

F. Financial Analysis

During several coordination meetings with the local sponsor, the USACE field office discussed and explained the recommended plan for a flood control project along Río Culebrinas at Aguadilla and Aguada. The local sponsor understands their responsibilities for contributing with all lands, easements and right-of-ways, relocation of utilities, and the acquisition of buildings and structures necessary for the implementation of the recommended plan. The local sponsor understands the Federal requirement for contributing a minimum of 5 percent cash of the total flood control first costs. In addition, the local sponsor understands that the maximum Federal share for the project including study cost is limited to \$7.0 millions.

Options for financing the local share and assessing the financial feasibility of the project were also discussed. The local sponsor has expressed their support for the recommended project and their intent to comply with all requirements as outlined in the report. Also, they presented their plan to finance their share by annual appropriations from the Puerto Rico legislature for the capital improvement program for flood control works managed by the Puerto Rico Department of Natural and Environmental Resources. These funds will be combined with funds obtained from selling of Government of Puerto Rico bonds for infrastructure development. The funds, now being programmed by the local sponsor, will cover their share of the total first cost for construction of the project in accordance with the report and latest PMP.

G. Ability to Pay

The application of the ability to pay procedures for determining a potential reduction in non-Federal cost shares for qualifying local sponsors is specified on ER 1165-2-121. The benefit test compares one fourth of the benefit to cost ratio to the normal non-Federal cost share requirement. Therefore, $3.8/4 = 0.95$ or 95 percent, which is more than the maximum allowable contribution of 50 percent of the total flood control cost, as established in the Water Resources Development Act of 1986, as amended by WRDA 1996. Therefore, the local sponsor does not qualify for an additional reduction in the non-Federal share under the ability to pay provision.

H. Risk Analysis

1. General. According to CESAD-EP-PL guidance letter, dated 28 April 1995, risk analysis must be considered and addressed in final DPRs and that those DPRs already underway when EC 1105-2-205 was issued may use a descriptive evaluation when full quantitative risk analysis would impose additional cost and time. However, in July 23, 1997, the Municipality of Aguadilla, the local sponsor, requested a waiver from using risk based analysis techniques in the evaluation or design of Río Culebrinas Flood Control project (see enclosure 3). The waiver was approved by SAD requested in accordance with Section 202 (h) (10) of the Water Resources Development Act of 1996 (see enclosure 4).

In accordance to the above guidance letter and approved risk analysis waiver, a limited risk analysis was made to examine the reasonableness of assumptions and variance of data for parameter's key to the recommended plan. Each evaluation described below revealed no major variance in the data.

2. Hydrologic and hydraulic variables. Reliability was addressed by sensitivity analyses for discharges-frequencies and stage-discharge relationships and cross section data. The hydraulic model was calibrated to high water marks from the 1975 flood event. That model was utilized for analyses of different frequency flood events for existing and post-project conditions. Levee design crests were determined as a result of two possible combinations of circumstances. First, Manning's roughness values for the channel were held to calibrated values and a 20 percent decrease in the bridges flow areas was used for the channel water surface profile. Second, the design discharge with 50 percent increase in Manning's roughness values was used for the floodway upstream from proposed channel. The 50 meters long overtopping sections are located in the downstream end of each levee between station 0+30 and 0+80. Upstream from station 0+80, a one-foot superiority was added to the levee crest elevation to ensure that overtopping would occur first at the designated location.

3. Socio-economics variables. A detailed survey of the number and types of structures in the flood plain was conducted. That information together with topographic and hydraulic data was utilized to divide the flood plain into damage reaches which were then subdivided into zones containing similar topography, land uses and type of structures. Though in each damage reach there are cases of extreme values of structures and contents at both end of the distribution, these represent less than 8 percent of the total. The structures in each reach have very similar values as they all were built following the same basic design. Families within each reach belong to the same income group. Residential developments at each reach not only have similar design but also occurred in relatively flat and leveled land with very little variation of first floor elevation from ground level. Very little variation is expected around the mean values of the socio-economic variables utilized for the damage and benefit analysis. Explicit inclusion of this variation in itself and in conjunction with the hydraulic variables described above, through risk analysis, would not alter the recommendations.

XII. CONCLUSIONS

The Río Culebrinas at Aguadilla and Aguada DPR shows that flooding is a major problem threatening life, property, and economic development in the town of Aguadilla and the community of Espinar in Aguada, Puerto Rico. It is economically justified and necessary to construct a flood control project along the Río Culebrinas. The recommended plan provides for levees and channels along the Río Culebrinas to protect over 3,300 families against the 100-Year Flood. The recommended plan proposes the following works: the construction of 3.3 kilometers of levees, a 60 meters pilot channel, and 4 interior drainage structures with drainage channels.

I have given consideration to all significant aspects in the overall public interest, including engineering feasibility, economic, social and environmental effects. The recommended plan described in the report provides the optimum solution for flood protection along the Río Culebrinas within the framework of the formulation concepts.

XIII. RECOMMENDATIONS

I recommend that the recommended plan for flood damage reduction along Río Culebrinas be approved under the authority contained in Section 205 of the 1948 Flood Control Act, as amended, with such modifications as in the discretion of the Chief of Engineers may be advisable, be authorized for implementation as a Federal project, with such modifications as advisable at the discretion of the Chief of Engineers, for a total investment cost to the United States estimated at \$2,410,600 and a benefit-to-cost ratio of 3.8 provided that, except as otherwise stated in these recommendations, the exact amount of non-Federal contributions shall be determined by the Chief of Engineers following policies satisfactory to the President and the United States Congress prior to project implementation, in accordance with the following requirements to which non-Federal interests must agree prior to implementation:

A. Provide a minimum of 35 percent of total project costs assigned to flood control, as further specified below:

1. Provide, during construction, a minimum cash contribution equal to 5 percent of total project costs assigned to flood control.

2. Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all acquisitions and relocations determined by the Government to be necessary for the construction, operation, and maintenance of the project.

3. Provide or pay to the Government the cost of providing all retaining dikes, waste weirs, bulkheads, and embankments, including all monitoring features and stilling basins, that may be required at any dredged or excavated material disposal areas required for the construction, operation, and maintenance of the project.

4. Provide, during construction, any additional cash amounts as are necessary to make its total contribution equal to 35 percent of total project costs assigned to flood control.

5. In no instance shall the Government's share of total project cost, including all preauthorization planning (reconnaissance studies, feasibility studies, etc.), exceed \$7,000,000. The local sponsor shall pay all project costs in excess of the Federal cost limitation of \$7,000,000.

B. Operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, at no cost to the Government, in accordance with applicable Federal and State laws and any specific directions prescribed by the Government.

C. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the local sponsor owns or controls for access to the project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project.

D. Hold and save the Government free from all damage arising for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project related betterments, except for damage due to the fault or negligence of the Government or the Government's contractors.

E. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs.

F. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project.

G. Assume complete financial responsibility for necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way necessary for construction, operation, or maintenance of the recommended project.

H. To the maximum extent practicable, operate, maintain, repair, replace and rehabilitate the project in a manner that will not cause liability to arise under CERCLA.

I. Participate in and comply with applicable Federal flood plain management and flood insurance programs.

J. Prevent future encroachments on project lands, easements, and rights-of-way, which might interfere with the proper functioning of the project.

K. Not less than once each year, inform affected interests of the limitations of the flood protection afforded by the project.

L. Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the flood protection levels provided by the recommended project.

M. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, Public Law 100-17, and the Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation, and maintenance of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

N. Comply with all applicable Federal and Puerto Rico laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964, Public Law 88-352, and Department of Defense Direction 5500.11 issued pursuant thereto and published in part 300 of title 32, Code of Federal Regulations, as well as Army Regulations 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

This recommendation is made with the provision that, prior to implementation, local interest enters into a Project Cooperation Agreement with the Department of the Army to provide the items of non-Federal responsibility stipulated in Subsection D.2. of Section XI. of this report.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before it is approved and funded by the Chief of Engineers.

James G. May
Colonel, Corps of Engineers
Commanding

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
SECTION 205
DRAFT DETAILED PROJECT REPORT
AND ENVIRONMENTAL ASSESSMENT**

ENCLOSURES

ESTADO LIBRE ASOCIADO DE PUERTO RICO 10
GOBIERNO MUNICIPAL DE AGUADILLA
APARTADO 1008
AGUADILLA, PUERTO RICO 00605
TELEFONO 891-1005 Ext. 223-201



August 21, 1989

District Engineer
U.S. Army Engineer District,
Jacksonville
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Sir:

In accordance with the provisions of Section 205 of the Flood Control Act of 1948, as amended, which authorizes the federal government to initiate investigations and studies to be made in the interest of flood control, the Municipality of Aguadilla hereby makes formal application for a study of a) Rio Culebrina, b) Caño Madre Vieja, c) Caño La Cucula, d) Río Subterráneo del Parterre o El Ojo de Agua.

The investigations will be conducted in two phases; the first phase is the reconnaissance study which will be funded by the Army Corps of Engineers. The Municipality of Aguadilla can provide 50 percent of the cost of the second phase, the feasibility study, and one-half of our share may consist of in-kind services.

The Municipality of Aguadilla can provide the following local cooperation and participation:

1. Provide without cost to the United States all land, easements and rights-of-way necessary for the construction of the project.
2. Provide without cost to the United States all necessary relocations and alterations of buildings, utilities, highways, bridges, sewers and related and special facilities.
3. Hold and save the United States free from damages due to the construction and subsequent maintenance of the project, except damages due to the fault of negligence of the United States or its contractors.

4. Maintain and operate the project works after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army.
5. Prevent future encroachment which interfere with proper functioning of the project for flood control.
6. Assume responsibility for all costs in excess of the federal cost limitation of \$5 million.
7. Provide guidance and leadership in preventing unwise future development of the flood plain by use of appropriate flood plain management techniques to reduce flood losses.
8. Provide a cash contribution of 5 percent of the project cost.
9. If the value of the sponsor's contribution does not exceed 25 percent of the project cost, provide a cash contribution to make the sponsor's total contributions equal to 25 percent.


Hon. Ramón Calero Bermúdez
Mayor
Municipality of Aguadilla

Gobierno Municipal de Aguadilla

Apartado 1008
Aguadilla, PR 00605
Tel. (787) 891-1005



Hon. Carlos Méndez
Alcalde

July 23, 1997

Dennis R. Duke
Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 1970
Jacksonville, Florida 32232-0019

Dear Mr. Duke:

I appreciate talking with your staff recently concerning the Corps of Engineer's guidance on risk and uncertainty procedures. We understand the cost increase and impact on the schedule in the event this procedure were to become part of the study process.

However, in accordance with section 202 (h) (10) of the Water Resources Development Act of 1996, we, the non-Federal sponsor for the Rio Culebrinas at Aguadilla, Puerto Rico - Detailed Project Report Study, request a waiver from using risk based analysis techniques in the evaluation or design of this flood damage reduction study.

We understand that hydraulic modeling will use modified risk and uncertainty procedures, and this degree of risk and uncertainty analysis is sufficient for our study purpose. We further understand this waiver will not impact the study schedule and cost, and will apply to all future planning and design efforts on this project.

Sincerely,


Carlos Méndez Martínez
Mayor

cc: María M. Jaunarena, Director
Office of Community Development

"AGUADILLA. NUEVO JARDIN DEL ATLANTICO"

Aguadilla

CESAD-ET-PL

MEMORANDUM FOR COMMANDER, HQUSACE, ATTN: CBCW-P, WASH DC 20314-1000

Subject: Rio Culebrinas, Puerto Rico, Section 205 Study (091854)

1. Reference Planning Guidance Letter No. 97-3, Flood Damage Reduction Risk-Based Analysis Waiver.
2. In accordance with the policy established in the above reference, concur in Jacksonville District's request for a waiver from risk-based analysis requirements for flood damage reduction studies.
3. The sponsor's request for the waiver and the District's analysis are enclosed. The Detailed Project Report is scheduled for completion in October 1998. Completion has been slowed by the sponsor's lack of funds. Methodologies to be used in lieu of risk-based analysis including sensitivity analysis will follow engineering regulations, circulars and technical letters in place immediately prior to the implementation of the requirements in 1992.
4. Point of contact for this subject is Denver Austin, CESAD-ET-PL, (404) 331-6739

FOR THE COMMANDER:

Encls

/s/
CARL R. POSTLEWATE
Director of Engineering
and Technical Services

**DRAFT
ENVIRONMENTAL
ASSESSMENT**

MARCH 2002

Rio Culebrinas

At Aguada and Aguadilla, Puerto Rico

Section 205

Detailed Project Report



U.S. Army Corps
of Engineers
Jacksonville District

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
DETAILED PROJECT REPORT
ENVIRONMENTAL ASSESSMENT**

TABLE OF CONTENTS

Subject	Page
1.00 SUMMARY	EA-1
2.00 INTRODUCTION	EA-2
2.01 Authority and Prior Studies	EA-2
2.02 Study Area Setting	EA-2
2.03 Problem Definition	EA-3
2.04 Study Goals and Objectives.....	EA-3
3.00 DESCRIPTION OF THE PROPOSED ACTION	EA-3
4.00 ANALYSIS OF ALTERNATIVES	EA-4
4.01 No Action	EA-4
4.02 Non-Structural Alternatives	EA-4
4.03 Structural Alternatives	EA-5
4.04 Recommended Plan	EA-8
5.00 AFFECTED ENVIRONMENT	EA-9
5.01 Vegetation and Wildlife	EA-9
5.02 Fishery Resources	EA-10
5.03 Coastal Barriers	EA-10
5.04 Wetlands	EA-11
5.05 Prime and Unique Farmland Soils	EA-11

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
 DETAILED PROJECT REPORT
 ENVIRONMENTAL ASSESSMENT**

TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
5.06 Cultural Resources	EA-11
5.07 Water Quality	EA-12
5.08 Hazardous, Toxic and Radiologic Waste	EA-12
5.09 Air Quality	EA-12
5.10 Aesthetic Resources	EA-12
5.11 Noise.....	EA-12
5.12 Socio-Economic Conditions	EA-12
6.00 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION.....	EA-13
6.01 Biological Resources	EA-13
6.02 Coastal Barriers	EA-13
6.03 Wetlands.....	EA-13
6.04 Prime and Unique Farmlands Soils	EA-15
6.05 Cultural Resources	EA-15
6.06 Water Quality	EA-15
6.07 Hazardous, Radiologic or Toxic Waste	EA-16
6.08 Air Quality	EA-16
6.09 Aesthetic Resources	EA-16
6.10 Noise.....	EA-16

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
DETAILED PROJECT REPORT
ENVIRONMENTAL ASSESSMENT**

TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
6.11 Effects on Community Cohesion and Socio-Economic Well-Being	EA-16
6.12 Unavoidable Impacts and Irretrievable Commitments of Resources	EA-16
6.13 Cumulative and Secondary Effects	EA-16
6.14 Relationship Between Short Term Use of the Environment and Long Term Productivity	EA-16
7.00 COMMITMENTS	EA-17
8.0 COMPLIANCE WITH LAWS, EXECUTIVE ORDERS AND REGULATIONS	EA-17
8.01 National Environmental Policy Act of 1969, as amended.....	EA-17
8.02 Endangered Species Act of 1973, as amended.....	EA-17
8.03 Fish and Wildlife Coordination Act of 1958, as amended	EA-17
8.04 National Historic Preservation Act of 1966, as amended	EA-18
8.05 Clean Water Act of 1972, as amended	EA-18
8.06 Clean Air Act of 1972, as amended	EA-18
8.07 Coastal Barriers Improvement Act of 1990	EA-18
8.08 Coastal Zone Management Act of 1972,as amended	EA-18
8.09 Farmland Protection Policy Act of 1981, as amended	EA-18

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
 DETAILED PROJECT REPORT
 ENVIRONMENTAL ASSESSMENT**

TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
8.10 Resource Conservation and Recovery Act of 1976, as amended, and Toxic Substances Control Act of 1976, as amended.....	EA-19
8.11 Executive Order 11990, Protection of Wetlands.....	EA-19
8.12 Executive Order 11988, Floodplain Management.....	EA-19
8.13 Executive Order 12898, Environmental Justice	EA-19
9.00 COORDINATION AND PUBLIC COMMENT.....	EA-19
10.00 LIST OF EA PREPARERS	EA-20
11.00 REFERENCES.....	EA-20
12.0 (PROPOSED) FINDING OF NO SIGNIFICANT IMPACT (FONSI)	EA-21
13.00 FIGURES.....	EA-23
Figure EA-1 Location and Coastal Barriers	EA-24
Figure EA-2 Preliminary Plan 1.....	EA-25
Figure EA-3 Preliminary Plan 2.....	EA-26
Figure EA-4 Final Alternative 1 & 2	EA-27
Figure EA-5 Final Alternative 3	EA-28
Figure EA-6 Recommended Plan (Modified Preliminary Plan 2)	EA-29
Figure EA-7 Typical Cross Sections	EA-30

RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO

**DETAILED PROJECT REPORT
ENVIRONMENTAL ASSESSMENT**

TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
14.00 EA ATTACHMENTS	EA-31
A. PUBLIC AND AGENCY COORDINATION AND COMMENT	
B. FISH AND WILDLIFE COORDINATION ACT REPORT	
C. CLEAN WATER ACT SECTION 404 (B)(1) EVALUATION AND MITIGATION PLAN	
D. COASTAL ZONE MANAGEMENT ACT COORDINATION- CERTIFICATION OF COMPLIANCE WITH P.R. COASTAL MANAGEMENT PLAN AND APPLICATION FOR CONCURRENCE FROM P.R. PLANNING BOARD	
E. SITE VIEW MEMORANDUM AND WRAP SCORE SHEETS	

RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
SECTION 205
DETAILED PROJECT REPORT

DRAFT ENVIRONMENTAL ASSESSMENT

1.00 SUMMARY

A feasibility study of flooding in southwestern Aguadilla and Espinar ward, Aguada, has led to the proposal of a structural solution to the frequent flooding caused by overflow of Río Culebrinas into Caño Madre Vieja. The proposed project includes two earthen levees, to be built parallel to the north and south banks of Caño Madre Vieja. Other project features are: a short cutoff channel, to connect two meanders of the stream where the Aguadilla Levee will interrupt it, four drainage structures, interior drainage channels, and a borrow area located in Aguada. Additional features would include three paved road ramps across the levees. The project would require about 110,000 cubic yards of fill, of which about 30,000 cubic yards would come from the cutoff and drainage channels and the rest from the borrow site at nearby Tablonal Quarry. Levees would be earthen, between 1 to 3.6 meters high, with 1(v) on 2.5 (h) side slopes and a 3-meter wide crest. Excavated material unsuitable for levee construction would be stored temporarily on site and used to top-dress the levees after structural construction is complete. The recommended project would provide protection against 1% recurrence probability flooding (the "100 year" return frequency flood).

Impacts of the proposed project on water quality, air quality, noise, visual aesthetic resources, wildlife habitat and endangered species are expected to be minimal. The proposed project levees would cover a corner of an existing mangrove stand and small areas of palustrine emergent wetlands (wet meadows). Total projected impacts will be to 1.5 acres of emergent prairie wetlands. Project channels would create approximately 9.6 acres of new open water and emergent wetlands.

Archeological deposits associated with the Iglesia de Espinar and deposits at PCI Site 1 will be adversely affected. In coordination with the State Historic Preservation Officer (SHPO), archeological data recovery will be undertaken to mitigate adverse effects. The Iglesia de Espinar ruins will be protected by the project from future flooding. A Phase II archeological assessment will be conducted on archeological deposits at site PCI 2.

2.00 INTRODUCTION

2.01 Authority and Prior Studies. This study and proposed project were developed under the authority of Section 205 of the 1948 Flood Control Act, as amended. A reconnaissance report on flooding problems in the study area was completed in 1991. This Detailed Project Report and Environmental Assessment discuss the results of a feasibility-phase study. The study covered lands in Espinar Ward ("barrio") in the Municipality of Aguada, and Victoria Ward in the Municipality of Aguadilla. The study area is located in the northwestern part of the island of Puerto Rico. The wards are located along the south and north banks, respectively, of Caño Madre Vieja, a tributary branch of Río Culebrinas. The recommended project would be built using Federal funding combined with funds contributed by the Municipalities of Aguada and Aguadilla, and the Puerto Rico Department of Natural and Environmental Resources (DNER).

2.02 Study Area Setting. Caño Madre Vieja is a 2.1-kilometer (1.3 miles) long tributary of Río Culebrinas, is an old river outlet of the major west slope river, Río Culebrinas that flows across the study area and discharges into Aguadilla Bay. This small intermittent stream is the political boundary dividing the municipalities of Aguadilla and Aguada. Both, the mouth of Caño Madre Vieja and the Río Culebrinas, 1.5 kilometers (0.88-mile) to the south, have sandbar restrictions. Río Culebrinas is one of the major Puerto Rican rivers, draining the northwestern limestone region around Aguadilla, as well as an extensive area of interior highlands in the vicinity of Moca, Las Marías, and San Sebastián (See Figure EA-1). The study/project area comprises low-lying lands located between the north bank of the main channel of the Río Culebrinas and the southernmost fringes of the city of Aguadilla. Both streams drain to the Aguadilla Bay. The last, coastal segment of the drainage is a wide, nearly flat floodplain bordered on the north by a limestone escarpment and the Jaicoa mountain range, and on the south by the Cadena San Francisco mountain range. The topography of the coastal part of the valley is virtually flat. "Caño Madre Vieja" is actually an old mouth of the meandering Culebrinas River, from which it branches about 2.1 km (1.3 miles) upstream of the project area. Water from the main river channel is impeded from entering Madre Vieja during low flow periods by a natural levee on the main River's north bank. When river levels rise in response to high rainfall events, this levee is overtopped and the river "spills over" into Madre Vieja channel, flooding the Espinar and Victoria neighborhoods.

The Madre Vieja Channel is itself a widely meandering stream, which carries little or no flow during dry periods, with the exception of local storm run off and local seepage from groundwater originating in the high Aguadilla limestone escarpment. The main River mouth and the Channel mouth are partially blocked during the dry season by sandbars. These bars are continually deposited by longshore sand drift, during the dry season. Rainy-season floods wash the sandbars out.

The coast in this region is a series of sandy beaches backed by a narrow, low dune berm. A long mangrove-lined slough parallels the berm behind the coastal dune. East of the mangrove stand, there are fairly extensive emergent wetlands on the Espinar side of the channel. The affected neighborhood on the north side is the Victoria ward of Aguadilla,

a long-established residential area consisting of closely spaced houses, a school and public parkland. Espinar ward of Aguada consists of more widely spaced individual residences. Lands right along the channel are former sugar cane lands, now fallow.

2.03 Problem Definition. The affected low-lying neighborhoods are flooded when heavy basin wide rainfall causes the Rio Culebrinas to rise in its coastal segment, sending floodwaters down the Madre Vieja channel. This channel also receives runoff from the high limestone escarpment located to the northeast of the project area. Flood damages occur to neighborhood houses when water enters the ground floor of these structures.

2.04 Study Goals and Objectives. The study's purpose was to develop feasible alternatives for reducing the existing flooding problems without causing adverse impacts to the communities, the environment, and the existing infrastructure of the area. Feasible alternatives are those that are cost effective, efficient and in compliance with applicable Federal and Commonwealth guidelines and regulations.

The specific goals are to protect lives, reduce property losses, avoid adverse effects on natural and socioeconomic resources of the region, and maximize net National Economic Development (NED).

3.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed project action is building two flood control levees to separate the last downstream segment of Caño Madre Vieja from adjoining residential communities. The levees would extend from high ground inland on the landside of the coastal berm, north and south of Caño Madre Vieja, northwest on the high ground on both sides of the channel, to the coastal berm. The northern levee is referred to as the Aguadilla Levee, and the southern levee is referred to as the Espinar Levee. Levees would prevent recurring flooding damages. The total length of both levees would be approximately 3.3 kilometers.

The Aguadilla levee would begin at high ground near Highway 2 and extend toward the Northwest for about 1.8 kilometers to end at the high ground near Yumet Avenue. A 4 meter deep, 43 meter wide (with 4 meter right-of-way on each shore), 60 meter long Caño Madre Vieja cutoff channel would be constructed at Caño Madre Vieja to reconnect a stream meander that would otherwise be obstructed by the Aguadilla levee. Refer to Section 4.04, Recommended Plan and to Figure EA-6.

The Espinar levee would begin at high ground at the southern end of the Espinar Community and extend to the east and then to the Northwest for about 1.5 kilometers to end before reaching the Coastal Barrier Segment PR-75. A levee spur will tie at high ground in the Espinar Community. The alignment of Espinar levee was adjusted to avoid, to the maximum extent feasible, cultural resources associated with the church and ruins located in Espinar.

Both levees would have an average structural height of 2.5 meters, 1 on 2.5 side slopes, an average levee base of 16 meters, and a levee crest width of 3 meters. (The ultimate height of the levees may be greater, as it is planned to dispose of excess excavated material, if any, as top dressing on the levee crest). The interior drainage facilities would consist of a 1 meter deep and 7 meter wide drainage channel along the protected side of each levee. Total right-of-way will include 5 meters on the flooding or unprotected side and 20 meters (including the drainage channel 9 meters from the levee) on the protected side of the levee.

One one-way drainage structure would be constructed at the Espinar Levee near the levee spur to provide drainage of interior channels into Caño Madre Vieja. Three one-way drainage structures would be constructed along the Aguadilla levee to provide drainage of interior channels into Caño Madre Vieja. Drainage structure outlets would be connected to Caño Madre Vieja.

The work would require about 110,000 cubic yards of fill of which about 32,000 cubic yards would come from the cutoff and drainage channels and the rest from the commercial borrow site at nearby Tablonal Quarry (See Figure EA-6).

4.00 ANALYSIS OF ALTERNATIVES

The range of alternatives considered varied from no-action (no flood control project would be constructed) through four non-structural and four structural alternatives.

4.01 No Action. The no action alternative would allow the existing and prospective flooding condition to continue. These damages will increase in the future as residences become denser in Espinar and Victoria Wards.

4.02 Non-Structural Alternatives. Applicable non-structural measures could include channel clean-out, flood insurance, flood-proofing existing structures, relocation of flood-prone residences outside of the flood zone, strict enforcement of flood plain development regulations (Planning Board Regulation Number 13) and a flood warning evacuation systems. Some of these measures are already available.

Channel clean out is a local responsibility, but flooding in this area does not appear to be due to channel obstructions. A flood warning alarm-based systems might be feasible in large basins to protect lives from catastrophic flooding, but the relatively small size of the Río Culebrinas basin would offer no benefit from a flood warning system. Flood insurance has been available in Puerto Rico for many years, but relatively few residents participate. Flood proofing residences in this area would entail raising the inhabited part of houses above the 100 year flood level. Because most structures are of reinforced concrete or block and concrete masonry construction, this alternative would be impossible. Likewise, relocation of residences would be very costly. The Victoria sector of Aguadilla is a long-established community, with densely built housing. Thus, non-structural alternatives are either already in place (periodic clean-out, flood insurance) or not really applicable.

4.03 Structural Alternatives. The four structural alternatives considered included flood proofing, multipurpose reservoirs, channel improvements, and levees and/or floodwalls.

The construction of a multipurpose reservoir could reduce flood levels by holding back peak flows until downstream flood plain conditions permit a controlled release of stored floodwaters. They can also be effective in fulfilling other water resources needs such as water supply and recreation. Previous USACE studies identified several potential reservoir sites in the upper Río Culebrinas. The relatively small size of all the potential reservoir sites within the Río Culebrinas basin would have little effect on reducing flood stages in the lower flood plain and their cost would be over \$50.0 millions. Therefore, the multipurpose reservoir alternative was not considered any further.

Channel improvements for Río Culebrinas along a straight alignment from Highway 2 towards the ocean would provide effective flood control to the entire lower flood plain. Any type of channel improvement would require an improved outlet and some type of velocity-control measures and channel revetment. An improved outlet to the ocean would require revetments to stabilize it and perhaps also jetties to protect it from coastal sand movements. Widening and deepening the present Río Culebrinas channel and route realignment practically throughout the lower flood plain would provide flood control to the entire flood plain. Any channel improvement alternative should also include an adequate schedule for maintaining the channel free of vegetation or other obstructions. The substantial channel improvements required for Río Culebrinas, in order to control major floods, could adversely impact the stream habitat of the native river shrimp and the natural water flow into the adjacent estuary and swamp. Since the cost of the required channel work would be over \$30.0 millions, which is beyond the funding limitation of the Continuing Authority Program, and will provide no net benefits, while causing an adverse impact to environmental and cultural resources in the flood plain, the channel improvement alternative was not considered any further.

Levees and floodwalls preclude floodwaters from entering damage-susceptible areas. They are considered in detail because of the physical and natural conditions of the area, and also because they appear to be the most practicable, acceptable, and efficient flood control measure for the study area. The physical conditions of the detailed study area are as follows, the urban development is located to just one side of the flood plain, for most reaches there is sufficient available open space between the river and the urban area to accommodate the levee, and levee construction materials are readily available in the area. Levees could provide low cost and effective flood protection to the town of Aguadilla and the community of Espinar. Therefore, flood control levee alternatives are considered the only practicable, acceptable, and efficient flood control measure for the Río Culebrinas lower flood plain. Three alternative levee alignments were developed into two preliminary plans, a short levee alignment and a twin levee alignment. The most cost effective and environmentally acceptable plan identified during the preliminary plan formulation process was then examined in detail during the final plan formulation process.

Preliminary Alternative 1

This alternative considers a single earthen levee from Highway 2 to the high ground at Espinar community. Alternative 1 would completely exclude flooding from the Caño Madre Vieja coastal flood plain. This alternative would protect the entire urban area of Aguadilla and Espinar against the 100-year flood, but would also deprive coastal emergent wetlands and mangroves of most of periodic riverine flooding. Refer to Figure EA-2.

This alternative would entail a levee footprint of approximately 2.33 hectares (5.76 acres) of farmland, of which approximately 1.97 hectares (4.87 acres) are in upland pastures and approximately 0.36 hectares (0.89 acres) are wet pasturelands. Secondary impacts would include the probable future elimination of approximately 31.5 hectares (77.8 acres) of agricultural lands by urban development, and potential impacts to freshwater wetlands, as well as stress to the mangroves due to deprivation of periodic fresh-water flushing. Unless there is no other practicable alternative, this alternative would violate the intent of E.O. 11988.

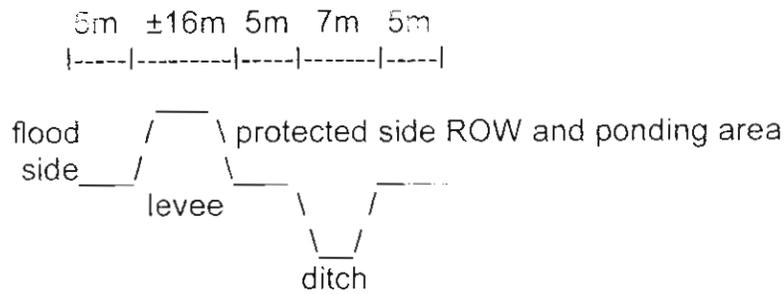
Preliminary Alternative 2

This alternative considers two levees, one protecting the urban area of Aguadilla, and one protecting the community of Espinar. This alternative would allow Caño Madre Vieja to continue acting as a floodway, while flood proofing coastal communities. The vacant agricultural land in the flood plain between the levees would not be protected. Refer to Figure EA-3.

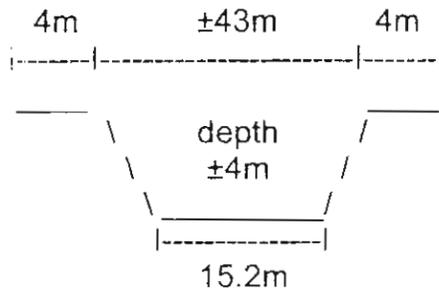
This alternative would eliminate by direct impact (footprint of the levee) approximately 4.75 hectares (11.7 acres) of farmland, of which approximately 2.2 hectares (5.4 acres) are in upland pastures and approximately 0.6 hectares (1.5 acres) are wet pasturelands (palustrine emergent wetlands). The remaining 1.95 hectares (4.8 acres) consist of uplands not dedicated to pasture lands. Based on a worst case analysis for impacts to the mangrove swamp forest, where the edge of the levee is aligned along the adjacent landowners' fence, approximately 0.2-acres (0.1 hectares) would be eliminated. This alternative would also cutoff approximately 980 meters of live stream from the Caño Madre Vieja.

To facilitate the identification and description of this alternative the two-levee alternative was divided in two sections, the Aguadilla Levee and the Espinar Levee. The Espinar Levee total right-of-way acreage, including 1 ramp, would be (1,500 meters long + 266 meters long for the Western spur) x 36 meters wide = 67,108 square meters = 16.58 acres. The Aguadilla Levee total right-of-way acreage, including 2 ramps, would be (1,800 meters long) x 38 meters wide = 68,400 square meters = 16.90 acres. As shown below, the typical levee right-of-way includes the levee and drainage channel footprint, ramps, and a maintenance easement on both sides.

1 acre = 43,560 sq. ft. or 4,047 sq. m. 1 ha = 2.47 acres or 10,000 sq.m.



Last, the Caño Madre Vieja cutoff channel would be approximately 60 meters long and 4 meters deep as shown on the typical cross section below. Permanent right-of-way covers about 60 meters long x 51 meters wide = 3,060 square meters = 0.8 acres.



Based on the preliminary plan formulation analysis, the two levee alternative is only practical, acceptable, and feasible flood control alternative that warrants to be examined in details as part of the final plans.

Final Alternative 1

This alternative combines 3.3 kilometers of levees, a small cutoff channel, three road ramps, and interior drainage facilities protecting the southwestern section of the town of Aguadilla and the community of Espinar, in Aguada, against the 50-Year flood from Río Culebrinas. The general right-of-way alignment and features of final alternative 1 are shown in Figure EA-4.

The Aguadilla Levee would begin at high ground near Highway 2 and extend towards the north for about 1.8 kilometers to end at high ground near Yumet Avenue. An approximate 60 meters long, 4 meters deep, and 43 meters wide Caño Madre Vieja cutoff channel would be constructed at Caño Madre Vieja to reconnect a stream meander to be obstructed by construction of the Aguadilla Levee. The proposed interior drainage channel would reconnect the meander interrupted by the levee. The Espinar levee would begin at high ground on the southern end of the Espinar Community and extend to the east and then to the north for about 1.5 kilometers to end just south of Coastal Barrier (CB) segment PR-75. The final plans considered a previously impacted portion of CB segment PR-75 as the northernmost tie up site for the Espinar levee. The recommended plan eliminated all

proposed work within the CB segment PR-75. This was done in order to comply with the stipulations of the Coastal Barriers Resources Act (CBRA) and the Coastal Barriers Improvement Act of 1990 (CBIA). These Acts prohibit the expenditure of Federal funds to enhance the infrastructure of a designated CB area in such a way to stimulate development of a CB. Both levees would have an average height of 1 meter, 1 vertical on 2.5 horizontal side slopes, and a levee crest of 3 meters. The interior drainage facilities would consist of a 1 meters deep and 7 meter wide drainage channel along the protected side of each levee. One two-way drainage structure would be constructed at the north end of the Espinar Levee and three one-way drainage structures would be constructed along the Aguadilla Levee. Drainage structure outlets would drain into to Caño Madre Vieja.

Final Alternative 2

This alternative considers the same project features as described for Final Alternative 1, but it provides a 100-year level of protection levees. The proposed 100-year levees would have an average height above ground of about 2 meters, 1 on 2.5 side slopes, and a levee crest of 3 meters. The general alignment and features of Final Alternative 2 are similar to Final Alternative 1 and are shown in Figure EA-4.

Final Alternative 3

This alternative considers the similar Aguadilla Levee features as described for Final Alternative 1 and Final Alternative 2, but it would be higher and wider providing protection for the Standard Project Flood (SPF). The proposed SPF Espinar Levee alignment would be twice as long, higher, and wider than the levee alignment considered for Final Alternative 1 and Final Alternative 2. The SPF levee alignment would begin north of the mouth of Río Culebrinas and extend to the south, to the east, and then to the north, around the community of Espinar, for about 3.3 kilometers to end at an existing rock jetty just south of the existing mouth of Caño Madre Vieja. The proposed SPF levee would have an average height above ground of about 3.0 meters, 1 on 2.5 side slopes, and a levee crest of 3 meters. The general alignment and important features are shown on Figure EA-5.

4.04 Recommended Plan.

Final Alternative 2 with modifications to the Espinar Levee for avoiding impacts to the Coastal Barrier segment PR-75 is the recommended plan. It maximizes the National Economic Development (NED) benefits. The recommended plan combines 3.3 kilometers of levees, a small cutoff channel, three road ramps, and interior drainage facilities protecting the town of Aguadilla and the community of Espinar, in Aguada, against the 100-year flood. The general alignment and important features of the recommended plan are shown on Figure EA-6, and typical cross sections are shown on Figure EA-7.

The recommended plan would substantially reduce the flooding problems in the detailed study area. The construction of a 100-year protection levee, interior drainage facilities and a small cutoff channel would take about 19.6 acres of lands and would require about 110,000 cubic yards of fill of which about 32,000 cubic yards would come from the

cutoff and drainage channels and the rest from the commercial borrow site. The plan would provide flood protection for about 550 acres of urban area. The recommended plan would not provide flood protection to vacant lands in the flood plain, nor would it significantly affect flood flows or timing in Caño Madre Vieja.

The proposed work will entail the disposal of approximately 1,000 cubic yards of spoil fill. Most will be disposed of within the right-of-way of the levees, on top or on the sides' slopes as top soil. Any spoil fill or debris that cannot be disposed of in that manner will be disposed of in the municipal landfill in use by the municipalities of Aguadilla and Aguada at the time the work takes place.

5.00 AFFECTED ENVIRONMENT

5.01 Vegetation and Wildlife. Most of the lands in the river valley area are now fallow unimproved pasture, but much of the area was planted in sugar cane for many decades. Prior to its agricultural use, climax vegetation would have been an open-crowned semi-deciduous hardwood forest of mixed species. More recently, land use has included use as cattle pasture and for sand extraction (shallow quarrying). Cattle grazing have limited tree and shrub vegetation to a few sporadic patches or riverbank stands of facultative wetland trees. The large marsh, called Cayures Swamp, and shown on Figure EA 2) located on the south bank of the Culebrinas River in Aguada, is reportedly used by special concern species including the masked duck and possibly West Indian whistling duck, but no recent sightings of these species are known to biologists of the Commonwealth Natural Heritage ("Patrimonio") program. The recommended plan avoids work in this area.

Espinar Community is surrounded by low, nearly level flood plain lands. Much of this land, formerly planted in sugar cane, has reverted to mixed (upland) grassland and wet grassland. To its west, and south of the mouth of Caño Madre Vieja, the low sandy beach berm is backed by a narrow mangrove swamp. The berm and mangroves is a designated Coastal Barrier segment (PR-75/75P). The landward edge of PR-75 coincides with the landward (eastern) side of the mangrove wetlands in Espinar. The land North of the Caño (designated PR-75P) has been developed into a city park with recreation on commercial facilities. A wet swale extends inland from the mangrove swamp. Vegetation in the swale is a mix of wetland grasses, herbs and salt-tolerant shrubs, including *Mimosa casta*, *Lonchocarpus dominguensis*, *Machaerium lunatum*, and *Thespesia populnea*.

The area around Espinar does not support a very diverse or unusual assemblage of wildlife. The mixed pasture and emergent wetlands of Caño Madre Vieja do not appear to be significant habitat, as indicated by field observations and the Fish and Wildlife Coordination Act Report. Green-backed heron fish and rest in the mangrove, and cattle and snowy egrets visit the shallow water areas to feed. In general, wildlife consists of common lizards and frogs, human tolerant species of birds (including kingbirds, grackles, bananaquits, and grassquits), rats and mice, and mongoose. Crustaceans include fiddler crabs and the blue land crab, *Cardisoma guanumi*.

