DEPARTMENT OF THE ARMY PERMIT APPLICATION

APRIL 2020

COLLIER COUNTY
COMPREHENSIVE WATERSHED IMPROVEMENT PLAN
COLLIER COUNTY, FLORIDA

SUPPLEMENTAL INFORMATION
ATTACHMENT 7

NATURAL RESOURCES ASSESSMENT

Collier County Comprehensive Watershed Improvement Project

Supplemental Information Attachment 7 Natural Resources Assessment

Introduction

Collier County proposes a hydrologic restoration of Picayune Strand State Forest and adjacent lands just east of Naples, FL. The 22,000 project assessment area includes a primary effects area of over 9,000 acres of wetlands (and some upland inclusions, mainly Pine Flatwoods). The remainder of the assessment area will have lesser effects, with no and de minis changes at the assessment area borders. The project area has little development; most privately owned property has not been significantly disturbed although some mining and agricultural activities still occur within the assessment footprint. The main disturbance includes dirt roads that allow seasonal access to the area. The project overview (**Supplemental Information Attachment 1**) and related construction drawings (**Permit Drawings**) provide a detailed description of the proposed project, project purpose and need, project operations, monitoring plans, and adaptive management plan.

Assessment Area Soils and Vegetation

Project area soils are described in **Appendix 1**. The appendix includes a USDA NRCS soil resources tailored to the project assessment area. Figures depicting the soils in each project impact area are included in **Supplemental Information Attachment 2** Application Figures**.**

The 22,131 acre assessment area is dominated (89% to the total land cover) by four vegetation communities (**Figure 1**): Cypress (FLUCCS 421), Cypress-Pine-Cabbage Palm (FLUCCS 5624), Hydric Pine (FLUCCS 625) and Pine Flatwoods (FLUCCS 411; an upland community). Mixed Wetland Hardwoods is the only other natural community with more than 1% coverage. Agricultural and disturbed land categories account for another 4.8%, and all other uses account for the remaining 6.3% of the assessment area.

Within the assessment area, the Core Rehydration Area (Figure 2: CRA: 2,389 acres) and the Flowway Extent (Figure 3: FE: 6,538 acres) comprise the area where the hydrologic restoration will be most complete. Land use cover of these areas, and the rest of the assessment area have land use distribution patterns similar to the overall land use structure (**Supplemental Information Attachment 6**: Vegetation Hydrology Effects Analysis). **Supplemental Information Attachment 6** also provides a detailed analysis of project effects on the dominant vegetation communities in the assessment area.

Animal Species

Common animal species include birds (green heron, red-bellied woodpecker, red shouldered hawk, herons); snakes (banded and green watersnakes, cottonmouth, mud, black racer); turtles (musk, red-bellied cooter, mud); frogs (leopard, pig, bull, green tree); mammals (feral hog, opossum, armadillo, raccoon, white-tailed deer, squirrels,), among others. Part of the project area is within the Picayune Strand Wildlife Management Area, where hunting is a popular activity. Hunting for deer and turkey, small game (gray squirrel, quail rabbit, raccoon opossum, armadillo beaver, coyote, skunk, nutria, non-native reptiles, and migratory birds in season), and frogs is regulated by the Florida Fish and Wildlife Conservation Commission (FWC) and may require a hunting license, depending on the species being hunted.

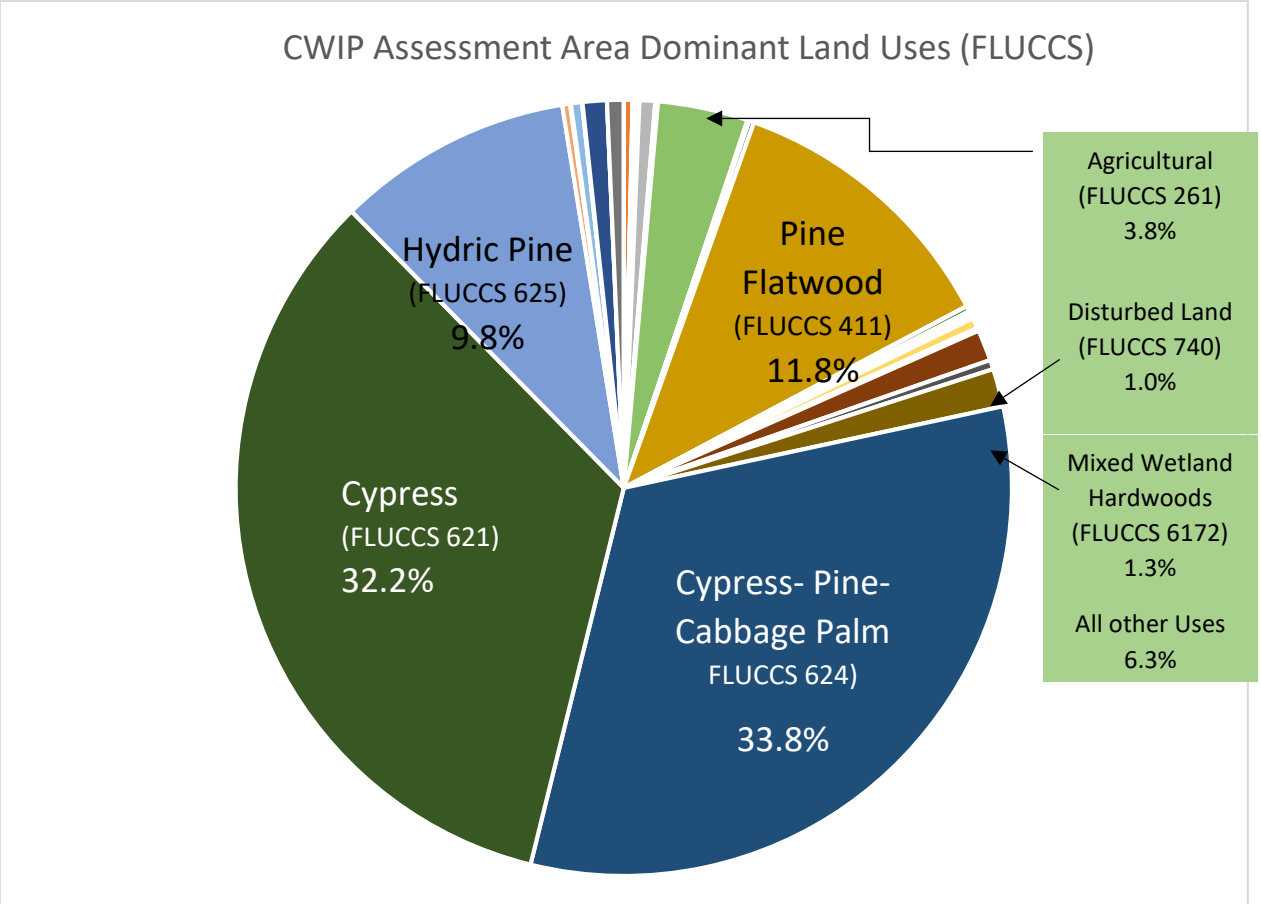


Figure 1. Percent FLUCCS land uses in the Project Assessment Area.

A number of state and federally listed animal species occur in the project area. **Table 1** summarizes the results of combined IPAC and FNAI database searches for species of concern and listed species of concern identified by USFWS (**Appendix 2**: Kim Dryden, Personal Communication December 5, 2019 Meeting Summary). No critical habitat for any of the species occurs in the project area.

Table 1. Listed Species known to Occur in the Project Assessment Area.

Class	Common Name	Scientific Name	Federal Status [1]	State Status [2]
Mammals	Florida Panther	*Puma concolor cougar*	Endangered	Endangered
	Mangrove Fox Squirrel	*Sicurus niger avicennia*	NL	Threatened
	Florida Bonneted Bat	*Eumops floridanus*	Endangered	Endangered
	West Indian Manatee	*Trichechus manatus*	Threatened	Threatened
Birds	Red-cockaded Woodpecker	*Picoides borealis*	Endangered	Endangered
	Wood Stork	*Mycteria americana*	Threatened	Threatened
Reptiles	Eastern indigo snake	*Drymarchon corais couperi*	Threatened	Threatened
	Gopher tortoise	*Gopherus polyphemus*	Candidate	Threatened

Class	Common Name	Scientific Name	Federal Status [1]	State Status [2]
[1] Official Species List; USFWS IPaC website (accessed January 2020) [2] FNAI Report for Matrix Unit 43874-43880, 43130-43136, 43502-43508, 42385-42391, 42757-42763, 41641-41648, 42012-42020, 41270-41273, 41649 (accessed January 2020) NL – Not Listed				

Of those listed species, Florida Panther, Red Cockaded Woodpecker, and Bonneted Bat are of particular concern, as the project will impact Florida Panther habitat, could (but is not likely to) affect Red Cockaded Woodpecker habitat. Little is known of the bonneted bat in the project area.

Appendix 3 Panther Habitat Assessment uses the USFWS Panther Habitat Assessment Methodology (USFWS, 2012) to calculate impacts of proposed project construction and required Panther Habitat Units (PHUs) to offset the proposed impacts. The USFWS and USACE will review the calculations and tabular results in Table 1 as part of the USACE permit application review process.

Table 2. Results of Florida Panther Habitat Assessment for the Project Impact Areas

Impact and Mitigation Panther Habitat Unit (PHU) Calculations	
Existing PHUs	354.52
Proposed PHUs	142.94
Net PHUs	211.58
Base Ratio	1.98
Required Mitigation PHUs	418.93

FWS has recommended that the county plan a denning survey prior to construction at any location. If any dens are located, USFWS will be contacted and it is likely construction will be halted until the den is vacated. At the appropriate time Collier County will submit a denning survey for approval and consult with FWS on the methods and survey results.

Appendix 4 Red Cockaded Woodpecker Habitat Hydrology Assessment assesses changes to the Red Cockaded woodpecker habitat in the project area by comparing long-term simulations of existing and with project hydrology by community type in the project areas where Red Cockaded woodpecker nests occur. The assessment indicates that the project will not impact RCW habitat hydrology. The RCW habitat areas, outside the main hydrologic effects area, shows only very minor or no changes in with-project hydrology of key vegetation communities in those locations.

Little is known of the Bonneted Bat in the project area or elsewhere in the region. as part of the federal authorization USFWS has required initial surveys of the Bonneted Bat (see **Appendix 2** for a summary of that discussion) around and within each impact area. The USFWS reviewed and accepted the proposed initial field survey plans, and fieldwork is now underway. Additional survey work may be required after the initial survey findings are reported.

The Vero Beach USFWS office has an Eastern Indigo sighting database, not currently available due to lawsuit activity, but when the database becomes available, FWS has requested that Collier County search the database to identify any sightings within 0.62 miles of each project construction footprint and consult with it on the results. Collier County plans to take all necessary actions recommended under the current Eastern Indigo Snake guidance to avoid and minimize impacts to this species.

The Wood Stork Core Foraging Area (18.6 mile radius of the nesting colony) intersects with the project footprint. USFWS-Vero Beach wood stork programmatic key was used to determine impacts to the Wood Stork. The key (**Appendix 5**) leads to a conclusion of May Affect Not Likely to Adversely Affect (MANLAA). Outside of the construction footprint, habitat restoration as a result of the project will also improve foraging habitat for the wood stork as they use wetlands to forage at the edges of channels and ditches.

Little gopher tortoise habitat exists in the project area (almost completely wetland habitats) and the Eastern Indigo snake does not use the burrow as a temperature refuge in southwest Florida.

The Mangrove Fox Squirrel (also known as the Big Cypress Fox Squirrel) is primarily a ground-dwelling species that inhabits stands of cypress, slash pine savanna, mangrove swamps, tropical hardwood forests, live oak woods, coastal broadleaf evergreen hammocks, and suburban habitats including golf courses, city parks, and residential areas in southwest Florida.
(https://myfwc.com/wildlifehabitats/profiles/mammals/land/big-cypress-fox-squirrel/)

The IPaC also listed other species that may be found in the larger project area. All are recognized as state and federally threatened species:

- Audubon's Crested Caracara *Polyborus plancus audubonii*
- Everglades Snail Kite *Rostrhamus sociabilis plumbeus*
- Florida Scrub-jay *Aphelocoma coerulescens*
- Red Knot *Calidris canutus rufa*
- American Crocodile *Crocodylus acutus (state listed as endangered, federally threatened)*

FWS recommendations for surveys and other actions to satisfy FWS project concerns regarding the species in the list immediately above are summarized in **Appendix 2**.

References

USFWS 2012. Panther Habitat Assessment Methodology September 24. 2012. Accessed 12-2019 at https://www.fws.gov/verobeach/MammalsPDFs/20120924_Panther%20Habitat%20Assessment%20Method_Appendix.pdf

APPENDIX 1: USDA – NRCS SOIL RESOURCE REPORT

United States Department of Agriculture

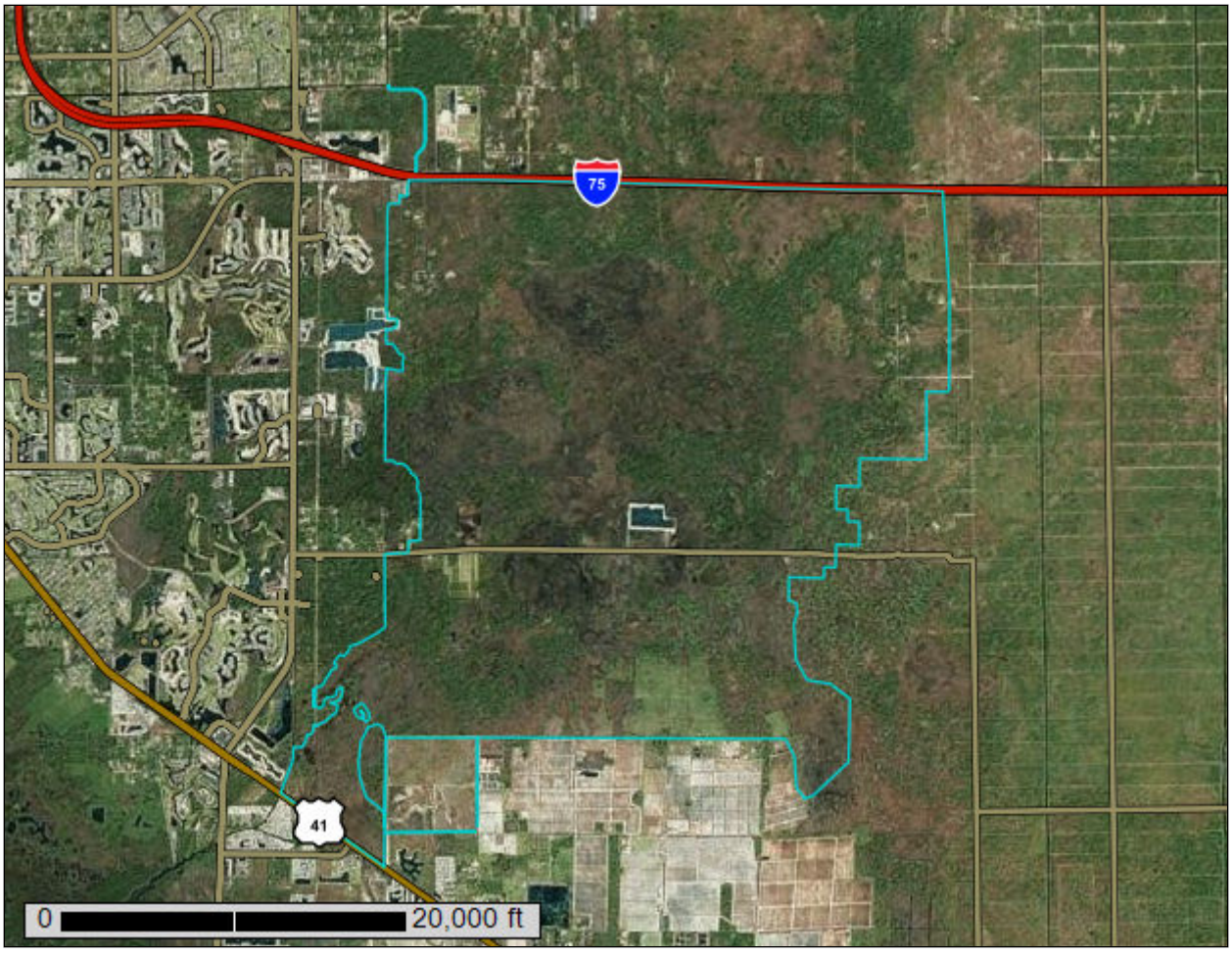
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Collier County Area, Florida

Project Assessment Area & Impact Footprints



February 4, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

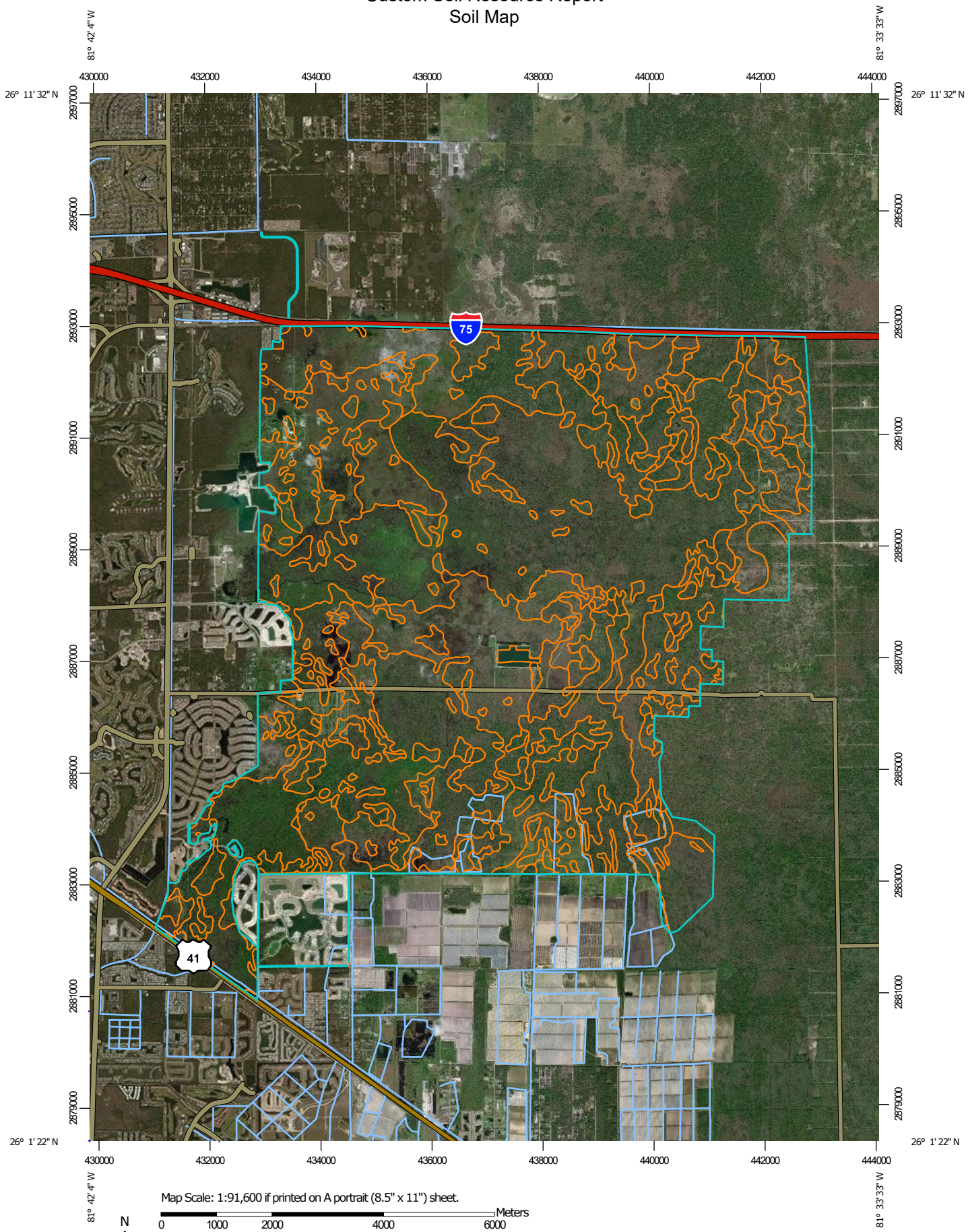
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Collier County Area, Florida
Survey Area Data: Version 13, Feb 3, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Dec 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2	Holopaw fine sand, limestone substratum, 0 to 2 percent slopes	3,346.7	15.1%
4	Chobee, limestone substratum-Dania, frequently ponded, association, 0 to 1 percent slopes	82.4	0.4%
10	Oldsmar fine sand, limestone substratum, 0 to 2 percent slopes	272.3	1.2%
11	Hallandale fine sand, 0 to 2 percent slopes	645.3	2.9%
14	Pineda fine sand, limestone substratum, 0 to 2 percent slopes	3,296.8	14.9%
18	Riviera fine sand, limestone substratum, 0 to 2 percent slopes	436.3	2.0%
20	Ft. Drum-Malabar, high association, 0 to 2 percent slopes	4.6	0.0%
21	Boca fine sand, 0 to 2 percent slopes	1,182.0	5.3%
22	Chobee, Winder, Gator soils, frequently ponded, 0 to 1 percent slopes	7.0	0.0%
23	Holopaw-Okeelanta, frequently ponded, assocaition, 0 to 1 percent slopes	20.3	0.1%
25	Boca-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 perent slopes	8,572.1	38.7%
27	Holopaw fine sand, 0 to 2 percent slopes	2.1	0.0%
31	Hilolo, Jupiter, Margate fine sands, 0 to 2 percent slopes	8.4	0.0%
48	Pennsuco silt loam, frequently ponded, 0 to 1 percent slopes	13.3	0.1%
49	Hallandale-Boca fine sands association, 0 to 2 percent slopes	3,991.1	18.0%
50	Ochopee fine sandy loam, low	108.5	0.5%
51	Ochopee fine sandy loam, frequently ponded, 0 to 2 percent slopes	27.6	0.1%
99	Water	36.0	0.2%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
102	Boca fine sand-Urban land complex, 0 to 2 percent slopes	1.1	0.0%
103	Boca-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes	23.2	0.1%
109	Ft. Drum-Malabar, high, fine sands-Urban land association, 0 to 2 percent slopes	0.3	0.0%
111	Hallandale-Boca fine sands-Urban land association, 0 to 2 percent slopes	3.9	0.0%
114	Holopaw fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes	29.4	0.1%
120	Malabar fine sand-Urban land complex, 0 to 2 percent slopes	14.1	0.1%
124	Oldsmar fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes	0.1	0.0%
125	Oldsmar fine sand-Urban land complex, 0 to 2 percent slopes	0.4	0.0%
128	Pineda fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes	12.0	0.1%
Totals for Area of Interest		**22,137.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion

of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Collier County Area, Florida

2—Holopaw fine sand, limestone substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fs
Elevation: 0 to 70 feet
Mean annual precipitation: 38 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Holopaw, limestone substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw, Limestone Substratum

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 5 inches: fine sand
Eg - 5 to 57 inches: fine sand
Btg - 57 to 62 inches: fine sandy loam
2R - 62 to 72 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 50 to 79 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G156AC141FL)
Other vegetative classification: Slough (R155XY011FL)

Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Chobee

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

4—Chobee, limestone substratum-Dania, frequently ponded, association, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y0j4
Elevation: 0 to 40 feet
Mean annual precipitation: 46 to 64 inches
Mean annual air temperature: 72 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Chobee, limestone substratum, and similar soils: 45 percent
Dania and similar soils: 45 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chobee, Limestone Substratum

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Loamy marine deposits over limestone

Typical profile

A1 - 0 to 6 inches: fine sandy loam
A2 - 6 to 13 inches: fine sandy loam
Btg - 13 to 45 inches: sandy clay loam
2R - 45 to 55 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 33 to 80 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Dania

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over limestone

Typical profile

Oa - 0 to 14 inches: muck
Cg - 14 to 16 inches: fine sand
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 10 to 29 inches to lithic bedrock

Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G156AC645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Minor Components

Gator

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Hallandale

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

10—Oldsmar fine sand, limestone substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9f2
Elevation: 0 to 30 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 70 to 77 degrees F

Frost-free period: 360 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Oldsmar, limestone substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oldsmar, Limestone Substratum

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 8 inches: fine sand
E - 8 to 34 inches: fine sand
Bh - 34 to 49 inches: fine sand
Btg - 49 to 60 inches: sandy clay loam
2R - 60 to 70 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 79 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Riviera, limestone substratum

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Wetland Hardwood Hammock (R156AY012FL)

Hydric soil rating: Yes

Wabasso

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Malabar

Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Immokalee

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

11—Hallandale fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2tzx2
Elevation: 0 to 70 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Hallandale and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hallandale

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear

Across-slope shape: Linear
Parent material: Sandy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 9 inches: fine sand
Bw - 9 to 12 inches: fine sand
2R - 12 to 22 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 7 to 20 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.95 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 0.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Boca

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Jupiter

Percent of map unit: 3 percent

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Cabbage Palm Flatwoods (R155XY005FL)
Hydric soil rating: Yes

Ft. drum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

14—Pineda fine sand, limestone substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x1n9
Elevation: 0 to 30 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of local importance

Map Unit Composition

Pineda, limestone substratum, and similar soils: 83 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pineda, Limestone Substratum

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 12 inches: fine sand
Bw - 12 to 18 inches: fine sand
E' - 18 to 30 inches: fine sand
Btg/E - 30 to 38 inches: sandy clay loam
Btg - 38 to 55 inches: fine sandy loam
2R - 55 to 65 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 80 inches to lithic bedrock

Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Pineda, limestone substratum ponded

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Hallandale

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 3 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave

Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Wabasso

Percent of map unit: 1 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

18—Riviera fine sand, limestone substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9g2
Elevation: 0 to 30 feet
Mean annual precipitation: 46 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Farmland of local importance

Map Unit Composition

Riviera, limestone substratum, and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riviera, Limestone Substratum

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 32 inches: fine sand
Btg/E - 32 to 45 inches: sandy clay loam
Btg - 45 to 54 inches: sandy clay loam
2R - 54 to 64 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 31 to 80 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G156AC241FL)
Other vegetative classification: Wetland Hardwood Hammock (R156AY012FL)
Hydric soil rating: Yes

Minor Components

Boca

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Copeland

Percent of map unit: 4 percent
Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Slough (R156BY011FL)
Hydric soil rating: Yes

20—Ft. Drum-Malabar, high association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fw
Elevation: 0 to 30 feet

Mean annual precipitation: 46 to 65 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Ft. drum and similar soils: 45 percent
Malabar and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ft. Drum

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 10 inches: fine sand
Bw - 10 to 22 inches: fine sand
Bkg - 22 to 32 inches: fine sandy loam
Ckg - 32 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Description of Malabar

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear

Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 17 inches: fine sand
Bw - 17 to 42 inches: fine sand
Bt - 42 to 59 inches: fine sandy loam
Cg - 59 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces

Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

21—Boca fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2svz8
Elevation: 0 to 60 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of local importance

Map Unit Composition

Boca and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 14 inches: fine sand
E/B - 14 to 25 inches: fine sand
Btg - 25 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: South Florida Flatwoods (R155XY003FL)
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Minor Components

Hallandale

Percent of map unit: 8 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Wabasso

Percent of map unit: 6 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pineda

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Ft. drum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

22—Chobee, Winder, Gator soils, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fd
Elevation: 0 to 50 feet
Mean annual precipitation: 43 to 55 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Chobee and similar soils: 31 percent
Gator and similar soils: 28 percent
Winder and similar soils: 26 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chobee

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loamy marine deposits

Typical profile

A - 0 to 13 inches: fine sandy loam
Btg - 13 to 68 inches: sandy clay loam
Ckg - 68 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 7 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Gator

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over sandy and loamy marine deposits

Typical profile

Oa - 0 to 25 inches: muck
Cg1 - 25 to 40 inches: fine sandy loam
Cg2 - 40 to 65 inches: fine sandy loam
Ckg3 - 65 to 80 inches: fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very high (about 14.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Winder

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex, linear
Across-slope shape: Concave, linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 15 inches: fine sand
Btg/E - 15 to 18 inches: sandy loam
Btg - 18 to 50 inches: sandy clay loam
Ckg - 50 to 80 inches: fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C/D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Pineda

Percent of map unit: 8 percent
Landform: Flats on marine terraces, depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 7 percent
Landform: Flats on marine terraces, depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex
Across-slope shape: Concave, linear
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

23—Holopaw-Okeelanta, frequently ponded, assocaition, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y0j6
Elevation: 0 to 40 feet
Mean annual precipitation: 46 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw, limestone substratum, and similar soils: 48 percent
Okeelanta and similar soils: 42 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw, Limestone Substratum

Setting

Landform: Depressions on flats on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 5 inches: fine sand
Eg - 5 to 57 inches: fine sand
Btg - 57 to 62 inches: fine sandy loam
2R - 62 to 72 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 50 to 79 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G156AC141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Okeelanta

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Herbaceous organic material over sandy marine deposits

Typical profile

Oa - 0 to 20 inches: muck
Cg - 20 to 52 inches: fine sand
Ckg - 52 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Depressions on flats on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave

Hydric soil rating: Yes

Gator

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

25—Boca-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 perent slopes

Map Unit Setting

National map unit symbol: 2x9g6
Elevation: 0 to 70 feet
Mean annual precipitation: 42 to 70 inches
Mean annual air temperature: 68 to 79 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Boca and similar soils: 31 percent
Riviera, limestone substratum, and similar soils: 30 percent
Copeland and similar soils: 29 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 26 inches: fine sand
Btg - 26 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 49 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Riviera, Limestone Substratum

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 32 inches: fine sand
Btg/E - 32 to 45 inches: sandy clay loam
Btg - 45 to 54 inches: sandy clay loam
2R - 54 to 64 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 31 to 80 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)

Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Copeland

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A1 - 0 to 8 inches: fine sandy loam
A2 - 8 to 20 inches: fine sandy loam
Btkg - 20 to 28 inches: sandy clay loam
2R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Dania

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces

Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Hallandale

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

27—Holopaw fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2vbpd
Elevation: 0 to 130 feet
Mean annual precipitation: 37 to 62 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Holopaw and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand
Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Boca

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave

Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

31—Hilolo, Jupiter, Margate fine sands, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y9fl
Elevation: 10 to 50 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 79 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Hilolo, limestone substratum, and similar soils: 30 percent
Margate and similar soils: 30 percent
Jupiter and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hilolo, Limestone Substratum

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 9 inches: fine sand
Eg - 9 to 12 inches: fine sand
Btkg - 12 to 45 inches: fine sandy loam
BCkg - 45 to 50 inches: fine sandy loam
Ckg - 50 to 61 inches: loamy fine sand
2R - 61 to 71 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 30 to 80 inches to lithic bedrock

Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Loamy and clayey soils on flats of hydric or mesic lowlands (G156AC341FL)
Other vegetative classification: Upland Hardwood Hammock (R155XY008FL)
Hydric soil rating: Yes

Description of Margate

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 17 inches: fine sand
Bw - 17 to 35 inches: fine sand
2R - 35 to 45 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 14 to 46 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)

Hydric soil rating: Yes

Description of Jupiter

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits over limestone

Typical profile

A1 - 0 to 4 inches: fine sand
A2 - 4 to 10 inches: fine sand
2R - 10 to 20 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 5 to 18 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 0.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G156AC141FL)
Other vegetative classification: Upland Hardwood Hammock (R155XY008FL)
Hydric soil rating: Yes

Minor Components

Pineda

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave

Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

48—Pennsuco silt loam, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fv
Elevation: 0 to 20 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Pennsuco and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pennsuco

Setting

Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty marine deposits over limestone

Typical profile

Ak - 0 to 5 inches: silt loam
Bkg - 5 to 40 inches: silt loam
2Ck - 40 to 48 inches: fine sand
3R - 48 to 58 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 12 to 64 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 90 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 10.0
Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Loamy and clayey soils on flats of hydric or mesic lowlands (G156BC341FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Ochopee

Percent of map unit: 5 percent
Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Scrub Cypress (R156AY013FL)
Hydric soil rating: Yes

49—Hallandale-Boca fine sands association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fv
Elevation: 0 to 70 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Hallandale and similar soils: 50 percent
Boca and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hallandale

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Sandy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 9 inches: fine sand
Bw - 9 to 12 inches: fine sand
2R - 12 to 22 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 7 to 20 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.95 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 0.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Boca

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 14 inches: fine sand
E/B - 14 to 25 inches: fine sand
Btg - 25 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: South Florida Flatwoods (R155XY003FL)
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Minor Components

Pineda

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Copeland

Percent of map unit: 5 percent
Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Slough (R156BY011FL)
Hydric soil rating: Yes

50—Ochopee fine sandy loam, low

Map Unit Setting

National map unit symbol: 1jfvj
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Ochopee, low, and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ochopee, Low

Setting

Landform: Marshes on marine terraces
Landform position (three-dimensional): Talf

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy marine deposits over limestone

Typical profile

A - 0 to 5 inches: fine sandy loam
Bk - 5 to 17 inches: fine sandy loam
2R - 17 to 21 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 6 to 20 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 45 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Loamy and clayey soils on flats of hydric or mesic lowlands (G156AC341FL)
Other vegetative classification: Wetland Hardwood Hammock (R156AY012FL)
Hydric soil rating: Yes

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: Unranked

51—Ochopee fine sandy loam, frequently ponded, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y9fq
Elevation: 0 to 30 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Ochopee and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ochopee

Setting

Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy marine deposits over limestone

Typical profile

Ak - 0 to 5 inches: fine sandy loam
Bk - 5 to 17 inches: fine sandy loam
2R - 17 to 27 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 50 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Loamy and clayey soils on flats of hydric or mesic lowlands (G156AC341FL)
Other vegetative classification: Scrub Cypress (R156AY013FL)
Hydric soil rating: Yes

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: No

99—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

102—Boca fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9c3
Elevation: 0 to 70 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Boca and similar soils: 42 percent
Urban land: 36 percent
Minor components: 22 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 14 inches: fine sand
E/B - 14 to 25 inches: fine sand
Btg - 25 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: South Florida Flatwoods (R155XY003FL)
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Hallandale

Percent of map unit: 8 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Wabasso

Percent of map unit: 6 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pineda

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces

Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Ft. drum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

103—Boca-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2x9g5
Elevation: 0 to 150 feet
Mean annual precipitation: 42 to 70 inches
Mean annual air temperature: 68 to 79 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Boca and similar soils: 24 percent
Riviera, limestone substratum, and similar soils: 23 percent
Copeland and similar soils: 22 percent
Urban land: 20 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 26 inches: fine sand
Btg - 26 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 49 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Riviera, Limestone Substratum

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 32 inches: fine sand
Btg/E - 32 to 45 inches: sandy clay loam
Btg - 45 to 54 inches: sandy clay loam
2R - 54 to 64 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 31 to 80 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Copeland

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A1 - 0 to 8 inches: fine sandy loam
A2 - 8 to 20 inches: fine sandy loam
Btkg - 20 to 28 inches: sandy clay loam
2R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Dania

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 2 percent
Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: No

Hallandale

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

109—Ft. Drum-Malabar, high, fine sands-Urban land association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fm
Elevation: 0 to 30 feet
Mean annual precipitation: 46 to 65 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Ft. drum and similar soils: 32 percent
Malabar and similar soils: 27 percent
Urban land: 24 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ft. Drum

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 10 inches: fine sand
Bw - 10 to 22 inches: fine sand
Bkg - 22 to 32 inches: fine sandy loam
Ckg - 32 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Description of Malabar

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 17 inches: fine sand
Bw - 17 to 42 inches: fine sand
Bt - 42 to 59 inches: fine sandy loam
Cg - 59 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger
Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda
Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw
Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar
Percent of map unit: 2 percent
Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Ft. drum
Percent of map unit: 2 percent
Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

111—Hallandale-Boca fine sands-Urban land association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fp
Elevation: 0 to 150 feet
Mean annual precipitation: 42 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Hallandale and similar soils: 33 percent
Boca and similar soils: 28 percent
Urban land: 24 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hallandale

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 9 inches: fine sand
Bw - 9 to 12 inches: fine sand
2R - 12 to 22 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 7 to 20 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.95 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 0.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Boca

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 14 inches: fine sand
E/B - 14 to 25 inches: fine sand
Btg - 25 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 8 to 40 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: South Florida Flatwoods (R155XY003FL)
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Copeland
Percent of map unit: 5 percent
Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Slough (R156BY011FL)
Hydric soil rating: Yes

Pineda
Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Hallandale
Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Boca
Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

114—Holopaw fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2x9fr

Elevation: 0 to 150 feet
Mean annual precipitation: 38 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw, limestone substratum, and similar soils: 45 percent
Urban land: 38 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw, Limestone Substratum

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 5 inches: fine sand
Eg - 5 to 57 inches: fine sand
Btg - 57 to 62 inches: fine sandy loam
2R - 62 to 72 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 50 to 79 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G156AC141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Boca
Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Chobee
Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Basinger
Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw, limestone substratum
Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

120—Malabar fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2x9cd
Elevation: 10 to 130 feet
Mean annual precipitation: 42 to 63 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days

Farmland classification: Not prime farmland

Map Unit Composition

Malabar and similar soils: 45 percent
Urban land: 38 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Malabar

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 17 inches: fine sand
Bw - 17 to 42 inches: fine sand
Btg - 42 to 59 inches: fine sandy loam
Cg - 59 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: Slough (R155XY011FL)
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: No parent material

Minor Components

Valkaria

Percent of map unit: 5 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pineda

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

Basinger

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

124—Oldsmar fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9f3
Elevation: 0 to 30 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Oldsmar, limestone substratum, and similar soils: 45 percent
Urban land: 38 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oldsmar, Limestone Substratum

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 8 inches: fine sand
E - 8 to 34 inches: fine sand
Bh - 34 to 49 inches: fine sand
Btg - 49 to 60 inches: sandy clay loam
2R - 60 to 70 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 79 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Riviera, limestone substratum

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Wetland Hardwood Hammock (R156AY012FL)
Hydric soil rating: Yes

Wabasso

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Malabar

Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar, limestone substratum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Immokalee

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

125—Oldsmar fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fh
Elevation: 0 to 100 feet
Mean annual precipitation: 5 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Oldsmar and similar soils: 45 percent
Urban land: 38 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oldsmar

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 35 inches: fine sand
Bh - 35 to 50 inches: fine sand
Btg - 50 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Malabar

Percent of map unit: 5 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Nettles

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Pineda

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear

Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear, convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

128—Pineda fine sand, limestone substratum-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fz
Elevation: 0 to 150 feet
Mean annual precipitation: 42 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Pineda, limestone substratum, and similar soils: 43 percent
Urban land: 38 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pineda, Limestone Substratum

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 12 inches: fine sand
Bw - 12 to 18 inches: fine sand
E' - 18 to 30 inches: fine sand
Btg/E - 30 to 38 inches: sandy clay loam
Btg - 38 to 55 inches: fine sandy loam
2R - 55 to 65 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 80 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Pineda, limestone substratum ponded

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces

Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Hallandale

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 3 percent
Landform: — error in exists on —
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

Wabasso

Percent of map unit: 1 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

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United States Department of Agriculture

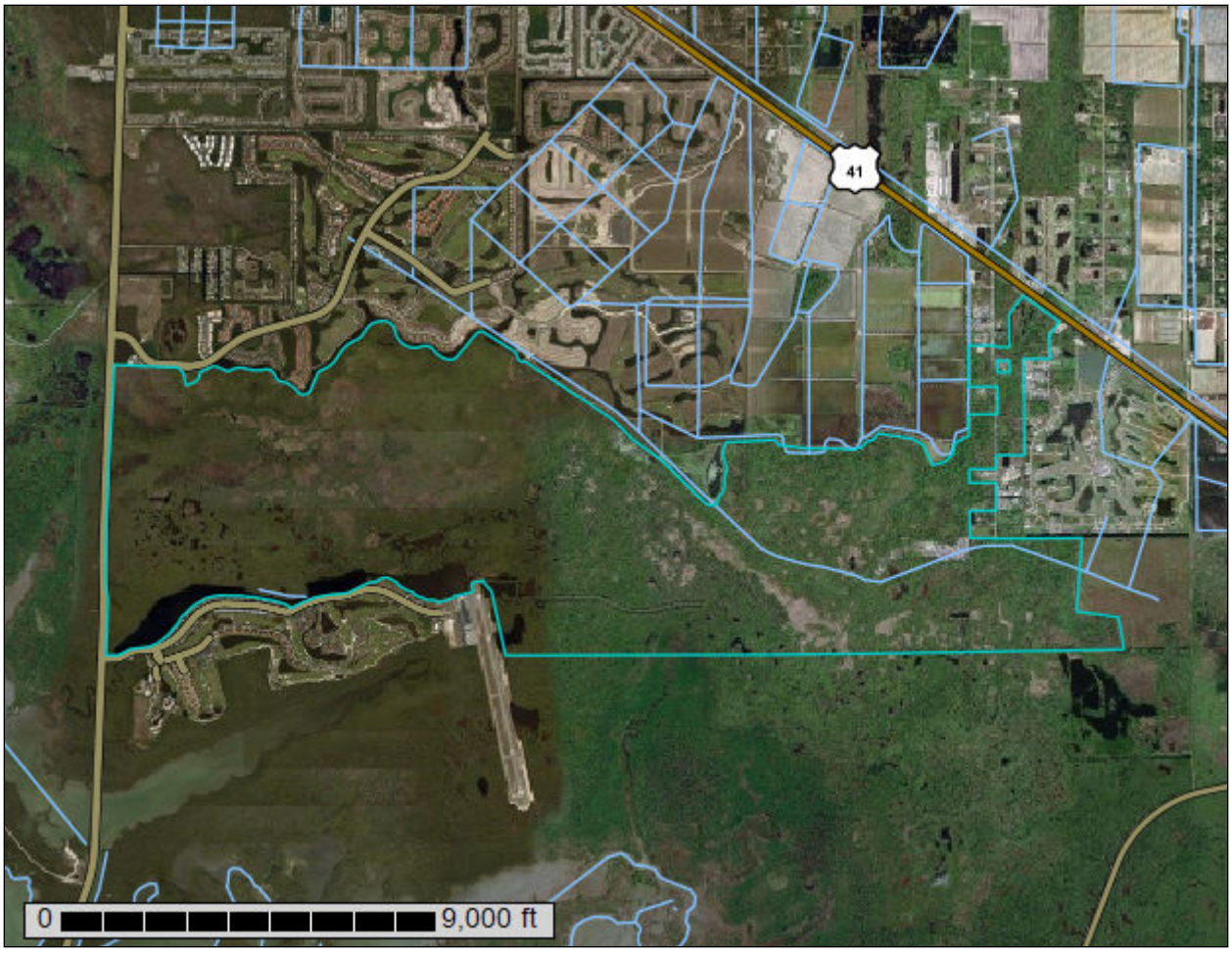
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Collier County Area, Florida

