The Benefits of Small Wetlands

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Executive Summary

Wetlands provide a variety of ecologic, hydrologic, environmental and aesthetic benefits. In the *Florida State of the Environment – Wetlands: A Guide to living with Florida's Wetlands*, the Florida Department of Environmental Protection (FDEP) states that "Wetlands are vital to the health of our environment." Wetlands in Florida that are less than one-half acre in size often lack State and federal protection and continue to be lost due to construction, filling and conversion to other uses. In Martin County (**MC**), the Comprehensive Growth Management Plan of 1982 and its subsequent revisions (**CGMP**) afford protection for wetlands of all sizes, which protect MC's environment and the quality of life of for its residents.

In October, 2016, an application, namely Comprehensive Plan Amendment 17-07 known as the Altman Amendment (**CPA-17-07**), was transmitted to MC requesting an amendment to MC's CGMP, with the aim of eliminating protection for non-tidal wetlands less than or equal to one half-acre in area that are within MC's Primary and Secondary Urban Service Districts. **CPA-17-07** did not include any data or analysis regarding the number, location or values of the wetlands that could be eliminated if the Amendment were to be approved. On March 2, 2017, County staff and the Local Planning Agency (**LPA**) recommended denial of the application. On April 25, 2017 the MC Board of County Commissioners (BOCC) is scheduled to hold a public hearing on proposed CPA-17-07.

In this paper, wetlands are defined and insights into the hydrologic and ecologic benefits of small wetlands are overviewed from the peer-reviewed publications cited herein. Examples of flora, fauna and hydrologic conditions observed in non-tidal wetlands less than one-half acre in size in Martin County's Urban Services Districts are also provided.

1.0 Introduction and Purpose.

Various governmental entities, including the State of Florida, the federal government (through the U.S. Army Corps of Engineers), and the Convention on Wetlands of International Importance (known as the Ramsar Convention) have adopted definitions of wetlands.

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For the purposes of protecting wetlands through Martin County Florida's Comprehensive Growth Management Plan, the definition adopted by the state of Florida applies. That definition, contained in Section 373.019(17) (Florida Statutes) and Section 62-340.200(19) (Florida Administrative Code), states:

> "Wetlands… refer to those areas that are inundated or saturated by surface water or ground water at a frequency and a duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above. These species, due to morphological, physiological, or reproductive adaptations, have the ability to grow, reproduce or persist in aquatic environments or anaerobic soil conditions. Florida wetlands include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, and mangrove swamps. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto …"

The method of determining the limits of a wetland (*i.e.,* wetland delineation) is described in Section 62-340.300 (F.A.C.) and relies on soil composition and the presence or absence of indicators that show the influence of water.

Wetlands are found throughout the United States, and the United States Department of Agriculture's National Resource Conservation Service (**NRCS**) estimates that there were previously approximately 221 million acres of wetlands in the lower 48 states (NRCS 2017). By 1984, 54% of all the wetlands in the U.S. had been drained or filled for development or agriculture (NRCS 2017)."

As society learned more about the values of wetlands, regulations were adopted to protect wetland ecosystems. By the 1990s, projects began to restore previously impacted wetlands, enhance existing wetlands and create new wetlands. In spite of a small and brief net gain of wetland acreage from 1998 - 2004, wetland losses now continue (Figure 1).

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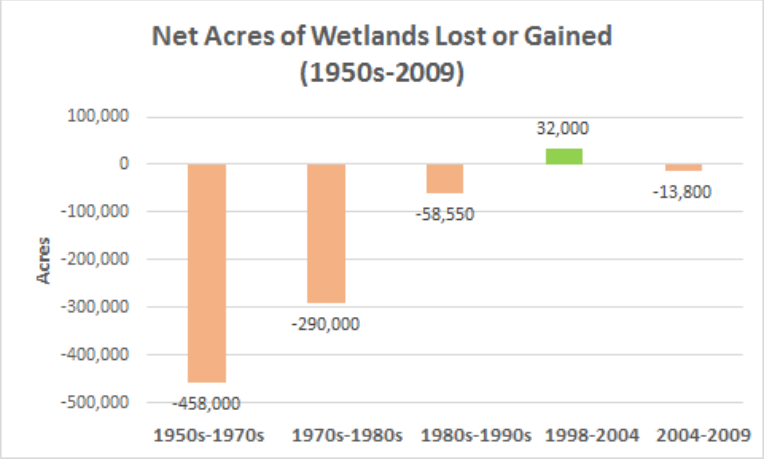
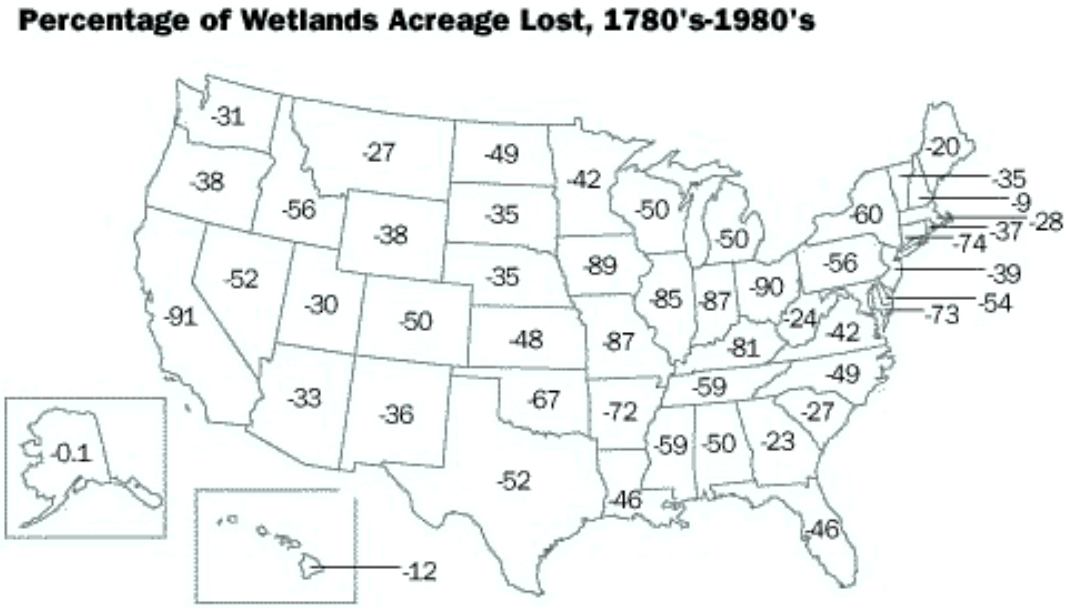


Figure 1
Wetland net losses throughout the United States
Source: National Resource Conservation Service, 2017

Although other States have lost greater percentages of their wetlands, Florida has suffered the greatest loss of wetland acreage in the country. The University of Florida's Institute of Food and Agricultural Sciences (IFAS) has reported Florida's wetland loss of 9.3 million acres is the largest acreage loss of any state (Figure 2; IFAS 2017).



