TABLE 4.13: HUNTUMS AND LONG BUSH GHUTS MAXIMUM DISCHARGES (cfs)

SUB-WATERSHED	RETURN PERIOD (years)					
	2	5	10	25	50	100
LONG BUSH1	384	569	688	846	988	1128
LONG BUSH2	517	764	924	1135	1325	1514
GORDON	552	815	985	1210	1411	1612
PICKERING	652	962	1162	1427	1664	1901
BOTANIC GARDEN	746	1105	1388	1646	1922	2196
HUNTUMS OUTLET	1279	1894	2291	2817	3289	3758

4.3.5 JOHNSON GHUT HYDROLOGIC MODELING RESULTS

The Johnson Ghut characteristics are presented in **Table 4.14** and **Map 4.5.** and the peak discharge estimates in **Table 4.15.**

TABLE 4.14: JOHNSON GHUT SUB-WATERSHED CHARACTERISTICS

SUB-WATERSHED	AREA (mi^2)	MAX. ELEV. (ft)	MIN. ELEV. (ft)	LENGTH (ft)	LAG TIME (hr)
PURCELL	0.33	1055.18	82.00	3116.00	0.10
BUTU	0.06	1091.00	45.92	3280.00	0.10
JOHNSON PORT	0.25	946.00	6.56	3444.00	0.11

TABLE 4.15: JOHNSON GHUT MAXIMUM DISCHARGES (cfs)

SUB-WATERSHED	RETURN PERIOD (years)					
	2	5	10	25	50	100
PURCELL	273	403	486	597	696	795
BUTU	323	476	575	705	822	939
JOHNSON PORT	530	781	943	1157	1350	1541

4.3.6 MAXIMUM DISCHARGE ESTIMATION FOR BVI WATERSHEDS

Based on the hydrologic modeling results it is possible to estimate the maximum discharges for the bigger watersheds, in the main islands of the BVI. The basic parameters are taken from the Huntums and Long Bush hydrologic modeling (**Table 4.13**). It is assumed that the unit discharge, or the discharge per unit area of watershed, for the different return periods, is constant for the various islands, and watersheds.

Of course, this is only an approximation, but taken into account the similarity of geomorphology and climatic conditions of the BVI, this estimation is reasonable as a first approximation. Of course, Anegada is excluded from this analysis, because its drainage pattern is completely different and undefined.

Unit discharges and the corresponding return periods are presented in **Table 4.16**, and indicates discharge at the watershed outlet.

TABLE 4.16: UNIT DISCHARGES FROM HUNTUMS GHUT

RETURN PERIOD (years)	DISCHARGE (cfs)	AREA (mi^2)	UNIT DISCHARGE (cfs/mi^2)
2	1279	1.58	809
5	1894	1.58	1199
10	2291	1.58	1450
25	2817	1.58	1783
50	3289	1.58	2082
100	3758	1.58	2378

The discharge estimations for 2, 5, 10, 25, 50 and 100 years return periods, are presented in **Table 4.17** for the main sub-watersheds of Tortola, **Tables 4.18** and **Table 4.19** present data for Virgin Gorda and for Jost Van Dyke island respectively.

