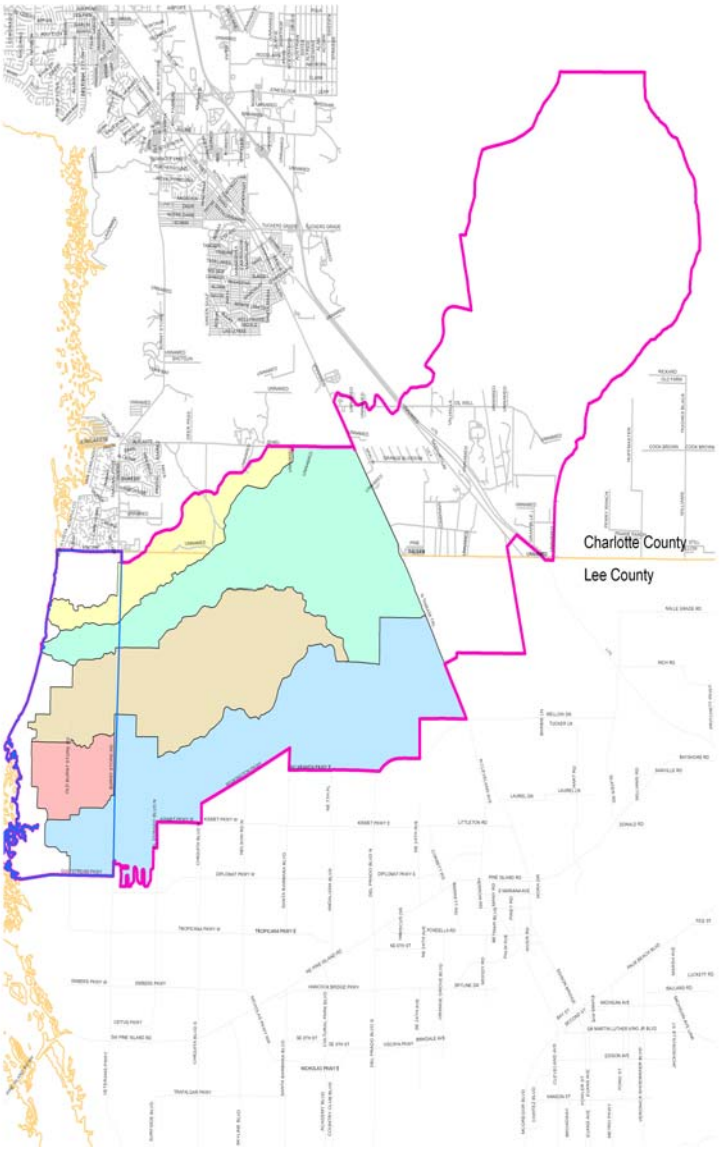
FINAL SUMMARY REPORT
Yucca Pens Hydrologic Restoration Plan
Task 1: Summary Report and Metadata
(Work Order No: 4600000893-WO03)



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1.0 INTRODUCTION/BACKGROUND

The following summary of the background information on the project area was extracted from the statement of work prepared by the South Florida Water Management District (SFWMD or District), which was included in the work order no. 4600000893-WO03.

In the 1950's, almost all of the watershed areas in the South Charlotte, North Lee County and Fred C. Babcock-Cecil M. Webb (Babcock-Webb) Wildlife Management Area (WMA) were drained by sheet flow in a southwesterly or southerly direction. There was no significant development to block this southwesterly and southerly sheet flow. The next 30 years, 1950 – 1980, brought development into these sheet flow areas and significant flooding began to occur. Sheet flow from the Babcock-Webb area of 40 square miles remained unchanged. Topographic changes since the 1980's have further blocked, constricted and concentrated what were formerly sheet flow areas. Expanded development in the study area has exacerbated both constrictions and flooding in these newly developed sheet flow areas. Sheet flows prior to 1975 normally crossed over U.S. 41 near the Charlotte/Lee County line. This was blocked when the west lanes of U.S. 41 were raised in 1975. Sheet flow from the upper reaches of the Gator Slough watershed (Babcock-Webb Area) was concentrated at the 145-ft wide bridge under I-75 near the Charlotte/Lee County line when it was constructed in 1980.

The Yucca Pens Unit consists of 13,242 acres within the Babcock-Webb WMA in both Lee and Charlotte Counties as shown in Figure 1. *A Conceptual Plan for Fred C. Babcock-Cecil M. Webb Wildlife Management Area 2003-2008* (Conceptual Plan) has been developed by the Florida Fish and Wildlife Conservation Commission (FWC) and approved by the Florida Department of Environmental Protection (FDEP). The Conceptual Plan contains resource management goals, objectives and strategies to restore and maintain the area hydrology to natural conditions where feasible. Historic sheet flow to the south has been significantly impeded due to development and diking, resulting in abnormally high water levels that cause degradation to the native upland habitat. The Conceptual Plan strategies specifically include working with the county and state government agencies to restore historical sheet flow to the area and contracting to complete a hydrology study of the Yucca Pens Unit. Additionally, Yucca Pens restoration is a component of the *Tentatively Selected Plan* of the *Southwest Florida Feasibility Study*. The purpose of this project is to conduct a reconnaissance study of the water characteristics of the Yucca Pens Unit in order to identify water management goals as well as available and needed data to make informed water management decisions in the area. Ultimately, the project information will be used to contribute to the net ecosystem benefit in the Cape Coral North Spreader watershed as part of the FDEP Ecosystem Management Agreement Process.

<u>Previous Planning Activities</u>
This area was described in the *Northwest Lee County Surface Water Management Plan*

prepared for Lee County by Boyle Engineering and completed in 2005. The main focus of this study was to develop a Geographic Information System database necessary for surface water management, develop a hydrologic/hydraulic model of the surface water management system, identify issues of concern, and assess existing and future level of service deficiencies for flooding along Burnt Store Road. Water quality modeling was also performed. The data developed in this study should provide a basis for the proposed restoration plan for the Yucca Pens Unit.

In 2004, Johnson Engineering prepared a report for the District entitled *South Charlotte County, North Lee County, Babcock/Webb Surface Water Management Concept Plan* to address flooding concerns in the vicinity of the Babcock-Webb WMA. The recommendations of this report should be considered in the preparation of the restoration plan.

1.1 PROJECT OBJECTIVE

The ultimate goal of this project is to restore historic sheet flow to the Yucca Pens unit. However, the primary objective of this contract (work order no. 4600000893-WO03) is to conduct a reconnaissance study of the water characteristics of the Yucca Pens Unit. This study will assist in making informed decisions to develop a multifunctional water management plan for implementing hydrologic restoration in the Yucca Pens Unit. The project will investigate the potential for restoring the historic outfall to the following systems: 1) Yucca Pen Creek, 2) Durden Creek, 3) Greenwell Branch, 4) Longview Run, and 5) Gator Slough. Runoff to these five systems (watersheds) originates in the Webb WMA and must pass through Charlotte County to reach the outfall in Lee County. A number of entities will be involved in the solution to this restoration including SFWMD, Southwest Florida Water Management District (SWFWMD), Lee and Charlotte counties specifically Lee County Natural Resources Division, Lee County Department of Transportation, Charlotte County Public Works Department, Charlotte County Growth Management Department, as well as the City of Cape Coral, FWC, FDEP, Florida Department of Transportation (FDOT), Charlotte Harbor Preserve State Park, and the Seminole Gulf Railway. Successful implementation of the recommendations of this plan will involve cooperation among all involved. A Yucca Pens Interagency Deliverable Review Team will be assembled by the District.

Restoration of the historic flow will reduce the amount of water that has been redirected to Gator Slough and lessen the impact of damaging point discharges through the Gator Slough Canal. The multifunctional water management plan will thus contribute to the net ecosystem benefit in the Cape Coral North Spreader watershed for the Ecosystem Management Agreement Process. A desired outcome of the project is that the Florida Fish and Wildlife Conservation Commission will implement the recommended hydrologic restoration plan for the Yucca Pens Unit in phases.

The restoration plan will be designed to meet the following objectives:

1. Restoration of sheet flow across the Yucca Pens unit
2. Provide outfall from Babcock-Webb WMA to the Yucca Pens unit – potential flow ways include Oil Well Road at I-75 and Harper & McNew Property at I-75
3. Investigate ways to allow water from the U.S. 41 ditch to sheet flow across Yucca Pens unit
4. Restoration of the ecological integrity of the ecosystem
5. Improvement of water retention and aquifer recharge
6. Restoration of flow severed by previous construction
7. Restoration of historic outfall to Charlotte Harbor

1.2 SCOPE OF WORK

The work in this project will consist of the reconnaissance study of the water characteristics in the Yucca Pens unit; a conceptual planning level evaluation of the issues relating to water supply, flood protection, water quality and natural systems; and development of a multifunctional water management plan for hydrologic restoration of the Yucca Pens unit. The multifunctional water management plan will include information on required permits for restoration. The project shall include field verification of the water characteristics as well as relevant research and a compilation and synthesis of existing information on hydrologic conditions within the Yucca Pens study area.

This study is a master planning level study, and is not intended to serve as an engineering study. All references to design during this study indicate conceptual planning level design without details. Implementation of any design recommendation developed during this study will require engineering analysis and design, which is beyond the scope of this contract.

BPC Group Inc. (BPC) has completed Task 1 of the work order issued by the District under Work Order No: 4600000893-WO03. The current work order is divided into several technical and deliverable tasks and sub-tasks as summarized below. Task 2 will be developed at the completion of the Task 1 activities.

Task 1: Prepare Summary Report and Metadata

Sub-Task 1.1: Kick-Off Meeting

The scope of this subtask included attending the kickoff meeting with the District staff with primary focus on a) clarifying the project requirements along with establishing lines of communication and project schedule, b) receive all relevant data collected and assembled by the District, and c) receive a geodatabase and the base map for the project prepared by the District. The meeting was held on April 16, 2009 at the office of the

FWC in Punta Gorda. BPC has prepared the meeting minutes, and is included in Appendix A of this report.

Sub-Task 1.2: Literature/Data Review
The scope of this sub-task included brief reviews of all documents, reports, and other relevant data provided by the District with focus on gaining better understanding of the challenges facing the Yucca Pens unit with respect to the long term plan requirements and the goal to restore historic sheet flow to the area.

Sub-Task 1.3: Prepare Summary Report and Metadata
This includes preparing and submitting the draft narrative description for the study area and metadata for the project base map within 4 weeks from the date of notice to proceed (NTP).

Task 2: Complete Reconnaissance Study of Yucca Pens Study Area & Technical Memorandum

Sub-Task 2.1: Update Site Specific Data
This includes developing the historic drainage pattern in the study area as well as conducting a limited visual field verification of hydrologic data, infrastructures, and drainage patterns including limited GPS survey (not at sub-meter level and not conducted by a licensed surveyor) as appropriate. The scope also includes a complete water budget analysis solely based on the results from the *Northwest Lee County Surface Water Management Plan* report and other studies to build a spreadsheet model to analyze outfall restoration.

Sub-Task 2.2: Address Water Quality Issues
The scope of this subtask includes customizing the existing ERD spreadsheet model or substitute with a more appropriate basin scale water quality model for evaluation of impacts from pollutants specific to the study area and to determine the efficiencies of potential BMPs. This analysis will be solely based on the data provided by the District.

Sub-Task 2.3: Prepare Draft Technical Memorandum for Multifunctional Water Management Plan
This includes preparing and submitting the 95% complete draft technical memorandum along with the field reconnaissance survey and analytical calculation results for the study area within four months from the date of NTP. The final technical memorandum shall incorporate the appropriate and applicable review comments from the District and the Interagency Deliverable Review Team and be submitted within two weeks from receiving the comments.

This report presents the findings of Task 1. A draft copy of this Task 1 report dated July 1, 2009 was submitted to the Interagency Deliverable Review Team (IDRT) members for their review. The comments from the IDRT members along with the response to these comments are presented in Appendix D. The Task 2 report will be prepared at a later date.

2.0 REVIEW SOURCES

The District provided copies of a number of reports, documents, GIS coverages, and data sources for our review. These sources of information are listed below.

2.1 REPORTS AND DOCUMENTS

- Northwest Lee County Surface Water Management Plan, March 2005. Prepared for Lee County; prepared by Boyle Engineering Corporation.
- Water Management Study: Cecil M. Webb Wildlife Management Area, June 1983. Prepared for the Florida Game and Fresh Water Fish Commission; prepared by Johnson Engineering, Inc.
- Lee County Interim Surface Water Management Master Plan, May 1990. Prepared for the Lee County Board of County Commissioners; prepared by Johnson Engineering. Extracted summary sections for Durden Creek Watershed, Greenwell Branch Watershed, Longview Run Watershed, Yucca Pen Creek Watershed, and Gator Slough Watershed were provided by South Florida Water Management District, Fort Myers, Florida.
- Gator Slough Stormwater Model, Phase 2: Model Construction and Calibration Report, July 2001. Prepared by Southern DataStream, Inc.; prepared for City of Cape Coral.
- Matlacha Pass Hydrologic Restoration Project - Phase 1, Staff Report and Addendum, March 2007. Prepared by South Florida Water Management District in response to the Permit Application 060301-5; Permittee: Lee County.
- North Fort Myers Drainage Restoration Project, Staff Report, February 2006. Prepared by South Florida Water Management District in response to the Permit Application 011130-16; Permittee: Lee County.
- North Fort Myers Drainage Restoration Project, General and Special Conditions, February 2006, July 2008, and April 2009. Prepared by South Florida Water Management District in response to the Permit Application 011130-16, 070529-14, and 090206-22; Permittee: Lee County.
- Surface Water Management Conceptual Plan: South Charlotte County, North Lee County, and Babcock/Webb. 2003. Prepared for South Florida Water Management District; prepared by Johnson Engineering.
- Southwest Florida Feasibility Study PDT Site Visit Notes, February 2009. Prepared for the Southwest Florida Feasibility Study Team; prepared by Everglades Partners Joint Venture.
- Historical (1977) Drainage Maps for Part of Lee County and Tuckers Grade.

2.2 GIS COVERAGES

- Raster Maps/Files
  - 2007/2008 Aerial Maps for Charlotte and Lee Counties
- Shapefiles
  - Yucca Pen Unit Boundary
  - Sub-basin Boundaries (NW Lee Model)
  - County Owned Lands for Lee County
  - State Owned Lands for Charlotte and Lee Counties
  - County Boundaries
  - Major Roads (including roads and trails, elevated major roads and unimproved roads for Charlotte County)
  - 2004/2005 Land Use and Land Cover Maps for Charlotte and Lee Counties
  - 2004 Soils Maps
  - Processed 2008 LiDAR Maps for Charlotte and Lee Counties
  - 1-, 2- and 10-Foot Topographic Contour Maps for Charlotte and Lee Counties
  - Flow ways (NW Lee Model and Lee County Historical Flowways)
  - Culverts and Bridges (1977 FDOT Plans, Google Earth, and Burnt Store Road, Seminole Gulf Railway)
  - Weirs, Drop Structures, Pipes, Canals, and Floodplains (partial information from NW Lee Model)

2.3 OTHER AVAILABLE DATA

- Culvert Information for the Project Area including updated culvert information from 1977 Plans.
- FLUCCS Wetland Categories Information used by SFWMD.
- Daily Mean Discharge data used in Gator Slough Stormwater Model for: August and September 1985; July and September 1987; August 1989; September 1996; July, August, and December 1997; June and August 1999.
- Cumulative 15-minute rainfall values used in Gator Slough Stormwater Model for: September 1996; August 1997; June and August 1999.
- Model Input Files for Gator Slough Stormwater Model (XP-SWMM, version 3.2).
- Model Input Files for existing Condition, Future Condition, and Proposed Condition for Northwest Lee County Model (ICPR, version 2.2).

3.0 SUMMARY AND DISCUSSION OF REVIEW RESULTS

A kickoff meeting was held on April 16, 2009 at the office of the FWC in Punta Gorda, Florida. The primary focus of the meeting was to receive: a) clarification on the project requirements along with establishing lines of communication and project schedule, b) all relevant data collected and assembled by the District, and c) a geodatabase and the base map for the project prepared by the District. BPC has prepared the meeting summary, and it is included in Appendix A.

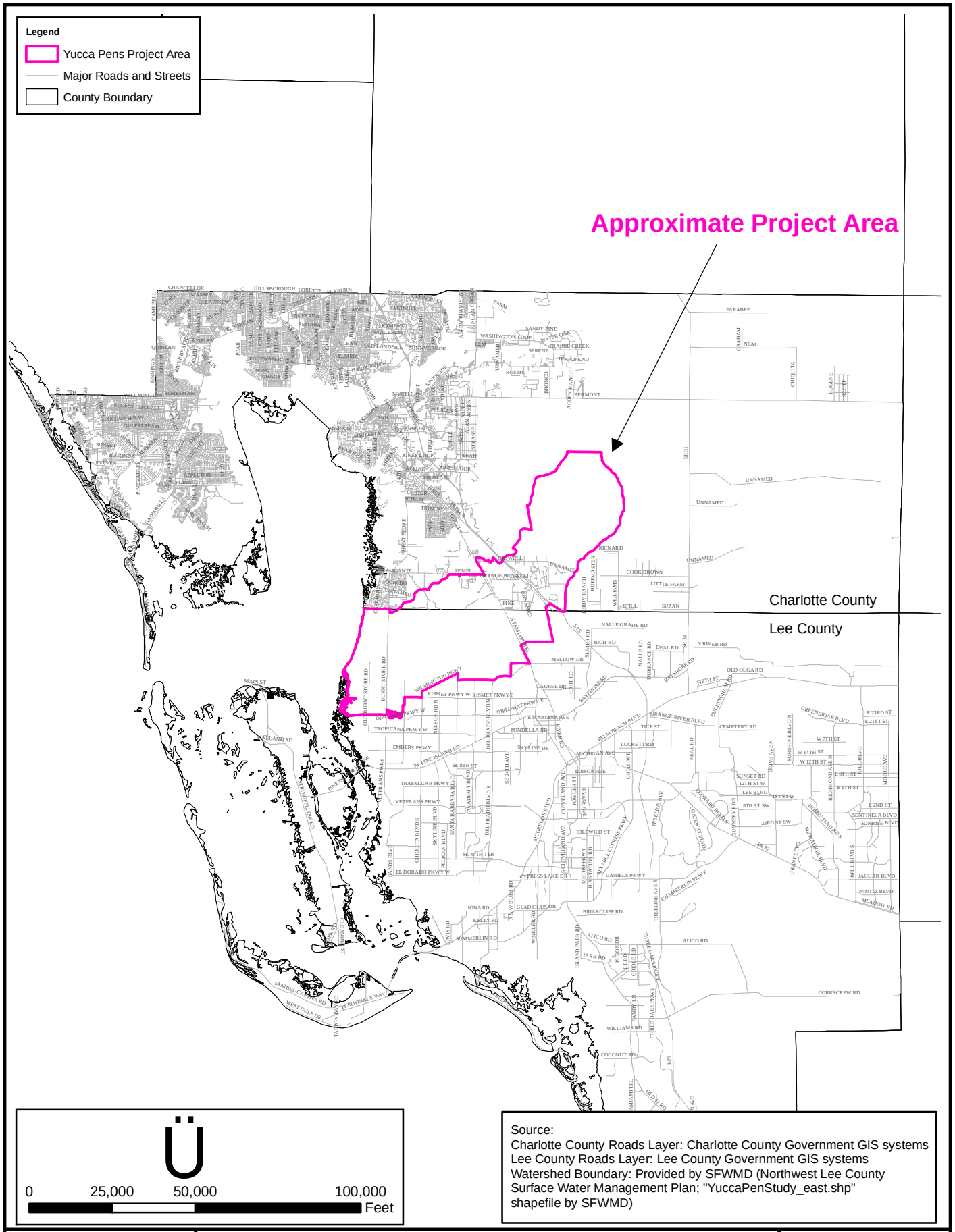
BPC reviewed all available documents and data to become familiar with the project extent and needs, and to gain better understanding of the challenges facing the Yucca Pens project area with respect to the long term plan requirements and the goal to restore historic sheet flow within the project area. Following is a brief summary of the data reviewed for this project. Further details on the review of each of the individual documents and reports are given in Appendix B.

3.1 PROJECT AREA

The Yucca Pens Hydrologic Restoration project area includes the five watersheds: Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview Run, and Gator Slough. Geographically, the Yucca Pens project area extends from Babcock-Webb WMA in Charlotte County along the north and east to Charlotte Harbor along the west and Gator Slough canal on the south. The approximate extent of the project area is shown on Figure 3-1. The road maps were downloaded from the county websites of Lee and Charlotte counties. The study area consists of approximately 52.8 square miles west of US 41 and about 44.8 square miles east of US 41. The approximate Yucca Pens project boundary shown on Figure 3-1 was generated by combining watershed boundary shapefiles provided by the District. A goal of this study is to refine these boundaries through analysis of data from previous studies and limited field verification.

3.2 WATERSHED BOUNDARIES

The Yucca Pens project area includes five watersheds as indicated earlier in Section 3.1. The shapefiles for the individual watersheds were provided by the District. As indicated in Section 2.2, these shapefiles were obtained from the NW Lee County Surface Water Management Plan study. These boundaries were combined to generate the Yucca Pens project area boundary. Figure 3-2 shows the individual watershed boundaries and the total Yucca Pens project area boundary. BPC did not perform any refinement to the watershed boundaries during this task. The refinement to these boundaries is anticipated only after limited field verification is completed during Task 2. Based on currently available information, the following table (Table 3-1) summarizes the total area of each watershed. These watersheds are shown on Figure 3-2.



