Final Report

Port Everglades Feasibility and Technical Study for the Creation of Mangrove Wetlands

Prepared for:

Broward County

Port Everglades Department
1850 Eller Drive
Ft. Lauderdale, FL 33316

January 26, 2009

CH2MHILL

3001 PGA Blvd.
Suite 300
Palm Beach Gardens, FL 33410

Project #172284

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Contents

Executive Summary

Port Everglades has determined that a westward expansion of the Southport Turning Notch is essential to increasing berthing capacity in the Port. The proposed Southport Turning Notch extension will provide an additional containerized cargo berth and provide access to the berth along the west boundary and a potential aggregate bulk material berth on the north boundary. This expansion will require the excavation of 8.7 acres of mangrove habitat currently included in a Conservation Easement granted to the FDEP on December 15, 1988.

In an effort to accomplish this task, the Port initiated consultation with the Florida Department of Environmental Protection (FDEP) to assess the feasibility of the project from a regulatory perspective. The Port developed a habitat enhancement proposal designed to make use of existing Port land adjacent to the existing Conservation Easement. The proposed enhancement project was presented to FDEP via a concept drawing shown in Appendix ES-A.

Following initial consultation, the Port responded to an email request for additional information from the Bureau of Beaches and Coastal Systems submitted by Steve MacLeod (please see Appendix ES-B for response letter dated May 8, 2008). Original FDEP questions and Broward County responses addressed tidal flushing of the created mangrove area, an assessment of potential contamination of soils and sediments from an existing marina operation and potential manatee disturbances resulting from the construction of bridge over the Florida Power and Light (FPL) discharge canal.

Following the initial consultation, Janet Llewellyn of FDEP submitted a May 13, 2008, response letter to the Port (see Appendix ES-C) indicating that the proposal had "enough merit to warrant further investigation," and that "significant information and design details still need to be addressed in order for the FDEP to fully evaluate the merits of the proposal." The letter then listed the following 10 items that the FDEP considered critical in making a final determination:

- The type of soil and level of soil contamination of the upland areas that are proposed for conversion to mangrove wetland;
- The tidal regime and a flushing analysis of the existing and proposed conservation area adjacent to the FPL discharge canal;
- The stormwater drainage plans for contributing areas around the proposed conservation area;
- The possibility of reconfiguring, removing or limiting the use of the proposed bridge over the discharge canal;
- The possibility of reconfiguring the proposed roadway west of the proposed canal bridge and the associated parking area in order to establish a connection between the wetland creation parcels;
- A proposed site plan for areas that would be restored to wetland mangrove communities, including surface elevations and planting layout.

- Evaluation of the ecological functions of the portion of the Conservation Easement to be released (adjacent to the Southport Turning Notch) in comparison to the functions of the proposed conservation area based on the design of the mangrove wetlands to be constructed. Use of the Uniform Mitigation Assessment Method (UMAM) is preferred by the FDEP.
- Effect of the proposed alterations on the existing portion of the Conservation Easement that would not be altered;
- The possibility of granting the State of Florida ownership of some or all of the existing and proposed Conservation Easement areas;
- Long term plans for the area around the proposed conservation site not reflected in the current draft of the Port Everglades 20-year Master Plan.

The Port subsequently contracted with CH2M HILL to perform the preliminary design and technical studies necessary to further assess the merits of the project and to answer the FDEP's questions. In terms of technical discipline, the requested data can be categorized into five (5) distinct work categories:

- Drawing preparation
- UMAM Assessment
- Hydrodynamic Assessment
- Stormwater Drainage Assessment
- Contamination Assessment (to be conducted by the Port after conceptual approval)

The majority of these items are included in the following sections of this report. Due to the high cost of the contamination assessment, this work has been delayed until FDEP agrees that the results of the work completed thus far continues to support the approval of an on-going Port enhancement to offset the removal of a portion of the existing Conservation Easement. The Port is ready to proceed with the contamination testing if the FDEP concurs. Please note that specific responses to the FDEP's list of critical items (FDEP letter dated May 13, 2008, Appendix ES-C) are also included in the Port's official cover letter to this report from the Port Director, Phil Allen. The overall report Section contents and summarized findings (when appropriate) are provided below.

Section 1 – Preliminary Project Drawings

Sections 2 – UMAM Comparison Technical Report

The Port is proposing an expansion of the existing Southport Turning Notch into 8.7 acres of the Conservation Easement. As a result of this expansion, the Port would like this encroached portion of the Conservation Easement to be released. In exchange for this expansion the Port is proposing 17 acres of mangrove wetland creation within uplands adjacent to the Southport Turning Notch as shown in the Preliminary Project Drawings (Section 1). The mitigation for the Southport Turning Notch impacts will be addressed at West Lake Park.

In an effort to demonstrate equanimity of the proposed exchange, UMAM evaluations were conducted for both the Conservation Easement to be released and the mangrove wetland to be created. Based upon the UMAM conducted for the proposed release and newly created areas, the total functional loss is 5.38 units and the total functional gain is 6.20 units, respectively. Please refer to the UMAM Comparison Report for more details (Section 2).

Section 3 – Hydrodynamic Modeling Analysis

A two-dimensional, depth-averaged hydrodynamic model has been constructed for both existing and proposed conditions at the project site. The numerical model was validated with field data collected over a 20 day period starting August 6, 2008. The results of the hydrodynamic model were used to drive a constituent transport model in order to quantify the flushing characteristics of the existing and proposed mangrove wetlands.

The proposed enhancement areas have a marsh plain elevation of +/- 2 ft MLW and minimal channel storage. The marsh areas will drain on every ebb tide. In the northern enhancement area on the west side of the FPL canal, the constructed channels are dead-end channels and will contain water at low tide. In the larger, southern enhancement area, the constructed channels flow though the site from the FPL canal into the Conservation Easement, connecting with a remnant channel. The addition of the largest (southwest) enhancement area will improve flushing in the Conservation Easement; the proposed channel will provide an increase in flushing flows to the southern portion of the Conservation Easement, thus improving circulation and reducing residence time.

The performance of the proposed enhancement area and the improvements in the flushing of the Conservation Easement provided by the project are contingent on the ability for water to flow from north to south through the channels in the proposed area and into the conservation area. A remnant channel (Figure 24 of the Hydrodynamic Modeling Analysis) must have adequate capacity and not serve as a bottleneck limiting flow into the southern portion of the Conservation Easement. It was recommended that this channel be improved during construction of the proposed enhancement areas. Furthermore, there is a large sand deposit at the intersection of this remnant channel and the north-south channel (see same Figure 24). It was recommended that this restriction should also be removed to improve flushing in the Conservation Easement. Both improvements have been added to the preliminary drawings. Please refer to the Hydrodynamic Modeling Analysis of Proposed Mangrove Enhancement Areas in Section 3 for more details.

Section 4 – Drainage Analysis Report

A drainage analysis was performed to document the existing and proposed drainage conditions affecting the proposed 17 acre wetland creation area located east of SE 18th Avenue and south of SE 36th Street. In addition, the review included existing and proposed stormwater treatment methods to determine compliance with current design criteria. The existing E-W Ditch located south of SE 36th Street conveys stormwater runoff from a 29.9 acre offsite drainage area to the FPL discharge canal. The offsite drainage area includes the Foreign Trade Zone (FTZ) and the 1800 Eller Drive Building.

The drainage concept for the proposed wetland creation area is affected by the proposed Bridge over FPL discharge canal. The proposed Bridge over FPL discharge canal affects permit SWM#06-00703-S, which should be modified to accommodate the proposed bridge and roadway improvements. Two stormwater management alternatives were evaluated for this project – an east to west (E-W) Ditch and an E-W Culvert. The E-W Ditch is designed to accommodate the first inch of stormwater runoff from 29.9 acres, and should be situated adjacent to the proposed driveway and parking lot. The minimum cross section geometry is shown in Table ES-1 of the Drainage Analysis in Section 4.

The E-W Culvert option is designed to accommodate the first inch of stormwater runoff from 29.9 acres. This option requires 44-18" diameter pipes in parallel to accommodate the required water quality treatment volume.

The E-W Ditch was recommended because the top width is less compared to the E-W Culvert. It was also recommended that the proposed 17 acre wetland creation area should be designed to accommodate the recommended E-W Ditch configuration and location. The stated recommendations have been incorporated into the preliminary drawings. Please refer to the Drainage Analysis in Section 5 for more detail.

APPENDIX ES-A

Concept Drawing

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APPENDIX ES-B

Broward County Port Everglades Department Response Letter, May 8, 2008

BROWARD COUNTY
FLORIDA

PORT EVERGLADES DEPARTMENT - Port Director's Office
1850 Eller Drive - Fort Lauderdale, Florida 33316
954-523-3404 FAX 954-523-8713

May 8, 2008

Mr. Steven MacLeod
Environmental Manager
Florida Department of Environmental Protection
Bureau of Beaches and Coastal Systems
3900 Commonwealth Boulevard, M.S. 300
Tallahassee, Florida 32399

Dear Mr. MacLeod:

We appreciate your thoughtful questions and submit the following abbreviated answers. When additional information becomes available, we will provide it to your office immediately.

Question:

- In order for the mangrove creation sites to function naturally and be as production as the mangroves in the existing Conservation Easement, they need to flush with marine waters. Given the continuous flow of fresh water in the FP&L outfall canal, we cannot assume that the tidal range and salinity at the creation sites will be sufficient. Could you provide some monitoring data (over several tidal cycles) to show the range of water levels, tidal frequency and salinity at the sites indicated on the map below:

We have advised you that the discharge canal is composed of salt water and not subject to fresh water exposure.

Question:

- Before construction of the mangrove restoration can be approved, a hydrographic flushing analysis would be required. Is there any data available at this time (in addition to the tidal range and frequency) that would help to demonstrate adequate flushing through the proposed wetland creation sites?

There is no data available at this time, but we would commit to completing the study as a part of our engineering and design of the enhanced area. We understand that as a part of the upland to wetland conversion, appropriate engineering will be required to include a hydrographic flushing analysis.

Question:

- Marinas and storage facilities often conduct boat cleaning and maintenance. These activities often discharge metals and petroleum products into the soil and benthic sediment. Is there reason to believe that there are contaminated sediments at the proposed creation sites? Have any sediment samples been tested for contaminants?

We have not completed a Phase II environmental study. A modified Phase I environmental audit was conducted of the Dry Marina area a few years ago. From this audit, we concluded that there does exist a potential for contaminants. A study of the entire area to identify contaminants that may require decontamination/mitigation would be completed as a part of the conversion plan.

Question:

- Please describe the level of traffic and associated noise that may be involved with the construction of the proposed bridge over the waterway and roadway improvements. This may adversely affect manatees utilizing the present and proposed Conservation Easement, especially the 'nursery' area north of the present marina.

The Port Seaport Engineering and Construction Division have submitted this question to an environmental consulting firm – comments will be forthcoming. Construction impacts will be alleviated by not allowing potential disruptions during manatee season in accordance with existing Port policy. Further, the existence of a lower level and heavy traffic bridge just north of the proposed bridge has not deterred migration of manatees further up the discharge canal. Please see the attached map, which details the manatee population, which is derived by annual survey data collected by Broward County.

Question:

- The DEP CAMA office asks if the Port will consider granting title of the proposed conservation areas to the state, rather than just enacting a Conservation Easement.

This would be a policy determination by the Board of County Commissioners, which could be considered as part of a conceptual approval by FDEP.

Question:

- The DEP Office of Intergovernmental Programs notes the fragmentation of the enhancement area due to the parking lot on the west side of the proposed bridge. Would it be possible to remove this parking lot/roadway or set it back from the canal to allow greater connectivity of the proposed enhancement area adjacent the manatee "nursery" basin with the contiguous mangrove area proposed to the south?

It is possible to relocate the parking lot to the West or North of the proposed roadway. Further, the use of a floating dock structure could be considered in lieu of keeping the existing bulkhead in place. Roadway areas to the bridge could not be relocated. We are willing to study alternatives to provide for water flow between the north and south side of the roadway. It would be our intent, with appropriate engineering, to insure a sufficient flow of water throughout the new Conservation Easement.

Please forward any additional questions for our response.

Sincerely,

Phillip C. Allen

Port Director

PCA/clo

Enclosure

APPENDIX ES-C

FDEP

Response Letter, May 13, 2008

Florida Department of Environmental Protection
Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

DIVISION OF WATER RESOURCE MANAGEMENT

OFFICE OF THE DIRECTOR
Janet G. Llewellyn

TO: 1) Phillip Allen, Port Dir., Port Everglades
Fax: 954.523.8713
2) Linda Shelley, Fowler White Boggs
Fax: 850.681.6036
3) Mollie Palmer, DEP

FROM: Yvonne Zola

COMPANY:

DATE: May 13, 2008

FAX NUMBER:

NO. OF PAGES INCLUDING COVER: 3

PHONE NUMBER

SENDER'S PHONE NO.: 850. 245-8676

RE:

SENDER'S FAX NO. 850-245-8356

☐ **Urgent** ☐ **For Review** ☐ **Please Comment** ☐ **Please Reply**

Notes/Comments:

Florida Department of Environmental Protection
Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

May 13, 2008

Philip C. Allen
Port Director
Port Everglades Department
1850 Eller Drive
Fort Lauderdale, Florida 33316

RE: New proposal for Port Everglades Conservation Easement

Dear Mr. Allen,

This letter is in response to the proposal discussed with Secretary Sole, and further outlined to us in your April 25, 2008, letter related to the potential release of 8.68 acres of the existing conservation easement at Port Everglades. As indicated by the Secretary, in order to be considered, any proposal must result in an overall greater benefit to the environment than the existing portion of the conservation easement to be released. We have done a preliminary evaluation based on the very conceptual information available at this point, and feel that the proposal has enough merit to warrant further investigation.

You provided additional information on May 8, 2008, in response to a compilation of e-mail questions from Department staff. We understand that much of the requested information was not readily available, so you provided the information that was on hand to facilitate a quick response. However, significant information and design details still need to be addressed in order for the Department to fully evaluate the merits of the proposal and determine if creation of a successful wetland mangrove area is possible.

Critical details include:

- The type of soil and level of soil contamination of the upland areas that are proposed for conversion to mangrove wetland;
- The tidal regime and a flushing analysis of the existing and proposed conservation area adjacent to the FPL discharge canal;
- The stormwater drainage plans for contributing areas around the proposed conservation area;

- The possibility of reconfiguring, removing or limiting the use of the proposed bridge over the discharge canal;
- The possibility of reconfiguring the proposed roadway west of the proposed canal bridge and the associated parking area in order to establish a connection between the wetland creation parcels;
- A proposed site plan for areas that would be restored to wetland mangrove communities, including surface elevations and planting layout.
- Evaluation of the ecological functions of the portion of the conservation easement to be released (adjacent to the turning notch) in comparison to the functions of the proposed conservation area based on the design of the mangrove wetlands to be constructed. Use of the Uniform Mitigation Assessment Method (UMAM) is preferred by the Department.
- Effect of the proposed alterations on the existing portion of the conservation easement that would not be altered;
- The possibility of granting to the State of Florida ownership of some or all of the existing and proposed conservation easement areas;
- Long-term plans for the area around the proposed conservation site not reflected in the current draft of the Port Everglades 20-year Master Plan.

We look forward to working with you on the evaluation of the proposal as additional information and design details become available. Please contact Steve MacLeod in our Bureau of Beaches and Coastal Systems at 850/414-7806 if you have any questions or concerns.

Sincerely,

Janet G. Llewellyn
Director
Division of Water Resource Management

JGL/smn

cc: Allan Sosnow, Broward Co.
Linda Shelly, Fowler White Boggs Banker
Mary Ann Poole, FWC, OPSC
Michael Sole, DEP, Secretary
Bob Ballard, DEP, Deputy Secretary
Michael Barnett, DEP, BBCS
Martin Seeling, DEP, BBCS

Preliminary Project Drawings

Port Everglades Conservation Easement
Port Everglades
Broward County, FL

Prepared for:

Broward County

Public Works Department
Seaport Engineering & Construction Division
1850 Eller Drive
Ft. Lauderdale, FL 33316-4201

January 26, 2009

CH2MHILL
3001 PGA Blvd.
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Palm Beach Gardens, FL 33410

Project #172284

Contents

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY

FIGURE 1

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

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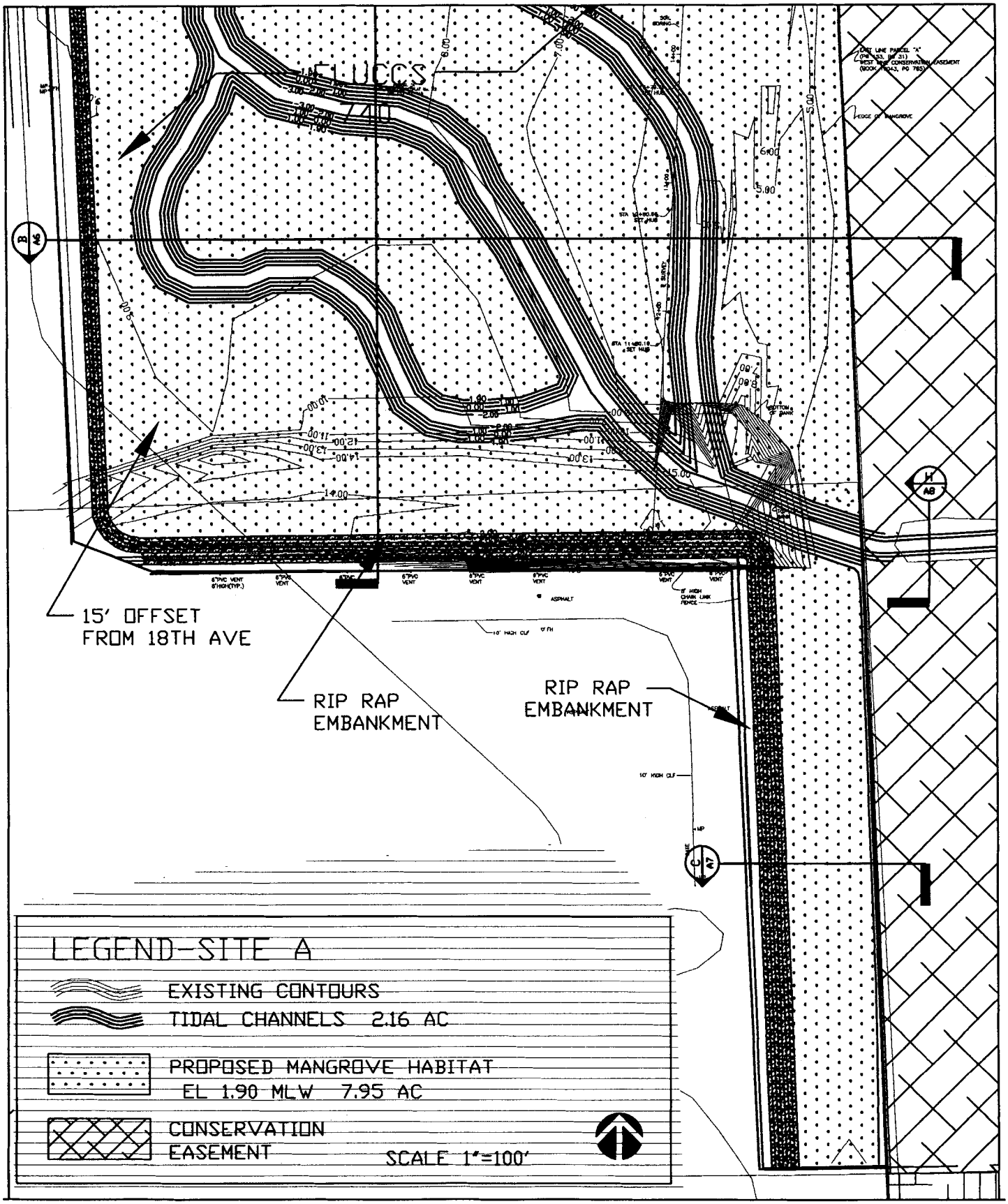

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE A PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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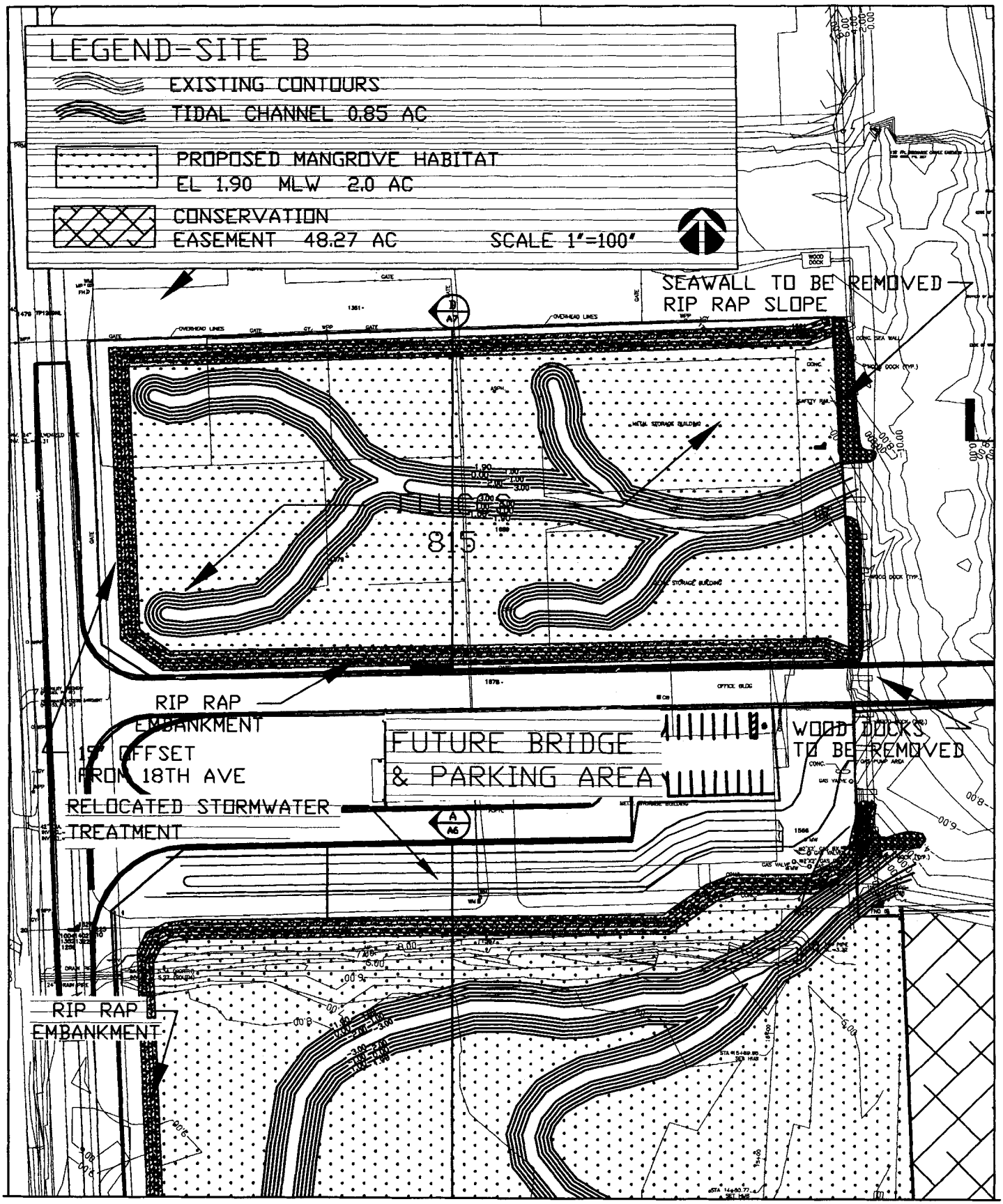

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PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

SITE B PROPOSED MANGROVE CREATION

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

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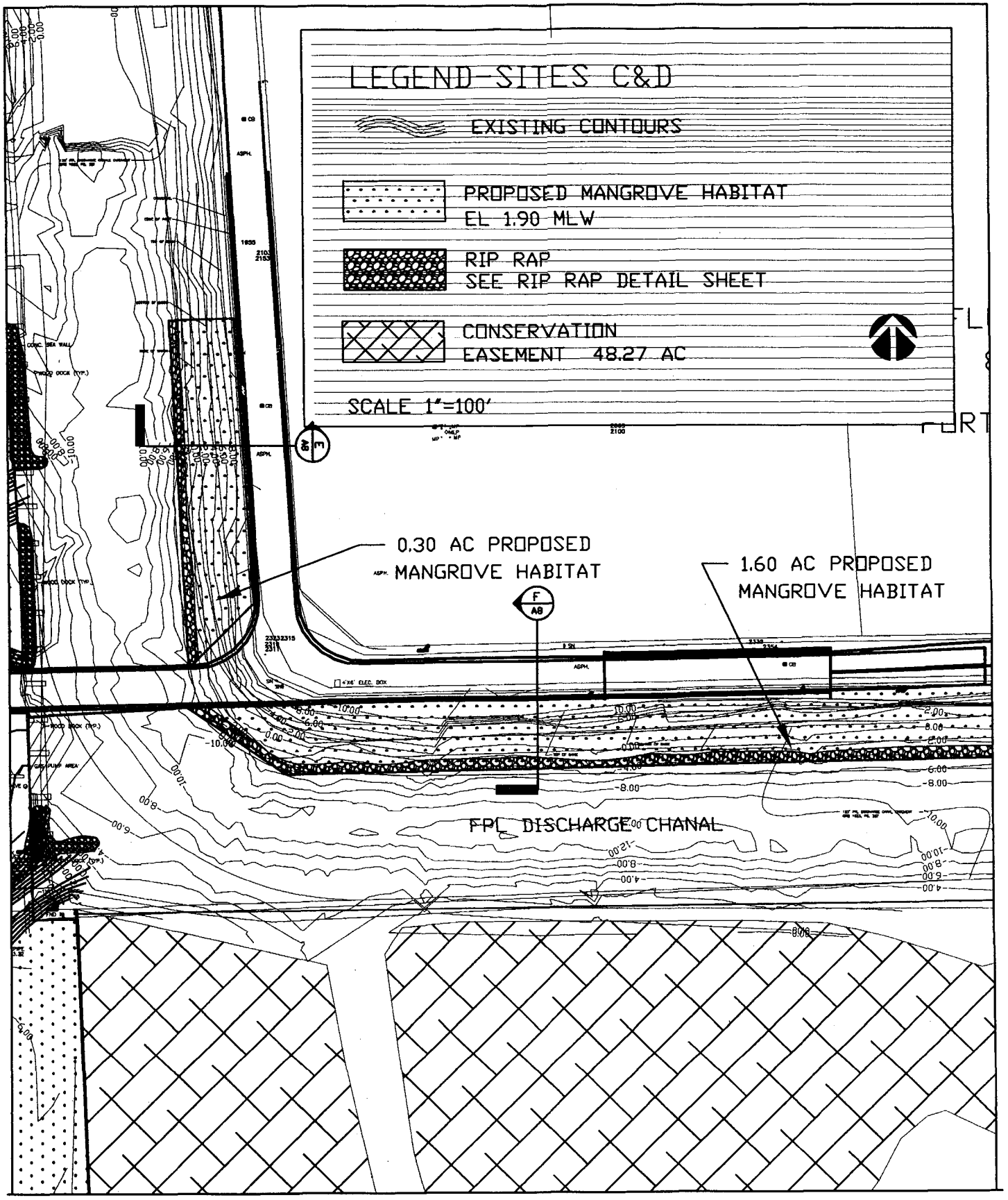

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE C&D PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

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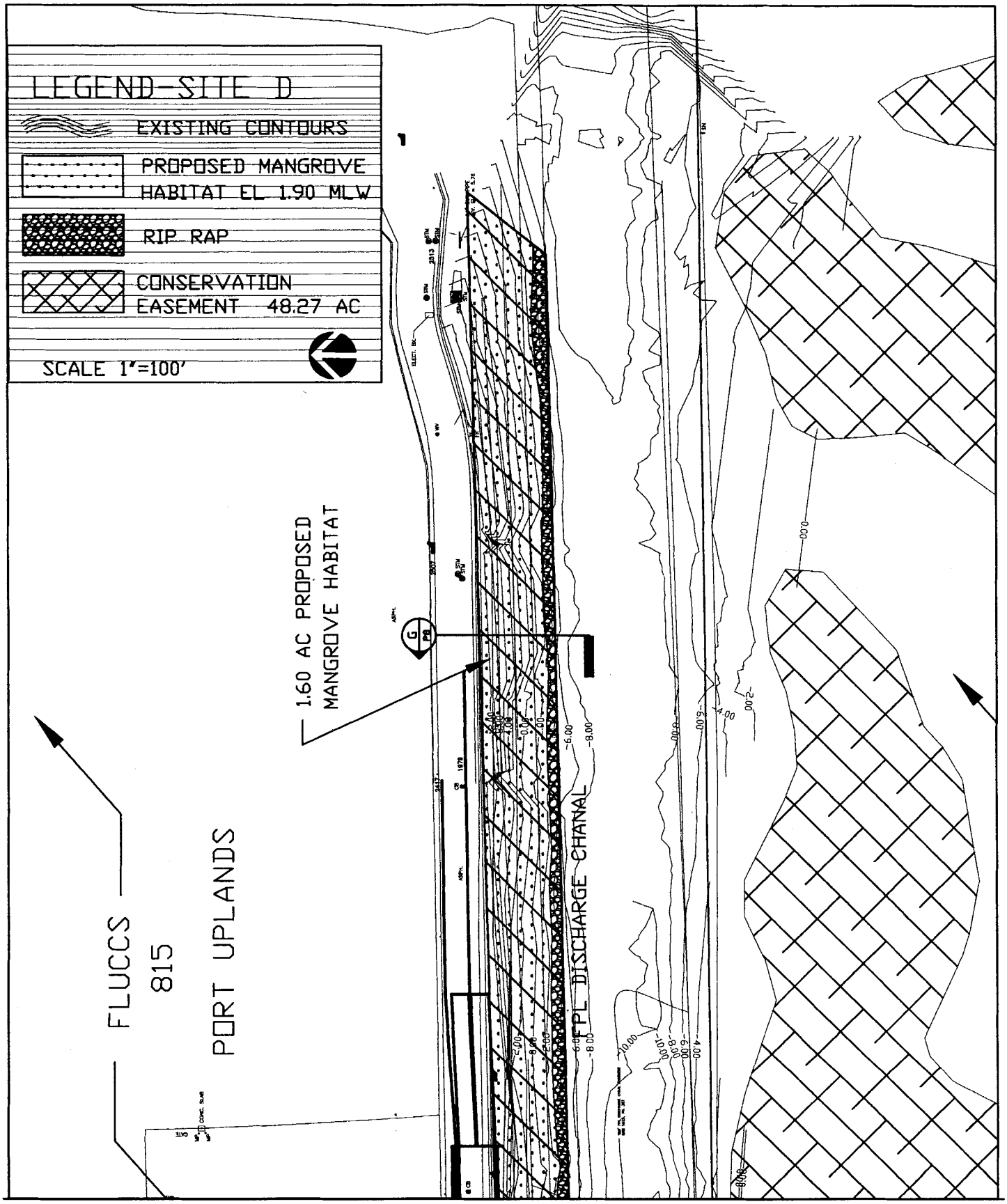

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE D- PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

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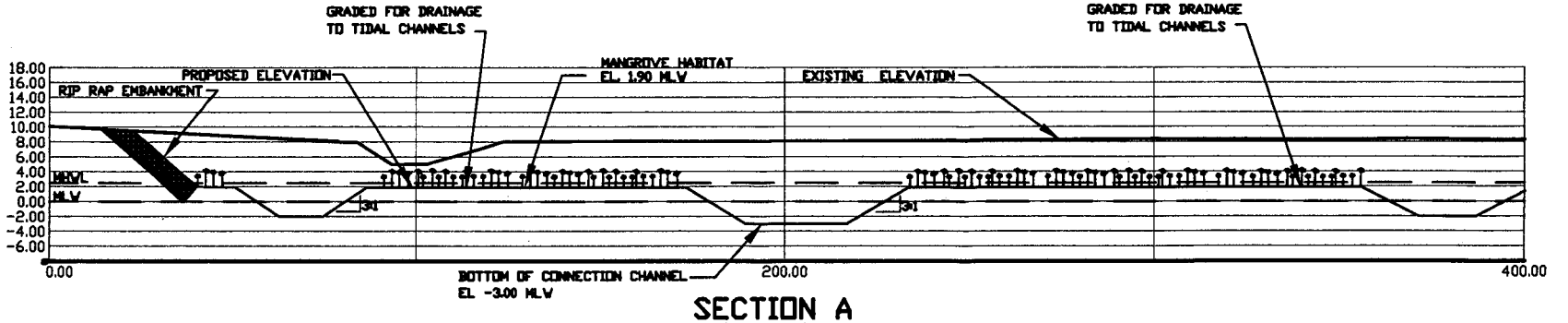

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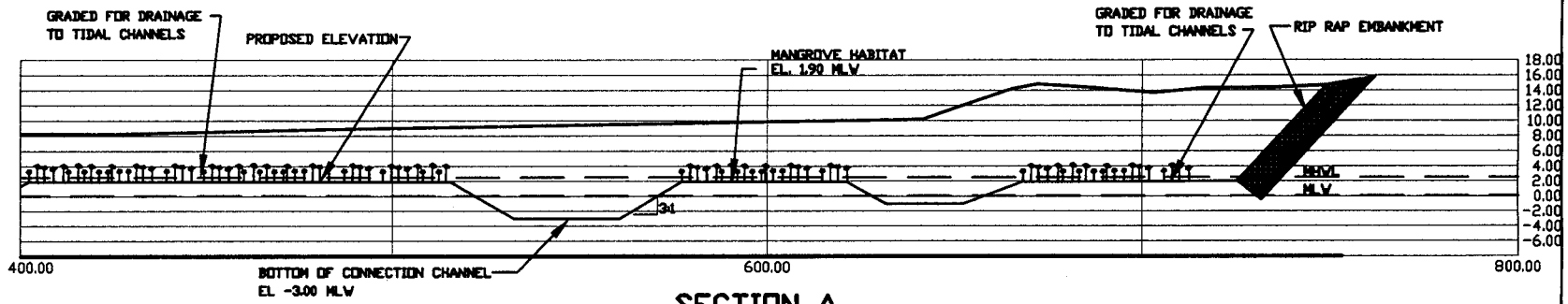

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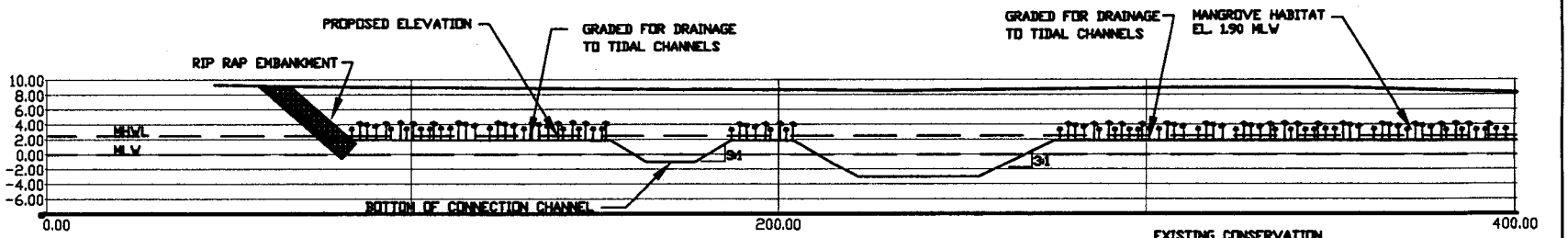

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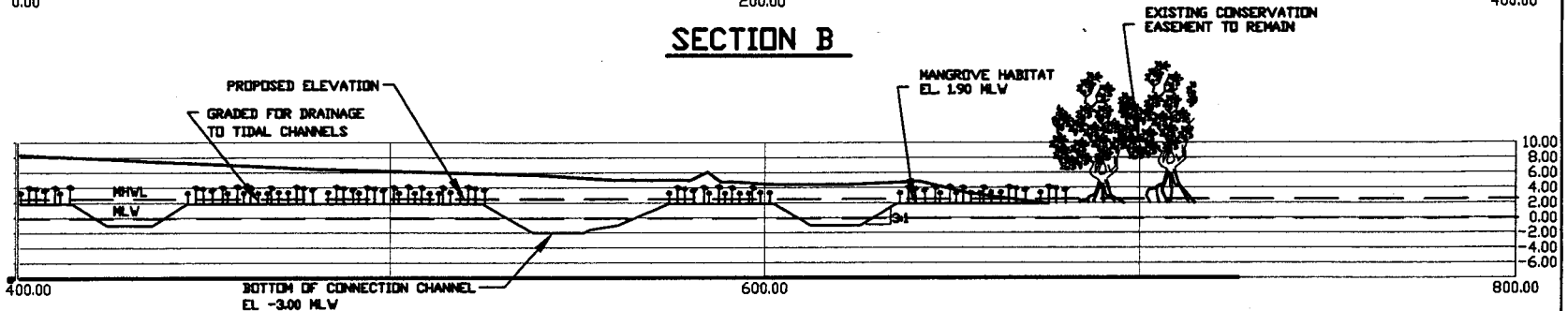

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE A CROSS SECTIONS

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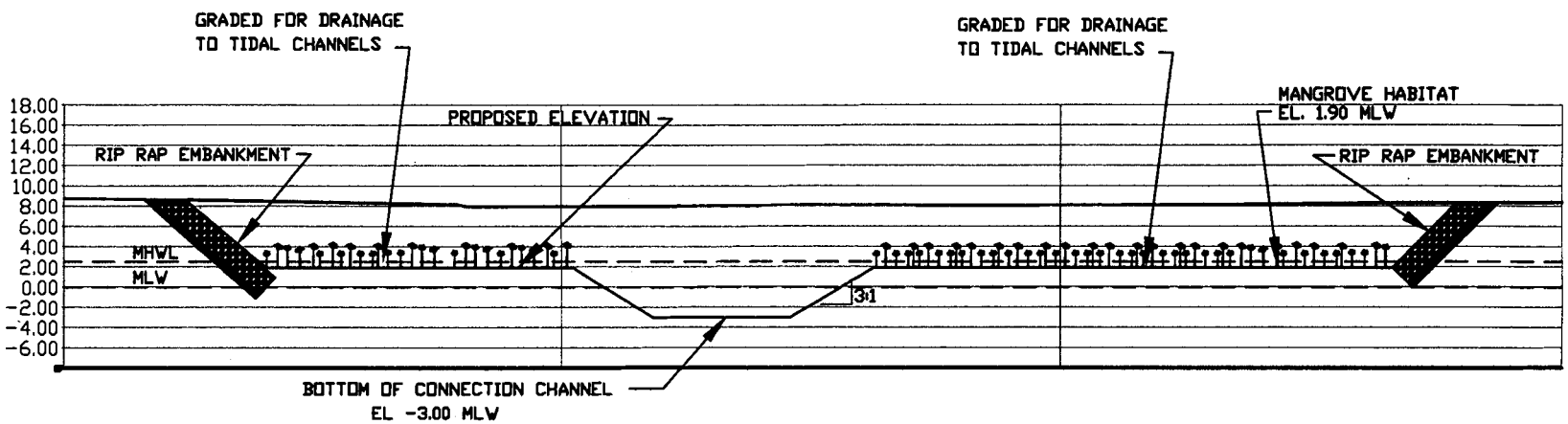

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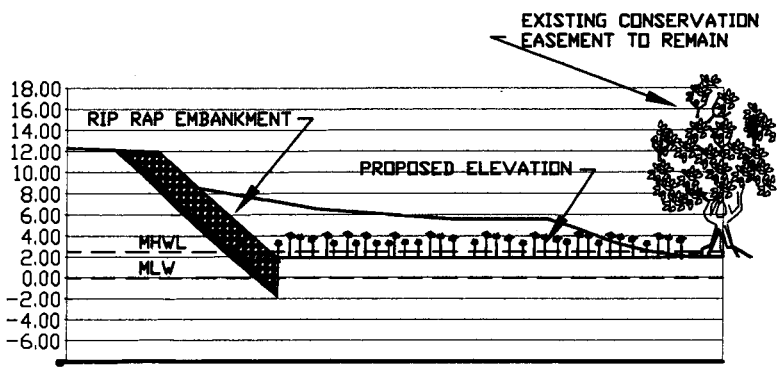

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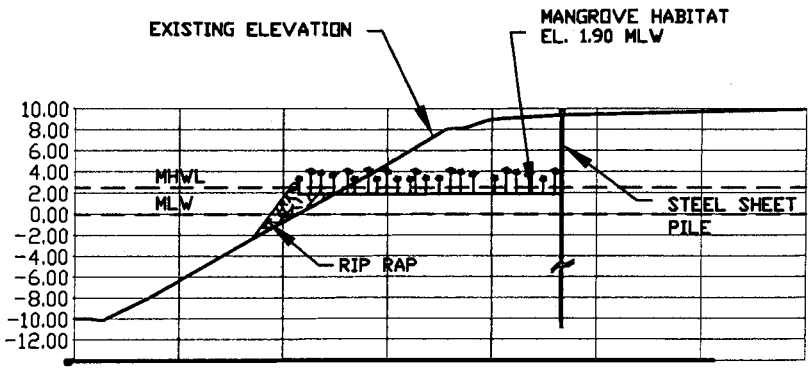

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PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

SITE B & C CROSS SECTIONS

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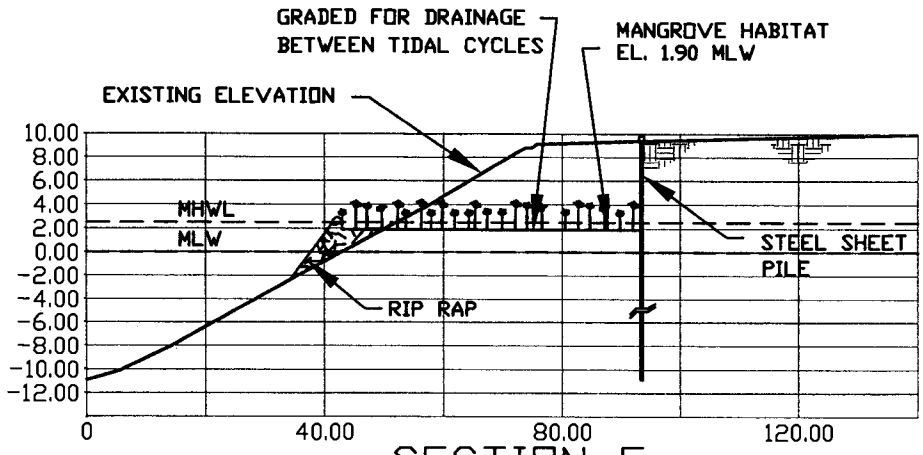

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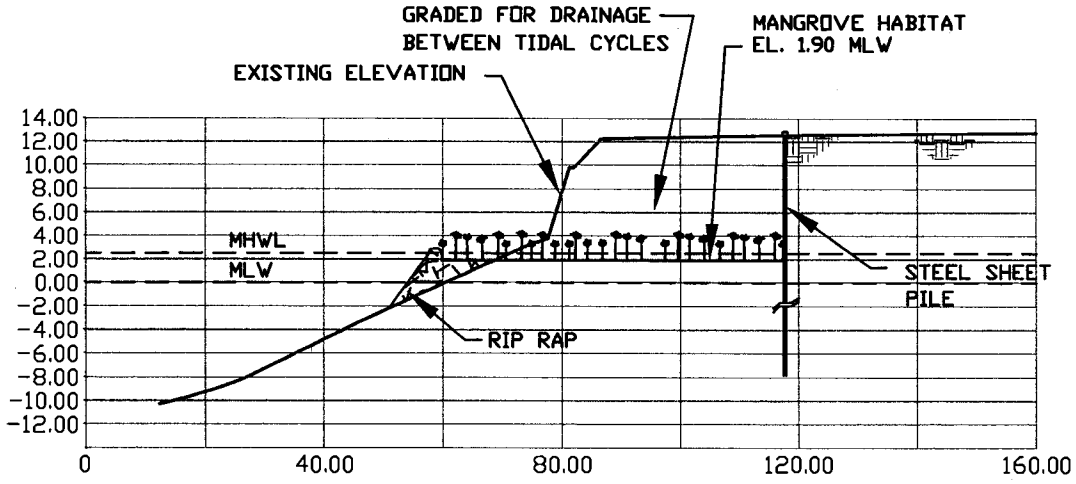

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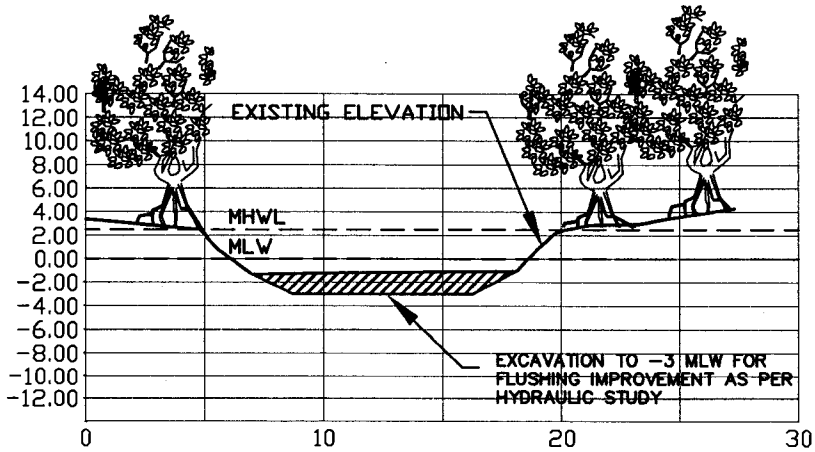

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE D CROSS SECTIONS

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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PLANTING NOTES:

MANGROVE HABITAT EL 1.90 MLW: THE MANGROVE HABITAT WILL BE GRADED TO WITHIN 0.10 FT OF THE SPECIFIED ELEVATION. PLANTINGS WILL BE 1 GALLON TREES, ON 5 FOOT STAGGERED CENTERS. TO HELP STABILIZE THE SUB-STRAIGHT AT TIME OF PLANTING, SPARTINA ALTERNIFLORA PLUGS WILL BE INTERSPERSED (5 FOOT CENTERS) WITH THE MANGROVE SEEDLINGS.

SIDE SLOPE PLANTINGS WILL CONSIST OF A MIXTURE THE FOLLOWING SPECIES

Baccharis halimifolia- saltbrush	1 Gallon
Borrichia arborescens- sea ox-eye daisy	1 Gallon
Borrichia frutescens- Sea ox-eye daisy	1 Gallon
Canavalia rosea- beach bean	1 Gallon
Distichlis spicata - seashore saltgrass	4" Liner
Ernodea litoralis- golden creeper	1 Gallon
Helianthus debilis- beach sunflower	1 Gallon
Iva imbricata- beach elder	1 Gallon
Paspalum vaginatum-salt jointgrass	4" Liner
Spartina patens- marsh hay cordgrass	4" Liner
Sporobolis virginicus- virginia dropseed	4" Liner
Batis martima- saltwort	4" Liner
Lycium carolinianum- christmas berry	1 Gallon
Scaerola plumieri- inkberry	1 Gallon
Pithecellobium keyensis- black bead	1 Gallon
Spartina spartina- gulf cord grass	4" Liner
Argusia gnaphalodes- sea lavender	1 Gallon
Coccoloba unifora- sea grape	3 Gallon

*1 GALLON ON 5 FT CENTERS
** 4" LINER ON 3FT CENTERS

PLOTTED:
TIME:
PLOT SCALE:
DESIGNED:
DRAWN:
CHECKED:
APPROVED:
DATE:

PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

PLANTING PLAN

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285
CAD FILE CAD FILE
SHEET NUMBER A9
SHEET OF

UMAM Comparison Report

Port Everglades Conservation Easement
Port Everglades
Broward County, FL

Prepared for:

Broward County

Public Works Department
Seaport Engineering & Construction Division
1850 Eller Drive
Ft. Lauderdale, FL 33316-4201

January 16, 2009

CH2MHILL
3001 PGA Blvd.
Suite 300
Palm Beach Gardens, FL 33410

Project #177284

Contents

Appendixes

1.0 Introduction

Port Everglades is proposing an expansion of the existing turning notch into 8.7 acres of the conservation easement (CE). As a result of this expansion Port Everglades would like this portion of the CE to be released. In exchange for this expansion the Port is proposing 17 acres of mangrove wetland creation within uplands adjacent to the turning notch as shown in Appendix 2-A, Project Drawings. The mitigation for the turning notch impacts will be addressed at West Lake Park.

In an effort to demonstrate equanimity of the exchange, UMAM evaluations have been conducted for both the CE to be released and the mangrove wetland to be created.

Mangrove Wetlands to be Removed

In January 2008, Coastal Systems International, Inc. performed a UMAM evaluation of the CE to be released (see Appendix 2-B, UMAM Assessment Form and Appendix 2-C, Polygon Map). The CE to be released was divided into 6 polygons that were independently scored (polygons 5-10). Polygon 5 consists of 0.36 acres of mangroves along the southern side of CE to be released. The 3 indicator scores for this polygon were: LLS -6, WE -4, CS -7 for a total Functional Loss of **0.21 Units**. Polygon 6 consists of 1.33 acres of mangrove wetlands along the eastern edge of the CE to be released. Because of its proximity to the upland, polygon 6 is impacted by exotic species growth. The indicator scores for polygon 6 were: LLS -4, WE -4, CS -3 for a total Functional Loss of **0.37 units**. Polygon 7 consists of 2.44 acres of mangroves along the northwestern side of the CE to be released. The indicator scores for polygon 7 were: LLS -7, WE -7, CS -8 for a total Functional Loss of **1.78 units**. Polygon 8 consists of 0.12 acres of mangroves located in the southern portion of the CE to be released. The indicator scores for polygon 8 were: LLS -3, WE -2, CS -1 for a total Functional Loss of **0.02 units**. Polygon 9 consists of 3.15 acres of mangroves located in the central portion of the CE to be released extending from the northern boundary to polygons 5 and 8. Tidal exchange within this area is limited by a berm along the channel. The indicator scores for polygon 9 were: LLS -6, WE -6, CS -7 for a total Functional Loss of **1.99 units**. Polygon 10 consists of 1.27 acres of mangroves located in the southwestern portion of the CE to be released. The indicator scores for polygon 10 were: LLS -7, WE -7, CS -7 for a total Functional Loss of **0.89 units**.