Human impact is prevalent throughout the area. Only occasional birds and crab burrows are noticeable. Other animals seen include cattle and domestic cats and dogs. No endangered, threatened, or special concern species (species listed in the DNER Natural Heritage inventory) are known from the immediate project lands.

5.02 Fishery Resources. The U.S. Fish and Wildlife Service (USFWS) identified freshwater river shrimp (*Macrobrachium carcinus*) as an aquatic species of concern and expressed concern that whatever alternative chosen, careful consideration be given to water flow which could impact the stream habitat of this migratory freshwater shrimp. Both the Río Culebrinas and Caño Madre Vieja are well known for their populations of this native river shrimp, which are caught and sold locally. However, the flood control features under consideration would not significantly affect flows or stages of either Río Culebrinas or Caño Madre Vieja and would not obstruct passage of these migratory organisms. On July 7, 1999, the USACE determined that the proposed work would take place inland of any existing designated Essential Fish Habitat (EFH) under jurisdiction of the National Marine Fisheries Service (NMFS), and would not affect it. This determination was coordinated with NMFS by letter on July 7, 1999. On August 4, 1999, NMFS stated that it had no comments or recommendations to offer. The recommended plan avoids impacts to aquatic species in the study area.

5.03 Coastal Barriers. The sandy coastal berms south and north of the mouth of Caño Madre Vieja are Coastal Barrier Segments PR-75 and PR-75P, respectively (refer to Figure EA-1). The mangrove-vegetated area along Espinar beach falls within Coastal Barrier PR-75. The coast in this region is a series of sandy beaches backed by a narrow, low dune berm, no more than 2-3 m high, and readily overwashed by storm swells. A long mangrove-lined slough parallels the berm behind the coastal dune. East of the mangrove stand, there are fairly extensive emergent wetlands on the Espinar side of the channel. Even farther East, the land rises again, and this is where the residences of Espinar ward are located. Barrier segment PR-75 is still largely undeveloped. The vegetation of the sandy berm is composed of a mix of native and exotic trees. The latter include coconut palms and tropical almonds (natives of Southeast Asia). The mangrove lined slough is fairly narrow and shallow (refer to Photos 11 and 12 of the DCAR, Attached). A 28-acre multi family housing development presently named "Costa de Marfil" is being proposed within CB segment PR-75, the proposed private housing development will consist of 240 apartments and 10 luxury villas, recreation facilities, and extensive parking facilities.

The "P" designation area near Parque Colón on the East side of the stream mouth indicates that the segment is considered protected by State or local regulations. This area is not subject to Federal restrictions. It is not known how this segment was included within the Coastal Barrier System, as it is a city park complete with a running track, public beach area, boat and passive play area dominated by several large, exotic shade trees (including one enormous fig tree that was converted to a tree house by the municipal architect). This park area has been subjected to extensive manipulation and shoreline stabilization after its designation but prior to beginning of the studies reported here. Alterations in this barrier included construction of two rock jetties, recreational and associated parking facilities, and

the construction and periodic maintenance dredging of a relocated Caño Madre Vieja outflow channel. However, as noted in the USFWS CAR, a small stand of mangrove also backs this segment and appears to be near the footprint of the Aguadilla Levee.

5.04 Wetlands. Along the footprint of the Aguadilla Levee is an emergent palustrine freshwater wetland. It is dominated by facultative wetland grasses including *Bracharia purpurascens* with 10% or less depressional wetlands. A similar situation exists along the Espinar Levee, except for a 100-foot by 70-foot area of mangrove swamp found at the Coastal Barrier. This is dominated by 90% red mangroves over 40 feet in height. The meander loop cut between both levees is dominated by 90% mature white mangrove.

The mangrove dominated slough running parallel to the coast behind the sand berms is shown on Photos 11 and 12 of the USFWS CAR. Red mangrove (*Rhizophora mangle*) dominates the channel and is backed by white and black mangroves. This slough is not flushed by all tides, as the mouth of the Caño becomes blocked by a sandbar with some frequency. However, storm tides and extreme Spring tides provide salt water flushing, while draining from the uplands provides fresh water input. Additionally, high storm waves can overwash the protective sand dune and add to the salt content of the mangrove soils. Conversely, during flood periods the water of the slough may be essentially freshwater. The estuarine nature of the area is shown by the presence of some less salt-tolerant species, such as leather fern.

5.05 Prime and Unique Farmland Soils. The principal soil associations found in the study and project area are Coloso-Toa and Bejucos-Jobos soils are found in the lower flood plain; the coastal berms are mapped as Cataño sandy soils Coloso soils were intensively used for sugar cane, and are prime farmland soils. In this area it appears that there are many inclusions of the wetter Bajuras soils. A form AD-1006 (enclosed in the coordination correspondence) has been prepared and will be coordinated with the Natural Resources Conservation Service (NRCS) for the project footprint.

5.06 Cultural Resources. The Río Culebrinas valley is a very important area in the prehistory and history of Puerto Rico. The area was inhabited throughout the Ceramic age of prehistory, demonstrated by archeological sites containing Saladoid and Ostionoid series ceramics. A nine kilometer (5.4 mile) stretch of coastline encompassing the study area is the conjectured 1493 landing site of Columbus. Sir Francis Drake visited the area in 1595. The Iglesia de Espinar, identified as the "ruins of the Hermitage of Inmaculada Concepción of Barrio Espinar, Aguada" on the property's draft National Register form, is one of Puerto Rico's earliest churches and is located adjacent to the Espinar Levee. The church was originally constructed in 1526. Numerous sugar producing haciendas and sugar mills were established in the river floodplain in the 19th and 20th Centuries.

A cultural resources survey was performed on the project area in 1999 (Cinquino et. al. 1999). The investigation identified four archeological sites. Two of the sites, PCI 1 and archeological deposits associated with the Iglesia de Espinar, are eligible for inclusion on the National Register. An additional site, PCI 2, is potentially eligible for the National Register, and Phase II testing is necessary. The fourth site, PCI 3, is not significant.

5.07 Water Quality. Río Culebrinas and Caño Madre Vieja are Class SD - Surface Waters. Class SD waters are intended for use as a raw source of public water supply, propagation and preservation of desirable species as well as primary and secondary contact recreation. Primary contact recreation is precluded in any water containing pathogenic organisms. A review of USGS Water Resources Data (Curtis, R. E., Jr., Z. Aquino, R. J. Vachier, P. L. Diaz, 1991 Water Resources Data Puerto Rico and the U. S. Virgin Islands, USGS-WDR-PR-90-1, 530pp.) revealed that Río Culebrinas water quality parameters measured near Aguada, two kilometers southwest of Aguadilla, are generally within water quality standards for Class SD waters. However, during unusually high flows certain constituents do exceed established standards. For example, iron (86,000ug/l) and zinc (130ug/l) concentrations measured in May 1990 were the highest recorded in Puerto Rico for the 1990-water year. There is no standard for iron but zinc exceeded the standard by 80 ug on this occasion.

5.08 Hazardous, Toxic and Radiological Waste. Review of the Aguadilla, Puerto Rico, U. S. Geological Survey (USGS) map indicates that urbanized or modified areas with potential for Hazardous, Toxic and Radiological Waste (HTRW) contamination are negligible in the study area. The predominant land use is agricultural and poses little or no HTRW threat. There appear to be no landfills, industrial waste treatment plants, light industries, or other facilities likely to generate HTRW. A civil works audit as defined in ER-1165-2-132 for HTRW materials was conducted in May 1995, and updated in May 1999. No signs of potential HTRW problems were identified and no sites with potential for contamination with HTRW were found. Furthermore, no contamination due to hazardous and toxic waste spills is known to be in the study area.

5.09 Air Quality. The general work area is dedicated to agriculture. Therefore, sources of air pollution are minimal and limited mostly to motor vehicles. Air quality is currently within acceptable EPA standards. There are no non-compliance air quality basins or air-sheds included within the proposed work area.

5.10 Aesthetic Resources. Existing visual aesthetic resources found in the Río Culebrinas flood plain are comprised of pasturelands, sugar cane fields, and croplands of the Caño Madre Vieja Channel Basin. A mature stand of shade trees is located along the floodplain on the northwest side of the intersection of Highway 111 and Highway 115. Dense mangroves can be found near the coast on each side of the channel basin, which possess aesthetic value. The mature coconut palms along the golden sandy beach are also an aesthetic element, but they are outside the immediate project area.

5.11 Noise. The area is a rural municipality, where natural noise levels are low, except in the immediate vicinity of highways.

5.12 Socio-Economic Conditions. The 16 "barrios" (wards) of Aguadilla and 18 of Aguada support populations of 63,511 persons and 39,536 persons, respectively. The local economy depends mainly on light manufacturing and local tourism. Other commercial activities of importance are fishing and, to a much lesser degree, small-scale agriculture.

6.00 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

There would be temporary adverse impacts on air quality, water quality, and aquatic life from clearing, excavating and compacting materials during the construction of levees and channels. No net loss of wetlands is expected.

In the Aguadilla area, residual flooding would cover about 54 acres outside the proposed project right-of-way. Of those, 16 acres are vacant\wetland\parks, and 38 acres are streets\houses\back yards. Urban area residual flooding in most areas would be very shallow nuisance flooding of about 1 foot.

In the Espinar area, residual flooding would cover about 36 acres outside the total project Right-of-way. Of these, 35 acres are vacant wetlands and 1 acre consists of back yards. Back yard flooding is very shallow at less than 1 foot.

6.01 Biological Resources. Total impacts of the project on biological resources are limited to the levee and channel footprints. Neither the timing, volume or duration of flooding on Caño Madre Vieja or Río Culebrinas would be affected by the proposed flood reduction features; therefore, no life stages of migratory stream organisms will be affected. After preliminary discussions with USFWS, the Western (Espinar) levee has been modified to avoid impacting CB segment PR-75, therefore, no mangrove stands will be affected by the levee.

6.02 Coastal Barriers. The proposed work will not result in an increase in the development of the area of Coastal Barrier segment PR-75P. This area has already been developed by the Municipality of Aguadilla.

The Coastal Barrier Resources Act and the Coastal Barriers Improvement Act preclude the use of Federal funds to construct any kind of infrastructure or protection works in a Coastal Barrier area. The intent is to prevent the use of Federal dollars for activities (such as protection from flooding) that may lead or be construed as possibly leading to the development of Coastal Barrier areas. None of the exceptions contemplated in that act apply to this work. For this reason, work within Coastal Barrier segment PR-75 was modified for the recommended plan and the Espinar Levee will end before penetrating Coastal Barrier segment PR-75.

6.03 Wetlands. Project completion will directly impact approximately 1.5 acres of emergent wet prairie currently used as pasturelands. These were assessed to have a total biological value of 1 unit, using the Wetlands Rapid Assessment Procedure Methodology (WRAP). The score was 0.48 for the pasture. Mitigation for unavoidable project impacts, if needed, would include enhancement of 1 acre of emergent wet prairie.

The USACE estimates that project completion will also result in the construction of drainage channels parallel to the levees. These will have an average width of approximately 7 meters (21 feet) and will run for the entire length of the levees. This will create approximately $21 \times 9,723 = 204,183$ square feet or 4.69 acres of habitat for fish and amphibian species.

The total footprint of the project is 34.98 acres, 16.58 in the Espinar Levee and 16.90 acres in the Aguadilla Levee. Direct biological impacts to 1.5 acres of emergent prairie will accrue. Additionally the remainder of the project will impact 33.48 acres of pasturelands. The 1.5 acres area has a WRAP score value of 0.76, and the remaining footprint has a value of 0.33. The total biological function impacted is equivalent to 12.28 acres of pristine wetland.

The only permanent ponding area along the Aguadilla Levee to be provided by the project would be within the protected side ROW {20 m (wide) x 1,836 m (long)= 9 acres}. The 9 acres ponding is already included in the total ROW.

The only permanent ponding area along the Espinar Levee to be provided by the project would be within the protected side ROW {20 m (wide) x 1,600 m (long)= 8 acres}. The 8 acres ponding is already included in the total ROW.

The drainage canals planned for the Espinar and Aguadilla levees will result in the creation of 6.7 acres of wetlands and waters of the United States. Water depths in these will vary from -2 to -4 feet. The USACE estimates that approximately $\frac{1}{2}$ of that acreage will be colonized by wetland plants and will become vegetated shallows useful for wading birds, and other fish, amphibian and invertebrate species. The remaining half of the acreage will also be of value as habitat and spawning ground for various aquatic species expected to colonize the area through its connection to existing water bodies. Additionally, the approximately 60 meter long by approximately 43 meter wide cutoff channel planned for approximately the halfway point between both levees, will result in the creation of an additional 0.9-acre of waters of the United States. The biological functional equivalence loss of 13 units of biological function would be offset by the creation of more than 13.4 units of biological function in wetlands and waters of the United States.

Any dredged spoil will be placed on top of the levees after they are constructed to specification. Excavated material that cannot be used because of any specific physical characteristic, will remain in the borrow pit site or be disposed of in the adjoining municipalities authorized solid waste landfills, operating at the time of project construction.

If any of the vacant lands within the residual flooding area are to be developed with or without the project, then Puerto Rico Planning Board Regulation 13 will require the developer provide an H&H analysis and to provide the area with some kind of flood improvements to eliminate existing river flooding or with project residual flooding (which is less than river flooding). The recommended course of action in this case is not to develop in any of the residual flood areas.

6.04 Prime and Unique Farmland Soils. The Recommended Plan would eliminate by direct impact approximately 4.75 hectares (11.7 acres) of farmland, of which approximately 2.2 hectares (5.43 acres) are in pasture production and approximately 0.6 hectares (1.5 acres) of wet pasturelands. The Recommended Plan would disconnect approximately 980 meters of live stream from the Caño Madre Vieja.

The remainder of the footprint of both levees (33.1 acres, or 13.4 hectares) traverses land that for more than 100 years has been dedicated to sugarcane cultivation and is currently used as pastureland. It is currently colonized by upland grasses. The Río Culebrinas and Caño Madre Vieja themselves are at a lower elevation than the surrounding lands. Additionally, extensive development exists adjacent to both confines of the work area. Therefore, development acts as a containment berm for any water flow from the north or south into the area bound by Río Culebrinas and Caño Madre Vieja. The rivers influence on the surrounding area would be limited to its immediate adjacency and any area inundated during flooding events. This would not ensure a continuous hydroperiod that would facilitate re-colonization by wetland species. If agricultural activity were to cease in the area bound by the Río Culebrinas and Caño Madre Vieja, it would not be expected to revert to wetlands.

The area is predominantly rural, with both small-scale commercial and subsistence agriculture existing on site. Coordination with the Natural Resources Conservation Service (NRCS) was initiated on September 29, 1999, and concluded on November 1, 1999. Although the NRCS identified approximately 13.0 acres of prime and unique farmland and 7.0 acres of statewide and local important farmland. However, on January 10, 2000, when the NRCS reply was received, Ms. Carmen Santiago of the NRCS stated that for scores over 160 (combined sections V and VI), at least 2 other alternatives should be rated and scored, unless there were overriding reasons to have only 1 alternative. In this case, with a borderline score of 162, she stated that our explanation in the Environmental Assessment (EA) and the "Reason for selection" part of Form AD-1006 was sufficient.

6.05 Cultural Resources. Archeological deposits associated with the Iglesia de Espinar and deposits at PCI Site1 will be adversely affected. Archeological data recovery will be undertaken to mitigate adverse effects. The Iglesia de Espinar ruins will be protected by the project from future flooding. A Phase II archeological assessment will be conducted at PCI 2.

6.06 Water Quality. Based on this preliminary analysis the Recommended Plan should not result in violations of water quality standards. Water quality will not be adversely impacted by this project, and Commonwealth water quality standards will be met. Contaminants will not be introduced by clean fill material that may become suspended or dissolved in the river water during the construction operations. Short-term increases in the turbidity are expected during the construction phase of the project; however, the system will re-establish itself as a productive part of the overall ecosystem. No long-term surface water quality problems will result.

6.07 Hazardous, Toxic or Radiological Waste (HTRW). No sources of HTRW have been identified in the area either with or without the project. Therefore, the proposed work will have no effect in the amount of HTRW in the work area.

6.08 Air Quality. With the project, the area will remain as a predominantly agricultural area. Therefore, the project will not result in any changes in air quality. Exhaust emissions from construction machinery will be negligible. Therefore, no adverse effects on air quality will result from the implementation of the proposed project. Fugitive dust may be generated by the excavation and deposition of fill material, as in the construction of levees. All dust and pollution suppression measures and equipment required under Federal and Commonwealth laws and regulations will be utilized during project construction.

6.09 Aesthetic Resources. The contention structures themselves will be harmoniously incorporated into the aesthetic appearance of the area. The quality of the aesthetically pleasing green areas where the work will take place will not be compromised by discordant project results.

6.10 Noise. At project completion, the area will remain rural and exhibit minimum noise. The proposed work will have no effect on current noise levels. Any noise due to construction will be temporary.

6.11 Effects on Community Cohesion and Socio-Economic Well-Being. The proposed work will result in enhanced community cohesion and socio-economic well being. This will be brought about by the enhanced opportunities for development and creation of employment sources both by the work itself and by the enhanced investment climate when the risk of property loss is abated. This will benefit community cohesion, when community members are no longer forced to migrate to other areas in search of employment.

6.12 Unavoidable Impacts and Irretrievable Commitments of Resources. None expected. Project impacts on biological values of existing wetland habitat will be mitigated for.

6.13 Cumulative and Secondary Effects. The project will result in the protection of the delimited area from further flooding damage. This will not result in a stimulus to the subsequent development of the area, as the local government will commit to non-development of the area adjacent to the protected sides of the levees.

6.14 Relationship Between Short Term Use of the Environment and Long Term Productivity. The project does not propose use of the environment as such. However, the use of a tract of land to provide the levee and channel footprints, if construed as "use," will be offset by the productivity benefits that will come to the area protected from flooding. These benefits will accrue both to the socio-economic component (whose life and property will be secured) and the biologic environmental component (since both existing wetland values, and the habitat values of agricultural and other rural areas will be protected from destruction through flooding).

7.00 COMMITMENTS

A Phase II archaeological investigation of any impacted sites will be performed during the plans and specifications phase prior to construction. A mitigation plan for cultural resources that might be impacted will be developed in coordination with the SHPO. Mitigation will be completed prior to project construction.

Pertinent USFWS recommendations for this project would be incorporated before completion of the final report. A concurrence with the USACE determination of consistency with the Puerto Rico Coastal Management Program will be sought from the Puerto Rico Planning Board (PRPB) when coordination of the recommended plan through this EA is complete and public comments have been received. This is in accordance with PRPB policy.

The government of Puerto Rico must commit to the non-development of the area comprised between the currently developed protected side of the levees and the levees themselves.

The recommended plan has been modified by deleting all proposed work within CB segment PR-75. This was in order to comply with the stipulations of the Coastal Barriers Resources Act and the Coastal Barriers Improvement Act of 1990. These Acts prohibit the expenditure of Federal funds to enhance the infrastructure of a designated Coastal Barrier area in such a way to stimulate development of a Coastal Barrier.

8.00 COMPLIANCE WITH LAWS EXECUTIVE ORDERS AND REGULATIONS

8.01 National Environmental Policy Act of 1969, as amended. Environmental information on the project has been compiled and this draft. Will be circulated prior to finalization in accordance with the National Environmental Policy Act.

8.02 Endangered Species Act of 1973, as amended. In the scoping process for this project, the USACE made a determination of no impact on any federally listed endangered or threatened species. The National Marine Fisheries Service concurred by letter dated August 8, 1995. A new Coordination Act Report (CAR) was received by the USACE on November 30, 1999. This document did not identify any endangered or threatened species in the work area, nor identified any impacts to the critical habitat of any endangered or threatened species.

8.03 Fish and Wildlife Coordination Act of 1958, as amended. In response to the requirements of this Act, the USACE has and will continue to maintain continuous coordination with the USFWS during all stages of the planning and construction process. Biologists from USFWS and DNER will continuously review the process. A CAR was received by the USACE on November 30, 1999. The USFWS recommended installing a

larger diameter two-way culvert to maintain hydrology to the mangrove channel parallel to the coastal barrier; that the wetlands in the protected side of the dikes be protected possibly by sitting the planned drainage culverts at an elevation such that the wetlands themselves are not drained into the flooding side of the dikes. The USFWS recommended mitigation through the development of additional estuarine and freshwater wetlands with the floods levees. The USACE decided to incorporate to the project design the recommendations of the USFWS regarding keeping the levee out of the Coastal Barrier segment PR-75, and coordinate this decision with the USFWS.

8.04 National Historic Preservation Act of 1966, as amended. Cultural resource Investigations and consultation with the Puerto Rico State Historic Preservation Officer (SHPO) are in compliance with the National Historic Preservation Act of 1966, as amended (P.L. 89-665), the Archeological and Historic Preservation Act (P.L. 93-291), and 36 CFR Part 800.

8.05 Clean Water Act of 1972, as amended. The study is in partial compliance. A Section 404(b) Evaluation has been completed and is presented in Attachment C. Full compliance will be achieved with issuance of a water quality certificate (WQC) from the Environmental Quality Board of Puerto Rico. WQC issuance is expected, but Commonwealth procedures require application to begin after NEPA coordination is completed, not before.

8.06 Clean Air Act of 1972, as amended. No significant emissions as defined in air quality regulations will be generated on the project, and no air quality permits will be required. Full compliance will be achieved with receipt of comments on the EA from the U.S. Environmental Protection Agency.

8.07 Coastal Barriers Improvement Act of 1990. The coastal berm originally proposed for tie-in of the Espinar Levee is designated Coastal Barrier (CB) segment PR-75. The part of the levee that impact a small portion of CB segment PR-75 was originally considered as essential to the successful attainment of the human protection goals of this project, at the 100-year flood level. However, the Coastal Barrier Resources Act and the Coastal Barrier Improvement Act preclude the use of Federal funds to construct any kind of infrastructure or protection works in a CB area. The intent is to prevent the use of federal Dollars for activities that may lead to the development of Coastal Barrier Areas (such as protection from flooding). None of the exceptions contemplated in that act apply to this work. Therefore, all work within CB segment PR-75 has been deleted from the project.

8.08 Coastal Zone Management Act of 1972, as amended. At this time the study and recommended plan have been determined to be in compliance with the major programs and objectives of the Puerto Rico Coastal Management Program. Concurrence from the Puerto Rico Planning Board (PRPB) will be sought when the public comment period on this EA has closed.

8.09 Farmland Protection Policy Act of 1981. Coordination with the NRCS was concluded on January 10, 2000. No further coordination is required.

8.10 Resource Conservation and Recovery Act of 1976, as amended, and Toxic Substances Control Act of 1976, as amended. No items regulated under these laws or other laws related to hazardous, toxic or radiological waste substances have been discovered. None are considered likely to exist in the study and project area.

8.11 Executive Order 11990, Protection of Wetlands. This Order requires that Federal Agencies avoid impacts to wetlands unless there are no practicable alternatives. It further requires that Federal Agencies minimize losses to the beneficial values of wetlands and preserve and enhance the beneficial values of wetlands. The recommended plan is in compliance with this Executive Order.

8.12 Executive Order 11988, Floodplain Management. The work is in compliance with this order. The project is located in a floodplain area where there are currently residences and permanently occupied structures. The project will result in protection of the inhabited areas adjacent to the floodplain area from further flooding.

8.13 Executive Order 12898, Environmental Justice. This Order prohibits disproportionately adverse Federal project effects on minority and low-income populations. The principal beneficiaries of the recommended improvements are the farmers, industrial, commercial agricultural workers, and associated persons who currently occupy the floodplain area. This is considered to be a low-income demographic group. The injection of 4 million dollars in Federal funds and matching sponsor funds into the local economy will significantly stimulate the local economy.

9.00 COORDINATION AND PUBLIC COMMENT

Environmental scoping was begun on February 26, 1991, during the Reconnaissance level studies. Additional scoping with Commonwealth and Federal agencies took place via letter dated July 14, 1995. Responses were received from the Office of the Governor of Puerto Rico, Puerto Rico Department of Agriculture, Puerto Rico Department of Natural and Environmental Resources, Puerto Rico Land Administration, Puerto Rico Planning Board, Administración De Servicios Municipales, Municipio de Aguadilla, Colegio De Ingenieros y Agrimensores De Puerto Rico, Puerto Rico Industrial Development Company, Oficina Estatal De Preservación Histórica (State Historic Preservation Office SHPO), and U.S. Fish and Wildlife Service. No adverse comments were noted in the responses received. After new regulations pursuant to the Magnuson-Stevens Fishery Resources July 6 and 7, 1999, prompted NMFS comments regarding no effects to EFH.

This Report and EA will be coordinated with all major Commonwealth agencies and to concerned Federal agencies in Puerto Rico and on the mainland for public review during at least a 45-day period, to comply with requirements of the National Environment Protection Act and the Puerto Rico Coastal Management Program.

10.0 LIST OF EA PREPARERS

Esteban Jiménez, Biologist, Barbara B. Cintrón, Biologist, David McCullough, Archeologist, Jorge M. Tous, Civil Engineer.

11.0 REFERENCES

Cinquino, Michael A., Robert J. Hanley, Michele H. Hayward, Frank J. Schiepati, Hugh Tosteson. Cultural Resource Survey of the Rio Culebrinas Flood Protection Project, Municipio of Aguadilla, Puerto Rico. Panamerican Consultants, Inc., Buffalo Branch Office, 36 Brunswick Road, Depew, New York 14043. July 1999.

Section 205, Reconnaissance Report, Rio Culebrinas at Aguadilla, Puerto Rico, U.S. Army Corps of Engineers, Jacksonville District, March 1992.

12.0 PROPOSED FINDING OF NO SIGNIFICANT IMPACT (FONSI).

I have reviewed the Detailed Project Report (DPR) and Environmental Assessment (EA) prepared for Río Culebrinas at Aguadilla and Aguada, Puerto Rico. The recommended plan in the DPR is the proposed action. I conclude that the proposed action will have no significant impact on the quality of the human environment. This conclusion is based on information analyzed in the DPR and EA. It also reflects pertinent information obtained from other agencies and special interest groups having jurisdiction by law and/or special expertise, and on comments and recommendations obtained after coordination of the DPR. Reasons for this conclusion are, in summary,

1. There will be no adverse impacts to endangered species of flora or fauna, wetlands or significant fish and wildlife populations or habitats. Recommendations of the US Fish and Wildlife Service regarding the Coastal Barrier segment PR-75, have been adopted.
2. Water quality will not be adversely affected. Puerto Rico water quality standards will be met and a Water Quality Certificate (WQC) will be obtained from the Puerto Rico Environmental Quality Board.
3. Archeological deposits associated with the Iglesia de Espinar and deposits at PCI Site 1 will be adversely affected. Archeological data recovery will be undertaken to mitigate adverse effects. The Iglesia de Espinar ruins will be protected by the project from future flooding. A Phase II archeological assessment will be conducted on archeological deposits at site PCI 2.
4. The USACE has determined that the project is consistent with the Puerto Rico Coastal Management Program. A Determination of Consistency is included in this EA. Puerto Rico Planning Board concurrence with the determination is expected, because no significant coastal resources will be affected, and no Puerto Rico or Federal agency has objected.
5. A level-1 survey and assessment for the presence of Hazardous, Toxic or Radiological Waste materials (HTRW), updated in 1998, indicated no known or suspected materials in the project footprint.
6. Public benefits include reduction flooding and damage to buildings and furnishings, improvement of public health and safety and elimination of other losses caused by flooding in this watershed, up to a return frequency of 1%. Adverse effects are temporary, will occur during construction, and include incidental noise and vehicular exhaust fumes. Construction activities will be planned, scheduled and sequenced to minimize adverse effects.

In consideration of the information summarized, I find that the proposed action will not significantly affect the human environment and do not require an Environmental Impact Statement.

Date

JAMES G. MAY
Colonel, Corps of Engineers
Commanding

13.0 FIGURES

Figure EA-1 Location and Coastal Barriers

Figure EA-2 Preliminary Plan 1

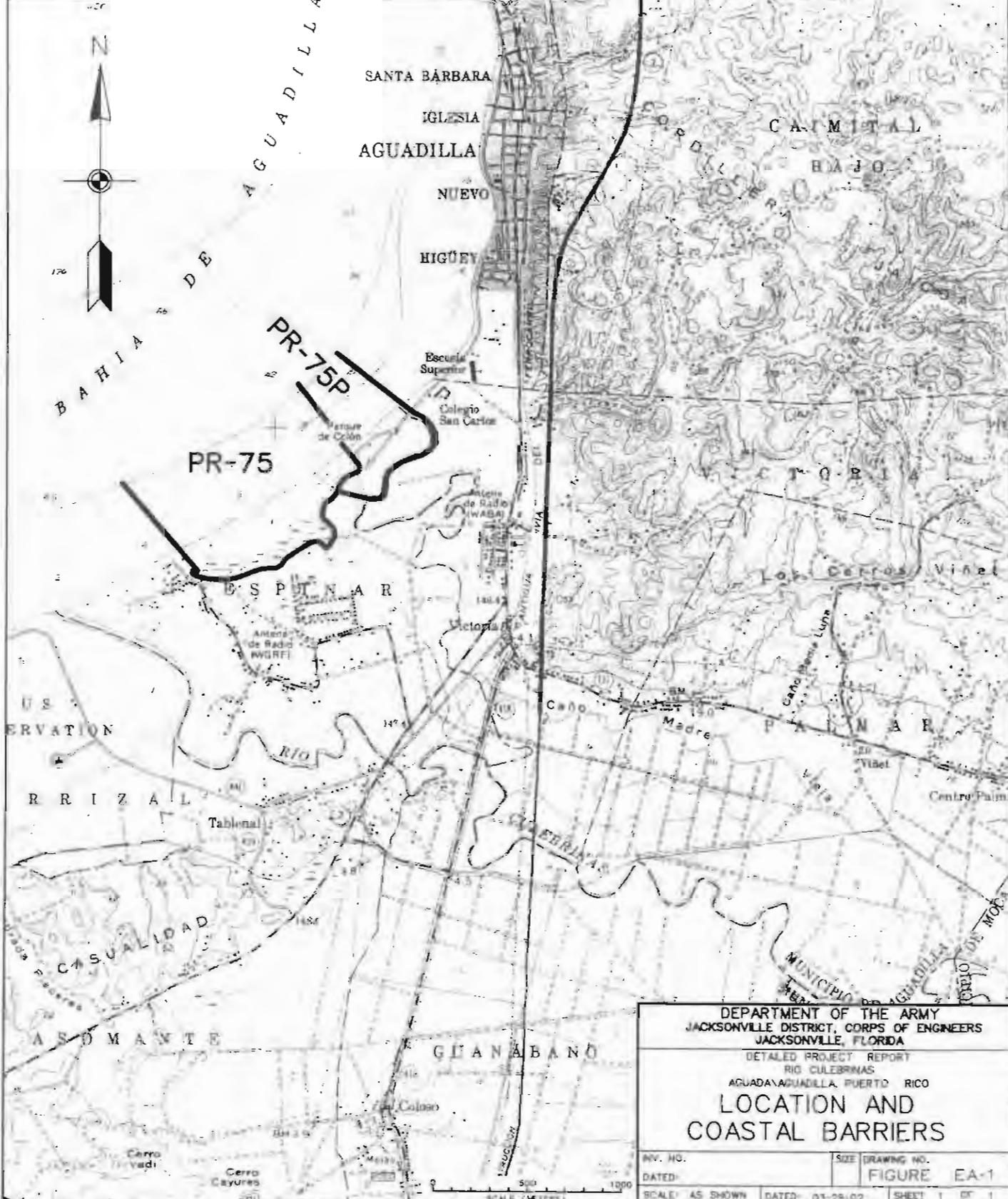
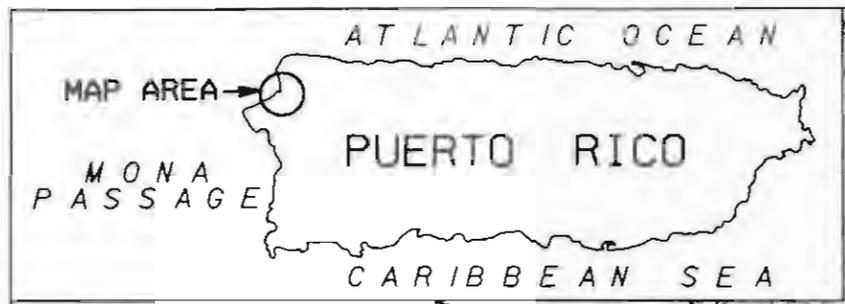
Figure EA-3 Preliminary Plan 2

Figure EA-4 Final Alternatives 1 & 2

Figure EA-5 Final Alternative 3

Figure EA-6 Recommended Plan (Modified Preliminary Plan 2)

Figure EA-7 Typical Cross Sections



AGUADILLA BAY



CAÑO MADRE VIEJA

PARQUE COLÓN

RIO CULEBRINAS

AGUADILLA

ESPINAR

TABLONAL

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

DETAILED PROJECT REPORT
RIO CULEBRINAS
AGUADILLA, PUERTO RICO

PRELIMINARY PLAN 1



REV. NO.	SIZE	DRAWING NO.
DATED:		FIGURE EA-2
SCALE: AS SHOWN	DATED: 03-26-02	SHEET 1 OF 1

AGUADILLA BAY

N



AGUADILLA LEVEE

CUTOFF CHANNEL

CAÑO MADRE VIEJA

ESPINAR LEVEE

RIO CULEBRINAS

PARQUE GOLDN

AGUADILLA

ESPINAR

HIGHWAY 442

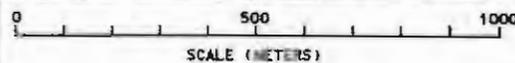
HIGHWAY 15

HIGHWAY 87

HIGHWAY 418

HIGHWAY 2

TABLONAL



DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA			
DETAILED PROJECT REPORT RIO CULEBRINAS AGUADAVAGUADILLA, PUERTO RICO			
PRELIMINARY PLAN 2			
INV. NO.	SIZE	DRAWING NO.	
DATED:		FIGURE EA-3	
SCALE: AS SHOWN	DATED: 03-25-02	SHEET 7 OF 1	

AGUADILLA BAY

N



AGUADILLA LEVEE

CUTOFF CHANNEL

CAÑO MADRE VIEJA

ESPINAR LEVEE

RIO CULEBRINAS

PARQUE COLON

AGUADILLA

ESPINAR

HIGHWAY 442

HIGHWAY 115

HIGHWAY 111

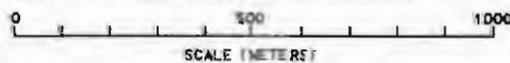
HIGHWAY 418

HIGHWAY 2

BORROW AREA

TABLONAL

DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA		
DETAILED PROJECT REPORT RIO CULEBRINAS AGUADAVAGUADILLA, PUERTO RICO		
FINAL ALTERNATIVES 1 & 2		
BY: NO.	SHEET DRAWING NO.	
DATED:	FIGURE EA-4	
SCALE: AS SHOWN	DATED: 03-28-02	SHEET 1 OF 1



