HYDROLOGIC – HYDRAULIC STUDY

El Nuevo Comandante
Canóvanas, Puerto Rico

July 2009

CMA ARCHITECTS & ENGINEERS LLP
San Juan, Puerto Rico

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SECTION 1.0
INTRODUCTION

Land Development Associates, S.E. (LDA) proposes the construction of a development in a 79.22 "cuerdas" (76.94 acres) parcel located in the municipality of Canovanas. The proposed development consists of 34.158 "cuerdas" for commercial use, 11.908 "cuerdas" for mixed commercial, 26.886 "cuerdas" for residential and 6.268 "cuerdas" of non-develop area, which include conservation, green, and buffer zone areas.

1.1 Objective

The objective of this report is to present the results fo the hydrologic and hydraulic study performed to determine the water surface elevations for the 100, 50, 25, 10, 5, and 2-year storms at the Bocaforma Creek in the vicinity of the project site. In addition, the study determined the improvements required to mitigate the effects of the proposed development on these levels and the increase in the generated runoff. This study was prepared in accordance with the Puerto Rico Planning Board (PRPB) Regulation No. 13[(1)], Resolution JP-94-254 [(2)] and Regulation No. 3[(3)]

1.2 Authority

This hydrologic-hydraulic study was performed by CMA Architects & Engineers LLP as requested by Land Development Associates, S.E. (LDA). It is part of the required engineering studies to develop the proposed project.

SECTION 2.0

PROJECT DESCRIPTION

2.1 Location

The proposed project is located off State Road PR-3, at the Barrio Pueblo Ward of the Municipality of Canovanas. The location of the proposed project is shown in Figure 1, which partially reproduces the United States Geological Survey (USGS) Topographic Quadrangle of the area of Canovanas[3]. An aerial photograph depicting the proposed project location and adjacent developments is included as Figure 2.

2.2 Existing Topography

The elevations at the project area vary from 60 to 5 meters, referred to mean sea level. These elevations were obtained from the USGS Topographic Quadrangle and from topographic survey plans of the area, prepared by licensed surveyor Angel Noel Torres, dated June 2006. A copy of the topographic plan is included as Appendix A.

2.3 Water Resources

The topographic quadrangle and the Flood Insurance Rate Map prepared by FEMA [4] show the Bocaforma Creek on the east side of the property limit area. The proposed project will be located to the west of the Bocaforma Creek and adjacent wetland.

2.4 Scope

This study has been divided in the following phases:

a) Hydrologic analysis of existing and proposed conditions of the site drainage basin. This includes field inspections and the review of available information to compute the required hydrologic parameters. Discharges will be determined for a storm event with a return period of 100, 50, 25, 10, 5 and 2 years with duration of 24 hours.

b) Hydraulic modeling of the existing conditions to determine the flood levels for the discharges obtained in Phase a).

c) Hydraulic modeling of the proposed conditions to determine the flood levels for the discharges obtained in Phase a). The flood levels obtained in this phase will be compared with the flood levels and discharges generated under the existing conditions to evaluate the mitigation structures required for the proposed project. This phase includes the design of a runoff detention structure and outlet. The proposed structure shall be designed to mitigate any increase in runoff generated by the proposed project.

SECTION 3.0

PRELIMINARY EVALUATION

3.1 Field Inspection

Several field visits were made to inspect the study area and determine some hydrologic and hydraulic parameters of the drainage basin, such as curve numbers and roughness coefficients.

In addition, a licensed surveyor prepared a topographic plan of the project area. All of these provided useful information for the development of the hydrologic-hydraulic model.

3.2 Previous Studies / Historical Data Collection

The project area is located within a Zone X classification according to the Flood Insurance Rate Map of the Federal Emergency Management Agency (FEMA) [(4)], This map is shown on Figures 3. Since Zone X is defined as an area determined to be outside the 0.2% annual chance floodplain, the project area is located outside the regulatory 100-year flood limits.

SECTION 4.0
HYDROLOGIC STUDY

The hydrologic analysis is the first phase of an H/H study. In this phase the runoff generated at a drainage basin is calculated for a given rainfall event. This runoff will be used in the hydraulic study to obtain the water surface levels for that rain event. This study will determine the runoff generated under existing and proposed conditions.

The hydrologic analysis was performed with the computer model PondPack (Version 10.1, 2008) developed by Bentley; and following several procedures that are applicable to small watersheds issued by Natural Resources Conservation Service (NRCS) formerly the Soil Conservation Service (SCS) presented in their National Engineering Handbook [(5)].

4.1 Hydrologic Parameters

Several hydrologic parameters need to be determined as part of the hydrologic study. A brief description of these parameters follows:

4.1.1 Basin Area

The drainage basin under study has an area of 423.71 acres (0.662 square miles). This basin has been divided for the existing conditions in three (3) sub-basins: A-1, A-2, and A-2A and for the proposed conditions in four (4) sub-basin A-1A, A-2, A-2B and A-2C. The areas and limits of each sub-basin were determined from the USGS Topographic Quadrangle and topographic survey prepared for this project. The delimitation of the drainage basins for existing and

proposed conditions is presented in figures 4 and 5 respectively.

4.1.2 Curve Number

The curve number (CN) for the area under study was determined taking into consideration the various soil types found in the basin, land use, vegetation type and the Antecedent Moisture Condition.

The NRCS(formerly SCS) [6], in cooperation with the University of Puerto Rico, has published soil surveys of Puerto Rico and classified the soils in four groups according to their minimum infiltration rates. These groups are defined as follows:

Group A – They have the lowest runoff potential. They are soils with high infiltration rates even when wetted and consist chiefly of deep, well to excessively drained sands and gravels. These soils have a high rate of water transmission.

Group B – They are soils with moderate infiltration rates when thoroughly wetted. They consist chiefly of moderately deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C – They have moderately high runoff potential. They are soils with low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, soils with moderately fine to fine texture, or soils with moderate water tables. These soils may be somewhat poorly drained.

Group D – They have the highest runoff potential. Soils with very low infiltration rates. They consist chiefly of clay soils with a high water table, soils with a clay pan

or clay layer at or near the surface and shallow soils over nearly impervious material. These soils have a very low rate of water transmission.

The soils of the area are classified as Type D. Figure 6 shows the NRCS soil map along the drainage basin areas. Table 1 presents the various soil types encountered and classified by their hydrologic group.

Table 1
Soil Hydrologic Classification

Soil Symbols	Soil Description	Hydrologic Classification
CbF2	Caguabo Clay Loam, 20 to 60 percent slopes	D
Co	Coloso SIlty Clay Loam	D
MaB	Mabi Clay, 12 to 20 percent slopes	D
MaC2	Mabi Clay, 5 to 12 percent slopes	D
MuE2	Mucara Silty Clay Loam, 20 to 40 percent slopes	D
Rrb	Rio Arriba Clay, 2 to 5 percent slope	D
RrC2	Rio Arriba Clay, 5 to 12 percent slopes	D
Gravel Pit	Gravel Pit	D

The NRCS (formerly SCS) has established CN values for these soil groups, according to the land use. These values were weighted according to the soil type and land use area percentage on each sub-basin to obtain a weighted CN value. Most of the lands at the drainage basins in the study area are covered with pasture. The location of the proposed project currently contains a quarry and the

cover has been determined to be bare soil for the existing condition based on site visits and aerial images. Curve number calculations are presented in Appendix B.

The Antecedent Moisture Condition, AMC, is an index of watershed wetness at the beginning of a storm used with the runoff estimation method. This index will be used to correct the weighted CN value obtained previously for each sub-basin. Three levels of AMC can be used: AMC I, AMC II and AMC III. AMC I is the condition where soils are dry, but not to the wilting point, AMC II is the average condition, and AMC III is the condition where heavy rainfall have occurred within the last five days and the soil is saturated. A condition of AMC II was used for this analysis.

4.1.3 Time of Concentration

Time of concentration is defined as the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest downstream within the watershed, in this case, the sub-basin outlet. The time of concentration is the sum of overland (upland) time and stream time. The overland time is calculated using the SCS average velocity equation:

$$T_o = \frac{L_o}{V_o}$$

where:

T_o = overland time (seconds)

L_o = overland length (feet)

v_o = overland velocity (feet/seconds) from TR-55 charts as function of average slope and surface cover [7]

The flow through the existing drainage channels was determined using the flood routing procedures described in Section 4.2, and the Manning's equation of open channel flow for the average velocity and the travel time as follows:

$$V_s = \frac{1.0}{n} * R^{2/3} * S^{1/2} \qquad (2)$$

$$T_s = \frac{L_s}{V_s} \qquad (3)$$

$$T_c = T_o + T_s \qquad (4)$$

Where:

V_s = average channel velocity (meter/seconds) from Manning's equation

n = roughness coefficient

R = hydraulic radius (meter)

S = average slope

T_s = channel time (seconds)

Ls = channel length (meter)

T_c = Time of Concentration (seconds)

Refer to Appendix B for time of concentration calculations.

4.1.4 Precipitation

Precipitation values for storms with frequencies of 100, 50, 25, 10, 5 and 2 years and duration of 24 hours were obtained from the NOAA Atlas 14 Vol. 3[8]. The Precipitation Frequency Data can be seen in Figure 10. Table 2 presents the study's precipitation data for the drainage basin location.:

Table 2
Precipitation Data for the Drainage Basin under study (inches)

Duration (hrs)	Frequencies (years)					
	100	50	25	10	5	2
24	15.03	13.09	11.23	8.97	7.35	5.44

Table 3 lists the main hydrologic parameters for each drainage sub-basin. These parameters will be used to obtain the flow hydrograph generated at each sub-basin.

Table 3
Main Hydrologic Parameters

Existing Conditions				Proposed Conditions			
Sub-Basin No.	Area (acres)	CN	Lag Time (hours)	Sub-Basin No.	Area (acres)	CN	Lag Time (hours)
A-1	53.36	83	0.197	A-1A	35.60	95	0.158
A-2	350.35	80	0.562	A-2	350.35	80	0.562
A-2a	20.00	94	0.149	A-2B	3.85	95	0.05
				A-2C	33.91	92	0.172

4.2 Hydrologic Study Results

The detailed calculations of all hydrologic parameters are included as Appendix B. The PondPack summaries of the hydrologic analyses for the existing and proposed conditions are included as Appendices C and D, respectively. The existing Hydrologic-Hydraulic modeling is included in the CD attached to the back of this document. Tables 4 through 10 contain the main results of these analyses for frequencies of 100, 50, 25, 10, 5 and 2 years, respectively. These tables include the individual flows calculated for each sub-basin.

Table 4
Hydrologic Study Results - 100-yr, 24-hr Storm

Sub-Basin No.	Existing Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1	652.77	12.08
A-2	2330.73	12.41
A-2A	294.66	12.00
Sub-Basin No.	**Proposed Conditions Peak Flow (ft^3/s)**	**Peak Time (hours)**
A-1A	511.67	12.00
A-2	2330.73	12.41
A-2B	75.32	11.91
A-2C	472.53	12.08

Table 5 Hydrologic Study Results - 50-yr, 24-hr Storm		
Sub-Basin No.	Existing Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1	588.79	12.08
A-2	1987.78	12.41
A-2A	256.08	12.08
Sub-Basin No.	Proposed Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1A	444.93	11.99
A-2	1987.78	12.41
A-2B	65.51	11.91
A-2C	410.19	12.08

Table 6 Hydrologic Study Results – 25-yr, 24-hr Storm		
Sub-Basin No.	Existing Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1	495.51	12.08
A-2	1657.69	12.41
A-2A	219.01	12.00
Sub-Basin No.	Proposed Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1A	380.85	11.99
A-2	1656.69	12.41
A-2B	56.09	11.91
A-2C	350.27	12.08

Table 7 Hydrologic Study Results – 10-yr, 24-hr Storm		
Sub-Basin No.	Existing Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1	381.45	12.08
A-2	1255.48	12.41
A-2A	173.84	12.00
Sub-Basin No.	Proposed Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1A	302.80	11.99
A-2	1255.48	12.41
A-2B	44.62	11.91
A-2C	277.16	12.08

Table 8 Hydrologic Study Results – 5-yr, 24-hr Storm		
Sub-Basin No.	Existing Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1	300.78	12.08
A-2	974.24	12.49
A-2A	141.91	12.00
Sub-Basin No.	Proposed Conditions Peak Flow (ft^3/s)	Peak Time (hours)
A-1A	247.69	11.99
A-2	974.24	12.49
A-2B	36.53	11.91
A-2C	225.42	12.08

Table 9 Hydrologic Study Results – 2-yr, 24-hr Storm		
Sub-Basin No.	**Existing Conditions Peak Flow (ft^3/s)**	**Peak Time (hours)**
A-1	202.28	12.00
A-2	636.18	12.49
A-2A	102.69	12.08
Sub-Basin No.	**Proposed Conditions Peak Flow (ft^3/s)**	**Peak Time (hours)**
A-1A	180.08	11.99
A-2	636.18	12.49
A-2B	26.60	11.91
A-2C	161.78	12.08

Table 10 Hydrologic Study Results at existing drainage structures			
Outlet ID	YEAR	Existing Conditions Peak Flow (ft^3/s)	Proposed Conditions Peak Flow (ft^3/s)
Ex. 48 pipe	2	202.28	180.08
	5	300.78	247.69
	10	381.45	302.80
	25	495.51	380.85
	50	588.79	444.93
	100	685.57	511.67
Box 14x 10	2	652.77	648.21
	5	1001.09	991.10
	10	1289.91	1276.70
	25	1700.94	1691.77
	50	2038.28	2034.48
	100	2388.78	2386.57

SECTION 5.0

HYDRAULIC STUDY

The hydraulic study for this project will consist in determining the number, size and capacity of the hydraulic structures (e.i. pond, weir and culvert) needed to manage the discharges obtained in the hydrologic study in order to comply with the requirements of PRPB Regulation No. 3[9] and determine the surface water elevations at the Bocaforma Creek for the 100, 50, 25, 10, 5 and 2-year storm event.

5.1 Historical Floods

According to the Flood Insurance Studies, no historical flood events have been reported in the project area. .

5.2 Existing Conditions Hydraulic Data

Figure 7 shows the location of the two principal hydraulic outlet structures at the study area. Those structures consist of a one cell 14ft x 10ft box culvert and 48 inch diameter culvert that pass under the State Road PR-3. The Box Culvert conveys the Bocaforma Creek flow and the 48 inches diameter conveys local discharges. An approximately 5.5 acre wetland area is located at both banks of the Bocaforma Creek at the easternmost portion of the property area (See Figure 13). From the topography and the hydraulic study results it can be seen that the Bocaforma Creek is the wetland's main source of water. This creek will be maintained unaltered. A part of the project area, identified as sub-basin A-2A in Figure 4, contributes surface runoff to the wetland. The drainage pattern on the study area runs mostly on a northerly direction, discharging into

the wetland at two points. This concentrated flow discharges are being maintained under the propose conditions. Figure 13 shows the drainage pattern in the project site area.

5.3 Proposed Conditions Hydraulic Data

Figure 8 shows the proposed hydraulic conditions at the project site. Sub-basin A-2B will discharge directly to the existing box culvert and the sub-basin A-2C will discharge into the proposed detention pond. The pond will have an outlet structure that consist of a 18 inch diameter pipe and a 24 inch diameter pipe. The pipes will be placed at the same location of the two main points of concentrated flow that discharge to the wetland for the existing condition. In this way the existing drainage pattern from the project area that drains towards the wetland will remain similar for the proposed condition. The pond will also include an emergency spillway.

Basin A-2 represents the Bocaforma Creek watershed and remains as in the existing condition. Sub basin A-1A drains towards the 48 inch diameter culvert at State Road PR-3. This sub-basin is smaller than existing conditions basin A-1, which drains toward the same culvert. This reduction in size represents, for basin A-1A, lower flows at the culvert than for the existing conditions. .

The detention pond will have a maximum water depth of 10.03 ft, a volume of 20.196 acre-ft, and a water surface elevation of 37.26 ft (11.36 meters) for the 100-year event .

5.4 Methodology

The hydraulic evaluation for the existing and proposed condition were performed with the computer software Pond Pack (Version 10.1, 2008), developed by Bentley. For the proposed conditions, a detention pond and outlet structures were modeled to maintain post development peak flows below pre-development peak flows and meet regulatory requirements by the P.R. Planning Board Regulation No. 3[9].

Additional analysis for the Bocaforma Creek was executed with the computer software HEC-RAS (Version 3.1.3). A water surface elevation (WSEL) of 9.10 meters, recorded at the point of interest from the FEMA Flood Insurance Rate Maps (Rev. J.) at Bocaforma Creek, was used as the downstream boundary condition in the hydraulic model for the 100-year storm. The critical depth was used as the upstream boundary condition. The HEC-RAS computer models were run in a mixed flow regime.

5.5 Hydraulic Study Results

The Pond Pack summaries of the hydraulic analysis for the existing and the proposed conditions are included in Appendices C and D respectively. The Existing and Proposed Conditions Hydrologic -Hydraulic Modeling are included in the CD attached to the back of this document. Table 11, show a summary of the main characteristics of the proposed pond. Table 12 shows a summary of the main characteristics of the outlet structures. The HEC-RAS reports of the hydraulic analysis for the existing and proposed conditions at the Bocaforma Creek are included in Appendix E. Table 13 shows a comparison of the water surface elevations and flow velocities under both conditions for the 100year–24hours storm events. Figure 11 shows the topographic survey and the

cross section locations used in the existing and proposed conditions hydraulic model.

Table 11
Proposed Pond Characteristics
(100 yr-24 hr Storm Event)

Pond ID	Invert Elevation	Bottom Area	Top Elevation	Top Area	Maximum Stage Elevation	Storage at Maximum Elevation
	(m)	(acre)	(m)	(acre)	(m)	(acre-ft)
Pond 1	8.30	1.93	11.9	2.88	11.36	20.196

Table 12
Proposed Outlet Structure Main Characteristics
(Pond 1)

Structure	Shape	Diameter (m)	No.of Barrels	Length (m)	Slope	Invert Elevation	
						Up (m)	Dn (m)
Culvert (Outlet Pipe #1)	circular	0.457	1	20	0.01	8.30	8.10
Culvert (Outlet Pipe #2)	circular	0.61	1	20	0.008	10.09	9.94

Table 13 Hydraulic Study Results – Bocaforma Creek 100-year, 24-hour Storm						
River Station	Existing Conditions			Proposed Conditions		
	Flow (m^3/s)	Water Surface Elevation (m)	Velocity (m/s)	Flow (m^3/s)	Water Surface Elevation (m)	Velocity (m/s)
5	67.65	9.82	1.92	67.58	9.82	2.00
4	67.65	9.12	0.35	67.58	9.12	0.35
3	67.65	9.11	0.29	67.58	9.11	0.30
2	67.65	9.11	0.18	67.58	9.11	0.25
1	67.65	9.10	0.29	67.58	9.10	0.28
0	67.65	9.10	0.10	67.58	9.10	0.10

SECTION 6.0

CONCLUSIONS

The following conclusions are based on the hydrologic-hydraulic analysis performed for reference project:

1) The modification of the drainage basin discharging into the existing 48 inches diameter culvert under State Road PR-3 causes a reduction in the discharge under proposed conditions in comparison to the existing conditions for the 100, 50, 25, 10, 5, and 2 year, 24-hour storms.

2) The proposed detention pond 1 will have storage capacity of 20.196 acre-ft and a water surface elevation of 11.36 m for 100yr-24hour storm event. Its outlet structures consist of 18 and 24 inch diameter culverts. This hydraulic design allows the water to discharge into the wetland at the same locations where concentrate surface runoff flows into, the similar to the existing condition.

3) The pond will be located at an offset of 10 meters from the wetland limit.

4) The Pond Bottom will be used as a percolation area with an infiltration capacity of 6.5 cfs using a hydraulic conductivity of 10^2 gal/day-ft^2, according to the natural soil material on site [10], and safety factor of 2. See Appendix F.

5) A hydraulic analysis was performed on HEC-RAS V.3.1.3 for the existing and proposed conditions at the Bocaforma Creek. This analysis demonstrates that the proposed project will not cause an increase in the calculated water surface elevations at the Bocaforma Creek.

6) A hydraulic analysis was performed on Pond Pack for existing and proposed conditions. This analysis demonstrates that the proposed project will not cause an increase in the peak flow discharges for the 2, 5, 10, 25, 50, and 100 year-24 hour storm under proposed conditions when compared to the existing conditions as required by PRPB Regulation No.3 [9].

SECTION 7.0

CERTIFICACION

Certifico que el ***Estudio Hidrológico e Hidráulico –El Nuevo Comandante*** el cual ubica en el Bo. Pueblo del municipio de Canóvanas, Puerto Rico, fue preparado utilizando las mejores prácticas de hidrología e hidráulica aplicables al proyecto según descritas en el documento propio, y que, basándose en los estudios y medidas de campo provistas por otras personas, los resultados en el estudio son ciertos y correctos.

Certifico hoy, 21 de julio de 2009.

Victor M. Gonzalez, P.E.

CMA Architects and Engineers LLP
Nombre de firma consultora

Jorge A. Tirado, P.E.
Lic. No. 15655

SECTION 8.0

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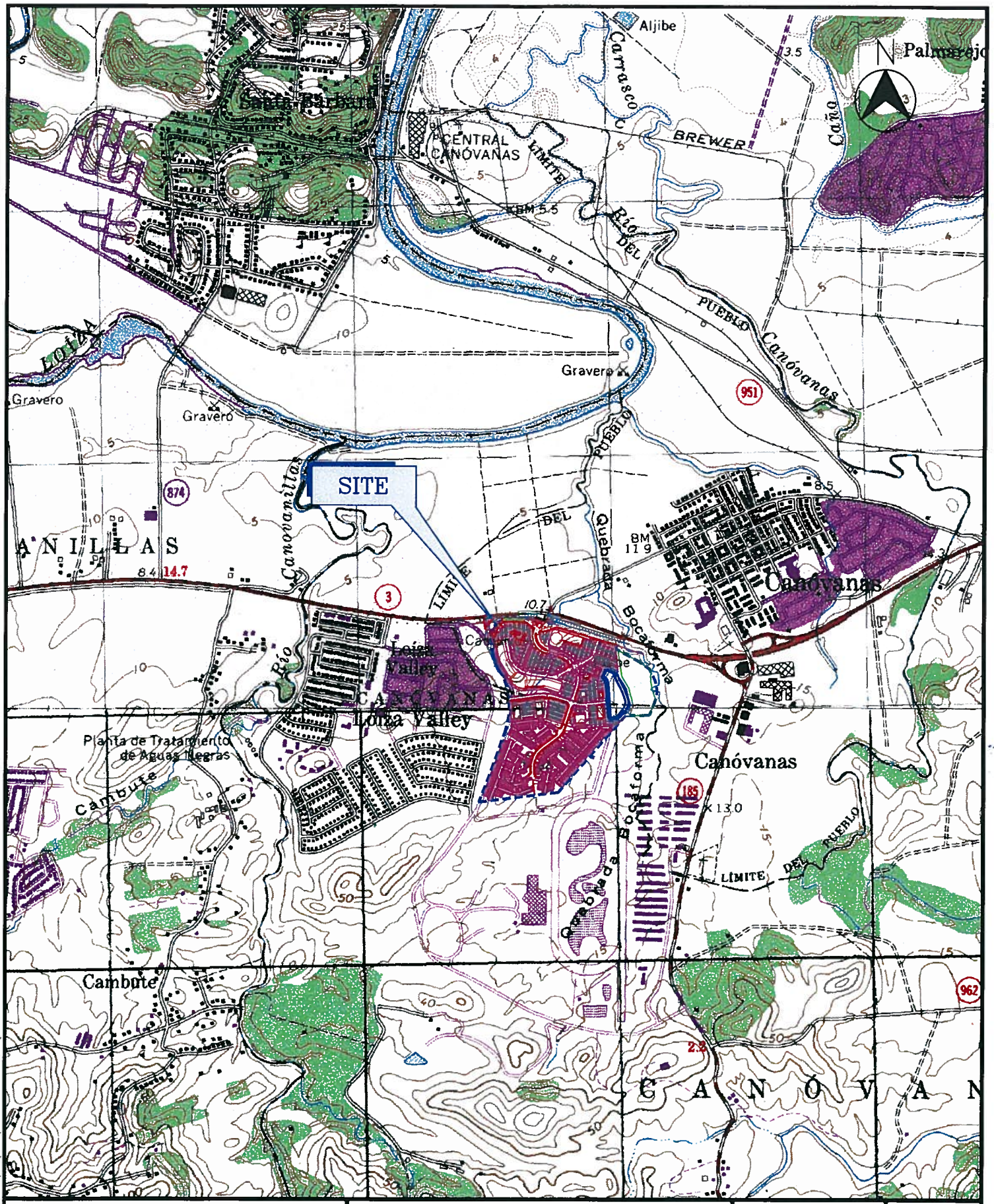
FIGURES



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LOCATION PLAN

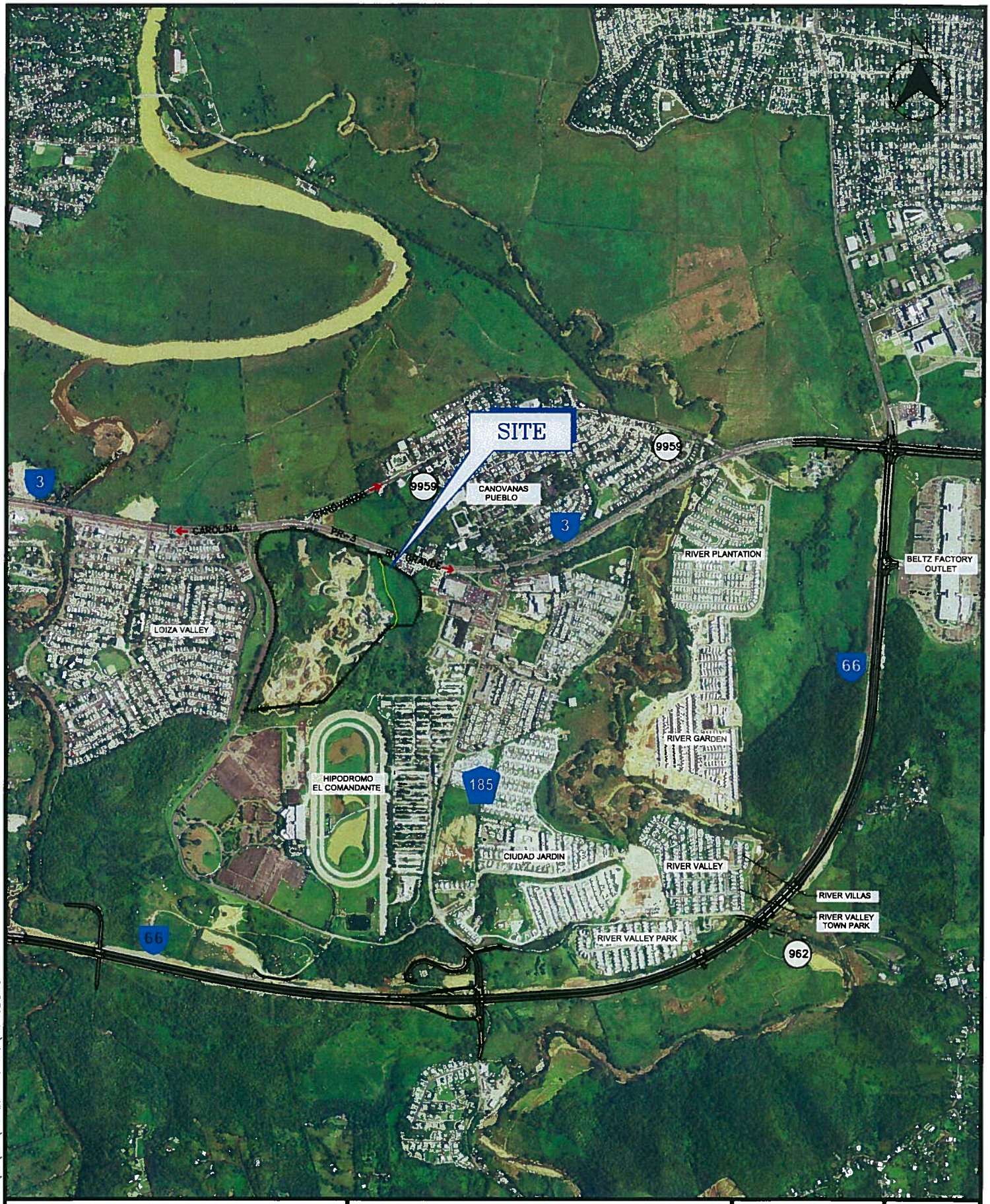
EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY
CANOVANAS, PUERTO RICO

