

ANEJO 6
Estudio Hidrológico Hidráulico
(diciembre de 2006)

Aspectos Hidrológicos
(agosto 2006)

TABLE OF CONTENTS

I. INTRODUCTION.....	1
Purpose of Study.....	1
Approach.....	2
Authorization	2
II. PROJECT BACKGROUND	3
Location	3
Topography.....	3
Flooding.....	3
Field Work	4
Former Studies.....	4
Study Level.....	4
III. HYDROLOGIC ANALYSIS	5
Methodology.....	5
Drainage Areas.....	5
Curve Numbers.....	6
Lag Time.....	6
Rainfall Data.....	7
Depth-Area Adjustment.....	7
Time Distribution of Rainfall.....	8
Rainfall Extraction.....	8
Hydrologic Results.....	8
IV. RUNOFF MITIGATION ANALYSIS	9
Methodology.....	9
Depth-Volume Relations	9
Flow – Depth Relations	10
Results.....	10

Mitigation Structure Dimensions and Accessories	12
V. HYDRAULIC ANALYSIS.....	14
Contraction and Expansion Coefficients	14
Hydraulics for Rio Cagüitas.....	14
VI. CONCLUSIONS AND RECOMMENDATIONS	18
Study Limits.....	19
VII. BIBLIOGRAPHY	20

LIST OF FIGURES

- FIGURE 1.** Location Map
- FIGURE 2.** Proposed Development Layout
- FIGURE 3.** Topography for Existing Condition
- FIGURE 4.** Drainage Areas at Existing Condition
- FIGURE 5.** Drainage Areas at Proposed Condition
- FIGURE 6.** Soils Map
- FIGURE 7.** FEMA Flood Insurance Rate Map
- FIGURE 8.** Proposed Structures Layout
- FIGURE 9.** Detention Pond Schematics for Pond P2K1
- FIGURE 10.** Detention Pond Schematics for Pond P2K2
- FIGURE 11.** Detention Pond Schematics for Pond P2LA
- FIGURE 12.** Detention Tank Schematics for Tank P2B
- FIGURE 13.** Detention Tank Schematics for Tank P2F
- FIGURE 14.** Detention Tank Schematics for Tank P2I
- FIGURE 15.** Cross Sections Location
- FIGURE 16.** 100-years Flood Footprint

LIST OF APPENDIXES

- APPENDIX A.** Hydrologic Parameters Estimation
- APPENDIX B.** HEC-1 Results for Existing Condition
- APPENDIX C.** HEC-1 Results or Proposed Condition
- APPENDIX D.** Detention Structure Volume and Discharge to Depth Relations
- APPENDIX E.** HEC-1 Results for Proposed Condition with Mitigation
- APPENDIX F.** HEC-RAS Results 100-years Flood Rio Cagiitas
- APPENDIX G.** Field Work

TERRAMAR DEVELOPMENT GROUP

LOS FARALLONES SITE HYDROLOGY

I. INTRODUCTION

Terramar Development Group is planning to develop a residential-commercial complex project named "Los Farallones" in 202-cuerdas located in the Autonomous Municipality of Caguas. The project will consist of 936 apartments, 80,000 square foot commercial area, and recreation and ancillary facilities pertaining to this type of project.

Three issues related to the hydrology of the site planned for development are of focus of this report: water bodies, storm watercourses, and floodability of the area. This report, along with general hydrologic information related to the site will provide a point of reference to assess and minimize the impacts on the hydrology from the construction of the project.

1.1 Location

The site is located to the north of state road PR-156, at Km. 56.0, Cañabón Ward, in the Autonomous Municipality of Caguas. It is bordered by Comunidad Las Carolinas on the north, state road PR-156 on the south, the property of Jose W. Cartagena and Blanca Longo on the east, and Puerto Rico Aqueduct and Sewer Authority, El Amal, Notre Dame and Better Roads Asphalt on the west. See Figure 1.

1.2 Project

Los Farallones project plans to be a residential-commercial complex consisting on 936 multifamily residential units distributed in 6 to 8 story buildings, with 80,000 square feet commercial space. The project will occupy approximately 73 cuerdas or 36% of the 202 cuerdas. The remaining land will be left in natural state for conservation. A preliminary layout of the project is shown in Figure 2.

Approach

The following steps have been undertaken throughout the study:

Hydrologic Analysis: The following parameters were determined for the hydrologic analysis: drainage areas, average soil curve number and runoff lag time. Based on these parameters, discharges for 100, 50, 25, 10 and 2-yr frequencies storm were determined for existing and proposed conditions. HEC-1 model was used.

Runoff Discharge Mitigation Analysis: A mitigation analysis was made in order to counteract the impact of the proposed development. HEC-1 model was used for the mitigation analysis. Discharges for 2, 10, 25, 50 and 100-year frequencies were analyzed for mitigation.

Hydraulic Analysis: A hydraulic analysis was made in order to determine the flood levels and 100-years flood footprint at the Rio Cagüitas. COE's HECRAS model as used.

Conclusions and recommendations were elaborated.

Authorization

Eng. Carlos Caceres on behalf the owner, authorized this study, under a contract signed with Eng. Casiano Ancalle, principal of CA Engineering.

II. PROJECT BACKGROUND

Location

The site is located to the north of state road PR-156, at Km. 56.0, Cañabón Ward, in the Autonomous Municipality of Caguas. It is bordered by Comunidad Las Carolinas on the north, state road PR-156 on the south, the property of Jose W. Cartagena and Blanca Longo on the east, and Puerto Rico Aqueduct and Sewer Authority, El Amal, Notre Dame and Better Roads Asphalt on the west. See Figure 1.

Topography

The project area has an irregular topography. Part of the portion of the project area located east of Río Cagüitas slopes to the south between elevation 175 and 85 meters; the other part slopes to the north. The area west of Río Cagüitas slopes to the east. Several storm watercourses are evident as a result of the uneven surface topography.

Water Bodies

Río Cagüitas is the main water body related to the project site, most of the project site drains to this watercourse. The project will not intend to affect this water body. Three man made ponds are located to the east of the site. One is located in the area that drains to Río Bairoa, and the others in the watershed of Río Cagüitas. USACOE doesn't have jurisdiction of them, according to the Jurisdictional Determination Study made by ECG Consulting Group.

Flooding

From the regulatory point of view, the project site is not classified as floodable for a 100-year rainfall event. Figure 7 shows a portion of the FEMA flood insurance rate map Panel 740 & 745, revised on April 2005.

Field Work

Field data used in this study was taken by the drawings provided by Surveyor Pedro Dávila Colón. This information was used for the hydraulic modeling. Results obtained in this study are based on this information. Fieldwork is attached in a pocket at the end of this study, as Appendix F.

Former Studies

No former hydrologic and hydraulic studies were identified for the project area. This study is based on the engineering criteria adopted for the analysis and the information provided by the engineer and gathered through site inspection and interviews of neighboring residents.

Study Level

This study is intended as an aid to the design engineer in the preparation of the construction drawings for the recommended structures. Figures, schematics and drawings must not be used as construction drawings. The design engineer must elaborate the construction drawings in agreement with the recommendations of this study.

III. HYDROLOGIC ANALYSIS

Methodology

The computer program entitled Flood Hydrograph Package (HEC-1) developed by the U.S. Army Corps of Engineers [1990] was used for the hydrologic analysis. Using this program, the Unit Hydrograph method and the Runoff Curve Number (CN) method, both developed by the Soil Conservation Service (SCS), were applied to determine the design hydrograph. This was computed by a process of translating the rainfall excess into a runoff hydrograph known as convolution.

Peak discharges ranging in frequencies from 2, 10, 25, 50 and 100-year were estimated for existing and proposed condition.

Drainage Areas

From the topography, northern area of the project site drains to the north, to some storm watercourses that are part of Rio Bairoa and Rio Cagüitas Basin. The southern area of the project drains to the south to Rio Cagüitas. The project area shows to have three independent drainage areas at existing condition: Drainage area P1 with 62.97 acres P2 with 104.75 acres and P3 with 35.46 acres. At proposed condition: Drainage area P1 has been reduced to 59.25, and drainage Area P2 has increased to 108.47 acres and has been split in sixteen sub areas: P2A with 3.71 acres, P2B with 4.60 acres, P2C with 3.54 acres, P2D 3.39, P2E 4.44, P2F 4.74, P2G 5.02, P2H 6.63, P2I 3.58, P2J 3.17, P2K1 13.67, P2K1a 3.11, P2K2 9.81, P2LA 10.95, P2LB 17.79 and P2M with 10.32 acres. Drainage Area P3 has 35.46 acres. Figure 4 shows the drainage areas at existing condition and Figure 5 at proposed condition.

Curve Numbers

Curve numbers were computed using the NRCS methodology. The classification of the soils of the site is included in the Soil Survey of the San Juan Area of Puerto Rico. This study was made for the Soil Conservation Service in cooperation with the University of Puerto Rico in 1972. According to this study, the soils found in the site were identified as Estacion Clay, Juncos Clay, Mabi Clay, Mucara Clay, Rio Arriba Clay, Toa Clay and Via Clay loam. The most predominant type found was Mucara Clay with over 60 percent of the total area. A more detailed classification is shown in Table 2. Figure 7 shows the site in a partial copy of the map of the Soil Survey of San Juan Area of Puerto Rico.

Appendix A shows the physiographic characteristics of the site and the weighted Curve Number (CN) estimations. Figure 6 shows the portion of the soil map corresponding to the project area.

Lag Time

The lag time was estimated as sixty percent of the time of concentration as estimated by the formula of Kirpitch.

$$T_C = 0.0078L^{0.77}/S^{0.385}$$

where:

- L = channel length (ft)
- S = channel slope
- T_c = Time of concentration in min

Detailed Lag Time calculations are shown in Appendix A.

Rainfall Data

The variation of rainfall volume with time was required as part of the storm input for the SCS Curve Number method. Therefore, the development of a design storm with a rainfall frequency and duration was necessary to compute the design hydrograph for the watershed. Rainfall data used in this study was obtained from the Technical Paper No. 42 (TP-42) [National Weather Service, 1961]. The rainfall depths for 100, 50, 25, 10 and 2-years frequency for several durations was used and are shown in Table 1. Rainfall depths for 5 and 15 minutes duration were extrapolated by a regression analysis of the IDF curves.

Table 1
Rainfall for 2, 10, 25, 50 y 100 years

		HOURS RAINFALL				
		2	10	25	50	100
YEARS	0.083	0.40	0.60	0.71	0.83	0.85
	0.25	0.98	1.44	1.67	1.93	2.02
	1	2.20	3.28	3.76	4.20	4.60
	2	2.70	4.25	4.75	5.25	6.00
	3	2.95	4.70	5.30	6.10	6.50
	6	3.80	5.75	6.60	7.50	8.25
	12	4.40	6.75	8.10	9.10	10.10
	24	4.90	7.90	9.50	10.80	12.10

Depth-Area Adjustment

Point rainfall estimates obtained from the TP-42 represent values for areas up to 10 mi²; therefore, a depth-area adjustment should be applied to the rainfall data when the watershed area is greater.

Time Distribution of Rainfall

The triangular type methodology was used to distribute the rainfall depth in time. This method is considered acceptable for small areas.

Rainfall Extraction

Rainfall extraction such as the vegetative interception, the depressional storage, and the infiltration were estimated using the SCS's Runoff Curve Number method. Though this method is used to predict runoff volume directly, the rainfall extraction is incorporated in the model as function of the curve number of the watershed.

Hydrologic Results

Following HEC-1 methodology, hydrographs were determined for existing and proposed condition. Input and output data for the HEC-1 model are included in Appendix B for existing condition and Appendix C for proposed condition. Table 2 shows the results of the hydrologic analysis.

Table 2
Peak Discharges for 2- 10- 25- 50 and 100-yr Frequencies

CONDITION	BASIN	Peak Flow (cfs)				
		2-yr	10-yr	25-yr	50-yr	100-yr
EXISTING	P1	242	396	467	536	581
	P2	351	561	664	773	820
	P3	127	203	241	280	296
PROPOSED	P1	235	382	450	517	560
	P2	443	701	833	974	1016
	P3	127	203	241	280	296

From the inspection of Table 2, the peak discharge for proposed condition at area project site is higher than the existing condition. The increment in discharge has to be mitigated as required by Puerto Rico Planning Board Regulation No. 3.

IV. RUNOFF MITIGATION ANALYSIS

The development of the site will increase the runoff discharge. The Puerto Rico Planning Board Regulation No. 3 requires a flow mitigation structure wherever an increase in discharge is produced. Therefore, flow detention structures will be included in the project.

Methodology

The computer program HEC-1 provides means for modeling detention structures. The purpose of detention is that the proposed condition peak discharge does not exceed the existing condition peak discharge.

Three detention ponds and three detention tanks has been considered for the project to mitigate the runoff increase. The discharge from the detention structures will merge to discharge into Rio Cagüitas. The design engineer must provide the means to assure that the entire runoff of the area P2B, P2F, P2I, P2K1, P2K2, P2LA, P2LB and P2M discharges onto their detention tanks and ponds respectively.

Depth-Volume Relations

The base area of Pond P2K1 will be 1483 square meters, base area of Pond P2K2 will be 600 square meters, and Pond P2LA will have 2868 square meters, all of the ponds will have side slopes 1V:2H. Bottom area for the Tanks P2B and P2F will be 50 sqm. and Tank P2I will have 40 square meters. The Depth-Volume calculations were made under the assumption of a square base. Appendix D includes a spreadsheet with the depth-volume relation computations and the curve for the pond.

Flow – Depth Relations

The control structure for the Pond P2K1 will consist on two (2) 30” diameter orifices at the pond bottom, and 20-foot wide rectangular weir located 1.5 meter above the bottom of the pond. Pond P2K2 will have two (2) 21” diameter orifices at the pond bottom, one (1) 24” diameter orifice located 0.83 meters above the bottom of the pond, and 20-foot wide rectangular weir located 1.83 meter above the pond bottom and Pond P2LA will have two (2) 24” diameter orifices at the pond bottom and 20-foot wide rectangular weir located 1.8 meter above the pond bottom. The control structure for the Tank P2B and Tank P2F will consist on one (1) 24” diameter orifice at the tank bottom, and 6.28-foot circular weir located 1.8 meter above the bottom of the tank. Tank P2I will have one (1) 24” diameter orifice at the tank bottom, and 6.28-foot weir located 1.7 meter above the bottom of the tank. Table 4 and Table 5 shows the characteristics for detention structures. Flow–Depth relations for these structures were estimated taking into consideration discharges through orifices. Flow through the orifices was computed using Torrecelli’s formula. Appendix D includes a spreadsheet with the depth-flow relation computations and its respective curve.

Results

Input and output data for the HEC-1 mitigation model are included in Appendix E. Table 3 shows the comparison of the discharges for existing, and proposed condition.

Table 3
Mitigation Analysis Results Comparison

CONDITION	BASIN	Peak Flow (cfs)				
		2-yr	10-yr	25-yr	50-yr	100-yr
EXISTING	P1	242	396	467	536	581
	P2	351	561	664	773	820
	P3	127	203	241	280	296
PROPOSED	P1	235	382	450	517	560
	P2	443	701	833	974	1016
	P3	127	203	241	280	296
PROPOSED W/MITIGATION	P1	235	382	450	517	560
	P2	351	532	627	721	759
	P3	127	203	241	280	296

The results of the detention analysis show that the proposed detention pond provides appropriate runoff mitigation for the 100-year frequency discharge. Mitigation for 2-, 10-, 25- and 50-yr frequency peak discharges was also verified.

Mitigation Structure Dimensions and Accessories

The maximum water stage at the Pond P2K1 for the 100-yr peak at pond will be 1.49m. (4.89 ft); Pond P2K2 will have a maximum water stage of 1.91m (6.28 ft) and Pond P2LA 1.81m. (5.96 ft). Final dimensions for the pond will include a minimum free board of 0.60 meters. Then, the detention pond will have the characteristics shown in Table 4.

Table 4
Detention Ponds Characteristics

		Pond P2K1	Pond P2K2	Pond P2LA
Pond Dimensions	Base Area	1483 m ²	600 m ²	2868 m ²
	Height	2.10 m	2.51 m	2.41 m
Outlet Accessories	Orifice@ bottom	Two (2)-30"ø	Two (2)-21"ø	Two (2)-24"ø
	Orifice@ 1.22 m	N/A	One-24"ø	N/A
Outlet Chamber Discharge	Weir Width	20 ft@ 1.50m above bottom	20 ft@ 1.83m above bottom	20 ft@ 1.80m above bottom
	Discharge Pipe	One-48"ø	One-42"ø	One-48"ø

The maximum water stage at the Tank P2B for the 100-yr peak at pond will be 1.86m. (6.13 ft); Tank P2F will have a maximum water stage of 1.90m (6.23 ft) and Tank P2I 1.69m. (5.53 ft). Final dimensions for the pond will include a minimum free board of 0.60 meters. Then, the Detention Tanks will have the characteristics shown in Table 5.

Table 5
Detention Tanks Characteristics

		Tank P2B	Tank P2F	Tank P2I
Tank Dimensions	Base Area	50 m ²	50 m ²	40 m ²
	Height	2.46 m	2.49 m	2.29 m
Outlet Accessories	Orifice@ bottom	One (1)-24"Ø	One (1)-24"Ø	One (1)-24"Ø
Outlet Chamber Discharge	Weir Width	6.28 ft@ 1.80m above bottom	6.28 ft@ 1.80m above bottom	6.28 ft@ 1.70m above bottom
	Discharge Pipe	One-36"Ø	One-36"Ø	One-36"Ø

For the mitigation analysis, the bottom geometry of the mitigation structures has been considered square but another shape can be used as well if the magnitude of the area is maintained. Figure 9 shows the schematics of the Detention Pond P2K1, Figure 10 and 11 for the Ponds P2K2 and P2LA, Figure 12, 13 and 14 shows the schematics for the Tanks P2B, P2F and P2I respectively and the outlet accessories.

V. HYDRAULIC ANALYSIS

The hydraulic analysis of the Rio Cagüitas was made in order to find the water levels and flood footprint of a 100-year rainfall event.

The hydraulic analysis was made by using the mathematical model HEC-RAS developed by the US Corps of Engineers. This model includes a subroutine for culverts that is necessary to simulate inlet control at over loaded piping systems. The friction coefficient used in the modeling was obtained from visual inspection of the existing structures; and cross-checked with the typical values provided by Barnes (1967) and Chow (1959). Manning's coefficient used for modeling the drainage system was 0.040 for existing condition and for the concrete pipes 0.013.

Field work was performed by surveyor Pedro Dávila. Copy of this work is included in Appendix H.

Contraction and Expansion Coefficients

Coefficients of contraction and expansion used are those recommended by the HEC-RAS user's manual. Thus, coefficients of 0.1 and 0.3 respectively were used for gradual transitions.

Hydraulics for Rio Cagüitas

Location of the cross sections used in the hydraulic run is shown in Figure 15. The hydraulic analysis was made for a 100-years discharge. One hundred years flood footprint is shown in Figure 16. Appendix F includes the analysis computer output. Tables No. 6 show the summary of the results for existing condition hydraulics.

Table 6

Hydraulics for Rio Caguítas (100-years Flood)

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude# Chl
1	18	100yrs	299.39	88.05	91.74	90.53	91.81	0.001381	1.18	265.47	152.82	0.27
1	18	50yrs	266.91	88.05	91.56	90.47	91.63	0.001489	1.17	237.80	145.87	0.27
1	18	25yrs	234.32	88.05	91.35	90.40	91.42	0.001719	1.17	207.76	140.29	0.29
1	18	10yrs	201.05	88.05	91.14	90.32	91.21	0.001967	1.15	179.70	135.16	0.30
1	18	2yrs	115.73	88.05	90.52	90.00	90.59	0.003988	1.16	100.57	119.52	0.39
1	17	100yrs	299.39	86.63	91.57		91.65	0.001333	1.36	248.33	124.03	0.27
1	17	50yrs	266.91	86.63	91.38		91.46	0.001380	1.35	225.42	114.42	0.27
1	17	25yrs	234.32	86.63	91.15		91.23	0.001492	1.36	199.53	110.48	0.28
1	17	10yrs	201.05	86.63	90.93		91.00	0.001561	1.35	175.46	106.68	0.28
1	17	2yrs	115.73	86.63	90.19		90.27	0.001901	1.34	103.79	84.90	0.30
1	16	100yrs	299.39	86.41	91.04		91.35	0.005156	2.50	124.83	60.52	0.52
1	16	50yrs	266.91	86.41	90.86		91.15	0.005002	2.43	113.96	56.49	0.51
1	16	25yrs	234.32	86.41	90.64		90.92	0.004416	2.35	102.79	48.86	0.48
1	16	10yrs	201.05	86.41	90.45		90.69	0.004189	2.20	93.60	46.47	0.46
1	16	2yrs	115.73	86.41	89.75		89.91	0.004051	1.81	64.03	37.87	0.44
1	15	100yrs	299.39	86.36	90.41		90.87	0.009590	3.00	99.65	50.38	0.68
1	15	50yrs	266.91	86.36	90.22		90.67	0.010204	2.95	90.47	49.26	0.69
1	15	25yrs	234.32	86.36	90.04		90.46	0.010798	2.88	81.50	48.13	0.71
1	15	10yrs	201.05	86.36	89.84		90.24	0.011615	2.79	71.98	46.91	0.72
1	15	2yrs	115.73	86.36	89.04		89.45	0.012293	2.82	41.02	27.21	0.73
1	14	100yrs	299.39	85.69	89.63		90.14	0.008008	3.18	94.18	38.12	0.65
1	14	50yrs	266.91	85.69	89.51		89.96	0.007335	2.98	89.63	37.47	0.61
1	14	25yrs	234.32	85.69	89.37		89.76	0.006660	2.77	84.65	36.76	0.58
1	14	10yrs	201.05	85.69	89.22		89.55	0.005954	2.54	79.14	35.95	0.55
1	14	2yrs	115.73	85.69	88.33		88.61	0.007965	2.36	49.10	31.18	0.60
1	13	100yrs	299.39	85.23	89.38		89.66	0.006439	2.35	127.56	70.78	0.56
1	13	50yrs	266.91	85.23	89.25		89.51	0.006326	2.25	118.56	69.11	0.55
1	13	25yrs	234.32	85.23	89.12		89.35	0.006184	2.15	109.12	67.12	0.54
1	13	10yrs	201.05	85.23	88.96		89.17	0.005982	2.03	99.12	64.76	0.52
1	13	2yrs	115.73	85.23	88.01		88.22	0.005249	2.03	56.90	33.22	0.50
1	12	100yrs	299.39	84.35	89.00		89.28	0.006363	2.32	129.09	71.94	0.55
1	12	50yrs	266.91	84.35	88.88		89.13	0.006207	2.21	120.59	70.76	0.54
1	12	25yrs	234.32	84.35	88.76		88.98	0.006039	2.10	111.63	69.50	0.53
1	12	10yrs	201.05	84.35	88.62		88.82	0.005818	1.97	102.14	68.13	0.51
1	12	2yrs	115.73	84.35	87.74		87.93	0.004419	1.93	60.06	33.21	0.46
1	11	100yrs	299.39	84.41	88.12		88.54	0.013143	2.86	104.61	73.41	0.77
1	11	50yrs	266.91	84.41	88.00		88.40	0.013566	2.78	95.96	71.98	0.77
1	11	25yrs	234.32	84.41	87.87		88.24	0.014139	2.70	86.69	70.02	0.78

1	11	10yrs	201.05	84.41	87.73	88.08	0.015053	2.62	76.63	67.83	0.79	
1	11	2yrs	115.73	84.41	87.11	87.41	0.009168	2.44	47.41	31.73	0.64	
1	10	100yrs	299.39	83.88	87.53	87.71	0.004490	1.90	157.53	92.65	0.47	
1	10	50yrs	266.91	83.88	87.43	87.59	0.004212	1.80	148.40	90.36	0.45	
1	10	25yrs	234.32	83.88	87.32	87.47	0.003915	1.69	138.73	87.87	0.43	
1	10	10yrs	201.05	83.88	87.20	87.32	0.003592	1.57	128.20	85.07	0.41	
1	10	2yrs	115.73	83.88	86.76	86.84	0.002938	1.24	93.04	75.16	0.36	
1	9	100yrs	299.39	83.16	86.54	86.78	0.008813	2.18	138.53	114.88	0.62	
1	9	50yrs	266.91	83.16	86.42	86.65	0.009844	2.16	124.55	113.61	0.64	
1	9	25yrs	234.32	83.16	86.30	86.53	0.011065	2.13	110.74	111.77	0.67	
1	9	10yrs	201.05	83.16	86.17	86.39	0.012540	2.08	96.91	109.91	0.70	
1	9	2yrs	115.73	83.16	85.84	86.01	0.012875	1.86	62.11	82.51	0.69	
1	8	100yrs	299.39	82.70	86.28	86.33	0.001191	1.05	295.64	173.81	0.24	
1	8	50yrs	266.91	82.70	86.13	86.18	0.001266	1.03	268.84	172.59	0.25	
1	8	25yrs	234.32	82.70	85.96	86.01	0.001363	1.01	240.67	170.47	0.25	
1	8	10yrs	201.05	82.70	85.78	85.83	0.001501	0.98	210.35	165.13	0.26	
1	8	2yrs	115.73	82.70	85.24	85.29	0.002227	0.91	127.35	136.84	0.30	
1	7	100yrs	299.39	81.92	85.83	86.05	0.003979	2.11	141.73	64.09	0.45	
1	7	50yrs	266.91	81.92	85.69	85.89	0.003834	2.01	132.82	62.97	0.44	
1	7	25yrs	234.32	81.92	85.54	85.72	0.003667	1.90	123.53	61.78	0.43	
1	7	10yrs	201.05	81.92	85.37	85.53	0.003513	1.78	113.11	60.41	0.41	
1	7	2yrs	115.73	81.92	84.82	84.92	0.003347	1.43	80.78	57.69	0.39	
1	6	100yrs	299.39	81.60	85.02	85.39	0.009603	2.71	110.62	66.59	0.67	
1	6	50yrs	266.91	81.60	84.88	85.23	0.009947	2.62	101.82	66.07	0.67	
1	6	25yrs	234.32	81.60	84.74	85.07	0.010402	2.53	92.58	65.53	0.68	
1	6	10yrs	201.05	81.60	84.58	84.89	0.010724	2.45	82.16	62.62	0.68	
1	6	2yrs	115.73	81.60	84.06	84.30	0.010748	2.18	53.13	48.38	0.66	
1	5	100yrs	299.39	81.50	84.61	83.60	84.80	0.003502	1.93	155.30	73.88	0.42
1	5	50yrs	266.91	81.50	84.48	83.50	84.65	0.003400	1.83	145.51	72.99	0.41
1	5	25yrs	234.32	81.50	84.34	83.39	84.49	0.003279	1.73	135.33	72.06	0.40
1	5	10yrs	201.05	81.50	84.18	83.27	84.32	0.003140	1.62	124.33	71.04	0.39
1	5	2yrs	115.73	81.50	83.71	82.92	83.79	0.002630	1.26	91.68	66.55	0.34
1	4	Bridge										
1	3	100yrs	299.39	81.57	84.22	84.59	0.007727	2.68	111.64	57.26	0.61	
1	3	50yrs	266.91	81.57	84.14	84.45	0.007081	2.50	106.62	56.88	0.58	
1	3	25yrs	234.32	81.57	84.04	84.31	0.006437	2.32	101.11	56.46	0.55	
1	3	10yrs	201.05	81.57	83.93	84.16	0.005790	2.12	94.81	55.98	0.52	
1	3	2yrs	115.73	81.57	83.55	83.67	0.004169	1.56	74.04	54.36	0.43	
1	2	100yrs	299.39	80.79	84.11	84.22	0.002041	1.69	216.47	123.94	0.33	
1	2	50yrs	266.91	80.79	84.02	84.12	0.001909	1.59	205.17	123.74	0.32	
1	2	25yrs	234.32	80.79	83.92	84.01	0.001772	1.49	192.93	123.51	0.31	
1	2	10yrs	201.05	80.79	83.81	83.88	0.001630	1.39	179.05	123.26	0.29	
1	2	2yrs	115.73	80.79	83.44	83.49	0.001209	1.06	134.77	118.67	0.24	

1	1	100yrs	299.39	80.72	83.91	83.52	84.11	0.006000	2.20	161.40	146.13	0.54
1	1	50yrs	266.91	80.72	83.82	83.44	84.01	0.006001	2.13	148.72	145.25	0.53
1	1	25yrs	234.32	80.72	83.73	83.35	83.90	0.006004	2.05	135.22	141.85	0.53
1	1	10yrs	201.05	80.72	83.62	83.27	83.78	0.006011	1.95	120.58	133.77	0.52
1	1	2yrs	115.73	80.72	83.28	82.99	83.40	0.006005	1.64	80.30	107.28	0.50

VI. CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions of this study:

1. According to the regulatory flood maps, the project site is not considered floodable for the 100-year rainfall event.
2. Proposed condition discharge for project area is higher than that of the existing condition. Runoff discharge mitigation is needed.
3. Mitigation reduces the local peak discharge for the project area from 1016 cfs to 759 cfs, which is less than the existing condition (820 cfs).

