Appendix B

Hydrology Study

Apéndice B

Estudio Hidrológico

Hydrologic Study

Synergy-Barceloneta, Barceloneta, Puerto Rico

Prepared for: Municipality of Barceloneta

Prepared by: PMG & Associates
Civil & Environmental Engineering Services

October 27, 2011

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION

Sunbeam Synergy Puerto Rico Corporation (SSPRC) is an independent power producer whose approach is based on the development of the appropriate use of waste to produce energy. SSPRC proposes the installation of a waste to energy facility to generate electricity from waste products. The Project is proposed on a farm with approximately 20.5 acres in the northern Puerto Rico area, located near the intersection PR-140 and PR-2, Barrio Cachete, within the Municipality of Barceloneta. Appendix A shows a location map and Appendix B a schematic plan of the SSPRC facility.

1.1 Study Purpose

The purpose of this study is to generate hydrologic data to estimate the flows and to determine the storm-water management facilities required to manage the excess runoff, if any, produced by the proposed development.

1.2 Scope of Work

The scope of work of this study is to generate hydrologic data required to estimate the peak flows and to determine the excess runoff produced by the project before and after the SSPRC is in place. The following tasks were performed to complete the hydrologic analysis scope of work:

1. Watershed delineation and flow pattern determination for the watershed contributing to the study reach;
2. Determination of soil type and land cover for the delineated watersheds;
3. Determination and assignment of design storm precipitation values for all watersheds;
4. Curve Number estimation for each delineated watershed based on the soil type and land cover;
5. Determination of time of concentration for each watershed;

6. Development and construction of a HEC-HMS (COE, V.3.4) hydrologic simulation model to determine the maximum flood flows generated by storm events with return periods of 2, 5, 10, 25, 50 and 100 years and 24 hours of duration for pre-developed and proposed condition;
7. Recommend the minimum storage volume required to manage the excess runoff.

2. DESCRIPTION OF STUDY AREA

2.1 Topography and Water Bodies

The Project area is located near the intersection of PR-140 with PR-2 at Cruce Dávila, Barrio Cachete, Barceloneta. The topography is highly variable with short distances principally to the south of the project where "mogotes" exist in the area. Elevation varies from 77.5 to 154 meters. The project site receives discharge waters from three offsite basins that drain by overland flow process to two natural discharge points, according to the topographic maps. Overland flow is the dominant drain process in the sub-basins indentified.

The land in the project site is fairly flat and is mostly brushes and grassland land cover. No water bodies are found within the project site. The nearest water body is Quebrada Cimarrona which can be found approximately 750 meters south of the project site. Quebrada Cimarrona is a tributary to Rio Grande de Manatí.

2.2 Flood Zone Classification

The project site is outside of the flood zone AE and is classified as Zone X according to FEMA's Flood Insurance Rate Map (FIRM) Panels #72000C0270J and #72000C0265H; November 19, 2009. Appendix C shows the Flood Prone Area Map.

2.3 Field Inspection

Field inspection along the study area was concluded on September 09, 2011. Local flow patterns were observed as well as outfall points from the delineated sub-basins. Field inspection also confirmed terrain roughness, vegetation cover, and urban development. The pictures collected in the field visit are shown in Appendix D.

3. HYDROLOGIC ANALYSIS

The major driving forces for the rainfall-runoff process are the intensity and duration of storm events, followed by watershed characteristics that translate the rainfall input into an output hydrograph at the outlet of the basin. Size, slope, shape, soils, and storage capacity are all important parameters in watershed geomorphology. Land use and land cover parameters can significantly alter the natural hydrologic response through increases in impervious cover, altered slopes, and improved drainage channel networks.

A hydrologic analysis was conducted to establish the peak discharge and runoff volumes frequency relationships for floods of the selected recurrence intervals for the project area.

3.1 Hydrologic Analysis Methodology

Advances in computer methods combined with larger and more extensive data-monitoring efforts have allowed for the development and application of simulation models in hydrology. Such models incorporate various equations to describe hydrology transport process and account for water balances through time.

The hydrologic simulation was performed in accordance with the methods developed by the Soil Conservation Service (SCS, Ref. 4). The hydrologic model used was HEC-HMS (Vers. 3.4) by the U.S. Army Corp of Engineers (Ref. 5). This computer program estimates the surface runoff resulting from any synthetic or natural rainstorm. Rainfall is transformed to runoff via unit hydrograph methods. Discharge is computed at the outlet of each sub-area.

3.2 Watershed Description

Our study divides the basin in five sub-basins for the pre-developed and proposed condition. Three of which are located upstream of the project site (Sub-Basin A1, Sub-Basin A-2 and Sub-Basin A-3) and two drain through the project

(Sub-Basin A-4 and Sub-Basin A-5). Sub-Basin A-1 has an area of 0.34 km^2 (84.3 acres) and the discharge point is located at west of the project site and drains by overland flow. The Sub-Basin A-2 has an area of 0.026 km^2 (6.5 acres) and drains to the southwest of the project site that will be developed. The Sub-Basin A-3 has an area of 0.094 km^2 (23.2 acres) and drains to the southeast of the project site that will not be developed. Sub-Basin A-4 (0.059 km^2) and A-5 (0.023 km^2) drain by overland flow from the project to two different discharge points. Sub-Basin A-4 is the watershed impacted by the development and Sub-Basin 5 is located within the Project Site, however this area will not have any construction activities, thus natural conditions will be preserved. Table 3.1 shows the resulting contributing areas for the Sub-Basins and Appendix E the Watershed Map.

3.3 Design Storm and Rainfall Data

The precipitation for the 2, 10, 25, and 100 years return period and 24 hours durations, where obtained from Atlas 14 Hydrometeorological Design Study Center at a latitude of 18.4233 and longitude of -66.5652. The values read are presented on Table 3.1 (See Appendix F). Rainfall temporal distributions were established according to the frequency distribution method. Appendix F shows the incremental rainfall distribution.

Table 3.1. Rainfall average values for storms with different return periods and 24-hour duration.

Precipitation Depth corresponding to Tr and 24 hours (inches)					
2	**5**	**10**	**25**	**50**	**100**
50 %	20 %	10%	4%	2%	1%
4.94	6.45	7.76	9.65	11.2	12.9

3.4 Runoff Curve Number

The SCS method of runoff estimation involves the computation of a runoff Curve Number (CN). This number corresponds to hydrologic soil-cover relations and land uses. The major factors to determine CN are the hydrologic soil group, cover type, and antecedent moisture condition.

Values of CN were obtained from tables prepared by the SCS for the Caribbean area and were weighted according to the soil type and land use area percentage on each sub-basin. Soil characteristics of the study area were identified by means of soil maps. The United States Department of Agriculture Soil Conservation Service (Ref. 6), in cooperation with the University of Puerto Rico has published soil maps as known as SSURGO maps and classified the soils according to their hydrologic characteristics. This method classifies the soils in four hydrologic groups according with their infiltration capacity. A soil classified A has a high infiltration rate and a soil with letter D has a slow infiltration rate, generally present with clay soil texture. The PRPB has digitized these maps. Land cover for the site was assigned base on aerial photography and site visit.

Runoff CN's were determined using the information provided in the Soil Map and Land Cover MAP together with the SCS tables. The combination of the soil and land cover map was achieved using GIS techniques.

3.4.1 Land Uses

The primary developed area within the study basin area is the Sector Hector Ruiz residential areas at Barceloneta and some industries. The entire study drainage basin is located within the Municipality of Barceloneta. Vegetation varies from brushes and pastureland in the lower part of the basin to woodland areas in the upper part. For the proposed condition, the land use for the waste to energy plant used in the hydrologic model is assumed to be light industry. The land cover map for the pre-developed and developed condition is shown in Appendix G.

3.4.2 Soil Type

Soil types within the basin are variable, the most common soil type found are Bayamon clay (MoF) with an area of 0.175 km^2 and clay soil texture, fallow by Rock outcrop Tanama complex and Bayamon clay loam with an area of 0.164 km^2 and

0.106 km^2 respectively. The predominant hydrologic soil group is type B with 0.373 km^2, and type D with 0.171 km^2. Appendix H shows the soil map.

Soil map data and landcover data were combined to obtain a CN. Once combined, soil and landuse properties were tabulated to obtain a weighted CN value for each sub-basin. Appendix I shows the CN calculation table. The computed CN for each sub-basin is shown on Table 2.

3.5 Time of Concentration

The time of concentration is a watershed characteristic that measure the runoff time and is defined as the travel time of a water particle from the hydraulically most remote point in the basin to the outflow location. The time of concentration was estimated for each basin using the commonly used method known as Soil Conservation Service (SCS) TR-55 Method. According with the SCS, water moves through a watershed as sheet flow, shallow concentrated flow, open channel, or some combination of these processes. The types that occur depend on the drainage area and can best be determined by field inspection.

SCS TR-55 equation follows and the computed times are shown in Table 2.

3.5.1 Sheet Flow

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

where:

Tc = time of concentration (hr)

L = stream flow length (ft)

S = stream slope

P_2 = 2 year, 24 hours rainfall (in)

n = Manning's coefficient

3.5.2 Shallow Concentrated Flow

After a maximum of 300 ft, sheet flow usually becomes shallow concentrated flow.

$T_c = L / 3600V$ where V is the velocity and its function of the land slope and the type of the soil cover, this velocity is estimated by Figure 3.1 at TR-55.

Hydrologic properties used to estimate the Tc for each basin is presented on Appendix I. The lag time is used as input parameter in the hydrologic model when the SCS Unit hydrograph method is applied. It is defined as the difference in time between the center of mass of net rainfall and center of mass of runoff and is calculated as 0.6*Tc.

3.6 Hydrologic Simulation

The hydrologic simulation model used for this study was HEC-HMS (Vers. 3.3). The simulation model incorporates 5 sub-basins with their respective hydrologic properties presented on Table 3.2. No reach routing computations were performed in the model, because no hydrograph attenuations are expected in short distances. Three junctions are calculated in the hydrologic simulation. Junction 1 receives runoff from Sub-Basins A-1, A-2 and A-4, where the longest time of concentration is from Sub-Basin A-1 (50 min). Junction 2 collects runoff water from Sub-Basin A-3 and Sub-Basin A-5.

The proposed conditions include the evaluation of excess runoff by the project area development with the waste to energy plant. Only Sub-basin A-4 will be impacted by the proposed development. All other sub-basins will preserve existing conditions.

Figure 3.1 shows the hydrologic configuration used in HEC-HMS for the existing and proposed condition.

Table 3.2. General hydrologic properties for sub-basins.