Receiving Waters



February 4, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

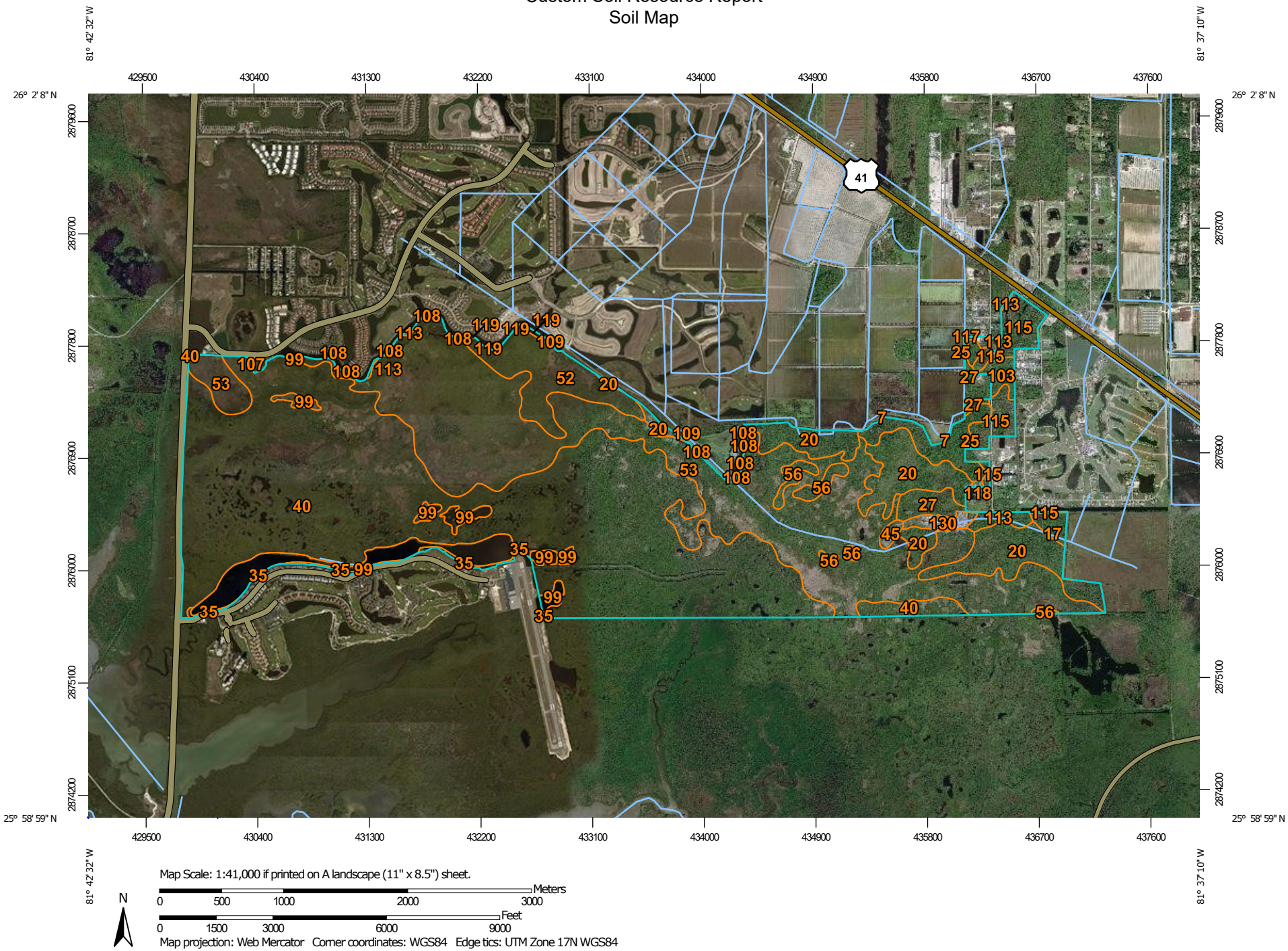
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:41,000 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Collier County Area, Florida
Survey Area Data: Version 13, Feb 3, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Dec 17, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7	Immokalee fine sand, 0 to 2 percent slopes	0.0	0.0%
17	Basinger fine sand, 0 to 2 percent slopes	12.1	0.4%
20	Ft. Drum-Malabar, high association, 0 to 2 percent slopes	227.1	7.8%
25	Boca-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 perent slopes	54.3	1.9%
27	Holopaw fine sand, 0 to 2 percent slopes	30.9	1.1%
35	St. Augustine, organic substratum-Urban land complex, 0 to 2 percent slopes	9.3	0.3%
40	Durbin and Wulfert mucks, tidal complex, 0 to 1 percent slopes	1,322.5	45.3%
45	Paola fine sand, 1 to 8 percent slopes	6.2	0.2%
52	Kesson muck, tidal, 0 to 1 percent slopes	109.4	3.7%
53	Estero and Peckish mucks, tidal, 0 to 1 percent slopes	890.8	30.5%
56	Basinger fine sand, occasionally flooded	28.6	1.0%
99	Water	112.5	3.8%
103	Boca-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes	14.3	0.5%
107	Durbin-Wulfert mucks, tidal-Urban land complex, 0 to 1 percent slopes	0.2	0.0%
108	Estero and Peckish mucks, tidal-Urban land complex, 0 to 1 percent slopes	0.6	0.0%
109	Ft. Drum-Malabar, high, fine sands-Urban land association, 0 to 2 percent slopes	0.1	0.0%
113	Holopaw fine sand-Urban land complex, 0 to 2 percent slopes	17.6	0.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
115	Holopaw-Basinger-Urban land complex, 0 to 2 perent slopes	63.0	2.2%
117	Immokalee fine sand-Urban land complex, 0 to 2 percent slopes	5.1	0.2%
118	Immokalee-Oldsmar, limestone substratum-Urban land complex, 0 to 2 percent slopes	0.9	0.0%
119	Kesson muck, tidal-Urban land complex, 0 to 1 percent slopes	1.3	0.0%
130	Pomello fine sand-Urban land complex, 0 to 2 percent slopes	14.6	0.5%
Totals for Area of Interest		**2,921.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Collier County Area, Florida

7—Immokalee fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2s3lk
Elevation: 0 to 130 feet
Mean annual precipitation: 44 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Immokalee and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Immokalee

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 35 inches: fine sand
Bh - 35 to 54 inches: fine sand
BC - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Basinger

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Wabasso

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pomello

Percent of map unit: 2 percent
Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: Sand Pine Scrub (R155XY001FL)
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Margate

Percent of map unit: 1 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Placid

Percent of map unit: 1 percent
Landform: Depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

17—Basinger fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2svym
Elevation: 0 to 100 feet
Mean annual precipitation: 42 to 63 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Basinger and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Basinger

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Parent material: Sandy marine deposits

Typical profile

Ag - 0 to 2 inches: fine sand
Eg - 2 to 18 inches: fine sand
Bh/E - 18 to 36 inches: fine sand
Cg - 36 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D

Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Myakka
Percent of map unit: 6 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Immokalee
Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pompano
Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Placid
Percent of map unit: 4 percent
Landform: Depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Felda
Percent of map unit: 1 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Anclote
Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip

Down-slope shape: Concave, convex
Across-slope shape: Concave, linear
Hydric soil rating: Yes

20—Ft. Drum-Malabar, high association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fw
Elevation: 0 to 30 feet
Mean annual precipitation: 46 to 65 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Ft. drum and similar soils: 45 percent
Malabar and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ft. Drum

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 10 inches: fine sand
Bw - 10 to 22 inches: fine sand
Bkg - 22 to 32 inches: fine sandy loam
Ckg - 32 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Description of Malabar

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 17 inches: fine sand
Bw - 17 to 42 inches: fine sand
Bt - 42 to 59 inches: fine sandy loam
Cg - 59 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave

Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

25—Boca-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 perent slopes

Map Unit Setting

National map unit symbol: 2x9g6
Elevation: 0 to 70 feet
Mean annual precipitation: 42 to 70 inches
Mean annual air temperature: 68 to 79 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Boca and similar soils: 31 percent
Riviera, limestone substratum, and similar soils: 30 percent
Copeland and similar soils: 29 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 26 inches: fine sand
Btg - 26 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 49 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Riviera, Limestone Substratum

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 32 inches: fine sand
Btg/E - 32 to 45 inches: sandy clay loam
Btg - 45 to 54 inches: sandy clay loam
2R - 54 to 64 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 31 to 80 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None

Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Copeland

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A1 - 0 to 8 inches: fine sandy loam
A2 - 8 to 20 inches: fine sandy loam
Btkg - 20 to 28 inches: sandy clay loam
2R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Dania

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Hallandale

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

27—Holopaw fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2vbpd
Elevation: 0 to 130 feet
Mean annual precipitation: 37 to 62 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Holopaw and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand
Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Boca

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

35—St. Augustine, organic substratum-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y0jb
Elevation: 0 to 20 feet
Mean annual precipitation: 45 to 70 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

St. augustine, organic substratum, and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of St. Augustine, Organic Substratum

Setting

Landform: Marine terraces

Landform position (three-dimensional): Tread, dip
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy mine spoil or earthy fill over herbaceous organic material

Typical profile

^C - 0 to 51 inches: paragravelly fine sand
Oab - 51 to 80 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Forage suitability group not assigned (G155XB999FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Matlacha

Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Hydric soil rating: No

Holopaw

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave

Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Myakka

Percent of map unit: 3 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Kesson, tidal

Percent of map unit: 1 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Canaveral

Percent of map unit: 1 percent
Landform: Flats on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Interfluve, tread, talf
Down-slope shape: Concave, convex
Across-slope shape: Linear
Hydric soil rating: No

40—Durbin and Wulfert mucks, tidal complex, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fg
Elevation: 0 to 10 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Durbin, tidal, and similar soils: 45 percent
Wulfert, tidal, and similar soils: 45 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Durbin, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Herbaceous organic material over sandy marine deposits

Typical profile

Oan1 - 0 to 40 inches: muck
Oan2 - 40 to 63 inches: muck
Cn - 63 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Hydric soil rating: Yes

Description of Wulfert, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material over sandy marine deposits

Typical profile

Oan1 - 0 to 12 inches: muck
Oan2 - 12 to 36 inches: muck
Cn - 36 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Very high (about 15.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G155XB999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Minor Components

Kesson, tidal

Percent of map unit: 5 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Pennsuco, tidal

Percent of map unit: 5 percent
Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

45—Paola fine sand, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2y9fs
Elevation: 0 to 20 feet
Mean annual precipitation: 45 to 56 inches

Mean annual air temperature: 72 to 79 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Paola and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paola

Setting

Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 32 inches: fine sand
B/E - 32 to 45 inches: fine sand
C - 45 to 80 inches: fine sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very high (20.00 to 50.02 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Sandy soils on ridges and dunes of xeric uplands (G155XB111FL)
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Minor Components

Pomello

Percent of map unit: 5 percent
Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear

Across-slope shape: Linear
Ecological site: Sand Pine Scrub (R155XY001FL)
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

52—Kesson muck, tidal, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fn
Elevation: 0 to 10 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 72 to 79 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Kesson, tidal, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kesson, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Thin herbaceous organic material over sandy marine deposits

Typical profile

Oan - 0 to 5 inches: muck
Akn - 5 to 10 inches: fine sand
Ckn1 - 10 to 34 inches: fine sand
Ckn2 - 34 to 49 inches: fine sand
Ckn3 - 49 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0

Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Minor Components

Peckish, tidal

Percent of map unit: 5 percent
Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Dania, tidal

Percent of map unit: 5 percent
Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

53—Estero and Peckish mucks, tidal, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fj
Elevation: 0 to 10 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Estero, tidal, and similar soils: 50 percent
Peckish, tidal, and similar soils: 45 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Estero, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, dip

Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Thin herbaceous organic material over sandy marine deposits

Typical profile

Oan - 0 to 6 inches: muck
An - 6 to 28 inches: fine sand
En - 28 to 40 inches: fine sand
Bhn - 40 to 62 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Description of Peckish, Tidal

Setting

Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile

An - 0 to 9 inches: mucky fine sand
En - 9 to 37 inches: fine sand
Bhnz - 37 to 42 inches: fine sand
Cn - 42 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent

Frequency of ponding: None
Salinity, maximum in profile: Strongly saline (32.0 to 200.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Minor Components

Wulfert, tidal

Percent of map unit: 5 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

56—Basinger fine sand, occasionally flooded

Map Unit Setting

National map unit symbol: 1jfvp
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Basinger and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Basinger

Setting

Landform: Ridges on tidal marshes on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 3 inches: fine sand
E - 3 to 25 inches: fine sand

Bh/E - 25 to 44 inches: fine sand
C - 44 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on stream terraces, flood plains, or in depressions (G156AC145FL)
Hydric soil rating: Yes

Minor Components

Immokalee

Percent of map unit: 2 percent
Landform: Marshes on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

99—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

103—Boca-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2x9g5
Elevation: 0 to 150 feet

Mean annual precipitation: 42 to 70 inches
Mean annual air temperature: 68 to 79 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Boca and similar soils: 24 percent
Riviera, limestone substratum, and similar soils: 23 percent
Copeland and similar soils: 22 percent
Urban land: 20 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Boca

Setting

Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 26 inches: fine sand
Btg - 26 to 30 inches: fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 49 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Riviera, Limestone Substratum

Setting

Landform: Flats on marine terraces, depressions on marine terraces

Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 32 inches: fine sand
Btg/E - 32 to 45 inches: sandy clay loam
Btg - 45 to 54 inches: sandy clay loam
2R - 54 to 64 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 31 to 80 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Copeland

Setting

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A1 - 0 to 8 inches: fine sandy loam
A2 - 8 to 20 inches: fine sandy loam
Btkg - 20 to 28 inches: sandy clay loam
2R - 28 to 38 inches: bedrock

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Very poorly drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: D
Forage suitability group: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Dania

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Boca

Percent of map unit: 2 percent
Landform: Flats on marine terraces, depressions on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: No

Hallandale

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

107—Durbin-Wulfert mucks, tidal-Urban land complex, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fh
Elevation: 0 to 10 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Durbin, tidal, and similar soils: 31 percent
Wulfert, tidal, and similar soils: 29 percent
Urban land: 27 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Durbin, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Herbaceous organic material over sandy marine deposits

Typical profile

Oan1 - 0 to 40 inches: muck
Oan2 - 40 to 63 inches: muck
Cn - 63 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Hydric soil rating: Yes

Description of Wulfert, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material over sandy marine deposits

Typical profile

Oan1 - 0 to 12 inches: muck
Oan2 - 12 to 36 inches: muck
Cn - 36 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Slightly saline to strongly saline (4.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Very high (about 15.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G155XB999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Kesson, tidal

Percent of map unit: 5 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Pennsuco

Percent of map unit: 5 percent
Landform: Marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Wulfert

Percent of map unit: 3 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

108—Estero and Peckish mucks, tidal-Urban land complex, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fk
Elevation: 0 to 10 feet
Mean annual precipitation: 42 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Estero, tidal, and similar soils: 33 percent
Peckish, tidal, and similar soils: 31 percent
Urban land: 29 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Estero, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Thin herbaceous organic material over sandy marine deposits

Typical profile

Oan - 0 to 6 inches: muck
An - 6 to 28 inches: fine sand
En - 28 to 40 inches: fine sand
Bhn - 40 to 62 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 7.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Description of Peckish, Tidal

Setting

Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile

An - 0 to 9 inches: mucky fine sand
En - 9 to 37 inches: fine sand
Bhnz - 37 to 42 inches: fine sand
Cn - 42 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Salinity, maximum in profile: Strongly saline (32.0 to 200.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Wulfert, tidal

Percent of map unit: 5 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Estero, tidal

Percent of map unit: 2 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

109—Ft. Drum-Malabar, high, fine sands-Urban land association, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fm
Elevation: 0 to 30 feet
Mean annual precipitation: 46 to 65 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Ft. drum and similar soils: 32 percent
Malabar and similar soils: 27 percent
Urban land: 24 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ft. Drum

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 10 inches: fine sand
Bw - 10 to 22 inches: fine sand
Bkg - 22 to 32 inches: fine sandy loam
Ckg - 32 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Description of Malabar

Setting

Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: fine sand
E - 5 to 17 inches: fine sand
Bw - 17 to 42 inches: fine sand
Bt - 42 to 59 inches: fine sandy loam
Cg - 59 to 80 inches: loamy fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None

Calcium carbonate, maximum in profile: 1 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, concave
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 2 percent
Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf

Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Ft. drum

Percent of map unit: 2 percent
Landform: Rises on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, rise, talf
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

113—Holopaw fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fq
Elevation: 0 to 150 feet
Mean annual precipitation: 37 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw and similar soils: 45 percent
Urban land: 38 percent
Minor components: 17 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand
Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Boca

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: South Florida Flatwoods (R155XY003FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)

Hydric soil rating: Yes

Riviera

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: Slough (R155XY011FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

115—Holopaw-Basinger-Urban land complex, 0 to 2 perent slopes

Map Unit Setting

National map unit symbol: 2y0j7
Elevation: 0 to 40 feet
Mean annual precipitation: 45 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Holopaw and similar soils: 32 percent
Basinger and similar soils: 28 percent
Urban land: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
Eg - 6 to 42 inches: fine sand

Btg - 42 to 60 inches: fine sandy loam
Cg - 60 to 80 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Basinger

Setting

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Parent material: Sandy marine deposits

Typical profile

Ag - 0 to 2 inches: fine sand
Eg - 2 to 18 inches: fine sand
Bh/E - 18 to 36 inches: fine sand
Cg - 36 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Myakka

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Oldsmar

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Hallandale

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

Basinger

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: No

117—Immokalee fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9fx
Elevation: 0 to 130 feet
Mean annual precipitation: 44 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Immokalee and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Immokalee

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 35 inches: fine sand
Bh - 35 to 54 inches: fine sand

BC - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Pomello

Percent of map unit: 3 percent
Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: Sand Pine Scrub (R155XY001FL)
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Placid

Percent of map unit: 2 percent
Landform: Depressions on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Margate

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: Yes

Wabasso

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Immokalee

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

118—Immokalee-Oldsmar, limestone substratum-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y0j8
Elevation: 0 to 50 feet
Mean annual precipitation: 45 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Immokalee and similar soils: 32 percent

Oldsmar, limestone substratum, and similar soils: 28 percent
Urban land: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Immokalee

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 35 inches: fine sand
Bh - 35 to 54 inches: fine sand
BC - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Oldsmar, Limestone Substratum

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and loamy marine deposits over limestone

Typical profile

A - 0 to 8 inches: fine sand
E - 8 to 34 inches: fine sand
Bh - 34 to 49 inches: fine sand

Btg - 49 to 60 inches: sandy clay loam
2R - 60 to 70 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 79 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Basinger

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Holopaw

Percent of map unit: 4 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 3 percent

Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear
Across-slope shape: Linear, concave
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Immokalee

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Oldsmar, limestone substratum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

119—Kesson muck, tidal-Urban land complex, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2y9fp
Elevation: 0 to 10 feet
Mean annual precipitation: 45 to 56 inches
Mean annual air temperature: 70 to 79 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Kesson, tidal, and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kesson, Tidal

Setting

Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear

Parent material: Thin herbaceous organic material over sandy marine deposits

Typical profile

Oan - 0 to 5 inches: muck
Akn - 5 to 10 inches: fine sand
Ckn1 - 10 to 34 inches: fine sand
Ckn2 - 34 to 49 inches: fine sand
Ckn3 - 49 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): High to very high (1.98 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Moderately saline to strongly saline (8.0 to 24.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 50.0
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156AC999FL)
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Peckish, tidal

Percent of map unit: 7 percent
Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

Dania, tidal

Percent of map unit: 6 percent
Landform: Tidal flats on marine terraces
Landform position (three-dimensional): Tread, dip

Down-slope shape: Linear, concave
Across-slope shape: Concave
Other vegetative classification: Freshwater Marshes and Ponds (R156AY010FL)
Hydric soil rating: Yes

Kesson, tidal

Percent of map unit: 2 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: No

130—Pomello fine sand-Urban land complex, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2x9g0
Elevation: 0 to 150 feet
Mean annual precipitation: 42 to 68 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Pomello and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pomello

Setting

Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 4 inches: fine sand
E - 4 to 42 inches: fine sand
Bh - 42 to 54 inches: fine sand
B/C - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained

Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: Sand Pine Scrub (R155XY001FL)
Forage suitability group: Sandy soils on rises and knolls of mesic uplands (G155XB131FL)
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: No parent material

Minor Components

Immokalee

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Riser, talf
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Duette

Percent of map unit: 5 percent
Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Jonathan

Percent of map unit: 3 percent
Landform: Knolls on marine terraces, ridges on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, tread, rise
Down-slope shape: Convex

Across-slope shape: Linear
Hydric soil rating: No

Tavares

Percent of map unit: 2 percent
Landform: Knolls on marine terraces, flatwoods on marine terraces, ridges on marine terraces, hills on marine terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, side slope, tread, rise
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Other vegetative classification: Sand Pine Scrub (R155XY001FL), Longleaf Pine-Turkey Oak Hills (R155XY002FL)
Hydric soil rating: No

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APPENDIX 2: FWS DEC. 5. 2019 MEETING SUMMARY

Meeting Notes

Subject: Meeting with Kim Dryden FWS. Recommendations for Listed Species Documentation

Date/Time: December 5, 2019, 9:00 am – 11:30 am

Location: Collier County Government Offices, Naples, FL

Meeting Participants
US FWS: Kim Dryden
Collier County: Gary McAlpin
Taylor Engineering: John Loper, David Stites, Kierstin Masse, Tayyab Mehmood (phone), Chris Ellis (phone)
EarthTech: Jeremy Sterk, Andrew McAuley

Summary

FWS Staff Roles and Regulatory Coordination
Kim Dryden will be leading the FWS efforts regarding the CWIP listed species effects analysis and any required formal consultations with USACE. USFWS Vero Beach regulatory staff and Kim Dryden's superiors (Roxanna Hinzman, Bob Progulske) in Vero Beach Senior Management group will be ultimately responsible for oversight of regulatory consultation efforts. Dryden has discussed and will continue coordination with the Vero Beach office staff to maintain the regulatory process.

ACTION ITEM FOR KIM DRYDEN (COMPLETED): Kim Dryden will email Muriel Blaisdell, USACE Ft. Myers Office Section Chief, to inform her that Kim is assigned to the Collier CWIP project and will be the reviewer for USFWS. Kim will copy Connie Kassler and Gary McAlpin on the email.

Robert Tewis, the currently assigned project manager, will retire from the USACE at the end of December and the USACE has not identified a replacement project manager. [*USACE indicated that they will assign a project manager when Collier County submits the permit.]*

ACTION ITEM FOR DAVID STITES – CONTACT MURIEL BLAISDELL, USACE (COMPLETED): David Stites will request a new USACE Project Manager; CWIP team leaders (Gary McAlpin, John Loper, David Stites) will meet with the new Project Manager once assigned.

ACTION ITEM FOR DAVID STITES – EMAIL TO KIM DRYDEN (COMPLETED): David Stites will send an email to Kim regarding contact with Vero Beach and Muriel Blaisdell. The email will also include other action items as defined during the December 5 meeting (see below). [*Kim Dryden's coordination with Vero Beach has largely resolved the coordination with the Vero Beach office. USACE indicated that they will assign a project manager when Collier County submits the permit.*]

Development of Monitoring and Assessment Group and Coordination with PSRP (CERP Picayune Strand Restoration Project)

- An interagency monitoring and assessment group may be valuable to maintain agency concurrency with the project. [While note not discussed, agencies may include Rookery Bay NERR,

FFS, FWS, FWC, SFWMD, USACE, FDEP, etc.] The PSRP has a monitoring and assessment group along with a water quality assessment subgroup as part of their project management program. It may be possible to work with the already created PSRP interagency group to coordinate on the CWIP project.

ACTION ITEM FOR CWIP TEAM – INTERNAL DISCUSSION (ONGOING): The CWIP team will need to discuss this internally. If appropriate, CWIP leadership will contact the PSRP management team to for further coordination and to develop this idea.

Listed Species Discussions

Incidental Take Permits

The proposed action may require an Incidental take permit (ITP) for some species. The FWS in Florida is writing localized guidance documents for a variety of listed species, which may include ITP requirements. Kim will check with Vero Beach regarding any automatic expectations in that regard, and whether there is available draft or approved guidance that the project will need to follow. Kim noted that the Panther guidance for southwest Florida is complete; though it was not discussed further. David Stites will follow up with Kim regarding the use of the new published guidance, as we did not clarify whether that was the Panther guidance for southwest Florida guidance she referred to.

Formal Consultation expected for Florida Panther, Florida Bonneted Bat.

Red Cockaded Woodpecker (RCW)

ACTION ITEM FOR KIM DRYDEN: Kim Dryden will verify that no formal consultation or ITP is necessary for RCW, assuming no direct habitat impacts, based on RCW habitat analysis.

ACTION ITEM FOR TAYLOR ENGINEERING: RCW analysis and summary

- Taylor Engineering needs to calculate acreages of impact, determine the hydrologic affect in each area (e.g. 1 month increase in hydroperiod, 1-inch increase in dry season groundwater depths, etc. for the pine flatwoods in super cluster 1), and provide figures and a short summary to Kim Dryden with the determination "may affect, not likely to adversely affect" by January 1.
    - Kim Dryden will look at the summary and will verify the effect determination.
    - Kim Dryden will also look at the summary and compare it to the new RCW determination key that is still under development and not available for public use.

ACTION ITEM FOR DAVID STITES – EMAIL KIM DRYDEN: David Stites will send a brief write-up (1-2 paragraphs plus graphics) for Kim to forward to Roxanna (Field Supervisor, USFWS) and Connie by Jan. 1.

Recommended Documentation

- RCW Hydrologic Habitat Analysis
    - Analysis approach
    - Comparison with Duever ranges
    - Stage-Duration Curves – We will make sure to identify those eastern S-D curves that include both CWIP + PSRP simulation results to assess effects of combined project; the remainder of the curves include the CWIP project only.

Florida Panther – Analysis and Mitigation Discussion

Florida Panther habitat units are vegetation-based (rather than habitat quality), so the project restoration will not provide "lift" to offset impacts within the construction footprint.

- Kim Dryden noted that there is a collared panther that has been documented by FWC biologists as using the culverts in this area to travel beneath I-75 during the dry season.
    - As such expected impacts to panther will include crossing impacts as increasing flows of water through the culverts will make the culverts unusable for any panthers currently using them to cross beneath I-75.
- Impacts to the Florida panther will also include impacts to panther habitat both north and south of I-75. These impacts will be calculated by using the panther habitat unit methodology developed by USFWS. These impacts may include both direct impacts (from construction activities) and indirect impacts (due to changes in hydrology; I-75 culvert use by Florida Panther).
- Potential Impact Categories
    - Direct Permanent– 15 acres of project construction footprint is about 150 Panther Habitat Units of Impact
    - Direct Temporary
    - Indirect / Secondary Permanent
    - Indirect / Secondary Temporary
- Mitigation – to be developed, led by Collier County
- **ACTION ITEM FOR DAVID STITES** – **Analysis Approach for Submittal to Kim Dryden:**
    - Calculate, document direct permanent impacts. Send estimate with project information to FWS for review, consideration of indirect and secondary impacts and further discussion of mitigation options
    - Per Kim Dryden possible mitigation approaches include:
        - Onsite – most desirable to FWS Panther expert
        - Mitigation Bank
        - Culvert enhancement – The culvert improvement design would include the addition of ledges within the culverts to be used as a 'catwalk' for panthers to get across the culvert in times of increased water flows. For this project the culvert redesign may not be applicable as the introduction of ledges within the culverts would negatively impede flows and, as such, would not be approved by FDOT (who owns/maintains the culverts and interstate), due to the FDOT requirement to maintain the current culvert cross section. [From John L: This won't be possible as part of the CWIP project. The FDOT is considering various options as a totally separate project.]
        - Purchase of land (within project area – David Schindel (sp?)) or elsewhere (Frank's Parcel?) – Kim Dryden suggested the county could purchase outparcels within North Belle Meade or the Picayune Strand State Forest to compensate for panther habitat impacts. She also suggested that if that was not possible or infeasible in some way the county could purchase other lands within the county adjacent to proposed wildlife crossings prioritized by USFWS.
        - County deal to holistically retrofit Culverts - Kim Dryden suggested it may be possible for the county to cut in on a separate project being undertaken by the

county to holistically retrofit culverts within the county using the culvert redesign plan described above.

- Exotic removal – Exotic plant removal is the mitigation option of lowest priority and would require a plan that indicates the parcels that would undergo exotic plant removal and a detailed process of how the county would conduct the exotic plant removal.
- Planting (or planting combined with exotic removal) – Cannot combine exotic removal with planting until operation demonstrates that the mitigation area is hydrologically appropriate for planting success.
- Note that FWS won't consider exotic removal and/or planting in PRSP due to current hydrologic projections. Within the CWIP project area, any exotic removal would have to be done in areas not already under conservation easement or other legal arrangement that includes such activity.

- **ACTION ITEM FOR CWIP TEAM – PANTHER ANALYSIS FORMAT AND APPROACH**: Obtain and review PSRP panther analysis and other more recent assessments. Include request for links to the information in ACTION ITEMS email to Kim Dryden.
- **ACTION ITEM FOR CWIP TEAM – PANTHER MITIGATION APPROACH**: Propose mitigation approach and run it by Kim. But first consult with Nick Casalanguida, Asst. County Administrator, prior to finalizing proposed mitigation strategy.
- **ACTION ITEM FOR CWIP TEAM– PANTHER DENNING SURVEY FIELDWORK PLAN /SCHEDULE:**
  - Prior to construction of any of the various structures associated with this project the applicant will need to check the project footprint for panther dens. If any dens are located, USFWS will need to be contacted and it is likely the project will be halted in that area until the den is vacated. Prior to the planned survey, we will submit a plan and consult with FWS on methods and results.

<u>Eastern Indigo Snake</u>

The Vero Beach FWS office has made available an Eastern Indigo sighting database. If the FWS database identifies any locations within 0.62 miles of the project impact area FWS requires formal consultation.

- Gopher tortoise burrows are not a primary habitat indicator in this area, as the climate is sufficiently warm that the snake does not require this refuge.
- Kim Dryden indicated there is a new eastern indigo snake determination key out of the Vero Beach office that is currently under litigation. It is possible that USFWS will revert back to the old key pending the outcome of the litigation.
- **ACTION ITEM – EMAIL TO KIM DRYDEN:** Include database request in email to Kim if not found on the net.

<u>Audubon's Crested Caracara</u>

- This species has recently become more commonly sighted in the Naples area. Per Kim Dryden, a preconstruction survey will need to be conducted within and adjacent to the work footprint per USFWS caracara nest survey methods. If any nests are located, USFWS will need to be contacted and it is likely the project will be halted in that area until the nest is vacated
  - Survey dates are the most recent survey season (Jan – April) before construction. Discussion included whether the standard protocol (observation followed by nest search

if observed) or going directly to nest search within the project impact area was the best approach. This will be resolved as we move through the FWS review. We will make a recommendation in the Draft BA.

- Kim Dryden suggested that outside of the construction footprint, habitat restoration as a result of the project will also improve foraging habitat for the caracara as they use wetlands to forage.
- **ACTION ITEM FOR CWIP TEAM – SURVEY PLAN FOR CRESTED CARACARA:** Discuss internally, resolve and draft approach to Caracara survey activities for submission as part of draft BA.

Bald Eagle – Nest Survey

- Kim Dryden suggested looking into known bald eagle nest location databases to determine if any bald eagle nests have been identified within limit set forth by the bald and golden eagle protection act. If so, a take permit will be required, if not, no permit will be necessary.
    - We will check the bald eagle nest database (state and federal) as well as reach out to agencies (FWC, FWS) to obtain any new information (locations not recorded)
- Preconstruction survey will be required
- NOTE in 2017 the FFWCC revised the state's bald eagle act for consistency with federal permitting, requiring only a federal permit for any potential take or disturbance of bald eagle nests.
- **ACTION ITEM FOR CWIP TEAM – DESKTOP ASSESSMENT AND PRECONSTRUCTION SURVEY PLAN FOR BALD EAGLE ACTIVITY:** We will develop and submit survey plan to FWS for review and approval.

Everglades Snail Kite

- Kim Dryden indicated that this project would improve habitat for the snail kite by improving the canals alongside I-75. Recognize in the BA as a potential benefit to the species.
- The snail kite is sporadically seen using canals in Collier County for foraging habitat. However, no known nests are located within or adjacent to the project site and therefore no impacts are expected.
- Per Kim Dryden, a nest survey will need to be conducted prior to any construction activities within and adjacent to the work footprint. If any nests are located (not just snail kites, but any type of bird), USFWS will need to be contacted and it is likely the project will be halted in that area until the nest is vacated

West Indian Manatee

- No impacts to the west Indian manatee are anticipated as there is no in-water work and the project will not result in changes to flows within Henderson Creek, which is the location of an important manatee area for overwintering (Henderson Creek Refuge).
    - Refuge protected under Argo Development Permit
    - In draft BA, we will mention that we are aware of the refuge and that the project will have no impact on it whatsoever.
- **ACTION ITEM FOR DAVID STITES – EMAIL TO KIM DRYDEN:** David Stites will request the Argo Development permit or link to the permit (if available).

American Crocodile

- Within the project area, alligator and crocodile nests are abundant along the 'road to nowhere', a berm within the receiving waters of the projects. The species is also present in other parts of the receiving water area, particularly the borrow pit north of the runway. Project has the potential (however small) to affect ponds near the executive airport used by the species – water quality, temperature changes should be discussed
- **ACTION ITEM FOR CWIP TEAM – COORDINATION WITH RBNERR:** Coordinate with Steve Burtoni and Keith Lockett of the Rookery Bay National Estuarine Research Reserve obtain a statement that says the project either will or will not impact this species and how the county can ameliorate for impacts if any impacts are identified. We will use results of discussion in draft BA.

<u>Bonneted Bat</u>

- Kim Dryden indicated that it is likely that bonneted bats may be found on the project site and therefore it would be necessary to conduct acoustic surveys within/adjacent to the construction footprints per the USFWS bonneted bat survey methodology. Information regarding the acoustic survey methodology can be found within the bonneted bat programmatic key. Kim Dryden suggested using this key to determine where and how to conduct bonneted bat surveys for the proposed project.
- Kim Dryden recommended a baseline survey and pre-construction survey. Prior to conducting any survey, Kim Dryden suggested submitting a map of survey locations to her to ensure the survey is compliant with the survey methodology. Each survey "day" must include the entire night (2 hrs. before sunset to 2 hrs. after sunrise?). Survey can't be performed during low temperatures (< 65° F) or rain. She also recommended including project benefits to bonneted bats as part of BA.
    - The baseline survey should include the direct impact area plus some buffer zone (250 feet?) as indicated in the USFWS bonneted bat survey methodology.
    - The pre-construction survey entails a nest survey within the direct impact area. The exact number of trees to be surveyed may be negotiated with USFWS depending on the size of the impact area and quality of the nesting trees (i.e. not all trees need to be surveyed). If any roosts are located, USFWS will need to be contacted and it is likely the project will be halted in that area until the roost is vacated.
- Kim Dryden indicated that the University of Florida is currently conducting a bat survey within the overall forest area. If the county is willing to wait for the survey to be completed, it may be possible to use that survey to determine if there are any hits within the construction footprint. If there are no hits, the project 'may affect, but is not likely to adversely affect' the bonneted bat, as, overall, the project will improve foraging habitat for the bat. If hits are identified within the construction footprint, a nest survey would need to be conducted in order to find the roost. If any roosts are located, USFWS will need to be contacted and it is likely the project will be halted in that area until the roost is vacated.
- **ACTION ITEM FOR EARTHTECH – SURVEY PLAN AND REVIEW:** Jeremy Sterk will develop and submit plans for bonneted bat baseline survey.
- **ACTION ITEM FOR DAVID STITES – EMAIL TO KIM DRYDEN:** David Stites will email Kim to verify the guidance dated October 22, 2019 that we previously received from her in late October is the most recent guidance document.

- Possible mitigation plans discussed included the placement of bat houses within high quality bat habitat. Need to be aware of locating houses near other structures (e.g. pump station) where the bats may also identify desirable roosting/nesting habitat

Wood stork

- Kim Dryden indicated the county should use the USFWS-Vero Beach wood stork programmatic key to determine impacts to the wood stork.
- Outside of the construction footprint, habitat restoration as a result of the project will also improve foraging habitat for the wood stork as they use wetlands to forage.

Black Rail

- The black rail is a candidate species for listing. Kim Dryden indicated there are no known locations of black rails within or adjacent to the project area, therefore no consultation will be necessary.

Sea Turtles

- No impacts to sea turtles are anticipated as there is no in-water work. Kim Dryden indicated the project may potentially improve habitat for sea turtles due to the restoration of the estuaries in the south of the project.

EFH

- No impacts to EFH are anticipated as there is no in-water work. Kim Dryden indicated the project may potentially improve estuarine EFH due to the restoration of the estuaries in the south of the project.
- Kim Dryden suggested the county meet with the National Marine Fisheries Service prior to permit application submittal to ensure no EFH impacts are expected.

ALL BIRD NESTS

- In the direct impact area, the presence of any bird nest must be reported to FWS for further consultation. [NOT DISCUSSED AT THE MEETING: THIS SUGGESTS THAT A PRECONSTRUCTION NEST SURVEY IS REQUIRED. VERIFY WITH FWS.] unclear how soon before construction this should be done.
- **ACTION ITEM FIELDWORK**: Preconstruction nest survey for all bird nests

"Nuisance" Species

- Constructed project areas that provide new habitat may attract species that the project to consider: Least Terns nesting in newly exposed bare ground during and immediately after construction, Black Banded Stilts and other shorebird / wetland species in emergent wetland habitat along flowway channel and spreader ditch during operations
- Mitigations:
    - During construction immediately grass large areas of exposed soil – e.g. road tops and sideslopes, berms, areas around concrete footprint of pump and weir structures

- During operations – survey for bird nests prior to vegetation management activities to develop appropriate management actions and schedules for maintaining open water areas and other vegetation control activities to avoid and minimize impacts to nests.

Water Quality

- Kim Dryden suggested submitting a report with what has been compiled thus far. Otherwise, the South Florida Water Management District will determine if there is any additional information needed regarding water quality.

UMAM

Kim Dryden indicated the South Florida Water Management District will take the lead on this component of the project. [*Meeting with SFWMD on Dec 16 discussed this issue and resolved a path forward]*

Document Production

ACTION ITEM FOR CWIP TEAM – BIOLOGICAL ASSESSMENT FOR USACE APPLICATION: As part of the permit application package, Kim Dryden indicated that a monitoring plan and operations plan would need to be included as attachments.

- The monitoring plan should include: 1) Hydrologic Monitoring Plan, 2) How the project will be assessed for each of the listed species described below, and 3) an Adaptive Management Plan.
  - Per David Stites, the hydrologic monitoring plan has been completed, however information regarding listed species and adaptive management still need to be added.
- The operation plan should contain figures and a summary of the plans for operating the control structures in different scenarios and should be compiled into a single document.
- Kim Dryden suggested that the applicant includes within the project description that the monitoring wells will be assessed for performance standards regarding listed species.
- Gary McAlpin indicated that monitoring of the 60-well system will be conducted for at least the next 5 years (pending approval of grant funding). These 5 years of monitoring will include the collection of baseline data (that data gathered now), data collection throughout the construction period, and approximately 1 year of monitoring following completion of construction.
- Required Documentation:
  - Project Description (for BA draft)
  - Project Operation Plan
  - Monitoring Program
    - Include monitoring schedule, period, expected future monitoring after current funding is expended
  - Monitoring Data Analysis Plan
    - Include general success criteria, thresholds, analysis approach, adaptive management plan, agency coordination (with agency names), reporting schedule
      - Reporting schedule for agency review – annual or longer; e.g. initial (at start of project operation), annual report, five-year review report. May

also include annual meetings starting at completion of construction and prior to water release.

- We have general target hydrologic ranges (Duever 2004) but have not developed action thresholds (e.g. when to reduce or stop inflows to manage surface water elevations).

- **ACTION ITEM FOR CWIP TEAM:** We will formulate an Adaptive Management Plan with Action Thresholds for all applicable listed species (not just RCW).

APPENDIX 3: PANTHER HABITAT ASSESSMENT

Collier County Comprehensive Watershed Improvement Project (CWIP)
Project Effects: Florida Panther (*Puma concolor cougar)* Habitat

Overview and Project Description

The Collier County Comprehensive Watershed Improvement Project (CWIP) proposes changes to hydrology in habitat for the Florida Panther (*Puma concolor coryi*), a state and federally endangered species. The 9,000-acre primary hydration area and project assessment area (22,000 acres between I-75 – US-41) are defined as primary panther habitat. See **Supplemental Information Attachment 6: Vegetation Hydrology Effects Analysis** for details on the project's effect on hydrology within the different vegetation communities. Lands in the primary and dispersal zones are of the highest importance in a landscape context to the Florida panther (USFWS 2012). In order to assess effects of the project on panther habitat, we propose the use of the US Fish and Wildlife Service (USFWS) methodology developed in 2006 and updated in 2012 (USFWS 2012). This methodology has also been attached at the end of this document as **Sub-Appendix 1**.

To evaluate project effects to the Florida panther, the USFWS method considers the contributions the project lands provide to the Florida panther, recognizing not all habitats provide the same functional value (USFWS 2012). As a result, the USFWS developed cost surface values for various habitat types, based on use by and presence in home ranges of panthers. The FWC, using a similar concept, assigned likely use values of habitats to dispersing panthers. The FWC's habitats were assigned habitat suitability ranks between 0 and 10, with higher values indicating higher likely use by dispersing panthers. The updated methodology has combined these values in order to consolidate the different habitat ranks (**Table 1**). This project will use current FLUCCS (Florida Land Use Classification Code System) data as the basis for habitat analysis and use the USFWS 2012 methodology as the guide for the calculations. NOTE: The land cover types described in the USFWS methodology are not classified using FLUCCS. See the *Panther Habitat Type* columns within **Table 2** & **Table 3** for details on what land cover types were assigned to the different FLUCCS communities present within the construction footprints.

<u>Project Description</u>

Water will be diverted from the Golden Gate Canal through pumps located upstream of the GG-3 weir. Based on a GG-3 flow duration analysis and permitted water diversions from the canal, the project proposes to divert 100 CFS when the discharge through the structure exceeds 450 CFS (~ 55 days/year) and 50 CFS when the discharge is between 200 CFS and 450 CFS (~ 83 days/year). Diversions will occur most often during the wet season however; sufficient water is expected to be available during early dry season to allow for smaller (i.e. 50 CFS) diversions. The diverted water will flow southwards via a proposed ditch that discharges water directly into the I-75 north canal. An operable gate structure is proposed on the I-75 north canal to force water to move eastwards and hence restrict discharge into Henderson Creek. The water will continue to flow south into the I-75 south canal through existing culverts under I-75, where it will be pumped into a proposed flowway located south of the canal, which will serve as an in-line water treatment facility providing settlement of solids to treat runoff from I-75. The spreader swale will have fixed weirs controlling water elevations in the entire flowway system as well as releasing water into Belle Meade Forest as sheet flow. Once released into the forest, the flow of water is driven by forest topography which slopes gradually from northeast to southwest. After infiltration and evapotranspiration losses, the remaining water will reach the southwest end where a collector ditch will receive the majority of the water near the eastern edge of Naples Reserve subdivision. The flow will be routed around the residential developments by means of proposed canals and will be discharged into U.S. 41 canal. A small portion of the forest water will continue to flow southwest as gravity sheet flow under Winding Cypress Drive. The

water will continue to flow south under Tamiami Trail through existing culverts. The water will be routed through the Fiddlers Creek residential developments using two existing canals both of which discharge into a linear lake bordering the southern boundary of Fiddler's Creek. The water will spill over the southern bank of the lake into wetlands fringing Rookery Bay as sheet flow. The sheet flow will continue to flow south and southwest towards Rookery Bay. A small fraction of the flow will make its way westwards under existing S.R. 951 culverts. The reader is referred to **Supplemental Information Attachment 5: Hydrologic and Hydraulic Modeling**, section 2.2.1.2, for details of the project drainage system and design details.

The project infrastructure will impact about 36 acres of wetlands and alter a total of about 60 acres of natural habitat. The habitat improvements over more than 9,000 acres provided by the rehydration will also provide the mitigation necessary to offset wetland impacts.

Methodology

Vegetation cover types and land uses were classified using the Florida Land Use and Cover Classification System (FLUCCS). The database used for the project and for the Panther Habitat Unit (PHU) calculations combined the most recent FNAI mapping of the Picayune Strand State Forest (which covers a large portion of the project area) with the most recent (2016) SFWMD FLUCCS mapping to create a seamless FLUCCS shapefile. Information regarding the creation of this shapefile and the overall composition of the vegetation communities can be found within **Supplemental Information Attachment 6: Vegetation Hydrology Effects Analysis**.

Habitat assessment methodology application

The project includes several sites accounting for 60.47 acres of impact. The development includes three pump stations, access roads, a spreader ditch to distribute water across a wide front in the Picayune Strand State Forest Cypress-dominated habitat, and berms, ditches, and other features to protect private outparcels and development existing at the edges of the project area. The wetlands and uplands in the construction footprints will be cleared and variously converted to uplands (pump stations, berms, etc.) or open water (channels / ditches). All berms will be completely grassed. No impervious surface is planned for access roads to the pump stations and other features that may need maintenance access. However, there will be some impervious surfaces associated with the concrete weirs found within the spreader swale and pump stations. Per the USFWS methodology, in rural settings berms may provide species benefit and should be classified as the habitat they will most resemble in the post-project condition (USFWS 2012). For this project, as the berms will be grassed, they will be evaluated as pasture.

The location of a project in the landscape of the core area of the Florida panther is important. The project area, within the primary panther habitat zone, includes only the most minimal development (drivable dirt tracks within the forest and a few outparcels) with no potential for future development within the larger project area, as it is part of the state forest. As recommended by USFWS, we have assumed a landscape base ratio of 1.98 as described in the 2012 assessment methodology.

