SUPPORTING REPORT F

HYDRODYNAMIC SIMULATION

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SUPPORTING REPORT F HYDRODYNAMIC SIMULATION

1. Introduction

In "The Master Plan on Flood Control in the Northern Rural Region of Santa Cruz" in 1996, flood analyses were conducted in the Chane – Pailon Area and the San Juan – Antofagasta Area to simulate the flood area with and without the flood mitigation and drainage improvement measures. The flood in 1992 was used to calibrate the hydrodynamic model. The hydrodynamic model was then used to simulate the probable flood for design rainfalls with 2, 5, 10, 20 and 50 year return periods.

In this study, the hydrodynamic model used in the Master Plan Study in 1996 was updated by using the new cross sections from the newly constructed bridges and the topographic survey conducted during the Study. The purposes for these are:

- To verify the application of the formulated hydrodynamic model for the current floods,
- To clarify mainly:
  - the extent of the back water effect from downstream of the Rio Chane,
  - the effect of the overflow from the Rio Grande,
  - the effect of the natural retarding basins in both areas for flood mitigation,
  - the effect of the newly constructed bridges to the flow in the Study Area and
  - the effect of the confluence at the Arroyo Jochi and Tacuaral.
- To simulate the design floods at each return period years,
- To clarify the improvement of flood condition with the project implementation compared to the condition without the project implementation.

2. Hydrodynamic Model Structures

2.1 Model Formulation

The hydrodynamic model was formulated with the same basis as in the Master Plan Study in 1996. The model was set up for the river basins in the study area those were classified as the target areas for structural measures as follows:

The Chane – Pailon Area	:	The Rio Chane-Pailon basin and The Okinawa Drainage basin
The San Juan – Antofagasta Area	:	The Arroyo Yapacanicito, Jochi and Tacuaral basin

(1) Model Formulation in the Chane – Pailon Area

The river system in the Rio Chane-Pailon basin and the Okinawa Drainage basin was composed of the main rivers, the Rio Chane and the Rio Pailon, 4 tributaries, the Quebrada Chacras, the Quebrada Toro, the Quebrada Maras and the Quebrada Meco and 1 drainage canal, the Okinawa Drainage. The basin was divided into 27 sub-basins in the main rivers, tributaries and drainage as follows:

River	Sub-basins	Total	Area (km^2)
Rio Chane	A-1, A-2, A-3, A-4, A-5 A-7, A-8, A-9, A-10, A-11	10	1,368.80
Rio Pailon	A-6	1	211.87
QDA Chacras	B-1, B-2, B-3	3	224.25
QDA Chane	C-1, C-2, C-3, C-9	4	235.61
QDA Toro	C-4, C-5, C-6	3	171.29
QDA Maras	C-7, C-8	2	62.36
QDA Meco	D-1	1	244.82
Okinawa Drainage	E-1, E-2, E-3	3	381.50

The coordinates and chainages of the river system were shown in Table F.2.1. The area and the connecting points of the river system were shown in Table F.2.2, F.2.3 and F.2.4.

A total of 17 runoff points were set up in the river model with 15 points in the rivers and tributaries and 2 points in the drainage in for the calculation. The location of these points and the connection of sub-basins were shown in Figure F.2.1 and F.2.2.

(2) Model Formulation in the San Juan – Antofagasta Area

The river system in the Arroyo Yapacanicito, Jochi and Tacuaral basin was composed of the main rivers, the Arroyo Yapacanicito, the Arroyo Jochi and the Arroyo Tacuaral and some water flowing routes found during flood periods. These routes were set up as tributaries in the model namely the Jochi-Tacu, the R/W Embank and the TMP-R/W. The drainage basin was divided into 14 sub-basins as follows:

River/Arroyo	Sub-basins	Total	Area (km^2)
Arroyo Jochi	J-1, J-2, J-3, J-4	4	148.0
Arroyo Tacuaral	T-1, T-2, T-3, T-4	4	252.8
Arroyo Yapacanicito	Y1-1, Y1-2, Y1-3, Y1-4, Y2-1, Y2-2	6	370.7

The coordinates and chainages of the river system were shown in Table F.2.5. The area and the connecting points of the river system were shown in Table F.2.6.

A total of 13 runoff points were set up in the river model with 5 points in the Arroyo Yapacanicito, 4 points in the Arroyo Jochi and 4 points in the Arroyo Tacuaral. The location of these points and the connection of sub-basins were shown in Figure F.2.3 and F.2.4.

2.2 Boundary Condition

The time series of flow rate in each sub-basin from the rainfall-runoff analysis were used as the inflows to the river system in the models.

Manning roughness coefficients of the rivers without the river improvement were set as follows:

Without the river improvement :

The Chane – Pailon Area	=	0.035
The San Juan – Antofagasta Area	=	0.045

With the river improvement :

Both areas	=	0.003

The other necessary parameters in the simulation were set same as in the Master Plan Study in 1996.

Water levels at the downstream end of the rivers during the current floods in 1997 and 1998 were obtained from the questionnaire surveys conducted during the study in both river basins.

2.3 Hydrodynamic Simulation Program

A hydrodynamic simulation program so called MIKE11 developed by the Dennis Hydraulic Institute (DHI) used in the Master Plan Study in 1996 was adopted in this study to analyze the current floods with the unsteady flow condition. The calibration

results and necessary parameters in the model set up in the Master Plan Study in 1996 were also used in this simulation.

3. Hydrodynamic Simulation for the Current Floods

3.1 Purposes

The flood analysis was conducted using the current floods in 1997 - 1998 those were reported to create flood damages in the study area in order to clarify the following points:

- The application of the flood model for the current floods,
- The effect of the back water from the Rio Pirai to the Rio Chane,
- The effect of the overflow from the Rio Grande,
- The effect of the retarding basin at the upstream of the Rio Pailon and QDA Chane,
- The effect of the construction of seven bridges along the Route number 9,
- The effect of the inundation from the Rio Yapacani,
- The effect of the retarding at the confluence of the Arroyo Jochi and Tacuaral,
- The effect of the inflow from the Arroyo Jochi to the San Juan area and
- The effect of the contraction in the Arroyo Yapacanicito, Jochi, Tacuaral and others.

3.2 Simulation Set-up

The simulation was done for the floods in 1997 and 1998 in order to compare with the actual inundation depths and areas obtained from the flood damage survey conducted in this study.

(1) Simulation Set-up in the Chane – Pailon Area

The simulation periods were as follows:

The Rio Chane- Pailon basin	:	November – December1997
The Okinawa drainage basin	:	November – December1997
	and	February – March 1998

The changes of river condition and flow due to the construction of 7 bridges after 1995, the overflow from the Rio Grande basin and the back water from the Rio Piray basin were to be clarified in the simulation. These points were taken into consideration in the hydrodynamic model as follows:

The effects to be clarified	The condition set up in the simulation
1). The effect of the contraction and the meandering in the Rio Chane and the Rio Pailon	The cross-sections were set up at the contraction and meandering to obtain the changes of hydraulic characteristics
2). The effect of the overflow from the Rio Grande to the Okinawa drainage	The calculation was done using the rainfalls during the period that was reported to have the overflow
3). The back water effect from the Rio Piray to the Rio Chane	The water level at the downstream end was set up by considering the back water from the Rio Piray
4). The effect of retarding at the upstream of the Rio Pailon and QDA Chane	The retarding was set up in terms of the storage volume in the cross sections at the confluence
5). The effect from the construction of seven bridges along the national highway number 9	The cross sections at the bridges were used in the simulation to obtain the changes of hydraulic characteristics

(2) Simulation Set-up in the San Juan – Antofagasta Area

The simulation period was as follows:
The Arroyo Yapacanicito, Jochi and Tacuaral Basin : January – February 1997

The changes of river condition and flow during the flood period were to be clarified. The main causes of these changes were the overflow from the Rio Yapacani, the contraction in the Arroyo Yapacanicito, Jochi, Tacuaral and others, the effect of retarding at the confluence of the Arroyo Jochi and Tacuaral and the inflow from the Arroyo Jochi to the San Juan area. These points were taken into consideration in the hydrodynamic model as follows:

The effects to be clarified	The condition set up in the simulation
1). The effect of the inundation from the Rio Yapacani	From the questionnaire surveys, there was reportedly no inundation from the Rio Yapacani after 1995. Therefore, no condition set up for this effect
2). The effect of the contraction in the Arroyo Yapacanicito, Jochi, Tacuaral and others	The cross-sections were set up at the contraction to obtain the changes of hydraulic characteristics
3). The effect of retarding at the confluence of the Arroyo Jochi and Tacuaral	The retarding was set up in terms of the storage volume in the cross sections at the confluence
4). The effect of an inflow from the Arroyo Jochi to the San Juan area	From the questionnaire surveys, there was reportedly no inflow from the Arroyo Jochi to the San Juan area after 1995. Therefore, the river network was changed according to this condition

3.3 Simulation Results

(1) In the Chane – Pailon Area

The simulation was done for the floods during November – December 1997 for the Rio Chane – Pailon basin and during November – December 1997 and February – March 1998 for the Okinawa drainage basin.

The Rio Chane – Pailon basin

The effect of the back water from the Rio Piray and the contraction of the rivers were examined by varying the water level at the downstream end of the Rio Chane for 2 cases, those are

Case I : Water level set up from the questionnaire survey
Case II : Very high water level set up for the comparison

The simulation results revealed that

1) In Case I, it was found that the water level profile from the simulation as shown in Figure F.3.1 was not much different from the flood damage survey conducted in this Study. The inundation depth varied 1.0 – 2.0 m. for the whole area. The maximum water levels and discharges were shown in Table F.3.1 and F.3.2.

   The model was therefore considered applicable for these floods.

2) In Case II, it was apparent that the effect of back water was terminated at the chainage 63.60 km which was the location of a bridge across the river at the junction of the Rio Chane and Pailon (or the cross section No. R310 in the Master Plan Study in 1996) as shown in Figure F.3.2.

   The hydraulic characteristics at the chainage 63.60 km and nearby were calculated as shown in Table F.3.3. The bank elevation at the chainage 63.60 km was sufficiently high to confine the peak water level during flood period in the river course while the other sections could not. Therefore, the Froude Number (Fr) at this section was comparatively high and the flow condition changed from the sub-critical flow in the upstream to almost the critical flow at this section and to the sub-critical flow again in the downstream. A summary of the Froude Number was as follows:

Chainage	Bank El. (m)	Max WL (m)	Cross section (m^2)	Depth (m)	Froude Number
62.10	239.44	239.77	219.95	6.60	0.44
63.50	237.96	238.28	620.37	6.63	0.32
63.60	240.00	237.97	103.37	6.36	0.96
63.70	237.90	238.18	385.53	6.60	0.42
67.50	235.62	236.96	379.96	7.94	0.27

Note : Froude No. $Fr = Q / A\sqrt{gD}$

Where Q = Discharge m^3/s, A = Cross section m^2
D = Hydraulic radius m, g = 9.81 m/s^2

Therefore, it was summarized that the effect of the back water from the Rio Piray was terminated at the Chainage 63.60 km due to the contraction at that section and the flow condition at that section was almost a critical flow.

3) The retarding basin at the upstream of the Rio Pailon was located between the chainage 2.00 km and 6.00 km and that of the QDA Chane was located between the chainage 13.60 km and 16.30 km. The peak discharges were as follows:

Chainage	Maximum discharge		Remarks
	(m^3/s)	Time	
RIO PAILON 2.500	125.35	1997/12/04 15:26	
RIO PAILON 3.500	121.52	1997/12/04 17:22	
RIO PAILON 4.500	118.92	1997/12/04 19:00	
RIO PAILON 5.500	116.36	1997/12/04 20:05	Effect of
RIO PAILON 6.500	75.51	1997/12/05 16:51	the retarding
RIO PAILON 7.500	75.01	1997/12/05 19:41	basin
RIO PAILON 8.500	74.70	1997/12/05 23:18	
RIO PAILON 9.500	74.58	1997/12/06 01:52	
QDA CHANE 14.017	191.43	1997/12/01 13:12	
QDA CHANE 14.850	191.28	1997/12/01 13:48	
QDA CHANE 15.683	189.67	1997/12/01 14:30	
QDA CHANE 16.150	188.05	1997/12/01 14:40	Effect of
QDA CHANE 16.250	50.65	1997/12/01 22:42	the retarding
QDA CHANE 16.717	50.60	1997/12/01 22:53	basin
QDA CHANE 17.550	48.35	1997/12/01 23:14	
QDA CHANE 18.383	46.60	1997/12/01 23:53	
QDA CHANE 19.150	46.61	1997/12/01 23:56	

The peak discharge at the upstream of the Rio Pailon was reduced for about 35 % after passing through the retarding basin. But the delayed time of the peak and the decrease of water level between the upstream and downstream of the retarding basin could not be found clearly.

The peak discharge at the upstream of the QDA Chane was reduced remarkably for about 73 % after passing through the retarding basin. But the delayed time of the peak and the decrease of the water level between the upstream and downstream of the retarding basin could not be found clearly either.

4) The cross sections at the newly constructed bridges along the National Road No. 9 were used in the simulation. The results showed no any sudden change in the water level at these cross sections, therefore, it was summarized that there was no effect from the construction of these bridges to the flow.

The Okinawa Drainage

The effect of the overflow from the Rio Grande was verified. The simulation was done during the period with and without the overflow as reported in the flood damage survey as follows:

Case I : The flood during November – December 1997,
(Without overflow from Rio Grande)

Case II : The flood during February – March 1998,
(With overflow from Rio Grande)

The simulation results revealed that

1) In Case I, the inundation depth as shown in Figure F.3.3 was found to be about 1.0 m for the whole drainage basin from the simulation. This showed a good agreement with the flood damage survey that the inundation covered all the drainage basin. However, the inundation depth from the simulation was slightly higher than the questionnaire survey in the upstream. The maximum water levels and discharges were shown in Table F.3.4.

The model was therefore considered applicable for this flood.

2) In Case II, the simulation result as shown in Figure F.3.4 clarified that there was almost no inundation during that period because the rainfalls in the basin at that time were not extensive. The water level was about same as the bank elevation. However the questionnaire survey revealed that at that period the whole area was inundated by the discharges from the Rio Grande.

Therefore, it was summarized that the causes of inundation in the Okinawa Drainage were from the heavy rainfalls in the basin and the overflow from the Rio Grande.

(2) In the San Juan – Antofagasta Area

The simulation was done for the floods during January – February 1997. However, from the flood damage survey, it was found that during that period

- There was no inundation from the Rio Yapacani
- There was no inflow from the Arroyo Jochi to the San Juan area

Therefore, these effects could not be verified from these floods.

The simulation results revealed that

1) The simulation as shown in Figure F.3.5 was applicable for the floods in 1997 in comparison with the questionnaire survey on the flood damages. The water level in the Rio Yapacanicito was slightly lower than the flood damage survey but still in an acceptable range.

   The model was therefore considered applicable for this flood.

2) The retarding basin at the confluence of the Arroyo Jochi and Tacuaral apparently delayed the peak period of the water level in the Arroyo Jochi's downstream of the retarding basin. The peak period in the upstream and downstream of the retarding basin were as follows:

Chainage	Maximum water level		Max. discharge	Remarks
	(m)	Time	(m^3/s)	
JOCHI 21.000	256.46	1997/02/06 06:40	55.68	
JOCHI 22.700	254.56	1997/02/06 22:51	55.68	
JOCHI 25.600	251.61	1997/02/07 11:48	55.68	
JOCHI 29.700	246.64	1997/02/04 04:28	66.32	Effect of
JOCHI 29.700	246.64	1997/02/04 04:28	66.32	the retarding
JOCHI 29.800	246.56	1997/02/04 09:18	66.32	basin
JOCHI 35.800	244.40	1997/02/08 15:27	35.18	
JOCHI 39.600	244.10	1997/02/08 17:03	36.69	

The retarding basin was located between the chainage 25.60 km and 35.80 km. The delayed time was in a range between 12 – 24 hours. The peak discharge in the Arroyo Jochi also decreased remarkably about 47% after the retarding basin.

However, the Arroyo Tacuaral also passed through this retarding basin but the delayed time at the downstream of the retarding basin could not be found. This was due to the topography of these rivers that the Arroyo Tacuaral has a lower elevation than the Arroyo Jochi. The flow direction in the retarding basin was mainly from the Arroyo Jochi towards the Arroyo Tacuaral. Therefore, the discharge at the downstream of the Arroyo Tacuaral after the retarding basin remarkably increased as follows:

Chainage	Maximum discharge		Remarks
	(m^3/s)	Time	
TACUARAL 21.750	111.43	1997/02/05 19:14	
TACUARAL 25.050	111.06	1997/02/05 21:15	
TACUARAL 27.550	139.18	1997/02/05 04:01	Retarding
TACUARAL 29.850	254.52	1997/02/04 05:37	Basin
TACUARAL 35.000	173.99	1997/02/08 10:55	

Maximum water levels and discharges in the Arroyo Yapacanicito, Jochi and Tacuaral basin were shown in Table F.3.5.

3) The water level fluctuation in the longitudinal profile was not so high and no any sudden water level change was found along all the rivers. Therefore, the effect of the contraction and meandering was considered negligibly small.

4. Improvement of the Hydrodynamic Simulation

Although the flood analysis for the current floods showed satisfactory results, the model was improved for the hydraulic design by using a new topographic survey conducted by the JICA Study Team in 1998. The range of new cross-sections of the rivers and drainage set up in the model were as follows:

River	Chainage of new cross-section (km)	
	From	To
The Chane-Pailon Area		
Chane	24.00	59.60
Pailon	60.00	88.10
Okinawa	0.00	26.80
The San Juan - Antofagasta Area		
Yapacanicito	14.30	31.70
Jochi	13.80	25.60
Tacuaral	16.80	22.60
San Juan km 11	0.00	2.41
San Juan km 13	0.00	3.82
San Juan km 15	0.00	8.93
San Juan km 17	0.00	4.27
San Juan km 24	0.00	5.58
San Juan km 28	0.00	10.55
Antofagasta	0.00	8.80
Road-cum-emb.	0.00	9.00

The model structure was in principle exactly same as in the Master Plan Study in 1996 and the progress stage of this study, except the number and shapes of the new cross sections.

The flood simulation was also done again with the new cross sections in order to compare with the result from the flood simulation in the Master Plan Study in 1996 and the progress stage of this study. It is found that the results using the new cross section were almost exactly same as before with no significant difference.

The new cross sections are shown in the Data Book.

4.1 Condition Set-up in the Simulation

In order to obtain sufficient information for the river design, preparation of flood hazard maps and economic analysis, a total of 10 cases each in the Chane - Pailon Area and the San Juan – Antofagasta Area was set up in the simulation. These cases, as shown below, were considered as sufficient to reveal all the necessary hydrodynamic information including water level, flow rate, etc. for the further analysis. The simulation cases are as follows:

Design Flow (return period year)	Calculation cases				Remarks
	Rio Chane-Pailon		A. Yapacanicito and others		
	Cross section		Cross section		
	Existing	Design	Existing	Design	
2	1	1	1	1	Flow rate in the calulation was design flow with different return period year
5	1	1	1	1	
10	1	1	1	1	
20	1	1	1	1	
50	1	1	1	1	
Total cases	5	5	5	5	

All design discharge hydrograph had the same shape but different magnitude as explained in the following section.

4.2 Simulation Results for Design Discharge

Simulation for the design discharge was done in the study area for 2 cases, those are:

Case I : Existing cross section with design discharge (without project)

Case II : Design cross section with design discharge (with project)

Case I and II were considered as the cases without and with the implementation of the project respectively.

(1) In the Chane – Pailon Area

The simulation was done for the design discharge with the return period 2, 5, 10, 20 and 50 years with the same shape but different magnitude. Peak runoff at each return period of the sub-basins is summarized as follows:

River	Sub-basin No.	Peak runoff at each sub-basin (m^3/s)				
		2 years	5 years	10 years	20 years	50 years
Chane - Pailon	A-1	126.8	178.1	212.1	244.6	286.7
	A-2	173.5	248.4	298.5	347.0	410.2
	A-3	196.9	279.6	334.6	387.5	456.3
	A-4	218.2	311.1	371.9	430.4	503.4
	A-5	55.2	77.2	91.8	106.4	124.4
	A-6	323.3	464.9	558.2	648.9	761.9
	A-7	169.6	242.9	291.2	338.1	396.7
	A-8	321.3	490.3	603.3	709.0	849.0
	A-9	210.7	318.7	390.6	457.8	546.6
	B-1	33.8	47.1	55.8	64.1	74.8
	B-2	181.3	257.5	308.3	357.1	420.6
	B-3	149.1	208.8	248.2	285.8	334.5
	C-1	14.7	20.5	24.4	28.0	32.7
	C-2	76.1	106.2	126.0	145.0	169.5
	C-3	188.5	265.7	317.0	365.8	429.0
	C-4	96.6	134.4	159.3	183.6	215.0
	C-5	47.8	65.9	77.7	88.9	103.5
	C-6	194.8	275.0	328.3	379.3	445.4
	C-7	87.1	122.0	144.9	166.7	194.9
	C-8	76.4	107.1	127.5	147.0	172.2
	D-1	314.3	449.4	538.6	625.2	733.3
	A-10	104.1	148.4	177.6	206.1	241.7
	A-11	307.8	444.5	535.0	622.9	732.9
	C-9	231.5	326.3	389.1	449.0	526.4
Okinawa	E-1	107.8	154.2	184.7	214.2	251.9
	E-2	133.4	190.8	228.6	265.0	311.6
	E-3	292.7	423.7	510.1	593.8	701.0

Note : The sub-basin number is shown in the figure of flow model

The time series of the runoff or the design hydrograph used in the calculation for return period 2, 5, 10, 20 and 50 years were shown in the Supporting Report -- B.

For Case I (without the project), the cross sections were updated in the priority area by the new topographic survey as shown in the Data Book.

For Case II (with the project), the cross sections were the design sections as proposed in the Master Plan Study in 1996 which were considered as sufficiently large and suitable to accommodate the flood at the design return period. The dimension of the design sections are summarized as follows:

River	Chainage (km)		Proposed cross section				River Slope
	From	to	Top Width (m)	Depth (m)	Side Slope (1/**)	Bed Width (m)	(1/***)
Chane	60.00	81.90	75.0	6.0	2.0	51.0	1,212
	81.90	88.00	100.0	6.0	2.0	76.0	1,500
Pailon	36.50	51.40	65.0	5.0	2.0	45.0	995
	51.40	59.60	70.0	5.0	2.0	50.0	908
Okinawa	0.00	7.00	25.0	4.0	2.0	9.0	3,600
	7.00	25.60	28.0	4.0	2.0	12.0	3,300

Results of the calculation are shown in Table F.4.1, F.4.2, F.4.3 and F.4.4 and Figure F.4.1.