TABLE 4.17: TORTOLA WATERSHED MAXIMUM DISCHARGES

WATERSHED	PERIM.	AREA	DISCHARGE (cfs)					
	(mi)	(mi^2)	RETURN PERIOD (years)					
			2	5	10	25	50	100
Two Ghut	5.06	0.75	602.96	893.63	1080.70	1328.89	1551.74	1772.35
Buntin Ghut	3.15	0.33	270.83	401.38	485.41	596.89	696.98	796.07
Brown Ghut	3.90	0.49	398.50	590.60	714.24	878.27	1025.55	1171.35
Valley Ghut	5.48	1.05	847.24	1255.67	1518.54	1867.27	2180.41	2490.40
Nibbs Ghut	5.18	0.97	786.88	1166.21	1410.35	1734.25	2025.07	2312.98
Long Bush G.	4.76	0.48	390.28	578.42	699.51	860.16	1004.40	1147.20
Huntums G.	5.03	0.93	751.80	1114.23	1347.48	1656.94	1934.80	2209.87
Jackass G.	2.96	0.21	166.22	246.36	297.93	366.35	427.79	488.60
Johnson G.	3.83	0.64	517.95	767.64	928.34	1141.54	1332.97	1522.48
James Ghut	3.60	0.48	388.38	575.61	696.11	855.98	999.52	1141.63
Spring Ghut	5.70	1.09	882.00	1307.19	1580.84	1943.89	2269.87	2592.58
Bomie Ghut	4.50	0.62	504.04	747.03	903.42	1110.89	1297.18	1481.61
Grey Ghut	3.00	0.27	217.42	322.23	389.69	479.18	559.54	639.09
Thousand G.	3.30	0.40	325.50	482.41	583.40	717.38	837.68	956.77
Johnny Cake	3.49	0.40	322.97	478.66	578.87	711.81	831.17	949.34
River Ghut	4.35	0.71	572.30	848.20	1025.76	1261 33	1472.85	1682.25
Garden Ghut	3.15	0.36	295.16	437.45	529.02	650.52	759.60	867.60
Shannon Ghut	3.38	0.43	346.35	513.32	620.78	763.35	891.36	1018.08
Old Ground G.	2.81	0.25	204.15	302.56	365.90	449.93	525.38	600.07
Cappoons Bay	1.80	0.15	119.45	177.04	214.10	263.27	307.42	351.13

TABLE 4.18: VIRGIN GORDA MAXIMUM DISCHARGES

WATERSHED	PERIM.	AREA	DISCHARGE (cfs)					
	(mi)	(mi^2)	RETURN PERIOD (years)					
			2	5	10	25	50	100
Plum Tree Bay	2.66	0.22	177.16	262.56	317.53	390.45	455.93	520.74
Valley Ghut	1.84	0.11	86.53	128.24	155.08	190.70	222.68	254.33
Little Bay Ghut	2.91	0.21	167.90	248.84	300.93	370.04	432.10	493.53
Black Rock G.	3.06	0.31	247.09	366.21	442.87	544.58	635.90	726.31
Cinnamon G.	2.66	0.18	145.56	215.73	260.89	320.80	374.60	427.85
Great Governor	3.34	0.41	333.21	493.84	597.22	734.37	857.52	979.44
Turn Ghut	2.31	0.20	158.42	234.79	283.94	349.15	407.70	465.66
Oil Nut Bay G.	1.66	0.08	63.99	94.84	114.70	141.04	164.69	188.10
Crab Hill Ghut	1.28	0.06	51.35	76.11	92.04	113.18	132.16	150.95
Windy Hill G.	1.16	0.05	43.07	63.84	77.20	94.93	110.85	126.61

TABLE 4.19: JOST VAN DYKE MAXIMUM DISCHARGES

WATERSHED	PERIM.	AREA	DISCHARGE (cfs)					
	(mi)	(mi^2	RETURN PERIOD (years)					
			2	5	10	25	50	100
Cherry Ghut	1.20	0.05	37.42	55.45	67.06	82.46	96.29	109.98
Old Mill G.	1.95	0.14	114.78	170.11	205.72	252.96	295.38	337.38
Great Ghut	1.48	0.08	62.57	92.74	112.15	137.90	161.03	183.92
The Ghut	3.28	0.37	301.23	446 44	539.90	663.89	775.22	885 43
Brown G.	2.98	0.30	246 11	364 76	441.12	542.42	633.38	723.43
Garner G.	1.98	0.16	130.07	192.78	233.13	286.67	334.75	382.34

4.4 HYDRAULIC MODELING

4.4.1 INTRODUCTION

The outputs of the hydrologic modeling process was used as inputs for the hydraulic modeling which involves an assessment of the water flow conditions of the drainage channel itself. This requires an understanding of the channel configurations, the type of channel surface and the nature of channel obstructions.

