United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

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Alan M. Dodd, Colonel
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard, Room 372
Jacksonville, Florida 32207-8175

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Service Consultation Code:	41420-2006-F-0204
Corps Application No.:	SAJ-2003-11158 (IP-MJD)
Date Received:	June 16, 2010
Formal Consultation Initiation Date:	September 11, 2011
Applicant:	Hacienda Lakes of Naples, LLC
Project:	Hacienda Lakes
County:	Collier

Dear Colonel Dodd:

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion for the construction of the Hacienda Lakes development project and its effects on the endangered Florida panther (*Puma concolor coryi*) and endangered wood stork (*Mycteria americana*) in accordance with section 7 of the Endangered Species Act of 1973 as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

The project as reviewed by the Service is based on information provided by the U.S. Army Corps of Engineers (Corps) in their June 16, 2010, Public Notice, and the biological assessment dated June 2010 provided by Passarella & Associates, Inc. (PAI). In the Public Notice and letter to the Service, the Corps determined the Hacienda Lakes project "may affect" the Florida panther and wood stork. The Corps also determined the project "may affect, but is not likely to adversely affect" the threatened eastern indigo snake (*Drymarchon corais couperi*) and the endangered red-cockaded woodpecker (RCW) (*Picoides borealis*). The purpose of the project is to construct a mixed-use residential community with a commercial center and recreational facilities in southwest Collier County (Figure 1).

Consultation History

Permitting for the project site was originally pursued by Vision and Faith, Inc. A joint South Florida Water Management District (District) and Corps Environmental Resource Permit (ERP) application was submitted by Vision and Faith, Inc., for the site on October 23, 2003, under the project name Feathers (Corps Project No. SAJ-2003-11158). In 2005, the Feathers project changed ownership and was renamed Toll-Rattlesnake DRI.

On March 20, 2006, the new applicant, Toll-Rattlesnake, LLC, provided the Corps with an environmental supplement and a biological assesssment for the project.

By letter dated April 10, 2006, the Corps provided the biological assessment for the Toll-Rattlesnake DRI (prepared by PAI) to the Service. The Corps requested concurrence on the determinations of "may affect, not likely to adversely affect" for the wood stork, bald eagle (*Haliaeetus leucocephalus*), and eastern indigo snake. The Corps made a "may affect" determination for the Florida panther and RCW, and requested formal consultation with the Service pursuant to Section 7 of the Act, as amended, for those determinations.

The Corps circulated a Public Notice for the Toll-Rattlesnake DRI on April 17, 2006. The proposal was to construct a mixed-use residential community with a commercial center, golf course, club house and other recreational facilities. The 2006 project proposed impacts to 581.88 acres (ac) of wetlands, which were heavily infested with exotics. The applicant offered onsite enhancement and preservation of 1,167.58 ac of wetlands and 209.53 ac of uplands as mitigation for the proposed impacts.

By letter dated February 22, 2007, the Service concurred with the Corps' determination that the project "may affect, not likely to adversely affect" the eastern indigo snake and bald eagle and "may affect" the Florida panther. The Service requested the Corps revise their determination for the RCW to "may affect, not likely to adversely affect." The Service did not concur with the "may affect, not likely to adversely affect" determination for the wood stork, and requested additional information for the wood stork and Florida panther prior to initiating formal consultation.

In 2009, the project was taken over by Hacienda Lakes of Naples, LLC, and on January 26, 2010, a joint ERP Application was filed with the Corps and District for Hacienda Lakes.

On June 16, 2010, the Corps circulated a Public Notice for Hacienda Lakes. The new project proposed 460.47 ac of wetland impacts (fill and excavation) and 14.30 ac of impacts to jurisdictional waters. The applicant proposed onsite mitigation totaling 1,287.32 ac of wetland enhancement, restoration, and preservation. Following restoration, the applicant proposes to transfer the mitigation lands to the State of Florida along with an escrow account to fund the perpetual maintenance and monitoring of the mitigation lands. The Corps requested concurrence on the determinations of "may affect, not likely to adversely affect" for the eastern indigo snake and RCW. The Corps made a "may affect" determination for the Florida panther and wood stork, and requested formal consultation with the Service pursuant to Section 7 of the Act, as amended, for those determinations.

On November 2, 2010, the Service sent correspondence to the Corps which requested additional information necessary to meet the requirements of 50 CFR §402.14(c). The Service requested specific information on project's effects to the panther and wood stork, and concurred with the Corps' determination that the project "may affect, but is not likely to adversely affect" the RCW and eastern indigo snake.

On September 11, 2011, the Service received sufficient information to initiate formal consultation.

The Service has reviewed all information received and concurs with the Corps' determination that the proposed project "may affect" the Florida panther and the wood stork. The Service also concurs with the Corps' determinations that the project "may affect, but is not likely to adversely affect" the RCW and eastern indigo snake.

The Service is providing this Biological Opinion in conclusion of formal consultation for the endangered Florida panther and wood stork.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The Corps' June 2010 Public Notice presented an application for fill and excavation in 474.77 ac of wetlands and other surface waters and alteration of 237.80 ac of uplands, impacting about 712.57 ac. The project site is 2,262.14 ac and consists of 1,747.79 ac of jurisdictional wetlands, 17.63 ac jurisdictional waters, and 496.72 ac of uplands. Subsequent information received from the applicant and Corps during consultation indicated the project has been modified such that impacts were reduced to 443.55 ac of wetlands, 4.39 ac of waters, and 224.24 ac of uplands, for a total project impact of 672.18 ac (Table 1, Figure 2).

The Public Notice also referenced the preservation of 1,549.56 ac, of which 1,287.32 ac are wetlands and 258.91 ac are uplands. Subsequent information received during consultation noted the preserve area had been increased to 1,589.97 ac, of which 1,544.16 ac will be placed under conservation easements. The remaining 45.81 ac will not be impacted by the project, but will not be placed under conservation easement as these properties are primarily existing easements and reserved rights-of-way.

The project's preserves also include 17.95 ac internal to the developed portions of the project. The preserve lands protected by conservation easements outside the development footprint total 1,533.77 ac and form a contiguous preserve with adjacent preserved lands. The 1,533.77 ac include 1,267.63 ac of wetlands, 3.06 ac of waters, and 263.08 ac of uplands (Table 1). The Picayune Strand State Forest is adjacent to the proposed preserve lands.

Restoration of wetlands and uplands in the Hacienda Lakes preserves will consist of the removal of exotic vegetation, and the planting of areas with appropriate native communities. The preserves will be placed under conservation easements granted to the District.

The dominant vegetation community on the project site is slash pine (*Pinus elliottii*) and cypress (*Taxodium distichum*) habitat. Land use and habitat cover types include 79.94 ac of land used for recreational purposes (Florida Sports Park and Junior Deputy facility); 19.93 ac of upland pasture; 54.24 ac of low pasture; 50.89 ac of palmetto prairie; 282.26 ac of pine and pine flatwood uplands; 13.46 ac of melaleuca (*Melaleuca quinquernervia*) uplands; 33.11 ac of forested hardwood/conifer uplands; 1.81 ac of Brazilian pepper (*Schinus terebinthifolius*) wetlands; 345.80 ac of melaleuca wetlands; 187.00 ac of cypress wetlands; 930.84 ac of mixed pine and cypress wetlands; 207.95 ac of pine flatwood wetlands; 11.40 ac of cabbage palm wetlands; 26.84 ac of mixed forested hardwood and conifer wetlands; 17.08 ac of freshwater marsh; 3.38 ac of ditches; 5.31 ac of borrow area/pond; 6.64 ac of disturbed uplands; 15.55 ac of disturbed wetlands; 4.42 ac of paved and

unpaved roadway; and 11.31 ac of utility easements. The invasive exotic, melaleuca, has encroached into the entire project site, with large portions of the site supporting densities greater than 50 percent coverage. The melaleuca coverage is generally greatest on the western and central portions of the site (Appendix 3A and 3B).

The project site generally lies along the east side of County Road (CR) 951 (Collier Boulevard) extending 1.5 miles to the east at its northern end and extending 3 miles to the east at its southern end. Approximately two-thirds of the property lies north of Sabal Palm Road and one-third south of Sabal Palm Road. The Willow Run Quarry is along the northern property boundary, and scattered single-family residences and the Winding Cypress Development of Regional Impact (DRI) are along the southern property boundary. The Picayune Strand State Forest is to the east. The Florida Sports Park and Collier County Sheriff's Junior Deputy Facility are located in the central portion of the property at the eastern end of the extension of Rattlesnake Hammock Road. An existing farm field is located north of Sabal Palm Road on the eastern portion of the property. The remaining portions of the site are undeveloped lands. A 45± acre outparcel owned by the State is located within the eastern portion of the property.

Adverse effect to the Florida panther and proposed compensation

The project development will adversely affect 728.39 ac of habitat available for occasional use for stalking of prey and dispersal by the Florida panther (Table 1a) (Figure 2). The habitat impact represents 3,129 Panther Habitat Units (PHUs) with a recommended compensation need of 7,823 PHUs (see discussion under Panther Habitat Assessment Methodology and Table 10). The project is within the Florida panther Primary Zone (Kautz et al. 2006) (Figure 3) and within the Service's Panther Focus Area (Figure 4).

The applicant's compensation plan proposes the preservation and restoration of 1,533.77 acres, adjacent to and east of the project development lands. These lands are in the panther Primary Zone and adjacent to panther habitat within the Picayune Strand State Forest. The preserve lands, following restoration, will provide 12,059 PHUs. The location of and restoration of these lands is consistent with the habitat conservation recommendations of the Panther Recovery Plan (Service 2008) goal 1.1.1.2.3. This goal recommends habitat preservation and restoration within the Primary Zone be provided in situations where land use intensification cannot be avoided. Based on the above, the applicant has proposed equivalent habitat protection and restoration to compensate for the functions and values of the lost habitat.

Adverse effect to the wood stork and proposed compensation

The project development will adversely affect 485.01 ac wetlands and waters available to wood storks for foraging (Table 1b). The remaining 1,280.41 ac of onsite wetlands and waters will be enhanced and preserved. The habitat impact represents a loss of 132.31 kilograms **(**kg) of wood stork foraging biomass, of which 113.36 kg represent short-hydroperiod biomass loss and 18.95 kg represent long-hydroperiod biomass loss (see discussion under Wood Stork Habitat Assessment Methodology and Table 15). The applicant proposes to provide onsite compensation for project effects to the wood stork through the restoration and preservation of 1,280.41 ac on the project site.

The onsite compensation provides an increase of 459.54 kg of biomass following restoration, of which 354.05 kg represent short-hydroperiod wetland biomass and 105.49 kg represent long-hydroperiod biomass. The net change, following project construction, is an increase of 327.23 kg of foraging biomass (459.54-132.31=327.23). This change represents an increase of 240.69 kg of short-hydroperiod biomass and 86.54 kg of long-hydroperiod biomass. Based on individual hydroperiod biomass changes, all hydroperiod biomass changes are positive (Table 15).

Action area

Florida Panther

The action area is defined as all areas to be directly or indirectly affected by the Federal action and not merely the immediate area involved in the action. Therefore, the Service considers the action area for this project as all lands within the project footprint and all lands located in the Service's panther Focus Area (Focus Area) within 25 miles of the boundary of the project footprint (Figure 5). The 25-mile buffer around the project footprint is based on mean dispersal distances of 37.3 kilometers (km) (23.2 miles) (Maehr et al. 2002a), and 40.1 km (24.9 miles) (Comiskey et al. 2002) reported for subadult male panthers. The 25-mile buffer distance encompasses the dispersal distance of both male and female panthers because male panther dispersal distances are known to exceed those reported for female panthers (Maehr et al. 2002a; Comiskey et al. 2002). The size of the action area for this consultation is consistent with action areas defined in our recent biological opinions for the panther, and it encompasses the wide ranging movements of subadult panthers and the large home territories of adult panthers.

The Focus Area denotes areas in Florida where development projects could potentially affect the panther (Figure 4) and is based on the scientific information on panther habitat usage provided in Kautz et al. (2006) and Thatcher et al. (2006). The Focus Area includes lands in Charlotte, Glades, Hendry, Lee, Collier, Palm Beach, Broward, Miami-Dade, and Monroe Counties, as well as the southern portion of Highlands County (Figure 4). Developed urban coastal areas in eastern Palm Beach, Broward, and Miami-Dade Counties, and in western Charlotte, Lee, and Collier Counties were excluded because they contain little or no panther habitat, and it is unlikely that panthers would use such areas. Additional details regarding the Panther Focus Area Zones (*e.g.,* Primary, Secondary, etc.) can be found in the *Habitat Characteristics/Ecosystem* and *South Florida Panther Population Goal* headings, below. Areas outside of the Panther Focus Area, but within the original Consultation Area (Figure 4), are collectively known as the "Other Zone."

Wood Stork

The Service determined the action area for the wood stork is larger than the proposed action area identified in the Corps' public notice. We note the project site is located within 18 miles of three active wood stork nesting colonies. Two of these colonies are located within the Corkscrew Sanctuary, about 16.4 miles and 17.6 miles north of the project site. The third wood stork nesting colony is located about 16.4 miles northeast of the project site, just north of the Fakahatchee Strand State Preserve. Coulter and Bryan (1993) found that 85 percent of wood

stork foraging occurs within 12.5 miles of the nesting colony. Furthermore, the Florida Fish and Wildlife Conservation Commission (FWC) considers the area within 18.6 miles of the nesting colony as the Core Foraging Area (CFA) for wood storks. For the purposes of this Biological Opinion, the action area is considered to include the project site and the CFAs of the three wood stork nesting colonies described above. The action area encompasses 1,621.1 square miles of Collier, Lee, and Hendry Counties (Figure 6).

Status of the species and critical habitat rangewide

Florida Panther

Species description

An adult Florida panther is unspotted and typically rusty reddish-brown on the back, tawny on the sides, and pale gray underneath. There has never been a melanistic (black) puma documented in North America (Tinsley 1970; 1987). Adult males can reach a length of 7 ft (2.1 meters [m]) from their nose to the tip of their tail and may exceed 161 pounds (lbs) (73 kg) in weight; but, typically adult males average around 116 lbs (52.6 kg) and stand about 24 to 28 inches (in) (60 to 70 centimeters [cm]) at the shoulder (Roelke 1990). Female panthers are smaller with an average weight of 75 lbs (34 kg) and length of 6 ft (1.8 m) (Roelke 1990). The skull of the Florida panther is unique in that it has a broad, flat, frontal region, and broad, high-arched or upward-expanded nasal bones (Young and Goldman 1946).

Florida panther kittens are gray with dark brown or blackish spots and five bands around the tail. The spots gradually fade as the kittens grow older and are almost unnoticeable by the time they are 6 months old. At this age, their bright blue eyes slowly turn to the light-brown straw color of the adult (Belden 1988).

Three external characterisics: a right angle crook at the terminal end of the tail, a whorl of hair or cowlick in the middle of the back, and irregular, white flecking on the head, nape, and shoulders – not found in combination in other subspecies of *Puma* (Belden 1986), were commonly observed in Florida panthers through the mid-1990s. The kinked tail and cowlicks were considered manifestations of inbreeding (Seal 1994); whereas the white flecking was thought to be a result of scarring from tick bites (Maehr 1992; Wilkins et al. 1997). Four other abnormalities prevalent in the panther population prior to the mid-1990s were cryptorchidism (one or two undescended testicles), low sperm quality, atrial septal defects (the opening between two atria in the heart fails to close normally during fetal development), and immune deficiencies; and these were suspected to be the result of low genetic variability (Roelke et al. 1993a).

A plan for genetic restoration and management of the Florida panther was developed in September 1994 (Seal 1994) and eight non-pregnant adult female Texas panthers (*Puma concolor stanleyana*) were released in five areas of south Florida from March to July 1995. Since this introgression, rates of genetic defects, including crooked tails and cowlicks, have dramatically decreased (Land et al. 2004). In addition, to date, neither atrial septal defects nor cryptorchidism have been found in introgressed panthers (Cunningham 2005a). As of January 27, 2003, none of the eight female Texas panthers introduced in 1995 remain in the wild.

Taxonomy

The Florida panther was first described by Charles B. Cory in 1896 as *Felis concolor floridana* (Cory 1896). The type specimen was collected in Sebastian, Florida. Bangs (1899), however, believed the Florida panther was restricted to peninsular Florida and could not intergrade with other *Felis* spp. Therefore, he assigned it full specific status and named it *Felis coryi* since *Felis floridana* had been used previously for a bobcat (*Lynx rufus*).

The taxonomic classification of the *Felis concolor* group was revised and described by Nelson and Goldman (1929) and Young and Goldman (1946). These authors differentiated 30 subspecies using geographic and morphometric (measurement of forms) criteria and reassigned the Florida panther to subspecific status as *Felis concolor coryi*. This designation also incorporated *F. arundivaga*, which had been classified by Hollister (1911) from specimens collected in Louisiana, into *F. c. coryi*. Nowell and Jackson (1996) reviewed the genus *Felis* and placed mountain lions, including the Florida panther, in the genus *Puma*. The taxonomic classification of the puma is now considered to be *Puma concolor* (Wozencraft 1993), making the accepted name for the Florida panther *P. c. coryi*.

Culver et al. (2000) examined genetic diversity within and among the described subspecies of *Puma concolor* using three groups of genetic markers and proposed a revision of the genus to include only six subspecies, one of which encompassed all puma in North America including the Florida panther. However, Culver et al. (2000) determined the Florida panther was one of several smaller populations that had unique features. Specifically, the number of polymorphic microsatellite loci and amount of variation were lower, and it was highly inbred (eight fixed loci). The degree to which the scientific community accepted the results of Culver et al. (2000) and the proposed change in taxonomy is not resolved at this time (Service 2008). The Florida panther remains listed as a subspecies, and continues to receive protection pursuant to the Act.

Federal status

The Florida panther is the last subspecies of *Puma* (also known as mountain lion, cougar, panther, or catamount) still surviving in the eastern United States. Historically occurring throughout the southeastern United States (Young and Goldman 1946), today the panther is restricted to less than 5 percent of its historic range in one breeding population of approximately 100 animals, located in south Florida.

When Europeans first came to this country, pumas roamed most all of North, Central, and South America. Early settlers attempted to eradicate pumas by every means possible. By 1899, it was believed Florida panthers had been restricted to peninsular Florida (Bangs 1899). By the late 1920s to mid-1930s, it was thought by many the Florida panther had been completely extirpated (Tinsley 1970). In 1935, Dave Newell, a Florida sportsman, hired Vince and Ernest Lee, Arizona houndsmen, to hunt for panthers in Florida. They killed eight in the Big Cypress Swamp (Newell 1935). Every survey conducted since then confirmed a breeding panther population occurs in southern Florida south of the Caloosahatchee River, and no survey since then has been able to confirm a reproducing panther population outside of southern Florida.

Attempts to eradicate panthers and a decline in panther prey (primarily white-tailed deer [*Odocoileus virginianus*]) resulted in a panther population threatened with extinction. Prior to 1949, panthers could be killed in Florida at any time of the year. In 1950, the Florida Game and Freshwater Fish Commission (now Florida Fish and Wildlife Conservation Commission [FWC]) declared the panther a regulated game species due to concerns over declining numbers. The FWC removed panthers from the game animal list in 1958 and gave them complete legal protection. On March 11, 1967, the Service listed the panther as endangered (32 FR 4001) throughout its historic range, and these animals received Federal protection under the passage of the Act. In addition, the Florida Panther Act (Florida Statute 372.671), a 1978 Florida State law, made killing a panther a felony. The Florida panther is listed as endangered by the States of Florida, Georgia, Louisiana, and Mississippi.

Since the panther was designated as an endangered species prior to enactment of the Act, there was no formal listing package identifying threats to the species as currently required by section 4(a)(1) of the Act. However, the Florida Panther Recovery Plan, third revision, addressed the five factor threats analysis (Service 2008). Critical habitat has not been designated for the panther.

Life history

Reproduction

Male Florida panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. The first sexual encounters for males normally occur at about 3 years based on 26 radio-collared panthers of both sexes (Maehr et al. 1991). Based on genetics work, some males may become breeders as early as 17 months. Breeding activity peaks from December to March (Shindle et al. 2003). Litters (n = 82) are produced throughout the year, with 56 to 60 percent of births occurring between March and June (Jansen et al. 2005; Lotz et al. 2005). The greatest number of births occurs in May and June (Jansen et al. 2005; Lotz et al. 2005). Female panthers bred as young as 18 months (Maehr et al. 1989) and successful reproduction has occurred up to 11 years old. The mean age of denning females is 4.6 ± 2.1 (standard deviation [sd]) years (Lotz et al. 2005). Age at first reproduction for 19 known-aged female panthers averaged 2.2 ± 0.246 (sd) years and ranged from 1.8 to 3.2 years. Average litter size is 2.4 ± 0.91 (sd) kittens. Seventy percent of litters are comprised of either two or three kittens. Mean birth intervals (elapsed time between successive litters) are 19.8 ± 9.0 (sd) months for female panthers (n = 56) (range 4.1 to 36.5 months) (Lotz et al. 2005). Females that lose their litters generally produce another more quickly; five of seven females whose kittens were brought into captivity successfully produced another litter an average of 10.4 months after the removal of the initial litter (Land 1994).

Panther dens are usually located closer to upland hardwoods, pinelands, and mixed wet forests and farther from freshwater marsh-wet prairie (Benson et al. 2008). Most den sites are located in dense saw palmetto (*Serenoa repens*), shrubs, or vines (Maehr 1990; Shindle et al. 2003, Benson et al. 2008). Den sites are used for 6 to 8 weeks by female panthers and their litters from birth to weaning (Benson et al. 2008). Independence and dispersal of young typically occurs at 18 months, but may occur as early as one year (Maehr 1992).

Survivorship and causes of mortality

Benson et al. (2009) analyzed survival and cause-specific mortality of subadult and adult Florida panthers. They found that sex and age influenced panther survival, as females survived better than males, and older adults (≥10 years) survived poorly compared with younger adults. Genetic ancestry strongly influenced annual survival of subadults and adults after introgression, as F_1 generation admixed panthers survived longer than pre-introgression panthers and non-F_1 admixed individuals (Benson et al. 2009).

Mortality records for uncollared panthers have been kept since February 13, 1972, and for radio-collared panthers since February 10, 1981. Through March 3, 2012, 317 mortalities have been documented. Of the 317 total mortalities, 161 were radio-collared panthers that died since 1981 (FWC 2010a). Intraspecific aggression was the leading cause of mortality for radio-collared panthers, and was more common for males than females (Benson et al. 2009). Older-adult males had significantly higher and subadult males had marginally higher mortality due to intraspecific aggression than prime-adult males (Benson et al. 2009). Most intraspecific aggression occurs between male panthers; but, aggressive encounters between males and females have occurred, resulting in the death of the female. Defense of kittens and\or a kill is suspected in half (5 of 10) of the known instances through 2003 (Shindle et al. 2003).

Following intraspecific aggression, the greatest causes of mortality for radio-collared Florida panthers was from unknown causes, vehicles, and other (Benson et al. 2009). From February 13, 1972, through February 6, 2012, 169 Florida panthers (radio-collared and uncollared) were hit by vehicles (FWC 2011). These collisions resulted in 161 panther fatalities and eight non-fatal injuries. The number of panther/vehicle collisions per year is positively correlated with the annual panther count (McBride et al. 2008).

Female panthers are considered adult residents if they are older than 18 months, have established home ranges and bred (Maehr et al. 1991). Land et al. (2004) reported 23 of 24 female panthers first captured as kittens survived to become residents and 18 (78.3 percent) produced litters; 1 female was too young to determine residency. Male panthers are considered adult residents if they are older than 3 years and have established a home range that overlaps with females. Thirty-one male panthers were captured as kittens and 12 (38.7 percent) of these cats survived to become residents (Jansen et al. 2005; FWC 2005). "Successful male recruitment may depend on the death or home range shift of a resident adult male" (Maehr et al. 1991). Turnover in the breeding population is low with documented mortality in radio-collared panthers being greatest in subadult and non-resident males (Maehr et al. 1991; Shindle et al. 2003).

Den sites of female panthers have been visited since 1992 and the kittens tagged with passive integrated transponder chips. Annual survival of these kittens has been determined to be 0.328 ± 0.072 (SE) (Hostetler et al. 2009). There was no evidence survival rate differed between male and female kittens or was influenced by litter size. Hostetler et al. (2009) found kitten survival generally increased with degree of admixture with introduced Texas pumas and decreased with panther abundance. Kitten survival is lowest during the first 3 months of their lives (Hostetler et al. 2009).

Dispersal

Panther dispersal begins after a juvenile becomes independent from its mother and continues until it establishes a home range. Dispersal distances are greater for males than females. Maehr et al. (2002a) reported a mean dispersal distance of 42.5 miles [68.4 km] for male panthers (n = 18) and 12.6 miles [20.3 km] for female panthers (n = 9). The maximum dispersal distance recorded for a young male was 139.2 miles (224.1 km) over a 7-month period followed by a secondary dispersal of 145 miles (233 km). Comiskey et al. (2002) found males disperse an average distance of 25 miles (40 km) and females typically remain in or disperse short distances from their natal ranges. Female dispersers are considered philopatric because they usually establish home ranges less than one average home range width from their natal range (Maehr et al. 2002a). Maehr et al. (2002a) reported all female dispersers (n = 9) were successful at establishing a home range whereas only 63 percent of males (n = 18) were successful. Young panthers become independent at 14 months on average for both sexes, but male dispersals are longer in duration than female dispersals (9.6 months and 7.0 months, respectively) (Maehr et al. 2002a). Dispersing males usually go through a period as transient (non-resident) subadults, moving through the fringes of the resident population and often occupying suboptimal habitat until an established range becomes vacant (Maehr 1997).

Most panther dispersal occurs south of the Caloosahatchee River. However, panthers have been documented north of the Caloosahatchee River over 125 times since February 1972 through field signs (*e.g.*, tracks, urine markers, scats), camera-trap photographs, carcasses from seven vehicle-related mortalities, telemetry from four radio-collared animals (Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; Maehr et al. 2002a; Belden and McBride 2005), two captured animals (one of which was radio collared), and one skeleton. From 1972 through 2004, panthers have been confirmed in 11 counties (Flagler, Glades, Highlands, Hillsborough, Indian River, Okeechobee, Orange, Osceola, Polk, Sarasota, Charlotte, and Volusia) north of the river (Belden et al. 1991; Belden and McBride 2005). However, to date, successful panther reproduction has not been documented north of the Caloosahatchee River (Belden and McBride 2005).

The Caloosahatchee River, a narrow (295-328 ft [90-100 m]), channelized river, and is probably is not a significant barrier to panther movements. Western subspecies of *Puma* are known to cross wide, swift-flowing rivers up to a mile in width (Seidensticker et al. 1973; Anderson 1983). However, the combination of the river, SR 80, and land uses along the river seems to have somewhat restricted panther dispersal northward (Maehr et al. 2002a). Documented physical evidence of at least 15 other uncollared male panthers has been confirmed north of the river since 1972, but neither female panthers nor reproduction have been documented in this area since 1973 (Belden and McBride 2005).

Home range dynamics and movements

Panthers require large areas to meet their needs. Numerous factors influence panther home range size, including: habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Home range sizes of six radio-collared panthers monitored between 1985 and 1990 averaged 128,000 ac (51,800 hectares [ha]) for resident adult males and 48,000 ac (19,425 ha) for resident adult females; transient males had a home range of 153,599 ac (62,160 ha)

(Maehr et al. 1991). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981 to 2000 and found resident males had a mean home range of 160,639 ac (65,009 ha) and females had a mean home range of 97,920 ac (39,627 ha). Beier et al. (2003) found home range size estimates for panthers reported by Maehr et al. (1991) and Comiskey et al. (2002) to be reliable.

Annual minimum convex polygon home range sizes of 52 adult radio-collared panthers monitored between 1998 and 2002 ranged from 15,360 to 293,759 ac (6,216 to 118,880 ha), averaging 89,600 ac (36,260 ha) for 20 resident adult males and 44,160 ac (17,871 ha) for 32 resident adult females (Land et al. 1999; Shindle et al. 2000, 2001; Land et al. 2002). The most current estimate of home-range sizes (minimum convex polygon method) for established, non-dispersing, adult, radio-collared panthers averaged 29,056 ac (11,759 ha) for females (n = 11) and 62,528 ac (25,304 ha) for males (n = 11) (Lotz et al. 2005). The average home range was 35,089 ac (14,200 ha) for resident females (n = 6) and 137,143 ac (55,500 ha) (n = 5) for males located at BICY (Jansen et al. 2005). Home ranges of resident adults tend to be stable unless influenced by the death of other residents; however, several males have shown significant home range shifts that may be related to aging. Home-range overlap is extensive among resident females and limited among resident males (Maehr et al. 1991).

Activity levels for Florida panthers are greatest at night with peaks around sunrise and after sunset (Maehr et al. 1990a). The lowest activity levels occur during the middle of the day. Female panthers at natal dens follow a similar pattern with less difference between high and low activity periods.

Telemetry data indicate panthers typically do not return to the same resting site day after day, with the exception of females with dens or panthers remaining near kill sites for several days. The presence of physical evidence such as tracks, scats, and urine markers confirm panthers move extensively within home ranges, visiting all parts of the range regularly in the course of hunting, breeding, and other activities (Maehr 1997; Comiskey et al. 2002). Males travel widely throughout their home ranges to maintain exclusive breeding rights to females. Females without kittens also move extensively within their ranges (Maehr 1997). Panthers are capable of moving large distances in short periods of time. Nightly panther movements of 12 miles (20 km) are not uncommon (Maehr et al. 1990a).

Intraspecific interactions

Interactions between panthers occur indirectly through urine markers or directly through contact. Urine markers are made by piling ground litter using a backwards-pushing motion with the hind feet. This pile is then scent-marked with urine and occasionally feces. Both sexes make urine markers. Apparently, males use them as a way to mark their territory and announce presence while females advertise their reproductive condition (FWC 2011a).

Adult females and their kittens interact more frequently than any other group of panthers. Interactions between adult male and female panthers last from 1 to 7 days and usually result in pregnancy (Maehr et al. 1991). Aggressive interactions between males often result in serious injury or death. Independent subadult males have been known to associate with each other for

several days and these interactions do not appear to be aggressive in nature. Aggression between males is the most common cause of male mortality and an important determinant of male spatial and recruitment patterns based on radio-collared panthers (Maehr et al. 1991; Shindle et al. 2003). Aggressive encounters between radio-collared males and females also have been documented (Shindle et al. 2003; Jansen et al. 2005).

Food habits

Primary panther prey species are white-tailed deer and feral hog (*Sus scrofa*) (Maehr et al. 1990b; Dalrymple and Bass 1996). Generally, feral hogs constitute the greatest biomass consumed by panthers north of the Alligator Alley section of I-75, while white-tailed deer are the greatest biomass consumed to the south (Maehr et al. 1990b). Secondary prey species include raccoons (*Procyon lotor*), nine-banded armadillos (*Dasypus novemcinctus*), marsh rabbits (*Sylvilagus palustris*) (Maehr et al. 1990b) and American alligators (*Alligator mississippiensis*) (Dalrymple and Bass 1996). No seasonal variation in diet has been detected. Maehr et al. (1990b) rarely observed domestic livestock in scats or kills of the Florida panther, although cattle were readily available in the study area. Recently, a male panther, believed to be associated with calf depredations, was captured and collared in eastern Collier County (FWC 2010c).

Little information on the feeding frequency of the Florida panther is available. However, the feeding frequency of the Puma is likely similar to the feeding frequency of the Florida panther. Ackerman et al. (1986) reported a resident adult male puma generally consumes one deer-sized prey every 8 to 11 days. Moreover, a female puma will consume one deer-sized prey item every 14 to 17 days for a resident female and one deer-sized prey item every 3.3 days for a female with three 13-month-old kittens.

Infectious diseases, parasites, and environmental contaminants

Viral diseases

Feline leukemia virus (FeLV) is common in domestic cats (*Felis catus*), but is quite rare in non-domestic felids. Routine testing for FeLV antigen (indicating active infection) in captured and necropsied panthers was negative since testing began in 1978. However, between November 2002 and February 2003, two panthers tested FeLV antigen positive (Cunningham 2005b; Cunningham et al. 2008). The following year, three more cases were diagnosed (Brown et al. 2008). All infected panthers had overlapping home ranges in the Okaloacoochee Slough ecosystem. Three of the panthers died due to suspected FeLV-related diseases (opportunistic bacterial infections and anemia) and the two others died from intraspecific aggression. Testing of serum samples collected from 1990 to 2005 for antibodies (indicating exposure) to FeLV indicated increasing exposure to FeLV beginning in the late 1990s and concentrated north of I-75. There was apparently minimal exposure to FeLV during this period south of I-75. Positive antibody titers in different areas at different times indicate that multiple introductions of the virus into the panther population may have occurred. These smaller epizootics were apparently self-limiting and did not result in any known mortalities. Positive antibody titers, in the absence of an active infection (antigen positive), indicate panthers can be exposed and overcome the infection (Cunningham 2005a). Genetic analysis of the panther FeLV determined the source of

this outbreak was a cross-species transmission from a domestic cat (Brown et al. 2008). Management of the disease includes vaccination (Cunningham et al. 2008) as well as removal of infected panthers to captivity for quarantine and supportive care. As of June 1, 2005, about one-third of the population had received at least one vaccination against FeLV (Cunningham et al. 2008). No new positive cases have been diagnosed since July 2004; however, the potential for reintroduction of the virus remains (Cunningham et al. 2008).

Pseudorabies virus (PRV aka Aujeszky's disease) causes respiratory and reproductive disorders in adult hogs and mortality in neonates, but is a rapidly fatal neurologic disease in carnivores. At least one panther died from PRV infection presumably through consumption of an infected feral hog (Glass et al. 1994). At least one panther has also died of rabies (Taylor et al. 2002). This panther was radio-collared but not vaccinated against the disease.

Feline immunodeficiency virus (FIV) is a retrovirus of felids that is endemic in the panther population. About 28 percent of Florida panthers were positive for antibodies to the puma lentivirus strain of FIV (Olmstead et al. 1992); however, the prevalence may be increasing. Between November 2004 and April 2005, 13 of 17 (76 percent) panthers tested were positive (M. Cunningham, FWC, unpublished data). The cause of this increase is unknown but warrants continued monitoring and investigation. There is also evidence of exposure to Feline panleukopenia virus (PLV) in adult panthers (Roelke et al. 1993b) although no PLV-related mortalities are known to have occurred.

Serological evidence of other viral diseases in the panther population includes feline calicivirus, feline herpes virus, and West Nile virus. However, these diseases are not believed to cause significant morbidity or mortality in the population. All panthers found dead due to unknown causes are tested for alphaviruses, flaviviruses (including West Nile virus), and canine distemper virus. These viruses have not been detected in panthers by viral culture or polymerase chain reaction (FWC, unpublished data).

Other infectious diseases

Bacteria have played a role in free-ranging panther morbidity and mortality as opportunistic pathogens, taking advantage of pre-existing trauma or FeLV infections (FWC, unpublished data). Dermatophytosis (ringworm infection) has been diagnosed in several panthers and resulted in severe generalized infection in at least one (Rotstein et al. 1999). Severe infections may reflect an underlying immunocompromise, possibly resulting from inbreeding depression or immunosuppressive viral infections.

Parasites

The hookworm, (*Ancylostoma pluridentatum*), is found in a high prevalence in the panther population. Other parasites identified from live-captured or necropsied panthers include: eight arthropod species, eight nematode species, three cestode species, two trematode species, and three protozoa species (Forrester et al. 1985; Forrester 1992; Wehinger et al. 1995; Rotstein et al. 1999; Land et al. 2002; Foster et al. 2006). Of these, only an arthropod, (*Notoedres felis*), caused significant morbidity in at least one panther (Maehr et al. 1995).

Environmental contaminants

Overall, mercury in south Florida biota has decreased over the last several years (Frederick et al. 2002). However, high mercury concentrations are still found in some panthers. At least one panther is thought to have died of mercury toxicosis, and mercury has been implicated in the death of two other panthers in ENP (Roelke 1991). One individual panther had mercury concentrations of 150 parts per million (ppm) in its hair (Land et al. 2004). Elevated levels of p, p'– DDE were also detected in fat from that panther. The role of mercury and/or p, p'– DDE in this panther's death is unknown and no cause of death was determined despite extensive diagnostic testing. Elevated mercury concentrations have also been found in panthers from Florida Panther National Wildlife Refuge (FPNWR). Two sibling neonatal kittens from this area had hair mercury concentrations of 35 and 40 ppm. Although other factors were believed to have been responsible, these kittens did not survive to leave their natal den and neonates may be more susceptible to the toxic effects of mercury (Berglund and Berlin 1969). Consistently high hair mercury values in ENP and FPNWR, and the finding of elevated values in some portions of BICY, warrant continued monitoring (Land et al. 2004). Other environmental contaminants found in panthers include polychlorinated biphenyls (Arochlor 1260).

Population dynamics

Status and distribution

The Florida panther once ranged throughout the southeastern United States from Arkansas and Louisiana eastward across Mississippi, Alabama, Georgia, Florida, and parts of South Carolina and Tennessee (Young and Goldman 1946). Historically, the panther intergraded to the north with *P. c. cougar*, to the west with *P. c. stanleyana*, and to the northwest with *P. c. hippolestes* (Young and Goldman 1946).

Although generally considered unreliable, sightings of panthers regularly occur throughout the southeast. Nonetheless, a reproducing population of panthers has not been documented to occur outside of south Florida for at least 30 years despite an extensive search effort (Belden et al. 1991; McBride et al. 1993; Clark et al. 2002). Survey reports and more than 70,000 locations of radio-collared panthers recorded between 1981 and 2004 clearly define the panther's current breeding range. Reproduction is known only in the Big Cypress Swamp and Everglades physiographic region in Collier, Lee, Hendry, Miami-Dade, and Monroe Counties, south of the Caloosahatchee River (Belden et al. 1991). As discussed previously, panthers occasionally disperse north of the Caloosahatchee River. However, these animals are likely all males searching to establish new territories. There is no evidence of female panthers or successful panther reproduction currently occurring north of the Caloosahatchee River (Nowak and McBride 1974; Belden et al. 1991; Land and Taylor 1998; Land et al. 1999; Shindle et al. 2000; McBride 2002; Belden and McBride 2005).

Puma are wide ranging, secretive, and occur at low densities. However, their tracks, urine markers, and scats are readily found by trained observers, and resident populations are easily located. Van Dyke et al. (1986a) determined that all resident puma, 78 percent of transient puma, and 57 percent of kittens could be detected by track searches in Utah. During 2 month-long investigations – one late in 1972 and early 1973 and another in 1974 – funded by the World

Wildlife Fund to determine if panthers still existed in Florida, McBride searched for signs of panthers in portions of south Florida. In 1972, McBride authenticated a road-killed male panther in Glades County and a female captured and released from a bobcat trap in Collier County (R. McBride, personal communication 2005). In 1973, McBride captured one female in Glades County (Nowak and McBride 1974). Based on this preliminary evidence, Nowak and McBride (1974) estimated the "population from the Lake Okeechobee area southward to be about 20 or 30 individuals." In 1974, McBride found evidence of only two additional panthers in the Fakahatchee Strand and suggested that "there could be as few as 10 individual panthers in the area around Lake Okeechobee and southward in the State" (Nowak and McBride 1975). This initial survey, while brief in nature, proved panthers still existed in Florida and delineated areas where a more exhaustive search was warranted. After this initial investigation, more comprehensive surveys on both public and private lands were completed (Reeves 1978; Belden and McBride 1983; Belden et al. 1991).

Using a population genetics approach, Culver et al. (2008) estimated to reduce the microsatellite variation to that seen in the Florida panther, a very small bottleneck size of approximately two animals (N_e) for several generations and a small effective population size (N_e) in other generations would be necessary. Using demographic data from Yellowstone pumas, Culver et al. (2008) estimated the ratio of effective (N_e) to census (N) population size to be 0.315 (N_e)/(N). Using this ratio, they determined that, for the Florida panther, the census population size necessary to explain the loss of microsatellite variation was approximately 41 (0.315=12.9/41) for the non-bottleneck generations and 6.2 (0.315=1.95/6.2) for the two bottleneck generations.

Minimum population counts

McBride et al. (2008) and McBride (2010) reported minimum population counts (*i.e.*, number known alive) based on physical evidence (*e.g.*, tracks, urine markers, panther treed with hounds, trail-camera photos). They counted adult and subadult panthers, but not kittens at the den. Three rules were used to distinguish individuals: (1) gender was determined by track size or stride length; (2) time (freshness) was determined by known events within the past 24 hours, such as wind or rain; and (3) distance between individual track sets. These rules were used as an exclusionary tool to avoid over-counting (McBride et al. 2008). The number of panthers detected and verified by physical evidence from 1981 to 1994 fluctuated between a high of 30 and a low of 19 adult and juvenile panthers, with the lowest point occurring in 1991 following the removal of seven juveniles and three kittens to initiate a captive breeding program (McBride et al. 2008). In 1995, eight female pumas from Texas were released to address suspected deleterious effects of inbreeding. From 1996 to 2003, the panther population was increasing at a rate of 14 percent per year with 26.6 kittens being produced annually (Johnson et al. 2010). The effective population size (N_e) rose from 16.4 in 1995 to 32.1 in 2007, with corresponding census populations (N) of 26 and 102, respectively. The corresponding N_e /N ratios were 0.631 and 0.314 (Johnson et al. 2010). The deterministic annual growth rate (λ) for pre-1995 panthers was 0.952 ± 0.026 (SE), suggestive of a shrinking population (Hostetler et al. 2009). However, the λ for the overall population now is 1.052 ± 0.023, suggestive of a growing population (Hostetler et al. 2009).

The population tripled since 1995 (McBride et al. 2008, Johnson et al. 2010), reaching a high of 117 by 2007 (mortalities not subtracted). Data reported in McBride (2000, 2001, 2004, 2006, 2007, and 2008), McBride et al. (2008, 2012), Johnson et al. (2010), and FWC (2002, 2003) noted minimum population counts of 62 panthers in 2000, 78 in 2001, 80 in 2002, 87 in 2003, 78 in 2004, 82 in 2005, 97 in 2006, 117 in 2007, 104 in 2008, 113 in 2009 115 in 2010, and 111 in 2011. Table 2 provides a yearly tabulation of the population counts with the annual mortalities also shown. The mortality data is recorded by the FWC and reported to the Service.

Population density

Maehr et al. (1991) provide an estimate of population density of 1 panther per 27,520 ac, based on 17 concurrently radio-collared and 4 uncollared panthers. They extrapolated this density to the area occupied by radio-collared panthers (1,245,435 ac) during the period 1985 to 1990 to achieve a population estimate of 46 adult panthers for southwest Florida (excluding ENP, eastern BCNP, and Glades and Highlands Counties). Beier et al. (2003), however, argued this estimate of density, although "reasonably rigorous," could not be extrapolated to other areas because it was not known whether densities were comparable in those areas. Kautz et al. (2006) provided a density estimate of 1 panther per 31,923 ac by dividing the panther count at that time (67) by the area within the Primary Zone. However, panther densities are variable across the landscape. Using an average of the 2007 to 2009 panther counts in the eight survey units covered by McBride et al. (2008) and Kautz et al. (2006), the density estimates range from a low of 1 panther per 81,479 ac to a high of 1 panther per 7,850 ac for the Primary Zone lands within these survey units.

FWC (2010a) provided an upper bound population estimate of 0.0177 panthers per square-kilometer (km^2) or 1 panther per 13,929 ac. Applying this density estimate to the Primary Zone (9,189 km^2) (2,270,652 ac) yields an upper estimate of 163 adult panthers. FWC's lower boundary limit is 100 panthers (1.09 panthers per 100 km^2 or 1 panther per 22,707 ac) and is based on annual verified panther sign data (McBride et al. 2008) and minimum number of panthers known to be alive (FWC 2010b). Applying the four densities to the Primary Zone would yield a population based on Kautz et al.'s (2006) density estimate of 71 panthers (1 panther per 31,923 ac). Maehr et al.'s (1991) estimate would yield a population of 83 panthers (1 panther per 27,520 ac) and FWC's (2010a) estimate would yield a low of 100 panthers (1 panther per 22,707 ac) and a high of 163 panthers (1 panther per 13,929 ac). For our evaluations however, the Service is continuing to use the average densities provided by Kautz et al. (2006) of one panther per 12,919 ha (31,923 ac) or one panther per 129 km^2.

Habitat characteristics/ecosystem

Landscape Composition

Noss and Cooperrider (1994) considered the landscape implications of maintaining viable panther populations. Assuming a male home range size of 137,599 ac (55,685 ha) (Maehr 1990), an adult sex ratio of 50:50 (Anderson 1983), and some margin of safety, they determined a reserve network as large as 15,625 to 23,438 mi^2 (40,469 to 60,703 km^2) would be needed to support an effective population size of 50 individuals (equating to an actual adult population of 100 to 200 panthers [Ballou et al. 1989]). However, to provide for long-term persistence based on an

effective population size of 500 individuals (equating to 1,000 to 2,000 adult panthers [Ballou et al. 1989]), could require as much as 156,251 to 234,376 mi^2 (404,687 to 607,031 km^2). This latter acreage corresponds to roughly 60 to 70 percent of the Florida panther's historical range. Although it is uncertain whether this much land is needed for panther recovery, it does provide some qualitative insight into the importance of habitat conservation across large landscapes for achieving a viable panther population (Noss and Cooperrider 1994).

Between 1981 and 2010, more than 90,000 locations were collected from more than 180 radio-collared panthers. Belden et al. (1988); Maehr et al. (1991); Maehr and Cox (1995); Maehr (1997); Kerkoff et al. (2000); Comiskey et al. (2002); Cox et al. (2006); and Kautz et al. (2006) provide information on habitat use based on various subsets of these data. Since almost all locations from radio collars have been collected during daytime hours (generally 0700 to 1100) using very high frequency (VHF) aerial telemetry, and because panthers are most active during nocturnal and crepuscular periods (Maehr et al. 1990a), daytime telemetry data may be insufficient to describe habitat use patterns of nocturnal animals (Beyer and Haufler 1994; Comiskey et al. 2002; Beier et al. 2003; Dickson et al. 2005; Beier et al. 2006). However, Land et al. (2008), investigated habitat selection of 12 panthers in the northern portion of the breeding range using Global Positioning System (GPS) telemetry data collected during nocturnal and diurnal periods, as well as VHF telemetry data collected only during diurnal periods, and found analysis of both types of telemetry data yielded similar results.

A landscape-level strategy for the conservation of the panther population in south Florida was developed using a Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 ac (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas (Kautz et al. 2006). In developing the model, data from radio-collared panthers collected from 1981 through 2000 were used to evaluate the relative importance of various land cover types as panther habitat, thus identifying landscape components important for panther habitat conservation. Those components were then combined with a least cost path (LCP) analysis to delineate three panther habitat conservation zones for south Florida: (1) Primary Zone – lands important to the long-term viability and persistence of the panther in the wild; (2) Secondary Zone – lands which few panthers use contiguous with the Primary Zone, but given sufficient habitat restoration could accommodate expansion of the panther population south of the Caloosahatchee River; and (3) Dispersal Zone – the area which may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006) (Figures 2 and 3). The Primary Zone is currently occupied and supports the breeding population of panthers. The Secondary Zone could support resident panthers with sufficient restoration. Although panthers move through the Dispersal Zone, it is not currently occupied by resident panthers.

These zones vary in size, ownership, and land cover composition. The Primary Zone is 2,270,711 ac (918,928 ha) in size, 73 percent of which is publicly owned, and includes portions of the BICY, ENP, Fakahatchee Strand Preserve State Park (FSPSP), FPNWR, Okaloacoochee Slough State Forest, and Picayune Strand State Forest. This zone's composition is 45 percent forest, 41 percent freshwater marsh, 7.6 percent agriculture lands, 2.6 percent prairie and shrub lands, and 0.52 percent urban lands (Kautz et al. 2006). The Secondary Zone is 812,157 ac (328,670 ha) in size, 38 percent of which is public land. This zone's composition is 43 percent

freshwater marsh, 36 percent agriculture, 11 percent forest, 6.1 percent prairie and shrub lands, and 2.3 percent low-density residential areas and open urban lands (Kautz et al. 2006). The Dispersal Zone is 28,160 ac (11,396 ha) in size, 12 percent of which is either publicly owned or in conservation easement. This zone's composition is 49 percent agriculture (primarily improved pasture and citrus groves), 29 percent forest (wetland and upland), 8.8 percent prairie and shrub land, 7.5 percent freshwater marsh, and 5.1 percent barren and urban lands (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 ac (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the average density during the timeframe of the study, based on telemetry and other occurrence data, to average one panther per 31,923 ac (12,919 ha). In the following discussions of the number of panthers that a particular zone may support, the lower number is based on the 31,923 ac (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 ac (11,000 ha) value (Maehr et al. 1991).

Based on these average densities, the Primary Zone could support 71 to 84 panthers; the Secondary Zone could support 8 to 10 panthers without habitat restoration and 25 to 30 panthers with habitat restoration (existing high quality panther habitat currently present in the Secondary Zone is estimated at 32 percent of the available Secondary Zone lands); and the Dispersal Zone could support 0 panthers. Taken together, the three zones in their current condition have the capacity to support about 79 to 94 Florida panthers.

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

Even though some suitable panther habitat remains in south-central Florida, it is widely scattered and fragmented (Belden and McBride 2005). Thatcher et al. (2006) used a statistical model in combination with a geographic information system (GIS) to develop a multivariate landscape-scale habitat model based on the Mahalanobis distance statistic (D^2) to evaluate habitats in south central Florida for potential expansion of the Florida panther population. They identified four potential habitat patches: the Avon Park Bombing Range area, Fisheating Creek/Babcock-Webb Wildlife Management Area (WMA), eastern Fisheating Creek, and the Duette Park/ Manatee County area. These habitat patches are smaller and more isolated compared with the current Florida panther range, and the landscape matrix where these habitat patches exist provides relatively poor habitat connectivity among the patches (Thatcher et al. 2006, 2009). Major highways and urban or agricultural development isolate these habitat patches, and they are rapidly being lost to the same development that threatens southern Florida (Belden and McBride 2005).

Panther habitat use

Radio-collar data and ground tracking indicate that panthers use the mosaic of habitats available to them as resting and denning sites, hunting grounds, and travel routes. The majority of panther telemetry locations (Belden 1986; Belden et al. 1988; Maehr 1990; Maehr et al. 1991; Maehr 1992; Smith and Bass 1994; Kerkhoff et al. 2000; Comiskey et al. 2002, Cox et al. 2006, Kautz

et al. 2006, Land et al. 2008) and natal den sites (Benson et al. 2008) were within or close to forested cover types, particularly cypress swamp, pinelands, hardwood swamp, and upland hardwood forests. Global Positioning System data has shown panthers (n = 12) use all habitats contained within their home ranges by selecting for forested habitat types and using all others in proportion to availability (Land et al. 2008).

Kautz et al. (2006) found that the smallest class of forest patches (*i.e.*, 9 to 26 ac [3.6 to 10.4 ha]) were the highest ranked forest patch sizes within panther home ranges. The diverse woody flora of forest edges probably provides cover suitable for stalking and ambushing prey (Belden et al. 1988; Cox et al. 2006). Also, dense understory vegetation comprised of saw palmetto provides some of the most important resting and denning cover for panthers (Maehr 1990; Benson et al. 2008). Shindle et al. (2003) estimated 73 percent of panther dens were in saw palmetto thickets.

Prey habitat use

Panther habitat selection is related to prey availability (Janis and Clark 1999; Dees et al. 2001) and, consequently, prey habitat use. Adequate cover, and the size, distribution, and abundance of available prey species are important factors to the persistence of panthers in south Florida and often determine the extent of panther use of an area. Duever et al. (1986) calculated a deer population of 1,760 in BICY, based on Harlow (1959) deer density estimates of 1 per 210 ac (85 ha) in pine forest, 1 per 299 ac (121 ha) in swamps, 1 per 1,280 ac (518 ha) in prairie, 1 per 250 ac (101 ha) in marshes, and 1 per 111 ac (45 ha) in hammocks. Schortemeyer et al (1991) estimated deer densities at 1 per 49 to 247 ac (20 to100 ha) in three management units of BICY based on track counts and aerial surveys. Labisky et al. (1995) reported 1 per 9 ac (20 ha) in southeastern BICY. Using track counts alone, McCown (1994) estimated 1 per 183 to 225 ac (74 to 91 ha) on the FPNWR and 1 per 133 to 200 ac (54 to 81 ha) in the FSPSP.

Hardwood hammocks and other forest cover types are important habitat for white-tailed deer and other panther prey (Harlow and Jones 1965; Belden et al. 1988; Maehr 1990; Maehr et al. 1991; Maehr 1992; Comiskey et al. 1994; Dees et al. 2001). Periodic understory brushfires (Dees et al. 2001) as well as increased amounts of edge (Miller 1993) may enhance deer use of hardwood hammocks, pine, and other forest cover types. However, wetland and other vegetation types can support high deer densities. In the Everglades, for example, deer appear to be adapted to a mosaic of intergrading patches comprised of wet prairie, hardwood tree islands, and peripheral wetland habitat (Fleming et al. 1994; Labisky et al. 2003). High-nutrient deer forage, especially preferred by females, includes hydrophytic marsh plants, white waterlily (*Nymphaea odorata*), and swamp lily (*Crinum americana*) (Loveless 1959; Labisky et al. 2003). Wetland willow (*Salix spp.*) thickets also provide nutritious browse for deer (Loveless 1959; Labisky et al. 2003). However, the importance of these habitat types to panthers is dependent upon the availability of stalking and ambush cover.

Marshes, rangeland, and low-intensity agricultural areas support prey populations of deer and hogs. The importance of these habitat types to panthers cannot be dismissed based solely on use or lack of use when daytime telemetry are the only data available (Comiskey et al. 2002; Beier et al. 2003; Comiskey et al. 2004; Beier et al. 2006).

Travel and dispersal corridors

In the absence of direct field observations/measurements, Harrison (1992) suggested landscape corridors for wide-ranging predators should be half the width of an average home range size. Following Harrison's (1992) suggestion, corridor widths for Florida panthers would range 6.1 to 10.9 miles (9.8 to17.6 km) depending on whether the target animal was an adult female or a transient male. Beier (1995) suggested that corridor widths for transient male puma in California could be as small as 30 percent of the average home range size of an adult. For Florida panthers, this would translate to a corridor width of 5.5 miles (8.8 km). Without supporting empirical evidence, Noss (1992) suggests regional corridors connecting larger hubs of habitat should be at least 1.0 mile (1.6 km) wide. Beier (1995) makes specific recommendations for very narrow corridor widths based on short corridor lengths in a California setting of wild lands completely surrounded by urban areas; he recommended that corridors with a length less than 0.5 mile (0.8 km) should be more than 328 ft (100 m) wide, and corridors extending 0.6 to 4 miles (1 to 7 km) should be more than 1,312 ft (400 m) wide. The Dispersal Zone encompasses 44 mi^2 (113 km^2) with a mean width of 3.4 miles (5.4 km). Although it is not adequate to support even one panther, the Dispersal Zone is strategically located and expected to function as an important landscape linkage to south-central Florida (Kautz et al. 2006). Transient male panthers currently utilize this zone as they disperse northward into south-central Florida.

Panther habitat evaluation and compensation

Population Viability Analysis (PVA) has emerged as a key component of endangered species conservation. This process is designed to incorporate demographic information into models that predict if a population is likely to persist in the future. PVAs incorporate deterministic and stochastic events including demographic and environmental variation, and natural catastrophes. PVAs have been criticized as being overly optimistic about future population levels (Brook et al. 1997) and should be viewed with caution; however, they are and have been shown to be surprisingly accurate for managing endangered taxa and evaluating different management practices (Brook 2000). They are also useful in conducting sensitivity analyses to determine where more precise information is needed (Hamilton and Moller 1995; Beissinger and Westphal 1998; Reed et al. 1998; Fieberg and Ellner 2000).

