Name	Category	Geographical location	Capacity	Number of rooms damaged
Allamanda Beach Resort	Hotel	Grand Anse	50 Rooms	4 damaged.
Blue Horizon	Hotel	Grand Anse	32 Rooms	All
Siesta Hotel	Siesta	Grand Anse	37 Rooms	11 damaged 6 destroyed
Mariposa Beach Resort	Hotel	Morne Rouge	31 Rooms 15 Appartments	21 damaged 2 damaged
Gem Holiday Beach	Appartments, cottages and villas	Morne Rouge Bay	20 Rooms	19 damaged
Grenada Grand Resort	Hotel	Grand Anse	212 Rooms	130 damaged
Coyaba Beach Resort	Hotel	Grans Anse	70 Rooms	
Grand View Inn	Appartments, cottages and villas	Mone Rouge	69 Rooms	51 rooms damaged 10 destroyed
La Luna	Hotel	Morne Rouge	16 Cottages	All damaged 5 cottages seriously damaged 1 cottage destroyed
True Blue Bay Resort	Hotel	True Blue	38 Rooms	28 Rooms damaged 12 badly damaged 3 cottages destroyed
Rex Grenadian Resort	Hotel	Point Salines	212 Rooms	Most rooms damaged. 127 badly damaged
La Source Resort	Hotels	Pink gin beach	100 Rooms	All rooms damaged 23 rooms not significantly damaged. 73 rooms with varying degrees of damage. 4 rooms destroyed.
Lance aux epines cottage	Appartments, cottages and villas	L'Anse aux Epines	11 Rooms	All badly damaged
Calabash Hotel	Hotel	L'Anse aux Epines	30 Rooms	All damaged 1 badly damaged.
Wave Crest Holiday Apartments	Appartments, cottages and villas	Grand Anse	22 Rooms	17 badly damaged
Roydon's	Appartments, cottages and villas	Grand Anse	6 Rooms 6 Appartments	3 rooms destroyed
St Ann's Guest house	Guest Houses	Paddock	12 Rooms	5 non-functional

Table 21 Sample of room damage by tourist accommodation

Name	Category	Geographical location	Capacity	Number of rooms damaged
Mamma's Lodge	Guest Houses		10 Rooms	All damaged and non-functional
Lexus Inn	Appartments, cottages and villas	Belmont	18 Rooms	All badly damaged and non-functional
Lazy Lagoon	Guest House	Lagoon Road	12 Rooms	All completely destroyed
Villamar Holiday Resort	Hotel	L'Anse aux Epinnes	20 Rooms	All badly damaged and non-functional
South Winds	Appartments, cottages and villas	Grand Anse	19 Rooms	Damage in most of the rooms

Source: On the basis of field interviews with owners/managers of the corresponding tourist accommodations.

Table 22 Sample of Room Damage by Tourist Accomodation

As a result of the damage many hotels have for all functional purposes shut down. At the current stage twenty-two tourist accommodations have functionally closed down their operations as a result of the phenomena. These represent 55% of the stock of saleable room capacity prior to Hurricane Ivan (See table 23 below).

Tourist accommodation	Percentage of total room capacity	Percentage of total bed capacity
Spice Island Beach Resort	4.3	2.1
Blue Horizons Cottage Hotel	2.1	1.7
Grand View Inn	4.5	2.0
Flamboyant Hotel	4.0	3.3
La Luna	1.0	0.4
Wave Crest Holiday Appartment	1.4	0.8
Palm C3urt Appartments	0.8	0.6
South Winds	1.2	1.0
Gem Holiday Beach Resort	1.0	1.2
Rex Granadian Resort	13.8	7.0
La Source Resort	6.5	5.2
Mariposa Beach Resort	2.7	1.6
Siesta Hotel	2.4	1.7
Lance Aux Epines Cottage	0.7	1.1
Roydon's Appartments	0.4	0.4
Villas of Grenada	1.0	2.1
Blue Orchid Hotel	1.0	0.8
Lazy Lagoon	0.4	0.2
Palm Grove Guest House	0.7	0.5
Coyaba Beach Resort	4.6	3.3
Winward Sands Inn	0.7	0.4
Villamar Holiday Resort	4.3	1.04
Percentage of the total	55.4	42

Source: Own estimations based on field interviews with owners and managers of tourist accommodations and on information provided by the Grenada Board of Tourism.

Table 23 Tourist accommodation functionally closed and number of room and beds

When valued in monetary terms tourist accommodations reported through their respective assessor's evaluations varying degrees of damages. A quick sample of a subset of tourist accommodations representing 38% of the saleable room capacity indicated that the extent of the damage ranged from 650,000 to 40 million EC$. It was estimated by the mission that the direct losses born by tourist establishments to their buildings and infrastructure amount to 167 million EC$ (See table 24 below). The figure was obtained on the basis on information provided by the bigger tourist accommodations (those with room capacity exceeding 50) on estimated losses to buildings and infrastructure, taking into account that the Hurricane affected close to 90% of the tourist accommodations; using, and assumptions, based on field work, that the damages to establishments with less than 30 bore losses on average of 300,000 EC$ per establishment. Losses to restaurants and gift shops were estimated at 30 million EC$.

Category	Millions of Eastern Caribbean Dollars
Total	196.7
Roofing and building structures (includes electricity repairs and plumbing)	166.7
Equipment and furniture	....
Restaurants	20
Gift shops	10

Source: Estimates based on field work, and meetings with the Grenada Board of Tourism and the Ministry of Finance.

Table 24 Tourist accommodation Subsector Direct damage by category

b) Indirect damages.

All hotel accommodations suffered and will continue to register indirect damages. Indirect damages are presented here under supply induced indirect damages and demand induced indirect damages.

The supply induced indirect damage refers mainly to the interruption of income flows or income foregone due to the loss in capacity (i.e., occupancy) resulting from the natural disasters. This follows from the type of information presented in table 24 above and considers in addition the rate of room occupancy, the realised room rate, and time during the year in which the disaster occurred. In the case of Grenada, Hurricane Ivan impacted one to two months before the high tourist season.

Finally the estimations also take into account the period for which the rooms and in this case many hotels will not be functional. Thus it was necessary to include not only the period for which the rooms that were damaged will not be functional but also, when the tourist establishment had shut operations, the entire revenue obtained from the occupancy of all the establishment's rooms. The calculations ultimately depended on the period during which the establishment in question would remain closed.