AGUADILLA BAY



AGUADILLA LEVEE

CUTOFF CHANNEL

CAÑO MADRE VIEJA

ESPINAR LEVEE

RIO CULEBRINAS

PARQUE COLON

AGUADILLA

ESPINAR

HIGHWAY 442

HIGHWAY 15

HIGHWAY 111

HIGHWAY 418

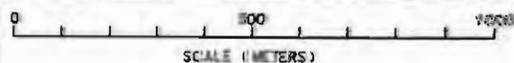
HIGHWAY 2

TABLONAL

DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA

DETAILED PROJECT REPORT
 RIO CULEBRINAS
 AGUADAGUADILLA, PUERTO RICO

FINAL ALTERNATIVE 3



INV. NO.	SIZE DRAWING NO.
DATED:	FIGURE EA-5
SCALE: AS SHOWN	DATED: 13-26-02
	SHEET 1 OF 1

AGUADILLA BAY



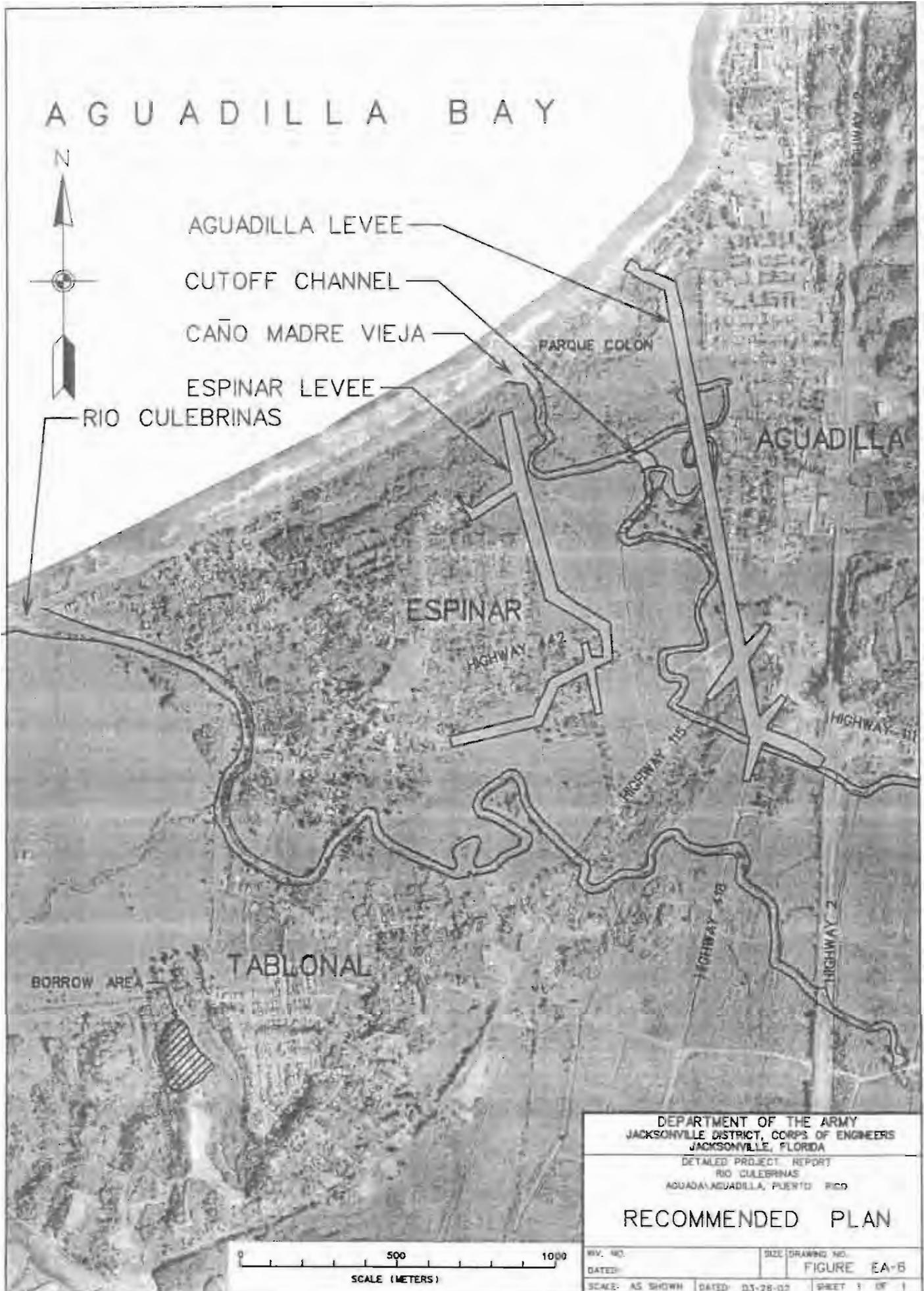
AGUADILLA LEVEE

CUTOFF CHANNEL

CAÑO MADRE VIEJA

ESPINAR LEVEE

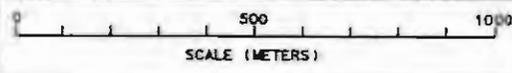
RIO CULEBRINAS

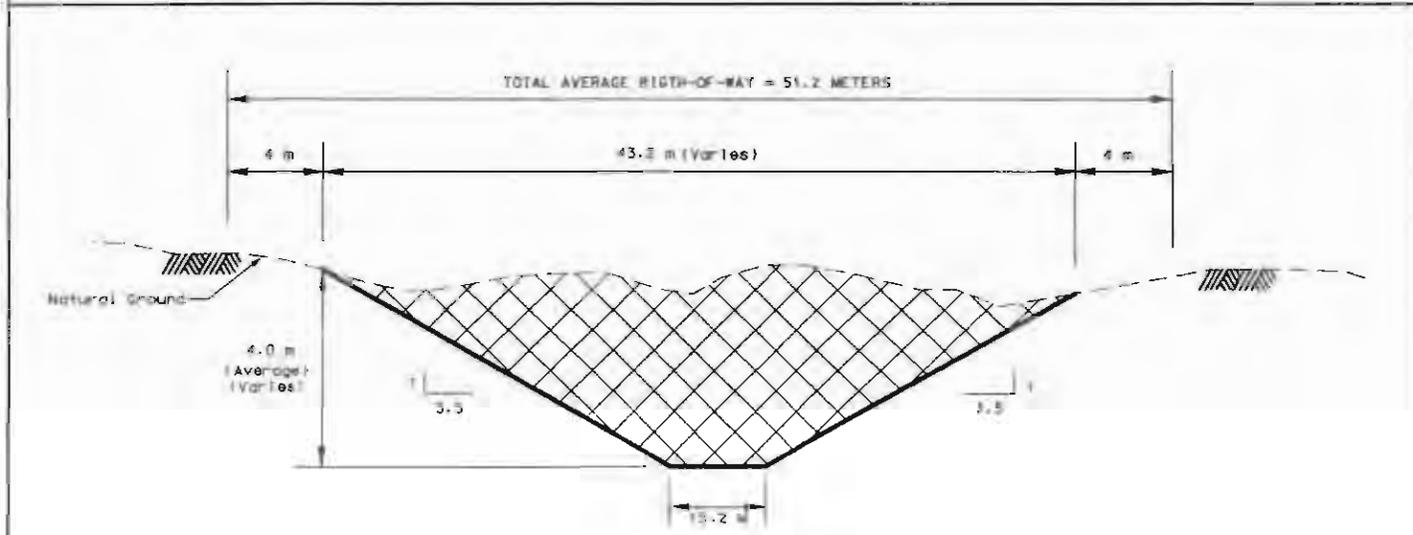
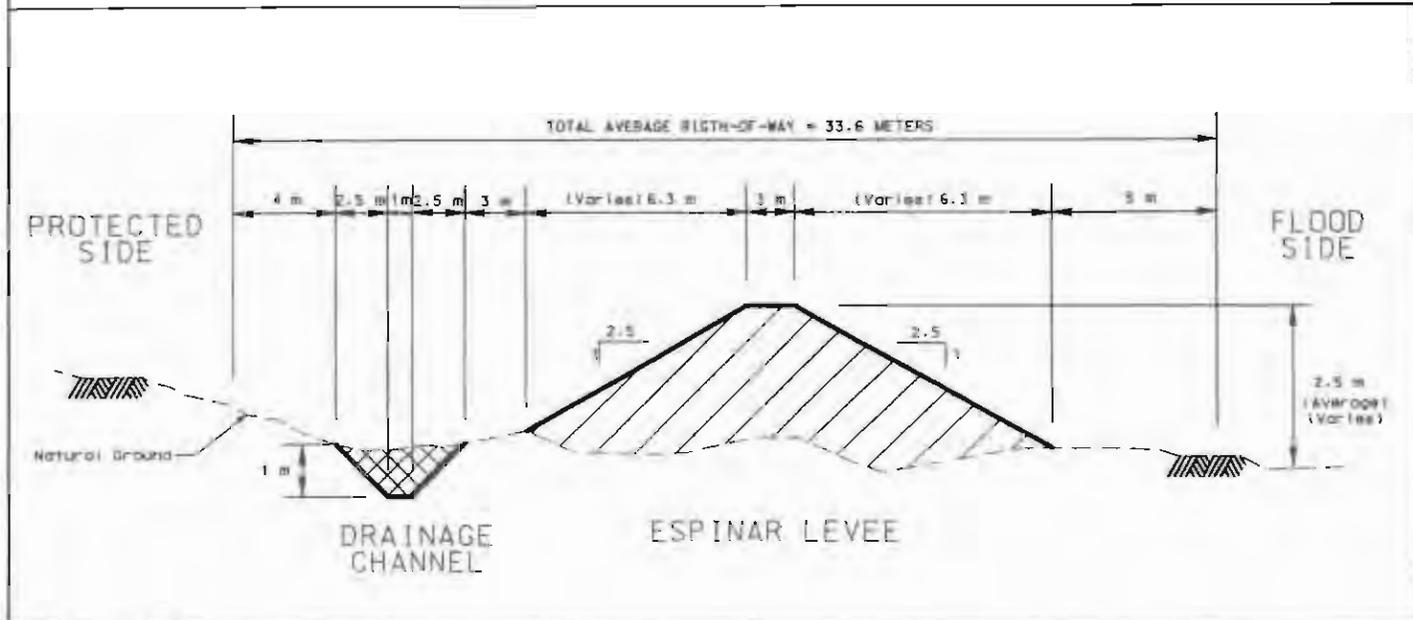
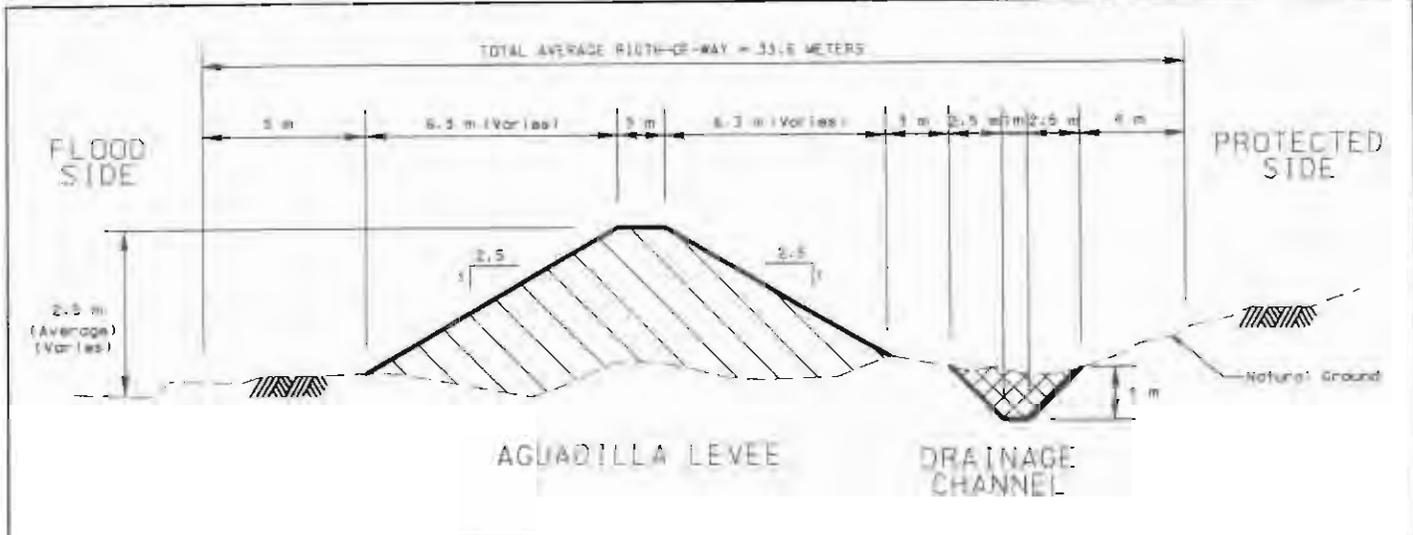


DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA
DETAILED PROJECT REPORT
RIO CULEBRINAS
AGUADA/AGUADILLA, PUERTO RICO

RECOMMENDED PLAN

REV. NO.	SIZE	DRAWING NO.
DATED		FIGURE EA-6
SCALE: AS SHOWN	DATED: 03-28-02	SHEET 1 OF 1





DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA

DETAILED PROJECT REPORT
 RIO CULEBRINAS
 AGUADA/AGUADILLA, PUERTO RICO

TYPICAL CROSS SECTIONS

REV. NO. _____ SIZE/DRAWING NO. _____
 DATED: _____ FIGURE EA-7
 SCALE: HTS DATED: 03-26-02 SHEET 1 OF 1

14.0 EA ATTACHMENTS

- A. PUBLIC AND AGENCY COORDINATION AND COMMENTS
- B. FISH AND WILDLIFE COORDINATION ACT REPORT
- C. CLEAN WATER ACT SECTION 404 (b)(1) EVALUATION AND MITIGATION PLAN
- D. COASTAL ZONE MANAGEMENT ACT COORDINATION – Certification of Compliance with PR Coastal Management Plan and Application for Concurrence from PR Planning Board.
- E. SITE VISIT MEMORANDUM AND WRAP SCORE SHEETS

A. PUBLIC AND AGENCY COORDINATION AND COMMENTS

Environmental scoping was initiated on February 26, 1991. Further scoping took place via letter dated July 14, 1995 (copy of scoping document is enclosed). Responses on the study were received from the Office of the Governor of Puerto Rico, Puerto Rico Department of Agriculture, Puerto Rico Department of Natural Resources, Puerto Rico Land Administration, Puerto Rico Planning Board, Administración De Servicios Municipales, Municipio de Aguadilla, Colegio De Ingenieros Y Agrimensores De Puerto Rico, Puerto Rico Industrial Development Company, Oficina Estatal De Preservación Histórica (SHPO), and United States Department of Interior Fish and Wildlife Service. No adverse comments were noted in the responses received.

10 January 2000

MEMORANDUM FOR RECORD

SUBJECT: Río Culebrinas Flood Control Project, USDA NRCS AD-1006

1. Today at 0915, I teleconferenced with Ms. Carmen Santiago (USDA-NRCS 787-766-5206 x240), regarding the NRCS letter of 1 November 1999, received today and addressing our 23 September 1999, Form AD-1006 regarding this project.

2. Ms. Santiago stated that for scores over 160 (combined sections V and VI), at least 2 other alternatives should be rated and scored, unless there were overriding reasons to have only 1 alternative. In this case, with a borderline score of 162, she stated that our explanation in the Environmental Assessment (EA) and the "Reason for selection" part of Form AD-1006 was sufficient.

3. Since she also stated that usually she never received anything back after returning these forms, I entered her address in our Federal officials roster for Puerto Rico, in order to send her a completed EA for her record.

////////////////////////////////////nothing follows////////////////////////////////////

ESTEBAN JIMENEZ
Biologist



DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

July 9, 1999

Planning Division
Environmental Resources Branch

TO THE ADDRESSEES ON THE ATTACHED LIST

The Jacksonville District, U.S. Army Corps of Engineers (USACE), wishes to re-coordinate for any resources agency issues and concerns in reference to the flood protection plans along the Río Culebrinas and Caño Madre Vieja, south of Aguadilla, Puerto Rico. This work was originally coordinated by letter dated April 26, 1991. The USACE continues to gather information to help define issues and concerns that were identified and addressed in the enclosed reconnaissance-level report for flood protection along the Río Culebrinas and Caño Madre Vieja, south of Aguadilla, Puerto Rico. Various preliminary alternative plans to provide protection against flooding were evaluated.

The study is currently in its feasibility phase. During the reconnaissance study environmental considerations such as potential presence of historical or archeological resources, aesthetics, recreation demand, endangered or threatened species and nearshore marine habitats were addressed. The reconnaissance phase of the study showed the project to implementable. At this time, the Municipality of Aguadilla has agreed to fund one-half of the study costs. Therefore, the feasibility phase of the study has been undertaken.

We welcome your views, comments and information about resources, study objectives and important features within the describe study area, as well as any suggested improvements. Letters of comments or inquiry should be addressed to the letterhead address to the attention of Planning Division, Environmental Studies Section and received by this office by July 31, 1999.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosures

MAILING LIST
AGUADA AND AGUADILLA, PUERTO RICO, SECTION 205 STUDIES

Hon. Pedro Rosselló
Governor of Puerto Rico
La Fortaleza
San Juan, PR 00901
Attn: Fed Affairs Coordinator

Hon. Ramón Calero Bermúdez
Mayor, Municipio of
Aguadilla
Box 1008
Aguadilla, PR 00605

Hon. Julio César Román
Mayor, Municipio of
Aguada
Box 517
Aguada, PR 00602

Mr. Pedro Gelabert
Secretary, Dept of Natural
& Environmental Resources
Box 5887
Pta de Tierra PR 00906

Ms Lisbeth Hyman,
Acting Asst. Director
Minerals and Water Resources
Administration, DNER
Box 5887 Pta. de Tierra
PR 00906

Lic. Héctor A Russe
President, Puerto Rico
Environmental Quality Board
PO Box 11488
Santurce, PR 00919

Ms. Norma E. Burgos
Chair, P.R. Planning Board
PO Box 41119 Minillas Sta
San Juan PR 00940-9985

Dr. Emilio M. Colón
Executive Director, PR
Aqueduct & Sewer Auth.
PO Box 7066 Bo Obrero Sta
Santurce PR 00916

Secretary of Agriculture
PO Box 10163
Santurce PR 00908

President,
Senado de Puerto Rico
Box 3431
San Juan PR 00904

President,
House of Representatives
of Puerto Rico
Box 2228
San Juan PR 00901

Exec Director,
PR Lands Administration
GPO Box 36-3767
San Juan PR 00936

Dr. Sergio L. González Quevedo
Exec Dir PR Highways Auth
GPO Box 42007
San Juan PR 00936

Director,
PR Office of Budget and
Management
Box 3228
San Juan PR 00902

Director, Civil Defense
Box 5127
Puerta de Tierra PR 00906

Mr. Pedro Toledo Dávila
Superintendent, PR Police
GPO Box 70166
San Juan PR 00936

Mr. Agustín García Acevedo
Pres, PR Telephone Co.
GPO Box 998
San Juan PR 00936

President,
PR Industrial Development Co.
GPO Box 2350
San Juan PR 00936

Secretary, Dept of Transportation
and Public Works
PO Box 41269 Minillas Sta
Santurce, PR 00940

Secretary, Dept of Recreation
and Sports
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San Juan PR 00902

Exec. Director,
PR Land Authority
PO Box 9745
Santurce PR 00908

Administrator
Puerto Rico Economic Development
Administration
PO Box 36-2350
San Juan PR 00936

Secretary,
Puerto Rico Dept of Housing
PO Box W
Plo Piedras PR 00928

Exec Director, Public Bldgs
Authority
Box 41029
Santurce PR 00940

Dr. Arleen Pabón de Rocafort
State Historic Preservation
Officer
Office of the Governor
La Fortaleza Box 82
San Juan PR 00901

Director,
Center for Investigations
Institute of Puerto Rico
Culture
Box 4184
San Juan, PR 00905

Executive Director,
Rural Housing Administration
Po Box 21365
Río Piedras PR 00928

Exec Director
PR Electric Power Authority
GPO Box 4267
San Juan PR 00936-4267

Mr. Juan Martínez
Director Soil Conservation
Service, San Juan Office
GPO Box 4868
San Juan PR 00936

Mr. James P. Oland
Field Supervisor, FWS
Caribbean Field Office
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Boquerón PR 00622

Eng. Carl-Axel P Soderberg
Director, Carib Field Office
U.S. EPA
Europa Bldg Suite 417
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Santurce PR 00909

Director,
Dept of Housing and Urban Dev.
159 Ave Chardón
New San Juan Bldg
Hato Rey, PR 00918-1804

District Chief,
Caribbean Dist., USGS WRD
GSA Center 651 Federal Drive
Suite 400-15
Guaynabo PR 00965

Natl Marine Fisheries Serv
Habitat Conservation Div. F-SER1
9721 Executive Center Drive
St. Petersburg, FL 33702

National Marine Fisheries Serv
3500 Delwood Beach Rd
Panama City FL 32407-7499

Natl Marine Fisheries Service
Miami Field Office
11420 N. Kendall Dr Ste 103
Miami Fl 33176

Regional Director, SE Region
U.S. Fish and Wildlife Service
1875 Century Blvd., Suite 200
Atlanta Ga 30345-3301

Environmental Impacts Branch
US EPA Region II
290 Broadway, 28th Floor
New York, NY 10007-1866

Executive Director
Advisory Council on
Historic Preservation
Old Post Office Bldg 809
1100 Pennsylvania Ave NW
Washington DC 20004-2590

Office of the Director
Ctr for Environmental Health
and Disease Control/F29
Center Clifton Rd
Atlanta GA 30333

Puerto Rico Conservation Trust
PO Box 4747
San Juan PR 00918

Puerto Rico Cons. Foundation
O'Neill #11 Altos
Hato Rey PR 00918

President, PR
Engineers & Surveyors' Assn
GPO Box 3845
San Juan PR 00936

PR Environmental Coalition
Cond Altos de Torrimar
90 Caribe Apt 146
Bayamon PR 00959

Dr. Gregory Morris & Assoc.
PO Box 5635
San Juan PR 00902-5635

Natural Resources Defense
Council
1350 New York Ave NW
Washington, DC 20005



United States
Department of
Agriculture

Natural
Resources
Conservation
Service

Caribbean Area
PO Box 364868
San Juan, PR
00936-4868

November 1, 1999

James C. Duck
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Duck:

Re: Río Culebrinas flood control project, Aguadilla/Aguada, Puerto Rico.

Based on the location map for the project, the predominant soils are: (Ce) Cataño sandy clay loam, (Ba) Bajura clay, (Es) Espinal sand, (Cn) Coloso silty clay loam, (Ig) Igualdad clay and (ToA) Toa silty clay loam, 0 to 2 percent slopes.

The map units ToA and Cn are considered prime farmland and prime farmland where drained, respectively. The maps units Ba and Ig are considered of statewide importance. Enclosed is the Farmland Conversion Impact Rating submitted by your office, with Part II, IV and V completed.

Also, map unit Ba is listed as a hydric soil; and map units Ce, Cn and ToA may contain hydric soil inclusions. On site investigation will be necessary to confirm the presence of wetlands.

Should you need more information, do not hesitate to contact me at (787) 766-5206, ext. 240.

Sincerely,

CARMEN L. SANTIAGO
Staff Soil Scientist

Enclosure

FARMLAND CONVERSION IMPACT RATING

PART I (To be completed by Federal Agency)		Date Of Land Evaluation Request 23 SEP 1999	
Name Of Project FLOOD CONTROL-RIO CULEBRINAS		Federal Agency Involved US ARMY CORPS OF ENGIN 5	
Proposed Land Use FLOOD CONTROL LEVEES/DYKES		County And State AGUADILLA/AGUADA - PUERTO RICO	
PART II (To be completed by SCS)		Date Request Received By SCS 29/Sept./1999	
Does the site contain prime, unique, statewide or local important farmland? (If no, the FPPA does not apply - do not complete additional parts of this form).		Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Acres Irrigated 1,000
		Average Farm Size 35 acres	
Major Crops Plantains	Farmable Land In Govt. Jurisdiction Acres: 111,794	Amount Of Farmland As Defined In FPPA Acres: 111,794	
Name Of Land Evaluation System Used Mayaguez LESA	Name Of Local Site Assessment System NONE	Date Land Evaluation Returned By SCS Nov. 1, 1999	
PART III (To be completed by Federal Agency)		Alternative Site Rating	
		Site A	Site B
A. Total Acres To Be Converted Directly		36.55	
B. Total Acres To Be Converted Indirectly		0	
C. Total Acres In Site		36.55	
PART IV (To be completed by SCS) Land Evaluation Information			
A. Total Acres Prime And Unique Farmland		13.0	
B. Total Acres Statewide And Local Important Farmland		7.0	
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		0.02%	
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		19.4%	
PART V (To be completed by SCS) Land Evaluation Criterion			
Relative Value Of Farmland To Be Converted (Scale Of 0 to 100 Points)		90	
PART VI (To be completed by Federal Agency)			
Site Assessment Criteria (These criteria are explained in 7 CFR 658.5(b))	Maximum Points		
1. Areas In Nonurban Use	14	7	
2. Perimeter In Nonurban Use	9	4	
3. Percent Of Site Being Farmed	19	13	
4. Protection Provided By State And Local Government	0	0	
5. Distance From Urban Builtup Area	0	0	
6. Distance To Urban Support Services	0	0	
7. Size Of Present Farm Unit Compared To Average	9	8	
8. Creation Of Nonfarmable Farmland	25	10	
9. Availability Of Farm Support Services	0	0	
10. On-Farm Investments	0	0	
11. Effects Of Conversion On Farm Support Services	25	21	
12. Compatibility With Existing Agricultural Use	9	9	
TOTAL SITE ASSESSMENT POINTS	160	72	
PART VII (To be completed by Federal Agency)			
Relative Value Of Farmland (From Part V)	100		
Total Site Assessment (From Part VI above or a local site assessment)	160		
TOTAL POINTS (Total of above 2 lines)	260		
Site Selected:	Date Of Selection:	Was A Local Site Assessment Used? Yes <input type="checkbox"/> No <input type="checkbox"/>	
Reason For Selection: THE WORK WILL ONLY IMPACT THE FOOTPRINTS OF THE PROPOSED LEVEES. THERE IS NO ALTERNATIVE TO CONSTRUCTING THE LEVEES IF AREA FLOODING IS TO BE CONTROLLED. ANY EXISTING AGRICULTURAL ACTIVITIES IN THE ADJACENT AREA WILL NOT BE AFFECTED.			

(See Instructions on reverse side)

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 - Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 - Originator will send copies A, B and C, together with maps indicating locations of site(s), to the Soil Conservation Service (SCS) local field office and retain copy D for their files. (Note: SCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field-office locations are available from the SCS State Conservationist in each state).

Step 3 - SCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

Step 4 - In cases where farmland covered by the FPPA will be converted by the proposed project, SCS field offices will complete Parts II, IV and V of the form.

Step 5 - SCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for SCS records).

Step 6 - The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 - The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land use controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.
2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in §658.5(b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will be weighted zero, however, criterion #8 will be weighted a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 13 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned, relative adjustments must be made to maintain the maximum total weight points at 160.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points", where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160.

Example: if the Site Assessment maximum is 200 points; and alternative Site "A" is rated 180 points:

$\text{Total points assigned Site A} = 180 \times 160 = 144 \text{ points for Site "A."}$

$\text{Maximum points possible} = 200$



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

August 4, 1999

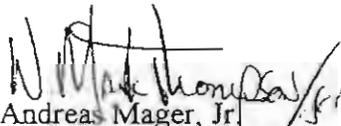
Colonel Joe R. Miller, District Engineer
Jacksonville District Corps of Engineers
Planning Division, Environmental Branch
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Miller:

The National Marine Fisheries Service (NMFS) has reviewed your staff's letter, dated July 7, 1999, regarding the flood protection plans being developed for a coastal segment of Cano Madre Vieja, a tributary of the Rio Culebrinas, in the Municipality of Aguadilla, Puerto Rico and the position that the project will have no effect on existing Essential Fish Habitat (EFH). According to the current plans, the proposed action consist of levee protection, upstream of the tributary mouth, that will not impact significant wetlands or involve major channel alterations of the stream. A culvert will be built to maintain a connection to an existing mangrove area and no barriers to fish migration will be constructed. No specific details are provided.

Based on our review of the general information provided, we have no comments or recommendation to offer at this time. Should there be subsequent changes in plans or additional information to indicate that there may be effects to EFH, please notify us so that we may reconsider our position on this matter. If you have any questions concerning these comments, please contact Mark Thompson of our Panama City office at 850/234-5061.

Sincerely,


Andreas Mager, Jr.
Assistant Regional Administrator
Habitat Conservation Division

cc:
F/SER4





OFFICE OF THE GOVERNOR
LA FORTALEZA

Control 99-2853

6 July 1999

Mr. James C. Duck
Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232

SHPO #05-24-91-01 RÍO CULEBRINAS FLOOD PROTECTION PROJECT, AGUADILLA, PUERTO RICO

Dear mister Duck:

Our Office has received and reviewed the draft report titled *Cultural Resource Survey of the Rio Culebrinas Flood Protection Project, Municipio of Aguadilla, Puerto Rico*, prepared by Michael A. Cinquino, et.al. of Panamerican Consultants, Inc.

We concur with the consultants' recommendations for PCI/Culebrinas Site 3, Iglesia de Espinar site and PCI/Culebrinas 1. We also concur with your determination of no adverse effect on the Molino de la Hacienda Concepción and the Puente del Río Culebrinas historic structures.

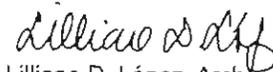
Further justification is necessary, however, for the determination of non-eligibility regarding PCI/Culebrinas Site 2. Hence, a research design and work plan for a Stage II Cultural Resources Assessment of the site is hereby requested for our review and concurrence prior to its implementation.

A data recovery research design and work plan is to be prepared for all eligible sites. Its implementation, after our review and concurrence, will serve as an appropriate treatment.

Once we have concurred on the determination of eligibility for PCI/Culebrinas Site 2, and in accordance with 36 CFR 800.6, a Memorandum of Agreement is to be drafted and executed as a means to resolve the otherwise adverse effect of the undertaking on identified historic property.

Should you have any questions regarding our comments, please do not hesitate to contact our Office.

Sincerely,


Lilliane D. López, Arch.
State Historic Preservation Officer

LDL/MB/ABR



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P. O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019



July 14, 1995

Planning Division
Environmental Branch

TO ADDRESSEES ON THE ENCLOSED LIST:

The Jacksonville District, U.S. Army Corps of Engineers, is beginning to gather information to help define issues and concerns that will be addressed relative to a flood damage reduction study along the Río Culebrinas at Aguada and Aguadilla, Puerto Rico. The study area is described in the enclosure to this letter and shown on the enclosed map. We welcome your views, comments and information about natural and cultural resources, study objectives and important environmental features within the described study area, as well as any suggested improvements.

Letters of comments or inquiry should be directed to the letterhead address to the attention of Planning Division, Environmental Studies Section, within 30 days of the date of this letter. If you are aware of any other person, organization or agency that may have an interest or comments regarding this study, please inform us or notify them so they may have an opportunity to comment.

Sincerely,

A. J. Salem
Chief, Planning Division

Enclosures

MAILING LIST
AGUADA AND AGUADILLA, PUERTO RICO, SECTION 205 STUDIES

Hon. Pedro Rosselló
Governor of Puerto Rico
La Fortaleza
San Juan, PR 00901
Attn: Fed Affairs Coordinator

Hon. Ramón Calero Bermúdez
Mayor, Municipio of
Aguadilla
Box 1008
Aguadilla, PR 00605

Hon. Julio César Román
Mayor, Municipio of
Aguada
Box 517
Aguada, PR 00602

Mr. Pedro Gelabert
Secretary, Dept of Natural
& Environmental Resources
Box 5887
Pta de Tierra PR 00906

Ms Lisbeth Hyman,
Acting Asst. Director
Minerals and Water Resources
Administration, DNER
Box 5887 Pta. de Tierra
PR 00906

Lic. Héctor A Russe
President, Puerto Rico
Environmental Quality Board
PO Box 11488
Santurce, PR 00919

Ms. Norma E. Burgos
Chair, P.R. Planning Board
PO Box 41119 Minillas Sta
San Juan PR 00940-9985

Dr. Emilio M. Colón
Executive Director, PR
Aqueduct & Sewer Auth.
PO Box 7066 Bo Obrero Sta
Santurce PR 00916

Secretary of Agriculture
PO Box 10163
Santurce PR 00908

President,
Senado de Puerto Rico
Box 3431
San Juan PR 00904

President,
House of Representatives
of Puerto Rico
Box 2228
San Juan PR 00901

Exec Director,
PR Lands Administration
GPO Box 36-3767
San Juan PR 00936

Dr. Sergio L. González Quevedo
Exec Dir PR Highways Auth
GPO Box 42007
San Juan PR 00936

Director,
PR Office of Budget and
Management
Box 3228
San Juan PR 00902

Director, Civil Defense
Box 5127
Puerta de Tierra PR 00906

Mr. Pedro Toledo Dávila
Superintendent, PR Police
GPO Box 70166
San Juan PR 00936

Mr. Agustín García Acevedo
Pres, PR Telephone Co.
GPO Box 998
San Juan PR 00936

President,
PR Industrial Development Co.
GPO Box 2350
San Juan PR 00936

Secretary, Dept of Transportation
and Public Works
PO Box 41269 Minillas Sta
Santurce, PR 00940

Secretary, Dept of Recreation
and Sports
Box 3207
San Juan PR 00902

Exec. Director,
PR Land Authority
PO Box 9745
Santurce PR 00908

Administrator
Puerto Rico Economic Development
Administration
PO Box 36-2350
San Juan PR 00936

Secretary,
Puerto Rico Dept of Housing
PO Box W
Rio Piedras PR 00928

Exec Director, Public Bldgs
Authority
Box 41029
Santurce PR 00940

Dr. Arleen Pabón de Rocafort
State Historic Preservation
Officer
Office of the Governor
La Fortaleza Box 82
San Juan PR 00901

Director,
Center for Investigations
Institute of Puerto Rico
Culture
Box 4184
San Juan, PR 00905

Executive Director,
Rural Housing Administration
Po Box 21365
Río Piedras PR 00928

Exec Director
PR Electric Power Authority
GPO Box 4267
San Juan PR 00936-4267

Mr. Juan Martínez
Director Soil Conservation
Service, San Juan Office
GPO Box 4868
San Juan PR 00936

Mr. James P. Oland
Field Supervisor, FWS
Caribbean Field Office
PO Box 491
Boquerón PR 00622

Eng. Carl-Axel P Soderberg
Director, Carib Field Office
U.S. EPA
Europa Bldg Suite 417
1492 P de Leon Stop 22
Santurce PR 00909

Director,
Dept of Housing and Urban Dev.
159 Ave Chardón
New San Juan Bldg
Hato Rey, PR 00918-1804

District Chief,
Caribbean Dist., USGS WRD
GSA Center 651 Federal Drive
Suite 400-15
Guaynabo PR 00965

Natl Marine Fisheries Serv
Habitat Conservation Div. F-SER1
9721 Executive Center Drive
St. Petersburg, FL 33702

National Marine Fisheries Serv
3500 Delwood Beach Rd
Panama City FL 32407-7499

Natl Marine Fisheries Service
Miami Field Office
11420 N. Kendall Dr Ste 103
Miami Fl 33176

Regional Director, SE Region
U.S. Fish and Wildlife Service
1875 Century Blvd., Suite 200
Atlanta Ga 30345-3301

Environmental Impacts Branch
US EPA Region II
290 Broadway, 28th Floor
New York, NY 10007-1866

Executive Director
Advisory Council on
Historic Preservation
Old Post Office Bldg 809
1100 Pennsylvania Ave NW
Washington DC 20004-2590

Office of the Director
Ctr for Environmental Health
and Disease Control/F29
Center Clifton Rd
Atlanta GA 30333

Puerto Rico Conservation Trust
PO Box 4747
San Juan PR 00918

Puerto Rico Cons. Foundation
O'Neill #11 Altos
Hato Rey PR 00918

President, PR
Engineers & Surveyors' Assn
GPO Box 3845
San Juan PR 00936

PR Environmental Coalition
Cond Altos de Torrimar
90 Caribe Apt 146
Bayamon PR 00959

Dr. Gregory Morris & Assoc.
PO Box 5635
San Juan PR 00902-5635

Natural Resources Defense
Council
1350 New York Ave NW
Washington, DC 20005

RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
FLOOD DAMAGE REDUCTION STUDY

1.0 Project. The U.S. Army Corps of Engineers, Jacksonville District, has begun a feasibility phase study to develop a Detailed Project Report (DPR) for flood damage reduction measures in the Río Culebrinas in Aguadilla and Aguada, Puerto Rico.

2.0 Authorization and Prior Studies. Study authority is Section 205 of the 1948 Flood Control Act, as amended. Any alternative plan recommended at the completion of this study would be cost-shared by a local sponsor. (The project would be jointly funded by the Municipios of Aguada and Aguadilla.) A Reconnaissance-level study conducted during 1991 led to a report dated March 1992 which discussed an implementable plan. (See enclosed figure.)

3.0. Location and Project Features. The enclosed map shows the geographic location of the project and the considered alternative. Flood protection measures under study include construction of earthen levees to protect the south wards of Aguadilla (especially Victoria ward) and Espinar ward of Aguadilla, as shown. The study will consider alternative locations for these features and varying levels of flood protection.

4.0 Environmental Documentation. Feasibility phase investigations are planning studies undertaken after preliminary studies have indicated a probable Federal interest in developing flood reduction measures for a geographic area. The purpose of the study is to identify one or more economically and environmentally feasible plans, to prepare complete documentation of the economic and environmental effects of these plans, and to recommend a plan for authorization. Environmental compliance of the alternatives will be assessed under the National Environmental Policy Act (NEPA). The appropriate NEPA document will be circulated when the present study phase is completed and one or more alternatives have been selected. Circulation of this project description and request for comments marks the beginning of the public involvement process under NEPA. Your information and views will assist our staff to evaluate the project area, identify significant natural and cultural resources and other pertinent new issues, opportunities or concerns, and address these issues. For additional information on the Río Culebrinas flood mitigation project, please contact Barbara Cintrón (Tel. 904-232-1692) at the letterhead address.

Enclosure



GOVERNMENT OF PUERTO RICO

Department of Agriculture

P.O. Box 10163
San Juan, Puerto Rico 00908-1163

Office of the Secretary

December 18, 1995

Mr. A. J. Salem
Chief, Planning Division
Environmental Studies Section
Department of the Army
Jacksonville District
Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

Re: Case No. 95-26(01)115-Army
Río Culebrinas at Aguada and Aguadilla
Case No. 95-01-116-Army
Río Ojo de Agua at Aguadilla

In response to your request for our views and comments regarding the projects for flood control along Río Culebrinas at Aguada and Aguadilla, and Río Ojo de Agua at Aguadilla, the Department of Agriculture proceeded to evaluate the affected area. The area is highly susceptible to flooding, and every year during the rainy season residential areas as well as agricultural land are subjected to flood damage.

The proposed projects will have a very positive impact on the community and will also favored the agricultural activities in the area. Most of the agricultural land along the Culebrinas River is dedicated to sugarcane production. Although, sugarcane is a highly tolerant crop to adverse conditions, heavy rainfall and flooding during harvesting reduce significantly sugar content. Consequently, the establishment of a flooding control system will contribute to increase sugarcane yields in the nearby farms.

Sincerely,

Miguel A. Muñoz
Undersecretary of Agriculture

CM 078 04485
Rev. 2/91
Cable Address
PREPA

PUERTO RICO ELECTRIC POWER AUTHORITY
San Juan, Puerto Rico

P O Box 354267
San Juan, Puerto Rico 00935-4267



September 12, 1995

Department of the Army
Jacksonville District
Corps of Engineers
PO Box 4970
Jacksonville, Florida 32232-0019

ATT: Planning Division, Environmental
Studies Section

Gentlemen:

As of the moment, our Agency does not have any comments or information regarding outstanding environmental features, natural and cultural resources or study objectives relative to the flood damage reduction study along the Río Culebrinas at Aguada and Aguadilla. Nevertheless, during the final design stages of this project, we should be consulted in relation to possible interferences with our electrical system infrastructure.

For future inquiries please contact Eng. Rafael Meléndez, Interim Electrical Distribution Superintendent, at (809) 289-3062 or (809) 289-3034 at your earliest convenience.

Cordially,

Angel L. Rivera Santana
Director, Planning and
Environmental Protection



COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF HOUSING
VIVIENDA

August 30, 1995

Mr. A.J. Salem

Chief, Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

ATT: Mrs. Barbara Cintrón
Planning Division
Environmental Branch

Dear Mr. Salem:

In reference to your request for comments we are submitting information of surrounding communities relative to a flood damage reduction study along the Rio Culebrinas in Aguadilla and Aguada, Puerto Rico.

Name of Community: Comunidad Espinar
Location: State Road 442, Km. 0.5, Aguadilla, Puerto Rico
Established: June 24, 1956
Number of Families: 203

Name of Community: Comunidad Tablonal
Location: State Road 900, Km. 0.3, Aguada, Puerto Rico
Established: April 19, 1986
Number of Families: 242

Name of Community: Comunidad Las Corozas
Location: State Road 417, Km. 1, Aguada, Puerto Rico
Established: June 11, 1944
Number of Families: 187

We enclosed a U.S.G.S. Quadrangle of Aguadilla pointing the developed communities in the municipalities Aguadilla and Aguada.

The Department of Housing endorse the flood protection measures under study to protect the south wards of Aguadilla.

Cordially,

Luz I. Estrella Juarbe
Assistant Secretary
for Planning and Technical Services

Enclosure
FRR/DV/LEJ/lar



August 29, 1995

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
P.O. Box 4970 Jacksonville,
Florida 32232-0019

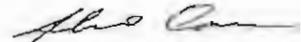
Dear Mr. Salem:

We has revised the map enclosed in your letter related to the studies that the U.S. Army Corps of Engineers are developing for flood damage reduction along Río Culebrinas and Río Ojo de Agua at Aguadilla and Aguada region.

The reference area was examined considering our outside plant, and we did not found any telephone facilities affected with your project.

If your agency understand that the final study and maps should be verify by our Company before the implementation of the jobs, do not hesitate to contact us.

truly yours,


Ing. Roberto Correa
Director,
Planning Department
P.R. Telephone Co.



ESTADO LIBRE ASOCIADO DE PUERTO RICO
OFICINA DEL GOBERNADOR
JUNTA DE PLANIFICACION

Centro Gubernamental Minillas, Edificio Norte
Ave. De Diego, Pda. 22
P.O. Box 41119, SAN JUAN, PUERTO RICO 00940-1119

A.J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District
Corps of Engineers
P.O. Box 1970
Jacksonville, Florida 32232-0019

Rec'd Aug 75

Attention: Planning Division
Environmental Branch

Dear Mr. Salem:

This is in reference to your request for comments on the feasibility phase study for the investigation of flood damage reduction measures to protect the Victoria and Espinar wards of the municipality of Aguadilla and Aguada from Rio Culebrinas floods.

The proposed flood protection measure includes the construction of earthen levees to protect the above mentioned sectors. According to FEMA's panel number 720000-0009D, both sectors were affected by the 100 year flood and were located within the designated floodway of Rio Culebrinas. The location of the levees may have impact in the floodway limits and the base flood elevations. This impact could be discussed in the detailed project report.

In relation to Espinar ward in public hearings conducted by the Planning Board about the regional plan, Aguada citizens expressed interest on the protection of the Espinar mangrove and the "Ermita Espinar". We also recommend to evaluate the impact of the 100 year flood of Rio Culebrinas in the Caño Madre Vieja flood levels, upstream and downstream of the bridge of Highway PR-2. The proposed alternative for the flood protection does not affect the Land Use Plans for both municipalities.

Cordially,

por Jose N. Caballero Mercado
Norma E. Burgos Andújar
Chairwoman

BAH/RMH/mia



OFFICE OF THE GOVERNOR
LA FORTALEZA

Control 95-2616

August 18, 1995

Mr. A. J. Salem
Chief, Planning Division
Environmental Resources Branch
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, FL 32232-0019

**SHPO 06-17-94-29 CHANNALIZATION STUDIES CULEBRINAS RIVER, AGUADILLA,
PUERTO RICO**

Dear Mr. Salem:

In response to your July 14, 1995 notice, we have reviewed our files concerning the above referenced project. Our records do not locate any known historic property along the project area, although it is believed that a sixteenth century Spanish hermitage may have been located in the area of the present day Espinar community. It is our recommendation that a cultural resources assessment of the area of potential effects be undertaken to establish the presence or absence of cultural resources.