It is found that the water level decreased significantly in the design sections (with the project) from the existing sections (without the project). A summary of the water depth difference is shown below

Rio	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Chane	88.000	-0.44	-0.78	-0.85	-1.02	-0.74
	86.400	-0.16	-0.48	-0.49	-0.20	-0.40
	84.800	0.09	-0.18	-0.20	-0.20	-0.20
	83.800	0.34	0.01	-0.09	0.16	-0.09
	82.800	0.40	-0.02	-0.15	0.22	-0.08
	81.900	0.38	-0.06	-0.20	-0.01	-0.13
	81.000	0.52	0.14	0.05	0.14	0.29
	80.000	1.29	0.53	0.43	0.47	0.42
	78.800	1.36	0.64	0.51	0.81	0.51
	77.700	0.87	0.17	0.03	0.22	0.08
	76.500	0.68	-0.01	-0.15	0.03	-0.08
	75.200	0.42	-0.08	-0.13	0.17	-0.04
	74.300	0.29	-0.25	-0.38	0.53	-0.28
	73.400	0.22	-0.44	-0.55	0.09	-0.42
	72.500	0.18	-0.40	-0.52	-0.16	-0.39
	71.500	0.12	-0.34	-0.42	-0.27	-0.32
	70.500	0.07	-0.41	-0.39	0.34	-0.26
	69.500	-0.05	-0.50	-0.45	-0.43	-0.33
	68.500	0.10	-0.38	-0.39	-0.24	-0.29
	67.500	0.04	-0.41	-0.46	0.21	-0.35
	66.500	0.00	-0.48	-0.52	-0.06	-0.42
	65.500	-0.05	-0.47	-0.56	0.12	-0.46
	64.500	-0.15	-0.54	-0.53	0.20	-0.28
	63.600	-0.27	-0.63	-0.65	-0.21	-0.41
	62.600	-0.28	-0.60	-0.61	-0.43	-0.38
	61.600	0.13	-0.26	-0.47	0.18	-0.34
	60.800	0.27	-0.06	-0.26	0.17	-0.35
	60.000	2.68	1.89	1.89	1.92	1.96
Average		0.32	-0.16	-0.23	0.10	-0.13

Rio	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Pailon	59.600	2.61	1.80	1.77	1.92	1.82
	58.900	3.26	2.64	2.65	3.28	2.88
	58.200	2.85	2.53	2.45	3.11	2.62
	57.500	2.97	2.78	2.64	2.96	2.73
	56.800	4.52	4.28	4.16	4.63	4.19
	55.650	4.25	4.11	3.93	4.25	3.96
	54.500	3.66	3.58	3.36	3.67	3.38
	53.900	3.33	3.28	3.02	3.39	2.99
	53.200	3.10	2.95	2.82	3.08	2.92
	52.500	3.15	2.96	2.83	3.30	2.85
	51.400	2.94	2.77	2.67	2.95	2.67
	50.300	2.90	2.71	2.63	2.85	2.59
	49.200	2.94	2.77	2.70	2.76	2.68
	47.800	2.00	1.85	1.72	2.19	1.69
	46.500	2.04	1.80	1.72	2.06	1.73
	45.300	2.01	1.82	1.69	2.03	1.68
	44.200	1.64	1.44	1.39	1.63	1.49
	42.800	1.27	1.20	1.20	1.53	1.39
	41.500	1.39	1.34	1.34	1.60	1.45
	40.500	1.52	1.46	1.46	2.09	1.63
	39.500	1.38	1.36	1.45	2.04	1.74
	38.500	0.92	1.04	1.20	1.31	1.23
	37.800	1.24	1.35	1.47	1.63	0.82
	37.100	1.61	1.69	1.80	2.19	1.44
	36.500	1.67	1.65	1.67	1.98	1.43
	36.500	1.60	1.58	1.57	1.62	1.35
	35.500	1.19	1.12	1.09	1.76	0.95
	34.600	0.90	0.79	0.80	1.17	0.77
	33.700	0.81	0.78	0.84	0.90	0.73
	32.300	0.87	0.85	0.88	1.23	0.90
	31.300	0.71	0.72	0.79	1.34	0.92
	30.600	0.72	0.75	0.83	1.09	0.98
	29.900	1.07	1.05	1.08	1.30	1.13
	24.000	0.95	0.88	0.95	-17.37	1.10
Average		2.06	1.93	1.90	1.69	1.91

River/ Drainage	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Okinawa	26.800	0.00	0.00	0.00	0.00	0.00
	25.600	0.09	0.05	0.06	0.04	0.02
	24.100	0.24	0.14	0.16	0.10	0.04
	23.600	0.26	0.17	0.21	0.15	0.07
	22.400	0.85	0.88	0.89	0.90	0.88
	20.600	0.56	0.57	0.61	0.64	0.67
	19.100	0.90	0.83	0.83	0.85	0.88
	18.300	1.12	1.02	1.02	1.03	1.05
	16.600	1.11	1.00	1.00	1.00	1.00
	15.900	1.01	0.89	0.88	0.89	0.91
	14.000	0.82	0.73	0.73	0.75	0.79
	13.200	0.87	0.69	0.68	0.69	0.70
	12.000	0.93	0.64	0.68	0.65	0.66
	10.100	1.15	0.83	0.88	0.84	0.82
	9.300	1.14	0.82	0.87	0.82	0.81
	8.400	1.03	0.72	0.79	0.75	0.73
	7.000	0.62	0.40	0.50	0.50	0.51
	6.300	0.46	0.38	0.40	0.38	0.37
	5.200	0.49	0.39	0.40	0.37	0.35
	0.000	0.54	0.59	0.44	0.41	0.38
Average		0.70	0.58	0.60	0.59	0.58

It should be noted the water level of the design cross sections (with the project) were higher than the existing sections (without the project) in some part because the design sections were set up in order to avoid the irregular flow. However, the effectiveness of the improvement with the project compared to the case without the project was considered from the decrease of the inundation depth as explained in the latter section.

(2) In the San Juan – Antofagasta Area

The Arroyo Yapacanicito, Jochi, Tacuaral, Tejeria and Antofagasta

The simulation was done for the design discharge with the return period 2, 5, 10, 20 and 50 years with the same shape but different magnitude as explained in the hydrological part. Peak runoff at each return period of the sub-basins is summarized as follows:

River	Sub-basin No.	Peak runoff at each sub-basin (m^3/s)				
		2 years	5 years	10 years	20 years	50 years
Yapacanicito	Y1-1	143.0	194.5	228.0	260.8	302.3
	Y1-2	232.2	319.0	376.2	431.7	502.5
	Y1-3	176.8	246.4	292.4	337.2	394.7
	Y1-4	184.5	255.6	302.1	347.8	405.7
	Y2-1	120.7	166.5	196.8	226.2	263.9
	Y2-2	55.1	74.7	87.3	99.9	115.6
Jochi	J-1	109.2	151.0	178.4	205.1	239.2
	J-2	87.7	120.3	142.5	163.5	190.7
	J-3	151.3	209.1	247.2	284.3	331.7
	J-4	103.8	142.0	166.5	190.8	221.3
Tacuaral	T-1	111.9	154.2	181.8	209.0	243.5
	T-2	166.5	231.7	274.9	316.9	370.7
	T-3	157.0	218.3	258.7	298.1	348.5
	T-4	183.5	251.8	296.1	339.7	394.9
Tejeria	-	67.2	88.1	101.5	114.4	131.1
Antofagasta	T-2	166.5	231.7	274.9	316.9	370.7

Note : 1) The sub-basin number is shown in the figure of flow model

2) Tejeria and Antofagasta have only one drainage basin each

3) Antofagasta basin is included in Tacuaral (T-2)

The time series of the runoff or the design hydrograph used in the calculation for return period 2, 5, 10, 20 and 50 years were shown in the Supporting Report B.

For Case I (without the project), the cross sections used were the existing cross section from the topographic survey conducted in this study as shown in the Data Book.

For Case II (with the project), the cross sections were the design sections as proposed in the Master Plan Study in 1996 which were considered as sufficiently large and suitable to accommodate the flood at the design return period. The dimension of the design sections are summarized as follows:

River	Chainage (km)		Proposed cross section				River Slope (1/***)
	From	to	Top Width (m)	Depth (m)	Side Slope (1/**)	Bed Width (m)	
Yapacanicito	14.30	28.10	30.0	3.0	2.0	18.0	1,280
	28.10	31.70	35.0	3.0	2.0	23.0	1,280
Jochi	13.80	16.00	22.0	3.5	2.0	8.0	900
	16.00	25.60	30.0	3.5	2.0	16.0	900
Tacuaral	16.80	22.60	26.0	4.0	2.0	10.0	900
Tejeria	0.00	2.98	20.0	4.0	2.0	4.0	900
	2.98	8.16	22.0	4.0	2.0	6.0	900
Antofagasta	0.00	8.79	28.0	4.0	2.0	12.0	900

Results of the calculation are shown in Table F.4.5, F.4.6, F.4.7 and F.4.8 and Figure F.4.2.

It is found that the water level decreased significantly from the condition of "without the project" to "with the project" as shown below:

Arroyo	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Yapacanicito	14.300	0.30	0.33	0.34	0.35	0.36
	14.320	0.33	0.33	0.28	0.27	0.27
	15.400	1.19	1.18	1.16	1.15	1.14
	16.400	0.81	0.76	0.75	0.79	0.89
	17.100	0.16	0.14	0.09	0.07	0.04
	19.000	-0.05	-0.07	-0.21	-0.40	-0.45
	20.000	-0.04	-0.07	-0.19	-0.33	-0.41
	20.400	-0.17	-0.23	-0.25	-0.26	-0.27
	22.200	0.67	0.60	0.51	0.50	0.36
	23.100	0.19	0.13	0.13	0.12	0.06
	24.100	0.14	0.13	0.09	0.10	0.08
	25.300	0.19	0.14	0.11	0.10	0.09
	26.200	0.18	0.15	0.12	0.12	0.10
	27.000	0.19	0.16	0.14	0.13	0.12
	28.100	0.18	0.15	0.13	0.12	0.11
	29.100	0.18	0.14	0.12	0.11	0.10
	30.100	0.19	0.15	0.12	0.12	0.11
	31.100	0.19	0.15	0.13	0.12	0.11
	31.700	0.19	0.15	0.13	0.12	0.11
	Average	0.26	0.23	0.19	0.17	0.15

It should be noted herein that some cross sections in the middle part of the Rio Yapacanicito had water level in the design sections higher than the existing sections because those existing sections were pretty low and therefore were designed to have higher elevation to avoid irregular flow. As a result, the water level in design section was higher than the existing section.

Arroyo	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Jochi	13.800	1.28	1.24	1.22	1.19	1.15
	15.000	0.40	0.35	0.33	0.29	1.39
	15.010	0.39	0.60	0.52	0.46	0.27
	15.020	0.42	0.37	0.34	0.31	0.68
	16.000	1.16	1.17	1.16	1.15	1.11
	17.200	1.56	1.61	1.61	1.61	1.59
	18.300	1.53	1.57	1.59	1.60	1.57
	19.000	1.51	1.55	1.57	1.57	1.55
	20.000	1.28	1.33	1.36	1.37	1.34
	20.900	1.32	1.38	1.41	1.42	1.40
	21.900	1.34	1.37	1.39	1.40	1.37
	22.700	1.55	1.57	1.58	1.58	1.56
	22.710	1.48	1.60	1.67	1.91	1.86
	22.720	1.51	1.54	1.55	1.56	1.54
	23.700	1.67	1.72	1.75	1.77	1.77
	24.900	1.90	1.54	1.43	1.41	1.40
	25.600	0.29	0.43	0.31	0.27	0.16
	Average	1.21	1.23	1.22	1.23	1.28

Arroyo	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Tacuaral	16.800	0.65	0.38	0.33	0.34	0.18
	16.810	0.65	0.37	0.33	0.34	0.18
	16.820	0.65	0.38	0.33	0.34	0.18
	17.600	0.65	0.37	0.33	0.34	0.18
	18.500	0.65	0.38	0.33	0.34	0.18
	19.100	0.65	0.36	0.32	0.34	0.18
	19.110	0.66	0.40	0.35	0.34	0.18
	19.120	0.65	0.33	0.29	0.34	0.18
	20.000	0.67	0.46	0.41	0.34	0.18
	21.200	0.62	0.20	0.17	0.34	0.19
	22.100	0.71	0.73	0.65	0.35	0.17
	22.600	0.54	0.61	0.59	0.33	0.20
	Average	0.65	0.41	0.37	0.34	0.18

Arroyo	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Tejeria	0.000	1.68	1.52	1.38	1.31	1.23
	1.010	0.95	0.82	0.60	0.47	0.47
	2.225	0.68	0.72	0.46	0.37	0.40
	2.975	0.54	0.52	0.44	0.41	0.37
	3.677	1.21	1.05	0.86	0.82	0.69
	4.860	1.10	0.97	0.85	0.86	0.59
	5.706	1.04	1.01	1.05	1.12	0.83
	6.879	0.92	0.83	0.73	0.65	0.60
	7.579	1.06	1.10	0.93	0.74	0.60
	8.160	1.60	1.60	1.60	1.60	1.60
	Average	1.08	1.01	0.89	0.83	0.74

Arroyo	Chainage (km)	Water level difference (m) (WL without - WL with)				
		2 year	5 year	10 year	20 year	50 year
Antofagasta	0.000	1.26	1.04	0.99	0.99	1.04
	1.040	1.10	0.90	0.85	0.83	0.87
	1.920	1.17	0.96	0.91	0.89	0.93
	2.550	1.19	1.00	0.96	0.95	0.96
	3.490	0.67	0.56	0.58	0.62	0.68
	4.300	1.07	0.93	0.92	0.93	0.96
	5.240	0.80	0.78	0.81	0.84	0.89
	6.560	0.46	0.35	0.38	0.42	0.49
	7.640	1.21	0.93	0.91	0.94	0.99
	8.250	1.70	1.35	1.30	1.32	1.36
	8.800	0.85	0.56	0.49	0.50	0.53
	10.600	0.00	0.00	0.00	0.00	0.00
	Average	0.96	0.78	0.76	0.77	0.81

The inundation depth was explained in the latter section. These results were also used afterwards for the flood mitigation measures.

The San Juan Drainage

The San Juan Drainage was not included in the hydrodynamic simulation due to its small size and low discharge. The flow condition during flood period was also considered as uniform rather than unsteady. Therefore, design discharge for the return period 2, 5, 10, 20 and 50 years were calculated from the Rational Formula and the flood condition was calculated from the uniform flow equation or Manning's Equation. Peak discharges at each return period in the drainage from the Rational Formula are as follow:

Drainage	Section No.	Peak discharge (m^3/s)				
		2 years	5 years	10 years	20 years	50 years
San Juan	km 09.00	14.92	19.94	23.18	26.27	30.26
	km 11.00	24.86	33.24	38.63	43.78	50.44
	km 13.00	41.97	55.65	64.45	72.90	83.78
	km 15.00	37.76	49.74	57.46	64.86	74.43
	km 17.00	31.80	41.89	48.39	54.62	62.68
	km 24.00	13.28	18.20	21.37	24.40	28.32
	km 28.00	48.77	63.92	73.67	83.04	95.14

The design cross sections were same as proposed in the Master Plan Study in 1996. The dimension of the design sections are summarized as follows:

San Juan Drainage	Proposed cross section				River Slope (1/***)
	Top Width (m)	Depth (m)	Side Slope (1/**)	Bed Width (m)	
km 09.00	11.0	3.0	1.0	11.0	1,500
km 11.00	11.0	3.0	1.0	11.0	1,500
km 13.00	11.0	3.0	1.0	11.0	1,500
km 15.00	11.0	3.0	1.0	11.0	1,500
km 17.00	11.0	3.0	1.0	11.0	1,500
km 24.00	11.0	3.0	1.0	11.0	1,500
km 28.00	11.0	3.0	1.0	11.0	1,500

This design section was used for the whole San Juan Drainage as shown in the Data Book.

TABLES

TABLE F.2.1 COORDINATES AND CHAINAGES IN THE HD MODEL IN THE RIO CHANE BASIN

River	Coordinate		Chainage
	X	Y	(m)
Rio Chane	100,600	65,500	0
	102,700	68,300	4,000
	105,200	71,000	8,000
	106,200	72,500	10,500
	107,500	75,400	14,000
	108,400	79,600	18,000
	109,700	82,800	22,000
	109,800	85,800	25,000
	109,700	89,500	28,500
	107,600	91,600	31,800
	107,600	93,300	33,700
	107,100	95,100	36,400
	107,000	95,200	36,500
	106,900	95,300	36,600
	105,200	97,000	38,500
	103,200	98,800	41,500
	102,500	101,000	44,200
	102,500	103,500	46,500
	100,300	104,500	49,200
	97,900	106,600	52,500
	97,600	108,700	54,500
	95,800	109,100	56,800
	93,700	108,900	59,600
	93,500	109,200	60,000
	92,300	110,900	62,100
	92,000	112,000	63,500
	92,000	112,200	63,600
	91,900	112,250	63,700
	88,800	113,700	67,500
	87,500	115,000	69,400
	87,200	117,500	72,000
	85,300	118,800	75,200
	83,000	119,000	77,700
	81,300	120,500	79,900
	81,500	120,600	80,000
	81,400	120,700	80,100
	77,300	122,300	84,800
	76,700	124,300	87,900
	75,500	124,500	88,000
	76,300	124,500	88,100
	73,300	124,000	90,500
	71,200	125,500	93,000
	69,000	126,000	95,000

River	Coordinate		Chainage
	X	Y	(m)
QDA Chane	90,500	77,500	0
	89,800	81,500	4,500
	92,000	84,000	8,200
	93,300	86,500	11,000
	93,700	87,400	12,000
	93,600	89,300	13,600
	93,800	91,700	16,100
	93,800	91,800	16,200
	93,800	91,900	16,300
	93,800	94,400	18,800
	94,000	96,500	20,900
	94,300	98,000	23,300
	94,200	101,300	25,800
	93,400	103,800	28,200
	93,200	106,200	30,800
	93,500	109,100	34,000
Rio Pailon	121,000	68,000	0
	119,700	70,200	2,000
	118,000	74,000	6,000
	116,200	77,200	10,000
	115,400	79,900	12,600
	115,400	80,000	12,700
	115,400	80,100	12,800
	115,000	81,800	14,500
	114,200	83,400	16,400
	114,100	83,500	16,500
	114,000	83,600	16,600
	112,900	86,400	19,400
	111,400	86,400	21,200
	111,300	86,500	21,300
	111,200	86,600	21,400
	109,800	89,000	24,000
QDA Meco	119,000	67,000	0
	121,000	68,000	2,000
	121,000	67,300	2,200
Rio Chico II	107,700	94,200	0
	106,400	95,000	1,900
	106,300	95,200	2,000
	106,300	95,300	2,200
	106,500	95,800	3,000

River	Coordinate		Chainage
	X	Y	(m)
QDA Toro	90,300	90,300	0
	90,200	90,700	400
	90,200	90,900	500
	90,300	91,000	600
	90,500	94,300	3,400
	91,000	95,000	4,600
	91,200	96,800	6,200
	92,200	99,400	9,200
	92,400	101,400	11,200
	92,700	105,500	16,000
QDA Maras	86,500	89,500	0
	86,500	89,800	400
	86,600	90,000	500
	86,500	90,000	700
	88,500	93,300	3,800
	89,000	93,800	5,000
	89,800	94,300	6,000
	91,000	95,100	7,300
QDA Chacras	84,400	89,300	0
	84,500	89,500	400
	84,700	90,000	500
	84,800	90,000	700
	83,000	92,300	3,500
	79,800	97,000	10,000
	80,200	99,400	12,500
	78,500	102,500	16,000
	78,800	105,500	19,000
	79,200	107,900	21,500
	80,000	110,000	23,700
	80,200	113,500	27,500
	81,500	116,000	30,500
	79,800	117,500	33,000
	79,800	121,300	36,500

TABLE F.2.2 SUB-BASINS IN THE RIO CHANE BASIN

River	Basin No.	Area (km^2)	Chainage (km)	
			Upstream	Downstream
Rio Chane	A-1	63.35	82.5	95.0
Rio Chane	A-2	198.68	60.0	82.5
Rio Chane	A-3	164.70	37.0	60.0
Rio Chane	A-4	60.10	32.0	37.0
Rio Chane	A-5	15.80	28.0	32.0
Rio Pailon	A-6	211.87	0.0	24.0
Rio Chane	A-7	112.68	0.0	28.0
Rio Chane	A-8	270.00	0.0	0.0
Rio Chane	A-9	141.89	0.0	0.0
Rio Chane	A-10	66.14	24.0	28.0
Rio Chane	A-11	275.46	28.0	31.8
QDA Chacras	B-1	6.72	34.5	36.5
QDA Chacras	B-2	153.49	0.5	34.5
QDA Chacras	B-3	64.04	0.0	0.0
QDA Chane	C-1	3.18	18.0	22.0
QDA Chane	C-2	35.03	4.2	18.0
QDA Chane	C-3	88.83	0.0	16.2
QDA Toro	C-4	38.77	4.0	16.0
QDA Toro	C-5	11.36	0.5	4.0
QDA Toro	C-6	121.16	0.0	0.0
QDA Maras	C-7	23.93	0.5	7.3
QDA Maras	C-8	38.43	0.0	0.0
QDA Meco	D-1	244.82	0.0	2.1
QDA Chane	C-9	108.57	0.0	0.0
Total		2,519.00		

TABLE F.2.3 CONNECTING POINTS OF SUB-BASINS TO THE RIO CHANE NETWORK

Sub-basin		Connected River	Chainage of river at Connecting Points (m)
1	A-8	Rio Chane	0
2	A-9	Rio Chane	0
3	A-7	Rio Chane	28,000
4	A-10	Rio Chane	28,000
5	A-11	Rio Chane	31,800
6	A-5	Rio Chane	32,000
7	A-4	Rio Chane	37,000
8	A-3	Rio Chane	60,000
9	A-2	Rio Chane	82,500
10	A-1	Rio Chane	95,000
11	C-9	QDA Chane	0
12	C-3	QDA Chane	16,200
13	C-2	QDA Chane	18,000
14	C-1	QDA Chane	22,000
15	A-6	Rio Pailon	24,000
16	D-1	QDA Meco	21,000
17	C-6	QDA Toro	0
18	C-5	QDA Toro	4,000
19	C-4	QDA Toro	16,000
20	C-8	QDA Maras	0
21	C-7	QDA Maras	7,300
22	B-3	QDA Chacras	400
23	B-2	QDA Chacras	34,500
24	B-1	QDA Chacras	36,500

TABLE F.2.4 COORDINATES,CHAINAGES,SUB-BASINS AND CONNECTING POINTS IN THE HD MODEL IN THE OKINAWA DRAINAGE BASIN

River	Coordinate		Chainage
	X	Y	(m)
Okinawa	0.0	0.0	0
Drainage	0.0	7.0	7,000
	0.0	25.0	25,000
	0.0	28.0	28,000

River	Basin	Area	Chainage (km)	
	No.	(km^2)	Upstream	Downstream
Okinawa	E-1	70.0	7.0	25.0
Drainage	E-2	75.9	1.0	7.0
	E-3	235.6	0.0	1.0
Total		381.5		

Sub-basin	Connected River	Chainage of river at Connecting Points (m)
E-1	Okinawa	25,000
E-2	Drainage	7,000
E-3		1,000

TABLE F.2.5 COORDINATES AND CHAINAGES IN THE HD MODEL IN THE RIO YAPACANI BASIN

River	Coordinate		Chainage
	X	Y	(m)
Arroyo Jochi	113.0	87.0	0
	113.0	90.0	3,000
	112.0	92.5	6,000
	109.5	94.0	9,520
	108.5	97.0	12,800
	109.0	100.0	15,360
	112.0	102.0	18,600
	112.5	104.0	21,000
	112.5	105.9	22,700
	112.5	106.0	22,800
	112.5	106.1	22,900
	113.5	108.0	25,600
	115.5	111.4	29,700
	115.5	111.4	29,800
	115.5	116.5	35,800
	113.0	121.0	43,400
Arroyo Tacuaral	116.0	88.0	0
	114.0	91.0	3,000
	113.0	94.0	6,000
	113.0	96.0	9,000
	115.0	99.0	12,000
	115.0	102.0	16,400
	115.0	104.0	18,240
	115.0	104.1	18,340
	115.0	104.2	18,440
	115.0	104.0	20,700
	115.0	105.1	20,800
	115.0	105.2	20,900
	114.2	106.0	22,600
	116.5	110.9	27,500
	116.5	111.0	27,600
	118.5	114.0	32,100
	120.5	118.0	37,900
Arroyo Jochi-Tacu	115.5	111.4	0
	116.5	111.4	1,000