The survey conducted by the mission on this particular issue yielded different answers. While forty percent of the establishments interviewed thought that they would be fully back in operations by December 15th, thirty percent was of the opinion that they would be back in operations in six months and the rest stated that their time frame was eight to twelve months. The full hotel infrastructure is expected to be operational in a year's time.

In addition supply induced indirect damages consider the higher rates of utility costs as a result of the interruption of electricity, drinking water and higher transportation costs. It also factors in security costs and the expenses associated with picking-up the debris which in some cases, namely in the case of the bigger hotels, has been substantial.

The interruption of electricity has forced many establishments to buy or rent a generator plant and incur into fuel, diesel fuel expenses. According to ground interviews and official sources of information, the indirect costs for diesel fuel were estimated on average at 1,625 EC$ per day.

The absence of drinking water has also led establishments to pay for transportation costs to provide drinking water. When this was the case, the cost of water was factored into the calculations at 900 EC$ per day.

The cost of operations associated with the picking-up of the debris varied according to the establishment in question. The mission found that in some cases the transactions associated with the picking up of debris were non-market transactions. In one case, the establishment owner/manager provided shelter for a group of workers of the hotel that had as a result of the hurricane lost their shelter in exchange for picking up the debris. In others hotel workers were re-hired at the wage of a laborer for cleaning up operations. The establishments at the higher end of the income strata contracted private firms to do the work.

The demand induced damages relate to income losses derived from the decline in tourist arrivals (in this particular case stayover) as a result of the passage of the Hurricane. The information here was obtained through tourist expenditure surveys (which provide level and composition by category of the expenditure) and airline and tour operator interviews.

The number of tourist stayover arrivals dropped to almost nil in September (the month in which the disaster took place). It is expected to remain close to that level for October and November. Some increase in stayover arrivals is expected in the month of December. In fact the pick up in stay-over arrivals will depend on the extent to which the tourist infrastructure has been repaired and is functional.

Contrarily at the time this report was drafted few cancellations were registered in the cruiseship industry. During the month of September two of the scheduled cruiseship calls were diverted to Dominica. In the month of October only one cruiseship liner will anchor in Dominica rather than in Grenada as scheduled (accounting for 2758 passengers). After the month of November a 10% o 15% drop in cruise-passengers is expected (See Figure 6). It has also been reported that one company, which accounts for 8% of the Cruiseship

industry is pulling its operations out of Grenada and will relocate to the neighbouring island of St. Vincent.

The disaster and the consequent drop in tourist arrivals has had devasting effects on tour operators. The larger tour operators have reported losses of 75,000 EC$ on average per month starting in September and have projected that level of losses until November. The smaller tour operators have reported losses of 10,000 EC$ on average per the months of September, October and November.

Table 25 provides estimates of the indirect damages sustained by the tourist accommodation sector. These are estimated at 68 million EC$ for the three months following the natural disaster.

The estimate combines both supply and demand induced effects. It was based on: (i) gross hotel revenues used in national accounts for the computation of the subsector contribution to GDP; (ii) inteviews with tour operators, (iii) estimations of the decline in stay over arrivals; (vi) computations of the average gross revenue per room; (vii) the number of saleable rooms, (viii) energy costs (mainly diesel fuel) equivalent to 3,250 EC$ per two-three days; (ix) water costs equivalent to 900 EC$ per day; (x) a laborer's wage of 70 EC$ per day; (xi) on the assumption that the disaster affected 90% of the tourist accommodations.[31]

	September-December
Total	67,580,285
Loss of gross revenue from occupancy of tourist accommodations	50,000,000
Loss of income of tour operators	2,475,000
Utilities	11,657,925
Electricity	7,502,625
Water	4,155,300
Security	600,000
Clean –up operations	3,447,360

Source: Estimated based on field interviews and information provided by the Grenada Hotel & Tourism Association and the Grenada Board of Tourism.

Table 25 Indirect damage for the last quarter of the year in Eastern Caribbean Dollars

After December it is expected that hotel accommodations will not incur in any additional utility costs or clean-up operations and that the hotel room capacity will be restored gradually. On the basis of an average revenue per room derived from national accounts statistics and considering that from December onwards 40% of the hotel capacity

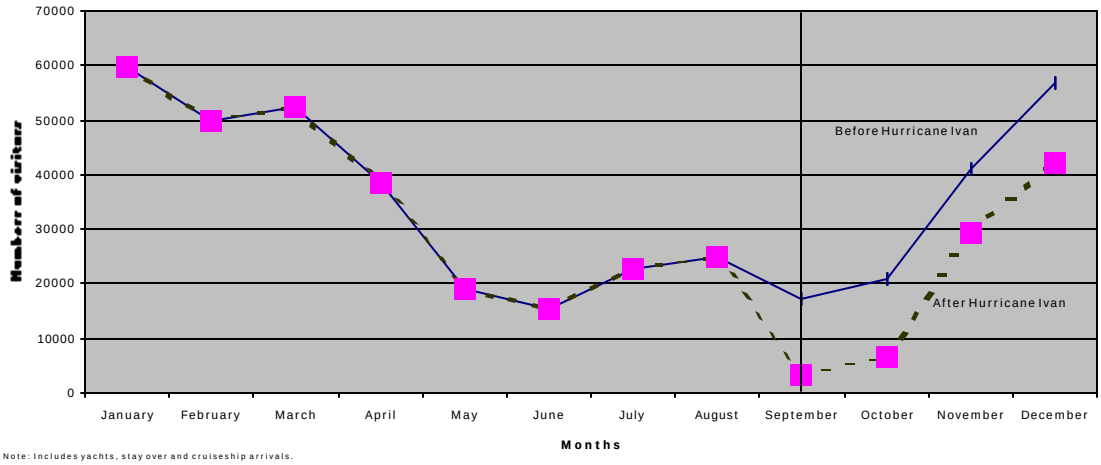
[31] An alternative method to calculate indirect costs at least for tourist accommodations consists is estimating the number of stay over visitors that will not be arriving due to the disaster. On this basis the loss of revemue from these non-arrivals can be obtained using the breakdown by type of tourist accommodation, the daily average expenditure and the weight of accommodation expenditures in total expenditures by type of accommodation. The result equaled 32.5 million for the months of September-December which is below the one obtained in Table 36 above which was arrived by analyzing hotel revenues. The available information however considers a sample representing less than 2% of stay over arrivals. See, The Grenada Board of Tourism, Grenada's Visitor, Expenditure and Motivation Survey (Winter 2003).

damaged by the hurricane would be restored and thereafter the room capacity would be restored at a rate of 10%, the indirect costs for the year 2005 sum up to 28, 937, 948 million EC$ (not taking into account tour operators income losses).[32]

2.2.3 The yachting subsector

The yachting subsector suffered significant damages mainly as a result of the impact of the wind on yachts. By far the majority of the damage was reported in the Island of Grenada. Carriacou did not incur in any losses and Petite Martinique reported only two yachts lost. The information here provided was obtained on the basis of interviews and surveys with the manager/owners of Grenada's Yacht Club, True blue Resort and Marina, Prickley Bay Marina, Martin's Marina, Grenada Marine and the Spice Island Marina. The last two establishments perform full service boatyards.

