CRYSTAL RIVER PRESERVE STATE PARK

Park Chapter

GULF COAST REGION

SURROUNDING LAND COVER
Forests
Agriculture
Salt Marsh & Wetlands
Silviculture

LUTRELL ISLAND
MARJORIE HARRIS-CARR CROSS-FLORIDA GREENWAY
DRUM ISLAND
CRYSTAL RIVER ENERGY COMPLEX (DUKE ENERGY)
POWER LINE RD
To Inglis
To Dunnellon
19
98
488
495
Rocky Cove
Support Area
SEEPAGE STREAM
Eco-Walk Trail
ECO-WALK ENTRANCE
Eco-Walk Office
Salt Creek
HYDRIC
7-Mile Loop Trail
Cedar Creek
FLOODPLAIN SWAMP
HAMMOCK
SALT
MARSH
TALLAHASSEE RD
7-MILE TRAIL/ BOAT BASIN ENTRANCE
CHURCHHOUSE HAMMOCK ENTRANCE
STATE PARK RD
SHELL ISLAND
SNAKE I.
Crystal Bay
Crystal River
FORT ISLAND TRAIL
MULLET HOLE
BOAT BASIN
BIG GRASS I
FORT ISLAND BEACH
CRYSTAL RIVER ARCHAEOLOGICAL STATE PARK
CRYSTAL RIVER
To Inverness
44
CAMP I.
Salt River
SPICE KEY
CRYSTAL RIVER N.W.R
Kings Bay
Gulf of Mexico
Sandy Hook
MULLET KEY
Dixie Bay
DIXIE SHORES TRAILHEAD
MANGROVE
Shark Pt.
BIRD KEYS
Mangrove Pt.
Boat Ramp
Fishing Access Trails
SUNCOAST KEYS
HYDRIC HAMMOCK
494
98
SALT
MARSH
The Narrows
OZELLO TRAIL
Ozello
Fish Creek Bay
ROCK ISLAND
St. Martin's River
BRAZILIAN PEPPER
Greenleaf Bay
Halls River
FLOODPLAIN SWAMP
Homosassa Springs
490
HALLS RIVER RD
490A
Head Creek
DOG I.
Game Creek Bay
Mud Creek
Price Creek
FLOODPLAIN MARSH
Shivers Bay
HYDRIC HAMMOCK
ELLIE SCHILLER HOMOSASSA SPRINGS WILDLIFE STATE PARK
W YULEE DR
MANGROVE
CRAWL KEY
GREEN KEY
SAND KEY
ST. MARTINS KEYS
Homosassa River
To St. Petersburg
YULEE SUGAR MILL RUINS HISTORIC STATE PARK
Homosassa
Tiger Tail Bay
False Channel
Petty Creek
Gustaf Bay
Homosassa Bay
SHELL ISLAND
MENDIT KEY
Mason Creek
North Channel
CHASSAHOWITZKA NATIONAL WILDLIFE REFUGE
Porpoise Bay
Blue Bay

PARK FEATURES
Park Boundary
Shell Mound
Structures
Entrances
Paved Park Roads
Unpaved Park Roads
Hiking Trails

N
W
E
S

CRYSTAL RIVER PRESERVE STATE PARK

CITRUS COUNTY, FLORIDA

0 0.5 1 Miles

INTRODUCTION

LOCATION AND ACQUISITION HISTORY

Crystal River Preserve State Park is located adjacent to the Gulf of Mexico in western Citrus County (see Vicinity Map). Access to the park is from U.S. Highway 19 west to State Park Street. The Vicinity Map also reflects significant land and water resources existing near the park.

Crystal River Preserve State Park was initially acquired on Aug. 20, 1974, as a donation from the Crystal River Development Corporation. Currently, the park comprises 27,667 acres. The Board of Trustees of the Internal Improvement Trust Fund (Trustees) hold fee simple title to the park and on March 7, 1996, the Trustees leased (Lease No. 4084) the property to Division of Recreation and Parks (DRP) under a 50-year lease. The current lease will expire on March 6, 2046.

Crystal River Preserve State Park is designated single-use to provide public outdoor recreation and conservation. There are no legislative or executive directives that constrain the use of this property (see Addendum 1). A legal description of the park property can be made available upon request to the Florida Department of Environmental Protection (DEP).

SECONDARY AND INCOMPATIBLE USES

In accordance with 253.034(5) F.S., the potential of the park to accommodate secondary management purposes was analyzed. These secondary purposes were considered within the context of DRP's statutory responsibilities and resource values. This analysis considered the park's natural and cultural resources, management needs, aesthetic values, visitation, and visitor experiences. It was determined that timber management as part of the park's natural community management and restoration activities could be accommodated in a manner that would be compatible and not interfere with the primary purpose of resource-based outdoor recreation and conservation. This compatible secondary management purpose is addressed in the *Resource Management Component* of the plan.

DRP has determined that uses such as water resource development projects, water supply projects, stormwater management projects, linear facilities and sustainable agriculture and forestry (other than those management activities specifically identified in this plan) would not be consistent with the management purposes of the park.

In accordance with 253.034(5) F.S., the potential for generating revenue to enhance management was also analyzed. Visitor fees and charges are the principal source of revenue generated by the park. It was determined that timber management as part of the park's natural community management and restoration activities could be appropriate at this park as an additional source of revenue for land management since it is compatible with the park's primary purpose of resource-based outdoor recreation and conservation. Generating revenue from consumptive uses or from activities that are not expressly related to resource management and conservation is not under consideration in this management plan.

PURPOSE AND SIGNIFICANCE OF THE PARK

Park Purpose

The purpose of Crystal River Preserve State Park is to protect the mosaic of diverse natural communities that sustain the biologically rich ecosystems comprising one of the state's largest springs complexes and an exemplary estuary, all of which provide outstanding resource-based recreational opportunities such as boating, paddling, fishing, hiking, biking, and nature appreciation.

Park Significance

- Protects the Crystal River, its springshed, and its mixing with the salt water of the Gulf of Mexico saltwater that create one of Florida's most productive and biologically diverse estuaries.

- Diverse natural communities such as salt marsh, hydric hammock, freshwater tidal wetlands, mangrove swamps and pine flatwoods. These natural communities serve as filters protecting the water quality of the estuary and buffers from the impacts of tropical cyclones.

- Protects habitat essential to numerous imperiled species such as the brown pelican, little blue heron, snowy egret, tricolored heron, yellow-crown night heron, ornate diamond-backed terrapin, gopher tortoise and four species of sea turtle.

- Numerous Native American cultural sites are dispersed throughout this coastal preserve.

Central Park Theme

Where a spring-fed river meets the salty Gulf of Mexico, wildlife thrives in a vibrant mosaic of coastal habitats at Crystal River Preserve State Park.

Crystal River Preserve State Park is classified as a state preserve in the DRP unit classification system. In the management of a state preserve, preservation and enhancement of natural conditions is all important. Resource considerations are given priority over user considerations and development is restricted to the minimum necessary for ensuring its protection and maintenance, limited access, user safety and convenience and appropriate interpretation. Permitted uses are primarily of a passive nature, related to the aesthetic, educational and recreational enjoyment of the park, although other compatible uses are permitted in limited amounts. Program emphasis is placed on interpretation of the natural and cultural attributes of the park.

OTHER DESIGNATIONS

The unit is not within an Area of Critical State Concern as defined in section 380.05; Florida Statutes and is not presently under study for such designation. The park is a component of the Florida Greenways and Trails System, administered by the DEP Office of Greenways and Trails.

All waters within the park have been designated as Outstanding Florida Waters, pursuant to Chapter 62-302, Florida Administrative Code. Surface waters in this park are also classified as Class III waters by DEP. The park is

adjacent to the St. Martins Marsh Aquatic Preserve as designated under the Florida Aquatic Preserve Act of 1975 (Section 258.35, Florida Statutes).

PARK ACCOMPLISHMENTS

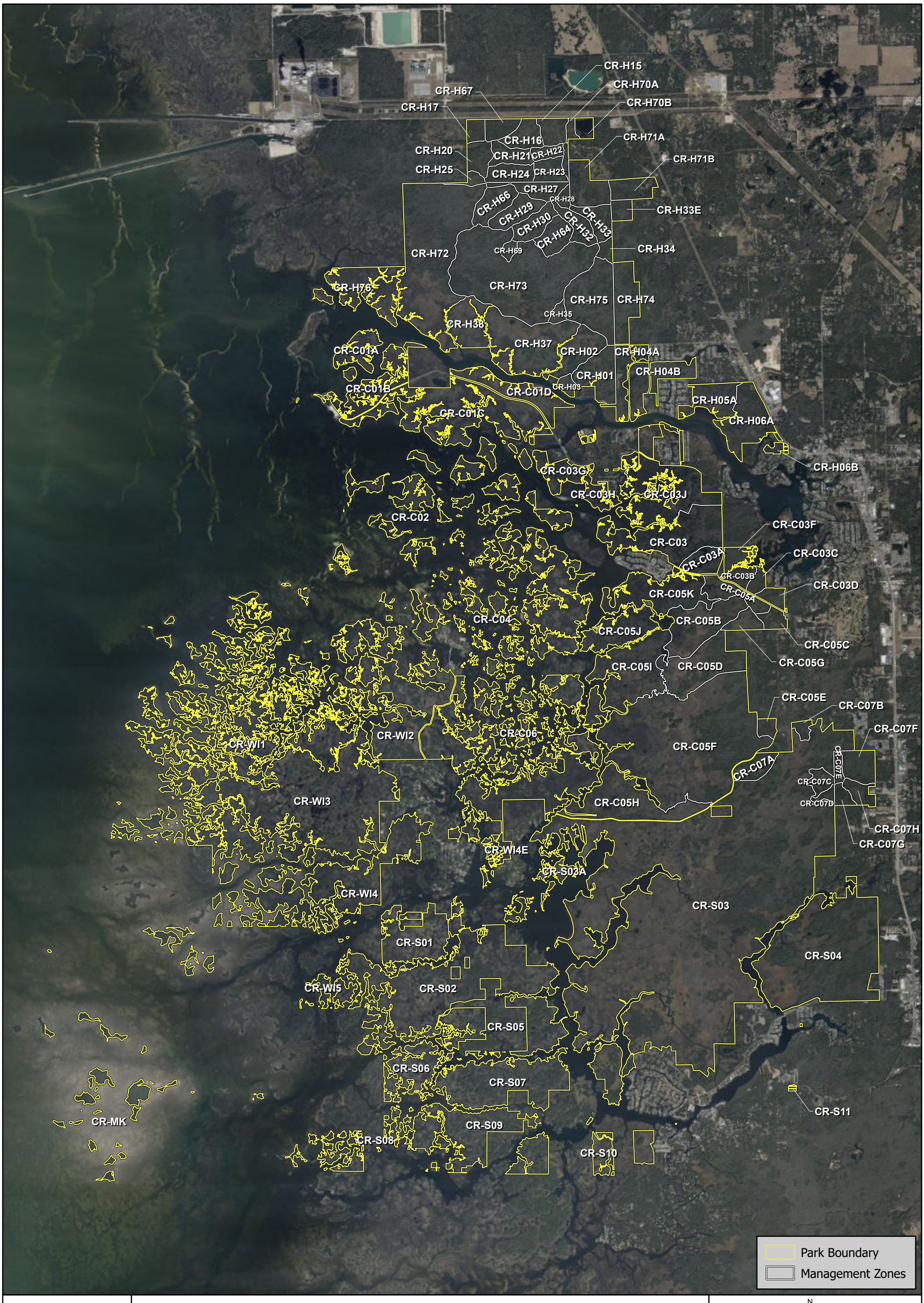
- Treated a total of 206.31 acres with prescribed fire between fiscal years 2018-19 and 2019-20, including some longtime fire-excluded areas.
- Treated 855 acres of invasive plants between fiscal years 2018-19 and 2019-20, including in-house and contracted treatments.
- Conducted mechanical treatment on 52.1 acres of understory live fuels in support of habitat restoration.
- Installed low water crossing and culvert replacements resulting in full restoration of hydrological continuity to 12.76 acres.

RESOURCE MANAGEMENT COMPONENT

Crystal River Preserve State Park Management Zones			
Management Zones	**Acreage**	**Managed with Prescribed Fire**	**Contains Cultural Resources**
CR-C1a	113.56	No	Yes
CR-C1b	252.71	No	Yes
CR-C1c	496.85	No	No
CR-C1d	165.92	No	No
CR-C2	488.05	No	Yes
CR-C3	367.07	Yes	No
CR-C3a	81.79	Yes	No
CR-C3b	47.72	Yes	No
CR-C3c	34.69	Yes	No
CR-C3d	39.47	Yes	No
CR-C3f	51.41	No	No
CR-C3g	102.35	No	No
CR-C3h	77.96	No	Yes
CR-C3j	391.91	Yes	No
CR-C4	777.38	No	Yes
CR-C5a	95.67	Yes	No
CR-C5b	253.63	Yes	No
CR-C5c	44.65	Yes	No
CR-C5d	276.41	Yes	No
CR-C5e	31.68	Yes	Unknown
CR-C5f	1,338.84	Yes	Unknown
CR-C5g	53.15	Yes	No
CR-C5h	333.21	No	No
CR-C5i	360.88	No	No
CR-C5j	180.51	No	Yes
CR-C5k	280.27	Yes	No
CR-C6	1,095.71	No	Yes

Crystal River Preserve State Park Management Zones			
Management Zones	**Acreage**	**Managed with Prescribed Fire**	**Contains Cultural Resources**
CR-C7	484.48	Yes	No
CR-C7a	77.71	Yes	No
CR-C7b	25.95	Yes	No
CR-C7c	46.08	Yes	No
CR-C7d	19.92	Yes	No
CR-C7e	25.58	Yes	No
CR-C7f	95.41	Yes	No
CR-C7h	53.22	Yes	No
CR-H1	151.80	Yes	Yes
CR-H2	137.47	Yes	Yes
CR-H3	26.87	No	No
CR-H4a	114.89	Yes	Yes
CR-H4b	171.97	No	Yes
CR-H5a	134.49	Yes	Yes
CR-H6a	217.63	Yes	Yes
CR-H6b	18.60	No	No
CR-H15	65.81	Yes	No
CR-H16	81.30	Yes	No
CR-H17	38.22	Yes	No
CR-H19	16.86	Yes	No
CR-H20	69.97	Yes	No
CR-H21	70.21	Yes	No
CR-H22	37.89	Yes	No
CR-H23	66.28	Yes	No
CR-H24	78.25	Yes	No
CR-H25	23.10	Yes	No
CR-H26	8.94	Yes	No
CR-H27	70.05	Yes	No
CR-H28	22.35	Yes	No
CR-H29	98.24	Yes	No
CR-H30	86.25	Yes	Yes
CR-H32	76.64	Yes	No
CR-H33	81.07	Yes	No
CR-H33e	41.00	Yes	Unknown
CR-H34	26.93	Yes	No
CR-H35	25.97	Yes	No
CR-H37	376.29	Yes	Yes
CR-H38	156.94	Yes	Unknown
CR-H64	90.07	Yes	No
CR-H66	102.95	Yes	No
CR-H67	57.41	Yes	No
CR-H69	21.13	No	No
CR-H70a	18.59	Yes	No

Crystal River Preserve State Park Management Zones			
Management Zones	**Acreage**	**Managed with Prescribed Fire**	**Contains Cultural Resources**
CR-H70b	34.57	No	No
CR-H71a	136.75	Yes	Unknown
CR-H71b	86.52	Yes	No
CR-H72	818.66	Yes	Yes
CR-H73	827.84	Yes	No
CR-H74*	163.14	Yes	No
CR-H75	277.23	Yes	No
CR-H76	256.77	No	Yes
CR-MK	146.95	No	No
CR-S1	282.09	No	Yes
CR-S2	1,095.83	No	Yes
CR-S3	4,367.11	No	Yes
CR-S3a	213.70	No	No
CR-S4	1,025.71	Yes	No
CR-S5	313.00	No	Yes
CR-S6	197.21	No	Yes
CR-S7	468.62	No	Yes
CR-S8	222.16	No	Yes
CR-S9	308.13	No	Yes
CR-S10	238.11	No	Yes
CR-WI1	1175.5	No	Yes
CR-WI2	708.00	No	Yes
CR-WI3	1,764.37	No	Unknown
CR-WI4	731.60	No	No
CR-WI4e	84.98	No	No



CRYSTAL RIVER PRESERVE STATE PARK
Management Zones

N

0 1 2 Miles

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TOPOGRAPHY

Crystal River Preserve State Park (i.e., Crystal River Preserve, or the preserve) is located within the Gulf Coastal Lowlands and Coastal Swamps physiographic divisions of the Central Geomorphic Zone of Florida (White 1970; Rupert and Arthur 1990; Raabe and Stumpf 1996). Characteristic features of these two physiographic divisions include marine terraces of variable thickness, limestone exposures, and remarkable karst topography (Scott et al. 2014). The marine terraces along the Gulf Coast were formed in the Pleistocene when sedimentary materials were deposited and then gradually eroded away as sea levels fluctuated.

Two marine terraces, Pamlico and Silver Bluff, characterize the Coastal Lowlands. The Pamlico terrace, which is described as being 8-25 feet above mean sea level (msl), comprises most of the Gulf Coastal Lowlands and consequently much of the preserve. The sandy "high" spots in the preserve represent ancient dunes. In the northwest corner of the preserve are areas where the Silver Bluff terrace is exposed. This terrace, the most recently exposed in the region, contains Pleistocene and Holocene sediments at elevations below eight feet msl (Wolfe 1990). Limestone underlies both the Pamlico and Silver Bluff terraces. Together, the two terraces are often categorized as Coastal Swamps (Puri and Vernon 1964; White 1970).

Most of Crystal River Preserve is basically a flat low-lying carbonate coastline (Williams et al. 1999). Elevations range from about 10 feet msl in the uplands to less than one foot msl in the western salt marsh fringes (see Topographic Map). Portions of the thick layer of limestone bedrock underlying the preserve have gradually dissolved over the millennia as acidic water has percolated through the marsh sediments, causing the surface of the limestone to become pitted in appearance. The karst topography that evolved is responsible for development of the area's characteristic landscape of reticulated tidal creeks and elevated marsh islands. The sediment layer overlying the limestone bedrock is thin, and rock outcrops are scattered throughout the preserve. Given the low elevation nature of this preserve, potential impacts of sea level rise to the parks natural and cultural resources are an important management concern (Scavia et al. 2002; Ellis et al. 2004; Dean et al. 2004).

Topographic alterations that occurred before the state acquired the preserve include several major excavations, numerous above-grade access roads, and spoil deposits in several developed areas. Two sizable pits located in the northern part of the preserve are relicts of limestone mining that once took place at the site. The pits are now filled with water; the larger of the two lacks aquatic vegetation because the water is so deep. Three ditches were dug in the area when plans to construct a waterfront residential area were still under consideration. Other topographic alterations in the preserve include old fire plow scars and man-made ponds.

SOILS

Of the seven soil orders that occur in Florida, four are found at Crystal River Preserve - Ultisols, Entisols, Spodosols, and Histosols. A mix of Entisols and Histosols occurs in the coastal marshes, while Histosols underlain by limestone are dominant in the higher elevations of the preserve (Brown et al. 1990). Ultisols and Spodosols are mainly found on some western edges of the preserve. Most soils in the preserve are characterized as poorly drained to very poorly drained. Twenty-nine soil types have been recorded in the preserve (Pilny et al. 1988). A map and complete description of these soils is found in Appendix.

Legend

Park Boundary

Elevation (Feet)

High : 61 ft

Mid : 32 ft

Low : Sea Level

20

15

30

10

5

Highest Point : 19.5 ft

Park Entrance

CRYSTAL RIVER PRESERVE STATE PARK

N

0 0.25 0.5 1 Miles

Florida Department of Environmental Protection
Division of Recreation and Parks
Date of aerial; 2011

TOPOGRAPHY MAP

Most of the 29 soil types fall within one or the other of two general soil associations: flatwoods soils (i.e., Boca-Broward-Redlevel and Bassinger-EuGallie-Myakka) and coastal swamp, marsh and island soils (i.e., Homosassa-Weekiwachee-Durbin and Rock outcrop-Hallandale-Homosassa) (Pliney et al. 1988). However, remnants of upland ridge soils (i.e., Tavares-Adamsville) occur along the western edge of the preserve and the Homosassa River region contains a unique coastal swamp soil association (i.e., Okeelanta-Lauderhill-Terra Ceia).

The two general soil associations are subdivided into six specific soil associations: Boca-Pineda limestone complex, Myakka-EuGallie limestone complex, Homosassa muck, Weekiwachee-Durbin muck, Hallandale rock outcrop complex and Rock outcrop-Homosassa-Lacoochee complex. Soils in the Boca complex are generally associated with limestone. These soils, found predominantly in the northernmost areas of the preserve, do not reach great depths but are the sandiest of the major series within the preserve. The Myakka-EuGallie soils complex, also associated with limestone bedrock, is found predominately along the western edge of the preserve in coastal cabbage palm flatwoods.

The Homosassa muck series is typically associated with salt marsh. The mucky soils flood daily during high tides. Strongly associated with the Homosassa muck series is the Weekiwachee-Durbin muck series, found in adjacent freshwater tidal marshes. These soils are nearly at sea level, contain a high degree of decomposed organic matter, and are very poorly drained.

Soils in the Hallandale-Rock outcrop complex are poorly drained mineral soils usually adjacent to saltmarsh. The limestone bedrock is no more than 20” from the surface. Tides cause flooding where these soils occur and marsh islands are the typical habitat found there. The islands are overlain by salt marsh or mangrove stands. The easternmost soil association within the preserve is the Rock outcrop-Homosassa-Lacoochee complex. The individual areas of limestone outcrop are generally small and scattered, however exposed large flat surfaces pitted with solution holes can be found.

Soils

- 2 - Adamsville fine sand, 0 to 2 percent slopes
- 5 - Basinger fine sand, 0 to 2 percent slopes
- 7 - Myakka-myakka, wet, fine sands, 0 to 2 percent slopes
- 11 - Tavares fine sand, 0 to 5 percent slopes
- 12 - Immokalee fine sand
- 13 - Okeelanta muck
- 20 - Pits
- 22 - Quartzipsamments, 0 to 5 percent slopes
- 23 - Weekiwachee-durbin mucks
- 24 - Okeelanta-lauderhill-terra ceia mucks
- 27 - Pomello fine sand, 0 to 5 percent slopes
- 28 - Redlevel fine sand
- 35 - Sparr fine sand, 0 to 5 percent slopes
- 36 - Eaugallie fine sand
- 37 - Matlacha, limestone substratum-urban land complex
- 38 - Rock outcrop-homosassa-lacoochee complex
- 39 - Hallandale-rock outcrop complex, rarely flooded
- 40 - Homosassa mucky fine sandy loam, 0 to 1 percent slopes
- 46 - Eaugallie fine sand, frequently ponded, 0 to 1 percent slopes
- 48 - Arents, 45 to 65 percent slopes
- 49 - Terra ceia-okeelanta association, very frequently flooded
- 50 - Kanapaha-kanapaha, wet, fine sand, 0 to 5 percent slopes
- 51 - Boca-pineda, limestone substratum complex
- 53 - Boca fine sand
- 55 - Udorthents, 0 to 5 percent slopes
- 58 - Myakka, limestone substratum-eaugallie, limestone substratum complex
- 59 - Boca fine sand, depressional
- 60 - Broward fine sand
- 61 - Orsino fine sand, 0 to 5 percent slopes
- 64 - Citronelle fine sand
- 99 - Water
- 100 - Waters of the Gulf of Mexico

CRYSTAL RIVER PRESERVE STATE PARK
Soils

N

0 1 2 Miles

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HYDROLOGY

Crystal River Preserve State Park is a significant part of a broad, karst-dominated landscape located along a lengthy stretch of relatively undeveloped coastline in western Citrus County. In this area, there are numerous spring-fed rivers embedded within a large matrix of hydric hammock, salt marsh, mangrove swamp, seagrass and other nearshore habitats that provide a constant source of fresh water to a relatively stable estuarine environment (Raabe and Stumpf 1996; Mattson et al. 2007). St. Martins Marsh Aquatic Preserve (AP) lies adjacent to and shares a common boundary with much of Crystal River Preserve State Park. Big Bend Sea Grasses Aquatic Preserve and St. Martins Marsh Aquatic Preserve comprise Florida's most significant publicly managed estuary and contain the largest seagrass beds in the state (DEP 2014).