Approximate Extent of Project Area

Figure 3-1

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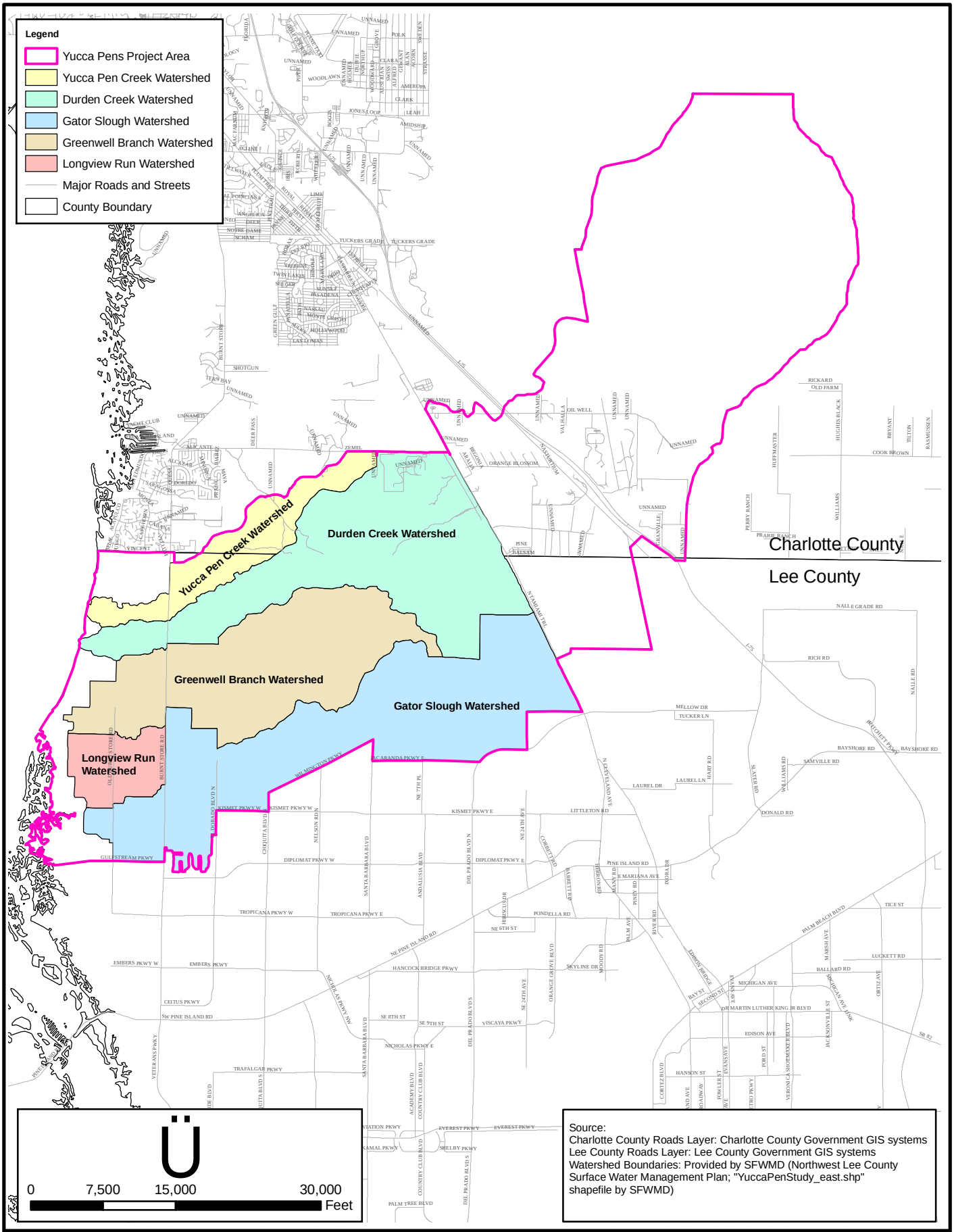

Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)

Approximate Watershed Boundaries

Figure 3-2

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Table 3-1 Watershed Acreages in Yucca Pens Project Area

Watershed	Total Area (acre)	Remarks
Yucca Pen Creek	2,618	Figure 3-2; confirmed with NW Lee Model
Durden Creek	9,050	Figure 3-2; confirmed with NW Lee Model
Greenwell Branch	7,339	Figure 3-2; confirmed with NW Lee Model
Longview Run	1,567	Figure 3-2; confirmed with NW Lee Model
Gator Slough (west segment)	10,471	Figure 3-2; confirmed with NW Lee Model
Gator Slough (east segment)	28,688	Figure 3-2; qualitatively with Gator Slough Model

3.3 TOPOGRAPHY

The project area extends to both sides of I-75 and US 41. These major highways impede the historic natural flow of stormwater from east to west, and the flow from one side of the highways to the other is controlled through engineered control structures (culverts and/or bridges). As summarized in the existing study reports, historic sheet flow to the south has been significantly impeded due to development and diking, resulting in abnormally concentrated flows.

The District provided raster datasets for the digital elevation models (DEMs) with cell sizes of 5, 10, 25, 50, and 100 feet, which were processed from the recently obtained LiDAR data. The Lee County and portions of the Charlotte County LiDAR data were obtained from the 2007 Coastal LiDAR Project implemented by the Florida Division of Emergency Management and cooperating agencies. Most of the LiDAR data from Charlotte County was obtained from the SWFWMD's ongoing LiDAR Data Collection Program. The District also provided the 1-, 2-, and 5-foot contour shape files generated from a smoothed version of the 10-foot DEM (i.e., DEM with cell size of 10 feet). The DEM was smoothed by running a focal-mean process, which removed the smallest-scale noise while retaining the essential shape and resolution. Then 1-foot contours were calculated using the spatial-analyst software. Arcs shorter than 100 feet in length were removed, thus simplifying the output and removing much of the clutter caused by very small bumps and depressions. The 2-foot and 5-foot contours were indexed from the 1-foot contours.

The contour maps are necessary to refine the watershed boundaries in Task 2. Figure 3-3 presents the color ramp visualization of the topographic variation within the project area at 2-foot contour intervals. The contour map is useful for visualization and qualitative evaluation. The hill-shade visualization of the topographic relief for the project area is shown on Figure 3-4. Figures 3-3 and 3-4 were developed from the contour shape files and 10-foot DEM raster dataset provided by the District. As can be seen from these figures, the general topography of the Yucca Pens project area is sloping southwest except for impediments resulting from the highways and major roads, and there is very little relief west of the Burnt Store Road.

3.4 WATERSHED CHARACTERISTICS

The watershed characteristics include, but are not limited to land use and land cover (LULC), delineation of wetlands, locations and specifications of hydraulic structures (such as culverts and bridges), specifications of flow conveyance systems (such as canals and flow ways), hydrologic conditions of the soils, and aerials. The hydrologic characteristics of significance would also include water budget, flow and rainfall, and water quality evaluation along with supporting computational details on BMPs.

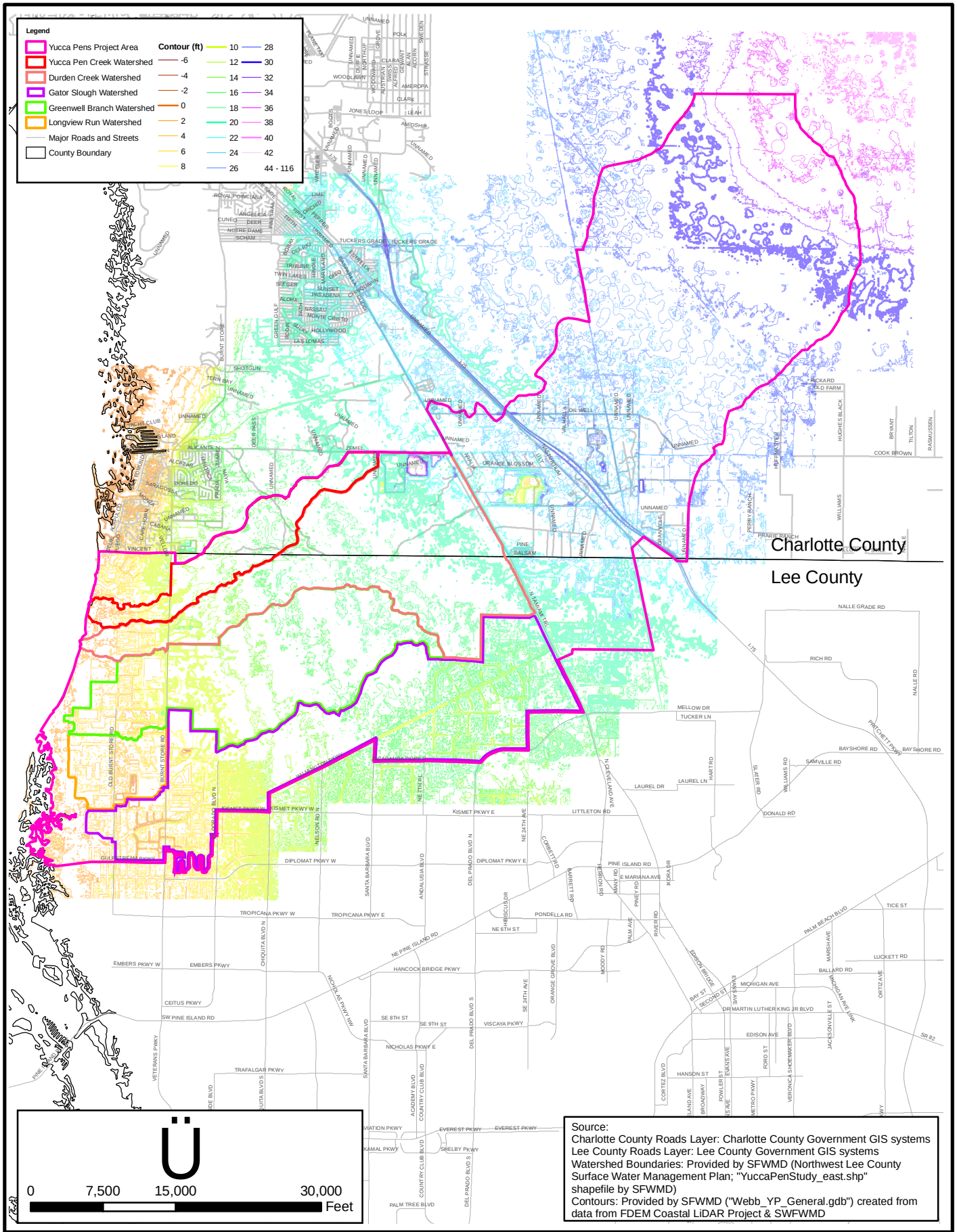
3.4.1 Land Use and Aerial Maps

Figure 3-5 presents the 2004/2005 LULC conditions for the project area, which includes both the Lee and Charlotte counties. The raster LULC maps for 2004/2005 for the project area were provided by the District. The dual year designation for these maps represents that mapping of the entire project area was not completed in one calendar year. The three predominant land use classes in Yucca Pens project area include the upland forestland (pine flatwoods), rangeland (palmetto prairies, dry prairies), and wetlands (wetland forest-hydric pine, freshwater marshes). The four predominant land use classes west of Burnt Store Road include the rangeland (dry prairies), upland forestland (pine flatwoods), wetlands (mangrove swamps), and water (channelized waterways).

Figure 3-6 presents the 2007/2008 aerial map for the project area. The raster aerial maps for 2007/2008 for the project area were provided by the District. These raster maps were obtained from the Lee and Charlotte counties. The dual year designation for these maps represents that mapping of the entire project area was not completed in one calendar year.

3.4.2 Wetlands

A current detailed field survey of the wetlands is not available for the project area. Instead, Figure 3-7 presents the wetlands category map for the project area. For the purpose of this study, the wetlands category map was generated from the LULC data reflecting the Florida Land Use and Cover Classification System (FLUCCS) codes identified by the District as representative of the wetlands. The FLUCCS codes identified for wetlands were grouped into three categories, and each category as a whole is represented in the wetland category map (Figure 3-7). The various categories are defined below.



Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
Contours: Provided by SFWMD ("Webb_YP_General.gdb") created from data from FDEM Coastal LiDAR Project & SWFWMD

Topographic Variation (2-foot Contour Interval)

Figure 3-3

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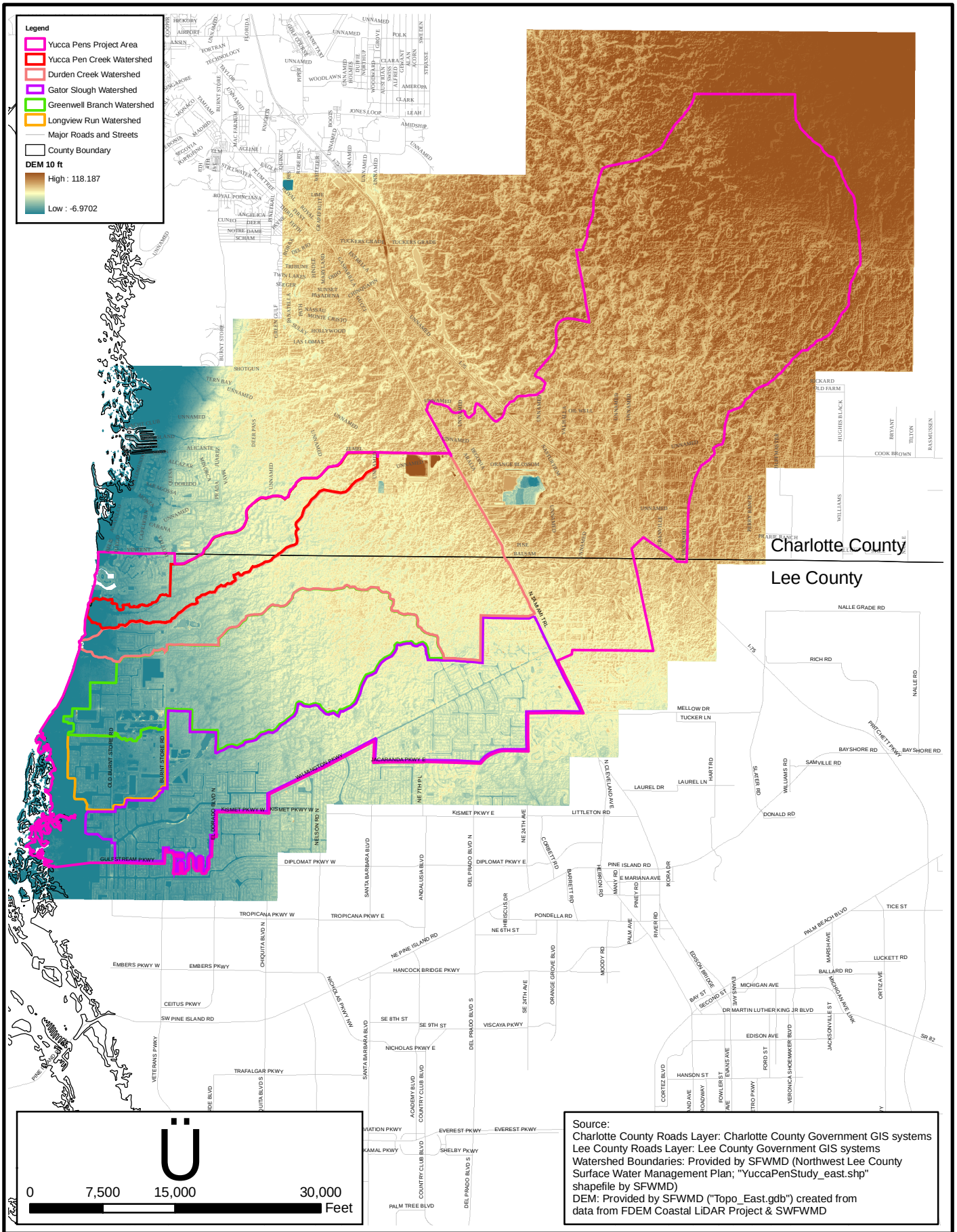

Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
DEM: Provided by SFWMD ("Topo_East.gdb") created from data from FDEM Coastal LiDAR Project & SWFWMD

Hill-Shade Visualization of 10-foot DEM

Figure 3-4

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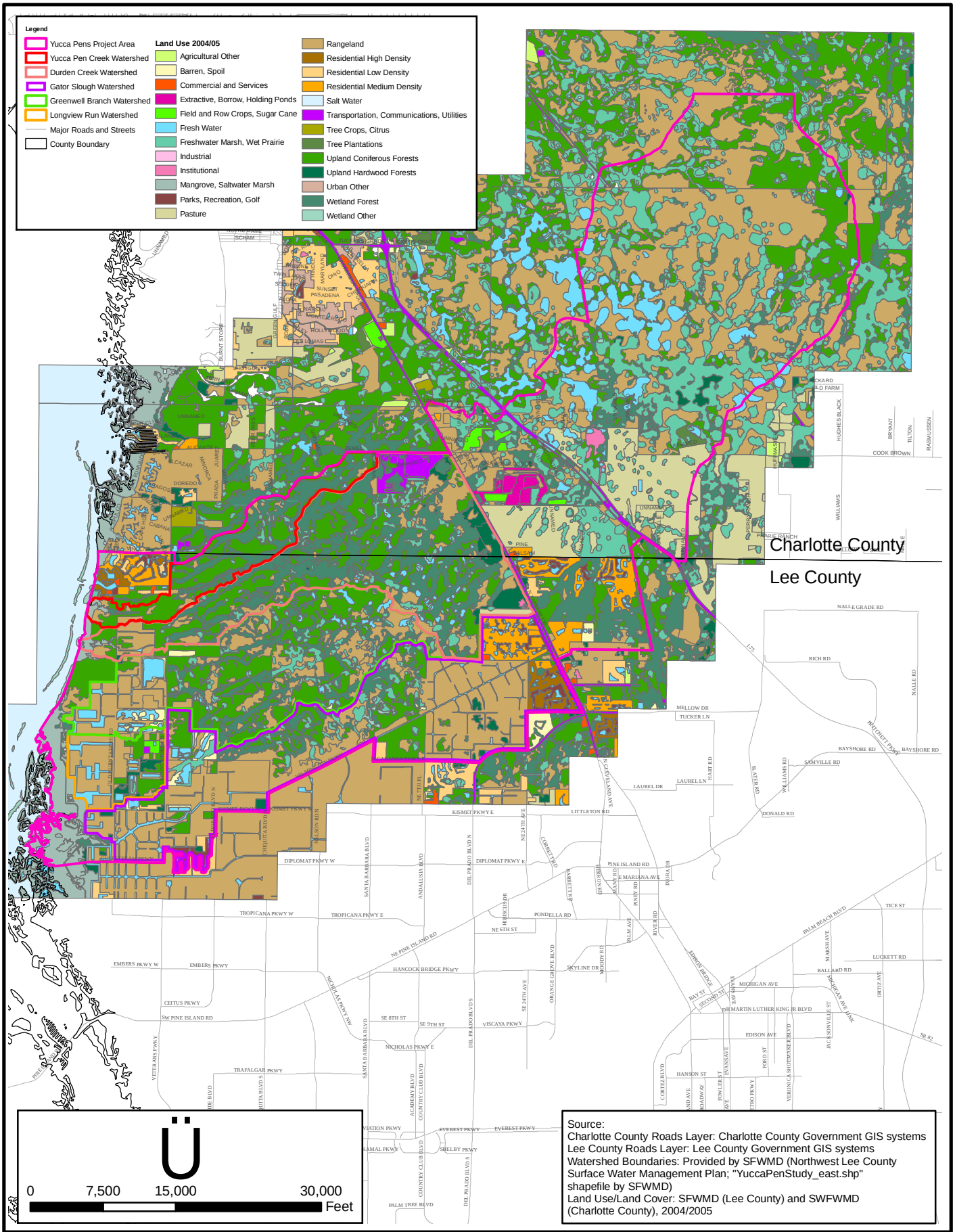

Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
Land Use/Land Cover: SFWMD (Lee County) and SWFWMD (Charlotte County), 2004/2005

2004/2005 Land Use/Land Cover Map

Figure 3-5

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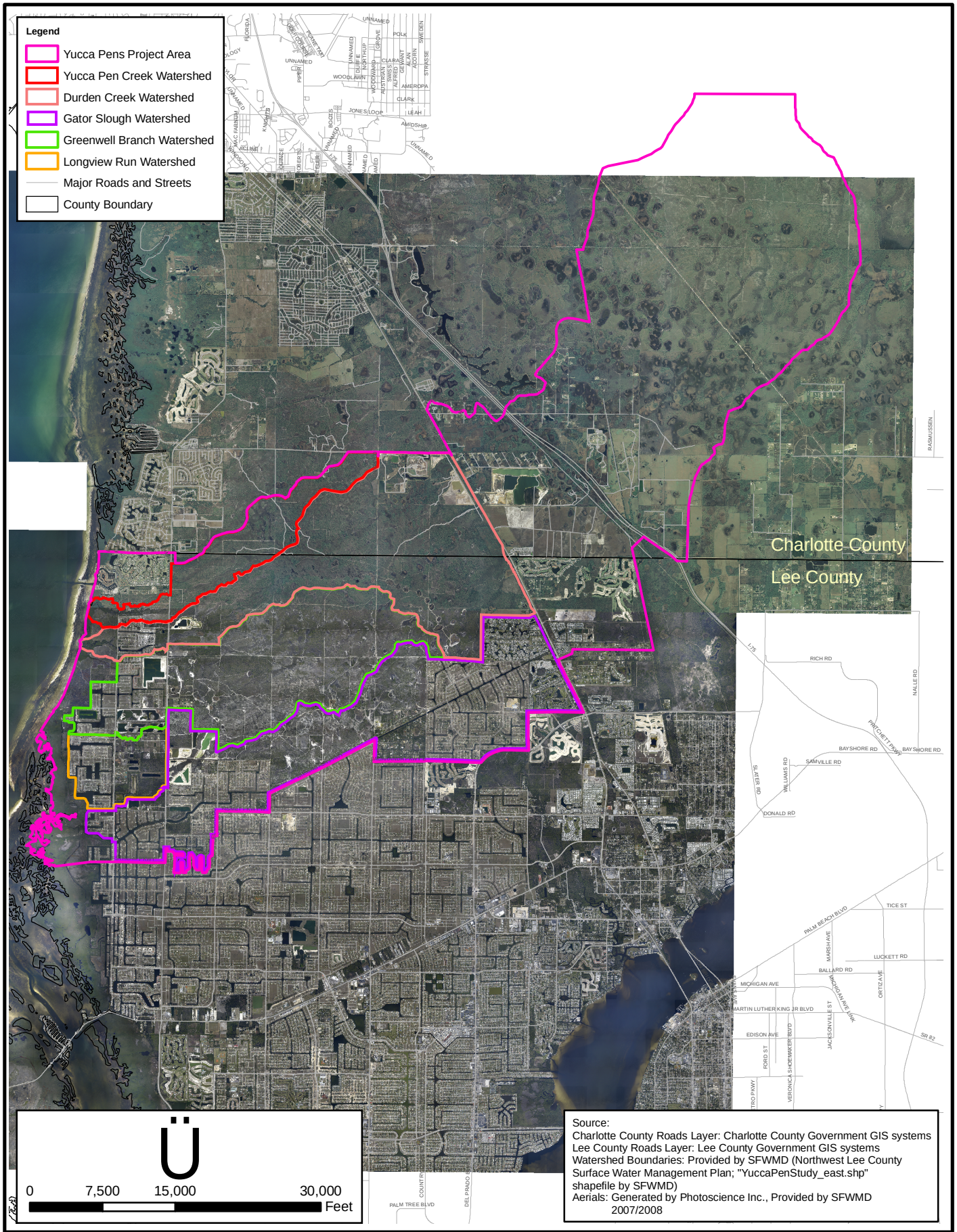