Figure 6
Estimated number of total visitor arrivals with and without the natural disaster
January - December
2004



Note: Includes yachts, stay over and cruiseship arrivals.
Source: On the basis of official information and informatioden provided by

a) Direct damages

At the time of the Hurricane, Grenada hosted 800 yachts. Of these fifteen sank, six disapeared and fifty were found stranded on land. The number of boats damaged is estimated at roughly 400. At present the yachting rescue operation is in the process of salvage. The repair phase will begin once the contractors have fully estimated the extent of the damage.

[32] These are however small compared to the loss of income of tourist accomodations.

Boats were damaged while at sea and also in boatyards. The extent of the damage was varied according to the marina and boatyards. Most boats however had a common pattern of damage. The direct damage refers mainly to:

- lost rings
- mast damages
- stainless steel framework
- hull damages.

Direct damage was also sustained by the yachting installations. These include (i) repairs to fence, car-park, electricity; (ii) electricity and plumbing; (iii) roof and infrastrucure; (iv) wall repairs; (v) refueling. According to interviews these categories represent 8%, 22%, 35%, 17% and 9% of the total respectively.

Taking into account that there were 800 yachts in Grenada at the time of disaster and that half have been damaged, 15 have been reported destroyed, the total direct damage is estimated to be of the order of 108 millions EC$. The figure was obtained through interviews with cruisers and yacht surveyors. It was also considered that the costing of yacht repairs can easily vary between 162,000 and 540,000 EC$.

b) Indirect damage

As in the case of tourist accommodations Indirect damage estimates comprise both supply and demand induced damages. Supply induced damages refer to the decline in income due in turn to reduction in harboring capacity due to the effects of the Hurricane.

At least three yachting installations in Grenada are closing and others have also considered moving their base of operations to safer locations. As a result the harboring capacity of the island will be at least temporarily reduced.

Demand induced damages refer mainly to the income loss due to the decline in the number of yacht arrivals due o the disaster. This will be determined in the short run by the Hurricane itself but also by a loss in the level of trust placed on Grenada as a Hurricane haven. The predicted number of yacht calls for 2004 without the Hurricane was 4,900, the projected number of yacht calls with the Hurricane is 4,380. Taking into account both the supply and demand induced factors in the yachting sector, the mission estimated the indirect losses to be 4.7 million EC$ (See table 26 below).

	Eastern Caribbean dollars Millions
Direct costs	
Yachting repairs and losses	108.7
Indirect costs	
Loss of direct expenditure	4.7
Total	113.4

Note: Indirect losses refer to the last three months of the year 2004.
Source: On the basis of field interviews and information provided by the Grenada Board of Tourism and the Marine and Yachting Association.

Table 37 Direct and Indirect damages : The yachting sub-sector

It is difficult at this point to estimate the indirect losses for the yachting sector for 2005 as there is no forecast on the expected number of yachts passengers for 2005 and little information regarding to what extent the passage of Hurricane Ivan will affect yachts' intentions of harboring in Grenada. If the assumptions are made that: (i) the number of yacht calls in 2005 would have increased in line with the expected average rate of growth of visitor arrivals (14%); (ii) the average length of stay for visiting yachts is 21 days; (iii) daily expenditure is 150 EC$; (iv) in 2005 that the effects of Ivan is the contraction in yacht calls by 40%, and that (v) the industry would recover by 2006, indirect costs for 2005 would sum up to 21.4 million EC$.

At the same time the disaster will have short run expansionary effects in activities related to repair and maintenance. These follow from the main areas that were damaged. These are rigging, stainless steel activities and fiber glass repair. The increase in demand for the services and goods of these sectors will generate additional income. Notwithstanding due to the absence of these skills in the labor force, some boats are being reaired in other locations (Trinidad and Tobago, Antigua and Barbuda, St. Maarten). Thus far the number of boats that have left represent 10% of the pre-Hurricane yachting float.

2.2.4 Secondary effects

Hurricane losses in the tourism sector will spill over the balance of payments, growth and income, expenditure effects and the level of indirect taxes (See table 27 below).

Balance of payment effects include increasing imports mostly for reconstruction phase of the tourist accommodation sector and yacht repairs. It also includes the decline in travel earnings due to the drop in stay-over arrivals. However, it is to be noted that the travel account will also register inflows as a consequence of travel associated mainly with family issues (family visits and also family members flying to other Caribbean countries due to loss of home or to continue their education studies). It is projected that the travel account of the balance of payments will contract by 45 millions EC$.

The economy is also likely to register insurance flows but only a part will flow into Grenada. In the particular case of the yachting sector, insurance flows will not find their way into Grenada since most yachts are owned by non-residents.

Effects on growth and income will include the change in the contribution of tourism to GDP as a result of the Hurricane. Taking into account the effects of the natural disaster the tourist sector will contract by 25%.

Secondary effects	Millions of Eastern Caribbean Dollars (unless stated otherwise)
Loss of expenditure	45.0
Loss in sectoral GDP (Constant 1990 dollars)	20.3
Loss of indirect tax revenue	2.7
Employment losses (direct and indirect)	
Number of unemployed	8,000
Note: On the basis on projected tourist expenditure The secondary effects are for 2004.	

Table 27 Secondary effects of the tourism sector

This also comprises the disposable income which is actually spent by the accommodation sector. Taking into account the major's hotels gross revenue, their tax payments and the variation in tourist arrivals, it is expected that net profits may decline in some cases by more than 50%.

The damages felt in the tourism sector also will spill over to indirect tax revenues. The estimate is that in terms of indirect tax revenues, the economy would lose close to 3 million EC$.

