BASELINE DOCUMENTATION REPORT

CALOOSAHATCHEE ECOSCAPE PROJECT

FERGUSON HOUSE FARMS, INC. PROPERTY

SECTIONS 2,3, 10, 11, 14, 15, 16, 21 & 22; TOWNSHIP 43 SOUTH; RANGE 30 EAST

COUNTY PARCELS: 1-30-43-02-A00-0004.0000, 1-30-43-10-A00-0003.0000, 1-30-43-11-A00-0004.0000, 1-30-43-14-A00-0006.0000, 1-30-43-14-A00-0007. 0000, 1-30-43-15-A00-0007.0000, 1-30-43-16-A00-0005.0000, 1-30-43-21-A00-0006.0000, and 1-30-43-22-A00-0006.0000

HENDRY COUNTY, FLORIDA

CONTRACT PL521.003

NORTHSTAR PROJECT NUMBER 40-23-510

Submitted to:

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January 2024

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HENDRY COUNTY, FLORIDA

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NorthStar Contracting Group, Inc., (NorthStar) certifies the authenticity of this report to the Florida Department of Environmental Protection – Division of State Lands (FDEP DSL) and to the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida and provides the following:

a) an environmental baseline inventory assessment was performed on the Subject Property the week of December 18, 2023;
b) the environmental baseline inventory report meets the requirements of Florida Department of Environmental Protection – Division of State Lands;
c) the accuracy, correctness, and completeness of the environmental assessment portion of the report is provided with the knowledge of the CERCLA requirements as set forth in 42 U.S.C. section 9601, as amended; and
d) the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida are entitled to rely on the information set forth in this baseline documentation.

Prepared by:



Date: January 31, 2024

Philip Stein
Environmental Professional

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SECTION 1.0 INTRODUCTION

The Florida Department of Environmental Protection (FDEP) – Division of State Lands (DSL) tasked NorthStar with the performance of a Baseline Documentation Report (BDR) for the Ferguson House Farms, Inc. property (Subject Property) in Hendry County, Florida. The BDR provides a record of a property's condition at the time of a conservation easement sale or donation. This documentation is the starting point for determining compliance with the easement restrictions. The requirements for a baseline documentation report are specified in FDEP's Standards for Conducting Combination Baseline Documentations / Environmental Site Assessment Reports. These requirements include the following minimum services for a baseline documentation report:

1. A description of the Property, including a general location map, specific location, size, legal description, and owner information.

2. A map delineating the community types [per Florida Natural Areas Inventory (FNAI) or both Florida Land Use and Cover Classification System (FLUCCS) and FNAI] present on the site, along with the estimated acreage of each habitat tract. Habitat acreages will be computed and provided either on the map or on a separate table included in the report. Habitat types will be recorded in the report text according to their dominant species by stratum (overstory, midstory, and groundcover) and the quality of the habitat. Unique features, such as springs, caves, sinkholes, artesian wells, rookeries, eagle nests, etc., will be noted and mapped on aerial photographs or referenced to the natural communities map. A description of the general condition and health of waterways, wetlands, and natural communities will be included. The habitat map and description will also include a summary of the type, location and aerial extent of nuisance or exotic plant species. The map should also indicate any agricultural, wetland, upland or other areas specifically referenced in the baseline documentation/environmental site assessment report.

3. A map and/or aerial photograph marked with the locations of any man-made improvements such as residences, farm buildings, storage tanks, signs, dikes/dams, canals/ditches, roads, bridges, etc., and marked with the locations of any historical or archaeological sites known or suspected.

4. Color photographs of the current site conditions oriented to specific locations on the Property. All trash sites on or potentially impacting the Property shall be photographed, with enough photographs to document the overall condition of the Property. (Baseline)

5. Color photographs of all man-made improvements such as residences, farm buildings, storage tanks, signs, dikes/dams, canals/ditches, roads, bridges, etc.

6. Indexed photographs representative of each habitat type and, if practicable, of listed species identified on site. Include photographs and descriptions of all agricultural uses (include intensity of use, such as grazing intensity or crop types).

7. A table summarizing the FNAI listed wildlife and plant species (common and scientific name) found during the assessment, along with their designated state and federal status.

8. A discussion of the type and location of listed plant and animal species found, including a discussion of the probability of on-site occurrences not observed.

9. Ensure that all site characteristics or features specifically referenced in the conservation easement (e.g., wetlands, natural communities, agricultural or silvicultural areas, and certain man-made features) are described in the text and/or indicated on appropriate maps.

10. Recommendations, if any, regarding appropriate management practices suggested to be employed on the Property consistent with the purposes and conditions of the easement. These recommendations should be included as an appendix and clearly marked as non-binding unless specifically required by the terms of the easement.

NorthStar has completed Environmental Baseline Documentation Report item numbers 1 through 10. Please note that this report does not represent a survey or a surveyor's report and is not intended to meet the Minimum Technical Standards for Surveys.

SECTION 2.0 SUBJECT PROPERTY LOCATION AND OWNER

2.1 Project Significance and Subject Property Location

The Subject Property is located within the Caloosahatchee Ecoscape Project and is currently utilized hunting and cattle ranching. The Subject Property is approximately 1,425.5-acres in total area consisting of nine contiguous parcels of land in Hendry County, Florida. The northern portion of the Subject Property is bound by State Road 80.

The Caloosahatchee Ecoscape Project falls within the Florida Forever Less Than Fee project category and was added to the priority list in 1998. Approximately half of the project area has been acquired under a conservation easement.

According to FDEP, acquisition of the CE on the Subject Property will provide the following benefits:

- Protection of scenic and other distinctive rural character of the landscape;
- Maintenance of soil productivity and control of soil erosion;
- Maintenance and enhancement of wildlife and game habitat;
- Protection of unique and fragile natural areas and rare species habitats;
- Maintenance or creation of a healthy balance of uneven aged timber classes;
- Maintenance or improvement of the overall quality of the timber resource;
- Maintenance of the value of the resource in avoiding land fragmentation;
- Protection of surface water quality, the Floridan Aquifer, wetlands, and riparian areas;
- Maintenance of economically viable agricultural practices that protect the landscape as a working enterprise in harmony with the open space and scenic qualities of the Property;
- Maintenance of existing upland/wetland natural communities;
- Restoration of disturbed upland/wetland natural communities.

The Subject Property is described in the legal description provided by FDEP DSL, which is included in **Appendix A** subject to changes with the final professional land survey of the easement boundaries. The Subject Property falls in Sections 2, 3, 10, 11, 14, 15, 16, 21 & 22 of Township 43 South, Range 30 East. The Subject Property falls within the Felda NE and Goodno Quadrangles as shown on the Florida United States Geological Survey (USGS) 7.5-minute topographic map (**Figure 1**).

According to the National Wetlands Inventory, the Subject Property consists of approximately 1,373.26-acres uplands and 52.27-acres wetlands. The Subject Property is illustrated on the National Wetlands Inventory Map provided in **Appendix B.**

2.2 Subject Property Owner Information

The Subject Property owner information is as follows:

Ferguson-House Farms, Inc.
5121 State Road 80
Moore Haven, FL 33935

SECTION 3.0 PHYSIOGRAPHY AND HYDROLOGY

3.1 Area Geomorphology

Hendry County's dominant physiographic units are the Everglades, the Sandy Flatlands, and the Big Cypress Swamp (Vernon, 1964). The Subject Property falls within the Sandy Flatlands, which are marine terrace sands deposited during the Pleistocene (Vernon, 1964). The Subject Property falls within the Talbot terrace, which slopes toward the Caloosahatchee River and has surface altitudes between 30 and 42 feet AMSL (Vernon, 1964). Related documentation from the adjoining Glades County, further subdivides this physiographic unit into the Caloosahatchee Valley, which is a low-lying valley feature in southern Glades County and northern Hendry County (Campbell, 1990). The Caloosahatchee Valley is bound to the east by Lake Okeechobee and grades into the Gulf Coastal Lowlands to the west (Campbell, 1990). Subject Property land elevations range from approximately 15 to 25 feet AMSL.

3.2 Soil Survey Review of Subject Property

A custom soil report was obtained from the Natural Resources Conservation Service (NRCS, 2023) for the Subject Property. The soil types and estimated acreage for each soil type identified at the Subject Property are listed in the table below.

Map Unit Symbol	Soil Map Unit Name	Estimated Acreage
1	Cypress Lake sand, 0 to 2 percent slopes	117.2
2	Pineda sand, limestone substratums	62.6
4	Oldsmar sand, 0 to 2 percent slopes	2.9
7	Immokalee sand, 0 to 2 percent slopes	336.3
8	Malabar sand, 0 to 2 percent slopes	256.3
9	Riviera fine sand, 0 to 2 percent slopes	10.0
10	Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes	12.74
14	Wabasso sand, limestone substratum, 0 to 2 percent slopes	38.2
15	Myakka sand, 0 to 2 percent slopes	97.4
17	Basinger sand, 0 to 2 percent slopes	17.0
19	Gator Muck, frequently ponded, 0 to 1 percent slopes	9.5
20	Okeelanta muck	9.1
21	Holopaw sand, 0 to 2 percent slopes	20.1
22	Valkaria sand	113.5
23	Brynwood sand, wet, 0 to 2 percent slopes	40.6
26	Holopaw sand, limestone substratum	67.0

Map Unit Symbol	Soil Map Unit Name	Estimated Acreage
27	Riviera fine sand, limestone substratum	5.8
29	Oldsmar sand, limestone substratum	141.4
33	Holopaw sand, frequently ponded, 0 to 1 percent slopes	26.4
51	Malabar fine sand, 0 to 2 percent slopes	41.8

Note: Estimated acreages are approximately and based on shape files provided by FDEP. They do not represent surveyed values.

A full description of the soils identified at the Subject Properties and maps showing the soil type underlying the Subject Properties are included in **Appendix D.**

3.3 Surface Water Classification

In Hendry County, Lake Okeechobee and portions of the Caloosahatchee River are classified as a Class I surface water (surface water bodies used for potable water supplies) (FDEP, 2016). All other oceans, rivers, creeks, swamps, bogs, or any other surface water features are classified as Class III Freshwater, or Marine water, and should follow the Class III Freshwater or Marine water Criteria as established in Chapter 62-302.400 of the Florida Administrative Code (FAC) (FDEP, 2016).

All waters in National Parks, State Parks, preserves, memorials, wildlife refuge, and wilderness areas are classified as Outstanding Florida Waters as established in Chapter 62-302.700, FAC (FDEP, 2016).

Storm water within the Subject Property will infiltrate through Subject Property soils and flow through a network of ditches to canals that will generally flow north into the Caloosahatchee Canal with sufficient rainfall. There are no natural waterways within the Subject Property.

3.4 Aquifer Classification

The following groundwater information is summarized from report “Recharge to the Surficial Aquifer System in Lee and Hendry Counties” (Krulikas, 1995). Hendy County primarily utilizes two regional aquifer systems, the Surficial and the Intermediate Aquifer systems, for potable water. The Surficial Aquifer is composed of two distinct water-bearing units known as the Surficial Aquifer and the Tamiami Aquifer. These aquifer deposits range in age from late Miocene to Holocene. The Intermediate Aquifer system is located within the more permeable beds of the Peace River Formation. These more permeable beds are often interbedded with less permeable units, leading to a confined aquifer of widely varying thickness. The Floridan Aquifer, although present, contains

elevated chloride and sulfate concentrations and is not commonly utilized for potable water in this portion of Hendry County.

SECTION 4.0 METHODOLOGY

Methods employed in the development of this baseline documentation report consisted of preliminary data research, on-site field assessments, and interviews with the landowner and land managers. The preliminary data obtained includes the Subject Property boundary, 2021 true color ortho-images, soil survey data, and the Florida Water Management District (WMD) land use/land cover classification data. Documented occurrences of rare and/or protected species and potentially rare and/or natural habitats were also reviewed. This data aided in the preparation of preliminary site maps utilized by NorthStar personnel during the field assessment. Digital photographs and Differential Global Positioning System (DGPS) coordinates were collected at all locations pertinent to the scope of services for this baseline inventory report. NorthStar personnel interviewed the landowner/land manager for information regarding possible cultural features, listed flora and fauna occurrences, non-native species, and land management practices.

4.1 Preliminary Data Research

Various sources of GIS and remotely sensed data were obtained, overlain, and compared using ArcGIS 10.x software to produce a preliminary field assessment map from which natural community types, cultural features, wildlife, and other noteworthy occurrences could later be documented. The preliminary data included:

- Subject Property boundary
- 2021 true color ortho-images
- Florida Water Management District and/or Florida Department of Transportation land cover features, which are categorized according to the Florida Land Use and Cover Classification System (FLUCCS)
- National Wetlands Inventory boundaries
- Soil Survey for Hendry County
- Cultural features (e.g., roadways, railway, archaeological sites)
- Florida natural Areas Inventory (FNAI) map and database search report for the project area

The NorthStar GIS/CADD department prepared large-scale, digitally rectified aerial photographs for the field personnel prior to the field assessment. Subject Property boundaries, FLUCCS extents, known wetland extents, existing easements, known archaeological sites, and features are generated in ArcGIS Desktop and converted to ArcGIS Pro Version 2.1 feature classes stored within a geodatabase, or obtained from existing ArcGIS Shape files or feature classes stored within a geodatabase (if available). Spatially corrected site boundaries, rectified digital aerial photography, digital quadrangle maps, existing digital photographs of the site, etc. were then preloaded on the handheld DGPS field data collector. Real-time DGPS tracking was performed while investigating the Subject Property, indicating the field personnel's current position to aid in site location

and confirmation of boundaries. The DGPS and handheld data collector were used to display and mark locations of noteworthy occurrences, and the data point's location (latitude and longitude) are captured using a Trimble R1 with ArcGIS Field Maps (current version) application on iPhone 14. GIS attribute data is entered at the time of DGPS data collection (i.e., DGPS location, description, sample data, photo ID, notes, etc.).

The compilation of this data into an editable field map provided a starting point from which natural communities present on the Subject Property were confirmed or better defined. Changes in aerial extent and classification of natural communities were recorded directly on the field maps. This information was subsequently updated to reflect current, ground-truthed conditions. The FNAI was consulted to identify documented occurrences of rare, threatened, or endangered species and to locate potential areas of rare natural habitat. Natural community nomenclature utilized in this report follows that of the FNAI Natural Community Guide 2010 edition. In those cases where a particular community did not precisely fit the FNAI classification, or appeared intermediate between community types, a notation was made, and the most closely fitting community name was used.

4.2 Landowner/Land Manager Interview

NorthStar personnel conducted interviews with the landowner representative to obtain information primarily about the presence and types of wildlife occurrences, listed species, invasive species, archaeological sites, and historic and current land management practices utilized at the Subject Property. NorthStar interviewed Dwayne House, owner of the property, in person and via email. Additionally, Mr. Keith Fountain, the owner representative, provided supplemental information via email and telephone. Mr. House provided the baseline documentation questionnaire, which are included in **Appendix D**.

Mr. House confirmed the Subject Property is used for agricultural purposes (cattle) and recreation (hunting). He indicated he has owned the Subject Property for more than 20 years and has been used for cattle ranching during that time. Mr. House indicated previous uses were cattle grazing, truck farming, rubber plantation, and marigold farming.

According to Mr. Fountain, cattle is grazed across the property at a ratio of approximately 1 head of cattle for every 2-acres. Mr. Fountain indicated the property is managed as part of a group of properties and the cattle are grazed across the group. He also indicated other intermittent land uses include beekeeping, cabbage palm harvesting, saw palmetto berry harvesting, and cutting sod.

There are no hunting leases associated with property. Mr. House indicated there are no buildings located on the property, only fences and other improvements associated with cattle operations. Mr. House indicated there are three shallow wells serving cattle

operations. Permit information is available through the South Florida Water Management District and is provided in **Appendix D**.

Mr. House indicated land management practices include prescribed burning, which is used to control underbrush and as an invasive plant treatment. Prescribed burning is conducted on a 3-year rotation using drip torches. He was unaware of any documented forest fires within the Subject Property boundary. He also indicated that herbicides are used along fence lines and to manage invasive/exotic plant species according to label instructions and BMPs.

The responses provided by Mr. House indicate he is unaware of any environmental issues, former chemical use, chemical storage system, or dumps present or historically present, on the property.

Mr. House indicated that various listed species such as caracara, gopher tortoise, eastern indigo snake, Florida sandhill crane, and Florida panther have been observed or likely to occur on the property. He also indicated that exotic species such as Brazilian pepper, smutgrass, and Caesar's weed are likely found on the property.

In addition, ranch hand Lily escorted NorthStar staff during the site visit. She provided access to each of the water wells and answered general questions about the property and the improvements. Lily has been working on the ranch for approximately 3 years.

4.3 Field Assessment

NorthStar personnel conducted a field assessment during the week of December 18, 2023. Field assessments are conducted to review and refine the type and aerial extent of wetland and upland habitats found on-site. Vehicular access was accomplished via State Road 80. The interior of the Subject Property was traversed through use of trail roads located within the property boundaries and on foot where necessary. Areas without accessible trail roads were visually inspected using current satellite and aerial photography and field-inspected on foot and via 4-wheel drive vehicle. The Existing Improvements Map and an Agricultural and Natural Lands Map are provided in **Appendix E**.

Special attention was given to each habitat identified on the Subject Property for the observation of wildlife utilization, particularly by rare and protected species. Photographic documentation and DGPS coordinates were recorded for selective habitats, improvements, agricultural areas, structures, animal feeders, and other notable occurrences. Photographic documentation, DGPS locations, a Vehicular Transects Map and field observation maps are provided in **Appendix F**.

Data is transferred back into our GIS database real time via cellular data services. All data collected was verified and used to generate maps in ArcView/ArcGIS (Shapefiles) for data analysis and reporting. Any necessary digital photograph enhancement was performed, and the digital site photographs were linked to their field locations in the GIS database. The use of these technologies and processes allows NorthStar to easily return to an exact site location for re-evaluation and comparison.

SECTION 5.0 SUBJECT PROPERTY DESCRIPTION

5.1 Primary Land Use of the Subject Property

The Subject Property location is shown on **Figure 1**. The Subject Property is utilized for cattle grazing and hunting. Intermittent uses include bee keeping, cabbage palm harvesting, saw palmetto berry harvesting, and pasture sod cutting. Past land uses have included vegetable farming, marigold farming, and rubber plantation.

5.2 Existing Improvements of the Subject Property

A semi-improved limerock road is located along the western boundary of the property and provides access from SR 80 to the north. Improvements on the property are limited to cattle fencing located around the perimeter of the property and throughout interior portions to segregate pastures. A cattle pen is located on the central portion of the property. Multiple gates are located around the property and provide access from multiple points. Three water wells were identified on the property with two windmill and one solar power. These wells serve cattle watering troughs. Various animal feeders, hunting stands, animal pens, cattle ponds, and water troughs were located throughout the property.

A map showing existing permanent improvement locations as well as maps showing the extent and acreage of agricultural land, pasture/hay production, and silviculture are included in **Appendix G**.

5.3 Natural Communities of the Subject Property

The concept of ecological communities is based on the awareness that a specific soil type commonly supports a specific vegetation community, which in turn provides the habitat needed by a specific wildlife species. These ecological communities are classified by their distinct and reoccurring assemblage of populations of plants, animals, fungi, and microorganisms naturally associated with each other and their physical environment. The FNAI has established a classification for each of Florida's eighty-one unique ecological communities. These classifications are defined in FNAI's Guide to the Natural Communities of Florida 2010 edition. Based on field observations in December 2023 and review of the FLUCCS delineations and definitions for the Subject Property, NorthStar assigned an FNAI classification to each FLUCCS unit present on the Subject Property. The ecological communities as well as altered land cover types were ground-truthed during the site visit. The observed ecological communities within the Subject Property area of interest are summarized in the table below followed by short descriptions of each community type. The communities are depicted within the Subject Property boundaries on the FLUCCS / Natural Communities located in **Appendix G.**

Hendry County			
FLUCCS Code	**FLUCCS Name**	**FNAI Classification**	**Acreage**
2110	Improved Pastures	Altered (improved pasture)	853.57
2120	Unimproved Pastures	Altered (semi-improved pasture)	360.82
2130	Woodland Pastures	Mesic Flatwood	160.65
5300	Reservoirs	Altered (Artificial Pond)	0.64
6210	Cypress	Dome Swamp	2.71
6215	Cypress – Domes/Head	Dome Swamp	1.52
6300	Wetland Forested Mixed	Hydric Hammock	29.84
6410	Freshwater Marshes / Graminoid Prairie - Marsh	Depression Marsh	13.35
6430	Wet Prairie	Wet Prairie	2.57

FNAI Altered Land Cover Types (FNAI, 2010)

Pasture – improved - pastures dominated by planted non-native or domesticated native forage species. Typically, current or recent pasture activities (grazing, mowing, fertilizing, etc.) are evident. Typical plants are bahiagrass, bermudagrass, pangolagrass, dogfennel, flatsedge, carpetgrass, crabgrasses, and rustweed.

Pasture - semi-improved – Dominated by a mix of planted non-native or domesticated native forage species and native groundcover, due to an incomplete conversion to pasture, not regeneration. Semi-improved pastures have been cleared of a significant percentage of their native vegetation and planted in non-native or domesticated native forage species, but still retain scattered patches of native vegetation with natural species composition and structure (most often small areas of mesic flatwoods) among the pastured areas. The planted areas are usually dominated by bahiagrass (Paspalum notatum) and can resemble improved pastures. Seeding of bahiagrass can also occur within areas of native groundcover. This category should apply regardless of recent pasture maintenance.

Artificial Pond – These areas are man-made water reservoirs. Examples include water retention ponds, cattle ponds, etc.

FNAI Natural Communities (FNAI, 2010)

Mesic Flatwood - (synonyms: pine flatwoods, pine savannahs, pine barrens). Mesic Flatwoods are characterized as an open canopy forest of widely spaced pine trees with

little or no understory but a dense ground cover of herbs and shrubs. Several variations of Mesic Flatwoods are recognized, the most common associations being longleaf pine - wiregrass - runner oak and slash pine - gallberry - saw palmetto. Other typical plants include St. Johns-wort, dwarf huckleberry, fetterbush, dwarf wax myrtle, stagger bush, blueberry, gopher apple, tar flower, bog buttons, blackroot, false foxglove, white-topped aster, yellow-eyed grass, and cutthroat grass. Typical animals of Mesic Flatwoods include oak toad, little grass frog, narrowmouth toad, black racer, red rat snake, southeastern kestrel, brown-headed nuthatch, pine warbler, Bachman's sparrow, cotton rat, cotton mouse, black bear, raccoon, gray fox, bobcat, and white-tailed deer.

Mesic Flatwoods occur on relatively flat, moderately to poorly drained terrain. The soils typically consist of 1 to 3 feet of acidic sands generally overlying an organic hardpan or clayey subsoil. The hardpan substantially reduces the percolation of water below and above its surface. During the rainy seasons, water frequently stands on the hardpan's surface and briefly inundates much of the flatwoods; while during the drier seasons, ground water is unobtainable for many plants whose roots fail to penetrate the hardpan. Thus, many plants are under the stress of water saturation during the wet seasons and under the stress of dehydration during the dry seasons.

Another important physical factor in Mesic Flatwoods is fire, which probably occurred every 1 to 8 years during pre-Columbian times. Nearly all plants and animals inhabiting this community are adapted to periodic fires; several species depend on fire for their continued existence. Without relatively frequent fires, Mesic Flatwoods succeed into hardwood-dominated forests whose closed canopy can essentially eliminate the ground cover herbs and shrubs. Additionally, the dense layer of litter that accumulates on unburned sites can eliminate the reproduction of pines which require a mineral soil substrate for proper germination. Thus, the integrity of the Mesic Flatwoods community is dependent on periodic fires. However, fires that are too frequent or too hot would eliminate pine recruitment and eventually transform Mesic Flatwoods into Dry Prairie.

Mesic Flatwoods are closely associated with and often grade into Wet Flatwoods, Dry Prairie, or Scrubby Flatwoods. The differences between these communities are generally related to minor topographic changes. Wet Flatwoods occupy the lower wetter areas, while Scrubby Flatwoods occupy the higher drier areas.

Mesic Flatwoods are the most widespread biological community in Florida, occupying an estimated 30 to 50 percent of the state's uplands. However, very few undisturbed areas of Mesic Flatwoods exist because of habitat mismanagement and silvicultural, agricultural, or residential development. Mesic Flatwoods are often fairly resilient, and with proper management they can generally be restored.

Dome Swamp - (synonyms: isolated wetland cypress dome, cypress pond, gum pond, bayhead, cypress gall, pine barrens pond). Dome Swamps are characterized as shallow, forested, usually circular depressions that generally present a domed profile because smaller trees grow in the shallower waters at the outer edge, while bigger trees grow in the deeper water in the interior. Pond cypress, swamp tupelo, and slash pine are common plants. Other typical plants include red maple, dahoon holly, swamp bay, sweetbay, loblolly bay, pond apple, Virginia willow, fetterbush, chain fern, netted chain fern, poison ivy, laurel greenbrier, Spanish moss, wild pine, royal fern, cinnamon fern, coastal plain willow, maidencane, orchids, wax myrtle, swamp titi, St. John's wort, sawgrass, lizard's tail, swamp primrose, water hyssop, redroot, sphagnum moss, floating heart, buttonbush, arum, and fire flag. Typical animals include flatwoods salamander, mole salamander, dwarf salamander, oak toad, southern cricket frog, pinewoods treefrog, little grass frog, narrowmouth toad, alligator, snapping turtle, striped mud turtle, mud turtle, eastern mud snake, cottonmouth, woodstork, wood duck, swallow-tailed kite, barred owl, pileated woodpecker, great-crested flycatcher, prothonotory warbler, and rusty blackbird.

Dome Swamps typically develop in sandy flatwoods and in karst areas where sand has slumped around or over a sinkhole, creating a conical depression. Soils are composed of peat, which becomes thickest toward the center of the dome, and are generally underlain with acidic sands and then limestone, although other subsoils may also occur. Some domes have a clay lens that helps retain water levels.

Dome Swamps often derive much of their water through runoff from surrounding uplands, but they may also be connected with underground channels, in which case subterranean flows would dominate the hydrological regime. Dome Swamps generally function as reservoirs that recharge the aquifer when adjacent water tables drop during drought periods. The normal hydroperiod for Dome Swamps is 200 to 300 days per year with water being deepest and remaining longest near the center of the dome.

Fire is essential for the maintenance of a cypress dome community. Without periodic fires, hardwood invasion and peat accumulation would convert the dome to Bottomland Forest or Bog. Dome Swamps dominated by bays are close to this transition. Fire frequency is greatest at the periphery of the dome and least in the interior where long hydroperiods and deep peat maintain high moisture levels for most of the year. The normal fire cycle might be as short as 3 to 5 years along the outer edge and as long as 100 to 150 years towards the center. The profile of a Dome Swamp (i.e., smaller trees at the periphery and largest trees near the center) is largely attributable to this fire regime. The shorter hydroperiods along the periphery permit fires to burn into the edge more often, occasionally killing the outer trees. Cypress is very tolerant of light surface fires, but muck fires burning into the peat can kill them, lower the ground surface, and transform a dome into a pond.

Dome Swamps may have a Depression Marsh or pond in their center, creating a doughnut appearance when viewed from above. Dome Swamps typically grade into Wet Prairie or Marl Prairie around the periphery, but they may also be bordered by Bottomland Forest or Swale. The species composition of Dome Swamps frequently overlaps with Strand Swamp, Wet Flatwoods, Basin Swamp, Baygall, Floodplain Swamp, and Freshwater Tidal Swamp.

Normal hydroperiods must be maintained. Somewhat deeper than normal water levels are not likely to do much harm, but extended hydroperiods will limit tree growth and prevent reproduction. Shortened hydroperiods will permit the invasion of mesophytic species, which will change the character of the understory and eventually allow hardwoods to replace cypress. Dome Swamps may also be degraded by pollution and the invasion of exotic plants.

Hydric Hammock – Hydric hammock is an evergreen hardwood and/or palm forest with a variable understory typically dominated by palms and ferns occurring on moist soils, often with limestone very near the surface. While species composition varies, the community generally has a closed canopy of oaks and palms, an open understory, and a sparse to a moderate groundcover of grasses and ferns. The canopy is dominated by swamp laurel oak (Quercus laurifolia) and/or live oak (Q. virginiana) with varying amounts of cabbage palm (Sabal palmetto), American elm (Ulmus americana), sweetbay (Magnolia virginiana), red cedar (Juniperus virginiana), red maple (Acer rubrum), sugarberry (Celtis laevigata), sweetgum (Liquidambar styraciflua), and water oak (Q. nigra). Cabbage palm is a common to dominant component of hydric hammock throughout most of Florida. Loblolly pine (Pinus taeda) may be frequent in some areas, but slash pine (Pinus elliottii) is less frequently encountered. In addition to saplings of canopy species, the understory may contain a number of small trees and shrubs. American hornbeam (Carpinus caroliniana) is often frequent, and various other woody species may be present including swamp dogwood (Cornus foemina), small-leaf viburnum (Viburnum obovatum), common persimmon (Diospyros virginiana), swamp bay (Persea palustris), wax myrtle (Myrica cerifera), dwarf palmetto (Sabal minor), American beautyberry (Callicarpa americana), and needle palm (Rhapidophyllum hystrix). Vines may be frequent and diverse; common species are eastern poison ivy (Toxicodendron radicans), peppervine (Ampelopsis arborea), rattan vine (Berchemia scandens), trumpet creeper (Campsis radicans), climbing hydrangea (Decumaria barbara), yellow jessamine (Gelsemium sempervirens), greenbriers (Smilax spp.), summer grape (Vitis aestivalis), and muscadine (Vitis rotundifolia). Herb cover, when present includes mostly graminoids and ferns with the following species commonly encountered: sedges (Carex spp.), woodoats (Chasmanthium spp.), smooth elephantsfoot (Elephantopus nudatus), Carolina scalystem (Elytraria caroliniensis), woodsgrass (Oplismenus hirtellus), maiden ferns (Thelypteris spp.),

cinnamon fern (Osmunda cinnamomea), royal fern (Osmunda regalis var. spectabilis), toothed midsorus fern (Blechnum serrulatum), netted chain fern (Woodwardia areolata), and Virginia chain fern (Woodwardia virginica). Epiphytes such as golden polypody (Phlebodium aureum), air-plants (Tillandsia spp.), and shoestring fern (Vittaria lineata) increase in frequency to the south along with other more subtropical shrubs such as myrsine (Rapanea punctata), and wild coffee (Psychotria nervosa; species list developed in part from Vince et al.).

Species composition is mainly influenced by flooding patterns. In saturated and frequently flooded environments, hydrophytic trees such as swamp tupelo (Nyssa sylvatica var. biflora) become more abundant. Frequency and depth of inundation have a pronounced effect on oak canopy composition as well, with saturated soils supporting more swamp laurel oak, and areas of infrequent flooding supporting more live oak. Increased salinity is a factor often limiting certain species. Rises in terrain as well as ecotones to mesic hammock and upland hardwood forest induce a greater cover of upland species, specifically southern magnolia (Magnolia grandiflora), pignut hickory (Carya glabra), and saw palmetto (Serenoa repens).

Hydric hammock occurs on low, flat, wet sites where limestone may be near the surface and soil moisture is kept high mainly by rainfall accumulation on poorly drained soils. Periodic flooding from rivers, seepage, and spring discharge may also contribute to hydric conditions. Soils are variable, usually somewhat acidic to slightly alkaline with little organic matter, and in all cases, alkaline materials are available in the substrate. In the extensive Gulf Hammock region shallow loamy soils (Waccasassa series) formed by marine sediments overlie a layer of Oligocene limestone near the surface that frequently outcrops. Deeper soils over limestone (Aripeka series) and deep sands with calcium carbonate nodules and shell fragments underlie many hammocks in peninsular Florida. These substrates are conducive for the growth of calciphiles characteristic of hydric hammock (red cedar, rattan vine, etc.). Hydric hammock is inundated only for short periods following heavy rains. The normal hydroperiod is seldom over 60 days per year. Fire may be rare or occasional depending on several factors including how often the surrounding community burns and hammock size.

Depression Marsh - (synonyms: isolated wetland, flatwoods pond, St. John's wort pond, pineland depression, ephemeral pond, seasonal marsh). Depression Marsh is characterized as a shallow, usually rounded depression in sand substrate with herbaceous vegetation often in concentric bands. Depression Marshes are similar in vegetation and physical features to, but are generally smaller than, Basin Marshes. Typical plants include St. John's wort, spikerush, yellow-eyed grass, chain fern, willows, maidencane, wax myrtle, swamp primrose, bloodroot, buttonbush, fire flag, pickerelweed, arrowheads, and bladderwort.

Larger and more permanent Depression Marshes may have many of the same plants and animals listed as typical of Basin Marshes. However, because of their isolation and small size, many Depression Marshes support a very different assemblage of species than that found in larger, more permanent wetlands. Depression Marshes are considered extremely important in providing breeding or foraging habitat for such species as the flatwoods salamander, mole salamander, tiger salamander, dwarf salamander, striped newt, oak toad, cricket frog, pinewoods treefrog, barking treefrog, squirrel treefrog, little grass frog, southern chorus frog, ornate chorus frog, narrowmouth toad, eastern spadefoot toad, gopher frog, white ibis, wood stork and sandhill crane. Depression Marshes occurring as isolated wetlands within larger upland ecosystems are of critical importance to many additional wetland and upland animals.

Depression Marshes are typical of karst regions where sand has slumped around or over a sinkhole and thereby created a conical depression subsequently filled by direct rain fall, runoff, or seepage from surrounding uplands. The substrate is usually acid sand with deepening peat toward the center. Some depressions may have developed or be maintained by a subsurface hardpan. Hydrological conditions vary, with most Depression Marshes drying in most years. Hydroperiods range widely from as few as 50 days or less to more than 200 days per year.

Fire is important to maintaining this community type by restricting invasion of shrubs and trees and the formation of peat. Fire frequency is often greatest around the periphery of the marsh and least toward the center. A severe peat fire can lower the ground surface and create a pond at the center of the marsh.

Depression Marshes are often associated with and grade into Wet Prairie, Seepage Slope, Wet Flatwoods, Mesic Flatwoods, Dome Swamp, or Bog. They also may occur in association with various types of lakes, such as Sandhill Lake or Flatwoods Lake.

Depression Marshes are threatened by drainage, agriculture, pollution, fire suppression, and invasion of exotic species. Depression Marshes may be filled and converted to other uses. A regional lowering of the water table because of overuse may eliminate many Depression Marshes. Depression Marshes on some public lands have been deepened by explosives to allow for stocking with game fish. By preying upon the eggs and larvae of frogs and salamanders, these fish may eliminate the amphibians that depend on such seasonal wetlands for successful reproduction. Likewise, many species of invertebrates not adapted to predation by fishes may be eliminated.

Wet Prairie - Wet prairie is an herbaceous community found on continuously wet, but not inundated, soils on somewhat flat or gentle slopes between lower lying depression

marshes, shrub bogs, or dome swamps and slightly higher wet or mesic flatwoods, or dry prairie. It is typically dominated by dense wiregrass (*Aristida stricta var. beyrichiana*) in the drier portions, along with foxtail club-moss (*Lycopodiella alopecuroides*), cutover muhly (*Muhlenbergia expansa*), yellow butterwort (*Pinguicula lutea*), and savannah meadowbeauty (*Rhexia alifanus*). In the wetter portions, wiregrass may occur with, or be replaced by, species in the sedge family, such as plumed beaksedge (*Rhynchospora plumosa*), featherbristle beaksedge (*R. oligantha*), Baldwin's nutrush (*Scleria baldwinii*), or slenderfruit nutrush (*S. georgiana*), plus longleaved threeawn (*Aristida palustris*). Also common in wetter areas are carnivorous species, such as pitcher plants (Sarracenia spp.), sundews (*Drosera spp*.), butterworts (*Pinguicula spp*.), and bladderworts (Utricularia spp.). Other characteristic species in this community include toothache grass (*Ctenium aromaticum*), pineland rayless goldenrod (*Bigelowia nudata*), flattened pipewort (*Eriocaulon compressum*), water cowbane (*Oxypolis filifolia*), and coastal plain yellow-eyed grass (*Xyris ambigua*).

Wet prairies in northern Florida and the calcareous variant in south-central Florida are some of the most diverse communities in the United States, with an average of over 20 species per square meter in some places and over 100 total species in any given stand. Factors contributing to this diversity include subtle spatial differences in moisture conditions across the wet prairie and temporal differences in fire and flooding regime from year to year, which favor different species and prevent any one species from excluding the others.