CMA# 05201

SCALE: 1:20,000

DATE: 02/17/09

FIGURE 1



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AERIAL PHOTO

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

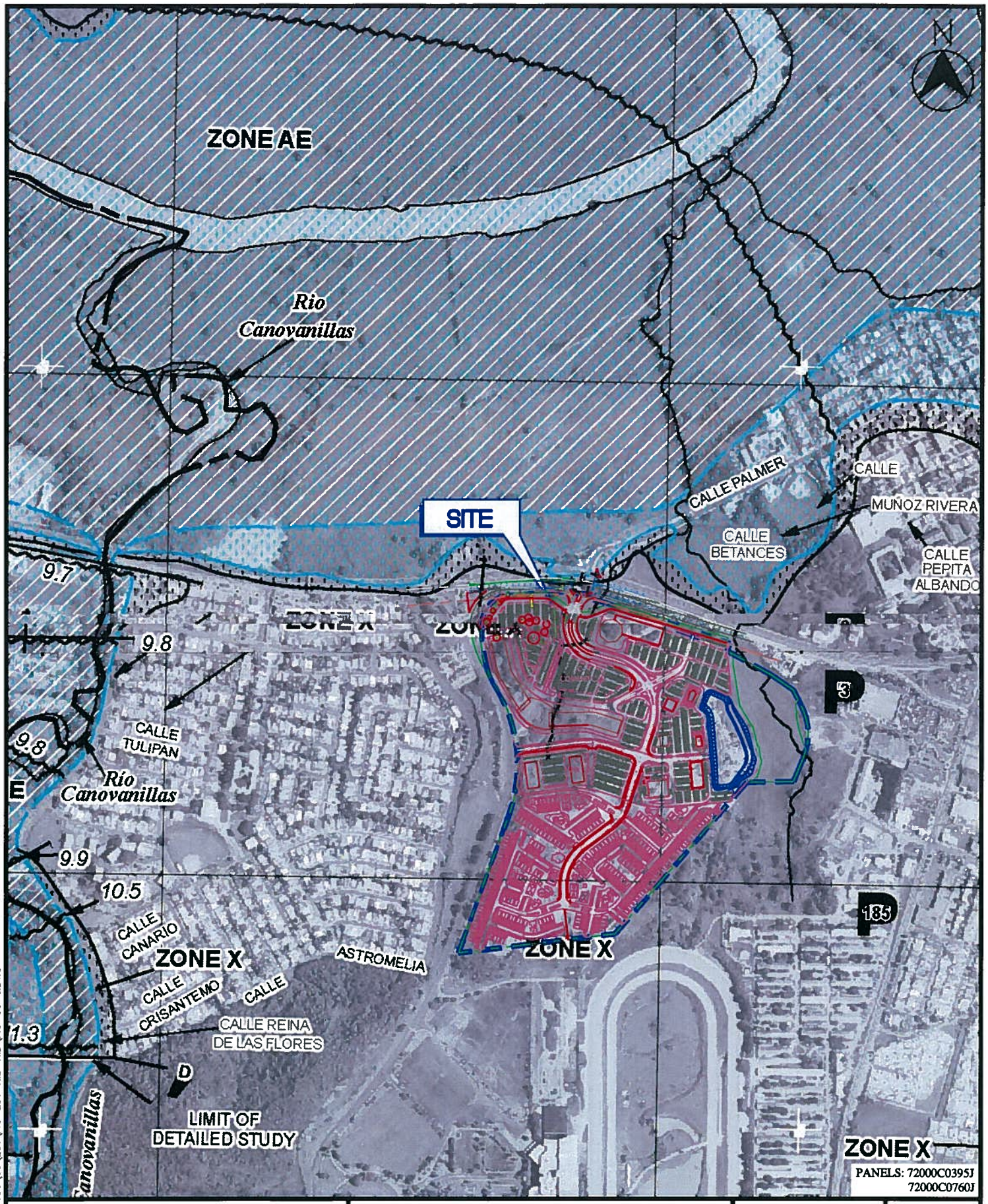
CMA# 05201

SCALE: 1:20,000

DATE: 10/06/06

FIGURE 2

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-02.DWG



FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-03-JJ.DWG

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FEMA–FLOOD INSURANCE RATE MAP

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

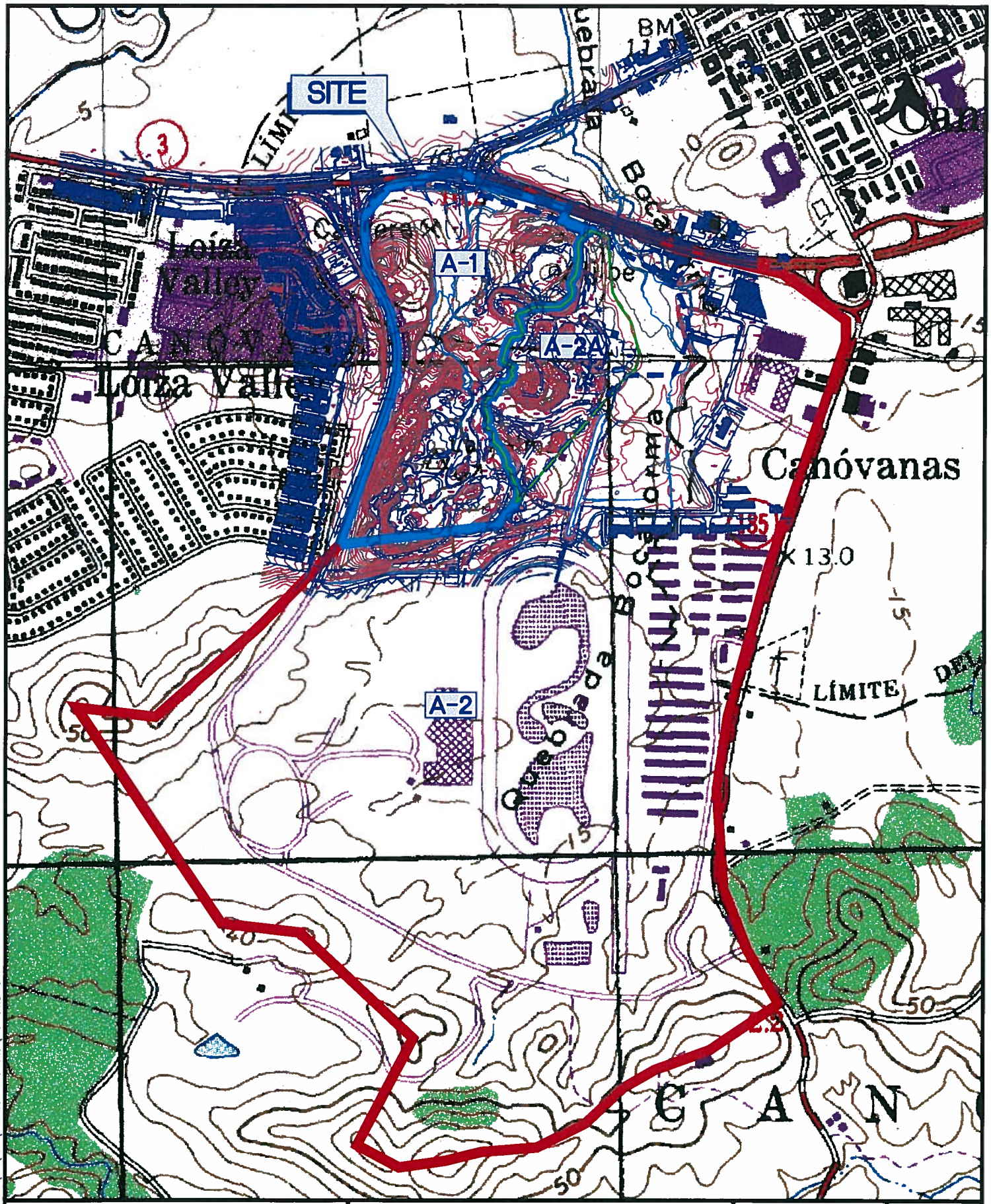
CANOVANAS, PUERTO RICO

CMA# 05201

SCALE: 1:10,000

DATE: 02/17/09

FIGURE 3



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DRAINAGE SUB-BASIN
EXISTING CONDITIONS

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

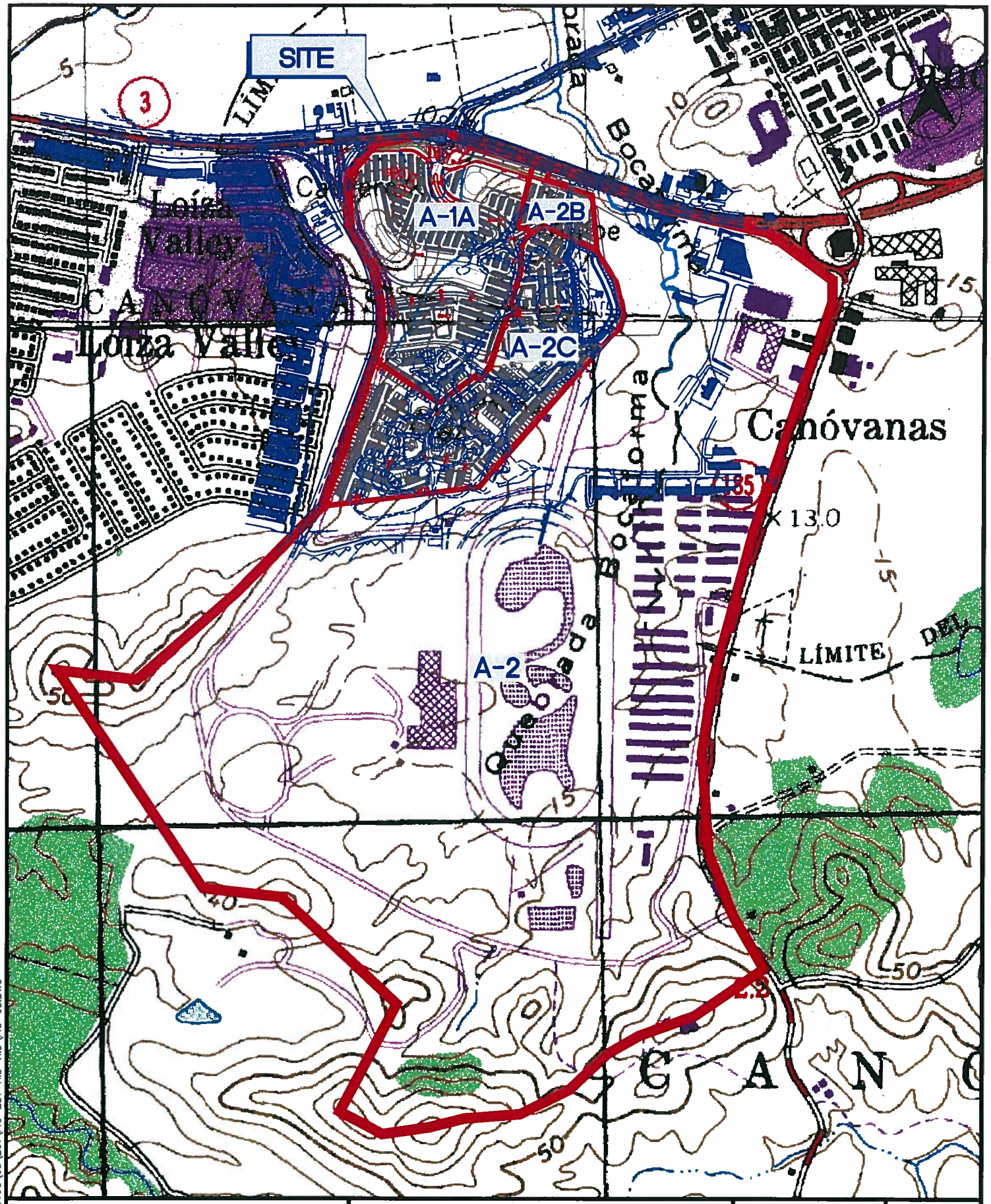
CMA# 05201

SCALE: 1:10,000

DATE: 07/15/09

FIGURE 4

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-04.DWG



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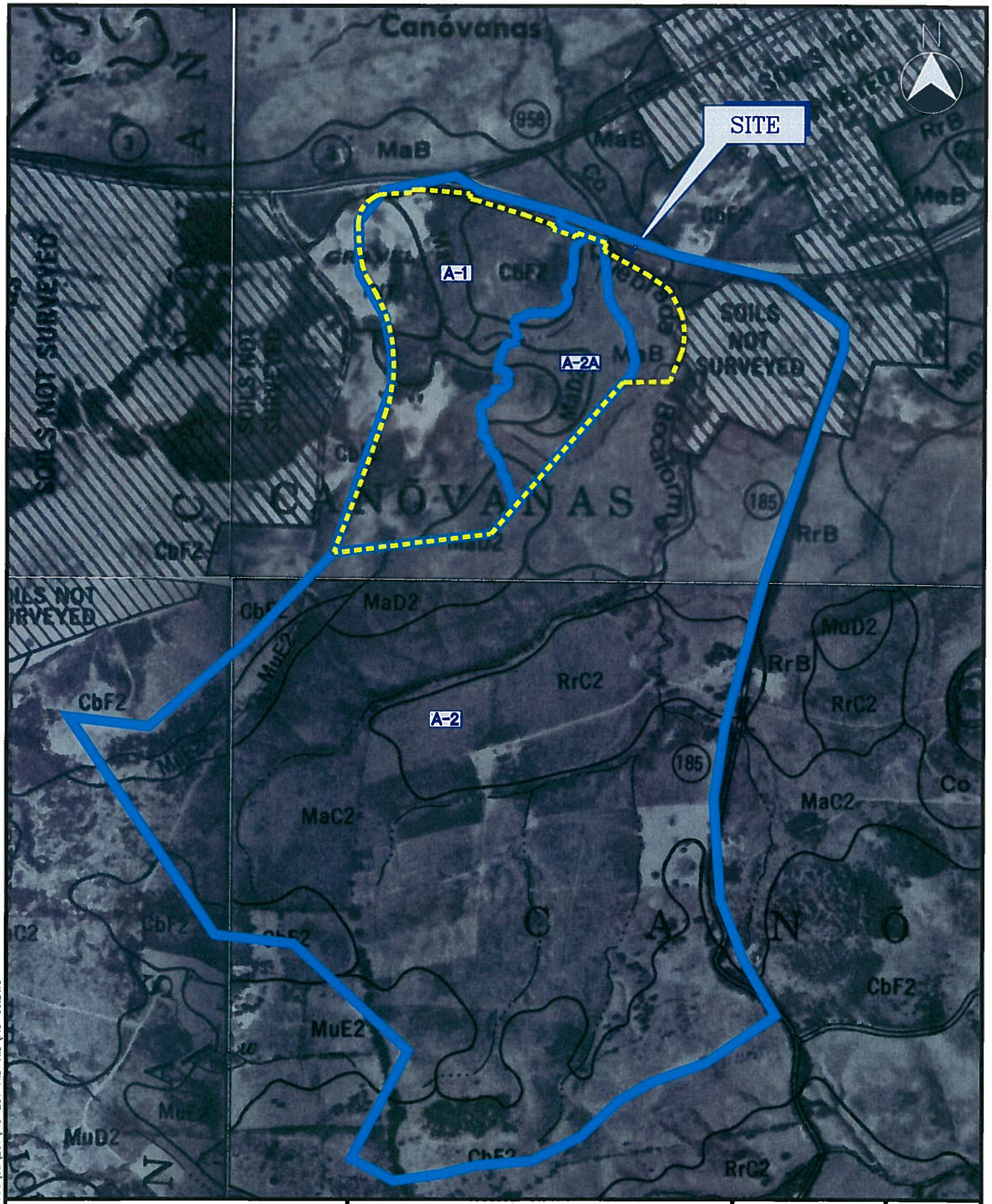
DRAINAGE SUB-BASIN PROPOSED CONDITIONS	CMA# 05201	FIGURE 5
EL NUEVO COMANDANTE HYDROLOGIC – HYDRAULIC STUDY	SCALE: 1:10,000	
CANOVANAS, PUERTO RICO	DATE: 07/15/09	

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-05.DWG



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U.S. DEPARTMENT OF AGRICULTURE SOILS MAP

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

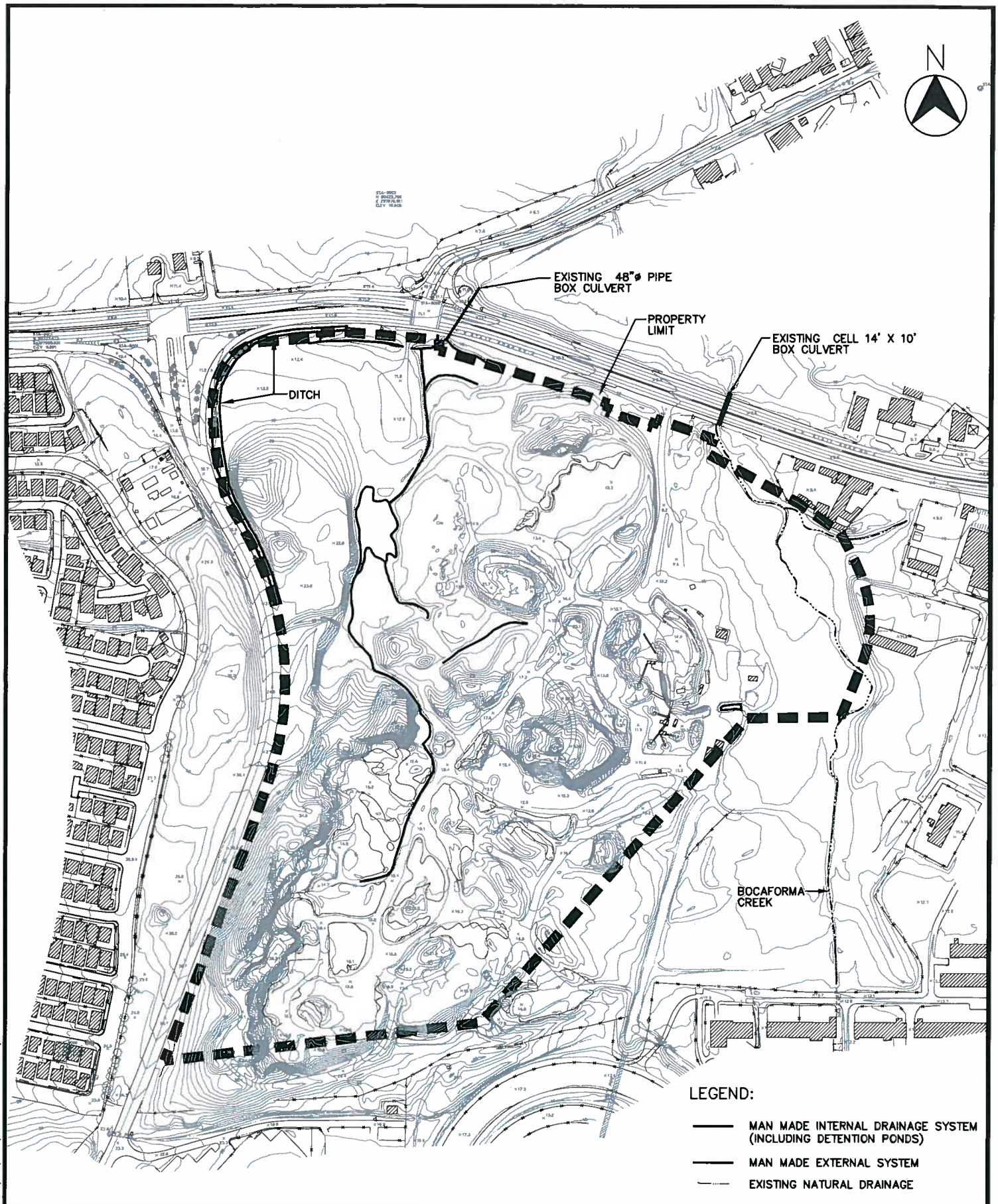
CMA# 05201

SCALE: 1:10,000

DATE: 07/15/09

FIGURE 6

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-06.DWG



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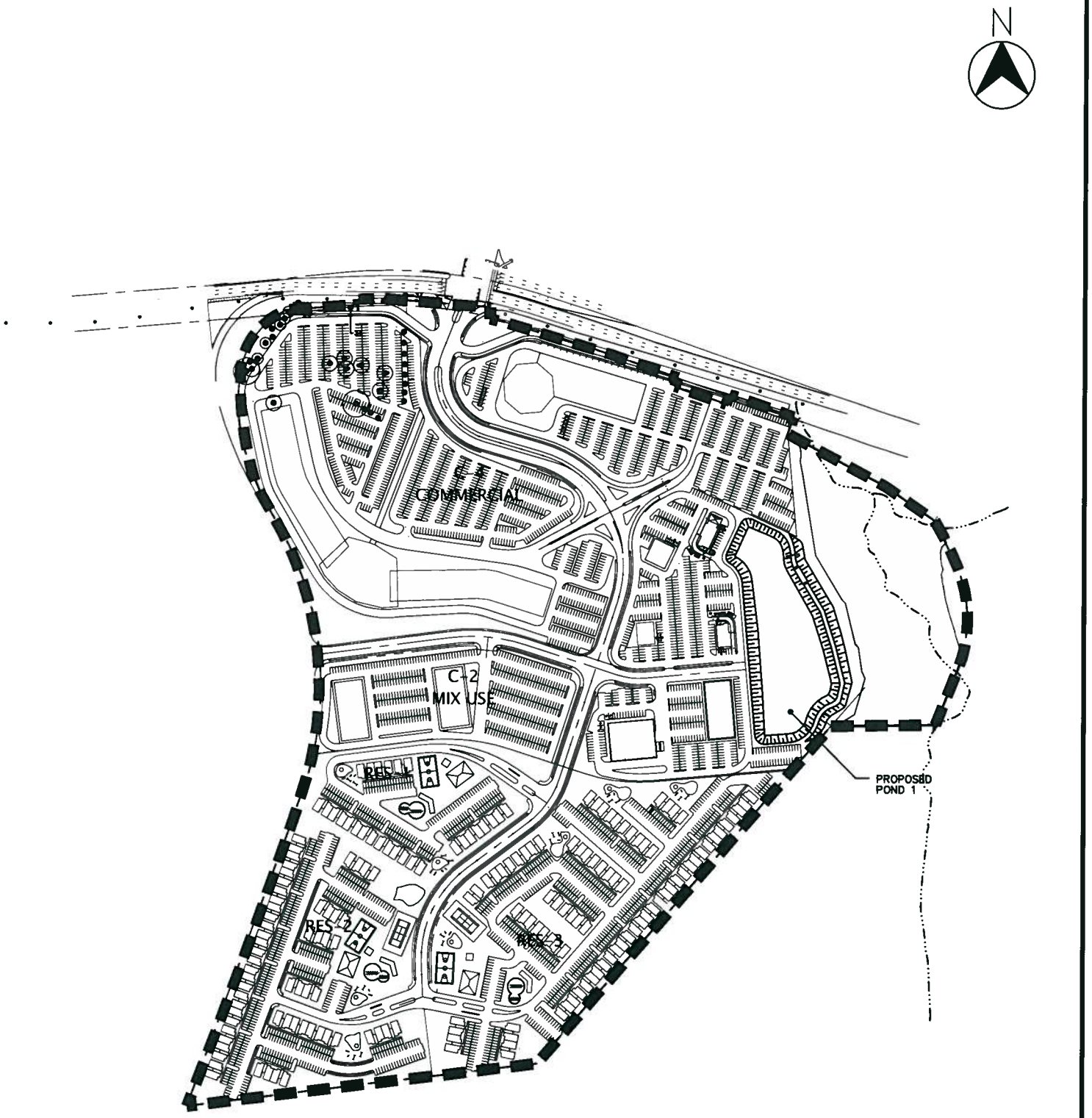
EXISTING CONDITIONS SURVEY PLAN	CMA# 05201	FIGURE 7
EL NUEVO COMANDANTE HYDROLOGIC – HYDRAULIC STUDY CANOVANAS, PUERTO RICO	ESCALA: 1: 5,000 FECHA: 07/15/09	

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-07.DWG



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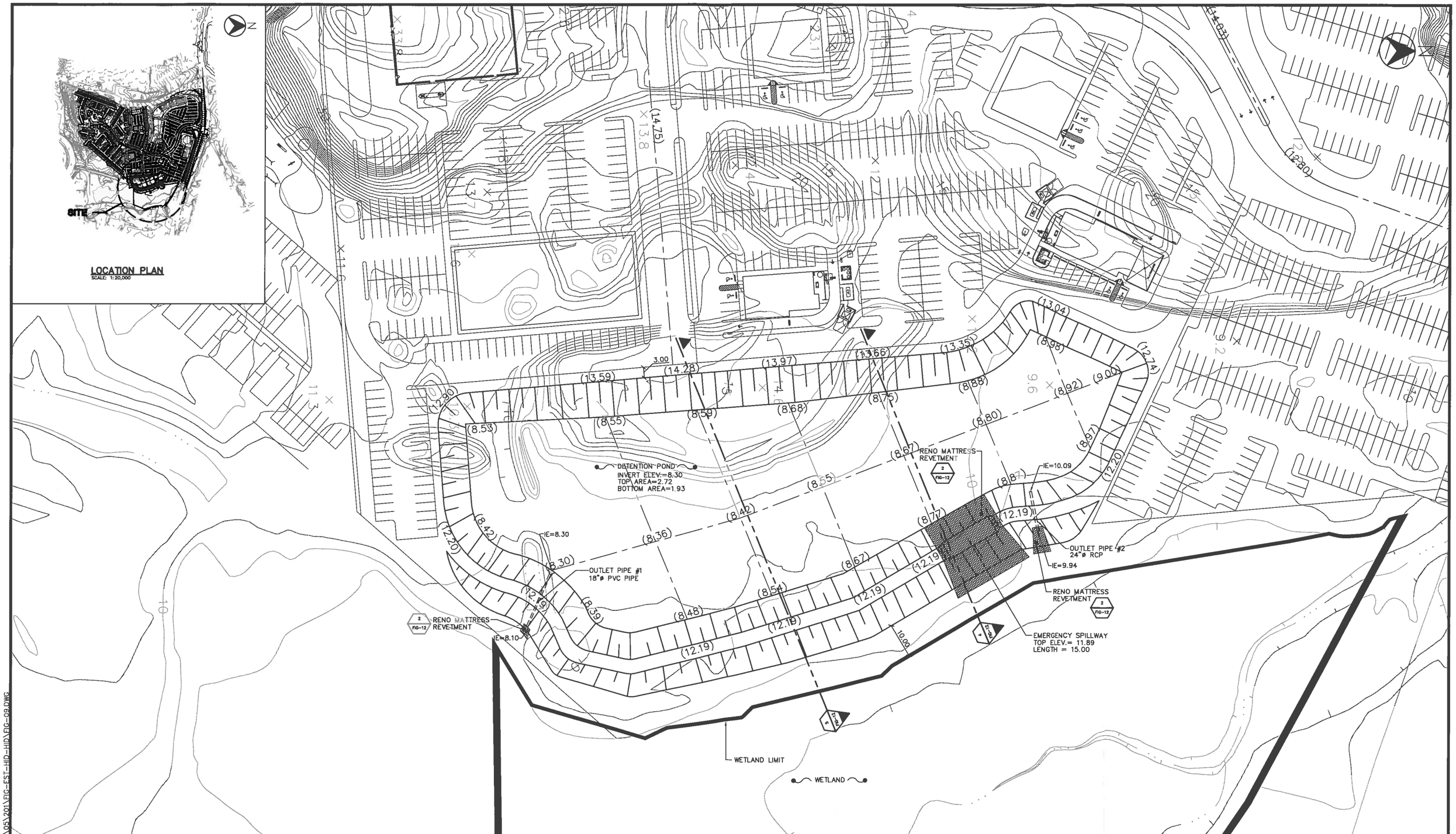
PROPOSED CONDITIONS

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY
CANOVANAS, PUERTO RICO

CMA# 05201
SCALE: 1:5,000
DATE: 07/15/09

FIGURE 8

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-08.DWG



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DETENTION POND LAYOUT AND GRADING PLAN

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

CMA# 05201

SCALE: 1: 1,000

DATE: 07/17/09

FIGURE 9

M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-09.DWG

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

Puerto Rico 18.37 N 65.91 W 164 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 3, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006

Extracted: Wed Feb 11 2009

Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Docs

Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.39	0.53	0.68	1.08	1.61	2.07	2.41	2.96	3.53	4.15	5.24	5.59	6.59	7.71	10.75	13.64	16.93	20.31
2	0.51	0.69	0.89	1.42	2.11	2.76	3.06	3.83	4.61	5.44	6.86	7.31	8.55	9.92	13.62	17.15	21.21	25.30
5	0.59	0.81	1.04	1.67	2.47	3.37	3.81	4.97	6.16	7.38	9.32	9.90	11.38	12.84	16.90	20.74	25.29	29.71
10	0.66	0.90	1.16	1.85	2.75	3.82	4.38	5.85	7.42	8.97	11.36	12.04	13.70	15.24	19.58	23.62	28.58	33.26
25	0.74	1.01	1.30	2.09	3.10	4.42	5.13	7.06	9.14	11.23	14.29	15.09	17.00	18.60	23.25	27.50	32.98	37.94
50	0.81	1.10	1.42	2.27	3.36	4.87	5.73	8.01	10.54	13.09	16.70	17.60	19.70	21.32	26.17	30.54	36.41	41.55
100	0.87	1.19	1.52	2.44	3.62	5.32	6.32	8.98	11.99	15.03	19.27	20.24	22.52	24.17	29.15	33.59	39.83	45.11
200	0.93	1.27	1.63	2.61	3.88	5.78	6.93	10.00	13.54	17.12	22.04	23.07	25.55	27.20	32.28	36.75	43.37	48.74
500	1.01	1.38	1.77	2.84	4.21	6.39	7.76	11.40	15.68	20.07	25.99	27.07	29.80	31.46	36.58	41.03	48.11	53.56
1000	1.07	1.47	1.88	3.02	4.47	6.86	8.40	12.51	17.40	22.46	29.23	30.32	33.24	34.90	39.97	44.37	51.79	57.26

* These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval.
Please refer to NOAA Atlas 14 Document for more information. NOTE: Formatting forces estimates near zero to appear as zero.