A detailed topographic survey was commissioned to obtain data on channel configuration. This involved the production of several cross sections of the drainage channels which are crucial inputs for the hydraulic modeling. Field surveys were carried out to determine the other parameters.

In general the model determines the capacity of the channel to handle flow discharge of varying magnitudes. The US COE HEC-2 model was used for this analysis. HEC-2 is a computer program intended for calculating water surface profiles for steady gradually varied flow in natural or man made channels. Effects of various obstructions such as bridges, culverts, and other structures in the drainage channel are considered in the computations. The program also has the capability for assessing the effects of channel improvements and levees on water surface profiles and can determine flood prone areas.

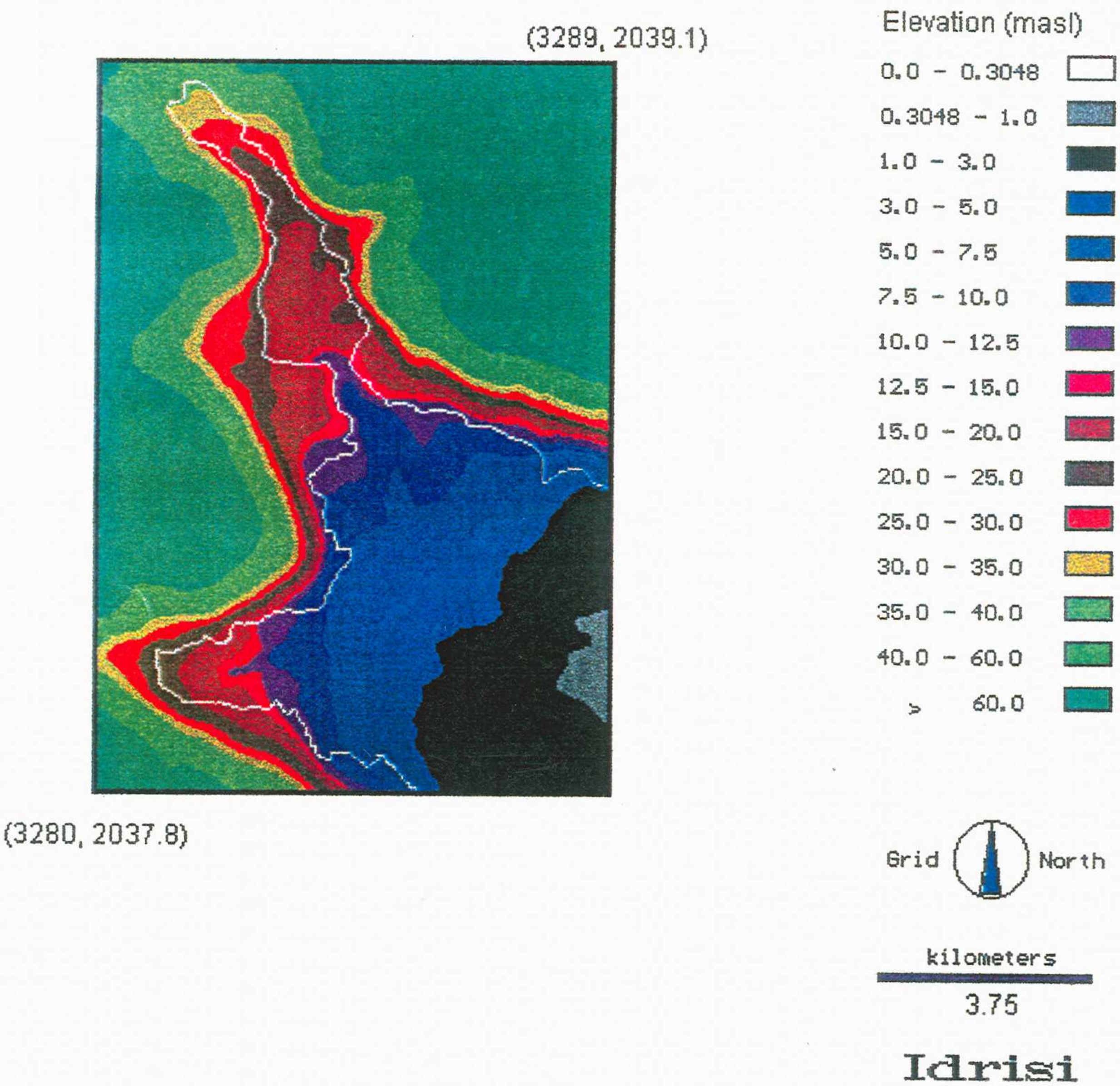
4.4.2 FLOOD PRONE AREAS

The final report presents a series of maps produced by GIS analysis that show the areal extent of over-bank flow that can result from discharges with return periods of 25, 50 and 100 years. One of these maps is shown in **Map 4.6.** The small quantities of flood water, the lack of detailed topography of the low lying areas, and the presence of many buildings and roads, does not allow us to produce an accurate delineation of the areas which might be affected from an extreme flood event.

These maps show the areas with elevations below the level of the water in the channel for a given discharge. The maps therefore indicate that in general terms over-bank flow can

MAP 4.6

Road Town Flood Prone Areas
Huntums and Long Bush Ghuts
25 years return period



extend over much of the flat low lying areas adjacent to the drainage channels as a result of even a 25 year flood event which would represent 24 hour rainfall of 11.4 inches. However the relatively low discharge through the channels results in small changes of water surface elevation and therefore the depth of inundation is shallow and the entire area would not be inundated simultaneously.

The HEC-2 model analysis did allow us to identify the sections of the drainage channels, **Map 4.7**, which are most inefficient in conveying large discharges. Based on the position of these sections, the areas most prone to flooding in Road Town is indicated in **Map 4.8**.

4.4.3 CHANNEL IMPROVEMENT

Channel improvement work involve steps to introduce geometric modifications of the channel course, in order to improve the hydraulic capacity and ideally transport all the amount of flow within the boundaries of the channel, so that no overbank flow will occur. **Map 4.7** indicates the reaches of the ghuts which should be modified to reduce the possibility of flooding.

