with intensities of 3-4. No damage was reported in either case from the distant country (pers. comm. M. Grandison).

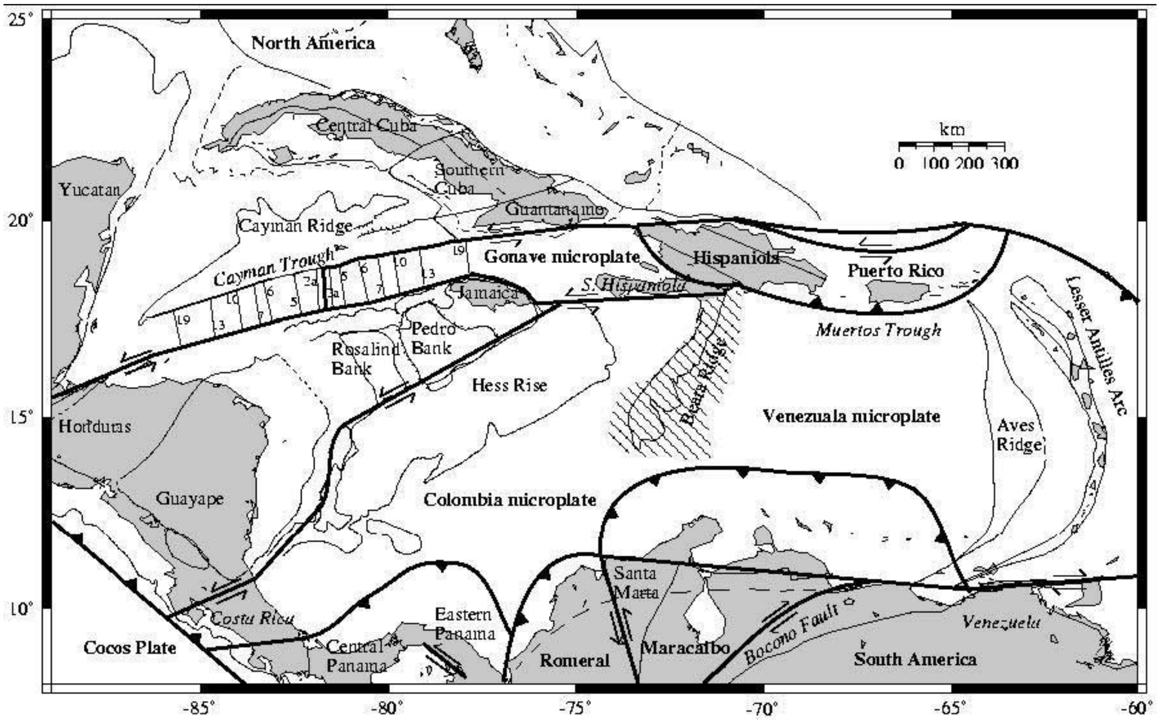


FIGURE 3-8: TECTONIC PLATES IN THE CARIBBEAN REGION

Figure 3-9 shows the epicenters of over one-hundred (100) earthquakes which have occurred in or near Jamaica between 1998 and 2001. With over 100 such occurrences, there was no significant damage to any approved infrastructure within the island to warrant consideration for the adjustment or revision of any building or construction codes for the island.

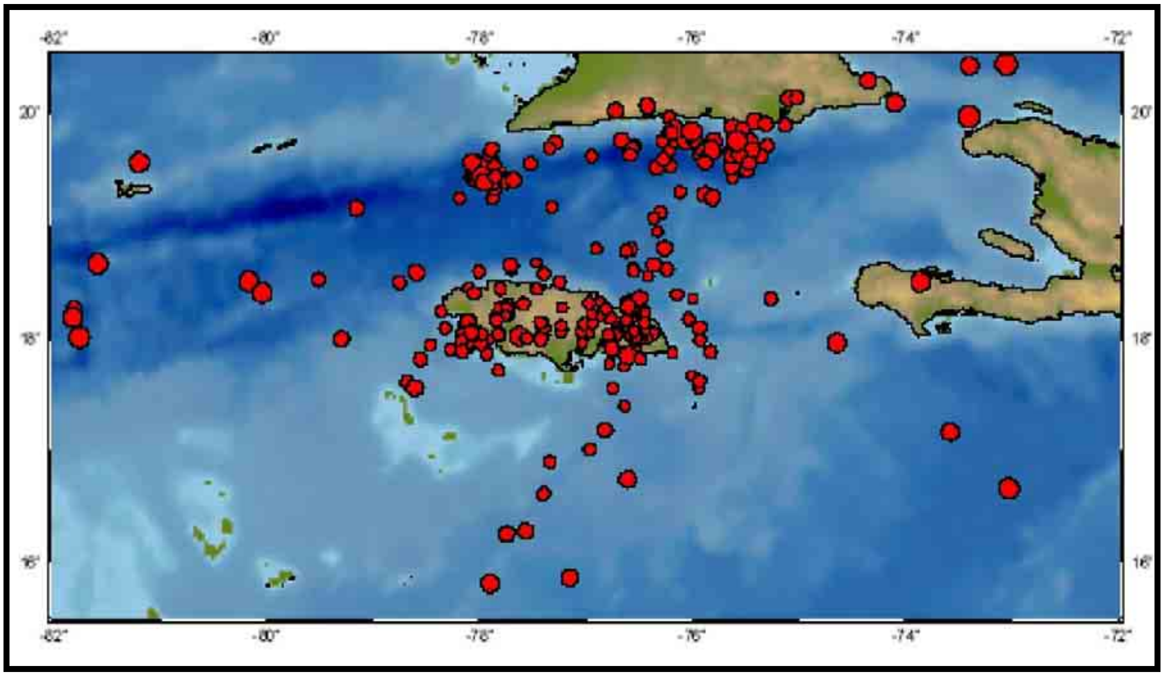


FIGURE 3-9: EPICENTRES OF EARTHQUAKES OCCURRING BETWEEN 1998 AND 2001 IN THE VICINITY OF JAMAICA[1]