Shaffer (1981) originally defined a viable population as follows: "a minimum viable population for any given species in any given habitat is the smallest isolated population having a 99 percent chance of remaining extant for 1,000 years despite the foreseeable effects of demographic, environmental and genetic stochasticity, and natural catastrophes." However, the goal of 95 percent probability of persistence for 100 years is the standard recommended by population biologists and is used in management strategies and conservation planning, particularly for situations where it is difficult to accurately predict long-term effects (Shaffer 1978, 1981, 1987; Sarkar 2004).

Since 1981 through June 2010, 182 Florida panthers have been radio-collared and monitored on public and private lands throughout south Florida (FWC 2010a). Radio-collar data were used by researchers to estimate survival rates and fecundity and were incorporated into PVA models previously developed for the Florida panther (Seal and Lacy 1989; Seal and Lacy 1992; Cox et al. 1994; Kautz and Cox 2001; Maehr et al. 2002b). These models incorporated a range of different model parameters such as general sex ratios, kitten survival rates, age distributions, and

various levels of habitat losses, density dependence, and intermittent catastrophes or epidemics. The outputs of these models predicted a variety of survival scenarios for the Florida panther and predicted population levels needed to ensure the survival of the species.

Root (2004) developed an updated set of PVA models for the Florida panther based on RAMAS GIS software. These models were used to perform a set of spatially explicit PVAs. Three general single-sex (*i.e.*, females only) models were constructed using demographic variables from Maehr et al. (2002b) and other sources. A conservative model was based on Seal and Lacy (1989), a moderate model was based on Seal and Lacy (1992), and an optimistic model was based on the 1999 consensus model of Maehr et al. (2002b). In each model, first-year kitten survival was set at 62 percent based on recent information from routine panther population monitoring (Shindle et al. 2001). All of the models assumed a 1:1 sex ratio, a stable age distribution, 50 percent of females breeding in any year, and an initial population of 41 females (82 individuals including males), which was the approximate population size in 2001 and 2002 (McBride 2001, 2002).

The use of 41 females in the model was based on the best available data when the model was developed. The total of 41 females represents the number of individual panthers documented in surveys by McBride (2001, 2002). While the total of 41 females includes subadults that do not yet breed, it is reasonable to use this total number in modeling to evaluate population trends for several reasons. First, it is not feasible to differentiate between subadults and adults through field observation. Second, although it is possible some of the 41 females were not breeding in year one of the model, these females would mature to breeding age by year 2 of the model. Third, the Root (2004) model assumed females to have "a 50 percent chance of breeding in a given year," and therefore only half of the 41 females were modeled as breeding each year. The primary reason the model (Root 2004) assumed a 50 percent chance of breeding in a given year is that kittens stay with their mother from 15 to 24 months prior to dispersal; however, this assumption accounts for the likelihood some of the 41 females would not breed in a given year, including subadult status of some individuals. Fourth, the Service recognizes the McBride data is not intended to provide a total population estimate. Although the Service believes population estimates derived through field surveys are close to the actual population number, it is likely some individuals in the current panther population have not been documented. In light of these factors, the Service believes it is reasonable to use the best available count of 41 subadult and adult females as the breeding population for modeling purposes.

Basic PVA versions

The basic versions of each model incorporated no catastrophes or epidemics, no change in habitat quality or amount, and a ceiling type of density dependence. The basic versions of the models incorporated a carrying capacity of 53 females (106 panthers with a 50:50 sex ratio). Variants of the models were run with differing values for density dependence, various levels of habitat loss, and intermittent catastrophes or epidemics. Each simulation was run with 10,000 replications for a 100-year period. The minimum number of panthers needed to ensure a 95 percent probability of persistence for 100 years was estimated in a series of simulations in which initial abundance was increased until probability of extinction at 100 years was no greater than 5 percent. More detailed information concerning the PVA model parameters appears in Root (2004).

The results of an earlier, conservative PVA model run done by Seal (1989) predicted a probability of extinction for the conservative model of 78.5 percent in 100 years with a mean final total abundance of 3.5 females. Also, the probability of a large decline in abundance (50 percent) was 94.1 percent. Later work based on an improved panther modeling and a larger sample of monitored panthers produced both a moderate and optimistic scenario (Root 2004). The moderate model resulted in a 5 percent probability of extinction and a mean final abundance of 42.3 females in 100 years. The probability of panther abundance declining by half the initial amount was 20 percent in 100 years under the moderate model. The optimistic model resulted in a 2 percent probability of extinction and mean final abundance of 51.2 females in 100 years. The probability of panther abundance declining by half the initial amount was only 9 percent in 100 years under the optimistic model. These models also provide a probability of persistence (100 percent minus probability of extinction) over a 100-year period of 95 percent for the moderate model and 98 percent for the optimistic model.

Model results were also provided by Root (2004) for probability of extinctions for 1 percent loss of habitat per year, within the first 25 years of the model run, based on both the moderate and optimistic scenarios. The 1 percent loss of habitat equates to essentially all remaining non-urban privately owned lands in the Primary Zone and corresponds to the estimated rate of habitat loss from 1986 to 1996 for the five southwest counties based on land use changes (Root 2004). For the moderate model, the model runs predict a probability of extinction increase of about 1 percent, from a probability of extinction of about 5 percent with no loss of habitat to 6 percent with 1.0 percent habitat loss per year, for the first 25 years. For the optimistic model, probability of extinction increased from about 2 percent with no loss of habitat to 3 percent with 1.0 percent habitat loss per year, for the first 25 years. These models also predicted the mean final abundance of females would decrease from 41 to 31 females, a 24.3 percent reduction for the moderate model and from 41 to 38 females, a 7.3 percent reduction for the optimistic model.

The model runs predict a probability of persistence (100 percent minus the probability of extinction) over a 100-year period of about 94 percent for the moderate model and 97 percent for the optimistic model. The model runs also predict a mean final abundance of 62 individuals (31 females and 31 males) for the moderate model and 76 individuals (38 females and 38 males) for the optimistic model.

Population guidelines

Kautz et al. (2006), following review of the output of Root's PVA models and those of other previous PVAs for the Florida panther, suggested a set of population guidelines for use in the management and recovery of the Florida panther. These guidelines are: (1) populations of less than 50 individuals are likely to become extinct in less than 100 years; (2) populations of 60 to 70 are barely viable and expected to decline by 25 percent over 100 years; (3) populations of 80 to 100 are likely stable but would still be subject to genetic problems (*i.e.*, heterozygosity would slowly decline); and (4) populations greater than 240 have a high probability of persistence for 100 years and are demographically stable and large enough to retain 90 percent of original genetic diversity.

Population guidelines for populations of panthers between 50 and 60 individuals and between 70 and 80 individuals were not specifically provided in Kautz et al. (2006). However, the Service views the guidelines in Kautz et al. (2006) as a continuum. Therefore, we consider populations of 50 to 60 individuals to be less than barely viable or not viable with declines in population and heterozygosity. Similarly, we consider populations of 70 to 80 to be more than barely viable or somewhat viable with some declines in population and heterozygosity. Like other population guidelines presented in Kautz et al. (2006), these assume no habitat loss or catastrophes. Root's (2004) moderate model runs, which have a carrying capacity 53 females (106 individuals), show final populations of 42.3 females (84 total) and 31.2 females (62 total) with extinction rates of 5 percent and 6 percent, respectively, for the basic and 1 percent habitat loss scenarios. The predicted final populations in Root (2004) are 84 and 62 panthers for no loss of habitat and 1 percent loss of habitat, respectively, over a 100-year period.

Kautz et al.'s (2006) population guidelines, when applied to the populations predicted by Root's (2004) moderate models, describe the "with habitat loss" population (62 panthers) as barely viable and expected to decline by 25 percent over a 100-year period. The "without habitat loss" population (84 panthers) is likely stable but would still be subject to genetic problems.

As discussed above, the panther population has shown an increase in the number of panthers reported yearly, beginning in 2000. The Service believes McBride's verified population of 97 panthers in 2006, 117 panthers in 2007, 104 in 2008, 113 in 2009, 115 in 2010, and 111 in 2011 is within Kautz et al.'s (2006) population guidelines representing a population that is likely stable but still may be subject to genetic problems.

The Service also believes the model runs show lands in the Primary Zone are important to the survival and recovery of the Florida panther, and sufficient lands need to be managed and protected in south Florida to provide for a population of 80 to 100 panthers, the population range defined as likely stable over 100 years, but subject to genetic problems. As discussed in the following section, the Service developed a landscape level program that, through regulatory reviews and coordinated conservation efforts with landowners and resource management partners, provides a mechanism to achieve this population threshold.

Model violations

The actual likelihood of population declines and extinctions may be different than the guidelines and models suggest, depending upon the number and severity of assumptions violated. The Service realizes that habitat loss is occurring at an estimated 0.8 percent loss of habitat per year (R. Kautz, FWC, personal communication, 2003, as cited in Service 2008). The Service accounted for some habitat loss and changes in habitat quality within its regulatory program, specifically through its habitat assessment methodology (discussed below). For example, we increased the base ratio used within this methodology to account for unexpected increases in habitat loss. Similarly, we consider changes in habitat quality and encourage habitat restoration wherever possible.

With regard to the assumption of no catastrophes, the Service considered the recent outbreak of feline leukemia in the panther population at Okaloacoochee Slough as a potential catastrophe. The FWC is carefully monitoring the situation and it appears to be under control at this time due to a successful vaccination program. However, if the outbreak spreads into the population, the Service will consider this as a catastrophe and factor this into our decisions.

We acknowledge uncertainties exist, assumptions can be violated, and catastrophes can occur. The Service and the FWC, along with our partners, will continue to monitor the panther population and the south Florida landscape and incorporate any new information and changes into our decision-making process.

Recovery goals

The recovery objectives identified in the final third revision of the Florida Panther Recovery Plan (Service 2008) are to: (1) maintain, restore, and expand the Florida panther population and its habitat in south Florida and, if feasible, expand the known occurrence of Florida panthers north of the Caloosahatchee River to maximize the probability of the long-term persistence of this metapopulation; (2) identify, secure, maintain, and restore habitat in potential reintroduction areas within the panther's historic range, and to establish viable populations of the panther outside south and south-central Florida; and (3) facilitate panther conservation and recovery through public awareness and education.

Habitat conservation and protection

Panthers, because of their wide-ranging movements and extensive spatial requirements, are particularly sensitive to habitat fragmentation (Harris 1984). Mac et al. (1998) defines habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." The reference to "unconnected patches" is a central underpinning of the definition. For panther conservation, this definition underscores the need to maintain contiguous habitat and protected habitat corridors in key locations in south Florida and throughout the panther's historic range. Habitat fragmentation can result from road construction, urban development, and agricultural land conversions.

Habitat protection has been identified as being one of the most important elements to achieving panther recovery. While efforts have been made to secure habitat, continued action is needed to obtain additions to and inholdings for public lands, assure linkages are maintained, restore degraded and fragmented habitat, and obtain the support of private landowners for maintaining property in a manner that is compatible with panther use. Conservation lands used by panthers are held and managed by a variety of entities including the Service, NPS, Seminole Tribe of Florida, Miccosukee Tribe of Indians of Florida, FWC, Florida Department of Environmental Protection (DEP), Florida Division of Forestry (FDOF), Water Management Districts, non-governmental organizations, counties, and private landowners.

Public lands

From 1944 to the present, approximately 2,756,802 ac (1,115,638 ha) of public lands in south Florida have been acquired, which benefit the Florida panther (Figure 8).

Tribal lands

Lands of the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida encompass over 350,079 ac (141,673 ha) in south Florida. Of these, 115,840 ac (46,879 ha) are used by panthers, and comprise 5 percent of the Primary Zone (Kautz 2006). In general, these lands are not specifically managed for the panther and are largely in cultivation. However, in 2007, the Seminole Tribe of Florida reserved about 4,144 ac within the Big Cypress Seminole Indian Reservation Native Area, an area encompassing about 14,724 ac, specifically for the benefit of the Florida panther. The remaining native area, about 10,580 ac, although not specifically managed for the Florida panther, provides high quality value habitat for the Florida panther and panther prey species.

Private lands

A variety of Federal, State, and private incentive programs are available to assist private landowners and other individuals with the protection and management of wildlife habitat. Voluntary agreements, estate planning, conservation easements, land exchanges, and mitigation banks are all methods that hold untapped potential for conserving private lands. In 1954, the National Audubon Society established the nearly 10,880-ac (4,403-ha) Corkscrew Swamp Sanctuary. However, little additional private land has been protected south of the Caloosahatchee River for panther conservation. A number of properties identified by the State Acquisition and Restoration Council for purchase by the Florida Forever Program are used by panthers (*e.g.*, Devil's Garden, Half Circle F Ranch, Pal Mal, and Panther Glades). North of the Caloosahatchee River, the Fisheating Creek Conservation Easement consists of 41,600 ac (16,835 ha) in Glades County, and it is a private holding used by dispersing male panthers.

Habitat and prey management

Land management agencies in south Florida are implementing fire programs that mimic a natural fire regime through the suppression of human-caused wildfires and the application of prescribed natural fires. No studies have been conducted to determine the effects of invasive plant management on panthers. However, invasive vegetation may reduce the panther's prey base by disrupting natural processes, such as water flow and fire, and by significantly reducing available forage for prey (Fleming et al. 1994). All public lands in south Florida have active invasive plant treatment programs. Management for panther prey consists of a variety of approaches, such as habitat management and regulation of hunting and ORV use.

Response to management activities

Few studies have examined the response of panthers to various land/habitat management activities. Dees et al. (2001) investigated panther habitat use in response to prescribed fire and found that panther use of pine habitats was greatest for the first year after the area had been burned and declined thereafter. Prescribed burning is believed to be important to panthers

because prey species (*e.g.*, deer and hogs) are attracted to burned habitats to take advantage of changes in vegetation structure and composition, including exploiting hard mast that is exposed and increased quality or quantity of forage (Dees et al. 2001). Responses of puma to logging activities (Van Dyke et al. 1986b) indicate that they generally avoid areas within their home range with intensification of disturbance.

There is the potential for disturbance to panthers from recreational uses on public lands. Maehr (1990) reported that indirect human disturbance of panthers may include activities associated with hunting and that panther use of Bear Island (part of BICY) is significantly less during the hunting season. Schortemeyer et al. (1991) examined the effects of deer hunting on panthers at BICY between 1983 and 1990. They concluded that, based on telemetry data, panthers may be altering their use patterns because of hunting. Janis and Clark (2002) compared the behavior of panthers before, during, and after the recreational deer and hog hunting season (October through December) on areas open (BICY) and closed (FPNWR, FSPSP) to hunting. Variables examined were: (1) activity rates; (2) movement rates; (3) predation success; (4) home range size; (5) home range shifts; (6) proximity to ORV trails; (7) use of areas with concentrated human activity; and (8) habitat selection. Responses to hunting for variables most directly related to panther energy intake or expenditure (*i.e.*, activity rates, movement rates, predation success of females) were not detected (Janis and Clark 2002). However, panthers reduced their use of Bear Island, an area of concentrated human activity, and were found farther from ORV trails during the hunting season, indicative of a reaction to human disturbance (Janis and Clark 2002). Whereas the reaction to trails was probably minor and could be related to prey behavior, decreased use of Bear Island most likely reflects a direct reaction to human activity and resulted in increased use of adjacent private lands (Janis and Clark 2002).

Adverse effects of roads

Roads and highways facilitate the movement of people and goods by cars and trucks, and may adversely affect the Florida panther. The construction of new roads and the widening of existing roads can result in the direct loss of wildlife habitat (Forman et al. 2003). Moreover, disturbance resulting from motorized vehicles may cause panthers to avoid busy roads. Maher (1990) reported that female panthers are less likely to cross busy highways. Consequently, roads may act as barriers affecting panther movement and fragmenting panther habitat. Panthers can also be injured or killed due to collisions with motorized vehicles when attempting to cross highways, and the potential for collisions increases as traffic increases. Adverse effects resulting from roads and highways represent a potential threat to the existing panther population.

Collisions with motor vehicles on highways appear to be a significant source of mortality for the Florida panther. As discussed above, the FWC documented 165 vehicle-related panther mortalities and 8 vehicle-related panther injuries from 1972 to the present on highways in south Florida. In portions of the panther's range, the rate of panther vehicle-related mortalities may be increasing. Smith et al. (2006) found that vehicle-related panther mortalities in Collier County increased by a factor of four from 2000 to the present, compared to previous decades. This increase in panther mortality is likely related to the increase in traffic from Collier County's population growth. Unfortunately, the effect of vehicle-related mortality on the existing panther population is largely unknown.

Wildlife underpasses, or crossings, can be constructed within highway corridors to reduce the potential for panther injuries and mortalities resulting from vehicle collisions. Underpasses allow panthers and other wildlife to safely cross under busy roadways, and maintain connectivity and gene flow within the panther population. Underpasses usually consist of a bridge, prefabricated concrete box, or culvert (Forman et al. 2003). Effective crossing structures are large enough to allow the passage of panthers and include adequate wing fencing to funnel panthers to the crossing site. Crossings should be designed so panthers have an unobstructed view of habitat on the opposite side of the underpass (Foster and Humphrey 1995). The status of lands adjacent to the crossing site should also be considered when determining the location of a crossing. Unprotected private lands adjacent to the crossing could be developed and render the crossing unviable. Accordingly, lands adjacent to crossings should be acquired or placed under a conservation easement or other protective covenant to ensure the crossing will function in perpetuity.

A number of wildlife crossings with associated fencing have already been constructed within major roadways in southwest Florida to benefit the panther and other wildlife species (Figure 8). In 1991, the FDOT finished the construction of 28 wildlife crossings within the I-75 corridor from U.S. Highway 27 to just west of Everglades Boulevard. A total of five vehicle-related panther mortalities were documented within this corridor prior to construction of the crossings. Following construction of the crossings, a total of four vehicle-related panther mortalities (all in 2009) were recorded in the corridor from 1991 to the present. For three of these mortalities, it appears the panther had entered the I-75 right-of-way through gaps in the fence at existing roadway intersections (*i.e.*, SR 29, Snake Road).

The FDOT also constructed six wildlife crossings on SR 29 between Oil Well Road and US 41. Crossings A, B, C, and D are located north of I-75 and Crossings E and F are located south of I-75. Crossings A and B were constructed in 2007, Crossings C and D were constructed in 1995, Crossing E was constructed in 1997, and Crossing F was constructed in 1999. Prior to construction of the SR 29 Crossings, a total of 10 vehicle-related panther mortalities were recorded near the locations of Crossings A and B from 1980 through 2004, and 2 vehicle-related panther mortalities were recorded near the location of Crossings C and D from 1979 through 1990. Vehicle-related panther mortalities have not been recorded in the vicinity of Crossings A, B, C, or D following their installation. A total of 2 vehicle-related panther mortalities were documented within 3.5 miles of the location of Crossing E prior to construction, and vehicle-related panther mortalities were not observed within 2.5 miles of the location of Crossing F prior to construction. Following construction of Crossings E and F, a total of four vehicle-related panther mortalities have been reported within 3 miles of Crossing E, and two vehicle-related panther mortalities have been documented within 1 mile of Crossing F. The observed increase in the number of vehicle-related panther mortalities following the construction of Crossings E and F may be related to the increase in the panther population within recent years.

Lee County, Collier County, and other entities proposing developments that may adversely affect the panther are working with the Service to construct additional needed crossings for the panther. For example, the Collier County Road Department is currently constructing two wildlife underpasses and barrier fencing within the Oil Well Road (CR 858) corridor at Camp Keais Strand, in association with the Oil Well Road widening project. Lee County constructed a

wildlife underpass and barrier fencing on Corkscrew Road in 2004. Moreover, in 2011, a wildlife underpass and barrier fencing was installed east of Immokalee on County Road (CR) 846 in Collier County, as part of the Habitat Conservation Plan for the City Gate development. Finally, a wildlife underpass was installed on Immokalee Road near CR 951 in association with the Twin Eagles development project.

The wildlife crossings described above represent a commendable effort by the FDOT and others to reduce panther deaths resulting from collisions with motor vehicles; however, more crossings are needed within the major roadways of south Florida to further reduce this threat to the panther and other wildlife species (Smith et al. 2006). Accordingly, recent studies have been conducted to identify locations for wildlife crossings in south Florida. Swanson et al. (2005) used a LCP modeling approach to identify the most likely travel routes for panthers among six major use areas in southwest Florida. LCP modeling takes into consideration elements in the landscape that permit or impede panther movement when traveling. Swanson et al. (2005) identified 20 key highway segments where LCPs intersected improved roadways. Smith et al. (2006) studied the movements of the Florida panther, the Florida black bear, and other wildlife species along SR 29, CR 846 and CR 858 in Collier County, Florida. Data analyzed in the study were obtained from roadkill and track surveys, infra-red camera monitoring stations, existing data provided by the FWC (Florida panther radio telemetry and vehicle mortality reports), and other studies. Smith et al. (2006) recommended new wildlife crossings be considered at various sites along these roadways to reduce vehicle-related mortality of panthers and other wildlife species, and to increase connectivity among wildlife populations. The Service continues to work with the FDOT, county road departments, and other entities to ensure wildlife crossings are installed as needed to promote safe passage of panthers and other wildlife across roadways.

Agriculture, development, and mining:

The Service developed a Panther Habitat Assessment methodology and refugia design in 2003 to help guide the agency in evaluating permit applications for projects that could affect panther habitat (see discussion below). This methodology was a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project applicant. Prior to the development of this methodology, the Service, from March 1984 through August 2003, concluded consultation on 41 projects involving the panther and habitat preservation (Table 3). The minimum expected result of these projects is impacts to 69,991 ac and the preservation of 14,203 ac of panther habitat. Of the 69,991 ac of impacts, 38,932 ac are due to agricultural conversion and 31,059 ac to development and mining. Portions (10,370 ac) of the largest agricultural conversion project, 28,700 ac by U.S. Sugar Corporation, were re-acquired by the Federal government as a component of the Talisman Land Acquisition (Section 390 of the Federal Agricultural Improvement and Reform Act of 1996 [Public Law 104-127] Farm Bill Cooperative Agreement, FB4) for use in the Comprehensive Everglades Restoration Plan (CERP). The non-agriculture impacts are permanent land losses, whereas the agricultural conversions may continue to provide some habitat function and value to panthers, depending on the type of conversion.

From August 2003 through the date of this Biological Opinion, the Service concluded consultations on 115 development projects affecting 26,032 ac with preservation of 28,846 ac (Table 3). Following our refugia design assessment approach, the projects affected 13,327 ac in the Primary Zone, 37 acres in the dispersal zone, 7,894 ac in the Secondary Zone, and 4,775 ac in the Other Zone. Compensation provided included 26,132 ac in the Primary Zone, 272 ac in the Secondary Zone, 675 ac in the Dispersal Zone, and 1,765 ac in the Other Zone. The project-affected lands were primarily agricultural fields consisting of row crops and citrus groves and natural lands with varying degrees of exotic vegetation. The PHU habitat value of these lands to the Florida panther, following our Panther Habitat Assessment methodology, was 81,844 primary equivalent PHUs; concurrently, the project's provided corresponding PHU preservation and enhancement of 219,336 primary equivalent PHUs. The preservation lands were generally native habitat lands or disturbed lands that included restoration components. Restoration components included exotic species removal, fire management, wetland hydrology improvement, improved forest management practices, and full habitat restoration from agriculture uses to native habitats.

South Florida panther population goal

The Service's goal for Florida panther conservation in south Florida is to locate, preserve, and restore lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of 80 to 100 individuals (adults and subadults) south of the Caloosahatchee River. The Service proposes to achieve this goal through land management partnerships with private landowners, through coordination with private landowners during review of development proposals, and through land management and acquisition programs with Federal, State, local, private, and Tribal partners. Based on an average density of 31,923 ac per panther as determined by Kautz et al. (2006), the acreages of lands necessary to achieve this goal are 2,553,840 ac for 80 panthers and 3,192,300 ac for 100 panthers.

The principal regulatory mechanism that allows the Service to work directly with private land owners during review of development and land alteration projects is section 10 of the Act. The Service also coordinates with Federal agencies pursuant to section 7 of the Act. In August 2000, the Service, to assist the Corps in assessing project effects to the Florida panther, developed the Florida panther final interim Standard Local Operating Procedures (SLOPES) for Endangered Species (Service 2000) (update in 2007; Service 2007a). The Florida panther SLOPES provide guidance to the Corps for assessing project effects to the Florida panther and recommends actions to minimize these effects. The Florida panther SLOPES also included a consultation area map that identified an action area where the Service believed land alteration projects may affect the Florida panther. The SLOPES document is available on the Corps' web site at:

http://www.saj.usace.army.mil/regulatory/what/species/panther.htm

In the original SLOPES, the consultation area map (the Map) was generated by the Service by overlaying existing and historical panther telemetry data on a profile of Florida and providing a connecting boundary surrounding most of these points. Since the development of the Map, we received more accurate and up-to-date information on Florida panther habitat usage.

Specifically, we received two documents that the Service believes reflect the most likely panther habitat usage profiles, although documentation clearly shows panther use of areas outside these locations. These documents are the publications by Kautz et al. (2006) and Thatcher et al. (2006). Based on the information in these documents, we clarified the boundaries of the Map to better reflect areas where Florida panthers predominate (Figure 2), and we refer to these areas cumulatively as the Florida Panther Focus Area. As part of this review, we also made revisions to components in the SLOPES documents in coordination with the Corps; these revisions address actions that can be taken by the Service, Corps, and project applicants that may benefit panthers and minimize effects from proposed projects (Service 2007a).

The Panther Focus Area was determined from the results of recent panther habitat models south of the Caloosahatchee River (Kautz et al. 2006) and north of the Caloosahatchee River (Thatcher et al. 2006). The Kautz et al. (2006) model of landscape components important to Florida panther habitat conservation was based on an analysis of panther habitat use and forest patch size. This model was used in combination with radio-telemetry records, home range overlaps, land use/land cover data, and satellite imagery to delineate Primary and Secondary areas that would be most important and comprise a landscape mosaic of cover types important to help support the current panther breeding population south of the Caloosahatchee River.

Thatcher et al. (2006, 2009) developed a habitat model using Florida panther home ranges in south Florida to identify landscape conditions (land-cover types, habitat patch size and configuration, road density and other human development activities, and other similar metrics) north of the Caloosahatchee River that were similar to those associated with the current panther breeding population.

The Panther Focus Area Map south of the Caloosahatchee River is divided into Primary, Secondary, and Dispersal Zones, and north of the Caloosahatchee River into the Primary Dispersal/Expansion Area.

Primary Zone

The Primary Zone is the area that is currently occupied and supports the only known breeding population of Florida panthers in the world. These lands are important to the long-term viability and persistence of the panther in the wild.

Secondary Zone

These lands are contiguous with the Primary Zone, and, although they are used to a lesser extent by panthers, they are important to the long-term viability and persistence of the panther in the wild. Panthers use these lands in a much lower density than in the Primary Zone.

Dispersal Zone

A known corridor between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River that may facilitate future panther expansion north of the Caloosahatchee River (Kautz et al. 2006). This Zone is necessary to facilitate the dispersal of panthers and future panther population expansion to areas north of the Caloosahatchee River. Marked panthers have been documented using this zone.

Primary dispersal/expansion area

This area is located within the Fisheating Creek/Babcock-Webb WMA region. These are lands identified by Thatcher et al. (2006) as potential panther habitat with the shortest habitat connection to the Panther Focus Area in south Florida. Several collared and uncollared male panthers have been documented in this area since 1973, and the last female documented north of the Caloosahatchee River was found in this area.

Landscape preservation need and compensation recommendations

Land preservation needs

To further refine the land preservation needs of the Florida panther, and to specifically develop a landscape-level program for the conservation of the Florida panther population in south Florida, the Service appointed a Florida Panther Subteam in February 2000. The Subteam was charged with developing a landscape-level strategy for the conservation of the Florida panther population in south Florida. The results of this collaborative effort are partially presented in Kautz et al. (2006). One of the primary population thresholds of this effort was to identify a strategically located set of lands containing sufficient area and appropriate land cover types to ensure the long-term survival of the south population of the Florida panther. Kautz et al. (2006) focused their efforts on the area south of the Caloosahatchee River, where the reproducing panther population currently exists.

Kautz et al. (2006) created an updated Florida panther potential habitat model based on the following criteria: (1) forest patches greater than 4.95 ac (2 ha); (2) non-urban cover types within 656 ft (200 m) of forest patches; and (3) exclusion of lands within 984 ft (300 m) of urban areas. The potential habitat map was reviewed in relation to telemetry data, recent satellite imagery (where available), and panther home range polygons. Boundaries were drawn around lands defined as the Primary Zone (Figures 2 and 3), defined as the most important area needed to support a self-sustaining panther population. Kautz et al. (2006) referred to these lands as essential; however, as observed in the two previous plans (Logan et al. 1993; Cox et al. 1994), lands within the boundaries of the Primary Zone included some urban areas and other lands not considered to be truly panther habitat (*i.e.*, active rock and sand mines). The landscape context of areas surrounding the Primary Zone was modeled and results were used to draw boundaries of the Secondary Zone (Figures 2 and 3), defined as the area capable of supporting the panther population in the Primary Zone, but where habitat restoration may be needed (Kautz et al. 2006).

Kautz et al. (2006) also identified, through a LCP model, the route most likely to be used by panthers dispersing out of south Florida, crossing the Caloosahatchee River, and dispersing into south-central Florida. Kautz et al. (2006) used ArcView GIS© version 3.3 and ArcView Spatial Analyst© version 2 (Environmental Systems Research, Incorporated, Redlands, California) to construct the LCP models and identify optimum panther dispersal corridor(s). The LCP models operated on a cost surface that ranked suitability of the landscape for use by dispersing panthers with lower scores indicating higher likelihood of use by dispersing panthers. Those dispersal routes connecting lands between the Panther Focus Area south of the Caloosahatchee River and the Panther Focus Area north of the Caloosahatchee River, which may facilitate future panther expansion north of the Caloosahatchee River, were defined as the Dispersal Zone (Figures 2 and 3)

(Kautz et al. 2006). The preservation of lands within this zone is important for the survival and recovery of the Florida panther, as these lands are the dispersal pathways for expansion of the south Florida panther population. The Primary Zone covers 2,270,590 ac (918,895 ha); the Secondary Zone covers 812,104 ac (328,654 ha); and the Dispersal Zone covers 27,883 ac (11,284 ha); providing a total of 3,110,578 ac (1,258,833 ha) (Kautz et al. 2006).

As part of their evaluation of occupied panther habitat, in addition to the average density estimate of one panther per 27,181 ac (11,000 ha) developed by Maehr et al. (1991), Kautz et al. (2006) estimated the present average density during the timeframe of the study, based on telemetry and other occurrence data, to average one panther per 31,923 ac (12,919 ha). In the following discussions of the number of panthers a particular zone may support, the lower number is based on the 31,923 ac (12,919 ha) value (Kautz et al. 2006) and the higher number is based on the 27,181 ac (11,000 ha) value (Maehr et al. 1991).

Based on these average densities, the Primary Zone could support 71 to 84 panthers; the Secondary Zone could support 8 to 10 panthers without habitat restoration and 25 to 30 panthers with habitat restoration (existing high quality panther habitat currently present in the Secondary Zone is estimated at 32 percent of the available Secondary Zone lands); and the Dispersal Zone could support 0 panthers. Taken together, the three zones in their current condition apparently have the capacity to support about 79 to 94 Florida panthers.

Kautz et al.'s (2006) assessment of available habitat south of the Caloosahatchee River determined that non-urban lands in the Primary, Secondary, and Dispersal Zones were not sufficient to sustain a population of 240 individuals south of the Caloosahatchee River. However, Kautz et al. (2006) determined sufficient lands were available south of the Caloosahatchee River to support a population of 79 to 94 individuals (although not all lands are managed and protected).

Compensation recommendations

To achieve our landscape scale effort to locate, preserve, and restore lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River, the Service chose the midpoint (90 panthers) in Kautz et al.'s (2006) population guidelines that a population of 80 to 100 panthers is likely to be stable, although subject to genetic problems, through 100 years. In addition, a population of 90 individuals is 8 individuals greater than a population of 82 individuals, which, according to the best available PVA (Root 2004), is 95 percent likely to persist over 100 years (assuming a 50:50 male to female ratio). These eight individuals provide a buffer for some of the assumptions in Root's (2004) PVA. Our process to determine compensation recommendations for project affects that cannot be avoided in both our section 7 and section 10 consultations is based on the amount and quality of habitat we believe is necessary to support a population of 90 panthers in south Florida.

The Service, based on Kautz et al.'s (2006) average panther population density of 31,923 acres per panther, determined 2,873,070 acres of Primary Zone "equivalent" lands need to be protected and managed. Since lands in the Secondary Zone are of less value to panthers than those in the Primary Zone, this equivalency factor is needed to assure additional acreage is acquired in the

Secondary Zone to compensate for its lower quality panther habitat. In other words, more than 31,923 acres per panther would be needed, hypothetically, if this acreage were all in the Secondary Zone (see discussion of Primary Zone equivalent lands in the following section). The combined acreage of lands within the Primary, Dispersal, and Secondary Zones is 3,110,577 acres (Kautz et al. 2006). Currently, 2,073,865 acres of Primary Zone equivalent lands are preserved (Table 2) and 1,202,699 acres of Primary Zone equivalent lands are at-risk (private ownership) (Table 3), so 799,205 additional acres need to be preserved to support a population of 90 panthers in south Florida (2,873,070 minus 2,073,865 equals 799,205).

The Service also consults on lands outside of the Primary, Secondary, and Dispersal Zones that may affect panthers, such as agricultural lands adjacent to the Panther Focus Area and proposals in urbanized areas that could generate traffic in or adjacent to the Panther Focus Area or have other identifiable impacts.

Primary Zone equivalent lands

Kautz et al. (2006), through their habitat evaluation of lands important to the Florida panther, identified three categories of lands, *i.e.,* Primary Zone, Secondary Zone, and Dispersal Zone, and documented the relative importance of these lands to the Florida panther. These lands, generally referred to as Kautz et al.'s panther core lands, include the majority of the home ranges of the current population of the Florida panther. The Service, in our evaluation of habitat needs for the Florida panther expanded the boundaries of the Kautz et al. (2006) lands to include those lands south of the Caloosahatchee River where additional telemetry points historically were recorded. These additional lands (about 819,995 ac), referred to as the "Other" Zone, are added to the lands in Kautz et al. (2006) panther core lands and represent the lands within the Service's 2000 consultation area boundary south of the Caloosahatchee River as shown in Figure 3. These lands (core lands and Other Zone lands) together are referred to by the Service as the Panther Core Area (labeled on Figure 5 as "Original Panther Consultation Area South of the Caloosahatchee River"). The "Other" Zone lands, as well as the lands within the Secondary Zone, provide less landscape benefit to the Florida panther than the Primary and Dispersal Zones, but are important as a component of our strategy to preserve sufficient lands to support a population of 90 panthers in south Florida.

To account for the lower landscape importance of these lands in our preservation strategy and in our habitat assessment methodology, we assigned lands in the Other Zone a value of 0.33 and lands in the Secondary Zone a value of 0.69 to convert these lands to Primary Zone value, *i.e.*, Primary Zone equivalents (Table 2). Kautz et al. (2006) identifies the need for restoration in the Secondary Zone to achieve maximum benefits. To estimate the Primary Zone equivalent of Secondary Zone lands, we derived a relative habitat value (average PHU value) for each by comparing the habitat ranks estimated in Kautz et al. (2006) for each habitat type per zone. The average PHU value for the Primary Zone is 6.94 and for the Secondary Zone 4.79. Based on these values, the habitat value of the Secondary Zone is roughly 69 percent (4.79/6.94=0.69) of the Primary Zone, and restoration is needed to achieve landscape function. Using this assessment, the 503,481 ac of Secondary Zone lands equate to 347,402 ac of Primary Zone equivalent lands. Dispersal Zone lands are considered equivalent to Primary Zone lands with a 1 to 1 value.

At-risk lands in the Other Zone total 819,995 ac. Actions on some of the Other Zone lands, such as actions in areas that have already been urbanized, will, in most situations, not have an impact on panthers or their habitat. We are considering that, within the Other Zone lands, these types of actions will account for 20 percent of the available lands and that actions on the remaining 80 percent of available lands may have an impact on panthers and could affect our southwest Florida panther population strategy. We will monitor this consideration carefully as we review proposed actions within the Other Zone. To estimate the acres of Primary Zone equivalent lands the 819,995 ac of Other Zone lands represent, we applied the 80 percent factor and the 33 percent factor to the available ac, which equate to 216,479 ac of Primary Zone equivalent lands (819,995 times 0.8 equals 655,996 times 0.33 equals 216,479).

These equivalent values, 0.33 and 0.69, for Other and Secondary Zones, respectively, and 1 to 1 for the Dispersal Zone, are important components in our assessment of compensation needs for a project in the panther consultation area and are components of our habitat assessment methodology as discussed in Appendix 1.

Analysis of the species likely to be affected

The Florida panther is an endangered cat restricted to 2 to 3 million acres of land in south Florida (6 to 9 percent of the total land area of Florida). The panther is a wide-ranging species that requires large areas of biotically diverse habitat to survive. Dispersing subadult males wander widely through unforested and disturbed habitat. Human population in south Florida has dramatically increased, from one million in 1950 to six million in 1990. In southwest Florida (Charlotte, Collier, and Lee Counties), where the reproducing panther population is primarily located, human population has increased from 833,892 in 2000 to an estimate of 1,231,100 in 2010, representing an increase of 47.6 percent over the 10-year period (University of Florida 2009). This population increase results in secondary disturbances such as increased human presence and noise, light, air, and water pollution. Increasing human population resulted in increasing impacts on native habitat and flora and fauna. Resulting threats to panthers include road mortality, habitat loss, habitat fragmentation, and human disturbance.

The Corps determined the Hacienda Lakes project "may affect" the Florida panther. The Service concurs with the Corps' determination and finds the project will result in adverse effects to the Florida panther and Florida panther habitat. The project's adverse effects to the panther will be discussed in the remainder of this Biological Opinion. Critical habitat has not been designated for the Florida panther, and therefore, will not be affected.

The Service developed a Panther Habitat Assessment Methodology and refugia design in 2003 to help guide the agency in evaluating permit applications for projects that could affect panther habitat. This methodology provided a way to assess the level of impacts to panthers expected from a given project, and to evaluate the effect of any proposed compensation offered by the project's applicant. The Habitat Assessment Methodology was updated in 2009. For a full description of our Habitat Assessment Methodology, please see Appendix 1.

Wood Stork

Species description

The wood stork was listed under the Act as endangered on February 28, 1984 (49 FR 7332). No critical habitat is designated for the wood stork; therefore, none will be affected. The wood stork is a large, long-legged wading bird, with a head to tail length of 85 to 115 cm (33 to 45 inches [in]) and a wingspan of 150 to 165 cm (59 to 65 in) (Coulter et al. 1999). The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. Wood storks fly with their neck and legs extended. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. During courtship and the early nesting season, adults have pale salmon coloring under the wings, fluffy undertail coverts that are longer than the tail, and their toes are bright pink. Immature wood storks, up to the age of about 3 years, have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999).

Life history

Wood stork nesting habitat consists of mangroves as low as 1 m (3 ft), cypress as tall as 30.5 m (100 ft), and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962, Rodgers et al. 1987, Ogden 1991, Coulter et al. 1999). Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004; Crozier and Cook 2004). Between breeding seasons or while foraging, wood storks may roost in trees over dry ground, on levees, or on large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002).

While the majority of stork nesting occurs within traditional rookeries, each year: a handful of new stork nesting colonies are discovered; a number of existing colonies become inactive depending on local environmental conditions; and some inactive colonies remain inactive (Meyer and Frederick 2004). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types, where prey are available to storks and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Calm water, about 2 to 16 in (5 to 40 cm) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). Typical foraging sites include freshwater marshes,

ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter and Bryan 1993; Coulter et al. 1999).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. During nesting, these areas must also be sufficiently close to the colony to allow storks to efficiently deliver prey to nestlings. Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida.

Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over 3 feet during the wet season (June-November), and then receding gradually during the dry season (December-May). Storks nest during the dry season and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for stork foraging and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short-hydroperiod wetlands being used early in the nesting season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the nesting season (Kahl 1964, Gawlik 2002).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Loftus and Ecklund 1994, Jordan et al. 1997 and 1998, Turner et al. 1999, Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential stork foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long-hydroperiod sites, also affect fish density and biomass in southern Florida.

Across the highly modified landscape of southern Florida, fish availability varies with respect to hydrologic gradients and nutrient availability gradients and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability. Dense submerged and emergent vegetation may reduce foraging suitability by preventing storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submerged and emergent vegetation does not detrimentally affect stork foraging and may be important to maintaining fish populations. Average submergent and emergent vegetation cover at foraging sites was 26 and 29 percent, respectively, at foraging sites at a Georgia colony but ranged from 0 to100 percent (Coulter and Bryan 1993). These cover values did not differ significantly from random wetland sites. Similarly, densely forested wetlands may preclude

storks from accessing prey within the areas (Coulter and Bryan 1993). Storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993, O'Hare and Dalrymple 1997, Coulter et al. 1999).

Carlson and Duever (1979) observed long distance movement of fish into deeper habitats is not a regular occurrence in the Big Cypress watershed communities. They also noted in their study the preponderance of obstacles and plant debris all contribute to hindering mobility and limiting movement across the site. In addition, in Chapman and Warburton's (2006) studies on *Gambusia*, they noted movement between drying pools was limited. Carlson and Duever (1979) concluded in their study that "*density and biomass of both wet and dry season fish populations are dependent primarily on the production of the particular site and not of adjacent habitats from which fish may have migrated*."

Wood storks feed almost entirely on fish between 2.5 to 25.4 cm (1 to 10 in) in length (Kahl 1964, Ogden et al. 1976, Coulter 1987), but may consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Lauritsen (Corkscrew Sanctuary, personal communication 2007, 2009) observed wood stork foraging on crayfish. Studies by Depkin et al. (1992) of wood stork foraging at colonies in east-central Georgia also noted the presence of crayfish in the diets of wood storks. In their analysis, crayfish represented 1 percent of the biomass and 1.9 percent of the prey items. Fish represented 92 percent of all individual prey items and 93 percent of the biomass. A similar study conducted by Bryan and Gariboldi (1998) also noted the presence of crayfish in wood stork diets and noted a similar frequency of occurrence. In the foraging studies conducted by Ogden et al. (1976), Coulter et al. (1999), Carlson and Duever (1979), Turner et al. (1999) and Trexler et al. (2002), little information is provided on consumption of invertebrates. Ogden et al. (1976) summarized information from Kahl's publications (1962, 1964) on stomach contents of wood storks sampled in south Florida and southwest Florida and noted all individuals examined contained only fish. Ogden et al.'s (1976) study also noted the prey consumed were fish, although the average density of prawns was 2.5 times the density of the most abundant fish.

Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Storks typically wade through the water with the beak immersed and open about 6.4 to 8.9 cm (2.5 to 3.5 in). When the wood stork encounters prey within its bill, the mandibles snap shut; the head is raised; and the food is swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956; Kahl 1964; Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

In Georgia, wood storks generally forage in wetlands within 50 km (31 miles) of the colony site (Bryan and Coulter 1987), but forage most frequently within 20 km (12 miles) of the colony (Coulter and Bryan 1993). Herring (2007) noted similar foraging patterns for wood storks in south Florida with most frequent foraging within 10.29 km (6.4 miles). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available, during shifts in seasonal and annual rainfall and surface water patterns, to support wood storks. Storks forage the greatest distances from the colony at the beginning of the nesting season, before eggs are laid, and near the end of the season when the young are large. They feed

nearest the colony during incubation (Browder 1984, Mitchell 1999). In south Florida, wood storks generally use wet prairie ponds early in the dry season, and then shift to slough ponds later in the dry season, thus, following water levels as it recedes into the ground (Browder 1984).

Gawlik (2002) characterized wood storks foraging in the Everglades as "searchers" that employ a foraging strategy of seeking out areas of high-density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, although prey was still sufficiently available that other wading bird species were still foraging in large numbers. Wood stork choice of foraging sites in the Everglades was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Breeding wood storks are believed to form new pair bonds every season. First age of breeding has been documented in 3- to 4-year old birds, but the average first age of breeding is unknown. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990). A single clutch of two to five (average three) eggs is laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation among years in the clutch sizes, and clutch size does not appear to be related to longitude, nest data, nesting density, or nesting numbers, and may be related to habitat conditions at the time of laying. Egg laying is staggered and incubation, which lasts about 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999). The younger birds are first to die during times of scarce food.

The young fledge in about 8 weeks, but will stay at the nest for 3 to 4 more weeks to be fed. Adults feed the young by regurgitating whole fish into the bottom of the nest about 3 to 10 times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999). Feedings are less frequent when wood storks are forced to fly great distances to locate food (Bryan et al. 1995). The total nesting period, from courtship and nest building through independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous and, consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding.

Wood stork colonies experience considerable variation in production among colonies and years in response to local habitat conditions and food availability (Holt 1929; Kahl 1964; Ogden et al. 1978; Clark 1978; Ehrhart 1979; Hopkins and Humphries 1983; Rodgers and Schwikert 1997). Recent studies (Rodgers et al. 2008; Bryan and Robinette 2008; Winn et al. 2008; Murphy and Coker 2008) documented production rates to be similar to rates published between the 1970s and 1990s. Rodgers et al. (2008) reported a combined production rate for 21 north and central Florida colonies from 2003 to 2005 of 1.19$\pm$ 0.09 fledglings per nest attempt (n=4,855 nests). Bryan and Robinette (2008) reported rates of 2.3 and 1.6 fledged young per nesting attempt for South Carolina and Georgia in 2004 and 2005. Murphy and Coker (2008) report that since listing, South Carolina colonies averaged 2.08 young per successful nest with a range of 1.72 to 2.73. The Palm Beach County Solid Waste Authority colony (Morrison, PBC, personal

communication, 2008) was documented with 0.86 fledgling per nesting attempt (2003 to 2008) with annual rates ranging from 0.25 to 1.49.

Rodgers and Schwikert (1997) reported on the breeding chronology of 21 north and central Florida wood stork colonies for the years 1981 to 1985. They found wood storks produced an average of 1.29 fledglings per nest and 0.42 fledgling per egg, which is a probability of survivorship from egg laying to fledgling of 42 percent (Rodgers and Schwikert 1997). The probability of survivorship from egg laying to day 14 is 80 percent, to day 28 (hatching) 70 percent, to day 42 (nestling 2 weeks of age) 62 percent, to day 56 (nestling 4 weeks of age) 56 percent, to day 70 (nestling 6 weeks of age) 50 percent and to day 84 (fledgling) 42 percent. The greatest losses occur from egg laying to hatching with a 30 percent loss of the nest production. From hatching to nestlings of 2 weeks of age, nest production loss is an additional 8 percent. Corresponding losses for the remainder of the nesting cycles are on the average of a 6 percent loss per 2 week increase in age of the nestling (Rodgers and Schwikert 1997).

During the period when a nesting colony is active, storks are dependent on consistent foraging opportunities in wetlands within about 20 to 30 km of the nest site (Kahl 1964 and Coulter and Bryan 1993) with the greatest energy demands occurring during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 201 kg (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964; Kushlan et al. 1975).

Fleming et al. (1994) as well as Ceilley and Bortone (2000) believe the short-hydroperiod wetlands in south Florida provide a more important pre-nesting foraging food source and a greater effect on early nestling survival for wood storks than the foraging base (grams of fish per square meter [m^2]) that is suggested in short-hydroperiod wetlands. For instance, Loftus and Eklund (1994) provided an estimate of 50 fish per m^2 for long-hydroperiod wetlands and 10 fish per m^2 for short-hydroperiod wetlands for foraging sites in the Everglades. Because of the consistent pattern of drying that normally occurs during the stork nesting season, the short-hydroperiod wetlands would also be the ones used for foraging early in the season, when long-hydroperiod wetlands remain too deep for storks to forage effectively or sufficient prey concentration has not yet occurred as a result of drying.

Although the short-hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long-hydroperiod wetlands, these short-hydroperiod wetlands were historically more extensive and provided foraging areas for storks during colony establishment, courtship, nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.*, 30 percent and 8 percent, respectively, from egg-laying to hatching and from hatching to nestling survival in 2 weeks) (Rodgers and Schwikert 1997).

Based on Kahl's (1964) estimate that 201 kg are needed for the success of a nest and 50 percent of the foraging base is needed in the middle third of the nesting cycle when chicks are about 23 to 45 days old (Kahl 1962), it is estimated about 50 kg are needed to meet the foraging needs of the adults and nestling in the first third of the nesting cycle. Considering the relatively low habitat foraging values these short-hydroperiod wetlands provide in relationship to corresponding

long-hydroperiod wetlands, much larger acreages of these wetlands are needed to ensure survival and to sustain development of nestlings. The disproportionate reduction (85 percent) of this specific habitat loss known to have occurred from development and over drainage has been proposed as a major cause of late colony formation and survivorship reduction in early nestling survival rates (Fleming et al. 1994).

Storks that are not breeding do not require the same degree of fish concentration that is required to sustain successful nesting. Kahl (1964) estimated the food requirements for an individual free-flying stork to be about 502 g (live weight) per day. Storks that are not nesting are able to find sufficient prey to sustain themselves in many wetlands that would not be suitable to sustain adults and chicks during nesting.

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely because of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage (Hylton et al. 2006).

In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004; Borkhataria et al. 2006a). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. In a study employing satellite telemetry, Borkhataria et al. (2006a) reported nearly all storks that had been tagged in the southeastern U.S. moved into Florida near the beginning of the dry season, including all subadult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006a). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006a). Range wide occurrence of wood storks in December, recorded during the 1995 to 2008 Audubon Society Christmas Bird Counts for the Southeast U.S. (Audubon 2008) suggests the majority of the southeastern U.S. wood stork population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007b). As a result of these general population-level movement patterns during the earlier period of the stork breeding season in southern Florida, the wetlands upon which nesting storks depend are also being heavily used by a significant portion of the southeastern U.S. wood stork population, including storks that breed in Georgia and the Carolinas, and subadult storks from throughout the stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

Population dynamics

The U.S. breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 and a low of 2,500 pairs during severe drought conditions in 1978 (49 FR 7332). The total number of nesting pairs in 1995 was 7,853 with 11 percent in South Carolina, 19 percent in Georgia, and 70 percent in Florida (Service 1997). Nesting data from 1981 to 2009 suggest that the wood stork population in the southeastern U.S. appears to be increasing (Figure 10). Population totals indicate the stork population has reached its highest level since it was listed as endangered in 1984. More than 12,700 wood stork pairs nested within their breeding range in the southeastern U.S. in 2009 (Service, 2010). The nesting and colony data show increases in both the number of nests and the number of colonies, with the greatest increases in both nests and colonies in Georgia, South Carolina, and North Carolina. Recent data also show a decrease in the average size of colonies (Frederick and Meyer 2008).

A review of the historic data show that, since the 1960s, the wood stork population declined in southern Florida and increased in northern Florida, Georgia, and South Carolina (Ogden et al. 1987). The number of nesting pairs in the Everglades and Big Cypress ecosystems (southern Florida) declined from 8,500 pairs in 1961 to 969 pairs in 1995. During the same period, nesting pairs in Georgia increased from 4 to 1,501 and nesting pairs in South Carolina increased from 11 to 829 (Service 1997). The number of nesting pairs in northern and central Florida doubled between 1976 and 1986 (Ogden 1991). Although Ogden (1991) attributed this to an increase in the availability of altered wetland and artificial wetland nesting sites, the regional increase coincided with the northward shift of the wood stork breeding population center and the overall population decline in the southern portion of the wood stork's range.

Between 1958 and 1985, the wood stork breeding population center shifted north from Lake Okeechobee to Polk County, a distance of about 132 km (82 miles) (Ogden et al. 1987). The 1976 breeding season was the last year when more pairs nested in south Florida than in central and north Florida. Production is generally higher in central-north Florida than south Florida. Whereas the number of colonies in south Florida remained relatively stable, the number of colonies in central and north Florida region continues to increase (Ogden et al. 1987). The increase in central-north Florida is associated with an increase in colony numbers and not colony size. Colonies in the north are smaller than colonies in the south. Historically, colonies in the south were associated with extensive wetlands and food was abundant. The implication is that food resources may be limiting colony sizes in central-north Florida (Ogden et al. 1987). Ogden et al. (1987) suggested the population shift is the result of deteriorating feeding conditions in south Florida and better nesting success rates in central and north Florida that compound population growth in that area.

The wood stork life-history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida.

Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony varies from year-to-year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Service 1997). A colony site may be vacant in years of drought or unfavorable conditions due to inadequate foraging conditions in the surrounding area (Kahl 1964). Traditional colony nesting sites may be abandoned completely by storks when hydrological changes occur such as removing surface water from beneath the colony trees (Service 1997, Coulter et al. 1999). Nesting failures and colony abandonment may also occur if unseasonable rainfall causes water levels to rise when they are normally receding, thus dispersing rather than concentrating forage fish (Kahl 1964, Service 1997, Coulter et al. 1999).

The annual climatological pattern that appeared to stimulate the heaviest nesting efforts by storks was a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring nesting season. This pattern produced widespread and prolonged flooding of summer marshes that maximized production of freshwater fishes, followed by steady drying that concentrated fish during the dry season when storks nest (Kahl 1964).

Status and distribution

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern U.S. (American Ornithologist Union 1983). Only the population segment that breeds in the southeastern U.S. is listed as endangered. In the U.S., wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910, Bent 1926, Howell 1932, Oberholser 1938, Dusi and Dusi 1968, Cone and Hall 1970, Oberholser and Kincaid 1974). Dahl (1990) estimates these states lost about 38 million ac, or 45.6 percent, of their historic wetlands between the 1780s and the 1980s. However, it is important to note wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern U.S. between the mid-1970s and mid-1980s were located in the Gulf-Atlantic Coastal Flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks are currently documented in all southern Florida counties, except for Okeechobee County. Additional expansion of the breeding range of wood storks in the southeastern U.S. may continue in coming years, both to the north and possibly to the west along the Gulf Coast (Service 2007b).

The decline that led to listing in the U.S. population of the wood storks is thought to be related to one or more of the following factors: (1) reduction in the number of available nesting sites; (2) lack of protection at nesting sites; and (3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year-to-year is relatively stable. They suggest loss of an adequate food base is a cause of wood stork declines. Ogden and Nesbitt (1979) also suggest that changes in remaining wetland systems in Florida, including drainage and impoundment, may be a larger concern for wood storks than loss of foraging habitat.

The primary cause of the wood stork population decline in the U.S. is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, through either local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year, but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and the total acreage of wetland types occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973. We combined their data for habitat types known to be important foraging habitat for wood storks (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and sawgrass marshes) and found these south Florida wetland habitat types have been reduced by about 35 percent since 1900.

The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s (Kushlan and Frohring 1986). Water level manipulation may decrease food production if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to utilize, while still supporting smaller prey fish. Water level manipulation can also facilitate raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings.

During the 1970s and 1980s, wood storks were observed to shift their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991). The percentage of nests in artificial habitats in central and north Florida increased from about 10 percent of all nesting pairs from 1959 to 1960 to 60 to 82 percent during 1976 to 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine (*Causuarina equisetifolia*). Ogden (1996) suggested the use of these artificial wetlands indicates wood storks are not finding suitable conditions within natural nesting habitat or they are finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

Human disturbance is a factor known to have a detrimental effect on wood stork nesting (Service 1997). Wood storks have been known to desert nests when disturbed by humans, thus exposing eggs and young birds to the elements and to predation by gulls and fish crows.

The role of chemical contamination in the decline of the wood stork is unclear. Pesticide levels high enough to cause eggshell thinning have been reported in wood storks, but decreased production has not yet been linked to chemical contamination (Ohlendorf et al. 1978; Fleming et al. 1984). Burger et al. (1993) studied heavy metal and selenium levels in wood storks from Florida and Costa Rica. Adult birds generally exhibited higher levels of contaminants than young birds. The authors attribute this to bioaccumulation in the adults who may be picking up contaminants at the colony nesting site and while foraging at other locations during the non-breeding season. There were higher levels of mercury in young birds from Florida than young

birds or adults from Costa Rica. Young birds from Florida also exhibited higher levels of cadmium and lead than young birds from Costa Rica. The authors recommended the lead levels in Florida be monitored. Burger et al. (1993) drew no conclusions about the potential health effects to wood storks.