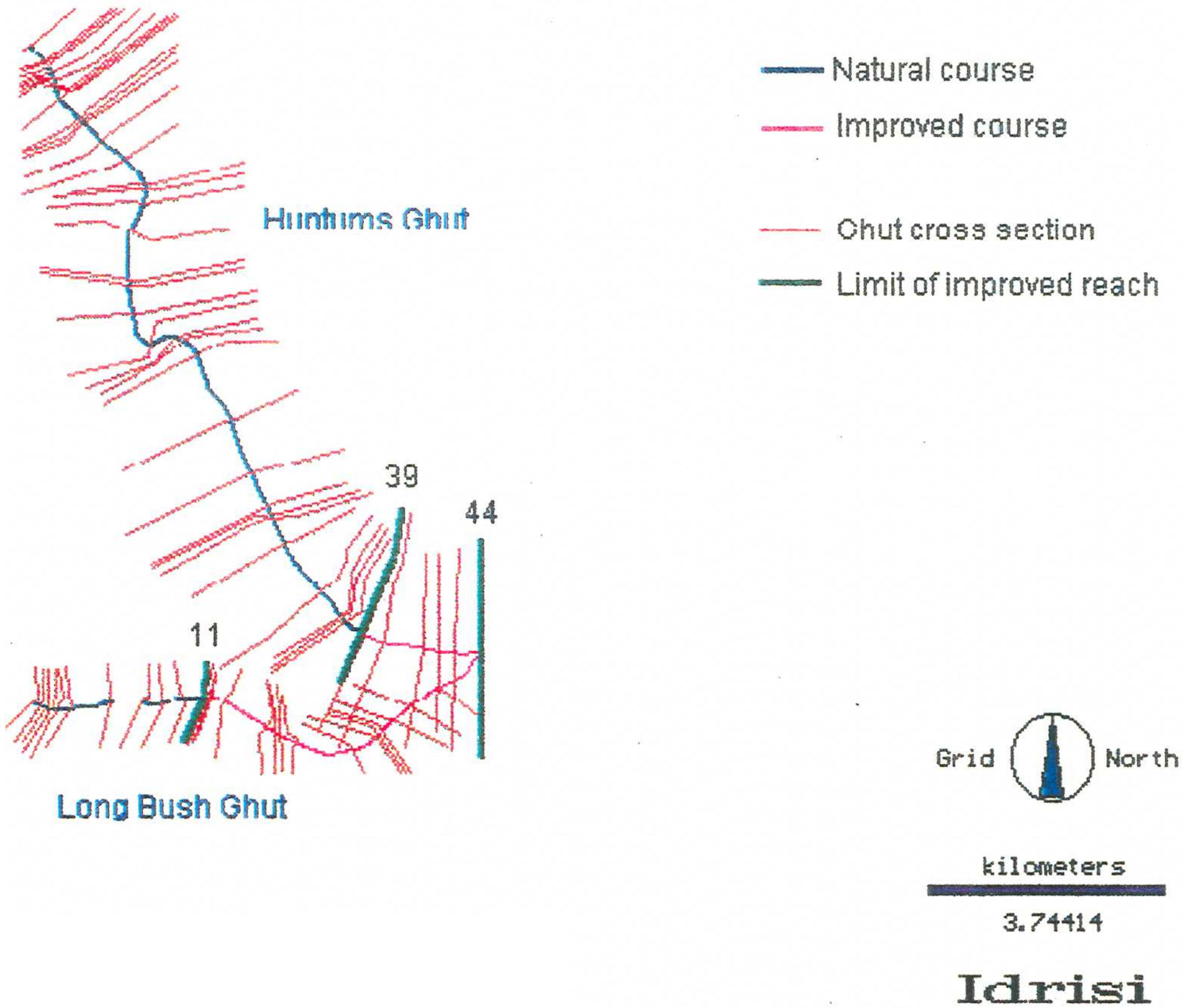
The model provides a series of options to improve the flow capacity of these reaches. One option is to increase the area of the channel section. If this is attempted in the low lying areas, the width of the channels become very large, because the low slope and tides do not permit deepening the channel bed.

In order to keep the dimensions small it is necessary therefore to improve the hydraulic energy efficiency of the channel. This can be achieved by a good quality concrete lining of the channel, including the walls and the channel bed.

Map 4.7

Channel Improved Reaches

Huntums and Long Bush Ghuts



Map 4.7 (Cont.)

Channel Improved Reaches

Johnson Ghut

4.5 CONCLUSIONS

The general drainage study indicates that only Tortola, Virgin Gorda and Jost Van Dyke possess drainage systems capable of causing flood hazards and the results of the precipitation analysis suggest that these events are quite infrequent. The return period for rainfall amounts of 11.4 inches in 24 hours for example, was estimated at 25 years. In general the hydrologic study suggests that the watersheds will produce relatively small discharges because of their small size, and the presence of abundant vegetation.

The hydraulic study of the Ghuts in Road Town indicates that the banks of the drainage channels can be overtopped as a result of a 25 year rainfall. However the water level would be very low and the presence of buildings and other obstructions will limit any significant damage to structures and or their contents to those located immediately adjacent to the drainage channel.

The areas of greatest susceptibility was also identified. In addition the hydraulic study identified areas for channel improvement to reduce flood hazard. In general the flooding hazard associated with the Ghuts in Road Town is not significant. However localised blockage of the drainage channels by debris for example can result in localised inundation.

The entire study provides important background data relating to the hydrological and hydraulic characteristics of the Ghuts which were studied in detail. This data could be very useful for more detailed study and for site specific design purposes.