Based upon the Coastal Systems International, Inc UMAM the Total functional loss for the CE to be released is **5.38 units**.

2.0 Mangrove Wetlands to Remain

As part of the overall biological investigation, the mangrove habitat within the existing conservation easement to remain was also evaluated by CH2M HILL. Mangrove wetlands within this area appeared in excellent condition. Trees were seeding with normal leaf loss and new growth. Some leaf exfoliation was observed as expected as part of the detrital export to the surrounding ecosystem. Certain portions of the area had been impacted by recent hurricanes but were exhibiting both re-growth of branches on damaged trees and recruitment of juveniles in open areas.

Channels were well flushed as evidenced by good channel depth and lack of unconsolidated sediments. Flood tidal flow at the time of inspection was of sufficient strength to move the boat forward without aid of the outboard. Numerous fish and bird species were observed throughout the mangrove area.

More internal portions of the mangrove habitat were difficult to observe due to shallower depths and narrowing channels. However, the same general indicators of good health appeared to be present in the more inaccessible areas as well. The construction of the mangrove habitat is anticipated to have a positive impact on the entire conservation easement via enhanced flushing and a net increase in habitat acreage. Removal of certain flow restrictions as illustrated on project plans will further increase the health and function of the ecosystem. The removal of the flow restrictions, specifically the high spot to the east of the southern proposed tidal channel in site A will have no effects on manatee usage of the site. The northern connection will maintain a minimum of 3 ft of water throughout the tidal cycle.

Because of the proximity to the FPL hot water discharge, which manatees frequent in the winter months, the existing conservation easement to remain functions as additional habitat for manatees. The attached manatee survey (Appendix 2-D) conducted in early 2008 reflects usage over a 3 month period. As can been seen by the survey, the conservation easement to remain is frequented by manatees, but the 8.7 ac. turning notch expansion area shows no utilization. This lack of usage can be attributed to the shallow depths of the remnant channels within the area. The release of the 8.7 ac. turning notch expansion area will have no effects on manatee utilization of the remaining conservation area.

3.0 Mangrove Wetlands to be Constructed

In exchange for the 8.7 acres of CE to be released, 17 acres of mangrove wetlands creation is proposed. The sites are adjacent to the existing CE and will further enhance the remaining CE with a net gain of 8.3 acres of additional mangrove habitat. The creation sites were designed based on the successful elevations utilized at the John U. Lloyd Beach State Park.

The two main sites identified as A and B as shown in Appendix 2-A will be constructed with a series of tidal channels that will remain inundated throughout the tidal cycle. Because the two areas will be bisected by the proposed bridge no direct connection between sites A and B is planned in the form of culverts. Both sites A and B will receive tidal inundation from tidal creeks connected to the FPL canal. These open water features will provide the necessary hydrology for the created mangrove habitat. The created mangrove habitat will be graded in a manor that will allow drainage to the tidal channels between tidal cycles. The entire created mangrove habitat will be inundated during the high tide portion of the cycle.

The remaining two sites identified as C and D as shown in Appendix 2-A are located along the FPL discharge canal. These two locations will receive tidal exchange through the riprap that will line the edge of the constructed planting shelves. These planting shelves will also be graded to allow drainage between tidal cycles.

Site A is a currently undeveloped upland with 10-20% exotic coverage. Site B is currently a dry marina with open storage yards. Sites C and D consist of steep slopes at the edge of port uplands. Exotic species form the predominate vegetative coverage of these side slopes.

The Functional Gain units calculation was assessed by dividing the product of the risk and time lag by the delta from the current and proposed conditions resulting in a Relative Functional Gain (RFG). The RFG was then multiplied by the number of acres for the site to arrive at the Total Functional Gain units. A conservative time lag of 1.45 or 11-15 years was used in the UMAM calculations to allow for the time for the mangroves to reach functional maturity. A relatively low risk of 1.25 was used since the design was based upon the mangrove habitat elevation of the nearby successful mitigation at John U. Lloyd Beach State Park. This wetland creation project has been identified by the Department as a "highly successful" mangrove creation effort. The creation of the mangrove wetland habitat will also assist in overall wetland health as a result of the removal of currently available exotic seed sources.

The Functional Gains for the mangrove creation areas are as follows:

Site A (11.73 acres) = **4.28 units**

Site B (3.54 acres) = **1.29 units**

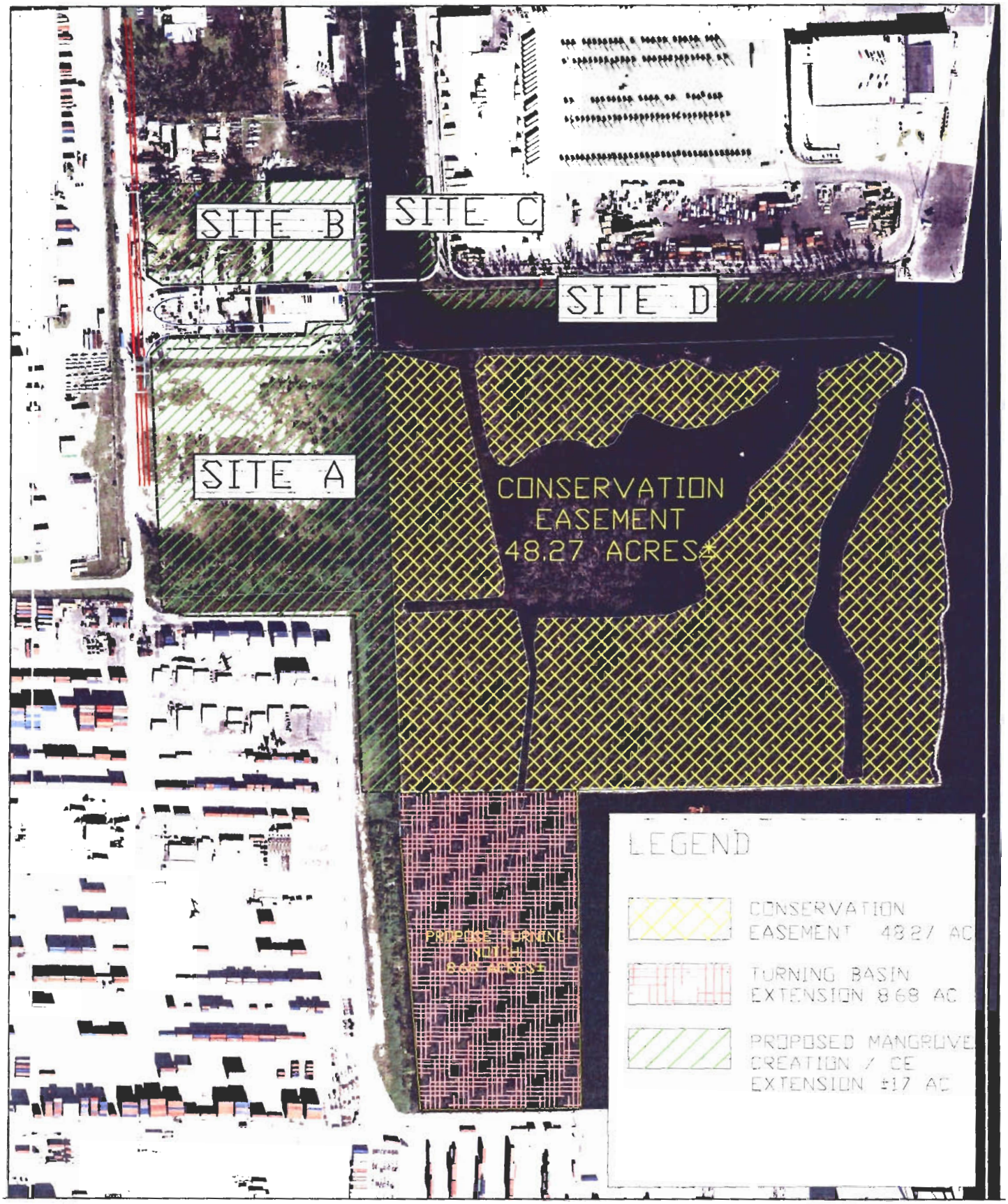
Sites C and D (1.78 acres) = **0.62 units**

Total Functional Gain for the mangrove wetlands to be constructed is **6.20 units.**

The UMAM evaluations for the CE to be released and the mangrove wetlands to be created indicate a positive functional gain of 0.82 units

APPENDIX 2-A

Project Drawings



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PLOT SCALE
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DRAWN
CHECKED
APPROVED
DATE

PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

FIGURE

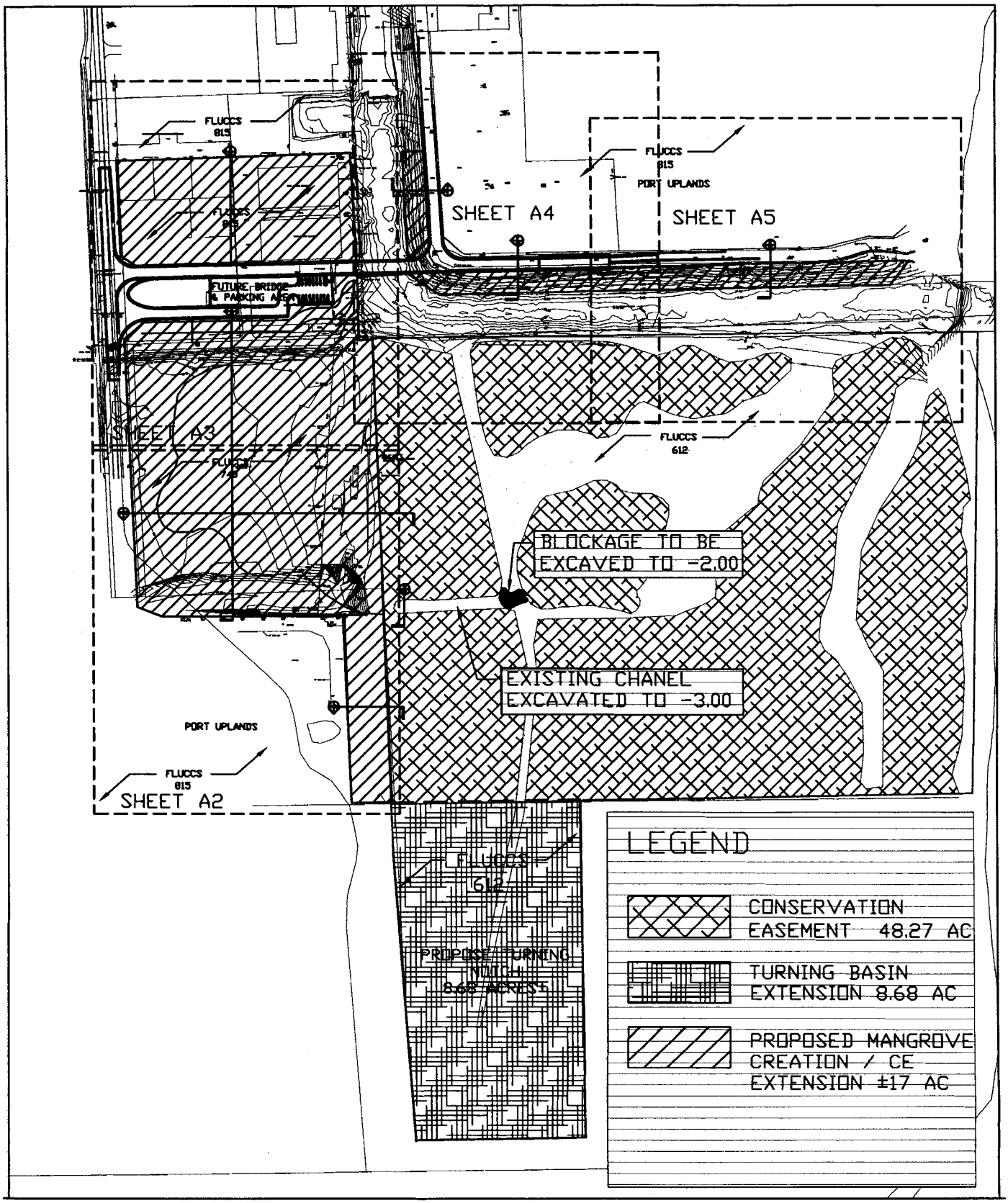
CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No 172285

CAD I.D.

SHEET NUMBER



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APPROVED:	–
DATE:	–

PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE PLAN–OVERVIEW

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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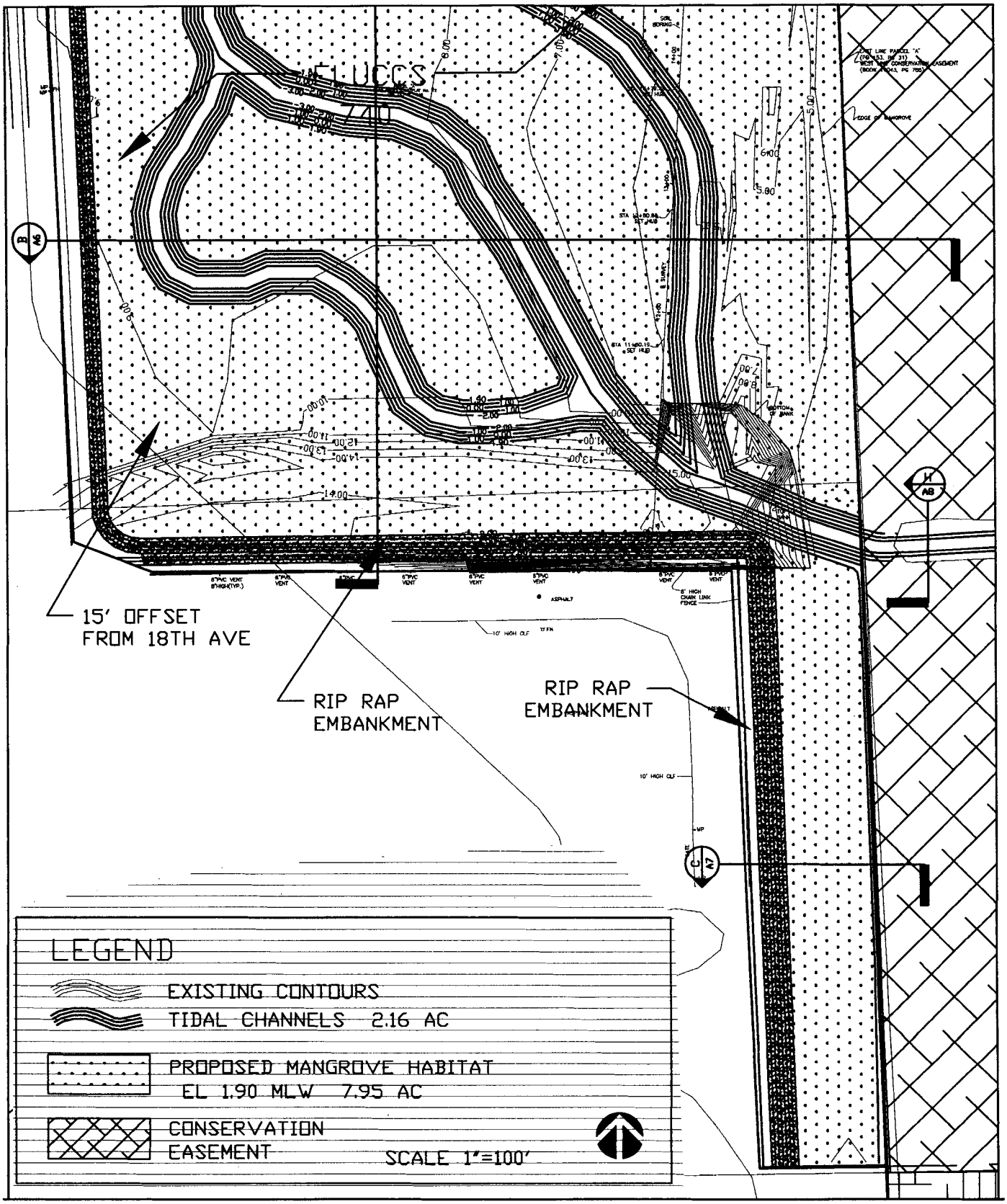

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE A PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

CAD FILE CAD FILE

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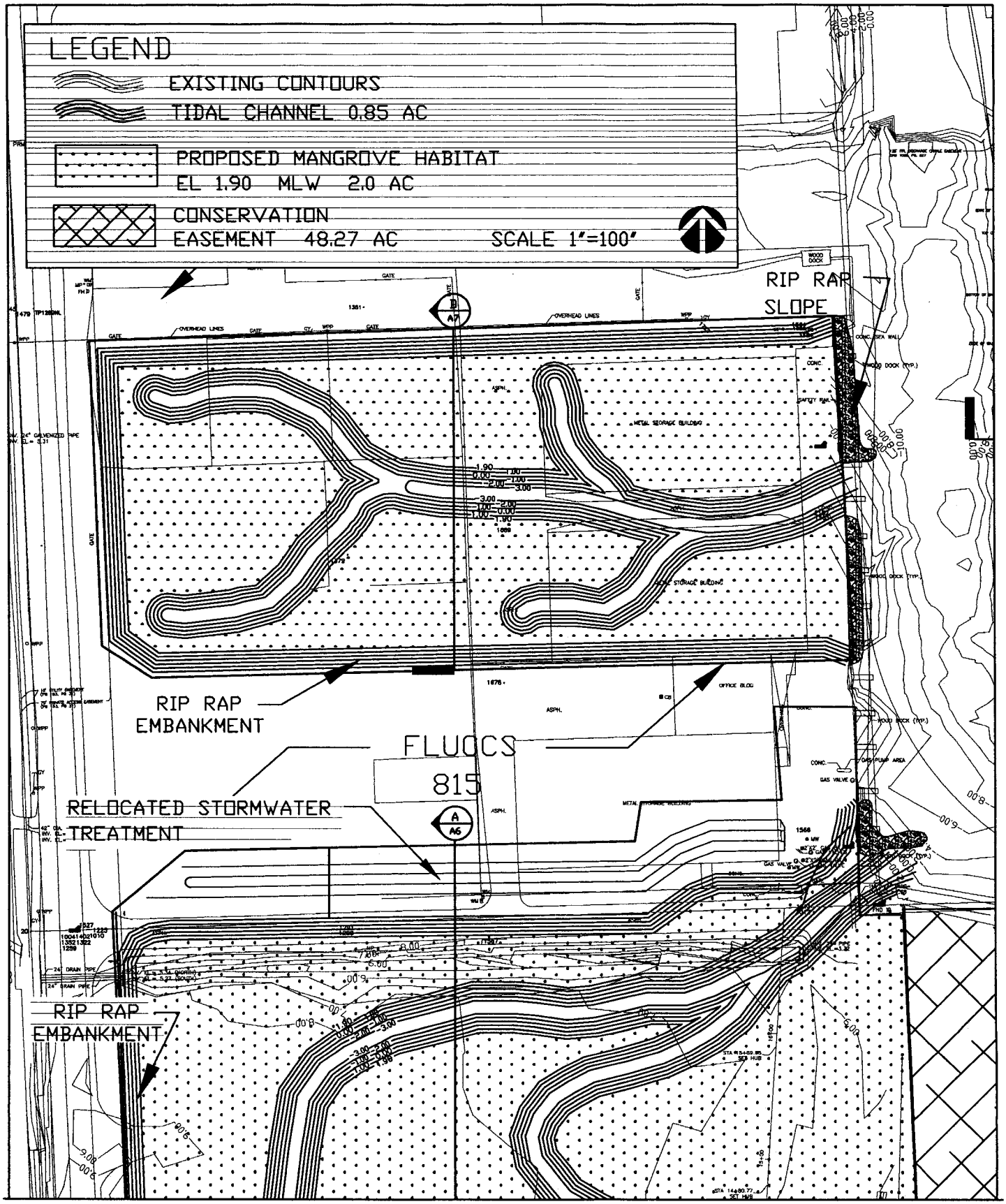

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE B PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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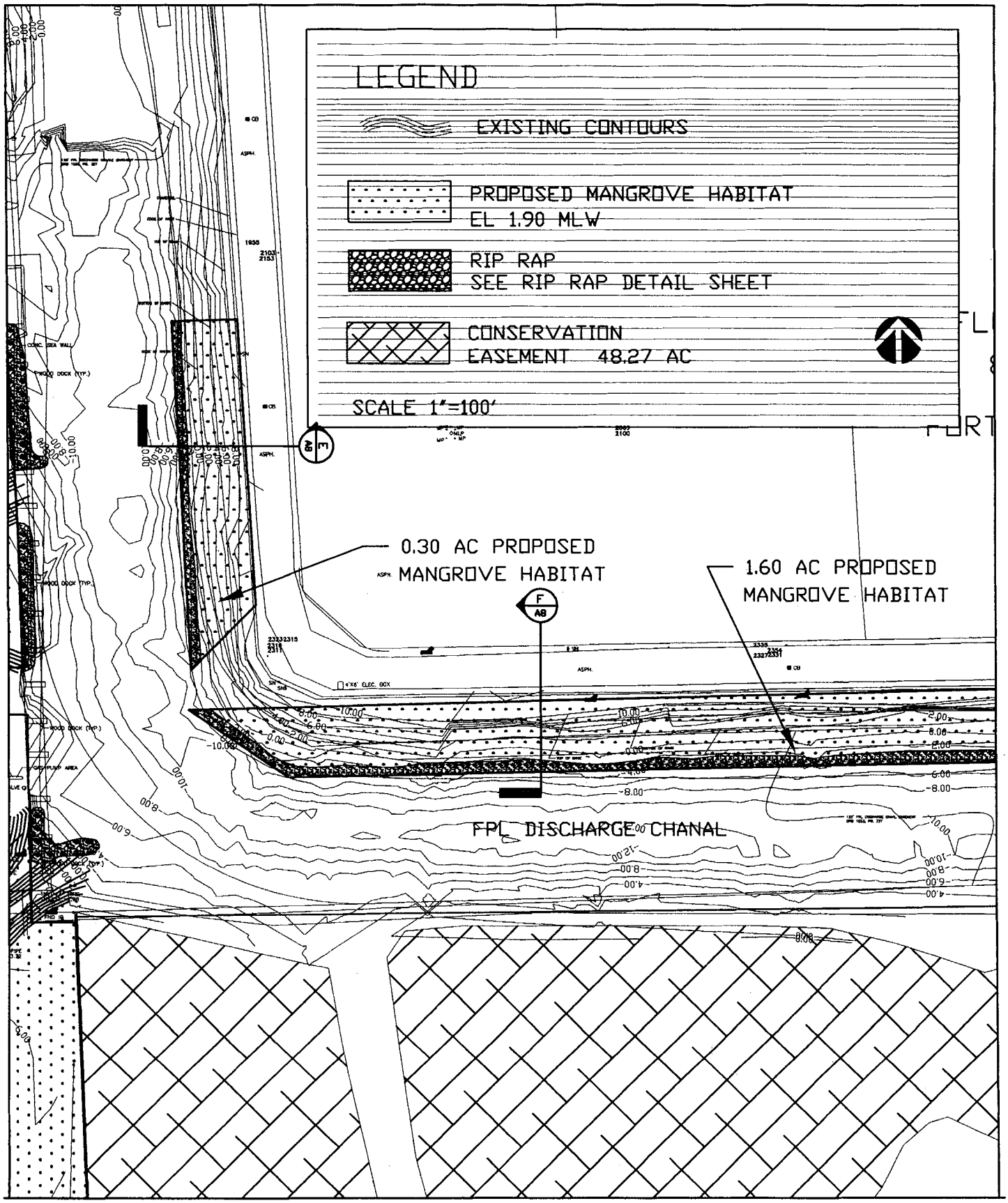

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DATE:	–

PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE C&D PROPOSED MANGROVE CREATION

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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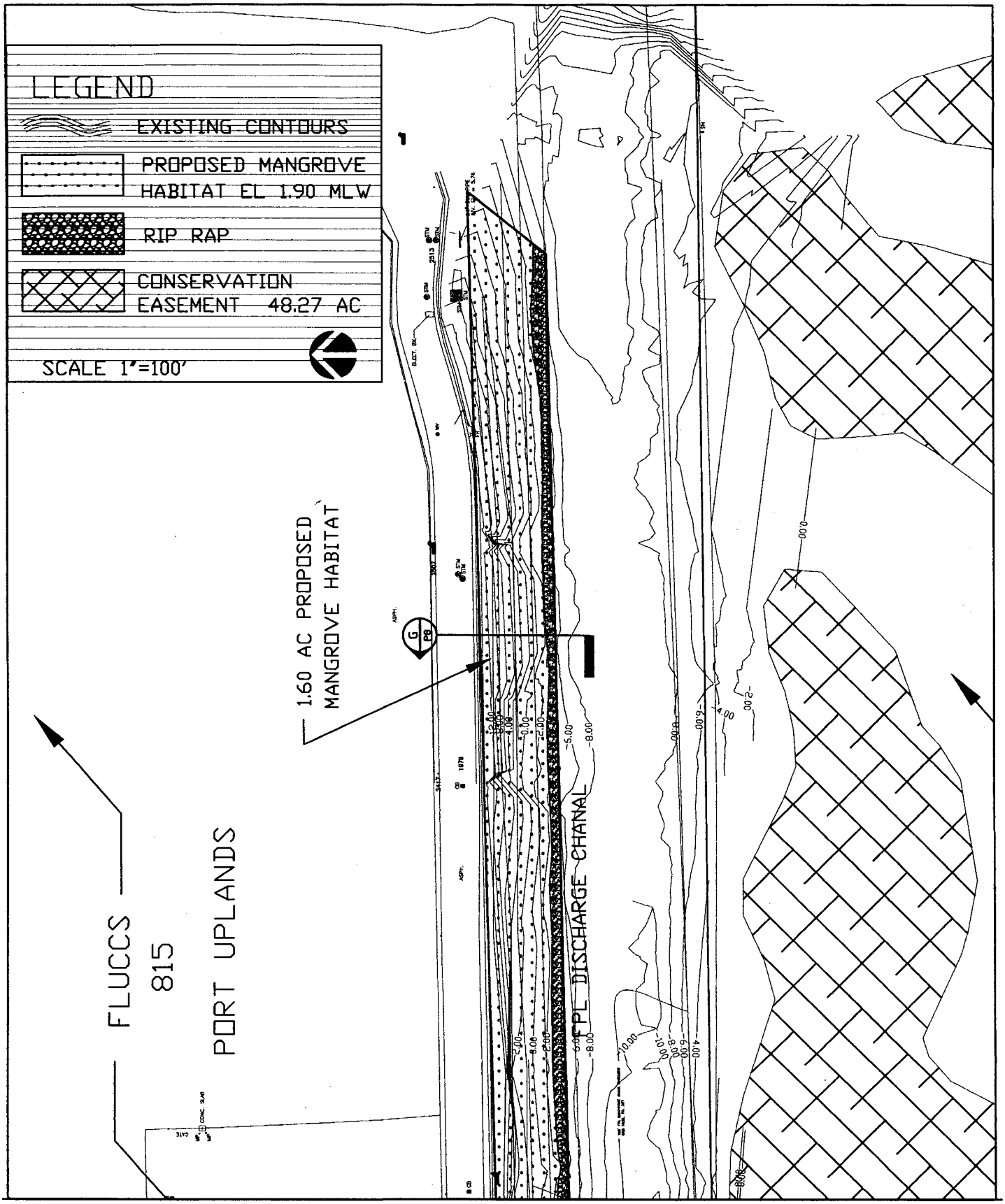

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE D– PROPOSED MANGROVE CREATION

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

CAD FILE CAD FILE

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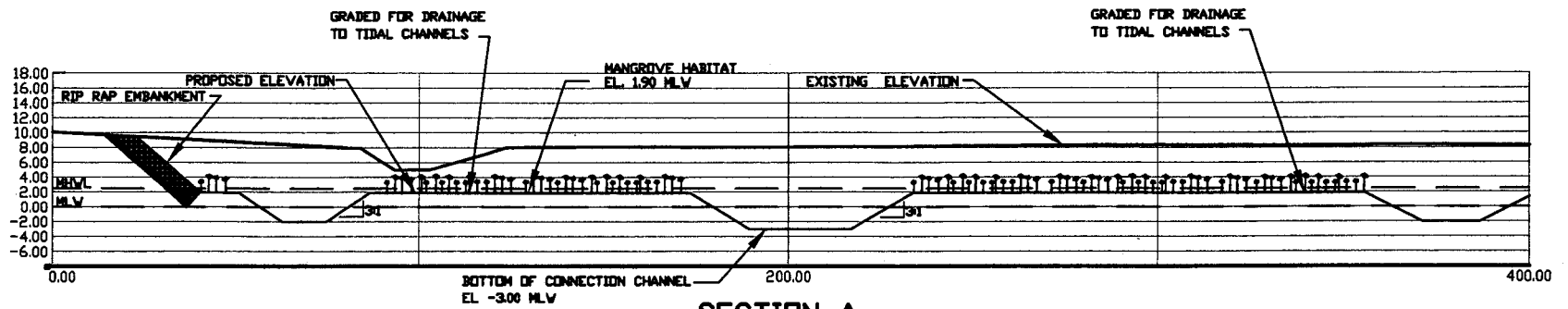
PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE A CROSS SECTIONS



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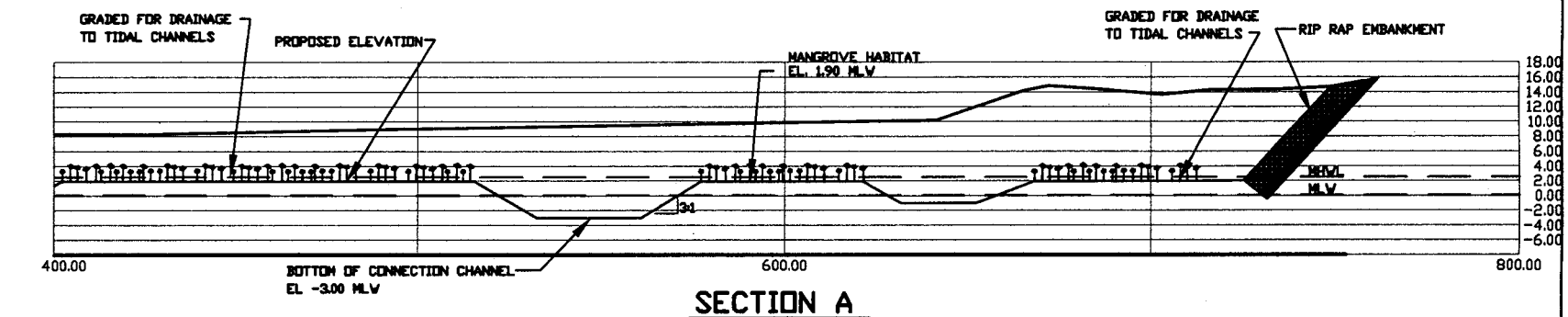

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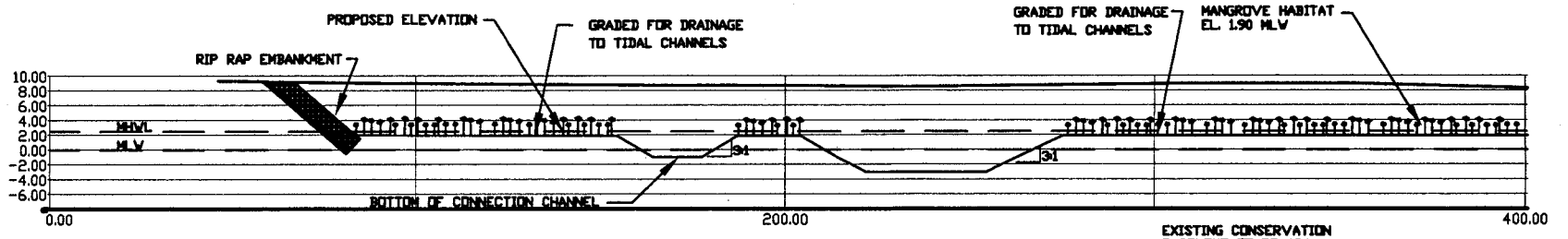

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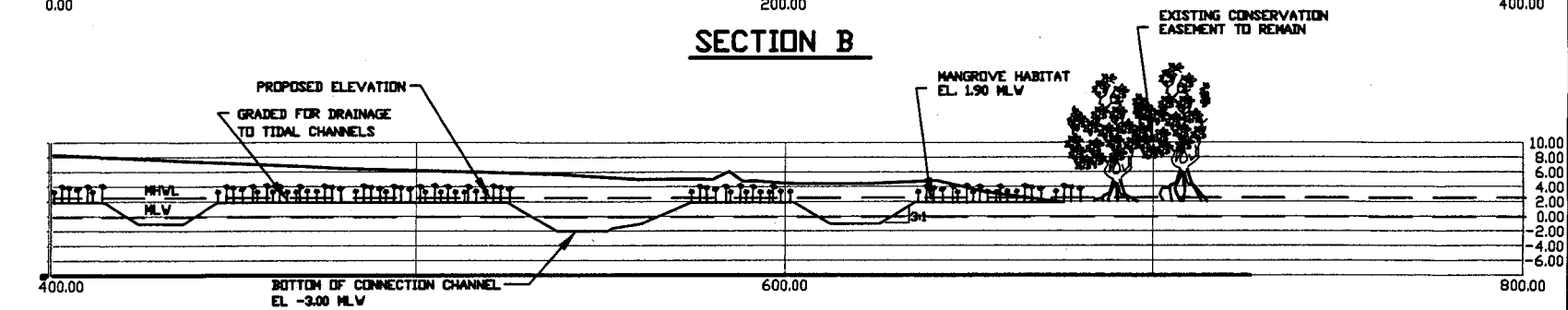

SECTION B

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

CAD FILE

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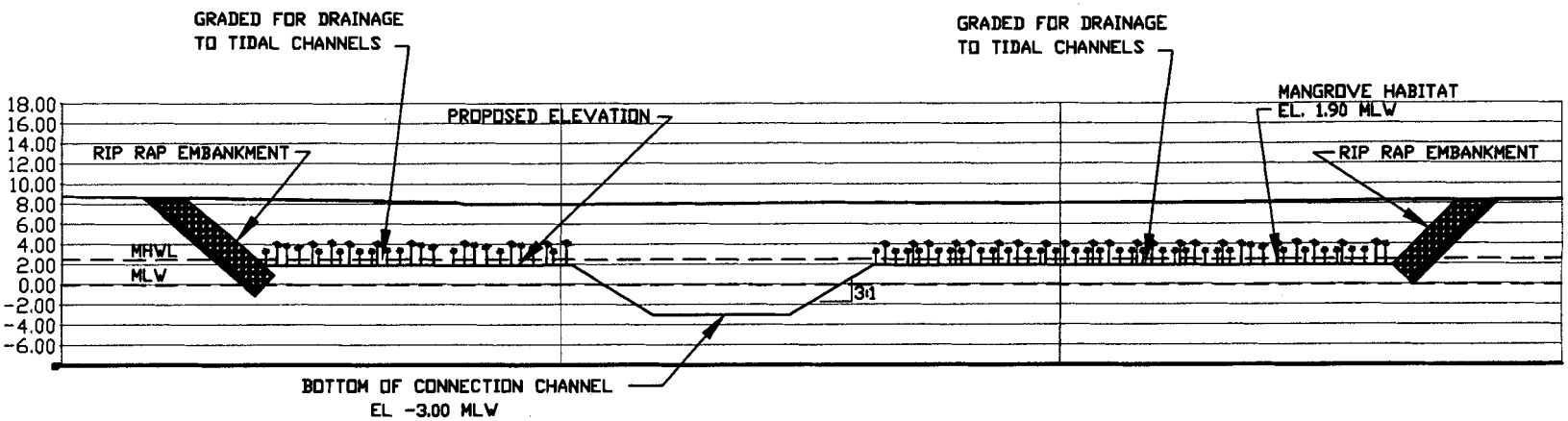

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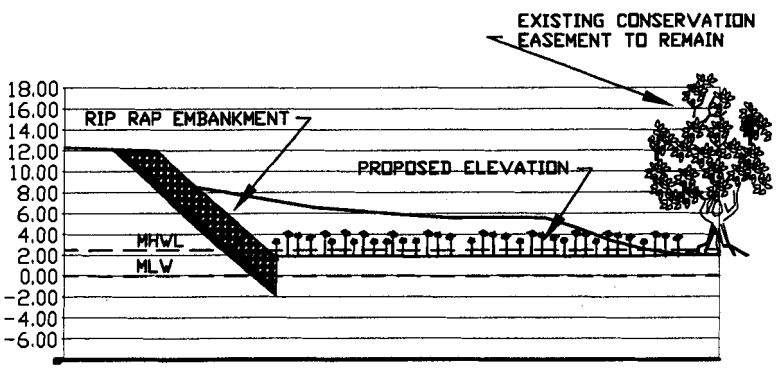

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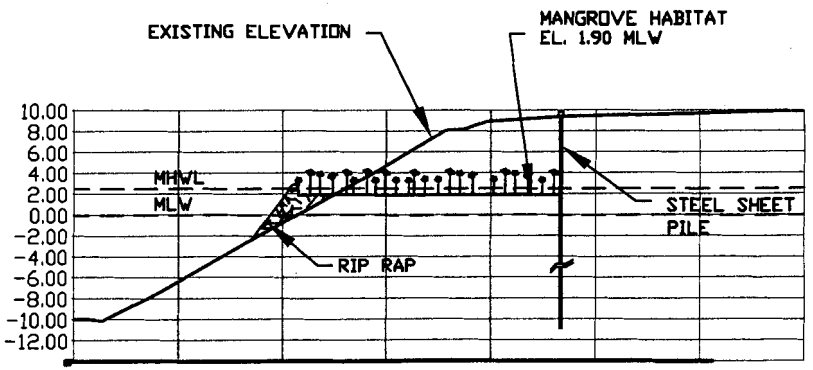

SECTION E

PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE B & C CROSS SECTIONS

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

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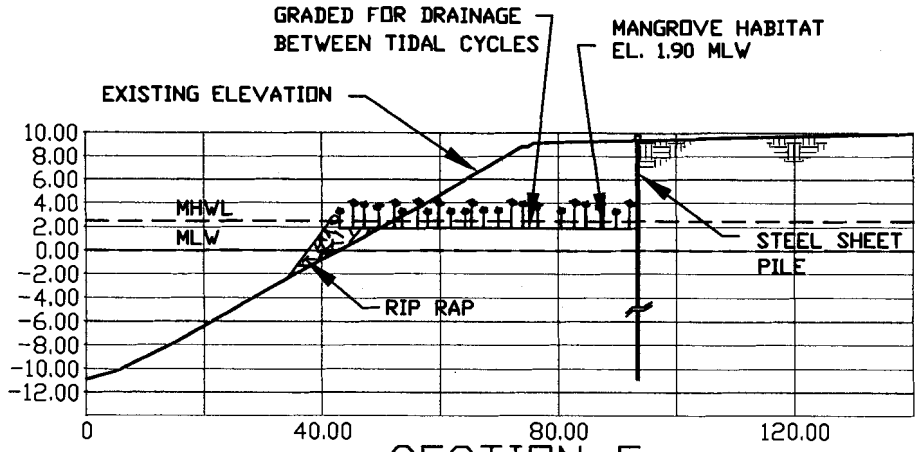

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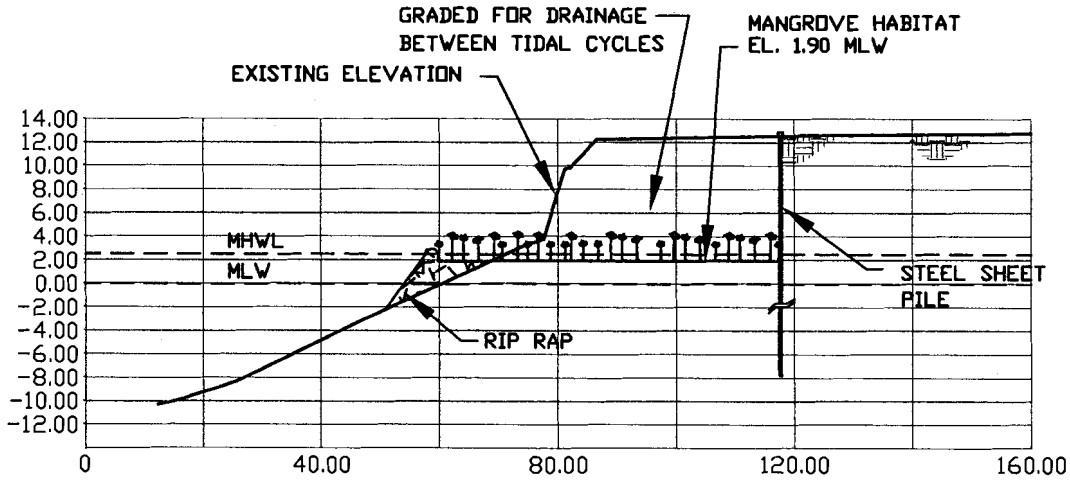

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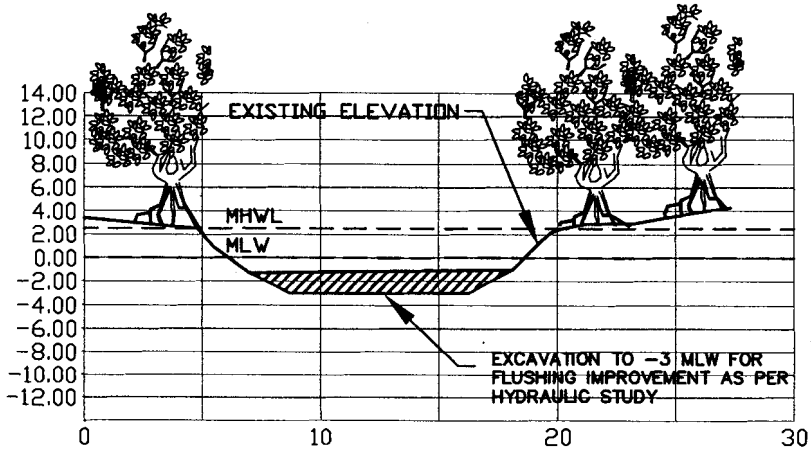

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PORT EVERGLADES CONSERVATION EASEMENT

PORT EVERGLADES

BROWARD COUNTY, FL

SITE D CROSS SECTIONS

CH2MHILL

4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285

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PLANTING NOTES:

MANGROVE HABITAT EL 1.90 MLW: THE MANGROVE HABITAT WILL BE GRADED TO WITHIN 0.10 FT OF THE SPECIFIED ELEVATION. PLANTINGS WILL BE 1 GALLON TREES, ON 5 FOOT STAGGERED CENTERS. TO HELP STABILIZE THE SUB-STRAIGHT AT TIME OF PLANTING, SPARTINA ALTERNIFLORA PLUGS WILL BE INTERSPERSED (5 FOOT CENTERS) WITH THE MANGROVE SEEDLINGS.

SIDE SLOPE PLANTINGS WILL CONSIST OF A MIXTURE THE FOLLOWING SPECIES

Baccharis halimifolia- saltbrush	1 Gallon
Borrichia arborescens- sea ox-eye daisy	1 Gallon
Borrichia frutescens- Sea ox-eye daisy	1 Gallon
Canavalia rosea- beach bean	1 Gallon
Distichlis spicata - seashore saltgrass	4" Liner
Ernodea litoralis- golden creeper	1 Gallon
Helianthus debilis- beach sunflower	1 Gallon
Iva imbricata- beach elder	1 Gallon
Paspalum vaginatum-salt jointgrass	4" Liner
Spartina patens- marsh hay cordgrass	4" Liner
Sporobolis virginicus- virginia dropseed	4" Liner
Batis martima- saltwort	4" Liner
Lycium carolinianum- christmas berry	1 Gallon
Scaerola plumieri- inkberry	1 Gallon
Pithecellobium keyensis- black bead	1 Gallon
Spartina spartina- gulf cord grass	4" Liner
Argusia gnaphalodes- sea lavender	1 Gallon
Coccoloba unifora- sea grape	3 Gallon

*1 GALLON ON 5 FT CENTERS
** 4" LINER ON 3FT CENTERS

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APPROVED:
DATE:

PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

PLANTING PLAN

CH2MHILL
4350 W Cypress
Suite # 600
Tampa, Florida
33607

JOB No. 172285
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APPENDIX 2-B

UMAM Assessment Form

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 5**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (mangrove swamp)	**N/A**	**Impact**	**0.36 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designetion of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mangrove wetlands located adjacent to the ICW, Port located immediately to the south, mangrove wetlands located to the north. Area is bordered to the east by a riprap revetment.

Assessment area description

Predominately red mangrove wetland with black and white mangroves also present. Area is characterized by a large amount of garbage and debris.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south, Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**

Functions	Mitigation for previous permit/other historic use
Mangroves provide nursery habitat for juvenile inshore and pelagic reef species, provide basis of food web in the form of detrital matter, provide roosting and foraging habitat for migratory and wading birds, stabilize sediment and provide protection of surrounding area from storm surge.	**This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates	**Little Blue heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Crab holes present

Additional relevant factors:

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 5**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**Concrete wall separating area from Port is located immediately to the south and west of the this area, riprap revetment to the east which separates area from ICW and mangrove wetlands are located to the north. Connection to surrounding area is limited by barriers (i.e. concrete wall to south, riprap revetment to the east) and there is a significant distance to the ICW. No exotics were present, however, pine needles were observed on the ground throughout the area as were large amounts of garbage and debris. With impact (dredging), mangrove swamp will no longer be present.**	**6**	**0**
.500(6)(b)Water Environment (n/a for uplands)	**Urban runoff from Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County, water levels lower than expected, decreased hydrological connection due to distance to ICW, barriers and limited tidal exchange. With impact (dredging), mangrove swamp will no longer be present.**	**4**	**0**
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Red, black, and white mangroves were present in this area, however, red was dominant overall. Black mangroves were dominant in trees under 5 feet tall and seedlings were common. Area was characterized by a large amount of garbage and debris, particularly plastic bottles. Pine needles were also observed throughout the area on the ground. The mean DBH was 2.4 inches. The mean tree height was 16 feet and the mean number of trees under 5 feet tall was 2.0. With impact (dredging), mangrove swamp will no longer be present.**	**7**	**0**

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.57	**0.00**

Delta = [with-current]
-0.57

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -0.21

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 6**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (mangrove swamp)	**N/A**	**Impact**	**1.33 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mangroves with uplands immediately adjacent to the west and south and berm located to the east.

Assessment area description

Tidally connected moangrove wetland with encroaching exotic species ranging from 30 to 100% at various data collection points.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south. Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**
Functions	Mitigation for previous permit/other historic use
Mangroves provide nursery habitat for juvenile inshore, pelagic and reef species, provide basis of food web in the form of dtrital matter, provide roosting and foraging habitat for migratory birds, stabilize sediment and provide protection.	**This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport**
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges, and other invertebrates	**Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

various spiders, crab holes

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 6**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: **4**	with: **0**	**Mangrove wetlands are tidally connected however there is a significant distance to the ICW. The Port is located directly to the west and south of this area and exotics are encroaching. connection to surrounding area is limited by berm located to the east of the assessment area. With impact (dredging), mangrove swamp will no longer be present.**
.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: **4**	with: **0**	**Urban runoff from Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County, water levels lower than expected, drecreased hydrological connection due to distance to ICW, barriers (i.e. berm) and limited tidal exchange. With impact (dredging), mangrove swamp will no longer be present.**
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: **3**	with: **0**	**Exotics in this area included Australian Pine, Wedelia, and Brazillian Pepper. The mean percent cover of exotics was 82%. Mangrove seedlings were rare. Black mangroves were the dominant species in trees below and above 5 feet in height. Red and white mangroves were also present at some of the points. The mean DBH of the trees was 1.9 inches. The mean tree height was 17 feet and the mean number of trees less than 5 feet tall was 0.7.**

Score = sum of above scores/30 (if uplands, divide by 20)		
current or w/o pres: **0.37**	with: **0.00**	

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres = **-0.49**

Delta = [with-current]
-0.37

If mitigation
Time lag (t-factor) =
Risk factor =

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 7**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (mangrove swamp)	**N/A**	**Impact**	**2.44 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mature mangrove wetlands, including a portion of the north south tidal channel, separated from the ICW to the east by a riprap boulder revetment. This area includes a portion of a tidal channel that runs north-south.

Assessment area description

Mature red mangrove wetland with black and white mangroves also present.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south. Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**

Functions	Mitigation for previous permit/other historic use
Mangroves provide nursery habitat for juvenile inshore and pelagic reef species, provide basis of food web in the form of detrital matter, provide manatee habitat, provide roosting and foraging habitat for migratory and wading birds, stabilize sedimen and provide protection of surrounding area from storm surge.	**This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates	**Manatee (E), Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Mangrove crabs, fiddler crabs, various spiders

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 7**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**Mangrove wetlands immediately surrond this area to the west and north and the Port is located in the near vicinity. A riprap revetment separates this area from the ICW. A tidal channel that runs north-south through this area provides a connection to the surrounding habitats. there is a long distance to open tidal waters of the ICW through the tidal channel, and the riprap wall slows tidal exchange. With impact (dredging), mangrove swamps will no longer be present.**	**7**	**0**
.500(6)(b)Water Environment (n/a for uplands)	**Data collection points in this area were either adjacent to the tidal channel or were in standing water between 0.5 and 1.5 feet deep. Urban runoff from the Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County and there is decreased hydrological connection due to distance to ICW. However, existing tidal channel provides good flushing. With impact (dredging), mangrove swamp will no longer be present.**	**7**	
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Red, black and white mangroves were present in this area, however, red was dominant overall. Red mangroves were the dominant species under 5 feet tall and seedlings were rare. All stages of mangroves were present but there were many large trees present. (1) Australian pine was observed in this area. The mean DBH of trees was 3.4 inches, mean tree height of 19 feet, while the mean number of trees less than 5 feet tall was 1.2. Extensive prop root systems were found throughout the area and some areas had open areas with less canopy.**	**8**	**0**

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.73	**0.00**

Delta = [with-current]
-0.73

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -1.78

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 8**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (mangrove swamp)	**N/A**	**Impact**	**0.12 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Within tidal mangroves at higher elevation than surrounding areas

Assessment area description

Mangrove area impacted by fill area approximately 16 feet wide

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south, Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**
Functions **Mangroves provie nursery habitat for juvenile pelagic reef species, provide basis of food web in the form of detrital matter, provide roosting and foraging habitat for migratory and wading birds, stabilize sediment and provide protection of surrounding area from storm surge.**	Mitigation for previous permit/other historic use **This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found) **Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates**	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area) **Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

None

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 8**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**Connection to surrounding area is limited by berm at higher elevation, significant distance from ICW and riprap revetment separating the ICW to the east. With impact (dredging), mangrove swamp will no longer be present.**	**3**	**0**
.500(6)(b)Water Environment (n/a for uplands)	**Urban runoff from Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County, water levels lower than expected, decreased hydrological connection due to distance to ICW, barriers, higher elevation and limited tidal exchange. With impact (dredging), mangrove swamp will no longer be present.**	**2**	**0**
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Only seedling present at lower elevation next to berm. With impact (dredging), mangrove swamp will no longer be present.**	**1**	**0**

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.20	0.00

Delta = [with-current]
-0.20

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -0.02

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 9**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (wetland swamp)	**N/A**	**Impact**	**3.15 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mature mangrove wetlands located west of existing berm and surrounded by mangrove wetlands.