Recovery goals

Methods to measure the biological aspect of the recovery of the wood stork are outlined in the Service's recovery plan (1997). The plan's recovery criteria state that reclassification, from endangered to threatened, could be considered when there are 6,000 nesting pairs and annual regional production is greater than 1.5 chicks per nest/year (both calculated over a 3-year average). Delisting could be considered when there are 10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional production is greater than 1.5 chicks per nest/year (calculated over a 5-year average). As a subset of the 10,000 nesting pairs, a minimum of 2,500 nesting pairs must occur in the Everglades and Big Cypress systems in south Florida. In 2001, the Service reinitiated another 5-year synoptic aerial survey effort for wood stork colonies throughout the southeast range of the species (Service 2003), and surveys have been conducted annually through 2006. Three-year averages calculated from nesting data from 2001 through 2006 indicate the total nesting population has been consistently above the 6,000 threshold, and the averages have ranged from about 7,400 to over 8,700 during this time period.

Wood stork nesting

Southeastern U.S.

Population totals for the southeast U.S. indicate the wood stork has reached its highest level since it was listed as endangered in 1984 (Service 2010a) (Table 6, Figure 10). In 2009, an estimated 12,720 wood stork pairs nested in 86 colonies within their breeding range in the southeastern U.S. Corresponding data in 2010 recorded 8,141 nests, a 36 percent reduction from 2009, although colonies increased from 86 in 2009 to 94 in 2010.

New colonies and increases in nesting wood storks were recorded in 2008 and 2010 in Georgia and South Carolina, with a nesting increase from 1,676 to 2, 708 in Georgia colonies and 134 to and 220 in South Carolina colonies. The number of rookeries in Georgia also increased from 19 to 28 (Service 2010a). Wood stork nesting was again recorded in North Carolina every year from 2006 through 2010, after it was first documented there in 2005. The above data continue to suggest the northward expansion of wood stork nesting.

Although the total number of colonies in Florida peaked at 63 in 2004 (Service 2010a), which is the highest to date in any year, the number of colonies and nesting wood storks in Florida appears to fluctuate yearly and varies around 43 colonies and 4,540 nests annually (Table 6). Current nesting data for the wood stork population in Florida show a reduction in population numbers in years 2007, 2008, and 2010 and increases in 2009 for most nests monitored. Significant reductions in nests production in 2007, 2008, and 2010 in the south Florida rookeries were reported. The 2007 and 2008 reductions were likely due to severe drought conditions (Cook and Herring 2007, Cook and Kobza 2008) and the reduction in the 2010 was attributed to a series of

south Florida cold fronts resulting in higher water stages than average and generally poor foraging conditions for the remainder of the breeding season (Cook and Kobza 2010).

Everglades and Big Cypress systems

The *South Florida Multi-Species Recovery Plan* (MSRP) (Service 1999) defines the Everglades and Big Cypress systems as the region south of Lake Okeechobee from Lee County on the west coast to Palm Beach County on the east coast. Total nesting pairs for colonies in this region have been variable, but have shown a general pattern of decline (Crozier and Gawlik 2003, Service 2003, Crozier and Cook 2004, Cook and Call 2005). However, in a review of the 10-year nesting data (Table 7, Figure 11), wood stork nesting success increased from the mid-1990s (an average of 400 to 500 pairs) to a high of 6,452 pairs in south Florida in 2009 (Cook and Kobza 2009). In 2010, wood stork nesting in south Florida started relatively early but was very much reduced (81 percent) relative to the record numbers of nests in 2009 and most colonies eventually failed. The 2010 productivity in the South Florida colonies was estimated at 1,282 nests associated with 13 colonies (Cook and Kobza 2010).

In 2006, the largest wood stork rookery complex in the U.S., the Corkscrew Sanctuary rookeries, with optimal foraging conditions in the watersheds, yielded high nesting success (600 nests, 1,428 chicks) The 2-year drought that followed in 2007 and 2008 resulted in no nesting (Cook and Herring 2007, Cook and Kobza 2008). However, optimal foraging conditions in 2009 resulted in the development of 1,120 nests, producing 2,570 nestlings (Audubon 2009). Nesting data in 2010 (Cook and Kobza 2010) noted that the Corkscrew Sanctuary and Caloosahatche East colonies produced no successful nests and that the Lenore Island and Barron Collier 29 rookeries produced 44 nests. Cook and Kobza (2010) suggest the reduced nests productivity in the 2010 nesting year were attributed to a series of south Florida cold fronts that produced freezing weather, large rain events and associated water level reversals. These weather systems resulted in higher water stages than average and generally poor foraging conditions for the remainder of the breeding season, and may also be applicable to the Corkscrew Sanctuary rookeries.

Analysis of the species likely to be affected

The primary cause of wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks and affected the prey base availability. The altered hydrology of the central and south Florida wetland systems has fostered the invasion of these systems by the exotic plant species, melaleuca. This plant produces a dense understory and closed canopy, limiting the suitability of these wetland systems to foraging by wood storks, although sufficient prey base may be present in the wetlands. Increasing human population resulted in increasing impacts on native habitat and flora and fauna. Continuing threats to wood storks include habitat loss, habitat fragmentation, and human disturbance.

Critical habitat has not been designated for the wood stork; therefore, none would be affected by the proposed action.

Other species in the action area

The Corps provided determinations of "may affect, not likely to adversely affect" for the threatened eastern indigo snake, and the endangered RCW.

Eastern Indigo Snake

Suitable habitat for the threatened eastern indigo snake may exist onsite. Because eastern indigo snakes use a variety of habitat types and have large home ranges, it is possible they occur within the project area. However, the agricultural lands provide little cover for a predator such as the eastern indigo snake. It is possible eastern indigo snakes reside in the natural areas that surround the project site and they may utilize the site during certain harvesting times when rodents are more prevalent. The applicant agreed to adhere to the Service's *Standard Protection Measures for the Eastern Indigo Snake* (Service 2004a) to minimize potential of harm or harassment to any resident snakes during land clearing and construction. Therefore, the Service concurs with the Corps' determination.

Red-Cockaded Woodpecker

Suitable habitat for the endangered RCW exists onsite. Typical habitat includes pine, pine-dominated pine/hardwood stands with a low or sparse understory, and ample old-growth pines. The proposed action will adversely affect about 271.31 ac of habitat that includes pine in the canopy. The affected lands fringe the western property boundary, are adjacent to existing development, and support exotic species densities (melaleuca) between 25 and 90 percent. PAI performed cavity tree and foraging surveys during the non-nesting season (2003 and 2009) and nesting season (2004 and 2010) in accordance with the Service's Species Conservation Guide and Survey Protocol for the RCW (Service 2004b). No RCWs were observed.

The onsite project preserve includes about 1,065.55 ac of lands that include pine in the canopy. As part of the mitigation plan, all of the native pine habitats in the preserve will be enhanced and placed under conservation easements. According to the FWC database for documented occurrences of RCWs, there are two abandoned cavity trees in an area designated for conservation in the southeast portion of the project site. Our database also shows several other locations of historic RCW activity about 0.5 mile west of the property and several locations of historic activity about 0.5 mile east of the property. The westerly locations are west of CR 951 and were characterized as "inactive" by the Florida Game and Fresh Water Fish Commission (FWC) in 1990. The easterly locations are characterized as "abandoned" by the Florida Natural Areas Inventory and are in proximity to several large areas proposed for conservation within the property. An active cluster is present in the adjacent Willow Run Quarry Preserve, which is northwest of the project site and is connected to proposed project preserve lands. One RCW was observed in this general area by PAI on May 26, 2004, during the nesting season.

Based on the surveys conducted by PAI, the quality of the habitat to be affected, and the occurrence data provided by FWC on the inactive status for surrounding historic cavity trees, the Service concurs with the Corps' determination. Further, the long-term preservation and maintenance of the 1,065.55 ac of pine canopy lands in the onsite preserve, while not in the territory of a known RCW colony, is likely to benefit the species overall.

ENVIRONMENTAL BASELINE

Climate change

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change (IPCC) Report (2007). The IPCC Report describes natural ecosystem changes with potential wide-spread effects on many organisms from marine mammals to migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution is dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007c).

Climate change at the global level drives change in weather at the regional level, though weather is also strongly affected by season and by local factors (*e.g.*, elevation, topography, latitude, proximity to the ocean). Temperatures are predicted to rise from 2^{o}C to 5^{o}C for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current predictive models offer a wide range of predicted changes.

Prior to the 2007 IPCC Report, Titus and Narayanan (1995) modeled the probability of sea level rise based on global warming. They estimated that the increase in global temperatures could likely raise sea level 6 inches by 2050 and 13 inches by 2100. While these estimates are lower than the estimates described in the IPCC Report (2007), Titus and Narayanan's (1995) modeling efforts developed probability-based projections that can be added to local tide-gauge trends to estimate future sea level at specific locations.

Whittle et al. (unpublished data 2008) applied several prominent climate change models to panther habitat in southwest Florida. Their review indicated a climate change-induced sea level rise of 1 meter (3 feet) will reduce southwest Florida panther habitat by 29 percent, at 3 meters (9.8 feet) by 62 percent, and at 5 meters (16.4 feet) by 90 percent. The consequences would be particularly dire for the panther, which has no other populations outside of low-lying south Florida. Their cost surface analyses identified likely migration routes that would link the south Florida panther population to suitable habitat to the north. However, without rapid conservation actions that establish a population to the north, they predict the Florida panther may go extinct in the wild due to climate change effects.

Climatic changes in south Florida could exacerbate current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). The Southwest Florida Regional Planning Council projected sea level rise in southwest Florida by 2200 based on Titus and Narayanan's (1995) worst-case

scenario of a 4-meter (13-foot) rise in 200 years. Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006b).

General environmental baseline

The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions, which occur simultaneously with the consultation in progress.

Florida Panther

The Service determined, for the purposes of this Biological Opinion, the action area is considered to include the project site and a 25-mile radius surrounding the site, with the westernmost boundary of the action area being the I-75 corridor (Figure 5).

Status of the species within the action area

Panther use of the Hacienda Lakes action area

The Service uses current and historical radio-telemetry data, information on habitat quality, prey base, and evidence of uncollared panthers to evaluate the status of the species in the action area. Panther telemetry data are collected 3 days per week from fixed-wing aircraft, usually in early to midmorning. However, researchers have shown panthers are most active between dusk and dawn (Maehr et al. 1990a, Beier 1995) and are typically at rest in dense ground cover during daytime monitoring flights (Land 1994). Therefore, telemetry locations may present an incomplete picture of panther activity patterns and habitat use (Comiskey et al. 2002).

This potential bias was not detected in a recent analysis by Land et al. (2008) using Global Positioning System (GPS) location data collected throughout a 24 hour day. This study revealed panther habitat selection patterns are similar when using either aerial telemetry data or GPS location data and that upland and wetland forests were the habitats most selected by panthers. There was an indication grassland-dry prairie habitats were used more at night than during daytime hours.

Only a subset of the panther population has been radio-collared. However, the large database of telemetry locations taken from radio-collared panthers south of the Caloosahatchee River can be used to estimate the size and number of home ranges and travel corridors south of the Caloosahatchee River. The FWC also uses observational data collected during telemetry flights to assess the yearly breeding activity of radio-collared panthers. Female panthers accompanied by kittens or male panthers within proximity of an adult female are assumed to have engaged in breeding activity during that year.

Within a 5-mile radius of the project site

Based on telemetry data, panthers have historically been recorded on the project site, including the proposed onsite preserves. As of June 29, 2011, at least four living radio-collared panthers, and one whose status is unknown, have been recorded on 1,514 occasions. Of these, the oldest record was from FP 66 (female) on November 18, 1999; FP 66 was last reported alive on April 28, 2000. However, panthers greater than 12 years of age are less likely to still be alive, based on the known longevity of the Florida panther in the wild of 10 to 12 years (FWC 2011). FP 147 (male) was recorded in 2006 and 2007, and was on the eastern border of the site in 2006. FP 193 (male) was recorded in May, June, and July 2011 adjacent to the southern boundary of the property. FP 146 (male) was recorded onsite and in the surrounding 5-mile area in 2006, 2007, and 2008. FP 148 (female) was also recorded onsite in 2006, 2009, and 2011. The most recent occurrence was FP 148 reported within 5 miles on June 29, 2011, and onsite on February 9, 2011.

Within the 25-mile radius action area

Based on telemetry data as of June 29, 2011, an additional 26 living radio-collared panthers have been recorded on 4,586 occasions within the action area. Six panthers, whose status is unknown, were also recorded on 2,826 occassions. Telemetry data reports 4 panthers in the action area in 2004, 4 in 2005, 9 in 2006, 11 in 2007, 9 in 2008, 7 in 2009, 14 in 2010, and 14 in 2011. In addition, Service review of telemetry and mortality data (FWC 2011) notes previous use of the action area by 110 other panthers prior to their mortality: 45 females and 65 males.

The status and activities of uncollared Florida panthers within the action area are unknown. The Service believes the project site may occasionally be used by other non-collared panthers because it contains habitat types used by panthers and their prey, and the project vicinity has been used historically by panthers as indicated by telemetry locations.

Road mortality

There have been 70 documented panther-vehicle collisions within the 25-mile action area (see Table 8 and Figure 9). The panther-vehicle collision closest to the project site occurred in 2005 (UCFP 73) (male) on CR 951, south of Rattlesnake Hammock Road. In the action area, from 2007 through 2012, there have been 29 panther road mortalities: 6 in 2007, 5 in 2008, 7 in 2009, 6 in 2010, 4 in 2011, and 1 in 2012. The most recent vehicle mortality in the action area was panther UCFP 167 (female) on US 41 west of Manatee Road (January 7, 2012).

Wildlife value

Listed species surveys have been conducted by PAI on the project site over the past several years. Listed species surveys were originally conducted by PAI in September through November 2002 and June 2003. PAI conducted an additional listed species survey in October and Nobember 2006 on the site for the Toll-Rattlesnake DRI. RCW surveys were conducted in October through December 2003 and in April and May 2004. In August 2009, PAI conducted an

updated listed species survey as part of the permitting process for Hacienda Lakes. The RCW surveys were updated for the Hacienda Lakes project in October through December 2009 and April and May 2010. Direct sightings of white-tailed deer and feral hogs, as well as tracks and scat have been observed during fieldwork on the site.

Census surveys for white-tailed deer and feral hogs utilizing track counts and spotlight surveys were conducted in June 2004. A total of 22 deer tracks and 30 hog tracks were observed during the track count and spotlight surveys. Based on the census survey, the applicant estimated deer densities ranging from one deer per 123 ac to one deer per 1,357 ac. Evidence of armadillo, bobcat, raccoon, and opossum has been observed onsite. Other small mammals also constituting panther prey may utilize the site. Bears, which also prey on small mammals, have been documented by their tracks, scat, and tree scratch marks throughout the site.

Based on the track surveys (Tyson 1952), deer densities on exotic-infested private lands in Lee County averaged one deer per 591 ac (Turrell 2001) to one deer per 534 ac (PAI 2004). In comparison, deer densities on wildlife management areas average one deer per 165 ac to one deer per 250 ac (Steelman et al. 1999). Density estimates from deer tracks, however, should be viewed with caution. Track estimates are most appropriately used as long-term indicators (McCown 1991) and several factors can influence counts including weather, food abundance, population density, season, and availability of water (O'Connell et al. 1999).

Habitat quality

Historical vegetation on the property included a mosaic of upland and wetland habitats that provided a seasonal pattern of plant growth. However, invasion of the habitats by exotic plants, primarily melaleuca and Brazilian pepper, and past agricultural practices on a portion of the site resulted in the growth of dense stands of monotypic plant species that provide reduced quality foraging needs for resident deer populations. Florida Land Use, Cover, and Forms Classification System (FLUCCS) mapping of the habitats on the property document that the dominant vegetative community type on the site is pine-cypress with varying degrees of melaleuca coverage. In general, the western and central portions of the site have a higher degree of melaleuca infestation, with decreased meleleuca coverage towards the eastern portion of the site. In recent years, melaleuca has spread across the site due in large part to widespread wildfires dispersing seeds from nearby areas with a high percentage of melaleuca. The proposed enhancements will result in a more diverse mosaic of plant species, which will provide an increased foraging value to resident deer populations.

Factors affecting the species environment within the action area

Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to, Federal, State, or private actions (human activities) in the action area that influence the construction of highways and urban development, agriculture operations, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, and public and private land protection efforts.

Federal action

Formal consultations

Federal actions implemented since the listing of the panther under the Act are included in the baseline for Florida panthers in south Florida. All formal consultations were initiated because of likely adverse effects to panthers. However, not all formal consultations concluded an anticipated incidental take of panthers or loss of panther habitat. Each formal consultation concluded the proposed action under review was not likely to jeopardize the continued existence of the panther.

Within the 25-mile action area

The Service, since January 2002 (10 years), formally consulted on 33 Federal actions, informally consulted on 25 Federal actions (excluding Comprehensive Everglades Restoration Plan [CERP] consultations), and provided 3 technical assistances which included habitat compensation for the panther (database entries for formal consultations prior to 1992 are incomplete for projects in the action area) (Appendix 3C). These projects impacted, or are expected to impact, about 16,205 ac of panther habitat. These projects also incorporated a total of 19,244 ac of preservation and restoration of panther habitat.

Within a 5-mile radius of the project site

The Service, within the last 10 years, formally consulted on 12 projects and informally consulted on 13 projects where compensation for direct impacts (land loss) has been provided (Table 9). As tabulated in Table 9, the combined habitat loss from these projects is 4,821 ac with a corresponding habitat compensation of 6,095 ac. The impacted lands border existing developments and prior to construction supported a mosaic of habitats for panther prey species and hunting and dispersal habitat for panthers. Existing habitat value to panther prey species (deer and hog), as discussed in the Biological Opinions and concurrence letters for these projects, was degraded by varying levels of exotic species infestations that also reduced the quantity and quality of foraging food base for these prey species.

The 6,095 ac of companion preserves were also degraded by exotic species infestations prior to restoration. Following restoration, primarily the removal of the exotic species, the quality and quantity of forage for panther prey species is expected to improve with a corresponding increase in use by panther prey and the Florida panther. In addition, the proposed 6,095 ac of companion preserves are interconnected to adjacent protected lands. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly owned lands and provide refugia for dispersing panthers. The Service concluded in all of the aforementioned Biological Opinions and concurrence letters that these projects, as proposed, do not jeopardize the survival and recovery of the Florida panther, that the proposed compensation plans provide habitat preservation and restoration within and near the project area, and the location and restoration of these lands is consistent with the Service's Panther Recovery Plan as described previously.

CERP actions

The Service completed formal consultation on one CERP project in the action area. The project is the Picayune Strand Restoration Project (PSRP). The PSRP will restore more than 55,000 ac of land to near pre-development conditions. Formerly known as the Southern Golden Gate Estates, the project area was planned as a residential subdivision in the 1950s and roads and drainage canals were constructed in the 1960s and early 1970s. The project will remove the infrastructure of the subdivision and restore its pre-drainage hydrology by construction of weirs, pumping stations, 10 miles of tie-back levees, 2.5 miles of spreader swales, 260 miles of road removal and degradation, and backfill of four major north-south canals. The Service's March 12, 2009, BO determined the proposed action was not likely to jeopardize the continued existence of the panther.

The Service completed section 7 consultation with the Corps on the Prairie Canal Early Start portion of the PSRP in October 2003. The Service concurred with the Corps' determination that the backfill of Prairie Canal on the eastern extent of the project "may affect, but is not likely to adversely affect" the Florida panther, wood stork, Everglade snail kite (*Rostrhamus sociabilis plumbeus*), West Indian manatee (*Trichechus manatus*) and its critical habitat, American crocodile (*Crocodylus acutus*), RCW, eastern indigo snake, and bald eagle. This concurrence was based on a project proposal developed by the applicant for the District, which included pre-project wildlife surveys, construction protection plans for affected listed species, and post-restoration project monitoring and reporting.

The Service, as a restoration partner, is also coordinating with the Corps, the District, and Lee County on the Southern Corkscrew Regional Ecosystem Watershed (CREW) project. The project is a 4,000-acre wetland restoration project that will provide wetland restoration, remove exotic species, fill agricultural ditches and provide water storage and aquifer recharge capacity to the CREW. Portions of the restoration completed to date include clearing exotics from 2,560 ac, removing roads and plugged agricultural ditches on 640 ac, and constructing the Kehl Canal Weir. As of January 2009, the District invested $27.4 million to conserve the lands, with the U.S. Department of the Interior contributing another $7 million to the restoration effort.

Federal action

Informal consultations

From July 2000 through September 2006, the Service also engaged in informal consultation for projects under 5 ac with the Corps on 757 projects affecting about 764.1 ac in Collier County (primarily Northern Golden Gate Estates) and about 202.8 ac in Lee County (primarily Lehigh Acres) (database entries for informal consultations prior to 2000 are incomplete for projects in the consultation area). Over the 6-year period, these informal consultations covered about 126 actions per year with an average impact of 1.3 ac per action. Habitat impacts per year were about 161.2 ac. Almost all of these projects involved the construction of single-family residences in partially developed areas, in most cases each project involved less than an acre of direct impact. Although panthers have been known to cross these areas to access other parts of

their range, prey base and denning utilization of these areas had already been affected by the ambient level of development and the addition of these residences was not expected to significantly further impact these habitat functions. For these actions, the Service concurred with the Corps' determination of "may affect, but is not likely to adversely affect" for these individual projects. These projects have been incorporated into the Service's environmental baseline for the Florida panther

Based in part on the historical consultation data referenced above, the Service, in 2007, provided the Corps with a Florida Panther Effect Determination Key (Key, February 19, 2007). The Key provides guidance to the Corps for making effect determinations for the Florida panther and results in "may affect, but is not likely to adversely affect" determinations for projects less than 1 acre. The Key provides an assessment that, on an individual basis, single-family residential developments on lots no larger than 1 acre will not have a measurable effect on panthers. Panthers are a wide ranging species and, individually, a 1-acre habitat change is not likely to adversely affect panthers. However, collectively they may have an effect and regular monitoring and reporting of these effects is important.

Non-federal actions

Isolated wetlands

We received information that within the action area, the Corps, between March 2004 and September 2006, issued non-jurisdictional wetland determinations for 10 projects totaling about 1,812.9 ac, with about 134 ac of isolated wetlands. We also received data that, during the 2008 calendar year, the Corps provided 15 non-jurisdictional wetland determinations for projects in Lee, Collier, and Charlotte counties affecting about 266 ac. Over this period of review, habitat impacts averaged 435.15 ac per year. These determinations were issued per jurisdictional guidance provided recently in the Supreme Court decision, *Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers,* 531 U.S. 159 (2001) and, therefore, they will not require a Federal Clean Water Act 404 wetland permit. However, since loss of panther habitat may occur from construction of these projects and no Corps wetland permit is required, the Service is recommending the applicants pursue incidental take permits in accordance with section 10 of the Act.

Non-federal action

State of Florida Environmental Resource Permit

Although the Corps of Engineers and the State of Florida, since 1982, have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice-versa, the State also reviews projects that have no wetland impacts or where the wetlands are not considered jurisdictional by the Corps. To determine which of these projects would likely include no wetland impacts and not require a section 404 Clean Water Act wetland permit from the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the

Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). Although subject to Federal review, for our purposes, we considered properties with less than 5 percent wetlands unlikely to require a section 404 wetland permit from the Corps as these wetlands would be avoided through project design in compliance with section 404(b)(1) guidelines that require impacts to wetlands be avoided and minimized to the maximum extent practicable.

Within the action area, the District issued Environmental Resource Permits (ERP) (August 2006 to August 2009) for 63 projects (13 in 2006, 27 in 2007, 18 in 2008, and 5 in 2009) impacting 12,032 ac total (1,041 ac of wetlands) and preserving 1,734 ac of wetlands and 188 ac of uplands. Based on FLUCCS mapping, about 47 projects (12 in 2006, 21 in 2007, 11 in 2008, and 3 in 2009) affecting 4,072 ac total (5.99 ac of wetlands), with 9.72 ac of wetland preservation and 11.02 ac of upland preservation, contain less than 5 percent wetlands. Over this 4-year period, the District issued an average of 12 projects per year, affecting 1,018 ac annually that could be expected to be subject to development without Federal permit involvement through section 404 of the Clean Water Act (Appendix 3E). This loss represents 14.0 percent of a female panther's average home range (29,059 ac) and 6.5 percent of a male panther's average home range (62,542 ac). However, since loss of panther habitat may occur from construction of these projects and no Corps wetland permit is required, the Service is recommending that the applicants pursue incidental take permits in accordance with section 10 of the Act.

Summary

From January 2002 through December 2011, the Service consulted on 818 projects negatively affecting 17,172 ac of panther habitat in south Florida. The Service also identified that, in the action area from 2006 through 2009, an additional 72 non-federal actions, affecting 6,151 ac, could be developed without Federal review, averaging 1,337.8 ac per year. These habitat losses could contribute to increases in intraspecific aggression and decreases in spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project areas will adjust the size and location of their ranges to account for this loss and that the adjustment is anticipated to occur in concert with project construction. These projects have been incorporated in the Service's environmental baseline for the Florida panther in this Biological Opinion and the Service determined, based on the location of these projects (generally in the western fringe of the panther's geographic range), the quality of the habitat present on these project sites, and the overall status of the Florida panther, that these projects individually and cumulatively do not jeopardize the survival and recovery of the Florida panther.

Activities within the action area also benefited panthers. The issuance of Corps permits preserved 19,244 ac of panther habitat (2002 to 2011). Within the same watershed (5-mile radius) as the proposed project, the issuance of Corps permits preserved 6,095 ac of companion preserve lands that are interconnected to each other and to the adjacent preserved lands. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly owned lands and provide refugia for dispersing panthers. In addition, installation of wildlife crossings under SR 29 and I-75 within the action area also benefited the panther by protecting habitat connectivity and reducing panther-vehicle

collision mortalities. The PSRP restoration project will restore more than 55,000 ac of land to near pre-development conditions and the CREW restoration project will restore about 4,000 ac of wetlands to near pre-development conditions. The District, between 2006 and 2009, through their ERP program is also preserving 1,734 ac of wetlands and 188 ac of uplands. Additional benefits resulted from the protection of high quality habitat through acquisition programs by the other Federal, State, and County resource agencies. For example, Lee County's Conservation Lands Program, since its inception in 1995, purchased a total of 23,820 ac; the most recent was a 1,213-ac acquisition adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 ac adjacent to Corkscrew Sanctuary and purchased the 2,500-acre Pepper Ranch.

Moreover, the management of public lands, including prescribed fire and eradication of exotic vegetation in the Picayune Strand State Forest, Fakahatchee Strand State Preserve, Florida Panther NWR, ENP, and other conservation areas, is intended to improve habitat for panther prey species, which benefits panthers within these areas.

EFFECTS OF THE ACTION

Factors to be considered

This section analyzes the direct, indirect, interrelated, and independent effects on the Florida panther. Direct effects are primarily habitat based and occur at the time of construction. Indirect effects occur later in time and can also be habitat based. In our assessment we are combining both direct and indirect effects as joint factors. The combined direct and indirect effects include: (1) temporary loss and fragmentation of panther habitat used for hunting, breeding and dispersing, and of habitat that supports panther prey; (2) permanent loss and fragmentation of panther habitat used for hunting, breeding and dispersing, and of habitat that supports panther prey; (3) changes in the geographic distribution of habitat for the species; (4) risk of roadway injury or mortality; (5) disturbance from construction activities; (6) panther/human interactions; and (7) intraspecific aggression.

Direct and indirect effects

To assess panther habitat, the Service, based in part on an evaluation of habitat use data for the Florida panther provided by Swainson et al. (2005) and Kautz et al. (2006), developed an assessment approach that provides a comparison of pre- and post-development habitat as a matrix of Primary Zone equivalent lands. The Primary Zone equivalent lands were then equated to the habitat preferences of the Florida panther and incorporated as a component of our goal to conserve sufficient lands to support a population of at least 90 panthers in south Florida. Additional information on the Primary Zone equivalent lands can be found in the Status of the Species section and Appendix 1.

As of January 2005, the Service has been using a panther habitat suitability ranking system based in part on methods in publications by Swanson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include CERP water treatment and retention areas located in the panther's range. Since the implementation of this ranking system, the Service received two additional, published habitat assessment studies (Cox et al. [2006] and

Land et al. [2008]) that further assess habitat usage by the Florida panther. As it is the Service's policy to incorporate the most current peer-reviewed science into our assessment and review of project effects on the Florida panther, we revised the current habitat suitability ranking system in 2009. For a full description of the original habitat assessment methodology and the associated updates done in 2009, please see Appendix 1 (Panther Habitat Assessment Methodology) at the back of this document.

Habitat assessment

Hacienda Lakes

The application of the habitat assessment methodology including the PHU determinations, landscape multiplier, base ratio, and compensation, is presented below for the Hacienda Lakes project and compensation areas. Table 10 illustrates the PHU calculations for the Hacienda Lakes project with impacts to 728.39 ac of land in the Primary Zone (672.18 ac of development, 17.95 ac internal preserve not accessible to panthers, and 38.26 ac that will not be placed under conservation easement) and compensation provided by the preservation and enhancement of about 1,533.77 ac of onsite panther habitat in the Primary Zone. Table 10 shows the 728.39-acre impact area represents a loss of 3,129 PHUs. This value is multiplied by 2.5 to provide the base ratio compensation need, which is 7,823 PHUs. Since the project is located in the Primary Zone and compensation is in the Primary Zone, the base ratio PHUs are unaffected by the landscape compensation multiplier of 1.0.

The 1,533.77 ac provided by onsite preserves provides for 12,059 PHUs. Therefore, the Service believes the habitat lost by the proposed project will be minimized by the compensation actions proposed by the applicant. The lands proposed for development are on the western limits of the panther's range, are in the Primary Zone, and panther prey foraging habitat value has been diminished by exotic infestation. Lands proposed for preservation and restoration are in the Primary Zone, adjacent to other natural lands, and following restoration will provide an increased foraging value to panther prey species and an expected corresponding increase in use by panther prey and panthers. The proposed compensation plans provide habitat preservation and restoration within and near the project area, and the location and restoration of these lands is consistent with the Service's Panther Recovery Plan as described previously.

Analysis for effects of the action

Habitat fragmentation

As discussed under Habitat Conservation and Protection within the Panther Recovery Objectives section, panthers are particularly sensitive to habitat fragmentation (Harris 1984), and contiguous protected habitat and corridors in key locations in south Florida are needed for panther conservation. Habitat fragmentation can result from road construction, urban development, large-scale mining operations, and agricultural land conversions within the habitat of panther prey species, and it affects the ability of panthers to move freely throughout their home ranges. Construction of highways in wildlife habitat typically results in loss of habitat, traffic-related injury, or mortality, and panther avoidance of associated human development. Female panthers appear to be less likely to cross roads than males, which may increase the effects of habitat fragmentation (Maehr 1990).

Though the value of the habitat on the project site has been reduced by agriculture practices, the permanent loss and fragmentation of habitat resulting from the proposed project may adversely affect the panther by decreasing the spatial extent of lands available to the panther. In addition panthers may be periodically disturbed at this location by human presence, road traffic, lights, and noise during project development.

Although there will be a permanent loss of panther habitat from construction of the project, the proposed restoration of lands in the onsite and offsite preserves will improve the habitat value of these lands such that they may be used more frequently by panthers or their prey. This may thereby increase, over time, the distribution and quality of habitat, which could reduce the local and landscape-scale effects of the initial habitat loss and fragmentation.

Temporary impacts and fragmentation of panther habitat, habitat that supports panther prey, and habitat for hunting, breeding, and dispersing panthers

The temporary impacts are associated with activities to remove the exotic species present in the preserve areas and will result in impacts to 1,589.97 ac onsite. Exotic and nuisance plants will be manually and mechanically removed from the preservation areas in order to facilitate re-vegetation by native plants. Following initial exotic treatment, semi-annual maintenance treatments will be conducted for the first 2 years to eliminate exotics that reappear. Portions of the preserve area where exotics are less than 50 percent will be left to regenerate naturally for at least 2 years before supplemental replanting is considered. Supplemental plantings will be conducted in areas where the density of exotics exceeds 50 percent. Exotic plant species will be controlled within the preserve footprint as part of the project action and managed in accordance with the Hacienda Lakes Mitigation and Monitoring Plan.

Once the exotic vegetation has been removed and the native vegetation restored, the lands are proposed to be donated to the State of Florida for perpetual preservation. In addition to the donation of the property to an appropriate public entity, the applicant will also establish an escrow fund for the long-term maintenance of the preserve. The amount of the non-wasting escrow fund will be determined at the time the preserve is turned over and based on the expected perpetual maintenance and monitoring requirements. However, until such time as that may happen, the entirety of the preserve shall be placed into conservation easements, and enforcement rights shall be granted to the District, Corps, Service, and Collier County. The conservation easement for this area will be filed and recorded prior to initial clearing activities associated with the project. It is also the responsibility of the applicant to reach the success criteria outlined in the Hacienda Lakes Mitigation and Monitoring Plan before donation.

Although there will be a temporary impact and fragmentation of habitat in the preserve areas during site restoration, these actions will restore these lands to habitats that may be used more frequently by panthers or their prey. The restored lands may provide a beneficial effect to the Florida panther through an increase in quality of habitat and may reduce the local and landscape-scale effects of the initial habitat loss and fragmentation.

Permanent loss and fragmentation of panther habitat, habitat that supports panther prey, and habitat for hunting, breeding and dispersing panthers

The project will result in the permanent loss of 728.39 ac of panther habitat (see Table 10). Though the habitat value of the existing project site to the panther and panther prey species has been reduced by exotic infestation, the permanent loss and fragmentation of habitat may adversely affect the panther by decreasing the spatial extent of lands available to the panther. In addition panthers may be periodically disturbed at these locations by human presence, road traffic, lights, and noise during project operations.

Although there will be a permanent loss of panther habitat from construction of the project, the proposed restoration of lands in the onsite preserves will restore these lands to habitats that may be used more frequently by panthers or their prey. This may increase, over time, the distribution and quality of habitat, which could reduce the local and landscape-scale effects of the initial habitat loss and fragmentation.

Changes in the geographic distribution of habitat for the species

The project will result in temporary impacts to about 1,533.77 ac onsite and the permanent loss of 728.39 ac of panther habitat in the Primary Zone of the panther focus area. The permanent loss represents 0.06 percent of the 1,202,699 ac of available non-urban private lands at risk in the Service's panther core area (Table 5). The Service's South Florida Panther Population Goal or refugia design is to preserve 2,873,070 ac of Primary Zone equivalent lands for a population of 90 panthers. Currently, 2,073,865 ac of Primary Zone equivalent lands are preserved (Table 5) and 1,202,699 ac of Primary Zone equivalent lands are at-risk (private ownership) (Table 6), so 799,205 additional acres need to be preserved in south Florida (2,873,070 minus 2,073,865 equals 799,205). The 1,533.77 ac of proposed preserves represent 0.19 percent of the lands needed for the Service's refugia design, and the location and restoration of these lands is consistent with the Service's Panther Recovery Plas as described previously.

Risk of roadway injury or mortality

In evaluating a project's potential to increase roadway mortality to the Florida panther, we consider the location of the project in relation to surrounding native habitats, preserved lands, and wildlife corridors that are frequently used by the Florida panther. We also consider the current configuration and traffic patterns of surrounding roadways and the projected increases in traffic and changes in traffic patterns expected to result from the proposed action. We evaluate the habitats present onsite, their importance in panther prey and forage for panther prey species, and if the site development would further restrict access to surrounding lands important to the Florida panther and panther prey species.

Some improvements may be necessary to enhance the existing lanes and drainage swales to meet public health and safety standards for ingress and egress of vehicles to the project development. The project will result in minor increased vehicular traffic in the project vicinity during construction and operation. Vehicular mortality and injury data provided by the FWS (see Table 9 and Figure 9) indicate collisions with motor vehicles have been increasing since 2001 in the project's 25-mile radius action area. In 2002 there were 3 documented panther-vehicle

collisions, 5 in 2003, 4 in 2004, 5 in 2005, 4 in 2006, 6 in 2007, 5 in 2008, 7 in 2009, 6 in 2010, 4 in 2011, and 1 in 2012. Of the 50 documented collisions, 29 (60 percent) occurred more than 10 miles away from the project site and 8 (16 percent) occurred between 5 and 10 miles from the project site, and 13 (26 percent). The closest panther-vehicle collision occurred in 2005 (UCFP 73 [male] on CR 951, just south of Rattlesnake Hammock Road).

An estimate of the traffic on the adjacent road network generated by the project was prepared by Tindale-Oliver & Associates, Inc. in 2009. Traffic estimates were expressed as average annual daily traffic (AADT). The analysis included the baseline condition of the road network in 2009 and 2019, and the projected increase in the projected traffic volume with the project in 2019.

Baseline traffic condition

As noted above, the traffic analysis summary projects the AADT on the adjacent road network 2009 and 2019 without considering project generated traffic. This reflects the baseline condition of the road network traffic which would occur whether or not project construction occurs. As expected, the traffic projections demonstrate an increase in AADT volumes on all analyzed roadway segments for the year 2019.

The largest increases in AADT in the baseline conditions (without project) occur on Rattlesnake Hammock Road from Santa Barbara Boulevard to Collier Boulevard (9.5 percent in 2019) and on Radio Road from Santa Barbara Boulevard to Davis Boulevard (9.0 percent in 2019).

Project generated AADTs

Project generated AADTs will result in an increase over baseline conditions referenced above for 2019. The largest AADT increase over baseline conditions generated by the project occur on Rattlesnake Hammock Road from Santa Barbara Boulevard to Collier Boulevard (42.3 percent in 2019) and on Collier Boulevard from Lord's Way Road to Rattlesnake Hammock Road (41.4 percent in 2019). Other increases in AADTs will occur on several segments of Collier Boulevard between Golden Gate Parkway and U.S. 41, and on several segments of Rattlesnake Hammock Road from U.S. 41 to Santa Barbara Boulevard.

In addition, vehicle trip generation resulting from the project will travel to the west, north and south on the existing road network within existing developed lands. No traffic increase is anticipated on the roadway network travelling east into the Panther Focus Area as a result of the project.

The risks to the panther from collisions with vehicles as a result of the Hacienda Lakes project are difficult to quantify. However, the Service believes the increase in traffic generated by the project may potentially contribute to mortality of panthers in the action area. Panthers are known to use project lands and 3 panther-vehicle mortalities (UCFP 143, UCFP 152, and UCFP 153) were recorded within 5 miles of the project site in 2010 and 2011.

Disturbance from construction activities

The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, land clearing, additional vehicle access, additional human presence, heavy equipment operation, road traffic, noise and lighting associated with the project will occur in phases, primarily during daylight hours, lasting over several years. The land clearing for the proposed development will be immediate and these lands will no longer be available as habitat for the Florida panther. The exotic species removal in the preserve lands will occur over several years. These activities and disturbances may cause panthers and or their prey to temporarily avoid the areas in which they occur. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project areas will adjust the size and location of their ranges to account for this loss and disturbance and the adjustment is anticipated to occur in concert with project construction.

Panther/human interactions

Potential increases in disturbance to the Florida panther and panther prey were evaluated. As construction proceeds across areas of the Hacienda Lakes site, an increase in panther/human interactions and prey disturbance may occur as construction activities often include dawn to dusk heavy equipment operations to remove site vegetation, site grading and infrastructure necessary for the development. Associated melaleuca removal and burning in the preserve lands also increases the potential for human and panther interactions. Panthers were documented (telemetry), and panther prey has been sighted on internal site trails during wildlife surveys, monitoring well logging, and fish surveys. Panthers and their prey may avoid locations of construction disturbance during site development and exotic species removal in the preserves, but are expected to resume normal behaviors in the preserve lands after the disturbance ceases.

The onsite preserves that are proposed on lands adjacent to the planned residential lots, school tract, and internal roadway increases the potential for direct panther/human interaction associated with panther use of the preserve lands. To minimize this affect, the applicant proposed the placement of stormwater retention lakes or fencing (minimum of 10-foot height with three string barbed wire outrigger) between development and the preserve lands. Although panthers may cross these border buffers, the increased activities and disturbances associated with residential development may cause panthers and/or their prey to avoid the areas.

Intraspecific aggression

Potential increases and decreases in Florida panther intraspecific aggression were evaluated as a result of temporary or permanent losses of habitat, which may cause panthers to compete for limited space within existing or overlapping territories. Potential increases in intraspecific aggression could occur as a result of permanent losses of habitat from installation of project infrastructure (roads, stormwater retention ponds, etc.). The project will result in the loss of 728.39 ac of panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 2.5 percent of a female panther's average home range (29,059 ac) and 1.2 percent of a male panther's average home range (62,542 ac).

We also provided an evaluation of documented intraspecific aggression between Florida panthers in the action area. Based on mortality data (FWC 2011), 115 panther deaths occurred in the action area since 1979 with 22 deaths (17 male and 5 female) from intraspecific aggression. Over the reporting period, the average is less than one death due to intraspecific mortality per year, with one in 2003, 2004, 2006, 2008, and 2009, three in 2010, two in 2011, and one in 2012. The most recent intraspecific mortality (FP133 - male) occurred on February 27, 2012, in Fakahatchee Strand State Preserve, 18.6 miles east of the project site. The closest intraspecific aggression mortality (FP170 – female) occurred on March 2, 2011, 10.9 miles east of the project site.

The risks to the panther from increases in intraspecific aggression as a result of the Hacienda Lakes project are difficult to quantify. However, given the relative small scale of historical use of project lands by panthers, the risk of increasing intraspecific competition is considered unlikely. In addition, intraspecific aggression is a common behavioral attribute of this species. Therefore, the relative change or increase in intraspecific aggression among young male panthers as a result of this project is also likely immeasurable.

Interrelated and interdependent actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the project.

Species response to the proposed action

The proposed action will result in increased human activity and noise in the project area during construction of the project. However, since panthers are not commonly known to use lands within and adjacent to the project site, activities associated with construction of the Hacienda Lakes project are not anticipated to significantly increase risk of disturbance to panthers, though some temporary disturbance may occur.

Panthers are sensitive to habitat fragmentation. However, the project site is located on the western fringe of occupied habitat, is adjacent to urban development, and is not located within known dispersal corridors between larger publicly owned managed lands (FWC 2006). Therefore, fragmentation of panther habitat is not expected to result from project implementation.

Since the project area provides panther habitat, the loss of habitat may contribute to an increase in intraspecific aggression and a decrease in the overall spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and the adjustment is anticipated to occur in concert with project construction.

ENVIRONMENTAL BASELINE

Wood Stork

As stated previously, the Service determined, for the purposes of this Biological Opinion, the action area is considered to include the project site and the CFAs of three affected wood stork nesting colonies (Figure 6). We note the project site is located within 18 miles of three active wood stork nesting colonies. Two of these colonies are located within the Corkscrew Sanctuary, about 16.4 miles and 17.6 miles north of the project site. The third wood stork nesting colony is located about 16.4 miles northeast of the project site, just north of the Fakahatchee Strand State Preserve. The action area encompasses about 1,621.1 square-miles of Collier, Lee, and Hendry Counties, Florida.

Status of the species within the action area

Habitat

Suitable wood stork foraging habitat consists of shallow wetlands with water depths of 2 to 15 inches. Data obtained from the National Wetland Inventory (NWI) indicate about 473,462 ac of wetlands containing potentially suitable habitat for wood stork foraging occur within the action area. However, the inventory was last updated in 1984 and increasing development in Lee, Collier, and Hendry Counties impacted some of these potential foraging areas. In order to provide a more accurate accounting of the wetlands within the CFAs of the three wood stork colonies, the Service used both the NWI and the FLUCCS maps. The specific step-by-step analysis used is referenced below.

The District maps are based on FLUCCS codes, which is a different land use classification than than that used in the NWIs. Corresponding NWI and wetland FLUCCS codes that provide overlapping wetland categories are the 500 and 600 series FLUCCS codes. However, there are several FLUCCS codes in the 200 and 400 categories that could be either upland or wetland. For instance, the majority of the subject property on the District maps is depicted as 4119 (pine flatwood [an upland FLUCCS code designation]). Corps' approved jurisdictional information on these types of habitats in the action area shows the majority of these properties as being hydric pine flatwoods that are considered wetlands, although not classified as such by the FLUCCS codes. The District maps also do not allow for wetland determinations on agricultural activities, such as pastures (200 series). For this reason, our analysis used both sets of maps. Specifically, we used the 1984 NWI map as the base map and overlaid the District maps. We eliminated the NWI wetlands areas the District maps depicted as developed. Those areas indicated on the District map as passive agricultural (such as pasture and fallow lands) that were also shown to be wetlands on the 1984 NWI maps were left in and counted as wetlands for purposes of this analysis. We also included those lands with a FLUCCS code of 4119 (hydric pine flatwoods) as wetlands in our analysis. Based on the above assessment we estimate the action area contains about 492,529 ac of wetlands suitable for wood stork foraging (Table 11).

Hydrology

Alteration of hydrology and historical flow-ways can result in restrictions in flows and drainages and can negatively influence wetlands and other surface water systems important to wood storks.

These influences can include changes in seasonal flooding patterns that affect drawdown cycles and produce extended periods of unusually high or low water. The extended periods of unusually high or low water may alter the vegetative community facilitating a change from a mixed open forest canopy with a herbaceous component to a closed canopy, dense forest without a herbaceous component.

The NWI, the District Land Use Maps, and personal knowledge have been used to estimate wetland coverage and hydroperiod classes within the CFA of the three colony sites. As previously discussed, we consider short-hydroperiods to be wetlands inundated for 180 days or fewer, which includes Classes 1, 2, and 3. Following this approach, the wetland hydroperiods for three CFAs were estimated and are shown in Table 12. The acreages are estimated from the NWI and District maps. We estimate about 152,818 ac of short-hydroperiod wetlands are within the CFAs of the three rookeries, with an additional 339,711 ac of long-hydroperiod wetlands.

Project area habitat

The analysis of existing habitats expected to be impacted by the proposed project is based on vegetation mapping conducted by PAI in their FLUCFCS mapping provided to the Corps. The prevalent community type is classified as pine-cypress with varying degrees of melaleuca infestation. The melaleuca coverage is highest on the western and central portions of the site and generally decreases to the east.

Project area hydrology

Project wetlands

As discussed for wetlands in the action area, a similar assessment of the wetland hydroperiods for the proposed development footprint (Table 12) and preserve areas (Table 19) was conducted. The hydroperiods of the wetlands within the development footprint are estimated at 478.51 ac of short-hydroperiod wetlands and 6.50 ac of long-hydroperiod wetlands (total 485.01). The existing hydroperiods (Table 13) of wetlands within the preserve footprints are estimated at 1,261.15 ac of short-hydroperiod wetlands and 19.26 ac of long-hydroperiod wetlands (total 1,280.41).

Historic and current patterns of wood storks in the action area

Wood stork nest surveys have been conducted annually at the three nesting colonies in the action area through aerial surveys (Meyer and Frederick 2004) and ground-based monitoring of stork numbers and reproductive success (Audubon 2010). Data for the two colonies located in Corkscrew Sanctuary noted 900 nests in 1999; 1,722 nests in 2000; no nests in 2001; 1,240 nests in 2002; 1,100 nests in 2003; and 520 nests in 2004. In 2005, birds attempted to nest, but most nests were ultimately abandoned. In 2006, 800 pairs nested and 1,550 birds fledged, with an average of 1.9 fledglings per nest (Lauritsen 2006). No nests were reported in 2007, 2008, and 2010, with 1,120 nests in 2009 (Cook and Kobza 2009, Cook and Kobza 2010). No nests have been reported at the northern most Corkscrew Sanctuary colony since 2004, with a report of 30 nests (Service 2010a). Additional data collected by the National Audubon Society indicate 2,538 wood storks fledged during 2000 and 3,160 fledged during 2002. In 2003 and 2004, 780 and 450 young were fledged, respectively (Audubon 2004).

On average over the last 44 years, 1,654 nests are initiated yearly, producing an average of 2,161 fledged young, or 1.3 young fledged per nest. However, the 44-year average is somewhat misleading. Prior to 1968, as many as 5,000 wood stork nests were initiated annually. Nesting activity peaked in 1961 when 6,000 nests produced a record of 17,000 fledglings, or 2.8 fledged young per nest. Surveys for nests at the third wood stork nesting colony located just north of the Fakahatchee Strand State Preserve, have recorded no nests recorded for the past 10 years. No data on nest productivity is available for the colony north of Fakahatchee Strand State Preserve; however, based on the overlapping CFAs, it is likely these birds face many of the same foraging conditions as the storks nesting within Corkscrew Sanctuary.

Historical data on colony locations identifies the Everglades basin colonies and the Corkscrew Sanctuary colonies as the primary nesting locations for wood storks in south Florida (Ogden and Nesbitt 1979). In the late 1950s and early 1960s, the Corkscrew Sanctuary colonies accounted for 51 percent of the Florida population, and supported about 6,000 nesting pairs (Audubon 2002). Survey data collected between 1991 and 1995 indicate the Corkscrew Sanctuary colonies represent about 12 percent of the Florida population of nesting storks and, collectively, the Corkscrew Sanctuary colonies consistently comprise one of the largest nesting colonies in Florida. The original listing recognized the relationship between the declining wood stork population, the loss of suitable foraging habitat, and colony nesting failures, particularly in the breeding colonies in south Florida where human actions had reduced wetland areas by about 35 percent (Ogden and Nesbitt 1979). Although the Corkscrew Sanctuary colonies currently account for only 12 percent of the Florida nesting population, these colonies continue to occasionally produce large numbers of young in south Florida (Service 1999). The acquisition and preservation of these colonies' habitat, and recovery of more natural hydropatterns within the foraging grounds surrounding these colonies, are recognized as important to the recovery of wood storks in south Florida (Service 1997, 1999).

Historic and current patterns of wood storks in the project footprint

No data are available to indicate wood storks historically nested in the Hacienda Lakes project area and none are known to have nested there since systematic statewide wading bird surveys were initiated in the 1970s. Ongoing wildlife surveys have been conducted and documented by PAI (2002, 2003, 2006, 2009, and 2010). During the survey periods, wood storks have been observed perching on cypress and slash pine trees, and foraging in ditches.

Factors affecting the species environment within the action area

Development pressures due to ongoing population growth in Collier and Lee Counties continue to threaten wetlands in the action area. Data from the U.S. Census Bureau (2010) from 2000 to 2010, show the populations of Collier, Hendry, and Lee Counties increased by 28, 8, and 37 percent, respectively. The population of this tri-county area estimated at 966,825 during the 2010 census is expected to continue to grow. In southwest Florida (Charlotte, Collier, and Lee Counties), the human population increased from 833,892 in 2000 to about 1,231,100 in 2010, representing an increase of 47.6 percent over the 10-year period (University of Florida 2010).

Factors that affect the species environment (positively and negatively) within the action area include, but are not limited to Federal, State, or private actions and other human activities in the action area that influence the construction of highways and urban development, agriculture

operations, resource extraction, public lands management (prescribed fire, public use, exotic eradication, etc.), hydrological restoration projects, and public and private land protection efforts.

Federal action

Formal consultations

Past and ongoing Federal and State actions affecting wood stork habitat in the action area include the issuance of Corps 404 and State of Florida ERP permits authorizing the filling of wetlands for development projects and other purposes. Since 1982, the Corps and the State have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice versa. From January 2002 through December 2011, in association with Formal consultations on other species within the action area, the Service consulted on 45 projects and informally consulted on 31 projects regarding the wood stork. The projects resulted in the loss of 4,293 ac of wetlands and the restoration and preservation of 17,984 ac of wetlands (Appendix 3D).

Within the same watershed as the Hacienda Lakes project (5-mile radius), the Service in association with Formal consultations on other species, consulted on 12 projects and informally consulted on 12 projects regarding the wood stork. The projects resulted in the loss of 1,399 ac of wetlands and the restoration and preservation of 3,945 ac of wetlands (Table 14, Appendix 3D).

The Service determined in the Biological Opinions and concurrence letters issued for these projects that individually and cumulatively these projects do not jeopardize the survival and recovery of the wood stork.

CERP actions

The Service completed informal consultations on three CERP projects in the action area, the PSRP, the Prairie Canal Early Start portion of the PSRP, and the Southern CREW project. Details on these projects can be found in the "Status of the Species within the Action Area" section for the Florida panther (above).

Federal action

Informal consultations

From July 2000 through September 2006, the Service conducted informal consultation for projects under 5 ac with the Corps on 757 projects affecting about 764.1 ac in Collier County (primarily Northern Golden Gate Estates) and about 202.8 ac in Lee County (primarily Lehigh Acres) (database entries for informal consultations prior to 2000 are incomplete for projects in the consultation area), with varying amounts of wetland impacts ranging from less that 0.1 ac to 5 ac. Almost all of these projects involved the construction of single-family residences in partially developed areas. As discussed above, existing habitat value to wood storks was diminished by varying levels of exotic species infestations. Generally for projects with wetland impacts greater than 0.1 acre, habitat compensation is required by the Corps that functionally replaces the wetland habitat value lost from the project impact. The Service concurred with the Corps' determinations of "may affect, but is not likely to adversely affect" for these individual projects. These projects have been incorporated into the Service's environmental baseline for the wood stork.

Based in part on historical consultation data referenced above, the Service, in 2007, provided the Corps with a Wood Stork Effect Determination Key (November 9, 2007), which was updated in 2010 (May 18, 2010). The Key provides guidance to the Corps for effect determinations for the wood stork and provides concurrence with "may affect, but is not likely to adversely affect" determinations for projects with less than 0.5 ac of wetland impact impact (provided they are further than 0.47 mile from an active colony site). The Key identifies that, on an individual basis, impacts to wetlands of less than 0.5 ac generally will not have a measurable effect on wood storks, although we request that the Corps require mitigation for these losses. Wood storks are a wide ranging species, and individually, habitat change from impacts to suitable foraging habitat of less than 0.5 ac are not likely to adversely affect wood storks. However, collectively they may have an effect, and, therefore, regular monitoring and reporting of these effects are important.

Non-federal actions

Isolated wetlands

We received information that, within the wood stork action area, the Corps, between March 2004 and September 2006, issued non-jurisdictional wetland determinations for 28 projects totaling about 2,439 ac, with about 190 ac of isolated wetlands. We also received data that, during the 2008 calendar year, the Corps provided 15 non-jurisdictional wetland determinations for projects in Lee, Collier, and Charlotte counties affecting 266 ac. These determinations were issued per jurisdictional guidance provided recently in the Supreme Court decision, *Solid Waste Agency of Northern Cook County vs. U.S. Army Corps of Engineers,* 531 U.S. 159 (2001) and, therefore, they will not require a Federal Clean Water Act 404 wetland permit. However, since loss of wood stork foraging habitat may occur from construction of these projects and no Corps wetland permit is required, the Service recommended the applicants pursue incidental take permits in accordance with section 10 of the Act.

Non-federal action

State of Florida ERP

Although the Corps and the State of Florida, since 1982, have had a joint wetland permit application process, where all permit applications submitted to the State are copied to the Corps and vice-versa, the State also reviews projects that have no wetland impacts or where the wetlands are not considered jurisdictional by the Corps. To determine which of these projects would likely include no wetland impacts and not require a section 404 Clean Water Act wetland permit from the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping units. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). Although subject to Federal review, for our purposes, we considered properties with less than 5 percent wetlands unlikely to require a section 404 wetland permit from the Corps, as these wetlands could be avoided through project design.

Within the wood stork action area, the District issued ERP permits (August 1, 2006 to August 1, 2009) for 328 projects (60 in 2006, 132 in 2007, 110 in 2008, and 25 in 2009) impacting 1,395.26 ac of wetlands (Appendix 3F). These projects also provided wetland preservation of 2,723.51 ac. Based on FLUCCS mapping, about 271 projects (55 in 2006, 109 in 2007, 89 in 2008, and 18 in 2009) affecting 15.24 ac of wetlands, with 16.01 ac of wetland preservation, could be expected to be subject to development without Federal permit involvement through the Clean Water Act section 404. Although the proposed State actions allowed a loss of wetlands, the applicants provided mitigation for these losses at an average ratio of 1.05 ac (15.24/16.01 = 1.05) (protected and restored) for every acre impacted. This wetland loss represents less than 0.003 percent (15.24/492,529 = 0.00003) of the estimated wetland acreage in the action area. Therefore, the Service believes these losses are discountable and insignificant and the proposed preservation and restoration of wetlands is beneficial to the wood stork.