River	Coordinate		Chainage
	X	Y	(m)
Arroyo Yapacanicito	110.5	86.0	0
	110.0	87.2	1,500
	109.2	89.0	3,600
	108.0	91.2	6,100
	106.5	93.0	8,600
	107.0	96.3	12,200
	107.5	98.5	14,300
	108.0	100.5	16,800
	107.3	102.0	18,000
	107.5	105.0	21,000
	108.2	107.0	23,500
	104.5	108.5	27,100
	106.5	110.0	29,900
	105.0	115.0	34,900
	101.5	116.0	39,900
	99.0	119.0	44,900
	95.0	120.0	49,900
	94.0	118.5	51,300
	92.0	121.5	56,300
	88.0	125.0	62,300
San Juan - DM1	106.5	93.0	0
	103.0	93.0	2,400
	104.0	93.0	2,500
R/W Embank	115.5	111.4	0
	115.6	111.4	100
	102.1	117.0	10,900
	102.0	117.0	11,000
TMP-R/W	115.0	110.0	0
	115.4	111.4	100

TABLE F.2.6 SUB-BASINS IN THE RIO YAPACANI BASIN

River/Arroyo	Basin No.	Area (km^2)	Chainage (m)		Chainage of River (m) at Connecting Points
			Upstream	Downstream	
Jochi	J-1	41.60	29,800	34,200	29,800
Jochi	J-2	11.80	25,600	29,800	25,600
Jochi	J-3	76.30	0	25,600	0
Jochi	J-4	18.30	0	0	0
Tacuaral	T-1	38.20	27,600	37,900	27,600
Tacuaral	T-2	88.20	27,600	27,600	27,600
Tacuaral	T-3	77.00	0	27,500	0
Tacuaral	T-4	49.40	0	0	0
Yapacanicito	Y1-1	66.80	51,300	62,300	51,300
Yapacanicito	Y1-2	98.40	29,900	51,300	29,900
Yapacanicito	Y1-3	95.90	8,600	29,900	8,600
Yapacanicito	Y1-4	34.90	0	8,600	0
Yapacanicito	Y2-1	62.80	51,300	51,300	51,300
Yapacanicito	Y2-2	11.90	51,300	51,300	51,300
Total		759.60			

TABLE F.3.1(1) MAXIMUM WATER LEVELS IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Water Level	
	(m)	Time
RIO CHANE 0.000	314.39	1997/12/04 10:28
RIO CHANE 1.000	313.66	1997/12/04 09:52
RIO CHANE 2.000	312.83	1997/12/04 10:09
RIO CHANE 3.000	312.00	1997/12/04 10:20
RIO CHANE 4.000	310.82	1997/12/04 10:18
RIO CHANE 5.000	309.06	1997/12/04 10:20
RIO CHANE 6.000	307.34	1997/12/04 10:24
RIO CHANE 7.000	305.51	1997/12/04 10:24
RIO CHANE 8.000	304.01	1997/12/04 10:28
RIO CHANE 8.833	302.99	1997/12/04 10:31
RIO CHANE 9.667	302.04	1997/12/04 10:35
RIO CHANE 10.500	300.66	1997/12/04 08:54
RIO CHANE 11.375	298.26	1997/12/04 08:26
RIO CHANE 12.250	295.88	1997/12/04 07:48
RIO CHANE 13.125	293.45	1997/12/04 07:39
RIO CHANE 14.000	291.04	1997/12/04 07:33
RIO CHANE 15.000	288.50	1997/12/04 07:26
RIO CHANE 16.000	285.97	1997/12/04 06:58
RIO CHANE 17.000	283.45	1997/12/04 07:01
RIO CHANE 18.000	280.94	1997/12/04 07:05
RIO CHANE 19.000	278.43	1997/12/04 07:07
RIO CHANE 20.000	275.93	1997/12/04 07:11
RIO CHANE 21.000	273.42	1997/12/01 02:09
RIO CHANE 22.000	270.96	1997/12/04 05:41
RIO CHANE 23.000	268.43	1997/12/04 11:18
RIO CHANE 24.000	266.36	1997/12/04 10:39
RIO CHANE 25.000	263.89	1997/12/04 18:46
RIO CHANE 25.875	262.46	1997/12/04 18:11
RIO CHANE 26.750	261.08	1997/12/04 19:20
RIO CHANE 27.625	259.72	1997/12/04 17:26
RIO CHANE 28.500	258.34	1997/12/04 22:41
RIO CHANE 28.500	258.34	1997/12/04 22:41
RIO CHANE 29.325	257.50	1997/12/05 00:24
RIO CHANE 30.150	256.88	1997/12/05 01:03
RIO CHANE 30.975	256.24	1997/12/05 01:20
RIO CHANE 31.800	255.15	1997/12/05 01:37
RIO CHANE 32.750	254.59	1997/12/05 02:54
RIO CHANE 33.700	253.97	1997/12/05 03:07
RIO CHANE 33.700	253.97	1997/12/05 03:07
RIO CHANE 34.600	253.91	1997/12/05 03:03
RIO CHANE 35.500	253.83	1997/12/05 02:52
RIO CHANE 36.400	253.67	1997/12/04 10:41
RIO CHANE 36.500	253.72	1997/12/04 10:37
RIO CHANE 36.600	253.77	1997/12/04 10:35
RIO CHANE 37.550	252.14	1997/12/04 12:35

River/Chainage	Maximum Water Level	
	(m)	Time
RIO CHANE 38.500	251.83	1997/12/05 05:03
RIO CHANE 38.500	251.83	1997/12/05 05:03
RIO CHANE 39.500	251.38	1997/12/05 05:54
RIO CHANE 40.500	250.91	1997/12/05 07:31
RIO CHANE 41.500	250.38	1997/12/05 18:32
RIO CHANE 42.400	250.15	1997/12/05 18:44
RIO CHANE 43.300	249.96	1997/12/05 19:29
RIO CHANE 44.200	249.68	1997/12/05 20:08
RIO CHANE 44.967	249.36	1997/12/05 22:17
RIO CHANE 45.733	249.16	1997/12/06 00:11
RIO CHANE 46.500	248.93	1997/12/06 05:59
RIO CHANE 47.400	248.41	1997/12/06 06:06
RIO CHANE 48.300	247.92	1997/12/06 06:59
RIO CHANE 49.200	247.45	1997/12/06 08:03
RIO CHANE 50.025	247.05	1997/12/06 09:00
RIO CHANE 50.850	246.70	1997/12/06 10:07
RIO CHANE 51.675	246.36	1997/12/06 12:08
RIO CHANE 52.500	245.97	1997/12/06 17:49
RIO CHANE 53.500	245.46	1997/12/06 19:06
RIO CHANE 54.500	244.75	1997/12/07 00:00
RIO CHANE 55.267	243.88	1997/12/07 00:00
RIO CHANE 56.033	242.98	1997/12/07 00:00
RIO CHANE 56.800	242.52	1997/12/07 00:00
RIO CHANE 57.733	242.14	1997/12/07 00:00
RIO CHANE 58.667	241.80	1997/12/07 00:00
RIO CHANE 59.600	241.47	1997/12/01 17:17
RIO CHANE 60.000	241.46	1997/12/01 17:11
RIO CHANE 60.000	241.46	1997/12/01 17:11
RIO CHANE 60.700	241.02	1997/12/01 18:06
RIO CHANE 61.400	240.54	1997/12/01 18:49
RIO CHANE 62.100	239.75	1997/12/01 19:31
RIO CHANE 62.800	239.13	1997/12/01 20:13
RIO CHANE 63.500	238.68	1997/12/01 20:48
RIO CHANE 63.600	238.42	1997/12/01 20:58
RIO CHANE 63.700	238.59	1997/12/01 20:56
RIO CHANE 64.650	237.88	1997/12/01 22:45
RIO CHANE 65.600	237.46	1997/12/01 23:58
RIO CHANE 66.550	237.18	1997/12/02 01:00
RIO CHANE 67.500	236.94	1997/12/02 01:53
RIO CHANE 68.450	236.67	1997/12/02 02:35
RIO CHANE 69.400	236.19	1997/12/02 03:36
RIO CHANE 70.267	235.48	1997/12/02 04:20
RIO CHANE 71.133	234.92	1997/12/02 05:01
RIO CHANE 72.000	234.42	1997/12/02 05:36
RIO CHANE 72.800	233.97	1997/12/02 06:15

TABLE F.3.1(2) MAXIMUM WATER LEVELS IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Water Level	
	(m)	Time
RIO CHANE 73.600	233.53	1997/12/02 06:54
RIO CHANE 74.400	233.09	1997/12/02 07:40
RIO CHANE 75.200	232.67	1997/12/02 08:31
RIO CHANE 76.033	232.24	1997/12/02 09:26
RIO CHANE 76.867	231.88	1997/12/02 10:16
RIO CHANE 77.700	231.60	1997/12/02 10:50
RIO CHANE 78.433	231.36	1997/12/02 11:14
RIO CHANE 79.167	231.09	1997/12/02 11:35
RIO CHANE 79.900	230.71	1997/12/02 12:05
RIO CHANE 80.000	230.56	1997/12/02 12:13
RIO CHANE 80.100	230.51	1997/12/02 12:16
RIO CHANE 81.040	229.77	1997/12/02 13:04
RIO CHANE 81.980	229.15	1997/12/02 13:36
RIO CHANE 82.920	228.70	1997/12/02 13:43
RIO CHANE 83.860	228.42	1997/12/02 13:21
RIO CHANE 84.800	228.37	1997/12/01 20:35
RIO CHANE 84.800	228.37	1997/12/01 20:35
RIO CHANE 85.575	228.26	1997/12/01 20:54
RIO CHANE 86.350	228.16	1997/12/01 21:11
RIO CHANE 87.125	228.03	1997/12/01 21:45
RIO CHANE 87.900	227.91	1997/12/01 22:24
RIO CHANE 88.000	227.80	1997/12/01 22:33
RIO CHANE 88.100	227.84	1997/12/01 22:27
RIO CHANE 88.900	227.37	1997/12/01 23:00
RIO CHANE 89.700	227.19	1997/12/01 23:21
RIO CHANE 90.500	227.13	1997/12/01 23:33
RIO CHANE 91.333	227.11	1997/12/01 23:39
RIO CHANE 92.167	227.09	1997/12/01 23:32
RIO CHANE 93.000	227.07	1997/12/01 23:32
RIO CHANE 94.000	227.04	1997/12/01 23:36
RIO CHANE 95.000	227.00	1997/11/30 00:01
QDA CHANE 0.000	290.48	1997/12/01 00:15
QDA CHANE 0.900	289.48	1997/12/01 01:28
QDA CHANE 1.800	288.47	1997/12/01 02:34
QDA CHANE 2.700	287.46	1997/12/01 03:50
QDA CHANE 3.600	286.38	1997/12/01 05:09
QDA CHANE 4.500	285.57	1997/12/01 04:58
QDA CHANE 5.425	284.30	1997/12/01 05:43
QDA CHANE 6.350	283.02	1997/12/01 03:05
QDA CHANE 7.275	281.82	1997/12/01 06:37
QDA CHANE 8.200	280.41	1997/12/01 09:11
QDA CHANE 9.133	278.73	1997/12/01 07:53
QDA CHANE 10.067	277.12	1997/12/01 10:05
QDA CHANE 11.000	275.27	1997/12/01 11:16
QDA CHANE 12.000	272.48	1997/12/01 12:08
QDA CHANE 12.800	270.55	1997/12/01 12:30
QDA CHANE 13.600	268.82	1997/12/01 13:04
QDA CHANE 14.433	267.57	1997/12/01 13:31
QDA CHANE 15.267	266.42	1997/12/01 14:43
QDA CHANE 16.100	264.95	1997/12/01 17:25
QDA CHANE 16.200	264.69	1997/12/01 23:18

River/Chainage	Maximum Water Level	
	(m)	Time
QDA CHANE 16.300	264.58	1997/12/01 22:47
QDA CHANE 17.133	262.95	1997/12/01 23:14
QDA CHANE 17.967	261.30	1997/12/01 23:57
QDA CHANE 18.800	259.67	1997/12/01 23:50
QDA CHANE 19.500	258.66	1997/12/01 23:59
QDA CHANE 20.200	257.39	1997/12/01 23:58
QDA CHANE 20.900	256.60	1997/12/02 00:30
QDA CHANE 21.700	255.67	1997/12/02 02:20
QDA CHANE 22.500	254.61	1997/12/02 03:44
QDA CHANE 23.300	253.17	1997/12/02 03:45
QDA CHANE 24.133	251.72	1997/12/02 05:15
QDA CHANE 24.967	250.54	1997/12/02 06:39
QDA CHANE 25.800	249.98	1997/12/02 06:48
QDA CHANE 26.600	248.42	1997/12/02 07:49
QDA CHANE 27.400	247.15	1997/12/02 07:59
QDA CHANE 28.200	245.76	1997/12/02 08:04
QDA CHANE 29.067	243.74	1997/12/02 07:54
QDA CHANE 29.933	243.59	1997/12/01 13:30
QDA CHANE 30.800	243.59	1997/12/01 13:25
QDA CHANE 30.800	243.59	1997/12/01 13:25
QDA CHANE 31.600	242.85	1997/12/01 14:40
QDA CHANE 32.400	242.17	1997/12/01 15:09
QDA CHANE 33.200	241.68	1997/12/01 15:48
QDA CHANE 34.000	241.46	1997/12/01 17:11
RIO PAILON 0.000	276.41	1997/12/04 16:28
RIO PAILON 1.000	276.32	1997/12/04 17:31
RIO PAILON 2.000	276.21	1997/12/04 18:48
RIO PAILON 3.000	276.10	1997/12/04 20:07
RIO PAILON 4.000	275.97	1997/12/04 21:58
RIO PAILON 5.000	275.81	1997/12/05 07:11
RIO PAILON 6.000	275.68	1997/12/05 21:49
RIO PAILON 7.000	275.56	1997/12/05 23:18
RIO PAILON 8.000	275.42	1997/12/06 00:45
RIO PAILON 9.000	275.24	1997/12/06 02:42
RIO PAILON 10.000	274.81	1997/12/06 06:33
RIO PAILON 10.867	273.59	1997/12/06 13:45
RIO PAILON 11.733	272.21	1997/12/06 15:02
RIO PAILON 12.600	271.00	1997/12/06 15:00
RIO PAILON 12.700	270.88	1997/12/06 15:12
RIO PAILON 12.800	270.70	1997/12/06 15:14
RIO PAILON 13.650	268.96	1997/12/06 15:08
RIO PAILON 14.500	267.43	1997/12/06 16:30
RIO PAILON 15.450	267.01	1997/12/06 16:38
RIO PAILON 16.400	266.54	1997/12/06 17:18
RIO PAILON 16.500	266.45	1997/12/06 17:03
RIO PAILON 16.600	266.28	1997/12/06 17:07
RIO PAILON 17.533	264.09	1997/12/06 18:04
RIO PAILON 18.467	262.73	1997/12/06 20:06
RIO PAILON 19.400	262.07	1997/12/06 21:56
RIO PAILON 20.300	261.33	1997/12/06 23:48
RIO PAILON 21.200	260.49	1997/12/07 00:00

TABLE F.3.1(3) MAXIMUM WATER LEVELS IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Water Level	
	(m)	Time
RIO PAILON 21.300	260.36	1997/12/07 00:00
RIO PAILON 21.400	260.11	1997/12/07 00:00
RIO PAILON 22.267	258.44	1997/12/04 23:39
RIO PAILON 23.133	258.37	1997/12/04 23:00
RIO PAILON 24.000	258.34	1997/12/04 22:41
QDA MECO 0.000	276.62	1997/12/06 03:34
QDA MECO 1.000	276.42	1997/12/04 16:22
QDA MECO 2.000	276.41	1997/12/04 16:28
QDA MECO 2.000	276.41	1997/12/04 16:28
QDA MECO 2.200	277.00	1997/11/30 00:01
R. CHICO II 0.000	253.97	1997/12/05 03:07
R. CHICO II 0.950	252.84	1997/12/05 04:52
R. CHICO II 1.900	252.82	1997/12/05 04:56
R. CHICO II 2.000	252.82	1997/12/05 04:52
R. CHICO II 2.200	252.00	1997/12/05 05:18
R. CHICO II 3.000	251.83	1997/12/05 05:03
QDA TORO 0.000	267.44	1997/12/01 04:00
QDA TORO 0.400	267.13	1997/12/01 04:06
QDA TORO 0.500	266.87	1997/12/01 04:07
QDA TORO 0.600	266.36	1997/12/01 03:52
QDA TORO 1.533	264.50	1997/12/01 04:28
QDA TORO 2.467	263.19	1997/12/01 04:54
QDA TORO 3.400	261.05	1997/12/01 05:17
QDA TORO 4.000	258.89	1997/12/01 01:31
QDA TORO 4.600	257.04	1997/12/01 00:09
QDA TORO 4.600	257.04	1997/12/01 00:09
QDA TORO 5.400	253.83	1997/12/01 00:30
QDA TORO 6.200	251.14	1997/12/01 01:22
QDA TORO 7.200	249.53	1997/12/01 02:27
QDA TORO 8.200	249.00	1997/12/01 03:57
QDA TORO 9.200	248.69	1997/12/01 04:23
QDA TORO 10.200	248.50	1997/12/01 07:16
QDA TORO 11.200	248.34	1997/12/01 09:57
QDA TORO 12.160	247.50	1997/12/01 09:27
QDA TORO 13.120	246.67	1997/12/01 09:39
QDA TORO 14.080	245.83	1997/12/01 11:59
QDA TORO 15.040	244.77	1997/12/01 12:51
QDA TORO 16.000	243.59	1997/12/01 13:25
QDA MARAS 0.000	272.85	1997/12/01 00:05
QDA MARAS 0.500	272.54	1997/11/30 23:17
QDA MARAS 0.700	272.09	1997/11/30 23:37
QDA MARAS 1.475	270.38	1997/11/30 23:45
QDA MARAS 2.250	268.92	1997/11/30 23:37
QDA MARAS 3.025	267.60	1997/12/01 00:05
QDA MARAS 3.800	266.19	1997/12/01 00:00
QDA MARAS 4.400	264.57	1997/12/01 00:19
QDA MARAS 5.000	263.04	1997/11/30 22:58
QDA MARAS 6.000	259.77	1997/11/30 22:57
QDA MARAS 6.650	257.40	1997/12/01 00:15
QDA MARAS 7.300	257.04	1997/12/01 00:09

River/Chainage	Maximum Water Level	
	(m)	Time
QDA CHACRAS 0.000	276.78	1997/12/01 01:27
QDA CHACRAS 0.400	276.31	1997/12/01 04:25
QDA CHACRAS 0.500	276.26	1997/12/01 04:37
QDA CHACRAS 0.700	275.73	1997/12/01 04:37
QDA CHACRAS 1.633	273.47	1997/12/01 04:50
QDA CHACRAS 2.567	272.09	1997/12/01 05:00
QDA CHACRAS 3.500	270.90	1997/12/01 05:35
QDA CHACRAS 4.429	269.72	1997/12/01 05:50
QDA CHACRAS 5.357	268.53	1997/12/01 06:13
QDA CHACRAS 6.286	267.33	1997/12/01 06:32
QDA CHACRAS 7.214	266.14	1997/12/01 06:58
QDA CHACRAS 8.143	264.98	1997/12/01 07:24
QDA CHACRAS 9.071	263.85	1997/12/01 07:52
QDA CHACRAS 10.000	262.77	1997/12/01 08:12
QDA CHACRAS 10.833	261.79	1997/12/01 08:39
QDA CHACRAS 11.667	261.26	1997/12/01 08:47
QDA CHACRAS 12.500	260.91	1997/12/01 08:47
QDA CHACRAS 13.375	259.74	1997/12/01 08:59
QDA CHACRAS 14.250	258.58	1997/12/01 09:17
QDA CHACRAS 15.125	257.45	1997/12/01 09:43
QDA CHACRAS 16.000	256.17	1997/12/01 10:13
QDA CHACRAS 17.000	254.34	1997/12/01 10:40
QDA CHACRAS 18.000	252.64	1997/12/01 10:55
QDA CHACRAS 19.000	250.52	1997/12/01 10:54
QDA CHACRAS 19.833	248.46	1997/12/01 11:05
QDA CHACRAS 20.667	247.40	1997/12/01 11:30
QDA CHACRAS 21.500	245.91	1997/12/01 11:44
QDA CHACRAS 22.233	243.66	1997/12/01 12:00
QDA CHACRAS 22.967	241.88	1997/12/01 12:15
QDA CHACRAS 23.700	241.15	1997/12/01 12:16
QDA CHACRAS 24.650	240.40	1997/12/01 12:21
QDA CHACRAS 25.600	239.65	1997/12/01 12:26
QDA CHACRAS 26.550	238.88	1997/12/01 12:30
QDA CHACRAS 27.500	237.56	1997/12/01 12:30
QDA CHACRAS 28.500	235.54	1997/12/01 12:46
QDA CHACRAS 29.500	234.49	1997/12/01 13:27
QDA CHACRAS 30.500	233.22	1997/12/01 13:57
QDA CHACRAS 31.333	232.09	1997/12/01 14:35
QDA CHACRAS 32.167	231.49	1997/12/01 14:44
QDA CHACRAS 33.000	230.89	1997/12/01 14:48
QDA CHACRAS 33.875	229.59	1997/12/01 14:38
QDA CHACRAS 34.750	228.63	1997/12/01 17:43
QDA CHACRAS 35.625	228.41	1997/12/01 19:55
QDA CHACRAS 36.500	228.37	1997/12/01 20:35

TABLE F.3.2(1) MAXIMUM DISCHARGES IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
RIO CHANE 0.500	581.62	1997/12/04 09:18
RIO CHANE 1.500	579.26	1997/12/04 09:46
RIO CHANE 2.500	578.25	1997/12/04 10:07
RIO CHANE 3.500	577.89	1997/12/04 10:18
RIO CHANE 4.500	577.89	1997/12/04 10:20
RIO CHANE 5.500	577.90	1997/12/04 10:22
RIO CHANE 6.500	577.88	1997/12/04 10:24
RIO CHANE 7.500	577.91	1997/12/04 10:28
RIO CHANE 8.417	577.94	1997/12/04 10:30
RIO CHANE 9.250	578.34	1997/12/04 10:33
RIO CHANE 10.083	581.88	1997/12/04 10:28
RIO CHANE 10.938	607.36	1997/12/04 09:16
RIO CHANE 11.813	669.23	1997/12/04 07:56
RIO CHANE 12.688	736.24	1997/12/04 07:00
RIO CHANE 13.563	795.08	1997/12/04 07:41
RIO CHANE 14.500	768.74	1997/12/04 07:15
RIO CHANE 15.500	731.96	1997/12/04 06:58
RIO CHANE 16.500	706.89	1997/12/04 06:01
RIO CHANE 17.500	711.56	1997/12/04 05:03
RIO CHANE 18.500	723.00	1997/12/04 05:05
RIO CHANE 19.500	727.67	1997/12/04 05:07
RIO CHANE 20.500	726.40	1997/12/04 05:09
RIO CHANE 21.500	728.49	1997/12/04 05:11
RIO CHANE 22.500	662.91	1997/12/04 05:41
RIO CHANE 23.500	578.20	1997/12/04 11:07
RIO CHANE 24.500	580.33	1997/12/04 11:20
RIO CHANE 25.438	402.42	1997/12/04 17:58
RIO CHANE 26.313	402.43	1997/12/04 18:30
RIO CHANE 27.188	401.44	1997/12/04 19:07
RIO CHANE 28.063	406.71	1997/12/04 19:48
RIO CHANE 28.913	431.75	1997/12/04 21:54
RIO CHANE 29.738	427.71	1997/12/04 23:31
RIO CHANE 30.563	425.87	1997/12/05 00:33
RIO CHANE 31.387	425.35	1997/12/05 01:03
RIO CHANE 32.275	430.46	1997/12/05 00:46
RIO CHANE 33.225	427.25	1997/12/05 02:07
RIO CHANE 34.150	60.84	1997/12/05 03:24
RIO CHANE 35.050	60.88	1997/12/05 03:35
RIO CHANE 35.950	61.83	1997/12/05 04:45
RIO CHANE 36.450	61.95	1997/12/05 04:46
RIO CHANE 36.550	61.96	1997/12/05 04:46
RIO CHANE 37.075	154.90	1997/12/04 10:46
RIO CHANE 38.025	151.53	1997/12/04 12:13
RIO CHANE 39.000	472.59	1997/12/05 04:50
RIO CHANE 40.000	471.37	1997/12/05 05:33