2007/2008 Aerial Map

Figure 3-6

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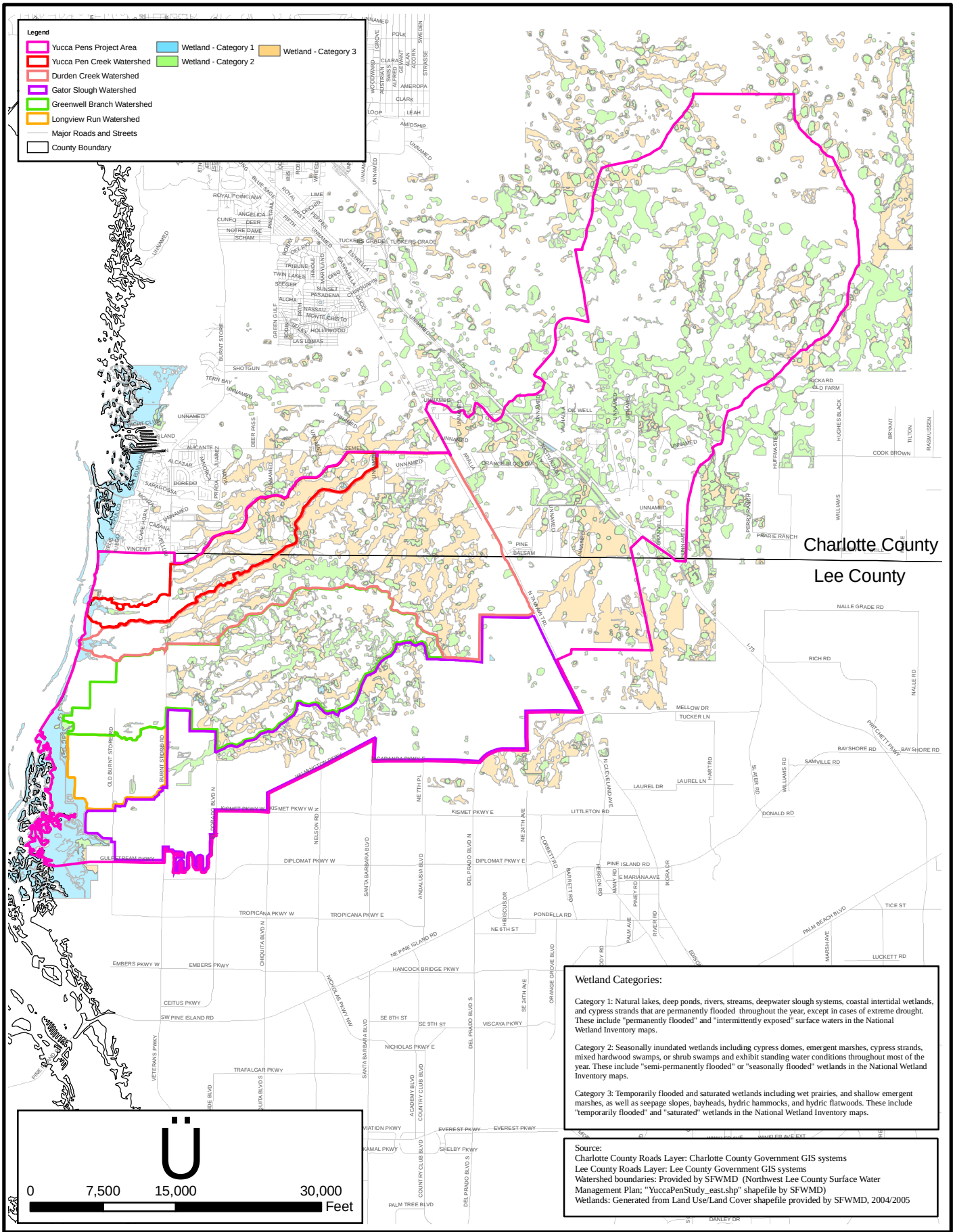

Wetland Categories Map

Figure 3-7

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- Category 1: FLUCCS Codes 5100, 5102, 5103, 5200, 5430, 5600, 6120, 6420, 6440, and 6510 representing natural lakes, deep ponds, rivers, streams, deep water slough systems, coastal intertidal wetlands, and cypress strands that are permanently flooded throughout the year except in cases of extreme droughts. These features primarily represent permanently flooded and intermittently exposed surface waters in the National Wetland Inventory maps.

- Category 2: FLUCCS Codes 6170, 6172, 6180, 6210, 6215, 6216, 6410, 6411, and 6412 representing seasonally inundated wetlands including cypress domes, emergent marshes, cypress strands, mixed hardwood swamps, or shrub swamps and exhibit standing water conditions throughout most of the year. These features primarily represent semi-permanently flooded or seasonally flooded wetlands in the National Wetland Inventory maps.

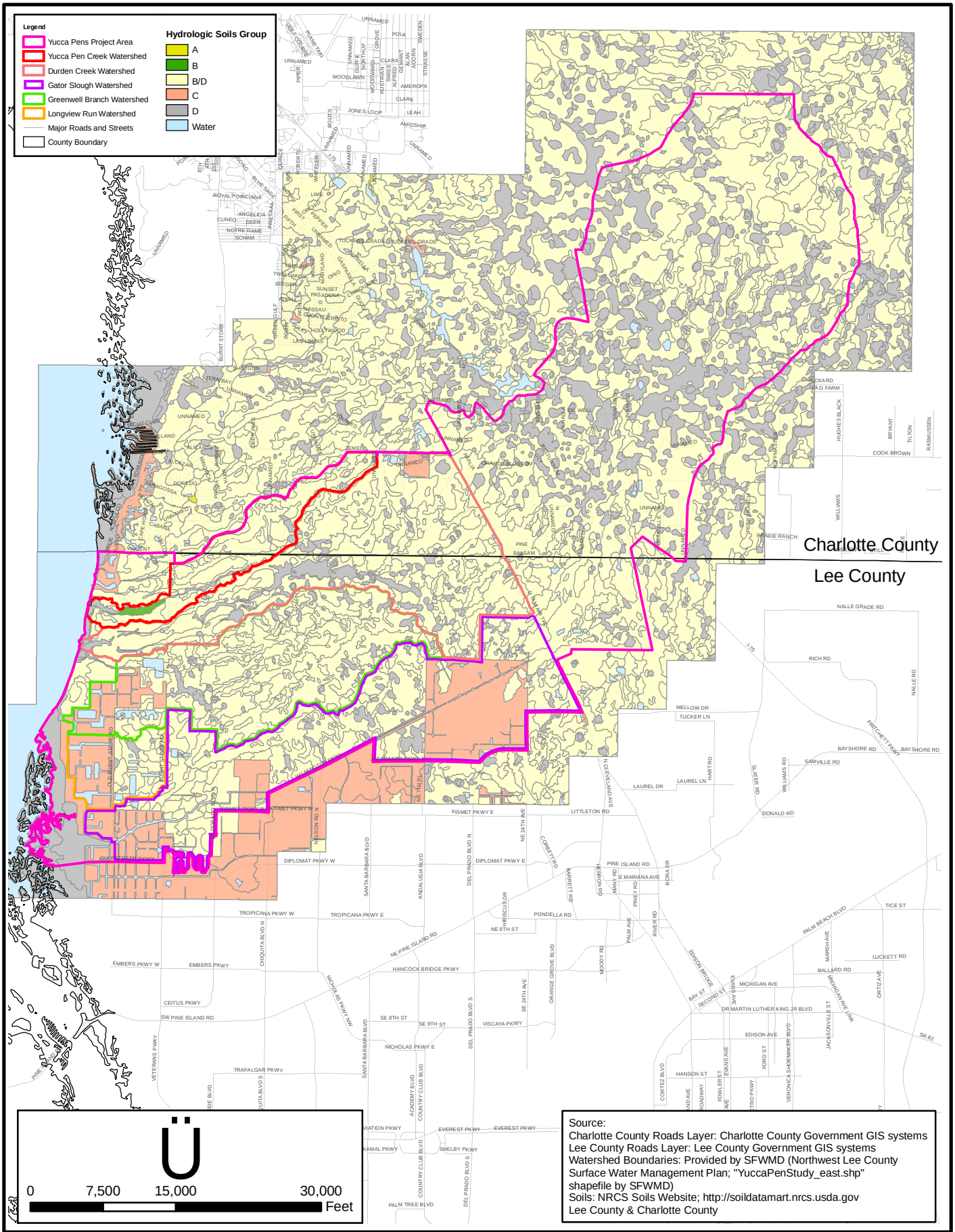
- Category 3: FLUCCS Codes 6110, 6111, 6191, 6240, 6250, 6260, and 6430 representing temporarily flooded and saturated wetlands including wet prairies and shallow emergent marshes as well as seepage slopes, bayheads, hydric hammocks, and hydric flatwoods. These features primarily represent temporarily flooded and saturated wetlands in the National Wetland Inventory maps.

3.4.3 NRCS Soils

Figure 3-8 presents the NRCS soils conditions categorized by hydrologic group. As can be seen from this figure, the predominant hydrologic soil group designation is B/D. The first soil group in the dual designation of hydrologic soil group denotes the drained condition and the second designation denotes the undrained condition. For example, the B/D designation indicates moderate infiltration rate (low runoff potential) of the soils under drained condition, and very slow infiltration rate (high runoff potential) under undrained conditions. Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted, and Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water. The hydrologic soil conditions will be useful in developing the hydrologic restoration plan in Task 2.

3.4.4 Hydraulic Structures

Figure 3-9a presents the locations of the culverts and bridges that were provided by the District. The District provided spreadsheets containing the structures information obtained from the Northwest Lee County Surface Water Management Plan Report, FDOT, and the Seminole Gulf Railway. BPC synthesized the information, regenerated a spreadsheet to make the information useful for this study, and then imported as a GIS layer as shown on Figure 3-9a. These structures include the culverts and bridges. Based on the review of available documents, there are a number of key bridges that control the flow ways across major highways and roads.



Source:
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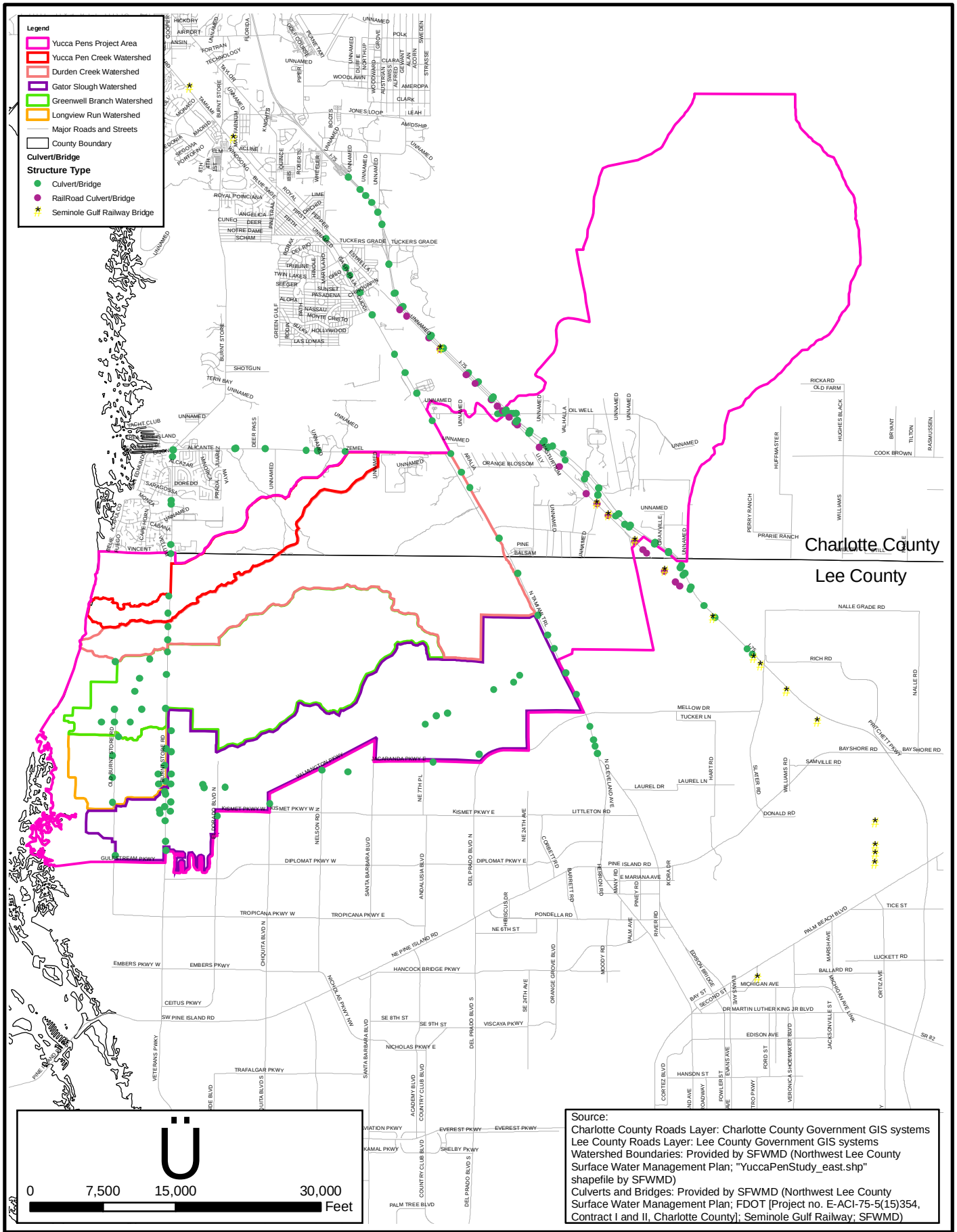
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
Soils: NRCS Soils Website; http://soildatamart.nrcs.usda.gov
Lee County & Charlotte County

NRCS Soils Map

Figure 3-8

08006.02A



Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
Culverts and Bridges: Provided by SFWMD (Northwest Lee County Surface Water Management Plan; FDOT [Project no. E-ACI-75-5(15)354, Contract I and II, Charlotte County]; Seminole Gulf Railway; SFWMD)

Hydraulic Structures Location: Culverts and Bridges

Figure 3-9a

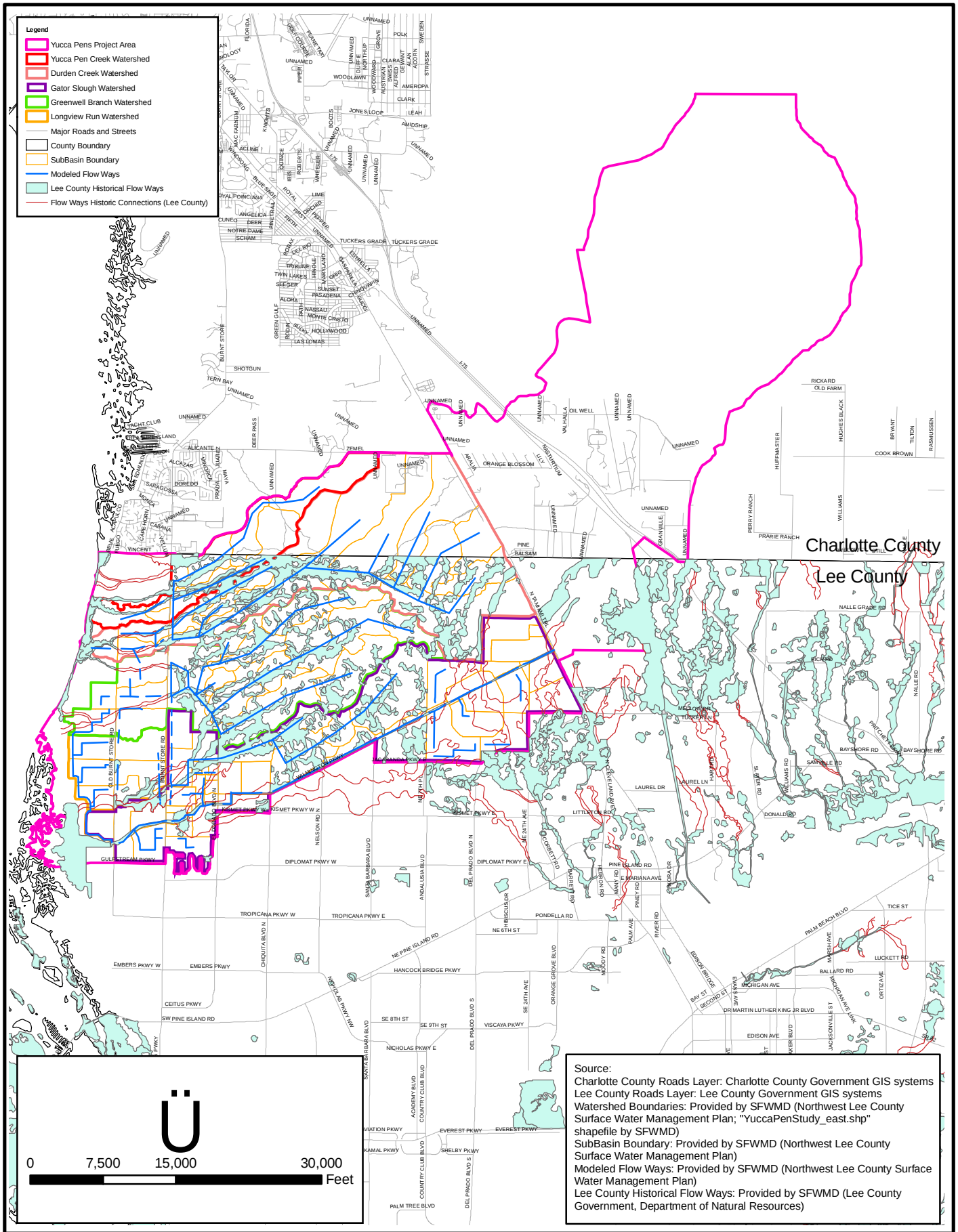
08006.02A

The locations of the modeled flow ways and weirs were identified from the ICPR model for the NW Lee County project. Figure 3-9b presents locations of the modeled flow ways included in the ICPR model for the NW Lee County project. Figure 3-9b also presents the Lee County Historical flow ways. Figure 3-9c presents locations of the modeled weirs and drop structures included in the ICPR model for the NW Lee County project. The shape files used to develop the Figures 3-9b and 3-9c were provided by the District. These shape files were created for the Northwest Lee County Surface Water Management Plan Report by Boyle Engineering. Based on our experience on hydraulic and hydrologic modeling of watersheds, some of these structures are likely to be physically non-existent (used only in modeling the hydraulic conveyance system). These will be confirmed during limited field verification activities in Task 2 of this study.

3.4.5 Water Budget

The water budget analysis of inflow and outflow for the project area is not available. The scope of this study indicates that the water budget analysis for the project area should be based on the results from previous studies. However, the previous studies as documented in Section 2 are incompatible to one another. Thus, completing this task as requested would require further analysis beyond the scope of this project. For example, the water budget for the Northwest Lee County project was completed for a 25-year, 72-hour design storm event, based on the model simulation, and included only the western portion of the Yucca Pens project area. The Lee County Interim Surface Water Management Master Plan presented water budget analysis only for the Gator Slough Proposed alternative, and did not extend to the current project area. The Gator Slough model report included SWMM model simulated mass balance for the total area, was not completed for individual watersheds, and did not extend to the current project area. All other previous studies did not include water budget analyses.

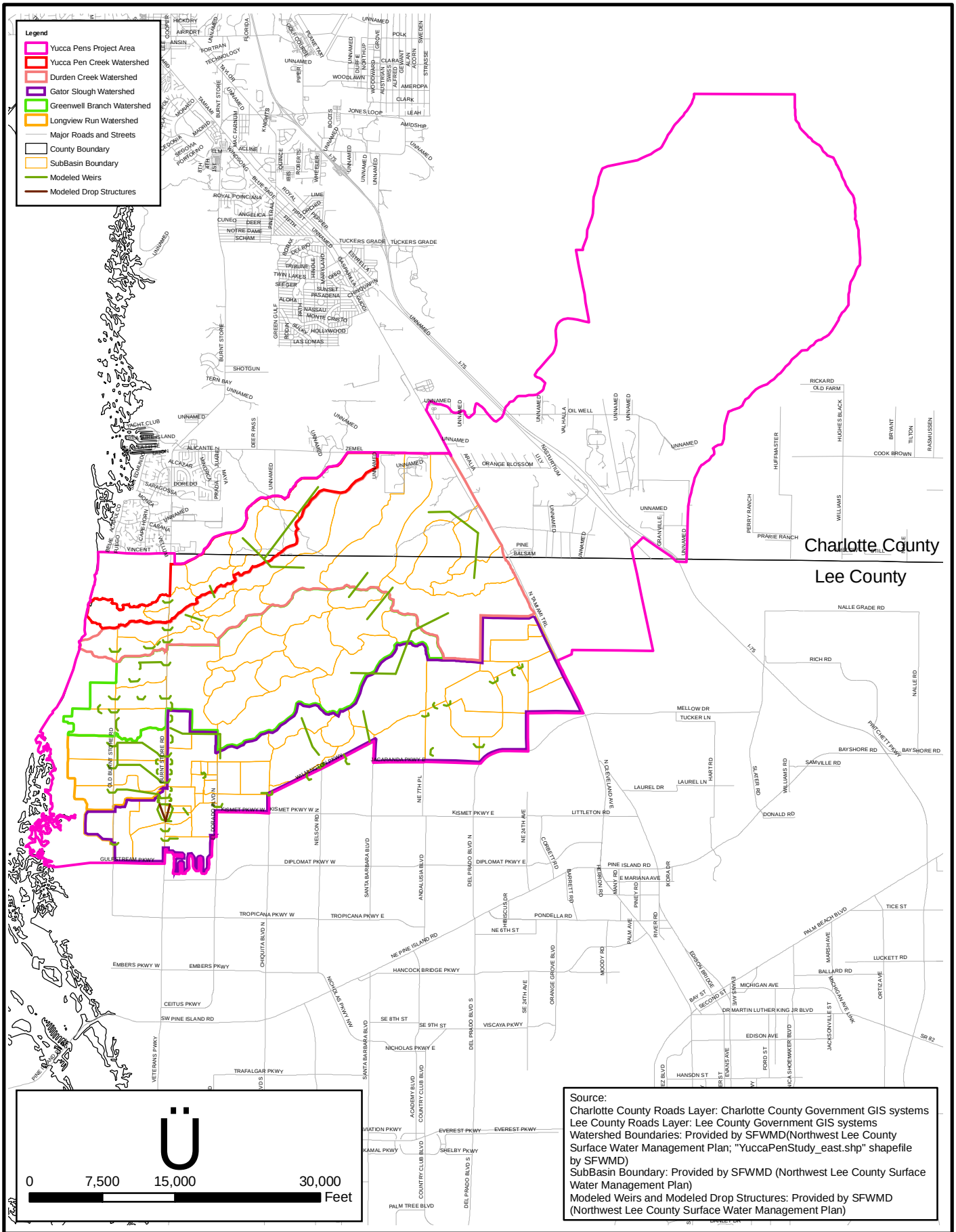
The water budget analysis for this study area will be based on simple balance of inflows and outflows to the watersheds. Some of the water budget components from the NW Lee County report, such as rainfalls and net infiltrations may be used, if determined appropriate. The current study will be based on analytical techniques using spreadsheet formulation or simplified computer modeling at the watershed level, while the NW Lee County report was based on a computer simulation model at sub-watershed level. The appropriateness of the water budget components for this study will be evaluated during Task 2.



