CHNEP Habitat Restoration Needs Plan (HRN) Phase II Report Addendum for the CHNEP Expansion Area

CALOOSAHATCHEE SUNSET. Aerial image looking west over the Caloosahatchee River at sunset. The Caloosahatchee flows through a region rich in agricultural production and heritage. This waterway has been a major barrier against northern migration for the Florida panther population. Male panthers have been swimming across the river for decades, but no female panthers were documented north of the Caloosahatchee between 1973 to 2016. Since November 2016, two female Florida panthers have been captured on game cameras north of the Caloosahatchee, giving hope for the recovery of the species into its northern range. September 2018. © Carlton Ward Jr.

Revised Draft October 2020

Prepared by Environmental Science Associates

TABLE OF CONTENTS

List of Tables

List of Figures

SECTION 1
Introduction

1.1 Background

The Coastal and Heartland National Estuary Program (CHNEP) developed the first phase of a Habitat Restoration Needs (HRN) plan to protect Central and Southwest Florida's water and wildlife, through habitat restoration, conservation, and effective management. The HRN plan articulates CHNEP's habitat restoration vision for the next 50 years as "a diverse environment of interconnected, healthy habitats that support natural processes and viable, resilient native plant and animal communities." The objective of the HRN plan is to provide guidance towards permanent acquisition, connection, protection, restoration, and management of natural terrestrial and aquatic habitats. The strategy is to promote and facilitate permanent acquisition and effective protection and management of critical natural habitats including wildlife dispersal areas, movement and habitat migration corridors, wetlands, flow ways; as well as environmentally sensitive lands and estuarine habitats. Habitat threats include construction of transportation corridors and new development, climate change and sea level rise, excessive consumptive water use, and water quality degradation.

The results of the HRN plan identified and quantified, by major habitat type, priority areas for:

- Existing targets for Management, Enhancement, and Restoration
- Potential opportunities for Preservation/Conservation and Reservation

The two main goals of the HRN are to identify 1) targets for where habitats can be enhanced or restored on existing protected lands and 2) opportunities for future protection.

The first phase of the HRN accomplished these goals for the main CHNEP area. However, to effectively address the problems in the Caloosahatchee River, and meet the goal of restoring the Caloosahatchee estuary, CHNEP expanded its boundaries in 2019 after the first phase of the HRN. This "expansion area" encompassed freshwater portions of the Caloosahatchee basin up to Lake Okeechobee in Glades and Hendry counties. This project expands the methodology of HRN Phase I to develop HRN outputs for the CHNEP expansion area.

1.2 Purpose

The purpose of this HRN addendum (Phase II) is to guide habitat preservation/conservation, reservation, and restoration efforts throughout the CHNEP expansion area, refine the CHNEP habitat restoration vision for the next 50 years, and define the habitat restoration goals for the

next 20 years. It also specifically identifies and quantifies habitat preservation/conservation and reservation opportunities and management/enhancement and restoration targets throughout the CHNEP area needed to reach the HRN vision and goals.

In addition to habitat protection, the goals, opportunities, and targets developed in this Plan can have a positive impact supporting, protecting, managing, and restoring water quality/quantity and natural systems. The information contained in this report helps to guide the CHNEP and its partners and stakeholders in implementing the CHNEP Comprehensive Conservation and Management Plan (CCMP) and other regional planning efforts including the South Florida Water Management (SFWMD) Caloosahatchee River Watershed Protection Plan. Additionally, information in this report can be used by local public and private land conservation and management entities to assist in their efforts to conserve connected priority habitats needed to conserve water and wildlife resources in their communities.

1.3 CHNEP Habitat Restoration Vision and Goals

The habitat restoration goals were developed to support the CHNEP Restoration Vision that was developed in collaboration with the CHNEP Management Conference:

> ***Vision: A diverse environment of interconnected, healthy habitats that support natural processes and viable, resilient native plant and animal communities.***

The following goals were developed using the Additive Hybrid Approach (AHA) methodology. These goals were used to develop the opportunities and targets discussed in later sections of this report.

- Management/Enhancement Areas:
  - Maintain or enhance the currently protected coastal and inland habitats to increase ecosystem functionality.
  - Manage or enhance native habitats within 100-year floodplains to allow for habitat migration.
- Preservation/Conservation Areas:
  - Increase preservation/conservation lands and conservation easements wherever feasible.
  - Identify opportunities in the 100-year floodplains and other identified wildlife corridors for facilitating habitat migration.
  - Focus HRN opportunities to be contiguous and adjacent to other existing conservation lands.
  - Work with willing landowners to increase or enhance preservation/conservation lands.

- Restoration Areas:
  - Restore publically-owned or private lands under conservation easement that contain non-native habitats, including those within 100-year floodplains to increase native habitat areas.

Areas of existing development were excluded from this analysis though there could potentially be opportunities to enhance existing development areas (e.g., living shorelines along seawalls to increase habitat, rain gardens along sidewalks and roadways for stormwater attenuation and treatment).

Public engagement is a major component of the CCMP, as an informed and engaged public are critical to making decisions and taking actions that increase the protection and restoration of estuaries and watersheds. More specifically, CHNEP seeks to promote environmental literacy, awareness, and stewardship. The HRN plan is an excellent vehicle for advancing the Fish, Wildlife and Habitat Protection is CCMP objective, as outputs are educational when accessible to the public. The CHNEP Water Atlas website consolidates environmental data for the program, as well as many others, and provides a great platform for engaging a wide variety of people. An additional objective for this study scope is to publish the results to publicly accessible platforms such as the CHNEP Water Atlas.

1.4 CHNEP Expansion Study Area

The CHNEP planning area currently encompasses 5,670 square miles (3,628,300 acres) in Central and Southwest Florida including all or parts of seven counties (**Figure 1**). Approximately 10% of this area is open bays, 33% is within the South Florida Water Management (SFWMD) jurisdiction, and 57% is within the Southwest Florida Water Management District (SWFWMD) jurisdiction. The CHNEP boundary is composed of eight main watersheds: Dona and Roberts Bays, Lemon Bay, Peace River, Myakka River, Charlotte Harbor, Caloosahatchee River, Pine Island/Matlacha Pass, and Estero Bay.

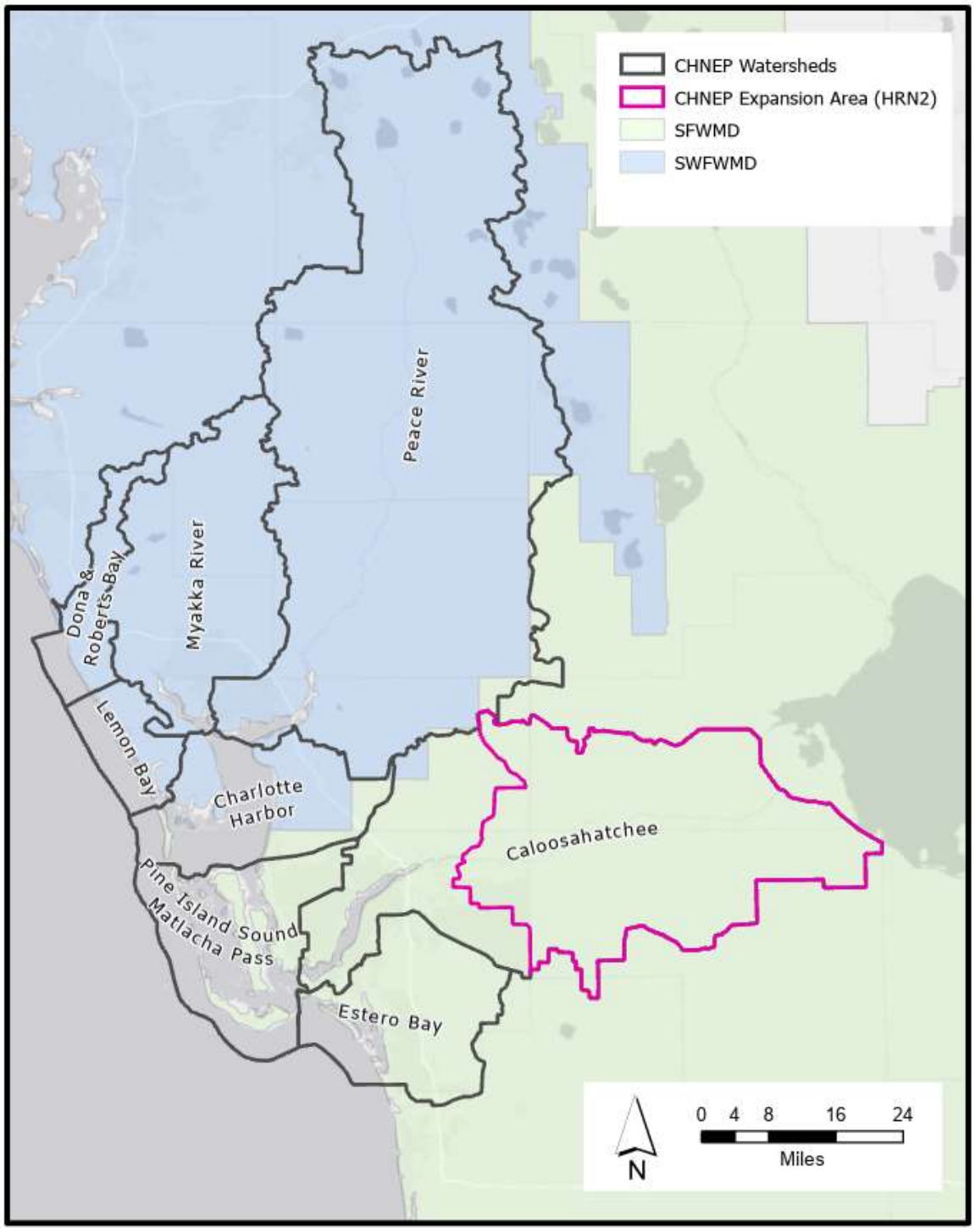

Figure 1
Map of the CHNEP service area watersheds and basins, including the expansion area symbolized in magenta with water management district boundaries

In 2019, CHNEP expanded its service area (CHNEP expansion area) to encompass the 946 square mile (605,615 acres) freshwater basin of the Caloosahatchee River from the current Tidal Caloosahatchee boundary at the Franklin Lock in Lee County, upstream to Lake Okeechobee. The entirety of this expansion area is within SFWMD boundaries, and almost all of this area in within Glades and Hendry Counties. There are small portions within Lee and Charlotte Counties. This expansion will increase the effectiveness of the CHNEP in being able to meet the goal of restoring the Caloosahatchee Estuary by addressing hydrologic and water quality problems in the freshwater Caloosahatchee Watershed.

The analyses presented in Phase II of the HRN focus on identifying opportunities for land preservation/conservation or reservation and setting targets for conducting land management/ enhancement or restoration within two spatial strata: freshwater Caloosahatchee River floodplains and freshwater Caloosahatchee River uplands. The analyses excluded developed areas and other areas that did not have identified habitat value for the purposes of this project (e.g. open waters). Priority areas were identified by local state and federal agencies, the CHNEP Management Conference member organizations, and other private land acquisition or governmental organizations.

1.5 Habitat Categories

Habitats within the CHNEP were identified using the SFWMD Land Cover Land Use datasets for 1999, 2009, and 2016. This system groups habitats with similar characteristics and assigns them a unique identifier code known as the Florida Land Use and Land Cover Classification System or FLUCCS code. FLUCCS codes are a hierarchical classification system with level 1 as general classifications (e.g. water, wetlands, development) and level 4 as specific classifications (e.g., sawgrass, shopping centers, wet melaleuca). To meet the purpose of this project, habitat types were grouped into native, non-native, and existing development categories based on level 4 FLUCCS classifications (**Tables 1 through 3**).

TABLE 1
NATIVE HABITAT LAND USE/LAND COVER CLASSIFICATIONS

Primary Classification	Secondary Classifications	FLUCCS Codes
Freshwater Wetland Habitats		
Wetland Hardwood Forests	N/A	6100
	Bay Swamps	6110
	Stream and Lake Swamps	6150
	Mixed Wetland Hardwoods	6170
	Mixed Shrubs	6172
	Willow and Elderberry	6180
Wetland Coniferous Forests	N/A	6200
	Cypress	6210
	Cypress Domes/Heads	6215
	Cypress Mixed Hardwoods	6216
	Cypress/Pine/Cabbage Palm	6240
	Hydric Pine Flatwoods	6250
Wetland Forested Mixed	N/A	6300
Vegetated Non-Forested Wetlands	Freshwater Marshes	6410
	Sawgrass	6411
	Wet Prairies	6430
	Emergent Aquatic Vegetation	6440
Upland Habitats		
Dry Prairie	N/A	3100
Shrub and Brushland	N/A	3200
	Palmetto Prairies	3210
	Coastal Scrub	3220
Mixed Rangeland	N/A	3300
Upland Coniferous Forests	N/A	4100
	Pine Flatwoods	4110
	Longleaf Pine	4120
	Sand Pine Scrub	4130
Upland Hardwood Forests	N/A	4200/4300
	Live Oak	4270
	Oak/Cabbage Palm	4271
	Cabbage Palm	4280
	Hardwood/Conifer Mixed	4340

TABLE 2
NON-NATIVE (POTENTIALLY RESTORABLE) LAND USE/LAND COVER CLASSIFICATIONS

Primary Classification	Secondary Classifications	FLUCCS Codes
Extractive	N/A	1600
	Strip Mines	1610
	Sand and Gravel Pits	1620
	Rock Quarries	1630
	Reclaimed Land	1650
	Holding Ponds	1660
Institutional	N/A	1700
	Educational	1710
Recreational	N/A	1800
	Golf Courses	1820
	Marinas and Fish Camps	1840
	Parks and Zoos	1850
Open Land	N/A	1900
Cropland and Pastureland	N/A	2100
	Improved Pastures	2110
	Unimproved Pastures	2120
	Row Crops	2140
	Field Crops	2150
Tree Crops	N/A	2200
	Citrus Groves	2210
	Other Groves	2230
	Abandoned Groves	2240
Feeding Operations	N/A	2300
Nurseries and Vineyards	N/A	2400
	Tree Nurseries	2410
	Sod Farms	2420
	Ornamentals	2430
Specialty Farms	N/A	2500
	Horse Farms	2510
	Dairies	2520
	Aquaculture	2540
	Tropical Fish Farms	2550
Other Open Lands	N/A	2600
Exotic Species	Brazilian Pepper	4220
	Melaleuca	4240
	Australian Pine	4370
	Wet Melaleuca	6191
Reservoirs (< 1 acres)	N/A	5300
Disturbed Lands	N/A	7400
Disturbed Lands	Borrow Areas	7420
Utilities	Spoil Areas	7430
	N/A	8300
Utilities	Treatment Ponds	8360

TABLE 3
EXISTING DEVELOPMENT AND NOT APPLICABLE LAND USE/LAND COVER CLASSIFICATIONS

Primary Classification	Secondary Classifications	FLUCCS Codes
Residential, Low Density	N/A	1100
	Fixed Single Family Units	1110
	Mobile Home Units	1120
	Mixed Units	1130
	Low Density Under Construction	1140
Residential, Medium Density	N/A	1200
	Fixed Single Family Units	1210
	Mobile Home Units	1220
	Mixed Units	1230
	Medium Density Under Construction	1290
Residential, High Density	N/A	1300
	Fixed Single Family Units	1310
	Mobile Home Units	1320
	Mixed Units	1330
	High Density Under Construction	1390
Commercial and Services	N/A	1400
	Retail Sales and Service	1410
	Shopping Centers	1411
	Junk Yards	1423
	Cemeteries	1480
	Commercial Under Construction	1490
Industrial	N/A	1500
	Oil and Gas Processing	1540
	Other Light Industrial	1550
Recreational	N/A	1800
	Stadiums	1870
Water	Natural Waterways	5110
	Channelized Waterway	5120
	Lakes	5200
	Reservoirs	5300
Transportation	N/A	8100
	Airports	8110
	Private	8113
Transportation Communications Utilities	Grass Airports	8115
	Railroads	8120
	Roads and Highways	8140
	N/A	8200
	N/A	8300
	Electric Power Facilities	8310
Communications	Electric Power Transmission Lines	8320
Utilities	Water Supply Plants	8330
	Sewage Treatment	8340
	Solid Waste Disposal	8350

1.6 Definitions

Throughout this document, several acronyms are used, for which the definitions are provided in the table below.

Acronym	Definition
AHA	Additive Hybrid Approach
BMPs	Best Management Practices
CCMP	Comprehensive Conservation and Management Plan
CHNEP	Coastal & Heartland National Estuary Partnership (formerly known as the Charlotte Harbor National Estuary Program).
CLIP	Critical Lands and Waters Identification Project
CREW	Corkscrew Regional Ecosystem Watershed
ESA	Environmental Science Associates
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FWC	Florida Fish and Wildlife Conservation Commission
FLUCCS	Florida Land Use Land Cover Classification System
GIS	Geographic Information System
HEM	Habitat Evolution Model
HRCC	Habitat Resiliency to Climate Change
HRN	Habitat Restoration Needs
IHN	Integrated Habitat Network
LCD	Landscape Conservation Design
LID	Low Impact Development
LiDAR	Light Detection and Ranging
MET	Management/Enhancement Targets
MFLs	Minimum Flows and Levels
MHHW	Mean Higher High Water
MLW	Mean Low Water
N/A	Not Applicable
NAVD88	North American Vertical Datum of 1998
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
PCO	Preservation/Conservation Opportunities
RT	Restoration Targets
SFWMD	South Florida Water Management District
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement and Management

USFWS	US Fish and Wildlife Service

This page intentionally left blank

SECTION 2
Methods

2.1 Habitat Status and Trends

The current status of major habitats helps to establish current benchmarks of habitat acreages and spatial distributions. Trend analyses reveal habitats with significant change. Significant habitat change either prompts further investigation or identifies the need for conservation and management actions. Important considerations for interpreting spatial temporal trend analyses are the consistencies among the various mapping and classification procedures and dataset products used in the analyses.