Summary

From January 2002 through December 2011, the Service consulted on 838 projects negatively affecting 5,263 ac of wetlands in south Florida. The Service identified that, in the action area, an additional 314 non-federal actions, affecting 471 ac, may have been developed without Federal review. Over the review period evaluated in the Environmental Baseline, the Service identified a combined loss of 5,734 ac of wetlands. The wetland losses represent 1.12 percent of the estimated wetlands in the action area.

Activities within the action area also benefited wood storks. The issuance of Corps permits preserved 17,984 ac of wetlands (January 2002 through December 2011). The wetland restoration associated with these projects represents about 4.17 percent of the wetlands in the action area. The PSRP restoration project will restore more than 55,000 ac of wetlands and uplands to near pre-development conditions and the CREW restoration project will restore about 4,000 ac of wetlands to near pre-development conditions. The District, through their ERP program is preserving 2,724 ac of wetlands. Additional benefits resulted from the acquisition of high quality habitat through acquisition programs by the other Federal, State, and County resource agencies. For example, Lee County's Conservation Lands Program, since its inception in 1995, purchased a total of 23,820 ac, the most recent acquisition was the 1,213 ac adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 ac adjacent to Corkscrew Sanctuary and the 2,500-acre Pepper Ranch.

These projects referenced above have been incorporated in the Service's environmental baseline for the wood stork in this Biological Opinion and the Service determined, based on the location of these projects, the quality of the habitat present on these project sites, and the overall status of the wood stork, that these projects individually and cumulatively do not jeopardize the survival and recovery of the wood stork.

EFFECTS OF THE ACTION

Factors to be considered

This section analyzes the direct, indirect, interrelated, and independent actions on the wood stork. Direct effects are primarily habitat based and occur at the time of construction. Indirect effects occur later in time and can also be habitat based. In our assessment we are combining both direct and indirect effects as joint factors. The combined direct and indirect effects include: (1) habitat fragmentation; (2) permanent loss of habitat; (3) changes in mosaic of hydroperiods; (4) changes in wood stork prey base (5) construction harassment; (6) reduction in the geographic distribution of habitat; and (7) habitat compensation.

Analysis for effects of the action

Direct and indirect effects

To evaluate habitat, the Service developed an assessment approach that provides a comparison of pre- and post-development habitat as a matrix of changes in biomass production and availability to foraging by wood storks. Factors that can affect biomass production and biomass availability for wood stork foraging include hydroperiod duration and prey accessibility. Prey accessibility can be affected by vegetation density and/or canopy cover.

Foraging habitat

Researchers have shown wood storks forage most efficiently and effectively in habitats where prey densities are high, the water is shallow, and the canopy is open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Prey availability to wood storks is dependent on a composite of variables consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too deep (greater than 30 cm [12 in]) for storks to forage or the tree canopy at the site is too dense for storks to land. Calm water, about 5 to 40 cm (2 to 16 in) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993).

The Service developed a functional assessment known as the "Wood Stork Foraging Habitat Assessment Methodology" (Methodology) which takes into account the following parameters: Vegetation Density, Wetland Hydroperiod, Prey Size Suitability, and Competition with other wading bird species for forage. For a full description of the Methodology, please see Appendix 2 at the back of this document. The Methodology can be used to estimate the biomass of wood stork forage provided per acre of wetland habitat and can be applied to both wetlands being impacted and the wetlands proposed as mitigation.

Following our Methodology, the proposed Hacienda Lakes project will result in the loss of about 132.31 kg of available wood stork forage biomass (Table 15, Appendix 3G). The estimated biomass loss is based on 485.01 ac of impacted wood stork foraging habitat. The exotic species foraging suitability values range from 3 percent to 100 percent. The hydroperiods vary from

Class 2 (60 to 120 days) to Class 4 (180 to 240 days) with 96 percent of the wetlands within the development footprint represented by Class 2.

A foraging prey base evaluation of the proposed wetland preserve (1,280.41 ac) provides a pre-enhancement forage biomass of 897.95 kg and a post-enhancement forage biomass of 1,357.49 kg to wood storks, this results in a net increase of 459.54 kg (1,357.49 – 897.95 = 459.54) (Table 15, Appendix 3H [pre] and 3I [post]). The exotic species foraging suitability values range from 3 percent to 100 percent. The hydroperiods vary from Class 2 (60 to 120 days) to Class 4 (180 to 240 days), with 85 percent of the wetlands within the project's preserve footprint (pre-enhancement) represented by Class 2 hydroperiod.

Habitat fragmentation

Mac et al. (1998) define habitat fragmentation as: "The breaking up of a habitat into unconnected patches interspersed with other habitat which may not be inhabitable by species occupying the habitat that was broken up. The breaking up is usually by human action, as, for example, the clearing of forest or grassland for agriculture, residential development, or overland electrical lines." In the case of the proposed project, about 485.01 ac of wetlands and waters will be lost by the development of the property. The applicant proposed about 10.05 ac of wetlands internal to the development that may provide foraging benefit to wood storks. These wetlands, although available for foraging, are only indirectly connected to other larger acreages of wetlands and are considered fragmented habitat. The applicant's remaining proposed onsite wetland preserve (1,270.41 ac) is adjacent existing preserve areas, including the Picayune Strand State Forest. For these reasons, fragmentation of wood stork habitat from the proposed project is not considered significant.

Permanent loss of habitat

The project will result in the loss of about 485.01 ac of wetlands on the site. The land will be converted to support a mixed use commercial and residential community. Habitat foraging suitability has been affected by exotic density coverage averaging 50 percent. This loss represents about 0.10 percent (485.01/492,529= 0.0010) of the available foraging area within the CFA of the three colonies in the action area. No wood storks are known to have nested within the project area, and all of the wading bird censuses conducted to date demonstrated that the area is only periodically used by wood storks.

Although there will be a permanent loss of wood stork foraging habitat from construction of the project, the proposed restoration of lands in the onsite preserves will result in habitat that may be used more frequently by wood storks. Over time, this may increase the distribution and quality of foraging habitat, which would reduce the local and landscape-scale effects of the initial habitat loss.

Changes in the mosaic of hydroperiods

Stork nesting success generally relies on a mosaic of hydroperiods within the CFA of the colony. Storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow

window of time when wetlands have sufficiently dried to begin concentrating prey, making water depths suitable for storks to access the prey. Once the wetland has dried to where the water levels are near the ground surface, the area is no longer suitable for stork foraging, and will not be suitable again until water levels rise and the area is repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short-hydroperiod wetlands used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964; Gawlik 2002). In our evaluation of hydroperiods within the wood stork action area (492,529 ac, overlap of all three rookeries), we determined that there were about 152,818 ac of short-hydroperiod wetlands and 339,711 ac of long-hydroperiod wetlands (Table 11).

Offsite hydrology

Historic sheetflow in the vicinity of the project has been significantly altered by the construction of Collier Boulevard (CR 951) and the associated CR 951 canal. Sabal Palm Road, which bisects the project's southern portion, has insufficient culverts to accommodate historic sheetflow from north to south. In addition, Willow Run Quarry, to the north of the project, and the Florida Power & Light easement, which runs through the west portion of the site, changed hydrologic patterns in the area. Additional development activities also occurred to the west and south of the project site further altering the hydrologic regime.

Onsite hydrology

Seasonal flows entering the project are to be regulated by a weir structure at the north end of the site and the onsite pass-through lakes are designed to accept the water and pass it through the site. Crest elevations on the weirs and box structures constructed for the onsite lakes will be high enough above ground level that water will enter the onsite lakes during high water events, but will then drain down naturally through the ground rather than discharge back out through the lakes. These structures are designed to regulate and temper the seasonal changes in hydroperiods. No hydrological changes in the adjacent onsite preserves and offsite wetlands are expected from the proposed action.

Project development

Short-hydroperiod wetlands in the project development footprint total about 478.51 ac. The loss of the 478.51 ac of short-hydroperiod wetlands represents about 0.31 percent (478.51/152,818= 0.0031) of the short-hydroperiod wetlands in the action area. Long-hydroperiod wetlands in the project footprint total about 6.50 ac. This loss of long-hydroperiod wetlands represents about 0.002 percent (6.50/339,711 = 0.00002) of the long-hydroperiod wetlands in the action area.

Project preserve:

The onsite preserves includes 1,280.41 ac of wetlands, with 1,261.15 ac considered short-hydroperiod wetlands and 19.26 ac considered long-hydroperiod wetlands. The proposed restoration actions are not changing the existing mosaic of hydroperiods present in the wetland preserves.

Changes in wood stork prey base

In our assessment of the Hacienda Lakes development footprint, we noted that the predominant wetland hydroperiod was a Class 2 (96 percent) with an average of 120 to 180 days inundation. To complete this analysis, we assumed the existing available foraging habitat would be available with or without the project. We calculated the proposed development will result in the loss of 132.31 kg of foraging biomass, of which 113.36 kg represent short-hydroperiod wetlands, and 18.95 kg represent long-hydroperiod wetlands (Table 15).

In our assessment of the preservation lands (Table 15), we determined that the wetland preserves provide an existing foraging base of 897.95 kg of biomass, prior to restoration. Following restoration, these lands provide 1,357.49 kg of biomass, an increase of 459.54 kg of biomass.

Due to the critical importance of short-hydroperiod wetlands in early nesting productivity of a wood stork colony, we also calculated the productivity of both short- and long-hydroperiod wetlands separately. The existing preserves currently provide 849.33 kg of short-hydroperiod biomass with a corresponding long-hydroperiod biomass of 48.62 kg. Following restoration, the wetland preserves will provide 1,203.38 kg of short-hydroperiod biomass and 154.11 kg of long-hydroperiod biomass.

Following the above analysis, the restoration actions proposed for the wetland preserves will provide an increase of 354.05 kg of short-hydroperiod biomass and 105.49 kg of long-hydroperiod biomass (Table 15). Considering that the expected biomass productivity loss from the proposed development is 132.31 kg, of which 113.36 kg represent short-hydroperiod biomass, and 18.95 kg represent long-hydroperiod biomass, the proposed restoration actions will provide a net increase of 240.69 kg (354.05-113.36=240.69) or a 2.12 fold increase (240.69 / 113.36 = 2.12) in short-hydroperiod biomass and a net increase of 86.54 kg (105.49 - 18.95 = 86.54) or a 4.57 fold increase (86.54 / 18.95 = 4.57) in long-hydroperiod biomass.

To summarize the discussion above, the project development will result in the loss of 485.01 ac of wetlands. The proposed compensation lands consist of 1,280.41 ac of wetlands. The hydroperiod class analysis shows that overall; the project development will result in a loss of 132.31 kg of biomass. The proposed restoration will provide an increase of 459.54 kg (1,357.49-897.95=459.54) of biomass over existing baseline of the wetlands in the preserve. The net increase is 327.23 kg of total biomass for the project (459.54-132.31=327.23). Both short- and long-hydroperiod classes show an increase in the biomass available for wood stork foraging following enhancement of the preserve wetlands.

Construction

The timing of construction for this project relative to sensitive periods of the wood stork's lifecycle is unknown. However, it is likely that all land clearing associated with the development will occur in phases over several years. The onsite internal wetland preserves, which provide a foraging prey base for wood storks in a suburban setting, may increase the likelihood of harassment and disturbance to the species. However, this is a common occurrence throughout the species range and is not expected to adversely affect the wood stork. In order to minimize

potential human/stork interactions, the applicant is proposing to educate all residents (through literature and signage) as to the potential presence of wood storks around the community. No known roosting or colony sites are known to occur within the project boundaries and based on site surveys of wood stork usage and the density of exotics present in onsite wetlands; we believe that wood stork usage of the property is limited. Therefore, we do not believe project construction will result in direct wood stork harassment or mortality.

Reduction in geographic distribution of habitat

Although the wood stork population in the southeastern U.S. fluctuates annually, the 3-year running average shows a continual growth over consecutive reporting periods (minimum of 3 consecutive years of data) (Table 7). Annual population totals indicate that the stork reached its highest level in 2009 with about 12,720 wood stork pairs nesting within their breeding range in the southeastern U.S. (Service 2010a). Wood stork nesting has been recorded in North Carolina in 2006 through 2010, after it was first documented there in 2005. New colonies were also reported in Georgia and South Carolina over the same reporting periods. In addition, several new colonies were also reported in Florida in 2006, 2009, and 2010. Cumulatively, the number of colonies also continues to rise with over 73 in 2008, 86 in 2009, and 94 in 2010. This suggests the northward expansion of wood stork nesting may be continuing. Although the proposed action will result in the loss of 485.01 ac of wetlands, we believe the proposed action will not significantly reduce the geographic distribution of habitat and the distribution of the species, especially considering the restoration and enhancement of wetlands. The loss represents about 0.31 percent of the short-hydroperiod wetlands in the action area and 0.002 percent of the long-hydroperiod wetlands in the action area.

Compensation

Wood stork habitat lost by the development will be offset by the preservation and enhancement of 1,280.14 ac of wetlands, of which about 10.05 ac are within the developed portions of the project and the remaining 1,270.09 ac are located east and south of the development, forming a contiguous preserve with additional offsite wetland preserves. The wetlands proposed for development are hydrologically disturbed and infested by exotics. The lands proposed for preservation are connected to other larger tracts of preserve lands and are consistent with the Service's goal to acquire, enhance, preserve, and recover natural hydropatterns to foraging habitat for the wood stork

Interrelated and interdependent actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No interrelated or interdependent actions are expected to result from the project.

Species response to the proposed action

The proposed action will result in increased human activity and noise in the project area during construction of the project. Wood storks are known to use lands within and adjacent to the

project site. However, though some temporary disturbance may occur to wood storks, activities associated with construction of the Hacienda Lakes project are not anticipated to significantly increase long-term risk of disturbance to wood storks.

The project will result in the loss of 485.01 ac of onsite wetlands and waters. Any loss of wood stork foraging habitat attributable to the project will be offset by the preservation and enhancement of 1,280.41 ac of onsite wetlands.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this Biological Opinion.

Florida Panther

Although future Federal actions affecting panthers within the action area are technically not linked to this project and will be considered in separate section 7 consultations, the Service notes several projects (last 10 years) within the same watershed (5-mile radius), have been the subject of section 7 consultations resulting in Biological Opinions and have been included in the environmental baseline. These projects (Table 9) impacted about 4,821 ac of habitat with conservation of 6,095 ac of habitat. The Service issued Biological Opinions on 12 projects and concurrence determinations on 13 projects. In the last 5 years, excluding the current consultation, the Service issued a Biological Opinion for the City Gate in 2009, Sembler Parthership in 2008, and Sabal Bay, Firano at Naples, and Journey's End in 2006. These most recent projects (last 5 years) affected 1,387 ac with corresponding compensation of 1,740 ac. Including Hacienda Lakes, these projects adversely affected 2,115 ac of habitat with compensation of 3,277 ac. The impacted lands border existing developments which, prior to construction, supported a mosaic of habitats that provided foraging for panther prey species and hunting and dispersal habitat to panthers. Existing habitat value to panther prey species (deer and hog), as discussed in the Biological Opinions for these projects, was degraded by varying levels of exotic species infestations that also diminished the quantity and quality of foraging food base for these prey species.

The 3,277 ac of proposed preserves related to the projects in the previous paragraph, prior to restoration were also affected by exotic species. Following restoration, primarily the removal of the exotic species, the quality and quantity of forage for panther prey species is expected to improve with a corresponding increase in use and presence by panther prey and the Florida panther. In addition, the proposed 3,277 ac of preserves are interconnected to each other and to adjacent preserved lands. These interconnected preserves provide greater access and facilitate panther and panther prey movement in and out of adjacent publicly owned lands and refugia for dispersing panthers.

The Service concluded in all of the aforementioned Biological Opinions that these projects, as proposed, do not jeopardize the survival and recovery of the Florida panther; that the proposed compensation plans provide habitat preservation and restoration within and near the project area; and the location and restoration of these lands is consistent with the Service's Panther Recovery Plan as described previously. Over the review period evaluated, the Service completed consultations affecting an average of 482 acres per year of panther habitat with a corresponding

preservation of 610 acres per year. The Service is considering this level of past development to represent the level of future Federal actions in the action area.

To determine the cumulative effects of future private actions that would affect the Florida panther and that may reasonably be certain to occur in the action area, the Service first identified the types of land alteration actions that could occur in the action area, then developed a mechanism to distinguish between those that will require future Federal review and those that are not likely to be a future Federal action, and thus meet the cumulative effects definition. To estimate future non-federal actions, the Service chose to identify and tabulate recent past non-federal actions and project this level of development as representative of future non-federal actions.

Within the action area, past and ongoing State and County actions affecting panther habitat include: (1) State of Florida DRI Orders (2005 to 2010); (2) Comprehensive Plan Amendments (2005 to 2010); and (3) District's ERP (2006 to 2009). To evaluate these effects, the Service incorporated FLUCCS mapping to determine properties that have no wetland impacts or are not considered jurisdictional by the Corps. To determine which of these projects was unlikely to require a section 404 Federal Clean Water Act wetland permit from the Corps, we identified the percentage of the project site that was classified as wetland habitat, based on the FLUCCS mapping. The mapping units relied on by the Service included the 600 series (wetland classifications) and the 411 and 419 pine flatwood classifications (hydric pine systems). For listing purposes, properties with less than 5 percent wetlands, although subject to Federal review, were deemed unlikely to require a section 404 wetland permit from the Corps as these wetlands could be avoided through project design in compliance with section 404(b)(1) guidelines, which require impacts to wetlands be avoided and minimized to the maximum extent practable.

Within the action area, the District issued ERP permits (August 2006 to August 2009) for 63 projects (13 in 2006, 27 in 2007, 18 in 2008, and 5 in 2009) impacting 12,032 ac total (1,041 ac of wetlands) and concurrently preserving 1,734 ac of wetlands and 188 ac of uplands. Based on FLUCCS mapping, about 47 projects (12 in 2006, 21 in 2007, 11 in 2008, and 3 in 2009), each containing less than 5 percent wetlands, could be expected to be developed without Federal review. These 47 projects through avoidance of wetland impacts would impact 4,072 ac of habitat. Over this 3-year period, the District issued an average of 16 projects per year affecting 1,357 ac of habitat that would not be subject to Federal review.

State and County land alteration permits in southwest Florida, not part of those actions listed above, generally include single-family residential developments within Northern Golden Gate Estates and Lehigh Acres. Vacant lands within the area of Northern Golden Gate Estates (north of I-75), totaled about 35,768 ac as of August 2003. The breakdown is: (1) wetlands, about 17,572 ac; (2) uplands, about 17,990 ac; and (3) open water, about 210 ac. Vacant lands within the area of Northern Golden Gate Estates as of September 2004 totaled 34,028 ac. To evaluate this change, the Service overlaid the plat boundaries on the 2004 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2003 aerials, and noted the changes.

The evaluation process provided an estimated 417 lots totaling 1,740 ac for Northern Golden Gate Estates. The breakdown of converted acres is: (1) wetlands, 696 ac; (2) uplands, 1,044 ac; and (3) water, 0 ac. Therefore, using NWI mapping for Northern Golden Gate Estates, a total of

about 1,740 ac could be expected to be subject to development in a year in these areas without Federal review. We expect that this level of annual development in Northern Golden Gate Estates did not significantly change between 2004 and 2012. Based on historical records for wetland permits issued by the Corps for these areas, most of these projects will involve the construction of single-family residences in partially developed areas and will involve less than an acre of impact.

Vacant lands within the area of Lehigh Acres totaled about 35,293 ac as of April 2002. The breakdown is estimated as: (1) wetlands, 1,124 ac; (2) uplands, 33,967 ac; and (3) water, 202 ac. Vacant lands within the area of Lehigh Acres totaled about 34,852 ac as of April 2003. To evaluate this change, the Service overlaid the plat boundaries on the 2003 aerials, queried the parcel data from Collier County's Property Appraisers Office, noted lots with developments, compared those to 2002 aerials, and noted the changes.

The evaluation process provided an estimate that 1,764 lots, affecting 441 ac of land, were converted from vacant to occupied during the 1-year period. The breakdown of converted acres is estimated as: (1) wetlands, 66 ac; (2) uplands, 375 ac; and (3) water, 0 ac. Therefore, using NWI mapping for Lehigh Acres, a total of about 441 ac could be expected to be subject to development in a year in these areas without Federal review. We expect this level of annual development in Lehigh Acres did not significantly change between 2003 and 2012.

In conclusion, the Service's cumulative effects analysis identified about 3,538 ac within the action area that could be developed annually without Federal review. This level of development, which the Service believes is representative of future non-federal actions, is reasonably certain to occur and, therefore, meets the definition of cumulative effect. This level of projected future development represents 12.2 percent (3,538/29,059=0.122) of a female panther's average home range (29,059 ac) and 3.5 percent (3,538/62,542=0.035) of a male panther's average home range (62,542 ac), though the impacts will be scattered and generally located on the fringes of occupied panther habitat. The impacted lands supported primarily disturbed vegetative communities, were in row crops, or were in partially developed areas.

These lands represent 0.18 percent (3,538/1,962,294=0.0018) of the non-urban private lands at risk in the Service's panther core area (1,962,294 ac). Based on the above analysis, we believe the loss of the habitat associated with these lands, though insignificant in the short term, may adversely impact the panther as development continues to occur in the future in the action area. The Service accounted for some habitat loss and changes in habitat quality through its habitat assessment methodology and is encouraging State and County entities responsible for permitting to pursue the section 10 (HCP) process to account and mitigate for adverse effects to the Florida panther.

Wood Stork

While future Federal actions located within the action area affecting wood storks are technically not linked to this project and will be considered in separate section 7 consultations, the Service notes that several projects (last 10 years), which are also within the same watershed (5-mile radius), have been the subject of section 7 consultations resulting in Biological Opinions and have been included in the environmental baseline. These projects (Table 15) impacted about 1,399 ac of wetlands and included conservation of 3,945 ac of wetlands. The Service issued

Biological Opinions on 12 projects and concurrence determinations on 12 projects. In the last 5 years, excluding the current consultation, the Service issued a Biological Opinion for Sembler Parthership in 2008, and Sabal Bay, Firano at Naples, and Journey's End in 2006. These most recent projects (last 5 years) affected 468 ac with corresponding compensation of 1,159 ac. Including Hacienda Lakes, these projects adversely affected 953 ac of wetlands with compensation of 2,439 ac. The Service also provided concurrence determinations for 12 actions during this same 5-year time period with impacts to 82 ac of wetlands with 123 ac of compensation. The Service concluded in the Biological Opinions and concurrence determinations for these projects that, individually and cumulatively, they do not jeopardize the survival and recovery of the wood stork.

The assessment for the above referenced formal consultations identified that the combined wetland loss (1,035 ac) represents a reduction of less than 1 percent (1,035/152,818=0.0068) of the short-hydroperiod wetlands within the CFA of the affected rookeries. Over the review period evaluated, the Service completed consultations affecting an average of 140 acres per year of wood stork habitat with a corresponding preservation of 395 acres per year. The Service is considering this level of past development to represent the level of future Federal actions that may occur in the action area.

To determine the cumulative effects of future private actions, the Service identified and analyzed future actions reasonably certain to occur within an action area. For evaluation purposes, the Service is considering the action area for the wood stork to include the CFAs of all three nesting colonies as they encompass the project area or a portion of it (Figure 6). The process to identify cumulative effects follows the same procedure identified for the Florida panther.

Within the action area, past and ongoing State and County actions affecting wood stork habitat include: (1) State of Florida DRI Orders (2005 to 2010); (2) Comprehensive Plan Amendments (2005 to 2010) and (3) District's ERP permits (2006 to 2009). The District issued ERP permits (August 1, 2006 to August 1, 2009) for 271 projects (55 in 2006, 109 in 2007, 89 in 2008, and 18 in 2009) that could be expected to be developed without Federal review, impacting 15.2 ac of wetlands and providing for the preservation of 16.0 ac of wetlands, which averages 5 ac of wetland impact and 5 ac of preserve per year. We believe these projects could be expected to be development without Federal review. We added to this the 762 ac per year (696+66=762) of wetlands associated with the proposed developments in Northern Golden Gate Estates and Lehigh Acres (encompassing State and County actions – see panther cumulative effects for details) for a total of 833 ac of wetlands per year. The Service believes 833 ac of wetlands may be developed per year without Federal review. This annual cumulative loss in the action area constitutes less than 0.16 percent (833/492,529=0.0017) of all wetlands available to wood storks in the three CFAs.

Although these wetlands may be impacted by non-federally reviewed actions and the productivity as a foraging prey base for wood storks may be affected, based on the status of species discussed previously and the status of the species in the action area, we find the loss/reduction of foraging value to the wood storks associated with these systems is not significant (0.16 percent).

CONCLUSION

Florida Panther

Panther usage

The timing of construction for this project, relative to sensitive periods of the panther's lifecycle, is unknown. However, it is likely all land clearing associated with the development will be completed in phases over several years. There are no known den sites within the project boundaries. The project will result in the loss of a relatively small amount (728.39 ac) of potential panther habitat. According to the most current home range estimates of the Florida panther (Lotz et al. 2005), this loss represents 2.5 percent of a female panther's average home range (29,059 ac) and 1.2 percent of a male panther's average home range (62,542 ac). Since the project area provides panther habitat and panthers have been documented onsite, the loss of habitat may contribute to an increase in intraspecific aggression and a decrease in the spatial extent of lands available to the panther for hunting, breeding, and dispersing. We anticipate any resident panthers with home ranges overlapping or in the vicinity of the project area will adjust the size and location of their ranges to account for this loss and that adjustment is anticipated to occur in concert with project construction.

Traffic

There will be traffic increases with project development. As discussed previously, the lands on the project site have been used by panthers and the proposed action will further restrict suitability of the site for use by either resident or dispersing panthers. The risk to the panther from collisions with vehicles as a result of the Hacienda Lakes project is difficult to quantify. The Service believes that the increase in traffic generated by the project may potentially contribute to mortality of panthers in the action area. Panthers are known to use project lands and 3 panther-vehicle mortalities (UCFP 143, UCFP 152, and UCFP 153) were recorded within 5 miles of the project site in 2010 and 2011. However, the majority of traffic generated from the site is expected to travel away from the panther focus area.

Habitat loss

Based on the habitat evaluations discussed previously, the Service believes the project will result in direct and indirect loss of about 728.39 ac of habitat within the Primary Zone (see discussion under Wildlife Assessment). Habitat types are exotic-infested wetlands and other natural communities. The prevalence of exotics within the project area provides reduced foraging value to panther prey species. We believe panther usage of the site is limited; however, the permanent loss is anticipated to adversely affect the panthers in the action area by decreasing the spatial extent of lands available for hunting, breeding, and dispersing. This loss of about 728.39 ac of panther habitat represents 0.04 percent of the 1,962,294 ac of available non-urban private lands in the core area. This loss of non-urban private lands on the western edge of the panther's range is small and will not significantly alter the Service's land conservation and preservation goals.

Compensation

The project will provide for the preservation of about 1,533.77 ac of Primary Zone habitat. The value of the habitats to the panther will be maintained long-term through hydrological restoration and the removal of exotic vegetation. The preservation of these lands in the panther core area represents 0.19 percent of the 799,205 ac of private lands still needed to support a population of 90 individuals.

The proposed compensation plan, which provides habitat preservation and restoration inside and outside the project action area, and the location of these lands is consistent with the Service's Panther Recovery Plas as described previously.

Fragmentation

The project site is also located on the western edge of occupied habitat, is adjacent to other existing and proposed development, and is not located within known dispersal corridors to larger publicly owned managed lands important to the panther. Therefore, fragmentation of panther habitat is not expected to result from project implementation.

Intraspecific aggression

Potential increases in intraspecific aggression and disturbance to the Florida panther were evaluated. The Service believes, as previously discussed, the habitat on the property provides reduced foraging for prey species, which directly affects the frequency and duration of use of the property by panthers. The risk to the panther from increases in intraspecific aggression as a result of the Hacienda Lakes project is difficult to quantify. However, given the small size of the project (as compared to a panther's territory), the limited use of project lands within the development footprint, the risk of increasing intraspecific competition is considered unlikely. Therefore, the relative change or increase in intraspecific aggression among panthers as a result of this project is also likely insignificant.

Cumulative analysis

In the cumulative analysis, the Service identified the potential loss of about 3,538 ac within the action area that could have been developed annually without Federal review and we believe this level of development represents future non-Federal actions. This acreage of proposed development represents a small percentage (0.18 percent of the 1,962,294 ac) of available non-urban private lands in the core area. In general, these lands, as was the case for the identified non-Federal action lands, are expected to be primarily within previously impacted areas or are in the western more urbanized portion of the Florida panther's consultation area. Although this small percentage of lands may be lost from the core area of private lands available for panther conservation, the Service believes the loss of these lands will not significantly diminish the Service's conservation and preservation goals for the panther.

Conservation land acquisitions

Additional benefits resulted from the acquisition of high quality habitat through acquisition programs by other Federal, State, County, and private organizations. For example, Lee County's Conservation Lands Program, since its inception in 1995 purchased a total of 23,820 ac, with the most recent acquisition being the 1,213 ac adjacent to the Bob Janes Preserve in eastern Lee County. A similar program in Collier County, the Conserve Collier Program, recently purchased 368 ac adjacent to Corkscrew Sanctuary and the 2,500-acre Pepper Ranch. As of 2010, conservation lands represent about 67 percent of the lands in Collier County and 31 percent of the lands in Lee County (FNAI 2010). Table 16 provides a representative distribution of land ownerships by county. Many of these lands are located within the Primary Zone of the Florida panther and are intended to be actively managed for the benefit of many wildlife species including the Florida panther. The preservation of these lands in the panther core area will have a beneficial effect on the panther and further the Service's goals for this species.

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of the Florida panther resulting from this project. However, the increase in traffic and potential increase in intraspecific aggression in the action area as a result of the project may adversely affect the Florida panther. We also note that, although 728.39 ac of lands that provide benefit to the Florida panther will be lost, the proposed onsite and offsite compensation lands (1,533.77 ac) will benefit the panther, and the location and restoration of these lands are consistent with the Service's Panther Recovery Plas as described previously.

The applicant has proposed sufficient habitat protection and restoration to compensate for the quantity, function, and value of the lost habitat. Taking all of the above into consideration, the Service believes the proposed Hacienda Lakes project is not likely to jeopardize the continued existence of the Florida panther. Critical habitat has not been designated for this species; therefore, none will be affected.

Wood Storks

Habitat loss and compensation

The project will result in the loss of 485.01 ac of onsite wetlands and waters. Loss of wood stork foraging habitat attributable to the project will be offset by the preservation and enhancement of 1,280.41 ac of onsite wetlands. As we discussed previously, the Service evaluates wood stork biomass productivity per hydroperiod class and, based on our analysis, we believe the project will not result in the loss of biomass associated with any of the hydroperiod classes of wetlands.

Fragmentation

The applicant proposed about 10 ac of wetlands internal to the development that provide foraging to wood storks. These wetlands, although available for foraging, are only indirectly connected to other larger acreages of wetlands and are considered fragmented habitat. The applicant's remaining proposed onsite wetland preserve (1,270 contiguous ac) is adjacent to existing and proposed preserve areas to the east and south. For these reasons, fragmentation of wood stork habitat is not significant.

Changes in the mosaic of hydroperiods

No changes are proposed to the existing hydroperiods within the adjacent onsite preserve and, based on data provided by the applicant; the proposed changes to the wetlands in the project footprint will not have an adverse affect on surrounding wetlands. The loss of the 478.51 ac of short-hydroperiod wetlands represents about 0.31 percent of the short-hydroperiod wetlands in the action area. Long-hydroperiod wetlands in the project's development footprint total about 6.50 ac. This loss of long-hydroperiod wetlands represents about 0.002 percent of the long-hydroperiod wetlands in the action area.

Cumulative analysis

In the cumulative analysis, the Service identified the potential loss of about 833 ac of wetlands that may have been developed annually without Federal review and we believe this level of development represents future non-Federal actions. This acreage of impact represents a small percentage of the available wetlands in the action area and although the productivity as a foraging prey base for wood storks may be affected, based on the status of species discussed previously and the status of the species in the action area, we find the loss/reduction of foraging value to the wood storks associated with these systems is not significant (0.16 percent) (833/492,529=0.0017).

Conservation land acquisitions

Additional benefits resulted from the acquisition of high quality habitat through acquisition programs by other Federal, State, County, and private organizations (see above under "Florida Panther – Conservation Land Acquisitions" and Table 16). These lands are intended to be actively managed for the benefit of many wildlife species, including the wood stork. The preservation of these lands will have a beneficial effect on the wood stork and further the Service's goals for this species.

In conclusion, the Service believes there will be no direct take in the form of mortality or injury of wood storks resulting from this project. The proposed restoration will provide a net increase of 327.23 kg of biomass across all hydroperiods. All hydroperiod classes show an increase in the biomass available for wood stork foraging following enhancement of the wetland preserves.

After reviewing the status of the wood stork, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's Biological Opinion that the development of the Hacienda Lakes project, as proposed, is not likely to jeopardize the continued existence of the wood stork. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly

impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking, that is incidental to and not intended as part of the agency action, is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are nondiscretionary and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to Hacienda Lakes of Naples, LLC, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require Hacienda Lakes of Naples, LLC, to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protection coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps or Hacienda Lakes of Naples, LLC, must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

AMOUNT OF TAKE

Florida Panther

The Service anticipates that incidental take of the Florida panther will be difficult to detect for the following reasons: (1) the Florida panther is wide-ranging; (2) the lands on the project site provide limited value to the Florida panther and panther prey species; and (3) lands adjacent to the project site consist of existing and proposed urban development that reduce their suitability for use by either resident or dispersing panthers. Therefore, the Service does not anticipate construction of the project will result in the direct mortality or injury of any Florida panthers. However, the Service anticipates direct take through minimal loss of habitat and indirect take in the form of harassment and harm due to potential increases in traffic and interspecific aggression within the 25-mile radius action area. Traffic and interspecific aggression are risks to the panther that are cumulative in nature, and, as such, they are difficult to quantify or to tie to any specific project.

Although there is a potential for indirect take to occur as described above, we believe that the level of incidental take resulting from the loss of 728.39 ac of panther habitat within the Primary Zone is moderated by the preservation and enhancement of 1,533.77 ac of panther habitat in the Primary Zone. The impact areas have an equivalent loss of 3,129 PHUs; once the 2.5 base multiplier is applied, this results in a recommended compensation value of 7,823 Primary Zone equivalent PHUs. This has been provided by the applicant in their compensation and mitigation proposal (Table 10).

Wood Storks

The Service anticipates incidental take of wood storks will be difficult to detect for the following reasons: (1) wood storks forage over a wide area; (2) the CFA includes all wetlands within 18.6 miles (30 km) of the colony site; and (3) losses in nest productivity may be masked by seasonal fluctuations in numbers based on other natural causes affecting food availability, such as drought or flooding, which will also affect foraging efficiency and nesting success. Based on the analysis provided in this Biological Opinion, we do not estimate a take of any nests from biomass losses. Across all hydroperiods, the proposed action with mitigation is estimated to provide an increase in biomass that would support 4.8 nests associated with short-hydroperiod wetlands and 0.6 nests associated with long-hydroperiod wetlands, with a combined increase of 327.23 kg of foraging biomass (Table 15).

The 327.23 kg of biomass represents 240.69 kg of short-hydroperiod and 86.54 kg of long-hydroperiod biomass productivity. Since we believe, in general, short-hydroperiod wetlands are important limiting factors in the action area, the proposed action, with its preserve enhancements, is estimated to provide a net increase in nest productivity associated with short-hydroperiod wetlands of about 4.8 nests over base conditions (240.69/50=4.8). We also note a corresponding increase of 86.54 kg of long-hydroperiod wetland biomass corresponding to an increase in nest productivity of 0.6 nest (86.54/151=0.6).

In addition to direct effects, increases in foraging opportunities resulting from the proposed action may also decrease the likelihood non-nesting wood storks will compete for prey with nesting wood storks. Because we cannot reliably predict the degree of competition or the number of non-nesting storks that forage in this area, we are unable to quantify any incidental take resulting from competition. The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712), or the Bald Eagle Protection Act of 1940, as amended (16 U.S.C. 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

EFFECT OF TAKE

In the accompanying Biological Opinion, the Service determined this level of anticipated take is not likely to result in jeopardy to the Florida panther or wood stork. Critical habitat has not been designated for these species; therefore, none will be affected.

REASONABLE AND PRUDENT MEASURES

The Service believes the Corps and the applicant have developed a project that has conservation measures necessary and appropriate to minimize the effect of incidental take of the Florida panther and wood stork. In summary, to compensate for impacts to 728.39 ac of habitat, Hacienda Lakes of Naples, LLC, proposes to enhance and preserve 1,533.77 ac on the project site. The applicant also provided mitigation and monitoring plans that include management actions, protection of these lands in perpetuity, and the establishment of escrow funds for perpertual management of the mitigation lands. Annual reports to the Service are a component of the management plans.

To minimize take of wood storks and panthers, the Service considers it necessary and appropriate to collect hydrological and biological data referenced in the preserve mitigation plans to ensure impacts do not occur to the hydrology or habitat in the preserves.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline reporting/monitoring requirements. The terms and conditions are non-discretionary.

1. The preservation sites will be managed in perpetuity for the control of invasive exotic vegetation as defined by the Florida Exotic Pest Plant Council's Pest Plant List Committee's 2011 List of Invasive Species (Category I and II; http://www.fleppc.org/list/list.htm) (2011), and managed for the benefit of the Florida panther and wood stork in accordance with the management and monitoring plans provided as part of this action.

2. The method of preservation for the proposed mitigation parcels shall be by conservation easement granted to the District or a Service-approved, non-profit entity with experience in managing conservation lands. Once the exotic vegetation has been removed and the native vegetation restored, the preserve lands outside of the development footprint (approximately 1,533.77 ac) are to be donated to the State of Florida or another appropriate public entity capable of providing such services and approved by the Service. In addition to the donation of the property to an appropriate public entity, the applicant will also establish a non-wasting escrow fund for the perpetual maintenance and monitoring of the donated preserve. The amount of the non-wasting endowment funds will be determined at the time the preserve is turned over and will be based on the perpetual maintenance and monitoring needs as determined and approved through coordinated discussions with the land recipient and the Service at the time of the proposed transfer. The monies generated from the non-wasting endowment funds must be sufficient to fund all land management costs including site fencing and fire break maintenance, taxes (if non-government), liability insurance (if site access is proposed and if non-government), site maintenance and monitoring actions, corresponding monitoring reports, escrow holder handling fee, and a 10 percent contingency category. To make the fund non-wasting, a capitalization rate will be determined by the State of Florida (or other appropriate entity to receive the lands) in coordination with and approved by the Service at the time the property is turned over.

3. Until such time as the land transfers have occurred, the entirety of the preserves shall be placed into conservation easements with enforcement rights granted to the District, Corps, Service, and Collier County. The conservation easements shall be filed in the county in which the properties are located and copies provided to the Service within 90 days of permit issuance and prior to any onsite land clearing. It is also the responsibility of the applicant to reach the success criteria outlined in the Hacienda Lakes Mitigation and Monitoring Plan prior to donation and to maintain the preserve until donation to the State (or other appropriate entity to receive the lands) with an approved escrow fund.

4. The Corps will provide a copy of the final permit to the Service upon issuance. The Corps will monitor the permit conditions regarding conservation measures to minimize incidental take of panthers and wood storks by providing the Service a report on implementation and compliance with the conservation measures within 1 year of the issuance date of the permit.

5. The Corps will provide documentation to the Service of all proposed onsite and offsite restoration and verification of the execution and terms of the conservation easements and the development and execution of the land transfer and endowment funds within 1 year of completion of the restoration.

6. Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office; Fish and Wildlife Service; 9549 Koger Boulevard, Suite 111; St. Petersburg, Florida 33702; 727-570-5398. Secondary notification should be made to the FWC; South Region; 3900 Drane Field Road; Lakeland, Florida; 33811-1299; 1-800-282-8002; and

   Care should be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured individuals or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends that the Corps continue to closely coordinate with us on the implementation of their Federal CWA section 404 permit program in areas where panthers and wood storks may be affected, so that - where applicable - compensation can be designed in such a manner that it provides benefits to these species. Additional guidance can be found in the Florida panther SLOPES (Service 2000) and the Wood Stork SLOPES and Effect Determination Key (Service 2010b).

The Service is not proposing any further conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the Hacienda Lakes development project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

(1) the amount or extent of incidental take is exceeded; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Thank you for your cooperation in the effort to protect fish and wildlife resources. If you have any questions regarding this project, please contact Allen Webb at 772-469-4246.

Sincerely yours,

for Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Fort Myers, Florida (Monika Dey)
EPA, West Palm Beach, Florida (Ron Meidema)
FWC, Naples, Florida (Darrell Land)
FWC, Tallahassee, Florida (FWC-CPS, Kipp Frohlich)
Service, Atlanta, Georgia (Ken Graham)
Service. Florida Panther NWR, Naples, Florida (Kevin Godsea)

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Table 1. Project Acreage and Compensation Summary

Project Acreage (ac)		Upland (ac)	Wetlands (ac)	Waters (ac)	Total (ac)
		496.72	1752.56	12.86	2262.14
Development Footprint	Total	224.94	455.71	9.48	690.13
	Development	224.24	443.55	4.39	672.18
	Preserve	0.70	12.16	5.09	17.95
Development Preserve	Total	0.70	12.16	5.09	17.95
Onsite Preserve		271.79	1296.85	3.38	1572.02
Summary Preserve (Onsite+Development Preserve)		272.49	1309.01	8.47	1589.97

Table 1a. Project Acreage and Compensation – Florida Panther

Panther Impacts	Upland (ac)	Wetlands (ac)	Waters (ac)	Total (ac)	PHU
Development	224.24	443.55	4.39	672.18	
Development Preserve	0.70	12.16	5.09	17.95	
Access Easements and ROW not to be placed in conservation easement	8.74	29.20	0.32	38.26	
Totals	233.68	484.91	9.80	728.39	3,129
Compensation Need 2.5 times PHU total					**7,823**
Onsite Panther Preserve	Upland (ac)	Wetlands (ac)	Waters (ac)	Total (ac)	PHU
Total Onsite Preserve	263.08	1267.63	3.06	1533.77	12,059
Total Compensation Provided	263.08	1267.63	3.06	1533.77	**12,059**

Table 1b. Project Acreage and Compensation – Wood Stork

Wood Stork	Wetland Acres		Biomass (kg)
Development (Including Preserves Not to be Placed Under Conservation Easement)	Total	485.01	132.31
	Short	478.51	113.36
	Long	6.50	18.95
	Loss		**132.31**
Onsite Preserve	Total	1,280.41	459.54*
	Short	1,230.12	354.05*
	Long	50.29	105.49*
	Gain		**459.54***

* Gain over existing baseline biomass following restoration.

Table 2. Reported Minimum Panther Population Counts

Year	Total	Mortality	Net
2000	62	13	49
2001	78	11	67
2002	80	14	66
2003	87	24	63
2004	78	20	58
2005	82	12	70
2006	97	19	78
2007	117	25	92
2008	104	23	81
2009	113	24	89
2010	115	24	91
2011	111	21	90

Table 3. Habitat preservation efforts resulting from formal and informal consultations with the Service for projects affecting Florida panther habitat from March 1984 to April 2012.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	530	0	0	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	1,517	0	0	0
10/17/86	4-1-87-016 4-1-87-017	unknown	NPS, BCNP (Exxon Master Plan Modification)	Collier	9	0	0	0
01/07/87	4-1-86-303	86IPM-20130	Collier Enterprises (citrus grove)	Collier	11,178	0	0	0
01/11/88	4-1-88-029	unknown	NPS, BCNP (NERCO - Clements Energy, Inc.)	Collier	3	0	0	0
02/23/88	4-1-88-055	unknown	NPS, BCNP (Shell Western E&P, Inc.)	Collier Miami-Dade Monroe	0	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81	USDOT, FHA (SR 29/I-75 Interchange)	Collier	350	0	0	0
08/15/90	4-1-90-289	unknown	NPS, BCNP [I-75 Rec. Access Plan (MM 31, 38, 49)]	Collier	150	0	0	0
09/24/90	4-1-90-212	89IPD-20207	U.S. Sugar Corp (46 mi2 ag conversion)	Hendry	28,740	700	0	700
10/23/1991	4-1-91-309	199130649	Miller Boulevard Extension (dirt road, pot hole fill and repair)	Collier	5	0	0	0
01/14/92	4-1-91-325	199101279 (IP-HH)	Dooner Gulf Coast Citrus (32 acre citrus grove)	Collier	40	40	0	40
09/25/92	4-1-92-340	unknown	BIA, STOF, BCSIR (1,995 acre citrus grove)	Hendry	1,995	0	0	0
06/18/93	4-1-93-217	199200393 (IP-SL)	Lee County DOT (Corkscrew Road)	Lee	107	0	0	0

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
02/25/94	4-1-94-209	199301131 (IP-KC)	Lee County DOT (Daniels Road extension)	Lee	65	0	0	0
05/09/94	4-1-93-251	199202019 (IP-KA)	Corkscrew Enterprises (The Habitat)	Lee	575	437	107	544
10/27/94	4-1-94-430	199302371 (IP-BB) 199400807 (IP-BB) 199400808 (IP-BB)	Timberland and Tiburon Florida Gulf Coast University Treeline Boulevard	Lee	1,088	526	0	526
03/15/95	4-1-94-F-247	19,930,041	Port LaBelle citrus farm revision	Glades Hendy	23	0	0	0
04/03/95	4-1-93-F-390	199,301,206	Sarasota County Landfill revision	Sarasota	550	0	0	0
05/24/95	4-1-95-230	199302130 (IP-TB)	FDOT, I-75 (Turner River access @ MM 70)	Collier	1,936	0	0	0
08/07/95	4-1-95-274	199405501 (IP-AW)	Bonita Bay Properties, Inc. (golf course)	Collier	509	491	0	491
08/15/95	4-1-94-214	199301495 (IP-MN)	SWFIA, Northeast Access Road	Lee	14	0	0	0
09/19/96	4-1-95-F-230	199302052 (IP-TB) 199301404 (IP-TB)	FDOT, I-75 (Central and West Broward access) FDOT, I-75 (Miami Canal Access)	Broward	116	0	0	0
03/10/98	4-1-98-F-3	L30(BICY)	NPS, BCNP (Calumet Florida, Inc. seismic testing)	Collier Miami-Dade Broward	0	0	0	0
03/27/98	4-1-97-F-635	199604158 (IP-SB)	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	359	190	0	190
06/11/99	4-1-98-F-398	199800622 (IP-SS)	STOF, BCSIR (water conservation plan)	Hendry	1,091	0	0	0

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
09/27/99	4-1-98-F-310	199130802 (IP-SB)	Lee County DOT (Daniels Parkway extension)	Lee	2,093	0	94	94
12/08/99	4-1-98-F-517	199607574 (IP-MN)	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	239	0	24	24
04/17/00	4-1-98-F-428	199507483 (IP-AM)	Miromar Development, Inc. (Miromar Lakes)	Lee	785	0	194	194
02/21/01	4-1-00-F-135	199803037 (IP-SR)	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	106	0	0	0
04/17/01	4-1-00-F-584	200001436 (IP-MN)	WCI Communities, Inc. (Sun City - Ft. Myers)	Lee	1,183	0	408	408
07/30/01	4-1-94-357	199003460 (IP-TB)	Naples Golf Estates	Collier	439	175	0	175
08/31/01	4-1-00-F-183	199900411 (IP-SR)	Worthington Communities, Inc. (Colonial G&CC)	Lee	1,083	0	640	640
12/14/01	4-1-00-F-585	199301156 (IP-MN)	SWFIA, Mid-field Terminal Expansion	Lee	8,058	0	6,986	6,986
03/07/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC)	Collier	121	75	80	155
04/24/02	4-1-01-F-148	199901378 (IP-SR)	Schulman, Robert, Trustee (Hawk's Haven)	Lee	1,531	267	0	267
09/24/02	4-1-01-F-135	200001574 (IP-DY)	State Road 80, LLC (Verandah)	Lee	1,456	0	320	320
10/08/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
05/19/03	4-1-02-I-1741	200200970 (IP-DEY)	Apex Center	Lee	95	10	18	28
06/10/03	4-1-01-F-1955	200003795 (IP-DY)	Walnut Lakes	Collier	157	21	145	166
06/18/03	4-1-01-F-136	199701947 (IP-SR)	Twin Eagles Phase II	Collier	491	57	98	155

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
06/23/03	4-1-01-F-143	199905571 (IP-SR)	Airport Technology Center	Lee	116	55	175	230
09/04/03	4-1-02-F-1486	200206725 (IP-MN)	State Road 80 Widening	Lee	33	2	12	14
10/06/03	4-1-02-F-0027	200102043 (IP-MN)	Bonita Beach Road Development	Lee	1,117	145	640	785
12/29/03	4-1-02-F-1743	200202926 (IP-MGH)	The Forum - Saratoga Investments	Lee	650	0	310	310
06/16/04	4-1-03-I-3401	198900960 (IP-HWB)	Olde Cypress Golf Club	Collier	389	175	0	175
01/18/05	4-1-04-F-4259	199702228 (TWM)	Bonita Springs Utilities	Lee	79	0	108	108
03/31/05	4-1-04-F-5656	200306759 (NW-MAE)	Gateway Shoppes II	Collier	82	0	122	122
04/08/05	4-1-04-F-8176	2004-5312 (AEK)	Big Cypress Rock Mine	Broward	110	0	220	220
04/29/05	4-1-04-F-5780 4-1-04-F-5982	2003-5331 (IP-TWM) 2003-6965 (IP-TWM)	Worthington Holdings Arborwood & Treeline Avenue Extension	Lee	2,330	0	1,700	1,700
06/06/05	4-1-03-F-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
09/26/05 10/26/05	4-1-04-F-9348	2004-1122 (IP-RMT)	Super Target Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	6	0	8	8
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	207	0	305	305
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	47	0	23	23

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	67	0	43	43
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
01/26/06	4-1-04-F-8940	20047053	The Orchard	Lee	93	0	81	81
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	17	0	47	47
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
03/31/06	4-1-05-PL-11343	20051909	Coral Keys Homes	Dade	31	0	61	61
02/25/05 03/*16*/05 06/29/05 04/04/06	4-1-04-F-6866	200309416 (NW-MAE)	Ava Maria University	Collier	5,027	0	6,114	6,114
05/09/06	41420-2006-F-0089	200403248	Collier Boulevard, Immokalee Rd. to Goldengate Blvd.	Collier	14	0	16	16
05/05/06	41420-2006-I-0274	2005-6176	Santa Barbara , Davis to Radio Road, Widening	Collier	6	0	3	3
05/09/06	41420-2006-I-0263	200506248	Santa Barbara Radio Road, Widening.	Collier	29	0	20	20
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
06/05/06	4-1-05-PL-8486	20041688	Seacrest School	Collier	31	0	16	16
06/09/06	4-1-05-PL-10965	200303733	HHJ Development	Dade	3	0	4	4
06/14/06	4-1-05-F-11855	200411010	Keysgate School Site	Dade	39	0	62	62
06/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	Collier	29	0	36	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	326	326
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
07/28/06	4-1-05-F-12330	20047920	Hamilton Place	Dade	10	0	50	50

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
08/21/06	41420-2006-I-0540	20041813	ASGM Business Park	Dade	41	0	25	25
09/12/06	41420-2006-F-0554	20057414	Miccosukee Government Complex	Dade	17	0	37	37
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	Collier	17	0	35	35
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	12	0	18	18
07/02/03 10/16/06	4-1-98-F-428 41420-2006-F-0667	199507483	Miromar Lakes Addition	Lee	366	169	390	559
10/18/06	41420-2007-F-0026	2004777	Treeline Preserve	Lee	97	0	95	95
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	30	30
10/26/06	41420-2006-I-0849	20055702	Marina Del Lago	Lee	49	0	36	36
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	38	0	52	52
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
10/27/06	41420-2006-I-0607	20064878	Seminole Reservation Access Road	Hendry	2	0	5	5
11/15/06	41420-2007-FA-0222	200412415	Barry Goldmeier 5th Avenue Estates	Dade	15	0	18	18
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	27	0	19	19
11/16/06	41420-2006-TA-0060	N/A	Collier County Elementary School K	Collier	26	0	17	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	58	0	29	29
12/07/06	41420-2006-FA-0781	20041689	Cypress Landing	Collier	46	0	18	18
01/19/07	41420-2006-I-0871	20061359	Brighton Veterans Center	Glades	9	0	8	8

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	323	0	371	371
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	39	0	36	36
05/01/07	41420-2006-I-0992	20045223	Seminole Motocross	Hendry	58	5	19	24
05/04/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	31	31
05/07/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	124	0	140	140
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111	29	110	139
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	11	0	15	15
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	Collier	35	0	18	18
06/14/04 03/21/05 08/24/07	4-1-04-F-5744	199603501 (IP-TWM)	Terafina	Collier	437	210	261	471
08/31/07	41420-2007-I-0866	2006-7022	Collier County School Site L	Collier	32	0	21	21
09/05/07	41420-2006-I-0051	2005-4186	Gulf Coast Landfill Expansion	Lee	123	0	65	65
09/17/07	41420-2007-FA-1540 41420-2007-FA-1540	2006-7875	Ave Maria Substation	Collier	4	0	3	3
10/31/07	41420-2007-F-1035	2004-3931	Big Cypress Regional General Permit - 83	Hendry Broward	100	0	175	175
01/09/08	41420-2006-FA-0927,0871	2006-1359	Horseshoe Community Expansion	Glades	52	37	19	57
01/22/08	41420-2008-FA-0021 41420-2008-I-005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	7	0	44	44
01/30/08	41420-2008-FA-0009 41420-2008-I-003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	7	0	12	12
02/07/08	41420-I-0015	200502117	Cleveland Clinic	Lee	36	0	19	19

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
02/07/08	41420-2007-FA-1120 41420-2007-I-0862	1993-0862	Poinciana Parkway	Polk	187	0	236	236
04/28/08	41420-2008-I-0313	2007-6414	Immokalee Rd Substation	Collier	1	0	1	1
04/28/08	41420-2008-FA-0126	2007-5187	A&H Commerce Park	Miami-Dade	100	0	150	150
06/26/08	41420-2007-FA-1150 41420-2007-F-1144	2007-2175	Immokalee Master Plan	Collier	506	0	1,015	1,015
07/02/08	41420-2007-FA-0592 41420-2007-F-0491	2005-7439	Kaicasa	Collier	72	0	183	183
07/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
07/14/08	41420-2008-I-0509	2007-4314	Gridley Medical Building	Collier	4	0	2	2
03/09/07 07/23/08	4-1-04-F-6112	20021683	Alico Airpark (Haul Ventures)	Collier	166	0	315	315
07/23/08	41420-2006-FA-0165 41420-2006-F-0846	2004-182	Premier Airport Park	Lee	180	0	211	211
09/04/08	41420-2008-FA-0415 41420-2008-I-0211	1984-4913	Colonial Boulevard Widening	Lee	35	0	39	39
09/25/08	41420-2008-FA-0702 41420-2008-I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
10/21/08	41420-2007-FA-01444	2007-0754	Royal Home Villas	Miami-Dade	19	0	57	57
12/17/08	41420-2006-FA-0023 41420-2008-F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
01/13/09	41420-2007-FA-1111 41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
01/30/02 02/12/09	4-1-98-F-372 and 41420-2006-F-0267	199402492 (IP-ML)	Florida Rock Industries, Inc. (Fort Myers Mine #2)	Lee	2,886	1,986	0	1,986
02/26/09	41420-2006-FA-0548 41420-2006-F-1011	2006-7018	Oil Well Road Widening	Collier	328	529	356	885
3/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier	240	0	102	102
04/30/09	41420-2009-FA-0555 41420-2009-I-0262	2009-00315	Alligator Alley Service Plaza Expansion	Broward	25	0	35	35
06/10/09	41420-2008-FA-0804	2007-7467	Greenfrog Substation	Miami-Dade	3	0	12	12
06/29/09	41420-2007-FA-1534 41420-2007-I-1186	2007-1676	Tamiami Crossing Commercial Development	Collier	25	0	19	19
07/10/09	41420-2007-FA-0283 41420-2007-I-0367	2008-4470	Home Center Plaza	Collier	16	0	5	5
11/03/09	41420-2009-FA-0619	Miccosukee	Emergency Helicopter Pad	Miami-Dade	1	0	1	1
11/03/09	41420-2007-FA-0620 41420-2007-I-0262	none	Tiger Camp Expansion	Miami-Dade	1	0	1	1
11/06/09	41420-2009-FA-0522	Seminole Tribe	Stanlo Compost Facility	Glades	2	0	6	6
01/05/10	41420-2009-FA-0523 41420-2009-I-0262	2005-2117	Bonita Beach Road East Water Storage Tank	Lee	15	0	5	5
01/28/10	41420-2010-CPA-0081 41420-2010-I-0068	2009-03039	Snake Road Improvements	Broward Hendry	18	0	20	20
03/03/10	41420-2010-CPA-0154 41420-2010-I-0129	2009-03450	Naples Landfill Gas to Energy	Collier	1	0	2	2
06/21/10	41420-2008-FA-0798 41420-2008-I-0928	2008-2429	Shaggy Sypress Ag. Operation	Collier	10	0	22	22
06/21/10	41420-2008-FA-0799 41420-2008-I-0929	2008-2429	Camp Keais Strand Ag. Operation	Collier	6	0	36	36

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
04/05/11	41420-2010-CPA-0134 41420-2010-F-0462	N/A	Big Cypress Seminole Indian Reservation Home Site Plan	Hendry Broward	225	0	395	395
02/21/03 03/09/05 03/02/07 05/03/07 05/24/11	4-1-01-F-607	200001926 (IP-SB)	Mirasol	Collier	810	914	363	1277
06/28/11	41420-2010-CPA-0525 41420=2010-F-0395	201001432 (IP-JPF)	I-75 Recreation Area at L29 Canal	Collier	15	0	28	28
03/30/11 07/07/11	41420-2011-CPA-0106 41420-2011-F-0108	2011-00391	Green Meadow Water Treatment Plant	Lee	23	0	33	33
8/4/2011	41420-2010-FA-0265,F-0164	2010-00191 (IP-JPF)	SR 80 from CR 833 to US 27 Widening	Hendry	40	0	41	41
10/19/11	41420-2007-FA-0564	2008-615-(ACR)	Hogan Island Quarry	Collier	968	41	1,181	1222
01/25/12	41420-2012-CPA-0112, F-0179	2009-01116	University Highlands Limited	Lee	208	0	181	181
08/21/06 02/07/12	4-1-03-F-3127	19956797	Atlantic Civil Ag Permit Extension	Miami-Dade	981	0	1,553	1,553
03/06/12	41420-2011-CPA-0133, F-0132	SAJ-2011-00926 (IP-GGL)	I75 Interchange and Access Road at SWFIA	Lee	139	0	44	44
11/13/07 03/21/12	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	138	0	134	134
06/01/12	41420-2011-CPA-0220 41420-2010-F-0213	SAJ-2011-00942 (IP-GGL)	SR 80 from Birchwood Parkway to Dalton Lane Road Widening	Hendry	40	0	23	23
06/05/12	41420-2011-CPA-0225 41420-2011-F-0218	SAJ-1993-15402 (IP-GGL	I-75 at Mile Marker 63 Rest Area	Collier	7		22	22
06/09/00 06/06/12	4-1-99-F-553	199900619 (IP-SB)	Vineyards Development Corp. (Naples Reserve GC)	Collier	748	75	346	421

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved On-site (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
09/08/05 03/28/08 07/13/12	4-1-04-F-5260 and 41420-2008-F-0112	200106580	Parklands Collier	Collier	301	341	434	775
07/18/12	41420-2006-F-0204	2003-11158 (IP-MJD)	Hacienda Lakes	Collier	728	1,534	0	1,534
pending	41420-2011-F-0240	2009-03941 (IP-JSC)	Seminole Rock Mine	Broward	205		1,062	1,062
				Total	**96,228**	**11,392**	**32,719**	**44,111**

Table 4. Land Held for Conservation within the Florida Panther Core Area

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
Total	2,578,152		2,073,865

Table 5. Undeveloped Privately Owned Land within Florida Panther Core Area

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
Total	1,798,295		1,202,699

* About 819,995 acres are at risk in the Other Zone with about 80 percent with resource value

Table 6. Wood Stork Nesting Data in the Southeastern U.S. (Gawlik 1987, Service 2011)

YEAR	TOTAL		3-Year Running Average Total		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies
1981	4,442	22			2,365	19	275	2	11	1		
1982	3,575	22			778	19	135	2	20	1		
1983	5,983	25	4,667	23	2,350	22	363	2	20	1		
1984	6,245	29	5,268	25	1,550	25	576	3	22	1		
1985	5,193	23	5,807	26	1,455	17	557	5	74	1		
1986	5,835	36	5,758	29	5,067	29	648	4	120	3		
1987					**		506	5	194	3		
1988					**		311	4	179	3		
1989					**		543	6	376	3		
1990					**		709	10	536	6		
1991	4,073	37			2,293	23	969	9	664	3		
1992					**		1,091	9	475	3		
1993	6,729	43			4,262	28	1,661	11	806	3		
1994	5,768	47			3,589	26	1,468	14	712	7		
1995	7,853	54	6,783	48	5,617	33	1,501	17	829	6		
1996					**		1,480	18	953	7		
1997	5,166	59			2,870	36	1,379	15	917	8		
1998					**		1,665	15	1,093	10		
1999	9,978	71			7341	42	1,139	13	520	8		

YEAR	TOTAL		3-Year Running Average Total		FLORIDA		GEORGIA		SOUTH CAROLINA		NORTH CAROLINA	
	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies	Nesting Pairs	Colonies
2000					**		566	7	1,236	11		
2001	5,582	44			3,246	23	1,162	12	1,174	9		
2002	7,855	70			5,463	46	1,256	14	1,136	10		
2003	8,813	78	7,417	64	5,804	49	1,653	18	1,356	11		
2004	8,379	93	8,349	80	4,726	63	1,596	17	2,034	13		
2005	5,572	73	7,588	81	2,304	40	1,817	19	1,407	14	32	1
2006	11,279	82	8,410	83	7,216	47	1,928	21	1,963	12	132	1
2007	4,406	55	7,086	70	1,553	25	1,054	15	1,607	14	192	1
2008	6,118	73	7,268	70	1,838	31	2,292	24	1,839	16	149	1
2009	12,720	86	7,748	71	9,428	54	1,676	19	1,482	12	134	1
2010	8,141	94	8,993	84	3,820	51	2,708	28	1,393	14	220	1
Average*	7,887	75	7,857	76	4,540	43	1,714	19	1,539	13	143	1

* Average is based on consecutive years of data (2001 through 2010)

Table 7. Total Number of Wood Stork Nesting Pairs within the Everglades and Big Cypress Basins, 1996 to Present

Year	Nesting Pairs	Colonies	3-Year Running Average	
			Nesting Pairs	Colonies
1996	1,215	1	--	--
1997	445	4	--	--
1998	478	3	713	3
1999	2,674	16	1,199	8
2000	3,996	8	2,383	9
2001	2,888	9	3,186	11
2002	3,463	11	3,449	9
2003	1,747	9	2,669	10
2004	1,485	9	2,232	10
2005	591	3	1,274	7
2006	2,648	9	1,575	7
2007	696	7	1,312	6
2008	344	4	1,229	7
2009	5,816	25	2,285	12
2010	1,282	13	2,481	14
Average	1,985	9		

Table 8. Panther-Vehicle Collisions within the Hacienda Lakes Action Area as of November 2011.