Wet prairie is noted for its many showy flowering herbs including false foxgloves (*Agalinis spp*.), grass pinks (*Calopogon spp*.), pipeworts (*Eriocaulon spp*.),rein orchids (*Platanthera spp*.), milkworts (*Polygala spp*.), meadowbeauties (*Rhexia spp*.), rosegentians (*Sabatia spp*.), yellow-eyed-grasses (*Xyris spp*.), white-top sedge (*Rhynchospora latifolia*), and composites in the genera Balduina, Carphephorus, Coreopsis, Eupatorium, Eurybia, Helenium, Helianthus, Rudbeckia, Solidago, and Symphyotrichum. Re-sprouting short shrubs that grow intermixed with the grasses, include two species of St. John's wort (*Hypericum brachyphyllum, H. myrtifolium*), evergreen bayberry (*Myrica caroliniensis*) and, in Panhandle Florida, bog tupelo (*Nyssa ursina*). A few stunted trees of slash pine (*Pinus elliottii*), pond cypress (*Taxodium ascendens*), or swamp tupelo (*Nyssa sylvatica var. biflora*) may be present. In northern Florida clumps of wetland shrubs such as titi (*Cyrilla racemiflora*), coastal sweet pepperbush (*Clethra alnifolia*), myrtle-leaved holly (*Ilex cassine var. myrtifolia*), and large gallberry (*Ilex coriacea*) are also seen.

Wet prairie usually occurs on acidic, nutrient-deficient, saturated soils. Soil series associated with wet prairies in the Panhandle include Plummer fine sands, Rutledge sandy loams, and Bladen sandy loams with clay subsoils. In the Florida peninsula, wet prairies, including those dominated by cutthroat grass, are often found on poorly drained Basinger

fine sands. Calcareous wet prairies are found in Central and south-central Florida on circum-neutral Felda or Wabasso fine sands with sandy loam subsoils.

A map illustrating the SFWMD FLUCCS/Natural Communities of the Subject Property is included in **Appendix G**.

5.4 Flora and Fauna Identified on the Subject Property

Non-listed Species Identified on the Subject Property

Fauna identified at the Subject Property by NorthStar personnel from direct visual evidence (including the animal itself, burrows, nests, tracks, scat, rutted areas, etc.) during the December 2023 baseline inventory assessments included the following: wild hogs *(Sus scrofa)*, cattle (*Bos taurus*), toad (*Anaxyrus terrestris*), black racer (*Coluber constrictor*), gray squirrel (*Sciurus carolinensis*), white-tailed deer (*Odocoieus virginianus*), racoon (*Procyon lotor),* red-shouldered hawk *(Buteo lineatus)*, black vulture *(Coragyps atratus)*, fish crow (*Corvus ossifragus),* cattle egret *(Bubulcus ibis*), quail (*Colinus virginianus*), great egret (*Ardea alba*), white ibis (*Eudocimus albus*), American crow (*Corvus brachyrhynchos*), American robin (*Turdus migratorius*), common grackle (*Quiscalus quiscula*), common ground dove (*Columbina passerine*), Gray catbird (*Dumetella carolinensis*), great blue heron (*Ardea Herodias*), great egret (*Ardea alba*), mourning dove (*Zenaida macroura*), northern mockingbird (*Mimus polyglottos*), osprey (*Pandion haliaetus*), coyote (*Canis latrans*), and American alligator (*Alligator mississippiensis*).

Flora identified at the Subject Property by NorthStar Personnel during the December 2023 baseline survey included Spanish moss *(Tillandsia usneoides),* airplants *(Tillandsia sp.),* water lily *(Nymphaeaceae sp.),* sundew (*Drosera capillaris*), dogfennel *(Eupatorium capillifolium),* wild iris *(Iris spuria),* bulrush *(Scirpoides holoschoenus),* palmetto *(Serenoa sp.),* cabbage palm *(Sabal palmetto),* slash pine (*Pinus elliotti*), longleaf pine *(Pinus palustris),* live oak *(Quercus virginiana),* oaks *(Quercus sp.),* cypress *(Cupressus sp.),* swamp bay (*Persea palustris*), willow *(Salix sp.),* wax myrtle (*Morella cerifera*), blackberry *(Rubus sp.),* smilax *(Smilax aspera sp.),* mushrooms *(Agaricomycetes sp.),* wild grape *(Vitis sp.),* bahiagrass (*Paspalum notatum*), various grasses (*Gramineae sp*.), saw grass (*Cladium sp*.), sedge *(Cyperus sp.),* citrus (*Citrus sp.),* fireflag (*Thalia geniculata*), and rushes *(Juncus sp.).* It should be noted that this is not intended to be a complete list of flora present on the Subject Property.

Listed Species Identified on the Subject Property

NorthStar personnel conducted the baseline inventory assessment on the Subject Property in December 2023. Special attention was given to the observation of wildlife utilization, particularly by listed species. Where possible, photographic documentation and GPS coordinates were recorded for selected areas where listed species were

identified. Listed species were identified by NorthStar personnel at the time of this baseline inventory assessment included Gopher Tortoise (*Gopherus Polyphemus*), Wood Stork (*Mycteria americana*), and Sandhill Crane (*Grus canadensis pratensis*). It should be noted that the property owner has also observed Florida Burrowing Owl (*Athene cunicularia floridana*), Crested Caracara (*Caracara plancus*), Eastern Indigo Snake (*Drymarchon couperie*), Florida Panther (*Puma concolor coryi*), and Big Cypress Fox Squirrel (*Sciurus niger avicennia*) within the Subject Property. Descriptions of the listed species observed by NorthStar are provided below.

GOPHER TORTOISE
Gopherus polyphemus
Order: Testudines
Family: Testudinidae
FNAI Ranks: G3/S3
U.S. Status: None in Florida; Threatened in Louisiana, Mississippi, and western Alabama
FL Status: Threatened
Photo Source: NorthStar archive



Description: A medium-sized turtle (to 10 in. = 254 mm) fully adapted for life on land. Upper shell brown and relatively flat above; lower shell yellowish, without hinge, and projecting forward, especially in male; skin brown to dark gray. Forelimbs greatly expanded for digging; hind limbs reduced, stumpy, and lacking any form of webbing between toes. Lower shell of male is somewhat concave. Young: scales of carapace often with yellow centers, skin yellowish to tan; approximately 2 in. (51 mm) shell length at hatching.

Similar Species: The only other native land turtle in Florida, the box turtle (*Terrapene carolina*), is distinguished by its smaller size (to 8 in. = 203 mm), less stout feet, moveable hinge on lower shell, and often but not always by black and yellow upper shell. Tortoise burrows, which are useful in determining species' presence, typically have lower, flatter profile than more rounded burrows of armadillos; this reflects differences in cross-sectional shapes of the two animals.

Habitat: Typically found in dry upland habitats, including sandhills, scrub, xeric oak hammock, and dry pine flatwoods; they also commonly use disturbed habitats such as pastures, old fields, and road shoulders. Tortoises excavate deep burrows for refuge from predators, weather, and fire; more than 300 other species of animals have been recorded sharing these burrows.

Seasonal Occurrence: Above-ground activity is greatly reduced during cold weather, with tortoises in northern Florida remaining below ground for months. Nonetheless, burrows are relatively conspicuous year-round.

Florida Distribution: State-wide except absent from the Everglades and Keys.

Range-wide Distribution: Lower Southeastern Coastal Plain, extending from southern South Carolina southward through lower Georgia and Florida and westward through southern Alabama, Mississippi, and extreme southeastern Louisiana.

Conservation Status: Despite its widespread occurrence throughout Florida, there is considerable concern about the declining abundance of this species. Much of its native habitat has been lost to agriculture, citriculture, forestry, mining, and urban and residential development. Although protected populations occur on many state, federal, and private conservation lands, recent development of a severe respiratory disease threatens even those.

Protection and Management: Manage large, undivided tracts of upland habitat to maintain native vegetative conditions; this generally requires periodic prescribed fire beneath trees to reduce brush and favor growth of grasses and forbs. Avoid building roads and houses in xeric uplands. Because of risk of introducing tortoises infected with respiratory disease to uncontaminated populations, tortoises should not be relocated except under strictly controlled programs.

FLORIDA SANDHILL CRANE
Grus canadensis pratensis



Order: Gruiformes
Family: Gruidae
FNAI Ranks: G5T2/S2
U.S. Status: Endangered (non-migratory Subspecies in Cuba and Mississippi only)
FL Status: Threatened.
U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit taking of birds, nests, or eggs.
Photo Source: NorthStar photo archive.

Description: A tall, long-necked, long-legged bird with a clump of feathers that droops over the rump. Adult is gray overall, with a whitish chin, cheek, and upper throat, and dull red skin on the crown and lores (lacking in immatures); feathers may have brownish red

staining resulting from preening with muddy bill. Immature has pale to tawny feathers on head and neck and a gray body with brownish red mottling. Flies with neck extended. Their distinctive rolling call can be heard from far away.

Similar Species: Indistinguishable from greater sandhill crane (*Grus canadensis tabida*), which winters in Florida. Greater sandhill crane generally arrives in Florida in October and leave in March, so the date observed or definite evidence of reproduction may be used to differentiate the two. Great blue heron (*Ardea herodias*) is sometimes mistakenly identified as a crane. This heron lacks the bald, red crown of the sandhill and flies with its neck tucked in, typical of herons and egrets. Whooping crane (*G. americana*) is white.

Habitat: Prairies, freshwater marshes, and pasture lands. Avoids forests and deep marshes but uses transition zones and edges between these and prairies or pasture lands. Will frequent agricultural areas like feed lots and crop fields, and golf courses and other open lawns, especially in winter and early spring. Nest is a mound of herbaceous plant material in shallow water or on the ground in marshy areas. Favors wetlands dominated by pickerelweed and maidencane.

Seasonal Occurrence: Non-migratory. Very sedentary, although may forage widely. Large influx of northern migratory subspecies in winter (October - March).

Florida Distribution: Most of peninsular Florida is within appropriate habitat, though not as common south of Lake Okeechobee. Rarely reported west of Taylor County.

Range-wide Distribution: Florida range plus extreme southeastern Georgia (Okefenokee Swamp).

Conservation Status: Population estimate in 1975 of approximately 4,000 birds (25 percent are non-breeding sub-adults) is still considered accurate. Habitat availability will become increasingly of concern as Florida continues to lose open rangeland and native prairie to development and more intensive agricultural uses (e.g., citrus, row crops). Nesting success in human-altered areas is well below that of native areas. Shallow wetlands used by cranes are easily affected by drainage of adjacent uplands even if they are not directly disturbed. Florida sandhill cranes are found on federal and state lands and on local government lands (e.g., wellfields).

Protection and Management: Because of large home-range requirements, public lands do not protect large populations of cranes. Acquire land, through fee-simple acquisition and conservation easements on suitable ranchlands, in areas that bolster existing protected populations. Periodic fire is important to retard invasion of woody vegetation

in crane habitat. Filling drainage ditches to restore natural hydrological conditions is important in some areas.

WOOD STORK
Mycteria americana
Order: Ciconiiformes
Family: Ciconiidae
FNAI Ranks: G4/S2
U.S. Status: Endangered, U.S. Migratory Bird Treaty Act and state Wildlife Code prohibit taking of birds, nests, or eggs.
FL Status: Endangered
Photo Source: NorthStar photo archive



Description: Very large, white wader with black in wings and a short black tail. Soars with neck and legs extended, displaying its long, broad wings, black flight feathers contrast with white along length of wings. Legs are dark and feet are beige. Adults have bare, scaly, dark-gray heads and necks and long, heavy, decurved bills. Head and neck of immature storks have grayish brown feathering, and their bills are yellowish.

Similar Species: American white pelicans (*Pelecanus erythrorynchos*) have a similar wing pattern and also soar but have short legs, white tail, and do not fly with necks extended. White ibis (*Eudocimus albus*) is much smaller and only has black on wing tips. Great egret (*Ardea alba*) lacks black on wings.

Habitat: Nests colonially in a variety of inundated forested wetlands, including cypress strands and domes, mixed hardwood swamps, sloughs, and mangroves. Increasingly found nesting in artificial habitats (e.g., impoundments and dredged areas with native or exotic vegetation) in north and central Florida. Forages mainly in shallow water in freshwater marshes, swamps, lagoons, ponds, tidal creeks, flooded pastures and ditches, where they are attracted to falling water levels that concentrate food sources (mainly fish).

Seasonal Occurrence: Post-breeding dispersal carries large numbers from more southern locales to more northern parts of range; in winter, northern birds move south. Annual and long-term use of nesting sites is very dependent on feeding conditions, which may be affected dramatically by altered hydrologic patterns. Colonies may form late November - early March in south Florida and February - March in central and northern Florida.

Florida Distribution: Locally rare to abundant in the peninsula and Big Bend, but generally rare or lacking in panhandle and the Florida Keys. Uncommon to rare in winter months in the north.

Range-wide Distribution: In U.S., breeds locally in South Carolina, Georgia, and Florida (formerly west to Texas). South, locally in lowlands from Mexico and northern Central America to South America (to western Ecuador, eastern Peru, Bolivia, northern Argentina), and rarely in Cuba and the Dominican Republic. Winters throughout breeding range except in South Carolina and Georgia.

Conservation Status: Many known breeding sites occur within public and private conservation lands. Dramatic decline in the large colonies (>500 individuals) formerly found in south Florida, and trend toward fewer birds distributed among smaller, more numerous colonies in central and northern Florida. Wood storks are very sensitive to manipulation of water regimes and loss of wetland habitat, which affect both nesting sites and feeding areas.

Protection and Management: Survey colony sites and important feeding areas regularly. Essential to protect wetland areas, closely monitor water quality, and manage hydrologic patterns that consider the needs of the wood stork.

NorthStar utilized a combination of the Florida's Endangered and Threatened Species list published by FFWCC (updated December 2022), FNAI's Standard Report, and Subject Property's landowner input to create a detailed table showing the listed species and the probability of occurrence for listed species on or near the Subject Property in Hendry County, Florida. The FFWCC maintains the state list of animals designated as endangered, threatened, and species of special concern, as well as those species under consideration for listing in accordance with Rules 68A-27, Florida Administrative Code. The probability of occurrence for listed species table is included in this report as **Table 1**.

5.5 Non-Native, Invasive Flora Identified at the Subject Property

NorthStar utilized the *Identification & Biology of Non-Native Plants in Florida's Natural Areas,* the Florida Invasive Species Council's list of invasive exotic species, and the land manager's knowledge of the property during the site investigation to help identify non-native invasive plant species that may be located on the Subject Property. Non-native invasive species present on the Subject Property include Brazilian peppertree, Caesar's weed, Japanese Climbing Fern, Floating Primrose-willow, Smutgrass, and Tropical Soda Apple. A brief description of the invasive species is provided below. A map showing the location of the invasive species occurrences is included in **Appendix H**.

Brazilian peppertree – *Schinus terebinthifolia*



Brazilian peppertree was introduced in Florida in the 1840's as an ornamental tree. They are related to poison ivy, poison oak, and poison sumac and may cause dermatitis. They are an evergreen shrub that may grow up to 30 feet and have clusters of white flowers and glossy, bright red fruit. The leaves are 1 to 2 inches long, elliptic, and finely toothed. The leaves are often reddish and have a reddish mid-rib. The trees thrive in both wetland and upland habitats. They are considered a category 1 invasive because they form dense canopies that shade out native plants and provide poor habitat for native animal species. Brazilian peppertrees were noted on the Subject Property (Photo Nos. 42 and 57).

Caesar's Weed – *Urena lobata*



Caesar weed is an erect flowering shrub that grows up to 10 feet in height. The plant has a single stalk with radiating branches that give it a bushy appearance. The leaves are oval, goose-feet and have three distinct glands on the veins. The flowers are small, pink or purple, and look very similar to hibiscus. This invasive weed's seeds have hooked bristles and will cling to clothing and fur, thus easily spreading the plant. Caesar weed invades disturbed areas and was present in many lowland areas within the Subject Property (Photo No. 15).

Japanese Climbing Fern – *Lygodium japonicum*



Japanese climbing fern is a vine-like plant with long, twining fronds up to 90 feet in length. Leafy branches off the main stem are 2- to 5-inches long with leaflet pairs. Leafy branches off the main stem are 4- to 8-inches long and a similar length. Leaflets are lobed and stalked with and may have dissected terminal lobes and irregularly shaped basal lobes. Fertile leaflets have two rows of sporangia along the leaf margin, which is slightly rolled to cover them. This fern is found in damp, disturbed areas such as yards and roadsides, but may also be found in swamps, marshes, other wetlands and upland woods. Spores are wind-dispersed and may be carried in dust on vehicles. The fern was introduced as an ornamental plant in 1932 and it is native to eastern Asia. It now

occurs as a naturalized invasive in the southeastern US, forming tangled walls of vegetation that smothers all surrounding vegetation and trees. Japanese climbing fern were observed on the Subject Property (Photo No. 78).

Peruvian Primrose-willow – (*Ludwigia peruviana*)



This invasive is a flower plant that grows up to 12 feet tall. It is a member of the evening primrose family originating from South America. The leaves are alternate, ovate and pointed, and 2 to 6 inches long. The flowers are bright yellow with four wide, oval petals and up to ½ inch wide. The fruit is small and reddish brown. It prefers wetlands and is a rapid colonizer that quickly crowds out native plants, reduces navigability, and reduces water flow. Peruvian primrose-willow was identified on the Subject Property (Photo No. 76).

Smutgrass –



Sporobolus indicus
Smutgrass is a coarse tussocky grass that grows to a height of between 70 centimeters and 2 meters. The seed head is up to 40 centimeters long and resembles a rat's tail. The branches at the bottom of the seed head often droop away from the central stem. The seeds, which are about the size of sugar grains, form at the ends of each floret. They are initially white and turn yellow-brow at maturity. Smutgrass flowers and seeds in the frost-free period of the year, with the main seeding in late summer/autumn. It hays off in the autumn leaving a distinctive straw of seedless heads. A native grass of South Africa, smutgrass has been widely introduced to natural communities in the Western Hemisphere where it is considered a noxious weed. Smutgrass was noted in some pasture areas (Photo No. 42 and 50).

Tropical Soda Apple – *Solanum viarum*



Tropical soda apple is an herbaceous, bushy perennial with stems covered in broad-based, straight or downward-pointing prickles and clothed in simple hairs. The leaves are alternate, with oval-triangular *blades* which are nearly as broad as long, covered in hairs and prickles. The flowers are white, in small terminal clusters, and the fruit is a globose berry 2-3 cm wide and resembles a tiny watermelon,

turning a dull yellow when ripe. Tropical soda apple is a recent accidental introduction, and the exact means of introduction remain unknown. First collected in Florida in 1988, it is rapidly crowding or shading out native plants in pastures, fields, groves, and other open disturbed areas throughout the central and northern parts of the state (Langeland & Burks, 1998). Tropical soda apple was noted scattered throughout the improved pastures on the central and southern portions of the Subject Property (Photo No. 46).

5.6 Ecological Data Report Review

Florida Natural Areas Inventory

The FNAI provided NorthStar with an ecological data report for the Subject Property on November 30, 2023. The FNAI data report is separated into three sections (Resource Priorities, Element Occurrences, and Biodiversity Matrix). The data report was created utilizing the database maintained by the FNAI, which is the single most comprehensive source of information available on the locations of rare species and other significant ecological resources. A copy of the FNAI's ecological data report, including site maps and summary tables, is included as **Appendix I**.

The Resource Priority data maps indicate all portions of the Subject Property are Priority 1 for landscape resources and surface water resources (FNAI, 2023). The biodiversity resource category for the Subject Property is a mix of high to lower priorities (FNAI, 2023).

The review of the Element Occurrences data includes occurrences of rare species and/or natural habitats. The Element Occurrences data indicate Crested Caracara, Florida Panther, and Bald Eagles are among the documented occurrences of endangered, threatened, and protected animals identified near the Subject Property (FNAI, 2023).

The Biodiversity Matrix Report data indicates areas, which based on landcover type, offer suitable habitat for one or more rare species known to occur in the vicinity of the Subject Property. The review of the Biodiversity Matrix Report data indicated the likelihood of various species occurrences on and around the Subject Property. These species are summarized in **Table 1**.

Florida Fish and Wildlife Conservation Commission (FFWCC)

NorthStar reviewed the Historical Waterbird Colony Locator database and the Bald Eagle Nest Locator database maintained by the FFWCC.

The FFWCC conducted statewide aerial surveys from the 1970's through the 1990's to locate waterbird (herons, egrets, ibises, spoonbills, storks, anhingas, cormorants, and pelicans) breeding colonies and estimate colony size and species composition. Fixed-wing aircraft were used to fly statewide East-West survey transects at 5-km intervals. The Historical Waterbird Locator database did not indicate any former waterbird breeding

colonies located on or near the Subject Property. According to the owner, no breeding colonies are present on the Subject Property.

Florida supports the largest number of breeding bald eagles (*Haliaeetus leucocephalus*) of any southeastern state. Approximately 70% of the occupied nesting territories in the southeast are in Florida. Known bald eagle nesting territories within the state were surveyed by the FFWCC during the 2003 nesting season with fixed-wing or rotary-wing aircraft beginning in late November 2002 and extending through mid-April 2003. This survey is updated on a rotating basis and last updated during the 2016-2017 nesting season. The Bald Eagle Nest Locater database indicated three Bald Eagle nest locations north of the Subject Property. These nests were active between 1998 and 2007. No Bald Eagles nests were observed on the Subject Property during the site reconnaissance. The owner indicated there may be two eagle nesting areas within the Subject Property.

The Breeding Bird Atlas attempted to record the breeding distributions of all bird species in the state during 1986 through 1991. The Breeding Bird Atlas project was a collaborative effort of the Audubon of Florida, the Florida Ornithological Society, and the FFWCC. The Breeding Bird Atlas database indicated was reviewed for the threatened and/or endangered bird species listed in **Table 1.** The Atlas identified the following listed bird species has confirmed breeding locations in Hendry County that may be near or on the Subject Property: Florida Burrowing Owl, Crested Caracara, and Sandhill Crane.

5.7 Archaeological Sites

According to the Florida Master Site File, there is one historical/cultural site in the Subject Property vicinity. This linear resource is designated as the Goodno Drainage Canal. A copy of the Florida Master Site File resource roster and a map showing the linear resource are included in **Appendix J**.

5.8 Subject Property Conservation Easement Summary

Based on the CE, the Grantor (property owner) will have the certain other rights under the terms of the conservation easement, which are briefly summarized below.

A. The right to observe, maintain, photograph, introduce and stock native fish or wildlife, hunt and fish, and conduct hiking, camping, and horseback riding. The Grantor may lease and sell these privileges/rights provided such activities do not violate the prohibitions listed below.
B. The right to conduct controlled or prescribed burning with authorization from local and state regulatory agencies.
C. The right to mortgage the property.
D. The right to contest tax appraisals or other charges related to the Subject Property.

E. The right to use, maintain, repair, and reconstruct but not relocate existing improvements, which are depicted in this document. Replacement structures may be increased in size no more than 125%. Existing access roads may be improved to shell or another pervious functional equivalent consistent with agricultural best management practices.
F. The right to the exclusive use of those improvements.
G. The right to continue existing agricultural practices in all areas depicted in this document (Agricultural areas map, **Appendix G**). BMP promulgated by the Florida Department of Agriculture and Consumer Services (FDACS) for fertilizers, pesticide, and herbicide application should be adopted.
H. The right to host relocated endangered or threatened species and species of special concern native to Florida.
I. The right to maintain and restore the existing natural upland and wetland communities, including removal of non-native, invasive species, and the reintroduction of native species.
J. The right to maintain the existing cattle operation following FDACS BMP for cow/calf operations.
K. The right to construct additional agricultural structures within agriculture or silviculture areas shown on the agricultural areas map, **Appendix G.** New structure must not exceed a cumulative square footage of 10,000 feet.
L. The right to utilize brush management practices to maintain or enhance natural areas provided the brush management is not intended to convert habitat to more intensive agricultural uses.
M. The right to maintain and construct perimeter fencing. Additionally, the right to maintain and construct cross fencing and animal pens within the agricultural areas depicted in the agricultural areas map, **Appendix G.**
N. The right to participate in programs/projects that benefit from, enhance and/or manage the environmental attributes or permissible agricultural uses of the Subject Property.
O. The right to maintain existing food plots for game and wildlife. New food plots may only be constructed with the approval of the Office of Environmental Services of the Division of State Lands.
P. The right to engage in silviculture in those areas identified as agricultural (Appendix G). Silvicultural activities should be conducted in conformance the FDACS BMP.
Q. The right to cultivate and harvest hay from existing pasture in compliance with FDACS BMP.
R. The right to construct one new residential structure with driveway and outbuildings. Residence is restricted to 5,000-square foot and outbuildings are limited to two 2,000 square foot structures. All will be located at least 150 feet from any wetland area and will be contained within 2.5 contiguous acres.

S. The right to divide the Property into two parcels, none smaller than 400-acres and both will remain under this CE.

The Conservation Easement also lists prohibited uses, which are summarized below:

A. No soil, trash, liquid, solid or hazardous waste, hazardous materials wastes or substances, toxic wastes or substances, pollutants or contaminants, or unsightly, offensive materials shall be dumped or placed on the Subject Property. This does not include reasonable amounts of waste generated by allowed activities.
B. No exploration or extraction of oil, gas, minerals, dolostone, peat, muck, marl, limestone/limerock, kaolin, fuller's earth, phosphate, clay, gravel, shell, sand, or other similar substances except as necessary to combat erosion or flooding. Further, the Grantor expressly agrees that notwithstanding any obligations upon it under an Oil, Gas and Mineral Special Warranty Deed (October 2, 2014), no mining, extraction, or exploration activities will impact or disturb the Subject Property.
C. No activities conducted that are detrimental to drainage, flood control, water conservation, erosion control, soil conservation, or habitat preservation. This includes a prohibition on dredging, dikes, altering water courses, and disruption or pollution of natural lakes, ponds, marshes, creeks, and other water bodies, unless approved by FDEP or the WMD. The Grantor may continue to operate, maintain, or replace existing water wells, as well as install up to two new wells for agricultural purposes.
D. No acts or uses detrimental to the preservation of the structural integrity or physical appearance of the Subject Property having archaeological significance. BPM promulgated by the Florida Division of Historical Resources will be followed.
E. No removal, destruction, cutting, trimming, mowing, alteration or spraying with biocides of trees, shrubs, or other natural vegetation, except as provided in the CE. No planting of nuisance exotic or non-native plants, as listed by the Florida Invasive Species Council. The Grantor shall, to the extent practical, control and prevent the spread of nuisance exotic or non-native plants within the Subject Property.
F. No commercial or industrial activity, or ingress, egress, or passage in conjunction with any commercial or industrial activity.
G. No new construction, temporary buildings, or mobile homes except as may be necessary for normal maintenance and operations or during emergency situations.
H. No construction or creation of new public roads or jeep trails except in areas reserved for agricultural use as depicted in this document and for access to the four residences that may be constructed.

I. No operation of motorized vehicles except on established trails and roads, unless necessary to protect or enhance the conservation purposes or for emergency purposes, cattle ranching, and to retrieve legally harvested game.
J. Areas currently improved for agriculture activities may continue to be used for agricultural purposes but may not be expanded into natural areas identified in this document (**Appendix G**).
K. Fertilizer use for agriculture activities shall be conducted in compliance with FDACS BMP. No agricultural activities shall occur within a 100-foot buffer around sinkholes or karst features.
L. No actions or activities that would adversely affect threatened or endangered species present within the Subject Property.
M. No subdivision of the Subject Property, except as provided in the easement.
N. No signs, billboards, or outdoor advertising. Allowed signage is limited to signs designating the Subject Property as protected land.
O. No commercial water wells.
P. No mitigation banks.

Based on the copy of the Deed of Conservation Easement for the Subject Property, the Grantee (FDEP DSL) will receive certain rights, which are briefly summarized below:

A. Enforcement: The right to enforce protection of the Subject Property's conservation values.
B. Development rights: All future development rights are terminated except as reserved in the CE.
C. Right of Entry: The right to enter the Subject Property, at reasonable times with reasonable notice, to monitor compliance with the Conservation Easement.
D. The right to prevent any activity or use of the Subject Property that is inconsistent with the CE and to require the restoration of any areas or features that may be damaged by inconsistent activities or uses.
E. The right of ingress and egress to the Subject Property.
F. The right to have taxes, assessments, and other charges paid by the Grantor.
G. Notice of Intent to sell: If the Grantor intends to sell the Subject Property, the Grantee will be given the option to acquire the Subject Property (first right of refusal).
H. Indemnification of liability for claims of loss, damage, expense, judgement, or claim resulting from the Grantor's use or ownership of the Subject Property
I. Indemnification of liability due to injury or property damage.
J. The right to have the Subject Property maintained as reflected within this document.
K. The right to remove damaged timber.

A draft copy of the Deed of Conservation Easement for the Subject Property provided by FDEP is included in **Appendix K**. Copies of potentially applicable and useful BMPs are provided in **Appendix L**.

5.9 Adjoining Land Activities

Land use in the immediate area is mostly agricultural uses, such as cattle ranching and citrus groves. State Road 80 is present to the north. Agricultural lands are present to the east, south, and west. Conservation lands in the vicinity include additionally sections of the Caloosahatchee Ecoscape Project, the Caloosahatchee River West Basin Storage Reservoir, the Fisheating Creek Ecosystem Project, Wetland Reserve Program Easement #223, and Ortona Indian Mounds Park. The nearest towns to the Subject Property are LaBelle, to the west, and Moore Haven, to the east, both of which are around 10 miles away.

Information regarding the current and historical land use of the adjoining properties was primarily gathered through a site inspection, the review of historical aerial photographs, water management district records, review of publicly available photographs, interviews with the Subject Property owner/land manager, and information in Google Earth's online program.

SECTION 6.0 REFERENCES

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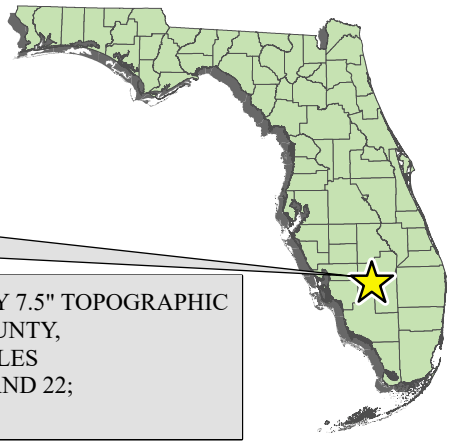
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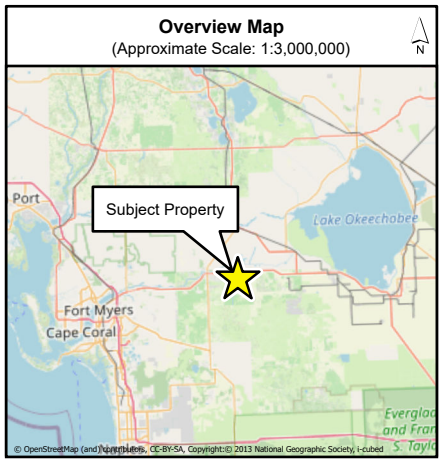
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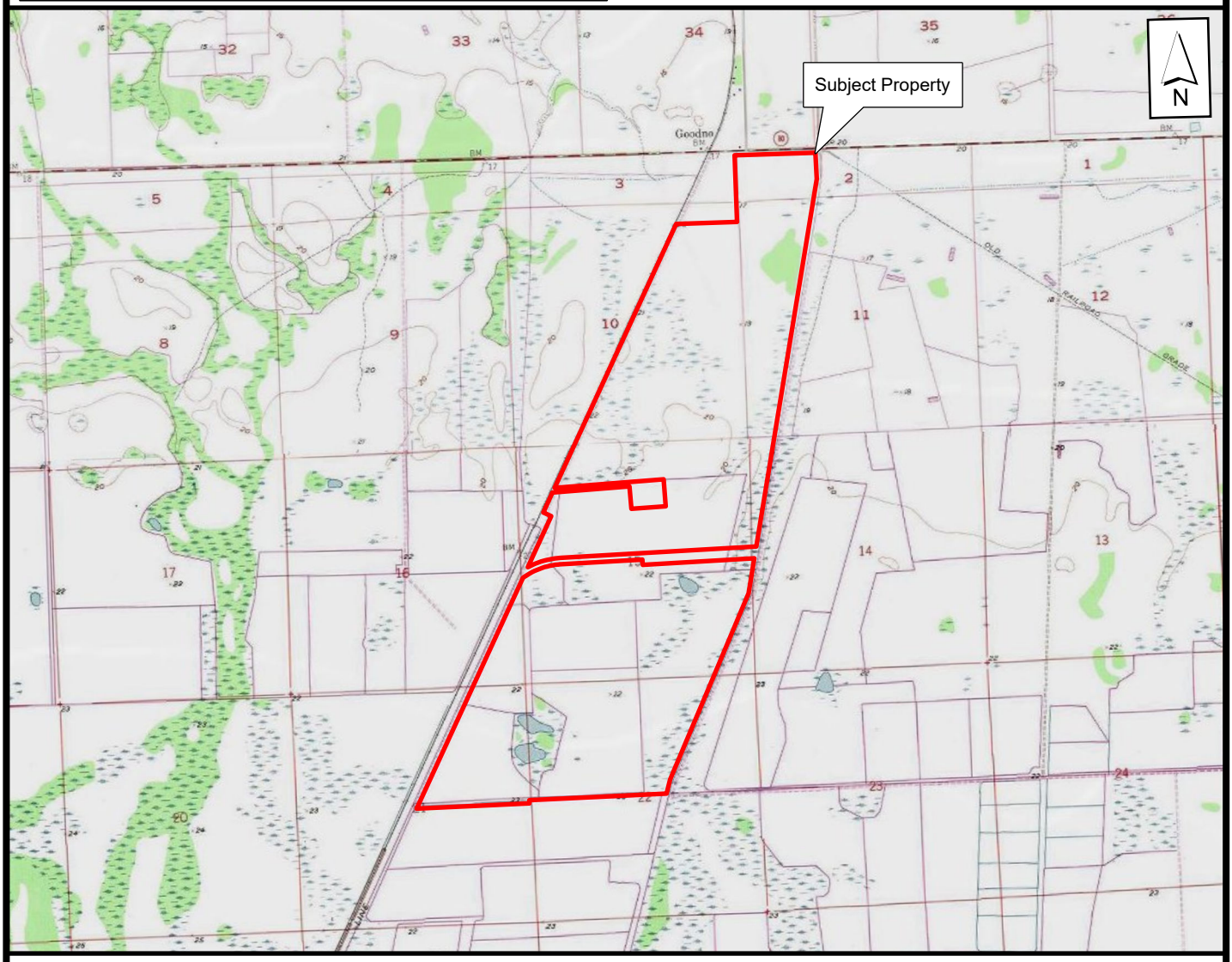
FIGURE



Site Location:
Ferguson-House Farms,
Hendry County, FL

UNITED STATES GEOLOGICAL SURVEY 7.5" TOPOGRAPHIC QUADRANGLE MAP FOR HENDRY COUNTY, GOODNO AND FELDA NE QUADRANGLES
SECTIONS: 02, 03, 10, 11, 14, 15, 16, 21, AND 22;
TOWNSHIP: 43S, RANGE: 30E





0 1 2 4 Miles

PROJECT NO.: 40-23-510		GIS ID: 4023510_SVM_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: FINAL	DATE: 12/11/2023	DRN BY: TW	CHK BY: PJ	STATUS: FINAL

NorthStar
Contracting Group, Inc.
325 JOHN KNOX RD, C100, TALLAHASSEE, FLORIDA 32303 PH:(850) 531-9860

FIGURE 1
SITE VICINITY MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

TABLES

Table 1: Probability of Occurrence of Federal or State Listed Flora and Fauna Species

	Scientific Name	Common Name	Federal Status (USFWS)	State Status (FFWCC)	Observed on Subject Property	Documented on Subject Property[1]	Likely on Subject Property[2]	Possibly on Subject Property[3]
Birds	*Antigone canadensis pratensis*	Florida Sandhill Crane	Not Listed	Threatened			X	
	Athene cunicularia floridana	Florida Burrowing Owl	Not Listed	Threatened				X
	Caracara cheriway	Crested Caracara	Threatened	Threatened			X	
	Mycteria americana	Wood Stork	Endangered	Endangered				
	Picoides borealis	Red-cockaded Woodpecker	Endangered	Endangered				X
Reptiles/Amphibians	Drymarchon couperi	Eastern indigo snake	Threatened	Threatened			X	
	Gopherus polyphemus	Gopher Tortoise	Not listed	Threatened				X
	Lithobates capito	Gopher frog	Under Review	Non listed				X
Mammals	*Eumops floridanus*	Florida bonneted bat	Endangered	Endangered				X
	Puma concolor coryi	Florida Panther	Endangered	Endangered			X	
	Sciurus niger avicennia	Big Cypress Fox Squirrel	Not Listed	Threatened			X	
Plants	*Calopogon multiflorus*	Many-flowered Grass-pink	Not Listed	Threatened				X
	Centrosema arenicola	Sand Butterfly Pea	Not Listed	Endangered				X
	Coleataenia abscissa	Cutthroatgrass	Not Listed	Threatened				X

See notes at end of table.

