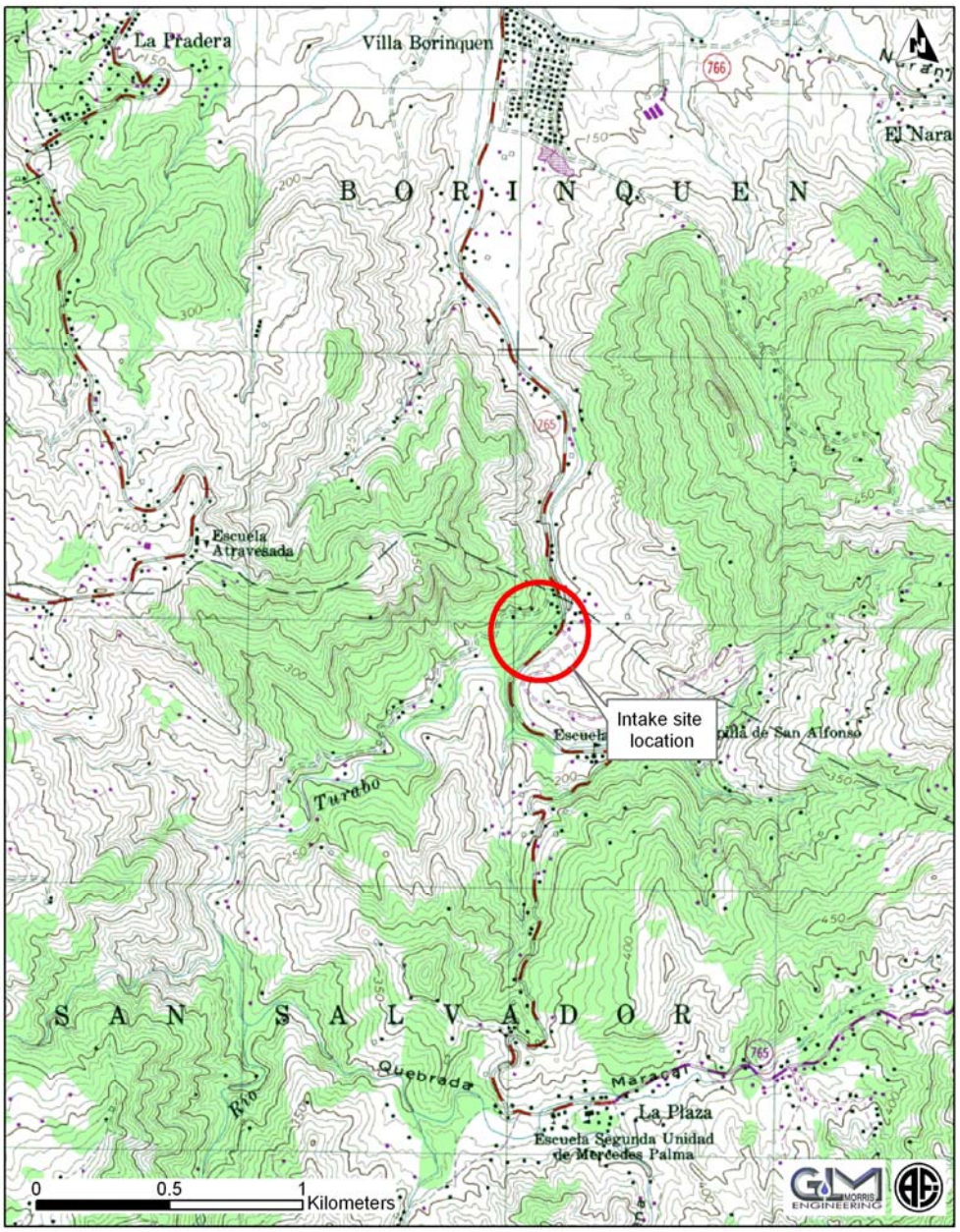
Nota al Lector:

Posterior a la emisión del presente estudio (**Estudio Hidrológico-Hidráulico, Toma Río Turabo**) se modificó el Plano Conceptual del Proyecto Embalse Beatriz (el Proyecto). El Proyecto según redefinido propone la construcción de una nueva planta de filtración en vez de la ampliación de la planta de filtración Caguas Sur y define las áreas de disposición de sedimentos y área de amortiguamiento de la cortina de la represa. Estas áreas en conjunto ocupan aproximadamente 70 cuerdas adicionales al área de estudio original, las cuales fueron estudiadas separadamente. Además incluye dos alternativas de acceso a la nueva planta de filtración, actualmente en evaluación. Sin embargo, estas modificaciones no alteran los resultados del presente estudio.

HYDROLOGIC-HYDRAULIC STUDY
Flood levels at Río Turabo Raw Water Intake
Caguas, PR



May, 2007

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Gregory L. Morris Engineering

Río Turabo Raw Water Intake
Hydrologic-Hydraulic Study

May, 2007

1. INTRODUCTION

1.1. Project Description and Location

The Quebrada Beatriz off-stream reservoir project will be located west of State Road Num. 52 in Caguas, P.R. The project consists of an earthfill dam that will create a lake with a total capacity of approximately 8.0 million m^3. The storage reservoir will be fed by a gravity raw water intake located on the Río Turabo, and water will be delivered to the dam by either pipeline or tunnel. The proposed structure will consist of an intake structure in the river and an off-channel diversion weir downstream of the intake to control the rate of diversion to the reservoir. **Figure 1** illustrates the location of the proposed reservoir and intake on the USGS topographic quadrangle for Caguas.

1.2. Scope and Purpose of Report

This report has been prepared to demonstrate compliance with Planning Board Regulation Num. 13 and to satisfy requirements for an intake construction permit. This study establishes project hydraulic design parameters such that after development, the 100-year flood levels along Río Turabo are not increased by more than 0.15 m.

1.3. Report Limitations and Warnings

It shall be the responsibility of the site engineer or the project's geotechnical consultant to adapt these hydraulic design recommendations to the soil and other conditions at the site in any matters concerning slope stability, conflicts with other infrastructure, etc.

1.4. Authorization

Preparation of this report was authorized by the P.R Infrastructure Financing Authority (AFI) by contract with Gregory L. Morris Engineering.

1.5. Personnel Involved in Project

Project:	Quebrada Beatriz Off-stream Reservoir;
	Río Turabo Raw water Intake
Report preparers:	Gregory L. Morris, P.E., Ph D.
	Luan M. Esteban, E.I.T.

2. STUDY AREA DESCRIPTION

2.1. Topography and Water Bodies

Rio Turabo is the only water body in the study area. It is a tributary to Rio Grande de Loíza. Watersheds elevations vary from 150 m in the area of the proposed intake, to 900 m at the upper watershed limit.

2.2. Prior Studies and Floodplain Mapping

Figure 2 shows flood zones within the project area on a digitized version of the FEMA Flood Insurance Rate Map (FIRM), panel 72000C1220H with an effective date of April 19, 2005. The project site is an unstudied reach of Río Turabo.

2.3. Field Observations

Field visits to the site were performed several times during 2005 to observe hydraulic conditions and coordinate survey data collection. The following conditions were observed:

- The channel consists of rock outcrops and the channel geometry is structurally controlled along the entire reach. The photograph in **Figure 3** illustrates the rock outcrops characteristic of the area.
- There is considerable recreational use of the river in this area, particularly on summer weekends. Rubbish (paper, plates, plastic bags, cans) are discarded in the river. Neighbors have reported that drowning have occurred in this area.
- The left (facing downstream) side of the river is a rock exposure, which would facilitate tunneling. The right-side has a "colmado" and highway PR-765. Vehicular access to the site is difficult.
- No hydraulic debris obstructing the flow were observed.
- Bed material consists of limited amounts of gravels. The river does not give the indication that bed material transport is significant.
- The river valley is very narrow, and sitting options for the intake structures are very limited.

2.4. Field Data

The hydraulic cross sections in the area of the intake were defined based on the topographic survey prepared by surveyor Luis Berrios (Lic. 8689), and attached at the end of this report.

3. STUDY APPROACH & METHODOLOGY

3.1. Conceptual Approach

To evaluate the effects of the proposed raw water intake on regulatory flood levels two models were prepared: existing condition and proposed condition. The analysis was performed by a one-dimensional steady flow hydraulic model.

3.2. Methodology for Hydrologic Analysis

The peak discharge along the study reach was computed by the Natural Resources Conservation Service's unit hydrograph (UH) methodology as implemented in the HEC-HMS (v. 3.0.1) computer program developed by the Hydrologic Engineering Center of the US Army Corps of Engineers.

Fifteen years of streamflow data from USGS gage Río Turabo above Borinquen (50053025) for water year 1990 through 2004 are available. This gage is located approximately 500 m downstream of the intake location.

3.3. Methodology for Hydraulic Analysis

Hydraulic analysis was performed using the steady-flow HEC-RAS computer model (U.S.Army Corps of Engineers, version 3.1.2; April 2004).

The hydraulic model simulates a reach 125 m in length, extending from approximately 5 m below the off-channel diversion weir to 7 m upstream of the propose intake structure.

4. HYDROLOGY

4.1. Watershed Delimitation

Watershed limits for the project site drainage area was determined by the topographic survey provided and the USGS topographic quadrangle for Caguas and Patillas. The watershed of Río Turabo at the intake location was divided in 3 sub-basins for the hydrologic analysis. Watershed limits of the study area are shown in **Figure 4.** Watershed areas are summarized in **Table 1**.

Table 1: Watershed areas

Sub-basins	Tributary area (km^2)
Río Turabo above confluence with Q. Maracai	9.69
Río Turabo below confluence with Q. Maracai	5.31
Unnamed stream above intake	2.95
Río Turabo at intake (total watershed area)	17.95

4.2. Rainfall

A hyetograph was constructed using the 100-year rainfall depths as reported by the US Department of Commerce (2006) in NOAA Atlas 14. The rainfall depths used to construct the hyetograph are shown in **Table 2**.

Table 2: Maximum 24 hour Rainfall.

Duration, hrs	Rainfall Depths	
	in	mm
1	4.17	105.9
2	6.25	158.6
3	7.46	189.4
6	10.66	270.8
12	14.19	360.5
24	18.57	471.7

4.3. Soils and Curve Number

The Curve Number represents the runoff potential within the watershed and is estimated based on soil type (hydrologic soil group), land use and antecedent moisture condition (AMC). In this study an AMC-II was used. The soils types within the

watersheds were obtained from digitized Natural Resources Conservation Service (NRCS) soils mapping. Soils within the study areas are shown in **Figure 6**. Aerial photography has been interpreted to determine the land uses within the study areas (**Figure 7**). ***Appendix A*** shows the curve number calculations for the analyzed watersheds. **Table 3** show results of curve number for each watershed.

Table 3: Curve Number for Analyzed Watersheds.

Watershed	Curve Number
Río Turabo above confluence with Q. Maracai	74
Río Turabo below confluence with Q. Maracai	75
Unnamed stream above intake	77

4.4. Time of Concentration

The time of concentration (Tc) is defined as the time required, given uniform rain, for 100% of the tributary area to influence discharge at the basin outlet. Time of concentration was computed using NRCS TR-55 methodologies.

For the initial 300 ft. of overland flow Tc was computed using the Sheet Flow equation for travel time as:

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5}(s)^{0.4}}$$

where;

Tt = Travel time (hr.)
n = Manning's roughness coefficient
L = Flow length (ft.)
P_2 = 2-year, 24-hr rainfall (5.50 in)
s = Mean slope for the flow length (ft/ft)

For the remaining flow length to the outlet point, Tc was computed using the Shallow Concentrated Flow equation for travel time as:

$$T_t = \frac{L}{3600 * V}$$

where;

Tt = Travel Time (min.)
L = Flow length (ft)
V = Average velocity (cfs); compute as:

$$V_{unpaved} = \sqrt{\frac{s}{.0039}} \qquad V_{paved} = \sqrt{\frac{s}{.0024}}$$

For channel flow, Manning's equation was used to calculate velocity:

$$V = \frac{1.49 * R^{2/3} * S^{1/2}}{n}$$

where:

V = channel velocity (ft/s)

R = channel hydraulic radius (ft)

S = channel slope

n = Manning's roughness coefficient

The travel time along the channel was calculated with the following equation:

$$t_c = \frac{L}{3600 * V}$$

where:

t_c = time of concentration

L = channel length (ft)

V = average velocity of flow (ft/s)

Table 4 shows the time of concentration calculated for each sub-basin and ***Appendix A*** includes the calculations.

Table 4: Time of Concentration by Sub-basin

Condition	Tc (min)
Río Turabo above confluence with Q. Maracai	42.8
Río Turabo below confluence with Q. Maracai	36.4
Unnamed stream above intake	12.1

4.5. Results of Hydrologic Analysis

The peak discharge along the study reach was computed by the Natural Resources Conservation Service's unit hydrograph (UH) methodology as implemented in the HEC-HMS (v. 3.0.1) computer program developed by the Hydrologic Engineering Center of the US Army Corps of Engineers.

Table 5 presents peak discharges obtained for the each sub-basin and at the intake location. Complete hydrologic simulation input data and results is contained in ***Appendix A***.

Table 5: Peak Discharges for the studied watersheds

Drainage area	Peak Discharge, cms		Peak Discharge, cfs	
	2-year	100-year	2-year	100-year
Río Turabo above confluence with Q. Maracai	66.5	245	2,348	8,652
Río Turabo below confluence with Q. Maracai	39.4	139	1,391	4,909
Unnamed stream above intake	24.7	80.5	872	2,843
Río Turabo at intake	127	460	4,485	16,245

4.6. Verification of Hydrology

López et al. (1979) from the USGS used data on peak flood discharges in watersheds around Puerto Rico to develop a regional regression equation to estimate peak runoff at ungaged sites. The following equation was used to verify the 100-year peak discharge produced by Río Turabo at the intake:

$$\boxed{Q_{100} = 286 * A^{0.832} * P^{0.531}}$$

where:

Q = peak discharge (cfs)

A = drainage area (mi^2)

P = annual rainfall (in/yr)

The annual rainfalls for the watersheds tributary to the study reach are based on the isohyetal map of long term mean annual rainfall prepared by Black & Veatch Consulting Engineers (1970). **Table 6** shows the annual rainfall and peak discharges obtained with the USGS regression method.

Table 6: Peak Discharge based on the USGS Regression Method.

Watershed	Area (mi^2)	Annual Rainfall (in/yr)	100-yr Peak Discharge, cfs
Río Turabo at the intake	6.93	95	16,070

Table 7 compares peak discharges obtained with HEC-HMS and those obtained with the verification method. Based on verification computations, the peak discharges produced by ICPR were accepted as reasonable.

Table 7: Comparison of Peak Discharge obtained with HEC-HMS and verification by López Equation.

Watershed	HEC-HMS, cfs	López equation, cfs
Río Turabo at the intake	16,245	16,070

5. HYDRAULIC ANALYSIS

5.1. Models geometry

Two hydraulic models were prepared for this analysis: Existing condition and proposed condition. Both models have the same 13 cross sections. Beginning at cross section RS-1 downstream from the proposed off-channel diversion weir and ending at cross section RS-13 upstream of the proposed instream intake structure.

Cross section locations were selected based on reference to topographic survey and field reconnaissance to best represent hydraulic characteristics along the study reach. **Table 8** lists the cross sections used for hydraulic analysis. **Figure 7** shows cross section locations and a plan view of the river intake and diversion weir.

Table 8: Cross Sections Used in Modeling.

HEC-RAS River station	Distance to next station (m)	Notes
13	6.2	Above intake
12	9.6	River intake
11	12.6	River intake
10	21.4	
9	11.5	
8	15.2	
7	13.2	
6	10.3	
5	2.1	
4	7.0	Diversion weir
3	4.2	Diversion weir
2	5.3	Diversion weir
1	0	Below diversion weir

5.2. Hydraulic Coefficients

Manning's n-value indicates the relative roughness of the channel which creates energy loss due to friction and turbulence (boundary and form losses). Manning's n-values were estimated based on field observations and checked with reference to Barnes (1967)

and Chow (1959). The values for the coefficient of expansion and contractions along the reach are those recommended in the HEC-RAS user's manual. There were no abrupt transitions along the study reach. **Table 9** shows the coefficients used in the hydraulic modeling.

Table 9: Hydraulic Coefficients used in the Hydraulic Model.

Parameter	Value
Manning's n - value	
Main channel	0.05
Left bank	0.07
Right bank	0.07
Coefficient of expansion	
Gradual transition	0.01
Abrupt transition	0.03

5.3. Hydraulic Analysis Results

The 100-year water surface elevations obtained for the existing and proposed condition are compared in **Table 10**. All HEC-RAS input data and results for the existing and proposed conditions are contained in ***Appendix B*** and ***Appendix C*** respectively.

Table 10: 100-year Water Surface Elevation for Existing and Proposed Conditions.

Cross section	Water surface elevation (m)			Velocity (m/s)	
	Existing 100-yr	Proposed 100-yr	Difference	Existing 100-yr	Proposed 100-yr
13	166.23	166.23	0	5.53	5.53
12	165.80	165.80	0	5.55	5.54
11	166.20	166.19	-0.01	3.84	3.86
10	166.37	166.37	0	2.86	2.86
9	166.24	166.24	0	3.06	3.06
8	165.18	165.18	0	5.42	5.42
7	164.10	164.17	0.07	5.25	5.17
6	164.47	164.53	0.06	3.83	3.78
5	164.46	164.53	0.06	3.70	3.65
4	164.41	164.30	-0.11	3.81	4.07
3	164.03	163.90	-0.13	4.54	4.81
2	164.10	164.01	-0.09	4.18	4.35
1	163.24	163.24	0	5.70	5.70

6. CONCLUSIONS AND RECOMMENDATIONS

The proposed raw water intake and diversion weir structures will not increase the 100-year water level of Río Turabo more than 0.15 m, in compliance with Sec. 7.02 of Puerto Rico Planning Board Regulation Num 13.

7. REFERENCES

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Lopez, M. A., Colon-Dieppa, Eloy, and Cobb, E.D. 1979. "Floods in Puerto Rico, Magnitude and Frequency". U.S. Geological Survey Water Resources Investigations Report.

FIGURES

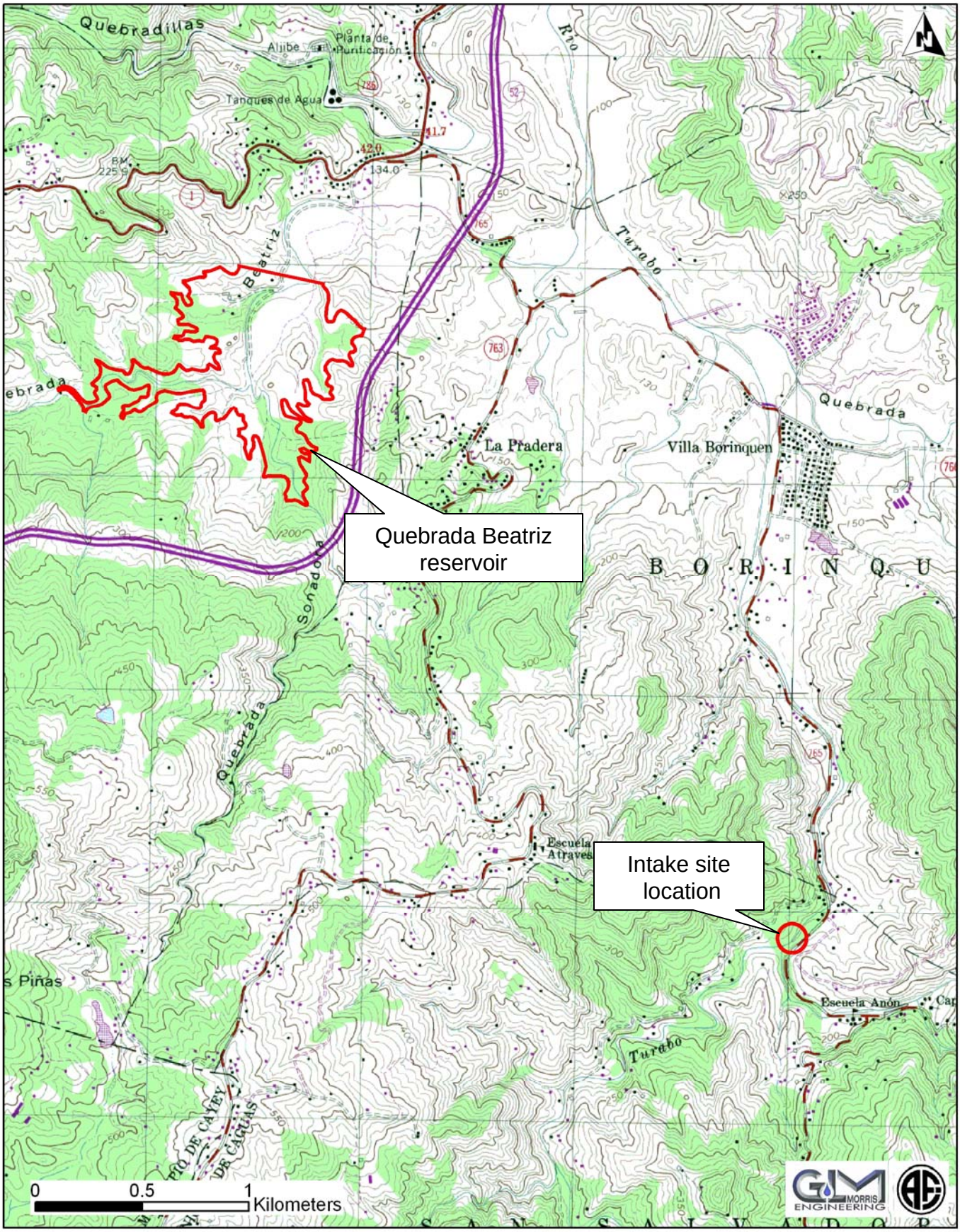


Figure 1: Site location on USGS Topographic Quadrangle for Caguas.

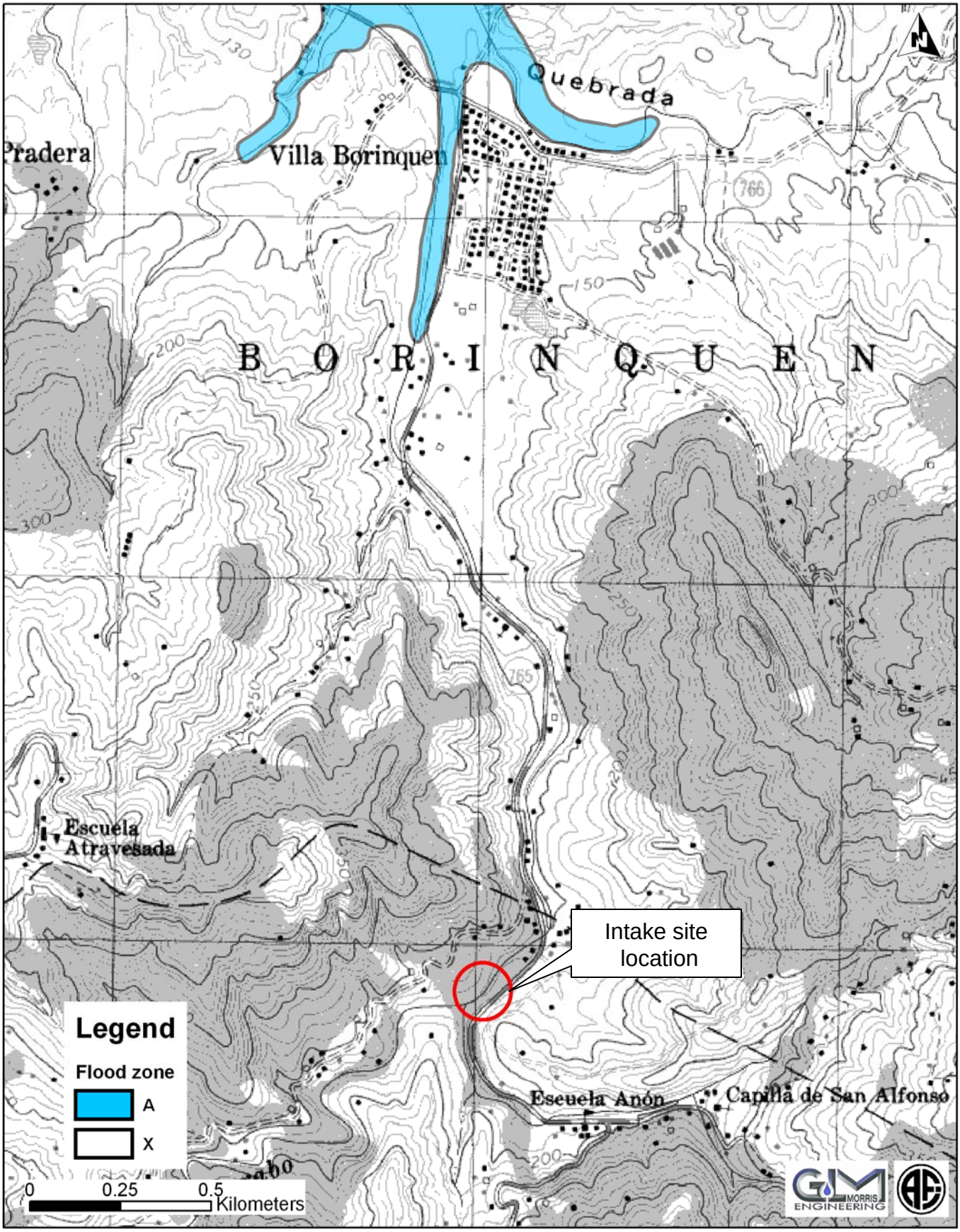


Figure 2: Digitized version of the FEMA FIRM Map panel 1220H, dated April 19, 2005.