Much of the natural habitat in the project impact areas are infested with exotic plant species, which affects the functional value the habitat type provides to foraging wildlife. Per the habitat assessment methodology, there is a habitat type and functional value for exotic species (USFWS 2012). Per the methodology, this category includes not only the total acres of pure exotic species habitats present but also the percent-value acreages of the exotic species present in other habitat types, as present throughout the project construction footprints.

To calculate the PHUs needed for mitigation, the existing and proposed panther habitat units were calculated for each of the project construction footprints using the habitat unit values described in **Table 1**. To calculate the existing PHUs, the following calculations were performed for each habitat type and summed to obtain a value of 354.52 PHUs (**Table 2**).

Equation 1

$$Total\ Acreage \times Percent\ 'Not - Exotic' \times Habitat\ Suitability\ Value$$

Equation 2

$$Total\ Acreage \times Percent\ 'Exotic' \times Exotic\ Habitat\ Suitability\ Value\ (= 3)$$

As the proposed berms will be entirely grassed, and per the panther methodology attached to this document, habitat values associated with pasture were assigned to those areas that will be converted to berm. As such, the panther habitat units associated with the proposed project were calculated as above to obtain a value of 142.94 PHUs (**Table 3**).

This results in a net loss of 211.58 PHUs within the project impact areas. This value of 211.58 PHUs was then multiplied by the 1.98 (the base ratio multiplier) resulting in a value of 418.93 PHUs for the project impact areas needed for mitigation (**Table 4**).

The base ratio is further described in the USFWS methodology (**Sub-Appendix 2**). Note: While the USFWS methodology document has a final base ratio multiplier of 2.5, Constance Cassler, USFWS recommended use of a base ratio value of 1.98 rather than 2.5 to remove the general traffic and development portions of the base ratio calculation (Personal Communication – Email Jan. 2020). See **Sub-Appendix 2** for figures depicting existing and proposed PHUs associated with each project impact area.

References

USFWS 2012 – United States Fish and Wildlife Service (USFWS), 2012. *Panther Habitat Assessment Methodology.* United States Fish & Wildlife Service, South Florida Ecological Services Office, Vero Beach, FL. Obtained November 2019 at: https://www.fws.gov/verobeach/MammalsPDFs/20120924_Panther%20Habitat%20Assessment%20Method_Appendix.pdf

Table 1. 2009 Habitat Unit Values for Use in Assessing Habitat Value to The Florida Panther (USFWS 2012).

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Reservoirs	*	Xeric scrub	4.5	Dry prairie	6.3
STAs	**	Orchards/groves	4.7	Upland Hardwood Forest	9.0
Urban	0	Marsh/ wet prairie	4.7	Cypress swamp	9.2
Water	0	Cropland	4.8	Hardwood swamp	9.2
Barren/Disturbed lands	3	Improved pasture	5.2	Hardwood-Pine	9.3
Coastal wetlands	3	Shrub swamp/brush	5.5	Upland-Hydric Pine forest	9.5
Exotic/nuisance plants	3	Unimproved pasture	5.7		

* PHU values for reservoirs are evaluated based on open water for the main water areas and the appropriate categories for berms and other non-water sections.

** PHU values for stormwater treatment areas vary depending on design criteria, mode of operation, location in native or non-native habitats, and other landscape features.

Table 2. Existing Panther Habitat Units

Location	FLUCCS	Total Acreage	Exotic Percent	Non-Exotic				Exotic				TOTAL IMPACT
				Acreage	Panther Habitat Type	Panther Habitat Value	Panther Habitat Unit	Acreage	Panther Habitat Type	Panther Habitat Value	Panther Habitat Unit	
North Belle Meade Flowway	411/Pine Flatwoods/E2: 25-50%	0.98	0.25	0.735	Upland-Hydric Pine Forest	9.5	6.99	0.25	Exotic/Nuisance Plants	3	0.74	
North Belle Meade Flowway	411/Pine Flatwoods/E3: 50-75%	0.04	0.5	0.021	Upland-Hydric Pine Forest	9.5	0.20	0.02	Exotic/Nuisance Plants	3	0.06	
North Belle Meade Flowway	411/Pine Flatwoods/E4: >75%	3.00	0.75	0.750	Upland-Hydric Pine Forest	9.5	7.12	2.25	Exotic/Nuisance Plants	3	6.75	
North Belle Meade Flowway	415/Mixed Pine/E3: 50-75%	0.74	0.5	0.368	Hardwood-Pine	9.3	3.43	0.37	Exotic/Nuisance Plants	3	1.11	
North Belle Meade Flowway	415/Mixed Pine/E4: >75%	0.52	0.75	0.130	Hardwood-Pine	9.3	1.21	0.39	Exotic/Nuisance Plants	3	1.17	
North Belle Meade Flowway	624/Cypress - Pine - Cabbage Palm/E3: 50-75%	5.75	0.5	2.874	Cypress Swamp	9.2	26.44	2.87	Exotic/Nuisance Plants	3	8.62	
North Belle Meade Flowway	8146/Primitive Trails/-	0.08	0	0.080	Barren/Disturbed Lands	3	0.24	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***11.11***				***TOTAL***	***45.63***			***TOTAL***	***18.45***	***64.08***
South Belle Meade Flowway	411/Pine Flatwoods/E1: <25%	8.10	0	8.104	Upland-Hydric Pine Forest	9.5	76.99	0.00	Exotic/Nuisance Plants	3	0.00	
South Belle Meade Flowway	411/Pine Flatwoods/E2: 25-50%	0.43	0.25	0.320	Upland-Hydric Pine Forest	9.2	2.95	0.11	Exotic/Nuisance Plants	3	0.32	
South Belle Meade Flowway	624/Cypress - Pine - Cabbage Palm/E1: <25%	10.94	0	10.939	Cypress Swamp	9.2	100.64	0.00	Exotic/Nuisance Plants	3	0.00	
South Belle Meade Flowway	624/Cypress - Pine - Cabbage Palm/E2: 25-50%	4.58	0.25	3.439	Cypress Swamp	9.2	31.64	1.15	Exotic/Nuisance Plants	3	3.44	
South Belle Meade Flowway	624/Cypress - Pine - Cabbage Palm/E3: 50-75%	0.95	0.5	0.477	Cypress Swamp	9.2	4.38	0.48	Exotic/Nuisance Plants	3	1.43	
South Belle Meade Flowway	8146/Primitive Trails/-	4.58	0	4.579	Barren/Disturbed Lands	3	13.74	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***29.59***				***TOTAL***	***230.33***			***TOTAL***	***5.19***	***235.52***
Southern Flowway 1	510/Streams and Waterways/-	2.89	0	2.891	Water	0	0.00	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 1	624/Cypress - Pine - Cabbage Palm/E2: 25-50%	1.88	0.25	1.411	Cypress Swamp	9.2	12.99	0.47	Exotic/Nuisance Plants	3	1.41	
Southern Flowway 1	740/Disturbed Land/-	0.08	0	0.085	Barren/Disturbed Lands	3	0.25	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 1	743/Berm/-	0.25	0	0.247	Improved Pasture	5.2	1.29	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***5.10***				***TOTAL***	***14.52***			***TOTAL***	***1.41***	***15.94***
Southern Flowway 2	510/Streams and Waterways/-	4.32	0	4.324	Water	0	0.00	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 2	743/Berm/-	0.47	0	0.467	Improved Pasture	5.2	2.43	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***4.79***				***TOTAL***	***2.43***			***TOTAL***	***0.00***	***2.43***
Southern Flowway 3	814/Roadway/-	4.05	0	4.045	Barren/Disturbed Lands	3	12.14	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***4.05***				***TOTAL***	***12.14***			***TOTAL***	***0.00***	***12.14***
Southern Flowway 4	510/Streams and Waterways/-	0.34	0	0.337	Water	0	0.00	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 4	621/Cypress/E1: <25%	0.34	0	0.340	Cypress Swamp	9.2	3.13	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 4	624/Cypress - Pine - Cabbage Palm/E1: <25%	0.45	0	0.452	Cypress Swamp	9.2	4.16	0.00	Exotic/Nuisance Plants	3	0.00	
Southern Flowway 4	8146/Primitive Trails/-	0.46	0	0.463	Barren/Disturbed Lands	3	1.39	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***1.59***				***TOTAL***	***8.68***			***TOTAL***	***0.00***	***8.68***
Pedestrian Path	8146/Primitive Trails	0.40	0	0.401	Barren/Disturbed Lands	3	1.20	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***0.40***				***TOTAL***	***1.20***			***TOTAL***	***0.00***	***1.20***
Sanders Blvd Property	500/Water/-	0.04	0	0.043	Water	0	0.00	0.00	Exotic/Nuisance Plants	3	0.00	
Sanders Blvd Property	619/Exotic Wetland Hardwoods/-	0.51	1	0.000	-	-	-	0.51	Exotic/Nuisance Plants	3	1.53	
Sanders Blvd Property	624/Cypress - Pine - Cabbage Palm/E4: >75%	1.07	0.75	0.268	Cypress Swamp	9.2	2.46	0.80	Exotic/Nuisance Plants	3	2.41	
Sanders Blvd Property	625/Wet Pinelands Hydric Pine/E4: >75%	0.92	0.75	0.229	Upland-Hydric Pine Forest	9.5	2.17	0.69	Exotic/Nuisance Plants	3	2.06	
Sanders Blvd Property	740/Disturbed Land/-	1.27	0	1.271	Barren/Disturbed Lands	3	3.81	0.00	Exotic/Nuisance Plants	3	0.00	
Sanders Blvd Property	814/Roads and Highways/-	0.03	0	0.026	Barren/Disturbed Lands	3	0.08	0.00	Exotic/Nuisance Plants	3	0.00	
	TOTAL	***3.84***				***TOTAL***	***8.53***			***TOTAL***	***6.00***	***14.53***
	TOTAL ACRES ALL AREAS	***60.47***									***GRAND TOTAL PHU***	***354.52***

PHU = panther habitat units

Table 3. Proposed Panther Habitat Units

Location	FLUCCS	Acreage	Panther Habitat Type	Panther Habitat Value	Panther Habitat Unit
North Belle Meade Flowway	211/Improved Pastures	6.97	Improved Pastures	5.2	36.25
North Belle Meade Flowway	512/Channelized Waterways, Canals	4.07	Water	0	0.00
North Belle Meade Flowway	8335/Pumping Stations	0.07	Urban	0	0.00
	TOTAL	***11.11***		***TOTAL***	***36.25***
South Belle Meade Flowway	211/Improved Pastures	14.83	Improved Pastures	5.2	77.09
South Belle Meade Flowway	512/Channelized Waterways, Canals	13.68	Water	0	0.00
South Belle Meade Flowway	740/Disturbed Land	0.17	Barren/Disturbed Lands	3	0.50
South Belle Meade Flowway	747/Dikes and Levees	0.83	Barren/Disturbed Lands	3	2.48
South Belle Meade Flowway	8335/Pumping Stations	0.09	Urban	0	0.00
	TOTAL	***29.59***		***TOTAL***	***80.07***
Southern Flowway 1	211/Improved Pastures	0.70	Improved Pastures	5.2	3.62
Southern Flowway 1	512/Channelized Waterways, Canals	4.41	Water	0	0.00
	TOTAL	***5.10***		***TOTAL***	***3.62***
Southern Flowway 2	211/Improved Pastures	1.37	Improved Pastures	5.2	7.12
Southern Flowway 2	512/Channelized Waterways, Canals	3.42	Water	0	0.00
	TOTAL	***4.79***		***TOTAL***	***7.12***
Southern Flowway 3	211/Improved Pastures	0.07	Improved Pastures	5.2	0.34
Southern Flowway 3	512/Channelized Waterways, Canals	3.98	Water	0	0.00
	TOTAL	***4.05***		***TOTAL***	***0.34***
Southern Flowway 4	211/Improved Pastures	0.40	Improved Pastures	5.2	2.07
Southern Flowway 4	512/Channelized Waterways, Canals	0.71	Water	0	0.00
Southern Flowway 4	8146/Primitive Trails	0.48	Barren/Disturbed Lands	3	1.45
	TOTAL	***1.59***		***TOTAL***	***3.52***
Pedestrian Path	8146/Primitive Trails	0.40	Barren/Disturbed Lands	3	1.20
	TOTAL	***0.40***		***TOTAL***	***1.20***
Sanders Blvd Property	211/Improved Pastures	2.08	Improved Pastures	5.2	10.82
Sanders Blvd Property	512/Channelized Waterways, Canals	1.65	Water	0	0.00
Sanders Blvd Property	8335/Pumping Stations	0.10	Urban	0	0.00
	TOTAL	***3.84***		***TOTAL***	***10.82***
	TOTAL ACRES ALL AREAS	***60.47***		***GRAND TOTAL PHU***	***142.94***
PHU = Panther Habitat Units					

Table 4. Results of Florida Panther Habitat Assessment for the Project Impact Areas

Impact and Mitigation PHU Calculations	
Existing PHUs	354.52
Proposed PHUs	142.94
Net PHUs	211.58
Base Ratio	1.98
Mitigation PHUs	**418.93**
PHU = Panther Habitat Units	

SUB-APPENDIX 1: USFWS PANTHER HABITAT ASSESSMENT METHODOLOGY (2012)

Panther Habitat Assessment Methodology **September 24, 2012**

The Service developed the panther habitat assessment methodology in 2006 and updated the methodology in 2009. To evaluate project effects to the Florida panther, the Service considers the contributions the project lands provide to the Florida panther, recognizing not all habitats provide the same functional value. Kautz et al. (2006) also recognized not all habitats provide the same habitat value to the Florida panther and developed cost surface values for various habitat types, based on use by and presence in home ranges of panthers. The FWC (2006), using a similar concept, assigned likely use values of habitats to dispersing panthers. The FWC's habitats were assigned habitat suitability ranks between 0 and 10, with higher values indicating higher likely use by dispersing panthers.

The Service chose to evaluate project effects to the Florida panther through a similar process. We incorporated many of the same habitat types referenced in Kautz et al. (2006) and FWC (2006) with several adjustments to the assigned habitat use values reflecting consolidation of similar types of habitats and the inclusion of Comprehensive Everglades Restoration Plan (CERP) water treatment and retention areas. We used these values (Tables PM1 and PM2) as the basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther, as discussed below.

Base ratio: To develop a base ratio that will provide for the protection of sufficient acreage of primary zone equivalent lands for a population of 90 panthers (31,923 acres per panther [Kautz et al. (2006)]) from the acreage of primary zone equivalent non-urban lands at risk, we developed the following approach.

The available primary zone equivalent lands at the time the methodology was developed (2006) were estimated at 3,276,563 acres (ac) (see Tables PM3 and PM4), with 2,073,865 ac of primary zone equivalent, non-urban lands preserved. The remaining non-urban, at-risk, private lands were estimated at 1,202,698 ac of primary zone equivalent lands. To meet the protected and managed lands threshold for a population of 90 panthers, an additional 799,205 ac of primary zone equivalent lands are needed. The base ratio is determined by dividing the primary equivalents of at-risk habitat to be secured (799,205 ac) by the result of the acres of at-risk habitat in the primary zone (610,935 ac) times the value of the primary zone (1); plus the at-risk acres in the dispersal zone (27,883 ac) times the value of the dispersal zone (1); plus the at-risk acres in the secondary zone (503,481 ac) times the value of the secondary zone (0.69); plus the at-risk acres in the other zone (655,996 ac) times the value of the other zone (0.33); minus the at-risk ac of habitat to be protected (799,205 ac). The results of this formula provide a base value of 1.98.

$$799{,}205 / ([(610{,}935 \times 1.0) + (27{,}883 \times 1) + (503{,}481 \times 0.69) + (655{,}996 \times 0.33)] - 799{,}205) = 1.98$$

In evaluating habitat losses in the consultation area, we used an estimate of 0.8 percent loss of habitat per year (Kautz, personal communication, 2004) to predict the amount of habitat loss anticipated in south Florida during the next 5 years (*i.e.*, 6,000 hectares/year [14,820 ac/ year]). We conservatively assume that we would be aware of half of the development projects that occur within the primary zone and the secondary zone combined. We further assume that 50 percent of these projects would be located in the primary zone and 50 percent would be located in the secondary zone. Based on these assumptions, we estimated that over a 5-year period about 37,000 ac (primary zone

equivalent of 31,265 ac) would be developed without Federal review. To reflect this loss of habitat we adjusted the base acreage density of 31,923 acres per panther (Kautz et al. [2006]) to a new base density of 32,275 ac per panther, an increase of 352 acres (31,265/90=352+31,923=32,275). This adjustment results in a base ratio change from 1.98 to 2.23.

The Service realizes habitat losses from individual single-family residential developments will collectively compromise the Service's landscape scale effort to secure sufficient lands for a population of 90 panthers. We believe that, on an individual basis, single-family residential developments by individual lot owners on lots no larger than 5.0 ac will not result in take of panthers on a lot-by-lot basis; however, collectively these losses may affect the panther. Panthers are a wide-ranging species, and individually a 5.0-acre habitat change will not have a measurable impact. Compensation for such small-scale losses on a lot-by-lot basis is unlikely to result in meaningful conservation benefits for the panther versus the more holistic landscape level conservation strategy used in our habitat assessment methodology. To account for these losses, based on the 0.08 percent annual loss referenced by Kautz (2004), we estimated the development of vacant lands (2003) in northern Golden Gate Estates and Lehigh Acres in Collier and Lee counties, respectively, at about 2,590 ac per year per development, or about 12,950 ac per development over a 5-year period. As above, to reflect this loss we adjusted the revised base acreage density to 32,563 ac, an increase of 288 acres (25,900/90=288+352+31,923=32,563). To account for this loss, we further adjusted the base value from 2.23 to 2.48.

There is also a need for road crossings in strategic locations and we believe there are projects that may not have habitat loss factors but will have traffic generation factors. The Service considers increases in traffic as an indirect effect from a project, which can contribute to panther mortality. For assessment purposes, since our habitat methodology does not provide a mechanism to address this type of effect directly, we are providing a habitat surrogate of 500 ac per year of habitat loss for these types of projects, with a not to exceed value of 2,500 ac over the 5-year period. The 500 ac per year is based on average cost of FDOT bridge/box culvert crossings (3.6 to 5 million dollars) converted to acreage equivalent costs (8,500/ac). This 2,500 acre habitat surrogate adds an additional 28 acres per panther to the above adjusted base for a new base of 32,951 ac per panther (2,500/90=28+288+352+31,923=32,591). Therefore, we have added another 0.02 to the base ratio to address traffic impacts, which could provide an incentive to implement crossings in key locations. Following the same approach shown above, we adjusted the base ratio from 2.48 to 2.5. The Service intends to re-evaluate this base ratio periodically and adjust as needed to make sure all adverse effects are adequately ameliorated and offset as required under section 7 of the act and to achieve the Service's landscape scale effort for the Florida panther.

The Service uses a very conservative density of panthers per area of habitat to calculate the compensation ratio for impacts south of the Caloosahatchee River. Specifically, the Service relied on the low estimate in the range presented in Kautz et al. (2006) to reach its factor of 2.5. This low estimate density value was calculated by dividing the documented number of panthers in 2000, or 62 panthers, by an estimate of the habitat in the primary zone that was most consistently occupied by panthers from 1981 to 2000. As previously mentioned, it is clear the

panther population south of the river has increased notably since 2000, in 2001 = 78 panthers; in 2002 = 80; in 2003 = 87; in 2004 = 78; in 2005 = 82; in 2006 = 97; in 2007 = 117; and 2008=104. In 2007 more panthers were documented in south Florida than have been documented since current verified estimates have been collected. Furthermore, none of the panthers recorded south of the Caloosahatchee River lives exclusively outside of the primary zone, although some do venture outside of it on occasion (McBride, personal communication, 2007).

The average population size south of the Caloosahatchee River over the past 7 years is 86. If we were to use this number instead of 62 to calculate the compensation ratio and to use the entire acreage of the primary zone as the denominator, the revised compensation ratio requirement would be 0.32 ac protected for every acre developed. Furthermore, if we excluded the "other zone" altogether from the analysis, the ratio would be 1.01, still lower than the Service's current ratio. We believe this conservative approach is warranted because of the inherent importance of habitat protection to panther conservation.

Landscape multiplier: As stated in the above section on primary zone equivalent lands, the location of a project in the landscape of the core area of the Florida panther is important. As we have previously discussed, lands in the primary and dispersal zones are of the highest importance in a landscape context to the Florida panther, with lands in the secondary zone of less importance, and lands in the other zone of lower importance. These zones affect the level of compensation the Service believes is necessary to minimize a project's effects to Florida panther habitat. Table PM5 provides the landscape compensation multipliers for various compensation scenarios. As an example, if a project is in the other zone and compensation is proposed in the primary zone, a primary zone equivalent multiplier of 0.33 is applied to the PHUs (see discussion below) developed for the project. If the project is in the secondary zone and compensation is in the primary zone, then a primary zone equivalent multiplier of 0.69 is applied to the PHUs developed for the project.

Panther Habitat Units – habitat functional value: Prior to applying the base ratio and landscape multipliers discussed above, we evaluate the project site and assign functional values to the habitats present. This is done by assigning each habitat type on-site a habitat suitability value from the habitats shown in Tables PM1 and PM2. The habitat suitability value for each habitat type is then multiplied by the acreage of that habitat type resulting in a number representing PHUs. These PHUs are summed for a site total, which is used as a measurement of the functional value the habitat provides to the Florida panthers. This process is also followed for the compensation sites.

As of January 2005, the Service has been using a panther habitat suitability ranking system based in part on methods in publications by Swanson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include CERP water treatment and retention areas located in the panther's range (Table PM1). Since the implementation of this ranking system, the Service has received two additional, published habitat assessment studies (Cox et al. [2006] and Land et al. [2008]) that further assess habitat usage by the Florida panther. As it is the Service's policy to incorporate the most current peer-reviewed science into our assessment

and review of project effects on the Florida panther, we have revised the current habitat suitability ranking system.

To revise these values, the Service, in coordination with FWC, examined the habitat ranking values in the two new papers referenced above and Kautz et al. (2006) publication and developed a spreadsheet. The spreadsheet was developed to: (1) compare the results of each of these published analyses; and (2) provide a habitat ranking system for each of the assessments. On the first page of the spreadsheet, labeled "panther habitat selection analysis - habitat papers comparison," we summarized the types of analyses performed as to whether it was second order (selection of a home range with a large study area) or third order (selection of habitats within a home range). For each of these analyses, we then listed the habitat types reported in each paper and their order of selection by panthers (Table PM6). We used the cost surface scores and the rank differences from the Kautz et al. (2006) analyses as the selection order and for a measure of statistical differences among the habitat types. Selected habitat types are represented as bold black numbers and avoided habitats are bold red numbers. Habitats that were neither selected nor avoided are shown as normal font black numbers. Ranks with the same letter are not different from each other. Results from the Cox et al. (2006) and Land et al. (2008) papers using Euclidean analyses are shown in a similar fashion.

On the second page of the spreadsheet, labeled "summary of ranking values," we ranked the habitat types on a scale from 0 to 10 according the results from each study and professional judgment (Table PM7). We used our original ranking for the Kautz et al. analyses (with the ranking scale reversed such that the best habitat received a "10" and the lowest quality habitat was "0").

We developed similar rankings for the habitat analyses reported in Cox et al. (2006) and Land et al. (2008). Selected habitats fell in the range of 7 to 10; habitats that were used in proportion to availability were ranked from 4 to 6; and habitats that were avoided by panthers were ranked from 0 to 3. Ranks for habitats within each of the 3 outcomes began at the top of each of the ranges (selected = 10, used in proportion to availability = 6, avoided = 3). Some shifting of the ranks occurred based on the letter-coded statistical ranking. For instance, under *Land GPS Euclidean third order* both upland and wetland forests were selected by panthers and were not statistically different from each other (note the ranking of a and ab for upland and wetland forest, respectively). However, wetland forest and dry prairie also were not significantly different from each other. To show these relationships, we ranked upland forest as a 10, wetland forest as a 9, and we increased dry prairie from a 6 (top of the neither selected nor avoided ranking) to a 7 to reflect the interplay between dry prairie and wetland forest based on professional judgment.

To generate a new ranking of panther habitats for use as a habitat assessment measure, we simply averaged the ranks of the six different analyses presented in the spreadsheet to the first decimal place. Half of these results were second order habitat analyses (Kautz et al. compositional, Kautz et al. Euclidean and Cox et al. Euclidean) and the other half were third order analyses (Cox et al. Euclidean; Land et al. VHF Euclidean; Land et al. GPS Euclidean).

In our assessment, we noted several outlier habitat rankings that, based on our understanding of habitat needs of the Florida panther and our concern for human/panther interactions, appear to provide conflicting values. These habitats and their associated rankings are: (1) barren/disturbed – 5.2; (2) urban – 5.0; (3) open water – 3.3; and (4) coastal wetlands – 1.0. We believe adjustments are warranted for these four categories and our adjusted values are based on the following:

Barren/disturbed: Barren/disturbed lands may include many temporary changes to land use, such as crop rotation and prescribed fires that likely have little impact on the value to panthers. Areas disturbed by human impact on a longer-term basis (*e.g.*, parking of equipment and material storage areas) have chronic effects on panthers that we judge decrease the value of these lands for panthers. Barren/disturbed lands include disturbed lands (Florida land use and cover classification system [FLUCCS] 740) and spoil areas (FLUCCS 733). Based on the above reasons, we assigned barren/disturbed land a value of 3.

Urban: Panther habitat models typically include urban in the "other" category that was neither avoided nor selected by panthers. Highly urbanized areas are not found in the panther core area that was used in assessing habitat use, as panthers have already selected against these land use types by reducing their range. However, urbanizing areas in more rural settings may appear in the assessment of habitat use. Nevertheless, we believe that potential human/panther interactions are important conflict factors to consider as well. Therefore, we assigned both developed rural and highly urbanized areas a value of 0.

Open water: Open water has been found to be either avoided by panthers or included in the "other" category that was neither avoided nor selected by panthers. We believe open water in any setting provides little to no value to panthers. However, open water edges and berms can be a valuable foraging area or dispersal pathway in more rural settings, although these edges in an urbanized setting could promote human/panther conflicts. Therefore, we assigned open water in an urban setting, with or without emergent vegetation, and surrounding berms a value of 0. However, in rural settings, the littoral edges and berms may provide species benefit and are further addressed under the reservoir discussion below.

Coastal wetlands: There are few strictly coastal wetlands, such as salt marshes and mangrove swamps, within the panther focus area. Where these occur, they are closely interspersed with other upland habitats. In this context, we believe that these areas are of greater value to the panther than the models indicate. These areas may, for the most part, be avoided by panthers; but, they can be of value in the proper landscape context to higher value habitats. Therefore we assigned these areas a value of 3.

We also note that three additional land uses and or habitat types referenced in our original habitat rankings were not components addressed directly in the model. These include: (1) exotic/ nuisance plants; (2) stormwater treatment areas (STAs); and (3) reservoirs. We believe these categories are important in our assessment of panther habitat values and warrant consideration in our habitat ranking system.

Exotic/nuisance plants: Although exotic plants can be suitable for providing denning cover and habitat connectivity between other land types for panthers and panther prey, they generally do not provide the preferred foraging base of plants consumed by deer and other herbivores (Fleming et al. 1994). We believe prey foraging value, or lack thereof, is an important constraint in our habitat assessments. Therefore, we assigned these habitats a value of 3. Likewise, some native plant species can become so dominant and dense, especially under altered hydrologic and fire suppression regimes, that they no longer provide high habitat value for the panther even though occasional use may occur. The most common example is dense, nearly monotypic cattail stands, which are of reduced value relative to less altered marsh communities. Another example of this type of nuisance species dominance is dense stands of cabbage palm dominated communities. For systems represented by this habitat profile, we also assigned a value of 3.

STAs (Everglades restoration): STAs are generally designed to provide a water quality treatment function for nutrient removal from received upstream discharges and may include multiple berms and adjacent littoral shelves. Depending on the design and mode of operation, they can become vegetated by dense monotypic stands of cattails or can incorporate a diverse mosaic of wetland communities and hydroperiods that support sawgrass and shrub/scrub species. Therefore, they can provide various levels of resource benefit to panthers and panther prey species as discussed below. For this reason, the final value of an STA is determined in a case-by-case basis during project review.

The Service participates in planning efforts that encourage location of STAs at sites with minimal areas of natural habitat, with a preference for sites that are currently in agriculture. Because these facilities by design are located in areas that currently provide a reduced value to panthers and panther prey species, the Service values these systems pre and post project development as a neutral effect on panthers. In these situations, the development of an STA from existing agriculture land uses would be evaluated as if the agriculture land use was present following project development, with no increase or decrease in habitat value to the panther.

However, this neutral effect assessment is only applicable to land conversions from nonnative habitats to STAs. For those projects that remove natural habitats, the Service considers STA functional values to mimic the value of the natural system the STA is designed to achieve. As an example, an STA design that results in a dense monotypic stand of cattails would be appropriately evaluated following the exotic/nuisance species profile. Similarly, a system designed to provide a diverse mosaic of wetland communities and hydroperiods would be evaluated following the wet prairie/marsh profile. Another system design that incorporates internal and external berms could include an edge benefit evaluation identifying the berms and adjacent littoral shelves and their benefit to the Florida panther and panther prey species, and follow the values provided for improved pasture for the berms and or wet prairie/marsh values for the littoral shelves. An individual project assessment of pre and post habitat impacts will identify whether the project as designed results in loss of functional value or provides benefit to the Florida panther and panther prey species.

Reservoirs (Everglades restoration, large water storage area, mines): Reservoirs were originally classified as their own category in our 2003 assessment method. They differ from open-water systems primarily with their location in the landscape. In urban areas, reservoirs have always been considered open water and given a value of 0. In rural areas, the open water portion of the reservoir provides no habitat value, although the edges and the berms can provide valuable foraging area or dispersal pathways for the panther and panther prey species. Therefore, the 2003 methodology assigned a value of 1.5 to reservoirs to attempt to account for these benefits.

After further consideration, we believe a more appropriate way to evaluate the value of reservoirs is to evaluate the open water component separately from the reservoir edges and berms. Therefore, we are no longer assigning a value to reservoirs as their own habitat classification. When large-scale reservoir projects are proposed in the rural landscape, all open water areas should be classified as such (value = 0). Berms and edges should be classified as the habitat they will most resemble in the post-project condition. For example: a 1,000-acre reservoir with 50 ac of grassed berms and 50 ac of berms with roads along the top would be evaluated as 900 ac of open water, 50 ac of pasture, and 50 ac of urban.

We also recognized the habitat matrix (Table PM7) lists four native habitats similar in functional habitat value to panthers as non-native habitats: marsh/wet prairie – 4.7; xeric scrub – 4.5; shrub and brush – 5.5; and dry prairie – 6.3. These habitat ratings, which are between 4 and 6, are classified as being neither selected nor avoided by panthers. The Service's Florida Panther Recovery Plan's (Service 2008) action 1.1.1.2.3 recommends habitat preservation and restoration within the primary zone be provided in situations where land use intensification cannot be avoided. We view this recommendation as a key parameter in our conservation goal to locate, preserve, and restore lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River.

Therefore, for assessment purposes, if a project is proposing restoration of non-native habitats (*e.g.*, pasture, row crops, groves, etc.) to native habitats, we believe that a restoration lift to a value of 7 is appropriate. The functional value of 7 corresponds to that value found in the literature where panthers begin to select for that habitat attribute (Table PM7). We also believe a full functional lift credit for these restorations is appropriate as the time lag from restoration to full functional value is estimated to be relatively short (less than 5 years) for non-forested systems. However, the calculation of forested restoration values remains the same as in the previous methodology, which is one-half the difference between pre- and post-restoration.

In summary, we believe appropriate adjustments to our original PHU values are warranted based on the most current peer-reviewed science and our category specific discussions above. Therefore, we have incorporated the above referenced values into our revised habitat assessment matrix and these values are the current basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table PM2).

Exotic species assessment: since many habitat types in south Florida are infested with exotic plant species, which affects the functional value a habitat type provides to foraging wildlife

species (*i.e.*, primarily deer and hog), we believe the presence of these species and the value these species provide to foraging wildlife needs to be considered in the habitat assessment methodology. As shown in Table PM2, we have a habitat type and functional value shown for exotic species. This category includes not only the total acres of pure exotic species habitats present but also the percent-value acreages of the exotic species present in other habitat types.

For example, a site with 100 ac of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 ac of pine flatwoods and 10 ac of exotics. Adding another 100 ac of cypress swamp with 10 percent exotics would change our site from 90 ac of pine flatwoods and 10 ac of exotics to 90 ac of pine flatwoods, 90 ac of cypress swamp, and 20 ac of exotics.

Habitat assessment methodology application – example: To illustrate the use of our habitat assessment methodology, we provide the following example. A 100-acre project site is proposed for a residential development. Plans call for the entire site to be cleared. The project site contains 90 ac of hydric pine flatwoods and 10 ac of exotic vegetation, and is located in the "secondary zone." The applicant has offered habitat compensation in the "primary zone" to minimize the impacts of the project to the Florida panther. To calculate the PHUs provided by the site, we multiply the habitat acreage by the "habitat suitability value" for each habitat type and add those values to obtain a value of 885 PHUs ((90 ac of pine flatwoods x 9.5 [the habitat suitability value for pine flatwoods] = 855 PHUs) + (10 ac of exotic vegetation x 3 [the habitat suitability value for exotics] = 30 PHUs) = 885 PHUs). The value of 885 PHUs is then multiplied by the 2.5 (the base ratio) and 0.69 (the landscape multiplier) resulting in a value of 1,527 PHUs for the project site. In this example, the acquisition of lands in the primary zone containing at least 1,527 PHUs is recommended to compensate for the loss of habitat to the Florida panther resulting from this project.

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Table PM1. Original panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Water	0	STA	4.5	Cypress swamp	9
Urban	0	Shrub swamp	5	Sand pine scrub	9
Coastal strand	1	Shrub and brush	5	Sandhill	9
Reservoir	1.5	Dry prairie	6	Hardwood-Pine forest	9
Mangrove swamp	2	Grassland/pasture	7	Pine forest	9
Salt marsh	2	Freshwater marsh	9	Xeric oak scrub	10
Exotic/nuisance plants	3	Bottomland hardwood	9	Hardwood forest	10
Cropland	4	Bay swamp	9		
Orchards/groves	4	Hardwood swamp	9		

Table PM2. Revised panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Reservoirs	*	Xeric scrub	4.5	Dry prairie	6.3
STAs	**	Orchards/groves	4.7	Upland Hardwood Forest	9.0
Urban	0	Marsh/ wet prairie	4.7	Cypress swamp	9.2
Water	0	Cropland	4.8	Hardwood swamp	9.2
Barren/Disturbed lands	3	Improved pasture	5.2	Hardwood-Pine	9.3
Coastal wetlands	3	Shrub swamp/brush	5.5	Upland-Hydric Pine forest	9.5
Exotic/nuisance plants	3	Unimproved pasture	5.7		

* PHU values for reservoirs are evaluated based on open water for the main water areas and the appropriate categories for berms and other non-water sections. Refer to pages 5- 7 for the accompanying text for guiding criteria for these systems.

** PHU values for stormwater treatment areas vary depending on design criteria, mode of operation, location in native or non-native habitats, and other landscape features. Refer to page 6 for the accompanying text for guiding criteria for these systems.

Table PM3. Land Held for Conservation within the Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
TOTAL	2,578,152	TOTAL	2,073,865

Table PM4. Undeveloped Privately Owned Land within Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
TOTAL	1,962,294	TOTAL	1,202,699

* About 819,995 ac are at-risk in the other zone with about 80 percent with resource value. Total ac of at-risk privately owned lands are 1,962,294 ac.

Table PM5. Landscape Compensation Multipliers.

Zone of Impacted Lands	Zone of Compensation Lands	Multiplier
Primary	Secondary	1.45
Secondary	Primary	0.69
Other	Secondary	0.48
Other	Primary	0.33

Table PM6. Panther Habitat Selection Analyses – Habitat Papers Comparison.

Habitats	Kautz compositional second order	rank	Kautz Euclidean second order	rank	Habitats	Cox Euclidean second order	rank	Cox Euclidean third order	rank	Habitats	Land VHF Euclidean third order	rank	Land GPS Euclidean third order	rank
Hardwood swamp	**1**	A	**3**	A	Coniferous forest	**1**	A	**1**	A	Upland forest	**1**	A	**1**	A
Pineland	**2**	A	**2**	AB	pineland					pine/hardwood				
Cypress swamp	3	AB	**1**	BC	Hardwood forest	**3**	C	**2**	A	hardwood hammock				
Upland forest	**1**	B	**4**	CD	hardwood hammock					pinelands				
Dry prairie	5	B	5	DE	mixed pine/hardwood					tropical hammock				
Shrub and brush	4	C	7	EF	palm/oak					palm/hardwood				
Xeric scrub	3	CD	**9**	F	tropical hammock					Wetland forest	**2**	A	**2**	AB
Marsh	5	CD	**9**	F	Forested wetland	**2**	B	**3**	A	cypress swamp				
Unimproved pasture	**7**	DE	7	G	cypress swamp					cypress/pine/palm				
Barren	6	E	**9**	G	mixed forest					mixed swamp				
Improved pasture	**9**	EF	6	G	shrub swamp					hardwood swamp				
Urban	8	F	8	G	hardwood swamp					Dry prairie/grass	3	B	3	BC
Cropland	**9**	F	8	H	other wet forest					grassland				
Citrus	**10**	G	8	H	Dry prairie/grass	**4**	C	4	B	unimproved pasture				
Coastal wetlands	**11**	G	8	H	dry prairie					improved pasture				
Open water	**10**	H	**10**	I	grassland					Marsh/shrub	6	B	4	C
Exotic plants					Open wetland	7	E	**7**	C	marsh/wet prairie				
STA					marsh and wet prairie					sawgrass				
Reservoir					sawgrass					cattail				
					cattail					shrub swamp				
					Agricultural	**5**	D	5	B	Other	4	B	5	C
second order - selection of home range with entire study area					improved pasture					open water				
third order - selection of habitats within home range					citrus					shrub/brush				
Bold (black) - habitat used more than availability (selection)					row crop					barren				
Bold (red) - habitat used less than availability (avoidance)					other agriculture					high impact urban				
rank - habitats with same letters did not differ in preference					Urban/barren	**6**	E	6	B	low impact urban				
					bare soil					extractive				
					high-impact urban					Agriculture	5	B	6	C
					low-impact urban					citrus				
					extractive					row crop				
										other agriculture				

Table PM7. Summary of Ranking Values

Habitats	Kautz compositional second order	Kautz Euclidean second order	Cox Euclidean second order	Cox Euclidean third order	Land VHF Euclidean third order	Land GPS Euclidean third order	Average
Hardwood swamp	10	7	9	10	10	9	9.2
Pineland	9	8	10	10	10	10	9.5
Cypress swamp	8	9	9	10	10	9	9.2
Upland forest	10	6	8	10	10	10	9.0
Dry prairie	6	5	8	6	6	7	6.3
Shrub and brush	7	3	no data	no data	6	6	5.5
Xeric scrub	8	1	no data	no data	no data	no data	4.5
Marsh	6	1	6	3	6	6	4.7
Unimproved pasture	4	3	8	6	6	7	5.7
Barren	5	1	7	6	6	6	5.2
Improved pasture	2	4	7	6	6	6	5.2
Urban	3	2	7	6	6	6	5.0
Cropland	2	2	7	6	6	6	4.8
Citrus	1	2	7	6	6	6	4.7
Coastal wetlands	0	2	no data	no data	no data	no data	1.0
Open water	1	0	no data	no data	6	6	3.3
Exotic plants							
STA							
Reservoir							

habitat selection	7,8,9,10
neither selected nor avoided	4,5,6
habitat avoidance	0,1,2,3

SUB-APPENDIX 2: PANTHER HABITAT ASSESSMENT FIGURES

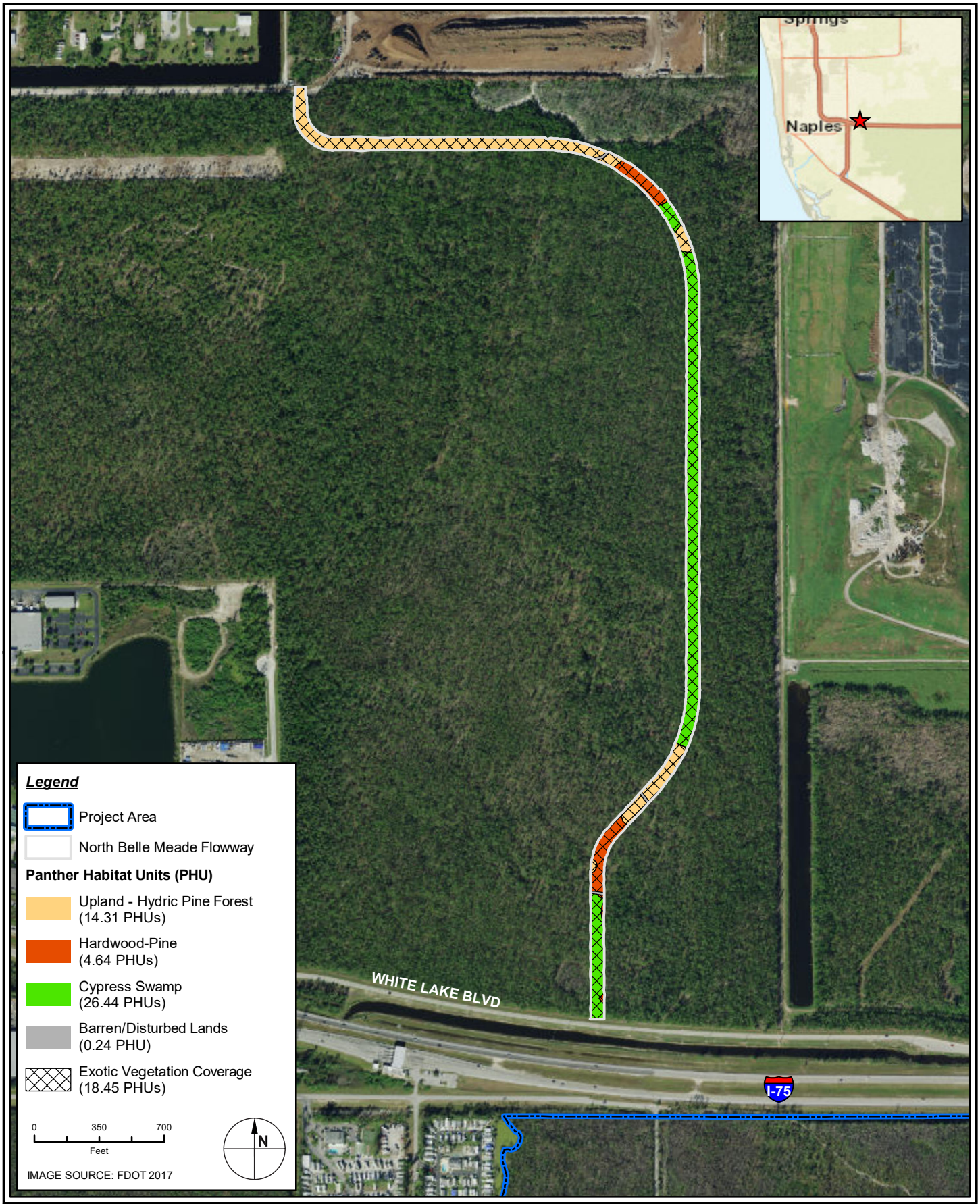

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FIGURE 1
NORTH BELLE MEADE FLOWWAY
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
DRAWN BY	KM
SHEET	
DATE	JAN 2020