A change analysis was completed for the CHNEP Expansion Area basin using the best available land use and land cover data. A conscious effort was made to remain consistent with the data sources used in previous mapping analyses for the entire CHNEP service area. These efforts used FLUCCS datasets stewarded by FDEP, SWFWMD, and SFWMD for mapped areas within their boundaries. The expansion area boundaries lay entirely within the SFWMD boundaries, therefore the SFWMD FLUCCS datasets were used for this task. The following datasets were accessible from the SFWMD Open GIS portal:

- 1999 land use and land cover: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd-land-cover-land-use-1999
- 2009 land use and land cover: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd-land-cover-land-use-2008-2009
- 2016 land use and land cover: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd-land-cover-land-use-2014-2016

The current analysis was performed using standard GIS methods such as clipping (extracting data spatially to the study area); reclassification (FLUCCS codes referenced to HRN roll up habitat classes); geometry calculation (acreages); and summarization (area statistics). All input data, intermediate data, and result data, including the scripted workflow are stored in a documented ArcGIS file geodatabase (.gdb), accessible with an ArcGIS Pro 2.x project (.aprx) that includes symbology, layouts, and table joins. The database and ArcGIS Pro project are included.

An important consideration in this analysis was differentiating the land use from the land cover attributes. Land cover generally classifies the landscape by the dominant natural vegetation (or non-vegetated) cover of an area. Land use considers artificial features in the landscape regardless of how dominant they are in an area. For example, there are many areas with a residential land

use and a forested land cover. In contrast to other water management districts (including SWFWMD), the SFWMD land cover and land use data contains Level 4 classifications for both land use and land cover. This requires additional decisions to use the SFWMD data appropriately. An investigation of project notes and derivative products of the HRN Phase 1 revealed that analysis used a combined dataset that incorporated the SWFWMD 1995 and 2011 FLUCCS and the SFWMD 1995 land use and 2009 land cover (as opposed to land use) to characterize the current the current condition. The decisions to use these data in this manner originated from recommendations of the CHNEP management conferences and habitat sub-committee.

2.2 Existing and Proposed Conservation

The coverage and extent of existing and planned preservation/conservation and management/ enhancement/restoration areas in the CHNEP was documented for the expansion area. This information is critical to quantifying opportunities and targets with the additive hybrid model. Relevant online data sources (including sources from HRN Phase I), were assimilated, formatted and documented into the HRN2 project geospatial database. These data were presented to the CHNEP management conference habitat conservation subcommittee for review and finalization before incorporation into the additive hybrid model. Information sources are discussed in sections 2.2.1 and 2.2.2.

2.2.1 Existing Conservation Projects

Florida Natural Areas Inventory

The Florida Natural Areas Inventory (FNAI) is the primary source for information on Florida's conservation lands. The database includes boundaries and statistics for more than 2,500 federal, state, local, and private managed areas, all provided directly by the managing agencies. The database includes lands that FNAI has identified as having natural resource value and that are being managed at least partially for conservation purposes. National parks, state forests, wildlife management areas, local and private preserves are examples of the managed areas included. This dataset is updated quarterly.

The FNAI Florida Conservation Lands (including acquired Florida Forever) datasets can be accessed here: https://fnai04.fnai.org:6443/arcgis/rest/services/ConLands/ .

Glades County Planning and Zoning Division

The Glades County Planning and Zoning Division is housed within the Community Development Department, serves as a facilitator for the general public and elected and appointed officials, and is responsible for assisting customers in complying with the County's Land Development Regulations, the Comprehensive Plan and the other land use regulations. The Division coordinates and assists with the development of and revisions to the Land Development Code and the Comprehensive Plan by processing applications for re-zonings, comprehensive plan amendments, special exceptions, variances, and other miscellaneous permits. The division provides technical data and recommendations for land development proposals to the Board of County Commissioners, Planning and Zoning Commission and the Board of Adjustment. This

includes stewarding the County's Land Development Regulations and Comprehensive Plan which only applies within unincorporated Glades County. Part of the Comprehensive Plan is zoning maps that include areas designated as parks and conservation.

Glades County zoning maps can be accessed here: https://arcg.is/5iSrm

Hendry County Planning and Zoning Department

The Hendry County Planning and Zoning Department similar to Glades County and is led by a Planning and Community Development Director who stewards a Comprehensive Plan that includes elements for Conservation and Economic Development among other topics. The Conservation element documents areas in the County designated with conservation deeds and agricultural conservation.

Hendry County zoning maps can be accessed here: http://arcg.is/1WAefIa

Lee County 20/20 Conservation

Conservation 20/20 is Lee County's environmentally-sensitive land acquisition and management program through which over 30,000 acres of conservation land have been protected in Lee County. This program is stewarded by Lee County Parks & Recreation, County Lands and Natural Resources staff. Besides conserving land, Lee County 20/20 has directly facilitated the successful passing of four ordinances and twelve resolutions. Additionally, there is a citizen advisory committee that meets monthly to:

- Review parcels for purchase consideration
- Make recommendations on negotiations
- Review, comment and recommend land stewardship plans and activities
- Recommend other general management items to the BOCC

Lee County 20/20 Conservation maps can be accessed here: https://leegis.leegov.com/arcgis/rest/services/OpenData/OpenData_Recreation/

SFWMD

The SFWMD developed the comprehensive Caloosahatchee River Watershed Protection Plan in cooperation with the Florida Department of Environmental Protection (FDEP), the Florida Department of Agriculture and Consumer Services (FDACS), other affected counties and municipalities, and a diversity of other stakeholder and public input. One of the first steps in this plan's development process was to inventory existing and planned hydrologic restoration projects to determine the cumulative benefit provided by those initiatives. A key objective includes reducing nutrient loads to meet any adopted Total Maximum Daily Loads (TMDLs). The plan's output is a systematic approach that identifies the best combination of watershed storage and water quality projects needed to help improve the quality, timing and distribution of water in the natural ecosystem. More specifically, the plan includes the Caloosahatchee River (C-43) West Basin Storage Reservoir; best management practices (BMPs) and regulatory programs, regional

water quality projects with an emphasis on nitrogen reduction, additional storage in the freshwater basins and local water quality/quantity projects.

Hydrologic restoration is a very important issue for CHNEP and SFWMD; however the focus of the HRN is habitat restoration, not just hydrologic restoration. While the C-43 project and other BMP projects do not fall into habitat restoration, there are other SFWMD projects that the HRN2 will incorporate.

Lake Hicpochee Hydrologic Enhancement Project

The Lake Hicpochee Hydrologic Enhancement Project (LHHEP) is a shallow water storage and hydrologic through way project that would provide additional storage, enhance ecological function, and aid in reducing nutrient loading into the Caloosahatchee River. The 3,200-acre project is located in eastern Glades County. The 670-acre first phase has been constructed, and the 2,488-acre second phase has been funded and is in project design and permitting.

West Coast Land Assessment

The SFWMD has acquired nearly 1.5 million acres of land to support flood control infrastructure, protect water resources and restore impaired ecosystems. As part of a broad effort to maximize its resources to meet mission-critical responsibilities, the District is conducting a comprehensive land assessment to ensure that each parcel is being put to its most effective use. Completed in September 2013, the first phase of the SFWMD land assessment was a review of fee-owned lands – approximately 750,000 acres in which the agency has full or shared ownership rights. As a result of the assessment process, some properties were recommended for potential exchange or surplus. Following further evaluation by the SFWMD staff, final recommendations on exchange or surplus of these lands are being presented to the Governing Board throughout the year.

2.2.2 Planned Projects

Florida Natural Areas Inventory

The FNAI maintains the boundaries of all current proposed Florida Forever environmental land acquisition projects approved by the State's Acquisition and Restoration Council and administered by the Florida Department of Environmental Protection, Division of State Lands, for the State Board of Trustees (BOT). These lands have been proposed for acquisition because of outstanding natural resources, opportunity for natural resource-based recreation, or historical and archaeological resources. This dataset does not include Florida Forever projects administered by the water management districts or by other state agencies. Note that boundaries of each Florida Forever BOT project are for the entire project, including areas that have already been acquired. The FFBOT data are updated approximately every two to four months.

The FNAI proposed Florida Forever BOT datasets can be accessed here: https://fnai04.fnai.org:6443/arcgis/rest/services/ConLands/

FNAI CLIP priorities 1, 2 and 3

The FNAI published the Critical Lands and Waters Identification Project (CLIP) version 4.0 in collaboration with the University of Florida Center for Landscape Conservation Planning, and Florida Fish and Wildlife Conservation Commission (Oetting et al., 2016). CLIP is a GIS database of statewide conservation priorities for a broad range of natural resources, including biodiversity, landscape function, surface water, groundwater, and marine resources. Many of the natural resource data layers included in CLIP were derived from the Florida Forever Conservation Needs Assessment developed by FNAI to support the Florida Forever environmental lands acquisition program. CLIP is also being used to inform the Cooperative Conservation Blueprint, a statewide conservation planning effort led by the Florida Fish and Wildlife Conservation Commission. The Blueprint is a key action called for in the FWC Wildlife Legacy Initiative.

The FNAI website provides public access to the CLIP 4.0 GIS database, that integrates nine core GIS data layers that are combined under three resource categories: Biodiversity; Landscapes; and Surface Water. Figure below shows the core data layers integrated under the three resource categories. This information represents the most comprehensive compilation and integrated analysis of Florida-specific geospatial natural resource data, and can be reliably used to identify critical lands and waters in priority need of protection in any Florida watershed.

Figure 2
CLIP Version 4.0 Database Hierarchy (Oetting et al., 2016)

For the purposes of the HRN, the core data layers included in the Aggregated CLIP model were used to identify proposed conservation lands. Five priority levels are distinguished in the Aggregated CLIP Model, with Priority 1 capturing the highest priority areas, and Priority 5 capturing the lowest priority areas. The Aggregated CLIP Model integrates priorities based on: maintenance of biodiversity; landscape integrity and contiguity; and surface water protection and management. Priority areas identified by the Aggregated CLIP Model represent the best professional judgement of state natural resource management agencies and associated academic experts.

Geospatial data for priority levels 1 through 3 in the Aggregated CLIP Model were used to identify proposed conservation lands for the HRN2. A detailed review of the areas captured under these priority levels indicated a reasonable subset of the most sensitive and critical native and potentially restorable habitats while allowing for anticipated human population growth and development in the region.

The FNAI CLIP datasets can be accessed here: https://fnai04.fnai.org:6443/arcgis/rest/services/CLIP

USFWS Florida Panther Focus Area

The U.S. Fish and Wildlife Service (USFWS) has worked for decades identifying suitable sites for Florida panther reintroduction. Their efforts have been concentrated in south-central Florida, and specifically in the Caloosahatchee Watershed where the expansion of panther habitat north of the Caloosahatchee River is possible. Under the current Recovery Plan, established in 2008, the USFWS will consider delisting the panther when three populations of at least 240 individuals each (excluding dependent-aged kittens) have been established, and sufficient habitat to support these populations is secured in the long-term. These recovery goals cannot succeed without establishing additional populations outside of southern Florida and this will require support from private landowners. Subsequently, many organizations (both private and public) have been engaged in the issues associated with re-introduction such as the population biology, landscape ecology, and education to facilitate public acceptance of panthers in their communities. Much work was published by the Nature Conservancy of Florida panther program, which has conserved many acres critical to panther reintroduction in the Caloosahatchee Watershed (https://www.nature.org/en-us/about-us/where-we-work/united-states/florida/stories-in-florida/save-the-florida-panther/).

Research has shown that male panthers from the south Florida population have migrated to south-central Florida, but an absence of females has inhibited expansion of the breeding population into this area. The primary considerations to expanding the breeding population of panthers into south-central Florida are determining whether suitable habitat exists, whether people there will accept panthers, if there are sufficient panther numbers in the age and sex classes necessary for expansion, and methods for expanding the population. Studies by Thatcher et al. (2006) evaluated habitats in south-central Florida and identified areas that might provide favorable habitat conditions. Even though some suitable panther habitat remains in this region, it occurs in widely scattered and relatively small patches fragmented by major highways and agricultural and urban development. The Dispersal Zone requires protection from development to provide a corridor to facilitate dispersal from south Florida to potentially suitable habitat north of the Caloosahatchee River. Maintaining connectivity is important; not only to facilitate dispersal, but also to enhance population exchange once female panthers reestablish in south-central Florida. Given the limited dispersal rates of female panthers and the present lack of suitable habitat conditions in the Dispersal Zone, it is likely that human intervention will be required to establish females north of the Caloosahatchee River.

The FWS Panther Focus Area geospatial dataset helps inform community development of conflict with panther reintroduction. If a project occurs within the focus area, impacts to the Florida Panther should be assessed and consultation with the US Fish and Wildlife Service should be initiated.

The USFWS Panther Focus Areas dataset can be accessed via the Florida Geographic Data Library here: https://www.fgdl.org/metadataexplorer/full_metadata.jsp?docId=%7BE072A782-1B15-4AAE-A79B-36F67FCB9BCB%7D&loggedIn

Hendry County Planning and Zoning Department

The Hendry County Comprehensive Plan has a Future Land Use (FLU) element that includes a category identified as Agriculture/Conservation. This Future Land Use Category is to designate areas within Hendry County that will continue in a rural and/or agricultural state through the planning horizon of 2040 and may contain jurisdictional wetlands. These designations are also informed by a 2009 Comprehensive Pathway Plan that identifies enhanced connectivity within the County with regards to future land use including conservation areas.

The Hendry County Future Land Use map can be accessed here: https://www.hendryfla.net/docs/FLU%20DISTRICT%20Map.pdf

Army Corps of Engineers Oxbow Restoration

River Oxbows are U-shaped water bodies on each side of the river channel, remnant bends of the original river. There are thirty-seven oxbows on Caloosahatchee River between Franklin Lock and the City of LaBelle. Landscape research has shown that oxbows have ecological significance, including habitat, educational, historical, and recreational value. The U.S. Army Corps of Engineers (USACE) developed a project to conserve and restore the oxbows on the Caloosahatchee River.

Oxbow restoration data were provided by Corey Anderson of the Florida Fish and Wildlife Conservation Commission, via personal communication.

2.3 Climate Change

The purpose of the climate change analysis portion of this effort is to understand and model how climate change may alter future hydrological conditions, which, in turn, may influence non-tidally connected habitats targeted for restoration. ESA partnered with landscape ecohydrology experts, Coshow Environmental Inc. (CEI), to complete the following objectives:

- Define key influencing factors driving the distribution of HRN habitats (Task 1 classifications) in the non-tidal Caloosahatchee watershed;
- Identify the best available geospatial datasets (including surrogates) that characterize these factors; and
- Determine how these factors may be altered from projected changes in climate (year 2070) as modeled by the latest IPCC report.

ESA found the several key influencing factors that will be altered due to climate change as scientific knowledge base and background to this study. Key influencing factors include

A) Sea Level Rise: Increased chlorides due to salt water intrusion from rising sea levels have not been found to be a factor in this watershed. The W.P. Franklin Lock and Dam were designed by the U.S. Army Corps of Engineers to prevent saltwater intrusion. There is no evidence that this design is failing as no increased chlorides or halophytic vegetation have been documented above the lock and dam. SFWMD modeled the current position of the 250 mg/l isochlor and it does not extend above the structure (https://www.sfwmd.gov/sites/default/files/documents/lee_wta_isochlor_2009.pdf).

B) Drying: While event-driven precipitation amounts fluctuate by 10% above and below normal averages, the constant evapotranspiration (ET) in the year 2060 is projected to increase by 7% (Carter et al. 2014, Flower et al 2017, Flower et al. 2019). Because ET is a constant climatic factor, the volumes of water associated with rates of ET exceed those of precipitation. This results in a decrease in effective precipitation and resulting decreases in groundwater levels (which are projected to be much lower by 2060). Additionally, a drier climate will inevitably lead to increased groundwater withdrawal for agricultural and potable supply. Groundwater withdrawal demands are not fully modeled in SFWMD, nor are the impacts to groundwater from increased demands. Therefore, this will be a difficult factor to support with certainty in this analysis.

C) Habitat migration: The classification and mapping of habitats at the scale modeled in the HRN have upper and lower bounds for depths to groundwater. This has been well documented by Rains et al. (2004, 2013), Hammersmark et al. (2010), and Nilsson et al. (2013). When not prevented by hard infrastructure or intensive land uses, plant communities will shift or migrate with their statistical norms of depth to groundwater.

With this background, ESA formed the conceptual model for this non-tidal watershed. The conceptual model can be described in the following two statements. Forcing from climate change will result in increased ET. Groundwater levels will be lower and the duration of wetland soil inundation to at and near surface elevations will also decline. According to Florida native species planting guides, soil moisture at depths 10 to 18 inches are critical for seedling recruitment and establishment for wetland trees. Wetland plant communities are limited by the duration shallow depth soil saturation (Cameron et al. 2020). Thus, as the duration of near-surface soil saturation or inundation decrease, wetland plant communities will shift away from dry areas. The current distribution of habitats will be altered.

To inform and implement this conceptual model we identified two important datasets.

1. SFWMD DBHYDRO well observations
2. SFWMD 2016 FLUCCS level 4 land cover

ESA extracted time series water level data from twenty-two surficial aquifer wells within and within proximity to the Caloosahatchee watershed. and transformed the heights above mean sea level NGVD29 to depths below ground surface, and then formed an observation-based cumulative distribution function modeling the duration of time groundwater is observed at a specific depth (duration of saturation) for each well. As a model assumption ESA selected the

duration of saturation within 18-inches of the surface for each well location and then modeled a continuous surface using an ordinary spherical krig to predict the duration of water at depth across the watershed (Jie et al. 2013). ESA performed a zonal statistics analysis for each native habitat (FLUCCS level 4 land cover), and generated summary statistics for each native natural habitat to form the average, lower bound (1 standard deviation below the mean) and minimum (lowest value) duration at depth.