The following are the recommendations of this study:

1. Mitigation structure will have the dimensions and accessories indicated in Table 4 and Table 5 of this report.
2. The pipes must be installed to the elevations given in this study; any change found necessary must be subject to hydraulic verification.
3. Grading of the site will be made taking into consideration the elevation given for the pipes in this study.
4. Structural stability of the ponds must be assured during the design.
5. It is very important to prepare a long-term maintenance plan, which should include the proposed pipes, the pond outlet structure and the receiving storm system inspection after each significant discharge events. Damages, if any, must be repaired promptly and properly.

Study Limits

All the recommendations specified in this study must be considered to assure the optimum performance of the proposed discharge mitigation tank and receiving stream. The design engineer will be responsible for elaborating the drawings in conformance with the recommendations of this study.

The results of this study are based on free flow conditions through the hydraulic structures. Proper maintenance must be developed to assure this condition. On the event of the occurrence of any severe obstruction to the flow, the results and recommendations may be impaired. Finally, results and recommendations included in this report must be used only and exclusively by the design engineer for the intended purposes as indicated in this study.

VII. BIBLIOGRAPHY

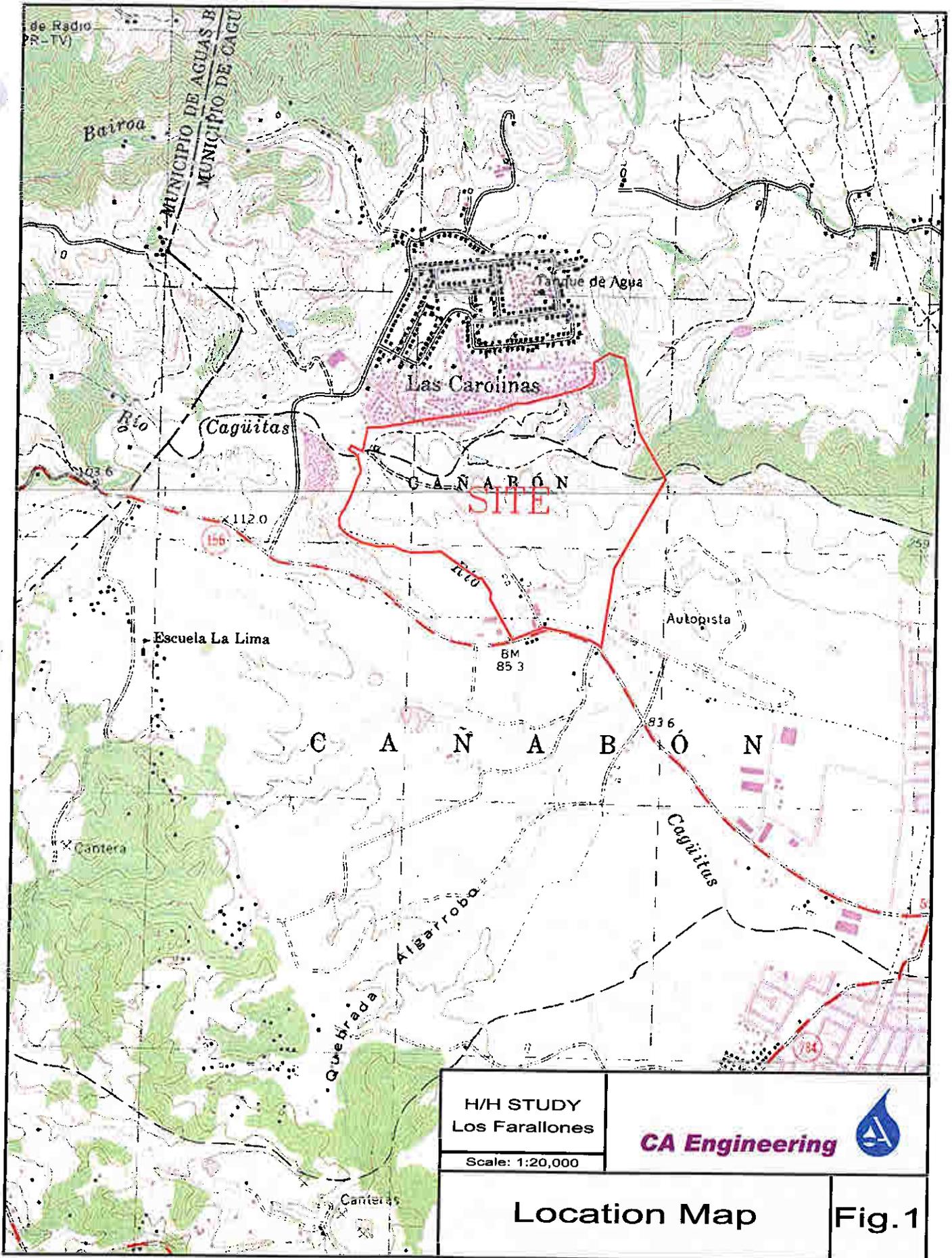
National Weather Service, 1961. *Generalized Estimates of Probable Maximum Precipitation and Rainfall Frequency Data for Puerto Rico and Virgin -Islands*. Technical Paper No. 42. U.S. Department of Commerce. Washington, D.C..

P.R. Planning Board, 1992. *Reglamento sobre Zonas Susceptibles a Inundaciones*. Reglamento de Planificación Número 13. Estado Libre Asociado de Puerto Rico, Oficina del Gobernador.

Soil Conservation Service, 1978. *Soil Survey of San Juan Area of Puerto Rico*. U.S. Department of Agriculture.

U.S. Army Corps of Engineers, 1990. *Flood Hydrograph Package (HEC-1), User's Manual*. Hydrologic Engineering Center. Davis, California.

FIGURES

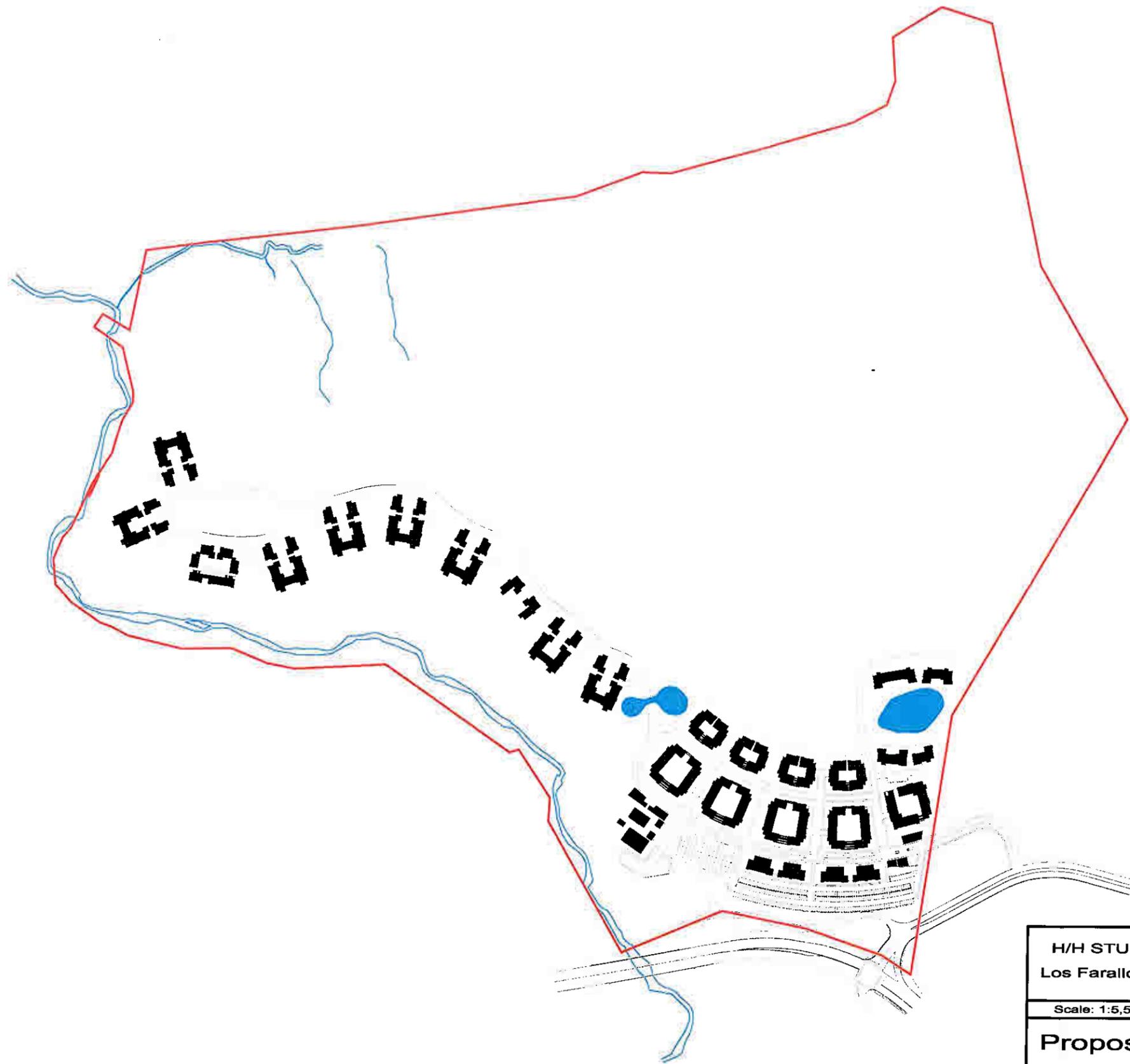


H/H STUDY
 Los Farallones
 Scale: 1:20,000

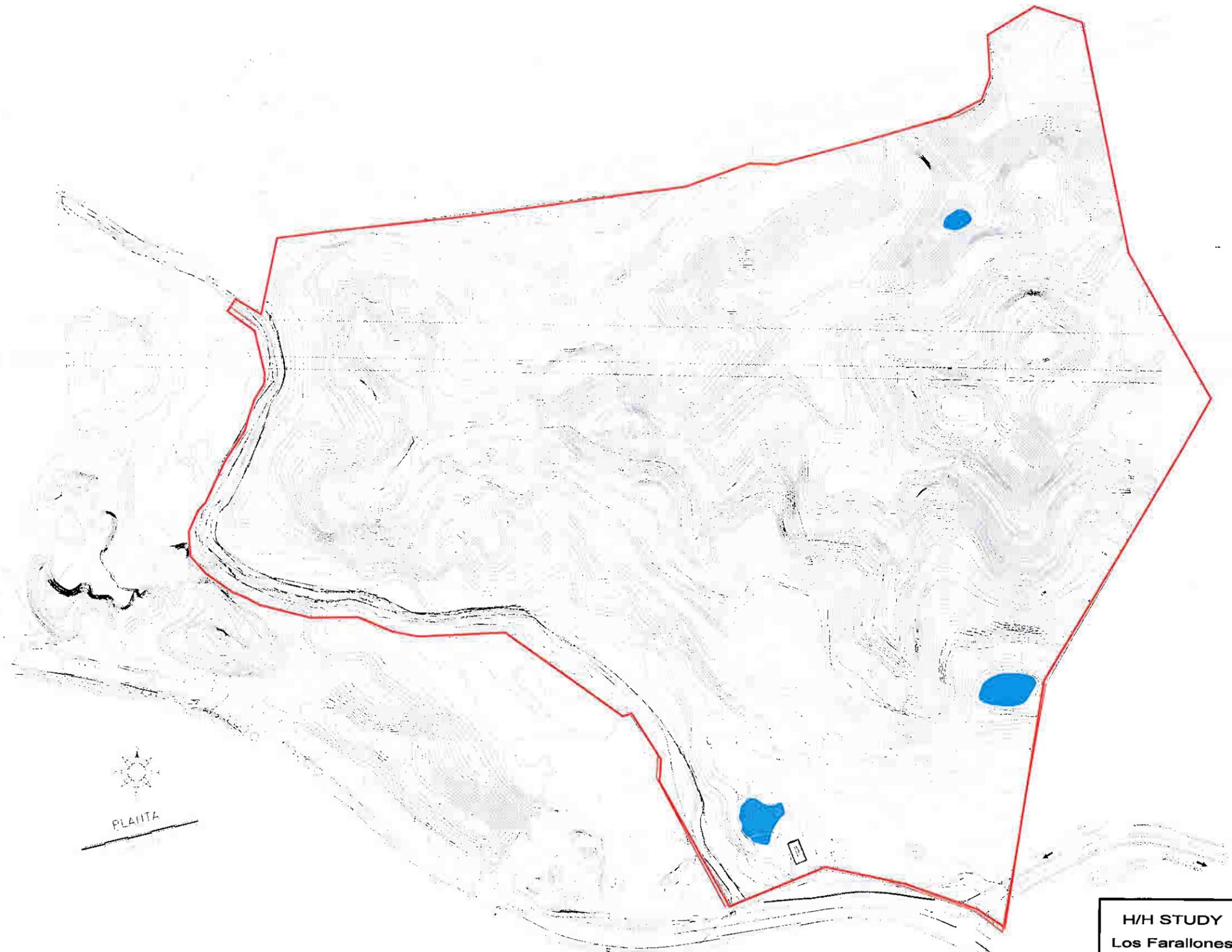


Location Map

Fig.1

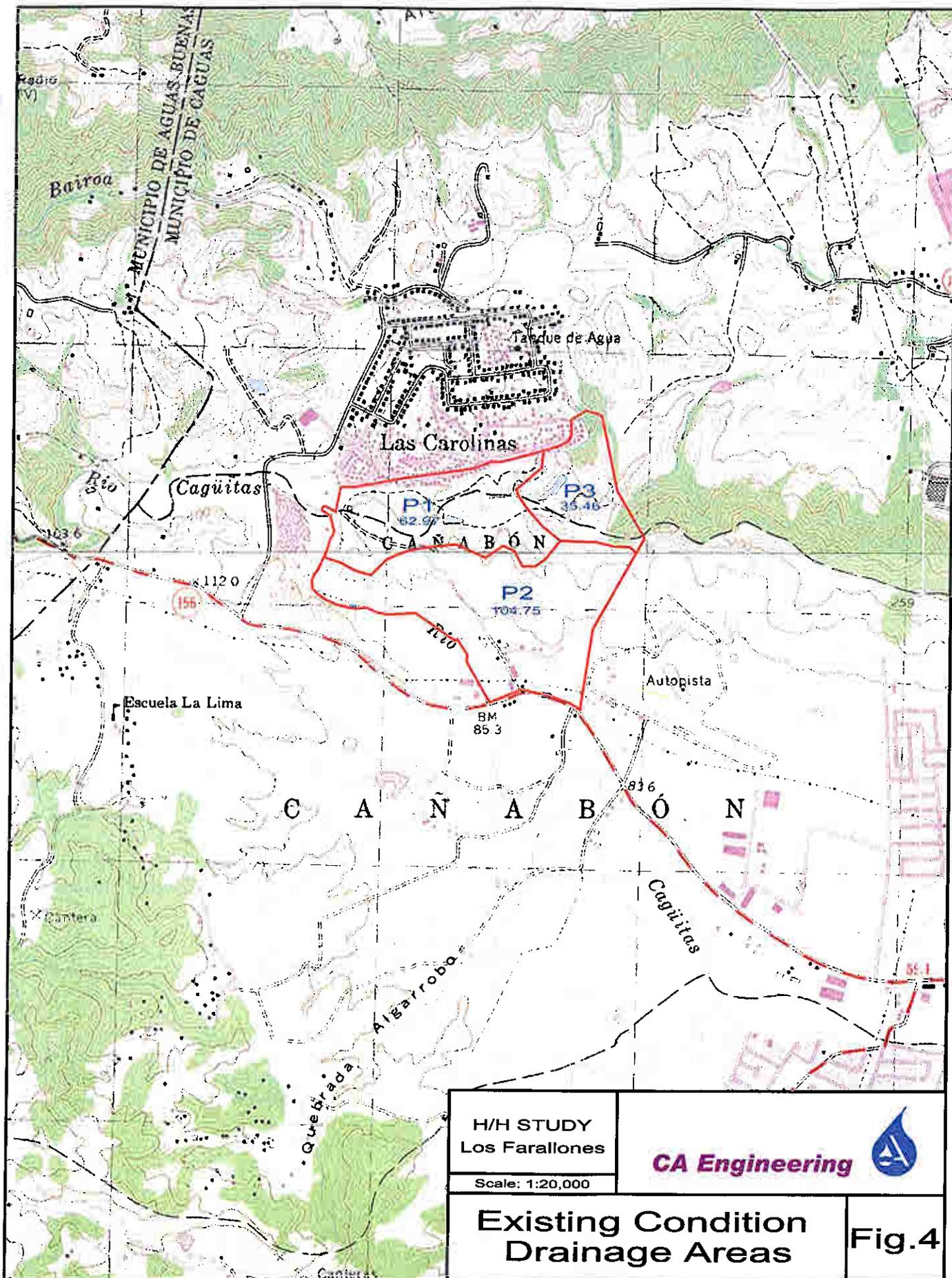


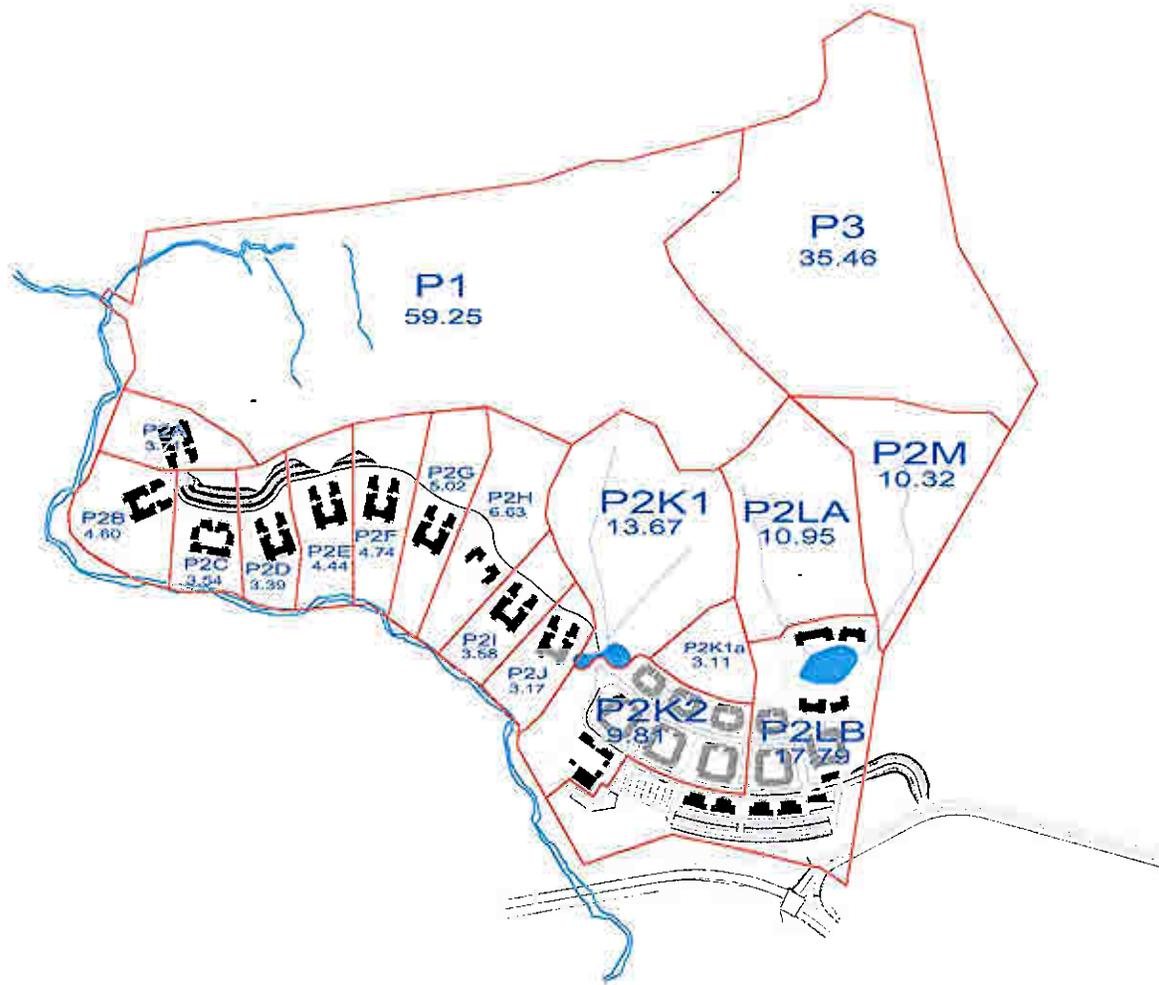
H/H STUDY Los Farallones	CA Engineering 
Scale: 1:5,500	
Proposed Development Layout	Fig.2



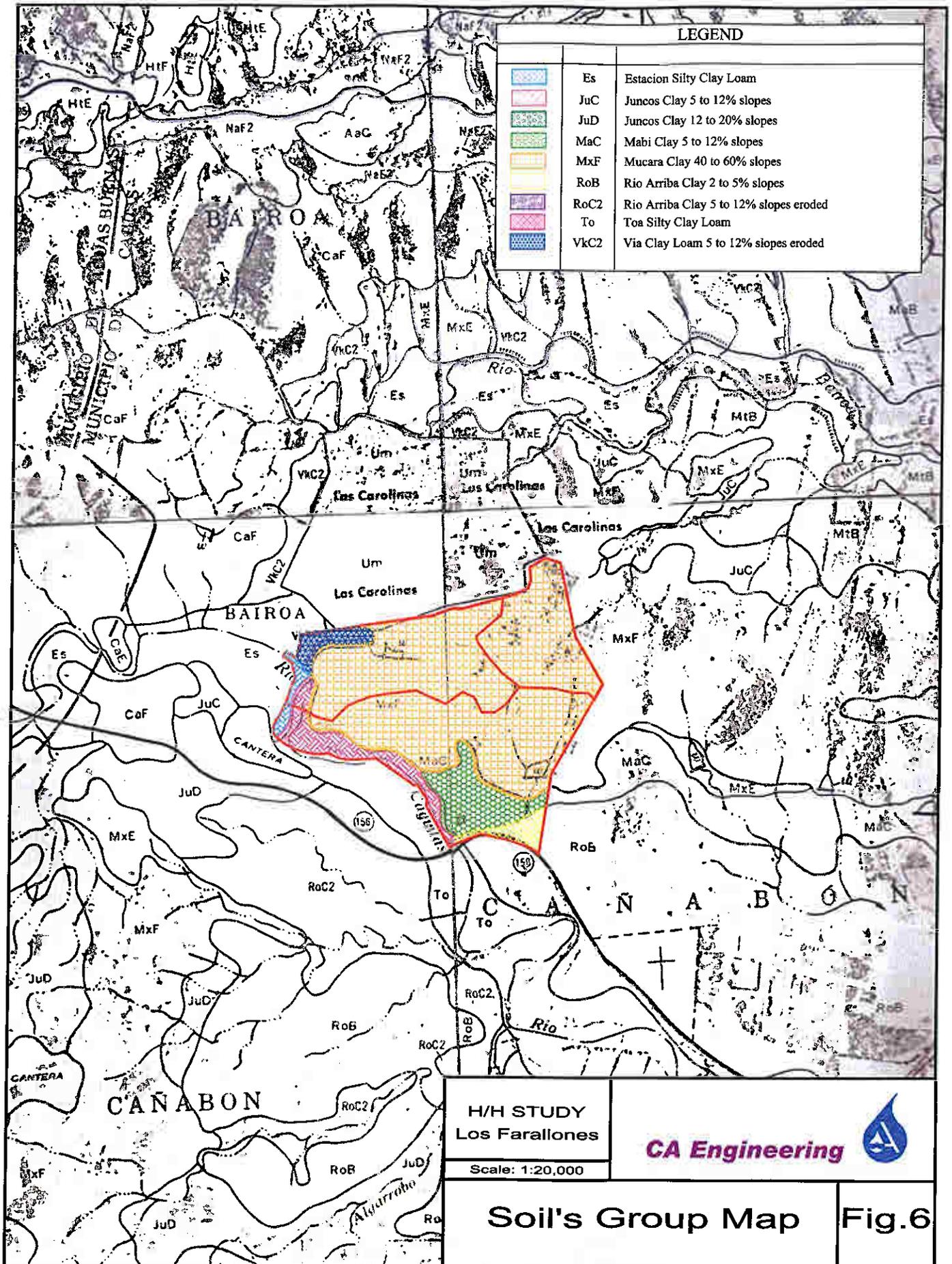
PLANTA

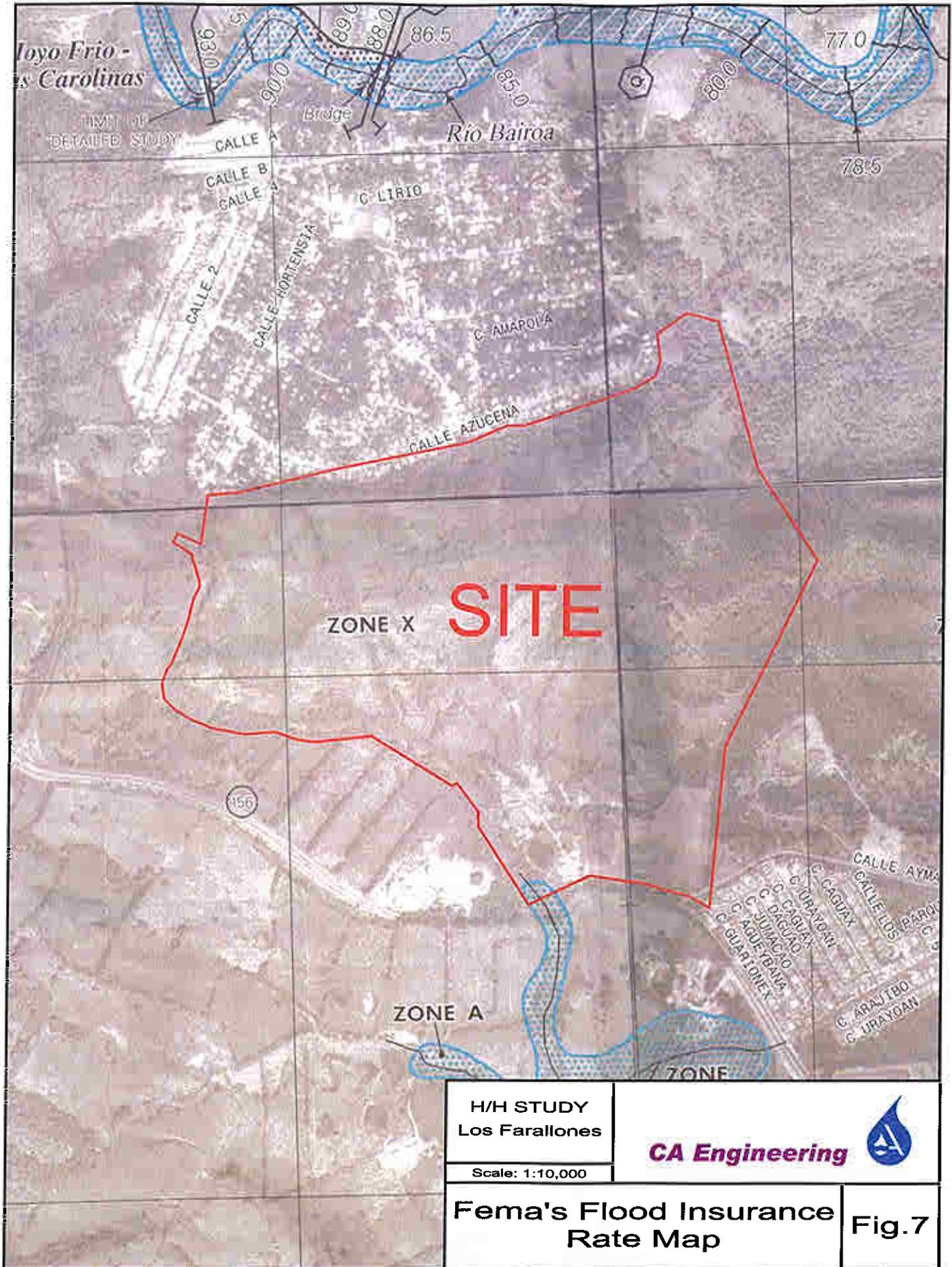
H/H STUDY Los Farallones	CA Engineering 
Scale: 1:3,500	
Existing Topography of the Site	Fig.3