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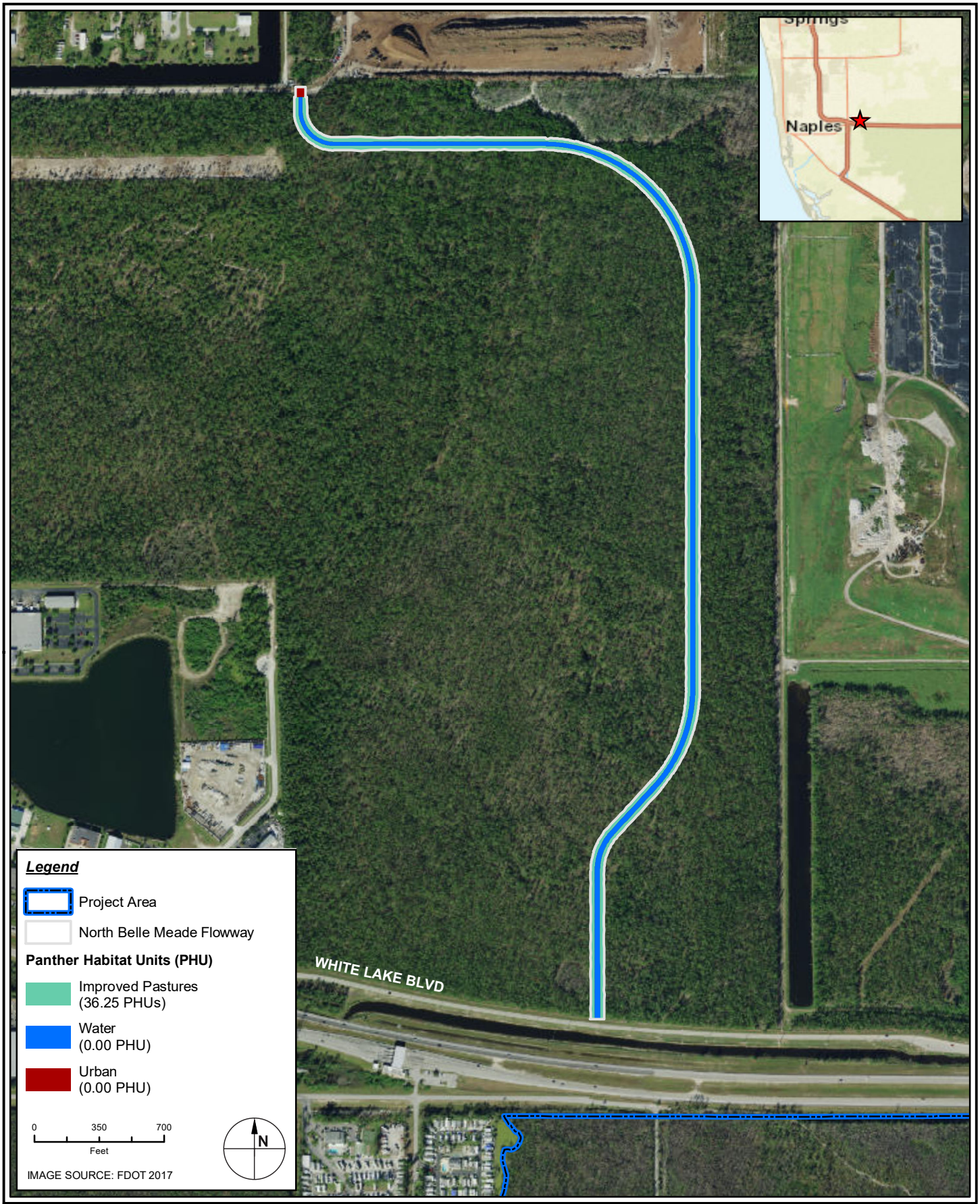

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FIGURE 2
NORTH BELLE MEADE FLOWWAY
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
DRAWN BY	KM
SHEET	
DATE	FEB 2020

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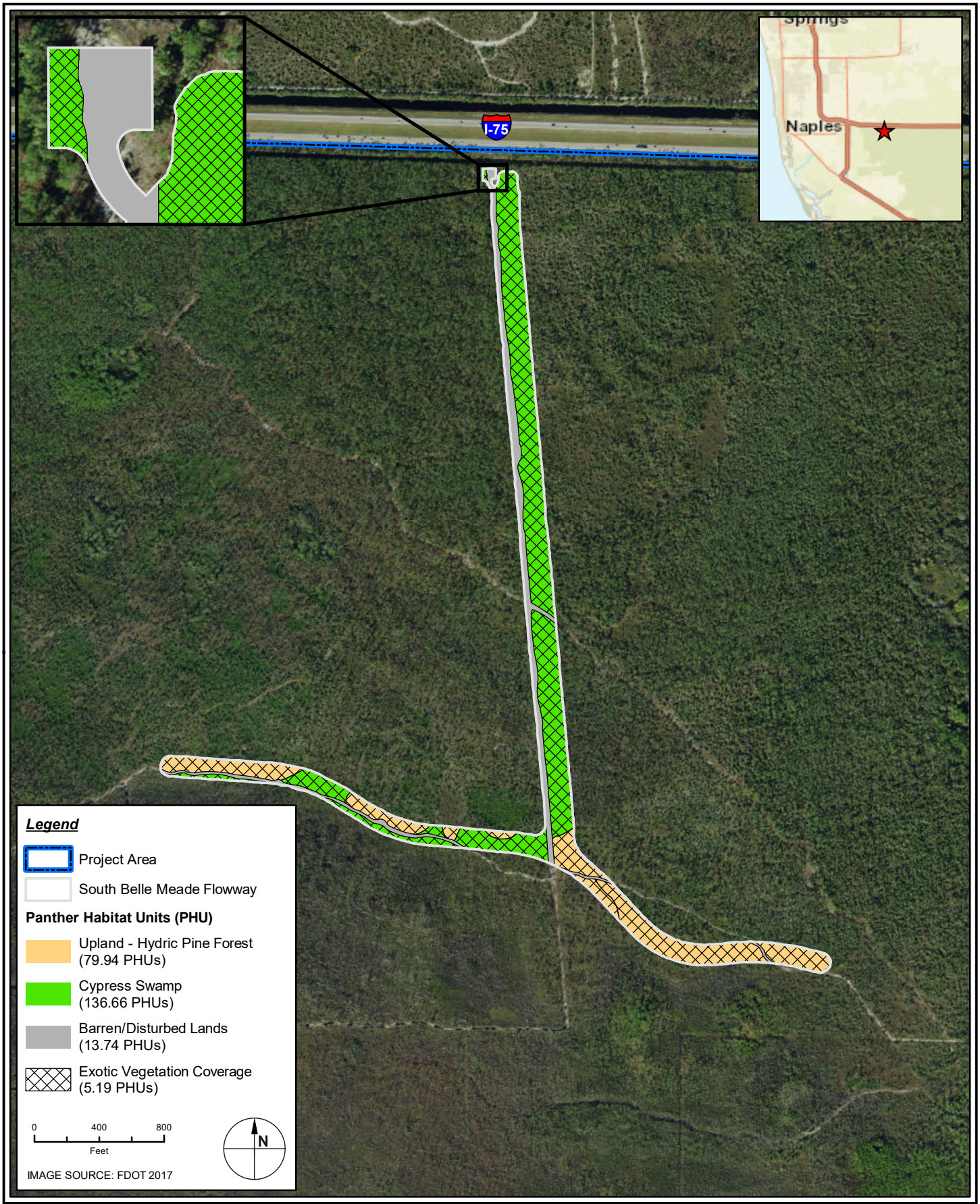

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FIGURE 3
SOUTH BELLE MEADE FLOWWAY
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
DRAWN BY	KM
SHEET	
DATE	JAN 2020

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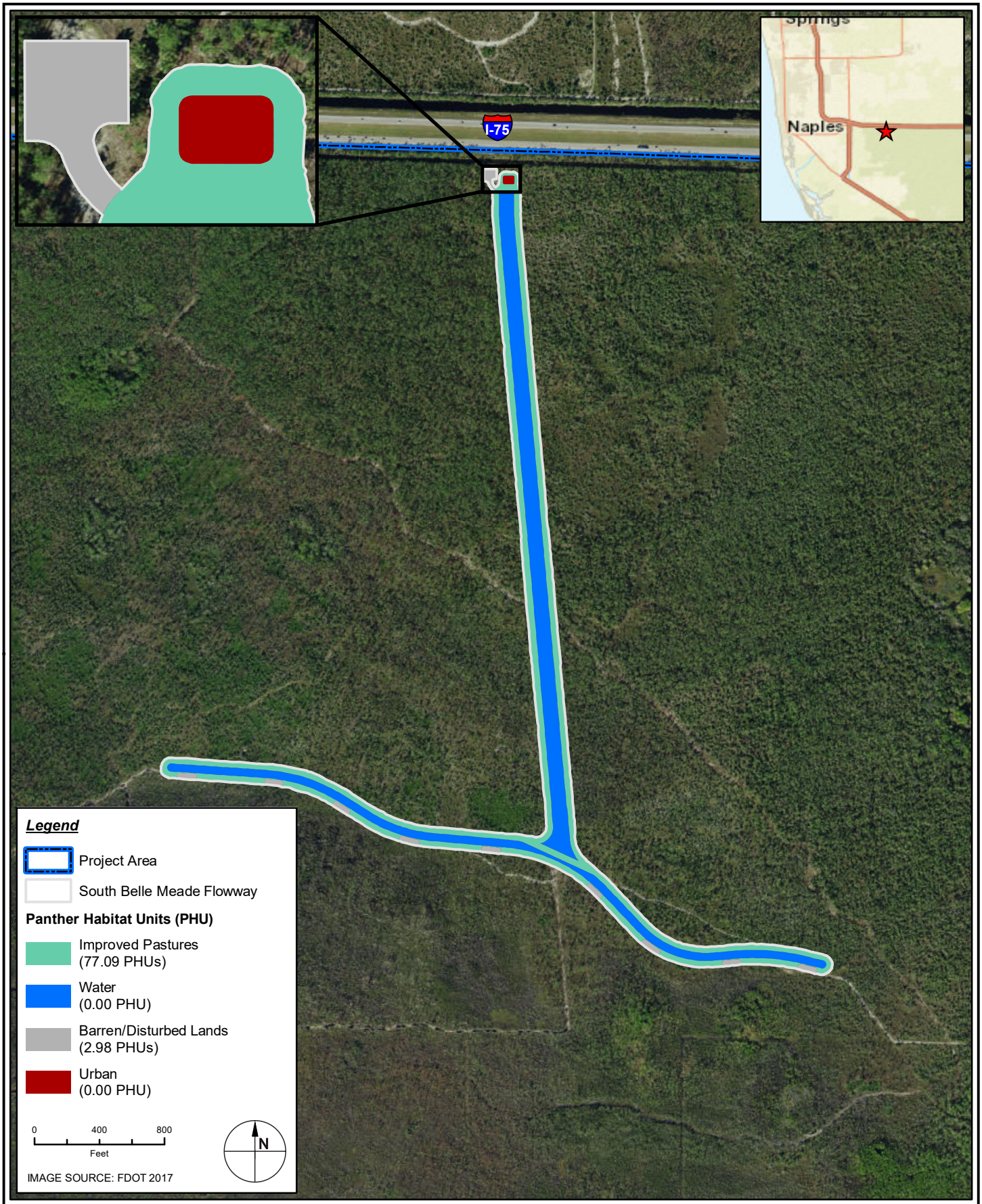

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FIGURE 4
SOUTH BELLE MEADE FLOWWAY
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
DRAWN BY	KM
SHEET	
DATE	JAN 2020

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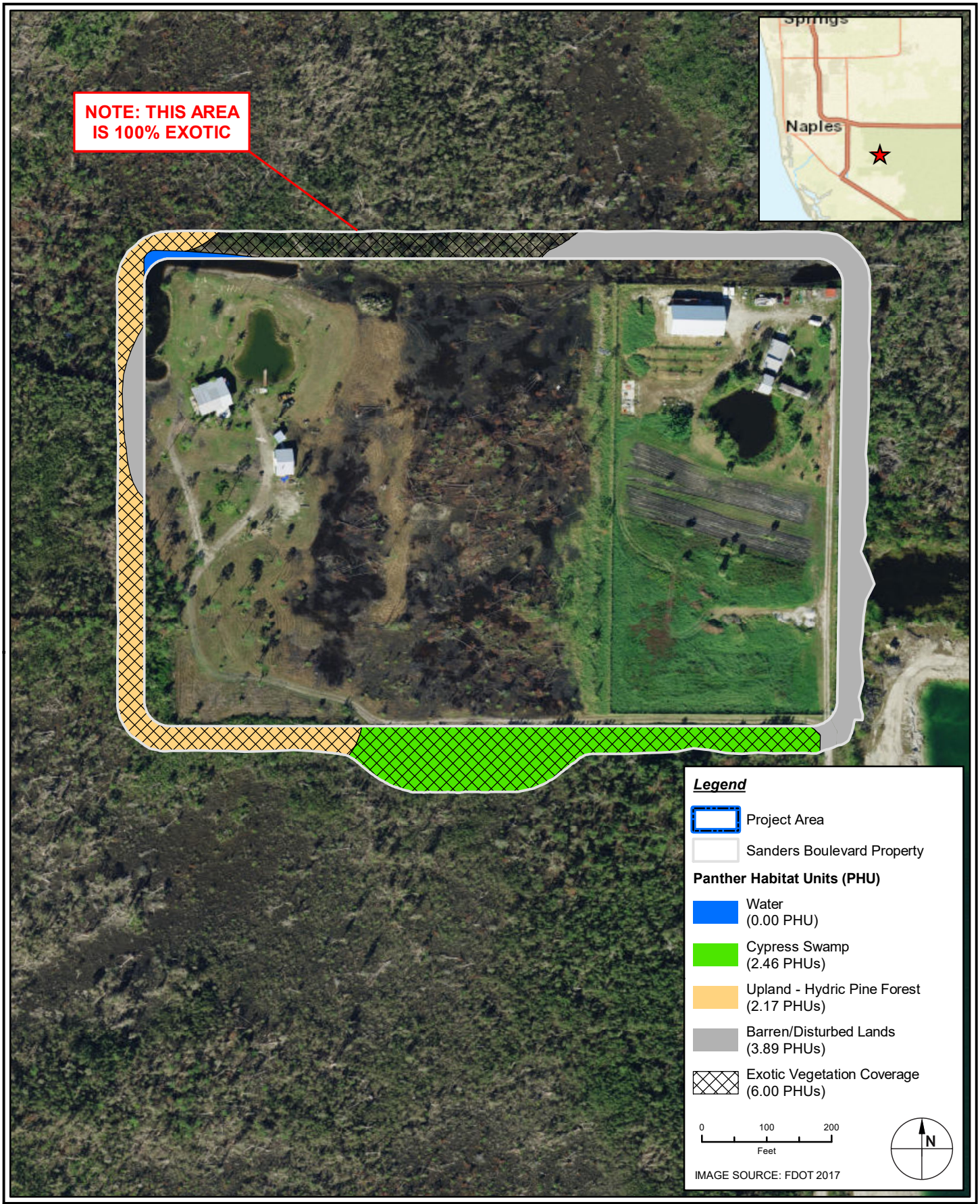

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FIGURE 5
SANDERS BOULEVARD PROPERTY
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
DRAWN BY	KM
SHEET	
DATE	JAN 2020

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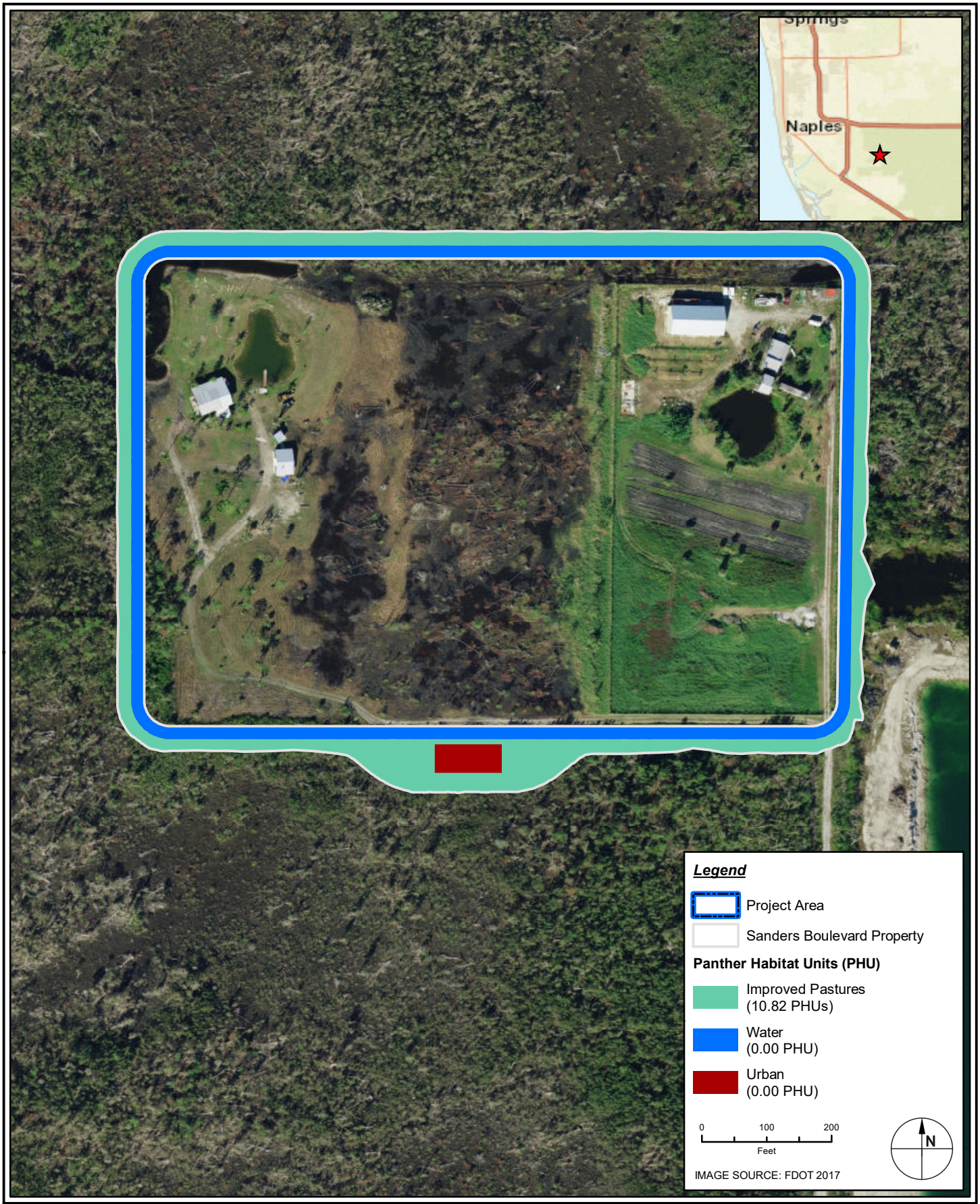

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FIGURE 6
SANDERS BOULEVARD PROPERTY
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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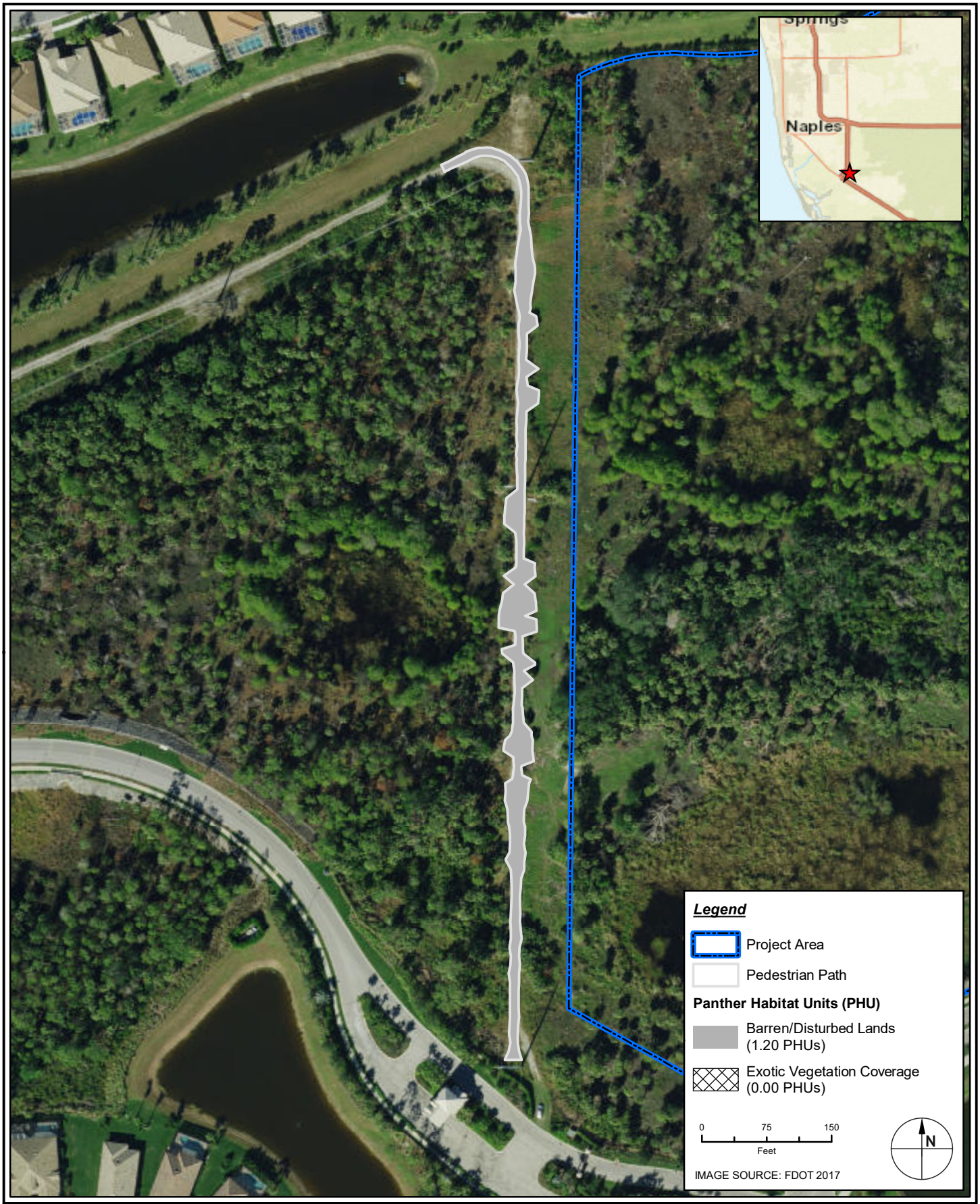

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FIGURE 7
PEDESTRIAN PATH
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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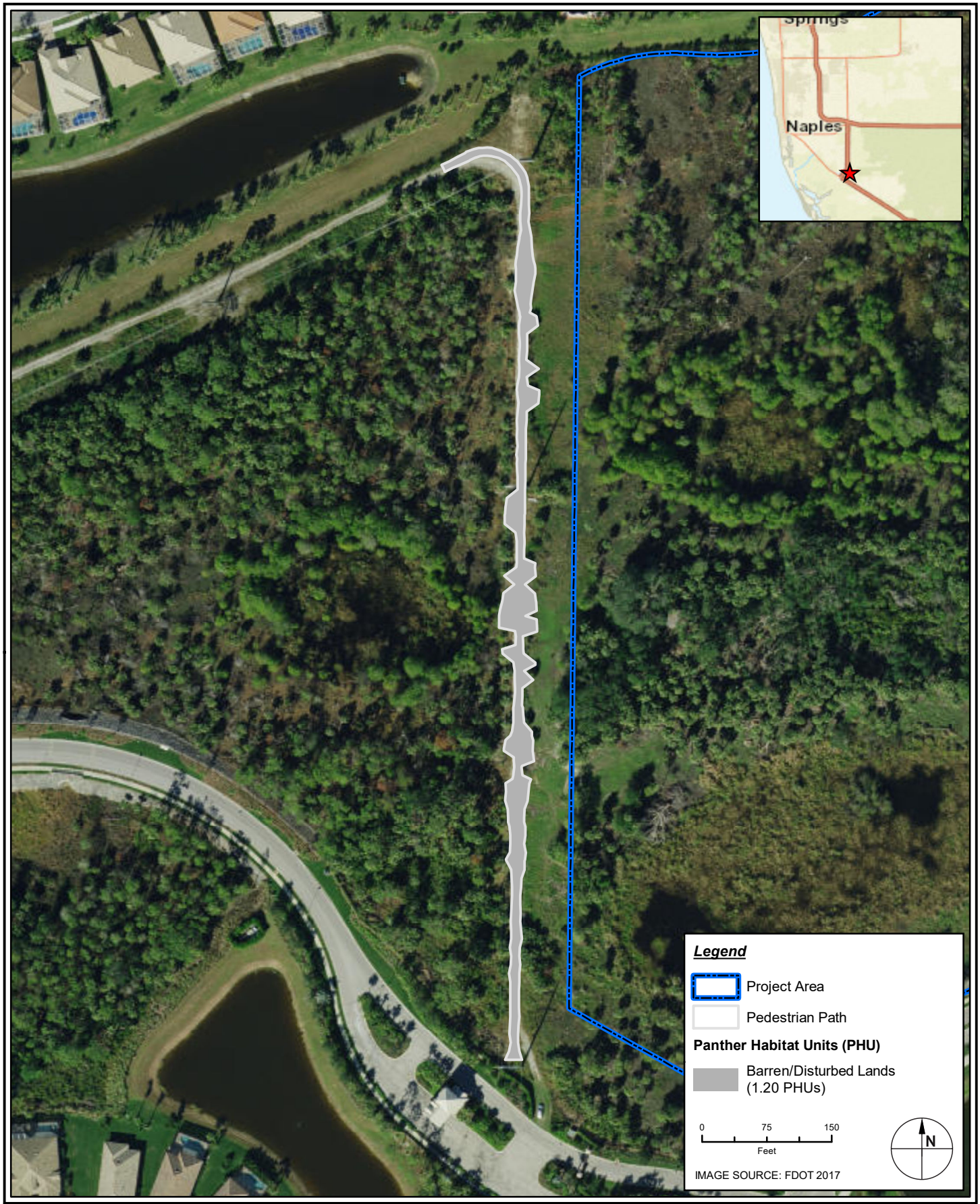

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FIGURE 8
PEDESTRIAN PATH
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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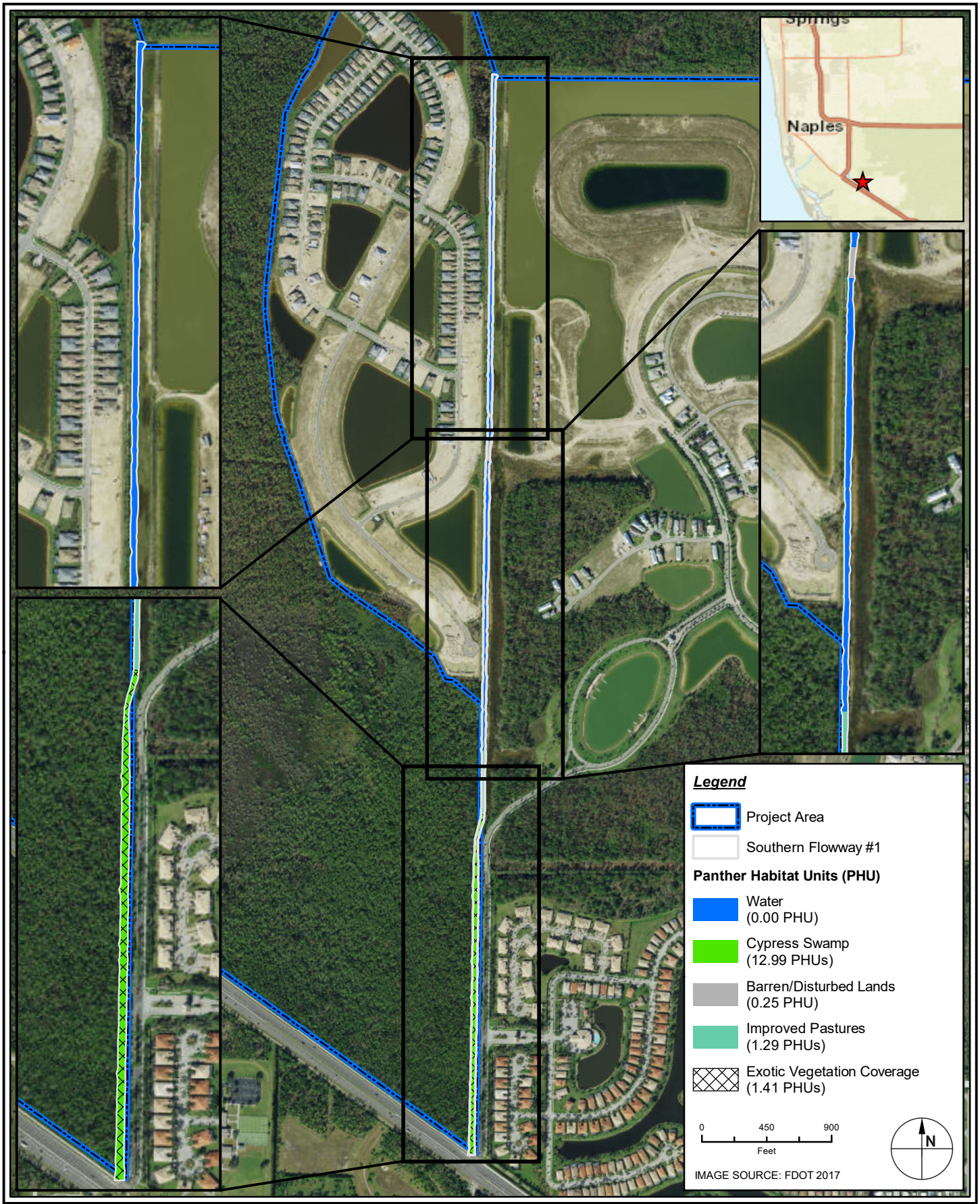

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FIGURE 9
SOUTHERN FLOWWAY #1
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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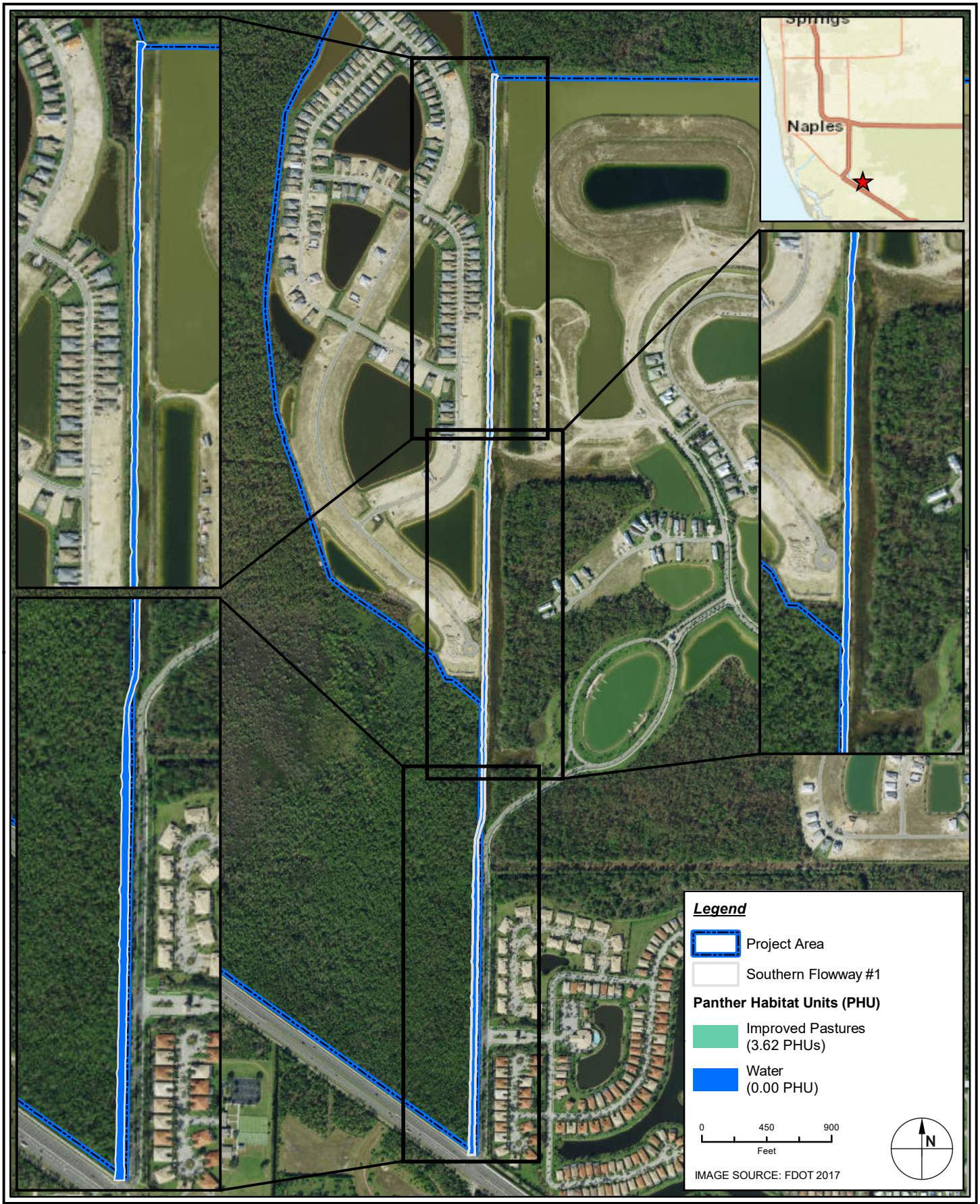

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FIGURE 10
SOUTHERN FLOWWAY #1
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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DATE	JAN 2020

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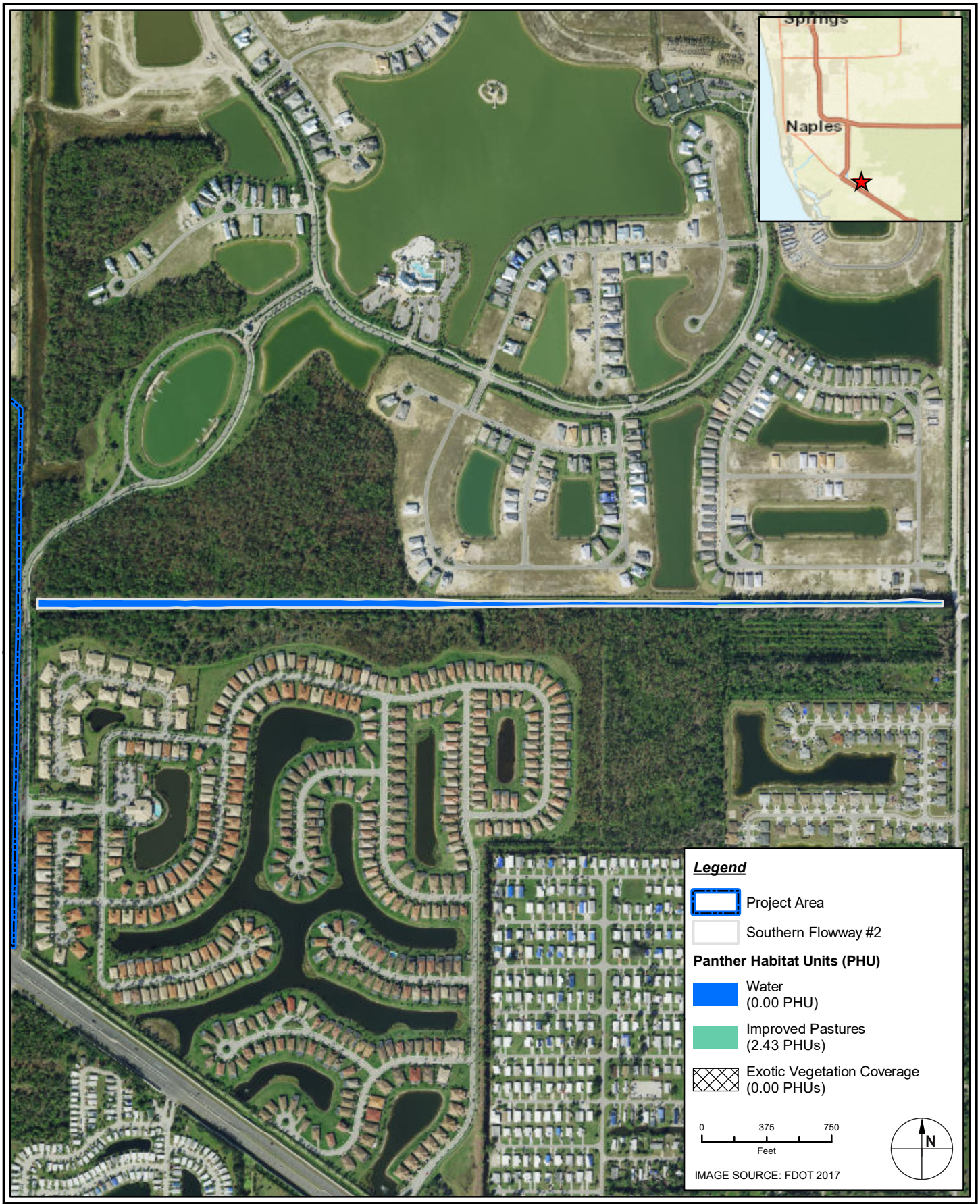

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FIGURE 11
SOUTHERN FLOWWAY #2
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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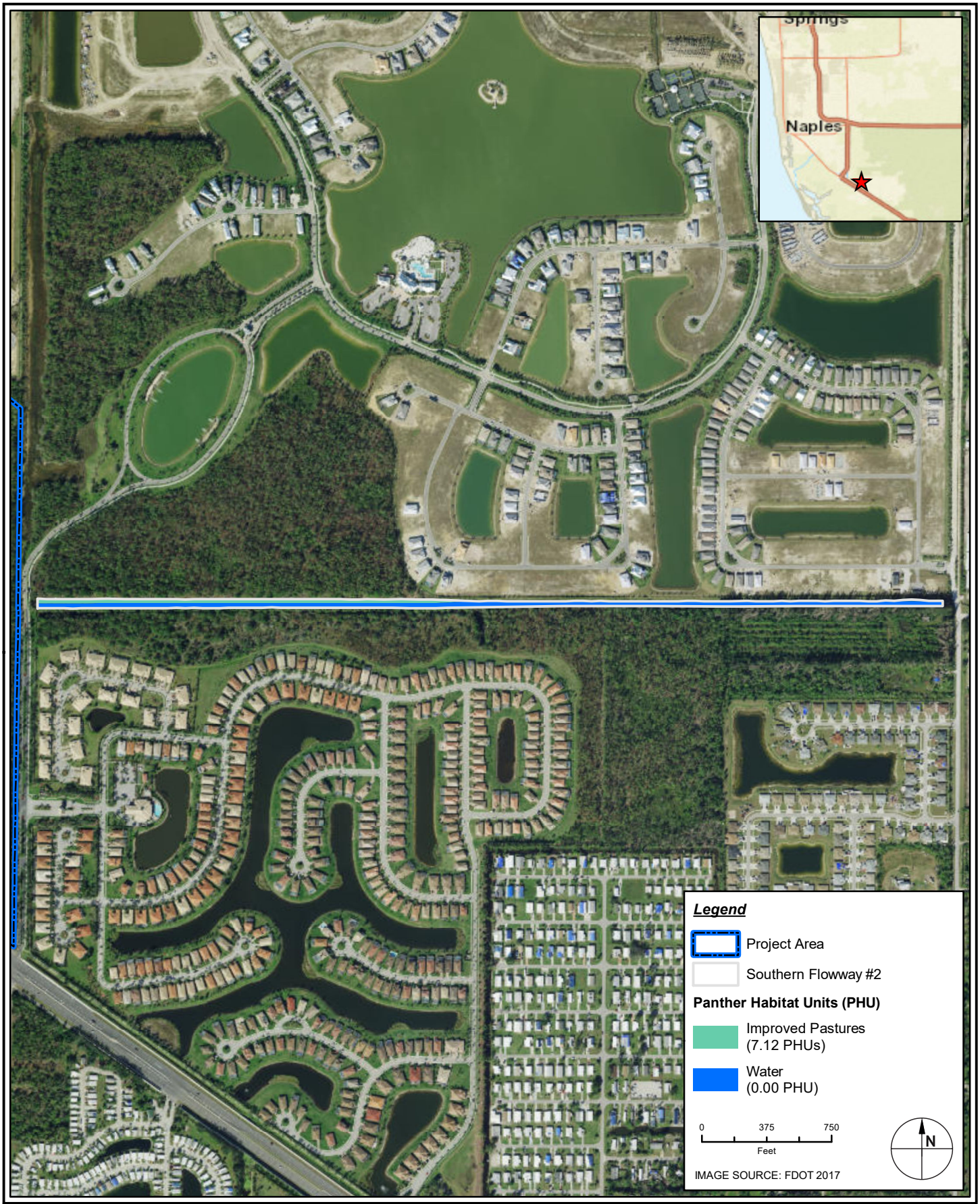

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FIGURE 12
SOUTHERN FLOWWAY #2
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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FIGURE 13
SOUTHERN FLOWWAY #3
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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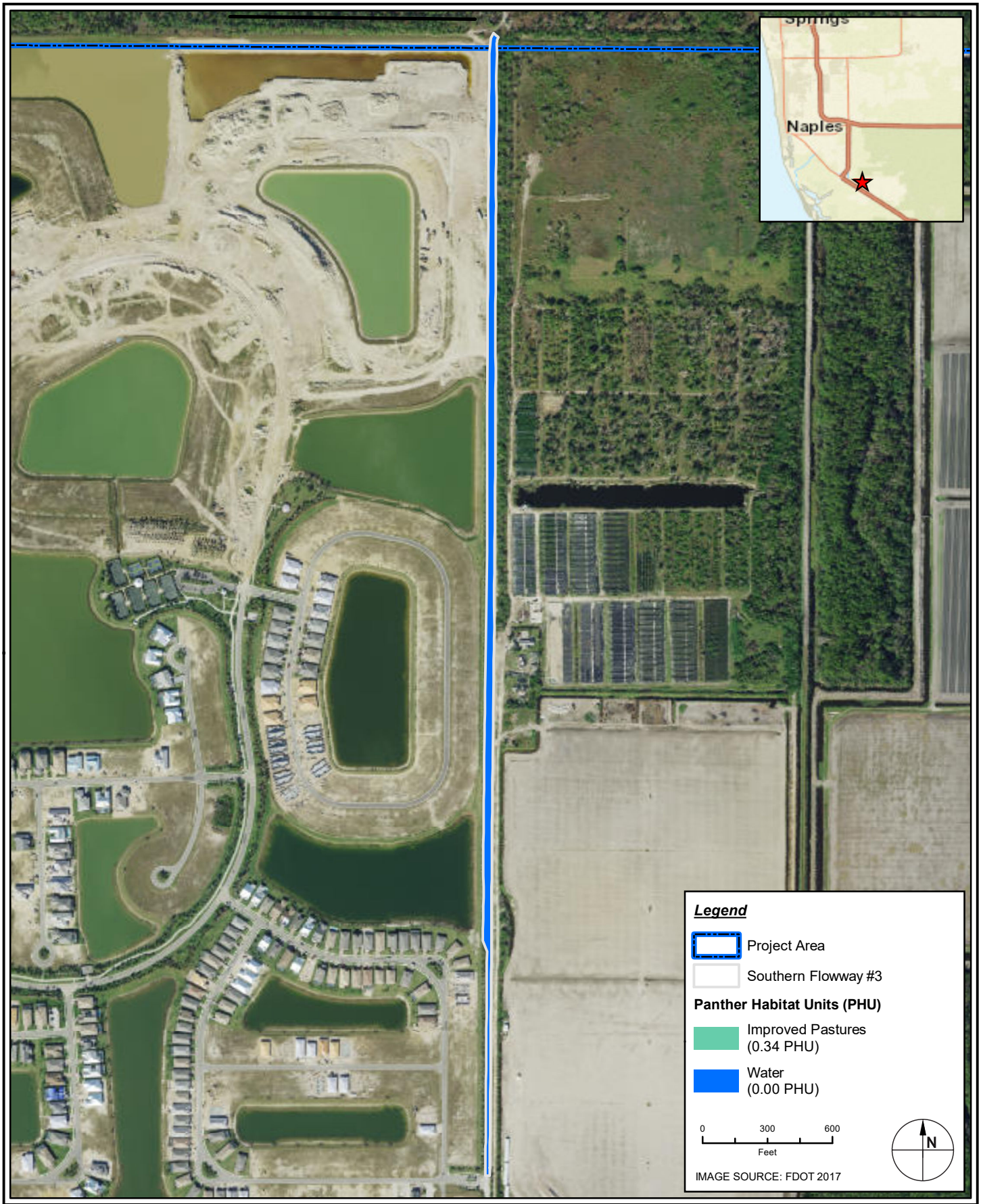

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FIGURE 14
SOUTHERN FLOWWAY #3
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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FIGURE 15
SOUTHERN FLOWWAY #4
EXISTING PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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DATE	JAN 2020

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FIGURE 16
SOUTHERN FLOWWAY #4
PROPOSED PANTHER HABITAT UNITS
PANTHER ANALYSIS
COLLIER COUNTY, FLORIDA

PROJECT	C2018-052
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DATE	JAN 2020

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APPENDIX 4: RED – COCKADED WOODPECKER HABITAT HYDROLOGY ASSESSSMENT

Appendix 4

Collier County Comprehensive Watershed Improvement Project (CWIP)

Project Effects: Red Cockaded Woodpecker (*Picoides borealis)* Habitat Hydrology

Introduction

Red-cockaded woodpecker (*Picoides borealis*)

The red-cockaded woodpecker (*Picoides borealis*) is a federally and State of Florida listed endangered species endemic to open, mature, and old growth pine ecosystems in the southeastern United States. Once common throughout the southeastern United States, the species has been extirpated from 6 of the 17 states where it previously occurred (USFWS 2003). Loss of habitat, particularly the old pines required for nesting and roosting, has been the primary cause of the species' decline. The current status of the species is described in the Red Cockaded Woodpecker Recovery Plan (USFWS 2003) and related documents. The RCW information provided in this section has been taken directly from USFWS (2003) and other referenced sources.