Figure 3-10, Figure 3-11, and Figure 3-12 are summarized in Table 3-12 in relation to the proposed coastal landing sites. Table 3-13 allows one to conceptualize the type of effect the predicted values in Table 3-12 are likely to have. In analyzing Table 3-12, it becomes evident the most seismically active of all three sites is that of the Bull Bay site. As such, this site may be used as reference for the expected worst case scenario for any seismic activity which may be experienced by all three sites. From Table 3-12, it is expected that that there is only a 10% probability of any earthquake which occurs in or is felt by the Bull Bay area to exceed an intensity of 8 (VIII) within a 50 year period. An earthquake of such intensity is not likely to damage, or sufficiently damage buildings designated as *Masonry A* or *Masonry B* type construction (Table 3-13). This is significant because most buildings in Jamaica are designed to one of the two Masonry types mentioned above – the proposed onshore shelter station is no different (See Figure 1-8). Further inspection of Table 3-13

[1] Source: *Earthquake Unit, University of the West Indies, Mona*

reveals that earthquakes of such intensity are not likely to cause damage to underground pipes or disrupt their orientation significantly. The cables that will have to be laid underground are of greater strength and flexibility than conventional underground pipes, and do not transmit volatile or heavy fluids, whose dynamics or reactions might produce further stress on the pipes during an earthquake. Therefore, they are less likely to break under similar stress and strain conditions than the conventional underground pipes discussed in Table 3-13. Therefore, given the degree and frequency of seismic activity in the Bull Bay area, it is evident that the installation of the cable system in this area will not be greatly threatened by seismic activity. Further, if one were to extrapolate in consideration of the remaining two sites, one could conclude that these sites are less likely to be threatened by the same intensity of seismic activity as the Bully Bay site and are therefore less threatened by seismic activity.

It is important to note that the Bull Bay building site is an existing cable site that has been in existence long before the 1998-2001 period assessed during this project, and there has not been (to our knowledge) any record of cable failure due to seismic activity in the area.

TABLE 3-12: 10% PROBABILITY EXCEEDANCE IN ANY 50 YEAR PERIOD OF THREE EARTHQUAKE PARAMETERS FOR THE PROPOSED LANDING SITES

Landing Point	Horizontal Ground Acceleration /gals	Maximum Mercalli Intensity /MMI	Horizontal Ground Velocity /cms^{-1}
Bull Bay, St. Thomas	270-295	>8	18-20
Tower Isle, St. Mary	270-295	7-8	18-20
Great River, Montego Bay, St. James	145-190	6-7	10-14

TABLE 3-13: MERCALLI SCALE[2]

Intensity	Effects	PGA*(gals)
I	Not felt. Marginal and long-period effects of large earthquakes.	less than 1
II	Felt by persons at rest, on upper floors or favourably placed.	1 - 2
III	Felt Indoors. Hanging objects swing. Vibration like passing of a light truck. Duration estimated. May not be recognized as an earthquake.	2 - 5
IV	Hanging objects swing. Vibration like passing of heavy trucks: or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Car alarms activated. Windows, dishes, doors rattle. Glasses clink, crockery clashes. In the upper range of IV wooden walls and frames creak.	5 - 10
V	Felt Outdoors. Direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close open. Shutters, pictures move, pendulum clocks stop, start, change rate.	10-25
VIa	Felt by all: many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books etc. off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small church and school bells ring. Trees, bushes shaken (visibly or heard to rustle).	25-50
VII	Difficult to stand. Noticed by car drivers. Hanging objects quiver. Furniture broken. Damage to masonry D including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones tiles cornices unbraced parapets, and architectural ornaments. Some cracks in masonry C. Waves on ponds; water turned turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete culverts damaged.	50-100
VIII	Steering of motor cars affected. Damage to masonry C: partial collapse. Some damage to masonry B, none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and steep slopes.	100-250
IX	General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures shifted off foundations if not bolted down. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks on ground. Sand boils, earthquake fountains, and sand craters.	250-500
X	Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes etc. Sand shifted horizontally on beaches and flat land. Rails bent slightly.	500-1000
XI	Rails bent greatly. Underground pipelines completely out of service.	**
XII	Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.	**

Notes[3]:
* PGA is the effective Peak Ground Acceleration during the earthquake. That is the maximum horizontal ground acceleration excluding high frequency spikes. 1 gal = 1 cm/sec/sec. Since the intensity of gravity (g) is about 10 meters/sec/sec 10 gals is about 1% of gravity
** At the highest intensity levels damage potential is determined increasingly by the effects of ground failure. Most types of ground are unable to sustain prolonged accelerations much greater than 500 gals.

[2] http://www.uwiseismic.com/Earthquakes/eq_monitoring.html#Anchor-MEASURIN-48543
[3] http://www.uwiseismic.com/Earthquakes/eq_monitoring.html#Anchor-MEASURIN-48543

Masonry A. Good workmanship, mortar and design: reinforced especially laterally and bound together using steel, concrete etc. Designed to resist lateral forces.
Masonry B. Good workmanship and mortar. Reinforced but not designed in detail; to resist horizontal forces.
Masonry C. Ordinary workmanship and mortar. No extreme weaknesses like failing to tie in at corners but neither reinforced nor designed to resist horizontal forces.
Masonry D. Weak materials such as adobe; poor mortar; low standards of workmanship; weak horizontally.
(From Elementary Seismology by C.F. Richter, Published by W.F. Freeman and Company, San Francisco 1958)