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POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

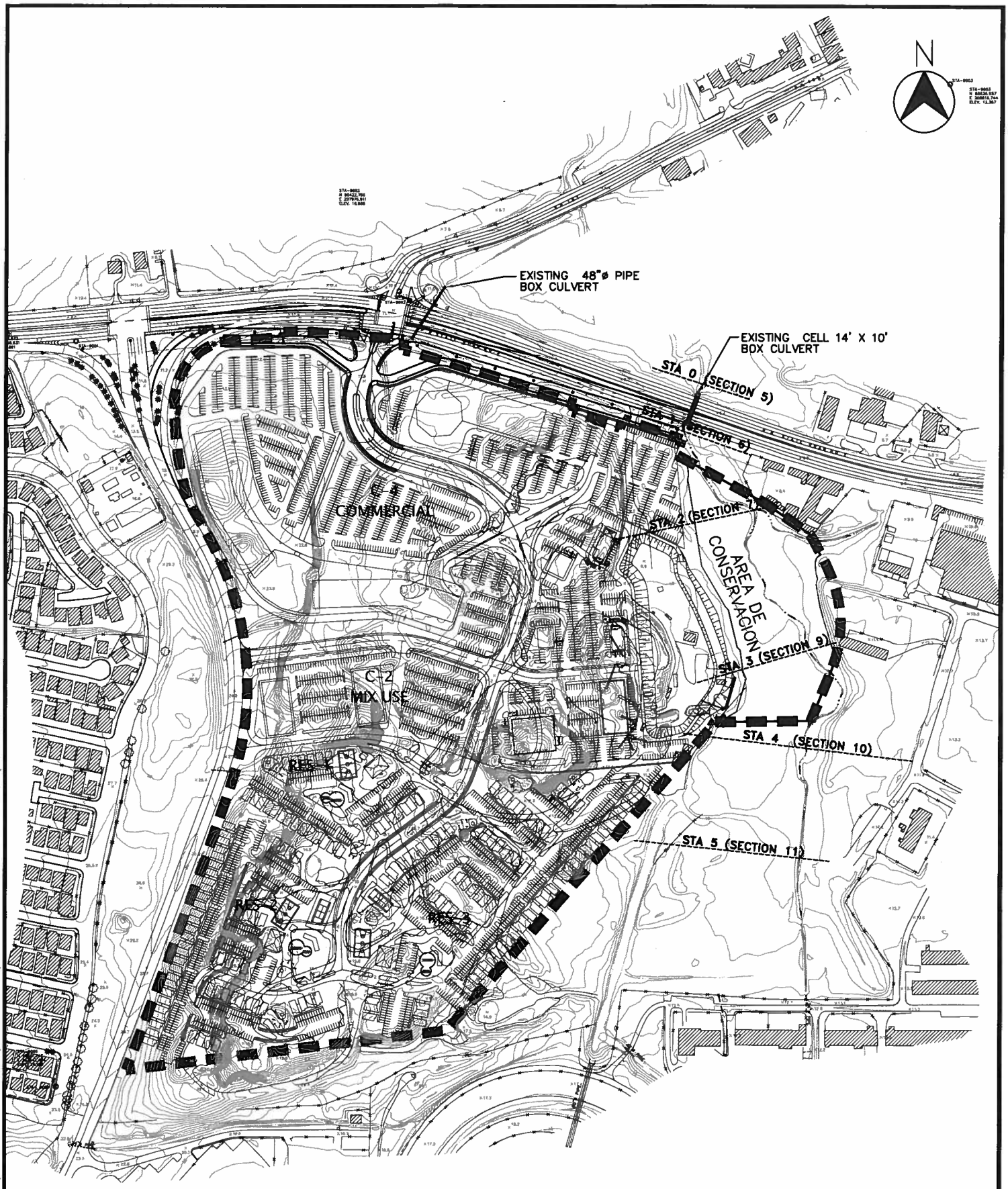
EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

CMA# 05201
SCALE: NOT TO SCALE
DATE: 07/15/09

FIGURE 10

FILE: M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-10.DWG



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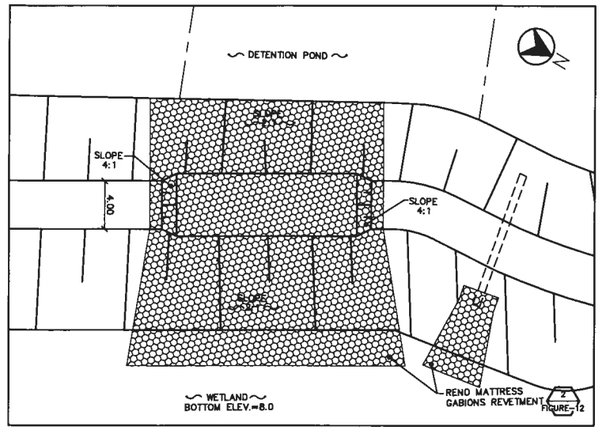
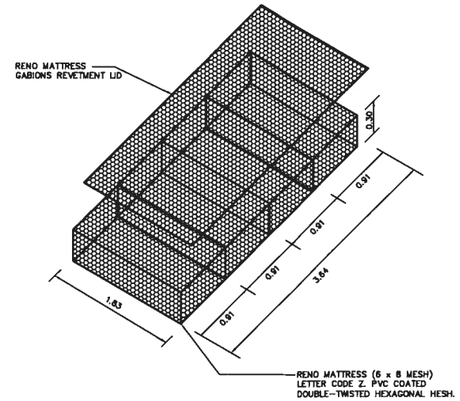
HYDRAULIC STUDY REFERENCE PLAN	CMA# 05201	FIGURE 11
EL NUEVO COMANDANTE HYDROLOGIC – HYDRAULIC STUDY CANOVANAS, PUERTO RICO	ESCALA: 1: 5,000 FECHA: 07/15/09	

FILE: M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\FIG-ESTUDIOS-HIDROLIGIC-HIDRAULIC\FIG-11.DWG

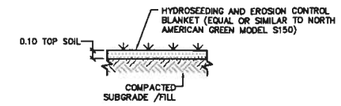


EMERGENCY SPILLWAY DETAIL (TYP.) 1 FIGURE-12
SCALE: 1:500

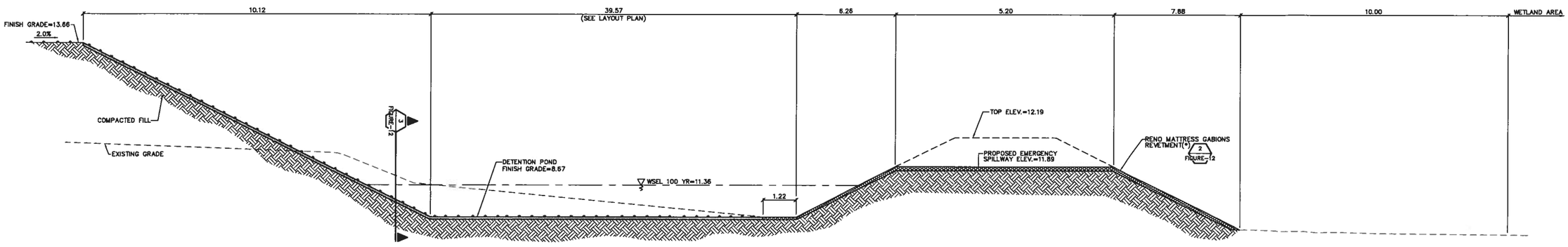


RENO MATTRESS REVETMENT CELL SIZE

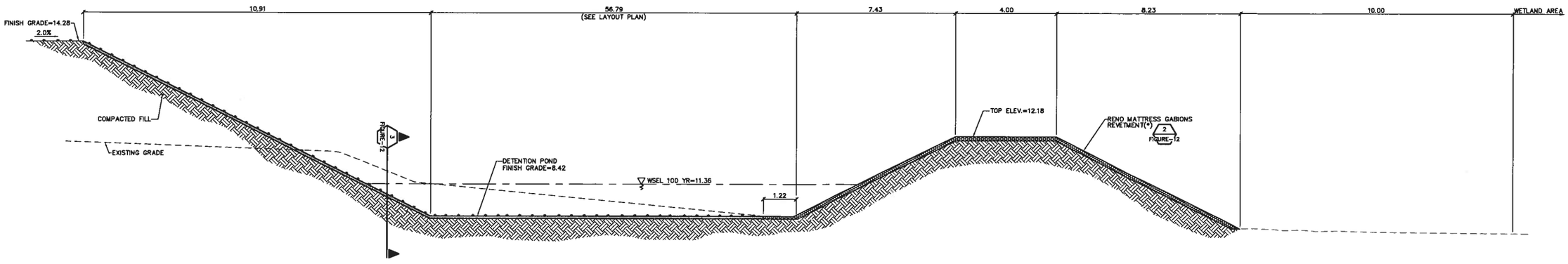
SECTION 2 FIGURE-12
SCALE: N.T.S.



SECTION 3 FIGURE-12
SCALE: N.T.S.



PROPOSED DETENTION POND 4 FIGURE-12
NOT TO SCALE



PROPOSED DETENTION POND 5 FIGURE-12
NOT TO SCALE

M:\CIVIL\PROYECTOS\05\201\FIG-EST-HID-HID\FIG-12.DWG

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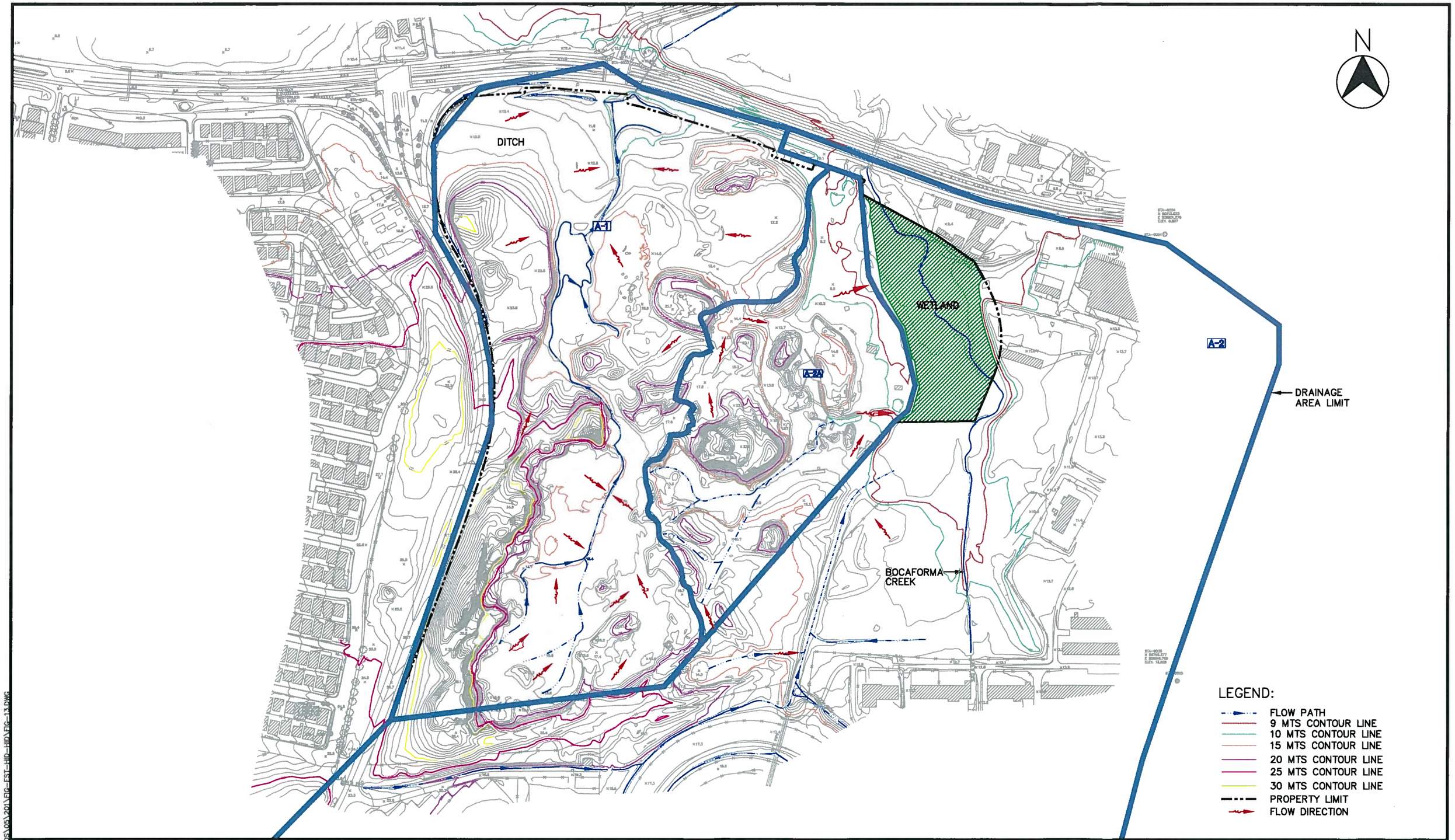
TYPICAL SECTIONS AND DETAILS

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

CMA# 05201
SCALE: AS SHOWN
DATE: 07/17/09

FIGURE 12



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EXISTING DRAINAGE FLOW PATTERN

EL NUEVO COMANDANTE
HYDROLOGIC – HYDRAULIC STUDY

CANOVANAS, PUERTO RICO

CMA# 05201

SCALE: 1: 4,000

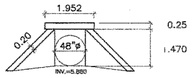
DATE: 07/17/09

FIGURE 13

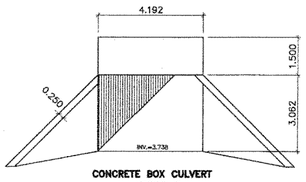
M:\CIVIL\PROYECTOS\05\2013\FIG-EST-HID-HID\FIG-13.DWG

APPENDICES

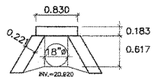
APPENDIX A
TOPOGRAPHIC PLAN



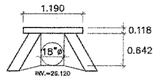
HEADWALL DETAIL A
SCALE 1:100



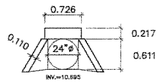
CONCRETE BOX CULVERT DETAIL B
SCALE 1:100



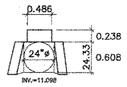
HEADWALL DETAIL C
SCALE 1:50



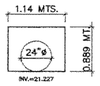
HEADWALL DETAIL D
SCALE 1:50



HEADWALL DETAIL E
SCALE 1:50

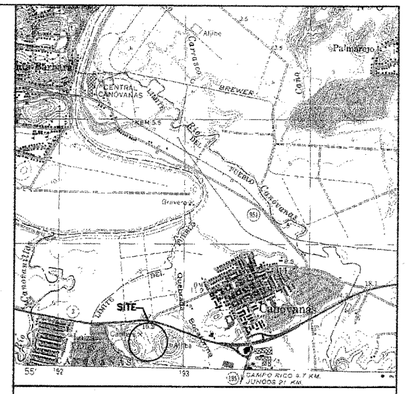


HEADWALL DETAIL F
SCALE 1:50



HEADWALL DETAIL G
SCALE 1:50

SCALE 1:2000



LOCATION MAP 1:20000

LEGEND:

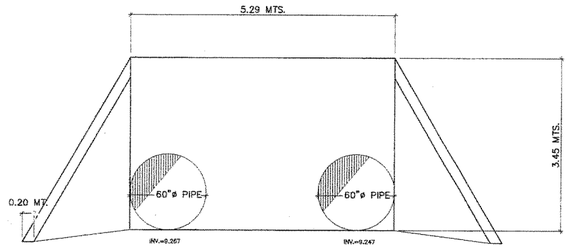
$\triangle^{J-9}$	HORIZONTAL AND VERTICAL CONTROL
8.007	SPOT ELEVATION

NOTES:

1) ALL DISTANCES AND ELEVATIONS ARE IN METERS.
2) THE HORIZONTAL CONTROL ARE REFERRED OF DRAWING PREPARED BY CARIBBEAN AERIAL SURVEY.
3) THE VERTICAL CONTROL ARE REFERRED OF DRAWING PREPARED BY CARIBBEAN AERIAL SURVEY.
4) THE DECIMAL POINT DENOTE THE PLACE OF THE ELEVATION EXCEPT WHEN OTHERWISE INDICATED.
5) THIS SURVEY WAS CARRY OUT WITH A TOTAL STATION.
6) THIS SURVEY WAS PERFORMED ON JUNE 2006.

HORIZONTAL & VERTICAL CONTROL

STATION	(Y) NORTH	(X) EAST	ELEVATION	DESCRIPTION
9001	60373. 6720	207660. 6310	9. 890	PK NAIL
9002	60422. 7660	207976. 9110	10. 600	PK NAIL
J-1	60323. 0780	207933. 3938	12. 090	STEEL ROD
J-2	60229. 5522	208000. 6159	15. 880	STEEL ROD
J-3	60061. 1154	207947. 4510	16. 700	STEEL ROD
J-4	60291. 5279	208263. 1658	8. 330	PK NAIL
J-5	60292. 3272	208229. 9517	9. 005	STEEL ROD
J-6	60132. 6099	208236. 7294	9. 713	STEEL ROD
J-9	60231. 6170	208453. 4920	8. 400	STEEL ROD
J-8	60093. 6864	208236. 9554	11. 173	STEEL ROD
J-9	59998. 7459	208285. 1056	11. 483	STEEL ROD
J-10	59873. 4471	208245. 8764	12. 977	STEEL ROD
J-11	59730. 9775	208310. 7198	11. 445	STEEL ROD



HEADWALL DETAIL H
SCALE 1:50

CARIBBEAN AERIAL SURVEYS, INC. 2484 CANOVANAS, P.R.

APPV'D.	BY	DATE	REMARKS	NO.

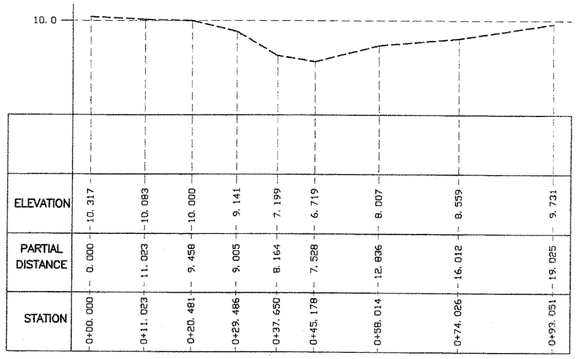
REVISIONS

Torres & Asociados
Agrimensores
CALLE TETUAN # 201-B OFI. 203, SAN JUAN P.R. Tel. (809) 721-0033

PLAN
EL NUEVO COMANDANTE QUARRY SITE, LOCATED AT CANOVANAS, P.R.

ANGEL TORRES VAZQUEZ
AGRIMENSOR LICENCIADO
LIC. 89751
ANGEL MOEL TORRES
LIC. NO. 9751 PLS

DRAWN BY: DATE 7/11/06
CHECKED BY: DATE
APPROVED BY: DATE
SCALE
PROJECT NO.
SHEET NO. 1 of 3

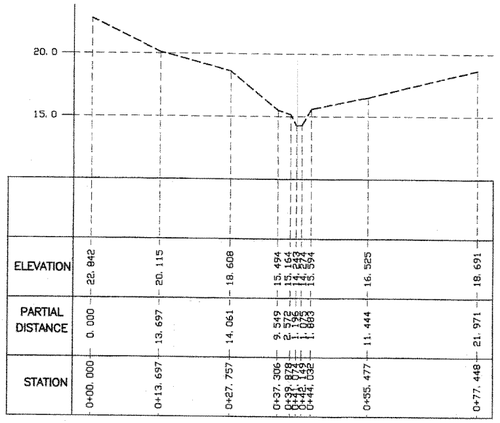


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	10.317	0.000
0+11.023	10.083	11.023
0+20.481	10.000	9.458
0+29.486	9.141	9.005
0+37.650	7.199	8.164
0+45.178	6.719	7.528
0+58.014	8.007	12.836
0+74.026	8.599	16.012
0+99.051	9.731	19.025

SECTION 1

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200



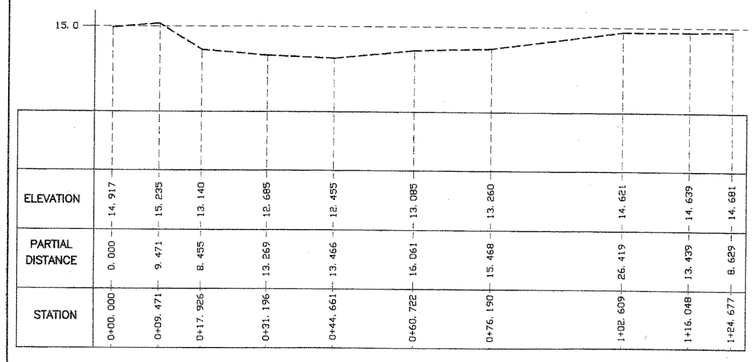
STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	22.842	0.000
0+13.697	20.115	13.697
0+27.757	18.608	14.061
0+37.306	15.494	9.549
0+38.872	15.144	1.566
0+39.679	14.943	0.807
0+40.742	14.694	1.063
0+44.032	14.594	3.290
0+55.477	16.525	11.444
0+77.448	18.691	21.971

SECTION 4

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

LOCATION MAP 1:20000

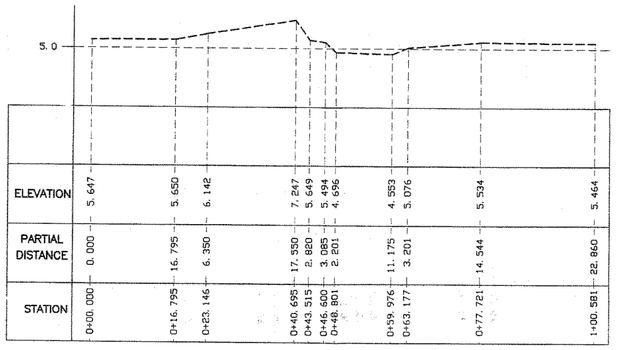


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	14.917	0.000
0+09.471	15.235	9.471
0+17.926	13.140	8.455
0+31.196	12.685	13.269
0+44.661	12.455	13.466
0+60.722	13.085	16.061
0+76.190	13.260	15.468
1+02.609	14.621	26.419
1+16.048	14.639	13.439
1+24.677	14.681	8.629

SECTION 2

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

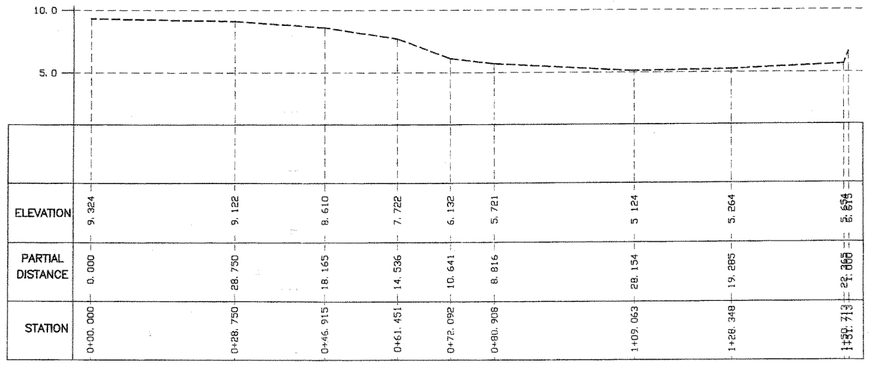


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	5.647	0.000
0+16.795	5.650	16.795
0+23.146	6.142	6.350
0+40.695	7.247	17.550
0+43.515	5.649	2.820
0+46.600	5.494	3.085
0+48.801	4.696	2.201
0+59.976	4.553	11.175
0+63.177	5.076	3.201
0+77.721	5.534	14.544
1+00.581	5.464	22.860

SECTION 5

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

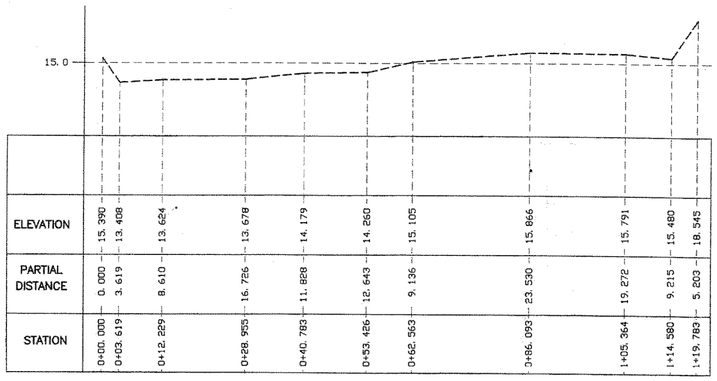


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	9.324	0.000
0+28.750	9.122	28.750
0+46.915	8.610	18.165
0+61.451	7.722	14.536
0+72.092	6.132	10.641
0+80.908	5.721	8.816
1+09.063	5.124	28.154
1+28.348	5.264	19.285
1+31.713	5.654	3.365
1+33.713	5.675	2.000

SECTION 7

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

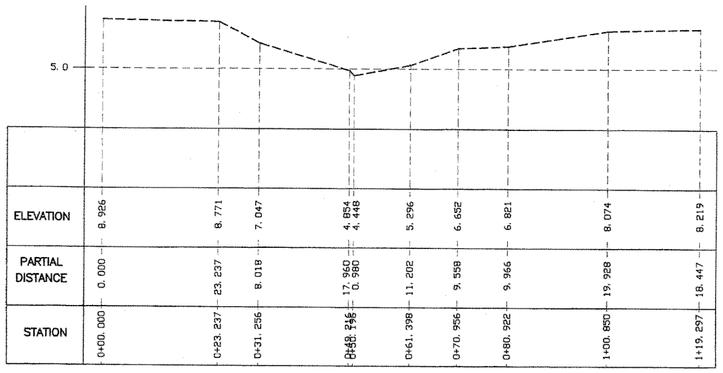


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	15.390	0.000
0+03.619	13.408	3.619
0+12.229	13.624	8.610
0+28.955	13.678	16.726
0+40.783	14.179	11.828
0+53.426	14.260	12.643
0+62.563	15.105	9.136
0+86.093	15.866	23.530
1+05.364	15.791	19.272
1+14.580	15.480	9.215
1+19.783	18.545	5.203

SECTION 3

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

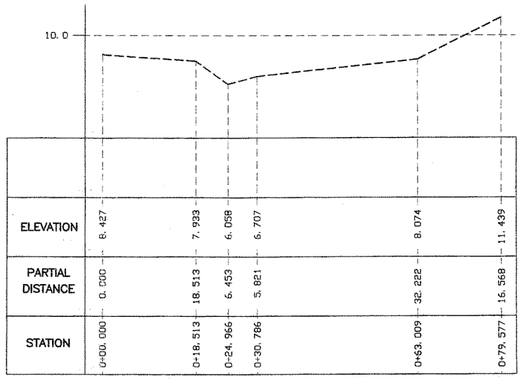


STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	8.926	0.000
0+23.237	8.771	23.237
0+31.256	7.047	8.018
0+48.216	4.654	17.960
0+48.796	4.448	0.580
0+61.398	5.296	11.202
0+70.956	6.652	9.558
0+80.922	6.821	9.966
1+00.850	8.074	19.928
1+19.297	8.219	18.447

SECTION 6

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200



STATION	ELEVATION	PARTIAL DISTANCE
0+00.000	8.427	0.000
0+18.513	7.933	18.513
0+24.966	6.058	6.453
0+30.786	6.707	5.821
0+63.009	8.074	32.222
0+79.577	11.439	16.568

SECTION 8

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

ANGEL NOEL TORRES VAZQUEZ
AGRIMENSOR LICENCIADO
LIC.#9751
PUERTO RICO

APPV'D.	BY	DATE	REMARKS	NO.