Figure 3: Proposed raw water intake location at Río Turabo, looking downstream.

Figure 4: Watershed limits.

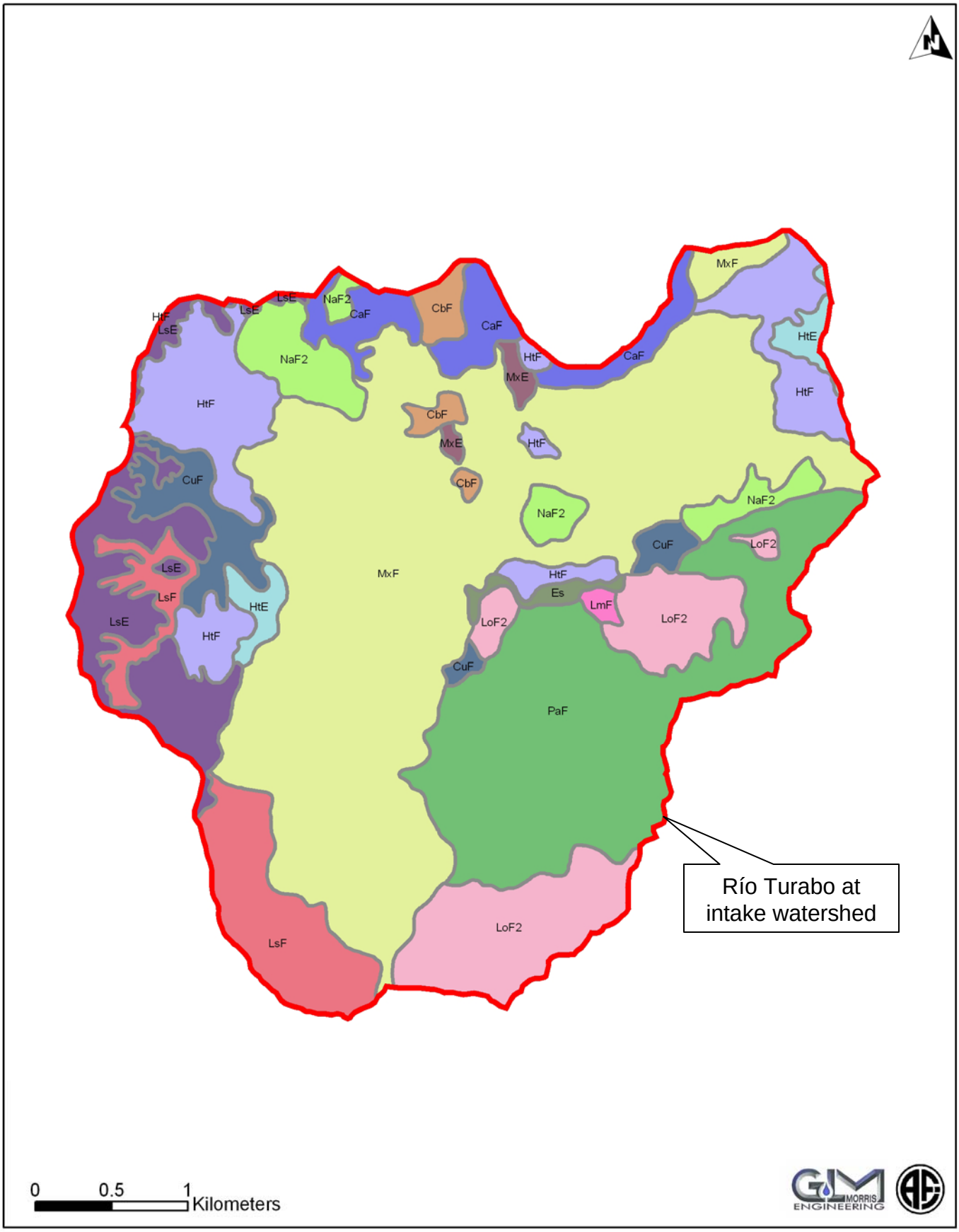


Figure 5: Soils within the watershed.

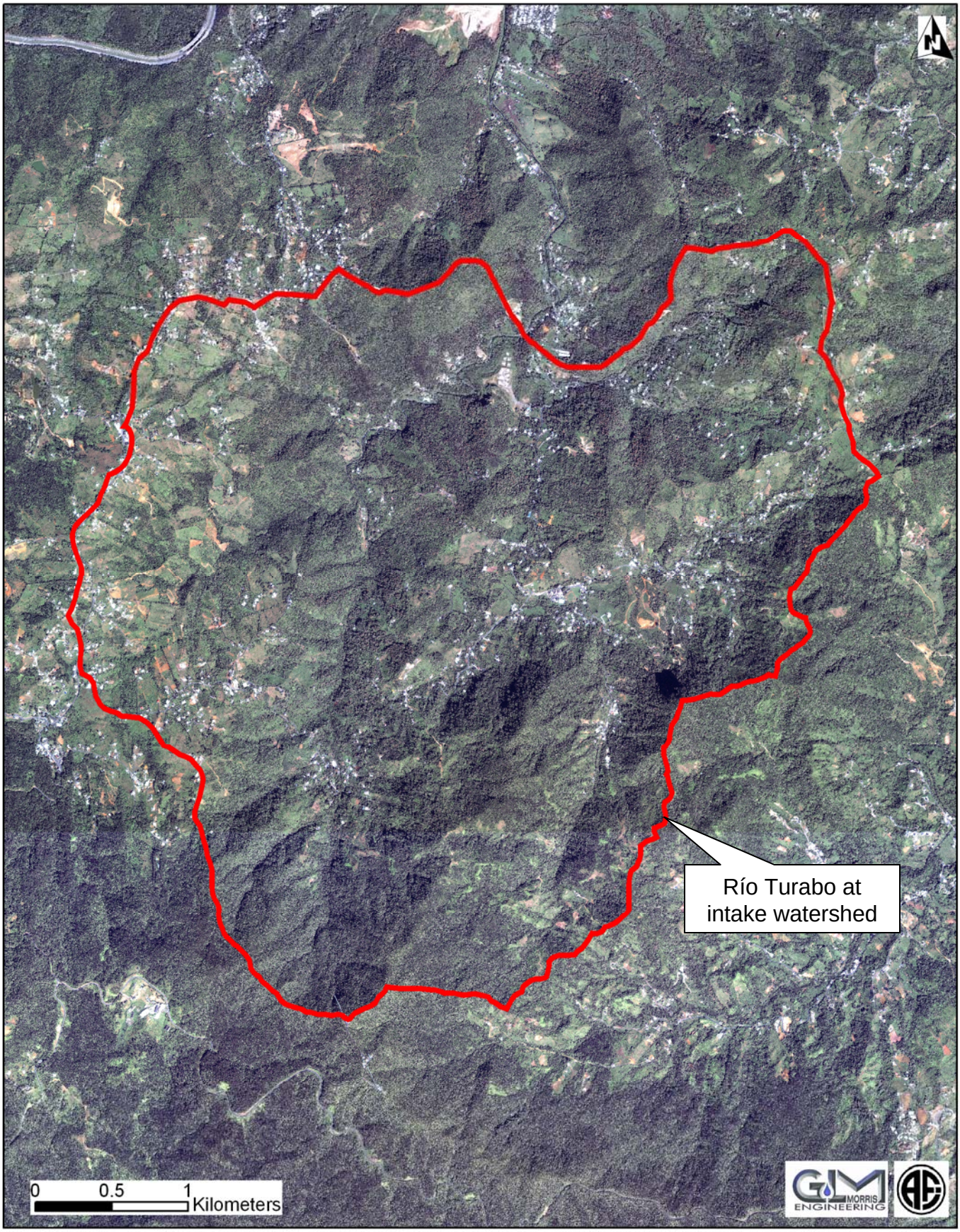


Figure 6: Aerial photography.

Figure 7: Hydraulic model cross section location map and raw water intake and diversion weir plan view.

APPENDIX A: Hydrologic Analysis Inputs and Results

APPENDIX A1: Curve Number Calculation

Sub Basin 1

Name	LU_DESC	MUSYM	HYDGRP	Area	Area (acres)	Grp Area	CN	CN*Area
Sub watershed 1	BUSHES AND GRASSLAND	LoF2	B	1378	0.340518			
Sub watershed 1	BUSHES AND GRASSLAND	LoF2	B	214813	53.08244			
Sub watershed 1	BUSHES AND GRASSLAND	LoF2	B	16538	4.086705			
Sub watershed 1	BUSHES AND GRASSLAND	CuF	B	2047	0.505834			
Sub watershed 1	BUSHES AND GRASSLAND	CuF	B	10665	2.635428			
Sub watershed 1	BUSHES AND GRASSLAND	CuF	B	349	0.086241			
Sub watershed 1	BUSHES AND GRASSLAND	LoF2	B	89680	22.16082			
Sub watershed 1	BUSHES AND GRASSLAND	Es	B	49601	12.2569	95.15489	56	5328.674
Sub watershed 1	BUSHES AND GRASSLAND	LsF	C	10716	2.648031			
Sub watershed 1	BUSHES AND GRASSLAND	LsE	C	51214	12.65549			
Sub watershed 1	BUSHES AND GRASSLAND	LsE	C	7792	1.925481			
Sub watershed 1	BUSHES AND GRASSLAND	HtE	C	7064	1.745585			
Sub watershed 1	BUSHES AND GRASSLAND	HtE	C	15333	3.788938			
Sub watershed 1	BUSHES AND GRASSLAND	HtF	C	6011	1.485378			
Sub watershed 1	BUSHES AND GRASSLAND	HtF	C	8967	2.215835	26.46474	70	1852.532
Sub watershed 1	BUSHES AND GRASSLAND	PaF	D	41737	10.31363			
Sub watershed 1	BUSHES AND GRASSLAND	PaF	D	19427	4.800606			
Sub watershed 1	BUSHES AND GRASSLAND	MxF	D	222000	54.85842			
Sub watershed 1	BUSHES AND GRASSLAND	MxF	D	4	0.000988			
Sub watershed 1	BUSHES AND GRASSLAND	PaF	D	110350	27.26859			
Sub watershed 1	BUSHES AND GRASSLAND	MxF	D	135	0.03336			
Sub watershed 1	BUSHES AND GRASSLAND	MxF	D	439313	108.5586			
Sub watershed 1	BUSHES AND GRASSLAND	MxF	D	844048	208.5727	414.4069	77	31909.33
Sub watershed 1	DENSE WOODLAND MEDIUM	LoF2	B	557769	137.8303			
Sub watershed 1	DENSE WOODLAND MEDIUM	LoF2	B	135307	33.43571			
Sub watershed 1	DENSE WOODLAND MEDIUM	LoF2	B	38226	9.446027			
Sub watershed 1	DENSE WOODLAND MEDIUM	LmF	B	12438	3.073554			
Sub watershed 1	DENSE WOODLAND MEDIUM	Es	B	5243	1.295598			
Sub watershed 1	DENSE WOODLAND MEDIUM	LoF2	B	230104	56.861			
Sub watershed 1	DENSE WOODLAND MEDIUM	LoF2	B	14661	3.62288	245.5651	55	13506.08
Sub watershed 1	DENSE WOODLAND MEDIUM	LsF	C	254153	62.80375			
Sub watershed 1	DENSE WOODLAND MEDIUM	LsE	C	3220	0.795694			
Sub watershed 1	DENSE WOODLAND MEDIUM	LsF	C	558232	137.9447			
Sub watershed 1	DENSE WOODLAND MEDIUM	NaF2	C	333	0.082288	201.6264	70	14113.85
Sub watershed 1	DENSE WOODLAND MEDIUM	MxF	D	422827	104.4848			
Sub watershed 1	DENSE WOODLAND MEDIUM	MxF	D	931780	230.2522			
Sub watershed 1	DENSE WOODLAND MEDIUM	MxF	D	157730	38.97666			
Sub watershed 1	DENSE WOODLAND MEDIUM	PaF	D	2559846	632.5635			
Sub watershed 1	DENSE WOODLAND MEDIUM	MxF	D	25029	6.184916	1012.462	77	77959.58
Sub watershed 1	HORTICULTURE	HtF	C	3046	0.752697	0.752697	85	63.97925
Sub watershed 1	PASTURELAND	Es	B	3	0.000741			
Sub watershed 1	PASTURELAND	Es	B	9806	2.423161			
Sub watershed 1	PASTURELAND	LoF2	B	35490	8.769934			
Sub watershed 1	PASTURELAND	LoF2	B	17967	4.439825			
Sub watershed 1	PASTURELAND	CuF	B	68635	16.96039	32.59406	69	2248.99
Sub watershed 1	PASTURELAND	HtF	C	78967	19.51354			
Sub watershed 1	PASTURELAND	NaF2	C	1806	0.446281			
Sub watershed 1	PASTURELAND	NaF2	C	123370	30.48596			
Sub watershed 1	PASTURELAND	HtF	C	18636	4.605142	55.05092	79	4349.023
Sub watershed 1	PASTURELAND	MxF	D	982	0.242662			
Sub watershed 1	PASTURELAND	PaF	D	73723	18.21769			
Sub watershed 1	PASTURELAND	PaF	D	1473	0.363993			
Sub watershed 1	PASTURELAND	PaF	D	33845	8.363438			
Sub watershed 1	PASTURELAND	PaF	D	7689	1.900029			
Sub watershed 1	PASTURELAND	MxF	D	203161	50.20311			
Sub watershed 1	PASTURELAND	MxF	D	55417	13.69409			
Sub watershed 1	PASTURELAND	MxF	D	69609	17.20108	110.1861	84	9255.633
Sub watershed 1	RIVER OR CHANNEL	LsF	C	13873	3.428157	3.428157	100	342.8157
Sub watershed 1	RIVER OR CHANNEL	MxF	D	54134	13.37705	13.37705	100	1337.705
Sub watershed 1	RURAL LOW DENSITY	CuF	B	25636	6.334912			
Sub watershed 1	RURAL LOW DENSITY	CuF	B	22	0.005436			

Sub watershed 1	RURAL LOW DENSITY	LoF2	B	5648	1.395677			
Sub watershed 1	RURAL LOW DENSITY	LoF2	B	5766	1.424836			
Sub watershed 1	RURAL LOW DENSITY	LmF	B	3339	0.8251			
Sub watershed 1	RURAL LOW DENSITY	LoF2	B	66448	16.41997			
Sub watershed 1	RURAL LOW DENSITY	LmF	B	24948	6.1649			
Sub watershed 1	RURAL LOW DENSITY	LmF	B	4505	1.113231			
Sub watershed 1	RURAL LOW DENSITY	Es	B	288	0.071168			
Sub watershed 1	RURAL LOW DENSITY	Es	B	32911	8.132637			
Sub watershed 1	RURAL LOW DENSITY	LoF2	B	76085	18.80136			
Sub watershed 1	RURAL LOW DENSITY	CuF	B	35906	8.872732			
Sub watershed 1	RURAL LOW DENSITY	LoF2	B	1478	0.365229	69.92719	65	4545.267
Sub watershed 1	RURAL LOW DENSITY	HtE	C	3030	0.748743			
Sub watershed 1	RURAL LOW DENSITY	HtF	C	64	0.015815			
Sub watershed 1	RURAL LOW DENSITY	HtF	C	3774	0.932593			
Sub watershed 1	RURAL LOW DENSITY	HtF	C	16904	4.177147			
Sub watershed 1	RURAL LOW DENSITY	NaF2	C	19781	4.888083			
Sub watershed 1	RURAL LOW DENSITY	NaF2	C	14482	3.578647			
Sub watershed 1	RURAL LOW DENSITY	NaF2	C	8677	2.144173	16.4852	77	1269.361
Sub watershed 1	RURAL LOW DENSITY	MxF	D	86095	21.27494			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	31907	7.884539			
Sub watershed 1	RURAL LOW DENSITY	PaF	D	44470	10.98898			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	1384	0.342			
Sub watershed 1	RURAL LOW DENSITY	PaF	D	2605	0.643722			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	11351	2.804946			
Sub watershed 1	RURAL LOW DENSITY	PaF	D	983	0.242909			
Sub watershed 1	RURAL LOW DENSITY	PaF	D	29027	7.172862			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	5422	1.33983			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	16683	4.122536			
Sub watershed 1	RURAL LOW DENSITY	PaF	D	61082	15.09397			
Sub watershed 1	RURAL LOW DENSITY	MxF	D	13288	3.283598	75.19483	83	6241.171
Sub watershed 1	RURAL MEDIUM DENSITY	LsE	C	889	0.219681			
Sub watershed 1	RURAL MEDIUM DENSITY	LsE	C	166	0.04102			
Sub watershed 1	RURAL MEDIUM DENSITY	LsE	C	112	0.027676			
Sub watershed 1	RURAL MEDIUM DENSITY	LsE	C	17585	4.345429	4.633807	79	366.0707
Sub watershed 1	RURAL MEDIUM DENSITY	MxF	D	51023	12.60829			
Sub watershed 1	RURAL MEDIUM DENSITY	MxF	D	15487	3.826993	16.43529	84	1380.564

SUM	2393.745	SUM	176070.6
		CN	73.55445
		Weigth CN	**74**

Sub Basin 2

Name	LU_DESC	MUSYM	HYDGRP	Area	Area (acres)	Grp Area	CN	CN*Area
Sub watershed 2	BUSHES AND GRASSLAND	CuF	B	1354	0.334587			
Sub watershed 2	BUSHES AND GRASSLAND	CuF	B	22515	5.563682			
Sub watershed 2	BUSHES AND GRASSLAND	CuF	B	161159	39.824	45.72227	56	2560.447
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	55927	13.82012			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	2364	0.584168			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	359	0.088712			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	546	0.134922			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	722	0.178413			
Sub watershed 2	BUSHES AND GRASSLAND	HtE	C	1019	0.251805			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	129076	31.89597			
Sub watershed 2	BUSHES AND GRASSLAND	HtF	C	115404	28.51748			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	90879	22.45711			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	70	0.017298			
Sub watershed 2	BUSHES AND GRASSLAND	LsF	C	1225	0.30271			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	574	0.141841			
Sub watershed 2	BUSHES AND GRASSLAND	HtE	C	43118	10.65489			
Sub watershed 2	BUSHES AND GRASSLAND	LsF	C	201699	49.84184			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	57662	14.24886			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	48	0.011861			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	80358	19.85727			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	2035	0.502869			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	14254	3.522306			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	6588	1.627961			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	527	0.130227			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	3503	0.865626			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	697	0.172236			
Sub watershed 2	BUSHES AND GRASSLAND	HtF	C	4641	1.146838			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	136	0.033607			
Sub watershed 2	BUSHES AND GRASSLAND	HtF	C	177	0.043738			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	6102	1.507865			
Sub watershed 2	BUSHES AND GRASSLAND	HtF	C	537820	132.9007			
Sub watershed 2	BUSHES AND GRASSLAND	NaF2	C	340025	84.02358			
Sub watershed 2	BUSHES AND GRASSLAND	HtF	C	6079	1.502182			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	6218	1.53653			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	33528	8.285104			
Sub watershed 2	BUSHES AND GRASSLAND	LsE	C	791	0.195464			
Sub watershed 2	BUSHES AND GRASSLAND	NaF2	C	4526	1.11842			
Sub watershed 2	BUSHES AND GRASSLAND	NaF2	C	39011	9.640008	441.7605	70	30923.24
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	132894	32.83944			
Sub watershed 2	BUSHES AND GRASSLAND	CbF	D	25966	6.416458			
Sub watershed 2	BUSHES AND GRASSLAND	MxE	D	26846	6.633915			
Sub watershed 2	BUSHES AND GRASSLAND	CbF	D	90	0.02224			
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	7324	1.809834			
Sub watershed 2	BUSHES AND GRASSLAND	CbF	D	67451	16.66782			
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	389744	96.30964			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	5170	1.277559			
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	27941	6.904501			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	10	0.002471			
Sub watershed 2	BUSHES AND GRASSLAND	MxE	D	5920	1.462891			
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	546426	135.0273			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	3678	0.908871			
Sub watershed 2	BUSHES AND GRASSLAND	MxF	D	124896	30.86305			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	104319	25.77827			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	118203	29.20914			
Sub watershed 2	BUSHES AND GRASSLAND	CaF	D	185241	45.7749			
Sub watershed 2	BUSHES AND GRASSLAND	CbF	D	128745	31.81418	469.7225	77	36168.63
Sub watershed 2	DENSE WOODLAND MEDIUM	CuF	B	6	0.001483			
Sub watershed 2	DENSE WOODLAND MEDIUM	CuF	B	116374	28.75718	28.75866	55	1581.726
Sub watershed 2	DENSE WOODLAND MEDIUM	HtF	C	228	0.056341			
Sub watershed 2	DENSE WOODLAND MEDIUM	HtF	C	12256	3.02858			
Sub watershed 2	DENSE WOODLAND MEDIUM	HtE	C	124	0.030642			
Sub watershed 2	DENSE WOODLAND MEDIUM	HtE	C	9218	2.27786			
Sub watershed 2	DENSE WOODLAND MEDIUM	HtE	C	1314	0.324703			
Sub watershed 2	DENSE WOODLAND MEDIUM	LsE	C	85	0.021004	5.73913	70	401.7391
Sub watershed 2	DENSE WOODLAND MEDIUM	MxF	D	145689	36.00121	36.00121	77	2772.093
Sub watershed 2	HIGH AND DENSE WOODLAN	CuF	B	7628	1.884955	1.884955	55	103.6725
Sub watershed 2	HIGH AND DENSE WOODLAN	HtF	C	9022	2.229426	2.229426	70	156.0598
Sub watershed 2	HORTICULTURE	CuF	B	26217	6.478483			

Sub watershed 2	HORTICULTURE	CuF	B	46829	11.57191			
Sub watershed 2	HORTICULTURE	CuF	B	9112	2.251666			
Sub watershed 2	HORTICULTURE	CuF	B	18	0.004448	20.30651	77	1563.601
Sub watershed 2	HORTICULTURE	LsE	C	20682	5.110729			
Sub watershed 2	HORTICULTURE	LsF	C	29455	7.278625			
Sub watershed 2	HORTICULTURE	LsF	C	2216	0.547596			
Sub watershed 2	HORTICULTURE	LsE	C	37794	9.339275			
Sub watershed 2	HORTICULTURE	LsE	C	46052	11.37991			
Sub watershed 2	HORTICULTURE	LsE	C	36717	9.073138			
Sub watershed 2	HORTICULTURE	LsE	C	537	0.132698			
Sub watershed 2	HORTICULTURE	LsE	C	1556	0.384503			
Sub watershed 2	HORTICULTURE	LsE	C	9179	2.268223			
Sub watershed 2	HORTICULTURE	HtF	C	69397	17.14869	62.66339	85	5326.388
Sub watershed 2	RIVER OR CHANNEL	HtF	C	49	0.012108	0.012108	100	1.210839
Sub watershed 2	RIVER OR CHANNEL	MxF	D	20395	5.039808			
Sub watershed 2	RIVER OR CHANNEL	CbF	D	1184	0.292578			
Sub watershed 2	RIVER OR CHANNEL	CbF	D	1714	0.423547			
Sub watershed 2	RIVER OR CHANNEL	MxF	D	13684	3.381453			
Sub watershed 2	RIVER OR CHANNEL	MxF	D	69	0.017051			
Sub watershed 2	RIVER OR CHANNEL	MxE	D	41	0.010132			
Sub watershed 2	RIVER OR CHANNEL	CaF	D	13012	3.215395	12.37996	100	1237.996
Sub watershed 2	RURAL LOW DENSITY	CuF	B	59	0.014579			
Sub watershed 2	RURAL LOW DENSITY	CuF	B	5213	1.288184			
Sub watershed 2	RURAL LOW DENSITY	CuF	B	11637	2.875619			
Sub watershed 2	RURAL LOW DENSITY	CuF	B	569	0.140606	4.318989	65	280.7343
Sub watershed 2	RURAL LOW DENSITY	HtF	C	59012	14.58246			
Sub watershed 2	RURAL LOW DENSITY	HtF	C	75	0.018533			
Sub watershed 2	RURAL LOW DENSITY	HtE	C	57958	14.322			
Sub watershed 2	RURAL LOW DENSITY	HtF	C	36015	8.899667			
Sub watershed 2	RURAL LOW DENSITY	HtF	C	1877	0.463825			
Sub watershed 2	RURAL LOW DENSITY	LsE	C	7404	1.829602			
Sub watershed 2	RURAL LOW DENSITY	HtF	C	51380	12.69651			
Sub watershed 2	RURAL LOW DENSITY	LsE	C	19859	4.907357	57.71995	77	4444.436
Sub watershed 2	RURAL LOW DENSITY	MxF	D	6758	1.669969			
Sub watershed 2	RURAL LOW DENSITY	CaF	D	12613	3.116798	4.786768	83	397.3017
Sub watershed 2	RURAL MEDIUM DENSITY	NaF2	C	22071	5.453965			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	11101	2.743168			
Sub watershed 2	RURAL MEDIUM DENSITY	NaF2	C	2955	0.73021	8.927343	79	705.2601
Sub watershed 2	RURAL MEDIUM DENSITY	CaF	D	1101	0.272068			
Sub watershed 2	RURAL MEDIUM DENSITY	CaF	D	1436	0.35485			
Sub watershed 2	RURAL MEDIUM DENSITY	CaF	D	1534	0.379067	1.005985	84	84.50272
Sub watershed 2	RURAL MEDIUM DENSITY	CuF	B	476	0.117624			
Sub watershed 2	RURAL MEDIUM DENSITY	CuF	B	5298	1.309189	1.426813	68	97.02329
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	7722	1.908183			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	4474	1.10557			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	126415	31.23841			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	6546	1.617582			
Sub watershed 2	RURAL MEDIUM DENSITY	LsF	C	441	0.108976			
Sub watershed 2	RURAL MEDIUM DENSITY	LsF	C	1774	0.438373			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	5371	1.327228			
Sub watershed 2	RURAL MEDIUM DENSITY	LsF	C	24988	6.174785			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	210345	51.97835			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	2383	0.588863			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	1956	0.483347			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	521	0.128744			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	70	0.017298			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	1025	0.253288			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	886	0.218939			
Sub watershed 2	RURAL MEDIUM DENSITY	HtF	C	157	0.038796			
Sub watershed 2	RURAL MEDIUM DENSITY	LsE	C	30303	7.488174	105.1149	79	8304.078
Sub watershed 2	URBAN UNDER CONSTRUCT	MxF	D	10507	2.596385			
Sub watershed 2	URBAN UNDER CONSTRUCT	MxE	D	664	0.164081	2.760466	94	259.4838
						1313.242		97369.62
							CN	74.14447
							Weigth CN	**75**