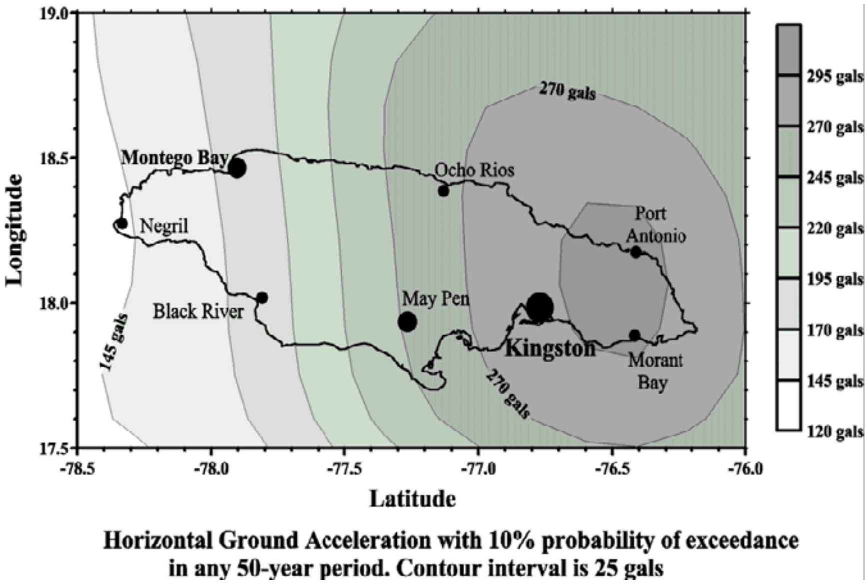


FIGURE 3-10: HORIZONTAL GROUND ACCELERATION IN JAMAICA[4]

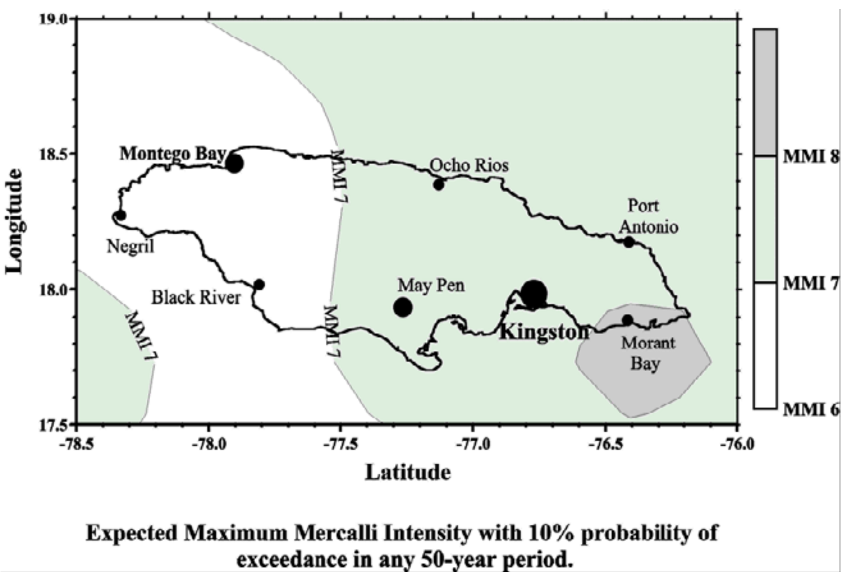


FIGURE 3-11: MAXIMUM MERCALLI INTENSITY IN JAMAICA[5]

4 http://www.oas.org/CDMP/document/seismap/
5 http://www.oas.org/CDMP/document/seismap/

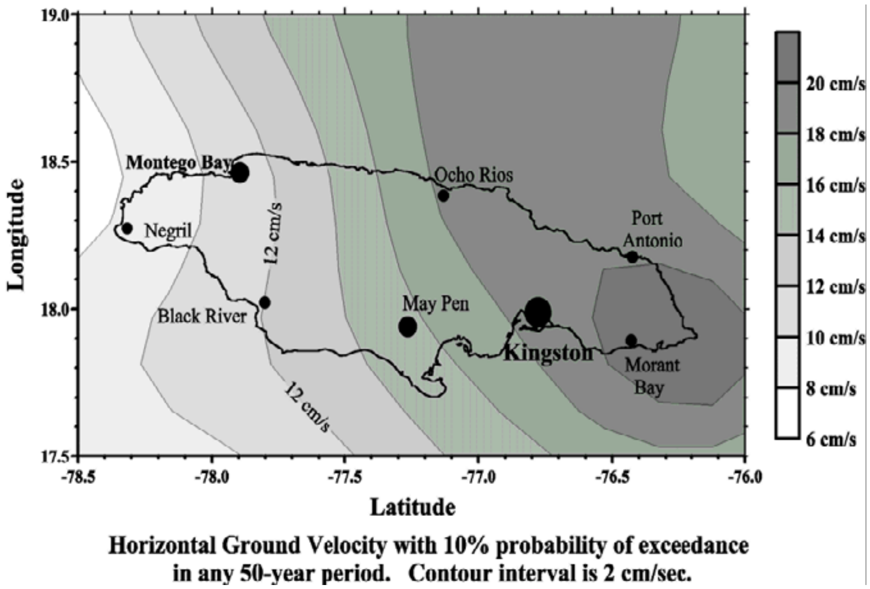


FIGURE 3-12: HORIZONTAL GROUND VELOCITY IN JAMAICA[6]

3.6.3 Hurricane/Cyclone Activity

Generating the data commonly associated with storm activity, and the consequent probable trends, for each landing point of the island is not necessarily feasible or a pragmatic assessment given the scope of this Environmental Impact Assessment. However, an appreciable approach would be to consider a reference point on the island, namely the center of the port of Kingston, and then use recorded cyclone activity over a period of time within the Caribbean region to estimate any associated trends related to the cyclone activity and the return period of such activities to the island[7]. This can be done confidently as Jamaica is a small island and is likely to be affected wholly regardless of the point of approach of a tropical depression or storm system.

Based on the values recorded in Table 3-14, Jamaica is estimated to have a 95% chance of experiencing, at the most, the wind

[6] http://www.oas.org/CDMP/document/seismap/

[7] ***Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,*** **Return Period Estimation of Hurricane Perils in the Caribbean,** Caribbean Disaster Mitigation Project April 1999

speeds associated with a *'Category 1'* hurricane every 10 years; and a similar chance of experiencing, at the most, the wind speeds associated with a *'Category 4'* hurricane every 50 years.

TABLE 3-14: KINGSTON CENTRAL PORT WIND RESULTS (KNOTS): MAXIMUM LIKELIHOOD ESTIMATES AND UPPER PREDICTION LIMITS FOR VARIOUS RETURN PERIODS (1 MINUTE SUSTAINED WIND AT 10 METERS ABOVE GROUND).[8]

Return Period	MLE	50%	75%	90%	95%	99%
10 year	57	58.2	61.2	63.9	66.0	70.4
25 year	76	77.0	81.6	86.7	90.6	104.4
50 year	89	90.5	97.0	105.0	111.4	130.4
100 year	102	103.1	112.8	124.0	133.1	157.8

The MLE (maximum likelihood estimate) column provides the best estimate as to the mostly likely extreme one minute-ten meter sustained wind for the various time frames.