REVISIONS

Torres & Asociados
Agrimensores

CALLE TETUAN # 201-B OFI. 202, SAN JUAN P.R. Tel. (809) 721-0033

PROFILES PLAN

EL NUEVO COMANDANTE QUARRY SITE, LOCATED AT CANOVANAS, P.R.

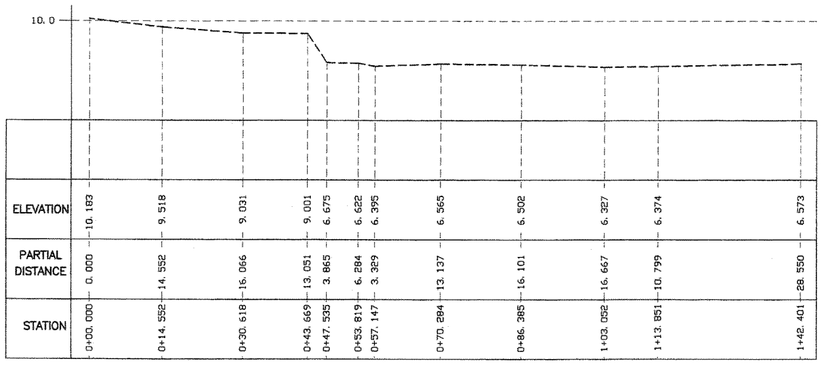
ORDERED BY: | TRACED BY: | SHEET SIZE | PROJECT NO.

ANGEL NOEL TORRES
LIC. NO. 9751 PLS

DATE: 7/11/96 | SCALE | DATE | SCALE | DATE

SHEETS 2 OF 3

SHEET NO.

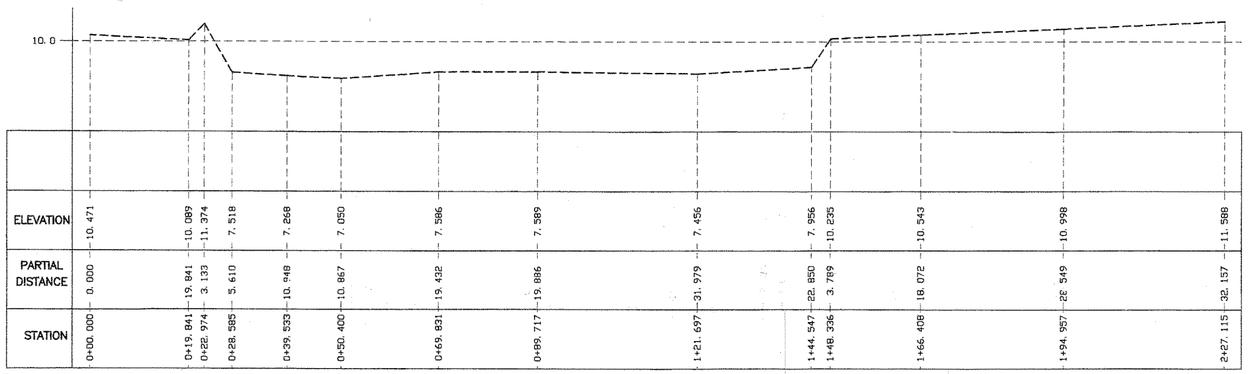


ELEVATION	10.183	9.518	9.031	9.001	6.675	6.622	6.395	6.565	6.502	6.327	6.374	6.573
PARTIAL DISTANCE	0.000	14.552	16.066	13.051	3.865	6.284	3.329	13.137	16.101	16.667	10.799	28.550
STATION	0+00.000	0+14.552	0+30.618	0+43.669	0+47.535	0+53.819	0+57.147	0+70.284	0+86.385	1+03.052	1+13.851	1+42.401

SECTION 9

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

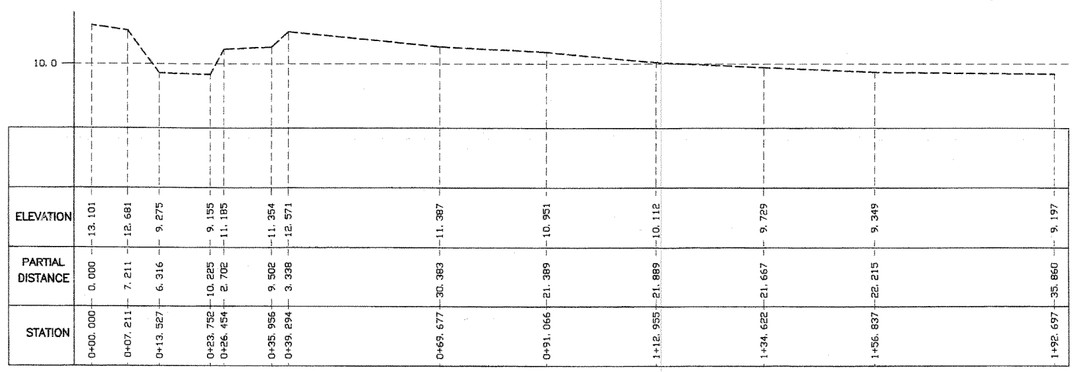


ELEVATION	10.471	10.089	11.374	7.518	7.268	7.050	7.586	7.589	7.456	7.956	10.235	10.543	10.998	11.586
PARTIAL DISTANCE	0.000	19.841	3.133	5.610	10.948	10.867	19.432	19.886	31.979	22.850	3.789	18.072	22.549	32.157
STATION	0+00.000	0+19.841	0+22.974	0+28.585	0+39.533	0+50.400	0+69.831	0+89.717	1+21.697	1+44.547	1+48.336	1+66.408	1+94.957	2+27.115

SECTION 10

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200



ELEVATION	13.101	12.681	9.275	9.155	11.185	11.354	12.571	11.387	10.951	10.112	9.729	9.349	9.197
PARTIAL DISTANCE	0.000	7.211	6.316	10.225	2.702	9.502	3.338	30.383	21.389	21.889	21.667	22.215	35.860
STATION	0+00.000	0+07.211	0+13.527	0+23.752	0+26.454	0+35.956	0+39.294	0+69.677	0+91.066	1+12.955	1+34.622	1+56.837	1+92.697

SECTION 11

HORIZONTAL SCALE 1:500

VERTICAL SCALE 1:200

LOCATION MAP 1:20000

ANGEL N. TORRES VAZQUEZ
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APPV'D.	BY	DATE	REMARKS	NO.

REVISIONS

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Agrimensores
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PROFILES PLAN

EL NUEVO COMANDANTE QUARRY SITE, LOCATED AT CANOVANAS, P.R.

DRAWN BY: | CHECKED BY: | SHEET TITLE | PROJECT NO.

ANGEL NOEL TORRES
LIC. NO. 9751 PLS

DATE: 1/11/06

SHEETS 3 OF 3 SHEET NO.

APPENDIX B
HYDROLOGIC PARAMETERS – DETAILED CALCULATIONS

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [X] Present [ ] Developed Basin A-1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area [X] acres [ ] mi^2 [ ] %	Product of CN x area
Mabi clay,5 to 12 percentage slopesMaC2 {D}	Pasture or Range, good condition	80			7.57	605.42
Caguabo clay loam, 20 to 60 percent slopes CbF2 {D}	Bare Soil	94			11.77	1106.70
Caguabo clay loam, 20 to 60 percent slopes CbF2 {D}	Pasture or Range, good condition	80			10.28	822.71
Mabi clay, 12 to 20 percent slopes, MaD2 {D}	Pasture or Range, good condition	80			5.83	466.10
Mabi clay, 0 to 5 percent slopes, MaB {D}	Pasture or Range, good condition	80			1.14	91.53
Gravel Pit	Pasture or Range, good condition	80			16.77	1341.24
				Totals ->	53.36	4433.71

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4433.71}{53.36} = 83.09$ **Use CN ->** **83**

S= 2.0353

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.38	5.44
Runoff,Q.....in	12.84	10.93	9.11	6.92	5.40	3.58

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

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Project	El Nuevo Comandante Canóvanas, PR				
By	VGN	Date	15-Jul-09	Project	# 05201H
Chkd	J.A. Tirado	Date	15-Jul-09	Page	

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [X] Present [ ] Developed Basin A-2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area [X] acres [ ] mi² [ ] %	Product of CN x area
Caguabo clay loam, 20 to 60 percent slopes CbF2 {D}	Pasture or Range,good condition	80			60.07	4805.48
Coloso silty clay loam Co {D}	Pasture or Range,good condition	80			1.20	95.71
Mabi clay, 0 to 5 percent slopes MaB {D}	Pasture or Range,good condition	80			34.75	2780.18
Mabi Clay, 12 to 20 percent slopes, MaD2 {D}	Pasture or Range,good condition	80			16.37	1309.97
Soil not surveyed	Pasture or Range,good condition	80			20.39	1630.82
Mabi clay, 5 to 12 percent slope MaC2 {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			142.48	11398.11
Mucara silty clay loam, 20 to 40 percent slopes MuE2 {D}	Pasture or Range,good condition	80			24.89	1991.09
Rio arriba clay, 5 to 12 percent slopes RrC2 {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			33.44	2675.58
Rio arriba clay, 2 to 5 percent slope Rrb {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			16.77	1341.24
				Totals ->	350.35	28028.18

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{28028.18}{350.35} = 80.00$ **Use CN ->** **80**

S= 2.5

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.38	5.44
Runoff,Q.....in	12.40	10.50	8.70	6.54	5.05	3.28

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

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Project	El Nuevo Comandante Canóvanas, PR				
By	VGN	Date	15-Jul-09	Project	# 05201H
Chkd	J.A. Tirado	Date	15-Jul-09	Page	

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [X] Present [ ] Developed Basin A-2A

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area [X] acres [ ] mi² [ ] %	Product of CN x area
Caguabo clay loam, 20 to 60 percent slopes CbF2 {D}	Bare Soil	94			5.71	537.14
Mabi clay, 0 to 5 percent slopes MaB {D}	Bare Soil	94			8.88	834.80
Mabi Clay, 12 to 20 percent slopes, MaD2 {D}	Bare Soil	94			5.41	508.19
				Totals ->	20.00	1880.13

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1880.13}{20.00} = 94.00$ **Use CN ->** **94**

S= 0.6383

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.38	5.44
Runoff,Q.....in	14.29	12.35	10.50	8.25	6.67	4.74

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

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Project	El Nuevo Comandante Canóvanas, PR				
By	VGN	Date	15-Jul-09	Project	# 05201H
Chkd	J.A. Tirado	Date	15-Jul-09	Page	

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [ ] Present [X] Developed Basin A-1

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area [X] acres [ ] mi^2 [ ] %	Product of CN x area
{D}	Commercial and Business	95			35.60	3382.11
				Totals ->	35.60	3382.11

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{3382.11}{35.60} = 95.00$ **Use CN ->** **95**

S= 0.5263

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.35	5.44
Runoff,Q.....in	14.42	12.48	10.62	8.37	6.75	4.86

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [ ] Present [X] Developed Basin A-2

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area X acres / mi² / %	Product of CN x area
Caguabo clay loam, 20 to 60 percent slopes CbF2 {D}	Pasture or Range,good condition	80			60.07	4805.48
Coloso silty clay loam Co {D}	Pasture or Range,good condition	80			1.20	95.71
Mabi clay, 0 to 5 percent slopes MaB {D}	Pasture or Range,good condition	80			34.75	2780.18
Mabi Clay, 12 to 20 percent slopes, MaD2 {D}	Pasture or Range,good condition	80			16.37	1309.97
Soil not surveyed	Pasture or Range,good condition	80			20.39	1630.82
Mabi clay, 5 to 12 percent slope MaC2 {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			142.48	11398.11
Mucara silty clay loam, 20 to 40 percent slopes MuE2 {D}	Pasture or Range,good condition	80			24.89	1991.09
Rio arriba clay, 5 to 12 percent slopes RrC2 {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			33.44	2675.58
Rio arriba clay, 2 to 5 percent slope Rrb {D}	Lawns, parks, golf course, cementeries etc.- vegetation established	80			16.77	1341.24
				Totals ->	350.35	28028.18

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{28028.18}{350.35} = 80.00$ **Use CN ->** **80**

S= 2.5

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.38	5.44
Runoff,Q.....in	12.40	10.50	8.70	6.54	5.05	3.28

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

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Project	El Nuevo Comandante Canóvanas, PR				
By	VGN	Date	15-Jul-09	Project	# 05201H
Chkd	J.A. Tirado	Date	15-Jul-09	Page	

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [ ] Present [X] Developed Sub-basin A-2B

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area [X] acres [ ] mi² [ ] %	Product of CN x area
{D}	Commercial and Business	95			3.85	365.75
				Totals ->	3.85	365.75

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{365.75}{3.85} = 95.00$ **Use CN ->** **95**

S= 0.5263

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.35	5.44
Runoff,Q.....in	14.42	12.48	10.62	8.37	6.75	4.86

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Worksheet 2 : Runoff curve number and runoff

Project	El Nuevo Comandante	By	VGN	Date	15-Jul-09
Location	Canóvanas, Puerto Rico	Checked	J.A. Tirado	Date	15-Jul-09

Check: [ ] Present [X] Developed Sub-basin A-2C

1. Runoff curve number

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN Table 2-2	CN Figure 2-3	CN Figure 2-4	Area X acres / mi² / %	Product of CN x area
{D}	Residential Districts by average lots size : 1/8 acres or less	92			33.91	3119.84
				Totals ->	33.91	3119.84

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{3119.84}{33.91} = 92.00$ **Use CN ->** **92**

S= 0.8696

2. Runoff

	Storm #1	*Storm #2*	*Storm #3*	*Storm #4*	*Storm #5*	*Storm #6*
Frequency.....yr	100	50	25	10	5	2
Rainfall, P (24-hr).....in	15.03	13.09	11.23	8.97	7.35	5.44
Runoff,Q.....in	14.03	12.10	10.25	8.00	6.40	4.52

(Use P and CN with table 2-1, figure 2-1, or equation 2-3 and 2-4)

Tc Calculations

Basin ID **A-1** (existing condition)

Overland Flow (t_o)

L (m) = 238.00 m

S = y2-y1/L Y1 (m)= 15.00 m

Y2 (m) = 25.00 m

S= 0.0420

(From Figure 3-1)

V (ft/s) = 3.30 ft/s (unpaved)

V (m/s) = 1.01 m/s

to (sec) = 236.56 secs. = 0.066 hrs.

Overland Flow (t_o)

L (m) = 588.00 m

S = y2-y1/L Y1 (m)= 5.86 m

Y2 (m) = 15.00 m

S= 0.0155

(From Figure 3-1)

V (ft/s) = 2.04 ft/s (unpaved)

V (m/s) = 0.62 m/s

to (sec) = 945.41 secs. = 0.263 hrs.

Tc = Σt_o 1181.97 secs. = 0.328 hrs.

Tlag = 0.6Tc **709.18 secs.** = **0.197 hrs.**

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Tc Calculations

Basin ID **A-2** (existing condition)

Overland Flow (t_o)

L (m) = 535.00 m

S = y2-y1/L Y1 (m)= 15.00 m

Y2 (m) = 60.00 m

S= 0.0841

(From Figure 3-1)

V (ft/s) = 4.70 ft/s (unpaved)

V (m/s) = 1.43 m/s

to (sec) = 373.36 secs. = 0.104 hrs.

Overland Flow (t_o)

L (m) = 648.00 m

S = y2-y1/L Y1 (m)= 10.00 m

Y2 (m) = 15.00 m

S= 0.0077

(From Figure 3-1)

V (ft/s) = 1.80 ft/s (paved)

V (m/s) = 0.55 m/s

to (sec) = 1180.80 secs. = 0.328 hrs.

Overland Flow (t_o)

L (m) = 915.00 m

S = y2-y1/L Y1 (m)= 3.74 m

Y2 (m) = 10.00 m

S= 0.0068

(From Figure 3-1)

V (ft/s) = 1.65 ft/s (unpaved)

V (m/s) = 0.50 m/s

to (sec) = 1818.91 secs. = 0.505 hrs.

$Tc = \Sigma t_o$ 3373.07 secs. = 0.937 hrs.

Tlag = 0.6Tc **2023.84 secs.** = **0.562 hrs.**

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Tc Calculations

Basin ID **A-2a** (existing condition)

Overland Flow (t_o)

L (m) =	95.96	m	
S = y2-y1/L	Y1 (m)=	12.40	m
	Y2 (m) =	39.00	m
S=	0.2772		

(From Figure 3-1)

V (ft/s) =	8.48	ft/s	(unpaved)
V (m/s) =	2.59	m/s	
to (sec) =	37.12	secs.	= 0.010 hrs.

Overland Flow (t_o)

L (m) =	77.36	m	
S = y2-y1/L	Y1 (m)=	12.30	m
	Y2 (m) =	12.40	m
S=	0.0013		

(From Figure 3-1)

V (ft/s) =	0.58	ft/s	(unpaved)
V (m/s) =	0.18	m/s	
to (sec) =	436.98	secs.	= 0.121 hrs.

Overland Flow (t_o)

L (m) =	92.00	m	
S = y2-y1/L	Y1 (m)=	11.60	m
	Y2 (m) =	12.30	m
S=	0.0076		

(From Figure 3-1)

V (ft/s) =	1.40	ft/s	(unpaved)
V (m/s) =	0.43	m/s	
to (sec) =	215.54	secs.	= 0.060 hrs.

Tc Calculations

Basin ID **A-2a (Cont.)** (existing condition)

Overland Flow (t_o)

L (m) =		153.21	m	
S = y2-y1/L	Y1 (m)=		8.00	m
	Y2 (m) =		11.60	m
	S=	0.0235		

(From Figure 3-1)

V (ft/s) =	2.44	ft/s	(unpaved)
V (m/s) =	0.74	m/s	

to (sec) =	205.95	secs.	=	0.057 hrs.

Tc = Σt_o	895.60	secs.	=	0.249 hrs.
Tlag = 0.6Tc	**537.36**	**secs.**	**=**	**0.149 hrs.**

Tc Calculations

Basin ID **A-1A** (proposed condition)

Overland Flow (t_o)

L (m) = 183.34 m
S = y2-y1/L Y1 (m)= 16.28 m
Y2 (m) = 24.93 m
S= 0.0472

(From Figure 3-1)

V (ft/s) = 4.41 ft/s (paved area)
V (m/s) = 1.34 m/s

to (sec) = 136.36 secs. = 0.038 hrs.

Overland Flow (t_o)

L (m) = 438.45 m
S = y2-y1/L Y1 (m)= 11.88 m
Y2 (m) = 16.28 m
S= 0.0100

(From Figure 3-1)

V (ft/s) = 2.03 ft/s (paved area)
V (m/s) = 0.62 m/s

to (sec) = 708.43 secs. = 0.197 hrs.

Overland Flow (t_o)

L (m) = 134.62 m
S = y2-y1/L Y1 (m)= 5.86 m
Y2 (m) = 11.88 m
S= 0.0447

(From Figure 3-1)

V (ft/s) = 4.31 ft/s (paved area)
V (m/s) = 1.31 m/s

to (sec) = 102.44 secs. = 0.028 hrs.

$Tc = \Sigma t_o$ 947.24 secs. = 0.263 hrs.

Tlag = 0.6Tc **568.34 secs.** = **0.158 hrs.**

Tc Calculations

Basin ID **A-2** (proposed condition)

Overland Flow (t_o)

L (m) = 535.00 m

S = y2-y1/L Y1 (m)= 15.00 m

Y2 (m) = 60.00 m

S= 0.0841

(From Figure 3-1)

V (ft/s) = 4.70 ft/s (unpaved)

V (m/s) = 1.43 m/s

to (sec) = 373.36 secs. = 0.104 hrs.

Overland Flow (t_o)

L (m) = 648.00 m

S = y2-y1/L Y1 (m)= 10.00 m

Y2 (m) = 15.00 m

S= 0.0077

(From Figure 3-1)

V (ft/s) = 1.80 ft/s (paved)

V (m/s) = 0.55 m/s

to (sec) = 1180.80 secs. = 0.328 hrs.

Overland Flow (t_o)

L (m) = 915.00 m

S = y2-y1/L Y1 (m)= 3.74 m

Y2 (m) = 10.00 m

S= 0.0068

(From Figure 3-1)

V (ft/s) = 1.65 ft/s (unpaved)

V (m/s) = 0.50 m/s

to (sec) = 1818.91 secs. = 0.505 hrs.

$Tc = \Sigma t_o$ 3373.07 secs. = 0.937 hrs.

Tlag = 0.6Tc **2023.84 secs.** = **0.562 hrs.**

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Tc Calculations

Basin ID **A-2b** (proposed condition)

Overland Flow (t_o)

L (m) =	46.02	m	
S = y2-y1/L	Y1 (m)=	12.80	m
	Y2 (m) =	14.03	m
S=	0.0267		

(From Figure 3-1)

V (ft/s) =	3.34	ft/s	(paved)
V (m/s) =	1.02	m/s	
to (sec) =	45.19	secs.	= 0.013 hrs.

Overland Flow (t_o)

L (m) =	104.33	m	
S = y2-y1/L	Y1 (m)=	10.00	m
	Y2 (m) =	12.80	m
S=	0.0268		

(From Figure 3-1)

V (ft/s) =	3.34	ft/s	(paved)
V (m/s) =	1.02	m/s	
to (sec) =	102.46	secs.	= 0.028 hrs.

Tc = Σt_o	147.65 secs.	=	0.041 hrs.
Tlag = 0.6Tc	**88.59 secs.**	**=**	**0.025 hrs.**
			0.083 hrs.

USE 5 min. for Tc

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Tc Calculations

Basin ID **A-2c** (proposed condition)

Overland Flow (t_o)

L (m) = 87.55 m

S = y2-y1/L Y1 (m)= 23.34 m

Y2 (m) = 25.00 m

S= 0.0190

(From Figure 3-1)

V (ft/s) = 2.80 ft/s (paved)

V (m/s) = 0.85 m/s

to (sec) = 102.56 secs. = 0.028 hrs.

Overland Flow (t_o)

L (m) = 145.97 m

S = y2-y1/L Y1 (m)= 15.66 m

Y2 (m) = 23.34 m

S= 0.0526

(From Figure 3-1)

V (ft/s) = 4.83 ft/s (paved)

V (m/s) = 1.47 m/s

to (sec) = 99.13 secs. = 0.028 hrs.

Overland Flow (t_o)

L (m) = 418.73 m

S = y2-y1/L Y1 (m)= 12.90 m

Y2 (m) = 15.66 m

S= 0.0066

(From Figure 3-1)

V (ft/s) = 1.65 ft/s (paved)

V (m/s) = 0.50 m/s

to (sec) = 832.39 secs. = 0.231 hrs.

$Tc = \Sigma t_o$ 1034.08 secs. = 0.287 hrs.