<p>H/H STUDY Los Farallones</p>	<p>CA Engineering </p>
<p>Scale: 1:10,000</p>	
<p>Proposed Condition Drainage Areas</p>	<p>Fig.5</p>





H/H STUDY
Los Farallones

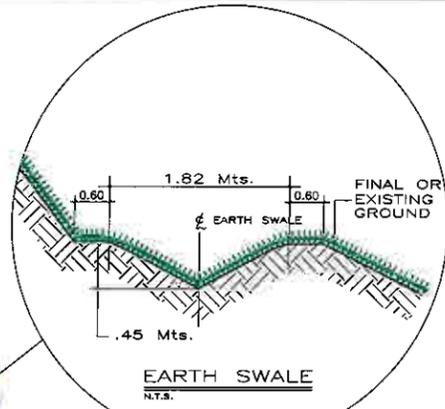
CA Engineering 

Scale: 1:10,000

**Fema's Flood Insurance
Rate Map**

Fig.7

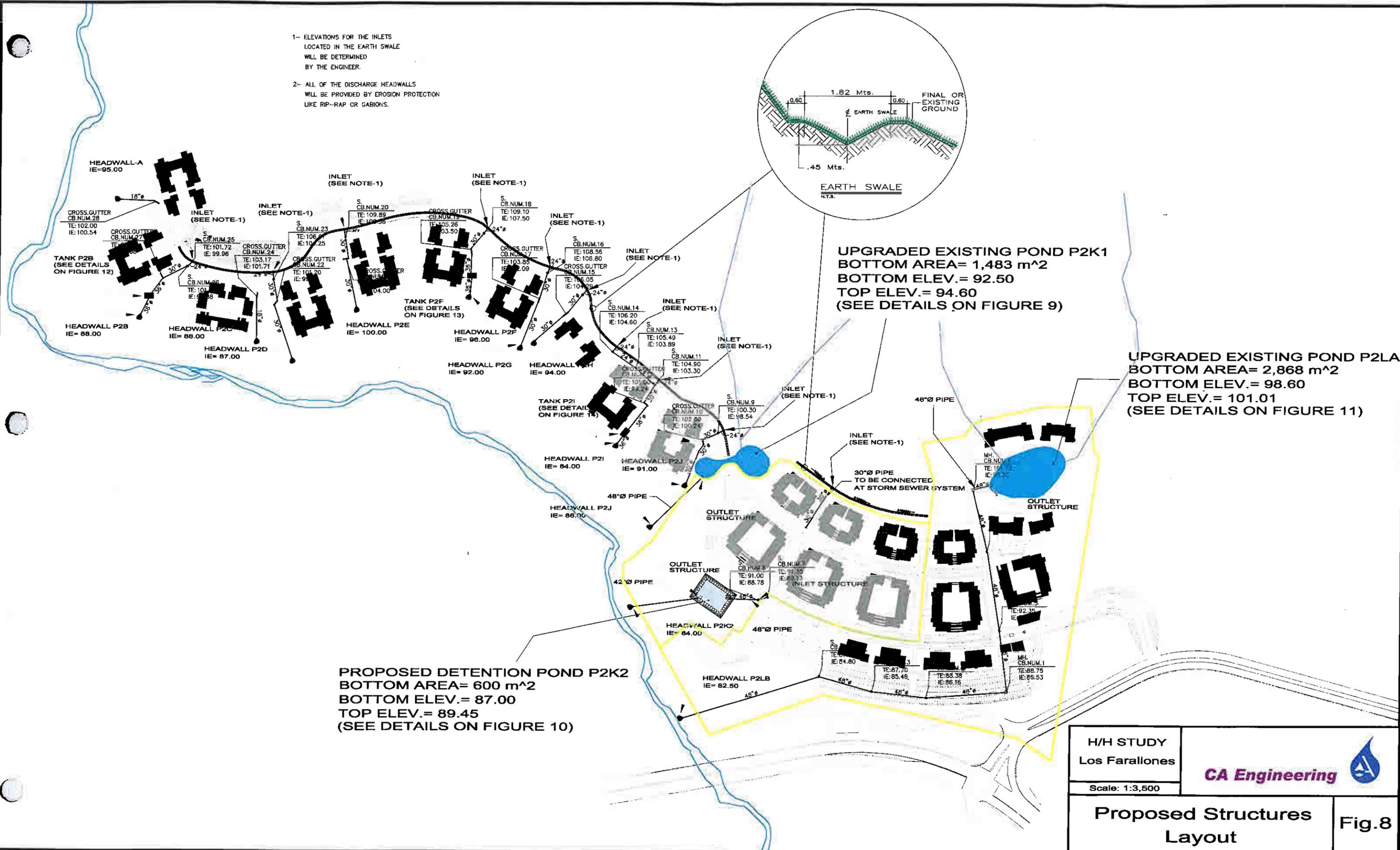
- 1- ELEVATIONS FOR THE INLETS LOCATED IN THE EARTH SWALE WILL BE DETERMINED BY THE ENGINEER.
- 2- ALL OF THE DISCHARGE HEADWALLS WILL BE PROVIDED BY EROSION PROTECTION LIKE RIP-RAP OR GABIONS.



UPGRADED EXISTING POND P2K1
 BOTTOM AREA= 1,483 m²
 BOTTOM ELEV.= 92.50
 TOP ELEV.= 94.60
 (SEE DETAILS ON FIGURE 9)

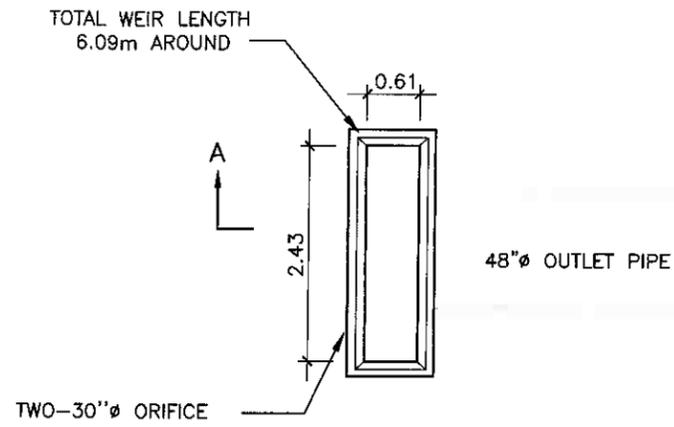
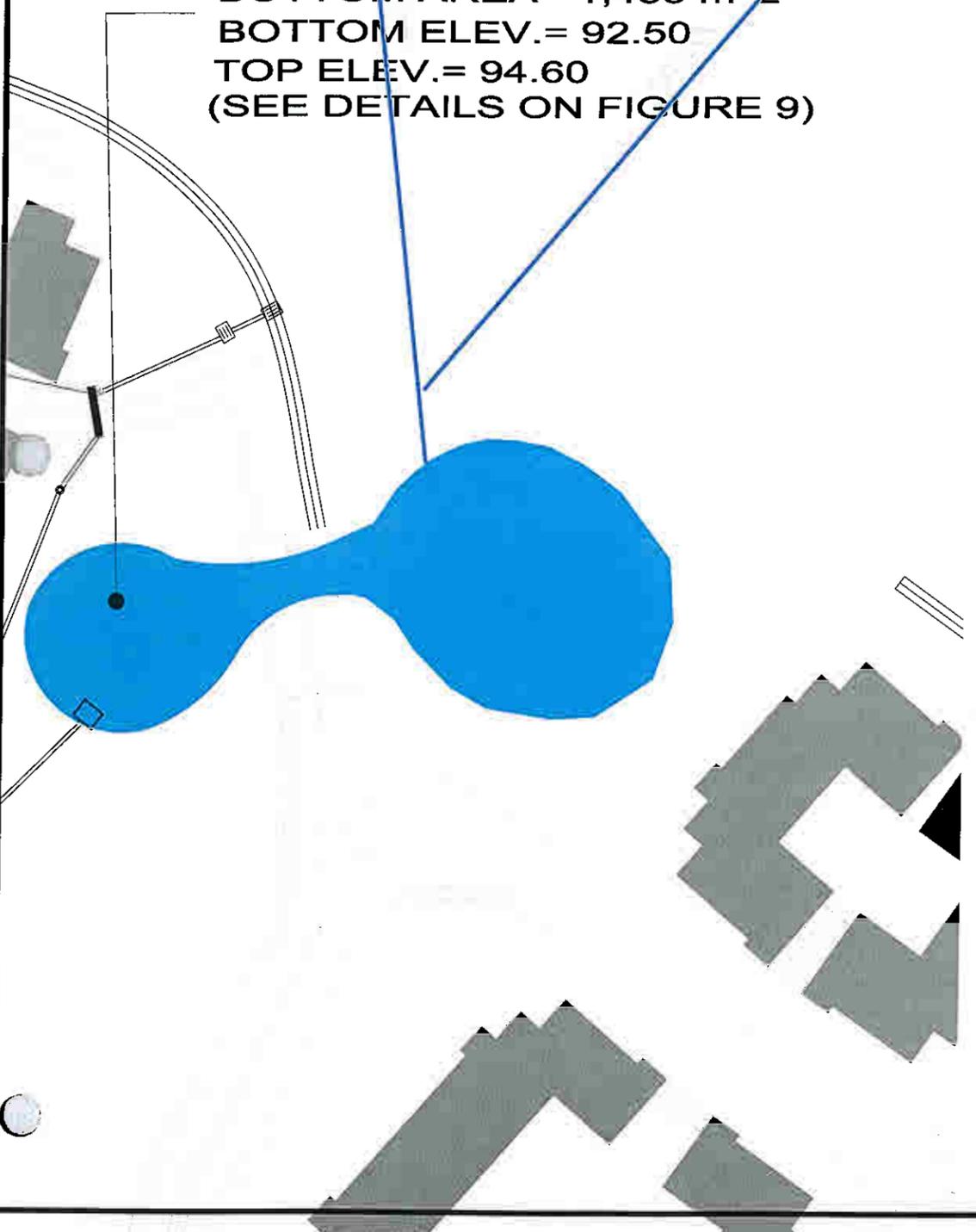
UPGRADED EXISTING POND P2LA
 BOTTOM AREA= 2,868 m²
 BOTTOM ELEV.= 98.60
 TOP ELEV.= 101.01
 (SEE DETAILS ON FIGURE 11)

PROPOSED DETENTION POND P2K2
 BOTTOM AREA= 600 m²
 BOTTOM ELEV.= 87.00
 TOP ELEV.= 89.45
 (SEE DETAILS ON FIGURE 10)

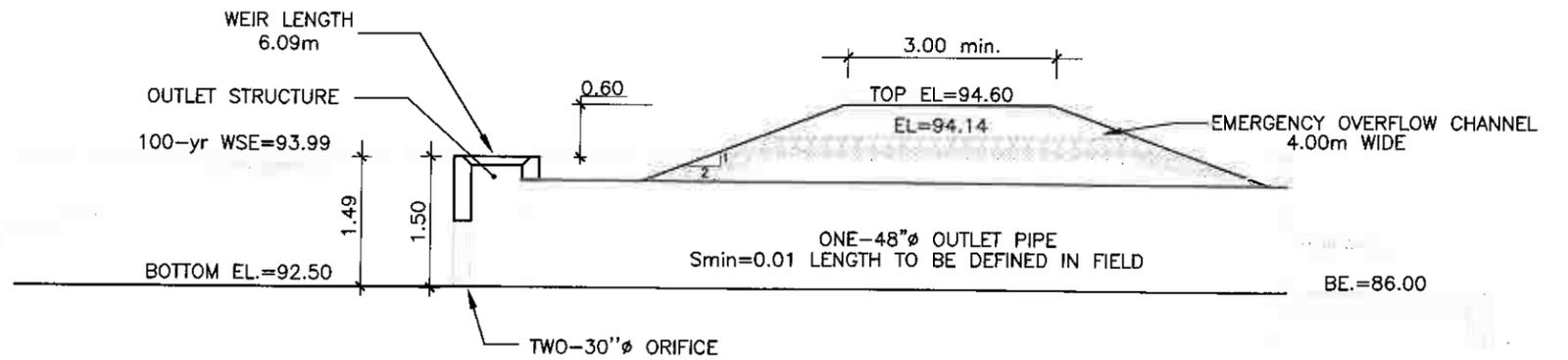


H/H STUDY Los Farallones	
Scale: 1:3,500	
Proposed Structures Layout	
Fig.8	

UPGRADED EXISTING POND P2K1
 BOTTOM AREA= 1,483 m²
 BOTTOM ELEV.= 92.50
 TOP ELEV.= 94.60
 (SEE DETAILS ON FIGURE 9)



PLAN VIEW
 NTS

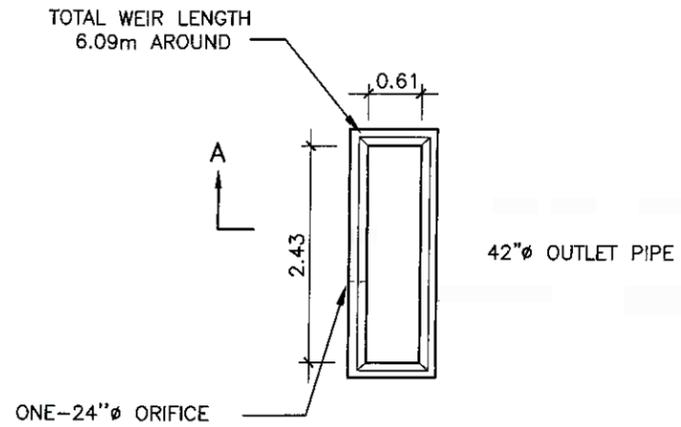
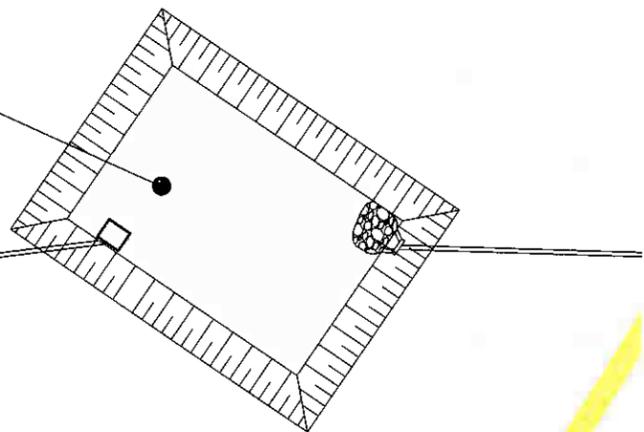


SECTION A-A
 NTS

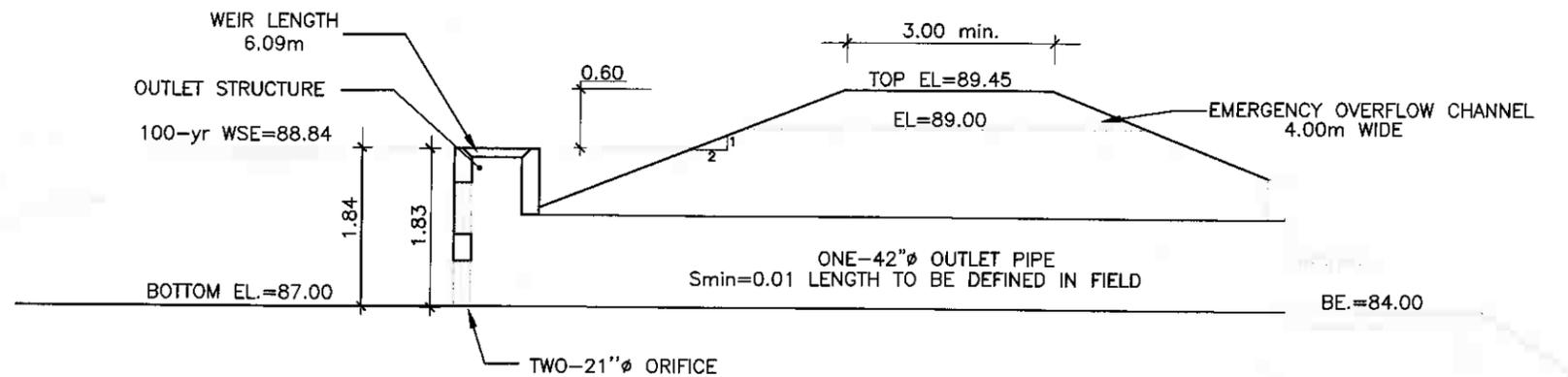
OUTLET STRUCTURE

H/H STUDY Los Farallones	
Scale: NTS	
Detention Pond Schematics For Pond P2K1	
Fig.9	

PROPOSED DETENTION POND P2
 BOTTOM AREA= 600 m²
 BOTTOM ELEV.= 87.00
 TOP ELEV.= 89.51
 (SEE DETAILS ON FIGURE 10)



PLAN VIEW
 NTS

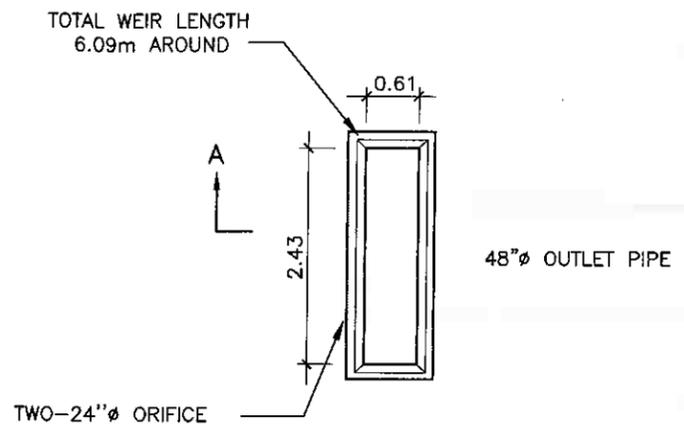
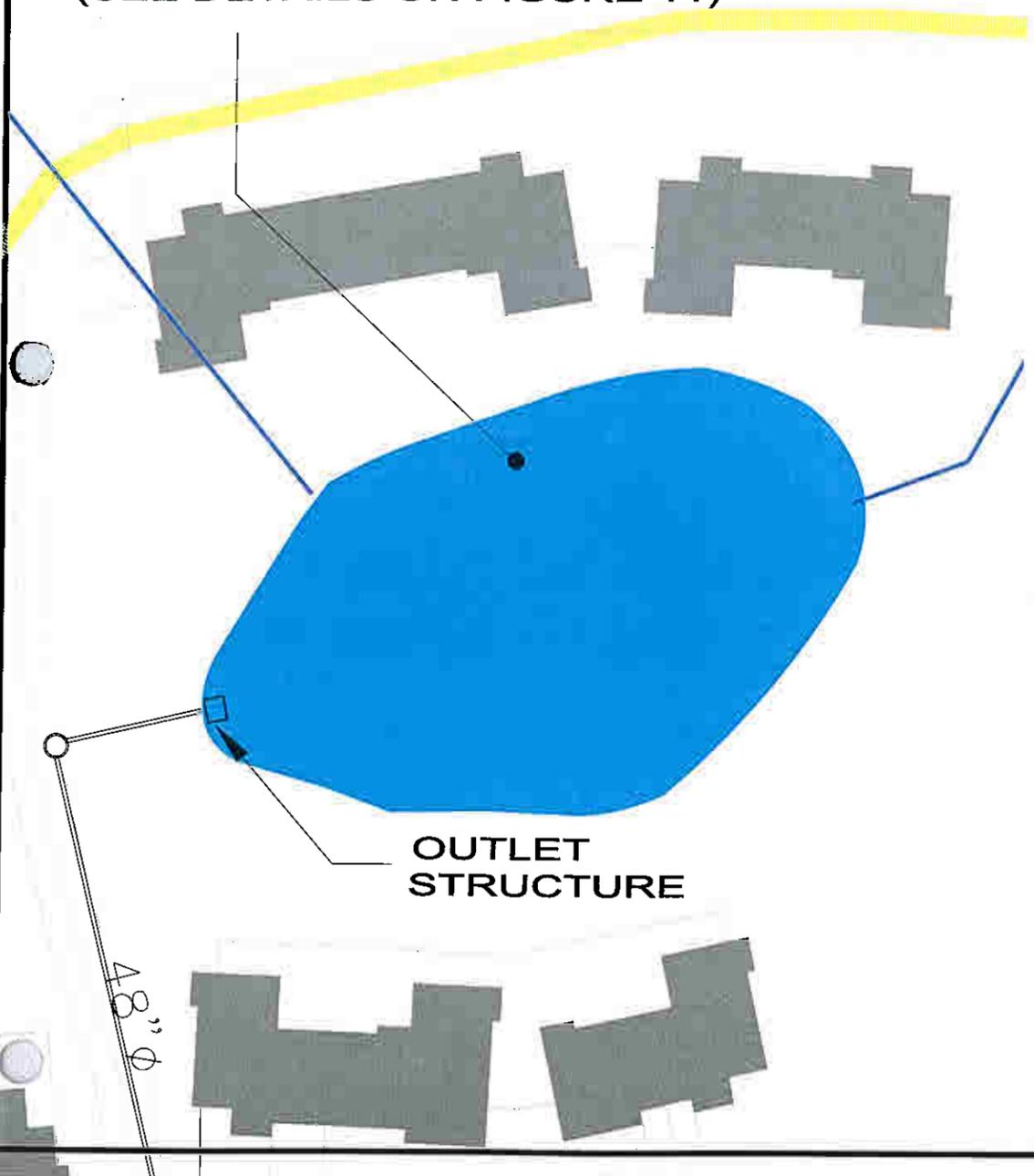


SECTION A-A
 NTS

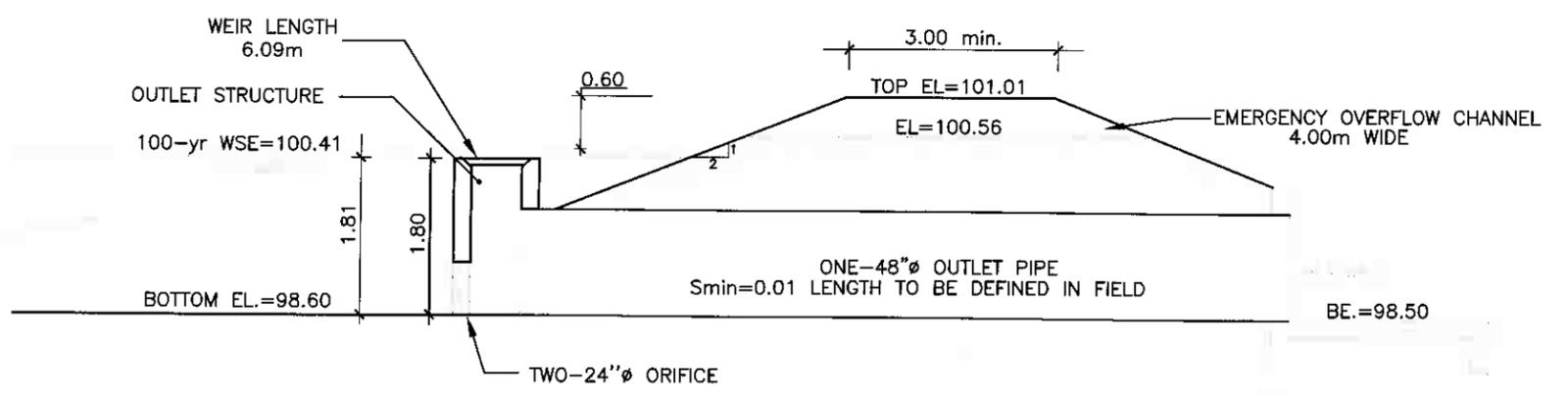
OUTLET STRUCTURE

H/H STUDY Los Farallones	
Scale: NTS	
Detention Pond Schematics For Pond P2K2	Fig.10

UPGRADED EXISTING POND P2LA
 BOTTOM AREA= 2,868 m²
 BOTTOM ELEV.= 98.60
 TOP ELEV.= 101.01
 (SEE DETAILS ON FIGURE 11)