Table 1: Probability of Occurrence of Federal or State Listed Flora and Fauna Species

	Scientific Name	Common Name	Federal Status (USFWS)	State Status (FFWCC)	Observed on Subject Property	Documented on Subject Property[1]	Likely on Subject Property[2]	Possibly on Subject Property[3]
Plants	*Lechea cernua*	Nodding Pinweed	Not Listed	Threatened				X
	Linum carteri var. smallii	Small's flax	Not Listed	Endangered				X
	Matelea floridana	Florida Spiny-pod	Not Listed	Endangered				X
	Nemastylis floridana	Celestial Lily	Not Listed	Endangered				X
	Nolina atopocarpa	Florida Beargrass	Not Listed	Threatened				X
	Plantanthera integra	Yellow fringless orchid	Not Listed	Endangered				X
	Salix floridana	Florida willow	Under Review	Endangered				X

Notes:

Observed by NorthStar personnel on the Subject Property

Observed by Owner/Interviewees on the Subject Property

[1]Documented indicates the species was documented on the Subject Property.

[2]Likely present indicates the species is documented within the Subject Property vincinity.

[3]Possibly present indicates the species ranges falls within the Subject Property and its vicinity.

X = occurance based on FNAI element occurance report.

USFWS = United States Fish and Wildlife

FFWCC = Florida Fish and Wildlife Conservation Commission

Source: Florida Natural Areas Inventory Searchable Tracking List and Florida's Endangered and Threatened Species List (FFWCC 2022).

http://www.fnai.org/bioticssearch.cfm

https://myfwc.com/media/1945/threatend-endangered-species.pdf

Appendix A.
Legal Description

EXHIBIT "A"

A parcel of land lying within Sections 2, 3, 10, 11, 14, 15 and 16, Township 43 South, Range 30 East, Hendry County, Florida, more particularly described as follows:
From the northeast corner of said Section 10, run North 89° 29' 29" West, along the north line of said Section 10, a distance of 989.69 feet to the Point of Beginning; thence North 26° 40' 59" East, 1108.23 feet; thence South 89° 49' 54" East, 216.20 feet; thence North 00° 12' 06" East, 10.00 feet; thence South 89° 47' 54" East, 2246.90 feet; thence South 00° 55' 48" East, 599.12 feet; thence South 11° 17' 55" West, 8617.61 feet; thence South 88° 37' 59" West, 2571.59 feet; thence South 01° 22' 01" East, 120.00 feet; thence North 88° 37' 59" East, 2401.21 feet; thence North 88° 32' 46" East, 143.47 feet; thence South 11° 17' 55" West, 803.08 feet; thence South 24° 47' 56" West, 2001.83 feet; thence South 88° 37' 59" West, 4356.17 feet; thence South 88° 38' 41" West, 1168.19 feet; thence North 26° 40' 59" East, 4310.65 feet; thence North 63° 19' 01" West, 200.00 feet; thence North 26° 41' 01" East, 7804.44 feet, to the Point of Beginning.

AND:

A parcel of land lying within Sections 21 and 22, Township 43 South, Range 30 East, Hendry County, Florida, more particularly described as follows:
Beginning at the northwest corner of said Section 22; thence North 88° 38' 09" East, along the north line of said Section 22, a distance of 4356.17 feet; thence South 24° 47' 56" West, along the westerly right of way line of the C-2 Canal (a 200 foot wide right of way), 2595.27 feet; thence South 16° 07' 51" West, 331.30 feet; thence South 89° 15' 32" West, 3125.22 feet; thence South 01° 05' 01" East, 75.00 feet; thence South 89° 15' 32" West, 2571.46 feet; thence North 26° 40' 59" East, along the easterly right of way of the C-1 Canal (a 200 foot wide right of way), 3012.14 feet; thence North 88° 38' 09" East, along the north line of said Section 21, a distance of 1168.16 feet, to the Point of Beginning.

LESS AND EXCEPT those portions thereof described in the Special Warranty Description to Barron Water Control District recorded in Official Records Book 606, page 1344 of the public records of Hendry County, Florida.

ALSO, LESS AND EXCEPT:

A parcel of land lying in a portion of Sections 2, 3, 10 and 11 Township 43 South, Range 30 East, Hendry County, Florida and being more particularly described as follows:
Commence at the Southeast corner of said Section 3, Thence, along the South line of said Section 3, N.89°26'23"W., for a distance of 990.67 feet to the intersection with the Easterly line of a 130 foot wide Abandoned Railroad Right-of-Way line, the Easterly line of a 130 foot wide Non-Exclusive Drainage Easement as recorded in Official Records Book 508, Page 1514 of the Public Records of Hendry County, Florida and to the POINT OF BEGINNING, Thence, along the said Easterly line, N.26°40'27"E.,

a distance of 1107.37 feet to the intersection with the South Right-of-Way line of State Road No. 80, by Warranty Deed from the Board of County Commissioners of Hendry County, Florida, as recorded in Official Records Book 533, Page 1358 of the said Public Records, and as shown on the Right-of-Way Map by the Florida Department of Transportation, Section 07010-0000, Dated 01/20/2010, Thence, along the said South Right-of-Way line of State Road No. 80 for the next three (3) descriptive calls, (1) S89°48'03"E., for a distance of 217.56 feet, Thence, (2) N.00°35'45"W., for a distance of 10.39 feet, Thence, (3) S89°48'03"E., for a distance of 408.45 feet, Thence, leaving the said South Right-of-Way line of State Road No. 80, South, for a distance of 1520.51 feet, Thence, West, for a distance of 1385.65 feet to the intersection with the said Easterly line of the 130 foot wide abandoned Railroad Right-of-Way and the Easterly line of the said Non-Exclusive Drainage Easement, Thence, along the said Easterly line, N.26°40'27"E., a distance of 585.05 feet to the POINT OF BEGINNING.

ALSO, LESS AND EXCEPT:

A parcel of land lying in Section 15, Township 43 South, Range 30 East, Hendry County, Florida and being more particularly described as follows:

Commence at the Northeast corner of said Section 15, Thence, along the North line of said Section 15, S.89° 12'43"W., a distance of 1823.40 feet, Thence, along a line that is perpendicular to the North line of said Section 15, S00°47'17"E., a distance of 862.33 feet to the POINT OF BEGINNING, Thence, S.02°32'30"E., for a distance of 612.00 feet, Thence, S87°27'30"W., a distance of 782.94 feet, Thence, N.02°32'30"W., a distance of 512.00 feet, Thence, S.87°27'30"W., a distance of 1757.88 feet to the intersection with the Easterly line of a 130 foot abandoned Railroad Right-of-Way line and the Easterly line of a 130 foot wide Non-Exclusive Drainage Easement, as recorded in Official Records Book 533, Page 1358, of the Public Records of Hendry County, Florida, Thence, along the said Easterly line, N.26°41'11"E., a distance of 114.59 feet, Thence, leaving the said Easterly line, N87° 27'30"E, a distance of 2484.87 feet to the POINT OF BEGINNING.

ALSO, LESS AND EXCEPT:

A PARCEL OF LAND LYING IN SECTION 14, TOWNSHIP 43 SOUTH, RANGE 30 EAST, HENDRY COUNTY, FLORIDA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHWEST CORNER OF SECTION 16, TOWNSHIP 43 SOUTH, RANGE 30 EAST, THENCE N.89°39'22"E., ALONG THE SOUTH LINE OF THE SOUTHWEST ONE-QUARTER OF SAID SECTION 16, A DISTANCE OF 2,698.43 FEET TO THE SOUTH ONE-QUARTER CORNER OF SAID SECTION 16; THENCE N.88°38'35"E., ALONG THE SOUTH LINE OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 16, A DISTANCE OF 245.41 FEET TO A TANGENT CURVE TO THE LEFT, SAID CURVE BEING CURVED CONCAVE TO THE NORTHWEST, HAVING A CENTRAL ANGLE OF 61°57'40" AND A RADIUS OF 1,690.00 FEET, AND HAVING A CHORD LENGTH OF 1,739.85 FEET AND A CHORD BEARING OF N.57°39'45"E., A DISTANCE OF 1,827.61 FEET TO THE EAST LINE OF A VACATED RAILROAD RIGHT-OF-WAY AS DESCRIBED IN OFFICIAL RECORDS BOOK 547, PAGE 573, PUBLIC RECORDS OF HENDRY COUNTY, FLORIDA, SAID LINE ALSO BEING THE WEST LINE OF CANAL NO. 1, AS DESCRIBED IN OFFICIAL RECORDS BOOK 606 PAGE 1344 OF SAID PUBLIC RECORDS; THENCE N.26°40'54"E., ALONG THE EAST LINE SAID VACATED RIGHT-OF-WAY, A DISTANCE A 1,077.57 FEET TO A TANGENT CURVE TO THE RIGHT, SAID CURVE BEING CURVED CONCAVE TO THE SOUTHEAST, HAVING A CENTRAL ANGLE OF 61°56'56" AND A RADIUS OF 1,610.00 FEET, AND HAVING A CHORD LENGTH OF 1,657.19 FEET AND A CHORD BEARING OF N.57°39'22"E., A DISTANCE OF 1,740.75 FEET; THENCE N.88°37'50"E., ALONG THE NORTH LINE OF CANAL 3-W (AND THE WESTERLY EXTENSION THEREOF), AS DESCRIBED IN SAID OFFICIAL RECORDS BOOK 606, PAGE 1344, A DISTANCE OF 4,271.09 FEET TO A POINT ON THE WEST LINE OF SAID SECTION 14, SAID POINT ALSO BEING THE POINT OF BEGINNING OF THE PARCEL OF LAND HEREIN DESCRIBED; THENCE N.01°11'39"W., ALONG THE WEST LINE OF SAID SECTION 14, A DISTANCE OF 145.00 FEET; THENCE N.88°37'50"E., ALONG A LINE 145.00 FEET NORTH OF AND PARALLEL WITH THE NORTH LINE OF SAID CANAL 3-W, A DISTANCE OF 192.75 FEET TO THE WEST LINE OF CANAL NO. 2, AS DESCRIBED IN SAID OFFICIAL RECORDS BOOK 606, PAGE 1344; THENCE S.11°17'59"W., ALONG THE WEST LINE OF SAID CANAL NO. 2, A DISTANCE OF 148.62 FEET TO THE NORTH LINE OF SAID CANAL 3-W; THENCE S.88°37'50"W., ALONG THE NORTH LINE OF SAID CANAL 3-W, A DISTANCE OF 160.60 FEET TO THE POINT OF BEGINNING.

ALSO LESS AND EXCEPT:

A PARCEL OF LAND LYING IN SECTION 15, TOWNSHIP 43 SOUTH, RANGE 30 EAST, HENDRY COUNTY, FLORIDA, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHWEST CORNER OF SECTION 16, TOWNSHIP 43 SOUTH, RANGE 30 EAST, THENCE N.89.39'22"E., ALONG THE SOUTH LINE OF THE SOUTHWEST ONE-QUARTER OF SAID SECTION 16, A DISTANCE OF 2,698.43 FEET TO THE SOUTH ONE-QUARTER CORNER OF SAID SECTION 16; THENCE N.88"38'35"E., ALONG THE SOUTH LINE OF THE SOUTHEAST ONE-QUARTER OF SAID SECTION 16, A DISTANCE OF 245.41 FEET TO A TANGENT CURVE TO THE LEFT, SAID CURVE BEING CURVED CONCAVE TO THE NORTHWEST, HAVING A CENTRAL ANGLE OF 61"57'40" AND A RADIUS OF 1,690.00 FEET, AND HAVING A CHORD LENGTH OF 1,739.85 FEET AND A CHORD BEARING OF N.5T39'45"E., A DISTANCE OF 1,827.61 FEET TO THE EAST LINE OF A VACATED RAILROAD RIGHT-OF-WAY AS DESCRIBED IN OFFICIAL RECORDS BOOK 547, PAGE 573, PUBLIC RECORDS OF HENDRY COUNTY, FLORIDA, SAID LINE ALSO BEING THE WEST LINE OF CANAL NO. 1 AS DESCRIBED IN OFFICIAL RECORDS BOOK 606 PAGE 1344 OF SAID PUBLIC RECORDS; THENCE N.26"40'54"E., ALONG THE EAST LINE SAID VACATED RIGHT-OF-WAY, A DISTANCE A 1,077.57 FEET TO A TANGENT CURVE TO THE RIGHT, SAID CURVE BEING CURVED CONCAVE TO THE SOUTHEAST, HAVING A CENTRAL ANGLE OF 28"51'47" AND A RADIUS OF 1,610.00 FEET, AND HAVING A CHORD LENGTH OF 802.50 FEET AND A CHORD BEARING OF N.41 "06' 48"E., A DISTANCE OF 811.04 FEET TO A POINT ON THE EAST LINE OF SAID CANAL NO. 1, SAID POINT ALSO BEING THE POINT OF BEGINNING OF THE PARCEL OF LAND HEREIN DESCRIBED; THENCE N.26"40'54"E., ALONG THE EAST LINE OF SAID CANAL NO. 1, A DISTANCE OF 267.78 FEET TO A NON-TANGENT CURVE TO THE RIGHT, SAID CURVE BEING CURVED CONCAVE TO THE SOUTHEAST, HAVING A CENTRAL ANGLE OF 25"24'24" AND A RADIUS OF 1,755.00 FEET, AND HAVING A CHORD LENGTH OF 771.86 FEET AND A CHORD BEARING OF N.75"55'38"E., A DISTANCE OF 778.22 FEET; THENCE N.88"37'50"E., ALONG A LINE 145.00 FEET NORTH OF AND PARALLEL WITH THE NORTH LINE OF CANAL 3-W (AND THE WESTERLY EXTENSION THEREOF), AS DESCRIBED IN SAID OFFICIAL RECORDS BOOK 606, PAGE 1344, A DISTANCE OF 4,271.53 FEET TO THE EAST LINE OF SECTION 15; THENCE S.01"11 '39"E., ALONG THE EAST LINE OF SAID SECTION 15, A DISTANCE OF 145.00 FEET TO THE NORTH LINE OF SAID CANAL 3-W; THENCE S.88"37'50"W., ALONG THE NORTH LINE OF SAID CANAL 3-W (AND THE WESTERLY EXTENSION THEREOF), A DISTANCE OF 4,271.09 FEET TO A TANGENT CURVE TO THE LEFT, SAID CURVE BEING CURVED CONCAVE TO THE SOUTHEAST, HAVING A CENTRAL ANGLE OF 33"05'09" AND A RADIUS OF 1,610.00 FEET, AND HAVING A CHORD LENGTH OF 916.84 FEET AND A CHORD BEARING OF S.72"05'16"W., A DISTANCE OF 929.71 FEET TO THE POINT OF BEGINNING.

NOTE: This legal description is for appraisal purposes, there may be revsions based on a boundary survey and title insurance commitment of the property.

BSM APPROVED

By: J.A. Date: 06/16/2023

Appendix B.
National Wetlands Inventory Map

N

Legend

- Uplands
- Wetlands
- Ferguson-House Farms Boundary

Land Type	Acreage
Wetlands	52.27
Uplands	1373.26
Total Acreage	1425.53

IMAGERY AND DATA SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) AND U.S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE. PUBLICATION DATE 1999. https://www.fws.gov/wetlands

0 0.25 0.5 1 Miles

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_NWI_Ferguson	
DRN BY: TW	REVISION NO.: 00
DATE: 12/11/2023	REVISION DATE: N/A
CHK BY: PJ	STATUS: FINAL

NorthStar Contracting Group, Inc.
325 JOHN KNOX ROAD, BUILDING C, SUITE 100,
TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

NATIONAL WETLANDS INVENTORY (NWI) MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Appendix C.
Soil Survey Documentation

United States Department of Agriculture

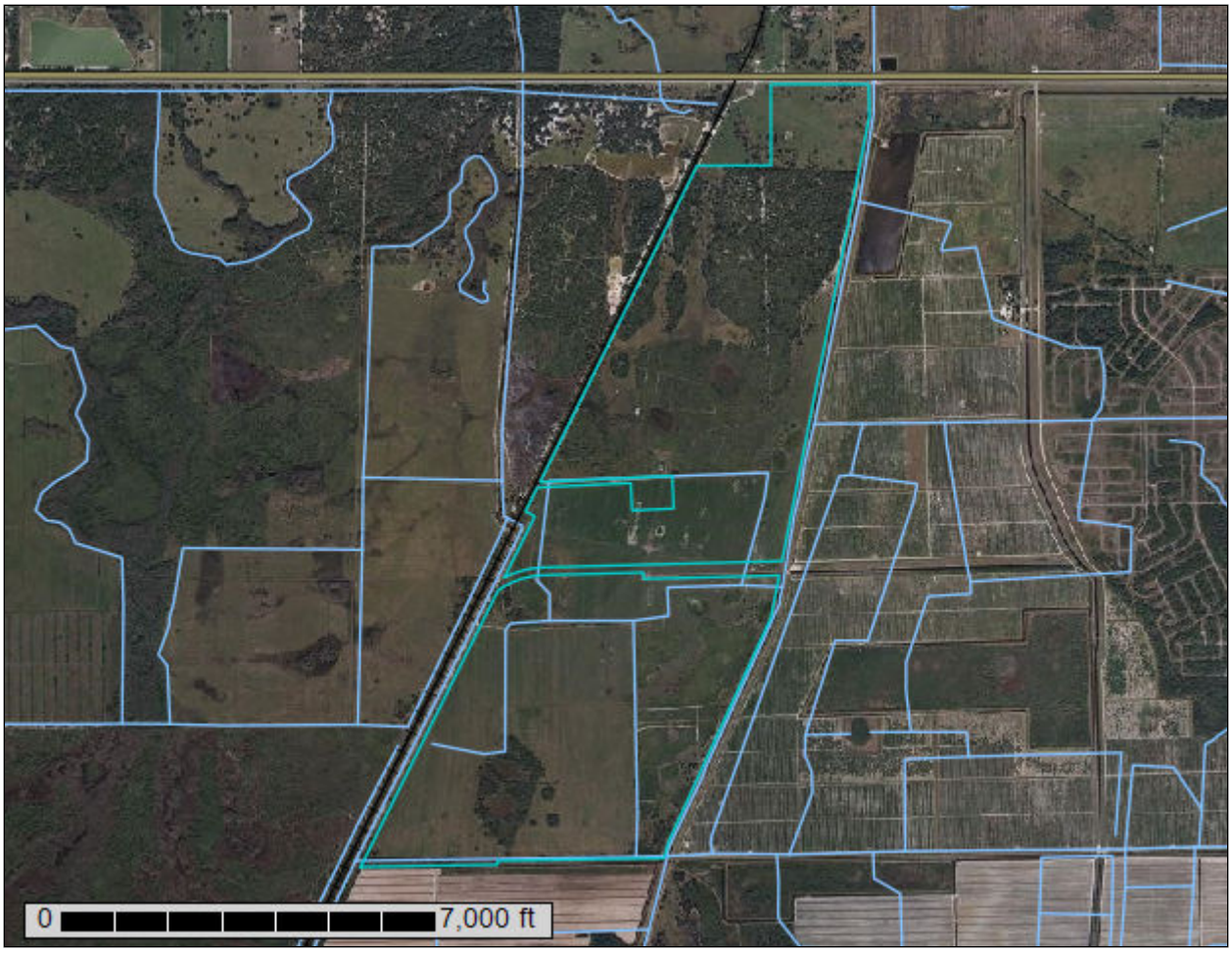
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Hendry County, Florida

Ferguson Farms



November 21, 2023

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: Hendry County, Florida
Survey Area Data: Version 23, Aug 28, 2023

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

Date(s) aerial images were photographed: Nov 14, 2021—Nov 23, 2021

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Cypress Lake sand, 0 to 2 percent slopes	117.2	8.2%
2	Pineda sand, limestone substratum	62.6	4.4%
4	Oldsmar sand, 0 to 2 percent slopes	2.9	0.2%
7	Immokalee sand, 0 to 2 percent slopes	336.3	23.6%
8	Malabar sand, 0 to 2 percent slopes	256.3	18.0%
9	Riviera fine sand, 0 to 2 percent slopes	10.0	0.7%
10	Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes	12.7	0.9%
14	Wabasso sand, limestone substratum, 0 to 2 percent slopes	38.0	2.7%
15	Myakka sand, 0 to 2 percent slopes	97.4	6.8%
17	Basinger sand, 0 to 2 percent slopes	17.0	1.2%
19	Gator muck, frequently ponded, 0 to 1 percent slopes	9.5	0.7%
20	Okeelanta muck	9.1	0.6%
21	Holopaw sand, 0 to 2 percent slopes	20.1	1.4%
22	Valkaria sand	113.5	8.0%
23	Brynwood sand, wet, 0 to 2 percent slopes	40.6	2.8%
26	Holopaw sand, limestone substratum	67.0	4.7%
27	Riviera sand, limestone substratum	5.8	0.4%
29	Oldsmar sand, limestone substratum	141.4	9.9%
33	Holopaw sand, frequently ponded, 0 to 1 percent slopes	26.4	1.8%
51	Malabar fine sand, high, 0 to 2 percent slopes	41.8	2.9%
Totals for Area of Interest		**1,425.7**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas

shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

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

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

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

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

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

Hendry County, Florida

1—Cypress Lake sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2zlf0
Elevation: 0 to 100 feet
Mean annual precipitation: 45 to 55 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Cypress Lake

Setting

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

Typical profile

Ap - 0 to 7 inches: sand
E - 7 to 28 inches: sand
Btg - 28 to 33 inches: fine sandy loam
2R - 33 to 43 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 13 to 58 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)

Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Hydric soil rating: No

Minor Components

Pineda
Percent of map unit: 4 percent
Landform: Drainageways on marine terraces, flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Hydric soil rating: Yes

Riviera
Percent of map unit: 4 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL), Slough (R156BY011FL)
Hydric soil rating: Yes

Brynwood
Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Wabasso
Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

2—Pineda sand, limestone substratum

Map Unit Setting

National map unit symbol: 17n44
Elevation: 0 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Pineda, Limestone Substratum

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 10 inches: sand
E/Bw - 10 to 32 inches: sand
Btg - 32 to 50 inches: sandy clay loam
2R - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 40 to 80 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks

Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Boca

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F156AY010FL - Subtropical Pine Flatwoods and Palmetto Prairie of Big Cypress
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pineda

Percent of map unit: 5 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 5 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 5 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

4—Oldsmar sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2sm4p
Elevation: 0 to 80 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Oldsmar

Setting

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

Typical profile

A - 0 to 6 inches: sand
E - 6 to 38 inches: sand
Bh - 38 to 50 inches: sand
Btg - 50 to 80 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks

Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Minor Components

Immokalee
Percent of map unit: 6 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Holopaw
Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Basinger
Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Cypress lake
Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Tequesta
Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave

Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G156AC645FL), Freshwater Marshes and Ponds (R156BY010FL)
Hydric soil rating: Yes

7—Immokalee sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2s3ll
Elevation: 0 to 150 feet
Mean annual precipitation: 42 to 57 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Immokalee

Setting

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

Typical profile

A - 0 to 9 inches: sand
E - 9 to 36 inches: sand
Bh - 36 to 55 inches: sand
C - 55 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Valkaria

Percent of map unit: 5 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pomello

Percent of map unit: 3 percent
Landform: Ridges on marine terraces, knolls on marine terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Interfluve, side slope, riser
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY150FL - Sandy Upland Mesic Flatwoods and Hammocks on Rises and Knolls
Other vegetative classification: Sandy soils on rises and knolls of mesic uplands (G155XB131FL), Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

Satellite

Percent of map unit: 2 percent
Landform: Drainageways on flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: F155XY150FL - Sandy Upland Mesic Flatwoods and Hammocks on Rises and Knolls

Other vegetative classification: Sand Pine Scrub (R155XY001FL), Sandy soils on rises and knolls of mesic uplands (G155XB131FL)
Hydric soil rating: No

Felda

Percent of map unit: 1 percent
Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

8—Malabar sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2sm5k
Elevation: 0 to 40 feet
Mean annual precipitation: 46 to 57 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Malabar

Setting

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

Typical profile

A - 0 to 5 inches: sand
E - 5 to 15 inches: sand
Bw - 15 to 35 inches: sand
E' - 35 to 45 inches: sand
Btg - 45 to 65 inches: sandy loam
Cg - 65 to 80 inches: loamy sand

Properties and qualities

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

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Holopaw

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 4 percent
Landform: Drainageways on marine terraces, flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, convex
Across-slope shape: Linear, concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear, convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)

Hydric soil rating: No

Cypress lake

Percent of map unit: 3 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

9—Riviera fine sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2tzw2
Elevation: 0 to 80 feet
Mean annual precipitation: 44 to 59 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Riviera

Setting

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

Typical profile

A - 0 to 6 inches: fine sand
E - 6 to 28 inches: fine sand
Bt/E - 28 to 32 inches: fine sandy loam
Btg - 32 to 42 inches: sandy clay loam
C - 42 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Wabasso

Percent of map unit: 8 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pinellas

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Cabbage Palm Flatwoods (R155XY005FL)
Hydric soil rating: No

Brynwood

Percent of map unit: 4 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Floridana

Percent of map unit: 2 percent

Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

10—Pineda-Pineda, wet, fine sand, 0 to 2 percent slopes

Map Unit Setting

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

Map Unit Composition

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

Description of Pineda

Setting

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

Typical profile

A - 0 to 1 inches: fine sand
E - 1 to 5 inches: fine sand

Bw - 5 to 36 inches: fine sand
Btg/E - 36 to 54 inches: fine sandy loam
Cg - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Hydric soil rating: No

Description of Pineda, Wet

Setting

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

Typical profile

A - 0 to 1 inches: fine sand
E - 1 to 5 inches: fine sand
Bw - 5 to 36 inches: fine sand
Btg/E - 36 to 54 inches: fine sandy loam
Cg - 54 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 15 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Slough (R155XY011FL), Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Hydric soil rating: Yes

Minor Components

Felda

Percent of map unit: 6 percent
Landform: Drainageways on marine terraces, flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Wabasso

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Valkaria

Percent of map unit: 2 percent
Landform: Drainageways on flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Linear, concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Cypress lake

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

Across-slope shape: Linear, concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Brynwood

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

14—Wabasso sand, limestone substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2tzws
Elevation: 0 to 50 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Wabasso, Limestone Substratum

Setting

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

Typical profile

A - 0 to 6 inches: sand
E - 6 to 25 inches: sand
Bh - 25 to 35 inches: sand
Btg - 35 to 45 inches: sandy clay loam
2R - 45 to 55 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 13 to 54 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Cypress lake

Percent of map unit: 6 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Brynwood

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Gentry

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

15—Myakka sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2twt9
Elevation: 10 to 130 feet
Mean annual precipitation: 43 to 62 inches
Mean annual air temperature: 64 to 77 degrees F
Frost-free period: 280 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Myakka

Setting

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

Typical profile

A - 0 to 6 inches: sand
E - 6 to 20 inches: sand
Bh - 20 to 36 inches: sand
C - 36 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Basinger

Percent of map unit: 5 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear, convex
Across-slope shape: Concave, linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Valkaria

Percent of map unit: 5 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

17—Basinger sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2vbpc
Elevation: 0 to 50 feet
Mean annual precipitation: 42 to 62 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Basinger

Setting

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

Typical profile

A - 0 to 6 inches: sand
E - 6 to 25 inches: sand
Bh - 25 to 50 inches: sand
C - 50 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks

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

Minor Components

Holopaw

Percent of map unit: 6 percent
Landform: Drainageways on marine terraces, flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Convex, concave, linear
Across-slope shape: Linear, concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Slough (R155XY011FL), Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Pompano

Percent of map unit: 3 percent
Landform: Drainageways on flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Anclote

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

19—Gator muck, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2tzwz
Elevation: 0 to 100 feet
Mean annual precipitation: 42 to 56 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Gator

Setting

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

Typical profile

Oa - 0 to 18 inches: muck
Cg1 - 18 to 36 inches: sandy clay loam
Cg2 - 36 to 55 inches: fine sandy loam
Cg3 - 55 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very high (about 13.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D

Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Minor Components

Terra ceia

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave, convex
Across-slope shape: Concave, linear
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Chobee

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY090FL - Loamy and Clayey Freshwater Isolated Marshes and Swamps
Other vegetative classification: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Tequesta

Percent of map unit: 4 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G156AC645FL), Freshwater Marshes and Ponds (R156BY010FL)
Hydric soil rating: Yes

Felda

Percent of map unit: 3 percent
Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)

Hydric soil rating: Yes

Pompano

Percent of map unit: 1 percent
Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

20—Okeelanta muck

Map Unit Setting

National map unit symbol: 17n4l
Elevation: 0 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Okeelanta, undrained, and similar soils: 50 percent
Okeelanta, drained, and similar soils: 37 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Okeelanta, Undrained

Setting

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

Typical profile

Oa - 0 to 48 inches: muck
C - 48 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None

Frequency of ponding: Frequent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very high (about 20.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Description of Okeelanta, Drained

Setting

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

Typical profile

Oa - 0 to 48 inches: muck
C - 48 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very high (about 20.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Forage suitability group: Organic soils in depressions and on flood plains (G155XB645FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Organic soils in depressions and on flood plains (G155XB645FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Delray

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Pahokee, drained

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Terra ceia

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Holopaw, depressional
Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Winder, depressional
Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Linear, concave
Ecological site: R155XY090FL - Loamy and Clayey Freshwater Isolated Marshes and Swamps
Other vegetative classification: Loamy and clayey soils on stream terraces, flood plains, or in depressions (G155XB345FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

21—Holopaw sand, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2x9g9
Elevation: 0 to 190 feet
Mean annual precipitation: 46 to 57 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition
Holopaw and similar soils: 84 percent
Minor components: 16 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

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

Typical profile

A - 0 to 5 inches: sand
Eg - 5 to 48 inches: sand
Btg - 48 to 65 inches: sandy clay loam
BCkg - 65 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)
Other vegetative classification: Slough (R155XY011FL), Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 6 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 4 percent
Landform: Drainageways on marine terraces, flats on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G156BC241FL), Slough (R156BY011FL)
Hydric soil rating: Yes

Oldsmar

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Talf, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: South Florida Flatwoods (R155XY003FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: No

Cypress lake

Percent of map unit: 2 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Gentry

Percent of map unit: 1 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Hydric soil rating: Yes

22—Valkaria sand

Map Unit Setting

National map unit symbol: 17n4n
Elevation: 10 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Valkaria and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Valkaria

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile

A - 0 to 10 inches: sand
E - 10 to 15 inches: sand
Bw - 15 to 45 inches: sand
C - 45 to 80 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 10 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps

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

Minor Components

Pompano
Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Pineda
Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar
Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Immokalee
Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Myakka
Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf

Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Basinger

Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

23—Brynwood sand, wet, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2zlfh
Elevation: 0 to 70 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Brynwood

Setting

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

Typical profile

A - 0 to 4 inches: sand
Bw - 4 to 16 inches: sand
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 7 to 20 inches to lithic bedrock
Drainage class: Poorly drained

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.95 in/hr)
Depth to water table: About 3 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Very low (about 0.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Minor Components

Jupiter

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Cabbage Palm Flatwoods (R155XY005FL)
Hydric soil rating: Yes

Cypress lake

Percent of map unit: 5 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Convex, linear
Across-slope shape: Linear, concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Wabasso, limestone substratum

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Riviera, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G156AC241FL), Wetland Hardwood Hammock (R156AY012FL)
Hydric soil rating: Yes

26—Holopaw sand, limestone substratum

Map Unit Setting

National map unit symbol: 17n4r
Elevation: 0 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Holopaw, Limestone Substratum

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 6 inches: sand
Eg - 6 to 45 inches: sand
Btg - 45 to 60 inches: sandy loam
2R - 60 to 64 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 50 to 80 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.01 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None

Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Boca

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F156AY010FL - Subtropical Pine Flatwoods and Palmetto Prairie of Big Cypress
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Basinger

Percent of map unit: 3 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Delray

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces

Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Oldsmar, limetone substratum

Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Riviera, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

27—Riviera sand, limestone substratum

Map Unit Setting

National map unit symbol: 17n4s
Elevation: 0 to 60 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F

Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Riviera, Limestone Substratum

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy and loamy marine deposits

Typical profile

A - 0 to 5 inches: sand
E - 5 to 35 inches: sand
Btg - 35 to 50 inches: sandy loam
2R - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 50 to 80 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 3.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL)
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Boca

Percent of map unit: 3 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex

Across-slope shape: Linear
Ecological site: F156AY010FL - Subtropical Pine Flatwoods and Palmetto Prairie of Big Cypress
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Gentry

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Gator

Percent of map unit: 3 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY100FL - Organic Freshwater Isolated Marshes and Swamps
Other vegetative classification: Organic soils in depressions and on flood plains (G155XB645FL), Freshwater Marshes and Ponds (R155XY010FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Winder

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear, concave
Across-slope shape: Concave, linear
Ecological site: F155XY140FL - Loamy and Clayey Hardwood Hammocks
Other vegetative classification: Loamy and clayey soils on flats of hydric or mesic lowlands (G155XB341FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Holopaw, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces

Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Wabasso, limestone substratum
Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

29—Oldsmar sand, limestone substratum

Map Unit Setting
National map unit symbol: 17n4v
Elevation: 0 to 100 feet
Mean annual precipitation: 46 to 54 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 358 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition
Oldsmar, limetone substratum, and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Oldsmar, Limetone Substratum

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

Typical profile
A - 0 to 5 inches: sand
E - 5 to 37 inches: sand
Bh - 37 to 63 inches: sand
Btg - 63 to 73 inches: sandy clay loam
2R - 73 to 77 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 60 to 73 inches to lithic bedrock
Drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Hallandale

Percent of map unit: 3 percent
Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F156AY030FL - Subtropical Moist Hammocks of Big Cypress
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: Yes

Pineda, limestone substratum

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Malabar

Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks

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

Immokalee
Percent of map unit: 2 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Holopaw, limestone substratum
Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Riviera, limestone substratum
Percent of map unit: 2 percent
Landform: Drainageways on marine terraces
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

33—Holopaw sand, frequently ponded, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: 2x9gb
Elevation: 0 to 190 feet
Mean annual precipitation: 46 to 57 inches
Mean annual air temperature: 68 to 77 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition
Holopaw and similar soils: 88 percent
Minor components: 12 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Holopaw

Setting

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

Typical profile

A - 0 to 5 inches: sand
Eg - 5 to 48 inches: sand
Btg - 48 to 65 inches: sandy clay loam
BCkg - 65 to 80 inches: sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 4 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A/D
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Forage suitability group: Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Sandy soils on stream terraces, flood plains, or in depressions (G155XB145FL)
Hydric soil rating: Yes

Minor Components

Basinger

Percent of map unit: 7 percent
Landform: Flats on marine terraces, drainageways on marine terraces
Landform position (three-dimensional): Tread, talf, dip
Down-slope shape: Concave, convex
Across-slope shape: Linear, concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Slough (R155XY011FL), Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

Riviera

Percent of map unit: 5 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R155XY080FL - Sandy over Loamy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Freshwater Marshes and Ponds (R155XY010FL), Sandy over loamy soils on stream terraces, flood plains, or in depressions (G155XB245FL)
Hydric soil rating: Yes

51—Malabar fine sand, high, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2svz4
Elevation: 0 to 80 feet
Mean annual precipitation: 42 to 64 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 355 to 365 days
Farmland classification: Farmland of unique importance

Map Unit Composition

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

Description of Malabar, High

Setting

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

Typical profile

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

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 4.0
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Minor Components

Oldsmar

Percent of map unit: 5 percent
Landform: Flatwoods on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Convex, linear
Across-slope shape: Linear
Ecological site: F155XY120FL - Sandy Flatwoods and Hammocks
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL), South Florida Flatwoods (R155XY003FL)
Hydric soil rating: No

Pineda

Percent of map unit: 4 percent
Landform: Drainageways on marine terraces, flats on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Felda

Percent of map unit: 4 percent
Landform: Drainageways on marine terraces, flatwoods on marine terraces
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Linear
Across-slope shape: Concave, linear
Ecological site: F155XY130FL - Sandy over Loamy Flatwoods and Hammocks
Other vegetative classification: Sandy over loamy soils on flats of hydric or mesic lowlands (G155XB241FL), Slough (R155XY011FL)
Hydric soil rating: Yes

Basinger

Percent of map unit: 2 percent
Landform: Depressions on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R155XY070FL - Sandy Freshwater Isolated Marshes and Swamps
Other vegetative classification: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Hydric soil rating: Yes

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Appendix D.
Owner-Provided Documentation

Baseline documentation questions

1. Have you seen any exotics invasive plants such as Japanese or Old World climbing ferns (specify which), cogon grass, torpedo grass, Chinese tallow, Devil's horsewhip, Caesar weed, or Tropical Soda Apple? Please provide the location of your sightings (I can send a map or you drop pins Google Earth or Google Maps and send them to me).
Tropical soda apple and Brazilian pepper. Will be identified on property inspection.