Crystal River Preserve State Park is located within the southern extent of Florida's Big Bend coastline but is more specifically within the northern third of the Springs Coast region (Wolfe 1990). This unique region encompasses approximately 2,000 square miles of coastal area from the Waccasassa River in Levy County south to the Anclote River in Pasco County. The Springs Coast region is appropriately named because of its five known springsheds and seven major river systems, including the Crystal and Homosassa rivers, both of which pass through Crystal River Preserve State Park.

The most prominent hydrological features in the park are these two spring-fed river systems, each defined by its own springshed, plus plentiful estuarine habitat and an expanse of one of the largest remaining stands of hydric hammock in the state (Simmons et al. 1989). Hydric hammock communities along the west coast of Florida, including those at Crystal River Preserve State Park, have undergone dramatic changes from rising sea levels for at least the past 30 years (Williams et al. 2003; Ellis et al. 2004; Dean et al. 2004).

Scientists that have worked immediately north of Crystal River in the Big Bend region over the past three decades have documented that Florida's west coast shorelines have been undergoing a dramatic natural community transformation from previously dominated freshwater systems to one that is predominately salt water (Casteneda and Putz 2007). It is unknown how many freshwater wetlands in the park, especially any that might contain groundwater fractures, have converted into brackish systems as a result of lowered aquifer levels from significant historic droughts, increased groundwater demand or changes associated with global sea level rise (Johnston and Bush 1988; Williams et al. 1999; Raabe et al. 2004; Knight 2015 Williams et al. 2003).

Flows in Crystal River and Homosassa River are derived from large spring complexes situated within an expansive groundwater discharge area fed directly by the Floridan aquifer (Jones et al. 1997; Yobbi and Knochenmus 1989a). The Crystal and Homosassa rivers and St. Martins Marsh Aquatic Preserve are all classified as Outstanding Florida Waters (OFW).

The Crystal River/Kings Bay springs complex (Crystal River Springs) is the second largest spring group in the state. It is classified as a Class III waterbody (Jones and Upchurch 1994; Champion and Starks 2001). There are more than 70 springs within the 600-acre Kings Bay embayment that constitute the headwaters of Crystal River Springs. All drain westerly for approximately 7 miles before entering the Gulf of Mexico (Citrus/Hernando Waterways Restoration Council 2013). The average discharge of this springs group ranges from 878 cubic feet per second (473 million gallons per day) to 1,053 cubic feet per second (567 million gallons per day) (Spechler and Schiffer 1995; Champion and Starks 2001; Scott et al. 2004). According to the Southwest Florida Water

Management District (SWFWMD), the groundwater contributing area for the Crystal River springshed is about 310 square miles, roughly the northern half of Citrus County (SWFWMD 2015a).

The Homosassa springs complex consists of more than 25 named springs that coalesce to form the Homosassa River, a Class II waterbody that flows westward for nearly 8 miles before emptying into the Gulf of Mexico (Leaper et al. 2012). The average discharge of this springs complex ranges from 354 cubic feet per second (190 million gallons per day) to 425 cubic feet per second (229 million gallons per day) (Jones et al. 1997; Champion and Starks 2001). The groundwater contributing area for the Homosassa springshed is about 270 square miles, roughly the southern half of Citrus County and eastern Hernando County (SWFWMD 2015b).

Minimal surface drainage occurs in the Springs Coast region. The major influences on surface water movement are Gulf of Mexico tides and groundwater flow from the Floridan aquifer (Fretwell 1983; Yobbi 1989; Yobbi and Knochenmus 1989b). The aquifer is unconfined throughout this coastal region and recharge is derived almost entirely from rainfall that occurs within each defined springshed. Groundwater flow is generally from east to west and aquifer discharge to the surface occurs at springs, submarine vents and lesser known fractures and seeps (Raabe and Bialkowska-Jelinska 2007). The continuous discharge of groundwater into Springs Coast estuaries plays an absolutely essential role in maintaining the health and productivity of the coastal ecosystems (Raabe and Bialkowska-Jelinska 2010). Average annual rainfall for the Springs Coast approaches 56 inches per year (Jones et al. 1997; Fernald and Purdum 1998). Measured rainfall in the park over the last 10 years has ranged from 28.5 to 65.7 inches per year, with an average of 47.6 inches.

The Floridan aquifer is the principal source of most of the water used in the area (Jones et al. 1997). Sands of varying thickness overlie the limestone and dolomite formations of the Floridan aquifer in the area. A surficial aquifer is not present in the coastal uplands, including within the park (Fretwell 1983). In fact, the upper boundary of the Floridan aquifer is at or very near the land surface within the park, as evidenced by the predominance of small, scattered karst dissolution features such as limestone outcrops (Raabe and Bialkowska-Jelinska 2010). Sinkholes and small fractures in the exposed limestone are commonplace in the park, and crystalline clear blue groundwater is often visible in the openings.

The watersheds of the Homosassa and Crystal rivers contain numerous short, meandering, perennial freshwater creek systems, including Salt, Dolphin, King, Game, Price, Deer, Gomez, and Crab creeks, some of which originate within the park. Nearly all of these perennial streams are Class II or Class III waterbodies and exhibit tidal characteristics.

For the most part, surface water drainage within the park is poor and large areas often flood. Much of the park's upland area drains directly into hydric hammocks and tidal creeks, and eventually to estuarine waters. Tidal fluctuations occur throughout the park, transporting large quantities of brackish water through networks of perennial freshwater streams, floodplain marsh creeks and embayments.

Wetlands are distributed through much of the park. By far the most dominant wetland habitat is salt marsh. Prior to their incorporation into Crystal River Preserve State Park, many salt marshes in the area had been altered by canals, ditches and berms for a variety of reasons, including future development. Other ditches, intended to drain wetlands or the U.S. Highway 19 corridor, are located within uplands in the park.

The coastal hydric hammock natural community, which occurs inland from the salt marsh, has a significant impact on hydrologic processes within the landscape (Wharton et al. 1977; Vince et al. 1989). During periods of heavy rainfall, hydric hammocks often flood. Surface water travels through this community as sheetflow, eventually entering streams that connect to estuarine waters. Through the temporary storage of surface water,

hydric hammock improves water quality and attenuates freshwater pulses into estuarine systems (Vince et al. 1989; Wolfe 1990). For at least 25 years, sea level rise has played a pivotal role in the conversion of several hydric hammock stands on the park into salt-dominated communities (e.g., salt marsh/mangrove) (Williams 2003; Ellis et al. 2004).

Numerous karst ponds are scattered throughout the park, ranging from brackish to freshwater. Salinity levels associated with particular ponds generally determine the biotic nature (i.e., brackish or freshwater) of these systems (Abbott and Judd 2000). Water sources for the ponds may include the Floridan aquifer, rainfall and tidal input from the Gulf of Mexico.

Watershed Issues: Alterations, withdrawals, saltwater intrusion, and enrichment

Complex interactions between surface waters and groundwater play a significant role in steering ecological processes in coastal ecosystems of the Springs Coast region (Raabe and Bialkowska-Jelinska 2007). Within the broad interface between estuarine and terrestrial systems in the region, major issues of concern include watershed alteration, groundwater withdrawal, saltwater intrusion and nutrient enrichment.

Watershed alterations

The excavation of mine pits and ditches, disruption or impoundment of natural sheetflow, and withdrawal of groundwater in the region are examples of watershed alterations that could negatively affect natural hydrological regimes in the park. Two notable excavations remaining from the limestone mining era in what is now Crystal River Preserve State Park are Mullet Hole (by Sailboat Avenue) and Powerline Quarry Pit. The Mullet Hole excavation is probably associated with an artificially created waterway between a local neighborhood development and Kings Bay. Portions of Mullet Hole are currently used for recreational fishing activities in the park. The Powerline Quarry Pit is an impoundment/artificial waterbody. Specific water quality parameters for the sites are unknown, however Powerline Quarry Pit appears to have a distinct connection with the Floridan aquifer.

Powerline Quarry Pit essentially consists of two excavations. The larger excavation is a crystalline clear, water-filled impoundment while the smaller one is a shallow pond. The two are separated from each other by an unpaved road. The primary pit, measuring 19.3 acres, is approximately 1,300 feet at its widest. Bordered by large limestone boulders, this pit is extremely steep-sided with essentially no littoral shelf. Depths range from 17 to 40 feet. The shallow pit supports some native vegetation that has become established over the years. Prior to being mined, the Powerline Quarry Pit area once supported mesic flatwoods, mesic hammock, basin marsh and dome swamp. There has been some discussion about possibly initiating restoration activities at Powerline Quarry Pit. The main focus of restoration there would be to enhance littoral habitat for the purpose of improving limnologic characteristics of the waterbody.

Several limestone mining operations adjacent to the park (e.g., Red Level, Crystal River Quarry and Inglis Quarry) are currently active, including one located on the northeastern park boundary (Nature Coast Mine) that was recently issued state approval to proceed. The proposed Nature Coast Mine is adjacent to the park's Powerline Quarry Pit. The potential cumulative impacts of these operations on water resources in the park are unknown, however water scientists suggest that groundwater mining can adversely influence ecological functions (Lines et al. 2012).

Other wetland alterations in the park have caused disruption of natural sheet flow regimes. Access roadways that pass through the park in various locations have fragmented the park's forested wetlands and tidally influenced communities to varying degrees. Given the park's location adjacent to a moderately sized city, it is

not surprising that some areas have become fragmented by roadways. For example, Fort Island Trail and Ozello Trail are major paved highways that pass through large portions of the park, bisecting numerous wetland communities. Mitigating the disruptions of natural sheet flow caused by these highways, as well as by unpaved roadways within the park, is a major focus of park restoration activities.

Most of the access roads that pass through the park were built prior to state acquisition. Many of the roads were raised in elevation by using stockpiled dredge material from canal/ditch excavations. There are also numerous historic ditches/canals scattered throughout the salt marsh areas of the park. Some of these excavations are associated with retention ponds or with roadside drainage improvements. It is not uncommon for park personnel to observe flooding conditions along various access roads within the park. In fact, certain roads in tidally influenced wetlands are known to be particularly vulnerable to washouts.

To improve drainage in locations where roads have been obstructing natural tidal flows, park staff have installed culverts of appropriate size and shape. For example, natural brackish water fluctuations in at least two tidal creeks in the Hollins tract (King's and Dolphin creeks) and in adjacent wetlands were improved in 2002 by the installation of large box culverts. Many other culverts of various sizes have been installed in the park and they appear to have partially re-established the dynamic tidal equilibrium.

Groundwater withdrawal

Many water managers have long been concerned about the unsustainable depletion of groundwater resources in the Floridan aquifer (Bush and Johnston 1988; Grubbs and Crandall 2007; Copeland et al. 2011). Concerns were heightened during the 1998-2002 and 2010-12 droughts, as water scientists documented significant declines in spring discharge at nearly all of Florida's first magnitude springs, including those along the Springs Coast (Copeland et al. 2011; Pittman 2012). One recent statewide analysis concluded that the drought of 1999-2001 had precipitated significant negative health trends in all the spring systems in the state, including Crystal and Homosassa, because of lowered groundwater levels, significant saline encroachment and simultaneous increases in groundwater use during one of Florida's worst droughts on record (Verdi et al. 2006).

Whether the evidence indicates that fluctuations in groundwater supply are natural (i.e., due to Atlantic multi-decadal oscillation) or anthropogenic (i.e., due to water supply withdrawals) is still being debated (Kelly 2004; Williams et al. 2011). Nonetheless, coastal springs have experienced significant increases in lateral saline encroachment compared to inland systems because of their proximity to the fresh/saline interface (Marella and Berndt 2005; Hydrogeologic Inc. 2011).

Saltwater encroachment along Florida's coasts has long been recognized as a threat to groundwater quality (Fairchild and Bentley 1977; Fretwell 1983). In the Springs Coast region, a natural saltwater wedge that diminishes in thickness landward extends inland from the gulf, intruding into the Floridan aquifer.

The depth of the saline wedge ranges from zero at the coast to around 250 feet inland (Fernald and Purdum 1998; Guvanasen et al. 2011). Boundaries of the zone of transition from saltwater (19,000 milligrams per liter chloride) to freshwater (25 milligrams per liter chloride) can fluctuate in response to changes in aquifer recharge and discharge (Fretwell 1983). It is highly probable that saltwater intrusion into the Floridan aquifer contributes to the brackish nature of surface waters within the park and that this phenomenon may alter the water chemistry of freshwater ponds over time.

It has been demonstrated that during periods of low groundwater levels, seawater can move inland through existing dissolution channels and mix directly with waters of the Floridan aquifer (Tihansky 2004; Shaban et al. 2005). In addition to the conduits in the aquifer, the limestone bedrock underlying the Floridan aquifer

contains large, interconnected fractures and faults that trend either northeast or northwest. These are referred to as "preferential flow pathways" (Lines et al. 2012). Flow pathways have the ability to extend adverse water quality or quantity impacts over a much larger region than just at a local point source. For example, saltwater intrusion in Pinellas County expanded significantly through preferential flow paths when groundwater levels were artificially lowered during localized extractions from water supply fields that were placed too close to the coastline (Tihansky 2004).

A recent statewide analysis of water quantity and quality variables compared groundwater and spring water parameters from 1991 to 2003 (Copeland et al. 2011). Specifically during that period, analysis indicated that the Floridan aquifer's freshwater "lens" had decreased significantly in volume and that significant saltwater encroachment had occurred throughout most of the state.

Nutrient enrichment

Over the past 40 years, the Springs Coast region along much of the eastern boundary of the park has experienced rapid development and human population growth. Water scientists now attribute the cumulative effects of increased groundwater consumption, saltwater encroachment and nutrient enrichment, especially within recognized springsheds, as an explanation for deteriorating estuarine and freshwater resources in this region (Copeland et al. 2011).

One example of the declining health of coastal spring ecosystems is that, as late as the 1970s, spring-run streams found within the Crystal and Homosassa River complexes supported dense and biologically diverse assemblages of submerged aquatic vegetation (SAV) (Odum 1957; Whitford 1956; Frazer et al. 2011, Jacoby et al. 2014). Long-term freshwater springs monitoring in this region has indicated that precipitous declines in SAV abundance occurred over the last decade (Frazer et al. 2007). It is now widely recognized that increased levels of nuisance algae, along with nutrient enrichment, are symptoms of the declining ecological health of springs in Florida (Kolasa and Pickett 1992; Hornsby et al. 2000; Stevenson et al. 2007; Brown et al. 2008; Jones et al. 1997; Munch et al. 2006; Cohen et al. 2007; Albertin et al. 2007; Wetland Solutions Inc. 2010).

In 1989, Crystal River/Kings Bay was declared a priority waterbody within the SWFWMD's Surface Water Improvement and Management (SWIM) program (SWFWMD 1999). The SWIM plan was extensively updated in 2016 with numerous restoration projects proposed for the springshed of this important spring group (SWFWMD 2016). Because of observed reductions in water clarity, decreases in SAV and the spread of nuisance aquatic vegetation/algae, water managers established a number of water quality improvement projects in Crystal River and Kings Bay that will help to restore historic surface water conditions within these impaired OFWs (Jones and Upchurch 1994; Jacoby et al. 2014). In 2013, the SWFWMD also acknowledged the importance of long-term research and assessment in all known springsheds within the Springs Coast region and pushed forward with a process to classify three additional priority springs (Homosassa, Chassahowitzka, and Weeki Wachee).

In 1996, DEP initiated a formal, statewide monitoring program for surface waters and groundwater, including waters within the Springs Coast region (Maddox et al. 1992; DEP 2005). These efforts were expanded in 2000. This program, called the Integrated Water Resource Monitoring Program (IWRMP), follows a comprehensive watershed approach based on natural hydrologic units. The 52 hydrologic basins in Florida are on a five-year rotating schedule that allows water resource issues to be addressed at different geographic scales (Livingston 2003). In addition, the IWRMP assigns a waterbody identification number (WBID) to each waterbody. This watershed approach provides a framework for implementing Total Maximum Daily Load (TMDL) requirements to restore and protect waterbodies that are declared impaired (Clark and DeBusk 2008).

Two water quality assessments for waterbodies in the Springs Coast region have already been accomplished (DEP 2006; DEP 2008). Several Crystal River/Kings Bay waterbodies have been declared impaired and have had TMDLs assigned to them (Bridger 2014).

Objective A: Conduct/obtain an assessment of the park's hydrological restoration needs.

- Action 1 - Continue to cooperate with other agencies and independent researchers in hydrological research and monitoring programs.
- Action 2 - Continue to monitor and track surface and groundwater quality issues within the region, especially concerning natural and cultural resource impacts associated with sea level rise.
- Action 3 - Continue to monitor land-use or zoning changes in the region and offer comments as appropriate.
- Action 4 - Continue to cooperate with the SWFWMD to establish meaningful MFLs in order to ensure maintenance of historic flows.
- Action 5 - Seek funding for dye trace studies within the two major springsheds to determine groundwater sources for karst features within the park.
- Action 6 - Conduct dye trace studies within the two major springsheds to determine groundwater sources for karst features within the park.

Significant hydrological features within Crystal River Preserve State Park include two major spring complexes and several perennial freshwater creek systems, as well as multiple karst solution features. Preservation of surface water and groundwater quality, and control of erosion and sedimentation into creek systems and karst features, will remain top priorities for DRP. The following are hydrological assessment actions recommended for Crystal River Preserve State Park.

DRP will continue its tradition of close cooperation with state and federal agencies and independent researchers engaged in hydrological research and monitoring programs within the park and the adjacent Crystal River, and it will encourage and facilitate additional research in those areas. Agencies such as the SWFWMD, the U.S. Geological Survey (USGS) and DEP will be relied upon to keep DRP apprised of any declines in surface water quality or any suspected contamination of groundwater in the region. DRP staff will continue to monitor and document any potential changes within hydric hammock or coastal forest communities, as well as any known archaeological resources that might be impacted by sea level rise. District 2 staff will continue to monitor Environmental Resource Permit (ERP) and Water Use Permit (WUP) requests for the region in order to provide timely and constructive comments that promote protection of the park's water resources. Additional cooperative efforts may include facilitating the review and approval of research permits and providing researchers with assistance in the field. Recommendations derived from the monitoring and research activities will be essential to the decision-making process during management planning.

The proximal sources of flow from the Floridan aquifer to karst features in the park are still unknown. To remedy that, DRP staff should continue to document any significant karst features within the park, especially those that might have a direct groundwater connection. Additionally, DRP should continue to encourage hydrological studies that are designed to delineate the two major springsheds associated with the park (as discussed in the *Hydrology* section above). Previous dye trace studies in other managed springsheds in Florida have provided park managers with invaluable information about the various sources of springs and the timing of surface to groundwater interactions that potentially affect important surface water bodies. In order for water managers to be able to protect water quality and potentially restore spring flows to their historic levels,

they will need to know the extent of the springshed. To facilitate that process, DRP should seek funding for dye trace studies to determine the groundwater sources for karst features in the park.

DRP will continue to monitor land-use or zoning changes within lands bordering the park. Major ground disturbances on neighboring properties or inadequate treatment of runoff into local streams could ultimately cause significant degradation of resources in the park. When appropriate, District 2 staff will provide comments to other agencies regarding proposed changes in land use or zoning that may affect the park. In addition, District 2 staff will closely monitor major limestone mining operations in the watershed upstream of the park and watch for significant changes that may adversely affect resources in the park.

DRP will continue to work closely with the SWFWMD to ensure that MFLs developed for the Crystal River Springs complex are implemented conscientiously and that historic groundwater flows are protected.

***Objective B*:** Restore natural hydrological conditions and functions to approximately 648 acres of salt marsh, 139 acres of freshwater tidal marsh, 213 acres of hydric hammock and floodplain swamp and 44 acres of wet flatwoods natural communities.

- Action 1 - Conduct an assessment and evaluate the hydrological impacts in the park, including drainage ditches and areas where natural sheetflow has been interrupted.
- Action 2 - Develop a hydrological restoration plan with prioritized projects for the park, including mitigation of the impounding effects of the western leg of the Seven Mile Loop Trail.
- Action 3 - Install low water crossing in zones CR-H71a and CR-H71b (1,245 feet) to improve wetland sheetflow.
- Action 4 - Install approximately 440 feet of low water crossing in zone CR-C05 to provide access and retain water flow across fire lines.
- Action 5 - Remove berm and backfill drainage ditches in zones CR-S4 (12,830 feet) and CR-S3 (16,785 feet) to restore wetlands to historic grade.
- Action 6 - Evaluate the removal of approximately 3,810 total feet of fill roads in several of the park's northernmost zones. Restore roadbeds to natural grade with appropriate stabilization as feasible.

Staff will initiate hydrological restoration measures for natural systems in the park wherever wetland communities have been artificially impounded or ditched and where ecological functions have been disrupted. If the park biologist determines that roads passing through wetland communities are significantly altering natural hydrological regimes, then DRP, using best management practices, will initiate corrective actions such as installing low water crossings or culverts in appropriate locations. In some cases, complete removal of above-grade roads may be warranted, especially if they no longer serve a useful purpose. These roads should be abandoned, and elevations restored to the historic grade of the adjacent natural landscape.

NATURAL COMMUNITIES

Crystal River Preserve State Park contains 20 distinct natural communities and 10 different altered landcover types (see Natural Communities Map). A list of plants and animals known to occur in the park is contained in Addendum 5.

Limestone Outcrop

As might be expected given the karst landscape prevalent in the area, Crystal River Preserve State Park contains numerous limestone exposures. These occur as limestone outcrops situated along the sides of

sinkholes and as large limestone boulders. Due to their limited size and erratic distribution, only selected examples of limestone outcrops and boulders are depicted in this plan's natural community map.

The limestone outcrops in the park are considered to be in good to excellent condition. Most are located well away from trails or roads or are screened from public view by abundant vegetation or undulating terrain. A few are visible along the banks of waterways such as the Crystal River. There are currently no apparent threats from invasive plants.

Limestone outcrops in the park must be protected from disturbance, especially any that are located near public access areas. Staff should take measures to prevent runoff and erosion from degrading the outcrops, particularly near existing trails or roadways. Personnel involved in the control of invasive plants in sinkholes and upland hardwood or bottomland forests should consider it likely that limestone outcrops or boulders harboring rare plants are nearby and should minimize ground disturbance and overspray of herbicide as much as possible. Mapping of significant limestone outcrops, accompanied by surveys for imperiled plant species, will be necessary to ensure their long-term protection.

Mesic Flatwoods

The mesic flatwoods community in the park occurs primarily north of the Crystal River at slightly higher elevations than the adjacent hydric hammock and freshwater tidal marsh communities. There are small patches of mesic flatwoods south of the river between Fort Island Trail (State Road 44 west) and Ozello Trail (County Road 494). These are relatively untouched and fire-excluded, but several hundred acres of flatwoods north of the river, prior to state acquisition, were used by the turpentine/naval store industry, divided into hunting parcels or cleared of original tree cover (mostly longleaf pines) and planted with off-site slash and loblolly pines (in 1973-74). Throughout the period before state acquisition, there was a practice of seeding all trails with centipede grass (*Eremochloa ophiuroides*) to minimize mowing needs. This grass has started to invade some zones that are opening due to timber harvests and prescribed fires.

Since 2001, various management practices, including four pine harvests, the reintroduction of fire, elimination of unused trails, control of turf grasses including centipede grass, removal of invasive cabbage palms, and planting of containerized longleaf pine seedlings, have encouraged the return of most of these areas from pine plantation to mesic flatwoods in various stages of restoration. One artifact of prior ground preparation in pine plantations is that some areas retain light to moderate disturbance features such as linear ridges several inches in height that are typical of machine planting. In addition, saw palmetto cover is atypically light in large areas due to the practice of bulldozing surface vegetation into large linear mounds or windrows prior to planting, roughly every sixth row. Visual evidence of the clearing of this palmetto layer can be seen in historic aerial photographs from the early 1970s. In most areas, the mounds of vegetation have long since rotted away or burned, but in zone CR-H33e the excessive depth of the scraping produced several long soil berms up to 5 feet above grade that remain.