Assessment area description

Predominately red magnrove wetland with black and white mangrove also present along with a large number of trees under 5 feet tall and abundant seedlings.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south, Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**
Functions **Mangroves provie nursery habitat for juvenile pelagic reef species, provide basis of food web in the form of detrital matter, provide roosting and foraging habitat for migratory and wading birds, stabilize sediment and provide protection of surrounding area from storm surge.**	Mitigation for previous permit/other historic use **This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found) **Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates**	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area) **Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Mangrove crabs, fiddler crabs, spiders

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 9**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**mangrove wetlands immediately surrond this area to the north, south, and west. Area is tidally connected; however separated from tidal channel by berm resulting in reduced tidal exchange and connection to surrounding areas. No exotics were present. The Port is located in the vicinity of this area. With impact (dredging), mangrove swamp will no longer be present.**	6	0
.500(6)(b)Water Environment (n/a for uplands)	**Urban runoff from Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County, slightly decreased hydrological connection and tidal exchange due to distance to ICW and separation from tidal channel. Sufficient water environment to support diverse community structure. With impact (dredging), mangrove swamp will no longer be present.**	6	0
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Red, black and white mangroves were present in this area; however, red was dominant overall. No exotics were present. Red mangroves were the dominant species under 5 feet tall and seedlings were abundant throughout. There were a large number of smaller trees present and the average number of trees under 5 feet tall per point was 7.9. DBH of trees was 2.2 inches and the mean tree height was 17 feet. With impact (dredging), mangrove swamp will no longer be present.**	7	

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.63	0.00

Delta = [with-current]
-0.63

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -1.99

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 9**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (wetland swamp)	**N/A**	**Impact**	**1.27 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mature mangrove wetlands, including a portion of the north south tidal channel, separated from the ICW to the east by a riprap bould revetment. Mangrove wetlands border area to the west, north, and south.

Assessment area description

Predominately red mangrove wetland with black and white mangroves also present. Seedlings were rare and there were a large number of trees less than 5 feet tall.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south, Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**
Functions	Mitigation for previous permit/other historic use
Mangroves provie nursery habitat for juvenile pelagic reef species, provide basis of food web in the form of detrital matter, provide roosting and foraging habitat for migratory and wading birds, stabilize sediment and provide protection of surrounding area from storm surge.	**This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates	**Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Mangrove crabs, fiddler crabs, spiders, raccoon

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 9**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
6120 (wetland swamp)	**N/A**	**Impact**	**1.27 acres**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63)/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Tidally connected mature mangrove wetlands, including a portion of the north south tidal channel, separated from the ICW to the east by a riprap bould revetment. Mangrove wetlands border area to the west, north, and south.

Assessment area description

Predominately red mangrove wetland with black and white mangroves also present. Seedlings were rare and there were a large number of trees less than 5 feet tall.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 36.2 acres of mangrove wetlands to the west and south, Port Everglades in surrounding area, John U. Lloyd State Park, West Lake Park	**Mangrove swamps are rare in Broward County**
Functions	Mitigation for previous permit/other historic use
Mangroves provie nursery habitat for juvenile pelagic reef species, provide basis of food web in the form of detrital matter, provide roosting and foraging habitat for migratory and wading birds, stabilize sediment and provide protection of surrounding area from storm surge.	**This area is part of a conservation easement that was granted to the then FDER by Port Everglades on 12/15/88 in accordance with dredge and fill permit # 060924019 for the development of the Southport Turning Notch.**
Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
Mangrove crabs, migratory and wading birds, juvenile fish, commercial fish, barnacles, oysters, sponges and other invertebrates	**Little Blue Heron (SSC), Snowy Egret (SSC), Tricolored Heron (SSC), Bald Eagle (E), Snook (SSC), Smalltooth Sawfish (T)**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

Mangrove crabs, fiddler crabs, spiders, raccoon

Additional relevant factors:

N/A

Assessment conducted by:	Assessment date(s):
Coastal Systems International, Inc.	**1/15/2008 - 1/17/2008**

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades Wetland Assessment	**N/A**	**Polygon 10**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Impact	**Coastal Systems Int.**	**1/15/2008 - 1/17/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**Tidally connected mangrove wetlands immediately surround this area to the north, south and west. Area is tidally connected; however reduced tidal exchange and connection to surrounding area as a result of a riprap revetment and distance to the ICW. No exotics were present. Port is located in the vicinity of this area. With impact (dredging), mangrove swamp will no longer be present.**	7	0
.500(6)(b)Water Environment (n/a for uplands)	**Urban runoff from Port and surrounding developed area; ICW receives stormwater runoff from all areas throughout the County; slighly decreased hyrological connection and tidal exchange due to distance along tidal channel to ICW and riprap revetment located to the east. With impact (dredging), mangrove swamp will no longer be present.**	7	0
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Red, black and white mangroves were present in this area; however, red was dominant overall. no exotics were present. Red mangroves were the dominant species under 5 feet tall and seedlings were rare. The mean number of trees under 5 feet was 2.9 while the mean DBH was 2.5 inches, mean tree height was 17 feet. With impact (dredging), mangrove swamp will no longer be present.**	7	0

Score = sum of above scores/30 (if uplands, divide by 20)		
current or w/o pres	with	
0.70	0.00	

Delta = [with-current]
-0.70

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

If mitigation
Time lag (t-factor) =
Risk factor =

For impact assessment areas
FL = delta x acres = -0.89

For mitigation assessment areas
RFG = delta/(t-factor x risk) =

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		**Scrape Down A**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
191 (undeveloped land)	**N/A**	**mitigation**	**11.73**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Site is adjacent to the existing FPL hot water discharge, ICW is located to the east, 48 ac Conservation Easement is located to the east. No hydrological connection

Assessment area description

Site is currently undeveloped upland. Site contains Australian pines and Brazilian pepper. Site borders the 48 ac. conservation easement.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
FPL discharge canal abuts a portion of the site. The ICW is located to east and a 48 ac conservation easement is located directly east of the site.	**Not Unique**

Functions	Mitigation for previous permit/other historic use
None	**Not mitigation**

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

None

Additional relevant factors:

Site is currently undeveloped upland with 10-20 coverage in exotic species.

Assessment conducted by:	Assessment date(s):
CH2M HILL	8/4/2008

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		**Scrape Down A**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	CH2M HILL	8/4/2008

Scoring Guidance	**Optimal (10)**	**Moderate(7)**	**Minimal (4)**	**Not Present (0)**
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

.500(6)(a) Location and Landscape Support	w/o pres or current: 6.00	with: 8.00

Current Conditions: Site is located within Port Everglades. Site is adjacent to 48 ac conservation easement and FPL hot water discharge canal. **Proposed Conditions:** Site will be directly connected to the conservation easement. Surrounding areas with exotic vegetation will be removed.

.500(6)(b)Water Environment (n/a for uplands)	w/o pres or current: 0.00	with: 9.00

Current Conditions: Site is currently upland with no hydrological connection **Proposed conditions:** The site will receive hydrological impute through a series of canals and tidal pools witch will be hydrological connected through the FPL discharge canal and the site will connect through one of the existing canals within the conservation easement.

.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	w/o pres or current: 0.00	with: 9.00

Current Conditions: Site is partially vegetated by Brazilian Pepper and Australian Pines. **Proposed conditions:** Site will be mangrove habitat with tidal pools and tidal creeks that allow for fish and wildlife usage. Expected usage will include foraging, roosting, nesting, nursery habitat for juvenile fish species .

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres: 0.20	with: 0.87

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

CH2M HILL
0.67

If mitigation	
Time lag (t-factor) =	1.46
Risk factor =	1.25

For mitigation assessment areas	
RFG = delta/(t-factor x risk) =	0.37

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		**Scrape Down B**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
191 (undeveloped land)	**N/A**	**Mitigation**	**3.54**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Site is adjacent to the existing FPL discharge canal, ICW is located to the east, 48 ac Conservation Easement is located to the south. To the north in the manatee nursery. No hydrological connection

Assessment area description

Site is currently dry marina and open yard storage.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to east, 48 ac conservation easement is located directly east of the site.	**Not Unique**

Functions	Mitigation for previous permit/other historic use
None	**Not mitigation**

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)
None	**None**

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

None

Additional relevant factors:

Site is currently a functioning dry dock marina, and open storage yards. The site is just south of the existing manatee nursery. Site will be hydrologicaly connected to the FPL discharge canal by a tidal channel. The tidal channel will provide habitat for fish and wildlife.

Assessment conducted by:	Assessment date(s):
CH2M HILL	8/4/2008

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		**Scrape Down B**
Impact or Mitigation	Assessment conducted by:	Assessment date:
Mitigation	**CH2M HILL**	**8/4/2008**

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

		w/o pres or current	with
.500(6)(a) Location and Landscape Support	**Current conditions:** Site is located within Port Everglades. Site is adjacent to 48 ac conservation easement and FPL discharge canal. **Proposed conditions:** 3.54 ac of surrounding areas will have exotic vegetation removed and will be excavated and planted with mangroves.	6.00	8.00
.500(6)(b)Water Environment (n/a for uplands)	**Current Conditions:** Site is currently upland with no hydrological connection **Proposed conditions:** The site will receive hydrological impute through a tidal channel which will be hydrologicaly connected through the FPL discharge canal.	0.00	9.00
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	**Current Conditions:** Site is currently a dry dock marina and open storage yard with scattered exotic vegetation. **Proposed conditions:** Site will be mangrove habitat with a tidal creek that allow for fish and wildlife usage. Expected usage will include foraging, roosting, nesting, nursery habitat for juvenile fish species .	0.00	9.00

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.20	0.87

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

CH2M HILL
0.67

If mitigation	
Time lag (t-factor) =	1.46
Risk factor =	1.25

For mitigation assessment areas	
RFG = delta/(t-factor x risk) =	0.37

PART I – Qualitative Description
(See Section 62-345.400, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		**Scrape Down C & D**

FLUCCs code	Further classification (optional)	Impact or Mitigation Site?	Assessment Area Size
191 (undeveloped land)	**N/A**	**Mitigation**	**1.78**

Basin/Watershed Name/Number	Affected Waterbody (Class)	Special Classification (i.e.OFW, AP, other local/state/federal designation of importance)
Southeast Coast(FL63/29/030902	**Class III**	**N/A**

Geographic relationship to and hydrologic connection with wetlands, other surface water, uplands

Site is adjacent to the existing FPL hotwater discharge, ICW is located to the east, 48 ac Conservation Easement is located to the South

Assessment area description

Site is currently undeveloped upland slope adjoining Port to the FPL Discharge canal. Site contains Australian pines and Brazilian pepper.

Significant nearby features	Uniqueness (considering the relative rarity in relation to the regional landscape.)
ICW is located to the east, 48 ac conservation easement is located directly south of the site. FPL discharge canal is adjacent to the site.	**Not Unique**

Functions	Mitigation for previous permit/other historic use
Current functions of the site are limited due to dense exotic growth with limited shoreline interface. Possible usage includes roosting.	**Not mitigation**

Anticipated Wildlife Utilization Based on Literature Review (List of species that are representative of the assessment area and reasonably expected to be found)	Anticipated Utilization by Listed Species (List species, their legal classification (E, T, SSC), type of use, and intensity of use of the assessment area)

Observed Evidence of Wildlife Utilization (List species directly observed, or other signs such as tracks, droppings, casings, nests, etc.):

roosting evident.

Additional relevant factors:

Currently the site is densely vegetated with Brazilian Pepper and Australian Pines.

Assessment conducted by:	Assessment date(s):
CH2M HILL	8/4/2008

PART II – Quantification of Assessment Area (impact or mitigation)
(See Sections 62-345.500 and .600, F.A.C.)

Site/Project Name	Application Number	Assessment Area Name or Number
Port Everglades		Scrape Down C & D
Impact or Mitigation	**Assessment conducted by:**	**Assessment date:**
Mitigation	CH2M HILL	8/4/2008

Scoring Guidance	Optimal (10)	Moderate(7)	Minimal (4)	Not Present (0)
The scoring of each indicator is based on what would be suitable for the type of wetland or surface water assessed	Condition is optimal and fully supports wetland/surface water functions	Condition is less than optimal, but sufficient to maintain most wetland/surface waterfunctions	Minimal level of support of wetland/surface water functions	Condition is insufficient to provide wetland/surface water functions

	w/o pres or current	with	
.500(6)(a) Location and Landscape Support	6.00	7.00	**Current Conditions:** Site is located within Port Everglades. Site is adjacent to 48 ac CE and FPL hotwater discharge canal. **Proposed Conditions:** Site will be continuous with adjacent CE and will have no exotic species present in the vicinity.
.500(6)(b)Water Environment (n/a for uplands)	0.00	9.00	**Current Conditions:** Site is currently upland with no hydrological connection **Proposed conditions:** The site will receive hydrological impute through rip rap which will line the edge of the created planting shelves.
.500(6)(c)Community structure 1. Vegetation and/or 2. Benthic Community	0.00	9.00	**Current Conditions:** Site is vegetated by Brazilian Pepper and Australian Pines. **Proposed conditions:** Site will be mangrove habitat with rip rap along the FPL canal edge. Expected usage will include foraging, roosting, nesting, nursery habitat for juvenile fish species .

Score = sum of above scores/30 (if uplands, divide by 20)	current or w/o pres	with
	0.20	0.83

If preservation as mitigation,
Preservation adjustment factor =
Adjusted mitigation delta =

For impact assessment areas
FL = delta x acres =

CH2M HILL
0.63

If mitigation	
Time lag (t-factor) =	1.46
Risk factor =	1.25

For mitigation assessment areas
RFG = delta/(t-factor x risk) = 0.35

Mitigation Determination Formulas
(See Section 62-345.600(3), F.A.C.)

For each impact assessment area:

(FL) Functional Loss = Impact Delta X Impact acres

For each mitigation assessment area:

(RFG) Relative Functional Gain = Mitigation Delta (adjusted for preservation, if applicable)/((t-factor)(risk))

(a) Mitigation Bank Credit Determination

The total potential credits for a mitigation bank is the sum of the credits for each assessment area where assessment area credits equal the RFG times the acres of the assessment area scored

Bank Assessment Area	RFG	X	Acres	=	Credits
example					
a.a.1					
a.a.2					
total					

(b) Mitigation needed to offset impacts, when using a mitigation bank

The number of mitigation bank credits needed, when the bank or regional offsite mitigation area is assessed in accordance with this rule, is equal to the summation of the calculated functional loss for each impact assessment area.

Impact Assessment Area	FL	=	Credits needed
example			
a.a.1			
a.a.2			
total			

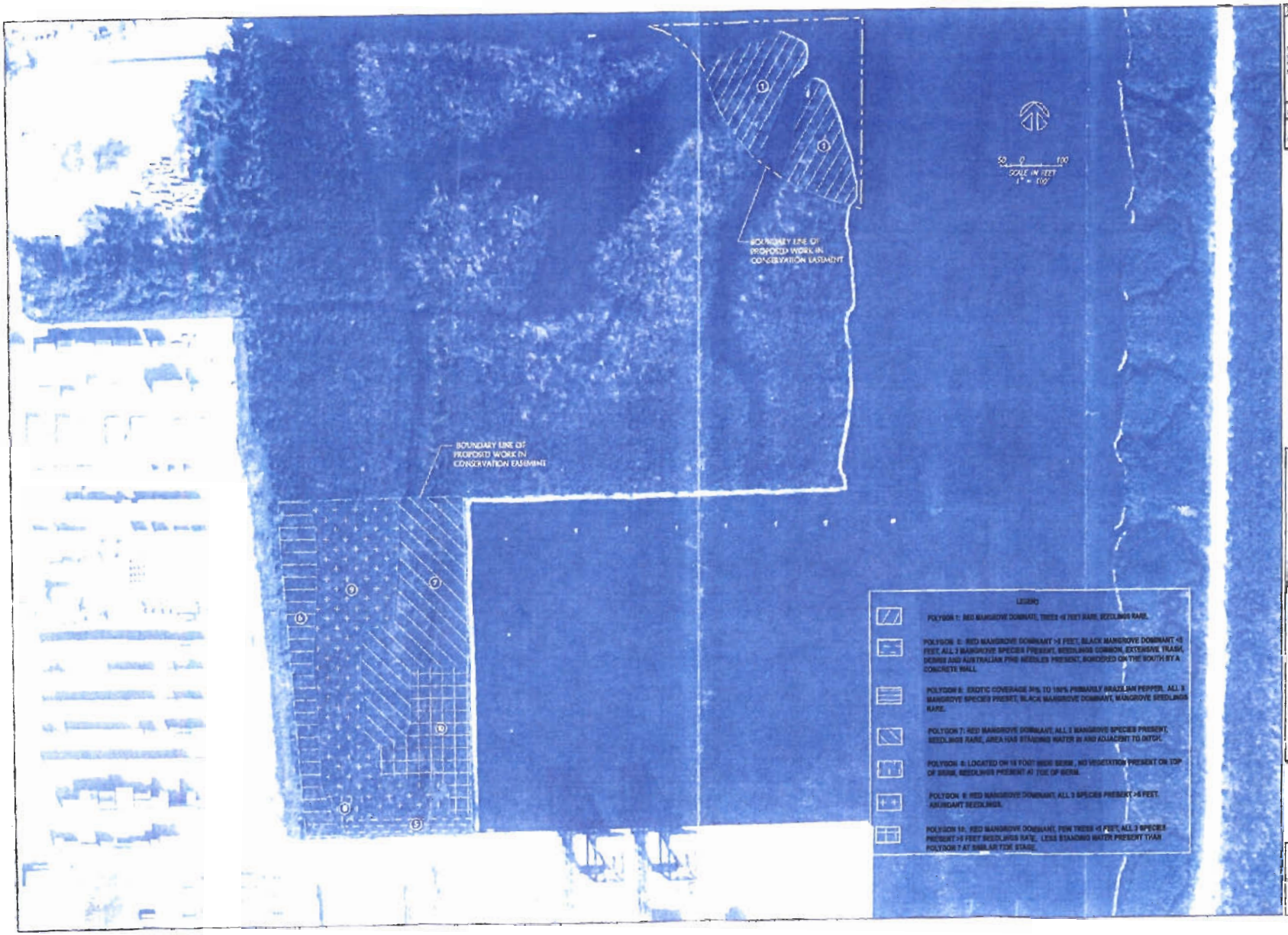
(c) Mitigation needed to offset impacts, when not using a bank

To determine the acres of mitigation needed to offset impacts when not using a bank or a regional offsite mitigation area as mitigation, divide functional loss (FL) by relative functional gain (RFG). If there are more than one impact assessment area or more than one mitigation assessment area, the total functional loss and total relative functional gain is determined by summation of the functional loss (FL) and relative functional gain (RFG) for each assessment area.

	FL	RFG	Acres	Total
example				
A		0.37	11.73	4.28
B		0.37	3.54	1.29
C&D		0.35	1.78	0.62
Total Funtional Gain				**6.20**
CE				
P5	-0.21			-0.21
P6	-0.49			-0.49
P7	-1.78			-1.78
P8	-0.02			-0.02
P9	-1.99			-1.99
P10	-0.89			-0.89
Total Functional Loss				**-5.38**

APPENDIX 2-C

Polygon Map



COASTAL SYSTEMS INTERNATIONAL, INC.
464 South Dixie Highway, Coral Gables, Florida 33146
Tel. 305-661-1053 Fax. 305-661-1914 www.CoastalSystems.net
STATE OF FLORIDA CA #7907
Coastal, Environmental, Civil Engineering and Management

COASTAL SYSTEMS INTERNATIONAL

FIGURE 4
MANGROVE RESOURCES DOCUMENTED WITHIN
8.7 ACRE AND 3.2 ACRE PARCELS
PORT EVERGLADES, BROWARD COUNTY, FLORIDA

1" = 100'
190307

4

APPENDIX 2-D

Manatee Survey

Manatee Survey, Port Everglades
(1/18/08-3/13/08)

△ Manatee Locations

BROWARD COUNTY FLORIDA

Public Works Department
Seaport Engineering and Construction Division

March 21, 2008

manatee.apr

Hydrodynamic Modeling Analysis of Proposed Mangrove Enhancement Areas

Port Everglades Conservation Easement
Port Everglades
Broward County, FL

Prepared for:

Broward County

Public Works Department
Seaport Engineering & Construction Division
1850 Eller Drive
Ft. Lauderdale, FL 33316-4201

January 26, 2009

CH2MHILL
3001 PGA Blvd.
Suite 300
Palm Beach Gardens, FL 33410

Project #172284

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1.0 Introduction

This report presents results of a multidimensional hydrodynamic modeling analysis of proposed mangrove enhancement activities at Port Everglades, Florida, related to expansion of the Port's turning notch. Approximately 8.68 acres of mangroves will be removed to expand the turning notch; a total of four areas encompassing 16.76 acres have been selected for enhancement. Figure 1.1 presents an overview of the project area showing the existing conservation easement, the proposed turning notch, and the proposed enhancement areas (green cross-hatch).

Note that there are 4 separate enhancement areas: two larger areas on the west side of the FPL Canal, and two additional smaller areas to the northeast. The majority of the proposed enhancement areas are located on the west side of the FPL Canal, and have been designed with shallow channels (-2 to -3 ft MLW) and a marsh plain elevation of +/- 2 feet MLW. The two smaller areas to the north and east of the canal have a design elevation of 2 feet MLW and no channels.

The numerical analysis used the Surfacewater Modeling System, which contains the two-dimensional, depth-averaged hydrodynamic model RMA-2 and the RMA-4 constituent transport model used for the flushing analysis. The Surfacewater Modeling System is widely used by engineers to model complex hydrodynamics in estuarine water bodies. The models contained in SMS were developed in part by the US Army Corps of Engineers.

FIGURE 1.1 EXISTING AND PROPOSED MANGROVE HABITAT

2.0 Field Data Collection

A field data collection campaign was designed and implemented to obtain oceanographic data in the vicinity of Port Everglades for use in the numerical modeling analysis. Instruments were deployed by CH2M HILL staff on August 6, 2008, and retrieved on August 26, 2008. The proposed 14 day deployment was extended because of Tropical Storm Faye, which passed over Florida from west to east (Naples to Melbourne) on August 19 and 20 and then again from East (near Daytona Beach) to West on August 21. The influence of the tropical storm is visible in the water level records when compared to local predicted tides.

Two InterOcean S4 current meters were deployed to measure current velocity, water depth, conductivity, and temperature. Instruments were anchored in place with concrete paving blocks and held in a vertical position via buoys. One meter was deployed on the eastern edge of the Intracoastal Waterway (ICW) just south of the U.S. Coast Guard Station, and the second meter was deployed in the FPL Canal, slightly north of center and roughly mid-way between the ICW and the Dry Marina. Two pressure transducers were also deployed to provide more accurate measurements of water levels in the vicinity of the project area; one instrument was deployed at the eastern end of the Dania Cutoff Canal, and the second was deployed in the ICW adjacent to the S4 meter. Figure 2.1 shows the deployment locations of both the S4 and water level instruments.

Figure 2.2 shows the current meter string deployed in the ICW. The instrument array consists of concrete blocks used to anchor the instrument array to the sea floor, an acoustic release to aid in retrieval of the instrument, the actual current meter, and two vinyl floats to keep the current meter oriented correctly in the water column. The components are linked with stainless steel cables. This meter was deployed at 14:25 on August 6, 2008, in approximately 43 feet of water, approximately 50 yards south of the manatee warning sign on the eastern edge of the ICW just south of the U.S. Coast Guard Station (26 deg, 5', 11.7" North; 80 deg, 6', 46.7" West).

Figure 2.3 shows the current meter as deployed in the FPL Canal. This meter was deployed in approximately 11 feet of water at 10:20 on August 6, 2008. An acoustic release was not required for this shallow deployment (26 deg, 04', 42.7" North; 80 deg, 07', 04.5" West). A security cable was attached to the current meter array, and then connected to a tree trunk on the northern bank of the FPL canal.

The two water level instruments were deployed Water level instruments were housed in PVC containers and affixed with pipe clamps to signposts. Figure 2.4 shows the signpost at the entrance of the Dania Canal (26 deg, 03', 52.9" North; 80 deg, 06', 49.7" West). The second water level recorder was deployed at a similar sign adjacent to the U.S. Coast Guard Station (26 deg, 05', 13.3" North; 80 deg, 06', 46.1" West).

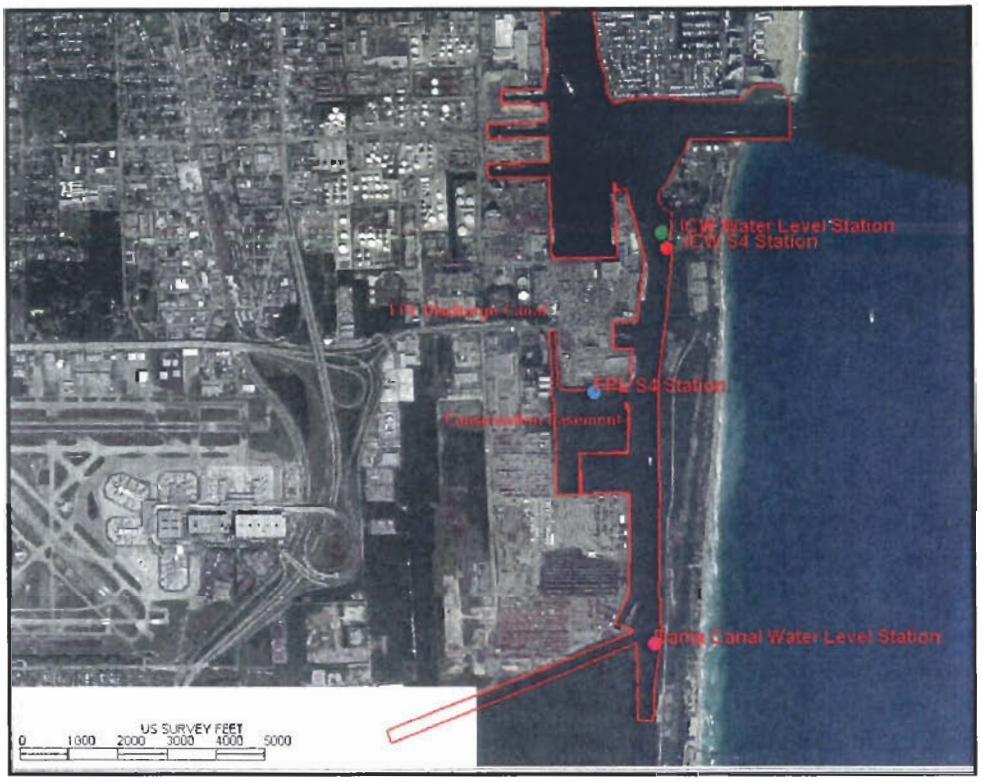

FIGURE 2.1 DEPLOYMENT SITES: S4 CURRENT METERS AND WATER LEVEL RECORDERS

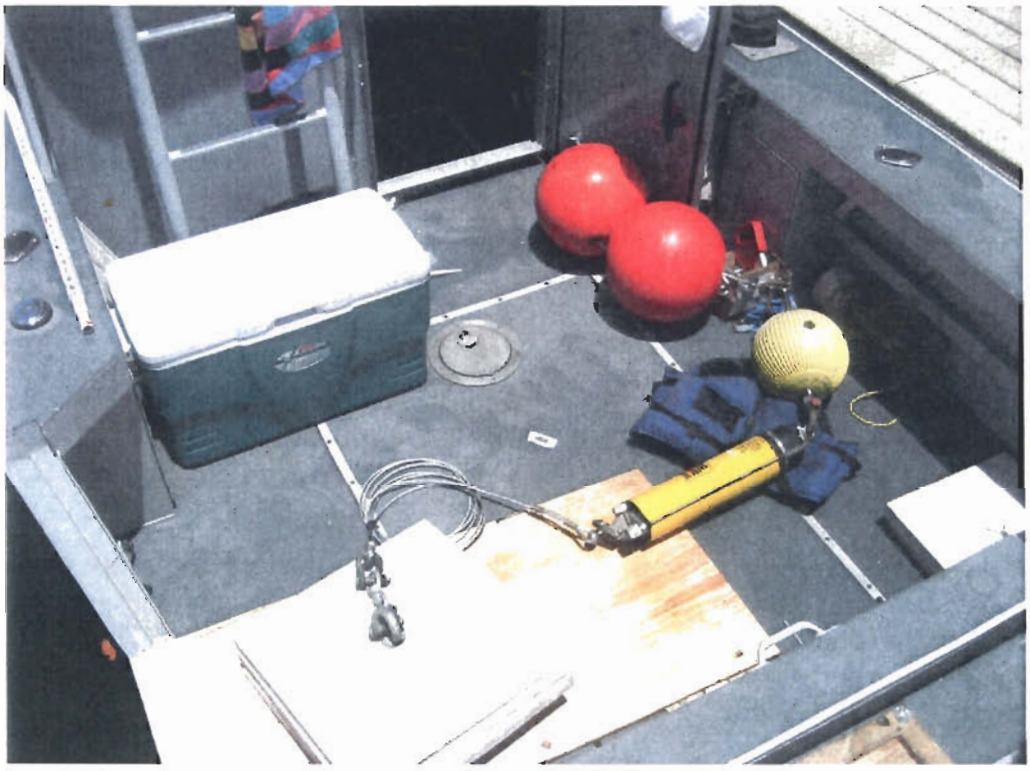

FIGURE 2.2. CURRENT METER STRING DEPLOYED AT ICW STATION

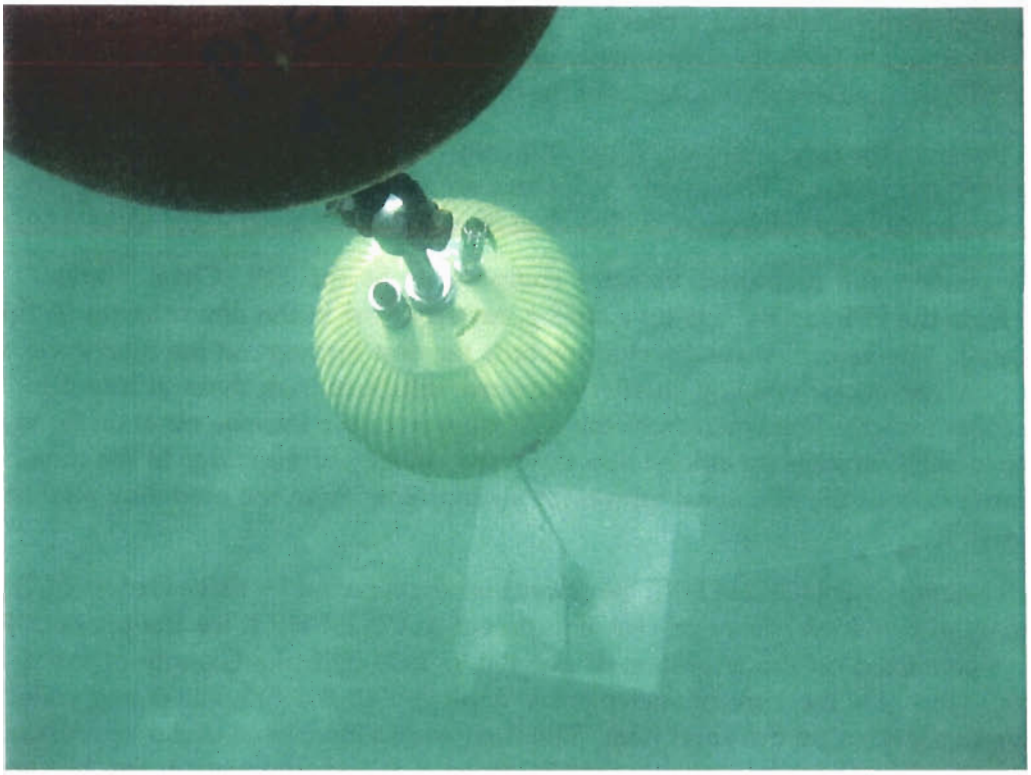

FIGURE 2.3. CURRENT METER DEPLOYED AT FPL CANAL STATION

FIGURE 2.4. DEPLOYMENT LOCATION FOR PRESSURE TRANSDUCER NEAR DANIA CANAL

Oceanographic instruments were retrieved by CH2M HILL personnel on August 26, 2008. Data was downloaded from the instruments, reviewed for quality, and provided for use in the numerical modeling analysis. Graphs of the data are presented and discussed below.

Figure 2.5 presents the time series of North and East velocity components measured by the S4 meter deployed at the ICW Station. Velocities are primarily aligned with the shipping channel in the north/south direction, with a clear bias to the north.

Figure 2.6 present the measured velocity components at the FPL Canal Station. The discharge from the FPL facility sets up a strong, easterly flow in the downstream section of the FPL Canal. The velocities are directed towards the east throughout the tidal cycle, with increased tidal elevations yielding smaller eastward velocities than those at low tide. The current records indicate that water from the ICW does not flow into the canal on flood tide. Rather, the increase in stage on a flood tide slows the velocity of discharge in the canal. The unidirectional flow in the FPL canal allows for a simplification in the modeling analysis, as discussed below.

Shortly after deployment, CH2M HILL personnel were contacted by Dave Orders of Orders Associates, who provided oceanographic equipment to CH2M HILL for the project. Dave Orders was contacted on the afternoon of August 8, 2008 by Mike Gigante of the Seastar Foundation, who saw the current meter array deployed in the FPL canal and called the contact number written on the vinyl float. The float would have been under approximately 3 feet of water. Mr. Gigante contends that he did not disturb the instrument, but merely called the contact number on the instrument. This conflicts with what Orders recalls him mentioning initially, that he attempted to pull up the meter but could not.

Figure 2.7 presents a portion of the data record during the first 4 days of deployment at the FPL Canal Station. There is clearly a change in the record on the afternoon of August 8, 2008. The change is clearly visible in the cross channel (North/South) velocity; it is not as clear in the East/West velocity (Figure 7). Thus, it seems likely that staff from the Seastar Foundation did interfere with the operation of the meter. It is possible that tampering with the instrument impeded its ability to rotate freely and thus biased the remainder of the data collection. However, the majority of the data record depicts tidally varying velocities expected at the project site, and since the cross channel velocity is generally small compared to the channel axis velocity, it was assumed that the data was sufficient for use in model verification.

Figures 2.8 and 2.9 present scatter plots of the measured currents in the ICW and the FPL Canal, respectively. These plots show the dominant direction of the currents (North in the ICW and East in the FPL Canal), as well as the relative magnitude of the minor, cross-channel currents.

Figure 2.10 shows the water temperature measured in the FPL Canal and in the ICW by the oceanographic equipment. Temperatures in the FPL are consistently higher than those in the ICW. Daily peak temperatures in the FPL Canal can be 2 to 5 degrees Celsius higher than those in the ICW. The timing of the rises in temperature in at the ICW Station indicate a warm water plume from the FPL discharge is being carried north past the ICW meter by tidal currents.

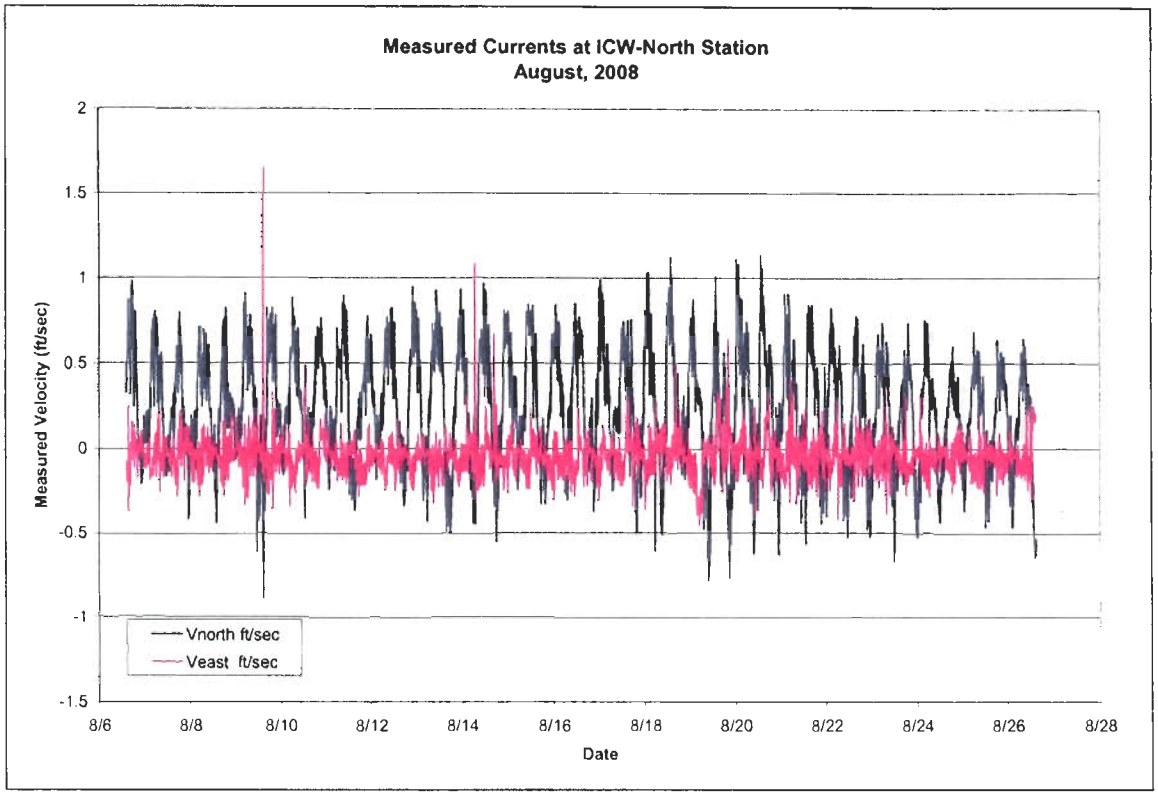

FIGURE 2.5. MEASURED VELOCITY COMPONENTS AT ICW STATION

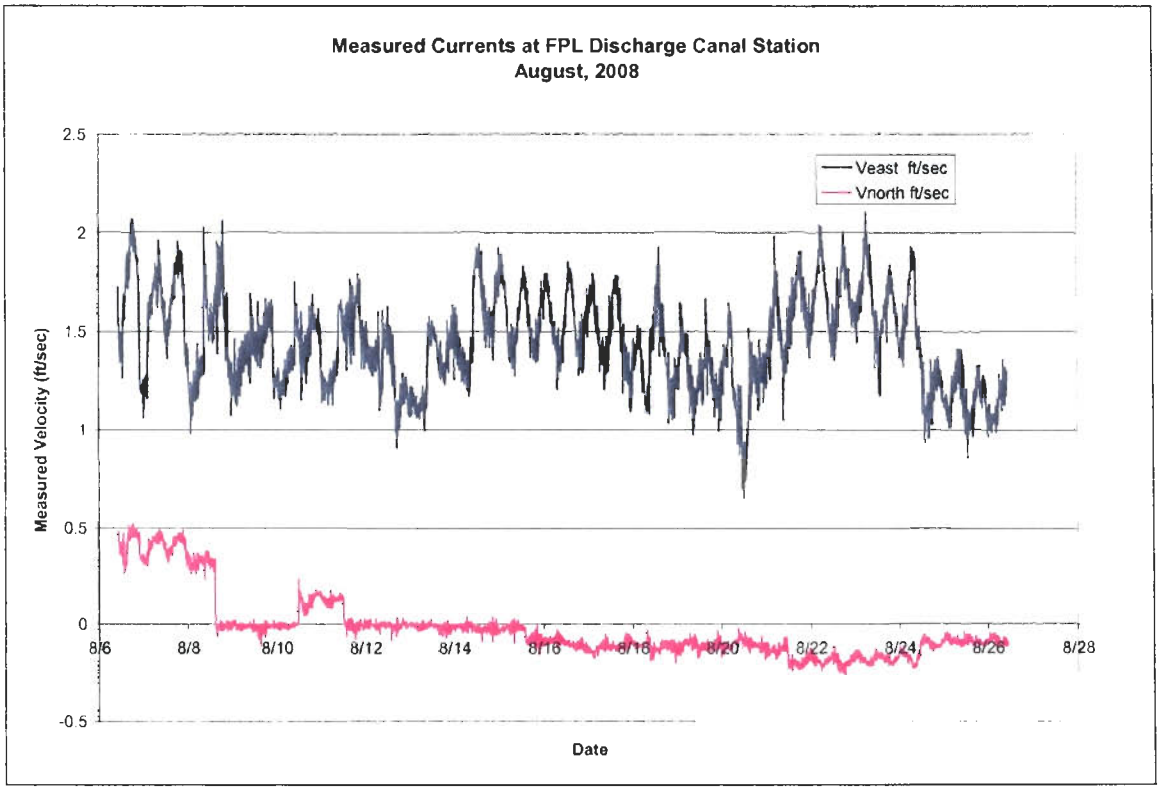

FIGURE 2.6. MEASURED VELOCITY COMPONENTS AT FPL CANAL STATION

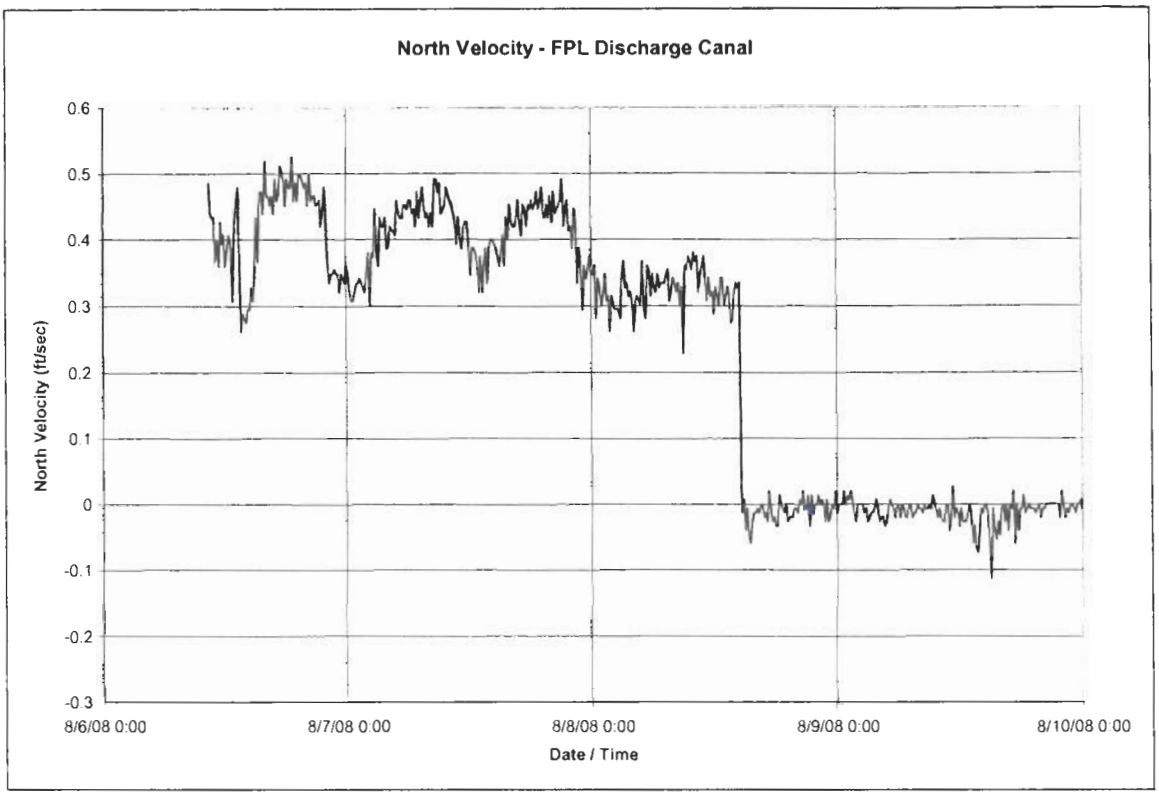

FIGURE 2.7. EVIDENCE OF PROBABLE TAMPERING WITH S4 METER IN FPL CANAL

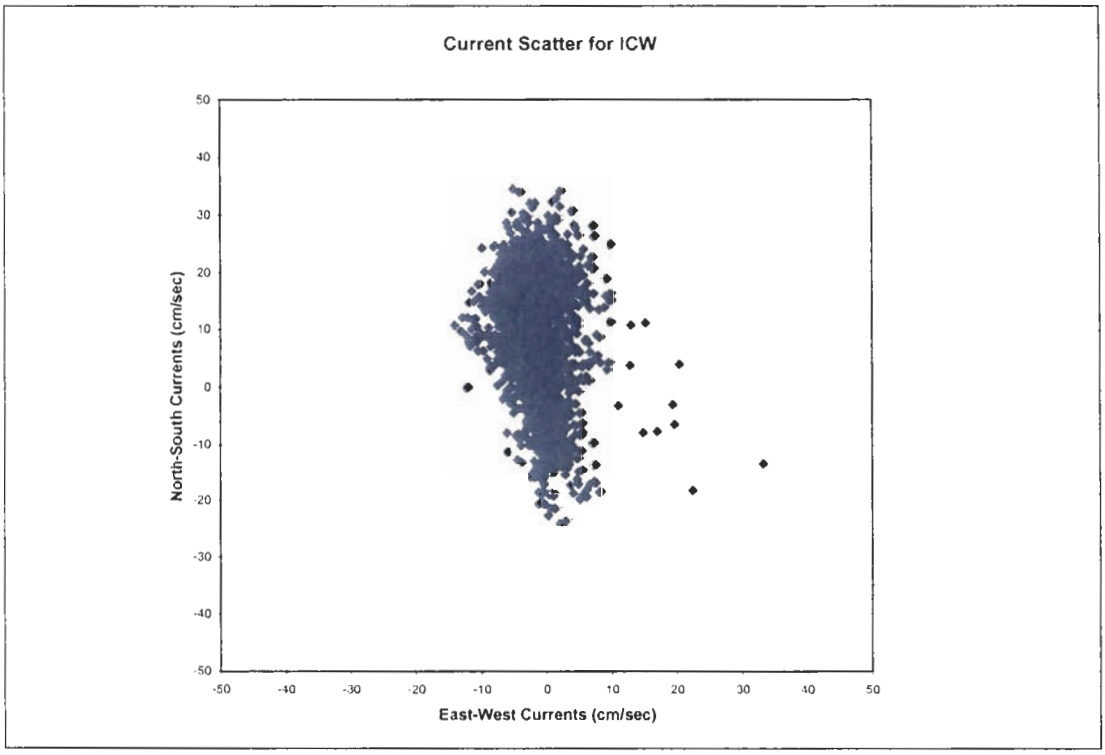

FIGURE 2.8. SCATTER PLOT OF MEASURED CURRENTS AT INTRACOASTAL WATERWAY STATION

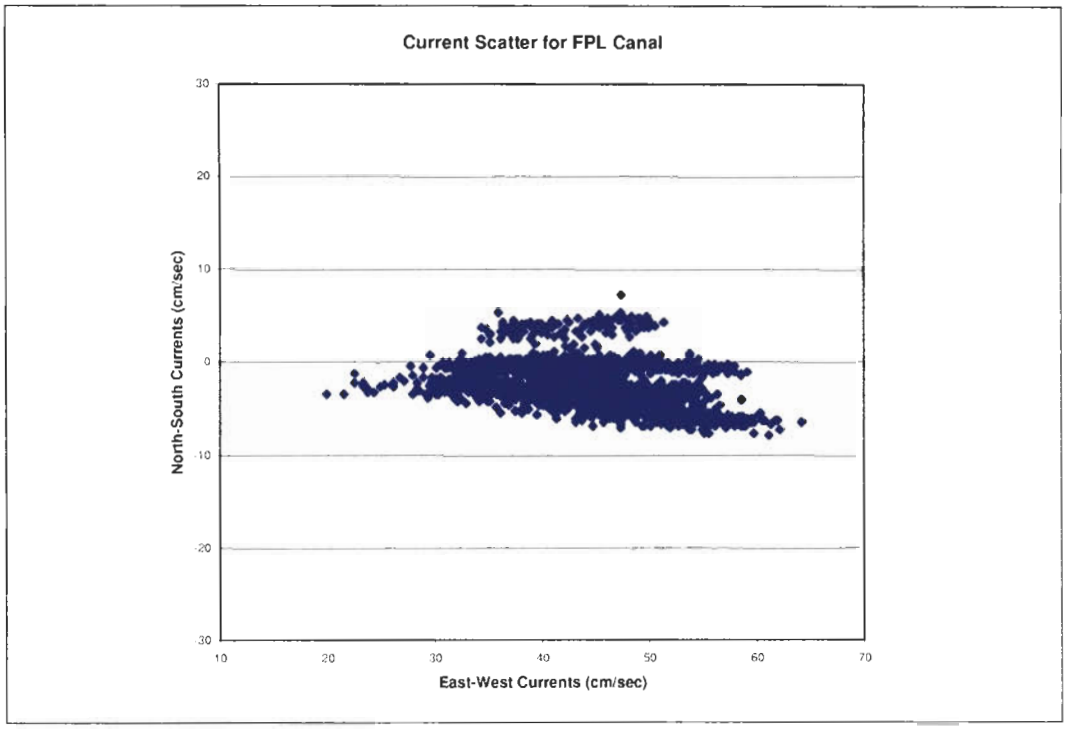

FIGURE 2.9. SCATTER PLOT OF MEASURED CURRENTS AT FPL CANAL STATION

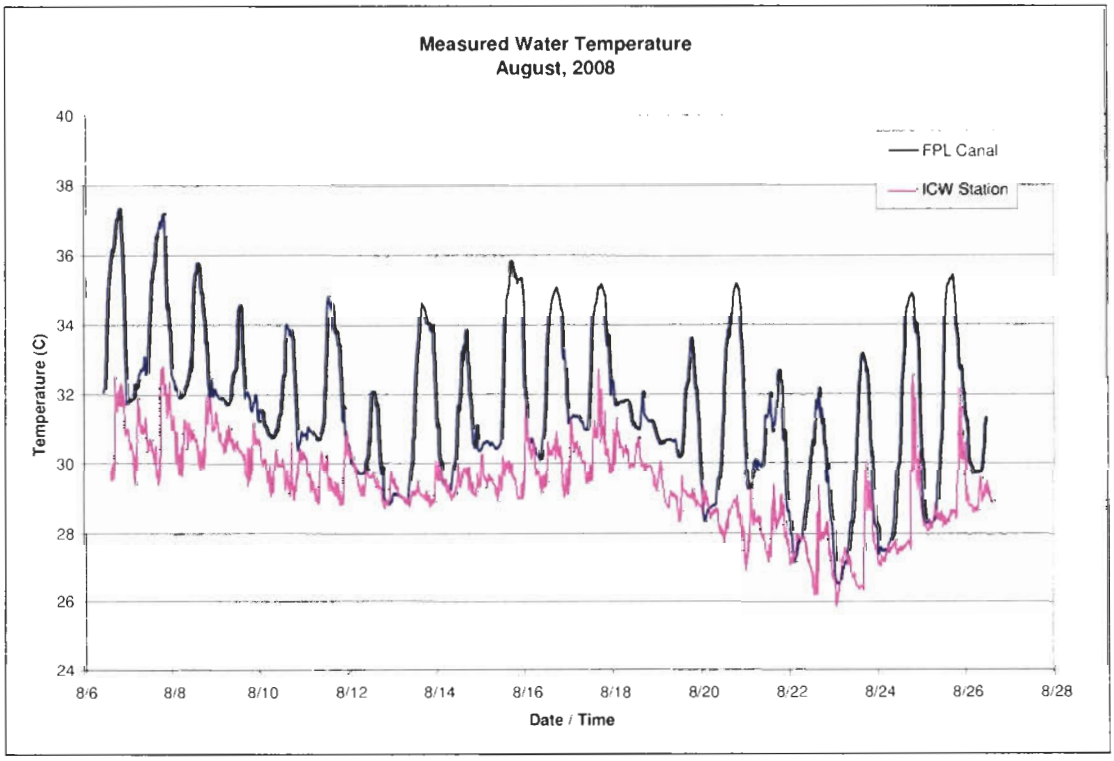

FIGURE 2.10. MEASURED WATER TEMPERATURE IN FPL CANAL AND IN ICW

3.0 Model Assumptions

The existing conservation easement is protected on the east and south by a limestone breakwater. This breakwater functions to reduce the impact of vessel wakes and wind-generated waves on the mangrove wetland. The breakwater is porous in that water can seep through into the mangrove wetland on flood tides, and water can drain out of the mangrove wetland during ebb tides. For the purposes of the modeling analysis, it is assumed that these breakwaters are not pervious, and thus all interaction between the ICW and the mangrove areas takes place via the FPL Canal. This is likely a conservative assumption with regard to the flushing analysis; predicted flushing times are likely longer than would be expected in the field because of the additional flow pathway through these breakwaters.