Red-cockaded woodpeckers are non-migratory, territorial. They live in cooperative breeding social units called groups. Such groups are typically comprised of a breeding pair and up to three helpers, which are usually males and most often offspring of the mated pair from previous years (Jackson 1994). Juvenile females disperse or are expulsed from the breeding groups. The red-cockaded woodpecker is long-lived for a bird its size; banded birds in the wild have reached 15 years of age, and a captive-reared bird was documented at 13 years (Jackson 1994). Because of the cooperative breeding system, red-cockaded woodpecker populations are unusually resistant to environmental and demographic variation, but highly sensitive to the spatial arrangement of habitat. The buffering effect of helpers against annual variation operates only when helpers can readily occupy breeding vacancies as they arise. Helpers do not disperse very far and typically occupy vacancies on their natal territory or a neighboring one. If groups are isolated in space, dispersal of helpers to neighboring territories is disrupted and the buffering effect of the helper class is lost. When this happens, populations become much less likely to persist through time. Also, the cooperative breeding system does not allow rapid natural growth of populations. Colonization of unoccupied habitat is an exceedingly slow process under natural conditions, because cavities take long periods of time to excavate and birds do not occupy habitat without cavities. As forests age and old pines become abundant, rates of natural cavity excavation and colonization may increase. Changes in hydrology in South Florida have resulted in the loss of pineland habitat (USFWS 2003). If a nesting habitat becomes damaged or degraded, residents may not likely disperse to other, more suitable, but distant habitat and human assisted relocation of individuals or pairs may be similarly unsuccessful (Kim Dryden, Personal Communication, 2019).

Red-cockaded woodpecker populations are widespread regionally but occupy small and disjunct areas in the south Florida region. Substantial clusters of red-cockaded woodpeckers occur in Three Lakes Wildlife Management Area (Osceola County), Avon Park Air Force Range (Highlands County), Cecil M. Webb Wildlife Management Area (Charlotte County), and Big Cypress National Preserve (Collier and Monroe Counties) with scattered small populations throughout the service area. There is no designated

critical habitat for the red-cockaded woodpecker. USFWS (2004). The Picayune Strand State Forest (PSSF) project area is part of the consultation area for the species.

Project Description

The Collier County Watershed Improvement Project (CWIP) proposes to enhance hydrologic conditions in the natural area immediately east of Naples, FL between I-75 and US-41 (**Figure 1**). The project area was once part of a much larger watershed draining from the north. Urban development and construction of I-75 cut off the northern third of the watershed. The runoff from that northern area was diverted into the Golden Gate Canal (GGC) as well as other ditches and drained to Naples Bay. The result was the dehydration of the area south of I-75, with attendant changes in vegetation communities due to changed hydrologic conditions. Collier County Collier County now proposes to return a portion of that diverted water to the project area. Due to other permitted water uses of the GGC flows, development within the project area for recreational and some residential/commercial uses, bordering urbanization, and the importance the habitat area for listed species, especially Red Cockaded Woodpecker and Florida Panther, Collier County proposes hydrologic restoration that will not impinge on other water uses or negatively impact developments bordering the project area.

The project will increase wet season hydration of approximately 9,000 acres west of Naples FL primarily in the western portion of the Picayune Strand State Forest (PSSF). Landscape boundaries of the hydration area include the I-75 corridor to the north, and city of Naples development to the west. To the south, the 6Ls Agricultural Area creates a boundary to project effects. To the east, the SFWMD CERP (Comprehensive Everglades Restoration Program) Picayune Strand Forest Restoration creates a hydrologic condition that the CWIP accounts for in evaluation of project effects in order to avoid negative hydrologic impacts.

Water withdrawn from the GGC during high flow periods will be diverted into a canal leading south to culverts under I-75 and then flow east within the I-75 stormwater canal on the south side of the highway for about a mile. A new canal running from that point south into the PSSF the project area includes water quality treatment in a linear flowway within a new canal, that terminates in a spreader ditch in the Picayune Strand State Forest (**Figure 1**). Flows will occur primarily during the wet season (May – October) but may also occur during high flow periods at other times of the year. Water reaching the south end of the project area will flow under US-41 and south into the tidal wetlands of Rookery Bay. The structures necessary to move water to the PSSF and additional structures are necessary to ensure the protection of private lands within the PSSF and residential development west of the 6L's agricultural area at the south end of the project. The project will impact about 60 acres of habitat within the USFWS RCW consultation Area, including about 35 acres of wetland (**Figure 1**).

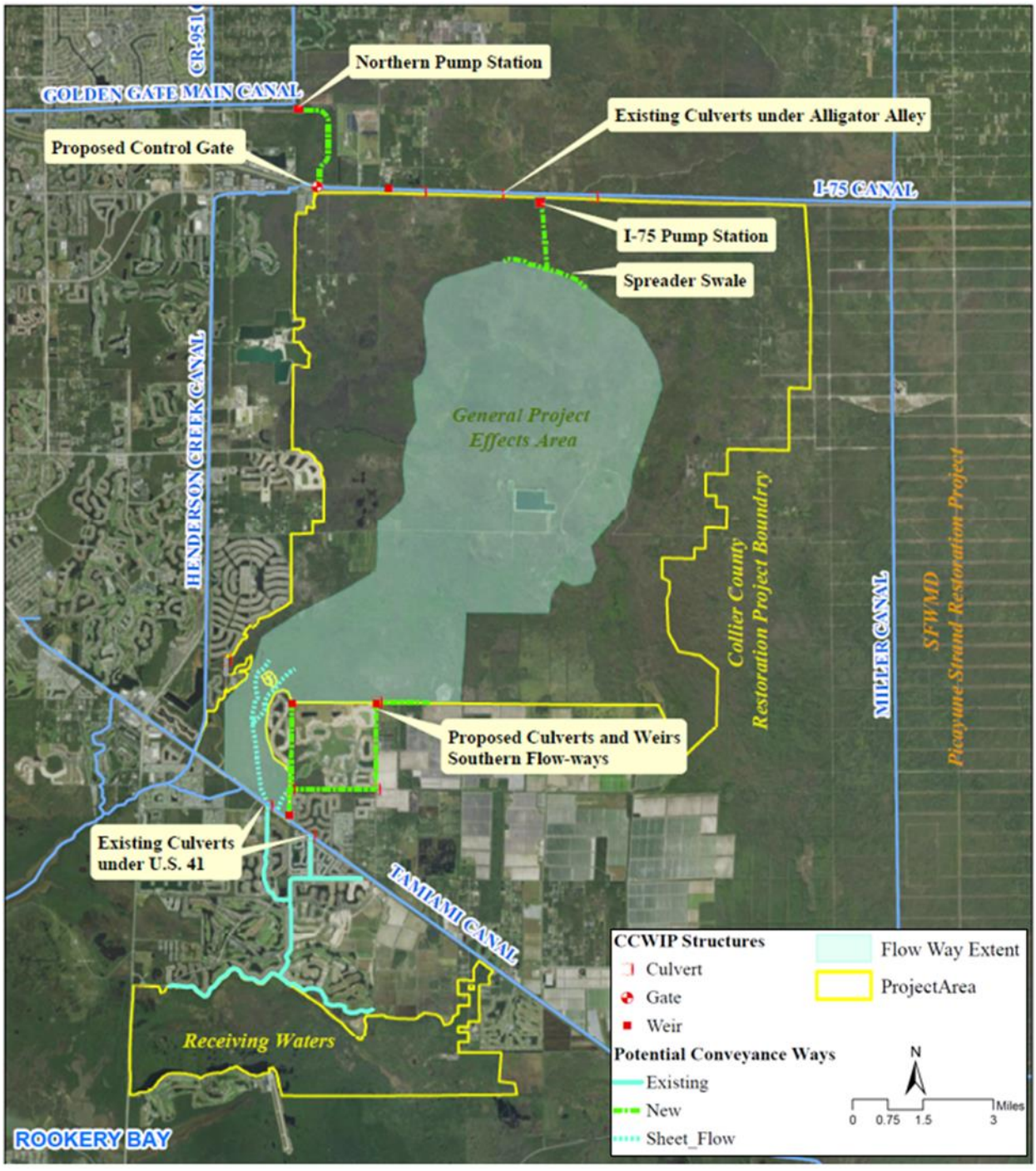

Figure 1. CWIP Restoration Project Overview

Project Area Conditions

The project evaluation area, about 22,000 acres, includes the western end of the Picayune Strand State Forest (PSSF) and other natural lands between the PSSF western boundary and the eastern edge of the Naples Florida development. The main effects of the project will occur in approximately 9,000 acres (**Figure 2**) identified as the Core Rehydration Area and Flowway Extent, dominated by four vegetation communities described by the Florida Land Use Cover and Classification Forms System (FLUCCS) as Cypress (FLUCCS 621), Cypress Pine Cabbage Palm (FLUCCS 624), Hydric Pine (FLUCCS 625), and Pine Flatwood (FLUCCS 411). Pine flatwoods are classified as uplands; the other dominant communities are wetlands. A similar community dominance occurs outside the 9,000-acre main effects area (**Figure 3, Figure 4, Table 1**). See **Supplemental Information Attachment 6** for detailed descriptions of project area community structure. Ten-year hydrologic simulations suggest that only minor and negligible hydrologic changes will occur outside the core rehydration area and flowway extent. Existing RCW habitat occurs almost entirely outside the main project effects area.

Red Cockaded Woodpecker (RCW) Core Foraging Areas in the Project Area

Two areas of multiple RCW nests occur within the project evaluation area (**Figure 5**; 2019 data provided by Jessica Spickler, Florida Fish and Wildlife Conservation Commission - FFWCC). Habitat quality of the Cluster area 1, in the northwest corner of the project evaluation area, was badly damaged by recent wildfires. While it is unclear whether the area will remain viable RCW habitat, it currently includes numerous nests and may recover in the long-term. Cluster area 2, much less impacted by wildfires of the past several years, is now the primary area of RCW nests in the project area. Cluster 2 extends to the east beyond the project evaluation area, into the Comprehensive Everglades Restoration Project (CERP) Picayune Strand Restoration Project (PSRP) effect area. Vegetation in the two RCW clusters as defined by the polygon comprised of all ½ mile core foraging areas is dominated by Cypress (FLUCCS 621 24%), Cypress Pine Cabbage Palm (FLUCCS 624 – 37%), Hydric Pine (FLUCCS 625, 18%), and Pine Flatwood (FLUCCS 411 17%), but includes a few small patches of other communities as well (**Figure 3** and **Figure 4**).

Analysis Focus and Objectives

A goal of the CWIP is to enhance hydrologic characteristics of the project area without negatively impacting habitats of listed species that use the area. Project RCW habitat effects assessment focuses on hydrologic changes within RCW habitat. The area used for the RCW habitat assessment, based on United States Fish and Wildlife Service (USFWS) and FFWCC data and recommendations, uses FLUCCS habitat polygons as the spatial footprint for assessment of effects. Results of project simulations defined for each selected vegetation polygon provides the data for assessment of change.

No comprehensive RCW habitat assessment has been conducted in the project area. However, the USFWS and FFWCC have extensive experience managing RCW and RCW habitat in this area. USFWS (Kim Dryden, personal communication 2019) recommended the use of a ½ mile radius core foraging area (CFA) around each nest as the assessment area basis. USFWS (2003) foraging habitat guidelines recommend all foraging habitat considered in an assessment be within 0.8 km (about ½ mile) of a cluster (i.e., the aggregation of active and inactive cavity trees defended by a single RCW group). The resulting polygon defining the edge of combined individual polygons and the project assessment area boundaries defined the focus area for RCW habitat effect evaluation; two CFA clusters resulted (**Figure 5**). Note that

while the CFA clusters extend to the east, the CWIP has responsibility for hydrologic conditions only to the boundaries shown in **Figure 5**, which provides the CFA Area 2 shape shown.

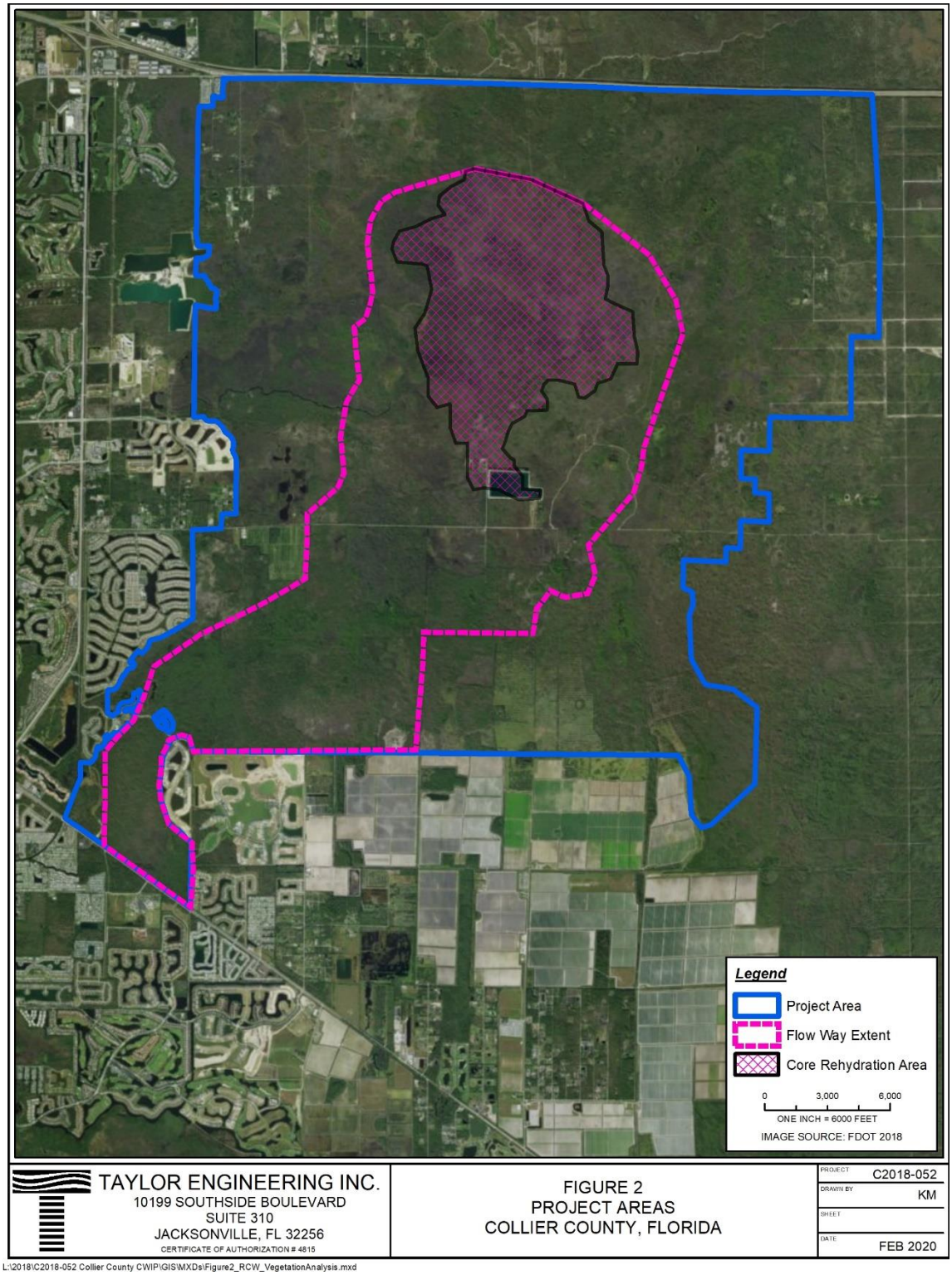

Figure 2. CWIP Core Rehydration Area and Flowway Extent, about 9,000 acres.

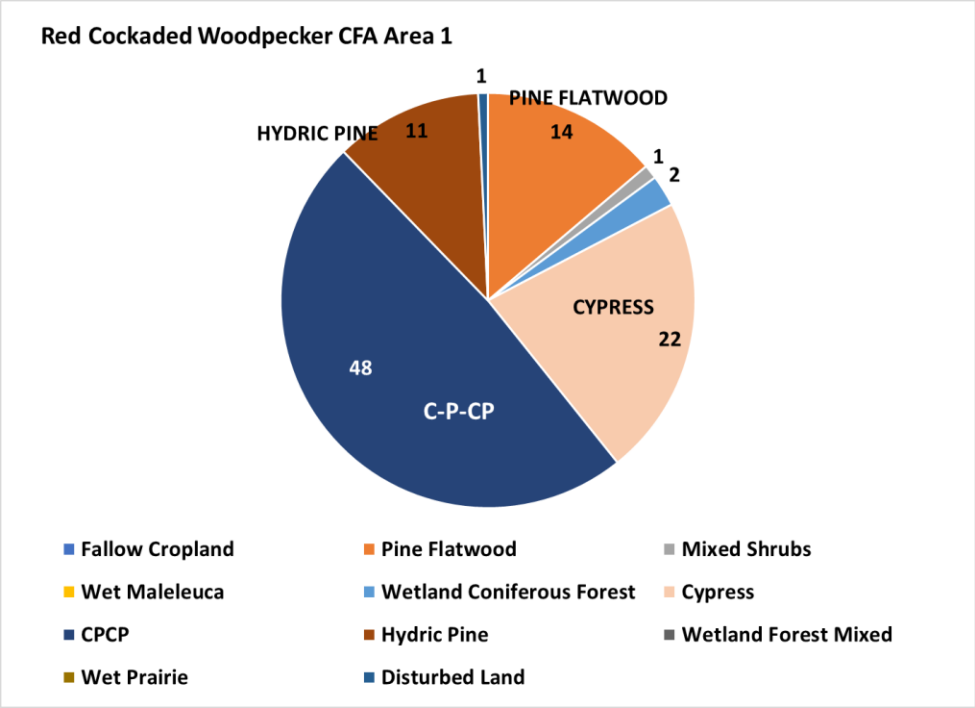

Figure 3. Percent Composition of communities within CFA Area 1

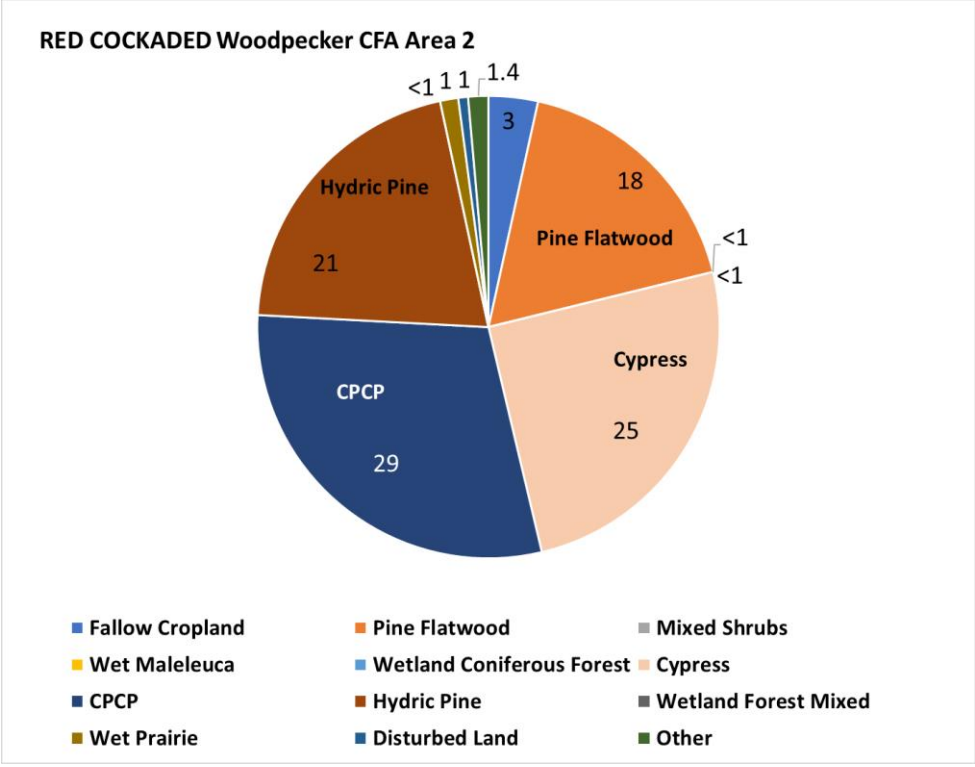

Figure 4. Percent Composition of Natural Communities within CFA Area 2

The CFA is a surrogate for the actual behavior of the species around a nest. The birds key on vegetation community conditions with a primary foraging area estimated to extend about a ½ mile from the nest within desirable habitats. RCW use of desirable vegetation communities may likely extend beyond the ½ mile CFA. Nesting cluster expansion also may occur in desirable areas immediately adjacent to the estimated CFA. Based on review of available technical literature on the species, Garabedian (2017) concluded that "there has been little empirical support for the foraging habitat thresholds included in the USFWS recovery plan as quantitative targets for RCW conservation". That research also summarized literature indicating variable habitat use and dispersal distances based on population densities and habitat qualities. Based on his own research, Garabedian (2017) concluded that while his research generally confirmed the 0.8 km (0.5 mile) foraging location boundaries, average RCW home ranges and forage areas were larger under low density population conditions than medium and high density population conditions and that foraging areas were not necessarily centered on cavity trees or clusters. Based on those research conclusions, the characteristics of the simulation data, and the highly dissected and heterogenous vegetation communities within the general project area and CFA clusters, we chose to assess complete vegetation community shapefiles. These shapefiles (**Figure 5, Table 1**) extend through the CFA cluster boundaries, testing the effects of project hydrology on CFA habitat areas and adjacent areas which may be important to the species' life functions.

Table 1. Characteristics of Vegetation Communities Used for Analysis of Project Hydrologic Effects on RCW Core Foraging Area Clusters

	Acres				
Cluster	**Cypress**	**C-P-CP***	**Hydric Pine**	**Pine Flatwood**	**Total**
1	189	1746	37	0	1971
2	853	329	378	332	1892

*C-P-CP = Cypress-Pine-Cabbage Palm

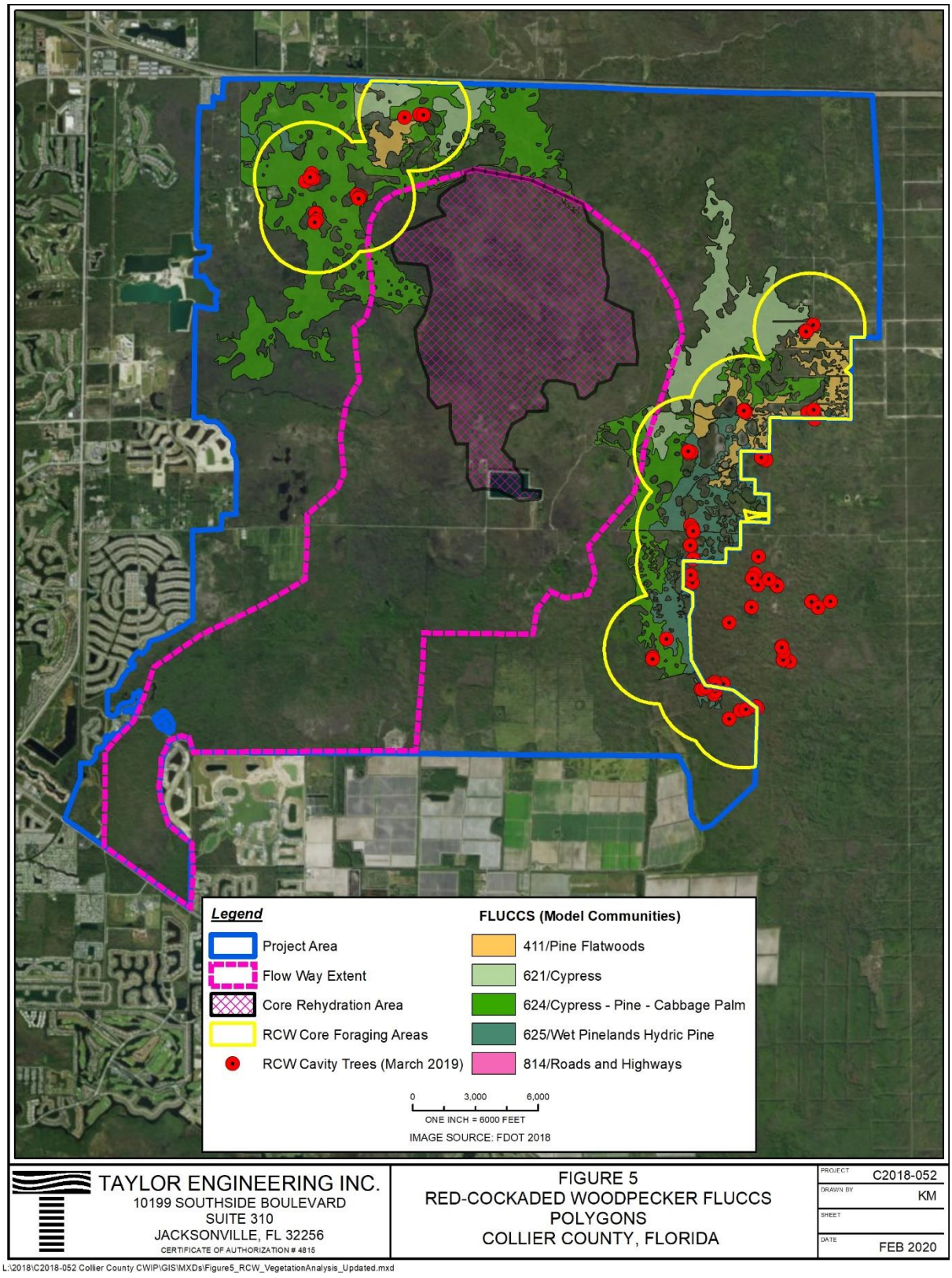

Figure 5. RCW Habitat Area: Large Polygons Used for Vegetation Hydrology Effects Analysis

Methods

Hydrologic Simulation and FLUCCS Vegetation Shapefile Creation

Ten-year hydrologic simulation methods and development of FLUCCS shapefile maps used in this analysis are briefly summarized **Sub-Appendix 1**. As explained there, shapefiles >32.3 acres in size were used to assess existing and with project to best characterized community hydrology for each of the dominant FLUCCS vegetation types.

Definition of Vegetation Shapefile Hydrology

The hydrologic simulations results were estimated for each vegetation shape by weighting the hydrologic values in the grid cells intersecting each shape by the fraction of the shape associated with each intersecting grid cell (**Sub-Appendix 2**). Each hydrologic model grid cell had an area of 3.23 acres.

Within the landscape, vegetation patches express the elevation and related hydrology at those locations. Smaller vegetation patches within larger, dominant vegetation communities are associated with surface elevations that are small in area but sufficiently uniform to allow development of a community associated with a different hydrology than the surrounding community or communities. The hydrology of the many small vegetation patches (**Table 2**) could likely be misrepresented by the weighting scheme used to calculate shape hydrology (**Sub-Appendix 2**). Since reducing the simulation model cell size to accommodate small shapes (many an acre or less) was infeasible due to the related increase in computational time, vegetation patches over 32.3 acres (large patches) were selected to represent expected hydrology for each of vegetation communities, regardless of patch size. These large patches were most likely to include all or most of multiple grid cells for calculation of vegetation shapefile hydrologic values. The hydrologic values obtained using this subset of the data were considered representative of all patches of a community type. Note that about 2,000 acres of the project evaluation area are accounted for by various other land uses including disturbed lands, mines, open waters, development, etc.

Table 2. Area Relationships of Dominant Natural Community Patches in the Project Area

Vegetation Community	Total Area (acres)	n	Patches >32.3 acres	% of Area > 32.3 acres	n
Hydric Pine (FLUCCS 625)	2,253	381	1,034	46%	13
Cypress-Pine Cabbage Palm (FLUCCS 624)	7,472	222	6,878	92%	26
Cypress (FLUCCS 621)	7,156	242	6,183	86%	23
Wet Coniferous Forest (FLUCCS 620)	1,102	13	402	83%	5
Pine Flatwoods (FLUCCS 411)	2,619	397	1,473	56%	12
Totals	20,602	1,255	15,970	78%	79

Vegetation Community Hydrology Standards

Duever (2004) identified average hydrologic ranges for FLUCCS codes 411 (Pine Flatwood), 625 (Hydric Pine), 621 (Cypress), and 620 (Wet Coniferous Forest) for the PSRP project. The averages were based on several years of hydrologic data collected from locations east of the project area and existing technical literature (**Table 3**). FLUCCS code 624 (Cypress-Pine-Cabbage Palm) was not included in that analysis, due to the lack of that community in the locations where measurements were collected. Duever (personal communication 2019) associated hydrology of Cypress Pine Cabbage Palm (C-P-CP), a dominant community in the CWIP project area with that of hydric pine, based on the presence of hydric pine in that (FLUCCS 625) vegetation association (**Table 3**). Wet Coniferous Forest was assumed to have hydrology comparable to Cypress.

Table 3. Duever-Estimated Community Hydrology

Hydrologic Statistic	Pine Flatwood	Hydric Pine	C-P-CP*	Cypress
Hydroperiod (months)	0 - 1	1 - 2	1 - 2	6 - 8
Average Wet Season Depth (inches)	0 - 2	2 - 6	2 - 6	18 - 24
Average Annual Dry Season Water Table (inches)	-46	-30	-30	-16
1 in 10 yr. low water depth (inches)	-76	-60	-60	-46

*C-P-CP = Cypress-Pine-Cabbage Palm

The elevation data for large vegetation polygons in the project area (**Figure 6**), calculated for shapefiles greater than 32.3 acres indicated that cypress-pine cabbage palm (C-P-CP) community typically occurred at a lower landscape elevation than hydric pine; and is thus likely to include hydrologic conditions more aligned with cypress than with hydric pine. The analysis uses the hydric pine standard for C-P-CP hydrology display purposes but focuses on the elevation and hydrologic data for this community when reaching conclusions regarding project impacts.

Hydrologic Assessment Methods

Three approaches were used to assess whether the project was likely to negatively impact RCW habitat hydrology, assuming negative hydrologic impacts would result in similar vegetation community effects. Existing and with project simulation results were tested by vegetation community shapefile in the following ways:

1. Differences between existing condition and with-project hydrologic indicator levels (average amount of change)
2. Comparison of large vegetation shapefile existing and with project hydrologic indicator values to Duever's expected average hydrologic conditions for those indicators
3. Comparison of stage duration curves for existing and with project conditions of specific hydrologic simulation grid cells within and without of the RCW CFA clusters.

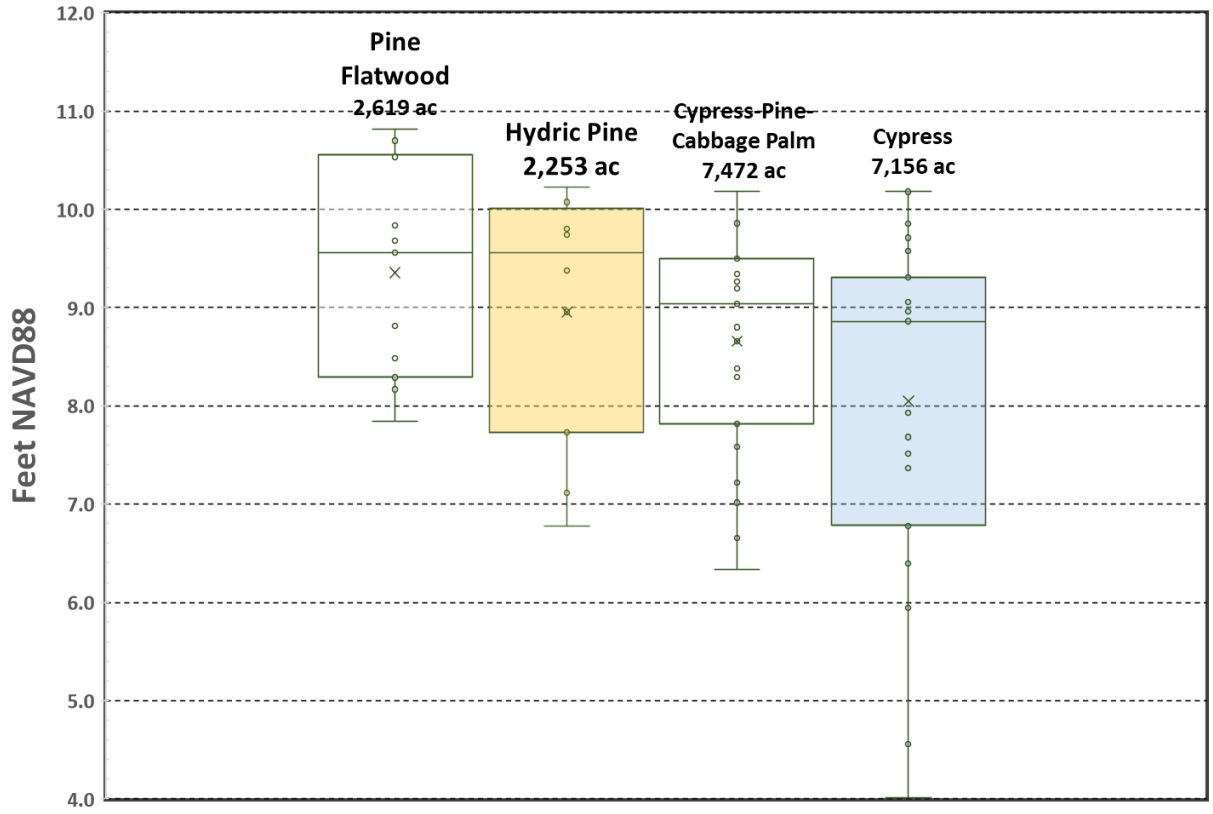

Figure 6: Box and Whisker Plot Summary of Elevation Characteristics of Large Vegetation Patches. The "Whiskers" display the interquartile range for each dataset

Results

Vegetation Shapefile Hydrology Compared to Duever (2004) Estimated Average Hydrology

Duever (2004, Duever, Personal Communication 2019) estimated average community hydrology was compared to simulation-estimated hydrology for RCW habitat shapefiles as defined above. **Table 4** provides the hydrologic statistics for each area. **Table 5** summarized the numeric differences in existing and with project hydrology by community type for hydroperiod, wet season water elevation, and dry season water table elevation.

The summarized simulation results suggest that

1. Existing and with project conditions are consistent with or drier than Deuver estimates, assuming the C-P-CP community has hydrology conditions closer to Cypress than Hydric Pine.
2. Hydroperiods show clear existing and with-project differences; C-P-CP shows the greatest change between existing and with project conditions, as might be expected if the landscape placement of that community was more like Cypress than Hydric Pine. Average wet season depths are consistent with landscape elevation differences.

3. All dry season water table elevations are below Duever average values. Average dry season depths are very similar, with only small differences between vegetation communities.
4. All communities experience the same dry season 1 in 10-year minimum depths; this is not surprising, as once water elevations recede well below the zone of most active vegetation uptake, hydrology is much less affected by the vegetation.
5. Considering by vegetation community and together as a habitat area, average differences between existing and with project conditions are small; not indicative of large hydrologic shifts that could imply major vegetation changes.

Table 4. Comparison of RCW Habitat Hydroperiod, Wet Season Water Elevation, and Dry Season Water Table Elevation Differences for Existing and With-Project Conditions

	Cluster 1			Cluster 2			
	Cypress	**C-P-CP**	**Hydric Pine**	**Cypress**	**C-P-CP**	**Hydric Pine**	**Pine Flatwood**
Hydroperiod (months)	0.2	1.7	0.3	0.4	3.0	2.1	1.3
Dry Season (inches Below Ground)	-38.6	-33.6	-42.3	-45.6	-28.8	-34.9	-39.9
Minimum Dry Season (inches Below Ground)	-80.5	-79.5	-86.4	-89.0	-74.7	-80.8	-86.4
Wet Season (inches Above Ground	0.0	0.3	0.0	0.0	1.4	0.4	0.1
Hydroperiod (months)	0.3	2.2	0.4	0.6	3.4	2.8	1.6
Dry Season (inches Below Ground)	-37.7	-32.2	-41.7	-44.5	-23.4	-32.6	-38.7
Minimum Dry Season (inches Below Ground)	-80.2	-79.3	-86.1	-88.8	-74.5	-80.6	-86.3
Wet Season (inches Above Ground)	0.0	0.8	0.0	0.1	2.9	1.4	0.3

*C-P-CP = Cypress-Pine-Cabbage Palm

Table 5. Differences Between Existing and With-Project Condition Hydrologic Indicator Values

RCW Area 1 Differences				
Vegetation Community	**Hydroperiod (months)**	**Dry Season (inches)**	**Minimum Dry Season (inches)**	**Wet Season (inches)**
Cypress	0.04	0.93	0.26	0.01
C-P-CP	0.46	1.43	0.25	0.49
Hydric Pine	0.03	0.69	0.33	0.00
RCW Area 2 Differences				
Vegetation Community	**Hydroperiod Differences (months)**	**Dry Season (inches)**	**Minimum Dry Season (inches)**	**Wet Season (inches)**
Cypress	0.12	1.07	0.22	0.08
C-P-CP	0.36	5.45	0.19	1.45
Hydric Pine	0.61	2.21	0.12	0.92
Pine Flatwood	0.33	1.17	0.11	0.16

As seen in **Figures 7-9**, the hydrologic indicator values in both RCW assessment areas remain within or below the Duever values. These polygons are in general the least influenced by the project. See the analysis of vegetation hydrology (**Supplemental Information Attachment 6**) for comparison.

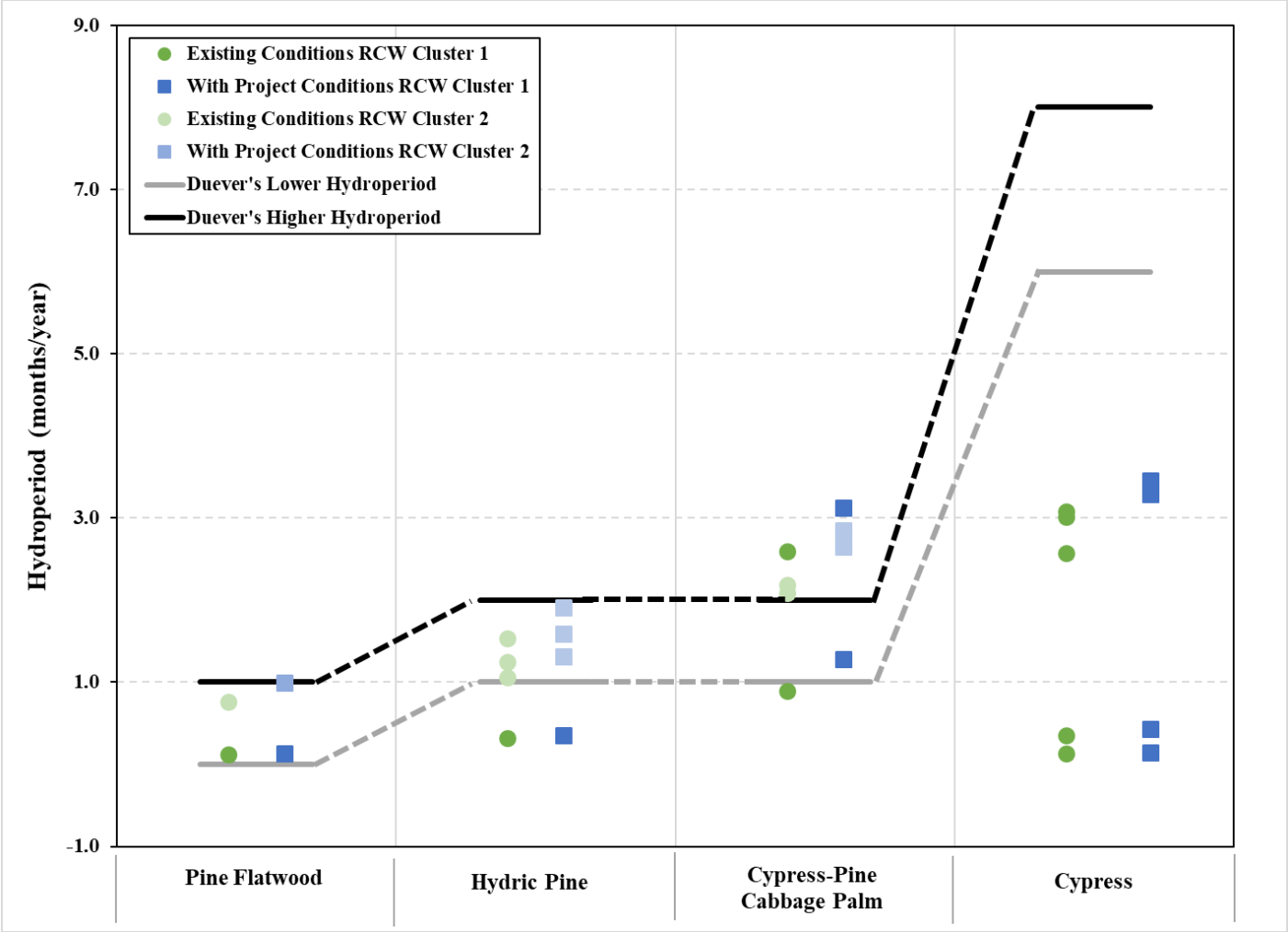

Figure 7. Duever (2004) Estimated Average FLUCCS Community and RCW Habitat Shapefile Hydroperiod, Existing and With-Project Conditions by RCW Area

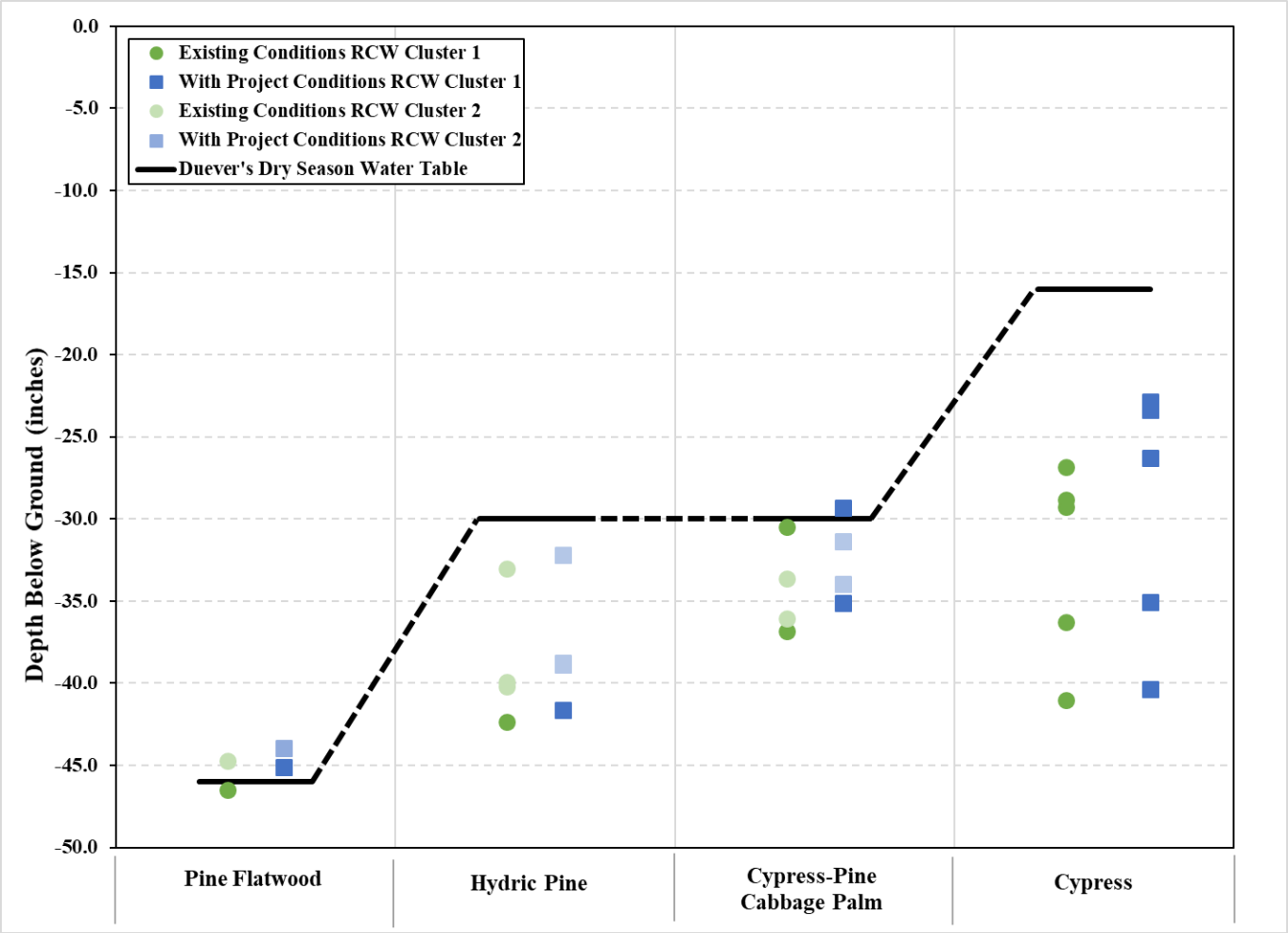

Figure 8. Duever (2004) Estimated Average FLUCCS Community and RCW Habitat Shapefile Dry Season Median Water Elevations, Existing and With-Project Conditions by Cluster

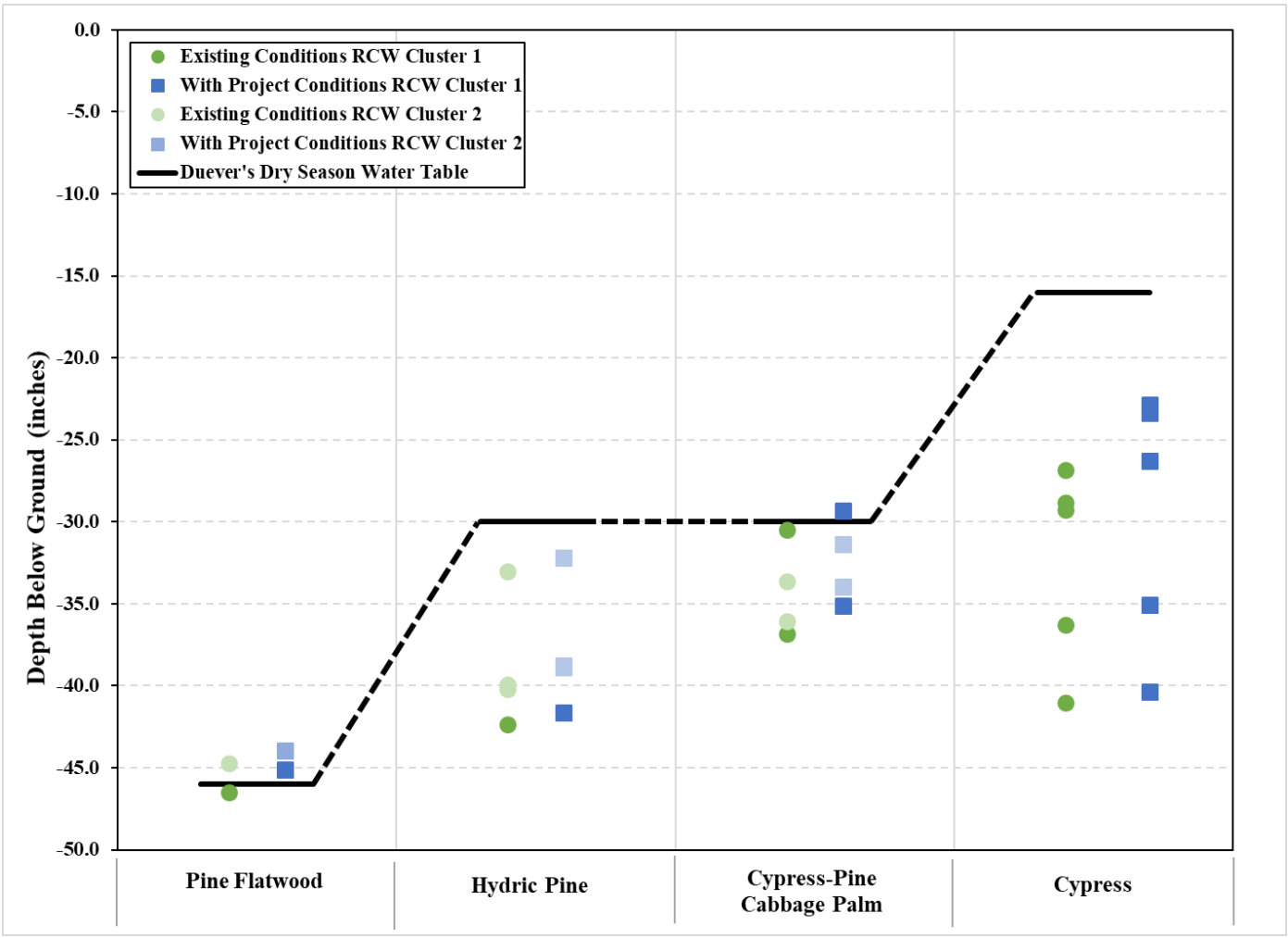

Figure 9. Duever (2004) Estimated Average FLUCCS Community and RCW Habitat Shapefile Wet Season Median Water Elevations, Existing and With-Project Conditions by Cluster

Stage Duration Curve Comparisons

Stage-duration curves provide another way to summarize project-related hydrologic changes. Model outputs of the combined groundwater-surface water model used to simulate project hydrology over a 10-year period were used to produce the stage duration curves for 21 locations within the project assessment area.