Tlag = 0.6Tc **620.45 secs.** = **0.172 hrs.**

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PONDPACK RESULTS– EXISTING CONDITIONS

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MASTER DESIGN STORM SUMMARY

Network Storm Collection: Carolina NOAA

Return Event	Total Depth in	Rainfall Type	RNF ID
2yr	5.4400	Synthetic Curve	TypeII 24hr
5yr	7.3800	Synthetic Curve	TypeII 24hr
10yr	8.9700	Synthetic Curve	TypeII 24hr
25yr	11.2300	Synthetic Curve	TypeII 24hr
50yr	13.0900	Synthetic Curve	TypeII 24hr
100yr	15.0300	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
BASIN A-1	AREA	2	15.887		12.0785	202.28		
BASIN A-1	AREA	5	23.943		12.0785	300.78		
BASIN A-1	AREA	10	30.700		12.0785	381.45		
BASIN A-1	AREA	25	40.437		12.0785	495.51		
BASIN A-1	AREA	50	48.521		12.0785	588.79		
BASIN A-1	AREA	100	56.996		12.0785	685.57		
*BOX 14X10	JCT	2	103.673		12.4117	652.77		
*BOX 14X10	JCT	5	158.447		12.4117	1001.09		
*BOX 14X10	JCT	10	204.686		12.4117	1289.91		
*BOX 14X10	JCT	25	271.582		12.4117	1700.94		
*BOX 14X10	JCT	50	327.280		12.4117	2038.28		
*BOX 14X10	JCT	100	385.771		12.4117	2388.78		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*EX 48 PIPE	JCT	2	15.887		12.0785	202.28		
*EX 48 PIPE	JCT	5	23.943		12.0785	300.78		
*EX 48 PIPE	JCT	10	30.700		12.0785	381.45		
*EX 48 PIPE	JCT	25	40.437		12.0785	495.51		
*EX 48 PIPE	JCT	50	48.521		12.0785	588.79		
*EX 48 PIPE	JCT	100	56.996		12.0785	685.57		
SUB-BASIN A-2	AREA	2	95.767		12.4950	636.18		
SUB-BASIN A-2	AREA	5	147.336		12.4950	974.24		
SUB-BASIN A-2	AREA	10	190.939		12.4117	1255.48		
SUB-BASIN A-2	AREA	25	254.082		12.4117	1657.69		
SUB-BASIN A-2	AREA	50	306.687		12.4117	1987.78		
SUB-BASIN A-2	AREA	100	361.951		12.4117	2330.73		
SUB-BASIN A-2A	AREA	2	7.905		11.9952	102.69		
SUB-BASIN A-2A	AREA	5	11.111		11.9952	141.91		
SUB-BASIN A-2A	AREA	10	13.747		11.9952	173.84		
SUB-BASIN A-2A	AREA	25	17.500		11.9952	219.01		
SUB-BASIN A-2A	AREA	50	20.593		11.9952	256.08		
SUB-BASIN A-2A	AREA	100	23.820		11.9952	294.66		

Title... Project Date: 8/3/2006
Project Engineer: Jorge Tirado
Project Title: El Nuevo Comandante
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Carolina NOAA

Storm Tag Name = 2yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 5.4400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 5yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 5 yr
Total Rainfall Depth= 7.3800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 10yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 8.9700 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 25yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 11.2300 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = 50yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 50 yr
Total Rainfall Depth= 13.0900 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Title... Project Date: 8/3/2006
Project Engineer: Jorge Tirado
Project Title: El Nuevo Comandante
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Carolina NOAA

Storm Tag Name = 100yr

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 15.0300 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 2yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

=============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0962 hrs
Computed Peak Flow             =   203.37 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   202.28 cfs
=============================================

                DRAINAGE AREA
             -------------------
             ID:BASIN A-1
             CN   =   83
             Area =      53.361 acres
             S    =   2.0482 in
             0.2S =    .4096 in

              Cumulative Runoff
             -------------------
                     3.5748 in
                     15.896 ac-ft

HYG Volume...         15.887 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 5yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

=============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0962 hrs
Computed Peak Flow             =   301.69 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   300.78 cfs
=============================================

                 DRAINAGE AREA
               -------------------
               ID:BASIN A-1
               CN   =   83
               Area =      53.361 acres
               S    =   2.0482 in
               0.2S =    .4096 in

                Cumulative Runoff
               -------------------
                       5.3873 in
                       23.956 ac-ft

HYG Volume...          23.943 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 10yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0962 hrs
Computed Peak Flow             =   382.18 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   381.45 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:BASIN A-1
              CN   =   83
              Area =      53.361 acres
              S    =   2.0482 in
              0.2S =    .4096 in

               Cumulative Runoff
              -------------------
                      6.9076 in
                      30.716 ac-ft

HYG Volume...         30.700 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 25yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0962 hrs
Computed Peak Flow             =   495.94 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   495.51 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:BASIN A-1
              CN   =   83
              Area =      53.361 acres
              S    =   2.0482 in
              0.2S =    .4096 in

               Cumulative Runoff
              -------------------
                      9.0982 in
                      40.457 ac-ft

HYG Volume...         40.437 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 50yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0962 hrs
Computed Peak Flow             =   588.97 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   588.79 cfs
============================================

                 DRAINAGE AREA
               -------------------
               ID:BASIN A-1
               CN   =   83
               Area =      53.361 acres
               S    =   2.0482 in
               0.2S =    .4096 in

                Cumulative Runoff
               -------------------
                      10.9170 in
                       48.545 ac-ft

HYG Volume...         48.521 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - BASIN A-1 100yr
Tc            = .3287 hrs
Drainage Area = 53.361 acres  Runoff CN= 83

============================================
Computational Time Increment   =   .04383 hrs
Computed Peak Time             =  12.0523 hrs
Computed Peak Flow             =   685.70 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   685.57 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:BASIN A-1
              CN   =   83
              Area =      53.361 acres
              S    =   2.0482 in
              0.2S =    .4096 in

               Cumulative Runoff
              -------------------
                     12.8239 in
                      57.025 ac-ft

HYG Volume...         56.996 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .32870 hrs (ID: BASIN A-1)
Computational Incr, Tm =   .04383 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.94 cfs
Unit peak time      Tp =   .21913 hrs
Unit receding limb, Tr =   .87653 hrs
Total unit time,    Tb =  1.09567 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 2yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =   636.85 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4950 hrs
Peak Flow, Interpolated Output =   636.18 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                      3.2801 in
                      95.765 ac-ft

HYG Volume...         95.767 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 5yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =   975.34 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4950 hrs
Peak Flow, Interpolated Output =   974.24 cfs
============================================

                 DRAINAGE AREA
               -------------------
               ID:SUB-BASIN A-2
               CN   =   80
               Area =     350.352 acres
               S    =   2.5000 in
               0.2S =    .5000 in

                Cumulative Runoff
               -------------------
                       5.0463 in
                      147.332 ac-ft

HYG Volume...        147.336 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 10yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =  1255.60 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1255.48 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                      6.5397 in
                     190.934 ac-ft

HYG Volume...        190.939 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 25yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  1659.60 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1657.69 cfs
============================================

                 DRAINAGE AREA
               -------------------
               ID:SUB-BASIN A-2
               CN   =   80
               Area =     350.352 acres
               S    =   2.5000 in
               0.2S =    .5000 in

                Cumulative Runoff
               -------------------
                       8.7024 in
                      254.076 ac-ft

HYG Volume...        254.082 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 50yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  1991.39 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1987.78 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                     10.5042 in
                     306.680 ac-ft

HYG Volume...        306.687 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2 100yr
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  2336.17 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  2330.73 cfs
============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                     12.3970 in
                     361.943 ac-ft

HYG Volume...        361.951 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB-BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 2yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

=============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   105.80 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   102.69 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2A
              CN   =   94
              Area =      20.001 acres
              S    =    .6383 in
              0.2S =    .1277 in

               Cumulative Runoff
              -------------------
                      4.7425 in
                       7.905 ac-ft

HYG Volume...          7.905 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 5yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   146.05 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   141.91 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB-BASIN A-2A
             CN   =   94
             Area =      20.001 acres
             S    =    .6383 in
             0.2S =    .1277 in

              Cumulative Runoff
             -------------------
                     6.6657 in
                     11.110 ac-ft

HYG Volume...        11.111 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 10yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

=============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   178.83 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   173.84 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2A
              CN   =   94
              Area =      20.001 acres
              S    =    .6383 in
              0.2S =    .1277 in

               Cumulative Runoff
              -------------------
                      8.2470 in
                      13.746 ac-ft

HYG Volume...         13.747 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 25yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

=============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   225.22 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   219.01 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB-BASIN A-2A
             CN   =   94
             Area =      20.001 acres
             S    =    .6383 in
             0.2S =    .1277 in

              Cumulative Runoff
             -------------------
                    10.4987 in
                     17.499 ac-ft

HYG Volume...         17.500 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 50yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   263.29 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   256.08 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
              -------------------
              ID:SUB-BASIN A-2A
              CN   =   94
              Area =      20.001 acres
              S    =    .6383 in
              0.2S =    .1277 in

               Cumulative Runoff
              -------------------
                     12.3540 in
                      20.591 ac-ft

HYG Volume...         20.593 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB-BASIN A-2A 100yr
Tc            = .2490 hrs
Drainage Area = 20.001 acres  Runoff CN= 94

============================================
Computational Time Increment   =   .03320 hrs
Computed Peak Time             =  12.0184 hrs
Computed Peak Flow             =   302.92 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   294.66 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB-BASIN A-2A
             CN   =   94
             Area =      20.001 acres
             S    =    .6383 in
             0.2S =    .1277 in

              Cumulative Runoff
             -------------------
                    14.2903 in
                     23.819 ac-ft

HYG Volume...         23.820 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .24900 hrs (ID: SUB-BASIN A-2A)
Computational Incr, Tm =   .03320 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    91.01 cfs
Unit peak time      Tp =   .16600 hrs
Unit receding limb, Tr =   .66400 hrs
Total unit time,    Tb =   .83000 hrs
```

3.06

----- C -----
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MASTER DESIGN STORM SUMMARY

Network Storm Collection: Carolina NOAA

Return Event	Total Depth in	Rainfall Type	RNF ID
Dev 2	5.4400	Synthetic Curve	TypeII 24hr
Dev 5	7.3800	Synthetic Curve	TypeII 24hr
Dev 10	8.9700	Synthetic Curve	TypeII 24hr
Dev 25	11.2300	Synthetic Curve	TypeII 24hr
Dev 50	13.0900	Synthetic Curve	TypeII 24hr
Dev100	15.0300	Synthetic Curve	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*BOX 14X10	JCT	2	100.620		12.4950	648.21		
*BOX 14X10	JCT	5	156.356		12.4950	991.10		
*BOX 14X10	JCT	10	203.747		12.4117	1276.70		
*BOX 14X10	JCT	25	272.755		12.4117	1691.77		
*BOX 14X10	JCT	50	330.392		12.4117	2034.48		
*BOX 14X10	JCT	100	391.038		12.4117	2386.57		
*EX 48 PIPE	JCT	2	14.407		11.9952	180.08		
*EX 48 PIPE	JCT	5	20.128		11.9952	247.69		
*EX 48 PIPE	JCT	10	24.828		11.9952	302.80		
*EX 48 PIPE	JCT	25	31.517		11.9952	380.85		
*EX 48 PIPE	JCT	50	37.026		11.9952	444.93		
*EX 48 PIPE	JCT	100	42.774		11.9952	511.67		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POND 1	IN	POND	2	12.764		12.0785	161.78		
POND 1	IN	POND	5	18.160		12.0785	225.42		
POND 1	IN	POND	10	22.607		12.0785	277.16		
POND 1	IN	POND	25	28.948		12.0785	350.27		
POND 1	IN	POND	50	34.177		12.0785	410.19		
POND 1	IN	POND	100	39.637		12.0785	472.53		
POND 1	OUT	POND	2	3.300		12.7449	10.15	31.24	5.868
POND 1	OUT	POND	5	6.851		12.8282	14.24	32.58	8.759
POND 1	OUT	POND	10	10.132		12.9115	18.22	33.69	11.268
POND 1	OUT	POND	25	15.277		12.7449	31.07	35.07	14.574
POND 1	OUT	POND	50	19.714		12.6616	42.10	36.14	17.262
POND 1	OUT	POND	100	24.476		12.6616	49.96	37.26	20.196
SUB BASIN A-1A		AREA	2	14.407		11.9952	180.08		
SUB BASIN A-1A		AREA	5	20.128		11.9952	247.69		
SUB BASIN A-1A		AREA	10	24.828		11.9952	302.80		
SUB BASIN A-1A		AREA	25	31.517		11.9952	380.85		
SUB BASIN A-1A		AREA	50	37.026		11.9952	444.93		
SUB BASIN A-1A		AREA	100	42.774		11.9952	511.67		
SUB BASIN A-2		AREA	2	95.767		12.4950	636.18		
SUB BASIN A-2		AREA	5	147.336		12.4950	974.24		
SUB BASIN A-2		AREA	10	190.939		12.4117	1255.48		
SUB BASIN A-2		AREA	25	254.082		12.4117	1657.69		
SUB BASIN A-2		AREA	50	306.687		12.4117	1987.78		
SUB BASIN A-2		AREA	100	361.951		12.4117	2330.73		
SUB BASIN A-2B		AREA	2	1.552		11.9119	26.60		
SUB BASIN A-2B		AREA	5	2.169		11.9119	36.53		
SUB BASIN A-2B		AREA	10	2.676		11.9119	44.62		
SUB BASIN A-2B		AREA	25	3.397		11.9119	56.09		
SUB BASIN A-2B		AREA	50	3.991		11.9119	65.51		
SUB BASIN A-2B		AREA	100	4.610		11.9119	75.32		

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
SUB BASIN A-2C	AREA	2	12.764		12.0785	161.78		
SUB BASIN A-2C	AREA	5	18.160		12.0785	225.42		
SUB BASIN A-2C	AREA	10	22.607		12.0785	277.16		
SUB BASIN A-2C	AREA	25	28.948		12.0785	350.27		
SUB BASIN A-2C	AREA	50	34.177		12.0785	410.19		
SUB BASIN A-2C	AREA	100	39.637		12.0785	472.53		

Title... Project Date: 8/3/2006
Project Engineer: Jorge Tirado
Project Title: El Nuevo Comandante
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Carolina NOAA

Storm Tag Name = Dev 2

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 2 yr
Total Rainfall Depth= 5.4400 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 5

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 5 yr
Total Rainfall Depth= 7.3800 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 10

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 10 yr
Total Rainfall Depth= 8.9700 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 25

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 25 yr
Total Rainfall Depth= 11.2300 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Storm Tag Name = Dev 50

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 50 yr
Total Rainfall Depth= 13.0900 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

Title... Project Date: 8/3/2006
Project Engineer: Jorge Tirado
Project Title: El Nuevo Comandante
Project Comments:

DESIGN STORMS SUMMARY

Design Storm File,ID = Carolina NOAA

Storm Tag Name = Dev100

Data Type, File, ID = Synthetic Storm TypeII 24hr
Storm Frequency = 100 yr
Total Rainfall Depth= 15.0300 in
Duration Multiplier = 1
Resulting Duration = 24.0000 hrs
Resulting Start Time= .0000 hrs Step= .1000 hrs End= 24.0000 hrs

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev  2
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   187.17 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   180.08 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     4.8557 in
                     14.406 ac-ft

HYG Volume...        14.407 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev  5
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   257.17 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   247.69 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     6.7839 in
                     20.126 ac-ft

HYG Volume...        20.128 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev 10
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   314.25 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   302.80 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     8.3679 in
                     24.826 ac-ft

HYG Volume...        24.828 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev 25
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   395.10 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   380.85 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                    10.6222 in
                     31.514 ac-ft

HYG Volume...         31.517 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev 50
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   461.48 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   444.93 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                    12.4789 in
                     37.022 ac-ft

HYG Volume...         37.026 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-1A Dev100
Tc            = .2630 hrs
Drainage Area = 35.601 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .03507 hrs
Computed Peak Time             =  12.0279 hrs
Computed Peak Flow             =   530.63 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9952 hrs
Peak Flow, Interpolated Output =   511.67 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-1A
             CN   =   95
             Area =      35.601 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                    14.4164 in
                     42.770 ac-ft

HYG Volume...         42.774 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .26300 hrs (ID: SUB BASIN A-1A)
Computational Incr, Tm =   .03507 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   153.38 cfs
Unit peak time      Tp =   .17533 hrs
Unit receding limb, Tr =   .70133 hrs
Total unit time,    Tb =   .87667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev  2
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =   636.85 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4950 hrs
Peak Flow, Interpolated Output =   636.18 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2
             CN   =   80
             Area =     350.352 acres
             S    =   2.5000 in
             0.2S =    .5000 in

              Cumulative Runoff
             -------------------
                     3.2801 in
                     95.765 ac-ft

HYG Volume...         95.767 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev  5
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

=============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =   975.34 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4950 hrs
Peak Flow, Interpolated Output =   974.24 cfs
=============================================

                DRAINAGE AREA
              -------------------
              ID:SUB BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                      5.0463 in
                     147.332 ac-ft

HYG Volume...        147.336 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev 10
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

=============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.4933 hrs
Computed Peak Flow             =  1255.60 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1255.48 cfs
=============================================

                 DRAINAGE AREA
               -------------------
               ID:SUB BASIN A-2
               CN   =   80
               Area =     350.352 acres
               S    =   2.5000 in
               0.2S =    .5000 in

                Cumulative Runoff
               -------------------
                       6.5397 in
                      190.934 ac-ft

HYG Volume...        190.939 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev 25
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

=============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  1659.60 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1657.69 cfs
=============================================

                DRAINAGE AREA
              -------------------
              ID:SUB BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                      8.7024 in
                     254.076 ac-ft

HYG Volume...        254.082 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev 50
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  1991.39 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  1987.78 cfs
============================================

                 DRAINAGE AREA
               -------------------
               ID:SUB BASIN A-2
               CN   =   80
               Area =     350.352 acres
               S    =   2.5000 in
               0.2S =    .5000 in

               Cumulative Runoff
               -------------------
                      10.5042 in
                      306.680 ac-ft

HYG Volume...         306.687 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2 Dev100
Tc            = .9370 hrs
Drainage Area = 350.352 acres  Runoff CN= 80

=============================================
Computational Time Increment   =   .12493 hrs
Computed Peak Time             =  12.3684 hrs
Computed Peak Flow             =  2336.17 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.4117 hrs
Peak Flow, Interpolated Output =  2330.73 cfs
=============================================

                DRAINAGE AREA
              -------------------
              ID:SUB BASIN A-2
              CN   =   80
              Area =     350.352 acres
              S    =   2.5000 in
              0.2S =    .5000 in

               Cumulative Runoff
              -------------------
                     12.3970 in
                     361.943 ac-ft

HYG Volume...        361.951 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .93700 hrs (ID: SUB BASIN A-2)
Computational Incr, Tm =   .12493 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   423.65 cfs
Unit peak time      Tp =   .62467 hrs
Unit receding limb, Tr =  2.49867 hrs
Total unit time,    Tb =  3.12333 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev  2
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    26.63 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    26.60 cfs
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2B
             CN   =   95
             Area =       3.850 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     4.8557 in
                      1.558 ac-ft

HYG Volume...          1.552 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev  5
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    36.55 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    36.53 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2B
             CN   =   95
             Area =       3.850 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     6.7839 in
                      2.177 ac-ft

HYG Volume...          2.169 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev 10
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    44.64 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    44.62 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2B
             CN   =   95
             Area =       3.850 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                     8.3679 in
                      2.685 ac-ft

HYG Volume...          2.676 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev 25
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    56.11 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    56.09 cfs
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2B
             CN   =   95
             Area =       3.850 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                    10.6222 in
                      3.408 ac-ft

HYG Volume...          3.397 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev 50
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    65.52 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    65.51 cfs
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2B
             CN   =   95
             Area =       3.850 acres
             S    =    .5263 in
             0.2S =    .1053 in

              Cumulative Runoff
             -------------------
                    12.4789 in
                      4.004 ac-ft

HYG Volume...          3.991 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2B Dev100
Tc            = .0833 hrs
Drainage Area = 3.850 acres  Runoff CN= 95

=============================================
Computational Time Increment   =   .01111 hrs
Computed Peak Time             =  11.9222 hrs
Computed Peak Flow             =    75.33 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  11.9119 hrs
Peak Flow, Interpolated Output =    75.32 cfs
=============================================

                 DRAINAGE AREA
               -------------------
               ID:SUB BASIN A-2B
               CN   =   95
               Area =       3.850 acres
               S    =    .5263 in
               0.2S =    .1053 in

                Cumulative Runoff
               -------------------
                      14.4164 in
                        4.625 ac-ft

HYG Volume...          4.610 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .08333 hrs (ID: SUB BASIN A-2B)
Computational Incr, Tm =   .01111 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =    52.35 cfs
Unit peak time      Tp =   .05556 hrs
Unit receding limb, Tr =   .22222 hrs
Total unit time,    Tb =   .27778 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 2 year storm
Duration      = 24.0000 hrs     Rain Depth = 5.4400 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev  2
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

==============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   165.75 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   161.78 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
==============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2C
             CN   =   92
             Area =      33.911 acres
             S    =    .8696 in
             0.2S =    .1739 in

              Cumulative Runoff
             -------------------
                     4.5198 in
                     12.773 ac-ft

HYG Volume...        12.764 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 5 year storm
Duration      = 24.0000 hrs     Rain Depth = 7.3800 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev  5
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   231.21 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   225.42 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2C
             CN   =   92
             Area =      33.911 acres
             S    =    .8696 in
             0.2S =    .1739 in

              Cumulative Runoff
             -------------------
                     6.4302 in
                     18.171 ac-ft

HYG Volume...        18.160 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 10 year storm
Duration      = 24.0000 hrs     Rain Depth = 8.9700 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev 10
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   284.42 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   277.16 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2C
             CN   =   92
             Area =      33.911 acres
             S    =    .8696 in
             0.2S =    .1739 in

              Cumulative Runoff
             -------------------
                     8.0048 in
                     22.621 ac-ft

HYG Volume...        22.607 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 25 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.2300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev 25
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

=============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   359.61 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   350.27 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2C
             CN   =   92
             Area =      33.911 acres
             S    =    .8696 in
             0.2S =    .1739 in

              Cumulative Runoff
             -------------------
                    10.2499 in
                     28.966 ac-ft

HYG Volume...         28.948 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 50 year storm
Duration      = 24.0000 hrs     Rain Depth = 13.0900 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev 50
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

=============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   421.22 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   410.19 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                 DRAINAGE AREA
              -------------------
              ID:SUB BASIN A-2C
              CN   =   92
              Area =      33.911 acres
              S    =    .8696 in
              0.2S =    .1739 in

               Cumulative Runoff
              -------------------
                     12.1014 in
                      34.198 ac-ft

HYG Volume...         34.177 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

```
SCS UNIT HYDROGRAPH METHOD

STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 15.0300 in
Rain Dir      = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
Rain File -ID =  - TypeII  24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July
HYG File - ID =  - SUB BASIN A-2C Dev100
Tc            = .2870 hrs
Drainage Area = 33.911 acres  Runoff CN= 92

=============================================
Computational Time Increment   =   .03827 hrs
Computed Peak Time             =  12.0540 hrs
Computed Peak Flow             =   485.31 cfs

Time Increment for HYG File    =    .0833 hrs
Peak Time, Interpolated Output =  12.0785 hrs
Peak Flow, Interpolated Output =   472.53 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
=============================================

                DRAINAGE AREA
             -------------------
             ID:SUB BASIN A-2C
             CN   =   92
             Area =      33.911 acres
             S    =    .8696 in
             0.2S =    .1739 in

              Cumulative Runoff
             -------------------
                    14.0346 in
                     39.661 ac-ft

HYG Volume...         39.637 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .28700 hrs (ID: SUB BASIN A-2C)
Computational Incr, Tm =   .03827 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   133.88 cfs
Unit peak time      Tp =   .19133 hrs
Unit receding limb, Tr =   .76533 hrs
Total unit time,    Tb =   .95667 hrs
```

Elevation (ft)	Planimeter (sq.in)	Area (acres)	A1+A2+sqr(A1*A2) (acres)	Volume (ac-ft)	Volume Sum (ac-ft)
27.23	-----	.0000	.0000	.000	.000
27.89	-----	.8540	.8540	.187	.187
29.53	-----	1.9341	4.0733	2.227	2.414
31.17	-----	2.0874	6.0308	3.298	5.712
32.81	-----	2.2426	6.4935	3.551	9.263
34.45	-----	2.3996	6.9619	3.807	13.070
36.09	-----	2.5585	7.4359	4.066	17.136
37.73	-----	2.7193	7.9155	4.328	21.464
39.37	-----	2.8819	8.4007	4.594	26.057

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 27.23 ft
Increment = .50 ft
Max. Elev.= 39.37 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Culvert-Circular	CV	--->	TW	27.300	39.370
Culvert-Circular	C3	--->	TW	33.100	39.370
Weir-Rectangular	W1	--->	TW	39.000	39.370
Weir-Rectangular	W0	--->	TW	39.000	39.370

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

```
Structure ID       = CV
Structure Type     = Culvert-Circular
-----------------------------------
No. Barrels        =         1
Barrel Diameter    =    1.5000 ft
Upstream Invert    =     27.30 ft
Dnstream Invert    =     26.57 ft
Horiz. Length      =     65.62 ft
Barrel Length      =     65.62 ft
Barrel Slope       =    .01112 ft/ft

OUTLET CONTROL DATA...
Mannings n         =     .0130
Ke                 =     .5000  (forward entrance loss)
Kb                 =   .018213  (per ft of full flow)
Kr                 =     .5000  (reverse entrance loss)
HW Convergence     =      .001  +/- ft

INLET CONTROL DATA...
Equation form      =         1
Inlet Control K    =     .0098
Inlet Control M    =    2.0000
Inlet Control c    =    .03980
Inlet Control Y    =     .6700
T1 ratio (HW/D)    =     1.154
T2 ratio (HW/D)    =     1.301
Slope Factor       =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     29.03 ft  --->  Flow =      7.58 cfs
At T2 Elev =     29.25 ft  --->  Flow =      8.66 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = C3
Structure Type    = Culvert-Circular
-----------------------------------
No. Barrels       =         1
Barrel Diameter   =    2.0000 ft
Upstream Invert   =     33.10 ft
Dnstream Invert   =     32.60 ft
Horiz. Length     =     65.62 ft
Barrel Length     =     65.62 ft
Barrel Slope      =    .00762 ft/ft

OUTLET CONTROL DATA...
Mannings n        =     .0130
Ke                =     .5000  (forward entrance loss)
Kb                =   .012411  (per ft of full flow)
Kr                =     .5000  (reverse entrance loss)
HW Convergence    =      .001  +/- ft

INLET CONTROL DATA...
Equation form     =         1
Inlet Control K   =     .0098
Inlet Control M   =    2.0000
Inlet Control c   =    .03980
Inlet Control Y   =     .6700
T1 ratio (HW/D)   =     1.156
T2 ratio (HW/D)   =     1.303
Slope Factor      =     -.500

Use unsubmerged inlet control Form 1 equ. below T1 elev.
Use   submerged inlet control Form 1 equ. above T2 elev.

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...
At T1 Elev =     35.41 ft  --->  Flow =     15.55 cfs
At T2 Elev =     35.71 ft  --->  Flow =     17.77 cfs
```

OUTLET STRUCTURE INPUT DATA

```
Structure ID      = W1
Structure Type    = Weir-Rectangular
------------------------------------
# of Openings     =         1
Crest Elev.       =     39.00 ft
Weir Length       =    525.00 ft
Weir Coeff.       =  3.367000

Weir TW effects     (Use adjustment equation)
```

```
Structure ID      = W0
Structure Type    = Weir-Rectangular
------------------------------------
# of Openings     =         1
Crest Elev.       =     39.00 ft
Weir Length       =     50.00 ft
Weir Coeff.       =  3.367000