PLAN VIEW
 NTS



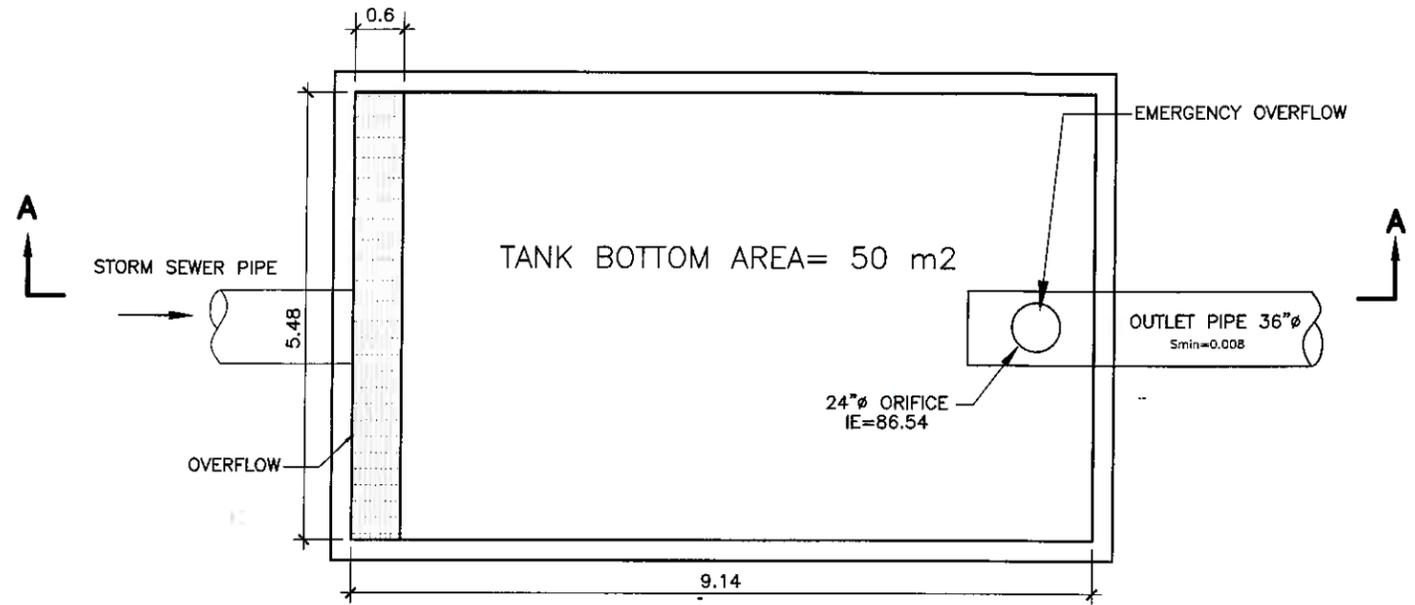
SECTION A-A
 NTS

OUTLET STRUCTURE

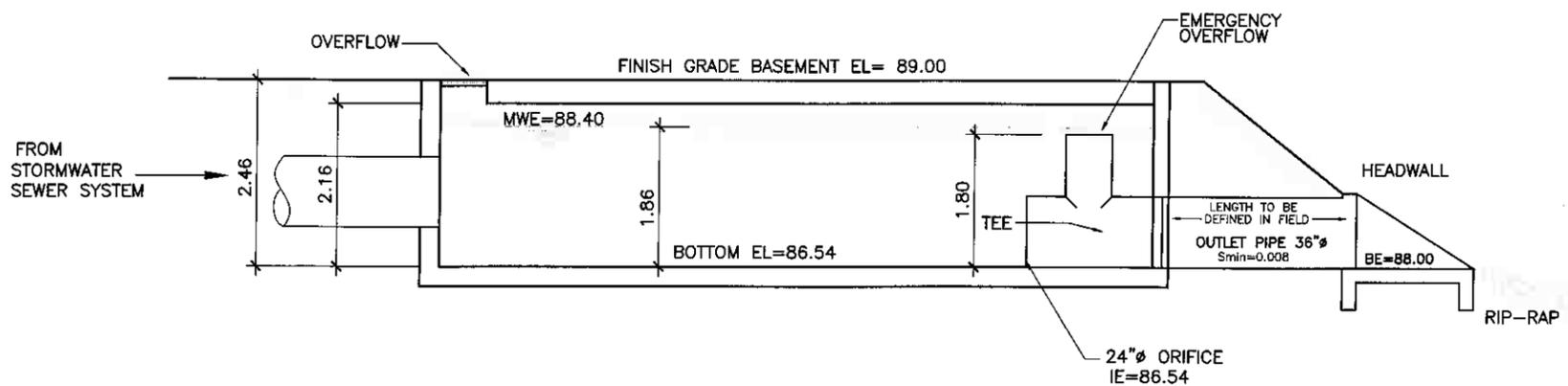
H/H STUDY Los Farallones	 CA Engineering
Scale: NTS	
Detention Pond Schematics For Pond P2LA	
Fig.11	

TANK P2B
(SEE DETAILS
ON THIS SHEET)

HEADWALL P2B
IE= 88.00

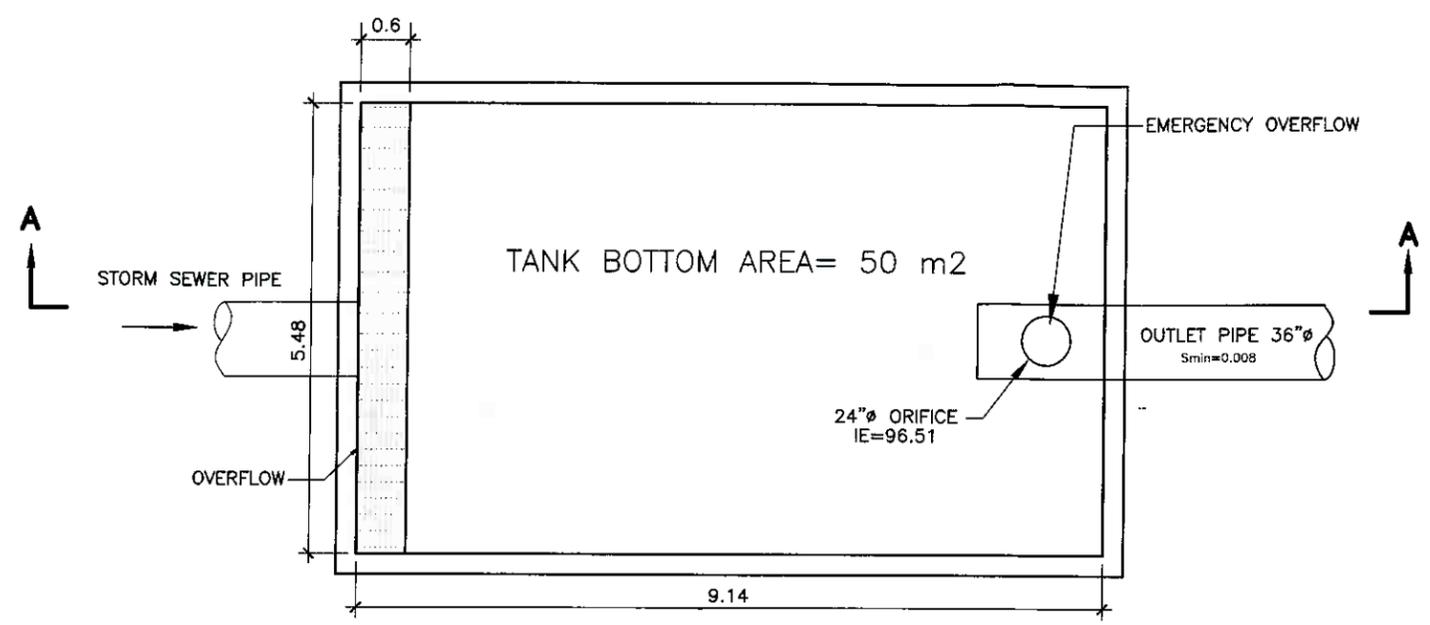
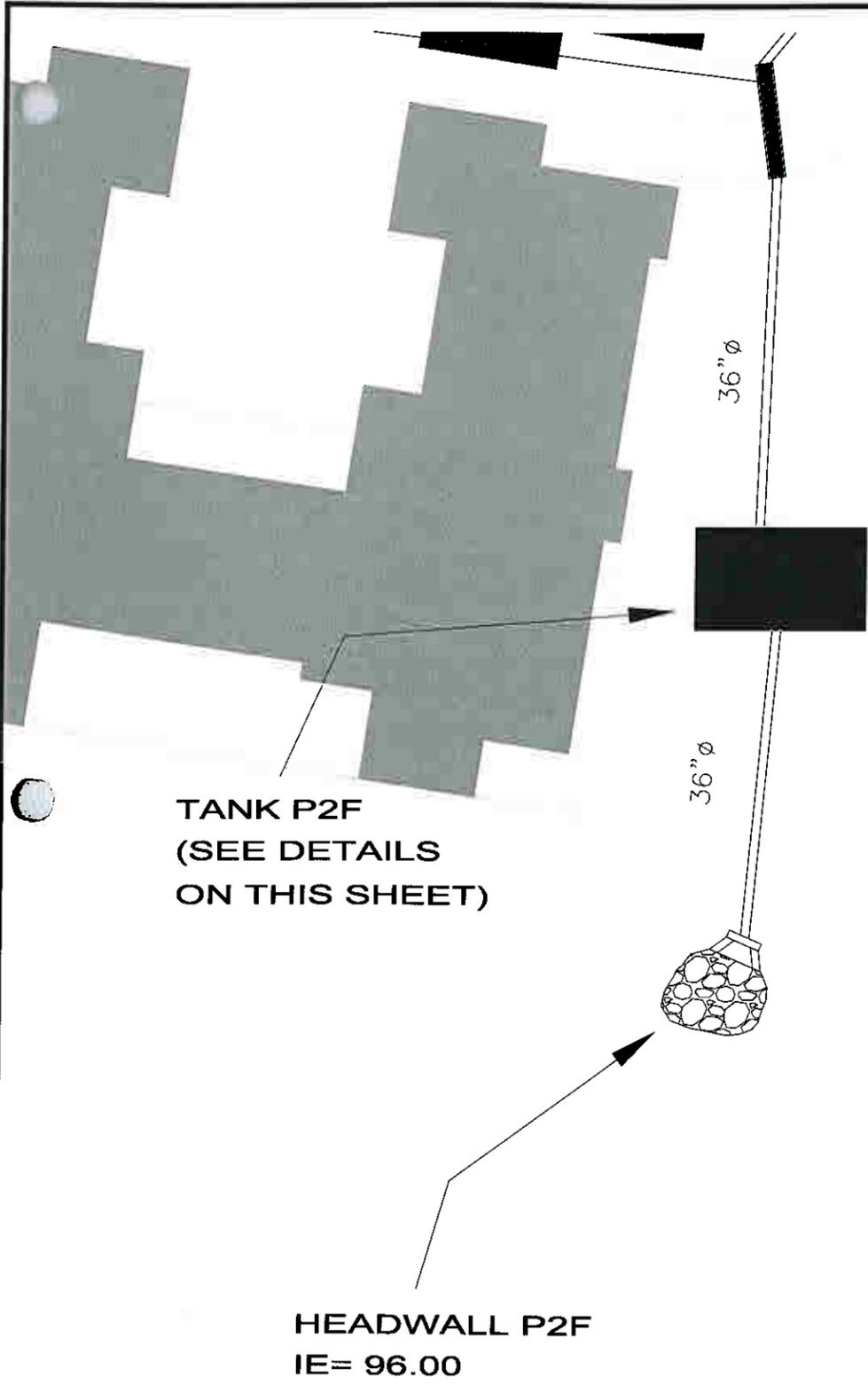


MITIGATION
TANK
PLAN VIEW
NTS



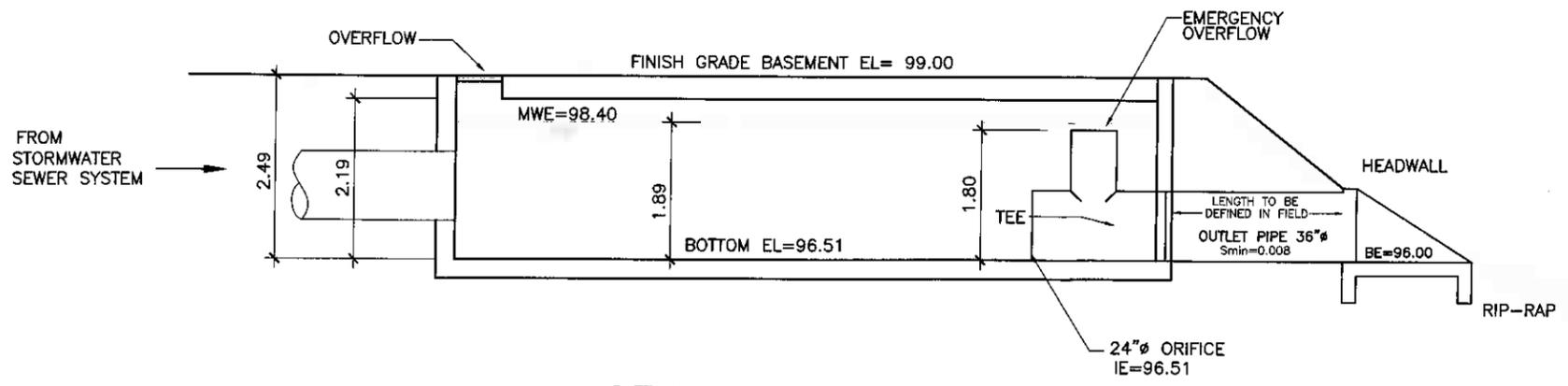
SECTION A-A
NTS

H/H STUDY Los Farallones	 CA Engineering
Scale: NTS	
Detention Tank Schematics For Tank P2B	
Fig. 12	



MITIGATION
TANK

PLAN VIEW
NTS

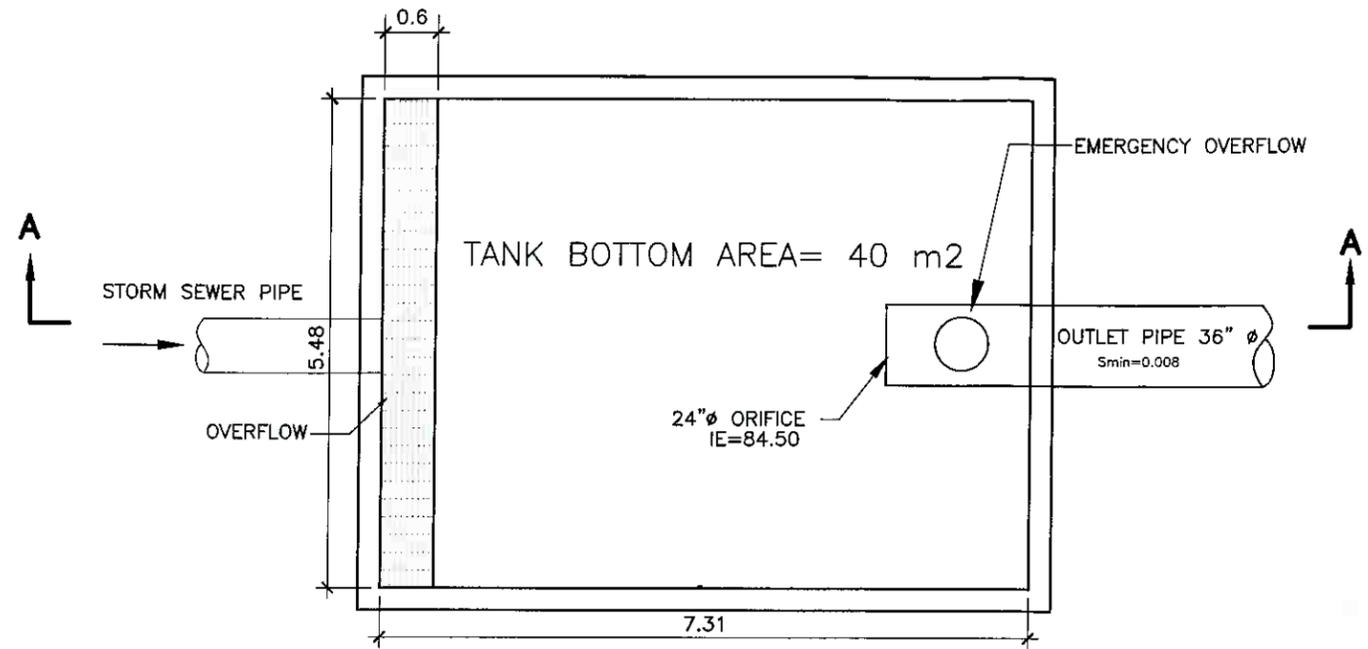


SECTION A-A
NTS

H/H STUDY Los Farallones	 CA Engineering
Scale: NTS	
Detention Tank Schematics For Tank P2F	
Fig. 13	

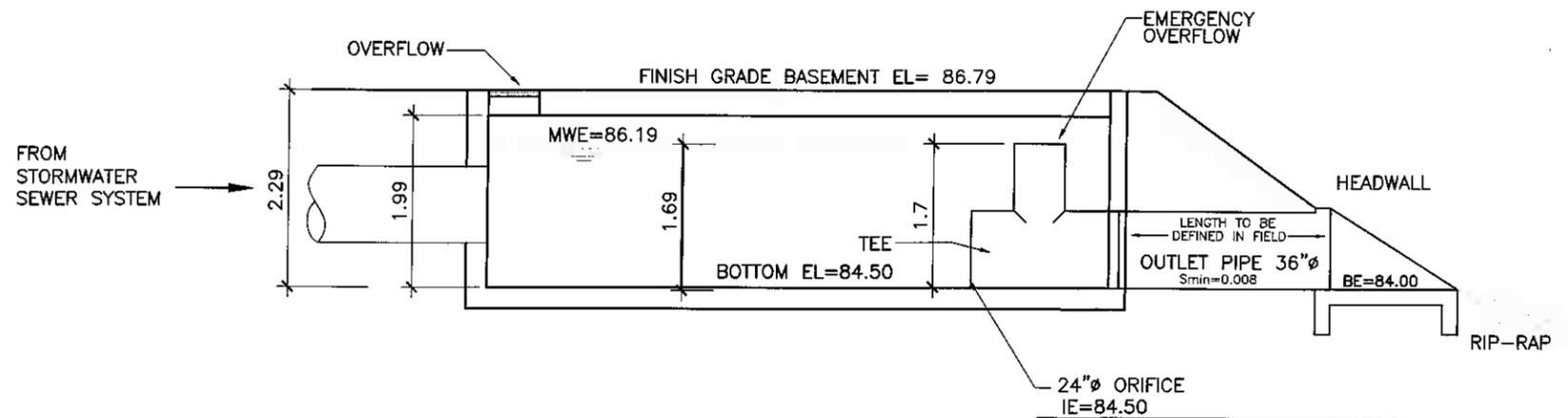
TANK P21
(SEE DETAILS
ON THIS SHEET)

HEADWALL P21
IE= 84.00



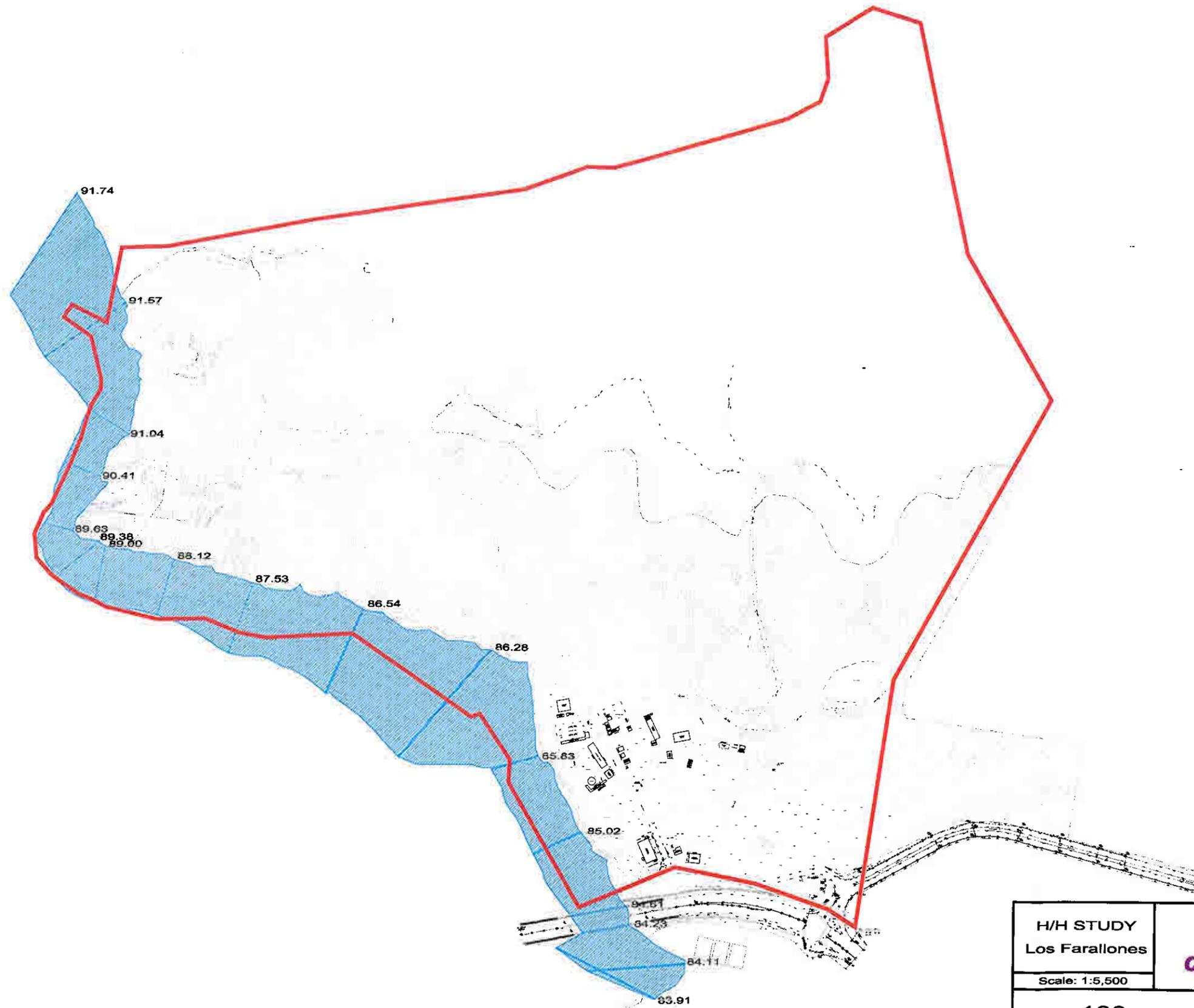
MITIGATION
TANK

PLAN VIEW
NTS



SECTION A-A
NTS

H/H STUDY Los Farallones	 CA Engineering
Scale: NTS	
Detention Tank Schematics	
For Tank P21	
Fig.14	



H/H STUDY Los Farallones Scale: 1:5,500	CA Engineering 
100 years Flood Footprint	Fig. 16

TERRAMAR DEVELOPMENT GROUP
SAN JUAN, PUERTO RICO

HYDROLOGIC ASPECTS OF
LOS FARALLONES
CAGUAS, PUERTO RICO



August, 2006

CA Engineering



PO BOX 190332, San Juan, PR 00919-0332
Phone: (787) 748-6106 Fax: (787) 780-0409

Website: <http://www.ca-eng.com>
E-mail: ancaltec@caribe.net

TERRAMAR DEVELOPMENT GROUP
LOS FARALLONES SITE HYDROLOGY

I. INTRODUCTION

Terramar Development Group is planning to develop a residential-commercial complex project named “Los Farallones” in 202-cuerdas located in the Autonomous Municipality of Caguas. The project will consist of 936 apartments, 80,000 square foot commercial area, and recreation and ancillary facilities pertaining to this type of project.

Three issues related to the hydrology of the site planned for development are of focus of this report: water bodies, storm watercourses, and floodability of the area. This report, along with general hydrologic information related to the site will provide a point of reference to assess and minimize the impacts on the hydrology from the construction of the project.

1.1 Location

The site is located to the north of state road PR-156, at Km. 56.0, Cañabón Ward, in the Autonomous Municipality of Caguas. It is bordered by Comunidad Las Carolinas on the north, state road PR-156 on the south, the property of Jose W. Cartagena and Blanca Longo on the east, and Puerto Rico Aqueduct and Sewer Authority, El Amal, Notre Dame and Better Roads Asphalt on the west. See Figure 1.

1.2 Project

Los Farallones project plans to be a residential-commercial complex consisting on 936 multifamily residential units distributed in buildings, with 80,000 square feet commercial space. The project will occupy approximately 73 cuerdas or 36% of the 202 cuerdas. The remaining land will be left in natural state for conservation. A preliminary layout of the project is shown in Figure 2.

1.3 Site Topography

The project area has an irregular topography. Part of the portion of the project area located east of Río Cagüitas slopes to the south between elevation 175 and 85 meters; the other part slopes to the north. The area west of Río Cagüitas slopes to the east. Several storm watercourses are evident as a result of the uneven surface topography.

II. HYDROLOGY

2.1 General

The project area belongs to two drainage basins:

- the northeastern portion (P1), which is relatively small, drains to Río Bairoa basin
- the rest (P2) to Río Cagüitas. Río Bairoa runs about 700 meters north of the project site, while Río Cagüitas crosses the project site.

The development will affect part of Area P2B; thus impacting several storm watercourses draining runoff to Río Cagüitas. Ecological value will be preserved on undeveloped Areas P1 and partial Area P2B. The area to the west of Río Cagüitas (P2C), which has a steep topography, will be left in natural state. See Figure 4.

2.1.1 Rainfall

There are no rain gages at the area of the project. Precipitation data from NOAA's Station Gurabo SSW, located at Latitude 18°16' and Longitude 66°00' in Gurabo Puerto Rico is included for reference. The monthly precipitation data during the period of 2001 to 2003 show its lowest in March 2001 with 0.95 inches; and its highest in November 2003 with as much as 17.76 inches. The average annual precipitation is 54.7, 57.09 and 79.97 inches, for 2001, 2002 and 2003, respectively. See Appendix A for data from NOAA.

The portion of the isohyetal map for Puerto Rico covering this watershed is shown in Figure 5 (Black & Veatch, 1970). Based on the isohyetal map the mean annual rainfall in the area of the project is about 70 inches/year.

Rainfall depths as a function of rainfall duration and frequency of occurrence were obtained from the Technical Paper No. 42 (TP-42) [National Weather Service]. The rainfall events of 2 through 100-years frequency for different durations for the area of the project are shown in Table 1.

Table 1
Rainfall Depths (Inches)

Duration (hours)	Frequency				
	<i>2-year</i>	<i>10-year</i>	<i>25-year</i>	<i>50-year</i>	<i>100-year</i>
1	2.20	3.28	3.76	4.20	4.60
2	2.70	4.25	4.75	5.25	6.0
3	2.95	4.70	5.30	6.10	6.50
6	3.80	5.75	6.60	7.50	8.25
12	4.40	6.75	8.10	9.10	10.10
24	4.90	7.90	9.50	10.80	12.10

2.1.2 Runoff

The project property shares two drainage basins: Río Bairoa and Río Cagüitas, both are tributaries to Rio Grande de Loiza. The USGS has a streamflow gage in the Rio Cagüitas near Caguas (gage 50055170). This gage is located on Latitude 18°13'59", Longitude 66°02'53", 0.9 miles southwest from Plaza de Caguas, 0.6 miles northeast from Escuela Bunker, and 1.2 miles northwest from Escuela Antonio S. Pedreira. See Figures 6. Mean annual runoff at this gage averages 10,450 acre-ft/year, equivalent to an average of 23.71 inches of annual rainfall between 1992-1996. According to the USGS Water Resources Data Puerto Rico and the Virgin Islands annual reports, the drainage area of this gage is 8.27 square miles.

2.1.3 Soils

The classification of the soil of the site is included in the Soil Survey of the San Juan Area of Puerto Rico. This study was made for the Soil Conservation Service in cooperation with the University of Puerto Rico in 1972. According to this study, the soils found in the site were identified as Estacion Clay, Juncos Clay, Mabi Clay, Mucara Clay, Rio Arriba Clay, Toa Clay and Via Clay loam. The most predominant type found was Mucara Clay with over 60 percent of the total area. A more detailed classification is shown in Table 2. Figure 7 shows the site in a partial copy of the map of the Soil Survey of San Juan Area of Puerto Rico.

Table 2: Soils Classification of the Site

Name	Description	Area	%
Es	Estacion Silty Clay Loam	17.83	6.98
JuC	Juncos Clay 5 to 12% slopes	11.75	4.61
JuD	Juncos Clay 12 to 20% slopes	5.12	2
MaC	Mabi clay 5 to 12% slopes	19.3	7.56
MxF	Mucara Clay 40 to 60% slopes	153.87	60.3
RoB	Rio Arriba Clay 2 to 5% slopes	5.25	2.05
RoC2	Rio Arriba Clay 5 to 12% slopes eroded	5.66	2.22
To	Toa Silty Clay Loam	30.38	11.9
VkC2	Via Clay Loam 5 to 12% slopes eroded	6.05	2.37

2.2 Rio Cagüitas

Río Cagüitas runs along the southern boundary of the portion of the site to be developed. Most of the runoff from the project site drains to this river. The nascent of Rio Cagüitas is at approximately 2,600 meters to the northwest of the project site. It runs from northwest to southeast crossing the property site. And it is water body with an approximate drainage area of 4,263 acres as seen in Figure 8. The project will not affect this water body except for some

discharge headwalls. The U.S. Army Corps of Engineers will be consulted as per its jurisdiction. A Nationwide Permit may be necessary.