The study of future environmental conditions is normally accepted with scenarios and alternative futures, though for the conciseness of this report we selected and modeled the future conditions based on a single drying scenario of 7.5%. The basis of this scenario is 7% dryer from increased ET, 2.5% dryer due to an increase in well production as a response to the drying conditions and 2% wetter due to increase in precipitation events.

Habitats

The lower bounds and minimum duration of soil saturation for each habitat were compared with the surface modeling the duration of soil saturation within 18-inches of soil surface for the 7.5% drying scenario. This resulted in a spatially explicit model for habitat areas at-risk of alteration and transition due to climate change. All analyses were performed with out-of-the box Esri ArcGIS Pro 2.x Spatial Analyst tools and Python scripting managed with Jupyter Notebooks.

It is expected that with the 7.5% scenario some areas of existing habitat areas will transition to other habitat types while, some areas will remain stable, and other areas of existing habitats will express structure that is between transition and stability. Models results will be categorized along this gradient in the following nomenclature:

- High transition risk: These areas represent native existing habitats where the duration of saturation within 18 inches for the 7.5% drying scenario is below the minimum threshold to support the habitat. Thus it is likely that these areas will transition to a habitat more adapted to drier conditions. Such as a Wet Prairie (FLUCCS 6430) transitioning to a Herbaceous (FLUCCS 3100) or Shrub and Brushland (3200) habitat type.
- Medium transition risk: These areas represent native existing habitats where the duration of saturation within 18-inches for the 7.5% drying scenario is between the mean and a standard deviation below the mean wetness to support the habitat. Thus, there is potential that these areas will transition to a habitat more adapted to drier conditions.
- Low transition risk: These areas represent native existing habitats where the duration of saturation within 18-inches for the 7.5% drying scenario is above the average wetness for the habitat.

Lastly, it is important to note that while land use was used in the HRN2 Additive Hybrid analysis, land cover is used in this HRN2 climate change analysis. This was due to the sparse development patterns in large portions of the HRN2 study area where significant native vegetation remained in development use areas. With the use of land cover designations, the native vegetation communities such as Cabbage Palm wetlands (FLUCCS land cover code of 6180) that are within a land use of Rural Residential (FLUCCS land use code 1180) will be included in this study. The additive hybrid designations will remain consistent.

2.4 Additive Hybrid Approach (AHA)

The purpose of Task 3 is to develop a list of priority habitats for targeting future habitat restoration, conservation, and land acquisition activities in CHNEP with the Additive Hybrid Approach (AHA) developed in HRN Phase I. Using the work products developed in Task 1 and Task 2, ESA built a GIS-based model (HRN2_AdditiveHybridModel.tif) consistent with the methods of HRN Phase I where the primary results of the AHA are presented as numeric opportunities and target acreages.

This section details the results of this approach. Preservation/Conservation Opportunities (PCO) are identified for privately-owned areas that have the potential for preservation/conservation or reservation activities. Management/Enhancement Targets (MET) and Restoration Targets (RT) are identified for existing native and non-native habitats on public lands that may be actively managed, enhanced, or restored. These analyses were conducted excluding developed areas, and "other" areas without identified habitat value (e.g., open waters, land used for environmental projects that are not habitat focused such as reservoirs used for water storage) by agencies, the CHNEP Management Conference, or other organizations.

The modeling methods used in this analysis are based on a set of geospatial techniques known as raster analysis, which is a common tool for landscape level habitat modeling. The technique improves processing time. The other important benefit to raster analysis techniques is the removal of topological errors from the analysis, thus the characterization of areas in this study watershed is equally accounted for without gaps or overlaps. Raster data structures such as the 8-bit unsigned raster datasets (.tif) used in the HRN2 additive hybrid analysis have a defined cell size (in this case 10x10 feet). There is one and only one cell for explicit 100 square foot areas on the landscape. More information about Raster Analysis techniques can be found in this course web page from the University of Washington (https://courses.washington.edu/gis250/lessons/raster_analysis1/exercise/index.html).

Vector data from tasks 1 and 2 such as the SFWMD FLUCCS, protected and proposed lands, and others were transformed into raster datasets with unique codes. The raster values in each dataset were reclassified as described below and then a simple raster calculator function was used as the kernel to the additive hybrid model. The results from the raster calculator were unique codes that are referenced to additive hybrid model classifications. The definition of model codes is included in the metadata of the raster datasets, as well as in the excel worksheet (calculation tab) provided as a data deliverable. Excel tables and geospatial data files including datasets, layers, processing scripts, and project documents will accompany this report.

SECTION 3
Results

3.1 Habitat Status and Trends

3.1.1 SFWMD Land Use

The following tables and maps (Table 4, Figures 3 through 5) quantify areas of selected habitat classes in the CHNEP expansion area (non-tidal Caloosahatchee River Basin) as mapped by SFWMD using land use FLUCCS for the years 1999, 2009, and 2016.

Over the almost 20-year period, Dry Prairie increased by 21%, while Upland Shrub and Brushland decreased by 24%, and Mixed Rangeland increased by 10%. Upland Forest areas decreased with Coniferous decreasing 21%, Hardwoods 2%, and Mixed Forested 4%. Some authors recognize a strong similarity between Pine Flatwoods and Dry Prairie habitats (Abrahamson and Hartnet 1990, FWC 2019). FLUCCS forested land cover categories are also defined as having tree canopy closure of 10% or more. Therefore, much of the increase in Dry Prairie habitat (and corresponding decrease in Coniferous Forest habitat) could be the result of decreased tree canopy cover closure in the former Coniferous Forest areas. Small changes in tree canopy cover closure (from 12% to 8% for example) may not represent significant changes in habitat function. Therefore, habitat changes discussed in this and following sections should be interpreted with caution.

Wetland forested habitat class comparisons between 1999 and 2016 are mixed, with a major (32%) decline in Wetland Coniferous Forests (cypress swamps) between 1999 and 2009, a major increase (38%) in the initial small acreage of Wetland Mixed Forests and slight, steady decline (6%) in Wetland Mixed Forests. Non-forested wetlands decreased by 6%, mostly between 1999 and 2009. Overall, wetlands in the expansion area declined from over 96,000 acres to just over 91,000 acres, primarily between 1999 and 2009. Changes in wetland habitat classes remained relatively stable between 2009 and 2016.

TABLE 4
AREA (IN ACRES) OF HRN2 HABITATS MAPPED WITH SFWMD LAND USE.

Habitat class	Acres			Percentage Change	
	1999	2009	2016	1999-2016	2009-2016
3100- Dry Prairie	4,165	5,261	5,269	21%	0.2%
3200- Upland Shrub and Brushland	23,790	19,493	19,171	-24%	-1.7%
3300- Mixed Rangeland	2,750	3,100	3,059	10%	-1.3%
4100- Upland Coniferous Forests	21,073	17,430	17,352	-21%	-0.4%
4200- Upland Hardwood Forests	13,911	13,650	13,583	-2%	-0.5%
4300- Upland Mixed Forests	5,913	5,701	5,680	-4%	-0.4%
5100- Streams and Waterways	920	36	36	-96%	0.0%
5200- Lakes	176	161	159	-10%	-1.4%
6100- Wetland Hardwood Forests	23,842	24,992	24,878	4%	-0.5%
6200- Wetland Coniferous Forests	16,775	12,739	12,755	-32%	0.1%
6300- Wetland Mixed Forests	1,058	1,699	1,697	38%	-0.1%
6400- Wetland Vegetated Non-Forests	54,966	51,784	51,883	-6%	0.2%

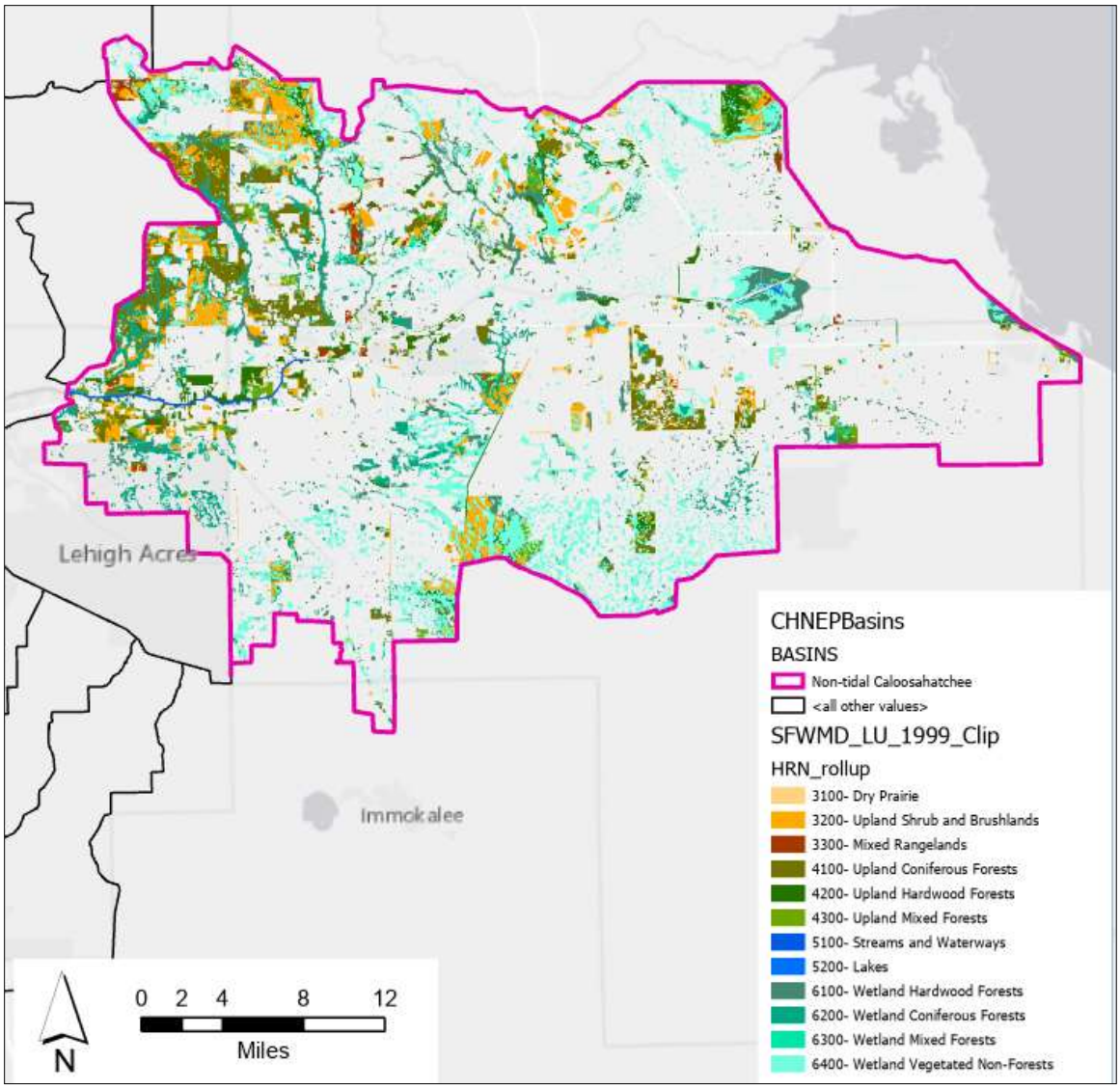

Figure 3
1999 Land Use Map

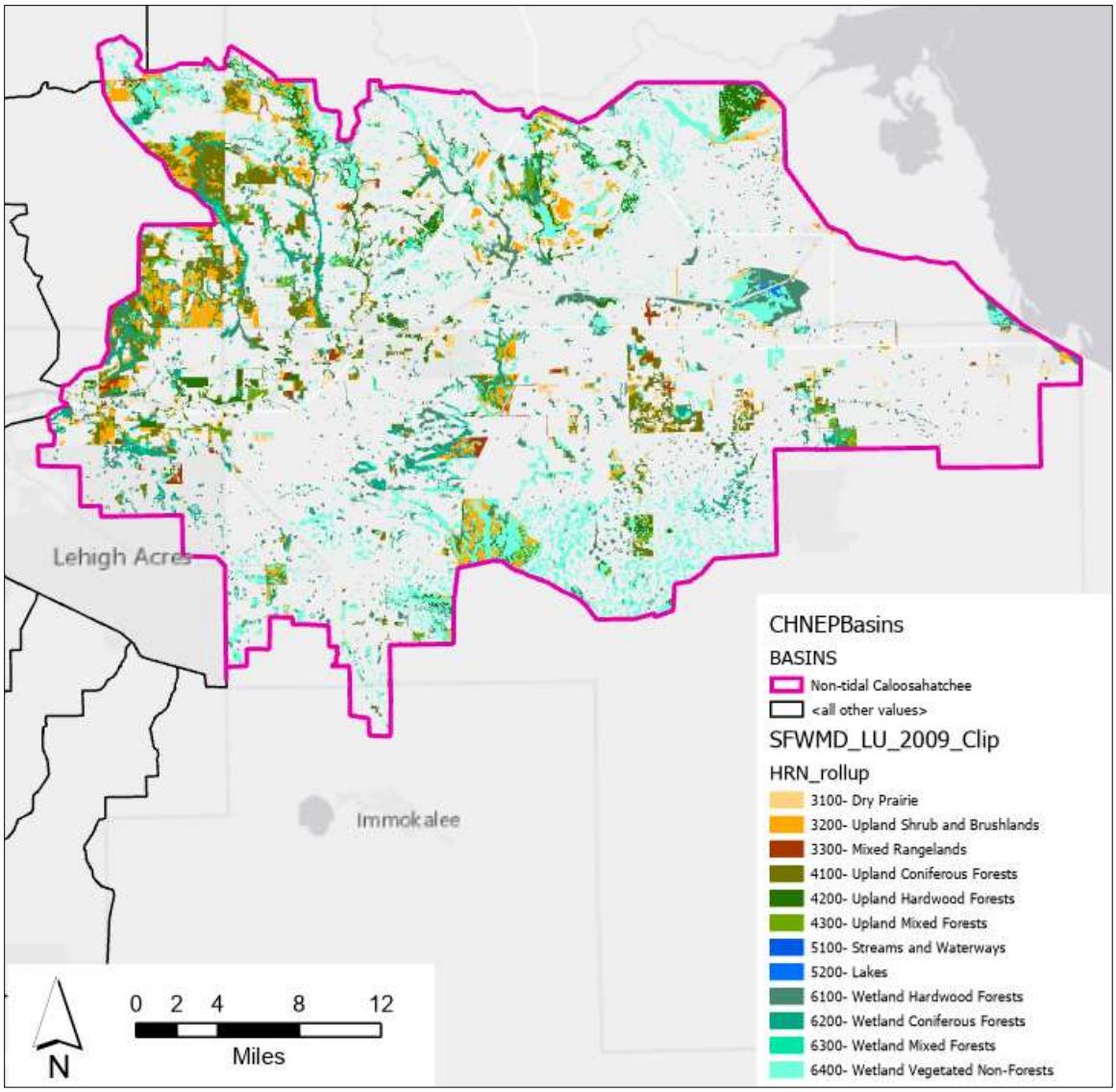

Figure 4
2009 Land Use Map

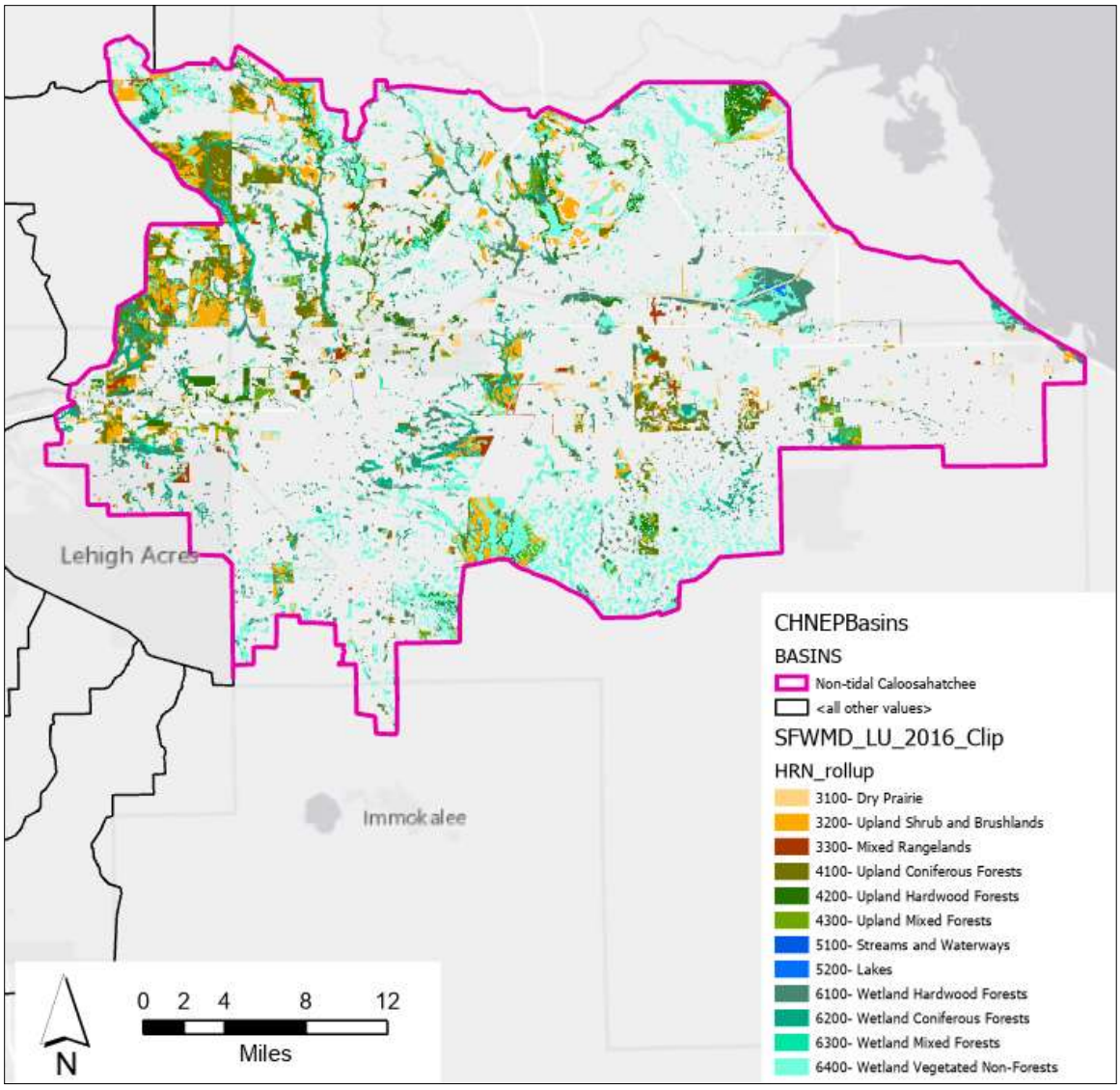

Figure 5
2016 Land Use Map

3.1.2 SFWMD Land Cover

The following table and maps (Table 5, Figures 6 through 8) quantify areas of selected habitat classes in the CHNEP expansion area (non-tidal Caloosahatchee River Basin) as mapped by SFWMD using land cover FLUCCS for the years 1999, 2009, and 2016. Over the almost 20-year period, Dry Prairie increased by 34%, Upland Shrub and Brushland decreases by 24%, and Mixed Rangeland remained relatively stable at 8% increase. Upland Forests expanded with Coniferous by 13%, Hardwoods by 48%, and Mixed Forest by 28%.