Date	Panther	Sex	Location	Distance	Direction
12/23/79	UCFP04	F	SR 29 just N SR 84	21	E
2/7/80	UCFP05	M	SR 29 near Sunniland	24.1	NE
4/19/81	UCFP06	F	SR 29 near Copeland	21.4	ESE
12/14/83	FP01	M	SR 84 18 MM	18.1	NE
11/12/84	UCFP12	F	SR 84 16 MM	16.3	NE
1/8/85	UCFP13	F	SR 84 MM16	16.5	NE
4/18/85	FP04	M	SR 84 17 MM	17.5	NE
10/26/85	FP07	M	SR 29 4 MI S SR 84	20.8	E
11/15/86	UCFP15	F	SR 84 16.5 MM	16.6	NE
12/14/87	FP13	M	SR 29 Sunniland	23.5	NE
11/26/90	FP37	M	SR 29 .5 M N I-75	21.1	E
2/4/91	UCFP20	F	SR 29 Pistol Pond Bridge	23.1	E
11/9/92	UCFP21	F	SR 29 Sunniland	23.5	NE
3/3/94	FP31	F	SR 29 Sunniland	23.5	ESE
7/17/98	FP51	M	SR 29 @ Bear Island Grade	21.2	E
1/15/00	FP63	M	6 mile N. of Pistol Pond, E. side of SR29 in Canal	23.3	E
2/28/00	K76	M	1 MI W SR 29, on CR 858	24.5	NE
5/7/01	UCFP40	M	SR 29 1/2 MI N of Jerome	21.6	ESE
5/7/01	UCFP39	F	SR 29 1/2 MI N of Jerome	21.7	SE
5/22/01	UCFP41	M	SR 29 Sunniland, near Mine Rd	23.6	NE
11/28/02	FP99	M	CR846 1/4 MI N Collier Fairground	16.5	NNE
4/10/02	UCFP46	M	1/2 MI N of Deep Lake, Collier	21.1	ESE
7/1/02	FP98	M	1 KM N Pistol Pond, SR 29	23.3	NE
12/9/03	UCFP60	M	US41, ~ 1 MI east of CR92	10.17	SSE
1/26/03	UCFP50	M	CR846 3.4 MI E Everglades Blvd	21.3	NNE
6/30/03	UCFP58	F	CR846 3/4 miles E of Everglades Blvd.	21.7	NNE
2/20/03	FP106	F	SR29 at Sunniland Mine entrance	23.5	NE
11/2/03	UCFP59	F	CR 858, 1.2 miles west of SR 29	23.6	NE
2/26/04	UCFP63	M	I-75, MM99 eastbound lane	3.9	NNE
8/17/04	K94	M	I-75, NEAR MM98 Eastbound Lane	4.6	NNE
6/27/04	UCFP66	M	I-75, MM93 0.5 MI W Everglades Blvd	8.3	NE
4/6/04	UCFP65	M	SR29, 200 YD N Bear Island Grade	22.3	E
4/7/05	UCFP73	M	CR951 S of Rattlesnake Hammock Road	0.5	WSW
8/29/05	K153	M	CR951, 1.2 M south of Davis Blvd.	2.8	NNW
9/18/05	UCFP76	M	US 41, 1.4 M east of CR 951	3.8	N
2/25/05	UCFP72	M	SR 29 near Jerome	21.3	ESE
12/2/05	K49	F	SR 29 1 mi N Wagon Wheel Road	22.3	SE
11/26/06	UCFP88	F	US 41 between Manatee Rd and CR951	3.6	S
1/26/06	UCFP79	F	CR846 2 mi N of CR858 - near Collier fair	17.3	NNE
7/6/06	UCFP86	U	SR29 0.6 mi south of Sunniland	23.4	NE
8/24/06	UCFP87	M	Corkscrew Rd. near Alico, Lee County	23.9	N
4/3/07	UCFP94	M	I-75 2 mi E of toll booth MM98, Collier County	4.5	NNE
6/11/07	UCFP98	M	SR29 at Jerome wildlife crossing	21.9	SE
3/29/07	UCFP92	M	US 41 1.2 mi W of SR 29	22.4	SE
9/12/07	UCFP102	M	I-75, 1.5 miles east of SR29	22.7	E

Date	Panther	Sex	Location	Distance	Direction
5/14/07	UCFP97	F	Corkscrew Rd. near Alico Road	23.8	N
3/30/07	UCFP93	M	I-75 .5 mi N Corkscrew Road, Lee County	24.4	NNW
5/22/08	UCFP107	F	2.4km S of US41 on CR951, moving east to west	4.8	SSW
3/9/08	UCFP103	M	Pine Ridge Road, half-way between CR951 and Logan Blvd.	7.6	NNW
7/28/08	UCFP108	F	Imokolee Road 1.7 Miles E of Oil Grade Road	21.3	NNE
11/29/08	UCFP114	F	CR858 (Oil Well Rd), Collier County; 1 mile east of Camp Keais Rd	21.6	NE
4/12/08	UCFP104	F	SR29, 2.6 km north of US 41	23.3	SE
12/31/09	UCFP136	F	County Barn Rd, .3 mi S of Davis Blvd	3.8	NW
9/6/09	UCFP125	F	I-75, MM 96.5	5.3	NNE
8/5/09	UCFP124	F	I-75 at MM 90	11.6	NE
1/17/09	K253	M	Eastbound exit ramp, I-75/SR29	20.8	E
5/14/09	UCFP121	M	SR29 approx. 4 miles South of -I75	20.8	E
12/29/09	UCFP135	F	2 miles N of Jerome on SR29	21.4	SE
5/25/09	UCFP122	M	Along Immokalee Road (n. side of road) near Camp Keasi Road	24.2	NNE
5/23/10	UCFP143	M	US41, 1.5 mi east of CR951	3.8	S
3/16/10	FP174	M	I-75 eastbound, MM95	5.7	NE
5/22/10	FP158	F	US 41, 0.5 mi east of SR92 (San Marco Rd)	9.3	SSE
5/3/10	UCFP142	F	Golden Gate Blvd near 7th St NE	9.3	NNE
12/13/10	UCFP149	M	GG Blvd at 7th ST NW, Collier County	9.3	NNE
4/15/10	UCFP140	M	1-75, MM 117, Lee County	17.1	N
1/21/11	UCFP153	M	MM98 on I75 Westbound, Collier County	4.2	NNE
1/13/11	UCFP152	F	MM98 on I75 Eastbound, Collier County	4.4	NNE
2/26/11	UCFP156	M	I-75 near MM114, Collier County	5.7	NE
3/25/11	FP83	F	US41 west of Port of the Islands	12.6	SSE
01/07/12	UCFP167	F	US41 west of Manatee Road, Collier County	4.4	S

Table 9. Consultations receiving compensation for panther habitat impacts within the Hacienda Lakes project watershed (5-mile radius)

Action	Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved Onsite (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
BO	3/7/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC)	Collier	121	75	80	155
BO	10/8/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
BO	5/18/05	4-1-03-I-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	44	0	64	64
BO	6/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
BO	7/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	231	0	61	61
BO	12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	23	0	23	23
BO	1/13/06	4-1-04-F-6707	20042404	Journey's End	Collier*	66	0	34	34
BO	2/9/06	4-1-05-11724	2005384	Firano at Naples	Collier*	24	0	19	19

Action	Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved Onsite (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
NLAA	5/9/06	41420-2006-I-0274	2005-6176(NW-RMT)	Santa Barbara Road from Davis Road to Radio Road	Collier	6	0	3	3
NLAA	5/9/06	41420-2006-I-0263, FA-0657	2005-6298 (NW-RMT)	Santa Barbara and Radio Roads	Collier	29	0	20	20
BO	5/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier*	1,017	1,313	223	1,536
NLAA	6/5/06	4-1-05-PL-8486	20041688	Seact School	Collier	31	0	16	16
NLAA	6/15/06	41420-2006-I-0362,FA 0811	20056176	Collier County Wellfield	Collier	29	0	36	36
NLAA	8/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
NLAA	12/7/06	41420-2006-FA-0781, I-0327	20041689	Cypress Landing	Collier	46	0	18	18
NLAA	5/4/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	25	25
NLAA	7/14/08	41420-2008-I-0509, FA 0590	2007-4314	Gridley Medical Building	Collier	4	0	2	2
NLAA	7/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
NLAA	9/25/08	41420-2008-FA-0702, I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
BO	12/17/08	41420-2006-FA-0023, F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier*	40	0	49	49
BO	3/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier*	240	0	102	102
NLAA	6/29/09	41420-2007-FA-1534	2007-1676	Tamiami Crossing Commercial Development	Collier	25	0	19	19
NLAA	7/10/09	41420-2009-FA-0283	2008-4470	Home Center Plaza	Collier	16	0	5	5
NLAA	3/3/10	41420-2010-CPA-0154	2009-03450	Naples Landfill Gas to Energy	Collier	1	0	2	2
BO	Pending	41420-2006-F-0204	2003-11158 (IP-MJD)	Hacienda Lakes	Collier*	728	1,534	0	1,537
Total						4,821	3,762	2,330	6,095

***** 5-mile radius

Table 10 Florida Panther Habitat Matrix- Panther Habitat Units

Land Cover Types	Habitat Values	Project Development – 672.18 ac Project Footprint[1] – 728.39 ac				Total Onsite Preserve – 1,589.97 ac Not Used for Panther Compensation – 56.21 ac Total Preserve Used for Panther – 1,533.77 ac			
		Functional Units Needed 7,823 PHUs				Functional Units Provided[2] 12,059 PHUs			
		PHU Loss 3,129 PHUs				Average PHU 12,059/1,533.77 = 7.86 PHUs			
		Pre		Post[1]		Pre		Post	
		Acres	PHU	Acres	PHU	Acres	PHU	Acres	PHU
Pine Forest	9.5	67.82	644	3.92	0	191.72	1,821	309.62	2,941
Hardwood-Pine	9.3	8.17	76	2.75	0	15.08	140	17.23	160
Cypress Swamp	9.2	97.39	896	30.69	0	633.63	5,829	1,069.86	9,843
Hardwood Swamp	9.2	0.63	6	0.54	0	6.59	61	10.54	97
Hardwood Forest	9	12.16	109	0.24	0	8.12	73	10.92	98
Dry Prairie	6.3	0	0	0	0	0	0	0.93	6
Dry Prairie Restored from Ag[3]	7	-	-	-	-	-	-	9.37	66
Unimproved Pasture	5.7	0.44	3	0.44	0	73.73	421	0	0
Shrub Swamp/Brush	5.5	10.75	59	1.62	0	37.53	206	52.37	288
Marsh/Wet Prairie	4.7	0.55	3	0	0	11.80	55	26.25	123
Marsh Restored from Ag[3]	7	-	-	-	-	-	-	26.36	185
Exotic/Nuisance Plants	3	410.52	1,232	0	0	548.92	1,647	0	0
Barren/Disturbed Lands	3	34.00	102	10.60	0	3.59	11	0	0
Water	0	5.62	0	5.41	0	3.06	0	0.32	0
Urban	0	80.34	0	672.18	0	0	0	0	0
Subtotal	-	728.39	3,129	728.39	0	1498.04	10,060	1,533.77	13,807

[1] Project Footprint includes 17.95 acres of internal preserve not accessible to panther after development, and 38.26 acres of preserve not to be placed under conservation easement due to existing access easements; therefore, 56.21 acres is scored as developed (zero) in the PHU analysis although it will be enhanced and preserved.

[2] Functional Units Provided are one-half of the difference between pre and post enhancement values added to the pre value, except that agriculture lands restored to non-forested native habitat receive full restoration value.

[3] Full restoration value given to non-forested habitat restored from agricultural lands.

Table 11. Hydroperiod classes of wetlands in the action area

Hydroperiod	Core Foraging Area Acreage			
	Corkscrew I (619018)*	Corkscrew II (619310)	North Catherine Island II (619161)	Combined
Class 1 - 0 to 60 days	85,850	79,356	125,087	152,818
Class 2 - 60 to 120 days				
Class 3 - 120 to 180 days				
Class 4 - 180 to 240 days	179,871	174,366	252,818	339,711
Class 5 - 240 to 300 days				
Class 6 - 300 to 330 days				
Class 7 - 330 to 365 days				
TOTAL	265,720	253,722	377,905	492,529

Table 12. Hydroperiod classes of wetlands in the development footprint

Hydroperiod	Development Footprint – Including Preserves Not to be Placed Under Conservation Easement (Ac)
Class 1 - 0 to 60 Days	0
Class 2 - 60 to 120 Days	467.83
Class 3 - 120 to 180 Days	10.68
Class 4 - 180 to 240 Days	6.50
Class 5 - 240 to 300 Days	0
Class 6 - 300 to 330 Days	0
Class 7 - 330 to 365 days	0
Short Hydrperiod	478.51
Long Hydroperiod	6.50
Total	**485.01**

Table 13. Hydroperiods of wetland preserves

Hydroperiod	Preserve Area Footprint Pre-Enhancement (Ac)	Preserve Area Footprint Post-Enhancement (Ac)
Class 1 - 0 to 60 Days	0	0
Class 2 - 60 to 120 Days	1,084.83	1,012.57
Class 3 - 120 to 180 Days	176.32	217.55
Class 4 - 180 to 240 Days	19.26	50.29
Class 5 - 240 to 300 Days	0	0
Class 6 - 300 to 330 Days	0	0
Class 7 - 330 to 365 days	0	0
Short Hydroperiod	1,261.15	1,230.12
Long Hydroperiod	19.26	50.29
Total	**1,280.41**	**1,280.41**

Table 14. Consultations receiving compensation for wetland impacts within the Hacienda Lakes project watershed (5-mile radius)

Date	Service Number	Corps Number	Project Name	County	Action	Impact	Comp	Impact	Comp
						Project		Wetlands	
03/07/02	4-1-00-F-178	199901251 (IP-MH)	Benton, Charles (Southern Marsh GC) San Remino Mine	Collier	BO	121	155	18	130
10/08/02	4-1-02-F-014	199602945 (IP-DY)	Barron Collier Company (Winding Cypress)	Collier	BO	1,088	1,870	201	765
05/18/05	4-1-03-I-7855	2003-11156 (IP-RMT)	Collier Regional Medical Center	Collier	BO	44	64	35	78
06/29/05	4-1-03-F-3915	199806220 (IP-MAE)	Wenthworth Estates - V.K. Development	Collier	BO	917	485	94	319
07/15/05	4-1-04-F-5786	199405829 (IP-CDC)	Land's End Preserve	Collier	BO	231	61	4	35
12/06/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	BO	23	23	10	23
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	BO	66	34	3	13
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier	BO	24	19	7	22
05/09/06	41420-2006-I-0274	2005-6176(NW-RMT)	Santa Barbara Road from Davis Road to Radio Road	Collier	NLAA	6	3	0	1
05/09/06	41420-2006-I-0263, FA-0657	2005-6298 (NW-RMT)	Santa Barbara and Radio Roads	Collier	NLAA	29	20	1	1
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	BO	1,017	1,536	432	1,075
06/05/06	4-1-05-PL-8486	20041688	Seact School	Collier	NLAA	31	16	13	18
06/15/06	41420-2006-I-0362 FA 0811	20056176	Collier County Wellfield	Collier	NLAA	29	36	21	36
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	NLAA	10	9	8	13
12/07/06	41420-2006-FA-0781,I-0327	20041689	Cypress Landing	Collier	NLAA	46	18	0	0
05/04/07	41420-2007-TA-0623	NA	Abercia North	Collier	TA	25	31	0	31
07/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	NLAA	18	14	9	14
07/14/08	41420-2008-I-0509, FA 0590	2007-4314	Gridley Medical Building	Collier	NLAA	4	2	2	2
09/25/08	41420-2008-FA-0702, I-0806	1988-1061	Alligator Alley Commercial Center	Collier	NLAA	41	18	13	5
12/17/08	41420-2006-FA-0023, F -0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	BO	40	49	26	49
03/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier	BO	240	102	0	0
06/29/09	41420-2007-FA-1534	2007-1676	Tamiami Crossing Commercial Development	Collier	NLAA	25	19	12	26
07/10/09	41420-2009-FA-0283	2008-4470	Home Center Plaza	Collier	NLAA	16	5	3	6
03/03/10	41420-2010-CPA-0154	2009-03450	Naples Landfill Gas to Energy	Collier	NLAA	1	3	1	3
07/18/12	41420-2006-F-0204	2003-11158 (IP-MJD)	Hacienda Lakes	Collier	BO	728	1,538	485	1,280
				Total	**25**	**4,820**	**6,130**	**1,399**	**3,945**

Table 15. Acreage and Biomass in Hydroperiod Classes of Wetlands Suitable for Wood Stork Foraging in the Development and the Pre and Post Restoration of the Preserves.

Hydroperiod	Development Footprint		Preserve Area				Net Change*		
			Pre Enhancement		Post Enhancement				
	Acres	Kg	Acres	Kg	Acres	Kg	Acres	Kg	Nests
Class 1: 0 to 60 Days									
Class 2: 60 to 120 Days	467.83	98.06	1084.83	558.86	1012.57	825.69	(467.83)	168.77	
Class 3: 120 to 180 Days	10.68	15.30	176.32	290.47	217.55	377.69	(10.68)	71.92	
Class 4: 180 to 240 Days	6.50	18.95	19.26	48.62	50.29	154.11	(6.50)	86.54	
Class 5: 240 to 300 Days									
Class 6: 300 to 330 Days									
Class 7: 330 to 365 Days									
Short Hydroperiod	478.51	113.36	1261.15	849.33	1230.12	1203.38	(478.51)	240.69	
Long Hydroperiod	6.50	18.95	19.26	48.62	50.29	154.11	(6.50)	86.54	
TOTAL	485.01	132.31	1280.41	897.95	1280.41	1357.49	(485.01)	327.23	

* The acreage net change is based on the overall increase/decrease in suitable wood stork foraging habitat within the project. The project will result in the loss of 485 acres of wetlands and waters. The preserves include 1280.41 acres of wetlands and waters that will be restored.

* The biomass net change is based on the overall increase/decrease of biomass available to wood storks. The proposed development will provide a loss of 132.31 kg of biomass. The preserves, prior to enhancement, provide a biomass of 897.95 kg, with a post enhancement value of 1,357.49 kg, equating to an increase of 459.54 kg of biomass. Subtraction the development loss from the biomass increase from the preserve restoration, the proposed action provides a net increase of 327.23 kg of biomass available for wood stork foraging.

Table 16. Conservation Lands Collier and Lee Counties (Acres) (FNAI 2010).

Ownership	Acreages	Percent Total
Collier County – Total Land Acreage - 1,296,640		
County	4,410	0.3%
State	209,820	16.2%
Federal	647,260	49.9%
Private	11,070	0.9%
Total Conservation Lands	872,560	67.3%
Lee County – Total Land Acreage - 347,520		
County	24,460	7.0%
State	49,650	14.3%
Federal	5,270	1.5%
Private	9,050	2.6%
Total Conservation Lands	108,810	31.3%

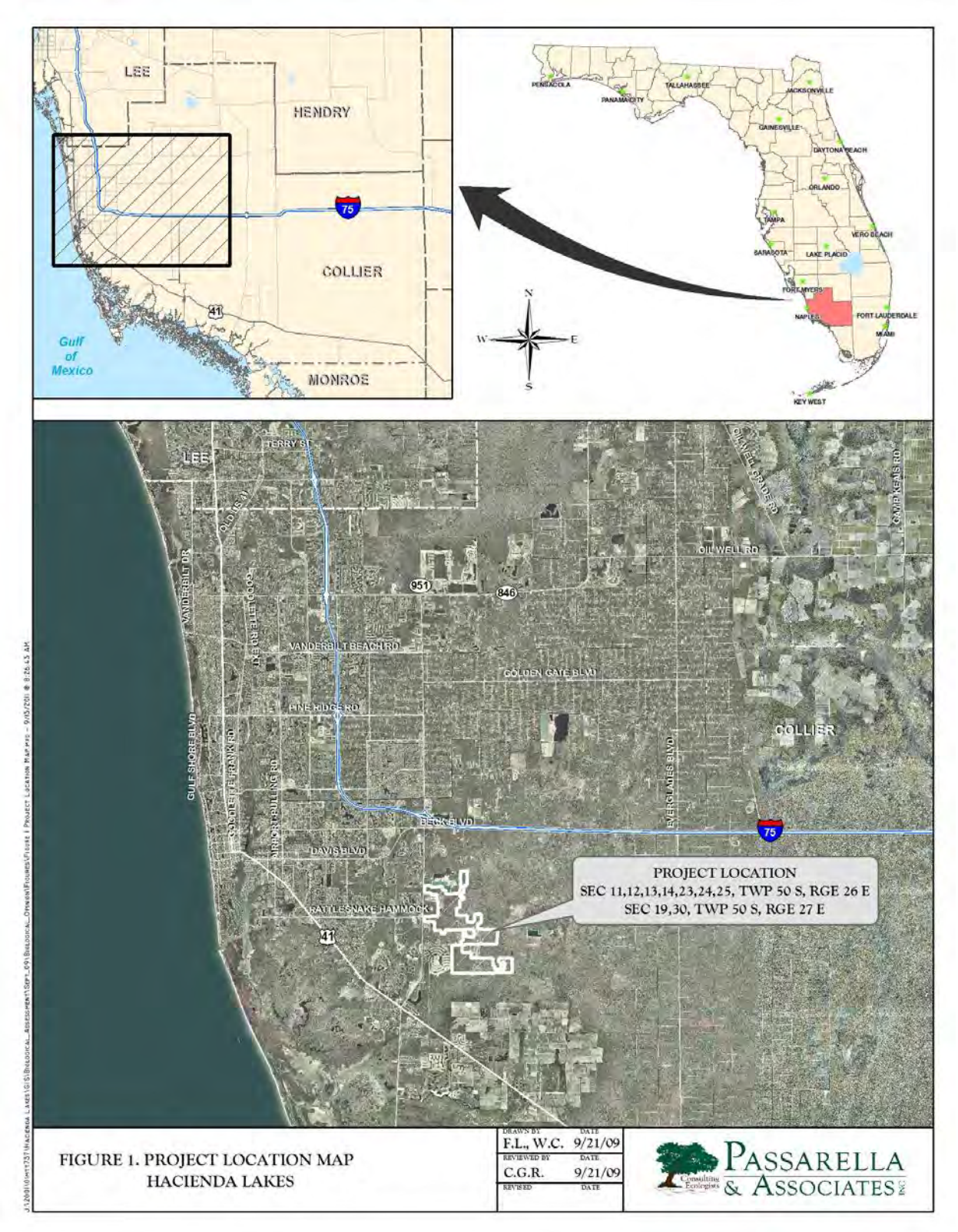

Figure 1. Location of proposed Hacienda Lakes project site.

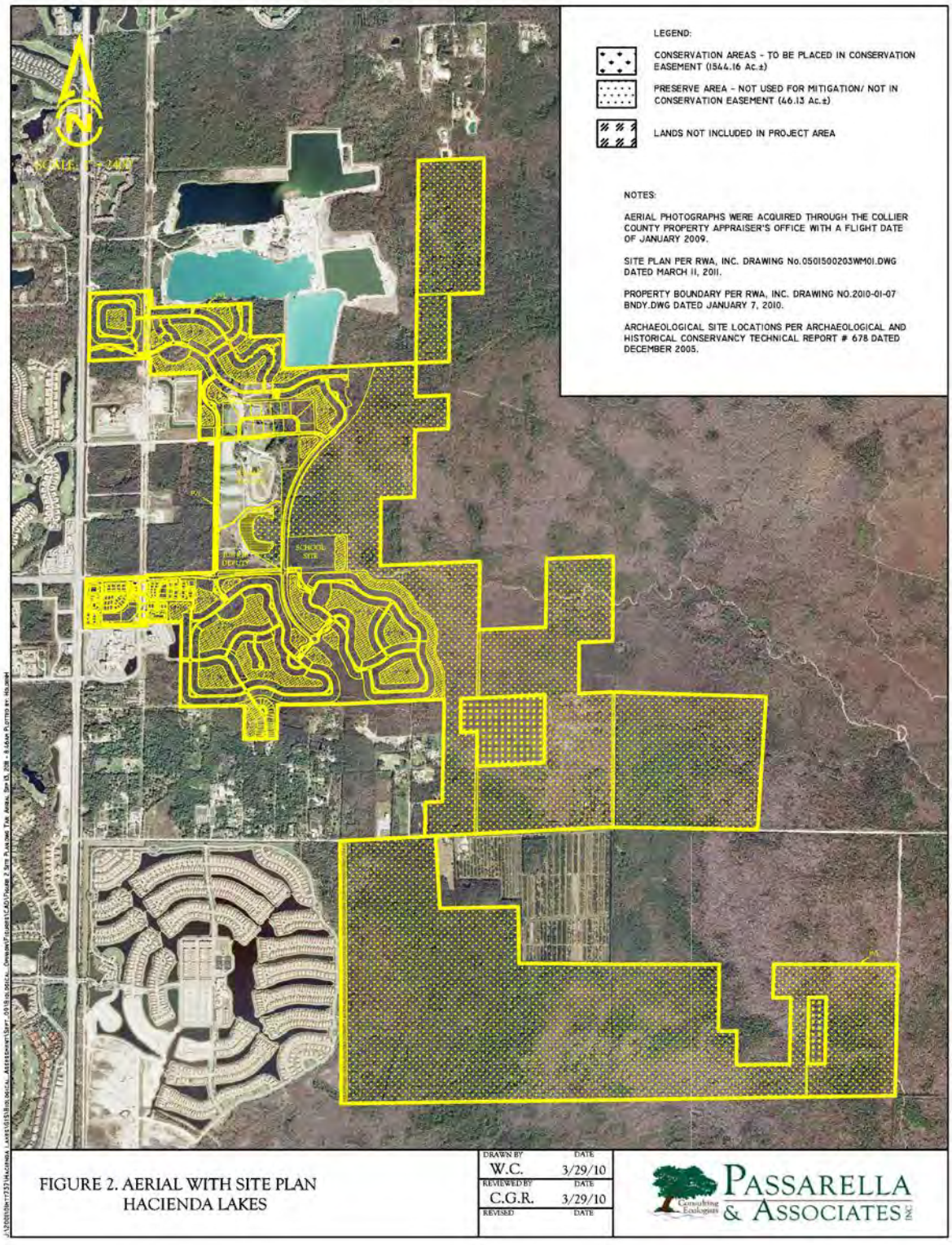

Figure 2. Site plan for Hacienda Lakes project.

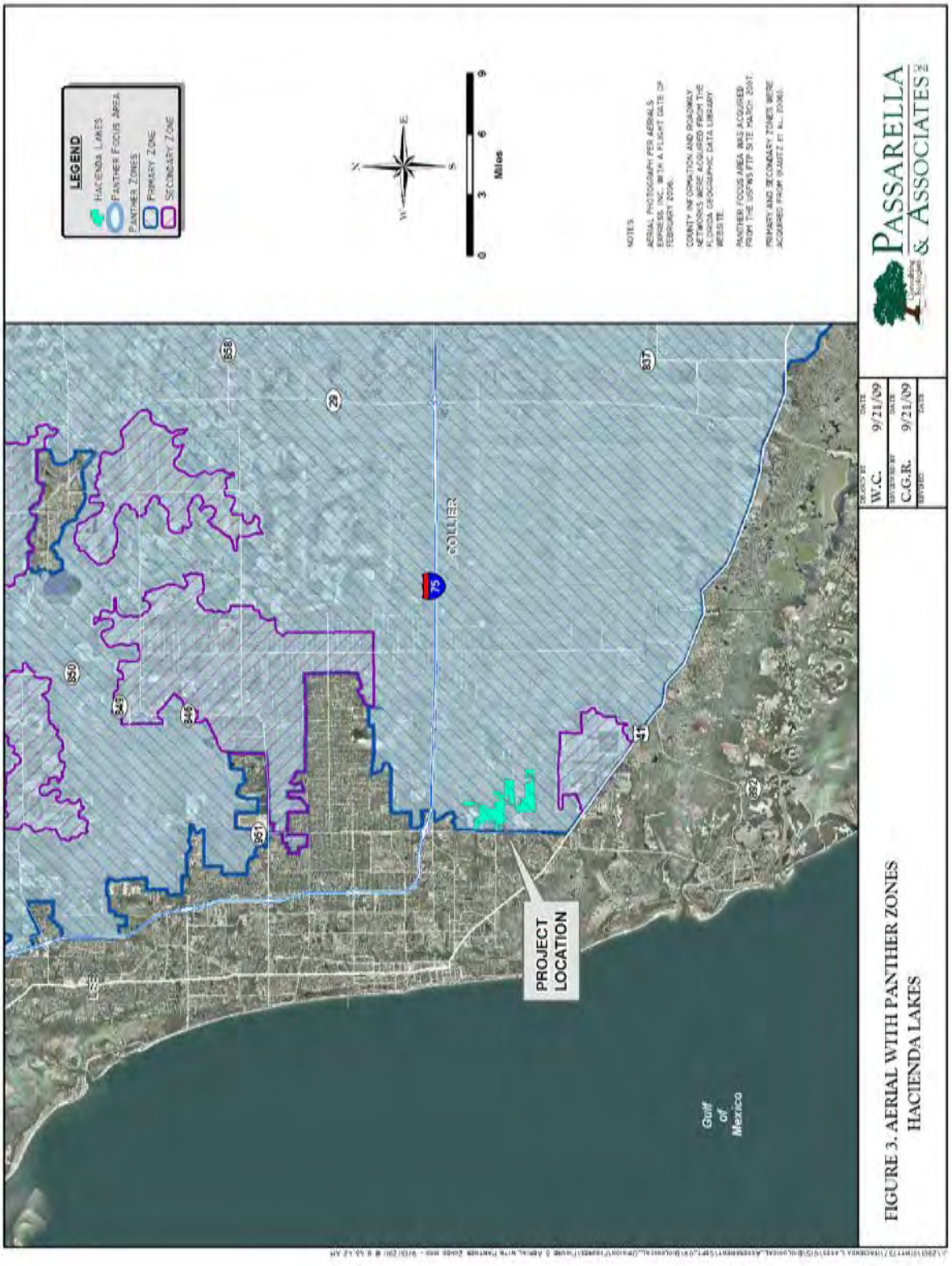

Figure 3. Hacienda Lakes project site in relation to Panther Primary and Secondary Zones.

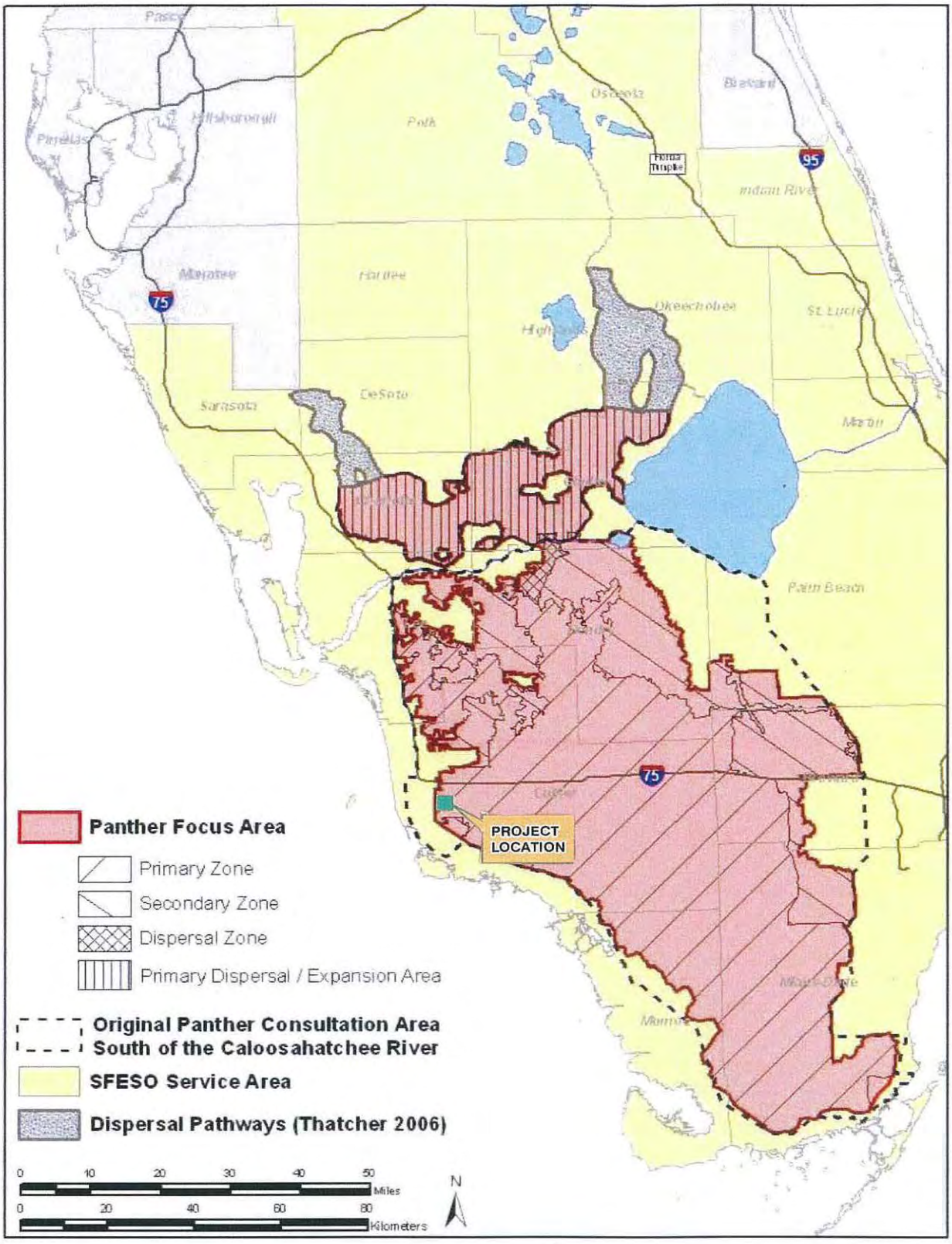

Figure 4. Florida Panther Focus Area.

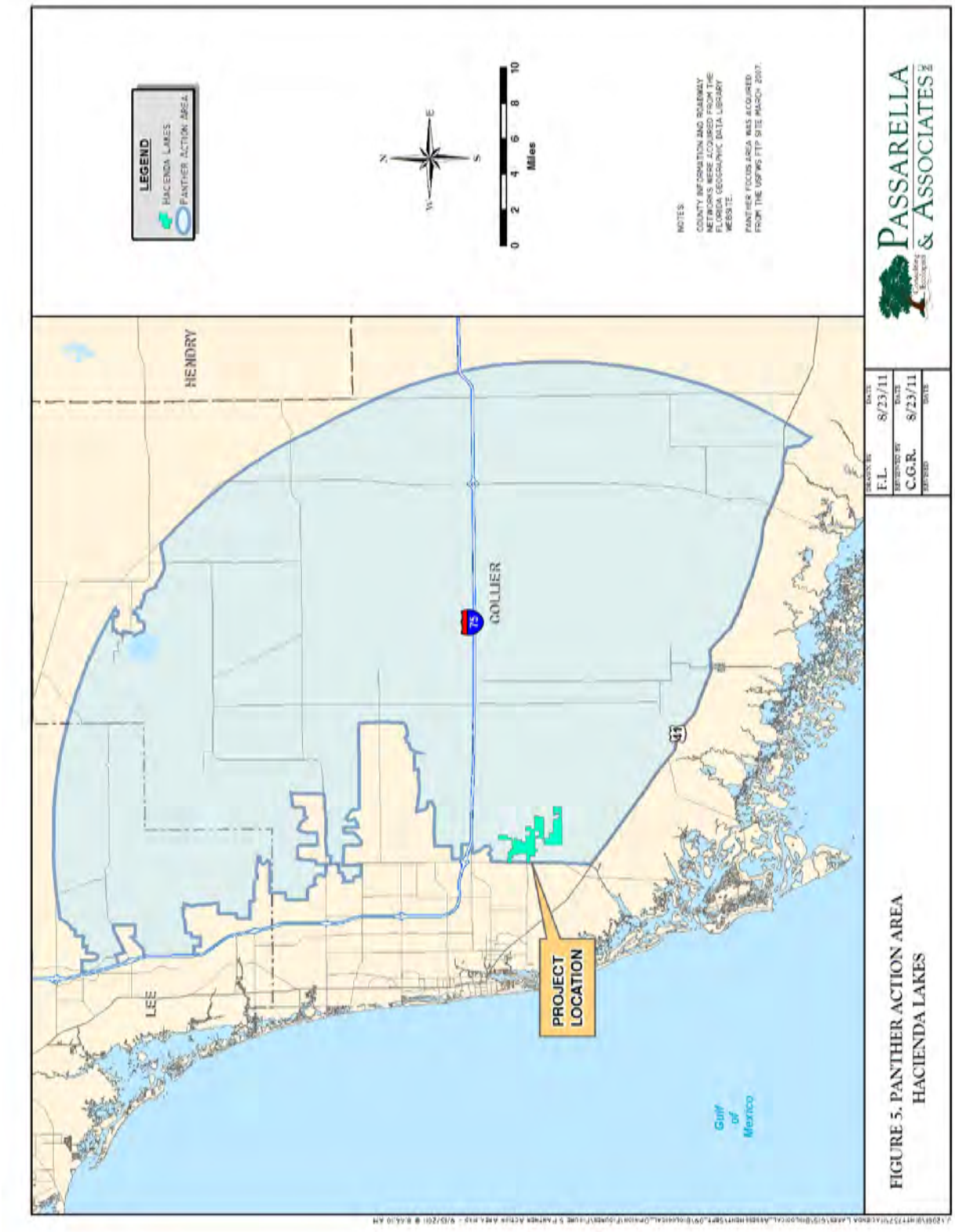

Figure 5. 25-mile Florida Panther Action Area for the Hacienda Lakes project.

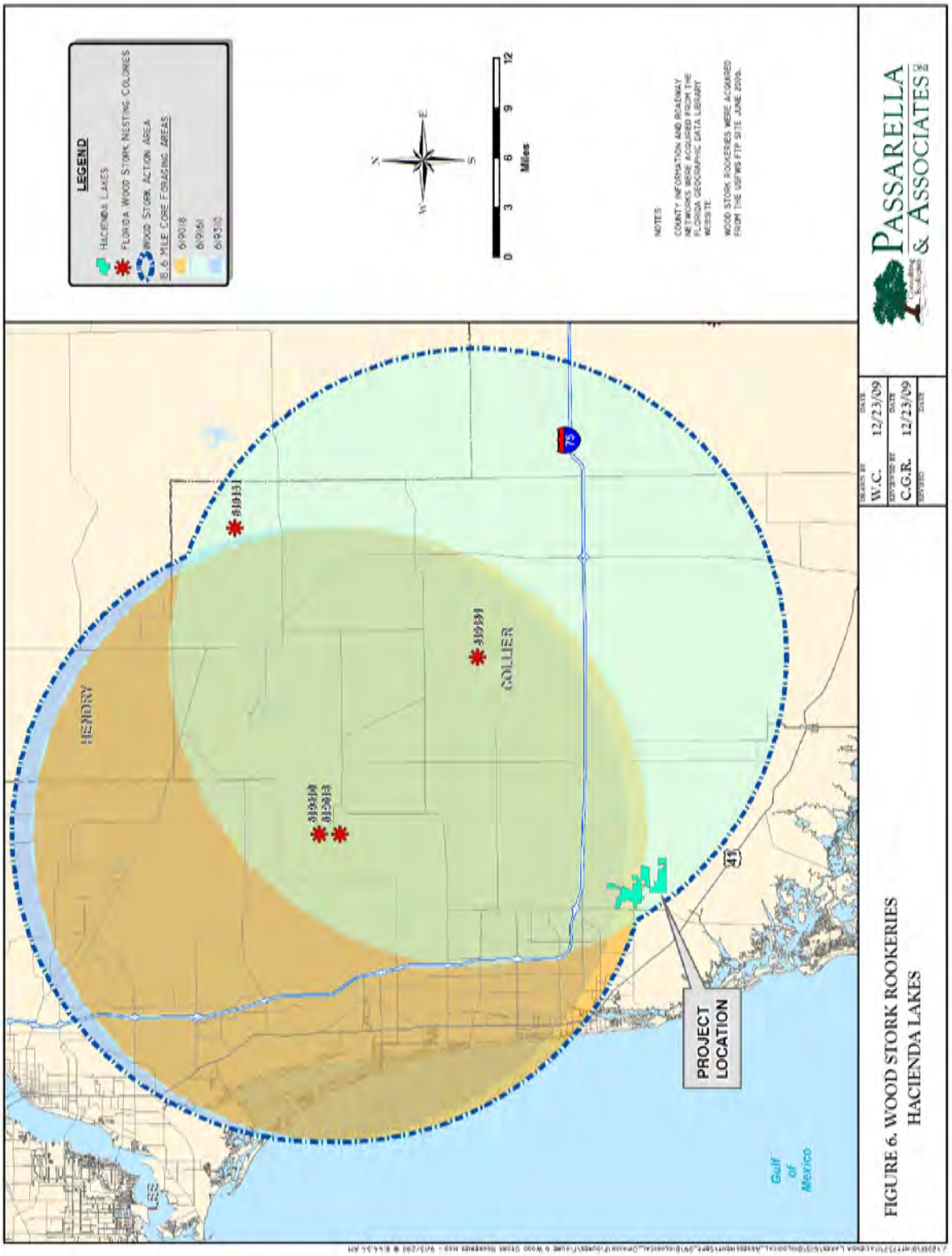

Figure 6. Wood Stork Action Area for the Hacienda Lakes project.

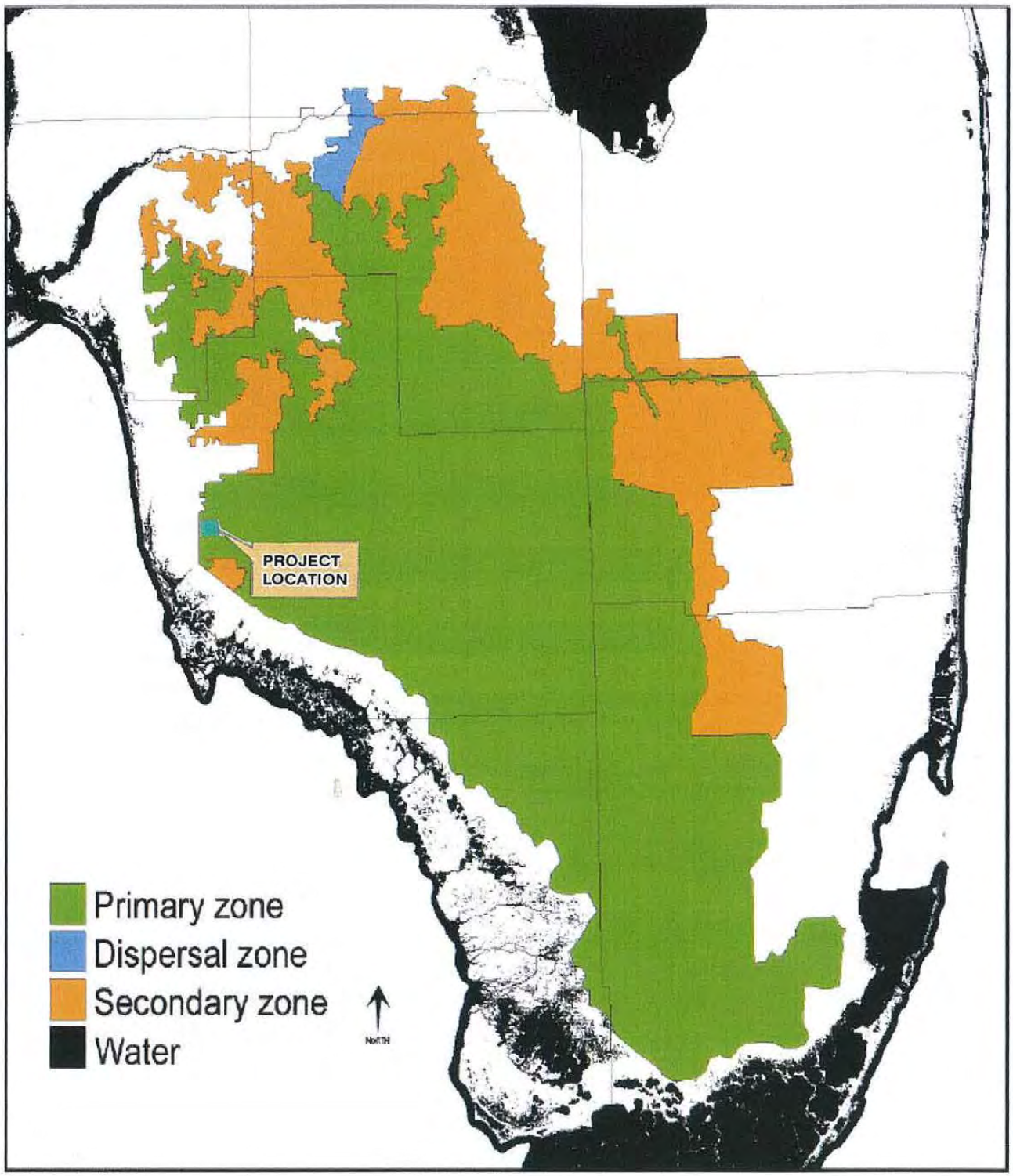

Figure 7. Florida Panther Zones (Kautz et al. 2006).