2.2.1 Annual Runoff

Mean annual precipitation is about 70 inches/year as shown on Figure 5. The relation runoff to precipitation at this area was set at 0.65 as corresponding to the area's curve number of 75. Therefore, the amount of surface runoff produced by the drainage area on an annual basis will be 17.69 MGD. Mean discharge was estimated for the purpose of showing the magnitude of the watercourse. The relationship used was developed by the USACOE and is expressed by the following formula:

$$Q_a = 0.73 * A^{0.760} * S^{-0.250} * (\text{Index} - 75)^{1.07}$$

where: A = Watershed area, mi²
 S = Main channel slope, m/m
 Index = Climatic index
 Q_a = Mean annual discharge, cfs.

Climate index taken from the climate index map for PR is 100. Therefore, mean discharge using this formula yields 40.11 cfs.

See Appendix B for computations.

2.2.2 Water Quality

No water quality records were found for the site. Through the type of activities identified within the watershed, it is inferred that the water does not get contaminated to the point that it is useless for drinking water. The activities found in the watershed are mostly domestic. Organic contaminants can be expected from failing septic tanks. Traces of agricultural

chemical products may also exist. But outside of them, no significant polluting industrial activity is found.

Solids are captured naturally as the water contacts the soil. In any natural system, the rainfall runoff migrating to the ocean picks up dissolved solids (DS), and suspended solids (SS). Since rainfall is the product of the condensation of evaporated water, when it reaches the earth's crust, it is essentially distilled water, with no solids. Distilled water is chemically active. This property plus the erosive forces generated by the water movement are responsible for solids capture. A certain amount of dissolved solids is necessary for buffering the chemical capacity of the rainfall water. As runoff builds up, dissolved solids in water also builds up. This way the corrosive nature of fresh runoff water is stabilized.

2.3 Storm Water Courses

Local storm watercourses at the project site run in two directions: a few to the north to Río Bairoa; and most to the south and southeast to Río Cagüitas. The storm watercourses in the Bairoa drainage basin exit the project site at three points, all located at the east boundary of the site. Most of the storm watercourses are dry or intermittent; but some of them will probably fall within the jurisdiction of the USACOE. A jurisdictional determination (JD) is being performed on this purpose. The minimum length of these watercourses is 150 meters and the maximum 500 meters. Most of them are characterized by having a steep slope. Each of these storm watercourses gathers runoff from small upstream offsite areas. See Figure 9.

2.4 Water Bodies

Río Cagüitas is the main water body related to the project site, most of the project site drains to this watercourse. The project will not intend to affect this water body. Some water bodies are in the process of being identified within the limits of the project site as per their jurisdiction of the USACOE. Three man made ponds are located to the east of the site. One is located in the area that drains to Río Bairoa, and the others in the watershed of Río Cagüitas.

2.5 Flooding

The area of the project is not classified as floodable by the FEMA's Flood Insurance Rate Map as shown in Figure 10.

2.6 Ground Water

Ground water is a significant loss (abstraction) to precipitation. The amount of ground water depends on the permeability of the soil. The water that permeates the subsoil usually accumulates and forms a water table, which is the ground water piezometric line. The slope of the water table indicates the direction of the groundwater movement. Ground water surfaces the ground when the ground elevation intersects the water table. There are no records of water table at the site. During the site inspection water wells were not found..

III. POSSIBLE IMPACTS

The development of the areas indicated in Chapter 2 will change the surface characteristics of the natural topography and therefore will introduce changes in the local hydrology of the site. This will create changes in the overall hydrology of the receiving water bodies and ultimately in the hydrology of Rio Cagüitas.

Apart from the environmental significance of the waters related to the areas of development, these waters are mainly for domestic water supply. The control of quality and quantity of water at the project site is necessary due to the water use downstream, including the largest water supply reservoir in Puerto Rico.

3.1 The Area of Development in Relation to the Concerned Watersheds

Considering that the drainage area for Rio Cagüitas is 4,263 acres and the area of development is 82 acres, and considering a linear relation between the drainage area and discharge, only 1.92 percent of the waters that are being conveyed by Rio Cagüitas will be

impacted. Quality wise, and assuming that all runoff from the developed project site is fully loaded with organic and inorganic contaminants, with concentrations similar to that of industrial wastewater, dilution would reduce the impact to traceable levels that would not be harmful when used for human consumption.

3.2 Runoff Increase Mitigation

The development of the site will increase the peak discharge. The original pervious soil will be substituted by impervious roofs, walkways and streets resulting in an increment of the runoff-rainfall ratio, thus in the peak discharge. The effect of the increment of the peak discharge can produce adverse effects on the downstream. Regulation No. 3 of The Puerto Rico Planning Board calls for mitigation of this increment. Therefore, the development of the site will include runoff increment mitigation structures in conformance with said state regulation.

3.3 Sediment Transport

Two stages of erosion have been evaluated: Erosion during construction and erosion after the project construction activities are completed.

During construction, a great amount of material is loosened. This material is mainly composed of suspended and settleable solids. Any rainfall event has the potential to transport material downstream. To counteract this possibility, the project site must be provided with appropriate solids capture structures such as: Sedimentation ponds, hay pack barriers, etc. On the permitting aspect, a CES plan conforming the requirements of the Puerto Rico Environmental Quality Board will be prepared, as well as a Storm Pollution Prevention Plan conforming EPA's requirements. The solids control structures will have dimensions and hydraulic characteristics to provide a good solids-capture rate.

After the construction activities are completed, the topography of the site will be conformed in such a way that the whole site will have flat green areas, protected slopes, concrete roofs and paved streets. Thus, the potential of erosion will be diminished: The horizontal terrains

will produce low runoff velocities and no loose material will be exposed to the dynamic action of the running storm water.

BIBLIOGRAPHY

Roberto E. Gierbolini. 1979, *Soil Survey of San Juan Area Southern Puerto Rico*, United States Department of Agriculture, Soil Conservation Service.

U.S Geological Survey, *Water Resources Data Puerto Rico and the Virgin Islands*, 1989-1996.

Chow, Ven TE. *Open Channel Hydraulics*, McGraw Hill Comp., New York, 1959.

U.S. Army Corps of Engineers, *Computation of Mean Annual Discharge*, Jacksonville District. San Juan Area Office, P.R.

TABLE OF CONTENTS

I. INTRODUCTION	1
1.1 Location	1
1.2 Project	1
1.3 Site Topography	2
II. HYDROLOGY.....	2
2.1 General.....	2
2.1.1 Rainfall.....	2
2.1.2 Runoff	3
2.1.3 Soils.....	4
2.2 Rio Cagüitas.....	4
2.2.1 Annual Runoff	5
2.2.2 Water Quality.....	5
2.3 Storm Water Courses	6
2.4 Water Bodies.....	6
2.5 Flooding	7
2.6 Ground water	7
III. POSSIBLE IMPACTS.....	7
3.1 The Area of Development in Relation to the Concerned Watersheds	7
3.2 Runoff Increase Mitigation.....	8
3.3 Sediment Transport.....	8
BIBLIOGRAPHY.....	10

LIST OF FIGURES

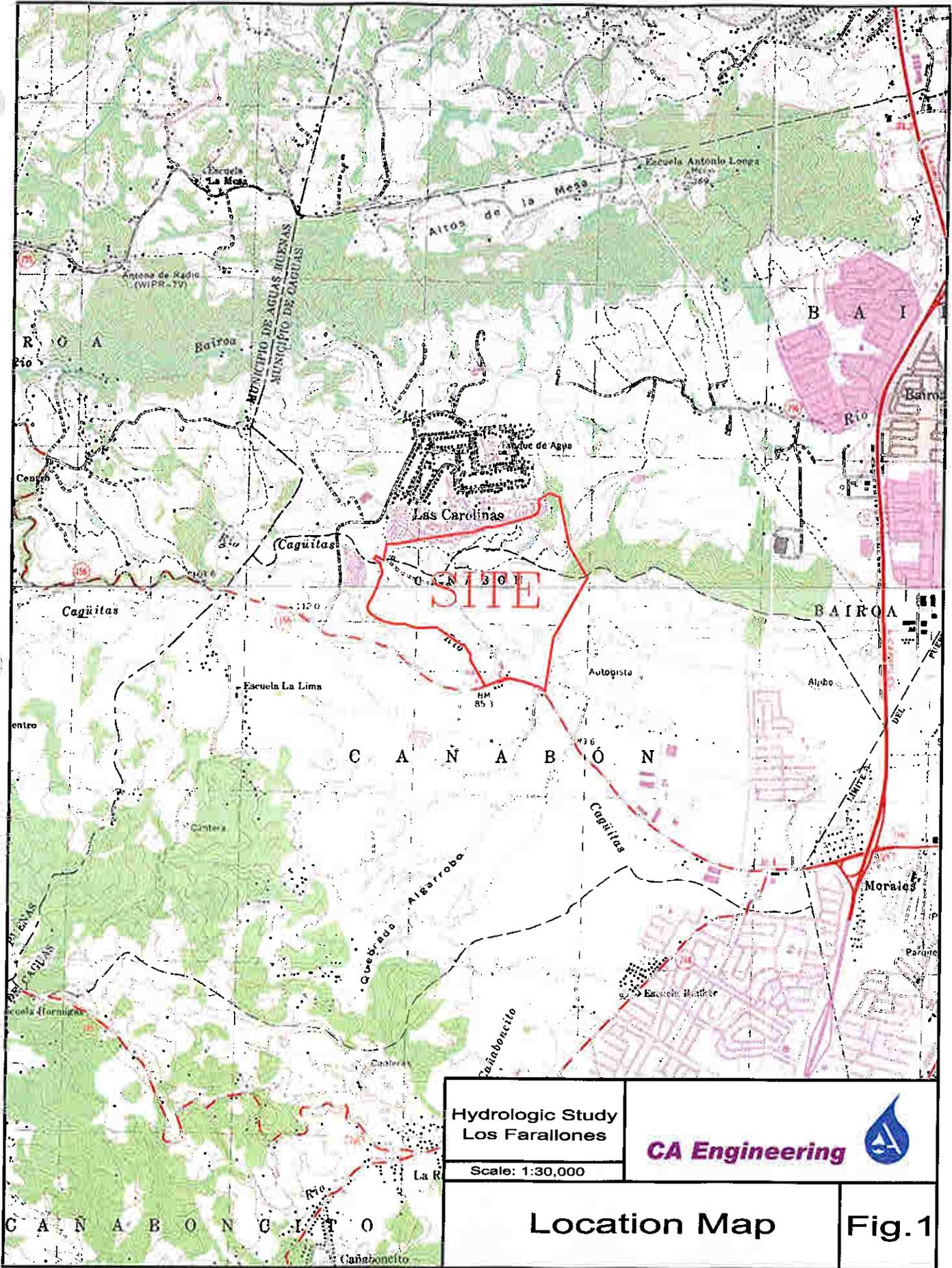
- FIGURE 1** Location
- FIGURE 2** Proposed Project
- FIGURE 3** Aerial Photograph
- FIGURE 4** Project Site Topography
- FIGURE 5** Isohyetal Map for Puerto Rico (Black & Veatch)
- FIGURE 6** USGS Stream Flow Gages Location
- FIGURE 7** Soils Map
- FIGURE 8** Drainage Areas
- FIGURE 9** Storm Water Courses
- FIGURE 10** Regulatory flood maps

LIST OF APPENDIXES

APPENDIX A NOAA's Precipitation data

APPENDIX B Computations

FIGURES

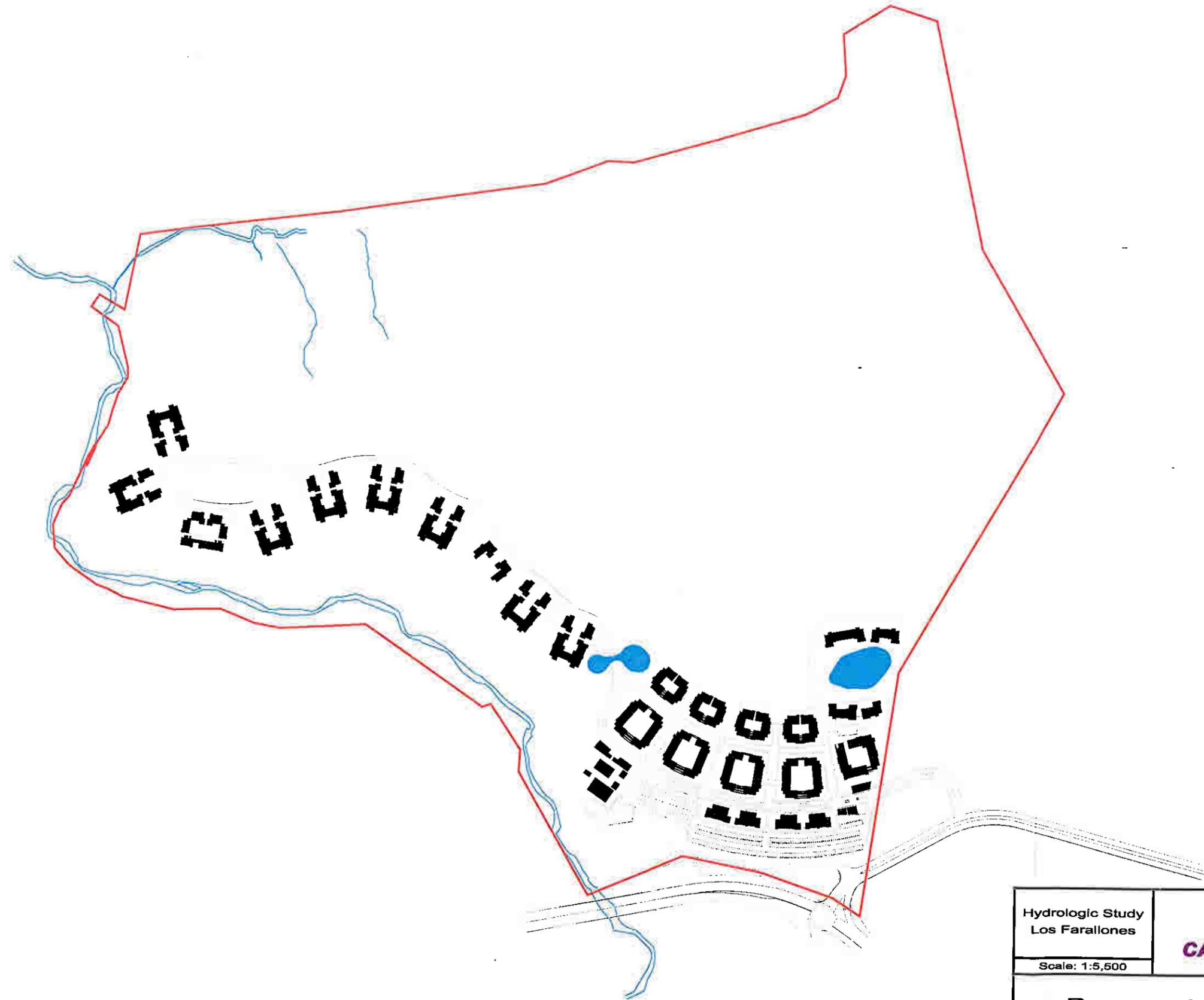


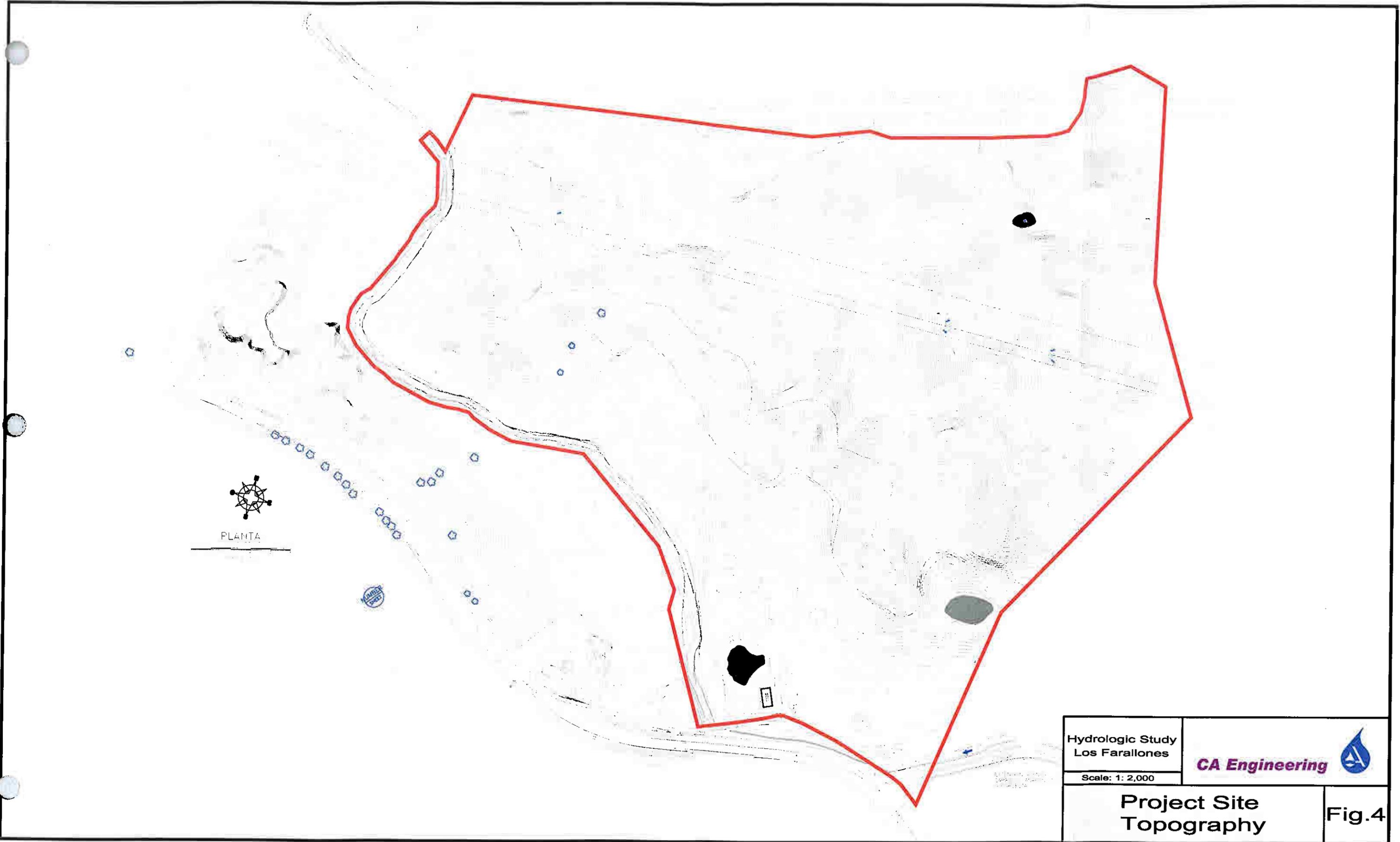
Hydrologic Study
 Los Farallones
 Scale: 1:30,000

CA Engineering 

Location Map

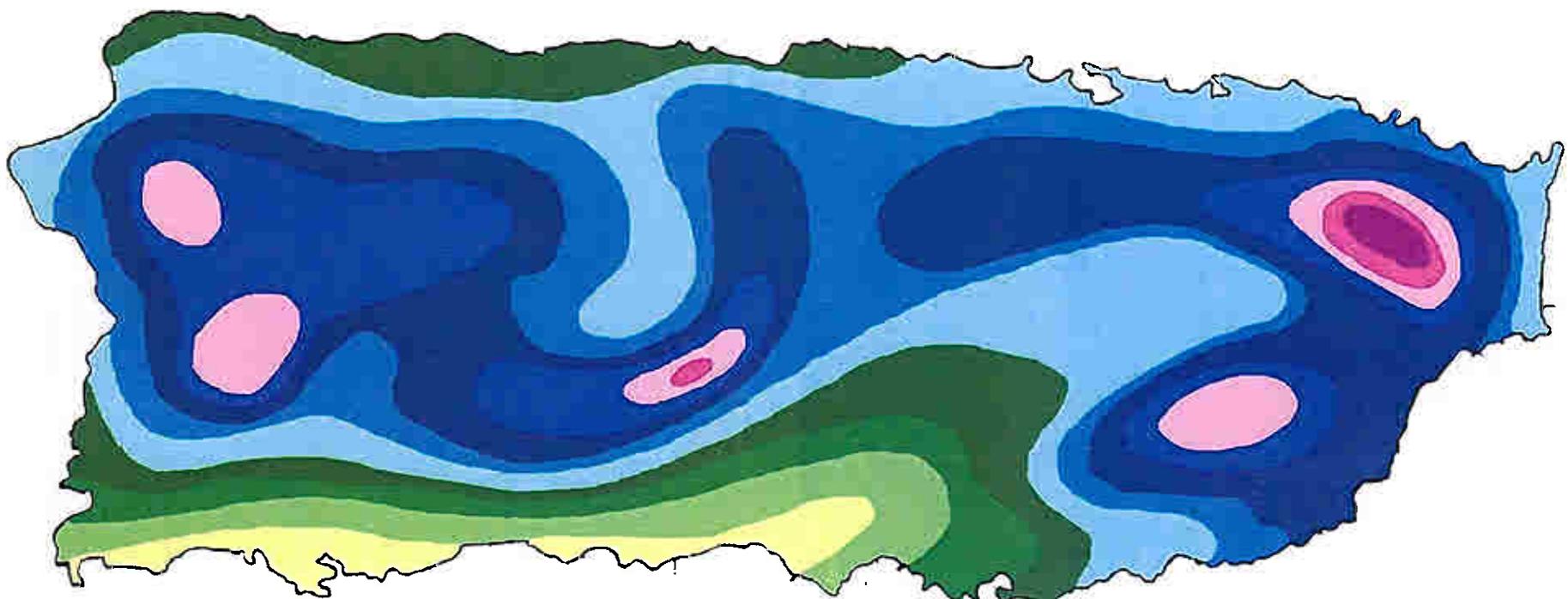
Fig. 1





PLANTA

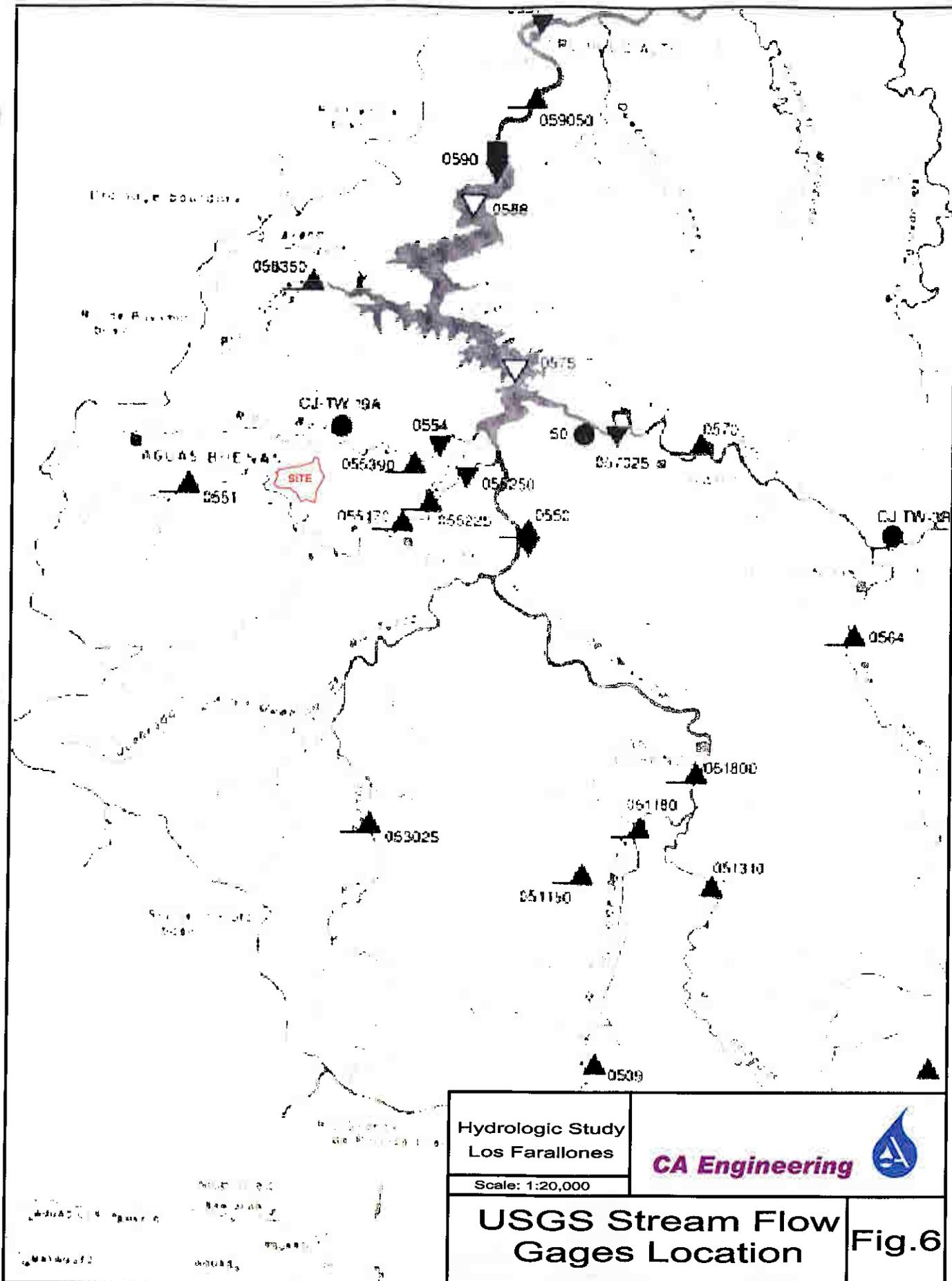
Hydrologic Study Los Farallones Scale: 1: 2,000	CA Engineering 
Project Site Topography	Fig.4



Legend (Inches)

Less than 35	80-90
35-40	90-100
40-50	100-150
50-60	150-200
60-70	More than 200
70-80	

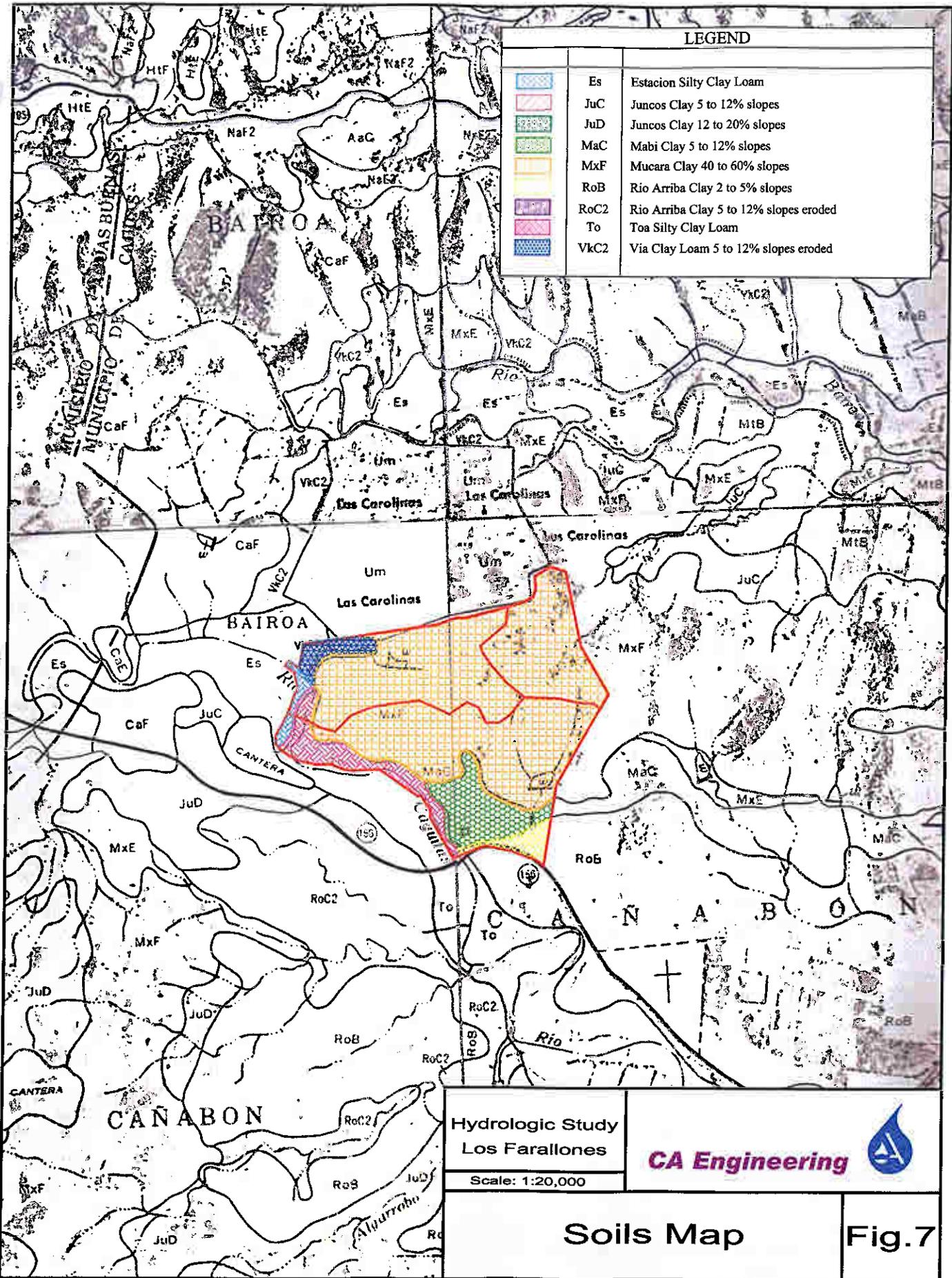
Hydrologic Study Los Farallones	CA Engineering 
Scale: NTS	
Average Annual Rainfall	Fig.5