Consultation of Table 3-15 shows that, within a 10 year period, the maximum storm surge expected is approximately 3.397m, and, within a 50 year period, the storm surge is unlikely to exceed 7.111m. Therefore, if the proposed minimum height for the construction of the on-shore shelter station of 3m above sea level is adhered to, the storm surge influence on the on-shore shelter station is not likely to occur in an overwhelming way, outside of a twenty-five year period. However, as stated earlier, the terrain of the sites is estimated to exceed the proposed minimum requirement, it is also expected to exceed the maximum storm surge within 100 years (Table 3-15). At all three landing sites the equipment building shares or exceeds the elevation of the resort hotels, residences and business establishments in their vicinity.

[8] ***Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,* Return Period Estimation of Hurricane Perils in the Caribbean,** Caribbean Disaster Mitigation Project April 1999

TABLE 3-15: KINGSTON CENTRAL PORT STORM SURGE RESULTS (METERS): MAXIMUM LIKELIHOOD ESTIMATES AND UPPER PREDICTION LIMITS FOR VARIOUS RETURN PERIODS[9].

Return Period	MLE	50%	75%	90%	95%	99%
10 year	2.737	2.758	2.958	3.122	3.193	3.397
25 year	3.848	3.897	4.193	4.519	4.791	5.505
50 year	4.693	4.714	5.157	5.636	5.932	7.112
100 year	5.539	5.586	6.136	6.941	7.542	8.777

TABLE 3-16: KINGSTON CENTRAL PORT WAVE HEIGHT RESULTS (UNTRANSFORMED DEEP WATER SIGNIFICANT WAVE HEIGHT IN METERS): MAXIMUM LIKELIHOOD ESTIMATES AND UPPER PREDICTION LIMITS FOR VARIOUS RETURN PERIODS.[10]

Return Period	MLE	50%	75%	90%	95%	99%
10 year	7.1	7.2	7.5	7.8	8.1	8.9
25 year	8.9	9.1	9.6	10.3	11.1	14.8
50 year	10.2	10.3	11.0	11.9	13.1	18.0
100 year	11.5	11.6	12.6	14.0	16.0	22.3

[9] ***Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,*** **Return Period Estimation of Hurricane Perils in the Caribbean,** Caribbean Disaster Mitigation Project April 1999

[10] ***Organization of American States General Secretariat Unit for Sustainable Development and Environment USAID-OAS,*** **Return Period Estimation of Hurricane Perils in the Caribbean,** Caribbean Disaster Mitigation Project April 1999

TABLE 3-17: TROPICAL CYCLONES AFFECTING JAMAICA (1900-2003)[11]

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
1	1900	August 3	Hurricane		St. Mary, Portland, St. Thomas and St. Ann	115 miles	
2	1901	July 5-6	Tropical Storm		South Coast	173 miles	
3	1901	September 13-14	Tropical Storm		North Coast	115 miles	
4	1903	August 10-11	Hurricane		Manchester, Clarendon, St. Elizabeth and Westmoreland		
5	1904	June 12-13	Tropical Storm		Westmoreland and Hanover		
6	1904	October 13-14	Tropical Storm		Western Jamaica	86 miles	
7	1905	October 4-5	Hurricane		Eastern Jamaica	23 miles	
8	1906	October 14	Hurricane		South Coast	115 miles	
9	1906	November 6-7	Tropical Storm		Western Jamaica	58 miles	
10	1907	June 24-25	Tropical Storm		South Coast	138 miles	
11	1908	September 29	Tropical Storm		Portland, St. Thomas and St. Mary	173 miles	
12	1909	July 16-17	Tropical Storm		South Coast	29 miles	

[11] Supplied by *Jeffrey Spencer*, **Climate Branch Head, Meteorological Service**

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
13	1909	August 6	Tropical Storm		South Coast	86 miles	
14	1909	August 23-24	Hurricane		Portland, St. Thomas, St. Mary and St. Ann	46 miles	
15	1909	September 15-16	Tropical Storm		Westmoreland and St. Elizabeth	115 miles	
16	1909	October 08	Hurricane		Westmoreland and St. Elizabeth	115 miles	
17	1909	November 11-12	Tropical Storm		St. Thomas and St. Andrew	144 miles	
18	1910	August 25-25	Tropical Storm		Manchester, St. Elizabeth and Clarendon		
19	1910	September 8-9	Hurricane		Portland, St. Mary, St. Ann and Trelawny	29 miles	
20	1911	October 24	Tropical Storm		Portland and St. Mary	58 miles	
21	1912	October 11	Tropical Storm		Hanover and Westmoreland	144 miles	
22	1912	November 18	Hurricane		Hanover and Westmoreland		
23	1915	August 12-13	Hurricane		St. Ann		
24	1915	September 01	Hurricane		Westmoreland	86 miles	

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
25	1915	September 25	Hurricane		St. Elizabeth and Clarendon	115 miles	
26	1916	August 15-16	Hurricane		Clarendon, St. Elizabeth, Manchester and Hanover		
27	1916	August 30-31	Hurricane		South Coast	69 miles	
28	1916	October 13	Hurricane		South Coast	144 miles	
29	1917	September 23	Hurricane		St. Mary	29 miles	
30	1918	August 3-4	Tropical Storm		South Coast	58 miles	
31	1923	October 18	Tropical Storm		Western Jamaica	144 miles	
32	1924	November 7-8	Tropical Storm		Clarendon and St. Ann		
33	1927	October 18	Tropical Storm		Hanover	86 miles	
34	1928	August 10-11	Hurricane		Portland, St. Mary and St. Thomas	115 miles	
35	1928	September 2-3	Tropical Storm		St. Catherine, Clarendon and Manchester		
36	1930	September 4-5	Tropical Storm		North east Coast	173 miles	
37	1931	August 13-14	Tropical Storm		South Coast	173 miles	
38	193	September 8-9	Tropical Storm		South Coast	58 miles	