Weir TW effects     (Use adjustment equation)
```

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = CV (Culvert-Circular)

Mannings open channel maximum capacity: 11.92 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
27.23	.00	REVERSE:		Flow is closed off
27.30	.00	REVERSE:		Flow is closed off
27.73	.00	REVERSE:		Flow is closed off
28.23	.00	REVERSE:		Flow is closed off
28.73	.00	REVERSE:		Flow is closed off
29.23	.00	REVERSE:		Flow is closed off
29.73	.00	REVERSE:		Flow is closed off
30.23	5.26	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=.137ft HL=.370ft Hev= .00ft		
30.73	8.06	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=.323ft HL=.870ft Hev= .00ft		
31.23	10.10	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=.508ft HL=1.369ft Hev= .00ft		
31.73	11.81	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=.694ft HL=1.870ft Hev= .00ft		
32.23	13.29	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=.880ft HL=2.371ft Hev= .00ft		
32.73	14.63	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.065ft HL=2.871ft Hev= .00ft		
33.10	15.54	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.202ft HL=3.239ft Hev= .00ft		
33.23	15.85	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.250ft HL=3.370ft Hev= .00ft		
33.73	16.99	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.436ft HL=3.871ft Hev= .00ft		
34.23	18.05	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.621ft HL=4.370ft Hev= .00ft		
34.73	19.06	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.807ft HL=4.871ft Hev= .00ft		
35.23	20.01	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=1.992ft HL=5.370ft Hev= .00ft		
35.73	20.92	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=2.178ft HL=5.870ft Hev= .00ft		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = CV (Culvert-Circular)

Mannings open channel maximum capacity: 11.92 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
36.23	21.79	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=2.363ft HL=6.370ft Hev= .00ft		
36.73	22.63	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=2.549ft HL=6.871ft Hev= .00ft		
37.23	23.44	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=2.735ft HL=7.370ft Hev= .00ft		
37.73	24.22	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=2.920ft HL=7.871ft Hev= .00ft		
38.23	24.98	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=3.106ft HL=8.370ft Hev= .00ft		
38.73	25.72	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=3.291ft HL=8.870ft Hev= .00ft		
39.00	26.10	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=3.391ft HL=9.139ft Hev= .00ft		
39.23	26.43	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=3.477ft HL=9.370ft Hev= .00ft		
39.37	26.63	29.86	.000	
		FULL FLOW...Lfull=65.62ft Vh=3.528ft HL=9.510ft Hev= .00ft		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = C3 (Culvert-Circular)

Mannings open channel maximum capacity: 21.24 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
27.23	.00	REVERSE:	Flow is closed off	
27.30	.00	REVERSE:	Flow is closed off	
27.73	.00	REVERSE:	Flow is closed off	
28.23	.00	REVERSE:	Flow is closed off	
28.73	.00	REVERSE:	Flow is closed off	
29.23	.00	REVERSE:	Flow is closed off	
29.73	.00	REVERSE:	Flow is closed off	
30.23	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
30.73	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
31.23	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
31.73	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
32.23	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
32.73	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
33.10	.00	29.86	.000	
		Upstream HW & DNstream TW < Inv.El		
33.23	.03	29.86	.000	
		CRIT.DEPTH CONTROL Vh= .042ft Dcr= .125ft CRIT.DEPTH Hev= .00ft		
33.73	1.46	29.86	.000	
		CRIT.DEPTH CONTROL Vh= .148ft Dcr= .422ft CRIT.DEPTH Hev= .00ft		
34.23	4.31	29.86	.000	
		RELAXED CONVERGENCE: HW +/-.015ft; Q +/-.1625cfs		
34.73	8.25	29.86	.000	
		CRIT.DEPTH CONTROL Vh= .404ft Dcr= 1.023ft CRIT.DEPTH Hev= .00ft		
35.23	12.86	29.86	.000	
		CRIT.DEPTH CONTROL Vh= .559ft Dcr= 1.288ft CRIT.DEPTH Hev= .00ft		
35.73	17.59	29.86	.000	
		CRIT.DEPTH CONTROL Vh= .737ft Dcr= 1.507ft CRIT.DEPTH Hev= .00ft		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = C3 (Culvert-Circular)

Mannings open channel maximum capacity: 21.24 cfs
Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
36.23	21.11	29.86	.000	
		INLET CONTROL...		Submerged: HW =3.13
36.73	23.87	29.86	.000	
		INLET CONTROL...		Submerged: HW =3.63
37.23	26.34	29.86	.000	
		INLET CONTROL...		Submerged: HW =4.13
37.73	28.60	29.86	.000	
		INLET CONTROL...		Submerged: HW =4.63
38.23	30.68	29.86	.000	
		INLET CONTROL...		Submerged: HW =5.13
38.73	32.65	29.86	.000	
		INLET CONTROL...		Submerged: HW =5.63
39.00	33.65	29.86	.000	
		INLET CONTROL...		Submerged: HW =5.90
39.23	34.49	29.86	.000	
		INLET CONTROL...		Submerged: HW =6.13
39.37	34.99	29.86	.000	
		INLET CONTROL...		Submerged: HW =6.27

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W1 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
27.23	.00	REVERSE: Flow is closed off		
27.30	.00	REVERSE: Flow is closed off		
27.73	.00	REVERSE: Flow is closed off		
28.23	.00	REVERSE: Flow is closed off		
28.73	.00	REVERSE: Flow is closed off		
29.23	.00	REVERSE: Flow is closed off		
29.73	.00	REVERSE: Flow is closed off		
30.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
30.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
31.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
31.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
32.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
32.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.10	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
34.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
34.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
35.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
35.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
36.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W1 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
36.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
37.23	.00	29.86	.000	HW & TW below Inv.El.=39.000
37.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
38.23	.00	29.86	.000	HW & TW below Inv.El.=39.000
38.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
39.00	.00	29.86	.000	H=.00; Htw=.00; Qfree=.00;
39.23	194.98	29.86	.000	H=.23; Htw=.00; Qfree=194.98;
39.37	397.96	29.86	.000	H=.37; Htw=.00; Qfree=397.96;

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W0 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
27.23	.00	REVERSE: Flow is closed off		
27.30	.00	REVERSE: Flow is closed off		
27.73	.00	REVERSE: Flow is closed off		
28.23	.00	REVERSE: Flow is closed off		
28.73	.00	REVERSE: Flow is closed off		
29.23	.00	REVERSE: Flow is closed off		
29.73	.00	REVERSE: Flow is closed off		
30.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
30.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
31.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
31.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
32.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
32.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.10	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
33.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
34.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
34.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
35.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
35.73	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		
36.23	.00	29.86	.000	
		HW & TW below Inv.El.=39.000		

RATING TABLE FOR ONE OUTLET TYPE

Structure ID = W0 (Weir-Rectangular)

Upstream ID = (Pond Water Surface)
DNstream ID = TW (Pond Outfall)

WS Elev,Device Q		Tail Water		Notes
WS Elev. ft	Q cfs	TW Elev ft	Converge +/-ft	Computation Messages
36.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
37.23	.00	29.86	.000	HW & TW below Inv.El.=39.000
37.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
38.23	.00	29.86	.000	HW & TW below Inv.El.=39.000
38.73	.00	29.86	.000	HW & TW below Inv.El.=39.000
39.00	.00	29.86	.000	H=.00; Htw=.00; Qfree=.00;
39.23	18.55	29.86	.000	H=.23; Htw=.00; Qfree=18.55;
39.37	37.85	29.86	.000	H=.37; Htw=.00; Qfree=37.85;

***** COMPOSITE OUTFLOW SUMMARY ****

CUMULATIVE HGL CONVERGENCE ERROR .000 (+/- ft)

WS Elev, Total Q		Notes		
		Converge		
Elev. ft	Q cfs	TW Elev ft	Error +/-ft	Contributing Structures
27.23	.00	29.86	.000	CV
27.30	.00	29.86	.000	CV
27.73	.00	29.86	.000	CV
28.23	.00	29.86	.000	CV
28.73	.00	29.86	.000	CV
29.23	.00	29.86	.000	CV
29.73	.00	29.86	.000	CV
30.23	5.26	29.86	.000	CV
30.73	8.06	29.86	.000	CV
31.23	10.10	29.86	.000	CV
31.73	11.81	29.86	.000	CV
32.23	13.29	29.86	.000	CV
32.73	14.63	29.86	.000	CV
33.10	15.54	29.86	.000	CV
33.23	15.88	29.86	.000	CV +C3
33.73	18.45	29.86	.000	CV +C3
34.23	22.36	29.86	.000	CV +C3
34.73	27.31	29.86	.000	CV +C3
35.23	32.86	29.86	.000	CV +C3
35.73	38.51	29.86	.000	CV +C3
36.23	42.90	29.86	.000	CV +C3
36.73	46.50	29.86	.000	CV +C3
37.23	49.78	29.86	.000	CV +C3
37.73	52.82	29.86	.000	CV +C3
38.23	55.67	29.86	.000	CV +C3
38.73	58.36	29.86	.000	CV +C3
39.00	59.76	29.86	.000	CV +C3 +W1 +W0
39.23	274.46	29.86	.000	CV +C3 +W1 +W0
39.37	497.43	29.86	.000	CV +C3 +W1 +W0

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
Inflow  HYG file = NONE STORED - POND 1       IN  Dev  2
Outflow HYG file = NONE STORED - POND 1       OUT Dev  2

Pond Node   Data = POND 1
Pond Volume Data = POND 1
Pond Outlet Data = Outlet Jul09

Infiltration =     6.50 cfs

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =    27.23 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0833 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    161.78 cfs    at   12.0785 hrs
Peak Outflow      =     10.15 cfs    at   12.7449 hrs
Peak Infiltration =      6.50 cfs    at   10.5791 hrs
-----------------------------------------------------
Peak Elevation    =     31.24 ft
Peak Storage =          5.868 ac-ft
=====================================================


MASS BALANCE (ac-ft)
---------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      12.764
- Infiltration =       9.465
- HYG Vol OUT  =       3.300
- Retained Vol =        .000
                  ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
Inflow  HYG file = NONE STORED - POND 1       IN  Dev  5
Outflow HYG file = NONE STORED - POND 1       OUT Dev  5

Pond Node   Data = POND 1
Pond Volume Data = POND 1
Pond Outlet Data = Outlet Jul09

Infiltration =     6.50 cfs

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =    27.23 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0833 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    225.42 cfs    at   12.0785 hrs
Peak Outflow      =     14.24 cfs    at   12.8282 hrs
Peak Infiltration =      6.50 cfs    at    9.7461 hrs
-----------------------------------------------------
Peak Elevation    =     32.58 ft
Peak Storage =          8.759 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      18.160
- Infiltration =      11.309
- HYG Vol OUT  =       6.851
- Retained Vol =        .000
                  ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
Inflow  HYG file = NONE STORED - POND 1       IN  Dev 10
Outflow HYG file = NONE STORED - POND 1       OUT Dev 10

Pond Node   Data = POND 1
Pond Volume Data = POND 1
Pond Outlet Data = Outlet Jul09

Infiltration =     6.50 cfs

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =    27.23 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0833 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    277.16 cfs    at   12.0785 hrs
Peak Outflow      =     18.22 cfs    at   12.9115 hrs
Peak Infiltration =      6.50 cfs    at    8.8298 hrs
-----------------------------------------------------
Peak Elevation    =     33.69 ft
Peak Storage =         11.268 ac-ft
=====================================================


MASS BALANCE (ac-ft)
---------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      22.607
- Infiltration =      12.475
- HYG Vol OUT  =      10.132
- Retained Vol =        .000
                  ----------
Unrouted Vol =       -.000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
Inflow  HYG file = NONE STORED - POND 1       IN  Dev 25
Outflow HYG file = NONE STORED - POND 1       OUT Dev 25

Pond Node   Data = POND 1
Pond Volume Data = POND 1
Pond Outlet Data = Outlet Jul09

Infiltration =     6.50 cfs

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =    27.23 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0833 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    350.27 cfs    at   12.0785 hrs
Peak Outflow      =     31.07 cfs    at   12.7449 hrs
Peak Infiltration =      6.50 cfs    at    7.9135 hrs
-----------------------------------------------------
Peak Elevation    =     35.07 ft
Peak Storage =         14.574 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      28.948
- Infiltration =      13.672
- HYG Vol OUT  =      15.277
- Retained Vol =        .000
                 ----------
Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

```
                    LEVEL POOL ROUTING SUMMARY

 HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
 Inflow  HYG file = NONE STORED - POND 1       IN  Dev 50
 Outflow HYG file = NONE STORED - POND 1       OUT Dev 50

 Pond Node   Data = POND 1
 Pond Volume Data = POND 1
 Pond Outlet Data = Outlet Jul09

 Infiltration =     6.50 cfs

 INITIAL CONDITIONS
 ----------------------------------
 Starting WS Elev   =    27.23 ft
 Starting Volume    =     .000 ac-ft
 Starting Outflow   =      .00 cfs
 Starting Infiltr.  =      .00 cfs
 Starting Total Qout=      .00 cfs
 Time Increment     =    .0833 hrs


 INFLOW/OUTFLOW HYDROGRAPH SUMMARY
 ====================================================
 Peak Inflow       =    410.19 cfs    at   12.0785 hrs
 Peak Outflow      =     42.10 cfs    at   12.6616 hrs
 Peak Infiltration =      6.50 cfs    at    6.6640 hrs
 ----------------------------------------------------
 Peak Elevation    =     36.14 ft
 Peak Storage =         17.262 ac-ft
 ====================================================


 MASS BALANCE (ac-ft)
 --------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      34.177
- Infiltration =      14.464
- HYG Vol OUT  =      19.714
- Retained Vol =        .000
                  ----------
 Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = M:\CIVIL\PROYECTOS\05\201 Nuevo Comandante\ESTUDIOS H-H\July 2009 H-H\
Inflow  HYG file = NONE STORED - POND 1       IN  Dev100
Outflow HYG file = NONE STORED - POND 1       OUT Dev100

Pond Node   Data = POND 1
Pond Volume Data = POND 1
Pond Outlet Data = Outlet Jul09

Infiltration =     6.50 cfs

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =    27.23 ft
Starting Volume    =     .000 ac-ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =    .0833 hrs


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    472.53 cfs    at   12.0785 hrs
Peak Outflow      =     49.96 cfs    at   12.6616 hrs
Peak Infiltration =      6.50 cfs    at    5.7477 hrs
-----------------------------------------------------
Peak Elevation    =     37.26 ft
Peak Storage =         20.196 ac-ft
=====================================================


MASS BALANCE (ac-ft)
--------------------------
+ Initial Vol  =        .000
+ HYG Vol IN   =      39.637
- Infiltration =      15.161
- HYG Vol OUT  =      24.476
- Retained Vol =        .000
                 ----------
Unrouted Vol =        .000 ac-ft  (.000% of Inflow Volume)
```

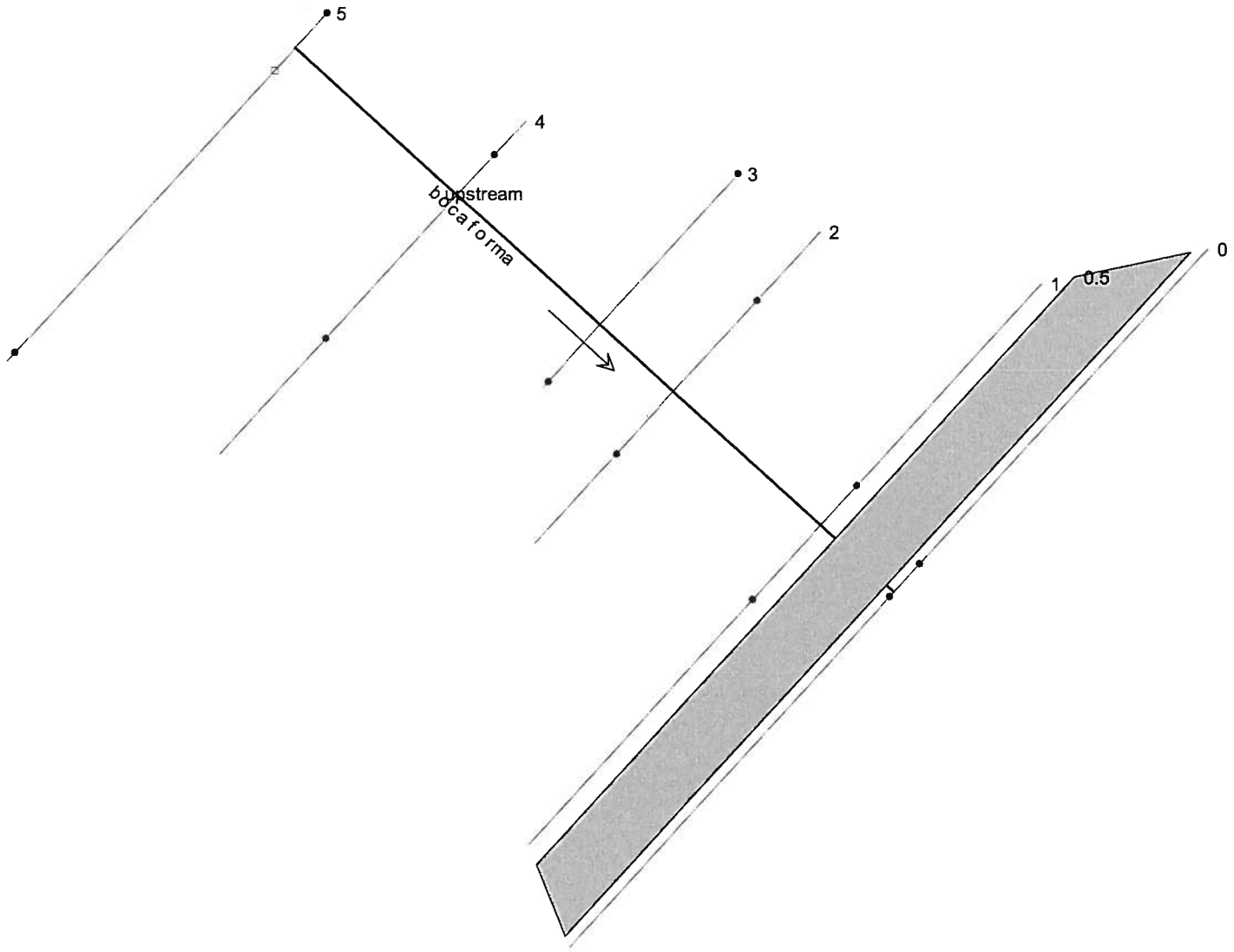
```
----- C -----
Carolina NOAA... 2.01

----- O -----
Outlet Jul09... 5.01, 5.05, 5.13

----- P -----
POND 1... 4.01
POND 1       OUT Dev  2... 6.01,
  6.02, 6.03, 6.04, 6.05, 6.06,
  3.01, 3.02, 3.03, 3.04, 3.05,
  3.06, 3.07, 3.08, 3.09, 3.10,
  3.11, 3.12, 3.13, 3.14, 3.15,
  3.16, 3.17, 3.18, 3.19, 3.20,
  3.21, 3.22, 3.23, 3.24

----- W -----
Watershed... 1.01
```

APPENDIX E
HEC-RAS RESULTS-EXISTING AND PROPOSED CONDITIONS


5
4
3
2
1
0.5
0
upstream
boca forma

HEC-RAS Plan: BOCANOAAXC River: bocaforma Reach: upstream Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
upstream	5	PF 1	67.65	9.15	9.82	9.82	10.00	0.033968	1.92	35.16	93.24	1.00
upstream	4	PF 1	67.65	7.05	9.12		9.12	0.000169	0.35	191.57	120.21	0.09
upstream	3	PF 1	67.65	6.33	9.11		9.11	0.000083	0.29	232.17	114.06	0.07
upstream	2	PF 1	67.65	5.12	9.11		9.11	0.000018	0.18	406.98	179.82	0.03
upstream	1	PF 1	67.65	4.45	9.10	6.08	9.10	0.000056	0.29	302.46	286.73	0.06
upstream	0.5		Culvert									
upstream	0	PF 1	67.65	4.55	9.10	5.83	9.10	0.000004	0.10	953.39	437.04	0.02

HEC-RAS Version 3.1.3 May 2005
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: qdaBocaforma
Project File : qdabocaforma.prj
Run Date and Time: 7/20/2009 1:05:30 PM

Project in SI units

Project Description:
El Nuevo Comandante (Quebrada Bocaforma)-Rev. Hec-Ras.

PLAN DATA

Plan Title: bocaformaNOAAXC
Plan File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.p02

Geometry Title: qdabocaformaXC
Geometry File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.g02

Flow Title : bocaformaFLOWXC
Flow File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.f02

Plan Description:
Existing Conditions.

Plan Summary Information:

Number of:	Cross Sections =	6	Multiple Openings =	0
	Culverts =	1	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: bocaformaFLOWXC
Flow File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.f02

Flow Data (m3/s)

River	Reach	RS	PF 1
bocaforma	upstream	5	67.65

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
bocaforma	upstream	PF 1	Known WS = 9.1	

GEOMETRY DATA

Geometry Title: qdabocaformaXC
Geometry File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.g02

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 5

INPUT
Description: Sta 5 (Section 11)
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	13.101	7.211	12.681	13.527	9.275	23.752	9.155	26.454	11.185
35.956	11.354	39.294	12.571	69.677	11.387	91.066	10.951	112.955	10.112
134.622	9.729	156.837	9.349	192.697	9.197	232	10	238	11

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	232	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	232	110	110	110	.1	.3

Left Levee Station= 39.29 Elevation= 12.57

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (m)	10.00	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.		0.050	
W.S. Elev (m)	9.82	Reach Len. (m)	110.00	110.00	110.00
Crit W.S. (m)	9.82	Flow Area (m2)		35.16	
E.G. Slope (m/m)	0.033968	Area (m2)		35.16	
Q Total (m3/s)	67.65	Flow (m3/s)		67.65	
Top Width (m)	93.24	Top Width (m)		93.24	

Vel Total (m/s)	1.92	Avg. Vel. (m/s)		1.92	
Max Chl Dpth (m)	0.66	Hydr. Depth (m)		0.38	
Conv. Total (m3/s)	367.1	Conv. (m3/s)		367.1	
Length Wtd. (m)	110.00	Wetted Per. (m)		93.25	
Min Ch El (m)	9.15	Shear (N/m2)		125.60	
Alpha	1.00	Stream Power (N/m s)		241.64	
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	11.74	81.06	20.25
C & E Loss (m)	0.05	Cum SA (1000 m2)	10.16	40.18	17.90

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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 4

INPUT
Description: Sta 4 (Section 10)
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	10.471	19.841	10.089	22.974	11.374	28.585	7.518	39.533	7.268
50.4	7.05	69.831	7.586	89.717	7.589	121.697	7.456	144.547	7.956
148.336	10.235	166.408	10.543	194.957	10.998	227.115	11.588		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	22.974	.05	148.336	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.974	148.336	52	97	110	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (m)	9.12	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.		0.050	

W.S. Elev (m)	9.12	Reach Len. (m)	52.00	97.00	110.00
Crit W.S. (m)		Flow Area (m2)		191.57	
E.G. Slope (m/m)	0.000169	Area (m2)		191.57	
Q Total (m3/s)	67.65	Flow (m3/s)		67.65	
Top Width (m)	120.21	Top Width (m)		120.21	
Vel Total (m/s)	0.35	Avg. Vel. (m/s)		0.35	
Max Chl Dpth (m)	2.07	Hydr. Depth (m)		1.59	
Conv. Total (m3/s)	5203.2	Conv. (m3/s)		5203.2	
Length Wtd. (m)	97.00	Wetted Per. (m)		121.05	
Min Ch El (m)	7.05	Shear (N/m2)		2.62	
Alpha	1.00	Stream Power (N/m s)		0.93	
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	11.74	68.59	20.25
C & E Loss (m)	0.00	Cum SA (1000 m2)	10.16	28.44	17.90

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 3

INPUT
Description: Sta 3 (Section 9)
)
Station Elevation Data num= 14

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	10.183	14.552	9.518	30.618	9.031	43.669	9.001	47.535	6.675
53.819	6.622	57.147	6.395	70.284	6.565	86.385	6.502	103.052	6.327
113.851	6.374	140	8	142	9	146	11		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	142	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	142	50	50	50	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (m)	9.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.		0.050	0.050
W.S. Elev (m)	9.11	Reach Len. (m)	50.00	50.00	50.00
Crit W.S. (m)		Flow Area (m2)		232.16	0.01
E.G. Slope (m/m)	0.000083	Area (m2)		232.16	0.01
Q Total (m3/s)	67.65	Flow (m3/s)		67.65	0.00
Top Width (m)	114.06	Top Width (m)		113.85	0.21
Vel Total (m/s)	0.29	Avg. Vel. (m/s)		0.29	0.02

Max Chl Dpth (m)	2.78	Hydr. Depth (m)		2.04	0.05
Conv. Total (m3/s)	7425.5	Conv. (m3/s)		7425.5	0.0
Length Wtd. (m)	50.00	Wetted Per. (m)		114.80	0.24
Min Ch El (m)	6.33	Shear (N/m2)		1.65	0.04
Alpha	1.00	Stream Power (N/m s)		0.48	0.00
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	11.74	48.04	20.25
C & E Loss (m)	0.00	Cum SA (1000 m2)	10.16	17.09	17.89

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: bocaforma
REACH: upstream RS: 2

INPUT
Description: Sta 2 (Section 7)
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	9.324	28.75	9.122	46.915	8.61	61.451	7.722	72.092	6.132
80.908	5.721	109.063	5.124	128.348	5.264	150.713	5.654	151.713	6.615
208.713	9	212.713	10						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	46.915	.05	151.713	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
46.915	151.713	110	100	65	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (m)	9.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.050	0.050	0.050
W.S. Elev (m)	9.11	Reach Len. (m)	110.00	100.00	65.00
Crit W.S. (m)		Flow Area (m2)	4.37	328.58	74.04
E.G. Slope (m/m)	0.000018	Area (m2)	4.37	328.58	74.04
Q Total (m3/s)	67.65	Flow (m3/s)	0.15	60.01	7.50
Top Width (m)	179.82	Top Width (m)	17.60	104.80	57.42
Vel Total (m/s)	0.17	Avg. Vel. (m/s)	0.03	0.18	0.10
Max Chl Dpth (m)	3.98	Hydr. Depth (m)	0.25	3.14	1.29
Conv. Total (m3/s)	15815.4	Conv. (m3/s)	34.5	14028.2	1752.7
Length Wtd. (m)	95.75	Wetted Per. (m)	17.61	105.35	57.49
Min Ch El (m)	5.12	Shear (N/m2)	0.04	0.56	0.23

Alpha	1.11	Stream Power (N/m s)	0.00	0.10	0.02
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	11.63	34.02	18.40
C & E Loss (m)	0.00	Cum SA (1000 m2)	9.72	11.62	16.45

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: bocaforma
REACH: upstream RS: 1

INPUT
Description: Sta 1 (Section 6)
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-115	10	0	8.926	23.237	8.771	31.256	7.047	49.216	4.854
50.196	4.448	61.398	5.296	70.956	6.652	80.922	6.821	100.85	8.074
119.297	8.219	268	9						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-115	.05	23.237	.05	100.85	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
23.237	100.85	50	50	50	.1	.3

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (m)	9.10	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.050	0.050	0.050
W.S. Elev (m)	9.10	Reach Len. (m)	50.00	50.00	50.00
Crit W.S. (m)	6.08	Flow Area (m2)	7.50	204.28	90.68
E.G. Slope (m/m)	0.000056	Area (m2)	7.50	204.28	90.68
Q Total (m3/s)	67.65	Flow (m3/s)	0.36	58.23	9.06
Top Width (m)	286.73	Top Width (m)	41.97	77.61	167.15
Vel Total (m/s)	0.22	Avg. Vel. (m/s)	0.05	0.29	0.10
Max Chl Dpth (m)	4.65	Hydr. Depth (m)	0.18	2.63	0.54
Conv. Total (m3/s)	9004.1	Conv. (m3/s)	47.6	7750.5	1205.9
Length Wtd. (m)	50.00	Wetted Per. (m)	41.97	78.18	167.25
Min Ch El (m)	4.45	Shear (N/m2)	0.10	1.45	0.30
Alpha	1.43	Stream Power (N/m s)	0.00	0.41	0.03
Frctn Loss (m)		Cum Volume (1000 m3)	10.97	7.38	13.04
C & E Loss (m)		Cum SA (1000 m2)	6.44	2.50	9.15

```
CULVERT


RIVER: bocaforma
REACH: upstream           RS: 0.5

INPUT
Description: existing box culvert
Distance from Upstream XS =      10
Deck/Roadway Width        =      35
Weir Coefficient          =    1.44
Upstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   23.24     8.3             120     8.3

Upstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -115      10       0   8.926  23.237   8.771  31.256   7.047  49.216   4.854
  50.196   4.448  61.398   5.296  70.956   6.652  80.922   6.821  100.85   8.074
 119.297   8.219     268       9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -115     .05  23.237     .05  100.85     .05

Bank Sta: Left   Right    Coeff Contr.   Expan.
        23.237  100.85             .1       .3

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    -150    8.18             250    8.18

Downstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -175       9       0   5.647  16.795    5.65  23.146   6.142  40.695   7.247
  43.515   5.649    46.6   5.494  48.801   4.696  59.976   4.553  63.177   5.076
  77.721   5.534 100.581   5.464     302      10

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -175     .05  40.695     .05  63.177     .05

Bank Sta: Left   Right    Coeff Contr.   Expan.
        40.695  63.177             .1       .3

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1           Box   3.062   4.192
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit
Loss Coef
                10      35     .013     .013        0                    .5
1
Upstream   Elevation =  3.738
```

```
          Centerline Station =  50.2
Downstream Elevation =  3.622
          Centerline Station =  54.44

CULVERT OUTPUT  Profile #PF 1  Culv Group:  Culvert #1

  Q Culv Group (m3/s)       2.98    Culv Full Len (m)        35.00
  # Barrels                    1    Culv Vel US (m/s)         0.23
  Q Barrel (m3/s)           2.98    Culv Vel DS (m/s)         0.23
  E.G. US. (m)              9.10    Culv Inv El Up (m)        3.74
  W.S. US. (m)              9.10    Culv Inv El Dn (m)        3.62
  E.G. DS (m)               9.10    Culv Frctn Ls (m)         0.00
  W.S. DS (m)               9.10    Culv Exit Loss (m)        0.00
  Delta EG (m)              0.00    Culv Entr Loss (m)        0.00
  Delta WS (m)              0.00    Q Weir (m3/s)            64.67
  E.G. IC (m)               9.10    Weir Sta Lft (m)        -19.08
  E.G. OC (m)               9.10    Weir Sta Rgt (m)        268.00
  Culvert Control         Outlet    Weir Submerg              0.99
  Culv WS Inlet (m)         6.80    Weir Max Depth (m)        0.88
  Culv WS Outlet (m)        6.68    Weir Avg Depth (m)        0.55
  Culv Nml Depth (m)                Weir Flow Area (m2)     157.88
  Culv Crt Depth (m)        0.37    Min El Weir Flow (m)      8.23


Warning: The weir over culvert is submerged.