2. What exotic plant management practices are currently and/or historically followed?
Spot treatment with herbicides and mechanical treatment according to label instructions and BMPs.

3. Are you aware of any invasive/destructive animals (such as Cane Toads, Cuban brown anoles, Wild hogs) present on the property? If so, can you provide common areas where you see them?
Feral hogs are present.

4. Later in the process, I will send you a list of threatened and endangered species likely to be present on the Subject Property. Review likely threatened and endangered species table. Many of these have online descriptions if you are unfamiliar with them. Have you or anyone else observed them on the property? Are you aware of any species of concern that are not listed in this table?

5. Do you know of any rookeries or group nesting areas?
None.

6. Are you aware of any bald eagle nests on the property?
Perhaps two nests across all properties, activity unknown.

7. Are you aware of any old cattle dip vats on the property? If so, where?
Yes, site will be identified on property inspection.

Baseline documentation questions

8. Are you aware of any archaeological sites? (arrow heads, flints, pottery) If so, please describe location.
No identified sites.

9. Please list the types of farming activities, current and past (sod, cattle, dairy, hay, timber, etc), with approximately dates of occurrence.
Cattle grazing (cow/calf operation), truck farming, rubber plantation and marigold farming.

10. If applicable, can you describe any of the following. In your descriptions, please provide dates or date ranges when possible.

a. Timber history (types of timber planted, etc)?
NA

b. Grazing history? Maximum head of cattle?
100+ years of cattle grazing, 1,800 head of cattle in aggregate on Goodno Ranch, which includes all three subject properties and other properties.

c. Forest-fire history?
Unknown.

d. Prescribed burning?
Yes, during period of ownership.

e. Row crop types?
Truck farming ~40 years ago.

11. Please list manmade structures, such as bridges, fences, former building sites, etc. Later in this project, we will send you a map with all the Property improvements for you to verify.
Fencing and other improvements associated with cow/calf operation, watering ponds for cattle, drainage control structures.

Baseline documentation questions

12. Please provide the approximate age and uses of buildings, barns, or other structures?
NA

13. Please provide the number and location of water wells. Include construction details (diameter, depth, production rate) if known.
Three shallow wells for cattle watering troughs.

14. Please provide the location and size of any man-made or enhanced ponds or water bodies (ditches, canals, etc)
Ponds can easily be identified on aerial photography, ditches on aerial photography or property inspection.

15. Please provide a list of known easements (utility, roadway, oil/gas/mineral)?
Please refer to title insurance commitments.

Pre-Environmental Site Assessment Questionnaire

Office (850)-661-4415
Email to: pjackson@northstar.com

Please answer the following questions in good faith and to the best of your knowledge. If a question does not apply, or if you are unsure of the answer, please indicate that in your response.

1. Please list your name and contact information, along with a brief description of your involvement with the property (including dates/length of time where possible).
Dwayne House, 5121 State Road 80, Moore Haven FL 33935, (305) 216-3637
Owner of property for more than 20 years.

2. Identify the main contacts for further inquiries (such as current operators and/or land managers), if they are different from the current property owner and may be able to provide information concerning the property.

Same as above.

3. Please provide the name and contact information for each hunting lease or other land use leases. Copies of the hunting leases would also be useful, if available.

NA

4. Are any natural water bodies or wetland areas located on the Subject Property? If so, provide the name, if applicable, a brief description and location?
Various unnamed wetlands.

5. Are any buildings, improvements, or other man-made modifications present on the Subject Property? Is so, please describe – including age, square footage (for buildings), if known.
No buildings, only fences and other improvements associated with cow/calf operation. There is a partially covered cow pen.

6. Are you aware of the presence of asbestos, lead paint, or PCBs in any structure, building, or equipment (electrical/mechanical) present on the Subject Property?
None.

7. How are the structures or storage areas being used?
NA

8. Are there any septic tanks? How many and where.
None.

9. Are there any water wells? How many and where. Share any construction details you may know.
Three shallow wells serving cattle watering troughs.

10. Is there electric service to the property? If so, who is the provider.
Yes, Glades Electric Cooperative.

11. What are the current land uses (commercial and recreational) of the Subject Property?
Cattle grazing (cow/calf operation) and hunting.

12. What are the previous uses of the Subject Property (to the best of your knowledge)?
Cattle grazing, truck farming, rubber plantation and marigold farming.

13. Are you aware of any previous environmental or archaeological assessments conducted for the Subject Property? If so, are you able to provide a copy of the assessment report(s) for review?
ESA when property was purchased and NRCS may have done archaeological assessments.

14. Are you aware of any <u>past</u> underground or aboveground storage tanks, chemical storage areas, or chemical mixing areas located on or adjacent to the Subject Property? If so, please describe and provide a location.

None.

15. Are you aware of any cattle dip vats associated with the property (past or present)? If so, please note the location and general condition below?
Yes, will be identified on property inspection.

16. If underground storage tanks (USTs) or aboveground storage tanks (ASTs) are currently present at the Subject Property, please complete the UST/AST form attached to this questionnaire. *If no tanks are present at the Subject Property, please disregard the UST/AST form.*
NA

17. Are you aware of any landfills (public or private) or any dumping on, or adjacent to, the Subject Property? If so, please describe and provide location and types of waste, if known.
None.

18. Is prescribed burning conducted on the Subject Property? If so, please describe frequency and ignition methods.

Yes, typically on a three-year rotation using drip torches for ignition.

19. Have there been any forest fires (wildfires) or any other type of uncontrolled fire on the Subject Property? If so, who responded to the fire? Do you know what suppressants were used to contain the fire?

Unknown.

20. Are you aware of any hazardous substances ever stored or produced on the Subject Property? If yes, please identify or provide the Safety Data Sheet for those hazardous substances.

None.

21. Are herbicides or pesticides utilized on the Subject Property? If so, please provide the name and application frequency. Where are these chemicals stored and mixed?
Yes, herbicides are used along fence lines and to manage invasive/exotic plant species according to label instructions and BMPSs. Names can be provided at your property inspection.

22. Have any State-, Federal-, or government-issued environmental permits been issued in relation to the Subject Property (for example, NPDES permits)?
None.

23. Are you aware of any liens, use restrictions, or deed covenants associated with the Subject Property? If so, please describe and provide the location.
Please see title insurance commitment.

24. Is there any other information you feel would be important or useful related to the Subject Property or immediately adjacent properties?
NA

Completed By: **Date Completed:**

Dwayne House

Dwayne A. House

UST / AST Form

Email to: pjackson@northstar.com

1. **Quantity** - How many underground storage tanks (USTs) are at the Subject Property? _____

   How many aboveground storage tanks (ASTs) are at the Subject Property? _____

2. **Location** - Please attach site maps, facility layouts or provide a description regarding where the tanks are located relative to one another. Include the map / layout / description and location of any groundwater monitoring wells, as well as the proximity of tanks to water retention ponds, surface impoundments, sewer / utility lines, storm / waste water lines, surface water, or stormwater drains.

3. **Ownership and Management** - *Please complete the following matrix for each tank at the Subject Property, adding lines if necessary.*

Tank ID	AST or UST	Owner	Operator Name/Organization	Relationship of Operator to Owner

Tank operator means any person in control of, or having responsibility for, the daily operation of the AST or UST system. Provide the individuals name, organization, and/or relationship to the owner

4. Who submits the required notification and reports to the regulatory agency? (For example, certification of installation, release reports, corrective action plans, etc.). _____

5. Who maintains tank documentation? _____

   Where is this documentation kept? _____

UST / AST
Form, continued

6. Who oversees and tracks product delivery and inventory control? Please provide the individuals name, organization, and/or relationship to the owner. _____

7. Who performs operation and maintenance of the equipment and systems? Please provide the individuals name, organization, and/or reports, corrective action plans, etc.). _____

8. **Tank Profile** - *Please complete the following matrix for each tank at the Subject Property, adding lines if necessary.*

Tank ID	Tank Capacity	Tank Construction Material	Product Stored in Tank	Dispenser (Y/N)	Piping Material	Secondary Containment (Y/N)	Any Releases (Y/N)	Release Follow-up Action

* **Construction Material Key:**
a) steel without protection *b) steel with cathodic protection* *c) steel with corrosion protection* *d) vaulted steel* *e) other metal*
f) fiberglass *g) fiberglass reinforced plastic* *h) steel-fiberglass-reinforced-plastic composite* *i) unknown* *j) other (list)*

** **Follow-up Release Action Key:**
k) release investigation *l) passive remediation* *m) soil removal* *n) vapor recovery* *o) inert fill material* *p) other (list)*

9. Have tank closure activities been performed in the past at the Subject Property? Yes _____ No _____

10. Are groundwater monitor well in place at the Subject Property? Yes _____ No _____

11. Are monitor well data, results, and reports available for the last two years? Yes _____ No _____

From: Keith Fountain
To: Jackson, Pamela
Subject: Re: Ferguson-House Baseline
Date: Wednesday, January 24, 2024 8:54:41 AM

Caution: This is an external email and may be malicious. Please take care when clicking links or opening attachments.

As far as carrying capacity, you can assume 1 per 2 acres. These three properties are actually managed as a group that includes other properties. I'll look at your other responses when back in the office.

Keith Fountain, Attorney
Keith Fountain Law PLLC
(407) 402-7091
Sent from my iPhone

On Jan 19, 2024, at 9:55 AM, Jackson, Pamela <PJackson@northstar.com> wrote:

Keith,
My responses are provided below for the Ferguson Farm Baseline and the text has been updated accordingly. I have also construed your comments to also apply to the Goodno East and West properties, where appropriate. When do you expect to have the comments for Goodno East and West? Also when I receive the information on the typical number of cattle per property, I will add that information to the interview section.
Pam

Pamela Jackson, PG
Contract Manager
NorthStar Contracting Group, Inc.
325 John Knox Road, Building C Suite 100
Mobile: 850-661-4415
24 Hour Emergency Response: 800.283.2933
www.NorthStar.com | pjackson@NorthStar.com

The World's Most Comprehensive Infrastructure & Environmental Solutions Company - **We Bring Answers**.

From: keith@keithfountainlaw.com <keith@keithfountainlaw.com>
Sent: Wednesday, January 17, 2024 10:12 AM
To: Jackson, Pamela <PJackson@NorthStar.com>

Subject: Ferguson-House Baseline

Caution: This is an external email and may be malicious. Please take care when clicking links or opening attachments.

These are my comments to the baseline documentation report for the Ferguson-House Farms property based on a cursory review and conversations with my client (page references refer to the PDF page number):

1. On page 2, there is a reference to certification or reliance in two places that should include the landowner. These products are certified to the purchaser only.
2. On page 7, I have several revisions or comments:
    a. You may want to verify your acreage once the survey is complete. My acreages are based on the information provided by FDEP. FDEP is aware that changes to the final acreage totals may occur (it's pretty common).
    b. I would note that your reference to nine parcels is nine Property Appraiser tax parcels (an administrative, not physical division). Addressed in text.
    c. Please add an additional easement purpose to your bullet points that states (verbatim from the conservation easement) "Maintenance of economically viable agricultural practices that protect the landscape as a working enterprise in harmony with the open space and scenic qualities of the Property", otherwise, there is no reference to agriculture in this statement. Replaced text with verbatim bullets from the CE.
    d. Just another note that the final surveyed legal description will probably change from what is currently attached.
    e. In 2.2, the landowner is Ferguson-House Farms, Inc. Addressed in text.

    Does this canal flow north? These Barron canals flow different directions. It is very flat out there but elevations to the south are higher than those to the north, so under certain conditions the will flow and most likely to the north unless there is enough rainfall to reverse flow. Modified the text to reflect this better.
3. In the second paragraph of 4.2 on page 11, the following agricultural activities are also performed continuously or intermittently on the property: beekeeping, cabbage palm harvesting, saw palmetto berry harvesting, and cutting of pasture sod when renovating pastures (there is an IFAS practice that describes this). I would also like it noted that cattle are grazed throughout the entirety of the property. I will confirm all of this with Mr. House. Added to the interview section, 4.2, as well as 5.1
4. Also on page 11, just a note to confirm that there are indeed three wells serving watering troughs. Clarified well purpose in the text.

5. At the top of page 13, the agricultural uses should include the additions in #4 above. Done
6. On page 31 there is a reference to an agricultural areas map. This is important in that there needs to be a single map that divides the property into the three categories referenced in the conservation easement: agricultural, silvicultural and natural areas. Item P of the CE provides the owner the right to engage in silviculture in areas depicted as agricultural area in the BDR. Since silviculture is a subset of agriculture, calling out areas specific for silviculture could potentially limits the owners use of those areas.
7. I suggest cleaning up the language on page 32, paragraph C, by noting the conservation easement allows the installation of two new wells for agriculture purposes. Corrected in text.
8. In section 5.9 on page 34, you may want to include a version of the FMLA map showing nearby conservation lands. Also, correct the spelling for LaBelle. Corrected spelling.
9. Page 40 has Table 1 which does not seem to correctly note the species that have been observed on the property by Mr. House or your company. As I recall, this table shows up again later (page 113) in the baseline. Updated the table.

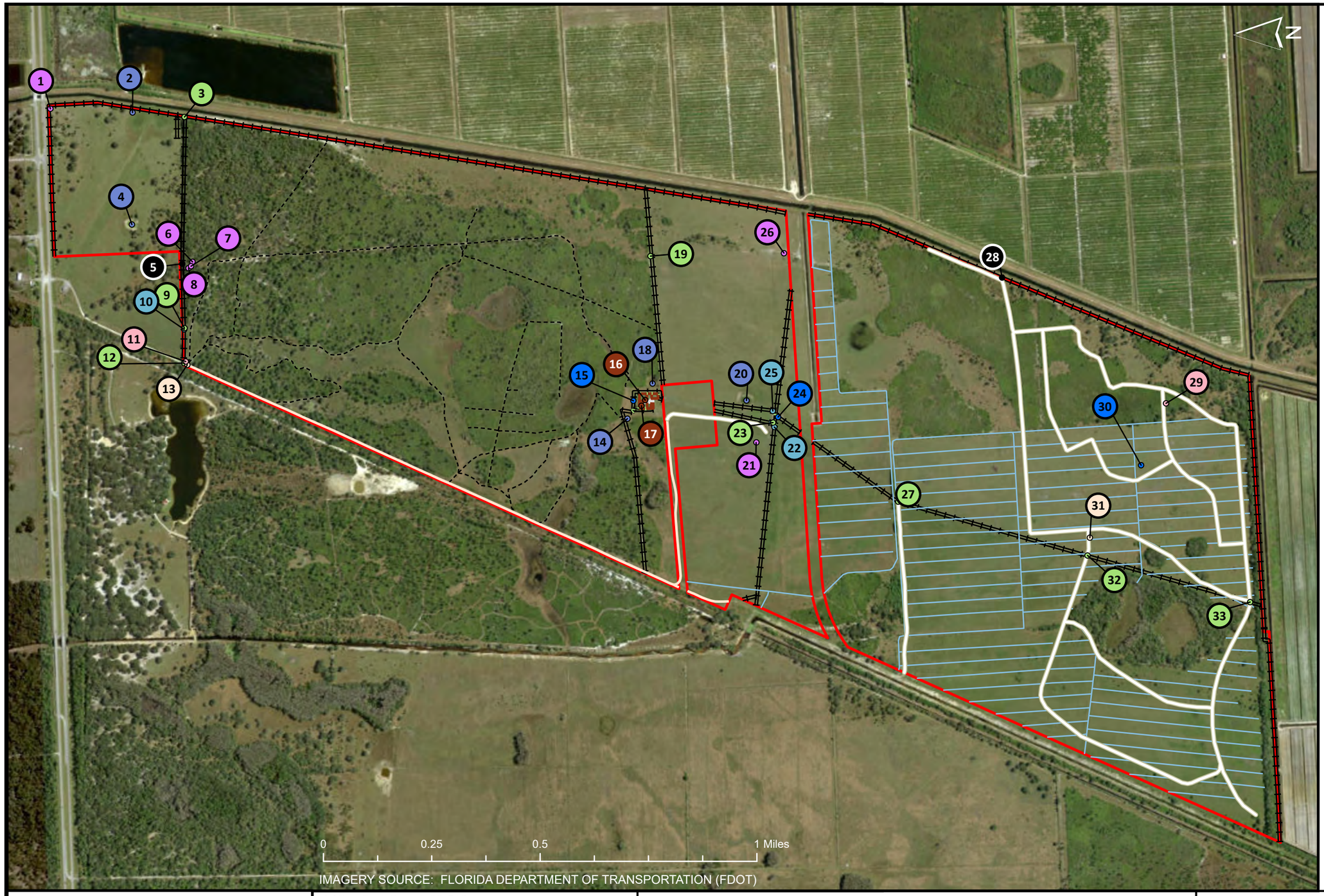
Thank you. Comments for the other two properties are coming soon.

Keith R. Fountain, Managing Attorney
KEITH FOUNTAIN LAW, PLLC

Florida Bar #724254
keith@keithfountainlaw.com
(407) 402-7091
Post Office Box 845
DeLand, Florida 32721

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Appendix E.
Improvements Maps



OBSERVATIONS:
*See next page for observations.

Legend

- Cattle Pen
- Cattle Pond
- Cattle Trough
- Fence
- Gate
- Other
- Road
- Trail
- Well / Water Pump
- Cattle Pen
- Cattle Trough
- Ditch / Canal
- Fence
- Gate
- Improved Road
- Structure
- Trail
- Trail Road
- Ferguson-House Farms

Note: This map has not been prepared by a professional land surveyor and does not represent surveyed values.

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_Improvements	
DRN BY: TW	REVISION NO.: 00
DATE: 1/10/2024	REVISION DATE: N/A
CHK BY: PS	STATUS: FINAL

NorthStar Contracting Group, Inc.

325 JOHN KNOX ROAD, BUILDING C, SUITE 100,
TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

IMPROVEMENTS MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

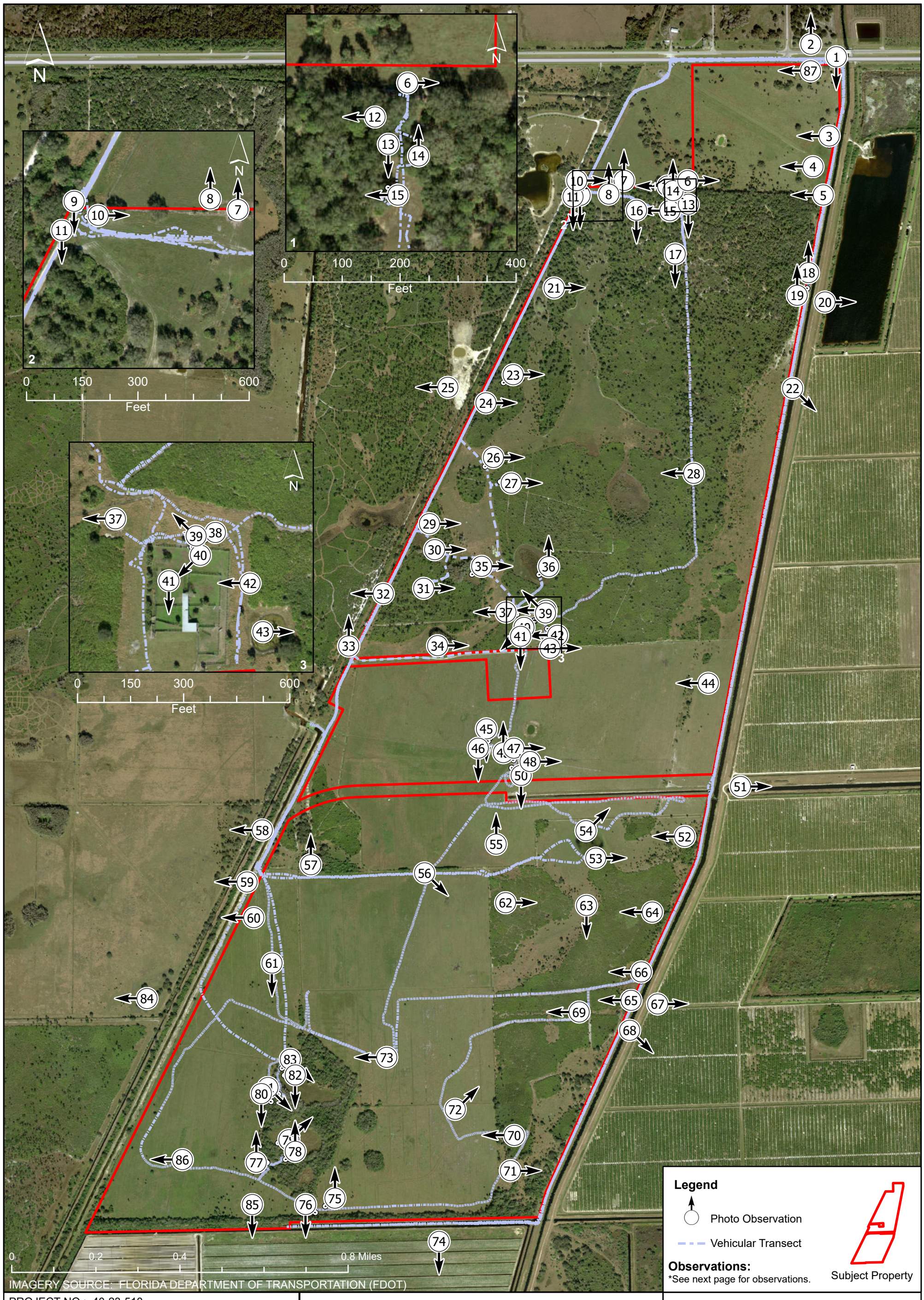
IMPROVEMENTS MAP ID	DESCRIPTION	IMPROVEMENT TYPE	LATITUDE	LONGITUDE	PHOTO LOG ID
1	Manhole - Water Main	Other	26.768017	-81.304482	1
2	Cattle pond	Cattle Pond	26.765274	-81.304741	3
3	Gate	Gate	26.763546	-81.304985	5
4	Cattle Pond	Cattle Pond	26.765442	-81.308914	
5	Typical fenceline	Fence	26.763811	-81.310448	6
6	Deer feeder	Other	26.763466	-81.310387	14
7	Deer feeder	Other	26.763519	-81.310547	13
8	Deer stand	Other	26.763607	-81.310616	12
9	Gate	Gate	26.763817	-81.312851	
10	Gate and water trough	Cattle Trough	26.763828	-81.312897	7
11	Trail road	Trail	26.763823	-81.314095	10
12	Typical gate	Gate	26.763874	-81.314148	9
13	West access road	Road	26.763771	-81.314217	11
14	Cattle pond	Cattle Pond	26.74913	-81.316856	37
15	Solar 4" well at cattle pens	Well / Water Pump	26.748911	-81.3162	40
16	Cattle pen	Cattle Pen	26.748516	-81.316193	
17	Horse pen	Cattle Pen	26.748646	-81.316399	41
18	Cattle pond	Cattle Pond	26.748247	-81.31559	43
19	Gate	Gate	26.748152	-81.310837	
20	Cattle Pond	Cattle Pond	26.745129	-81.316353	
21	Mineral stand	Other	26.744854	-81.317932	45
22	Water trough	Cattle Trough	26.744232	-81.317383	47
23	Gate	Gate	26.744268	-81.317215	
24	Solar well - not identified by permit	Well / Water Pump	26.744095	-81.317017	49
25	Water trough	Cattle Trough	26.744265	-81.31678	48
26	Mineral stand	Other	26.743685	-81.310928	
27	Gate	Gate	26.740189	-81.320343	
28	Typical fenceline	Fence	26.736425	-81.312149	66
29	Trailroad	Trail	26.731112	-81.31707	70
30	Solar 4" well	Well / Water Pump	26.732025	-81.319336	72
31	Trailroad and swales	Road	26.733831	-81.32196	73
32	Gate	Gate	26.733932	-81.322617	
33	Gate	Gate	26.728558	-81.324585	

PROJECT NO.: 40-23-510		GIS ID: 4023510_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: FINAL	DATE: 1/10/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

NorthStar
Contracting Group, Inc.
325 JOHN KNOX RD, C100, TALLAHASSEE, FLORIDA 32303 PH:(850) 531-9860

IMPROVEMENTS MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Appendix F.
Photographic Documentation, Photo Location, and Vehicular Transects Maps



PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_POM_BDR	
DRN BY: TW	REVISION NO.: 00
DATE: 1/17/2024	REVISION DATE: N/A
CHK BY: PJ	STATUS: FINAL

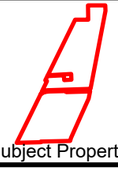
NorthStar
Contracting Group, Inc.
325 JOHN KNOX RD, C100, TALLAHASSEE, FLORIDA 32303 PH:(850) 531-9860

PHOTO LOCATION & VEHICULAR TRANSECTS MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

PHOTO LOG ID	DESCRIPTION	LATITUDE	LONGITUDE
1	Manhole - Water Main	26.768017	-81.304482
2	Adjacent property to the North	26.768761	-81.305428
3	Cattle pond	26.765274	-81.304741
4	Improved pasture	26.764225	-81.305374
5	Gate	26.763546	-81.304985
6	Typical fenceline	26.763811	-81.310448
7	Gate and water trough	26.763828	-81.312897
8	Windmill on adjoining property	26.763906	-81.313019
9	Typical gate	26.763874	-81.314148
10	Trail road	26.763823	-81.314095
11	West access road	26.763771	-81.314217
12	Deer stand	26.763607	-81.310616
13	Deer feeder	26.763519	-81.310547
14	Deer feeder	26.763466	-81.310387
15	Caesar weed	26.763313	-81.310547
16	Woodland pasture	26.763054	-81.312172
17	Woodland pasture	26.761536	-81.310692
18	Gopher tortoise burrow	26.760557	-81.305565
19	Gopher tortoise burrow	26.760334	-81.305618
20	Adjacent property to the East	26.759848	-81.304939
21	Woodland pasture	26.760386	-81.315361
22	Water control structure	26.756872	-81.306198
23	Woodland pasture	26.757132	-81.317329
24	Water tote, apiaries, and miscellaneous debris	26.756735	-81.318008
25	Adjacent property to the West	26.756969	-81.319466
26	Improved pasture and wetland	26.754242	-81.318054
27	Woodland pasture	26.753716	-81.317474

PHOTO LOG ID	DESCRIPTION	LATITUDE	LONGITUDE
28	Miscellaneous debris	26.753954	-81.310028
29	Woodland pasture	26.752266	-81.320206
30	Wetland	26.751366	-81.320015
31	Woodland pasture	26.750032	-81.320442
32	Apiary	26.749548	-81.321999
33	Railroad bed	26.748053	-81.323341
34	Improved pasture, trailroad, and cypress wetland	26.748047	-81.319916
35	Wetland	26.750517	-81.318581
36	Wetland	26.750496	-81.316002
37	Cattle pond	26.74913	-81.316856
38	Old tires	26.748966	-81.316086
39	Cattle pens	26.748924	-81.316162
40	Solar 4" well at cattle pens	26.748911	-81.3162
41	Horse pen	26.748646	-81.316399
42	Brazilian peppertree	26.748625	-81.315697
43	Cattle pond	26.748247	-81.31559
44	Improved pasture	26.746698	-81.309509
45	Mineral stand	26.744854	-81.317932
46	Tropical soda apple	26.744753	-81.317993
47	Water trough	26.744232	-81.317383
48	Water trough	26.744265	-81.31678
49	Solar well - not identified by permit	26.744095	-81.317017
50	Smutgrass	26.743824	-81.317093
51	Tractor trailer and storage tanks on adjacent property	26.743124	-81.308289
52	Improved pasture	26.741409	-81.310448
53	Wood storks	26.740677	-81.313873
54	Wetland	26.741318	-81.314247
55	Improved pasture	26.741179	-81.317703
56	Brazilian pepper	26.7402	-81.320465
57	Woodland pasture	26.740501	-81.324844
58	Wood stork	26.741711	-81.326706

PHOTO LOG ID	DESCRIPTION	LATITUDE	LONGITUDE
59	Canal	26.739918	-81.327301
60	Mineral stand	26.738684	-81.327049
61	Typical swale in improved pasture	26.73711	-81.326355
62	Unimproved pasture	26.739153	-81.317352
63	Wetland	26.739042	-81.31424
64	Unimproved pasture	26.738802	-81.311714
65	Unimproved pasture	26.736065	-81.312546
66	Typical fenceline	26.736425	-81.312149
67	Adjacent property to the East	26.735626	-81.311523
68	Adjacent canal	26.734722	-81.312607
69	Possible former utility corridor	26.735363	-81.314545
70	Trailroad	26.731112	-81.31707
71	Brazilian pepper	26.729895	-81.317223
72	Solar 4" well	26.732025	-81.319336
73	Trailroad and swales	26.733831	-81.32196
74	Adjacent property to the South	26.727463	-81.319984
75	Cattle herd	26.728712	-81.324356
76	Peruvian primrose-willow	26.728497	-81.324738
77	Forested wetland	26.730228	-81.326584
78	Climbing fern	26.730337	-81.325882
79	Wetland	26.730904	-81.326164
80	Cabbage palm	26.732334	-81.326416
81	Cypress wetland	26.732592	-81.326126
82	Wetland	26.733242	-81.325905
83	Cypress wetland	26.733488	-81.325996
84	Adjacent property to the West	26.735909	-81.331169
85	Improved pasture	26.728771	-81.327164
86	Manure and bio solids pile	26.730337	-81.329842
87	Former cattle dip vat location	26.76815	-81.305443



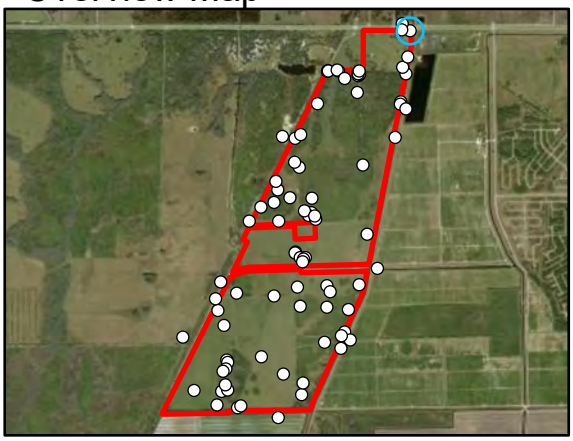
PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 40_23_510_POM_BDR	
DRN BY: TW	REVISION NO.: 00
DATE: 1/17/2024	REVISION DATE: N/A
CHK BY: PJ	STATUS: FINAL

NorthStar Contracting Group, Inc.