Sub-Basins	Parameters				
		Actual Condition		Proposed Condition	
	Area (km^2)	CN (AMC II)	Tc (min)	CN (AMC II)	Tc (min)
Sub-Basin A-1	0.341043	66.9	50.0	66.9	50.0
Sub-Basin A-2	0.026365	70.6	45.0	70.6	45.0
Sub-Basin A-3	0.093798	66.3	5.2	66.3	5.2
Sub-Basin A-4	0.05943	56.7	42.7	81.8	14.7
Sub-Basin A-5	0.02267	56.3	15.6	56.3	15.6

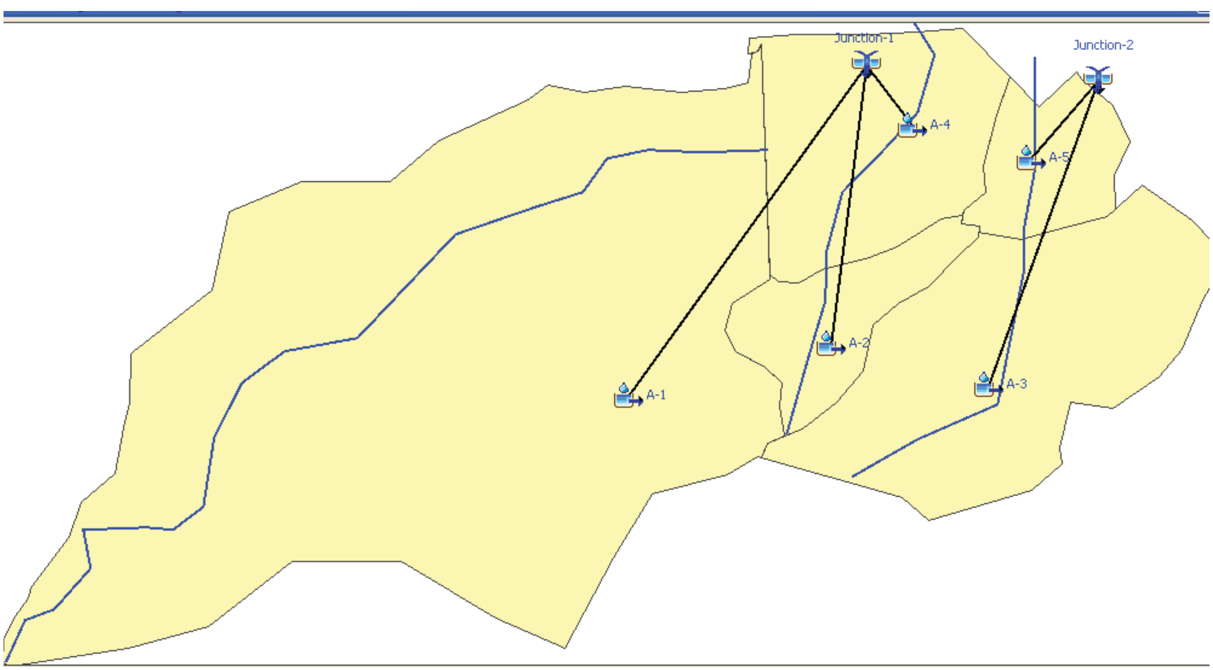


Figure 3.1. Configuration of hydrologic simulation model.

3.6.1 Hydrologic Analysis Results

The SCS Dimensionless Unit Hydrograph Method was used to calculate the design discharge for the 2, 5, 10, 25, 50 and 100 years storm event with 24-hour duration. The SCS method uses the Lag time instead of the Tc. The Lag Time can be obtained by multiplying the Tc by 0.6.

Table 3.3 and Table 3.4 show the simulation results for current hydrologic condition and proposed condition respectively. The table shows that a runoff increment of 1.224 cms (43.23 cfs) occurs for Subasin A-4 due to the proposed development. However, on Junction 1 the difference is not as noticeable. The reduction in difference can be attributed to the convolution of hydrographs at the junction. Nevertheless, the excess runoff must be managed within the project site before discharging it downstream.

Table 3.3. Hydrologic simulation results for existing condition

Basin/Junction ID	Return Period	100	50	25	10	5	2
	Drainage Area	Peak Discharge					
	(Km^2)	(cms)					
Sub-Basin A-1	*0.341043*	*6.576*	*5.942*	*5.272*	*4.254*	*3.295*	*1.946*
Sub-Basin A-2	*0.026365*	*0.565*	*0.516*	*0.464*	*0.384*	*0.306*	*0.193*
Sub-Basin A-3	*0.093798*	*4.098*	*3.722*	*3.310*	*2.684*	*2.085*	*1.221*
Sub-Basin A-4	*0.059430*	*0.997*	*0.869*	*0.738*	*0.549*	*0.384*	*0.178*
Sub-Basin A-5	*0.022670*	*0.555*	*0.484*	*0.41*	*0.304*	*0.209*	*0.09*
Junction-1	*0.426838*	*8.117*	*7.311*	*6.459*	*5.177*	*3.978*	*2.314*
Junction-2	*0.116468*	*4.488*	*4.057*	*3.588*	*2.879*	*2.207*	*1.26*

Table 3.4 Hydrologic simulation results for proposed condition

Basin/Junction ID	Return Period	100	50	25	10	5	2
	Drainage Area	Peak Discharge					
	(Km^2)	(cms)					
Sub-Basin A-1	*0.341043*	*6.576*	*5.942*	*5.272*	*4.254*	*3.295*	*1.946*
Sub-Basin A-2	*0.026365*	*0.565*	*0.516*	*0.464*	*0.384*	*0.306*	*0.193*
Sub-Basin A-3	*0.093798*	*4.098*	*3.722*	*3.310*	*2.684*	*2.085*	*1.221*
Sub-Basin A-4	*0.059430*	*2.221*	*2.094*	*1.948*	*1.723*	*1.482*	*1.09*
Sub-Basin A-5	*0.022670*	*0.555*	*0.484*	*0.41*	*0.304*	*0.209*	*0.09*
Junction-1	*0.426838*	*8.022*	*7.279*	*6.497*	*5.3*	*4.161*	*2.534*
Junction-2	*0.116468*	*4.488*	*4.057*	*3.588*	*2.879*	*2.207*	*1.26*

3.6.2 Pond Volume Estimation

As shown on Table 3.3 and Table 3.4, the proposed development will generate higher peak flows at Sub-Basin-4, therefore the excess runoff must be managed. When comparing the storm water hydrograph from existing and proposed conditions it can be determine that approximately 5,460 cubic meters (4.4 acre-feet) are required to manage the excess runoff. To accomplish this, a detention pond will be required. The Figure 3.2 shows the difference between the existent and proposed condition for 100 years return period.

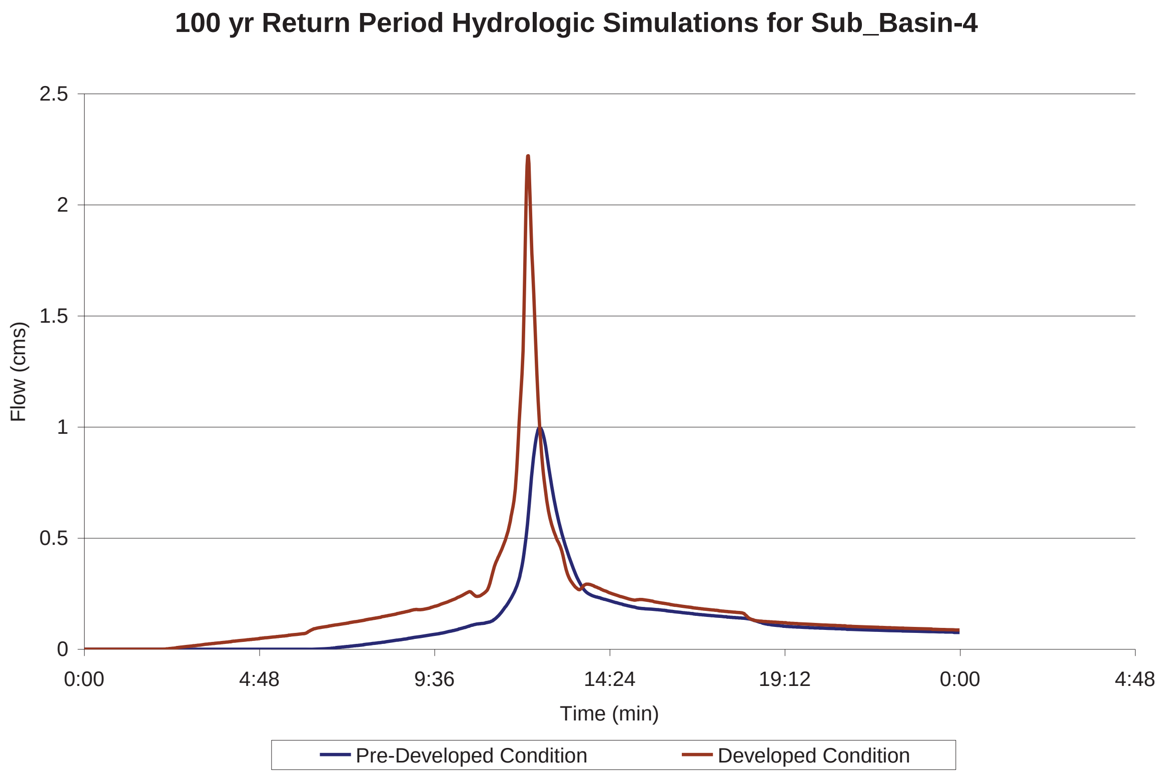


Figure 3.2 Hydrograph comparison between existing and proposed conditions for 100 years return period.

3.7 Cooling System

The energy generation process needs water volume to cool the system. The estimated water quantity to cool the waste to energy process was calculated in 250 gal/min or 1362 cubic meters per day.

If the storm water management pond is to be used also for the cooling process then, additional storage volume will be required.

The mean annual rainfall for the project area is estimated in 60 inches per year or 5 feet per year (REF 8). The drainage area contributing to the project site is equivalent to the one determined for Junction 1 which is in total approximately 105 acres. The available runoff by average annual rainfall at the pond will be 365 acre*ft/year or 1 ac-ft per day. This water could be used to replace evaporation losses due to the cooling system.

4. CONCLUSIONS AND RECOMMENDATIONS

After performing a hydrologic study for the Storm-Water Management of the Synergy Waste to Energy Power Plant, the following conclusions and recommendations can be made:

- The project site consists of a parcel of approximately 14 acres.
- Currently the entire project site is undeveloped.
- Approximately 11 acres will be used for the project development
- The site topography is very flat which provides for the surface runoff to flow overland under sheet flow conditions towards drainage swales located along the center of the property.
- To manage the excess runoff, 5,460 cubic meters of storage above should be provided within a proposed pond.
- Pond outflow must be controled by an outlet structure designed to discharge equal or less flow than pre-developed condition results. The outlet structure dimensions shall be sized based on the pond configuration and pond water levels.
- The outlet structure should include an emergency overflow provision in case flows higher than design conditions are generated.
- If the retention pond is to be used as part of the cooling process, then additional storage should be provided. The outlet structure should consider the additional storage as well.

5. LIMITATIONS OF STUDY

This study has been prepared according to accepted engineering practices. The conclusions and recommendations provided on this report are based on the data available at the time the study was completed. **It is the responsibility of the design engineer to follow all of the recommendations stated on this report**. Changes to the proposed site layout and\or any of the improvements recommended on this report should be consulted with the hydrologist preparing this document, as it could alter or invalidate some or all of the results presented herein.

6. REFERENCES

1- Puerto Rico Planning Board. "Reglamento Sobre Areas Especiales de Riesgo a Inundación: "Planning Regulation Num. 13." (2005)

2-FEMA, Flood Insurance Study for the Commonwealth of Puerto Rico, Nov 18, 2009

3- U.S. Department of the Interior, Geological Survey. (unpublished). Regional Flood Frequency for Puerto Rico. M. A. Lopez (author).

4- SCS, National Engineering Handbook, Section 4, 1985

5- HEC, Hydrologic Modeling System- Version 3.4, Davis, CA, 2009

6- SCS, Soil Survey of San Juan Area Puerto Rico, Department of Agriculture SCS, Nov. 1978

7- Ramos-Ginés, O., Estimation of Magnitude and Frequency of Floods for Streams in Puerto Rico: New Empirical Models: USGS Water-ResoSSPRCes Investigations Report 99-4142. San Juan, Puerto Rico, 1999 (Appendix 1, page 34).