If you have any questions or comments, please do not hesitate to contact our State Archaeologist Miguel Bonini in our Office. Your interest and cooperation in helping to protect Puerto Rico's archaeological and historical resources are appreciated.

Cordially,

Lilliane D. López
Lilliane D. López, Arch.
State Historic Preservation Officer

LDL/MB/



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - REGION II

290 BROADWAY

NEW YORK, NEW YORK 10007-1866

AUG 16 1995

Mr. A. J. Salem, Chief
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

The Environmental Protection Agency (EPA) has reviewed the feasibility phase study to develop a detailed project report for flood damage reduction measures in the Rio Culebrinas in Aguadilla and Aguada, Puerto Rico. Flood protection measures being considered include construction of earthen levees; alternative locations for these structures and varying levels of flood protection will be studied. In addition to the standard range of topics covered by environmental documentation developed pursuant to the National Environmental Policy Act, we recommend that your environmental documentation include the following elements.

- A description of the aquatic and terrestrial environments to be impacted by each alternative should include the identification and delineation of all wetlands, the identification of floodplains and cultural resources, and the identification of other significant environmental resources in the project area. This description should also include an evaluation of the potential for encountering any contamination in the study area.
- An evaluation of the potential environmental impacts associated with the proposed project should include analyses of impacts to wetlands, water quality, floodplains, coastal zones, cultural resources, and other significant aspects of the environment. If the environmental document determines that adverse impacts to environmental resources are unavoidable, measures to mitigate these impacts must be developed and discussed in the document.
- Sedimentation and erosion impacts should be evaluated. Specifically, please provide information regarding erosion control during project implementation, and an evaluation of erosion and sedimentation impacts to Aguadilla Bay.

Thank you for the opportunity to comment. If you have any questions concerning this letter, please contact Ms. Evelyn Tapani-Rosenthal of my staff at (212) 637-3497.

Sincerely yours,



Laura J. Livingston, Assistant Chief
Environmental Impacts Branch



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

August 8, 1995

904/234-5061

Colonel Terry Rice
District Engineer, Jacksonville District
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Rice:

The National Marine Fisheries Service (NMFS) has reviewed the notice dated July 14, 1995 with a due date of August 13, 1995, regarding the flood reduction study along the Río Culebrina at Aguada and Aguadilla, Puerto Rico. The project features include construction of an earthen levee to protect the south wards of Aguadilla, (i.e., Victoria and Espinar).

Based on the information contained in the notice, we anticipate that any adverse effect that might occur on marine and anadromous fishery resources would be minimal. The project would impact areas that are predominantly agricultural and of little habitat value. We therefore have no additional comments to provide on this project.

Sincerely,

2 Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

cc:
Mr. A. J. Salem
Chief, Planning Division
Environmental Branch
Department of the Army, Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

F/SEO2
F/SEO23-MIAMI





DEPARTAMENTO DE RECURSOS NATURALES

October 9, 1991

Mr. A. J. Salem
Department of the Army
Jacksonville District of
Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear mister Salem:

The Department of Natural Resources, DNR carried out an analysis of the Reconnaissance Studies of the Ojo de Agua River, Culebrinas River and Madre Vieja Creek in Aguadilla in which the following comments are submitted.

We understand that it is necessary to take protective measures for the urban center and southern area of Aguadilla. In addition, consideration should be given to the feasibility of constructing works for the prevention of erosion (conservation of soils due to runoff from the Jaicoa hills).

The area flooded by Ojo de Agua River in the urban center of Aguadilla is affected by the overflow of the water channel that runs from east to west. Because of the intensity of precipitation, and the lack of hydraulic capacity, the channel is inadequate to carry the flood flows through the central area of Aguadilla.

The urban area proposed for channeling does not present any limitations; however, consideration must be given to its effect on the natural communities within the river (particularly fish, shrimp and mollusk).

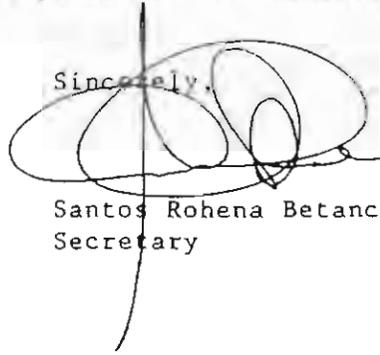
CULEBRINAS RIVER AND MADRE VIEJA CREEK

Most of the area included in the drainage basin is made up steep hills both include extensive coastal wetland areas, predominantly marshy.

It is recommended that the CoE assures the potencial impact of this project on the wetlands area's, since even if it is not an acknowledge habitat, it could be important in diverting flood waters of both bodies of water.

Finally, the Department recommends considering which will be the negative impact on these projects. As shown in topographical map there exists a large space between the area of both projects. If you need any other assistance during the study, please do not hesitate to contact our Department.

Sincerely,

A handwritten signature in black ink, consisting of several overlapping loops and a long vertical stroke extending downwards.

Santos Rohena Betancourt
Secretary



United States Department of the Interior

FISH AND WILDLIFE SERVICE
CARIBBEAN FIELD OFFICE
P.O. BOX 491
BOQUERON, PUERTO RICO 00622

July 5, 1991

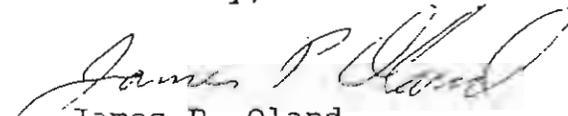
Mr. A. J. Salem
Chief, Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232

Re: Flood Control Protection
Rio Culebrinas, Caño
Madre Vieja, Aguadilla, PR

Dear Mr. Salem:

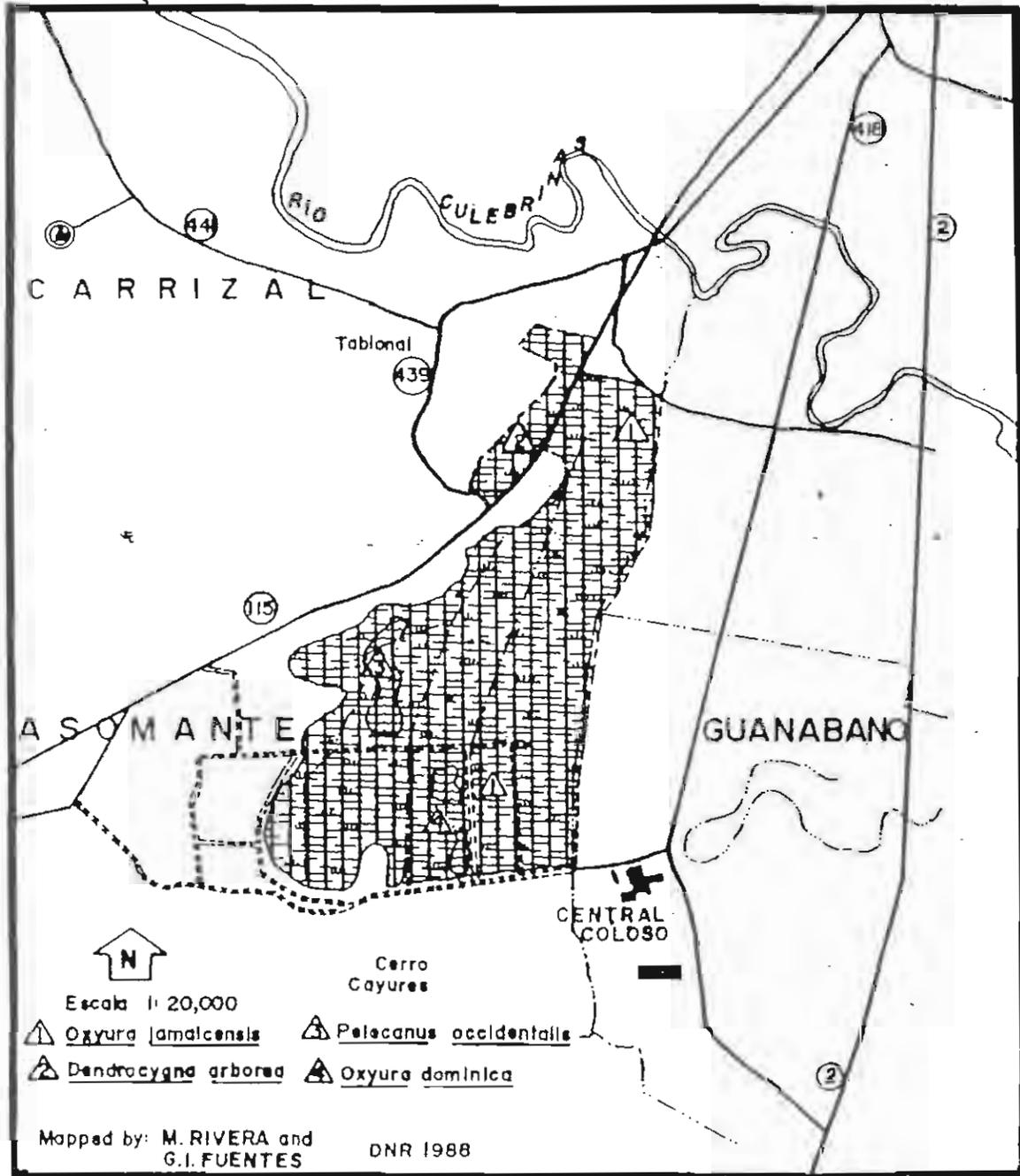
This is in reply to your request for comments on the above referenced Flood Control project. The Rio Culebrinas in Aguadilla is well known for its population of native river shrimp (Macrobrachium carcinus). This shrimp is caught locally and sold. A small estuarine wetland is located at the mouth of the Culebrinas. The Culebrinas is also hydrologically connected to the nearby Cayures Swamp (see map). This freshwater wetland provides important habitat to the rare masked duck Oxyura dominica. Any channel improvements or structural improvements that might affect stream habitat for the shrimp and water flow into the estuary or swamp, will have to be carefully considered. If you have any questions please contact Felix Lopez of my staff.

Sincerely,


James P. Oland
Field Supervisor

encl (1)
fhl
cc:
COE, San Juan

CAYURES SWAMP



MAP 14



ESTADO LIBRE ASOCIADO DE PUERTO RICO
ADMINISTRACION DE SERVICIOS MUNICIPALES
EDIF. PLAZA BARBOSA - AVE. BARBOSA 306
HATO REY, PUERTO RICO 00917
GPO BOX 70167, SAN JUAN, P.R. 00936
TEL.: 754-1600

June 20, 1991

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Florida 3232-0019

Dear Mr. Salem:

Reference is made to your letter dated April 26, regarding flood protection along the Río Culebrinas and Caño Madre Vieja, south of Aguadilla.

As determined by our Engineering Bureau, both rivers running in a western direction, cross State Road PR-418 and previous PR-2, affecting a large community on normal flooding. This includes residential users, agricultural, a radio station control and antenna, plus a U. S. Reservation on the southwest bank of Río Culebrinas.

A more detailed reconnaissance of the area demonstrated that the agricultural land flooded by Río Culebrinas is a rich one used for cattle raising and includes several structures that possibly will interfere with any canalization project. At the same time Caño Madre Vieja is affected by a long extension of "mangle" which is under control by the Department of Natural Resources.

A detailed study of land located East of State Roads PR-418 and present PR-2, demonstrates that Caño Madre Vieja receives waters from Río Culebrinas which can be controlled by a filling or leveling project, leaving its channel for local run-off or storm sewers in the area. This will reduce flood danger to a minimum, and will permit the Municipality to develop the area for recreational purposes.

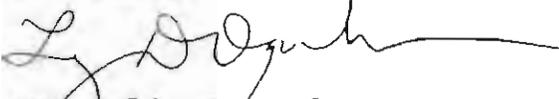
Mr. A. J. Salem

June 20, 1991

Page 2

Flood control of Río Culebrinas from State Road PR-418 to the beach, crossing former State Road PR-2, can be improved by straightening some sections or loops and building an earthen "levee" within the channel and area to be protected.

Cordially,



Luz Delia Oquendo
Acting Administrator



COLEGIO DE INGENIEROS Y AGRIMENSORES DE PUERTO RICO

JUNTA DE GOBIERNO
1990-91

ING. MIGUEL A. ROA VARGAS
Presidente

ING. JOSE RAMIRO RODRIGUEZ
1er. Vicepresidente

AGRIM. EUGENIO LOPEZ ENCARNACION
2do. Vicepresidente

ING. ELLIOT MERCED MONTAÑEZ
Secretario

AGRIM. PABLO CARDONA GUZMAN
Tesorero

ING. FELIX A. CARDONA
Auditor

DIRECTORES

AGRIM. LUIS BERRIOS MONTES

ING. JUAN A. BONNET, JR.

ING. WILFREDO DE JESUS MALAVE

ING. ALBERTO DE LOS REYES

AGRIM. HECTOR L. DEL RIO TORRES

ING. JOSE MANUEL FERNANDEZ

ING. LORENZO GONZALEZ ALEMAN

ING. ABRAHAM HERNANDEZ

ING. EDGAR HERNANDEZ

ING. JOSE M. IZQUIERDO

ING. ESTEBAN LAMADRID

ING. CARLOS LAZARO

ING. VICTOR H. MALAGON

ING. JOSE I. NICOLAU

ING. CARMEN QUIÑONES DE RIVAS

ING. DENJIRO RIVERA

ING. MARITZA RIVERA

ING. REINALDO SANTISTEBAN

ING. HECTOR VELAZQUEZ VELAZQUEZ

ING. SAMUEL ROSARIO SANTOS

Pasado Presidente
Fallecido

ING. JAIRO P. LASCARRO

Pasado Presidente

June 20, 1991

Mr. A. J. Salem
Chief Planning Division
Environmental Resources Branch
P O Box 4970
Jacksonville, Florida 32232-0019

Dear Mr. Salem:

Your request for comments and information was referred to this office after the May 26, 1991 deadline.

Please be advised that Eng. Samuel Rosario passed away on May 10, 1990 and at present our President is Miguel A. Roa Vargas. Our new address is as follows:

Colegio de Ingenieros y Agrimensores de P.R.
P O Box 363845
San Juan, P.R. 00936-3845

We will be eager in future issues to offer our comments or inquiries to your office.

Sincerely,

Juan R. Figueroa Laugier, P.E.
Executive Director

JRFL/id

cc: Miguel A. Roa Vargas, P.E.
José E. Valls, P.E.
Ponce Chapter President



United States Department of the Interior

FISH AND WILDLIFE SERVICE
 CARIBBEAN FIELD OFFICE
 P.O. BOX 491
 BOQUERON, PUERTO RICO 00622

June 12, 1991

JUN 20 11 09 AM '91

Mr. A. J. Salem
 Chief, Planning Division
 U.S. Army Corp of Engineers
 Jacksonville District Office
 P.O. Box 4970
 Jacksonville, FL 32232-0019

Dear Mr. Salem:

This is in response to a letter of May 15, 1991 received in this office on May 20, 1991 requesting a list of any threatened or endangered species that may be present in the study area for the flood protection project along Rio Culebrinas, Aguafilla.

After reviewing our files we found that no threatened or endangered species occur near the proposed study area. However, we consider that the Espinar wetland; northwest of the proposed site, may be affected by the proposed Diversion Channel. This channel may eventually drain the Caño Madre Vieja which directly connects with the coastal wetland.

This office does not favorably endorse any activities which may affect wetlands, therefore, we suggest that the possible impacts of the Diversion Island on the Espinar wetland be evaluated.

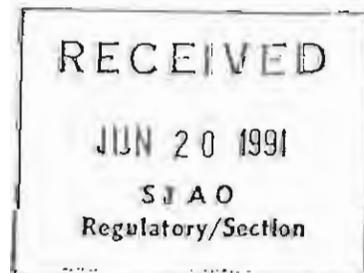
Should you have any questions, please contact Jorge E. Saliva from our office at 851-7297.

Sincerely,

Susan R. Silander
 Acting Field Supervisor

jes

cc: DNR, Natural Heritage Program
 EPA, San Juan





COMMONWEALTH OF PUERTO RICO
OFFICE OF THE GOVERNOR
PUERTO RICO PLANNING BOARD

Minillas Governmental Center, North Bldg.
De Diego Ave, Stop 22
P. O. Box 41119, San Juan, P. R. 00940 - 1119

June 4, 1991

A. J. Salem, Chief
Planning Division
Department of the Army
Jacksonville District
Corps of Engineers
P.O. Box 4970
Jacksonville, Florida - 32232-0019

Att: Environmental Studies Section

Dear Mr. Salem:

I write in reference to your request for comments on the reconnaissance-level report for the Rio Culebrinas and Caño Madre Vieja flood protection project, south of the Municipality of Aguadilla. Historical records show that the area west of Highway PR-2 has been affected by floods of both Rio Culebrinas and the Caño.

According to FEMA's panel number 720000-0009B and our Flood Zones Map number 1D, Urb. Garcia, Urb. Victoria and the Public Housing Project José Aponte were affected by the 100 year-flood, and were classified within the floodway. Urban development was restricted because of the floods, as shown in dotted lines, in our Land Use Plan for Aguadilla, (corresponding parts included). The Plan also proposes that the lands located northeast and adjacent to the mouth of Caño Madre Vieja be used for recreational uses.

Any additional information that you may need will be furnished on request.

Cordially,

Patria G. Custodio
Chairperson

Enclosure





DEPARTMENT OF NATURAL RESOURCES

May 23, 1991

Mr. A. J. Salem
Chief, Planning Division
Department of the Army
Jacksonville District
Corps of Engineers
PO Box 4970
Jacksonville Florida 32232-0019

Attn: Environmental Studies Section

Dear Mr. Salem:

Re: Reconnaissance Study Rio Culebrinas
and Caño Madre Vieja, Aguadilla

The Flood Control Area of the Department of Natural Resources is aware of the problems of flooding south of the town of Aguadilla. At the present time, our Area is not considering any projects to provide flood protection to the municipality of Aguadilla.

If our assistance is needed during the study, please feel free to contact our Area.

Sincerely,

Hilton Miró Detrés
Hilton Miró Detrés
Assistant Secretary
Flood Control Area

LH/JAA/lic



COMMONWEALTH OF PUERTO RICO

DA GRICULTURE

P.O. Box 10163
Sanjurjo, Puerto Rico 00908

OFFICE OF THE SECRETARY

May 17, 1991

Mr. A.J. Salem
Chief Planning Division
Department of the Army
Jacksonville District Corps
of Engineers
PO Box 4970
Jacksonville, Florida 32232

Dear Mr. Salem:

Your proposal for a reconnaissance-level report for flood protection along the Río Culebrinas and Caño Madre Vieja, South of Aguadilla, Puerto Rico, is important for the area and for the agricultural development. One of our greatest sugarcane mill is located close to the Río Culebrinas and Caño Madre Vieja. This river is a source of water for the Coloso Mill.

Sugarcane, pasture and other crops are cultivated throughout the area.

We understand that a protection against flooding will help our farmers in the area.

If you need more information, do not hesitate to contact me.

Sincerely yours,

Alfonso L. Dávila Silva
Secretary of Agriculture



Address all correspondence to the
Executive Director
PEDRO HERNANDEZ-PURCELL

June 3, 1991

Mr. A. J. Salem
Chief, Planning Division
Environmental Resources Branch
Department of the Army
Jacksonville Corps of Engineers
P O. Box 4970
Jacksonville, Florida 32232-0019

Re: Possible alternatives for flood
protection along Ríos Ojo de Agua,
Río Culebrinas, Caño Madre Vieja,
Aquadilla, Puerto Rico and Río Loco,
Guánica, Puerto Rico

Dear Mr. Salem:

Reference is made to your letters of April 29,
May 1, and April 26, you asked for our opinion on the
above reference subjects.

Due to the preliminary content of the information,
we cannot offer an opinion on the project.

We will comment and evaluate any document with the
alternative proposed when these are presented to our
agency.

Cordially,



Pedro Hernández Purcell
Executive Director

cc: Agrim. Román Aulet
Eng. Mojica

GOBIERNO
del
ESTADO LIBRE ASOCIADO
de la
ISLA DE PUERTO RICO



OFICINA DEL GOBERNADOR
LA FORTALEZA
SAN JUAN DE PUERTO RICO

MARIANO GERARDO CORONAS CASTRO
DIRECTOR / OFICIAL

May 30, 1991

Mr. A. J. Salem
Chief
Planning Division
Department of the Army
Jacksonville District Corps of Engineers
P. O. Box 4970
Jacksonville, Fla 32232-0019

RE: SHPO 05-24-91-01 FLOOD PROTECTION PROJECT OF RIO CULEBRINES AND
CAÑO MADRE FLOOD CONTROL PROJECT, AGUADILLA, PUERTO RICO

Dear Mr. Salem:

Our staff has reviewed the preliminary information for the above referenced project.

The general area is ecological very sensitive. The coastal swamp, the Culebrines river and the Caño Madre Vieja make this an ideal area for location of indian sites. In addition we have reports of some sites within the Espinar Sector, inside the triangle form by the three natural resources. Therefore, we have determined that a cultural resources study (Stage IA-IB) should be carried out to locate potential archaeological sites in the project area, prior to any construction or earthmovement.

If you have any questions, please contact State Archaeologist Dr. Michael A. Cinquino at our Office. Your interest and cooperation in helping to protect Puerto Rico's historical and archaeological resources are appreciated.

Cordially yours,

Luis F. Irizarry
Deputy SHPO

LFI/asc/91-2618

cc: Mr. Carmelo Cáez
US COE, San Juan



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del
ESTADO LIBRE ASOCIADO
de la
ISLA DE PUERTO RICO



OFICINA DEL GOBERNADOR
LA FORTALEZA
SAN JUAN DE PUERTO RICO

MARIANO GERARDO CORONAS CASTRO
DIRECTOR / OFICIAL

Fecha: 05/24/91
Núm. Control Recibo: 91-2619
Ref. No. SHPO: 08-21-90-01
Descripción del Proyecto:
RIO CULEBRINAS AND CANO
MADRE, AGUADILLA

MR. A. J. SALEM
DEPARTMENT OF THE ARMY
BOX 4970
JACKSONVILLE FL 32232

Estimado señor(a): SALEM

Acusamos recibo de los documentos sometidos a nuestra oficina para evaluación y endoso, el 24 de mayo de 1991.

Su caso tiene asignado el número de referencia (SHPO No.) escrito en la parte superior derecha de este acuse de recibo de documentos. Si tiene cualquier duda o pregunta, refiérase a dicho número para localizar rápidamente el expediente. Nuestra oficina se comunicará con usted en un término razonable, el cual estimamos no debe exceder los próximos treinta (30) días laborables, a los efectos de emitir sanción favorable, de denegación o recabar información adicional necesaria para la evaluación del proyecto, en correspondencia a la normativa federal aplicable.

De surgir cualquier duda respecto al proceso de evaluación, puede comunicarse con nuestro funcionario el Arq. Luis Fernando Irizarry, asistente del que suscribe a cargo del Programa Estatal de Preservación Histórica.

Sin otro particular al cual referirme, aprovecho la oportunidad para reiterarle mi consideración más distinguida.

Mariano Gerardo Coronas Castro
Oficial



COMMONWEALTH OF PUERTO RICO
PUERTO RICO INDUSTRIAL DEVELOPMENT COMPANY
G.P.O. BOX 2350 SAN JUAN, PUERTO RICO 00936

TELEX: 3252678
3654319
3855245

May 14, 1991

91 MAY 30 PM 2

Department of the Army
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attention: Mr. A. J. Salem
Chief, Planning Division
Environmental Studies Section

Dear Mr. Salem:

Re: Reconnaissance - level report for flood
protection along the Río Culebrinas and
Caño Madre Vieja in Aguadilla

This refers to your notice of April 26, 1991, about the proposed
first phase of the study mentioned above.

We considered this study as a very important and useful first step
planned by the Corps of Engineers in Aguadilla. If the feasibility
phase of the study is recommended because it is found that the
project is implementable and eventually, the necessary funds are
available to realize the project, the municipality of Aguadilla
will have plenty land to develop. Currently, the whole flat land
located west and east of Road PR-2 and north and south along of
Río Culebrinas and Caño Madre Vieja are affected by floods. See
map included.

Unfortunately, we have not been able to identify any information
in our hands that would be useful to you in this phase of the
study. We own no properties in the study area.

We do want, however, to congratulate the Corps of Engineers for
coming up with this most needed study.

Sincerely

Miguel A. Rivera Carrasquillo
Development Vice President

Enclosure

B. FISH AND WILDLIFE COORDINATION ACT REPORT



United States Department of the Interior



FISH AND WILDLIFE SERVICE

Boqueron Field Office
P.O. Box 491
Boqueron, Puerto Rico 00622

November 19, 1999

Mr. James C. Duck, Chief
Jacksonville District Planning Division
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Attn. Mr. Esteban Jiménez

Re: Coordination Act Report
Culebrinas River Flood Control Project

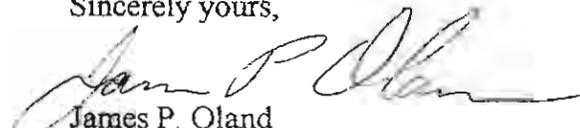
Dear Mr. Duck :

Enclosed please find an original and 1 copy of the Fish and Wildlife Service Coordination Act Report for the proposed Culebrinas River flood control project. Another copy has been provided to the Antilles Area Office, Planning Division, and a copy has been sent to the Department of Natural and Environmental Resources.

The Coordination Act Report discusses the fish and wildlife resources of the area and points out that a portion of the proposed project, the north end of the west levee, would fall within a designated Coastal Barrier Unit. The Service would like the opportunity to provide further Coordination Act comments if modifications are planned for this project.

Thank you for the opportunity to comment on this action.

Sincerely yours,


James P. Oland
Field Supervisor

bby

cc:

DNER, San Juan
COE, San Juan

Culebrinas River Flood Control Project

**Prepared by Beverly Yoshioka
U.S. Fish and Wildlife Service
Boqueron Field Office**

November 1999

Culebrinas River Flood Control Project

Executive Summary

The U.S. Army Corps of Engineers, Jacksonville District, is planning a flood control project for an associated river mouth drainage of the Culebrinas River, Caño Madre Vieja. During high flood events, the Culebrinas River overflows its channel upstream of highway PR-2 and at the first meander curve just downstream of PR-2. The flood waters enter Caño Madre Vieja flooding out the southwestern sectors of Aguadilla and the northeastern portion of the community of Espinar.

The preferred alternative would place two dikes east and west of the Caño to maintain the flood waters within this floodway. To accommodate the eastern levee, a double meander of flowing stream in the Caño would be eliminated via a cut-off channel. The western levee would cross a mangrove forest and channel near the mouth of the Caño, directly impacting some mangroves and indirectly affecting the existing hydrology that supplies tidal flow to the mangrove forest that would be left outside the flood dikes.

The Service's major concern centers around the potential indirect and secondary impacts for the mangrove forest and other wetlands that would remain outside the flood levee. The section of the mangrove forest where the west levee would pass through lies within Coastal Barrier unit PR-75. Our understanding is that this precludes the use of Federal funds for projects, including flood control projects authorized after the date of the inclusion of the Coastal Barrier unit. Another concern is for the section of river to be eliminated. The Service believes that ample opportunities exist in the area for appropriate mitigation, however, there has been no specific mitigation plan discussed to this point.

Introduction

The Río Culebrinas is the fifth largest watershed in Puerto Rico with a total drainage area of approximately 103 square miles. The river flows at a relatively low gradient out of the central mountain region in a northwesterly direction, emptying into Aguadilla Bay southwest of the town of Aguadilla. Historically the river has meandered throughout the valley (C type meandering stream, Rosgen hydrogeomorphic classification), and the mouth of the river has periodically migrated. Caño Madre Vieja, to the north of the Culebrinas River, is considered to be an abandoned river mouth that now carries only localized drainage except during flood stages on the Culebrinas. The beach in this area receives moderate to high energy sea conditions, and the coastline is subject to erosion. The beach between the Culebrinas River and Caño Madre Vieja has a low berm, and is backed by herbaceous and mangrove forest wetlands with a direct hydrological connection to the Caño.

One of the major island highways, PR-2, crosses the Culebrinas River in a north/south direction. The highway is elevated above the surrounding floodplain, although the river is capable of going over the highway during flood stage (Figure 1). The highway bridges the Culebrinas River and culverts maintain flow in the upper part of Caño Madre Vieja. When the Culebrinas exceeds bank-full flows, it floods over the first large meander below PR-2, and into the drainage for Caño Madre Vieja, flooding both the Espinar Community and the southwestern low-lying portions of Aguadilla. In higher flood stages, it overflows above PR-2, also draining towards the Caño.

The river has no major impoundments, but does have a small low head dam (Photos 1 and 2) built in the early part of the century to provide a water diversion for the Coloso Sugar Mill. This diversion is still used to provide process water for the mill. In 1998, the Puerto Rico Aqueducts and Sewers Authority (PRASA) along with the Commonwealth Infrastructure Agency (AFI) developed a surface water intake for potable water using the impoundment from this dam. The dam is located several hundred meters upstream of PR-2, and the pump house is located on an elevated stand next to the diversion dam (presumably above the 100 year flood stage). The raw water is currently pumped up to the Aguadilla treatment plant, but AFI is considering the creation of an off-river reservoir/ sedimentation lake near the damsite to supply additional firm yield and reduce the very high sediment load in the raw water extracted from the river. Because of its narrow design, it is likely that the existing dam serves as a constriction creating overflow into the floodplain above PR-2 during flood stage.

The dam acts as a partial barrier for fish and shrimp migration upstream, and juvenile shrimp can generally be seen migrating upstream on the cement bulkhead of the weir in the wetted zone above the water flow (Photo 3). Native fish (approximately 6 species) and shrimp (as many as 14 species) are compulsory migrators, requiring a portion of their life cycles in estuarine or marine waters. At least six species of shrimps are large enough to be fished for human consumption, one species reaching very large sizes (Photo 4). Most of these species are also likely to occur in Caño Madre Vieja along with estuarine fish such as snook, tarpon, mullet, mojarra, and jacks; and crustaceans such as blue crabs and land crabs. Fishermen of the area

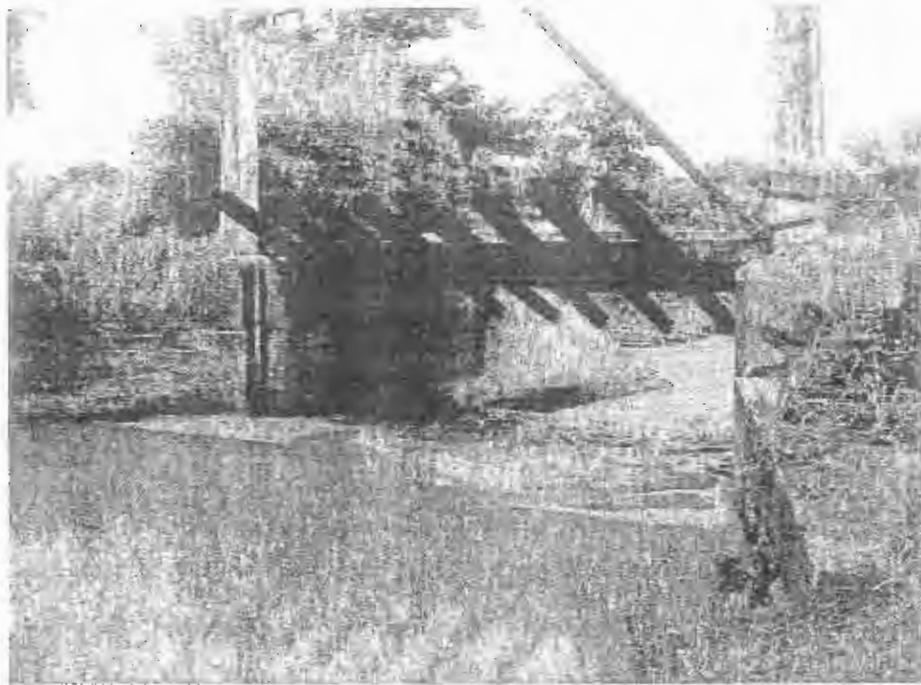


Photo 1. Coloso diversion dam from the upstream side. Note that the opening is very narrow and topped by a road.

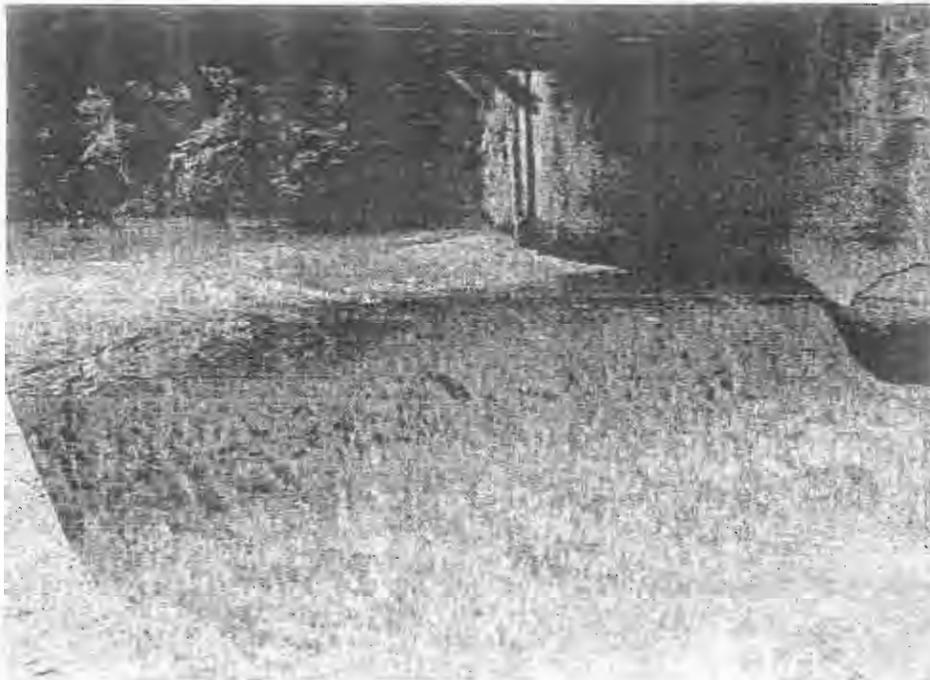


Photo 2. Downstream side of the Coloso dam. Drop during lower flows (photo condition) approximately 2 meters including a lower step not shown in the photo. Note that the vertical sidewalls have a wetted zone.

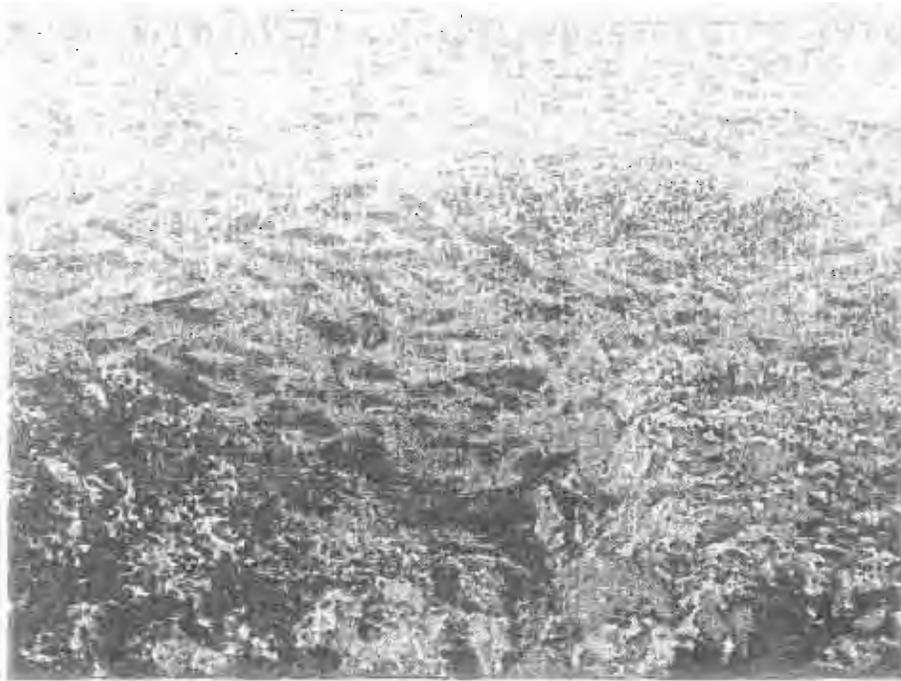


Photo 3. Juvenile shrimps, approximately 1 cm long, migrating upstream in the wetted (splash zone of the dam side walls.

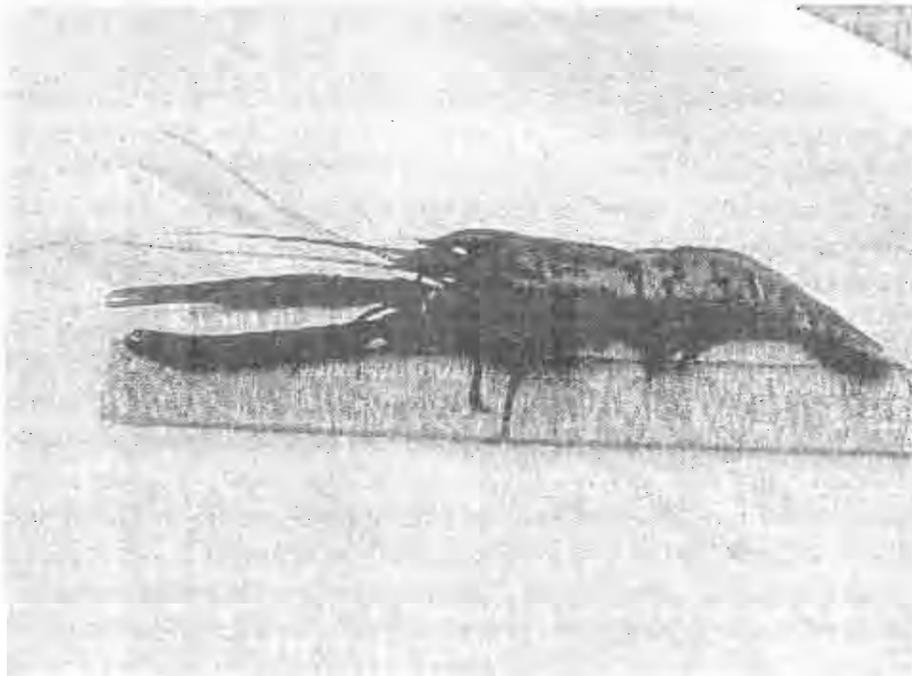


Photo 4. A specimen of *Macrobrachium carolinus*, the largest species of freshwater shrimp. This species can reach overall lengths of 18 inches and a pound in weight. This, and four other species of shrimp are actively fished.

have commented that they catch fish and the larger species of shrimp from both the Culebrinas and the Caño and its canals for consumption. The Service is participating in a fishway project for the Coloso Mill dam with AFI and PRASA.

A large wetland area, the Cayures marsh, lies south of the Culebrinas River near the Coloso sugar mill. This wetland area is a DNER designated Critical Coastal Wildlife Area providing habitat for a number of waterfowl species. The marsh consists of some interconnected ponding areas associated with overflow from the river. This wetland area will not be discussed further as the preferred alternative would not impact this marsh. In addition to the Cayures marsh, herbaceous wetlands occur on the south side of the Culebrinas River and are directly associated with the river.