Finally and most important, the effects on the tourism sector will have a negative impact on employment. The impact on employment refers not only to direct employment but also indirect employment. The estimate of job losses ranges from 2,860 if the impact of the Hurricane touches only the 'direct jobs' component of employment in the tourism industry. If the direct and indirect components are taken into account the number of jobs lost can be of the order of at least 8,000.

2.3 The Manufacturing Sector

The manufacturing sector in Grenada is relatively small, accounting for approximately 6.0 per cent of GDP. The sector is dominated by the production of beverage and tobacco; garments; grain mill products and bakery products; and chemicals and paints.

Since 2001, the sector registered declines in each year, which averaged 4.5 per cent over the period, and activity in the sector was projected to remain stagnant in 2004. This was

influenced by the fluctuations in output of the major industrial products, particularly chemicals and paints and grain mill products and bakery products. Over the period 2005 and 2007, growth in manufacturing is projected to be marginal at an average rate of 1.0 per cent.

With the passage of hurricane Ivan, the sector experienced significant damage of approximately 75 per cent of buildings and stocks. The level of employment in the sector was also significantly reduced, particularly in the industries related to the production of garments and furniture as some of these entities are not expected to recommence operations in 2004.

Consequently, the sector is projected to decline by 10.0 percent in 2004, by 5.0 percent in 2005 and remain stagnant in the subsequent years.

Table 28 below summarises the direct and indirect effects of hurricane Ivan on some of the major industrial enterprises. The data is based on a survey response of twenty five (25) enterprises in the manufacturing sector. The survey questionnaire, which was prepared and distributed by the OECS mission while carrying out the assessment of the damage, requested data on the level of employment before and after the hurricane; the status of the operations of the enterprise; value of sales; the value of buildings, equipment and machinery, and inventories; and the estimated loss as a result of the hurricane. Based on the data received, both direct and indirect damage was calculated.

The direct damage is related to the destruction of assets at the time of the hurricane namely, buildings, equipment and machinery, and inventories. The indirect costs are related mainly to the loss in flows of income and additional cost as a result of the hurricane.

As indicated in the table, the direct damage is much higher than the indirect damage, and this is associated with the high cost of buildings and equipment. The direct damage to the sector was estimated at $17 million EC$ and the indirect cost at $4 million EC$.

Among the manufacturing industries, the rum, furniture and garment industries suffered the most significant damage. In the case of the production of rum, buildings were most severely affected while for the furniture and garment industries both buildings and inventories were damaged. The beverage sub-sector, which dominates the industry, was affected by damage to buildings but operations were not halted for a lengthy period. A number of light manufacturing industries lost substantial portions of inventories and suffered from damage to buildings. The period for the commencement of their operations is uncertain.

Type of Establishment-:	Direct Damage	Indirect Damage	Total
Production of			
Beverages	2.6	0.1	2.7
Furniture	2.4	0.4	2.8
Rum	4.0	0.9	4.9
Garments and Bags	4.6	1.7	6.3
Food	0.8	0.2	1.0
Other	3.4	1.0	4.4
Total	17.8	4.3	22.9

Source: On the basis of field interviews and information provided by the manufacturer's association and the ministry of finance and planning.

Table 31 The manufacturing sector Direct and indirect damage in Millions of Eastern Caribbean Dollars

2.4 The Wholesale and Retail Sector

The wholesale and retail trade which accounts for approximately 10 per cent of GDP, comprises a large variety of traders in foodstuff, clothing and accessories, and books and stationary. Development in the sector is generally influenced by the performance of the other economic sectors and, except in 2001 when overall economic activity declined, the wholesale and retail trade sector has been recording growth. In 2004, the sector was estimated to grow by 8.0 per cent and at an average rate of 7.0 per cent between 2005 and 2007.

Following hurricane Ivan, the sector is projected to record zero growth in 2004. Despite the projected growth on construction, the wholesale and retail sector will be adversely affected by the reduction in income from the other major economic sectors namely tourism and agriculture. In addition, the sector suffered both direct and indirect damage from the hurricane, which interrupted normal business activities.

The direct damage is related to that of physical assets and stocks. The sector was seriously affected by the loss of inventories due mainly to the looting that occurred immediately after the hurricane. This contributed to indirect damage as entities did not immediately reopen because of the general impact of the devastation; the loss of stocks from the hurricane and the subsequent looting; and the need to secure available stocks. A period of restricted trading in supermarkets was manifested in limited opening hours and restrictions on the number of shoppers in the supermarket.

At this stage as the sector had not been able to complete the run on their inventory stocks following the disaster. The mission was nonetheless able to provide an estimate of indirect damage based on national accounts and in site interviews. The value of the indirect damage was estimated at 11 million EC $.

3. Infrastructure

3.1 Public Utilities

Electricity

Grenada's electricity is provided by the privately owned Grenada Electricity Services Ltd. (GRENLEC), from its power station located in Queen's Park, St. George's. GRENLEC's present generating capacity is 40 megawatts, and was scheduled to be upgraded to 43 megawatts by the end of 2004, with a peak load of 25 megawatts. As a result of the hurricane[33], it is estimated that 80% of GRENLEC's distribution system was damaged, while the main generating system was left essentially intact (some water induced damage to panels occurred).

Photo 4 Typical Damage to Electric Poles

A damage assessment subsequent to the hurricane was carried out by USAID and by CARILEC. These assessments confirmed that the majority of the damage occurred in the parishes of St. George and St. David, while in the north of the island, the damage was not as extensive.

One of the key rehabilitation strategies adopted by GRENLEC has been the assignment of priority areas for the restoration of power. These are described following.

1. The ***health sector***, specifically power was restored within 3-4 days to the main general hospital in St. George and to the Mt. Gay Mental Hospital. This was achieved through the restoration of a feeder supply from the main generating plant. For hospitals such as the Princess Alice Hospital in Grenville, where it was not possible to restore the feeder supply, a standby plant was installed.
2. Priority was then assigned to the ***security forces***, where either feeder supply or standby plants were used.
3. ***Water supply systems*** were also assigned secondary priority, which proved to be a relatively difficult objective given the remote nature of some of these systems. Portable generators have now been installed at the two most critical sites, Baillie's

[33] Information obtained through discussion with Mr. Vernon Lawrence, CEO of GRENLEC

Bacolet and Chemin Valley. Six other portable plants have been sourced from the United States and are to be flown in to be installed at six sites which are to be designated by NAWASA. It is estimated that by the end of September, 2004, all water supply stations should be powered and in operation.