325 JOHN KNOX ROAD, BUILDING C, SUITE 100,
TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

PHOTO LOCATION & VEHICULAR TRANSECTS MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

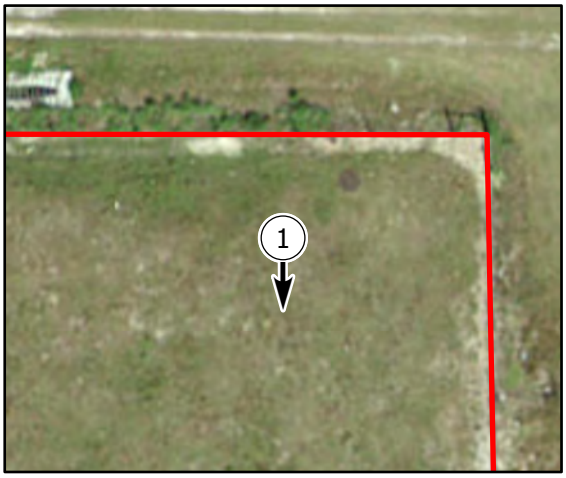
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 1:

Manhole - Water Main

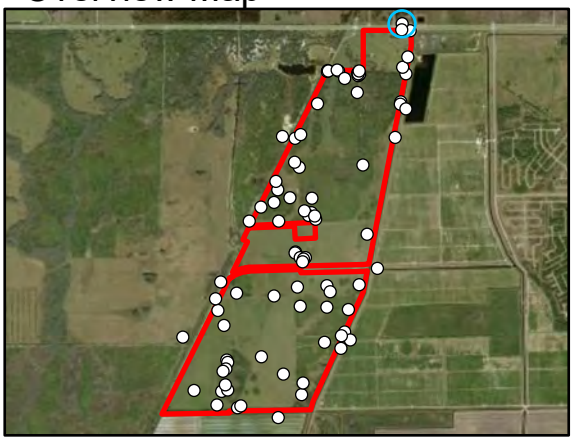


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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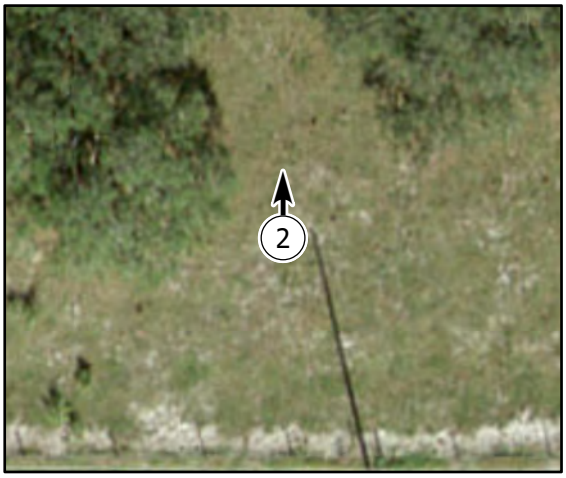
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 2:

Adjacent property to the North

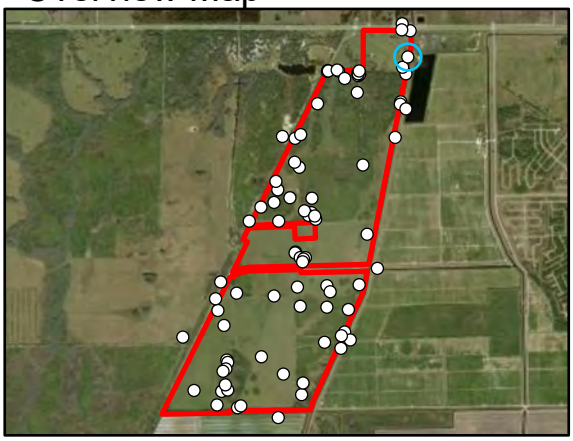


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 3:

Cattle pond

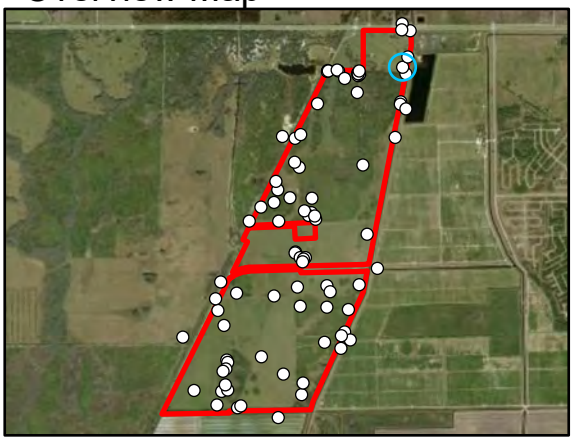


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 4:

Improved pasture

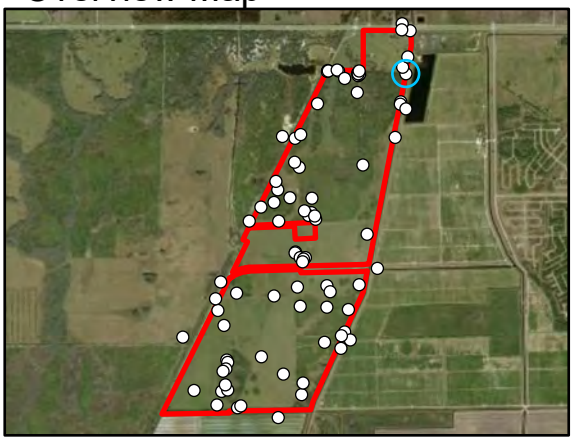


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 5:

Gate

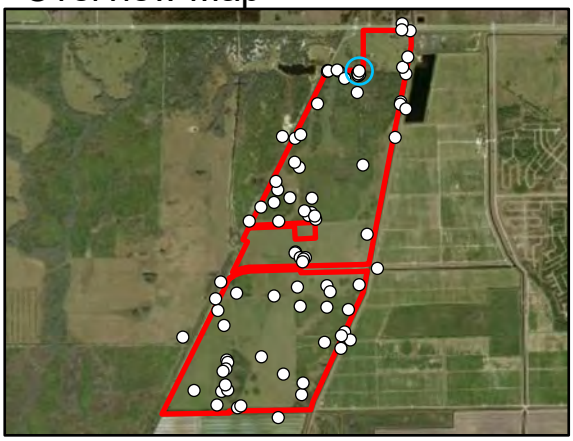


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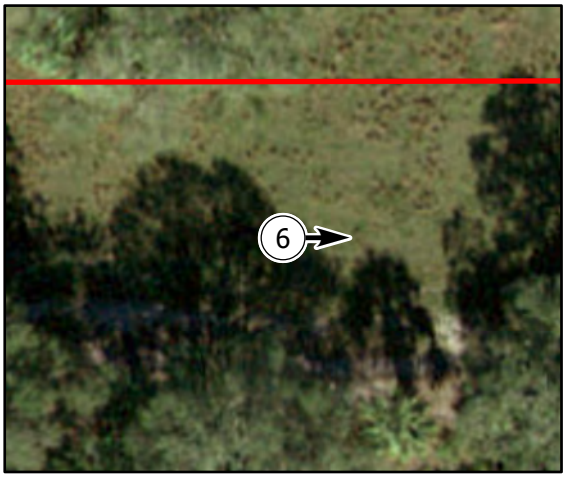
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 6:

Typical fenceline

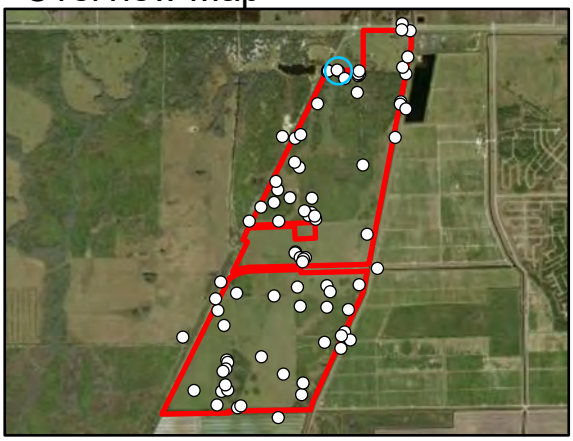


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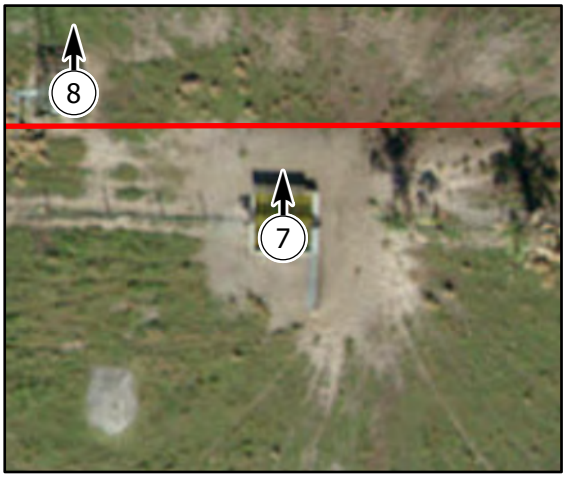
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 7:

Gate and water trough

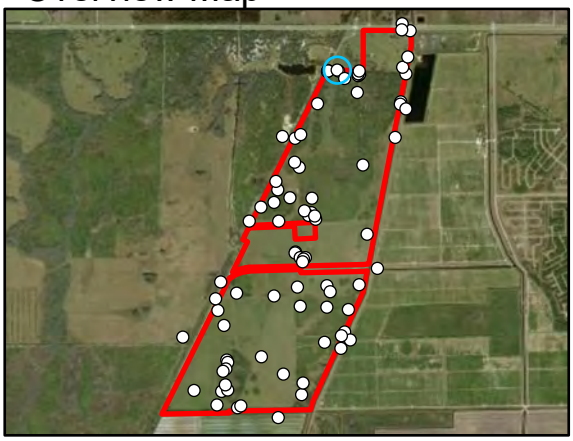


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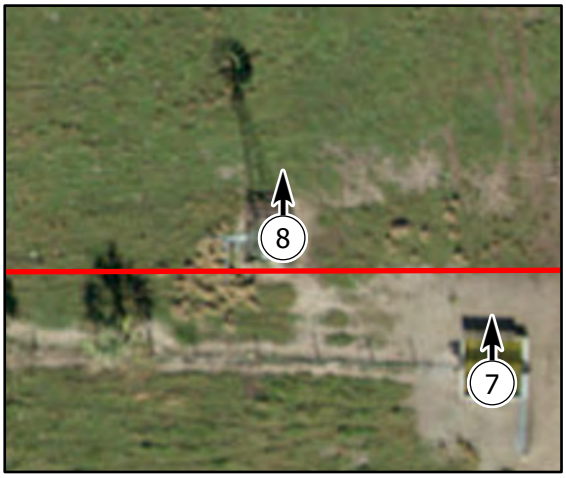
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 8:

Windmill on adjoining property

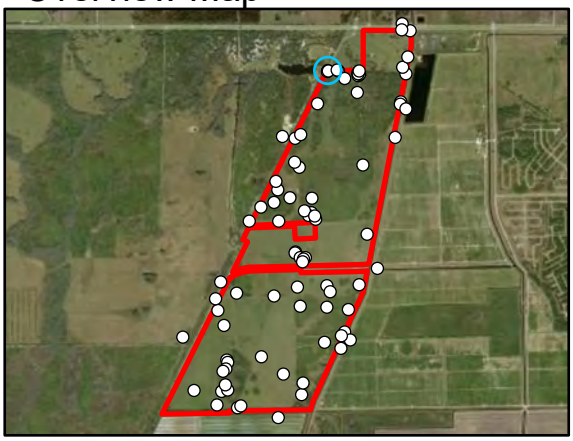


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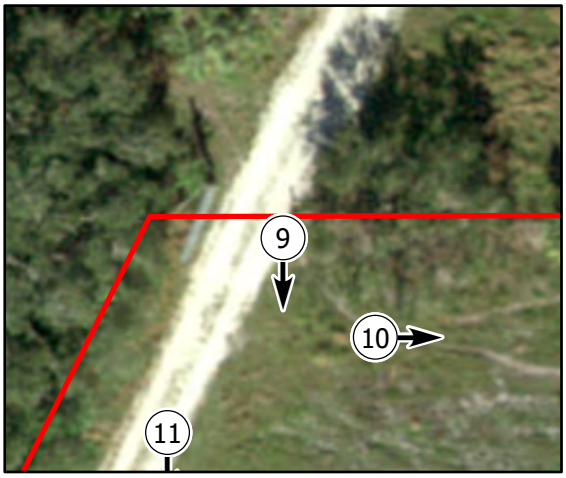
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 9:

Typical gate

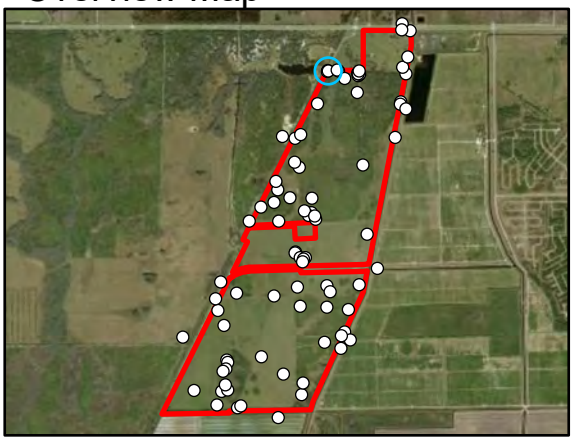


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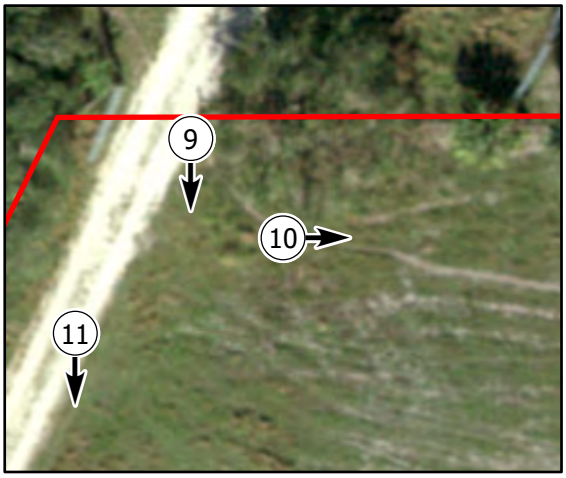
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 10:

Trail road

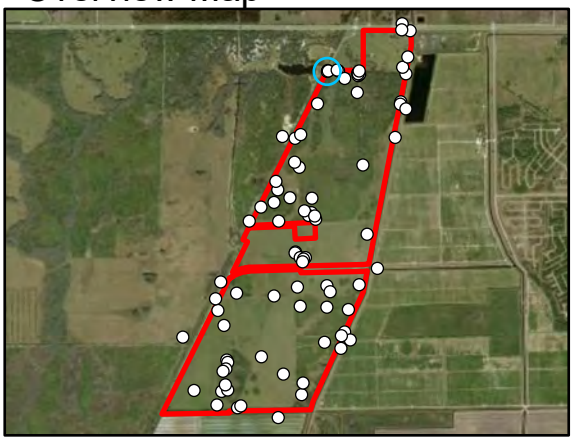


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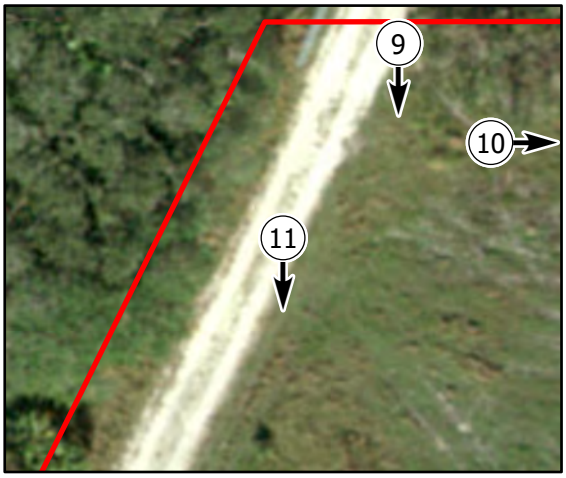
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 11:

West access road

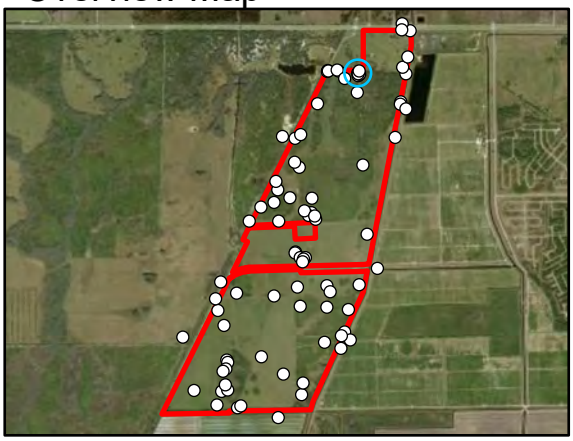


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 12:

Deer stand

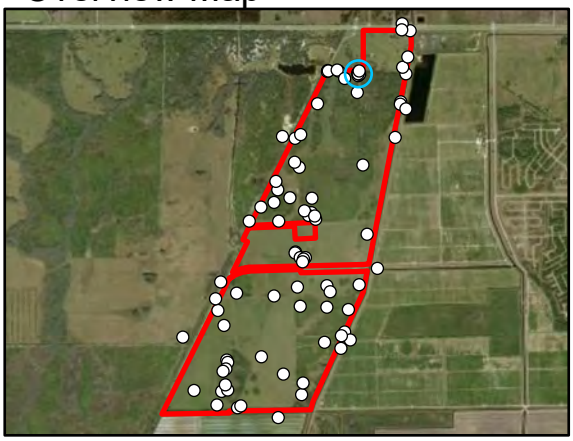


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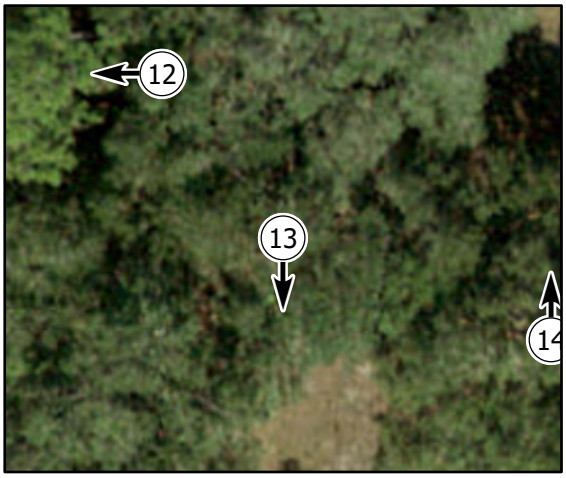
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 13:

Deer feeder

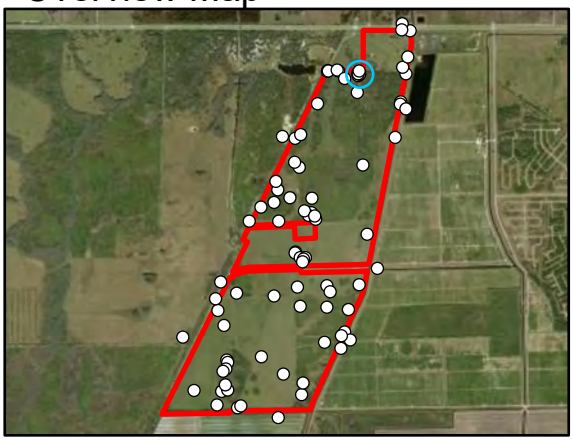


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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 14:

Deer feeder

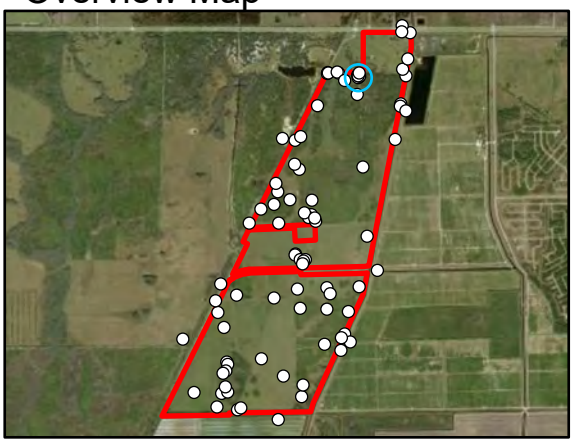


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HENDRY COUNTY, FLORIDA
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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 15:

Caesar weed

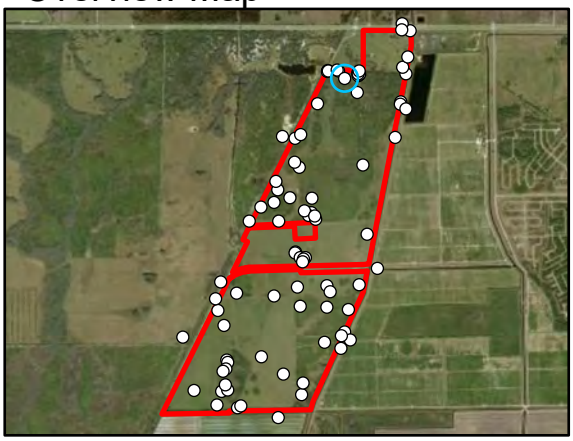


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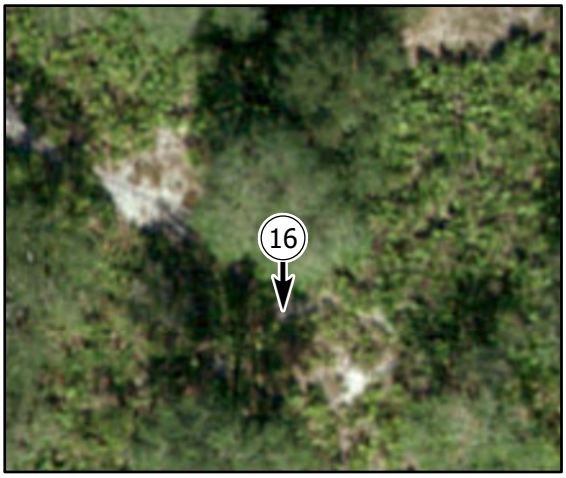
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 16:

Woodland pasture

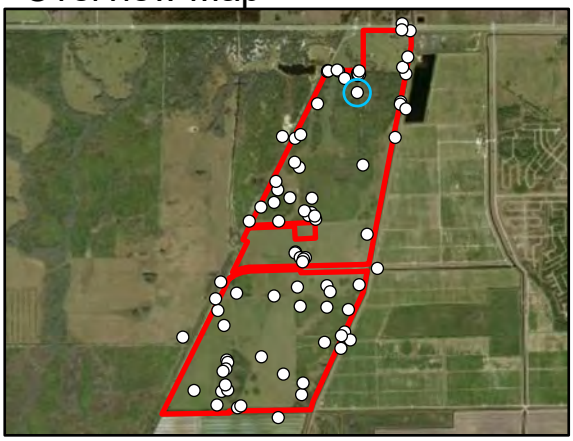


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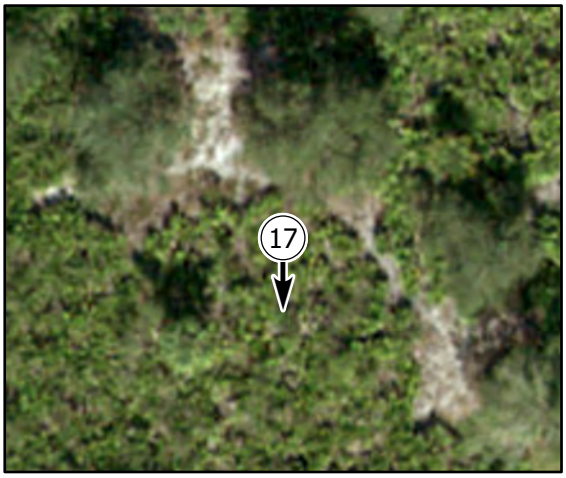
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 17:

Woodland pasture

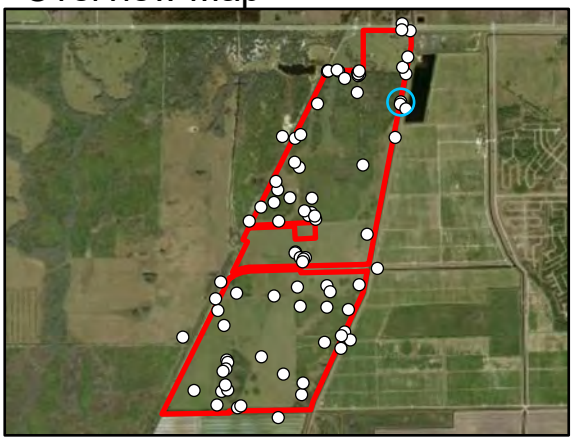


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 18:

Gopher tortoise burrow

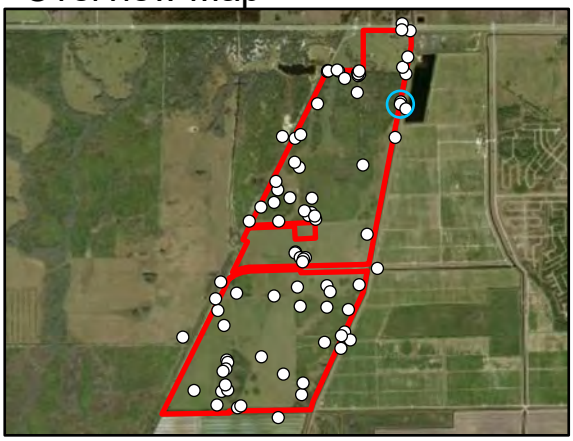


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 19:

Gopher tortoise burrow

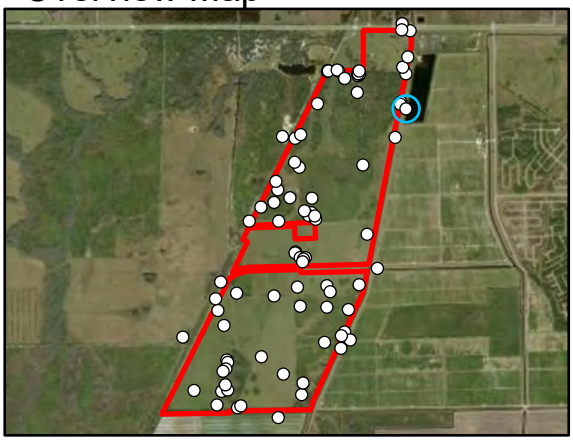


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

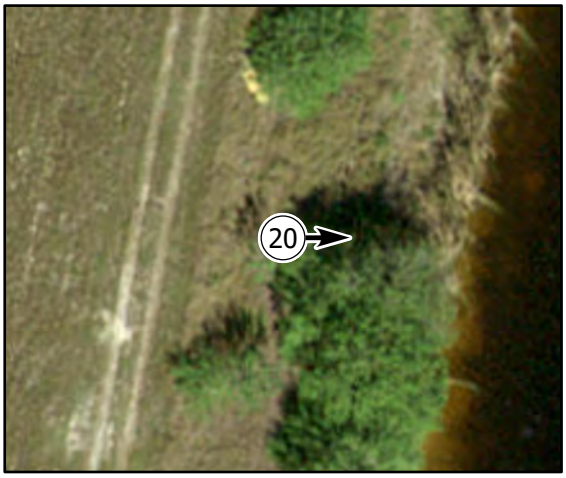
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 20:

Adjacent property to the East

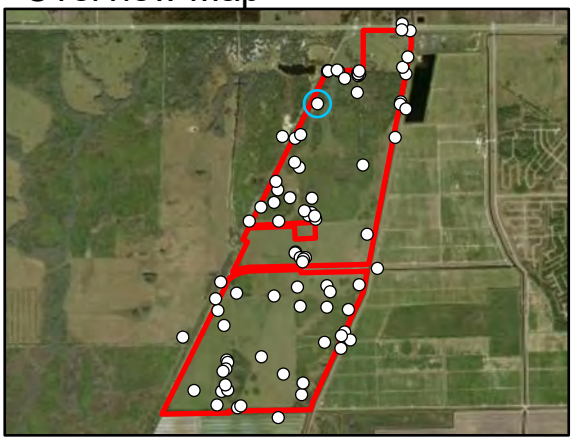


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 21:

Woodland pasture

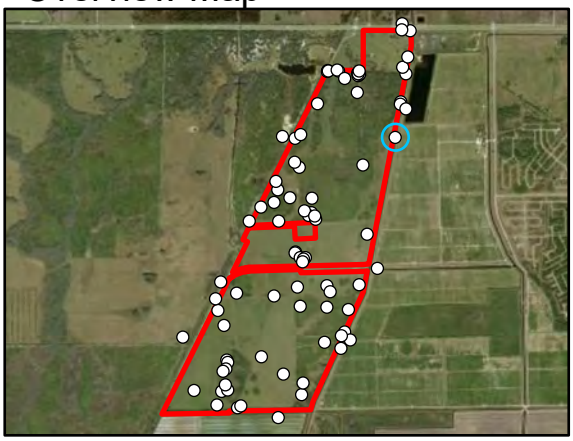


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 22:

Water control structure

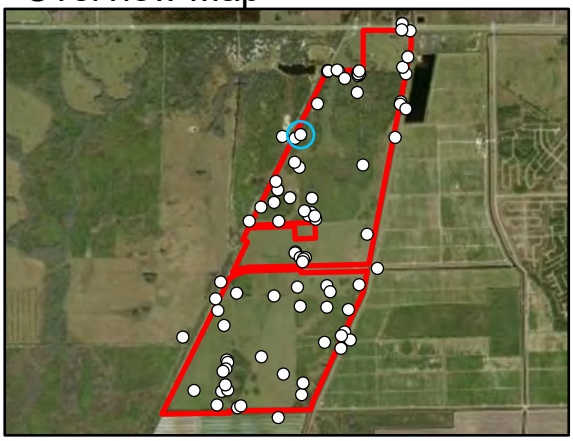


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 23:

Woodland pasture

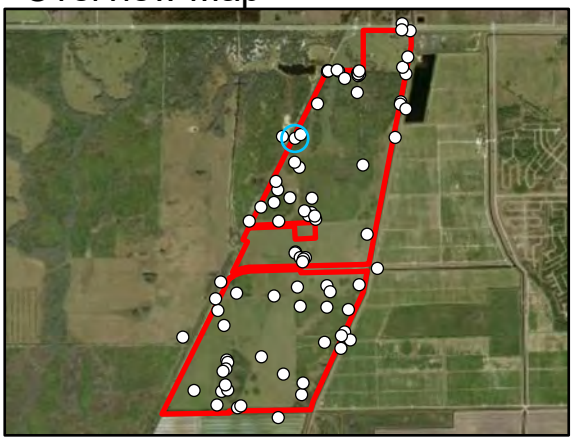


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 24:

Water tote, apiaries, and miscellaneous debris

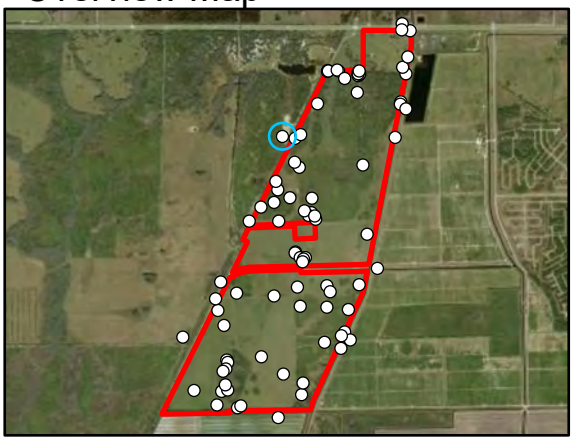


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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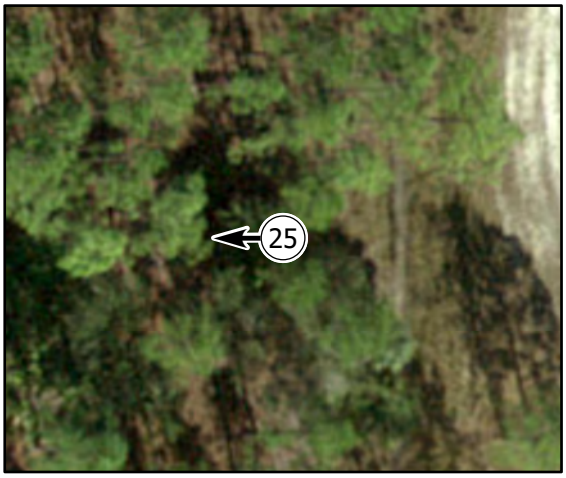
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 25:

Adjacent property to the West

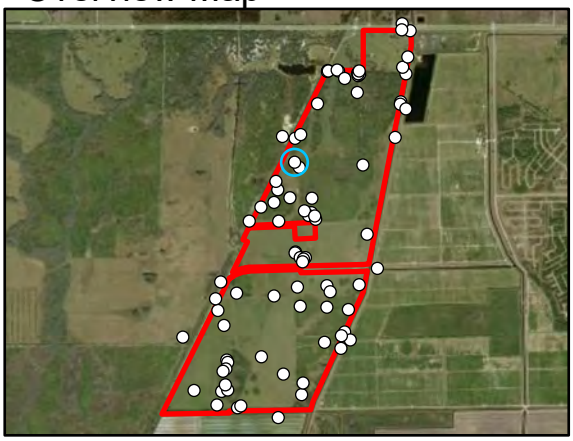


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 26:

Improved pasture and wetland

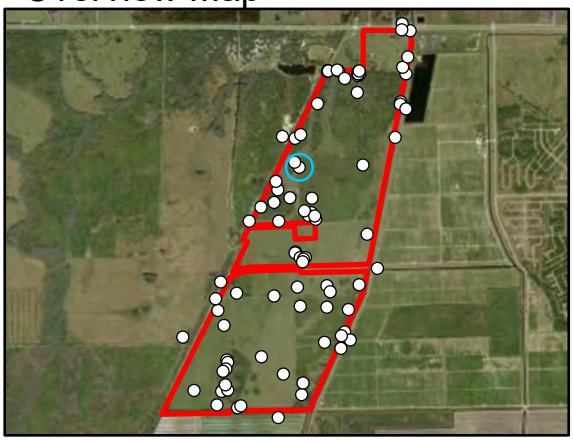


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 27:

Woodland pasture

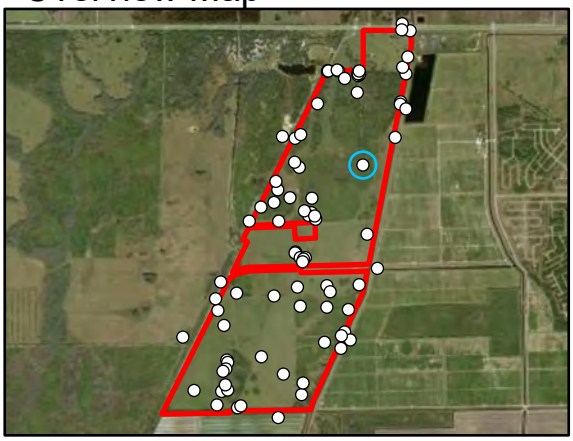


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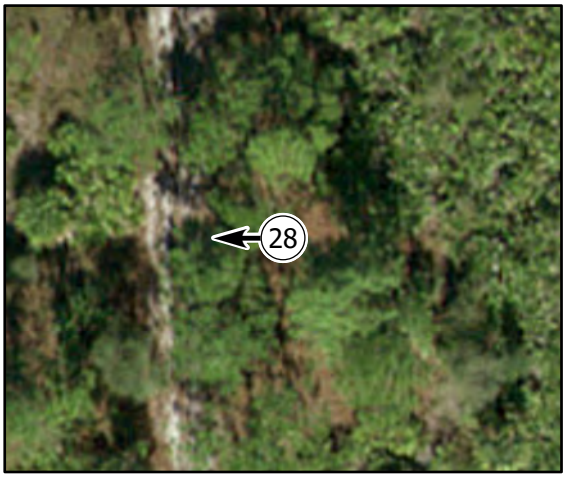
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 28:

Miscellaneous debris

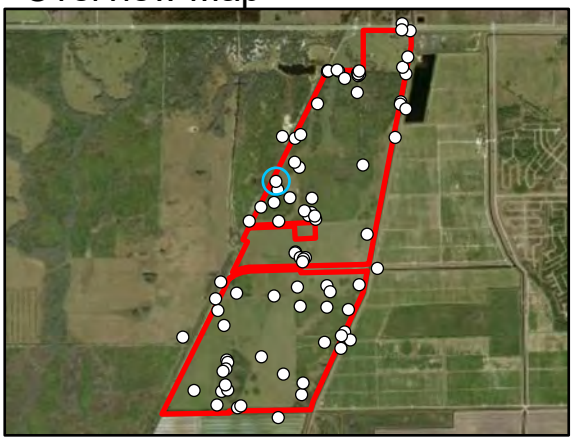


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
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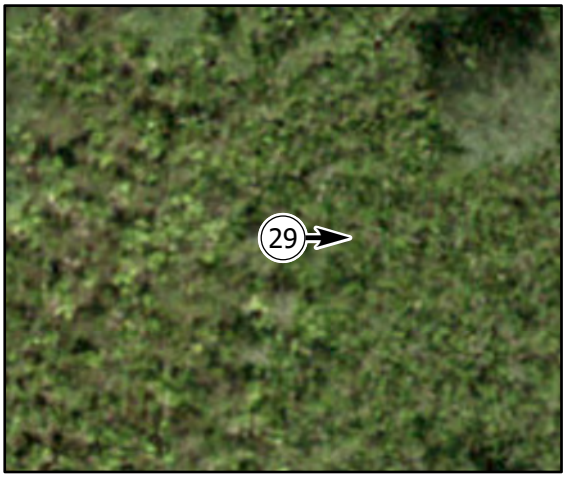
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 29:

Woodland pasture

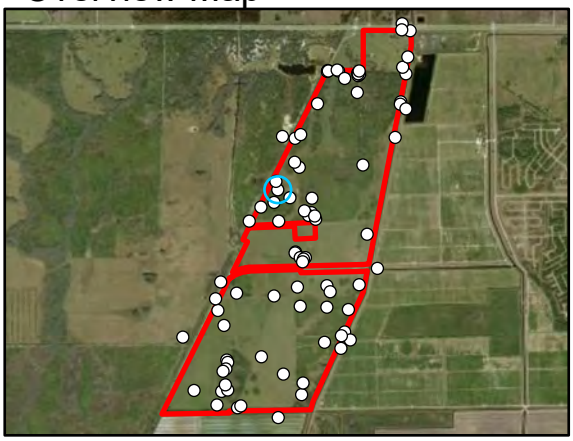


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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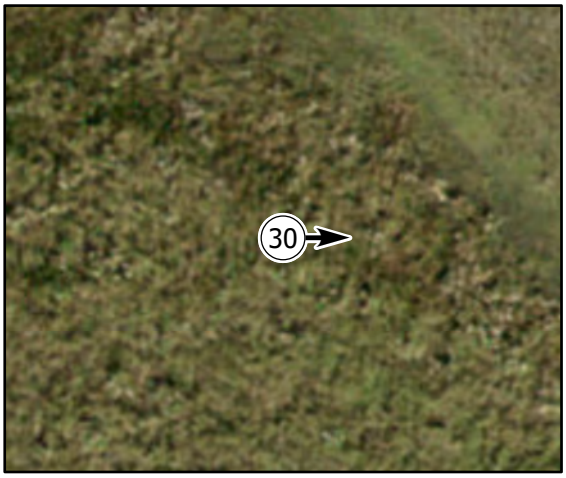
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 30:

Wetland

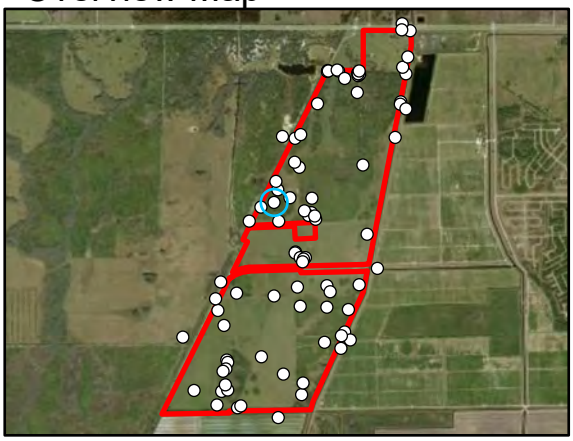


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

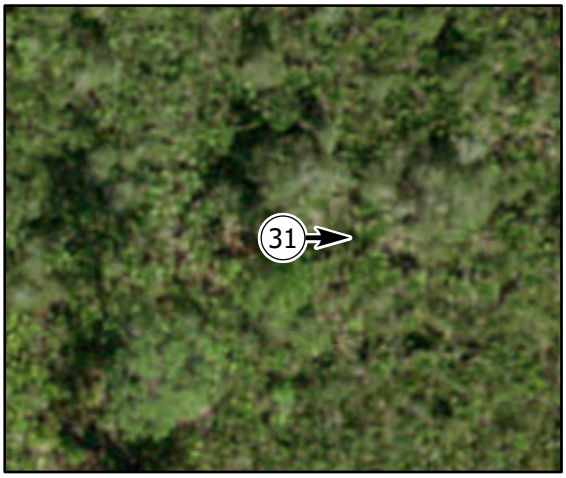
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 31:

Woodland pasture

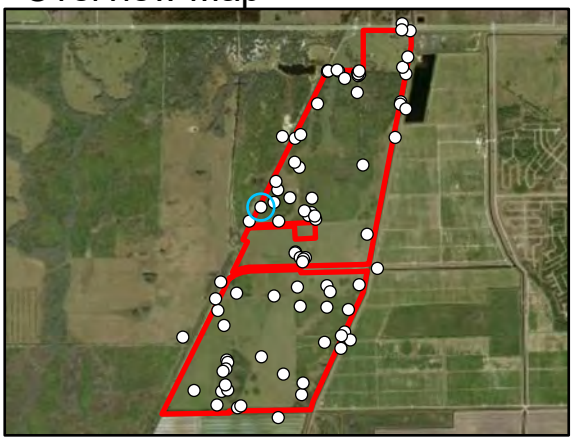


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 32:

Apiary

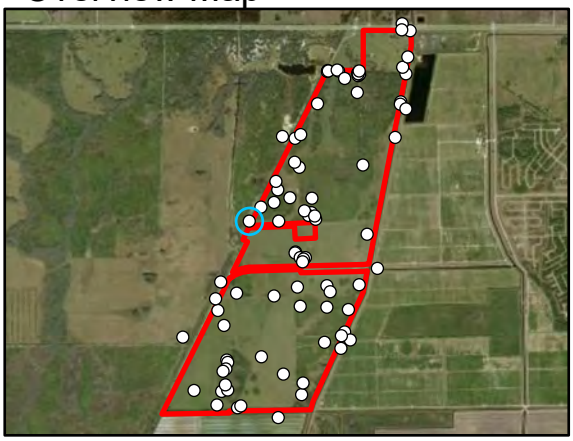


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 33:

Railroad bed

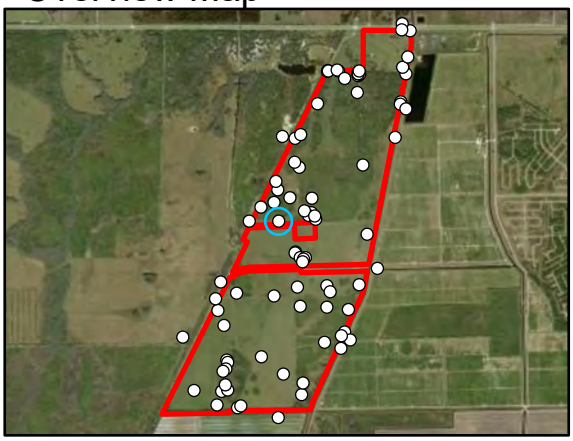


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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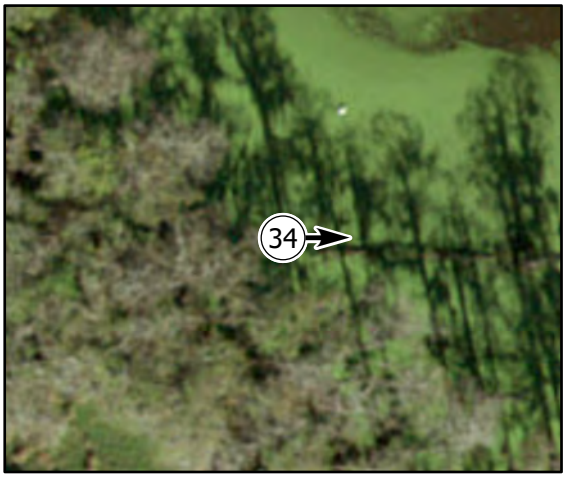
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 34:

Improved pasture, trailroad, and cypress wetland

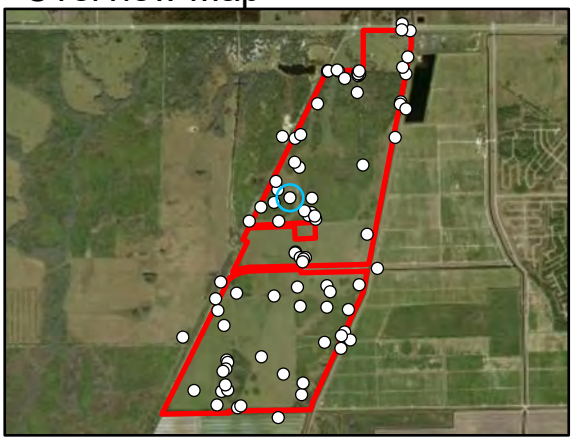


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 35:

Wetland

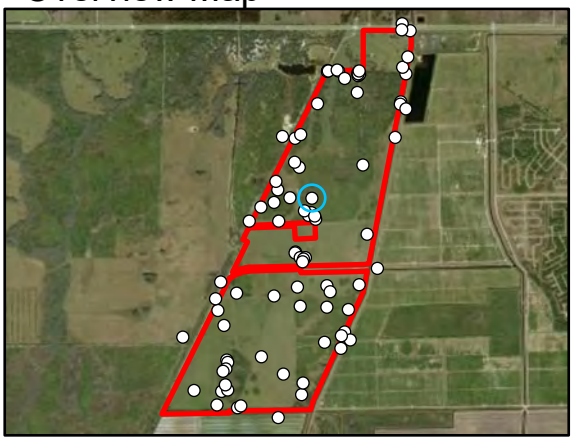


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 36:

Wetland

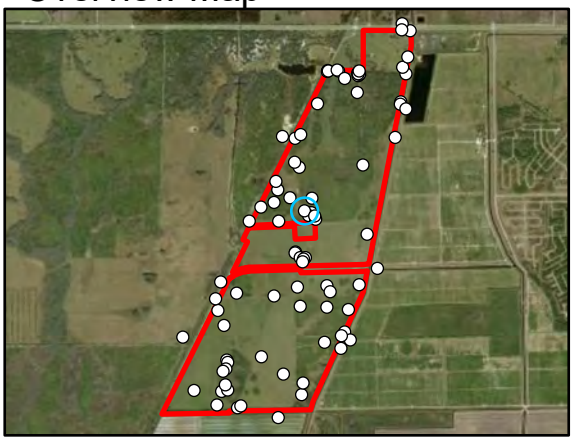


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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 37:

Cattle pond

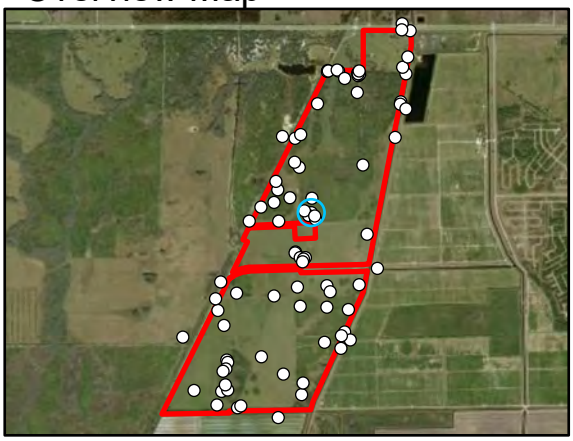


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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 38:

Old tires

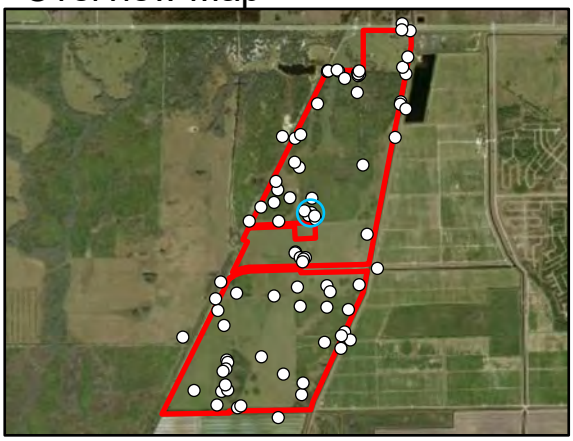


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 39:

Cattle pens

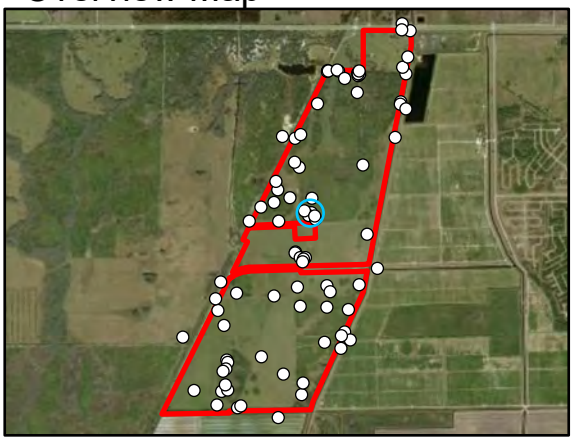


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 40:

Solar 4" well at cattle pens

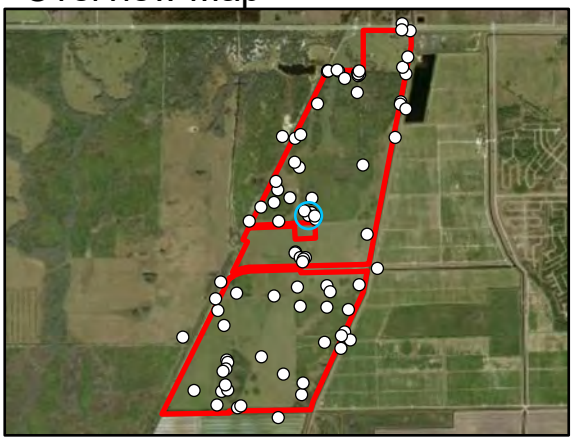


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 41:

Horse pen

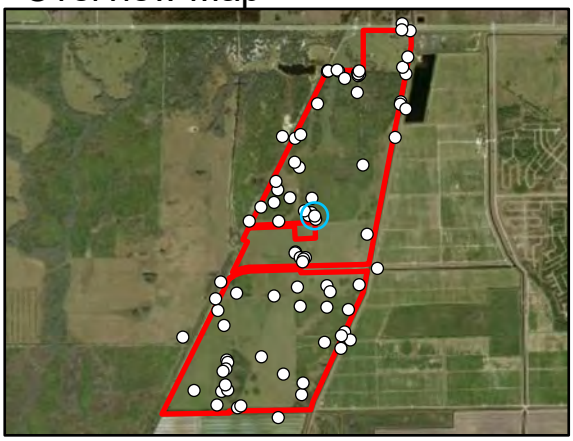


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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

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N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 42:

Brazilian peppertree

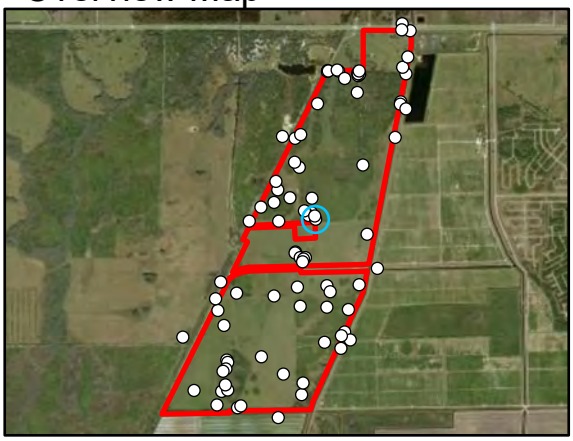


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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 43:

Cattle pond

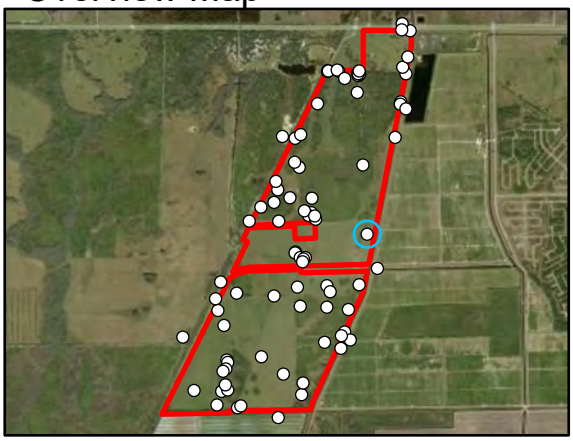


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NORTHSTAR PROJECT NO.: 40-23-510

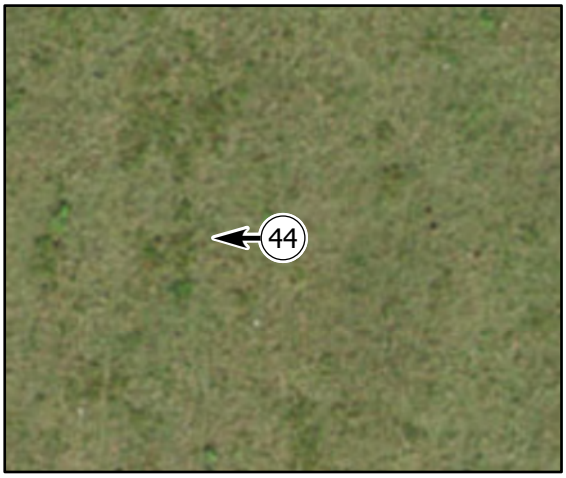
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 44:

Improved pasture

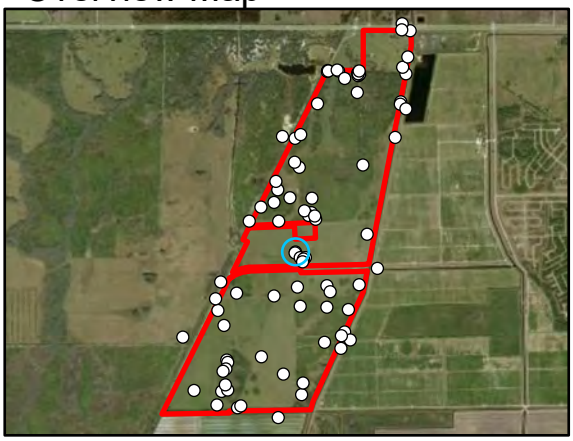


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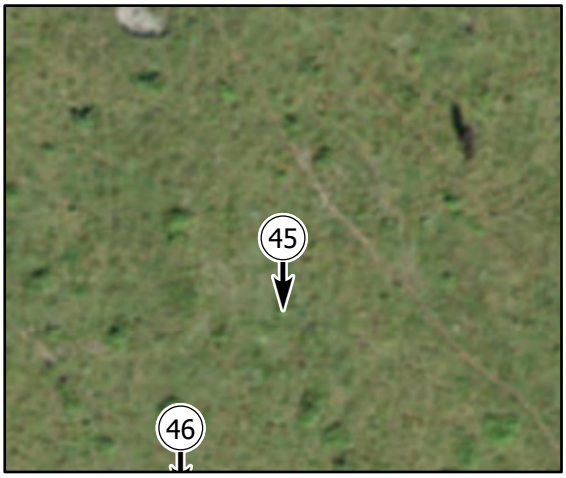
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 45:

Mineral stand

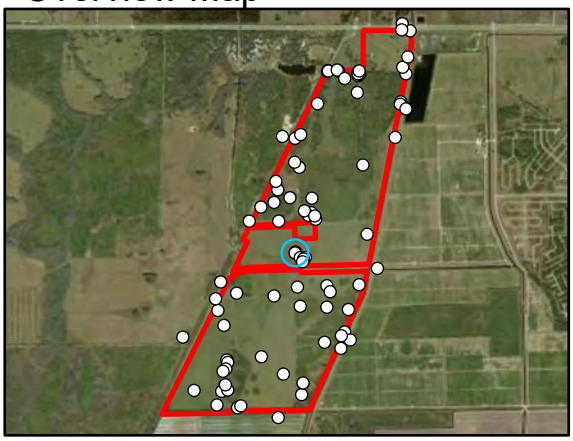


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PHOTO OBSERVATION LOG
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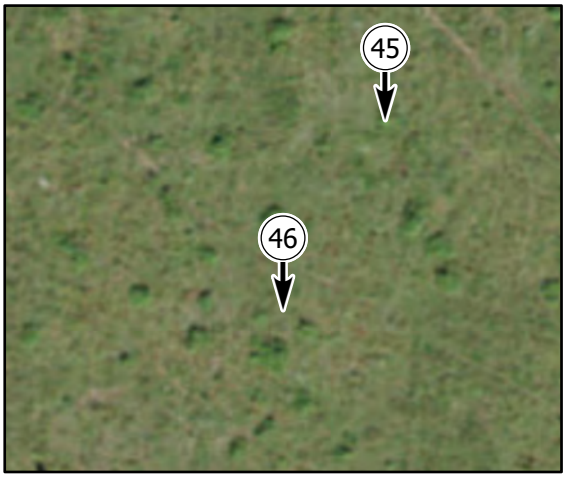
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 46:

Tropical soda apple

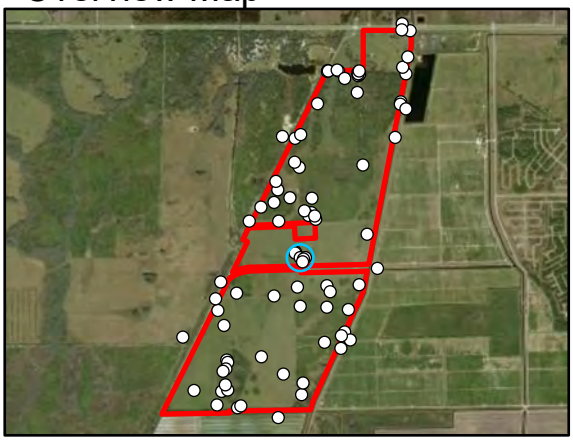


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 47:

Water trough

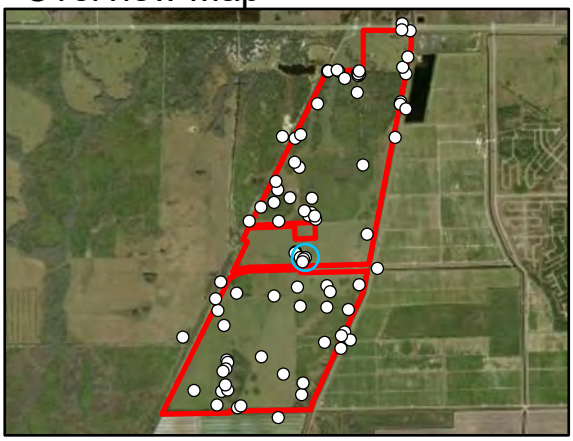


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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 48:

Water trough

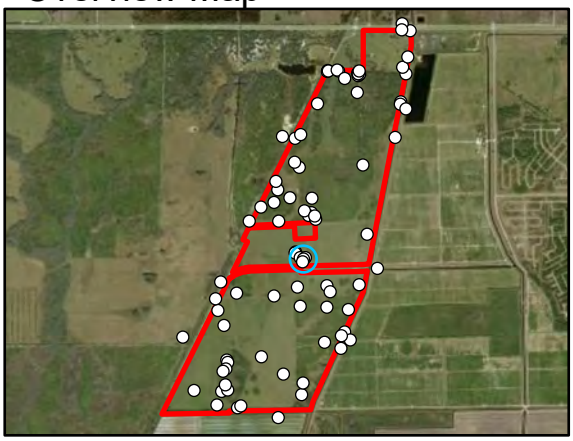


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 49:

Solar well - not identified by permit

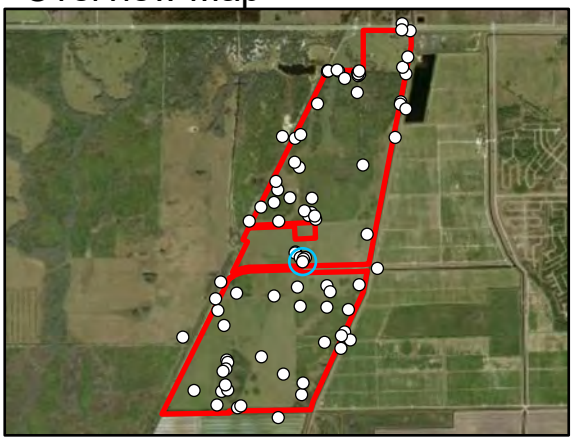


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 50:

Smutgrass

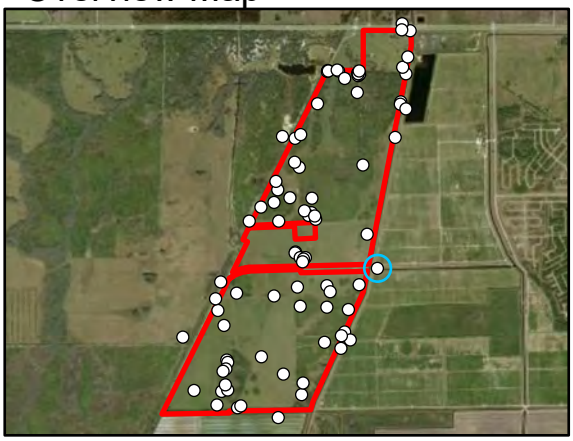


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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

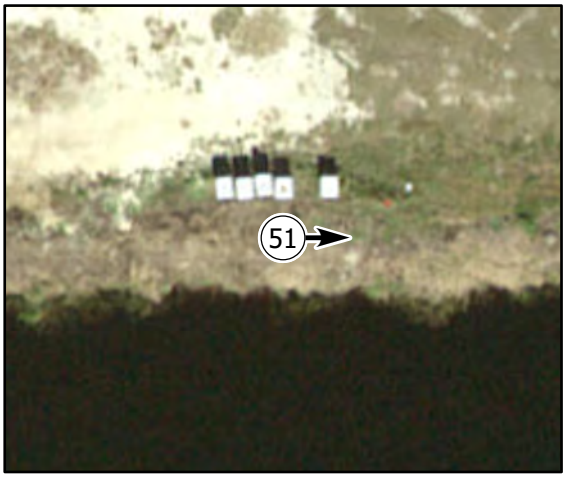
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 51:

Tractor trailer and storage tanks on adjacent property

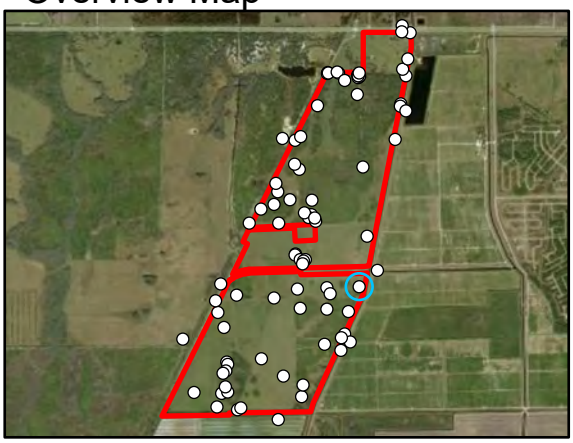


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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
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NORTHSTAR PROJECT NO.: 40-23-510

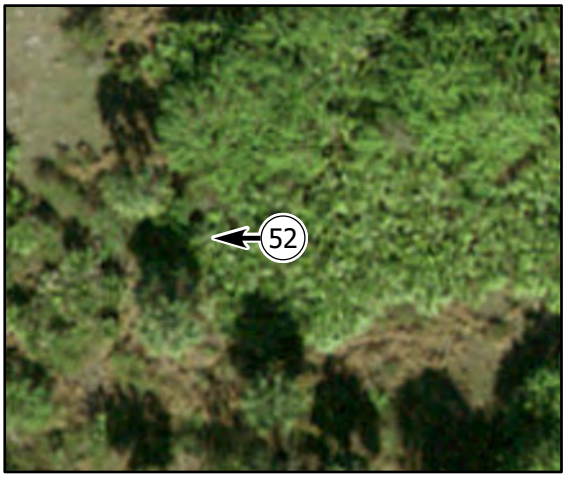
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 52:

Improved pasture

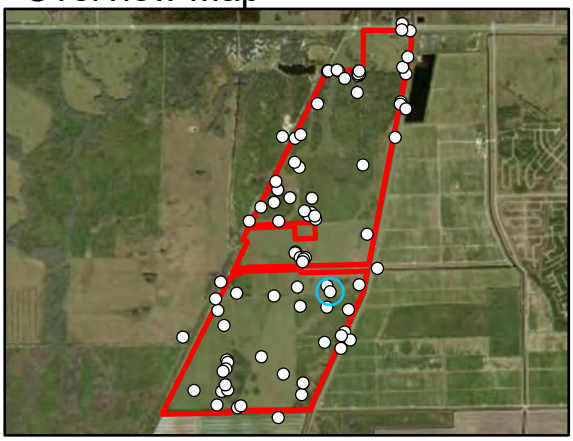


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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 53:

Wood storks

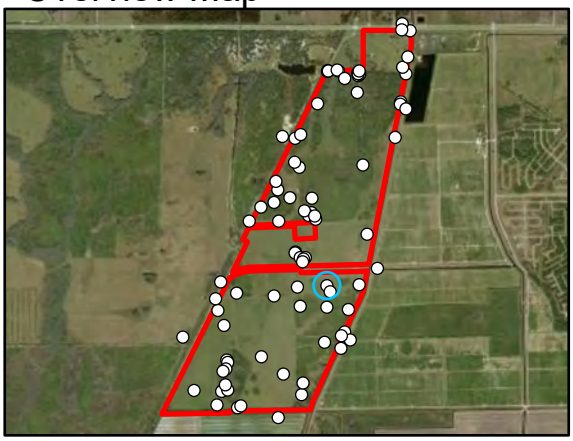


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HENDRY COUNTY, FLORIDA
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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 54:

Wetland

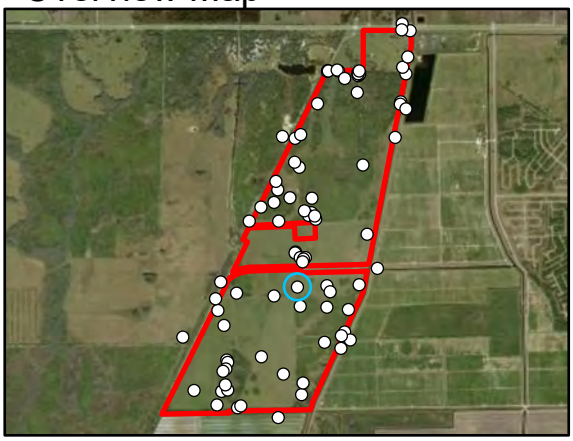


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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 55:

Improved pasture

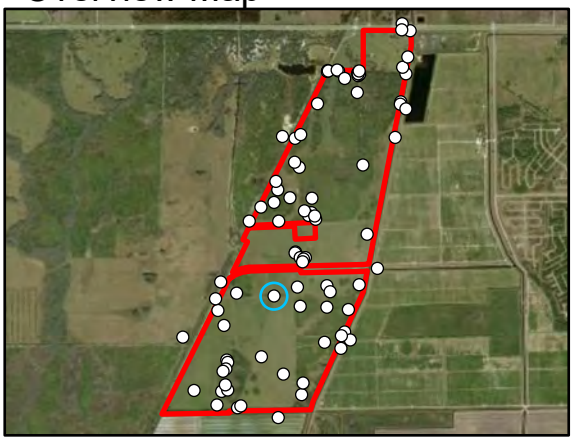


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 56:

Brazilian pepper

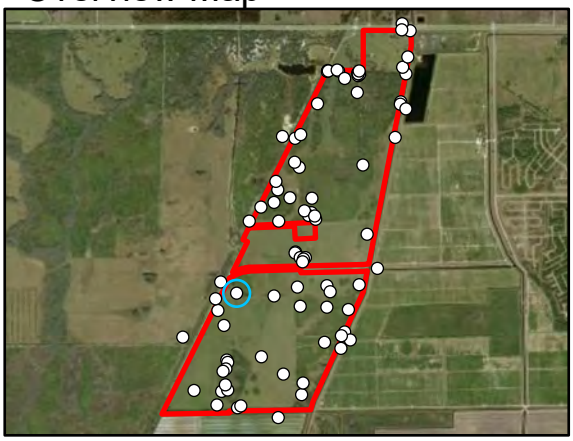


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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 57:

Woodland pasture

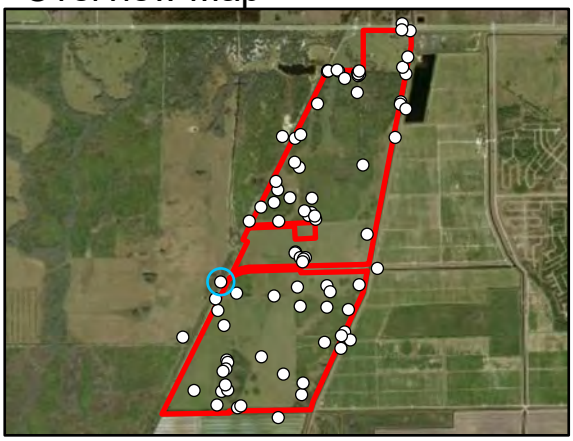


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 58:

Wood stork

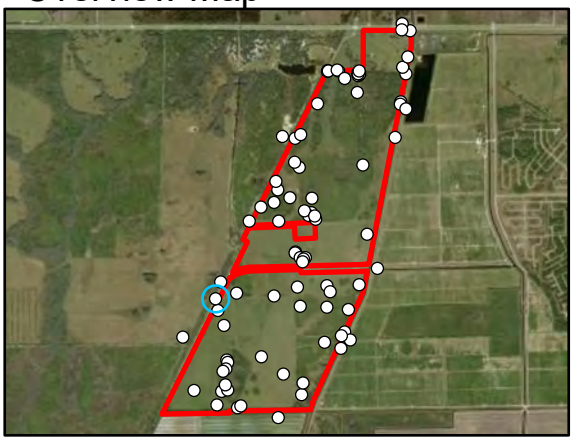


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

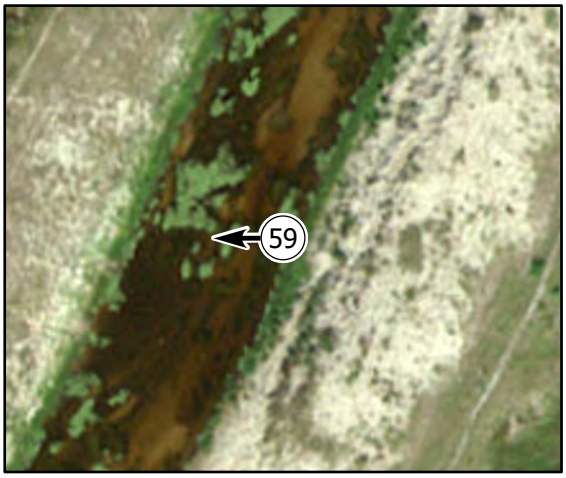
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 59:

Canal

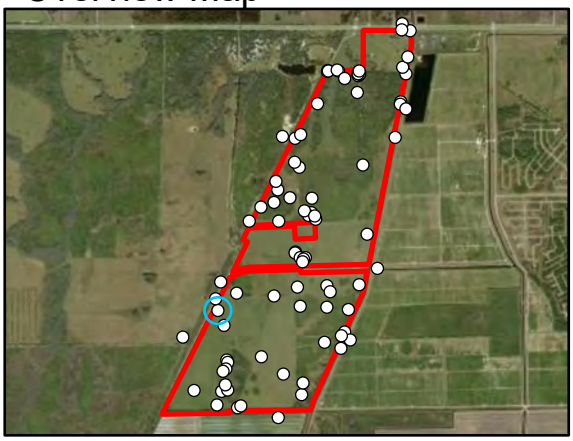


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 60:

Mineral stand

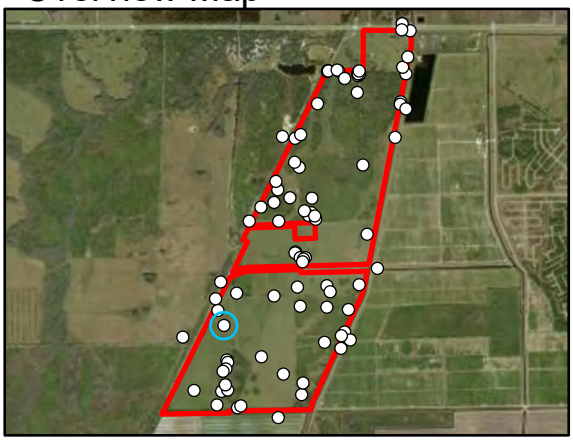


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 61:

Typical swale in improved pasture

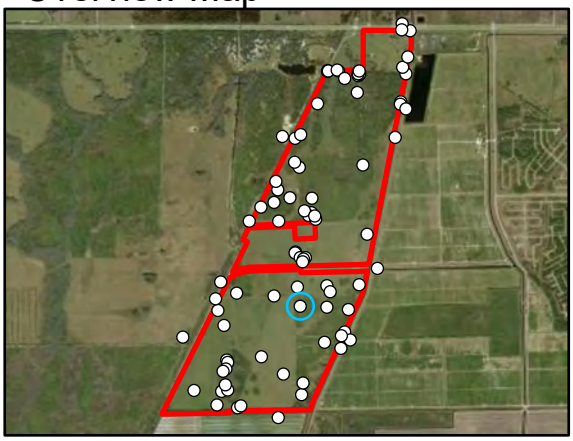


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 62:

Unimproved pasture

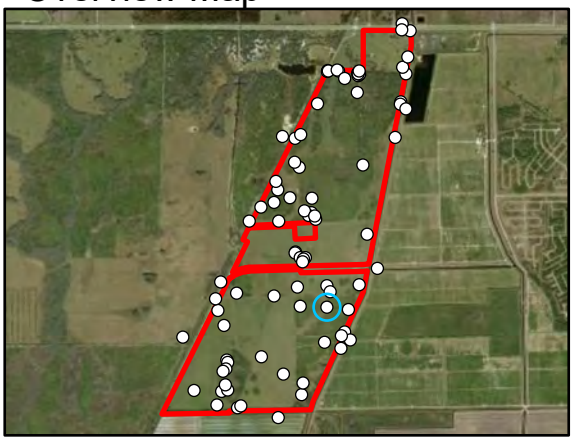


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 63:

Wetland

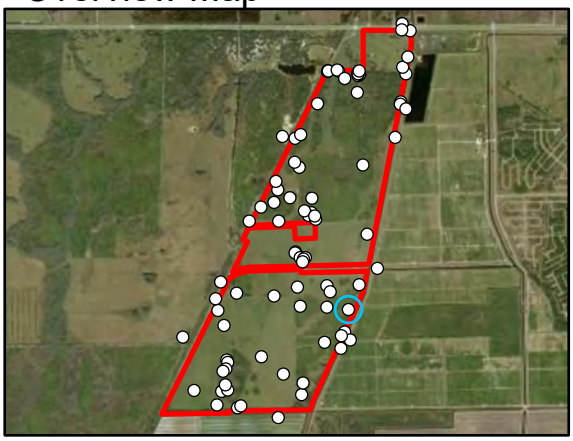


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
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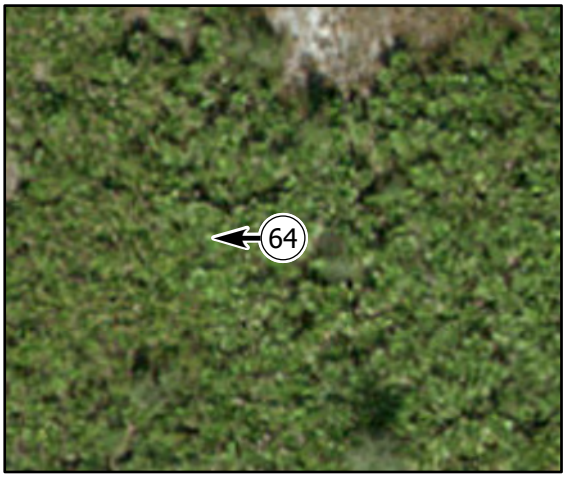
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 64:

Unimproved pasture

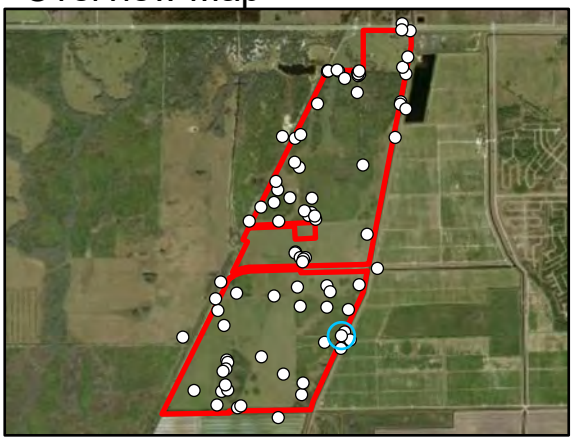


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

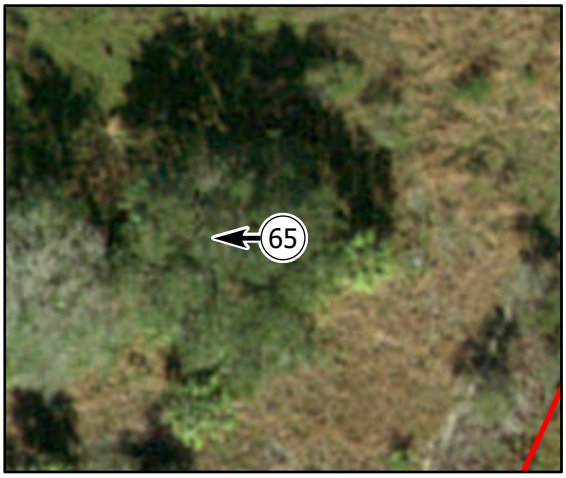
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 65:

Unimproved pasture

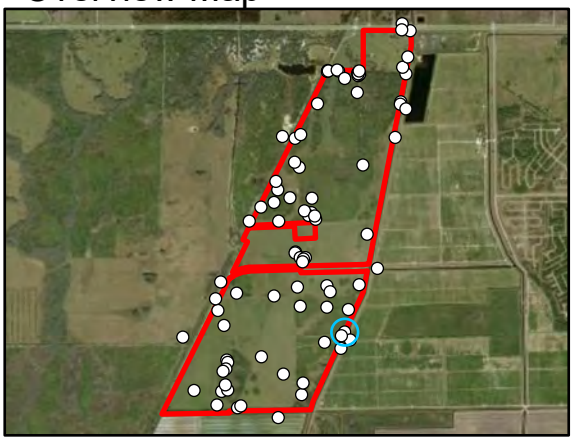


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
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Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 66:

Typical fenceline

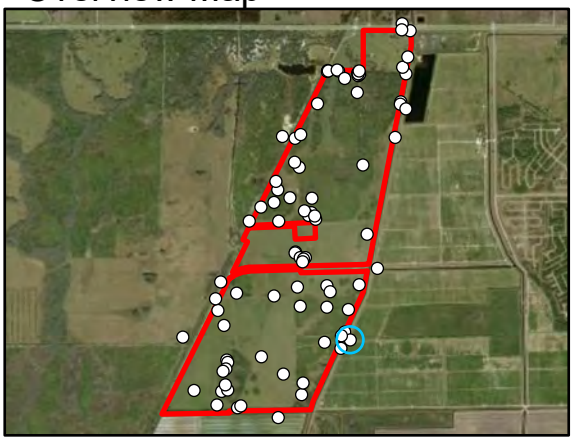


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

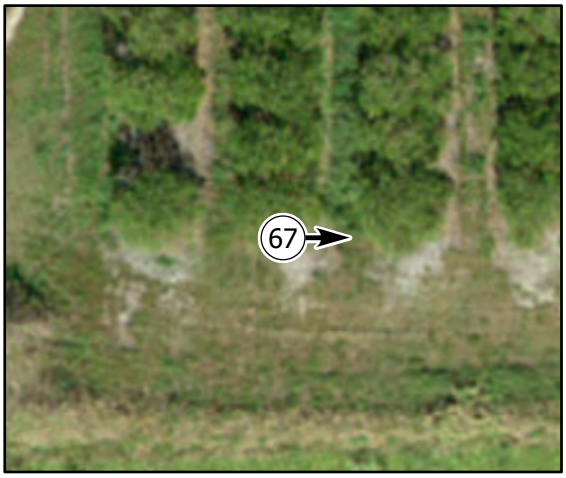
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 67:

Adjacent property to the East

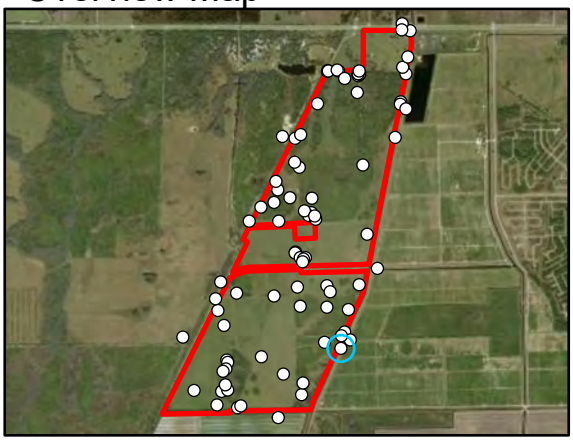


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 68:

Adjacent canal

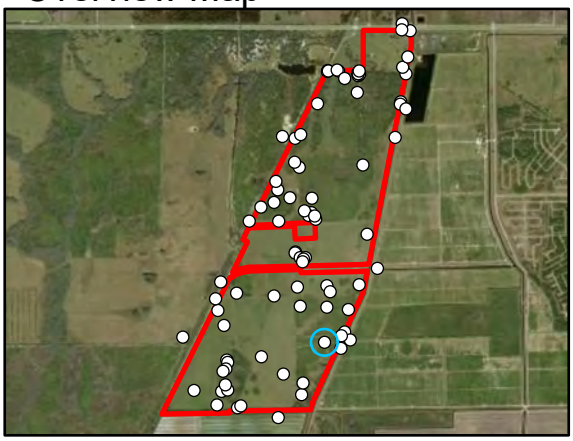


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

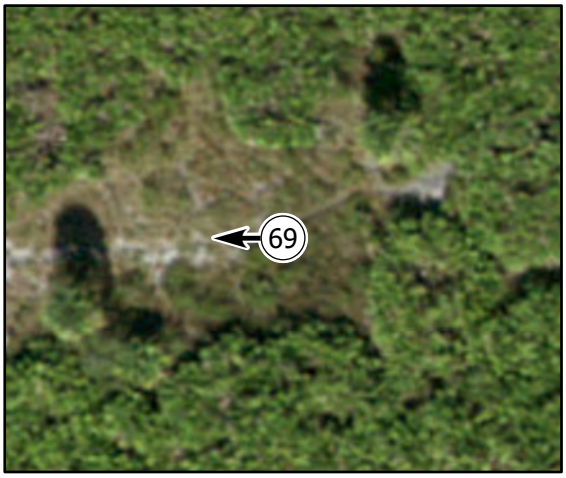
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 69:

Possible former utility corridor

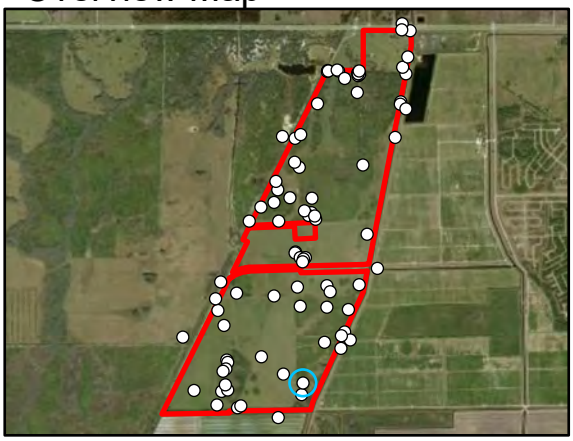


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REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 70:

Trailroad

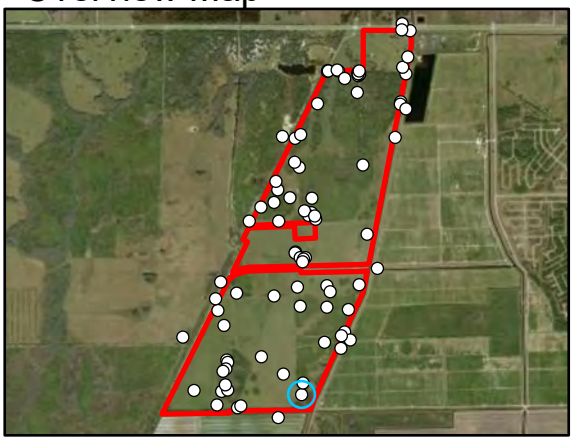


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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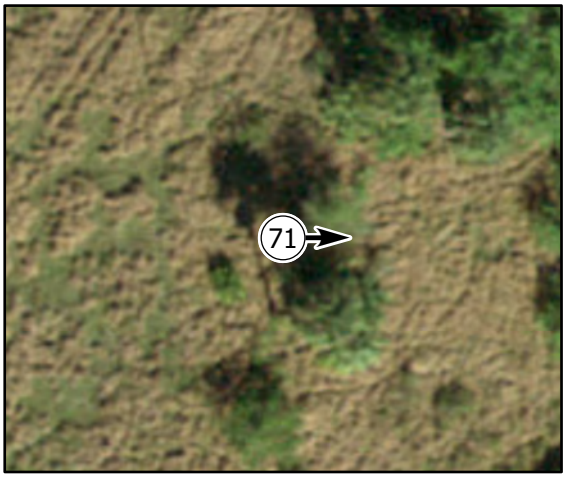
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 71:

Brazilian pepper

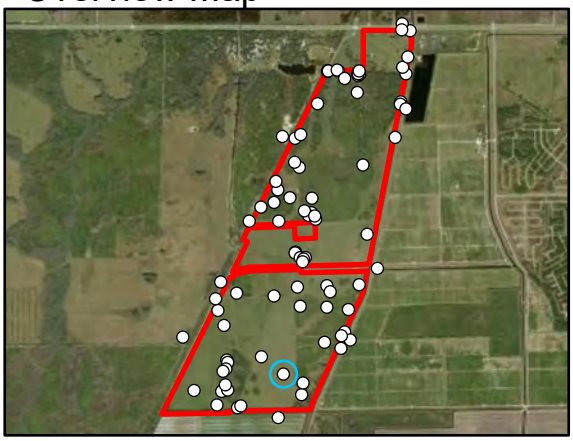


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 72:

Solar 4" well

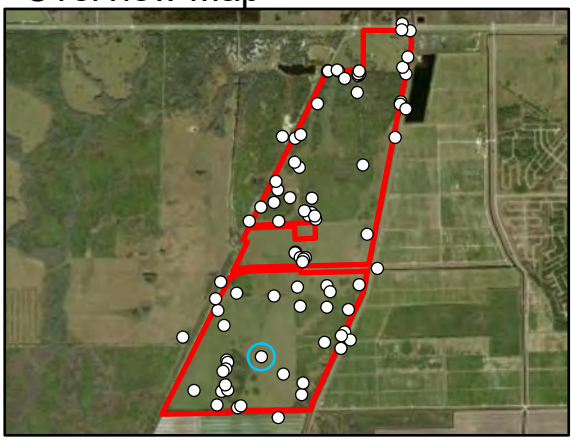


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 73:

Trailroad and swales

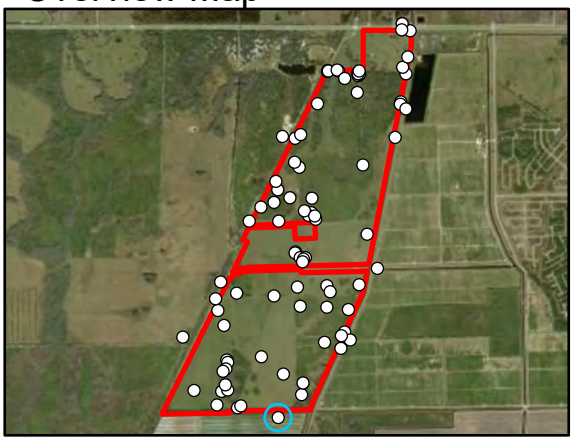


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
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HENDRY COUNTY, FLORIDA
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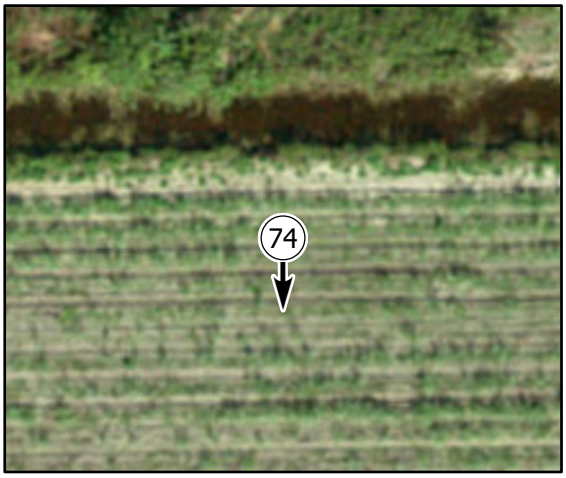
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 74:

Adjacent property to the South

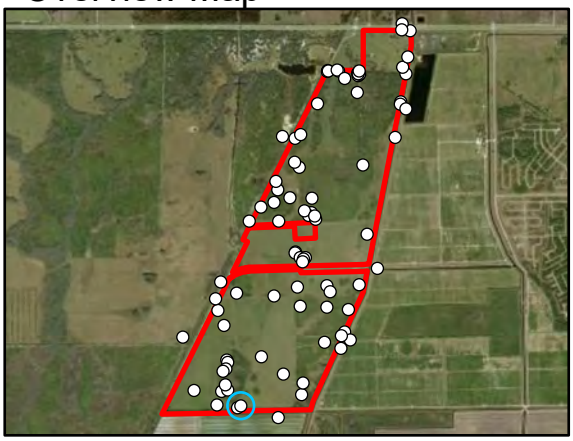


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 75:

Cattle herd

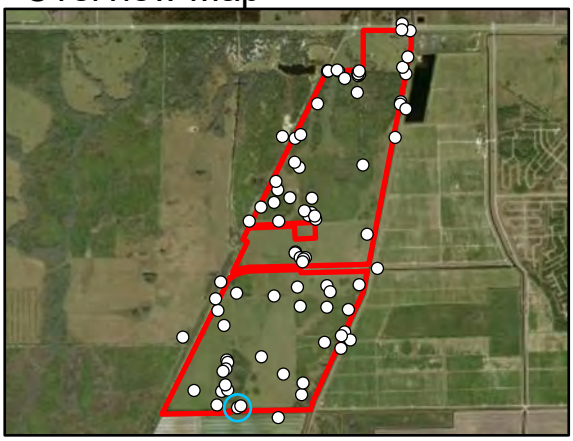


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 76:

Peruvian primrose-willow

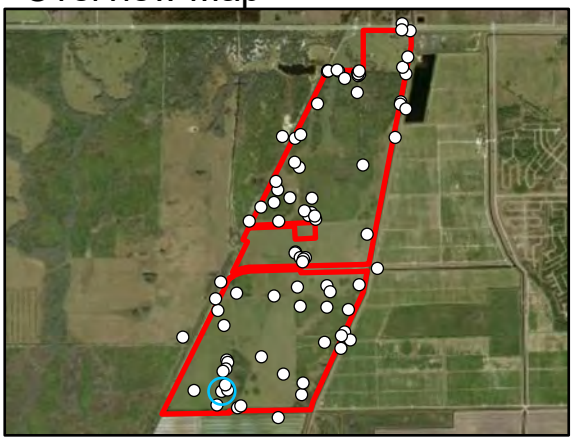


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

NorthStar
Contracting Group, Inc.
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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 77:

Forested wetland

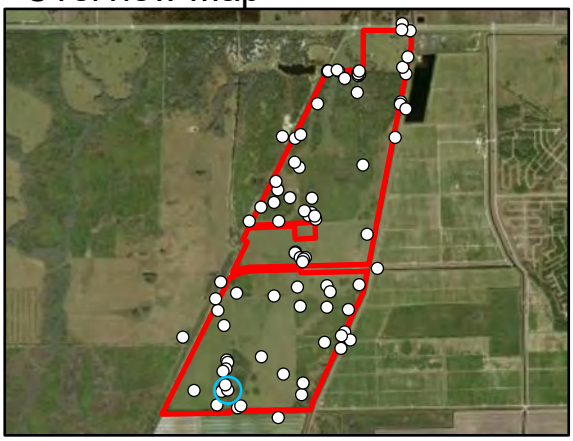


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

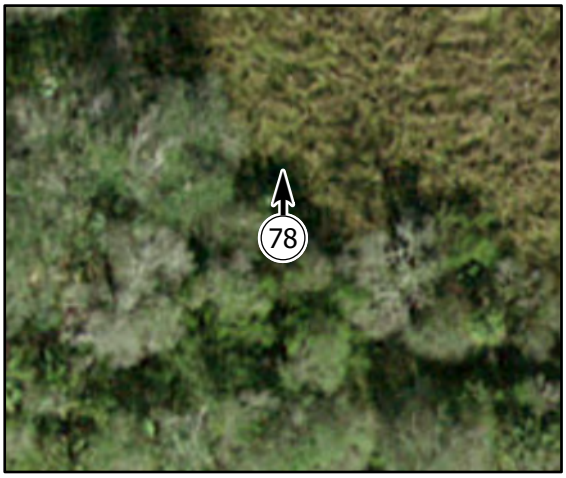
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 78:

Climbing fern

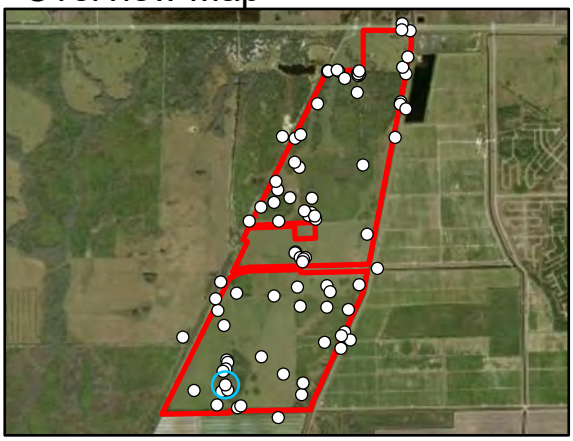


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 79:

Wetland

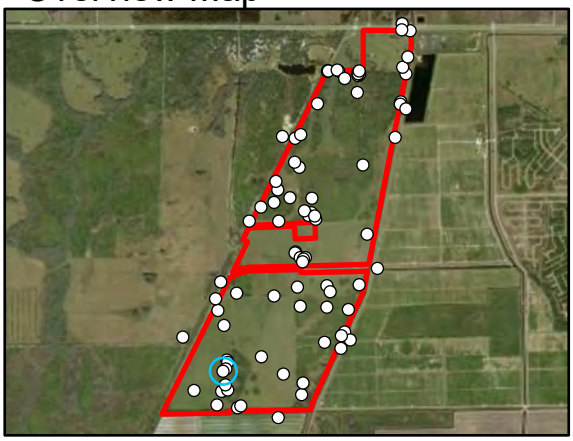


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

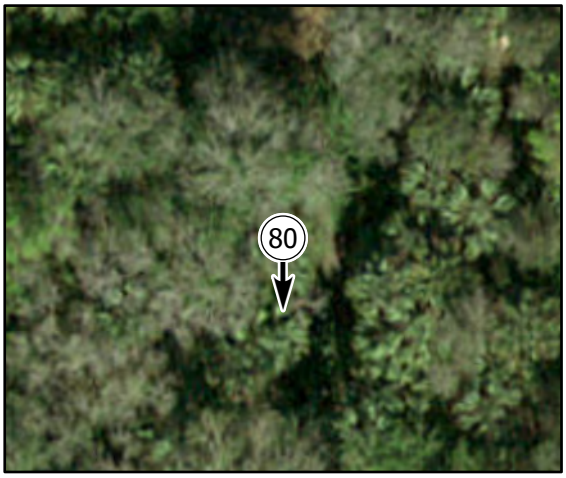
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 80:

Cabbage palm

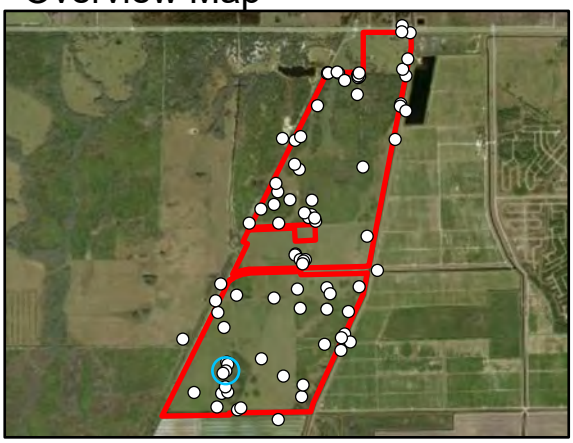


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 81:

Cypress wetland

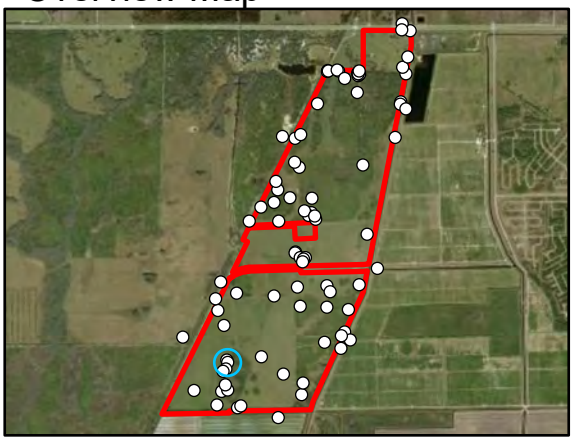


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 82:

Wetland

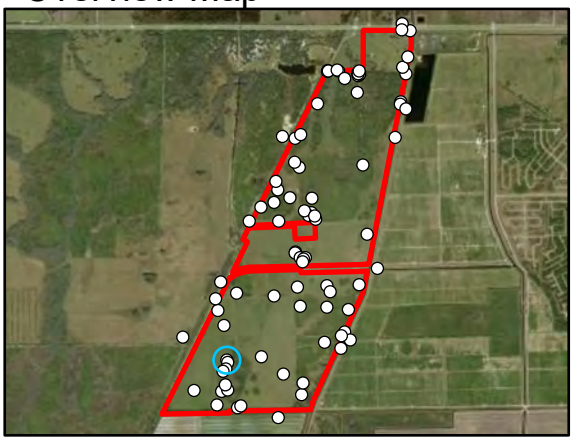


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 83:

Cypress wetland

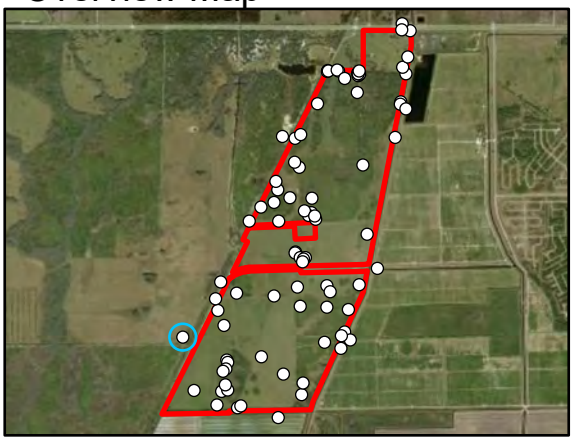


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

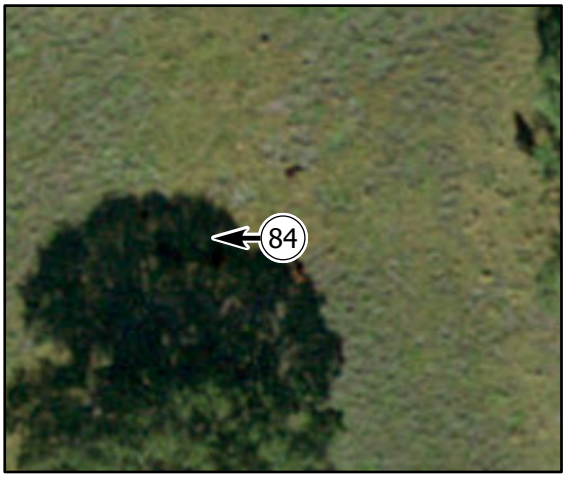
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 84:

Adjacent property to the West

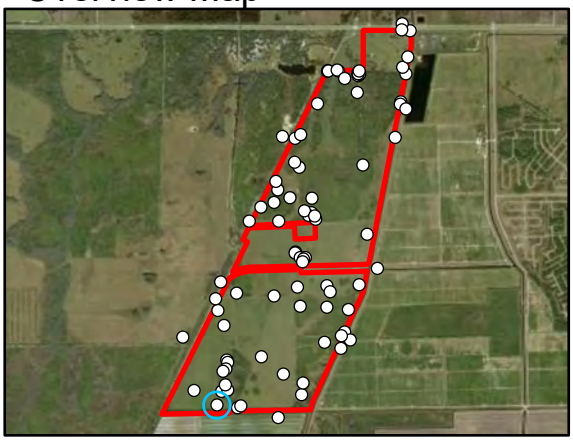


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

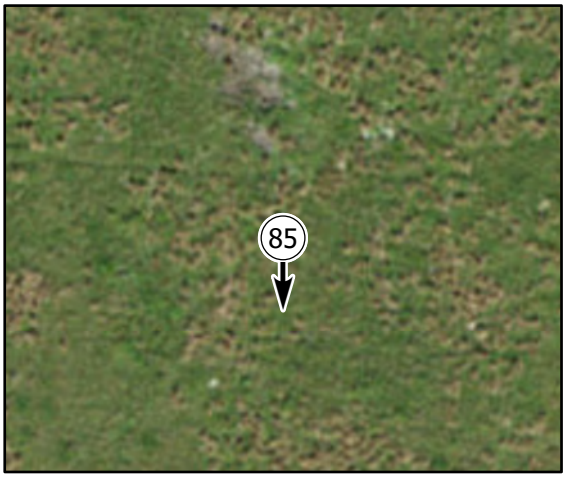
Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 85:

Improved pasture

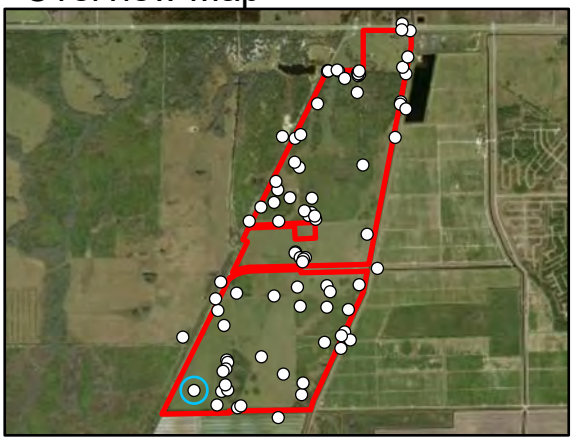


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 86:

Manure and bio solids pile

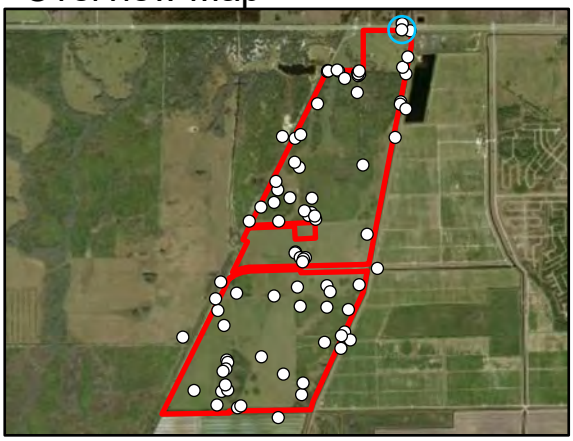


PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

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PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Overview Map



N 0 0.75 1.5 3 Miles

Detail Map

*Area shown indicated by blue outline on Overview Map.



N 0 15 30 60 Feet

Legend

Photo Observation

Ferguson-House Farms

Photograph 87:

Former cattle dip vat location



PROJECT NO.: 40-23-510		GIS ID: 4023510_POL_BDR	PROJECT MANAGER: PAMELA JACKSON, PG		
REVISION NO.: 00	REVISION DATE: N/A	DATE: 1/18/2024	DRN BY: TW	CHK BY: PS	STATUS: FINAL

NorthStar Contracting Group, Inc.
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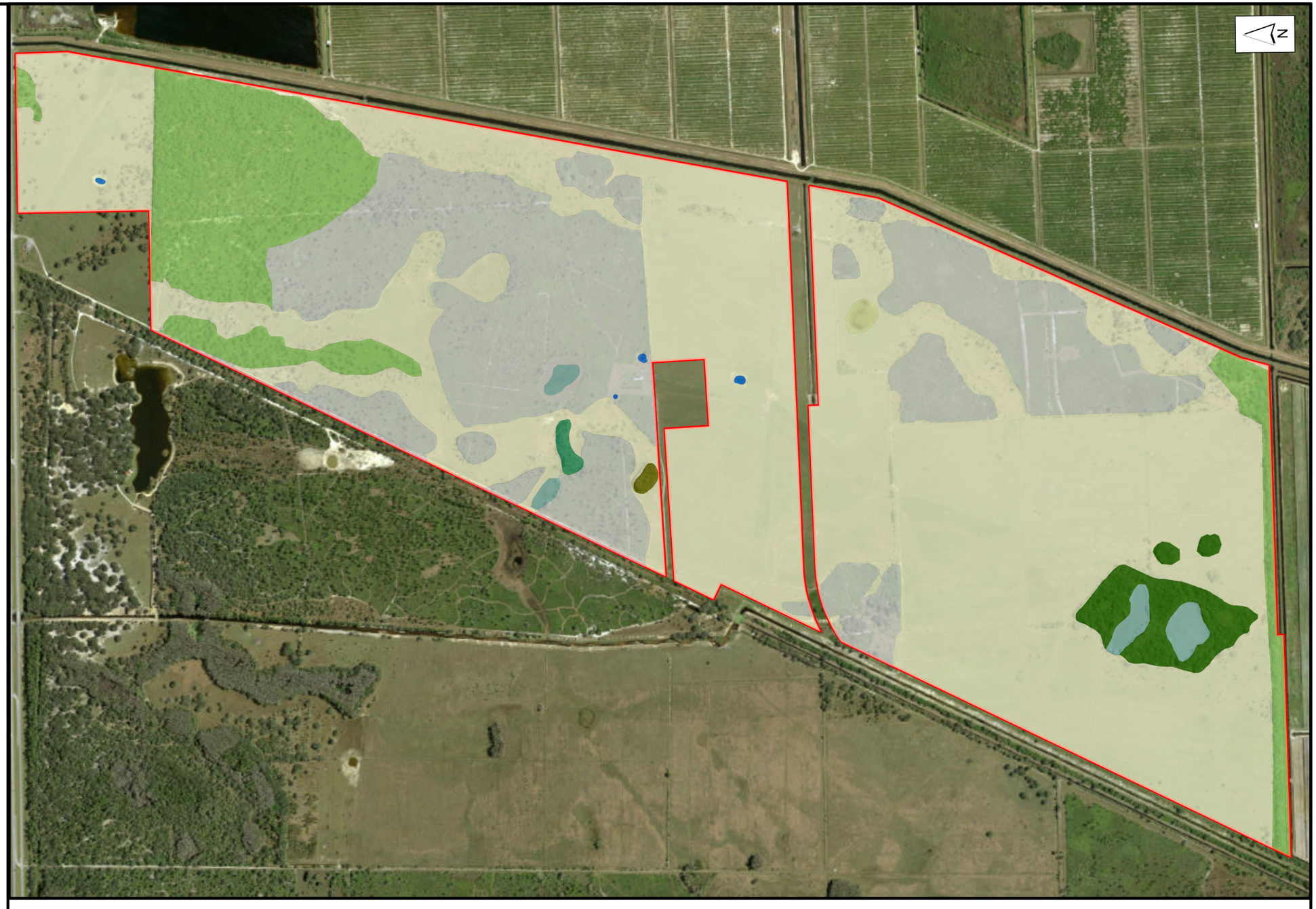
PHOTO OBSERVATION LOG
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Appendix G.
FLUCCS / Natural Communities Map and Agricultural and Natural Areas Map

FLORIDA LAND USE, COVER, AND FORMS CLASSIFICATION SYSTEM (FLUCCS)

- 2110: Improved Pastures
- 2120: Unimproved Pastures
- 2130: Woodland Pastures
- 5300: Reservoirs
- 6210: Cypress
- 6215: Cypress- Domes/Heads
- 6300: Wetland Forested Mixed
- 6410: Freshwater Marshes / Graminoid Prairie - Marsh
- 6430: Wet Prairie
- Ferguson-House Farms

FLUCCS CODE	FLUCCS Name	Acreage
2110	Improved Pastures	853.57
2120	Unimproved Pastures	360.82
2130	Woodland Pastures	160.65
5300	Reservoirs	0.64
6210	Cypress	2.71
6215	Cypress- Domes/Heads	1.52
6300	Wetland Forested Mixed	29.84
6410	Freshwater Marshes / Graminoid Prairie - Marsh	13.35
6430	Wet Prairie	2.57



IMAGERY AND DATA SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) AND FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP) GEOSPATIAL OPEN DATA - STATEWIDE LAND USE LAND COVER

0 0.25 0.5 1 Miles

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_FLUCCS	
DRN BY: TW	REVISION NO.: 00
DATE: 1/3/2024	REVISION DATE: N/A
CHK BY: PS	STATUS: FINAL

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TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

FLORIDA LAND USE, COVER, AND FORMS CLASSIFICATION SYSTEM (FLUCCS)
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Legend

Ferguson-House Farms

Area Type

Agricultural

Natural

Area Type	Acreage
Agricultural	1215.03
Natural	210.65
Total Acreage	1425.67

IMAGERY AND DATA SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT) AND FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION (FDEP) GEOSPATIAL OPEN DATA - STATEWIDE LAND USE LAND COVER

0 0.25 0.5 1 Miles

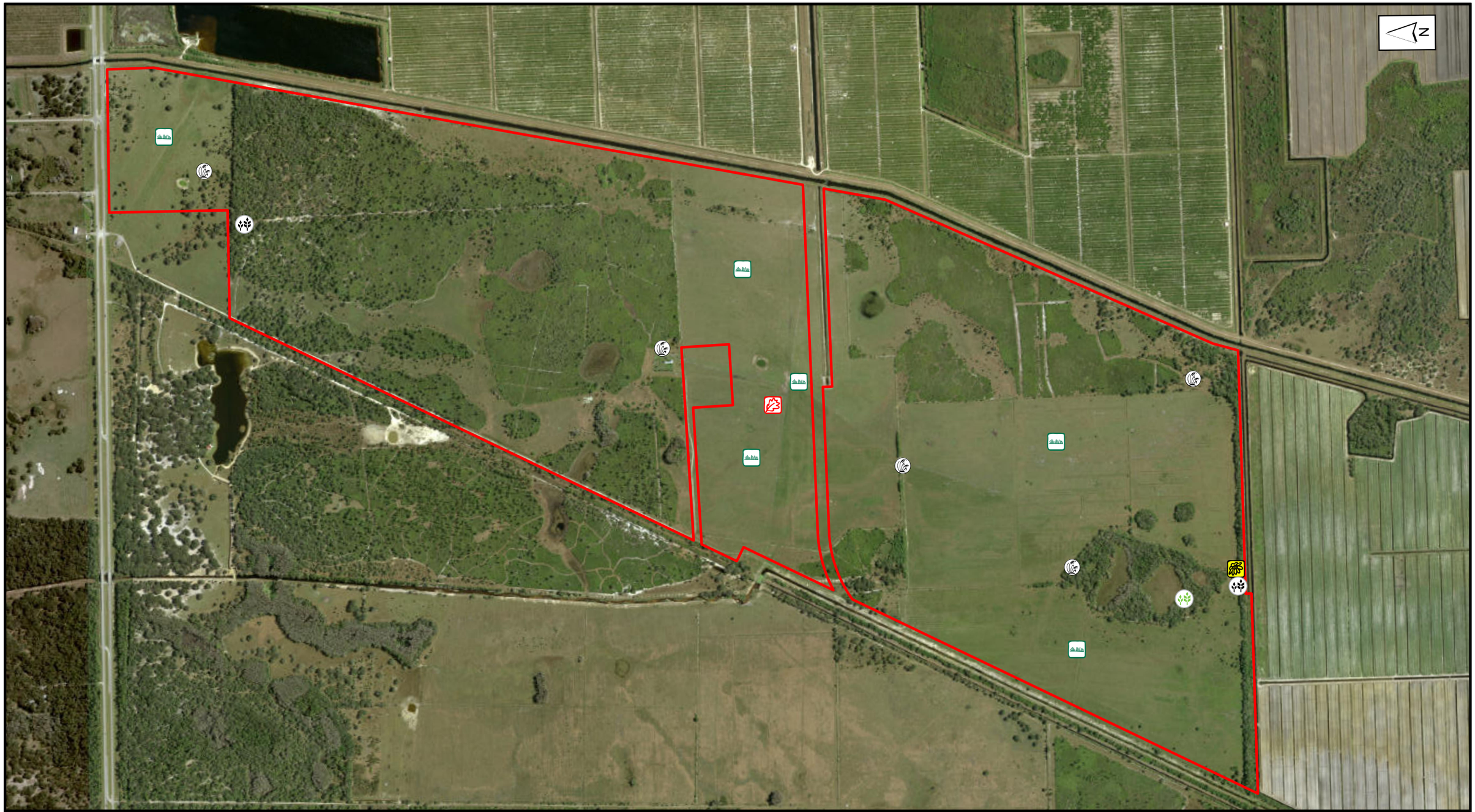
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PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_Area_Type	
DRN BY: TW	REVISION NO.: 00
DATE: 1/10/2024	REVISION DATE: N/A
CHK BY: PS	STATUS: FINAL

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TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

AGRICULTURAL AND NATURAL AREAS MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Appendix H.
Listed and Exotic Species Location Maps



Legend

- Ferguson-House Farms

Exotic Species

- Brazilian Peppertree (Schinus terebinthifolia)
- Caesar Weed (Urena lobata)
- Japanese Climbing Fern (Lygodium japonicum)
- Peruvian primrose-willow (Ludwigia peruviana)
- Smutgrass (Sporobolus indicus)
- Tropical Soda Apple (Solanum viarum)

IMAGERY SOURCE: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)

0 0.25 0.5 1 Miles

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 4023510_Exotic_Species	
DRN BY: TW	REVISION NO.: 00
DATE: 1/5/2024	REVISION DATE: N/A
CHK BY: PJ	STATUS: FINAL

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PH: (850) 661-4415

EXOTIC SPECIES MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Legend

- Ferguson-House Farms

Listed Species

- American Kestrel (Falco sparverius)
- Gopher Tortoise (Gopherus polyphemus)
- Wood Stork (Mycteria americana)
- Sandhill Crane (Grus canadensis)

IMAGERY SOURCES: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT)

0 0.25 0.5 1 Miles

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 40_23_510_Listed_Species	
DRN BY: TW	REVISION NO.: 00
DATE: 1/3/2024	REVISION DATE: N/A
CHK BY: PJ	STATUS: FINAL

NorthStar Contracting Group, Inc.