Twenty-two states have lost at least 50 percent of their original wetlands. Seven states—Indiana, Illinois, Missouri, Kentucky, Iowa, California, and Ohio—have lost over 80 percent of their original wetlands. Since the 1970's, the most extensive losses of wetlands have been in Louisiana, Mississippi, Arkansas, Florida, South Carolina, and North Carolina.
Source: Mitch and Gosselink. Wetlands. 2nd Edition, Van Nostrand Reinhold, 1993

Figure 2

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Currently, wetlands of all sizes in Martin County, Florida are protected through the County's **CGMP** and Land Development Regulations (**LDR**s). In October 2016, an application was transmitted to Martin County requesting a text amendment that, if approved, would eliminate protection of wetlands that are less than or equal to one-half acre in size, which are not tidally influenced, and which are located in the County's Primary or Secondary Urban Services District.

As detailed below, small wetlands play important roles for people and wildlife throughout large geographic areas via stormwater retention, nutrient uptake, aquifer recharge, and as habitat for native plants and animals.

The primary purpose of this paper is to provide detailed scientific information regarding the benefits and functions of small urban wetlands in Martin County, so that decision makers and others have facts upon which to base decisions regarding protection of wetlands.

2.0 Stormwater Retention.

Wetlands near the headwaters of rivers slow the flow of rainwater runoff, preventing sudden, damaging floods both locally and downstream (Tilley *et al.* 1998). Although small, geographically isolated wetlands may not continuously connect to other surface waters, they can be important features in a local watershed, and there are still significant hydrologic, biogeochemical and biological connectivities to downstream waters (Cohen *et al.* 2016). The varying levels of such connectivity and slower groundwater flow coming from small wetlands serve to diversify landscape functions within the mosaic of watershed habitats. For example, studies by Knight (1993) and Millar (1971) provide evidence that small wetlands have higher rates of evapotranspiration (*i.e.,* sum of evaporation and plant transpiration, see Figure 3) and are thus more efficient than large wetlands at reducing runoff (Blackwell & Pilgrim 2011).

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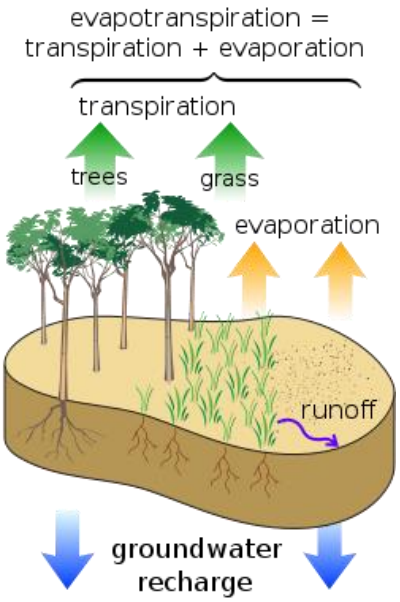

Figure 3
Small wetlands have higher rates of evapotranspiration than do larger wetlands, serving to reduce storm runoff and reduce the likelihood of flooding in Martin County's urban areas.
Evapotranspiration
Source: Knight, 1993

One example of the stormwater retention capacity of small, non-tidal wetlands within Martin County's Urban Services Districts is evident through analysis of Figure 4.

Figure 4
Stormwater Retention

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During the dry season, the combined losses to evaporation, evapotranspiration and groundwater recharge reduce surface water in this small (< 0.5 acre) urban wetland to the small open-water area in the middle of the photo. The abundance of emergent wetland vegetation toward the perimeter, indicates that during periods of high rainfall, the introduction of stormwater increases the water level and area of saturated soils from 20 – 40 feet up-slope.

Analysis of Google Earth aerial imagery confirms the highly variable water levels in this same wetland (Figures 5a and 5b).

Figures 5**a** (left) and 5b (right), showing highly variable water levels based on times when cumulative water losses exceed stormwater input (5a) and when stormwater input exceeds cumulative water losses by transpiration, evapotranspiration and groundwater seepage (5b). Photo sources: Google Earth.

Wetlands of all sizes in Florida may be connected underground via porous limestone and other geologic features, and together impact the water table to buffer flooding events or hydrologic pulses. To manage stormwater effectively, a variety of wetland sizes is needed to serve in roles such as nutrient sinks, sediment traps and to dampen hydrologic pulses (Tilley *et al.* 1998). By attenuating stormwater flow downstream, small wetlands within Urban Service Districts play a critical role in keeping unwanted nutrients and pollutants from reaching urban ditches and streams that lead to the St. Lucie River Estuary, Indian River Lagoon and other surface waters in Martin County.

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Finding: Non-tidal wetlands less than one half-acre in size within Martin County's Urban Service District retain stormwater within their individual watersheds and drainage basins. Allowing these wetlands to be destroyed for construction or development would eliminate their ability to collect and retain stormwater.

3.0 Wetlands Serve to Remove Pollutants and Nutrients.

Wetlands are widely known for their value in removing pollutants (*e.g.*, metals) and excessive nutrients [*e.g.*, soluble nitrogen (N) and Phosphorus (P) and their salts] from surface waters (reviewed in Fisher & Acreman 2004). Often referred to as "Mother Nature's Kidneys," wetlands absorb nutrients and reduce eutrophication in adjacent surface waters (Fisher & Acreman 2004). Eutrophication, the process through which a body of water becomes enriched in dissolved nutrients, is caused by excessive nutrients from runoff and leads to dense growth of plant life such as algal blooms (Fink & Charlier 2004). Without in-situ preservation of Martin County's small wetlands, there will be increased nutrient loaded runoff entering the St. Lucie River Estuary, the Indian River Lagoon, and other surface waters, which would likely contribute to future toxic algal blooms.

3.1 Uptake of Nutrients.

The University of Florida's Institute of Food and Agricultural Sciences (IFAS) maintains the Indian River Research and Education Center in Fort Pierce. In a study at that facility, Lu *et al.* (2010) documented the extent to which water quality is improved as nutrients are removed from surface waters through plant growth. The study used water lettuce (*Pistia stratiotes*), a floating wetland plant that is common in surface waters in Martin County and the Treasure Coast. A major finding of the study was that:

> "Water turbidity was decreased by more than 60%. Inorganic N (NH_4^+ and NO_3^-) concentrations in treatment plots were more than 50% lower than those in control plots (without plant). Reductions in both PO_4^{3-} and total P were approximately 14-31%, as compared to the control plots."

Water lettuce is present in Martin County (Wunderlin *et al.* 2017), and it is likely that biotic surveys of non-tidal wetlands less than one half-acre in size within Martin County's Urban Services District would reveal the presence of this useful plant species. Allowing the destruction of wetlands less than one half-acre in size would likely result in the loss of water lettuce, thereby preventing the uptake of phosphorus and nitrogen from the environment.