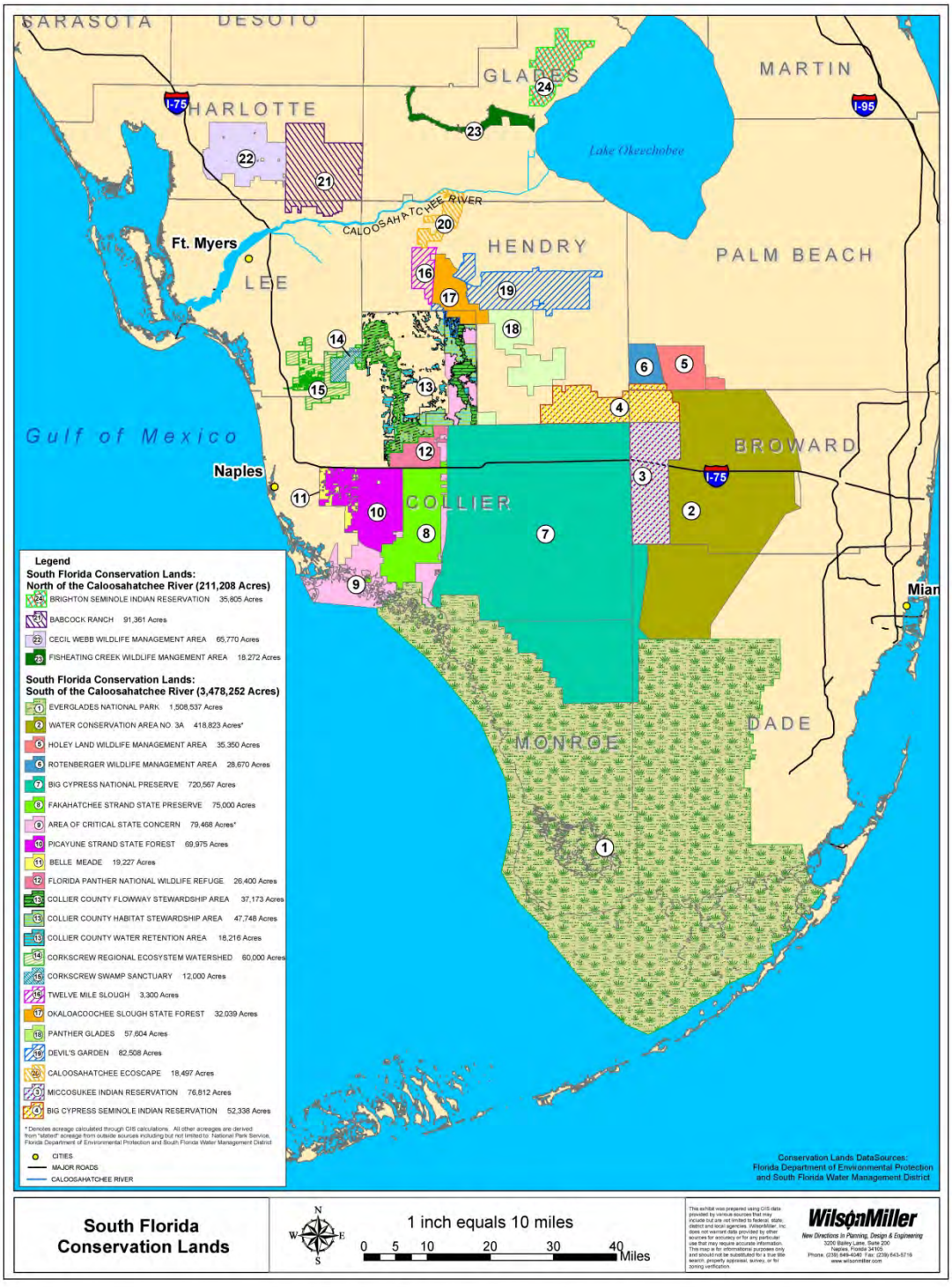

Figure 8. South Florida conservation lands**.**

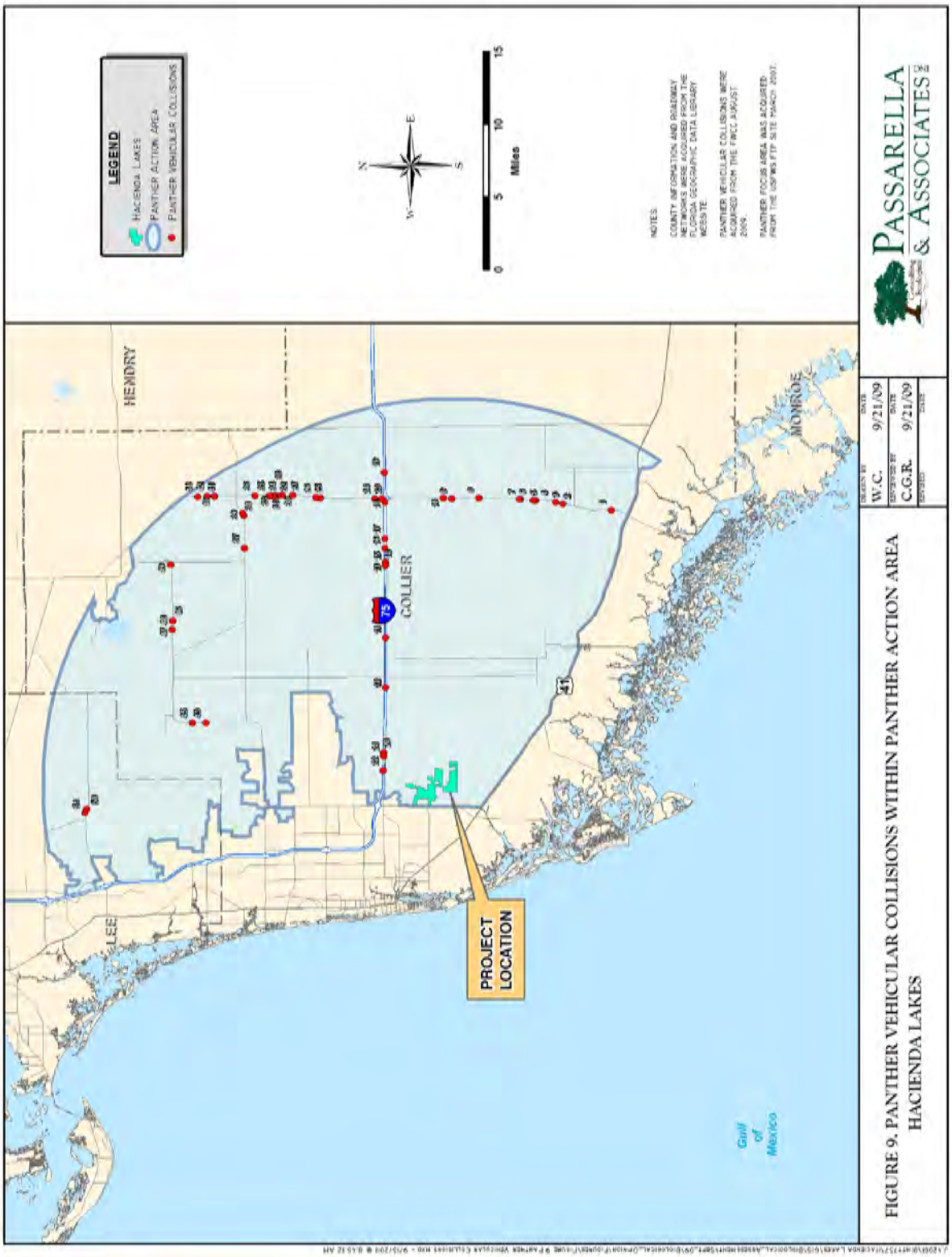

Figure 9. Panther-vehicle collisions and wildlife crossings within panther action area as of March 31, 2011.

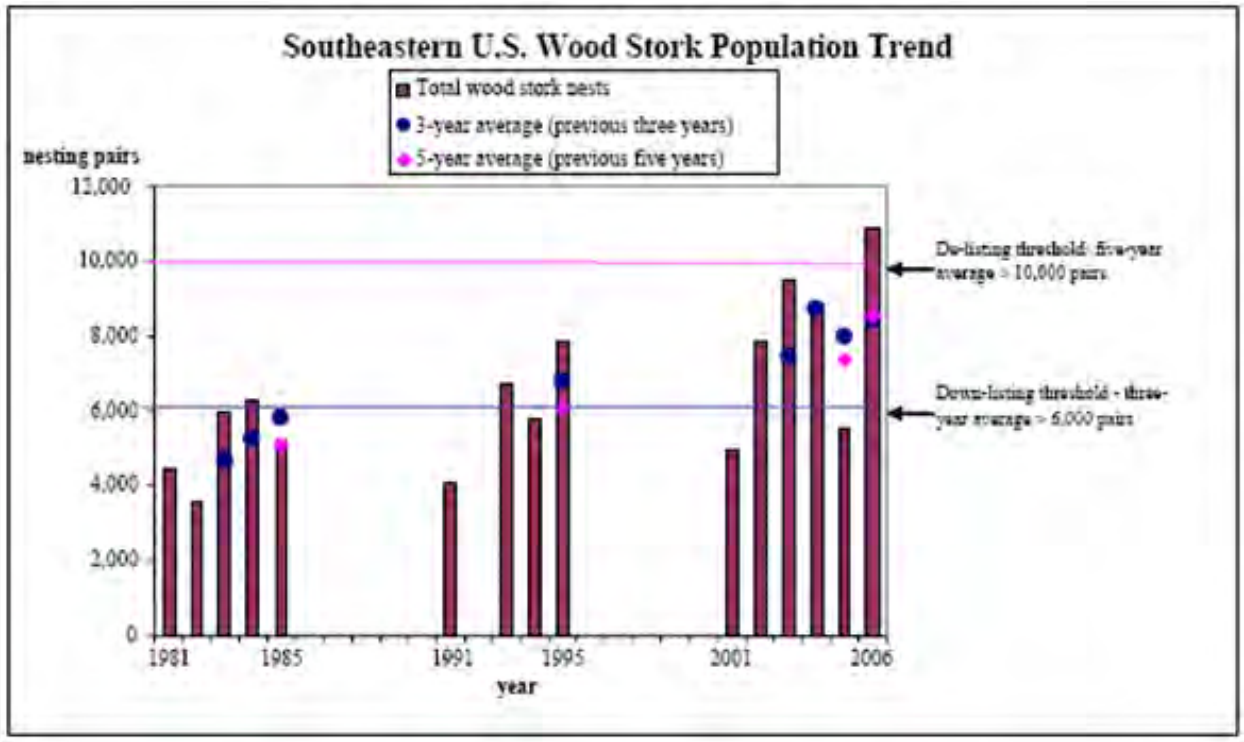

Figure 10. Total Wood Stork Nesting in the Southeastern U.S. in Relation to Recovery Criteria.

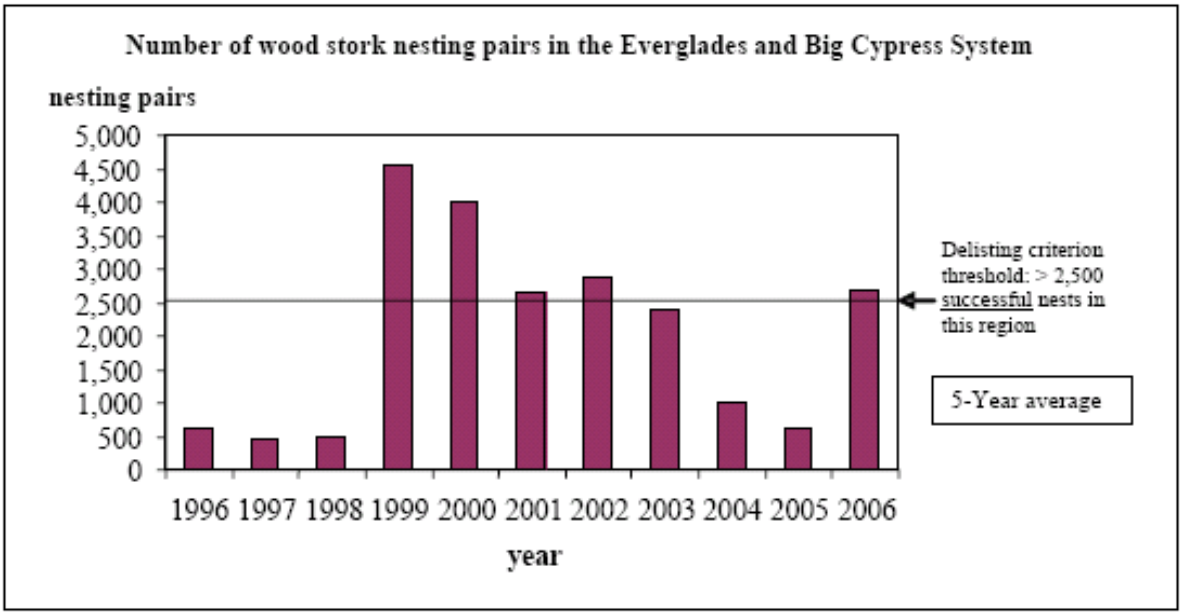

Figure 11. Graph of Wood Stork Nesting in Everglades and Big Cypress System**.**

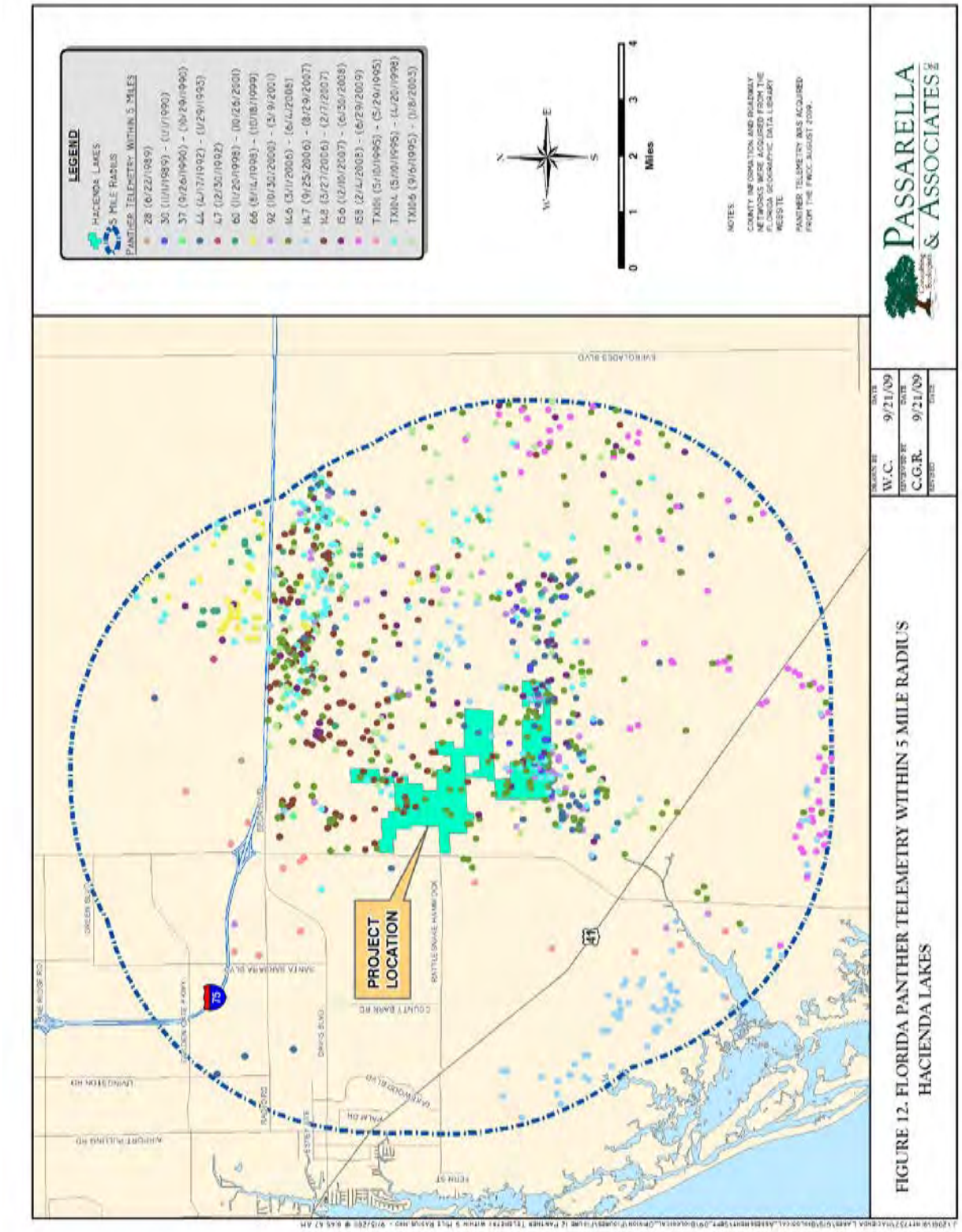

Figure 12. Panther telemetry within a 5-mile radius of the project site.

Appendix 1

Panther Habitat Assessment Methodology

Appendix 2

Wood Stork Foraging Habitat Assessment Methodology

Appendix 3

Hacienda Base Data

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Appendix 1

Panther Habitat Assessment Methodology

Panther Habitat Assessment Methodology

The Service developed the panther habitat assessment methodology in 2006 and updated the methodology in 2009. To evaluate project effects to the Florida panther, the Service considers the contributions the project lands provide to the Florida panther, recognizing not all habitats provide the same functional value. Kautz et al. (2006) also recognized not all habitats provide the same habitat value to the Florida panther and developed cost surface values for various habitat types, based on use by and presence in home ranges of panthers. The FWC (2006), using a similar concept, assigned likely use values of habitats to dispersing panthers. The FWC's habitats were assigned habitat suitability ranks between 0 and 10, with higher values indicating higher likely use by dispersing panthers.

The Service chose to evaluate project effects to the Florida panther through a similar process. We incorporated many of the same habitat types referenced in Kautz et al. (2006) and FWC (2006) with several adjustments to the assigned habitat use values reflecting consolidation of similar types of habitats and the inclusion of Comprehensive Everglades Restoration Plan (CERP) water treatment and retention areas. We used these values (Tables PM1 and PM2) as the basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther, as discussed below.

Base ratio: To develop a base ratio that will provide for the protection of sufficient acreage of primary zone equivalent lands for a population of 90 panthers (31,923 acres per panther [Kautz et al. (2006)]) from the acreage of primary zone equivalent non-urban lands at risk, we developed the following approach.

The available primary zone equivalent lands at the time the methodology was developed (2006) were estimated at 3,276,563 acres (ac) (see Tables PM3 and PM4), with 2,073,865 ac of primary zone equivalent, non-urban lands preserved. The remaining non-urban, at-risk, private lands were estimated at 1,202,698 ac of primary zone equivalent lands. To meet the protected and managed lands threshold for a population of 90 panthers, an additional 799,205 ac of primary zone equivalent lands are needed. The base ratio is determined by dividing the primary equivalents of at-risk habitat to be secured (799,205 ac) by the result of the acres of at-risk habitat in the primary zone (610,935 ac) times the value of the primary zone (1); plus the at-risk acres in the dispersal zone (27,883 ac) times the value of the dispersal zone (1); plus the at-risk acres in the secondary zone (503,481 ac) times the value of the secondary zone (0.69); plus the at-risk acres in the other zone (655,996 ac) times the value of the other zone (0.33); minus the at-risk ac of habitat to be protected (799,205 ac). The results of this formula provide a base value of 1.98.

$$799{,}205 / ([(610{,}935 \times 1.0) + (27{,}883 \times 1) + (503{,}481 \times 0.69) + (655{,}996 \times 0.33)] - 799{,}205) = 1.98$$

In evaluating habitat losses in the consultation area, we used an estimate of 0.8 percent loss of habitat per year (R. Kautz, FWC, personal communication, 2004) to predict the amount of habitat loss anticipated in south Florida during the next 5 years (*i.e.*, 6,000 hectares/year [14,820 ac/ year]). We conservatively assume that we would be aware of half of the development projects that occur within the primary zone and the secondary zone combined. We further assume that 50 percent of these projects would be located in the primary zone and 50 percent would be located in the secondary zone. Based on these assumptions, we estimated that over a 5-year period about 37,000 ac (primary

zone equivalent of 31,265 ac) would be developed without Federal review. To reflect this loss of habitat we adjusted the base acreage density of 31,923 acres per panther (Kautz et al. [2006]) to a new base density of 32,275 ac per panther, an increase of 352 acres (31,265/90=352+31,923=32,275). This adjustment results in a base ratio change from 1.98 to 2.23.

The Service realizes habitat losses from individual single-family residential developments will collectively compromise the Service's landscape scale effort to secure sufficient lands for a population of 90 panthers. We believe that, on an individual basis, single-family residential developments by individual lot owners on lots no larger than 5.0 ac will not result in take of panthers on a lot-by-lot basis; however, collectively these losses may affect the panther. Panthers are a wide-ranging species, and individually a 5.0-acre habitat change will not have a measurable impact. Compensation for such small-scale losses on a lot-by-lot basis is unlikely to result in meaningful conservation benefits for the panther versus the more holistic landscape level conservation strategy used in our habitat assessment methodology. To account for these losses, based on the 0.08 percent annual loss referenced by Kautz (2004), we estimated the development of vacant lands (2003) in northern Golden Gate Estates and Lehigh Acres in Collier and Lee counties, respectively, at about 2,590 ac per year per development, or about 12,950 ac per development over a 5-year period. As above, to reflect this loss we adjusted the revised base acreage density to 32,563 ac, an increase of 288 acres (25,900/90=288+352+31,923=32,563). To account for this loss, we further adjusted the base value from 2.23 to 2.48.

There is also a need for road crossings in strategic locations and we believe there are projects that may not have habitat loss factors but will have traffic generation factors. The Service considers increases in traffic as an indirect effect from a project, which can contribute to panther mortality. For assessment purposes, since our habitat methodology does not provide a mechanism to address this type of effect directly, we are providing a habitat surrogate of 500 ac per year of habitat loss for these types of projects, with a not to exceed value of 2,500 ac over the 5-year period. The 500 ac per year is based on average cost of FDOT bridge/box culvert crossings (3.6 to 5 million dollars) converted to acreage equivalent costs (8,500/ac). This 2,500 acre habitat surrogate adds an additional 28 acres per panther to the above adjusted base for a new base of 32,951 ac per panther (2,500/90=28+288+352+31,923=32,591). Therefore, we have added another 0.02 to the base ratio to address traffic impacts, which could provide an incentive to implement crossings in key locations. Following the same approach shown above, we adjusted the base ratio from 2.48 to 2.5. The Service intends to re-evaluate this base ratio periodically and adjust as needed to make sure all adverse effects are adequately ameliorated and offset as required under section 7 of the act and to achieve the Service's landscape scale effort for the Florida panther.

The Service uses a very conservative density of panthers per area of habitat to calculate the compensation ratio for impacts south of the Caloosahatchee River. Specifically, the Service relied on the low estimate in the range presented in Kautz et al. (2006) to reach its factor of 2.5. This low estimate density value was calculated by dividing the documented number of panthers in 2000, or 62 panthers, by an estimate of the habitat in the primary zone that was most consistently occupied by panthers from 1981 to 2000. As previously mentioned, it is clear the

panther population south of the river has increased notably since 2000, in 2001 = 78 panthers; in 2002 = 80; in 2003 = 87; in 2004 = 78; in 2005 = 82; in 2006 = 97; in 2007 = 117; and 2008=104. In 2007 more panthers were documented in south Florida than have been documented since current verified estimates have been collected. Furthermore, none of the panthers recorded south of the Caloosahatchee River lives exclusively outside of the primary zone, although some do venture outside of it on occasion (McBride 2007).

The average population size south of the Caloosahatchee River over the past 7 years is 86. If we were to use this number instead of 62 to calculate the compensation ratio and to use the entire acreage of the primary zone as the denominator, the revised compensation ratio requirement would be 0.32 ac protected for every acre developed. Furthermore, if we excluded the "other zone" altogether from the analysis, the ratio would be 1.01, still lower than the Service's current ratio. We believe this conservative approach is warranted because of the inherent importance of habitat protection to panther conservation.

Landscape multiplier: As stated in the above section on primary zone equivalent lands, the location of a project in the landscape of the core area of the Florida panther is important. As we have previously discussed, lands in the primary and dispersal zones are of the highest importance in a landscape context to the Florida panther, with lands in the secondary zone of less importance, and lands in the other zone of lower importance. These zones affect the level of compensation the Service believes is necessary to minimize a project's effects to Florida panther habitat. Table PM5 provides the landscape compensation multipliers for various compensation scenarios. As an example, if a project is in the other zone and compensation is proposed in the primary zone, a primary zone equivalent multiplier of 0.33 is applied to the PHUs (see discussion below) developed for the project. If the project is in the secondary zone and compensation is in the primary zone, then a primary zone equivalent multiplier of 0.69 is applied to the PHUs developed for the project.

Panther Habitat Units – habitat functional value: Prior to applying the base ratio and landscape multipliers discussed above, we evaluate the project site and assign functional values to the habitats present. This is done by assigning each habitat type on-site a habitat suitability value from the habitats shown in Tables PM1 and PM2. The habitat suitability value for each habitat type is then multiplied by the acreage of that habitat type resulting in a number representing PHUs. These PHUs are summed for a site total, which is used as a measurement of the functional value the habitat provides to the Florida panthers. This process is also followed for the compensation sites.

As of January 2005, the Service has been using a panther habitat suitability ranking system based in part on methods in publications by Swanson et al. (2005) and Kautz et al. (2006) and adjusted by the Service to consolidate similar types of habitats and to include CERP water treatment and retention areas located in the panther's range (Table PM1). Since the implementation of this ranking system, the Service has received two additional, published habitat assessment studies (Cox et al. [2006] and Land et al. [2008]) that further assess habitat usage by the Florida panther. As it is the Service's policy to incorporate the most current peer-reviewed science into our assessment

and review of project effects on the Florida panther, we have revised the current habitat suitability ranking system.

To revise these values, the Service, in coordination with FWC, examined the habitat ranking values in the two new papers referenced above and Kautz et al. (2006) publication and developed a spreadsheet. The spreadsheet was developed to: (1) compare the results of each of these published analyses; and (2) provide a habitat ranking system for each of the assessments. On the first page of the spreadsheet, labeled "panther habitat selection analysis - habitat papers comparison," we summarized the types of analyses performed as to whether it was second order (selection of a home range with a large study area) or third order (selection of habitats within a home range). For each of these analyses, we then listed the habitat types reported in each paper and their order of selection by panthers (Table PM6). We used the cost surface scores and the rank differences from the Kautz et al. (2006) analyses as the selection order and for a measure of statistical differences among the habitat types. Selected habitat types are represented as bold black numbers and avoided habitats are bold red numbers. Habitats that were neither selected nor avoided are shown as normal font black numbers. Ranks with the same letter are not different from each other. Results from the Cox et al. (2006) and Land et al. (2008) papers using Euclidean analyses are shown in a similar fashion.

On the second page of the spreadsheet, labeled "summary of ranking values," we ranked the habitat types on a scale from 0 to 10 according the results from each study and professional judgment (Table PM7). We used our original ranking for the Kautz et al. analyses (with the ranking scale reversed such that the best habitat received a "10" and the lowest quality habitat was "0").

We developed similar rankings for the habitat analyses reported in Cox et al. (2006) and Land et al. (2008). Selected habitats fell in the range of 7 to 10; habitats that were used in proportion to availability were ranked from 4 to 6; and habitats that were avoided by panthers were ranked from 0 to 3. Ranks for habitats within each of the 3 outcomes began at the top of each of the ranges (selected = 10, used in proportion to availability = 6, avoided = 3). Some shifting of the ranks occurred based on the letter-coded statistical ranking. For instance, under *Land GPS Euclidean third order* both upland and wetland forests were selected by panthers and were not statistically different from each other (note the ranking of a and ab for upland and wetland forest, respectively). However, wetland forest and dry prairie also were not significantly different from each other. To show these relationships, we ranked upland forest as a 10, wetland forest as a 9, and we increased dry prairie from a 6 (top of the neither selected nor avoided ranking) to a 7 to reflect the interplay between dry prairie and wetland forest based on professional judgment.

To generate a new ranking of panther habitats for use as a habitat assessment measure, we simply averaged the ranks of the six different analyses presented in the spreadsheet to the first decimal place. Half of these results were second order habitat analyses (Kautz et al. compositional, Kautz et al. Euclidean and Cox et al. Euclidean) and the other half were third order analyses (Cox et al. Euclidean; Land et al. VHF Euclidean; Land et al. GPS Euclidean).

In our assessment, we noted several outlier habitat rankings that, based on our understanding of habitat needs of the Florida panther and our concern for human/panther interactions, appear to provide conflicting values. These habitats and their associated rankings are: (1) barren/disturbed – 5.2; (2) urban – 5.0; (3) open water – 3.3; and (4) coastal wetlands – 1.0. We believe adjustments are warranted for these four categories and our adjusted values are based on the following:

Barren/disturbed: Barren/disturbed lands may include many temporary changes to land use, such as crop rotation and prescribed fires that likely have little impact on the value to panthers. Areas disturbed by human impact on a longer-term basis (*e.g.*, parking of equipment and material storage areas) have chronic effects on panthers that we judge decrease the value of these lands for panthers. Barren/disturbed lands include disturbed lands (Florida land use and cover classification system [FLUCCS] 740) and spoil areas (FLUCCS 733). Based on the above reasons, we assigned barren/disturbed land a value of 3.

Urban: Panther habitat models typically include urban in the "other" category that was neither avoided nor selected by panthers. Highly urbanized areas are not found in the panther core area that was used in assessing habitat use, as panthers have already selected against these land use types by reducing their range. However, urbanizing areas in more rural settings may appear in the assessment of habitat use. Nevertheless, we believe that potential human/panther interactions are important conflict factors to consider as well. Therefore, we assigned both developed rural and highly urbanized areas a value of 0.

Open water: Open water has been found to be either avoided by panthers or included in the "other" category that was neither avoided nor selected by panthers. We believe open water in any setting provides little to no value to panthers. However, open water edges and berms can be a valuable foraging area or dispersal pathway in more rural settings, although these edges in an urbanized setting could promote human/panther conflicts. Therefore, we assigned open water in an urban setting, with or without emergent vegetation, and surrounding berms a value of 0. However, in rural settings, the littoral edges and berms may provide species benefit and are further addressed under the reservoir discussion below.

Coastal wetlands: There are few strictly coastal wetlands, such as salt marshes and mangrove swamps, within the panther focus area. Where these occur, they are closely interspersed with other upland habitats. In this context, we believe that these areas are of greater value to the panther than the models indicate. These areas may, for the most part, be avoided by panthers; but, they can be of value in the proper landscape context to higher value habitats. Therefore we assigned these areas a value of 3.

We also note that three additional land uses and or habitat types referenced in our original habitat rankings were not components addressed directly in the model. These include: (1) exotic/ nuisance plants; (2) stormwater treatment areas (STAs); and (3) reservoirs. We believe these categories are important in our assessment of panther habitat values and warrant consideration in our habitat ranking system.

Exotic/nuisance plants: Although exotic plants can be suitable for providing denning cover and habitat connectivity between other land types for panthers and panther prey, they generally do not provide the preferred foraging base of plants consumed by deer and other herbivores (Fleming et al. 1994). We believe prey foraging value, or lack thereof, is an important constraint in our habitat assessments. Therefore, we assigned these habitats a value of 3. Likewise, some native plant species can become so dominant and dense, especially under altered hydrologic and fire suppression regimes, that they no longer provide high habitat value for the panther even though occasional use may occur. The most common example is dense, nearly monotypic cattail stands, which are of reduced value relative to less altered marsh communities. Another example of this type of nuisance species dominance is dense stands of cabbage palm dominated communities. For systems represented by this habitat profile, we also assigned a value of 3.

STAs (Everglades restoration): STAs are generally designed to provide a water quality treatment function for nutrient removal from received upstream discharges and may include multiple berms and adjacent littoral shelves. Depending on the design and mode of operation, they can become vegetated by dense monotypic stands of cattails or can incorporate a diverse mosaic of wetland communities and hydroperiods that support sawgrass and shrub/scrub species. Therefore, they can provide various levels of resource benefit to panthers and panther prey species as discussed below. For this reason, the final value of an STA is determined in a case-by-case basis during project review.

The Service participates in planning efforts that encourage location of STAs at sites with minimal areas of natural habitat, with a preference for sites that are currently in agriculture. Because these facilities by design are located in areas that currently provide a reduced value to panthers and panther prey species, the Service values these systems pre and post project development as a neutral effect on panthers. In these situations, the development of an STA from existing agriculture land uses would be evaluated as if the agriculture land use was present following project development, with no increase or decrease in habitat value to the panther.

However, this neutral effect assessment is only applicable to land conversions from nonnative habitats to STAs. For those projects that remove natural habitats, the Service considers STA functional values to mimic the value of the natural system the STA is designed to achieve. As an example, an STA design that results in a dense monotypic stand of cattails would be appropriately evaluated following the exotic/nuisance species profile. Similarly, a system designed to provide a diverse mosaic of wetland communities and hydroperiods would be evaluated following the wet prairie/marsh profile. Another system design that incorporates internal and external berms could include an edge benefit evaluation identifying the berms and adjacent littoral shelves and their benefit to the Florida panther and panther prey species, and follow the values provided for improved pasture for the berms and or wet prairie/marsh values for the littoral shelves. An individual project assessment of pre and post habitat impacts will identify whether the project as designed results in loss of functional value or provides benefit to the Florida panther and panther prey species.

Reservoirs (Everglades restoration, large water storage area, mines): Reservoirs were originally classified as their own category in our 2003 assessment method. They differ from open-water systems primarily with their location in the landscape. In urban areas, reservoirs have always been considered open water and given a value of 0. In rural areas, the open water portion of the reservoir provides no habitat value, although the edges and the berms can provide valuable foraging area or dispersal pathways for the panther and panther prey species. Therefore, the 2003 methodology assigned a value of 1.5 to reservoirs to attempt to account for these benefits.

After further consideration, we believe a more appropriate way to evaluate the value of reservoirs is to evaluate the open water component separately from the reservoir edges and berms. Therefore, we are no longer assigning a value to reservoirs as their own habitat classification. When large-scale reservoir projects are proposed in the rural landscape, all open water areas should be classified as such (value = 0). Berms and edges should be classified as the habitat they will most resemble in the post-project condition. For example: a 1,000-acre reservoir with 50 ac of grassed berms and 50 ac of berms with roads along the top would be evaluated as 900 ac of open water, 50 ac of pasture, and 50 ac of urban.

We also recognized the habitat matrix (Table PM7) lists four native habitats similar in functional habitat value to panthers as non-native habitats: marsh/wet prairie – 4.7; xeric scrub – 4.5; shrub and brush – 5.5; and dry prairie – 6.3. These habitat ratings, which are between 4 and 6, are classified as being neither selected nor avoided by panthers. The Service's Florida panther draft Recovery Plan's (Service 2008) action 1.1.1.2.3 recommends habitat preservation and restoration within the primary zone be provided in situations where land use intensification cannot be avoided. We view this recommendation as a key parameter in our conservation goal to locate, preserve, and restore lands containing sufficient area and appropriate land cover types to ensure the long-term survival of a population of Florida panthers south of the Caloosahatchee River.

Therefore, for assessment purposes, if a project is proposing restoration of non-native habitats (*e.g.*, pasture, row crops, groves, etc.) to native habitats, we believe that a restoration lift to a value of 7 is appropriate. The functional value of 7 corresponds to that value found in the literature where panthers begin to select for that habitat attribute (Table PM7). We also believe a full functional lift credit for these restorations is appropriate as the time lag from restoration to full functional value is estimated to be relatively short (less than 5 years) for non-forested systems. However, the calculation of forested restoration values remains the same as in the previous methodology, which is one-half the difference between pre- and post-restoration.

In summary, we believe appropriate adjustments to our original PHU values are warranted based on the most current peer-reviewed science and our category specific discussions above. Therefore, we have incorporated the above referenced values into our revised habitat assessment matrix and these values are the current basis for habitat evaluations and the recommended compensation values to minimize project effects to the Florida panther (Table PM2).

Exotic species assessment: since many habitat types in south Florida are infested with exotic plant species, which affects the functional value a habitat type provides to foraging wildlife

species (*i.e.*, primarily deer and hog), we believe the presence of these species and the value these species provide to foraging wildlife needs to be considered in the habitat assessment methodology. As shown in Table PM2, we have a habitat type and functional value shown for exotic species. This category includes not only the total acres of pure exotic species habitats present but also the percent-value acreages of the exotic species present in other habitat types.

For example, a site with 100 ac of pine flatwoods with 10 percent exotics would be treated in our habitat assessment methodology as 90 ac of pine flatwoods and 10 ac of exotics. Adding another 100 ac of cypress swamp with 10 percent exotics would change our site from 90 ac of pine flatwoods and 10 ac of exotics to 90 ac of pine flatwoods, 90 ac of cypress swamp, and 20 ac of exotics.

Habitat assessment methodology application – example: To illustrate the use of our habitat assessment methodology, we provide the following example. A 100-acre project site is proposed for a residential development. Plans call for the entire site to be cleared. The project site contains 90 ac of hydric pine flatwoods and 10 ac of exotic vegetation, and is located in the "secondary zone." The applicant has offered habitat compensation in the "primary zone" to minimize the impacts of the project to the Florida panther. To calculate the PHUs provided by the site, we multiply the habitat acreage by the "habitat suitability value" for each habitat type and add those values to obtain a value of 885 PHUs ((90 ac of pine flatwoods x 9.5 [the habitat suitability value for pine flatwoods] = 855 PHUs) + (10 ac of exotic vegetation x 3 [the habitat suitability value for exotics] = 30 PHUs) = 885 PHUs). The value of 885 PHUs is then multiplied by the 2.5 (the base ratio) and 0.69 (the landscape multiplier) resulting in a value of 1,527 PHUs for the project site. In this example, the acquisition of lands in the primary zone containing at least 1,527 PHUs is recommended to compensate for the loss of habitat to the Florida panther resulting from this project.

Table PM1. Original panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Water	0	STA	4.5	Cypress swamp	9
Urban	0	Shrub swamp	5	Sand pine scrub	9
Coastal strand	1	Shrub and brush	5	Sandhill	9
Reservoir	1.5	Dry prairie	6	Hardwood-Pine forest	9
Mangrove swamp	2	Grassland/pasture	7	Pine forest	9
Salt marsh	2	Freshwater marsh	9	Xeric oak scrub	10
Exotic/nuisance plants	3	Bottomland hardwood	9	Hardwood forest	10
Cropland	4	Bay swamp	9		
Orchards/groves	4	Hardwood swamp	9		

Table PM2. Revised panther habitat unit values for use in assessing habitat value to the Florida panther.

Land Cover Type	Value	Land Cover Type	Value	Land Cover Type	Value
Reservoirs	*	Xeric scrub	4.5	Dry prairie	6.3
STAs	**	Orchards/groves	4.7	Upland Hardwood Forest	9.0
Urban	0	Marsh/ wet prairie	4.7	Cypress swamp	9.2
Water	0	Cropland	4.8	Hardwood swamp	9.2
Barren/Disturbed lands	3	Improved pasture	5.2	Hardwood-Pine	9.3
Coastal wetlands	3	Shrub swamp/brush	5.5	Upland-Hydric Pine forest	9.5
Exotic/nuisance plants	3	Unimproved pasture	5.7		

* PHU values for reservoirs are evaluated based on open water for the main water areas and the appropriate categories for berms and other non-water sections. Refer to pages 5- 7 for the accompanying text for guiding criteria for these systems.

** PHU values for stormwater treatment areas vary depending on design criteria, mode of operation, location in native or non-native habitats, and other landscape features. Refer to page 6 for the accompanying text for guiding criteria for these systems.

Table PM3. Land Held for Conservation within the Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	1,659,657	1.00	1,659,657
Dispersal	0	1.00	0
Secondary	308,623	0.69	212,950
Other	609,872	0.33	201,258
TOTAL	2,578,152	TOTAL	2,073,865

Table PM4. Undeveloped Privately Owned Land within Florida Panther Core Area.

	Acres	Primary Equivalent Factor	Primary Equivalent Acres
Primary	610,935	1.00	610,935
Dispersal	27,883	1.00	27,883
Secondary	503,481	0.69	347,402
Other	655,996*	0.33	216,479
TOTAL	1,962,294	TOTAL	1,202,699

* About 819,995 ac are at-risk in the other zone with about 80 percent with resource value. Total ac of at-risk privately owned lands are 1,962,294 ac.

Table PM5. Landscape Compensation Multipliers.

Zone of Impacted Lands	Zone of Compensation Lands	Multiplier
Primary	Secondary	1.45
Secondary	Primary	0.69
Other	Secondary	0.48
Other	Primary	0.33

Table PM6. Panther Habitat Selection Analyses – Habitat Papers Comparison.

Habitats	Kautz compositional second order	rank	Kautz Euclidean second order	rank	Habitats	Cox Euclidean second order	rank	Cox Euclidean third order	rank	Habitats	Land VHF Euclidean third order	rank	Land GPS Euclidean third order	rank
Hardwood swamp	1	A	3	A	Coniferous forest	1	A	1	A	Upland forest	1	A	1	A
Pineland	2	A	2	AB	pineland					pine/hardwood				
Cypress swamp	3	AB	1	BC	Hardwood forest	3	C	2	A	hardwood hammock				
Upland forest	1	B	4	CD	hardwood hammock					pinelands				
Dry prairie	5	B	5	DE	mixed pine/hardwood					tropical hammock				
Shrub and brush	1	C	7	EF	palm/oak					palm/hardwood				
Xeric scrub	3	CD	9	F	tropical hammock					Wetland forest	2	A	2	AB
Marsh	5	CD	9	F	Forested wetland	2	B	3	A	cypress swamp				
Unimproved pasture	7	DE	7	G	cypress swamp					cypress/pine/palm				
Barren	6	E	9	G	mixed forest					mixed swamp				
Improved pasture	9	EF	6	G	shrub swamp					hardwood swamp				
Urban	8	F	8	G	hardwood swamp					Dry prairie/grass	3	B	3	BC
Cropland	9	F	8	H	other wet forest					grassland				
Citrus	10	G	8	H	Dry prairie grass	4	C	4	B	unimproved pasture				
Coastal wetlands	11	G	8	H	dry prairie					improved pasture				
Open water	10	H	10	I	grassland					Marsh/shrub	6	B	4	C
Exotic plants					Open wetland	7	I	7	C	marsh/wet prairie				
STA					marsh and wet prairie					sawgrass				
Reservoir					sawgrass					cattail				
					cattail					shrub swamp				
					Agricultural	5	D	5	B	Other	4	B	5	C
second order - selection of home range with entire study area					improved pasture					open water				
third order - selection of habitats within home range					citrus					shrub/brush				
Bold (black) - habitat used more than availability (=selection)					row crop					barren				
Bold (red) - habitat used less than availability (avoidance)					other agriculture					high impact urban				
rank - habitats with same letters did not differ in preference					Urban/barren	6	I	6	B	low impact urban				
					bare soil					extractive				
					high-impact urban					Agriculture	5	B	6	C
					low-impact urban					citrus				
					extractive					row crop				
										other agriculture				

Table PM7. Summary of Ranking Values

Habitats	Kautz compositional second order	Kautz Euclidean second order	Cox Euclidean second order	Cox Euclidean third order	Land VHF Euclidean third order	Land GPS Euclidean third order	Average
Hardwood swamp	10	7	9	10	10	9	9.2
Pineland	9	8	10	10	10	10	9.5
Cypress swamp	8	9	9	10	10	9	9.2
Upland forest	10	6	8	10	10	10	9.0
Dry prairie	6	5	8	6	6	7	6.3
Shrub and brush	7	3	no data	no data	6	6	5.5
Xeric scrub	8	1	no data	no data	no data	no data	4.5
Marsh	6	1	6	3	6	6	4.7
Unimproved pasture	4	3	8	6	6	7	5.7
Barren	5	1	7	6	6	6	5.2
Improved pasture	2	4	7	6	6	6	5.2
Urban	3	2	7	6	6	6	5.0
Cropland	2	2	7	6	6	6	4.8
Citrus	1	2	7	6	6	6	4.7
Coastal wetlands	0	2	no data	no data	no data	no data	1.0
Open water	1	0	no data	no data	6	6	3.3
Exotic plants							
STA							
Reservoir							

habitat selection	7.8.9.10
neither selected nor avoided	4.5.6
habitat avoidance	0.1.2.3

Appendix 2

Wood Stork Foraging Habitat Assessment Methodology

Wood Stork Foraging Habitat Assessment Methodology

The decline of the wood stork in the United States is primarily due to the loss of wetland habitats and the concomitant reduction in prey availability. To determine the effect of development actions on the wood stork in south Florida, the Service has chosen to assess the action's effect on wood stork foraging habitat. As such, the Service has developed a functional assessment known as the "Wood Stork Foraging Habitat Assessment Methodology" (Methodology), as described below. The Methodology can be used to estimate the biomass of wood stork forage provided per unit quantity of wetland habitat. The assessment can be applied to both wetlands being lost by a development project and the wetlands proposed as mitigation.

The Service has identified four parameters that can be used in the estimation of wood stork prey biomass:

1. Vegetation Density
2. Wetland Hydroperiod
3. Prey Size Suitability
4. Competition with other wading bird species for forage

Parameter 1 - Density of vegetation

As discussed previously, a wetland's suitability for wood stork foraging is partially dependent on its vegetation density. Coulter and Bryan (1993) found that wood storks prefer to forage in ponds and marshes with little or no canopy. Wood storks have been observed foraging in forested wetlands (*e.g.,* swamps, mesic woodlands etc.), but prefer open areas within these habitat types (Coulter and Bryan 1993; P.C. Frederick, University of Florida, personal communication 2006; J.A. Rodgers, FWC, personal communication 2006). Coulter and Bryan (1993) suggested that wetlands with open canopies may be more readily detected by wood storks and are easier to land at than at closed-canopy sites. Wetlands with sparse canopies also allow wood storks to take flight more quickly to avoid predators.

The presence of invasive exotic plants may also affect wood stork foraging. Melaleuca (*Melaleuca quinqueneriva*) is an exotic tree species that has become established in south Florida's wetlands. Melalueca produces dense stands that may limit a site's accessibility to foraging by wading birds including the wood stork. O'Hare and Dalrymple (1997) investigated the effects of melalueca infestation on wetland-dependent birds in south Florida wetlands. A moderate level of melalueca infestation was found to have little effect on the production of some prey species use by the wood stork (*i.e.*, amphibians and reptiles) as long as the wetland's critical abiotic factors (*e.g.,* hydrology) were not significantly impaired (O'Hare and Dalrymple 1997). However, fish abundance was found to decrease in closed canopy melalueca forests. Wood storks will forage in melaleuca-dominated wetlands when the distribution of trees is sparse or non-continuous (*i.e.*, areas of broken stands due to blow-downs). However, wood storks generally will not forage in melaleuca where the stem density is high and the canopy closed (P.C. Frederick, University of Florida, personal communication 2006). The limiting factor to wood stork foraging within melalueca-dominated wetlands appears to be the restriction of access to the area resulting from the presence of the vegetation.

Parameter 1 - Foraging suitability value (Vegetation Density)

To determine how the presence of invasive exotic vegetation may affect wood stork foraging, we developed foraging suitability indices for wetlands (as described below) using data from O'Hare and Dalrymple (1997). O'Hare and Dalrymple (1997) identified five vegetation classes based on coverage of melalueca (Table WSM1):

Table WSM1. Classes of Melalueca Coverage (from O'Hare and Dalrymple 1997).

75-100 percent mature dense melaleuca coverage (DMM)
75-100 percent sapling dense melaleuca coverage (DMS or SDM)
50-75 percent melaleuca coverage (P75)
0-50 percent melaleuca coverage (P50)
0-10 percent melaleuca coverage (Marsh [MAR])

The number of wetland-dependent bird species and individuals observed per cover type by O'Hare and Dalrymple (1997) are listed in columns 2 and 3 in Table WSM2.

Table WSM2. Foraging suitability indices for wetland-dependent birds species.

Cover type	No. of species (S)	No. of individuals (I)	S*I	Foraging suitability
DMM	1	2	2	0.001
DMS	4	10	40	0.025
P75	10	59	590	0.372
P50	11	92	1,012	0.639
MAR	12	132	1,584	1.000

The foraging suitability index for wetlands dependent birds is calculated for each cover type from O'Hare and Dalrymple (1997) (Table WSM2) by multiplying the number of species observed (S) by the number of individuals observed (I). The product (S*I) is then divided by the product of the number of species for MAR and the number of individuals for MAR (12 x 132 = 1,584) observed by O'Hare and Dalrymple (1997). Based on the calculations listed above, we developed foraging suitability indices for wetlands used by wood storks based on the coverage of exotic plants (Table WSM3). The Service chose 0.03 (the foraging suitability index for the DMS cover type, rounded up from 0.025) to define foraging suitability for exotic plant coverage ranging from 76 percent to 100 percent.

Table WSM3. Wood Stork Foraging Suitability Indices.

Exotic Plants (percent coverage)	Foraging Suitability Index
0 to 25	1.00
26 to 50	0.64 (rounded up from 0.639)
51 to 75	0.37 (rounded down from 0.372)
76 to 100	0.03 (rounded up from 0.025)

Parameter 2 – Wetland Hydroperiod

Hydroperiod: The hydroperiod of a wetland can affect the density of wood stork prey species. For example, studies of Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) have shown that the density of small forage fish increases with hydroperiod. Marshes inundated for less than 120 days per year average ± 4 fish/meter $(m)^2$, and marshes inundated for more than 340 days per year average ± 25 fish/m^2 (Loftus and Eklund 1994; Trexler et al. 2002).

Kushlan (1990) described short hydroperiod wetlands as wetlands inundated from 0 to 180 days per year, intermediate hydroperiod wetlands as wetlands inundated from 180 to 270 days per year, and long hydroperiod wetlands as wetlands inundated from 270 to 360 days per year. However, Trexler et al. (2002) defined short hydroperiod wetlands as wetlands with less than 300 days per year inundation. For the purposes of our Methodology, the Service defines wetlands inundated from 0 to 180 days per year as "short hydroperiod" wetlands and wetlands inundated from 180 to 360 days per year as "long hydroperiod" wetlands. In addition, we have adopted the seven wetland hydroperiod classes for wetlands in south Florida used by the SFWMD in their evaluation of various restoration projects throughout the Everglades Protection Area (Table WSM4).

Table WSM4. SFWMD's hydroperiod classes for Everglades Protection Area.

Hydroperiod Class	Number of days inundated
1	0-60
2	60-120
3	120-180
4	180-240
5	240-300
6	300-330
7	330-365

The Service estimated the fish biomass available to the wood stork for each of the SFWMD's hydroperiod classes listed in Table WSM4 as follows. First, we took estimates of fish density (number of fish/ m^2) for the various hydroperiod classes presented in Trexler et al. (2002) (Table WSM5). Trexler et al. (2002) derived these density estimates from throw trap sampling of wetland sites in the Everglades, and the estimates were presented as the square root of the number of fish/m^2 for each of six hydroperiod classes. It is important to note that Trexler et al. (2002) used six hydroperiod classes to characterize the length of inundation during the year compared to the seven hydroperiod classed employed by the SFWMD and used by the Service in our Methodology (Table WSM4). The fish density estimates presented Trexler et al. 2002, increase with hydroperiod class, and this trend has been noted by other investigators (Turner et al. 1999, Turner and Trexler 1997, Carlson and Duever 1979).

Table WSM5. Fish densities per hydroperiod from Trexler et al. (2002).

Hydroperiod class	Days inundated	Fish Density(fish/m^2)*
Class 1	0-120	2.0
Class 2	120-180	3.0
Class 3	180-240	4.0
Class 4	240-300	4.5
Class 5	300-330	4.8
Class 6	330-365	5.0

*As presented, these densities are square root transformed, as described in Trexler et al 2002.

For our assessment, we transformed the fish density data provided by Trexler et al. 2002 to obtain fish density values for each of seven hydroperiods defined by the SFWMD. We obtained a fish density value of 2 fish/m^2 for the SFWMD's Class 1 hydroperiod (0 to 60 days inundated; Table WSM6) by extrapolating Trexler et al.'s Class 1 hydroperiod fish density value of 2.0 fish/m^2 for 0 to 120 days inundated to 1.0 fish/$m.^2$ and doubling this value. To calculate fish density values for the remaining SFWMD hydroperiods (Classes 2 through 7), the fish density values for hydroperiod classes 1 through 6 presented by Trexler et al. 2002 (Table WSM5) were squared. Fish density values for each of the seven SFWMD hydroperiod classes are as presented in Table WSM6.

Table WSM6. Extrapolated values of fish density per each SFWMD hydroperiod.

Hydroperiod class	Days inundated	Fish density
Class 1	0-60	2 fish/m^2
Class 2	60-120	4 fish/m^2
Class 3	120-180	9 fish/m^2
Class 4	180-240	16 fish/m^2
Class 5	240-300	20 fish/m^2
Class 6	300-330	23 fish/m^2
Class 7	330-365	25 fish/m^2

The Service is aware the throw-trap method used by Trexler et al. (2002) generally only captures fish 8 centimeters (cm) (3.15 inches [in]) or less in total length. However, the Service believes the data provide a good approximation of the fish sizes preferred by wood storks. We note Ogden et al (1976) found wood storks generally consume fish ranging in total length from 1.5 cm (0.59 in) to 9 cm (3.54 in), and Kushlan et. al. (1975) reported wood storks feed primarily on fish from 6 cm (2.36 in) to 8 cm (3.15 in) total length. The Service is aware wood storks will occasionally forage on fish larger than 8cm total length, and we acknowledge this size class of fish is not completely captured by our methodology. However, we note only a small proportion of the wood stork's diet consists of fish greater than 8 cm total length. As such, we do not believe our assessment of wood stork foraging biomass is significantly flawed.

The transformed estimates of fish density listed in Table WSM6 are now used to estimate fish biomass for each of the seven hydroperiods. For our assessment, we considered class 7 hydroperiod wetlands with a density of 25 fish/m^2 to have a mean annual biomass of

6.5 grams /m^2 (wet mass). This estimate of mean annual biomass was based on studies conducted by Turner et al. (1999), Trexler et al. (2002), and Carlson and Duever (1979) in Everglades National Park and WCA 3A. In these studies, the mean biomass (standing stock) of fish from Class 5 and 6 hydroperiod wetlands ranged from 5.5 to 6.5 grams/m^2 (wet mass). These data were originally calculated as g/m^2 dry mass and converted to g/m^2 wet mass following the procedures referenced in Kushlan et al (1986) and also referenced in Turner et al (1999). The fish density data provided in Turner et al. (1999) included both data from samples representing fish 8 cm or smaller and fish larger than 8 cm (3.15 in) and included summaries of data presented in Turner and Trexler (1997), Carlson and Duever (1979), and Loftus and Eklund (1994). These data sets also applied a 0.6 g/m^2 (dry mass) correction estimate for fish greater than 8 cm (3.15 in) based on Turner et al's (1999) block-net rotenone samples.

We estimated the biomass for the SFWMD hydroperiod classes 1 through 6 based on the fish density of 25 fish/m^2 and the biomass of 6.5 grams/m^2 wet mass derived for the Class 7 hydroperiod described above. First, we calculated a mean biomass per fish value of 0.26 grams/m^2 wet mass by dividing 6.5 grams/m^2 wet mass by 25 fish/m^2. We then multiplied the mean biomass per fish value of 0.26 grams/m^2 wet mass by the fish density values for hydroperiod classes 1 through 6. For example, the biomass of fish provided by the Class 3 hydroperiod is 2.3 grams/m^2 (9*0.26 = 2.3). The calculated values of fish biomass are presented in Table WSM7.

Table WSM7. Estimated mean annual fish biomass for SFWMD's hydroperiods.

Hydroperiod class	Days inundated	Mean annual fish biomass
Class 1	0-60	0.5 gram/m^2
Class 2	60-120	1.0 gram/m^2
Class 3	120-180	2.3 grams/m^2
Class 4	180-240	4.2 grams/m^2
Class 5	240-300	5.2 grams/m^2
Class 6	300-330	6.0 grams/m^2
Class 7	330-365	6.5 grams/m^2

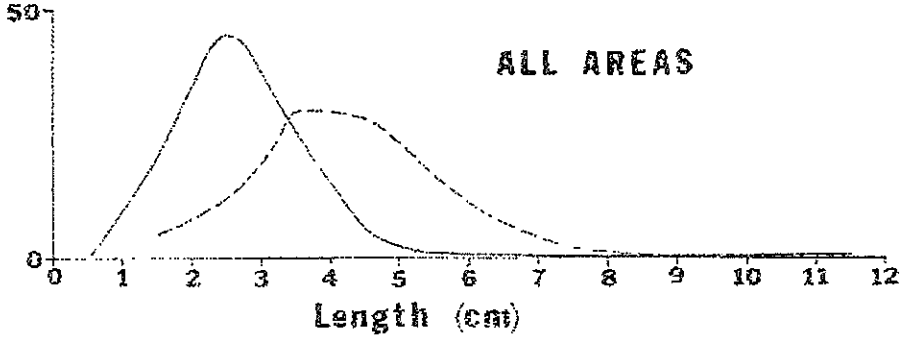
Parameter 3 – Prey Size Suitability

Wood storks are highly selective in their feeding habits. Ogden et al. (1976) reported that five species of fish comprised over 85 percent of the number and 84 percent of the biomass of over 3,000 prey items collected from adult and nestling wood storks (Table WSM8). These species were also observed to be consumed by wood storks in greater proportion than smaller and more abundant fish species [*e.g.*, mosquito fish (*Gambusia affinis*), least killifish (*Heterandria formosa*), and bluefin killifish (*Lucania goodei*)]. This may be the result of the small body size of these species not eliciting a bill-snapping reflex by wood storks (Coulter et al. 1999).

Table WSM8. Primary fish species consumed by wood storks from Ogden et al. (1976).

Common name	Scientific name	Percent individuals	Percent biomass
Sunfishes	*Centrarchidae* spp.	14	44
Yellow bullhead	*Italurus natalis*	2	12
Marsh killifish	*Fundulus confluentus*	18	11
Flagfish	*Jordenella floridae*	32	7
Sailfin molly	*Poecilia latipinna*	20	11

The following figure from Ogden et al. (1976) compares the frequency (expressed as percent, 0 to 50) of the fish size available to wood storks (solid line) and the frequency of fish size consumed by wood storks (dashed line).



The area under the dashed line represents the size of fish most likely consumed by wood storks (1.5 to 9.0 cm in total length). The Service has adopted this range of fish sizes as those most likely to be consumed by the wood stork and we will use this size range in our assessment of wood stork forage (see discussion below). As discussed above, the throw-trap method used by Trexler et al. (2002) generally only captures fish 8 cm or less in total length, and wood storks occasionally comsume fish larger than 8cm in total length. However, the Service believes the data from Trexler et al. (2002) provide a good approximation of the fish sizes preferred by wood storks.

The next element of our wood stork Methodology is the wood stork suitable prey base (biomass per hydroperiod). The wood stork suitability prey base is comprised of two components: (1) the amount of biomass per hydroperiod class within the range of fish sizes likely to be consumed by wood storks and (2) the likelihood that this prey base is actually consumed by the wood stork.