8- GLM Engineers, Mean Annual Rainfall Map for Puerto Rico, DRNA, June 2009

9- Hydrology Subcomittee of the Interagency Advisory Comittee on Water Data, Guidelines for Determining Flood Flow Frequcncy: Bulletein 17B of the Hydrology Subcomittee, Office of Water Data Coordination, U.S. Geological Survey, Reston, VA, 1982.

10- Arcement, G.J., Schneider, V.R. Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains: USGS Water-Supply Paper 2339. United States Government Printing Office, 1989.

11- Cowan, W.L., Estimating Hydraulic Roughness Coefficients: Agricultural Engineering, v. 37, no 7, p. 473-475, 1956.

12-Chow V. T. Handbook of Applied Hydrology. McGraw-Hill Book Company. (1964)

13-Bedient, P. and W. Huber. Hydrology and Floodplain Analysis. Addison-Wesley Publishing Company. (1992)

14-Gupta, R.S. Hydrologic and Hydraulic System. Prentice Hall Inc. (1989)

15-McCuen, R.H. Hydrologic Analysis and Design. Prentice Hall Inc. (1998) Puerto Rico

7. CERTIFICATION

I, Pedro M. García Campos, MSCE, PE, hereby certify that the calculations included on **Hydrologic Study for Synergy Waste to Energy Power Plant**, Barceloneta Puerto Rico were performed by me.

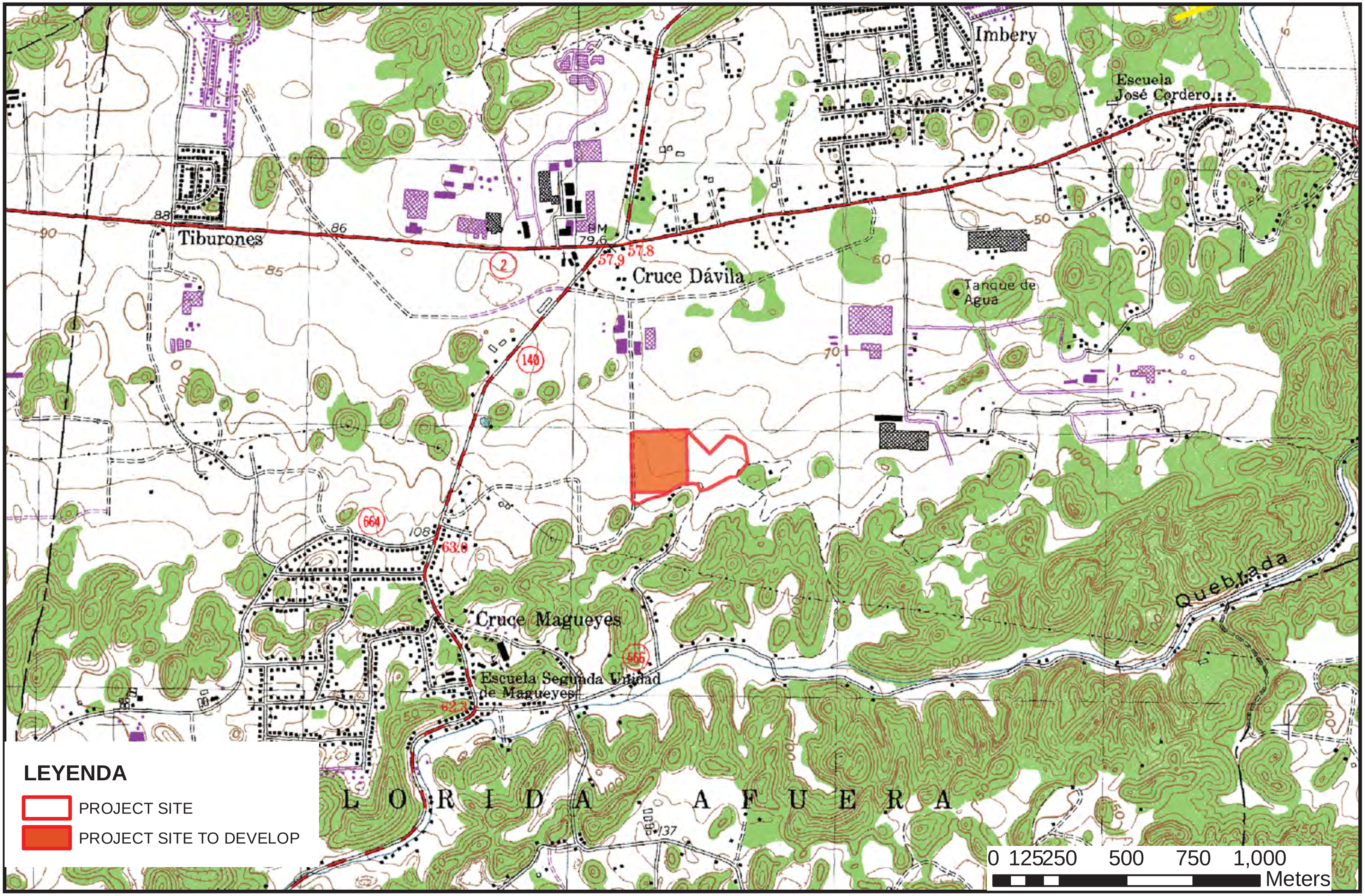
Related to this report, I certify that to the best of my knowledge, the information included on this document is truthful, correct, and complete.

Pedro M. García Campos, MSCE, PE

Lic. 18874

8. APPENDICES

Appendix A: Location Map



N W E S

SCALE: 1:20,000

LOCATION MAP
SYNERGY-BARCELONETA PROJECT

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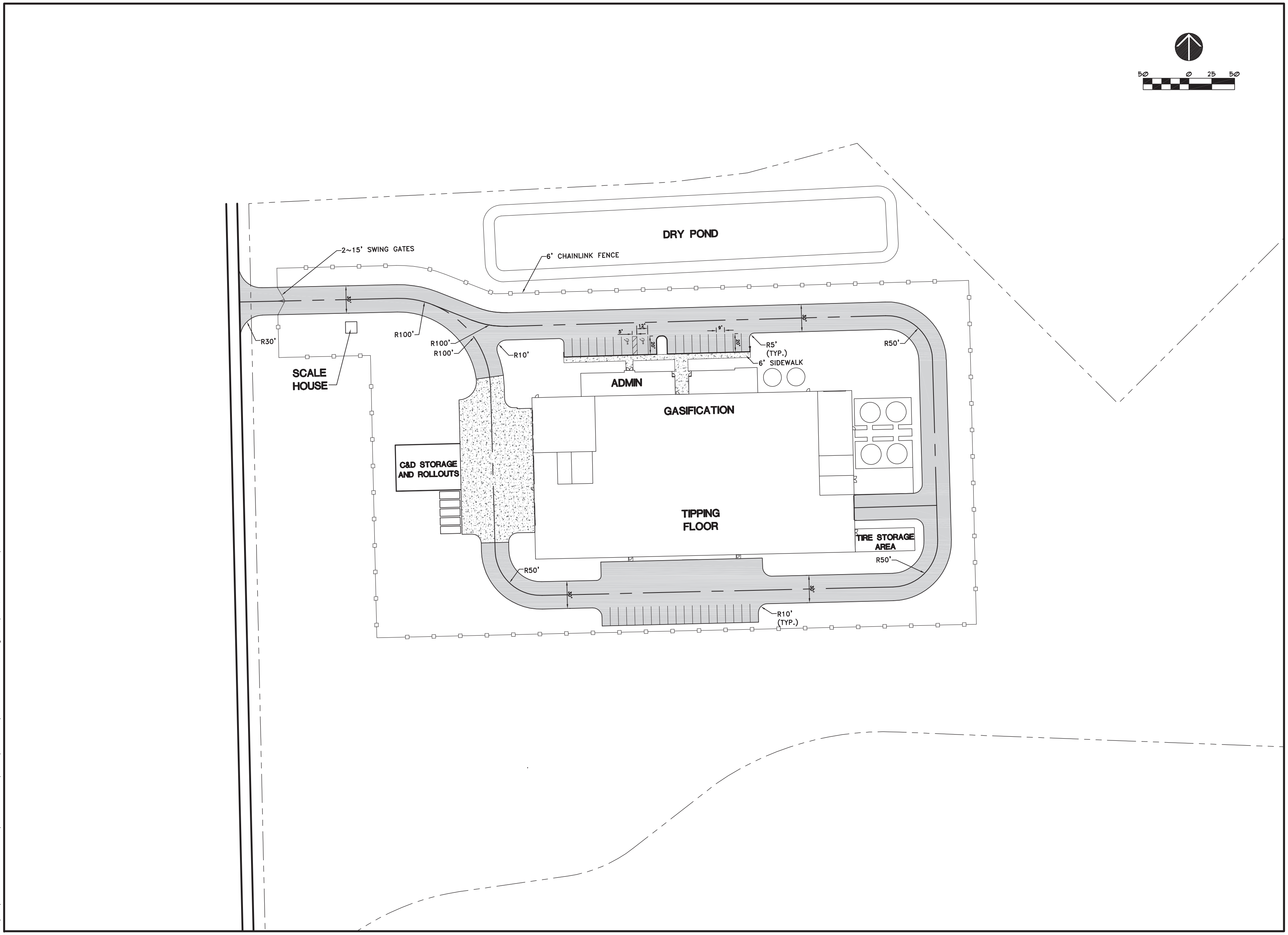
Civil & Environmental Engineering Services
Tel:939-645-3500 Fax. 787-743-8983 www.pmggroupllc.com
Acosta #12 Barrio Pueblo Caguas, PR 00725

SOURCE: USGS QUADRANGULE BARBELONETA

Appendix B: Proposed SSPRC Layout



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DATE : 9-15-11
PROJECT NO. : 110007.01
DESIGNED BY : RPS
DRAWN BY : DPT
SCALE : AS NOTED

No.	Date	Revision

THIS DRAWING NOT RELEASED FOR CONSTRUCTION UNLESS SO NOTED ABOVE

SHEET TITLE

FACILITY LAYOUT/SITE PLAN

DESIGN DOCUMENT
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SHEET

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Appendix C: Flood Prone Area Map

70000 FT

ty map revision history prior to Commonwealth of Puerto Rico and mapping, refer to the Community Map History table located in the Flood dy report for this jurisdiction.

if flood insurance is available in this community, contact your Insurance e National Flood Insurance Program at 1-800-638-6620.