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In "Wetland nutrient removal; a review of the evidence," Fisher and Acreman (2004) reported on the results of a study of 57 wetlands around the world. Study sites included marshes, swamps, floodplains, fens, riparian wetlands and peatlands in North America, Asia, Europe, Africa and Australasia, during the period from the mid-1970's through 2003. Among other things, the study found that

> "Swamps and marshes differed from riparian (river) zones in their nutrient function characteristics by being slightly more effective at nutrient reduction."

In essence, wetlands that retained their surface water were more effective than riparian wetlands in retaining nutrients. Riparian zones have river characteristics including flowing surface water. Geographically isolated wetlands that are less than one half-acre in size function like the swamps and marshes studied by Fisher & Acreman (2004) in that they accept surface water runoff and retain sediments and nutrients. One important benefit associated with maintaining isolated wetlands, especially in urban settings, is the ability of those wetlands to permanently capture nutrients. The vegetation and soils in these wetlands chemically bind and convert nutrients (*e.g.,* phosphorus and nitrogen) to biomass, rather than just filtering out those nutrients or retaining them in sediment.

Several studies around the world (*e.g.,* Thayaparan *et al.* 2013, Akinbile *et al.* 2015) have revealed the effectiveness of feathered mosquitofern (*Azolla pinnata*) in removing nutrients and metals such as lead (Pb) from surface waters. Not only does *A. pinnata* occur in Martin County (Wunderlin *et al.* 2017), it is indeed present in at least one wetland that is less than one half-acre in size that is located within Martin County's Primary Urban Services District (G. Braun *Pers. Obs.* 2017; Figure 6).

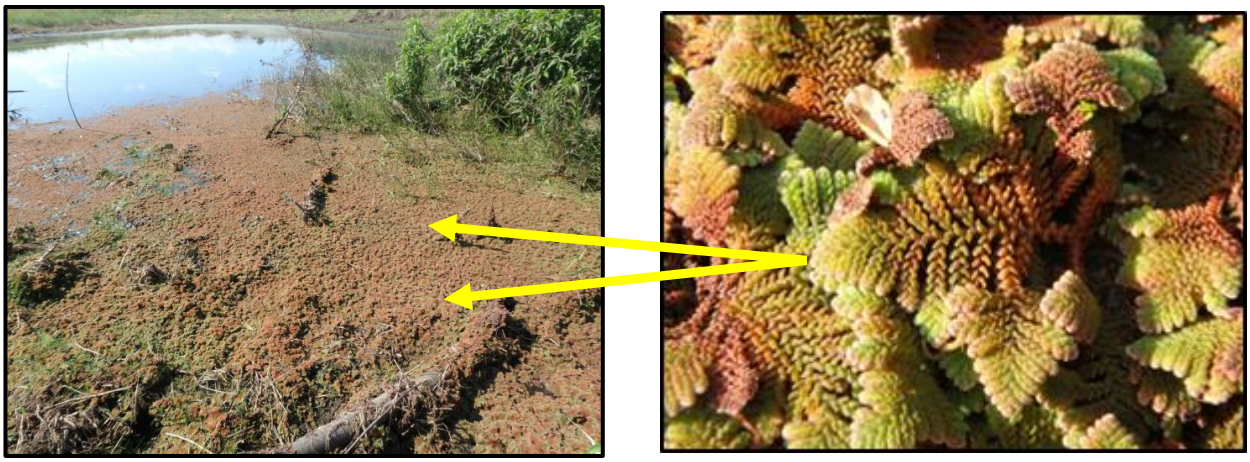

Figure 6

Feathered Mosquitofern (*Azolla pinnata*) was found to be abundant in a non-tidal wetland less than one half-acre in size within Martin County's Primary Urban Services District (Palm City).
Date of Photos: January 23, 2017

3.2 Uptake of Metals

While nutrients are a major contributor to water quality degradation (*e.g.,* algal blooms) in Martin County and on the Treasure Coast, harmful metals are also present in surface water runoff, particularly in urban areas where rains carry road runoff into wetlands. Many studies have shown the effectiveness of aquatic plants in sequestering and accumulating metals. Metal uptake studies performed on plant species that are documented to occur in Martin County include water hyacinth (*Eichhornia crassipes*; Mishra *et al.* 2008, Muramoto & Oki 1983), and duckweed (*Lemna minor*; Azarpira (2014), as well as above mentioned mosquito fern (*A. pinnata*; Mishra *et al.* 2008, Thayaparan *et al.* 2013) and water lettuce (*P. stratiotes*; Maine *et al.* 2004, Mishra *et al.* 2008).

Studies by Muthukrishnan (2010) and others confirm that stormwater carries nutrients, heavy metals and other chemicals from urban areas and agricultural fields and that these contaminants contribute to the degradation of aquatic ecosystems.

As a follow-up to her study at IFAS' Indian River Research and Education Center, Lu et al. (2011) conducted laboratory analyses and field studies to determine the extent to which *Pistia stratiotes* also uptakes and binds heavy metals (Fe, Mn, Zn, Cu, Cr, Ni, Pb, Cd, Co) and non-heavy metals (K, Ca, Na, Mg, Al). Among her findings, results and conclusions are the following:

1) "The growth of water lettuce reduced Al, Fe and Mn concentrations in water by > 20%, K and Cu by >10%, and Ca, Mg, Zn and Na to a lesser extent.
2) A larger proportion of Ca, Cd, Co, Fe, Mg, Mn, and Zn was adsorbed or deposited on the external root surfaces while more Al, Cr, Cu, Ni, and Pb were absorbed and accumulated within the roots.
3) Compared to heavy metals such as Cd, Cu, Zn, and Pb, non-heavy metals such as K, Ca, Na, Mg, and Al are usually overlooked. Although they are not as deteriorating as heavy metals, they also affect water quality and contribute to algal bloom."

The presence of water lettuce (*P. stratiotes*), mosquito fern (*A. pinnata*) and other nutrient-consuming hydrophytes in surface waters in Martin County aids uptake of excess nutrients and a variety of metals, thereby reducing contaminants from entering waterways.

Finding: Protecting small geographically isolated wetlands within Martin County's Urban Services District aids uptake of nutrients and metals from surface waters that would otherwise be more likely to reach other surface waters and contribute to decreased water quality.

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4.0 Aquifer Recharge and Saltwater Intrusion.

4.1 Aquifer Recharge

As water percolates through naturally-occurring water-permeable soils in Martin County, it recharges the surficial aquifer. The extent of contribution to groundwater recharge varies considerably, based on soils and the underlying hydrology. In his presentation entitled "Wetland Hydrology, Transport Processes and Modelling", the University of Florida's Wetland Biogeochemistry Laboratory Soil and Water Science Department, J. Jawitz (2008) provides a graphic illustration of the contribution by wetlands to groundwater recharge (Figure 7).