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
RIO CHANE 46.117	370.67	1997/12/05 18:59
RIO CHANE 46.950	347.31	1997/12/06 05:02
RIO CHANE 47.850	347.13	1997/12/06 05:57
RIO CHANE 48.750	346.97	1997/12/06 06:47
RIO CHANE 49.612	346.71	1997/12/06 07:41
RIO CHANE 50.438	346.46	1997/12/06 08:30
RIO CHANE 51.263	346.18	1997/12/06 09:17
RIO CHANE 52.087	345.61	1997/12/06 10:07
RIO CHANE 53.000	338.21	1997/12/06 17:07
RIO CHANE 54.000	337.89	1997/12/06 18:11
RIO CHANE 54.883	328.46	1997/12/07 00:00
RIO CHANE 55.650	327.89	1997/12/07 00:00
RIO CHANE 56.417	326.10	1997/12/07 00:00
RIO CHANE 57.267	323.02	1997/12/07 00:00
RIO CHANE 58.200	320.23	1997/12/07 00:00
RIO CHANE 59.133	318.26	1997/12/07 00:00
RIO CHANE 59.800	316.65	1997/12/07 00:00
RIO CHANE 60.350	496.22	1997/12/01 16:02
RIO CHANE 61.050	491.76	1997/12/01 17:32
RIO CHANE 61.750	488.54	1997/12/01 18:46
RIO CHANE 62.450	487.07	1997/12/01 19:15
RIO CHANE 63.150	485.19	1997/12/01 19:45
RIO CHANE 63.550	484.26	1997/12/01 20:00
RIO CHANE 63.650	484.25	1997/12/01 20:00
RIO CHANE 64.175	483.28	1997/12/01 20:24
RIO CHANE 65.125	480.30	1997/12/01 21:04
RIO CHANE 66.075	477.25	1997/12/01 21:48
RIO CHANE 67.025	473.01	1997/12/01 23:09
RIO CHANE 67.975	467.89	1997/12/02 00:27
RIO CHANE 68.925	463.84	1997/12/02 01:56
RIO CHANE 69.833	459.77	1997/12/02 03:02
RIO CHANE 70.700	457.27	1997/12/02 03:46
RIO CHANE 71.567	455.04	1997/12/02 04:26
RIO CHANE 72.400	452.98	1997/12/02 05:01
RIO CHANE 73.200	451.04	1997/12/02 05:36
RIO CHANE 74.000	449.09	1997/12/02 06:13
RIO CHANE 74.800	447.03	1997/12/02 06:48
RIO CHANE 75.617	444.59	1997/12/02 07:28
RIO CHANE 76.450	441.48	1997/12/02 08:12
RIO CHANE 77.283	438.06	1997/12/02 08:59
RIO CHANE 78.067	435.16	1997/12/02 09:43
RIO CHANE 78.800	432.97	1997/12/02 10:21
RIO CHANE 79.533	431.58	1997/12/02 11:03
RIO CHANE 79.950	430.68	1997/12/02 11:26
RIO CHANE 80.050	430.49	1997/12/02 11:30

TABLE F.3.2(2) MAXIMUM DISCHARGES IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
RIO CHANE 80.570	429.83	1997/12/02 11:58
RIO CHANE 81.510	428.39	1997/12/02 12:43
RIO CHANE 82.450	427.33	1997/12/02 13:26
RIO CHANE 83.390	430.38	1997/12/02 14:00
RIO CHANE 84.330	431.12	1997/12/02 14:17
RIO CHANE 87.950	539.72	1997/12/01 22:13
RIO CHANE 88.050	539.72	1997/12/01 22:14
RIO CHANE 88.500	539.57	1997/12/01 22:26
RIO CHANE 89.300	539.02	1997/12/01 22:49
RIO CHANE 90.100	538.62	1997/12/01 23:05
RIO CHANE 90.917	538.38	1997/12/01 23:18
RIO CHANE 91.750	538.24	1997/12/01 23:30
RIO CHANE 92.583	538.18	1997/12/01 23:38
RIO CHANE 93.500	538.16	1997/12/01 23:45
RIO CHANE 94.500	538.17	1997/12/01 23:49
QDA CHANE 0.450	174.76	1997/12/01 00:40
QDA CHANE 1.350	172.25	1997/12/01 01:49
QDA CHANE 2.250	168.16	1997/12/01 02:53
QDA CHANE 3.150	160.72	1997/12/01 04:05
QDA CHANE 4.050	150.65	1997/12/01 05:07
QDA CHANE 4.963	221.43	1997/12/01 05:06
QDA CHANE 5.888	218.20	1997/12/01 05:45
QDA CHANE 6.813	216.40	1997/12/01 06:15
QDA CHANE 7.737	215.70	1997/12/01 06:46
QDA CHANE 8.667	195.97	1997/12/01 08:16
QDA CHANE 9.600	198.98	1997/12/01 08:45
QDA CHANE 10.533	195.35	1997/12/01 10:10
QDA CHANE 11.500	193.59	1997/12/01 11:30
QDA CHANE 12.400	192.31	1997/12/01 12:13
QDA CHANE 13.200	192.09	1997/12/01 12:38
QDA CHANE 14.017	191.43	1997/12/01 13:12
QDA CHANE 14.850	191.28	1997/12/01 13:48
QDA CHANE 15.683	189.67	1997/12/01 14:30
QDA CHANE 16.150	188.05	1997/12/01 14:40
QDA CHANE 16.250	50.65	1997/12/01 22:42
QDA CHANE 16.717	50.60	1997/12/01 22:53
QDA CHANE 17.550	48.35	1997/12/01 23:14
QDA CHANE 18.383	46.60	1997/12/01 23:53
QDA CHANE 19.150	46.61	1997/12/01 23:56
QDA CHANE 19.850	46.59	1997/12/02 00:01
QDA CHANE 20.550	46.61	1997/12/02 00:06
QDA CHANE 21.300	48.17	1997/12/02 01:19
QDA CHANE 22.100	46.18	1997/12/02 02:40
QDA CHANE 22.900	44.43	1997/12/02 03:45
QDA CHANE 23.717	45.17	1997/12/02 04:04
QDA CHANE 24.550	42.69	1997/12/02 05:03
QDA CHANE 25.383	40.47	1997/12/02 06:28
QDA CHANE 26.200	40.39	1997/12/02 06:45
QDA CHANE 27.000	39.80	1997/12/02 07:47
QDA CHANE 27.800	39.78	1997/12/02 07:58
QDA CHANE 28.633	39.78	1997/12/02 08:03

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
QDA CHANE 29.500	39.79	1997/12/02 08:08
QDA CHANE 30.367	40.15	1997/12/02 08:09
QDA CHANE 31.200	290.39	1997/12/01 12:49
QDA CHANE 32.000	286.92	1997/12/01 14:02
QDA CHANE 32.800	285.76	1997/12/01 14:39
QDA CHANE 33.600	285.31	1997/12/01 14:48
RIO PAILON 0.500	137.68	1997/12/04 12:22
RIO PAILON 1.500	130.92	1997/12/04 13:35
RIO PAILON 2.500	125.35	1997/12/04 15:26
RIO PAILON 3.500	121.52	1997/12/04 17:22
RIO PAILON 4.500	118.92	1997/12/04 19:00
RIO PAILON 5.500	116.36	1997/12/04 20:05
RIO PAILON 6.500	75.51	1997/12/05 16:51
RIO PAILON 7.500	75.01	1997/12/05 19:41
RIO PAILON 8.500	74.70	1997/12/05 23:18
RIO PAILON 9.500	74.58	1997/12/06 01:52
RIO PAILON 10.433	74.44	1997/12/06 04:45
RIO PAILON 11.300	74.29	1997/12/06 13:22
RIO PAILON 12.167	74.28	1997/12/06 15:37
RIO PAILON 12.650	74.28	1997/12/06 15:41
RIO PAILON 12.750	74.28	1997/12/06 15:42
RIO PAILON 13.225	74.28	1997/12/06 15:42
RIO PAILON 14.075	74.28	1997/12/06 15:47
RIO PAILON 14.975	74.28	1997/12/06 15:56
RIO PAILON 15.925	74.28	1997/12/06 17:15
RIO PAILON 16.450	74.28	1997/12/06 17:18
RIO PAILON 16.550	74.28	1997/12/06 17:18
RIO PAILON 17.067	74.28	1997/12/06 17:26
RIO PAILON 18.000	74.28	1997/12/06 17:30
RIO PAILON 18.933	74.27	1997/12/06 17:19
RIO PAILON 19.850	74.26	1997/12/06 17:11
RIO PAILON 20.750	74.26	1997/12/06 17:02
RIO PAILON 21.250	74.25	1997/12/06 16:57
RIO PAILON 21.350	74.25	1997/12/06 16:56
RIO PAILON 21.833	74.25	1997/12/06 16:55
RIO PAILON 22.700	74.40	1997/12/06 17:11
RIO PAILON 23.567	76.81	1997/12/06 17:07
QDA MECO 0.500	92.47	1997/12/06 03:30
QDA MECO 1.500	91.67	1997/12/06 03:53
QDA MECO 2.100	7.77	1997/11/30 00:01
R. CHICO II 0.475	371.89	1997/12/04 22:26
R. CHICO II 1.425	362.85	1997/12/05 03:18
R. CHICO II 1.950	555.25	1997/12/04 23:20
R. CHICO II 2.100	516.63	1997/12/04 19:56
R. CHICO II 2.600	361.06	1997/12/05 05:33
QDA TORO 0.200	380.75	1997/11/30 22:19
QDA TORO 0.450	223.29	1997/12/01 04:07
QDA TORO 0.550	232.03	1997/12/01 03:59
QDA TORO 1.067	232.67	1997/12/01 04:09
QDA TORO 2.000	231.92	1997/12/01 04:31
QDA TORO 2.933	230.86	1997/12/01 05:00

TABLE F.3.2(3) MAXIMUM DISCHARGES IN THE RIO CHANE-PAILON BASIN

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
QDA TORO 3.700	230.22	1997/12/01 05:12
QDA TORO 4.300	336.87	1997/12/01 01:27
QDA TORO 5.000	504.36	1997/12/01 01:08
QDA TORO 5.800	504.34	1997/12/01 01:13
QDA TORO 6.700	504.04	1997/12/01 01:31
QDA TORO 7.700	499.92	1997/12/01 01:49
QDA TORO 8.700	487.52	1997/12/01 02:25
QDA TORO 9.700	472.74	1997/12/01 02:57
QDA TORO 10.700	460.99	1997/12/01 03:14
QDA TORO 11.680	287.47	1997/12/01 08:34
QDA TORO 12.640	286.05	1997/12/01 09:15
QDA TORO 13.600	285.97	1997/12/01 09:50
QDA TORO 14.560	280.21	1997/12/01 11:28
QDA TORO 15.520	277.64	1997/12/01 12:11
QDA MARAS 0.250	93.52	1997/12/01 01:06
QDA MARAS 0.600	171.27	1997/11/30 23:00
QDA MARAS 1.087	169.23	1997/11/30 23:37
QDA MARAS 1.863	169.14	1997/11/30 23:44
QDA MARAS 2.638	169.22	1997/11/30 23:51
QDA MARAS 3.413	169.00	1997/12/01 00:01
QDA MARAS 4.100	169.07	1997/12/01 00:10
QDA MARAS 4.700	179.60	1997/11/30 22:55
QDA MARAS 5.500	311.73	1997/11/30 22:55
QDA MARAS 6.325	201.29	1997/11/30 22:57
QDA MARAS 6.975	169.62	1997/12/01 00:22
QDA CHACRAS 0.200	212.85	1997/12/01 00:39
QDA CHACRAS 0.450	168.01	1997/12/01 01:43
QDA CHACRAS 0.600	412.93	1997/12/01 04:22
QDA CHACRAS 1.167	412.61	1997/12/01 04:40
QDA CHACRAS 2.100	412.50	1997/12/01 04:52
QDA CHACRAS 3.033	412.45	1997/12/01 05:10
QDA CHACRAS 3.964	411.73	1997/12/01 05:38
QDA CHACRAS 4.893	411.52	1997/12/01 05:58
QDA CHACRAS 5.821	411.23	1997/12/01 06:15
QDA CHACRAS 6.750	410.76	1997/12/01 06:36
QDA CHACRAS 7.679	410.09	1997/12/01 06:59
QDA CHACRAS 8.607	409.21	1997/12/01 07:23
QDA CHACRAS 9.536	408.22	1997/12/01 07:51
QDA CHACRAS 10.417	407.65	1997/12/01 08:13
QDA CHACRAS 11.250	406.73	1997/12/01 08:36
QDA CHACRAS 12.083	406.57	1997/12/01 08:47
QDA CHACRAS 12.938	406.57	1997/12/01 08:50
QDA CHACRAS 13.813	406.47	1997/12/01 09:00
QDA CHACRAS 14.688	406.07	1997/12/01 09:18
QDA CHACRAS 15.563	405.26	1997/12/01 09:45
QDA CHACRAS 16.500	404.33	1997/12/01 10:18
QDA CHACRAS 17.500	403.70	1997/12/01 10:43
QDA CHACRAS 18.500	403.50	1997/12/01 10:56
QDA CHACRAS 19.417	403.51	1997/12/01 10:58
QDA CHACRAS 20.250	403.38	1997/12/01 11:08
QDA CHACRAS 21.083	402.77	1997/12/01 11:30

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
QDA CHACRAS 21.867	402.50	1997/12/01 11:48
QDA CHACRAS 22.600	402.28	1997/12/01 12:03
QDA CHACRAS 23.333	402.14	1997/12/01 12:14
QDA CHACRAS 24.175	402.11	1997/12/01 12:17
QDA CHACRAS 25.125	402.08	1997/12/01 12:23
QDA CHACRAS 26.075	402.06	1997/12/01 12:28
QDA CHACRAS 27.025	402.04	1997/12/01 12:31
QDA CHACRAS 28.000	402.05	1997/12/01 12:33
QDA CHACRAS 29.000	401.83	1997/12/01 12:46
QDA CHACRAS 30.000	400.16	1997/12/01 13:23
QDA CHACRAS 30.917	398.76	1997/12/01 14:00
QDA CHACRAS 31.750	397.33	1997/12/01 14:30
QDA CHACRAS 32.583	397.08	1997/12/01 14:44
QDA CHACRAS 33.438	397.06	1997/12/01 14:46
QDA CHACRAS 34.313	397.12	1997/12/01 14:48
QDA CHACRAS 35.188	396.76	1997/12/01 14:55
QDA CHACRAS 36.063	392.73	1997/12/01 15:06

TABLE F.3.3 CALCULATION OF HYDRAULIC CHARACTERISTICS AT THE CHAINAGE 63.61 KM

Chainage	Elevation (m)		Max Q	Max WL	Depth	Cross section	Hydraulic	Froude
	Bed	Bank	(m^3/s)	(m)	(m)	(m^2)	Radius (m)	Number
62.10	233.17	239.44	494.0	239.77	6.60	219.95	2.71	0.44
63.50	231.65	237.96	494.0	238.28	6.63	620.37	0.62	0.32
63.60	231.61	240.00	494.0	237.97	6.36	103.37	2.50	0.96
63.70	231.58	237.90	494.0	238.18	6.60	385.53	0.97	0.42
67.50	229.02	235.62	494.0	236.96	7.94	379.96	2.44	0.27

TABLE F.3.4 MAXIMUM WATER LEVELS AND DISCHARGES IN THE OKINAWA DRAINAGE BASIN

River/Chainage	Maximum Water Level	
	(m)	Time
OKI-DR 0.000	250.53	1997/12/05 01:09
OKI-DR 7.000	248.24	1997/12/04 16:00
OKI-DR 16.000	241.13	1997/12/05 00:39
OKI-DR 25.000	234.94	1997/12/04 19:50
OKI-DR 28.000	230.00	1997/11/30 00:10

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
OKI-DR 1.000	17.47	1997/12/05 01:20
OKI-DR 11.500	117.25	1997/11/30 00:10
OKI-DR 20.500	240.36	1997/11/30 00:10
OKI-DR 26.500	426.91	1997/11/30 00:10

TABLE F.3.5 MAXIMUM WATER LEVELS AND DISCHARGES IN THE ARROYO YAPACANICITO,JOCHI AND TACUARAL BASIN

River/Chainage	Maximum Water Level		Remarks
	(m)	Time	
JOCHI 0.000	288.85	1997/02/04 04:35	
JOCHI 3.000	284.66	1997/02/04 03:43	
JOCHI 6.000	281.50	1997/02/05 01:46	
JOCHI 9.520	277.01	1997/02/05 15:19	
JOCHI 12.800	268.96	1997/02/06 01:17	
JOCHI 15.360	264.50	1997/02/06 20:42	
JOCHI 18.600	259.61	1997/02/06 21:55	
JOCHI 21.000	256.46	1997/02/06 06:40	
JOCHI 22.700	254.56	1997/02/06 22:51	
JOCHI 25.600	251.61	1997/02/07 11:48	
JOCHI 29.700	246.64	1997/02/04 04:28	Effect of
JOCHI 29.700	246.64	1997/02/04 04:28	the retarding
JOCHI 29.800	246.56	1997/02/04 09:18	basin
JOCHI 35.800	244.40	1997/02/08 15:27	
JOCHI 39.600	244.10	1997/02/08 17:03	
JOCHI 43.400	244.00	1997/01/31 00:01	Effect of D/S water level
TACUARAL 0.000	279.65	1997/02/04 03:41	
TACUARAL 3.000	276.38	1997/02/04 02:33	
TACUARAL 6.000	272.59	1997/02/04 14:24	
TACUARAL 9.000	269.28	1997/02/04 12:31	
TACUARAL 12.000	265.48	1997/02/04 22:18	
TACUARAL 16.400	261.19	1997/02/05 09:21	
TACUARAL 18.240	260.38	1997/02/05 09:04	
TACUARAL 18.340	260.10	1997/02/05 09:00	
TACUARAL 18.440	259.90	1997/02/05 09:06	
TACUARAL 20.700	256.69	1997/02/05 18:42	
TACUARAL 20.800	256.41	1997/02/05 18:23	
TACUARAL 20.900	256.38	1997/02/05 18:37	
TACUARAL 22.600	252.84	1997/02/05 21:15	
TACUARAL 27.500	246.65	1997/02/04 07:50	Effect of
TACUARAL 27.600	246.63	1997/02/04 04:39	the retarding
TACUARAL 27.600	246.63	1997/02/04 04:39	basin
TACUARAL 32.100	245.05	1997/02/08 11:44	
TACUARAL 37.900	243.50	1997/01/31 00:01	Effect of D/S water level
JOCHI-TACU 0.000	246.64	1997/02/04 04:28	
JOCHI-TACU 1.000	246.63	1997/02/04 04:39	
YAPACANICITO 0.000	282.94	1997/02/03 16:05	
YAPACANICITO 1.500	281.38	1997/02/03 17:28	
YAPACANICITO 3.600	279.24	1997/02/03 19:39	
YAPACANICITO 6.100	276.48	1997/02/03 21:56	
YAPACANICITO 8.600	274.63	1997/02/04 06:11	
YAPACANICITO 8.600	274.63	1997/02/04 06:11	
YAPACANICITO 12.200	270.60	1997/02/04 20:28	
YAPACANICITO 14.300	266.20	1997/02/04 20:41	
YAPACANICITO 16.800	263.41	1997/02/04 17:56	
YAPACANICITO 18.000	261.40	1997/02/06 04:59	
YAPACANICITO 21.000	257.62	1997/02/06 07:26	
YAPACANICITO 23.500	255.75	1997/02/06 02:47	
YAPACANICITO 27.100	252.94	1997/02/06 09:04	
YAPACANICITO 39.900	245.34	1997/02/06 01:02	
YAPACANICITO 44.900	241.98	1997/02/06 16:15	
YAPACANICITO 49.900	239.69	1997/02/04 01:30	Effect of D/S water level
YAPACANICITO 56.300	235.47	1997/02/04 13:15	
YAPACANICITO 59.300	234.30	1997/02/04 13:39	
YAPACANICITO 62.300	234.00	1997/01/31 00:01	
SANJUAN-DMI 0.000	274.63	1997/02/04 06:11	
SANJUAN-DMI 0.800	274.56	1997/02/04 06:33	
SANJUAN-DMI 1.600	274.52	1997/02/04 06:35	
SANJUAN-DMI 2.400	274.50	1997/02/04 06:35	
SANJUAN-DMI 2.500	271.00	1997/01/31 00:00	Effect of D/S water level

River/Chainage	Maximum Discharge	
	(m^3/s)	Time
JOCHI 6.920	57.81	1997/02/05 01:48
JOCHI 9.620	55.95	1997/02/05 15:22
JOCHI 14.080	55.85	1997/02/06 20:00
JOCHI 15.460	55.74	1997/02/06 20:51
JOCHI 19.800	55.69	1997/02/06 22:04
JOCHI 21.850	55.68	1997/02/06 22:27
JOCHI 22.750	55.68	1997/02/06 23:06
JOCHI 22.850	55.68	1997/02/06 23:06
JOCHI 24.250	55.68	1997/02/06 23:14
JOCHI 27.650	66.32	1997/02/09 02:56
JOCHI 29.750	35.18	1997/02/04 07:26
JOCHI 32.800	61.30	1997/02/04 09:35
JOCHI 37.700	36.69	1997/02/08 15:15
JOCHI 41.500	36.68	1997/02/08 17:41
TACUARAL 1.500	189.95	1997/02/04 01:37
TACUARAL 4.500	190.09	1997/02/04 03:37
TACUARAL 7.500	167.51	1997/02/04 13:35
TACUARAL 10.500	167.95	1997/02/04 15:07
TACUARAL 14.200	164.33	1997/02/05 01:03
TACUARAL 17.320	132.52	1997/02/05 08:51
TACUARAL 18.290	132.48	1997/02/05 09:12
TACUARAL 18.390	132.48	1997/02/05 09:15
TACUARAL 19.570	132.66	1997/02/05 09:56
TACUARAL 20.750	111.42	1997/02/05 18:44
TACUARAL 20.850	111.42	1997/02/05 18:44
TACUARAL 21.750	111.43	1997/02/05 19:14
TACUARAL 25.050	111.06	1997/02/05 21:15
TACUARAL 27.550	139.18	1997/02/05 04:01
TACUARAL 29.850	254.52	1997/02/04 05:37
TACUARAL 35.000	173.99	1997/02/08 10:55
JOCHI-TACU 0.050	121.88	1997/02/09 18:26
YAPACANICITO 0.750	139.96	1997/02/03 16:07
YAPACANICITO 2.550	134.96	1997/02/03 17:48
YAPACANICITO 4.850	125.76	1997/02/03 19:52
YAPACANICITO 7.350	116.73	1997/02/03 22:03
YAPACANICITO 8.610	75.83	1997/02/04 06:18
YAPACANICITO 12.210	63.12	1997/02/04 20:41
YAPACANICITO 14.310	63.12	1997/02/04 20:56
YAPACANICITO 17.400	63.69	1997/02/05 00:13
YAPACANICITO 18.010	29.43	1997/02/06 05:03
YAPACANICITO 22.250	29.20	1997/02/06 06:17
YAPACANICITO 25.300	29.56	1997/02/06 06:18
YAPACANICITO 28.500	30.24	1997/02/06 14:03
YAPACANICITO 32.400	138.62	1997/02/04 11:54
YAPACANICITO 37.400	118.59	1997/02/05 12:12
YAPACANICITO 42.400	114.42	1997/02/06 03:32
YAPACANICITO 47.400	111.14	1997/02/06 22:37
YAPACANICITO 50.600	126.05	1997/02/04 07:46
YAPACANICITO 53.800	369.89	1997/02/04 00:13
YAPACANICITO 57.800	228.19	1997/02/04 12:45
YAPACANICITO 60.800	228.03	1997/02/04 13:41
SANJUAN-DMI 0.400	84.02	1997/02/07 12:37
SANJUAN-DMI 1.200	76.36	1997/02/07 11:14
SANJUAN-DMI 2.000	67.59	1997/02/07 10:03
SANJUAN-DMI 2.490	57.62	1997/02/04 06:41