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
	1						
39	1931	September 12-13	Tropical Storm		St. Thomas, St. Catherine, Manchester Clarendon and St. Elizabeth		
40	1932	September 28-29	Tropical Storm		St. Thomas, St. Catherine, Manchester and Clarendon		
41	1932	November 8-9	Hurricane		Hanover and Westmoreland	150 miles	
42	1933	July 1-2	Hurricane		South Western Coast	173 miles	
43	1933	July 16-17	Tropical Storm		St. Mary and St. Ann		
44	1933	August 16	Tropical Storm		St. Elizabeth and Westmoreland	96 miles	
45	1933	September 19-20	Hurricane		South Coast	81 miles	
46	1933	October 29-30	Hurricane		Westmoreland, Hanover and St. James		
47	1934	October 20-21	Tropical Storm		St. Catherine, St. Ann and Trelawny		
48	1935	September 24	Hurricane		Hanover and Westmoreland	58 miles	
49	193	October 21-23	Hurricane		East- north-	58 miles	

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
	5				west coast		
50	1938	August 11-12	Hurricane		South Coast	58 miles	
51	1938	August 23-24	Hurricane		South Coast	144 miles	
52	1939	November 1-3	Hurricane		North west coast	58 miles	
53	1942	August 24-25	Hurricane		North Coast	144 miles	
54	1942	September 18-19	Tropical Storm		North Coast	29 miles	
55	1944	July 26-27	Tropical Storm		South Coast	115 miles	
56	1944	August 20-21	Hurricane		St. Thomas to Negril		
57	1944	October 13-14	Hurricane		West Coast	144 miles	
58	1945	October 11	Hurricane		West Coast	144 miles	
59	1947	August 11	Tropical Storm		South-west coast	173 miles	
60	1947	September 20	Tropical Storm		St. James and Hanover		
61	1948	September 18	Tropical Storm		Hanover		
62	1949	October 12-13	Tropical Storm		Westmoreland, Hanover and St. James		
63	1950	October 15-16	Hurricane	King	Westmoreland and Hanover	58 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
64	1951	August 17-18	Hurricane	Charlie	St.Andrew, St. Catherine, Manchester and Clarendon		
65	1951	September 4-5	Tropical Storm	Dog	South Coast	144 miles	
66	1953	September 23-24	Tropical Storm	Florence	South Coast	46 miles	
67	1953	October 3-4	Tropical Storm		North-west Coast	58 miles	
68	1954	October 11-12	Hurricane	Hazel	Eastern Coast	115 miles	
69	1955	August 23	Tropical Depression		South Western Coast	115 miles	
70	1955	September 14	Tropical Storm	Hilda	North Coast	127 miles	
71	1955	September 26-27	Hurricane	Janet	South Coast	144 miles	
72	1956	October 30-31	Tropical Depression	Greta	East Coast	58 miles	
73	1958	September 1-2	Hurricane	Ella	North-east Coast	115 miles	
74	1958	September 15	Tropical Storm	Gerda	North Coast	58 miles	
75	1961	October 15-16	Tropical Depression	Gerda	Kingston, St. Andrew, St. Catherine and St. Ann		
76	1963	October 4-6	Hurricane	Flora	Eastern half	173 miles	
77	1964	August 24-25	Hurricane	Cleo	St. Ann, St. Mary and	58 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
					Portland		
78	1966	September 29-30	Hurricane	Inez	St.Mary and Portland	144 miles	
79	1967	September 12-13	Tropical Storm	Beulah	St. Thomas	52 miles	
80	1969	August 31	Tropical Storm	Franceli a	South Coast	144 miles	
81	1970	May 20-22	Tropical Storm		Hanover and Westmoreland	121 miles	
82	1973	October 17	Tropical Storm	Gilda	Hanover, Westmoreland and St. James	121 miles	
83	1974	August 31	Hurricane	Carmen	South Coast	46 miles	
84	1974	September 15	Tropical Storm	Fifi	South Coast	52 miles	
85	1975	August 25	Tropical Depression	Caroline	North Coast	150 miles	
86	1975	September 18	Tropical Storm	Eloise	North Coast	115 miles	
87	1979	June 12	Tropical Depression		St. James, Hanover, St.Elizabeth and Westmoreland	86 miles	
88	1979	September 02	Hurricane	David	Eastern half	173 miles	
89	1979	September 11-13	Hurricane	Frederic	South eastern section	127 miles	
90	1980	August 5-6	Hurricane	Allen	East and North Coasts	35 miles	

No.	Year	Dates of passages over or when closest to island	Type of weather system	Name	Section of island most affected	Nearest distance to island	WARNING MESSAGES
91	1981	August 7-21	Tropical Depression	Dennis	Southwestern Jamaica		
92	1988	September 8-19	Hurricane	Gilbert	The entire island E-W		
93	1994	November 8-21	Tropical Storm	Gordon	Central Jamaica		
94	1996	November 18-26	Hurricane	Marco	Southern Jamaica	479 miles	
95	1998	September 15-October 1	Hurricane	Georges	Northern and Eastern Jamaica	151 miles	
96	1998	October 22- November 5	Hurricane	Mitch	Southern and Western Jamaica	138 miles	
97	1999	November 13-15	Hurricane	Lenny	Southern Jamaica	90 miles	
98	2000	August 22-25	Hurricane	Debby	Eastern Jamaica	90 miles	
99	2000	September 19-20	Tropical Depression 10		Kingston, St. Andrew, St. Thomas, St. Catherine & Clarendon		
100	2001	August 15-23	Tropical Storm	Chantal	Southern Parishes of Jamaica, and Pedro Banks		
101	2001	October 4-9	Hurricane	Iris	Southern Parishes of Jamaica, and Pedro Banks		
102	2001	October 5	Tropical Depression 11				News Release- System could