Wetland forested habitat class comparisons between 1999 and 2016 are mixed, with a major (32%) decline in Wetland Coniferous Forests (Cypress and Hydric Pine Flatwoods), an increase in the small acreage of Wetland Mixed Forests, and stable fluctuation in Wetland Mixed Forests. Non-forested wetlands decreased by 6%, mostly between 1999 and 2009. Overall, wetlands in the expansion area declined from over 96,000 acres to just over 91,000 acres, primarily between 1999 and 2009. Changes in wetland habitat classes remained relatively stable between 2009 and 2016.

TABLE 5
AREA (IN ACRES) OF HRN2 HABITATS MAPPED WITH SFWMD LAND COVER.

	Acres			Percent Change	
Habitat class	**1999**	**2009**	**2016**	**1999-2016**	**2009-2016**
3100- Dry Prairie	13,449	20,868	20,324	34%	-2.7%
3200- Upland Shrub and Brushland	33,085	27,046	26,734	-24%	-1.2%
3300- Mixed Rangeland	3,729	4,042	3,999	7%	-1.1%
4100- Upland Coniferous Forests	26,407	30,388	30,309	13%	-0.3%
4200- Upland Hardwood Forests	15,148	29,094	29,033	48%	-0.2%
4300- Upland Mixed Forests	7,634	10,651	10,630	28%	-0.2%
5100- Streams and Waterways	920	36	36	-96%	0.0%
5200- Lakes	176	161	159	-10%	-1.4%
6100- Wetland Hardwood Forests	23,842	25,056	24,942	4%	-0.5%
6200- Wetland Coniferous Forests	16,833	12,739	12,755	-32%	0.1%
6300- Wetland Mixed Forests	1,058	1,711	1,709	38%	-0.1%
6400- Wetland Vegetated Non-Forests	54,966	51,802	51,899	-6%	0.2%

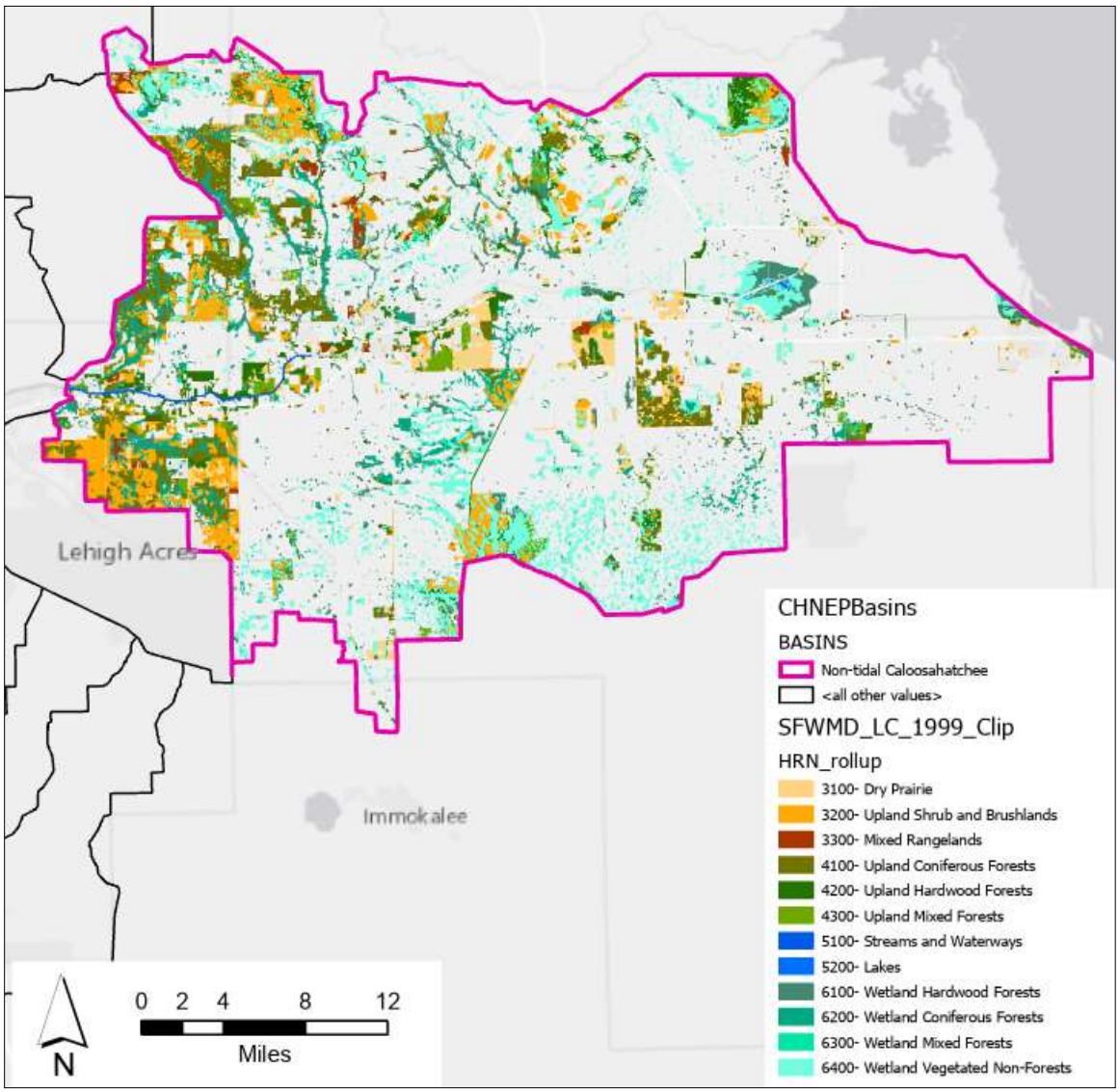

Figure 6
1999 Land cover Map

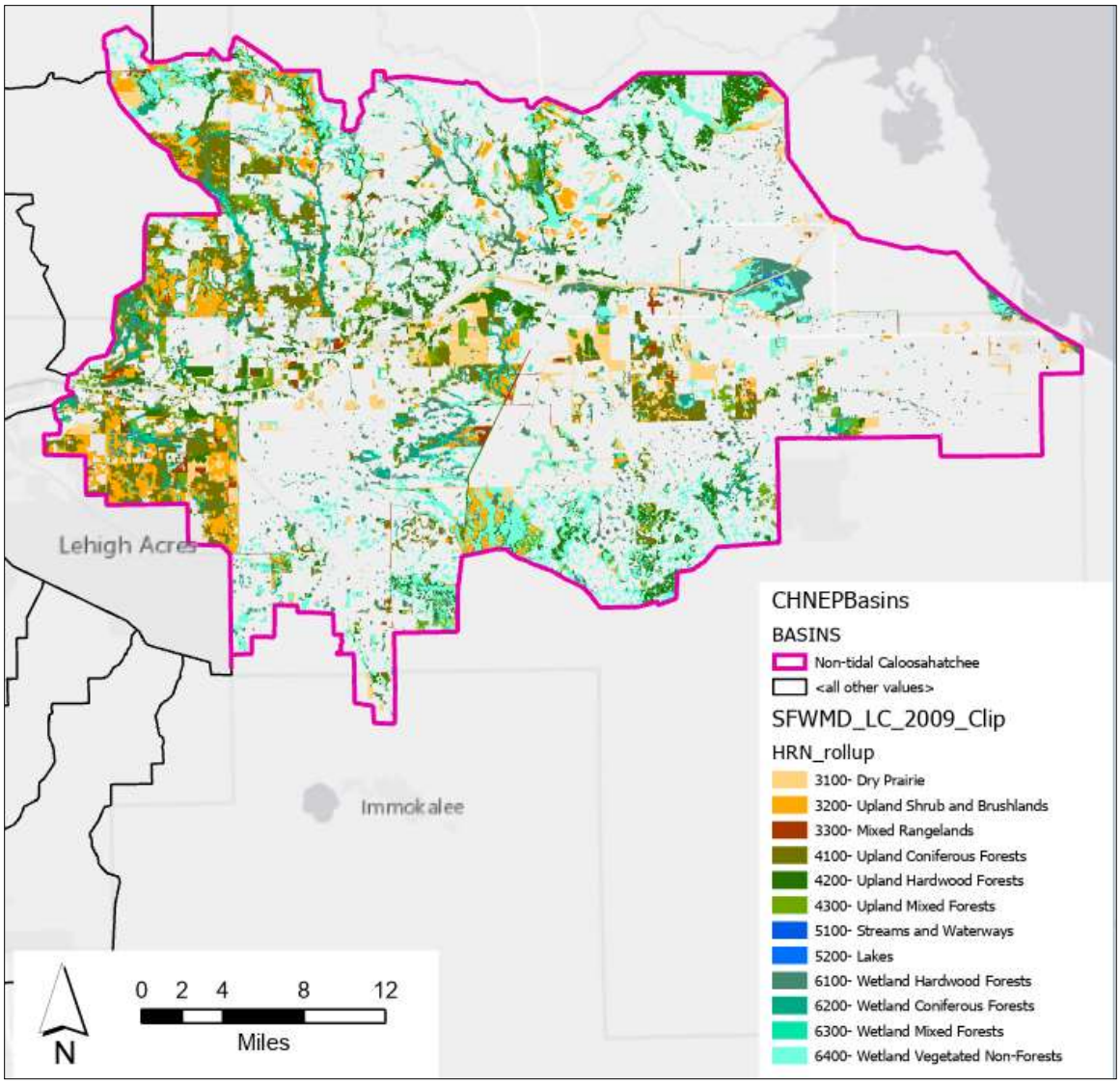

Figure 7
2009 Land Cover Map

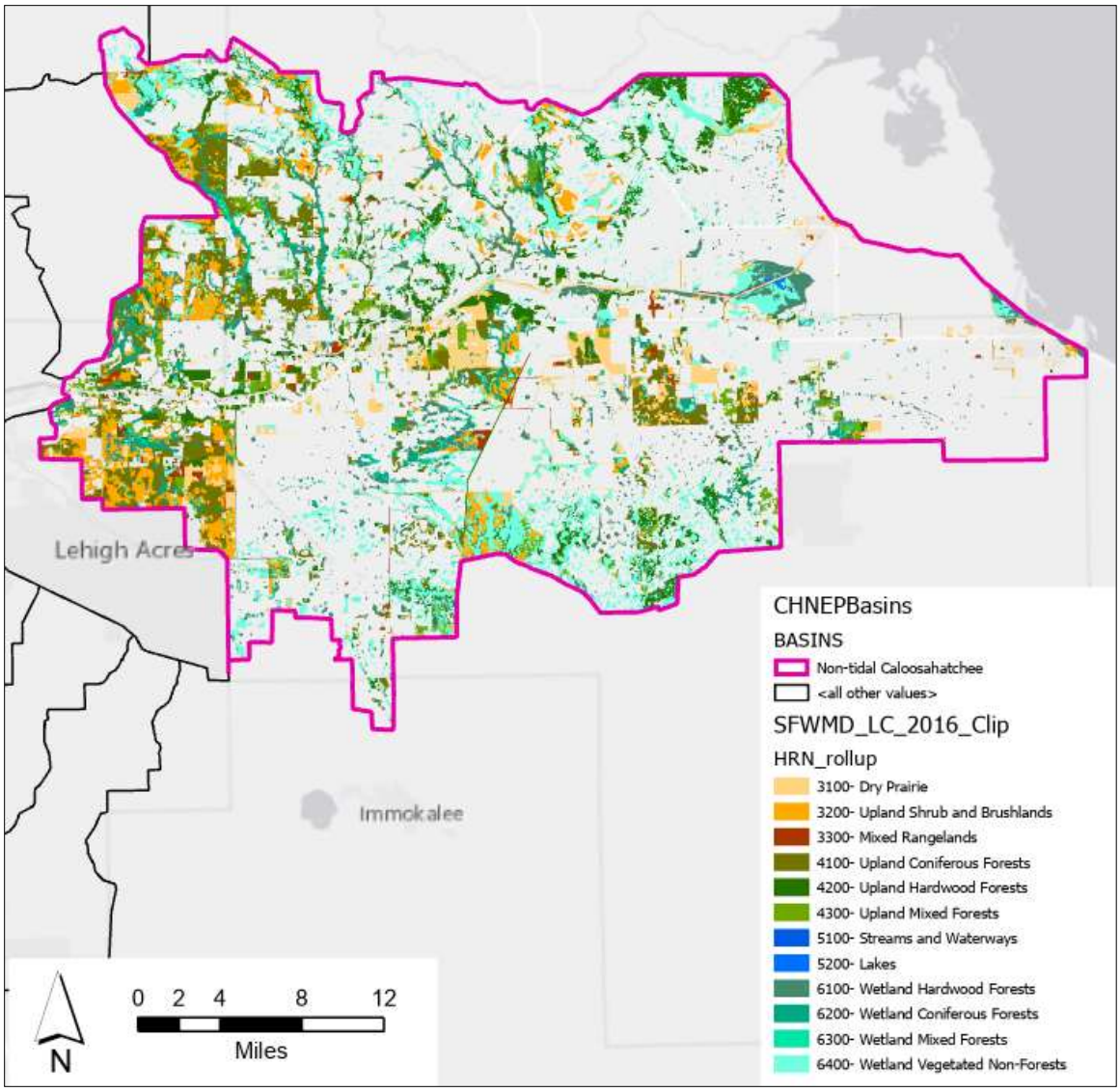

Figure 8
2016 Land Cover Map

A clear recommendation from the March 5, 2020 HRN2 Habitat Subcommittee Meeting in LaBelle, Florida is that the land use classifications are more appropriate for the Additive Hybrid HRN model, and thus should be used to document habitat status and trends in the expansion area. ESA initially recommended use of the SFWMD 1999, 2009, and 2016 land cover datasets as a spatial temporal time series to provide the best comparison year to year for mapping and classifications. The advantage of using land cover is remaining consistent with the HRN 1 watersheds. Land cover allows for more accurate identification of current habitat structure and ecological value where native or non-native habitats dominate within partially altered lands (e.g. platted lots in Lehigh Acres). However, these advantages are outweighed by the ecological cost that artificial features (e.g. roads, canals, and pesticide application) have on the habitat captured by land use, and thus are not to be classified as native natural vegetated habitats. Additionally, stakeholders (Lehigh Acres MSID) identified economic value of the land use for areas of conflicting land use and land cover with no direct plans for conservation of the natural land cover except in designated conservation areas. Another advantage of using land use is that the 1995 dataset contains land use FLUCCS, thus it can be appropriately compared with the SFWMD 1999, 2009, and 2016 land use datasets.

3.2 Existing and Proposed Conservation

Spatial data tables are displayed as features in maps shown in this section with areas summarized in tables. A key recommendation from the March 5, 2020 HRN2 Habitat Conservation Subcommittee meeting in LaBelle, Florida was to separate hydrologic projects, specifically the C-43 reservoir, from other existing habitat conservation projects. While the C-43 project proposes to provide for some habitat creation, the primary objective of the project is water storage. In addition, major stakeholders from Hendry County, Glades County, and Lehigh Acres provided input and their information agreed with the documented existing and future habitat conservation and restoration projects detailed in this report.

It is important to note that while much of the land use in Lehigh Acres MSID has been identified as developed, there are many open parcels with native habitats that are suitable as smaller habitat conservation or water storage areas. Water storage and small habitat conservation areas within already developed areas are beyond what is identified in this additive hybrid modeling approach and therefore, are not represented in Tables 6 through 9 and the Figure 9 through Figure 14 maps.