Locations for assessment were selected to assess the effects of the CWIP project alone and in conjunction with a fully functional Comprehensive Everglades Restoration Program Picayune Strand Restoration Project (PSRP) immediately east of the CWIP project area with a focus on those vegetation communities most commonly used by RCW or identified by USFWS and Florida Forestry Service as potential RCW habitat (**Figure 10**). At each location, the simulation results from a single hydrologic simulation cell (3.2 acres) wholly contained within one vegetation type was selected for analysis

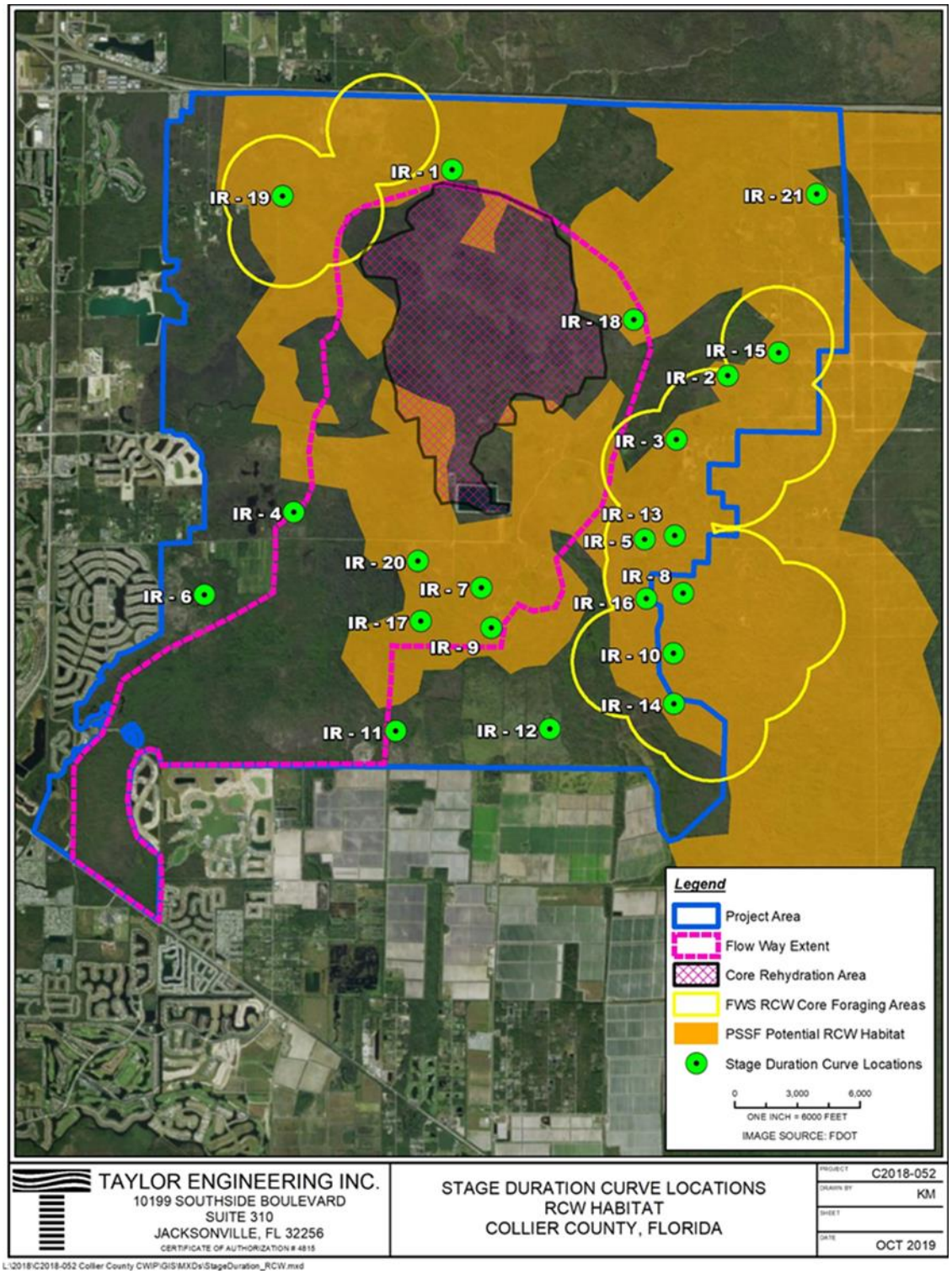

Figure 10. Stage Duration Curve Locations and RCW Habitat Areas

Stage duration curves (**Sub-Appendix 3**) were plotted and the plot data used to calculate related hydrologic statistics including hydroperiod (the period when the water table exceeded the ground elevation, average water depth during that time, average water table elevation during the SFWMD-

defined wet season (May 15 – October 15) and dry season (October 16 – May 14) water elevations. Statistics were calculated for existing and with project conditions for single simulation grid cells within the dominant communities (**Table 6**), with findings for hydroperiod and dry season elevations summarized in **Table 7**. The average water table elevations are always below the ground elevation because the calculated hydroperiods are always much shorter than the SFWMD wet and dry season periods (5 and 7 months long, respectively) and even during the wet season the water elevations above the ground surface do not offset the below-ground depths of the water table during the rest of the wet season. We calculated the average water elevation for the period that the water was above the ground surface to provide another dataset for comparison to the Duever average values for the PSRP wetland communities; the actual "wet season" period used for those calculations was not clearly defined.

The data indicate that for those simulation grid cells, the average values almost always fell below or within the Duever (2004) expected average values Since soil water table elevations are strongly influenced by site-specific soil conditions it is not surprising the data show some variability; there does not appear to be sufficient variability to suggest any pattern of exceedences of the Denver averages; in fact most of the data are less than the Duever estimates. The exceptions to this general conclusion, locations IR-6 and IR-7, mapped as pine flatwood and cypress pine cabbage palm communities. At an elevation of 7.8 ft NAVD88, IR-6 lies well below the pine flatwood community and within the Hydric Pine and Cypress-Pine-Cabbage Palm elevations. (**Sub-Appendix 3, Figure A3-5**). Since the vegetation communities at the select locations were not verified by direct observation; it is very possible that the community at IR-6 is identified incorrectly identified. IR-7 lies at the same elevation as IR-6 and while Duever (Personal Communication 2019) identified Cypress-Pine-Cabbage Palm communities as likely having hydrologic characteristics similar to Hydric Pine, the data collected for this project suggest that the C-P-CP community in the project area occurs in landscape elevations more typical of Cypress. Therefore, these anomalies do not suggest that the project may produce extreme hydrologic conditions in general for those communities; almost all the rest of the data suggest the opposite; that in fact the project has only a minor effect within the area of primary hydrologic change, and inconsequential hydrologic effects outside that area, where the current RCW colonies are located and where the habitat suggests that future colonies may develop or be developed as part of the RCW Recovery Plan actions.

Hydrologic average values were not calculated for stage duration curves of combined CWIP and PSRP simulations shown in in several figures in **Sub-Appendix 3**. it is clear from the presented figures and data that the combined project water elevations are as inconsequential to the RCW habitat as are the effects of the CWIP alone. The adjacent PSRP proposes rehydration of about 55,000 acres of the former Golden Gate Estates, drained for development that was never built. One objective of the CWIP project is to avoid negative hydrologic changes on the eastern project border when added to hydrologic changes created by the PSRP; that project is already in progress, although not yet complete. With-Project PSRP hydrologic simulations results provided by the South Florida Water Management District added to results at the same locations from the CWIP hydrologic simulations estimated the combined projects' changes.

Table 6. Average Hydrologic Values for 21 locations within the Project Assessment Area for Existing and With Project Simulations.

						Water Table Depths From Soil Surface			
Location ID*	FLUCCS ID	Hydrologic Condition	Simulation Hydroperiod (months)	Duever Hydroperiod (months)	Simulation Hydroperiod Average Water Depth Above Surface (Inches)	Average Simulated Wet Season Water Depth (inches)	Duever Average Wet Season Water Depth (inches)	Dry Season Average Water Table depth (inches)	Duever Average Dry Season Depth (inches)
IR-1	411	Existing	0.0	0 - 1	0.17	-36	0 - 2	-45	-46
		With-Project	0.1		0.11	-30		-41	
IR-2	624	Existing	2.4	1 - 2	0.32	-24	1 - 2	-36	-30
		With-Project	2.6		0.38	-23		-34	
IR-3	411	Existing	0.0	0 - 1	0.04 (one value)	-41	0 - 2	-51	-46
		With-Project	0.0		0.06 (one value)	-39		-49	
IR-4	411	Existing	0.0	0 - 1	0.14	-30	0 - 2	-37	-46
		With-Project	0.0		0.14	-29		-35	
IR-5	625	Existing	1.2	1 - 2	0.24	-30	0 - 1	-41	-30
		With-Project	1.9		0.3	-28		-39	
IR-6	411	Existing	2.2	0 - 1	0.2	-25	0 - 2	-32	-46
		With-Project	2.5		0.24	-24		-31	
IR-7	624	Existing	3.7	1 - 2	0.26	-18	1 - 2	-27	-30
		With-Project	4.3		0.55	-17		-24	
IR-8	624	Existing	1.4	1 - 2	0.11	-28	1 - 2	-39	-30
		With-Project	1.7		0.13	-27		-37	

						Water Table Depths From Soil Surface			
Location ID*	FLUCCS ID	Hydrologic Condition	Simulation Hydroperiod (months)	Duever Hydroperiod (months)	Simulation Hydroperiod Average Water Depth Above Surface (Inches)	Average Simulated Wet Season Water Depth (inches)	Duever Average Wet Season Water Depth (inches)	Dry Season Average Water Table depth (inches)	Duever Average Dry Season Depth (inches)
IR-9	624	Existing	0.2	1 - 2	0.11	-30	1 - 2	-39	-30
		With-Project	0.6		0.1	-28		-37	
IR-10	624	Existing	1.1	1 - 2	0.06	-26	1 - 2	-37	-30
		With-Project	1.4		0.075	-26		-36	
IR-11	621	Existing	3.7	6 - 8	0.54	-13	18 - 24	-27	-16
		With-Project	4.0		1.25	-11		-24	
IR-13	625	Existing	1.0	1 - 2	0.14	-33	2 - 6	-44	-30
		With-Project	1.3		0.14	-32		-43	
IR-14	625	Existing	0.6	1 - 2	0.14	-25	2 - 6	-36	-30
		With-Project	0.8		0.14	-24		-36	
IR-15	411	Existing	0.0	0 - 1	0.09	-37	0 - 2	-50	-46
		With-Project	0.0		0.07	-37		-50	
IR-16	411	Existing	0.5	0 - 1	0.06	-28	0 - 2	-38	-46
		With-Project	0.7		0.07	-27		-37	
IR-17	625	Existing	1.0	1 - 2	0.14	-27	2 - 6	-36	-30
		With-Project	2.5		0.19	-24		-33	
IR-18	411	Existing	0.1	0 - 1	0.11	-31	0 - 2	-41	-46

						Water Table Depths From Soil Surface			
Location ID*	**FLUCCS ID**	**Hydrologic Condition**	**Simulation Hydroperiod (months)**	**Duever Hydroperiod (months)**	**Simulation Hydroperiod Average Water Depth Above Surface (Inches)**	**Average Simulated Wet Season Water Depth (inches)**	**Duever Average Wet Season Water Depth (inches)**	**Dry Season Average Water Table depth (inches)**	**Duever Average Dry Season Depth (inches)**
		With-Project	0.1		0.09	-29		-38	
IR-19	411	Existing	0.0	0 - 1	0.03 (one value)	-41	0 - 2	-49	-46
		With-Project	0.0		0.03 (one value)	-39		-48	
IR-20	411	Existing	0.1	0 - 1	0.15	-29	0 - 2	-37	-46
		With-Project	0.4		0.11	-26		-34	
IR-21	625	Existing	0.0	1 - 2	0.03 (one value)	-42	2 - 6	-55	-30
		With-Project	0.0		0.03 (one value)	-42		-55	
IR-12**	fallow cropland	Existing	1.7	na	0.45	-24	na	-37	na
		With-Project	2.8		0.6	-22		-35	

* See Figure

** Duever (2004) did not provide average hydrologic values for this FLUCCS code.

Stage-Duration curves of existing and with project hydrologic simulations included:

- 10 locations within Pine Flatwood
- 5 locations within Hydric Pine
- 4 locations within Cypress Pine Cabbage Palm
- 1 location within cypress
- 1 one location in fallow cropland (just north of the 6L's area)

The hydrologic simulation data for each curve was extracted from a single simulation model cell within the vegetation community type shown in the figure.

Existing and with-Project stage duration curves were compared to Duever (2004) expected hydroperiod and dry season water table elevations at 21 sites in the CWIP project area. Six figures (IR-2, IR-3, IR-8, IR-10, IR-13, and IR-15) include simulated effects of the Everglades PSRP project to the east of the CWIP in addition to the existing and with project condition simulation results.

Pine Flatwoods (FLUCCS 411)

Pine flatwood is a mesic upland community that has the greatest potential as high-quality RCW habitat. With one exception, (IR-6) the existing and with project conditions were very similar. At IR -6, hydroperiod increased, but with very shallow water depths. Dry season water table elevations did not change significantly.

Hydric Pine (FLUCCS 625)

The Hydric Pine community is slightly lower in the landscape than Pine Flatwood, but simulations comparisons revealed very little difference between scenarios

Cypress-Pine- Cabbage Palm (C-P-CP; FLUCCS 624)

Duever (Personal Communication) recommended using Hydric Pine hydrology to asses project changes for the C-P-CP community, as he did not report hydrologic measures for this community in Duever (2004). Site IR-2 was reflective of more typical hydrologic conditions for C-P-CP in the larger project area: both scenarios exceeded Hydric Pine hydroperiod targets. With project the locations showed a higher dry-season water table elevation, although still not greatly exceeding the hydric pine average dry season water table. Other C-P-CP locations had similar dry season water table elevations but shorter, shallower hydroperiods. Note that locations considered in the stage duration curves were identified to consider potential effects on RCW habitat. Hydrologic simulation results for large patches of C-P-CP within the CWIP identified hydrologic conditions more like Cypress than Hydric Pine in several locations. A more complete comparison considering Cypress hydrology as well as Hydric Pine is provided elsewhere

Cypress (FLUCCS 621)

A single Cypress location was assessed and found to be drier than expected in both existing and with project scenarios.

Fallow Cropland (FLUCCS 281)

The site falls within the hydric pine hydrologic indicator ranges.

Table 7. Summary of Stage-Duration Curve Existing and With Project Comparisons for hydroperiod and dry season water table elevations

Station ID	FLUCCS code	FLUCCS Name	Hydroperiod Change with Project	Dry season water table elevation Change with Project
IR-1	411	Pine Flatwood	No difference between existing and with-project hydroperiods of a few days / year	Existing conditions fall below Duever target 5 months per year. With-project decreases elevations below Duever target to 3.2 months / year)
IR-2*	624	Cypress-Pine-Cabbage Palm	All conditions exceed Duever C-P-CP hydroperiod existing condition by about 2.5 months. With-project-with-PSRP extends hydroperiod to about 3.5 months	Scenarios range within one month. Existing conditions: 6.5 months/year below Duever target. With-project-with-PSRP conditions below Duever elevation 5.5 months / year
IR-3*	411	Pine Flatwood	Existing and with-project within Duever hydroperiod range (0-1 month)	Scenarios differ by as much as one month. Existing condition elevations below Duever target 6 months per year. With-project-with-PSRP conditions below Duever elevation 5 months / year
IR-4	411	Pine Flatwood	Slight difference between existing and with-project hydroperiods of a few days/yr.	Existing and with-project elevations below Duever dry-season elevations for 4 and 3.5 months/yr.
IR-5	625	Hydric Pine	All scenarios fall within Duever ranges	Existing and With-Project dry-season elevations below Duever target for 7.5 and 7 months / year
IR-6	411	Pine Flatwood	Existing condition 2.5 months/ yr. With-project increases hydroperiod to about 3 months.	No difference between existing and with-project conditions - 2.5 months / yr. below Duever dry-season elevation estimate
IR-7	624	Cypress-Pine-Cabbage Palm	Existing and with-project conditions exceed Duever range. Existing condition 3.5 months/yr.; with-project almost 5 months/yr.	Existing elevations deeper than Duever estimate 2 months per year. With-project elevations are deeper 1.5 months /yr.
IR-8*[1]	624	Cypress-Pine-Cabbage Palm	All scenarios within Duever ranges. Very little difference among scenarios.	All scenarios almost identical; deeper than Duever elevation about 7 months / year
IR-9	411	Pine Flatwood	Minimal change; both scenarios within Deuver hydroperiod range (0-1 month/yr)	Existing and with-project elevations differ by about ½ month; 4 and 3.5 months below Duever dry-season elevation estimate.

Station ID	FLUCCS code	FLUCCS Name	Hydroperiod Change with Project	Dry season water table elevation Change with Project
IR-10*[1]	624	Cypress-Pine-Cabbage Palm	Scenarios almost identical; about 1.5 months/yr	Scenarios almost identical; deeper than Deuver dry-season elevation 7 – 6 months / yr.
IR-11	621	Cypress	Existing condition hydroperiod 7.5 months. With-project increased 0.5 months. Both well below Duever hydroperiod range	Both scenarios have water tables lower than Duever dry season average about 8 months / year in
IR-12	261	Fallow Cropland	Existing hydroperiod 2 months With-project hydroperiod extended to 3 months/yr. both scenarios are within hydric pine hydroperiod range	Existing and with-project elevations below Duever estimate differ by ½ month: Dry-season water table lower than -30 inches is 7 months; with-project 6.5 months
IR-13*	625	Hydric Pine	Scenarios hydroperiods range 1-1.5 months/yr: at lower end of Duever hydric pine estimate	Dry-season elevations very similar; Water table lower than Duever dry season estimate for about 8 months/yr in existing and 7.5 months/yr in with-project conditions.
IR-14	625	Hydric Pine	Both scenarios have hydroperiods about 1 month/yr: the Duever minimum hydric pine hydroperiod	Scenarios identical: Water table lower than Duever value 6.5 months/yr.
IR-15*	411	Pine Flatwood	All scenarios have hydroperiod a few days per year or less.	Existing condition dry season elevations deeper than Duever average about 5.5 months/yr. Wit- project-with-PSRP project elevations below Duever about 4 months / year.
IR-16	411	Pine Flatwood	Little difference between scenarios with hydroperiods 1 month/yr or less.	Very little difference between scenarios: Existing condition 4.5 months lower than Duever elevation. With-project 4 months
IR-17	625	Hydric Pine	One-month existing condition hydroperiod (minimum Duever hydroperiod); with-project hydroperiod nearly 3 months/yr, 1 month longer than Duever max hydroperiod.	Existing condition dry season elevations deeper than Duever average 6.5 months/yr. With-project causes a 1-month decrease (to 5.5 months) in elevations deeper than Duever average

Station ID	FLUCCS code	FLUCCS Name	Hydroperiod Change with Project	Dry season water table elevation Change with Project
IR-18	411	Pine Flatwood	Scenarios very similar with flooded conditions a few days/ yr.	Existing condition elevations deeper than Duever dry-season average 5 months/yr. With project elevations deeper 2 months/yr.
IR-19	411	Pine Flatwood	No change - hydroperiod 1 day or less /yr.	Existing condition 5.5 months/ yr below Duever dry-season average. With-project 4 months per year below Duever target elevation.
IR-20	411	Pine Flatwood	Both existing and with-project hydroperiods less than 1/2 month/year	Existing condition elevation below Duever dry season average about 3.5 months/yr; with-project condition decreases to about 2.5 months/yr.
IR-21	411	Hydric Pine	No difference between existing and with project conditions: zero-day hydroperiods	No difference between existing and with project conditions: about 6.5 months/yr. deeper than Duever target elevation

*indicates that the curves in the figure include the existing condition, the with-project condition, the existing condition with the PSPR, and with project / with PSRP

[1]Location outside the CWIP to the east (within the Everglades PSRP)

Monitoring and Adaptive Management Plans

Monitoring Plan

Collier County has defined a monitoring plan, installed a monitoring system, and is currently collecting background information from that system.

The basic monitoring system is described in **Supplemental Information Attachment 1: Project Overview** and related appendices and shown in **Figure 11**. Sixty shallow wells were installed to a target depth of approximately four (4) feet below grade surface or until refusal occurred. Hobo MX2001 water level loggers were installed to record water depths at four (4) hour intervals and is downloaded quarterly. Water quality data is collected during each download event at 20 of the wells (**Figure 11**)**.** At each well location, beginning with well installation in the late spring and summer of 2019, transect and plot vegetation data, along with site photographs are recorded annually. The vegetation sampling plan includes groundcover, mid-story, and canopy species measurements to allow understanding of both short-term and long-term vegetation community responses and allow consideration of conditions important to key plant and animal species. The pre-construction data collection period will provide the baseline information that will allow validation of the hydrologic simulation model and if appropriate modification of the model parameters to best simulate the existing conditions. During project operation, the collected data will support validation of the model (with modifications if appropriate) and allow adaptive management to provide the long-term best project execution of the project.

While the hydrologic response is rapid, the vegetation response will occur over a period of years. The baseline and operation period annual data will be compared for change beginning after a full year of operation and collection of the first annual operating period vegetation data.

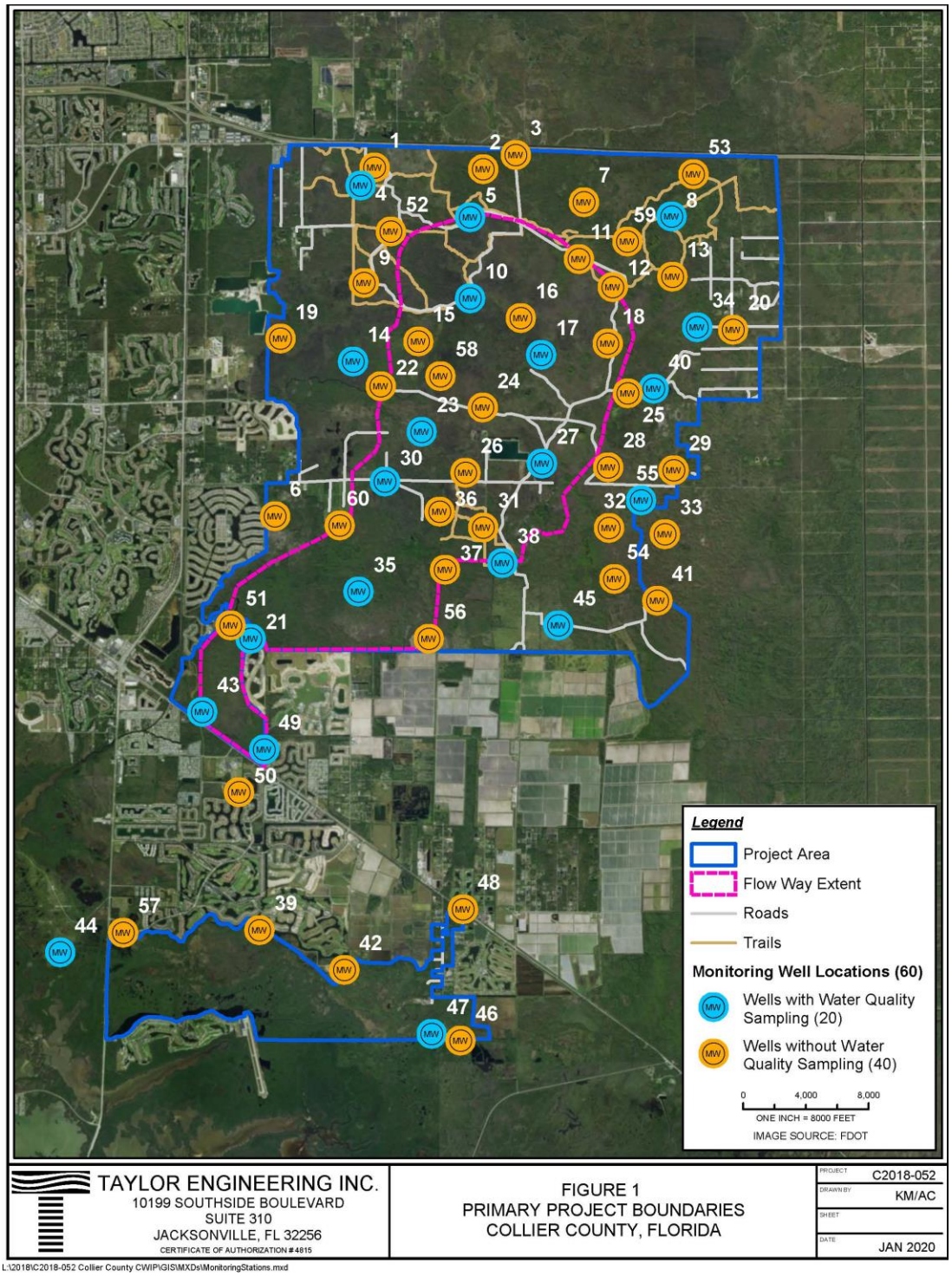

Figure 11. CWIP Hydrologic, Water Quality, and Vegetation Monitoring Stations

Adaptive Management Plan

Introduction

The CWIP project has the goals of enhancing hydrologic conditions in the PSSF project area and decreasing freshwater flows to Naples Bay, without creating significant environmental impacts. The operational plan for withdrawing water from Golden Gate Canal and discharging it into the PSSF provides the basis to achieve the project goals. However, the operational plans are based on model results; once the project begins operating and data from the monitoring system are collected and analyzed, those plans can be adjusted to refine the operations to better meet the goals. This approach is the heart of the adaptive management plan for the CWIP.

For the CWIP, adaptive management intends to improve project operations to better meet project goals: to improve habitats in general (Picayune Strand State Forest, Naples Bay, and Rookery Bay wetlands) and habitat for listed and managed species, to protect and enhance human activity (e.g., recreation in the state forest), and to protect existing infrastructure. While led by Collier County, other project stakeholders, with key roles in conceiving, developing, and implementing the project have a significant role in the adaptive management process. Those stakeholders include at least the following: Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, Florida Forestry Service, Rookery Bay National Estuarine Research Reserve, South Florida Water Management District, US Fish and Wildlife Service, and United States Army Corps of Engineers, and the citizens of the state of Florida.

Short Term and Long-Term Adaptive Management Plan

Collier County has divided the adaptive management process into short-term and long-term actions. Using the monitoring data, Collier County will alter short-term and long-term operational plans to enhance the project performance. The current plans, based on hydrologic simulations, identify pump activation and pumping rates based on GGC flow rates. The plans also call for shutting down the pumps when high rainfall is forecast or high water levels in the CWIP effect area are observed that may result in negative impacts to infrastructure (see **Supplemental Information Attachment 10: Operational & Management Plans** and a summary description in **Supplemental Information Attachment 1: Project Overview**). The monitoring data will allow evaluation of the performance the project using the GGC flow values and allow the county to identify changes to those plans to maintain or enhance target hydrologic conditions without impacting development (roads, houses, private property, etc.). It may be possible to assess the effects of short-term operations as soon as one full quarter of data collection after the operational events occur. This will mainly involve storm-associated shutdown values; longer term datasets (at least a year period) will be necessary to begin to assess overall project performance and identify any long-term pumping changes.

The current plans will be provisionally revised as the environmental data that reflect the results of the operational plans are analyzed. Some decisions may be made quickly, for instance if the storm-related pump shutdown is assessed to have been planned to occur too close to the expected event. Longer-term, as annual operational data become available, Collier County will be able to assess and adjust the seasonal operations.

As soon as sufficient data are available to assess the effects of short-term events (e.g. hurricanes or droughts) Collier County will assess whether the operational plan was appropriate & effective. As

necessary, the county will identify necessary changes in the operation plans for better project performance and inform the project stakeholders of any recommended changes. As necessary, the county will hold workshops to present the data and change recommendations.

Once the project begins operating, Collier County will hold an annual Adaptive management Plan Review with key stakeholders to present analysis of project performance and obtain consensus for significant changes to the operational plans. The county will release an annual project report and hold annual technical workshops to present the prior year project performance, compare of predicted and actual project performance, and obtain consensus on desirable changes to the operational plan.

Red-Cockaded Woodpecker Habitat Adaptive Management Plan Component

The Red-Cockaded Woodpecker (RCW) population in the project area is a very important natural resource to which the project cannot cause adverse impacts. Benefits to the population by improving the habitat of that species is not a project goal but would certainly be appreciated by the county and all the project stakeholders. Beneficial vegetation changes would probably not be measurable for a number of years. However, hydrologic data can provide evidence of impact avoidance on an annual basis. Therefore, annual evaluation of hydroperiod and water elevation data and vegetation transect data from each well location will provide a basis for assessment of project performance and allow development of recommendations to ensure continued avoidance of impacts to RCW. Changes to the monitoring plans based on the monitoring RCW area hydrologic monitoring results will be considered annually. The expert RCW stakeholders (Florida Forestry Service, Florida Fish and Wildlife Conservation Commission, and the US Fish and Wildlife Service) will form a subgroup focused on project performance considering the RCW. The analysis results may also support the goals and objectives of the agencies responsible for RCW recovery.

Adaptive Management Plan Summary

The Collier County CWIP Adaptive Management Plan includes the following components

- Intensive hydrologic, water quality, and vegetation community data collection and analysis.
- Ongoing review and analysis as needed to assess the performance of key short-term operational and identify immediately necessary plan changes.
- Annual assessment of project performance compared to predicted performance, project objectives, and project goals.
- Based on short-term and long-term performance, adjustment of the operation plans to provide best possible project performance.
- Ongoing informal and annual formal coordination with key stakeholders to maintain their understanding of the project performance and consensus for necessary and beneficial changes to project operations.
- The annual project performance evaluation will include a separate evaluation focus on the Red Cockaded Woodpecker habitat hydrology, based on the baseline RCW habitat hydrology assessment provided as part of the project permit package. A stakeholder expert group will work with Collier County on this evaluation and any recommendations for changes to better ensure RCW habitat impact avoidance.

Summary

The combined analyses strongly suggest the proposed CWIP project will not negatively impact RCW habitat. Slightly wetter hydrologic conditions may in fact benefit the area, at least to the extent that it may help reduce the frequency and intensity of wildfires. Collier County has developed an intensive monitoring program now collecting baseline data and has an adaptive management plan to consult and coordinate with the agency stakeholders to ensure that the project is operated to enhance the Picayune Strand State Forest and avoid impacts to the RCW.

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https://www.fws.gov/verobeach/BirdsPDFs/200407SlopesCompleteRedCockadedWoodpecker.pdf

Sub-Appendix 1.

Definition of Vegetation Community Shapefiles

Florida Land Use/Cover Classification System - Florida Natural Areas Inventory Crosswalk

Vegetation Community Shapefile Creation and Data Summary

Definition of Vegetation Community Shapefiles

The 10-year hydrologic simulation results used in this assessment were the product of a combined surface groundwater continuous simulation model. The model used a 375 ft x 375 ft (3.23 acre) grid as the basis for reporting simulation results. Each grid cell produced one simulation value for each day of the simulation period. Daily grid cell results for SFWMD-defined wet season (DATE _ DATE) and dry season (DATE _ DATE), and hydroperiod (days when the water level was above the ground surface for the cell) were averaged over the 10 year simulation period to provide the data for the analysis.

A shapefile depicting the vegetation communities within the project area was created by merging the most recently created Picayune Strand State Forest (PSSF) Florida Natural Areas Inventory (FNAI) shapefile provided by the Florida Forest Service (FFS 2018), the South Florida Water Management District (SFWMD) Land Cover Land Use 2014 – 2016 shapefile (SFWMD 2018), and FLUCCS vegetation communities delineated within outparcels of the PSSF using aerial imagery and vegetation community signatures and polygon definitions from defined polygons on outparcel boundaries.

The PSSF FNAI shapefile defines vegetation communities only within the boundaries of the PSSF and as such does not include any information for the private outparcels within the forest bounds (**Figure 1**). These outparcels range in size from 0.25 acres to 525 acres. In order to create a seamless shapefile for the project area, the communities within these boundaries were delineated within ESRI's ArcMap® version 10.5.1 (ESRI 2016) using 2018 aerial imagery for Collier County provided through the Florida Department of Transportation (FDOT) Aerial Photo LookUp System (FDOT 2018). The vegetation communities within the outparcels were attributed using the FNAI classification scheme (FNAI 2010), tied into the PSSF FNAI shapefile, and attributed using the FNAI classification scheme. The data were clipped to the project area. The PSSF vegetation communities were tied into the SFWMD Land Cover 2016 shapefile (**Figure 3**). However, as the vegetation communities within the SFWMD shapefile were attributed using the Florida Land Cover Classification System (FLUCCS) (FLUCCS 2018) rather than FNAI, a crosswalk was used to attribute each of the shapefiles using both FLUCCS and FNAI classification systems. This crosswalk was created using the Habitat Classification and Field Reconnaissance table provided by the Florida Fish and Wildlife Conservation Commission (FWC 2018), adjusted to include all the communities defined within the project area. As the PSSF FNAI data (and subsequently the outparcel data) were delineated at a finer scale than the SFWMD FLUCCS data, the data were merged using the FNAI information. Along the boundaries of the PSSF, vegetation communities were again delineated using the FDOT imagery in order to tie the PSSF FNAI shapefile to the SFWMD shapefile. Once these communities were tied together, a seamless shapefile was created that maintained both the FNAI and FLUCCS information, as well as source information for each of the communities.

For analysis purposes, the FLUCCS-FNAI shapefile created for the project area was dissolved using the FLUCCS information in order to create a shapefile with slightly coarser detail and fewer very small shapefiles. These resulting shapefiles defined the vegetation community used in the analyses.

REFERENCES

FDOT 2018 – Florida Department of Transportation (FDOT), 2018. COL 2018. Flight 6438. Resolution 0.5 ft. Acquired 12/1/2017 - 12/11/2017. Prepared by GIS Office, FDOT, Tallahassee, FL. Obtained September 2018 from https://fdotewp1.dot.state.fl.us/AerialPhotoLookUpSystem/.

FLUCCS 2018 – Florida Fish and Wildlife Conservation Commission (FWC), 2018. *Florida Land Cover Classification System*. Prepared by Robert Kawula & Jennylyn Redner, Center for Spatial Analysis, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

FNAI 2010 – Florida Natural Areas Inventory (FNAI), 2010. *Guide to the natural communities of Florida: 2010 edition*. Florida Natural Areas Inventory, Tallahassee, FL.

FWC 2018– Florida Fish and Wildlife Conservation Commission (FWC), 2018. *Habitat Classification and Field Reconnaissance*. Prepared by Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. Accessed September 2018 at: http://fwcg.myfwc.com/index_files/textonly/slide12.html

Florida Land Use/Cover Classification System - Florida Natural Areas Inventory Crosswalk

The Collier County Comprehensive Watershed Improvement Plan (CWIP) project area had vegetation community GIS information available in two different formats. As the vegetation communities within the existing shapefiles were attributed using two different classification systems, a crosswalk was used to attribute each of the shapefiles using both FLUCCS (Florida Land Use Cover Classification System) and FNAI (Florida Natural Areas Inventory) classification systems. The FLUCCS, developed by the Florida Fish and Wildlife Conservation Commission (FWC), incorporated classifications currently used by the Florida Fish and Wildlife Conservation Commission (FWC), Florida Natural Areas Inventory (FNAI), and Florida's water management districts (WMD) (FLUCCS 2018). It includes all categories of land use, including, but not limited to natural communities. The FNAI Classification System was developed by the Florida Natural Areas Inventory (FNAI) and categorizes the original, natural biological associations of Florida (FNAI 2010). A Natural Community is defined as a distinct and recurring assemblage of populations of plants, animals, fungi, and microorganisms naturally associated with each other and their physical environment (FNAI 2010). The crosswalk used for the majority of the communities in this project area (**Table 1**) was created using the Habitat Classification and Field Reconnaissance table provided by the Florida Fish and Wildlife Conservation Commission (FWC 2018), adjusted to include all of the communities defined within the project area. As the FNAI delineates vegetation communities in finer detail than FLUCCS, we found it necessary to create an additional crosswalk (**Table 2**) to use on case-by-case basis for certain community types in an effort to maintain more FNAI dataset detail for dominant FLUCCS codes in the project area.

REFERENCES

FNAI 2010 – Florida Natural Areas Inventory (FNAI), 2010. *Guide to the natural communities of Florida: 2010 edition*. Florida Natural Areas Inventory, Tallahassee, FL.