N

MAP SCALE
1:10,000

0.25 0 0.5
Kilometers

500 1,000 1,500 2,000 2,500 3,000 3,500
Feet

5 0.125 0 0.25
Miles

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0270J

FIRM
FLOOD INSURANCE RATE MAP

COMMONWEALTH OF PUERTO RICO AND MUNICIPALITIES

PANEL 270 OF 2160

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PUERTO RICO	720000	0270	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
72000C0270J

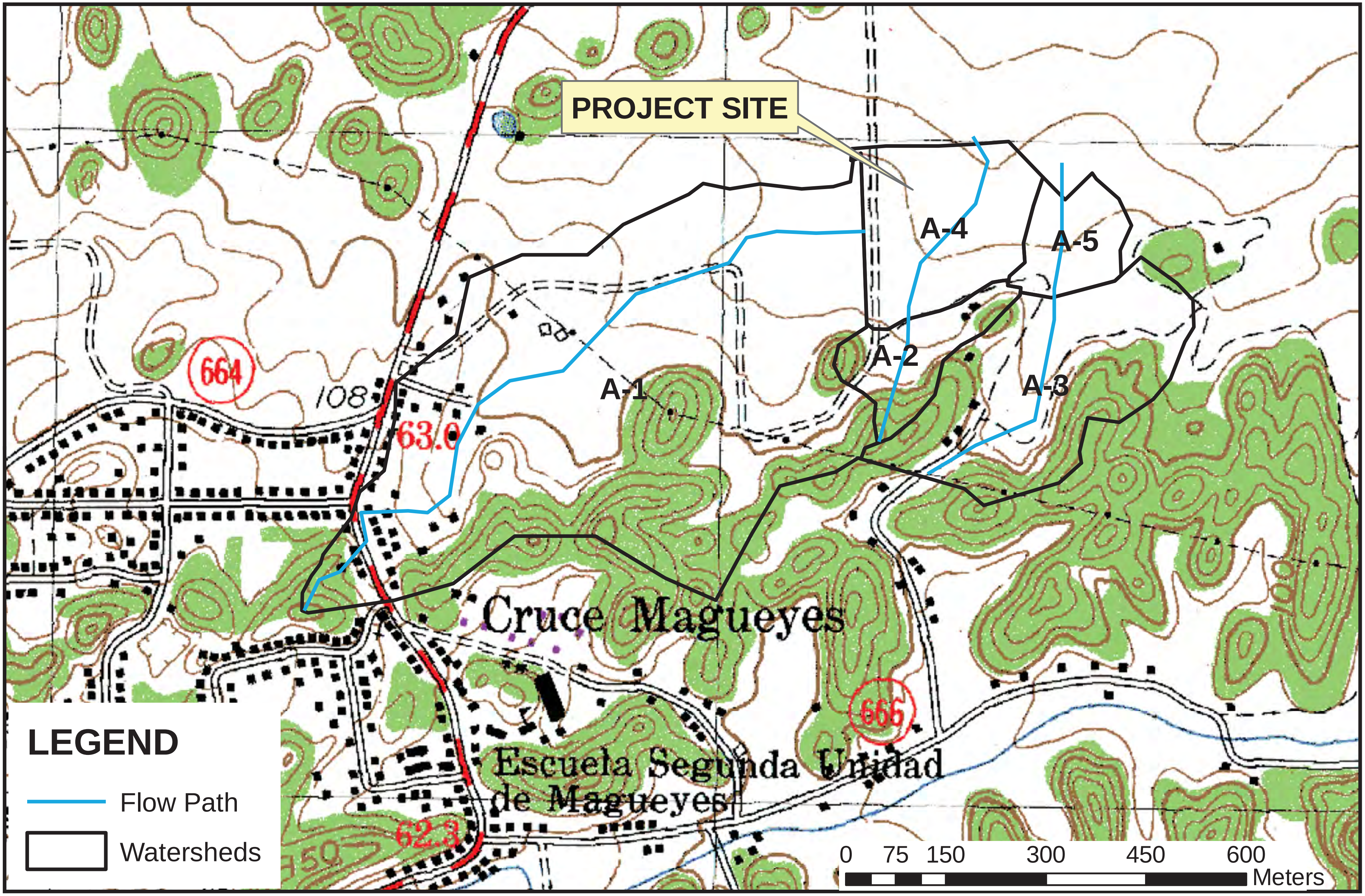
MAP REVISED
NOVEMBER 18, 2009

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix D. Field Photos

Appendix E: Watershed Map



SOURCE: USGS QUADRANGULE BARBELONETA

N W E S

SCALE: 1:8,000

WATERSHED MAP

SYNERGY-BARCELONETA PROJECT

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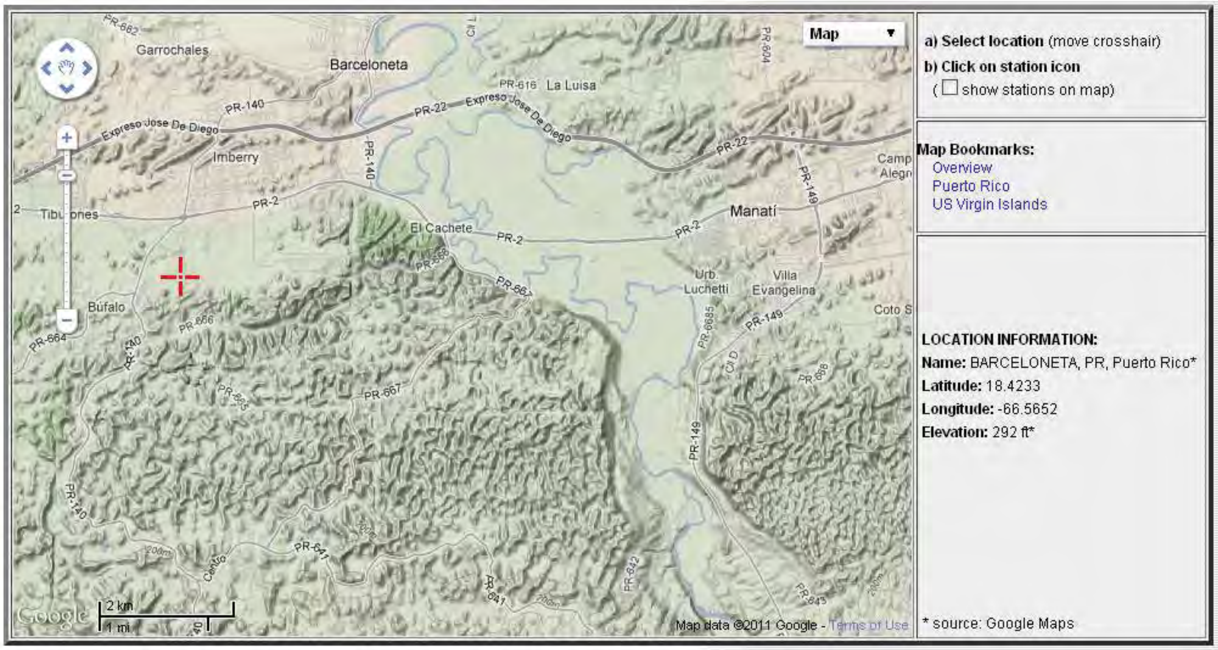
Appendix F. Precipitation Data

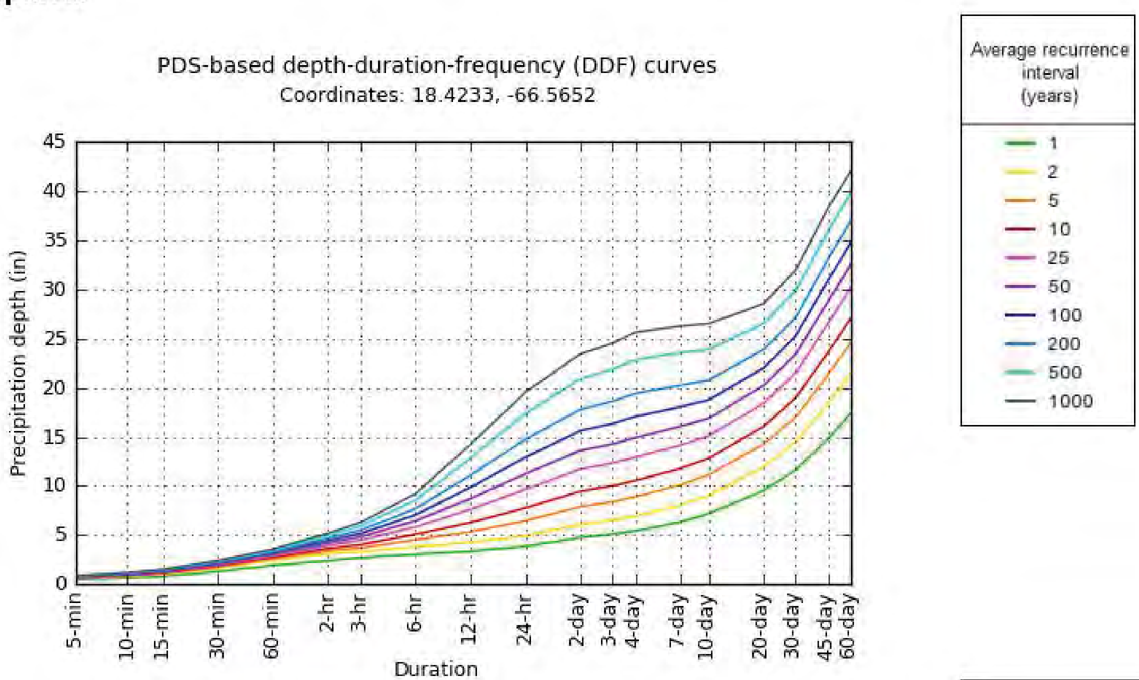
PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
		50	20	10	4	2	1			
5-min	**0.458** (0.454-0.506)	**0.585** (0.558-0.612)	**0.625** (0.596-0.655)	**0.66** (0.629-0.692)	**0.703** (0.669-0.742)	**0.735** (0.697-0.780)	**0.764** (0.722-0.815)	**0.794** (0.746-0.854)	**0.831** (0.774-0.904)	**0.858** (0.795-0.941)
10-min	**0.626** (0.620-0.692)	**0.8** (0.762-0.836)	**0.854** (0.815-0.895)	**0.903** (0.860-0.946)	**0.96** (0.914-1.01)	**1** (0.953-1.06)	**1.04** (0.987-1.11)	**1.08** (1.02-1.17)	**1.14** (1.06-1.24)	**1.17** (1.09-1.29)
15-min	**0.804** (0.796-0.888)	**1.03** (0.978-1.07)	**1.1** (1.05-1.15)	**1.16** (1.10-1.21)	**1.23** (1.17-1.30)	**1.29** (1.22-1.37)	**1.34** (1.27-1.43)	**1.39** (1.31-1.50)	**1.46** (1.36-1.58)	**1.5** (1.39-1.65)
30-min	**1.29** (1.27-1.42)	**1.64** (1.57-1.72)	**1.76** (1.67-1.84)	**1.85** (1.77-1.94)	**1.97** (1.88-2.08)	**2.06** (1.96-2.19)	**2.15** (2.03-2.29)	**2.23** (2.10-2.40)	**2.33** (2.17-2.54)	**2.41** (2.23-2.64)
60-min	**1.91** (1.89-2.11)	**2.44** (2.32-2.55)	**2.6** (2.48-2.73)	**2.75** (2.62-2.88)	**2.93** (2.79-3.09)	**3.06** (2.90-3.25)	**3.19** (3.01-3.39)	**3.31** (3.11-3.56)	**3.46** (3.23-3.77)	**3.57** (3.31-3.92)
2-hr	**2.4** (2.40-2.66)	**3.09** (2.94-3.24)	**3.4** (3.22-3.56)	**3.64** (3.45-3.83)	**3.97** (3.74-4.20)	**4.21** (3.95-4.50)	**4.44** (4.13-4.78)	**4.67** (4.31-5.09)	**4.96** (4.53-5.49)	**5.18** (4.69-5.79)
3-hr	**2.69** (2.54-2.85)	**3.29** (3.12-3.49)	**3.69** (3.47-3.91)	**4.02** (3.77-4.27)	**4.46** (4.16-4.79)	**4.8** (4.44-5.21)	**5.14** (4.71-5.62)	**5.48** (4.96-6.08)	**5.93** (5.28-6.70)	**6.27** (5.53-7.17)
6-hr	**3.06** (2.82-3.33)	**3.82** (3.53-4.15)	**4.5** (4.14-4.91)	**5.07** (4.62-5.54)	**5.83** (5.25-6.45)	**6.44** (5.73-7.20)	**7.04** (6.18-7.96)	**7.67** (6.63-8.82)	**8.53** (7.23-10.0)	**9.19** (7.67-10.9)
12-hr	**3.36** (3.01-3.79)	**4.26** (3.82-4.81)	**5.34** (4.75-6.05)	**6.27** (5.51-7.14)	**7.6** (6.55-8.77)	**8.69** (7.37-10.2)	**9.84** (8.19-11.6)	**11.1** (9.03-13.3)	**12.8** (10.2-15.8)	**14.2** (11.0-17.8)
24-hr	**3.85** (3.47-4.28)	**4.94** (4.46-5.50)	**6.45** (5.80-7.18)	**7.76** (6.92-8.62)	**9.65** (8.51-10.8)	**11.2** (9.79-12.6)	**12.9** (11.1-14.6)	**14.7** (12.6-16.8)	**17.4** (14.5-20.0)	**19.5** (16.1-22.7)