Past periods of fire suppression and disturbance, particularly prior to state acquisition, caused much of the mesic flatwoods in the park to become more overgrown with woody shrubs, cabbage palms and saw palmetto than would have occurred under a natural fire regime. The use of prescribed fire and tree girdling has largely controlled the invasion of flatwoods by off-site hardwoods such as laurel oak and water oak at most sites. The cabbage palm invasion of mesic flatwoods formerly disturbed by silvicultural activities is still a widespread problem, however. This invasion is exacerbated by the mechanical removal of saw palmetto in some areas. In the worst areas, the natural community resembles a form of palm-dominated mesic hammock with some hardwoods and plantation remnant slash and loblolly pines interspersed. Substantial effort will be required to fully restore these sections to the desired future condition. In certain flatwoods along the coast or in hammock

Natural Communities (in Acres)

- AFP - Abandoned Field/Abandoned Pasture 114.89
- AP - Artificial Pond 11.40
- BA - Borrow Area 88.98
- BM - Basin Marsh 172.78
- BS - Basin Swamp 338.43
- CD - Canal/ditch 46.65
- DM - Depression Marsh 137.44
- DS - Dome Swamp 11.62
- DV - Developed 26.17
- ECNS - Estuarine Consolidated Substrate 11.04
- EUS - Estuarine Unconsolidated Substrate 203.11
- FM - Floodplain Marsh 998.42
- FS - Floodplain Swamp 599.72
- HH - Hydric Hammock 6005.82
- IEM - Invasive Exotic Monoculture 179.`8
- LO - Limestone Outcrop 5.41
- MEH - Mesic Hammock 105.45
- MF - Mesic Flatwoods 1257.33
- MS - Mangrove Swamp 1657.18
- PP - Pine Plantation 19.49
- RD - Road 4.64
- RNC - Restoration Natural Community 29.73
- SA - Spoil Area 161.74
- SAM - Salt Marsh 14486.60
- SC - Scrub 56.16
- SCF - Scrubby Flatwoods 351.34
- SH - Sandhill 52.74
- SHF - Successional Hardwood Forest 120.01
- SHM - Shell Mound 40.73
- SKLK - Sinkhole Lake 2.54
- SST - Seepage Stream 26.37
- WF - Wet Flatwoods 236.38
- XH - Xeric Hammock 119.66

MEH
MF
BA
SST
ABP
BS
MF
CD
BS
HH
FS
FS
SAM
FM
SA
SHF
FM
HH
BS
SCF
SCF
BM
EUS
SAM
SC
SH
DV
CD
SAM
IEM
HH
FS
BM
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SAM
FM
HH

CRYSTAL RIVER PRESERVER STATE PARK
Natural Communities - Existing Conditions

N

Miles

0 1 2

This graphical representation is provided for informational purposes and should not be considered authoritative for navigational, engineering, legal, and other uses.

AP - Artificial Pond
BM - Basin Marsh
BS - Basin Swamp
DM - Depression Marsh
DS - Dome Swamp
DV - Developed
ECNS - Estuarine Consolidated Substrate
EUS - Estuarine Unconsolidated Substrate
FM - Floodplain Marsh
FPLK - Flatwoods/Prairie Lake
FS - Floodplain Swamp
FTM - Freshwater Tidal Marsh*
FTS - Freshwater Tidal Swamp
HH - Hydric Hammock
LO - Limestone Outcrop
MEH - Mesic Hammock
MF - Mesic Flatwoods
MS - Mangrove Swamp
RD - Road
SAM - Salt Marsh
SC - Scrub
SCF - Scrubby Flatwoods
SH - Sandhill
SHM - Shell Mound
SKLK - Sinkhole Lake
SST - Seepage Stream
UMW - Upland Mixed Woodland
WF - Wet Flatwoods

MEH
MF
MEH
SST
MF
FS
HH
MF
FTM
BS
SCF
SAM
HH
HH
FTS
BM
FM

CRYSTAL RIVER PRESERVE STATE PARK
Natural Communities - Desired Future Conditions

N

0 1 2 Miles

This graphical representation is provided for informational purposes and should not be considered authoritative for navigational, engineering, legal, and other uses.

centers, cabbage palms will be tolerated along the fringes as a mid-story component that was present historically.

Past land use practices depleted, or sometimes even eliminated, some of the natural components of the mesic flatwoods in the park, particularly the dominant stands of mature longleaf pines which were all but eliminated. Ground disturbance by feral hogs (*Sus scrofa*) continues to be a problem, degrading the groundcover in many areas, especially in borders between flatwoods and depression marshes or other wetlands, but also within the flatwoods matrix itself. Early efforts at introducing prescribed fire, especially near the north boundary, had greater than desired effects. The resulting fire damage required salvage clearcutting of several sections in 2001, greatly modifying the structure of the tree canopy in those flatwoods. With reduced competition and less shade, the cabbage palm mid-story in these areas became quite dense.

Conversely, early efforts at cogongrass (*Imperata cylindrica*) control were quite successful, reducing the distribution of this invasive in the mesic flatwoods to a few acres of scattered infestations. Despite heavy disturbance in the past, all the typical vegetative components mentioned above are well represented in the flatwoods here, in addition to several notable species such as Cateby's lily (*Lilium catesbaei*), dwarf pawpaw (*Asimina pygmaea*), narrowleaf sunflower (*Helianthus angustifolium*), pine hyacinth (*Clematis baldwinii*) and atamasco lily (*Zephyranthes atamasco*). Herbaceous groundcover composition and density over many of these areas has responded well to growing season fire and the reduction of the woody mid-story, showing up to a 15-fold increase in groundcover in comparison with non-treated areas. In fact, the mesic flatwoods in zones CR-H17 and CR-H34 have improved to the point that they are now roughly estimated to be at 75% of target condition.

The condition of mesic flatwoods in the park ranges from fair to good, depending on past land-use practices as well as the degree to which staff have been able to improve their condition using restoration techniques. However, the majority of the mesic flatwoods is considered to be in fair condition.

Restoration of logged areas in the north end of the park has proceeded steadily since 2006, mainly through the use of prescribed fire in varying seasons, herbiciding and mechanical treatment of cabbage palms and turf grasses, and the planting of containerized longleaf pines. These practices should continue as needed. The remaining areas of concentrated planted pines in the mesic flatwoods are quite small and will likely be unsuitable for contract timbering, but they will gradually be thinned through hand-felling and the continued application of prescribed fire.

In coastal sections of flatwoods in zones CR-C3, CR-C4 and CR-C5, mechanical fuel treatments are still needed, as well as additional prescribed fire in areas with heavy fuel loads (i.e., areas with a 25-plus year absence of fire). Along the south side of the Seven Mile Loop Trail, coastal slash pines will reseed and eventually attain a density naturally in tune with the frequency of fire application and hydrologic cycles. Ultimately, improvement of areas of mesic flatwoods that are in the worst condition will depend on the continued prevention of invasive plant infestations, establishment of a stronger hog control program and maintenance of a consistent prescribed fire program. Success will require the ability to introduce fire to sections of flatwoods that have burnable freshwater or salt marsh habitat along their boundaries and that are difficult to access with typical fire control equipment. The more than 475 acres of longleaf pines planted since 2008 will also need to reach maturity before the rating of much of the mesic flatwoods can improve from good condition to excellent, with some semblance of its historic nature restored.

Mesic Hammock

The few areas of mesic hammock found at Crystal River Preserve State Park usually occur on plateaus or slopes above basin marsh, swamp, or hydric hammock. Perhaps the most common variety is the type surrounding the shop area in zone CR-H67. This is positioned above a basin marsh that is part of an ephemeral drainage through adjacent zones. It grades into mesic flatwoods to the north and east, where its boundaries have been defined by frequent fire. Similarly, a strip of mesic hammock separates the hydric hammock west of U.S. Highway 19 in zones CR-H5 and CR-H6 from the historical upland pine area near the front of those zones. Development of mesic hammock in this area may have been caused by inadequate fire frequency, perhaps a result of direct suppression. Another variety of mesic hammock in the park occupies "islands" of higher ground within floodplain communities (hydric hammock, floodplain swamp and basin swamp) in zones CR-H69 and CR-H73. Though they often contain pines, these small areas are located where landscape characteristics may greatly hinder the spread of fire from nearby fire-type communities.

Dominant canopy species in the more mature areas of mesic hammock in the park include laurel oak, live oak, cabbage palm, southern magnolia, pignut hickory and loblolly pine (*Pinus taeda*). Other species such as slash pine, red cedar (*Juniperus virginiana*), sugarberry (*Celtis laevigata*) and basswood (*Tilia americana*) are less common. Common understory species may include juvenile cabbage palms, saw palmetto (ranging in density from moderate to high), coastalplain staggerbush (*Lyonia fruticosa*), sparkleberry, deerberry (*Vaccinium stamineum*), highbush blueberry, red bay (*Persea borbonia*), yaupon holly and American beautyberry. Groundcover is sparse, with bracken fern and low panic grasses occasional.

Mesic hammock in the park is fairly limited and well defined with the exception of areas of interface with successional hardwood forest in zone CR-H5 and areas in zone CR-H33e where wetlands transition to uplands. Successive fire treatments in CR-H33e will likely separate true mesic hammock from flatwoods areas upslope. There is evidence that loblolly pines in the transitional areas of CR-H33e were used historically for turpentine and lumber. Saw palmetto and 25 to 35-year-old laurel oak, water oak and sweetgum (*Liquidambar styraciflua*) are dominant species within much of CR-H33e's hammock. With the exception of the areas described, however, the majority of mesic hammock in the park has proven quite tolerant of past uses and currently is in fair to good condition.

Little active management of mesic hammock is required beyond control of feral hog populations and periodic surveys for invasive plants. The condition of areas in flux will be partially determined and defined by fire management in adjacent areas. In addition, the park's maintenance shop and several outbuildings are located in a developed area which retains some hammock overstory but lies within a larger area of intact mesic hammock. A great deal of debris left by the previous owner has been removed from areas near the shop, including car parts and frames. Care must be taken to better define and mark the boundaries of the shop area to ensure that no materials, trash or tools are dumped or stored outside established lines separating the developed area from mesic hammock.

Sandhill

As may be expected in a coastal area, sandhill comprises the smallest upland acreage in the park. The sandhill occurs in isolated areas at slightly higher elevations, grading into mesic flatwoods, scrub or hydric hammock. In addition, all the historic sandhill community in the park has been logged of some or all of the original longleaf pine overstory. Some areas are now devoid of pines, and other places were planted in slash pine. After logging operations to thin the slash pines were completed, the sections of sandhill in zones CR-H20, CR-H25 and CR-H72 retain scattered turkey oaks and sand live oaks, but also enough off-site pines to maintain needle drop and carry fire. The sandhills here have little to no sand pines present. Representative sandhill shrubs such as dwarf huckleberry, pricklypear (*Opuntia humifusa*) and gopher apple (*Licania michauxii*) are present, with scattered

clumps of saw palmetto and cabbage palms. Herbaceous groundcover components such as narrowleaf silkgrass, bracken fern and blazing stars (*Liatris* spp.) are scattered throughout, with legumes including snoutbean (*Rhynchosia michauxii*), Elliott's milkpea (*Galactia elliottii*) and butterfly pea (*Centrosema virginianum*) also present.

The sandhill in zone CR-H20 (approx. 15.7 acres) was used historically as a dove field and for wildlife openings/food plots, which has greatly hampered the recovery of groundcover species. Zone CR-H20 has a very sparse understory of species similar to those described above but has been heavily invaded on the east side by centipede grass and bahiagrass (*Paspalum notatum*). It retains the overstory slash pine at one-third the previous density and was planted at a density of about 200 longleaf pine seedlings per acre in 2013. Since the zone CR-H20 sandhill is in transition, it better fits the description for the altered landcover type, "Restoration Natural Community," as described by the Florida Natural Areas Inventory (FNAI) in the Guide to the Natural Communities of Florida, Appendix 2 (Florida Natural Areas Inventory 2010).

The sandhill in zone CR-C7 is generally intact, having been lightly used for timber and turpentine, but fire-excluded since long before state acquisition. The sandhill section in zone CR-C7c (12.7 acres) is now a derived overstory of large 40 to 50-foot turkey oaks with few remnants of longleaf pines. The understory in both areas consists of younger individuals of the same species, supplemented by widely scattered sand live oaks (*Quercus geminata*). Sparkleberry and deerberry are representative shrubs and saw palmetto is occasional. Wiregrass and herbaceous groundcover in all areas is scattered and suppressed by years of thick needle and leaf drop. The area in zone CR-C7c is far enough from target condition (poor condition) that it should also be classified as restoration natural community.

The distribution of the sandhill community in the park seems to coincide with slightly thicker (higher), well drained soils, namely Adamsville, Basinger and Boca fine sands. Boca fine sand has a much greater distribution than the other two types, also underlying most of the mesic flatwoods on the north end. The isolated nature of the sandhill in zone CR-C7 has made management there far more difficult than in the remnants occurring in zones CR-H20, CR-H25, CR-H26 and CR-H72, which are adjacent to an extensive flatwoods area with a longer management history.

The condition of the sandhill community in the park ranges from poor to moderate. The sandhill that will be easiest to restore will be the sections in zones CR-C7e, C7f, C7g and C7h, as these were thinned to a desired level in 2007 and only require careful application of fire to cycle nutrients, kill invading laurel oaks and release what groundcover seedbank persists. The sandhill in the north end of zone CR-H72 is in fair condition, as the shrub layer is still dominant and the restoration pines there are only a few years old. The sandhill in zone CR-H20 is nearly devoid of native groundcover and retains slash pine in the overstory, so it is similarly in fair to poor condition.

Off-site hardwoods and turkey oaks dominate some of the sandhill in zone CR-C7 that has experienced long-term fire exclusion and has relatively few large longleaf pines remaining. This area will require mechanical thinning of turkey oaks and application of fire to release groundcover species. Zones that require restoration but retain at least some of the typical sandhill groundcover species will be given a higher priority than degraded sites now devoid of characteristic species. Other than that, the continued use (and introduction in some cases) of frequent prescribed fire in the park's sandhills will be essential to maintaining community structure and ecological integrity. In areas of sandhill already burned and requiring little tree removal (i.e., zones CRH20 and CR-H72), removal of turf grasses and groundcover restoration including shrub mowing, planting of wiregrass plugs, longleaf pine planting and grass and forb seeding will likely be necessary to restore the areas to near target condition.

Since 2001, logging projects have thinned off-site slash pines and native longleaf pines in five zones containing sandhill. The two sections considered to be in poor condition will require much more restoration work before they will be in good enough condition to support the full range of species that should occur there.

Scrub

The scrub community in Crystal River Preserve State Park is positioned on isolated knolls quite close to the tidal river marsh but separated from by thin strips of hydric hammock. All scrub patches are difficult to access with motor vehicles due to overgrowth and the absence of trails or fire lines. The scrub areas are bordered by and grade into sandhill or mesic flatwoods on the high side.

All are located between Ozello Trail (County Road 494) and U.S. HIghway 19 in zone CR-C7. They occur on varying depths of fine sands of the Adamsville, Basinger, Myakka or Eaugallie series, occasionally over limestone substrate.

Scrub habitat at the park is extremely overgrown with dense shrubs far above the optimal average height recommendations for managing the Florida scrub-jay (*Aphelocoma coerulescens*) or other scrub endemics. The normal bare sand openings and varying shrub height are absent here due to decades of fire exclusion. The sand pine (*Pinus clausa*) scrub variety does not occur at the park, leaving these trees notably absent. Though relatively free of invasives and undisturbed by historic land-use activities in the region, scrub habitat at the park is only in fair condition due to the lack of management with fire or fuel height treatments.

Nearly all scrub habitat in the park is in dire need of fuel height reduction and prescribed fire. Mechanical treatment could be used to help knock down fuel heights and produce spatial openings that are characteristic of a healthy scrub. Roller-chopping would be the best option to achieve desired results, followed by prescribed fire (Weekly et al. 2008). Where fire can move into sawgrass river marsh, caution must be exercised to tie fire lines into hydric hammock or another non-fire type community that will create a viable natural break.

Scrubby Flatwoods

The scrubby flatwoods community in the park occurs primarily on sandy knolls of fine sand in the Adamsville, Tavares, Basinger, Eaugallie or Myakka series, some of which are underlain by a limestone substratum complex. These typically grade into and are upslope from mesic to wet flatwoods or hydric hammock. In the absence of regular fire, ecotones between these community types may easily become blurred. All the scrubby flatwoods in the park are located on a raised ridge between Kings Bay and the Salt River (zones CR-C5 and CR-C7) or on elevated knolls in the vicinity of County Road 494 in zones CR-C5, CR-C7 or south to zone CR-S4.

According to a revised description of scrubby flatwoods published by FNAI in 2010, the shrub layer of that community consists of one or more species of scrub oak as well as a variety of other shrubs that are also found in mesic flatwoods. In addition to the species mentioned above, other shrub species common in the park's scrubby flatwoods include coastal plain staggerbush, garberia (Garberia heterophylla), and deerberry.

The scrubby flatwoods canopy in the park has a sparse cover of remnant longleaf pines, probably due to prior but unrecorded tree harvests before the state acquired the property. Pond pine (*Pinus serotina*) has become common in some of the areas where fire has been excluded or suppressed for a long time. This condition is especially prevalent in zones CR-C3 and CR-C5 south of the Crystal River where the scrubby flatwoods are surrounded by wet flatwoods that provide the seed source. The initial burn in two zones here has served to top-kill or stress many of these pond pines, especially in the driest areas they had invaded. These zones remain in fair condition as they still have a very significant palmetto layer in addition to the remaining pond pine issue.

Amidst the scrubby flatwoods in zone CR-C3a are ditch lakes and limerock spoil layers left by early fill removal activities associated with building roads for two local developments (The Islands and Dixie Shores). In this zone, some of the original scrubby flatwoods will be classed as altered landcover types "impoundment" and "spoil area." The remainder has been mowed along its perimeter in preparation for prescribed fire and is fairly intact despite an excessively thick shrub layer. Areas with moderate prior disturbance tend to be invaded with a higher proportion of red cedars and cabbage palms. There are also cogongrass and air potato (*Dioscorea bulbifera*) infestations in this zone that are currently under chemical, mechanical and biological treatment regimes.

The other examples of scrubby flatwoods in the park are in fair condition. Few invasive problems exist in these areas, with the invasives presence either initially sparse or gradually reduced by staff in the years since DRP assumed management in 2004. These areas have a thick, tall shrub layer of saw palmetto, scrub oaks and lyonia due to decades of fire absence.

The condition of the scrubby flatwoods in the park ranges from poor to moderate, depending on the success of prescribed fires at thinning invading pond pines and controlling woody shrubs. Roughly two-thirds of the scrubby flatwoods have yet to experience prescribed fire due to their difficult position in the landscape far from trails and within a large matrix of non-fire type communities.

Restoration of overgrown scrubby flatwoods to a more characteristic condition through prescribed fire alone will probably not be possible. Though initial treatments with fire have proven effective at controlling some pond pines and a majority of the scrub oaks, some oaks remain too large to be affected and the excessive saw palmetto coverage cannot be reduced in this manner. It will be necessary to mechanically treat overgrown sites to lower the fuel structure and thin palmettos prior to returning prescribed fire to these sites. The preferred fire return interval for the scrubby flatwoods in the park is five to 12 years.

Shell Mound

Shell mounds within the park are smaller, more scattered, and more isolated than the organized mound complexes found in the adjacent Crystal River Archaeological State Park. They do, however, largely contain the same basic materials, including discarded oyster shells and broken tools such as conch hammers and pottery. They are present along the marsh and hammock boundaries of the Salt River, Crystal River, and Homosassa River, as well as along various other lesser creeks and marsh-hammock islands in the region. Due to historical occupation and coastal erosion, the mound areas occurring west of Ozello Trail in the WI zones are the most degraded and have yielded the least information about prehistoric human activity in the region, while others in zones CR-C2, CR-C3, CR-C5, and CR-C6 (east of State Road 494) are slightly better, with about 40% of sites in good condition and containing significant resources. All shell mound sites in the park are in areas that are dynamic in the sense that they are highly affected by tidal action and sea level rise. They can also be protected by rooting of plants such as marsh elder when they are positioned against the surge, but excessive root development can disturb the shell heap integrity when pulled out by storm or human disturbance. Despite this, the overall condition of the mounds in Crystal River Preserve State Park is fair to good, but likely to decline over time (Ellis and Dean 2004).

The shell mound areas that still have significant cultural resources onsite should be monitored at least yearly to evaluate both the stability of the mound and any trends in vegetation loss/erosion or human disturbance. Brazilian pepper and other invasives will continue to be removed in such a way as to not disturb any subsurface resources. Dead trees will be dealt with similarly to limit ground disturbance. Locations of sites should be made known to law enforcement and their presence encouraged as much as possible to protect these resources.

Finally, staff can make law enforcement more effective if they mark many perimeter sites with official signage identifying the site as a state park.

Wet Flatwoods

The cabbage palm flatwoods in the park occur along Ozello Trail, Fort Island Trail and in isolated patches along the western Seven Mile Loop Trail in the Hollins tract. They generally occur adjacent to and grade into flatwoods, basin marsh, river marsh or hydric hammock and are dominated by slash pine, pond pine or loblolly. The wet flatwoods in zones CR-H72, CR-H73 and CR-H35 were planted with off-site slash pine in 1973 (DEP 2004). Fire has thinned some of the excessive overstory there, but these areas were not deemed suitable for a timber harvest operation. In zone CR-C5, the wet flatwoods occur downslope from the scrubby flatwoods ridges. Less than half of the wet flatwoods outside of the Hollins tract have seen fire. This fire exclusion has caused the shrub layer to be highly developed to the point where the herbaceous layer is reduced. Chinese tallowtree (*Triadica sebifera*) has been an issue in some of these wet areas but is currently reduced to maintenance status. The overall condition of wet flatwoods in the park is fair.

The remainder of the wet flatwoods in the park that have not yet been treated with fire need to be prepped and divided into small enough sections to burn safely. Once the fuel loading is reduced, fire should be applied regularly to begin the process of limiting woody mid-story development and encouraging the herbaceous layer characteristic of this community type.

Basin Swamp

Basin swamps in the park occur adjacent to mesic flatwoods and positioned along river marshes that border Kings Bay or tributary tidal creeks of the Salt and Crystal rivers. There are also several sections that are simply lower depressions with longer hydroperiods within the larger hydric hammock area in the central management zones at the north end of the park, namely zones CR-H73, CR-H69, CR-H30 and CR-H25.

Cypress trees are notably absent from most of the basin swamps in the park, possibly due to historic harvest, which was common throughout this area. Swamp bay is quite common, but the vast majority of adult specimens have been decimated by laurel wilt (*Raffaelea lauricola*) disease transmitted by the red bay ambrosia beetle (*Xyleborus glabratus*). Plantation pines occur in the edges of some of the swamps that grade into mesic hammock. Overall, however, the basin swamps are in moderate to good condition and the continued use of fire will help re-establish proper community boundaries.

Prescribed fires should be allowed to burn into the edges of basin swamps to maintain the natural ecotone between them and surrounding flatwoods. Removal of off-site loblolly pines may be necessary to improve the condition of some of the basin swamps.

Depression Marsh

Depression marshes in the park occur as small, scattered, isolated and mainly herbaceous wetlands. These marshes are shallow and often do not fit FNAI's standard description in that they may not be rounded, sometimes do not have concentric bands of marsh vegetation around them and may lack deeper portions containing open water. Recurring drought events from 1998 through 2012 have caused these marshes at Crystal River Preserve State Park to experience generally lower water levels. Typically, the marshes are dry most of the year. Depression marshes are important as ephemeral wetlands for many amphibian and invertebrate species (Moler and Franz 1987).