The FPL facility discharges at a constant rate of 1936 cfs (870,000 gpm) through four 80,000 gpm pumps and four 137,500 gpm pumps. The upper portion of the discharge canal (North of the Port offices) can be excluded without compromising the numerical results. The grid resolution and small time step required to model high flow rates through successive 90 degree channel bends would considerably hamper model simulations.

4.0 Existing Conditions Hydrodynamic Model

A numerical model grid was constructed representing existing conditions in the vicinity of the project site. The main grid extends from the Dania Canal in the south to north of the A1A Bridge. Bathymetry (hydrographic survey data) for Port Everglades and the Intracoastal Waterway was provided in electronic format by the U.S. Army Corps of Engineers. Port staff provided electronic data of soundings in the FPL Canal. Depths in the existing mangrove conservation area were set based on field reconnaissance during deployment of the oceanographic equipment on August 6, 2008.

The hydrodynamic model solves the conservation equations of mass and momentum to predict water level and velocity (x and y) at every node in the model grid. Figure 4.1 presents the coverage of the model constructed for this analysis. There are 4455 elements and 11922 nodes in the boundary-fitted model grid.

The numerical model requires specification of time-varying boundary conditions. For this model, tidal stages at Dania Canal and at the tidal connection with ocean were specified, as was the discharge from the FPL power plant. The model also requires Manning's friction coefficients. Two separate values were used in the model: the open water and channel areas were specified with a value of 0.025, and the mangrove wetland areas were set to 0.40 to account for their influence on the flow. Model simulations were conducted with a 12 minute time step.

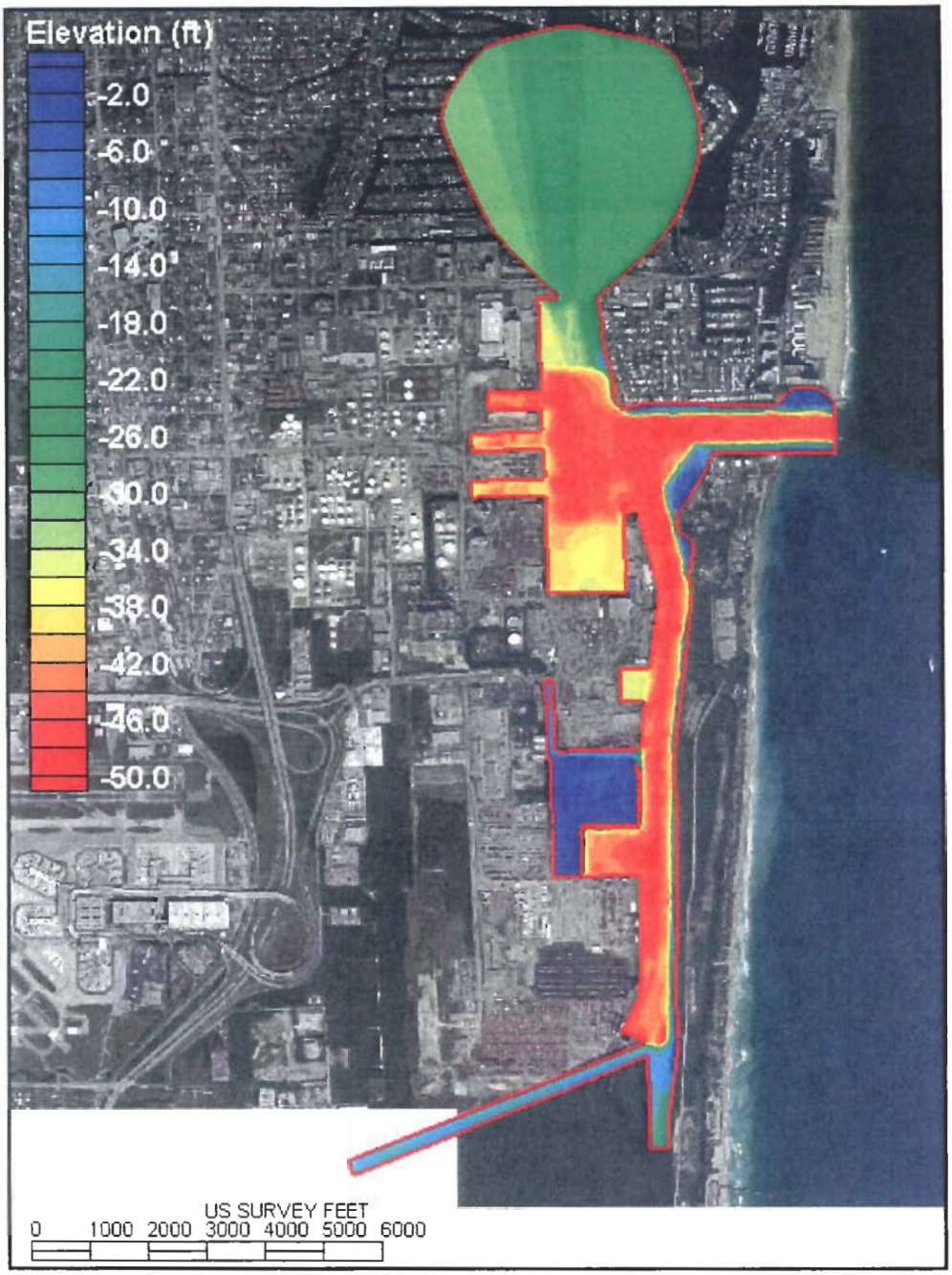

FIGURE 4.1. MODEL GRID COVERAGE AND BATHYMETRY

Model predicted velocities are presented in Figure 4.2 and compared to currents measured by the S4 current meters. In the FPL Canal, the predicted velocities are of a similar magnitude and range as the measured currents. The predicted velocities deviate from the measured values during the 4 day period corresponding to August 8-11, 2008. Recall that this meter may have been tampered with during this time. The agreement between predicted and measured velocities improves towards the end of this 10 day period.

The agreement between predicted and measured currents at the ICW station are adequate for the purposes of this application, considering it focuses on an area influenced by stages in the ICW more than currents in the ICW. The predicted tidal current magnitudes demonstrate more symmetry than the measured currents. Measured data indicate that the currents are significantly stronger during ebb time (see Figure 4.3).

There is a small phase lag in water surface elevation between the Dania Canal and the ocean inlet. The ability to predict the magnitude and phasing of the tidally varying north-south currents in the ICW requires the proper specification of this phase lag. The northward bias in Figure 9 indicates that the currents flow strongly to the north on rising tides, and may flow either south or north on ebb tide. This indicates the basin is filling from the south, pushing north up the ICW on the rising tide.

Figure 4.4 shows the variability in predicted currents in the FPL canal near the current meter. Model predictions for three separate location in the FPL canal are presented; point "B" is the approximate location of the current meter, point "A" is 20 feet towards the bank and point "C" is 20 feet towards the channel center. Note the significant variation in predicted velocity with a short change in location across the channel.

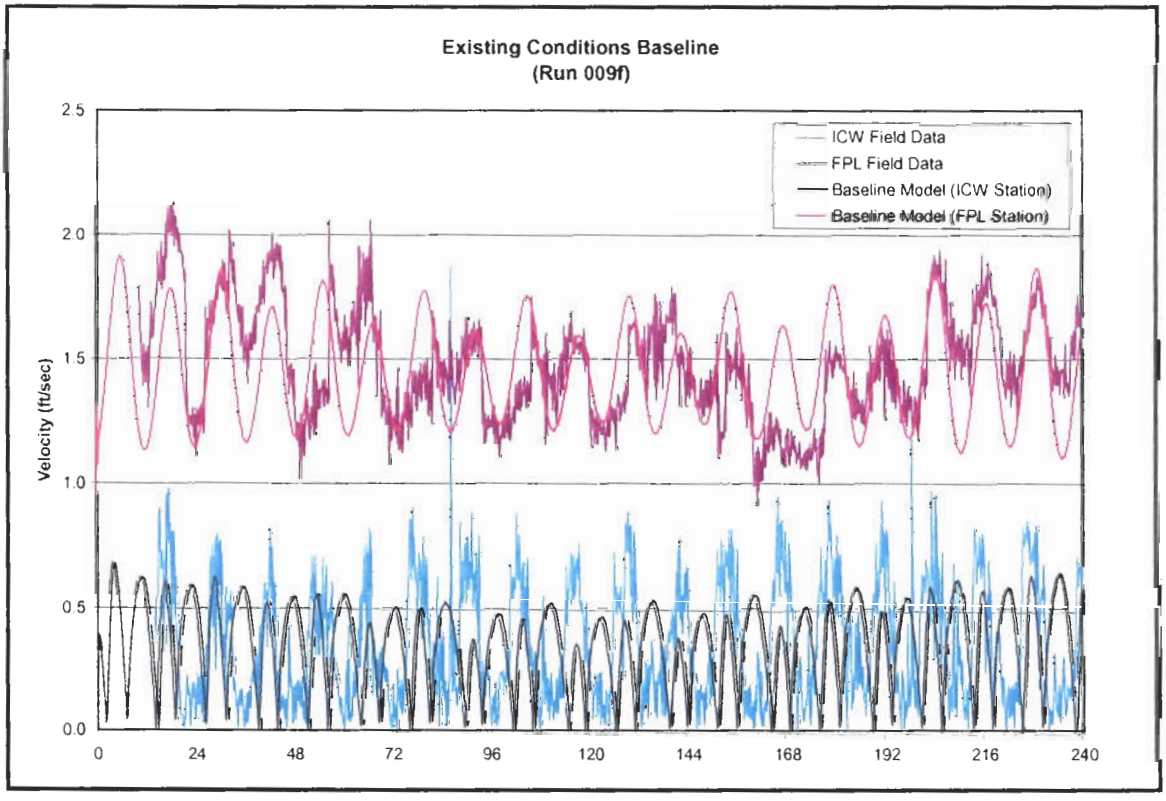

FIGURE 4.2. COMPARISON OF PREDICTED AND MEASURED CURRENT MAGNITUDES

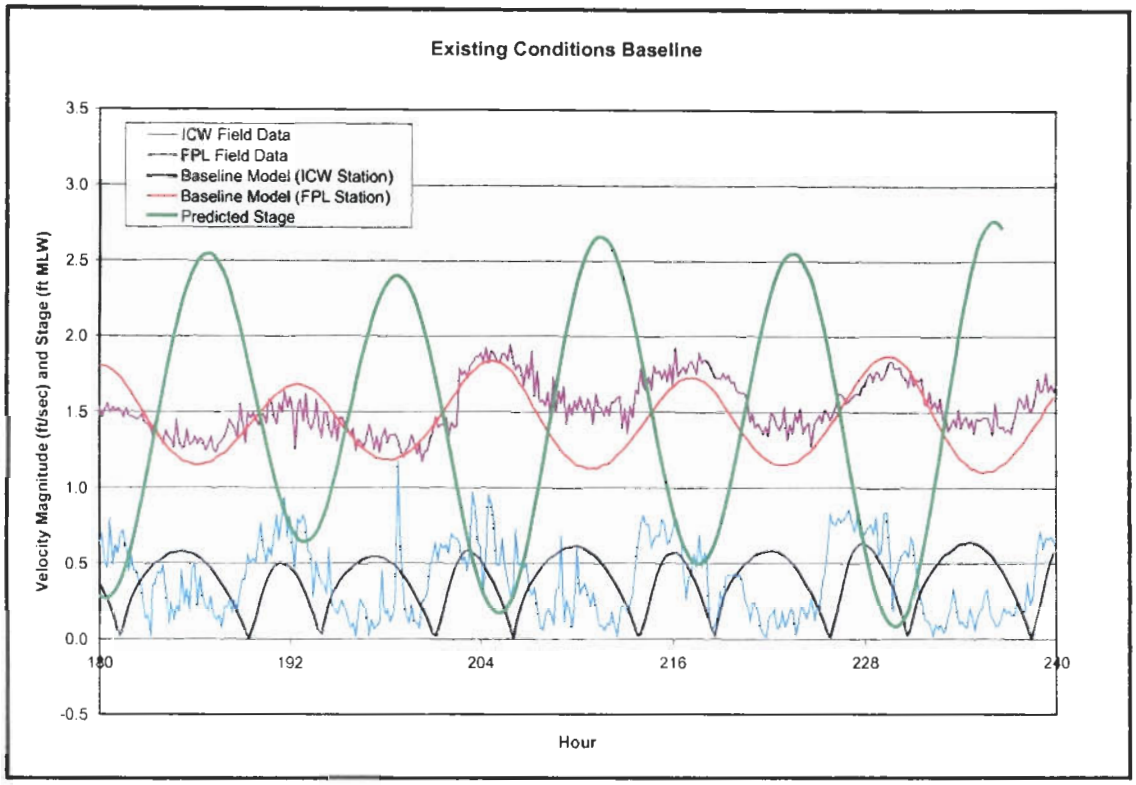

FIGURE 4.3. FINAL 2.5 DAYS OF BASELINE SIMULATION

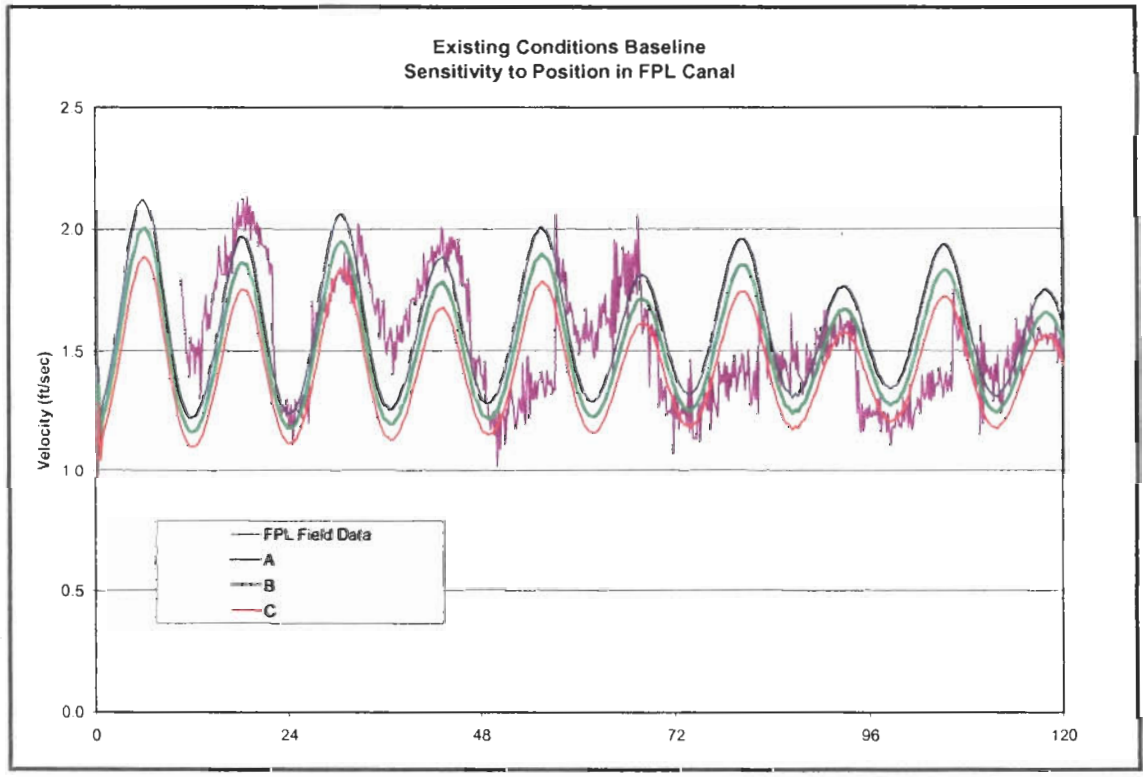

FIGURE 4.4. VARIATION IN FPL CANAL CURRENTS WITH LOCATION

A small portion of the full model grid was used for the flushing studies, based on the unidirectional flow in the FPL Canal. Figure 4.5 shows the whole sub-grid used in the flushing analysis. Water surface elevations at the eastern edge of the FPL Canal were taken from the full model grid and applied as a boundary condition in the small model grid. A 24- hour period was selected as a representative tide that could be applied in a repeating fashion for longer duration simulations with the constituent transport model (Figure 4.6).

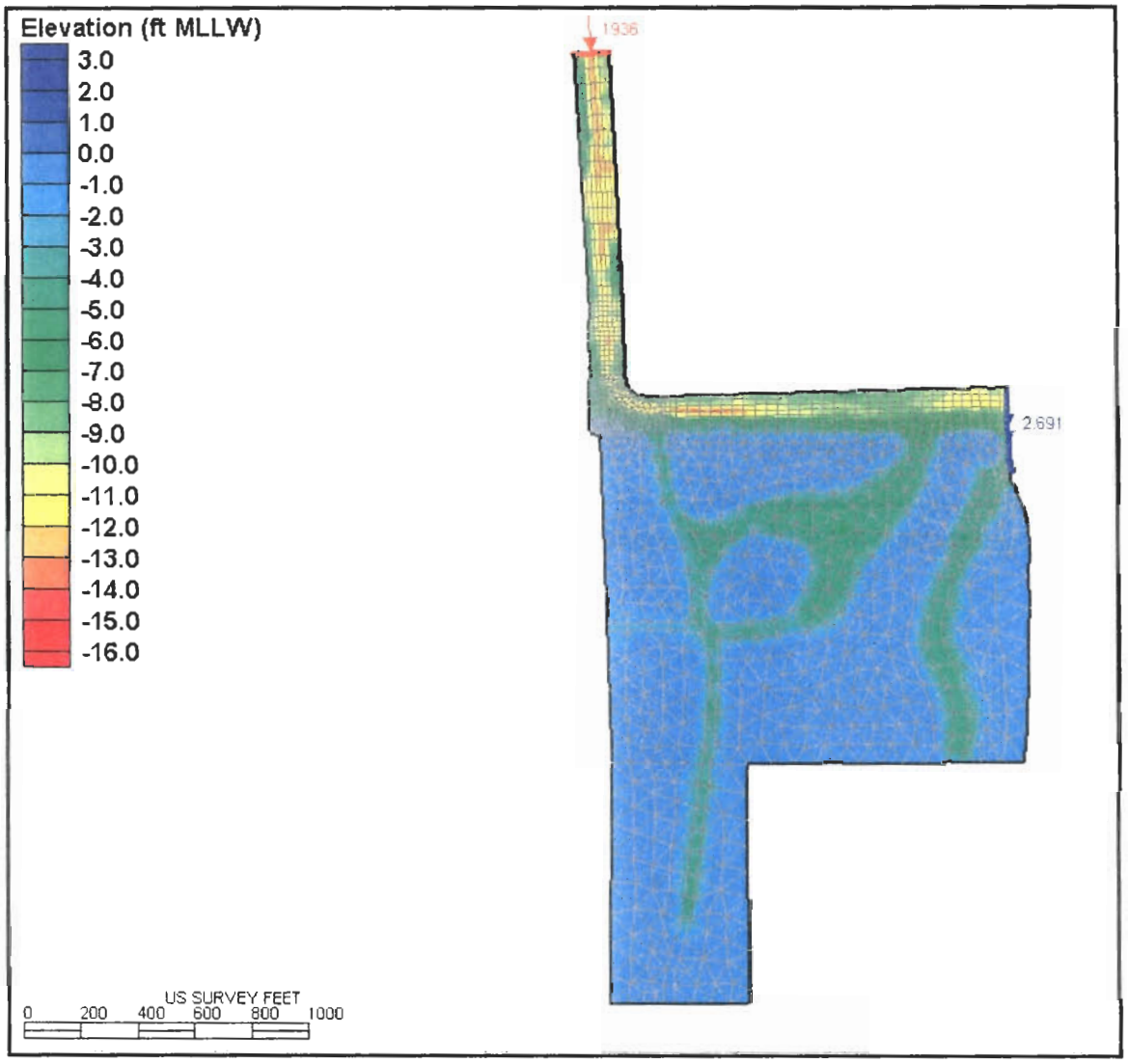

FIGURE 4.5. REDUCED MODEL MESH USED IN FLUSHING ANALYSIS

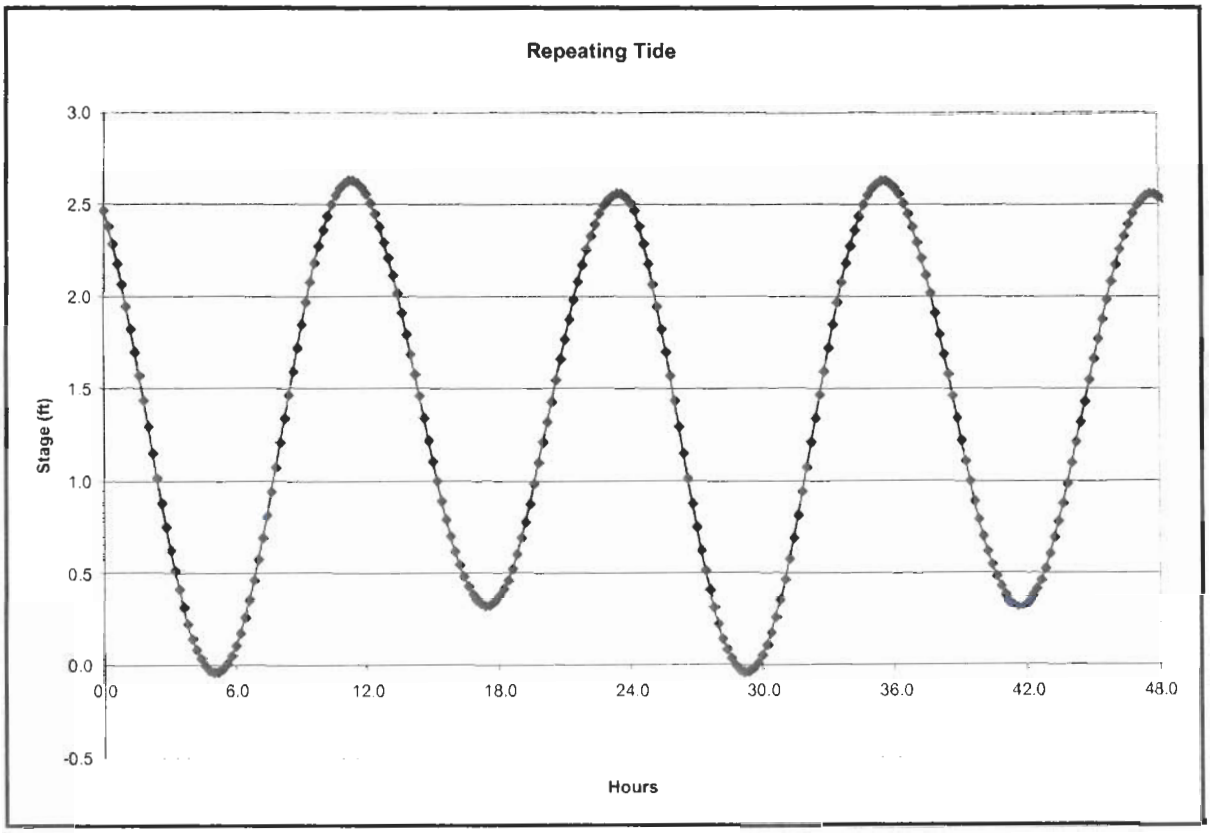

FIGURE 4.6. REPEATING TIDE USED IN HYDRODYNAMIC SIMULATIONS WITH SMALL GRID

5.0 Proposed Conditions Hydrodynamic Model

The model grid developed for the existing conditions was modified to reflect the proposed mitigation areas adjacent to the FPL Canal. Figures 5.1 and 5.2 show the model grid representing the FPL Canal, conservation easement, and proposed enhancement areas.

Hydrodynamic model simulations were conducted with identical boundary conditions used in the existing conditions model discussed above. Inflows were set at a constant 1936 cfs, and the time varying water level specified at the eastern end of the discharge canal were taken from the full existing conditions model simulation. Model simulations were conducted for a 24-hour period, chosen so that multiple periods could be seamlessly linked to model extended durations.

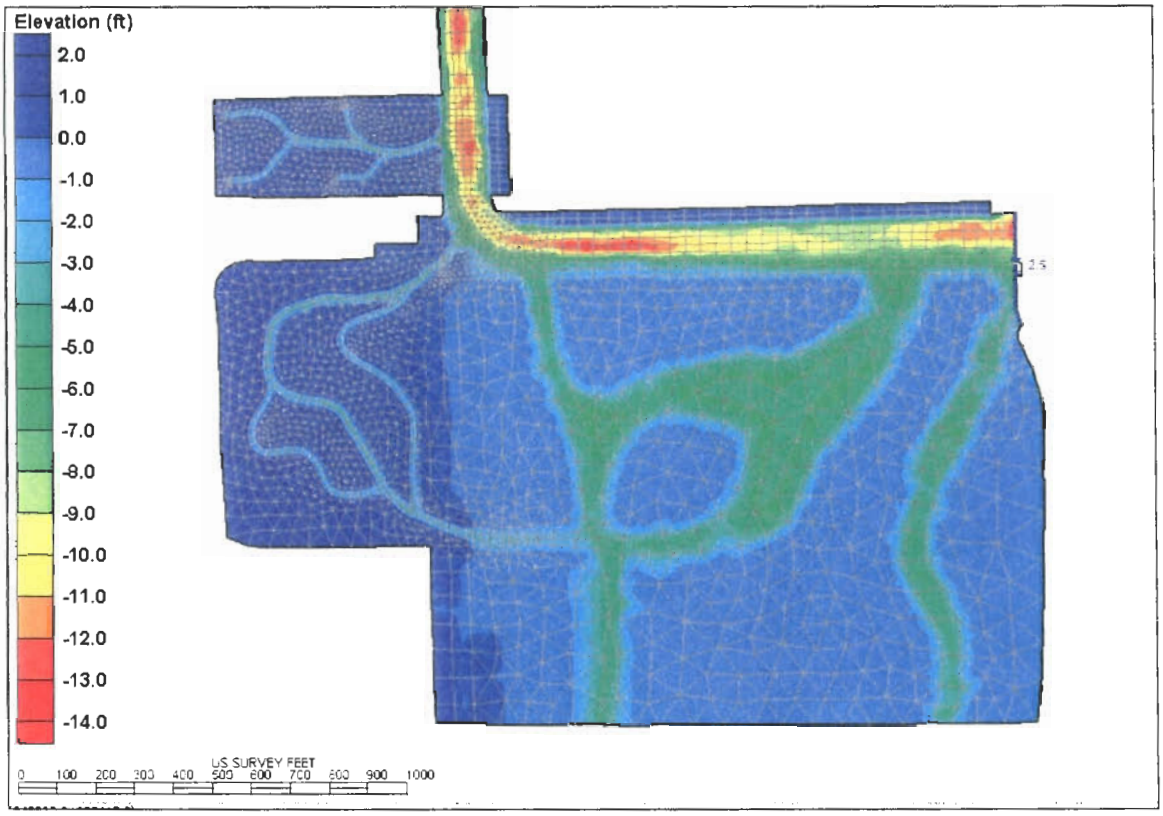

FIGURE 5.1. MODEL GRID WITH PROPOSED MANGROVE AREAS

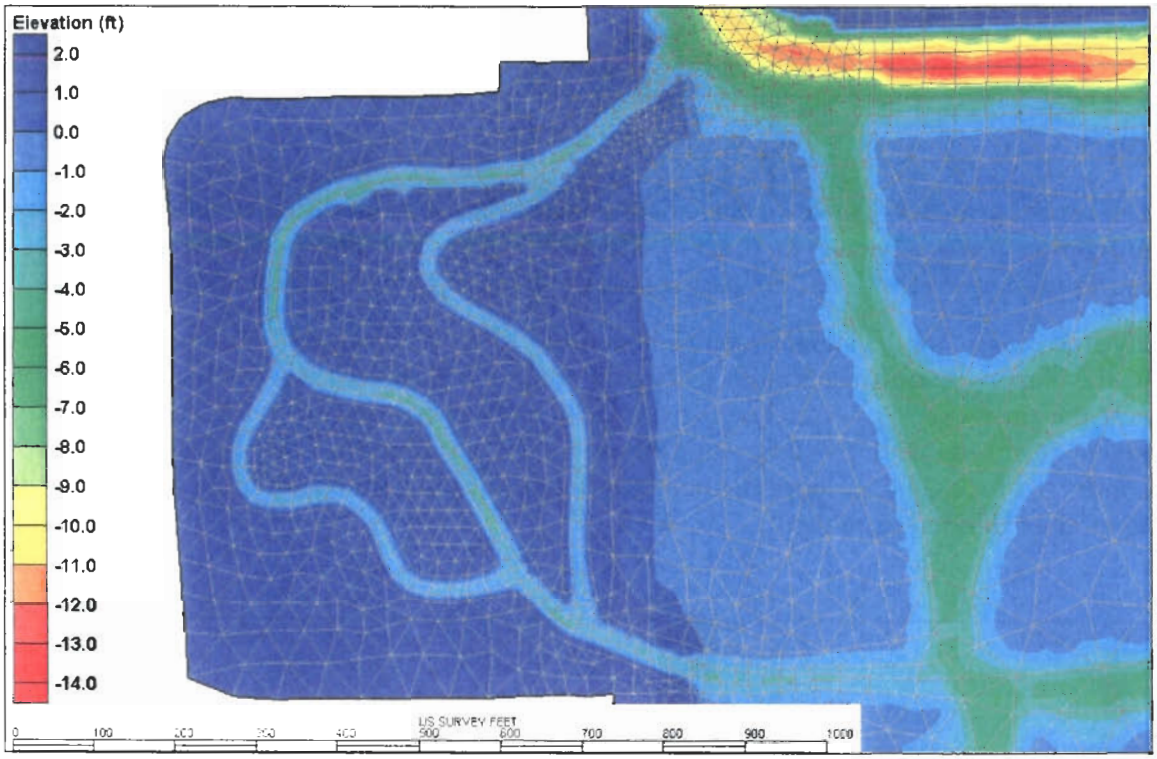

FIGURE 5.2. CLOSE UP OF MODEL GRID FOR SOUTHERN PROPOSED MANGROVE WETLAND AREA

6.0 Flushing Studies

Results of the hydrodynamic models were used as input in the constituent transport model to ascertain the flushing characteristics of the existing and proposed mangrove areas. A conservative tracer is tracked through time with an advection/dispersion model, subject to the hydrodynamics at the project site as predicted by the 2D RMA2 model.

The bottom elevation near the mangroves in the existing mangrove conservation easement is at approximately -0.5 to 0 feet MLW, based on field reconnaissance during deployment of the oceanographic equipment. This is considerably lower than the marsh plain elevation proposed for the mitigation areas. A recent, successful mitigation project at John Lloyd Park, near the Port Everglades project site, was used as a basis for design. The marsh elevation at John Lloyd Park was 2 feet above MLW, indicating tidal inundation once every twelve hours, on average.

Since the proposed marsh areas are above mean tide level, they will drain on every ebb tide. The current conservation easement does not completely drain because of a lower base elevation. In terms of flushing, the proposed areas will thus flush completely on each tide, except possibly for the channel areas, whereas water remains in the conservation easement wetlands because of their greater depth. Furthermore, the existing conservation easement has significant, relatively deep (6 ft MLW) open water areas. Flushing of the conservation easement is a function of the volume exchanged on each tide in relation to the volume stored in the wetland and open water areas at low tide.

In order to quantify the relative flushing rates of the existing and proposed wetland areas, a numerical flushing study was conducted. The study sets the initial concentration in the model grid to an arbitrary concentration of 100 parts per thousand (ppt), and then uses the results of the hydrodynamic model to predict the decrease in concentration of the conservative substance with time. The time series of concentration at a given location provides information on the flushing capacity of the system. A flushing time can be defined as the time it takes for the concentration to be reduced to some fraction, say one-tenth, of its original value. Furthermore, the flushing time can be compared to the theoretical residence time, calculated as the system volume divided by the inflow rate.

Time series results of predicted concentrations are presented for several locations throughout the enhancement area and conservation easement (Figure 6.1). Contour plots are also presented to demonstrate differences in the mixing characteristics between the existing and proposed conditions. Flushing simulations begin at hour 0 with a high tide, and progress for 5 days. This is a conservative approach, as the flushing improves during low tide because of the decrease in volume stored in the mangrove areas.

Figure 6.2 presents a comparison of the predicted tracer concentration with time for the 5 locations in the existing conservation easement. In the existing conservation easement area, the southern portion of the site has the longest retention time. This is due in part to the assumption that the flow through the riprap barriers lining the site is negligible. The oscillations seen in the record at the southwest corner of the site (Point A) are caused by

variations in the circulation patterns inside the conservation easement with the tide. On a rising tide, water from the power plant flows past Point A into the southwestern corner of the site, a dead end as modeled (see Figure 4.5). On the ebb tide, this water carrying a relatively high tracer concentration flows north past Point A, and the concentration rises. This is repeated until the southwest corner is flushed out. The southeast corner of the conservation easement (Point B) also has a relatively high residence time. The concentration at Point B is reduced to 10 percent of its original value after 36.8 hours.

Figure 6.3 shows the predicted tracer concentration at 7 locations in the conservation easement and proposed mangrove wetland areas reflecting the proposed geometric configuration at the project site. The flushing in the conservation easement is improved considerably with the addition of the proposed enhancement areas, specifically the large southern site with flow-through channels. Figures 6.4 and 6.5 present the improvement in flushing at Points A and B, respectively. A summary of the time required to achieve 90% flushing at each output location is provided in Table 6.1.

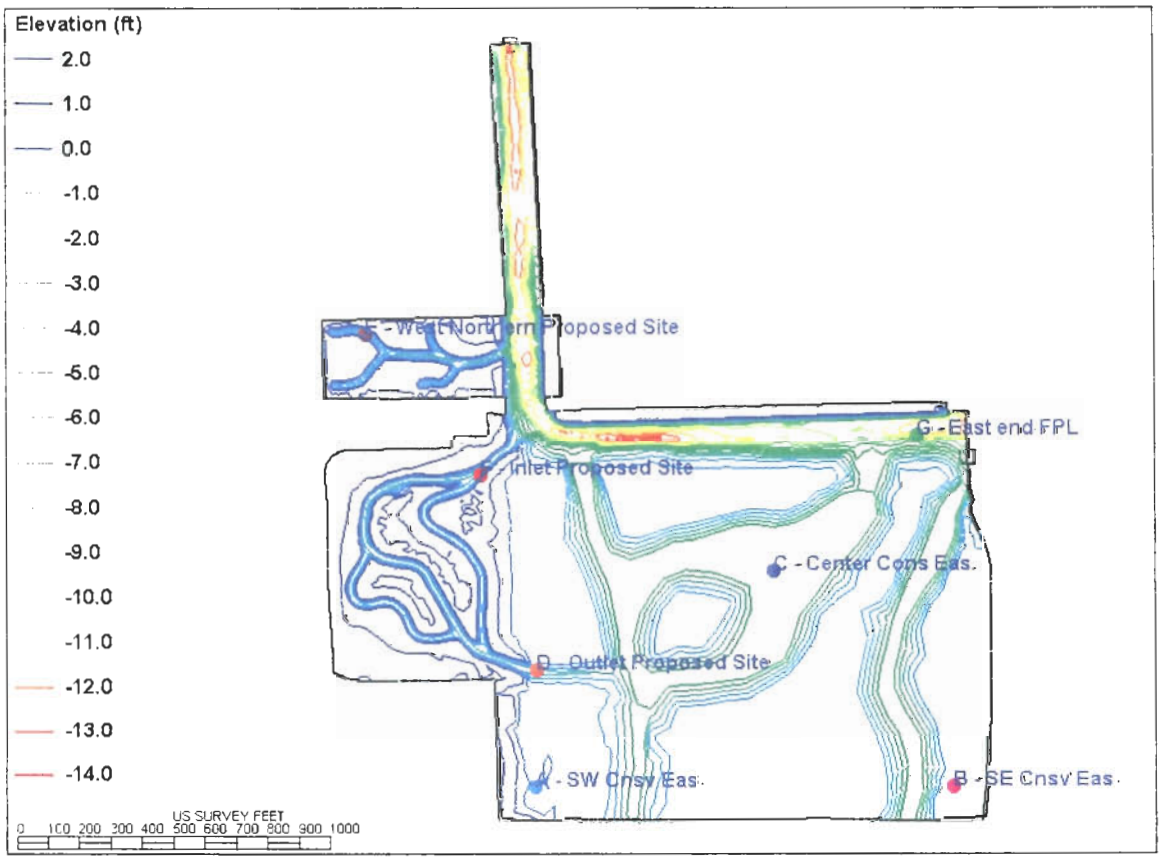

FIGURE 6.1. LOCATIONS OF CONSTITUENT OUTPUT FOR ANALYSIS

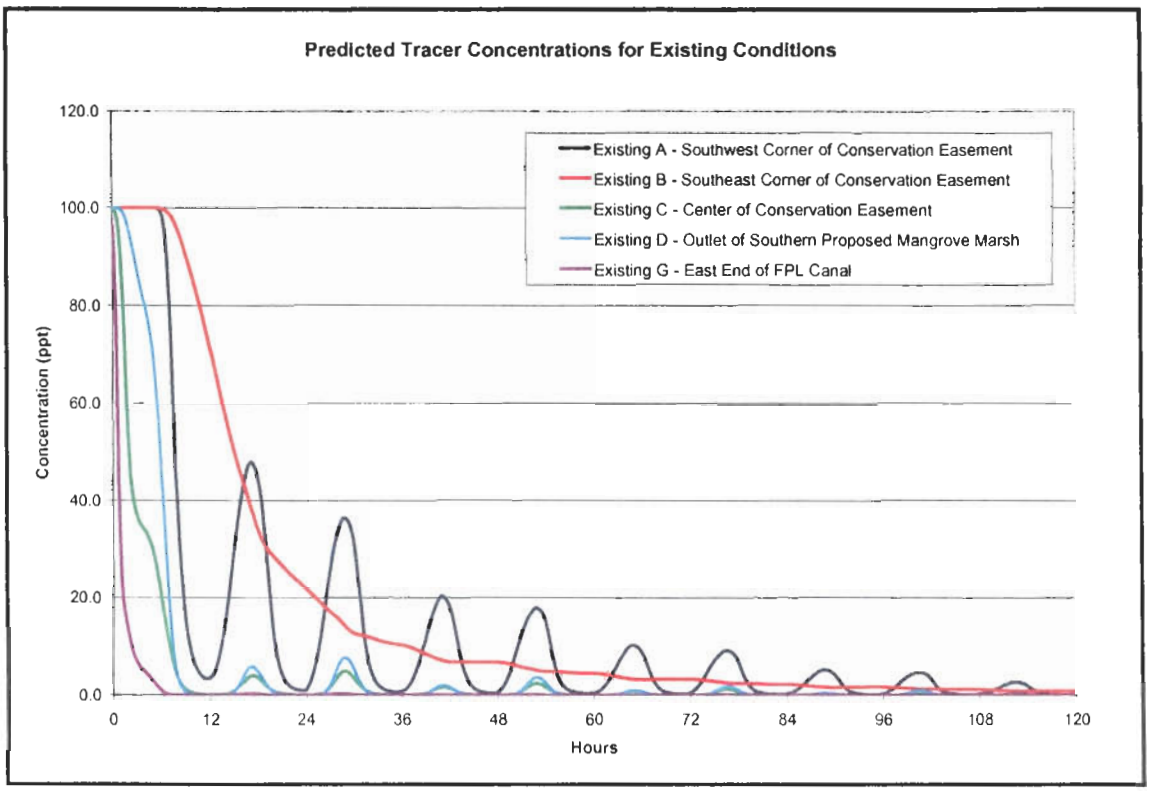

FIGURE 6.2. PREDICTED TRACER CONCENTRATION IN CONSERVATION EASEMENT (EXISTING CONDITIONS)

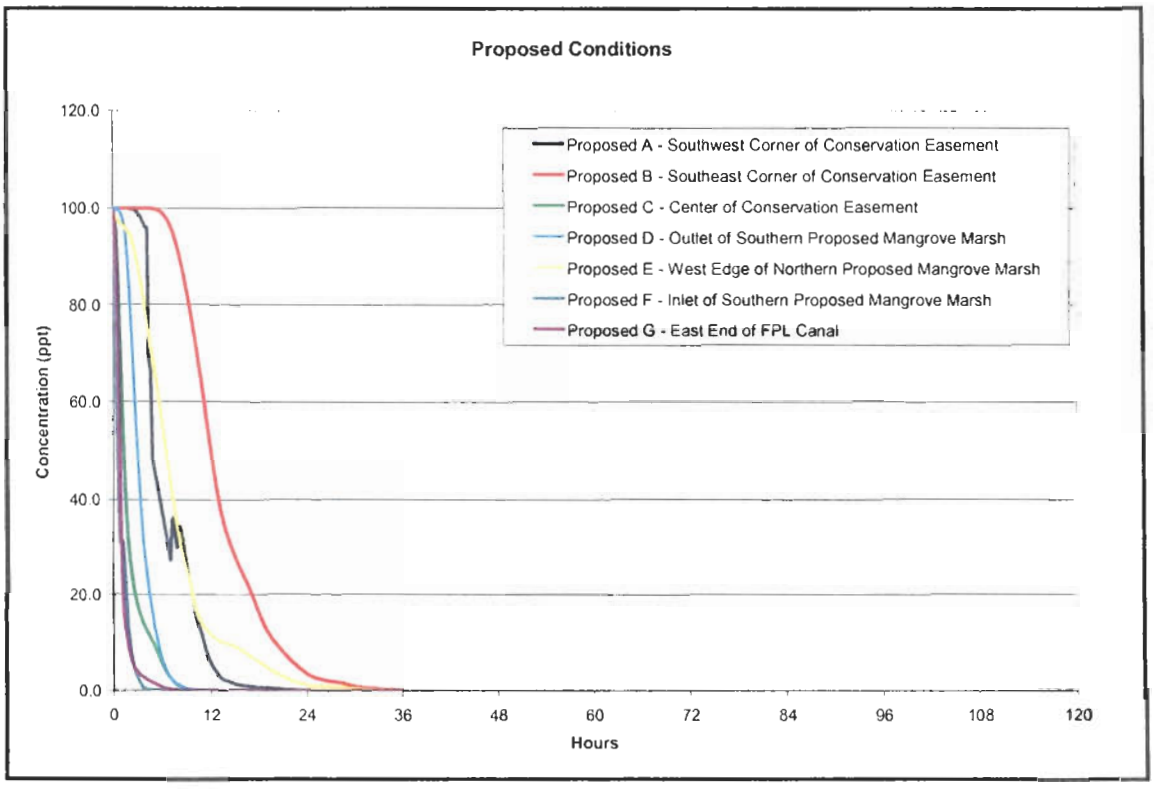

FIGURE 6.3. PREDICTED TRACER CONCENTRATION IN MANGROVE WETLANDS AND CONSERVATION EASEMENT (PROPOSED CONDITIONS)

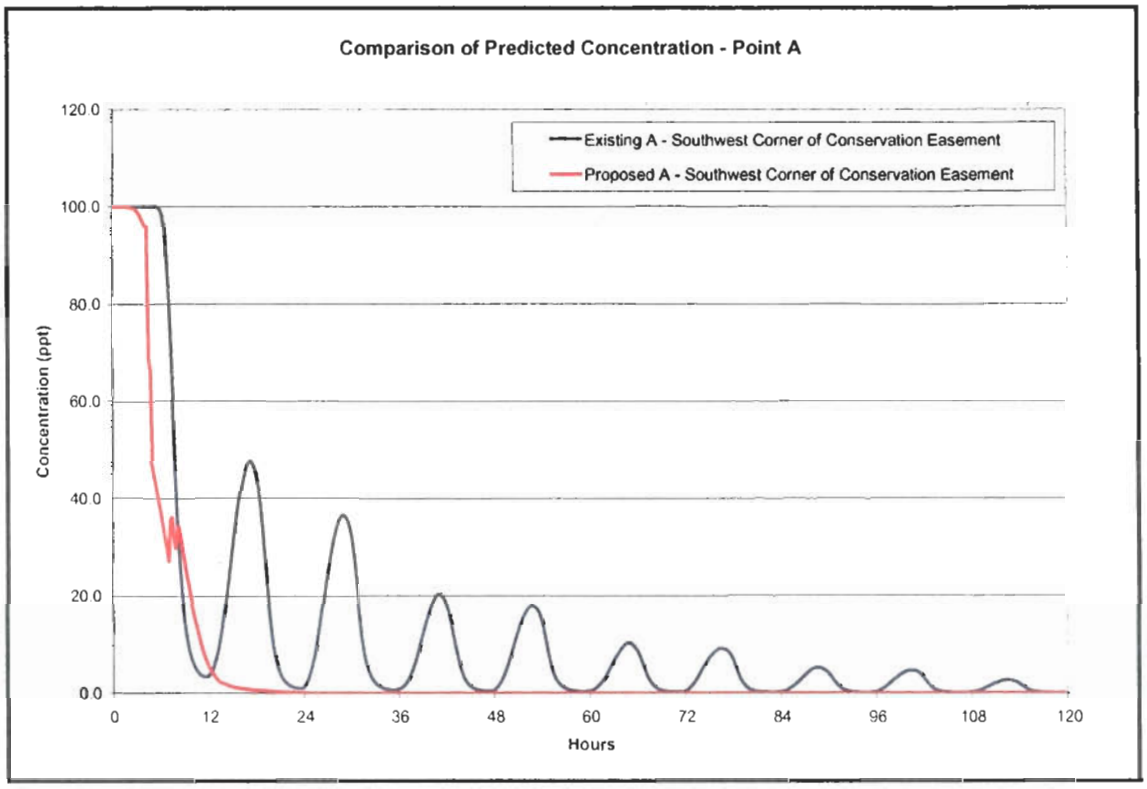

FIGURE 6.4. PREDICTED TRACER CONCENTRATIONS AT POINT A; EXISTING AND PROPOSED GEOMETRY

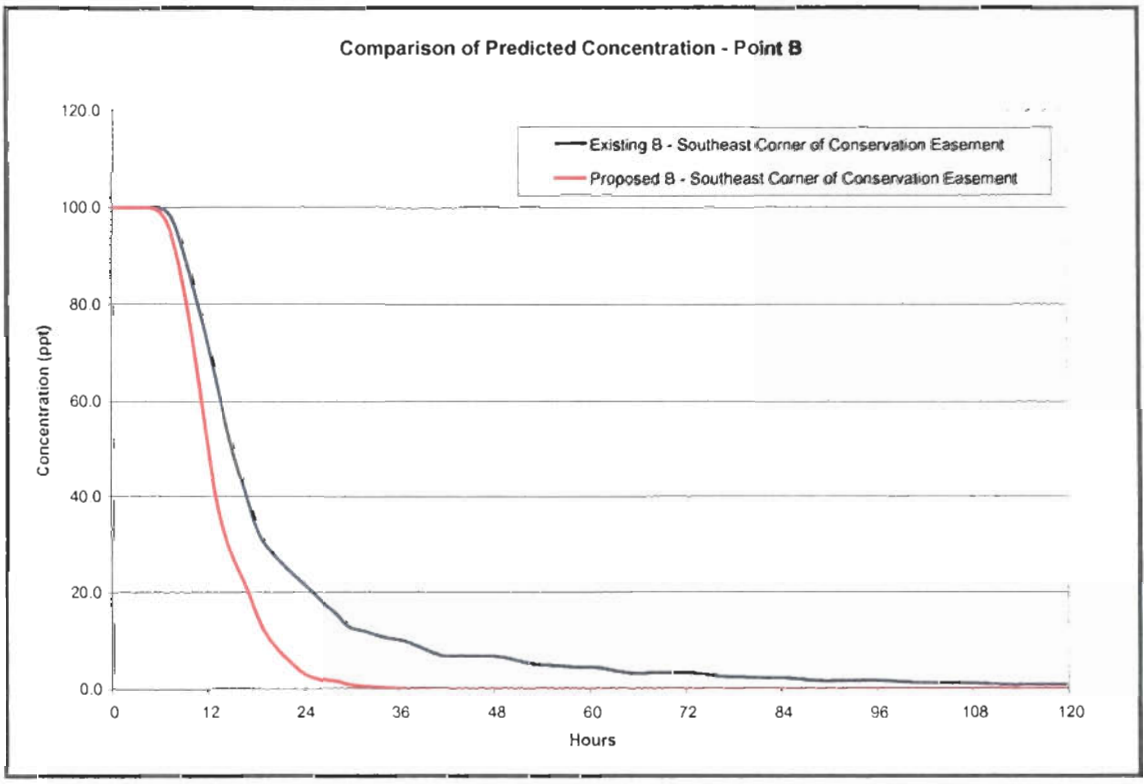

FIGURE 6.5. PREDICTED TRACER CONCENTRATIONS AT POINT B; EXISTING AND PROPOSED GEOMETRY

TABLE 6.1. TIME IN HOURS TO REDUCE TRACER CONCENTRATION BY 90%

Hour when Concentration Remains Below 10 ppt

Location	Existing	Proposed
A - Southwest Corner of Conservation Easement	65.4	11.2
B - Southeast Corner of Conservation Easement	36.8	20.0
C - Center of Conservation Easement	7.0	4.8
D - Outlet of Southern Proposed Mangrove Marsh	7.4	5.6
E - West Edge of Northern Proposed Mangrove Marsh	N/A	13.4
F - Inlet of Southern Proposed Mangrove Marsh	N/A	2.0
G - East End of FPL Canal	2.4	1.8

7.0 Summary and Conclusions

A two-dimensional, depth-averaged hydrodynamic model has been constructed for both existing and proposed conditions at the project site. The hydrodynamic and water quality models used in this analysis are robust and have been used worldwide for several decades. There are often limitations in the application of a set of models to a particular location. In the case of the mangrove enhancement project, limitations were addressed by the adoption of conservative assumptions. For example, it is difficult to correctly represent the effect that the rubble mound structures protecting the conservation easement have on the local tidal exchange. In the model, it is assumed that the rubble mound structures do not allow any exchange with the conservation easement, and that all exchange with the easement occurs through the FPL Canal. This is likely conservative, in that there is some flow through the rubble mound structures. The flushing predicted by the model is thus underestimated, and considered conservative. The numerical model was validated with field data collected over a 20 day period starting August 6, 2008. In regards to the disturbance of the meters during the data collection event, a review of the current meter data indicates that the meter was disturbed on the afternoon of August 8, 2008. Following this disturbance, the northern component of measured velocities appear suspect. Fortunately, the dominant currents in the FPL Canal are in the east/west direction. The data record exhibits expected tidal variation in the long-channel velocity components. Furthermore, the range in tidal velocities in the channel after the meter was tampered with are consistent with the range in velocities at the beginning of the deployment. It was assumed for the purposes of the modeling analysis that the data was not compromised by staff from the Seastar Foundation.