Hydraulic Structures Location Map: Flow Ways

Figure 3-9b

08006.02A



Source:
Charlotte County Roads Layer: Charlotte County Government GIS systems
Lee County Roads Layer: Lee County Government GIS systems
Watershed Boundaries: Provided by SFWMD(Northwest Lee County Surface Water Management Plan; "YuccaPenStudy_east.shp" shapefile by SFWMD)
SubBasin Boundary: Provided by SFWMD (Northwest Lee County Surface Water Management Plan)
Modeled Weirs and Modeled Drop Structures: Provided by SFWMD (Northwest Lee County Surface Water Management Plan)

Hydraulic Structures Location Map: Modeled Weirs and Modeled Drop Structures

Figure 3-9c

08006.02A

3.4.6 Water Quality

At the time of developing the scope of work, it was contemplated to update the ERD model documented in the NW Lee County report. Subsequently, the FDEP released the list of impaired waters on May 19, 2009, which includes the Gator Slough Canal located within the project area. Chlorophyll–a and BOD were the parameters of concern requiring TMDL criteria in the Gator Slough canal. Considering these developments, BPC recommends the use of WMM model, using the land use categories pertinent to the project area, to perform the water quality analysis for this study. The FDEP has used this model for several TMDL studies in the state. The water quality analysis is expected to be completed in Task 2.

3.5 MODEL RELATED INFORMATION

The ICPR (version 2.2) model input and output files to execute the existing condition, future condition, and proposed condition for Northwest Lee County Model is available. Similarly, the XP-SWMM (version 3.2) model input and output files to execute the Gator Slough Stormwater Model are available. However, implementation or update of these simulation models is beyond the scope of this study. The hydrologic and hydraulic modeling of the restoration plans would be necessary during the detailed analysis and design phase of the study.

3.6 BASE MAP AND METADATA

3.6.1 Base Map Features and GIS Coverages

The base map includes all the layers shown on Figures 3-1 through 3-9c. These layers are listed below.

- Watershed boundaries
- Topographic details
- Land use conditions
- Aerial maps
- Wetlands
- Hydrologic conditions of soils
- Hydraulic structures
- Roads and streets, including highways

The GIS coverages for the majority of these layers were provided by the District. BPC downloaded the GIS coverages for the other features from the web sites of Lee and Charlotte counties. The geodatabase and the coverages were modified as appropriate to suit the objective and scope of this study. All the features are cataloged as separate layers in the ArcGIS (version 9.2) environment. Some of these features will be refined in Task 2 after

completion of the limited field verification and incorporation of the appropriate and relevant elements from the previous study results.

An electronic copy of the ArcGIS (version 9.2) coverages of the base map is included in a DVD and presented in Appendix C. A "Task 1 Readme" file listing the summary of directory structure is included in the DVD. Further details on the data organization and a hard copy of the "Task 1 Readme" file are included in Appendix C.

3.6.2 Metadata for Base Map

BPC has prepared the FGDC compliance metadata for each layer that is included in the base map coverage. In compliance with FGDC, the metadata from original files were imported for each feature class, and then edited the metadata files to update the incomplete information and the technical details on the modifications. A total of 44 metadata files were generated for the base map presented in this report, which are grouped in accordance with the directory structure given below.

- Aerials – 2 metadata files for aerials of Lee and Charlotte Counties, one for each county (a total of 195 tiles)
- Boundaries – 16 metadata files
- Contour – 1 metadata file
- Landuse_East.gdb – 10 metadata files
- Roads – 2 metadata files
- Soils – 2 metadata file
- Structures – 7 metadata files
- Topo_East.gdb – 1 metadata file
- Wetland – 3 metadata files

In accordance with the scope of work, BPC prepared the metadata files in the XML format using ArcCatalog. These metadata files are included within the GIS coverages (Appendix C). For convenience of the readers, BPC has also prepared copies of these metadata files in HTML format, and they are included in the DVD. A complete list of these metadata file names are presented in Appendix C. A hard copy of the actual content of an example of a metadata file (e.g., "Yucca Pens Project Area") is presented in Appendix C.

3.7 RELEVANT RECOMMENDATIONS FROM PREVIOUS STUDIES

Some of the previous studies were conducted for flood control studies, while the others were aimed at restoration activities. The current study is not a flood control project, rather the objective of this project is to develop conceptual hydrologic restoration plans. Based on the objectives of the current project, following is a summary of the relevant recommendations.

Northwest Lee County Surface Water Management Plan, March 2005

- Develop new topographic data for the study area; use updated topographic data to refine the delineated watershed boundary; develop a GIS database for the study area to capture all watershed relevant information; collect more hydraulics and conveyance data within Long View Run watershed; and install weather station on Burnt Store Road for better accuracy of rainfall data for the study area.
- A detailed field survey should be conducted for engineering design purpose; update the runoff curve number of each sub-basin according to future developments and other landuse changes; update time of concentration of individual sub-basins according to the new topographic data; and determine accurate seasonal high water elevations to design flood control/water quality improvement structures. The curve number and time of concentration are standard hydrologic model parameters used to estimate runoff (for definition refer to "Urban Hydrology for Small Watersheds, TR-55, June 1986; Engineering Division, U.S. Department of Agriculture").
- For future study in the watersheds, the developed watershed model should be converted into ICPR Version 3.0; convert the Cape Coral canal system model from SWMM to ICPR Version 3.0 for integrated study of Northwest Lee region and City of Cape Coral canal system.
- Purchase additional right of way on Burnt Store Road if the roadway expansion occurs; maintain control structures on Burnt Store Road on a regular interval for full conveyance capacity of the control structures; construct wet or dry retention / detention system within the unincorporated areas of Lee County east of Burnt Store Road to provide treatment for 1-inch of runoff from developed areas.

Water Management Study: Cecil M. Webb Wildlife Management Area, June 1983

- Proposed a Water Management Plan that included the following phased approach:
  - Implement a Pilot Plan that includes immediate maintenance of the two existing Webb Lake outfall structures, the creation of a bypass flow way west of Webb Lake Road, and structural improvements to the North Prong of Alligator Creek and to the South Branch of Myrtle Slough;
  - Create a Tucker's Grade water control system;
  - Construct a single outlet control structure on each of the five maintenance channels identified in the report to control 60 percent of the outflow from the Webb WMA; and
  - Create a major retention Area at the intersection of Tucker's Grade and SAL Grade.

Lee County Interim Surface Water Management Master Plan, May 1990

- Gator Slough is highly altered system which sends water rapidly to the estuary in Matlacha Pass and this characteristic has caused damage to the seagrasses in the shallow waters adjacent to the mouths of small natural creeks extending from the spreader system.

- Charlotte and Lee Counties will need to cooperate on any watershed work in Charlotte County for any development that would increase the volume of water in Gator Slough.
- Repair portions of the spreader waterway's seaward edge to better distribute water to the estuarine areas; and place fixed weir structures adjacent to the canal in Section 23 and 27 to reduce over drainage and control canal sedimentation.
- Divert or provide longer detention in the Cape Coral canal system to reduce the existing impacts to seagrass.
- Add the adjacent wetlands on the eastern side of U.S. 41 to the flow way.

Matlacha Pass Hydrologic Restoration Project - Phase 1, March 2007

- Expand and improve cross-drain culverts under Burnt Store Road to improve east west flow pattern, and side drains and roadside ditches along Burnt Store Road to improve conveyance within the individual basins in order to reduce inter basin flows between Greenwell Branch and Gator Slough Basins; and remove cross drain at the intersection of Durden Parkway and Burnt Store Road.

Surface Water Management Conceptual Plan: South Charlotte County, North Lee County, and Babcock/Webb, 2003

- Acquire online storage areas where practical to attenuate flood flows as they move south in addition to the right-of-ways along Gator Slough Outfall, such as Oil Well Grade Road to the 145-foot I-75 Bridge.

4.0 FUTURE TASK ACTIVITIES

BPC will immediately begin to work on Task 2 activities. The various activities in Task 2 include:

- **Update Site Specific Data.** This includes developing the historic drainage pattern in the study area as well as conducting a limited visual field verification of hydrologic data, infrastructures, and drainage patterns including limited GPS survey (not at sub-meter level and not conducted by a licensed surveyor) as appropriate. The field verification will focus on the presence of flow-way diversions along critical flow paths. The GPS survey will be conducted using handheld GPS units such as Garmin GPSMAP 76CSx or Magellan Triton 2000. These units have an accuracy of 10 meters (33 feet). A water budget analysis will be completed based on the methodology described in Section 3.4.5 of this report to analyze outfall restoration.

- **Address Water Quality Issues.** A basin scale water quality model using WMM program will be developed to evaluate the impacts from pollutants specific to the study area and to determine the efficiencies of potential BMPs.

- **Prepare Draft Technical Memorandum for Multifunctional Water Management Plan.** A technical memorandum will be prepared and submitted for District review. This report will include field reconnaissance survey completed during this task along with analytical calculation results performed for this study area.

The conceptual level restoration plan will be developed to meet the following objectives:

- Restoration of sheet flow across the Yucca Pens unit
- Provide outfall from Babcock-Webb WMA to the Yucca Pens unit – potential flow ways include Oil Well Road at I-75 and Harper & McNew Property at I-75
- Investigate ways to allow water from the U.S. 41 ditch to sheet flow across Yucca Pens unit
- Restoration of the ecological integrity of the ecosystem
- Improvement of water retention and aquifer recharge
- Restoration of flow severed by previous construction
- Restoration of historic outfall to Charlotte Harbor

Updated Schedule

Based on the Task 1 report delivery of July 1, 2009, we have developed the revised schedule as given below.

- **Progress Report** (not a technical report) **August 28, 2009**
  (Describing the work completed towards:

Develop Historic Drainage Pattern,
Visual Field Verification, Water Budget Analysis)

- **Draft Technical Memorandum** (95% Complete) **October 2, 2009**
  (Draft version of the report after completion of remaining subtasks:
  Address Water Quality Issues, Multifunctional Water Management Plan)
- **Final Review Comments Due to BPC** **October 19, 2009**
  (Comments from all agencies including the Interagency Deliverable Review Team)
- **Final Technical Memorandum** (100% Complete) **October 30, 2009**

The final schedule may be adjusted if appropriate.

APPENDIX A
Kick-Off Meeting Summary

BPC Group Inc.
Engineers • Scientists • Planners • Surveyors
6925 Lake Ellenor Drive, Suite 112, Orlando, Florida 32809
Phone 407-851-5020; Fax 407-857-3154; www. bpcgi.com

Task 1.1 Kick-Off Meeting Summary
Yucca Pens Hydrologic Restoration Plan
(Work Order # 4600000893-WO03)

Subject: Project Kickoff Meeting
Date & Time: April 16, 2009 (9:30 am – 11:30 am)
Location: Florida Fish & Wildlife Conservation Commission, Tuckers Grade Office, Punta Gorda, Florida

Attendees: Clyde Dabbs, Jr, South Florida Water Management District
Judith Nothdurft, South Florida Water Management District
Scott Legg, South Florida Water Management District
Julianna da Frota, South Florida Water Management District
Mike Kemmerer, Florida Fish & Wildlife Conservation Commission
Josh Birchfield, Florida Fish & Wildlife Conservation Commission
Cason Pope, Florida Fish & Wildlife Conservation Commission
Bijay K. Panigrahi, BPC Group
Ananda V. Aduvala, BPC Group
Glen J. Richardson, BPC Group

Meeting Summary:

- After general introduction of the attendees, Clyde gave the opening remarks for the Yucca Pens project. He presented a brief history of the project watershed and the past activities along with an overall objective of the current study for the Yucca Pens unit. He explained that the current study is needed to support "The Cape Coral North Spreader Ecosystem Management Agreement Process", which is currently underway.

- Clyde explained that boundary of the Yucca Pens project area includes five watersheds: Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview Run, and Gator Slough. He spoke briefly about the project boundary and other hydrological features of the Yucca Pens project area.

- Mike provided a brief overview of the Yucca Pens Unit history and noted the need to know where the current flows are in the Yucca Pens area.

- Judith started off with an overview of the statement of work and briefly explained the project objectives, scope of work, and the tasks to be accomplished as part of this project. Clyde iterated that Judith would be the prime contact for this Project and Julianna would assist her with the GIS data. Judith discussed the project objectives

and mentioned that the Task 1 summary report and metadata for the base map of the study area would be due four weeks from the project kickoff meeting date (April 16, 2009).

- Bijay talked about the roles of various BPC Group personnel for this Project. Bijay stated that he would serve as the project manager and would be the single point of communications for this project.

- As per the statement of work, Judith provided three DVDs to BPC Group that contained GIS datasets and Literatures to be reviewed as part of the Task 1. The District prepared the base map and geodatabase for the project area, and delivered it to BPC Group during the kickoff meeting. Ananda and Julianna opened the GIS coverages to develop a preliminary understanding of the datasets included in the DVDs. It was indicated that the LiDAR data along with the topographic contours were currently being processed by the District, and they would be made available to BPC as soon as possible. More complete GIS coverages were requested for the soils and land use maps for the project area.

- BPC indicated that a more comprehensive review of the GIS datasets would be performed at the office, and BPC would get back to the District for additional information, if necessary.

- Bijay requested Mike to share his experiences and concerns about the ecology and hydrology of the Yucca Pens project area. Mike briefly explained the past history of the flow pattern in the Babcock-Webb Wildlife Management Area which was primarily sheet flow until the flow was blocked and diverted by construction of highways. His major concern was controlling the potential damage to fish and wildlife in the area. He expressed that the water level in the area had changed since the flow diversion structures were in place.

- Mike stated that he would provide a letter for BPC Group to enter the Yucca Pens Unit to do their field work. Mike also indicated he would be available to answer questions from Bijay.

APPENDIX B
Review Summary of Reports and Documents

Document: Northwest Lee County Surface Water Management Plan, March 2005. Prepared for Lee County; prepared by Boyle Engineering Corporation.

Review Summary: The objectives of this study were to assess the existing and future level of service for roadway flooding along Burnt Store Road, assess the existing and future water quality levels in the study areas, and recommend Best Management Practices (BMPs) to address the water quality issues in the existing system.

The study area consisted of Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview Run, and Gator Slough watersheds on northwest region of Lee County. The study area was surrounded by US 41 (North Tamiami Trail) on the east, Charlotte Harbor Bay on the west, Lee-Charlotte county line on the north, and a part of the Cape Coral canal system on the west of Burnt Store road. The overall slope of the watersheds was reported as approximately 0.05% or 2.6 feet per mile. Approximately 30% of the study area within City of Cape Coral was classified as single-family residential. Most of the study area east of Burnt Store Road consisted of grasslands and shrub vegetation. The soils within the study area were reported as predominantly fine sands under the hydrologic soil groups of B/D and D. Table 4.2 of the report presents a detail description of soil types in the study area.

It was reported that a major portion of the study area east of Burnt Store Road contained wetland consisting of Palustrine Forested/Emergent Seasonal wetlands (PFO4/EM5C), Palustrine Forested/Emergent Temporary wetlands (PFO4/EM5A), and Palustrine Emergent Seasonal wetlands (PEM5C). A more complete detail on the descriptions of wetland types is given in Table 6.1 of the source document.

Except for rainfalls and aerial maps, the study used data prior to the year 2000. The rainfall and aerials represented 2003 conditions. For the purpose of modeling, the study area was divided into 94 sub-basins consisting of 10 sub-basins for Yucca Pen Creek watershed ranging in size from 61.5 to 624.3 acres, 16 sub-basins for Durden Creek watershed ranging in size from 113.0 to 151.7 acres, 18 sub-basins for Greenwell Branch watershed ranging in size from 116.9 to 845.5 acres, 6 sub-basins for Longview Run watershed ranging in size from 166.9 to 335.0 acres, and 44 sub-basins for Gator Slough watershed ranging in size from 17.6 to 546.6 acres. The total drainage area of the study watersheds was 48.4 square miles.

The flow and water quantity within the study area was modeled using the ICPR model (version 2.2). It was reported that the ICPR model was calibrated and verified for a major rainfall event of June 2003 using NEXRAD rainfall data and observed 15-min streamflow data in Gator Slough at US 41 obtained from USGS. Gumbel statistical analysis was performed to provide Gator Slough inflow rating curves for various design storms. Ten design storms namely; 2-year 24-hour event, 5-year 24-hour event, 10-year 24-hour event, 25-year 24-hour event, 100-year 24-hour event, 2-year 72-hour event, 5-year 72-hour event, 10-year 72-hour event, 25-year 72-hour event, and 100-year 72-hour event were used for the

modeling purpose. The model result for both existing and future condition suggested an approximately 4-inch to 6-inch roadway flooding at Durden Creek Main culvert and at Culvert number 6 along Burnt Store Road.

Eight cross-drain culverts in Burnt Store Road north of Gator Slough bridge and fourteen channel cross-sections in the extensive areas east of Burnt Store Road were surveyed. A brief description of the culverts and bridges in the study area is given below.

Culvert Number	Location	Dimension	Up-Stream invert (ft)	Down-Stream invert (ft)	Type
1	0.85 miles south of Lee-Charlotte county line	7-ft x 10-ft	4.00	4.00	concrete box culvert
2	0.57 miles south of Culvert 1	30-inch	8.10	7.50	RCP
3	0.31 miles north of the intersection of Durden Parkway at Burnt Store Road	48-inch	6.50	5.70	HDPE pipe
4	0.19 mile south of Durden Parkway and Burnt Store Road Intersection	24-inch	8.10	8.00	RCP
5	0.57 miles south of Culvert 4	24-inch	7.60	6.80	HDPE pipe
6	1 mile south of Culvert 5	24-inch	5.40	5.20	RCP
7	0.6 mile south of Culvert 6	30-inch	4.80	4.60	RCP
8	0.47 miles north of Gator Slough bridge	36-inch	3.50	3.30	RCP
9	0.13 miles south of Gator Slough bridge	4-ft x 8-ft	2.87	2.87	box culvert
10	0.18 miles south of Bridge 9	11-ft x 34-ft	-	-	-

The dimensions of the four drop structures at the southern end of the side ditches running parallel to Burnt Store Road is given below.

- D-5180A: Located on the east side of Burnt Store Road, Weir – 44”x52”, Pipe –1x36”, 38’ long, Weir invert elevation = 3.2
- D-5180B: Located on the east side of Burnt Store Road, Weir – 36”x48” Pipe –1x36”, 34’ long, Weir invert elevation = 3.2
- D-5190A: Located on the west side of Burnt Store Road, Weir – 48”x75” Pipe –34”x53”, 38’ long, Weir invert elevation = 3.0
- D-5190B: Located on the west side of Burnt Store Road, Weir – 36”x48” Pipe –1x36”, 32’ long, Weir invert elevation = 3.0

A detail description of the structure information is provided in Table 11.1 of the reference document.

As reported in the document, the study followed the following steps to calculate the untreated constituent concentrations in the study area.

- Comparison of landuse categories – EMC of seven water quality parameters were calculated based on the landuse characteristics of the sub-basins (Table 15.1 of the source document).

- Determination of mean event concentrations - The mean event concentration for different landuse in the study area was assigned from Table 7 of the ERD model document (Table 15.2 of the source document).
- Estimation of pollutant loadings from stormwater runoff
- Estimation of total untreated constituents concentration in mg/l

The existing condition landuse runoff coefficients were obtained from Table 4 of ERD model document. After estimation of pollutant loadings, the total untreated constituent concentration for each watershed was calculated (Table 15.4 of the source document). Similarly, the future conditions water quality modeling was completed for varying degree of DCIA values. Comparisons between existing and future conditions model results indicated that the concentrations of BOD, TP, and Lead did not meet the desired level of service for both the existing and future conditions. The water quality treatment requirements for potential retention/detention systems were calculated only for the areas not owned by the State. A detail description of treatment volume required for three watersheds is given below (Table 15.9 of the source document).

Watershed	Land Area (ac)	Treatment Volume Required (ac-ft)	
		0.5" treatment	1" treatment
Yucca Pen	650	27	54
Durden Creek	290	12	24
Greenwell Branch	1550	65	130

The conclusions and recommendations from the report included:

- The water quality model (ERD) suggested that the concentration of BOD, TP, and Lead did meet the water quality standard set by FDEP both for existing and future landuse conditions
- The future landuse conditions had slightly higher constituent concentrations compared to the existing landuse conditions
- The pollutant removal efficiencies of dry/wet retention or detention systems are most effective and It varies from 60% to 90%
- Wet or dry retention / detention system should be incorporated within the unincorporated areas of Lee County east of Burnt Store Road to provide treatment for 1-inch of runoff from developed areas
- Accurate determination of seasonal high water tables for proper designing of BMPs

The water budget analysis of inflow and outflow of the study area was performed for 25-yr 72-hr design storm. A rainfall depth of 10.5-inches for this design storm occurred across approximately 30,965 acres total drainage area (excluding Gator Slough watershed east of US 41) which generated an inflow of 27,095 ac-ft into the system. An additional upstream

inflow of approximately 122 ac-ft entered into Gator Slough canal for 25-yr 72-hr design storm. Except Gator Slough, no other watersheds received upstream inflow. Hence, a total inflow of approximately 27,220 ac-ft entered into the system.