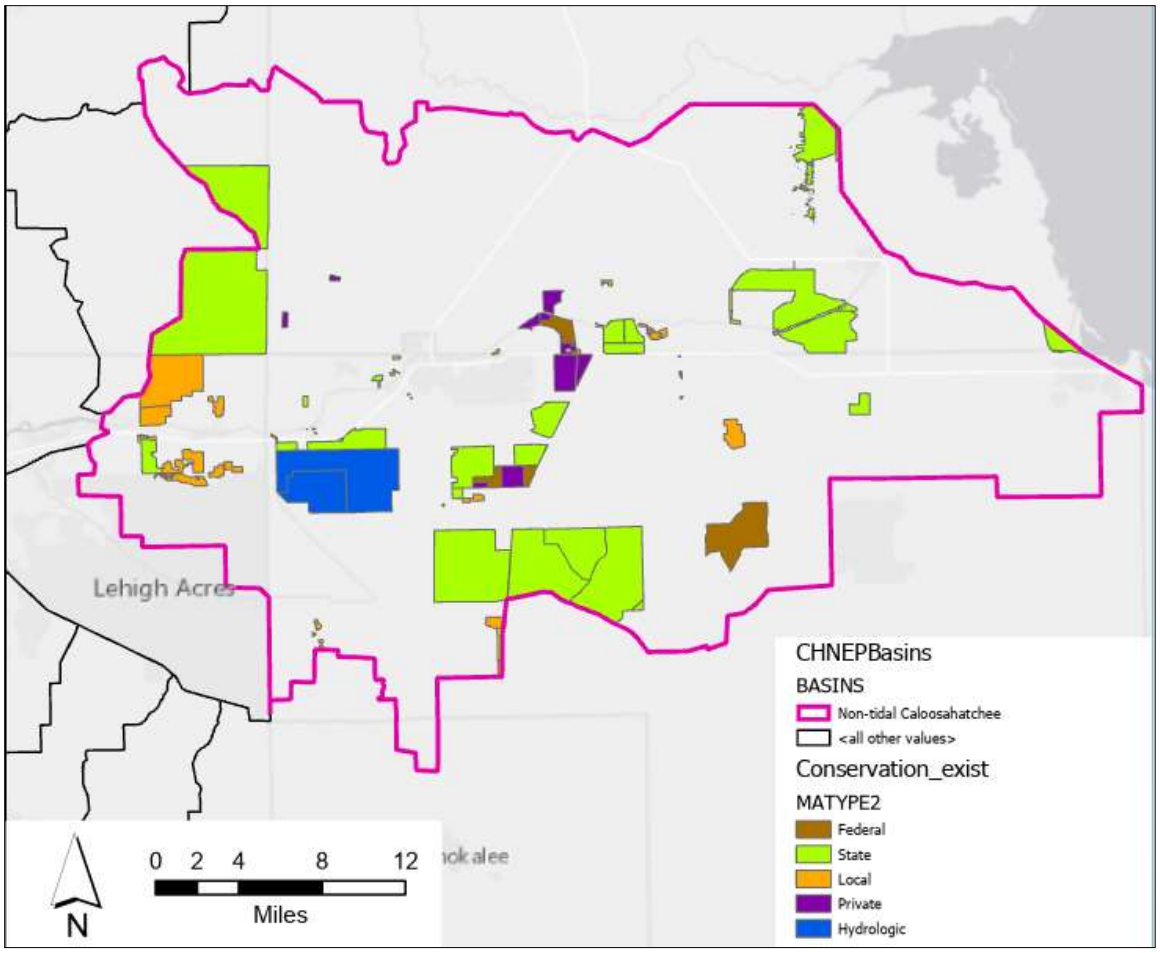

Figure 9
Existing Conservation Lands and Map

TABLE 6
EXISTING PROJECTS SUMMARY

Management Type	Number of Projects	Area in Acres
Federal	4	5,063
State	22	63,633
Local	38	8,526
Private	7	3,533
Hydrologic	1	10,492

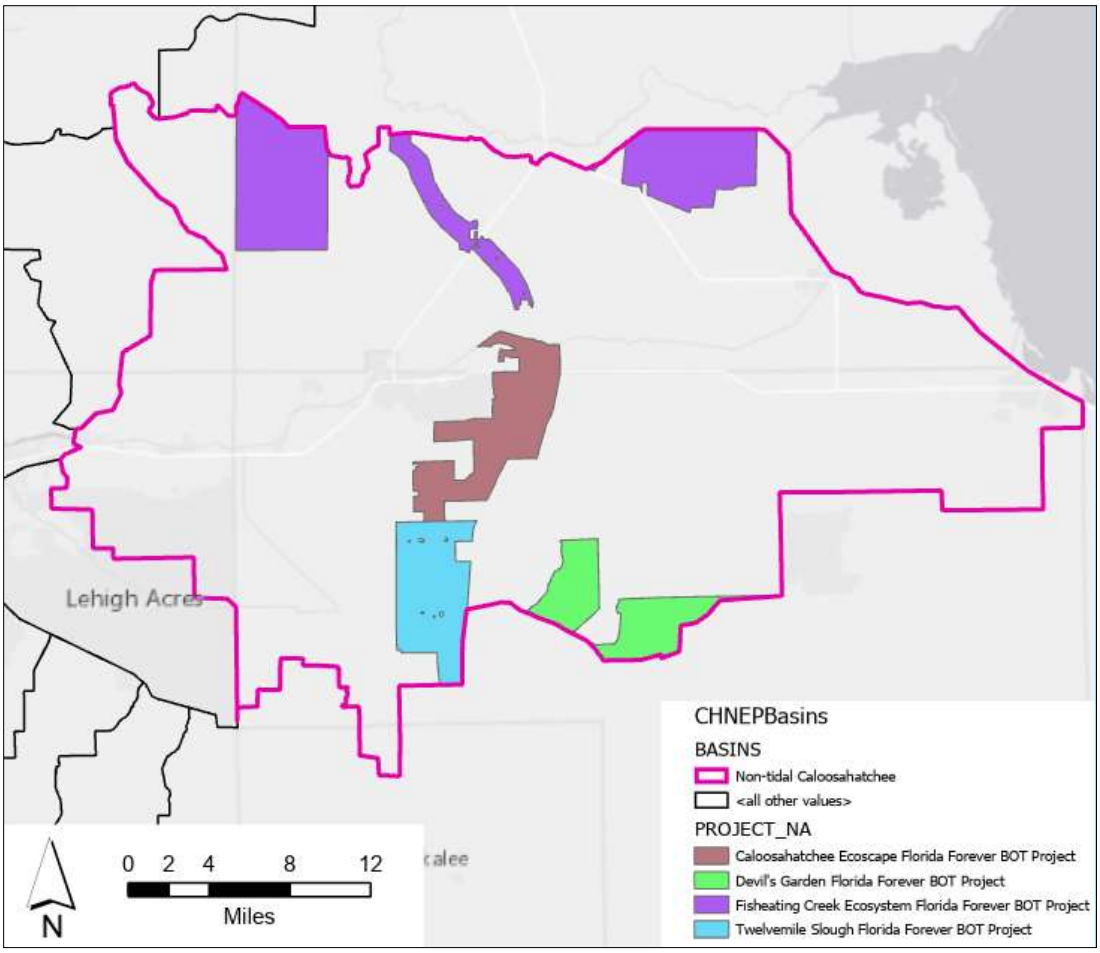

Figure 10
Planned Florida Forever Projects

TABLE 7
PLANNED FLORIDA FOREVER SUMMARY

Management Type	Rank	Area in Acres
Devil's Garden	Critical Natural Lands	14,257
Caloosahatchee Ecoscape	Critical Natural Lands	18,454
Twelvemile Slough	Critical Natural Lands	15,464
Fisheating Creek Ecosystem	Less-Than-Fee Category	39,623

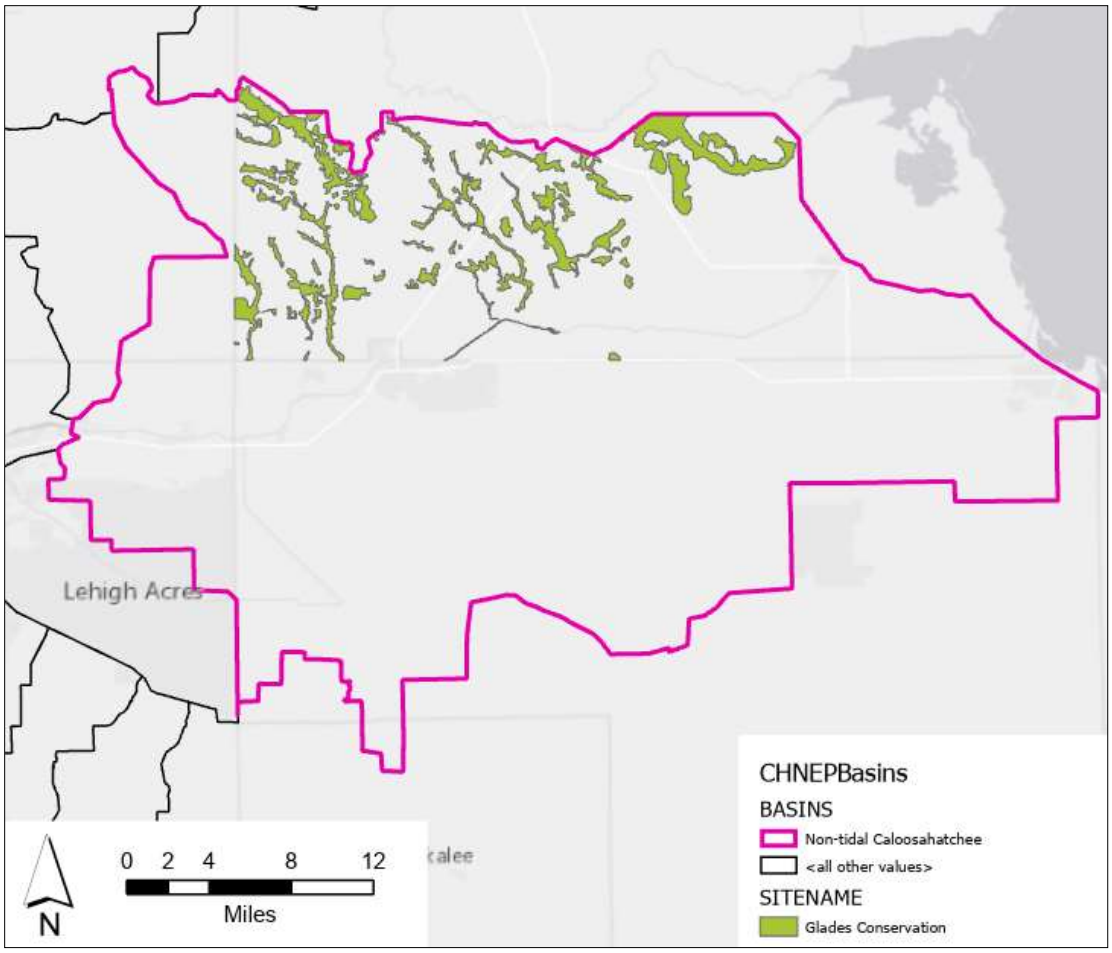

Figure 11
Planned Glades County Conservation Projects (26,584 acres)

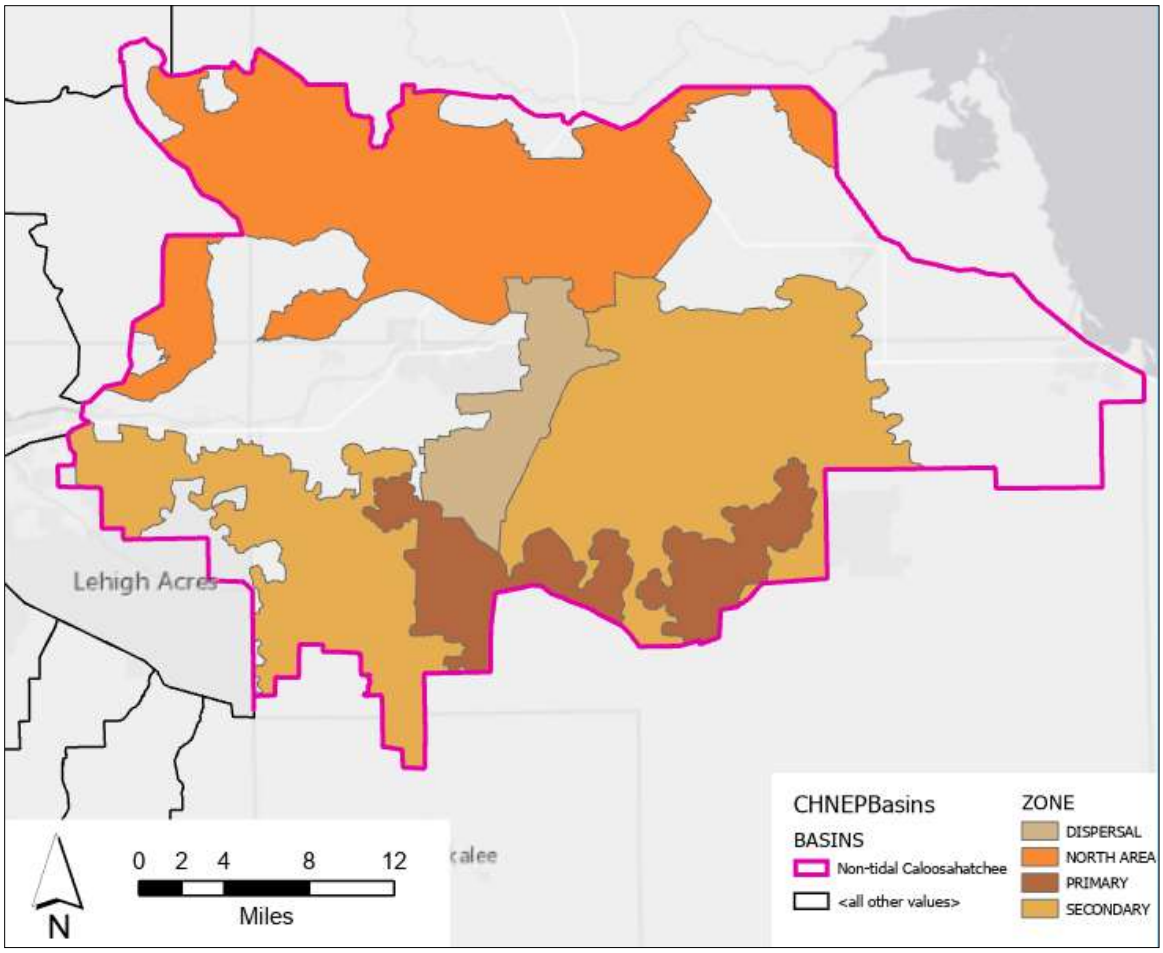

Figure 12
Planned USFWS Panther Critical Habitat Projects

TABLE 8
PLANNED USFWS PANTHER CRITICAL HABITAT SUMMARY

Zone	Area in Acres
North Area	143,112
Primary	46,222
Secondary	179,110
Dispersal	27,881

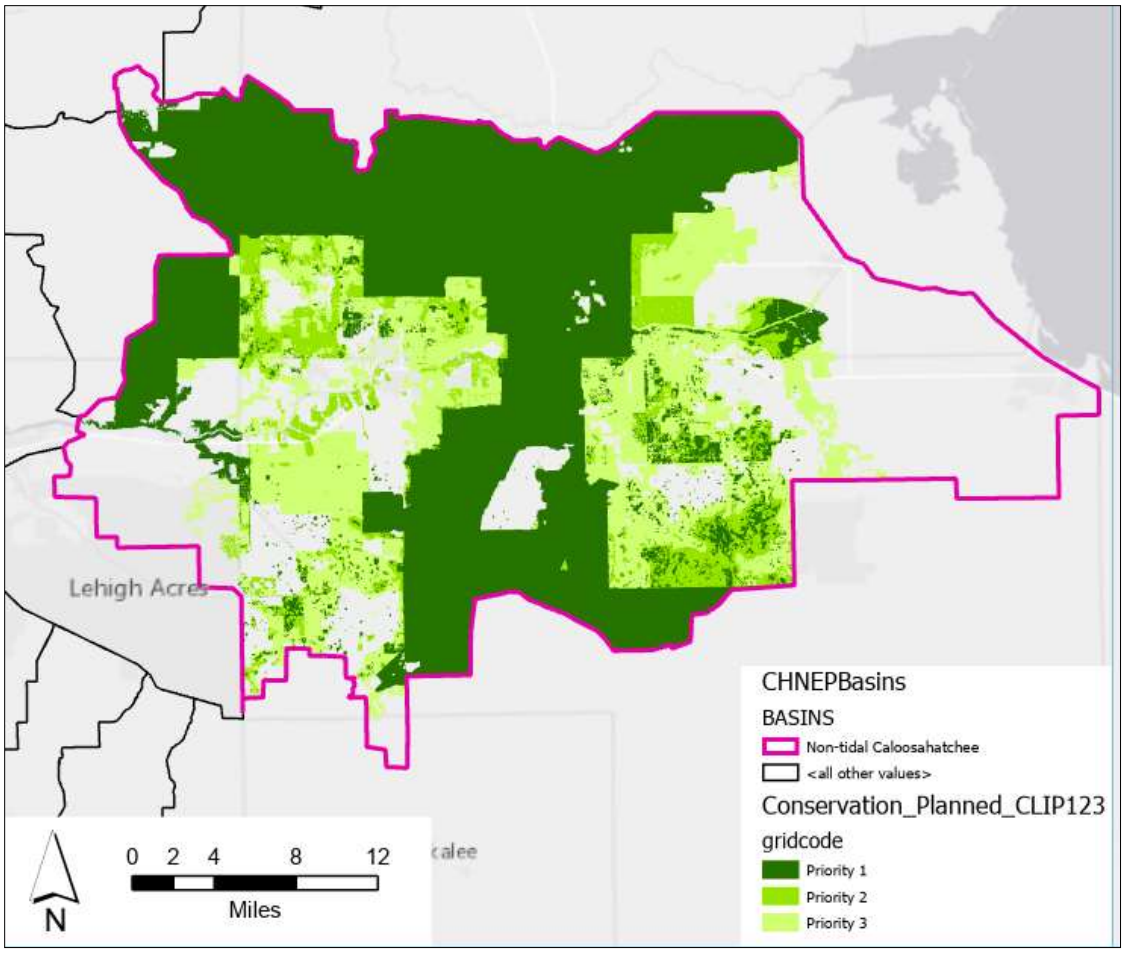

Figure 13
Planned CLIP 4.0 Priority Areas.