The results of the hydrodynamic model were used to drive a constituent transport model in order to quantify the flushing characteristics of the existing and proposed mangrove wetlands.

The proposed enhancement areas have a marsh plain elevation of 2 ft MLW and minimal channel storage. The marsh areas will drain on every ebb tide. In the northern enhancement area on the west side of the FPL Canal, the constructed channels are dead-end channels and will contain water at low tide. In the larger, southern enhancement area, the constructed channels flow though the site from the FPL canal into the conservation easement, connecting with a remnant channel. The addition of the largest (southwest) enhancement area will improve flushing in the conservation easement; the proposed channel will provide an increase in flushing flows to the southern portion of the conservation easement, thus improving circulation and reducing residence time.

The performance of the proposed enhancement area and the improvements in the flushing of the conservation easement provided by the project are contingent on the ability for water to flow from north to south through the channels in the proposed area and into the conservation area. The remnant channel (Figure 7.1) must have adequate capacity and not serve as a bottleneck limiting flow into the southern portion of the conservation easement. It is recommended that this channel be improved during construction of the proposed enhancement areas. Furthermore, there is a large sand deposit at the intersection of this

remnant channel and the north-south channel (see Figure 7.1). This restriction should also be removed to improve flushing in the conservation easement.

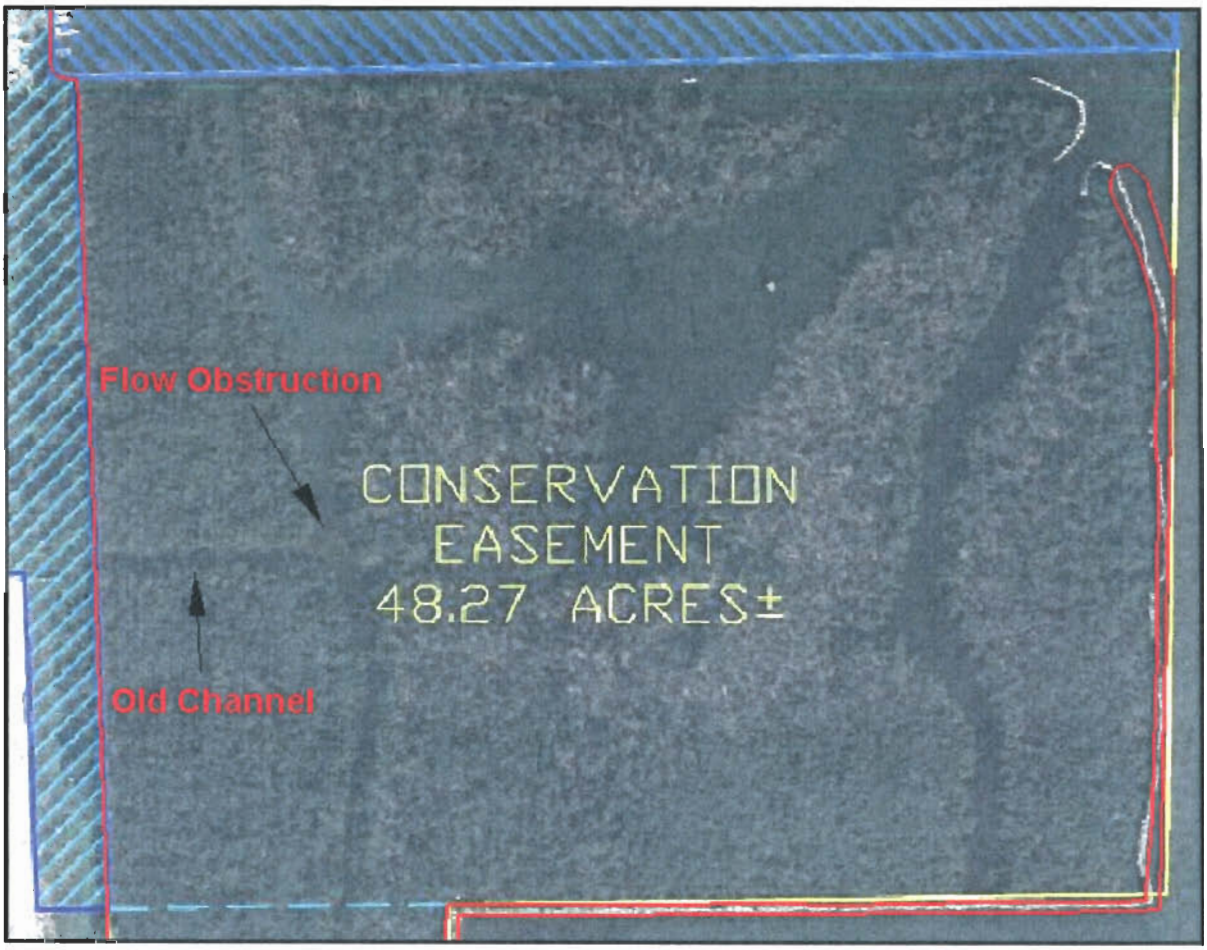

FIGURE 7.1. RECOMMENDED IMPROVEMENTS

Drainage Analysis Report

Port Everglades Conservation Easement
Port Everglades
Broward County, FL

Prepared for:

Broward County

Public Works Department
Seaport Engineering & Construction Division
1850 Eller Drive
Ft. Lauderdale, FL 33316-4201

January 26, 2009

CH2MHILL
3001 PGA Blvd
Suite 300
Palm Beach Gardens, FL 33410

Project #172284

Contents

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Attachments

Executive Summary

This memorandum documents the existing and proposed drainage conditions affecting the proposed 17 acre wetland creation area located east of SE 18th Avenue and south of SE 36th Street. In addition, the review includes existing and proposed stormwater treatment methods to determine compliance with current design criteria. The purpose of the project is to swap 8.7 acres with a portion of an existing conservation easement for the new wetland creation area. The existing conservation easement is proposed as a turning notch to facilitate port operations and navigation at Berth 30.

The existing E-W Ditch located south of SE 36th Street conveys stormwater runoff from a 29.9 offsite drainage area to the FPL Discharge Canal. The offsite drainage area includes the Foreign Trade Zone (FTZ) and 1800 Eller Drive Building.

The drainage concept for the proposed wetland creation area is affected by the proposed Bridge over FPL Discharge Canal. The proposed Bridge Over FPL Discharge Canal affects permit SWM#06-00703-S, which should be modified to accommodate the proposed bridge and roadway improvements. Two stormwater management alternatives were evaluated for this project – the E-W Ditch and the E-W Culvert. The E-W Ditch is designed to accommodate the first inch of stormwater runoff from 29.9 acres, and should be situated adjacent to the proposed driveway and parking lot. The minimum cross section geometry is shown in Table ES-1.

TABLE ES-1
E-W Ditch Cross Section Geometry

Parameter	Value
Bottom Width (BW)	80'
Front Slope (FS)	1:1
Back Slope (BS)	1:1
Depth (D)	Varies 3.6' to 5.8'
Top Width (TW)	Varies 89' to 91'
Top Width (including maintenance)	Varies 109' to 111"

The E-W Culvert option is designed to accommodate the first inch of stormwater runoff from 29.9 acres. This option requires 44-18" diameter pipes in parallel to accommodate the required water quality treatment volume.

The E-W Ditch is recommended because the top width is less compared to the E-W Culvert. As a result, more enhancement area is available with the Ditch. The proposed 17 acre wetland creation area should be designed to accommodate the recommended E-W Ditch configuration and location.

1.0 Introduction

This memorandum summarizes the review of existing and proposed drainage plan in the vicinity of the proposed wetland creation area, and the stormwater treatment methods to determine compliance with current design criteria. The proposed wetland creation area is located on a 17 acre vacant parcel bounded by SE 36th Street on the north, Berth 30 on the south, conservation easement to the east, and SE 18th Avenue to the West (see Figure 1.1 - Location Map).

The purpose of the project is to swap 8.7 acres existing conservation easement for the 17 acre wetland creation area. The existing conservation easement is proposed as a turning notch to facilitate port operations and navigation at Berth 30.

The memorandum provides a drainage concept plan, and excludes final drainage analysis and construction plans for new stormwater management facilities associated with the proposed wetland creation area.

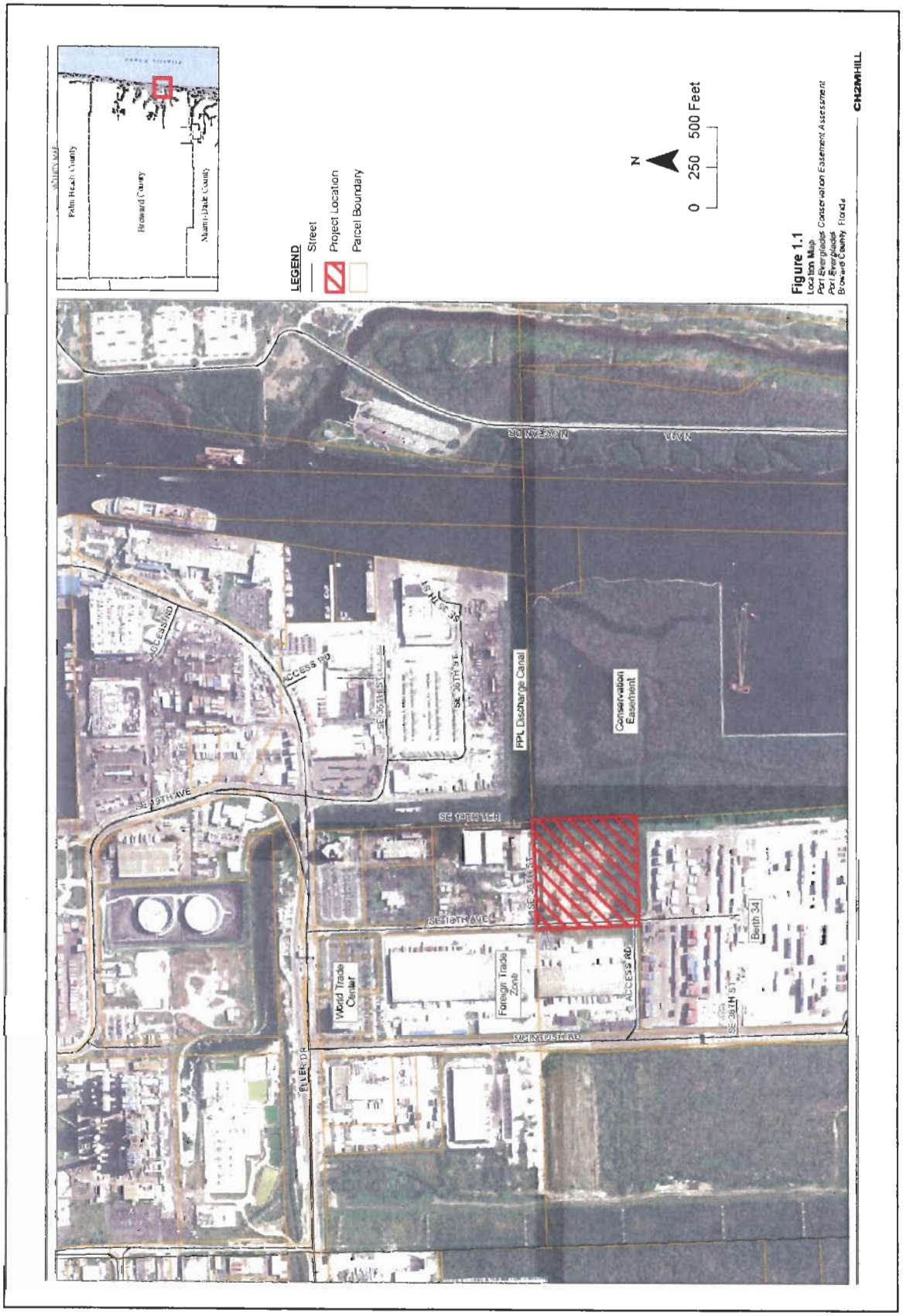


Figure 1.1
Location Map
Port Everglades Conservation Easement Assessment
Port Everglades
Broward County, Florida

CH2MHILL

2.0 Existing Drainage

Stormwater runoff from a 29.9 offsite drainage area flows overland to an existing E-W Ditch on the north side of the proposed wetland creation area (see Figure 2.1 – Existing Drainage Map). The offsite drainage area includes the Foreign Trade Zone (FTZ) and 1800 Eller Drive Building .

Stormwater runoff from the FTZ and WTC sites flow east via an existing 2-24" RCP crossing SE 18th Avenue from the N-S Ditch to the E-W Ditch(see Appendix 4-A). The existing E-W Ditch flows east from SE 18th Avenue to an existing control structure, and discharges to the FPL Discharge Canal. The existing control structure consists of a 24" RCP with a concrete weir at elevation 4.84 feet. The control structure details are included in Appendix 4-A. Stormwater runoff from the remainder of the 17-acre vacant parcel flows east to the existing conservation easement, and does not flow to the existing E-W Ditch along SE 36th Street.

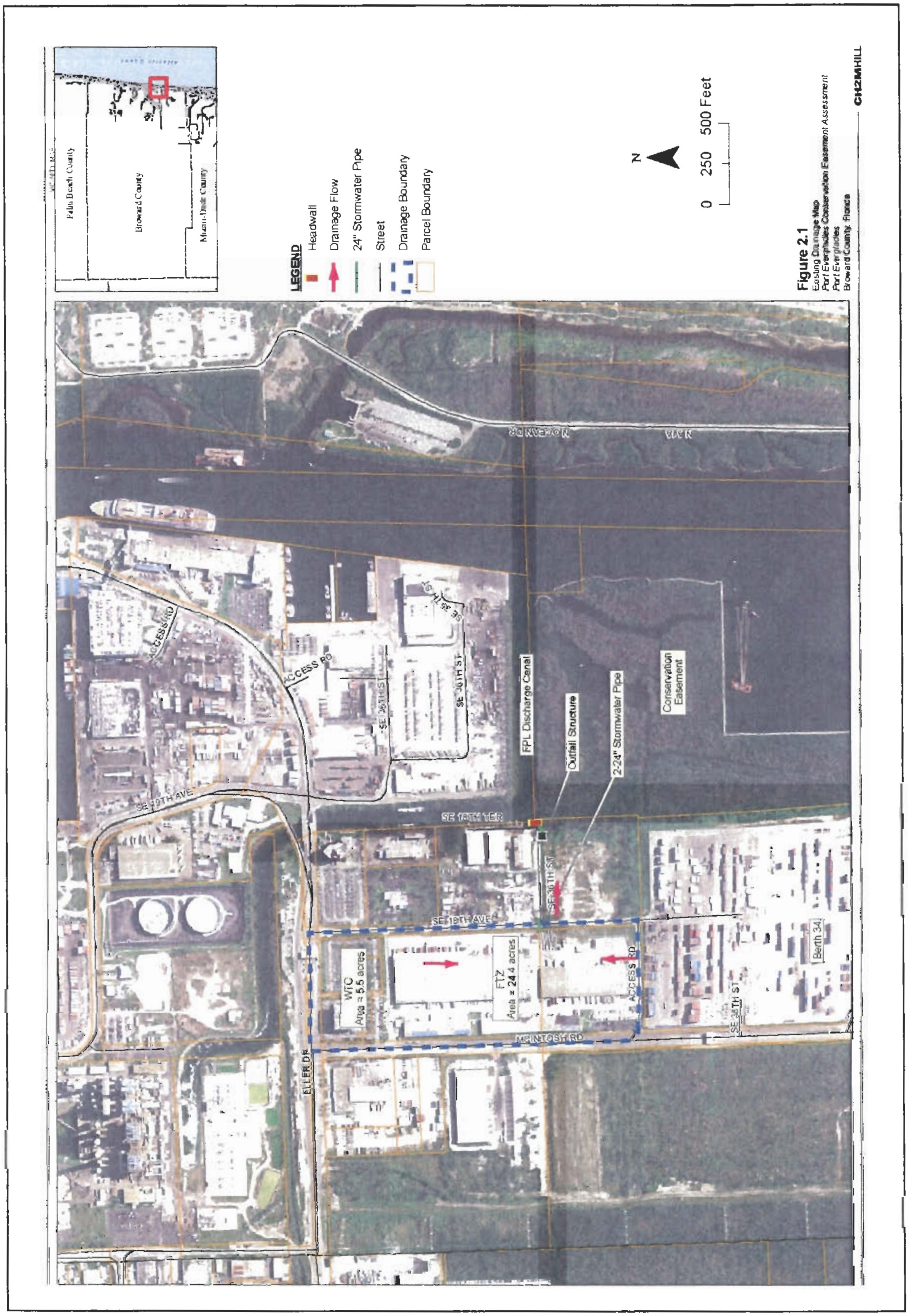


Figure 2.1
Existing Drainage Map
Port Everglades Conservation Easement Assessment
Port Everglades
Broward County, Florida

3.0 Proposed Drainage

The drainage concept plan for the proposed wetland creation area will be affected by the proposed bridge over FPL Discharge Canal. The project includes the construction of a new 1,360 LF two-lane road and bridge from SE 18th Avenue to a point east of the FPL Discharge Canal. The new mainline road is situated north of SE 36th Street and includes a future parking lot (see Appendix 4-B – Bridge Over FPL Discharge Canal Construction Plans).

The proposed Bridge over FPL Discharge Canal affects permit SWM #06-00703-S, which should be modified based on information contained in the Port Everglades Bridge Over FPL Discharge Canal Drainage Report by Craven Thompson & Associates, Inc. dated August 2008 (see Appendix 4-C).

Stormwater runoff from the new roadway and bridge will be treated in exfiltration trenches located under the proposed roadway prior to discharging to the FPL Discharge Canal. There are two discharge points for the exfiltration trenches which are located on the east and west side of the canal, respectively. The existing exfiltration trench system located in the Dry Marina parking lot (north of SE 36th Avenue) should be removed to accommodate the new exfiltration trench system for the proposed bridge and roadway.

The proposed stormwater runoff from the 29.9 acre offsite drainage should continue to flow east to the E-W Ditch; however, the width of the E-W Ditch should be modified to meet stormwater treatment requirements for upstream drainage improvements. Drainage improvements are recommended to minimize flooding at the FTZ and the WTC, and alternative stormwater designs are included in the document entitled Drainage Study at Port Everglades Foreign Trade Zone, 1987 (see Figure 3.1 and Appendix 4-D).

3.1 Stormwater Treatment Alternatives

Four (4) alternative stormwater treatment systems were considered for this project. The alternatives include:

1. E-W Ditch
2. E-W Culvert
3. E-W Underground Exfiltration System
4. E-W Stormwater Pond

E-W Ditch (Recommended)

Alternative 1 consists of widening the E-W Ditch to accommodate the required stormwater treatment volume (one inch of runoff). The top width varies from 109′ to 111′ based on an 80′ bottom width with 1:1 side slopes (see Figure 3.2). The E-W Ditch is recommended because it is the least costly alternative to construct and maintain.

E-W Culvert

Alternative 2 includes constructing the E-W Culvert to accommodate the required stormwater treatment volume (one inch of runoff). The top width is 154 ft. based on 44-18" RCP (see Figure 3.3). Water quality treatment calculations are included in Appendix 4-E. The E-W Culvert is not recommended because it is more costly to construct compared to the E-W Ditch. In addition, the surface area required to construct the E-W Culvert is greater compared to the other alternatives.

E-W Underground Exfiltration System

Alternative 3 involves constructing an E-W Underground Exfiltration System to accommodate the required stormwater treatment volume (one inch of runoff). The E-W Exfiltration is not recommended because it is more costly to construct compared to the E-W Ditch. In addition, the in-situ soils may not be compatible with this type of treatment system.

E-W Stormwater Pond

Alternative 4 requires constructing an E-W Stormwater Pond to accommodate the required stormwater treatment volume (one inch of runoff). The E-W Stormwater Pond is not recommended because it requires more surface area compared to the E-W Ditch.

3.2 Maintenance

Maintenance requirements associated with the E-W Ditch and E-W Culvert are presented in this section.

E-W Ditch

Maintenance requirements for the E-W Ditch include:

1. Mowing
2. Removing Vegetation
3. Sediment Removal

Mowing above the waterline and along channel banks is required to control grass and weeds. Mowing in the ditch is recommended during the dry season to avoid the need to do a 'wet' clean out. Additional considerations for mowing include:

- Remove mowed material from the ditch, so it does not reduce drainage efficiency.
- Prevent mowed material from re-entering the channel to improve water quality.

Vegetation can be controlled manually, mechanically, or chemically. The method used will depend upon the characteristics of the vegetation, its location, and other factors. Hand cutting and/or hand removal of vegetation is the preferred method for vegetation maintenance. All grass cuttings or fallen debris from hand-cutting or pruning should be cleared from the ditch to prevent flow blockages and to prevent decaying material from affecting water quality.

Removing sediment should occur during the dry period. The ditch should be blocked when maintenance work occurs to prevent sediment from moving downstream. Only remove sufficient material to keep the original ditch cross section. Removed material should be placed in a location so that the material cannot re-enter the ditch.

E-W Culvert

Culverts increase the potential for waterway blockage by debris and sediment. Scour caused by high velocity flows at the outlet and turbulence at the inlet are the primary maintenance concern. Routine maintenance for culverts involves the removal of obstructions, and the repair of erosion and scour holes.

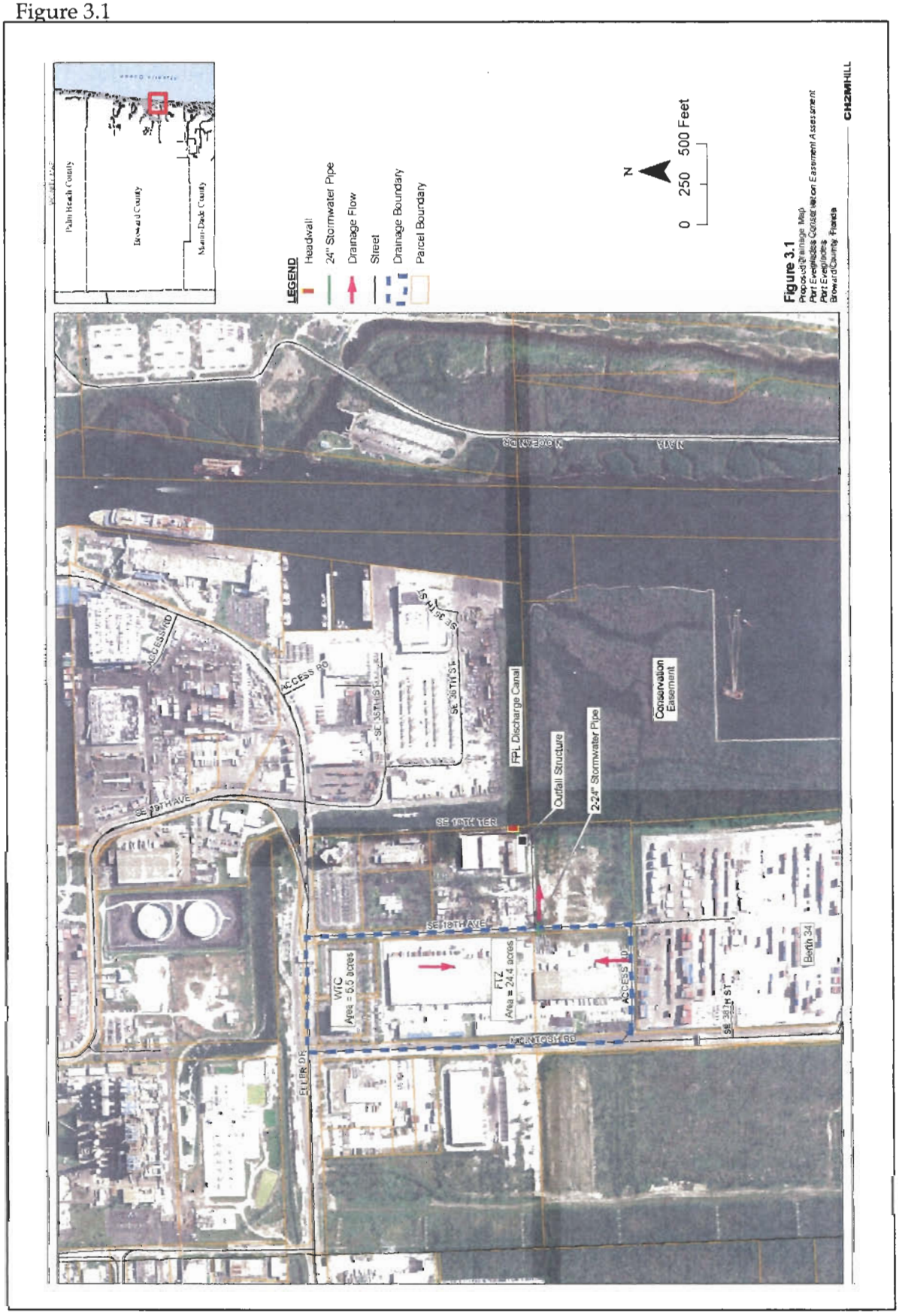
E-W Underground Exfiltration System

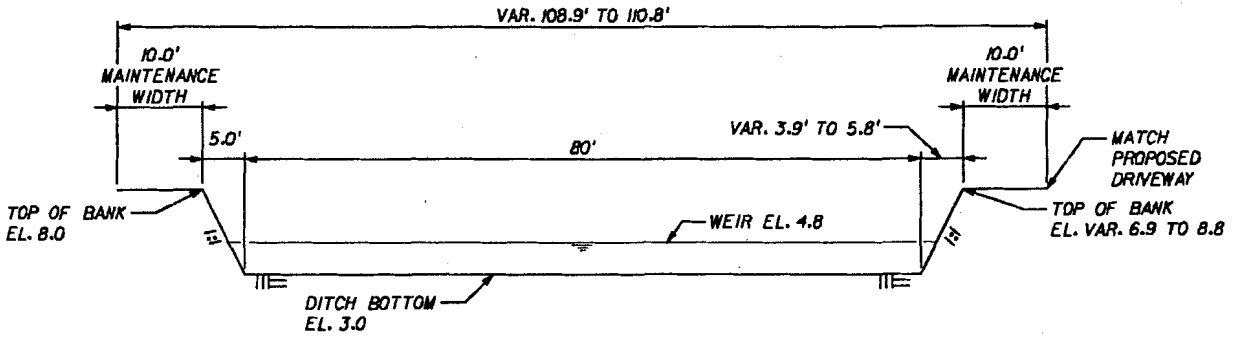
Maintenance of the E-W Underground Exfiltration System requires frequent inspection and detailed step by step procedures to maintain operational efficacy.

E-W Stormwater Pond

Maintenance requirements for the E-W Stormwater Pond are similar to the E-W Ditch.

Figure 3.1


Palm Beach County
Broward County
Miami-Dade County
LEGEND
Headwall
24" Stormwater Pipe
Drainage Flow
Street
Drainage Boundary
Parcel Boundary
N
0 250 500 Feet
Figure 3.1
Proposed Drainage Map
Port Everglades Conservation Easement Assessment
Port Everglades
Broward County, Florida
CH2MHILL
NORTH FORK NEW RIVER
ACCESS RD
SE 35TH ST
SE 36TH ST
SE 19TH AVE
FPL Discharge Canal
Outfall Structure
24" Stormwater Pipe
Conservation Easement
SE 19TH TER
SE 19TH AVE
W1C
Area = 5.0 acres
F1Z
Area = 24.4 acres
ACCESS RD
Berth 34
SE 38TH ST
MCINTOSH RD
FT LAUDERDALE



NOTE:

WEIR ELEVATION INFORMATION OBTAINED FROM THE DOCUMENT ENTITLED: TOPO EAST OF FOREIGN TRADE ZONE, 5/13/87

E-W DITCH TYPICAL SECTION
NTS

FIGURE 3.2
E-W DITCH TYPICAL SECTION
PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

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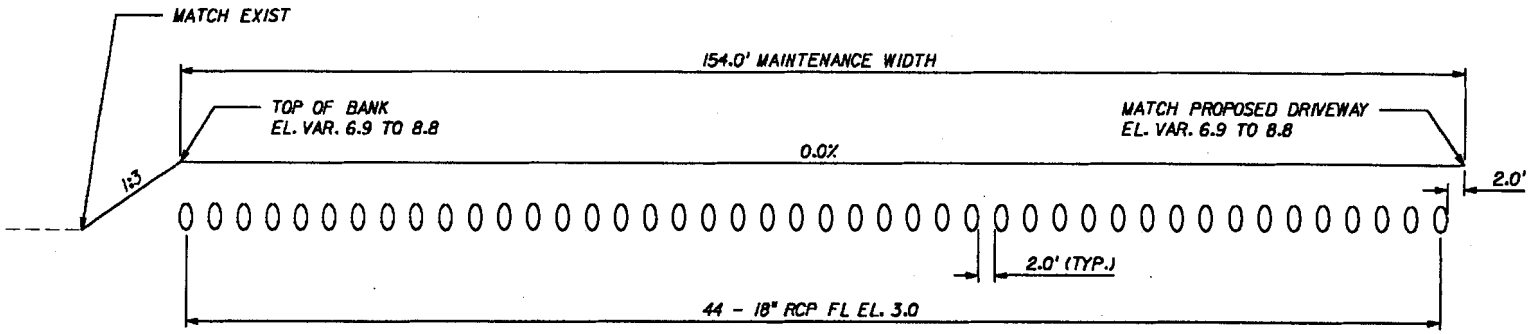

E-W CULVERT TYPICAL SECTION
NTS

FIGURE 3.3
E-W CULVERT TYPICAL SECTION
PORT EVERGLADES CONSERVATION EASEMENT
PORT EVERGLADES
BROWARD COUNTY, FL

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11/7/2008 12:36:31 PM \\Tampa\ports\Everglades_Port\Port_Everglades_CE\Drawings\Figure3.3.dgn

4.0 Summary and Recommendations

The existing E-W Ditch south of SE 36th Street conveys stormwater runoff from the FTZ and WTC to the FPL Discharge Canal. The new E-W Ditch should be situated adjacent to the proposed driveway and parking lot associated with the proposed Bridge over FPL Discharge Canal.

Two stormwater management alternatives were evaluated for this project – the E-W Ditch and the E-W Culvert. The E-W Ditch is designed to accommodate the first inch of stormwater runoff from 29.9 acres, and should be situated adjacent to the proposed driveway and parking lot. The new E-W Ditch cross section geometry is shown in Table 4.1:

TABLE 4.1
E-W Ditch Cross Section Geometry

Parameter	Value
Bottom Width (BW)	80'
Front Slope (FS)	1:1
Back Slope (BS)	1:1
Depth (D)	Varies 3.6' to 5.8'
Top Width (TW)	Varies 89' to 91'
Top Width (including maintenance)	Varies 109' to 111"

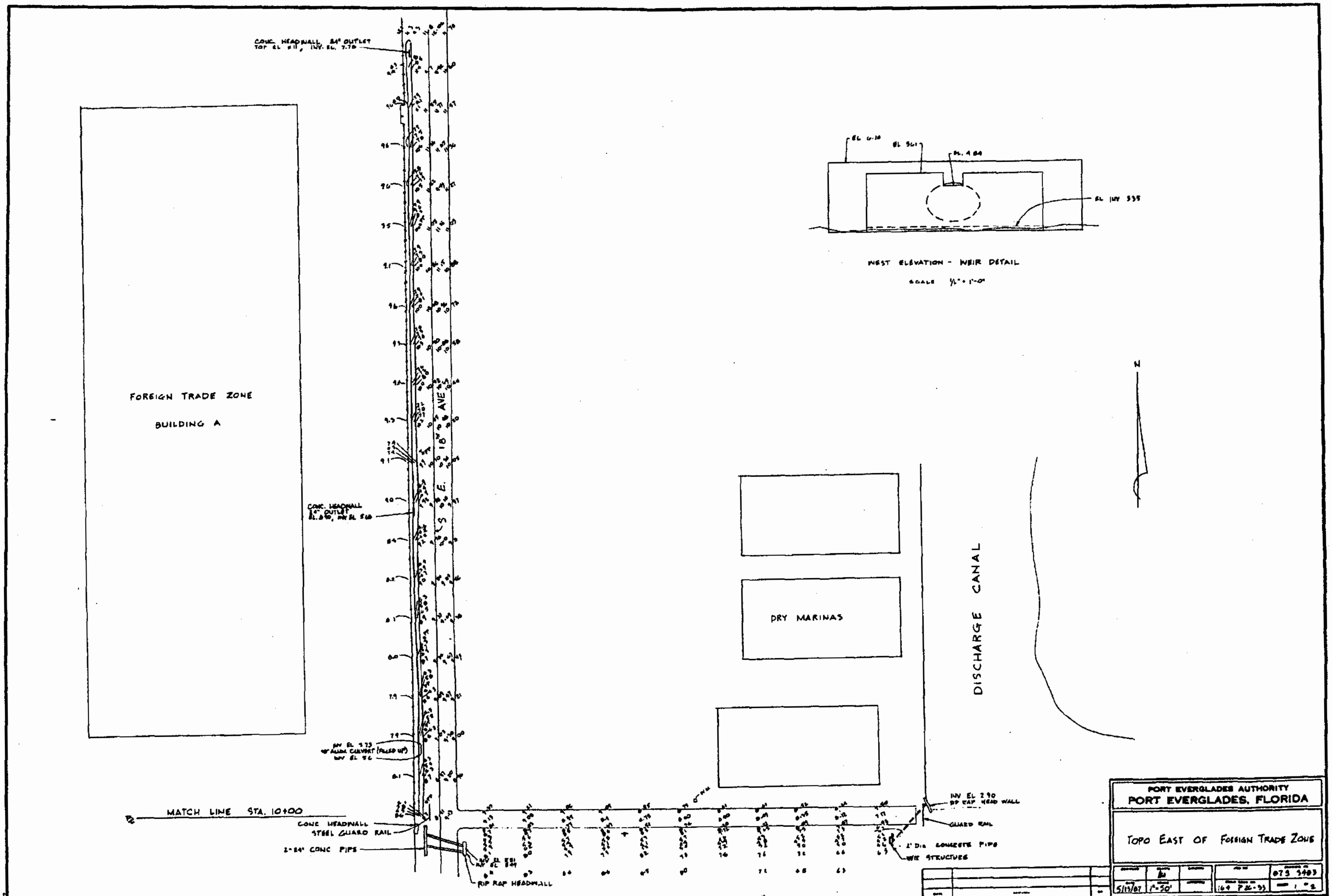
Figure 3.2 shows the E-W Ditch typical section. A new control structure is required to match the new E-W Ditch configuration and location prior to discharging in the FPL Discharge Canal. The new control structure should include a low flow concrete weir for stormwater treatment with 2-24" RCP discharging to the FPL Discharge Canal.

Figure 3.3 shows the E-W Culvert which was evaluated and designed to accommodate the first inch of stormwater runoff from 29.9 acres. This option requires 44-18" diameter pipes in parallel to accommodate the required stormwater quality treatment volume.

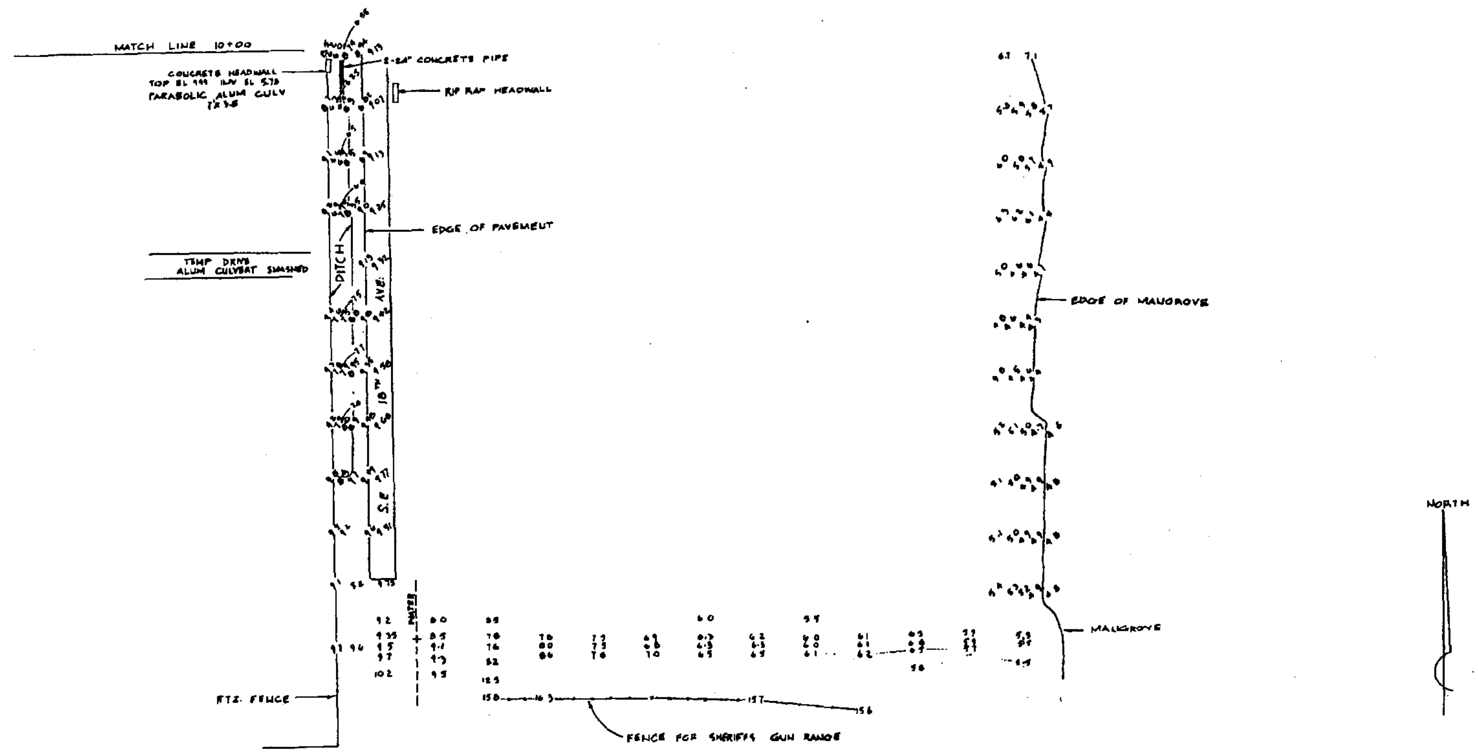
The E-W Ditch is recommended because the top width is less compared to the E-W Culvert and because the ditch provides more area for enhancement. The proposed 17-acre wetland creation area should be designed to accommodate the recommended E-W Ditch configuration and location.

APPENDIX 4-A

Topo East of Foreign Trade Zone



FOREIGN TRADE ZONE
BUILDING A
S.E. 18th AVE
DRY MARINAS
DISCHARGE CANAL
WEST ELEVATION - WEIR DETAIL
MATCH LINE STA. 10+00
CONC. HEADWALL
STEEL GUARD RAIL
RIP RAP HEADWALL
GUARD RAIL
N
PORT EVERGLADES AUTHORITY
PORT EVERGLADES, FLORIDA
TOPO EAST OF FOREIGN TRADE ZONE
5/13/87
1"=50'



PORT EVERGLADES AUTHORITY
PORT EVERGLADES, FLORIDA

TOPO EAST OF
FOREIGN TRADE ZONE

APPENDIX 4-B

Port Everglades Bridge Over FPL Discharge Canal Construction Plans

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PAVING NOTES

A. GENERAL:

1. ALL UNDERGROUND UTILITIES SHALL BE COMPLETED PRIOR TO CONSTRUCTION OF LIME ROCK BASE.
2. ALL EXISTING PAVEMENT, CUT OR DAMAGED BY CONSTRUCTION, SHALL BE PROPERLY RESTORED AT THE CONTRACTOR'S EXPENSE.
3. WHERE ANY PROPOSED PAVEMENT IS TO BE CONNECTED TO EXISTING PAVEMENT, THE EXISTING EDGE OF PAVEMENT SHALL BE SAW CUT.

B. MATERIALS:

1. BASE COURSE SHALL BE CRUSHED LIME ROCK MIAMI OOLITE WITH A MINIMUM OF 70% CARBONATES OF CALCIUM AND MAGNESIUM (60% FOR PARKING AREAS). THE LIQUID LIMIT SHALL NOT EXCEED 35 AND THE MATERIAL SHALL BE NON-PLASTIC. AT LEAST 97% (BY WEIGHT) OF THE MATERIAL SHALL PASS A 3 1/2 INCH SIEVE AND THE MATERIAL SHALL BE UNIFORMLY GRADED DOWN TO DUST.
2. ASPHALT SURFACES SHALL BE TYPE S-III ASPHALTIC CONCRETE, UNLESS OTHERWISE SPECIFIED ON THE PLANS.

C. INSTALLATION:

1. SUBGRADE SHALL BE A MIN. 12 INCHES THICK (UNLESS OTHERWISE NOTED) AND SHALL BE A MINIMUM LBR OF 40. THE SUBGRADE SHALL BE COMPACTED TO A MINIMUM OF 98% OF THE MAXIMUM DRY DENSITY PER AAS THE LOWER 12" OF SUBGRADE SHALL BE COMPACTED TO 100% OF THE MAXIMUM DENSITY (ASTM D-1557).
2. BASE COURSE MATERIAL FOR PAVED AREAS SHALL BE A MINIMUM THICKNESS OF 14". BASE COURSE MATERIAL SHALL HAVE A MINIMUM LBR 100, UNLESS OTHERWISE INDICATED.
3. BASE COURSE SHALL BE COMPACTED TO 98% OF THE MAXIMUM DENSITY AS PER, ASTM D-1557, OR LATEST REVISION.
4. INSTALLATION OF THE WEARING SURFACE SHALL CONFORM WITH THE REQUIREMENTS OF THE D.O.T. STANDARD SPECIFICATIONS FOR TYPE S-1 ASPHALTIC CONCRETE.

D. TESTING

1. THE FINISHED SURFACE OF THE BASE COURSE AND THAT OF THE WEARING SURFACE SHALL NOT VARY MORE THAN 1/4" FROM THE TEMPLATE, NOR 0.1 FT. FROM PROPOSED FINISHED GRADE ELEVATIONS AS DEPICTED ON THE DESIGN DRAWINGS. ANY IRREGULARITIES EXCEEDING THESE LIMITS SHALL BE CORRECTED BY SCARIFYING TO A DEPTH OF THREE (3) INCHES, REMOVING OR ADDING ROCK AS MAY BE REQUIRED, AND WATERING, ROLLING AND COMPACTING THE SCARIFIED AREA.
2. DENSITY TESTS SHALL BE TAKEN BY AN INDEPENDENT TESTING LABORATORY CERTIFIED BY THE STATE OF FLORIDA, WHERE DIRECTED BY THE ENGINEER.
3. ALL TESTING COSTS (PAVING) SHALL BE PAID FOR BY THE OWNER EXCEPT THOSE TESTS FAILING TO MEET THE SPECIFIED REQUIREMENTS WHICH ARE TO BE PAID BY THE CONTRACTOR.

STORM DRAINAGE

A. GENERAL:

1. CATCH BASIN GRATES AND RIM ELEVATIONS AS SHOWN ON PLANS SHALL BE ADJUSTED TO CONFORM TO NEW OR EXISTING GRADES.
2. DISTANCES AND LENGTHS SHOWN ON PLANS ARE REFERENCED TO THE CENTER OF STRUCTURES.
3. CONTRACTOR SHALL BE RESPONSIBLE TO PREPARE A STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AND TO COMPLY WITH ALL STATE AND FEDERAL REGULATIONS RELATED TO THE STORM WATER DISCHARGE FROM CONSTRUCTION RELATED ACTIVITIES THAT DISTURB ONE OR MORE ACRES OF LAND.

B. MATERIALS:

NOTE: WHERE MORE THAN ONE SPECIFIED MATERIAL EXISTS FOR AN ITEM, IT IS THE CONTRACTORS OPTION TO USE EITHER MATERIAL.

1. HIGH DENSITY POLYETHYLENE PIPE (HDPE) SIZES 12" – 36", SHALL BE CORRUGATED TYPE, SMOOTH INTERIOR, CONFORMING TO ASTM F405, ASTM F667, AASHTO M252 AND AASHTO M294 AS MANUFACTURED BY ADVANCED DRAINAGE SYSTEMS OR APPROVED EQUAL.
2. RIP RAP HEADWALLS SHALL BE CONSTRUCTED OF SAND/CEMENT WITH A MINIMUM 2000 PSI COMPRESSIVE STRENGTH TO MEET FLORIDA D.O.T. STANDARDS. THE BAGS SHALL BE PERMEABLE BURLAP, CLOTH OR PAPER. A CONCRETE CAP SHALL BE POURED ON TOP OF THE SAND/CEMENT RIP RAP BAGS WITH A MINIMUM 3000 PSI COMPRESSION STRENGTH.
3. ALL DRAINAGE CATCH BASINS AND STRUCTURES SHALL BE PRECAST CONCRETE AS MANUFACTURED BY U.S. PRECAST CORPORATION, OR APPROVED EQUAL. THE MINIMUM WALL AND SLAB THICKNESS SHALL BE 8 INCHES AND THE MINIMUM REINFORCING SHALL BE NO. 4 BARS AT 12 INCHES EACH WAY UNLESS OTHERWISE INDICATED. CONCRETE SHALL BE MINIMUM OF fc=4000 PSI AT 28 DAYS.

C. INSTALLATION:

1. PIPE SHALL BE PLACED ON A MINIMUM OF 8" STABLE GRANULAR MATERIAL FREE OF ROCK FORMATION AND OTHER FOREIGN FORMATIONS, AND CONSTRUCTED TO A UNIFORM GRADE AND LINE.
2. BACKFILL MATERIAL SHALL BE WELL GRADED GRANULAR MATERIAL, WELL TAMPED IN LAYERS NOT TO EXCEED 6 INCHES TO A HEIGHT OF 12 INCHES ABOVE PIPE AS SHOWN ON THE PLANS.
3. PROVIDE A MINIMUM PROTECTIVE COVER OF 18 INCHES OVER STORM SEWER AND AVOID UNNECESSARY CROSSING BY HEAVY CONSTRUCTION VEHICLES DURING CONSTRUCTION.
4. THE CONTRACTOR SHALL NOTIFY SEAPORT CONSTRUCTION DIVISION AT LEAST 7 DAYS PRIOR TO THE START OF CONSTRUCTION.

DATE	BY	DESCRIPTION
12/17/07	MTR	
	A.S.	
	J.K.	
	K.M.H.	
	K.M.H.	