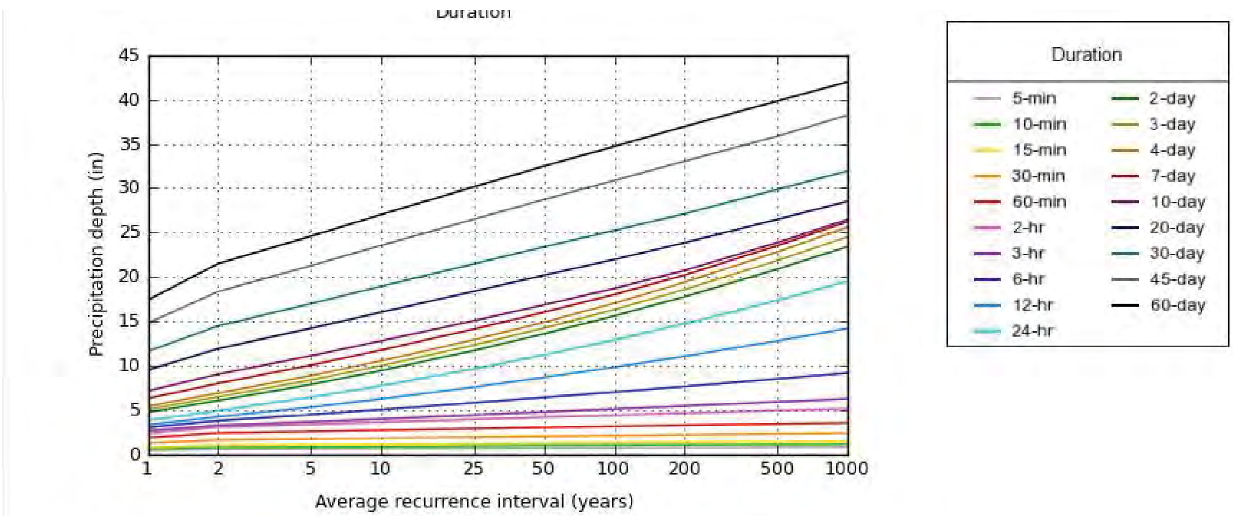


POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 3, Version 4

PF graphical

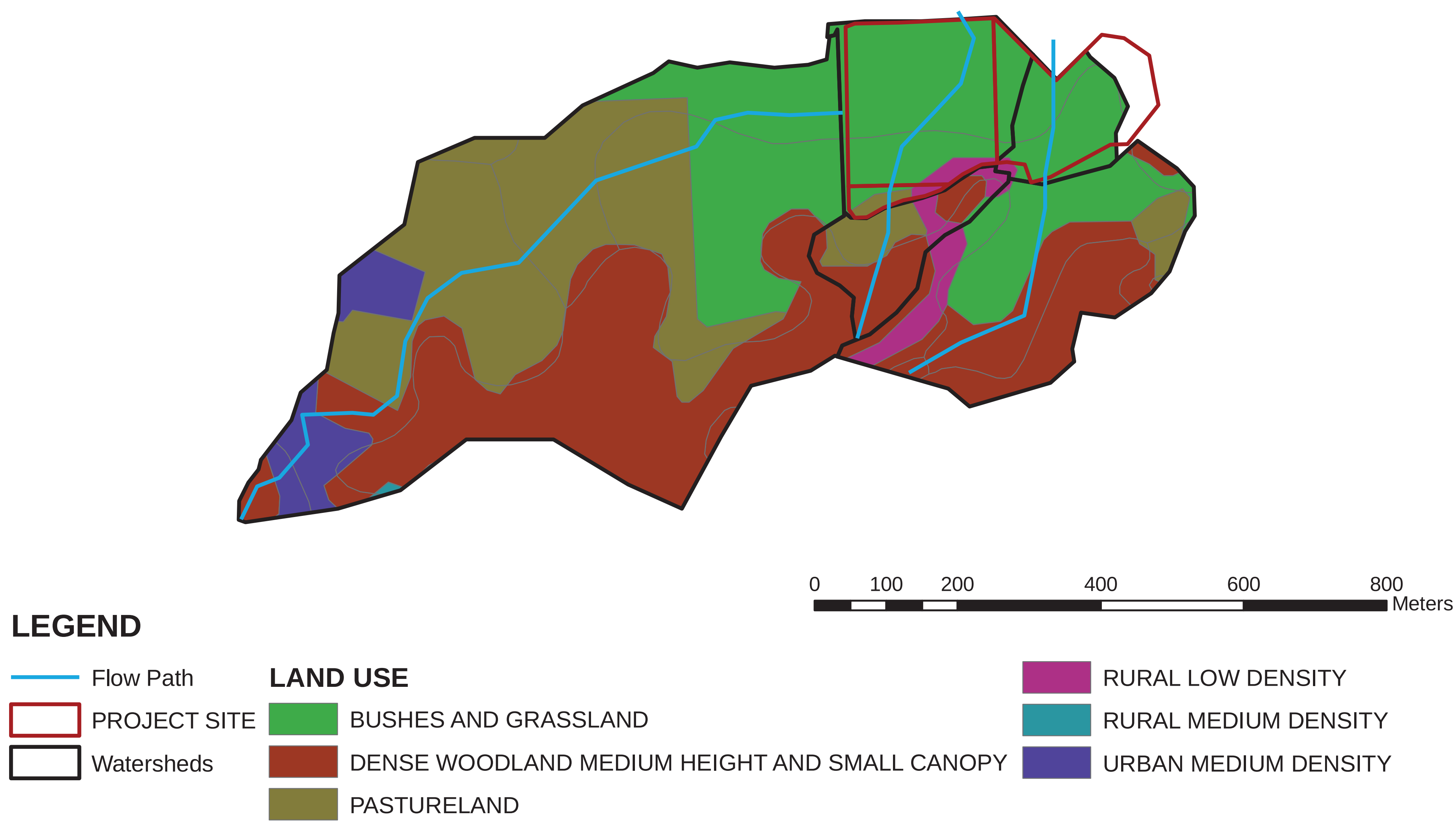




NOAA/NWS/OHD/HDSC

Created (GMT): Tue Oct 11 15:43:11 2011

Appendix G: Land Cover Map



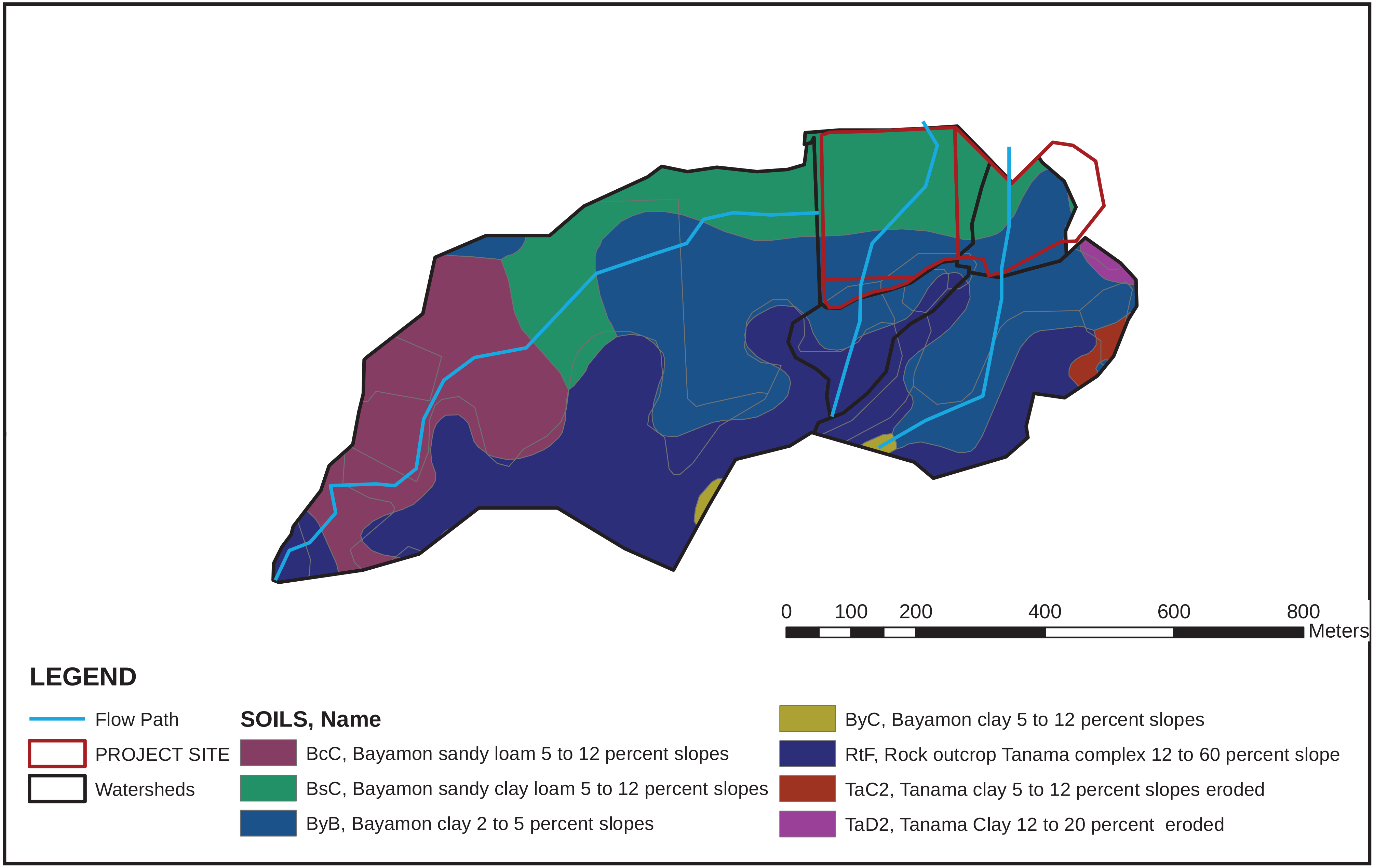
SCALE: 1:8,000

LAND USE MAP

SYNERGY-BARCELONETA PROJECT

PMG & Associates, LLC
Civil & Environmental Engineering Services
Tel:939-645-3500 Fax. 787-743-8983 www.pmggroupllc.com
Acosta #12 Barrio Pueblo Caguas, PR 00725