TABLE F.4.1(1) WATER LEVEL FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Section	Chainage in HD Model (km)	Acc. Distance in Topo Survey (m)	Existing			Prop. Riverbed EL (m)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
								Existing cross section					Design cross section				
				Left Bank	Riverbed	Right Bank		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Chane	No. 28	60.000	26,354	244.286	238.242	244.437	234.629	242.71	242.99	243.14	243.29	243.47	240.03	241.10	241.25	241.37	241.51
	No. 27	60.800	25,441	240.088	233.709	240.125	234.121	239.69	240.49	240.57	240.65	240.82	239.42	240.55	240.83	240.48	241.17
	No. 26	61.600	24,646	239.532	232.972	238.979	233.680	238.95	239.52	239.79	240.00	240.32	238.82	239.78	240.26	239.82	240.66
	No. 25	62.600	23,229	239.578	231.949	238.830	232.893	237.88	238.62	238.99	239.29	239.63	238.16	239.22	239.60	239.72	240.01
	No. 24	63.600	22,748	238.378	231.799	237.782	232.625	237.79	238.49	238.86	239.16	239.50	238.06	239.12	239.51	239.37	239.91
	No. 23	64.500	21,817	239.143	230.725	239.548	232.108	237.56	238.25	238.64	238.93	239.27	237.71	238.79	239.17	238.73	239.55
	No. 22	65.500	20,812	237.726	231.065	238.267	231.550	237.02	237.68	237.96	238.16	238.46	237.07	238.15	238.52	238.04	238.92
	No. 21	66.500	19,745	237.127	229.245	236.859	230.957	236.40	236.95	237.29	237.52	237.84	236.40	237.43	237.81	237.58	238.26
	No. 20	67.500	18,876	235.705	228.568	235.248	230.474	235.97	236.54	236.88	237.14	237.45	235.93	236.95	237.34	236.93	237.80
	No. 19	68.500	17,966	235.251	228.911	236.790	229.969	235.24	235.85	236.28	236.55	236.90	235.14	236.23	236.67	236.79	237.19
	No. 18	69.500	16,951	233.925	228.623	234.151	229.405	234.93	235.59	236.07	236.33	236.67	234.98	236.09	236.52	236.76	237.00
	No. 17	70.500	15,936	235.677	227.598	235.409	228.841	234.58	235.24	235.78	236.07	236.43	234.51	235.65	236.17	235.73	236.69
	No. 16	71.500	14,821	235.601	226.602	236.064	228.222	234.12	234.62	234.98	235.27	235.71	234.00	234.96	235.40	235.54	236.03
	No. 15	72.500	13,844	231.806	227.436	234.238	227.679	233.84	234.34	234.72	235.04	235.41	233.66	234.74	235.24	235.20	235.80
	No. 14	73.400	12,773	232.479	226.925	234.664	227.084	233.38	233.94	234.34	234.69	235.08	233.16	234.38	234.89	234.60	235.50
	No. 13	74.300	12,030	234.073	226.330	234.948	226.671	232.94	233.50	233.88	234.23	234.65	232.65	233.75	234.26	233.70	234.93
	No. 12	75.200	11,349	233.970	225.706	233.855	226.293	232.56	233.05	233.34	233.58	233.90	232.14	233.13	233.47	233.41	233.94
	No. 11	76.500	10,192	233.608	226.328	230.865	225.650	232.05	232.47	232.75	233.02	233.36	231.37	232.48	232.90	232.99	233.44
	No. 10	77.700	9,292	232.315	224.950	227.820	225.150	231.93	232.35	232.62	232.88	233.21	231.06	232.18	232.59	232.66	233.13
	No. 9	78.800	8,275	231.822	224.770	232.776	224.585	231.73	232.13	232.40	232.66	232.99	230.37	231.49	231.89	231.85	232.48
	No. 8	80.000	7,351	234.050	225.922	230.278	224.072	230.82	231.26	231.61	231.84	232.15	229.53	230.73	231.18	231.37	231.73
	No. 7	81.000	6,044	230.591	223.990	231.812	223.345	229.28	229.80	230.06	230.36	230.77	228.76	229.66	230.01	230.22	230.48
	No. 6	81.900	5,103	226.672	223.542	231.683	222.822	229.07	229.56	229.78	230.01	230.32	228.69	229.62	229.98	230.02	230.45
	No. 5	82.800	4,124	226.451	222.832	230.171	222.473	228.94	229.44	229.65	229.86	230.15	228.54	229.46	229.80	229.64	230.23
	No. 4	83.800	3,002	228.598	222.236	229.708	222.072	228.62	229.15	229.35	229.52	229.77	228.28	229.14	229.44	229.36	229.86
	No. 3	84.800	2,089	227.788	221.616	228.670	221.746	228.15	228.71	228.97	229.16	229.36	228.06	228.89	229.17	229.36	229.56
	No. 2	86.400	1,149	227.185	221.955	228.151	221.410	227.57	228.04	228.30	228.52	228.76	227.73	228.52	228.79	228.72	229.16
	No. 1	88.000	0	227.463	221.794	226.155	221.000	226.38	226.69	226.91	227.14	227.44	226.82	227.47	227.76	228.16	228.18

TABLE F.4.1(2) WATER LEVEL FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Section	Chainage in HD Model (km)	Acc. Distance in Topo Survey (m)	Existing			Prop. Riverbed EL (m)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
								Existing cross section					Design cross section				
				Left Bank	Riverbed	Right Bank		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Pailon	No. 33	24.000	58,032	256.647	253.692	258.817	252.724	259.34	259.67	259.91	260.12	260.39	258.39	258.79	258.96	277.49	259.29
	No. 32	29.900	57,429	258.332	252.300	258.387	252.624	258.91	259.22	259.45	259.65	259.91	257.84	258.17	258.37	258.35	258.78
	No. 31	30.600	56,630	257.532	252.805	257.603	252.491	258.42	258.79	259.04	259.25	259.52	257.70	258.04	258.21	258.16	258.54
	No. 30	31.300	55,181	256.591	251.823	256.982	252.249	258.18	258.56	258.81	259.01	259.27	257.47	257.84	258.02	257.67	258.35
	No. 29	32.300	54,048	256.273	251.902	256.255	252.060	257.79	258.16	258.39	258.58	258.81	256.92	257.31	257.51	257.35	257.91
	No. 28	33.700	53,048	256.163	251.573	256.621	251.894	257.35	257.69	257.89	258.06	258.27	256.54	256.91	257.05	257.16	257.54
	No. 27	34.600	52,167	255.418	252.195	255.575	251.747	257.17	257.46	257.62	257.75	257.92	256.27	256.67	256.82	256.58	257.15
	No. 26	35.500	51,006	257.104	251.887	256.231	251.553	257.03	257.34	257.51	257.64	257.81	255.84	256.22	256.42	255.88	256.86
	No. 25	36.500	49,986	255.548	252.421	255.221	251.383	256.50	256.80	256.97	257.10	257.28	254.90	255.22	255.40	255.48	255.93
	No. 25	36.500	49,986	255.548	252.421	255.221	251.383	256.50	256.80	256.97	257.10	257.28	254.83	255.15	255.30	255.12	255.85
	No. 24	37.100	48,688	255.343	251.433	254.903	250.518	256.10	256.49	256.74	256.94	257.18	254.49	254.80	254.94	254.75	255.74
	No. 23	37.800	47,686	254.669	251.413	254.645	249.850	255.39	255.78	256.06	256.28	256.56	254.15	254.43	254.59	254.65	255.74
	No. 22	38.500	46,768	253.463	250.632	253.448	249.238	254.98	255.42	255.72	255.96	256.25	254.06	254.38	254.52	254.65	255.02
	No. 21	39.500	45,942	253.351	249.798	253.450	248.687	254.77	255.18	255.46	255.68	255.96	253.39	253.82	254.01	253.64	254.22
	No. 20	40.500	44,756	252.351	248.077	252.105	247.897	254.30	254.67	254.91	255.10	255.35	252.78	253.21	253.45	253.01	253.72
	No. 19	41.500	43,217	251.905	248.613	252.968	246.871	253.63	253.94	254.14	254.33	254.57	252.24	252.60	252.80	252.73	253.12
	No. 18	42.800	42,781	252.445	247.857	251.474	246.580	252.90	253.23	253.46	253.65	253.91	251.63	252.03	252.26	252.12	252.52
	No. 17	44.200	41,632	251.052	248.427	251.142	245.814	252.43	252.76	252.98	253.17	253.41	250.79	251.32	251.59	251.54	251.92
	No. 16	45.300	40,697	251.226	248.296	250.996	245.191	252.17	252.46	252.65	252.82	253.05	250.16	250.64	250.96	250.79	251.37
	No. 15	46.500	39,675	251.131	246.781	251.346	244.509	251.56	251.78	251.94	252.08	252.28	249.52	249.98	250.22	250.02	250.55
	No. 14	47.800	38,936	249.271	245.241	249.481	244.016	250.69	250.99	251.18	251.36	251.58	248.69	249.14	249.46	249.17	249.89
	No. 13	49.200	37,958	249.836	247.392	250.002	243.365	250.47	250.74	250.93	251.09	251.30	247.53	247.97	248.23	248.33	248.62
	No. 12	50.300	36,414	248.898	247.532	248.887	242.335	249.76	250.03	250.21	250.36	250.58	246.86	247.32	247.58	247.51	247.99
	No. 11	51.400	35,150	247.719	246.367	247.785	241.493	249.02	249.31	249.50	249.67	249.89	246.08	246.54	246.83	246.72	247.22
	No. 10	52.500	33,888	247.204	244.481	246.672	240.651	248.49	248.76	248.95	249.11	249.33	245.34	245.80	246.12	245.81	246.48
	No. 9	53.200	33,505	247.235	243.985	247.355	240.396	247.91	248.22	248.43	248.61	248.85	244.81	245.27	245.61	245.53	245.93
	No. 8	53.900	32,447	244.603	243.073	245.333	239.691	247.59	247.99	248.23	248.42	248.68	244.26	244.71	245.21	245.03	245.69
	No. 7	54.500	31,742	246.207	242.102	245.707	239.221	247.52	247.90	248.13	248.32	248.56	243.86	244.32	244.77	244.65	245.18
	No. 6	55.650	30,668	245.989	241.226	245.764	238.505	247.32	247.71	247.94	248.12	248.35	243.07	243.60	244.01	243.87	244.39
	No. 5	56.800	29,673	245.932	240.767	247.553	237.842	246.79	247.18	247.42	247.57	247.78	242.27	242.90	243.26	242.94	243.59
	No. 4	57.500	28,754	244.455	239.598	244.571	237.229	244.73	245.25	245.42	245.58	245.79	241.76	242.47	242.78	242.62	243.06
	No. 3	58.200	28,011	241.190	239.042	244.246	236.733	244.02	244.57	244.87	245.13	245.40	241.17	242.04	242.42	242.02	242.78
	No. 2	58.900	27,331	244.681	238.311	244.702	236.280	243.73	244.22	244.49	244.78	245.06	240.47	241.58	241.84	241.50	242.18
	No. 1	59.600	26,354	244.286	238.242	244.437	235.629	242.71	242.99	243.14	243.29	243.47	240.10	241.19	241.37	241.37	241.65

TABLE F.4.1(3) WATER LEVEL FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chane	0.000	290.66	290.90	291.04	291.18	291.34	290.66	290.90	291.04	290.20	291.34
	0.900	289.67	289.92	290.07	290.20	290.37	289.67	289.92	290.07	289.22	290.37
	1.800	288.69	288.93	289.09	289.22	289.39	288.69	288.93	289.09	288.24	289.39
	2.700	287.69	287.95	288.10	288.24	288.41	287.69	287.95	288.10	287.26	288.41
	3.600	286.71	286.97	287.12	287.26	287.43	286.71	286.97	287.12	286.18	287.43
	4.500	285.65	285.90	286.05	286.18	286.35	285.65	285.90	286.05	284.96	286.35
	5.425	284.41	284.67	284.82	284.96	285.13	284.41	284.67	284.82	283.73	285.13
	6.350	283.15	283.42	283.59	283.73	283.91	283.15	283.42	283.59	282.50	283.91
	7.275	281.96	282.23	282.38	282.50	282.65	281.96	282.23	282.38	280.76	282.65
	8.200	280.46	280.60	280.68	280.76	280.84	280.46	280.60	280.68	279.08	280.84
	9.133	278.76	278.92	279.01	279.08	279.18	278.77	278.91	279.00	277.50	279.18
	10.067	277.19	277.34	277.42	277.50	277.59	277.19	277.34	277.43	275.53	277.59
	11.000	275.33	275.46	275.53	275.59	275.68	275.29	275.37	275.48	273.42	275.54
	12.000	272.55	272.69	272.76	272.83	272.91	271.29	271.67	271.90	270.25	272.23
	12.800	270.61	270.75	270.83	270.90	270.99	269.63	270.01	270.12	268.73	270.41
	13.600	268.90	269.06	269.15	269.24	269.34	268.02	268.48	268.63	267.32	268.81
	14.433	267.66	267.83	267.94	268.02	268.13	266.43	266.87	267.10	265.63	267.47
	15.267	266.51	266.66	266.75	266.82	266.91	264.82	265.22	265.44	264.22	265.88
	16.100	265.19	265.50	265.68	265.85	266.05	263.02	263.41	263.93	263.38	264.52
	16.200	265.06	265.36	265.54	265.69	265.88	262.62	262.98	263.19	262.96	263.62
	16.300	264.88	265.00	265.08	265.17	265.28	262.24	262.57	262.75	261.73	263.17
	17.133	263.37	263.51	263.59	263.69	263.82	261.17	261.47	261.60	260.80	261.92
	17.967	261.88	262.10	262.19	262.28	262.41	260.14	260.48	260.64	259.74	261.01
	18.800	260.18	260.49	260.62	260.72	260.81	259.02	259.36	259.56	258.74	259.93
	19.500	258.80	258.89	258.91	258.92	258.95	259.10	258.41	258.58	257.47	258.91
	20.200	257.51	257.63	257.68	257.73	257.82	257.19	257.29	257.37	256.64	257.55
	20.900	256.76	256.93	257.02	257.12	257.25	256.28	256.38	256.41	255.61	256.74
	21.700	255.84	256.00	256.09	256.20	256.34	255.24	255.52	255.57	254.75	255.85
	22.500	254.95	255.14	255.24	255.35	255.50	254.18	254.54	254.67	253.60	254.96
	23.300	253.83	254.05	254.17	254.27	254.39	253.05	253.31	253.46	252.34	253.79
	24.133	252.06	252.32	252.43	252.55	252.67	251.76	252.02	252.19	251.25	252.56
	24.967	251.16	251.43	251.54	251.65	251.83	250.56	250.89	251.09	250.09	251.46
	25.800	250.50	250.75	250.88	251.00	251.16	249.40	249.73	249.93	249.00	250.36
	26.600	249.25	249.63	249.78	249.90	250.06	248.30	248.64	248.84	247.88	249.25
	27.400	248.08	248.60	248.75	248.89	249.05	247.19	247.52	247.72	246.60	248.12
	28.200	246.56	247.34	247.59	247.79	247.93	245.94	246.26	246.45	245.05	246.83
	29.067	244.50	245.33	245.71	246.07	246.46	244.40	244.71	244.94	244.39	245.29
	29.933	243.59	244.06	244.43	244.66	244.93	243.09	243.76	244.17	244.29	244.64
	30.800	243.55	244.01	244.34	244.54	244.73	242.97	243.65	244.08	244.29	244.54
	30.800	243.55	244.01	244.34	244.54	244.73	242.97	243.65	244.08	243.06	244.54
	31.600	243.12	243.43	243.59	243.77	243.97	241.75	242.52	242.85	242.16	243.48
	32.400	242.81	243.08	243.22	243.37	243.54	240.82	241.73	241.98	241.59	242.44
	33.200	242.72	243.00	243.14	243.29	243.47	240.28	241.30	241.47	241.37	241.78
	34.000	242.71	242.99	243.14	243.29	243.47	240.03	241.10	241.25	276.92	241.51

River	Chainage in HD Model (km)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Meco	0.000	276.82	277.14	277.32	277.49	277.69	276.82	277.14	277.32	277.29	277.69
	1.000	276.64	276.95	277.13	277.29	277.48	276.64	276.95	277.13	276.92	277.48
	2.000	276.21	276.52	276.72	276.92	277.16	276.21	276.52	276.72	276.92	277.16
	2.000	276.21	276.52	276.72	276.92	277.16	276.21	276.52	276.72	275.50	277.16
	2.200	275.50	275.50	275.50	275.50	275.50	275.50	275.50	275.50	275.50	275.50
Chico II	0.000	257.17	257.46	257.62	257.75	257.92	256.54	256.91	257.05	256.54	257.15
	0.750	256.55	256.83	257.02	257.17	257.37	255.99	256.31	256.44	255.92	256.57
	1.500	256.13	256.46	256.66	256.85	257.07	255.51	255.76	255.86	255.50	256.11
	2.300	256.10	256.43	256.63	256.83	257.04	255.01	255.37	255.50	255.35	255.96
	2.400	256.08	256.37	256.57	256.74	256.96	254.88	255.25	255.37	255.13	255.92
	2.450	256.11	256.51	256.77	256.96	257.20	254.76	255.10	255.14	254.65	255.74
	3.000	256.10	256.49	256.74	256.94	257.18	254.06	254.38	254.52	267.45	255.74
Toro	0.000	267.27	267.33	267.39	267.45	267.55	267.30	267.34	267.39	266.76	267.78
	0.400	266.54	266.65	266.72	266.80	266.94	266.60	266.60	267.88	266.57	267.01
	0.500	266.51	266.46	266.50	266.56	266.68	266.58	266.57	267.84	266.53	266.61
	0.600	266.30	266.37	266.41	266.53	266.69	266.30	266.37	267.34	265.29	266.60
	1.533	264.39	264.52	264.67	265.30	265.45	264.39	264.51	265.51	263.49	265.40
	2.467	262.67	263.30	263.43	263.50	263.66	262.67	263.30	263.64	261.28	263.59
	3.400	260.97	261.16	261.25	261.29	261.40	260.97	261.16	261.38	258.91	261.44
	4.000	258.37	258.85	258.89	258.90	258.94	258.31	258.85	258.94	257.04	259.25
	4.600	256.68	257.01	257.03	257.04	257.08	256.17	256.74	257.01	257.04	257.12
	4.600	256.68	257.01	257.03	257.04	257.08	256.17	256.74	257.01		257.12
	5.400	253.50	253.60	253.82	253.85	253.90	251.75	252.20	252.50	252.68	252.97
	6.200	250.84	250.99	251.11	251.21	251.48	249.05	249.52	249.83	249.98	250.22
	7.200	249.15	249.39	249.58	249.75	250.11	248.28	248.66	248.93	248.99	249.03
	8.200	248.62	248.92	249.11	249.22	249.42	247.57	247.74	247.95	248.10	248.36
	9.200	248.42	248.66	248.82	248.91	249.07	246.49	247.04	247.38	247.66	247.96
	10.200	248.29	248.49	248.62	248.72	248.86	246.20	246.73	247.11	247.38	247.67
	11.200	248.17	248.33	248.43	248.51	248.62	245.93	246.48	246.86	247.13	247.46
	12.160	247.34	247.50	247.60	247.69	247.80	245.30	245.85	246.24	246.50	246.81
	13.120	246.48	246.67	246.77	246.86	246.97	244.67	245.24	245.64	245.89	246.17
	14.080	245.48	245.85	245.95	246.04	246.15	244.07	244.66	245.06	245.29	245.53
	15.040	244.39	244.98	245.13	245.20	245.31	243.49	244.12	244.53	244.73	244.93
	16.000	243.55	244.01	244.34	244.54	244.73	242.97	243.65	244.08	244.29	244.54
QDA. Maras	0.000	272.70	272.81	272.86	272.90	272.97	272.74	272.82	272.88	272.93	273.00
	0.400	271.94	272.25	272.39	272.49	272.60	271.94	272.25	272.40	272.51	272.62
	0.500	271.83	272.07	272.18	272.27	272.35	271.84	272.08	272.18	272.27	272.35
	0.700	271.48	271.70	271.78	271.86	271.96	271.49	271.71	271.78	271.86	271.95
	1.475	269.98	270.17	270.24	270.29	270.34	270.02	270.21	270.27	270.32	270.37
	2.250	268.57	268.73	268.81	268.86	268.90	268.63	268.79	268.84	268.87	268.92
	3.025	267.39	267.49	267.52	267.55	267.59	267.44	267.50	267.55	267.58	267.63
	3.800	265.90	265.98	266.13	266.16	266.20	265.90	265.86	266.04	266.14	266.17
	4.400	264.16	264.46	264.53	264.56	264.58	262.88	262.93	262.95	262.98	263.01
	5.000	262.75	263.01	263.02	263.03	263.05	259.66	259.74	259.78	259.84	259.92
	6.650	257.07	257.31	257.38	257.45	257.50	257.07	257.47	257.72	257.87	258.09
	7.300	256.68	257.01	257.03	257.04	257.08	256.17	256.74	257.01	257.04	257.12

TABLE F.4.1(4) WATER LEVEL FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chacras	0.000	276.54	276.73	276.84	276.93	277.02	276.59	276.81	276.94	277.04	277.13
	0.400	275.85	276.06	276.18	276.30	276.45	275.89	276.11	276.24	276.33	276.45
	0.500	275.66	275.86	276.00	276.15	276.33	275.74	275.94	276.08	276.19	276.32
	0.700	275.18	275.29	275.36	275.44	275.53	275.17	275.28	275.36	275.44	275.53
	1.633	272.75	272.91	273.01	273.12	273.24	272.74	272.90	273.01	273.12	273.24
	2.567	271.59	271.71	271.78	271.86	271.94	271.58	271.70	271.78	271.85	271.94
	3.500	270.48	270.59	270.65	270.71	270.78	270.47	270.58	270.65	270.71	270.79
	4.429	269.20	269.33	269.42	269.51	269.60	269.19	269.32	269.41	269.50	269.60
	5.357	267.92	268.08	268.17	268.28	268.39	267.91	268.06	268.17	268.28	268.40
	6.286	266.65	266.83	266.94	267.06	267.20	266.64	266.82	266.94	267.06	267.20
	7.214	265.40	265.61	265.74	265.87	266.02	265.39	265.60	265.73	265.87	266.02
	8.143	264.19	264.42	264.56	264.71	264.87	264.17	264.41	264.56	264.70	264.87
	9.071	263.01	263.28	263.43	263.59	263.78	262.99	263.26	263.43	263.59	263.78
	10.000	261.96	262.25	262.41	262.56	262.72	261.95	262.23	262.40	262.56	262.72
	10.833	261.11	261.36	261.51	261.64	261.79	261.10	261.35	261.50	261.64	261.79
	11.667	260.70	260.90	261.02	261.13	261.28	260.69	260.89	261.01	261.13	261.27
	12.500	260.43	260.60	260.71	260.81	260.93	260.43	260.59	260.70	260.80	260.93
	13.375	259.26	259.44	259.54	259.65	259.78	259.25	259.43	259.54	259.65	259.78
	14.250	258.08	258.27	258.39	258.51	258.64	258.07	258.26	258.39	258.50	258.64
	15.125	256.96	257.16	257.28	257.39	257.53	256.95	257.15	257.27	257.39	257.53
	16.000	255.73	255.92	256.03	256.13	256.26	255.72	255.91	256.02	256.13	256.26
	17.000	253.92	254.10	254.21	254.32	254.45	253.90	254.09	254.20	254.31	254.45