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
							affect the island
103	2001	October 9	Tropical Wave, Remnants of Tropical Storm	Jerry			News Release
104	2001	Oct 30-31	Tropical Depression		Most Parishes		2 Flash flood Warnings for northeastern and southern parishes, Flash flood watch for the rest of the island. 2 Flash Flood Warnings for northern and southwestern parishes. Flash flood watch for the rest of the island
105	2001	October 29-November 6	Hurricane	Michelle	Indirect effect on entire island, especially northeastern parishes		4 Flash flood warnings for northern and southwestern parishes. Flash flood watch for the rest of the island. 3 Flash flood warnings for entire island. 1 News Release

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
106	2001	November 26	Hurricane	Olga			News release not expecting direct impact but system could affect the island
107	2002	September 15	Tropical Depression 10				Special news release
108	2002	September 16-17	Tropical Wave		Northern and Southeastern		2 flash flood watches, flash flood watch for the entire island
109	2002	September 17-19	Tropical Depression 10 Regenerates		Northern and southeastern parishes, Gale force winds over southeastern sections		Bulletin 1-6, Tropical Storm Warning.Bulletin 1-6 Tropical storm warning . Bulletin 1-6 Tropical Storm Warning, Bulletin 7 Tropical storm Warning Lifted, 9 Flash Flood warnings
110	2002	September 20-24	Tropical Storm Spiral Bands from Hurricane Isidore	Isidore			

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
111	2002	September 24-October 1	Tropical Storm, Tropical Depression, Hurricane	Lilli	All parishes and some offshore areas		Bulletin 1-5 (No watch or warning) Bulletin 6-8 Tropical Storm Watch in effect , Bulletin 9 Tropical storm watch Lifted, Bulletin 10, Bulletin 11, Bulletin 12-26 Tropical storm Warning Bulletin 27 Tropical Storm Warning Bulletin 28 Tropical Storm Warning Lifted, Flood warning in effect. *Flash flood warning, news release (warning lifted)*
112	2002	October 14-16	Tropical Depression 14		Southern and Western Parishes		4 Flash Flood Watches, 1 Flash Flood Warning, 1 News Release

No.	**Year**	**Dates of passages over or when closest to island**	**Type of weather system**	**Name**	**Section of island most affected**	**Nearest distance to island**	**WARNING MESSAGES**
113	2003	July 8-9	Tropical Storm	Claudette	Most Parishes		Bulletin 1 Tropical Storm Watch Bulletin 2-8 Tropical Storm Warning Bulletin 9 Tropical Storm Warning Lifted
114	2003	July 23	Tropical Wave, Remnants of Tropical Depression 6		St.Mary, Portland, St. Thomas, St. Ann, Trelawny		2 News Releases
115	2003	August 29	Tropical Wave, Remnants of Tropical Depression 9		Most Parishes		1 News Release, 1 Severe Weather Alert
116	2003	December 4	Tropical Depression 20 Tropical Storm	Odette	North-Central and northeastern parishes, sections of southern parishes		Bulletin 1-2 Tropical Storm Watch Bulletin 3-9 Tropical Storm Warning Bulletin 10 Tropical Storm Warning Lifted.

3.6.4 Flooding Vulnerability

Assessing whether an area is prone to flooding or not, not only requires a hydrostratigraphic assessment of the area, but also the collection of physical data such as rainfall run-off patterns, topography and information obtained from actual flooding events (especially as perceived by individuals who reside or frequent the area during such events) over a statistically appreciable period. Such information is not readily available from relevant statutory agencies in a compiled an organized format and is beyond the scope of this Environmental Impact Assessment. However, conclusions may be drawn from available data, including informal reports of flooding, or the absence thereof.

It is estimated that the project sites are located in areas where the soil can be permeable to semi-permeable, with the exception of the site in Tower Isle St. Mary, which is described as impermeable (See Figure 3-13 through to Figure 3-15). Permeability or semi-permeability of the areas implies that water should percolate through the ground and drain into the underlying aquifers or aquicludes. Hence, in the absence of extreme weather conditions, namely heavy consistent and prolonged rainfall, the mentioned areas should not flood readily. Further, none of the sites are located in sink holes or areas of deep depression, therefore, issues related to runoffs from surrounding areas should not add to the flooding vulnerability of the areas to flooding.

There has been no specifically reported flooding for the Great River area, or the Tower Isle area. There has been, however, reported flooding in the Frankfort area just west of the Tower Isle area. However, the conclusive cause of such a flooding event has not been determined. (pers. comm. – A. Haiduk, WRA) The extent of flooding from a significant flooding event in 2001 for the Bull Bay area is seen in Figure 3-16, which is some distance from the proposed project site, and is not estimated to have had any significant effect on the proposed project site in that period. It should be noted that the project sites in Bull Bay and Tower Isle, are located on presently occupied properties, with Bull Bay at an elevation of approximately 60m above sea level, well above potential flood levels. None of two these sites have reported issues of flooding.