To estimate the fraction of the available fish biomass within the size range of fish likely to be consumed by wood storks (1.5 to 9.0 cm), the Service used the following approach. We noted that Kushlan et al. (1986) listed the mean biomass of the warmouth (*Lepomis gulosus*) as 36.76 g (rounded to 36.8 g in Appendix WSM-A [see page 12]). In Trexler et al. (2002), the warmouth accounts for about 0.048 percent (18/37,715=0.000477) of the total number of fish collected during the study (Appendix WSM-A). We then multiplied the mean biomass of 36.76 g of the warmouth reported by Kushlan et al. (1986) by the percent occurrence value of 0.048 percent provided by Trexler et al. 2002 to calculate an adjusted mean biomass of 1.75 g (36.76 g * 0.048 = 1.75 g). The mean biomass of the warmouth (1.75 g) accounts for 6.57 percent (1.75/26.715 = 0.0657) of the estimated average biomass (26.715 g) of Trexler et al.'s (2002)

samples. Using the Service's estimate of mean annual biomass for class 7 hydroperiod wetlands of 6.5 g/m^2, the warmouth biomass for class 7 hydroperiod wetlands would be 0.427 g/m^2 (6.5 g/m^2 x 0.0657 = 0.427 g/m^2).

However, the Service noted the size frequency distribution (assumed normal) of warmouth from Kushlan et al. (1986) indicate that 48 percent of warmouth sampled were greater than 9 cm total length and 0.6 percent were less than 1.5 cm total length. As such, 48.6 percent of warmouth were outside of the size range (1.5 cm to 9 cm total length) of fish most likely consumed by the wood stork. The mean annual biomass for warmouth for class 7 hydroperiod wetlands in the size range likely consumed by the wood stork is calculated as 0.208 g/m^2 [0.427*(0.48+0.006)]=0.2075 g/m^2 (rounded to 0.208). Using this approach for all fish species collected by Trexler et al. 2002 (Appendix WSM-A) for class 7 hydroperiod wetlands, the Service estimates that only 3.685 g/m^2 of the 6.5 g/m^2 mean annual fish biomass consists of fish within the size range likely consumed by wood storks (about 57 percent [3.685/6.5*100=56.7] of the total mean annual fish biomass available).

The Service also used data in Ogden et al 1976 (Appendix WSM-A) to estimate the available mean annual fish biomass for fish within the size range likely consumed by wood storks for class 7 hydroperiod wetlands. We calculated that 2.97 g/m^2 of the 6.5 g/m^2 mean annual fish biomass for a class 7 hydroperiod wetland (about 45.7 percent) consists of fish within the size range likely to be consumed by wood storks.

Finally, we adjusted the values of estimated mean annual fish biomass for each of the SFWMD's hydroperiods (Table WSM7) to reflect the size of fish most likely consumed by woods storks. This was accomplished by adding the biomass value of 3.685 g/m^2 (derived from data in Kushlan et al. 1986 and Trexler et al. 2002; Appendix WSM-A) to the biomass value of 2.97 g/m^2 (derived from data in Ogden et al 1976 2002; Appendix WSM-A) and dividing the sum of 6.665 g/m^2 by to obtain a mean value of 3.33 g/m^2 for class 7 hydroperiod wetlands. The Service notes that the mean biomass value of 3.33 g/m^2 s for class 7 hydroperiod wetlands comprises 51 percent of the mean annual biomass estimate of 6.5 g/m^2 for class 7 hydroperiod wetlands listed in Table WSM7 (3.33 g/m^2/6.5 g/m^2 = 0.51 or 51 percent). Therefore, we multiplied each value of mean annual fish biomass listed in Table WSM7 to calculate values of mean annual fish biomass per hydroperiod adjusted for the size range of fish (1 to 9 cm total length) most likely to be consumed by wood storks (*i.e.*, the wood stork suitable prey base) (Table WSM9).

Table WSM9. Estimates of suitable fish biomass per hydroperiod.

Hydroperiod class	Days inundated	Fish biomass
Class 1	0-60	0.26 gram/m^2
Class 2	60-120	0.52 gram/m^2
Class 3	120-180	1.196 grams/m^2
Class 4	180-240	2.184 grams/m^2
Class 5	240-300	2.704 grams/m^2
Class 6	300-330	3.12 grams/m^2
Class 7	330-365	3.38 grams/m^2

Crayfish Biomass

Although the diet of the wood stork is made up primarily of fish, wood storks are known to forage on crayfish (*Procambarus* spp.) (J. Lauritsen, Audubon Corkscrew Swamp Sanctuary, personal communication 2007, 2009; Depkin et al. 1992; Bryan and Gariboldi 1998; Kahl 1964). Depkin et al. (1992) report that crayfish make up 1 percent of the biomass and 1.9 percent of the prey items observed for wood storks from east-central Georgia and also noted the presence of crayfish in the diets of wood storks (fish represented 92 percent of all individual prey items and 93 percent of the total biomass). Lauritsen (Audubon Corkscrew Swamp Sanctuary, personal communication 2007, 2009) suggests crayfish may be an important source of food for wood storks. The importance of crayfish in the wood stork's diet in unclear. Nonetheless, the Service has decided to assess crayfish biomass as part of our estimate of biomass production per hydroperiod.

The presence of melalueca in wetlands does not seem to affect the use of these habitats by crayfish. O'Hare and Dalrymple (1997) found that crayfish are randomly distributed among cover types and melaleuca coverage did not largely affect dispersion patterns. Lauritsen (Corkscrew Swamp Sanctuary 2007, 2009) noted crayfish occur in wetlands with dense melaleuca and migrate to more open areas as water levels fall during the dry season. Hendrix and Loftus (2000) noted that *P. alleni* typically burrow during the dry season, a behavior which provides persistence during droughts, and *P. fallax* was typically found in long hydroperiod wetlands.

Acosta and Perry (2002) assessed the biomass of the *P. alleni* from seasonal wetlands of various hydroperiods within the Florida Everglades. However, Acosta and Perry (2002) defined wetland hydroperiods in terms of months of inundation. Therefore, the Service converted the hydroperiod class used in Acosta and Perry (2002) from months of inundation to days of inundation for use in our Methodology. Acosta and Perry (2002) only provided crayfish density and biomass estimates for wetlands of hydroperiod class 2, 4, and 5, and the converted values are 0.10 gram/m^2, 0.15 gram/m^2, and 0.23 gram/m^2, respectively (Table WSM10). Acosta and Perry (2002) noted that long hydroperiod wetlands typically had densities of crayfish two times greater than medium hydroperiod wetlands and five times greater than short hydroperiod wetlands. Therefore, we estimated the crayfish biomass for hydroperiod Class 3 wetlands by adding the crayfish biomass estimate for hydroperiod class 2 wetlands (0.10 gram/m^2) to the crayfish biomass estimate for hydroperiod class 4 wetlands (0.15 gram/m^2) and divided the sum (0.25 gram/m^2) by 2 to obtain a value of 0.125 gram/m^2 (rounded to 0.13 gram/m^2 in Table WSM10). The Service estimated the mean annual crayfish biomass for Class 1 hydroperiod wetlands based on Acosta and Perry's (2002) comment that long hydroperiod wetlands typically had densities five times greater than short hydroperiod wetlands. Therefore, the Service used Acosta and Perry's (2002) average long hydroperiod value for crayfish biomass of 0.229 grams/m^2 and divided this value by 5 to calculate a value of 0.05 gram/m^2 for Class 1 hydroperiod wetlands (0.229/5=0.045). We estimated the crayfish biomass value for the Class 7 hydroperiod wetlands based on the maximum density recorded in Acosta and Perry's (2002) study (0.248 gram/m^2, rounded to 0.25 gram/m^2 in Table WSM10). Finally, we estimated the crayfish biomass for class 6 hydroperiod wetlands by adding the crayfish biomass estimate for hydroperiod class 5 wetlands (0.23 gram/m^2) to the crayfish biomass estimate for hydroperiod

class 7 (0.25 gram/m^2) and divided the (0.48 gram/m^2) by 2 to obtain a value of 0.24 gram/m^2 (Table WSM10).

To estimate the total forage biomass available to the wood stork for each wetland hydroperiod class (Table WSM9), we added the value of mean annual crayfish biomass derived from Acosta and Perry 2002 to the value of mean annual biomass estimated for fish (Table WSM10).

Table WSM10. Estimates of suitable fish biomass and crayfish biomass per hydroperiod.

Hydroperiod class	Fish biomass	Crayfish biomass	Total biomass	Percent change
Class 1	0.26 gram/m^2	0.05 gram/m^2	0.31 gram/m^2	19.2
Class 2	0.52 gram/m^2	0.10 gram/m^2	0.62 gram/m^2	19.2
Class 3	1.19 grams/m^2	0.13 gram/m^2	1.32 grams/m^2	10.5
Class 4	2.18 grams/m^2	0.15 gram/m^2	2.34 grams/m^2	7.0
Class 5	2.70 grams/m^2	0.23 gram/m^2	2.93 grams/m^2	8.4
Class 6	3.12 grams/m^2	0.24 gram/m^2	3.36 grams/m^2	7.7
Class 7	3.38 grams/m^2	0.25 gram/m^2	3.63 grams/m^2	7.4

Parameter 4 – Competition with other wading bird species for forage

The computer simulations of wood stork colony population size by Fleming et al. (1994) assumed that only 10 percent of the wood stork forage prey base is available to be consumed by wood storks. This reduction in prey availability was attributed to water level of the foraging habitat, and in part to the effects of competition with other wading bird species. Fleming et al. (1994) did not specify the magnitude of each effect, but the Service believes it is likely competition with other wading bird species limits the availability of prey to wood storks. As such, the Service has included competition with other wading bird species for forage as a parameter in our assessment of wood stork forage biomass.

The Service has chosen to assess the effects of competition of other wading bird species on wood stork biomass availability as follows. We have adopted the assumption made by Fleming et al. (1994) that only 10 percent of the potential forage at a wetland site is available to wood storks for foraging. This figure represents a 90 percent reduction of total forage biomass actually available to wood storks at a wetland site. The Service considers competition for forage with other wading bird species, as well as the 3 factors described above (vegetation density, wetland hydroperiod, and prey size) as all contributing equally to the reduction in forage availability. Consequently, we find that each factor comprises 0.225 or 22.5 percent of the total 90 percent reduction in forage availability (4 x 22.5 = 90 percent). As discussed above, our assessment has already accounted for the effects of vegetation density, wetland hydroperiod, and prey size. To adjust the estimates of total biomass per hydroperiod presented in Table WSM10 for the effects of competition with other wading bird species, we have established a competition adjustment factor of 0.325. This factor was calculated by subtracting 0.675 (the sum of reduction in forage availability due to vegetation density, wetland hydroperiod, and prey size [0.225 + 0.225 + 0.225 = 0.675) from 1 (this number represents 100 percent of the total forage

biomass present at a wetland site) (1 – 0.675 = 0.325). Table WSM11 presents estimates of total forage biomass adjusted for competition.

Table WSM 11. Estimates of total biomass of fish and crayfish per hydroperiod adjusted for the effect of competition with other wading birds.

Hydroperiod class	Total Fish and Crayfish Biomass	Competition Factor	Adjusted Total biomass (Total Fish and Crayfish Biomass x Competition Factor)
Class 1	0.31 gram/m^2	0.325	0.1008 gram/m^2
Class 2	0.62 gram/m^2	0.325	0.2015 gram/m^2
Class 3	1.32 grams/m^2	0.325	0.4290 grams/m^2
Class 4	2.34 grams/m^2	0.325	0.7605 grams/m^2
Class 5	2.93 grams/m^2	0.325	0.9523 grams/m^2
Class 6	3.36 grams/m^2	0.325	1.0920 grams/m^2
Class 7	3.63 grams/m^2	0.325	1.1798 grams/m^2

Summary of the factors affecting vulnerability of wetland habitats to wood stork foraging in the action area

Through the above discussions, we have identified that there are essentially four parameters in assessing wood stork foraging habitat.

1. The density of vegetation within habitats suitable for wood stork foraging;

2. The hydroperiod of the wetland, including two subcomponents: (a) the fish density per hydroperiod (number of fish), and (b) the fish biomass per hydroperiod (g/m^2);

3. The size of prey size; and

4. Competition with other wading bird species

All four of these parameters can be used to calculate an estimate of the forage biomass available to wood storks in a wetland. As such, the Methodology can be applied to both wetlands being lost by a development project and the wetlands proposed as mitigation to assess the effect of an action on wood stork foraging. The following example illustrates the use of the Methodology:

> A development project results in the loss of 50 acres of wetland (25 acres of Class 3 hydroperiod and 25 acres of Class 4 hydroperiod), each containing 10 percent cover of melaleuca. The forage biomass of a each wetland is calculated by multiplying the number of acres of wetlands impacted by 4,047 m^2 (to convert acres to m^2) by the amount of actual biomass consumed by the wood stork (Table WSM11) and the exotic foraging suitability index (Table WSM3). The Service's Methodology considers the portion of the wetland covered by exotic vegetation (*i.e.*, the 10 percent melalueca in this

example) as 100 percent suitable to wood storks. To adjust for habitat availability and the wood stork competition factor, the value of forage biomass derived in Table WSM11 is multiplied by 1.0 (*i.e.,* habitat is 100 percent suitable for wood storks). The product is divided by 1,000 grams to convert the forage biomass value calculated in grams to kilograms.

The 25 acres of class 3 hydroperiod wetlands provide 43.4 kg of biomass forage [(25 acres x 4,047 m^2 /acre x 0.4290 g/m^2 (Table WSM11) x 1.0 (Table WSM3))/1,000 grams =43.4 kg)], and the 25 acres of class 4 hydroperiod wetlands provide 76.94 kg of biomass forage [(25 acres x 4,047 m^2 /acre x 0.7605 g/m^2 (Table WSM11) x 1.0 (Table WSM3) x 1.0)/1,000 grams =76.94 kg)]. The total forage biomass (fish and crayfish) lost due to the action is 120.34 kg (43.4 kg from class 3 hydroperiod wetlands + 76.94 kg from class 4 hydroperiod wetlands), and this value represents the loss of 0.61 nest based on Kahl's (1964) estimate that 201 kg of forage was needed for a successful wood stork nest.

Appendix WSM-A.

Data from Kushlan et al. (1986), Ogden et al. 1986, and Trexler et al. (2002) used by the Service to estimate the fraction of the available fish biomass within the size range of fish that may be consumed by wood storks.

		Kushlan et al. (1986)				Ogden et al. (1976)		Everglades - Trexler et al. (2002)				
Species	Common name	Mean Mass (g)	Proportion of fish < 15mm	Proportion of fish > 90mm	Proportion within 15-90 mm wood stork preference	% items consumed by stork	% biomass consumed by stork	Total collected	% of total collected	Mean mass based on % collected	Mass within 6 g/m2	Mass within stork prey size
Osteichtheyes												
Amia calva	Bowfin	1307.3	0.000	0.997	0.002	0.1	0.1		0.000	0.000	0.000	0.000
Lepisosterus platyrhincus	gar	182.5	0.012	0.948	0.039	0.2	2.8	1	0.003	0.484	0.109	0.004
Elops saurus	lady fish	346.7	0.000	1.000	0.000				0.000	0.000	0.000	0.000
Notemigonus crysoleucas	golden shiner	2.5	0.086	0.028	0.885	0.1	0.2		0.000	0.000	0.000	0.000
Notropis petersoni	coastal shiner	0.3	0.029	0.000	0.971			60	0.159	0.046	0.010	0.010
Notropis maculatus	taillight shiner					0.2	0.1	1	0.003	0.000	0.000	0.000
Erimuzon sucetta	Lake cubsucker	20.5	0.300	0.211	0.489				0.000	0.000	0.000	0.000
Ictalurus natalis	yellow bullhead catfish	29.0	0.063	0.438	0.499	1.7	11.8	29	0.077	2.228	0.500	0.250
Ameiurus nebulosus	brown bullhead catfish								0.000	0.000	0.000	0.000
Noturus gyrinus	tadpole madtom	1.4	0.052	0.000	0.948	0.2	0.1	8	0.021	0.029	0.007	0.006
Clarias batrachus	walking catfish	40.5	0.016	0.796	0.188			4	0.011	0.429	0.096	0.018
Bagre marinus	gafftopsail catfish	464.4	0.000	0.997	0.003				0.000	0.000	0.000	0.000
Opsanus beta	gulf toadfish	14.9	0.001	0.339	0.660				0.000	0.000	0.000	0.000
Strongylura notata	redfin needlefish	3.9	0.034	0.669	0.297				0.000	0.000	0.000	0.000
Adinia xenica	diamond killfish	0.7	0.002	0.000	0.998				0.000	0.000	0.000	0.000
Cyprinidon variegatus	sheepshead minnow	0.3	0.278	0.000	0.722	4.1	2.7	41	0.109	0.035	0.008	0.006
Floridichthylys carpio	goldspotted killfish	1.1	0.033	0.000	0.967				0.000	0.000	0.000	0.000
Fundulus chrysotus	golden topminnow	0.4	0.273	0.000	0.727	1.3	0.8	1844	4.889	1.750	0.393	0.286
Fundulus confluentus	marsh killifish	0.5	0.188	0.000	0.812	18.0	10.7	87	0.231	0.120	0.027	0.022
Fundulus grandis	gulf killfish	9.9	0.001	0.118	0.881				0.000	0.000	0.000	0.000
Fundulus seminolis	seminole killifish	5.8	0.000	0.110	0.890	0.7	3.1	1	0.003	0.016	0.003	0.003
Jordanella floridae	flagfish	0.3	0.260	0.000	0.740	32.0	7.0	1783	4.728	1.480	0.332	0.246
Lucania goodei	bluefin killifish	0.1	0.280	0.000	0.720	0.1	0.1	8391	22.248	2.759	0.620	0.446
Lucania parva	rainwater killifish	0.2	0.150	0.000	0.850	0.3	0.1	1	0.003	0.001	0.000	0.000
Gambusia affinus	mosquitofish	0.1	0.464	0.000	0.536	6.3	0.5	9825	26.051	2.214	0.497	0.266
Heterandria formosa	least killifish	0.0	0.917	0.000	0.083	0.5	0.1	12713	33.708	1.315	0.295	0.025
Poecilia latipinna	sailfin molly	0.2	0.292	0.000	0.708	19.8	10.6	1699	4.505	1.081	0.243	0.172
Labidesthes sicculus	brook silverside	0.5	0.002	0.000	0.998	0.1	0.1	5	0.013	0.007	0.002	0.002
Menidia beryllina	tidewater silverside	0.8	0.000	0.000	1.000	0.1	0.1		0.000	0.000	0.000	0.000
Elassoma evergladei	everglades pygmy sunfish	0.2	0.250	0.000	0.750			487	1.291	0.200	0.045	0.034
Enneacanthus gloriosus	bluespotted sunfish	0.5	0.155	0.000	0.845	0.8	0.9	238	0.631	0.321	0.072	0.061
Lepomis gulosus	warmouth	36.8	0.006	0.484	0.510	4.8	27.2	18	0.048	1.754	0.394	0.201
Lepomis macrochirus	bluegill	21.2	0.047	0.283	0.670	0.3	0.7	6	0.016	0.337	0.076	0.051
Lepomis marginatus	dollar sunfish	2.1	0.046	0.000	0.954			14	0.037	0.077	0.017	0.016
Lepomis microlophus	redear sunfish	30.8	0.052	0.362	0.586	2.3	5.4	55	0.146	4.490	1.008	0.591
Lepomis punctatus	spotted sunfish	7.0	0.182	0.030	0.787	2.8	8.7	197	0.522	3.661	0.822	0.647
Lepomis	unidentified sunfish	12.6	0.137	0.134	0.729	2.5	1.0	16	0.042	0.534	0.120	0.087
Sunfish	unidentified sunfish	9.8	0.175	0.070	0.754	2.5	1.0		0.000	0.000	0.000	0.000
Micropterus salmoides	largemouth bass	104.0	0.007	0.855	0.138	0.3	4.4	4	0.011	1.103	0.248	0.034
Etheostoma fusiforme	swamp darter	0.4	0.002	0.000	0.998			2	0.005	0.002	0.001	0.001
Astronotus ocellatus	oscar								0.000	0.000	0.000	0.000
Hemichromis bimaculatus	jewelfish	4.2*	0.092*	0.000*	0.908*				0.000	0.000	0.000	0.000
Spilotum nicaraguense	Nicaraguan cichlid								0.000	0.000	0.000	0.000
Eucinostomus gula	jenny mojarra	2.9	0.000	0.000	1.000				0.000	0.000	0.000	0.000
Haemulon plumieri	white grunt	6.2	0.000	0.011	0.988				0.000	0.000	0.000	0.000
Lagodon rhomboides	pinfish	7.1	0.001	0.039	0.960				0.000	0.000	0.000	0.000
Bairdiella chrysoura	silver perch	7.1	0.000	0.047	0.953				0.000	0.000	0.000	0.000
Cichlasoma bimaculatum	black acara	13.0	0.000	0.005	0.995			7	0.019	0.242	0.054	0.054
Cichlasoma urophthalmus	mayan cichlid							21	0.056	0.000	0.000	0.000
Mugil curema	white mullet					0.1	0.8		0.000	0.000	0.000	0.000
Rivulus marmoratus	rivulus					0.1	0.1		0.000	0.000	0.000	0.000
Esox niger	chain pickerel					0.1	0.1	5	0.013	0.000	0.000	0.000
Erimyzon sucetta	lake chubsucker							145	0.384	0.000	0.000	0.000
Belonesox belizanus	pike killifish							3	0.008	0.000	0.000	0.000
Tilapia mariae	spotted tilapia							4	0.011	0.000	0.000	0.000
Total								**37715**	**100.000**	**26.715**	**6.000**	**3.639**

*Shaded estimate of average mass from length-weight relationship given for species on www.fishbase.org with average length assumed to be 5 cm (FLMNH). The proportion of fish length less than 1.5 cm was set to be the average of all sunfish.

Appendix 3

Hacienda Base Data

Appendix 3A. Acres of habitats within the development footprint.

	Pre-Development Acreage Total	< 25% Melaleuca Coverage	25% - 50% Melaleuca Coverage	50% - 75% Melaleuca Coverage	Greater than 75% Melaleuca Coverage	Post-Development Acreage Total
UPLANDS						
180 – Recreational Land Use	79.94	79.94				
321 – Palmetto Prairie	10.84	3.20	6.78	0.86		
411 – Pine Flatwoods	75.68	6.06	64.68	4.57	0.33	
415 – Other Pine	20.02		3.65	9.90	6.47	
424 - Melaleuca	6.23				6.23	
428 – Cabbage Palm	20.15	0.85	16.06	3.24		
6245 – Cypress, Drained	3.69		1.31	2.38		
740, 743 – Disturbed, Spoil	4.81	4.81				
814, 8146 - Roads	0.56	0.56				
830, 832 – Utilities	2.37	2.37				
Developed						224.24
Sub-total	224.24	97.79	92.48	20.95	13.03	224.24
WETLANDS						
4221 – Brazilian Pepper	0.18				0.18	
4241 – Melaleuca	220.13				220.13	
621 – Cypress	4.32	1.37	2.94			
624 – Pine / Cypress	163.34	15.74	53.97	66.35	27.28	
625 – Hydric Pine Flatwoods	28.60		6.34	16.54	5.72	
628 – Hydric Cabbage Palm	0.33	0.33				
630 – Wetland Hardwood-Conifer	8.65	1.44	7.21			
631 – Wetland Shrub	5.33			5.33		
641 – Freshwater Marsh	0.88		0.88			
7401 – Hydric Disturbed	7.02	7.02				
742 – Borrow Area	0.22	0.22				
8301, 8321 – Hydric Utilities	8.94	8.94				
Developed						447.94
Sub-total	447.94	35.06	71.34	88.22	253.31	447.94
TOTAL	672.18	132.85	163.82	109.17	266.34	672.18

Appendix 3B. Acreages of habitats within the preserve footprint.

	Pre-Development Acreage Total	< 25% Melaleuca Coverage	25% - 50% Melaleuca Coverage	50% - 75% Melaleuca Coverage	Greater than 75% Melaleuca Coverage
UPLANDS					
212 – Unimproved Pasture	9.37	9.37			
260 – Rural Lands	10.56	10.56			
321 – Palmetto Prairie	39.92	24.64	6.64	2.92	5.73
411 – Pine Flatwoods	182.25	86.18	79.96	16.08	0.03
415 – Other Pine	4.50		3.29	1.21	
424 - Melaleuca	7.26				7.26
426 – Tropical Hardwoods	3.07	0.81	2.26		
427 – Live Oak	4.23	3.91	0.32		
428 – Cabbage Palm	3.86	0.53	3.33		
434 – Hardwood-Conifer Mixed	1.80	1.80			
740, 747 – Disturbed, Berms	1.82	1.82			
8146 – Unpaved Road	3.86	3.86			
Sub-total	272.49	143.48	95.80	20.19	13.02
WETLANDS					
262 – Low Pasture	54.05	54.05			
4221 – Hydric Brazilian Pepper	1.63				1.63
4241 – Hydric Melaleuca	125.71				125.71
514 – Ditch	3.38	3.38			
618 – Willow	13.45	10.98	2.48		
621 – Cypress	182.70	156.53	24.72	1.45	
624 – Pine / Cypress	767.67	272.50	294.17	201.00	
625 – Hydric Pine Flatwood	109.33	31.53	21.89	49.26	6.65
628 – Hydric Cabbage Palm	11.08	2.08	6.94	2.06	
630 – Wetland Hardwood-Conifer	18.19	18.19			
631 – Wetland Shrub	0.50			0.50	
641 – Freshwater Marsh	16.18	6.76	9.41		
7401 – Hydric Disturbed	8.53	8.53			
742 – Borrow Area	5.09	5.09			
Sub-total	1,317.49	569.62	359.61	254.27	133.99
TOTAL	1,589.98	713.10	455.41	274.46	147.01

Appendix 3C. Data - Service Consultations - Hacienda Lakes Action Area Project List – Panthers.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved Onsite (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
3/7/02	4-1-00-F-178	199901251	Benton, Charles (Southern Marsh)	Collier	121	75	80	155
10/8/02	4-1-02-F-014	199602945	Barron Collier Company (Winding Cypress)	Collier	1,088	840	1,030	1,870
6/10/03	4-1-01-F-1955	200003795	Walnut Lakes	Collier	157	21	145	166
6/18/03	4-1-01-F-136	199701947	Twin Eagles Phase II	Collier	593	57	98	155
10/6/03	4-1-02-F-0027	200102043	Bonita Beach Road Development	Lee	1,117	145	640	785
1/18/05	4-1-04-F-4259	199702228	Bonita Springs Utilities	Lee	79	0	108	108
3/31/05	4-1-04-F-5656	200306759)	Gateway Shoppes II	Collier	82	0	122	122
5/18/05	4-1-03-I-7855	2003-11156	Collier Regional Medical Center	Collier	44	0	64	64
6/29/05	4-1-03-F-3915	199806220	Wenthworth Estates - V.K. Development	Collier	917	0	458	458
7/15/05	4-1-04-F-5786	199405829	Land's End Preserve	Collier	231	0	61	61
10/26/05	4-1-04-F-9348	2004-1122	Super Target Brentwood Land Partners	Collier	34	0	20	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	108	0	61	61
12/6/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier	23	0	23	23
1/4/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	40	0	10	10
1/13/06	4-1-04-F-6707	20042404	Journey's End	Collier	66	0	34	34
2/9/06	4-1-05-11724	2005384	Firano at Naples	Collier	24	0	19	19
2/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	17	0	47	47
2/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	10	0	13	13
4/4/06	4-1-04-F-6866	200309416	Ava Maria University	Collier	5,027	0	6,114	6,114
5/9/06	41420-2006-I-0089	2004-3248	Collier Boulevard (C.R. 951) from Immokalee Road to Corkscrew Boulevard	Collier	14	0	16	16
5/9/06	41420-2006-I-0263	2005-6298	Santa Barbara and Radio Roads	Collier	29	0	20	20
5/9/06	41420-2006-I-0274	2005-6176	Santa Barbara Road from Davis Road to Radio Road	Collier	6	0	3	3
5/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier	1,017	1,313	223	1,536
6/5/06	4-1-05-PL-8486	20041688	Seact School	Collier	31	0	16	16
6/15/06	41420-2006-I-0362	20056176	Collier County Wellfield	Collier	29	0	36	36
7/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	244	0	326	326
7/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	131	0	119	119
8/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier	10	0	9	9
8/21/06	41420-2006-I-0540	20041813	ASGM Business Park	Dade	41	0	25	25
10/5/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	12	0	18	18
10/16/06	41420-2006-F-0667	199507483	Miromar Addition	Lee	366	0	390	390
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	14	0	30	30

Appendix 3C. Data - Service Consultations - Hacienda Lakes Action Area Project List – Panthers.

Date	Service Log No.	Corps Application No.	Project Name	County	Habitat Impacts (Acres)	Habitat Preserved Onsite (Acres)	Habitat Preserved Off-site (Acres)	Total Habitat Preserved (Acres)
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	18	0	35	35
12/5/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	58	0	29	29
12/7/06	41420-2006-FA-0781, I-0327	20041689	Cypress Landing	Collier	46	0	18	18
4/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	39	0	36	36
5/4/07	41420-2007-TA-0623	NA	Abercia North	Collier	25	0	25	25
6/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	111	0	139	139
7/3/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	11	0	15	15
8/24/07	4-1-04-F-5744	199603501	Terafina	Collier	437	210	261	471
8/31/07	41420-2007-I-0866	2006-7022	Collier County School Site L	Collier	32	0	21	21
9/17/07	41420-2007-FA-1540	2006-7875	Ave Maria Substation	Collier	4	0	3	3
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	138	0	134	134
1/22/08	41420-2008-FA-0021, I-0005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	7	0	44	44
7/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier	19	0	14	14
7/14/08	41420-2008-I-0509, FA 0590	2007-4314	Gridley Medical Building	Collier	4	0	2	2
9/25/08	41420-2008-FA-0702, I-0806	1988-1061	Alligator Alley Commercial Center	Collier	41	0	18	18
12/17/08	41420-2006-FA-0023, F-0018	1999-4926	Sembler Partnership McMullen Parcel	Collier	40	0	49	49
1/13/09	41420-2007-I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	5	2	5	7
2/26/09	41420-2006-FA-0548	2006-7018	Oil Well Road Widening	Collier	328	0	356	356
3/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier	240	0	102	102
6/29/09	41420-2007-FA-1534	2007-1676	Tamiami Crossing Commercial Development	Collier	25	0	19	19
7/10/09	41420-2009-FA-0283	2008-4470	Home Center Plaza	Collier	16	0	5	5
1/5/10	41420-2009-FA-0523	2005-2117	Bonita Beach Road East Water Storage Tank	Lee	15	0	5	5
3/3/10	41420-2010-CPA-0154	2009-03450	Naples Landfill Gas to Energy	Collier	1	0	2	2
6/21/10	41420-2008-FA-0799	2008-2429	Camp Keais Strand Ag. Operation	Collier	6	0	36	36
6/21/10	41420-2008-FA-0798	2008-2429	Shaggy Cypress Ag. Operation	Collier	10	0	22	22
5/24/11	4-1-01-F-607	200001926	Mirasol	Collier	810	914	363	1,277
10/19/11	41420-2007-FA-0564	2008-615	Hogan Island Quarry	Collier	968	41	1,219	1,219
				Total	23,137	6,785	14,327	21,115

Appendix 3D. Data - Service Consultations - Hacienda Lakes Action Area Project List – Wood Storks

Date	Service Number	Corps Number	Project Name	County	Action	Impacts	Comp	Impacts	Comp
						Project		Wetlands	
03/29/84	4-1-83-195	83M-1317	CMC Development Corporation (Ford Test Track)	Collier	BO	530	0	3	0
02/21/85	4-1-85-018	FAP #?	USDOT, FHA (conversion of Hwy 84 to I-75)	Broward Collier	BO	1,517	0	0	0
02/10/89	4-1-89-001	FAP IR-75-4(88)81 89PG-20156	USDOT, FHA (SR 29/I-75 Interchange)	Collier	BO	350	0	57	0
10/23/91	4-1-91-309	199130649	Collier County - Unpaved Miller Boulevard Extension (dirt road, pot hole fill and repair)	Collier	BO	5	0	5	0
01/14/92	4-1-91-325	199101279	Dooner Gulf Coast Citrus (32 acre citrus grove)	Collier	BO	40	40	0	0
06/18/93	4-1-93-217	199200393	Lee County DOT (Corkscrew Road)	Lee	BO	107	13	5	5
02/25/94	4-1-94-209	199301131	Lee County DOT (Daniels Road extension)	Lee	BO	65	40	10	5
05/09/94	4-1-93-251	199202019	Corkscrew Enterprises (The Habitat aka Belle Terra	Lee	BO	563	437	111	351
10/27/94	4-1-94-430	199302371 199400807 199400808	Timberland and Tiburon/Florida Gulf Coast University/Treeline Boulevard	Lee	BO	1,088	526	141	426
08/07/95	4-1-95-274	199405501	Bonita Bay Properties, Inc. (golf course)	Collier	BO	509	491	2	0
08/15/95	4-1-94-214	199301495	SWFIA, Northeast Access Road	Lee	BO	14	0	3	0
03/27/98	4-1-97-F-635	199604158	Bonness, Joseph D., Jr. Trustee (Willow Run Quarry)	Collier	BO	359	190	122	324
09/27/99	4-1-98-F-310	199130802	Lee County DOT (Daniels Parkway extension)	Lee	BO	2,093	94	20	94
12/08/99	4-1-98-F-517	199607574	Kaufmann Holdings, Inc. (Cypress Creek Farms)	Collier	BO	239	24	2	24
04/17/00	4-1-98-F-428	199507483	Miromar Development, Inc. (Miromar Lakes)	Lee	BO	1,323	194	231	187
06/09/00	4-1-99-F-553	199900619	Vineyards Development Corp. (Naples Reserve GC)	Collier	BO	833	320	114	395
02/21/01	4-1-00-F-135	199803037	Wortzel & Landl, Co-Trustees (Corkscrew Ranch)	Lee	BO	106	0	2	4
07/30/01	4-1-94-357	199003460	Naples Golf Estates	Collier	BO	290	175	121	324
12/14/01	4-1-00-F-585	199301156	SWFIA, Mid-field Terminal Expansion	Lee	BO	8,058	6,986	709	4,293
03/07/02	4-1-00-F-178	199901251	Benton, Charles (Southern Marsh GC) San Remino Mine	Collier*	BO	121	155	18	130
10/08/02	4-1-02-F-014	199602945	Barron Collier Company (Winding Cypress)	Collier*	BO	1,088	1,870	201	765
06/10/03	4-1-01-F-1955	200003795	Walnut Lakes (Reflection Lakes)	Collier	BO	157	166	73	26
06/18/03	4-1-01-F-136	199701947	Twin Eagles Phase II	Collier	BO	593	155	133	175
06/23/03	4-1-01-F-143	199905571	Airport Technology Center	Lee	BO	116	230	37	159
07/02/03	4-1-98-F-428	199507483	Addition to Miromar Lakes	Lee	BO	342	498	87	309
10/06/03	4-1-02-F-0027	200102043	Bonita Beach Road Development	Lee	BO	1,117	785	99	531
01/18/05	4-1-04-F-4259	199702228	Bonita Springs Utilities	Lee	BO	79	108	69	118
05/18/05	4-1-03-I-7855	2003-11156	Collier Regional Medical Center	Collier*	BO	44	64	35	78
06/29/05	4-1-03-F-3915	199806220	Wenthworth Estates - V.K. Development	Collier*	BO	917	485	94	319
07/15/05	4-1-04-F-5786	199405829	Land's End Preserve	Collier*	BO	231	61	4	35
10/26/05	4-1-04-F-9348	2004-1122	Super Target Brentwood Land Partners	Collier	BO	34	20	16	20
11/23/05	4-1-04-F-6043	20039414	Waterways Join Venture IV	Collier	BO	108	61	35	73
11/29/05	4-1-04-F-8847	20048995	Seminole Tribe of FL Administrative Complex	Collier	BO	6	8	1	1
12/06/05	4-1-03-F-3483	200302409	Southwest Florida Investment Property, LLC	Lee	BO	207	305	47	351
12/06/05	4-1-04-F-6691	200310689	Rattlesnake Hammock Road	Collier*	BO	23	23	10	23
01/04/06	4-1-04-F-8388	2004554	Immokalee Regional Airport - Phase I	Collier	BO	67	43	7	7
01/04/06	4-1-04-F-9777	20048577	Logan Boulevard Extension	Collier	BO	40	10	2	10
01/13/06	4-1-04-F-6707	20042404	Journey's End	Collier*	BO	66	34	3	13
02/09/06	4-1-05-11724	2005384	Firano at Naples	Collier*	BO	24	19	7	22

Appendix 3D. Data - Service Consultations - Hacienda Lakes Action Area Project List – Wood Storks

Date	Service Number	Corps Number	Project Name	County	Action	Impacts	Comp	Impacts	Comp
						Project		Wetlands	
02/22/06	4-1-04-F-6505	200101122	Corkscrew Road	Lee	BO	17	47	5	26
02/23/06	4-1-04-F-5244	200312276	Summit Church	Lee	BO	10	13	9	13
04/04/06	4-1-04-F-6866	200309416	Ava Maria University	Collier	BO	5.027	6.114	30	4.463
05/09/06	41420-2006-I-0089	2004-3248	Collier Boulevard (C.R. 951) from Immokalee Road to Corkscrew Boulevard	Collier	BO	14	16	7	16
05/09/06	41420-2006-I-0274	2005-6176 -	Santa Barbara Road from Davis Road to Radio Road	Collier*	NLAA	6	3	0	1
05/09/06	41420-2006-I-0263, FA-0657	2005-6298	Santa Barbara and Radio Roads	Collier*	NLAA	29	20	1	1
05/16/06	4-1-05-F-10309	19971924	Sabal Bay	Collier*	BO	1.017	1.536	432	1.075
06/05/06	4-1-05-PL-8486	20041688	Seact School	Collier*	NLAA	31	16	13	18
06/15/06	41420-2006-I-0362 FA 0811	20056176	Collier County Wellfield	Collier*	NLAA	29	36	21	36
07/12/06	41420-2006-F-0282	200311150	Cypress Shadows	Lee	BO	244	326	126	262
07/28/06	4-1-04-F-7279	20041695	Raffia Preserve	Collier	BO	131	119	56	119
08/15/06	41420-2006-I-0151	20031963	Naples Custom Homes	Collier*	NLAA	10	9	8	13
09/22/06	41420-2006-I-0355	20040047	Immokalee Seminole Reservation Road Improvements	Collier	NLAA	17	35	1	1
10/05/06	41420-2006-I-0616	20065295	New Curve on Corkscrew Road	Lee	NLAA	12	18	1	4
10/16/06	41420-2006-F-0667	199507483	Miromar Addition	Lee	BO	366	390	87	158
10/25/06	41420-2006-F-0442	20047046	Koreshan Boulevard Extension	Lee	BO	14	30	14	30
10/26/06	41420-2006-F-0787	200306755	Jetway Tradeport	Collier	BO	38	52	18	51
10/27/06	41420-2006-I-0203	20057180	Living Word Family Church	Collier	NLAA	18	35	11	39
11/15/06	41420-2006-TA-0727	N/A	Liberty Landing	Collier	TA	27	19	1	2
11/16/06	41420-2006-TA-0060, FA 0081	N/A	Collier County Elementary School K	Collier	TA	26	17	0	17
12/05/06	41420-2006-FA-1179	20057179	The Roberts Group CPD	Lee	NLAA	58	29	4	13
12/07/06	41420-2006-FA-0781.I-0327	20041689	Cypress Landing	Collier*	NLAA	46	18	0	0
03/09/07	41420-2006-F-0850	200312445	Airport Interstate Commerce Park	Lee	BO	323	371	86	401
04/13/07	41420-2007-TA-0618	NA	Collier County School Site J - Everglades Blvd.	Collier	TA	39	56	0	56
05/04/07	41420-2007-TA-0623	NA	Abercia North	Collier*	TA	25	31	0	31
05/07/07	41420-2007-I-0581	1999-4313	Savanna Lakes	Lee	NLAA	124	140	9	60
06/19/07	41420-2007-I-0997	2006-2583	Caloosa Reserve	Collier	NLAA	111	139	4	5
07/03/07	41420-2007-TA-0818	NA	Woodcrest Development	Collier	TA	11	15	1	1
07/17/07	41420-2007-I-0330	2006-6377	Faith Landing	Collier	NLAA	35	18	2	5

Appendix 3D. Data - Service Consultations - Hacienda Lakes Action Area Project List – Wood Storks

Date	Service Number	Corps Number	Project Name	County	Action	Impacts	Comp	Impacts	Comp
						Project		Wetlands	
08/24/07	4-1-04-F-5744	199603501	Terafina	Collier	BO	437	471	296	475
08/31/07	41420-2007-I-0866	2006-7022	Collier County School Site L	Collier	NLAA	32	21	14	14
09/17/07	41420-2007-FA-1540	2006-7875	Ave Maria Substation	Collier	NLAA	4	3	1	3
11/13/07	41420-2006-FA-1430	2005-782	Summit Lakes	Collier	NLAA	138	134	27	16
01/22/08	41420-2008-FA-0021, I-0005	2007-4503	I-75 from Collier County Line to South of Corkscrew Road	Lee	NLAA	7	44	80	44
01/30/08	41420-2008-FA-0009 -I-0003	2007-4884	I-75 from Corkscrew Road to Daniels Parkway	Lee	NLAA	7	12	15	10
02/07/08	41420-I-0015	200502117	Cleveland Clinic	Lee	NLAA	36	19	25	6
04/28/08	41420-2008-I-0313,FA0442	2007-6414	Immokalee Rd Substation LCEC	Collier	NLAA	1	1	1	1
06/26/08	41420-2007-FA-1150	2007-2175	Immokalee Master Plan	Collier	BO	506	1,015	1	1,014
07/02/08	41420-2007-FA-0592	2005-7439	Kaicasa	Collier	BO	72	183	2	264
07/14/08	41420-2008-I-0508	2005-6488	Amerimed Medical Center	Collier*	NLAA	18	14	9	14
07/14/08	41420-2008-I-0509, FA 0590	2007-4314	Gridley Medical Building	Collier*	NLAA	4	2	2	2
07/23/08	4-1-04-F-6112, F-0872	20021683	Alico Airpark (Haul Ventures)	Collier	BO	166	315	46	475
07/23/08	41420-2006-FA-0165, F-0846	2004-182	Premier Airport Park	Lee	BO	180	211	49	202
09/25/08	41420-2008-FA-0702, I-0806	1988-1061	Alligator Alley Commercial Center	Collier*	NLAA	41	18	13	5
12/17/08	41420-2006-FA-0023, F - 0018	1999-4926	Sembler Partnership McMullen Parcel	Collier*	BO	40	49	26	49
01/13/09	41420-2007-FA-1111 I-1083	2007-1264	Big Corkscrew Island Fire Control & Rescue	Collier	NLAA	5	7	1	6
02/12/09	4-1-98-F-372 06-F-0247	199402492	Florida Rock Industries, Inc. (Fort Myers Mine #2) Amended	Lee	BO	2,913	1,960	334	1,693
02/26/09	41420-2006-FA-0548, FA-0548	2006-7018	Oil Well Road Widening	Collier	BO	329	356	50	525
03/30/09	41420-2006-FA-1342	HCP - 2009	City Gate Development	Collier*	BO	240	102	0	0
06/29/09	41420-2007-FA-1534	2007-1676	Tamiami Crossing Commercial Development	Collier*	NLAA	25	19	12	26
07/10/09	41420-2009-FA-0283	2008-4470	Home Center Plaza	Collier*	NLAA	16	5	3	6
01/05/10	41420-2009-FA-0523	2005-2117	Bonita Beach Road East Water Storage Tank	Lee	NLAA	15	5	0	0
03/03/10	41420-2010-CPA-0154	2009-03450	Naples Landfill Gas to Energy	Collier*	NLAA	1	3	1	3
06/21/10	41420-2008-FA-0798	2008-2429	Shaggy Cypress Ag. Operation	Collier	NLAA	10	22	35	22
06/21/10	41420-2008-FA-0799	2008-2429	Camp Keais Strand Ag. Operation	Collier	NLAA	6	36	10	38
05/24/11	4-1-01-F-607	200001926	Mirasol	Collier	BO	810	1,277	645	831

Appendix 3D. Data - Service Consultations - Hacienda Lakes Action Area Project List – Wood Storks

Date	Service Number	Corps Number	Project Name	County	Action	Impacts Project	Comp Project	Impacts Wetlands	Comp Wetlands
07/07/11	41420-2011-CPA-0106.F-0108	2011-00391	Green Meadow Water Treatment Plant	Lee	NLAA	23	33	4	33
10/19/11	41420-2007-FA-0564	2008-615-	Hogan Island Quarry	Collier	BO	968	1,219	56	75
12/01/11	41420-2011-CPA-0133.F-0132	2011-00926	I75 Interchange and Access Road at SWFIA	Lee	BO	61	44	91	44
12/30/11	4-1-04-I-5260	200106580	Parklands Collier	Collier	BO	301	775	33	726
12/30/11	41420-2006-F-0204	2003-11158	Hacienda Lakes	Collier*	BO	728	1,538	485	1,280
				Total	100	39,464	34,211	5,950	24,416

Since 2002	Acres		21,375	24,681	4,293	17,984
	Count	81	81	81	75	78
	BO	45				
	NLAA	31				
	TA	5				
*Since 2002 5-mile radius	Acres		4,820	6,130	1,399	3,945
	Count	25	25	25	22	23
	BO	12				
	NLAA	12				
	TA	1				

Appendix 3E. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Panthers.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT OF WETLAND ON PROJECT
>5% Wetlands									
061122-6	11-01567-P-02	December 21, 2007	Twin Eagles Phase 2- Wetland Boardwalks	3.14	3.14	0.40	2.74	0.00	100.00%
080606-13	36-03802-P	October 9, 2008	I-75 Pond C-12 (Segment C - Application No 070817-14)	1.58	1.58	1.58	0.00	0.00	100.00%
090112-9	36-03802-P	February 25, 2009	I-75 Improvements Collier/Lee Co Line To Corkscrew Rd.Sgmt B	2.79	2.79	0.25	2.54	0.00	100.00%
070206-6	11-02336-P	May 8, 2008	Ave Maria Phase 2 - Conservation Area Modification	8.40	8.20	0.00	8.20	0.20	97.62%
060524-2	11-02031-P	September 13, 2007	Mirasol	1,713.45	1,426.41	595.52	830.89	109.58	83.25%
060713-9	11-02055-P	August 7, 2007	Saturnia Falls (F.K.A Terafina P.U.D)	646.49	533.10	280.06	253.04	31.37	82.46%
061010-15	11-01745-P	March 12, 2009	Oil Well Rd (Cr 858) From E Immokalee Rd To E Camp Keais Rd	898.33	574.22	49.18	525.04	4.17	63.92%
060928-9	11-02874-P	July 10, 2008	Elementary School Site L	34.03	20.92	11.95	8.97	2.69	61.48%
070213-11	11-02813-P	January 29, 2008	Big Corkscrew Island Fire Control Station Number 14	6.47	2.54	0.72	1.82	0.21	39.26%
070803-18	36-03802-P	February 14, 2008	I-75 Collier/Lee Co. Line North To Corkscrew Road/Segment B	408.23	133.90	79.46	33.71	0.00	32.80%
070806-9	11-02234-P	April 10, 2008	Heritage Bay	2,562.20	834.90	0.00	0.00	0.00	32.59%
060522-3	11-02231-P	November 15, 2007	Parklands Collier	973.91	291.03	0.00	0.00	0.00	29.88%
060206-14	36-06026-P	November 9, 2006	Corkscrew Ranch	61.78	11.48	0.00	4.58	3.36	18.58%
070817-14	36-03802-P	February 14, 2008	I-75 Corkscrew Road To Daniels Parkway/Segment C	479.65	60.79	15.00	40.97	0.00	12.67%
060223-1	11-02704-P	October 3, 2007	Pristine Estates	48.84	4.52	0.00	4.52	5.42	9.25%
060329-16	11-02603-P	April 12, 2007	Mockingbird Crossing (F.K.A. Caloosa Reserve)	110.95	8.06	0.72	7.34	20.37	7.26%
Sub-Total for projects with greater than 5 percent wetlands (General Permits)				**7,960.24**	**3,917.58**	**1,034.84**	**1,724.36**	**177.37**	-
<5% WETLANDS and NA									
060317-3	11-02126-P	August 17, 2006	C.C.P.S Middle School E.E.	45.68	1.21	0.31	0.90	5.25	2.65%
060720-6	11-02477-P	January 26, 2007	Orchid Cove Improvements	49.96	0.59	0.00	0.00	0.00	1.18%

Appendix 3E. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Panthers.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT OF WETLAND ON PROJECT
060926-9	36-04234-P	October 11, 2007	Bonita Beach Road Golf Club Rpd Aka Beach Road Golf Estates	484.85	5.67	5.23	0.44	4.08	1.17%
070301-16	11-02336-P	September 6, 2007	Ave Maria Phase 2 - Oil Well Road Canal Phase 2	85.40	0.45	0.45	0.00	0.00	0.53%
061102-2	11-02664-P	January 30, 2007	Village Oaks Elementary School Additions And Renovations	20.00	0.08	0.00	0.00	0.00	0.40%
060421-11	11-01737-P	August 3, 2006	Immokalee Road (Cr 846)	69.31	0.00	0.00	0.00	0.00	0.00%
060331-14	11-02599-P	August 22, 2006	Elementary School J	22.13	0.00	0.00	0.00	0.00	0.00%
060306-15	36-04234-P	September 22, 2006	East Bonita Active Adult Rpd Improvements	6.29	0.00	0.00	0.00	0.00	0.00%
060421-18	11-02234-P	October 18, 2006	Heritage Bay Affordable Housing	24.64	0.00	0.00	0.00	0.00	0.00%
060711-28	11-02336-P	October 30, 2006	Ave Maria Phase 2 - Oil Well Road Canal	41.90	0.00	0.00	0.00	0.00	0.00%
060814-10	11-02234-P-02	November 21, 2006	Collier County Ems Site	2.60	0.00	0.00	0.00	0.00	0.00%
060728-2	11-02336-P	November 22, 2006	Ave Maria Park Of Commerce	96.21	0.00	0.00	0.00	0.00	0.00%
060531-5	11-02200-P-02	December 7, 2006	Arrowhead Reserve Villages	18.57	0.00	0.00	0.00	0.00	0.00%
060809-10	11-02513-P	December 7, 2006	Collier Boulevard	54.16	0.00	0.00	0.00	0.00	0.00%
061004-3	11-02336-P	January 4, 2007	Middlebrooke Townhomes	20.20	0.00	0.00	0.00	0.00	0.00%
061115-12	36-05196-P	January 10, 2007	Corkscrew Road Curves Outfall Modification	14.07	0.00	0.00	0.00	0.00	0.00%
060627-4	11-02336-P	January 11, 2007	Bellerawalk At Ave Maria - Phase 2 E.R.P.	779.50	0.00	0.00	0.00	0.00	0.00%
061215-11	11-01863-P-05	January 17, 2007	Springhill Suites (Lot 16)	4.55	0.00	0.00	0.00	0.00	0.00%
061113-4	11-02336-P	February 12, 2007	Del Webb Sales And Welcome Center (Fka Model Center)	0.41	0.00	0.00	0.00	0.00	0.00%
060811-9	36-06268-P	February 17, 2007	Bonita Springs Utilities Operations Center	11.67	0.00	0.00	0.00	0.00	0.00%
070103-5	11-02336-P-02	February 27, 2007	Emerson Park Sales Center	0.55	0.00	0.00	0.00	0.00	0.00%
070403-5	36-06026-P	June 22, 2007	Corkscrew Ranch	61.78	0.00	0.00	0.00	0.00	0.00%
070327-7	11-02336-P-03	July 12, 2007	Del Webb Amenity Campus	11.40	0.00	0.00	0.00	0.00	0.00%
070314-18	36-03269-P	July 21, 2007	Bella Terra (Fka The Habitat)	57.10	0.00	0.00	0.00	0.00	0.00%
070622-15	11-02268-P-03	July 31, 2007	Tuffy Automotive Center At Mission Hills	0.89	0.00	0.00	0.00	0.00	0.00%
070302-14	36-03743-P-02	August 16, 2007	Bonita Beach Road Widening - Sections 4 And 5	41.35	0.00	0.00	0.00	0.00	0.00%
070525-9	36-03269-P	September 12, 2007	Bella Terra Phase 5	21.13	0.00	0.00	0.00	0.00	0.00%

Appendix 3E. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Panthers.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT OF WETLAND ON PROJECT
070719-7	36-03802-P	September 12, 2007	I-75 At Bonita Beach Rd, Corkscrew Rd, Daniels Pkwy	1.17	0.00	0.00	0.00	0.00	0.00%
070823-19	11-01863-P-06	October 12, 2007	Fairfield Inn Lot 15 Citygate	4.06	0.00	0.00	0.00	0.00	0.00%
070605-24	36-06550-P	November 15, 2007	Pine Lake Preserve	29.52	0.00	NA	8.38	1.69	0.00%
070823-17	11-02130-P	February 8, 2008	Rattlesnake Crossings	19.91	0.00	0.00	0.00	0.00	0.00%
070830-23	11-02432-P	March 6, 2008	Orange Blossom Ranch Basin 4a1 Improvements	1.76	0.00	0.00	0.00	0.00	0.00%
070220-9	36-06538-P	March 13, 2008	Plumosa Pit	36.82	0.00	0.00	0.00	0.00	0.00%
070314-9	11-02013-P	May 15, 2008	Deseret Naples Farm 2	1,244.40	0.00	0.00	0.00	0.00	0.00%
080325-14	11-02336-P	June 24, 2008	Arthrex At Ave Maria	18.30	0.00	0.00	0.00	0.00	0.00%
071214-15	11-02336-P	July 3, 2008	Ave Maria School Of Law	12.40	0.00	0.00	0.00	0.00	0.00%
080110-10	11-02928-P	October 7, 2008	Captiva Pond	46.87	0.00	0.00	0.00	0.00	0.00%
080409-14	36-03269-P	November 20, 2008	Bella Terra Fka The Habitat	3.98	0.00	0.00	0.00	0.00	0.00%
080829-8	11-02234-P	December 11, 2008	Heritage Bay - Clubhouse Modification	10.80	0.00	0.00	0.00	0.00	0.00%
080625-10	36-03269-P	December 23, 2008	Bella Terra (Fka The Habitat)	61.49	0.00	0.00	0.00	0.00	0.00%
080714-4	11-01737-P	January 22, 2009	Immokalee Collier Intersection Improvements	8.14	0.00	0.00	0.00	0.00	0.00%
080109-24	11-02336-P	February 2, 2009	Ave Maria Recreation Center	3.60	0.00	0.00	0.00	0.00	0.00%
070118-10	11-02336-P-05	March 10, 2009	Ave Maria Red Rabbit	1.96	0.00	0.00	0.00	0.00	0.00%
070216-7	36-06303-P	March 12, 2007	Alico Farm Field	147.00	NA	NA	NA	NA	NA
071023-22	11-02831-P	January 11, 2008	Triple G Loop (Picayune Strand State Forest)	4.35	NA	NA	NA	NA	NA
060124-5	36-05393-P-02	September 21, 2006	Cypress Shadows	352.83	NA	NA	NA	NA	NA
060823-5	11-02637-P	October 20, 2006	Flamingo Bend Nursery	16.46	NA	NA	NA	NA	NA
Sub-Total for projects with less than 5 percent wetlands and NA				**4,072.12**	**8.00**	**5.99**	**9.72**	**11.02**	-
Totals				**12,032.36**	**3,925.58**	**1,040.83**	**1,734.08**	**188.39**	-