Appendix H: Soil Maps



SCALE: 1:8,000

SOILS MAP

SYNERGY-BARCELONETA PROJECT

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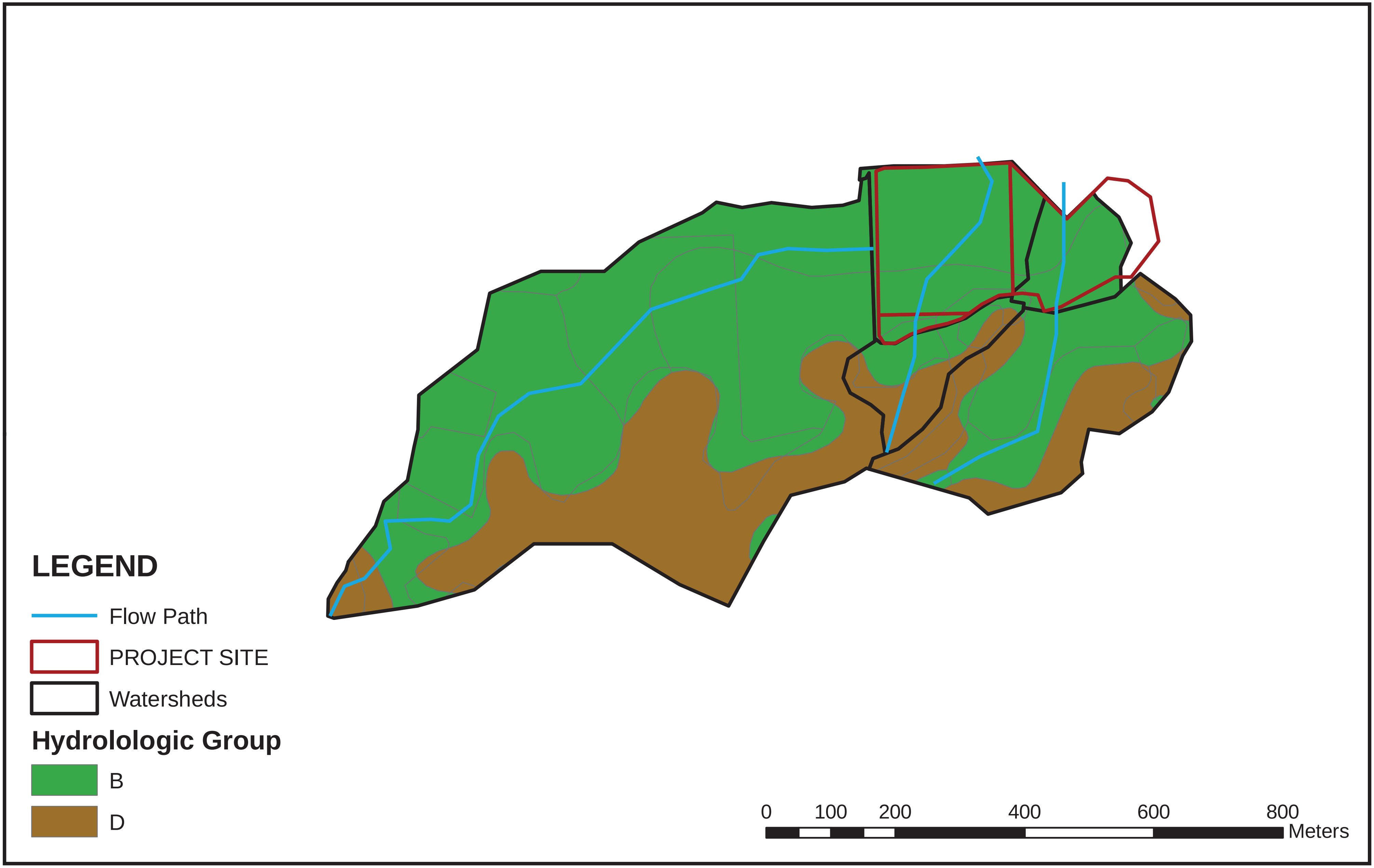

SCALE: 1:8,000

HYDROLOGIC GROUP MAP
SYNERGY-BARCELONETA PROJECT

PMG & Associates, LLC
Civil & Environmental Engineering Services
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Appendix I. Hydrologic Data Calculation Sheets

CONCENTRATION TIME

SUB-BASIN A-1

Existing Condition

Sheet flow	Units	
	m	ft
Longitude	87	285.36
Up Elevation	152	498.56
Down Stream Elevation	116	380.48
Slope	0.414	41.379
n Manning	0.1	DENSE WOODLAND MEDIUM HEIGHT AND SMALL CANOPY
P2	4.94	in
Concentration time	0.065	hr
Tlag	2.356	min

Shallow Flow

UpEL (m)	DSEL (m)	Longitude (m)	Long (ft)	Slope %	Land Use	Velocity (Table) (ft/s)	Tc (hr)	Tlag (hr)	Tlag (min)
116	106	200	656	5.0	Urban	4.5	0.0405	0.243	1.458
106	86	870	2853.6	2.3	Pasture	1.1	0.7206	0.432	25.941

Existing Condition

Tc total	0.83	hr
Tlag	0.50	hr
Tlag	29.76	min

SUB-BASIN A-2

Existing Condition

Sheet flow Actual	Units m	 ft
Longitude	90	295.2
Up Elevation	134	439.52
Down Stream Elevation	93	305.04
Slope	0.456	45.556
n Manning	0.1	Woods
P2	4.94	in
Concentration time	0.065	hr
Tlag	2.329	min

Shallow Flow

UpEL (m)	DSEL (m)	Longitude (m)	Long (ft)	Slope (%)	Land Use	Velocity (Table) (ft/s)	Tc (hr)	Tlag (hr)	Tlag (min)
93	87.5	106	347.68	5.1887	Urban	4.5	0.021	0.013	0.773

	Actual	
Tc total	0.09	hr
Tlag	0.05	hr
Tlag	3.10	min

SUB-BASIN A-3

Existing Condition

Sheet flow	Unidades	
	m	Ft
Longitude	125	410
Up Elevation	97	318.16
Down Stream Elevation	35	114.8
Slope	0.1	
n Manning	0.055	Grass
Concentration time	0.096	Hr
Tlag	3.444	Min

Shallow Flow

UpEL (m)	DSEL (m)	Longitude (m)	Long (ft)	Slope (%)	Velocity (Table) (ft/s)	Tc (hr)	Tlag (hr)	Tlag (min)
97	86	283	928.24	3.8869	1	0.257844	0.154707	**9.2824**

Tc total	0.35	hr
Tlag	0.21	hr
Tlag	12.73	min

SUB-BASIN A-4

Sheet flow	Units	
	M	Ft
Longitude	72	236.16
Up Elevation	88	288.64
Down Stream Elevation	86.5	283.72
Slope	0.021	2.083
n Manning	0.08	PASTURE
P2	4.94	In
Concentration time	0.156	Hr
Tlag	5.598	Min

Shallow Flow

	UpEL (m)	DSEL (m)	Longitude (m)	Long (ft)	Slope (%)	Land Use	Velocity (Table) (ft/s)	Tc (hr)	Tlag (hr)	Tlag (min)
Actual	86.5	77.5	275	902	3.2727	Pasture	0.45	0.557	0.334	20.044
Future	87.5	77.5	275	902	3.6364	Project	2.8	0.089	0.054	3.221

	Actual	Future	
Tc total	0.71	0.24	hr
Tlag	0.43	0.15	hr
Tlag	25.64	8.82	min

SUB-BASIN A-5

Sheet flow	Actual	
	Units	
	M	Ft
Longitude	81	265.68
Up Elevation	86	282.08
Down Stream Elevation	84	275.52
Slope	0.025	2.469
n Manning	0.08	Pasture
Concentration time	0.16	Hr
Tlag	5.75	Min

Shallow Flow

	UpEL (m)	DSEL (m)	Longitude (m)	Long (ft)	Slope (%)	Velocity (Table) (ft/s)	Tc (hr)	Tlag (hr)	Tlag (min)
Actual	84	80.5	93	305.04	3.76	0.85	**0.099686**	0.1	3.6

	Actual	
Tc total	0.26	hr
Tlag	0.16	hr
Tlag	9.34	min

CURVE NUMBER COMPUTATION FOR EXISTING CONDITION

MU	Hydro-Group	Soil Name	LAND USE_DESC	AREA (m^2)	WSH	CN	Product
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	BUSHES AND GRASSLAND	25238	A-1	56	1413328
ByB	B	Bayamon clay 2 to 5 percent slopes		40415	A-1	56	2263232
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		101	A-1	77	7800
BcC	B	Bayamon sandy loam 5 to 12 percent slopes		13387	A-1	55	736291
ByB	B	Bayamon clay 2 to 5 percent slopes		3590	A-1	55	197452
ByC	B	Bayamon clay 5 to 12 percent slopes	DENSE WOODLAND MEDIUM HEIGHT AND SMALL CANOPY	1208	A-1	55	66421
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes		2131	A-1	55	117217
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		3434	A-1	77	264389
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		100943	A-1	77	7772592
ByB	B	Bayamon clay 2 to 5 percent slopes		3042	A-1	61	185532
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes		30121	A-1	61	1837399
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	PASTURELAND	57556	A-1	61	3510924
ByB	B	Bayamon clay 2 to 5 percent slopes		32668	A-1	61	1992743
ByB	B	Bayamon clay 2 to 5 percent slopes		0	A-1	61	17
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		4217	A-1	80	337365
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	RURAL MEDIUM DENSITY	123	A-1	71	8757
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		351	A-1	85	29812
BcC	B	Bayamon sandy loam 5 to 12 percent slopes		18881	A-1	92	1737031
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	URBAN MEDIUM DENSITY	509	A-1	95	48353
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		3414	A-1	95	324301
			Area (m^2)	**341328.2**			**22850954**
					CN	**66.9**	

MU	Hydro-Group	Soil Name	LAND USE_DESC	AREA (m^2)	WSH	CN	Product
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	BUSHES AND GRASSLAND	368	A-2	77	28333
ByB	B	Bayamon clay 2 to 5 percent slopes	DENSE WOODLAND MEDIUM HEIGHT AND SMALL CANOPY	1865	A-2	55	102571
ByB	B	Bayamon clay 2 to 5 percent slopes		302	A-2	55	16611
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		1383	A-2	77	106474
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		10964	A-2	77	844219
ByB	B	Bayamon clay 2 to 5 percent slopes	PASTURELAND	6921	A-2	61	422156
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		1174	A-2	80	93890
ByB	B	Bayamon clay 2 to 5 percent slopes	RURAL LOW DENSITY	784	A-2	68	53311
ByB	B	Bayamon clay 2 to 5 percent slopes		1447	A-2	68	98370
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		1150	A-2	84	96609
			Area (m^2)	**26356.5**			**1862543**
					CN	**70.7**	