TABLE 9
PLANNED CLIP 4.0 PRIORITY AREAS SUMMARY

Zone	Area in Acres
Priority 1	256,801
Priority 2	41,753
Priority 3	109,333

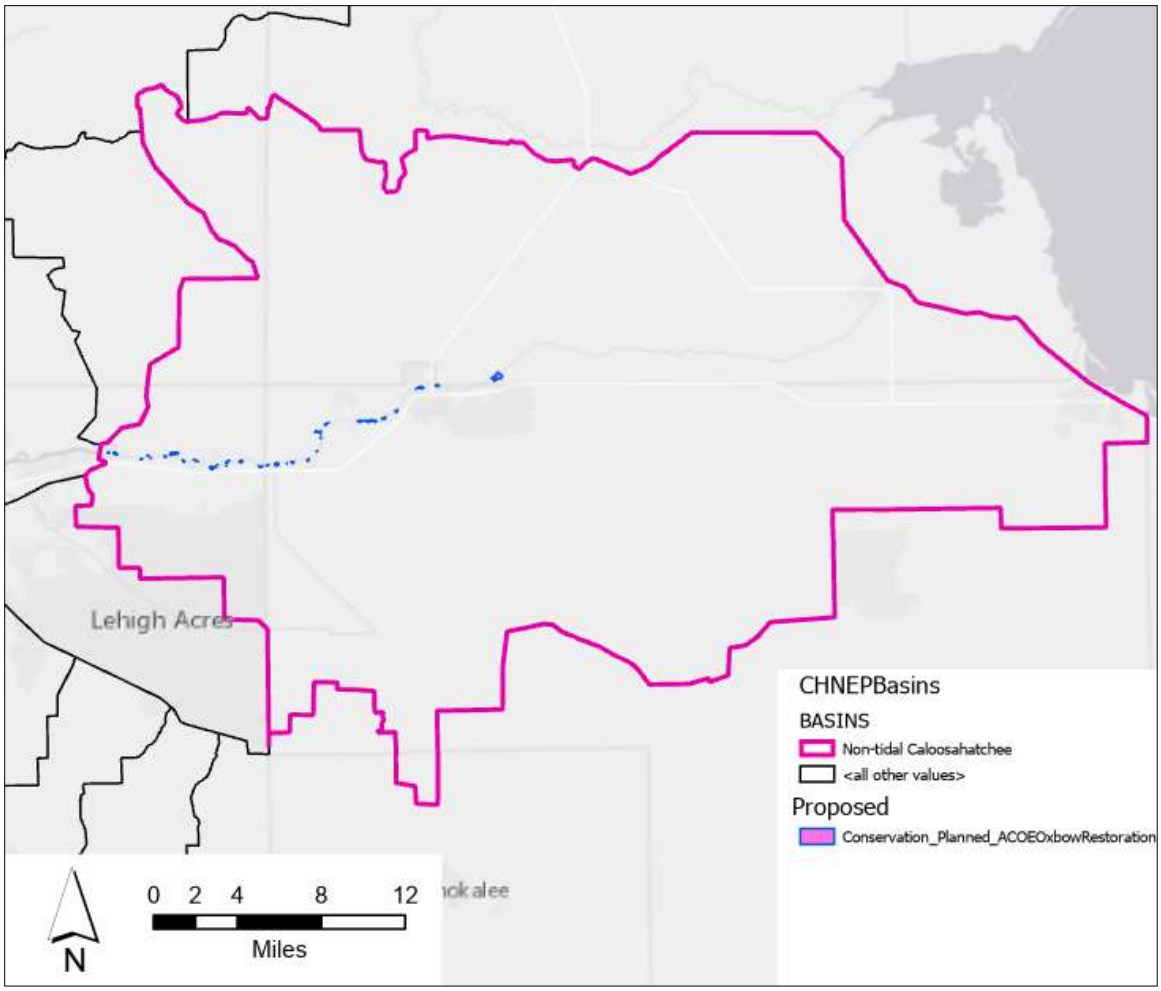

Figure 14
Planned ACOE Oxbow Restoration projects (46 areas at 325 acres total)

3.3 Climate Change

The results of the landscape ecohydrological model developed for the CHNEP expansion area identify and locate native habitat areas that are at-risk for transition into another habitat type due to groundwater drying conditions from global climate change in the year 2060. As presented in the following tables and maps, there is a significant area of native habitat at-risk of transition into habitats adapted for drier conditions

Tables 10 and 11 and Figures 15 and 16 summarize the area in acres and relative percent of probable transition with the 7.5% drying scenario. The tables show that almost 19,000 acres of Non-Forested Wetlands and over 10,000 acres of Upland Hardwood Forests are in high risk of transition. 76% of Mixed Forested Wetlands and 65% of Coniferous Wetland Forests (hydric pine flatwoods and cypress swamps) have a medium or high risk of transition. Over 40% of Mixed Rangelands, Upland forests, and Hardwood and Non-Forested Wetlands have a low transition risk.

TABLE 10
NATIVE HABITATS AREAS AT-RISK OF TRANSITION DUE TO CLIMATE CHANGE

Land Cover Habitat Class	Current (acres)	Transition Risk		
		Low (acres)	Medium (acres)	High (acres)
3100 – Dry Prairie	20,295	6,883	5,571	7,841
3200 – Upland Shrub and Brushland	26,693	10,064	11,566	5,063
3300 – Mixed Rangeland	3,993	1,686	894	1,413
4100 – Upland Coniferous Forests	30,262	8,635	16,894	4,733
4200 – Upland Hardwood Forests	26,973	12,365	4,524	10,084
4300 – Upland Mixed Forests	10,597	3,654	2,908	4,035
6100 – Wetland Hardwood Forests	24,265	9,781	8,426	6,058
6200 – Wetland Coniferous Forests	13,127	4,591	4,156	4,380
6300 – Wetland Mixed Forests	1,706	415	852	439
6400 – Wetland Vegetated Non-Forests	51,821	24,576	8,517	18,728

TABLE 11
NATIVE HABITATS AREA PERCENTAGES AT-RISK OF TRANSITION DUE TO CLIMATE CHANGE

Land Cover Habitat Class	Current (acres)	Transition Risk		
		Low	Medium	High
3100 – Dry Prairie	20,295	34%	27%	39%
3200 – Upland Shrub and Brushland	26,693	38%	43%	19%
3300 – Mixed Rangeland	3,993	42%	22%	35%
4100 – Upland Coniferous Forests	30,262	29%	56%	16%
4200 – Upland Hardwood Forests	26,973	46%	17%	37%
4300 – Upland Mixed Forests	10,597	34%	27%	38%
6100 – Wetland Hardwood Forests	24,265	40%	35%	25%
6200 – Wetland Coniferous Forests	13,127	35%	32%	33%
6300 – Wetland Mixed Forests	1,706	24%	50%	26%
6400 – Wetland Vegetated Non-Forests	51,821	47%	16%	36%

The map figures below (Figure 15) shows the spatial distribution of different levels of transition risk for native habitats by 2060. The current duration of soil saturation within 18-inches soil surface (Figure 16) corresponds with the habitat maps. The native habitats with high transition risk centers around the monitoring well observations south of the river in the central southwest that have been observed to be drier. However, the habitats north of the river are in this low category because they are lower in elevation and surrounded by wetlands with assumed hydrologic recharge connections.

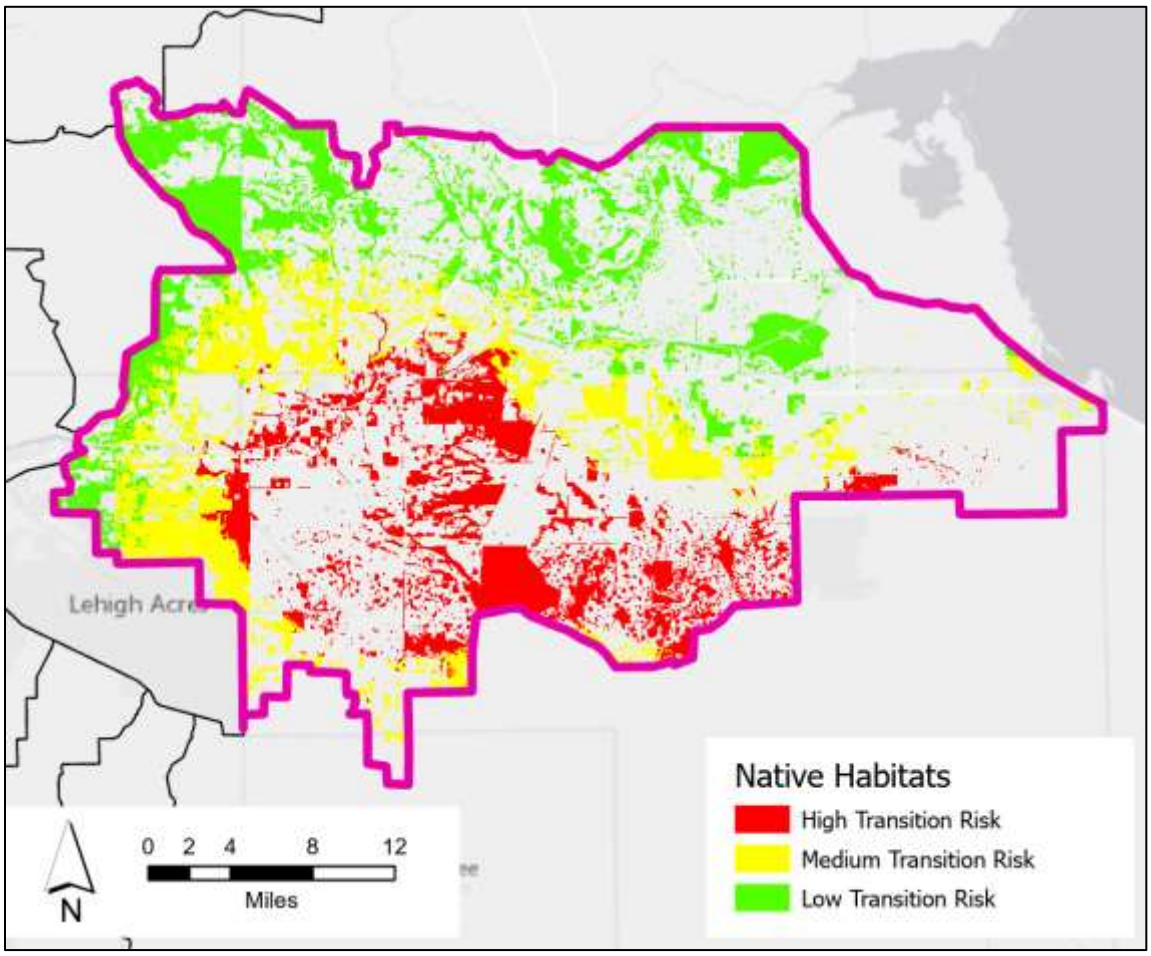

Figure 15
Map of At-Risk Habitats with a 2060 Drying Scenario of 7.5 % at 18-Inches of Depth

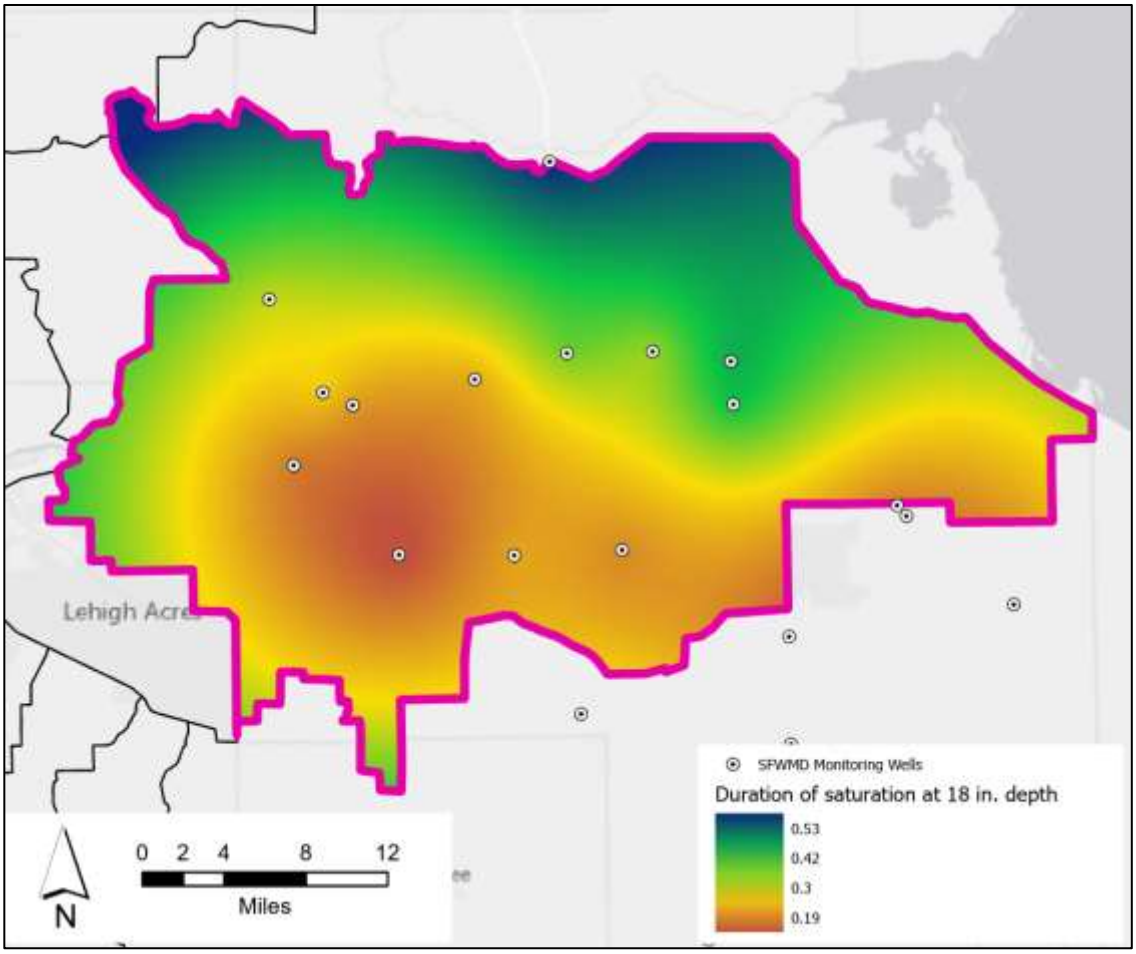

Figure 16
Modeled duration of saturation within 18-inches of the surface with SFWMD Monitoring Wells

3.4 Additive Hybrid Approach

3.4.1 Existing Development

The following map (Figure 17) reclassifies the 2016 SFWMD land use established by HRN Phase I methodology as 'Existing Development'. In the 605,615-acre watershed there are 46,074 acres (8% of the watershed) of Existing Development.

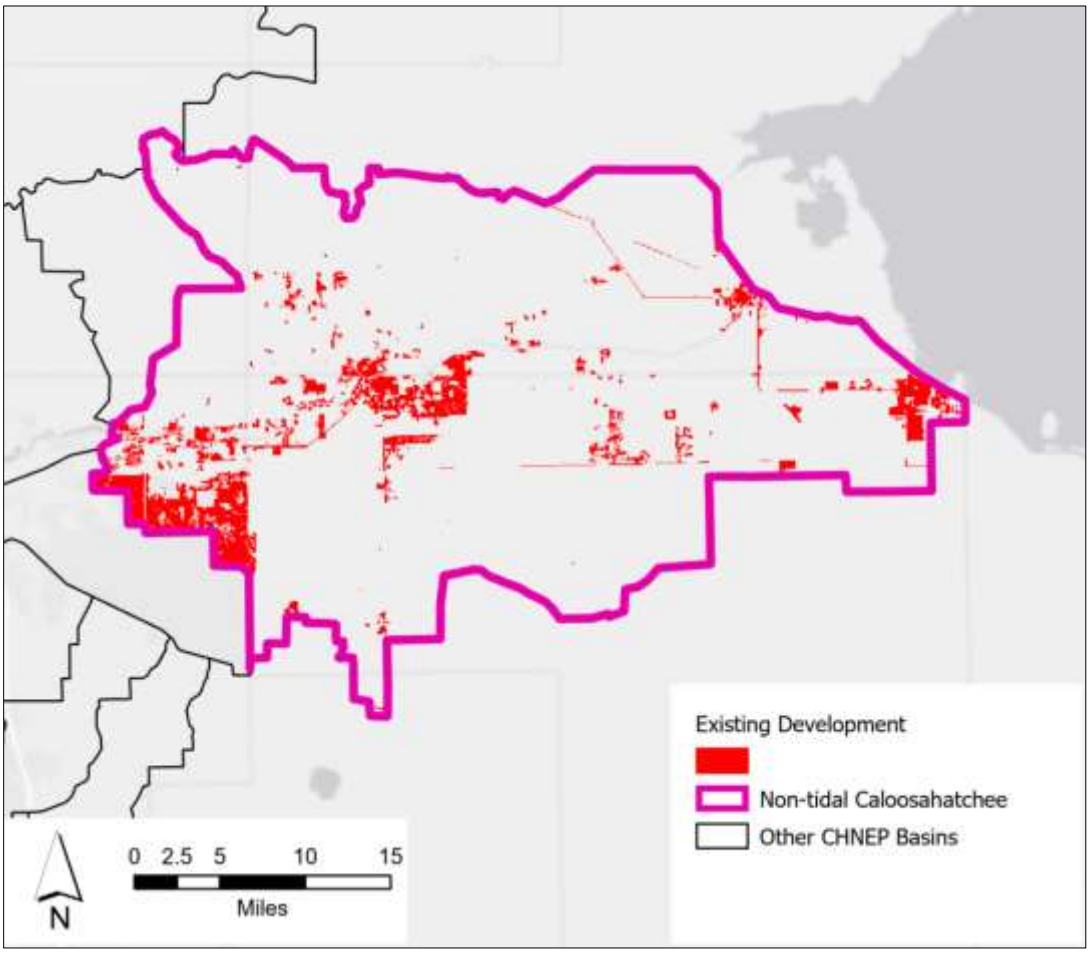

Figure 17
Existing Development Map

3.4.2 Management/Enhancement (MET) and Restoration Targets (RT)

This category consists of both public lands and private lands that are currently under public conservation easements or otherwise protected for preservation or conservation purposes.