FIGURE 3-13: HYDROSTRATIGRAPHIC MAP OF BULL BAY SITE

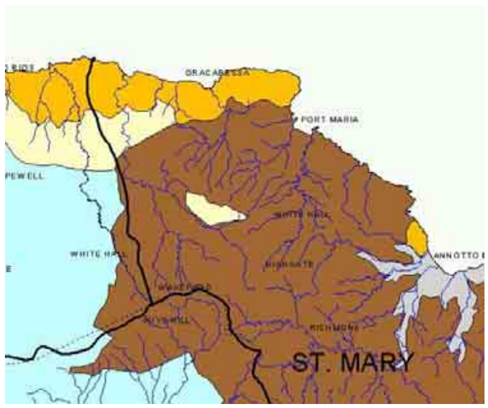


FIGURE 3-14: HYDROSTRATIGRAPHIC MAP OF ST. MARY

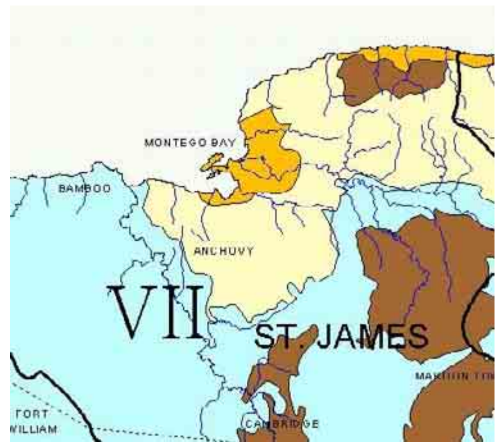
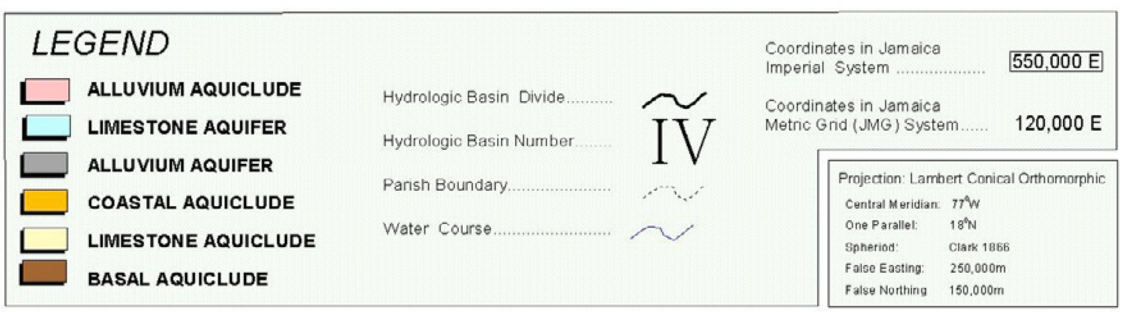


FIGURE 3-15: HYDROSTRATIGRAPHIC MAP OF MONTEGO BAY



Hydorstraigphic Images and Legend are extracted from a Larger Hydrostraigrphic Map of Jamaica[12]

[12] Provided by *The Water Resources Authority (WRA),* Jamaica

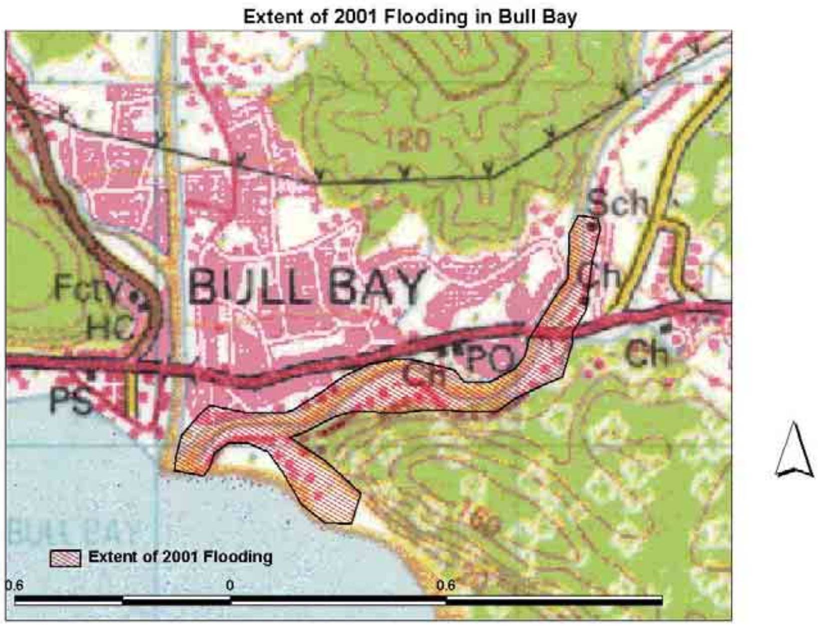


FIGURE 3-16 EXTENT OF 2001 FLOODING IN BULL BAY[13]

3.6.5 Land Slide Vulnerability

Currently, the Mines & Geology division of the Land Services arm of the government has not generated Landslide Susceptibility maps for every parish of the island. Consequently, only two of the three areas proposed currently have any landslide vulnerability data available. Such information is currently available only for the Bull Bay, St. Thomas site and the Tower Isle, St. Mary Site; no accessible susceptibility maps have been generated for St. James, and consequently no maps are available for Great River area.

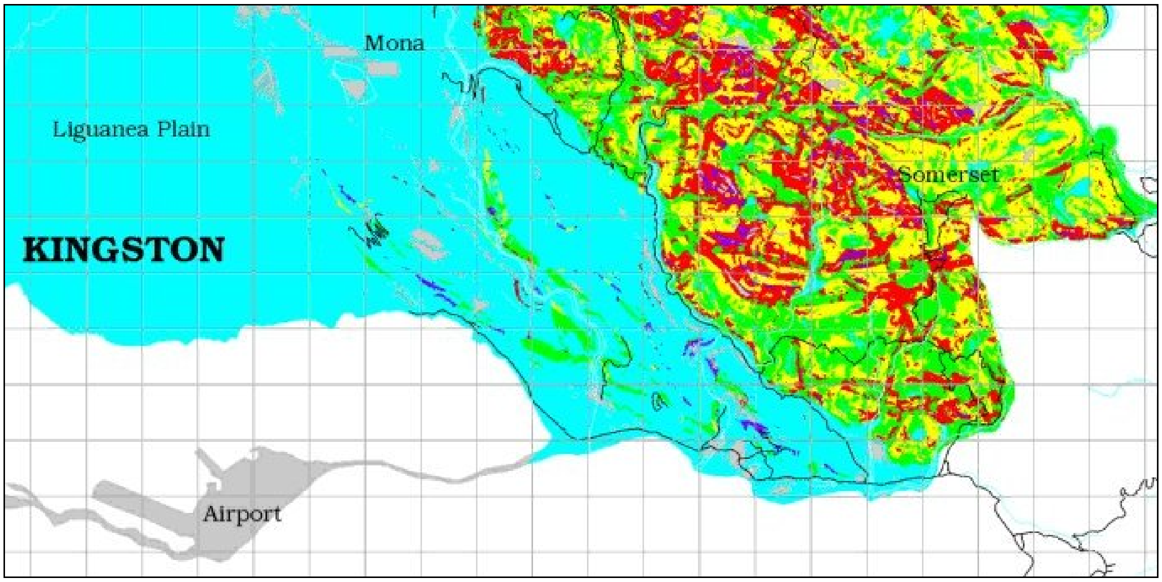
A landslide is a natural disaster that cannot be definitely predicted or practically monitored during its occurrence; therefore one cannot be absolute in classifying an area in its susceptibility. In fact much of the classification process is done and defined through measurements which must be updated within a period that is discretionary and based on numerous factors. Landslides can be triggered directly and indirectly by

[13] Courtesy of *The Water Resources Authority (WRA)*, Jamaica

things such as tectonic activity, rainfall, terrain alteration, geology, etc.