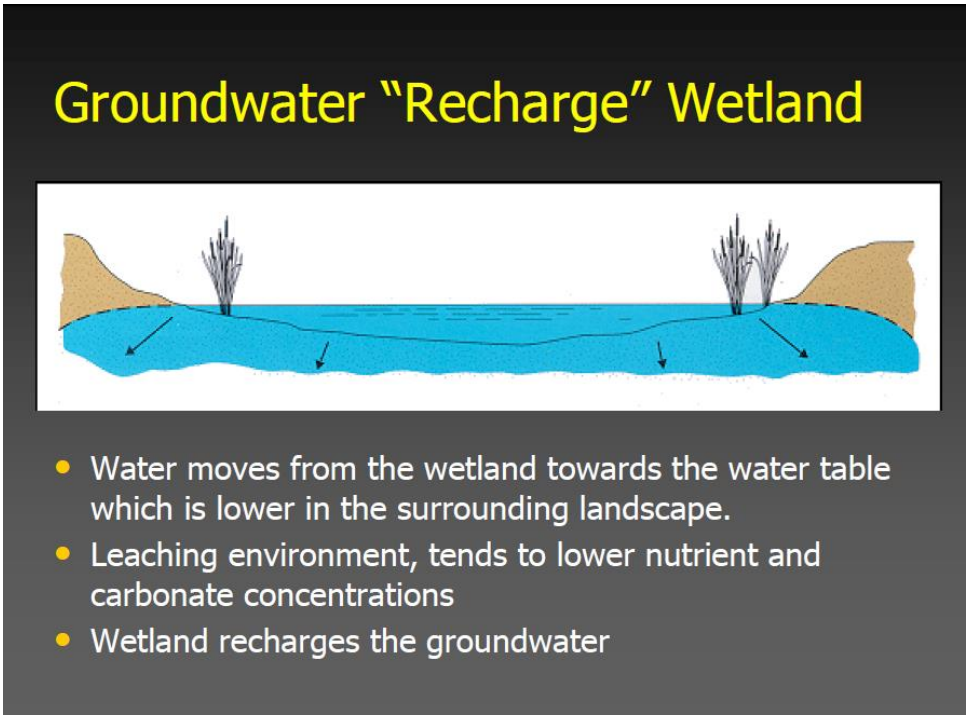

Figure 7
Contribution of Wetlands to Groundwater Recharge
Source: University of Florida Wetland Biogeochemistry Laboratory Soil and

As water recharges the aquifer, it helps maintain the supply of fresh water in wells that draw from the surficial aquifer.

4.2 Saltwater intrusion

Harmful saltwater intrusion into SE Florida's aquifer occurs by several mechanisms. Two such mechanisms summarized in a U.S. Geological Survey report by Prinos *et al.* (2014) include:

- "The gradual encroachment of saltwater from the ocean along the base of the aquifer resulting from reductions in freshwater head relative to sea level" and
- "The flow of saltwater inland through canals where it leaks into the aquifer."

Such saltwater intrusion not only contaminates drinking water in Florida's surficial aquifer in general, and in Martin County, it also negatively impacts wildlife not adapted to unnatural increases in salinity.

Geographically isolated wetlands (GIWs) exhibit seasonal hydrologic effects and have a positive impact on downstream flow (Evenson *et al.* 2014, Golden *et al.* 2014) and water quality (Cohen *et al.* 2016). Models by Evenson *et al.* (2014) investigated "downstream hydrologic effects of various distributions of GIWs within the watershed. Results suggested that: (1) GIWs have seasonally dependent effects on base flow; (2) GIWs mitigate peak flows; and (3) The presence of GIWs on the landscape impacts the watershed water balance."

Put into context, the elimination of small isolated wetlands from Martin County's urban services districts will adversely impact hydrology downstream. For example, just 50 years ago, the Northwest Fork of the Loxahatchee River, which flows through Jonathan Dickinson State Park, was home to an abundance of cypress trees and river turtles. Cypress trees have died and the previously-existing freshwater ecosystem has been replaced by a more estuarine environment (Roberts *et al.* 2008). This ecosystem's composition shifted as a result of hydrologic changes that included the loss of wetlands in the River's headwaters. Further elimination of wetlands, including small ones less than one half-acre in size will continue to allow saltwater to intrude further inland.

Finding: Protecting small non-tidal, geographically isolated wetlands within Martin County's Urban Services District promotes groundwater recharge and reduces saltwater intrusion. Destruction of wetlands and their replacement with impervious surfaces will reduce groundwater recharge and exacerbate current trends that result in saltwater intrusion and contamination of existing wells that withdraw water from the surficial aquifer.

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5.0 Habitat for Native Flora and Fauna.

Smaller wetlands have a greater perimeter:area ratio than do larger wetlands (Cohen *et al.* 2016), providing more shallow habitat edges needed for foraging and reproduction by a diverse assemblage of organisms, including plants, invertebrates, amphibians and reptiles, birds and mammals. The seasonal hydrology of smaller, ephemeral wetlands favors the reproduction of amphibians and arthropods because their juvenile life stages benefit from a lack of predatory fish in wetlands that dry seasonally. The following examples highlight how smaller wetlands are critical to maintaining biodiversity.

PLANTS. Richness of vascular plant species was found to be greater among several small wetlands when compared to a single large wetland of comparable area in New Zealand (Richardson *et al.* 2015). This pattern of native wetland plant diversity being greater in smaller wetlands was also revealed via models by Deane *et al.* (2017), where the loss of isolated wetland patches resulted in more than twice the number of plant species extinctions than did the loss of an equivalent area at one wetland site. This result is logical, as less than 5% of the area were small wetlands that contained more than 16% of endemic plant species (Deane *et al.* 2017), likely a reflection of the greater habitat niche diversity found in various small wetlands versus an equivalent larger connected area.

AMPHIBIANS. In their egg and juvenile stages, amphibians are particularly vulnerable to predatory fish. Small, isolated wetlands have seasonal hydrology with shorter hydroperiods, that is, small wetlands often dry up during Florida's dry season and so predatory fish cannot survive there. As water levels in these wetlands increase as a result of summer rains, these small wetlands are ideal nurseries for amphibian eggs and larvae to develop into juvenile frogs and salamanders with reduced pressure from predators.

Indeed, several studies have revealed high amphibian diversity in small isolated wetlands in the coastal plains of south-eastern USA. In five South Carolina (SC) wetlands ranging from 0.94 ac – 2.62 ac (0.38 – 1.06 ha), 20 amphibian and 36 reptile species were recorded by Russell *et al.* (2002). Similar numbers of amphibian species were recorded at various small wetlands along the Savannah River Site in SC, including 1.24 ac (0.5 ha) Rainbow Bay with 27 frog and salamander species, 1.24 ac (0.5 ha) Sun Bay with 22 amphibian species, 0.2 ac (0.08 ha) Karen's Pond with a remarkable 19

species, and 1.24 ac (0.5 ha) Squirrel Bay with 21 different kinds of amphibians (Semlitsch & Bodie 1998).