MU	Hydro-Group	Soil Name	LAND USE_DESC	AREA (m^2)	WSH	CN	Product
ByB	B	Bayamon clay 2 to 5 percent slopes	BUSHES AND GRASSLAND	26827	A-3	56	1502284
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		3000	A-3	77	230974
TaD2	D	Tanama Clay 12 to 20 percent eroded		1402	A-3	77	107975
TaC2	D	Tanama clay 5 to 12 percent slopes eroded		104	A-3	77	8045
ByB	B	Bayamon clay 2 to 5 percent slopes	DENSE WOODLAND MEDIUM HEIGHT AND SMALL CANOPY	18296	A-3	55	1006265
ByB	B	Bayamon clay 2 to 5 percent slopes		67	A-3	55	3693
ByC	B	Bayamon clay 5 to 12 percent slopes		1087	A-3	55	59769
TaC2	D	Tanama clay 5 to 12 percent slopes eroded		2017	A-3	77	155306
TaD2	D	Tanama Clay 12 to 20 percent eroded		1278	A-3	77	98414
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		22833	A-3	77	1758151
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		3271	A-3	77	251856
ByB	B	Bayamon clay 2 to 5 percent slopes	PASTURELAND	3816	A-3	61	232787
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		83	A-3	80	6663
TaD2	D	Tanama Clay 12 to 20 percent eroded		17	A-3	80	1392
TaC2	D	Tanama clay 5 to 12 percent slopes eroded		1777	A-3	80	142142
ByB	B	Bayamon clay 2 to 5 percent slopes	RURAL LOW DENSITY	955	A-3	68	64973
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope		7046	A-3	84	591888
			Area (m^2)	**93877**			**6222578**
					CN	**66.3**	

MU	Hydro-Group	Soil Name	LAND USE_DESC	AREA (m^2)	WSH	CN	Product
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	BUSHES AND GRASSLAND	40948	A-4	56	2293113
ByB	B	Bayamon clay 2 to 5 percent slopes		14007	A-4	56	784413
ByB	B	Bayamon clay 2 to 5 percent slopes	PASTURELAND	1797	A-4	61	109623
ByB	B	Bayamon clay 2 to 5 percent slopes	RURAL LOW DENSITY	2875	A-4	68	195502
			Area (m^2)	**59628**			**3382651**
					CN	**56.7**	

MU	Hydro-Group	Soil Name	LAND USE_DESC	AREA (m^2)	WSH	CN	Product
ByB	B	Bayamon clay 2 to 5 percent slopes	BUSHES AND GRASSLAND	14999	A-5	56	839922
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes		7077	A-5	56	396339
ByB	B	Bayamon clay 2 to 5 percent slopes	DENSE WOODLAND MEDIUM HEIGHT AND SMALL CANOPY	66	A-5	55	3634
ByB	B	Bayamon clay 2 to 5 percent slopes	RURAL LOW DENSITY	569	A-5	68	38708
			Area (m^2)	**22711**			**1278603**
					CN	**56.3**	

CURVE NUMBER COMPUTATION FOR PROPOSED CONDITION

MU	Hydro Group	Soil Name	CN	LAND USE_DESC	AREA (m^2)	WSH	Product
BsC	B	Bayamon sandy clay loam 5 to 12 percent	56		25216.9	A-1	1412147
ByB	B	Bayamon clay 2 to 5 percent slopes	56		40381.1	A-1	2261340
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	BUSHES AND GRASSLAND	101.2	A-1	7793
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	55		13376.0	A-1	735680
ByB	B	Bayamon clay 2 to 5 percent slopes	55		3587.0	A-1	197287
ByC	B	Bayamon clay 5 to 12 percent slopes	55		1206.6	A-1	66365
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	55	DENSE WOODLAND	2129.4	A-1	117119
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	MEDIUM HEIGHT AND	3430.8	A-1	264170
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	SMALL CANOPY	100858.6	A-1	7766113
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	61		30096.2	A-1	1835870
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	61		57508.3	A-1	3508008
ByB	B	Bayamon clay 2 to 5 percent slopes	61		32640.7	A-1	1991082
ByB	B	Bayamon clay 2 to 5 percent slopes	61		0.3	A-1	17
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	80		4213.5	A-1	337083
ByB	B	Bayamon clay 2 to 5 percent slopes	61	PASTURELAND	3039.0	A-1	185377
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	71		123.2	A-1	8750
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	85		350.4	A-1	29787
BcC	B	Bayamon sandy loam 5 to 12 percent slopes	92		18865.1	A-1	1735591
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	95	RURAL	508.6	A-1	48313
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	95	MEDIUM DENSITY	3410.9	A-1	324032
				TOTAL (M^2)	**341044.0**		**22831926**
					CN	**66.9**	

MU	Hydro-Group	Soil Name	CN	LAND USE_DESC	AREA (m^2)	WSH	Product
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	BUSHES AND GRASSLAND	367.7	A-2	28309
ByB	B	Bayamon clay 2 to 5 percent slopes	55	DENSE	1863.4	A-2	102485
ByB	B	Bayamon clay 2 to 5 percent slopes	55	WOODLAND	301.8	A-2	16597
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	MEDIUM HEIGHT AND	1381.6	A-2	106385
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	SMALL CANOPY	10954.7	A-2	843511
ByB	B	Bayamon clay 2 to 5 percent slopes	61		7137.3	A-2	435375
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	80	PASTURELAND	1172.6	A-2	93811
ByB	B	Bayamon clay 2 to 5 percent slopes	68		2531.1	A-2	172114
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	84	RURAL LOW DENSITY	1149.1	A-2	96528
				TOTAL (M^2)	**26859.2**		**1895114**
					CN	**70.6**	

MU	Hydro-Group	Soil Name	CN	LAND USE_DESC	AREA (m^2)	WSH	Product
ByB	B	Bayamon clay 2 to 5 percent slopes	56		26803.9	A-3	1501021
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77		2997.1	A-3	230780
TaD2	D	Tanama Clay 12 to 20 percent eroded	77	BUSHES AND	1401.1	A-3	107884
TaC2	D	Tanama clay 5 to 12 percent slopes eroded	77	GRASSLAND	104.4	A-3	8038
ByB	B	Bayamon clay 2 to 5 percent slopes	55		18280.3	A-3	1005419
ByB	B	Bayamon clay 2 to 5 percent slopes	55		67.1	A-3	3690
ByC	B	Bayamon clay 5 to 12 percent slopes	55		1085.8	A-3	59719
TaC2	D	Tanama clay 5 to 12 percent slopes eroded	77	DENSE	2015.3	A-3	155175
TaD2	D	Tanama Clay 12 to 20 percent eroded	77	WOODLAND	1277.0	A-3	98332
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	MEDIUM HEIGHT AND	22813.9	A-3	1756672
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	77	SMALL CANOPY	3268.1	A-3	251645
ByB	B	Bayamon clay 2 to 5 percent slopes	61		3813.0	A-3	232591
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	80		83.2	A-3	6658
TaD2	D	Tanama Clay 12 to 20 percent eroded	80		17.4	A-3	1391
TaC2	D	Tanama clay 5 to 12 percent slopes eroded	80	PASTURELAND	1775.3	A-3	142022
ByB	B	Bayamon clay 2 to 5 percent slopes	68		954.7	A-3	64918
RtF	D	Rock outcrop Tanama complex 12 to 60 percent slope	84	RURAL LOW DENSITY	7040.4	A-3	591391
				TOTAL (M^2)	**93798.0**		**6217346**
					CN	**66.3**	

MU	Hydro-Group	Soil Name	CN	LAND USE_DESC	AREA (m^2)	WSH	Product
ByB	B	Bayamon clay 2 to 5 percent slopes	56		820.0	A-4	45919
ByB	B	Bayamon clay 2 to 5 percent slopes	56		1228.0	A-4	68769
ByB	B	Bayamon clay 2 to 5 percent slopes	56		361.7	A-4	20256
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	56		5605.5	A-4	313906
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	56	BUSHES AND GRASSLAND	2610.1	A-4	146163
ByB	B	Bayamon clay 2 to 5 percent slopes	80	PASTURELAND	1573.1	A-4	125848
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	88		32805.5	A-4	2886888
ByB	B	Bayamon clay 2 to 5 percent slopes	88		11585.9	A-4	1019559
ByB	B	Bayamon clay 2 to 5 percent slopes	88	PROJECT SITE	1973.0	A-4	173628
ByB	B	Bayamon clay 2 to 5 percent slopes	68	RURAL LOW	588.7	A-4	40032
ByB	B	Bayamon clay 2 to 5 percent slopes	68	DENSITY	8.5	A-4	579
				TOTAL (M^2)	**59160.0**		**4841547**
					CN	**81.8**	

MU	Hydro-Group	Soil Name	CN	LAND USE_DESC	AREA (m^2)	WSH	Product
ByB	B	Bayamon clay 2 to 5 percent slopes	56		2293.2	A-5	128418
BsC	B	Bayamon sandy clay loam 5 to 12 percent slopes	56	BUSHES AND	6958.1	A-5	389654
ByB	B	Bayamon clay 2 to 5 percent slopes	56	GRASSLAND	12692.8	A-5	710798
ByB	B	Bayamon clay 2 to 5 percent slopes	55	DENSE	0.2	A-5	11
ByB	B	Bayamon clay 2 to 5 percent slopes	55	WOODLAND MEDIUM HEIGHT AND SMALL CANOPY	65.8	A-5	3621
ByB	B	Bayamon clay 2 to 5 percent slopes	68	RURAL LOW	444.1	A-5	30198
ByB	B	Bayamon clay 2 to 5 percent slopes	68	DENSITY	124.7	A-5	8478
				TOTAL (M^2)	**22578.9**		**1271176**
					CN	**56.3**	