River	Chainage in HD Model (km)	Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chacras	18.000	252.21	252.42	252.53	252.63	252.76	252.23	252.41	252.52	252.63	252.76
	19.000	250.11	250.37	250.45	250.53	250.63	250.24	250.36	250.44	250.52	250.63
	19.833	248.03	248.24	248.37	248.49	248.64	248.00	248.22	248.36	248.49	248.64
	20.667	246.96	247.19	247.32	247.45	247.60	246.95	247.18	247.31	247.44	247.60
	21.500	245.49	245.70	245.83	245.96	246.11	245.48	245.69	245.83	245.95	246.11
	22.233	243.21	243.46	243.60	243.72	243.84	243.20	243.44	243.59	243.71	243.84
	22.967	241.43	241.68	241.83	241.97	242.15	241.42	241.67	241.82	241.96	242.15
	23.700	240.71	240.96	241.12	241.26	241.44	240.70	240.95	241.11	241.26	241.44
	24.650	239.97	240.23	240.38	240.53	240.71	239.96	240.21	240.37	240.52	240.71
	25.600	239.23	239.49	239.65	239.80	239.98	239.22	239.48	239.64	239.79	239.97
	26.550	238.52	238.76	238.89	239.03	239.19	238.51	238.74	238.88	239.02	239.18
	27.500	237.32	237.48	237.58	237.68	237.82	237.31	237.47	237.57	237.68	237.82
	28.500	235.17	235.44	235.59	235.74	235.93	235.16	235.42	235.58	235.73	235.93
	29.500	234.09	234.38	234.55	234.72	234.89	234.08	234.37	234.54	234.71	234.89
	30.500	232.82	233.12	233.30	233.47	233.64	232.81	233.10	233.28	233.46	233.64
	31.333	231.70	232.01	232.19	232.38	232.62	231.69	232.00	232.18	232.36	232.61
	32.167	231.10	231.42	231.60	231.78	232.01	231.09	231.41	231.59	231.77	232.01
	33.000	230.61	230.84	230.97	231.09	231.25	230.60	230.83	230.96	231.09	231.27
	33.875	229.30	229.55	229.72	229.89	230.11	229.36	229.64	229.83	230.00	230.21
	34.750	228.29	228.78	229.08	229.30	229.53	228.38	229.04	229.30	229.49	229.69
	35.625	228.16	228.72	228.99	229.19	229.40	228.11	228.92	229.20	229.39	229.58
	36.500	228.15	228.71	228.97	229.16	229.36	228.06	228.89	229.17	229.36	229.56

TABLE F.4.2(1) FLOW RATE FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Chane	0.500	521.45	787.41	964.32	1,129.48	1,347.67	436.25	654.43	807.81	954.97	1,153.70
	1.500	519.13	784.32	960.89	1,125.79	1,343.61	435.21	652.93	805.98	952.89	1,151.01
	2.500	518.19	783.26	959.74	1,124.61	1,342.36	434.88	652.48	805.44	952.30	1,150.25
	3.500	518.25	783.39	959.94	1,124.86	1,342.64	435.04	652.71	805.71	952.65	1,150.58
	4.500	518.57	783.90	960.59	1,125.68	1,343.52	435.33	653.10	806.27	953.27	1,151.23
	5.500	518.87	784.35	961.17	1,126.40	1,344.37	435.61	653.53	806.78	953.92	1,151.99
	6.500	519.15	784.79	961.75	1,127.11	1,345.14	435.89	653.97	807.27	954.60	1,152.70
	7.500	519.45	785.30	962.38	1,127.87	1,346.00	436.16	654.38	807.83	955.21	1,153.32
	8.417	519.74	785.69	962.83	1,128.38	1,346.53	436.41	654.72	808.28	955.75	1,153.94
	9.250	519.98	786.02	963.30	1,129.00	1,347.23	436.65	655.08	808.65	956.27	1,154.42
	10.083	520.20	786.44	963.80	1,129.58	1,347.86	436.88	655.43	809.11	956.74	1,155.00
	10.969	520.46	786.87	964.31	1,130.20	1,348.55	437.14	655.78	809.56	957.28	1,155.63
	11.906	520.76	787.30	964.83	1,130.93	1,349.43	437.33	656.13	810.01	957.88	1,156.25
	12.844	521.05	787.70	965.45	1,131.67	1,350.25	437.55	656.47	810.45	958.45	1,156.83
	13.781	521.34	788.17	966.04	1,132.37	1,351.00	437.85	656.85	810.88	959.01	1,157.43
	14.719	521.63	788.64	966.60	1,133.02	1,351.76	438.03	657.25	811.38	959.58	1,158.13
	15.656	521.90	789.09	967.12	1,133.72	1,352.61	438.45	657.67	811.92	960.19	1,158.83
	16.594	522.13	789.52	967.69	1,134.46	1,353.40	438.89	658.08	812.43	960.86	1,159.48
	17.531	522.43	789.92	968.29	1,135.16	1,354.12	438.67	658.47	812.92	961.49	1,160.17
	18.500	522.76	790.40	968.88	1,135.82	1,354.93	438.81	658.87	813.40	962.09	1,160.89
	19.500	523.06	790.90	969.43	1,136.56	1,355.80	439.89	659.29	813.94	962.67	1,161.56
	20.500	523.35	791.36	970.01	1,137.33	1,356.58	440.26	659.72	814.46	963.34	1,162.19
	21.500	523.63	791.80	970.65	1,138.05	1,357.33	439.72	660.10	814.94	963.95	1,162.88
	22.500	523.93	792.25	971.23	1,138.68	1,358.19	439.94	660.54	815.46	964.59	1,163.61
	23.500	524.07	792.63	971.76	1,139.37	1,358.89	439.94	660.51	815.48	964.73	1,163.76
	24.500	525.27	793.15	971.80	1,139.20	1,357.88	442.59	665.18	819.32	968.49	1,167.76
	25.438	347.76	476.37	569.35	662.79	793.09	408.11	559.28	676.15	768.75	878.71
	26.313	348.80	477.68	570.32	663.89	794.51	408.59	558.30	674.97	770.63	883.43
	27.188	348.74	479.02	573.44	667.44	798.51	408.58	557.22	673.39	768.94	890.01
	28.063	346.97	474.87	571.62	665.28	796.40	410.57	557.70	673.28	769.76	893.33
	28.850	425.77	594.57	728.65	860.64	1,045.63	508.19	606.29	677.46	749.61	823.99
	29.550	472.63	665.71	818.19	966.18	1,170.71	562.55	681.35	743.59	806.38	889.74
	30.250	518.92	736.10	907.01	1,070.91	1,294.99	620.63	757.68	829.49	901.79	994.50
	30.950	561.01	803.82	993.67	1,173.55	1,417.35	673.90	833.51	917.90	1,000.92	1,107.15
	31.800	576.13	832.27	1,031.76	1,219.15	1,472.19	690.75	863.14	954.85	1,044.11	1,159.55
	32.650	571.46	826.18	1,026.75	1,214.13	1,467.08	691.56	858.81	951.38	1,040.18	1,153.35
	33.350	563.73	818.38	1,021.35	1,209.29	1,461.88	688.29	855.68	946.32	1,035.32	1,146.65
	34.150	549.34	801.99	1,007.01	1,195.19	1,445.12	465.49	565.43	627.90	687.08	1,124.57
	35.050	435.06	614.38	735.59	853.36	1,008.77	458.89	539.46	590.32	650.36	756.02
	35.950	434.49	613.43	737.58	855.33	1,016.35	459.98	535.18	586.95	646.55	752.61
	36.450	435.79	617.76	741.98	864.81	1,028.77	460.57	535.54	587.25	646.82	752.83
	36.550	436.08	617.83	742.06	865.29	1,029.72	460.69	535.62	587.32	646.89	752.89
	36.850	437.56	630.47	779.31	922.05	1,101.40	461.03	535.83	587.50	647.06	753.01
	37.450	507.57	826.90	1,091.65	1,296.39	1,548.29	461.36	536.12	587.32	646.14	1,020.78

Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
	Existing cross section					Design cross section				
	2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
38.150	493.16	783.37	1,008.77	1,216.72	1,472.84	461.44	536.34	585.66	644.08	1,018.75
39.000	485.56	747.45	961.67	1,152.34	1,409.72	674.00	799.16	888.28	981.30	1,017.48
40.000	480.25	732.55	935.32	1,116.53	1,364.99	674.00	792.78	882.63	975.53	1,015.60
41.000	478.68	727.86	927.60	1,102.77	1,344.80	668.60	790.71	877.46	969.96	1,011.68
41.825	414.24	602.00	745.22	881.43	1,076.54	668.78	790.79	876.37	948.32	985.98
42.475	413.75	601.30	744.12	880.09	1,074.98	668.80	788.18	872.32	944.98	984.37
43.150	413.03	600.45	743.08	878.54	1,073.08	665.80	786.57	870.15	942.07	982.94
43.850	412.25	599.59	742.04	877.14	1,071.09	664.52	784.74	866.56	938.79	981.06
44.475	411.71	598.93	741.20	876.13	1,069.47	664.71	783.19	861.21	935.70	978.96
45.025	411.46	598.59	740.73	875.51	1,068.43	664.86	782.23	858.85	933.53	977.29
45.600	411.21	598.19	740.18	874.76	1,067.40	665.05	782.36	857.21	932.56	976.60
46.200	411.12	597.91	739.71	874.04	1,066.31	665.23	782.51	857.30	932.68	976.13
46.825	410.83	596.20	736.36	868.30	1,056.69	665.42	782.67	857.40	932.82	976.27
47.475	410.35	595.60	735.64	867.41	1,055.66	665.62	782.82	857.44	932.87	975.72
48.150	409.71	594.89	734.84	866.44	1,054.58	665.81	781.91	854.67	929.45	974.16
48.850	409.32	594.44	734.32	865.78	1,053.81	665.45	781.73	854.06	929.08	973.66
49.475	409.15	594.21	734.03	865.39	1,053.30	665.56	781.87	854.14	929.19	973.78
50.025	409.05	594.04	733.79	865.04	1,052.83	664.11	781.25	852.91	928.46	973.43
50.575	408.94	593.83	733.48	864.58	1,052.17	664.27	781.40	853.03	928.58	973.55
51.125	408.72	593.44	732.92	863.80	1,051.09	664.00	781.35	852.73	928.39	973.52
51.675	408.28	592.74	731.97	862.55	1,049.41	664.19	781.52	852.85	928.51	973.64
52.225	407.70	591.84	730.74	860.92	1,047.22	664.39	781.68	852.96	928.61	973.75
52.850	395.10	571.43	704.62	828.46	1,008.01	664.61	781.88	853.09	928.71	973.88
53.550	394.06	569.79	702.16	825.57	1,004.62	664.83	782.10	856.91	936.42	978.19
54.200	391.16	567.04	698.59	821.83	1,000.55	665.06	782.29	860.37	941.27	985.41
54.787	370.45	549.85	675.69	800.28	976.02	665.25	782.46	868.01	948.78	993.39
55.362	369.09	549.51	675.12	799.91	975.52	665.36	782.59	875.23	956.12	1,001.40
55.938	368.20	549.38	674.81	799.74	975.24	665.57	782.77	882.72	963.56	1,009.43
56.513	367.92	549.45	674.77	799.76	975.17	665.78	782.96	890.21	971.07	1,017.66
57.150	368.06	549.61	674.93	799.92	975.29	666.01	783.18	898.50	979.51	1,026.97
57.850	368.21	549.57	674.84	799.60	975.07	666.27	783.42	907.66	988.88	1,037.40
58.550	368.24	549.57	674.87	799.18	974.88	666.55	785.25	915.87	997.50	1,047.31
59.250	368.40	549.73	675.02	799.01	974.93	666.84	793.59	924.92	1,006.77	1,057.65
59.800	368.48	549.81	675.11	799.20	975.27	667.09	800.14	932.09	1,014.15	1,065.93
60.400	430.40	622.91	753.85	892.09	1,096.04	910.92	1,367.78	1,581.75	1,725.89	1,895.93
61.200	430.59	622.91	754.17	892.20	1,096.12	914.58	1,367.35	1,580.99	1,730.12	1,902.30
62.100	430.77	622.83	754.01	891.65	1,095.25	918.21	1,357.42	1,576.10	1,733.16	1,908.36
63.050	430.25	621.89	753.36	890.93	1,093.98	907.19	1,353.95	1,577.15	1,735.71	1,912.09
64.100	429.63	620.32	752.32	889.69	1,092.72	891.76	1,342.39	1,576.25	1,740.54	1,918.33
65.000	431.94	620.34	752.31	889.63	1,092.63	897.77	1,343.91	1,582.24	1,748.49	1,926.59
66.000	436.59	619.90	752.48	889.58	1,091.87	903.49	1,344.20	1,583.85	1,752.18	1,932.94
67.000	441.27	619.69	752.02	889.05	1,090.90	909.33	1,337.70	1,580.60	1,752.13	1,936.20
68.000	443.63	618.86	750.51	887.93	1,089.69	905.72	1,330.93	1,576.05	1,752.18	1,937.37
68.950	447.72	618.15	749.30	887.26	1,089.07	911.32	1,330.10	1,577.83	1,757.12	1,935.38

TABLE F.4.2(2) FLOW RATE FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Chane	69.450	448.29	617.70	748.28	886.73	1,088.54	908.13	1,329.54	1,578.06	1,758.77	1,938.44
	69.550	448.42	617.61	748.05	886.62	1,088.41	907.75	1,329.42	1,578.24	1,759.16	1,939.05
	70.050	449.61	617.38	747.18	886.21	1,088.01	906.88	1,329.01	1,579.57	1,761.19	1,942.46
	71.000	453.30	617.59	745.99	885.17	1,087.03	913.20	1,324.49	1,576.95	1,758.65	1,943.54
	72.000	457.21	617.80	746.20	885.39	1,086.52	919.79	1,334.66	1,586.21	1,761.46	1,942.79
	72.950	458.69	617.39	745.50	884.12	1,085.67	917.35	1,335.39	1,580.42	1,758.51	1,942.32
	73.850	460.28	617.12	745.31	883.81	1,085.42	919.67	1,337.97	1,583.82	1,758.57	1,943.92
	74.750	463.30	617.30	745.50	883.58	1,085.23	925.85	1,347.03	1,587.74	1,764.98	1,952.20
	75.525	465.90	618.52	745.66	883.74	1,085.29	931.05	1,354.72	1,596.39	1,774.39	1,962.70
	76.175	468.03	620.53	745.39	883.42	1,085.01	933.39	1,358.48	1,600.06	1,778.77	1,967.94
	76.800	468.09	622.23	745.17	883.07	1,084.72	930.08	1,359.08	1,601.80	1,782.00	1,972.45
	77.400	468.30	623.89	744.98	882.78	1,084.44	928.73	1,359.47	1,602.40	1,783.65	1,974.00
	77.975	468.81	625.53	744.82	882.52	1,084.21	928.41	1,361.62	1,603.82	1,784.14	1,975.05
	78.525	469.32	626.99	744.63	882.22	1,083.94	927.90	1,362.91	1,605.41	1,786.44	1,976.57
	79.075	470.29	628.63	744.49	881.92	1,083.69	931.80	1,367.12	1,608.32	1,790.53	1,978.08
	79.625	471.50	630.30	744.50	881.89	1,083.68	935.20	1,370.48	1,612.47	1,795.33	1,983.42
	79.950	472.18	644.63	891.25	881.88	1,083.67	937.49	1,370.81	1,614.32	1,797.95	1,986.44
	80.050	472.45	631.66	744.53	881.88	1,083.67	938.19	1,370.97	1,614.94	1,798.75	1,987.37
	80.550	473.49	633.28	744.53	881.86	1,083.67	941.68	1,372.85	1,618.12	1,802.97	1,992.11
	81.450	475.86	636.41	744.73	881.86	1,083.43	947.60	1,381.16	1,627.33	1,812.72	2,001.42
	82.350	477.43	640.44	744.58	881.04	1,082.91	939.58	1,380.83	1,631.12	1,818.19	2,008.26

Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
	Existing cross section					Design cross section				
	2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
83.300	478.53	643.62	746.50	880.86	1,082.85	928.38	1,378.77	1,634.14	1,823.24	2,013.87
84.300	479.38	646.31	747.59	880.66	1,082.51	928.35	1,374.92	1,634.52	1,825.79	2,016.92
85.200	573.62	797.49	950.97	1,101.94	1,269.91	1,172.91	1,690.38	1,972.46	2,178.29	2,405.27
86.000	571.77	793.57	944.59	1,092.00	1,264.53	1,161.16	1,682.78	1,967.13	2,173.23	2,398.86
86.775	570.60	791.05	941.24	1,086.32	1,261.63	1,152.04	1,678.71	1,963.96	2,168.83	2,392.52
87.525	570.72	790.83	940.27	1,084.65	1,260.60	1,151.12	1,678.00	1,963.17	2,166.21	2,387.90
87.950	570.90	791.02	940.55	1,085.05	1,261.13	1,151.34	1,678.28	1,963.39	2,153.14	2,351.85
88.050	570.95	791.07	940.63	1,085.16	1,261.28	1,151.43	1,678.38	1,963.49	2,153.23	2,351.94
88.500	571.13	791.25	940.90	1,085.56	1,261.86	1,151.67	1,678.73	1,963.66	2,153.43	2,352.08
89.300	571.12	791.03	940.59	1,085.20	1,261.92	1,151.51	1,676.22	1,961.33	2,152.15	2,351.02
90.100	570.87	790.40	939.74	1,084.09	1,261.20	1,148.94	1,670.46	1,956.60	2,149.52	2,348.97
90.917	570.43	789.48	938.68	1,082.72	1,260.09	1,144.52	1,664.20	1,951.93	2,147.06	2,347.14
91.750	570.12	788.89	938.14	1,082.10	1,259.56	1,141.24	1,659.58	1,948.50	2,145.32	2,345.86
92.583	570.14	788.69	938.03	1,081.95	1,259.59	1,139.30	1,656.77	1,946.38	2,144.33	2,345.15
93.500	570.34	788.77	938.21	1,082.21	1,260.00	1,138.47	1,655.43	1,945.48	2,143.95	2,344.92
94.500	570.66	789.09	938.61	1,082.74	1,260.73	1,138.60	1,655.39	1,945.53	2,144.21	2,345.21

TABLE F.4.2(3) FLOW RATE FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Pailon	0.500	93.39	135.51	168.01	202.61	250.91	93.39	135.51	168.01	202.61	250.91
	1.500	93.06	136.06	169.15	204.41	253.72	93.06	136.06	169.15	204.41	253.72
	2.500	92.92	136.73	170.40	206.37	256.59	92.92	136.73	170.40	206.37	256.59
	3.500	92.89	137.39	171.60	208.26	259.26	92.89	137.39	171.60	208.26	259.26
	4.500	92.72	137.74	172.45	209.75	261.34	92.72	137.74	172.45	209.75	261.34
	5.500	91.87	137.18	172.29	210.05	261.85	91.87	137.17	172.29	210.05	261.85
	6.500	63.73	90.51	111.40	133.77	167.06	63.73	90.50	111.40	133.77	167.06
	7.500	63.39	90.36	111.13	133.28	166.85	63.39	90.36	111.13	133.28	166.84
	8.500	63.27	90.32	110.95	133.10	166.84	63.27	90.32	110.95	133.10	166.84
	9.500	63.31	90.36	110.82	133.20	166.99	63.31	90.36	110.82	133.20	166.99
	10.433	63.33	90.30	110.48	133.45	167.22	63.33	90.29	110.48	133.45	167.22
	11.300	63.23	90.13	110.20	133.48	167.20	63.23	90.12	110.20	133.48	167.20
	12.167	63.36	90.24	110.30	133.54	167.32	63.36	90.24	110.30	133.54	167.32
	12.650	63.48	90.36	110.42	133.66	167.46	63.48	90.36	110.42	133.66	167.46
	12.750	63.50	90.38	110.44	133.68	167.49	63.50	90.38	110.44	133.68	167.49
	13.225	63.62	90.50	110.55	133.81	167.63	63.62	90.50	110.55	133.81	167.63
	14.075	71.69	97.60	114.07	134.02	167.87	71.69	97.60	114.07	134.02	167.87
	14.975	82.33	112.27	132.16	153.60	186.51	82.33	112.27	132.16	153.60	186.51
	15.925	93.39	127.19	150.65	174.56	210.06	93.37	127.18	150.65	174.56	210.15
	16.450	99.50	135.55	161.01	186.46	223.44	99.47	135.54	161.06	186.46	223.57
	16.550	100.67	137.16	163.01	188.73	226.00	100.65	137.15	163.06	188.73	226.13
	17.067	106.83	145.67	173.48	200.66	239.47	106.80	145.65	173.53	200.66	239.60
	18.000	117.88	160.77	191.65	221.38	263.01	117.86	160.80	191.25	221.59	263.47
	18.933	127.58	175.61	209.76	242.29	286.95	127.59	175.72	208.94	242.58	287.70
	19.850	137.99	190.38	228.05	263.25	311.04	138.02	190.57	226.89	263.79	312.07
	20.750	148.34	205.19	246.31	284.31	335.44	148.39	205.44	244.79	285.12	336.64
	21.250	154.16	213.51	256.56	296.20	349.21	154.20	213.80	254.88	297.15	350.60
	21.350	155.32	215.19	258.60	298.60	351.99	155.37	215.48	256.89	299.58	353.42
	21.833	160.89	222.92	267.58	309.15	364.40	161.04	223.57	266.46	311.01	366.74
	22.700	170.01	235.24	282.31	326.59	384.93	171.01	238.11	283.66	331.85	390.89
	23.567	175.70	243.74	291.35	334.79	395.37	180.58	252.40	300.56	351.73	412.26
QDA. Chane	0.450	239.16	334.32	397.60	457.91	536.23	239.16	334.32	397.60	457.91	536.23
	1.350	244.88	341.86	406.27	467.87	547.71	244.88	341.86	406.27	467.87	547.71
	2.250	249.36	348.79	414.83	478.14	560.10	249.36	348.79	414.83	478.14	560.10
	3.150	252.76	354.89	422.57	487.34	571.37	252.76	354.89	422.57	487.34	571.37
	4.050	255.39	360.05	429.62	496.22	582.60	255.39	360.05	429.62	496.22	582.60
	4.963	259.65	367.58	438.99	507.58	596.60	259.65	367.58	438.99	507.58	596.60
	5.887	262.29	376.10	450.37	521.57	613.73	262.29	376.10	450.37	521.57	613.73
	6.813	264.95	382.71	459.46	533.38	629.43	264.94	382.71	459.47	533.39	629.43
	7.738	264.45	386.83	466.37	542.49	641.31	264.43	386.80	466.35	542.47	641.29
	8.667	214.38	277.04	315.43	350.96	396.49	214.29	276.50	315.05	350.70	396.47
	9.600	217.64	281.48	320.99	357.67	404.84	218.65	280.95	320.57	357.41	404.67
	10.533	219.95	285.33	326.03	363.94	412.70	219.90	284.84	325.72	363.62	412.63
	11.500	222.88	289.43	331.25	370.33	420.76	220.22	287.93	335.78	378.67	421.57
	12.400	223.99	292.87	335.76	376.00	427.98	223.92	294.60	335.94	377.14	429.28
	13.200	225.55	296.00	339.73	380.90	434.11	225.52	299.41	341.18	383.86	435.19
	14.017	226.29	298.70	343.34	385.48	440.04	227.93	301.69	344.21	388.05	441.33
	14.850	226.79	300.97	346.50	389.60	445.50	229.69	305.63	348.55	389.53	445.28
	15.683	227.25	303.68	350.50	394.88	452.11	231.98	309.38	352.16	393.07	448.59
	16.150	225.70	343.20	727.65	818.38	766.56	233.13	444.03	354.71	396.02	452.24
	16.250	97.93	160.67	190.98	241.26	313.19	163.34	245.42	278.32	289.56	351.54
	16.717	95.88	141.11	172.23	207.84	261.27	159.30	208.10	237.38	265.99	307.31
	17.550	93.81	139.86	168.87	203.62	256.19	158.16	206.57	233.88	262.05	299.62
	18.383	91.09	139.05	168.48	203.35	255.20	158.29	203.95	231.76	258.91	295.93
	19.150	90.57	138.55	167.98	202.84	253.36	158.29	203.96	231.93	259.07	296.23
	19.850	90.62	138.66	168.07	202.93	253.40	158.39	203.88	232.05	259.15	296.38
	20.550	90.69	138.65	168.05	202.88	253.27	158.48	203.82	232.22	259.26	296.48
	21.300	89.18	138.20	167.80	202.61	252.83	158.50	204.47	231.89	257.97	295.36
	22.100	90.75	137.77	167.43	202.14	252.19	158.51	204.13	231.98	257.55	294.81
	22.900	88.85	137.31	166.94	201.62	251.58	158.48	204.04	231.95	256.97	294.62
	23.717	87.53	136.89	166.31	197.94	244.09	158.44	204.08	231.94	256.92	294.62