Hydrologic Study Los Farallones	
Scale: 1:20,000	
USGS Stream Flow Gages Location	
Fig.6	

LEGEND

	Es	Estacion Silty Clay Loam
	JuC	Juncos Clay 5 to 12% slopes
	JuD	Juncos Clay 12 to 20% slopes
	MaC	Mabi Clay 5 to 12% slopes
	MxF	Mucara Clay 40 to 60% slopes
	RoB	Rio Arriba Clay 2 to 5% slopes
	RoC2	Rio Arriba Clay 5 to 12% slopes eroded
	To	Toa Silty Clay Loam
	VkC2	Via Clay Loam 5 to 12% slopes eroded

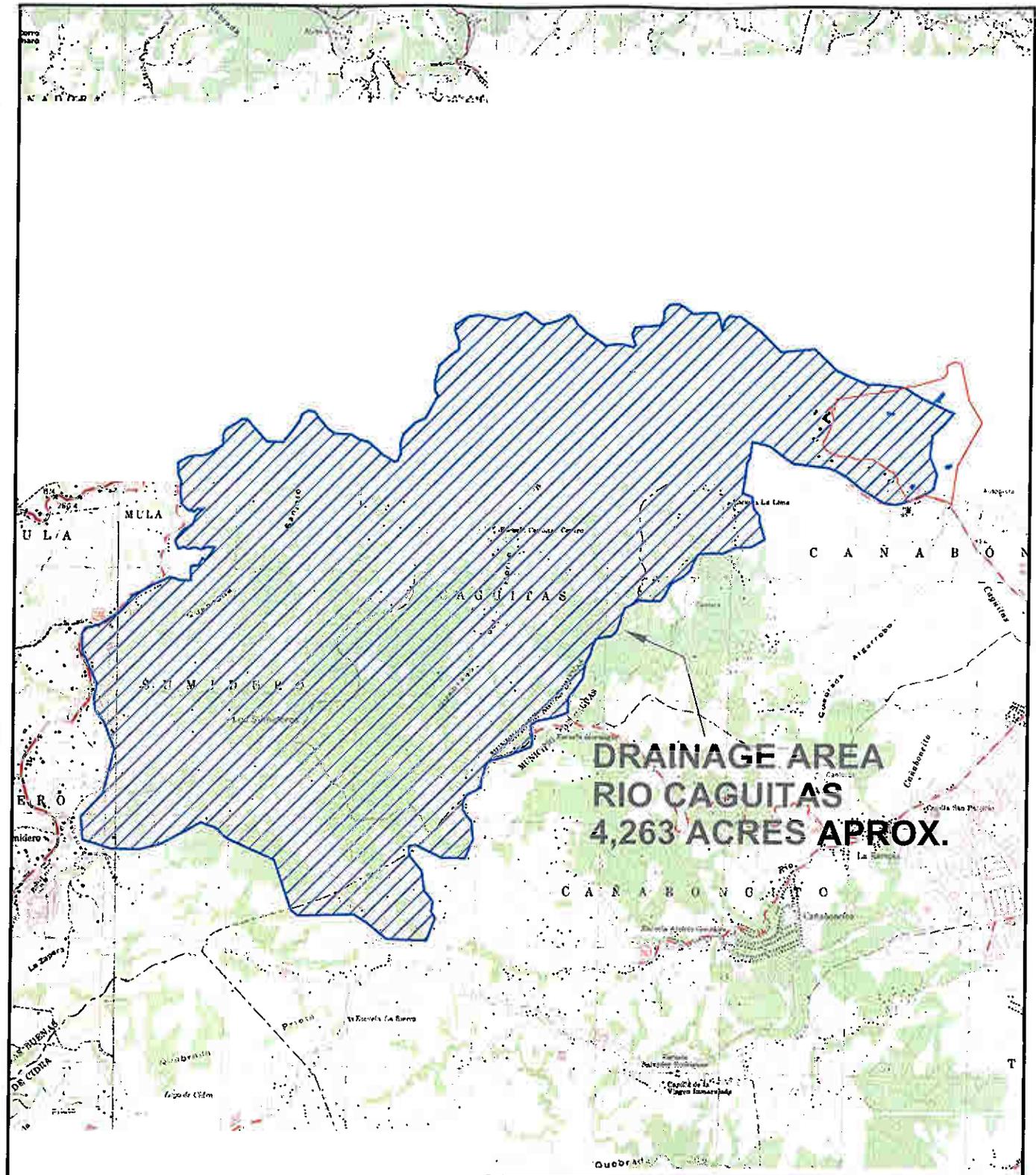


Hydrologic Study
 Los Farallones
 Scale: 1:20,000

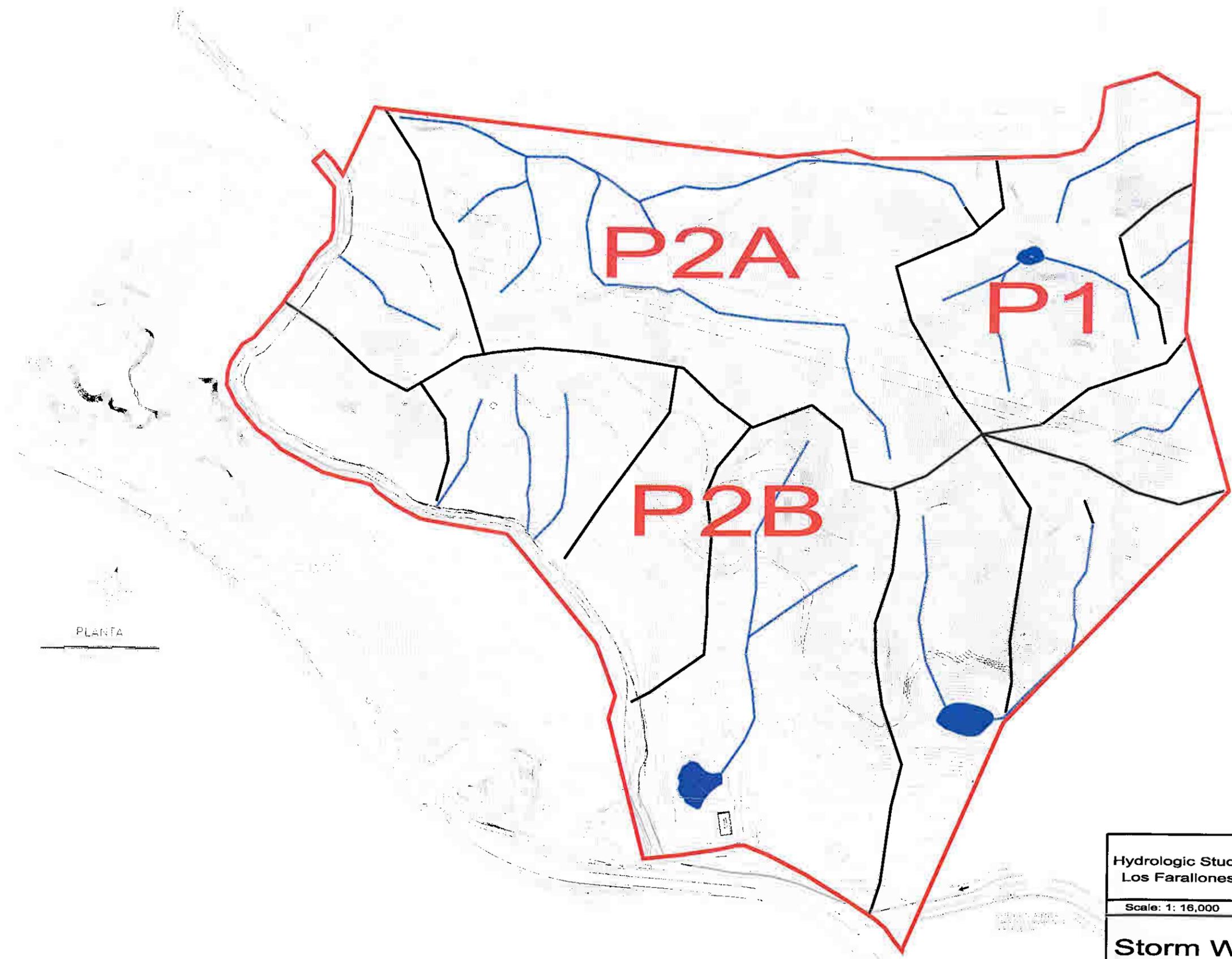


Soils Map

Fig.7



<p>Hydrologic Study Los Farallones Scale: 1:45,000</p>	<p>CA Engineering </p>
<p>Drainage Areas</p>	<p>Fig.8</p>



PLANTA

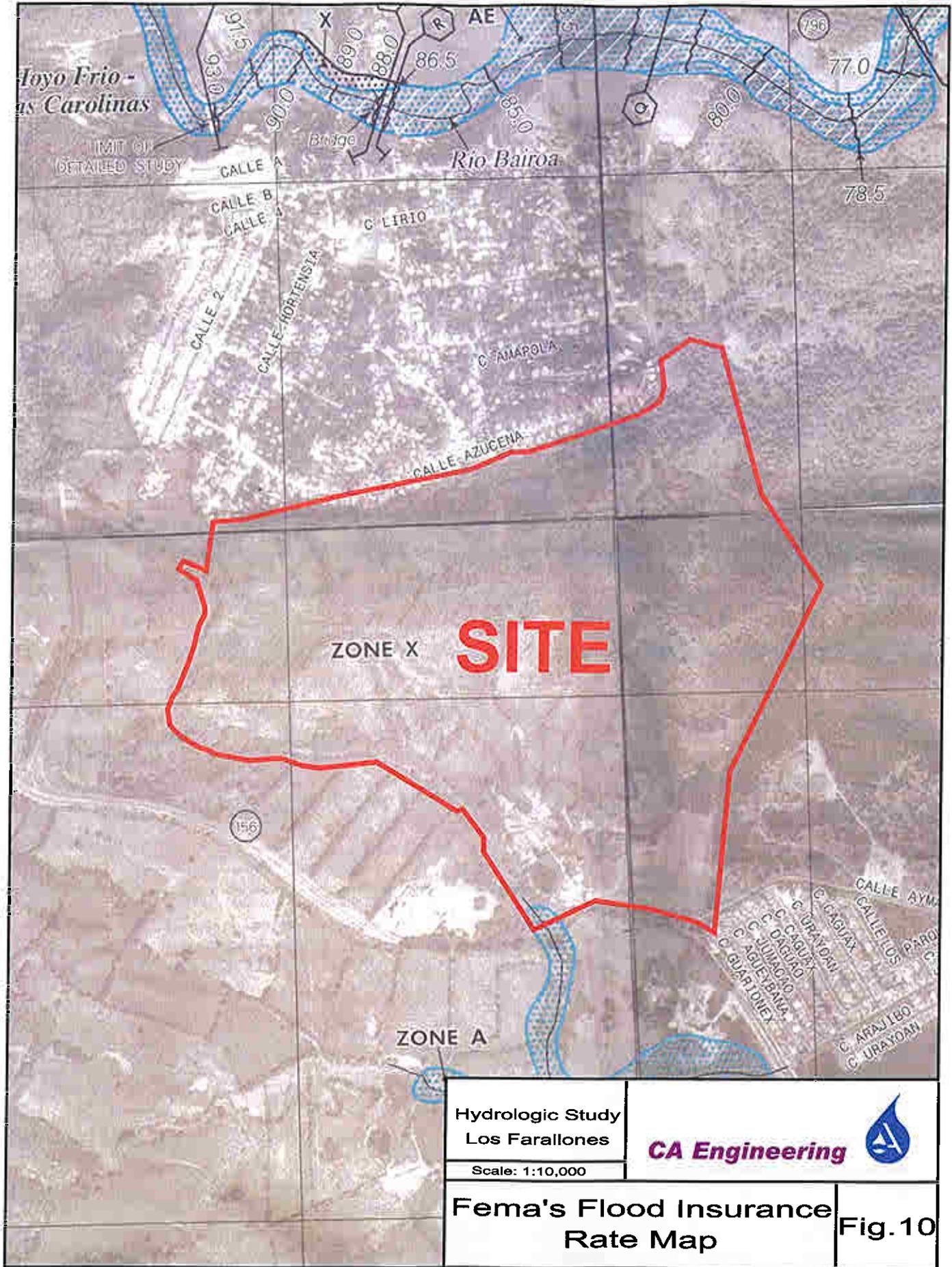
Hydrologic Study
Los Farallones

Scale: 1: 16,000

CA Engineering



Storm Watercourses Fig.9



Hydrologic Study
Los Farallones

Scale: 1:10,000

CA Engineering



Fema's Flood Insurance
Rate Map

Fig. 10

APPENDIXES

APPENDIX A

NOAA'S PRECIPITATION DATA

APPENDIXES

APPENDIX A

NOAA'S PRECIPITATION DATA

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP.	DEPARTURE										
PUERTO RICO												
NORTH COASTAL 01												
ARECIBO 3 ESE	M 6.17	3.37	M 1.76	-.95	M .99	-2.27	M 2.56	-2.54	M 5.28	-1.98	M 4.03	-.74
BORINQUEN AIRPORT	2.59	-1.80	M		.72	-2.42	3.98	-.88	2.46	-4.15	3.69	-4.82
DORADO 2 WNW	2.80	-2.23	M		1.36		5.49	-.90	6.76	-1.67	1.89	-1.99
RIO PIEDRAS EXP STA	2.91	.10	M	3.27	1.12	1.59	2.27	-1.49	5.90	-.03	2.01	-2.25
SAN JUAN WSFO AP	3.62	-.05	2.52	-.44	1.10	-2.03	3.58	-1.15	5.10	-1.56	2.53	-2.25
--DIVISIONAL DATA-->												
SOUTH COASTAL 02												
AGUIRRE	.63	-.70	6.56	5.37	3.77	2.63	.66	-.92	5.96	2.03	.45	-3.31
BOCA	1.16	.23	.53	-.32	1.76	.58	1.04	-.66	9.77	6.57	.27	-1.75
COAMO 2 SW	.65	-.18	.75	.18	1.40	.09	3.15	1.23	4.80	1.06	6.12	3.92
ENSENADA 1 W	.22	-.75	.48	-.27	.12	-1.01	1.74	.06	12.61	9.47	.51	-1.32
LAJAS SUBSTATION	1.75	-.63	2.11	.33	1.19	-1.05	3.70	-.41	14.70	9.79	2.45	-.57
MAGUEYES ISLAND	.66	-.47	4.37	3.43	.24	-.84	4.52	3.23	6.59	3.82	.28	-1.25
PONCE 4 E	.59	-.26	.73	-.11	1.15	-.29	1.86	-.26	5.30	1.15	2.70	.15
PONCE CITY	M .43	-.33	M .41	-.20	M 1.58	.83	M 1.02	-.60	M 4.78	1.38	M .33	-2.04
SANTA ISABEL 2 ENE	.75	-.19	.50	-.55	.95	-.32	2.07	-.18	13.61	10.31	.00	-1.70
SANTA RITA	.76	-.24	1.83	.98	1.35	-.14	2.20	.36	8.68	5.23	1.46	-.80
--DIVISIONAL DATA-->												
NORTHERN SLOPES 03												
BARCELONETA 3 SW	3.28		4.21		M 1.41	-1.57	4.80		7.45		2.79	
CALERO CAMP	3.88	1.38	1.94	-.48	1.42	-1.75	2.90	-1.25	12.20	5.32	2.97	-3.19
CANOVANAS	3.63	-.79	4.51	.81	.37	-4.28	4.17	-.97	6.30	-2.15	2.46	-2.99
ISABELA SUBSTATION	4.59	1.24	1.84	-1.81	2.14	-1.38	2.57	-5.06	8.47	-.16	1.77	-5.81
MANATI 2 E	3.10	-.95	4.66	1.38	1.59	-1.97	3.58	-1.59	3.56	-3.63	2.44	-1.11
MORA CAMP	4.17	1.15	1.75	-1.26	.77		2.10	-3.38	7.30	-.23	1.31	-4.37
RINCON	5.01		.54		3.45	-.07	4.48		11.71		7.36	
TRUJILLO ALTO 2 SSW	4.78	.87	3.40	.12	1.59	-1.70	5.83	.38	5.85	-1.97	4.33	-1.35
--DIVISIONAL DATA-->												
SOUTHERN SLOPES 04												
BENAVENTE BERMUDEZ	1.87		1.50		1.81		1.18		3.31		1.71	
CORRAL VIEJO	.51	-.76	.22	-.80	2.97	1.05	1.71	-1.15	8.62	.45	1.81	-1.53
GUAYABAL	.98	-1.00	2.66	.95	2.64	-.96	2.08	-.05	7.09	1.89	1.29	-3.42
GUAYAMA 2 E	.11	-1.01	1.42	.54	1.49	.01	2.10	-.42	5.02	-.72	2.58	-.07
JUANA DIAZ CAMP	1.32	-1.75	2.52	.08	4.34	1.68	5.85	2.80	6.38	-.36	1.04	-4.18
MAUNABO	1.93	-.36	1.41	-.91	.96	-2.38	7.89	1.46	5.07	-3.72	5.64	-3.45
MAYAGUEZ CITY	.23	-1.39	.32	-1.58	.38	-2.13	12.56	8.29	19.33	11.99	1.09	-7.06
MAYAGUEZ AIRPORT	1.01		2.46		2.80		1.38		6.25		1.12	
PATILLAS	1.79		1.81		2.53		5.08		6.13		2.06	
PENUELAS 1 NE	M 1.12		M 2.13		M 2.50		21.90	18.80	10.60	5.54	6.20	2.63
FUERTO REAL	.62		.88		2.81		2.35		3.61		2.06	
ROOSEVELT ROADS	1.15		.70		1.15		10.29		9.76		2.29	
SABANA GRANDE 2 ENE	1.05	-1.09	1.51	-.40	2.20	-.24	3.86	3.03	14.61	1.94	.93	-2.46
YAUCO 1 NW	1.05		1.51		2.20		6.49		8.31		2.45	
--DIVISIONAL DATA-->												
EASTERN INTERIOR 05												
AIBONITO 1 S	3.28		3.58		2.68		4.11		8.00		1.67	
CAYEY 1 E	1.92	-.67	1.31	-1.03	M 2.93		M 3.16		.72	-5.06	.66	-3.87
GURABO SUBSTATION	2.62	-.44	2.76	.27	.95	-2.04	2.65	-.73	4.68	-1.78	1.47	-3.85
JAJOME ALTO	2.38	-2.02	3.24	-.21	5.09	1.03	2.66	-2.12	5.02	-2.86	.48	-6.35
JUNCOS 1 SE	2.35	-.33	1.87	-.60	3.13	-.27	7.16	-.97	6.64	-.86	2.93	-2.78
PARAISO	3.29	-1.63	2.14	-2.28	5.02	.30	11.70	.53	7.26	-5.46	5.82	-1.42
PICO DEL ESTE	7.97		8.56		4.28		7.20		12.63		10.15	
RIO BLANCO LOWER	3.23	-2.15	4.11	-.46	6.75	1.88	6.16	-.46	7.20	-4.66	2.58	-5.72
SAN LORENZO 3 S	2.87		3.61		3.55		3.54		9.89		2.18	
--DIVISIONAL DATA-->												
WESTERN INTERIOR 06												
ACEITUNA	.61	-1.29	.99	-.88	4.73	2.11	3.72	-2.39	11.43	3.53	5.51	.09
ADJUNTAS 1 NW	1.20	-1.26	.80	-1.55	.90	-2.86	7.65	2.28	12.25	4.14	6.15	.48
ADJUNTAS SUBSTATION	2.13		1.15		.92		10.25		14.62		5.57	

PUERTO RICO AND VIRGIN ISLANDS
2001

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP.	DEPART.												
PUERTO RICO														
NORTH COASTAL 01	M		M		M		M		M		M		M	
ARECIBO 3 ESE	4.50	.23	5.08	-.97	9.71	4.53	7.50	1.14	6.77	.63	7.29	2.51	61.64	
BORINQUEN AIRPORT	4.84	-.91	6.00	-1.15	2.26	-3.12	5.97	.22	15.64	8.35	10.65	3.39		
DORADO 2 WNW	8.49	1.49	7.76	-1.35	7.27	-1.08	2.72	-6.21	10.51	1.63	12.97	5.63	56.05	3.71
RIO PIEDRAS EXP STA	3.57	-.80	6.44	1.12	5.05	-.23	5.00	-.71	6.25	.31	11.79	7.07	61.96	.67
SAN JUAN WSFO AP	5.35	.48	6.32	.06	6.07	.58	5.30	-.73	9.79	3.16	10.68	4.60		
--DIVISIONAL DATA-->														
SOUTH COASTAL 02														
AGUIRRE	4.24	.81	4.33	-1.41	.96	-4.42	4.74	-3.79	.14	-3.90	4.23	2.27	36.67	-5.34
BOCA	.33	-1.57	3.39	.00	1.77	-3.10	3.78	-2.10	1.02	-2.95	1.80	.71	26.62	-4.36
COAMO 2 SW	1.35	-.52	14.30	10.10	4.65	-.44	4.15	-3.49	1.20	-2.55	2.40	1.07	44.92	10.47
ENSENADA 1 W	.09	-1.72	2.69	-.88	.64	-4.72	2.63	-2.83	4.24	.33	1.63	.07	27.60	-3.57
LAJAS SUBSTATION	2.30	-1.32	1.61	-5.81	2.93	-5.01	1.78	-5.82	2.80	-2.95	4.58	1.80	41.90	-11.65
MAGUEYES ISLAND	.42	-1.32	1.62	-1.94	3.66	-1.28	1.60	-3.31	2.35	-1.93	2.09	.48	28.40	-1.38
PONCE 4 E	2.04	-.89	11.50	5.82	1.85	-3.84	.84	-7.67	.47	-4.50	1.51	.26	30.54	-10.44
PONCE CITY	.62	-1.59	13.50	9.63	3.13	-1.44	2.24	-4.80	1.19	-2.16	1.50	.18	30.73	-1.14
SANTA ISABEL 2 ENE	1.50	-.24	3.56	-.31	.40	-5.40	3.38	-2.29	1.05	-3.58	2.27	1.12	30.04	-3.33
SANTA RITA	1.43	-.77	6.28	2.12	2.22	-2.95	2.79	-3.67	1.61	-2.54	2.45	1.01	33.06	-1.13
--DIVISIONAL DATA-->														
NORTHERN SLOPES 03														
BARCELONETA 3 SW	6.69		3.57		2.20		4.76		13.77		8.38		64.15	8.24
CALERO CAMP	5.46	1.61	4.46	-1.36	7.73	2.67	7.78	1.43	7.10	1.59	6.32	2.09	72.44	-3.27
CANOVANAS	5.33	-2.04	8.64	.53	5.08	-1.41	6.69	-.63	11.80	2.96	12.41	5.16	57.36	-19.41
ISABELA SUBSTATION	5.13	-.35	3.81	-3.24	4.61	-2.23	4.76	-2.93	9.88	1.74	9.56	3.48	61.97	.92
MAYAGUEZ CITY	4.97	.88	5.27	.07	5.44	.19	3.89	-2.26	13.89	7.04	9.03	2.28	57.82	-1.86
MAYAGUEZ AIRPORT	4.97	.88	5.27	.07	5.44	.19	3.89	-2.26	13.89	7.04	9.03	2.28	57.82	-1.86
MORA LAMPA	1.33	.40	5.45	2.44	3.13	-5.22	3.71	.51	4.44	1.44	4.44	1.44	47.97	1.79
TRUJILLO SANTA 2 ENE	6.59	.40	5.45	2.44	3.13	-5.22	3.71	.51	4.44	1.44	4.44	1.44	47.97	1.79
--DIVISIONAL DATA-->														
SOUTHERN SLOPES 04														
BENAVENTE-HORMIGUEROS	2.24		2.37		7.90		5.19		4.64		2.08		47.29	
CORRAL VIEJO	2.02	-1.10	10.56	4.46	4.03	-3.13	2.71	-6.88	4.73	-1.04	1.05	-.62	42.07	-6.57
GUAYABAL	5.79	.83	12.77	6.23	3.02	-3.61	5.89	-3.28	1.29	-4.07	5.76	3.26	51.22	-1.31
GUAYAMA 2 E	2.55	-.21	6.24	1.16	3.50	-2.05	1.53	-6.91	1.37	-3.07	1.89	.42	29.80	-10.89
JUANA DIAZ CAMP	5.25	-.45	10.64	2.96	3.93	-3.93	9.51	-.21	7.15	-.52	10.40	5.58	68.33	1.70
MAUNABO	11.10	.11	9.07	-2.84	M 10.12		7.05	-4.25	3.13	-3.08	9.57	7.45	M 72.94	
MAYAGUEZ CITY	21.90	12.07	13.53	3.22	M 27.38	18.52	18.07	9.31	3.26	-1.48	3.68	1.98	121.73	51.74
MAYAGUEZ AIRPORT	4.06		10.18		.79		8.57		.55		4.22		42.30	
PATILLAS	1.27		6.97		7.00		4.65		4.10		4.33		46.78	
PENUELAS 1 NE	23.30	19.22	7.00	1.07	M		M		M		M		M	
PUERTO REAL	2.74		M 4.67		2.28		4.05		3.51		6.15		37.17	
ROOSEVELT ROADS	5.43		6.92		10.87		3.58		6.68		10.52		70.65	
SABANA GRANDE 2 ENE	1.31		5.08		3.13		3.74		2.62		4.91		43.19	
YAUCO 1 NW	6.84	1.43	8.44	1.16	6.71	-1.11	6.21	-2.97	3.59	-2.50	5.38	2.32	59.18	-.89
--DIVISIONAL DATA-->														
EASTERN INTERIOR 05														
AIBONITO 1 S	3.44		8.28		4.31		5.27		10.93		5.25		60.80	
CAYEY 1 E	M 6.34	1.20	M 6.28	-1.29	M 3.42	-3.56	M 7.73	.30	M 8.28	1.34	M 7.01	1.79	54.70	-8.79
GURABO SUBSTATION	6.55	-.37	6.23	-2.68	5.72	-2.53	7.55	-3.19	11.25	3.87	7.44	2.31	63.60	-15.12
JAJOME ALTO	5.94	-.07	9.50	1.56	3.71	-3.28	6.59	-1.58	12.15	5.15	6.23	1.06	63.70	-2.43
JUNCOS 1 SE	8.48	1.51	6.45	-2.52	8.62	-.73	8.21	-4.63	13.77	2.92	17.41	8.81	93.63	-4.60
PARAISO	10.85		20.19		15.15		14.11		24.08		23.01		162.68	
PICO DEL ESTE	8.13	-.90	11.21	.80	10.84	.05	8.38	-4.23	10.64	-.32	9.99	1.73	89.22	-14.44
RIO BLANCO LOWER	5.09		13.28		4.54		8.28		9.56		8.02		74.41	
SAN LORENZO 3 S	6.85	-.25	10.18	1.23	7.04	-1.02	8.27	-1.66	12.58	4.07	10.55	4.07	81.31	-1.08
--DIVISIONAL DATA-->														
WESTERN INTERIOR 06														
ACEITUNA	6.66	1.90	8.94	1.67	9.10	-1.40	6.01	-8.41	8.73	1.48	7.63	5.11	74.06	1.52
ADJUNTAS 1 NW	6.45	.04	5.15	-4.94	10.80	-1.59	7.40	-3.99	7.90	1.02	6.55	3.27	73.20	-4.96
ADJUNTAS SUBSTATION	7.15		7.78		9.43		6.78		6.68		4.69		77.15	