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
>5% WETLANDS									
080321-16	36-03802-P	May 20, 2008	Design-Build Public-Private Partnership For I-75(Segment B)	2.52	2.52	1.39	0.21	0.00	100.00%
080606-13	36-03802-P	October 9, 2008	I-75 Pond C-12 (Segment C - Application No 070817-14)	1.58	1.58	1.58	0.00	0.00	100.00%
090112-9	36-03802-P	February 25, 2009	I-75 Improvements Collier/Lee Co Line To Corkscrew Rd Sgmt B	2.79	2.79	0.25	2.54	0.00	100.00%
060616-26	11-02060-P	September 27, 2007	Conservation Easement Modification For Delasol	0.44	0.44	0.44	0.00	0.00	100.00%
060912-3	36-05136-P	October 12, 2007	Southwest International Commerce Park	3.38	3.38	0.24	3.14	0.00	100.00%
061122-6	11-01567-P-02	December 21, 2007	Twin Eagles Phase 2- Wetland Boardwalks	3.14	3.14	0.40	2.74	0.00	100.00%
061219-10	11-02836-P	March 13, 2008	North Naples Fire District Number 48	3.40	3.40	2.85	0.55	0.00	100.00%
060616-6	36-04678-P	December 5, 2006	Wachovia Bank Arborwood Branch	1.27	1.27	0.00	0.00	0.00	99.93%
070206-6	11-02336-P	May 8, 2008	Ave Maria Phase 2 - Conservation Area Modification	8.40	8.20	0.00	8.20	0.20	97.62%
060414-2	36-05430-P	October 12, 2006	Island Park Regional Mitigation Area	158.46	143.35	0.00	143.35	15.11	90.46%
060524-2	11-02031-P	September 13, 2007	Mirasol	1,713.45	1,426.41	595.52	830.89	109.58	83.25%
060713-9	11-02055-P	August 7, 2007	Saturnia Falls (F.K.A Terafina P.U.D)	646.49	533.10	280.06	253.04	31.37	82.46%
060810-3	11-02856-P	May 15, 2008	Santa Barbara Boulevard Extension	90.27	69.82	33.82	36.00	2.00	77.35%
060223-4	36-03098-P	October 8, 2006	Laurel Oaks Lots 31-34	2.43	1.83	0.00	0.00	0.22	75.41%
060511-19	36-04603-P	January 23, 2007	Mangrove Waterways Fka Bonita Commercial	1.50	1.03	0.37	0.66	0.00	68.67%
061010-15	11-01745-P	March 12, 2009	Oil Well Rd (Cr 858) From E Immokalee Rd To E Camp Keais Rd	898.33	574.22	49.18	525.04	4.17	63.92%
060928-9	11-02874-P	July 10, 2008	Elementary School Site L	34.03	20.92	11.95	8.97	2.69	61.48%
060606-2	36-06586-P	January 8, 2008	Arlington Commerce Park	80.57	49.10	36.79	12.31	3.16	60.94%
070110-1	11-02737-P	August 15, 2007	Oakes Park	4.79	2.76	0.00	2.76	0.45	57.62%
080204-12	36-06994-P	November 26, 2008	Halfway Creek Lock Up	10.55	5.88	0.16	5.72	1.58	55.73%
070910-13	36-06851-P	June 6, 2008	South Trail Fire Protection And Rescue Service District	1.88	0.85	0.85	0.00	0.00	45.21%
070214-9	11-02779-P	November 21, 2007	Collier County Ems Site	2.22	0.99	0.07	1.00	0.13	44.59%
070508-27	36-06693-P	February 14, 2008	Pinnacle Center	12.18	5.26	2.80	2.46	0.29	43.19%
070213-11	11-02813-P	January 29, 2008	Big Corkscrew Island Fire Control Station Number 14	6.47	2.54	0.72	1.82	0.21	39.26%
070306-10	36-05427-P	May 15, 2008	Premier Airport Park	240.59	80.08	44.75	35.33	14.83	33.28%
070803-18	36-03802-P	February 14, 2008	I-75 Collier/Lee Co. Line North To Corkscrew Road/Segment B	408.23	133.90	79.46	33.71	0.00	32.80%
070806-9	11-02234-P	April 10, 2008	Heritage Bay	2,562.20	834.90	0.00	0.00	0.00	32.59%
060630-3	36-04978-P-02	October 3, 2007	Coastal Villages - Phase 3	23.36	7.40	7.40	0.00	0.00	31.68%
061114-5	11-02743-P	October 11, 2007	Diamonte Estates	8.85	2.72	2.72	0.00	0.00	30.73%
071226-27	36-07096-P	May 14, 2009	Daniels Marketplace	65.52	19.60	13.97	5.63	2.74	29.91%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
060522-3	11-02231-P	November 15, 2007	Parklands Collier	973.91	291.03	0.00	0.00	0.00	29.88%
060417-2	26-00844-P	April 12, 2007	Corbitt Farms	797.00	230.13	0.00	230.13	0.00	28.87%
061019-1	36-05370-P	February 27, 2008	Bella Lugo	4.80	1.25	0.30	0.95	0.00	26.04%
070531-7	36-05268-P	January 13, 2009	Three Oaks Pkwy-Oriole Rd Ext And Mcgarvey Researeh Park	822.33	192.70	173.99	154.71	0.37	23.43%
060224-4	26-00820-P	November 9, 2006	Section 33 Farm	738.66	162.66	0.00	162.66	0.00	22.02%
080421-16	11-03000-P	April 17, 2009	Unity Faith Missionary Baptist Church	5.23	1.15	0.21	0.94	0.00	21.99%
080401-6	36-06326-P	February 6, 2009	Midtown Estero Village Improvements	34.02	7.40	0.00	7.40	3.90	21.75%
060613-9	36-06326-P	March 30, 2007	Midtown Estero Village	34.02	7.40	0.00	7.40	3.92	21.75%
070723-6	26-00721-P	March 13, 2008	Church Road Borrow Pit/Steps To The Future Childrens Home	640.47	134.81	4.61	130.20	4.92	21.05%
060206-14	36-06026-P	November 9, 2006	Corkscrew Ranch	61.78	11.48	0.00	4.58	3.36	18.58%
060908-1	11-02785-P	January 8, 2008	Faith Landing	35.11	6.31	1.43	4.88	1.22	17.97%
060428-19	11-01414-P	April 12, 2007	Collier County Public School Bus Garage	9.17	1.39	1.39	0.00	0.00	15.16%
070817-14	36-03802-P	February 14, 2008	I-75 Corkscrew Road To Daniels Parkway/Segment C	479.65	60.79	15.00	40.97	0.00	12.67%
070622-11	36-06551-P	October 11, 2007	Marni Fields	16.45	2.05	2.05	0.00	0.00	12.46%
070330-7	36-03802-P	October 24, 2007	Ramp Wn Ditch Modification At Sr93 (I-75)/Alico Road	8.90	1.03	1.03	0.00	0.00	11.57%
060524-11	36-06446-P	August 3, 2007	Daniels Road Business Park	4.35	0.46	0.00	0.46	0.05	10.57%
080221-21	36-05268-P	March 13, 2009	Three Oaks Commerce Park	58.90	6.17	0.00	6.17	0.37	10.48%
061121-4	11-02694-P	April 20, 2007	Naples Nissan	15.17	1.51	0.62	0.89	0.31	9.96%
060223-1	11-02704-P	October 3, 2007	Pristine Estates	48.84	4.52	0.00	4.52	5.42	9.25%
071004-16	36-03802-P	June 12, 2008	I-75 Daniels Parkway To Colonial Boulevard/Segments D And E	405.13	36.00	6.73	26.39	0.00	8.89%
060329-16	11-02603-P	April 12, 2007	Mockingbird Crossing (F.K.A. Caloosa Reserve)	110.95	8.06	0.72	7.34	20.37	7.26%
060413-2	36-06396-P	June 5, 2007	Broadway Grande Shoppes	5.32	0.38	0.38	0.00	0.00	7.14%
080125-30	36-05639-P	March 21, 2008	Crossroads Commerce Center	70.06	4.63	0.00	0.00	0.00	6.61%
060818-8	36-03802-P	June 14, 2007	I-75 Widening South Of Bonita Bch Rd To Lee/Collier Co. Line	40.86	2.61	2.02	0.00	0.00	6.39%
060302-16	11-02364-P-02	January 16, 2007	Bucks Run / Restoration Church	13.31	0.84	0.00	0.84	1.23	6.31%
080207-26	11-02911-P	November 3, 2008	Esperanza Place Pud	29.60	1.80	1.80	0.00	0.00	6.08%
Sub-Total for projects with greater than 5 percent wetlands (General Permits)				**12,463.28**	**5,121.94**	**1,380.02**	**2,707.50**	**234.17**	-
<5% WETLANDS and NA									
060629-5	36-06518-P	August 16, 2007	Midtown Estero	48.22	2.10	0.00	2.10	3.62	4.36%
080303-14	11-02960-P	December 22, 2008	Conservancy Of Southwest Florida - The	19.96	0.79	0.00	0.79	0.00	3.96%
061208-25	36-06526-P	August 29, 2007	Villas Of Paradise	11.17	0.36	0.36	0.00	0.00	3.22%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
060925-7	36-06537-P	October 26, 2007	Alico Road Business Park Tracts A And B	23.30	0.74	0.00	0.74	1.57	3.18%
060317-3	11-02126-P	August 17, 2006	C.C.P.S Middle School E.E.	45.68	1.21	0.31	0.90	5.25	2.65%
070315-22	11-02931-P	October 14, 2008	Gaspar Station	17.70	0.40	0.36	0.00	0.00	2.26%
070213-14	11-02912-P	August 27, 2008	Napoli Village	8.97	0.16	0.00	1.36	0.34	1.78%
070726-19	26-00922-P	May 1, 2008	H C G M Llc Borrow Pit	98.36	1.40	1.40	0.00	0.00	1.42%
060926-9	36-04234-P	October 11, 2007	Bonita Beach Road Golf Club Rpd Aka Beach Road Golf Estates	484.85	5.67	5.23	0.44	4.08	1.17%
061025-17	11-02801-P	December 21, 2007	Brooks Village	20.31	0.20	0.20	0.00	0.00	0.98%
060731-4	36-06202-P	June 14, 2007	Formosa Industrial Park	128.77	1.03	0.55	0.48	2.22	0.80%
070301-16	11-02336-P	September 6, 2007	Ave Maria Phase 2 - Oil Well Road Canal Phase 2	85.40	0.45	0.45	0.00	0.00	0.53%
061102-2	11-02664-P	January 30, 2007	Village Oaks Elementary School Additions And Renovations	20.00	0.08	0.00	0.00	0.00	0.40%
060816-10	36-03908-P-06	October 13, 2006	Lot 11 Alico Commercial Park	1.34	0.00	0.00	0.00	0.00	0.03%
070502-30	36-03865-P	October 4, 2007	Appalachian Oil Corporation	5.37	0.00	0.00	0.00	0.00	0.00%
060120-17	36-05955-P	August 23, 2006	Estero Ridge	5.84	0.00	0.00	0.00	0.00	0.00%
060113-16	36-06431-P	July 2, 2007	Emerson Condominiums	26.12	0.00	0.00	0.00	0.00	0.00%
070706-18	11-02725-P	August 1, 2007	Golden Gate Community Park Picnic Pavilion And Boat Landing	1.00	0.00	0.00	0.00	0.00	0.00%
070530-21	36-04753-P-03	August 13, 2007	Shops At Tuscany Park	2.59	0.00	0.00	0.00	0.00	0.00%
070502-31	36-06488-P	August 15, 2007	Whitney Interstate Industrial Park	30.12	0.00	0.00	0.00	0.00	0.00%
070302-14	36-03743-P-02	August 16, 2007	Bonita Beach Road Widening - Sections 4 And 5	41.35	0.00	0.00	0.00	0.00	0.00%
070627-22	36-06601-P	August 25, 2007	Canal Crossing I-75 And Three Oaks Boulevard	0.94	0.00	0.00	0.00	0.00	0.00%
070803-23	36-05518-P	August 28, 2007	Alico Lakes Village	31.73	0.00	0.00	0.00	0.00	0.00%
070515-1	11-02735-P	September 5, 2007	Immokalee Career Center	6.56	0.00	0.00	0.00	0.00	0.00%
070209-7	11-01997-P-02	September 11, 2007	Elementary School Site G	17.58	0.00	0.00	0.00	0.00	0.00%
070525-9	36-03269-P	September 12, 2007	Bella Terra Phase 5	21.13	0.00	0.00	0.00	0.00	0.00%
070719-7	36-03802-P	September 12, 2007	I-75 At Bonita Beach Rd, Corkscrew Rd, Daniels Pkwy	1.17	0.00	0.00	0.00	0.00	0.00%
070427-18	36-06202-P	September 14, 2007	Formosa Basin 3 Phase 1	10.00	0.00	0.00	0.00	0.00	0.00%
070813-17	36-05136-P-04	September 14, 2007	Treasure Chest	7.58	0.00	0.00	0.00	0.00	0.00%
070504-20	36-03587-P-04	September 18, 2007	Springhill Suites At Coconut Crossing	3.53	0.00	0.00	0.00	0.00	0.00%
070730-21	36-05518-P-02	September 21, 2007	Chick-Fil-A -- Alico Lakes Villages	1.00	0.00	0.00	0.00	0.00	0.00%
070629-27	11-02756-P	September 27, 2007	Henderson Creek Canal Directional Bore Crossing	1.00	0.00	0.00	0.00	0.00	0.00%
070831-19	36-06564-P	October 1, 2007	Marni Fields Soccer Complex	18.36	0.00	0.00	0.00	0.00	0.00%
070413-19	36-06563-P	October 2, 2007	Valuguard Self Storage	3.02	0.00	0.00	0.00	0.00	0.00%
070507-28	11-01821-P	October 11, 2007	Tuscany Reserve Phase 1 - Tracts E, J & Conservation Area 3	341.10	0.00	0.00	0.00	0.00	0.00%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
070223-6	36-04779-P	October 12, 2007	San Carlos Water Control District -Strike Ln. Detention Area	2.74	0.00	0.00	0.00	0.00	0.00%
070823-19	11-01863-P-06	October 12, 2007	Fairfield Inn Lot 15 Citygate	4.06	0.00	0.00	0.00	0.00	0.00%
070907-16	36-04678-P-02	October 15, 2007	Fifth Third Bank Improvements At Daniels And Treeline	1.37	0.00	0.00	0.00	0.00	0.00%
070209-5	11-01821-P	October 18, 2007	Tuscany Reserve Basin 1 Modification To Tract A	7.35	0.00	0.00	0.00	0.00	0.00%
070622-29	36-03908-P-12	October 19, 2007	Hawk's Preserve	0.94	0.00	0.00	0.00	0.00	0.00%
070829-16	36-05136-P-05	October 26, 2007	Southwest International Tract F2	3.88	0.00	0.00	0.00	0.00	0.00%
070502-19	36-04092-P-02	October 30, 2007	Paseo South Basin	200.79	0.00	0.00	0.00	0.00	0.00%
071008-16	36-06427-P	November 13, 2007	Bonefish Plaza	4.46	0.00	0.00	0.00	0.00	0.00%
071009-12	36-05022-P	November 14, 2007	Lee Road Extension	9.45	0.00	0.00	0.00	0.00	0.00%
070605-24	36-06550-P	November 15, 2007	Pine Lake Preserve	29.52	0.00	NA	8.38	1.69	0.00%
070418-1	36-04722-P-02	November 30, 2007	Bonita Beach Petroleum Developers	1.21	0.00	0.00	0.00	0.00	0.00%
070430-23	11-01662-P-08	December 4, 2007	J L C Lawn Care	1.44	0.00	0.00	0.00	0.00	0.00%
071107-7	36-04753-P-04	December 18, 2007	Tuscany Park	13.59	0.00	0.00	0.00	0.00	0.00%
071011-16	36-06676-P	January 7, 2008	Londonderry Plaza	3.83	0.00	0.00	0.00	0.00	0.00%
070719-8	36-06362-P	January 14, 2008	Infiniti Of Fort Myers Improvements	3.97	0.00	0.00	0.00	0.00	0.00%
070308-3	11-01765-P-02	January 17, 2008	Fifth Third Bank Naples - Gateway Shoppes	1.03	0.00	0.00	0.00	0.00	0.00%
071009-10	36-05372-P	January 17, 2008	Carissa Commercial Park - Parcel 7 Modifications	3.57	0.00	0.00	0.00	0.00	0.00%
070823-17	11-02130-P	February 8, 2008	Rattlesnake Crossings	19.91	0.00	0.00	0.00	0.00	0.00%
070824-23	36-06722-P	February 8, 2008	Rosen Building Supplies	3.96	0.00	0.00	0.00	0.00	0.00%
071121-15	36-05198-P-03	February 12, 2008	Arbys Alico	1.25	0.00	0.00	0.00	0.00	0.00%
070713-5	36-04292-P-02	February 15, 2008	Serrano (Fka Riverwoods At Bonita Springs)	24.02	0.00	0.00	0.00	0.00	0.00%
071113-20	11-01662-P-09	February 20, 2008	Lot 5 - Phase 3 - White Lake	0.50	0.00	0.00	0.00	0.00	0.00%
080116-21	36-03803-P-02	March 4, 2008	Home Depot Outparcel 4	1.19	0.00	0.00	0.00	0.00	0.00%
070830-23	11-02432-P	March 6, 2008	Orange Blossom Ranch Basin 4a1 Improvements	1.76	0.00	0.00	0.00	0.00	0.00%
080130-37	36-02988-P	March 7, 2008	Us 41 Turn Lane Improvements For Coconut Trace-Coconut Cross	2.37	0.00	0.00	0.00	0.00	0.00%
070904-23	36-05518-P-03	March 10, 2008	7 Eleven At Alico Lakes	1.50	0.00	0.00	0.00	0.00	0.00%
070220-9	36-06538-P	March 13, 2008	Plumosa Pit	36.82	0.00	0.00	0.00	0.00	0.00%
070608-13	11-01743-P	March 14, 2008	Naples Municipal Airport East & South Quadrant Improvements	18.20	0.00	0.00	0.00	0.00	0.00%
071102-14	36-05142-P-02	March 14, 2008	Calistoga At Coconut Trace	2.53	0.00	0.00	0.00	0.00	0.00%
070606-13	36-04988-P-03	March 17, 2008	Rooms To Go At The Paradise Shoppes Of Estero	2.99	0.00	0.00	0.00	0.00	0.00%
071207-15	11-01889-P	March 31, 2008	Davis Crossings	18.78	0.00	0.00	0.00	0.00	0.00%
070821-24	36-03933-P	April 2, 2008	Stonewood Crossing	36.36	0.00	0.00	0.00	0.00	0.00%

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071015-14	11-02234-P-04	April 8, 2008	Heritage Bay Tract D	11.53	0.00	0.00	0.00	0.00	0.00%
070913-17	11-01743-P	April 9, 2008	Naples Executive Air Terminal And Hangar	2.03	0.00	0.00	0.00	0.00	0.00%
080122-16	11-01590-P	April 21, 2008	Forest Glen Of Naples	92.45	0.00	0.00	0.00	0.00	0.00%
071128-32	11-02336-P-04	April 24, 2008	Davita Site (Tract F-6 Ave Maria Park Of Commerce)	3.72	0.00	0.00	0.00	0.00	0.00%
080305-12	36-06400-P	April 30, 2008	Hydro Rock Maintenance Facility	28.27	0.00	0.00	0.00	0.00	0.00%
071031-20	36-04113-P	May 5, 2008	Alico Road	2.41	0.00	0.00	0.00	0.00	0.00%
071012-18	36-05254-P-02	May 8, 2008	Estero Retail Unit	4.36	0.00	0.00	0.00	0.00	0.00%
070406-20	11-02867-P	May 9, 2008	Standing Oaks	41.11	0.00	0.00	0.00	0.00	0.00%
070928-18	36-06202-P	May 13, 2008	Formosa Industrial Park - Basin 3 / N Alico Rd	60.77	0.00	0.00	0.00	0.00	0.00%
070314-9	11-02013-P	May 15, 2008	Deseret Naples Farm 2	1244.40	0.00	0.00	0.00	0.00	0.00%
080128-31	11-02234-P-05	May 15, 2008	Cameron Commons Unit One	12.18	0.00	0.00	0.00	0.00	0.00%
080402-9	36-06825-P	May 19, 2008	G Weaver Hipps Elementary School- School V	16.26	0.00	0.00	0.00	0.00	0.00%
080111-21	36-03098-P	May 21, 2008	Orchid Bay Tennis Pro Shop And Golfhouse At West Bay	10.16	0.00	0.00	0.00	0.00	0.00%
071026-12	36-04771-P	June 4, 2008	Plaza At Parker Commons - The	3.86	0.00	0.00	0.00	0.00	0.00%
080415-6	36-05889-P	June 4, 2008	Richview Court Drainage Improvements 2	0.33	0.00	0.00	0.00	0.00	0.00%
080122-18	36-04988-P-04	June 12, 2008	Chick-Fil-A, Paradise Shoppes Of Estero	1.39	0.00	0.00	0.00	0.00	0.00%
071213-20	26-00930-P	June 19, 2008	Charltons Pond	28.77	0.00	0.00	0.00	0.00	0.00%
080325-14	11-02336-P	June 24, 2008	Arthrex At Ave Maria	18.30	0.00	0.00	0.00	0.00	0.00%
080125-25	36-06872-P	June 26, 2008	Bonita Springs Old 41 Road Post Office	8.90	0.00	0.00	0.00	0.00	0.00%
080213-13	36-03587-P	June 26, 2008	Kohl's At Coconut Crossing - Tract K	9.88	0.00	0.00	0.00	0.00	0.00%
080404-15	11-02801-P	July 2, 2008	Brooks Village	23.48	0.00	0.00	0.00	0.00	0.00%
071214-15	11-02336-P	July 3, 2008	Ave Maria School Of Law	12.40	0.00	0.00	0.00	0.00	0.00%
080514-7	36-06231-P	July 24, 2008	Harbour Plaza	11.89	0.00	0.00	0.00	0.00	0.00%
080425-9	36-05136-P-06	August 13, 2008	Southwest Florida Executive Valet Parking	12.67	0.00	0.00	0.00	0.00	0.00%
080625-6	36-03568-P	August 14, 2008	East 100 Acres At Miromar Lakes	6.92	0.00	0.00	0.00	0.00	0.00%
080318-14	36-04579-P	August 26, 2008	San Carlos Town Center	7.44	0.00	0.00	0.00	0.00	0.00%
080620-3	11-01484-P	September 5, 2008	Wedgewood At Vanderbilt Pines - Bulkhead Installation	10.20	0.00	0.00	0.00	0.00	0.00%
080506-13	36-06211-P-03	September 12, 2008	University Plaza	15.20	0.00	0.00	0.00	0.00	0.00%
080609-10	11-01743-P	September 16, 2008	Sterling Aviation Hanger	1.48	0.00	0.00	0.00	0.00	0.00%
071101-15	36-06940-P	September 17, 2008	James Mann Properties	44.88	0.00	0.00	0.00	0.00	0.00%
080220-20	36-03596-P	September 24, 2008	Lovers Key State Park - Dredge And Dock Repair	0.07	0.00	0.00	0.00	0.00	0.00%
080619-9	36-05889-P-02	October 2, 2008	Morton Avenue West Roadside Swales Improvements	1.50	0.00	0.00	0.00	0.00	0.00%
080110-10	11-02928-P	October 7, 2008	Captiva Pond	46.87	0.00	0.00	0.00	0.00	0.00%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
080616-5	36-04076-P	October 10, 2008	Renaissance	506.90	0.00	0.00	0.00	0.00	0.00%
070925-17	36-04351-P-02	October 14, 2008	My Garage	3.58	0.00	0.00	0.00	0.00	0.00%
080623-8	11-02936-P	October 15, 2008	Conner Park	3.34	0.00	0.00	0.00	0.00	0.00%
080603-5	36-05142-P-03	October 16, 2008	Suntrust Bank At Coconut Trace	1.33	0.00	0.00	0.00	0.00	0.00%
080623-3	36-05519-P	October 17, 2008	Fifth Third Bank No. 74848	2.41	0.00	0.00	0.00	0.00	0.00%
070103-6	36-06960-P	November 6, 2008	Coral Self-Storage	5.00	0.00	0.00	0.00	0.00	0.00%
080331-15	11-02947-P	November 7, 2008	Naples Church Of Christ	19.11	0.00	0.00	0.00	0.00	0.00%
080716-12	36-04749-P	November 7, 2008	Airport Technology Center	90.59	0.00	0.00	0.00	0.00	0.00%
070423-16	36-06992-P	November 19, 2008	Whitehead 70 Ac	70.71	0.00	0.00	0.00	0.00	0.00%
070223-40	36-06995-P	November 20, 2008	200 Joel Boulevard	9.24	0.00	0.00	0.00	0.00	0.00%
080409-14	36-03269-P	November 20, 2008	Bella Terra Fka The Habitat	3.98	0.00	0.00	0.00	0.00	0.00%
080307-13	36-06989-P	November 21, 2008	Bucks Lane Storage	9.98	0.00	0.00	0.00	0.00	0.00%
080912-6	11-01859-P-02	November 25, 2008	Super Target Phase B 1	1.58	0.00	0.00	0.00	0.00	0.00%
080416-2	36-05195-P	November 26, 2008	Golden Palms Motor Coach Estates	54.45	0.00	0.00	0.00	0.00	0.00%
080912-9	36-03568-P	November 26, 2008	Miromar Lakes Tract Ff Beach Cottages	4.99	0.00	0.00	0.00	0.00	0.00%
070831-20	36-07003-P	December 5, 2008	Preserve At San Carlos Park - The	9.29	0.00	0.00	0.00	0.61	0.00%
080407-11	11-01662-P-10	December 9, 2008	Schardt Parking Facility	0.50	0.00	0.00	0.00	0.00	0.00%
080829-8	11-02234-P	December 11, 2008	Heritage Bay - Clubhouse Modification	10.80	0.00	0.00	0.00	0.00	0.00%
080915-3	11-02894-P	December 18, 2008	Freestate Cpud Phase 2	7.34	0.00	5.37	0.00	0.00	0.00%
080625-10	36-03269-P	December 23, 2008	Bella Terra (Fka The Habitat)	61.49	0.00	0.00	0.00	0.00	0.00%
080929-14	11-01743-P	December 23, 2008	Rexair Apron Expansion	0.41	0.00	0.00	0.00	0.00	0.00%
080722-2	36-04107-P	December 31, 2008	Lakes Of Estero Phase 2	10.09	0.00	0.00	0.00	0.00	0.00%
080923-3	11-01505-P	January 13, 2009	Pebblebrooke Commercial Phase 4 Improvements	10.57	0.00	0.00	0.00	0.00	0.00%
080502-1	36-03635-P	January 14, 2009	Heritage Palms Estates	12.94	0.00	0.00	0.00	0.00	0.00%
081002-5	36-07042-P	January 14, 2009	Pawlet Plaza	10.02	0.00	0.00	0.00	0.00	0.00%
080130-1	36-03831-P	January 16, 2009	Gulf Coast Town Center	10.60	0.00	0.00	0.00	0.00	0.00%
080714-4	11-01737-P	January 22, 2009	Immokalee Collier Intersection Improvements	8.14	0.00	0.00	0.00	0.00	0.00%
081006-13	36-05372-P	January 23, 2009	Carissa Commerical Park-Turn Lane	27.42	0.00	0.00	0.00	0.00	0.00%
080109-24	11-02336-P	February 2, 2009	Ave Maria Recreation Center	3.60	0.00	0.00	0.00	0.00	0.00%
080605-5	36-07058-P	February 2, 2009	Bonita Springs Retirement Village	20.00	0.00	0.00	0.00	0.00	0.00%
080808-1	36-07059-P	February 2, 2009	Gulf Coast Medical Park	4.80	0.00	0.00	0.00	0.00	0.00%
081010-13	11-01792-P	February 13, 2009	First Baptist Church Of Naples Athletic Complex	90.36	0.00	0.00	0.00	0.00	0.00%
070921-22	36-07071-P	March 5, 2009	Devonwood Auto Dealership	5.58	0.00	0.00	0.00	0.00	0.00%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
070118-10	11-02336-P-05	March 10, 2009	Ave Maria Red Rabbit	1.96	0.00	0.00	0.00	0.00	0.00%
081222-7	36-06851-P	March 20, 2009	Daniels Fire Station	1.88	0.00	0.00	0.00	0.00	0.00%
080425-6	36-05265-P	July 17, 2009	Wooten Park	14.47	0.00	0.00	0.00	0.00	0.00%
060127-5	36-05268-P-02	September 27, 2007	Shoppes Of Gulf Coast	33.95	0.00	0.00	0.00	0.00	0.00%
060215-13	36-04589-P-05	August 7, 2006	All My Sons Moving And Storage	4.41	0.00	0.00	0.00	0.00	0.00%
060215-16	36-04499-P-04	October 27, 2006	Shoppes At Hawthorne	3.58	0.00	0.00	0.00	0.00	0.00%
060216-19	11-02227-P	August 17, 2006	Burning Tree Drive	2.89	0.00	0.00	0.00	0.00	0.00%
060303-5	36-04499-P-03	August 15, 2006	Maravu	61.62	0.00	0.00	0.00	0.00	0.00%
060306-15	36-04234-P	September 22, 2006	East Bonita Active Adult Rpd Improvements	6.29	0.00	0.00	0.00	0.00	0.00%
060310-14	36-05988-P	October 12, 2006	Laredo Lakes	130.80	0.00	0.00	0.00	0.00	0.00%
060313-3	36-06211-P-02	January 26, 2007	Gulfcoast Towncenter - Road Modification	4.96	0.00	0.00	0.00	0.00	0.00%
060313-4	36-04507-P	August 15, 2006	Palomino Lane	3.64	0.00	0.00	0.00	0.00	0.00%
060316-7	36-06044-P	October 12, 2006	Crown Pointe	14.29	0.00	0.00	0.00	0.00	0.00%
060329-28	36-06694-P	January 15, 2008	Alico Lake Villages	58.95	0.00	0.00	0.00	0.00	0.00%
060331-14	11-02599-P	August 22, 2006	Elementary School J	22.13	0.00	0.00	0.00	0.00	0.00%
060407-2	36-06202-P	June 28, 2007	Formosa Industrial Park Tract 67	12.81	0.00	0.00	0.00	0.00	0.00%
060407-9	36-03587-P	November 21, 2006	Coconut Road Mpd Improvements	45.61	0.00	0.00	0.00	0.00	0.00%
060414-3	36-06103-P	November 16, 2006	Rose Eagle Ridge	9.35	0.00	0.00	0.00	0.00	0.00%
060421-11	11-01737-P	August 3, 2006	Immokalee Road (Cr 846)	69.31	0.00	0.00	0.00	0.00	0.00%
060421-18	11-02234-P	October 18, 2006	Heritage Bay Affordable Housing	24.64	0.00	0.00	0.00	0.00	0.00%
060427-21	11-01863-P-04	August 16, 2006	Tib Bank	1.65	0.00	0.00	0.00	0.00	0.00%
060502-8	36-04988-P-02	September 25, 2006	Bank Of America - Estero	1.43	0.00	0.00	0.00	0.00	0.00%
060503-10	36-03765-P	September 13, 2006	Copperhead	298.86	0.00	0.00	0.00	0.00	0.00%
060522-2	11-01909-P-02	October 4, 2006	Market Center Lots 5 And 6 Fka West Port Commerce Center	6.89	0.00	0.00	0.00	0.00	0.00%
060525-13	36-05332-P-02	October 6, 2006	Bmw Of Fort Myers	7.55	0.00	0.00	0.00	0.00	0.00%
060526-5	36-06455-P	October 29, 2007	Treeline Office Complex	59.56	0.00	0.00	0.00	0.00	0.00%
060526-8	36-04092-P	April 4, 2007	Paseo	9.49	0.00	0.00	0.00	0.00	0.00%
060531-5	11-02200-P-02	December 7, 2006	Arrowhead Reserve Villages	18.57	0.00	0.00	0.00	0.00	0.00%
060608-18	11-01859-P-02	October 4, 2006	Super Target-Tarpon Bay Plaza	29.01	0.00	0.00	0.00	0.00	0.00%
060612-3	36-03802-P	December 19, 2006	Fdot Regional Transportation Management Center	10.20	0.00	0.00	0.00	0.00	0.00%
060613-6	36-02988-P	October 30, 2006	Us 41 (Sr 45) Improvements From Old Us 41 To Corkscrew Road	85.40	0.00	0.00	0.00	0.00	0.00%
060621-3	11-01567-P-02	October 10, 2006	Twin Eagles Golf Course Maintenance Area Expansion	7.35	0.00	0.00	0.00	0.00	0.00%
060623-1	36-03802-P	October 5, 2006	I-75 Rest Area Improvements	15.95	0.00	0.00	0.00	0.00	0.00%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
060623-27	36-03219-P	October 20, 2006	Pelican Sound Blvd Floating Dock Ramp And Walkway	1.00	0.00	0.00	0.00	0.00	0.00%
060623-6	11-02363-P-02	August 1, 2006	Insouth Bank	2.38	0.00	0.00	0.00	0.00	0.00%
060627-4	11-02336-P	January 11, 2007	Bellerawalk At Ave Maria - Phase 2 E.R.P.	779.50	0.00	0.00	0.00	0.00	0.00%
060630-8	36-03908-P-09	December 4, 2006	Pro Comp Custom Rods	0.93	0.00	0.00	0.00	0.00	0.00%
060703-5	11-02090-P-04	October 15, 2007	Brighton Medical Building (Brittany Medical Building)	1.55	0.00	0.00	0.00	0.00	0.00%
060711-28	11-02336-P	October 30, 2006	Ave Maria Phase 2 - Oil Well Road Canal	41.90	0.00	0.00	0.00	0.00	0.00%
060713-11	11-02627-P	October 27, 2006	Elementary School K	26.03	0.00	0.00	0.00	0.00	0.00%
060718-6	11-01662-P-06	September 13, 2006	Southwest Florida Vehicle Maintenance	0.56	0.00	0.00	0.00	0.00	0.00%
060724-9	36-04799-P-02	October 13, 2006	Lots 1 And 2 At Estero Town Commons	3.04	0.00	0.00	0.00	0.00	0.00%
060725-15	36-03210-P-02	September 21, 2006	Bank Strip Center	0.76	0.00	0.00	0.00	0.00	0.00%
060725-2	36-04799-P	September 21, 2006	Lots 4 And 5 At Estero Town Commons	0.23	0.00	No data	No data	No data	0.00%
060728-2	11-02336-P	November 22, 2006	Ave Maria Park Of Commerce	96.21	0.00	0.00	0.00	0.00	0.00%
060802-1	36-05198-P-02	January 12, 2007	Jetway Tradeport Hotel	6.02	0.00	0.00	0.00	0.00	0.00%
060804-5	11-02146-P	May 3, 2007	Vita Tuscana	29.00	0.00	0.00	0.00	0.00	0.00%
060809-10	11-02513-P	December 7, 2006	Collier Boulevard	54.16	0.00	0.00	0.00	0.00	0.00%
060809-4	11-01543-P-05	September 27, 2006	Borgata Square	2.10	0.00	0.00	0.00	0.00	0.00%
060811-9	36-06268-P	February 17, 2007	Bonita Springs Utilities Operations Center	11.67	0.00	0.00	0.00	0.00	0.00%
060814-10	11-02234-P-02	November 21, 2006	Collier County Ems Site	2.60	0.00	0.00	0.00	0.00	0.00%
060815-10	36-05483-P-02	October 13, 2006	Cardiology Consultants Of Southwest Florida	1.22	0.00	0.00	0.00	0.00	0.00%
060817-4	11-02090-P-03	October 13, 2006	Lot 10 At Edison Village	1.34	0.00	0.00	0.00	0.00	0.00%
060822-3	36-03908-P-07	October 20, 2006	Bonita Limestone Transportation Inc	0.93	0.00	0.00	0.00	0.00	0.00%
060825-12	36-06253-P	February 21, 2007	Great Space Self Storage	3.67	0.00	0.00	0.00	0.00	0.00%
060825-13	36-03587-P-05	February 12, 2008	Tangomar At Coconut Crossing (Fka Coconut Road Mpd)	14.13	0.00	0.00	0.00	0.00	0.00%
060825-4	36-03643-P	November 21, 2006	Coconut Road Widening West Of Us41	2.87	0.00	0.00	0.00	0.00	0.00%
060908-2	36-04073-P-02	November 7, 2006	Fifth Third Bank	7.31	0.00	0.00	0.00	0.00	0.00%
060911-13	36-06400-P	June 29, 2007	Hydro Rock Maintenance Facility	28.27	0.00	0.00	0.00	0.00	0.00%
060914-1	36-04076-P	October 26, 2006	Sam Sneads - Daniels Galleria East Lot 4	1.92	0.00	0.00	0.00	0.00	0.00%
060918-13	11-02653-P	December 12, 2006	Golden Gate Middle School Additions And Renovations	20.63	0.00	0.00	0.00	0.00	0.00%
060922-2	36-03134-P-02	December 21, 2006	Lot 3 East Point Commercial Park	1.91	0.00	0.00	0.00	0.00	0.00%
060927-9	36-03908-P-08	November 21, 2006	Lot 26 Alico Commercial Park	1.23	0.00	0.00	0.00	0.00	0.00%
061004-3	11-02336-P	January 4, 2007	Middlebrooke Townhomes	20.20	0.00	0.00	0.00	0.00	0.00%
061013-11	11-01743-P	January 24, 2007	Naples Municipal Airport North Quadrant Improvements	10.00	0.00	0.00	0.00	0.00	0.00%
061013-28	36-04753-P-02	January 18, 2007	Koreshan 36 Improvements	36.28	0.00	0.00	0.00	0.00	0.00%

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061017-7	11-02176-P	March 1, 2007	Golden Gate High School - Tropicana Bridge	61.92	0.00	0.00	0.00	0.00	0.00%
061018-10	11-01737-P	September 18, 2007	Immokalee Road (C R 846) - From I-75 To Valewood Dr.	0.41	0.00	0.00	0.00	0.00	0.00%
061026-28	26-00877-P	October 11, 2007	Mims Sand Mine	140.10	0.00	0.00	0.00	0.00	0.00%
061027-2	36-06425-P	July 9, 2007	Trusted Medical Park	3.96	0.00	0.00	0.00	0.00	0.00%
061027-5	11-02242-P-02	May 31, 2007	Delivery By Design	0.86	0.00	0.00	0.00	0.00	0.00%
061027-7	36-04678-P-02	May 9, 2007	Fifth Third Bank - Dantree Commercial Center	1.37	0.00	0.00	0.00	0.00	0.00%
061030-1	11-02090-P-02	June 12, 2007	Amsouth Bank - Hammock Cove	1.87	0.00	0.00	0.00	0.00	0.00%
061103-3	36-04589-P-06	April 27, 2007	Colonial Bank - Regional Headquarters	2.89	0.00	0.00	0.00	0.00	0.00%
061103-8	11-01662-P	December 22, 2006	Leo Jr Lawn And Irrigation	1.07	0.00	0.00	0.00	0.00	0.00%
061106-6	36-03908-P-10	December 22, 2006	Lot 17 Alico	1.46	0.00	0.00	0.00	0.00	0.00%
061113-4	11-02336-P	February 12, 2007	Del Webb Sales And Welcome Center (Fka Model Center)	0.41	0.00	0.00	0.00	0.00	0.00%
061113-8	11-01859-P-02	April 6, 2007	Chilis Restaurant - East Naples	1.88	0.00	0.00	0.00	0.00	0.00%
061114-18	11-02531-P	April 12, 2007	Reserve At Eden Gardens Improvements The	20.19	0.00	0.00	0.00	0.00	0.00%
061115-12	36-05196-P	January 10, 2007	Corkscrew Road Curves Outfall Modification	14.07	0.00	0.00	0.00	0.00	0.00%
061117-22	36-03908-P-11	May 8, 2007	Willy Lopez Alico Commercial Park	0.93	0.00	0.00	0.00	0.00	0.00%
061120-12	36-05136-P-02	February 16, 2007	Sw International Tract L And M	12.85	0.00	0.00	0.00	0.00	0.00%
061120-16	36-05136-P-03	February 16, 2007	Sw International Tract K	6.55	0.00	0.00	0.00	0.00	0.00%
061201-2	36-03587-P-02	January 29, 2007	Cvs Pharmacy At Coconut Crossing	3.62	0.00	0.00	0.00	0.00	0.00%
061213-6	11-02663-P	January 8, 2007	Golden Gate Intermediate Center North 400 Parking Addition	3.70	0.00	0.00	0.00	0.00	0.00%
061215-11	11-01863-P-05	January 17, 2007	Springhill Suites (Lot 16)	4.55	0.00	0.00	0.00	0.00	0.00%
061215-8	36-04296-P-03	May 11, 2007	Lee Boulevard West	3.34	0.00	0.00	0.00	0.00	0.00%
061218-6	11-02670-P	February 16, 2007	Interstate 75 (Sr 93) Contraflow At Collier Blvd (Cr 951)	2.74	0.00	0.00	0.00	0.00	0.00%
070103-2	36-04853-P	April 17, 2007	Bridgetown Reuse Lake (Lake Number 10)	2.98	0.00	0.00	0.00	0.00	0.00%
070103-5	11-02336-P-02	February 27, 2007	Emerson Park Sales Center	0.55	0.00	0.00	0.00	0.00	0.00%
070105-2	11-01662-P-07	April 16, 2007	Insealators Building	0.58	0.00	0.00	0.00	0.00	0.00%
070108-9	36-03823-P-02	April 18, 2007	Burks Plaza	2.74	0.00	0.00	0.00	0.00	0.00%
070125-23	36-03675-P-02	May 2, 2007	Town Lakes Ministorage	5.18	0.00	0.00	0.00	0.00	0.00%
070201-14	36-04798-P-03	May 8, 2007	Advanced Insurance	2.33	0.00	0.00	0.00	0.00	0.00%
070205-8	11-02252-P	April 6, 2007	West Eustis Avenue Stormwater Improvements	0.45	0.00	0.00	0.00	0.00	0.00%
070206-8	36-04853-P	May 22, 2007	Somerset At The Plantation Clubhouse	5.58	0.00	0.00	0.00	0.00	0.00%
070207-29	36-03831-P-02	May 16, 2007	Gulf Coast Town Center Sun Trust	1.25	0.00	0.00	0.00	0.00	0.00%
070209-10	36-03568-P	April 6, 2007	East 100 Acres At Miromar Lakes	1.75	0.00	0.00	0.00	0.00	0.00%
070214-11	36-05518-P	June 27, 2007	Alico Lakes Village	31.73	0.00	0.00	0.00	0.00	0.00%

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
070226-28	36-06342-P	April 26, 2007	West Cypress View	5.03	0.00	0.00	0.00	0.00	0.00%
070226-33	36-06341-P	April 26, 2007	East Cypress View	4.92	0.00	0.00	0.00	0.00	0.00%
070301-20	36-05858-P	June 12, 2007	Center Town Commons	4.95	0.00	0.00	0.00	0.00	0.00%
070305-15	36-05372-P-02	June 15, 2007	Carissa Parcel 1 And Crystal Drive	3.17	0.00	0.00	0.00	0.00	0.00%
070309-1	36-06362-P	May 7, 2007	Infinity Of Fort Myers	3.97	0.00	0.00	0.00	0.00	0.00%
070313-12	36-05415-P	July 11, 2007	Airport Interstate Commerce Park -- Lake Modification	322.30	0.00	0.00	0.00	0.00	0.00%
070314-18	36-03269-P	July 21, 2007	Bella Terra (Fka The Habitat)	57.10	0.00	0.00	0.00	0.00	0.00%
070320-20	36-03865-P	July 19, 2007	Corkscrew Retail Center	8.57	0.00	0.00	0.00	0.00	0.00%
070327-7	11-02336-P-03	July 12, 2007	Del Webb Amenity Campus	11.40	0.00	0.00	0.00	0.00	0.00%
070403-5	36-06026-P	June 22, 2007	Corkscrew Ranch	61.78	0.00	0.00	0.00	0.00	0.00%
070412-25	36-03062-P	July 24, 2007	Heron Pond Phase 2	8.67	0.00	0.00	0.00	0.00	0.00%
070419-8	36-06202-P	July 19, 2007	Formosa Industrial Park Parcels 65 And 66	20.13	0.00	0.00	0.00	0.00	0.00%
070427-5	36-05592-P	July 20, 2007	Bella Villa Shops	1.40	0.00	0.00	0.00	0.00	0.00%
070510-28	36-03587-P-03	July 31, 2007	Orion Bank	1.05	0.00	0.00	0.00	0.00	0.00%
070604-8	36-04853-P-02	July 25, 2007	Treeline Elementary	13.09	0.00	0.00	0.00	0.00	0.00%
070622-15	11-02268-P-03	July 31, 2007	Tuffy Automotive Center At Mission Hills	0.89	0.00	0.00	0.00	0.00	0.00%
060124-5	36-05393-P-02	September 21, 2006	Cypress Shadows	352.83	NA	NA	NA	NA	NA
070917-28	11-02771-P	October 17, 2007	Logan Woods Preserve Fence Installation	5.69	NA	NA	NA	NA	NA
071023-22	11-02831-P	January 11, 2008	Triple G Loop (Picayune Strand State Forest)	4.35	NA	NA	NA	NA	NA
080205-38	36-06747-P	March 6, 2008	Mulloch Creek Weir Replacement	1.00	NA	NA	NA	NA	NA
070705-12	36-03744-P	June 6, 2008	Vasari Country Club	14.26	NA	0.82	0.82	0.76	NA
080310-9	11-02878-P	June 6, 2008	Cr 901 Vanderbilt Drive Over Cocohatchee Canal	2.02	NA	0.19	0.00	0.00	NA
070905-22	11-02135-P	June 12, 2008	Off Road Vehicle Trail Rehabilitation	366.00	NA	NA	NA	NA	NA
071206-21	36-03764-P	November 13, 2008	Alico Lakeside	322.19	NA	NA	NA	NA	NA
080912-7	11-02953-P	November 13, 2008	Bridge Repairs No 030153 And 030154	0.48	NA	NA	NA	NA	NA
080912-8	11-02952-P	November 13, 2008	Collier County Bridge Repairs - Bridge No 034014	0.10	NA	NA	NA	NA	NA
081223-26	36-07051-P	January 22, 2009	Crystal Drive Transmission Line Improvements	4.59	NA	NA	NA	NA	NA
081212-6	11-02971-P	February 2, 2009	20th Pl Sw Pedestrian Bridge	0.24	NA	NA	NA	NA	NA
090209-17	11-02994-P	March 10, 2009	Delnor Wiggins Pass State Park Ranger Station Replacement	1.24	NA	NA	NA	NA	NA
090122-6	11-02997-P	March 24, 2009	Barron River Canal Culvert Crossing	0.06	NA	NA	NA	NA	NA
060713-3	11-02597-P	August 11, 2006	Collier County Riviera Golf Estates - Lake Interconnect	0.09	NA	NA	NA	NA	NA
060828-8	11-02621-P	September 27, 2006	Railhead Scrub Preserve Fence	76.27	NA	NA	0.00	0.00	NA
060926-14	36-03295-P	November 17, 2006	Pueblo Bonito Phase 3	11.81	NA	NA	NA	NA	NA

Appendix 3F. Data - District ERP 2006 to 2009 - Hacienda Lakes Action Area Project List – Wood Storks.

APPLICATION NO.	PERMIT NO.	APPROVED DATE	PROJECT NAME	PROJECT AC.	WETLAND AC.	WETLAND IMPACTS AC.	WETLAND PRESERVE AC.	UPLAND PRESERVE AC.	PERCENT WETLANDS ON PROJECT
060926-6	36-04853-P	January 11, 2007	Botanica Lakes Phase 2	24.31	NA	NA	NA	NA	NA
060929-7	11-02088-P	April 9, 2007	Childrens Museum Of North Collier Regional Park	2.30	NA	NA	NA	NA	NA
070216-7	36-06303-P	March 12, 2007	Alico Farm Field	147.00	NA	NA	NA	NA	NA
070605-15	11-02716-P	July 5, 2007	Wet Woods Preserve Fence	25.50	NA	NA	NA	NA	NA
070618-15	36-06475-P	July 20, 2007	R O Raw Water Transmission Main Phase 2	1.00	NA	NA	NA	NA	NA
071212-23	36-06728-P	February 15, 2008	I D D Canal G Maintenance Crossing	1.00	NA	NA	NA	NA	NA
Sub-Total for projects with less than 5 percent wetlands and NA				**9,473.33**	**14.59**	**15.24**	**16.01**	**20.14**	**-**
Totals				**21,936.61**	**5,136.53**	**1,395.26**	**2,723.51**	**254.31**	**-**

Appendix 3G. Wood Stork Suitable Foraging Prey Base Loss – Development Area

USFWS Habitat Code	Wetland Impact* (Acres)	Wetland Impact (m^2)	Foraging Suitability Value (percent)	Wetland Hydroperiod Class	Biomass Consumed by Wood Storks** (grams/m^2)	Prey Biomass Consumed by Wood Storks (kg)
DBP	0.18	728.43	3	2	0.20	0.00
DM	224.30	907,710	3	2	0.20	5.49
HP90	5.72	23,148.02	3	2	0.20	0.14
HP75	17.31	70,051.09	37	2	0.20	5.22
HP50	6.74	27,275.81	64	2	0.20	3.51
HP	0.07	283.28	100	2	0.20	0.06
C75	0.50	2,023.43	37	3	0.43	0.32
C50	4.31	17,441.95	64	3	0.43	4.79
C	5.87	23,755.05	100	3	0.43	10.19
PC90	27.28	110,398.24	3	2	0.20	0.67
PC75	71.66	289,997.73	37	2	0.20	21.62
PC50	60.24	243,782.63	64	2	0.20	31.44
PC	18.14	73,409.98	100	2	0.20	14.79
WF50	7.75	31,363.14	64	2	0.20	4.05
WF	2.02	8,174.65	100	2	0.20	1.65
WS75	5.33	21,569.75	37	2	0.20	1.61
WS	0.09	364.22	100	2	0.20	0.07
WP90	11.87	48,036.19	3	2	0.20	0.29
M50	0.88	3,561.23	64	4	0.76	1.73
DC	5.30	21,448.34	100	4	0.76	16.24
SP	0.32	1,294.99	100	4	0.76	0.98
FW	0.18	728.43	100	2	0.20	0.15
HU	8.95	36,219.37	100	2	0.20	7.30
Totals	**485.01**	**1,962,765.95**	-	-	-	**132.31**

* Impact acreage includes 31.66± acres of wetlands and 5.41± acres of Waters that are not used as mitigation and will not be placed under conservation easement.

** Includes the wood stork competition factor of 32.5 percent.

DBP = Dense Brazilian Pepper (>95% Mature Brazilian Pepper Coverage)
DM = Dense Melaleuca (>95% Melaleuca Coverage)
HP90 = Hydric Pine (76-95% Exotics)
HP75 = Hydric Pine (50-75% Exotics)
HP50 = Hydric Pine (25-49% Exotics)
HP = Hydric Pine (0-24% Exotics)
C75 = Cypress (50-75% Exotics)
C50 = Cypress (25-49% Exotics)
C = Cypress (0-24% Exotics)
PC90 = Pine/Cypress (76-95% Exotics)
PC75 = Pine/Cypress (50-75% Exotics)
PC50 = Pine/Cypress (25-49% Exotics)
PC = Pine/Cypress (0-24% Exotics)
WF75 = Wetland Forest (50-75% Exotics)
WF50 = Wetland Forest (25-49% Exotics)
WF = Wetland Forest (0-24% Exotics)
WS75 = Wetland Shrub (50-75% Exotics)
WS50 = Wetland Shrub (25-49% Exotics)
WS = Wetland Shrub (0-24% Exotics)
WP90 = Wet Prairie (76-95% Exotics)
M50 = Marsh (25-49% Exotics)
M = Marsh (0-24% Exotics)
FW = Farmed Wetland
DC = Ditch/Canal
SP = Seasonal Pond
HU = Hydric Utilities Corridor

Appendix 3H. Wood Stork Suitable Foraging Prey Base Prior to Enhancement/Restoration – Preserve Area

USFWS Habitat Code	Wetland Enhancement (Acres)	Wetland Enhancement (m^2)	Foraging Suitability Value (percent)	Wetland Hydroperiod Class	Biomass Consumed by Wood Storks* (grams/m^2)	Total Prey Biomass (kilograms)
DBP	1.63	6,596.38	3	2	0.20	0.04
DM	121.50	491,693.06	3	2	0.20	2.97
HP90	6.65	26,911.60	3	2	0.20	0.16
HP75	48.50	196,272.54	37	2	0.20	14.63
HP50	21.49	86,966.95	64	2	0.20	11.22
HP	31.47	127,354.57	100	2	0.20	25.66
C75	0.95	3,844.51	37	3	0.43	0.61
C50	23.36	94,534.57	64	3	0.43	25.96
C	152.01	615,162.65	100	3	0.43	263.91
PC75	195.69	791,929.33	37	2	0.20	59.04
PC50	287.92	1,165,170.90	64	2	0.20	150.26
PC	269.91	1,092,287.02	100	2	0.20	220.10
WF75	2.05	8,296.06	37	2	0.20	0.62
WF50	6.40	25,899.88	64	2	0.20	3.34
WF	20.02	81,018.07	100	2	0.20	16.33
WS75	0.50	2,023.43	37	2	0.20	0.15
WS50	2.48	10,036.20	64	2	0.20	1.29
WS	10.88	44,029.80	100	2	0.20	8.87
WP90	3.68	14,892.43	3	2	0.20	0.09
M50	9.43	38,161.86	64	4	0.76	18.50
M	6.77	27,397.22	100	4	0.76	20.75
DC	3.06	12,383.38	100	4	0.76	9.38
FW	54.06	218,773.06	100	2	0.20	44.08
Totals	**1,280.41**	**5,181,635.47**	-	-	-	**897.96**

* Includes the wood stork competition factor of 32.5 percent.

DBP = Dense Brazilian Pepper (>95% Mature Brazilian Pepper Coverage)
DM = Dense Melaleuca (>95% Melaleuca Coverage)
HP90 = Hydric Pine (76-95% Exotics)
HP75 = Hydric Pine (50-75% Exotics)
HP50 = Hydric Pine (25-49% Exotics)
HP = Hydric Pine (0-24% Exotics)
C75 = Cypress (50-75% Exotics)
C50 = Cypress (25-49% Exotics)
C = Cypress (0-24% Exotics)
PC90 = Pine/Cypress (76-95% Exotics)
PC75 = Pine/Cypress (50-75% Exotics)
PC50 = Pine/Cypress (25-49% Exotics)
PC = Pine/Cypress (0-24% Exotics)
WF75 = Wetland Forest (50-75% Exotics)
WF50 = Wetland Forest (25-49% Exotics)
WF = Wetland Forest (0-24% Exotics)
WS75 = Wetland Shrub (50-75% Exotics)
WS50 = Wetland Shrub (25-49% Exotics)
WS = Wetland Shrub (0-24% Exotics)
WP90 = Wet Prairie (76-95% Exotics)
M50 = Marsh (25-49% Exotics)
M = Marsh (0-24% Exotics)
FW = Farmed Wetland
DC = Ditch/Canal
SP = Seasonal Pond
HU = Hydric Utilities Corridor

Appendix 3I. Wood Stork Suitable Foraging Prey Base After Enhancement/Restoration – Preserve Area

USFWS Habitat Code	Wetland Enhancement (Acres)	Wetland Enhancement (m^2)	Foraging Suitability Value (percent)	Wetland Hydroperiod Class	Biomass Consumed by Wood Storks* (grams/m^2)	Total Prey Biomass (kilograms)
HP	108.11	437,505.65	100	2	0.20	88.16
C[1]	217.55	880,393.62	100	3	0.43	377.69
PC[2]	858.45	3,474,023.90	100	2	0.20	700.02
WF	28.47	115,214.00	100	2	0.20	23.22
WS	13.86	56,089.43	100	2	0.20	11.30
WP	3.68	14,892.43	100	2	0.20	3.00
M[3]	49.97	202,221.42	100	4	0.76	153.13
DC[4]	0.32	1,294.99	100	4	0.76	0.98
Totals	**1,280.41**	**5,181,635.44**	-	-	-	**1,357.50**

* Includes the wood stork competition factor of 32.5 percent.

[1] Includes the addition of 41.23 acres of restored C habitat from DM and FW
[2] Includes the addition of 104.93 acres of enhanced PC habitat from DM, DBP and DC
[3] Includes the addition of 33.77 acres of created M habitat from DM and FW
[4] Deducted 2.74 acres which are to be filled, re-graded, and planted as PC

HP = Hydric Pine
C = Cypress
PC = Pine/Cypress
WF = Wetland Forest
WS = Wetland Shrub
WP = Wet Prairie
M = Marsh
DC = Ditch/Canal