The outflow from individual watershed into Matlacha Pass/Cape Coral Canal System was obtained from ICPR model simulation. The following table (Table 16.1 of the source document) shows that the outflow volume was the greatest (6,863ac-ft) for Gator Slough and least (1,343 ac-ft) for Longview Run. The outflow as percentage of total inflow ranged from 61.8% to 80.6%. The water budget analysis for 25-hrs and 72-hrs design storm showed that the total inflow into the system was approximately 27,220 ac-ft whereas the total outflow from the system was approximately 18,200 ac-ft. The total infiltration / storage in the study area were approximately 9,020 ac-ft. The following table presents a detail description of water budget for Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview Run, and Gator Slough

Watershed	Rainfall (ac-ft)	Upstream Inflow (ac-ft)	Net Inter-basin Flow (ac-ft)	% of Rainfall Lost by Inter-basin Flow	Total Inflow (ac-ft)	Infiltration/Storage (ac-ft)		Outflow	
						(ac-ft)	% of Total Inflow	(ac-ft)	% of Total Inflow
Yucca Pen Creek	2289.96	0.00	121.06	0.00%	2411.02	468.90	19.4%	1942.12	80.6%
Durden Creek	7916.65	0.00	-2942.97	-37.17%	4973.68	2052.13	41.3%	2921.55	58.7%
Greenwell Branch	6357.23	0.00	1090.80	0.00%	7448.03	2324.17	31.2%	5123.86	68.8%
Longview Run	1370.51	0.00	804.10	0.00%	2174.61	831.50	38.2%	1343.11	61.8%
Gator Slough	9160.20	121.68	927.04	0.00%	10208.92	3346.26	32.8%	6862.66	67.2%
All Watersheds	27094.55	121.68	---	---	27216.26	9022.96	33.2%	18193.30	66.8%

Note: Upstream inflow of Gator Slough occurs at US-41 culvert.
Inter-basin flows were obtained from ICPR model results.
Total Inflow = Rainfall + Upstream Inflow + Net Inter-basin Flow
Yucca Pen Creek Outflow is the "Cumulative Inflow" at Node 1080 as given by ICPR Model.
Durden Creek Outflow is the "Cumulative Inflow" at Node 2290 as given by ICPR Model.
Greenwell Branch Outflow is the sum of "Cumulative Inflows" at Nodes 3270 & 3310 as given by ICPR Model.
Longview Run Outflow is the sum of "Cumulative Inflows" at Nodes 4030, 4060, & 4080 as given by ICPR Model.
Gator Slough Outflow is the "Cumulative Inflow" at Node 6420 as given by ICPR Model.

The study report included the following recommendations.

- The entire Cape Coral Canal System should be included as part of the study area due to connection with Gator Slough
- Development of new topographic data for the study area
- Development of a GIS database for the study area to capture all watershed relevant information
- A detailed field survey should be conducted for engineering design purpose
- Use of updated topographic data to refine the delineated watershed boundary

- Purchase of additional right of way on Burnt Store Road if the roadway expansion occurs
- Determination of accurate seasonal high water elevations to design flood control/water quality improvement structures
- For future study in the watersheds, the developed watershed model should be converted into ICPR Version 3.0
- In order to maintain the consistency, ICPR should be used for future studies
- Conversion of the Cape Coral canal system model from SWMM to ICPR Version 3.0 is required for integrated study of Northwest Lee region and City of Cape Coral canal system
- According to future developments and other landuse changes, the runoff curve number of each subbasin should be updated
- The time of concentration of individual subbasins should be updated according to the new topographic data
- The control structures on Burnt Store Road should be maintained on a regular interval for full conveyance capacity of the control structures
- Collection of more hydraulics and conveyance data within Subbasins LV-2 and LV-3
- Installation of weather station on Burnt Store Road for better accuracy of rainfall data for the study area
- Construction of Wet or dry retention / detention system within the unincorporated areas of Lee County east of Burnt Store Road to provide treatment for 1-inch of runoff from developed areas

Document: Water Management Study: Cecil M. Webb Wildlife Management Area, June 1983. Prepared for the Florida Game and Fresh Water Fish Commission; prepared by Johnson Engineering, Inc.

Review Summary: This report described a water management study for the Cecil M. Webb Wildlife Management Area in Charlotte County. The report was divided into the following sections: Introduction, Background, Objectives, Watersheds and Hydrology, Surface Water Analysis, Wildlife Enhancement Through Water Management, Water Management Plan, Conclusions, Recommendations, Cost Estimates, and an Appendix. The "Surface Water Analysis" section contained information on the water management study analysis but did not include elevation data on any of the existing structures at the study area.

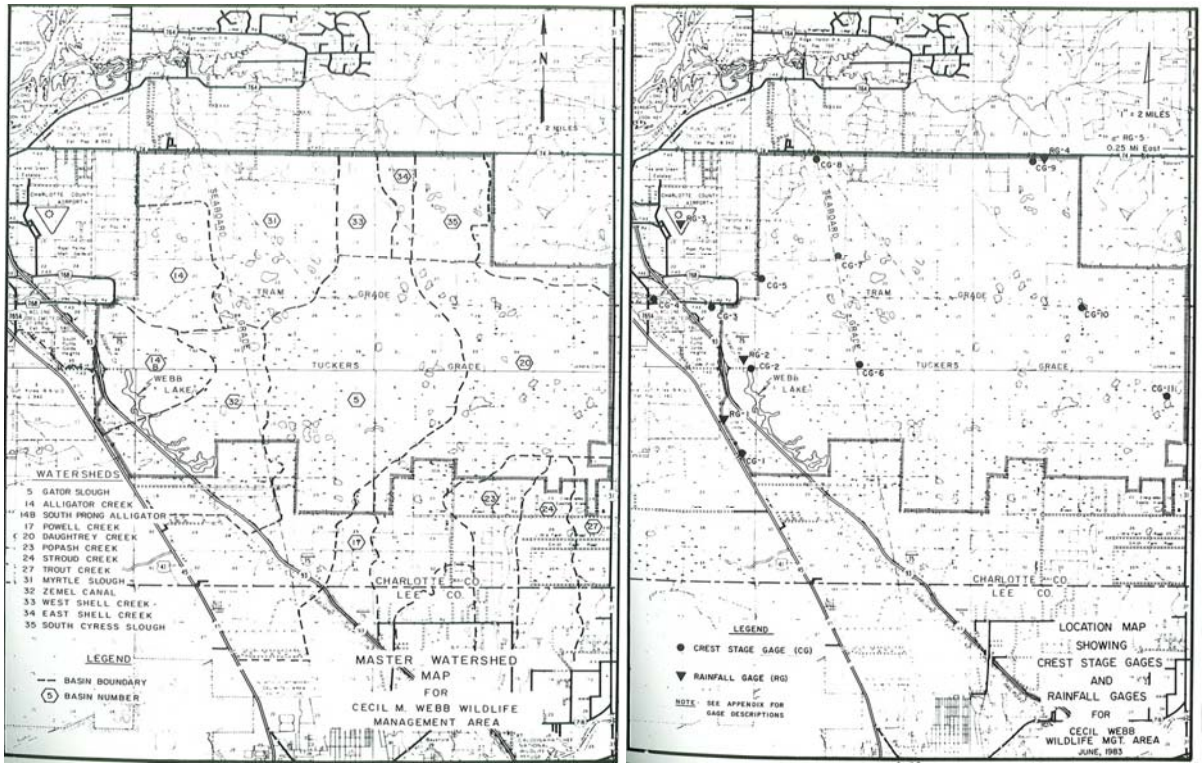
The purpose of this study was to provide data for a surface water management plan for the wildlife area with the primary objectives of improving fish and wildlife habitat, increasing the ability to enhance vegetative communities, managing the water resources to better attenuate the extremes of the winter dry and summer wet seasons, and assisting in alleviating the peripheral flooding problems of adjoining land owners. The Cecil M. Webb Wildlife Management Area (Webb WMA) is located approximately 10 miles southeast of the city of Punta Gorda, and encompassed approximately 105 square miles at the time of this 1983

study. The Webb WMA was generally bordered by S.R. 74 on the north, S.R. 31 on the east, Oil Well Grade/Cook-Brown Road on the south, and U.S. 41 on the west at the time of this study. The report identified nine (9) major watersheds within the Webb WMA. These watersheds and the approximated areas that each encompassed within the Webb WMA are listed in the table below.

Watershed	Approximate Area (Square Miles)
Myrtle Slough	17
West Shell Creek Tributary	4
East Shell Creek	2.5
South Cypress Slough	5.5
Daughtrey Creek	23
Gator Slough	26
Zemel Canal	9
Alligator Creek South Prong	8
Alligator Creek North Prong	6

Of these nine (9) major watersheds, only Gator Slough extended into the boundaries of the Yucca Pens study area. The portion of the Gator Slough Watershed lying within the Webb WMA consisted of approximately 26 square miles. The Gator Slough Watershed generally lies in the center of the Webb WMA and drains southward into Gator Slough Canal, which runs to the west into Charlotte Harbor. This study did not include hydrology computations for the Gator Slough Watershed area, although it did mention previous investigations which recommended improvements to the drainage in the lower reaches of the watershed system. These improvements are located outside of the Webb WMA and would have a minimal effect on this area. The primary watersheds are shown on a watershed map of the area below.

The Webb WMA is generally a very flat and very poorly drained palmetto prairie that is heavily ponded during the summer rainy season, especially on the south and southwest portions which are completely inundated with surface water movements by sheet flow to the south and west. At the end of the winter dry season, the water table is generally about two feet below natural ground surface except in depressional areas, where the water table is at or near the ground surface. The study area consists of sandy soils which are underlain in some areas by sandy and clayey soils below a depth of about two feet. The very poor hydraulic conductivity of the soils accounts for evapotranspiration and runoff from surface water sheet flow removing most of the seasonal recharge from the area. Sheet flow drainage across the study area is received primarily by the Peace River on the north, the Caloosahatchee River on the south, and Charlotte Harbor on the west. Virtually no sheet flow runs to the east. The development of peripheral lands in recent years has restricted sheet flow, causing it to be redirected by dikes and roads towards culvert outlets, bridges, and creeks. Topographic elevations range from 40 feet NGVD in the northeast to 20 feet NGVD in the south and southwest. The locations are shown on the crest stage gage and rainfall gage map below.



Hydrographs were developed using rainfall and runoff curves from SFWMD to estimate initial runoff and the field measurements were used to determine outflow. The hydrographs basically depict the drainage system sheet flows from the central upland areas into the lower downstream areas near the periphery of the Webb WMA.

The 1982 crest stage measurements were combined with the measurements taken in 1977 to compute backwater profiles using the HEC-2 computer program to determine capacities and responses to flood flows. Although this study did not include the entire Gator Slough Watershed, wet weather reconnaissance of the area indicated significant unused capacity for Gator Slough west of U.S. 41. The inclusion of a flow control structure in the Seaboard Airline (SAL) ditch upstream of Oil Well Grade Road was recommended to solve this problem. The report includes crest gage readings and discharge measurements taken during this study.

This water management study outlined the following conclusions:

- The basic Webb water management system has not been altered in the recent past, except for Webb Lake.
- Water control has not had an active role in water management planning.
- The most cost effective measure to be taken is the maintenance of existing outfall channels for improved flood controls.

- Maintenance of outfall channels would benefit peripheral lands in that flood flows would be better attenuated through controlled structures.
- The absence of a water management system accentuates climatic extremes to the detriment of the Webb WMA.
- Existing topographic features represent significant opportunities to develop a cost effective water control system that would enhance the game and fish habitat.
- Such a proposed water control system would be practical to implement and operate.
- A small scale water management system should be implemented on a pilot basis for evaluation purposes.
- The existing Webb WMA provides a limitless opportunity to enhance the game and fresh water fish habitat through improved water control.

The Water Management Plan proposed in this document outlined four phases of immediate action:

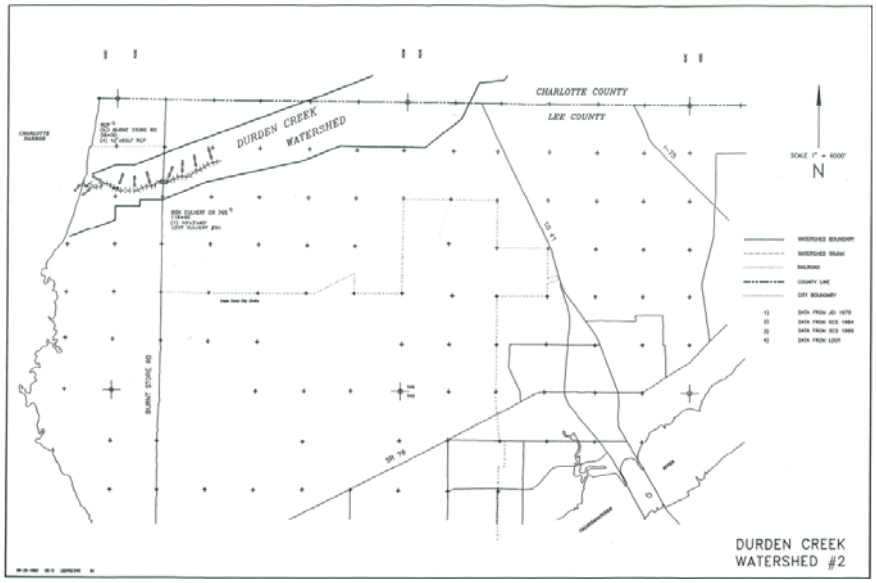
- Phase I: Implement a Pilot Plan that includes immediate maintenance of the two existing Webb Lake outfall structures, the creation of a bypass flow way west of Webb Lake Road, and structural improvements to the North Prong of Alligator Creek and to the South Branch of Myrtle Slough.
- Phase II: Creation of a Tucker's Grade water control system
- Phase III: Construction of a single outlet control structure on each of five specified channels to control 60 percent of the outflow from the Webb WMA.
- Phase IV: Creation of a major retention Area at the intersection of Tucker's Grade and SAL Grade.

Document: Lee County Interim Surface Water Management Master Plan, May 1990. Prepared for the Lee County Board of County Commissioners; prepared by Johnson Engineering. Extracted summary sections for Durden Creek Watershed, Greenwell Branch Watershed, Longview Run Watershed, Yucca Pen Creek Watershed, and Gator Slough Watershed were provided by South Florida Water Management District, Fort Myers, Florida

Review Summary: Following is a brief summary of this report that is relevant to the Yucca Pens project area.

Durden Creek Watershed:
The Durden Creek is approximately 11 sq. mi (8 sq. mi- Lee County & 3 sq. mi- Charlotte County) in surface area as shown below. Hydrology in the watershed is predominantly sheet flow intermingling with watersheds to the north and south. The only significant conveyance facility in this region is the set of 4-24" RCP's under Burnt Store Road. There are no water quality problems with residential development in downstream portion of watershed. The wet

season water table upstream of Burnt Store Road is equal to Ground level or above for two months of the year. Allowable discharge for the stream is 13 csm. No rights-of-way exists along east of Burnt Store Road. On the West of the road there are rights-of-way for the canal system. Right of Way information is provided in the Figure 2 of the report.

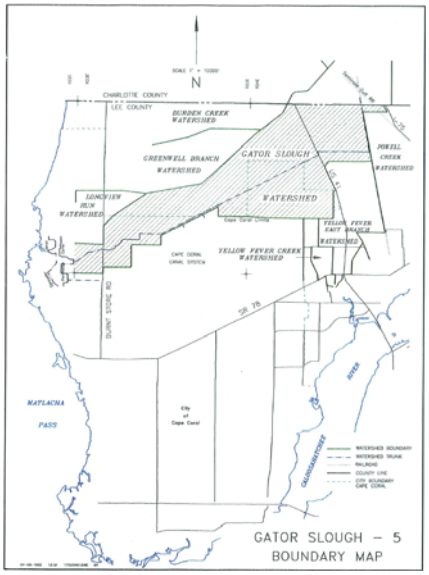


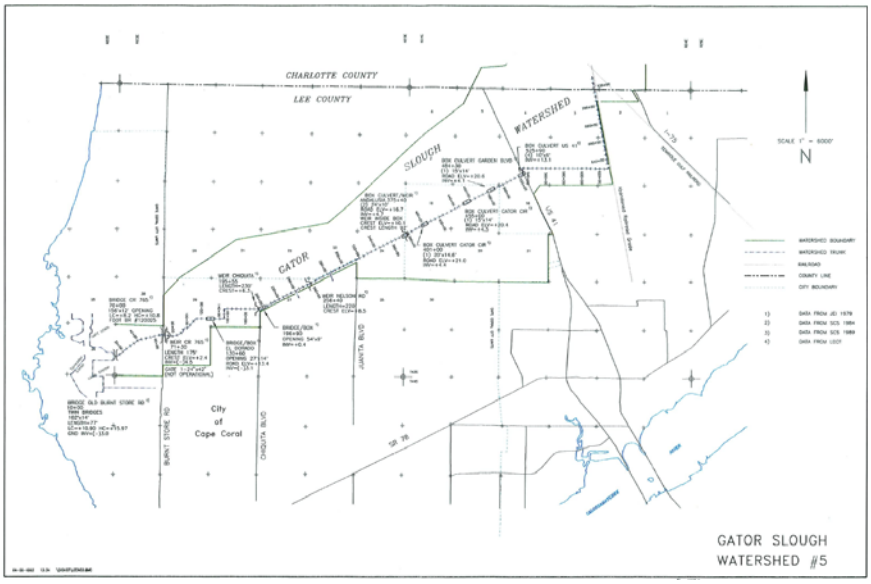
Gator Slough Watershed:

Watershed Location: Gator Slough Watershed is approximately 55 square miles (30 sq. mi in Charlotte County & 25 sq. mi in Lee County) in surface area. The watershed within the Lee County varies in width from one mile across at the downstream end to about three miles across at the upstream end. The current watershed boundary within the Lee County is confirmed by field reconnaissance by Johnson Engineering as well as various topographic mapping sources and Johnson Engineering in-house data.

Conveyance Elements: Gator Slough has 4 water control structures. The conveyance is an excavated channel from its outfall at the City of Cape Coral perimeter canal to the east end of the "Tara Woods" portion of the channel upstream of U.S. 41. The majority of the channel segments have a relatively uniform cross sectional area with abrupt changes in shape at certain locations. Surface water is conveyed by sheet flow from the SAL railroad grade to Tara Woods. There are several tributary channels from the City of Cape Coral which connect to the main Gator Slough conveyance. Gator Slough is tidally controlled downstream of the Burnt Store Road weir. At the downstream of Burnt Store Road, the channel is relatively clean of vegetation while at the upstream, the channel has areas of heavy vegetation constrictions. Development of City of Cape Coral has encroached and filled the floodplain. The report recommends installation of additional weirs in the tributary canals to better control discharge to the tidal receiving waters and replacing the undersized structures in the Gator Slough Canal. The report also suggests implementation of a channel maintenance

schedule to remove the vegetative and siltation constrictions, thereby enabling the channel to better convey medium to large storm events. The structure information is provided in the map below.





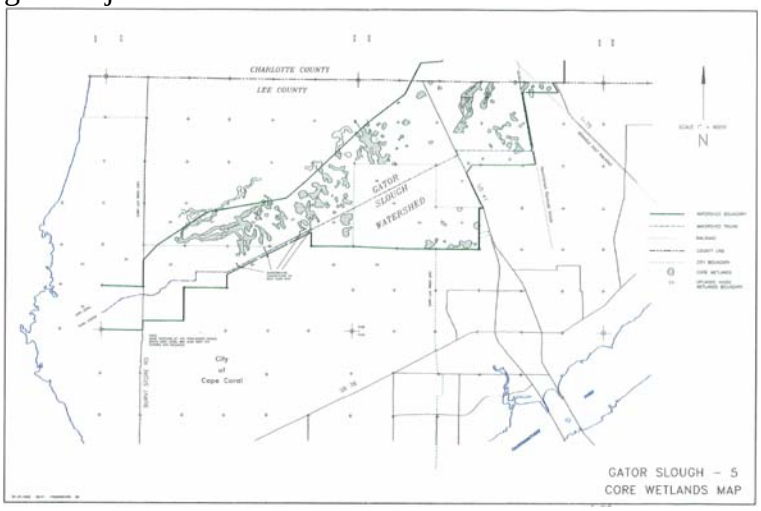
Sensitive Lands: The following conclusions were drawn based on the Sensitive area study of the watershed:

- Gator Slough is highly altered system which sends water rapidly to the estuary in Matlacha Pass and this characteristic has caused damage to the seagrasses in the shallow waters adjacent to the mouths of small natural creeks extending from the spreader system.

- None of the existing wetlands are close enough to the main flow-way to be considered for inclusion in the study except for one wetland in Section 10, east of U.S. 41.
- The complex canal system and weirs within the City of Cape Coral should offer some potential for water storage and diversion to the south.
- Some uncontrolled drainages on the north side of the main flow-way will continue to overdrain the adjacent lands, including some wetlands.
- Charlotte and Lee Counties will need to cooperate on any watershed work in Charlotte County for any development that would increase the volume of water in Gator Slough.

The following recommendations were suggested to protect the Sensitive Areas:

- Repairing portions of the spreader waterway's seaward edge to better distribute water to the estuarine areas
- Placing fixed weir structures adjacent to the canal in Section 23 and 27 to reduce over drainage and control canal sedimentation.
- Diverting or providing longer detention in the Cape Coral canal system to reduce the existing impacts to seagrass.
- Adding the adjacent wetlands on the eastern side of U.S. 41 to the flowway.



Right of Way: Adequate rights-of way or easements exist for the portion of the Gator slough Canal. Additional rights-of-way are needed along the canal in three locations. The locations details are shown on Page 5-R/WM of the report. It was recommended in the report to purchase the old SAL railroad right-of-w**a**y for the main north/south flow route for surface waters from Charlotte County. It was also suggested to obtain/transfer rights-of-way or easements along the conveyance where they are currently non-existent or not wide enough.