Invasion of the depression marshes by wax myrtle, red maple and coastal plain willow is normally kept in check by prescribed fire and natural flooding. However, adaptable invaders such as slash pine and pond pine remain

in some of the depression marshes despite the application of fire. In some cases, the ability of trees and shrubs to compete is enhanced by ditching along roads or some other artificial manipulations that prevent the marsh from maintaining a higher water level that would help to exclude these species. Reductions in the regional water table may lead to more frequent droughts and additional incursions by hardwoods and may eventually encourage succession of some marshes to mesic hammock. The depression marshes at the park are currently in good condition.

Where appropriate, the park should apply prescribed fire to depression marshes at the same time as adjacent fire-type natural communities. Maintenance of a natural ecotone is important, as is keeping the marshes free of invasive species. Removal of well-established slash pines and other hardwoods that have resisted fire may require additional measures such as felling or herbicide control.

Dome Swamp

Zones CR-H17, CR-H19, CR-H23 and CR-H71w contain three areas where classic dome swamp historically existed. Currently, none of these domes has a cypress overstory component, but swamp bay and swamp tupelo persist, along with a typical array of understory plants. It is likely that the cypress was logged out decades ago, before state ownership. Other than the lack of cypress, these three areas are in good condition, having had little recent disturbance except for occasional hog rooting. An example of dome swamp that still has its cypress intact occurs in zone CR-C7e between two areas of sandhill.

These few examples of dome swamp should be protected from unnatural disturbances. However, prescribed fire teams will allow fires conducted in adjacent fire-maintained natural communities to burn through the ecotone into the dome swamp periodically. This will occur under conditions appropriate for restoring the natural transition zone and maintaining the natural fire regime essential to dome management. Removal of off-site loblolly pines may be beneficial in some areas, in addition to removal of feral hogs. Park staff will regularly monitor the dome swamps for the appearance of invasive plants and will remove any found.

Floodplain Marsh

Freshwater tidal marsh in the park typically borders tidal creeks that feed one of the rivers forming the estuary. They lie between the hydric hammocks and the tidal creeks, mostly on Homosassa Mucky Fine Sandy Loam or Okeelanta Muck. They occur throughout the park and transition to salt marsh, where the average salt content favors that community, but are strongly affected by tidal push of brackish water on salt water, rising and falling with an interplay of tide and rainfall events.

In some areas, such as the crossing of the marsh on the Loop Trail (zones CR-H73 to CR-H37), lateral ditching along the trail and limited flow under the trail may inhibit flows to the lower marsh. In addition to these minor flow issues, fire exclusion for many decades has allowed red cedar and cabbage palm to invade these marshes, adding to the expected thickets of willow. This, along with many years of reduced rainfall and fire exclusion, has made many of these marshes less open than they were historically. Aerial photographs from 1973 show many small thickets of shrubs scattered in this system, but a generally open condition prevailed, dominated by grass.

Establishment of low water crossings or increased flow structures where roads interface with the marsh will aid in maintaining a natural sheetflow situation in the freshwater tidal marsh. Where appropriate, the park should treat river marsh with prescribed fire at the same time as adjacent fire-type natural communities or as the dominant community depending on size. Maintenance of a natural ecotone is important, as is keeping the marshes free of invasive species. Removal of well-established woody shrubs and small trees may require additional measures such as mowing, which must be done by hand or with specialized equipment. Access to

creek boundaries of burn units with airboats or tracked vehicles will be key to long-term fire maintenance of these communities.

Floodplain Swamp

Floodplain swamps in the park occur in floodways within the deepest parts of hydric hammocks, serving as transitional water storage areas for surrounding uplands both within and outside the park. These drainages ultimately feed freshwater tidal marshes and creeks. As such, some of these swamps will be more properly identified as freshwater tidal swamps. They experience some tidal action, including occasional brackish water pulses, but ultimately they share many of the same species. Where this community transitions to open marsh, small patches of sawgrass can be found in the understory along with increased occurrence of leather fern. Cypress is notably absent from these swamps, but that is not uncommon along the coast. If prior logging activities were responsible for the loss of the cypress, little evidence of that remains today. As in all the swamps in the park, laurel wilt disease has killed a majority of the adult swamp bays. Invasive plants have had very little impact on the floodplain swamp areas. Feral hog impacts have been more severe in the shallower sections of the swamp but are considered moderate. Existing causeways and roadbeds that cross narrow strands of floodplain swamp may negatively affect the natural hydrological regime. Aside from these minor impacts, the floodplain swamps in the park are in good to excellent condition due to the fact that they were not used in timber management, mining or other land altering programs prior to state acquisition.

Floodplain swamps require little active management other than erosion protection and control of invasive species, including hogs. Biological staff will continue to monitor trails crossing the floodplain swamp for erosion issues and will mitigate impacts as needed, including installing low water crossings along sections of trail. Staff will also monitor the swamps regularly for signs of invasive plants and animals, including feral hogs.

Hydric Hammock

Hydric hammock is the second-most abundant community in the park, covering nearly 3,600 acres. Hydric hammock areas are located on the eastern side of the park and are typically positioned between an upland community such as mesic flatwoods and a larger strip of freshwater tidal marsh. Hydric hammocks play a critical role in the regional hydrology (Simmons et al. 1989). They serve the important function of temporarily storing water in high rainfall periods, but typically retain scattered small pockets of standing water up to 70 days per year. Hydric hammocks occur on a variety of sand to muck soils but are always low lying and situated over a limestone substratum that occasionally projects above ground as exposed outcrops or bare rock areas. Soil depth can be as little as 20 centimeters in these areas. In areas further west where there is a greater salt influence, the sub-type of hydric hammock called coastal hydric hammock plays a similar role in the landscape. Larger areas of hydric hammock frequently interface with or are divided by floodplain swamp drainages that lead to one or the other of several tidal creeks in the park.

Hog rooting and wallowing have the greatest negative effect on hydric hammock in the park. Especially in dry periods when mast production is highest (October through December), large areas of hammock may be impacted. This can alter the understory while removing mast and other forage for native species. Infestations of invasives such as air potato, skunkvine (*Paederia foetida*), Chinese tallowtree and Brazilian pepper have been under constant management in these hammocks, but they persist in scattered pockets at very low densities. There are also a few zones where historic ditching associated with road or trail construction has cut into the hammock substrate, interrupting natural sheet flow. This has occurred most extensively in sections between zones CR-H38, CR-H73 and CR-H72 along the south loop trail. Finally, there are about 24 acres of hydric hammock in the northwest section of zone CR-H73 that historically have had loblolly pines planted in them. These pines should by thinned or removed so that the natural limits of the hammock can be re-established through regular prescribed fire.

The coastal hydric hammock in the park is dominated by red cedars and cabbage palms, with remnant live oaks or loblolly pines occasionally present toward the center of the hammock depending on the profile and degree of tidal overwash. These hammocks are situated where limestone outcrops project slightly above the level of the marsh. Continued sea level rise threatens these distinct upland hammock areas, though outright tidal overwash is rare. Rather, the gradual effect of the rising water has been a long-term die-off of canopy trees near the hammock edges over several decades, slowly converting these areas to driftwood-littered salt flats or outright salt marsh (Williams et al 1999)

Over the past 25 years, researchers have documented the gradual recession of the hydric hammock and a conversion of coastal hydric hammock islands to salt-dominated communities (Ellis et al. 2004). A comparison of aerial photography illustrates the die-off of sabal palms, oaks and red cedars on islands within the salt marsh, however, there has not been a complete analysis of these changes within the park.

The presence of mature individuals of red cedar, which is not fire tolerant, may indicate that the community has a long fire return interval. However, many of the older red cedars in the coastal hammocks were once subjected to harvesting for shingles, furniture and other uses. As early as 1882, there was a mill in Crystal River that produced pencil blanks, sourcing wood from coastal hydric hammocks in the region (Bash 2006). Consequently, the vast majority of red cedars on this coast are second growth individuals that currently reach a maximum of 30-40 feet in height.

The understory in coastal hydric hammock is sparse, as in regular hydric hammock, but common shrubs include Florida coontie, wild coffee (*Psychotria nervosa*) and yaupon holly. Thick patches of other shrubs and trees such as myrsine (*Myrsine cubana*) and saffron plum occur in some places but are not widely distributed. Where the land is low and open there may be large patches of leather fern, and cabbage palm may be the only tree in the canopy. At the transition of coastal hydric hammock to hydric hammock, other hardwood trees appear and typical salt intolerant understory plants become more diverse. At the transition to salt marsh, typical shrubs include Christmas berry (*Lycium carolinianum*), saltwater false willow (*Baccharis angustifolia*), saltbush (*Baccharis halimifolia*) and buttonwood (*Conocarpus erectus*). This system rarely if ever experiences fire. Lightning strikes within this community typically burn out very small areas (less than half an acre) and extinguish on their own.

The overwhelming factor leading to the degraded condition of coastal hydric hammock in the park is the Brazilian pepper infestation. Due to the sheer density of Brazilian pepper trees and the exclusion of typical overstory species there, several sections of this community sub-type have been classified as the altered landcover type, “Invasive Exotic Monoculture”. Most of the infestations, however, range from maintenance condition to a 50-60% coverage that can be handled by conventional invasive management tactics.

A general reduction of hog numbers within the park would greatly benefit the hydric hammock and many other natural communities. Staff will continue to monitor hydric hammocks for the presence of invasive plants. Planted pines in wetter areas should be felled by hand over time if there are no safety concerns, as the areas are not suitable for contract logging. Staff should continue to allow fires to burn into the fringes of hydric hammock in order to push its boundaries back to historic limits. Three sections of the Seven Mile Loop trail may be suitable for placement of low water crossings that would benefit hydric hammock and other nearby communities by achieving a more natural sheetflow. Details about any improvement activities planned for hydric hammock in the park are contained in the *Resource Management* section of this plan, in “Goals and Objectives” listed under the heading, “Natural Communities Management.”

Management of the coastal hydric hammock in the park must continue to feature the long-term, organized eradication of invasive plants such as Brazilian pepper, skunkvine, Sprenger's asparagus-fern (*Asparagus aethiopicus*) and other invasives to counteract the heavy seed production and resilience of these invasive species. Most of the invasives management will consist of targeted basal bark treatment using appropriate herbicides. The occasional cutting of cedar trees by persons camping illegally on some hammock islands has proven to be a minor issue that will be dealt with as encountered.

Mangrove Swamp

The mangrove swamps in the park occur in zone CR-WI1 and in the St. Martins Keys. They are often surrounded by good quality seagrass beds or by bare substrate (i.e., estuarine unconsolidated substrate). Mangrove swamps can grade into adjacent salt marsh, but they more often occur as separate islands of vegetation. Larger, more developed islands may contain all four mangrove species, but the understory component of islands situated in deeper water can be completely inundated at all tides. The mangroves provide critical habitat for a variety of fish and wildlife and provide roosting and rookery areas for coastal bird species. The mangrove swamps in the park have not been subjected to storm or freeze damage in recent years and are in excellent condition.

As with salt marsh, mangrove swamps require little active management other than periodic checks for damage from storms or human activity.

Salt Marsh

Salt marsh, including the salt flat variant, is by far the largest natural community by acreage in the park and it is most definitely a defining feature. Salt marsh represents the seaward extent of the park in many places, with only tidal mangrove swamps extending further into the Gulf of Mexico. Salt marsh is typically bordered by freshwater tidal marsh or coastal hydric hammock, but also occasionally by scrubby flatwoods. Large islands of salt marsh have formed on the seaward side of the Salt River. These islands range in size from less than an acre to a few hundred acres and are frequently dotted with patches of coastal hydric hammock. The salt marsh islands have become established on muck soils that were transported by constant river outflow and deposited in the estuary. The extent of the muck can vary from nonexistent in salt flat rock outcrops to more than two meters in depth elsewhere, frequently overlaying rock outcrop or substratum.

The quality of the salt marsh in the park is slightly compromised by the presence of historic mosquito and drainage ditches in zone CR-S3 and by various disturbances incurred during construction of State Road 44 west and County Road 494. In addition, the occasional airboat and vehicle trails that traverse the marsh have scarred some areas, creating sites of semi-permanent damage where the vegetation has been completely removed. Park staff have installed boulders in places where people have illegally driven trucks or ATVs into the marsh. Staff have also placed boundary signs. These measures have had the desired effect of lessening the severity of damage. Educational signage created by park staff is now present at all boat ramps in the area. The signs outline the importance of not running airboats over salt marsh vegetation. However, impacts such as those described above affect only a tiny fraction of the total area of salt marsh in the park, and the overall quality of this community is still excellent.

In general, salt marsh is quite resilient and requires little active management. The areas that contain historical ditching could be returned to grade by pushing the adjacent berms into the low areas. This type of program will require long-term development and funding, as well as the cooperation of the SWFWMD. Staff will continue to exclude all vehicles from the high marsh, using a variety of deterrents including barriers and signage. Law enforcement agencies should be made aware of the long-term detrimental effect of airboats that take short

cuts and create trails across the salt marsh, and they should be encouraged to maintain enough presence to keep this damage from occurring on a regular basis.

Sinkhole Lake

Because of the extent of underlying limestone, Crystal River Preserve State Park is dotted with numerous limestone-based features characteristic of karst topography. Some sinkhole lakes maintain a direct connection to the Floridan aquifer. Lakes that are close to hiking trails can be subject to littering, soil compaction and disturbance of vegetation. In general, the sinkhole lakes in the park are in excellent condition.

Management of sinkhole lakes must emphasize protection. The edges of sinkhole lakes need to be protected from impacts that could accelerate erosion and sedimentation. Increased erosion can cause a decline in water quality, especially if a karst window is present. Access to most of the sinkhole lakes is usually restricted except for legitimate research purposes or park management activities. An additional management need is protection of the quality and quantity of groundwater and surface waters feeding the sinkhole lakes.

Seepage Stream

Seepage streams are numerous within the northern management units (i.e., Hollins Tract) as small creeks that drain the upland areas along the eastern boundary of the park. One such stream flows through the currently undeveloped Nature Coast Mine property and enters the park at zone CR-H19. As of 2016, mine operations had not begun, but necessary permits are in place for this development to proceed, including a significant alteration (i.e., channelization and ditching) of the natural hydrology of this seepage stream. Upstream of the park, this seepage system is in poor condition because it receives untreated local stormwater runoff. However, downstream of the mine and within the park, this seepage stream is in good condition. Similar seepage streams are found in this region of the park. Stormwater runoff from areas outside of the park can impact these seepage systems.

Protection of the watersheds of seepage streams is important in maintaining and enhancing water quality and quantity. Dramatic changes can occur to down grade wetland systems from impacts associated with un-attenuated stormwater runoff.

Estuarine Consolidated Substrate

Estuarine-based limestone outcrops are common along tidal creeks, salt marshes and coastal shore habitats of the park. These outcrops are important since shellfish, particularly oysters, often colonize them. The full extent of this community within the park is currently unknown. Where this community type is observed, it is in good to excellent condition and is important for wildlife such as marine turtles that use the park as nursery grounds.

Like salt marsh, this community is resilient and requires little active management other than periodic checks for damage from storms or human activity.

Estuarine Unconsolidated Substrate

Although some estuarine unconsolidated substrate communities within the park have limited amounts of sand deposition from adjacent uplands, most of this community along this low-energy coastline is dominated by mud deposits. Most upper reaches of tidal creeks within the park commonly have extensive mud flats that are important feeding areas for wading birds and shorebirds. Additionally, when these areas are tidally inundated, they can be used as resting/feeding grounds for other wildlife such as ornate diamond-back terrapins (*Malaclemys terrapin macrospilota*) and the three species of marine turtle known to occur within the park. This community type is in good to excellent condition.

Like salt marsh, this community is fairly resilient and requires little active management other than periodic checks for damage from storms or human activity. Heavy pollution disturbance such as an accumulation of toxic levels of heavy metals, oils or pesticides within these unconsolidated substrates can become problematic and impact the local food web. Significant amounts of these compounds in the sediments can kill infaunal organisms, thereby eliminating a food source for certain fishes, birds and other organisms.

Altered Landcover Types

Most of the park has only been under the active management of the Florida Park Service and the CAMA division of DEP before that since the late 1990s. Land use in various parts of the park before state acquisition included naval stores/turpentine industry, cattle ranching, silviculture including harvest and planting of cedars and pines, hunt parcel leases, and dragline dredging for road building and lime rock mining. Most of these activities occurred after 1897 (Hollins 2016; Dunn 1989). These activities produced mild to severe alterations in the natural land cover in much of the park.

The dramatic changes that took place in the landscape between 1944 and today are clearly evident in historical aerial photographs. By 1944, small sections of flatwoods near the current Eco-walk trailhead (zone CR-H71e) had been converted to improved pasture. Ditching to drain the U.S. 19 corridor had directed water into the park just west of there, but little additional development other than the building of Fort Island Trail and Ozello Trail had occurred. Much of the original old growth longleaf pine in the driest flatwoods sections had been cleared from the site following turpentine operations early in the 20th century. Ditching for marsh drainage, road building or mosquito control in the marsh south of Ozello Trail and borrow pit mining for limerock and developments occurred in the 1960s. Prominent mine pits are found off Powerline Road in zones CR-H70e and CR-H70w and off Fort Island Trail in zones CR-C3a and CR-C3k. Miles of canals used for access and drainage were installed between 1965 and 1972. In 1973 and 1974, over 675 acres of flatwoods and adjacent communities were converted to either loblolly or slash pine plantations. Much of the plantation that was placed in marginal habitats such as river marsh has since succumbed to extremes of salt and inundation. The restoration process for plantations in the park has progressed significantly since 2006, when major offsite slash pine harvests and growing season burning was first introduced. Even areas of the park that had an established history of burning have dramatically improved during that time span due to an increased commitment to more frequent prescribed fire, particularly growing season fires.

Abandoned Pasture

The abandoned pasture in the park covers the majority of zones CR-H71w and CR-H71e. There are also roughly 37 acres that were once in improved pasture dominated by bahiagrass that will be classified as semi-improved. The remainder of this altered landcover type has had various ditching, clearing and berm building projects from the 1940s to the 1970s that have altered the sheetflow and contributed to the abundance of wax myrtle, dog fennel (*Eupatorium capillifolium*) and dewberry (*Rubus trivialis*).

Small pockets of abandoned pasture contain vegetative remnants of their former natural community such as the occasional pawpaw (*Asimina reticulata*), meadowbeauty (*Rhexia* spp.) or atamasco lily. Invasive species such as cogongrass, purple sesban (*Sesbania punice*a), rattlebox (*Crotalaria* spp.), Chinese tallowtree and nutgrass (*Cyperus* spp.) have all taken residence in disturbed pasture areas and are under various stages of control. This problem is exacerbated by the presence and influence of feral hogs. Prescribed fire has assisted in management of the shrub layer here and in control of some invasives. Northern bobwhite (*Colinus virginianus*), deer (*Odocoileus virginianus*) and American kestrel (*Falco sparverius*) are among the desirable species that the pasture areas still support when well managed for an open condition.

These two zones should continue to be treated with prescribed fire and cabbage palm should continue to be removed as much as possible to aid in fire application and general restoration. Reduction of feral hog impacts will also be key to limiting ongoing disturbance in the pasture areas. Mowing of wax myrtle has produced variable results but should continue to assist in shrub control. A restoration plan that includes elimination of all turf grasses and other invasive plants, coupled with restoration of the natural grade and native groundcover, needs to be developed.

Canal/Ditch

Ditches were cut in various places in the park historically for drainage or to borrow material for road building. These occur adjacent to existing roads and trails that cut through the park along the Seven Mile Loop Trail and along public roads traversing the park. In addition, there were access canals cut in the vicinity of the River Haven development in zone CR-S4. Lastly, sometime between 1944 and 1973, 2.45 miles of canals were cut as part of an unknown development south of Ozello Trail in zone CR-S3. The ditches extant in the park appear to be standard dragline ditches where the material was either removed, laid next to the canal in a spoil bank or used to build up the adjacent roadbed. The ditches vary in width from only a few feet to over 15 feet.

No active management is necessary other than occasional survey for invasive plants and treatment as needed. Given the extent of the ditching, restoration would require the drafting of a detailed restoration and monitoring plan involving SWFWMD personnel.

Developed

Crystal River Preserve State Park has various developed areas, including the office/visitor center complex in zone CR-CR-H1, five trailheads, one visiting scientist office area in zone CR-H71e, and the shop complex in zone CR-H67. The shop area includes two residences, three shop and fire equipment buildings and many smaller shed and storage areas. The largest developed trailheads are at the Eco-walk and Church house Hammock trails. The trailhead area at Eco-walk includes two buildings that house Gulf Archaeological Research Institute (GARI) with its visiting scientist.

Resource management in the developed areas will focus on removal of all priority invasive plants (i.e., Florida Exotic Pest Plant Council (FLEPPC) Category I and II species) and replacement of landscaping with native species where possible. Other management measures will include maintenance of proper stormwater and wastewater management facilities and the designing of future development so that it is compatible with prescribed fire management in adjacent natural areas. Shop area boundaries will be set and enforced to prevent accumulation of materials outside the designated area in the surrounding hammock.

Impoundment/Artificial Pond

Small scale borrow pit ponds occur throughout the park with a concentration along the north end and in the Dixie Shores area (zones CR-C3 and CR-C5). Another isolated borrow pit holding brackish water occurs off of Ozello Trail. Most borrow pits appear along roadways and were likely used as sources of road base and fill during original construction. Due to the rocky geology of the coast, most of the deeper pits have a limerock bottom, with shallower areas having a disintegrated marl substrate. Vegetation varies from native emergent marsh vegetation such as sawgrass to mats of submerged native and invasive weeds such as water-milfoil (Myriophyllum heterophyllum).

The large Dixie Shores borrow pits and spoil areas in zone CR-C3 were created as part of the Suncoast City Developments beginning in 1962 (Dixie Shores Property Owners Association 2016). These borrow areas were part the master plan for the development of additional residential lots that were never fully implemented. The soil and limerock material from these borrow pits was used for fill on house lots in low-lying areas of the

development. Most of the borrow areas were abandoned and now remain as partially vegetated, open-water limerock pits. There is at least one borrow pit that has a connection to the salt marsh and thus receives periodic tidal flows, however the majority are not connected. Nearly all of these open-water borrow pits are vegetated and do support various wildlife, including fish. A long pit in zone CR-C5c behind Connel Heights Fire Station is shallower than those described above and occurs in deeper soils. Much of the vegetation there is the same as is found in basin marshes in the area but is dominated by emergent vegetation such as arrowhead (*Sagittaria latifolia*).

The largest and deepest borrow area is actually a 19.4-acre mine pit lake that was excavated for limerock in the very early 1970s. It is adjacent to two smaller pits and a 5.3-acre scraped area that is approximating a depression marsh function with almost total sawgrass coverage. The pit water depth is from 17 to just over 40 feet. It is bermed along the edges with spoil material and vegetation including cabbage palm and wax myrtle, but it contains very little aquatic vegetation due to the depth.

Artificial pits/ponds/lakes located within pyrogenic communities should be incorporated into the fire treatment area when prescribed fires are conducted. Invasive species should be removed where possible. All pits should be evaluated for feasibility of restoration. Shallower pits are likely to be restorable to grade, but some of the larger pits will require that a plan to make them most functional as some sort of wetland or lake community be drawn.

Invasive Exotic Monoculture

Forty-eight acres of hammocks that fit this community description exist in zones CR-S5 and CR-S6. These coastal hydric hammocks are isolated by water and marsh, requiring boat travel to access. They are completely infested with adult Brazilian pepper that constitutes nearly 100% cover. There is little native vegetation once the transitional zone from salt marsh is passed.

The conversion of these areas to native vegetation will not be easy, requiring a plan that involves mechanically clearing access trails through the vegetation, chemical treatment of the Brazilian pepper and retreatment of the future sprouts emerging from the heavy seed layer in the bottom of the hammock. When this has been accomplished, the state of the hammock will need to be evaluated for re-establishment of native vegetation such as the palms, cedars, and other plants characteristic of this area.