Landslides have the potential to affect every aspect of the fibre optic cable operation. Landslides can remove building foundations or simply swallow entire buildings. Therefore, it would be prudent to build the on shore shelter stations in areas that are not considered to be susceptible to the type of landslides which have such overwhelming and destructive capabilities or to provide the necessary engineering to offset the possibility. Landslides can also trigger wave action if there is an instant collapse of sections of the land into the sea. The degree of wave action varies across a spectrum of generic wave to mega tsunami, which depends on the amount of land mass which collapses instantly into the sea. Such events, however, are unlikely in Jamaica given the geology and the level of volcanic activity on the island. Landslides in this regard can affect the near shore operations of the cable system through these wave actions (Section 3.6.1.1)

Figure 3-17 shows the land slide susceptibility of parts of Kingston & St. Andrew. According to Figure 3-17, the proposed project area has a low susceptibility to deep landslides, meaning that the probability of any occurrence of a deep landslide is anywhere between 0-0.02.



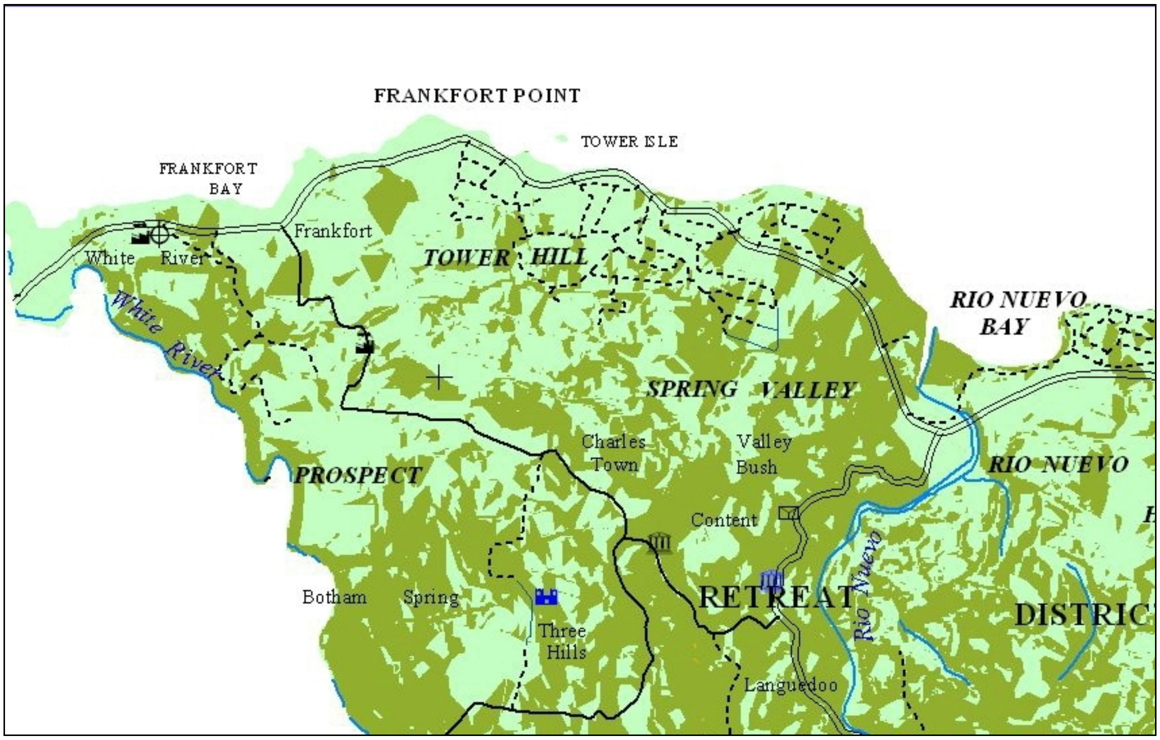
KEY

	Non-Susceptibility
	Low susceptibility (0-2%)
	Moderate Susceptibility (2-3.5%)
	Moderate-High Susceptibility (3.5-4.5%)
	High Susceptibility (4.5-6%)
	Very High Susceptibility (6-83%)

FIGURE 3-17: LAND SLIDE SUSCEPTIBILITY MAP FOR BULL BAY, ST. THOMAS SITE[14]

Figure 3-18 shows the landslide susceptibility of the upper north-western corner of St. Mary, which borders the parish of St. Ann. The colour coded key indicates that this region is ***'Negligible to Low'*** or ***'Moderate'*** in its classification as being susceptible to landslides. From the same map, The Tower Isle area is classified as being ***'Negligible to Low'*** in its susceptibility to landslides.

[14] http://www.oas.org/CDMP/document/kma/landslmap.htm



KEY

	Negligible-Low Landslide Susceptibility
	Moderate Landslide Susceptibility

FIGURE 3-18: LAND SLIDE SUSCEPTIBILITY MAP FOR TOWER ISLE, ST. MARY SITE

*Extracted from a larger Landslide susceptibility map, which details the entire parish of St. Mary.[15]

3.6.6 Overall Assessment of Natural Hazard Vulnerability of Sites

Tremendous effort has been made by Fibralink to both identify and select cable routes and landing sites that will satisfy as best as possible the majority of areas of concerns associated with this project. As such, a lot of effort has been put into selecting routes that will have minimal impact on marine life and structures, land sites that will be limited in exposure and impact to natural hazards or have the potential to cause any major damage than the existing structures that will be in proximity to them.

[15] Provided by Mines & Geology

All of the onshore facilities and sites have been designed to withstand hurricane force winds and sea conditions, thereby enabling the system to remain active during times when they are most needed. This includes the back-up power generation.