CROSS SECTION


RIVER: bocaforma
REACH: upstream           RS: 0

INPUT
Description: Sta 0 (Section 5)
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    -175       9       0   5.647  16.795    5.65  23.146   6.142  40.695   7.247
  43.515   5.649   46.6   5.494  48.801   4.696  59.976   4.553  63.177   5.076
  77.721   5.534 100.581   5.464     302      10

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    -175     .05  40.695     .05  63.177     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        40.695  63.177                 0       0       0             .1       .3

CROSS SECTION OUTPUT  Profile #PF 1


  E.G. Elev (m)             9.10    Element                 Left OB    Channel   Right OB

  Vel Head (m)              0.00    Wt. n-Val.               0.050      0.050      0.050

  W.S. Elev (m)             9.10    Reach Len. (m)

  Crit W.S. (m)             5.83    Flow Area (m2)          431.43      90.91     431.05

  E.G. Slope (m/m)      0.000004    Area (m2)               431.43      90.91     431.05

  Q Total (m3/s)           67.65    Flow (m3/s)              28.36       9.39      29.90

  Top Width (m)           437.04    Top Width (m)           215.70      22.48     198.87

  Vel Total (m/s)           0.07    Avg. Vel. (m/s)           0.07       0.10       0.07

  Max Chl Dpth (m)          4.55    Hydr. Depth (m)           2.00       4.04       2.17

  Conv. Total (m3/s)     32660.1    Conv. (m3/s)           13689.9     4533.6    14436.7
```

Length Wtd. (m)		Wetted Per. (m)	215.88	23.09	198.92
Min Ch El (m)	4.55	Shear (N/m2)	0.08	0.17	0.09
Alpha	1.08	Stream Power (N/m s)	0.01	0.02	0.01
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

SUMMARY OF MANNING'S N VALUES

River:bocaforma

Reach	River Sta.	n1	n2	n3
upstream	5	.05	.05	.05
upstream	4	.05	.05	.05
upstream	3	.05	.05	.05
upstream	2	.05	.05	.05
upstream	1	.05	.05	.05
upstream	0.5	Culvert		
upstream	0	.05	.05	.05

SUMMARY OF REACH LENGTHS

River: bocaforma

Reach	River Sta.	Left	Channel	Right
upstream	5	110	110	110
upstream	4	52	97	110
upstream	3	50	50	50
upstream	2	110	100	65
upstream	1	50	50	50
upstream	0.5	Culvert		
upstream	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: bocaforma

Reach	River Sta.	Contr.	Expan.
upstream	5	.1	.3
upstream	4	.1	.3
upstream	3	.1	.3
upstream	2	.1	.3
upstream	1	.1	.3
upstream	0.5	Culvert	
upstream	0	.1	.3

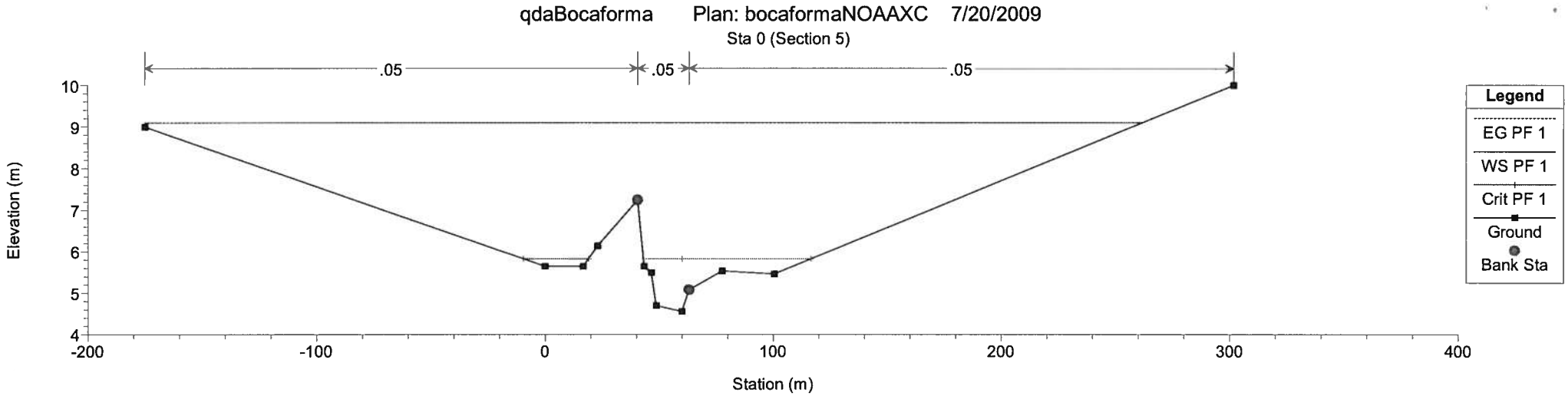
Profile Output Table - Standard Table 1

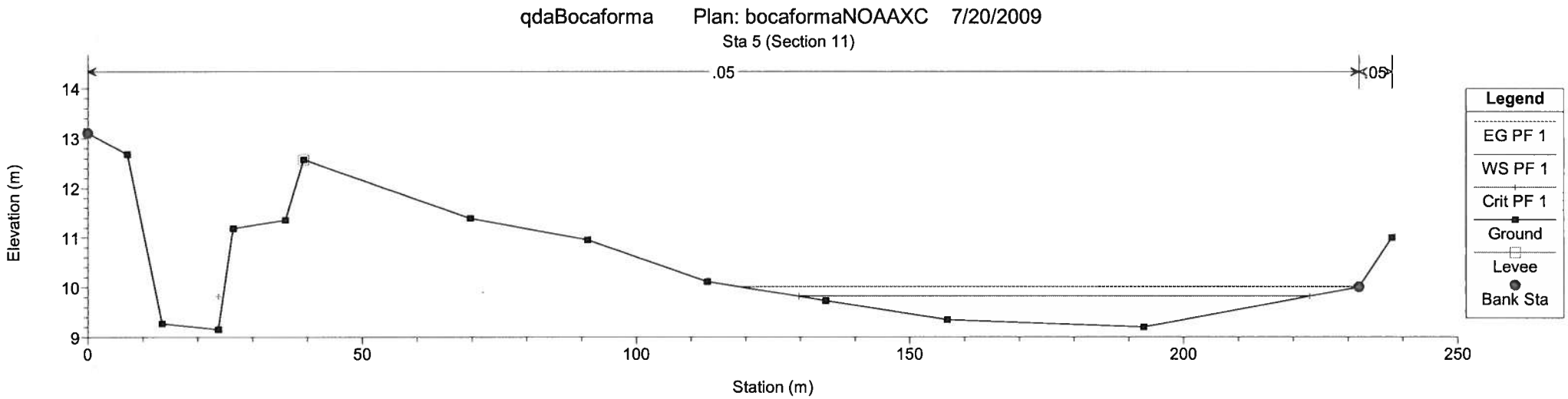
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)						

```
(m)          (m/m)        (m/s)          (m2)           (m)


  upstream       5                PF 1         67.65         9.15         9.82         9.82
10.00      0.033968        1.92        35.16        93.24             1.00
  upstream       4                PF 1         67.65         7.05         9.12
9.12      0.000169        0.35       191.57       120.21             0.09
  upstream       3                PF 1         67.65         6.33         9.11
9.11      0.000083        0.29       232.17       114.06             0.07
  upstream       2                PF 1         67.65         5.12         9.11
9.11      0.000018        0.18       406.98       179.82             0.03
  upstream       1                PF 1         67.65         4.45         9.10         6.08
9.10      0.000056        0.29       302.46       286.73             0.06
  upstream       0.5                          Culvert

  upstream       0                PF 1         67.65         4.55         9.10         5.83
9.10      0.000004        0.10       953.39       437.04             0.02
```


qdaBocaforma Plan: bocaformaNOAAXC 7/20/2009
Sta 0 (Section 5)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


qdaBocaforma Plan: bocaformaNOAAXC 7/20/2009
Sta 5 (Section 11)
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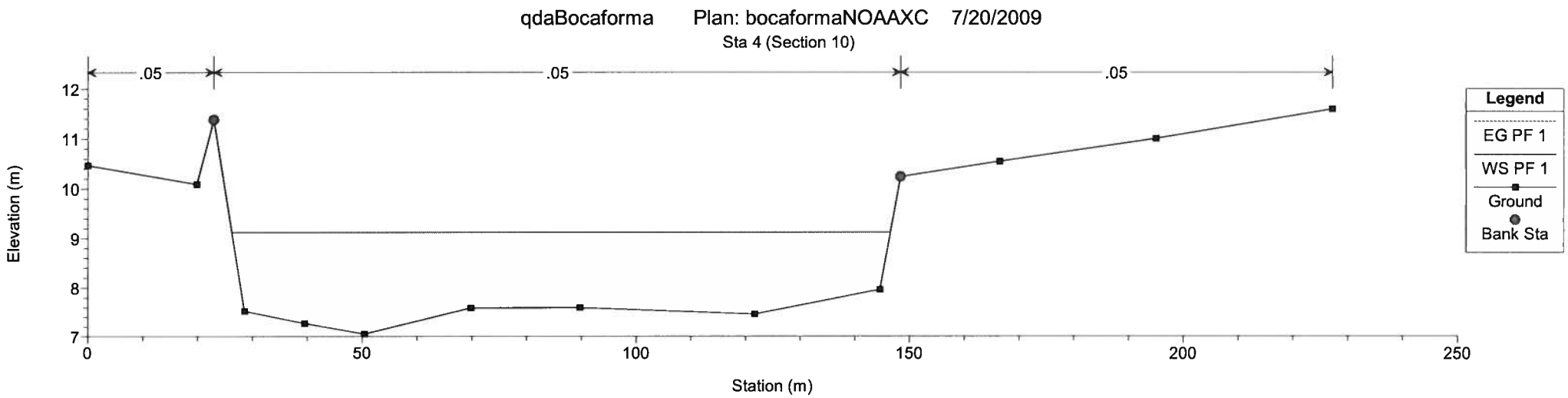
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Levee
Bank Sta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Sta 4 (Section 10)
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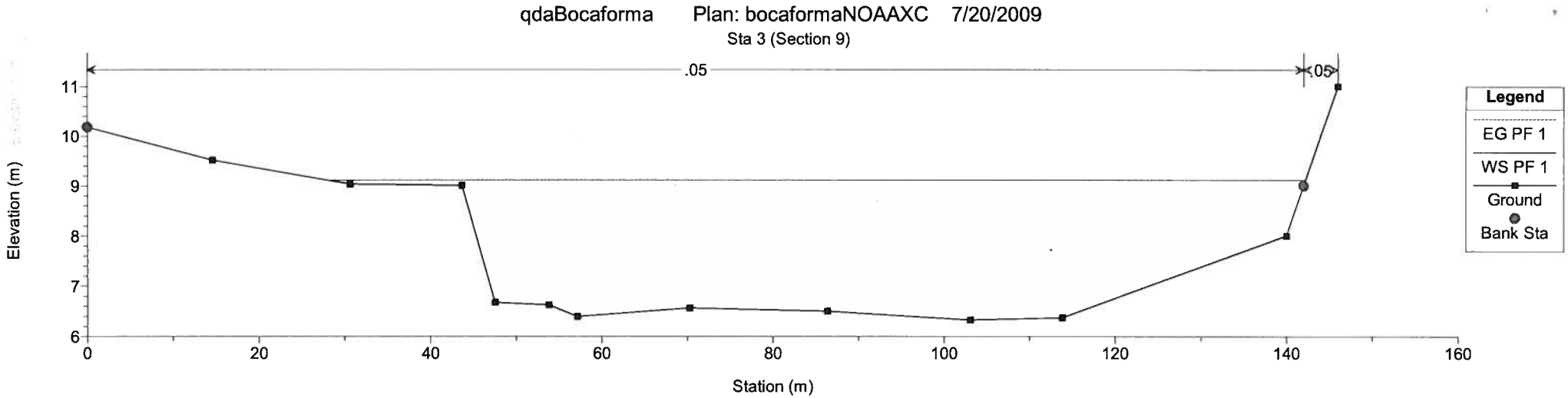
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta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Sta 3 (Section 9)
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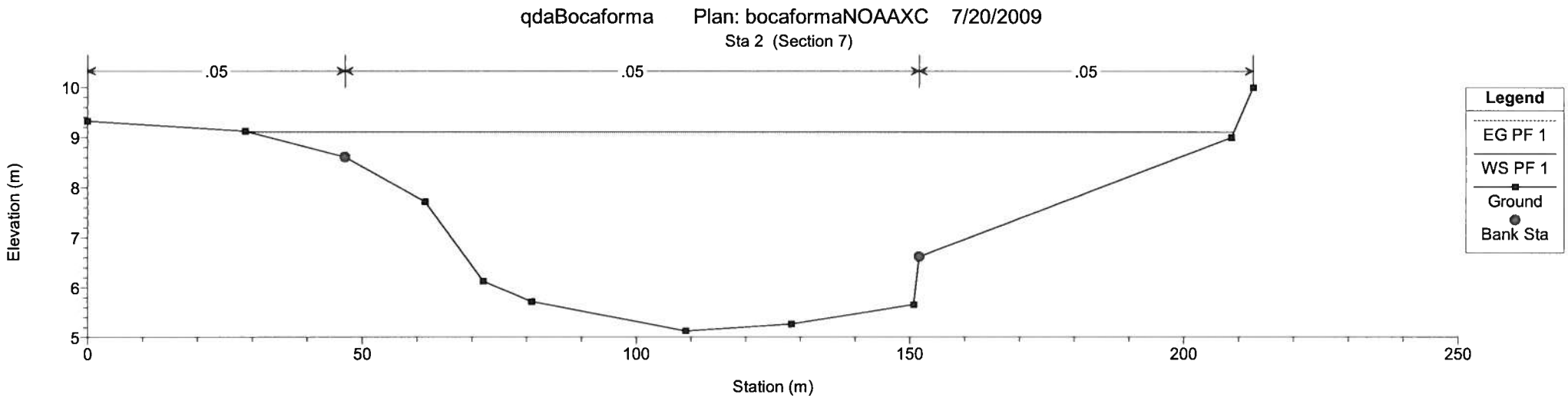
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta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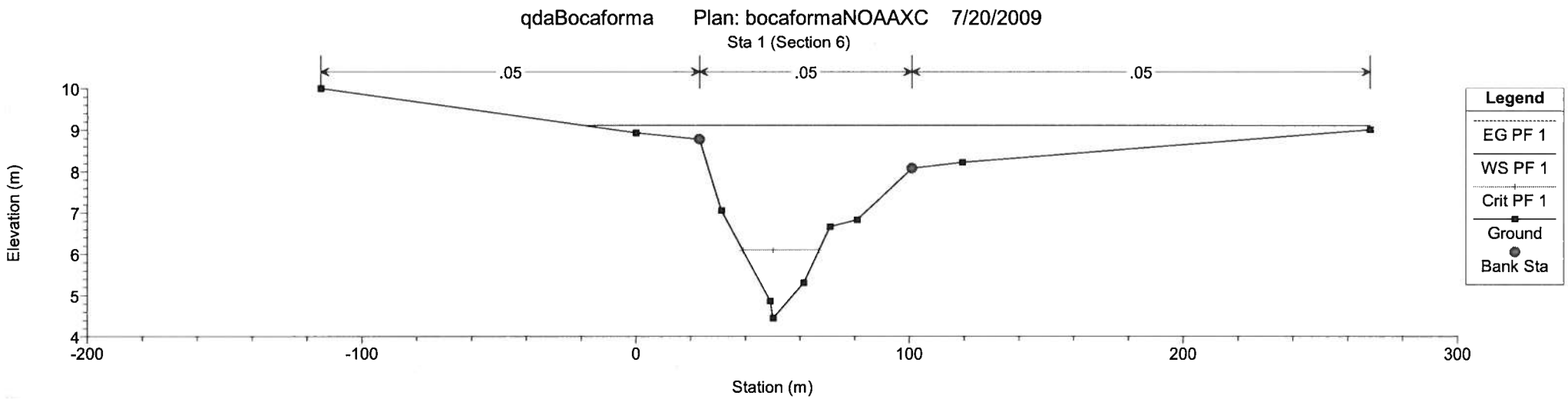
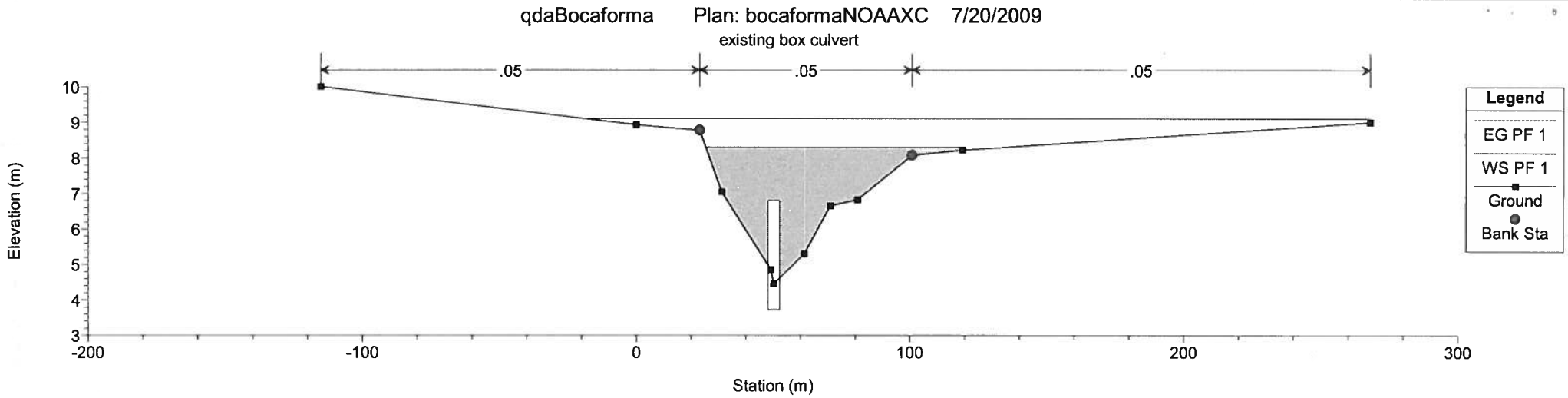
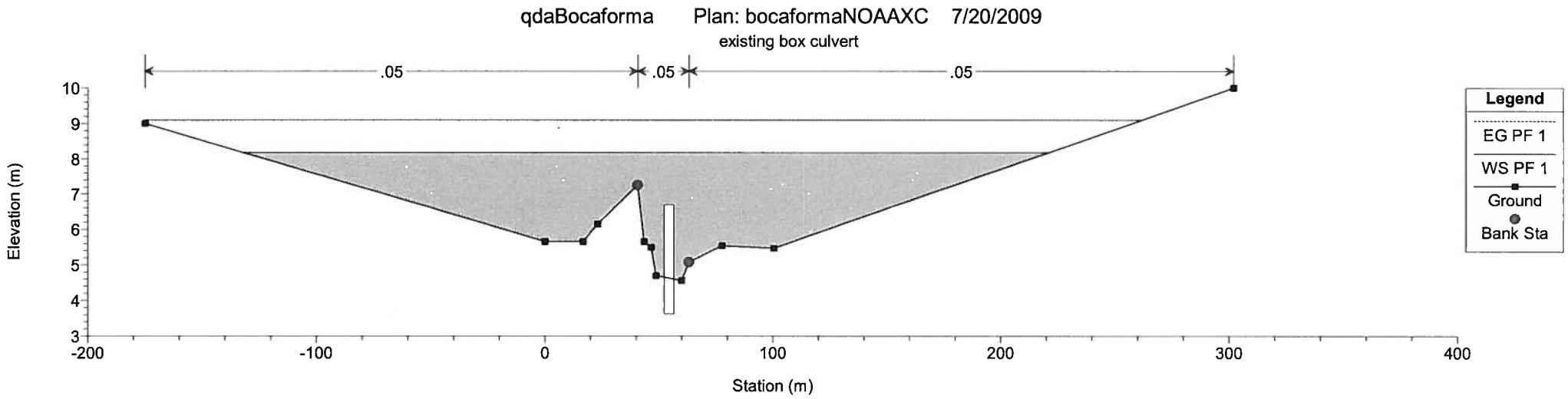
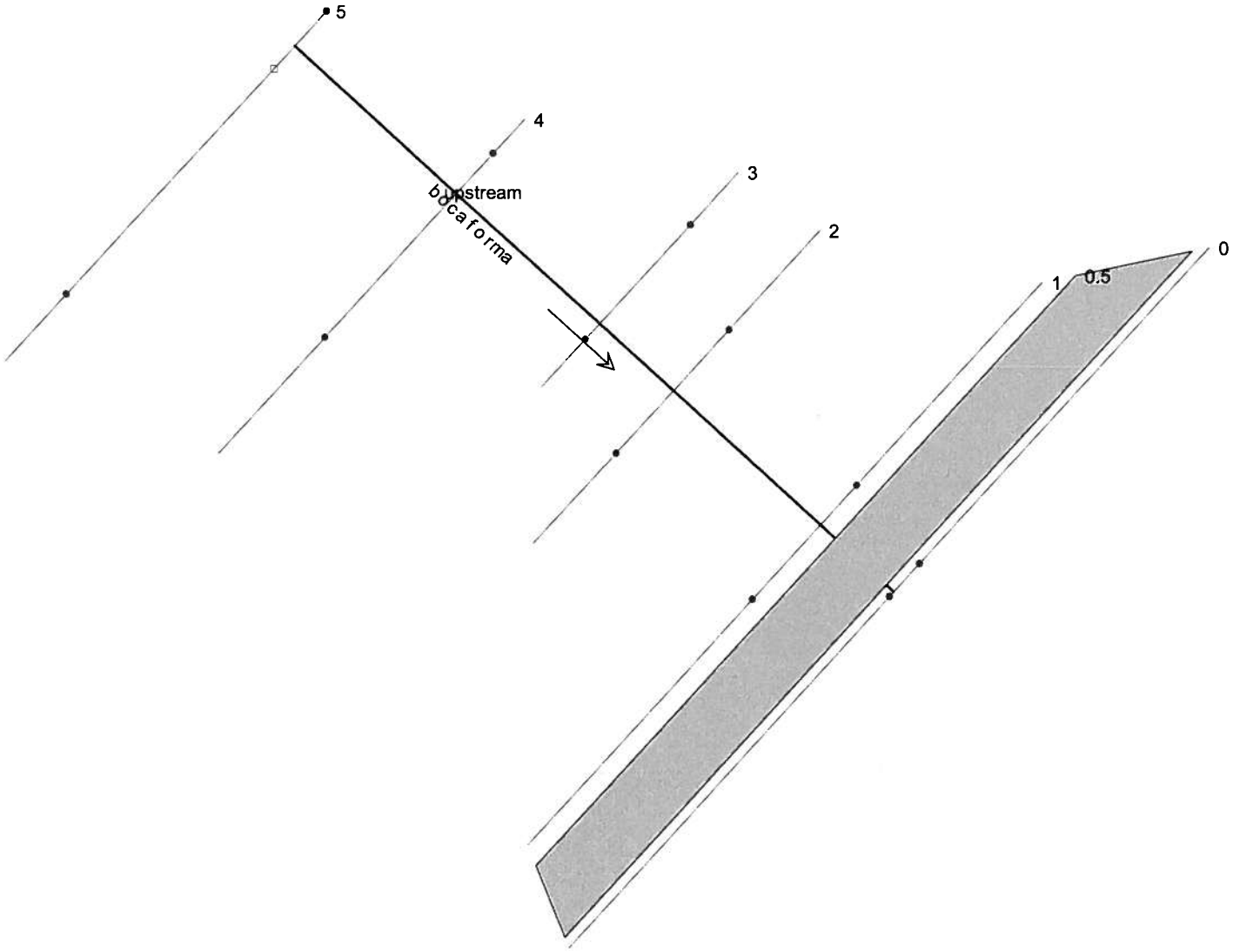
Sta 2 (Section 7)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


qdaBocaforma Plan: bocaformaNOAAXC 7/20/2009
Sta 1 (Section 6)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


qdaBocaforma Plan: bocaformaNOAAXC 7/20/2009
existing box culvert
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


qdaBocaforma Plan: bocaformaNOAAXC 7/20/2009
existing box culvert
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


5
4
3
2
1
0.5
0
upstream
boca forma

HEC-RAS Plan: BOCANOAAPC River: bocaforma Reach: upstream Profile: Q100

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
upstream	5	Q100	67.58	9.15	9.82	9.82	10.01	0.032628	2.00	35.43	93.54	0.99
upstream	4	Q100	67.58	7.05	9.12		9.12	0.000168	0.35	191.78	120.22	0.09
upstream	3	Q100	67.58	6.33	9.11		9.11	0.000075	0.30	231.99	106.72	0.06
upstream	2	Q100	67.58	5.12	9.11		9.11	0.000030	0.25	308.58	124.89	0.04
upstream	1	Q100	67.58	4.45	9.10	6.09	9.11	0.000056	0.28	302.83	286.87	0.06
upstream	0.5		Culvert									
upstream	0	Q100	67.58	4.55	9.10	5.83	9.10	0.000004	0.10	953.92	437.10	0.02

HEC-RAS Version 3.1.3 May 2005
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
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PROJECT DATA
Project Title: qdaBocaforma
Project File : qdabocaforma.prj
Run Date and Time: 7/20/2009 11:56:07 AM

Project in SI units

Project Description:
El Nuevo Comandante (Quebrada Bocaforma)-Rev. Hec-Ras.

PLAN DATA

Plan Title: bocaformaNOAAPC
Plan File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.p01

Geometry Title: qdabocaformaPC
Geometry File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.g01

Flow Title : bocaformaFLOWPC
Flow File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.f01

Plan Description:
Proposed Conditions.

Plan Summary Information:

Number of:	Cross Sections =	6	Multiple Openings =	0
	Culverts =	1	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: bocaformaFLOWPC
Flow File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.f01

Flow Data (m3/s)

River	Reach	RS	Q100
bocaforma	upstream	5	67.58

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
bocaforma	upstream	Q100		Known WS = 9.1013

GEOMETRY DATA

Geometry Title: qdabocaformaPC
Geometry File : c:\Documents and Settings\lr.000\Desktop\05201-Rev. Hec-Ras\qdabocaforma.g01

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 5

INPUT
Description: Sta 5 (Section 11)
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	13.101	7.211	12.681	13.527	9.275	23.752	9.155	26.454	11.185
35.956	11.354	39.294	12.571	69.677	11.387	91.066	10.951	112.955	10.112
134.622	9.729	156.837	9.349	192.697	9.197	232	10	238	11

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	0	.05	192.697	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
0	192.697	110	110	110	.1	.3

Left Levee Station= 39.29 Elevation= 12.57

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	10.01	Element	Left OB	Channel	Right OB
Vel Head (m)	0.19	Wt. n-Val.		0.050	0.050
W.S. Elev (m)	9.82	Reach Len. (m)	110.00	110.00	110.00
Crit W.S. (m)	9.82	Flow Area (m2)		25.98	9.45
E.G. Slope (m/m)	0.032628	Area (m2)		25.98	9.45
Q Total (m3/s)	67.58	Flow (m3/s)		51.93	15.65
Top Width (m)	93.54	Top Width (m)		63.13	30.41

Vel Total (m/s)	1.91	Avg. Vel. (m/s)		2.00	1.66
Max Chl Dpth (m)	0.66	Hydr. Depth (m)		0.41	0.31
Conv. Total (m3/s)	374.1	Conv. (m3/s)		287.5	86.6
Length Wtd. (m)	110.00	Wetted Per. (m)		63.13	30.42
Min Ch El (m)	9.15	Shear (N/m2)		131.67	99.37
Alpha	1.02	Stream Power (N/m s)		263.18	164.63
Frctn Loss (m)	0.06	Cum Volume (1000 m3)	11.40	69.74	24.91
C & E Loss (m)	0.05	Cum SA (1000 m2)	8.77	33.11	21.83

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.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 4

INPUT
Description: Sta 4 (Section 10)
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	12.19	1.95	12.19	6.33	10	19.841	10.089	22.974	11.374
28.585	7.518	39.533	7.268	50.4	7.05	69.831	7.586	89.717	7.589
121.697	7.456	144.547	7.956	148.336	10.235	166.408	10.543	194.957	10.998
227.115	11.588								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	22.974	.05	148.336	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.974	148.336	52	97	110	.1	.3

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	9.12	Element	Left OB	Channel	Right OB
Vel Head (m)	0.01	Wt. n-Val.		0.050	

W.S. Elev (m)	9.12	Reach Len. (m)	52.00	97.00	110.00
Crit W.S. (m)		Flow Area (m2)		191.78	
E.G. Slope (m/m)	0.000168	Area (m2)		191.78	
Q Total (m3/s)	67.58	Flow (m3/s)		67.58	
Top Width (m)	120.22	Top Width (m)		120.22	
Vel Total (m/s)	0.35	Avg. Vel. (m/s)		0.35	
Max Chl Dpth (m)	2.07	Hydr. Depth (m)		1.60	
Conv. Total (m3/s)	5212.6	Conv. (m3/s)		5212.6	
Length Wtd. (m)	98.27	Wetted Per. (m)		121.06	
Min Ch El (m)	7.05	Shear (N/m2)		2.61	
Alpha	1.00	Stream Power (N/m s)		0.92	
Frctn Loss (m)	0.01	Cum Volume (1000 m3)	11.40	57.76	24.39
C & E Loss (m)	0.00	Cum SA (1000 m2)	8.77	23.02	20.16

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: bocaforma
REACH: upstream RS: 3

INPUT
Description: Sta 3 (Section 9)
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	12.19	29.326	12.19	35.646	9.031	36	9	43.669	9.001
47.535	6.675	53.819	6.622	57.147	6.395	70.284	6.565	86.385	6.502
103.052	6.327	113.851	6.374	140	8	142	9	146	11

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	35.646	.05	113.851	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
35.646	113.851	50	50	50	.1	.3

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	9.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.050	0.050	0.050
W.S. Elev (m)	9.11	Reach Len. (m)	50.00	50.00	50.00
Crit W.S. (m)		Flow Area (m2)	0.01	180.52	51.46
E.G. Slope (m/m)	0.000075	Area (m2)	0.01	180.52	51.46
Q Total (m3/s)	67.58	Flow (m3/s)	0.00	54.40	13.18

Top Width (m)	106.72	Top Width (m)	0.15	78.20	28.36
Vel Total (m/s)	0.29	Avg. Vel. (m/s)	0.02	0.30	0.26
Max Chl Dpth (m)	2.78	Hydr. Depth (m)	0.04	2.31	1.81
Conv. Total (m3/s)	7790.9	Conv. (m3/s)	0.0	6271.0	1519.9
Length Wtd. (m)	50.00	Wetted Per. (m)	0.17	78.86	28.68
Min Ch El (m)	6.33	Shear (N/m2)	0.03	1.69	1.32
Alpha	1.01	Stream Power (N/m s)	0.00	0.51	0.34
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	11.40	39.70	21.56
C & E Loss (m)	0.00	Cum SA (1000 m2)	8.76	13.40	18.60

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: bocaforma
REACH: upstream RS: 2

INPUT
Description: Sta 2 (Section 7)
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	17.5	67.49	17.5	90.196	6.132	109.063	5.124	128.348	5.264
150.713	5.654	151.713	6.615	208.713	9	212.713	10		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	67.49	.05	151.713	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
67.49	151.713	110	100	65	.1	.3

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	9.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.		0.050	0.050
W.S. Elev (m)	9.11	Reach Len. (m)	110.00	100.00	65.00
Crit W.S. (m)		Flow Area (m2)		234.50	74.08
E.G. Slope (m/m)	0.000030	Area (m2)		234.50	74.08
Q Total (m3/s)	67.58	Flow (m3/s)		58.02	9.56
Top Width (m)	124.89	Top Width (m)		67.46	57.43
Vel Total (m/s)	0.22	Avg. Vel. (m/s)		0.25	0.13
Max Chl Dpth (m)	3.98	Hydr. Depth (m)		3.48	1.29
Conv. Total (m3/s)	12399.2	Conv. (m3/s)		10644.6	1754.6

Length Wtd. (m)	95.20	Wetted Per. (m)		68.58	57.49
Min Ch El (m)	5.12	Shear (N/m2)		1.00	0.38
Alpha	1.14	Stream Power (N/m s)		0.25	0.05
Frctn Loss (m)	0.00	Cum Volume (1000 m3)	11.40	29.33	18.42
C & E Loss (m)	0.00	Cum SA (1000 m2)	8.76	9.76	16.45

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 1

INPUT
Description: Sta 1 (Section 6)
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-115	10	0	8.926	23.237	8.771	31.256	7.047	49.216	4.854
50.196	4.448	61.398	5.296	70.956	6.652	80.922	6.821	100.85	8.074
119.297	8.219	268	9						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-115	.05	23.237	.05	100.85	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
23.237	100.85	50	50	50	.1	.3

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	9.11	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.050	0.050	0.050
W.S. Elev (m)	9.10	Reach Len. (m)	50.00	50.00	50.00
Crit W.S. (m)	6.09	Flow Area (m2)	7.56	204.38	90.90
E.G. Slope (m/m)	0.000056	Area (m2)	7.56	204.38	90.90
Q Total (m3/s)	67.58	Flow (m3/s)	0.36	58.14	9.08
Top Width (m)	286.87	Top Width (m)	42.10	77.61	167.15
Vel Total (m/s)	0.22	Avg. Vel. (m/s)	0.05	0.28	0.10
Max Chl Dpth (m)	4.65	Hydr. Depth (m)	0.18	2.63	0.54
Conv. Total (m3/s)	9015.6	Conv. (m3/s)	48.1	7756.8	1210.7
Length Wtd. (m)	50.00	Wetted Per. (m)	42.11	78.18	167.25
Min Ch El (m)	4.45	Shear (N/m2)	0.10	1.44	0.30
Alpha	1.43	Stream Power (N/m s)	0.00	0.41	0.03
Frctn Loss (m)		Cum Volume (1000 m3)	10.98	7.38	13.05
C & E Loss (m)		Cum SA (1000 m2)	6.44	2.50	9.15

CULVERT

RIVER: bocaforma
REACH: upstream RS: 0.5

INPUT
Description: existing box culvert
Distance from Upstream XS = 10
Deck/Roadway Width = 35
Weir Coefficient = 1.44
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
23.24	8.3		120	8.3	

Upstream Bridge Cross Section Data
Station Elevation Data num= 12

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-115	10	0	8.926	23.237	8.771	31.256	7.047	49.216	4.854
50.196	4.448	61.398	5.296	70.956	6.652	80.922	6.821	100.85	8.074
119.297	8.219	268	9						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-115	.05	23.237	.05	100.85	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
23.237	100.85	.1	.3

Downstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-150	8.18		250	8.18	

Downstream Bridge Cross Section Data
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-175	9	0	5.647	16.795	5.65	23.146	6.142	40.695	7.247
43.515	5.649	46.6	5.494	48.801	4.696	59.976	4.553	63.177	5.076
77.721	5.534	100.581	5.464	302	10				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-175	.05	40.695	.05	63.177	.05

Bank Sta: Left	Right	Coeff Contr.	Expan.
40.695	63.177	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .95
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Culvert #1	Box	3.062	4.192

FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG

Culvert	Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
1	10	35	.013	.013	0	.5	

Upstream Elevation = 3.738
Centerline Station = 50.2

Downstream Elevation = 3.622
Centerline Station = 54.44

CULVERT OUTPUT Profile #Q100 Culv Group: Culvert #1

Q Culv Group (m3/s)	2.99	Culv Full Len (m)	35.00
# Barrels	1	Culv Vel US (m/s)	0.23
Q Barrel (m3/s)	2.99	Culv Vel DS (m/s)	0.23
E.G. US. (m)	9.11	Culv Inv El Up (m)	3.74
W.S. US. (m)	9.10	Culv Inv El Dn (m)	3.62
E.G. DS (m)	9.10	Culv Frctn Ls (m)	0.00
W.S. DS (m)	9.10	Culv Exit Loss (m)	0.00
Delta EG (m)	0.00	Culv Entr Loss (m)	0.00
Delta WS (m)	0.00	Q Weir (m3/s)	64.59
E.G. IC (m)	9.10	Weir Sta Lft (m)	-19.20
E.G. OC (m)	9.11	Weir Sta Rgt (m)	268.00
Culvert Control	Outlet	Weir Submerg	0.99
Culv WS Inlet (m)	6.80	Weir Max Depth (m)	0.88
Culv WS Outlet (m)	6.68	Weir Avg Depth (m)	0.55
Culv Nml Depth (m)		Weir Flow Area (m2)	158.22
Culv Crt Depth (m)	0.37	Min El Weir Flow (m)	8.23

Warning: The weir over culvert is submerged.

CROSS SECTION

RIVER: bocaforma
REACH: upstream RS: 0

INPUT
Description: Sta 0 (Section 5)
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-175	9	0	5.647	16.795	5.65	23.146	6.142	40.695	7.247
43.515	5.649	46.6	5.494	48.801	4.696	59.976	4.553	63.177	5.076
77.721	5.534	100.581	5.464	302	10				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-175	.05	40.695	.05	63.177	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
40.695	63.177	0	0	0	.1	.3

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (m)	9.10	Element	Left OB	Channel	Right OB
Vel Head (m)	0.00	Wt. n-Val.	0.050	0.050	0.050
W.S. Elev (m)	9.10	Reach Len. (m)			
Crit W.S. (m)	5.83	Flow Area (m2)	431.69	90.94	431.29
E.G. Slope (m/m)	0.000004	Area (m2)	431.69	90.94	431.29
Q Total (m3/s)	67.58	Flow (m3/s)	28.33	9.38	29.87
Top Width (m)	437.10	Top Width (m)	215.70	22.48	198.92
Vel Total (m/s)	0.07	Avg. Vel. (m/s)	0.07	0.10	0.07
Max Chl Dpth (m)	4.55	Hydr. Depth (m)	2.00	4.05	2.17
Conv. Total (m3/s)	32687.2	Conv. (m3/s)	13703.7	4535.9	14447.6
Length Wtd. (m)		Wetted Per. (m)	215.88	23.09	198.97

Min Ch El (m)	4.55	Shear (N/m2)	0.08	0.17	0.09
Alpha	1.08	Stream Power (N/m s)	0.01	0.02	0.01
Frctn Loss (m)		Cum Volume (1000 m3)			
C & E Loss (m)		Cum SA (1000 m2)			

SUMMARY OF MANNING'S N VALUES

River:bocaforma

Reach	River Sta.	n1	n2	n3
upstream	5	.05	.05	.05
upstream	4	.05	.05	.05
upstream	3	.05	.05	.05
upstream	2	.05	.05	.05
upstream	1	.05	.05	.05
upstream	0.5	Culvert		
upstream	0	.05	.05	.05

SUMMARY OF REACH LENGTHS

River: bocaforma

Reach	River Sta.	Left	Channel	Right
upstream	5	110	110	110
upstream	4	52	97	110
upstream	3	50	50	50
upstream	2	110	100	65
upstream	1	50	50	50
upstream	0.5	Culvert		
upstream	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: bocaforma

Reach	River Sta.	Contr.	Expan.
upstream	5	.1	.3
upstream	4	.1	.3
upstream	3	.1	.3
upstream	2	.1	.3
upstream	1	.1	.3
upstream	0.5	Culvert	
upstream	0	.1	.3

Profile Output Table - Standard Table 1

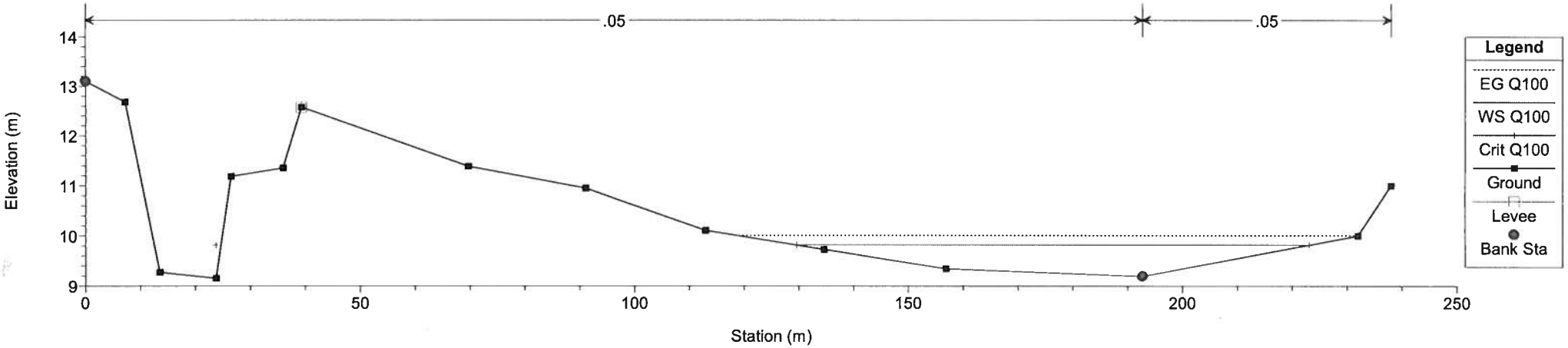
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	