Pasture – Semi-Improved

The semi-improved pasture in the park occurs as patches within the matrix of the abandoned pasture type in zones CR-H71e and CRH71w along with natural communities of mesic flatwoods, basin swamp and depression marsh. There are also roughly 37 acres of this improved pasture cover that are dominated by bahiagrass. Occasional wax myrtle, dog fennel and dewberry occur as well. Native species such as atamasco lily or starrush (*Rhynchospora colorata*) occur in response to fire and hydrological regimes. Staff has attempted to restore the flatwoods groundcover on 3 acres of this community in zone CRH71e as a demonstration plot. Results were mixed.

A restoration plan that includes elimination of all turf grass and other invasive plants coupled with restoration of the native groundcover needs to be developed.

Road

A paved road extends from the main park entrance and accesses the Mullet Hole fishing area, Crystal Cove trails and the visitor center/office complex situated on the Crystal River. The paved shop road off of Powerline Road accesses the shop and two residence buildings. Numerous unpaved roads serve double-duty as trails and

fire breaks within the park and along boundaries. Over 2.9 miles of unpaved trails have been eliminated since 2006 by combining management units, removing centipede grass and closing to all traffic. The condition of the paved roads from a transit standpoint is good to fair. Each will require resurfacing in the next few years. Other unpaved road sections at the park are raised with fill. These will be classed as a spoil area to facilitate removal or conversion. (See spoil area treatment below.)

Other unpaved roads not in use will be eliminated via the previous methods or by restoring to grade.

Restoration Natural Community

There are two former sandhill sites and one flatwoods site in the park that fit the FNAI description for an altered landcover type recently defined as "restoration natural community." Two sites are located in the Hollins tract and the other is in CR-C7C.

The CR-H20 site, about 15.7 acres in size, is situated directly south of the park's shop area. Much progress has been made but the restoration process is still underway. This area suffers from previous heavy land uses including turpentine operations, cattle ranching, conversion to a wildlife food plot/dove field and commercial timber operations. Currently, the groundcover expected to occur in a healthy sandhill is sparse to absent. Invasive turf grasses as described above are present over approximately 5 acres at roughly 25% density. Off-site planted pines still dominate the overstory, and native turkey, post and sand live oaks are sparse. Though this area has twice been treated with prescribed fire and has had 200 longleaf pines per acre planted in 2012, it is still in need of major groundcover restoration efforts.

The site in the north end of CR-H29 totals approximately 18.2 acres and has a history of failed plantation from 1973. Prior to that, historic aerial photographs clearly show a mesic flatwoods condition with widely spaced overstory pines. Mechanical treatments and fire started in 2016, but this area needs more to restore proper groundcover and overstory conditions.

The CR-C7c site, about 12.7 acres in size and located just west of U.S. Highway 19 off Arber Court, is a native longleaf sandhill section that was clearcut prior to state acquisition. Aerial photos from 1949 show that there was no evidence then of an access road or other activity there, including turpentining or tree harvesting.

Zones CR-H20 and H29 require much more restoration work, including additional herbicide treatment, groundcover plantings and further application of prescribed fire. Other than that, the most important factor will be the continued use of frequent prescribed fire, which is essential to maintaining community structure and ecological integrity.

Spoil Area

In multiple areas, historic lime rock mining, road building and other development from 1962-1973 left deposits of soil and limestone boulders in many areas of the park. These almost always occur as deposits adjacent to canals, old mine pits and larger lime rock borrow areas described above under the "Artificial Pond" heading. These spoil mounds can be as high as 22 feet above the natural grade. Usually a subset of the plants inhabiting the closest community of the same elevation take up there, along with various native and invasive weed species, including highly invasive plants. Cabbage palms, red cedar and sugar hackberry favor these calcareous disturbed sites as well as other species including beauty berry, foxtail grass (*Setaria parviflora*), prickly pear and beggarticks (*Bidens alba*). Coastal spoils are particularly prone to lantana (*Lantana camara*) and Brazilian pepper infestations. A particularly large disturbance off Fort Island Trail around the Redfish Hole Fishing Trail includes 61 acres of linear spoil mounds and borrow pits that see some tidal flushing through two estuarine

creek systems. DRP biologists will work with interested agencies, including the Florida Fish and Wildlife Conservation Commission (FWC) and the SWFWMD to restore this area to salt marsh and hammock islands.

No active management is necessary other than occasional survey for invasive plants and treatment of these as needed. Though this plan will not cover the scope of project necessary to restore all of the spoil areas in the park, as funding and planning assistance becomes available, the park will work to restore spoil areas that will have the greatest impact on ecological function for the natural systems here.

Successional Hardwood Forest

The area above Churchhouse Hammock has remnant pines present, longleaf pines at the trailhead area and some loblollies further back. Catface scars, nails and sheet metal fragments characteristic of turpentine operations are present on many of the pines here. The entire site has been heavily invaded by laurel oaks up to 14 inches in diameter. In addition, a thick coverage of cabbage palm has developed here. Trees characteristic of adjacent mesic and hydric hammock communities are also present, including pignut hickory and magnolia. Other remnants of the pine community that once existed here are present in the form of sand post oak, wiregrass, gopher tortoise (*Gopherus polyphemus*) and six-lined racerunner (*Aspidoscelis sexlineata*). This area has had prescribed fire, but it needs fuels treatment to reduce cabbage palms in the upper transitional flatwoods sections that still hold longleaf pines.

Substantial effort will be required to restore pyrogenic natural communities in areas that have changed to successional hardwood forest. Such areas will generally not be targeted for intensive restoration activities such as off-site hardwood removal until the natural communities that are still relatively extant in the parks have been restored to the desired degree. However, prescribed fires in the altered areas will continue. Limited removal of palms and laurel oaks will continue after each fire cycle to open the pine dominated areas.

Objective A: Maintain 2,250 acres within the optimum fire return interval.

- Action 1 - Develop/update annual prescribed fire plan.
- Action 2 - Conduct prescribed fire on 679-1,500 acres annually.
- Action 3 - Incorporate 655 fire-type acres into new fire zones via installation of firebreaks, fuel mowing projects and use of specialized equipment as necessary to meet DRP standards.

Table X contains a list of all fire-dependent natural communities found within the park, their associated acreage and optimal fire return interval, and the annual average target for acres to be burned.

Prescribed Fire Management		
Natural Community	**Acres**	**Optimal Fire Return Interval (Years)**
Sandhill	99	1-3
Mesic Flatwoods	1,256	2-4
Wet Flatwoods	233	2-5
Scrubby Flatwoods	311	3-8
Scrub	52	4-10
Sawgrass Marsh	886	2-5
Abandoned Pasture	194	2-3
Annual Target Acreage	679 – 1,500	

Crystal River Preserve State Park has many fire-adapted natural communities, with the greatest acreages represented by mesic flatwoods and freshwater marshes. The marshes include basin marsh, depression marsh and the freshwater tidal marsh variant of floodplain marsh, all of which are dominated by sawgrass. There are also several hundred acres of scrubby flatwoods found primarily along Fort Island Trail and small pockets of scrub and sandhill, all requiring fire application to maintain optimum ecosystem health. Between 679 and 1,500 acres should be treated annually to restore and maintain the fire-dependent communities in the park.

All the fire zones north of the Crystal River (Hollins Tract) have been treated two to four times since 2004. They are adapting well to the conversion of over 430 acres of former plantation back to a form of mesic flatwoods. The plan to remove cabbage palm from dry flatwoods in order to restore groundcover has begun. Initial efforts after 2015 show that this is a successful strategy for increasing groundcover diversity.

Over many of these zones, excessive cabbage palm invasion has resulted in very hot fires, but thinning of the palms has gradually improved herbaceous groundcover response and allowed for more manageable fire operations. For safety purposes, park management has made it a priority to significantly reduce the number of cabbage palms that are growing adjacent to fire lines during the preparation of fire zones. Cabbage palms are notorious for torching and causing spot fires during prescribed fires. From 2006-08, park staff implemented three major projects to establish new fire zones along the Fort Island Trail section of the park, including over 20,250 feet of new fire line constructed and 19.5 acres of overgrown scrub mowed (in zones with CR-C3x and CR-C5x designations). Since 2010, management projects like these have allowed park staff to burn 122 acres of a total of 385 fire-type acres along the Fort Island Trail. However, the untreated scrub continues to be backlogged and remains an obstacle to full success of the fire program at the park. Additional mowing will likely be required to make the remaining scrub zones safe to treat with fire.

Remaining fire-type acres in the park occur within scattered hammocks adjacent to salt marsh or along the eastern third of Ozello Trail in a matrix of hydric hammock and swamps. These backlogged areas have yet to be carved into burn zones, but planning toward this goal has begun. While some mowing has occurred within zones CR-C5e and CR-C7b, most of the backlogged areas will need major fire line work before they can be classified as bona fide fire zones.

The Sterchi tract (zones CR-C7c & CR-C7h), located behind the closed Pro-Line boats factory at the end of Arber Court west of U.S. 19, contains 197 acres of fire-type community (sandhill, scrub and mesic flatwoods), 15 acres of which has been treated with prescribed fire to date. Much of the remaining area is ready to burn, only needing the correct condition range. The scrub in the western part of this area (CR-C7c) is overgrown and should be mechanically treated prior to burning.

Fire-dependent wildlife species in the park include the gopher tortoise, indigo snake, and eastern diamondback rattlesnake (*Crotalus adamanteus*). All of these species favor areas that support vegetation and prey that are enhanced by regular fires (Means and Campbell 1982, Morin 2005, Steen et. Al 2013). There are no recent records for the southern fox squirrel or Florida mouse from the park. These species have historically occupied portions of the park, remain in the region and may return if correct habitat conditions are promoted and maintained with fire. In all of these cases, it will be modification of the structure of remaining overgrown areas with mechanical treatments and frequent fire that will reveal the potential for recovery of the open, diverse groundcover that these species depend on.

***Objective B*:** Conduct habitat/natural community restoration activities within 36.6 acres of restoration natural community to facilitate conversion to sandhill or flatwoods.

- Action 1 - Develop/update a site-specific restoration plan for converting 36.6 acres (5.7 acres CR-H20, 12.7 acres CR-C7c, 18.2 acres CR-H29) of restoration natural community back to the original sandhill or flatwoods.
- Action 2 - Implement the restoration plan, including but not limited to:
    - Removal of non-native turf grass on approximately 5.7 acres in zone CR-H20.
    - Thinning of adult turkey oaks on 12.7 acres in zone CR-C7c.
    - Chemical treatment of cabbage palms in CR-H29.
    - Applying prescribed fire to sites and planting of native groundcover species, including wiregrass.
    - Re-establishment of longleaf pine as the dominant overstory tree by planting 300-400 seedlings per acre.
- Action 3 - Biennially conduct groundcover surveys similar to previous surveys in the park to assess the percentage target condition reached.

Staff will initiate habitat restoration measures for natural systems in the park wherever natural communities have been artificially impacted and where ecological functions have been disrupted. Due to the rare occurrence of sandhill in the park, this project is the highest priority among Objectives B-F.

Objective C: Conduct habitat/natural community restoration activities within 31 acres of successional hardwood forest to facilitate conversion to mesic flatwoods.

- Action 1 - Develop/update a site-specific plan to restore 31 acres of successional hardwood forest in zones CR-H5 and CR-H6 to mesic flatwoods.
- Action 2 - Implement the restoration plan, including but not limited to:
    - Removal of invasive cabbage palms over the extent that was historically open flatwoods.
    - Protection of cat-faced adult pines from fire damage during prescribed fire operations.
    - Girdling of laurel oaks within the restoration target area.
    - Mowing thickets of smaller oaks to open up the sites before initiating prescribed fire operations.
    - Continuing to limit the coverage of native/non-native vines (i.e., air potato) in the restoration area by using accepted control methods.
- Action 3 - Continue photo-point monitoring and begin biennial groundcover surveys to determine success of restoration activities.

Staff will initiate habitat restoration measures for natural systems in the park where natural communities have been impacted and where ecological functions have been disrupted. This project is the second priority among Objectives B-F.

Objective D: Develop habitat restoration plan for a combined 193 acres within areas currently delineated as pasture. (Implement restoration on a combined 50 acres.)

- Action 1 - Develop a site-specific plan to restore 193 acres (37 acres semi-improved pasture, 156 acres abandoned pasture) in zones CR-H71a and CR-H71b. (Initial restoration to begin with 50 acres described below.)
- Action 2 - Implement the restoration plan to a 16-acre section of semi-improved pasture in zone CR-H71a to restore basic mesic flatwoods conditions including but not limited to:
    - Successive herbicide treatments of bahiagrass monoculture areas to achieve a minimum 90% kill rate.
    - Establishment of appropriate groundcover components through collection of native seeds in other zones and planting of native shrubs.
    - Planting of 300-400 longleaf pine seedlings per acre to establish appropriate overstory cover.
- Action 3 - Implement the restoration plan for a 34-acre section of abandoned pasture in zone CR-H71b to restore basic mesic flatwoods conditions including but not limited to:
    - Mowing of large areas of invasive wax myrtle.
    - Herbicide treatment of bahiagrass and dewberry covered sections to achieve a minimum 90% kill rate.
    - Establishment of appropriate groundcover components through collection of native seeds and planting of native shrubs.
    - Planting of 300-400 longleaf pine seedlings per acre to establish appropriate over-story cover.
- Action 4 - Through biennial vegetation surveys, determine success of restoration projects by evaluating percentage increase in native species coverage.

Staff will initiate habitat restoration measures for natural systems in the park wherever natural communities have been artificially impacted and where ecological functions have been disrupted. This project is the third priority among Objectives B-F.

Objective E: Conduct habitat/natural community restoration activities within 48 acres of invasive monoculture to facilitate conversion to coastal hydric hammock.

- Action 1 - Develop/update a site-specific plan to restore 48 acres of invasive monoculture (i.e., Brazilian pepper) in zones CR-S4 and CR-S5 to coastal hydric hammock.
- Action 2 - Implement the restoration plan, including but not limited to:
    - Cut-stump herbicide treatments on lines of Brazilian pepper trees to provide access into hammocks.
    - Sequential treatment of adult Brazilian pepper, section by section, until 95% control of adults is achieved on 48 acres.
    - Surveying of zones within two years of initial treatment and treatment of re-sprouting juveniles with foliar chemical application.
    - Removal of dead adult trees as necessary.
- Action 3 - Continue vegetation surveys to determine percentage cover of native species remaining.

Staff will initiate habitat restoration measures for natural systems in the park wherever natural communities have been artificially impacted and where ecological functions have been disrupted. Due to recent progress in removing invasives in surrounding areas, this is considered the lowest priority among the restoration projects.

Objective F: Conduct natural community/habitat improvement activities on 153 acres of mesic flatwoods natural community.

- Action 1 - Remove excessive cabbage palm coverage on 153 acres of mesic flatwoods in the Hollins tract through mechanical and chemical means.
- Action 3 - Plant 300-400 longleaf pines per acre to restore the appropriate overstory component on the remaining 69 acres of former plantation in zones CR-H24, CR-H29 and CR-H15.

Objective G: Evaluate the funding and restoration process necessary to restore 61 acres of salt marsh that have been impacted by linear spoil piles and tidal borrow areas in Zone CR-C3J.

- Action 1 - Work with relevant agencies to create a restoration plan for the Redfish Hole area.
- Action 3 - Apply for funding necessary to restore this area, including provision of DEP matching funds as necessary.

Staff will initiate habitat improvement measures for natural systems in the park wherever natural communities have been artificially impacted and where ecological functions have been disrupted.

IMPERILED SPECIES

Thirteen imperiled plant species and 40 imperiled animal species have been recorded at Crystal River Preserve State Park. Given the wide variety of natural communities in the park, it is not surprising that there is a high diversity of imperiled plants and animals there as well.

One of the more notable imperiled plants in the park is the manyflowered grasspink (*Calopogon multiflorus*). This endangered orchid was documented in 2003 from a single observation by park staff. It is a fire-maintained species with populations that generally consist of only a few plants. Since reintroducing growing season prescribed fire, this plant has now been documented in two additional zones. Continued use of prescribed fire, maintenance of natural hydroperiod, and protection of wetlands from impacts of park operations and recreational activities are all vital tools for conserving this and several other imperiled plants in the park, including Cateby's lily, yellow-flowered butterwort (*Pinguicula lutea*), blueflower butterwort (*Pinguicula caerulea*), gypsy-spikes (*Platanthera flava*) and spiked crested coralroot (*Hexalectris spicata*).

Restoration measures (e.g., fire and selective hardwood removal) that are effective at reducing canopy density in fire-dependent natural communities will ultimately benefit groundcover species that require full sunlight (Kirkman et al. 2001). In fact, many of the park's flowering plants have already responded dramatically to recent restoration efforts, especially prescribed fire. However, herbiciding of invasive hardwoods to open up the canopy must be done very carefully to ensure that imperiled groundcover species are not harmed. Other potential threats to imperiled plants in the park include alteration of wetlands, plant poaching and ground disturbance caused by rooting animals such as armadillos and feral hogs.

Imperiled animal species should also benefit from the prescribed fire program at the park. The specific effects of fire on most invertebrate assemblages are largely unknown, but the retention of unburned refugia within

suitable habitats and adjustments to the frequency and seasonality of prescribed fires may be critical elements for continued survival of imperiled butterflies (Schweitzer et al. 2011).

Crystal River Preserve State Park currently harbors a greater number of imperiled bird species (26) than any other class of vertebrates. The park is an important stopover point for many migrant birds, and its diverse wetlands provide suitable nesting habitat for imperiled residents such as the little blue heron (*Egretta caerulea*) and tricolored heron (*Egretta tricolor*). Marian's marsh wren (*Cistothorus palustris marianae*) is an imperiled bird that inhabits salt marsh areas in the park. The population status of this species is still relatively unknown (Kale 1996; Sauer et al. 2014). A recent biological review of this species conducted by FWC concluded that increased monitoring efforts were needed because of ongoing threats to salt marsh habitat along the Gulf Coast and a trend of declining marsh wren populations in the area (FWC 2011).

Another notable record for the park is the Florida scrub-jay. This Florida endemic was last recorded in the park in the late 1990s but is now locally extirpated for unknown reasons. The substantial bird list for the park is the result of multiple organized bird counts over the years, including Audubon Christmas Bird Counts since 1987, focused surveys along the Great Florida Birding Trail and annual North American Migration counts.

Several imperiled reptiles occur within the park. The gulf salt marsh snake (*Nerodia clarki clarki*) has been found throughout the salt marsh and mangrove swamp communities. This species is known to have a wide zone of intergradation throughout Citrus County and Levy County with a southern form known as the mangrove water snake (*Nerodia clarki compressicauda*).

The ornate diamond-back terrapin is an important and highly vulnerable species of greatest conservation need that forages and nests within estuarine habitats of Crystal River Preserve State Park and the adjacent aquatic preserve (FWC 2012). The eastern indigo snake (*Drymarchon corais*) is a federally listed upland species that is becoming increasingly rare throughout its range due to loss and fragmentation of its critical habitat (Enge et al. 2013). Indigo snakes utilize gopher tortoise burrows as refugia and for thermoregulation, especially during periods of cold weather. An additional imperiled reptile species is the common kingsnake (*Lampropeltis getula*) which has also experienced significant population declines in recent decades. Based on recent sightings, including some in the park, populations appear to still exist in the Gulf Hammock region of the Florida Gulf Coast.

The gopher tortoise is one of the better-known imperiled reptiles in Florida. It is recognized as a keystone species of critical importance because hundreds of commensal species, mostly invertebrates, utilize their burrows as refugia (Jackson and Milstrey 1994). Tortoises typically inhabit well-drained sandy soils in a variety of upland habitats such as sandhill, mesic flatwoods, upland mixed woodland, and scrubby flatwoods. Because of its keystone status, the gopher tortoise is considered an indicator of upland natural community health. Prescribed fire is a vital tool to maintain tortoise habitat. In the absence of frequent fire, hardwood trees invade upland communities and shade out herbaceous plants required by tortoises for forage. FWC has adopted a statewide protocol for monitoring gopher tortoises based on a line transect distance sampling method (LTDS) (Smith et al. 2009). Any assessments of the status of gopher tortoise populations in the park should consider using this standard protocol.

Four species of marine turtle occur within the park's estuaries and adjacent waters of the Gulf of Mexico, namely Kemp's ridley sea turtle (*Lepidochelys kempii*), hawksbill sea turtle (*Eretmochelys imbricata*), loggerhead sea turtle (*Caretta caretta*) and green sea turtle (*Chelonia mydas*). The life history for each of these marine turtles is complex. Nonetheless, it is well known that nearshore estuarine habitats adjacent to the park are extremely important as "early-age" feeding grounds for these species. The estuarine resources of the

Springs Coast region are exceptionally diverse with lush beds of submerged aquatic vegetation (SAV) and highly productive benthic macroinvertebrate communities that attract young marine turtles year-round. The constant pulses of freshwater into estuaries that characterize this region are critical to maintaining natural hydrology and sustaining water quality and quantity in the lush SAV and benthic communities.

Although occasional signs of Florida black bear (*Ursus americanus floridanus*) have been noted in Crystal River Preserve State Park, apparently no bears are permanent residents there. One of Florida's smallest bear populations exists in the area immediately south of the park near the Chassahowitzka River (Maehr et al. 2003). Research suggests that habitat fragmentation has played a detrimental role by isolating this group of bears from neighboring populations (Cox et al. 1994). In the early 2000s, wildlife biologists released and tracked a radio-collared black bear that was struck by a car on a road bordering the park. This individual almost immediately turned south and returned to the Chassahowitzka region.

Florida manatees are year-round residents of Kings Bay adjacent to the park. They are attracted to Kings Bay's abundant freshwater springs and associated SAV assemblages (Hauxwell et al. 2003). In fact, the manatee is one of the biggest tourism draws in the city of Crystal River, especially during winter months when manatees crowd into the relatively warm, aquifer-fed springs of the Kings Bay/Crystal River system. Manatees, however, do not seem inclined to enter the smaller tidal creeks and shallow estuarine waters that are actually within the official boundaries of Crystal River Preserve State Park. Consequently, there are no known sightings of manatees within the park itself and the Florida manatee is not listed in the imperiled species table.

Table 2 contains a list of all known imperiled species within the park and identifies their status as defined by various entities. It also identifies the types of management actions that are currently being taken by DRP staff or others and identifies the current level of monitoring effort. The codes used under the column headings for management actions and monitoring level are defined following the table. Explanations for federal and state status as well as FNAI global and state rank are provided in Appendix.