From documents provided by the Corps, we understand that a number of alternatives have been considered to provide some Flood Hazard Mitigation for already developed portions of the community of Espinar and the southwestern communities of Aguadilla. The first alternative proposed was to construct a single flood levee from PR-2, just southwest of Caño Madre Vieja extending along the south side of Espinar, tying into a hill to the west to isolate the Caño from the floodwaters of the Culebrinas River (Figure 2). This would have provided flood protection for the western communities of Aguadilla, greatly reduced the floodplain of Caño Madre Vieja, and protected portions of the Espinar community. It would have raised flood levels in the Culebrinas River, however, thus affecting other portions of the Espinar community along the Culebrinas River. It also would have reduced the frequency of high flows that help maintain the channel and mouth of Caño Madre Vieja and encouraged development in much of the currently uninhabited floodplain along the Caño, violating E.O. 11988 for the protection of floodplains. To be effective, this plan would have to include channelization of the lower Culebrinas River to minimize the flood levels on its course, eliminating the river meanders and associated wetlands, and increasing maintenance costs for the floodway channel. Channelization of the lower Culebrinas River would have been likely to affect hydrology in the neighboring associated Cayures marsh. Our understanding is that this alternative has been discarded due to high costs and environmental considerations.

Alternative 2 from the original Reconnaissance Report (Figure 3) would provide two flood levees: one along the eastern side of Caño Madre Vieja north of PR-2 to protect southern Aguadilla, and a flood ring levee on the west side of the Caño. The original design would also have included a continuation of this levee on the north side of Espinar. Various permutations of Alternative 2 have been considered by the Corps as additional alternatives, mostly as variations to the western levee. In addition to the levees, the various permutations of this alternative also require the elimination of a double meander of Caño Madre Vieja via a short cut-off channel to accommodate the eastern levee. A modified version of Alternative 2 is the currently preferred alternative described as "Plan 1" in the Detailed Project Report (Figure 4). The western levee of this plan was altered to include the Iglesia de Espinar, a historic church for that community, in the protected area. The portion of the levee behind the beach berm and just north of Espinar community was eliminated, and the end of the levee was tied into the beach berm on the west side of the mouth of the Caño. One-way drainage structures are to be incorporated into the levee at strategic points. This last alternative has been further modified to include a two-way culvert

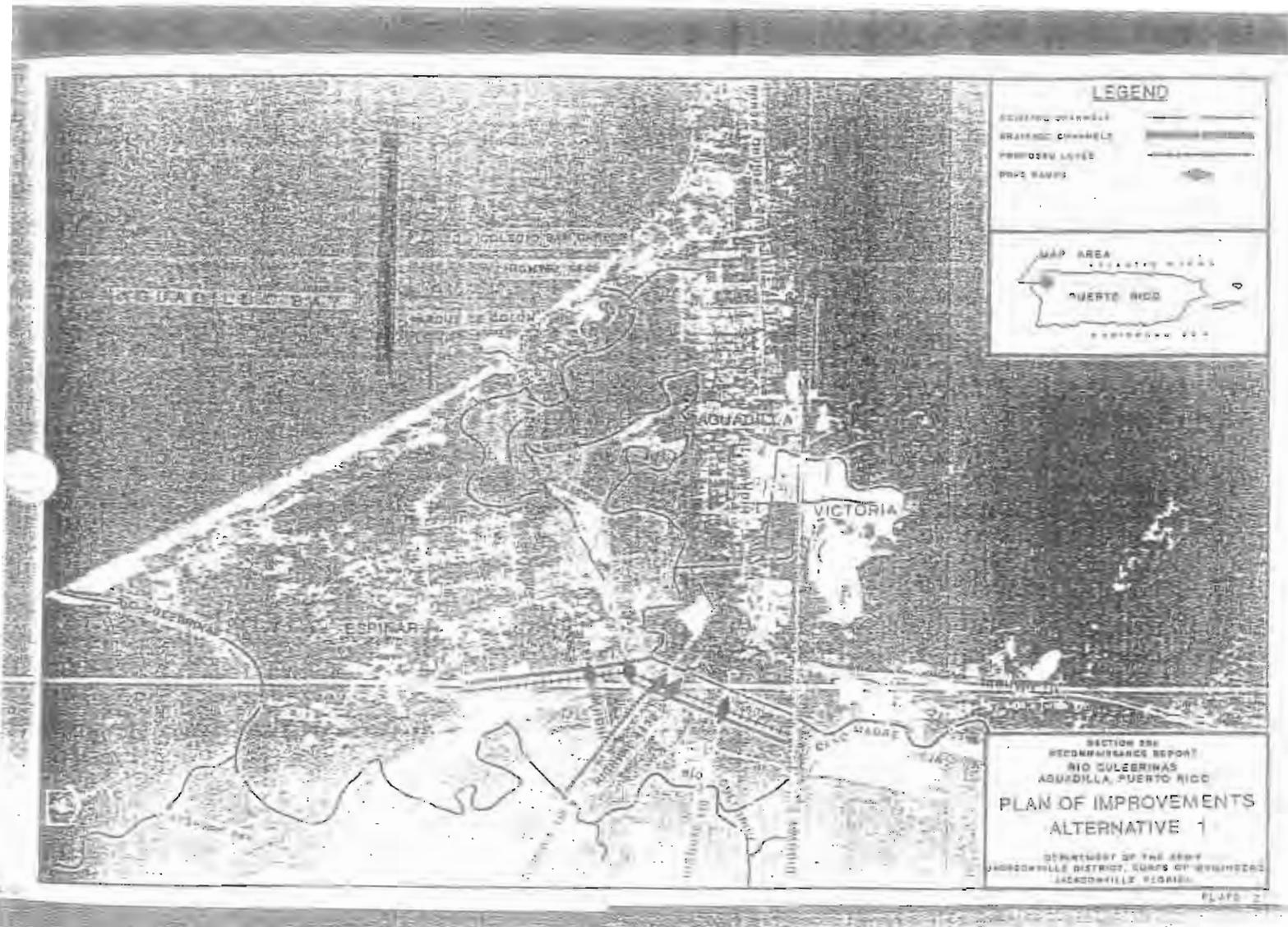


Figure 2 Original alternative 1 from Section 205 Reconnaissance Report, 1992.

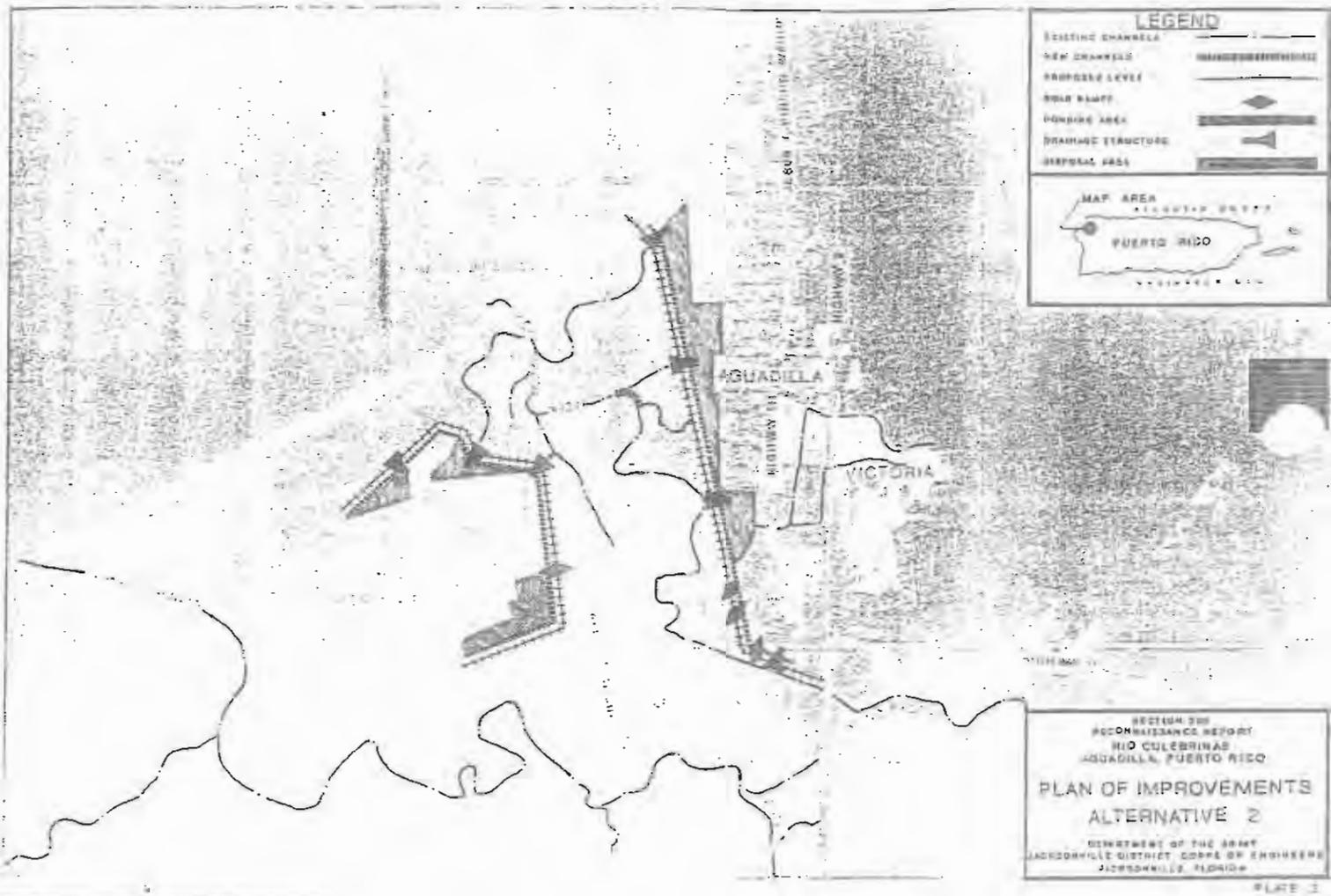


Figure 3. Original Alternative 2 from Section 205 Reconnaissance Report, 1991.



Figure 4. Currently favored alternative with the modified west levee.

to provide hydrology to the mangrove forest channel that runs on the north and east sides of the Espinar community.

Fish and Wildlife Trust Resources

Evaluation of the fish and wildlife trust resources for this CAR focus strictly on the Caño Madre Vieja area that would be affected by the currently favored alternative. Both the Cayures marsh and the low-head dam discussed above are outside of the immediate project area, but should be evaluated if further alternatives outside the lower Caño Madre Vieja area are considered. The lower Culebrinas River valley includes areas of herbaceous and forested (mostly mangrove) wetlands. Most of the forested wetlands in the immediate project area are located near the mouth of Caño Madre Vieja.

On the east side of the Caño, Aguadilla developed a public park with recreational facilities, a boat ramp, and an athletic field and track. The beach front road on the west side from the town to the park is protected in most areas by rip-rap. The mouth of the Caño is protected by breakwater/groins, the larger one lying on the east side of the mouth (Photos 5 and 6). These help maintain the mouth open and provide some protection for small boats entering and leaving the mouth. Our understanding is that the municipality of Aguadilla may also periodically provide maintenance to keep the mouth open, and that no new alterations are planned for the mouth the the Caño. The eastern side of the Caño mouth lies within Coastal Barrier unit PR-75P, while the western side of the mouth lies within Coastal Barrier PR-75 (Figure 5). On the west side of the Caño mouth is a small groin, but the beach berm is otherwise in a relatively natural condition. The western levee would tie into the beach berm within PR-75. According to the information available in our office on CBRA, the use of Federal funds is prohibited, and exempt activities do not include flood control work authorized after the date the relevant unit was included in the CBRA (in this case 1990).

While the Service has no ongoing beach monitoring projects in the area, a previous site inspection revealed the beach between Caño Madre Vieja and the Espinar community is likely to be suitable nesting habitat for the endangered hawksbill sea turtle (*Eretmochelys imbricata*) and the leatherback sea turtle (*Dermochelys coriacea*). While the project does not contemplate any alterations to the beach area, project changes that would require alterations to this beach should require consultation under Section 7 of the Endangered Species Act. This section of the beach also lies within Coastal Barrier Unit PR-75.

Soils

Caño Madre Vieja and the lower Culebrinas River lie within two major soil associations: the Coloso-Toa Association described as nearly level porous loamy soils, and the Bejucos-Jobos Association consisting of strongly leached soils with a very tight, clayey subsoil. Caño Madre Vieja lies mostly within the intersection of these two major associations. Soils in the project area are all either considered to be hydric soils or non-hydric soils with hydric inclusions (Figure 6). Those considered to be hydric soils include Bajura clay (Ba), Iguadad clay (Ig), and Tidal swamp (Td). The non hydric soils with hydric inclusions include Toa silty clay-loam (ToA),



Photo 5. A view of southwestern Aguadilla from PR-2 above the town. The jetty visible in the middle of the coastline is the eastern jetty of Caño Madre Vieja.

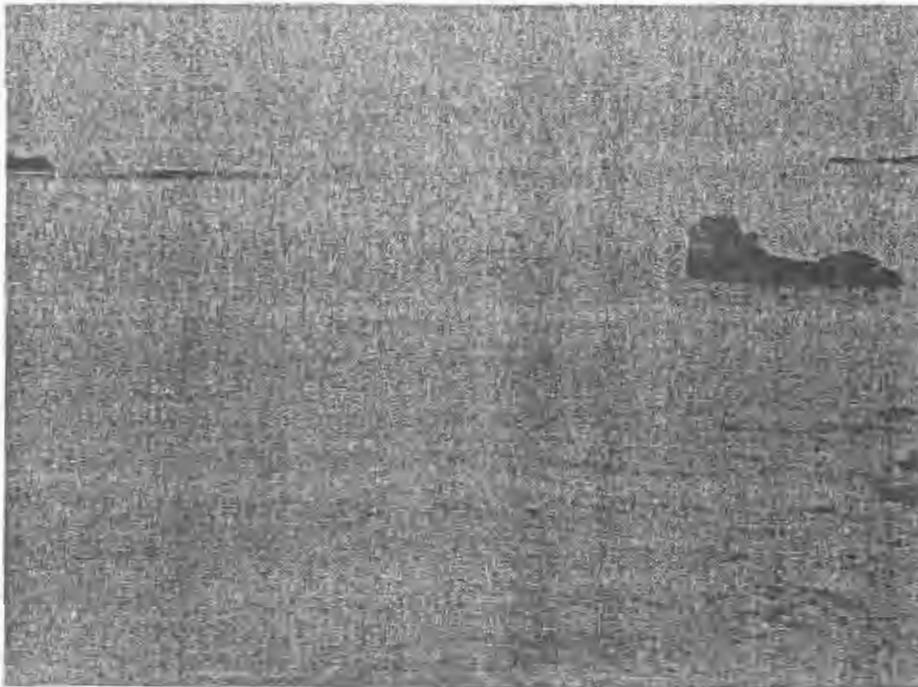


Photo 6. Open mouth of Caño Madre Vieja from Parque Colón on the east side. The tip of the small western jetty is visible on the left side of the picture.

Coloso silty clay-loam (Cn), Cataño sandy clay-loam (Ce), and Cataño sand (Cd). In general, the unmapped inclusions may be small units of the above listed known hydric soils, or would be described as “unnamed inclusions”. These unnamed inclusions generally have a lot of the characteristics of the surrounding soils and may lack obvious hydric indicators, but are often ponded. In the case of soils with heavy clay content, hydric indicators may not be obvious, and inclusions are usually within depressional wetland areas where the hydrology is maintained by ponding rather than flooding. NRCS has noted that the hydric soil indicators in such soils are good for saturation only and may not be present in ponding situations. Drainage channels have been dug on both sides of the Caño in various places, and while some have been maintained others have not, making the hydrology of the area complex.

Existing Conditions

The National Wetland Inventory Map (Figure 7) of the area indicates relatively extensive wetlands in the Caño Madre Vieja area. While wetlands east of Caño Madre Vieja may be over-estimated in the maps, some areas marked as uplands within the proposed levees may be in the process of reverting to wetlands. The mouth of Caño Madre Vieja is mapped as Cd on the soil map, and is a classic small stream opening on a dynamic beach. The beach berms, while considered to be uplands are relatively narrow. On the eastern side of the Caño, as mentioned above, the beach berm has been elevated for the coastal road and further altered with groins and rip-rap to protect the park development, the public road, and the school. The beach berm on the western side of the Caño mouth has retained more natural characteristics with some forest of coconut palms and portia tree (*Thespesia populnea*), and West-Indian almond (*Terminalia catappa*).

Typically small rivers form sand bar sills in the river mouths during low flows and may even close during very low flows. As mentioned above, this channel is generally maintained open by the groins and occasional maintenance. Both east and west of the mouth, the beach berm is backed by the two side drainages that enter into the Caño near the mouth. These drainages are mapped as Tidal swamp (Td) and contain the riverine mangrove associations commonly found in small drainages where water accumulates behind the river mouth bar. Red mangroves (*Rhizophora mangle*) generally occur as fringes immediately adjacent to the channels, while black mangroves (*Avicennia germinans*) dominate in the saturated areas away from the open channel. On the beach side of this channel, red mangrove on the channel is backed by white mangrove (*Laguncularia racemosa*), and indication that soils are not hypersaline in this area. Leather ferns (*Achrosticum* spp.) are also commonly found in this association.

The eastern forested wetlands have been reduced since the NWI maps were made by the park development, particularly the athletic track and by the western edge of the school (Colegio San Carlos). The remaining wetlands still retain mangroves and other wet tolerant trees such as west-indian almond (*Terminalia catappa*), and palms (Photos 7 and 8). The seaward edge of the east dike would pass through the edge of the school yard, possibly cutting off a small segment of this drainage and wetland forest.

The western drainage divides with one arm passing just behind the beach berm directly west,



Figure 7. NWI map of the project with the dike layout and rough approximation of wetland types

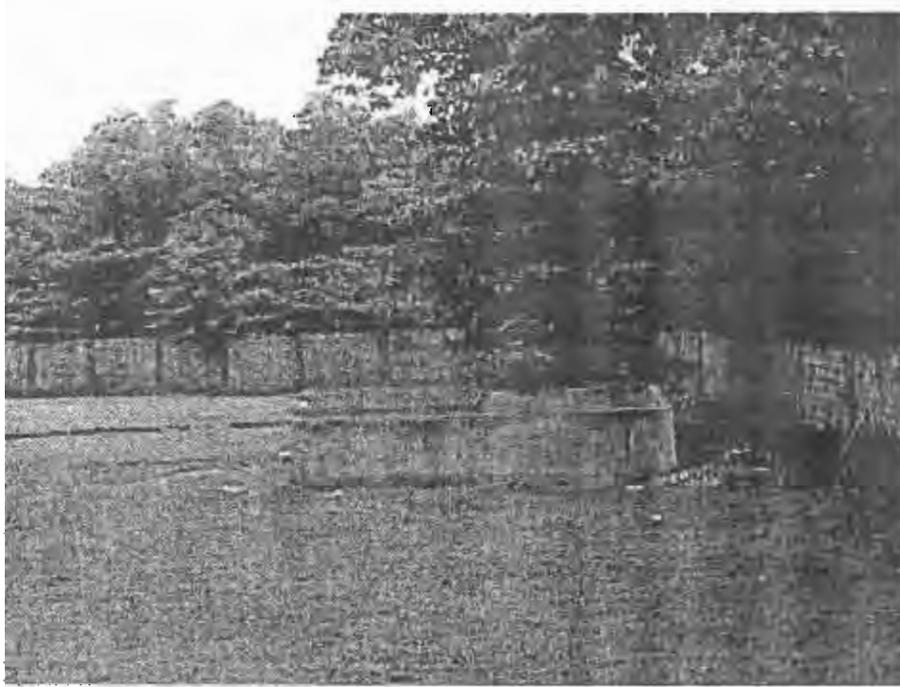


Photo 7. Colegio San Carlos school yard with the forested drainage behind it. The eastern levee would pass through part of the school yard and forest.



Photo 8. The forested drainage from the road just west of the school. Upland trees are in the foreground on the road levee and mangroves are in the background.

and the other arm meandering south on the edge of Espinar community. The mangrove forest along the southern portion of this drainage next to the Espinar community is well developed with some trees exceeding 30 feet in height. The channel is also connected to an intermittent drainage lying on the north side of Espinar, just behind the beach berm. The wetlands behind the beach berm are dominated by cattail (*Typha domingensis*) and other herbaceous vegetation to the west, probably a result of past (and current) land clearing and sand extraction. A previous wetland violation was noted in that area, and these wetlands were recently disturbed by land clearing activities (Photos 9 and 10). It appears that most of the cleared wetlands consisted of cattail (*Typha domingensis*) mixed with sedges and salt grass. The western dike would cut across the mangrove channel to tie into the existing beach berm just to the west of the mouth of Caño Madre Vieja. While the current plan calls for a two-way culvert to maintain tidal flow into this channel, the size of the culvert is critical in maintaining the hydraulic capacity of this channel. At the narrowest point in the vicinity of the proposed dike, the channel is approximately five feet in width and at least a foot in depth (Photos 11 and 12). Our understanding is that the Corps is currently considering a 2' diameter two-way culvert which appears to be considerably below the existing hydraulic capacity of the channel.

The east side of the Caño, south of the mangrove channel and park, lies between the side channel and a large curve in the main channel. It is mapped as Cataño sandy clay-loam (Ce) just south of the channel, shifting to Coloso silty clay-loam (Cn) and Igualdad clay (Ig) to the east. Probably reflecting these mixed soil associations, the plant community is patchy, varying between FACU and FACW herbaceous plant species. Most of the area is in grasses classified as FACU (*Panicum maximum*) with patches including sedges and FACW grasses such as *Brachiaria purpurascens*. The plant association shifts to cyperids and leather fern as the wetland forest is approached to the north, and the soils shift to Cataño sandy clay-loam. Much of the area on the eastern side of the Caño near the existing community could be considered as uplands, however, small changes in topography promote the wetland plant species in shallow depressions. The area is complex, and should be considered to be a mixture of wetlands and uplands that perform a number of wetland functions including filtration and sedimentation.

On the west side of Caño Madre Vieja, south of the mangrove channel, the soils are mapped as Cataño sandy clay-loam (Ce), grading into Bajuras clay. The plant community in this area strongly reflects the hydric soils, being dominated by wetland grasses and sedges (Photos 13 and 14). The ground in this area was completely saturated, with ponded water in places during the October 12 site visit. This area is bordered on the west by the mangrove lined channel adjacent to Espinar community. The dike would pass through this area.

Further south, in the vicinity of the double meander that would be impacted by the project (see below), the soils shift from Coloso silty clay-loam (Cn) on the east bank and within the meander area to Toa silty clay-loam (ToA) further west. Some small forest stands of geno-geno (*Lonchocarpus domingensis*) lie on or near the Caño meanders to be cut off by the levee (Photo 15 and 16). This tree is often found associated with drainages in drier areas and is considered to be a FACW tree. Some of the trees lie within a meander channel below bankfull levels, and fiddler crabs were abundant in the area indicating the likelihood of occasional estuarine conditions. Otherwise, the east bank area is dominated by guinea grass (*Panicum maximum*,

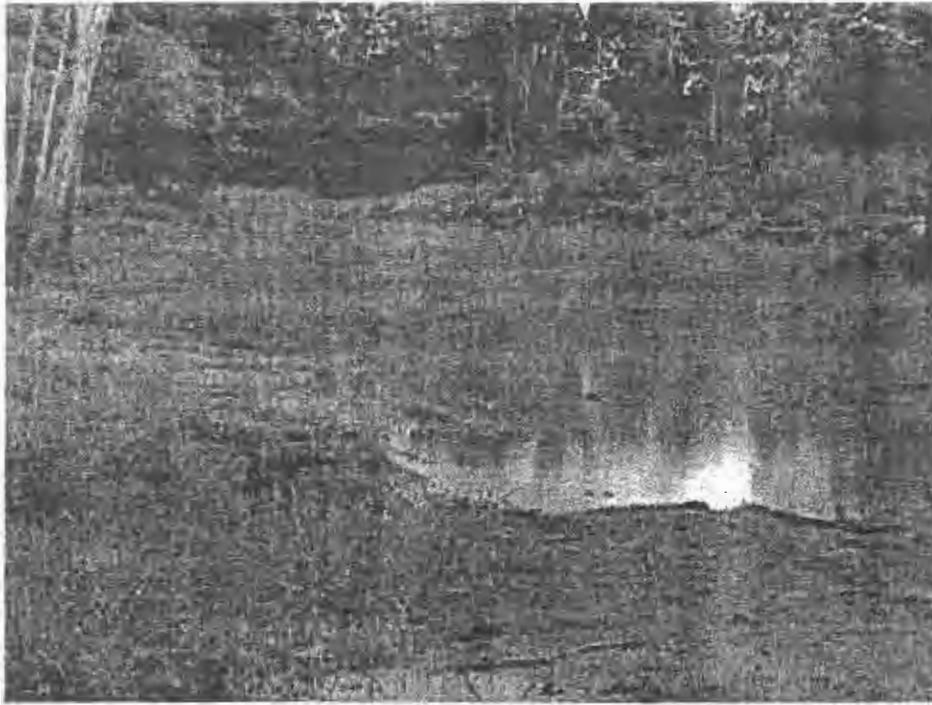


Photo 9. Recently disturbed wetland area behind the beach berm to the west of Caño Madre Vieja. Note the piles of cleared vegetation and soil deposited in wetlands towards the mangrove forest.



Photo 10. Cleared wetland area behind beach berm west of the Caño showing piled debris that includes some trees.

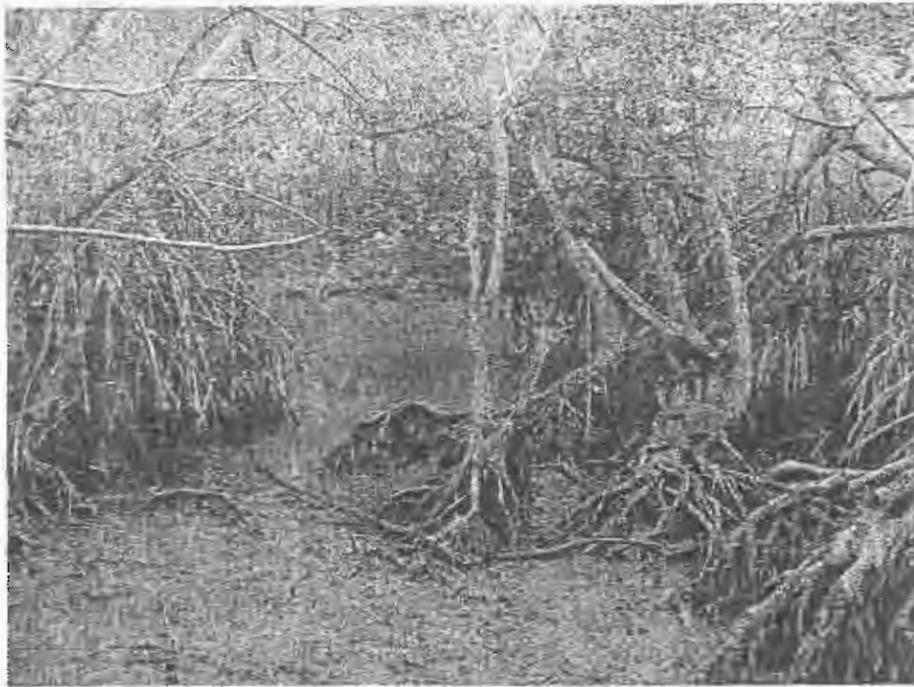


Photo 11. Predominantly red mangrove forest in the area where the western dike would cross and near the narrow point of the channel. The tide was moving out and at low stage.



Photo 12. Mixed red and white mangroves along the mangrove channel area behind the beach berm west of the Caño.

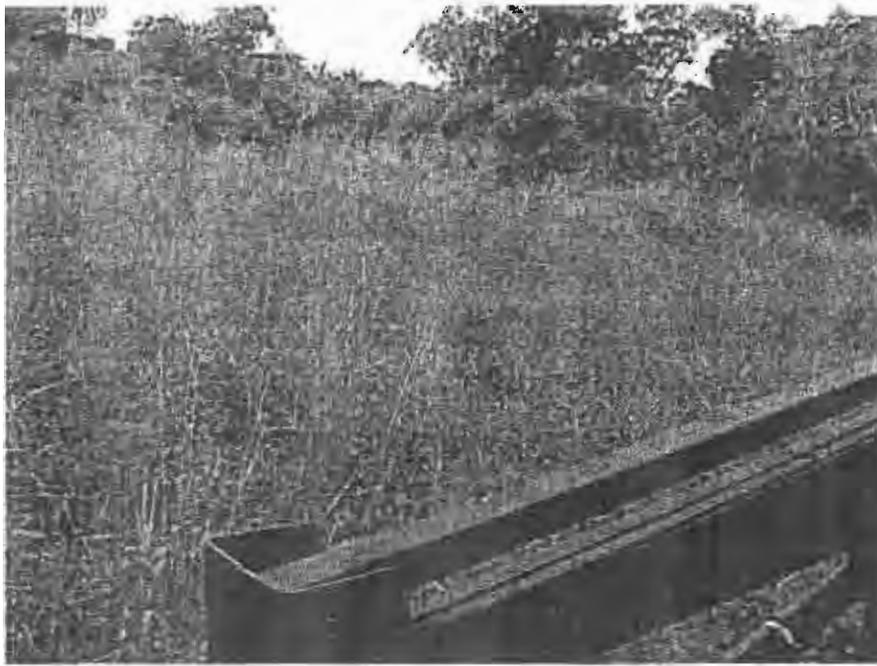


Photo 13. Sedge dominated wetlands on the west side of the Caño, south of the mangrove channel (visible in background). The ground was ponded with several inches of water during this visit.



Photo 14. Another view of sedge/wetland grass dominated area. The entire area on the west side of the channel was too wet to enter with conventional 4 wheel drive vehicles and could only be accessed on foot or by tractor.



Photo 15. Mixed uplands and wet prairie area on the eastern side of the Caño, near the meanders that would be impacted. The larger trees are geno-geno (*Lonchocarpus domingensis*), and the herbaceous plants are mostly guinea grass (*Panicum maximum*) mixed with cyperids and *Brachiaria purpurascens*.



Photo 16. Geno-geno trees next to the river. Fiddler crabs were in abundance around the roots of the trees in this area.



Photo 17. Western side of the Caño, approaching the edge. Note upland trees on the top of the river bank. Many of the grasses are FACW such as *Brachiaria purpurascens* and *Paspalum millegrana*.



Photo 18. View downstream of the Caño from the west bank just downstream of the meanders. Trees near the water-line are mangroves (red and some white). Most are under 10 feet in height.

FACU), and the southern Aguadilla communities have developed up to the edges of the meanders at some points. The west bank is still largely in sugarcane production, with very deep furrows made to help drain the soils. Depressional areas have sedges and FACW grasses moving in. A drainage channel coming from the edge of Espinar community divides this area from the sedge dominated areas further north.

Small mangroves still occur on the Caño banks just downstream of the double meander (Photos 17 and 18). The size of the mangroves probably reflect the last time this Caño was mechanically cleaned out. While the Corps does not intend further alteration to the cut-off meander, the hydrology would be highly altered from an estuarine to a fresh-water ponding condition. Some of the trees would be eliminated, though it appears that most would be outside the immediate footprint of the levee.

Further upstream, to the southeast, the eastern dike would pass through a forested area and over two roads (Figure 4). The forest in this area has some mature mango trees, but is heavily dominated by *Albizia procera*, an introduced legume that colonizes old cane fields and disturbed areas. *Albizia* tends to form monocultures and provides little wildlife habitat value. While this species is often found in relatively wet soils on the edges of wetlands, it is considered to be an upland species.

Wildlife seen in the Caño Madre Vieja included a number of herons and egrets, smooth-billed ani's (*Crotophaga ani*), and the red bishop (*Euplectes orix*). The presence of fiddler crabs in the vicinity of the double meander indicates that estuarine conditions occur at least that far upstream. Other likely fauna would include mongoose, rats, the cane toad (*Bufo marinus*), and other common amphibians, reptiles, and birds in the less disturbed areas with trees. The aquatic freshwater species of fishes and shrimps should occur in the Caño as well as the Culebrinas River.

Potential Project Impacts and Recommendations

The draft Environmental Assessment for the project estimates a wetland loss of approximately 0.5 acres of mangroves (under worst case scenario), and approximately 1.5 acres of wet prairie. It would also eliminate approximately 980 meters of active stream (meander to be cut off). The EA emphasizes that these are strictly estimates of direct impacts from the footprint of the levee, and do not include indirect or secondary impacts likely to occur in wetlands outside of the flood levees. The EA does not consider the fragmentation of wetlands by the dike and associated construction (including the small pilot channel and land to be disturbed during the construction phase). Estimated impact width for the levee footprint includes: a side access on the inside of the levee (5m), the levee footprint (approximately 21m with side slopes), access between the levee and small pilot channel (9m), pilot channel on the outside of levee (7m), and 4m of disturbed area outside of the pilot channel. The total width of the disturbed area would be approximately 46m or 150 feet. Permanent impacts would likely be less, but should include at least the levee footprint to the pilot channel (approximately 21 m).

Indirect and secondary impacts should receive careful consideration as they are likely to be

greater and have longer term impacts on the Caño's wetlands than the direct impacts. Indirect effects would be likely to include hydrology modifications to wetlands lying outside the flood levee and meander wetlands to be cut off by the diversion channel within the flood levees. Secondary impacts would include the likelihood that wetlands remaining outside of the levees would be filled for urban expansion.

Much of the alignment of the eastern levee would lie within uplands, except where it passes in the vicinity of the mangrove wetlands near the school and where it cuts off the Caño meanders. The eastern levee would impinge on the edge of the mangrove fringed channel between the track and Colegio San Carlos, and the impact area is likely to be small as this is a much more restricted forested wetland area than the mangrove channel next to Espinar. The major impact to the meander to be cut off would be due to the cut-off channel within the levee. The tendency over time should be for this meander to fill with sediment since the only hydrology would be provided by the one-way drainage structure through the dike. At the least, the character of the channel and any associated wetlands would change.

The western dike, as currently contemplated cuts across a small portion of the mangrove forest and channel near Espinar and bisects the relatively large herbaceous (sedge dominated) wetland south of the mangroves. The hydrology currently supporting the mangroves is likely to be altered. As mentioned above, the seaward end of the dike, including the mangrove channel crossing, lies within Coastal Barrier PR-75. The two-way culvert being proposed for maintaining hydrology to the Espinar mangrove channel is only 2 feet in diameter. Heavy flood waters moving down this channel would be drained through additional one way drainage structures. Our understanding is that the sizing of the two-way culvert was based on a need to prevent back-flow flooding into the side channel as the flood stage rises on the main channel within the dikes. Apparently this is also based on the assumption of continued partial closing of the Caño, forcing flood levels to as high as 2 meter near the mouth of the Caño. Heavy flooding has traditionally opened this mouth, and the mouth rarely closes now due to the groin/breakwater modifications and periodic maintenance by the municipality.

The original version of the two-levee alternative (Figure 3) included a flood ring levee immediately adjacent to the south, east and north sides of Espinar community. The variation to include the church could still be used within this alternative. That alternative would have impinged on the mangrove channel immediately adjacent to the northeast part of Espinar community, but would have remained south of the back-berm herbaceous and forested wetlands and Coastal Barrier Unit PR-75 and it would have avoided impacts to the sedge dominated wetlands south of the mangroves. The mangroves that would be impacted could be mitigated by relocating the portion of the channel to be impacted slightly eastward and replanting mangroves.

If the currently favored alternative can still be developed under the Coastal Barriers Resources Act, we strongly recommend that the Corps consider installing a larger two-way culvert to maintain tidal flows in the mangrove channel. Reducing the hydraulic capacity of this channel would be likely to encourage sedimentation upstream of the culvert. While the general tendency of flows in the existing mangrove channel is seaward, the persistence of mangroves far upstream along this channel indicates that seawater moves in as a tidal salinity wedge, at least during

spring tides (or normal tides in low rainfall periods). Maintaining adequate two-way flow may be critical to maintaining this system. The additional one-way flood-plain culverts should be slightly elevated above the two-way culvert to encourage the normal flows to continue passing through the principal two-way culvert, and to maintain the existing hydrology in the wetlands upstream.

Wetlands outside of the dike are supposed to be maintained as ponding areas to reduce community flooding, and allow these areas to drain out as flood levels recede within the flood dikes. The Corps should stipulate how these ponding areas would be maintained. Considerations for maintaining these areas as wetlands should include careful evaluation of the elevations of the one-way drainage structures through the dikes. If these ponding areas are not protected through acquisition and posting, they are likely to be developed in a piece-meal fashion through incidental filling and should be considered as part of the secondary impacts of the project.

For wetland impacts that cannot be avoided, we believe that significant opportunities exist within the flood levee dikes for wetland restoration, and possibly some creation. The presence of young mangroves far up the channel of Caño Madre Vieja indicates that the area has probably been periodically altered through channel clearing. Mangroves could be planted, and to some degree, allowed to naturally colonize the Caño margins. Post-project conditions within the dike floodway area may preclude the little agricultural use currently occurring there. Without maintenance of existing drainage channels, more of the area would be likely to revert to wetlands. This obviously depends on the future plans for agricultural use and sand/earth extraction in the area.

The sedge dominated area on the west side of the Caño near the mangrove forest would be particularly suitable for estuarine and freshwater forested wetland restoration. Since this area would lie mostly outside the flood levee, protection of this area from future development would be critical. If no use restrictions are put on these wetlands, they should be considered to be part of secondary project impacts. The upstream portions of this area may be capable of supporting fresh-water wetland trees such as swamp apple (*Annona glabra*), (*Machaerium lunatum*), and swamp bloodwood (*Pterocarpus officinalis*). Freshwater forested wetlands in similar positions on the landscape used to be quite abundant in Puerto Rico, but were largely eliminated by clearing for agriculture early in this century. A *Pterocarpus officinalis* forest (Caño Boquilla) occurs on a similar small drainage associated with the Añasco River to the south and is in the process of becoming a Natural Reserve.

In summary, we recommend that the preferred alternative be re-evaluated to avoid impacts within Coastal Barrier PR-75. If the Corps determines that the project can still proceed as proposed under CBRA, careful consideration should be given to the capacity of the two-way culvert to maintain hydrology to the mangrove channel. The wetland areas outside of the flood dikes would also have to be protected in some manner and the drainage culvert elevations would be critical to maintaining these wetlands. Mitigation needs could be met through development of additional estuarine and freshwater forested wetlands within the flood levees.

C. CLEAN WATER ACT SECTION 404 (b)(1) EVALUATION AND MITIGATION PLAN

The proposed levees will impact through fill deposition a 0.2-acre red mangrove area, a 1.5-acre emergent prairie area, and 35.55 acres of wet prairie within the projected footprint. These are currently used as pastureland. Hydrologic flow through the area comprised between both planned levees will be unaltered.

The work should not result in violations of water quality standards. Water quality will not be adversely impacted by this project, and Commonwealth water quality standards will be met. Contaminants will not be introduced by clean fill material that may become suspended or dissolved in the river water during the construction operations. Short-term increases in the turbidity are expected during the construction phase of the project; however, the system will re-establish itself as a productive part of the overall ecosystem. No long-term surface water quality problems will result.

Full compliance will be achieved with issuance of a water quality certificate (WQC) from the Environmental Quality Board of Puerto Rico. WQC issuance is expected, but Commonwealth procedures require application to begin after NEPA coordination is completed, not before.