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chane	24.550	85.63	136.85	166.26	197.88	243.97	158.42	203.53	231.40	256.02	294.61
	25.383	85.05	136.70	166.05	197.65	243.66	158.08	202.88	230.92	255.45	294.49
	26.200	83.89	136.47	165.84	197.52	243.56	158.05	202.83	230.85	255.36	293.00
	27.000	81.44	136.10	165.26	197.35	243.37	156.30	201.01	229.58	253.52	292.22
	27.800	79.09	135.25	164.89	196.78	243.15	155.86	200.46	229.18	253.05	292.01
	28.633	79.07	134.80	164.23	195.06	241.69	155.85	200.46	229.16	253.00	291.99
	29.500	79.08	134.82	164.28	195.13	241.35	155.83	200.43	229.13	253.00	292.00
	30.367	79.11	134.91	164.46	195.22	241.96	155.84	200.44	229.68	252.99	292.03
	31.200	256.68	330.72	378.87	436.47	511.32	427.87	562.18	652.91	714.23	827.46
	32.000	254.65	329.40	377.81	435.81	510.67	427.92	562.12	652.85	714.19	825.72
	32.800	252.96	328.23	376.39	434.30	509.49	428.05	562.07	652.78	714.12	825.37
	33.600	250.52	327.32	374.94	432.57	508.12	428.33	561.99	652.66	714.00	824.23
QDA. Meco	0.500	82.15	115.75	137.75	159.07	185.66	82.15	115.75	137.75	159.07	185.66
	1.500	235.26	335.87	401.57	465.09	544.20	235.26	335.87	401.57	465.09	544.20
	2.100	4.27	5.12	5.60	6.03	6.53	4.27	5.12	5.60	6.03	6.53
Chico II	0.375	109.72	185.47	271.30	343.05	442.56	220.84	276.83	305.22	335.65	330.00
	1.125	108.80	184.31	270.24	341.95	444.64	220.61	276.51	304.08	334.91	327.93
	1.900	114.72	223.88	304.91	376.22	469.97	220.76	276.65	303.26	334.77	324.55
	2.350	124.74	672.77	634.87	1,055.46	1,365.65	220.06	274.79	302.43	335.68	319.93
	2.425	194.34	889.90	1,043.41	1,529.71	1,528.97	220.06	270.71	314.91	341.74	331.40
	2.725	163.21	565.31	765.701	894.63	1,088.35	220.01	271.03	314.94	341.76	331.71
QDA. Toro	0.200	199.57	279.41	332.39	382.86	446.54	200.87	279.43	332.44	383.03	574.56
	0.450	214.66	279.47	332.41	382.64	445.75	258.98	279.47	998.32	382.83	476.08
	0.550	199.57	279.60	332.56	382.79	445.89	216.85	279.60	3,019.77	382.98	664.55
	1.067	199.79	279.81	332.64	368.78	427.65	199.82	279.83	563.31	370.09	429.67
	2.000	201.52	281.89	334.00	364.38	429.06	201.54	281.91	446.20	362.62	428.66
	2.933	201.08	282.73	334.59	361.34	429.28	201.20	282.88	425.55	359.48	426.92
	3.700	201.96	283.34	335.79	361.53	430.39	202.07	283.33	418.28	359.68	426.97
	4.300	203.61	284.99	338.21	363.48	432.42	203.67	285.13	416.81	361.29	428.12
	5.000	308.12	413.60	494.97	528.43	601.40	308.89	413.05	486.42	536.12	616.61
	5.800	312.16	418.16	489.08	535.49	606.53	311.88	416.34	490.86	539.93	623.17
	6.700	316.18	422.47	491.06	540.49	600.09	316.33	421.24	497.48	548.89	633.04
	7.700	320.25	425.78	494.07	543.62	592.91	320.71	425.65	506.57	561.76	643.42
	8.700	318.41	424.03	493.28	545.47	592.85	327.25	429.61	508.95	561.10	643.79
	9.700	312.21	419.44	489.46	539.99	590.47	330.62	426.17	498.59	549.79	641.91
	10.700	308.08	416.27	486.66	537.83	588.74	331.41	428.27	501.14	553.71	645.75
	11.680	225.42	285.96	323.75	358.98	405.31	335.21	432.09	505.88	560.60	648.57
	12.640	226.38	286.14	324.35	359.16	405.27	338.90	435.82	510.48	567.31	651.23
	13.600	223.07	286.39	324.66	359.23	405.11	342.53	439.51	515.03	573.97	654.12
	14.560	221.11	283.91	324.98	359.28	404.90	346.07	443.12	519.46	580.04	657.35
	15.520	221.38	279.58	325.31	358.80	403.75	349.43	446.59	523.67	584.61	658.39
QDA. Maras	0.200	81.44	112.03	132.34	151.82	176.91	81.44	112.03	132.34	151.77	176.87
	0.450	81.41	110.04	129.32	148.23	173.16	81.41	110.81	129.37	148.35	173.31
	0.600	81.24	101.74	114.85	129.54	148.64	81.09	102.03	115.26	129.94	149.79
	1.087	83.06	103.63	117.01	131.94	151.13	82.90	103.99	117.42	132.44	152.64
	1.862	86.22	106.90	120.81	136.06	155.54	86.02	107.49	121.26	136.71	157.52
	2.628	89.67	110.36	124.71	140.39	160.40	89.44	111.08	125.44	141.19	162.72
	3.412	92.77	116.18	130.77	144.70	165.37	92.47	115.52	130.82	146.27	167.92
	4.700	98.85	133.21	143.83	164.86	188.21	96.25	124.98	139.43	160.10	178.96
	5.500	102.89	175.05	159.93	180.38	205.73	100.54	135.29	151.37	174.75	200.65
	6.325	111.27	151.86	172.77	196.12	240.73	105.77	145.43	163.47	187.38	217.96
	6.975	116.21	151.34	173.37	206.54	246.38	112.25	151.18	175.91	199.88	235.43

TABLE F.4.2(4) FLOW RATE FROM HD CALCULATION IN THE RIO CHANE-PAILON BASIN

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chacras	0.200	150.39	204.96	240.01	281.54	332.68	148.54	200.67	236.34	276.77	331.71
	0.450	142.22	190.61	221.84	258.60	300.83	137.45	184.71	220.15	257.56	302.79
	0.600	142.62	191.20	222.57	259.45	301.83	137.88	185.34	220.91	258.43	303.77
	1.167	144.20	193.65	225.54	262.91	305.95	139.55	187.95	223.87	261.89	307.59
	2.100	147.81	199.15	232.07	270.46	314.84	143.32	193.66	230.57	269.52	316.24
	3.033	151.41	204.07	238.08	277.53	323.14	147.09	198.78	236.68	276.71	324.43
	3.964	155.20	209.61	244.76	284.68	331.40	151.05	204.52	243.49	283.93	332.56
	4.893	158.97	215.18	251.45	292.34	340.36	154.98	210.22	250.20	291.61	341.38
	5.821	162.69	220.77	258.10	299.91	349.33	158.87	215.94	256.86	299.24	350.19
	6.750	166.48	226.31	264.71	307.44	358.16	162.77	221.64	263.35	306.74	358.77
	7.679	170.28	231.79	271.22	314.70	366.70	166.62	227.19	269.71	313.89	367.20
	8.607	174.00	237.12	277.54	321.69	374.96	170.43	232.57	275.80	320.77	375.15
	9.536	177.28	241.97	283.42	328.23	383.00	173.84	237.51	281.39	327.10	382.91
	10.417	179.65	246.33	289.30	334.98	391.39	176.46	241.95	287.04	333.68	391.19
	11.250	183.05	251.57	295.26	340.60	398.19	179.92	247.15	292.91	339.09	397.78
	12.083	186.88	257.11	301.95	348.31	407.34	183.70	252.69	299.57	346.73	406.91
	12.938	191.30	263.36	309.44	356.97	417.58	188.09	258.92	307.04	355.38	417.14
	13.813	195.65	269.36	316.60	365.20	427.26	192.37	264.87	314.15	363.56	426.81
	14.688	199.17	274.70	322.97	372.43	435.73	196.06	270.16	320.40	370.70	435.22
	15.563	201.76	278.97	328.24	378.38	442.88	198.64	274.41	325.51	376.59	442.18
	16.500	205.41	282.92	333.23	384.08	449.67	201.46	278.33	330.27	382.10	448.81
	17.500	208.78	287.92	339.39	391.31	458.22	204.97	283.31	336.31	389.11	457.35
	18.500	212.95	293.99	346.75	399.87	468.44	209.10	289.27	343.50	397.58	467.50

River	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
QDA. Chacras	19.417	217.34	300.23	354.24	408.64	478.86	213.38	295.38	350.90	406.25	477.90
	20.250	220.69	305.40	360.45	415.90	487.44	216.75	300.45	357.02	413.38	486.45
	21.083	221.55	309.32	365.35	421.62	494.28	218.32	304.31	361.75	418.95	493.12
	21.867	224.75	313.71	370.42	427.24	500.76	221.43	308.61	366.73	424.59	499.53
	22.600	227.57	317.52	374.72	432.74	507.12	224.24	312.39	370.94	429.87	505.83
	23.333	230.31	321.71	379.81	438.75	514.22	226.97	316.49	375.91	435.75	512.90
	24.175	233.89	326.95	386.07	446.12	523.03	230.48	321.59	382.07	443.06	521.59
	25.125	237.90	332.83	393.13	454.42	532.88	234.42	327.31	388.98	451.25	531.38
	26.075	241.91	338.70	400.20	462.73	542.66	238.34	333.04	395.84	459.37	541.17
	27.025	245.93	344.59	407.24	471.01	552.53	242.24	338.77	402.76	467.52	550.91
	28.000	250.07	350.68	414.56	479.62	562.77	246.30	344.69	409.91	476.00	561.07
	29.000	254.12	356.27	421.25	487.34	572.03	250.24	350.16	416.46	483.60	570.20
	30.000	254.77	359.43	425.43	492.10	579.14	251.43	353.43	420.50	488.05	577.16
	30.917	256.72	362.31	428.00	494.30	582.26	253.61	356.37	423.04	489.44	579.95
	31.750	256.30	364.49	431.30	497.53	586.38	253.53	358.68	426.27	492.67	583.74
	32.583	258.37	368.42	436.23	503.25	593.38	255.69	362.58	431.06	498.23	590.58
	33.438	261.14	372.89	441.73	509.70	601.23	258.47	366.93	436.41	504.49	598.24
	34.313	264.14	377.42	446.94	515.65	608.45	261.14	369.94	439.79	508.35	603.19
	35.188	265.10	378.57	446.95	516.01	609.65	259.16	365.37	433.36	502.26	597.73
	36.063	262.59	375.32	441.02	510.08	604.52	253.86	349.05	418.82	487.60	583.39

TABLE F.4.3 WATER LEVEL FROM HD CALCULATION IN THE OKINAWA DRAINAGE

Drainage	Section	Chainage in HD Model	Acc. Distance in Topo Survey (m)	Existing			Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
							Existing cross section					Design cross section				
				Left Bank	Riverbed	Right Bank	2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Okinawa	No. 24	0.000		252.000		252.000	252.470	252.810	252.840	252.990	253.190	251.930	252.220	252.400	252.580	252.810
	No. 23	5.200	21,652	251.590	247.540	251.555	252.110	252.240	252.390	252.480	252.610	251.620	251.850	251.990	252.110	252.260
	No. 22	6.300	20,550	250.970	249.410	251.212	251.890	252.000	252.130	252.210	252.320	251.430	251.620	251.730	251.830	251.950
	No. 21	7.000	19,839	250.972	249.472	251.072	251.730	251.700	251.880	251.940	252.020	251.110	251.300	251.380	251.440	251.510
	No. 20	8.400	18,429	250.316	249.161	250.381	251.570	251.530	251.720	251.770	251.850	250.540	250.810	250.930	251.020	251.120
	No. 19	9.300	17,570	250.744	249.214	250.744	251.470	251.430	251.610	251.660	251.740	250.330	250.610	250.740	250.840	250.930
	No. 18	10.100	16,711	250.348	249.762	250.468	251.300	251.270	251.450	251.510	251.580	250.150	250.440	250.570	250.670	250.760
	No. 17	11.100	15,740	250.595	248.775	251.155	251.010	250.990	251.160	251.220	251.290	249.920	250.210	250.330	250.430	250.530
	No. 16	12.000	14,807	250.425	248.483	251.281	250.650	250.640	250.800	250.860	250.970	249.720	250.000	250.120	250.210	250.310
	No. 15	13.200	13,639	249.579	248.524	250.679	250.300	250.400	250.520	250.620	250.740	249.430	249.710	249.840	249.930	250.040
	No. 14	14.000	12,846	249.609	248.219	250.149	250.050	250.220	250.350	250.460	250.600	249.230	249.490	249.620	249.710	249.810
	No. 13	15.300	11,538	248.720	247.015	248.810	249.810	250.020	250.170	250.290	250.430	248.920	249.230	249.360	249.460	249.570
	No. 12	15.900	10,968	248.711	247.081	248.916	249.760	249.970	250.110	250.230	250.370	248.750	249.080	249.230	249.340	249.460
	No. 11	16.600	10,229	248.858	246.661	249.228	249.660	249.860	250.010	250.130	250.260	248.550	248.860	249.010	249.130	249.260
	No. 10	18.300	8,540	248.719	245.914	248.789	249.170	249.350	249.470	249.580	249.700	248.050	248.330	248.450	248.550	248.650
	No. 9	19.100	7,714	248.008	245.758	248.198	248.690	248.870	248.990	249.100	249.230	247.790	248.040	248.160	248.250	248.350
	No. 8	20.600	6,267	247.001	245.201	247.289	247.830	248.070	248.220	248.340	248.480	247.270	247.500	247.610	247.700	247.810
	No. 7	21.400	5,415	246.597	244.667	246.797	247.580	247.810	247.950	248.070	248.200	246.960	247.180	247.300	247.400	247.510
	No. 6	22.400	4,433	246.567	245.247	246.807	247.260	247.460	247.570	247.670	247.770	246.410	246.580	246.680	246.770	246.890
	No. 5	23.600	3,222	245.379	244.069	245.559	246.130	246.140	246.270	246.340	246.440	245.870	245.970	246.060	246.190	246.370
	No. 4	24.100	2,728	245.250	243.930	245.430	246.000	246.010	246.130	246.210	246.330	245.760	245.870	245.970	246.110	246.290
	No. 3	25.600	1,280	245.097	244.917	245.077	245.500	245.629	245.799	245.954	246.124	245.410	245.576	245.739	245.916	246.109
	No. 2	26.500	302	244.929	243.077	244.869	245.290	245.450	245.640	245.830	246.020	245.230	245.430	245.620	245.820	246.020
	No. 1	26.800	0	244.414	242.944	244.704	245.200	245.400	245.600	245.800	246.000	245.200	245.400	245.600	245.800	246.000

TABLE F.4.4 FLOW RATE FROM HD CALCULATION IN THE OKINAWA DRAINAGE BASIN

Drainage	Chainage in HD Model (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Okinawa	1.000	32.830	41.586	75.128	79.205	84.509	14.995	22.601	28.128	33.782	41.554
	5.750	86.411	120.018	142.273	157.012	179.223	73.016	96.998	116.933	137.309	164.512
	6.650	97.692	137.304	163.922	181.646	208.703	86.237	114.875	138.528	162.822	195.120
	7.700	42.335	50.796	63.899	68.999	75.929	89.761	100.427	109.233	116.103	124.601
	8.850	43.161	51.970	63.918	69.009	76.087	95.472	108.325	116.174	123.302	132.527
	9.700	44.148	54.228	64.144	71.842	82.341	99.467	112.459	121.547	128.775	138.969
	10.600	36.800	44.675	59.544	64.654	71.774	103.936	118.544	128.237	135.747	144.214
	11.550	36.958	44.834	59.700	64.808	71.924	108.893	124.447	133.513	140.569	148.647
	12.600	37.133	45.010	59.875	64.984	72.099	114.543	131.765	140.726	147.466	154.936
	13.600	37.537	48.660	60.039	66.126	75.288	119.881	138.356	148.318	155.873	164.113
	14.650	41.743	54.236	65.248	74.385	85.388	125.657	146.045	156.713	165.131	174.722
	15.600	44.421	59.236	71.406	81.886	94.636	129.874	150.781	162.721	172.239	183.400
	16.250	46.556	62.787	75.821	87.208	101.114	133.280	154.790	167.108	177.244	189.385
	17.450	50.850	69.691	84.406	97.494	113.551	139.487	162.579	175.887	187.026	200.701
	18.700	55.385	77.095	93.567	108.465	126.844	146.126	170.895	185.500	198.066	213.809
	19.850	59.368	83.413	101.219	117.578	137.889	152.343	178.826	194.153	207.274	224.517
	21.000	61.410	88.152	107.600	125.503	147.823	156.995	184.956	201.431	215.803	235.035
	21.900	63.135	91.950	112.657	131.765	155.645	160.433	190.053	207.197	222.462	243.256
	23.000	65.611	96.839	119.013	139.568	165.301	165.787	197.116	214.868	230.805	253.169
	23.850	36.891	44.635	56.643	62.231	69.931	107.945	117.026	119.561	125.492	141.090
	25.300	36.889	44.634	56.639	62.229	69.930	107.646	117.031	119.613	125.581	141.187
	26.650	36.888	44.634	56.639	62.229	69.930	107.645	117.031	119.614	125.582	141.188

TABLE F.4.5(1) WATER LEVEL FROM HD CALCULATION IN THE ARROYO YAPACANICITO,JOCHI AND TACUARAL

Arroyo	Section	Chainage in F/S (km)	Existing Elevation (m)			Maximum water level from probable floods (m) for existing and design cross sections									
						2 Year		5 Year		10 Year		20 Year		50 Year	
			Left	Bed	Right	Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Yapacanicito		0.000	283.02	278.61	282.56	282.95	282.95	283.37	283.37	283.60	283.60	283.79	283.79	284.02	284.02
		1.500	281.52	277.11	281.06	281.28	281.28	281.72	281.72	281.96	281.96	282.16	282.16	282.40	282.40
		3.600	279.42	275.01	278.96	278.97	278.97	279.39	279.39	279.63	279.63	279.85	279.85	280.09	280.09
		6.100	276.92	272.51	276.46	276.18	276.18	276.57	276.57	276.82	276.82	277.05	277.05	277.33	277.33
		8.600	274.42	270.01	273.96	274.37	274.37	274.48	274.48	274.54	274.54	274.61	274.61	274.69	274.69
		12.200	270.82	266.41	270.36	270.05	270.05	270.26	270.26	270.37	270.37	270.48	270.48	270.62	270.62
Improvement	No. 1	14.300	268.22	262.21	268.26	267.56	267.26	267.75	267.42	267.84	267.50	267.93	267.58	268.04	267.68
	No. 2	14.320	268.22	262.21	268.26	267.44	267.11	267.61	267.28	267.70	267.42	267.78	267.51	267.87	267.60
	No. 3	15.400	265.11	261.94	266.74	266.35	265.16	266.47	265.30	266.53	265.37	266.58	265.43	266.65	265.51
	No. 4	16.400	265.08	261.69	266.60	264.86	264.05	265.00	264.24	265.09	264.34	265.19	264.40	265.38	264.48
	No. 5	17.100	262.85	260.39	264.41	262.67	262.51	262.71	262.57	262.74	262.65	262.80	262.73	262.84	262.80
	No. 6	19.000	259.72	256.00	259.85	259.56	259.61	259.60	259.67	259.63	259.84	259.67	260.07	259.70	260.15
	No. 7	20.000	257.77	255.32	259.68	257.60	257.64	257.65	257.72	257.68	257.87	257.72	258.05	257.75	258.16
	No. 8	20.400	254.71	252.78	256.60	255.79	255.96	255.89	256.11	255.94	256.19	255.99	256.25	256.05	256.32
	No. 9	22.200	257.80	254.88	256.35	256.30	255.63	256.38	255.78	256.45	255.94	256.51	256.01	256.53	256.17
	No. 10	23.100	255.55	254.24	257.95	255.52	255.33	255.58	255.45	255.74	255.61	255.81	255.69	255.83	255.77
	No. 11	24.100	257.34	253.56	255.07	255.59	255.44	255.69	255.56	255.75	255.66	255.81	255.71	255.88	255.80
	No. 12	25.300	254.49	253.39	256.75	255.50	255.31	255.60	255.46	255.65	255.54	255.81	255.71	256.02	255.93
	No. 13	26.200	253.98	252.91	256.31	254.40	254.22	254.73	254.58	254.95	254.83	255.16	255.04	255.40	255.30
	No. 14	27.000	253.70	252.04	255.56	254.40	254.20	254.80	254.64	255.04	254.90	255.26	255.13	255.52	255.40
	No. 15	28.100	255.88	252.31	253.64	253.51	253.32	253.93	253.77	254.17	254.04	254.40	254.27	254.66	254.54
	No. 16	29.100	255.18	251.65	253.17	253.29	253.12	253.72	253.57	253.97	253.85	254.19	254.08	254.45	254.35
	No. 17	30.100	254.60	251.36	252.38	252.56	252.37	252.97	252.82	253.22	253.09	253.44	253.32	253.69	253.58
	No. 18	31.100	253.05	250.49	254.33	252.73	252.54	253.04	252.89	253.22	253.09	253.38	253.26	253.57	253.46
	No. 19	31.700	251.56	250.64	253.98	252.14	251.95	252.29	252.14	252.39	252.26	252.47	252.35	252.58	252.47
		36.700	248.30	245.51	249.60	246.04	247.61	246.25	248.07	246.35	248.34	246.43	248.59	246.55	248.88
		41.700	245.06	242.27	246.36	243.67	245.20	243.89	245.64	244.00	245.90	244.09	246.14	244.21	246.41
		46.700	241.82	239.03	243.12	239.62	240.94	239.82	241.35	239.92	241.59	240.02	241.82	240.13	242.10
		51.700	238.58	235.79	239.88	239.98	240.13	240.41	240.59	240.67	240.88	240.92	241.14	241.21	241.47
		53.100	237.67	234.88	238.97	238.90	239.08	239.34	239.53	239.60	239.81	239.84	240.05	240.12	240.37
		58.100	234.43	231.64	235.73	239.35	239.67	239.82	240.16	240.09	240.42	240.32	240.62	240.56	240.81
		62.300	230.30	227.75	231.42	232.30	232.30	232.30	232.30	232.30	232.30	232.30	232.30	232.30	232.30