Ground Water Table: The wet season ground water levels ranged from ground surface to two feet below the ground surface. Gator Slough lowers the groundwater levels immediately adjacent to the creek. It was recommended to use ground water cross sections from the

proposed wells/gages to determine applicable control elevations for projects near to the canal. Installing additional wells would better define the water table conditions near the canal.

Soils: The majority of the Gator Slough watershed has soils from the following groups: Boca, Matlacha gravelly fine sand, Oldsmar, Pineda and Wabasso. These soils are all in the B/D hydrologic group except the Matlacha gravelly fine sand. The Matlacha gravelly fine sand is a C classification with the water table 2 to 3 feet below the land surface.

Hydrology: Most of the Gator Slough watershed exhibits runoff characteristics associated with open lands. Much of the development within the watershed discharges stormwater flow directly into the Gator Slough with little or no detention. The report recommends establishing a hydraulic connection between the I-75 bridge in Charlotte County and the Tara Woods channel in Lee County and periodic maintenance of channels within the City of Cape Coral.

Topography: The Topography of the watershed varies from +7' NGVD at the western boundary of the Cape Coral to about +24' NGVD at the upstream end of the watershed. Since there is a large area of overland flow in the upper reaches of this watershed, there is a mingling of flows between the Gator Slough watershed and the Powell Creek watershed, generally located in the area east and north of Western Acres between the old SAL railroad grade and I-75. The report points out some constrictions, which significantly altered the natural flow regime at the upstream reaches of the watershed:

- Construction of Cape Coral
- Raising U.S. 41 about 2 ft in 1975
- Construction of I-75 in the early 1980's
- Extensive farm diking in the area upstream of I-75
- Developments such as Western Acres, Lakeville, Del Tura, Pine Lakes, Tara Woods and Del Vera have been extensively filled and perimeter dikes have been constructed

One of the way to overcome this problem is to install the a weir at a strategic location in the upper reaches of the watershed to better control merging floodwaters between Gator Slough and Powell Creek watersheds and monitoring the development within the watershed to ensure proper utilization of the control structures.

Hydrologic/Hydraulic Modeling: The existing and proposed conditions for the Gator Slough watershed were modeled using HEC-1 by Johnson Engineering, only a portion of the channel within Lee County was modeled using HEC-2 numerical model developed by US Army Corp of Engineers. The inputs for this model are: Rainfall, Cross Sectional data, Channel Conditions, Structure data, Flow data, Starting Water surface elevations, Roughness factors and job control data. Model results from report show that the existing structures at Old Burnt Store Road, El Dorado, Chiquita Boulevard, West Gator Circle, East Gator Circle and Garden Boulevard are constrictions to the flow in a greater than a 5-year storm event. The channel sections from Chiquita to Juanita and upstream from the northeast corner of Section

17, Township 43 South, Range 24 East and upstream from Station 500+00 are constrictive in less than a 5-year storm event. It was concluded from study that increasing the channel and structure capacity may be a solution to this problem.

Water Quality: A Non-Point Source (NPS) Water Quality Model was used to determine the pollutant loadings generated from the Gator Slough watershed and delivery of those pollutants to the Gator Slough watershed outfall, Matlacha Pass, just downstream of Burnt Store Road. The primary purpose of this modeling was to compare the relative differences in loadings and pollutant deliveries between existing and different future scenarios. A detailed description of NPS model is included in Volume III of the Master Plan. The parameters used in this water quality modeling included landuse characteristics, soils, point sources and wet detention Best Management Practices (BMP's). The modeling results are summarized in Table 8-2 of the report. Based on the NPS Modeling results, increases in TN, TP, Pb and Zn are expected for both scenarios B2 and C2. Due to undeveloped nature of the existing Gator Slough Watershed, even a low level of development without BMP's will greatly increase the percentage of loadings generated within the watershed.

Water Budget: Three alternative methods to divert and/or store water currently being discharged from the Gator Slough watershed are discussed in this section of the report. They are:

- Construction of control structure at the connection of Gator Slough trunk system and Powell Creek system.
- A second possible way to divert flowway from Gator Slough system is to direct water into the existing northerly Cape Coral canals which branch off from the main Gator Slough canal.
- Third Alternative to reduce the amount of water being discharged from the Gator Slough watershed and provide recharge to the basin is Aquifer Storage and Recovery (ASR).

Proposed Improvements: The following improvements were suggested in the watershed:

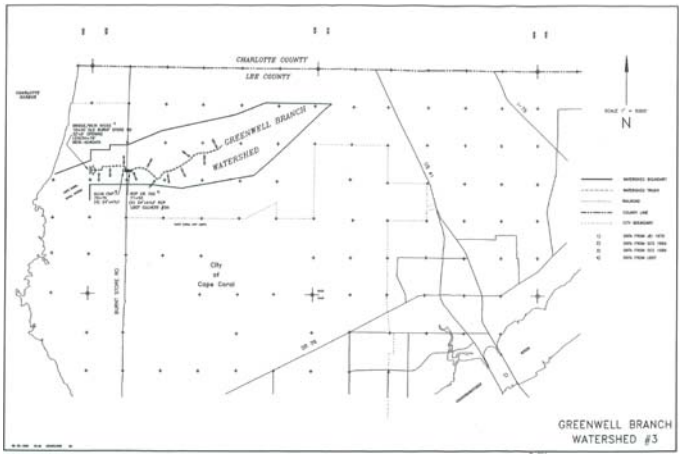
- Establishing a maximum allowable discharge from the Webb Wildlife Management Area to the main Gator Slough channel.
- Establishing a vegetation maintenance program for the channel.
- Enlarging the channel from station 490+00 to the east side of Tara Woods.
- Coordinating with the City of Cape Coral for the enlargement of the undersized road crossings, diversion of water from the main canal and repair of the spreader canal.
- Installing a weir immediately upstream of the U.S. 41 box culvert.
- Constructing a weir with two crests and gate sets at the northeast corner of the Western Acres sub division.
- Obtaining adequate rights-of-way or easements along the portion of the flow route where it is currently non-existent or inadequate for future improvement, including off-line wetlands.

- Construction of a detention area near the downstream end of the system for water quality enhancement.

The total cost estimate for the proposed improvements is estimated to be $7,348,000. The Existing and Proposed plans and profiles can be seen in the report from pages 5-PP1 -5PP10.

Greenwell Branch Watershed:

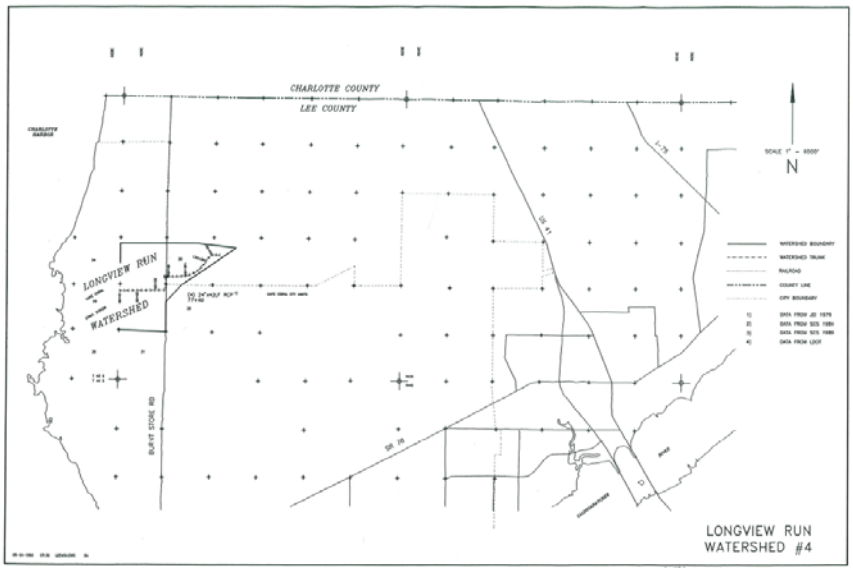
Greenwell Branch watershed is approximately 10 sq. mi in surface area located in Lee County. The watershed is primarily sheet flow until it reaches Burnt Store Road. The easterly portion of the watershed area between Burnt Store Road and U.S. 41 borders the Gator Slough watershed. It is predominantly sheet flow intermingling with watersheds to the north and south. The only significant conveyance facility in this region is the set of 4-24" RCP's under Burnt Store Road. No water quality sampling is proposed at this time since the watershed is mostly undeveloped with residential at the downstream end. The wet season water table upstream of Burnt Store Road is equal to Ground level or above for two months of the year. Allowable discharge for the stream is 13 csm. The implementation includes replacing culverts west of Burnt Store Road (Sta. 70+75) and coordinating with Charlotte County and Cape Coral to insure proper watershed planning. No rights-of-way exists along east of Burnt Store Road. On the West of the road there are rights-of-way for the canal system. The right of way information is provided in the Figure 2 of the report.



Longview Run Watershed:

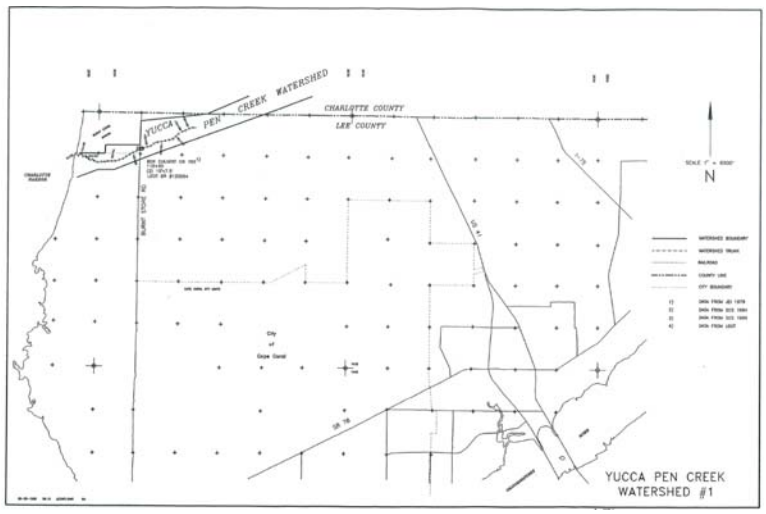
Longview Run watershed is approximately 4 sq. mi in surface area located in Lee County. The sheet flow east of Burnt Store Road changes to channelized flow as it crosses the road. A ditch on the west side provides major conveyance. The only significant conveyance facility in this region is the set of 4-24" RCP's under Burnt Store Road. No water quality sampling is proposed at this time since the watershed is mostly undeveloped with residential at the downstream end. The wet season water table upstream of Burnt Store Road is equal to Ground level or above for two months of the year. Allowable discharge for the stream is 13 csm. Implementation includes coordinating with Charlotte County and Cape Coral to insure

proper watershed planning. There are no known rights-of-way in this watershed. The right of way information is provided in the Figure 2 of the report.



Yucca Pen Creek Watershed:

Yucca Pen Creek watershed is approximately 9 sq. mi (2 sq. mi- Lee County & 7 sq. mi- Charlotte County) in surface area. It is predominantly sheet flow intermingling with watersheds to the north and south. The only significant conveyance facility in this region is a 10'x 3' box culvert at Burnt Store Road. There are no known water quality problems in this sparsely populated watershed. Residential development is concentrated at the downstream end.

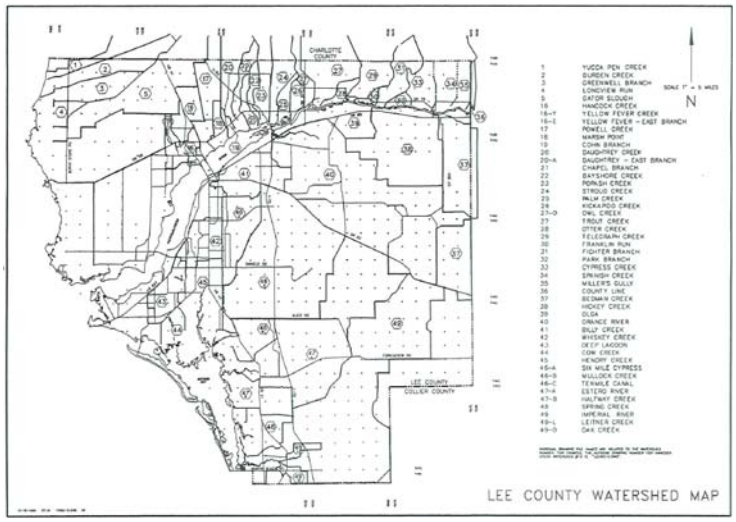


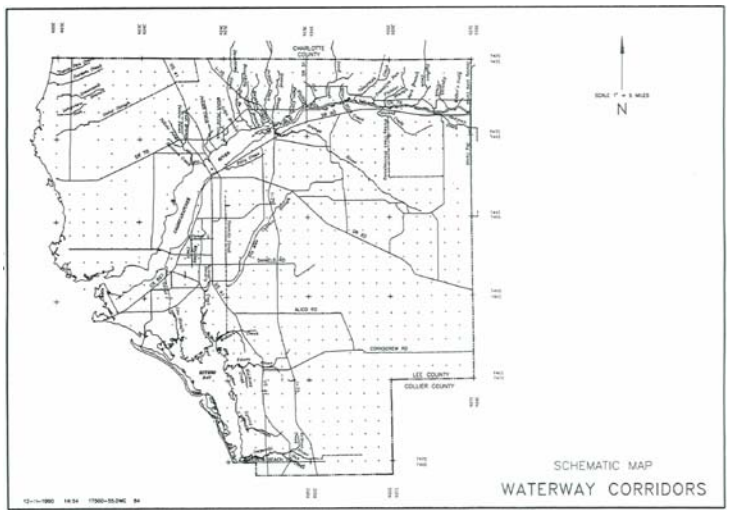
The wet season water table upstream of Burnt Store Road is equal to Ground level or above for two months of the year. Allowable discharge for the stream is 13 csm. Implementation

includes reviewing the watershed area for potential as a detention and recharge area and coordinating with Charlotte County and Cape Coral to insure proper watershed planning. Stream side protection is warranted west of Burnt Store Road. The right of way information is provided in the Figure 2 of the report.

Lee County Watershed:

This document provides Lee county watershed and waterway corridor maps along with the Disk inventory (Pages A-7 through A-9).





Document: Gator Slough Stormwater Model, Phase 2: Model Construction and Calibration Report, July 2001. Prepared by Southern DataStream, Inc.; prepared for City of Cape Coral.

Review Summary: The objective of the Draft report was to evaluate the canal system enhancement plan of raising weir elevation (Weir numbers 19, 15, 14, 13 and 11) under design storm events: 5-year 1-day, 25-year 3-day, and 100-year 3-day storm events, using Storm Water Management Model (SWMM) developed by XP-Software (XP-SWMM2000). The report contained five sections and they are: Project Purpose and Scope, Scope of Work Revision, Literature Survey, Project Data, and Model Calibration Results and Conclusions.

The study area is located in the northwest area of Lee County and covers an approximately fifty-two square miles in the counties of Lee and Charlotte. The modeling study focused mainly on Lee County Portion of Watershed. Figure 1 shows the watershed location.

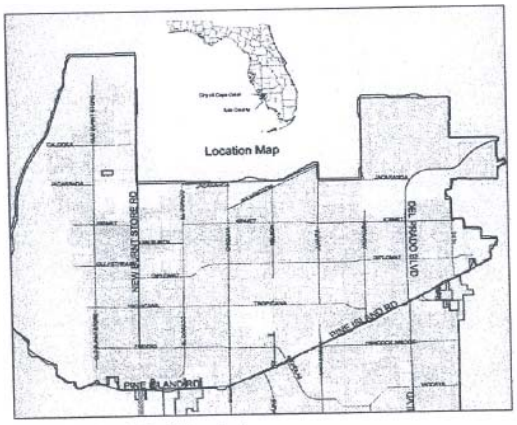


Figure. 1 Map of the Watershed

The input parameters for the model such as canal dimensions/field info/hydraulic structures, soils, discharge data, and rainfall data were extracted from a number of sources as identified in the source document.

The topography within the watershed varies in elevation from about +7 ft NGVD at the western boundary of Cape Coral to about +10 ft NGVD at Chiquita Boulevard, then to about +17 ft NGVD at Andalusia Boulevard, with about +24 ft NGVD at the north end of Lee County portion of the watershed. The average ground slope in both Lee and Charlotte counties is about one foot per mile. The Majority of the Gator Slough Watershed has soils from the following groups: Boca, Matlacha gravely fine sand, Oldsmar, Pineda and Wabasso. These soils are all in the B/D hydrologic group except the Matlacha gravelly fine sand, which is hydrologic group C.

In the present study, the water table was assumed to be 1.5 ft below the natural ground level to run a steady state groundwater outflow calibration. The MODFLOW results presented in the report have been used as the calibration target to fix the groundwater parameters of the XP SWMM options. The Groundwater input parameters used in the XP SWMM 2000 model are summarized in Table 3 of the report. Max infiltration rate = 2 inch/hour, Min infiltration

rate = 0.1 inch/hour. Decay rate of infiltration = 0.00115 sec^{-1}. Initial depth is assumed to be 4 ft below local land surface. Different *n* values were used in the model based on the conveyance system.

- Channels in the tidal reaches = 0.03
- Freshwater channel located east of Nelson road = 0.07
- From Nelson road due west until weir 11, 13, 14, and 15 = 0.05 or 0.06.

The list of critical attributes of each sub-catchment and conveyance element of the system is provided in pages 59 through 77 of the report.

Tidal Boundary Conditions: The Cape Coral city canals system bounded by the Lee-Charlotte County line on the north limit and by Pine Island road to the south, flows through the basins eventually discharging to the North Spreader Canal System. The Spreader Canal System is designed to intercept discharge of freshwater from the Cape Coral network. The existing Spreader Canal consists of the North Spreader Waterway to the north of Pine Island Road, taken into account in this study, and the South Spreader Waterway to the south of Pine Island Road. In the downstream of Burnt Store Road, North of Spreader Waterway, the conveyance is controlled by the tidal conditions of Matlacha Pass.

Model Geometry and Configuration: For the portion of the watershed north and east of US 41, the model utilizes historical data as the input hydrograph to Gator Slough at its easternmost node. Between Burnt Store Road and US 41 a detailed simulation of the existing canal system is performed. The majority of the channel segments have a relatively uniform cross section with abrupt changes at certain locations. The four main channels are: Gator Slough, Horseshoe, Hermosa, and Shadroe. The cross-sections of Gator Slough Canal are; Bottom Width from 30 to 200 ft, Depth = 12 ft, Bank Slope = 2:1, Side Slope (weir # 9 to weir # 4) = 0.001, (weir # 19 to weir # 11) = 0.0003. The cross-sections and side slopes for other canals are discussed in Page 50 and 51 of the report.

Other Structures: Three water control structures are located downstream of Weir 19; these are weirs 9 (rectangular), 4 (Reinforced concrete rectangular) and 11 (Reinforced concrete rectangular). Downstream of weir 11 there is one culvert and one bridge (94). Upstream of weir 11, there are two other bridges (74 and BS). Bridges and culverts are located on both the main channel and the branch canals. Weir specifications are not mentioned in the report. They are referred to "Report by Connell, Metcalf and Eddy (1979)" and "Johnson Engineering report (1991)".

Upstream Inflow Data: The only data available for calibration and verification was for the Gator Slough Canal Watershed. Therefore, the conceptual methodology adopted to calibrate the model has been to use one year of data for only one subwatershed, Gator Slough Canal Watershed, and assume that the calibrated parameters are applicable to other basins. Upstream inflow to Gator Slough originating from the portions of watershed located north and east of Hwy US 41 are inserted as a "User Inflow" input in node 31 of the model. The

period selected for model calibration includes 24 days from September 5th to 28th, 1996. The input hydrograph at node 31-1 yr event is shown in Figure 38 of the report.

Evaporation and Rainfall Data: The average monthly Evaporation data from periods 1989 to 1997 is obtained from Southwest Florida Research and Education Center. The rainfall data used for calibration come from gauging station of Lake Fairway. However, no rainfall data is provided in the report.

Results: Flow Peak: USGS = 346 cfs, Model = 331 cfs, Deviation = 69 cfs (4.3 %)
Flow Volume: USGS = 8 inches, Model = 7.2 inches, Deviation = 0.8 inches (10%)
Base Flow: USGS = 50 cfs, Model = 50 cfs

Results show that the model is performing well considering the limitations of rainfall dataset. The calibration results are shown in figures 42 through 44, along with the Mass Balance table shown below.