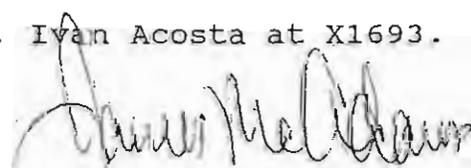
13 July 1995

MEMORANDUM FOR Chief, Environmental Studies Section 

SUBJECT: Rio Culebrinas Water Quality (404), Air Quality, and HTRW Input

1. Enclosed is a copy of the water quality, air quality, and HTRW Civil Works Report for subject project for your use. The report is summarized below.
2. Water Quality. Water Quality will not be adversely impacted by this project, and Commonwealth water quality standards will be met. Contaminants will not be introduced by clean fill material that may become suspended or dissolved in the river water during the construction operations. Short term increases in turbidity are expected during the construction phase of the project; however, the system will re-establish itself as a productive part of the overall ecosystem. No long-term surface water quality problems will result.
3. Air Quality. No adverse effects on air quality will result from the implementation of the proposed project. Fugitive dust may be generated by excavation and deposition of fill material, as in the construction of levees. All dust and pollution suppression measures and equipment required under Federal and Commonwealth laws and regulations will be utilized during project construction.
4. Hazardous Toxic and Radiological Wastes (HTRW). Preliminary research (background information, literature search, etc.) revealed that no known sources of HTRW materials exist in the directly impacted portions of the project corridors. A civil works audit as defined in ER-1165-2-132 for HTRW materials was conducted in May of 1995. The following signs of potential HTRW problems were not identified: landfills, dumps, and disposal areas; burning or burned areas; tanks; vats, lagoons, ponds, and basins sludge pits; pits, quarries, and borrow areas; wells; containers of unidentified substances; spills, seepage, and slicks; odors; dead or stressed vegetation; water treatment plants; ditches, trenches, or depressions; mounds and dirt piles; transport areas, such as boat or rail yards, harbors, airports, and truck terminals; and abandoned buildings. No sites with potential for contamination with HTRW were found. Additional trip reports, photos, and other documentation are on file in the CESAJ District office.
5. POC for this work is Mr. Ivan Acosta at X1693.

Encl



JAMES J. MC ADAMS
Chief, Environmental
Quality Section

WATER QUALITY, AIR QUALITY AND HTRW CIVIL WORKS REPORT FOR
RIO CULEBRINAS AT AGUADILLA, PUERTO RICO.

1. HAZARDOUS TOXIC RADIOLOGICAL WASTE (HTRW) INITIAL ASSESSMENT (Reconnaissance Phase). An initial HTRW assessment was conducted for a Section 205 Flood Control project to be located along Rio Culebrinas at Aguadilla, Puerto Rico. (see attachments 1 and 2 for location and vicinity maps). This assessment also included an investigation of the water quality and air quality potential impact in the project area. The assessment addresses the existence of, or potential for, HTRW contamination on lands, structures and submerged lands in the study area, or external HTRW contamination which could impact or be impacted by the proposed project. Contamination problems will be considered in determining whether to proceed to the feasibility phase. The assessment will help identify and develop the level of effort to be undertaken in the feasibility phase.

a. Level of effort. Consideration of HTRW in the initial assessment phase involves the same level of detail given to other engineering, economic, real estate, and environmental aspects of the project. This initial HTRW assessment of the project area relied primarily on existing documents, interviews, and observations gathered during the conduct of a site visit.

b. Procedures. The following was documented.

i. Land Uses: The predominant land usage in the project area consists of agriculture and poses little or no HTRW threat. The proposed work will be carried out from Highway 2 to high ground at Espinar community.

ii. Adjacent Problems: In an interview with Felix Lopez, US Fish and Wildlife Services representative, it was indicated that the area presented no adverse impacts or HTRW threat.

iii. Soils: The principal soil types found in the Rio Culebrinas basin area are the Valdora-Moca, Colinas-Soler, Caguabo-Mucara, and the Consumo-Humatatas in the uplands and the Coloso-Toa and Bejucos-Jobos in the lower flood plain. These soils are predominantly of the "D" type, indicating high runoff potential. Type "B" soils, indicating moderate drainage potential, are also found within the basin. The principal soil type surrounding the proposed work site Coloso-Toa.

According to the U.S. Weather Bureau climatological zone designations, the upper part of the basin lies within the western interior zone; the northern part and flood plain are in the northern slopes zone.

iv. Photos: Current and historical photographs have been studied and compared to assist in identifying potentially contaminated sites/structures (see attachment 3). No evidence of contaminated sites was found.

v. History: The Rio Culebrinas flood control project is located on the northwestern coast of Puerto Rico at Aguadilla, approximately 130 kilometers (81 miles) from the city of San Juan. The river flows in a westerly direction through the municipalities of Lares, San Sebastian, Moca, Aguada, and Aguadilla to discharge into the Aguadilla Bay. The basin is bordered on the north, south, and east by other river basins, and on the west by the bay.

Since the turn of the century, there have been at least 38 damaging floods on the Rio Culebrinas Basin. The largest flood of record occurred on September 16, 1975. This flood had an estimated recurrence interval of approximately 25 years. The discharge associated with this flood was estimated at 1,954 cms (69,000 cfs), and stages just downstream of Highway 2, where ground elevation averages about 4.0 meters, reached about 7.2 meters (23.6 feet) above mean sea level. Other large floods in the Rio Culebrinas for which records are available occurred in October 1972, May 1980, October 1981, May 1985, May 1986 and August 1988. The dates of these events, elevations above mean sea level (msl), and their respective peak discharges in cubic meters per second (cms) as determined by the United States Geologic Survey (USGS) at the Moca gaging stations are shown on Table 1 of the Reconnaissance Report dated March 1992.

vi. Records Search: Appropriate available records, such as community right-to-know records have been reviewed. Also contacted was the U.S. Fish and Wildlife Service and the Puerto Rico Environmental Quality Board (EQB), with the same results as mentioned above. No problems were identified.

vii. Anecdotal Evidence: To obtain additional information, long-time local residents or workers were interviewed about past land uses, potential contamination, and any history of HTRW problems. No HTRW problems were identified.

viii. Agency Coordination: Federal, State, and local regulatory or response agencies were consulted for license/permit actions, for any violations, enforcement actions, and/or litigation against property owners, and for general information about local HTRW problems such as illegal dumping and past contamination, etc. No other problems were found.

ix. Site Visitation Sheet: A visual survey of the proposed project site was made to determine the potential for HTRW. No evidence of surface contamination or partially buried containers, discolored soil, seeping liquids, films on water, abnormal or dead vegetation or animals, suspect odors, dead-end pipes, abnormal grading, fills, or depressions were observed.

a. An experienced Environmental Engineer was part of the team doing field visits and made record searches, interviews, and on-site visual evaluation for possible HTRW contamination.

b. Results. A preliminary assessment was conducted in May 1995 to address the existence or potential for occurrence of HTRW contamination on lands, including structures and submerged lands, in the Rio Culebrinas project/study area in Aguadilla, Puerto Rico. The preliminary assessment for the project/study area included a project review, site literature/document review, and site reconnaissance. During each assessment, the following signs of potential HTRW problems were looked for:

Landfills, dumps, disposal areas
Burning or burned areas
Tanks (underground surface)
Vats, lagoon, ponds or basins sludge pits
Excavations (pits, quarries borrow areas)
Wells
Containers of unidentified substances
Spills, seepage, slicks

Odors

Dead or stressed vegetation (brown, spotted curled or withered leaves)

Water treatment plants

Ditches, trenches, depressions

Mounds and dirt piles

Transport areas (i.e. boat yards, harbors, rail yards, airports, truck terminals)

Abandoned buildings

c. There is refuse floating on the canal, (see attachment 3 for photographs of the area). The components of the refuse are garbage, food wastes, and rubbish which includes glass, tin cans and paper. This could present a direct threat to human health in the future. The relationship between solid wastes and human diseases should be apparent. Improper disposal of solid wastes is a definite health hazard, which can serve as the catalyst for the spread of at least 22 human diseases. The most important vectors (vectors are means by which disease organisms are transmitted) of human diseases in regard to solid wastes are rats and flies (water, air and food can be factors). The fly is a prolific breeder (70,000 flies can be produced in 1 cubic foot of garbage) and a carrier of many diseases, e.g., bacillary dysentery. Rats destroy property and can cause infection by direct bite; they are also dangerous as carriers of insects which can also act as vectors. Refuse is unsightly, unhealthy, and damaging to the wildlife.

The refuse appears to be primarily municipal solid waste and debris rather than excavatable dirt. We recommend that the refuse be removed from the Rio Culebrinas and properly disposed of in a sanitary landfill. Also is recommended that a public awareness campaign (newsletter, signs, etc.) be developed in the project area and vicinity to avoid further contamination and to address the impact to human, wildlife, and aquatic environments.

d. Resolution of HTRW issues. No issues were found.

e. Sponsor's commitment. The Feasibility Cost Sharing Agreement (FCSA) will state that the development of a response plan for dealing with any HTRW discovered is a 100 percent non-Federal cost as stated in Engineering Regulation 1165 -2- 132 "Water Resources Policies and Authorities - HTRW Guidance for Civil Works Projects", dated June 1992.

2. WATER QUALITY. The EQB has designated the waters of Rio Culebrinas as class SD. According to USGS, the water from Rio Culebrinas is of good quality and suitable for most purposes. Short term local increases in water turbidity are expected due to construction activities. All appropriate measures required by EQB regulations would be adopted. It is believed that conditions will return to normal soon after construction activities have terminated. A data base analysis of the historical data available was performed on the EPA STORET system and the USGS Water Resources Data-Puerto Rico and U.S. Virgin Islands, with the following results; one station was reported to collect data from the vicinity of the proposed area between 1968 to 1989. This station collected samples to test for inorganic and bacterial constituents in water. Two stations upstream from the proposed work site were also studied. These stations collected samples to test for organic, inorganic, and bacterial constituents in water. The values reported from these stations comply within the EQB Parameters for waters with the SD classification, with certain exceptions. Fecal contamination may be the most serious water quality problem. In addition, the data reflected concentrations of lead greater than EQB specifications.

Hydrologist, Senen Guzman, USGS Puerto Rico, suggested that these elevated levels were most likely due to urban runoff from the city of San Sebastian and were fairly typical of the area.

3. AIR QUALITY. The air quality in the Rio Culebrinas area is good due to the presence of either on-, or off-shore coastal breezes. The EQB, Air Quality Division has classified the Rio Culebrinas project area as an attainment area. No appreciable decrease in air quality is expected in the future because of the presence of either on-, or off-shore coastal breezes. Fugitive dust can be generated by excavation and deposit of fill material, as in the construction of levees. All appropriate measures required by EQB regulations will be adopted during construction.

STATEMENT OF WORK

Prepared By:

Signed: Brenda W. Stamps
Brenda W. Stamps, Biologist
Environmental Quality Section
USACOE - Jacksonville District

5 July 1995
Date

Signed: Ivan Acosta
Ivan Acosta, Environmental Engineer
Environmental Quality Section
USACOE - Jacksonville District

7/5/95
Date

Reviewed By:

Signed: James McAdams
James McAdams, Chief Environmental
Quality Section
USACOE - Jacksonville District

7/6/95
Date

Approved By:

Signed: Hanley K. Smith
Hanley K. Smith, Chief Environmental
Resources Branch
USACOE - Jacksonville District

7/6/95
Date

SECTION 404(b) EVALUATION

Flood Control Project Río Culebrinas Aguada and Aguadilla, Puerto Rico

I. Project Description

a. Location. The proposed work will be performed Caño Madre Vieja and Río Culebrinas, between the municipalities of Aguada and Aguadilla, Puerto Rico.

b. General Description. The proposed plan calls for the construction of two flood control levees to separate the last downstream segment of Caño Madre Vieja from adjoining residential communities. Other project features are: a short cutoff channel, to connect two meanders of the stream where the Aguadilla Levee will interrupt it, four drainage structures, interior drainage channels, and a commercial borrow area located in Aguada.

c. Authority and Purpose. This study and proposed project were developed under the authority of Section 205 of the 1948 Flood Control Act, as amended.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. Clean, toxic contaminant-free fill will be used.

(2) Quantity of Material. Approximately 110,000 cubic yards of fill. And 1,000 cubic yards of spoil fill.

(3) Source of Material. Approximately 30,000 cubic yards would come from the cutoff and drainage channels and the rest from the commercial borrow site at nearby Tablonal Quarry.

e. Description of the proposed Discharge Site.

(1) Location. Most spoil fill will be disposed of within the right-of-way of the levees, on top or on the sides slopes as topsoil. Any spoil fill or debris that cannot be disposed of in that manner will be disposed of in the municipal landfill in use by the Municipalities of Agüadilla and Aguada at the time the work takes place.

(2) Size. The approximately 19.6 acres. Area of the levee footprints. And the minimal debris and spoil found to be unsuitable will go in the existing landfills.

(3) Type of Site. Mostly uplands pastureland.

(4) Type of Habitat. Footprint of the levees

(5) Timing and Duration of Discharge. Duration of the actual levee construction.

f. Description of Disposal Method. Transportation over existing roads, using commercial trucks. Deposition at existing municipal sanitary landfills.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Both levees would have an average structural height of 2.5 meters, 1 on 2.5 side slopes, an average levee base of 16 meters, and a levee crest width of 3 meters.

(2) Sediment Type. Sandy silt.

(2) Dredge/Fill Material Movement. Material to be excavated by backhoe and carried to final destination using dump trucks.

(4) Physical Effects on Benthos. No effect is expected on the Benthic habitat.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. These are Class SD waters. No changes are expected.

(2) Current Patterns and Circulation. Existing fast water flow patterns for the Culebrinas River will remain unchanged.

(3) Normal Water Level Fluctuations and Salinity Gradients. No changes are expected.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. None expected. The disposal site is the footprint of the levee and the municipal landfill, no permanent turbidity level changes are

expected during deposition. The acceptable turbidity levels in the Culebrinas River (50 NTUs) will not be exceeded.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Since no significant changes in turbidity are expected, no significant changes in light penetration are expected, either.

(b) Dissolved Oxygen. The amount of dissolved oxygen 5.0 mg/l (PPM) is not expected to vary.

(c) Toxic Metals, Organics, and Pathogens. No increase expected in these parameters.

(d) Aesthetics. The earthen levees will be re colonized by the existing vegetation, blending with the surroundings

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. No effect.

(b) Suspension/Filter Feeders. No effect.

(c) Sight Feeders. No effect.

d. Contaminant Determinations.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. None.

(2) Effects on Benthos. None.

(3) Effects on Nekton. None.

(3) Effects on the Aquatic Food Web. None.

(5) Effects on Special Aquatic Sites.

(a) Hardground and Coral Reef Communities. Doesn't apply.

(b) Sanctuaries and Refuges. Not applicable.

(c) Wetlands. The project will impact approximately 1.5 acres of emergent wet prairie currently used as pasturelands, and having a total biological value of 1 unit in accordance with the Wetlands Rapid Assessment Procedure Methodology (WRAP). Mitigation for unavoidable project impacts, if needed, would include enhancement of 1 acre of emergent wet prairie.

(d) Mud Flats. Not applicable.

(e) Vegetated Shallows. Not applicable.

(f) Riffle and Pool Complexes. Not applicable.

(6) Endangered and Threatened Species. No endangered species was identified in the work area.

(7) Other Wildlife. Not applicable.

(8) Actions to Minimize Impacts. The design and footprint of the project were modified to avoid work inside the wetlands of Coastal barrier PR-75.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Not applicable.

(2) Determination of Compliance with Applicable Water Quality Standards. Fill deposition will occur within the footprints of the levees on existing pasturelands. Other deposition will be in contained, approved municipal landfills. The Corps has thus determined that the proposed work complies with Applicable Water Quality Standards.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. Not applicable.

(b) Recreational and Commercial Fisheries. Not applicable.

(c) Water Related Recreation. Not applicable.

(d) Aesthetics. No aesthetic changes are foreseen, the levees will be re-colonized by the local vegetation.

(a) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Not applicable.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. None expected.

h. Determination of Secondary Effects on the Aquatic Ecosystem. None expected.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The construction of the levees and associated canal cut will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

e. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

f. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

SECTION 404(b) EVALUATION

Flood Control Project Río Culebrinas Aguada and Aguadilla, Puerto Rico

I. Project Description

a. Location. The proposed work will be performed Caño Madre Vieja and Río Culebrinas, between the municipalities of Aguada and Aguadilla, Puerto Rico.

b. General Description. The proposed plan calls for the construction of two flood control levees to separate the last downstream segment of Caño Madre Vieja from adjoining residential communities. Other project features are: a short cutoff channel, to connect two meanders of the stream where the Aguadilla Levee will interrupt it, four drainage structures, interior drainage channels, and a commercial borrow area located in Aguada.

c. Authority and Purpose. This study and proposed project were developed under the authority of Section 205 of the 1948 Flood Control Act, as amended.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. Clean, toxic contaminant-free fill will be used.

(2) Quantity of Material. Approximately 110,000 cubic yards of fill. And 1,000 cubic yards of spoil fill.

(3) Source of Material. Approximately 30,000 cubic yards would come from the cutoff and drainage channels and the rest from the commercial borrow site at nearby Tablonal Quarry.

e. Description of the proposed Discharge Site.

(1) Location. Most spoil fill will be disposed of within the right-of-way of the levees, on top or on the sides slopes as topsoil. Any spoil fill or debris that cannot be disposed of in that manner will be disposed of in the municipal landfill in use by the Municipalities of Aguadilla and Aguada at the time the work takes place.

(2) Size. The approximately 19.6 acres. Area of the levee footprints. And the minimal debris and spoil found to be unsuitable will go in the existing landfills.

(3) Type of Site. Mostly uplands pastureland.

(4) Type of Habitat. Footprint of the levees

(5) Timing and Duration of Discharge. Duration of the actual levee construction.

f. Description of Disposal Method. Transportation over existing roads, using commercial trucks. Deposition at existing municipal sanitary landfills.

II. Factual Determinations

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. Both levees would have an average structural height of 2.5 meters, 1 on 2.5 side slopes, an average levee base of 16 meters, and a levee crest width of 3 meters.

(2) Sediment Type. Sandy silt.

(2) Dredge/Fill Material Movement. Material to be excavated by backhoe and carried to final destination using dump trucks.

(4) Physical Effects on Benthos. No effect is expected on the Benthic habitat.

b. Water Circulation, Fluctuation and Salinity Determination.

(1) Water Column Effects. These are Class SD waters. No changes are expected.

(2) Current Patterns and Circulation. Existing fast water flow patterns for the Culebrinas River will remain unchanged.

(3) Normal Water Level Fluctuations and Salinity Gradients. No changes are expected.

c. Suspended Particulate/Turbidity Determinations.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site. None expected. The disposal site is the footprint of the levee and the municipal landfill, no permanent turbidity level changes are expected during deposition. The acceptable turbidity levels in the Culebrinas River (50 NTUs) will not be exceeded.

(2) Effects on the Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Since no significant changes in turbidity are expected, no significant changes in light penetration are expected, either.

(b) Dissolved Oxygen. The amount of dissolved oxygen 5.0 mg/L (PPM) is not expected to vary.

(c) Toxic Metals, Organics, and Pathogens. No increase expected in these parameters.

(d) Aesthetics. The earthen levees will be re colonized by the existing vegetation, blending with the surroundings

(3) Effects on Biota.

(a) Primary Productivity and Photosynthesis. No effect.

(b) Suspension/Filter Feeders. No effect.

(c) Sight Feeders. No effect.

d. Contaminant Determinations.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. None.

(2) Effects on Benthos. None.

(3) Effects on Nekton. None.

(3) Effects on the Aquatic Food Web. None.

(5) Effects on Special Aquatic Sites.

(a) Hardground and Coral Reef Communities. Doesn't apply.

(b) Sanctuaries and Refuges. Not applicable.

(c) Wetlands. The project will impact approximately 1.5 acres of emergent wet prairie currently used as pasturelands, and having a total biological value of 1 unit in accordance with the Wetlands Rapid Assessment Procedure Methodology (WRAP). Mitigation for unavoidable project impacts, if needed, would include enhancement of 1 acre of emergent wet prairie.

(d) Mud Flats. Not applicable.

(e) Vegetated Shallows. Not applicable.

(f) Riffle and Pool Complexes. Not applicable.

(6) Endangered and Threatened Species. No endangered species was identified in the work area.

(7) Other Wildlife. Not applicable.

(8) Actions to Minimize Impacts. The design and footprint of the project were modified to avoid work inside the wetlands of Coastal barrier PR-75.

f. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. Not applicable.

(2) Determination of Compliance with Applicable Water Quality Standards. Fill deposition will occur within the footprints of the levees on existing pasturelands. Other deposition will be in contained, approved municipal landfills. The Corps has thus determined that the proposed work complies with Applicable Water Quality Standards.

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supplies. Not applicable.

(b) Recreational and Commercial Fisheries. Not applicable.

(c) Water Related Recreation. Not applicable.

(d) Aesthetics. No aesthetic changes are foreseen, the levees will be re-colonized by the local vegetation.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. Not applicable.

g. Determination of Cumulative Effects on the Aquatic Ecosystem. None expected.

h. Determination of Secondary Effects on the Aquatic Ecosystem. None expected.

III. Findings of Compliance or Non-compliance with the Restrictions on Discharge.

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. No practicable alternative exists which meets the study objectives that does not involve discharge of fill into waters of the United States.

c. After consideration of disposal site dilution and dispersion, the discharge of fill materials will not cause or contribute to, violations of any applicable State water quality standards for Class III waters. The discharge operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The construction of the levees and associated canal cut will not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

e. The placement of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic species and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values will not occur.

f. On the basis of the guidelines, the proposed disposal site for the discharge of dredged material is specified as complying with the requirements of these guidelines.

D. COASTAL ZONE MANAGEMENT ACT COORDINATION – Certification of Compliance with PR Coastal Management Plan and Application for Concurrence from PR Planning Board.

At this time the study and recommended plan have been determined to be in compliance with the major programs and objectives of the Puerto Rico Coastal Management Program. Concurrence from the Puerto Rico Planning Board (PRPB) will be sought when the public comment period on this EA has closed.



COMMONWEALTH OF PUERTO RICO
OFFICE OF THE GOVERNOR
PUERTO RICO PLANNING BOARD

Minillas Governmental Center, North Bldg.
De Diego Ave; Stop 22
P. O. Box 41119, San Juan, P. R. 00940 - 111

June 4, 1991

A. J. Salem, Chief
Planning Division
Department of the Army
Jacksonville District
Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Att: Environmental Studies Section

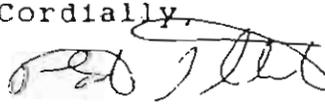
Dear Mr. Salem:

I write in reference to your request for comments on the reconnaissance-level report for the Rio Culebrinas and Caño Madre Vieja flood protection project, south of the Municipality of Aguadilla. Historical records show that the area west of Highway PR-2 has been affected by floods of both Rio Culebrinas and the Caño.

According to FEMA's panel number 720000-0009B and our Flood Zones Map number 1D, Urb. Garcia, Urb. Victoria and the Public Housing Project José Aponte were affected by the 100 year-flood, and were classified within the floodway. Urban development was restricted because of the floods, as shown in dotted lines, in our Land Use Plan for Aguadilla, (corresponding parts included). The Plan also proposes that the lands located northeast and adjacent to the mouth of Caño Madre Vieja be used for recreational uses.

Any additional information that you may need will be furnished on request.

Cordially,



Patria G. Custodio
Chairperson

Enclosure



E. SITE VISIT MEMORANDUM AND WRAP SCORE SHEETS

Project completion will directly impact approximately 1.5 acres of emergent wet prairie currently used as pasturelands and 0.2-acre of Red mangrove swamp. These were assessed to have a total biological value of 1 unit, using the Wetlands Rapid Assessment Procedure Methodology (WRAP). The score was 0.48 for the pasture and 0.56 for the Red mangrove. Mitigation for unavoidable project impacts, if needed, would include enhancement of 1 acre of emergent wet prairie. The USACE estimates that project completion will also result in the construction of drainage channels parallel to the levees. These will have an average width of approximately 7 meters (21feet) and will run for the entire length of the levees. This will create approximately $21 \times 9,723 = 204,183$ square feet or 4.69 acres of habitat for fish and amphibian species.

Assuming creation of at least 13 meters (40 feet) of shallow littoral area on both banks of each channel, an additional 8.93 acres of wetlands would be created. The USACE believes that the wetlands and waters of the United States created by the project would avoid a net loss of wetlands.

Present during the October 12, 1999 site visit: Beverly Yoshioka USFWS; Ana Román, USFWS; Jorge M. Tous, USACE; Esteban Jimenez, USACE.

MEMORANDUM FOR RECORD

SUBJECT: Culebrinas River Flood Control (Aguadilla & Espinar Levees) Project Site Visit

1. Going west to east along the Aguadilla levee footprint (24.2 acres or 98,095 square meters including levee, drainage channel, ramps, and right of way), the start is an approximately 35% urban developed area. It continues along fields use for horses grazing. Sawgrass predominates with few depressional wetlands. Functional wetlands are 10% or less of the total footprint area of the proposed Aguadilla levee. These are found mostly halfway along the footprint.

2. A similar situation is seen along the Espinar levee proposed footprint (17.5 acres or 70,861 square meters including levee, drainage channel, ramps, and right of way). Upland herbaceous species and sawgrass predominate. Mangroves and cattail (*Typha spp.*) are found in 10% or less of the footprint area. The most impressive wetland vegetation is seen in an approximately 100-foot by 70-foot section of coastal barrier vegetated over 90% by climax red mangroves with a height over 50 feet. This exists in the margins of the drainage channel, which exist parallel to the coastline in a south-north attitude, no more than 500 feet inland and connecting to the estuary at the mouth of the Culebrinas River. Considerable sediment extrusion into the bay is seen at the Culebrinas River estuary.

3. For the projected cut at the central area approximately halfway between the two projected levees: The area currently includes drainage channels with flowing water, supporting mature white mangrove populations with approximately 90% coverage for some 25 feet from the existing channel margins. An mangrove juvenile and *Typha* understory dominates.

/////////////////////////////////nothing follows/////////////////////////////////

ESTEBAN JIMENEZ
Biologist

EVALUATION SUMMARY

ESTUARINE WETLAND RAPID ASSESSMENT PROCEDURE

Date of Site Visit: 12 Oct 99

E-WRAP SCORE 0.78

Evaluator(s): E Jimenez

Project/Site: R. Culebrines (Espino Levee at Coastal Barrier)

Permit Number:

Wetland ID:

Wetland Type: Saltwater Swamp

Land Use: Coastal Barrier and Run off channel

SCORE

NOTES

2 Fish and Wildlife Utilization:

Slight human impact due to adjacent beach and area habitation.
Debris seen. No fish seen.
Crustacean burrows.

2.5 Overstory/Shrub Canopy:

Mature Red Mangrove > 90%

1.5 Ground Cover:

Juvenile Mangrove and Typha 40%

2.5 Upland/Wetland Buffer:

> 30', < 300'

2.5 Field Indicators of Wetland Hydrology:

Flowing water in channel.
Adequate hydroperiod.

3 Water Quality Inputs and Treatment:

14
18

Local Use 3 unimprov
natural
Pre-treatment 3 unimprov
natural

EVALUATION SUMMARY

ESTUARINE WETLAND RAPID ASSESSMENT PROCEDURE

Date of Site Visit: 12 Oct 99

E-WRAP SCORE 0.33

Evaluator(s): E. Jimenez

Project/Site: R. Culebrinas (Espinor Levee)

Permit Number:

Wetland ID:

Wetland Type: Emergent (Freshwater Flat) prairie

Land Use: Agricultural Use

SCORE

NOTES

0.5 Fish and Wildlife Utilization:

Cattle and associated bird species
No fish seen.

0.5 Overstory/Shrub Canopy:

Upland Spp. ~ 80%

0.5 Ground Cover:

~ 10% Cattail (Typha). Predominant upland Spp.

1.5 Upland/Wetland Buffer:

> 30'. Connection to wildlife corridors

0.5 Field Indicators of Wetland Hydrology:

Altered wetland hydrology would require scrapedown.

2.5 Water Quality Inputs and Treatment:

$\frac{6}{18}$

Land Use 2.5 Bar

Pre-treatment 2.5 Berms

EVALUATION SUMMARY

Without Proj

ESTUARINE WETLAND RAPID ASSESSMENT PROCEDURE

Date of Site Visit: 12 Oct 99

E-WRAP SCORE 0.33

Evaluator(s): E. Jimenez

Project/Site: Rio Culebrinas (Aguadilla Levee following Cano Madre Vieja)

Permit Number:

Wetland ID:

Wetland Type: Freshwater Flat (emergent prairie)

Land Use: Horse/Cattle pasture

SCORE

NOTES

1 Fish and Wildlife Utilization:

Birds associated with cattle (i.e. egrets). No fish seen. Various crab burrows.

0 Overstory/Shrub Canopy:

No nesting. <10% in some depressional areas.

0.5 Ground Cover:

Typha and Buttonwood 10%

1.5 Upland/Wetland Buffer:

30' > x <300'. Wildlife corridor connections.

1 Field Indicators of Wetland Hydrology:

Transitional vegetation indicating interference with hydrology.

2 Water Quality Inputs and Treatment:

$$L4 = 2.5(.5) + 2(.5) \\ = 1.25 + 1.0$$

6. 2.25 + 1.75

Land Use 50% high d
vegetation; 50% pas
Pre-treatment 1 dry ret
2.5 Berms

EVALUATION SUMMARY

Without Project

ESTUARINE WETLAND RAPID ASSESSMENT PROCEDURE

Date of Site Visit: 12 Oct 99

E-WRAP SCORE 0.76

Evaluator(s): E. Jimenez

Project/Site: R. Culebrinas (Planned cutoff between Espinar and Aguadilla)

Permit Number:

Wetland ID:

Wetland Type: Mangrove forest and existing channel.

Land Use: Undeveloped.

SCORE

NOTES

2 Fish and Wildlife Utilization:

No fish seen. Birds (crane) seen. Rodents crabs and burrows.

3 Overstory/Shrub Canopy:

Over 90% mature mangrove (white)

2 Ground Cover:

Wetland spp., Mangrove juveniles.

2 Upland/Wetland Buffer:

30' > x < 300', undeveloped. Connected to possible wildlife corridors.

2 Field Indicators of Wetland Hydrology:

Standing water with high hydroperiod. Supports wetland vegetation.

2.75 Water Quality Inputs and Treatment:

$$\frac{13.75}{18} = 0.76 \quad \frac{3+2.5=5.5}{2 \quad 2} = 2.75$$

Land Use: 3 Open

Pre-treatment 2.5 wet ditches swales.

**RIO CULEBRINAS AT AGUADILLA AND AGUADA, PUERTO RICO
SECTION 205
DRAFT DETAILED PROJECT REPORT
AND ENVIRONMENTAL ASSESSMENT**

**APPENDIX A
HYDROLOGY AND HYDRAULICS**

RIO CULEBRINAS
AGUADA/AGUADILLA, PUERTO RICO
DETAILED PROJECT REPORT

APPENDIX A
HYDROLOGY AND HYDRAULICS

TABLE OF CONTENTS

I.	INTRODUCTION.	A-1
II.	DRAINAGE BASIN INFORMATION.	A-1
	A. Location.	A-1
	B. Topography.	A-1
	C. Geology, Soils and Vegetation	A-1
	D. Climate	A-2
	E. Main Streams and Tributaries.	A-2
	F. Available Hydrologic Data	A-2
	G. Historical Floods	A-2
	H. Flood Flow Frequency Analysis	A-3
	I. Rainfall.	A-3
III.	HYDROLOGIC ANALYSIS	A-4
	A. Computer Programs	A-4
	B. Formation of HEC-1 and UNET Models.	A-4
	1. Drainage Area	A-4
	2. Curve Numbers	A-4
	3. Lag Times	A-4
	4. Rainfall.	A-5
	5. Flood Routings.	A-5
	6. Discharge for Existing Conditions with Future Land Uses	A-5
	C. Hydrology of Interior Flooding.	A-6
	D. Other Sources of Flooding	A-6
IV.	HYDRAULICS.	A-7
	A. Existing Conditions	A-7
	1. Hydraulic Model	A-7
	2. Survey Data	A-7
	3. Roughness Coefficients.	A-7
	4. Starting Conditions	A-7
	5. Model Verification.	A-8
	6. Flood Stages.	A-8
	B. Sediment Assessment	A-8
	1. Existing Conditions	A-8
	2. With Project Conditions	A-8

V.	HYDRAULIC DESIGNS	A-9
A.	Hydraulic Design Criteria	A-9
B.	Design Objective.	A-9
C.	Levees.	A-9
	1. Aguadilla Levee	A-10
	2. Espinar Levee	A-10
	3. Side Slopes	A-10
	4. Levee Crest Elevation	A-10
	5. Levee Overtopping Analysis.	A-11
	6. Reliability Analysis of the Selected Levees.	A-12
D.	Channels.	A-12
	1. Cutoff Channel.	A-12
	2. Interior Drainage Channels.	A-13
E.	Drainage Structures	A-13
	1. Aguadilla Levee	A-13
	a. AL-S-1.	A-13
	b. AL-S-2.	A-13
	c. AL-S-3.	A-13
	2. Espinar Levee	A-14
	a. EL-S-1a	A-14
F.	Road Ramps.	A-14
G.	Borrow Area	A-14
H.	Performance	A-14
	1. Levee Design Protection	A-14
	2. Residual Flooding	A-15
	3. People at Risk.	A-15

LIST OF FIGURES

<u>TITLE</u>	<u>FIGURE NO.</u>
Location Map with Basin and Sub-Basins	A-1
100-Year Flood Hydrograph at Mouth of Rio Culebrinas . .	A-2
100-Year Flood Hydrograph at Mouth of Cano Madre Vieja .	A-3
Flow Frequency at United States Geological Survey (USGS) Gage No. 50147800	A-4
Rating Curve Between Rio Culebrinas and Cano Madre Vieja	A-5

LIST OF TABLES

<u>TITLE</u>	<u>TABLE NO.</u>
Historical Flood Data for Rio Culebrinas	A-1
Rainfall for Various Frequencies and Durations	A-2
Watershed Parameters	A-3
Summary of Peak Discharges	A-4
Wave Run-up and Wind Set-up	A-5
Existing and With Project Water Surface Elevations . . .	A-6
100-Year Levee Crest Elevations	A-7
Hydraulic Design Data Interior Drainage Structures . . .	A-8
Hydraulic Design Data Interior Drainage Channels	A-9
Hydraulic Design Data Cutoff Channel	A-10
Interior Flood Hydrology	A-11
Interior Drainage - Residual Flood Elevations	A-12
Reliability Analysis at Levee Cross Section 1568	A-13

LIST OF PLATES

<u>TITLE</u>	<u>PLATE NO.</u>
Existing Conditions Flooded Areas (5 and 100-yr)	A-1
Recommended Plan	A-2
Residual Flooded Areas	A-3
Aguadilla Levee Profile 100-Year	A-4
Espinar Levee Profile 100-Year	A-5
Espinar Levee Spur Profile 100-Year	A-6

I. INTRODUCTION

This appendix presents the basic hydrologic data and analyses used to define the flooding conditions for the Rio Culebrinas Detailed Project Report.

II. DRAINAGE BASIN INFORMATION

A. Location

The Rio Culebrinas basin is located in the northwestern part of the island of Puerto Rico, about 130 kilometers from the City of San Juan. The basin is bordered to the north and east by the Rio Guajataca basin, to the south by the Rio Culebra and Rio Grande de Añasco basins, and to the west by Aguadilla Bay. There are no impounding reservoirs within the river basin. The drainage area of the watershed is about 322.6 square kilometers. Figure A-1 shows where the study area is located in Puerto Rico along with the basin and subbasins of Rio Culebrinas.

B. Topography

The basin is considered a fairly gently sloping basin with elevations ranging from sea level at Aguadilla Bay, to over 300 meters near Juncal, at the basin divide between Rio Culebrinas and Rio Guajataca. A prominent feature of the basin is a 100 meter high limestone escarpment that extends along its northern boundary.

C. Geology, Soils and Vegetation

The principal soil associations found in the Rio Culebrinas watershed area are the Voladora-Moca, Colinas-Soler, Caguabo-Mucara, and the Consumo-Humatas, in the uplands and the Coloso-Toa and Bejucos-Jobos in the lower flood plain. These soils are mostly of the D type with a high runoff potential. Type B soils with moderate degree of drainage potential are also found in this basin. The flood plain is composed of alluvial deposits of sands silts, clays and gravels of various sizes.

The forest and pasture areas are located in the eastern hilly part of the watershed and the urban area is located near the ocean. Land use within the flood prone area is urban with commercial and light industrial areas.

D. Climate

The climate in this area is characteristically tropical. Mean annual temperature in this region varies from approximately 21 degrees centigrade to 26 degrees centigrade. Mean annual precipitation for the region varies from 115 to 205 centimeters. The annual pattern of rainfall in the basin is such that the wettest period of the year is the hurricane season, which occurs in the latter part of the summer and the early part of fall.

E. Main Streams and Tributaries

The Rio Culebrinas originates in the western part of the Cordillera Central (the central mountain range of Puerto Rico) at an elevation of about 300 meters above mean sea level and flows in a westerly direction through the towns of San Sebastian and Moca to discharge into the Aguadilla Bay. The major tributaries for Rio Culebrinas are Rio Guatemala, Rio Cano, Rio Sonador and Quebrada Grande. The total length of Rio Culebrinas is about 44 kilometers.

The Cano Madre Vieja is a distributary of Rio Culebrinas and is about 2.1 kilometers long. This is an old river outlet that flows across the study area and discharges into the Aguadilla Bay. This small intermittent stream is the boundary dividing the municipality of Aguadilla to the east from the community of Espinar to the west.

F. Available Hydrologic Data

The US Geological Survey (USGS), in cooperation with local and other federal agencies, collects and maintains a large amount of water resources data in Puerto Rico. There is one USGS gage recording peak flows and/or peak stages in Rio Culebrinas. This USGS gaging station numbered 50147800 is located at PR Hwy 404 near Moca, Puerto Rico. Approximate location is shown in Figure A-1.

G. Historical Floods

Since the turn of the century there have been at least 38 damaging floods in the Rio Culebrinas Basin. The largest flood of record occurred on September 16, 1975. This flood had an estimated recurrence interval of approximately 25 years. The discharge associated with this flood was estimated at 1,954 cubic meters per second (cms) and stages just downstream of PR Hwy 2 were 7.2

meters, mean sea level (msl), about 3.2 meters of water depth.

The most outstanding recent floods in the Aguadilla area for which stream gaging station records exceeded 850 cms were those which occurred during October 1972, May 1980, October 1981, May 1985, May 1986 and August 1988. There are twenty three other large floods in the Rio Culebrinas for which records at the stream gaging station exceeded 566 cms. These are indicated in Table A-1.

H. Flood Flow Frequency Analysis

A log-Pearson Type III frequency analysis was performed on the 35-years of annual peak discharge data listed in Table A-1. The US Army Corps of Engineers computer program Flood Frequency Analysis (FFA) was used for the analysis. The estimated discharge-frequency curve is shown in Figure A-4 along with the expected probability adjustments. The plotting positions of the discharge data are included in the figure for comparison. The frequency curves corresponding to the 5% and the 95% confidence limits are also shown in Figure A-4.

I. Rainfall

The National Weather Service (NWS) operates several rain gages in Puerto Rico. The NWS Technical Paper No. 42 (TP-42) shows generalized estimates of the Probable Maximum Precipitation (PMP) and rainfall depth-frequency data for Puerto Rico and the US Virgin Islands. Contained in the report are isopluvial maps of precipitation contours for selected frequencies. The maps indicate rainfall increases toward the central mountain region of Puerto Rico. Point rainfalls representing Rio Culebrinas basin were obtained from TP-42 and are listed in Table A-2.

The Standard Project Storm (SPS) is defined as the most severe flood-producing rainfall depth-area-duration relationship and the isohyetal pattern of any storm that is considered reasonably characteristic of the region.

The PMP is defined as the greatest depth of precipitation for a given duration that is physically possible over a given size storm area at a particular geographical location at a certain time of the year. The SPS was assumed to be 50 percent of the PMP.