TABLE F.4.5(2) WATER LEVEL FROM HD CALCULATION IN THE ARROYO YAPACANICITO,JOCHI AND TACUARAL

Arroyo	Section	Chainage in F/S (km)	Existing Elevation (m)			Maximum water level from probable floods (m) for existing and design cross sections									
						2 Year		5 Year		10 Year		20 Year		50 Year	
			Left	Bed	Right	Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Jochi		0.000	288.23	283.88	288.13	288.82	288.82	289.10	289.10	289.27	289.27	289.43	289.43	289.62	289.62
		3.000	284.23	279.88	284.39	284.69	284.69	285.16	285.16	285.43	285.43	285.65	285.65	285.90	285.90
		6.000	280.23	275.88	280.39	281.05	281.05	281.24	281.24	281.36	281.36	281.47	281.47	281.62	281.62
		9.520	275.49	271.88	275.11	276.47	276.47	276.68	276.68	276.81	276.81	276.92	276.92	277.06	277.06
		12.800	268.75	265.91	268.88	269.01	268.86	269.05	268.92	269.07	268.96	269.08	269.00	269.10	269.03
	No. 1	13.800	266.62	264.83	266.32	267.63	266.35	267.69	266.45	267.72	266.51	267.75	266.56	267.78	266.63
	No. 2	15.000	265.08	262.11	265.08	265.11	264.71	265.20	264.85	265.26	264.93	265.28	264.99	266.47	265.07
		15.010	265.08	261.03	265.08	265.27	264.88	265.43	264.83	265.42	264.90	265.42	264.96	266.09	265.82
		15.020	265.08	262.11	265.08	265.08	264.66	265.17	264.80	265.22	264.88	265.25	264.94	265.71	265.03
	No. 3	16.000	264.07	261.03	264.83	264.89	263.74	264.99	263.83	265.03	263.87	265.07	263.92	265.09	263.98
	No. 4	17.200	262.92	260.08	263.44	263.35	261.79	263.48	261.87	263.53	261.92	263.57	261.95	263.60	262.01
	No. 5	18.300	262.62	258.66	262.34	261.86	260.33	261.98	260.42	262.05	260.46	262.10	260.50	262.13	260.56
	No. 6	19.000	261.55	257.75	261.04	260.95	259.44	261.08	259.53	261.14	259.58	261.19	259.62	261.23	259.68
	No. 7	20.000	260.78	256.80	260.60	260.70	259.42	260.84	259.51	260.92	259.56	260.97	259.60	261.00	259.67
	No. 8	20.900	260.06	255.13	260.80	259.96	258.63	260.11	258.73	260.19	258.78	260.24	258.82	260.28	258.88
	No. 9	21.900	258.95	253.66	259.34	259.07	257.73	259.19	257.82	259.25	257.86	259.30	257.90	259.33	257.96
	No. 10	22.700	258.43	253.73	259.09	258.31	256.76	258.41	256.84	258.47	256.89	258.51	256.92	258.54	256.98
		22.710	258.91	253.73	259.09	258.44	256.96	258.76	257.16	259.08	257.42	259.15	257.24	259.42	257.56
		22.720	258.91	253.73	259.09	258.20	256.68	258.31	256.77	258.36	256.81	258.41	256.85	258.44	256.90
	No. 11	23.700	256.00	252.22	255.93	256.80	255.14	256.93	255.21	257.00	255.25	257.05	255.28	257.10	255.33
	No. 12	24.900	254.19	250.38	254.33	254.59	252.69	254.66	253.13	254.71	253.28	254.75	253.34	254.80	253.40
	No. 13	25.600	253.61	248.89	253.62	252.81	252.51	252.92	252.50	252.97	252.66	253.00	252.73	252.96	252.80
		29.700	251.36	244.03	251.06	246.75	245.98	246.07	246.22	246.27	246.40	246.47	246.57	246.69	246.77
		29.800	246.46	243.46	246.46	245.71	245.92	246.02	246.17	246.20	246.35	246.38	246.50	246.60	246.74
		35.800	245.50	242.34	243.55	243.72	243.74	243.82	243.85	243.88	243.92	243.93	244.00	243.96	244.16
		43.400	242.93	241.05	242.68	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00
Tacuaral		0.000	279.21	275.44	279.05	279.48	279.48	279.60	279.60	279.66	279.66	279.72	279.72	279.79	279.79
		3.000	275.73	271.96	275.57	276.14	276.14	276.31	276.31	276.41	276.41	276.49	276.49	276.59	276.59
		6.000	272.26	268.49	272.10	272.47	272.47	272.56	272.55	272.60	272.60	272.64	272.64	272.68	272.68
		9.000	268.78	265.01	268.62	269.06	269.06	269.16	269.18	269.21	269.25	269.25	269.28	269.32	269.35
		12.000	265.31	261.54	265.15	265.47	265.45	265.55	265.51	265.60	265.55	265.63	265.59	265.66	265.63
	No. 1	16.800	260.35	255.88	260.49	260.58	259.92	260.72	260.34	260.74	260.41	260.76	260.42	260.77	260.59
		16.810	260.35	255.88	260.49	260.63	259.98	264.18	263.80	260.79	260.46	265.84	265.50	267.63	267.45
		16.820	260.35	255.88	260.49	260.69	260.04	260.84	260.47	260.83	260.50	260.88	260.54	260.87	260.69
	No. 2	17.600	259.88	256.32	260.04	260.00	259.35	260.14	259.77	260.16	259.83	260.18	259.83	260.19	260.01
	No. 3	18.500	259.00	255.13	259.06	258.87	258.21	259.03	258.65	259.06	258.72	259.10	258.76	259.12	258.94
	No. 4	19.100	258.31	253.62	258.12	258.27	257.62	258.46	258.10	258.51	258.19	258.55	258.21	258.59	258.41
		19.110	257.62	253.62	258.12	258.51	257.85	258.45	258.05	258.77	258.42	258.95	258.61	259.32	259.14
		19.120	257.62	253.62	258.12	258.24	257.59	258.43	258.10	258.48	258.19	258.52	258.18	258.56	258.38
	No. 5	20.000	257.28	254.28	257.33	257.50	256.84	257.69	257.23	257.74	257.33	257.77	257.43	257.80	257.63
	No. 6	21.200	256.12	252.98	255.86	256.14	255.52	256.31	256.11	256.35	256.18	256.38	256.04	256.41	256.22
	No. 7	22.100	254.58	252.43	254.50	254.49	253.78	254.60	253.87	254.63	253.98	254.65	254.30	254.67	254.51
	No. 8	22.600	254.36	249.03	254.37	252.36	251.82	252.50	251.89	252.54	251.94	252.56	252.24	252.58	252.37
		27.500	245.41	240.19	245.22	245.77	246.00	246.08	246.25	246.26	246.43	246.43	246.58	246.61	246.80
		27.600	245.41	240.19	245.22	245.74	245.98	246.06	246.22	246.26	246.40	246.47	246.56	246.69	246.77
		32.100	243.30	239.30	243.50	244.40	244.44	244.64	244.69	244.76	244.84	244.87	244.95	244.84	245.07
		37.900	241.90	238.90	242.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00	243.00

TABLE F.4.6(1) FLOW RATE FROM HD CALCULATION IN THE ARROYO YAPACANICITO,JOCHI AND TACUARAL

Arroyo	Chainage in F/S (km)	Maximumflow rate from probable floods (m^3/s) for existing and design cross sections									
		2 Year		5 Year		10 Year		20 Year		50 Year	
		Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Yapacanicito	0.750	138.59	138.59	191.55	191.55	225.63	225.63	258.77	258.77	299.75	299.75
	2.550	118.15	118.15	165.30	165.30	198.72	198.72	231.63	231.63	273.67	273.67
	4.850	101.18	101.18	138.92	138.92	167.74	167.74	197.73	197.73	236.37	236.37
	7.350	93.27	93.27	122.53	122.53	144.40	144.40	167.52	167.52	200.75	200.75
	8.610	52.63	52.63	60.02	60.02	65.10	65.10	72.95	72.95	83.13	83.13
	12.210	48.00	48.00	53.67	53.67	56.81	56.81	59.88	59.88	63.74	63.74
Improvement	14.310	48.00	47.99	53.67	53.66	56.80	56.80	59.88	59.88	63.73	63.73
	14.860	48.00	47.99	53.67	53.66	56.80	56.80	59.88	59.88	63.73	63.73
	15.900	48.00	47.98	53.67	53.66	56.80	56.80	59.88	59.87	63.72	63.73
	16.750	47.99	47.97	53.67	53.66	56.80	56.79	59.87	59.86	63.69	63.70
	18.010	47.99	47.96	53.67	53.65	56.80	56.75	59.87	59.61	63.64	63.42
	18.550	47.99	47.96	53.66	53.65	56.79	56.75	59.87	59.61	63.64	63.42
	19.300	47.98	47.96	53.66	53.65	56.79	56.75	59.87	59.61	63.64	63.42
	20.200	47.92	47.96	53.60	53.66	56.74	56.74	59.82	59.61	63.59	63.42
	21.300	47.26	47.97	53.05	53.67	56.23	56.73	59.33	59.59	63.15	63.39
	22.650	39.58	48.02	44.34	53.70	47.08	56.74	49.83	59.59	53.30	63.39
	23.600	39.48	48.25	44.27	53.74	47.02	56.77	49.78	59.60	53.26	63.39
	24.700	39.37	48.93	44.20	54.01	46.97	56.85	49.73	59.62	53.19	63.39
	25.750	39.28	50.54	44.15	54.83	46.92	57.16	49.69	59.66	53.10	63.40
	26.600	39.23	54.04	44.10	57.20	46.89	59.04	49.66	61.31	53.02	64.32
	27.550	39.23	57.40	44.06	61.63	46.85	63.54	49.63	65.06	52.91	70.01
	28.600	39.33	61.22	45.89	66.40	49.57	68.78	52.83	70.33	59.51	77.04
	29.600	42.00	63.68	51.27	69.31	57.29	72.06	63.10	76.43	71.59	84.50
	30.600	182.44	201.74	255.36	281.89	304.06	333.05	351.56	380.13	410.40	441.30
	31.400	181.97	201.74	254.75	281.38	303.36	332.19	350.80	379.37	409.55	440.31
	34.200	181.80	201.57	254.38	281.01	303.22	332.05	351.01	379.57	408.81	439.57
	39.200	174.69	194.46	241.68	268.31	289.19	318.02	336.91	365.47	393.86	424.63
	44.200	166.95	186.72	227.55	254.17	273.22	302.05	319.80	348.36	375.55	406.31
	49.200	156.66	176.43	212.96	239.59	256.26	285.09	301.92	330.48	358.09	388.85
	52.400	264.65	296.83	364.26	405.53	428.81	476.94	490.98	545.35	570.69	640.59
	55.600	246.55	290.70	343.32	400.22	408.58	474.17	471.85	545.02	552.60	639.14
	60.200	212.90	265.73	295.70	371.82	355.66	448.45	416.67	524.25	499.40	625.98

TABLE F.4.6(2) FLOW RATE FROM HD CALCULATION IN THE ARROYO YAPACANICITO,JOCHI AND TACUARAL

Arroyo	Chainage in F/S (km)	Maximumflow rate from probable floods (m^3/s) for existing and design cross sections									
		2 Year		5 Year		10 Year		20 Year		50 Year	
		Existing	Design	Existing	Design	Existing	Design	Existing	Design	Existing	Design
Jochi	1.500	146.35	146.35	202.33	202.33	237.14	237.14	269.22	269.22	309.12	309.12
	4.500	143.41	143.41	199.10	199.10	233.90	233.90	266.17	266.17	306.41	306.41
	6.920	50.22	50.22	53.43	53.43	55.35	55.35	57.21	57.21	59.77	59.77
	9.620	46.51	46.51	50.24	50.24	52.39	52.39	54.25	54.25	56.71	56.71
	13.300	46.05	46.23	50.14	49.90	52.28	52.00	53.89	53.78	55.69	56.44
Improvement	14.400	51.50	46.23	55.15	49.90	57.61	52.00	58.46	53.78	59.92	56.44
	15.005	54.65	46.23	57.90	49.90	59.55	52.00	60.44	53.78	60.94	56.43
	15.015	56.22	46.23	59.28	49.90	60.51	52.00	61.43	53.78	61.45	56.43
	15.460	57.79	46.23	60.66	49.90	61.48	52.00	62.42	53.78	61.96	56.43
	16.600	46.33	46.23	50.45	49.90	52.70	52.00	54.25	53.78	55.44	56.43
	17.750	46.02	46.23	49.89	49.90	52.13	52.00	53.67	53.78	54.89	56.43
	18.650	45.93	46.23	49.88	49.90	52.08	52.00	53.63	53.78	54.84	56.43
	19.300	45.92	46.23	49.87	49.90	52.07	52.00	53.62	53.78	54.82	56.43
	20.450	45.90	46.23	49.87	49.90	52.05	52.00	53.61	53.78	54.79	56.43
	21.400	45.88	46.23	49.86	49.90	52.04	52.00	53.61	53.78	54.77	56.43
	22.300	45.88	46.23	49.86	49.90	52.03	52.00	53.61	53.78	54.74	56.43
	22.705	45.87	46.23	49.86	49.90	52.03	52.00	53.61	53.78	54.73	56.43
	22.715	45.87	46.23	49.86	49.90	52.03	52.00	53.60	53.78	54.73	56.43
	23.210	45.87	46.23	49.86	49.90	52.03	52.00	53.60	53.78	54.72	56.43
	24.300	45.86	46.23	49.85	49.89	52.02	51.99	53.60	53.78	54.68	56.44
	25.250	45.86	46.25	49.85	49.93	52.02	52.01	53.61	53.79	54.68	56.43
	27.650	48.64	104.59	58.04	141.30	62.31	153.26	64.93	175.46	62.62	200.33
	29.750	23.49	24.44	23.92	26.74	23.58	26.84	23.67	26.89	24.34	37.61
	32.800	19.70	20.48	25.91	26.79	30.11	31.13	34.60	39.75	72.77	87.11
	37.700	12.07	12.70	15.45	16.54	17.79	19.44	20.04	22.92	21.34	31.20
	41.500	11.37	12.07	14.59	15.95	16.77	18.75	18.85	22.15	19.40	30.75
Tacuaral	1.500	159.76	159.78	181.24	181.25	193.69	193.69	204.95	204.95	218.39	218.37
	4.500	158.70	158.75	180.28	180.27	192.66	192.63	203.73	203.71	216.89	216.87
	7.500	144.78	144.47	157.99	158.84	165.27	166.34	171.46	172.25	179.03	179.94
	10.500	144.54	143.78	158.05	158.86	165.49	166.73	171.84	172.46	179.53	180.53
	14.400	137.71	139.97	153.21	148.80	159.96	154.32	163.38	160.48	168.24	165.47
Improvement	16.805	168.07	153.32	183.51	198.74	198.46	217.94	207.07	231.29	229.20	242.69
	16.815	168.35	177.72	173.51	184.84	194.40	201.16	203.05	221.48	217.50	238.29
	17.210	146.01	140.12	172.06	189.08	184.51	190.67	180.84	212.87	178.89	222.32
	18.050	129.16	140.12	151.62	148.82	154.06	167.50	157.85	198.13	159.45	213.26
	18.800	127.26	140.10	149.20	148.81	152.59	157.10	156.77	193.98	158.30	205.97
	19.105	155.37	140.16	161.65	162.64	166.41	172.59	197.48	201.37	203.37	225.36
	19.115	169.62	158.74	169.88	179.77	183.09	189.56	191.54	201.45	205.28	209.32
	19.560	112.02	140.16	135.07	148.83	141.09	177.77	145.83	257.72	150.21	233.29
	20.600	111.86	140.10	134.94	148.80	141.03	154.32	145.81	172.04	150.06	201.52
	21.650	111.54	140.10	134.74	148.80	140.92	154.32	145.78	171.82	149.71	190.31
	22.350	111.77	140.11	134.81	148.80	140.95	154.32	145.80	171.58	149.53	189.99
	25.050	110.64	140.11	134.12	148.80	140.58	154.31	145.66	170.86	148.66	189.47
	27.550	103.63	128.86	127.83	151.16	138.11	165.15	148.32	177.01	159.88	198.78
	29.850	141.45	167.37	172.72	199.00	195.53	221.21	222.32	240.32	253.91	270.96
	35.000	102.89	105.96	125.26	130.84	137.83	146.33	149.73	158.90	146.75	172.46

TABLE F.4.7 WATER LEVEL FROM HD CALCULATION IN THE ARROYO TACUARAL AND ANTOFAGASTA

Arroyo	Sect. No.	Chainage in F/S (km)	Existing Elevation (m)			Maximum water level from probable flood (m)					Maximum water level from probable flood (m)				
						Existing cross section					Design cross section				
			Left	Bed	Right	2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Tejeria	No. 10	0.000	290.93	289.03	290.90	291.28	291.77	292.05	292.25	292.42	289.61	290.25	290.67	290.95	291.19
	No. 9	1.010	293.33	288.89	292.46	291.00	291.45	291.70	291.88	292.12	290.06	290.62	291.10	291.40	291.65
	No. 8	2.225	290.60	286.05	290.87	288.46	288.90	289.26	289.47	289.76	287.78	288.19	288.80	289.10	289.35
	No. 7	2.975	290.28	283.89	290.94	286.41	286.78	287.08	287.38	287.66	285.88	286.26	286.64	286.97	287.29
	No. 6	3.677	284.79	281.85	285.62	284.96	285.27	285.59	285.85	286.08	283.75	284.23	284.73	285.03	285.39
	No. 5	4.860	283.38	280.13	284.24	283.33	283.54	283.89	284.10	284.34	282.22	282.57	283.04	283.24	283.75
	No. 4	5.706	283.05	278.16	283.45	282.35	282.56	282.94	283.27	283.46	281.31	281.56	281.89	282.16	282.62
	No. 3	6.879	281.18	277.15	287.32	281.82	281.90	282.15	282.40	282.49	280.90	281.07	281.41	281.74	281.89
	No. 2	7.579	280.87	276.34	281.47	281.73	281.85	281.97	282.19	282.24	280.67	280.75	281.04	281.45	281.64
	No. 1	8.160	279.48	276.67	285.22	281.30	281.30	281.30	281.30	281.30	279.70	279.70	279.70	279.70	279.70
Antofagasta	No. 12	0.000	262.30	260.90	263.00	263.18	263.45	263.63	263.78	263.98	261.92	262.41	262.64	262.79	262.94
	No. 11	1.042	260.40	260.12	262.20	261.99	262.33	262.51	262.67	262.88	260.89	261.43	261.66	261.84	262.01
	No. 10	1.916	261.00	258.01	261.20	261.03	261.37	261.54	261.69	261.89	259.86	260.41	260.63	260.80	260.96
	No. 9	2.549	269.40	257.00	259.90	260.08	260.37	260.55	260.70	260.88	258.89	259.37	259.59	259.75	259.92
	No. 8	3.492	257.40	254.96	259.40	258.62	259.04	259.29	259.50	259.73	257.95	258.48	258.71	258.88	259.05
	No. 7	4.304	258.80	254.05	258.30	258.23	258.67	258.91	259.11	259.33	257.16	257.74	257.99	258.18	258.37
	No. 6	5.242	258.30	253.07	258.00	256.90	257.42	257.68	257.89	258.12	256.10	256.64	256.87	257.05	257.23
	No. 5	6.559	255.50	250.34	255.70	254.99	255.33	255.54	255.72	255.93	254.53	254.98	255.16	255.30	255.44
	No. 4	7.638	253.60	250.30	253.80	254.83	255.12	255.31	255.47	255.66	253.62	254.19	254.40	254.53	254.67
	No. 3	8.253	255.00	251.16	255.00	254.65	254.91	255.08	255.22	255.38	252.95	253.56	253.78	253.90	254.02
	No. 2	8.797	253.00	249.65	252.80	253.00	253.32	253.51	253.65	253.83	252.15	252.76	253.02	253.15	253.30
	No. 1	8.797	251.10	249.65	251.10	250.16	250.87	251.20	251.50	251.87	250.16	250.87	251.20	251.50	251.87

TABLE F.4.8 FLOW RATE FROM HD CALCULATION IN THE ARROYO TACUARAL AND ANTOFAGASTA

Arroyo	Chainage in F/S (km)	Maximum flow rate from probable flood (m^3/s)					Maximum flow rate from probable flood (m^3/s)				
		Existing cross section					Design cross section				
		2 year	5 year	10 year	20 year	50 year	2 year	5 year	10 year	20 year	50 year
Tejeria	0.505	6.40	7.62	9.65	10.69	11.76	6.61	7.86	9.95	11.20	12.88
	1.617	12.82	15.24	19.27	20.89	22.74	13.22	15.72	19.88	22.37	25.71
	2.600	19.23	22.92	29.07	32.03	35.38	19.82	23.58	29.84	33.56	38.57
	3.326	25.69	30.66	38.95	43.25	48.23	26.42	31.45	39.82	44.83	51.48
	4.268	32.01	38.38	49.00	54.86	61.39	32.69	39.00	49.51	55.77	64.11
	5.283	37.39	43.92	54.80	61.83	69.92	38.31	45.39	57.20	64.30	72.82
	6.292	49.29	57.59	71.42	80.31	90.86	49.72	59.22	75.05	84.16	99.15
	7.229	55.42	64.70	80.17	89.77	101.62	50.18	61.41	80.14	129.94	138.33
	7.869	67.50	82.10	97.54	108.74	123.27	60.52	88.59	96.70	109.44	127.78
Antofagasta	0.520	94.95	128.91	153.08	177.52	209.95	166.19	223.08	250.97	273.33	297.01
	1.480	94.87	128.80	152.91	177.34	209.74	165.95	222.94	250.88	273.23	296.95
	2.235	94.80	128.64	152.73	177.17	209.57	165.92	222.91	250.86	273.19	296.89
	3.020	94.73	128.52	152.58	177.01	209.39	165.89	222.88	250.79	273.12	296.74
	3.895	94.52	128.22	152.31	176.63	209.01	165.57	222.69	250.63	272.97	296.59
	4.770	94.48	128.13	152.19	176.45	208.84	165.54	222.65	250.59	272.92	296.54
	5.900	94.48	128.11	152.16	176.44	208.80	165.52	222.65	250.58	272.92	296.54
	7.100	94.41	127.99	151.91	176.18	208.57	165.49	222.60	250.54	272.87	296.48
	7.945	94.32	127.83	151.77	175.99	208.40	165.34	222.36	250.38	272.65	296.23
	8.525	94.33	127.83	151.77	175.97	208.39	165.34	222.36	250.37	272.63	296.19
	9.700	94.30	127.68	151.65	175.85	208.25	165.32	222.33	249.87	270.38	291.40