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PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL
PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION

GENERAL NOTES

KEVIN M HART
FLORIDA P.E. NO. 37120

PROJECT NO.
06-0044

D-1

SHEET 1 OF 11

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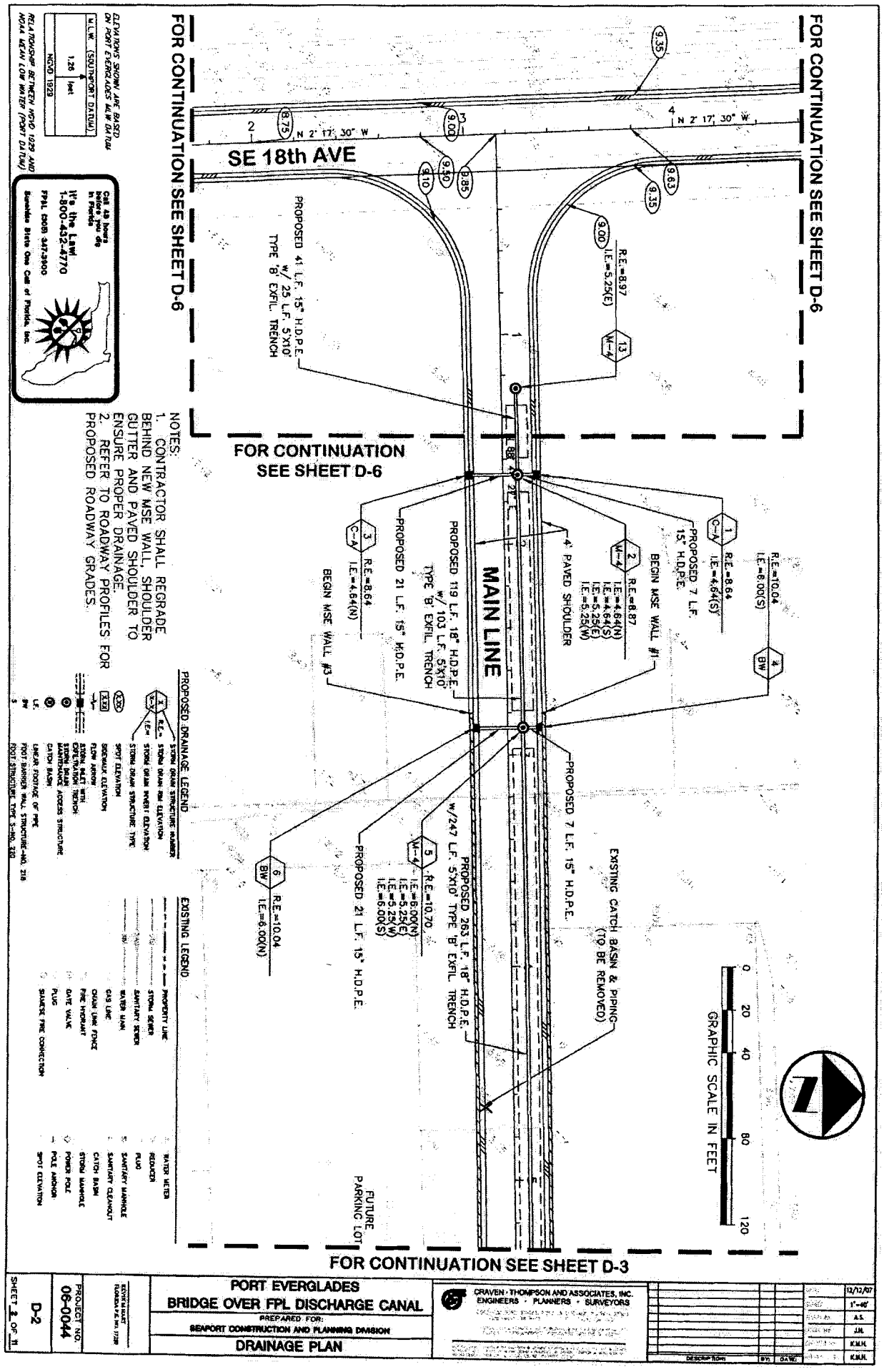
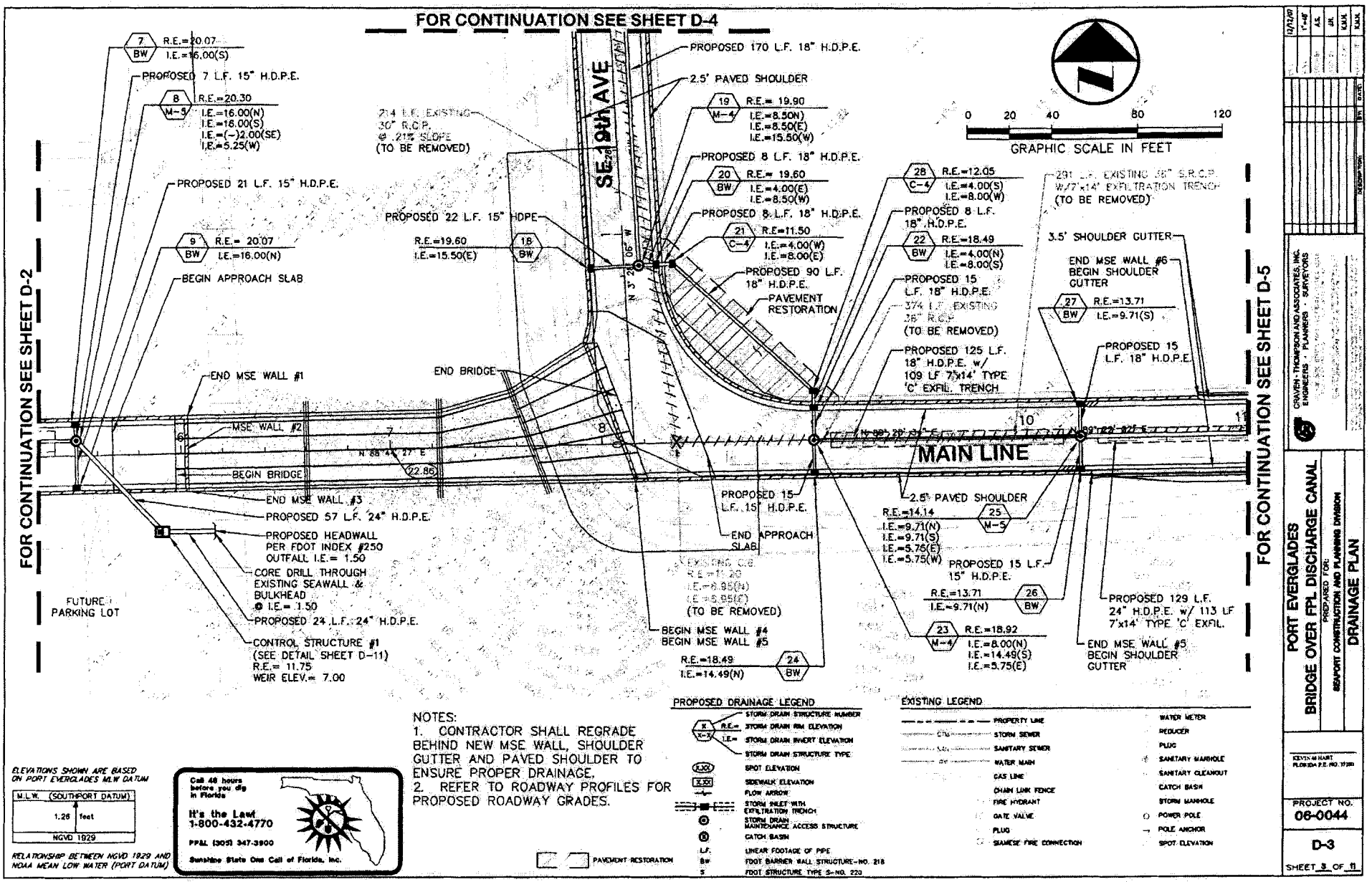


PROJECT NO. 06-0044	PORT EVERGLADES BRIDGE OVER FPL DISCHARGE CANAL	CRAVEN · THOMPSON AND ASSOCIATES, INC. ENGINEERS · PLANNERS · SURVEYORS	12/12/07
D-2	PREPARED FOR: SEAPORT CONSTRUCTION AND PLANNING DIVISION		1"=40'
SHEET 2 OF 11	DRAINAGE PLAN		A.S.
			J.M.
			K.M.H.
			K.M.H.
		DESCRIPTION BY DATE	



NOTES:
1. CONTRACTOR SHALL REGRADE BEHIND NEW MSE WALL, SHOULDER GUTTER AND PAVED SHOULDER TO ENSURE PROPER DRAINAGE.
2. REFER TO ROADWAY PROFILES FOR PROPOSED ROADWAY GRADES.

PROPOSED DRAINAGE LEGEND

- STORM DRAIN STRUCTURE NUMBER
- R.E.= STORM DRAIN RIM ELEVATION
- I.E.= STORM DRAIN INVERT ELEVATION
- STORM DRAIN STRUCTURE TYPE
- SPOT ELEVATION
- SIDEWALK ELEVATION
- FLOW ARROW
- STORM INLET WITH EXFILTRATION TRENCH
- STORM DRAIN MAINTENANCE ACCESS STRUCTURE
- CATCH BASIN
- L.F. LINEAR FOOTAGE OF PIPE
- BW FDOT BARRIER WALL STRUCTURE-NO. 218
- S FDOT STRUCTURE TYPE S-NO. 220
- PAVEMENT RESTORATION

EXISTING LEGEND

- PROPERTY LINE
- STORM SEWER
- SANITARY SEWER
- WATER MAIN
- GAS LINE
- CHAIN LINK FENCE
- FIRE HYDRANT
- GATE VALVE
- PLUG
- SIAMESE FIRE CONNECTION
- WATER METER
- REDUCER
- PLUG
- SANITARY MANHOLE
- SANITARY CLEANOUT
- CATCH BASIN
- STORM MANHOLE
- POWER POLE
- POLE ANCHOR
- SPOT ELEVATION

ELEVATIONS SHOWN ARE BASED ON PORT EVERGLADES MLW DATUM

M.L.W. (SOUTHPORT DATUM)	
1.26	feet
NGVD 1929	

RELATIONSHIP BETWEEN NGVD 1929 AND NOAA MEAN LOW WATER (PORT DATUM)

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PREPARED FOR: SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE PLAN

CRAVEN · THOMPSON AND ASSOCIATES, INC. ENGINEERS · PLANNERS · SURVEYORS

KEVIN M. HART FLORIDA P.E. NO. 57200

PROJECT NO. 06-0044

D-3

SHEET 3 OF 11

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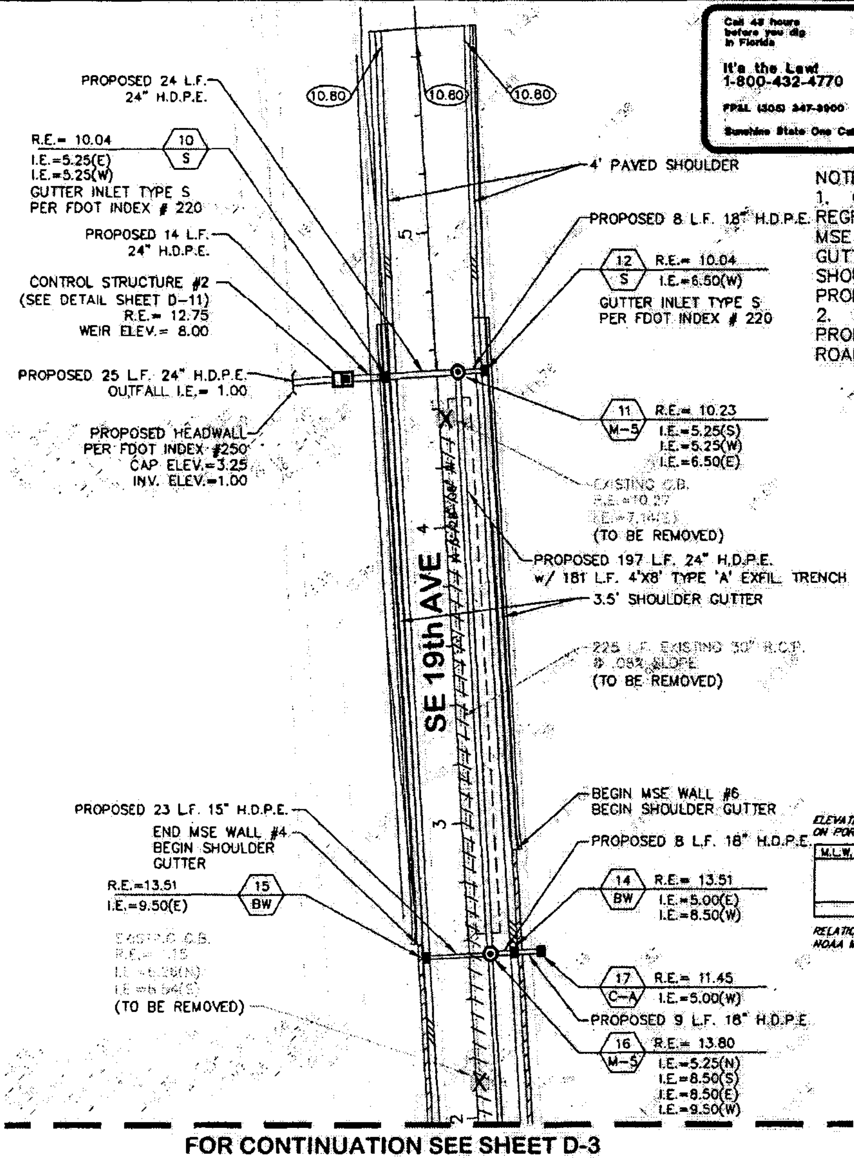

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NOTES:
1. CONTRACTOR SHALL REGRADE BEHIND NEW MSE WALL, SHOULDER GUTTER AND PAVED SHOULDER TO ENSURE PROPER DRAINAGE.
2. REFER TO ROADWAY PROFILES FOR PROPOSED ROADWAY GRADES.

GRAPHIC SCALE IN FEET (0, 20, 40, 80, 120)

NOTE:
1. TYPE S STRUCTURES TO CONFORM TO FDOT STANDARD INDEX NO. 220
2. TYPE BW INLETS TO CONFORM TO FDOT STANDARD INDEX NO. 218

STRUCTURE No.	STRUCTURE TYPE	RIM ELEV.	INV. ELEV.	INV. ELEV.	INV. ELEV.
1	C-A	R.E.=8.64	I.E.=4.64 (S)		
2	M-4	R.E.=8.87	I.E.=4.64 (N)	I.E.=4.64 (S)	I.E.=5.25 (E),(W)
3	C-A	R.E.=8.64	I.E.=4.64 (N)		
4	BW	R.E.=10.04	I.E.=6.00 (S)		
5	M-4	R.E.=10.70	I.E.=6.00 (N),(S)	I.E.=5.25 (E)	I.E.=5.25 (W)
6	BW	R.E.=10.04	I.E.=6.00 (N)		
7	BW	R.E.=20.07	I.E.=16.00 (S)		
8	M-5	R.E.=20.30	I.E.=16.00 (N),(S)	I.E.=(-)2.00 (SE)	I.E.=5.25 (W)
9	BW	R.E.=20.07	I.E.=16.00 (N)		
10	S	R.E.=10.04	I.E.=5.25 (E)	I.E.=5.25 (W)	
11	M-5	R.E.=10.23	I.E.=5.25 (S)	I.E.=5.25 (W)	I.E.=6.50 (E)
12	S	R.E.=10.04	I.E.=6.50 (W)		
13	M-4	R.E.=8.97	I.E.=5.25 (E)		
14	BW	R.E.=13.51	I.E.=5.00 (E)	I.E.=8.50 (W)	
15	BW	R.E.=13.51	I.E.=9.50 (E)		
16	M-5	R.E.=13.80	8.50(S), 8.50(E)	I.E.=9.50 (W)	I.E.=5.25 (N)
17	C-A	R.E.=11.45	I.E.=5.00 (W)		
18	BW	R.E.=19.60	I.E.=15.50 (E)		
19	M-4	R.E.=19.90	I.E.=8.50 (N)	I.E.=8.50 (E)	I.E.=15.50 (W)
20	BW	R.E.=19.60	I.E.=4.00 (E)	I.E.=8.50 (W)	
21	C-4	R.E.=11.50	I.E.=8.00 (E)	I.E.=4.00 (W)	
22	BW	R.E.=18.49	I.E.=4.00 (N)	I.E.=8.00 (S)	
23	M-4	R.E.=18.92	I.E.=8.00 (N)	I.E.=14.49 (S)	I.E.=5.75 (E)
24	BW	R.E.=18.49	I.E.=14.49 (N)		
25	M-5	R.E.=14.14	I.E.=9.71 (N),(S)	I.E.=5.75 (E)	I.E.=5.75 (W)
26	BW	R.E.=13.71	I.E.=9.71 (N)		
27	BW	R.E.=13.71	I.E.=9.71 (S)		
28	C-4	R.E.=12.05	I.E.=4.00 (S)	I.E.=8.00 (W)	
29	S	R.E.=12.43	I.E.=8.43 (S)		
30	M-5	R.E.=12.78	I.E.=8.43 (N),(S)	I.E.=6.00 (E)	I.E.=5.75 (W)
31	S	R.E.=12.43	I.E.=8.43 (N)		
CS#1	CS	R.E.=11.75	WEIR ELEV=7.00		
CS#2	CS	R.E.=12.75	WEIR ELEV=8.00		

ELEVATIONS SHOWN ARE BASED ON PORT EVERGLADES MLW DATUM

M.L.W. (SOUTHPORT DATUM)
1.26 feet
NGVD 1929

RELATIONSHIP BETWEEN NGVD 1929 AND NOAA MEAN LOW WATER (PORT DATUM)

PROPOSED DRAINAGE LEGEND
- STORM DRAIN STRUCTURE NUMBER
- R.E.= STORM DRAIN RIM ELEVATION
- I.E.= STORM DRAIN INVERT ELEVATION
- STORM DRAIN STRUCTURE TYPE
- SPOT ELEVATION
- SIDEWALK ELEVATION
- FLOW ARROW
- STORM INLET WITH EXFILTRATION TRENCH
- STORM DRAIN MAINTENANCE ACCESS STRUCTURE
- CATCH BASIN
- L.F. LINEAR FOOTAGE OF PIPE
- BW FDOT BARRIER WALL STRUCTURE-NO. 218
- S FDOT STRUCTURE TYPE S-NO. 220

EXISTING LEGEND
- PROPERTY LINE
- STORM SEWER
- SANITARY SEWER
- WATER MAIN
- GAS LINE
- CHAIN LINK FENCE
- FIRE HYDRANT
- GATE VALVE
- PLUG
- SIAMESE FIRE CONNECTION
- WATER METER
- REDUCER
- PLUG
- SANITARY MANHOLE
- SANITARY CLEANOUT
- CATCH BASIN
- STORM MANHOLE
- POWER POLE
- POLE ANCHOR
- SPOT ELEVATION

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PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL

PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION

DRAINAGE PLAN

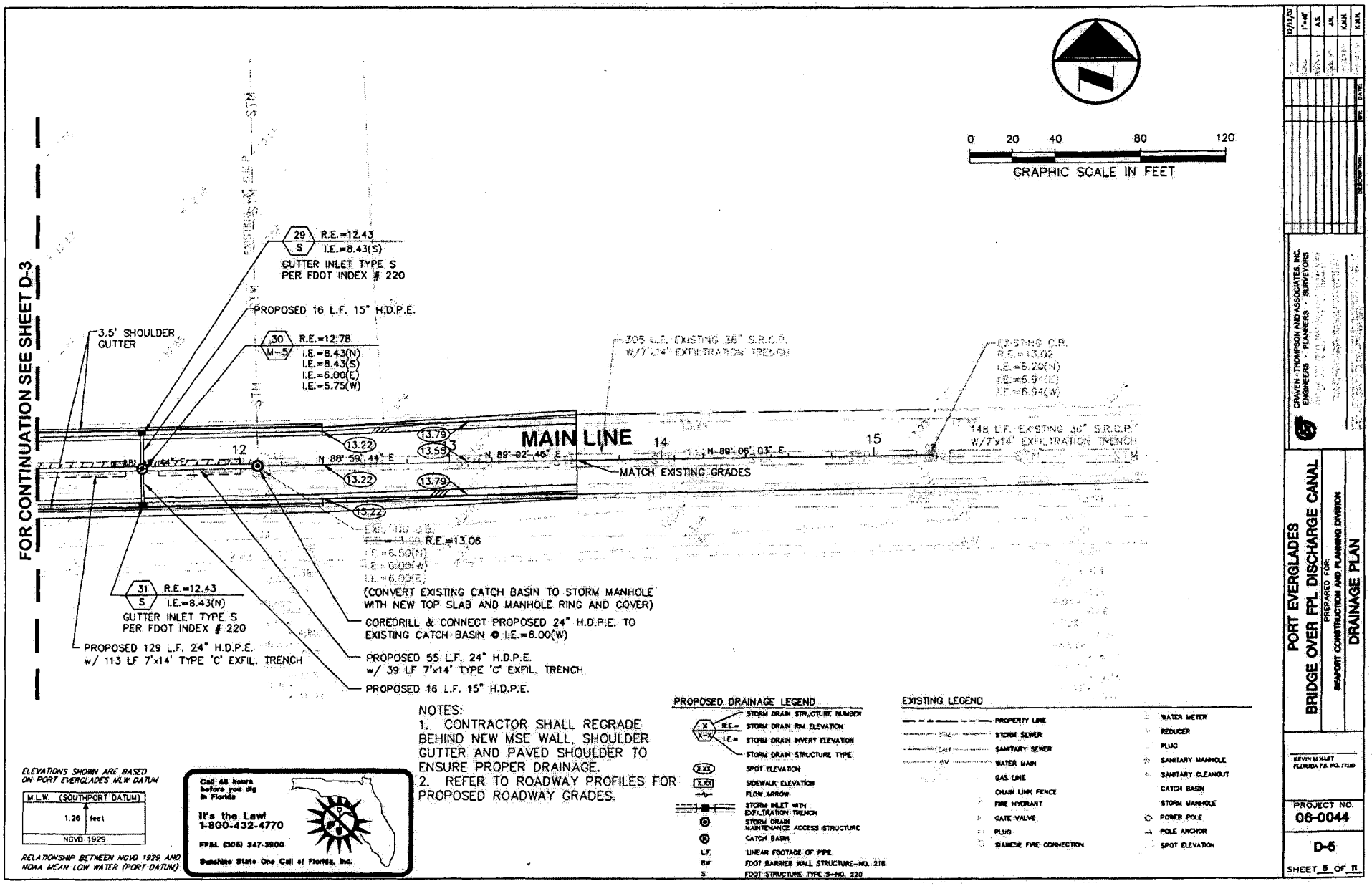
KEVIN M. HART
FLORIDA P.E. NO. 37390

	12/12/07
	1"=40'
	A.S.
	J.H.
	K.M.H.
	K.M.H.

DESCRIPTION | BY | DATE

PROJECT NO. 06-0044

D-4



NOTES:
1. CONTRACTOR SHALL REGRADE BEHIND NEW MSE WALL, SHOULDER GUTTER AND PAVED SHOULDER TO ENSURE PROPER DRAINAGE.
2. REFER TO ROADWAY PROFILES FOR PROPOSED ROADWAY GRADES.

PROPOSED DRAINAGE LEGEND

- X / R.E.= / I.E.= — STORM DRAIN STRUCTURE NUMBER; STORM DRAIN RIM ELEVATION; STORM DRAIN INVERT ELEVATION; STORM DRAIN STRUCTURE TYPE
- (XX.XX) — SPOT ELEVATION
- [XX.XX] — SIDEWALK ELEVATION
- FLOW ARROW
- STORM INLET WITH EXFILTRATION TRENCH
- STORM DRAIN MAINTENANCE ACCESS STRUCTURE
- (R) — CATCH BASIN
- L.F. — LINEAR FOOTAGE OF PIPE
- BW — FDOT BARRIER WALL STRUCTURE-NO. 216
- S — FDOT STRUCTURE TYPE 'S'-NO. 220

EXISTING LEGEND

- PROPERTY LINE
- STM — STORM SEWER
- SAN — SANITARY SEWER
- W — WATER MAIN
- GAS LINE
- CHAIN LINK FENCE
- FIRE HYDRANT
- GATE VALVE
- PLUG
- SIAMESE FIRE CONNECTION
- WATER METER
- REDUCER
- PLUG
- SANITARY MANHOLE
- SANITARY CLEANOUT
- CATCH BASIN
- STORM MANHOLE
- POWER POLE
- POLE ANCHOR
- SPOT ELEVATION

ELEVATIONS SHOWN ARE BASED ON PORT EVERGLADES M.L.W. DATUM

M.L.W. (SOUTHPORT DATUM)	
1.26	feet
NGVD 1929	

RELATIONSHIP BETWEEN NGVD 1929 AND NOAA MEAN LOW WATER (PORT DATUM)

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DATE	BY	DESCRIPTION
12/12/07		
1"=40'	A.S.	
	J.R.	
	K.M.H.	
	K.M.H.	

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DRAINAGE PLAN

KEVIN M. HART
FLORIDA P.E. NO. 77160

PROJECT NO.
06-0044

D-5

SHEET 5 OF 11

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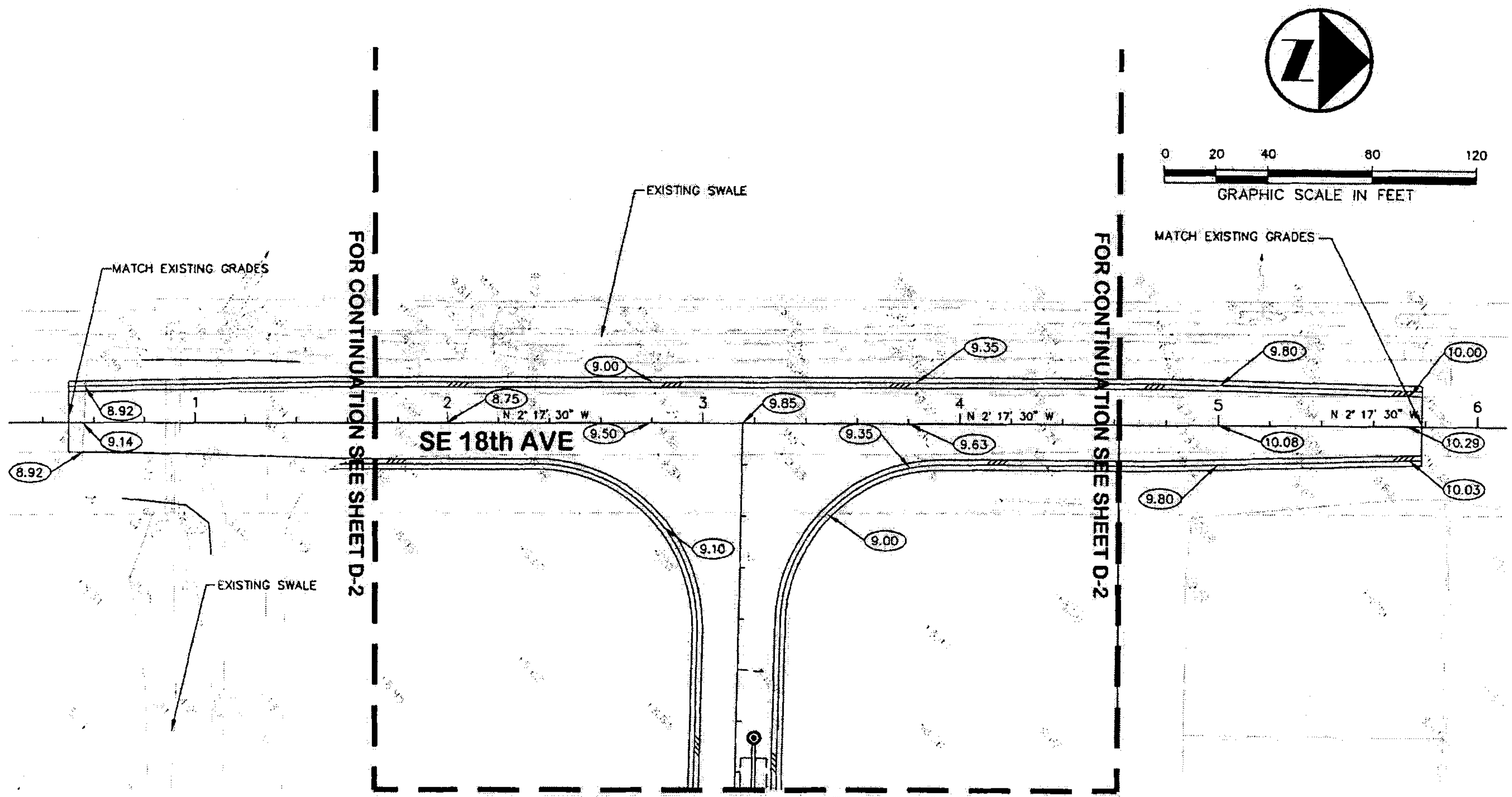

FOR CONTINUATION SEE SHEET D-2

NOTES:
1. CONTRACTOR SHALL REGRADE BEHIND NEW MSE WALL, SHOULDER GUTTER AND PAVED SHOULDER TO ENSURE PROPER DRAINAGE.
2. REFER TO ROADWAY PROFILES FOR PROPOSED ROADWAY GRADES.

PROPOSED DRAINAGE LEGEND
- STORM DRAIN STRUCTURE NUMBER
- R.E.= STORM DRAIN RIM ELEVATION
- I.E.= STORM DRAIN INVERT ELEVATION
- STORM DRAIN STRUCTURE TYPE
- SPOT ELEVATION
- SIDEWALK ELEVATION
- FLOW ARROW
- STORM INLET WITH EXFILTRATION TRENCH
- STORM DRAIN MAINTENANCE ACCESS STRUCTURE
- CATCH BASIN
- L.F. LINEAR FOOTAGE OF PIPE
- BW FDOT BARRIER WALL STRUCTURE-NO. 218
- S FDOT STRUCTURE TYPE S-NO. 220

EXISTING LEGEND
- PROPERTY LINE
- STORM SEWER
- SANITARY SEWER
- WATER MAIN
- GAS LINE
- CHAIN LINK FENCE
- FIRE HYDRANT
- GATE VALVE
- PLUG
- SIAMESE FIRE CONNECTION
- WATER METER
- REDUCER
- PLUG
- SANITARY MANHOLE
- SANITARY CLEANOUT
- CATCH BASIN
- STORM MANHOLE
- POWER POLE
- POLE ANCHOR
- SPOT ELEVATION

ELEVATIONS SHOWN ARE BASED ON PORT EVERGLADES MLW DATUM

M.L.W. (SOUTHPORT DATUM)	
1.26	feet
NGVD 1929	

RELATIONSHIP BETWEEN NGVD 1929 AND NOAA MEAN LOW WATER (PORT DATUM)

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PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE PLAN

KEVIN M. HART
FLORIDA P.E. NO. 17249

PROJECT NO.
06-0044

D-6

SHEET 8 OF 11

DESCRIPTION	BY	DATE

	12/12/07
	1"=40'
	A.S.
	J.K.
	K.M.H.
	K.M.H.

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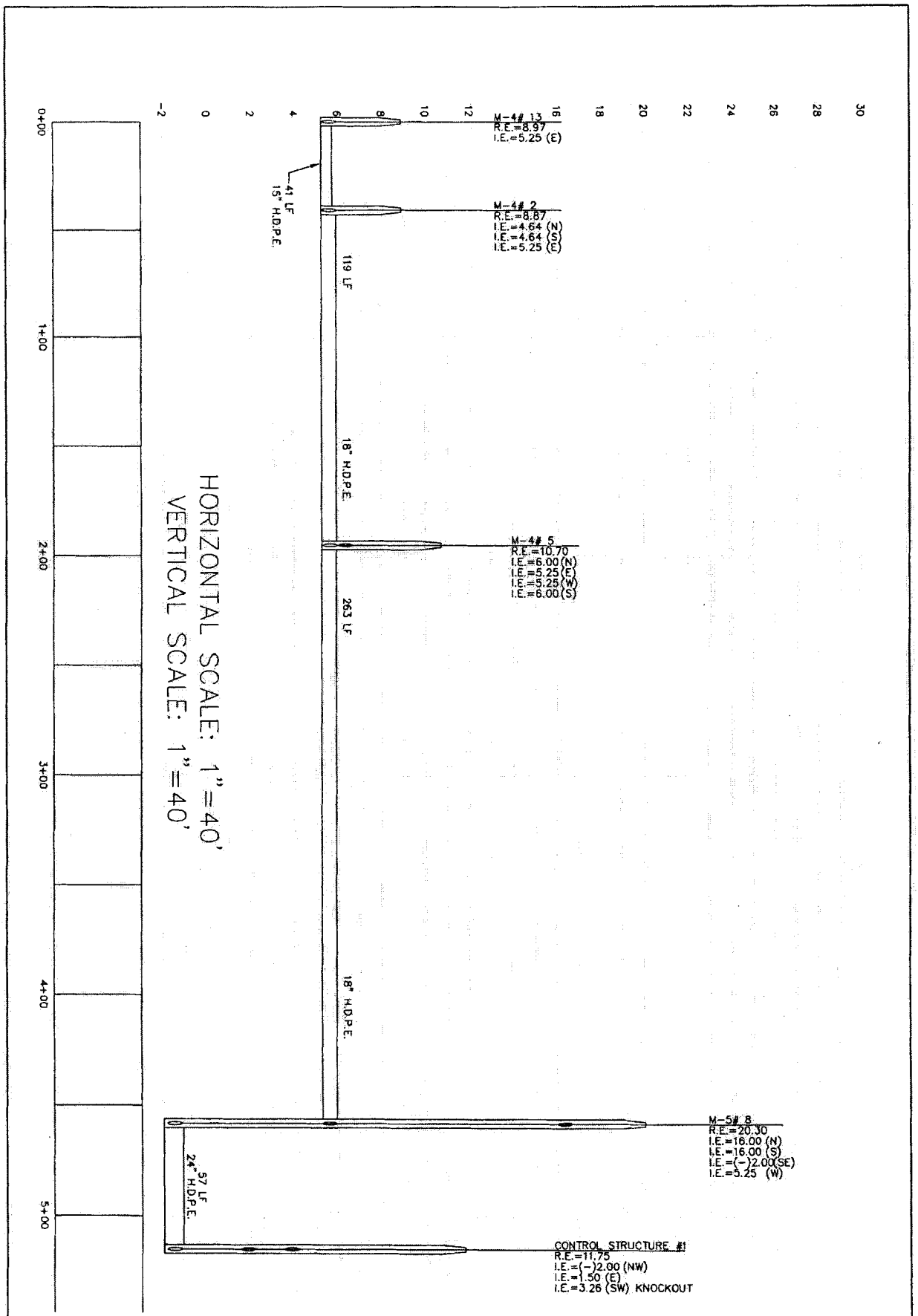

SHEET 7 OF 11	D-7	PROJECT NO. 06-0044	KEITH M. KRAFT FLORIDA P.E. NO. 57749

PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL
PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE PROFILES

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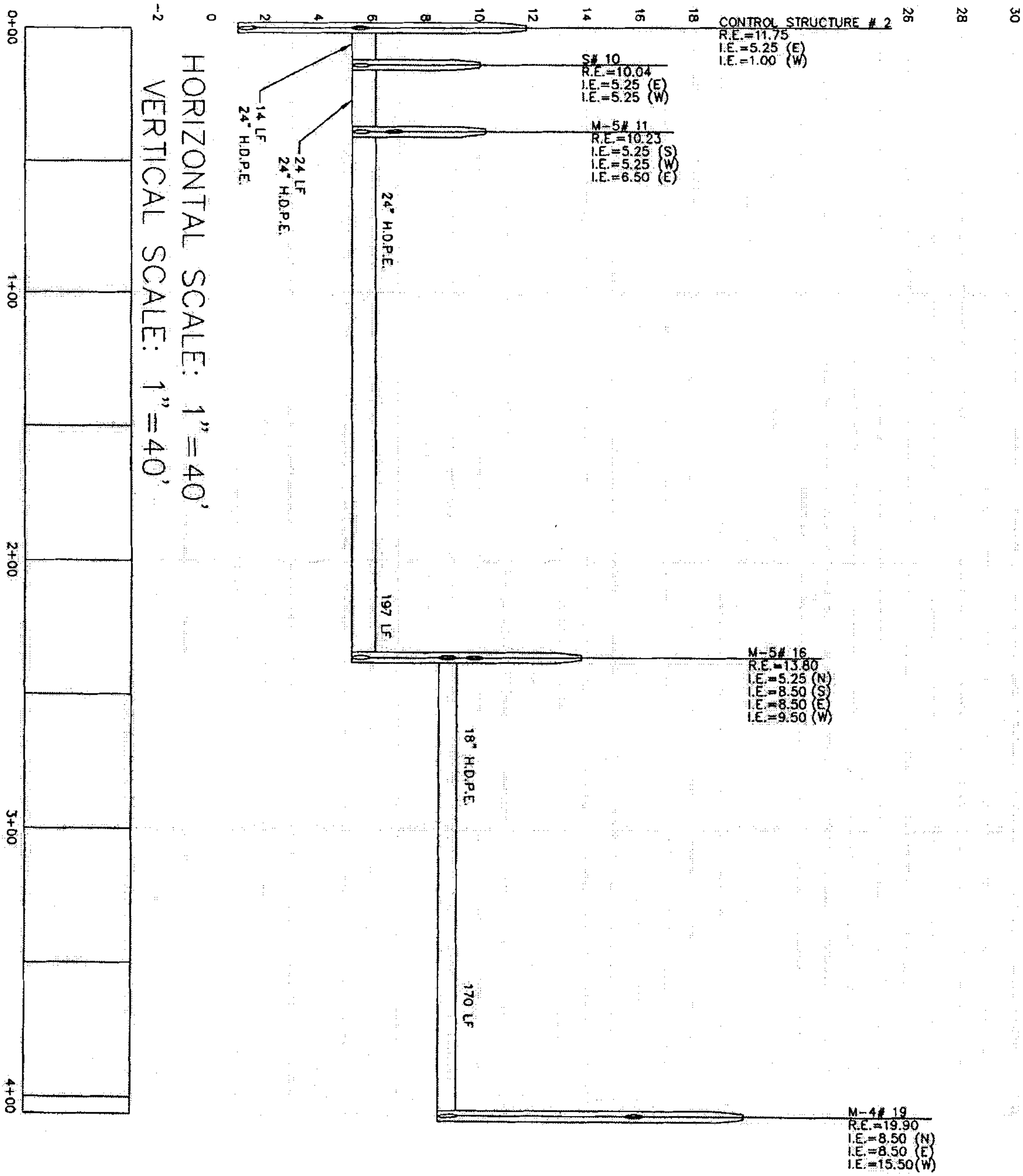
DESCRIPTION	BY	DATE
		23-07-08
		1"=40'
		A.S.
		E.P.
		K.M.H.
		K.M.H.



PORT EVERGLADES

BRIDGE OVER FPL DISCHARGE CANAL

PREPARED FOR:

SEAPORT CONSTRUCTION AND PLANNING DIVISION

DRAINAGE PROFILES

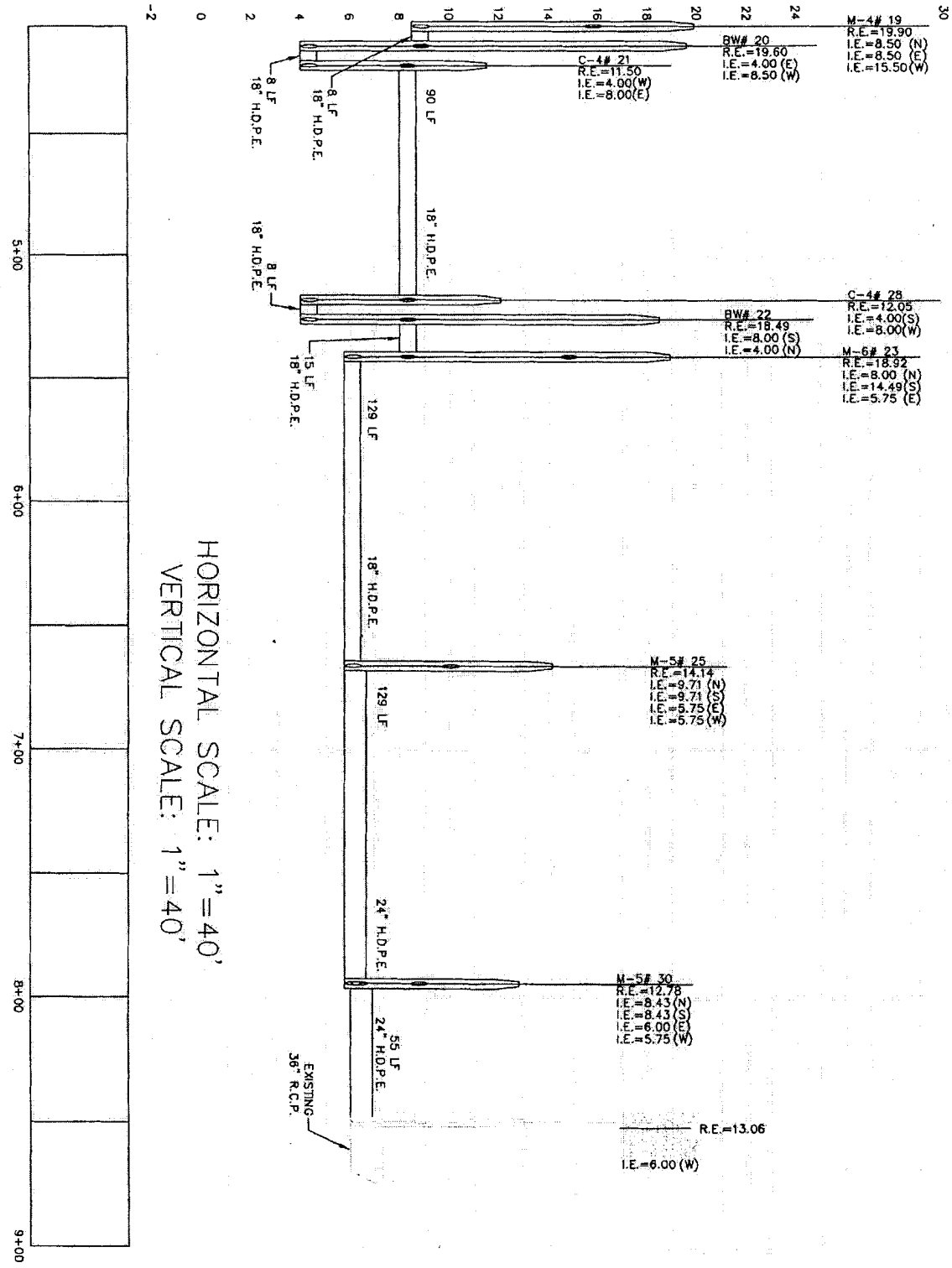
CRAVEN · THOMPSON AND ASSOCIATES, INC.
ENGINEERS · PLANNERS · SURVEYORS

PROJECT NO. 06-0044

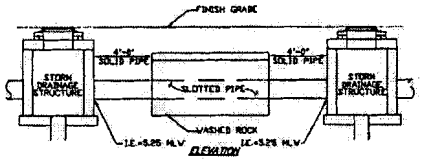
D-8

SHEET 8 OF 11

N:\dwgs\eng\PROJECTS\2006\06-0044\Current\06-0044-PGD_PERMIT-PROFILES.dwg [D-9] Aug 26, 2008 4:51pm ASCHEFFER



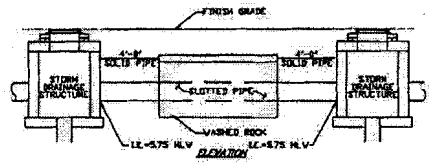
SHEET 9 OF 11	D-9	PROJECT NO. 06-0044	PORT EVERGLADES BRIDGE OVER FPL DISCHARGE CANAL PREPARED FOR: SEAPORT CONSTRUCTION AND PLANNING DIVISION DRAINAGE PROFILES	CRAVEN · THOMPSON AND ASSOCIATES, INC. ENGINEERS · PLANNERS · SURVEYORS	03-07-08 1"=40' A.S. C.P. K.M.H. K.M.H.



NOTES:
1. CONTRACTOR SHALL REMOVE ALL UNSUITABLE MATERIAL UNDER DRAINAGE CULVERTS
2. PIPES SHALL TERMINATE 5 FEET FROM END OF TRENCH OR CONNECT TO ADDITIONAL CATCH BASINS AS REQUIRED.
3. BALLAST ROCK SHALL BE FROM FRESH WATER WASHED FREE OF DELETERIOUS MATTER.
4. PEARDEK SHALL BE USED ON THE TOP 6".

EXFILTRATION TRENCH DETAIL - TYPE A (4'X8')

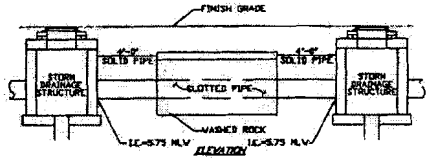
SCALE: NONE



NOTES:
1. CONTRACTOR SHALL REMOVE ALL UNSUITABLE MATERIAL UNDER DRAINAGE CULVERTS
2. PIPES SHALL TERMINATE 5 FEET FROM END OF TRENCH OR CONNECT TO ADDITIONAL CATCH BASINS AS REQUIRED.
3. BALLAST ROCK SHALL BE FROM FRESH WATER WASHED FREE OF DELETERIOUS MATTER.
4. PEARDEK SHALL BE USED ON THE TOP 6".

EXFILTRATION TRENCH DETAIL - TYPE B (5'X10')

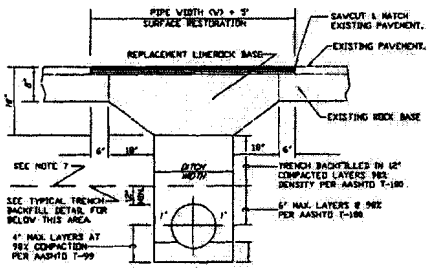
SCALE: NONE



NOTES:
1. CONTRACTOR SHALL REMOVE ALL UNSUITABLE MATERIAL UNDER DRAINAGE CULVERTS
2. PIPES SHALL TERMINATE 5 FEET FROM END OF TRENCH OR CONNECT TO ADDITIONAL CATCH BASINS AS REQUIRED.
3. BALLAST ROCK SHALL BE FROM FRESH WATER WASHED FREE OF DELETERIOUS MATTER.
4. PEARDEK SHALL BE USED ON THE TOP 6".

EXFILTRATION TRENCH DETAIL - TYPE C (7'X14')

SCALE: NONE

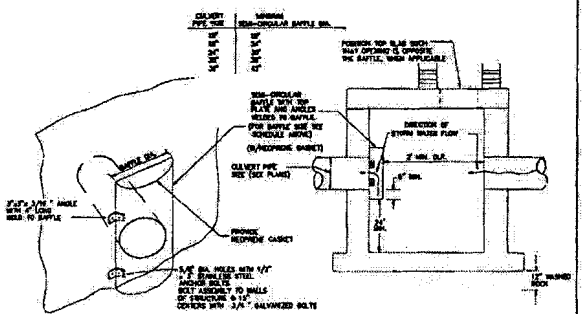


NOTES:
1. REPLACED BASE MATERIAL OVER PIPE SHALL BE TWICE THE THICKNESS OF THE ORIGINAL BASE.
2. BASE MATERIALS SHALL BE PLACED IN 6" MAXIMUM LAYERS AND EACH LAYER THOROUGHLY ROLLED OR TAMPED TO A DENSITY OF 98% (AASHTO T-180).
3. ASPHALT CONCRETE PAVEMENT JOINTS SHALL BE MECHANICALLY SAWED.
4. SURFACE TREATED PAVEMENT JOINTS SHALL BE LAPPED AND FEATHERED.
5. SURFACE MATERIAL SHALL BE CONSISTENT WITH EXISTING SURFACE.
6. BASE MATERIAL SHALL HAVE A MINIMUM L.B.R. OF 100 AND A MINIMUM CARBONATE CONTENT OF 70% (50% FOR LOCAL STREETS - AS APPROVED BY THE ENGINEER).
7. MECHANICAL COMPACTION NOT ALLOWED BELOW THIS LINE.

TRENCH DETAIL - PAVED AREAS

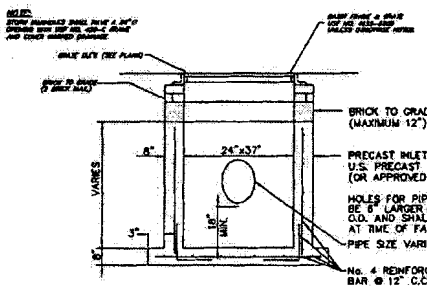
SCALE: NONE

NOTE: PRB'S SHALL BE INSTALLED ON THE DRAINFIELD SIDE OF ALL C.B. INLETS



POLLUTION RETARDANT BAFFLE (PRB) CONTROL DEVICE

N.T.S.



TYPE C-A INLET - RECTANGULAR

N.T.S.

NOTE: ALL ELEVATIONS IN THIS DRAWING ARE BASED ON MEAN LOW WATER DATUM VERTICAL DATUM

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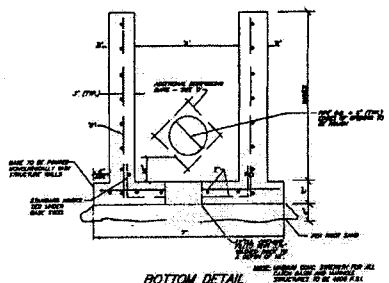
PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL
PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE DETAILS

PROJECT NO.
08-0044

D-10

SHEET 10 OF 11

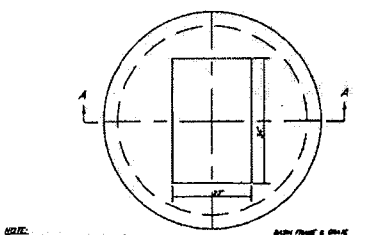


BOTTOM DETAIL

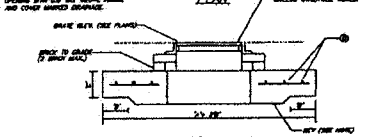
TYPE	'A'	'B'	'C'	'D'	'E'	'F'	'G'
C-1	4'-0"ø	8"	10"	@ 12" C.C.E.W.	@ 12" C.C.E.W.	2'-1"ø	@ 8" C.C.E.W.
C-3	5'-0"ø	8"	10"	@ 12" C.C.E.W.	@ 12" C.C.E.W.	3'-1"ø	@ 8" C.C.E.W.
C-5	6'-0"ø	8"	10"	@ 12" C.C.E.W.	@ 8" C.C.E.W.	4'-1"ø	@ 8" C.C.E.W.
C-7	7'-0"ø	8"	10"	@ 12" C.C.E.W.	@ 8" C.C.E.W.	5'-1"ø	@ 8" C.C.E.W.
C-9	8'-0"ø	10"	10"	@ 12" C.C.E.W.	@ 8" C.C.E.W.	10'-2"ø	@ 8" C.C.E.W.
C-9	10'-0"ø	12"	12"	@ 12" C.C.E.W.	@ 8" C.C.E.W.	13'-0"ø	@ 8" C.C.E.W.