FLUCCS 2018 – Florida Fish and Wildlife Conservation Commission (FWC), 2018. *Florida Land Cover Classification System*. Prepared by Robert Kawula & Jennylyn Redner, Center for Spatial Analysis, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

FWC 2018– Florida Fish and Wildlife Conservation Commission (FWC), 2018. *Habitat Classification and Field Reconnaissance*. Prepared by Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida. Accessed September 2018 at: http://fwcg.myfwc.com/index_files/textonly/slide12.html

Table 1: Standard FLUCCS – FNAI Crosswalk

FLUCCS Code	FLUCCS Name	FNAI
1180	Rural Residential	Developed
1210	Fixed Single-Family Units	Developed
1290	Medium Density Under Construction	Developed
1320	Mobile Home Units	Developed
1330	Multiple Dwelling Units, Low Rise	Developed
1390	High Density Under Construction	Developed
1400	Commercial & Services	Developed
1700	Institutional	Developed
1900	Open Land	Clearing
2230	Other Groves	Agriculture
2230	Other Groves	Agriculture
2610	Fallow Cropland	Abandoned Field/Abandoned Pasture
2610	Fallow Cropland	Abandoned Field/Abandoned Pasture
3100	Herbaceous (Dry Prairie)	Dry Prairie
3200	Upland Shrub and Brushland	Dry Prairie
3210	Palmetto Prairies	Dry Prairie
4110	Pine Flatwoods	Mesic Flatwoods
4340	Upland Mixed Coniferous/Hardwood	Upland Mixed Coniferous Hardwood
5120	Channelized Waterways, Canals	Canal/Ditch
5300	Reservoirs	Artificial Pond
5300	Reservoirs	Inland Ponds and Sloughs
5300	Reservoirs	Swamp Lake
6120	Mangrove Swamp	Mangrove Swamp
6170	Mixed Wetland Hardwoods	Hydric Hammock
6191	Wet Melaleuca	Invasive Exotic Monoculture
6200	Wetland Coniferous Forests	Wet Flatwoods
6215	Cypress- Domes/Heads	Dome Swamp
6216	Cypress - Mixed Hardwoods	Strand Swamp
6250	Wet Pineland Hydric Pine	Wet Flatwoods
6300	Wetland Forested Mixed	Floodplain Swamp
6300	Wetland Forested Mixed	Mesic Hammock
6410	Freshwater Marshes / Graminoid Prairie - Marsh	Marl Prairie
6410	Freshwater/Graminoid Prairie – Marsh	Wet Prairie
6420	Saltwater Marshes / Halophytic Herbaceous Prairie	Salt Marsh
7400	Disturbed Land (Except Artificial Ponds and Roads)	Clearing
7400	Disturbed Land	Spoil Area
7400	Disturbed Land	Clearing
8140	Roads and Highways	Road

Table 2: Alternate FLUCCS – FNAI Crosswalk

FNAI	FNAI Subtype	FLUCCS Code	FLUCCS Name
Wet Flatwoods	Mixed Cypress/Pine/Palm	6240	Cypress-Pine-Cabbage Palm
	NOT Mixed Cypress/Pine/Palm	6172	Wet Pinelands Hydric Pine
Hydric Hammock	Wet Flatwoods	6250	Wet Pinelands Hydric Pine
	NOT Wet Flatwoods	6172	Mixed Shrubs
Dome Swamp	Palm	6240	Cypress - Pine - Cabbage Palm
	NOT Palm	6210	Cypress
Wet Prairie	Mixed Cypress/Pine/Palm	6240	Cypress-Pine-Cabbage Palm
	NOT Mixed Cypress/Pine/Palm	6430	Wet Prairie
Developed	CASE BY CASE	8140 /1400 / 1180	Roads and Highways / Commercial and Services / Rural Residential

Vegetation Community Shapefile Creation and Data Summary

Vegetation Community Shapefile Creation

Source Data

Table 1: Source Data

Source Data	Reference	Description
Picayune Strand State Forest (PSSF) Florida Natural Areas Inventory (FNAI)	FFS 2018	Florida Forest Service (FFS) Historic Natural Community Mapping Project: This is a polygon file that delineates natural communities on FFS managed lands as identified by FNAI staff during field surveys. Most polygons have associated natural community point data that describes the ecological condition within the polygons.
South Florida Water Management District (SFWMD) Land Cover Land Use 2014 – 2016	SFWMD 2018	This data set serves as documentation of land cover and land use (LCLU) within the South Florida Water Management District as it existed in 2014-16. Land Cover Land Use data was updated from 2008-09 LCLU by photo-interpretation from 2014-16 aerial photography and classified using the SFWMD modified FLUCCS classification system. Features were interpreted from the county-based aerial photography (4 in - 2 ft pixel). The features were updated on screen from the 2008-09 vector data. Horizontal accuracy of the data corresponds to the positional accuracy of the county aerial photography. The minimum mapping unit for classification was 0.5 acres for wetlands and 5 acres for uplands.
Collier County 2018 Aerial Imagery	FDOT 2018	Provided through the Florida Department of Transportation (FDOT) Aerial Photo LookUp System. Flight: 6438. Resolution: 0.5 ft. Acquired: 12/1/2017 - 12/11/2017.

Tools

Table 2: Processing Tools Provided within ESRI's ArcMap (ESRI 2016)

Tool Name	Toolbox	Description
ERASE	Analysis	Creates a feature class by overlaying the Input Features with the polygons of the Erase Features. Only those portions of the input features falling outside the erase features outside boundaries are copied to the output feature class.
CLIP	Analysis	Extracts input features that overlay the clip features.
DISSOLVE	Data Management	Aggregates features based on specified attributes.

Process Steps

1. Using the outline of the PSSF FNAI shapefile, a new shapefile was made containing the areas within the outparcels of the State Forest using the ERASE tool.
2. Using the FDOT 2018 imagery as a reference, vegetation communities were delineated within the outparcels by cutting each outparcel polygon into different shapes depicting the outline of the different vegetation signatures using a CINTIQ® 22HD Interactive Pen Display Tablet (WACOM Technology Corporation). Map scale was set between 1:500 to 1,500.
3. Polygons within the outparcel shapefile were attributed using the FNAI classification system (FNAI 2010) by using the corresponding vegetation signatures within PSSF FNAI shapefiles.
4. The PSSF FNAI shapefile, Outparcel shapefile, and SFWMD shapefile were each clipped to the project boundary using the CLIP tool.
5. The PSSF FNAI shapefile and Outparcel shapefile were erased from the clipped SFWMD shapefile using the ERASE tool.
6. The crosswalk described above was used to attribute each of the shapefiles with the corresponding FLUCCS or FNAI information.
7. Using the FNAI attribute information, the data were merged together. Along the boundaries of the PSSF, vegetation communities were again delineated according the vegetation signatures using the FDOT imagery in order to tie the PSSF FNAI shapefile to the SFWMD shapefile via a CINTIQ® 22HD Interactive Pen Display Tablet (WACOM Technology Corporation).
8. Any new shapes were attributed with both FNAI and FLUCCS information.
9. A seamless shapefile was then created that maintained both the FNAI and FLUCCS information, as well as source information for each of the communities by merging the PSSF FNAI shapefile, Outparcel shapefile, and SFWMD shapefile (including the edits described in step 7).
10. After a single shapefile was created for all the information, the data were aggregated based on FLUCCS Information, FNAI Information, and Source Information using the DISSOLVE tool.
11. Topology was run on the dissolved shapefile to identify any gaps or overlapping data. Any errors identified were fixed. This shapefile (Final_FLUCCS_FNAI) was then uploaded into the Collier Watershed Improvement Plan GIS database for submittal to the County following project completion.
12. For analyses purposes only, an additional shapefile (FLUCCS_Only_ForAnalyses) was created that aggregated the polygons based only on FLUCCS information using the DISSOLVE tool. This was done in order to create a slightly coarser dataset that would be more appropriate for use with the hydrologic data information.

Vegetation Community Data Summary

Project Area

Table 3: FLUCCS Acreages

FLUCCS	Acreage
113/Mixed Units, Fixed and Mobile Home Units	3.36
118/Rural Residential	81.51
121/Fixed Single Family Units	4.27
122/Mobile Home Units	1.30
123/Mixed Units, Fixed and Mobile Home Units	1.20
129/Medium Density Under Construction	3.06
132/Mobile Home Units	0.09
133/Multiple Dwelling Units, Low Rise	2.27
139/High Density Under Construction	36.16
1423/Junk Yards	14.72
162/Sand and Gravel Pits	2.60
182/Golf Course	0.60
190/Open Land	15.40
211/Improved Pastures	0.88
223/Other Groves	143.98
232/Poultry Feeding Operations	14.56
251/Horse Farms	10.44
261/Fallow Cropland	831.21
310/Herbaceous (Dry Prairie)	6.38
320/Upland Shrub and Brushland	16.35
321/Palmetto Prairies	46.44
411/Pine Flatwoods	2619.09
422/Brazilian Pepper	0.92
424/Melaleuca	50.29
434/Upland Mixed Coniferous / Hardwood	45.43
512/Channelized Waterways, Canals	38.49
520/Lakes	4.23
530/Reservoirs	103.31
542/Embayments Not Opening Directly to Gulf or Ocean	153.33
612/Mangrove Swamp	1451.30
617/Mixed Wetland Hardwoods	94.93
6172/Mixed Shrubs	545.94
6191/Wet Melaleuca	99.86
620/Wetland Coniferous Forests	387.07
621/Cypress	7155.85
624/Cypress - Pine - Cabbage Palm	7471.77

FLUCCS	Acreage
625/Wet Pinelands Hydric Pine	2253.52
630/Wetland Forested Mixed	233.52
641/Freshwater Marshes / Graminoid Prairie - Marsh	93.62
642/Saltwater Marshes / Halophytic Herbaceous Prairie	527.75
643/Wet Prairie	101.23
644/Emergent Aquatic Vegetation	4.69
740/Disturbed Land	224.24
811/Airports	0.41
814/Roads and Highways	154.20
834/Sewage Treatment	1.09
TOTAL	25052.88

Table 4: FNAI Acreages

FNAI	Acreage
Abandoned Field/Abandoned Pasture	823.24
Agriculture	159.42
Artificial Pond	103.31
Basin Marsh	79.29
Basin Swamp	68.64
Canal/Ditch	38.49
Clearing	239.64
Developed	163.08
Dome Swamp	674.05
Dry Prairie	54.19
Floodplain Swamp	187.44
Hydric Hammock	492.94
Inland Ponds and Sloughs	153.33
Mangrove Swamp	1451.30
Marl Prairie	98.32
Mesic Flatwoods	2676.79
Mesic Hammock	46.99
Road	162.18
Strand Swamp	6659.41
Swamp Lake	4.23
Tidal Marsh	527.75
Upland Hardwood Forest	45.43
Wet Flatwoods	10042.18
Wet Prairie	101.23
TOTAL	25052.88

Data described in this appendix were created and processed using ArcGIS® software by Esri (Version 10.5.1). ArcGIS® and ArcMap™ are the intellectual property of Esri and are used herein under license. Copyright© Esri.

References

FDOT 2018 – Florida Department of Transportation (FDOT), 2018. COL 2018. Flight 6438. Resolution 0.5 ft. Acquired 12/1/2017 - 12/11/2017. Prepared by GIS Office, FDOT, Tallahassee, FL. Obtained September 2018 from https://fdotewp1.dot.state.fl.us/AerialPhotoLookUpSystem/.

FFS 2018 – Florida Forest Service, 2018. *Picayune Strand State Forest (PSSF) Historic Natural Community Mapping Project*. Prepared by the Florida Natural Areas Inventory Staff, Tallahassee, FL.

ESRI 2016 – Environmental Systems Research Institute (ESRI), 2016. *ArcGIS. Version 10.5.1.* Environmental Systems Research Institute, Inc., Redlands, CA.

FNAI 2010 – Florida Natural Areas Inventory (FNAI), 2010. *Guide to the natural communities of Florida: 2010 edition*. Florida Natural Areas Inventory, Tallahassee, FL.

FLUCCS 2018 – Florida Fish and Wildlife Conservation Commission (FWC), 2018. *Florida Land Cover Classification System*. Prepared by Robert Kawula & Jennylyn Redner, Center for Spatial Analysis, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

SFWMD 2018 – South Florida Water Management District (SFWMD), 2018. *SFWMD Land Cover Land Use 2014 – 2016.* South Florida Water Management District, West Palm Beach, FL. Obtained November 2018 at: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd-land-cover-land-use-2014-2016.

Sub-Appendix 2

Calculation of Weighted Average Hydrologic Statistics

Calculation of Weighted Average Hydrologic Statistics

Weighted hydrologic statistic for each shape within a FLUCCS codes:

$$H_{swn} = H_{cn} * (A_w / Ac)$$

$$\text{mean } H_{sw} = (\sum H_{swn})/n$$

Where

- s = a hydrologic statistic - hydroperiod, wet season annual average depth, dry season annual average depth, dry season 1/10-year annual average lowest depth
- H_{swn} = area-weighted cell hydrologic statistic value
- H_{cn}= raster cell hydrologic statistic value
- A_w = area of cell within intersecting veg polygon
- A_c = area of cell

Hydrologic statistic mean for each FLUCCS code:

$$H_{sfi} = (\sum(H_{wnix)} (A_{ix} / \sum A_{ix}))/n_i$$

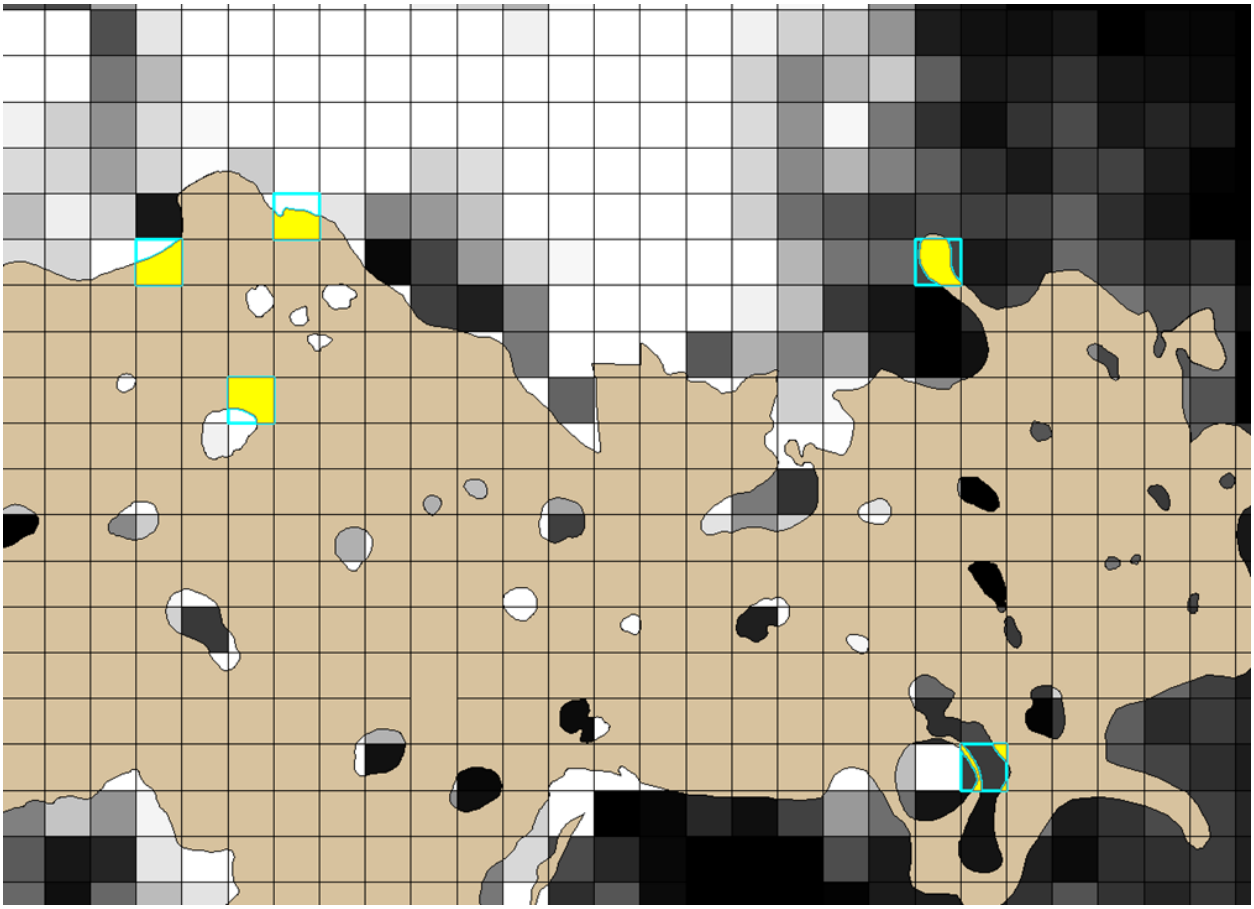
Where:

- H_{sfi} = The hydrologic statistic average value for FLUCCS code i
- s = a hydrologic statistic –
- H_{wnix} = A hydrologic statistic value wn for one shape x of FLUCCS code i
- A_{ix} = area of FLUCCS code i shape x
- n_i = number of shapes for FLUCCS code i

For different multiple polygon areas (e.g. for Red Cockaded Woodpecker core foraging areas - CFA) the same general equations would apply to a calculation of the weighted hydrologic statistics for each FLUCCS shape intersecting a CFA, each FLUCCS code, and CFA mean hydrologic statistics.

Polygon Example (and see Figure below)

- The cell with red borders (full cell) has the average overland depth of 9.0 inches.
- After intersection with cypress polygon, only about 71.9% of the cell falls in the cypress polygon (yellow colored segment). Hence, the area weighted average overland depth for the cypress cell comes out to be 6.5 inches (71.9% of 9.0 inches).
- I have shown some other bordering cells following the same methodology.
- Whereas, the cells that fall 100 % within the cypress polygons will retain the raster values.



Sub-Appendix 3

Stage Duration Curves

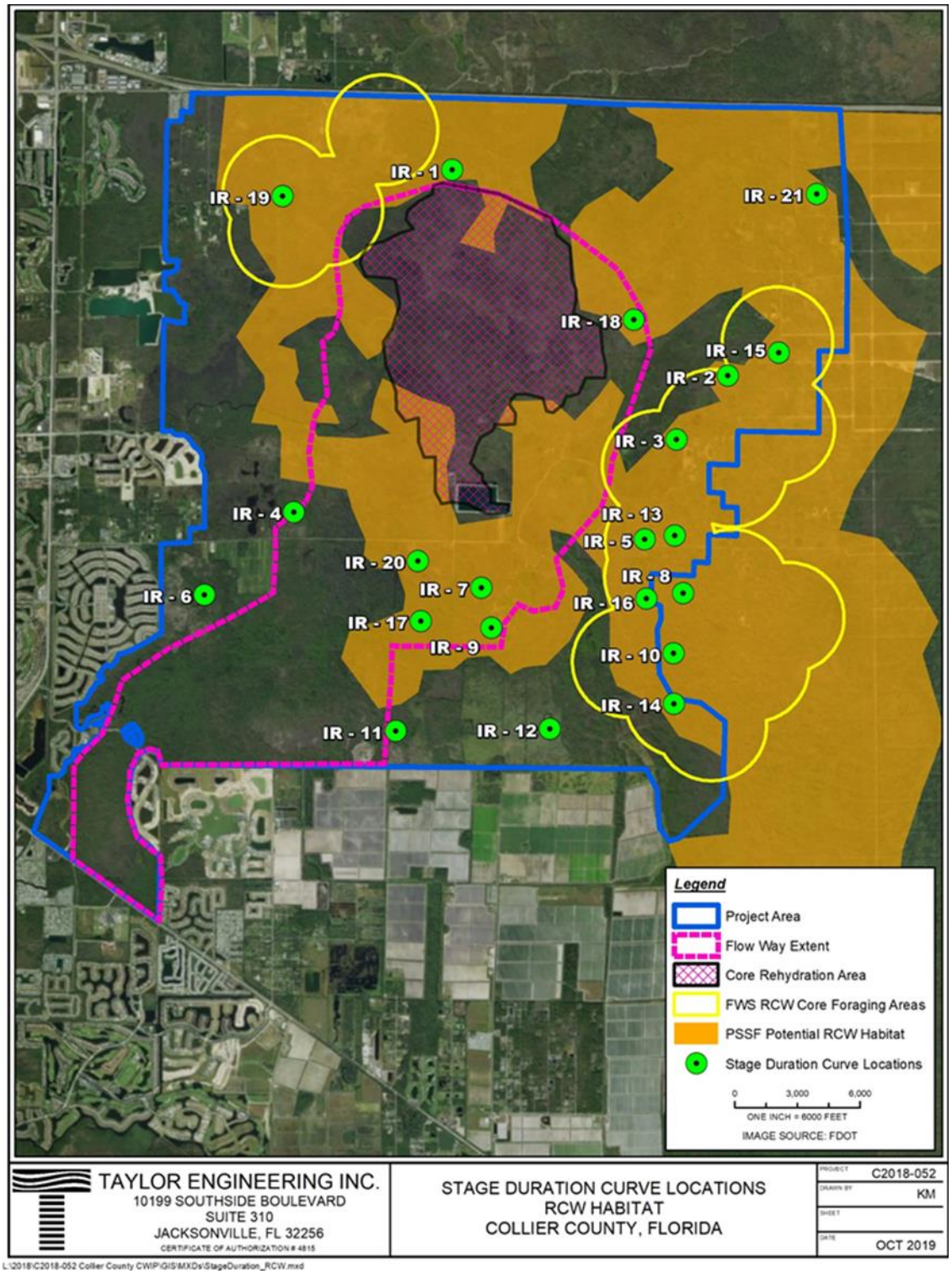
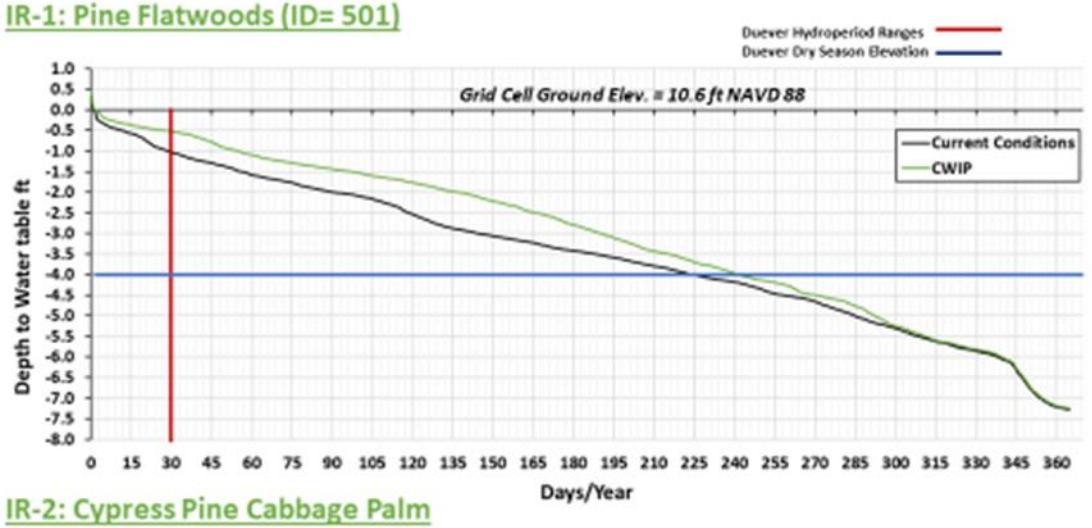


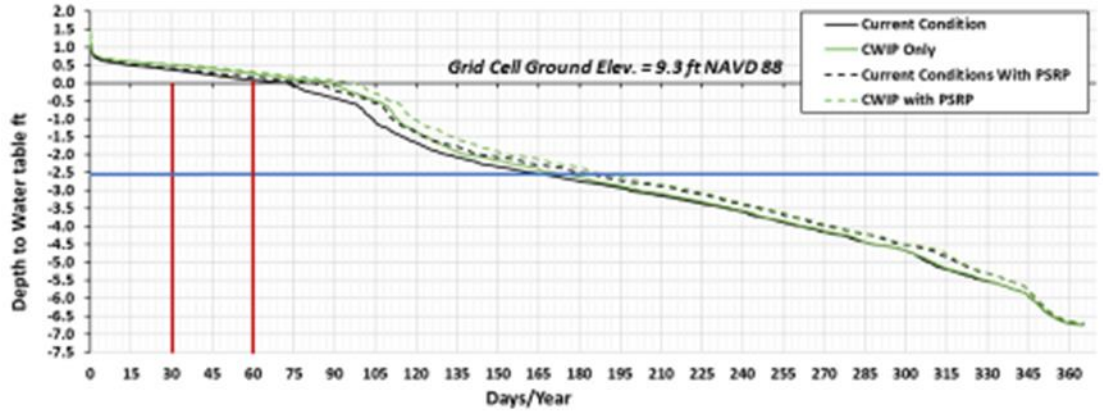
Figure A5-1. Stage Duration Curve Locations and RCW Habitat Areas

Stage-Duration Curves: Current Conditions and CWIP

IR-1: Pine Flatwoods (ID= 501)



IR-2: Cypress Pine Cabbage Palm



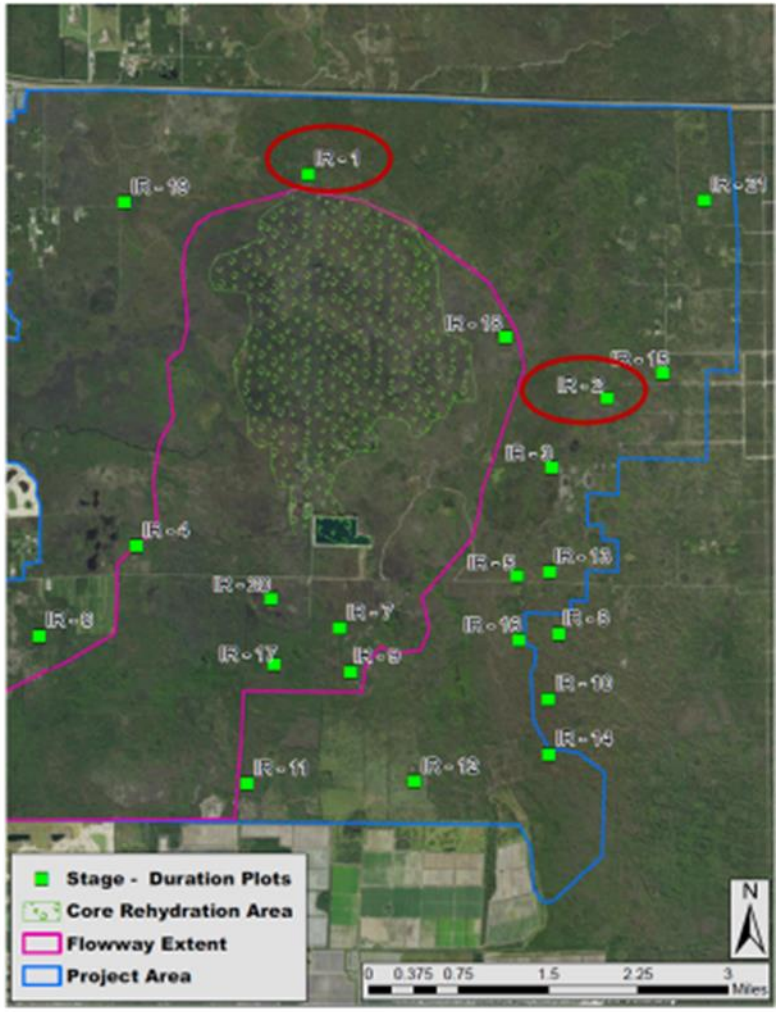
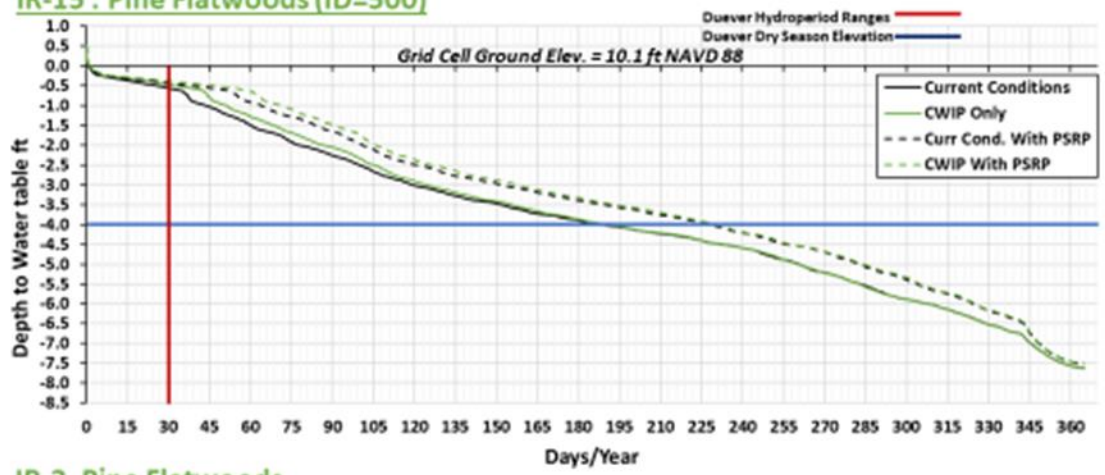


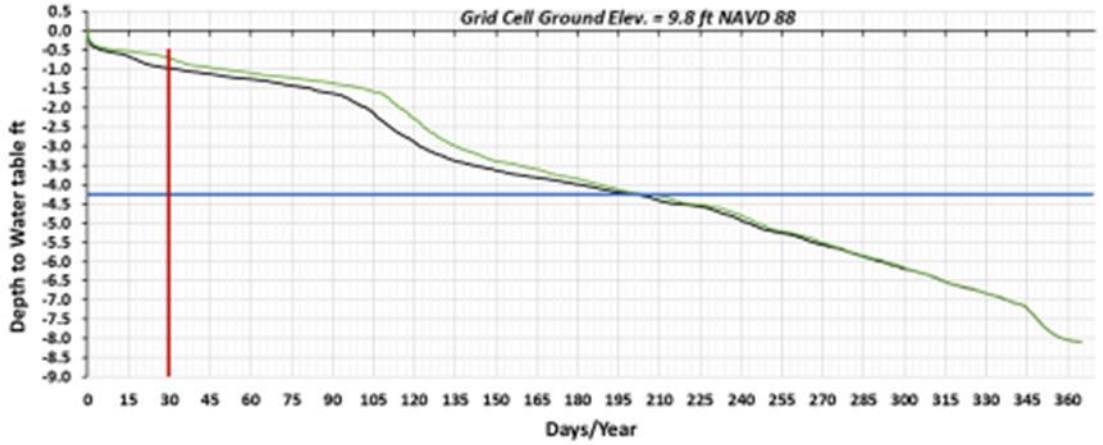
Figure A3-2

Stage-Duration Curves – Current and CWIP Conditions

IR-15 : Pine Flatwoods (ID=500)



IR-3 Pine Flatwoods



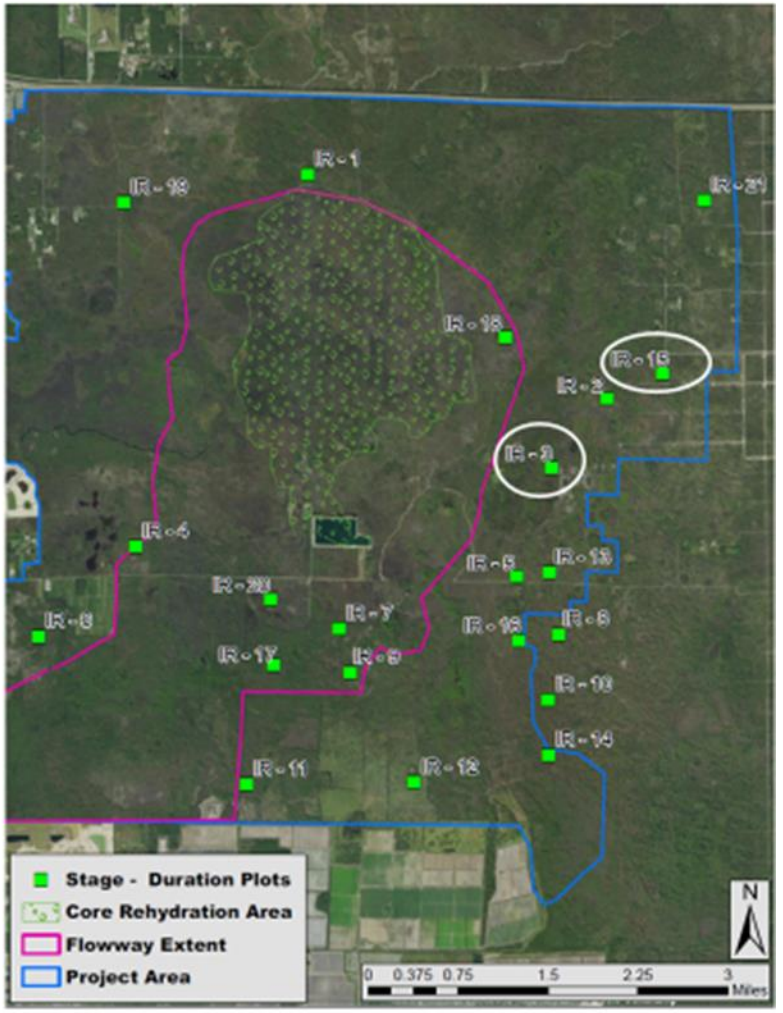


Figure A5-3

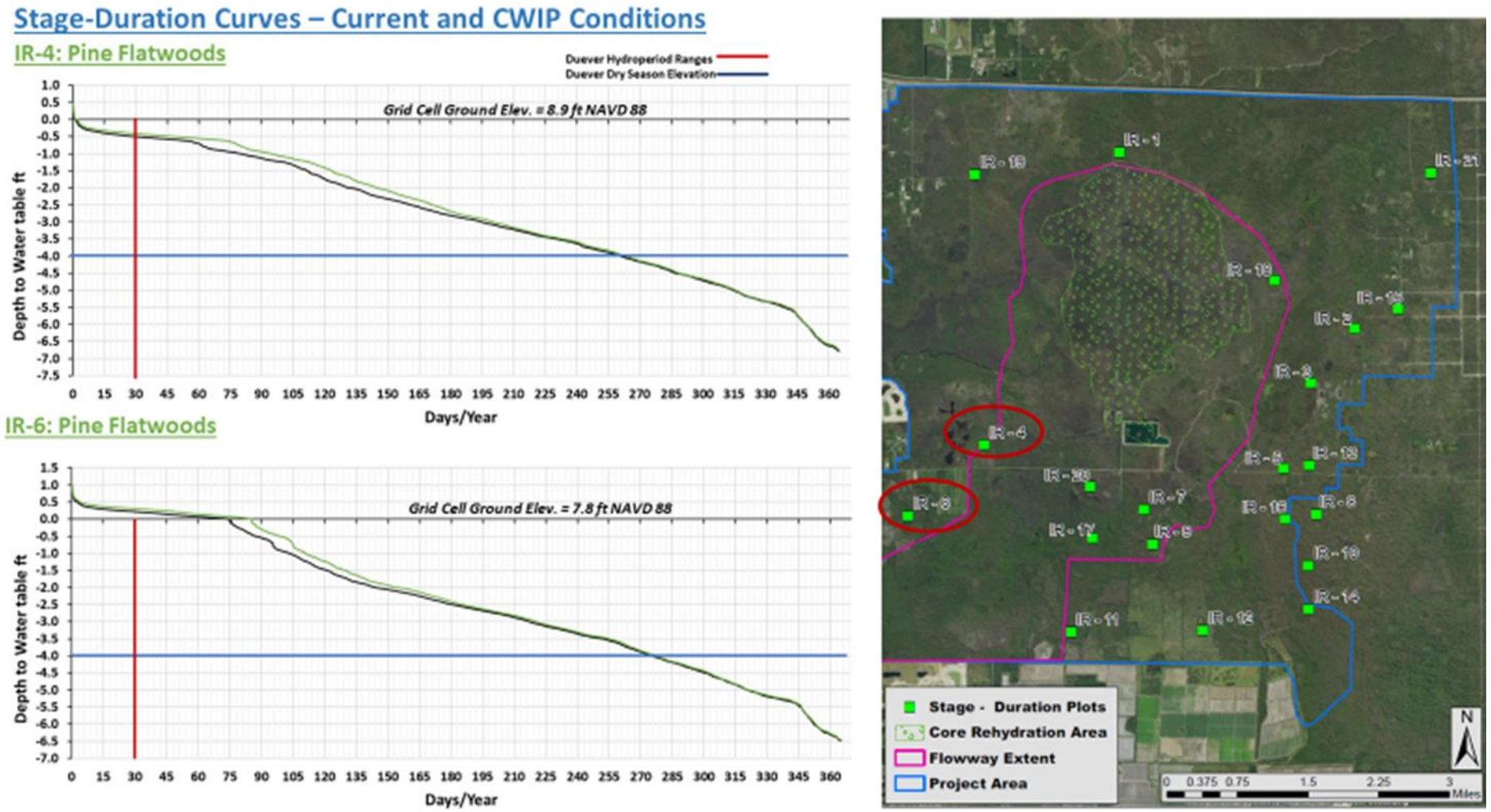

Stage-Duration Curves – Current and CWIP Conditions
IR-4: Pine Flatwoods
Duever Hydroperiod Ranges
Duever Dry Season Elevation
Grid Cell Ground Elev. = 8.9 ft NAVD 88
Depth to Water table ft
Days/Year
IR-6: Pine Flatwoods
Grid Cell Ground Elev. = 7.8 ft NAVD 88
Depth to Water table ft
Days/Year
Stage - Duration Plots
Core Rehydration Area
Flowway Extent
Project Area
N
0 0.375 0.75 1.5 2.25 3
Miles

Figure A3-4

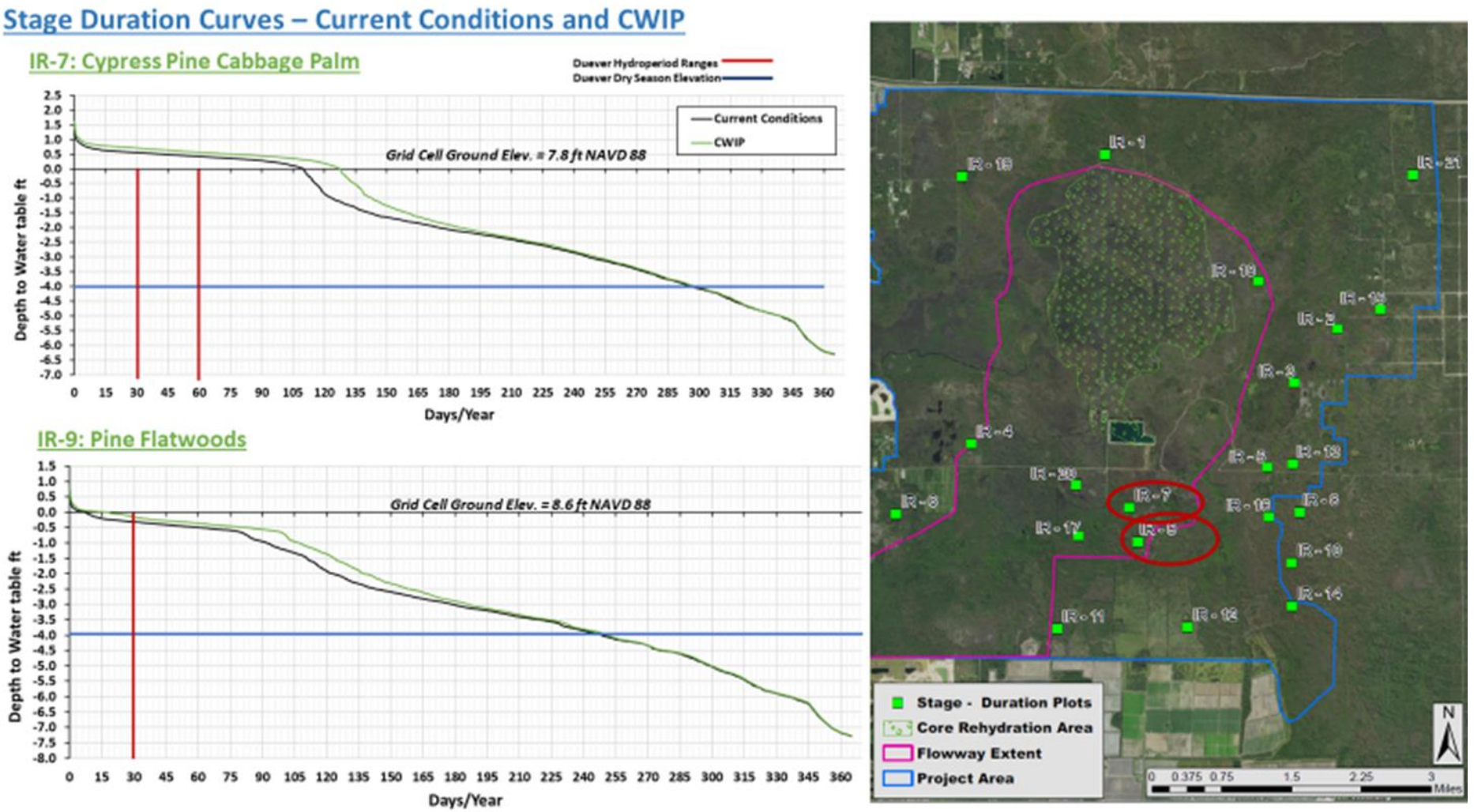
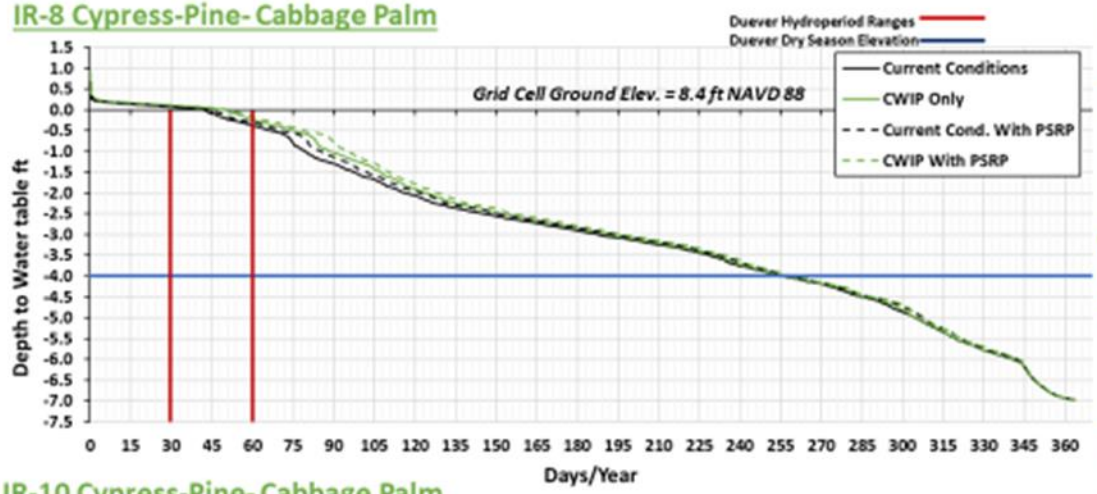

Stage Duration Curves – Current Conditions and CWIP
IR-7: Cypress Pine Cabbage Palm
Duever Hydroperiod Ranges
Duever Dry Season Elevation
Current Conditions
CWIP
Grid Cell Ground Elev. = 7.8 ft NAVD 88
Depth to Water table ft
Days/Year
IR-9: Pine Flatwoods
Grid Cell Ground Elev. = 8.6 ft NAVD 88
Depth to Water table ft
Days/Year
IR-1
IR-10
IR-21
IR-19
IR-2
IR-4
IR-20
IR-7
IR-8
IR-17
IR-5
IR-16
IR-6
IR-18
IR-14
IR-11
IR-12
Stage - Duration Plots
Core Rehydration Area
Flowway Extent
Project Area
N
0 0.375 0.75 1.5 2.25 3
Miles