PUERTO RICO AND VIRGIN ISLANDS
2001

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP.	DEPARTURE										
ARECIBO OBSERVATORY	4.22		3.03		3.86		5.26		12.53		7.40	
CACAOS-OROCOVIS	2.71		3.32		3.54		7.05		6.43		11.93	
CERRO GORDO CIALES	M 2.89		M 2.14		M 5.97		M 5.80		M 9.77		M 9.05	
CERRO MARAVILLA	2.31	.31	1.07	-1.25	1.52	-1.48	6.55	2.08	13.62	3.73	9.40	-.50
COLOSO	3.80	-1.32	3.96	-.48	1.75	-4.28	4.57	-4.07	5.59	-4.56	4.26	.23
COROZAL SUBSTATION	3.99	.63	3.68	.57	2.72	-1.46	5.85	-.72	11.54	1.34	4.95	-1.95
DOS BOCAS	7.42	4.56	2.58	-.76	1.20	-2.94	4.43	-1.48	13.62	4.23	3.40	-4.09
GUAJATACA DAM	.00		.00		.00		7.60		8.50		3.75	
HACIENDA CONSTANZA	2.16		3.17		5.01		5.78		8.02		6.18	
JAYUYA	3.56		1.84		3.23		15.34		10.40		6.71	
MARICAO 2 SSW	2.22	-.16	1.78	-1.08	3.64	-1.26	15.31	7.42	9.63	-.14	8.72	.73
MARICAO FISH HATCHERY	3.64		4.79		1.82		3.67		5.88		1.47	
MONTE BELLO MANATI	5.34	1.43	4.10	.82	1.46	-3.09	4.79	-2.23	4.50	-4.41	5.68	2.35
MOROVIS 1 N	4.51		4.24		2.33		4.32		5.56		3.92	
NEGRO-COROZAL												
SAN SEBASTIAN 2 WNW	M 2.13		M 2.65		M 4.78		M 8.40		M 10.81		M 6.34	
TORO NEGRO FOREST												
UTUADO	M .33	-1.34	M .19	-1.16	M 2.42	.47	M 2.10	-3.19	M 7.74	.73	M 6.50	1.76
VILLALBA 1 E	.33	-1.34	.19	-1.16	2.42	.47	2.10	-3.19	7.74	.73	6.50	1.76
--DIVISIONAL DATA----->	2.90	.20	2.39	-.32	2.73	-1.12	6.76	.39	9.60	.56	6.15	.11
OUTLYING ISLANDS 07												
MONA ISLAND 2	2.50		2.60		.21		5.58		7.78		.54	
--DIVISIONAL DATA----->	2.50		2.60		.21		5.58		7.78		.54	
VIRGIN ISLANDS												
ST THOMAS 01			.98		.61		2.00		5.06		.28	
REDHOOK BAY ST THOMAS	1.91		1.63	.03	1.47	-.47	2.22	-.27	3.92	-.20	.54	-2.08
TRUMAN FIELD AIRPORT	R 2.29	.31	1.63	.03	1.47	-.47	2.22	-.27	3.92	-.20	.54	-2.08
WINDWARD	2.29	.31	1.63	.03	1.47	-.47	2.22	-.27	3.92	-.20	.54	-2.08
--DIVISIONAL DATA----->	2.24	.31	1.47	.41	.85	1.11	2.22	-.27	4.14	-.48	.48	-1.33
ST JOHN 02												
ALEX HAMILTON FLD FAA	M 3.45	.42	M 3.57	1.50	M 1.45	.95	M 3.66	.55	M 10.90	5.66	M 1.10	2.16
ANNALY	1.34	-.82	2.48	.89	.61	-1.24	1.19	-1.36	11.08	7.01	.10	-2.83
BETH UPPER NEW WORKS	.61		.94		.45		.85		7.85		.09	
COTTON VALLEY 2	.89	-1.11	1.68	.33	.43	-1.08	1.32	-.80	9.42	5.75	.26	-2.06
EAST HILL	1.35		1.93		.20		1.73		9.48		.44	
ESTATE THE SIGHT	.91	-1.25	2.85	1.25	1.25	-.33	.84	-1.60	12.15	8.25	.24	-2.37
GRANARD	.89		2.90		.43		1.56		9.14		.96	
MONTPELLIER	1.35	-1.20	2.34	.46	.69	-1.32	1.60	-1.40	10.00	5.38	.46	-2.45
--DIVISIONAL DATA----->												
ST JOHN 03												
CANEEL BAY PLANTATION	M 1.81		M 1.72		M .38		M 2.26		M 4.97		M 1.79	
CORAL BAY	2.16	-1.18	1.00	-1.47	.97	-1.67	4.65	.95	3.97	-1.75	1.92	-1.44
CRUZ BAY	1.99	-.56	1.36	-.52	.68	-1.33	3.46	.46	4.47	-.15	1.86	-1.05
--DIVISIONAL DATA----->												

PUERTO RICO AND VIRGIN ISLANDS
2001

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP.	DEPART.												
ARECIBO OBSERVATORY	6.19		6.96		4.12		8.53		10.72		10.14		82.96	
CACAO-OROCOVIS	4.83		6.59		5.31		4.58		21.60		8.20		86.09	
CERRO GORDO CIALES			13.19		17.85		11.45	M		M			90.74	12.53
CERRO MARAVILLA	11.08		10.11	-.71	11.75	1.97	15.28	6.21	4.36	-1.00	6.37	3.84	67.73	-19.53
COLOSO	8.40	-.67	10.11		11.75		7.16	-2.95	14.47	5.61	8.81	.87	86.31	7.86
COROZAL SUBSTATION	2.33	-3.40	5.84	-2.13	5.19	-3.05	7.16		13.73	5.92	8.57	3.88	76.41	3.69
DOS BOCAS	7.20	2.26	9.36	2.43	9.54	-.56	5.18	-4.48	9.13	2.44	8.33	4.00	64.52	
GUAJATACA DAM	10.10	4.73	3.36	-3.05	7.87	-.02	4.97	-3.93	4.20		7.10		95.58	
HACIENDA CONSTANZA	12.30		5.77		7.38		7.92		13.17		8.41		104.68	
JAYUYA	7.79		12.40		15.71		9.27		7.58		12.97		90.21	-6.47
MARICAO 2 SSW	12.43		7.48		13.87		5.68	-8.05	6.57	-2.07	9.48	6.44	71.30	.65
MARICAO FISH HATCHERY	8.51	-.63	8.59	-3.57	10.08	-4.10					9.21	3.33	73.04	
MONTE BELLO MANATI	3.96		3.44		2.97		M		17.24	9.84	10.26			
MOROVIS 1 N	3.97	-.22	5.71	-.46	5.33	-2.05	3.97	-4.66	17.94		10.26			
MOROVIS 1 N	4.19		6.27		4.28		5.22							
NEGRO-COROZAL							M				6.47		86.46	
SAN SEBASTIAN 2 WNW	M		M		M		M		12.03					
TORO NEGRO FOREST	8.84		8.78		9.48		5.75						45.07	-18.58
UTUADO	1.92	-1.99	6.73	.09	6.71	-2.89	3.96	-8.65	4.54	-2.43	1.93	.02	79.50	1.64
VILLALBA 1 E	7.07	1.21	7.50	-.89	8.78	-1.62	7.05	-4.32	10.62	3.29	7.95	4.15	45.41	
--DIVISIONAL DATA-->													45.41	
OUTLYING ISLANDS 07	2.61		5.79		1.26		2.16		4.95		9.43		45.41	
MONA ISLAND 2	2.61		5.79		1.26		2.16		4.95		9.43			
--DIVISIONAL DATA-->														
VIRGIN ISLANDS														
ST JOHN														
WINDWARD BAY ST THOMAS	4.17	1.29	4.74	1.85	3.32	1.81	4.57	1.85	1.07	1.01	4.14	1.81	11.99	7.33
TRUMAN FIELD AIRPORT	3.16	.27	3.96	-.31	3.08	-0.33	4.16	-1.84	1.14	4.48	1.04	2.56	33.51	12.46
WINTERBERG	3.42	.34	3.37	-1.24	3.24	-2.35	4.42	-1.47	1.44	-4.78	6.32	2.56		
--DIVISIONAL DATA-->														
ST CROIX 02														
ALEX HAMILTON FLD FAA	M		M		M		M		M		M		60.77	8.74
ANNALY	1.45	-1.98	4.33	-.51	2.04	-4.37	6.25	-.25	6.27	-.96	16.28	11.79	47.69	4.35
BETH UPPER NEW WORKS	2.65	-.10	5.11	.82	2.14	-3.40	5.66	-.07	7.07	1.04	8.26	4.41		
COTTON VALLEY 2	1.45												36.35	-1.62
EAST HILL	2.36	-.21	3.64	-.64	1.33	-3.34	5.22	.19	3.03	-2.06	6.77	3.41	43.35	3.11
ESTATE THE SIGHT	2.37		3.11		1.37				4.94		7.13		47.52	
GRANARD	.57	-2.15	3.03	-.96	2.68	-2.15	5.81	.99	4.88	-.97	8.14	4.40	44.93	-1.09
MONTPELLIER	3.88		4.44		.91		7.31		3.84		11.26			
--DIVISIONAL DATA-->	2.10	-.98	3.94	-.67	1.75	-3.84	6.05	.26	5.01	-1.21	9.64	5.88		
ST JOHN 03														
CANEEL BAY PLANTATION	M		M		M		M		M		M		46.43	
CORAL BAY	3.77		6.46		2.15		5.64		2.27		13.21		43.59	-10.79
CRUZ BAY	3.45	-.84	6.07	.24	2.04	-4.52	7.05	.78	3.79	-2.29	6.52	2.40	45.05	-.97
--DIVISIONAL DATA-->	3.61	.53	6.27	1.66	2.10	-3.49	6.35	.56	3.03	-3.19	9.87	6.11		

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP.	DEPARTURE										
PUERTO RICO												
NORTH COASTAL 01												
BORINQUEN AIRPORT												
DORADO 2 WNW	2.45	.12	1.22	-1.36	1.30	-.92	6.18	3.00	4.17	-2.11	4.63	-.46
RIO PIEDRAS EXP STA	4.87	.08	1.70	-1.95	1.49	-1.01	8.42	4.07	5.71	.01	4.68	.93
SAN JUAN INTL AP	3.94	-.38	M		M		6.18	3.00	4.17	-2.11	4.63	-.46
--DIVISIONAL DATA-->	3.33	.31					8.42	4.07	5.71	.01	4.68	.93
SOUTH COASTAL 02												
AGUIRRE	3.65	-.02	1.29	-1.67	1.13	-1.01	15.02	9.99	7.48	.66	2.62	-1.99
BOCA	.45	-.83			1.31	-1.82	4.85	1.14	3.24	-2.05	1.82	-1.70
COAMO 2 SW	.04	-.89	.30	-.93	.88	-.35	8.62	3.89	5.15	-1.91	3.44	-1.34
ENSENADA 1 W	.00	-1.21	.47	-.38	4.06	2.88	4.13	2.86	2.72	-1.27	6.06	3.11
LAJAS SUBSTATION	.00	-1.06	4.41	3.28			5.83	4.13	1.07	-2.13	7.21	5.19
MAGUEYES ISLAND	.53	-1.43	.32	-.59	1.57	.18						
PONCE 4 E	.16	-1.15	.89	-1.23	2.67	-.68	5.09	3.29	.11	-3.25	2.83	1.14
SANTA ISABEL 2 ENE	.05	-.94	.31	-.84	1.43	-.23	6.72	3.98	2.15	-2.00	2.74	.03
SANTA RITA	.05	-.71	.25	-.82	3.50	1.99	4.13	2.67	1.68	-1.18	3.45	1.96
--DIVISIONAL DATA-->	.00	-.94	.13	-.48	1.21	.46	4.82	2.87	3.45	-.57	6.46	4.48
NORTHERN SLOPES 03												
BARCELONETA 3 SW	.14	-.86	.00	-1.05	2.90	1.63	5.44	3.82	3.07	-.33	6.24	3.87
CALERO CAMP	4.35		.79	-.06	2.28	1.07	6.35	4.10	.75	-2.55	3.17	1.47
CANOVANAS	1.84	-1.08	1.20		2.74		5.31	3.47	1.88	-1.57	4.77	2.51
ISABELA SUBSTATION	5.33	.33	.31	-2.26	1.98	-.70	6.96		2.41		3.51	
MANATI 2 E	3.39	.38	2.14	-1.99	3.93	.89	8.20	4.67	5.63	-1.21	3.56	-2.49
MORA CAMP	3.45	-.60	.42	-2.85	4.16	.78	7.62	2.45	5.09	-2.05	3.75	-1.99
REINCON	3.13	-.25	2.00	-1.33	2.36		13.63	8.84	4.49	-3.08	3.82	-2.54
TRUJILLO ALTO 2 SW	.06	-1.56	.60	-2.37	3.55	-.41	6.42	1.52	1.83	-4.59	3.03	.09
--DIVISIONAL DATA-->	3.84	-.14	.77	-1.18	.07	-1.82	12.58	7.69	4.71	-2.66	3.49	-2.16
SOUTHERN SLOPES 04												
BENAVENTE-HORMIGUEROS	3.17	-.07	2.19	-1.41	2.97	-.38	1.16	-2.10	2.36	-3.97	M	1.63
GENERAL VIEJA	1.04		1.20	-1.76	2.72	-.57	16.36	11.28	5.92	-1.00	1.63	-2.90
LAUREL							9.12	4.24	4.06	-3.30	3.24	-2.71
LAUREL 2 E												
LAUREL 2 W												
MARIN DIAZ CAMP	1.41	-.15	.79	-1.14	4.51	1.42	11.17	4.01	2.44	-.71	4.17	2.71
MAUNABO	.11	-1.17	.88	-.86	2.06	.20	8.06	1.87	7.88	-.78	7.81	5.15
MAYAGUEZ CITY	3.71	-.10	1.11	-2.04	2.46	-.95	8.37	2.14	6.19	1.08	11.03	6.94
MAYAGUEZ AIRPORT	.01	-1.58	.46	-2.06	1.39	-1.21	6.87	5.90	3.22	-1.04	5.68	3.62
PATILLAS	.50	-1.13	.08	-1.93	2.47		10.14	3.84	2.66	-3.64	6.01	1.12
PENUELAS 1 NE	2.64		M		.01	-2.80	16.88	6.10	4.13	-3.13	3.75	-2.57
PUERTO REAL	.08		.72		.83		4.89	12.99	13.79	6.26	7.13	.12
ROOSEVELT ROADS	M		M		3.34		9.30		3.62		8.86	
SABANA GRANDE 2 ENE	2.10	-.58	.90	-1.54	.57	-2.14	M		2.81		3.62	
YAJCO 1 NW	1.26		2.31		3.85		3.79	.94	M		M	
--DIVISIONAL DATA-->	.05		.63		3.42		13.39		3.41	-2.72	3.54	.24
EASTERN INTERIOR 05												
ALBONITO 1 S	1.05	-1.09	.73	-1.18	2.69	.25	8.73	5.27	4.30	-2.07	5.82	.91
GURABO SUBSTATION	3.55	.72	2.36	-.51	2.43	-.50	9.60	5.58	3.41	-2.59	4.15	2.05
JAJOME ALTO	3.07	-.32	2.85	-.04	3.50	.55	9.79	6.36	4.40	-1.30	3.53	-.90
JUNCOS 1 SE	3.89	-.65	2.79	-.94	2.83	-.83	7.80	3.89	3.59	-3.41	7.76	2.46
PARAIISO	1.93	-1.11	1.59	-1.33	3.16	-.37	8.76	5.21	4.91	-1.66	3.51	-1.49
PICO DEL ESTE	6.70	1.78	2.93	-1.49	2.82	-1.90	10.07	3.44	4.46	-8.26	8.09	.85
RIO BLANCO LOWER	15.27	3.30	6.75	-3.77	8.51	-1.76	19.61	8.07	15.58	-2.78	13.94	1.24
SAN LORENZO 3 S	5.07	-.31	2.23	-2.34	2.15	-2.72	12.26	5.66	12.58	.72	10.53	2.22
--DIVISIONAL DATA-->	4.06		2.33		2.99		11.53		6.20		9.08	
WESTERN INTERIOR 06												
ACEITUNA	5.44	.99	2.98	-.80	3.55	-.64	11.18	5.83	6.89	-1.99	7.52	.81
ADJUNTAS 1 NW	.16	-2.42	1.44	-.94	10.52	7.80	16.23	10.34	6.17	-1.33	9.96	5.14
ADJUNTAS SUBSTATION	.85	-3.29	1.95	-.51	4.70	1.28	15.05	10.30	2.35	-5.99	3.10	-2.03
ARECIBO OBSERVATORY	.97	-1.40	2.12	-.60	4.06	-.25	18.53	12.48	4.00	-4.23	3.88	-.95
CACAOS-CROCOVIS	3.39	-.06	2.07	-1.57	3.34	-.84	16.12	9.33	7.43	-3.00	2.61	-3.70
CERRO MARAVILLA	3.46	-.77	2.87	-1.13	5.81	2.06	28.36	22.26	2.81	-7.38	3.34	-.72
	M		3.25	-.33	6.97	2.63	26.18	19.19	5.04	-6.08	10.86	4.21

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP.	DEPART.												
PUERTO RICO														
NORTH COASTAL 01														
BORINQUEN AIRPORT	3.89	-.43	3.69	-2.10	3.57	-.67	3.76	-2.48	2.45	-1.78	1.74	-1.69	39.05	-10.02
DORADO 2 WNW	5.86	-.23	4.60	-1.65	8.46	2.60	5.54	-.41	2.65	-4.04	4.73	-1.64	58.91	-2.78
RIO PIEDRAS EXP STA	2.12	-3.40	M	5.50	11.50	4.25	8.19	.68	2.87	-5.22	3.11	-2.39		
SAN JUAN INTL AP R	5.16	1.00	6.70	1.48	7.45	1.85	4.81	-.25	2.65	-3.52	4.59	.02	46.69	-4.07
--DIVISIONAL DATA----->	4.26	-.61	5.00	-1.26	7.75	2.26	5.58	-.45	2.71	-3.92	3.54	-2.54	52.30	-8.99
SOUTH COASTAL 02														
AGUIRRE	8.79	6.00	1.80	-2.72	4.51	-2.24	2.07	-4.81	1.27	-3.23	2.02	.27	35.00	-4.14
BOCA	.57	-1.33	1.85	-1.54	5.31	.44	1.01	-4.87	1.38	-2.59	.73	-.36	29.53	-1.45
COAMO 2 SW														
ENSENADA 1 W	.00	-1.87	4.09	1.08	2.41	-3.20	2.58	-2.91	1.18	-2.58	.40	-1.12	20.58	-10.89
LAJAS SUBSTATION	1.31	-1.35	5.27	-.42	2.78	-3.76	5.33	-1.47	3.02	-2.34	.78	-1.51	34.19	-10.82
MAGUEYES ISLAND	.96	-.70	1.52	-1.98	2.39	-2.54	1.02	-4.14	.14	-4.09	.71	-.57	17.90	-12.33
PONCE 4 E	.35	-2.13	.97	-2.94	6.18	.26	.72	-5.68	2.23	-1.89	1.06	-.07	30.04	-5.44
SANTA ISABEL 2 ENE	.93	-1.28	2.01	-1.85	4.65	.08	5.04	-2.00	M		1.35	.03		
SANTA RITA	.00	-1.74	1.50	-2.37	5.65	-.15	2.17	-3.50	.00	-4.63	1.85	.70	24.34	-9.03
--DIVISIONAL DATA----->	1.61	-.59	2.38	-1.78	4.24	-.93	2.49	-3.97	1.32	-2.83	1.11	-.33	28.32	-5.87
NORTHERN SLOPES 03														
BARCELONETA 3 SW	1.26		4.18		7.08		3.69		2.85		1.69		41.92	
CALERO CAMP	3.62	-.25	4.86	-1.17	3.10	-2.66	4.52	-2.29	4.27	-.66	2.51	-1.03	44.40	-11.13
CANOVANAS	3.07	-4.23	5.96	-2.01	9.03	1.87	5.73	-1.10	3.28	-5.97	6.11	-1.21	61.04	-14.01
ISABELA SUBSTATION	5.92	1.28	4.30	-2.06	3.37	-2.80	7.34	.10	5.41	.11	2.46	-.76	59.71	-2.60
MANATI 2 E	1.93	-1.72	3.95	-.95	3.81	-1.76	2.78	-3.39	1.89	-4.47	3.06	-3.71	35.51	-21.32
MORA CAMP	3.84	-.42	4.15	-1.34	2.92	-2.47	5.38	-.86	3.57	-1.49	2.04	-2.29	49.96	-8.36
RINCÓN	M				5.75	-.65	3.61	-2.80	M					
TRUJILLO ALTO 2 SSW	4.09	-1.60	5.53	-2.10	8.98	1.27	3.24	-4.18	1.87	-5.40	3.42	-2.45	60.04	-9.01
--DIVISIONAL DATA----->	3.39	-1.70	4.70	-1.61	5.51	-.41	4.54	-2.25	2.31	-2.30	2.94	-2.47	42.02	-5.13
WESTERN INTERIOR 04														
GUAYAMA 2 S	3.01	-3.42	5.88	-.85	4.77	-3.43	2.49	-5.65	4.33	-1.65	2.85	.35	48.01	-4.00
JUANA DIAZ CAMP	.72	-2.17	1.60	-2.39	4.50	-2.16	2.43	-5.25	1.71	-2.59	.82	-.58	32.00	-7.74
MAUNABO	3.15	-2.46	5.80	-1.05	4.83	-4.05	4.81	-4.33	8.50	-.42	7.03	2.17	55.87	-12.17
MAYAGUEZ CITY	2.76	-5.92	8.45	-.71	4.30	-6.31	6.02	-2.91	5.81	1.11	2.60	.80	M 50.90	
MAYAGUEZ AIRPORT	14.04	4.69	8.24	-1.64	4.72	-5.77	22.83	14.03	10.82	5.97	2.72	1.23	101.76	32.02
PATILLAS	4.43		4.78		4.10		1.55							
PENUELAS 1 NE	1.57		4.70		2.34		7.09		6.69		4.62		46.88	
PUERTO REAL	M		M		M		M		M		M			
ROOSEVELT ROADS	1.34	-2.40			4.27	-1.91	4.05	-2.75	2.90	-3.23	3.35	-.71		
SABANA GRANDE 2 ENE	2.49		9.51		4.83		14.29		5.72		4.27		69.12	
YAUCO 1 NW	1.70		3.86		4.30		2.27		1.40		2.84		35.14	
--DIVISIONAL DATA----->	3.09	-2.32	5.76	-1.52	4.39	-3.43	6.52	-2.66	4.78	-1.31	3.28	.22	51.14	-8.93
EASTERN INTERIOR 05														
ALBONITO 1 S	1.26	-1.59	2.00	-2.50	8.34	2.08	1.14	-5.47	.34	-5.45	3.47	-.40	42.15	-7.61
GUPABO SUBSTATION	2.45	-2.58	7.99	-.38	6.15	-1.71	4.78	-2.10	2.17	-5.10	6.41	1.77	57.09	-4.99
JAJOME ALTO	2.86	-3.14	3.09	-4.37	9.80	1.23	4.06	-4.86	2.91	-4.79	5.71	.97	57.09	-14.44
JUNCOS 1 SE	4.37	-1.25	5.49	-1.93	M		4.06	-3.44	1.31	-5.92	4.11	-.54		
PAFAISO	4.97	-2.00	8.90	-.07	5.64	-3.71	10.30	-7.54	6.05	-4.80	4.99	-3.61	78.92	-22.31
PICO DEL ESIE	7.54	-5.31	15.38	.72	7.19	-8.94	14.78	-2.78	7.54	-11.07	9.10	-5.77	140.02	-29.65
RIO BLANCO LOWER	3.43	-5.60	10.73	-.32	19.07	-.32	7.68	-4.93	6.62	-4.34	8.79	-2.47	89.16	-14.50
SAN LORENZO 3 S	4.69		9.80		7.39		4.42		2.82		6.25		71.56	
--DIVISIONAL DATA----->	3.96	-3.14	7.92	-3.03	7.98	-.28	6.39	-3.34	3.72	-4.79	5.79	-.96	73.08	-9.33
WESTERN INTERIOR 06														
ACEITUNA	2.35	-2.02	5.70	-1.03	9.13	-1.59	11.94	1.84	3.15	-3.80	1.96	.51	78.08	8.08
ADJUNTAS 1 NW	3.20	2.98	7.65	-2.34	7.76	-5.46	6.98	-4.24	6.24	.86	4.05	1.46	62.12	-13.04
ADJUNTAS SUBSTATION	1.24	-4.99	9.44	1.24	6.97	-5.16	6.43	-4.45	8.15	3.05	4.15	1.43	70.34	-3.33
AFCIBO OBSERVATORY	6.18	-.47	11.85	4.30	6.48	-3.12	9.42	-1.58	6.91	.54	1.31	-3.27	77.11	-3.44
CACAOS-GROCOVIS	1.34	-2.25	10.93	3.80	7.48	-3.61	7.56	-3.48	2.15	-5.33	3.00	-1.08	79.11	2.31
CERRO MARAVILLA	3.65	-2.14	12.60	3.02	11.42	-2.59	18.37	3.70	M		M			