Apéndice C

Estudio Arqueológico

Centro de Investigaciones Arqueológicas

Bieque

APDO. 10987, CAPARRA STA.,SAN JUAN, PUERTO RICO 00922

EVALUACIÓN DE RECURSOS ARQUEOLÓGICOS FASE 1A –

FINCA BUFFALO

CARRETERA ESTATAL PR- #140 KM. 70.9 INTERIOR BARRIO FLORIDA AFUERA, BARCELONETA, PUERTO RICO

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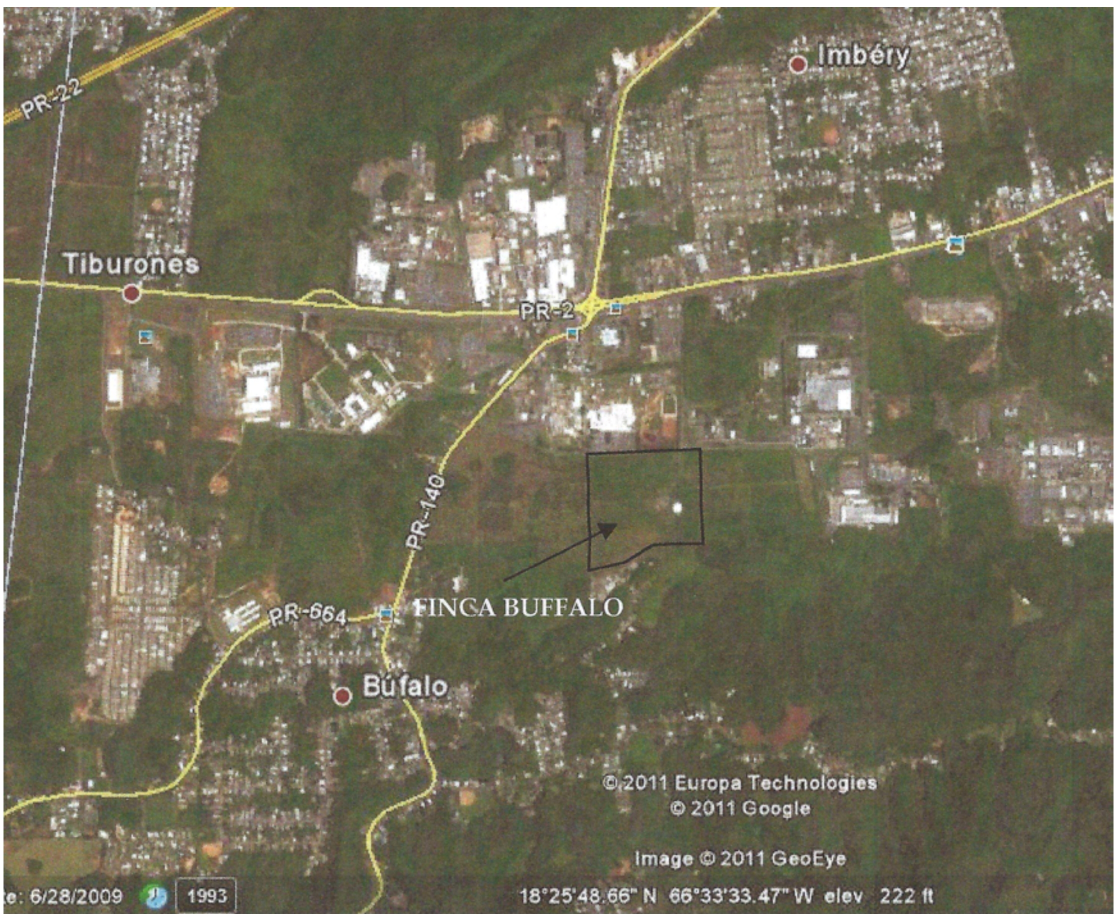
TABLA DE CONTENIDO

I. INTRODUCCIÓN

El siguiente informe presenta los resultados de la investigación arqueológica **Fase 1A**, realizada durante el mes de octubre del corriente año, para el propuesto proyecto **Finca Buffalo.** El proyecto acoge uno de los predios de la Finca Buffalo la cual ocupa un área aproximada de 20 cuerdas. El propuesto proyecto se ubica en la carretera PR-#140 Km. 70.9 Interior, del barrio Florida Afuera en el municipio de Barceloneta.



Mediante dicho proyecto se propone establecer una planta de energía a partir de basura. Con este propósito esta finca ha sido arrendada por la Autoridad de Tierras mediante certificación Núm. 2009-11-01AT y 2010-01-02AT.

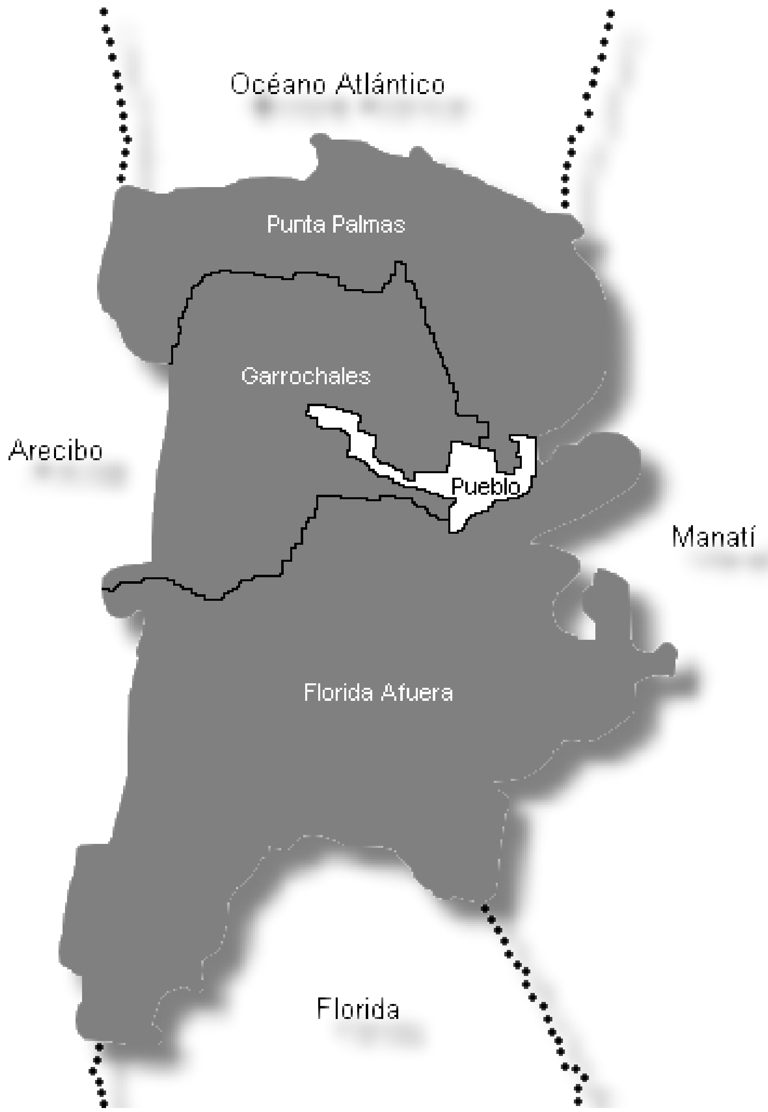
En virtud de los requerimientos del Reglamento para la Radicación y Evaluación Arqueológica de Proyectos de Construcción y Desarrollo (Departamento de Estado #46435 y las disposiciones de la Ley 112 de Protección del patrimonio Arqueológico Terrestre de Puerto Rico fechada del 20 de julio de 1988) se requiere que las agencias relacionadas con la protección del patrimonio arqueológico de Puerto Rico y los proyectistas privados tomen en consideración los recursos culturales conocidos o que puedan existir en los terrenos que sean objeto de algún tipo de desarrollo.

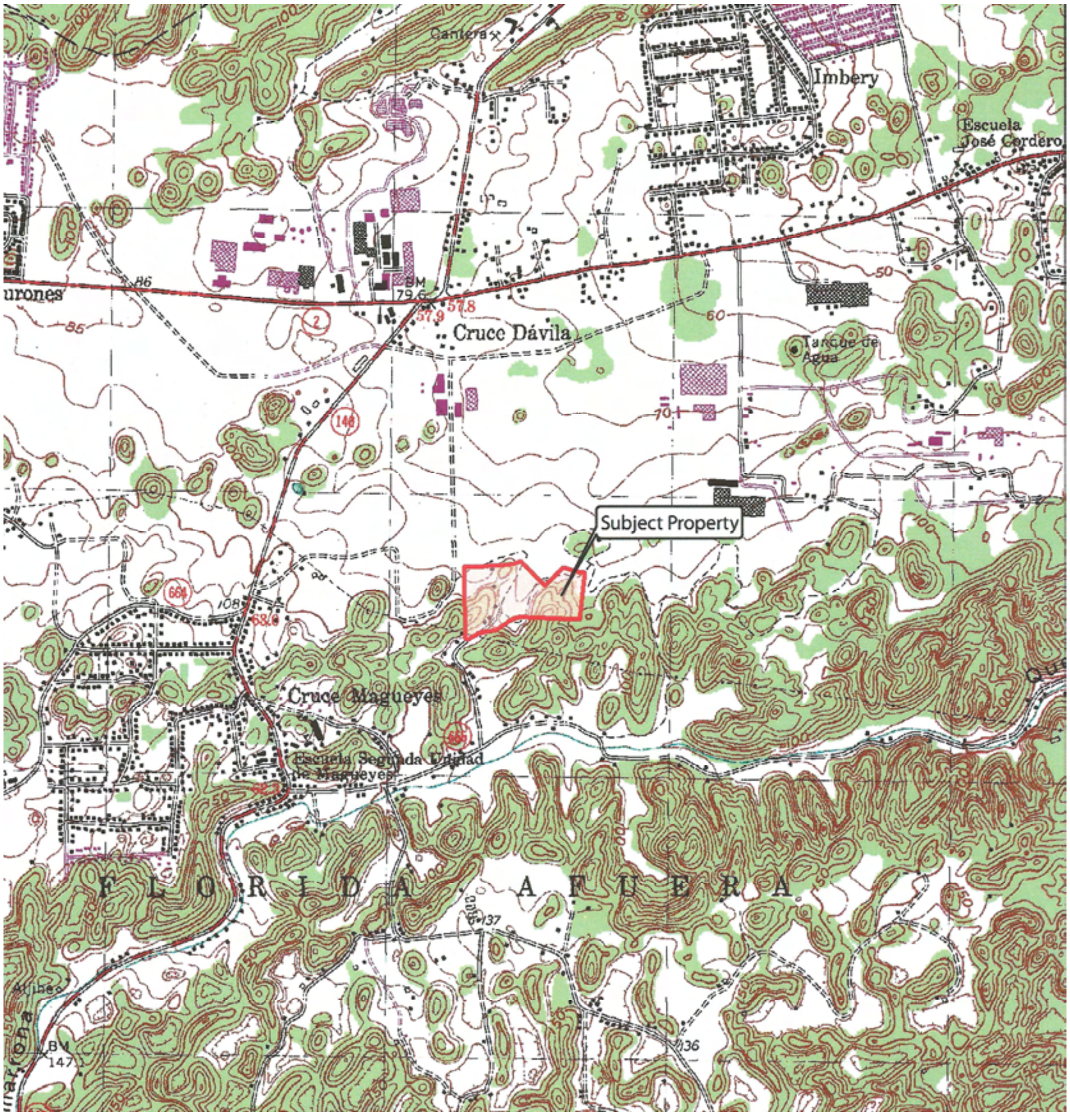
A tales efectos es necesario llevar a cabo evaluaciones arqueológicas con miras a determinar la presencia o ausencia de recursos culturales en dichos terrenos, previo a cualquier movimiento de terreno que pueda poner en peligro la integridad de los recursos culturales conocidos o potenciales.

II. LOCALIZACIÓN

El municipio de Barceloneta se encuentra localizado en la costa Norte de Puerto Rico, su territorio abarca 48.5 kilómetros cuadrados (18.7 millas ^{2}). Colinda al Norte con el Océano Atlántico, al Sur con el municipio de Florida, al Este con el municipio de Manatí y al Oeste con el municipio de Arecibo. El acceso principal al municipio se logra a través de la Carretera Estatal PR #2.

Actualmente sus barrios son: Barceloneta Pueblo, Palmas Altas, Garrochales y Florida Afuera.





En los límites del predio evaluado el cual se identifica como "G" tenemos las siguientes colindancias; hacia el **Norte**; el predio A de la Finca Buffalo, también, hacia el noreste, facilidades de AAA.

Por el límite **Sur;** tenemos el predio cercado con alambres de púas haciendo límite con el camino municipal que colinda también al Sur con almacén de vagones de carga, además de con terrenos de la Autoridad de Tierras de Puerto Rico hacia el sureste.

En el límite **Este** existe colindancia con el predio B de la finca Buffalo, hacia el sureste hay un pequeño mogote, que no pertenece al predio G, que tiene un bosque de acacias, helechos y otras plantas y es uno de baja elevación.

Por el límite **Oeste** tenemos una verja con alambre de púas que limita con un camino municipal asfaltado, orientado de Norte a Sur, la cual colinda a su vez con terrenos de la Autoridad de Tierras de Puerto Rico al Oeste.