4. The ***commercial sectors*** were then targeted for start up (tertiary priority). These areas are contained primarily in downtown St. George's, where substantial restoration of power has already taken place north to Tanteen and south to the Carenage. It is estimated that by the end of September 2004, all of St. George's (town) will be powered. Grenville is to receive a generator, with full power to be back in that town by the first week of October. From Grenville, the feed will go westward to Gouyave.
5. The next area also targeted for restoration (tertiary priority) was the ***main tourism area*** of Grand Anse. GRENLEC anticipates restoration of power to this area towards the end of September 2004.

An additional plant was placed at the ***St. George's University*** and the main feeder supply is presently being restored back to True Blue. Line crews are working their way from True Blue back to Grand Anse. The efforts for these areas are being helped with the emplacement of a 1.5 MW unit that has been located in Lance Aux Epines.

Photo 5 1.5 MW Unit in Lance Aux Epines

The long-term restoration strategy for GRENLEC includes the importation of 1000 electricity poles, which are due to arrive by end September, 2004 from the United States. Following this, it is expected that the main load centres will be restored by mid-October, while for general distribution, all power should be back within a period of six (6) months.

Assistance has been received from electricity generating companies out of Trinidad, St. Lucia, St. Vincent, Montserrat, Antigua and Dominica. In addition, the Trinidad and Tobago Electricity Corporation (T&TEC) has brought in pole diggers (digger derricks) and bucket trucks, while VINLEC out of St. Vincent also sent in some equipment. These have greatly assisted the restoration efforts. Notwithstanding this assistance, <u>additional pole diggers are sorely needed</u> in order to bring the entire country back on stream. A long term mitigation strategy for the reduction of vulnerability within this sector may be to lay underground cables. In order to optimize economies for such an undertaking, however, this would likely have to be coordinated with Cable & Wireless, and be concentrated within specific population centres such as St. George's and Grenville.

The damage assessment carried out for this utility estimates a restoration cost of EC$70 million (direct costs). In terms of resultant losses of revenue, the following is noted:

- Monthly revenues are approximately EC$8.5 million
- No revenues are expected to be collected for the month of September
- 50% of the revenues for this utility come from St. George's, Grand Anse and Grenville, where power will be restored within the first month.
- Over the remaining five (5) month period, it is assumed that power will be restored to rural areas at a rate of 10% per month.
- Using these facts and assumptions it is estimated that the total loss of revenue to this utility as a result of Hurricane Ivan (indirect costs) would be EC$21.3 million.

Water Supply and Sewerage

NAWASA, a government owned Statutory body, is responsible for water supply in Grenada. In all, there are twenty-five (25) dams/intake structures in the NAWASA system. The Authority plans in 2004, to commission a new desalination plant with a design capacity of 1,820 m^3/day (0.4 mgd). This desalination plant is intended to supply the Woburn storage tank during the dry season.

NAWASA operates the Grand Anse sewerage system which serves the residential, tourism and industrial areas from Falege, Grand Anse to Point Salines, with collection, screening and pumping to a sea outfall at Point Salines.

As a result of the storm[34], it was assessed that the dams suffered damage through siltation and the introduction of debris and trees. In addition, several distribution lines (from the dams to the treatment plants) were damaged, as they are supported overland on elevated columns and thrust blocks (Photo 3). These structures were in turn damaged by falling trees.

[34] Telephone interview with Mr. Neptune, Acting Manager of Production and Quality

Photo 6 Damaged Water Supply Infrastructure at Beausejour

Damage was spread across the island, but was worse in the southern and eastern parishes. Rehabilitation strategies include:

1. An initial temporary cleaning of all dams (already completed)
2. Proper cleaning of dams on a systematic basis. Three dams have already been properly cleaned, Concorde, Vendham and Radix. Annandale is to be cleaned by excavator by the end of September, 2004. It should be noted that restoration activities have been hampered by the relatively remote locations of many dams and consequent lack of access.
3. Temporary repairs to the trunk main on the Beausejour Bridge were made, however, these have to be redone and made permanent.
4. The distribution system at the Les Avocats site also needs to be repaired.

It is estimated that close to 90% capacity would be available by the end of September, 2004, however, water supply is still intermittent up to the time of writing of this report. This has prompted an advisory for the public to boil all water prior to consumption.

A damage assessment carried out by NAWASA revealed the following capital cost estimate breakdown for rehabilitation of services.

Pipeline Repairs	EC$2.5 million
Repairs to Buildings	EC$2.5 million
Repairs to plant (pumping stations, reservoirs, etc.)	EC$1.5 million

This results in a total estimate of direct replacement costs of EC$6.5 million. It should be noted that no damages were reported for the Grand Anse sewerage system and outfall. In terms of indirect costs as a result of loss of revenue, the following can be noted:

- Total daily revenues equal EC$46,000/day
- Based on the above assumption table 19 lists indirect costs by geographical location.

Parish/Region	% of Revenue
Carriacou	0.5
St. George	70
St. David	9
St. Andrew	14
St. Patrick	3
St. Mark	1.5
St. John	2

Table 32 Indirect costs in water supply and sewerage by parish

- It has been assumed that there has been a 70% loss of revenue overall in the month of September.
- Based on the referenced interview, it has been assumed that only 10% loss of revenue will occur in the month of October.
- No loss of income is expected to be incurred in November.
- Based on these facts and assumptions, it is computed that the total expected loss of revenues for this utility (indirect losses) will be EC$1.1 million.

Telecommunications and Broadcasting

Cable & Wireless Grenada is currently the sole telecommunications company offering direct exchange lines service to customers in Grenada. The company, 70% owned by Cable & Wireless plc, has in place an 18 optic fiber cable ring around Grenada (part of the Eastern Caribbean Fiber System) and has over 30,000 lines installed. A wide range of modern telecommunications services is provided through this company.

The telecoms industry has been deregulated in Grenada, and there are now several mobile and internet service providers established in the country. These include Digicel, AT&T and GNP.

Following the storm, a detailed damage assessment was carried out by Cable & Wireless, with assistance from both regional and extra-regional resources of the parent company. The assessment revealed the following information[35].

- Both cellular and land line networks remain largely in operation.
- The lines on the east coast were installed underground, whereas those on the west coast were largely above ground. As a result, significant damage was sustained to poles on the west coast.