III. HYDROLOGIC ANALYSIS

A. Computer Programs

The US Army Corps of Engineers HEC-1 computer program was used to calculate the flood hydrographs for various sub-basins. The HEC-1 estimates surface runoff resulting from synthetic or observed storm events. Several choices of estimating the rainfall-runoff relationships are available in HEC-1. The Soil Conservation Service (SCS) runoff curve number methodology was selected for the Rio Culebrinas basin. Runoff curve numbers are functions of soil types, land uses and Antecedent Moisture Conditions (AMC).

Flood routings were performed for the Rio Culebrinas by the Hydrologic Engineering Center computer program entitled UNET. The UNET is a one-dimensional unsteady flow model that can simulate dendritic and network (looped) system.

B. Formation of HEC-1 and UNET Models

1. Drainage Area

Available USGS quadrangle maps on a scale of 1 to 20,000 were used to delineate drainage boundaries for the Rio Culebrinas basin. Surveys collected in February and March 1995 were also used. The watershed was divided into 30 sub-basins as shown in Figure A-1.

2. Curve Numbers

Runoff curve numbers were estimated for each sub-basin by considering soil types, land uses, and the AMC, appropriate for the rainfall frequency events. AMC I conditions were used for 50, 20, and 10 percent chance flood; AMC II conditions for 4 and 2 percent chance floods; AMC III conditions were adopted for 1 percent and events rarer than 1 percent. Estimated curve numbers for various sub-basins and AMC conditions are listed in Table A-3.

3. Lag Times

The lag times were computed for each sub-basin by dividing each stream into several reaches and applying the following formula:

$$L = \frac{X^{**0.8} * (S+1)^{**0.7}}{1900 * Y^{**0.5}}$$

where

L = Lag in hours

X = Hydraulic length of watershed in feet

S = (1000/Curve Number) - 10

Y = Average watershed land slope in percent

4. Rainfall

The TP-42 point rainfall data for various durations were adjusted for the drainage area of the entire basin by HEC-1. Necessary corrections were also made to convert partial duration to equivalent annual series rainfall. Balanced storms were then generated by HEC-1 for various frequencies. Calculations were performed at 5-minute intervals.

5. Flood Routings

A UNET model was used in combination with HEC-1 generated sub-basin hydrographs for flood routing through the Rio Culebrinas valley. Cross section data were taken from surveys and available USGS quadrangle maps. Manning's roughness values and other loss coefficients were initially estimated and calibrated to historical events documented in the USGS flood atlas.

6. Discharge for Existing Conditions with Future Land Uses

The peak discharge-frequency data estimated by the HEC-1/UNET model along Rio Culebrinas and at the mouth of Cano Madre Vieja are listed in Table A-4. A flood hydrograph estimated for 24-hour storm for the 100-year event at the mouth of Rio Culebrinas and the mouth of Cano Madre Vieja are plotted in Figure A-2 and Figure A-3, respectively.

C. Hydrology of Interior Flooding

This analysis addresses the management of interior surface runoff from areas that are protected by project levees, reflecting future conditions development. Culvert outlet structures that allow for drainage of the interior areas to Cano Madre Vieja are provided through each levee segment. US Army Corps of Engineers Hydrologic Engineering Center Interior Flood Hydrology (HEC-IFH) Package was used for the analysis of the interior flooding hydrology.

HEC-IFH is a comprehensive computer program that performs all of the components of an interior flooding analysis. It is a framework on which the analyst can model rainfall-runoff, routing, interior ponding, and gravity outlet performance, as a dynamic, interactive simulation that includes changing flood conditions in the receiving stream. For this study, interior area flood elevation-frequency relationships were determined for various alternative gravity outlet configurations by using design storm event analysis in combination with interior area runoff parameters that reflect future conditions development. The resulting runoff was routed through existing interior ponding areas adjacent to the project levees, and then through gravity outlet culvert structures draining to Cano Madre Vieja. Coincident exterior flood stage 10-year hydrograph for the with-project condition was used for the tailwater boundary condition affecting each culvert.

No minimum facilities for interior drainage were identified in the pre-project condition. Existing conditions flood stages were used to define minimum gravity outlet facilities that would drain the protected areas before those stages were exceeded. Hydraulic design data for interior drainage structures are listed in Table A-8. Interior flood hydrology data and residual flood elevations are presented in Table A-11 and Table A-12, respectively.

D. Other Sources of Flooding

The detailed study area can also be flooded by hurricane tides from the ocean. Tidal flooding effects were not considered in the analysis. Tidal flood protection was not within the scope of the riverine protection project.

IV. HYDRAULICS

A. Existing Conditions

1. Hydraulic Model

Hydraulic modeling of existing conditions flood stages and post project stages were compiled by using UNET.

From the upstream side of PR Hwy 2 to the coastline the area was divided into three reaches. Once floodwaters pass the PR Hwy 2 crossing, the overbank flow is divided between the outlets of Cano Madre Vieja and Rio Culebrinas. Reach 1 was identified upstream of PR Hwy 2. Reach 2 went from PR Hwy 2 to the mouth of Rio Culebrinas and Reach 3 went from PR Hwy 2 to the mouth of Cano Madre Vieja. A rating curve was used between Rio Culebrinas and Cano Madre Vieja. This rating curve is shown in Figure A-5.

2. Survey Data

The Rio Culebrinas area was surveyed in February and March 1995. Detailed topographic maps were prepared to a scale of 1 to 2,000 with a .5 meter contour interval. Detailed information of the bridges and culverts were obtained from the surveyor's field books. A site visit to the area in August 1995 also helped verify the topographic information on the maps. All elevations are referenced to the National Geodetic Vertical Datum (NGVD). The horizontal and vertical datums are referenced to the North American Datum of 1983 and 1929, respectively.

3. Roughness Coefficients

A Manning's roughness value of 0.10 was used for the overbank areas of the flow way, while a value of 0.035 was used for the channel sections. These values were based on aerial photographs, site inspection and engineering judgment.

4. Starting Conditions

Stage-discharge curves at the first cross section were computed using both normal depth and critical depth analyses. A high tide level of 0.6 meters was assumed in the Aguadilla Bay. The stage-discharge curve corresponding to the normal depth analysis was chosen for

this study based on the high water elevations listed in Hydrologic Investigations Atlas HA-457 which discusses the flood of November 27, 1968 and shows the limits of that flood delineated for the Aguada/Aguadilla area.

5. Model Verification

A flood atlas prepared by the USGS for the flood of November 27, 1968 that affected the Aguada/Aguadilla area showed high water marks and estimated flood stage contours. The USGS gage station 50147800 at PR Highway 404 recorded an estimated discharge of 850 cms. From Figure A-4 this would be less than a 10-year event.

6. Flood Stages

The existing conditions flood stages were simulated by the HEC-1 and UNET models developed for the basin. Table A-6 shows the water surface elevations under existing and with project conditions in the study area. Plate A-1 shows the flooded area for the 5 and 100-year events under existing conditions.

B. Sediment Assessment

1. Existing Conditions

Computer modeling of the existing flood plain showed that most flood flow is conveyed through the overbank areas of the floodplain. The existing channel is small and is overtopped by storms events with a 50% chance of exceedance (1 in 2-years frequency). The existing natural dominant discharge channel is very small relative to the conveyance required at design storm rates. Base flow in the existing channel is small.

Tropical and farm vegetation covers most of the floodplain and reduces sediment potential. Soils in the floodplain are a mixture of coarse sand, silt and clay with tropical vegetation as ground cover.

2. With Project Conditions

The average channel velocity during a 100-year event in Rio Culebrinas would range between .75 and 6.60 meters per second (mps). For Cano Madre Vieja the average channel velocity would range between .6 and 3.33 mps. Higher velocities would be expected near the bridges. The short duration of higher velocity flows and

erosion resistant nature of the channel soil type should resist large erosion related sediment movement within the channel.

The average overbank velocity along Rio Culebrinas would range between .2 and 3.75 mps. For Cano Madre Vieja the average overbank velocity would range between .46 and 2.21 mps. Vegetative cover and soil type should resist sediment movement under proposed conditions.

Sediment transport in the floodway is not expected to increase or decrease due to this project. The proposed levees would not significantly alter the current sedimentation regime within the basin.

V. HYDRAULIC DESIGNS

A. Hydraulic Design Criteria

Hydraulic design criteria and procedures used herein are in accordance with standard engineering practice and applicable provisions of Corps Engineering Manuals and the Waterways Experimental Station "Hydraulic Design Criteria" relative to design and construction of Civil Works Projects. Engineering criteria adopted to meet special local conditions are in accordance with that previously approved for similar projects.

B. Design Objective

The main flood control feature for this study consists of two levee segments and a levee spur designed for a 100-year level of protection. Each levee segment will be provided with drainage structures and all levees will have an interior drainage channel. Road ramps will be provided where the proposed levees intersect existing roads. A cutoff channel will also be provided since one of the proposed levees segments would intersect Cano Madre Vieja.

C. Levees

The 100-year level of protection with the proposed levee alignment was determined to be the most beneficial alternative. The existing condition UNET model was modified to represent the with project conditions by terminating cross sections at stations which would cross the proposed levee alignment. Plate A-2 shows the recommended plan. The two levee segments are identified as the Aguadilla levee and the Espinar levee with a levee spur.

1. Aguadilla Levee

This proposed levee segment starts at the coastline and ends at PR Hwy 2. It is approximately 1,836 meters long and has an average levee height of about 2.60 meters. There will be three drainage structures and two road ramps for this levee segment. An interior drainage channel would be required along the protected side of the levee. A culvert will be provided where the road ramps intersects the interior drainage channel. An existing concrete box culvert over Cano Madre Vieja would be impacted by one of the road ramps. This box culvert will be extended to accommodate the proposed road ramp. Plate A-2 shows the layout of the Aguadilla levee. Plate A-4 is a profile of the Aguadilla levee with the design water surface profile.

2. Espinar Levee

This proposed levee segment starts at the edge of the coastal barrier zone and ties into high grounds south of the community of Espinar. It is approximately 1,496 meters long and has an average levee height of about 2.49 meters. There will be one drainage structure through this levee and a road ramp would also be required. An interior drainage channel would be required along the protected side of the levee. A culvert will be provided where the road ramp intersects the interior drainage channel. The Espinar levee will also have a levee spur. The Espinar levee spur starts from Espinar levee Station 2+10 and ties into high grounds north of the community of Espinar. Plate A-2 shows the layout of the Espinar levee and connecting levee spur. Plates A-5 and A-6 are profiles of the Espinar levee and Espinar levee spur with the design water surface profile, respectively.

3. Side Slopes

Side slopes of the proposed levees were based on existing soil conditions, type of material used in construction and a stability analysis. The levee side slopes on the flood side and protected side would be 1 vertical to 2.5 horizontal.

4. Levee Crest Elevations

The levee crest elevations were determined by selecting the highest profile that resulted from a

worst case scenario. The 100-year water surface profile was computed with the following combinations:

- a. Design discharge with the design "n" values
- b. Design discharge with 20 percent increased "n" values.
- c. 20 percent increased discharge hydrograph with design "n" values.

Bridge openings were reduced by 20 percent to account for debris accumulations. The 100-year water surface profile computed with a 20 percent increased discharge is slightly higher than the other profile and it was selected as the minimum levee grade.

Wave heights, periods, and durations caused by several wind speeds were computed by a shallow water wave forecasting model "SHALWAVE" described in the Coastal Engineering Research Center Instruction Report 86-2. Wave runup and wind setup calculations were performed using the Shore Protection Manual and are listed in Table A-5. A smooth levee surface was assumed in the calculations.

The 100-year levee crest elevation for the Aguadilla levee and the Espinar levee with the levee spur are presented in Table A-7.

5. Levee Overtopping Analysis

An overtopping analysis was performed on the Rio Culebrinas according to ETL 1110-2-299 dated 22 August 1986. The levees were evaluated as one system and an overtopping reach was identified for each levee segment. Overtopping water surface profiles were computed by considering the uncertainties in "n" values, bridge openings, discharge hydrographs and wind speeds.

For the Aguadilla and Espinar levees the overtopping reach is located between corresponding levee stations 0+00 and 0+50. Each overtopping reach was identified as the least critical site where initial failure would occur during severe floods. The least amount of damage in the region would be sustained if initial levee overtopping occurred at this location. Superiority is provided to insure overtopping at the proposed reach. The overtopping reach is 50 meters long and would be given 1 foot of superiority less than the remainder of the levee segment.

6. Reliability Analysis of the Selected Levees

This study was granted a waiver from doing a full risk analysis. However, a reliability analysis to determine probability of stage non-exceedance was conducted. The risk analysis computer program, available from the Hydrologic Engineering Center (HEC), was used for the reliability analysis. This analysis was conducted following ER 1105-2-101 to determine the reliability of the selected levees. Cross section 1568 was selected for this analysis which takes into consideration the uncertainty in discharge-frequencies, stage-discharges, and cross section data. Five thousand iterations were made with Latin Hypercube sampling method to determine the reliability.

The discharge-frequency data required for the reliability analysis were taken from the results of the UNET analysis. The logarithmic mean, standard deviation, and skew were determined, as per the Water Resources Council Bulletin 17B, from 1 percent, 10 percent and 50 percent chance flood events.

The stage-discharge rating curve was developed for the design "n" values from the UNET analysis. Water surface profiles were computed for possible high and low "n" values. A minimum standard deviation of 0.274 meter was required as per Table A-3 of the EC 1105-2-205.

Input data and results of the reliability analysis of the proposed levees at cross section 1568 for the SPF, 1 percent and 2 percent flood events are shown in Table A-13.

D. Channels

1. Cutoff Channel

The proposed Agvadilla Levee would intersect Cano Madre Vieja at various locations. In order to continue the flow in Cano Madre Vieja to the coastline a cutoff channel would be required. The conveyance capacity of this cutoff channel would be the same as in the existing Cano Madre Vieja channel. Hydraulic design data for the cutoff channel are shown in Table A-10.

2. Interior Drainage Channels

An interior drainage channel would be provided along the protected side of each levee segment and along the Espinar levee spur. Hydraulic design data for the interior drainage channels are provided in Table A-9.

E. Drainage Structures

There will be a total of four drainage structures as part of the recommended plan. The Aguadilla levee will have three drainage structures and the Espinar levee will have one drainage structure. The culverts at each drainage structure consist of corrugated metal pipes (CMP) with a bituminous coating and each culvert will have a flap gate on the levee flood side. Hydraulic design data of the drainage structures are indicated in Table A-8. Locations of the proposed drainage structures are shown on Plate A-2. The following describes each drainage structure:

1. Aguadilla Levee

a. AL-S-1

The drainage structure at Aguadilla levee station 1+39.5 consists of three-1.52 meter diameter CMP. The invert of the culverts would be set at elevation -.3 meters, NGVD and have an approximate length of 15 meters. All culverts would be equipped with flap gates on the levee flood side to prevent backflow in the protected area.

b. AL-S-2

The drainage structure at Aguadilla levee station 6+05.5 consists of six-1.52 meter diameter CMP. The invert of the culverts would be set at elevation -.3 meters, NGVD and have an approximate length of 19 meters. All culverts would be equipped with flap gates on the levee flood side to prevent backflow in the protected area.

c. AL-S-3

The drainage structure at Aguadilla levee station 10+52.9 consists of three-1.52 meter diameter CMP. The invert of the culverts would be set at elevation -.3 meters, NGVD and have an approximate length

of 20 meters. All culverts would be equipped with flap gates on the levee flood side to prevent backflow in the protected area.

2. Espinar Levee

a. EL-S-1a

The drainage structure at Espinar levee station 2+50 consists of two-1.52 meter diameter CMP. The invert of the culverts would be set at elevation -.3 meters, NGVD and have an approximate length of 27 meters. The two-1.52 meter diameter culverts would be equipped with flap gates on the levee flood side to prevent backflow in the protected area.

F. Road Ramps

Road ramps would be required where PR Hwy 418 and PR Hwy 115 intersects the proposed Aguadilla levee. Another road ramp would be required where PR Hwy 442 intersects the proposed Espinar Levee. A .91 meter diameter CMP would be provided where each road ramp intersects the interior drainage channel. Hydraulic design data for the interior drainage channels is shown in Table A-9.

The proposed road ramp at PR Hwy 418 would impact an existing concrete box culvert at Cano Madre Vieja. This culvert would be extended to accommodate the flood side of this road ramp.

G. Borrow Area

For this project there will be one source for borrow material. However, suitable excavated material from the construction of the drainage structures, the interior drainage channels and the cutoff channel could also be used for the construction of the proposed levees. The proposed borrow area does not impact the drainage of the existing floodway. The location of the borrow area is indicated in the Geotechnical Appendix, Plate B-2.

H. Performance

1. Levee Design Protection

Design discharge water surface elevations within the floodway up to and including the 1% chance flood will be prevented from overtopping the levees. Events that

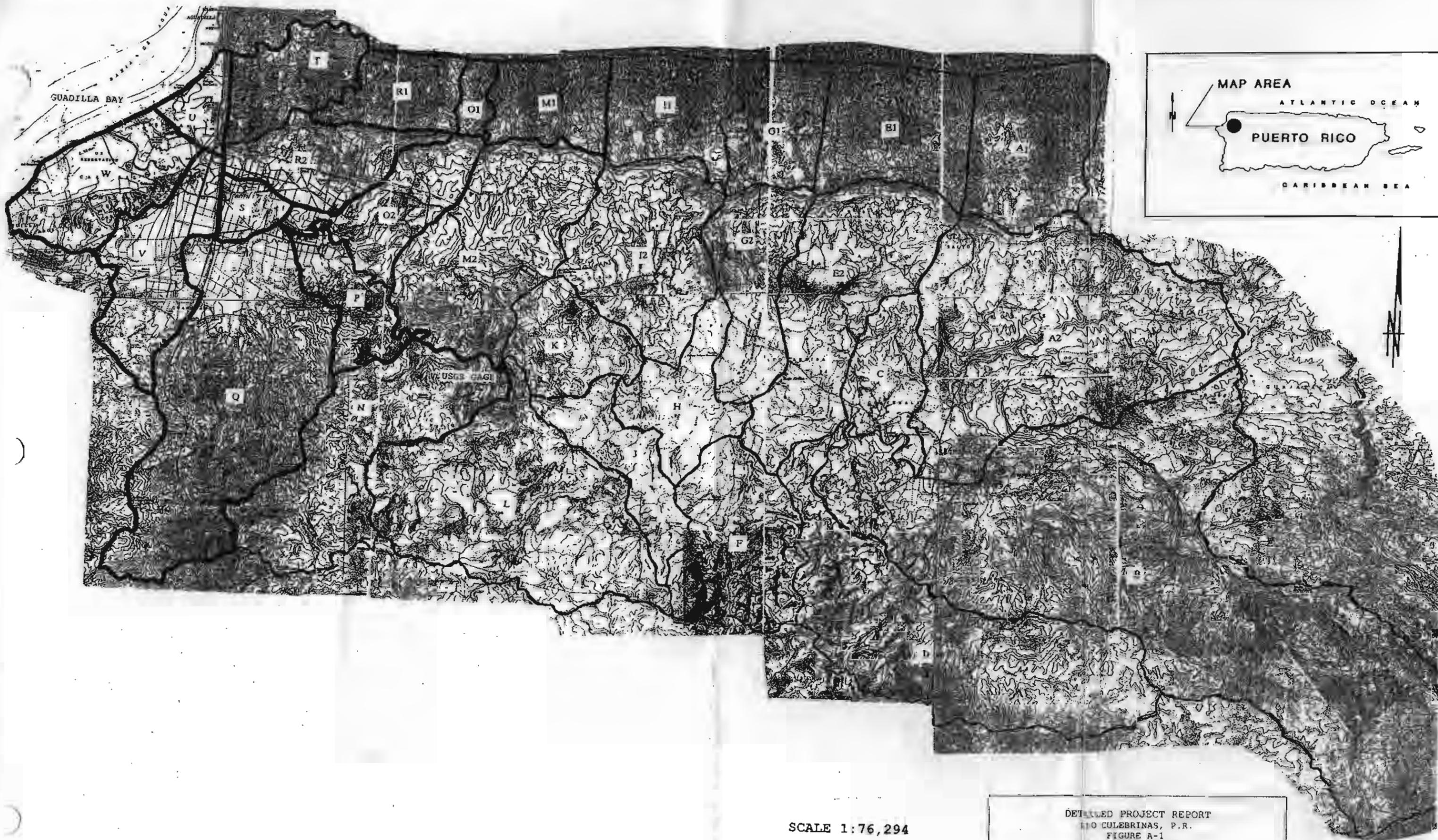
exceed the design capacity are rare but could occur. In the event of a flood greater than design discharges overtopping of one or both levees could occur. Each levee would be provided with a 50 meter long overtopping segment with a lower levee crest elevation. Paragraph C.5. provides a description of that design. Overtopping flows would discharge to an undeveloped area. These overtopping reaches were selected to minimize damage and provide warning that a design event has been exceeded.

2. Residual Flooding

Runoff from the protected side of the levees would collect in designated ponding areas and discharge to the flood plain through culverts. The culverts at the drainage structures would be fitted with flap gate controls that would prohibit flow from the flood plain into the protected area. Analyses of various rainfall and flood events were compiled to determine the extent of residual flooding in those areas. Plate A-3 indicates the extent of the area flooded due to the 1% chance flood event in the floodway and a 10% chance flood event in the protected areas. The ponding areas are an essential part of the interior drainage plan for each levee segment.

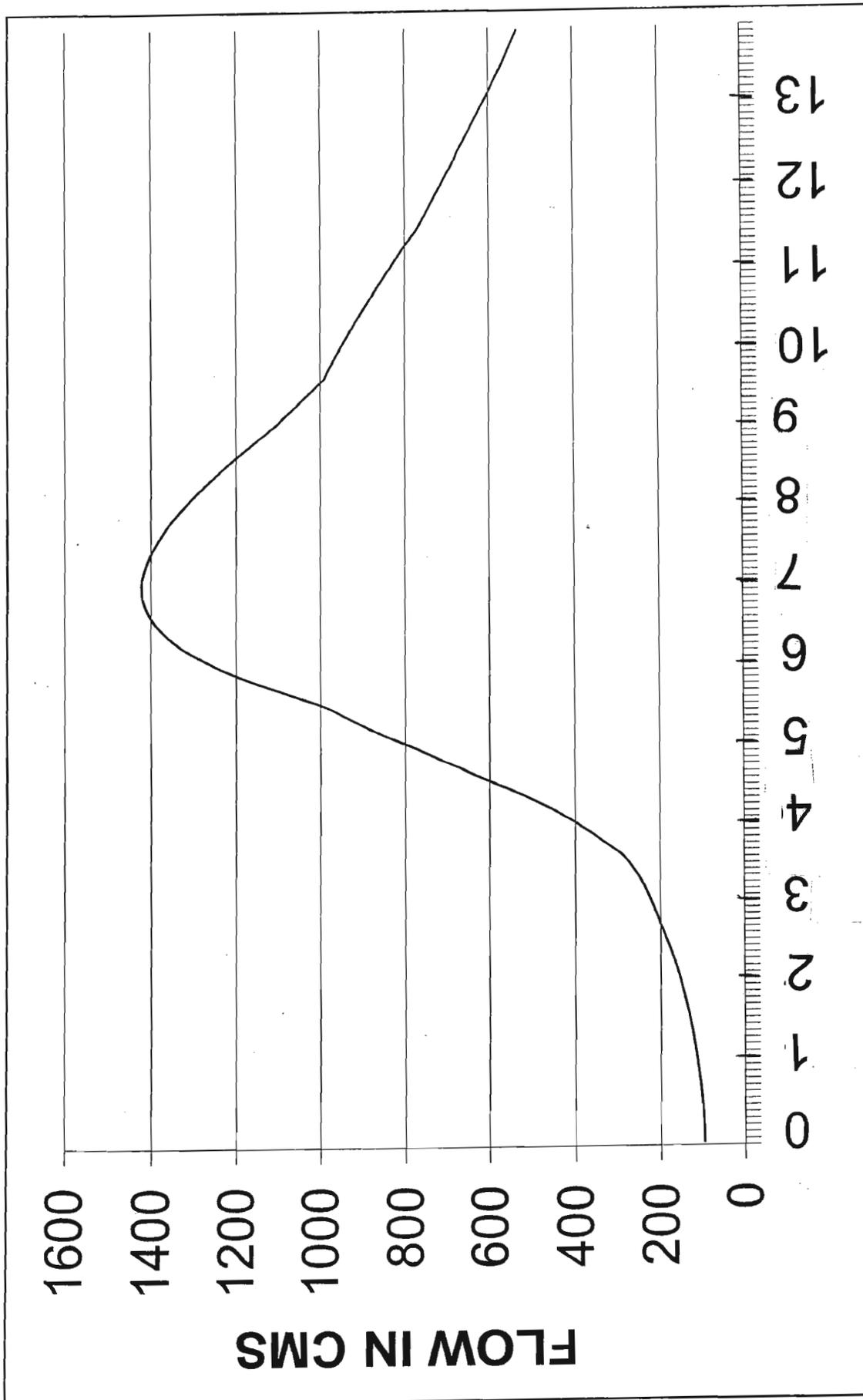
3. People at Risk

Events are of a "flashflood" nature with little time available for warning people in the area. Overtopping would first occur at a designated segment of levee. Overtopping flow at the Aguadilla levee would discharge into a ponding area and convey along a interior drainage channel that will be connected with the other drainage structures. Overtopping flow at the Espinar levee would discharge into an uninhabited area. Peak discharges for the Rio Culebrinas basin occur within 7 hours after initial rainfall and last only about 30 minutes. Therefore overtopping is expected to be brief. However, initial water velocities as a result of overtopping could be high until the tailwater stage increase. At the north end of the Espinar levee floodwaters would flank the levee and reach the western side of the community of Espinar. Ponding stages related to a 10-year event would also impact the eastern side of the community of Espinar. Plate A-3 shows the interior flooded areas for the 10-year event.



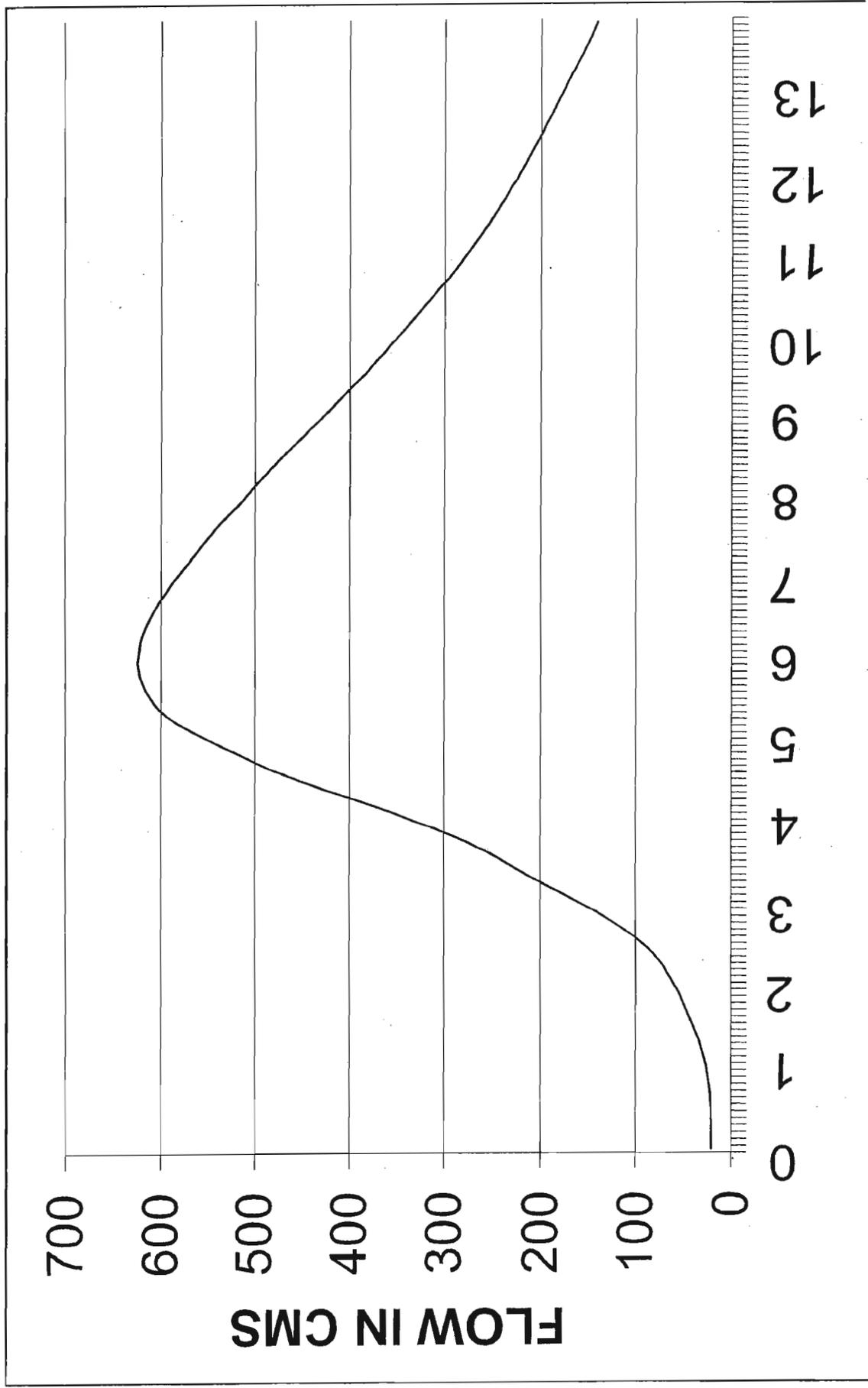
SCALE 1:76,294

DETAILED PROJECT REPORT
 RIO CULEBRINAS, P.R.
 FIGURE A-1
 LOCATION MAP WITH
 BASIN AND SUB-BASINS
 DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA



HOURS

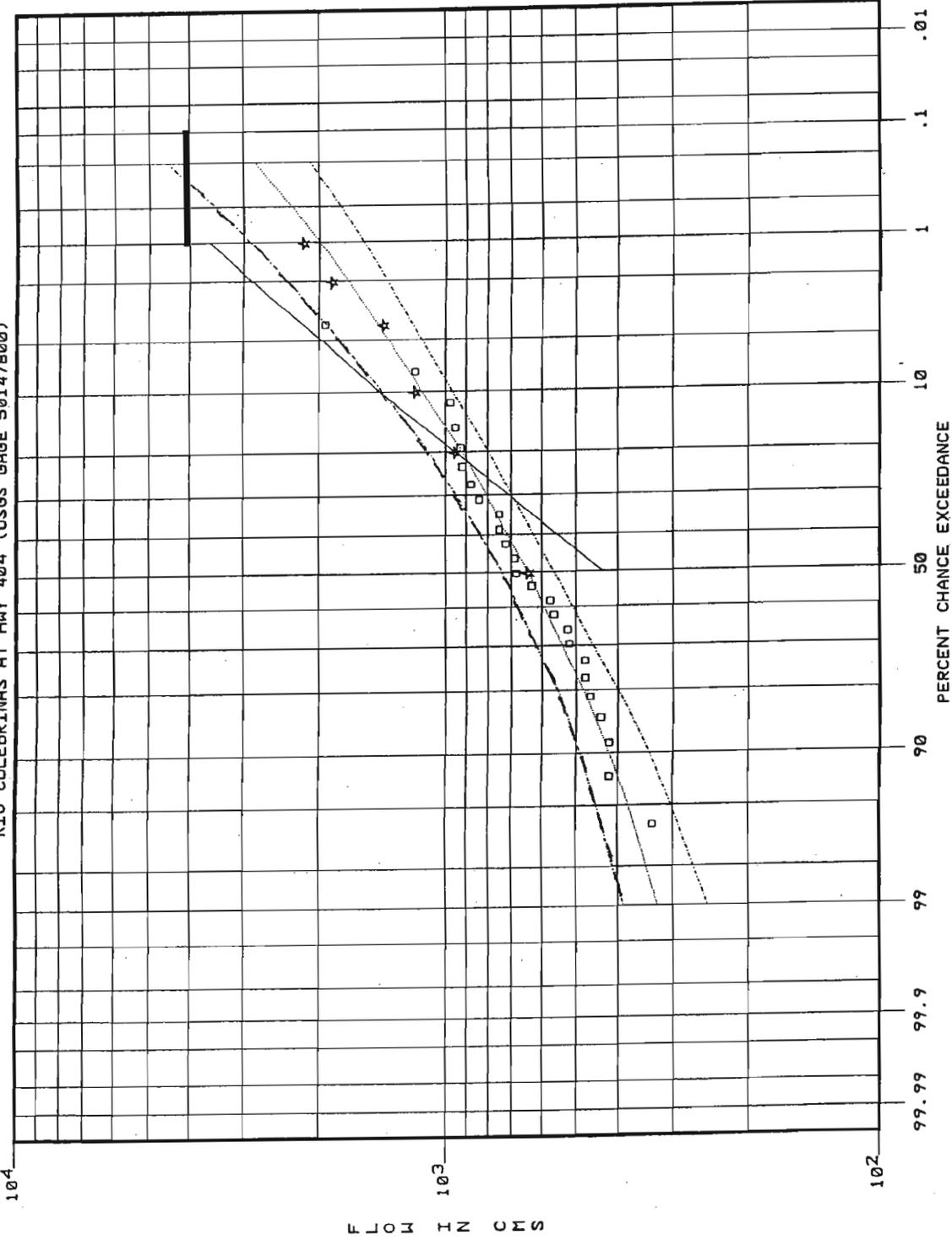
DETAILED PROJECT REPORT
 RIO CULEBRINAS, P.R.
 FIGURE A-2
 100-YEAR FLOOD HYDROGRAPH
 AT MOUTH OF RIO CULEBRINAS
 DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA



HOURS

DETAILED PROJECT REPORT
 RIO CULEBRINAS, P.R.
 FIGURE A-3
 100-YEAR FLOOD HYDROGRAPH
 AT MOUTH OF CANO MADRE VIEJA
 DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA.

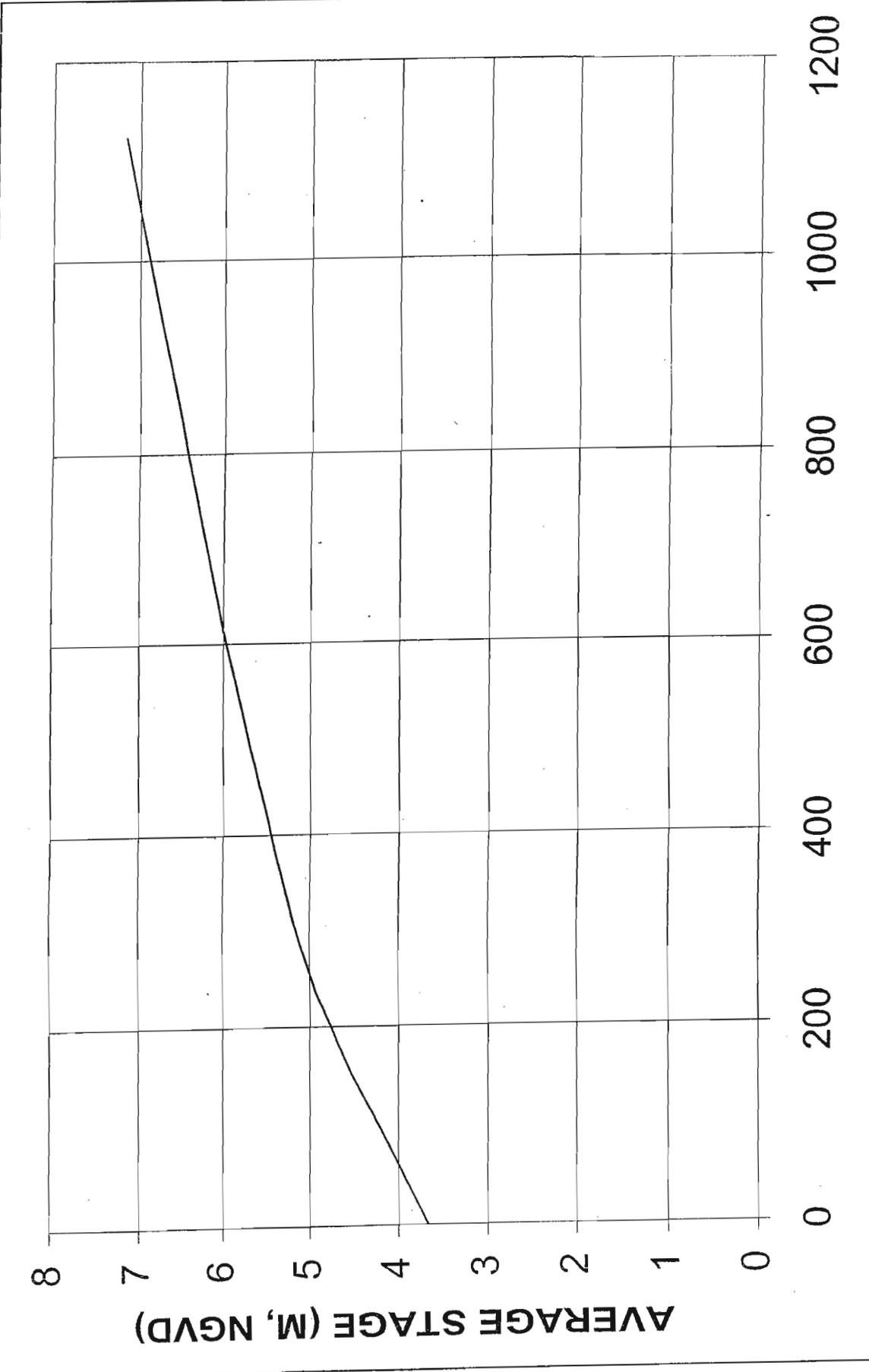
RIO CULEBRINAS AT HWY 404 (USGS GAGE 50147800)



HEC-1
SPF (HEC-1)
REGIONAL EQUATION

COMPUTED
5% CONFIDENCE LIMIT
95% CONFIDENCE LIMIT
WEIBULL PLOTTING POSITION

DETAILED PROJECT REPORT
RIO CULEBRINAS, P.R.
FIGURE A-4
FLOW FREQUENCY AT
USGS GAGE 50147800
DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE FLORIDA



TOTAL FLOW (CMS)

DETAILED PROJECT REPORT
 RIO CULEBRINAS, P.R.
 FIGURE A-5
 RATING CURVE BETWEEN
 RIO CULEBRINAS AND CANO MADRE VIEJA
 DEPARTMENT OF THE AF
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA

TABLE A-1

**RIO CULEBRINAS DETAILED PROJECT REPORT
 HISTORICAL FLOODS DATA FOR RIO CULEBRINAS
 AT USGS GAGING STATION 50147800
 AT PR HIGHWAY 404, NEAR MOCA, PUERTO RICO**

DATE OF FLOOD	DISCHARGE CMS	WATER SURFACE ELEVATION METERS, NGVD
November 27, 1968	850	73.7
October 30, 1969	700	72.4
May 7, 1970	575	71.1
June 13, 1972	700	72.4
October 21, 1972	960	74.6
September 16, 1975	1955	84.6
November 4, 1977	680	72
September 23, 1978	640	71.6
September 25, 1978	730	72.6
May 19, 1980	690	72.3
May 27, 1980	890	74.3
February 15, 1981	570	71
October 24, 1981	935	74.7
July 20, 1982	685	72.3
June 5, 1984	690	72.4
September 15, 1984	760	73
October 6, 1984	675	72.2
May 18, 1985	930	74.7
May 19, 1985	705	72.5
June 25, 1985	730	72.8
October 1, 1985	580	71.1
October 7, 1985	660	72
November 3, 1985	720	72.7
April 27, 1986	780	73.2
May 3, 1986	665	72.1
May 5, 1986	985	75.1
May 6, 1986	685	72.3
May 13, 1986	845	73.9
October 18, 1986	670	72.2
October 19, 1986	660	72
December 1, 1986	635	71.8
September 11, 1987	760	73.1
October 7, 1987	730	72.8
August 24, 1988	1200	76.8
October 26, 1988	640	71.8