The following map (Figure 18) reclassifies the SFWMD land use 2016 FLUCCS codes as native habitats and non-native habitats that are located within existing conservation lands. In the 605,615-acre watershed there are 47,108 (8% of the watershed) acres of native habitats on existing preservation/conservation lands (MET), these areas represent natural lands that may need ongoing management and enhancement activities (e.g., prescribed burning, exotic species control), and 33,142 acres (5% of the watershed) of Protected Land / Non- Native Habitats (RT). The RT areas represent potentially restorable non-native habitats that could benefit from more intensive restoration activities (e.g., regrading/planting, hydrologic restoration).

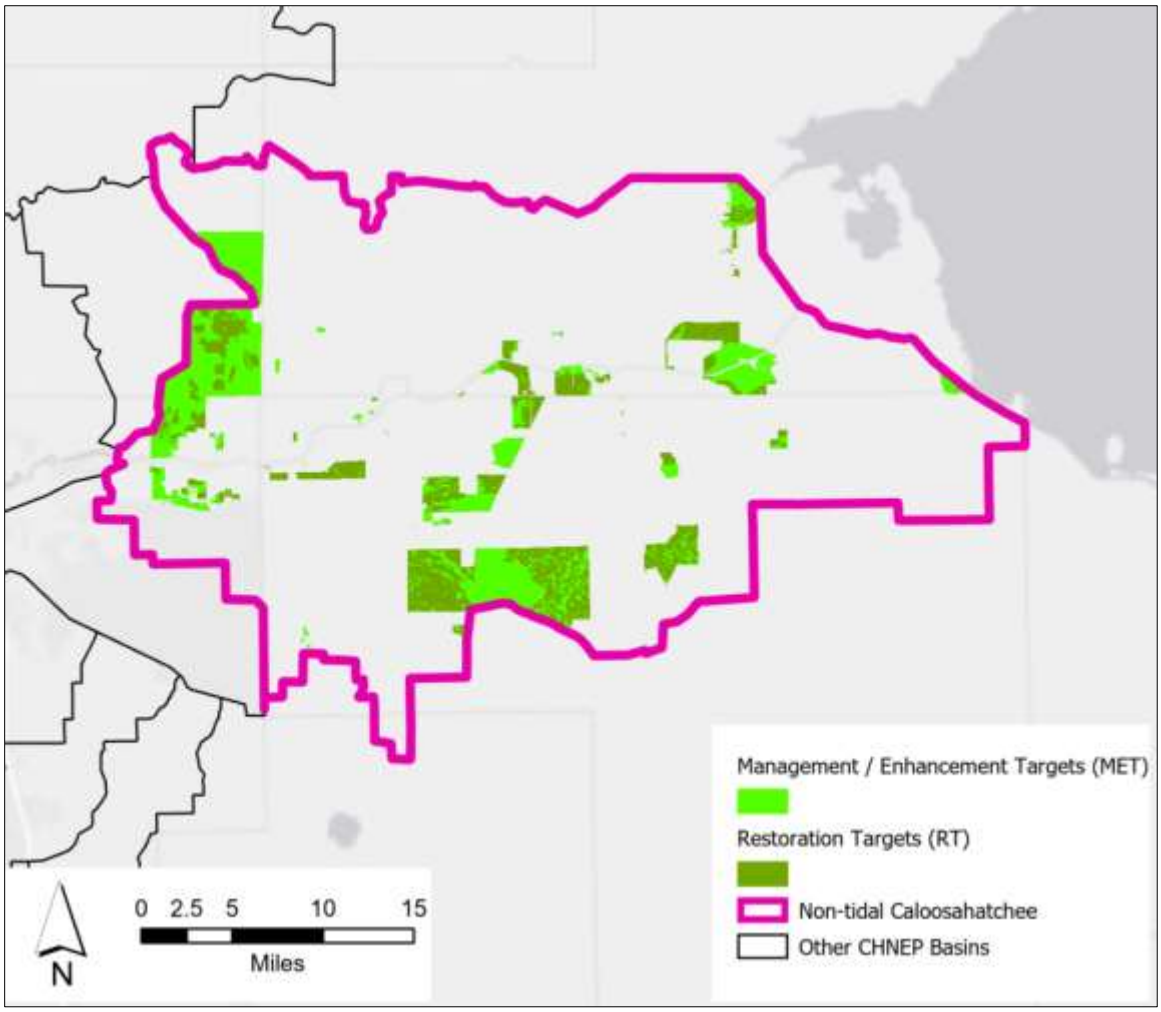

Figure 18
Management / Enhancement and Restoration Targets Map

3.4.3 Preservation/Conservation Opportunities (PCO)

This category consists of unprotected Lands, both native and non-native, with habitat value as identified by the previous HRN methodology and approved by stakeholders. The PCO were identified from private lands that may be considered for preservation or conservation through acquisition, easement, or other means. As priority habitats are preserved, they can be later sorted in the Management/Enhancement Targets if they are native or Restoration Targets if they are non-native.

The following map (Figure 19) shows reclassified SFWMD land use 2016 FLUCCS Codes as native habitats and non-native habitats that are located within proposed conservation lands. In the 605,615-acre watershed there are 105,954 (17% of the watershed) acres of Proposed Conservation Land /Native Habitats with Identified Habitat Value (Native PCO) and 262,808 acres (43% of the watershed) of Proposed Conservation Land /Non-Native Habitats with Identified Habitat Value (Non-Native PCO).

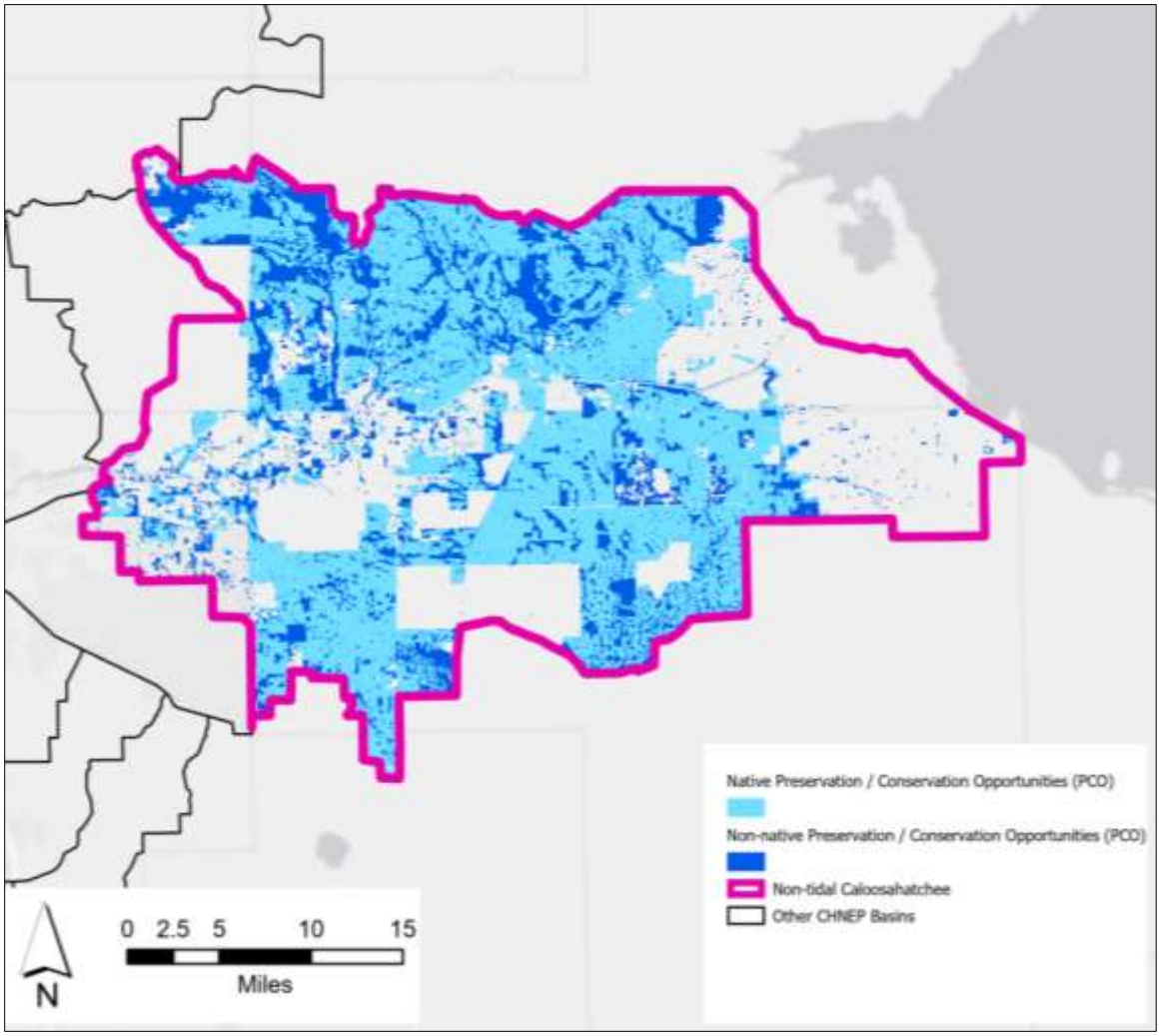

Figure 19
Native and Non-Native Preservation /Conservation Opportunities Map

3.4.4 Other Lands

There are other lands in the watershed to be accounted for in the watershed area. This includes Open Water, and hydrologic projects such as the C-43 Reservoir, and non-native habitats that are not included in a wish list for protection and designated as lands without identified habitat value. The following map (Figure 20) shows reclassified SFWMD land use 2016 FLUCCS Codes as 'Open Water'. In the 605,615-acre watershed there are 16,977 acres (3% of the watershed) of Open Water and 93,552 (15% of the watershed) acres of Lands Without Identified Habitat Value.

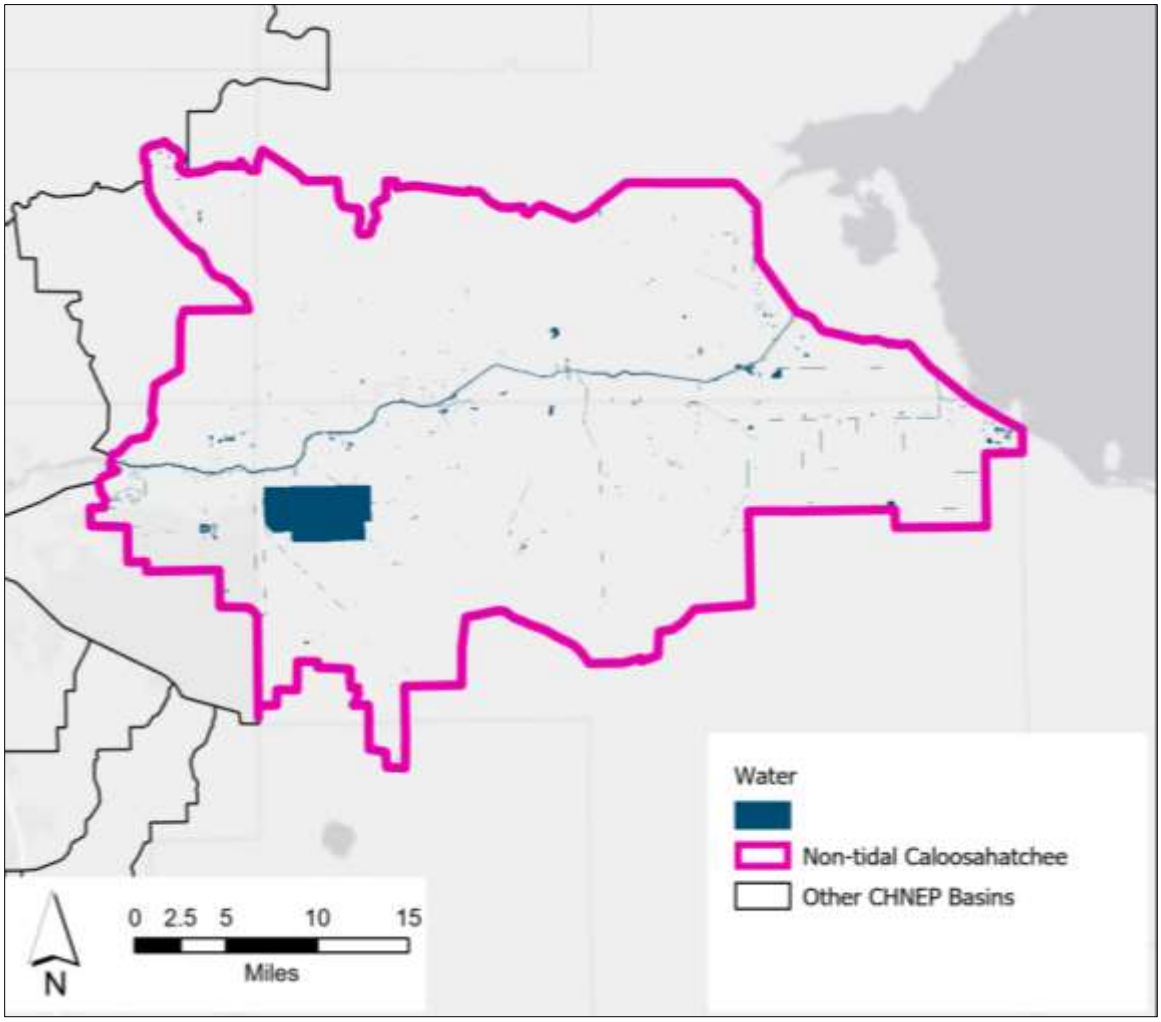

Figure 20
Open Water Map

3.4.5 Strata

Based on analyses in HRN Phase I and recommendations from stakeholders, the HRN2 addresses the entire CHNEP expansion area, but is primarily focused on freshwater wetland and upland habitats that fall within two distinct spatial strata – river floodplain and upland. The non-tidal watershed in the Caloosahatchee does not contain the coastal stratum or associated habitat types as identified in HRN Phase I, so the analysis instead focused on the Upland and River floodplain strata. The following tables have the SFWMD land use 2016 FLUCCS Codes reclassified as 'Uplands' and 'River floodplain' as determined by the above-mentioned methodology. The river floodplain stratum includes all areas within the FEMA (1996) mapped 100-year floodplains for major tributaries to the Caloosahatchee River. The 100-year floodplains of the tributaries typically include forested and herbaceous freshwater wetlands and native riparian upland communities. The upland stratum includes areas that are landward of the coastal stratum and outside the 100- year river floodplains. Upland habitats provide important ecosystem functions including aquifer recharge and wildlife habitat. Rare or highly threatened upland habitats include sand pine scrub, longleaf pine, wet pine flatwoods, and hydrologically isolated forested and herbaceous wetlands.

In the 605,615-acre watershed there are 91,245 acres (15% of the watershed) of River Floodplain, of which 71,373 acres (78% of the watershed) is within the existing 100-year FEMA floodplain. There are 26,118 acres (4% of the watershed) are Protected Native Freshwater Wetlands, 467 acres are Protected Non-Native habitats, and 64,660 (70% of the watershed) acres are Unprotected Native Freshwater Wetlands.

There are 444,217 acres (72% of the watershed) of Uplands, of which 426,227 acres (96% of the watershed) contain lands with identified habitat value. There are 20,990 acres (3% of the watershed) of Protected Native Uplands, 32,675 acres (5% of the watershed) of Protected Non-Native habitats, 41,294 acres (7% of the watershed) of Unprotected Native Uplands, and 259,664 acres (42% of the watershed) of Unprotected Non-Native habitats.