[35] Interview with Mr. Aaron Moses, Head of Human Resources, Cable & Wireless

Photo 7 Downed Poles Carrying Communication Cables

- All cell sites were installed with generators.
- Significant damage was sustained to overhead fibres and to distribution lines, for which it is estimated that there was a 60% loss island-wide.
- Damage was also caused post-storm by people driving over lines and accidentally chopping cables as part of clean-up efforts.
- After the hurricane, it was discovered that the antennae (i.e. sectors) at several cell site locations had been blown off alignment by the wind. These all had to be realigned.

Restoration efforts have been ongoing since the hurricane, and Cable & Wireless have carried out restoration activities in concert with GRENLEC, with whom it shares the use of poles. At time of writing of this report, the following was the status of the restoration strategy.

- 21 of 24 GSM cellular sites were up and running
- 10 of 12 TDMA cellular sites were now back in operation
- 15 of 21 switches were now working
- The primary problem with the restoration activities will lie with the distribution lines, which are not expected to be fully operational for another six (6) months.
- As a measure of goodwill, Cable & Wireless has given the month of September free to all land line and internet users.
- It should be noted that meter readings indicate that approximately 10,000-15,000 lines are presently working, out of a total of 34,500 residential and commercial

lines. This is believed, however, to reflect an unreal situation, as in some cases the lines may be functional, however the individual house may have been destroyed.

The damage sustained has been estimated at EC$30 million, with a replacement cost (direct cost) of EC$42 million. This difference is accounted for by the fact that duties are now payable on the required equipment, whereas previously they were not. Estimates for the damages sustained by the other cellular providers have been made based on a preliminary estimate of the relative market share of these providers. This results in the following:

1. Digicel EC$10 million
2. AT&T EC$10 million
3. GNP EC$ 5 million

In all, this gives a total estimate of direct cost for this utility sector, of EC$67 million.
In terms of indirect costs as a result of loss of revenue, the following can be noted:

- There have been some losses of revenue from the cellular telephone network. In the first day after the storm, it is assumed that 10-15% of cell sites were working in the two northernmost parishes. Two days after the event, 12 of 24 GSM sites were up and running. Two weeks later, 23 of 24 GSM sites were up and running. This leads to the assumption that on Day 1 following the event, cellular phone revenues would have been reduced by 90%. Between Day 2 and Day 7, cellular phone revenues would have been reduced by 50%. Between Day 7 and Day 14, revenues would have been reduced by 20%. After Day 14, revenue reductions would have been minimal (5%). These assumptions may be tempered by the fact that there has been significant increased cell phone usage since the hurricane. It is not, however, possible to quantify this increased usage at this stage.
- On average, residential customers pay EC$60/month for land lines. Commercial customers can be expected to pay approximately EC$105/month per phone. This equates to monthly revenues of EC$2.4 million.
- Cell phone revenues are approximately 60% of land line revenues, or approximately EC$33,000 per day.
- Prior to the hurricane, there were 27,500 residential lines and 7,500 business lines.
- No revenues are expected to be collected for the month of September throughout the island.
- It is assumed that by the end of September, 30% of all land lines will be in operation and that revenues may be collected for them.
- It has also been assumed that 50% of land lines will be restored between October and February, at a rate of 10% per month and that revenues may be collected for them.
- Finally, it has been assumed that the remaining 20% of lines, even if repaired within the six month window, will likely require a further six months before housing infrastructure has been upgraded to the point where land line fees may be charged.
- The total loss of revenue (indirect losses) from land lines over the next twelve (12) months will be EC$57 million.

- The total loss of revenue (indirect losses) from cell phones as a result of the hurricane is estimated to be EC$280,000. This includes a 40% markup to account for the other cellular operators.

The cable providers in Grenada are Cable Vision and Wee TV. Damage assessments carried out for this sub-sector total EC$5 million. To replace this damaged equipment, which primarily consists of the lines, will require an estimated EC$7.5 million. This service is not expected to be restored for another six months. Using a customer base of approximately 15,000 and at a monthly rate of EC$60, the indirect losses are expected to be EC$5.4 million. This estimate does not include losses from advertising revenues.

There are approximately eight (8) broadcasting stations in Grenada. All of these were out of service during and immediately after the storm. At the time of writing this report, three stations were partially back on the air. Based on discussions with the main operators, a figure of EC$2 million can be assumed for the rehabilitation costs.

Roads and Drainage

A detailed field review of the road network throughout the island revealed that in general, with a few exceptions, the main roads were largely intact. This fact was largely due to the limited amount of rainfall that fell during the hurricane. Where damage and/or limitations to access occurred, it was primarily due to: land slippage; erosion; fallen trees and wave effects.

Land Slippage

Land slippage was observed at St. Paul's, where clean-up efforts took approximately three days. Other sites of slippage included River Road and Brizan. In addition, the effects of the storm worsened the effects of a major landslide that had occurred previously on the Western Main Road on the approach to Gouyave (Photo 8). This landslide occurred before the hurricane and urgently needs to be cleared and some slope stabilization works carried out.

Photo 8 Land Slippage at Gouyave Blocking Western Main Road

Mitigation strategies for this slide could include either some form of slope stabilization, or relocation of the roadway to a lower level with sea defence works to protect it. It is

estimated that the cost of repairs to this location is approximately EC$1.2 million. No indirect costs have been assigned to this project, as the length of the diversion roadway is sufficiently short that it does not present a significant difference from the main route.

Erosion

Erosion of road edge was noted particularly at Grand Etang and Westerhaul (Photo 9). This type of road failure is characterised by removal of a section of the road, through the action of a slope failure. Remedial works should include a retaining wall, which would have to be designed on a site specific basis. Estimated costs to repair these two locations will be EC$500,000.

Photo 9 Erosion of Roadway at Westerhaul

Fallen Trees

A number of roads were blocked by fallen trees all over the island (Photo 10). This phenomenon is discussed in the Environmental Section, where the prevalence of downed trees in the Grand Etang Forest Reserve was noted. Following the hurricane, the Ministry of Works sent out 15 crews to carry out clearing exercises island-wide. Each crew consists of a front end loader, a dump truck and labourers with chain saws. Estimated costs for this activity will be EC$1.2 million.