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP.	DEPARTURE										
COLOSO	1.04	-.99	.58	-1.98	1.87	-1.14	19.43	6.32	3.53	-5.93	4.18	-5.53
COROZAL SUBSTATION	3.81	-.47	1.89	-2.32	2.90	-1.35	7.39	.82	6.76	-.92	1.54	-1.44
DOS BOCAS	2.92	-.46	2.05	-1.19	2.29	-1.76	17.75	11.78	3.66	-6.83	2.73	-3.19
GUAJMATA DAM	3.11	-.03	1.92	-1.40	2.99	-.99	16.04	10.47	4.68	-5.84	4.77	-2.11
HACIENDA CONSTANZA	.00	-1.91	.00	-2.64	.00	-3.16	6.54	1.79	6.64	-1.24	6.44	-1.26
JAYUYA	3.04	-.49	2.51	-.75	12.35	9.26	23.65	18.72	2.16	-6.52	2.94	-1.31
MARICAO 2 SSW	1.48	-1.53	2.58	-1.17	5.18	-.10	14.04	7.25	10.09	.66	4.34	-1.24
MARICAO FISH HATCHERY	.79	-1.88	.79	-2.48	5.49	.59	16.19	9.16	10.93	1.33	2.55	-5.48
MOROVIS 1 N	3.48	-.36	1.94	-1.54	2.19	-1.57	12.09	5.74	2.48	-5.96	3.30	.49
NEGRO-COROZAL	4.96	.43	3.42	-.37	3.60	-.47	13.21	6.31	2.33	-4.65	2.28	-.09
TORO NEGRO FOREST	1.43											
VILLALBA 1 E	1.43											
--DIVISIONAL DATA----->	2.18	-.52	1.96	-.75	4.64	.79	16.11	9.74	5.07	-3.97	4.30	-1.74
OUTLYING ISLANDS 07												
MONA ISLAND 2	.97	-1.31	2.05	.22	M		5.18	3.30	2.51	-2.06	4.89	2.16
--DIVISIONAL DATA----->	.97		2.05				5.18		2.51		4.89	
VIRGIN ISLANDS												
ST THOMAS 01												
REDHOOK BAY ST THOMAS	.00	-2.12	1.47	-.04	1.15	-.25	3.14	.75	.09	-3.62	4.23	2.43
TRUMAN FIELD AIRPORT R	1.73	-.16	1.11	-.40	.82	-.70	1.50	-.89	1.29	-2.07	3.05	.71
WINTBERG	2.35	-.18	2.25	.50	1.48	-.73	3.61	.60	1.14	-3.46	2.24	-.64
--DIVISIONAL DATA----->	1.36	-1.19	1.61	-.27	1.15	-.86	2.75	-.25	.84	-3.78	3.18	.27
ST CROIX 02												
ALEX HAMILTON FLD FAA	M		M		M		M		M		M	
ANNALY	1.50	-1.42	2.00	-.25	1.07	-1.22	4.50	1.60	1.10	-2.94	1.36	-1.73
BETH UPEEP NEW WORKS	2.05	-.06	1.75	-.14	2.03	.13	4.76	2.55	.19	-3.35	1.74	-.75
COTTON VALLEY 2	M		M		M		M		M		M	
EAST HILL	1.67	-.11	1.36	-.15	.53	-.96	1.75	-.37	.56	-2.97	.97	-1.13
ESTATE THE SIGHT	1.92	-.17	2.16	.58	.61	-.95	1.80	-.47	1.01	-2.60	.86	-1.38
GRANARD	2.06	-.02	2.40	.67	.50	-1.17	1.51	-.69	1.26	-2.28	1.22	-1.02
MONTICLO					M		M		M		M	
ST JOHN												
TANDEL BAY PLANTATION	M		M		M		M		M		M	
TORAL BAY	2.28	-.61	1.74	-.17	3.76	-.18	1.77	-.75	1.11	-.77	4.11	-.77
CRUZ BAY	2.73	.00	1.77	-.30	3.57	1.76	3.34	-.01	1.17	-3.01	4.13	1.76
EAST END							1.75		1.50		2.38	
--DIVISIONAL DATA----->	2.51	-.04	1.76	-.12	3.77	1.76	2.51	-.49	1.26	-3.36	2.89	-.02

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP	DEPART	PRECIP	DEPART	PRECIP	DEPART	PRECIP	DEPART	PRECIP	DEPART	PRECIP	DEPART	PRECIP	DEPART
COLOSO	10.20	2.23	20.17	10.07	8.37	-1.37	10.39	1.78	8.05	3.51	1.16	-1.27	79.97	5.70
COROZAL SUBSTATION	4.55	-0.01	3.45	-3.23	9.41	1.05	5.20	-3.71	2.88	-4.70	2.03	-3.98	51.81	-20.26
DOS BOCAS	5.98	1.61	7.99	1.13	6.47	-3.68	11.61	2.02	3.65	-2.93	2.20	-1.81	69.30	-5.31
GUAJAYATA DAM	3.84	-1.24	11.12	4.22	6.05	-2.61	5.42	-3.93	3.95	-1.95	1.10	-2.64	64.99	-8.05
HACIENDA CONSTANZA	7.22	-2.51	6.80	-3.19	3.90	-7.13	9.16	-1.59	3.05	-2.40	.00	-1.34	48.75	-26.38
JAYUYA	2.81	-1.98	12.15	5.75	M									
MARICAO 2 SSW	5.00	-3.52	M 12.61		12.44	-1.22	14.45	-4.41	9.51	.22	2.17	-1.24	M 93.89	
MARICAO FISH HATCHERY	6.87	-2.11	13.99	2.36	10.36	-5.03	14.89	.54	8.60	.13	3.41	-.64	94.77	-2.23
MOROVIS 1 N	3.75	-.09	2.85	-3.34	7.73	-.36	9.05	-.59	2.58	-4.46	2.67	-2.38	54.11	-13.24
NEGRO-COROZAL	4.31	.61	4.83	-.74	13.65	5.11	3.28	-5.02	.91	-6.55	2.18	2.89	58.96	-8.32
TORO NEGRO FOREST							10.44							
VILLALBA 1 E														
--DIVISIONAL DATA----->	4.53	-1.33	9.39	1.00	8.50	-1.90	9.51	-1.86	5.01	-2.32	2.24	-1.56	73.44	-4.42
OUTLYING ISLANDS 07														
MONA ISLAND 2	2.16	-.53	4.36	1.15	2.49	-2.02	1.33	-3.08	2.10	-2.00	3.13	1.04		
--DIVISIONAL DATA----->	2.16		4.36		2.49		1.33		2.10		3.13			
VIRGIN ISLANDS														
ST THOMAS 01														
REDHOOK BAY ST THOMAS	.15	-2.55	2.31	-1.83	5.50	.46	3.82	-.53	2.12	-2.83	1.87	-1.02	25.85	-11.15
TRUMAN FIELD AIRPORT R	1.29	-1.13	1.26	-2.24	9.74	4.40	3.41	-2.16	3.74	-1.54	3.21	.47	32.16	-5.71
WINTBERG	3.67	.78	.91	-3.36	4.12	-1.19	2.74	-2.96	3.42	-2.12	2.58	-.65	30.51	-13.41
--DIVISIONAL DATA----->	1.70	-1.38	1.49	-3.12	6.45	.86	3.32	-2.47	3.09	-3.13	2.55	-1.21	29.49	-16.53
ST CROIX 02														
ALEX HAMILTON FLD FAA	M		M		M		M		M		M			
ANNALY	1.35	-2.13	2.28	-1.88	4.50	-2.63	2.20	-4.40	4.20	-2.75	5.25	.84	31.31	-18.91
BETH UPPER NEW WORKS	1.97	-.99	1.89	-2.14	4.94	-1.28	2.04	-4.06	4.29	-1.82	2.58	-1.10	30.23	-12.91
COTTON VALLEY 2	M		M		M		M		M		M			
EAST HILL	1.09	-1.57	2.40	-1.24	1.94	-3.27	1.61	-3.31	1.22	-3.81	3.90	.90	19.00	-17.99
ENRIQUE JIM SIGHT	M		M		M		M		M		M			
MANUELITA														
--DIVISIONAL DATA----->	1.14	-1.41	1.31	-0.68	1.4	-0.36	1.1	-1.47	1.48	-1.31	2.15	.87	1.31	-.6
ST JOHN 03														
CANEEL BAY PLANTATION														
CORAL BAY	M		M				M		2.80	-4.45	3.30	-.86		
CRUZ BAY	1.83	-1.37	4.50	.33	6.07	.05	2.12	-2.85	3.28	-3.14	2.79	-.83	37.30	-7.61
EAST END	2.02		3.67		3.48		3.59		2.00		3.66			
--DIVISIONAL DATA----->	1.93	-1.15	4.09	-.52	4.78	-.81	2.86	-2.93	2.69	-3.53	3.25	-.51	34.30	-11.72

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		JUN	
	PRECIP	DEPARTURE										
PUERTO RICO												
NORTH COASTAL 01												
BOINQUEN AIRPORT	5.90	3.57	6.63	-1.95	7.53	1.69	10.73	3.55	4.34	1.50	11.50	1.50
DEBAGO 2 NW	7.14	2.35	4.53	.88	7.73	1.77	6.58	2.23	2.57	1.74	11.20	1.74
RIO PIPIRNAS EXP STA	3.30	-1.02	2.71	-.95	4.56	1.25	9.64	4.91	5.04	1.59	11.50	1.59
SAN JUAN INTL AP R	4.59	1.57	2.22	-.08	1.48	-.56	9.37	5.66	1.87	1.11	11.50	1.11
--DIVISIONAL DATA----->	5.23	1.56	2.52	-.44	1.83	-.30	8.93	4.20	1.41	1.17	11.50	1.17
SOUTH COASTAL 02												
AGUIRRE	1.84	.56	1.53	.30	1.38	.15	7.00	5.72	1.67	1.11	11.50	1.11
BOCA	.95	.02	.99	-.14	1.90	.72	13.79	12.39	1.27	1.11	11.50	1.11
COAMO 2 SW					2.91	1.28	9.33	6.94	4.05	1.11	11.50	1.11
INGENIADA 1 W	.48	-.58	.25	-.66	.82	-.57	14.40	12.60	.91	1.11	11.50	1.11
LAIAS SUBSTATION	2.90	.84	1.91	-.21	3.25	1.34	12.01	10.27	1.54	1.11	11.50	1.11
MAYAGUEZ ISLAND	.48	-.83	.50	-.65	.88	-.32	8.54	7.58	.28	1.11	11.50	1.11
PANCA 4 E	2.04	1.05	1.95	.89	2.68	1.17	10.37	8.42	.51	1.11	11.50	1.11
SANTA ISABEL 2 ENE			1.59	.98	2.20	1.45	9.52	7.96	.58	1.11	11.50	1.11
SANTA RITA	.75	-.19	.70	-.35	1.45	.18	9.35	7.10	.25	1.11	11.50	1.11
--DIVISIONAL DATA----->	1.33	.33	1.18	-.33	1.95	.74	10.59	8.75	1.17	1.11	11.50	1.11
NORTHERN SLOPES 03												
BARCELONETA 3 SW	2.84		1.55		1.04		8.05		2.02		11.50	
CAJERO CAMP	4.12	1.20	.52	-2.05	.56	-2.12	11.22	7.69	4.12	1.11	11.50	1.11
CANGUANAS	6.92	1.92	2.98	-1.15	.95	-2.09	9.16	3.99	1.94	1.11	11.50	1.11
ISABELA SUBSTATION	3.96	.95	1.25	-2.02	1.72	-1.66	14.71	9.92	6.34	1.11	11.50	1.11
MANATI 2 E	3.96	-1.09	1.67	-1.66	.81	-1.96	5.21	.31	3.25	1.11	11.50	1.11
MOPA CAMP	3.48	.10	1.92	-1.05	.66	-2.43	12.92	8.03	3.55	1.11	11.50	1.11
REINCON											11.50	
TRUJILLO ALTO 2 SSW	5.10	2.12	2.64	-.96	2.11	-1.24	12.67	8.59	1.21	1.11	11.50	1.11
--DIVISIONAL DATA----->	4.34	1.10	1.79	-1.17	3.15	-2.14	12.28	7.10	3.41	1.11	11.50	1.11
SOUTHERN SLOPES 04												
CORRAL VIEJO	3.12	.89	2.23	.24	2.98	.34	15.51	12.95	2.02	1.11	11.50	1.11
GUAYABAL	2.56	.66	1.71	.27	3.40	1.30				1.11	11.50	1.11
GUAYAMA 2 E	3.21	1.92	2.09	.16	5.40	3.54	8.92	9.33	1.44	1.11	11.50	1.11
SOUTHERN INTERIOR 05												
BARCELONETA 1 NE	8.13		2.34		3.67		11.56				11.50	
BOQUEVILIT ROAD	7.47	.79	1.20	-1.22	.77	-1.94	16.50	7.11			11.50	
SABANA GRANDE 2 NE	2.64		3.96		4.54		13.17				11.50	
YABO 1 NW	1.50		1.41		3.04		1.39		.44		11.50	
--DIVISIONAL DATA----->	2.44	.31	2.17	.26	2.77	.28	11.56	7.93	3.17	1.11	11.50	1.11
EASTERN INTERIOR 06												
ARBONITO 1 S	2.47	-.34	4.64	1.77	1.92	-1.01	24.14	20.11	4.27	1.11	11.50	1.11
CORRADO SUBSTATION	5.92	2.53	2.79	-1.10	1.99	-1.96	13.50	11.13	3.43	1.11	11.50	1.11
GUAYAMA ALTO	5.57	1.73	5.23	1.50	2.42	-2.26	11.48	7.94	1.90	1.11	11.50	1.11
REINCON 1 SE	4.23	.39	3.79	.87	1.42	-1.17	23.54	19.24	2.14	1.11	11.50	1.11
SAVAISO	6.14	1.44	3.33	-1.09	3.15	-2.09	11.09	11.36	1.06	1.11	11.50	1.11
TRINIDAD DEL ESTE	10.56	-1.41	9.32	-1.22	5.06	5.21	24.17	21.33	11.03	1.11	11.50	1.11
RIO BLANCO LOWER	5.22	.18	5.22	.63	5.84	1.37	11.32	11.17	4.82	1.11	11.50	1.11
SAN LORENZO 2 S	8.26		6.63		2.51		1.74		1.48		11.50	
SANTA ALEJUTE											11.50	
--DIVISIONAL DATA----->	5.99	1.34	5.11	1.33	3.05	-1.14	11.58	8.71	5.97	1.11	11.50	1.11
WESTERN INTERIOR 07												
ACEITUNA	2.84	.62	1.27	-.57	4.19	1.56	14.12	8.93	4.24	1.11	11.50	1.11
ALBUERTAS 1 NE	1.82	-.54	6.11	1.84	1.79	.37	6.41	7.4	5.73	1.11	11.50	1.11
ALBUERTAS SUBSTATION	2.24	-.92	1.17	-.41	2.74	1.15	11.27	9.7	2.52	1.11	11.50	1.11
AMERINDO RESERVATORY	4.47	.98	2.40	-1.14	1.11	1.27	11.11	9.11	1.73	1.11	11.50	1.11
BARCELONETA 3 SW	4.67	.44	2.59	-1.41	4.17	1.49	11.11	8.11	6.11	1.11	11.50	1.11
BARCELONETA 3 SW	1.61	.98	1.27	-.87	1.01	-.43	11.31	8.54	6.18	1.11	11.50	1.11
COJEDO	3.59	1.50	2.14	-.17	2.81	.18	11.22	7.1	4.72	1.11	11.50	1.11

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP.	DEPART.												
PUERTO RICO														
NORTH COASTAL 01														
ROBINSON AIRPORT	3.49	-.03	5.20	-.59	6.44	2.20	11.59	2.15	16.47	1.14	1.71	1.11	13.11	11.71
DOPADO 2 NW	7.30	1.67	6.15	1.50	2.05	-3.81	3.64	-2.31	16.64	-2.11	1.49	1.11	16.34	11.91
RIO PIEDRAL EXH STA	3.89	-1.63	6.12	.78	10.44	3.19	7.65	2.66	M	1.01	1.11	1.11	11.11	11.11
SAN JUAN INTL AP	4.70	.54	5.65	.43	4.50	1.10	4.63	-1.23	11.26	5.84	1.11	1.11	11.11	11.11
--DIVISIONAL DATA----->	4.85	-.02	6.78	.52	6.86	.37	5.98	1.05	12.79	6.71	4.74	1.11	11.11	11.11
SOUTH COASTAL 02														
AGUIFERE	1.92	-.87	5.19	.63	1.48	-5.27	5.24	-3.04	23.78	14.04	4.01	1.11	11.11	11.70
BOCA	.68	-1.22	3.13	-.26	2.32	-2.65	7.74	1.86	23.30	19.11	1.68	1.11	11.11	11.11
COAMO 2 SW					4.57	-3.31	6.33	-1.94	8.05	3.17	1.11	1.11	11.11	11.11
ENNEHADA 1 W	.00	-1.87	3.29	1.28	2.35	-3.25	6.40	-.91	21.13	14.77	2.81	1.11	11.11	22.11
LAJAS SUBSTATION	2.07	-.59	3.84	-1.65	4.08	-2.46	7.38	-.58	19.07	14.08	2.81	1.11	11.11	11.11
MAGUEYES ISLAND	1.51	-.15	2.60	-.90	2.19	-2.74	4.52	-.64	16.73	12.99	1.11	1.11	11.11	11.11
PONCE 4 E	2.73	-.25	3.85	-1.06	3.24	-3.66	7.14	-.74	14.51	19.29	4.19	1.11	11.11	19.66
SANTA ISABEL 2 ENE	2.55	-.34	4.23	-.35	1.18	-3.19	4.64	-2.40	18.65	15.40	5.11	1.11	11.11	11.11
SANTA PITA	.00	-1.74	2.55	-2.32	3.70	-2.10	2.68	-2.99	22.55	17.92	2.91	1.11	11.11	17.86
--DIVISIONAL DATA----->	1.43	-.77	3.58	-.58	2.78	-2.39	5.79	-.67	18.64	14.49	4.77	1.11	11.11	20.00
NORTHERN SLOPES 03														
BARCELONETA 3 SW	3.08		5.87		7.17		4.51		11.25		2.81		11.11	
CALERO CAMP	3.40	-.47	7.04	1.01	2.78	-2.98	5.34	2.53	10.95	5.17	1.11	1.11	11.11	11.54
CANOVANAS	4.97	-2.33	11.28	3.31	4.48	-2.68	4.98	-1.85	27.40	13.15	1.11	1.11	11.11	11.57
ISABELA SUBSTATION	6.95	2.31	7.06	.70	2.84	-3.33	11.11	3.87	13.50	8.20	1.11	1.11	11.11	17.18
MANATI 2 E	4.95	1.30	4.96	.56	6.41	.84	6.32	-.15	18.33	12.03	1.11	1.11	11.11	11.18
MORA CAMP	3.85	-.41	7.78	2.29	3.79	-1.60	4.37	-1.67	9.84	4.74	1.11	1.11	11.11	11.15
RINCON														
TPUJILLO ALTO 7 SSW	4.96	-.73	14.51	6.88	5.48	-2.23	8.98	1.46	18.24	10.97	1.11	1.11	11.11	14.06
--DIVISIONAL DATA----->	4.59	-.50	8.36	2.05	4.71	-1.21	7.12	1.33	14.81	8.20	4.47	1.11	11.11	4.61
SOUTHERN SLOPES 04														
MAYAGUEZ														
MAYAGUEZ CITY														
MAYAGUEZ AIRPORT	M		M	12.04	5.44	-5.05	12.41	3.61	M		1.65	1.11	11.11	
PATILLAS														
PERUENAS 1 NE	4.70		6.21		9.12		15.25		18.29		9.01		11.11	
ROOSEVELT ROADS														
SABANA GRANDE 2 ENE	4.96		4.74		11.24		14.14		14.71		3.10		11.11	11.11
YAUCO 1 NW	1.88		6.76		5.51		6.65		19.62		4.11		11.11	11.11
--DIVISIONAL DATA----->	3.49	-1.92	5.68	-1.50	7.40	-.42	11.41	2.18	19.35	13.26	5.40	1.11	11.11	16.12
EASTERN INTERIOR 05														
AGUINCO 1 S	6.26	3.31	5.91	1.43	8.72	2.46	7.75	1.14	25.43	19.64	8.11	1.11	11.11	11.52
BARABO SUBSTATION	3.13	-1.90	7.15	-.46	5.34	-2.60	6.73	-.55	17.76	10.49	8.11	1.11	11.11	17.89
CAGUAY ALIC	7.69	1.09	10.17	2.71	8.92	1.65	9.94	-.85	23.39	15.63	11.11	1.11	11.11	28.25
CUNTO 1 SE	4.96	-.66	5.96	-1.41	5.85	2.64	6.91	-.53	21.95	14.72	6.11	1.11	11.11	14.51
DAPAZO	1.27	2.40	8.97	.00	13.34	3.84	8.20	4.64	23.97	13.12	11.11	1.11	11.11	26.83
DIC. DEL ESTE	12.81	.60	14.50	-.16	17.72	-5.72	12.11	5.45	34.11	20.50	11.11	1.11	11.11	11.11
DIO BLANCO LAWR	6.70	-2.27	11.88	1.27	7.11	-3.68	9.14	3.47	11.15	30.39	10.84	1.11	11.11	17.24
SAN LOPEZ	9.18		9.60		6.36		3.14		21.10		10.84		11.11	
SIBERIA ALBERO	M		M		M		M		M		M		M	
--DIVISIONAL DATA----->	7.54	1.43	9.25	.30	9.04	1.12	9.69	-1.24	21.97	17.02	10.10	1.11	11.11	34.65
WESTERN INTERIOR 06														
AGUADANA	1.76	-2.61	8.84	2.11	7.95	2.71	12.44	4.74	20.39	13.57	8.10	1.11	11.11	18.83
ALBERTAL NW	1.53	-2.65	5.34	-4.95	10.36	1.60	13.64	9.17	11.43	12.05	6.73	1.11	11.11	19.11
ALMONTAR SUBSTATION	6.30	.07	5.27	2.83	9.23	-2.84	15.17	5.23	15.12	5.80	6.84	1.11	11.11	12.11
ARECIBO OBSERVATORY	3.17	-2.52	9.39	2.84	9.43	-.11	11.17	2.77	10.38	4.01	6.05	1.11	11.11	7.93
CACAYAS - RUCAYAS	3.35	-.24	3.31	-2.82	9.40	1.77	14.11	5.60	19.64	12.15	8.17	4.17	11.11	15.03
CERRO MREAVILLA	3.31	-2.56	2.16	-1.42	1.76	-6.11	11.11	9.01	M		M		M	
COLON	5.05	-2.88	10.38	2.8	8.99	-1.65	11.84	3.23	8.88	4.34	6.05	3.39	10.25	13.58

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JAN		FEB		MAR		APR		MAY		TOTAL	
	PRECIP	DEPARTURE										
AGUADILLA CURTIENGA	6.10	1.85	2.34	2.14	3.84	1.41	11.34	1.77	2.81	-4.87	1.35	1.11
AGUAS BUENAS	3.10	.28	1.94	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES DAM	2.71	.84	1.94	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES CONSTANZA	3.16	1.17	2.34	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES FISH HATCHERY	3.67	1.54	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 1 N	1.34	-1.33	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 2 NW	2.57	-1.23	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 1 R	6.78	2.47	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 2 SW	3.22	1.17	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 1 E	1.76	-.91	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES 2 E	2.41	.71	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
- DIVISIONAL DATA - - - - ->												
AGUAS CALIENTES ISLANDS 07	1.43	-.85	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
AGUAS CALIENTES ISLAND 2	1.43	-.85	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
- DIVISIONAL DATA - - - - ->												
VIRGIN ISLANDS												
ST THOMAS 01												
BENNICOCK BAY ST THOMAS	2.35	.24	1.19	1.19	M	1.19	11.34	1.97	8.41	1.88	1.11	1.11
TROMAN FIELD AIRPORT	1.65	-.24	1.19	1.19	M	1.19	11.34	1.97	8.41	1.88	1.11	1.11
WINTBERG	2.60	-.53	1.19	1.19	RR	1.19	10.34	1.97	8.41	1.88	1.11	1.11
- DIVISIONAL DATA - - - - ->	2.00	-.55	1.19	1.19								
ST JOHN 02												
ALEX HAMILTON FLD FAA	M		M		M		M		M			
ANNALY	M		M		M		M		M			
BETH UPPER NEW WORKS	2.73	.62	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
EAST HILL	1.51	-.03	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
GRANARD	1.80	-.28	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
MONTPELLIER	1.11	-1.05	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
- DIVISIONAL DATA - - - - ->	1.86	-.69	1.19	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
ST JOHN 03												
CORAL BAY	2.69	-.20	1.62	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
CRUISE BAY	1.35	-.34	2.34	1.19	1.11	1.94	10.34	1.97	8.41	1.88	1.11	1.11
CRUISE BAY	1.11											

PUERTO RICO AND VIRGIN ISLANDS
2003

TOTAL PRECIPITATION AND DEPARTURES FROM NORMAL (INCHES)

STATION	JUL		AUG		SEP		OCT		NOV		DEC		ANNUAL	
	PRECIP	DEPART												
COROZAL SUBSTATION	4.30	-1.26	5.93	-1.75	8.14	-1.11	7.63	-1.97	11.62	4.04	6.90	8.9	70.32	-1.75
DOS BOCAS	3.75	-1.62	5.73	-1.63	8.71	1.27	11.76	5.17	9.64	3.06	5.99	1.98	77.35	2.77
GUAJAYATA DAM	3.64	-1.44	7.28	1.39	8.23	-1.10	7.93	1.41	13.29	7.39	3.39	-1.35	42.43	-1.41
HACIENDA CONSTANZA	5.22	-4.51	10.91	1.81	7.88	8.19	5.00	3.35	19.35	4.80	2.00	6.66	61.69	-13.44
MARICAO 2 SSW	4.89	-3.63	3.94	-7.34	16.27	2.17	13.14	-1.46	16.16	6.97	16.22	6.51	195.46	5.45
MARICAO FISH HATCHERY	5.25	-3.73	6.46	-5.23	13.93	4.70	11.13	3.34	18.08	9.55	8.28	5.11	73.56	7.00
MOROVIS 1 N	5.87	2.03	6.73	1.54	16.17	2.70	6.43	1.19	14.31	7.67	6.26	1.21	78.12	11.34
NEGRO-COROZAL	5.45	1.75	6.28	1.71	11.17	1.84	6.43	1.67	13.10	5.94	5.66	1.59	136.34	
TOPO NEGRO FOREST	3.03		7.52		11.17		8.61		28.95		10.48		61.84	-1.71
VILLALBA 1 E	1.74	-3.17	5.20	-1.44	6.83	3.11	10.00	1.61	14.57	7.66	4.12	2.21	81.11	7.25
--DIVISIONAL DATA-----	4.63	-1.87	6.80	-1.49	6.11	1.27	11.06	2.99	14.88	7.55	6.65	2.85	81.11	
OUTLYING ISLANDS 07														
MONA ISLAND 2	1.66	-1.01	3.72	1.51	1.34	1.11	8.64	4.23	8.29	4.19	7.25	5.16	49.17	13.09
--DIVISIONAL DATA-----	1.66		3.72		1.34		8.64		8.29		7.25		49.17	
VIRGIN ISLANDS														
ST THOMAS 01														
REDHOOK BAY ST THOMAS	2.03	-1.47	1.65	-2.49	3.91	1.17	1.91	1.49	M		M		M	
TRUMAN FIELD AIRPORT E	2.81	1.39	3.34	-1.16	M		1.38	1.80	18.19	14.11	1.99	1.25	M	51.11
WINIBERG	3.37	1.48	2.20	-2.07	2.34	1.17	1.54	1.31	17.63	12.09	1.65	-1.57	47.16	1.24
--DIVISIONAL DATA-----	2.74	-1.34	2.40	-2.21	3.07	2.36	2.54	1.27	18.01	11.79	3.33	-1.43	49.37	3.20
ST CROIX 02														
ALEX HAMILTON FLD FAA ANNALY	M		M		M		M		M		M			
BETH UPPER NEW WORKS														
EAST HILL	3.33	1.67	3.12	-1.52	2.03	1.77	1.67	1.52	13.19	15.16	4.97	1.97	49.41	9.42
GRANARD														
MONTPELLIER	6.81	3.50	6.39	2.65	1.25	4.30	1.11	1.77	M		1.00	-1.58	51.10	4.76
--DIVISIONAL DATA-----	5.07	1.99	4.76	1.15	1.64	3.07	1.49	2.30	20.19	13.93	3.93	1.23	51.10	
ST JOHN 05														

APPENDIX B

COMPUTATIONS

AVERAGE RUNOFF VOLUME	
Area, Acres	5292
m2	21168000
Mean Precipitation, inch/year	70
m/year	1.778
Volume, m3/year	37636704
cu ft /year	1328107150
cuft/day	3638650
gall/day	27217100
Runoff Coeficient	0.65
Estimated Runoff Volume, GPD	17691115
Estimated Runoff Volume, MGD	17.6911

MEAN ANNUAL DISCHARGE	
Area, sq mi	8.26875
S	0.2
Index	100
Q, cfs	40.11631678
gpd	25926052.28