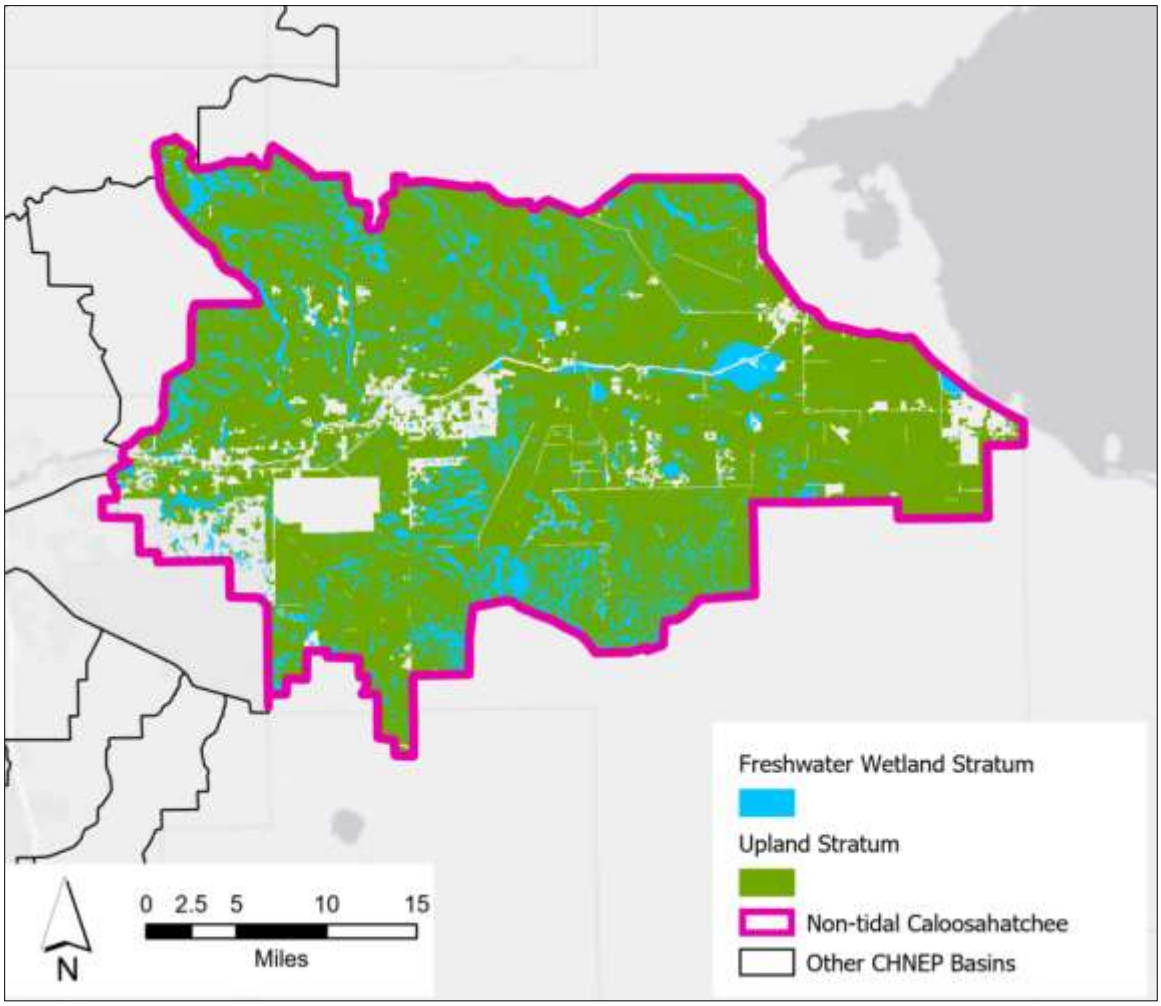

Figure 21
Upland and Freshwater Wetland Stratum

TABLE 12
AREA IN ACRES OF STRATA

Strata	Management Enhancement Targets	Restoration Targets	Native P/C Opportunities	Non-Native P/C Opportunities
Freshwater Wetland	26,118	467	64,660	N/A
Upland	20,990	32,675	41,294	259,664
Total	47,108	33,142	105,954	259,664

3.4.6 Combined Opportunities

Below is a map with the combined targets and opportunities followed by a table for each HRN2 Additive Hybrid component.

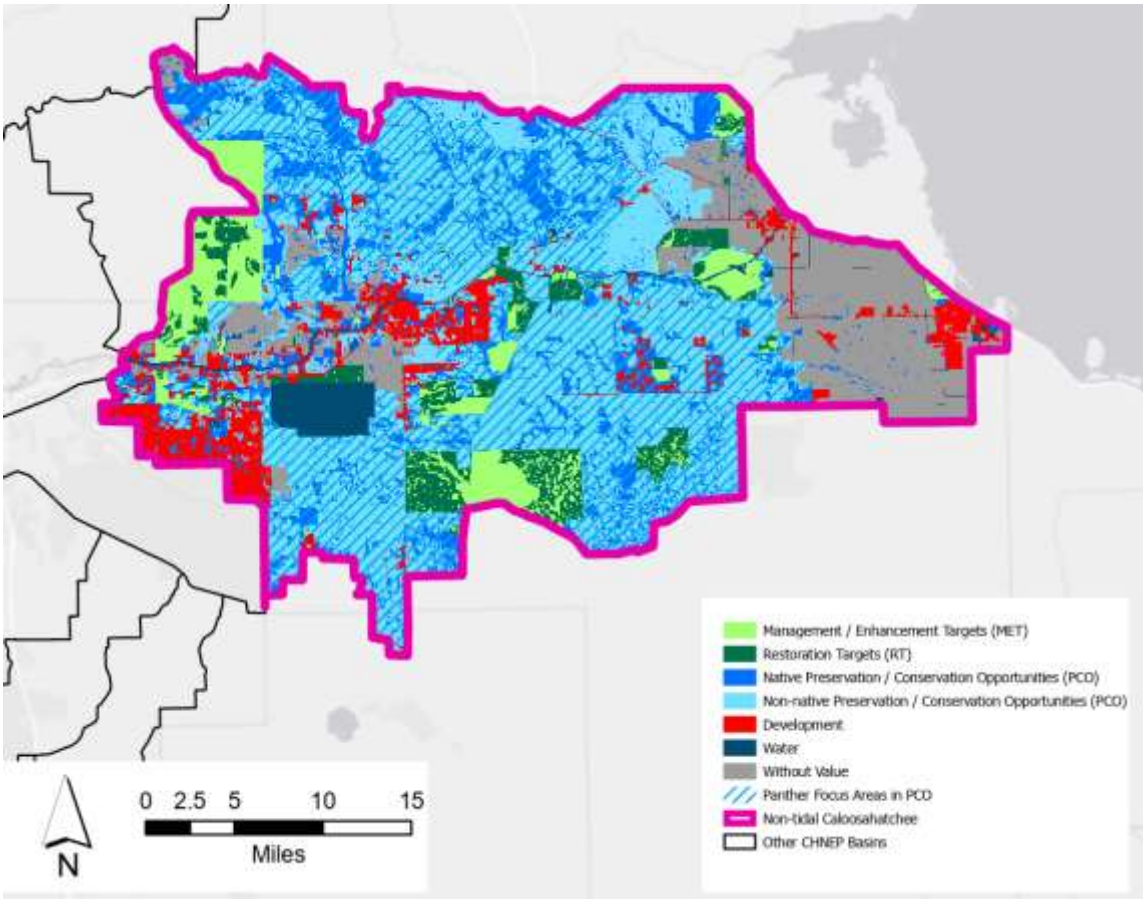

Figure 22
Combined Opportunities Map

TABLE 13
AREA IN ACRES OF ADDITIVE HYBRID COMPONENTS

HRN2 Component	Acres
Existing Development	46,074
Management Enhancement Targets	47,108
Restoration Targets	33,142
Native P/C Opportunities*	105,954
Non-Native P/C Opportunities*	262,808
Without Value	93,552
Water	16,977
Total	605,615
* Panther Focus Areas in PCO	303,017
Webmap link: http://arcg.is/1i4L4P0	

This page intentionally left blank

SECTION 4
Strategy for Regular HRN Updates

Habitat protection and restoration requires an iterative approach driven by the identified goals implemented by stakeholders. In order to make effective progress, the following recommendations are presented:

- Share goals, opportunities, targets, and restoration methodologies developed in the project with resource managers throughout the CHNEP area to manage and plan habitat restoration.
- Continue to poll existing stakeholders and reach out to partner agencies to periodically update their habitat restoration projects and conservations lands database.
- Evaluate progress on the goals developed as part of this HRN project.
- Periodically assess restoration opportunities and targets as new land use data becomes available.
- Consider standardizing land use and land cover mapping methods to remove mapping bias and error between FLUCCS datasets, across time frames and water management districts.

Conservation Update

The strategy above specifically includes the identification of newly acquired lands for restoration in order to: 1) track successful objectives of the HRN; and 2) document updated existing conservation areas. While this report addendum was being developed, updated data indicated that portions of the proposed Florida Forever Devil's Garden project are now conserved by the Florida Forever program. This change effectively replaces Native and Non-native PCO, Panther Priority areas (hatched blue areas in Figure 26) with MET and RO (green areas).

Figure 11 shows the extent of the over 14,000 acres of the almost 83,000-acre project Devil's Garden project within the Caloosahatchee watershed spanning both Hardee and Collier counties. Devil's Garden is categorized as a critical natural lands project and will help preserve a large conservation landscape habitat for the federally Endangered Florida panther. As a working ranch, the project area is primarily improved pasture. Non-forested wetlands, including basin and depression marshes, swales, and wet prairies are common natural communities on the property. Rare species on site include Florida panther, eastern indigo snake, and wood stork.

This page intentionally left blank

SECTION 5
Additional Management Recommendations

5.1 Private Agricultural Land Considerations

The CHNEP expansion area contains a significant amount of private agricultural lands, much of it in active production. Many of these lands score high in the PVR index (productivity, versatility and resiliency) and are 'Nationally Significant', which is the country's best land for long-term production of food and other crops as identified by the American Farmland Trust's Farms Under Threat report (Freegood et al. 2020).

The AHA methodology classifies most of this land area as native and non-native PCO, primarily because these lands also provide critical support to Florida panthers by contributing to their foraging habitat and migration pathways in the watershed on both sides of the Caloosahatchee River. As discussed in Section 3.4.6 above, over 300,000 acres of the almost 370,000 acres of PCO lands are designated by the USFWS as Florida panther focus areas. This is over 80% of the potential conservation lands. Given this perspective of the landscape elicited by the AHA model, it is important to consider how these private lands do not necessarily require acquisition, or a transfer to public management, in order to preserve or conserve panther habitat.

First, numerous studies and datasets show that the features of developed land uses, such as roadways, neighborhoods, and other commercial and industrial developments create conflicts with Florida panthers (FWRI 2020, Schwabb and Zandbergen 2011). Research suggests that Florida panthers alter their movement patterns in response to anthropogenic disturbances associated with development (Prat-Guitart et al. 2020).

Second, as stated succinctly in a 1990 Conservation Biology paper (Maehr 1990), Florida panther conservation strategies "must go beyond traditional land acquisition by government and include economic programs to preserve critical landscapes on private land". However, there is active discussion on how this thinking is applied to panther recovery planning. Previous assumptions, that "panthers are forest obligates and wouldn't move across more than a 90-meter (about 300 feet) gap of non-forest" habitat were demonstrated to be inaccurate by a FWS Scientific Review Team (2003), and by Goss (2005). The migration of male and female panthers across active agricultural landscapes in Hendry county, across the Caloosahatchee River into Glades County, has demonstrated to Florida panther managers that private agricultural lands are important habitats to support successful recovery of Florida panthers.

Lastly, consider how agricultural lands may be preserved, while maintaining their agricultural functions and production, and still supporting Florida panther habitat functions. There are many

programs to support this conservation duality. The FDACS enrolls producers into a Wildlife BMP incentive program (https://www.fdacs.gov/content/download/61100/file/WildlifeBMP_final.pdf). There is not yet a Florida panther wildlife BMP written into the manual, though it is still in the early planning stages. However, participation in FDACS BMP incentive programs are temporary, subject to voluntary participation of the landowners, and as such, BMPs can be terminated if the landowners change their minds about further program participation, or upon sale of the land to new owners.

More binding and permanent conservation programs include the FDACS The Rural and Family Lands Protection Program (https://www.fdacs.gov/Consumer-Resources/Protect-Our-Environment/Rural-and-Family-Lands-Protection-Program). This is an agricultural land preservation program designed to protect important agricultural lands through the acquisition of permanent agricultural land conservation easements. Finally, special conservation easements can be developed between active farmers and wildlife conservation so that lands can maintain multiple uses. The best examples are Logino and Triangle Ranches which are north of the CHNEP expansion area in the Myakka Basin (https://www.conservationfoundation.com/longino-ranch-conservation-area/). This is a 4,000 acre area of privately owned land consisting of native habitats as well as active agriculture that has been in conservation since the 2002. Florida panthers are observed regularly at Logino Ranch.

These types of conservation programs could be important land management tools for the many large agricultural land owners within the Caloosahatchee watershed, as they face increasing financial challenges on continued farm and ranch operations, and increased pressure to sell to development resulting from increasing land prices. Identifying existing conservation tools to assist landowners who wish to maintain their lands in agricultural production and “keep the land in the family” will have the added conservation benefit of preserving these extensive farm and pasture lands for wildlife habitat and migration.

Sunrise at Triangle Ranch in Myakka, Florida. A conserved ranch where farmers and wildlife such as Florida panthers can continue their business on the land well into the future. © Glenn Gardner courtesy of Conservation Foundation of the Gulf Coast

This page intentionally left blank

BIBLIOGRAPHY

Abrahamson, W.G., and D.C. Hartnett. 1990. Pine Flatwoods and Dry Prairies. Chapter 7 (pp. 103-149) in *Ecosystems of Florida*. R.L Myers and J.J. Ewel (eds.). University of Florida Press. Gainesville, Florida.

Beier, P., M. Vaughan, M. Conroy, and H. Quigley. 2003. Analysis of scientific literature related to the Florida panther. Tallahassee (Florida): Florida Fish and Wildlife Conservation Commission Bureau of Wildlife Diversity Conservation. Available: http:// www.myfwc.com/critters/panther/Beier-Panther-SRT.pdf

Cameron, C.R., M.C. Hancock, D.W. Carr, M.K. Hurst, D.E. Campbell, T.J. Venning, P.D. Tara, and K. Rouse Holzwart. 2020. Hydroperiods of Cypress Domes in West-Central Florida, USA. Wetlands 40:1-10.

Carter, L. M., J. W. Jones, L. Berry, V. Burkett, J. F. Murley, J. Obeysekera, P. J. Schramm, and D. Wear. 2014. Ch. 17: Southeast and the Caribbean. Climate Change Impacts in the United States: The Third National Climate Assessment. J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 396-417. doi:10.7930/J0NP22CB.

ESA and Wood. 2019. Habitat Restoration Needs Plan for The Coastal and Heartland National Estuary Partnership Area. CHNEP Scientific and Programmatic Publication. Prepared by Accessed July 7, 2020. https://00f2e13b-36ff-42db-a187-b1a5d3023a82.filesusr.com/ugd/ 252fd8_ed0895280d2a4dbf8366bbff2df2d7c4.pdf .

Florida Fish and Wildlife Conservation Commission (FWC). 2019. Florida's Wildlife Legacy Initiative: Florida's State Wildlife Action Plan. Tallahassee, Florida.

Florida Native Species Planting Guide accessed from: https://efotg.sc.egov.usda.gov/references/ public/FL/612-fl.guidance.A.pine.pdf

Freedgood, J., M. Hunter, J. Dempsey, A. Sorensen. 2020. Farms Under Threat: The State of the States. Washington, DC: American Farmland Trust.

FWRI. Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute. Florida Panther Mortality accessed from: https://atoll.floridamarine.org/arcgis/rest/services/ FWC_GIS/OpenData_FWSppLoc/MapServer/7

Flower, H., M. Rains, and C. Fitz. 2017. Visioning the Future: Scenarios Modeling of the Florida Coastal Everglades. Environmental Management 60.5:989.

Flower, H., M. Rains, Fitz HC, Orem W, Obeysekera J, Newman S, Reddy KR, and Osborne TZ. 2019. Shifting ground: Landscape-scale modeling of soil biogeochemistry under climate change in the Florida Everglades. Environmental Management 64:416-435

Gross, L. (2005). Why not the best? How science failed the Florida panther. PLoS Biol, 3(9), e333.

Hammersmark, C.T., S.Z. Dobrowski, M.C. Rains, and J.F. Mount. 2010. Simulated effects of stream restoration on the distribution of wet- meadow vegetation. Restoration Ecology 18.6:882-893.

Jie, C., Z. Hanting, Q. Hui, W. Jianhua and Z. Xuedi. 2013. Selecting Proper Method for Groundwater Interpolation Based on Spatial Correlation. pp. 1192-1195 in *2013 Fourth International Conference on Digital Manufacturing & Automation*. Qingdao.

Maehr, D. S. 1990. The Florida panther and private lands. Conservation Biology, 4(2), 167-170.

Nilsson KA, Rains MC, Lewis DB, Trout KE. (2013). Hydrologic characterization of 56 geographically isolated wetlands in west-central Florida using a probabilistic method. Wetland Ecology and Management 21:1–14

Oetting et al. 2016 accessed from: https://www.fnai.org/pdf/CLIP_v4_technical_report.pdf

Prat-Guitart, M., Onorato, D. P., Hines, J. E., & Oli, M. K. (2020). Spatiotemporal pattern of interactions between an apex predator and sympatric species. Journal of Mammalogy.

Rains, M.C., Landry, S., Rains, K.C. et al. Using Net Wetland Loss, Current Wetland Condition, and Planned Future Watershed Condition for Wetland Conservation Planning and Prioritization, Tampa Bay Watershed, Florida. Wetlands 33, 949–963 (2013).

Rains, Mark Cable, Jeffrey F. Mount, and Eric W. Larsen. "Simulated changes in shallow groundwater and vegetation distributions under different reservoir operations scenarios." Ecological Applications 14.1 (2004): 192-207.

Schwab, A. C., & Zandbergen, P. A. (2011). Vehicle-related mortality and road crossing behavior of the Florida panther. Applied Geography, 31(2), 859-870.

SFWMD 2014 - 2016 Land Cover accessed from: https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd-land-cover-land-use-2014-2016

SFWMD DB Hydro database accessed from: https://apps.sfwmd.gov/WAB/EnvironmentalMonitoring/index.html

Thatcher, C. A., F. T. van Manen, and J. D. Clark. 2006. Identifying suitable sites for Florida panther reintroduction. Journal of Wildlife Management 70:752-763

The Race for the Caloosahatchee River. Accessed January 20, 2020. https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/race-for-caloosahatchee/

U.S. Fish and Wildlife Service (USFWS). 2008. Florida Panther Recovery Plan (Puma concolor coryi), Third Revision. U.S. Fish and Wildlife Service. Atlanta, Georgia.