Table 9. Mass balance table

Gator Slough Canal Watershed		
1 year event Sep 5-28, 1996		
Total Area	396,657,360	ft^2
South of Hwy 41	9,106	acres
	14.23	sq. miles
	volume	depth over total area
	(cubic feet)	(inches)
Tot. Inflow	32,719,680	1.0
from North of Hwy 41		
Tot. Rain	277,329,604	8.4
Lake FairAway station		
Tot. Infiltration	177,162,896	5.4
Tot. ET	130,799,266	4.0
Ground Flow	107,381,486	3.2
Tot. outflow	238,055,396	7.2
link weir # 11		
Tot. outflow		
of USGS data	263,260,800	8.0
Missing Runoff	25,205,404	0.8
Percent error	9.6	

Document: Matlacha Pass Hydrologic Restoration Project - Phase 1, Staff Report and Addendum, March 2007. Prepared by South Florida Water Management District in response to the Permit Application 060301-5; Permittee: Lee County

Review Summary: This report was prepared in response to the permit application by Lee County for construction to restore the historical flow patterns in the northwest Lee County drainage basin. The staff report along with addendum was primarily focused on evaluation of the permits and revisions along with specifications of general and special conditions for the project. The study area is located within the right- of- way of Burnt Store Road (within the roadway and roadside swales) north of Gator Slough. Out of 80.1 acres of total study

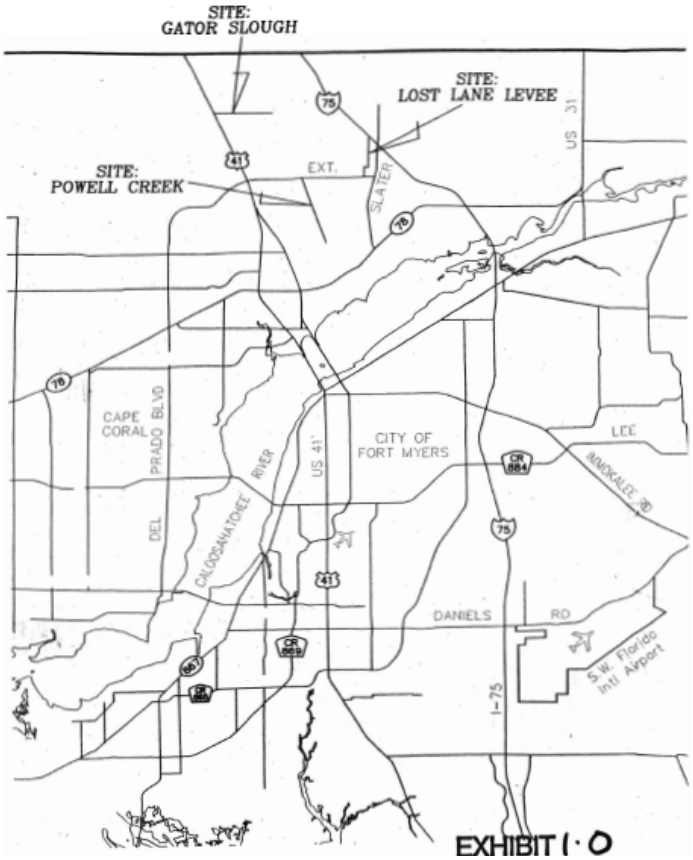
area, roadway consists of 11.6 acres, pervious area spreads on 55.4 acres, and the wetland consists of 13.1 acres. Out of 13.1 acres of wetland, hydric pine comprises of 0.58 acres, hydric melaleuca consists of 4.06 acres, melaleuca invaded freshwater marsh spreads on 2.47acres, freshwater marsh presents in 2.86 acres, and hydric disturbed land consists of 3.18 acres. The total directly impacted wetland area was 5.48 acres located with the eastern and western roadside swales. The freshwater herbaceous mitigation bank was constructed on 1.37 acres at Little Pine Island Mitigation Bank. The following recommendations were proposed in order to prevent the historical flow patterns in the study area.

- Expansion of three cross-drain culverts at stations 82.5, 138.0, and 195.5 under Burnt Store Road to improve east west flow pattern
- Improvement of side drain and roadside ditches along Burnt Store Road to improve the cross-drain culverts conveyance within the individual basins in order to reduce inter basin flows between Greenwell Branch and Gator Slough Basins
- Construction of two drop structures at Burnt Store Road (station 11.0) north of Gator Slough bridge
- Improvement of swale between the Burnt Store Road bridge and station 85.0 in Gator Slough Basin
- Removal of cross drain at the intersection of Durden Parkway and Burnt Store Road
- Maintaining the north invert of side drain pipe at elevation 10.35 feet located at Durden Parkway- Burnt Store Road intersection

Document: North Fort Myers Drainage Restoration Project, Staff Report, February 2006. Prepared by South Florida Water Management District in response to the Permit Application 011130-16; Permittee: Lee County

Review Summary: This report was prepared in response to the permit application by Lee County for construction to restore the surface water flow in Gator Slough System, the Lost lane Levee/ Lee County 2020 Parcel, and the Powel Creek System in northern Lee County. The staff report along with addendum was primarily focused on evaluation of the permits and revisions along with specifications of general and special conditions for the project.

Exhibit 1 of the reference document shows that the Lost Lane site is an approximate backward L shape area located between Lost Lane on the east and Prairie Pines on the west. The south side extends up to Del Prado extension railway through south side of I-75 and the CSX railway. The Powell Creek starts approximately 3.2 miles east of US 41- Del Prado intersection in a north south direction down to the Caloosahatchee River. The Gator Slough begins approximately 2.5 miles north of Powell Creek and Del Prado intersection. First, it flows approximately 3.4 miles in east west direction and then turns 90 degree south for 0.25 miles finally discharging water into Cape Coral Canal System through a culvert under US 41. The Lost Lane site consists of approximately 2.63 acres wetland whereas the Powell Creek contains 7.43 acres wetland and 13.07 acres in case of Gator Slough.



Source: Exhibit 1 of the reference document

The following recommendations were proposed in order to prevent the flooding in the study area.

- Installation of ditch plug along the full length of Lost Lane Levee from I-75 (northern end) to Del Prado (southern end)
- Excavation of 1.32 acres borrow pit along the east west portion of the Prairie Pines area and a series of 20 feet wide top ditch blocks on Lost Lane Levee
- Replacement of twin 60 inch culverts by environmental weirs in Powell Creek
- Development of Powell Creek canal from the twin 60 inch to Del Prado
- Construction of diversion weir at southern edge of degraded willow marsh in Powell Creek
- Construction of berm on south side of the channel and a concrete ditch block weir at western end of Gator Slough improvement area
- Restoration of 4.62 acres of wetland in Lost Lane site and enhancement of 59.14 acres of wetlands within the Prairie Pines 20/20 parcel

Document: North Fort Myers Drainage Restoration Project, General and Special Conditions, February 2006, July 2008, and April 2009. Prepared by South Florida Water Management District in response to the Permit Application 011130-16, 070529-14, and 090206-22; Permittee: Lee County

Review Summary: This document provides the special and general condition for the permit for construction and operation in 14.17 acres which is a part of North Fort Myers Drainage Restoration project. The special conditions of relevance include:

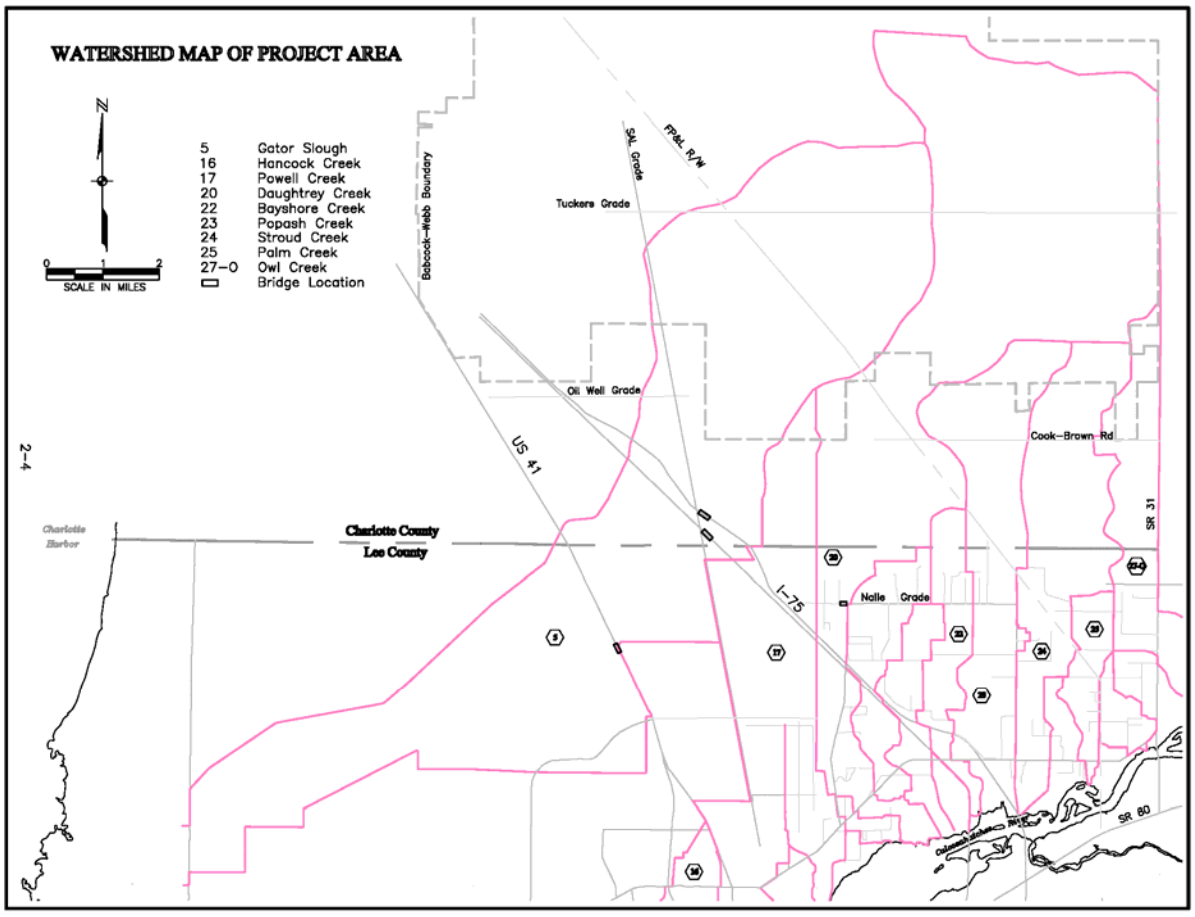
- The construction permit is up to July 10, 2013
- The dimension of discharge facilities should follow the given dimensions
    - Structure 1: 1-2' W X 3.08' L drop inlet with crest at elevation 21.5' NGVD29
      Receiving body: U.S. 41 drainage swale
      Control elevation: 18 feet NGVD29
    - Structure 2: 1-3" dia. circular orifice with invert at elev. 18' NGVD29
      104 LF of 24" dia. REINFORCED CONCRETE PIPE culvert
      1-2' W X 3.08' L drop inlet with crest at elev. 20.5' NGVD29
      Receiving body: Lake
      Control elevation: 18 feet NGVD29
- The permittee is responsible for water quality problems resulting from construction or operation of the surface water management system
- Sedimentation and turbidity should not be violated during construction activity
- The side slope of the lake should no steeper than 4:1 to a depth of 2 feet below control elevation
- Facilities not mentioned in the permit should not be constructed without approval
- Routine maintenance surface water management system to remove all trapped sediments and debris
- Minimum building floor elevation: BASIN: Basin -23.00 feet NGVD29
- Minimum road crown elevation: Basin: Basin -20.20 feet NGVD29
- Minimum parking lot elevation: Basin: Basin -20.20 feet NGVD29
- Best management practice should be implemented for disposal of animal waste and other by products

Document: Surface Water Management Conceptual Plan: South Charlotte County, North Lee County, and Babcock/Webb. 2003. Prepared for South Florida Water Management District; prepared by Johnson Engineering.

Review Summary: This report is a conceptual surface water management plan that covers South Charlotte County, North Lee County, and the Babcock/Webb Wildlife Management Area. The report is divided into the following sections: Introduction, Watershed Map, Historic Flow Routes and Existing Problem Areas, Conceptual Surface Water Management Plan, Conclusions and Recommendations, and an Appendix. The study area is generally bounded by the SFWMD boundary on the north, S.R. 31 on the east, Nalle Grade Road (and

its theoretical east-west extensions) on the south, and U.S. 41 on the west. The objectives of this report were to prepare an integrated watershed map, define the basic problems and identify major areas of flooding, and conceptually outline plans for potential solutions.

The primary watersheds include (from west to east) Gator Slough, Powell Creek, Daughtrey Creek, Bayshore Creek, Popash Creek, Stroud Creek, Palm Creek, and Owl Creek. These watersheds are shown below on a watershed map of the project area.



Of these watershed areas, only Gator Slough extends into the boundaries of the Yucca Pens Unit. The portion of the Gator Slough Watershed lying within the study area of this report consists of approximately 48.7 square miles. The watersheds and the amount of area each encompass at the study area are listed in the table below (excerpted from the source document).

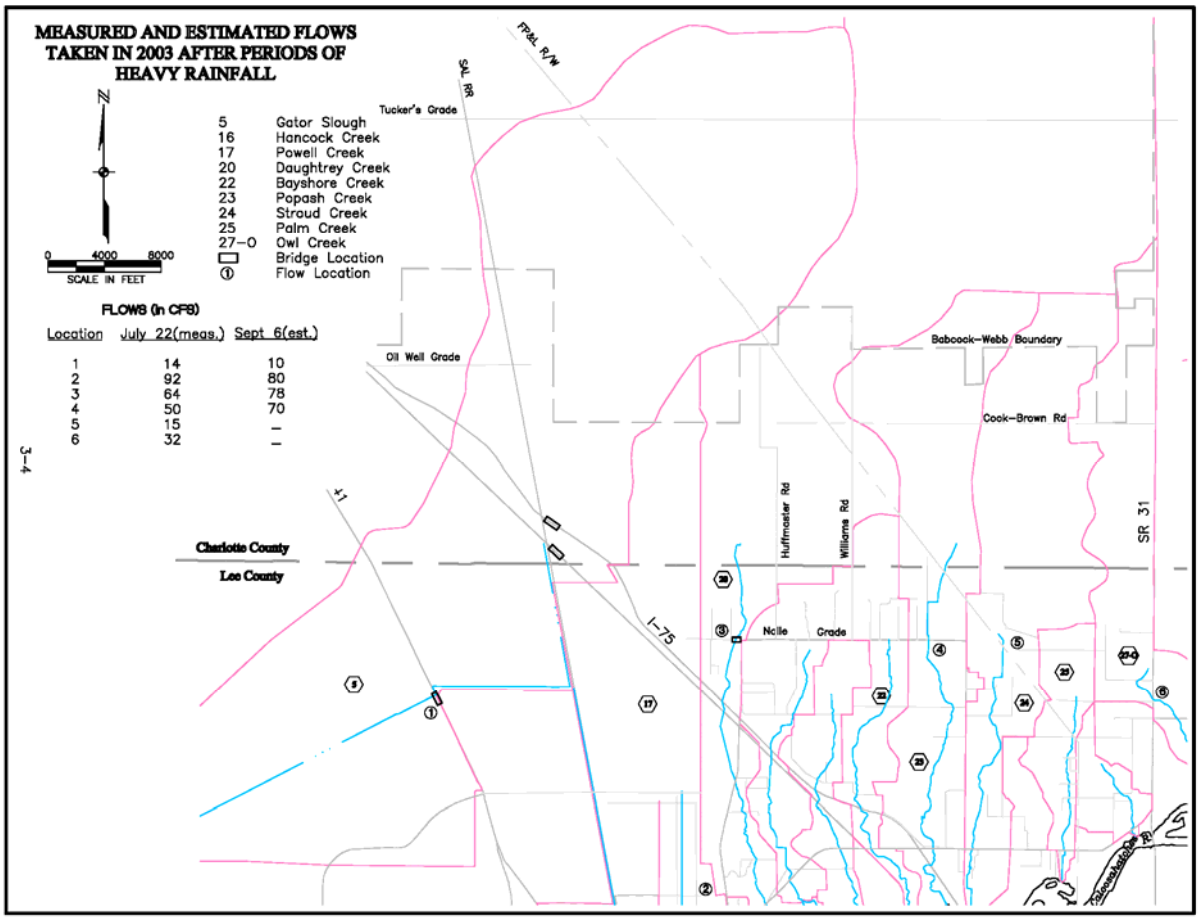
WATERSHED AREA TABLE

AREAS IN SQUARE MILES

WATERSHED	BABCOCK/WEBB	CHAR.CO.(non Babcock/Webb)	LEE CO (to Caloosahatchee R.)	TOTAL WATERSHED AREA
5-GATOR SLOUGH	18.4	7.5	22.8	48.7
16-HANCOCK CREEK	0.0	0.0	4.8	4.8
17-POWELL CREEK	0.3	1.8	9.2	11.3
20-DAUGHTRY CREEK	22.3	7.1	4.1	33.5
22-BAYSHORE CREEK	0.0	0.4	2.5	2.9
23-POPASH CREEK	1.1	4.0	4.2	9.3
24-STROUD CREEK	0.9	4.2	4.0	9.1
25-PALM CREEK	0.0	0.0	1.8	1.8
27-0-OWL CREEK	0.7	2.6	2.4	5.7

Drainage throughout the study area had been primarily from sheet flow in a southwesterly or southerly direction to major drainage structures located at the study area boundaries. These drainage structures existed at the following locations: Gator Slough at U.S. 41 and Powell, Daughtrey, Bayshore, Popash, Stroud, and Palm Creeks at S.R. 78. Recent construction in the Babcock/Webb downstream flow areas has restricted this sheet flow and significant flooding began to occur. An area parallel to and 1500 feet south of Oil Well Grade Road between I-75 and the abandoned Seaboard Airline (SAL) grade was diked, severely constricting flow from the Babcock/Webb area to the south. Sheet flow south to the Caloosahatchee River began to be blocked by development in the Nalle Grade Road area. When the west lanes of U.S. 41 were raised in 1975, sheet flow that crossed over U.S. 41 near the Charlotte/Lee County line was blocked. Prior to construction of I-75 in 1980, sheet flow in the Gator Slough Watershed across the study area was southwesterly towards U.S. 41 into Charlotte Harbor. Diking of a large area from near Oil Well Grade Road south to the I-75 Bridge in the 1980's and subsequent development between U.S. 41 and the 145-foot I-75 Bridge further constricted flow through Gator Slough at the study area.

In order to confirm these constrictive impacts, outfall flows were measured in 2003 following periods of heavy rainfall. The purpose of these measurements was to determine if runoff from upstream sheet flow areas (such as the Babcock/Webb area) were reaching downstream locations. The map below shows the locations of the outfall flows where these measurements were taken.



The table below compares the calculated, measured, and estimated runoff flows taken at each downstream location during this study. This report does not include elevation data on any of the existing structures at the study area.

Location	Upstream Watershed Area	Calculated flow for 1"/day runoff	Measured flow 7/22/03	Estimated flow 9/6/03
1.Gator Box @ US 41	30	807	14	10
2.Powell Box @ Laurel Dr.	6	161	92	80
3.Daughtrey Bridge @ Nalle Grade	31	834	64	78
4.Popash Bridge @ Nalle Grade	6	161	50	70
5.Stroud Culv. near Nalle Grade	6	161	15	-
6.Owl Box @ SR 31	8	215	32	-

The largest watersheds, Gator Slough and Daughtrey Creek, were discharging at rates ranging from only 0.02 to 0.08 inches per day. Since the upstream sheet flow areas were already full prior to these periods of heavy rainfall, runoff to the downstream locations

(measured flow) should have been significant. Although the rainfall total from June through September was over 50 inches, the estimated runoffs were in the range of only 1.5 inches per month. These measurements show the absence of significant downstream flows, indicating upstream constrictions or blockages resulting in substantial ponding or flooding. It had thus been determined that downstream outfall routes must be restored to alleviate upstream flooding. Hydrologic/hydraulic or water quality modeling data is not included in this report.

This conceptual surface water management plan identified three primary options to approaching flood control problems in the study area:

1) Take no action.
2) Acquisition of developed and undeveloped land generally north of Nalle Grade and Del Prado Road Extensions.
3) Opening and perpetuation of primary flow ways, diversion of flows in Gator Slough and Daugherty Creek outfalls and development of off-line detention areas to help attenuate flood flows where practical.

Options 1 and 2 did not appear viable because increased and accelerated development pressures will continue to exacerbate flood problems. Option 3 appeared the most likely to relieve some of the flood problems. Option 3 was determined to be practical under the following courses of action:

1) Re-open historical Gator Slough drainage way.
2) Acquire land areas for off-line storage.
3) Remove constrictions in the Powell Creek – Del Prado area.
4) Protect and perpetuate the Daughtrey Creek flow-way.
5) Investigate a potential diversion swale along the east side of FP&L right-of-way.
6) Enlarge the gate on the Daughtrey Creek impoundment to provide added protection downstream.

The following recommendations were outlined by the conceptual surface water management plan:

1) Acquire right-of-ways along Gator Slough Outfall as listed below:
    a. Oil Well Grade Road to the 145-foot I-75 Bridge.
    b. I-75 to northeast corner of Western Acres.
    c. Northeast corner of Western Acres west to existing Tara Woods Channel.
2) Acquire online storage areas where practical to attenuate flood flows as they move south.
3) Open up the Powell Creek – Del Prado area to route flows south. Care must be taken to not overload downstream structures as they are designed for runoff from only an 11 square mile upstream watershed area.
4) Protect the Daughtrey Creek flow way route from encroachment and remove constrictions.

5) Actuate plan for preparation of an FP&L right-of-way flow way and connection to Palm Creek or Caloosahatchee River.
6) Enlarge the gate on the Daughtrey Creek impoundment in the Babcock/Webb area to provide added protection downstream.
7) The SFWMD will advise the consultant if additional information is needed related to design flow and pipe sizing.

1

APPENDIX C
Base Map and Metadata Files

Task 1 Summary Report
Yucca Pens Hydrologic Restoration Plan
File: Task 1 Readme

NOTE:
This file contains an inventory of the digital data found on the Yucca Pens Hydrologic Restoration Plan DVD. This DVD contains all of the report text, figures, and digital data (GIS coverages including geodatabase) for Task 1 of the study. The main directory structure in the DVD is given below.

Folder Name	**Description**
Readme	Contains the "Task 1 Readme" file (contents of this file)
Report	Contains complete report including Figures and Appendices
Base Map	Contains ArcGIS Coverages (includes metadata in XML format)
Base Map Metadata	Contains all metadata files in HTML format

****

CONDITIONS OF USE:
BPC Group provides this digital data for the express use of:
South Florida Water Management District.
Data contained herein may be subject to change without notice. Responsibility for the accuracy of current conditions and/or digital transfers is solely that of the user. The user of this information must determine the suitability for the intended purpose.
These "CONDITIONS OF USE" shall be supplied to all users of this data.
****

In order to access data recorded on this DVD, a compatible PC along with the following software is required:

Windows XP or higher
Microsoft Office Professional (2003 or later)
ArcGIS Version 9.2 or higher
Adobe Acrobat reader 8 or later or equivalent PDF reader
Internet Explorer Version 8 or higher or comparable software

The total hard disk space required to load all data on this DVD is approximately 3 gigabytes.

NOTE: All data presented in this DVD is for planning purposes only; they may not be suitable for engineering analysis; and the end user is solely responsible for its use. It must be verified in the field prior to any design use.
****

DVD Inventory

Folder Name	**Description**
Readme	Contains the content of this file (Task 1 Readme).
Report	Contains complete report including Figures and Appendices.
Base Map	Contains ArcGIS Coverages (includes metadata in XML format).
Aerials	Contains aerials for Lee and Charlotte counties (195 tiles) (each aerial is represented by 3 files: *.sdw, *.sid, *.aux).