SPECIFICATIONS

PRECAST CIRCULAR DRAINAGE STRUCTURE

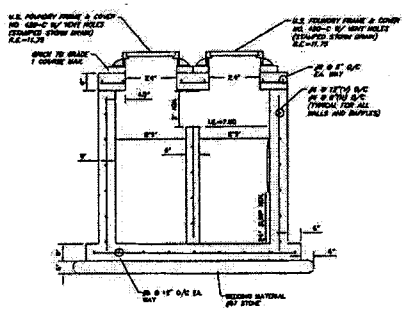


PLAN



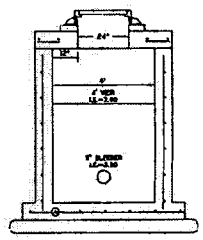
SECTION A-A

TOP SLAB DETAIL

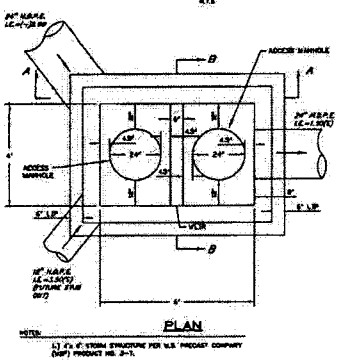


SECTION A-A

SEE PLAN VIEW SHEET FOR STRUCTURE ORIENTATION

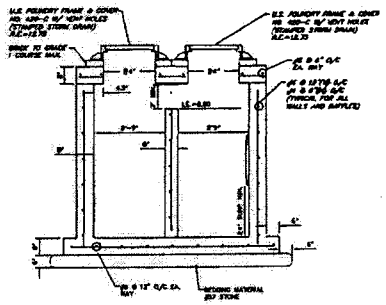


SECTION B-B



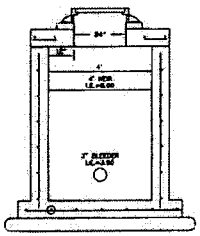
PLAN

CONTROL STRUCTURE #1

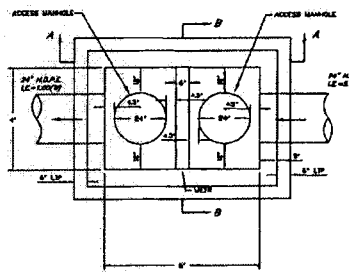


SECTION A-A

SEE PLAN VIEW SHEET FOR STRUCTURE ORIENTATION



SECTION B-B



PLAN

CONTROL STRUCTURE #2

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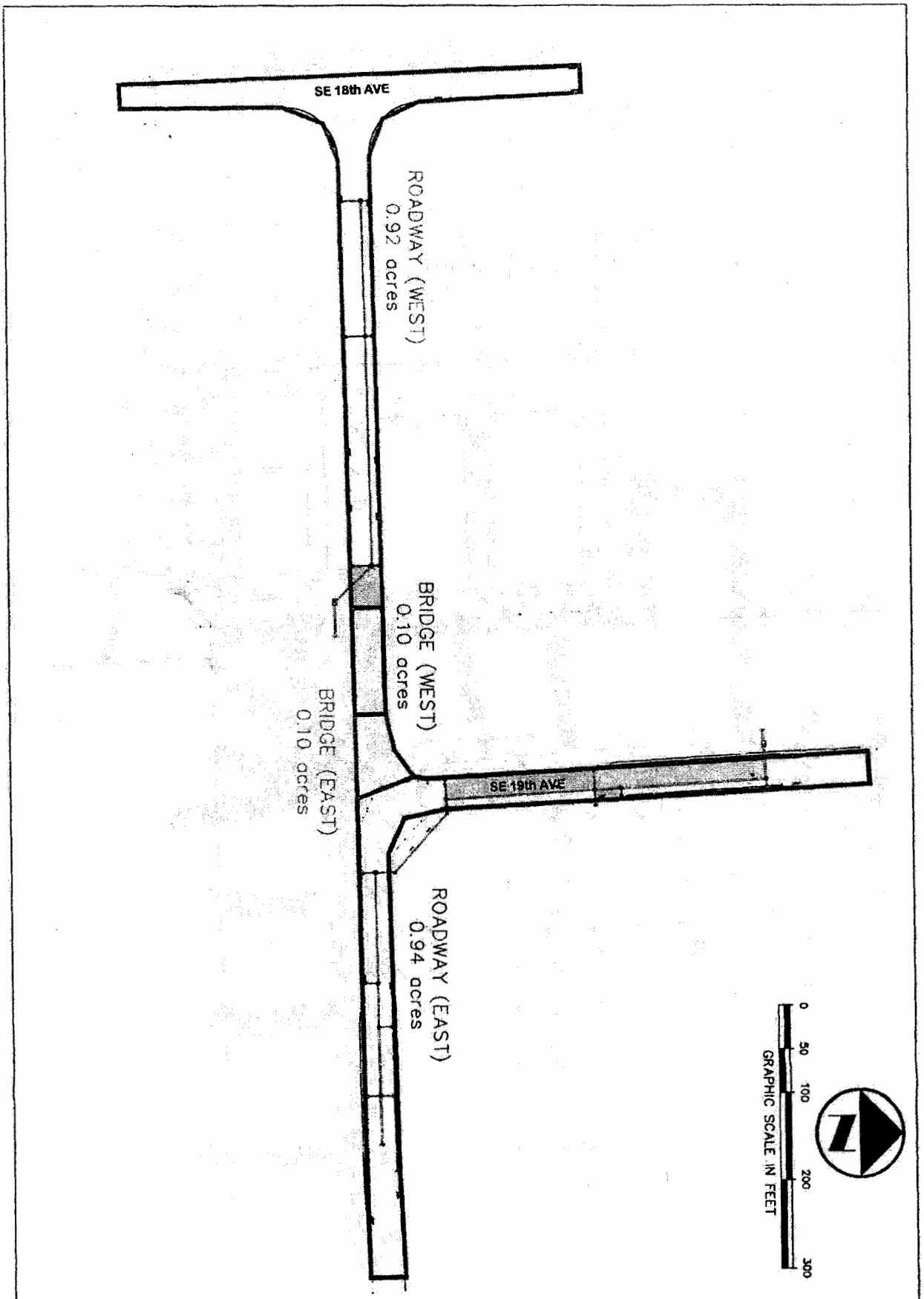
PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL
PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE DETAILS

PROJECT NO.
06-0044

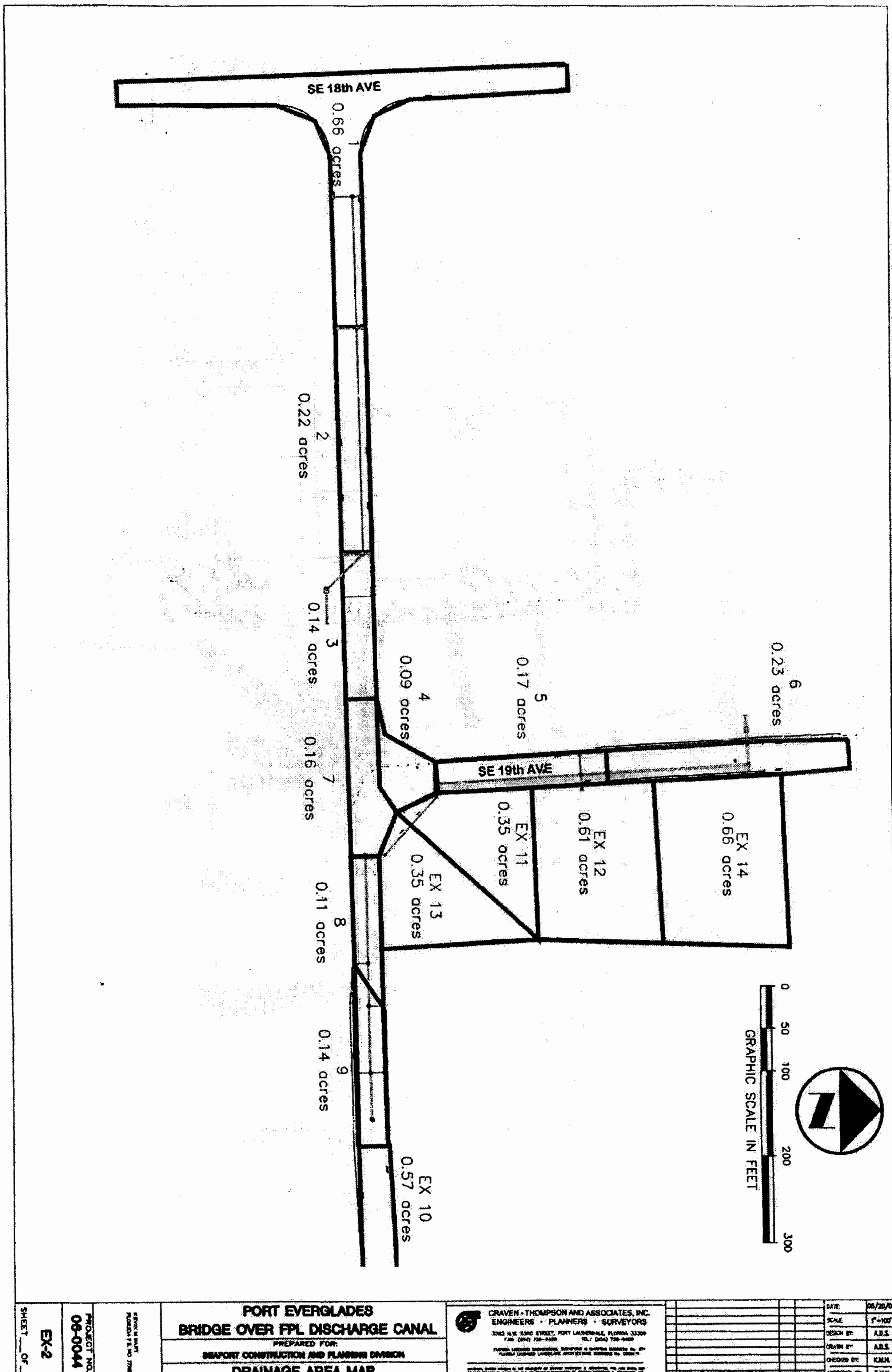
D-11

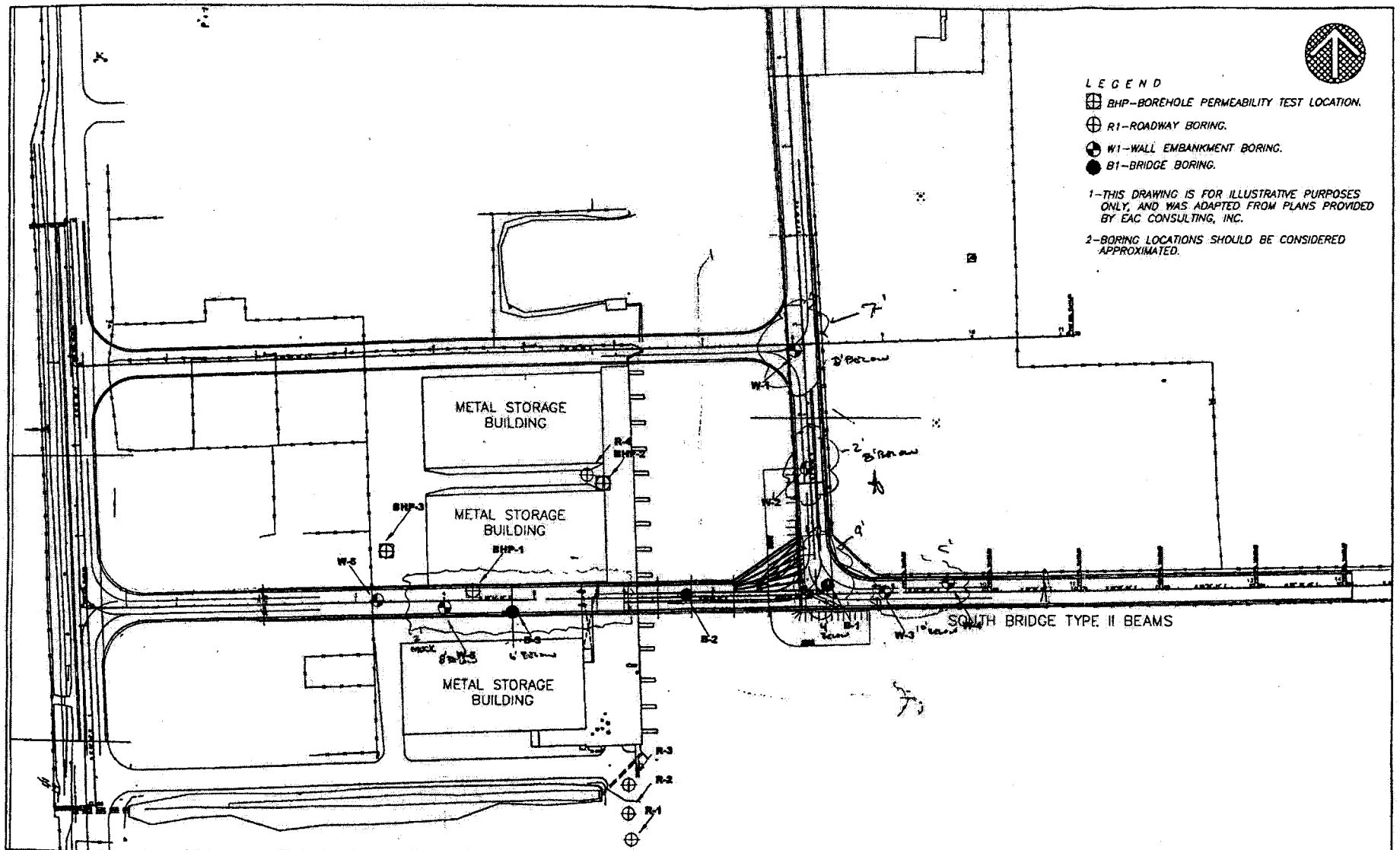
SHEET 11 OF 11

N: \dwgs\eng\PROJECTS\2008\08-0044\Current\08-0044-00TP.ALL.dwg [EX-1] Aug 20, 2008 3:38pm ASCHEFFER



SHEET EX-1 OF	PROJECT NO. 08-0044	PORT EVERGLADES BRIDGE OVER FPL DISCHARGE CANAL PREPARED FOR: SEAPORT CONSTRUCTION AND PLANNING DIVISION SITE AREA EXHIBIT	CRAVEN · THOMPSON AND ASSOCIATES, INC. ENGINEERS · PLANNERS · SURVEYORS	DATE: 08/20/08 SCALE: 1"=100' DESIGN BY: A.B.S. DRAWN BY: A.B.S. CHECKED BY: R.M.H. APPROVED BY: R.M.H.


SE 18th AVE
1
0.66 acres
2
0.22 acres
3
0.14 acres
4
0.09 acres
5
0.17 acres
6
0.23 acres
SE 19th AVE
7
0.16 acres
8
0.11 acres
9
0.14 acres
EX 10
0.57 acres
EX 11
0.35 acres
EX 12
0.61 acres
EX 13
0.35 acres
EX 14
0.66 acres
0
50
100
200
300
GRAPHIC SCALE IN FEET
PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL
PREPARED FOR:
SEAPORT CONSTRUCTION AND PLANNING DIVISION
DRAINAGE AREA MAP
CRAVEN - THOMPSON AND ASSOCIATES, INC.
ENGINEERS · PLANNERS · SURVEYORS
PROJECT NO.
06-0044
EX-2
SHEET __ OF __



REVISIONS

Date	By	Description	Date	By	Description

Drawn by	A.	07/24/03
Checked by	RK	07/24/03
Designed by		
Checked by		
Approved by	RAJ KRISHNASAMY, P.E.	

TIERRA GEOTECHNICAL • MATERIALS & ENGINEERING

Business License No. 6486

ENGINEER OF RECORD:
Raj Krishnasamy, P.E.
P.E. License No. 53567
2765 Vista Parkway Suite 10
West Palm Beach, Florida 33411

SEAL:

ROAD NO.	COUNTY	PROJECT NO.
–	BROWARD	6611–07–303

SHEET TITLE: SITE PLAN

PROJECT DESC: FPL DISCHARGE BRIDGE
PALM BEACH COUNTY, FLORIDA

SHEET NO. 1

APPENDIX 4-C

Port Everglades
Bridge Over FPL Discharge Canal
Drainage Report

PORT EVERGLADES
BRIDGE OVER FPL DISCHARGE CANAL

DRAINAGE REPORT

Prepared For:
PORT EVERGLADES

AUGUST, 2008

Prepared By:

Craven Thompson & Associates, Inc.
3563 N.W. 53rd Street
Fort Lauderdale, Florida 33309

Florida Licensed Engineering, Surveying & Mapping Business No. 271

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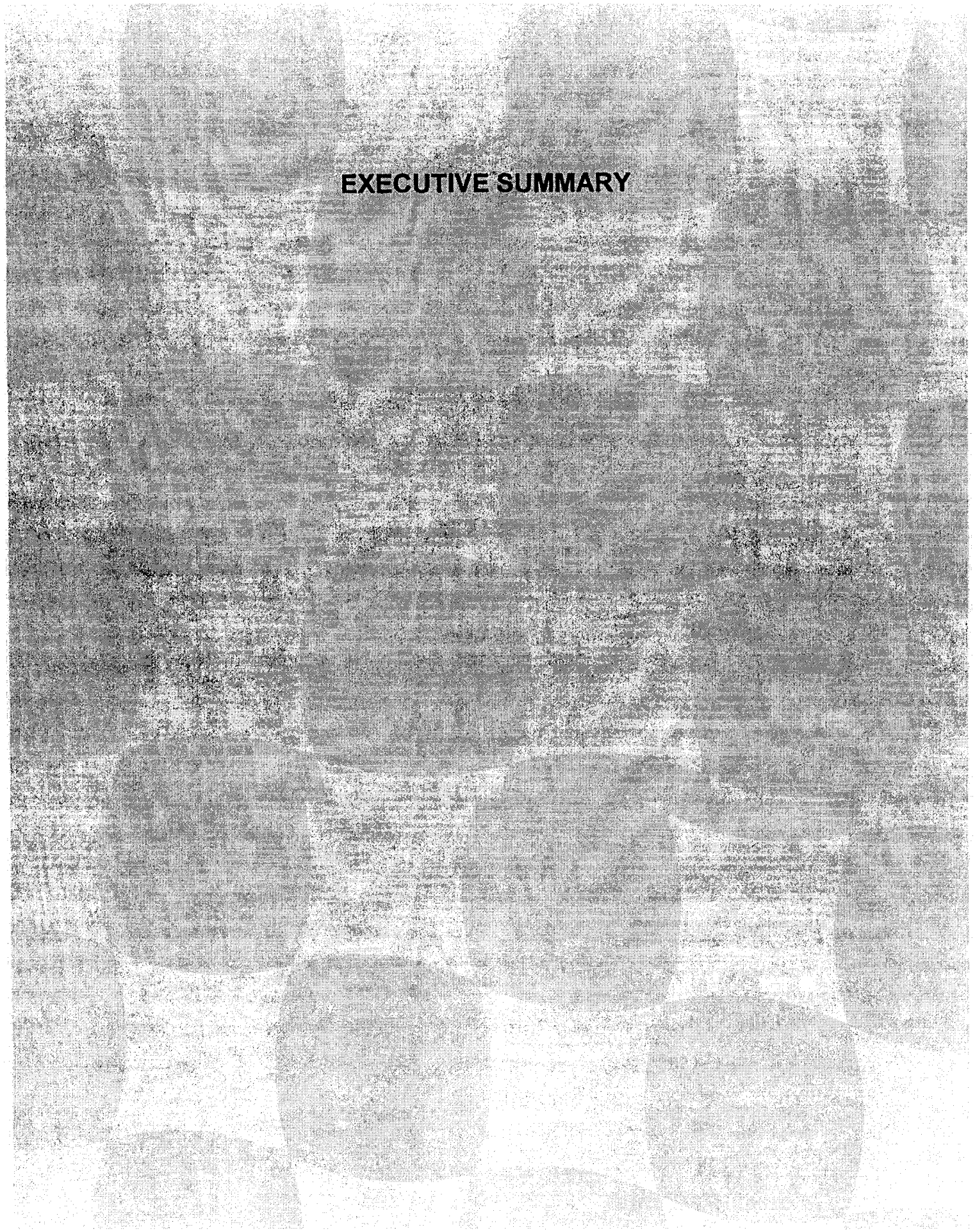


EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

a. Introduction

This drainage report is for the construction of a bridge crossing the FPL Discharge Canal, connecting SE 18th Avenue & SE 19th Avenue in Port Everglades. In 1990, Permit #06-00703-S was issued for the 29.69 acre Berth 29 site. This permit will be modified to include the bridge and the additional R/W west to SE 18th Avenue. The proposed improvements will also include the demolition an existing building on the west side of the FPL Discharge Canal to accommodate for this 36' wide road.

The total proposed site area is 2.06 acres; 0.20 acres of bridge coverage, 0.92 acres on the west and 0.94 acres on the east side of the FPL Discharge Canal. Using the stage vs. storage calculations from Permit #06-00703, we have attached calculations that show the stages for the 29.69 Acre site have not been affected by the addition of the proposed roadway and bridge.

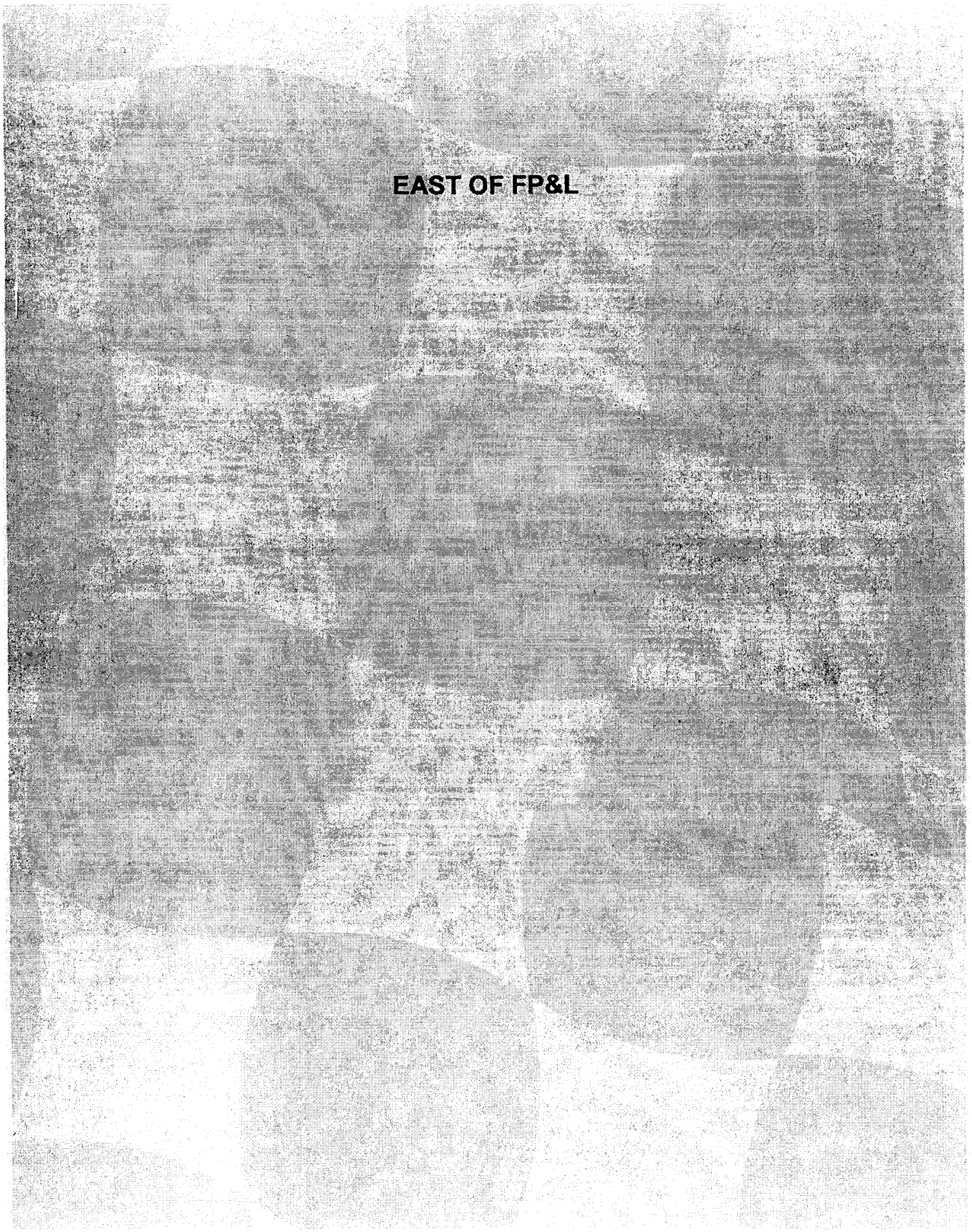
On the East side of the FPL Discharge Canal, Permit # 06-00703-S provides water quality for the 0.94 acres of roadway. In order to accommodate for the proposed structure, the existing drainage system must be removed and the existing soil must be stabilized. The drainage system will be replaced in kind and all additional water quality will be provided by 4'X8' exfiltration trench. There is one existing control structure and one proposed control structure, both with weirs at elevation 8.00 MLW. On the West side of the FPL Discharge Canal, all water quality will be provided for by 5'X10' exfiltration trench. There is one proposed control structure with a weir at elevation 7.00 MLW.

PERMIT MODIFICATION

Port Everglades Bridge Over the FPL Discharge Canal
Prepared by: Craven Thompson & Associates, Inc.
August, 2008

SITE AREA BREAKDOWN

Type	ACRES	%
Bridge (EAST)	0.10	4.85%
Bridge (WEST)	0.10	4.85%
Roadway (EAST)	0.94	45.63%
Roadway (WEST)	0.92	44.66%
Total	**2.06**	**100.00%**


EAST OF FP&L

Port Everglades Bridge Over the FPL Discharge Canal
Prepared by: Craven Thompson & Associates, Inc.
August, 2008

WATER QUALITY CALCULATIONS - EAST OF FPL DISCHARGE CANAL

Water quality for 0.94 Ac Roadway (EAST) provided for under SFWMD Permit #06-00703-S
291 LF of existing 7' X 14' Exfiltration Trench removed and replaced by proposed Exfiltration Trench

EAST PORTION OF BRIDGE & ROADWAY EAST OF FPL DISCHARGE CANAL:

WATER QUALITY REQUIRED:

Treatment provided by existing 291 LF of 7' X 14' Exfiltration Trench (To be removed)	0.376	Ac-Ft
+ 2.5" over Percent Impervious: (East Portion of Bridge) 2.5" X (0.10) = .25 Ac-In	0.021	Ac-Ft
Total Water Quality Required:	**0.397**	**Ac-Ft**

WATER QUALITY PROVIDED:

7' X 14' Exfiltration Trench - TYPE C (261 LF)	0.337	Ac-Ft
+ 4' X 8' Exfiltration Trench - TYPE A (181 LF)	0.092	Ac-Ft
Total Water Quality Provided:	**0.429**	**Ac-Ft**

Port Everglades Bridge Over the FPL Discharge Canal
Prepared by: Craven Thompson & Associates, Inc.
August, 2008

EXFILTRATION TRENCH SUMMARY - EAST OF FPL DISCHARGE CANAL

TOTAL EXISTING TRENCH LEGNTH REMOVED - 7' X 14' Exfiltration Trench			
H_2=	DEPTH TO WATER TABLE (Ft.)	=	4.74
D_U=	NON SATURATED TRENCH DEPTH (Ft.)	=	6.74
D_S=	SATURATED TRENCH DEPTH (Ft.)	=	0.26
W=	TRENCH WIDTH (Ft.)	=	14.00
K=	*HYDRAULIC CONDUCTIVITY (CFS/FT2-FT-HEAD)	=	2.71E-05
V=	VOLUME TO BE TREATED (ACRE-INCHES)	=	4.51
L=	LENGTH OF TRENCH (Ft.)	=	291.00

L=	$V/[(K*(H_2*W+2H_2D_U-D_U^2+2H_2D_S)+(1.39*10^{-4}*WD_U))]$

$V_{TREATED\ (Ac\text{-}In)}$ =	4.506
$V_{TREATED\ (Ac\text{-}Ft)}$ =	0.376

TOTAL STORAGE PROVIDED BY 4' X 8' Exfiltration Trench (TYPE A)			
H_2=	DEPTH TO WATER TABLE (Ft.)	=	4.74
D_U=	NON SATURATED TRENCH DEPTH (Ft.)	=	4.00
D_S=	SATURATED TRENCH DEPTH (Ft.)	=	0.00
W=	TRENCH WIDTH (Ft.)	=	8.00
K=	*HYDRAULIC CONDUCTIVITY (CFS/FT2-FT-HEAD)	=	2.71E-05
V=	VOLUME TO BE TREATED (ACRE-INCHES)	=	1.10
L=	LENGTH OF TRENCH (Ft.)	=	181.00

L=	$V/[(K*(H_2*W+2H_2D_U-D_U^2+2H_2D_S)+(1.39*10^{-4}*WD_U))]$

$V_{TREATED\ (Ac\text{-}In)}$ =	1.099
$V_{TREATED\ (Ac\text{-}Ft)}$ =	0.092

TOTAL STORAGE PROVIDED - 7' X 14' Exfiltration Trench (TYPE C)			
H_2=	DEPTH TO WATER TABLE (Ft.)	=	4.74
D_U=	NON SATURATED TRENCH DEPTH (Ft.)	=	6.74
D_S=	SATURATED TRENCH DEPTH (Ft.)	=	0.26
W=	TRENCH WIDTH (Ft.)	=	14.00
K=	*HYDRAULIC CONDUCTIVITY (CFS/FT2-FT-HEAD)	=	2.71E-05
V=	VOLUME TO BE TREATED (ACRE-INCHES)	=	4.04
L=	LENGTH OF TRENCH (Ft.)	=	261.00

L=	$V/[(K*(H_2*W+2H_2D_U-D_U^2+2H_2D_S)+(1.39*10^{-4}*WD_U))]$

$V_{TREATED\ (Ac\text{-}In)}$ =	4.041
$V_{TREATED\ (Ac\text{-}Ft)}$ =	0.337

WEIR LENGTH	4 FT.
WEIR ELEVATION	8 FT. NGVD
WEIR COEFFICIENT	3.2
TYPE OF BLEEDER SLOT	HORIZONTAL RECTANGLE
SLOT INVERT ELEV.	8 FT. NGVD
NOTCH HEIGHT	0 FT.
NOTCH WIDTH	0 FT.

PIPE DATA

DIAMETER	2 FT.
LENGTH	40 FT.
N-VALUE	.009

	WEIR FLOW IN CFS			PIPE	
STAGE	WEIR	BLEEDER	TOTAL	FLOW	
FLOW					
8.00	0.00	0.00	0.00	.00	.00
8.50	4.53	0.00	4.53	13.52	4.53
9.00	12.80	0.00	12.80	19.13	12.80
10.00	36.20	0.00	36.20	27.05	27.05
10.50	50.60	0.00	50.60	30.24	30.24
11.00	66.51	0.00	66.51	33.13	33.13
11.50	83.81	0.00	83.81	35.78	35.78
12.00	102.40	0.00	102.40	38.25	38.25
12.50	122.19	0.00	122.19	40.57	40.57
13.00	143.11	0.00	143.11	42.77	42.77
13.50	165.10	0.00	165.10	44.85	44.85
13.80	178.79	0.00	178.79	46.06	46.06

PRE_10,25

S C S P R O G R A M

PROJECT NAME . . . . : FPL DISCHARGE CANAL BRIDGE - PRE
REVIEWER . . . . . : ADS
PROJECT AREA . . . . : 29.69 ACRES
GROUND STORAGE . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . : 10.00 YEARS
RAINFALL DURATION . . : 1-DAY
24-HOUR RAINFALL . . : 9.50 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	4.53
9.00	4.80	12.80
10.00	8.73	27.05
10.50	11.28	30.24
11.00	14.68	33.13
11.50	20.35	35.78
12.00	26.73	38.25
12.50	34.93	40.57
13.00	47.55	42.77
13.50	61.84	44.85
13.80	70.38	46.06

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.43	.04	1.2	.1	.1	.0	.0	.0	2.18
8.00	1.30	.55	6.4	1.4	1.4	.0	.0	.0	4.99
10.00	2.02	1.14	10.7	2.8	2.8	.0	.0	.0	7.67
11.00	2.56	1.61	16.4	4.0	3.8	.2	4.6	1.8	8.50
11.50	3.03	2.05	26.2	5.1	4.6	.5	9.6	7.0	8.81
11.75	4.46	3.40	161.3	8.4	7.7	.7	17.2	13.4	9.31
12.00	6.23	5.12	206.4	12.7	11.5	1.2	27.8	22.5	10.12
12.50	6.93	5.80	40.7	14.3	11.9	2.4	30.4	29.7	10.54
13.00	7.29	6.15	21.2	15.2	11.6	3.6	30.3	30.4	10.51
14.00	7.77	6.63	12.9	16.4	10.3	6.1	28.8	29.6	10.28
16.00	8.36	7.21	8.4	17.8	7.4	10.4	22.0	26.1	9.64
20.00	9.04	7.89	5.1	19.5	4.3	15.2	8.4	14.6	8.74
24.00	9.50	8.34	3.4	20.6	3.6	17.0	3.9	5.4	8.43

SUMMARY INFORMATION

MAXIMUM STAGE WAS 10.54 FEET AT 12.75 HOURS
MAXIMUM DISCHARGE WAS 30.5 CFS AT 12.75 HOURS

PRE_10,25
S C S P R O G R A M

PROJECT NAME . . . . . : FPL DISCHARGE CANAL BRIDGE - PRE
REVIEWER . . . . . : ADS
PROJECT AREA . . . . . : 29.69 ACRES
GROUND STORAGE . . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . . : 25.00 YEARS
RAINFALL DURATION . . : 3-DAY
24-HOUR RAINFALL . . . : 12.00 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	4.53
9.00	4.80	12.80
10.00	8.73	27.05
10.50	11.28	30.24
11.00	14.68	33.13
11.50	20.35	35.78
12.00	26.73	38.25
12.50	34.93	40.57
13.00	47.55	42.77
13.50	61.84	44.85
13.80	70.38	46.06

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.29	.01	.3	.0	.0	.0	.0	.0	2.03
8.00	.58	.10	1.0	.2	.2	.0	.0	.0	2.53
12.00	.88	.26	1.4	.6	.6	.0	.0	.0	3.42
16.00	1.17	.45	1.6	1.1	1.1	.0	.0	.0	4.54
20.00	1.46	.67	1.7	1.7	1.7	.0	.0	.0	5.80
24.00	1.75	.91	1.8	2.3	2.3	.0	.0	.0	6.85
28.00	2.18	1.28	2.8	3.2	3.1	.1	1.1	.1	8.12
32.00	2.60	1.66	2.9	4.1	3.4	.7	2.6	2.1	8.29
36.00	3.03	2.05	2.9	5.1	3.4	1.7	2.9	2.8	8.32
40.00	3.46	2.45	3.0	6.0	3.4	2.6	3.0	2.9	8.33
44.00	3.88	2.85	3.0	7.0	3.4	3.6	3.0	3.0	8.33
48.00	4.31	3.25	3.1	8.1	3.5	4.6	3.0	3.0	8.34
52.00	4.85	3.77	4.9	9.3	3.6	5.7	3.9	3.4	8.43
56.00	5.95	4.85	10.5	12.0	4.3	7.7	8.4	5.9	8.74
58.00	6.86	5.74	15.5	14.2	4.9	9.3	12.0	10.1	8.95
59.00	7.54	6.40	22.6	15.8	5.4	10.4	14.2	13.1	9.10
59.50	8.14	6.99	35.4	17.3	6.2	11.1	16.7	15.3	9.27
59.75	9.94	8.77	213.0	21.7	10.2	11.5	24.5	20.6	9.82
60.00	12.18	10.99	266.6	27.2	15.1	12.1	31.2	27.8	10.66
60.50	13.06	11.86	52.1	29.4	15.9	13.5	33.5	32.8	11.06
61.00	13.51	12.32	27.2	30.5	15.7	14.8	33.5	33.5	11.06
62.00	14.12	12.93	16.4	32.0	14.4	17.6	32.8	33.2	10.94
64.00	14.87	13.67	10.7	33.8	11.1	22.7	29.9	31.4	10.44
68.00	15.73	14.53	6.4	35.9	5.6	30.3	15.5	23.0	9.19
72.00	16.31	15.10	4.3	37.4	3.9	33.5	5.6	9.6	8.57

SUMMARY INFORMATION

MAXIMUM STAGE WAS 11.08 FEET AT 60.75 HOURS
MAXIMUM DISCHARGE WAS 33.5 CFS AT 60.75 HOURS

PRE_100
S C S P R O G R A M

PROJECT NAME . . . . : FPL DISCHARGE BRIDGE-PRE
REVIEWER . . . . . : ADS
PROJECT AREA . . . . : 29.69 ACRES
GROUND STORAGE . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . : 100.00 YEARS
RAINFALL DURATION . . : 3-DAY
24-HOUR RAINFALL . . : 15.00 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	.00
9.00	4.80	.00
10.00	8.73	.00
10.50	11.28	.00
11.00	14.68	.00
11.50	20.35	.00
12.00	26.73	.00
12.50	34.93	.00
13.00	47.55	.00
13.50	61.84	.00
13.80	70.38	.00

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM, OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.37	.02	.6	.0	.0	.0	.0	.0	2.10
8.00	.73	.17	1.5	.4	.4	.0	.0	.0	2.93
12.00	1.10	.40	1.9	1.0	1.0	.0	.0	.0	4.24
16.00	1.46	.67	2.1	1.7	1.7	.0	.0	.0	5.79
20.00	1.82	.97	2.3	2.4	2.4	.0	.0	.0	7.10
24.00	2.19	1.29	2.4	3.2	3.2	.0	.0	.0	8.17
28.00	2.72	1.77	3.6	4.4	4.4	.0	.0	.0	8.79
32.00	3.25	2.26	3.7	5.6	5.6	.0	.0	.0	9.19
36.00	3.79	2.76	3.8	6.8	6.8	.0	.0	.0	9.50
40.00	4.32	3.27	3.8	8.1	8.1	.0	.0	.0	9.82
44.00	4.85	3.78	3.8	9.3	9.3	.0	.0	.0	10.11
48.00	5.38	4.29	3.9	10.6	10.6	.0	.0	.0	10.36
52.00	6.06	4.95	6.1	12.2	12.2	.0	.0	.0	10.63
56.00	7.44	6.30	13.2	15.6	15.6	.0	.0	.0	11.07
58.00	8.58	7.43	19.5	18.4	18.4	.0	.0	.0	11.31
59.00	9.42	8.26	28.4	20.4	20.4	.0	.0	.0	11.48
59.50	10.17	9.00	44.5	22.3	22.3	.0	.0	.0	11.61
59.75	12.42	11.23	267.4	27.8	27.8	.0	.0	.0	11.87
60.00	15.22	14.02	334.1	34.7	34.7	.0	.0	.0	12.28
60.50	16.32	15.11	65.3	37.4	37.4	.0	.0	.0	12.57
61.00	16.89	15.68	34.0	38.8	38.8	.0	.0	.0	12.64
62.00	17.66	16.44	20.6	40.7	40.7	.0	.0	.0	12.72
64.00	18.58	17.37	13.4	43.0	43.0	.0	.0	.0	12.81
68.00	19.66	18.45	8.1	45.6	45.6	.0	.0	.0	12.92
72.00	20.39	19.17	5.4	47.4	47.4	.0	.0	.0	12.99

SUMMARY INFORMATION

MAXIMUM STAGE WAS 12.99 FEET AT 72.00 HOURS
MAXIMUM DISCHARGE WAS .0 CFS AT .00 HOURS

POST_10.25

S C S P R O G R A M

PROJECT NAME . . . . : FPL DISCHARGE CANAL BRIDGE - POST
REVIEWER . . . . . : ADS
PROJECT AREA . . . . : 29.69 ACRES
GROUND STORAGE . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . : 10.00 YEARS
RAINFALL DURATION . . : 1-DAY
24-HOUR RAINFALL . . : 9.50 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	4.53
9.00	4.80	12.80
10.00	8.73	27.05
10.50	11.28	30.24
11.00	14.68	33.13
11.50	20.35	35.78
12.00	26.70	38.25
12.50	34.82	40.57
13.00	47.31	42.77
13.50	61.41	44.85
13.80	69.71	46.06

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.43	.04	1.2	.1	.1	.0	.0	.0	2.18
8.00	1.30	.55	6.4	1.4	1.4	.0	.0	.0	4.99
10.00	2.02	1.14	10.7	2.8	2.8	.0	.0	.0	7.67
11.00	2.56	1.61	16.4	4.0	3.8	.2	4.6	1.8	8.50
11.50	3.03	2.05	26.2	5.1	4.6	.5	9.6	7.0	8.81
11.75	4.46	3.40	161.3	8.4	7.7	.7	17.2	13.4	9.31
12.00	6.23	5.12	206.4	12.7	11.5	1.2	27.8	22.5	10.12
12.50	6.93	5.80	40.7	14.3	11.9	2.4	30.4	29.7	10.54
13.00	7.29	6.15	21.2	15.2	11.6	3.6	30.3	30.4	10.51
14.00	7.77	6.63	12.9	16.4	10.3	6.1	28.8	29.6	10.28
16.00	8.36	7.21	8.4	17.8	7.4	10.4	22.0	26.1	9.64
20.00	9.04	7.89	5.1	19.5	4.3	15.2	8.4	14.6	8.74
24.00	9.50	8.34	3.4	20.6	3.6	17.0	3.9	5.4	8.43

SUMMARY INFORMATION

MAXIMUM STAGE WAS 10.54 FEET AT 12.75 HOURS
MAXIMUM DISCHARGE WAS 30.5 CFS AT 12.75 HOURS

POST_10,25
S C S P R O G R A M

PROJECT NAME . . . . : FPL DISCHARGE CANAL BRIDGE - POST
REVIEWER . . . . . : ADS
PROJECT AREA . . . . : 29.69 ACRES
GROUND STORAGE . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . : 25.00 YEARS
RAINFALL DURATION . . : 3-DAY
24-HOUR RAINFALL . . : 12.00 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	4.53
9.00	4.80	12.80
10.00	8.73	27.05
10.50	11.28	30.24
11.00	14.68	33.13
11.50	20.35	35.78
12.00	26.70	38.25
12.50	34.82	40.57
13.00	47.31	42.77
13.50	61.41	44.85
13.80	69.71	46.06

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.29	.01	.3	.0	.0	.0	.0	.0	2.03
8.00	.58	.10	1.0	.2	.2	.0	.0	.0	2.53
12.00	.88	.26	1.4	.6	.6	.0	.0	.0	3.42
16.00	1.17	.45	1.6	1.1	1.1	.0	.0	.0	4.54
20.00	1.46	.67	1.7	1.7	1.7	.0	.0	.0	5.80
24.00	1.75	.91	1.8	2.3	2.3	.0	.0	.0	6.85
28.00	2.18	1.28	2.8	3.2	3.1	.1	1.1	.1	8.12
32.00	2.60	1.66	2.9	4.1	3.4	.7	2.6	2.1	8.29
36.00	3.03	2.05	2.9	5.1	3.4	1.7	2.9	2.8	8.32
40.00	3.46	2.45	3.0	6.0	3.4	2.6	3.0	2.9	8.33
44.00	3.88	2.85	3.0	7.0	3.4	3.6	3.0	3.0	8.33
48.00	4.31	3.25	3.1	8.1	3.5	4.6	3.0	3.0	8.34
52.00	4.85	3.77	4.9	9.3	3.6	5.7	3.9	3.4	8.43
56.00	5.95	4.85	10.5	12.0	4.3	7.7	8.4	5.9	8.74
58.00	6.86	5.74	15.5	14.2	4.9	9.3	12.0	10.1	8.95
59.00	7.54	6.40	22.6	15.8	5.4	10.4	14.2	13.1	9.10
59.50	8.14	6.99	35.4	17.3	6.2	11.1	16.7	15.3	9.27
59.75	9.94	8.77	213.0	21.7	10.2	11.5	24.5	20.6	9.82
60.00	12.18	10.99	266.6	27.2	15.1	12.1	31.2	27.8	10.66
60.50	13.06	11.86	52.1	29.4	15.9	13.5	33.5	32.8	11.06
61.00	13.51	12.32	27.2	30.5	15.7	14.8	33.5	33.5	11.06
62.00	14.12	12.93	16.4	32.0	14.4	17.6	32.8	33.2	10.94
64.00	14.87	13.67	10.7	33.8	11.1	22.7	29.9	31.4	10.44
68.00	15.73	14.53	6.4	35.9	5.6	30.3	15.5	23.0	9.19
72.00	16.31	15.10	4.3	37.4	3.9	33.5	5.6	9.6	8.57

SUMMARY INFORMATION

MAXIMUM STAGE WAS 11.08 FEET AT 60.75 HOURS
MAXIMUM DISCHARGE WAS 33.5 CFS AT 60.75 HOURS

POST_100
S C S P R O G R A M

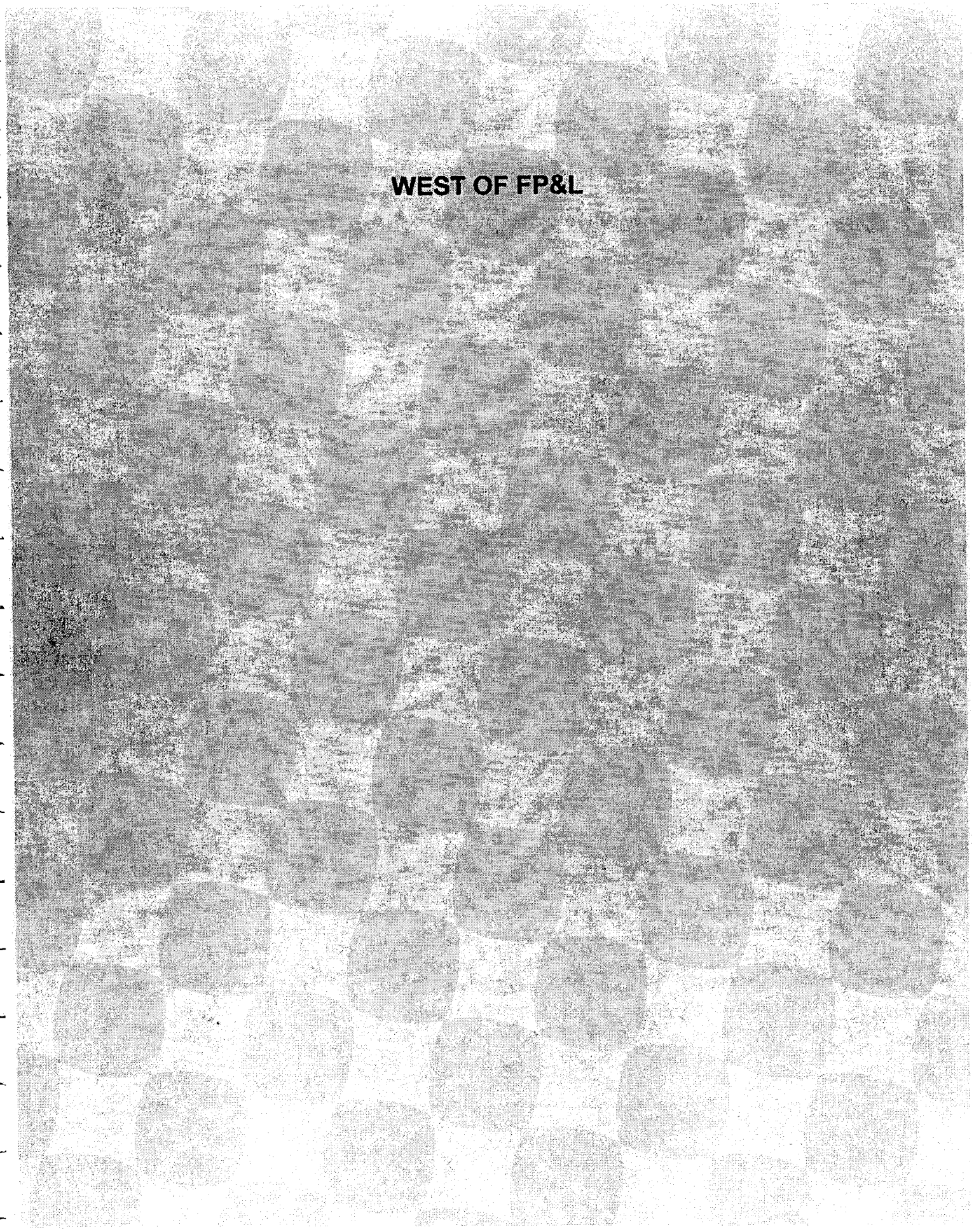
PROJECT NAME . . . . : FPL DISCHARGE BRIDGE - POST
REVIEWER . . . . . : ADS
PROJECT AREA . . . . : 29.69 ACRES
GROUND STORAGE . . . : 1.06 INCHES
TERMINATION DISCHARGE : 999.00 CFS
DISTRIBUTION TYPE . . : SFWMD
RETURN FREQUENCY . . : 100.00 YEARS
RAINFALL DURATION . . : 3-DAY
24-HOUR RAINFALL . . : 15.00 INCHES
REPORTING SEQUENCE . : STANDARDIZED