Imperiled Species Inventory						
Common and Scientific Name	**Imperiled Species Status**				**Management Actions**	**Monitoring Level**
	FWC	**USFWS**	**FDACS**	**FNAI**		
PLANTS						
Golden leather fern *Acrosticum aureum*			ST		10,13	Tier 1
Manyflowered grasspink *Calopogon multiflorus*			ST	G2G3,S2 S3	1,2,10,13	Tier 2
Chapman's sedge *Carex chapmanii*			ST	G3,S3	1,2,10,13	Tier 1
Spiked crested coralroot *Hexalectris spicata*			SE		1,2,10,13	Tier 2

Imperiled Species Inventory						
Common and Scientific Name	**Imperiled Species Status**				**Management Actions**	**Monitoring Level**
	FWC	**USFWS**	**FDACS**	**FNAI**		
Catesby's lily *Lilium catesbaei*			ST		1,2,10,13	Tier 1
Cardinal flower *Lobelia cardinalis*			ST		2,10,13	Tier 1
Shell-mound pricklypear *Opuntia stricta*			ST		2,10, 13	Tier 1
Blueflower butterwort *Pinguicula caerulea*			ST		1,2,10,13	Tier 1
Yellow-flowered butterwort *Pinguicula lutea*			ST		1,2,10,13	Tier 1
Gypsy-spikes *Platanthera flava*			ST		1,2,10,13	Tier 2
Giant wild pine *Tillandsia utriculata*			SE		10,13	Tier 1
Rainlily *Zephyranthes atamasco*			ST		1,2,10,13	Tier 1
INVERTEBRATES						
Mourning cloak *Nymphalis antiopa*				G5,S2	1,13	Tier 1
REPTILES						
American alligator *Alligator mississippiensis*	FT(S/A)	SAT		G5,S4	4,10, 13	Tier 1
Loggerhead sea turtle *Caretta caretta*	FT	FT		G3,S3	4,13	Tier 1
Green turtle sea turtle *Chelonia mydas*	FT	FT		G3, S2S3	4,13	Tier 1
Eastern indigo snake *Drymarchon couperi*	FT	FT		G3,S2?	1,10, 13	Tier 2
Hawksbill sea turtle *Eretmochelys imbricata*	FE	FE		G3,S1	4,13	Tier 1
Gopher tortoise *Gopherus polyphemus*	ST	N		G3,S3	1,6,7,810 ,13	Tier 2
Common kingsnake *Lampropeltis getula*				G5, S1S2	10,13	Tier 2
Kemp's ridley sea turtle *Lepidochelys kempii*	FE	FE		G1,S1	4,13	Tier 1

Imperiled Species Inventory						
Common and Scientific Name	**Imperiled Species Status**				**Management Actions**	**Monitoring Level**
	FWC	**USFWS**	**FDACS**	**FNAI**		
Gulf salt marsh snake *Nerodia clarkii clarkii*				G4T3, S2	4,13	Tier 1
BIRDS						
Scott's seaside sparrow *Ammospiza maritimus peninsulae*	ST			G4T3, S3	2,4,9, 13	Tier 2
Florida sandhill crane *Antigone canadensis pratensis*	ST			G5T2, S2	4,9,13	Tier 2
Florida scrub jay *Aphelocoma coerulescens*	FT	FT		G1G2,S1 S2	1,3,6,713	Tier 2
Short-tailed hawk *Buteo brachyurus*				G4G5,S1	13	Tier 2
Rufa red knot *Calidris canutus rufa*	FT	FT		G4T2, S2N	4,9,13	Tier 2
Wilson's plover *Charadrius wilsonia*				G5,S2	4,8,9, 10,13	Tier 2
Marian's marsh wren *Cistothorus palustris marianae*	ST			G5T3, S3	2,4,9, 13	Tier 2
Little blue heron *Egretta caerulea*	ST			G5,S4	4,9,13	Tier 2
Tricolored heron *Egretta tricolor*	ST			G5,S4	4,9,13	Tier 2
Swallow-tailed kite *Elanoides forficatus*				G5,S2	13	Tier 2
Merlin *Falco columbarius*				G5,S2	13	Tier 2
Peregrine falcon *Falco peregrinus*				G4,S2	13	Tier 2
Magnificent frigatebird *Fregata magnificens*				G5,S1	13	Tier 2
Whooping crane *Grus americana*	FXN	XN		G1,SNR	4,9,13	Tier 2
American oystercatcher *Haematopus palliatus*	ST			G5,S2	2,4,8,910 ,13	Tier 2

Imperiled Species Inventory						
Common and Scientific Name	**Imperiled Species Status**				**Management Actions**	**Monitoring Level**
	FWC	**USFWS**	**FDACS**	**FNAI**		
Black rail *Laterallus jamaicensis*				G3,S2	2,4,9, 13	Tier 2
Wood stork *Mycteria americana*	FT	FT		G4,S2	4,13	Tier 2
Roseate spoonbill *Platalea ajaja*	ST			G5,S2	4,13	Tier 2
American avocet *Recurvirostra americana*				G5,S2	4,13	Tier 2
Black skimmer *Rynchops niger*	ST			G5,S3	4,9,10,13	Tier 2
Least tern *Sterna antillarum*	ST			G4,S3	4,8,9, 10,13	Tier 2
Sandwich Tern *Thalasseus sandvicensis*				G5,S2	4,13	Tier 2

Management Actions

1. Prescribed Fire
2. Invasive Plant Removal
3. Population Translocation/Augmentation/Restocking
4. Hydrological Maintenance/Restoration
5. Nest Boxes/Artificial Cavities
6. Hardwood Removal
7. Mechanical Treatment
8. Predator Control
9. Erosion Control
10. Protection from visitor impacts (establish buffers)/law enforcement
11. Decoys (shorebirds)
12. Vegetation planting
13. Outreach and Education
14. Other

Monitoring Level

Tier 1: Non-Targeted Observation/Documentation: includes documentation of species presence through casual/passive observation during routine park activities (i.e. not conducting species-specific searches). Documentation may be in the form of Wildlife Observation Forms, or other district specific methods used to communicate observations.
Tier 2: Targeted Presence/Absence: includes monitoring methods/activities that are specifically intended to document presence/absence of a particular species or suite of species.
Tier 3: Population Estimate/Index: an approximation of the true population size or population index based on a widely accepted method of sampling.
Tier 4: Population Census: A complete count of an entire population with demographic analysis, including mortality, reproduction, emigration, and immigration.
Tier 5: Other: may include habitat assessments for a particular species or suite of species or any other specific methods used as indicators to gather information about a particular species.

***Objective A*:** Develop/update baseline imperiled species occurrence inventory lists for plants and animals.

Additional surveys for imperiled plant and animal species are needed at Crystal River Preserve State Park to ensure that all imperiled species are documented. DRP will enlist the assistance of academic researchers and staff from other agencies during development of species occurrence inventory lists, especially where necessary for certain taxonomic groups.

Objective B: Monitor and document five selected imperiled animal species in the park.

- Action 1 - Develop monitoring protocols for five selected imperiled animal species, including the gopher tortoise, eastern indigo snake, common kingsnake, Scott's seaside sparrow and Marian's marsh wren.
- Action 2 - Implement monitoring protocols for the five imperiled animal species listed in Action 1.

As upland natural community restoration and improvement projects proceed, particularly prescribed fire, it will be increasingly important to track gopher tortoise numbers. Documentation of sightings of eastern indigo snakes and common kingsnakes will provide important information about the status of these declining species in the park. Monitoring of Scott's seaside sparrow and Marian's marsh wren will be conducted through cooperative survey efforts with FWC.

Crystal River Preserve State Park serves as one of the primary monitoring locations for the annual National Audubon Christmas Bird Count (CBC) in the Crystal River area. The Citrus County CBC, which has been conducted for over 25 years, uses the same monitoring protocol every year and provides data on long-term population trends. Many of the imperiled bird species are documented annually during the CBC.

Objective C: Monitor and document three selected imperiled plant species in the park (spiked crested coralroot, many flowered grasspink and gypsy-spikes).

- Action 1 - Develop monitoring protocols for three selected imperiled plant species including spiked crested coralroot, many flowered grasspink and gypsy-spikes.
- Action 2 - Implement monitoring protocols for three imperiled plant species including those listed in Action 1 above.

Three imperiled plant species will be surveyed and documented periodically to detect the presence of any new populations that may have appeared in the park and assess their condition. These imperiled plants include spiked crested coralroot, many flowered grasspink and gypsy-spikes, all indicator species of fire-dominated pine communities. Specific protocols will be developed and implemented for these species in cooperation with FNAI.

INVASIVE SPECIES

Crystal River Preserve State Park has substantial infestations of invasive plants (see Table 3 below). Of these species, Brazilian pepper (*Schinus terebinthifolius*) is by far the largest problem in coverage and density. The primary means by which invasive non-native plants spread into the park are escapes from adjacent private properties, dispersion by birds and storm surges. Brazilian pepper and Chinese tallowtree in particular owe their dispersal to frugivorous birds. Sprenger's asparagus-fern is a popular groundcover plant that is still sold legally in Florida. It is seen in areas where landscape debris is dumped, although it is also carried by birds to

offshore hammocks. Japanese climbing fern (*Lygodium japonicum*) is most often spread by floodwaters or by contaminated equipment or soil. Cogongrass sources typically include infested logging equipment, mowers, tractors and contaminated soil or lime rock.

All management zones in the park have been surveyed for invasive plants, and staff will continue to survey them on a regular basis. At the time of this plan, approximately 767 infested acres covering approximately 3,741 gross acres of the park are being tracked as part of the invasive plant management program. Since 2013, about 5,770 gross acres of invasive plants have been treated at Crystal River Preserve State Park. Annual treatment have ranged from 43 to 487 infested acres depending on staff availability, contract funding levels and weather conditions. Treatments have greatly reduced the density and coverage of invasive infestations in many areas. A complete Exotic Invasive Plant Integrated Management Plan has been drafted by the park biologist (DEP 2012).

This plan describes in detail the invasive weeds of concern, treatment methods and tactics for a multi-pronged approach to management including biological, mechanical and chemical means of treatment and volunteer and educational methods of management. The plan is updated on a biennial basis.

In addition to Florida Invasive Species Council (FISC) Category I and Category II invasive species, the park contains invasive grasses such as centipede grass and bahiagrass. These species persist on some trails and firebreaks as well as in the semi-improved pasture described above. They are invading some areas where fire and logging have opened up the groundcover layer.

The most significant invasive animal in the park is the feral hog. Hogs are plentiful in the park and cause significant damage to marshes and other seasonally wet areas.

Species Name **Scientific Name - Common Name**	**FLEPPC Category**	**Distribution**	**Zone ID**
Albizia julibrissin - Mimosa	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-C03A, CR-C05A, CR-H71B, CR-S03, CR-C03A, CR-C05F, CR-C03C,
Ardisia crenata - Coral ardisia	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-S04, CR-H05A, CR-H06A, CR-H06B, CR-H06
Asparagus aethiopicus - Sprenger's asparagus-fern	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-C03A, CR-C03J, CR-WI3, CR-C03, CR-C06
Cinnamomum camphora - Camphor-tree	I	Single Plant or Clump, Scattered Plants or Clumps	CR-C01, CR-H67, CR-H70B, CR-S04, CR-C03, CR-C03C, CR-C05F, CR-H01, CR-H02, CR-H71A
Colocasia esculenta - Wild taro	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-C03J, CR-H06, CR-H06B
Cyperus involucratus - Umbrella plant	II	Scattered Plants or Clumps	CR-C03J

Species Name Scientific Name - Common Name	FLEPPC Category	Distribution	Zone ID
Dioscorea bulbifera – Air potato	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-H04, CR-C03, CR-C03J, CR-H04A, CR-H05, CR-H06, CR-C03A, CR-H05A, CR-H06A
Imperata cylindrica - Cogongrass	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches, Dominant Cover, Dense Monoculture, Linearly Scattered	CR-C03A, CR-C04, CR-H01, CR-H17, CR-H70B, CR-H71A, CR-H71e, CR-H71w, CR-H29, CR-C05F, CR-H04A, CR-H04B, CR-H06, CR-H17, CR-H21, CR-H33, CR-H67, CR-H71A, CR-H73, CR-H75, CR-C03, CR-H06B, CR-H15, CR-H27, CR-H28, CR-H30, CR-H33, CR-H66, CR-H67, CR-H70e, CR-H71A, CR-H73, CR-H04, CR-H06A, CR-H71B
Lantana camara - Lantana	I	Single Plant or Clump, Scattered Plants or Clumps Scattered Dense Patches Dense Monoculture	CR-C03J, CR-C05A, CR-C05H, CR-H01, CR-H04B, CR-H06A, CR-H06B, CR-C03, CR-C03A, CR-C03J, CR-C05C, CR-H04A, CR-H04
Leucaena leucocephala - Lead tree	II	Linearly Scattered	CR-S03
Lygodium japonicum - Japanese climbing fern	I	Single Plant or Clump, Scattered Plants or Clumps	CR-H04, CR-H04A, CR-H28, CR-H70B, CR-H01, CR-H02
Melinis repens - Natal grass	I	Single Plant or Clump, Scattered Plants or Clumps Scattered Dense Patches	CR-H04A, CR-H06A, CR-H70B, CR-H70e
Paederia foetida - Skunk vine	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches	CR-C03J, CR-C05C, CR-H04, CR-H71w, CR-C03A, CR-C05F, CR-H01, CR-H02, CR-H04A, CR-H04B, CR-H06A, CR-H71A, CR-WI3
Panicum repens - Torpedo grass	I	Scattered Plants or Clumps	CR-H04A
Pteris vittata - Chinese brake fern	II	Single Plant or Clump, Dominant Cover, Scattered Plants or Clumps, Scattered Dense Patches	CR-H04B, CR-H04, CR-H66, CR-H67, CR-H73 CR-H04A, CR-H29, CR-H72
Ruellia simplex - Mexican petunia	I	Scattered Plants or Clumps	CR-C03J

Species Name Scientific Name - Common Name	FLEPPC Category	Distribution	Zone ID
Sapium sebiferum - Chinese tallow tree	I	Single Plant or Clump, Scattered Plants or Clumps Scattered Dense Patches	CR-C05C, CR-C07F, CR-H05A, CR-H33e, CR-H71B, CR-C03A, CR-C03D, CR-C03J, CR-C05A, CR-C05C, CR-C05F, CR-H04B, CR-H05A, CR-H27, CR-H71A, CR-H71w, CR-H74, CR-C03C, CR-C05E, CR-H29
Schinus terebinthifolius - Brazilian pepper	I	Single Plant or Clump, Scattered Plants or Clumps, Scattered Dense Patches Dominant Cover Dense Monoculture Linearly Scattered	CR-C03, CR-C04, CR-H04B, CR-H38, CR-H71e, CR-H74, CR-S03, CR-S04, CR-C01, CR-C01B, CR-C01C, CR-C01D, CR-C03A, CR-C03C, CR-C03G, CR-C03J, CR-C05, CR-C05A, CR-C05B, CR-C05C, CR-C05D, CR-C05F, CR-C05H, CR-C05I, CR-C05J, CR-C05K, CR-C06, CR-C07, CR-H01, CR-H02, CR-H03, CR-H04, CR-H04A, CR-H04B, CR-H05A, CR-H37, CR-H70e, CR-H71A, CR-H72, CR-H73, CR-S01, CR-S02, CR-S04, CR-S06, CR-S10, CR-WI2, CR-WI3, CR-WI4, CR-WI4e, CR-C01, CR-C05A, CR-C05J, CR-C05K, CR-C06, CR-H05, CR-H76, CR-S05, CR-S07, CR-S08, CR-S09, CR-WI3, CR-WI4, CR-WI4e, CR-S08, CR-S09,
Senna pendula - Climbing cassia	I	Single Plant or Clump	CR-C03J
Sesbania punicea - Purple sesban	II	Single Plant or Clump	CR-H71e
Solanum viarum - Tropical soda apple	I	Single Plant or Clump	CR-H70A
Syngonium podophyllum - Arrowhead vine	I	Single Plant or Clump	CR-C03J

DRP actively removes invasive species from state parks, with priority being given to those causing the most ecological damage. Removal techniques may include mechanical treatment, herbicides or biocontrol agents.

***Objective A*:** Annually treat a minimum of 250 gross acres containing up to 91 infested acres of invasive plant species in the park.

- Action 1 - Annually develop/update an invasive plant management work plan that includes 170-205 acres of contract treatment areas for different funding sources.
- Action 2 - Implement the annual work plan by treating 45-80 acres in the park annually with staff and continuing maintenance and follow-up treatments as needed.
- Action 3 - Complete invasive plant surveys on a minimum of 1,715 acres of the park annually to stay current with conditions.

Continuous updates of invasive plant coverage surveys will guide future treatment locations and priorities. In general, there will continue to be an emphasis on retreatment of existing treatment zones and only incremental and small expansion into zones never before treated. In any given year, approximately 75% of the treatments executed by staff should be in previously treated areas, 15% should be in new treatment areas with the goal of eliminating seed sources adjacent to prior treatments, and 10% or less should be on county or private rights-of-way and other lands with permission.

In addition, staff each year will develop maps and scopes of work to execute contract treatment of zones that will serve the overall goal of expanding the areas in maintenance condition. Education and volunteer activities associated with invasive plant and animal species are discussed in the Exotic Invasive Plant Integrated Management Plan (2012).

Objective B: Implement control measures to remove a minimum of 150 invasive feral hogs in the park annually.

- Action 1 - Make full use of smart cell camera hog trapping systems owned by the park.
- Action 2 - Coordinate with the U.S. Department of Agriculture (USDA) to establish a work plan that will reduce damage and remove hogs to protect intact communities and sensitive plant populations in the park.

CULTURAL RESOURCES

Prehistoric and Historic Archaeological Sites

All significant archaeological sites within the park that represent Florida's cultural periods or significant historic events or persons are preserved in good condition in perpetuity, protected from physical threats and interpreted to the public.

Crystal River Preserve State Park has 111 archaeological sites and three resource groups recorded with the FMSF. Several sites have a historic component overlaying earlier prehistoric occupations. Addendum 7 contains a table of those sites complete with site numbers, the significance of each site and site condition assessments. Archaeological research indicates the region has been occupied by prehistoric aboriginal people for the past 12,000 years, and perhaps earlier.

The site inventory for Crystal River Preserve State Park includes a wide range of resources that cover a considerable span of Florida's prehistory up to the period of historic contact, including Archaic (Orange and Transitional), Woodland (Deptford, Swift Creek, and Weeden Island), and late prehistoric (Safety Harbor) sites. Site types may include habitations, villages, shell mounds, middens and resource acquisition sites. Several of the large prehistoric complexes within the park extend onto adjacent private properties or onto other DEP-managed lands. Of the latter, Crystal River Mounds (CI00001) and the Roberts Island complex (CI00037-41) are managed as part of the adjacent Crystal River Archaeological State Park.

The prehistoric sites are unevenly distributed across Crystal River Preserve State Park and may be found in nearly every coastal physiographic context. However, the majority are located in the coastal lowlands and marshes, on marsh islands or along tidal creeks leading out to the Gulf of Mexico. The level of field survey within those coastal contexts is high. Extensive field surveys have already been conducted on Crystal River and its adjacent marshes out to the Gulf of Mexico, along Salt River and Homosassa River, on portions of Roberts Island, in the outer island group including Mullet Key, and within the Ozello Archipelago and the inner island group. Most of the island and tidal creek bank sites have an underwater component evidencing inundation due to sea level change over the past 6,000 years. These site contexts are the most vulnerable to rising waters and impacts from storm surge and flooding.

Since 1992, the Gulf Archeology Research Institute (GARI) has conducted surveys and cultural resource inventories in specific tracts within what is now Crystal River Preserve State Park and within the adjacent St. Martins Marsh Aquatic Preserve, whose saltmarsh and marsh islands closely intermesh with the western fringes of the park (Dean et al. 2004; Ellis et al. 2001, 2002), as well as in other parts of western Citrus County (Ellis et al. 1993, 1995). The purpose of the GARI surveys was to gain a better understanding of the lifeways of residential populations along the Gulf Coast through time. Unfortunately, the dynamic coastal environment has not been kind to the archaeological record, and what remains represents only a small fraction of the whole. Sea level rise (and the accompanying drop in the water table), land subsidence, wave and tidal action, storm surge and other environmental perturbations have killed hammock vegetation, scoured limestone platforms, eroded soils, and displaced or totally swallowed large numbers of archaeological sites. Some regions have fared worse than others, depending on their topographic and sedimentary environments. For example, site loss in the Ozello Archipelago has been catastrophic. Despite these issues, the number of sites successfully identified by GARI has been high, basically by using natural-cultural modeling that incorporates parameters such as natural resources potential, topography, sea level change through time and vegetation.

The Springs Coast region was heavily utilized by prehistoric human populations during the Middle/Late Archaic, Deptford and Weeden Island periods (Miller 1973; Bullen 1951; Bullen and Bullen 1961). Lithic scatters occur on Pleistocene aeolian dunes or relict tidal bar features. Shell midden sites occur in all physiographic regions but are concentrated on limestone islands within the salt marsh, on offshore islands, or along riverbanks. Burial mounds usually occur inland, and mound-village complexes are known to be located at the mouth of the Withlacoochee River, around Kings Bay and along the Crystal River, and at Roberts Island. Few prehistoric sites have been found in the local flatwoods regions, and these are usually located on scattered elevated sand "islands."

The subtle locational differences among site types, along with differential spatial and temporal distributions in lithic, shell and ceramic resources, suggest that several settlement pattern shifts occurred through time in

response to environmental perturbations. In the early Deptford through Weeden Island periods, the mesic hammocks in and around the estuaries and saltmarshes were heavily utilized. There are several midden sites on offshore islands that were potential fishing/hunting communities (i.e., coastal villages) (Bullen and Bullen 1961; Dean et al. 2004). It was also during the Deptford period when the large ceremonial complexes such as at the Crystal River site began to emerge. The environmental constraints (e.g., topography of the bedrock) for the location of these communities and complexes, as well as differences in artifact types among them, hint at the possibility that affiliations between sites and villages may be able to be determined as more investigations take place.

Achieving an understanding of the temporal affiliations and functions of the many sites in the extremely skewed coastal archaeological record is greatly hindered by the lack of systematic excavations and absence of radiometric dates. Within and adjacent to Crystal River Preserve State Park, the only sites that have been professionally excavated are the Crystal River site (CI00001) (Ellis et al. 2003; Weisman and Marquardt 1988) and the Wash Island site (CI00042) (Bullen and Bullen 1961, 1963). Recent work at the adjacent Crystal River site (Pluckhahn et al 2009), as well as the Roberts Island shell mound complex, has greatly contributed to the understanding of this underreported site. Wash Island is a plus-75-meter-long shell midden on the north bank of the Crystal River that is notable for the earliest cord-marked sherds on the central Gulf Coast, the high number of Hernando points, and the diverse array of pottery types that include several Transitional period types. A 5-by-10-foot stratigraphic test excavated by the Bullens in 1963 demonstrated that the midden was constructed over three occupations and included a Safety Harbor zone (0-9 inches), a Weeden Island zone (9-27 inches), and an earlier post-Orange/early Deptford zone (Bullen and Bullen 1963). Pasco Plain and sand-tempered plain pottery dominated the assemblage, but other types included decorated Pasco and Perico wares. Other artifacts included Hernando and Citrus points, a limestone cup, steatite vessel fragments, Busycon whelk and crown conch shell tools, and faunal remains consisting of nearshore fish, sea and terrestrial turtles, and deer.

This assemblage at Wash Island hints at a shared cultural tradition with the Crystal River site. Reconnaissance surveys by GARI in other parts of the park have documented numerous post- or late-archaic midden sites that are located in similar environmental locations and contain similarly stratified deposits. These deposits are marked by the dominance of Pasco pottery wares, a high number of conch shell tools and heavy utilization of local marsh fauna. Additional excavation at select sites should enable an enhanced degree of resolution that will clarify the subtle material differences enmeshed within these regional and more static culture traits.

From this brief review of archaeological trends in the Crystal River region of the Gulf Coast, a few predictions can be made about probable future survey results:

- The presence of two major mound-village complexes just south and east of Crystal River Preserve State Park, along with the findings of numerous archaeological surveys along the coast, indicate that a large aboriginal population and a high number of sites are to be expected in the area. Archaeological sites within the coastal marshes today are usually situated in cabbage palm hammocks, on limestone highs around artesian wells, and on relict dunes and tidal bars. That is not necessarily an ancient context, and it is one of continuing research. The survey area within Crystal River Preserve State Park consists of marshlands rimming a shelf embayment near the mouth of the Crystal River that is undergoing rapid change due to sea level rise, land subsidence and wave/tidal action. It is expected that landform modifications in the form of hammock loss and scouring of limestone islands will cause severe loss of archaeological sites in the future. The surviving sites will probably be in the more stable or elevated

areas. There should be gaps in the cultural history represented by sites that were once located on elevated areas but are now inundated or scoured clean. The western half of the survey area is likely to be the most severely affected because the Crystal River is at its widest there and the limestone islands are scattered and less elevated. Secondarily deposited sites derived from the original ones may be found in nearby solution holes, sand bars and tidal stream channels.

- Paleoindian and Archaic sites, most likely represented as lithic scatters, are expected to be few in number in Crystal River Preserve State Park and may not be discovered unless relict features (e.g., sinks, Pleistocene dunes) are present. Pottery dating to the Safety Harbor Period is not well represented in local collections. Therefore, sites of this period may be difficult to identify. Shellfish remains will likely be the most prominent surviving cultural material present at the sites. Oyster is expected to dominate all sites, but marsh clam, mussel, crown conch, Busycon and quahog will also be common. The latter three species were commonly modified into gouges, picks, hammers, and other tools. Shell midden sites are likely to be the dominant site type. These can vary considerably in size, composition and organization, ranging from light scatters of shell containing no artifacts to stratified earth and shell middens that represent procurement and tasking stations or single- and multi-family habitation camps. These sites would likely occur on the limestone highs within the saltmarsh and in the large mesic hammocks east of the marshlands.