Creek watershed

Name	LU_DESC	MUSYM	HYDGRP	Area	Area (acres)	Grp Area	CN	CN*Area
Creek watershed	BUSHES AND GRASSLAND	NaF2	C	5610	1.386287			
Creek watershed	BUSHES AND GRASSLAND	NaF2	C	81341	20.10017			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	480	0.118613			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	7493	1.851595			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	4358	1.076905			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	9	0.002224			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	3408	0.842151			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	58037	14.34152			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	31978	7.902084			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	9	0.002224			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	123748	30.57937			
Creek watershed	BUSHES AND GRASSLAND	HtE	C	85098	21.02857			
Creek watershed	BUSHES AND GRASSLAND	HtF	C	206463	51.01907			
Creek watershed	BUSHES AND GRASSLAND	NaF2	C	122	0.030147	150.2809	70	10519.67
Creek watershed	BUSHES AND GRASSLAND	MxF	D	6280	1.551851			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	150976	37.30768			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	123345	30.47978			
Creek watershed	BUSHES AND GRASSLAND	CaF	D	2624	0.648417			
Creek watershed	BUSHES AND GRASSLAND	CaF	D	4279	1.057384			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	5178	1.279536			
Creek watershed	BUSHES AND GRASSLAND	MxE	D	33959	8.391608			
Creek watershed	BUSHES AND GRASSLAND	CaF	D	338	0.083523			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	202283	49.98615			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	982407	242.7626			
Creek watershed	BUSHES AND GRASSLAND	CaF	D	4580	1.131764			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	796	0.1967			
Creek watershed	BUSHES AND GRASSLAND	CaF	D	168320	41.59356			
Creek watershed	BUSHES AND GRASSLAND	MxF	D	136119	33.63637	450.1069	77	34658.23
Creek watershed	DENSE WOODLAND MEDIUM HEIGHT AND	CaF	D	358	0.088465			
Creek watershed	DENSE WOODLAND MEDIUM HEIGHT AND	CaF	D	1333	0.329398	0.417863	77	32.17545
Creek watershed	HORTICULTURE	HtF	C	78076	19.29336			
Creek watershed	HORTICULTURE	HtE	C	25401	6.276841	25.5702	85	2173.467
Creek watershed	PASTURELAND	HtF	C	4	0.000988			
Creek watershed	PASTURELAND	NaF2	C	464	0.114659			
Creek watershed	PASTURELAND	NaF2	C	767	0.189533			
Creek watershed	PASTURELAND	HtF	C	13769	3.402458	3.707638	79	292.9034
Creek watershed	PASTURELAND	MxF	D	2671	0.660031			
Creek watershed	PASTURELAND	MxF	D	179870	44.44768	45.10771	84	3789.047
Creek watershed	RURAL LOW DENSITY	NaF2	C	30701	7.586524			
Creek watershed	RURAL LOW DENSITY	HtF	C	746	0.184344			
Creek watershed	RURAL LOW DENSITY	HtF	C	16429	4.05977			
Creek watershed	RURAL LOW DENSITY	HtF	C	43	0.010626	11.84126	77	911.7773
Creek watershed	RURAL LOW DENSITY	MxF	D	16956	4.189997			
Creek watershed	RURAL LOW DENSITY	MxF	D	1687	0.416875			
Creek watershed	RURAL LOW DENSITY	MxF	D	15395	3.804258			
Creek watershed	RURAL LOW DENSITY	MxF	D	1177	0.290848			
Creek watershed	RURAL LOW DENSITY	MxF	D	9193	2.271682			
Creek watershed	RURAL LOW DENSITY	MxF	D	3802	0.939512			
Creek watershed	RURAL LOW DENSITY	MxF	D	6650	1.643282			
Creek watershed	RURAL LOW DENSITY	MxF	D	2575	0.636308			
Creek watershed	RURAL LOW DENSITY	CaF	D	17675	4.367669			
Creek watershed	RURAL LOW DENSITY	CaF	D	5795	1.432002			
Creek watershed	RURAL LOW DENSITY	MxF	D	58523	14.46162	34.45405	83	2859.686
Creek watershed	URBAN UNDER CONSTRUCTION	MxF	D	17011	4.203588			
Creek watershed	URBAN UNDER CONSTRUCTION	MxE	D	18684	4.617003	8.820591	94	829.1356

SUM	730.3072	SUM	56066.09
		CN	76.77056
		Weight CN	**77**

APPENDIX A2: Time of Concentration Calculation

Time of Concentration: Río Turabo - Sub-basin 1

	Segment	Length (m)	U/S Elev (m)	D/S Elev (m)	Slope	2-yr Precip (in)	n-value	Avg. Flow Depth (m)	Vel (m/s)	Froude No	Tc (min)	Tc (hrs)
1	Sheet Flow (L<300 ft)	91.44	880	850	0.328	5.7	0.400	---	0.12	---	12.65	0.21
2	Shallow Conc. Flow	453	850	675	0.386	---	---	---	3.0	---	2.49	0.04
3	Channel Flow (Manning)	3,215	675	330	0.107	---	0.130	1.2	2.8	0.83	18.83	0.31
4	Channel Flow (Manning)	1,804	330	231	0.055	---	0.090	1.5	3.4	0.89	8.82	0.15
	Total Distance	5,563								**Total Time of Conc.**	**42.8**	**0.71**

Time of Concentration: Río Turabo - Sub-basin 2

	Segment	Length (m)	U/S Elev (m)	D/S Elev (m)	Slope	2-yr Precip (in)	n-value	Avg. Flow Depth (m)	Vel (m/s)	Froude No	Tc (min)	Tc (hrs)
1	Sheet Flow (L<300 ft)	91.44	621	609	0.131	5.7	0.150	---	0.18	---	8.33	0.14
2	Shallow Conc. Flow	753	609	470	0.185	---	---	---	2.1	---	5.98	
3	Channel Flow (Manning)	2,164	470	220	0.116	---	0.130	1.2	3.0	0.86	12.22	0.20
4	Channel Flow (Manning)	2,208	220	160	0.027	---	0.070	2.0	3.7	0.84	9.84	0.16
	Total Distance	5,216								**Total Time of Conc.**	**36.4**	**0.51**

Time of Concentration: Río Turabo - Creek

	Segment	Length (m)	U/S Elev (m)	D/S Elev (m)	Slope	2-yr Precip (in)	n-value	Avg. Flow Depth (m)	Vel (m/s)	Froude No	Tc (min)	Tc (hrs)
1	Sheet Flow (L<300 ft)	91.44	530	509	0.230	5.7	0.150	---	0.23	---	6.66	0.11
2	Shallow Conc. Flow	753	509	395	0.151	---	---	---	1.9	---	6.61	
3	Channel Flow (Manning)	2,164	395	165	0.106	---	0.130	1.1	2.7	0.81	13.50	0.22
	Total Distance	3,008								**Total Time of Conc.**	**26.8**	**0.34**

Time of Concentration: Río Turabo - Rastreo

Segment	Length (m)	U/S Elev (m)	D/S Elev (m)	Slope	2-yr Precip (in)	n-value	Paved? (Y or N)	Avg. Flow Depth (m)	Vel (m/s)	Froude No	Tc (min)	Tc (hrs)
1 Channel Flow (Manning)	2,531	220	160	0.024	---	0.070	---	2.0	3.5	0.79	12.08	0.20
Total Distance	2,531									**Total Time of Conc.**	**12.1**	**0.20**

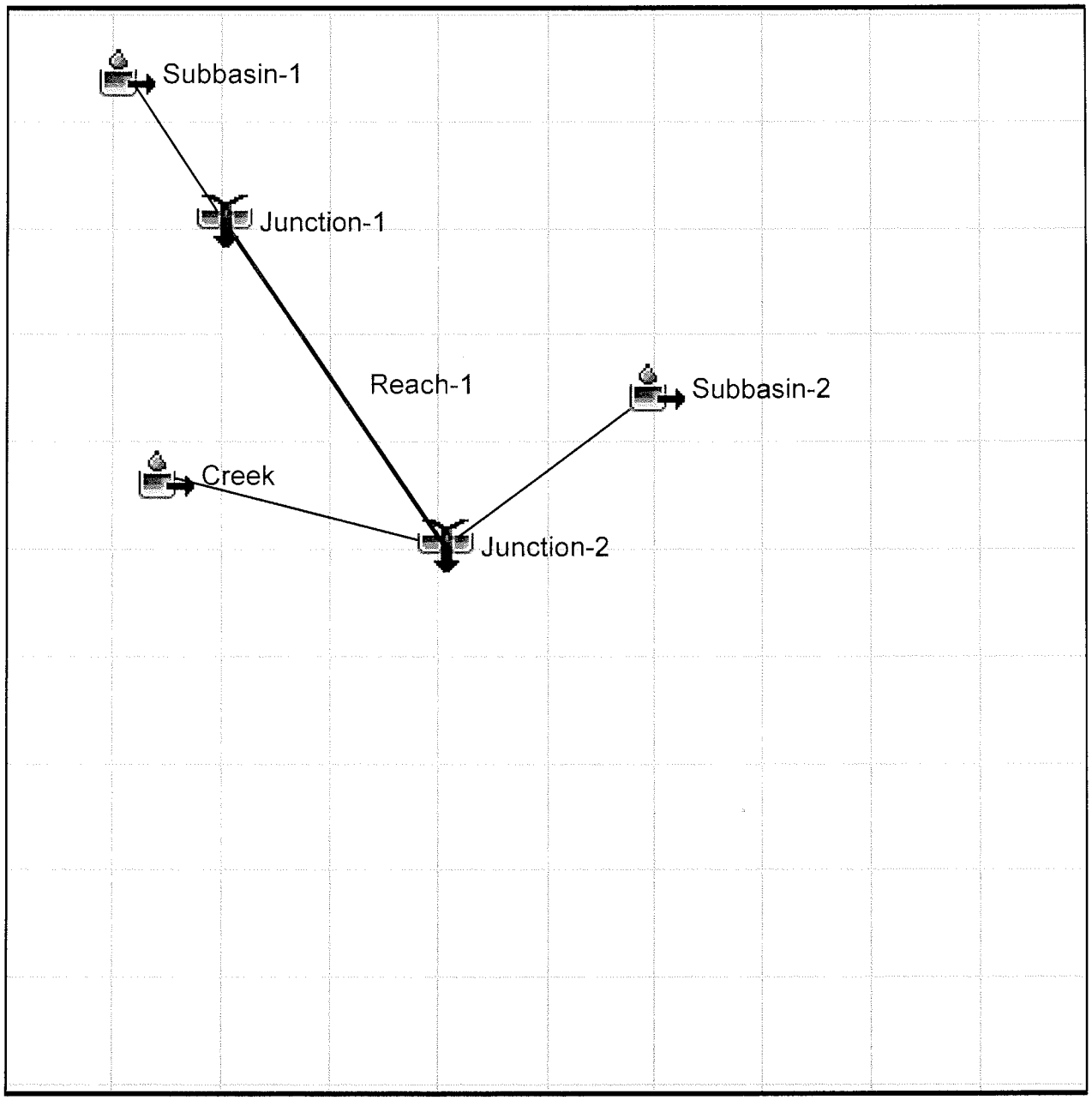
APPENDIX A3: HEC-HMS Hydrologic Modeling Results

HEC-HMS

Project : RioTurabo

Basin Model : Rio Turabo

Mar 28 15:23:02 VET 2007



Project: RioTurabo Simulation Run: 100-yr

Start of Run:	12Jan2007, 00:00	Basin Model:	Rio Turabo
End of Run:	13Jan2007, 00:00	Meteorologic Model:	100-yr
Compute Time:	28Mar2007, 15:17:22	Control Specifications:	Control 1

Volume Units: MM

Hydrologic Element	Drainage Area (KM2)	Peak Discharge (M3/S)	Time of Peak	Volume (MM)
Creek	2.9500	80.50	12Jan2007, 12:30	388.02
Junction-1	9.6870	245.10	12Jan2007, 12:35	372.71
Junction-2	17.9470	459.04	12Jan2007, 12:35	376.44
Reach-1	9.6870	245.03	12Jan2007, 12:45	371.81
Subbasin-1	9.6870	245.10	12Jan2007, 12:35	372.71
Subbasin-2	5.3100	139.37	12Jan2007, 12:35	378.45

Project : RioTurabo Simulation Run : 100-yr Subbasin: Subbasin-1

Start of Run :	12Jan2007, 00:00	Basin Model :	Rio Turabo
End of Run :	13Jan2007, 00:00	Meteorologic Model :	100-yr
Compute Time :	28Mar2007, 15:17:22	Control Specifications :	Control 1

Volume Units : MM

Computed Results

Peak Discharge :	245.10 (M3/S)	Date/Time of Peak Discharge :	12Jan2007, 12:35
Total Precipitation :	469.36 (MM)	Total Direct Runoff :	372.71 (MM)
Total Loss :	92.36 (MM)	Total Baseflow :	0.00 (MM)
Total Excess :	377.00 (MM)	Discharge :	372.71 (MM)

Project : RioTurabo Simulation Run : 100-yr Junction: Junction-1

Start of Run :	12Jan2007, 00:00	Basin Model :	Rio Turabo
End of Run :	13Jan2007, 00:00	Meteorologic Model :	100-yr
Compute Time :	28Mar2007, 15:17:22	Control Specifications :	Control 1

Volume Units : MM

Computed Results

Peak Outflow :	245.10 (M3/S)	Date/Time of Peak Outflow :	12Jan2007, 12:35
Total Outflow :	372.71 (MM)		

Project : RioTurabo Simulation Run : 100-yr Subbasin: Subbasin-2

Start of Run :	12Jan2007, 00:00	Basin Model :	Rio Turabo
End of Run :	13Jan2007, 00:00	Meteorologic Model :	100-yr
Compute Time :	28Mar2007, 15:17:22	Control Specifications :	Control 1

Volume Units : MM

Computed Results

Peak Discharge :	139.37 (M3/S)	Date/Time of Peak Discharge :	12Jan2007, 12:35
Total Precipitation :	470.39 (MM)	Total Direct Runoff :	378.45 (MM)
Total Loss :	88.28 (MM)	Total Baseflow :	0.00 (MM)
Total Excess :	382.11 (MM)	Discharge :	378.45 (MM)

Project : RioTurabo Simulation Run : 100-yr Junction: Junction-2

Start of Run :	12Jan2007, 00:00	Basin Model :	Rio Turabo
End of Run :	13Jan2007, 00:00	Meteorologic Model :	100-yr
Compute Time :	28Mar2007, 15:17:22	Control Specifications :	Control 1

Volume Units : MM

Computed Results

Peak Outflow :	459.04 (M3/S)	Date/Time of Peak Outflow :	12Jan2007, 12:35
Total Outflow :	376.44 (MM)		

Project : RioTurabo Simulation Run : 100-yr Subbasin: Creek

Start of Run :	12Jan2007, 00:00	Basin Model :	Rio Turabo
End of Run :	13Jan2007, 00:00	Meteorologic Model :	100-yr
Compute Time :	28Mar2007, 15:17:22	Control Specifications :	Control 1

Volume Units : MM

Computed Results

Peak Discharge :	80.50 (M3/S)	Date/Time of Peak Discharge :	12Jan2007, 12:30
Total Precipitation :	470.96 (MM)	Total Direct Runoff :	388.02 (MM)
Total Loss :	80.22 (MM)	Total Baseflow :	0.00 (MM)
Total Excess :	390.74 (MM)	Discharge :	388.02 (MM)

APPENDIX B: HEC-RAS Inputs and Results for the Existing Condition Model

HEC-RAS Version 3.1.2 April 2004
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HH Rio Turabo Intake
Project File : HH_Rio_Turabo_intake.prj
Run Date and Time: 3/28/2007 2:55:22 PM

Project in SI units

PLAN DATA

Plan Title: Plan 19
Plan File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.p19

Geometry Title: HH Río Turabo intake; existing 3
Geometry File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.g05

Flow Title : HH Río Turabo Intake
Flow File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.f01

Plan Summary Information:

Number of:	Cross Sections	= 13	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only

Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: HH Río Turabo Intake
Flow File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.f01

Flow Data (m3/s)

River	Reach	RS	100-yr	2-yr
Río Turabo	Intake	13	460	127

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Río Turabo	Intake	100-yr	Normal S = 0.05	Normal S = 0.05

GEOMETRY DATA

Geometry Title: HH Río Turabo intake; existing 3
Geometry File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.g05

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 13

INPUT
Description: RS-13
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	21.58	166.5	23.93	165.5	25.07	165	26.01	164.5
27.18	164	28.04	163.5	28.44	163	28.9	162.5	35.49	162.35
38.17	162.05	39.68	162.5	41.16	162.94	44.25	163	49.26	163.5
50.17	164	53.24	165	55.23	166	56.29	166.5	57.67	167
62.45	167.5	66.11	168	67.36	169	68.48	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	27.18	.05	50.17	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

```
         27.18   50.17             2.29    6.17     7.7             .1       .3

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           167.71    Element                 Left OB    Channel
Right OB
  Vel Head (m)              1.49    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           166.23    Reach Len. (m)            2.29       6.17
7.70
  Crit W.S. (m)           166.23    Flow Area (m2)            5.43      79.12
6.79
  E.G. Slope (m/m)      0.015460    Area (m2)                 5.43      79.12
6.79
  Q Total (m3/s)          460.00    Flow (m3/s)               9.63     437.23
13.13
  Top Width (m)            33.48    Top Width (m)             4.95      22.99
5.54
  Vel Total (m/s)           5.04    Avg. Vel. (m/s)           1.77       5.53
1.93
  Max Chl Dpth (m)          4.18    Hydr. Depth (m)           1.10       3.44
1.23
  Conv. Total (m3/s)      3699.6    Conv. (m3/s)              77.5     3516.5
105.6
  Length Wtd. (m)           6.14    Wetted Per. (m)           5.43      23.89
5.98
  Min Ch El (m)           162.05    Shear (N/m2)            151.43     502.20
172.13
  Alpha                     1.15    Stream Power (N/m s)    268.78    2775.10
332.74
  Frctn Loss (m)            0.11    Cum Volume (1000 m3)      0.59      13.09
2.17
  C & E Loss (m)            0.00    Cum SA (1000 m2)          0.46       2.71
1.76


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program used critical depth for the water surface and continued on with
the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current
and previous cross section.
         This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was
set equal to critical
         depth, the calculated water surface came back below critical depth.
This indicates that there is
         not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           164.97    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.72    Wt. n-Val.               0.070      0.050
0.070
```

W.S. Elev (m)	164.25	Reach Len. (m)	2.29	6.17	7.70
Crit W.S. (m)	164.25	Flow Area (m2)	0.07	33.66	0.09
E.G. Slope (m/m)	0.022488	Area (m2)	0.07	33.66	0.09
Q Total (m3/s)	127.00	Flow (m3/s)	0.04	126.92	0.05
Top Width (m)	24.33	Top Width (m)	0.58	22.99	0.76
Vel Total (m/s)	3.75	Avg. Vel. (m/s)	0.50	3.77	0.52
Max Chl Dpth (m)	2.20	Hydr. Depth (m)	0.12	1.46	0.12
Conv. Total (m3/s)	846.9	Conv. (m3/s)	0.2	846.3	0.3
Length Wtd. (m)	6.17	Wetted Per. (m)	0.63	23.89	0.80
Min Ch El (m)	162.05	Shear (N/m2)	25.14	310.79	26.00
Alpha	1.01	Stream Power (N/m s)	12.66	1171.71	13.39
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	0.00	6.02	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.02	2.69	0.03

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 12

INPUT
Description: RS-12
Station Elevation Data num= 41

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	20.91	166.5	22.05	166	23.14	165.5	23.95	165
24.76	164.5	25.91	164	26.36	163.5	27.02	162.5	27.41	163.81
28.02	163.49	28.67	162.86	29.18	162.36	29.62	161.91	30.04	160.93
30.31	159.75	30.6	159.85	31.18	160.34	32.51	161.47	33.99	162.55
35.78	162.83	36.78	162.58	38.68	161.63	39.77	161.52	42.27	162.74

46.78	162.5	47.74	163	48.29	163.5	49.25	164	50.27	164.5
52.19	165	53.19	165.5	54.1	166	55.08	166.5	60.68	167
63.86	167.5	64.44	168	65.04	168.5	65.64	169	66.24	169.5
66.84	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	25.91	.05	49.25	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
25.91	49.25	8	9.55	10.42	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	167.32	Element	Left OB	Channel	Right OB
Vel Head (m)	1.53	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	165.80	Reach Len. (m)	8.00	9.55	10.42
Crit W.S. (m)	165.80	Flow Area (m2)	3.16	80.54	4.21
E.G. Slope (m/m)	0.020028	Area (m2)	3.16	80.54	4.21
Q Total (m3/s)	460.00	Flow (m3/s)	5.59	446.67	7.74
Top Width (m)	31.23	Top Width (m)	3.41	23.34	4.48
Vel Total (m/s)	5.23	Avg. Vel. (m/s)	1.77	5.55	1.84
Max Chl Dpth (m)	6.05	Hydr. Depth (m)	0.93	3.45	0.94
Conv. Total (m3/s)	3250.4	Conv. (m3/s)	39.5	3156.2	54.7
Length Wtd. (m)	9.54	Wetted Per. (m)	3.87	29.36	4.85
Min Ch El (m)	159.75	Shear (N/m2)	160.57	538.69	170.38
Alpha	1.09	Stream Power (N/m s)	283.85	2987.57	313.31
Frctn Loss (m)	0.09	Cum Volume (1000 m3)	0.58	12.60	2.13
C & E Loss (m)	0.25	Cum SA (1000 m2)	0.45	2.57	1.72

Warning: The energy equation could not be balanced within the specified number of iterations. The
program selected the water surface that had the least amount of error between computed and
assumed values.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than

0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	164.51	Element	Left OB	Channel	Right OB
Vel Head (m)	0.74	Wt. n-Val.		0.050	
W.S. Elev (m)	163.77	Reach Len. (m)	8.00	9.55	10.42
Crit W.S. (m)	163.77	Flow Area (m2)		33.26	
E.G. Slope (m/m)	0.029547	Area (m2)		33.26	
Q Total (m3/s)	127.00	Flow (m3/s)		127.00	
Top Width (m)	22.58	Top Width (m)		22.58	
Vel Total (m/s)	3.82	Avg. Vel. (m/s)		3.82	
Max Chl Dpth (m)	4.02	Hydr. Depth (m)		1.47	
Conv. Total (m3/s)	738.8	Conv. (m3/s)		738.8	
Length Wtd. (m)	9.55	Wetted Per. (m)		28.40	
Min Ch El (m)	159.75	Shear (N/m2)		339.24	
Alpha	1.00	Stream Power (N/m s)		1295.55	
Frctn Loss (m)	0.15	Cum Volume (1000 m3)	0.00	5.81	0.00
C & E Loss (m)	0.10	Cum SA (1000 m2)	0.02	2.55	0.02