```
  upstream      5              Q100        67.58        9.15        9.82        9.82
10.01     0.032628       2.00        35.43        93.54            0.99
  upstream      4              Q100        67.58        7.05        9.12
9.12     0.000168       0.35       191.78       120.22            0.09
  upstream      3              Q100        67.58        6.33        9.11
9.11     0.000075       0.30       231.99       106.72            0.06
  upstream      2              Q100        67.58        5.12        9.11
9.11     0.000030       0.25       308.58       124.89            0.04
  upstream      1              Q100        67.58        4.45        9.10        6.09
9.11     0.000056       0.28       302.83       286.87            0.06
  upstream      0.5                         Culvert

  upstream      0              Q100        67.58        4.55        9.10        5.83
9.10     0.000004       0.10       953.92       437.10            0.02
```

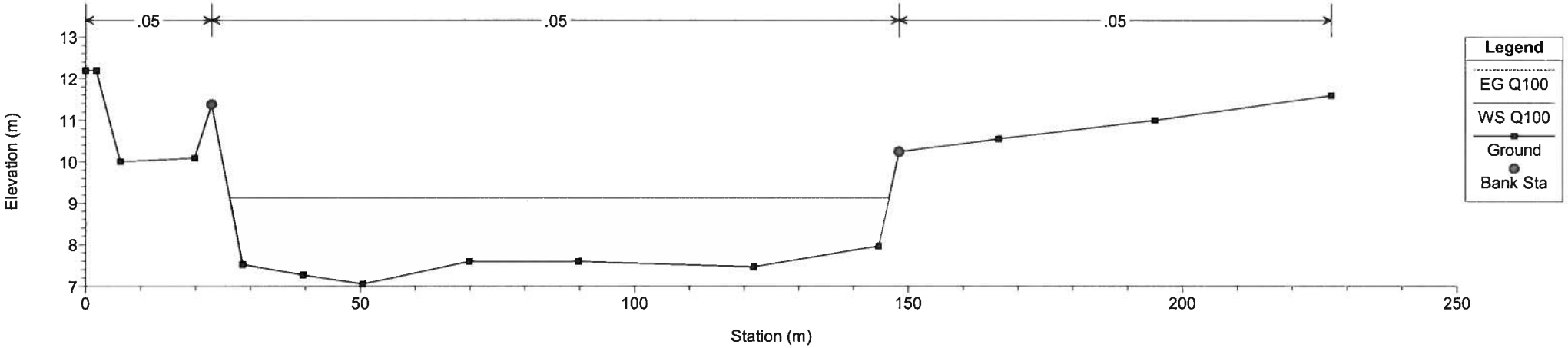
qdaBocaforma Plan: bocaformaNOAAPC 7/20/2009

Sta 5 (Section 11)



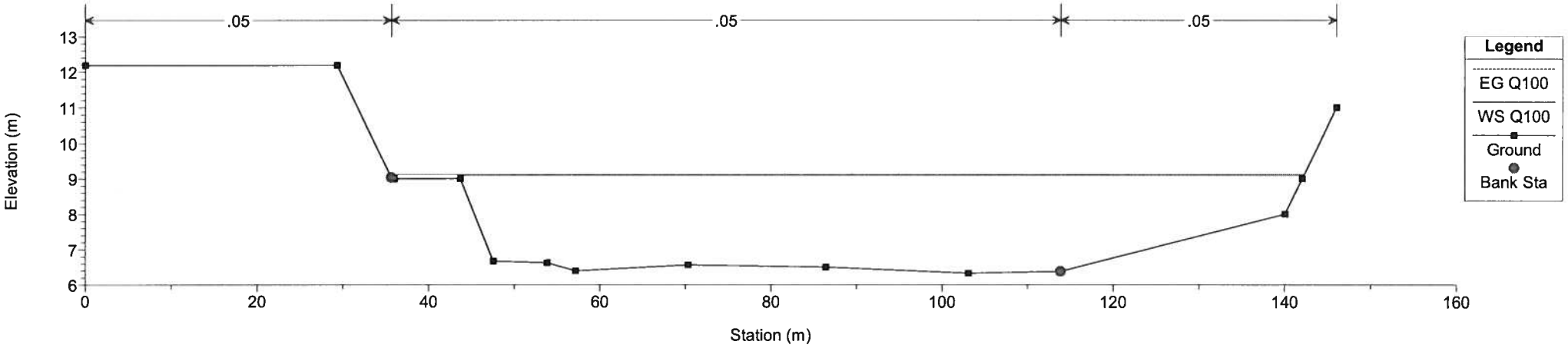
qdaBocaforma Plan: bocaformaNOAAPC 7/20/2009

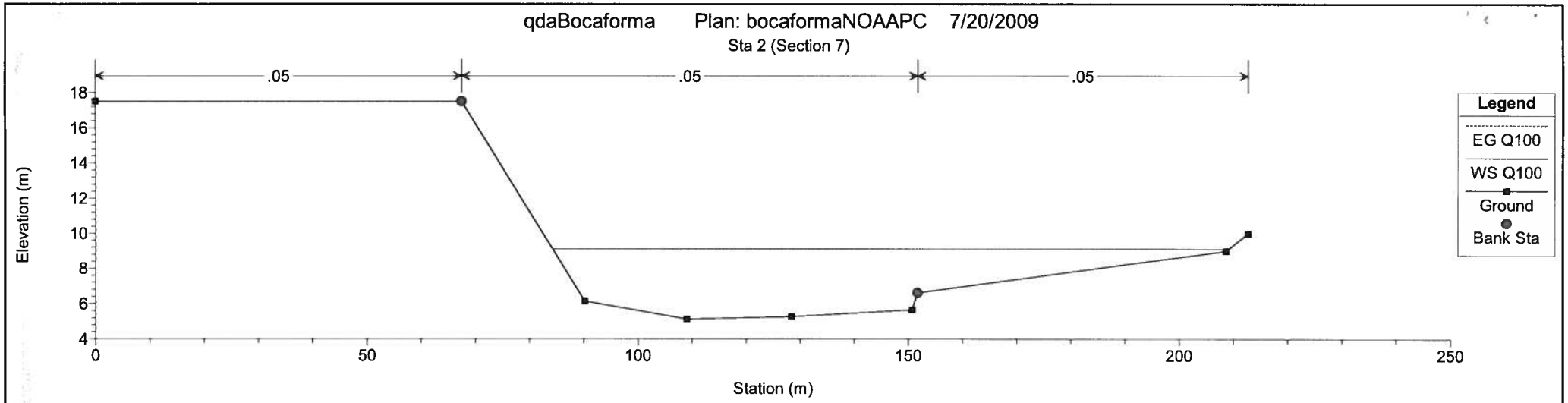
Sta 4 (Section 10)



qdaBocaforma Plan: bocaformaNOAAPC 7/20/2009

Sta 3 (Section 9)

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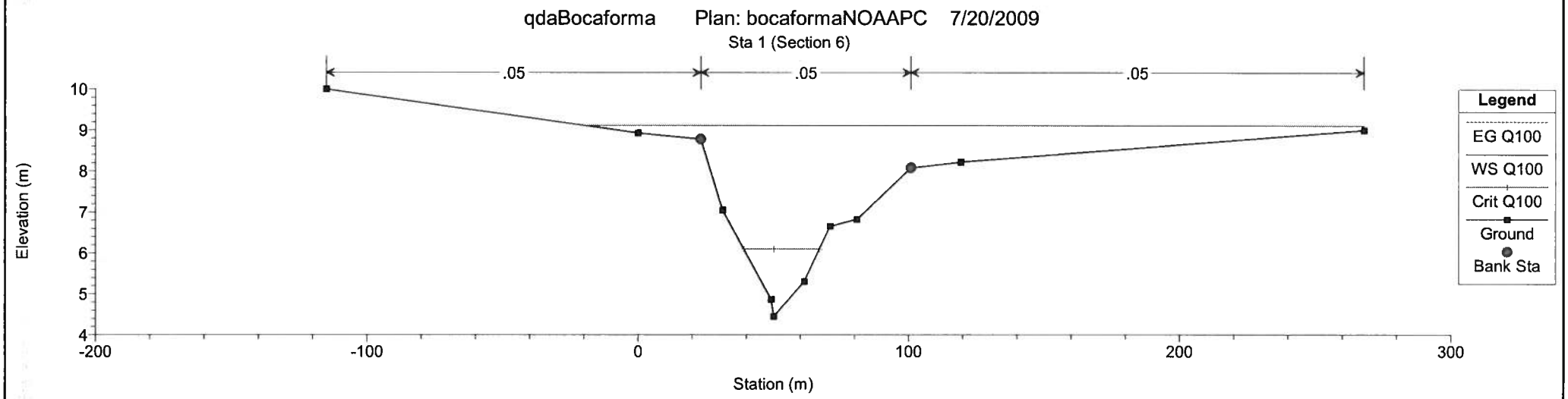
Sta 2 (Section 7)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG Q100
WS Q100
Ground
Bank Sta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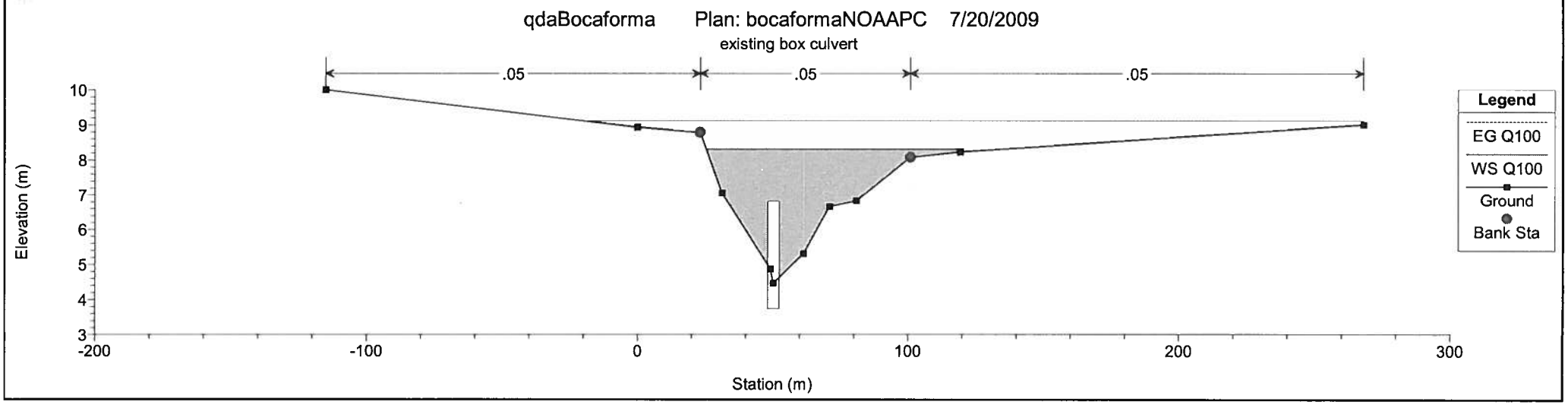
Sta 1 (Section 6)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG Q100
WS Q100
Crit Q100
Ground
Bank Sta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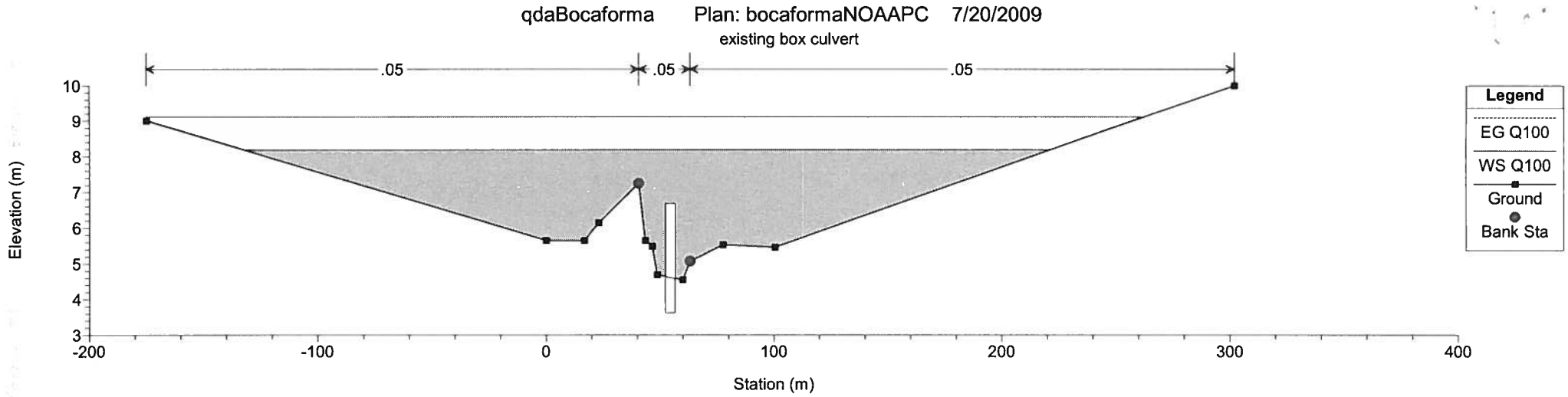
existing box culvert
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG Q100
WS Q100
Ground
Bank Sta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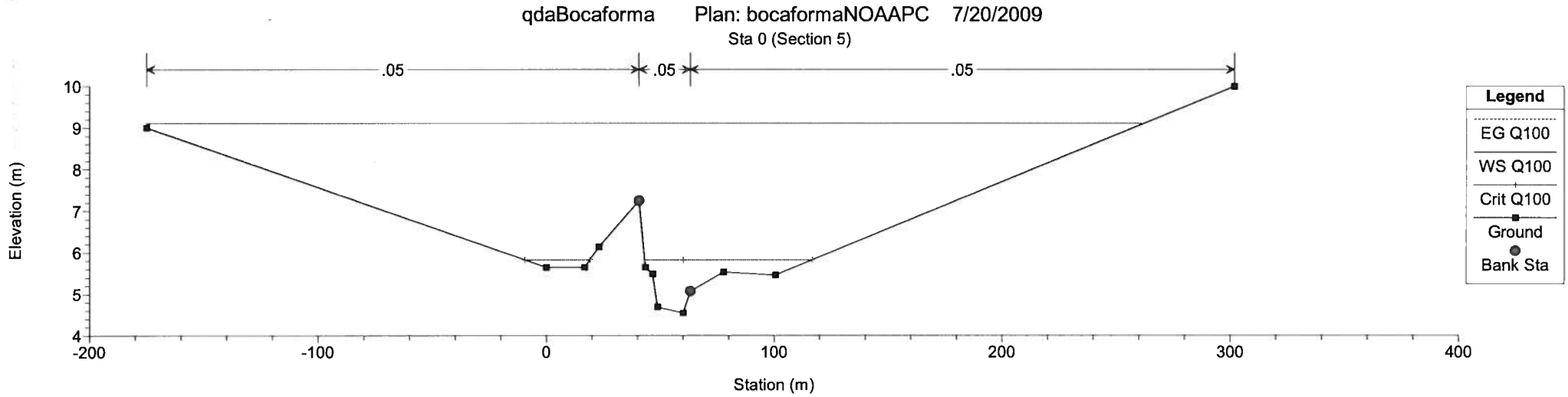
existing box culvert
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG Q100
WS Q100
Ground
Bank Sta


qdaBocaforma Plan: bocaformaNOAAPC 7/20/2009
Sta 0 (Section 5)
.05
.05
.05
Elevation (m)
Station (m)
Legend
EG Q100
WS Q100
Crit Q100
Ground
Bank Sta

APPENDIX F
PERCOLATION CALCULATIONS

PERMEABILITY

Bottom Area of Pond = 1.93 Acres = 84,071 ft^2

Soil Material:
Sandstone
Hydraulic Conductivity (K) = 10^2 gal/day-ft^2 (see reference 10)

10^2 gal/day-ft^2/646,317 = 1.55 x (10^{-4} ft^3/s-ft^2) * 84,701ft^2

= <u>13 ft^3/s</u>

Using a safety factor of 2:
13 cfs/2 = 6.5 cfs

6.5 cfs used in the computations.

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Project:		
El Nuevo Comandante		
By: VGN	Date: 07/16/2009	Project #: 05201H
Check: JAT	Date: 07/16/2009	Page: 1 of 1

APPENDIX G
PONDPACK MODEL – ELECTRONIC COPY

THE FOLLOWING FILES ARE STORED IN THE CD BELOW:

I) Hydrologic-Hydraulic Modeling (Bentley Pond Pack v10.01)

1) Existing Conditions
   i) 090721exist cond NOAA.ppw

2) Proposed Conditions
   i) 090721pcond NOAA tw=29.86 ft.ppw