In Putnam County, Florida at 0.4 ac (0.16 ha) Breezeway Pond, 16 amphibian species were recorded, including prolific breeders (Dodd & Cade 1998). From 1985-1990, this temporary depression marsh was home to at least 2,500 striped newts (*Notophthalmus perstriatus*; toe-clipped for recaptures), a species that is near threatened and declining according to the International Union for the Conservation of Nature (IUCN). These newts are dependent on temporary wetlands adjacent to sandy uplands for reproduction and dispersal, respectively (Dodd & Cade 1998), and are only known to breed in small wetlands that only seasonally have standing water. Small wetlands and sandy uplands are being heavily developed and so it is not surprising that the only remaining populations of this newt are restricted to protected areas (IUCN 2004 report: http://www.iucnredlist.org/details/14872/0). In addition to the newts, this site was also home to ~5700 breeding adult eastern narrow-mouthed toads (*Gastrophryne carolinensis*; Dodd & Cade 1998). The hundreds of thousands of eggs and juvenile amphibians produced at such small wetland sites are a critical part of the food web for a variety of animals at both the small wetland and adjacent upland sites.

No data or analysis about the potential presence of similar organisms in small urban wetlands in Martin County that could be impacted by the proposed Comprehensive Plan Amendment was provided by the applicant.

INSECTS. There are a multitude of other species that depend on food, breeding and other niche resources that only small, nontidal wetlands can provide. Martin County wetlands less than one half-acre in size are an important source of invertebrates, including insects. Even when these wetlands dry seasonally, many wetland insects recolonize rapidly, thanks to their desiccation-resistant eggs (Batzer & Wissinger 1996). Insect prey species vary among wetlands that vary in hydroperiod. Small wetlands with a dry period provide habitat for different insect species than larger wetlands that permanently have surface water.

BIRDS. Both migratory birds and resident wading birds in southeast Florida, including a number of endangered and threatened species that are popular with residents and tourists, feed on wetland prey and thus urgently require the wetland habitat that small wetlands provide. The diversity and availability of aquatic arthropods and other aquatic prey in shallow small wetlands has led to an abundance of birds in Martin County. Without these small urban wetlands, the variety of insect food that these attractive wading birds need will be reduced.

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The Wood Stork Recovery Plan (FWS, 1997) identified the need to protect long and short hydroperiod wetlands as a key component for the recovery of the species. In its five-year Summary and Evaluation of the status of wood storks, FWS (2006) re-affirmed its position that:

> "Wood Storks are a wetland dependent species and loss of foraging wetlands continues to be the primary threat to this population. To ensure long-term survival and recovery of this population, wood storks require a mosaic of wetlands with varying climatological and seasonal conditions around colonies and within the wintering habitat in the coastal plain of the Southeast U.S.".

In SE Florida in the northern Everglades, Bancroft *et al.* (2002) studied water depth versus abundance of wading birds including wood storks (*Mycteria americana*), great blue herons (*Ardea herodias*), great egrets (*Casmerodius albus*), and white ibises (*Eudocimus albus*). For each species, they found a:

> "water depth threshold beyond which predicted bird abundance declined. This threshold of maximum use reflected species-specific foraging constraints, not simply leg length. Wood storks have the longest legs of these four species, but their numbers began to decline at intermediate water levels whereas the numbers of the great blue heron did not decline until water levels were much deeper."

The low water depth threshold for white ibis was explained by Bancroft *et al.* (2002):

> "Ibis have short legs and frequently probe their bill into the sediment to find invertebrates. Thus, water depths cannot be much greater than the length of the bill and head of an ibis."

This finding was corroborated by Beerens *et al.* (2011), specifically indicating that shallow (*i.e.*, from -9 to +8 cm depth) wetlands are critical to foraging needs of Florida's declining White Ibis population. From the 1930s to 2001, the white ibis population in the Everglades has declined by over 85% (Beerens *et al.* 2011), and this trend would likely carry over into a decline of white ibis in Martin County if the shallow foraging niche in small wetlands lose their protected status the proposed amendment to Martin County's CGMP.

Martin County's Comprehensive Plan includes protection for various aquatic or wetland-dependent listed animal species for which habitat management guidelines have been developed by the FWS or the State of Florida. In addition to the species mentioned in Martin County's Comprehensive Plan, several wildlife species that use

wetlands during all or part of their life cycle are designated by the State of Florida as Endangered, Threatened or Species of Special Concern (Table 1).

Table 1
Wildlife Species that are designated as Threatened, Endangered and Species of Special Concern that are wetland-dependent and which are known to occur in non-tidal wetlands in Martin County

Species		Status	Known to occur in fresh water wetlands in Martin Co.	Likely to occur in wetlands less than ½ acre in size?
Common Name	Scientific Name			
American Alligator	*Alligator missippiensis*	FT(S/A)	Yes	Unlikely
Fl. Sandhill Crane	*Grus canadensis pratensis*	T	Yes	Yes
Limpkin	*Aramus guarauna*	SSC	Yes	Potentially
Little Blue Heron	*Egretta caerulea*	SSC	Yes	Yes
Roseate Spoonbill	*Platalea ajaja*	SSC	Yes	Potentially
Snowy Egret	*Egretta thula*	SSC	Yes	Potentially
Tri-colored Heron	*Egretta tricolor*	SSC	Yes	Potentially
White Ibis	*Eudocimus albus*	SSC	Yes	Yes
Wood Stork	*Mycteria americana*	FT	Yes	Yes

Abbreviations: SSC = Florida Species of Special Concern; FT(S/A) = Federally Threatened due to Similarity of Appearance), T = Threatened, FT = Federally Threatened

The federal Migratory Bird Treaty Act (MBTA) and the Florida Wildlife Code (Chapter 62, F.A.C.) protect many additional species of wetland-dependent birds (Table 2).

Table 2
Wetland-dependent birds potentially present in small, non-tidal urban wetlands in Martin County

Species Common Name: Scientific Name	MBTA	Chap 62	Found in FW Wetlands in FL	Likely in MC wetlands < ½ acre
Anhinga, *Anhinga anhinga*	Yes	Yes	Yes	Possibly
Bittern, American, *Botaurus lentiginosus*	Yes	Yes	Yes	Possibly
Bittern, Least, *Ixobrychus exilis*	Yes	Yes	Yes	Possibly
Blackbird, Red-winged, *Agelaius phoeniceus*	Yes	Yes	Yes	Probably
Coot, American, *Fulica americana*	Yes	Yes	Yes	Possibly
Cormorant, Double-crested; *Phalacrocorax auritus*	Yes	Yes	Yes	Possibly