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 11

INPUT
Description: RS-11
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	17.56	165.6	18.24	165	18.95	164.5	19.66	164
20.48	163.5	22.28	163.21	22.82	163	23.22	162.5	24.11	162
25.29	162.22	27.12	160.92	27.72	161.5	28.17	160.76	38.14	161.5
40.57	161.5	44.62	162	45.51	162.5	46.6	163	50.43	164
51.09	164.88	51.26	164.5	51.68	164.79	52.29	165	53.45	165.5
54.47	166	60.96	166.5	62.34	167	63.06	167.5	64.86	168.5
66.08	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	22.82	.05	46.6	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.82	46.6	7.47	12.58	16.24	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	166.90	Element	Left OB	Channel	Right OB
Vel Head (m)	0.70	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	166.20	Reach Len. (m)	7.47	12.58	16.24
Crit W.S. (m)		Flow Area (m2)	12.54	110.73	15.03
E.G. Slope (m/m)	0.005204	Area (m2)	12.54	110.73	15.03
Q Total (m3/s)	460.00	Flow (m3/s)	16.79	424.84	18.37
Top Width (m)	41.90	Top Width (m)	7.65	23.78	10.46
Vel Total (m/s)	3.33	Avg. Vel. (m/s)	1.34	3.84	1.22
Max Chl Dpth (m)	5.44	Hydr. Depth (m)	1.64	4.66	1.44
Conv. Total (m3/s)	6376.4	Conv. (m3/s)	232.7	5889.0	254.6
Length Wtd. (m)	12.60	Wetted Per. (m)	8.47	25.54	11.63
Min Ch El (m)	160.76	Shear (N/m2)	75.55	221.31	65.94
Alpha	1.24	Stream Power (N/m s)	101.12	849.12	80.61
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.52	11.68	2.03

```
  C & E Loss (m)            0.09    Cum SA (1000 m2)          0.41       2.35
1.65


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           163.82    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.41    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           163.41    Reach Len. (m)            7.47      12.58
16.24
  Crit W.S. (m)                     Flow Area (m2)            0.29      44.40
0.32
  E.G. Slope (m/m)      0.009744    Area (m2)                 0.29      44.40
0.32
  Q Total (m3/s)          127.00    Flow (m3/s)               0.12     126.73
0.15
  Top Width (m)            27.13    Top Width (m)             1.78      23.78
1.57
  Vel Total (m/s)           2.82    Avg. Vel. (m/s)           0.41       2.85
0.48
  Max Chl Dpth (m)          2.65    Hydr. Depth (m)           0.16       1.87
0.21
  Conv. Total (m3/s)      1286.6    Conv. (m3/s)               1.2     1283.8
1.6
  Length Wtd. (m)          12.58    Wetted Per. (m)           1.84      25.54
1.62
  Min Ch El (m)           160.76    Shear (N/m2)             15.03     166.13
18.96
  Alpha                     1.02    Stream Power (N/m s)      6.18     474.22
9.10
  Frctn Loss (m)            0.07    Cum Volume (1000 m3)      0.00       5.44
0.00
  C & E Loss (m)            0.06    Cum SA (1000 m2)          0.01       2.33
0.02


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION


RIVER: Río Turabo
REACH: Intake             RS: 10

INPUT
```

Description: RS-10
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	12.7	165	14.14	164	15.11	163.446	15.89	163
16.51	162.5	18.42	162	20.36	161.5	22.1	161	22.54	161
23.24	161	30.44	161	34.92	161	41.9	161	42.36	160.7
42.83	161.5	43.32	162	43.85	162.5	44.74	163	45.54	163.5
46.37	164	47.04	164.5	55.72	165	57.69	165.5	58.6	166
59.16	167	59.77	167.5	60.29	168	61.2	168.5	62.25	169.5
62.73	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	15.11	.05	45.54	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.11	45.54	21.67	21.36	19.89	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	166.76	Element	Left OB	Channel	Right OB
Vel Head (m)	0.40	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	166.37	Reach Len. (m)	21.67	21.36	19.89
Crit W.S. (m)		Flow Area (m2)	7.62	151.82	20.41
E.G. Slope (m/m)	0.002589	Area (m2)	7.62	151.82	20.41
Q Total (m3/s)	460.00	Flow (m3/s)	6.09	434.82	19.08
Top Width (m)	49.57	Top Width (m)	5.88	30.43	13.26
Vel Total (m/s)	2.56	Avg. Vel. (m/s)	0.80	2.86	0.93
Max Chl Dpth (m)	5.67	Hydr. Depth (m)	1.30	4.99	1.54
Conv. Total (m3/s)	9041.1	Conv. (m3/s)	119.8	8546.2	375.1
Length Wtd. (m)	21.31	Wetted Per. (m)	6.60	32.15	13.99
Min Ch El (m)	160.70	Shear (N/m2)	29.31	119.87	37.04
Alpha	1.19	Stream Power (N/m s)	23.45	343.30	34.63
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	0.44	10.03	1.74
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.36	2.01	1.45

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	163.69	Element	Left OB	Channel	Right OB

```
  Vel Head (m)              0.20    Wt. n-Val.               0.070      0.050
  W.S. Elev (m)           163.49    Reach Len. (m)           21.67      21.36
19.89
  Crit W.S. (m)                     Flow Area (m2)            0.00      64.21
  E.G. Slope (m/m)      0.003884    Area (m2)                 0.00      64.21
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
  Top Width (m)            30.48    Top Width (m)             0.07      30.41
  Vel Total (m/s)           1.98    Avg. Vel. (m/s)           0.06       1.98
  Max Chl Dpth (m)          2.79    Hydr. Depth (m)           0.02       2.11
  Conv. Total (m3/s)      2037.7    Conv. (m3/s)               0.0     2037.7
  Length Wtd. (m)          21.36    Wetted Per. (m)           0.08      32.13
  Min Ch El (m)           160.70    Shear (N/m2)              0.68      76.13
  Alpha                     1.00    Stream Power (N/m s)      0.04     150.58
  Frctn Loss (m)            0.08    Cum Volume (1000 m3)      0.00       4.76
0.00
  C & E Loss (m)            0.00    Cum SA (1000 m2)          0.00       1.99
0.00


CROSS SECTION


RIVER: Río Turabo
REACH: Intake             RS: 9

INPUT
Description: RS-9
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     170   10.95 163.392    11.6     163    12.3   162.5   14.54     162
   15.82   161.5   18.13     161   20.32   160.5   21.68  160.14   24.82  158.73
   31.34     160    32.3   160.5   33.37  162.86   34.56     163   38.27   163.5
   39.38   163.6   43.41  165.05    46.9  165.01   52.47  165.22   56.63   165.5
   57.65   166.5   59.01   167.5   59.48     168      60   168.5   60.51   169.5
   60.77     170

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   10.95     .05   38.27     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         10.95   38.27            13.08   11.48    11.6             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
    46.9   52.47  171.11

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           166.70    Element                  Left OB    Channel
Right OB
  Vel Head (m)              0.46    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           166.24    Reach Len. (m)           13.08      11.48
11.60
  Crit W.S. (m)                     Flow Area (m2)            6.73     142.63
18.90
```

```
  E.G. Slope (m/m)      0.002934    Area (m2)                 6.73     142.63
18.90
  Q Total (m3/s)          460.00    Flow (m3/s)               5.95     436.80
17.25
  Top Width (m)            45.59    Top Width (m)             4.72      27.32
13.55
  Vel Total (m/s)           2.73    Avg. Vel. (m/s)           0.88       3.06
0.91
  Max Chl Dpth (m)          7.51    Hydr. Depth (m)           1.43       5.22
1.40
  Conv. Total (m3/s)      8492.6    Conv. (m3/s)             109.8     8064.3
318.5
  Length Wtd. (m)          11.52    Wetted Per. (m)           5.52      30.01
16.37
  Min Ch El (m)           158.73    Shear (N/m2)             35.11     136.76
33.21
  Alpha                     1.20    Stream Power (N/m s)     31.02     418.83
30.32
  Frctn Loss (m)            0.06    Cum Volume (1000 m3)      0.29       6.89
1.35
  C & E Loss (m)            0.09    Cum SA (1000 m2)          0.24       1.39
1.19


Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           163.61    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.19    Wt. n-Val.               0.070      0.050
  W.S. Elev (m)           163.42    Reach Len. (m)           13.08      11.48
11.60
  Crit W.S. (m)                     Flow Area (m2)            0.00      65.45
  E.G. Slope (m/m)      0.003235    Area (m2)                 0.00      65.45
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
  Top Width (m)            26.74    Top Width (m)             0.04      26.70
  Vel Total (m/s)           1.94    Avg. Vel. (m/s)           0.04       1.94
  Max Chl Dpth (m)          4.69    Hydr. Depth (m)           0.01       2.45
  Conv. Total (m3/s)      2232.7    Conv. (m3/s)               0.0     2232.7
  Length Wtd. (m)          11.48    Wetted Per. (m)           0.05      29.38
  Min Ch El (m)           158.73    Shear (N/m2)              0.33      70.68
  Alpha                     1.00    Stream Power (N/m s)      0.01     137.15
  Frctn Loss (m)            0.08    Cum Volume (1000 m3)      0.00       3.37
0.00
  C & E Loss (m)            0.07    Cum SA (1000 m2)          0.00       1.38
0.00
```

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 8

INPUT
Description: RS-8
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	13.81	162.586	13.97	162.5	15.65	162	17.61	161.5
17.84	161	18.74	160.5	19.27	160	19.61	160	19.82	160.35
21.25	159.96	22.04	160.24	29.2	160.5	29.75	161	31.69	162.59
32.19	163	35.34	163.5	38.58	164	50.87	165	51.08	164.99
57.88	169.7	79.04	170						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	13.81	.05	31.69	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
13.81	31.69	7.06	15.22	20.5	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
51.08	57.88	171.11

CROSS SECTION OUTPUT Profile #100-yr

			Left OB	Channel	Right OB
E.G. Elev (m)	166.55	Element			
Vel Head (m)	1.37	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	165.18	Reach Len. (m)	7.06	15.22	20.50
Crit W.S. (m)	165.18	Flow Area (m2)	6.27	77.03	20.30
E.G. Slope (m/m)	0.011944	Area (m2)	6.27	77.03	20.30
Q Total (m3/s)	460.00	Flow (m3/s)	10.69	417.13	32.18
Top Width (m)	42.10	Top Width (m)	4.83	17.88	19.39
Vel Total (m/s)	4.44	Avg. Vel. (m/s)	1.71	5.42	1.59
Max Chl Dpth (m)	5.22	Hydr. Depth (m)	1.30	4.31	1.05
Conv. Total (m3/s)	4209.1	Conv. (m3/s)	97.8	3816.8	294.4

```
  Length Wtd. (m)          15.28    Wetted Per. (m)           5.48      19.75
19.85
  Min Ch El (m)           159.96    Shear (N/m2)            133.84     456.77
119.82
  Alpha                     1.36    Stream Power (N/m s)    228.40    2473.59
189.92
  Frctn Loss (m)            0.17    Cum Volume (1000 m3)      0.20       5.63
1.12
  C & E Loss (m)            0.00    Cum SA (1000 m2)          0.18       1.13
0.99


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program used critical depth for the water surface and continued on with
the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current
and previous cross section.
         This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was
set equal to critical
         depth, the calculated water surface came back below critical depth.
This indicates that there is
         not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           163.46    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.87    Wt. n-Val.                          0.050
  W.S. Elev (m)           162.59    Reach Len. (m)            7.06      15.22
20.50
  Crit W.S. (m)           162.59    Flow Area (m2)                      30.68
  E.G. Slope (m/m)      0.023805    Area (m2)                 0.00      30.68
  Q Total (m3/s)          127.00    Flow (m3/s)                        127.00
  Top Width (m)            17.88    Top Width (m)             0.00      17.88
  Vel Total (m/s)           4.14    Avg. Vel. (m/s)                     4.14
  Max Chl Dpth (m)          2.63    Hydr. Depth (m)                     1.72
  Conv. Total (m3/s)       823.1    Conv. (m3/s)                       823.1
  Length Wtd. (m)          15.22    Wetted Per. (m)                    19.75
  Min Ch El (m)           159.96    Shear (N/m2)                       362.68
  Alpha                     1.00    Stream Power (N/m s)              1501.26
  Frctn Loss (m)            0.15    Cum Volume (1000 m3)      0.00       2.82
0.00
  C & E Loss (m)            0.16    Cum SA (1000 m2)          0.00       1.13
0.00


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program used critical depth for the water surface and continued on with
the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
```

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 7

INPUT
Description: RS-7
Station Elevation Data num= 46

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	13.69	161.811	14.21	161.5	14.51	161	14.99	160
15.54	159	15.87	158.5	16.15	158	16.86	157.5	17.04	157.5
17.05	158	17.27	158	18.28	157.5	19.2	157	19.54	157
20.55	157.5	21.15	158	21.56	158	23.19	158	23.61	158.5
25.13	158.5	26.26	158.5	26.56	159	26.72	159.5	26.83	160
27.86	160.5	28.95	161	29.95	161.812	32.03	163.5	32.23	164
32.41	164.5	32.59	165	32.72	165.5	32.84	165.56	36.59	165.46
37.98	165.5	43.36	165.5	44.52	166	44.72	166.12	54.1	166.09
58.86	166.5	59.2	167	59.46	168	59.49	167.5	59.7	168.5
81.86	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	13.69	.05	29.95	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
13.69 29.95 10.56 13.22 12.99 .1 .3
Blocked Obstructions num= 1

Sta L	Sta R	Elev
44.72	54.1	169.9

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.47	Element	Left OB	Channel	Right OB
Vel Head (m)	1.37	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.10	Reach Len. (m)	10.56	13.22	12.99
Crit W.S. (m)		Flow Area (m2)	4.37	85.63	3.07

```
  E.G. Slope (m/m)      0.010831    Area (m2)                 4.37      85.63
3.07
  Q Total (m3/s)          460.00    Flow (m3/s)               6.42     449.25
4.33
  Top Width (m)            22.40    Top Width (m)             3.82      16.26
2.32
  Vel Total (m/s)           4.94    Avg. Vel. (m/s)           1.47       5.25
1.41
  Max Chl Dpth (m)          7.10    Hydr. Depth (m)           1.14       5.27
1.33
  Conv. Total (m3/s)      4420.0    Conv. (m3/s)              61.7     4316.7
41.6
  Length Wtd. (m)          13.19    Wetted Per. (m)           4.46      21.40
3.32
  Min Ch El (m)           157.00    Shear (N/m2)            104.24     425.05
98.21
  Alpha                     1.10    Stream Power (N/m s)    153.05    2229.98
138.57
  Frctn Loss (m)            0.09    Cum Volume (1000 m3)      0.16       4.39
0.88
  C & E Loss (m)            0.20    Cum SA (1000 m2)          0.15       0.87
0.77


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           162.18    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.34    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           161.84    Reach Len. (m)           10.56      13.22
12.99
  Crit W.S. (m)                     Flow Area (m2)            0.00      48.94
0.00
  E.G. Slope (m/m)      0.005586    Area (m2)                 0.00      48.94
0.00
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
0.00
  Top Width (m)            16.35    Top Width (m)             0.05      16.26
0.04
  Vel Total (m/s)           2.59    Avg. Vel. (m/s)           0.06       2.59
0.05
  Max Chl Dpth (m)          4.84    Hydr. Depth (m)           0.02       3.01
0.01
  Conv. Total (m3/s)      1699.2    Conv. (m3/s)               0.0     1699.2
0.0
  Length Wtd. (m)          13.22    Wetted Per. (m)           0.06      21.40
0.05
```

Min Ch El (m)	157.00	Shear (N/m2)	0.72	125.30	0.64
Alpha	1.00	Stream Power (N/m s)	0.04	325.15	0.03
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	0.00	2.21	0.00
C & E Loss (m)	0.03	Cum SA (1000 m2)	0.00	0.87	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 6

INPUT
Description: RS-6
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	11.19	162.5	11.47	161.817	11.6	161.5	11.86	160.5
12.03	160	12.61	159.5	13.97	159	15.16	158.51	16.46	158.48
17.67	158.46	19.02	158.48	20.38	158.48	21.77	158.46	23.05	158.5
23.41	158.34	24.45	158	25.6	158	26.27	158.5	27.1	159
28.43	159.5	29.83	160	30.99	160.5	32.14	161	32.58	161.817
33.19	162.95	33.39	163	39.16	163	44.58	164	46.28	163.8
55.68	167.92	57.55	168	62.95	168.15	86.63	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	11.47	.05	32.58	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
11.47	32.58	3.83	10.25	22.74	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
46.28	55.68	169.9

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.19	Element	Left OB	Channel	Right OB
Vel Head (m)	0.72	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.47	Reach Len. (m)	3.83	10.25	22.74
Crit W.S. (m)		Flow Area (m2)	3.53	115.00	16.24
E.G. Slope (m/m)	0.004566	Area (m2)	3.53	115.00	16.24
Q Total (m3/s)	460.00	Flow (m3/s)	3.00	440.58	16.42
Top Width (m)	38.02	Top Width (m)	3.21	21.11	13.70
Vel Total (m/s)	3.41	Avg. Vel. (m/s)	0.85	3.83	1.01

Max Chl Dpth (m)	6.47	Hydr. Depth (m)	1.10	5.45	1.19
Conv. Total (m3/s)	6807.4	Conv. (m3/s)	44.5	6520.0	242.9
Length Wtd. (m)	10.83	Wetted Per. (m)	4.27	24.09	15.15
Min Ch El (m)	158.00	Shear (N/m2)	37.04	213.73	47.99
Alpha	1.21	Stream Power (N/m s)	31.50	818.85	48.51
Frctn Loss (m)	0.05	Cum Volume (1000 m3)	0.12	3.06	0.75
C & E Loss (m)	0.02	Cum SA (1000 m2)	0.11	0.62	0.67

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	162.09	Element	Left OB	Channel	Right OB
Vel Head (m)	0.23	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	161.87	Reach Len. (m)	3.83	10.25	22.74
Crit W.S. (m)		Flow Area (m2)	0.00	60.11	0.00
E.G. Slope (m/m)	0.003298	Area (m2)	0.00	60.11	0.00
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	0.00
Top Width (m)	21.16	Top Width (m)	0.02	21.11	0.03
Vel Total (m/s)	2.11	Avg. Vel. (m/s)	0.04	2.11	0.04
Max Chl Dpth (m)	3.87	Hydr. Depth (m)	0.02	2.85	0.02
Conv. Total (m3/s)	2211.4	Conv. (m3/s)	0.0	2211.4	0.0
Length Wtd. (m)	10.25	Wetted Per. (m)	0.05	24.09	0.06
Min Ch El (m)	158.00	Shear (N/m2)	0.31	80.69	0.38
Alpha	1.00	Stream Power (N/m s)	0.01	170.49	0.02
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.00	1.49	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.00	0.62	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 5

INPUT

Description: RS-5
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	10.43	163.5	10.69	162.5	10.92	161.758	11	161.5
11.13	161	11.58	160.5	12.35	160	13.09	159.5	13.89	159
17.49	158.5	21.01	158.5	25.53	158.5	25.92	158.5	27.26	159
28.39	159.5	29.52	160	30.61	160.5	31.52	161	32.66	161.5
33.27	161.761	33.83	162	37.99	162.5	45.39	163.5	51.61	164
54.92	164.5	58.18	165	63.95	165.22	64.88	165.5	66.42	166
67.97	166.5	69	167	71.32	167.5	99.36	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	10.92	.05	33.27	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
10.92	33.27	2.23	2.1	4.27	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
63.95	69	168.27

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.12	Element	Left OB	Channel	Right OB
Vel Head (m)	0.66	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.46	Reach Len. (m)	2.23	2.10	4.27
Crit W.S. (m)		Flow Area (m2)	1.66	116.25	26.59
E.G. Slope (m/m)	0.004261	Area (m2)	1.66	116.25	26.59
Q Total (m3/s)	460.00	Flow (m3/s)	0.92	430.59	28.49
Top Width (m)	45.78	Top Width (m)	2.03	22.35	21.40
Vel Total (m/s)	3.18	Avg. Vel. (m/s)	0.55	3.70	1.07
Max Chl Dpth (m)	5.96	Hydr. Depth (m)	0.82	5.20	1.24
Conv. Total (m3/s)	7047.1	Conv. (m3/s)	14.1	6596.7	436.4
Length Wtd. (m)	2.23	Wetted Per. (m)	3.63	24.33	21.60
Min Ch El (m)	158.50	Shear (N/m2)	19.10	199.68	51.45
Alpha	1.27	Stream Power (N/m s)	10.57	739.61	55.12
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.11	1.88	0.27
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.10	0.40	0.27

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	162.05	Element	Left OB	Channel	Right OB
Vel Head (m)	0.26	Wt. n-Val.	0.000	0.050	0.070
W.S. Elev (m)	161.80	Reach Len. (m)	2.23	2.10	4.27
Crit W.S. (m)		Flow Area (m2)	0.00	56.75	0.00
E.G. Slope (m/m)	0.004047	Area (m2)	0.00	56.75	0.00
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	0.00
Top Width (m)	22.45	Top Width (m)	0.01	22.35	0.09
Vel Total (m/s)	2.24	Avg. Vel. (m/s)	0.03	2.24	0.06
Max Chl Dpth (m)	3.30	Hydr. Depth (m)	0.02	2.54	0.02
Conv. Total (m3/s)	1996.3	Conv. (m3/s)	0.0	1996.3	0.0
Length Wtd. (m)	2.10	Wetted Per. (m)	0.04	24.33	0.10
Min Ch El (m)	158.50	Shear (N/m2)		92.58	0.70
Alpha	1.00	Stream Power (N/m s)		207.20	0.04
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	0.00	0.90	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.00	0.40	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 4