Photo 10 Typical Example of Fallen Trees

Coastal Damage

The area from Soubise to Marquis was severely impacted by storm surge and wave effects. As a result of this, almost of all the houses and boats on the seaward side of the road were washed over to the landward side of the road, thereby blocking the road. After the passage of the storm, residents of the area cleared the demolished housing. Many of these residents have started to rebuild homes on the same lots that were affected by the hurricane storm surge and wave action (Photo 11). Mitigation action for this low lying area should ideally be relocation/resettlement of this community. Failing this, some form of coastal protection works (e.g. breakwaters) should be implemented, so that widening and increase in height of the beach lands may be achieved. The cost of construction of breakwaters for this area is estimated to be approximately EC$3.0 million.

Photo 11 Reconstruction of housing at Soubise/Marquis

Airports

The passage of Hurricane Ivan resulted in damage to the Point Salines International Airport (PSIA). Damage was sustained to:

- Navigational aids (VOR, DME and NDB)
- Precision approach craft indicators (PAPI's). Two of these units are presently functional out of a total of four.
- The tower radio and equipment.
- Automatic flight plan processing system.
- Miscellaneous antennae.
- Approach lights, turning lights and runway lights.
- Air conditioners.

Structural damage was noted in the Tower, Terminal Building, Crash Fire and Rescue Building, Central Generating Station, Aviation Services office, Taxi Association office, Staff House. Of note was the collapse of the Store Equipment Building (Photo 12).

Photo 12 Total Collapse of Walls of Store Equipment Building for PSIA

The estimated cost of structural repairs is EC$1.0 million. This does not include the cost of repairs for specialized equipment, which is presently being assessed. It should be noted that after the passage of the hurricane, all flights, with the exception of emergency and relief flights, were put on hold. Passenger service resumed after a period of approximately one week. During this period, September 6th to 13th, there was loss of revenue from: landing fees; cargo through-put; navigational Aids; Fuel through-put; aircraft overtime; ground handling; aircraft parking; concessionaires; offices; departure tax; and passenger facilitation charges. Discussions with PSIA management revealed an approximate estimate of lost revenues as a result of the hurricane, of EC$500,000.

Seaports

Damage to the main port terminal was confined to structural building damage (Photos 13 and 14). No damage was reported as occurring to the container stacking equipment, to the docks or to the fendering system. At the new cruise terminal location, no damage was reported as occurring to the dock, although minor damage occurred to the new Welcome Centre. In particular, a damage assessment commissioned by the Port Authority revealed that damages were recorded to the:

- Storage sheds;
- Caricom shed;
- Administration offices;
- Baggage shed;
- Police Station;
- Yard office.
- Lighthouse;
- Post office

This damage assessment revealed a total damage estimate of EC$3.4 million. Following the hurricane, operations resumed at the port after a period of approximately one week. This delay resulted from a difficulty in getting staff to return to work within that period, and also was due to the fact that efforts were concentrated on the processing and clearing of relief supplies. It should be noted, however, that resumption of normal commercial activities has taken approximately three weeks. An approximate estimate of lost revenues for the port was obtained by assuming a value equivalent to 75% of the revenues

recorded in September 2003. This gave a value of indirect losses for the Port of EC$670,000.

Photo 13 Queen's Wharehouse


Photo 14 Damaged Geest Wharehouse

4. Effects on the Environment

4.1 The Environmental Baseline

The state of Grenada, which includes the islands of Carriacou and Petit Martinique and several small uninhabited islands mainly off the east coast. The highest point is Mount Saint Catherine, at 840m. Carriacou, located 24km to the northeast of Grenada is much less mountainous and has an area of 34km^2 . Petit Martinique is 2.3km^2 and lies east of the northern section of Carriacou.

Despite centuries of agricultural cultivation and recent tourism activity, Grenada, up to the time of hurricane Ivan, still retained some of its mountaintop forests and coral reefs, over 450 species of flowering plants, 150 species of birds, and mostly undamaged landscape vistas. The nation has also had a diversity of cultural resources: Carib (Amerindian) archeological sites; historical sites spanning over 400 years of human drama and socio-economic activity (including forts, sugar mills, rum distilleries, and estate houses).

Mountain peaks, steep ridges and deep narrow valleys dominate the interior of Grenada. The volcanic geology of the interior is the dominant factor that produced this landscape. The coastal periphery of Grenada presents a landscape which is much more subdued than the interior. The western side of the island displays a more rugged aspect as the central ridge is nearer to the coast on that side; the slopes are gentler on the east, and there are some fairly extensive coastal plains. The topography of the southwestern and northeastern parts of the island consists of low hills.

4.1.1 Marine and Coastal Habitats[36]

Mangroves
With the exception of the harbours at St. George's and Halifax, the west coast consists of a series of shallow bays separated by headlands, as do the north and northeast coasts. The southeast coast, south of Telescope Point and the south coast westerly of Point Salines are deeply indented with many small bays that had previously been backed by mangrove swamps. Mangrove vegetation also existed at Lavera Pond, St. Patrick and at Harvey Vale, Carriacou. Other areas included the Conference/Pearls area and the bays between St. David and Prickly Bay on the south coast off the main island. The main species of mangrove included red mangrove (*Rhizophora mangle*), black mangrove (*Avecennia germinans*), white mangrove (*Laguncularia racemosa*), and button wood (*Conacarpus erectus*). The rest of the coastal area is considered dry woodland and cactus shrub and made up of a mixture of species including *Impomea sp*. In some sandy beaches, sea grape (*Cocoloba uvifera*), coconuts (*Cocos nucifera*), almond (*Terminalia cattapa*) and manchineel (*Hippomane mancinella*).

Sea Grass Beds
Marine plants included sea grass communities which existed in the Telescope area and within the barrier type reef extending from Grenville Bay to (MAP) Prickly Bay in the South; at Carriacou in the L'Esterre Bay and Machineel Bay and within the reef at North Bay, Isle de Rhonde. The main species are turtle grass, *Thalassia testudinum* and mantee grass, *Syringodium filiforme*. Other marine plants include various species of green, blue green, brown and red algae, some of which are locally used as a food. A variety of seaweeds or sea moss (red marine algae) mainly *Graciliria sp*. was harvested at notable sand-mud locations at Calliste, Conference, Pearls and Telescope as well as locations at Carriacou and Isle de Ronde. The sea moss is harvested primarily for local consumption although some of the dried plants are exported to neighboring islands. Sustainable harvesting of the sea moss has been maintained at Calliste, St. George's.