STAGE (FT)	STORAGE (AF)	DISCHARGE (CFS)
2.00	.00	.00
6.00	1.74	.00
8.00	2.91	.00
8.50	3.67	.00
9.00	4.80	.00
10.00	8.73	.00
10.50	11.28	.00
11.00	14.68	.00
11.50	20.35	.00
12.00	26.70	.00
12.50	34.82	.00
13.00	47.31	.00
13.50	61.41	.00
13.80	69.71	.00

					- - - - - - R E S E R V O I R - - - - - -				
TIME (HR)	RAIN FALL (IN)	ACCUM. RUNOFF (IN)	BASIN DISCHGE (CFS)	ACCUM. INFLOW (AF)	VOLUME (AF)	ACCUM. OUTFLOW (AF)	INSTANT DISCHGE (CFS)	AVERAGE DISCHGE (CFS)	STAGE (FT)
.00	.00	.00	.0	.0	.0	.0	.0	.0	2.00
4.00	.37	.02	.6	.0	.0	.0	.0	.0	2.10
8.00	.73	.17	1.5	.4	.4	.0	.0	.0	2.93
12.00	1.10	.40	1.9	1.0	1.0	.0	.0	.0	4.24
16.00	1.46	.67	2.1	1.7	1.7	.0	.0	.0	5.79
20.00	1.82	.97	2.3	2.4	2.4	.0	.0	.0	7.10
24.00	2.19	1.29	2.4	3.2	3.2	.0	.0	.0	8.17
28.00	2.72	1.77	3.6	4.4	4.4	.0	.0	.0	8.79
32.00	3.25	2.26	3.7	5.6	5.6	.0	.0	.0	9.19
36.00	3.79	2.76	3.8	6.8	6.8	.0	.0	.0	9.50
40.00	4.32	3.27	3.8	8.1	8.1	.0	.0	.0	9.82
44.00	4.85	3.78	3.8	9.3	9.3	.0	.0	.0	10.11
48.00	5.38	4.29	3.9	10.6	10.6	.0	.0	.0	10.36
52.00	6.06	4.95	6.1	12.2	12.2	.0	.0	.0	10.63
56.00	7.44	6.30	13.2	15.6	15.6	.0	.0	.0	11.07
58.00	8.58	7.43	19.5	18.4	18.4	.0	.0	.0	11.31
59.00	9.42	8.26	28.4	20.4	20.4	.0	.0	.0	11.48
59.50	10.17	9.00	44.5	22.3	22.3	.0	.0	.0	11.61
59.75	12.42	11.23	267.4	27.8	27.8	.0	.0	.0	11.87
60.00	15.22	14.02	334.1	34.7	34.7	.0	.0	.0	12.28
60.50	16.32	15.11	65.3	37.4	37.4	.0	.0	.0	12.58
61.00	16.89	15.68	34.0	38.8	38.8	.0	.0	.0	12.65
62.00	17.66	16.44	20.6	40.7	40.7	.0	.0	.0	12.73
64.00	18.58	17.37	13.4	43.0	43.0	.0	.0	.0	12.82
68.00	19.66	18.45	8.1	45.6	45.6	.0	.0	.0	12.93
72.00	20.39	19.17	5.4	47.4	47.4	.0	.0	.0	13.00

SUMMARY INFORMATION

MAXIMUM STAGE WAS 13.00 FEET AT 72.00 HOURS
MAXIMUM DISCHARGE WAS .0 CFS AT .00 HOURS


WEST OF FP&L

Port Everglades Bridge Over the FPL Discharge Canal
Prepared by: Craven Thompson & Associates, Inc.
August, 2008

WATER QUALITY CALCULATIONS - WEST OF FPL DISCHARGE CANAL

WEST PORTION OF BRIDGE & ROADWAY WEST OF FPL DISCHARGE CANAL:

WATER QUALITY REQUIRED:

2.5" over Percent Impervious: (Roadway (WEST) + West Portion of Bridge)		
2.5" X (0.92 + .10) = 2.55 Ac-In	0.213	Ac-Ft
Total Water Quality Required:	**0.213**	**Ac-Ft**

WATER QUALITY PROVIDED:

5' X 10' Exfiltration Trench - TYPE B (375 LF)	0.214	Ac-Ft
Total Water Quality Provided:	**0.214**	**Ac-Ft**

Port Everglades Bridge Over the FPL Discharge Canal
Prepared by: Craven Thompson & Associates, Inc.
August, 2008

EXFILTRATION TRENCH SUMMARY - WEST OF FPL DISCHARGE CANAL

TOTAL STORAGE PROVIDED BY 5' X 10' Exfiltration Trench (TYPE B)			
H_2=	DEPTH TO WATER TABLE (Ft.)	=	3.74
D_U=	NON SATURATED TRENCH DEPTH (Ft.)	=	3.74
D_S=	SATURATED TRENCH DEPTH (Ft.)	=	1.26
W=	TRENCH WIDTH (Ft.)	=	10.00
K=	*HYDRAULIC CONDUCTIVITY (CFS/FT2-FT-HEAD)	=	2.71E-05
V=	VOLUME TO BE TREATED (ACRE-INCHES)	=	**2.57**
L=	LENGTH OF TRENCH (Ft.)	=	**375.00**

L=	$V/[(K*(H_2*W+2H_2D_U-D_U^2+2H_2D_S)+(1.39*10^{-4}*WD_U))]$

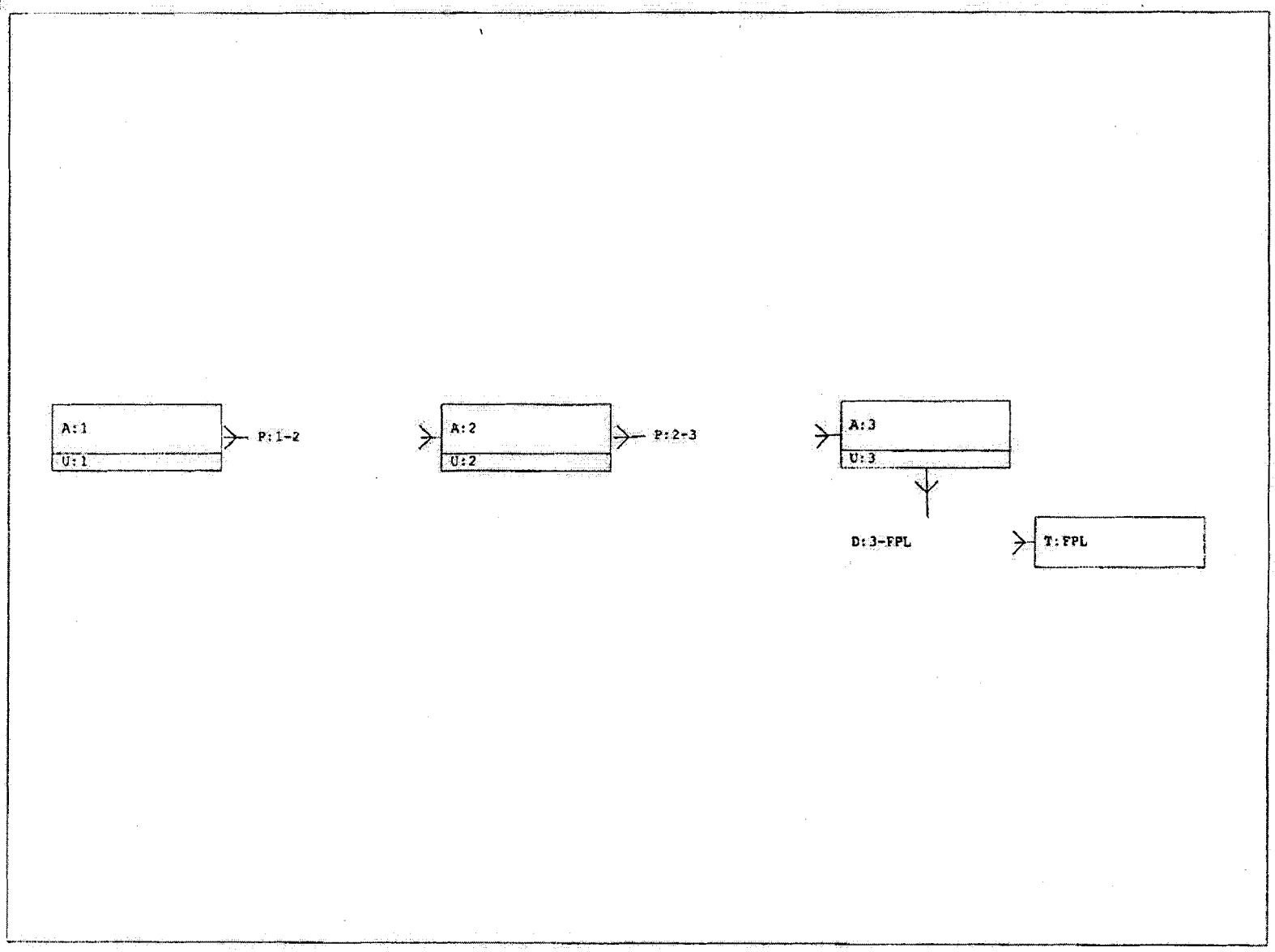
$V_{TREATED\ (Ac\text{-}In)}$ =	**2.568**
$V_{TREATED\ (Ac\text{-}Ft)}$ =	**0.214**

FPL DISCHARGE CANAL BRIDGE-WEST
ICPR NODAL DIAGRAM

Nodes
A Stage/Area
V Stage/Volume
T Time/Stage
M Manhole

Basins
O Overland Flow
U SCS Unit Hydro
S Santa Barbara

Links
P Pipe
W Weir
C Channel
D Drop Structure
B Bridge
R Rating Curve
H Breach



INPUT REPORT

FPL DISCHARGE CANAL BRIDGE-WEST
INPUT REPORT

==== Basins ====

Name: 1 Node: 1 Status: Onsite
Group: BASE Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256 Peaking Factor: 256.0
Rainfall File: Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000 Time of Conc(min): 30.00
Area(ac): 0.660 Time Shift(hrs): 0.00
Curve Number: 95.00 Max Allowable Q(cfs): 999999.000
DCIA(%): 100.00

Name: 2 Node: 2 Status: Onsite
Group: BASE Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256 Peaking Factor: 256.0
Rainfall File: Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000 Time of Conc(min): 30.00
Area(ac): 0.220 Time Shift(hrs): 0.00
Curve Number: 95.00 Max Allowable Q(cfs): 999999.000
DCIA(%): 100.00

Name: 3 Node: 3 Status: Onsite
Group: BASE Type: SCS Unit Hydrograph

Unit Hydrograph: Uh256 Peaking Factor: 256.0
Rainfall File: Storm Duration(hrs): 0.00
Rainfall Amount(in): 0.000 Time of Conc(min): 30.00
Area(ac): 0.140 Time Shift(hrs): 0.00
Curve Number: 95.00 Max Allowable Q(cfs): 999999.000
DCIA(%): 100.00

==== Nodes ====

Name: 1 Base Flow(cfs): 0.000 Init Stage(ft): 3.260
Group: BASE Warn Stage(ft): 8.640
Type: Stage/Area

VOLUME OF TRENCH CALCULATION: 128 LF OF 5'X10' EXFIL. (TYPE B) = 0.877 AC-IN/12=0.073 AC-FT
0.073 AC-FT / 3.74' = .0195 AC.

Stage(ft)	Area(ac)
3.260	0.0195
7.000	0.0195
7.010	0.0000
8.640	0.0000
11.290	0.6600

Name: 2 Base Flow(cfs): 0.000 Init Stage(ft): 3.260
Group: BASE Warn Stage(ft): 10.040
Type: Stage/Area

VOLUME OF TRENCH CALCULATION: 247 LF OF 5'X10' EXFIL. (TYPE B) =
1.692 AC-IN/12=0.141 AC-FT
0.141 AC-FT / 3.74' = .0377 AC

Stage(ft)	Area(ac)
3.260	0.0377
7.000	0.0377
7.010	0.0000
10.040	0.0000
20.500	0.2200

Name: 3 Base Flow(cfs): 0.000 Init Stage(ft): 3.260
Group: BASE Warn Stage(ft): 20.070
Type: Stage/Area

Stage(ft)	Area(ac)
20.070	0.0000
22.860	0.1400

Name: FPL Base Flow(cfs): 0.000 Init Stage(ft): 3.260
Group: BASE Warn Stage(ft): 3.260
Type: Time/Stage

Time(hrs)	Stage(ft)
0.00	3.260
96.00	3.260

Cross Sections

Name: Group: BASE

Encroachment: No

Station(ft)	Elevation(ft)	Manning's N

Operating Tables

Name: Group: BASE
Type: Bottom Clip
Function: Time vs. Depth of Clip

Time(hrs)	Clip Depth(in)

Pipes

Name: 1-2 From Node: 1 Length(ft): 154.00
Group: BASE To Node: 2 Count: 1
Friction Equation: Average Conveyance
Solution Algorithm: Automatic
Flow: Both
Entrance Loss Coef: 0.00
Exit Loss Coef: 0.00
Bend Loss Coef: 0.00
Outlet Ctrl Spec: Use dc or tw
Inlet Ctrl Spec: Use dn
Stabilizer Option: None

	UPSTREAM	DOWNSTREAM
Geometry:	Circular	Circular
Span(in):	18.00	18.00
Rise(in):	18.00	18.00
Invert(ft):	5.250	5.250
Manning's N:	0.009000	0.009000
Top Clip(in):	0.000	0.000
Bot Clip(in):	0.000	0.000

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Name: 2-3 From Node: 2 Length(ft): 263.00
Group: BASE To Node: 3 Count: 1
Friction Equation: Average Conveyance
Solution Algorithm: Automatic
Flow: Both
Entrance Loss Coef: 0.00
Exit Loss Coef: 0.00

	UPSTREAM	DOWNSTREAM
Geometry:	Circular	Circular
Span(in):	18.00	18.00
Rise(in):	18.00	18.00

Invert(ft):	5.250	5.250	Bend Loss Coef:	0.00
Manning's N:	0.009000	0.009000	Outlet Ctrl Spec:	Use dc or tw
Top Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dn
Bot Clip(in):	0.000	0.000	Stabilizer Option:	None

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Drop Structures

Name: 3-FPL
Group: BASE
From Node: 3
To Node: FPL
Length(ft): 57.00
Count: 1

	UPSTREAM	DOWNSTREAM		
Geometry:	Circular	Circular	Friction Equation:	Average Conveyance
Span(in):	24.00	24.00	Solution Algorithm:	Automatic
Rise(in):	24.00	24.00	Flow:	Both
Invert(ft):	-1.000	1.500	Entrance Loss Coef:	0.000
Manning's N:	0.009000	0.009000	Exit Loss Coef:	0.000
Top Clip(in):	0.000	0.000	Outlet Ctrl Spec:	Use dc or tw
Bot Clip(in):	0.000	0.000	Inlet Ctrl Spec:	Use dn
			Solution Incs:	10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

*** Weir 1 of 1 for Drop Structure 3-FPL ***

TABLE

Count:	1	Bottom Clip(in):	0.000
Type:	Horizontal	Top Clip(in):	0.000
Flow:	Both	Weir Disc Coef:	3.200
Geometry:	Rectangular	Orifice Disc Coef:	0.600
Span(in):	48.00	Invert(ft):	7.000
Rise(in):	36.00	Control Elev(ft):	7.000

Hydrology Simulations

Name: 100YR
Filename: M:\icpr3\southportpecc\sim\100YRCONT.R32

Override Defaults: Yes
Storm Duration(hrs): 72.00
Rainfall File: Sfwmd72
Rainfall Amount(in): 18.35

Time(hrs)	Print Inc(min)
100.000	15.00

Name: 10YR
Filename: M:\icpr3\southportpecc\sim\10YRCONT.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: SFWMD24
Rainfall Amount(in): 8.70

Time(hrs)	Print Inc(min)
100.000	15.00

Name: 25YR
Filename: M:\icpr3\southportpecc\sim\25YRCONT.R32

Override Defaults: Yes
Storm Duration(hrs): 72.00
Rainfall File: Sfwmd72
Rainfall Amount(in): 14.95

Time(hrs)	Print Inc(min)
100.000	15.00

==== Routing Simulations ====

Name: 100YR Hydrology Sim: 100YR
Filename: M:\icpr3\southportpecc\sim\100YRCONT1B.I32

Execute: No Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 84.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: 100 Boundary Flows:

Time(hrs)	Print Inc(min)
100.000	15.000

Group	Run
BASE	Yes

Name: 10YR Hydrology Sim: 10YR
Filename: M:\icpr3\southportpecc\sim\10YRCONT1B.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 36.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: 10 Boundary Flows:

Time(hrs)	Print Inc(min)
100.000	15.000

Group	Run
BASE	Yes

Name: 25YR Hydrology Sim: 25YR
Filename: M:\icpr3\southportpecc\sim\25YRCONT1B.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 10.000
Start Time(hrs): 0.000 End Time(hrs): 84.00
Min Calc Time(sec): 0.5000 Max Calc Time(sec): 60.0000
Boundary Stages: 25 Boundary Flows:

Time(hrs)	Print Inc(min)
100.000	15.000

Group	Run
BASE	Yes

Boundary Conditions

Name: 25 Node: FPL Type: Stage

Time(hrs)	Stage(ft)
0.000	3.260
96.000	3.260

Name: 100 Node: FPL Type: Stage

Time(hrs)	Stage(ft)
0.000	3.260
96.000	3.260

Name: 10 Node: FPL Type: Stage

Time(hrs)	Stage(ft)
0.000	3.260
48.000	3.260

10 YR – 1 DAY RESULTS

FPL DISCHARGE CANAL BRIDGE-WEST
NODE MAXIMUM REPORT
10 YEAR

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1	BASE	10YR	12.25	7.349	8.640	0.0050	119	12.25	2.085	12.31	2.155
2	BASE	10YR	12.26	7.299	10.040	0.0065	129	12.31	2.815	12.23	2.810
3	BASE	10YR	12.26	7.173	20.070	-1.9900	123	12.23	3.249	12.26	3.213
FPL	BASE	10YR	0.00	3.260	3.260	-0.0000	0	12.26	3.213	0.00	0.000

FPL DISCHARGE CANAL BRIDGE-WEST
LINK MAXIMUM REPORT
10 YEAR

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
1-2	BASE	10YR	12.31	2.155	-0.891	12.25	7.349	12.26	7.299
2-3	BASE	10YR	12.23	2.810	0.934	12.26	7.299	12.26	7.173
3-FPL	BASE	10YR	12.26	3.213	-0.099	12.26	7.173	0.00	3.260

25 YR – 3 DAY RESULTS

FPL DISCHARGE CANAL BRIDGE-WEST
NODE MAXIMUM REPORT
25 YEAR

Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	Max Outflow cfs
1	BASE	25YR	60.25	7.484	8.640	0.0049	119	60.25	2.637	60.25	2.631
2	BASE	25YR	60.25	7.406	10.040	0.0050	129	60.25	3.508	60.25	3.565
3	BASE	25YR	60.25	7.202	20.070	-1.9900	123	60.25	4.124	60.25	4.064
FPL	BASE	25YR	0.00	3.260	3.260	-0.0000	0	60.25	4.064	0.00	0.000

FPL DISCHARGE CANAL BRIDGE-WEST
LINK MAXIMUM REPORT
25 YEAR

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
1-2	BASE	10YR	12.31	2.155	-0.891	12.25	7.349	12.26	7.299
2-3	BASE	10YR	12.23	2.810	0.934	12.26	7.299	12.26	7.173
3-FPL	BASE	10YR	12.26	3.213	-0.099	12.26	7.173	0.00	3.260

EXHIBITS

4.0 GROUNDWATER CONDITIONS

4.1 Groundwater

The groundwater table was measured at the boring locations following termination of drilling and after a short stabilization period on the order of five (5) to ten (10) minutes. The depth to the water table at the boring locations generally ranged from 3.0 to 10.0 feet below the existing grades. The groundwater table measured at each of the boring location is presented on the boring profiles in the Appendix.

Groundwater conditions will vary with environmental variations and seasonal conditions, such as the frequency and magnitude of rainfall patterns, as well as man-made influences (i.e. existing canals, swales, drainage ponds, under drains and areas of covered soils like, paved parking lots and sidewalks). Fluctuation should be anticipated. We recommend that the contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on his construction procedure.

4.2 Seasonal High Groundwater Estimates

The flood Insurance Rate Map (FIRM) number 12011C0307F (panel 307 of 319) effective August 18, 1992 by Federal Emergency Management Agency (FEMA) indicates a part of the site to be in Zone AE with the 100-year flood level determined to be at el +6 NGVD. Our review of the USGS (United States Geological Survey) data of wells in the general vicinity of the project site indicates that the daily maximum ground water elevation between 1990 and 2007 generally varied between about el +3 and el +6, NGVD. There have been relatively few instances when the daily maximum ground water elevation was recorded at el +7, NGVD.

4.3 Borehole Permeability (BHP) Test Results

A total of three (3) BHP tests were performed using the usual open-hole, constant head methodology. The holes were 10 feet deep, and were drilled with a 6-inch diameter solid stem auger so that soil samples could be retrieved for visual classification by an engineer. The boring was completed as open well with gravel pack (6-20 silica sand). The well screen slot widths were 0.020 inches. Water from the drill rig tank was then pumped into the open well, and the amount of water required maintaining constant head was recorded. Results of our field permeability tests are presented below.

LOCATION	DEPTH INTERVAL (Feet)	SOIL DESCRIPTION	HYDRAULIC CONDUCTIVITY (cfs/ft^2 per foot of Head Induced)
BHP-1	0 – 4 4 – 6 6 – 10	Tan Sand and limerock Gray silty sand Dark brown organic stained sand	5.99×10^{-5}

Groundwater level was about 6 feet below exiting grade

LOCATION	DEPTH INTERVAL (Feet)	SOIL DESCRIPTION	HYDRAULIC CONDUCTIVITY (cfs/ft^2 per foot of Head Induced)
BHP-2	0 – 2 2 – 5 5– 10	Tan Sand and limerock Peat and sit Tan sand with shell	1.11 x10^{-5}

Groundwater level was about 6 feet below exiting grade

LOCATION	DEPTH INTERVAL (Feet)	SOIL DESCRIPTION	HYDRAULIC CONDUCTIVITY (cfs/ft^2 per foot of Head Induced)
BHP-3	0 – 4 4 – 6 6– 10	Tan Sand and limerock Gray Sand Gray silty sand	1.05 x10^{-5}

Groundwater level was about 6 feet below exiting grade

4.4 Environmental Corrosion Testing

Environmental corrosion tests were performed on soil samples recovered at the proposed bridge and embankment locations. Environmental corrosion tests include parameters such as pH, resistivity, sulfate and chloride content. These laboratory test results were used to perform the environmental classification in accordance with Section 1.3 of FDOT Structures Design Guidelines, Topic No. 625-020-154-b. Based on the laboratory test results the environmental classification for the bridge is extremely aggressive, and for the embankment/approach is slightly to moderately aggressive.

APPENDIX 4-D

Drainage Study at Port Everglades Foreign Trade Zone

DRAINAGE STUDY

AT

PORT EVERGLADES
FOREIGN TRADE ZONE

AT

S.E. 18TH AVENUE, SOUTH OF ELLER DRIVE
HOLLYWOOD, FLORIDA

PREPARED FOR:

PORT EVERGLADES AUTHORITY

ENGINEERING DEPARTMENT

PREPARED BY:

ROBERT H. MILLER AND ASSOCIATES, INC.
4800 S.W. 64TH AVENUE
SUITE 103
DAVIE, FLORIDA 33314

NOVEMBER 1987

Purpose

The purpose of this report is to review the existing drainage situation at the Foreign Trade Zone (FTZ), analyze alternative designs to improve it, and make a recommendation to the Port Everglades Authority. This report also includes recommendations for storm water management for future development of the 10-acre property to the east of the FTZ.

General

This report is based on the following data:

1. The FTZ and the World Trade Center are in the same watershed area which drains east through a ditch into the Florida Power and Light Company (FP&L) discharge canal (see Exhibit 8).

2. The area of the FTZ and the World Trade Center site is approximately 29.9 acres at 100% impervious.

3. The area of the property east of the FTZ is approximately 10 acres to be developed at 100% impervious.

4. The Mean High Water elevation is 2.0 NGVD, taken from the Broward County Maps, which is equivalent to elevation 0.74 Mean Low Water.

5. Government requirements will remain the same when the 10-acre parcel east of the FTZ is developed.

6. It is assumed that the power poles on the north-south ditch along 18th Avenue are not desired to be relocated.

7. All dimensions and elevations are Mean Low Water and based on the topographical survey provided by the Port Everglades Authority, entitled Topo East of Foreign Trade Zone, dated May 13, 1987.

9. Future building G is included in the drainage calculations.

Review of Existing Drainage

The FTZ is a 24.4 acre industrial site consisting of four (4) main buildings. The storm water is conveyed through a system of catch basins with positive drainage to a 71" x 47" arch culvert which discharges into an off-site ditch. The ditch runs north-south parallel to S.E. 18th Avenue; this will be referred to as the N-S ditch. This ditch is connected by two (2) 24" reinforced concrete pipes (RCP) to another ditch that runs east-west on the east side of S.E. 18th Avenue; this will be referred to as the E-W ditch. This ditch has a weir structure at the east end and discharges into the FP&L discharge canal through a 24" RCP.

The on-site drainage system at the FTZ is adequate, since the previous problem at building F was remedied by adding bleed-off fittings along the roof overflow piping. The 71" x 47" arch culvert is also adequate in capacity to handle the storm runoff from this site.

The off-site drainage ditches are not adequate in volume. The storage volume of the existing ditches is approximately 0.87 acre-feet (AF). The recommended design storm event of 3-year, 1-hour requires a volume of 2.49 AF. This required volume is equivalent to the first inch of stormwater run-off from the entire site.

The off-site 24" pipes are not adequate in discharge capacities. The required pipe capacity for the FTZ and the World Trade Center is 79.4 cubic feet per second (CFS). The capacity of two 24" RCPs is 25 CFS. Therefore, future improvements to off-site discharge pipes will be required.

Government Requirements

There are two (2) ways to view changes to the existing drainage systems. First, where improvements are designed to correct existing drainage problems, the construction work can be considered part of an operation and maintenance effort - requiring no water management government approvals. The design of these improvements should meet current surface water management regulations. Second, where expansions to the existing system are made (such as for Building G or the 10-acre property), will be required design plans and surface water management approvals. The following governing agencies have jurisdiction:

South Florida Water Management District (SFWMD):

A general permit will be required for any new surface water management system. For water quality, detention volume shall be provided for the first inch of run-off from the developed project, or the total run-off of 2.5 inches times the percentage of imperviousness, whichever is greater. The 10-acre property will require a detention volume of approximately 2.08 AF.

Broward County Water Resources Management Division (BCWRMD):

A permit from BCWRMD will also be required for any new surface water management system. The design frequency will be according to the 3-year rainfall intensity. Since the SFWMD criteria will be the most conservative for detention volume, the 2.08 AF will govern for the 10-acre property.

City of Hollywood:

A permit from the City of Hollywood will need to be obtained before construction on the 10-acre property can begin. They will accept systems designed to meet BCWRMD criteria.

To correct existing drainage problems at the FTZ, the surface water management system should be redesigned to comply with current government criteria. The required volume of detention shall be equal to 1" of runoff from the 29.9 acre site or 2.49 AF. The FTZ discharge capacity should be increased by supplementing the two 24" RCPs under 18th Avenue or replacing them with one large culvert.

Alternative Solutions to Present Drainage Problem

To improve the surface water management system of the FTZ, the volume of the ditches needs to be increased. Which alternative will be the most cost-effective will depend on the amount of funds available now and how much land can be used on the undeveloped 10-acre property for detention purposes.

The discharge pipe capacity must be increased to improve the present surface water management system. This can be accomplished under 18th Avenue by either adding a 48" culvert to the two existing 24" RCPs or by replacing them with one 71" x 47" culvert. By constructing one large culvert to replace and augment the two small pipes, extension of the 71" x 47" culvert eastward across the 10-acre property at the time of development will be simpler and more economical. The 24" discharge pipe at the FP&L canal has not been included in the cost estimates at the direction of the Port Authority Engineer. The redesign of this outfall can be accomplished as part of the future development of the 10-acre property. Until that time the excess storm water volume will overflow onto the 10-acre property only during major storm events.

The following alternatives, #1 through #4, are based on the required detention volume of 4.57 AF for both the FTZ and the 10-acre property. They are in descending order by expense, in terms of the acreage needed from the 10-acre property for detention. Construction cost estimates follow as Exhibits 1 through 5.

Alternative #1:
North-south ditch and east-west ditch at side slopes of 1:1 with an estimated construction cost of $143,157 and a loss of 0.56 acres from the 10-acre property. See Exhibits 1 and 6.

Alternative #2:
North-south ditch at 1:1 side slopes and east-west ditch at 1:3 side slopes with an estimated construction cost of $129,357 and a loss of 0.74 acres from the 10-acre parcel. See Exhibits 2 and 6.

Alternative #3:
North-south ditch at 1:3 side slopes and east-west ditch at 1:1 side slopes with an estimated construction cost of $45,085 and a loss of 1.0 acre from the 10-acre property. See Exhibits 3 and 6.

Alternative #4:
North-south ditch and east-west ditch at side slopes of 1:3 with an estimated construction cost of $31,285 and a loss of 1.18 acres from the 10-acre property. See Exhibits 4 and 6.

Alternative #5:
If it is desired to correct the FTZ drainage problem without planning for the future drainage needs of the 10-acre property, improvements would include north-south ditch at 1:1 side slopes, with an estimated construction cost of $108,135. See Exhibits 5 and 7.

Maintenance Program

It is very important that a maintenance program be established to keep the surface water management system working properly. If an erosion control system, such as Armorform (see attached manufacturer's literature), is used on the slopes of the ditches, maintenance will be minimal. The bottom of the ditches, however, will need to be cleared periodically. This can be accomplished by the use of herbicides. As practiced by local drainage districts, grasses should be sprayed three (3) times a year at an estimated cost of $200 per treatment per acre, materials and labor included. A permit from the Department of Natural Resources is required for a herbicide maintenance program.

Recommended Alternative

Alternatives #1 through #4 address the required detention volume for the FTZ and the 10-acre property to the east. Since the 10-acre property is vacant and no site plan has yet been designed, the most cost-effective alternative would be Alternative #5, which addresses the FTZ only. If the site plan of the 10-acre property dictates that the east-west ditch area will be needed for parking, it can be culverted and filled, and a new detention area can be constructed in another area. If the ditch can remain

at its present location, it can be widened and deepened as needed for the required detention volume.

Selection of recommended Alternative #5, at an estimated cost of $108,135, will provide the needed drainage detention for the existing surface water management system, and greater flexibility for future development of the 10-acre property.

ROBERT H. MILLER & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
4800 S.W. 64 AVE., SUITE 103
DAVIE, FLORIDA 33314
791-2900

FOREIGN TRADE ZONE — PROJECT NUMBER 7411-01 — 11/12/87

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
N-S DITCH @ 1:1 SLOPE				
ARMORFORM EROSION CONTROL SYSTEM	22960	SF	$2.00	$45,920
GUARDRAIL	1640	LF	$24.00	$39,360
CLEARING OF VEGETATION	5102	SY	$0.50	$2,551
DIGGING OF DITCH	3533	CY	$1.50	$5,300
71X47 UNDER ROAD	60	LF	$200.00	$12,000
PAVEMENT RESTORATION	100	SF	$28.00	$2,800
			SUBTOTAL	$107,931
			15% CONTINGENCY	$124,120
E-W DITCH @ 1:1 SLOPE				
ARMORFORM EROSION CONTROL SYSTEM	6000	SF	$2.00	$12,000
CLEARING OF VEGETATION	1800	SY	$0.50	$900
DIGGING OF DITCH	2436	CY	$1.50	$3,654
			SUBTOTAL	$16,554
			15% CONTINGENCY	$19,037
			TOTAL	$143,157

EXHIBIT 1

ROBERT H. MILLER & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
4800 S.W. 64 AVE., SUITE 103
DAVIE, FLORIDA 33314
791-2900

FOREIGN TRADE ZONE — PROJECT NUMBER 7411-01 — 11/12/87

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
N-S DITCH @ 1:1 SLOPE				
ARMORFORM EROSION CONTROL SYSTEM	22960	SF	$2.00	$45,920
GUARDRAIL	1640	LF	$24.00	$39,360
CLEARING OF VEGETATION	5102	SY	$0.50	$2,551
DIGGING OF DITCH	3533	CY	$1.50	$5,300
71X47 UNDER ROAD	60	LF	$200.00	$12,000
PAVEMENT RESTORATION	100	SF	$28.00	$2,800
			SUBTOTAL	$107,931
			15% CONTINGENCY	$124,120
E-W DITCH @ 1:3 SLOPE				
CLEARING OF VEGETATION	1800	SY	$0.50	$900
DIGGING OF DITCH	2436	CY	$1.50	$3,654
			SUBTOTAL	$4,554
			15% CONTINGENCY	$5,237
			TOTAL	$129,357

EXHIBIT 2

ROBERT H. MILLER & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
4800 S.W. 64 AVE., SUITE 103
DAVIE, FLORIDA 33314
791-2900

FOREIGN TRADE ZONE — PROJECT NUMBER 7411-01 — 11/12/87

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
N-S DITCH @ 1:3 SLOPE				
CLEARING OF VEGETATION	5102	SY	$0.50	$2,551
DIGGING OF DITCH	629	CY	$1.50	$944
71X47 UNDER ROAD	60	LF	$200.00	$12,000
PAVEMENT RESTORATION	100	SF	$28.00	$2,800
			SUBTOTAL	$18,295
			15% CONTINGENCY	$21,039
E-W DITCH @ 1:1 SLOPE				
ARMORFORM EROSION CONTROL SYSTEM	6000	SF	$2.00	$12,000
CLEARING OF VEGETATION	1800	SY	$0.50	$900
DIGGING OF DITCH	5340	CY	$1.50	$8,010
			SUBTOTAL	$20,910
			15% CONTINGENCY	$24,046
			TOTAL	$45,085

EXHIBIT 3

ROBERT H. MILLER & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
4800 S.W. 64 AVE., SUITE 103
DAVIE, FLORIDA 33314
791-2900

FOREIGN TRADE ZONE — PROJECT NUMBER 7411-01 — 11/12/87

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
N-S DITCH @ 1:3 SLOPE				
CLEARING OF VEGETATION	5102	SY	$0.50	$2,551
DIGGING OF DITCH	629	CY	$1.50	$944
71X47 UNDER ROAD	60	LF	$200.00	$12,000
PAVEMENT RESTORATION	100	SF	$28.00	$2,800
			SUBTOTAL	$18,295
			15% CONTINGENCY	$21,039
E-W DITCH @ 1:3 SLOPE				
CLEARING OF VEGETATION	1800	SY	$0.50	$900
DIGGING OF DITCH	5340	CY	$1.50	$8,010
			SUBTOTAL	$8,910
			15% CONTINGENCY	$10,247
			TOTAL	$31,285

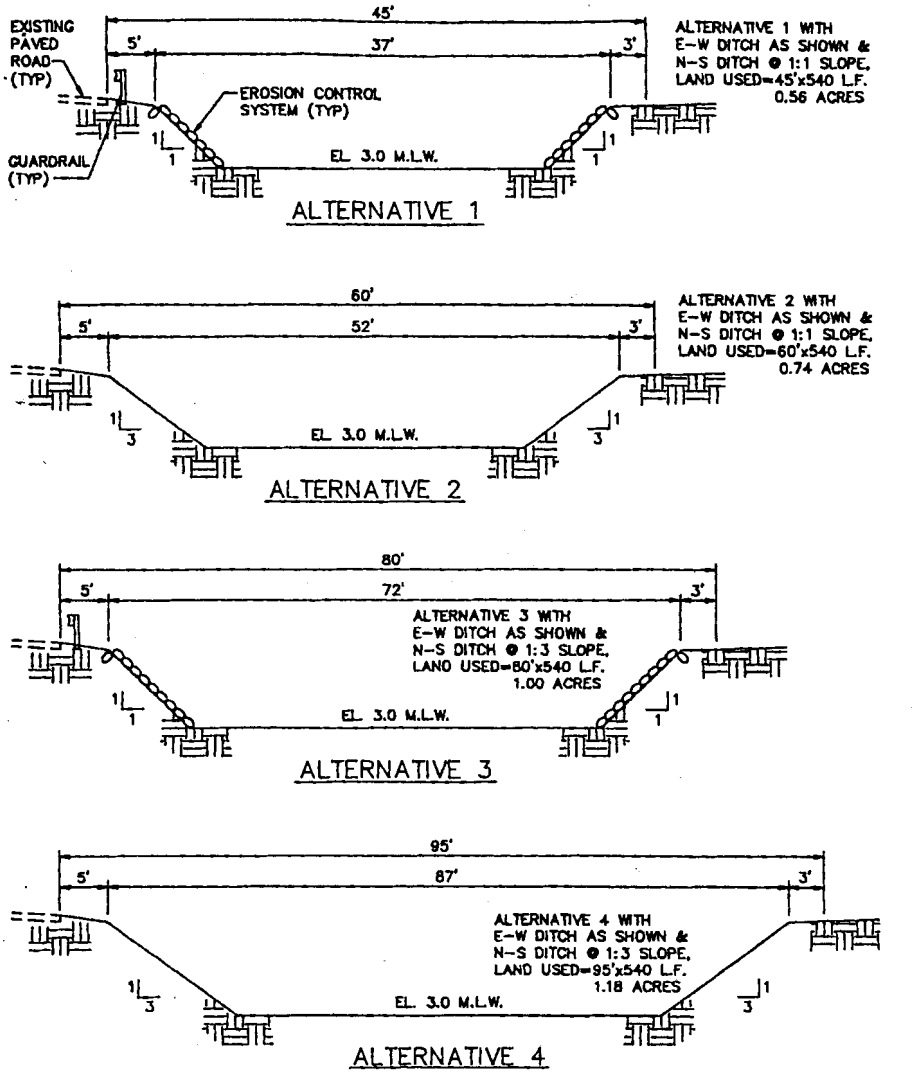
EXHIBIT 4

ROBERT H. MILLER & ASSOCIATES, INC.
CONSULTING CIVIL ENGINEERS
4800 S.W. 64 AVE., SUITE 103
DAVIE, FLORIDA 33314
791-2900

FOREIGN TRADE ZONE — PROJECT NUMBER 7411-01 — 11/12/87

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
N-S DITCH @ 1:1 SLOPE				
ARMORFORM EROSION CONTROL SYSTEM	22960	SF	$2.00	$45,920
GUARDRAIL	1640	LF	$24.00	$39,360
CLEARING OF VEGETATION (N-S)	5102	SY	$0.50	$2,551
CLEARING OF VEGETATION (E-W)	1800	SY	$0.50	$900
DIGGING OF DITCH	3533	CY	$1.50	$5,300
			SUBTOTAL	$94,031
		15% CONTINGENCY		$108,135
			TOTAL	$108,135

EXHIBIT 5

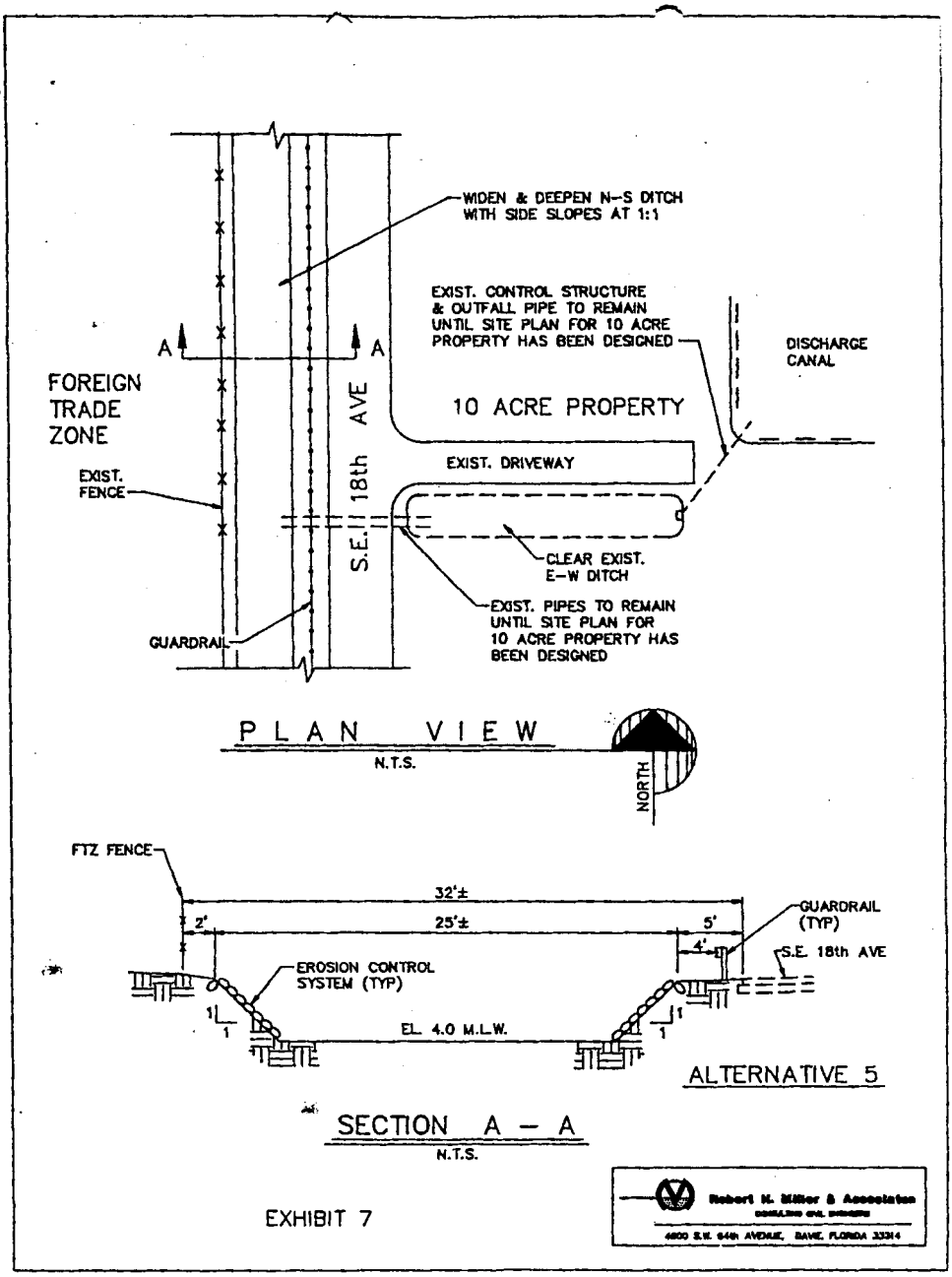


EAST-WEST DITCH CROSS-SECTIONS

N.T.S.

EXHIBIT 6

Robert N. Miller & Associates
CONSULTING CIVIL ENGINEERS
4600 S.W. 64th AVENUE, DAVIE, FLORIDA 33314


WIDEN & DEEPEN N-S DITCH WITH SIDE SLOPES AT 1:1
EXIST. CONTROL STRUCTURE & OUTFALL PIPE TO REMAIN UNTIL SITE PLAN FOR 10 ACRE PROPERTY HAS BEEN DESIGNED
DISCHARGE CANAL
A
A
FOREIGN TRADE ZONE
10 ACRE PROPERTY
S.E. 18th AVE
EXIST. DRIVEWAY
EXIST. FENCE
CLEAR EXIST. E-W DITCH
EXIST. PIPES TO REMAIN UNTIL SITE PLAN FOR 10 ACRE PROPERTY HAS BEEN DESIGNED
GUARDRAIL
PLAN VIEW
N.T.S.
NORTH
FTZ FENCE
32'±
2'
25'±
5'
4'
GUARDRAIL (TYP)
S.E. 18th AVE
EROSION CONTROL SYSTEM (TYP)
1
1
EL. 4.0 M.L.W.
1
1
ALTERNATIVE 5
SECTION A – A
N.T.S.
EXHIBIT 7
Robert H. Miller & Association
4600 S.W. 64th AVENUE, DAVIE, FLORIDA 33314

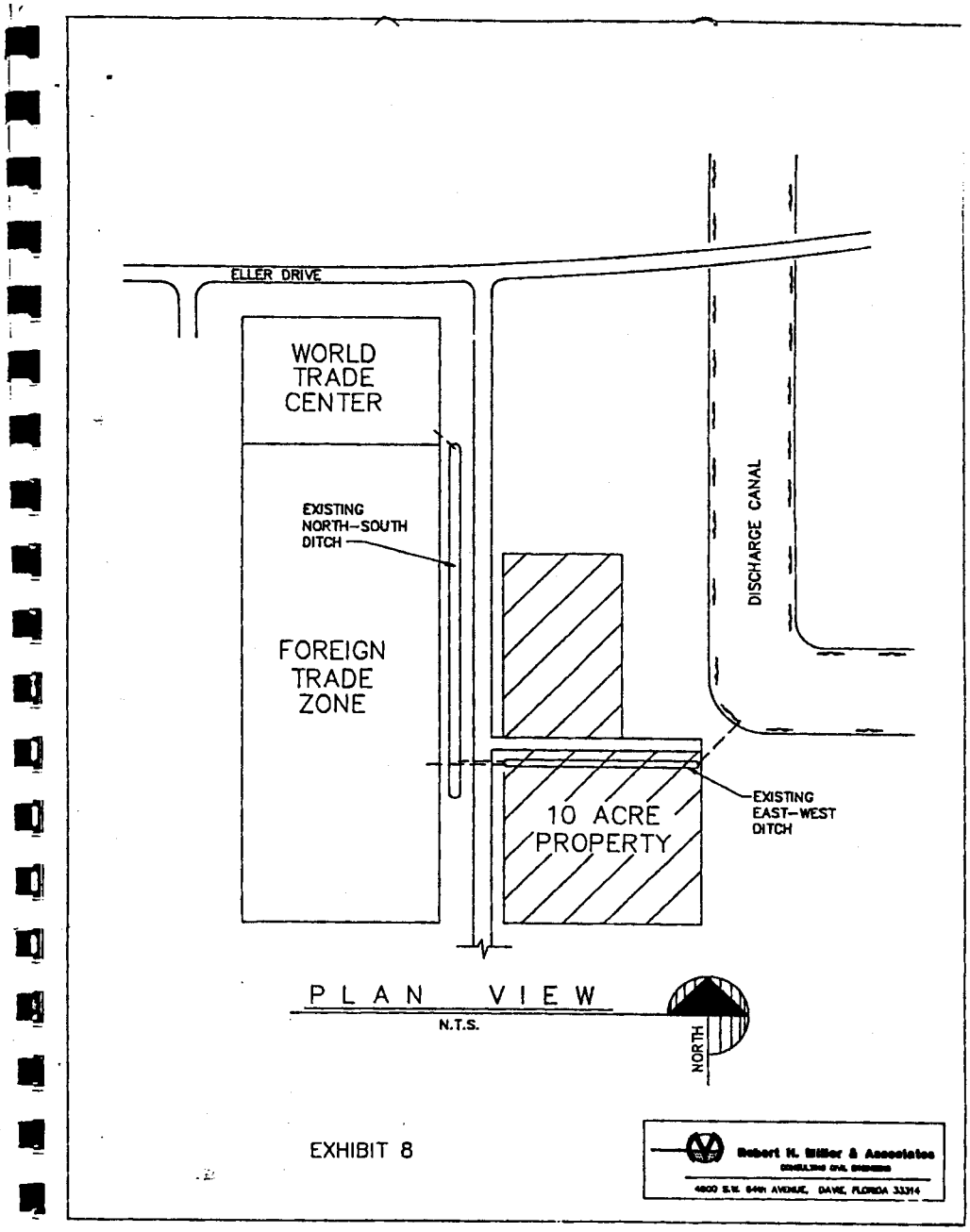


EXHIBIT 8

Robert H. Miller & Associates
CONSULTING CIVIL ENGINEERS
4800 S.W. 64th AVENUE, DAVIE, FLORIDA 33314

APPENDIX 4-E

Water Quality Treatment Calculations

Berth 30-34A Conservation Easement Assessment
Port Everglades
Water Quality Treatment Calculations

1. Existing Drainage Area

1.1 Foreign Trade Zone Drainage Area (DA) =	24.4	ac			
1.2 World Trade Center Drainage Area (DA) =	5.5	ac			
1.3 Total Drainage Area (DA) =	29.9	ac			

2. Required Water Quality Treatment Volume

2.1 First inch of stormwater runoff [DA x (1 in/12 in/ft] =	2.03	ac-ft			

3. Provided Water Quality Treatment Volume

3.1 New N-S Ditch

Average Bottom Elevation =	3.50	ft			
Weir Elevation =	4.84	ft			
Top of Bank Elevation (TOB) =	7.90	ft			
Water Quality Treatment Depth (WQTD) =	1.34	ft			
Total Depth (D) =	4.40	ft			
Bottom Width (BW) =	16.0	ft			
Side Slope (V:H) =	1				
Top Width (TW) =	25	ft			
Water Quality Treatment Cross Sectional Area (WQTA) =	24.12	sq ft			
Total Cross Sectional Area (A) =	79.2	sq ft			
Length (L) =	2,035	ft			
Water Quality Treatment Volume (WQTV) =	49,084	cu ft	=	1.13	ac ft
Total Volume (V) =	161,172	cu ft	=	3.70	ac ft

3.2 New E-W Ditch

Average Bottom Elevation =	3.00	ft			
Weir Elevation =	4.84	ft			
Top of Bank Elevation (TOB) =	6.30	ft			
Water Quality Treatment Depth (WQTD) =	1.84	ft			
Total Depth (D) =	3.30	ft			
Bottom Width (BW) =	80.0	ft			
Side Slope (V:H) =	1				
Top Width (TW) =	87	ft			
Water Quality Treatment Cross Sectional Area (WQTA) =	150.88	sq ft			
Total Cross Sectional Area (A) =	270.6	sq ft			
Length (L) =	525	ft			
Water Quality Treatment Volume (WQTV) =	40,828	cu ft	=	0.94	ac ft
Total Volume (V) =	142,065	cu ft	=	3.26	ac ft

3.3 New N-S and E-W Ditch

Total Water Quality Treatment Volume (WQTV) =	89,912	ac ft	=	2.06	ac ft Acceptable