Sandhill, *Grus canadensis*	Yes	Yes	Yes	Possibly
Duck, Mottled, *Anas fulvigula*	Yes	Yes	Yes	Possibly
Duck, Ring-necked, *Aythya collaris*	Yes	Yes	Yes	Possibly
Duck, Wood, *Aix sponsa*	Yes	Yes	Yes	Possibly
Egret, Great, *Ardea alba*	Yes	Yes	Yes	Confirmed
Egret, Snowy, *Egretta thula*	Yes	Yes	Yes	Possibly
Gallinule, Purple, *Porphyrio martinica*	Yes	Yes	Yes	Possibly
Grebe, Pied-billed, *Podilymbus podiceps*	Yes	Yes	Yes	Confirmed
Gull, Laughing, *Leucophaeus atricilla*	Yes	Yes	Yes	Unlikely
Heron, Great Blue, *Ardea herodias*	Yes	Yes	Yes	Possibly
Heron, Green, *Butorides virescens*	Yes	Yes	Yes	Probably
Heron, Little Blue, *Egretta caerulea*	Yes	Yes	Yes	Confirmed
Heron, Tricolored, *Egretta tricolor*	Yes	Yes	Yes	Probably
Ibis, Glossy, *Plegadis falcinellus*	Yes	Yes	Yes	Possibly
Ibis, White, *Eudocimus albus*	Yes	Yes	Yes	Probably
Killdeer, *Charadrius vociferus*	Yes	Yes	Yes	Possibly
Kingfisher, Belted, *Megaceryle alcyon*	Yes	Yes	Yes	Unlikely
Kite, Snail, *Rostrhamus sociabilis*	Yes	Yes	Yes	Unlikely
Limpkin, *Aramus guarauna*	Yes	Yes	Yes	Unlikely
Mallard, *Anas platyrhynchos*	Yes	Yes	Yes	Possibly
Merganser, Hooded, *Lophodytes cucullatus*	Yes	Yes	Yes	Possibly
Moorhen, Common, *Gallinula chloropus*	Yes	Yes	Yes	Confirmed
Night-heron, Black-crowned, *Nycticorax nycticorax*	Yes	Yes	Yes	Possibly
Yellow-crowned, *Nyctanassa violacea*	Yes	Yes	Yes	Possibly
Virginia, *Rallus limicola*	Yes	Yes	Yes	Possibly
Sandpiper, Pectoral, *Calidris melanotos*	Yes	Yes	Yes	Possibly
Sandpiper, Least, *Calidris minutilla*	Yes	Yes	Yes	Possibly
Sandpiper, Spotted, *Actitis macularius*	Yes	Yes	Yes	Possibly
Scaup, Lesser, *Aythya affinis*	Yes	Yes	Yes	Possibly
Teal, Blue-winged, *Anas discors*	Yes	Yes	Yes	Possibly
Teal, Green-winged, *Anas crecca*	Yes	Yes	Yes	Possibly
Vireo, White-eyed, *Vireo griseus*	Yes	Yes	Yes	Likely
Warbler, Palm, *Dendroica palmarum*	Yes	Yes	Yes	Likely
Waterthrush, Louisiana, *Parkesia motacilla*	Yes	Yes	Yes	Possibly
Waterthrush, Northern, *Parkesia noveboracensis*	Yes	Yes	Yes	Possibly
Wren, Carolina, *Thryothorus ludovicianus*	Yes	Yes	Yes	Possibly
Wren, Marsh, *Cistothorus palustris*	Yes	Yes	Yes	Possibly
Yellowlegs, Greater, *Tringa melanoleuca*	Yes	Yes	Yes	Possibly
Yellowlegs, Lesser, *Tringa flavipes*	Yes	Yes	Yes	Possibly
Yellowthroat, Common, *Geothlypis trichas*	Yes	Yes	Yes	Likely

The Benefits of Small Wetlands

During cursory investigations of non-tidal wetlands less than one-half acre in size which are within Martin County's Primary and Secondary Urban Services Districts, several of these wetland-dependent species have been observed and documented (Figures 8, 9 and 10).

The applicant provided no data or analysis indicating the extent to which these and other species would be impacted by the proposed Amendment to Martin County's Comprehensive Growth Management Plan.

The Benefits of Small Wetlands

Figure 8
Wading birds foraging in a non-tidal wetland less than one-half acre within Martin County's Urban Services District
Date of Photos: April 10, 2017

Figure 9
Little Blue Heron (Immature)

Figure 10
Great Egret

The Benefits of Small Wetlands

Additional species that are protected by the MBTA and Chapter 62 of the Florida Wildlife Code and which have been observed in other non-tidal wetlands less than one half-acre in size within Martin County's Urban Services Districts include common moorhens (Figure 11) and pied-billed grebes (Figure 12).

Figure 11
Common Moorhens in a non-tidal wetlands less than one half-acre in size within Martin County's Urban Services Districts (Stuart area)
Date of Photo: April 10, 2017

Figure 12
One of two pied-billed grebes observed in a non-tidal wetland less than one half-acre in size within Martin County's Urban Services Districts (Hobe Sound area)
Date of Photo: January 27, 2017

The Benefits of Small Wetlands

Additionally the Florida Department of Environmental Protection identifies dozens of species of plants that are indicators of wetlands. Many of those species can be found in Martin County and may be present in wetlands that are one half-acre or under in size. Of these species, there is a subset of species that are also designated by the Florida Department of Agriculture and Consumer Services (FDACS) as endangered, threatened or commercially exploited species.

Whether state-listed as endangered or threatened, several herbaceous wetland plants (e.g. Catesby's lily (*Lilium catesbaei*), golden leather fern (*Acrostichum aureum*)) are documented to occur in non-tidal wetlands within the Urban Services Districts in Martin County. A current lack of verification of the presence of these species, and others, in wetlands less than one half-acre in size, may be more attributable to a lack of investigation rather than a lack of presence.

Due to the seasonal nature of some plants (e.g., *Lilium catesbaei)*, above ground portions are only visible for parts of the year. This seasonality makes these species less likely to be documented during environmental assessments, which are typically conducted by most environmental consultants during one-time-only site investigations.

The presence of numerous other herbaceous wetland species that are not designated as threatened or endangered (e.g., *Viola lanceolata* (Figure 13) would be confirmed if property assessments included multi-seasonal investigations.

Figure 13
Bog white violet (*Viola lanceolata*), photographed in a non-tidal wetland less than one half-acre in size within Martin County's Primary Urban Services District (Port Salerno area). This species is an example of floral diversity that is often overlooked during environmental assessment due to the presence of above-ground plant parts only seasonal.
Date of Photo: February 6, 2017

The Benefits of Small Wetlands

The presence of these species adds to the biodiversity in wetlands in Martin County's Urban Services Districts. Allowing the destruction of naturally-occurring wetlands in Martin County, and replacement of these wetlands with residential, commercial and other development will reduce biodiversity and the abundance of native flora and fauna.

The wood stork (*M. americana*) is Federally-designated as Threatened (Gruver & Coffey 2017). Wood storks have been observed in the vicinity of, and flying over non-tidal wetlands less than one half-acre within Martin County's Primary Urbans Services District (D.G. Braun, *Pers. Obs*.). As noted above, wood storks require shallow wetlands for foraging, a result corroborated by Bryan *et al.* (2012) who reviewed "Wood Stork foraging range and foraging habitat use throughout their U.S. breeding range, based on follow flight studies involving > 20 colonies." This study also found that wood storks foraged up to 12 miles (20 km) from their breeding colonies and that "various types of forested wetlands often provided a major component of the foraging habitats used by breeding storks." These studies revealed that wood storks need to be within 12 miles (20 km) of their breeding colonies for successful chick rearing, with access to shallow wetlands for foraging. Research (Fleming 1994) has also shown that when water levels are inappropriate (either too high or too low) at the beginning of nesting season, wood storks will delay, abandon or cease to nest.