- Although mound-village complexes have not been recorded within Crystal River Preserve State Park itself, they do occur on nearby lands to the east and south, including Crystal River Archaeological State Park. It is logical to assume that portions of the residential populations that historically were served by the Crystal River Mounds site or the Roberts Island complex will have occupied locales within what is now Crystal River Preserve State Park. The artifact assemblages within the park may therefore reflect affinities to these complexes.

- Burial sites in the region, including the Crystal River Mounds, are generally of sand or oyster shell construction and are located away from shell midden villages. They are low and fragile and are highly susceptible to damage from bioturbation and erosion. In many cases, they are not recognizable until discovered via erosional exposure or field testing. Though rarely discovered, burial sites require extra protection against looting and continuing erosion. The current inventory for Crystal River Preserve State Park contains several burial site candidates among its potentially significant sites.

- In future surveys, coastal communities will probably have to be defined on the basis of a constellation of small and large midden sites in close proximity to one another that can be culturally linked via similar artifact assemblages or unique stratigraphic sequences. Site distribution within these communities is geared to the topography of the bedrock but should be somewhat linear along the Crystal River. It is expected that the degree of erosion across the limestone elevations closest to the gulf, however, will reduce researchers' abilities to locate small sites or even clusters of sites.

- The majority of the shell midden sites will probably lack diagnostics. If they do contain pottery, the most common types are expected to be sand-tempered plain (probably Deptford) and limestone-tempered plain (probably Pasco Plain). Therefore, cultural affiliations defined for sites will be broad (e.g., Transitional through Weeden Island periods).

- Where diagnostic lithic artifacts do occur, they will likely fall into a temporal range similar to that of the pottery (i.e., post-Late Archaic through Weeden Island II). At the Wash Island and Crystal River sites,

the most common point types include Citrus and Hernando projectiles. At the Crystal River site, a bluish-black chert was commonly used (Ellis et al. 2003). This chert appears to be derived from a local source, now inundated, and it will likely be the major type found in the middens of this time period. Earlier (Archaic) sites may contain chert from the Tampa Bay region. Other lithic artifacts to be expected include limestone tools (e.g., plummets) and pieces of coral.

- Finally, the vertebrate remains that are recovered are likely to be dominated by local species, including sea and terrestrial turtles, nearshore fish, deer, and small mammals of upland and mesic coastal plain habitats.

Of the 111 archaeological sites in Crystal River Preserve State Park, only one is currently listed on the National Register of Historic Places, but some archaeological surveyors suggest that at least seven additional sites may be National Register eligible. The sole site on the National Register is Mullet Key (CI00022), which is a prehistoric shell midden/campsite located about 4.5 miles south of the mouth of Crystal River. The horseshoe-shaped island has a maximum elevation of about 2 meters at low tide, making it considerably higher than the neighboring mangrove and grass islands. Despite modern-day use by fishermen and boaters and threats posed by wave action and rising sea levels, the site is considered to be in good condition. Ceramics recorded at the site date from about 500 B.C. to A.D. 1500 and include Deptford, Weeden Island and Safety Harbor components. According to the FMSF, Mullet Key may contain unmarked human remains.

Artifacts collected at various Crystal River sites considered to be possibly eligible for the National Historic Register indicate that a broad range of aboriginal cultures are represented, including Deptford, Weeden Island I, Weeden Island II and Safety Harbor. Some of the sites have deteriorated since the original site forms were filed with the FMSF and may no longer be eligible. One site that has remained in good condition, however, is Spice Key (CI00224). Located on the eastern edge of the Suncoast Keys southwest of the mouth of the Salt River, it contains a 1-meter high shell midden that was once vegetated with cabbage palms and cedars but is now covered with halophytic shrubs. Ceramics from the Deptford Island and Weeden Island I cultures have been recorded there. The midden shell is very compacted on Spice Key, so the site may be able to maintain its integrity for the near future despite increased threats from wave and tidal action.

Another National Register-eligible site that is still in good condition is Sickle Midden (CI01197), which is described in the FMSF as a 0.75-meter high, stratified shell midden located in salt marshes southwest of the mouth of the Salt River. In contrast with Spice Key, this midden has retained much of its characteristic vegetation in the form of a cedar and cabbage palm hammock. Ceramics recorded at the site represent the Deptford and Weeden Island cultures. Sickle Midden is similar to Spice Key in that it contains compacted and cemented shell, making it somewhat resistant to wave action. No looting or vandalism has been detected at the site.

Despite the apparent stability of some of the more important sites in Crystal River Preserve State Park, at least for the time being, the ever-increasing threat of significant site perturbation seems to warrant additional precautions, including the encouragement of additional archaeological evaluations. All sites that the Phase I survey has recommended as potentially National Register-eligible should receive comprehensive Phase II archaeological evaluations if they are subject to immediate or short-term impacts.

A functioning predictive model for Crystal River Preserve State Park was completed in 2012. As part of the modeling project, a team from the University of South Florida's Alliance for Integrated Spatial Technologies used LIDAR remote sensing imagery, historic aerial photographs, historic survey maps and existing

archaeological research maps in developing a map of the park showing areas of high, medium and low sensitivity for archaeological resources (Collins 2012). This map will be consulted whenever any ground disturbing activities or archaeological studies are planned for the park. The modeling team calculated that approximately 1,376 acres (5%) of the park should be considered as areas of high sensitivity for archaeological resources and 442 acres (1.6%) as areas of medium sensitivity. Although no actual ground-truthing took place, analysis of various types of imagery enabled the team to correct the spatial boundaries for 12 sites previously recorded in the park (CI00224, CI00418, CI00576, CI00578, CI00586, CI001066, CI001193, CI001201, CI001202, CI001217, CI001303, and CI001312).

Over 50% of the surface area of Crystal River Preserve State Park has undergone thorough archaeological survey, focusing on areas of high public use, highly threatened areas (natural and anthropogenic threats), remote but accessible islands, and Crystal River itself. This work covered high and low probability areas to facilitate actual modeling.

Crystal River Preserve State Park is located in the midst of the Nature Coast area of Florida, and its many acres of coastal lands and islands attract a considerable amount of pedestrian day use. Because the cultural materials and archaeological deposits within the park are spread across such a large geographic area, there is ample opportunity for visitors to engage in casual or even purposeful artifact collecting. Moreover, the consequence of public pedestrian use and occasional digging for artifacts is a continual movement of mounded shell deposits downslope toward the water's edge, where the materials are further shifted by tidal and surge action. In fact, these deposits are often situated in the primary effect zone for coastal surge and local sea level change. Because of the concurrent impacts of public use and natural processes, coastal and estuarine archaeological sites within the park are especially vulnerable and their threat level is high.

Crystal River Preserve State Park's cultural resource inventory is assessed annually by visiting scientists from GARI. During these visits, archaeologists assess site conditions and local natural contexts and evaluate threats to effective preservation. The prioritization of threatened natural and archaeological contexts constitutes a fundamental part of the park's cultural resource management practice. Actions recommended for archaeological sites may be of a remedial, essential, or emergency nature.

The management of cultural resources within an expansive coastal context becomes even more complicated when exacerbating influences such as rising sea levels, climate change and increased exposure to pedestrian impacts are factored in. Cultural resources often represent the last surviving constituency of physical evidence for a long prehistoric past. They are irreplaceable and extremely vulnerable to disturbance. The park manager and staff at Crystal River Preserve State Park routinely consult with cultural resource professionals in GARI and with visiting scientists who have conducted the majority of the primary field work and research within the park, as well as along the west-central Gulf Coast of Florida. These experts in turn consult with professionals from the Bureau of Natural and Cultural Resources (BNCR) and Division of Historical Resources (DHR) to effect optimally phased archaeological studies consistent with the nature of their environmental setting. Before the initiation of projects proposed for the park, all activities related to land clearing or ground disturbance, and all major repairs or additions to historic structures listed or eligible for listing in the National Register of Historic Places, are coordinated with BNCR prior to being submitted to DHR for review and comment.

Most of the archaeological sites in the park are situated along a coastline which is experiencing not only a significant rise in sea level but also burgeoning population growth. Sites are currently subject to greater wave action, higher tidal surges, and ever-increasing numbers of recreational users. The primary treatments for

significant archaeological sites in the park are preservation and stabilization. Site preservation in the park primarily consists of protection from vandalism or looting, monitoring use and reducing visitation if necessary. The use of educational signage may be appropriate at some sites. Site stabilization techniques used in the park include monitoring of protective vegetation and revegetating of site surfaces if needed. A recommended treatment for each site is indicated in the Cultural Sites table in Appendix. In addition, GARI archaeologists recommend that 56 of the park's sites be formally tested for the National Register of Historic Places.

Historic Structures

There are no historic structures at Crystal River Preserve State Park.

Collections

All historic, natural history and archaeological objects within the park that represent Florida's cultural periods, significant historic events or persons, or natural history specimens are preserved in good condition in perpetuity, protected from physical threats and interpreted to the public.

Crystal River Preserve State Park does not have any archaeological collections. To guide future park management, however, a Scope of Collections Statement should be prepared, indicating that the park currently does not have a collection and does not accept or acquire items for any collection. Items brought to the park office are noted for site attribution and, after consultation, are shipped to DHR for curation.

Cultural Sites Listed in the Florida Master Site File

FMSF # and Site Name	Culture/Period	Description	Significance	Condition	Treatment
CI00017 Rock Landing	Prehistoric/Unspecified	Prehistoric mound(s)	NE	G	P
CI00022 Mullet Key	Prehistoric/Late Archaic/Deptford	Prehistoric shell midden/Prehistoric campsite	NRL	G	P
CI00042 Crystal River 8 - Wash Island	Prehistoric/Archaic, 8500 B.C.-1000 B.C.	Prehistoric campsite	NE	G	P
CI00050 Crevasse Island	Prehistoric/Weeden Island II	Prehistoric shell midden	NE	G	P
CI00087 Ozello 3	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI00088 Ozello 5	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P
CI00118 Fort Island	Prehistoric/Late Archaic/Weeden Island	Prehistoric shell midden	NE	G	P
CI00121 FPC 43 (Florida Power Corporation)	Prehistoric/Weeden Island, A.D. 450-1000	Prehistoric shell midden	NE	F	ST
CI00132 Tiger Tail Bay	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P
CI00137 North Shivers Bay Midden	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI00138 Salt River 2	Prehistoric/Archaic, 8500 B.C.-1000 B.C.	Prehistoric shell midden	NE	F	P
CI00224 Spice Key	Prehistoric/Weeden Island 1	Prehistoric shell midden/Prehistoric campsite	NE	G	P
CI00225 Four Palms	Prehistoric/Unspecified Woodland	Prehistoric campsite	NE	G	P
CI00226 Unnamed	Prehistoric/Unspecified; Historic/19th century American, 1821-present	Prehistoric shell midden/Historic refuse dump	NE	G	P
CI00230 Unnamed	Prehistoric/Unspecified	Prehistoric shell midden/Historic refuse dump	NE	G	P
CI00231 Unnamed	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P
CI00234 Unnamed	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P
CI00232 Unnamed	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI00233 Unnamed	Prehistoric/Unspecified	Prehistoric shell midden	NE	G	P
CI00418 Salt River Narrows 1	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI00419 Salt River Narrows 2	Prehistoric/Weeden Island, Safety Harbor; Historic/20th century American, 1900-present	Prehistoric campsite/Historic	NE	G	P
CI00427 Stoney/Lane Tract I	Prehistoric/Weeden Island A.D. 450-1000	Prehistoric campsite	NE	G	P
CI00444 Last Island	Prehistoric/Unspecified	Prehistoric campsite	NE	G	P
CI00449 Stone Wall	Historic/American unspecified	Historic Farmstead	NE	F	ST
CI00450 White Sand Hammock	Prehistoric/Unspecified	Prehistoric campsite	NE	F	ST
CI00451 Willey Point	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	F	ST
CI00556 Houle #1	Prehistoric/Unspecified	Prehistoric campsite	NE	F	ST
CI00557 Ocala and Gulf Railroad	Historic/19th century American, 1821-1899	Historic railroad linear resource group	NE	P	ST
CI00575 Bagley Cove	Prehistoric/Archaic, Deptford, Weeden Island; Historic/20th century American	Prehistoric habitation	NE	F	ST
CI00576 Opposite the Rocks	Prehistoric/Unspecified	Prehistoric campsite	NE	F	ST
CI00578 South Salt River I	Prehistoric/Deptford; Historic/20th century American, 1900-present	Prehistoric habitation/Historic	NE	F	ST

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI00582 South Tiger Tail Bay I	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric shell midden	NE	F	P
CI00585 Willey Point I	Prehistoric/Woodland	Prehistoric shell midden	NE	F	P
CI00586 Willey Point II	Prehistoric/Woodland	Prehistoric/Spec. site for procurement of raw materials	NE	F	P
CI00601 False Channel Island	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric shell midden/ Prehistoric habitation	NE	F	P
CI00604 Hell Gate West III	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00607 Lashley Point	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	F	P
CI00869 Little Homosassa River I	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric shell midden	NE	F	P
CI00870 Little Homosassa River II	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00871 Little Homosassa River III	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00872 Little Homosassa River IV	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric shell midden	NE	F	P
CI00873 Little Homosassa River V	Prehistoric/Weeden Island, A.D. 450-1000	Prehistoric shell midden	NE	F	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI00874 Little Homosassa River VB	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00875 Little Homosassa River VI	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00876 Little Homosassa River VII	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00877 Little Homosassa River VIII	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00878 Little Homosassa River IX	Prehistoric/Weeden Island, A.D. 450-1000	Prehistoric shell midden	NE	F	P
CI00879 Little Homosassa River X	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00880 Little Homosassa River XI	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00881 Little Homosassa River XII	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P
CI00882 Little Homosassa River XIII	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI00884 Little Homosassa River XV	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric shell midden	NE	F	P
CI01059 Hollins Tract 1	Prehistoric/Unspecified	Prehistoric campsite	NE	F	ST
CI01060 North Lashley 1	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	P	ST
CI01065 Game Creek 1	Prehistoric/Unspecified; Historic/20th century American, 1900-present	Prehistoric shell midden/Historic habitation	NE	P	ST
CI01066 Mud Creek 1	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	P	ST
CI01068 Narrows	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST
CI01069 Point One	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST
CI01193 Camp Island	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric shell midden	NE	F	P
CI01194 Keith's 2	Prehistoric/Archaic, 8500 B.C.-1000 B.C.	Prehistoric campsite	NE	P	P
CI01195 Wasted	Prehistoric/Unspecified	Prehistoric shell midden	NE	P	ST
CI01196 Washed Up	Prehistoric/Unspecified	Prehistoric shell midden	NE	P	ST
CI01197 Sickle Midden	Prehistoric/Unspecified; Historic/19th century American, 1821-1899	Prehistoric shell midden/Historic campsite	NE	G	P
CI01198 Ofunlv Midden	Prehistoric/Unspecified	Prehistoric shell midden	NE	F	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI01202 Chiento Illifoki	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI01199 Etoh Midden	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST
CI01200 Hidden Midden	Prehistoric/Unspecified	Prehistoric midden(s)	NE	F	P
CI01201 Illifoki	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric shell midden/Prehistoric campsite	NE	P	ST
CI01204 Wash Island Shadow	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI01205 Lakache	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI01206 Land's End	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	G	P
CI01207 Lost Cedar	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	P	ST
CI01208 Gomez Midden	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric campsite	NE	P	ST
CI01209 Kings Creek Midden	Prehistoric/Unspecified	Prehistoric shell midden	NE	P	ST
CI01210 Dying Palms Midden	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric campsite	NE	P	ST
CI01212 Deer Mouth	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST
CI01213 Deer Creek 1	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI01214 Deer Creek 2	Prehistoric/Unspecified	Prehistoric campsite	NE	P	ST
CI01215 Pig's Last Stand	Prehistoric/Unspecified	Prehistoric shell midden	NE	P	ST
CI01216 Eagle Scout Hill	Prehistoric/Unspecified	Prehistoric campsite	NE	G	P
CI01217 Mother Osprey	Prehistoric/Deptford, 700 B.C.-300 B.C./Transitional	Prehistoric shell midden/Prehistoric campsite	NE	F	P
CI01218 Deer Stand 3	Prehistoric/Unspecified	Prehistoric/Spec. site for procurement of raw materials	NE	F	P
CI01219 Deer Creek 4	Prehistoric/Unspecified	Prehistoric campsite	NE	G	P
CI01282 THLU'THLU	Prehistoric/Weeden Island 2	Prehistoric/Spec. site for procurement of raw materials	NE	G	P
CI01283 AMPA 1	Prehistoric/Weeden Island 1 and 2	Prehistoric/Spec. site for procurement of raw materials	NE	F	P
CI01284 AMPA 2	Prehistoric/Weeden Island 1 and 2	Prehistoric/Spec. site for procurement of raw materials	NE	F	P
CI01285 Iste'lane - 1	Historic/19th century American, 1821-1899	Historic building remains	NE	P	ST
CI01286 Ampa 3	Prehistoric/Weeden Island 1	Prehistoric midden/ habitation	NE	G	P
CI01287 AMPA 4	Prehistoric/Weeden Island 1	Prehistoric midden/ habitation	NE	G	P
CI01288 THLA 2	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	P	ST
CI01289 THLA 3	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	P	ST
CI01290 THLA 4	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	P	ST

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI01291 THLA 5	Prehistoric/Weeden Island 1 and 2	Prehistoric midden/ habitation	NE	P	ST
CI01292 THLA 6	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	P	ST
CI01294 Huti 2	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	F	P
CI01295 Huti 3	Prehistoric/Weeden Island 1	Prehistoric midden/ habitation	NE	G	P
CI01296 Huti 4	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	G	P
CI01298 Huti 6	Prehistoric/Weeden Island 1 and 2	Prehistoric midden/ habitation	NE	G	P
CI01299 Huti 7	Prehistoric/Weeden Island 1 and 2	Prehistoric midden/ habitation	NE	G	P
CI01300 Iste Lane 2	Historic/20th century American, 1900-present	Historic habitation/ cistern	NE	P	ST
CI01301 Thampko 7	Prehistoric/Deptford, 700 B.C.-300 B.C./Weeden Island 1	Prehistoric midden/ habitation	NE	P	ST
CI01302 Thampko 8	Prehistoric/Archaic, 8500 B.C.-1000 B.C./Deptford 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	P	ST
CI01303 Thampko 1	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01304 Thampko 2	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01305 Thampko 3	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01306 Thampko 4	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01307 Thampko 5	Prehistoric/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P

Cultural Sites Listed in the Florida Master Site File					
FMSF # and Site Name	**Culture/Period**	**Description**	**Significance**	**Condition**	**Treatment**
CI01308 Thampko 6	Prehistoric/Archaic, 8500 B.C.-1000 B.C./Deptford 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01309 THLA 9	Prehistoric/Unspecified	Prehistoric midden/ habitation	NE	P	ST
CI01310 THLA 10	Prehistoric/Unspecified/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	P	ST
CI01311 THLA 11	Prehistoric/Unspecified/Deptford, 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	P	ST
CI01312 Chiento 1	Prehistoric/Archaic, 8500 B.C.-1000 B.C./Deptford 700 B.C.-300 B.C.	Prehistoric midden/ habitation	NE	G	P
CI01377 CR 490A Halls River Road	Historic/19th century American, 1821-1899	Historic road linear resource group	NE	P	ST
CI01457 Old Tallahassee Road	Historic/19th century American, 1821-1899	Historic road linear resource group	NE	P	ST

***Objective A*:** Assess and evaluate 114 of 114 recorded cultural resources in the park.

- Action 1 - Complete 114 assessments/evaluations of recorded cultural sites, prioritizing sites most in need of preservation and stabilization projects.
- Action 2 - Continue to employ a long-term protocol for tracking condition changes, testing to determine National Historic Register eligibility, and prioritize sites that need preservation and stabilization at each archaeological site.
- Action 3 - Improve and implement a plan for more frequent surveillance of archaeological sites that have been looted in the past and those subject to impacts from pedestrian access.
- Action 4 - Improve and implement a plan for more frequent surveillance of archaeological sites that are currently or previously have been impacted by natural coastal forces, climate effects and sea level changes, then implement the plan.

Park personnel, GARI staff and other cultural resource professionals currently visit all cultural sites within the park on a regular basis. This formalized process continually generates baseline and comparative information for each site. The park will develop and implement an enhanced plan for more frequent surveillance of archaeological sites that have been looted in the past. Vetted preserve volunteers will provide assistance.

Archaeological sites along the coastline are currently subject to greater wave action, higher tidal surges, and ever-increasing numbers of pedestrian users, particularly boaters and fishermen. The threat of significant disturbance of many of the sites is growing and additional precautions may be needed, including encouragement of additional archaeological evaluation.

GARI has developed a rapid midden assessment program to facilitate tracking the condition of coastal sites. This program addresses cultural resources within the park that have sustained damage and potential impacts, as well as assesses the physical and ecological context of the site. Doing so allows for a systemic and multi-resource management approach.

Objective B: Compile reliable documentation for all recorded historic and archaeological resources**.**

- Action 1 - Ensure all known sites, including newly found ones, are recorded or updated in the Florida Master Site File.
- Action 2 - Conduct a Phase I archaeological survey in all priority areas identified by the 2012 predictive model or by other studies.
- Action 3 - Conduct comprehensive Phase II archaeological evaluations of sites that have National Historic Register potential and are subject to immediate or short-term impacts.
- Action 4 - Develop and adopt a Scope of Collections Statement.
- Action 5 - Conduct additional research about prehistoric settlement and other patterns pertinent to cultural lifeways within the park and how they relate to broader cultural patterns in the region and the adjacent Big Bend.

The locations of all known archaeological sites in the park have been mapped using GPS technology. If new sites are found, their boundaries will also be mapped. As this information is compiled, staff will update the FMSF forms for the sites and forward the information to the FMSF. All new sites will be recorded with the FMSF as they are discovered.

Research within Crystal River Preserve State Park about prehistoric settlement and other cultural patterns through time and how they relate to broader settlement patterns in the region has been underway continuously since the 1960s, owing to sustained interest in the unique Crystal River mound complex (CI00001) located in the adjacent Crystal River Archaeological State Park. This range of research has continued with each successive archaeological study such that the fundamental cultural sequence and relevant behavior of prehistoric populations are better known for the Crystal River area than for the remainder of the west-central Gulf Coast. Several important archaeological sites that exist on private property (i.e., Shell Island) and non-park DEP properties to the north could contribute valuable information to an expanded archaeological study of the area.

The park needs additional, comprehensive Phase I surveys, with priority given to lands west of the Ozello Archipelago and immediately north of the Homosassa River, as well as coastal marshlands and remnants of the near-coastal plain east of the Salt River between the Homosassa River and the north boundary of the Inner Island group. Surveys to date have included sites of all sizes and types without regard to any specific resource type. Areas representing ancient or historic human activity/behavior have been recorded. Recommendations for additional survey of specific management zones will be guided by a research design grounded on previous research and models and based on prioritized needs or threats, or both.

Phase II archaeological evaluation is needed at threatened sites that Phase I survey has indicated have the potential to be eligible for the National Register. Phase II survey is particularly necessary at Wash Island (CI00042) to confirm the site's eligibility for the National Register and to determine the means necessary for protecting it against environmental and anthropogenic impacts. This site has deteriorated to the point that terrestrial archaeology methods must now be supplemented by wet site methods. Two recent tropical storm events have dramatically reduced riverbank midden deposits. The site is distressed and needs immediate attention.

Even though the park currently does not have any collections, a Scope of Collections Statement should be prepared to guide management in the future. The statement should indicate that the park does not have a collection and does not accept or acquire items for any collection.

Objective C: Bring three of 114 recorded cultural resources into good condition.

- Action 1 - Design and implement regular monitoring programs for 114 cultural sites.
- Action 2 - Create and implement a cyclical maintenance program for each cultural resource.
- Action 3 - Investigate the Wash Island, Camp Island and Mullet Key sites and improve their protection from natural and anthropogenic impacts.