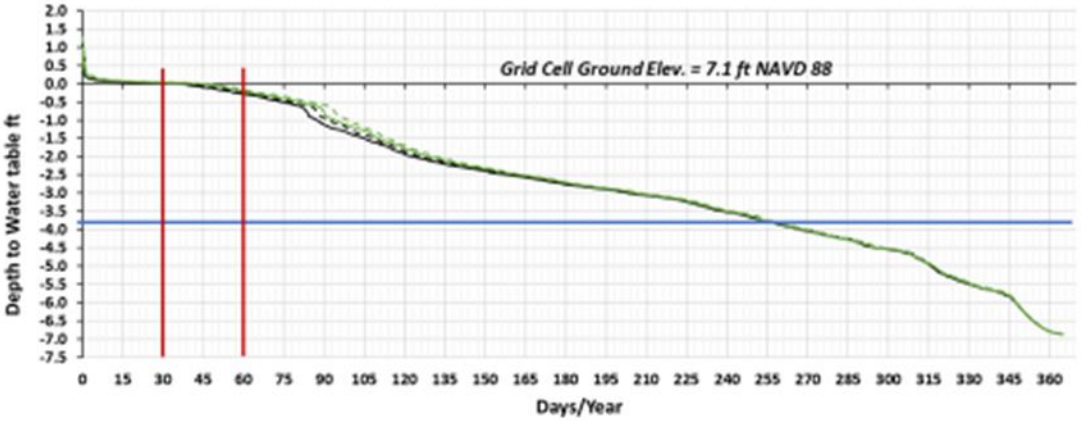
Figure A3-5

Stage-Duration Curves – Current and CWIP Conditions

IR-8 Cypress-Pine- Cabbage Palm



IR-10 Cypress-Pine- Cabbage Palm



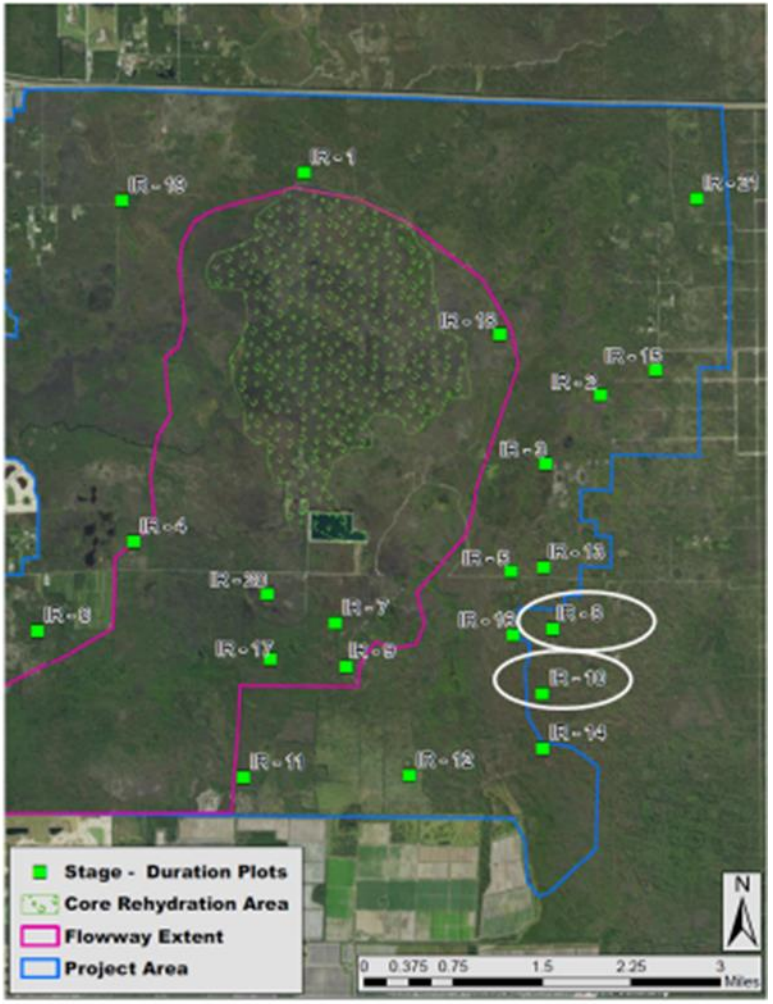
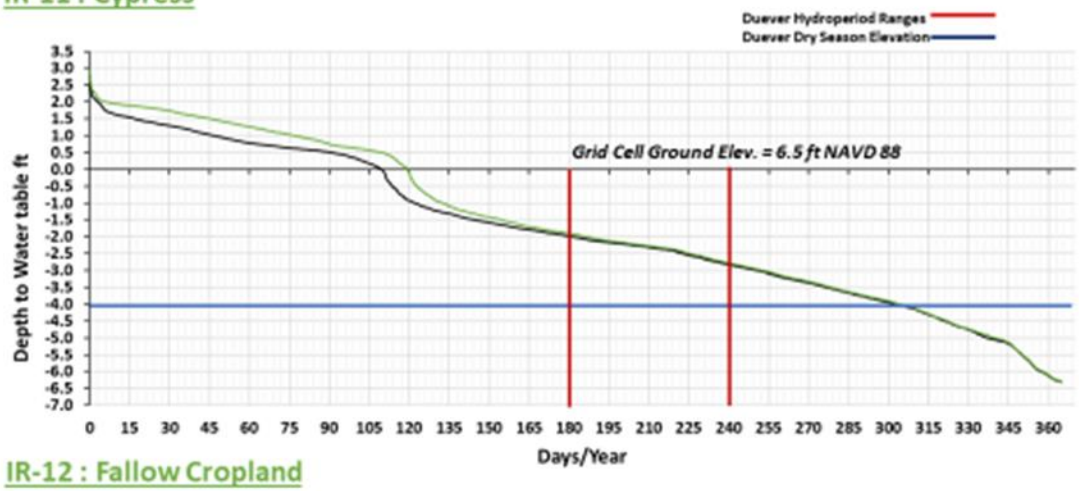


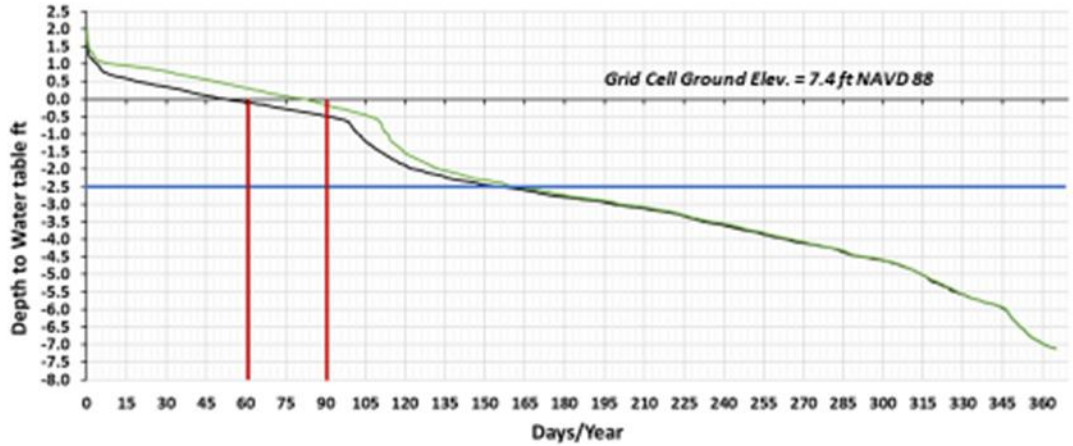
Figure A3-6

Water Table Depths (ft) – Current Conditions and CWIP

IR-11 : Cypress



IR-12 : Fallow Cropland



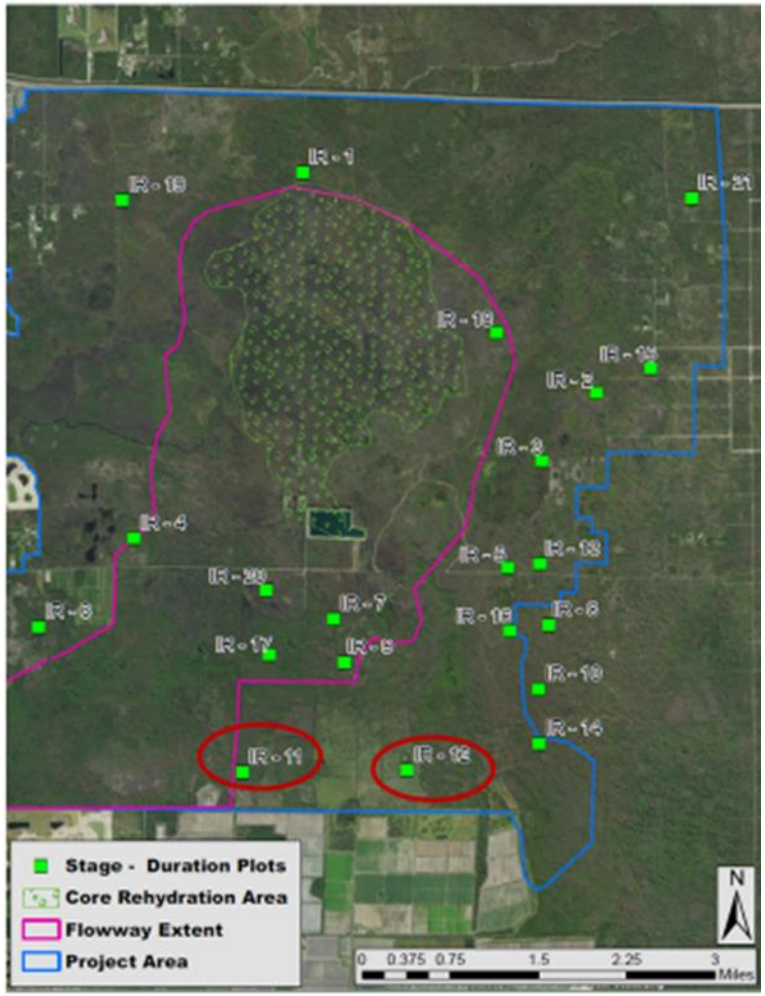
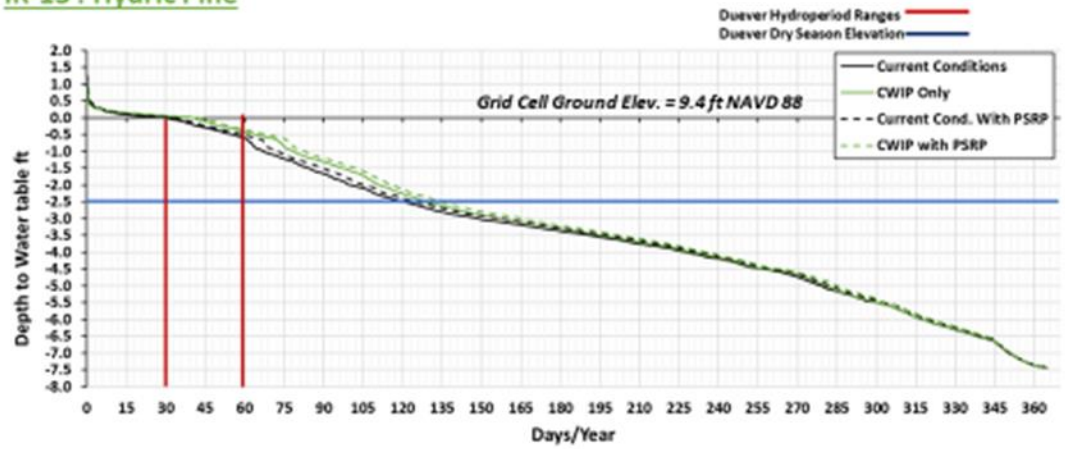


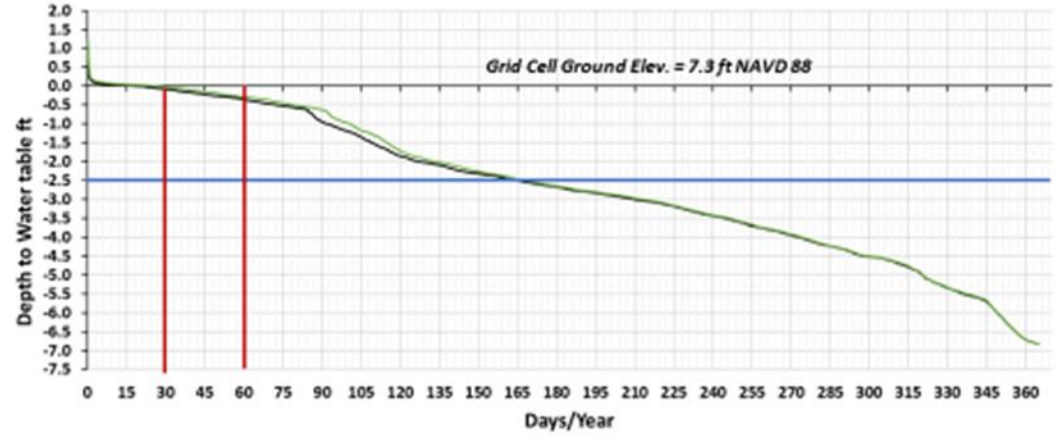
Figure A3-7

Stage – Duration Curves: Current Conditions and CWIP

IR-13 : Hydric Pine



IR-14 : Hydric Pine



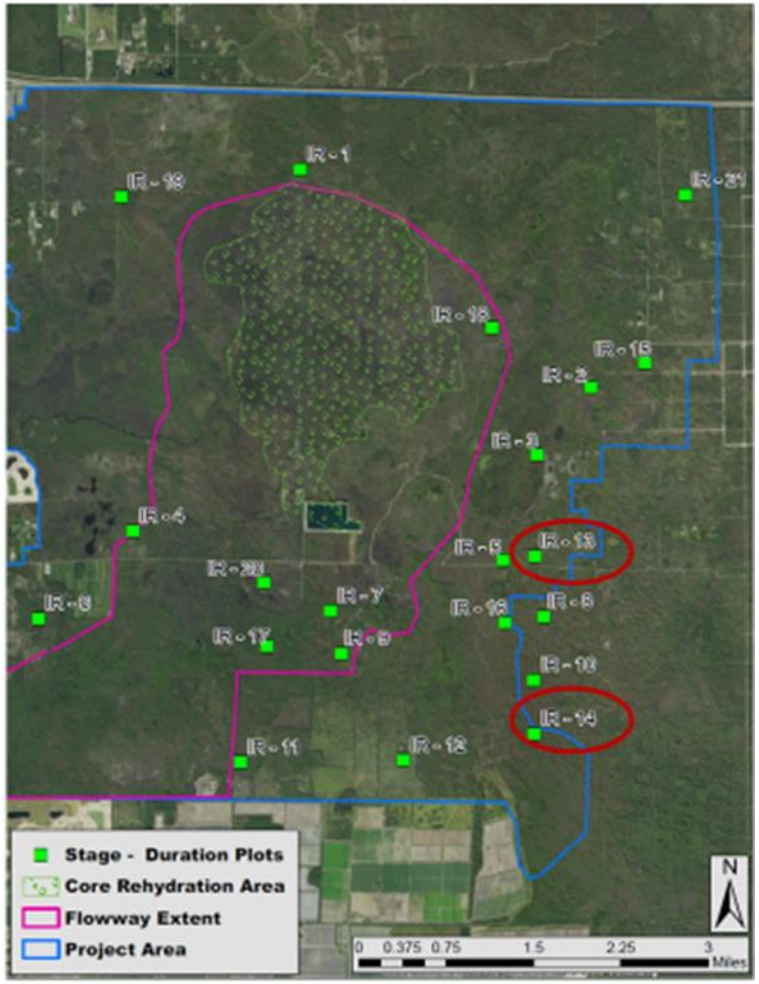
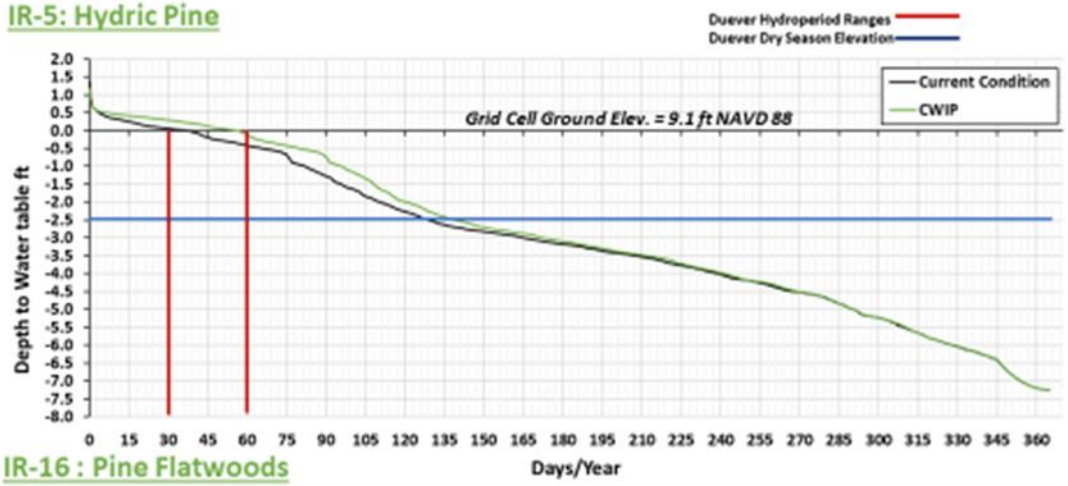


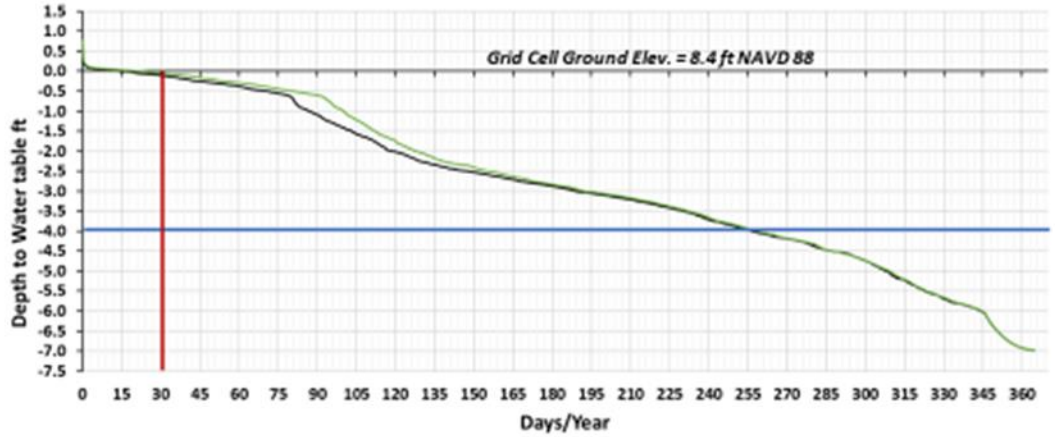
Figure A3-8

Stage Duration Curves – Current Conditions and CWIP

IR-5: Hydric Pine



IR-16 : Pine Flatwoods



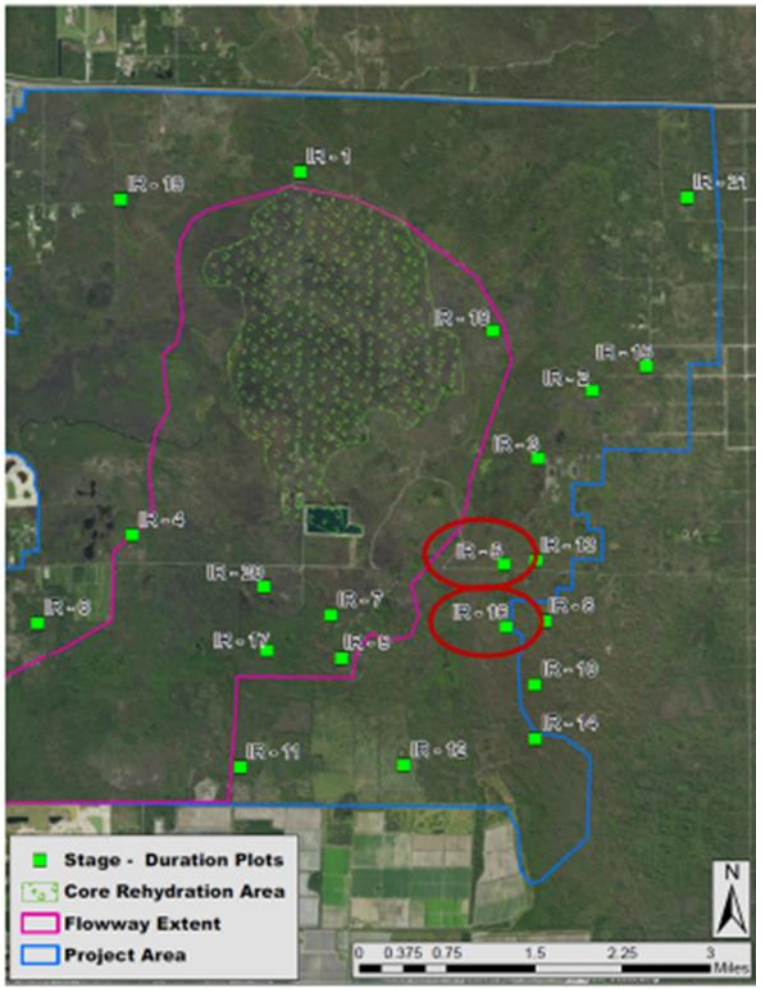


Figure A3-9

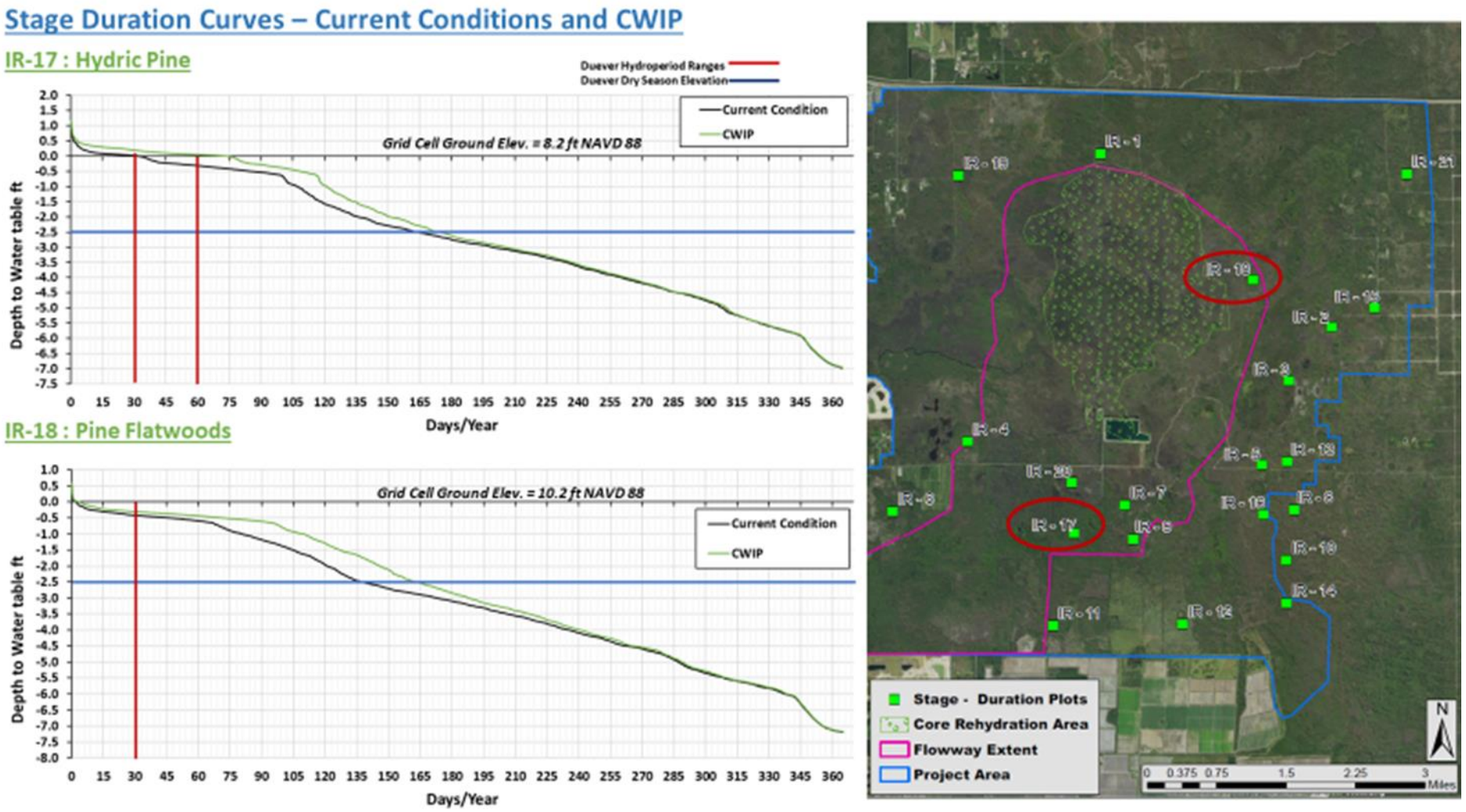
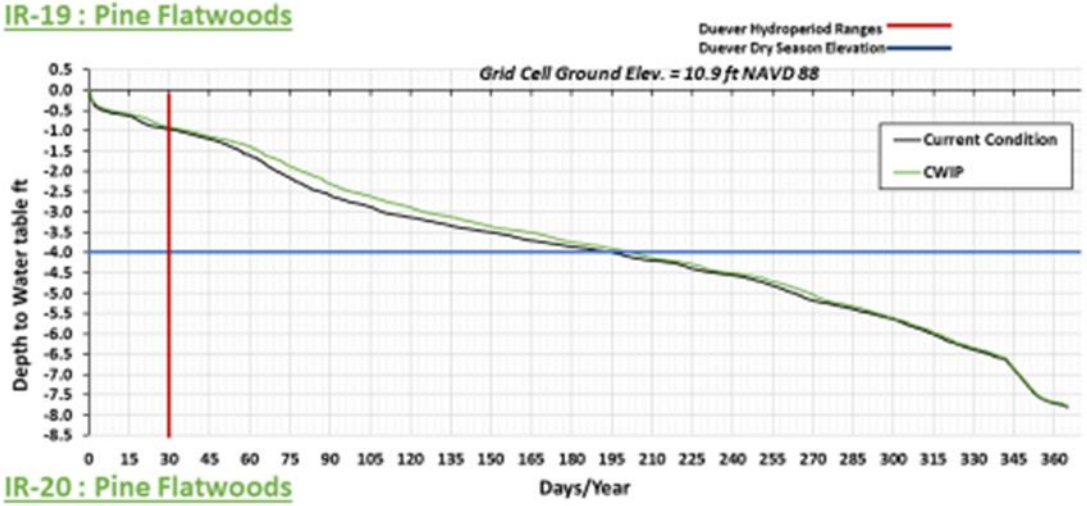

Stage Duration Curves – Current Conditions and CWIP
IR-17 : Hydric Pine
Duever Hydroperiod Ranges
Duever Dry Season Elevation
Current Condition
CWIP
Grid Cell Ground Elev. = 8.2 ft NAVD 88
Depth to Water table ft
Days/Year
IR-18 : Pine Flatwoods
Grid Cell Ground Elev. = 10.2 ft NAVD 88
Current Condition
CWIP
Depth to Water table ft
Days/Year
IR-1
IR-21
IR-10
IR-2
IR-9
IR-4
IR-5
IR-13
IR-20
IR-7
IR-8
IR-17
IR-6
IR-19
IR-14
IR-11
IR-12
Stage - Duration Plots
Core Rehydration Area
Flowway Extent
Project Area
N
0 0.375 0.75 1.5 2.25 3
Miles

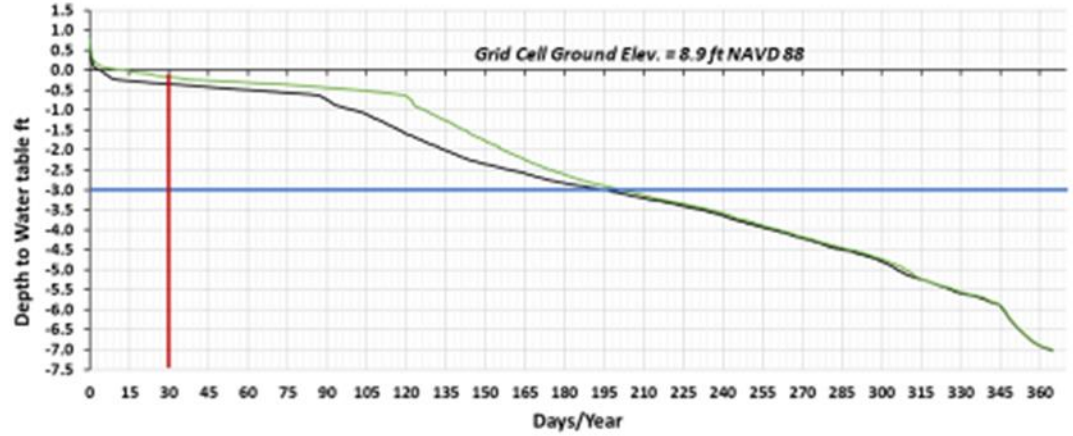
Figure A3-10

Stage Duration Curves – Current Conditions and CWIP

IR-19 : Pine Flatwoods



IR-20 : Pine Flatwoods



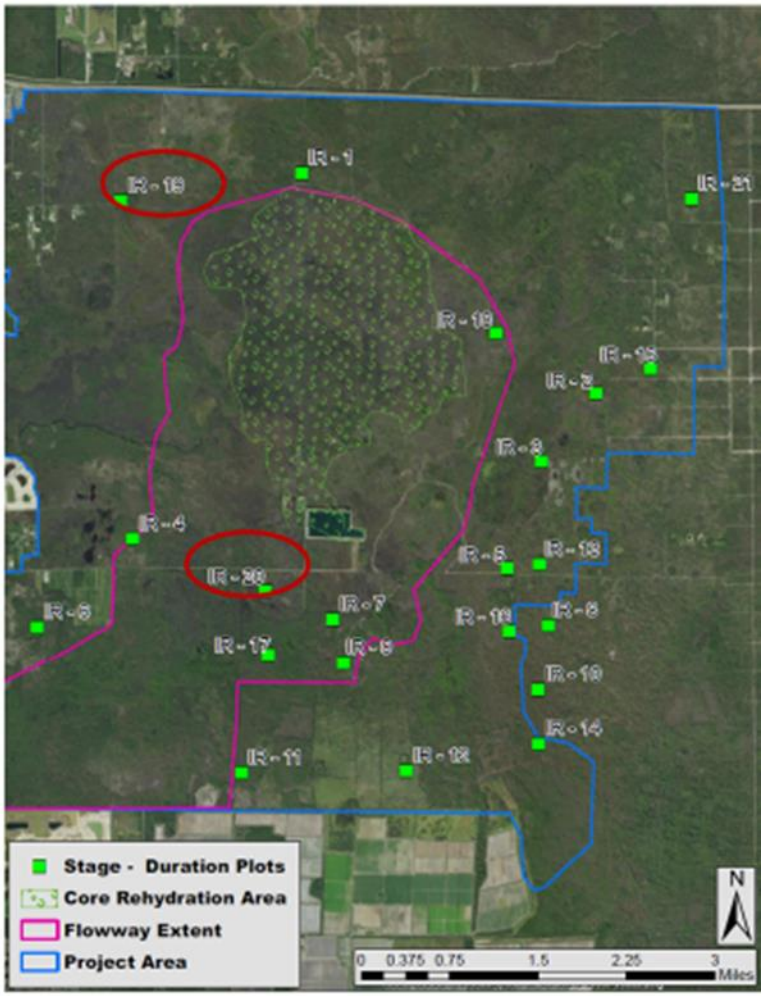
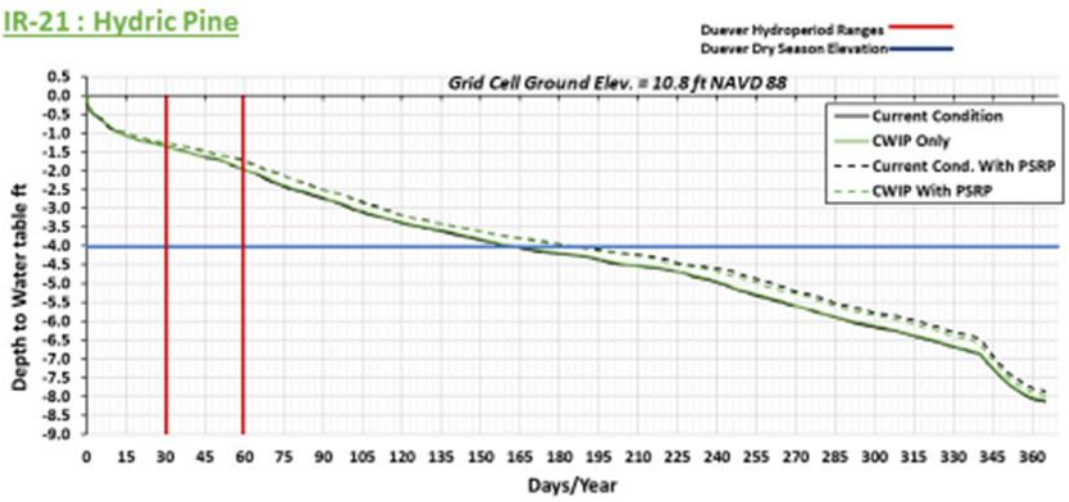


Figure A3-11

Stage Duration Curves – Current Conditions and CWIP



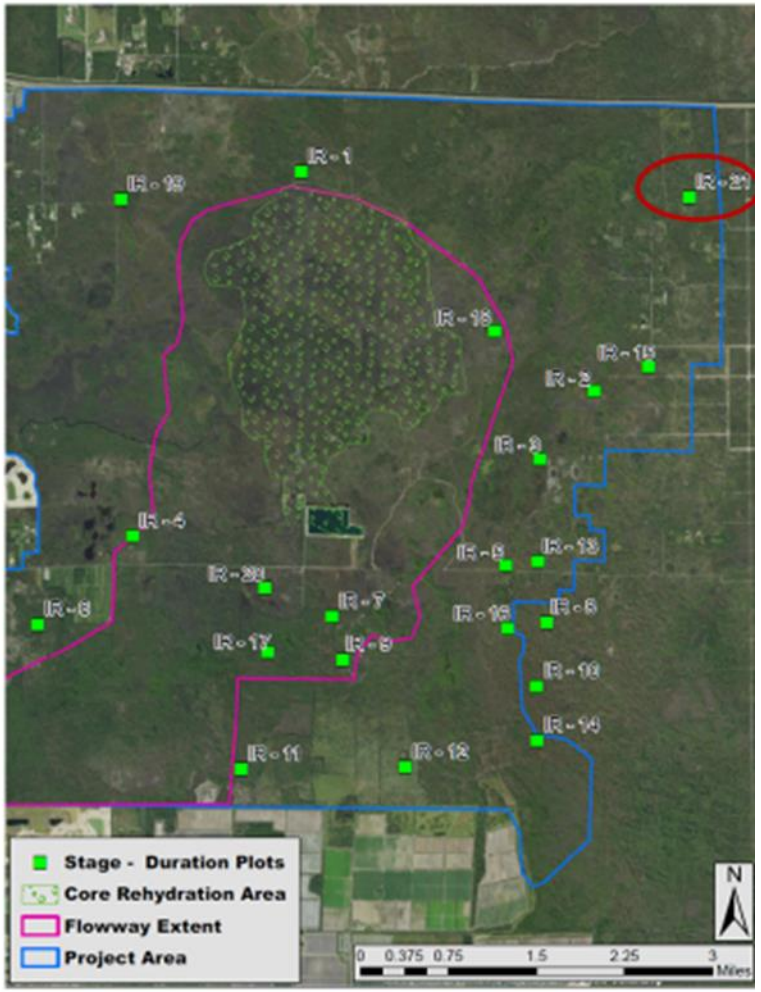


Figure A3-12

APPENDIX 5: WOOD STORK PROGRAMMATIC KEY

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

May 18, 2010

Donnie Kinard
Chief, Regulatory Division
Jacksonville District Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Service Federal Activity Code: 41420-2007-FA-1494
Service Consultation Code: 41420-2007-I-0964
Subject: South Florida Programmatic Concurrence
Species: Wood Stork

Dear Mr. Kinard:

This letter addresses minor errors identified in our January 25, 2010, wood stork key and as such, supplants the previous key. The key criteria and wood stork biomass foraging assessment methodology have not been affected by these minor revisions.

The Fish and Wildlife Service's (Service) South Florida Ecological Services Office (SFESO) and the U.S. Army Corps of Engineers Jacksonville District (Corps) have been working together to streamline the consultation process for federally listed species associated with the Corps' wetland permitting program. The Service provided letters to the Corps dated March 23, 2007, and October 18, 2007, in response to a request for a multi-county programmatic concurrence with a criteria-based determination of "may affect, not likely to adversely affect" (NLAA) for the threatened eastern indigo snake (*Drymarchon corais couperi*) and the endangered wood stork (*Mycteria americana*) for projects involving freshwater wetland impacts within specified Florida counties. In our letters, we provided effect determination keys for these two federally listed species, with specific criteria for the Service to concur with a determination of NLAA.

The Service has revisited these keys recently and believes new information provides cause to revise these keys. Specifically, the new information relates to foraging efficiencies and prey base assessments for the wood stork and permitting requirements for the eastern indigo snake. This letter addresses the wood stork key and is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The eastern indigo snake key will be provided in a separate letter.

Wood stork

Habitat

The wood stork is primarily associated with freshwater and estuarine habitats that are used for nesting, roosting, and foraging. Wood storks typically construct their nests in medium to tall

trees that occur in stands located either in swamps or on islands surrounded by relatively broad expanses of open water (Ogden 1991, 1996; Rodgers et al. 1996). Successful colonies are those that have limited human disturbance and low exposure to land-based predators. Nesting colonies protected from land-based predators are characterized as those surrounded by large expanses of open water or where the nest trees are inundated at the onset of nesting and remain inundated throughout most of the breeding cycle. These colonies have water depths between 0.9 and 1.5 meters (3 and 5 feet) during the breeding season.

Successful nesting generally involves combinations of average or above-average rainfall during the summer rainy season and an absence of unusually rainy or cold weather during the winter-spring breeding season (Kahl 1964; Rodgers et al. 1987). This pattern produces widespread and prolonged flooding of summer marshes, which maximize production of freshwater fishes, followed by steady drying that concentrate fish during the season when storks nest (Kahl 1964). Successful nesting colonies are those that have a large number of foraging sites. To maintain a wide range of foraging sites, a variety of wetland types should be present, with both short and long hydroperiods. The Service (1999) describes a short hydroperiod as a 1 to 5-month wet/dry cycle, and a long hydroperiod as greater than 5 months. During the wet season, wood storks generally feed in the shallow water of the short-hydroperiod wetlands and in coastal habitats during low tide. During the dry season, foraging shifts to longer hydroperiod interior wetlands as they progressively dry-down (though usually retaining some surface water throughout the dry season).

Wood storks occur in a wide variety of wetland habitats. Typical foraging sites for the wood stork include freshwater marshes and stock ponds, shallow, seasonally flooded roadside and agricultural ditches, narrow tidal creeks and shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Because of their specialized feeding behavior, wood storks forage most effectively in shallow-water areas with highly concentrated prey. Through tactolocation, or grope feeding, wood storks in south Florida feed almost exclusively on fish between 2 and 25 centimeters [cm] (1 and 10 inches) in length (Ogden et al. 1976). Good foraging conditions are characterized by water that is relatively calm, uncluttered by dense thickets of aquatic vegetation, and having a water depth between 5 and 38 cm (5 and 15 inches) deep, although wood storks may forage in other wetlands. Ideally, preferred foraging wetlands would include a mosaic of emergent and shallow open-water areas. The emergent component provides nursery habitat for small fish, frogs, and other aquatic prey and the shallow, open-water areas provide sites for concentration of the prey during seasonal dry-down of the wetland.

Conservation Measures

The Service routinely concurs with the Corps' "may affect, not likely to adversely affect" determination for individual project effects to the wood stork when project effects are insignificant due to scope or location, or if assurances are given that wetland impacts have been avoided, minimized, and adequately compensated such that there is no net loss in foraging potential. We utilize our *Habitat Management Guidelines for the Wood Stork in the Southeast Region* (Service 1990) (Enclosure 1) (HMG) in project evaluation. The HMG is currently under review and once final will replace the enclosed HMG. There is no designated critical habitat for the wood stork.

The SFESO recognizes a 29.9 kilometer [km] (18.6-mile) core foraging area (CFA) around all known wood stork colonies in south Florida. Enclosure 2 (to be updated as necessary) provides locations of colonies and their CFAs in south Florida that have been documented as active within the last 10 years. The Service believes loss of suitable wetlands within these CFAs may reduce foraging opportunities for the wood stork. To minimize adverse effects to the wood stork, we recommend compensation be provided for impacts to foraging habitat. The compensation should consider wetland type, location, function, and value (hydrology, vegetation, prey utilization) to ensure that wetland functions lost due to the project are adequately offset. Wetlands offered as compensation should be of the same hydroperiod and located within the CFAs of the affected wood stork colonies. The Service may accept, under special circumstances, wetland compensation located outside the CFAs of the affected wood stork nesting colonies. On occasion, wetland credits purchased from a "Service Approved" mitigation bank located outside the CFAs could be acceptable to the Service, depending on location of impacted wetlands relative to the permitted service area of the bank, and whether or not the bank has wetlands having the same hydroperiod as the impacted wetland.

In an effort to reduce correspondence in effect determinations and responses, the Service is providing the Wood Stork Effect Determination Key below. If the use of this key results in a Corps determination of "no effect" for a particular project, the Service supports this determination. If the use of this Key results in a determination of NLAA, the Service concurs with this determination[1]. This Key is subject to revisitation as the Corps and Service deem necessary.

The Key is as follows:

A. Project within 0.76 km (0.47 mile)[2] of an active colony site[3] ..... "*may affect*[4]"

Project impacts Suitable Foraging Habitat (SFH)[5] at a location greater than 0.76 km (0.47 mile) from a colony site..... ..... "*go to* B"

[1] With an outcome of "no effect" or "NLAA" as outlined in this key, and the project has less than 20.2 hectares (50 acres) of wetland impacts, the requirements of section 7 of the Act are fulfilled for the wood stork and no further action is required. For projects with greater than 20.2 hectares (50 acres) of wetland impacts, written concurrence of NLAA from the Service is necessary.

[2] Within the secondary zone (the average distance from the border of a colony to the limits of the secondary zone is 0.76 km (2,500 feet, or 0.47 mi).

[3] An active colony is defined as a colony that is currently being used for nesting by wood storks or has historically over the last 10 years been used for nesting by wood storks.

[4] Consultation may be concluded informally or formally depending on project impacts.

[5] Suitable foraging habitat (SFH) includes wetlands that typically have shallow-open water areas that are relatively calm and have a permanent or seasonal water depth between 5 to 38 cm (2 to 15 inches) deep. Other shallow non-wetland water bodies are also SFH. SFH supports and concentrates, or is capable of supporting and concentrating small fish, frogs, and other aquatic prey. Examples of SFH include, but are not limited to freshwater marshes, small ponds, shallow, seasonally flooded roadside or agricultural ditches, seasonally flooded pastures, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs.

Project does not affect SFH..... *"no effect[1]"*.

B. Project impact to SFH is less than 0.20 hectare (one-half acre)[6].....*NLAA[1]"*

Project impact to SFH is greater in scope than 0.20 hectare (one-half acre)..... *go to* C

C. Project impacts to SFH not within the CFA (29.9 km, 18.6 miles) of a colony site .....*go to* D

Project impacts to SFH within the CFA of a colony site .....*go to* E

D. Project impacts to SFH have been avoided and minimized to the extent practicable; compensation (Service approved mitigation bank or as provided in accordance with Mitigation Rule 33 CFR Part 332) for unavoidable impacts is proposed in accordance with the CWA section 404(b)(1) guidelines; and habitat compensation replaces the foraging value matching the hydroperiod[7] of the wetlands affected and provides foraging value similar to, or higher than, that of impacted wetlands. See Enclosure 3 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[8]..... *NLAA[1]"*

Project not as above..... *"may affect[4]"*

E. Project provides SFH compensation in accordance with the CWA section 404(b)(1) guidelines and is not contrary to the HMG; habitat compensation is within the appropriate CFA or within the service area of a Service-approved mitigation bank; and habitat compensation replaces foraging value, consisting of wetland enhancement or restoration matching the hydroperiod[7] of the wetlands affected, and provides foraging value similar

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[6] On an individual basis, SFH impacts to wetlands less than 0.20 hectare (one-half acre) generally will not have a measurable effect on wood storks, although we request that the Corps require mitigation for these losses when appropriate. Wood storks are a wide ranging species, and individually, habitat change from impacts to SFH less than one-half acre are not likely to adversely affect wood storks. However, collectively they may have an effect and therefore regular monitoring and reporting of these effects are important.

[7] Several researchers (Flemming et al. 1994; Ceilley and Bortone 2000) believe that the short hydroperiod wetlands provide a more important pre-nesting foraging food source and a greater early nestling survivor value for wood storks than the foraging base (grams of fish per square meter) than long hydroperiod wetlands provide. Although the short hydroperiod wetlands may provide less fish, these prey bases historically were more extensive and met the foraging needs of the pre-nesting storks and the early-age nestlings. Nest productivity may suffer as a result of the loss of short hydroperiod wetlands. We believe that most wetland fill and excavation impacts permitted in south Florida are in short hydroperiod wetlands. Therefore, we believe that it is especially important that impacts to these short hydroperiod wetlands within CFAs are avoided, minimized, and compensated for by enhancement/restoration of short hydroperiod wetlands.

[8] For this Key, the Service requires an analysis of foraging prey base losses and enhancements from the proposed action as shown in the examples in Enclosure 3 for projects with greater than 2.02 hectares (5 acres) of wetland impacts. For projects with less than 2.02 hectares (5 acres) of wetland impacts, an individual foraging prey base analysis is not necessary although type for type wetland compensation is still a requirement of the Key.

to, or higher than, that of impacted wetlands. See Enclosure 3 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[8].....*"NLAA[1]"*

Project does not satisfy these elements .....*"may affect[4]"*

This Key does not apply to Comprehensive Everglades Restoration Plan projects, as they will require project-specific consultations with the Service.

Monitoring and Reporting Effects

For the Service to monitor cumulative effects, it is important for the Corps to monitor the number of permits and provide information to the Service regarding the number of permits issued where the effect determination was: "may affect, not likely to adversely affect." We request that the Corps send us an annual summary consisting of: project dates, Corps identification numbers, project acreages, project wetland acreages, and project locations in latitude and longitude in decimal degrees.

Thank you for your cooperation and effort in protecting federally listed species. If you have any questions, please contact Allen Webb at extension 246.

Sincerely yours,

Paul Souza
Field Supervisor
South Florida Ecological Services Office

Enclosures

cc: w/enclosures (electronic only)
Corps, Jacksonville, Florida (Stu Santos)
EPA, West Palm Beach, Florida (Richard Harvey)
FWC, Vero Beach, Florida (Joe Walsh)
Service, Jacksonville, Florida (Billy Brooks)