INPUT
Description: RS-4
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	10.08	163.5	10.62	161.758	10.7	161.5	11.1	161
11.9	160.5	13.33	159.5	16.15	159	17.07	158.5	17.6	158
19.56	158	20.42	158.5	25.61	158.5	25.99	158.5	26.87	159
29.14	160	31.32	161	32.74	161.763	33.18	162	33.72	162
35.07	162.5	37.06	162.5	39.97	162.84	41.4	163	43.21	163.23
44.62	163.5	51.39	164	54.69	164.5	58.05	165	64.46	165.3
69.55	166.83	70.21	167	101.17	170				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	10.62	.05	32.74	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

```
         10.62   32.74            11.64    6.98    3.11             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   64.46   69.55  168.27

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           165.11    Element                  Left OB    Channel
Right OB
  Vel Head (m)              0.70    Wt. n-Val.                0.070      0.050
0.070
  W.S. Elev (m)           164.41    Reach Len. (m)            11.64       6.98
3.11
  Crit W.S. (m)                     Flow Area (m2)             1.60     113.42
25.11
  E.G. Slope (m/m)      0.004642    Area (m2)                  1.60     113.42
25.11
  Q Total (m3/s)          460.00    Flow (m3/s)                0.92     432.06
27.02
  Top Width (m)            45.41    Top Width (m)              1.95      22.12
21.34
  Vel Total (m/s)           3.28    Avg. Vel. (m/s)            0.58       3.81
1.08
  Max Chl Dpth (m)          6.41    Hydr. Depth (m)            0.82       5.13
1.18
  Conv. Total (m3/s)      6751.2    Conv. (m3/s)               13.6     6341.1
396.6
  Length Wtd. (m)           6.83    Wetted Per. (m)            3.50      24.27
21.61
  Min Ch El (m)           158.00    Shear (N/m2)              20.81     212.79
52.91
  Alpha                     1.27    Stream Power (N/m s)      12.02     810.59
56.93
  Frctn Loss (m)            0.04    Cum Volume (1000 m3)       0.11       1.64
0.16
  C & E Loss (m)            0.03    Cum SA (1000 m2)           0.10       0.35
0.18


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           162.04    Element                  Left OB    Channel
Right OB
  Vel Head (m)              0.27    Wt. n-Val.                0.000      0.050
0.000
  W.S. Elev (m)           161.77    Reach Len. (m)            11.64       6.98
3.11
  Crit W.S. (m)                     Flow Area (m2)             0.00      55.16
0.00
  E.G. Slope (m/m)      0.004434    Area (m2)                  0.00      55.16
0.00
  Q Total (m3/s)          127.00    Flow (m3/s)                0.00     127.00
0.00
```

```
  Top Width (m)            22.14    Top Width (m)             0.00      22.12
0.02
  Vel Total (m/s)           2.30    Avg. Vel. (m/s)           0.02       2.30
0.03
  Max Chl Dpth (m)          3.77    Hydr. Depth (m)           0.01       2.49
0.01
  Conv. Total (m3/s)      1907.3    Conv. (m3/s)               0.0     1907.3
0.0
  Length Wtd. (m)           6.98    Wetted Per. (m)           0.02      24.27
0.02
  Min Ch El (m)           158.00    Shear (N/m2)                        98.84
  Alpha                     1.00    Stream Power (N/m s)               227.55
  Frctn Loss (m)            0.04    Cum Volume (1000 m3)      0.00       0.78
0.00
  C & E Loss (m)            0.01    Cum SA (1000 m2)          0.00       0.35
0.00


CROSS SECTION


RIVER: Río Turabo
REACH: Intake             RS: 3

INPUT
Description: RS-3
Station Elevation Data    num=      35
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     170   13.01     164    13.4   163.5   14.04     163   14.71   162.5
   15.39     162   16.05   161.5   16.56     161    16.9   160.5   17.18     160
   17.49   159.5   17.84     159   17.92   158.5   19.34     158   21.89     158
   23.64   158.5   26.03     159   30.78   159.5   33.63   160.5   36.57   161.5
   37.72  162.11   38.46   162.5   43.49     163   44.39  163.12   47.16   163.5
   53.62     164   58.06   164.5   61.23     165   69.62  165.44   69.94   165.5
   71.82     166   73.79   166.5   74.71  166.73   75.88     167  106.62     170

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   16.05     .05   36.57     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         16.05   36.57             7.81    4.17    4.71             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   69.62   74.71  168.27

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           165.04    Element                  Left OB    Channel
Right OB
  Vel Head (m)              1.00    Wt. n-Val.                0.070      0.050
0.070
  W.S. Elev (m)           164.03    Reach Len. (m)             7.81       4.17
4.71
  Crit W.S. (m)                     Flow Area (m2)             4.19      96.47
14.99
```

```
  E.G. Slope (m/m)      0.007537    Area (m2)                 4.19      96.47
14.99
  Q Total (m3/s)          460.00    Flow (m3/s)               5.33     438.01
16.67
  Top Width (m)            40.96    Top Width (m)             3.11      20.52
17.33
  Vel Total (m/s)           3.98    Avg. Vel. (m/s)           1.27       4.54
1.11
  Max Chl Dpth (m)          6.03    Hydr. Depth (m)           1.35       4.70
0.86
  Conv. Total (m3/s)      5298.4    Conv. (m3/s)              61.4     5045.1
192.0
  Length Wtd. (m)           4.23    Wetted Per. (m)           4.03      22.82
17.66
  Min Ch El (m)           158.00    Shear (N/m2)             76.81     312.53
62.73
  Alpha                     1.24    Stream Power (N/m s)     97.74    1418.97
69.74
  Frctn Loss (m)            0.03    Cum Volume (1000 m3)      0.08       0.91
0.09
  C & E Loss (m)            0.04    Cum SA (1000 m2)          0.07       0.20
0.12


CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           162.00    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.37    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           161.62    Reach Len. (m)            7.81       4.17
4.71
  Crit W.S. (m)                     Flow Area (m2)            0.01      47.07
0.01
  E.G. Slope (m/m)      0.006929    Area (m2)                 0.01      47.07
0.01
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
0.00
  Top Width (m)            20.92    Top Width (m)             0.16      20.52
0.23
  Vel Total (m/s)           2.70    Avg. Vel. (m/s)           0.16       2.70
0.17
  Max Chl Dpth (m)          3.62    Hydr. Depth (m)           0.06       2.29
0.06
  Conv. Total (m3/s)      1525.7    Conv. (m3/s)               0.0     1525.6
0.0
  Length Wtd. (m)           4.17    Wetted Per. (m)           0.21      22.82
0.27
  Min Ch El (m)           158.00    Shear (N/m2)              3.37     140.19
3.74
  Alpha                     1.00    Stream Power (N/m s)      0.54     378.23
0.64
  Frctn Loss (m)            0.03    Cum Volume (1000 m3)      0.00       0.42
0.00
  C & E Loss (m)            0.01    Cum SA (1000 m2)          0.00       0.20
0.00
```

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 2

INPUT
Description: RS-2
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	19.86	162	20.99	160	21.52	159	21.82	158.5
26.08	158.53	33.22	158.53	33.87	159	34.49	159.5	36.27	160
38.93	160.5	40.76	161	41.6	161.5	42.43	162	42.89	162.39
43.07	162.5	44.06	163	47.1	163	49.5	163.29	51.16	163.5
56.68	164	62.04	164.5	65.21	165	76.21	165.5	77.52	166
78.92	166.5	80.88	167	112.88	170				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	19.86	.05	42.43	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
19.86	42.43	6.6	5.25	4.31	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	164.96	Element	Left OB	Channel	Right OB
Vel Head (m)	0.86	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.10	Reach Len. (m)	6.60	5.25	4.31
Crit W.S. (m)	162.89	Flow Area (m2)	5.49	106.12	11.36
E.G. Slope (m/m)	0.006485	Area (m2)	5.49	106.12	11.36
Q Total (m3/s)	460.00	Flow (m3/s)	6.22	443.26	10.52
Top Width (m)	43.15	Top Width (m)	5.22	22.57	15.36
Vel Total (m/s)	3.74	Avg. Vel. (m/s)	1.13	4.18	0.93
Max Chl Dpth (m)	5.60	Hydr. Depth (m)	1.05	4.70	0.74
Conv. Total (m3/s)	5712.2	Conv. (m3/s)	77.2	5504.3	130.7
Length Wtd. (m)	5.26	Wetted Per. (m)	5.63	25.41	15.71
Min Ch El (m)	158.50	Shear (N/m2)	62.04	265.60	45.97
Alpha	1.20	Stream Power (N/m s)	70.21	1109.38	42.60
Frctn Loss (m)	0.05	Cum Volume (1000 m3)	0.04	0.48	0.03

```
  C & E Loss (m)            0.07    Cum SA (1000 m2)          0.04       0.11
0.04


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           161.95    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.32    Wt. n-Val.                          0.050
  W.S. Elev (m)           161.63    Reach Len. (m)            6.60       5.25
4.31
  Crit W.S. (m)                     Flow Area (m2)                      50.48
  E.G. Slope (m/m)      0.005961    Area (m2)                           50.48
  Q Total (m3/s)          127.00    Flow (m3/s)                        127.00
  Top Width (m)            21.75    Top Width (m)                       21.75
  Vel Total (m/s)           2.52    Avg. Vel. (m/s)                      2.52
  Max Chl Dpth (m)          3.13    Hydr. Depth (m)                      2.32
  Conv. Total (m3/s)      1645.0    Conv. (m3/s)                       1645.0
  Length Wtd. (m)           5.25    Wetted Per. (m)                     24.27
  Min Ch El (m)           158.50    Shear (N/m2)                       121.56
  Alpha                     1.00    Stream Power (N/m s)               305.83
  Frctn Loss (m)            0.06    Cum Volume (1000 m3)                 0.22
0.00
  C & E Loss (m)            0.05    Cum SA (1000 m2)                     0.11
0.00


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION


RIVER: Río Turabo
REACH: Intake             RS: 1

INPUT
Description: RS-1
Station Elevation Data    num=      27
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     170   21.97 161.321    22.6 161.072   26.58   159.5   26.88     159
   27.08   158.5   31.66   158.5   35.38     159   35.78   159.5   38.83     160
   42.03   160.5   43.52     161   44.38   161.5   45.14     162   45.69   162.5
   46.53     163   47.97   163.5   62.18     164   64.88   164.5   67.29     165
```

```
   77.62     165   78.84     165    79.8   165.5   80.98     166   82.52   166.5
    83.9     167  116.76     170

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07    22.6     .05   43.52     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
          22.6   43.52                0       0       0             .1       .3

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           164.84    Element                 Left OB    Channel
Right OB
  Vel Head (m)              1.60    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           163.24    Reach Len. (m)
  Crit W.S. (m)           163.24    Flow Area (m2)            5.95      77.80
3.89
  E.G. Slope (m/m)      0.015302    Area (m2)                 5.95      77.80
3.89
  Q Total (m3/s)          460.00    Flow (m3/s)              10.58     443.06
6.36
  Top Width (m)            30.11    Top Width (m)             5.49      20.92
3.70
  Vel Total (m/s)           5.25    Avg. Vel. (m/s)           1.78       5.70
1.64
  Max Chl Dpth (m)          4.74    Hydr. Depth (m)           1.08       3.72
1.05
  Conv. Total (m3/s)      3718.6    Conv. (m3/s)              85.5     3581.7
51.4
  Length Wtd. (m)                   Wetted Per. (m)           5.90      22.28
4.36
  Min Ch El (m)           158.50    Shear (N/m2)            151.34     524.08
133.76
  Alpha                     1.14    Stream Power (N/m s)    268.95    2984.64
218.92
  Frctn Loss (m)                    Cum Volume (1000 m3)
  C & E Loss (m)                    Cum SA (1000 m2)


Warning: Slope too steep for slope area to converge during supercritical flow
calculations (normal depth is
         below critical depth). Water surface set to critical depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           161.85    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.78    Wt. n-Val.                          0.050
0.070
  W.S. Elev (m)           161.07    Reach Len. (m)
  Crit W.S. (m)           161.07    Flow Area (m2)                      32.38
0.00
  E.G. Slope (m/m)      0.023349    Area (m2)                           32.38
0.00
```

Q Total (m3/s)	127.00	Flow (m3/s)	127.00
0.00			
Top Width (m)	21.03	Top Width (m)	20.91
0.12			
Vel Total (m/s)	3.92	Avg. Vel. (m/s)	3.92
0.21			
Max Chl Dpth (m)	2.57	Hydr. Depth (m)	1.55
0.03			
Conv. Total (m3/s)	831.1	Conv. (m3/s)	831.1
0.0			
Length Wtd. (m)		Wetted Per. (m)	22.27
0.14			
Min Ch El (m)	158.50	Shear (N/m2)	332.92
6.90			
Alpha	1.00	Stream Power (N/m s)	1305.77
1.46			
Frctn Loss (m)		Cum Volume (1000 m3)	
C & E Loss (m)		Cum SA (1000 m2)	

Warning: Slope too steep for slope area to converge during supercritical flow calculations (normal depth is
below critical depth). Water surface set to critical depth.

SUMMARY OF MANNING'S N VALUES

River:Río Turabo

Reach	River Sta.	n1	n2	n3
Intake	13	.07	.05	.07
Intake	12	.07	.05	.07
Intake	11	.07	.05	.07
Intake	10	.07	.05	.07
Intake	9	.07	.05	.07
Intake	8	.07	.05	.07
Intake	7	.07	.05	.07
Intake	6	.07	.05	.07
Intake	5	.07	.05	.07
Intake	4	.07	.05	.07
Intake	3	.07	.05	.07
Intake	2	.07	.05	.07
Intake	1	.07	.05	.07

SUMMARY OF REACH LENGTHS

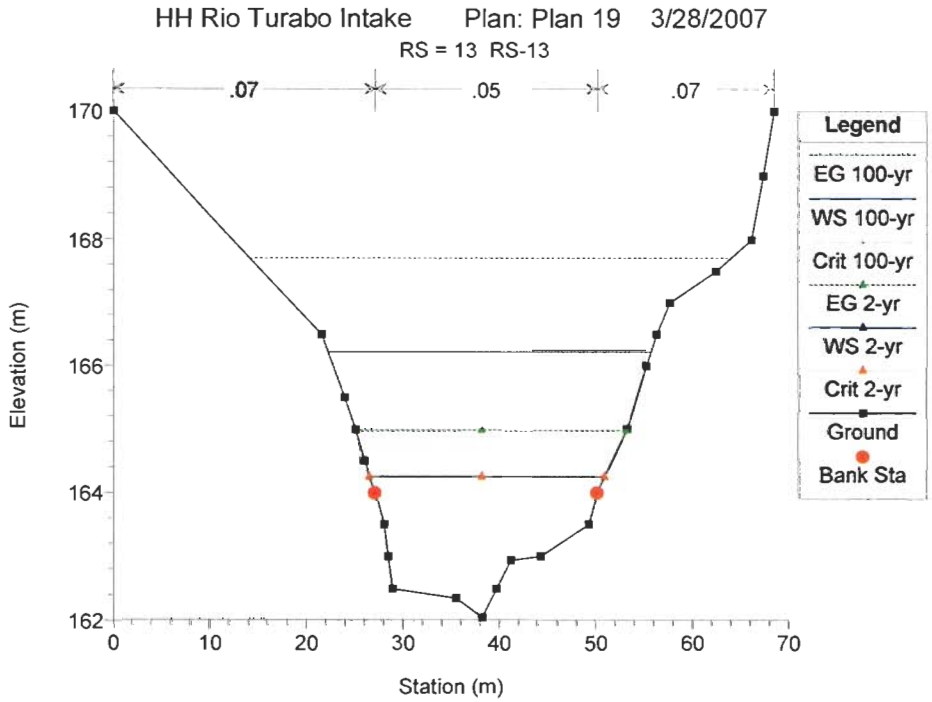
River: Río Turabo

Reach	River Sta.	Left	Channel	Right
Intake	13	2.29	6.17	7.7
Intake	12	8	9.55	10.42

Intake	11	7.47	12.58	16.24
Intake	10	21.67	21.36	19.89
Intake	9	13.08	11.48	11.6
Intake	8	7.06	15.22	20.5
Intake	7	10.56	13.22	12.99
Intake	6	3.83	10.25	22.74
Intake	5	2.23	2.1	4.27
Intake	4	11.64	6.98	3.11
Intake	3	7.81	4.17	4.71
Intake	2	6.6	5.25	4.31
Intake	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Río Turabo