Coral Reefs
Most of the reefs around Grenada and the Grenadines, especially along the East and South East are in varying stages of degradation and recuperation. The islands adjacent to the Lavera Bay have reef systems with Sugar Loaf being in the best state of recovery and dominated by elkhorn coral (*Acropora palmate*). There is one barrier type reef stretching from Telescope Point to Marquis Islands with elkhorn coral, finger coral (*Porites porites*) and some boulder coral including mustard, and brain coral. Small fringing reefs mainly of elkhorn coral exist along the southeast and the south coast of Point Salines. These reefs have shown some signs of recovery but most of them remain covered with algae.

On the north west coast of Grenada, the reef at Red Rock, originally dominated by elkhorn coral has suffered much physical damage from strong storm swells that frequently hit the area. Reefs also exist at Beausejour and Molinere. The reefs at

[36] This section is informed by the Biodiversity Strategy and Action Plan for Grenada. This was prepared in July 2000 and consisted of gathering information on the status of biological resources, benefits, threats to and loss of biodiversity and the causes of these threats and losses.

Mollinere have been steadily degrading as a result of overuse mainly by tourists. The three fathoms reef in Grand Anse is badly degraded; however, the six fathoms reef is still in good shape. Large barrier reefs occur along the east coasts of Carriacou, Petit Martinique and some of the smaller islets of the Grenadines. These are strongly dominated by elkhorn corals in the shallower's waters and boulder coral in the fore reef. Saline and White Islands have an excellent reef system and presently have the best species combination in the area.

Forests and Natural Vegetation

Prior to Hurricane Ivan there was very little documentation on the composition and status of Grenada's forests. However, three (3) endemic species of plants were known: the Grand Etang Fern (*Danaea sp.*), the Cabbage Palm (*Oxeodoxa oleracea*) and one endemic tree species (*Maythenus grenadensis*).

Using the Beard classification, there were six (6) major forest communities:

- Cloud Forest (montane thicket, palm break and elfin woodlands). Generally, these forests were located in the inaccessible upper slopes of Grand Etang and on Mt. St. Catherine. They have suffered little degradation and appear to be under no serious threat.
- Rain Forest and Lower Montane Rain Forest. These forests occurred below the cloud cover and where rainfall exceeds 2500mm per annum. The best remnants were found in the Grand Etang Forest Reserve.
- Evergreen and Semi-evergreen forests. These forests occurred where the rainfall is between 2000 and 2500mm per annum. A 40 to 60ha of this forest type was found at Morne Gazo in the south.
- Deciduous Forest and Cactus Scrub. These occurred at lower elevations where the rainfall is between 1000 – 2000mm per annum, usually falling within a five month period. They were found in the north and south of mainland Grenada, and on Carriacou and Petit Martinique.
- Littoral Woodlands. A small patch remained at the edge of Levera woodland in the northeast of Grenada.
- Mangrove woodlands (this has already been described above).

None timber forest products, primarily screw pine (*Pandanus utilis*) and bamboo (*Bambusa vulgaris*) are harvested and utilized for making baskets and other handicraft. Many naturally occurring herbs are also used to produce herbal medicines, especially in the rural areas.

Wildlife

Records on faunal species numbers, distribution and their current status are extremely limited. The terrestrial wildlife[37] is thought to consist of:

- Four amphibian species
- Eight species of lizards

[37] Groome, 1970. The list by Groome may be incomplete, and some of species mentioned may no longer exist.

- Five species of snake
- One hundred and fifty species of birds (18 are thought to be threatened)
- Four native species of terrestrial mammals
- Eleven native species of bats
- One endemic specie of weevil (*Diaprepes sp.*)
- Several species of fresh water shrimps and land crabs

The dry forest in the south and north of the island is considered prime habitat for the Grenada Dove (*Leptotila wellsi*) and the Grenadian Hook-billed kite (*Chondrohierax uncinatus*). Grenada is also home to four bird species that are endemic to the Lesser Antilles[38]. These include the Grenada flycatcher (*Myiarchus nugatory*), the Scaly-breasted thrasher (*Margarops fuscus*), the Lesser Antillian bullfinch (*Loxigilla noctis*), and the Lesser Antillian tanager (*Tangara cucullata*).

Hunting, for recreation and a source of food, was a very popular activity in Grenada. The main animals hunted were: manicou, armadillo, mona monkey, ramier pigeon, and iguana.

Fisheries

The International Centre for Living Aquatic Resource Management (ICLARM) records 233 marine species, 69 marine/brackish water species and 17 species for fresh water.

Records of fish landings classify the range of marine species into pelagic finfish, demersal finfish, crustaceans and shellfish; the unclassified fish are mainly dermesals. The near shore and off shore coral reefs provide the base for dermasal fish such as snappers, groupers, grunts, doctorfish, etc., while the off-shore ocean provides Yellow-fin Tunas, Oceangar, Marlin, Dolphin fish and King fish among others. Beach seines very close to shore harvest jacks and robins when such fish come off the ocean deep on a daily basis. Divers in significant quantities traditionally harvest crustaceans and other shellfish such as lobsters, turtles and conch.

Although a large segment of the national fishery remains semi-subsistence, commercial fisheries has been quite significant. The Yellow-fin Tuna is a highly sough-after species because of its market value; it now accounts for the largest species catch in national landings. Before the hurricane, tuna fishery contributed, on an average, to at least 16% of landed catches.

The environmental profile of each of the parishes in Grenada is presented in Table 20.

[38] CCA/GOG/USAID 1999

Parish	Population	Natural Resources (Key)
St. George's	31,994	Beaches, coral reef, Grand Etang Rain Forest, rivers, dry scrub forests, waterfalls, lakes, mangrove forests, off shore islands, bays and sheltered harbours
St. John's	8,752	Rivers, waterfalls, beaches, lakes, mangrove forests, bays and sheltered harbours
St. Mark's	3,861	Rain forests, rivers
St. Patrick's	10,118	Forests, rivers, beaches, lakes, mangrove forests, coral reefs, offshore islands, dry scrub forests
St. Andrew's	24,135	Forests, beaches, coral reefs, waterfalls, dry scrub forests, rivers (Great River)
St. David's	11,011	Dry forests, mid-elevation wet forests, beaches, coral reefs, mangrove forests, sheltered bays
Carriacou and Petit Martinique	5,726	Coral reefs and beaches, mangrove forests, oyster beds, sheltered bays, dry scrub forests

Table 33 Environmental Profile for Parishes in Grenada[39]

Grande Anse Beach

Concord Falls

Lavera

Photo 15 Some Environmental Assets before Hurricane Ivan

[39] Jessamy 1999

Figure7 Map showing environmental assets