CHAPTER 9 LOSS ESTIMATION

9.1 INTRODUCTION

The quantitative vulnerability data available from chapter 8 makes it possible to estimate the likely economic losses that might result from high velocity winds and earthquake induced ground shaking. In this chapter the damage ratio curves from chapter 8 is used to estimate the structural damage to buildings, utility poles and boats from high velocity winds and the structural damage from ground shaking.

In general the methodology involves estimating the replacement cost of the structure and then establishing the economic losses from a given magnitude hazard event by applying the damage ratio for that event. Therefore if the replacement cost of a structure is $100 and a hazard event of magnitude X is found to produce a damage ratio of 30%, then the economic loss is $30. In this way the economic loss for different magnitude of a hazardous phenomena can be estimated.

In this respect the elements at risk inventory as a digital dataset within the GIS database provided a convenient platform for the calculation of loss estimates. Because detailed information on buildings is only available for Road Town, loss estimate calculations were carried out on the building stock of Road Town. Estimates for the rest of the BVI were made by extrapolating the Road Town data to augment data available for buildings outside of Road Town.

9.2 WIND DAMAGE LOSSES TO BUILDINGS

9.2.1 REPLACEMENT VALUE ESTIMATION

The footprints of buildings, in the inventory of the elements at risk provides a measure of the area occupied by buildings. The total area of the building is then calculated by multiplying the footprint area by the number of floors. The current replacement value of each building was estimated by multiplying the cost per unit area by the total area of the building.

Two general replacement costs per unit area were used. Replacement values of US$100 and US$150 per square foot were used for residential and commercial buildings respectively. Using these figures, the replacement cost for each building in Road Town was calculated. The total value of residential buildings calculated digitized from 1991 data, is US$97 million and commercial buildings US$128 million.

9.2.2 LOSS ESTIMATE CALCULATION

The economic loss for each building was then calculated for (SS) hurricane categories (1-4) by multiplying the replacement value by the damage ratio for each class of building. The estimates are presented in **Table 9.1.**

TABLE 9.1: Estimates of structural damage cost to residential and commercial structures in Road Town.

HURRICANE CATEGORY (SS)	ROADTOWN (1991) ESTIMATED DAMAGE (million US$)	BVI (1991) (million US$)
1	11	33
2	40	120
3	87	261

4	150	450

From the inventory of buildings dataset it is known that the total building stock in the BVI is about three times the number in Road Town. Table 9.1 therefore gives a rough estimate of the losses to the entire BVI stock, which assumes a similar distribution of building types throughout the rest of the BVI as that of Road Town. A more precise estimation of damage for the entire BVI requires a detailed classification of the buildings similar to that done for Road Town.

9.3 WIND DAMAGE LOSSES TO THE ELECTRICAL DISTRIBUTION SYSTEM

The inventory of the elements at risk dataset and the estimated damage ratios for utility poles given in **Table 8.9** was used to estimate the losses that might result from category 1,2,3 and 4 hurricanes. The inventory of utility poles consists of 1723, 35 foot, wooden poles. Based on a price per pole of US$150, the total value of utility poles is $258,450. Using this figure with the damage ratios from **Table 8.9** yields the estimated losses to utility poles given below in **Table 9.2**.

TABLE 9.2: Estimated losses to utility poles

HURRICANE CATEGORY	VALUE OF POLES DAMAGED (BASE TERRAIN)	VALUE OF POLES DAMAGED (SPEED-UP TERRAIN)	TOTAL POLE DAMAGE (US$)
1	0	1,275	1,275
2	11,625	7,650	19,275
3	69,750	14,025	83,775
4	127,875	19,890	147,765

The number of poles at locations with normal hurricane wind hazard IE in base terrain was determined from the wind hazard susceptibility map as were the poles in areas where there is a speed up effect. The poles in areas of speed up were deemed to be subjected to hurricane force winds of the category higher than that under consideration. Therefore the damage ratio assigned to these areas for each category hurricane corresponded to the ratio of the next higher category.

Since this estimation relies on an incomplete dataset for the electrical transmission line network, this figure is conservative but does provide a ball park figure to work with. Of course the actual cost to repair the transmission lines would require a number of other components in addition to replacing the poles, and therefore the total replacement cost will be much higher.

9.4 WIND DAMAGE LOSSES TO BOATS

An estimate of the possible damage to boats was carried out by using the damage ratios presented in **TABLE 8.6** and the inventory of the elements at risk dataset. A replacement cost of $85,000 was used as an average figure for the 35-50 foot yachts which predominate in the BVI charter boat industry. A figure of $40,000 was used as the average replacement cost for small open craft commonly used by fishermen, and as pleasure boats.

Using these figures the estimated losses to unprotected boats from (SS) category 1-4 hurricanes was obtained, **Table 9.3.**

TABLE 9.3: Estimates of damage to unprotected boats.

HURRICANE CATEGORY	DAMAGE RATIO YACHTS (35 -50 FT)	DAMAGE RATIO SMALL OPEN CRAFT	ESTIMATED DAMAGE (US$MILLION)

1	0.065	0.09	5.76
2	0.3	0.41	26.4
3	0.7	0.83	58.6
4	0.95	0.99	76.3

9.5 EARTHQUAKE LOSSES TO BUILDINGS

By utilizing the damage ratios for expected structural damage due earthquake ground shaking in **Table 8.13** it is possible to establish rough estimates for the losses which might result from earthquake events of known MMI (intensity) values.

The total value of buildings in Road Town from the building inventory dataset amounts to about 225 million US dollars. **Table 9.4** shows the losses to structures which might result from different intensity earthquakes. The calculation assumes that all buildings in the dataset were constructed to similar standards. The estimates provide a rough estimate of potential damage to buildings in Road Town.

TABLE 9.4: Estimated losses to Road Town buildings resulting from different intensity earthquakes.

EARTHQUAKE INTENSITY (MMI)	DAMAGE RATIO (%)	EXPECTED LOSSES ROADTOWN (US$ million)
V	0.5	1.1
VI	1.5	3.4
VII	5.0	11.3
VIII	17	38.0