The U.S Fish and Wildlife Service (FWS) has determined that, in South Florida, wetlands that are located within 18.6 miles of a wood stork nesting colony to be within a "Core Foraging Area" (**CFA**). Wetlands within CFAs that potentially provide foraging habitat for wood storks are given greater protection by FWS and the U.S. Army Corps of Engineers during reviews of permit applications. Because wood storks eat a variety of aquatic organisms, including those that are found in small wetlands and non-tidal wetlands that are less than one half-acre in size, those wetlands provide foraging habitat for wood storks. Monitoring and mapping by FWS shows the location of known wood stork nesting areas and their corresponding CFAs (Figure 8).

In its five-year status report on wood storks, FWS (2006) states:

> "Many researchers (Flemming *et al.* 1994, Ceilley & Bartone 2000) believe that short-hydroperiod wetlands provide a more important pre-nesting food source for wood storks than the foraging base suggests. Many of these are isolated wetlands and are being lost at an alarming rate (Flemming 1994). Wetlands that wood storks use for foraging are being lost through permitted activities where mitigation is being provided. However, it is not known if wood stork foraging wetlands are being replaced with like quality foraging wetlands within the core foraging area of an impacted colony. Frederick and Meyer (in press) suggest that the decline in colony size in Florida reflects the increasingly fragmented nature of Florida's wetlands."

The Benefits of Small Wetlands

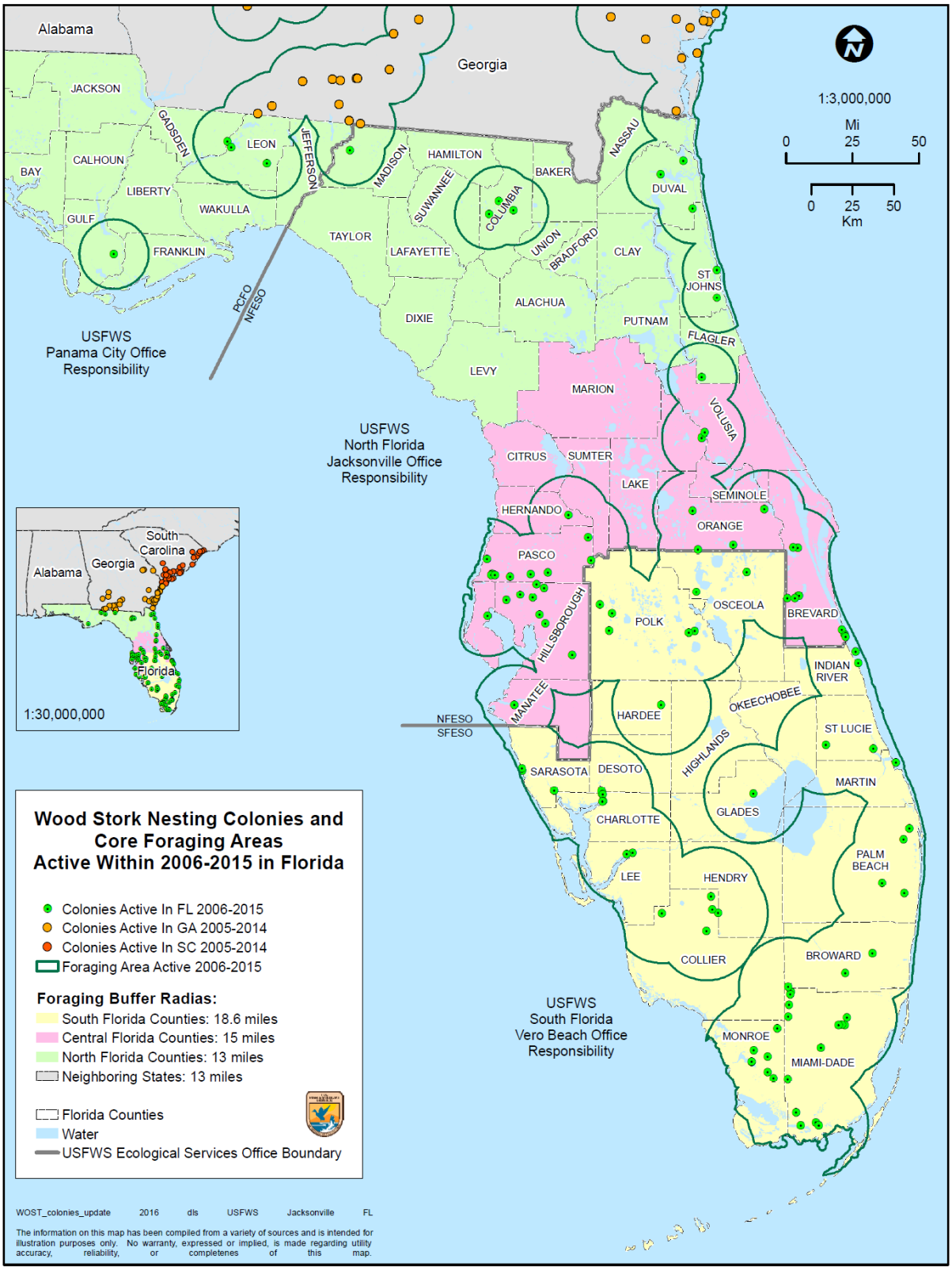

Figure 8
Wood Stork Nesting Colonies and Core Foraging Areas
Source: U.S. Fish and Wildlife Service

Two wood stork nesting colonies have CFAs that extend into Martin County's Primary and Secondary Urban Service Districts. These colonies are located at Bird Island (east of the Archipelago in Sewall's Point) and in southern St Lucie County in the North Fork of the St. Lucie River. Analysis of Google Earth aerial photographs indicate that there are numerous non-tidal wetlands that are less than one half-acre in size within Martin County's Urban Services Districts which are also within one or more designated wood stork CFA.

Finding: Protecting non-tidal wetlands that are less than one half-acre in size within Martin County's Urban Services District has contributed to sustainable populations of native flora and fauna in urban areas of Martin County. The continued presence of species that contribute to biodiversity, some of which are protected by state and/or federal laws, within Martin County's Urban Services Districts, requires an on-going commitment to protecting the habitats upon which these species are dependent, including small, non-tidal wetlands.