Reach	River Sta.	Contr.	Expan.
Intake	13	.1	.3
Intake	12	.1	.3
Intake	11	.1	.3
Intake	10	.1	.3
Intake	9	.1	.3
Intake	8	.1	.3
Intake	7	.1	.3
Intake	6	.1	.3
Intake	5	.1	.3
Intake	4	.1	.3
Intake	3	.1	.3
Intake	2	.1	.3
Intake	1	.1	.3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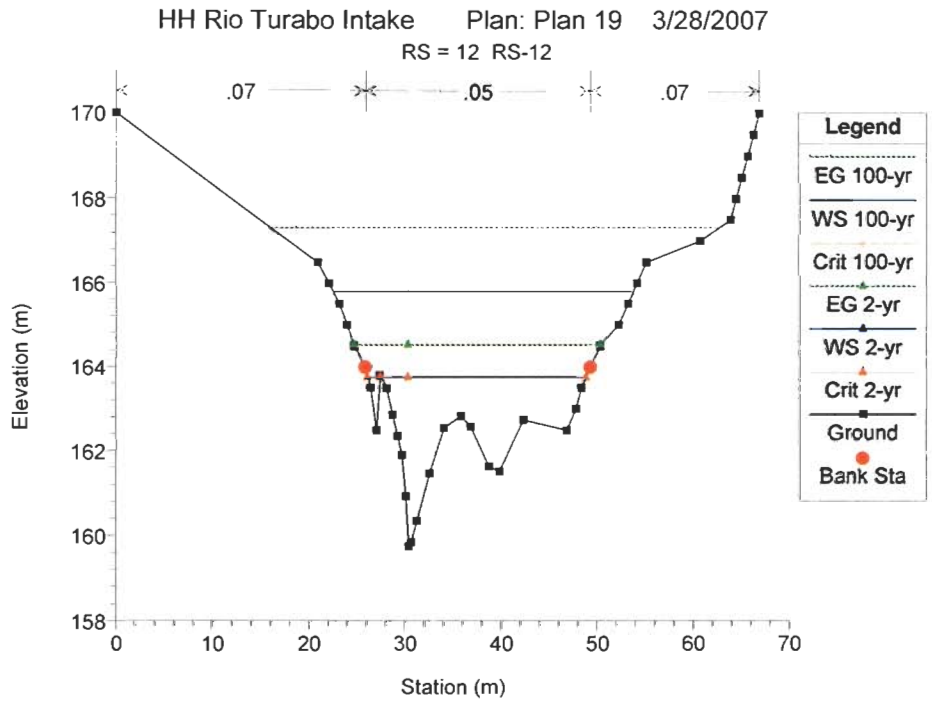
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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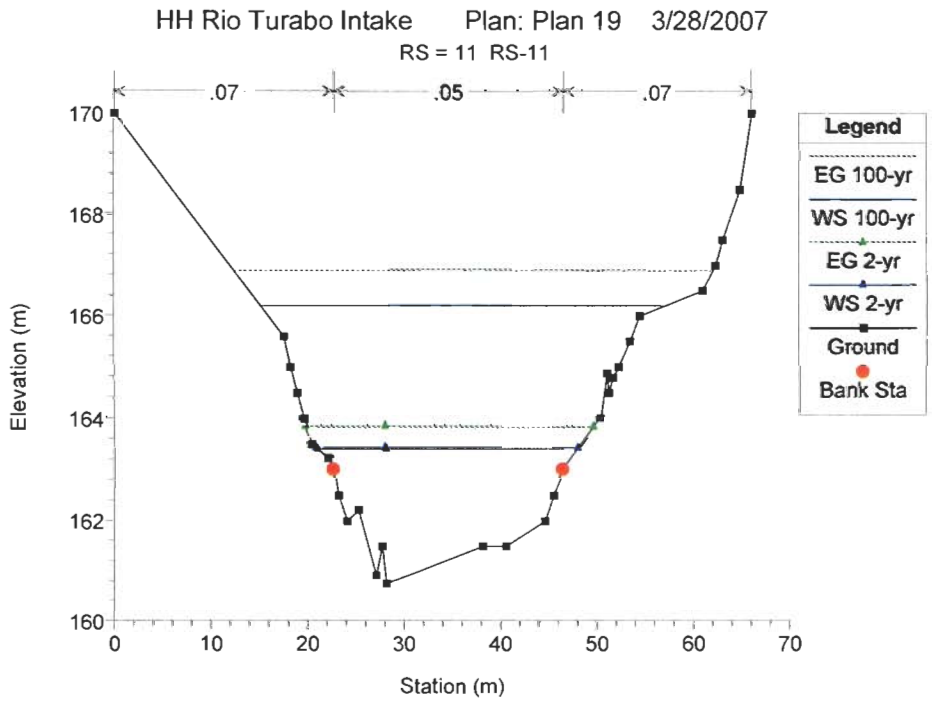
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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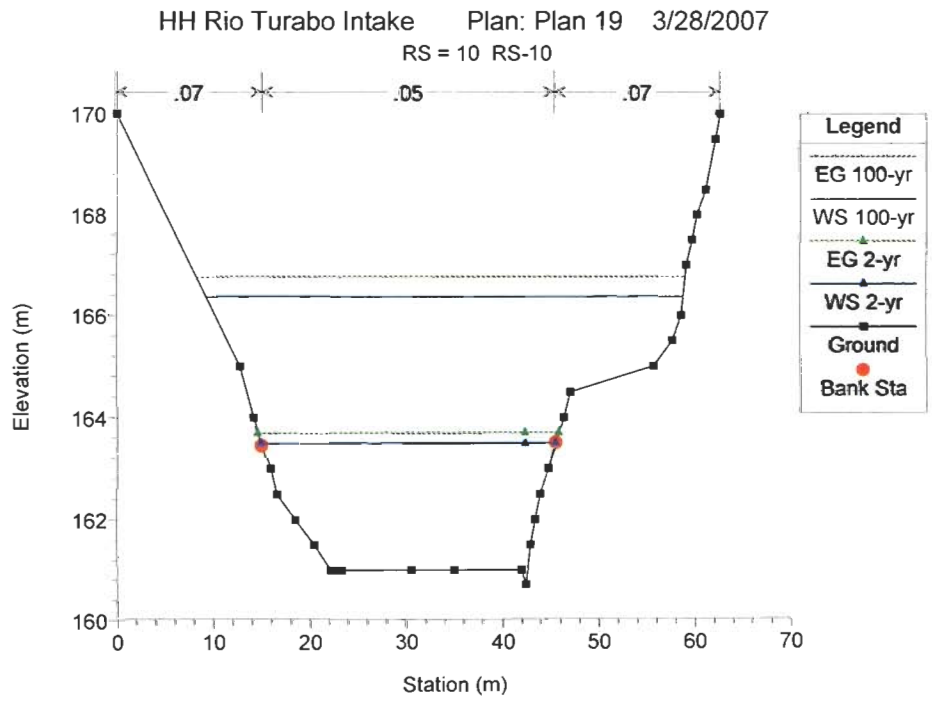
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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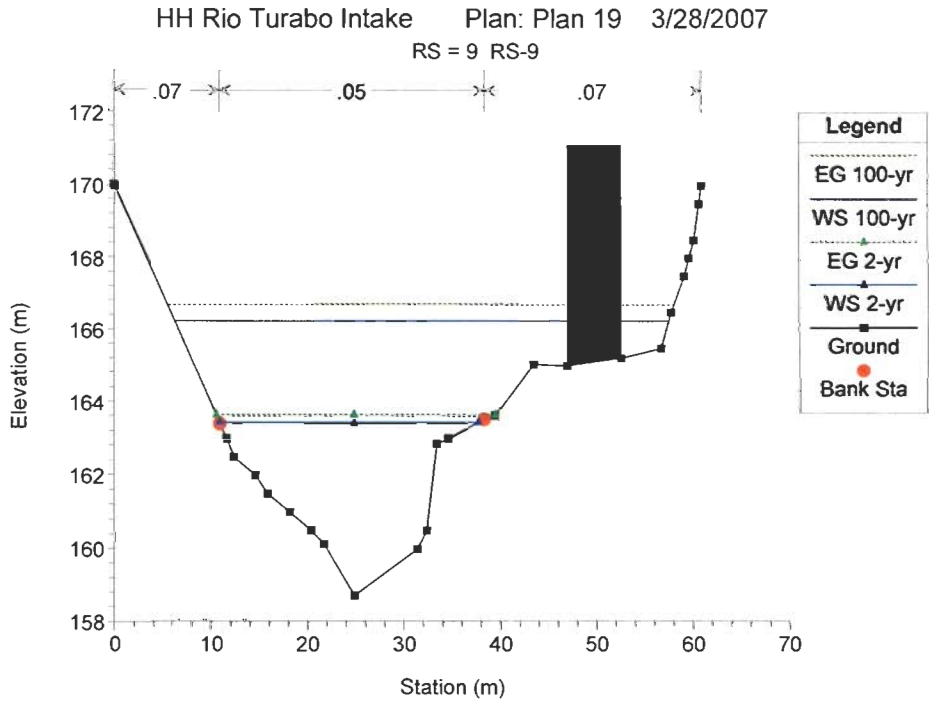
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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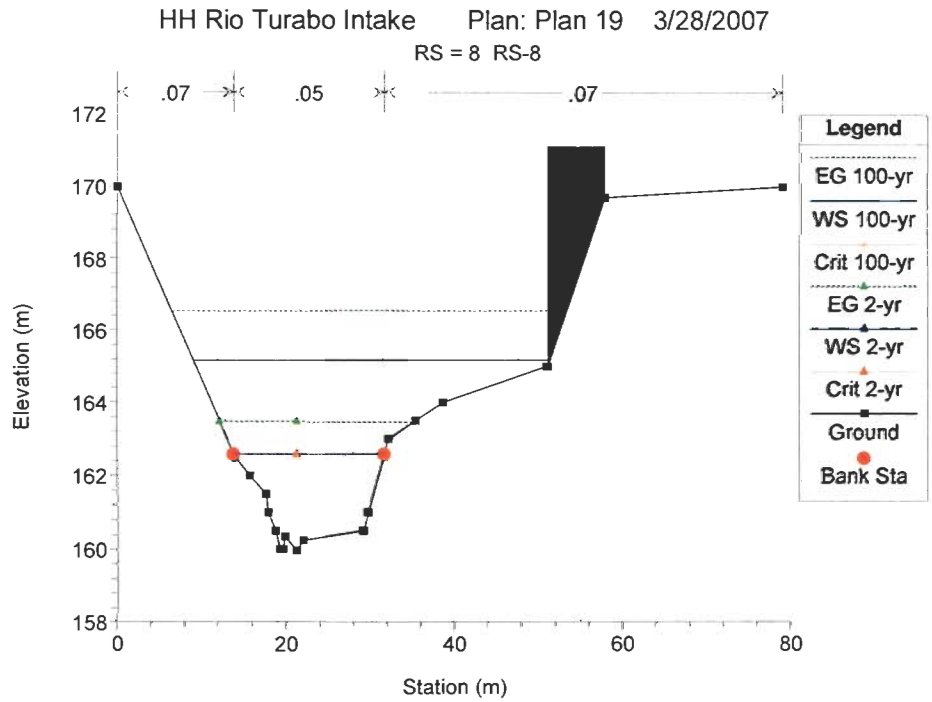
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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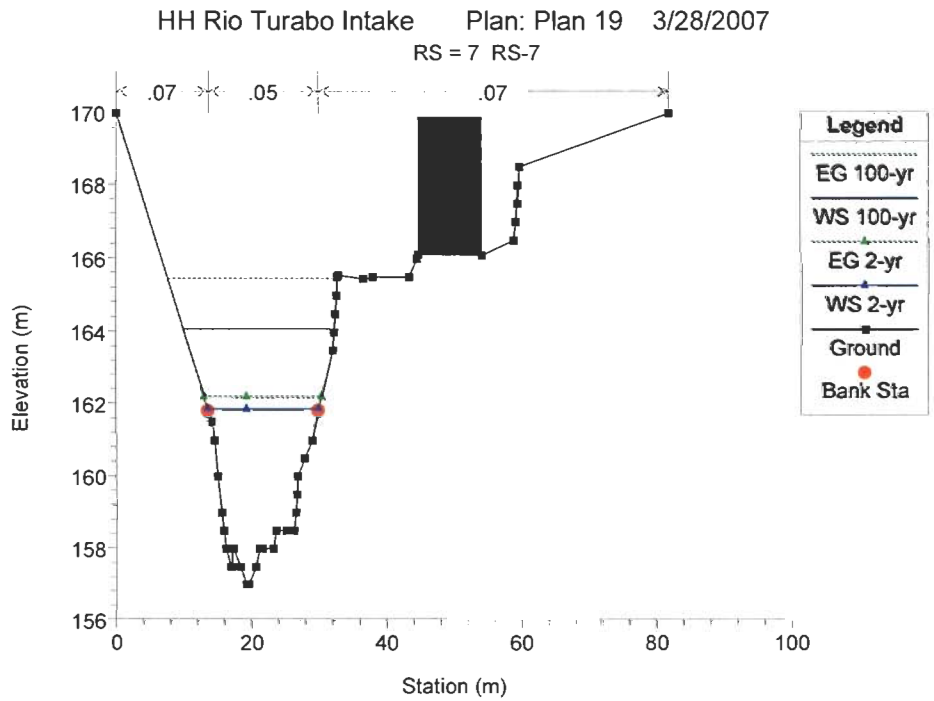
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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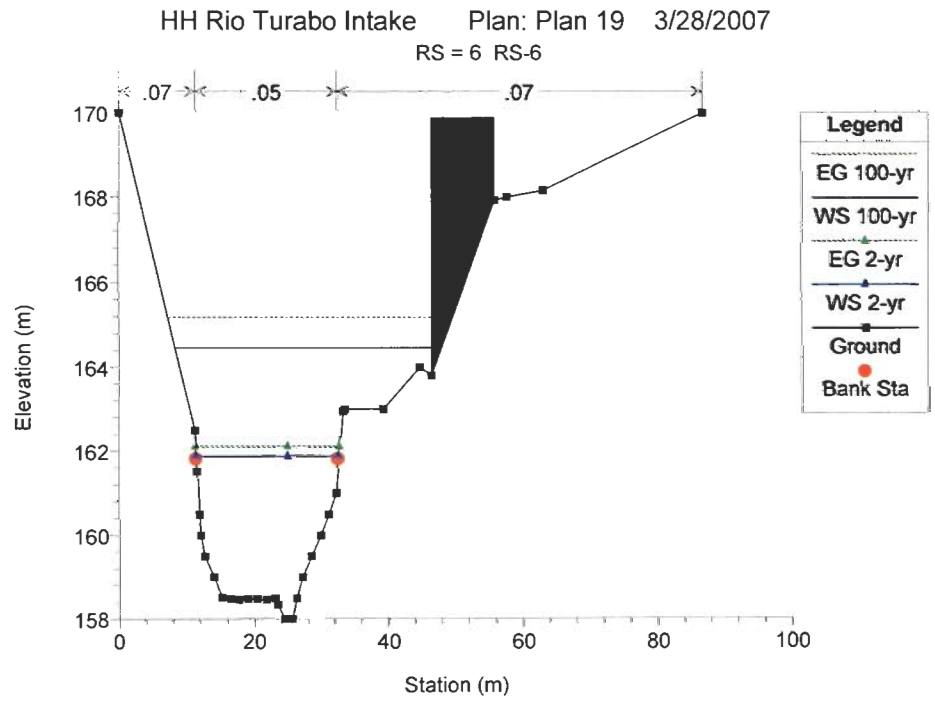
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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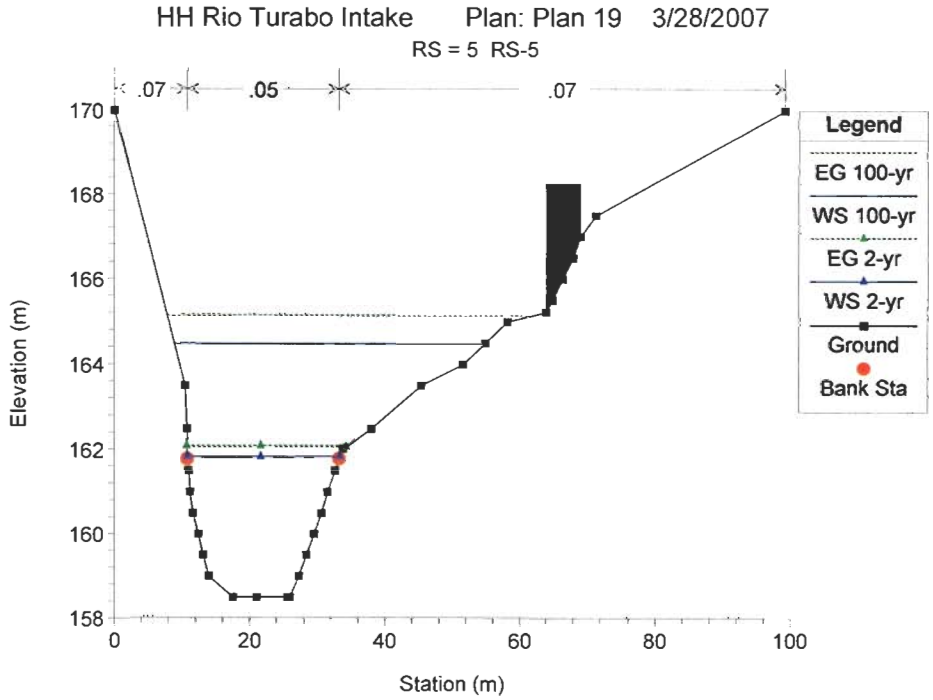
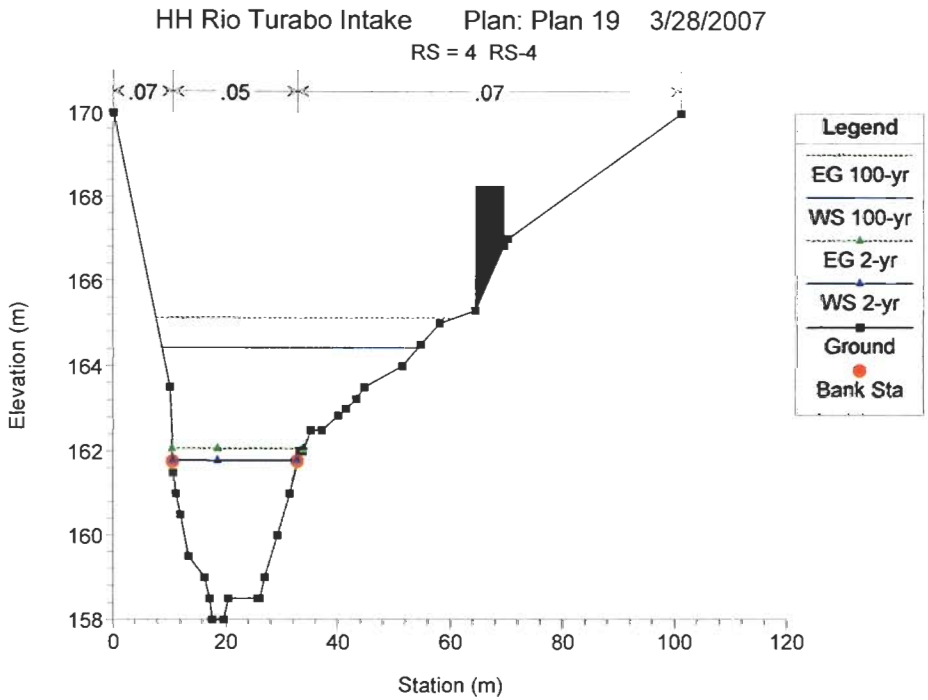
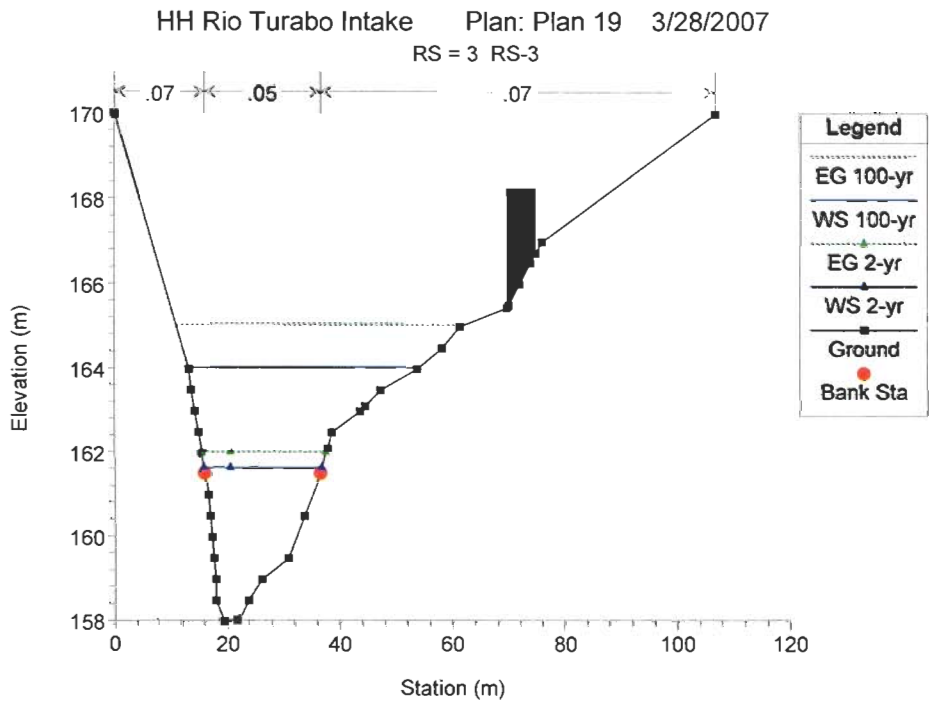
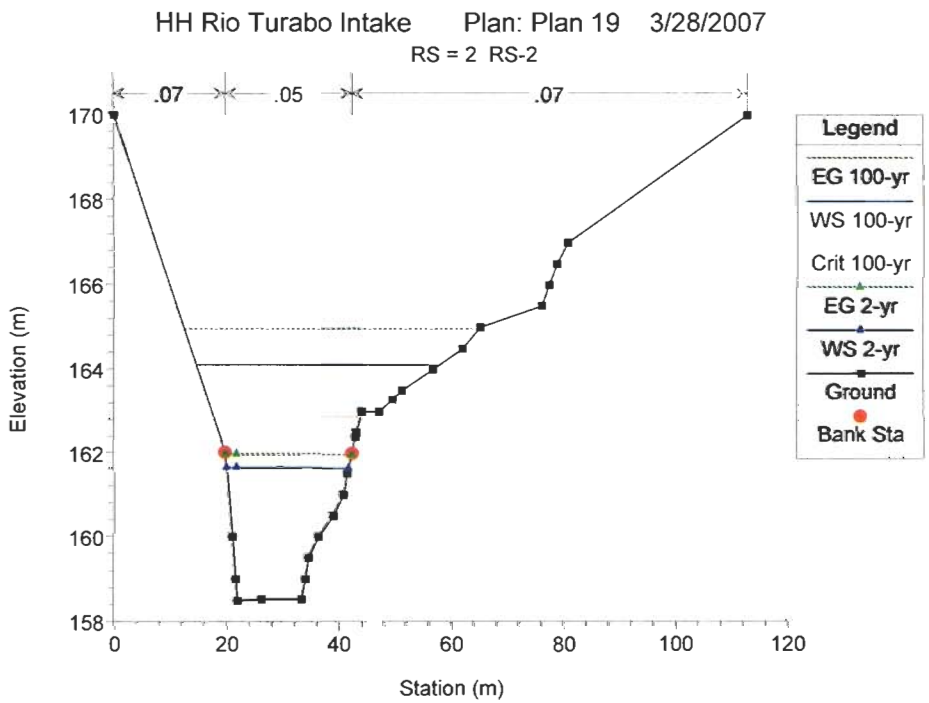
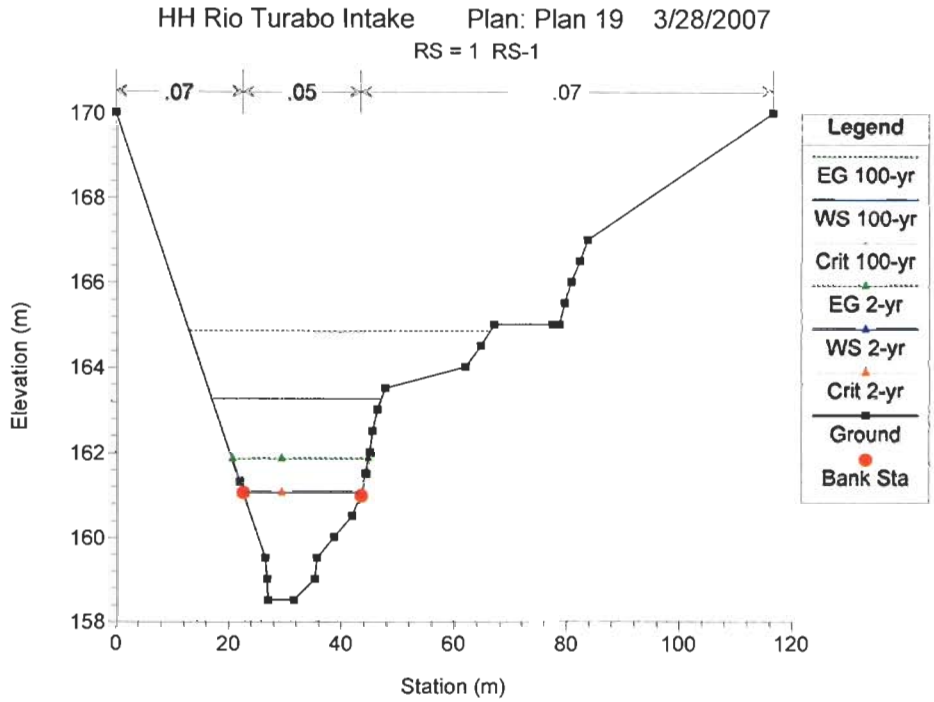
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 19 3/28/2007
RS = 5 RS-5
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 19 3/28/2007
RS = 4 RS-4
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 19 3/28/2007
RS = 3 RS-3
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 19 3/28/2007
RS = 2 RS-2
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 19 3/28/2007
RS = 1 RS-1
.07
.05
.07
Elevation (m)
Station (m)
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta

APPENDIX C: HEC-RAS Inputs and Results for the Proposed Condition Model

HEC-RAS Version 3.1.2 April 2004
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: HH Rio Turabo Intake
Project File : HH_Rio_Turabo_intake.prj
Run Date and Time: 3/28/2007 3:02:47 PM

Project in SI units

PLAN DATA

Plan Title: Plan 20
Plan File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.p20

Geometry Title: HH Río Turabo intake; proposed3
Geometry File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.g06

Flow Title : HH Río Turabo Intake
Flow File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.f01

Plan Summary Information:

Number of:	Cross Sections	= 13	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.003
Critical depth calculation tolerance = 0.003
Maximum number of iterations = 20
Maximum difference tolerance = 0.1
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only

Friction Slope Method: Average Conveyance
Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: HH Río Turabo Intake
Flow File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.f01

Flow Data (m3/s)

River	Reach	RS	100-yr	2-yr
Río Turabo	Intake	13	460	127

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Río Turabo	Intake	100-yr	Normal S = 0.05	Normal S = 0.05

GEOMETRY DATA

Geometry Title: HH Río Turabo intake; proposed3
Geometry File : q:\Feasibility\Beatriz\Hydrologic and Hydraulic Analysis\HH Rio Turabo\Hec-Ras\Rio Turabo (021706)\HH_Rio_Turabo_intake.g06

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 13

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	21.58	166.5	23.93	165.5	25.07	165	26.01	164.5
27.18	164	28.04	163.5	28.44	163	28.9	162.5	35.49	162.35
38.17	162.05	39.68	162.5	41.16	162.94	44.25	163	49.26	163.5
50.17	164	53.24	165	55.23	166	56.29	166.5	57.67	167
62.45	167.5	66.11	168	67.36	169	68.48	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	27.18	.05	50.17	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

```
         27.18   50.17             2.29    6.17     7.7             .1       .3

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           167.71    Element                 Left OB    Channel
Right OB
  Vel Head (m)              1.49    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           166.23    Reach Len. (m)            2.29       6.17
7.70
  Crit W.S. (m)           166.23    Flow Area (m2)            5.43      79.12
6.79
  E.G. Slope (m/m)      0.015460    Area (m2)                 5.43      79.12
6.79
  Q Total (m3/s)          460.00    Flow (m3/s)               9.63     437.23
13.13
  Top Width (m)            33.48    Top Width (m)             4.95      22.99
5.54
  Vel Total (m/s)           5.04    Avg. Vel. (m/s)           1.77       5.53
1.93
  Max Chl Dpth (m)          4.18    Hydr. Depth (m)           1.10       3.44
1.23
  Conv. Total (m3/s)      3699.6    Conv. (m3/s)              77.5     3516.5
105.6
  Length Wtd. (m)           6.14    Wetted Per. (m)           5.43      23.89
5.98
  Min Ch El (m)           162.05    Shear (N/m2)            151.43     502.20
172.13
  Alpha                     1.15    Stream Power (N/m s)    268.78    2775.10
332.74
  Frctn Loss (m)            0.11    Cum Volume (1000 m3)      0.59      13.08
2.08
  C & E Loss (m)            0.00    Cum SA (1000 m2)          0.46       2.71
1.70


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program used critical depth for the water surface and continued on with
the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current
and previous cross section.
         This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was
set equal to critical
         depth, the calculated water surface came back below critical depth.
This indicates that there is
         not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           164.97    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.72    Wt. n-Val.               0.070      0.050
0.070
```

W.S. Elev (m)	164.25	Reach Len. (m)	2.29	6.17	7.70
Crit W.S. (m)	164.25	Flow Area (m2)	0.07	33.66	0.09
E.G. Slope (m/m)	0.022488	Area (m2)	0.07	33.66	0.09
Q Total (m3/s)	127.00	Flow (m3/s)	0.04	126.92	0.05
Top Width (m)	24.33	Top Width (m)	0.58	22.99	0.76
Vel Total (m/s)	3.75	Avg. Vel. (m/s)	0.50	3.77	0.52
Max Chl Dpth (m)	2.20	Hydr. Depth (m)	0.12	1.46	0.12
Conv. Total (m3/s)	846.9	Conv. (m3/s)	0.2	846.3	0.3
Length Wtd. (m)	6.17	Wetted Per. (m)	0.63	23.89	0.80
Min Ch El (m)	162.05	Shear (N/m2)	25.14	310.79	26.00
Alpha	1.01	Stream Power (N/m s)	12.66	1171.71	13.39
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	0.00	6.00	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.02	2.69	0.03

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 12

INPUT
Description:
Station Elevation Data num= 41

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	20.91	166.5	22.05	166	23.14	165.5	23.95	165
24.76	164.5	25.91	164	26.36	163.5	27.02	162.5	27.41	163.81
28.02	163.49	28.67	162.86	29.18	162.36	29.62	161.91	30.04	160.93
30.31	159.75	30.6	159.85	31.18	160.34	32.51	161.47	33.99	162.55
35.78	162.83	36.78	162.58	38.68	161.63	39.77	161.52	42.27	162.74

```
   46.78   162.5   47.74     163   48.29   163.5   49.25     164   50.27   164.5
   52.19     165   53.19   165.5    54.1     166   55.08   166.5   60.68     167
   63.86   167.5   64.44     168   65.04   168.5   65.64     169   66.24   169.5
   66.84     170

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   25.91     .05   49.25     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         25.91   49.25                8    9.55   10.42             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   39.77   42.27  161.75

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           167.32    Element                  Left OB    Channel
Right OB
  Vel Head (m)              1.53    Wt. n-Val.                0.070      0.050
0.070
  W.S. Elev (m)           165.80    Reach Len. (m)            8.00       9.55
10.42
  Crit W.S. (m)           165.80    Flow Area (m2)            3.17      80.55
4.22
  E.G. Slope (m/m)      0.020174    Area (m2)                 3.17      80.55
4.22
  Q Total (m3/s)          460.00    Flow (m3/s)               5.63     446.57
7.80
  Top Width (m)            31.24    Top Width (m)             3.42      23.34
4.48
  Vel Total (m/s)           5.23    Avg. Vel. (m/s)           1.78       5.54
1.85
  Max Chl Dpth (m)          6.05    Hydr. Depth (m)           0.93       3.45
0.94
  Conv. Total (m3/s)      3238.7    Conv. (m3/s)              39.6     3144.1
54.9
  Length Wtd. (m)           9.54    Wetted Per. (m)           3.87      29.54
4.86
  Min Ch El (m)           159.75    Shear (N/m2)            161.94     539.42
171.91
  Alpha                     1.09    Stream Power (N/m s)    287.53    2990.64
317.63
  Frctn Loss (m)            0.09    Cum Volume (1000 m3)      0.58      12.59
2.04
  C & E Loss (m)            0.25    Cum SA (1000 m2)          0.45       2.57
1.66


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program selected the water surface that had the least amount of error
between computed and
         assumed values.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
```

additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	164.51	Element	Left OB	Channel	Right OB
Vel Head (m)	0.74	Wt. n-Val.		0.050	
W.S. Elev (m)	163.77	Reach Len. (m)	8.00	9.55	10.42
Crit W.S. (m)	163.77	Flow Area (m2)		33.25	
E.G. Slope (m/m)	0.029822	Area (m2)		33.25	
Q Total (m3/s)	127.00	Flow (m3/s)		127.00	
Top Width (m)	22.60	Top Width (m)		22.60	
Vel Total (m/s)	3.82	Avg. Vel. (m/s)		3.82	
Max Chl Dpth (m)	4.02	Hydr. Depth (m)		1.47	
Conv. Total (m3/s)	735.4	Conv. (m3/s)		735.4	
Length Wtd. (m)	9.55	Wetted Per. (m)		28.60	
Min Ch El (m)	159.75	Shear (N/m2)		340.07	
Alpha	1.00	Stream Power (N/m s)		1298.80	
Frctn Loss (m)	0.16	Cum Volume (1000 m3)	0.00	5.80	0.00
C & E Loss (m)	0.09	Cum SA (1000 m2)	0.02	2.55	0.02

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is

not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 11

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	17.56	165.6	18.24	165	18.95	164.5	19.66	164
20.48	163.5	22.28	163.21	22.82	163	23.22	162.5	24.11	162
25.29	162.22	27.12	160.92	27.72	161.5	28.17	160.76	38.14	161.5
40.57	161.5	44.62	162	45.51	162.5	46.6	163	50.43	164
51.09	164.88	51.26	164.5	51.68	164.79	52.29	165	53.45	165.5
54.47	166	60.96	166.5	62.34	167	63.06	167.5	64.86	168.5
66.08	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	22.82	.05	46.6	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
22.82 46.6 7.47 12.58 16.24 .1 .3
Blocked Obstructions num= 1

Sta L	Sta R	Elev
35.12	37.61	161.75

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	166.90	Element	Left OB	Channel	Right OB
Vel Head (m)	0.71	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	166.19	Reach Len. (m)	7.47	12.58	16.24
Crit W.S. (m)		Flow Area (m2)	12.51	109.66	14.97
E.G. Slope (m/m)	0.005560	Area (m2)	12.51	109.66	14.97
Q Total (m3/s)	460.00	Flow (m3/s)	17.30	423.76	18.95
Top Width (m)	41.81	Top Width (m)	7.63	23.78	10.40
Vel Total (m/s)	3.35	Avg. Vel. (m/s)	1.38	3.86	1.27
Max Chl Dpth (m)	5.43	Hydr. Depth (m)	1.64	4.61	1.44
Conv. Total (m3/s)	6169.0	Conv. (m3/s)	231.9	5682.9	254.1
Length Wtd. (m)	12.60	Wetted Per. (m)	8.45	26.29	11.57

```
  Min Ch El (m)           160.76    Shear (N/m2)             80.66     227.42
70.60
  Alpha                     1.23    Stream Power (N/m s)    111.55     878.83
89.34
  Frctn Loss (m)            0.05    Cum Volume (1000 m3)      0.51      11.68
1.94
  C & E Loss (m)            0.09    Cum SA (1000 m2)          0.41       2.35
1.58


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           163.84    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.44    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           163.40    Reach Len. (m)            7.47      12.58
16.24
  Crit W.S. (m)                     Flow Area (m2)            0.27      43.13
0.30
  E.G. Slope (m/m)      0.011157    Area (m2)                 0.27      43.13
0.30
  Q Total (m3/s)          127.00    Flow (m3/s)               0.11     126.73
0.15
  Top Width (m)            27.00    Top Width (m)             1.70      23.78
1.52
  Vel Total (m/s)           2.91    Avg. Vel. (m/s)           0.43       2.94
0.50
  Max Chl Dpth (m)          2.64    Hydr. Depth (m)           0.16       1.81
0.20
  Conv. Total (m3/s)      1202.3    Conv. (m3/s)               1.1     1199.8
1.4
  Length Wtd. (m)          12.58    Wetted Per. (m)           1.76      26.29
1.57
  Min Ch El (m)           160.76    Shear (N/m2)             16.59     179.49
21.01
  Alpha                     1.02    Stream Power (N/m s)      7.12     527.41
10.55
  Frctn Loss (m)            0.08    Cum Volume (1000 m3)      0.00       5.43
0.00
  C & E Loss (m)            0.07    Cum SA (1000 m2)          0.01       2.33
0.02


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
```