TABLE A-2

**RIO CULEBRINAS DETAILED PROJECT REPORT
RAINFALL FOR VARIOUS FREQUENCIES AND DURATIONS**

PERCENT CHANCE STORM	RAINFALL IN MM							
	DURATION IN HOURS							
	0.083	0.25	1	2	3	6	12	24
50	14	29	53	61	72	86	104	117
20	17	36	66	79	91	107	132	155
10	19	41	72	91	104	127	146	180
4	21	45	79	104	117	150	178	198
2	24	51	91	114	127	155	191	229
1	26	55	99	124	150	180	216	249
SPF	29	61	114	203	264	381	445	508

TABLE A-3

**RIO CULEBRINAS DETAILED PROJECT REPORT
WATERSHED PARAMETERS**

SUB-BASIN IDENTIFICATION	DRAINAGE AREA (SQ KM)	CURVE NUMBER		LAG IN HOURS
		AMC II	AMC III	
A1	9.24	80	91	0.82
A2	28.72	80	91	0.59
B	56.51	80	91	1.40
C	4.84	80	91	0.17
D	21.85	80	91	1.02
E1	8.84	80	91	0.49
E2	14.12	80	91	0.36
F	10.31	80	91	0.27
G1	4.35	80	91	0.57
G2	7.15	80	91	0.28
H	5.80	80	91	0.08
I1	6.85	80	91	0.39
I2	11.47	80	91	0.31
J	5.10	80	91	0.27
K	5.41	80	91	0.21
L	19.63	80	91	0.28
M1	5.73	80	91	0.23
M2	15.51	81	92	0.30
N	13.86	81	92	0.30
O1	1.14	80	91	0.23
O2	6.25	81	92	0.19
P	4.41	85	94	0.04
Q	22.35	86	94	0.63
R1	4.34	84	93	0.23
R2	5.85	86	94	0.22
S	1.67	84	93	0.28
T	4.94	80	91	0.44
U	2.05	86	94	0.30
V	7.31	85	94	0.37
W	7.00	85	94	0.35
TOTAL	322.60			

TABLE A-4

**RIO CULEBRINAS DETAILED PROJECT REPORT
SUMMARY OF PEAK DISCHARGES
ESTIMATED BY HEC-1/UNET ROUTING MODEL**

PERCENT CHANCE STORM EVENTS	PEAK DISCHARGES IN CMS			
	USGS GAGE 50147800	UPSTREAM LIMIT OF STUDY	PR HWY 2	MOOUTH
50	652	701	334	143
20	964	1036	473	240
10	1193	1313	573	312
4	1411	1587	693	397
2	1893	2102	941	536
1	2206	2508	1098	625
SPF	4111	5214	3016	1221

TABLE A-5

**RIO CULEBRINAS DETAILED PROJECT REPORT
WAVE RUNUP AND WIND SETUP**

LEVEE SEGMENT	LEVEE STATION	FETCH LENGTH (M)	WIND SPEED KM/HOUR	WAVE PERIOD (SEC)	WAVE HEIGHT (M)	WAVE RUNUP (M)	WIND SETUP (M)	TOTAL (M)
AGUADILLA	4 + 00	538	25	0.99	0.10	0.13	0.01	0.14
			48	1.23	0.18	0.22	0.02	0.24
	13 + 00	1003	25	1.21	0.13	0.19	0.01	0.20
			48	1.48	0.24	0.30	0.04	0.34
ESPINAR	6 + 80	991	25	1.19	0.13	0.18	0.01	0.19
			48	1.47	0.23	0.30	0.04	0.34

TABLE A-6

RIO CULEBRINAS DETAILED PROJECT REPORT
EXISTING AND WITH PROJECT WATER SURFACE ELEVATIONS

BRIDGE	CROSS SECTION	MILE	2-YEAR		5-YEAR		10-YEAR		25-YEAR		50-YEAR		100-YEAR		SPF	
			WITH PROJECT	EXISTING												
Reach 1 EAST OF PR HWY 2		5.82	7.18	7.18	7.81	8.18	8.18	8.46	8.45	8.45	9.00	9.00	9.30	9.30	11.12	11.12
		5.07	6.91	6.91	7.50	7.83	7.83	8.09	8.09	8.09	8.60	8.60	8.90	8.90	10.92	10.92
		4.39	6.40	6.40	6.91	7.25	7.25	7.52	7.52	7.52	8.06	8.06	8.40	8.40	10.66	10.66
		3.68	5.78	5.78	6.28	6.61	6.61	6.90	6.90	6.90	7.55	7.55	7.95	7.95	10.43	10.43
		202	3.00	5.17	5.15	5.76	6.14	6.11	6.50	6.50	7.25	7.25	7.66	7.66	10.24	10.24
		104	2.93	5.13	5.10	5.73	6.11	6.08	6.47	6.44	7.23	7.23	7.65	7.65	10.23	10.23
	PR Hwy 2	4090	2.93	5.13	5.10	5.73	6.11	6.08	6.47	6.44	7.23	7.23	7.65	7.65	10.23	10.23
		3992	2.87	4.79	4.74	5.08	5.35	5.26	5.51	5.41	6.09	6.05	6.38	6.38	8.36	8.36
		3821	2.77	4.92	4.88	5.34	5.59	5.53	5.81	5.74	6.44	6.24	6.44	6.24	7.57	7.38
		3705	2.68	4.73	4.68	5.13	5.06	5.27	5.58	5.47	5.96	5.84	6.18	5.98	7.36	7.13
3428		2.52	4.55	4.50	4.94	4.84	5.07	5.40	5.27	5.78	5.63	5.98	5.77	7.17	6.91	
3214		2.39	4.28	4.20	4.68	4.55	4.79	5.19	5.02	5.57	5.38	5.74	5.54	6.95	7.13	
3187		2.38	4.23	4.14	4.63	4.50	4.91	4.73	5.15	4.97	5.53	5.34	5.49	6.91	6.63	
3154		2.35	4.22	4.14	4.63	4.49	4.89	4.71	5.13	4.95	5.52	5.34	5.74	6.90	6.62	
3055		2.29	4.19	4.09	4.59	4.45	4.87	4.69	5.11	4.92	5.48	5.30	5.70	6.88	6.60	
2614		2.08	4.12	4.02	4.53	4.42	4.84	4.66	5.09	4.90	5.45	5.27	5.66	6.79	6.52	
Reach 2 - Rio Culebrinas	2570	2.00	3.63	3.54	3.99	3.87	4.39	4.07	4.75	4.51	5.17	4.97	5.39	5.13	6.58	6.30
	2440	1.92	3.33	3.24	3.68	3.57	3.89	3.75	4.09	3.93	4.51	4.28	4.72	4.47	5.88	5.63
	2377	1.88	3.18	3.10	3.51	3.39	3.73	3.58	3.94	3.77	4.38	4.14	4.59	4.34	5.73	5.48
	1950	1.29	2.94	2.85	3.32	3.17	3.55	3.39	3.79	3.60	4.26	4.01	4.46	4.22	5.55	5.31
	1451	0.91	2.88	2.78	3.26	3.12	3.50	3.33	3.73	3.55	4.20	3.96	4.40	4.17	5.45	5.23
	1353	0.84	2.77	2.71	3.25	3.11	3.49	3.32	3.72	3.54	4.19	3.95	4.39	4.16	5.42	5.21
	1286	0.80	2.86	2.77	3.25	3.10	3.48	3.32	3.72	3.53	4.19	3.94	4.38	4.15	5.41	5.20
	1091	0.68	2.85	2.75	3.24	3.09	3.47	3.30	3.70	3.52	4.17	3.93	4.36	4.13	5.37	5.16
	850	0.53	2.83	2.73	3.22	3.07	3.46	3.29	3.69	3.50	4.16	3.92	4.35	4.12	5.34	5.13
	721	0.45	2.79	2.71	3.20	3.05	3.44	3.28	3.68	3.49	4.15	3.91	4.34	4.11	5.31	5.11
Reach 3 - Cano Madre Vieja	604	0.38	2.74	2.65	3.17	3.01	3.41	3.25	3.65	3.47	4.13	3.89	4.31	4.09	5.27	5.08
	403	0.25	2.60	2.49	3.08	2.91	3.35	3.17	3.60	3.41	4.08	3.84	4.26	4.05	5.18	4.99
	163	0.10	2.40	2.30	2.93	2.75	3.23	3.02	3.51	3.29	4.00	3.76	4.17	3.97	5.00	4.85
	44	0.03	2.04	1.94	2.58	2.38	2.92	2.70	3.28	2.99	3.84	3.59	4.02	3.81	4.81	4.67
	3573	2.54	5.13	5.10	5.73	5.69	6.11	6.08	6.47	6.44	7.23	7.20	7.65	7.78	10.23	10.23
	3463	2.47	5.13	5.10	5.73	5.69	6.11	6.08	6.47	6.44	7.23	7.20	7.65	7.78	10.23	10.23
	3280	2.36	4.76	4.73	5.16	5.10	5.39	5.32	5.60	5.50	5.96	5.86	6.17	5.99	7.31	7.07
	3240	2.33	4.67	4.54	5.07	4.86	5.30	5.04	5.51	5.20	5.88	5.52	6.09	5.65	7.25	6.65
	3134	2.27	4.60	4.53	4.97	4.84	5.20	5.01	5.41	5.17	5.77	5.48	5.98	5.60	7.15	6.59
	3101	2.25	4.51	4.42	4.89	4.74	5.13	4.94	5.35	5.12	5.73	5.45	5.95	5.57	7.14	6.58
Old Narrow Bridge	3085	2.24	4.32	4.31	4.66	4.60	4.88	4.80	5.07	4.98	5.37	5.28	5.53	5.41	6.40	6.32
	2993	2.18	4.31	4.26	4.67	4.52	4.89	4.71	5.09	4.98	5.37	5.29	5.59	5.29	6.38	6.18
	2891	2.11	3.70	3.62	4.04	3.92	4.23	4.11	4.43	4.30	4.71	4.60	4.87	4.72	5.74	5.58
	2826	2.07	3.16	3.24	3.51	3.67	3.75	3.89	3.96	4.11	4.29	4.44	4.44	4.55	5.32	5.41
	2545	1.81	2.83	2.95	3.20	3.42	3.46	3.67	3.68	3.91	4.02	4.25	4.18	4.36	5.09	5.19
	2491	1.78	2.74	2.86	3.10	3.31	3.35	3.57	3.58	3.81	3.91	4.16	4.08	4.26	4.99	5.07
	2424	1.74	2.66	2.78	3.03	3.23	3.28	3.48	3.51	3.72	3.85	4.06	4.01	4.17	4.91	4.80
	2307	1.67	2.57	2.67	2.94	3.11	3.19	3.36	3.42	3.59	3.92	3.92	3.91	4.02	4.76	4.60
	2200	1.60	2.45	2.53	2.83	2.97	3.08	3.22	3.32	3.42	3.65	3.74	3.80	3.84	4.55	4.61
	2095	1.53	2.39	2.46	2.78	2.89	3.03	3.15	3.26	3.35	3.59	3.65	3.74	3.76	4.57	4.51
Reach 3 - Cano Madre Vieja	1568	1.10	2.32	2.35	2.72	2.82	3.03	3.08	3.21	3.28	3.53	3.52	3.68	3.67	4.48	4.40
	1482	1.04	2.29	2.31	2.69	2.78	2.93	3.04	3.17	3.24	3.49	3.52	3.63	3.62	4.41	4.33
	1112	0.78	2.25	2.20	2.64	2.73	2.89	3.00	3.13	3.20	3.46	3.46	3.58	3.56	4.33	4.25
	480	0.30	2.20	2.20	2.60	2.70	2.84	2.97	3.08	3.16	3.39	3.41	3.52	3.51	4.25	4.17
	381	0.24	2.08	2.15	2.47	2.65	2.70	2.91	2.93	3.10	3.22	3.33	3.41	3.41	4.02	4.02
	255	0.16	2.02	2.10	2.39	2.59	2.62	2.86	2.84	3.05	3.13	3.27	3.24	3.34	3.94	3.94
	209	0.13	1.97	2.07	2.34	2.56	2.56	2.82	2.82	3.02	3.08	3.24	3.18	3.32	3.75	3.91
	163	0.10	1.88	2.02	2.21	2.49	2.41	2.74	2.60	2.98	2.88	3.21	3.01	3.28	3.58	3.58
	74	0.05	1.71	1.79	2.07	2.23	2.29	2.51	2.69	2.69	2.80	3.06	2.94	3.15	3.52	3.52
	17	0.01	1.53	1.64	1.86	2.05	2.06	2.28	2.26	2.55	2.59	2.86	2.72	2.97	3.28	3.28

NOTE: WATER SURFACE ELEVATIONS ARE IN METERS, NGVD

TABLE A-7

RIO CULEBRINAS DETAILED PROJECT REPORT
HYDRAULIC DESIGN DATA
100-YEAR LEVEE CREST ELEVATIONS

LEVEE SEGMENT	ROAD RAMP	DRAINAGE STRUCTURE	LEVEE STATION	MINIMUM LEVEE PROFILE TO ACCOMMODATE 20 PERCENT INCREASE IN DISCHARGE OR "N" VALUE M. NGVD	WAVE RUNUP AND WIND SETUP FOR 48 KM/HOUR WIND METERS	SUPERIORITY METERS	LEVEE CREST ELEVATION M, NGVD	AVERAGE GROUND ELEVATION M, NGVD	LEVEE HEIGHT METERS	DESIGN WATER SURFACE ELEVATION M. NGVD
AGUADILLA	PR HWY 115	AL-S-1	0 + 0.00	2.81	0.24	0.00	3.05	1.00	2.05	2.72
			0 + 32.54	2.81	0.24	0.00	3.05	2.20	0.85	2.72
			0 + 76.23	3.19	0.24	0.09	3.52	1.50	2.02	2.94
			1 + 39.50	3.34	0.24	0.09	3.67	1.70	1.97	2.98
			1 + 79.72	3.43	0.24	0.15	3.82	1.72	2.10	3.01
			2 + 25.58	3.51	0.24	0.30	4.05	1.30	2.75	3.18
			2 + 68.05	3.55	0.24	0.30	4.09	1.22	2.87	3.24
			3 + 44.59	3.63	0.24	0.30	4.17	1.80	2.37	3.34
			5 + 27.92	3.78	0.24	0.30	4.32	1.00	3.32	3.52
			6 + 05.50	3.83	0.24	0.30	4.37	2.06	2.31	3.58
			6 + 07.29	3.83	0.24	0.30	4.37	1.00	3.37	3.58
			7 + 71.41	3.88	0.34	0.30	4.52	2.00	2.52	3.63
			8 + 65.06	3.93	0.34	0.30	4.57	2.00	2.57	3.68
			9 + 44.83	3.98	0.34	0.30	4.62	1.68	2.94	3.74
			10 + 52.90	4.04	0.34	0.30	4.68	2.98	1.70	3.80
			10 + 54.61	4.04	0.34	0.30	4.68	2.50	2.18	3.80
			11 + 28.82	4.14	0.34	0.30	4.78	2.60	2.18	3.91
			11 + 91.52	4.24	0.34	0.30	4.88	2.68	2.20	4.01
			12 + 39.36	4.63	0.34	0.30	5.27	2.22	3.05	4.40
			13 + 30.31	4.69	0.34	0.30	5.33	3.00	2.33	4.46
			13 + 66.80	5.36	0.34	0.30	6.00	2.91	3.09	5.14
			13 + 80.59	5.62	0.34	0.30	6.26	2.91	3.35	5.39
			14 + 12.01	5.84	0.34	0.30	6.48	3.18	3.30	5.63
			15 + 06.36	5.87	0.34	0.30	6.51	3.04	3.47	5.66
16 + 13.66	5.90	0.34	0.30	6.54	3.85	2.69	5.70			
16 + 16.60	5.91	0.34	0.30	6.55	3.85	2.70	5.71			
16 + 31.19	5.99	0.34	0.30	6.63	3.85	2.78	5.78			
17 + 15.70	6.20	0.34	0.30	6.84	3.28	3.56	5.98			
18 + 00.81	6.38	0.34	0.30	7.02	3.66	3.36	6.18			
18 + 19.59	6.61	0.34	0.30	7.25	4.00	3.25	6.44			
18 + 36.00	6.61	0.34	0.30	7.25	5.82	1.43	6.44			
18 + 40.00	6.61	0.34	0.30	7.25	7.25	0.00	6.44			
ESPINAR	PR HWY 442	EL-S-1a	0 + 00.00	3.30	0.34	0.00	3.64	1.23	2.41	2.97
			0 + 47.13	3.43	0.34	0.00	3.77	1.30	2.47	3.01
			0 + 91.40	3.51	0.34	0.30	4.15	1.10	3.05	3.18
			1 + 36.82	3.55	0.34	0.30	4.19	1.00	3.19	3.24
			2 + 00.64	3.63	0.34	0.30	4.27	1.00	3.27	3.34
			2 + 10.00	3.65	0.34	0.30	4.29	1.00	3.29	3.37
			2 + 50.00	3.76	0.34	0.30	4.40	1.00	3.40	3.50
			2 + 58.14	3.78	0.34	0.30	4.42	1.00	3.42	3.52
			3 + 39.73	3.83	0.34	0.30	4.47	1.00	3.47	3.58
			4 + 22.14	3.88	0.34	0.30	4.52	1.00	3.52	3.63
			4 + 99.25	3.93	0.34	0.30	4.57	1.66	2.91	3.68
			5 + 91.60	3.98	0.34	0.30	4.62	1.50	3.12	3.74
			6 + 80.98	4.04	0.34	0.30	4.68	2.80	1.88	3.80
			7 + 98.79	4.14	0.34	0.30	4.78	2.70	2.08	3.91
			8 + 81.23	4.24	0.34	0.30	4.88	3.24	1.64	4.01
			9 + 55.80	4.38	0.34	0.30	5.02	4.00	1.02	4.19
			10 + 78.67	4.60	0.34	0.30	5.24	4.00	1.24	4.38
			11 + 60.58	4.61	0.34	0.30	5.25	3.61	1.64	4.39
			13 + 41.89	4.61	0.34	0.30	5.25	3.69	1.56	4.39
			14 + 80.00	4.61	0.34	0.30	5.25	4.00	1.25	4.39
14 + 96.00	4.61	0.34	0.30	5.25	5.25	0.00	4.39			
ESPINAR LEVEE SPUR			0 + 00.00	3.30	0.34	0.30	4.29	1.00	3.29	2.97
			0 + 50.00	3.30	0.34	0.30	3.94	1.00	2.94	2.97
			1 + 00.00	3.30	0.34	0.30	3.94	1.10	2.84	2.97
			2 + 00.00	3.30	0.34	0.30	3.94	1.00	2.94	2.97
			2 + 66.00	3.30	0.34	0.30	3.64	3.64	0.00	2.97

re Espinar levee spur ties into Espinar levee

TABLE A-8
RIO CULEBRINAS DETAILED PROJECT REPORT
HYDRAULIC DESIGN DATA
INTERIOR DRAINAGE STRUCTURES

LEVEE SEGMENT	DRAINAGE STRUCTURE	LEVEE STATION	AVERAGE GROUND ELEVATION (M, NGVD)	LEVEE CROWN ELEVATION (M, NGVD)	CULVERT INVERT ELEVATION (M, NGVD)	CULVERT LENGTH* (M)	CULVERT NO. - DIA (M)	TYPE OF CONTROL
AGUADILLA	AL-S-1	1+39.5	1.70	3.67	-0.3	15	3 - 1.52	FLAPGATE
	AL-S-2	6+05.5	2.06	4.37	-0.3	19	6 - 1.52	FLAPGATE
	AL-S-3	10+52.9	2.98	4.68	-0.3	20	3 - 1.52	FLAPGATE
ESPINAR	EL-S-1a	2+ 50.0	1.00	4.40	-0.3	27	2 - 1.52	FLAPGATE

NOTE: *Computed with a levee crown width of 3.0 meters and 1V:2.5H side slopes.
 Culverts are corrugated metal pipes (CMP) with bituminous coating.

TABLE A-9

RIO CULEBRINAS DETAILED PROJECT REPORT
 HYDRAULIC DESIGN DATA
 INTERIOR DRAINAGE CHANNELS

LEVEE SEGMENT	LEVEE STATION	AVERAGE GROUND ELEVATION M, NGVD	ROAD RAMP	DRAINAGE STRUCTURE	COMMENT No. - Dia. (M)	CHANNEL INVERT M, NGVD
AGUADILLA	0 + 0.00	1.00				
	0 + 32.54	2.20			Slope =.005	0.24
	0 + 76.23	1.50				0.02
	1 + 39.50	1.70		AL-S-1	3 - 1.52 CMP	-0.30
	1 + 79.72	1.72				-0.30
	2 + 25.58	1.30				-0.30
	2 + 68.05	1.22				-0.30
	3 + 44.59	1.80				-0.30
	5 + 27.92	1.00				-0.30
	6 + 05.50	2.06		AL-S-2	6 - 1.52 CMP	-0.30
	6 + 07.29	1.00				-0.30
	7 + 71.41	2.00				-0.30
	8 + 65.06	2.00				-0.30
	9 + 44.83	1.68				-0.30
	10 + 52.90	2.98		AL-S-3	3 - 1.52 CMP	-0.30
	10 + 54.61	2.50				-0.29
	11 + 28.82	2.60				0.08
	11 + 91.52	2.68				0.39
	12 + 39.36	2.22				0.63
	13 + 30.31	3.00				1.09
	13 + 66.80	2.91	PR HWY 115		1 - 0.91 CMP**	1.27
	13 + 80.59	2.91				1.34
	14 + 12.01	3.18				1.50
	15 + 06.36	3.04				1.97
	16 + 13.66	3.85				2.50
	16 + 16.6	3.85	PR HWY 418		1 - 0.91 CMP**	2.52
16 + 31.19	3.85				2.59	
17 + 15.70	3.28				3.01	
18 + 00.81	3.66				3.44	
18 + 19.59	4.00				3.53	
18 + 36.00	5.82			Slope =.005	3.62	
18 + 40.00	7.25					
ESPINAR	0 + 00.00	1.00				
	0 + 47.13	1.60				
	0 + 91.40	1.40				
	1 + 36.82	1.22				
	2 + 00.64	1.10				
	2 + 10.00	1.00				
	2 + 50.00	1.00		EL-S-1a	2 - 1.52 CMP	-0.30
	2 + 58.14	1.00				-0.10
	3 + 39.73	1.00				-0.01
	4 + 22.14	1.00				0.12
	4 + 99.25	1.00				0.23
	5 + 91.60	1.00				0.40
	6 + 80.98	1.66				0.56
	7 + 98.79	1.50				0.72
	8 + 81.23	2.80				0.90
	9 + 55.80	2.70	PR HWY 442		1 - 0.91 CMP**	1.08
	10 + 78.67	3.24				1.32
11 + 60.58	4.00				1.48	
13 + 41.89	4.00				1.63	
14 + 80.00	3.61				1.88	
14 + 96.00	3.69			Slope =.002	2.04	
ESPINAR LEVEE SPUR	0 + 00.00	1.00				
	0 + 50.00	1.00				-0.30
	1 + 00.00	1.10				-0.20
	2 + 00.00	1.00				0.00
	2 + 50.00	3.00				0.10
	2 + 66.00	3.64			Slope =.002	

* Where Espinar levee spur ties into Espinar levee.
 ** Corrugated Metal Pipe (CMP) at road ramps will not have a flap gate.
 Channel bottom width and side slopes are 1 meter and 1V:3H, respectively.
 Espinar levee spur channel will drain toward EL-S-1a

TABLE A-10

**RIO CULEBRINAS DETAILED PROJECT REPORT
HYDRAULIC DESIGN DATA
CUTOFF CHANNEL**

LOCATION	EXISTING GR. ELEV. M-NGVD	CHANNEL INVERT M-NGVD	BOTTOM CHANNEL WIDTH (M)	SIDE SLOPE	TYPE OF CHANNEL
UPSTREAM END	5.64	0.52	15.2	1V:3.5H	EARTHEN
DOWNSTREAM END	3.97	0.46	15.2	1V:3.5H	EARTHEN
	3.61	0.36	15.2	1V:3.5H	EARTHEN

TABLE A-11

**RIO CULEBRINAS DETAILED PROJECT REPORT
INTERIOR FLOOD HYDROLOGY**

LEEVE SEGMENT	DRAINAGE STRUCTURE	DRAINAGE AREA SQ KM	PEAK FLOWS IN CMS PERCENT CHANCE FLOOD EVENTS						
			50	20	10	4	2	1	SPF
AGUADILLA	AL-S-1 AL-S-2 AL-S-3	3.18	9	21	49	56	77	84	108
ESPINAR	EL-S-1a	0.34	1	3	7	8	13	14	17

TABLE A-12

**RIO CULEBRINAS DETAILED PROJECT REPORT
INTERIOR DRAINAGE - RESIDUAL FLOOD ELEVATIONS**

LEEVE SEGMENT	DRAINAGE STRUCTURE	RESIDUAL FLOOD ELEVATIONS IN METERS, NGVD PERCENT CHANCE FLOOD EVENTS		
		10	4	2
AGUADILLA	AL-S-1 AL-S-2 AL-S-3	2.22	2.31	2.40
ESPINAR	EL-S-1a	1.99	2.06	2.14

TABLE A-13

**RIO CULEBRINAS DETAILED PROJECT REPORT
RELIABILITY ANALYSIS
AT LEVEE CROSS SECTION 1568**

LOG PEAK DISCHARGE STATISTICS			
MEAN = 3.7243 STD DEV = 0.2500 SKEW = 0.2454 EVENTS = 31			
STAGE-DISCHARGE RELATIONSHIP			
	DISCHARGE CMS	STAGE METERS	
	147	2.34	
	249	2.77	
	317	3.04	
	402	3.30	
	530	3.62	
	623	3.78	
	1218	4.63	
STD DEV OF STAGE FLUCTUATIONS 0.274 METERS			
DATA FOR LEVEE			
LEVEE CREST ELEVATION = 4.57 METERS WAVE RUNUP AND WIND SETUP = 0.34 METERS MINIMUM LEVEE GRADE + SUPERIORITY = 3.93 METERS DESIGN WATER SURFACE ELEVATION = 3.68 METERS			
STAGE METERS	PERCENT PROBABILITY OF STAGE NON-EXCEEDANCE		
	SPF	.01 EVENT	.02 EVENT
3.50	2.54	18.21	37.14
3.93	21.87	62.95	82.92
4.50	72.82	95.64	98.71
4.57	78.34	96.59	99.13
5.00	97.59	99.62	99.85

LEGEND

-  5-YEAR FLOOD AREA
-  100-YEAR FLOOD AREA



AGUADILLA BAY



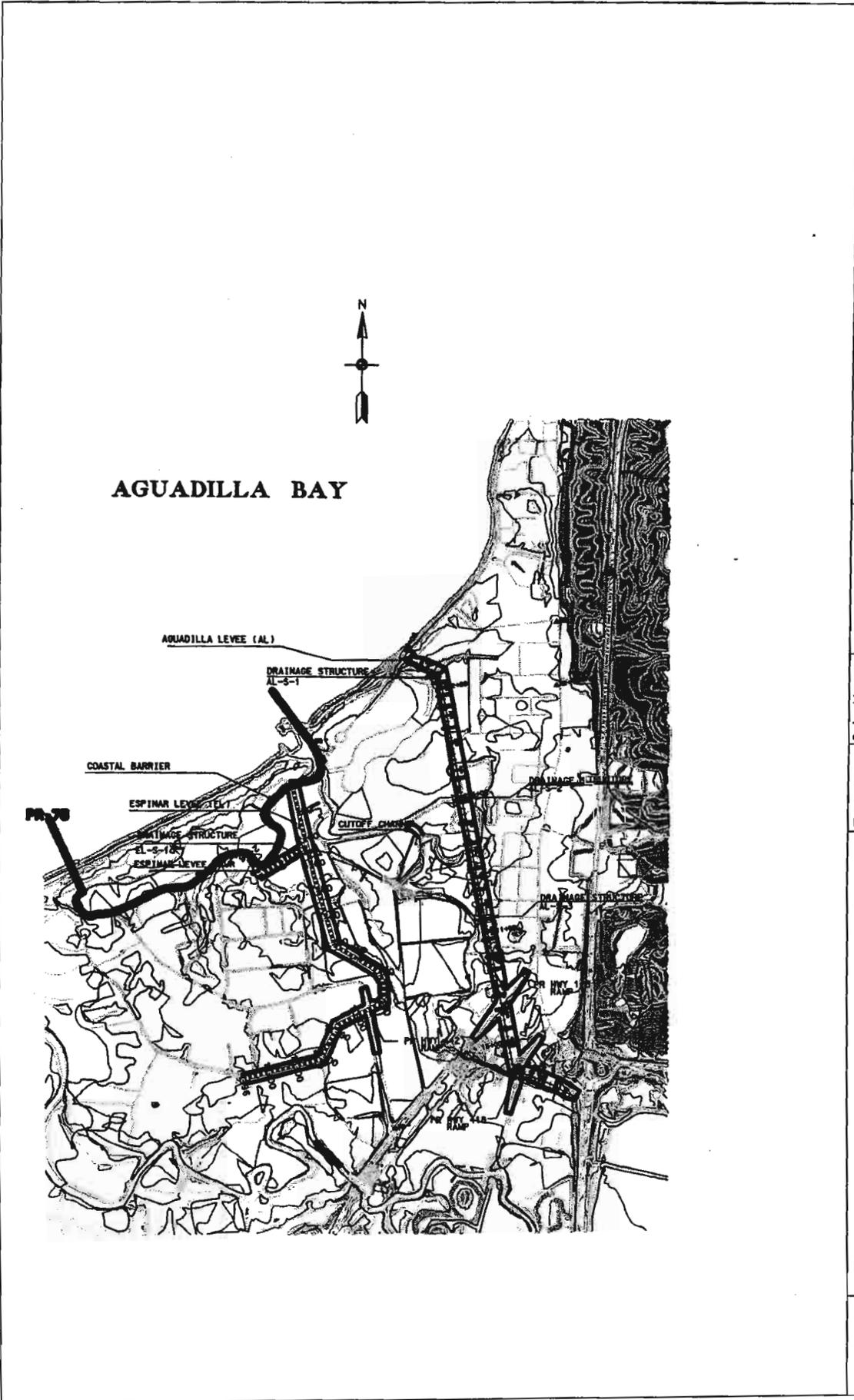
RIO CULEBRINAS of AGUADA/AGUADILLA
 PUERTO RICO
 EXISTING CONDITIONS
 FLOODED AREAS
 5-YEAR and 100-YEAR

PLATE
 A-1

File name:
 Reference list:
 Designed by:
 Draft by: [redacted] Cnd by:
 Scale:
 Plot date: 7/20/88
 Plot size: 720x1116
 Dated: JULY 1988
 D.O. NO.

DEPARTMENT OF THE ARMY
 JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
 JACKSONVILLE, FLORIDA





US Army Corps
of Engineers
Jacksonville District

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JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
JACKSONVILLE, FLORIDA

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Drawn by:	Plot date:
Checked by:	Plot code:
Date:	D.O. FILE NO.

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Reference file:

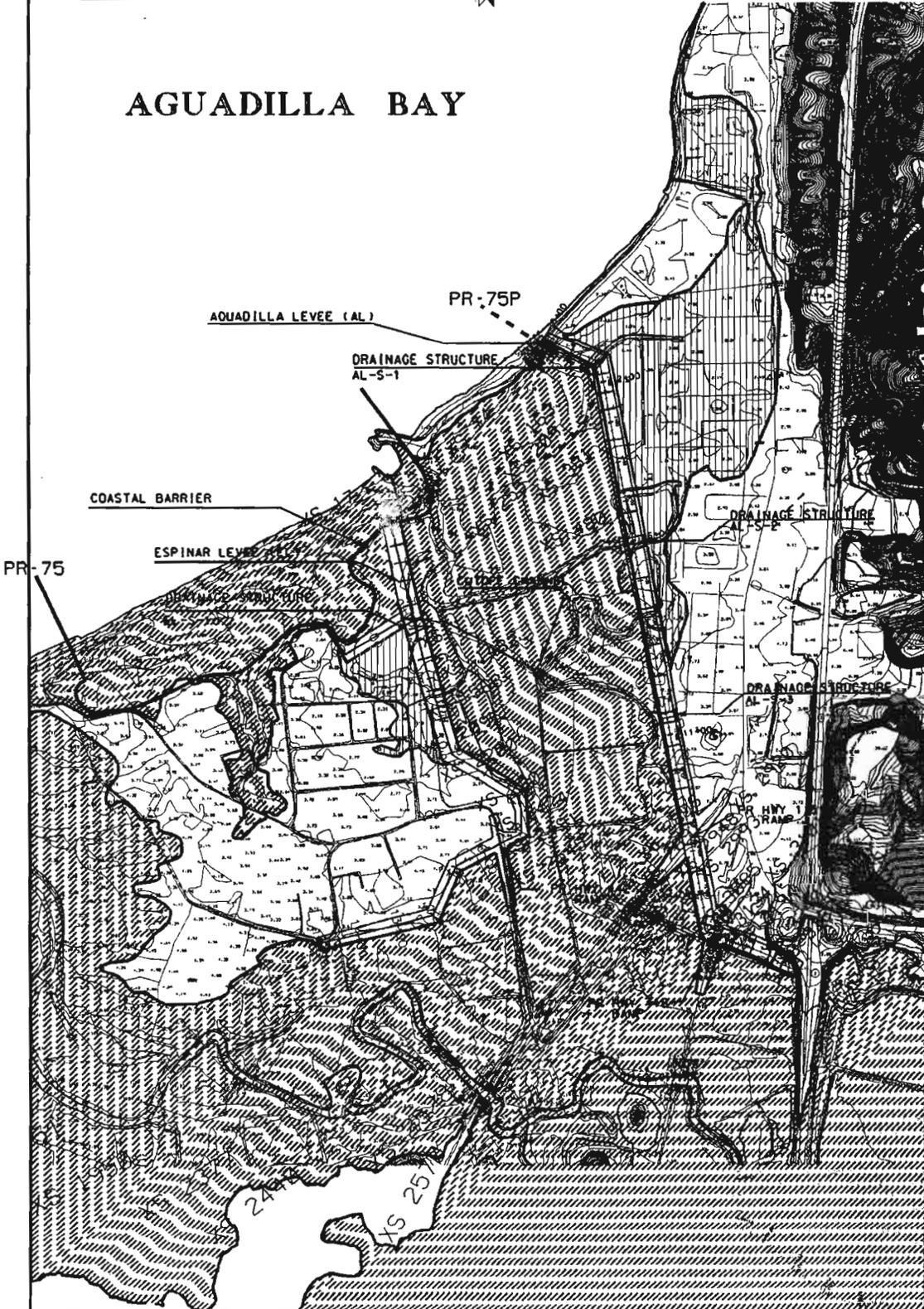
RIO CULEBRINAS AT AGUADA/AGUADILLA
PUERTO RICO
DETAILED PROJECT REPORT
RECOMMENDED PLAN

PLATE
A-2

LEGEND



AGUADILLA BAY



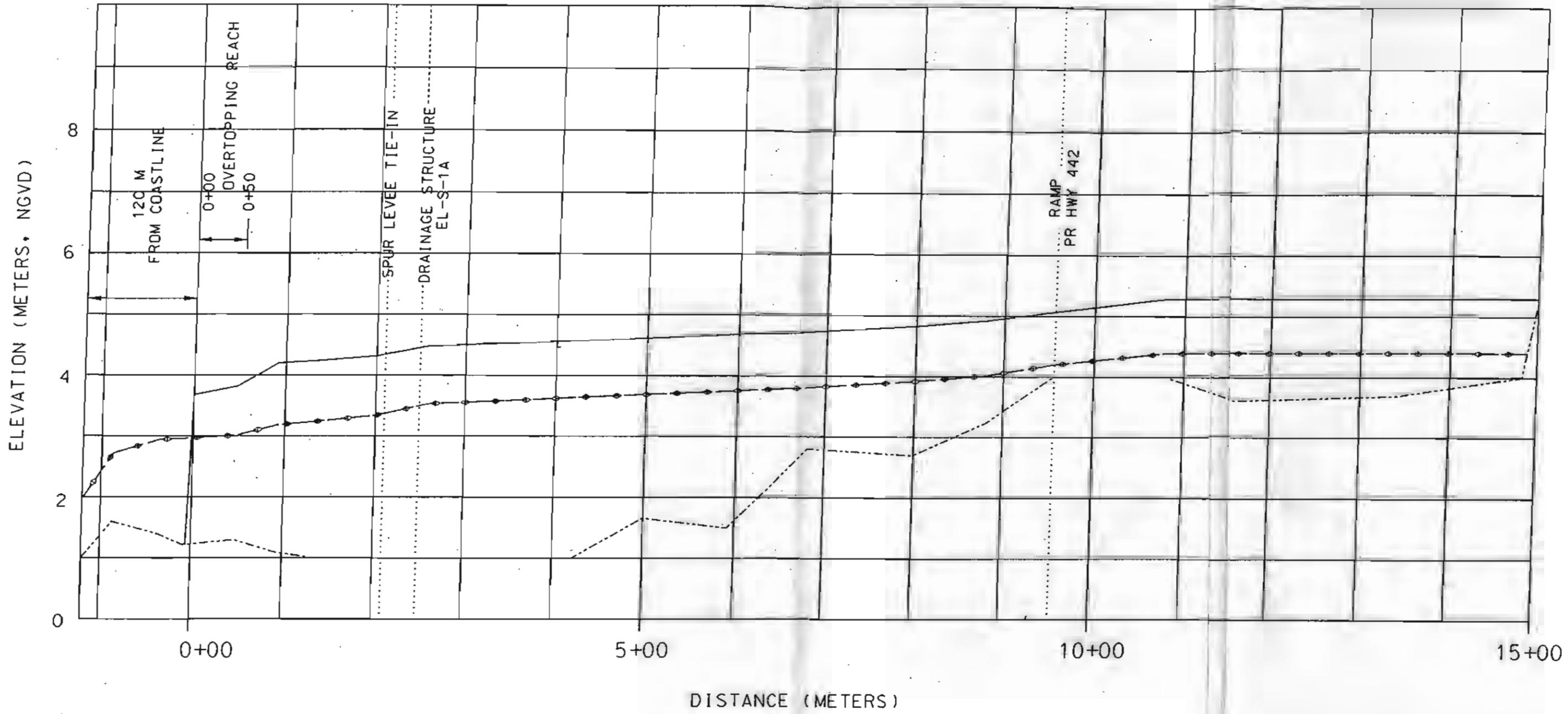
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JACKSONVILLE, FLORIDA

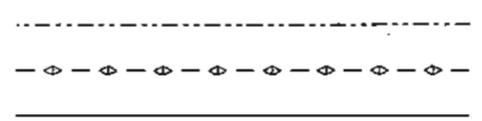
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 D. O. FILE NO.

File name:
 Reference files:
 RIO CULEBRINAS AT AGUADILLA/AGUADILLA
 PUERTO RICO
 DETAILED PROJECT REPORT
 RESIDUAL FLOODED AREA

PLATE
 A-3



LEGEND



EXISTING GROUND ELEVATION
 DESIGN WATER SURFACE ELEVATION
 LEVEE CREST ELEVATION

REFERENCE FILENAMES	DEPARTMENT OF THE ARMY JACKSONVILLE DISTRICT, CORPS OF ENGINEERS JACKSONVILLE, FLORIDA		
	AQUADA/AQUADILLA, PUERTO RICO RIO CULEBRINAS ESPINAR LEVEE PROFILE 100-YEAR		
DESIGN ENG.:	INV. NO.:	SIZE:	DWG. NO.:
CHECKED BY:	DATED:		
DRAWN BY:	SCALE: AS SHOWN	DATED: JUNE, 1999	PLATE A-5