Boundaries	Contains 1 Personal Geodatabase file (7 features classes) and 9 other shapefiles containing the boundary information for Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview and Gator Slough watershed. The Folder also contains shapefile of Florida County Boundaries (each shapefile is represented by 6 files: *.dbf, *.prj, *.sbn, *.sbx, *.shp, *.shx).
Contour	Contains only 1 Geodatabase file of 1 ft contours for Yucca Pens project area.
LandUse_East.gdb	Contains 2004/2005 Land Use/ Land Cover Geodatabase file for Yucca Pens project area.
Roads	Contains 2 shapefiles representing the Roads and Streets information for Lee and Charlotte County (each shapefile is represented by 6 files: *.dbf, *.prj, *.sbn, *.sbx, *.shp, *.shx).
Soils	Contains 2 shapefiles representing Soils in Lee and Charlotte County for Yucca Pens project area (each shapefile is represented by 6 files: *.dbf, *.prj, *.sbn, *.sbx, *.shp, *.shx).
Structures	Contains 5 shapefiles and 2 feature classes representing the Culverts/Bridges, Weirs, Drop Structures, Canals, Seminole Gulf Railway Culverts/Bridges, Historic Flow Ways (Lee County) and Flow Way connections information inside the Yucca Pens project area (each shapefile is represented by 6 files: *.dbf, *.prj, *.sbn, *.sbx, *.shp, *.shx). The folder also contains 3 PDF files of FDOT scanned documents for Culverts/Bridges inside the project area.
Topo_East.gdb	Contains 10 ft DEM for Covering Yucca Pens project area.
Wetland	Contains 3 shapefiles representing the three categories of Wetlands inside the Yucca Pens project area (each shapefile is represented by 6 files: *.dbf, *.prj, *.sbn, *.sbx, *.shp, *.shx).

Base Map Metadata	Contains all metadata files in HTML format.
Aerials	Aerials of Lee and Charlotte Counties contains 2 metadata files, one for each county (a total of 195 tiles).
Boundaries	Contains 16 metadata files for Boundaries.
Contour	Contains 1 metadata file for 1-ft Contours.
LandUse_East.gdb	Contains 10 metadata file for Land Use/ Land Cover.
Roads	Contains 3 metadata files for Roads and Streets.
Soils	Contains 2 metadata file for Soils.
Structures	Contains 7 metadata files for Culverts/Bridges, Weirs, Drop Structures, Flowways and Channels, including Seminole Gulf Railway bridges/culverts.
Topo_East.gdb	Contains 1 metadata file for DEM.
Wetland	Contains 3 metadata files for 3 categories of wetlands.

Task 1 Summary Report
Yucca Pens Hydrologic Restoration Plan
List of Metadata Files in HTML Format

List of Metadata Files in HTML Format included in the "Base Map Metadata" folder in the DVD.

Folder: Aerials (2007/2008 Aerials for Lee and Charlotte Counties)

There are 195 raster files of aerials: one file for each tile of the aerials. These represent the aerials for two counties: Lee and Charlotte Counties. The following two files are listed as representative of the Lee County metadata file and Charlotte County metadata file.

charlotte county aerials.html	Metadata file for 189 tiles for Charlotte County
lee county aerials.html	Metadata file for 6 tiles for Lee county

Folder: Boundaries	**(Watershed boundaries and County boundaries)**
durden_creek.html	Metadata file for durden_creek
gator_slough.html	Metadata file for gator_slough
gator_slough_divide.html	Metadata file for gator_slough_divide
greenwell_branch.html	Metadata file for greenwell_branch
longview_run.html	Metadata file for longview_run
yucca_pens_creek.html	Metadata file for yucca_pens_creek
burnt_store_boundary.html	Metadata file for burnt_store_boundary.shp
cntbnd.html	Metadata file for cntbnd.shp
durden_creek_subbasins.html	Metadata file for durden_creek_subbasins.shp
gator_slough_subbasins.html	Metadata file for gator_slough_subbasins.shp
greenwell_branch_subbasin.html	Metadata file for greenwell_branch_subbasin.shp
longview_subbasins.html	Metadata file for longview_subbasins.shp
subbasins_081804.html	Metadata file for subbasins_081804.shp
webb_watersheds.html	Metadata file for webb_watersheds.shp
yucca_pens_subbasins.html	Metadata file for yucca_pens_subbasins.shp
yucca_pens_project_area.html	Metadata file for yucca_pens_project_area.shp

Folder: Contour	**(Topographic Contours for the Project Area)**
contour10_1ft_east.html	Metadata file for contour10_1ft_east

Folder: Landuse_East.gdb	**(2004/2005 Land Use Land Cover Maps)**
fdem_tiles_east.html	Metadata file for fdem_tiles_east
flu_234.html	Metadata file for flu_234
flu_main.html	Metadata file for flu_main
flu_misc.html	Metadata file for flu_misc
flu_model.html	Metadata file for flu_model
landuse_fluccs.html	Metadata file for landuse_fluccs
landuse_source.html	Metadata file for landuse_source
lu_main.html	Metadata file for lu_main
lu_model.html	Metadata file for lu_model
stats.html	Metadata file for stats

Folder: Roads	**(Major roads and streets for the project area)**
MajorRoads.html	Metadata file for MajorRoads.shp
streets.html	Metadata file for streets.shp

Task 1 Summary Report
Yucca Pens Hydrologic Restoration Plan
List of Metadata Files in HTML Format

Folder: Soils	**(NRCS soils maps for the project area)**
Soils_clipped_Lee.html	Metadata file for Soils_clipped_Lee.shp
Soils_clipped_Charlotte .html	Metadata file for Soils_clipped_Charlotte.shp
Folder: Structures	**(Hydraulic structures: culverts, canals, weirs)**
channels_120604.html	Metadata file for channels_120604.shp
culverts_bpc_generated.html	Metadata file for culverts_bpc_generated.shp
drop_structures_120604.html	Metadata file for drop_structures_120604.shp
flowways2005.html	Metadata file for feature class flowways2005
flowwayshistoricconnections.html	Metadata file for feature class flowwayshistoricconnections
sgrr_bridges_culverts.html	Metadata file for SGRR_bridges_culverts.shp
weirs_120604.html	Metadata file for weirs_120604.shp
Folder: Topo_East.gdb	**(DEM raster datasets for the project area)**
topoeast_10ft.html	Metadata file for topoeast_10ft
Folder: Wetland	**(Wetland categories for the project area)**
category_1.html	Metadata file for category_1.shp
category_2.html	Metadata file for category_2.shp
category_3.html	Metadata file for category_3.shp

Metadata:

- Identification_Information
- Data_Quality_Information
- Spatial_Data_Organization_Information
- Spatial_Reference_Information
- Entity_and_Attribute_Information
- Distribution_Information
- Metadata_Reference_Information

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Citation:
Citation_Information:
Originator:
Northwest Lee Stormwater Management Plan Report by Boyle Engineering Corporation and SFWMD
Publication_Date: March 2005
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Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage:
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Abstract:
The Shapefile contains Yucca Pens Project Area boundary obtained after merging 5 watersheds; Yucca Pen Creek, Durden Creek, Greenwell Branch, Longview Branch and Gator Slough watershed (Including Watersheds on East and West part of US-41).
Purpose: Conduct a Site Reconnaissance Study of Yucca Pens Area
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East_Bounding_Coordinate: -81.819716

North_Bounding_Coordinate: 26.902205
South_Bounding_Coordinate: 26.679194
Keywords:
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Access_Constraints: No Access Constraints
Use_Constraints: No User Constraints
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
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Contact_Person: Bijay K. Panigrahi
Contact_Address:
Address: 6925 Lake Ellenor Drive, Suite 112
City: Orlando
State_or_Province: Florida
Postal_Code: 32809
Country: USA
Contact_Voice_Telephone: 407-851-5020
Contact_Electronic_Mail_Address: bpanigrahi@bpcgi.com
Native_Data_Set_Environment:
Microsoft Windows XP Version 5.1 (Build 2600) Service Pack 3; ESRI ArcCatalog 9.2.6.1500

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False_Easting: 656166.666667
False_Northing: 0.000000
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Planar_Coordinate_Encoding_Method: coordinate pair
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Abscissa_Resolution: 0.000000
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Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Vertical_Coordinate_System_Definition:
Altitude_System_Definition:
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Altitude_Distance_Units: feet
Altitude_Encoding_Method:
Explicit elevation coordinate included with horizontal coordinates

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Attribute_Definition: Internal feature number.
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Attribute_Domain_Values:

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Sequential unique whole numbers that are automatically generated.
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Attribute_Definition: Internal feature number.
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Sequential unique whole numbers that are automatically generated.
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Attribute_Definition: Feature geometry.
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Attribute_Label: SHAPE_Leng

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Metadata_Reference_Information:
Metadata_Date: 06/29/2009
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: BPC Group
Contact_Person: Bijay K. Panigrahi
Contact_Address:
Address_Type: mailing and physical address
Address: 6925 Lake Ellenor Drive, Suite 112
City: Orlando
State_or_Province: Florida
Postal_Code: 32809
Country: USA

Contact_Voice_Telephone: 407-851-5020
Contact_Electronic_Mail_Address: bpanigrahi@bpcgi.com
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
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APPENDIX D
Response to Interagency Deliverable Review Team Comments

YUCCA PENS HYDROLOGIC RESTORATION PLAN
INTERAGENCY DELIVERABLE REVIEW TEAM COMMENTS

DELIVERABLE # 1 - SUMMARY REPORT AND METADATA

Instructions:
Please submit comments via e-mail to each of the following addresses: **Judith Nothdurft (jnothdur@sfwmd.gov); CC: Clyde Dabbs (cdabbsjr@sfwmd.gov) & Julianna da Frota (jdafrota@sfwmd.gov)**
Please complete the requested information for each comment
Please consolidate comments for individual agency/organization on one comment sheet

Section #: Indicate Section such as 3.4 or 3.4.1 as applicable and **Page #**
Line #: If multiple lines are included in your comment, please copy and paste the referenced text or include the first line followed by a hyphen and the last line without spaces
Comments: Please be very specific with your comments
Language or verbal changes - Please cut and paste the original excerpt, strike through words to be omitted and underline added words
Comments needing references - Please provide an electronic version (pdf or word) of references or web addresses to reference the document
Name/Agency: This is the name of the person making the comment and agency or entity they work for
PM/Consultant Response to Comments: Project Manager or Consultant's response including if comments were incorporated or addressed and where

Section #, Page #, and Line #	Comment	Name/Agency	SFWMD/Consultant Response to Comments; Incorporated or Addressed Y/N - Where
	Reviewed Deliverable #1 - no comments	Shelley Thornton/SWFWMD	Thank you.
	Reviewed Deliverable #1 - no comments	Bill Byle/Charlotte County Growth Management Dept.	Thank you.
	Reviewed Deliverable #1 - no comments	Harry Neeves/Seminole Gulf Railway	Thank you.
	Reviewed Deliverable #1 - no comments	Stephanie Smith/Cape Coral Public Works	Thank you.
General	We believe the Task 1 report adequately summarizes the data and information given to the contractors by the SFWMD.	Jennifer Nelson, John Aspiolea, Melynda Brown/FDEP	Thank you.
General	As we move into Task 2 of the project, we recommend that the work done by our small group on flowway restoration options (meeting on 6-5-09) be incorporated and further developed.	Jennifer Nelson, John Aspiolea, Melynda Brown/FDEP	The SFWMD will forward the NSEMA **NEB: Flowway Restoration Meeting 6-5-09 Notes** to the consultant. This will be noted in the Task 2 Technical Memorandum as part of the NSEMA process. It is beyond the current scope of work.
General	In addition, we would like to emphasize the importance of incorporating projects or actions aimed at improving the hydrologic and water quality characteristics of natural systems including freshwater wetlands, and the receiving estuarine systems into the Multifunctional Water Management Plan.	Jennifer Nelson, John Aspiolea, Melynda Brown/FDEP	Beyond the current scope of work. This may be considered as a recommendation in the Task 2 Technical Memorandum.
1.2, 1-3, 19-20	The type of permits required will be very general, because without a specific design it's hard to specify the exact level of permitting needed.	Laura Layman/SFWMD	Concurred.
2.1, 2-1, 38	May want to add ERP application number references for SR31 widening application, Babcock Ranch ERP, Magnolia Landing, Edison Farms and Williams Road excavation application. Also, Interstate 75 widening from Lee/Charlotte County line to north of Tuckers Grade will be submitting an ERP application in the near future, which has ramifications for this study area. Another project to be aware of is the proposed Charlotte County Wellfield northeast of Babcock Ranch (east of SR 31 and South of Bermont Road).	Laura Layman/SFWMD	Beyond the current scope of work. This may be considered as a recommendation in the Task 2 Technical Memorandum.

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General	General comment: would be a good idea to survey onsite/nearby wetlands for signs of biological indicators for average wet season water levels (stain lines, lichen lines, adventitious roots, etc.) Also can use any surface water monitoring data in the area, if available.	Laura Layman/SFWMD	Beyond the current scope of work This may be considered as a recommendation in the Task 2 Technical Memorandum.
2.2, 2-2, 21	GIS Coverages: I would recommend adding nearby wellfield boundaries and also water use permit boundaries.	Laura Layman/SFWMD	Beyond the current scope of work. This may be considered as a recommendation in the Task 2 Technical Memorandum.
4.0, 4-1, 32	Need to clarify what "restoration of ecological integrity of the ecosystem" means. For wetlands, you can set specific hydrologic stage and duration targets for different habitat types.	Laura Layman/SFWMD	This will be defined in the Task 2 Technical Memorandum.
2.1, 2-1, 38	**Comment on 7/1/09 Draft Report** - The consultant must review the goals and objectives of the management plan for the Charlotte Harbor Buffer State Park and Aquatic Preserve maintained by DEP. Portions of the preserve is located within the Yucca Pen watershed. Restoration efforts shall meet the goals and objectives of the preserve.	Anura Karuna-Muni/Lee County Natural Resources	The *Charlotte Harbor Preserve State Park Unit Management Plan and Charlotte Harbor Aquatic Preserves Management Plan* have been forwarded to the consultant. The goals and objectives of these Plans relevant to the *Yucca Pens Hydrologic Restoration Plan* will be summarized in the Task 2 Technical Memorandum.
2.3, 2-2, 35	**Comment on 7/1/09 Draft Report** - Culvert information from Matlacha Pass Hydrologic Restoration Plan - Phase I by Lee County	Anura Karuna-Muni/Lee County Natural Resources	This document is included in the Review Sources provided to the consultant and a summary of the report is included in Appendix B Review Summary of Reports and Documents.
3.7, 3-18, 30	**Comment on 7/1/09 Draft Report** - Recommendations from management plan for the Charlotte Harbor Buffer State Park and Aquatic Preserve must be included.	Anura Karuna-Muni/Lee County Natural Resources	These Plans have been forwarded to the consultant. The goals and objectives of these Plans relevant to the Yucca Pens Hydrologic Restoration Plan will be summarized in the Task 2 Technical Memorandum.
General	**Comments on 5/28/09 Draft Report -** The report looks incomplete; lacks details and specifics	Anura Karuna-Muni/Lee County Natural Resources	Comment is not relevant as it was based on the preliminary 5/28/09 Draft.
1, 1, 41	**Comment on 5/28/09 Draft report -** The consultant must review the goals and objectives of the management plan for the Charlotte Harbor Buffer State Park and Aquatic Preserve maintained by DEP. Portions of the preserve is located within the Yucca Pen watershed. Restoration efforts shall meet the goals and objectives of the preserve.	Anura Karuna-Muni/Lee County Natural Resources	These Plans have been forwarded to the consultant. The goals and objectives of these Plans relevant to the Yucca Pens Hydrologic Restoration Plan will be summarized in the Task 2 Technical Memorandum.
1, 1, 20	**Comment on 5/28/09 Draft Report -** No mention about the existing railroad bed and its implications on the water resources	Anura Karuna-Muni/Lee County Natural Resources	This is a summary report deliverable. The implications of relevant elements will be included in Task 2 Technical Memorandum conceptual plan development.
1.1, 3, 11	**Comments on 5/28/09 Draft Report** - Objectives shall include restoration of outfalls to Matlacha Pass and Charlotte Harbor Buffer State Park and Aquatic Preserve.	Anura Karuna-Muni/Lee County Natural Resources	The Yucca Pens Hydrologic Restoration Plan, 2.0 Objectives, Objective 7. states: Restoration of historic outfall to Charlotte Harbor.

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1.1, 3, 11	**Comment on 5/28/09 Draft Report** - Some of the historic flows to Matlacha Pass and Charlotte Harbor is cut off by construction of I-75 causing redistribution of some of these flows east of I-75 to flow south resulting flooding in North Fort Myers areas. Restoration of hydrologic conditions east of I-75 also must be considered.	Anura Karuna-Muni/Lee County Natural Resources	The Yucca Pens Hydrologic Restoration Plan is investigating flow restrictions that impact the Yucca Pens project area, which includes some areas east of I-75.
1.2, 4, 31	**Comment on 5/28/09 Draft Report** - Why the water quality analysis based only on WMD data? Why other available data is not used?	Anura Karuna-Muni/Lee County Natural Resources	SFWMD PM will request the commenter to provide the relevant data that he is referring to and those datasets may be considered for incorporation in Task 2.
1.2, 4, 38	**Comment on 5/28/09 Draft Report -** Need to review reports related to historical drainage maps for areas east of I-75	Anura Karuna-Muni/Lee County Natural Resources	The SFWMD PM will request the commenter to clarify which reports and maps he is referring to.
1.2, 4, 39	**Comment on 5/28/09 Draft Report -** Need to review goals and objectives of the management plan for Charlotte Harbor Buffer State Park and Aquatic Preserve	Anura Karuna-Muni/Lee County Natural Resources	These Plans have been forwarded to the consultant. The goals and objectives of these Plans relevant to the Yucca Pens Hydrologic Restoration Plan will be summarized in the Task 2 Technical Memorandum.
2.3, 6, 34	**Comment on 5/28/09 Draft Report** - Other data must include hydrologic data in the Lee County hydrologic data network	Anura Karuna-Muni/Lee County Natural Resources	The SFWMD PM will request the commenter to provide the relevant data that he is referring to and those datasets may be incorporated in Task 2.
3.1.1, 7, 24	**Comment on 5/28/09 Draft Report** - Check the south boundary of fig 3-1 east of I-75	Anura Karuna-Muni/Lee County Natural Resources	The consultant will check this.
3.1.3, 10, 21	**Comment on 5/28/09 Draft Report** - My understanding of Lidar data in Lee county is it meets national map accuracy standards for 2-foot contours. Check with Amy Hoyt (tel. 239 533 8558) at Lee county or Tim Liebermann at WMD.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
3.1.5, 13, 20	**Comment on 5/28/09 Draft Report** - Summary of the modeling of NW Lee county study is provided on the report. Details are provided in the appendices. Hard copy of the volume 2 of the report containing all appendices is available in the Lee county natural resources library.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
4.0, 19, 9	**Comment on 5/28/09 Draft Report** - Hard copy of the volume 2 of the report containing all appendices is available in the Lee county natural resources library.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
4.0, 19, 15	**Comment on 5/28/09 Draft Report** - My understanding of Lidar data in Lee county is it meets national map accuracy standards for 2-foot contours. Check with Amy Hoyt (tel. 239 533 8558) at Lee county or Tim Liebermann at WMD.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
4.0, 20, 9	**Comment on 5/28/09 Draft Report** - Hard copy of the volume 2 of the report containing all appendices is available in the Lee county natural resources library.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
4.0, 20, 15	**Comment on 5/28/09 Draft Report -**The WMD needs to include other parties affected by this study to their meetings with the consultant.	Anura Karuna-Muni/Lee County Natural Resources	SFWMD has assembled a Yucca Pens Interagency Deliverable review Team to provide input and comments on the Yucca Pens Hydrologic Restoration Plan.
Appendix A, A-3, 7	**Comment on 5/28/98 Draft Report -** A hard copy of appendices is available at Lee county natural resources library.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.
Appendix A, A-4,16	**Comment on 5/28/09 Draft Report** - Appendix G is available in the volume 2 of the report. A hard copy of the volume 2 of the report containing all appendices is available in the Lee county natural resources library.	Anura Karuna-Muni/Lee County Natural Resources	This issue has been resolved as reflected in the 7/1/09 Draft Summary Report and Metadata.

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1.1, 1-3, 12	Add "Maintenance recommendations of existing flow ways" to the list of objectives.	John DeGiovine Jr./Charlotte County Public Works	This can be added as a recommendation in the Task 2 Technical Memorandum.
4, 4-1, 36	Add "Maintenance recommendations of existing flow ways" to the list of objectives.	John DeGiovine Jr./Charlotte County Public Works	This can be added as a recommendation in the Task 2 Technical Memorandum.
General	Although this document and its objectives references restoring historic sheet flow where feasible, channel maintenance (where it is necessary), should also be evaluated for the following reasons: 1. The lack of channel maintenance may be a factor with respect to existing flooding conditions. 2. If an agency chose to perform channel maintenance activities, this could drastically increase flow rates and potentially adversely affect downstream conditions if not considered in the modeling.	John DeGiovine Jr./Charlotte County Public Works	This can be added as a recommendation in the Task 2 Technical Memorandum.
1.2,1-4, 25	Sub Task 2.1 -Recommend including an evaluation of major roads with respect to local governments stormwater level of service (LOS) objectives to aid in determining culvert deficiencies.	John DeGiovine Jr./Charlotte County Public Works	This can be added as a recommendation in the Task 2 Technical Memorandum.
1.1, 1-2, 39-41	This needs to be reworded to include FWC but also various other City, County, State and Federal Agencies that may cooperate in this project. With budgetary constraints as they are, it is unlikely FWC alone will be able to complete this in a timely manner.	Mike Kemmerer/FWC	Concur. The SFWMD would be looking for participation from all partners in the region for any potential future project implementation.
	The one drawing I was a little confused about was regarding the structures and how they determined where they would go. I am sure this will or may change after the field visit and other items that may go into the final report.	Mike Kemmerer/FWC	The structure coordinates in Figure 3-9a were provided based on the information extracted from the available sources listed in Section 2 of Deliverable #1, Summary Report and Metadata. Figures 3-9b and 3-9c are schematic modeling diagrams representing values used in modeling from the NW Lee County Surface Water Management Plan.