6.0 Consistency with the Comprehensive Growth Management Plan (CGMP).

In recognition of the various community, wildlife, hydrologic, nutrient cycling and ecological benefits that all wetlands provide, MC has protected wetlands since first adopting its CGMP in 1982. This protection has been memorialized through 'Comp Plan' policies, goals, objectives and Land Development Regulations (LDRs). Protection of wetlands is one of the key tenets through which the County has earned accolades and an award for having an outstanding Comprehensive Plan. In 1983, the 1982 Plan received an Award of Merit from the Florida Chapter of the American Planning Association. CGMP Policy 9.1G.1 regarding protection of wetlands, specifically states:

> "All wetlands in Martin County shall be protected. Negative impacts shall not be allowed in wetlands or within the buffer surrounding the wetland."

On several occasions during the 35 years since the initial CGMP was adopted, MC has enhanced its protection of wetlands through amendments to the CGMP. Wetlands within Planned Unit Developments (PUDs) and other development projects that exceed designated thresholds must now be managed pursuant to County-approved Preserve Area Management Plans (PAMPs). Protected buffer zones around wetlands have been adopted, and eventually widened, after it became apparent that narrow buffers were inadequate in protecting wetlands from adverse impacts emanating from nearby activities. MC's CGMP Goal 2.2 states that:

> "Martin County shall ensure natural resource conservation and conservation of the area's natural communities." And that "Martin County shall preserve all wetlands regardless of size unless prohibited by law."

The Benefits of Small Wetlands

In order to prevent conflict with the Bert J. Harris, Jr., Private Property Rights Protection Act, and meet other requirements, Martin County has adopted several exceptions which allow wetland impacts under certain, very limited circumstances. These exceptions recognize that at times, there may be extenuating circumstances in which the greater public good may be served if wetlands are not preserved *in situ*. The fact that these exceptions are very limited reflects the County's overall understanding and philosophy that protection of wetlands of all sizes is the best way the County can preserve its aquatic environment, reduce the likelihood that excess nutrients will reach rivers and estuaries, allow for aquifer recharge, and cost effectively manage its stormwater.

Six additional existing CGMP policies address specific issues related to the protection of wetlands, including wetlands that are one half-acre or less, are here noted.

1. Policy 9.1E.8 **Flood Protection**:

> "Floodplains and natural harbors (*i.e.*, Manatee Pocket) in Martin County shall continue to be recognized as unique resources requiring protection and conservation in the stormwater and flood control component of the Land Development regulations. Floodplains and natural harbors and shores shall be treated specifically for slope protection and erosion control/mitigation."

The relevancy of Policy 9.1E.8 to the protection of small (less than one half-acre) urban wetlands being challenged for development is that some such wetlands occur within floodplain areas.

2. Policy 91F.2 **Site Excavations between or within wetland systems**:

> "Excavated lakes designed to be part of a site's stormwater management system shall be designed to protect and maintain normal hydroperiods in preserved adjacent wetlands against negative impacts of activities. The functions and values associated with preserved wetland areas shall be protected during and after excavation activities."

The relevancy of this Policy to the protection of wetlands that are less than one half-acre in size is the acknowledgement that the presence and values of geographically isolated wetlands need to be protected from secondary adverse impacts even when they are protected *in situ*.

3. Policy 9.1G.2.(5) **Preserve Areas Management Plan (PAMP) provisions**:

> "Any applicant for development plan approval must contain a PAMP to protect all wetlands located on and off the site."

The relevancy of this Policy to the protection of wetlands that are less than one half-acre in size is the acknowledgment that solely preserving wetlands *in situ* is not enough to protect their long-term viability. Active management through the implementation of required Management Plan activities (*e.g.*, removal of invasive exotic species, maintenance of healthy hydroperiods) is necessary to protect the functions and values of all wetlands, without regard to their size.

4. Policy 9.1J.13. **Intensity and density transition zones**:

> "New land development shall provide for intensity and density transition zones abutting conservation areas and passive public parks. To maintain compatibility and to harmonize with the wildlife populations and natural systems, new development adjacent to conservation areas or passive public parks shall be limited to single family development. The following activities shall be prohibited within the first tier or block of new development:
>
> (1) Altering the hydrologic regime or lowering the water table;
> (2) Generating, storing or handling of hazardous wastes;
> (3) Generating nuisance, dust, lighting or odors; and
> (4) Generating high concentrations of excessive nutrient runoff."

The relevancy of this Policy to the protection of wetlands that are less than one half-acre in size is the acknowledgment that wetlands, regardless of their size, have specific hydrologic requirements, and that these wetlands have benefits and serve community functions as buffers from development and nutrient collection and uptake.

5. Policy 13.2A.1. **Reduction of Discharges**:

> "Martin County shall reduce the rate and quantity of freshwater discharges, sediment loads entering the St. Lucie River through cooperation with the appropriate regulatory agencies and development of programs to address all freshwater discharges. Toxic pollutants in these waters and their sources shall be identified and their discharges be eliminated."

The relevancy of this Policy to the protection of wetlands that are less than one half-acre in size is the acknowledgement that all wetlands, regardless of their size and location, serve to collect stormwater (and its associated pollutants) and reduce the likelihood that these pollutants will reach surface waters, including the St. Lucie River Estuary and the Indian River Lagoon.

6. Policy 13.3A.4. **Increase in extent and quality of wetlands**:

> "Martin County shall continue to protect wetlands by preservation and restoration to increase spatial extent and functional quality of watershed wetlands."

The relevancy of this Policy to the protection of wetlands that are less than one half-acre in size is the very direct statement that all wetlands in the county shall be protected.

Finding: Protecting wetlands, including small geographically isolated wetlands within Martin County's Urban Services District has been a cornerstone of the Martin County's award-winning Comprehensive Growth Management Plan (CGMP). Eliminating the protection of wetlands from Martin County's CGMP would have a cascading and compounding effect on numerous local Policies and Land Development Regulations that were publicly available to current residents when they decided to buy land and homes and live in Martin County.

7.0 Conclusions.

Non-tidal wetlands less than one half-acre in size are valuable because they:

- Prevent or reduce flooding by trapping runoff from rain;
- Clean water by trapping excess nutrients, metal contaminants, and sediments;
- Contain plants that process and bind excess nutrients and metal contaminants, permanently keeping them out of rivers, thereby reducing their contribution to algal blooms in the St. Lucie River Estuary and the Indian River Lagoon;
- Help to maintain a freshwater table higher than sea level to reduce or prevent saltwater intrusion;
- Allow reproduction of insects and amphibians that require short-hydroperiod wetlands;
- Provide important foraging habitat to wildlife including wading birds;
- Provide part of the depth continuum needed to support foraging by birds that are protected by state and federal endangered species regulations, the Migratory Bird Treaty Act and the Florida Wildlife Code;
- Provide aesthetically pleasing habitats that are valued by residents and visitors;
- Increase the quality of life and property values for residents of Martin County;
- Have been legally protected since 1982;
- Are valued by County residents, as evidenced by the recent outpouring of public involvement by people who oppose eliminating wetland protections; and
- Have attracted new residents who have bought properties in Martin County knowing that Martin County protects wetlands of all sizes.

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