Crystal River Preserve State Park annually conducts a simple repeatable protocol for tracking changes at each archaeological site, preferably consisting of a geocoded baseline photograph and a condition checklist sheet. Photographs are taken regardless of whether a change in condition occurred at a site.

If remedial action is recommended for a cultural site, then monitoring of vegetation loss or changes that are affecting the natural community and/or the preservation of archaeological resources is warranted. This is a routine monitoring function. Essential action warrants stabilization of the natural context or archaeological site via revegetation of native plants, and/or posting of additional protection or educational signage, and/or possibly limiting or prohibiting pedestrian use. Emergency action warrants

immediate protective measures to prevent the loss of natural or cultural context. The latter action may be through direct mitigation using coastal erosion control measures or archaeological data recovery excavation, or both. Recommendations may be subject to change depending on the results of ongoing monitoring.

Three of the sites in the park now considered to be in fair or good condition may be able to be upgraded to good condition, or kept in good condition, if visitation is kept at reasonable levels and some revegetation is attempted. The exposure of sequential deposition at Wash Island (CI00042) and its location along the Crystal River make it a daily destination for day use and camping, as well as casual looting. Pending systematic archaeological work, this site may be sealed over and revegetated with saltwater tolerant plants. Camp Island (CI01193) is well used by campers and day visitors, and the pedestrian traffic and collecting is degrading the site surface and banks. Either public use should be barred on the island or visitation restricted to areas away from the prehistoric midden. Mullet Key (CI00022) is a nearshore site that is migrating due to coastal surge forces. It is a popular venue for kayakers, and the cumulative impacts of pedestrian and natural stressors have severely weakened the remaining shell midden. Low-growing, salt tolerant vegetation should be planted on Mullet Key and signage installed that indicates pedestrian access is restricted.

LAND USE COMPONENT

VISITATION

Spanning 28,000 acres along Florida's Nature Coast, Crystal River Preserve State Park protects a vast mosaic of coastal wetlands and forests. The various tidal creeks associated with the salt marshes and adjoining wetlands within the park are popular destinations for paddlers, anglers, and adventurers. The pine uplands provide land-based recreational activities such as hiking, biking, and nature study.

The main entrance to the park off North Sailboat Avenue leads visitors to the boat basin area, which is perhaps the most popular destination in the park. From the boat basin, visitors can take an adventure-filled eco-heritage boat expedition down the Crystal River and into the Gulf of Mexico where it is common to see bald eagles, ospreys, manatees, and dolphins. A sunset cruise is another experience available to park guests. Scallop season opens each year on July 1 and brings an abundance of harvesters looking for the prized Florida bay scallop. Two canoe and kayak launches are available for park visitors, one across from the park office at the boat basin area and the second at the neighboring Mullet Hole area, which is also a popular fishing spot. Redfish Hole, located off Fort Island Trail, is another popular fishing destination for visitors.

The Florida Circumnavigational Saltwater Paddling Trail meanders through the archipelago on its 1,515-mile route along Florida's coast from Big Lagoon State Park in Pensacola to Fort Clinch State Park in Jacksonville. Segment 7 of the paddling trail, known as the Nature Coast segment, meanders through 89 miles of the St. Martins Marsh Aquatic Preserve and links the Marjorie Harris Carr Cross Florida Greenway and Anclote Key State Park. A primitive campsite is located off the paddling trail as well.

North of the park entrance is the Seven Mile Loop Trail, which is popular for hikers and off-road cyclists. Visitors can also experience the northern portions of the park on a two-mile hike accessed from the Eco-walk trail located off Tallahassee Road. These two trails also provide a view of natural habitat restoration through prescribed fire conducted by DRP and cooperating agencies.

Visitation Trends

Crystal River Preserve State Park provides a year-round destination for hiking, biking, kayaking, paddling, fishing, and nature appreciation. The winter months draw paddlers to the clear Crystal River, whose warm spring-fed waters are a sanctuary for manatees, particularly during cold-weather events. Bird watchers and other nature enthusiasts enjoy the maritime hammocks and open marsh vistas with year-round wildlife viewing opportunities.

EXISTING FACILITIES AND INFRASTRUCTURE

Use areas are widely spaced across the park's 28,000 acres. The park's administrative office, restroom and storage sheds are located at the boat basin. Additionally, there is a kayak launch, two covered pavilions and a boat dock which is utilized by the park concessionaire. A boat ramp is also located here for official use only by FWC, the DEP Office of Resilience and Coastal Protection, the Citrus County Sheriff's Department and park staff. Volunteers with the U.S. Coast Guard Auxiliary maintain a radio base in a building adjacent to the park office.

A popular fishing spot called The Mullet Hole is located off Sailboat Avenue. It contains a kayak launch, a short hiking trail, and access for shoreline anglers. This use area is supported by a small unimproved parking area and one small pavilion.

The Churchhouse Hammock use area is located directly off U.S. Highway 19. Facilities include a short trail to Bagley Cove and a small picnic pavilion at the trailhead. The current parking area provides much more capacity than the park requires.

The Fort Island Trail use area is located at the western end of County Road 44 (West Fort Island Trail) and provides access to the Dixie Shores and Redfish Hole hiking trails. Citrus County maintains a beach use area, boat ramp, fishing pier and associated boardwalk and pavilion at the far west end of Fort Island Trail. Access to these facilities located on the Gulf of Mexico is often compromised due to water levels at high tide.

The Seven Mile Loop Trail is located just west of the main park entrance off West State Park Street. The trailhead is accessed off State Park Street. This is a popular spot for both hikers and bikers.

The Eco-walk Trail is located in the northeastern portion of the park and is accessed from U.S. Highway 19 and North Tallahassee Road. Aside from providing access to the Eco-walk Trail, the trailhead area accommodates the Gulf Archaeological Research Institute (GARI) office and equipment storage. The Eco-walk Trail consists of a short loop directly adjacent to the Seven Mile Loop Trail. Park roads consist of 0.4 miles of paved road, 6.3 miles of stabilized road and 31 miles of unstabilized resource management roads.

Facilities Inventory

Boat Basin Area	
Park Office	1
United States Coast Guard Auxiliary Station	1
Restroom	1
Boat Ramp (Law enforcement use only)	1
Picnic Pavilion (Small)	2
Paddling launch	1
Pole Barn	2
Storage Shed	7
Fixed Pier/Dock	11
Paved Parking Area	1
Mullet Hole Area	
Pavilion (Small)	1
Paddling launch	1
Hiking Trail (Crystal Cove)	1.7 mi.

Unpaved Parking Area	1
Churchhouse Hammock Area	
Picnic Pavilion (Small)	1
Hiking Trail (Churchhouse Hammock)	1.4 mi.
Boardwalk	1
Unpaved Parking Area	1
Fort Island Trail Area	
Interpretive Kiosk	1
Dixie Shores Hiking Trail	1.7 mi.
Redfish Hole Hiking Trail	1.7 mi.
Paved Parking Area	1
Unpaved Parking Area	1
7-Mile Loop Trail	
Hiking/Biking	7.2 mi.
Interpretive Kiosk	1
Eco-Walk Trail Area	
Gulf Archaeology Research Institute Office Building(s)	2
Interpretive Kiosk	1
Hiking Trail (Eco-Walk)	2.2 mi.
Storage Shed	1
Pumphouse Shed	1
Stage	1
Unpaved Parking Area	1
Parkwide	
Paved road (mileage)	0.4
Stabilized Road (mileage)	6.3
Un-stabilized Road (mileage)	31.0

CONCEPTUAL LAND USE PLAN

Detailed Conceptual Land Use Plan Objectives

The following objectives provide for improvements at seven use areas at Crystal River Preserve State Park within the 10-year planning cycle.

State Park Street/Museum Point

Objective: Create a unified entrance station for Crystal River Preserve and Crystal River Archeological State Parks.

Action:

- *Construct an entrance station, pending land acquisition.*

There is a great need for a unified entrance station that serves both Crystal River Preserve State Park and Crystal River Archaeological State Park. Entrance stations provide a critical and necessary first point of contact between the visitor and park staff, as well as fee collection. The entrance station would be constructed on State Park Street just before it reaches Museum Point to provide access to both parks. This would be contingent upon annexing portions of State Park Street and Museum Point from Citrus County, as well as the acquisition of parcels north of State Park Street identified in the Optimum Boundary Map.

Boat Basin Area – Existing Park Headquarters/Administration Office
Objective: Enhance the resiliency of park infrastructure to flooding events.
Action:

- *Relocate the park administrative office, sheds, and out-buildings to alternative area of park (Mullet Hole or Eco-walk).*

The boat basin is the most popular area of the park. However, it is prone to major flooding events. Hurricane Hermine in 2016 caused extensive damage to the park office. Ideally, a new administrative office should be constructed at a more inland location, and mobile structures such as sheds and out-buildings should be relocated accordingly. However, if the current location is maintained, a more sustainably designed structure that is appropriately elevated is proposed. As opposed to alternative sites for the park headquarters, this location is on the waterfront, which is both advantageous and disadvantageous (vulnerable to storm and flood events). As a coastal park unit, this adjacency is strategic for interpretive, experiential, and operational purposes. In its current form, the aesthetics of the site are inconsistent with the priorities of welcoming visitors to a unit that prioritizes natural resource preservation. Reorganization and beautification of the site would be needed if continued. If continued, structures would need to be constructed for storm resistance or resilience, likely off-grade.

Mullet Hole - Alternative Park Headquarters
Objective: Enhance visitor access and park resiliency.
Action:

- *Alternative park headquarters location.*

Repurposing and reconfiguring the existing Mullet Hole parking and access area to include the park administrative office would allow for two points of access, 1) east from Sailboat Avenue or 2) south from State Park Street and would still provide for existing wildlife observation and fishing uses. While this location provides a greater distance from the river, a new structure would still require appropriate elevation. Given the potential for flooding at Mullet Hole, further alternatives for the location of the administrative office are considered, such as the Eco-walk Trail.

Eco-Walk Trailhead/Trail - Alternative Park Headquarters and Potential Campground
Objective: Enhance interpretive elements and identify the best locations for park infrastructure.
Action:

- Alternative park headquarters location and potential campground
- Improve trail signage and wayfinding

The Eco-walk trailhead houses the Gulf Archaeological Research Institute (GARI) office and equipment storage. This area is a second alternative location for the administrative office relocation. This area has a

significantly higher elevation, greater distance from the estuary (approximately 2.8 miles) and is more conveniently located near existing utilities.

This plan provisions for the installation of a campground facility. Districtwide, the nearest existing state park campground is 25 miles east at Rainbow Springs State Park. A new campground at Crystal River Preserve State Park may fill a geographic gap.

Crystal River Preserve State Park, however, being situated along a low coastline, is especially vulnerable to the impacts of sea level rise. While this plan does not definitively determine the suitability of a campground development, it evaluates the decisional criteria.

Challenges to this type of facility at Crystal River

- Classification of the unit as a preserve, which prioritizes natural resource preservation over infrastructural development. Development and management of campground facilities may not be congruent with its unit classification and program area emphasis.
- Current lack of a staffed entrance/ranger station, which poses operational and oversight challenges.
- Limited recreational opportunities, such that the park may not be sufficiently regarded as a destination. As a result, a campground at the park may be more heavily visited for the town of Crystal River (i.e., attractions outside of the park) than for the park itself.
- Sea level rise – flooding, partial and/or complete inundation, and secondary impacts to potable water, wastewater systems, electricity, and municipal and park road access
- Substantial infrastructural investment where viability may be limited as the region faces rising sea levels.
- Inadequate buffering from non-conservation land uses in the near vicinity.

Benefits to this type of facility at Crystal River

- Fill a regional gap in camping/overnight accommodations within DRP.
- Increase park visitation.
- Stimulate other recreation developments in the park.
    - The campground may be integrated with other recreational infrastructure to facilitate a cohesive park experience.
- Complement the ecotourism development interests of Citrus County and city of Crystal River.

One of the few upland sites that provides adequate space and suitable connection to recreational and interpretive assets is the Eco-walk loop trail. Approximately 5 to 7 acres may be viable for a standard facility campground (30-site) within the western end of the interior of the existing Eco-walk loop trail. The Eco-walk trailhead could also be developed as a headquarters site without construction of a campground.

If a campground is not constructed over the existing trail system at Eco-walk, the trail stemming from the trailhead will require improvements to the visitor experience. Aging interpretive signs along the walk require replacement. Wayfinding signs are also needed to provide a clear sense of place and direction.

If deemed appropriate, planning and design for a full-service campground at this park should consider and maximize implementation of feasible green/sustainability measures.

Seven Mile Loop Trail
Objective: Provide interpretive and wayfinding elements to connect trails.
Action:

- *Eco-walk Trail connector.*

There is currently no connection between the Eco-walk Trail and the Seven Mile Loop Trail. Hikers often end up on the Seven Mile Loop Trail by way of a staff service road. A formalized and well-interpreted connection is needed to clearly provide and delineate a link between the two trails.

If the Mullet Hole use area is improved as discussed above, consideration should be given to relocating the Seven Mile Loop trailhead to this site or enhancing the current location.

Churchhouse Hammock Trailhead and Picnic Area
Objective: Update infrastructure footprint to address the level of visitor use.
Action:

- *Parking lot redevelopment.*
- *Boardwalk extensions.*
- *Trail stabilization.*

The current size and configuration of the Churchhouse Hammock trailhead parking area is largely inherent. This area is excessively large and needs to be redeveloped to correlate with the level of use and to maximize re-naturalization of underutilized space.

A portion of the boardwalk section of the trail was removed recently due to wood rot and other safety concerns. This boardwalk should be reconstructed and once again extend to Bagley Cove. The boardwalk will allow visitors a view out to the water at Bagley Cove, even at high tide.

Upland segments of the trail with rough terrain should be leveled and stabilized with appropriate local materials such as lime rock. Segments that frequently hold water should be improved with boardwalks.

Redfish Hole
Objective: Restore damaged habitat.
Action:

- *Salt marsh restoration.*

This area was originally dredged in anticipation of residential development that never transpired, creating a significant hydrological disturbance. DRP should work with the SWFWMD and FWC to re-establish the natural grade by backfilling canals. This is critical to restore the saltmarsh habitat for estuary fish, shellfish and crustaceans, among other wildlife.

Salt River
Objective: Provide aquatic access to park users.
Action:

- *Proposed paddling access point.*

An unofficial watercraft launch has been created along the West Ozello Trail (County Road 494) that accesses the Florida Circumnavigational Saltwater Paddling Trail. This area should be considered for a

park or concession-operated paddle craft launch facility to create a safe and viable access point within feasible range of deep water with enhanced recreational appeal. In general, the facility would provide shorter paddling options directly within the heart of the estuarine preserve as opposed to having to commit to the entire 13-mile stretch of the paddling trail.

Any capital improvements at the park, particularly within the seaward islands, must acknowledge the eventual inevitability of inundation due to sea level rise. Restoration and protection of coastal habitats such as salt marsh and hydric hammock, while critically important, are at best interim measures to mitigate threats to infrastructure. The long-term eventuality is gradual landward retreat of facilities from coastal areas that are increasingly impacted by flooding or completely lost to the rising Gulf of Mexico.

In that interim, the effectiveness of visitor use management within this estuarine park will ultimately determine its ability to withstand and mitigate increasingly severe flooding associated with tropical cyclones and other anthropogenically-enhanced storm related events. The protection of the many hammock and mangrove islands from visitor impacts is key to preserving this sustainability as far into the future as feasible. Interpretation and enforcement of rules that regulate and restrict boat landings and other physical contact with these remote islands is in the best interest of all. Cooperation with the associated aquatic preserve to develop low impact tie-offs/mooring balls in appropriate areas can help avoid boating impacts to sensitive estuarine habitats such a forested islands and seagrass beds.

1. Main Entrance - Construction of an entrance station.
2. Boat Basin - Potentially relocate the park administrative office, sheds, and out-buildings to alternative area of park. (Mullet Hole or Eco-Walk)
3. Mullet Hole - Alternative park headquarters location.
4. Eco-Walk Trailhead/Trail - Alternative park headquarters location and potential campground. Improve trail signage and wayfinding.
5. 7-Mile Loop Trail - Eco-Walk trail connector.
6. Churchhouse Hammock Trailhead and Picnic Area - Parking lot redevelopment, Boardwalk extensions, stabilize trail.
7. Redfish Hole - Salt marsh restoration.
8. Salt River - Proposed paddling concessionaire.

Gulf of Mexico

Crystal River

98

19

Proposals

Paddling Trail

Existing Trails

State of Florida, Earthstar Geographics

Crystal River Preserve State Park

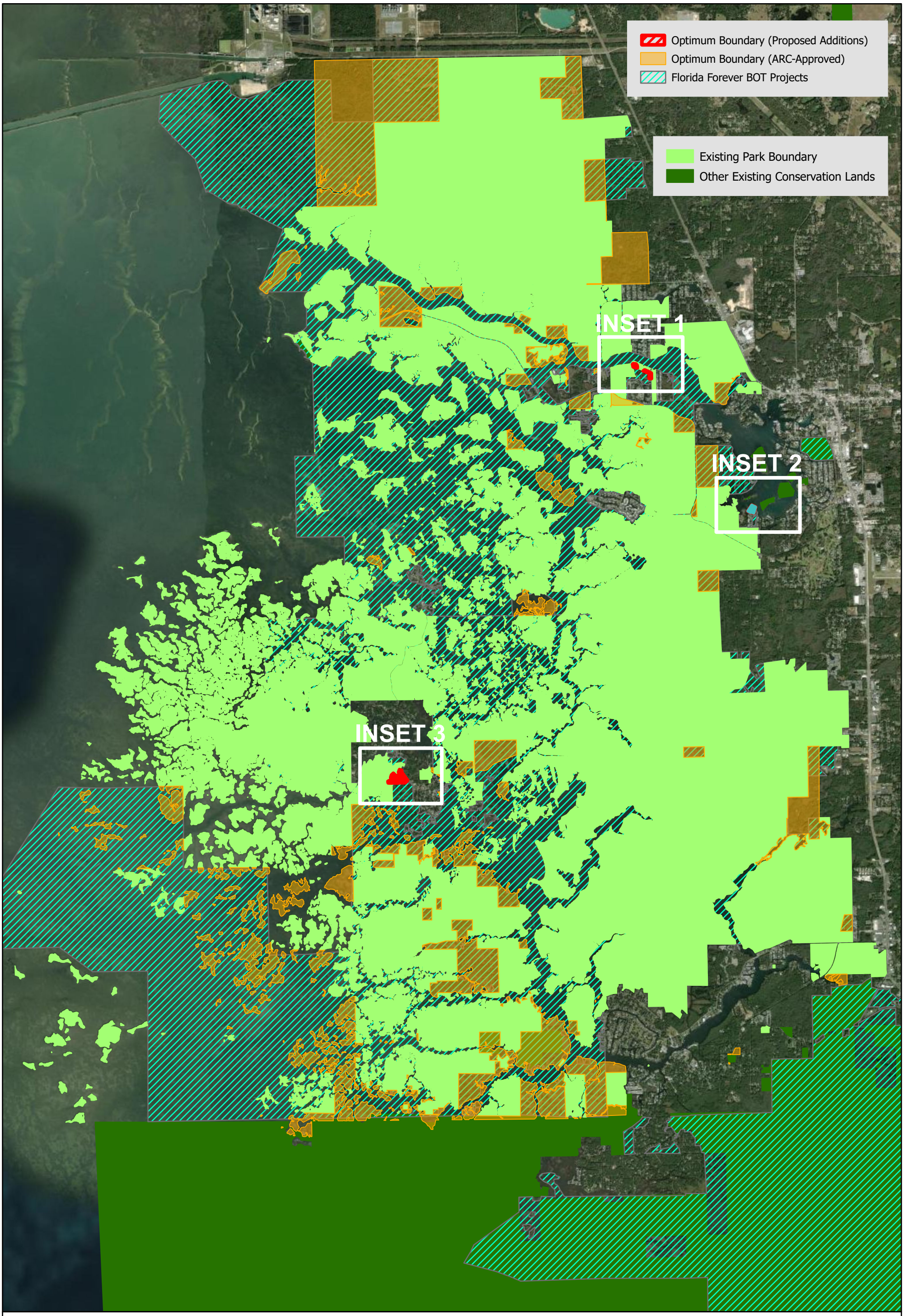
Conceptual Land Use Plan

0 1 2 Miles

N

OPTIMUM BOUNDARY

Several parcels, approximately 5,000 acres in total, have been identified for the optimum boundary of Crystal River Preserve State Park. Many of these parcels are included on the optimum boundary to improve habitat connectivity in the marshlands bordering the Gulf of Mexico and ensure the protection of some of the last remaining patches of the hydric hammock natural community in the state. Other parcels have been included for resource management and operational purposes. In particular, parcels north of State Park Street on the park's eastern boundary will be required to achieve the proposed combined entrance station for the preserve and archaeological site. No lands currently within the park boundary have been identified as surplus to the management needs of the park.



Crystal River Preserve State Park

Optimum Boundary Map

0 1 2 Miles

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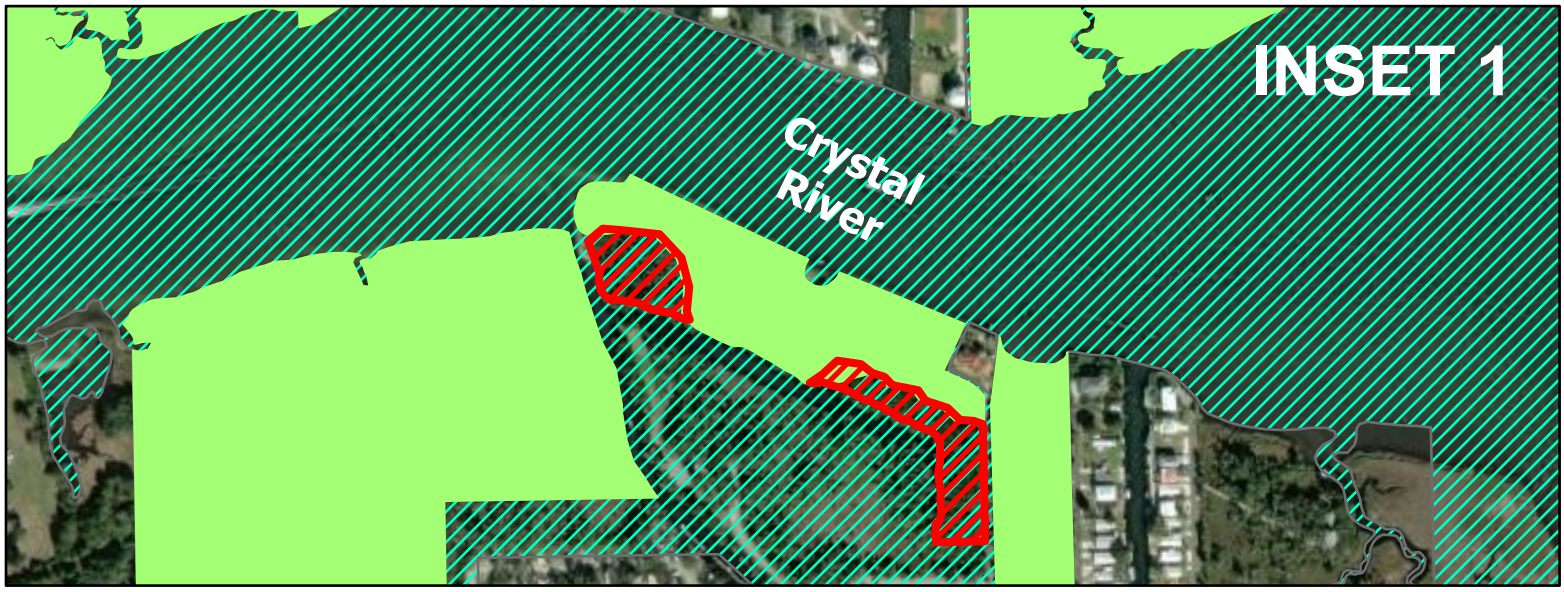

Crystal River Preserve State Park

Optimum Boundary Page 2 of 2

0 350 700 Feet

N