0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 10

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	12.7	165	14.14	164	15.11	163.446	15.89	163
16.51	162.5	18.42	162	20.36	161.5	22.1	161	22.54	161
23.24	161	30.44	161	34.92	161	41.9	161	42.36	160.7
42.83	161.5	43.32	162	43.85	162.5	44.74	163	45.54	163.5
46.37	164	47.04	164.5	55.72	165	57.69	165.5	58.6	166
59.16	167	59.77	167.5	60.29	168	61.2	168.5	62.25	169.5
62.73	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	15.11	.05	45.54	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15.11	45.54	21.67	21.36	19.89	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	166.76	Element	Left OB	Channel	Right OB
Vel Head (m)	0.40	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	166.37	Reach Len. (m)	21.67	21.36	19.89
Crit W.S. (m)		Flow Area (m2)	7.62	151.82	20.41
E.G. Slope (m/m)	0.002589	Area (m2)	7.62	151.82	20.41
Q Total (m3/s)	460.00	Flow (m3/s)	6.09	434.82	19.08
Top Width (m)	49.57	Top Width (m)	5.88	30.43	13.26
Vel Total (m/s)	2.56	Avg. Vel. (m/s)	0.80	2.86	0.93
Max Chl Dpth (m)	5.67	Hydr. Depth (m)	1.30	4.99	1.54
Conv. Total (m3/s)	9040.9	Conv. (m3/s)	119.8	8546.1	375.1
Length Wtd. (m)	21.31	Wetted Per. (m)	6.60	32.15	13.99
Min Ch El (m)	160.70	Shear (N/m2)	29.31	119.87	37.04
Alpha	1.19	Stream Power (N/m s)	23.45	343.31	34.63

Frctn Loss (m)	0.06	Cum Volume (1000 m3)	0.44	10.04	1.65
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.35	2.01	1.39

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	163.69	Element	Left OB	Channel	Right OB
Vel Head (m)	0.20	Wt. n-Val.	0.070	0.050	19.89
W.S. Elev (m)	163.49	Reach Len. (m)	21.67	21.36	
Crit W.S. (m)		Flow Area (m2)	0.00	64.21	
E.G. Slope (m/m)	0.003884	Area (m2)	0.00	64.21	
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	
Top Width (m)	30.48	Top Width (m)	0.07	30.41	
Vel Total (m/s)	1.98	Avg. Vel. (m/s)	0.06	1.98	
Max Chl Dpth (m)	2.79	Hydr. Depth (m)	0.02	2.11	
Conv. Total (m3/s)	2037.7	Conv. (m3/s)	0.0	2037.7	
Length Wtd. (m)	21.36	Wetted Per. (m)	0.08	32.13	
Min Ch El (m)	160.70	Shear (N/m2)	0.68	76.13	
Alpha	1.00	Stream Power (N/m s)	0.04	150.58	
Frctn Loss (m)	0.08	Cum Volume (1000 m3)	0.00	4.76	0.00
C & E Loss (m)	0.00	Cum SA (1000 m2)	0.00	1.99	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 9

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	10.95	163.392	11.6	163	12.3	162.5	14.54	162
15.82	161.5	18.13	161	20.32	160.5	21.68	160.14	24.82	158.73
31.34	160	32.3	160.5	33.37	162.86	34.56	163	38.27	163.5
39.38	163.6	43.41	165.05	46.9	165.01	52.47	165.22	56.63	165.5
57.65	166.5	59.01	167.5	59.48	168	60	168.5	60.51	169.5
60.77	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	10.95	.05	38.27	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
10.95	38.27	13.08	11.48	11.6	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
46.9	52.47	171.11

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	166.70	Element	Left OB	Channel	Right OB
Vel Head (m)	0.46	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	166.24	Reach Len. (m)	13.08	11.48	11.60
Crit W.S. (m)		Flow Area (m2)	6.73	142.63	18.90
E.G. Slope (m/m)	0.002934	Area (m2)	6.73	142.63	18.90
Q Total (m3/s)	460.00	Flow (m3/s)	5.95	436.80	17.25
Top Width (m)	45.59	Top Width (m)	4.72	27.32	13.55
Vel Total (m/s)	2.73	Avg. Vel. (m/s)	0.88	3.06	0.91
Max Chl Dpth (m)	7.51	Hydr. Depth (m)	1.43	5.22	1.40
Conv. Total (m3/s)	8492.5	Conv. (m3/s)	109.8	8064.2	318.5
Length Wtd. (m)	11.52	Wetted Per. (m)	5.52	30.01	16.37
Min Ch El (m)	158.73	Shear (N/m2)	35.11	136.76	33.21
Alpha	1.20	Stream Power (N/m s)	31.02	418.84	30.32
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	0.28	6.89	1.26
C & E Loss (m)	0.09	Cum SA (1000 m2)	0.24	1.39	1.12

Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	163.61	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.	0.070	0.050	
W.S. Elev (m)	163.42	Reach Len. (m)	13.08	11.48	11.60
Crit W.S. (m)		Flow Area (m2)	0.00	65.45	
E.G. Slope (m/m)	0.003235	Area (m2)	0.00	65.45	
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	
Top Width (m)	26.74	Top Width (m)	0.04	26.70	
Vel Total (m/s)	1.94	Avg. Vel. (m/s)	0.04	1.94	
Max Chl Dpth (m)	4.69	Hydr. Depth (m)	0.01	2.45	
Conv. Total (m3/s)	2232.7	Conv. (m3/s)	0.0	2232.7	

```
  Length Wtd. (m)          11.48    Wetted Per. (m)           0.05      29.38
  Min Ch El (m)           158.73    Shear (N/m2)              0.33      70.68
  Alpha                     1.00    Stream Power (N/m s)      0.01     137.15
  Frctn Loss (m)            0.08    Cum Volume (1000 m3)      0.00       3.37
0.00
  C & E Loss (m)            0.07    Cum SA (1000 m2)          0.00       1.38
0.00


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION


RIVER: Río Turabo
REACH: Intake             RS: 8

INPUT
Description:
Station Elevation Data    num=      23
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     170   12.88 163.085   13.81 162.586   13.97   162.5   15.65     162
   17.61   161.5   17.84     161   18.74   160.5   19.27     160   19.61     160
   19.82  160.35   21.25  159.96   22.04  160.24    29.2   160.5   29.75     161
   31.69  162.59   32.19     163   35.34   163.5   38.58     164   50.87     165
   51.08  164.99   57.88   169.7   79.04     170

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .07   13.81     .05   31.69     .07

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.
Expan.
         13.81   31.69             7.06   15.22    20.5             .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   51.08   57.88  171.11

CROSS SECTION OUTPUT  Profile #100-yr

  E.G. Elev (m)           166.55    Element                  Left OB    Channel
Right OB
  Vel Head (m)              1.37    Wt. n-Val.                0.070      0.050
0.070
  W.S. Elev (m)           165.18    Reach Len. (m)            7.06      15.22
20.50
  Crit W.S. (m)           165.18    Flow Area (m2)            6.27      77.03
20.30
  E.G. Slope (m/m)      0.011944    Area (m2)                 6.27      77.03
20.30
```

```
  Q Total (m3/s)          460.00    Flow (m3/s)              10.70     417.13
32.18
  Top Width (m)            42.10    Top Width (m)             4.83      17.88
19.39
  Vel Total (m/s)           4.44    Avg. Vel. (m/s)           1.71       5.42
1.59
  Max Chl Dpth (m)          5.22    Hydr. Depth (m)           1.30       4.31
1.05
  Conv. Total (m3/s)      4209.0    Conv. (m3/s)              97.9     3816.7
294.4
  Length Wtd. (m)          15.28    Wetted Per. (m)           5.48      19.75
19.85
  Min Ch El (m)           159.96    Shear (N/m2)            133.86     456.77
119.82
  Alpha                     1.36    Stream Power (N/m s)    228.44    2473.60
189.92
  Frctn Loss (m)            0.17    Cum Volume (1000 m3)      0.20       5.63
1.03
  C & E Loss (m)            0.01    Cum SA (1000 m2)          0.18       1.13
0.93


Warning: The energy equation could not be balanced within the specified number
of iterations.  The
         program used critical depth for the water surface and continued on with
the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current
and previous cross section.
         This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was
set equal to critical
         depth, the calculated water surface came back below critical depth.
This indicates that there is
         not a valid subcritical answer.  The program defaulted to critical
depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           163.46    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.87    Wt. n-Val.                          0.050
  W.S. Elev (m)           162.59    Reach Len. (m)            7.06      15.22
20.50
  Crit W.S. (m)           162.59    Flow Area (m2)                      30.68
  E.G. Slope (m/m)      0.023805    Area (m2)                 0.00      30.68
  Q Total (m3/s)          127.00    Flow (m3/s)                        127.00
  Top Width (m)            17.88    Top Width (m)             0.00      17.88
  Vel Total (m/s)           4.14    Avg. Vel. (m/s)                     4.14
  Max Chl Dpth (m)          2.63    Hydr. Depth (m)                     1.72
  Conv. Total (m3/s)       823.1    Conv. (m3/s)                       823.1
  Length Wtd. (m)          15.22    Wetted Per. (m)                    19.75
  Min Ch El (m)           159.96    Shear (N/m2)                       362.68
  Alpha                     1.00    Stream Power (N/m s)              1501.26
  Frctn Loss (m)            0.15    Cum Volume (1000 m3)      0.00       2.82
0.00
  C & E Loss (m)            0.16    Cum SA (1000 m2)          0.00       1.13
0.00
```

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.
This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical
depth, the calculated water surface came back below critical depth. This indicates that there is
not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 7

INPUT
Description:
Station Elevation Data num= 46

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	13.69	161.811	14.21	161.5	14.51	161	14.99	160
15.54	159	15.87	158.5	16.15	158	16.86	157.5	17.04	157.5
17.05	158	17.27	158	18.28	157.5	19.2	157	19.54	157
20.55	157.5	21.15	158	21.56	158	23.19	158	23.61	158.5
25.13	158.5	26.26	158.5	26.56	159	26.72	159.5	26.83	160
27.86	160.5	28.95	161	29.95	161.812	32.03	163.5	32.23	164
32.41	164.5	32.59	165	32.72	165.5	32.84	165.56	36.59	165.46
37.98	165.5	43.36	165.5	44.52	166	44.72	166.12	54.1	166.09
58.86	166.5	59.2	167	59.46	168	59.49	167.5	59.7	168.5
81.86	170								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	13.69	.05	29.95	.07

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
13.69 29.95 10.56 13.22 12.99 .1 .3
Blocked Obstructions num= 1

Sta L	Sta R	Elev
44.72	54.1	169.9

CROSS SECTION OUTPUT Profile #100-yr

```
  E.G. Elev (m)           165.50    Element                 Left OB    Channel
Right OB
  Vel Head (m)              1.33    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           164.17    Reach Len. (m)           10.56      13.22
12.99
  Crit W.S. (m)                     Flow Area (m2)            4.66      86.83
3.24
  E.G. Slope (m/m)      0.010313    Area (m2)                 4.66      86.83
3.24
  Q Total (m3/s)          460.00    Flow (m3/s)               6.82     448.63
4.56
  Top Width (m)            22.55    Top Width (m)             3.95      16.26
2.34
  Vel Total (m/s)           4.86    Avg. Vel. (m/s)           1.46       5.17
1.41
  Max Chl Dpth (m)          7.17    Hydr. Depth (m)           1.18       5.34
1.38
  Conv. Total (m3/s)      4529.7    Conv. (m3/s)              67.1     4417.7
44.9
  Length Wtd. (m)          13.19    Wetted Per. (m)           4.60      21.40
3.40
  Min Ch El (m)           157.00    Shear (N/m2)            102.45     410.37
96.45
  Alpha                     1.11    Stream Power (N/m s)    149.91    2120.36
135.58
  Frctn Loss (m)            0.08    Cum Volume (1000 m3)      0.16       4.39
0.79
  C & E Loss (m)            0.19    Cum SA (1000 m2)          0.15       0.87
0.71


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           162.18    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.34    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           161.84    Reach Len. (m)           10.56      13.22
12.99
  Crit W.S. (m)                     Flow Area (m2)            0.00      48.94
0.00
  E.G. Slope (m/m)      0.005586    Area (m2)                 0.00      48.94
0.00
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
0.00
  Top Width (m)            16.35    Top Width (m)             0.05      16.26
0.04
```

Vel Total (m/s)	2.59	Avg. Vel. (m/s)	0.06	2.59	0.05
Max Chl Dpth (m)	4.84	Hydr. Depth (m)	0.02	3.01	0.01
Conv. Total (m3/s)	1699.2	Conv. (m3/s)	0.0	1699.2	0.0
Length Wtd. (m)	13.22	Wetted Per. (m)	0.06	21.40	0.05
Min Ch El (m)	157.00	Shear (N/m2)	0.72	125.30	0.64
Alpha	1.00	Stream Power (N/m s)	0.04	325.15	0.03
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	0.00	2.21	0.00
C & E Loss (m)	0.03	Cum SA (1000 m2)	0.00	0.87	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 6

INPUT
Description:
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	11.19	162.5	11.47	161.817	11.6	161.5	11.86	160.5
12.03	160	12.61	159.5	13.97	159	15.16	158.51	16.46	158.48
17.67	158.46	19.02	158.48	20.38	158.48	21.77	158.46	23.05	158.5
23.41	158.34	24.45	158	25.6	158	26.27	158.5	27.1	159
28.43	159.5	29.83	160	30.99	160.5	32.14	161	32.58	161.817
33.19	162.95	33.39	163	39.16	163	44.58	164	46.28	163.8
55.68	167.92	57.55	168	62.95	168.15	86.63	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	11.47	.05	32.58	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
11.47	32.58	3.83	10.25	22.74	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
46.28	55.68	169.9

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.23	Element	Left OB	Channel	Right OB
Vel Head (m)	0.70	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.53	Reach Len. (m)	3.83	10.25	22.74
Crit W.S. (m)		Flow Area (m2)	3.74	116.32	17.10

```
  E.G. Slope (m/m)      0.004371    Area (m2)                 3.74     116.32
17.10
  Q Total (m3/s)          460.00    Flow (m3/s)               3.17     439.37
17.46
  Top Width (m)            38.12    Top Width (m)             3.31      21.11
13.70
  Vel Total (m/s)           3.35    Avg. Vel. (m/s)           0.85       3.78
1.02
  Max Chl Dpth (m)          6.53    Hydr. Depth (m)           1.13       5.51
1.25
  Conv. Total (m3/s)      6957.9    Conv. (m3/s)              48.0     6645.9
264.1
  Length Wtd. (m)          10.86    Wetted Per. (m)           4.38      24.09
15.22
  Min Ch El (m)           158.00    Shear (N/m2)             36.54     206.94
48.17
  Alpha                     1.22    Stream Power (N/m s)     31.03     781.64
49.18
  Frctn Loss (m)            0.05    Cum Volume (1000 m3)      0.11       3.04
0.66
  C & E Loss (m)            0.02    Cum SA (1000 m2)          0.11       0.62
0.60


CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           162.09    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.23    Wt. n-Val.               0.070      0.050
0.070
  W.S. Elev (m)           161.87    Reach Len. (m)            3.83      10.25
22.74
  Crit W.S. (m)                     Flow Area (m2)            0.00      60.11
0.00
  E.G. Slope (m/m)      0.003298    Area (m2)                 0.00      60.11
0.00
  Q Total (m3/s)          127.00    Flow (m3/s)               0.00     127.00
0.00
  Top Width (m)            21.16    Top Width (m)             0.02      21.11
0.03
  Vel Total (m/s)           2.11    Avg. Vel. (m/s)           0.04       2.11
0.04
  Max Chl Dpth (m)          3.87    Hydr. Depth (m)           0.02       2.85
0.02
  Conv. Total (m3/s)      2211.4    Conv. (m3/s)               0.0     2211.4
0.0
  Length Wtd. (m)          10.25    Wetted Per. (m)           0.05      24.09
0.06
  Min Ch El (m)           158.00    Shear (N/m2)              0.31      80.69
0.38
  Alpha                     1.00    Stream Power (N/m s)      0.01     170.49
0.02
  Frctn Loss (m)            0.04    Cum Volume (1000 m3)      0.00       1.49
0.00
  C & E Loss (m)            0.00    Cum SA (1000 m2)          0.00       0.62
0.00
```

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 5

INPUT
Description:
Station Elevation Data num= 34

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	10.43	163.5	10.69	162.5	10.92	161.758	11	161.5
11.13	161	11.58	160.5	12.35	160	13.09	159.5	13.89	159
17.49	158.5	21.01	158.5	25.53	158.5	25.92	158.5	27.26	159
28.39	159.5	29.52	160	30.61	160.5	31.52	161	32.66	161.5
33.27	161.761	33.83	162	37.99	162.5	45.39	163.5	51.61	164
54.92	164.5	58.18	165	63.95	165.22	64.88	165.5	66.42	166
67.97	166.5	69	167	71.32	167.5	99.36	170		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	10.92	.05	33.27	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
10.92	33.27	2.23	2.1	4.27	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
63.95	69	168.27

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.16	Element	Left OB	Channel	Right OB
Vel Head (m)	0.64	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.53	Reach Len. (m)	2.23	2.10	4.27
Crit W.S. (m)		Flow Area (m2)	1.80	117.72	28.01
E.G. Slope (m/m)	0.004058	Area (m2)	1.80	117.72	28.01
Q Total (m3/s)	460.00	Flow (m3/s)	1.00	429.09	29.91
Top Width (m)	46.31	Top Width (m)	2.14	22.35	21.83
Vel Total (m/s)	3.12	Avg. Vel. (m/s)	0.56	3.65	1.07
Max Chl Dpth (m)	6.03	Hydr. Depth (m)	0.84	5.27	1.28
Conv. Total (m3/s)	7220.9	Conv. (m3/s)	15.7	6735.7	469.5
Length Wtd. (m)	2.19	Wetted Per. (m)	3.75	24.33	22.03
Min Ch El (m)	158.50	Shear (N/m2)	19.04	192.58	50.59

```
  Alpha                      1.28    Stream Power (N/m s)     10.60     701.98
54.03
  Frctn Loss (m)             0.01    Cum Volume (1000 m3)      0.10       1.84
0.14
  C & E Loss (m)             0.02    Cum SA (1000 m2)          0.10       0.40
0.20


Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)            162.05    Element                 Left OB    Channel
Right OB
  Vel Head (m)               0.26    Wt. n-Val.               0.000      0.050
0.070
  W.S. Elev (m)            161.80    Reach Len. (m)            2.23       2.10
4.27
  Crit W.S. (m)                      Flow Area (m2)            0.00      56.75
0.00
  E.G. Slope (m/m)       0.004047    Area (m2)                 0.00      56.75
0.00
  Q Total (m3/s)           127.00    Flow (m3/s)               0.00     127.00
0.00
  Top Width (m)             22.45    Top Width (m)             0.01      22.35
0.09
  Vel Total (m/s)            2.24    Avg. Vel. (m/s)           0.03       2.24
0.06
  Max Chl Dpth (m)           3.30    Hydr. Depth (m)           0.02       2.54
0.02
  Conv. Total (m3/s)       1996.3    Conv. (m3/s)               0.0     1996.3
0.0
  Length Wtd. (m)            2.10    Wetted Per. (m)           0.04      24.33
0.10
  Min Ch El (m)            158.50    Shear (N/m2)                        92.58
0.70
  Alpha                      1.00    Stream Power (N/m s)               207.20
0.04
  Frctn Loss (m)             0.01    Cum Volume (1000 m3)      0.00       0.90
0.00
  C & E Loss (m)             0.00    Cum SA (1000 m2)          0.00       0.40
0.00


CROSS SECTION


RIVER: Río Turabo
REACH: Intake              RS: 4

INPUT
Description:
Station Elevation Data    num=      33
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     170   10.08   163.5   10.62 161.758    10.7   161.5    11.1     161
```

11.9	160.5	13.33	159.5	16.15	159	17.07	158.5	17.6	158
19.56	158	20.42	158.5	25.61	158.5	25.99	158.5	26.87	159
29.14	160	31.32	161	32.74	161.763	33.18	162	33.72	162
35.07	162.5	37.06	162.5	39.97	162.84	41.4	163	43.21	163.23
44.62	163.5	51.39	164	54.69	164.5	58.05	165	64.46	165.3
69.55	166.83	70.21	167	101.17	170				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	10.62	.05	32.74	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
10.62	32.74	11.64	6.98	3.11	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
64.46	69.55	168.27	33.18	39.97	164.2

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.13	Element	Left OB	Channel	Right OB
Vel Head (m)	0.83	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.30	Reach Len. (m)	11.64	6.98	3.11
Crit W.S. (m)		Flow Area (m2)	1.41	111.13	11.28
E.G. Slope (m/m)	0.005440	Area (m2)	1.41	111.13	11.28
Q Total (m3/s)	460.00	Flow (m3/s)	0.84	452.05	7.11
Top Width (m)	44.56	Top Width (m)	1.79	22.12	20.66
Vel Total (m/s)	3.72	Avg. Vel. (m/s)	0.60	4.07	0.63
Max Chl Dpth (m)	6.30	Hydr. Depth (m)	0.79	5.02	0.55
Conv. Total (m3/s)	6236.7	Conv. (m3/s)	11.4	6128.9	96.4
Length Wtd. (m)	6.96	Wetted Per. (m)	3.31	24.27	24.37
Min Ch El (m)	158.00	Shear (N/m2)	22.68	244.31	24.70
Alpha	1.18	Stream Power (N/m s)	13.51	993.82	15.57
Frctn Loss (m)	0.05	Cum Volume (1000 m3)	0.10	1.60	0.06
C & E Loss (m)	0.03	Cum SA (1000 m2)	0.09	0.35	0.11

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	162.04	Element	Left OB	Channel	Right OB
Vel Head (m)	0.27	Wt. n-Val.	0.000	0.050	0.000
W.S. Elev (m)	161.77	Reach Len. (m)	11.64	6.98	3.11
Crit W.S. (m)		Flow Area (m2)	0.00	55.16	0.00
E.G. Slope (m/m)	0.004434	Area (m2)	0.00	55.16	0.00
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	0.00
Top Width (m)	22.14	Top Width (m)	0.00	22.12	0.02
Vel Total (m/s)	2.30	Avg. Vel. (m/s)	0.02	2.30	0.03
Max Chl Dpth (m)	3.77	Hydr. Depth (m)	0.01	2.49	0.01
Conv. Total (m3/s)	1907.3	Conv. (m3/s)	0.0	1907.3	0.0
Length Wtd. (m)	6.98	Wetted Per. (m)	0.02	24.27	0.02
Min Ch El (m)	158.00	Shear (N/m2)		98.84	
Alpha	1.00	Stream Power (N/m s)		227.55	
Frctn Loss (m)	0.04	Cum Volume (1000 m3)	0.00	0.78	0.00
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.00	0.35	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 3

INPUT
Description:
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	13.01	164	13.4	163.5	14.04	163	14.71	162.5
15.39	162	16.05	161.5	16.56	161	16.9	160.5	17.18	160
17.49	159.5	17.84	159	17.92	158.5	19.34	158	21.89	158
23.64	158.5	26.03	159	30.78	159.5	33.63	160.5	36.57	161.5
37.72	162.11	38.46	162.5	43.49	163	44.39	163.12	47.16	163.5
53.62	164	58.06	164.5	61.23	165	69.62	165.44	69.94	165.5
71.82	166	73.79	166.5	74.71	166.73	75.88	167	106.62	170

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	16.05	.05	36.57	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
16.05	36.57	7.81	4.17	4.71	.1	.3

Blocked Obstructions num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
69.62	74.71	168.27	37.72	44.39	164.2

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	165.05	Element	Left OB	Channel	Right OB
Vel Head (m)	1.16	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	163.90	Reach Len. (m)	7.81	4.17	4.71
Crit W.S. (m)		Flow Area (m2)	3.78	93.67	5.04
E.G. Slope (m/m)	0.008804	Area (m2)	3.78	93.67	5.04
Q Total (m3/s)	460.00	Flow (m3/s)	5.02	450.66	4.32
Top Width (m)	32.51	Top Width (m)	2.96	20.52	9.03
Vel Total (m/s)	4.49	Avg. Vel. (m/s)	1.33	4.81	0.86
Max Chl Dpth (m)	5.90	Hydr. Depth (m)	1.28	4.56	0.56
Conv. Total (m3/s)	4902.5	Conv. (m3/s)	53.5	4803.0	46.0
Length Wtd. (m)	4.22	Wetted Per. (m)	3.82	22.82	11.78
Min Ch El (m)	158.00	Shear (N/m2)	85.31	354.43	36.90
Alpha	1.13	Stream Power (N/m s)	113.45	1705.28	31.64
Frctn Loss (m)	0.03	Cum Volume (1000 m3)	0.07	0.89	0.03
C & E Loss (m)	0.06	Cum SA (1000 m2)	0.07	0.20	0.06

Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.

CROSS SECTION OUTPUT Profile #2-yr

E.G. Elev (m)	162.00	Element	Left OB	Channel	Right OB
Vel Head (m)	0.37	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	161.62	Reach Len. (m)	7.81	4.17	4.71
Crit W.S. (m)		Flow Area (m2)	0.01	47.07	0.01
E.G. Slope (m/m)	0.006929	Area (m2)	0.01	47.07	0.01
Q Total (m3/s)	127.00	Flow (m3/s)	0.00	127.00	0.00

Top Width (m)	20.92	Top Width (m)	0.16	20.52	0.23
Vel Total (m/s)	2.70	Avg. Vel. (m/s)	0.16	2.70	0.17
Max Chl Dpth (m)	3.62	Hydr. Depth (m)	0.06	2.29	0.06
Conv. Total (m3/s)	1525.7	Conv. (m3/s)	0.0	1525.6	0.0
Length Wtd. (m)	4.17	Wetted Per. (m)	0.21	22.82	0.27
Min Ch El (m)	158.00	Shear (N/m2)	3.37	140.19	3.74
Alpha	1.00	Stream Power (N/m s)	0.54	378.23	0.64
Frctn Loss (m)	0.03	Cum Volume (1000 m3)	0.00	0.42	0.00
C & E Loss (m)	0.01	Cum SA (1000 m2)	0.00	0.20	0.00

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 2

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	19.86	162	20.99	160	21.52	159	21.82	158.5
26.08	158.53	33.22	158.53	33.87	159	34.49	159.5	36.27	160
38.93	160.5	40.76	161	41.6	161.5	42.43	162	42.89	162.39
43.07	162.5	44.06	163	47.1	163	49.5	163.29	51.16	163.5
56.68	164	62.04	164.5	65.21	165	76.21	165.5	77.52	166
78.92	166.5	80.88	167	112.88	170				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	19.86	.05	42.43	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
19.86	42.43	6.6	5.25	4.31	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
42.89	49.5	164.2

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	164.96	Element	Left OB	Channel	Right OB
Vel Head (m)	0.95	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	164.01	Reach Len. (m)	6.60	5.25	4.31

```
  Crit W.S. (m)                      Flow Area (m2)            4.99     103.91
3.26
  E.G. Slope (m/m)      0.007245     Area (m2)                 4.99     103.91
3.26
  Q Total (m3/s)          460.00     Flow (m3/s)               5.79     452.36
1.86
  Top Width (m)            35.25     Top Width (m)             4.98      22.57
7.70
  Vel Total (m/s)           4.10     Avg. Vel. (m/s)           1.16       4.35
0.57
  Max Chl Dpth (m)          5.51     Hydr. Depth (m)           1.00       4.60
0.42
  Conv. Total (m3/s)      5404.4     Conv. (m3/s)              68.0     5314.6
21.8
  Length Wtd. (m)           5.27     Wetted Per. (m)           5.37      25.41
10.21
  Min Ch El (m)           158.50     Shear (N/m2)             66.09     290.53
22.67
  Alpha                     1.11     Stream Power (N/m s)     76.57    1264.75
12.93
  Frctn Loss (m)            0.05     Cum Volume (1000 m3)      0.04       0.48
0.02
  C & E Loss (m)            0.06     Cum SA (1000 m2)          0.03       0.11
0.02


Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may
indicate the need for
         additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream
conveyance) is less than
         0.7 or greater than 1.4.  This may indicate the need for additional
cross sections.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           161.95     Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.32     Wt. n-Val.                          0.050
  W.S. Elev (m)           161.63     Reach Len. (m)            6.60       5.25
4.31
  Crit W.S. (m)                      Flow Area (m2)                      50.48
  E.G. Slope (m/m)      0.005961     Area (m2)                           50.48
  Q Total (m3/s)          127.00     Flow (m3/s)                        127.00
  Top Width (m)            21.75     Top Width (m)                       21.75
  Vel Total (m/s)           2.52     Avg. Vel. (m/s)                      2.52
  Max Chl Dpth (m)          3.13     Hydr. Depth (m)                      2.32
  Conv. Total (m3/s)      1645.0     Conv. (m3/s)                       1645.0
  Length Wtd. (m)           5.25     Wetted Per. (m)                     24.27
  Min Ch El (m)           158.50     Shear (N/m2)                       121.56
  Alpha                     1.00     Stream Power (N/m s)               305.83
  Frctn Loss (m)            0.06     Cum Volume (1000 m3)                 0.22
0.00
  C & E Loss (m)            0.05     Cum SA (1000 m2)                     0.11
0.00
```

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for
additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than
0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Río Turabo
REACH: Intake RS: 1

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	170	21.97	161.321	22.6	161.072	26.58	159.5	26.88	159
27.08	158.5	31.66	158.5	35.38	159	35.78	159.5	38.83	160
42.03	160.5	43.52	161	44.38	161.5	45.14	162	45.69	162.5
46.53	163	47.97	163.5	62.18	164	64.88	164.5	67.29	165
77.62	165	78.84	165	79.8	165.5	80.98	166	82.52	166.5
83.9	167	116.76	170						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	22.6	.05	43.52	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.6	43.52	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #100-yr

E.G. Elev (m)	164.84	Element	Left OB	Channel	Right OB
Vel Head (m)	1.60	Wt. n-Val.	0.070	0.050	0.070
W.S. Elev (m)	163.24	Reach Len. (m)			
Crit W.S. (m)	163.24	Flow Area (m2)	5.95	77.80	3.89
E.G. Slope (m/m)	0.015302	Area (m2)	5.95	77.80	3.89
Q Total (m3/s)	460.00	Flow (m3/s)	10.58	443.06	6.36
Top Width (m)	30.11	Top Width (m)	5.49	20.92	3.70
Vel Total (m/s)	5.25	Avg. Vel. (m/s)	1.78	5.70	1.64
Max Chl Dpth (m)	4.74	Hydr. Depth (m)	1.08	3.72	1.05
Conv. Total (m3/s)	3718.6	Conv. (m3/s)	85.5	3581.7	51.4
Length Wtd. (m)		Wetted Per. (m)	5.90	22.28	4.36

```
  Min Ch El (m)           158.50    Shear (N/m2)            151.34     524.08
133.76
  Alpha                     1.14    Stream Power (N/m s)    268.95    2984.64
218.92
  Frctn Loss (m)                    Cum Volume (1000 m3)
  C & E Loss (m)                    Cum SA (1000 m2)


Warning: Slope too steep for slope area to converge during supercritical flow
calculations (normal depth is
         below critical depth). Water surface set to critical depth.

CROSS SECTION OUTPUT  Profile #2-yr

  E.G. Elev (m)           161.85    Element                 Left OB    Channel
Right OB
  Vel Head (m)              0.78    Wt. n-Val.                          0.050
0.070
  W.S. Elev (m)           161.07    Reach Len. (m)
  Crit W.S. (m)           161.07    Flow Area (m2)                      32.38
0.00
  E.G. Slope (m/m)      0.023349    Area (m2)                           32.38
0.00
  Q Total (m3/s)          127.00    Flow (m3/s)                        127.00
0.00
  Top Width (m)            21.03    Top Width (m)                       20.91
0.12
  Vel Total (m/s)           3.92    Avg. Vel. (m/s)                      3.92
0.21
  Max Chl Dpth (m)          2.57    Hydr. Depth (m)                      1.55
0.03
  Conv. Total (m3/s)       831.1    Conv. (m3/s)                        831.1
0.0
  Length Wtd. (m)                   Wetted Per. (m)                     22.27
0.14
  Min Ch El (m)           158.50    Shear (N/m2)                       332.92
6.90
  Alpha                     1.00    Stream Power (N/m s)              1305.77
1.46
  Frctn Loss (m)                    Cum Volume (1000 m3)
  C & E Loss (m)                    Cum SA (1000 m2)


Warning: Slope too steep for slope area to converge during supercritical flow
calculations (normal depth is
         below critical depth). Water surface set to critical depth.



SUMMARY OF MANNING'S N VALUES

River:Río Turabo

      Reach          River Sta.       n1        n2        n3

 Intake               13                  .07       .05       .07
 Intake               12                  .07       .05       .07
```

Intake	11	.07	.05	.07
Intake	10	.07	.05	.07
Intake	9	.07	.05	.07
Intake	8	.07	.05	.07
Intake	7	.07	.05	.07
Intake	6	.07	.05	.07
Intake	5	.07	.05	.07
Intake	4	.07	.05	.07
Intake	3	.07	.05	.07
Intake	2	.07	.05	.07
Intake	1	.07	.05	.07

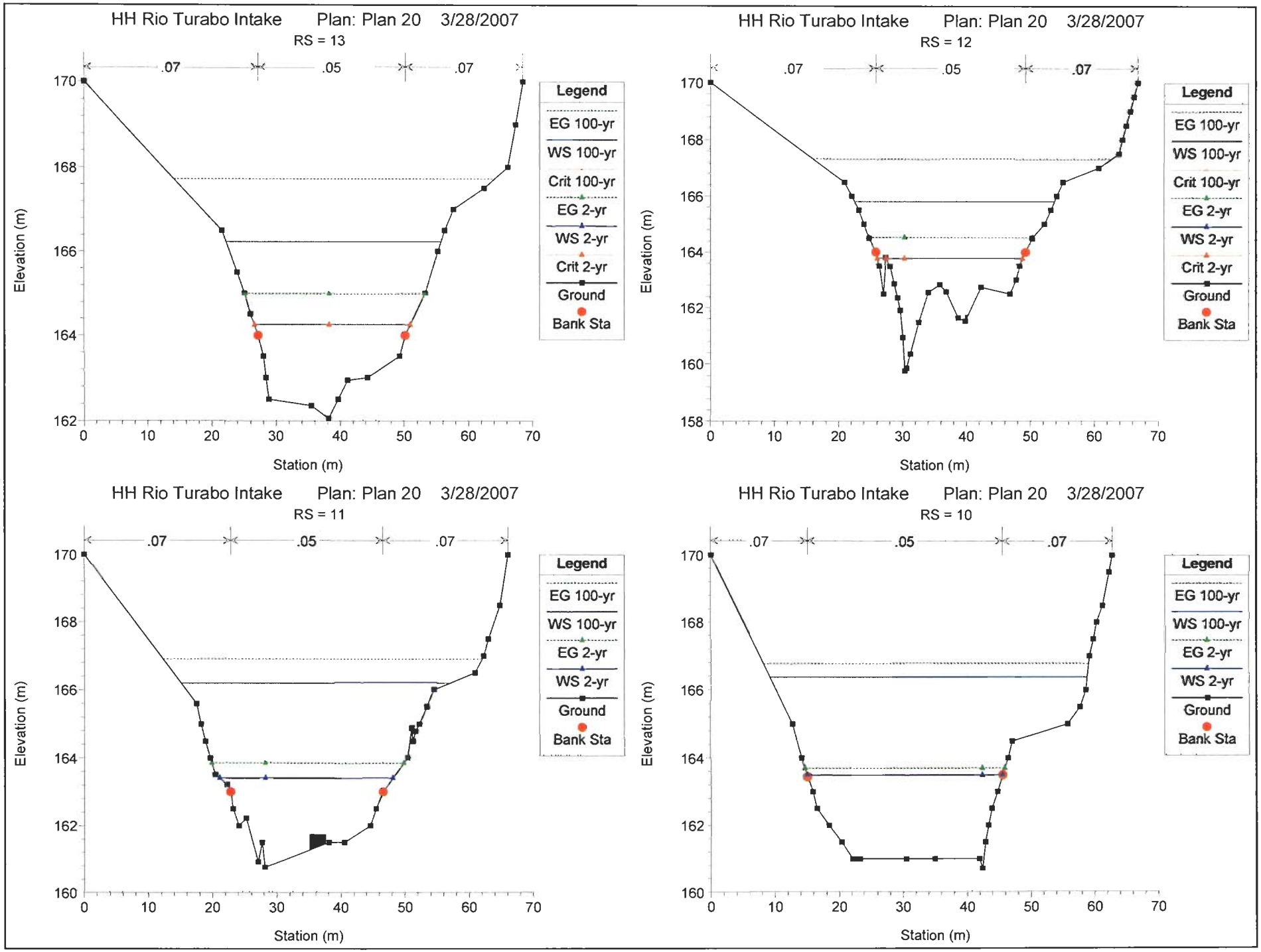
SUMMARY OF REACH LENGTHS

River: Río Turabo

Reach	River Sta.	Left	Channel	Right
Intake	13	2.29	6.17	7.7
Intake	12	8	9.55	10.42
Intake	11	7.47	12.58	16.24
Intake	10	21.67	21.36	19.89
Intake	9	13.08	11.48	11.6
Intake	8	7.06	15.22	20.5
Intake	7	10.56	13.22	12.99
Intake	6	3.83	10.25	22.74
Intake	5	2.23	2.1	4.27
Intake	4	11.64	6.98	3.11
Intake	3	7.81	4.17	4.71
Intake	2	6.6	5.25	4.31
Intake	1	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Río Turabo

Reach	River Sta.	Contr.	Expan.
Intake	13	.1	.3
Intake	12	.1	.3
Intake	11	.1	.3
Intake	10	.1	.3
Intake	9	.1	.3
Intake	8	.1	.3
Intake	7	.1	.3
Intake	6	.1	.3
Intake	5	.1	.3
Intake	4	.1	.3
Intake	3	.1	.3
Intake	2	.1	.3
Intake	1	.1	.3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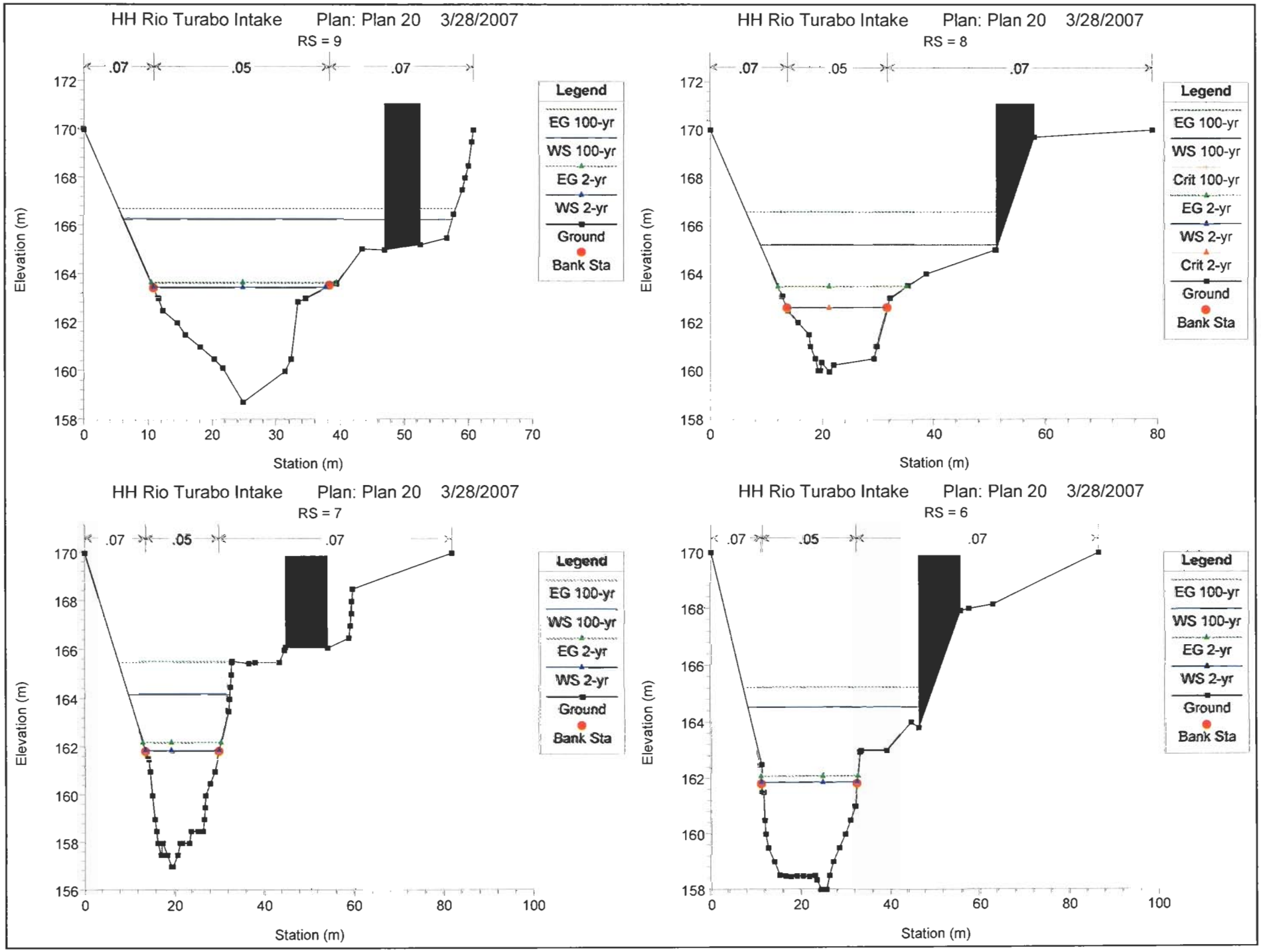
RS = 13
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 12
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 11
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 10
.07
.05
.07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)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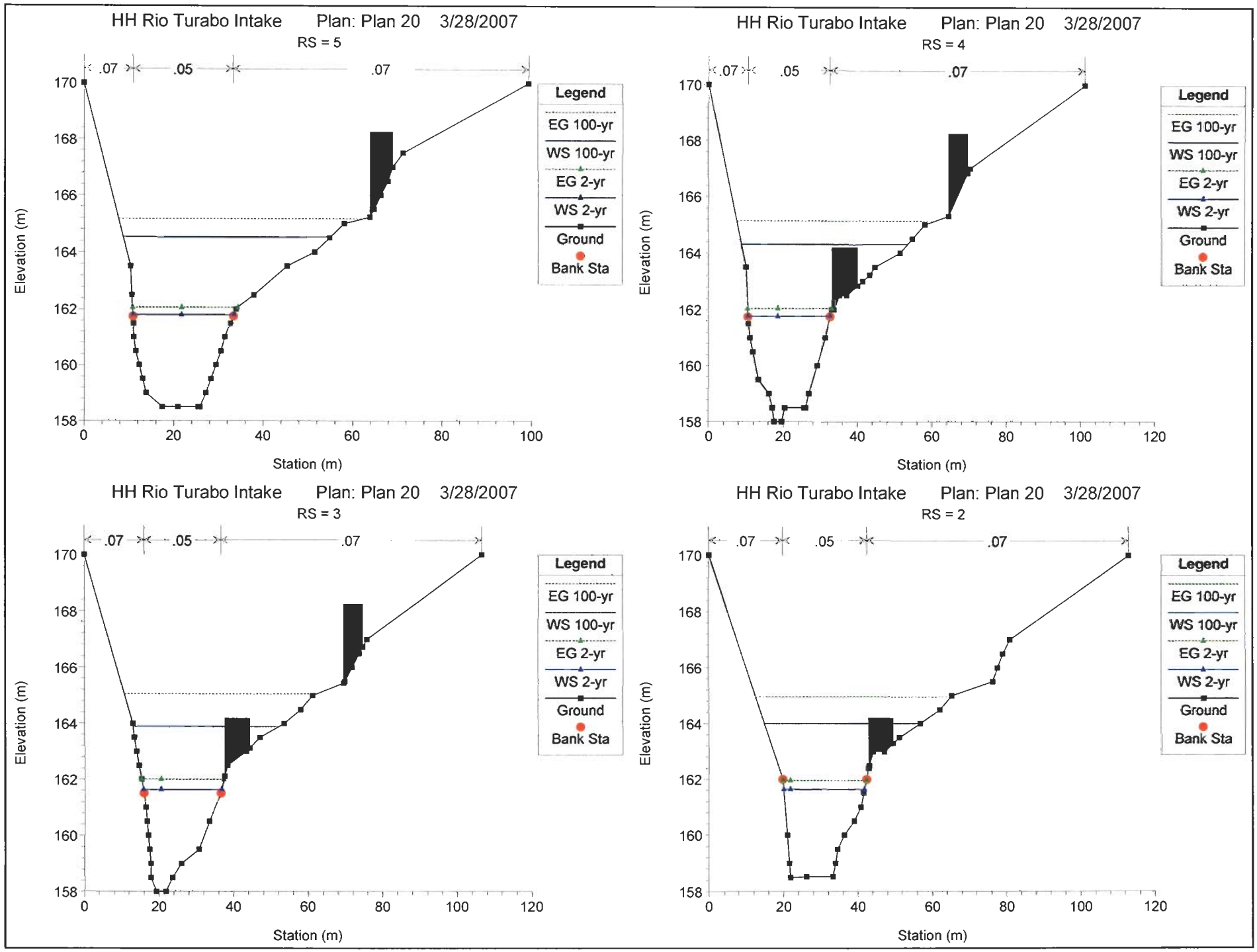
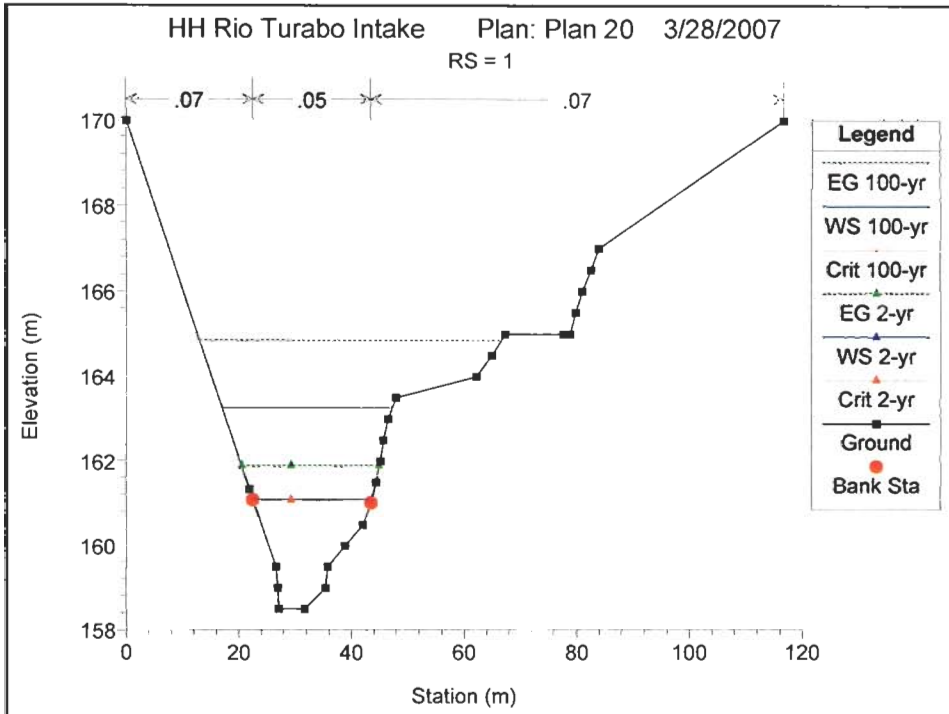
.07 .05 .07
Elevation (m)
Station (m)
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 8
.07 .05 .07
Elevation (m)
Station (m)
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 7
.07 .05 .07
Elevation (m)
Station (m)
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 6
.07 .05 .07
Elevation (m)
Station (m)
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta


HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 5
.07 .05 .07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 4
.07 .05 .07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 3
.07 .05 .07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)
HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 2
.07 .05 .07
Legend
EG 100-yr
WS 100-yr
EG 2-yr
WS 2-yr
Ground
Bank Sta
Elevation (m)
Station (m)


HH Rio Turabo Intake Plan: Plan 20 3/28/2007
RS = 1
.07
.05
.07
Elevation (m)
170
168
166
164
162
160
158
0
20
40
60
80
100
120
Station (m)
Legend
EG 100-yr
WS 100-yr
Crit 100-yr
EG 2-yr
WS 2-yr
Crit 2-yr
Ground
Bank Sta