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TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

LISTED SPECIES MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

Appendix I.
FNAI Ecological Data Report

Florida
Natural Areas
Inventory

1018 Thomasville Road
Suite 200-C
Tallahassee, FL 32303
850-224-8207
fax 850-681-9364
www.fnai.org

November 30, 2023

Pamela Jackson
NorthStar Contracting Group, Inc.
325 John Knox Road, Building C Suite 100
Tallahassee, FL 32303

Dear Ms. Jackson,

Thank you for requesting information from the Florida Natural Areas Inventory (FNAI). At your request we have produced the following report for your project area.

The purpose of this Standard Data Report is to provide objective scientific information on natural resources located in the vicinity of a site of interest, in order to inform those involved in project planning and evaluation. This Report makes no determination of the suitability of a proposed project for this location, or the potential impacts of the project on natural resources in the area.

Project: Ferguson House Farms

Date Received: 11/20/2023

Location: Hendry County

Element Occurrences

A search of our maps and database indicates that we currently have a few element occurrences mapped in the vicinity of the study area (see enclosed map and element occurrence table). Please be advised that a lack of element occurrences in the FNAI database is not a sufficient indication of the absence of rare or endangered species on a site.

Federally Listed Species

Our data indicate federally listed species are present on or very near this site, specifically Florida Panther (*Puma concolor coryi*) (see enclosed map and tables for details). This statement should not be interpreted as a legal determination of presence or absence of federally listed species on a property.

The element occurrences data layer includes occurrences of rare species and natural communities. The map legend indicates that some element occurrences occur in the general vicinity of the label point. This may be due to lack of precision of the source data, or an element that occurs over an extended area (such as a wide ranging species or large natural community). For animals and plants, element occurrences generally refer to more than a casual sighting; they usually indicate a viable population of the species. Note that some element occurrences represent historically documented observations which may no longer be extant. Extirpated element occurrences will be marked with an 'X' following the occurrence label on the enclosed map.

Likely and Potential Rare Species

In addition to documented occurrences, other rare species and natural communities may be identified on or near the site based on habitat models and species range models (see enclosed Biodiversity Matrix Report). These species should be taken into consideration in field surveys, land management, and impact avoidance and mitigation.

Florida Resources
and Environmental
Analysis Center

Institute of Science
and Public Affairs

The Florida State University

FNAI habitat models indicate areas, which based on land cover type, offer suitable habitat for one or more rare species that is known to occur in the vicinity. Habitat models have been developed for approximately 300 of the rarest species tracked by the Inventory, including all federally listed species.

FNAI species range models indicate areas that are within the known or predicted range of a species, based on climate variables, soils, vegetation, and/or slope. Species range models have been developed for approximately 340 species, including all federally listed species.

The FNAI Biodiversity Matrix Geodatabase compiles Documented, Likely, and Potential species and natural communities for each square mile Matrix Unit statewide.

CLIP

The enclosed map shows natural resource conservation priorities based on the Critical Lands and Waters Identification Project. CLIP is based on many of the same natural resource data developed for the Florida Forever Conservation Needs Assessment, but provides an overall picture of conservation priorities across different resource categories, including biodiversity, landscapes, surface waters, and aggregated CLIP priorities (that combine the individual resource categories). CLIP is also based primarily on remote sensed data and is not intended to be the definitive authority on natural resources on a site.

For more information on CLIP, visit https://www.fnai.org/services/clip.

Land Acquisition Projects

This site appears to be located within the Caloosahatchee Ecoscape Florida Forever BOT Project, which is part of the State of Florida's Conservation and Recreation Lands land acquisition program. For more information on this Florida Forever Project, contact the Florida Department of Environmental Protection, Division of State Lands or visit https://floridadep.gov/lands/environmental-services/content/florida-forever.

Florida Forever Board of Trustees (BOT) projects are proposed and acquired through the Florida Department of Environmental Protection, Division of State Lands. The state has no specific land management authority over these lands until they are purchased.

The Inventory always recommends that professionals familiar with Florida's flora and fauna conduct a site-specific survey to determine the current presence or absence of rare, threatened, or endangered species.

Please visit www.fnai.org/species-communities/tracking-main for county or statewide element occurrence distributions and links to more element information.

The database maintained by the Florida Natural Areas Inventory is the single most comprehensive source of information available on the locations of rare species and other significant ecological resources. However, the data are not always based on comprehensive or site-specific field surveys. Therefore this information should not be regarded as a final statement on the biological resources of the site being considered, nor should it be substituted for on-site surveys. Inventory data are designed for the purposes of conservation planning and scientific research, and are not intended for use as the primary criteria for regulatory decisions.

Information provided by this database may not be published without prior written notification to the Florida Natural Areas Inventory, and the Inventory must be credited as an information source in these publications. **The maps contain sensitive environmental information, please do not distribute or publish without prior consent from FNAI.** FNAI data may not be resold for profit.

Thank you for your use of FNAI services. An invoice will be mailed separately. If I can be of further assistance, please contact me at (850) 224-8207 or at kbrinegar@fnai.fsu.edu.

Sincerely,

Kerri Brinegar

Kerri Brinegar
GIS / Data Services

Encl

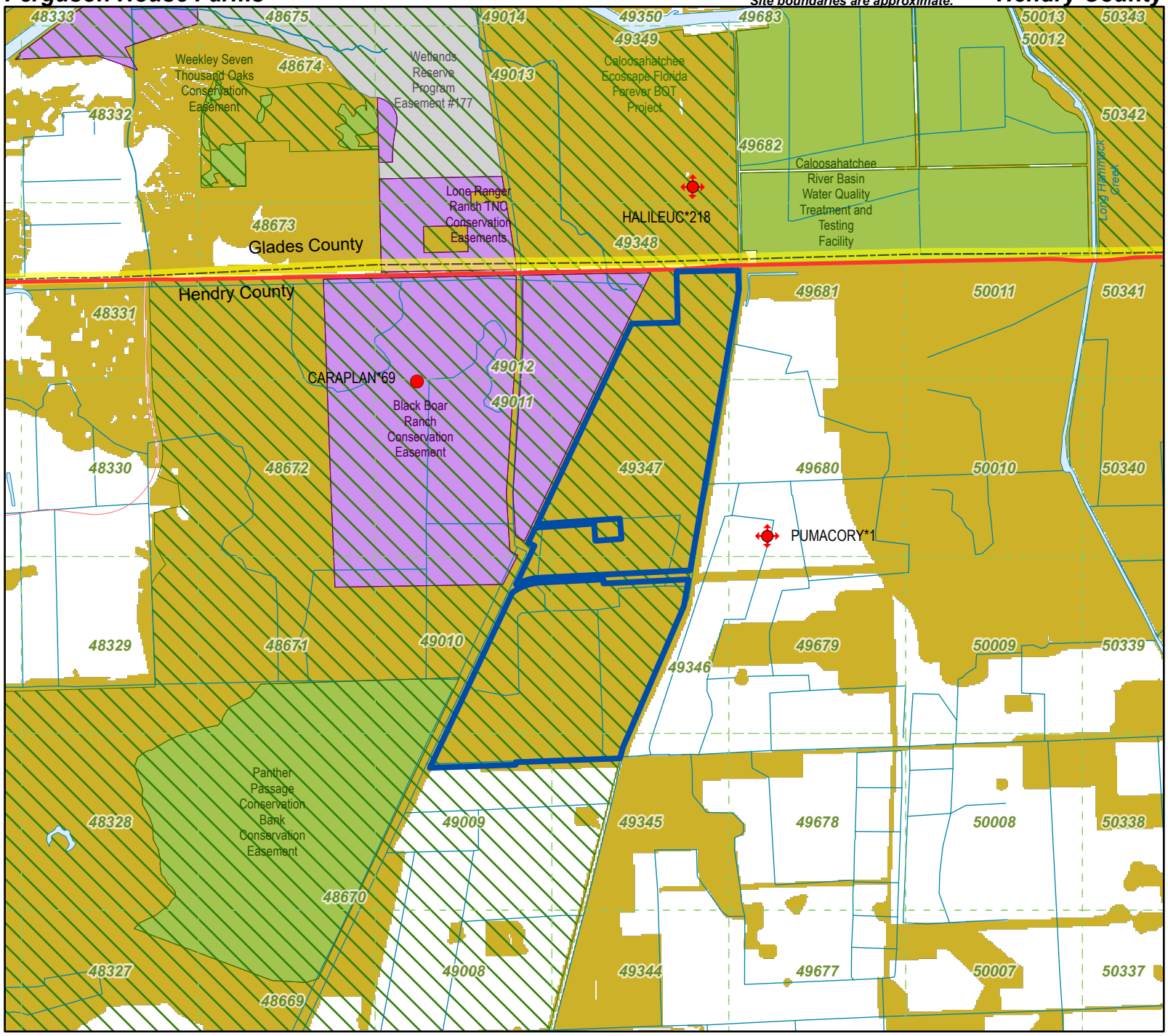
1018 Thomasville Road
Suite 200-C
Tallahassee, FL 32303
(850) 224-8207
www.fnai.org

Florida Natural Areas Inventory

Ferguson House Farms

Site boundaries are approximate.

Hendry County



N

0 0.75 1.5 3 Miles

Map produced by KAB
11/30/2023

Element Occurrences

- Animals
- Plants
- Communities
- Other
- Data Sensitive

Point Indicates General Vicinity of Element

Conservation Lands

- Federal
- State
- Local
- Private
- State Aquatic Preserves

Land Acquisition Projects

- Florida Forever Board of Trustees Projects
- FNAI Rare Species Habitat
- FNAI Biodiversity Matrix Square Mile Units
- County Boundary
- Roads
- Water

NOTE

This map contains environmentally sensitive information. Please do not distribute or publish without prior consent from FNAI. Map should not be interpreted without accompanying documents.

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Ferguson House Farms

Site boundaries are approximate.

CLIP v4.0 Resource Priorities

Biodiversity Resource Category
- Priority 1 - highest
- Priority 2
- Priority 3
- Priority 4
- Priority 5

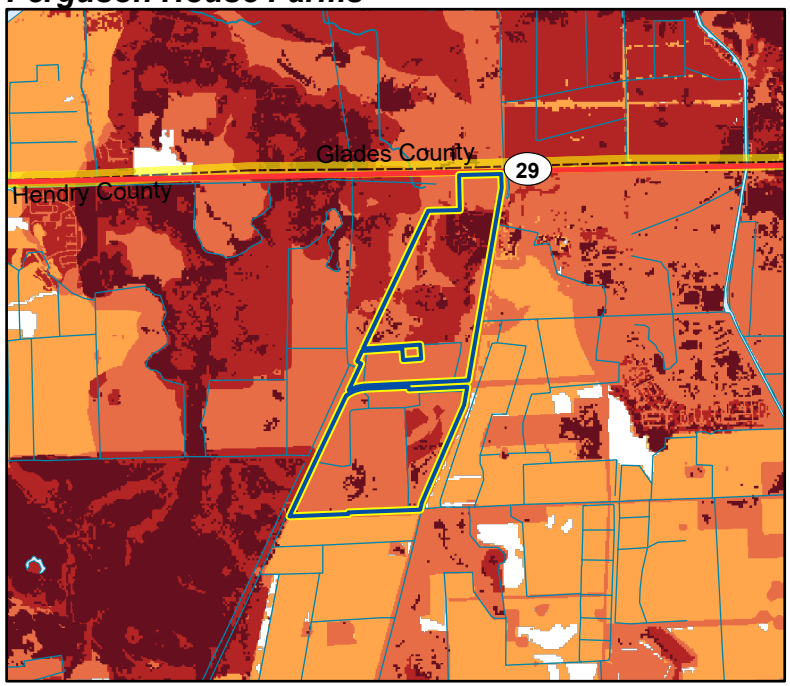
Landscape Resource Category
- Priority 1 - highest
- Priority 2
- Priority 3
- Priority 4
- Priority 5

Surface Water Resource Category
- Priority 1 - highest
- Priority 2
- Priority 3
- Priority 4
- Priority 5

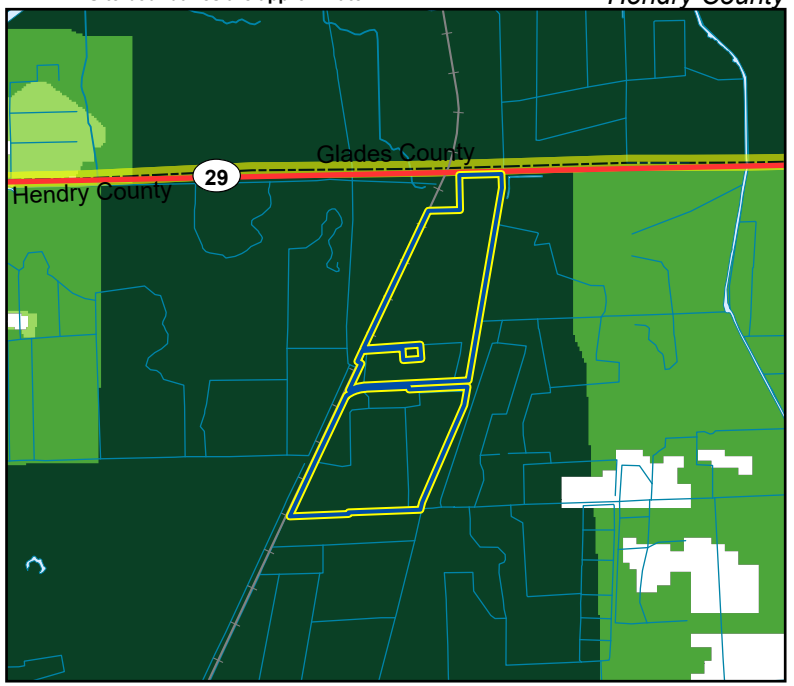
Aggregated CLIP Priorities
- Priority 1 - highest
- Priority 2
- Priority 3
- Priority 4
- Priority 5

Site Boundary

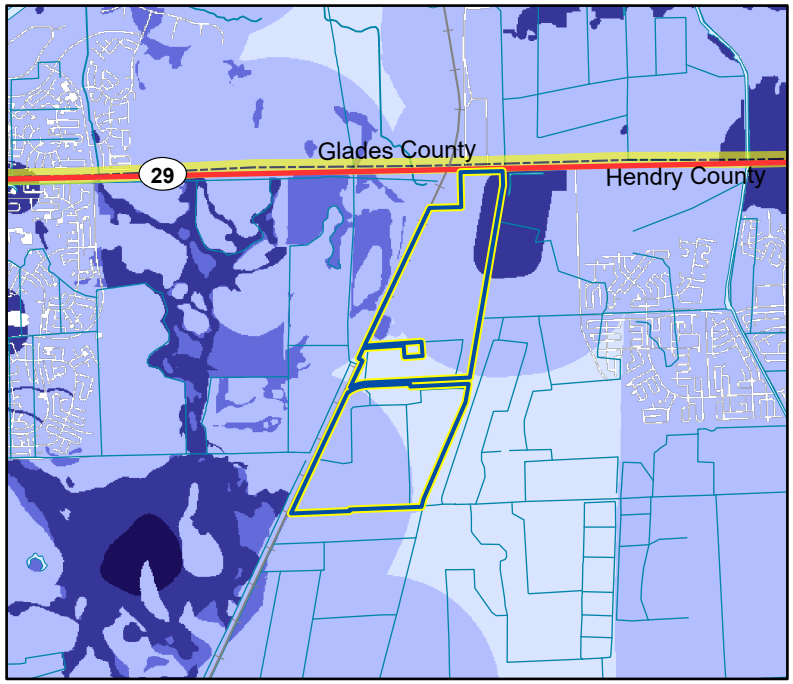
Map should not be interpreted without accompanying documents.



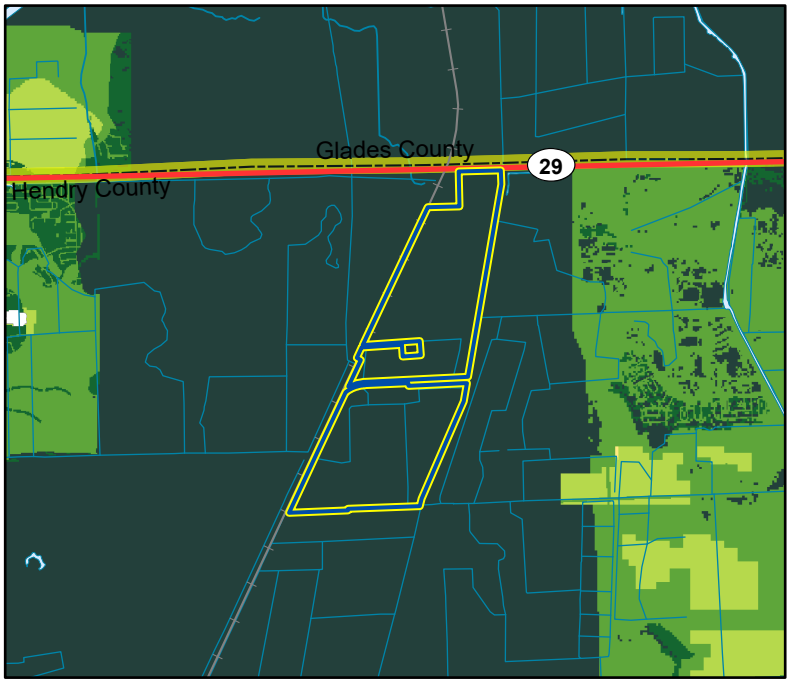
CLIP Biodiversity Resource Priorities



CLIP Landscape Resource Priorities



CLIP Surface Water Resource Priorities



CLIP Aggregated Resource Priorities

0 0.5 1 2 3 4 5 6 Miles

Hendry County

Critical Lands and Waters Identification Project (CLIP) is a cooperative effort between the FSU Florida Natural Areas Inventory, UF Center for Landscape Conservation Planning, and FL Fish & Wildlife Conservation Commission, with additional funding from FL Dept of Environmental Protection and US Fish & Wildlife Service.

Map produced by KAB
11/30/2023

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Florida Natural Areas Inventory

FNAI ELEMENT OCCURRENCE REPORT on or near

Ferguson House Farms

Map Label	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Listing	Observation Date	Description	EO Comments
CARAPLAN*69	*Caracara plancus*	Crested Caracara	G5	S2	T	FT	1989-03-05	Improved pasture (U97GFC02).	1989-03-05: R. Titus observed one adult roosting in pine beside SR 80 (U97GFC02). Located ca. 2 mi NE of mapped occurrence; FNAI assumes siting is within territory of mapped occurrence (S. Jue). 1973-1978: Active territory/breeding pair (U83LAY02).
HALILEUC*218	*Haliaeetus leucocephalus*	Bald Eagle	G5	S3	N	N	2003	No general description given	Nest status 1995-2003: Continuously active. (U03FWC01FLUS). Previous data (note different format) NEST; 1995: PRODUCED 1 YOUNG; 1994: PRODUCED 1 YOUNG; 1993: PRODUCED 1 YOUNG; 1992: ACTIVE, PRODUCED 0 YOUNG; 1991: ACTIVE, PRODUCED 0 YOUNG; 1990: PRODUCED 2 YOUNG; 1989: PRODUCED 1 YOUNG; ACTIVE 1978-1982, 1984-1988; USURPED BY OWL 1983; FLEDGED YOUNG 1979-1980, 1982, 1986, 1988; UNKNOWN 1978, 1981, 1983-1985.
PUMACORY*1	*Puma concolor coryi*	Florida Panther	G5T1	S1	E	FE	2018-02-27	1990: part of Big Cypress Swamp, includes several water courses, numerous ponds and low "uplands". Diverse habitats include wet and dry prairie, cypress forest (logged), mixed pines, mixed hardwoods; seasonally flooded (PNDMAE01FLUS).	1941-12-14: 1 specimen collected by Ross Allen, no date given, FSM #14699; specimen (FSM #12004) from 14-18 miles southeast of Immokalee, collected by Paul B. Welch (Weiland Welch Ranch). 1979-12-23: road kill from 200 yards north of Alligator Alley (FSM #11915) collected by Frank Weed, Sr. 1980-02-07: road kill from 1 mile south of Sunniland, SR-29, collected by FGFWFC (FSM #11927). 1990: 13 panthers within EO were radio-collared and monitored during 1989 and 1990 by Maehr (U90MAE01FLUS)--panthers in other occurrences also collared. Museum specimens. 2007-04-15: Panthers walked in cement and left tracks on bridge. Prints of both male and female and kitten tracks. Not mapped due to locational uncertainty. 2012: Estimated population size is between 100 and 160 adult and subadult individuals (U12FWC01FLUS). 2018-02-26: one adult and two tracks observed (F18FNA18FLUS).

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Florida Natural Areas Inventory

Aggregated Biodiversity Matrix Report

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Listing
Documented					
Puma concolor coryi	Florida Panther	G5T1	S1	E	FE
Likely					
Antigone canadensis pratensis	Florida Sandhill Crane	G5T2	S2	N	ST
Caracara plancus	Crested Caracara	G5	S2	T	FT
Drymarchon couperi	Eastern Indigo Snake	G3	S2?	T	FT
Haliaeetus leucocephalus	Bald Eagle	G5	S3	N	N
Mesic flatwoods		G4	S4	N	N
Mustela frenata peninsulae	Florida Long-tailed Weasel	G5T3?	S3?	N	N
Sciurus niger avicennia	Big Cypress Fox Squirrel	G5T2	S2	N	ST
Potential					
Athene cunicularia floridana	Florida Burrowing Owl	G4T3	S3	N	ST
Calopogon multiflorus	many-flowered grass-pink	G2G3	S2S3	N	T
Centrosema arenicola	sand butterfly pea	G2Q	S2	N	E
Coleataenia abscissa	cutthroatgrass	G3	S3	N	E
Dryobates borealis	Red-cockaded Woodpecker		S2	E, PT	FE
Eumops floridanus	Florida bonneted bat	G1	S1	E	FE
Gopherus polyphemus	Gopher Tortoise	G3	S3	N	ST
Gymnopogon chapmanianus	Chapman's skeletongrass		S3	N	N
Lechea cernua	nodding pinweed		S3	N	T
Linum smallii	Small's flax	G2	S2	N	E
Lithobates capito	Gopher Frog	G2G3	S3	UR	N
Matelea floridana	Florida spiny-pod	G2	S2	N	E
Nemastylis floridana	celestial lily	G3	S3	N	E
Neofiber alleni	Round-tailed Muskrat	G2	S2	N	N
Nolina atopocarpa	Florida beargrass	G3	S3	N	T
Peucaea aestivalis	Bachman's Sparrow		S3	N	N
Platanthera integra	yellow fringeless orchid	G3G4	S2	N	E
Podomys floridanus	Florida Mouse	G3	S3	N	N
Salix floridana	Florida willow	G2G3	S2S3	UR	E
Sciurus niger niger	Southeastern Fox Squirrel	G5T5	S3	N	N
Ursus americanus floridanus	Florida Black Bear	G5T4	S4	N	N

Definitions: *Documented - Rare species and natural communities documented on or near this site.*
Documented-Historic - Rare species and natural communities documented, but not observed/reported within the last twenty years.
Likely - Rare species and natural communities likely to occur on this site based on suitable habitat and/or known occurrences in the vicinity.
Potential - This site lies within the known or predicted range of the species listed.

Elements and Element Occurrences

An **element** is any exemplary or rare component of the natural environment, such as a species, natural community, bird rookery, spring, sinkhole, cave, or other ecological feature.

An **element occurrence (EO)** is an area of land and/or water in which a species or natural community is, or was, present. An EO should have practical conservation value for the Element as evidenced by potential continued (or historical) presence and/or regular recurrence at a given location.

Element Ranking and Legal Status

Using a ranking system developed by NatureServe and the Natural Heritage Program Network, the Florida Natural Areas Inventory assigns two ranks for each element. The global rank is based on an element's worldwide status; the state rank is based on the status of the element in Florida. Element ranks are based on many factors, the most important ones being estimated number of Element Occurrences (EOs), estimated abundance (number of individuals for species; area for natural communities), geographic range, estimated number of adequately protected EOs, relative threat of destruction, and ecological fragility.

FNAI GLOBAL ELEMENT RANK

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2 = Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
G3 = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
G4 = Apparently secure globally (may be rare in parts of range).
G5 = Demonstrably secure globally.
GH = Of historical occurrence throughout its range, may be rediscovered (e.g., ivory-billed woodpecker).
GX = Believed to be extinct throughout range.
GXC = Extirpated from the wild but still known from captivity or cultivation.
G#? = Tentative rank (e.g., G2?).
G#G# = Range of rank; insufficient data to assign specific global rank (e.g., G2G3).
G#T# = Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1).
G#Q = Rank of questionable species - ranked as species but questionable whether it is species or subspecies; numbers have same definition as above (e.g., G2Q).
G#T#Q = Same as above, but validity as subspecies or variety is questioned.
GU = Unrankable; due to a lack of information no rank or range can be assigned (e.g., GUT2).
GNA = Ranking is not applicable because the element is not a suitable target for conservation (e.g. a hybrid species).
GNR = Element not yet ranked (temporary).
GNRTNR = Neither the element nor the taxonomic subgroup has yet been ranked.

FNAI STATE ELEMENT RANK

S1 = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
S2 = Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
S3 = Either very rare and local in Florida (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
S4 = Apparently secure in Florida (may be rare in parts of range).
S5 = Demonstrably secure in Florida.
SH = Of historical occurrence in Florida, possibly extirpated, but may be rediscovered (e.g., ivory-billed woodpecker).
SX = Believed to be extirpated throughout Florida.
SU = Unrankable; due to a lack of information no rank or range can be assigned.
SNA = State ranking is not applicable because the element is not a suitable target for conservation (e.g. a hybrid species).
SNR = Element not yet ranked (temporary).

FEDERAL LEGAL STATUS

Legal status information provided by FNAI for information only. For official definitions and lists of protected species, consult the relevant federal agency.

Definitions derived from U.S. Endangered Species Act of 1973, Sec. 3. Note that the federal status given by FNAI refers only to Florida populations and that federal status may differ elsewhere.

C = Candidate species for which federal listing agencies have sufficient information on biological vulnerability and threats to support proposing to list the species as Endangered or Threatened.
E = Endangered: species in danger of extinction throughout all or a significant portion of its range.
E, T = Species currently listed endangered in a portion of its range but only listed as threatened in other areas
E, PDL = Species currently listed endangered but has been proposed for delisting.
E, PT = Species currently listed endangered but has been proposed for listing as threatened.
E, XN = Species currently listed endangered but tracked population is a non-essential experimental population.
T = Threatened: species likely to become Endangered within the foreseeable future throughout all or a significant portion of its range.
PE = Species proposed for listing as endangered.
PS = - An infraspecific taxon or population has federal status but the entire species does not - status is in only a portion of the species range.
PT = Species proposed for listing as threatened.
SAT = Treated as threatened due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species.
SC = Not currently listed, but considered a "species of concern" to USFWS.
DL = Delisted.
UR = Under review.

STATE LEGAL STATUS

Provided by FNAI for information only. For official definitions and lists of protected species, consult the relevant state agency.

Animals: Definitions derived from "Florida's Endangered Species and Species of Special Concern, Official Lists" published by Florida Fish and Wildlife Conservation Commission, 1 August 1997, and subsequent updates.

C = Candidate for listing at the Federal level by the U. S. Fish and Wildlife Service
FE = Listed as Endangered Species at the Federal level by the U. S. Fish and Wildlife Service
FT = Listed as Threatened Species at the Federal level by the U. S. Fish and Wildlife Service
FXN = Federal listed as an experimental population in Florida
FT(S/A) = Federal Threatened due to similarity of appearance
ST = State population listed as Threatened by the FFWCC. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.
SSC = Listed as Species of Special Concern by the FFWCC. Defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species. (SSC* for Pandion haliaetus (Osprey) indicates that this status applies in Monroe county only.)
N = Not currently listed, nor currently being considered for listing.

Plants: Definitions derived from Sections 581.011, 581.185 and 581.185(2), Florida Statutes, and the Preservation of Native Flora of Florida Act, 5B-40.001. FNAI does not track all state-regulated plant species; for a complete list of state-regulated plant species, call Florida Division of Plant Industry, 352-372-3505 or see: https://www.flrules.org/gateway/ChapterHome.asp?Chapter=5B-40.

E = Endangered: species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue; includes all species determined to be endangered or threatened pursuant to the U.S. Endangered Species Act.
T = Threatened: species native to the state that are in rapid decline in the number of plants within the state, but which have not so decreased in number as to cause them to be Endangered.
CE = Commercially exploited: species native to the state which are subject to being removed in significant numbers from native habitats in the state and sold or transported for sale.
N = Not currently listed, nor currently being considered for listing.

Element Occurrence Ranking

FNAI ranks of quality of the element occurrence in terms of its viability (EORANK). Viability is estimated using a combination of factors that contribute to continued survival of the element at the location. Among these are the size of the EO, general condition of the EO at the site, and the conditions of the landscape surrounding the EO (e.g. an immediate threat to an EO by local development pressure could lower an EO rank).

A = Excellent estimated viability
A? = Possibly excellent estimated viability
AB = Excellent or good estimated viability
AC = Excellent, good, or fair estimated viability
B = Good estimated viability
B? = Possibly good estimated viability
BC = Good or fair estimated viability
BD = Good, fair, or poor estimated viability
C = Fair estimated viability
C? = Possibly fair estimated viability
CD = Fair or poor estimated viability
D = Poor estimated viability
D? = Possibly poor estimated viability
E = Verified extant (viability not assessed)
F = Failed to find
H = Historical
NR = Not ranked, a placeholder when an EO is not (yet) ranked.
U = Unrankable
X = Extirpated

*For additional detail on the above ranks see: http://www.natureserve.org/explorer/eorankguide.htm

FNAI also uses the following EO ranks:

H? = Possibly historical
F? = Possibly failed to find
X? = Possibly extirpated

The following offers further explanation of the H and X ranks as they are used by FNAI:

The rank of H is used when there is a lack of recent field information verifying the continued existence of an EO, such as (a) when an EO is based only on historical collections data; or (b) when an EO was ranked A, B, C, D, or E at one time and is later, without field survey work, considered to be possibly extirpated due to general habitat loss or degradation of the environment in the area. This definition of the H rank is dependent on an interpretation of what constitutes "recent" field information. Generally, if there is no known survey of an EO within the last 20 to 40 years, it should be assigned an H rank. While these time frames represent suggested maximum limits, the actual time period for historical EOs may vary according to the biology of the element and the specific landscape context of each occurrence (including anthropogenic alteration of the environment). Thus, an H rank may be assigned to an EO before the maximum time frames have lapsed. Occurrences that have not been surveyed for periods exceeding these time frames should not be ranked A, B, C, or D. The higher maximum limit for plants and communities (i.e., ranging from 20 to 40 years) is based upon the assumption that occurrences of these elements generally have the potential to persist at a given location for longer periods of time. This greater potential is a reflection of plant biology and community dynamics. However, landscape factors must also be considered. Thus, areas with more anthropogenic impacts on the environment (e.g., development) will be at the lower end of the range, and less-impacted areas will be at the higher end.

The rank of X is assigned to EOs for which there is documented destruction of habitat or environment, or persuasive evidence of eradication based on adequate survey (i.e., thorough or repeated survey efforts by one or more experienced observers at times and under conditions appropriate for the Element at that location).

Appendix J.
Florida Master Site File Inquiry Letter

Legend

- Ferguson-House Farms

Archeological Sites

- Cultural Resource Assessment Survey, State Road 80 PD&E Study From Birchwood Parkway to US 27, Glades and Hendry Counties, Florida
- Cultural Resource Survey of Portions of the Port LaBelle Development Tract
- Historic Structures Assessment Survey of State Road 80 from Dalton Lane to Indian Hills Drive Hendry County, Florida

IMAGERY AND DATA SOURCE: FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT), FLORIDA MASTER FILE INQUIRY

0 0.25 0.5 1 Miles

PROJECT NO.: 40-23-510	
PROJECT MANAGER: PAMELA JACKSON, PG	
GIS ID: 40_23_510_Archeology	
DRN BY: TW	REVISION NO.: 00
DATE: 1/9/2024	REVISION DATE: N/A
CHK BY: PS	STATUS: FINAL

NorthStar Contracting Group, Inc.
325 JOHN KNOX ROAD, BUILDING C, SUITE 100,
TALLAHASSEE, FLORIDA 32303
PH: (850) 661-4415

ARCHEOLOGY SITES MAP
BASELINE DOCUMENTATION REPORT
FERGUSON HOUSE FARMS PROPERTY
HENDRY COUNTY, FLORIDA
NORTHSTAR PROJECT NO.: 40-23-510

AR=0
SS=0
CM=0
RG=1
BR=0
Total=1

Cultural Resource Roster

SiteID	Type	Site Name	Address	Additional Info	SHPO Eval	NR Status
HN00361	RG	Goodno Drainage Canal	LaBelle	Linear Resource	Not Eligible	

Manuscript Roster

Total=3

MS#	Title	Publication Information	Year
19404	Historic Structures Assessment Survey of State Road 80 from Dalton Lane to Indian Hills Drive Hendry County, Florida	SEARCH, prepared for Inwood Consulting Engineers, Inc.	2011
11588	Cultural Resource Assessment Survey, State Road 80 PD&E Study From Birchwood Parkway to US 27, Glades and Hendry Counties, Florida	Archaeological Consultants, Inc. Submitted to Florida Department of Transportation, Bartow, Florida.	2004
359	Cultural Resource Survey of Portions of the Port LaBelle Development Tract	CCC Enterprises.	1980

Appendix K.
Draft Deed of Conservation Easement

Exhibit “B”

Project Name: Caloosahatchee Ecoscape/Ferguson-House Farms
This instrument prepared by and returned to:
Tanja Hall
Division of State Lands
3900 Commonwealth Blvd.
Mail Station 115
Tallahassee, FL 32399-3000

DEED OF CONSERVATION EASEMENT

THIS GRANT OF CONSERVATION EASEMENT is made this ___ day of _____, 2023, by FERGUSON-HOUSE FARMS, INC., a Florida corporation, whose address is P.O. Box 014739, Miami, Florida 33101 ("Grantor"), in favor of the BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA ("Trustees"), whose address is Florida Department of Environmental Protection (“DEP”), Division of State Lands, 3900 Commonwealth Blvd., Mail Station 115, Tallahassee, Florida 32399-3000, ("Grantee").

The terms “Grantor” and “Grantee” shall include the singular and the plural, and the heirs, successors and assigns of Grantor and Grantee, and the provisions of this easement shall be binding upon and inure to the benefit of Grantor, Grantee and their heirs, successors and assigns.

RECITALS

A. Grantor is the sole owner in fee simple of certain real property in Hendry County, Florida, more particularly described in Exhibit “A” attached hereto and incorporated by reference (hereinafter, the "Property").

B. Grantor and the Grantee mutually recognize the special character of the Property and have the common purpose of conserving certain values and character of the Property by conveyance to the Grantee of a perpetual conservation easement on, under, over, and across the Property, to conserve the character of the Property, continue certain land use patterns that do not significantly impair the character of the Property, and prohibit certain further development activity on the Property.

C. The specific conservation values of the Property are documented in the “Baseline Inventory Report for the Ferguson-House Farms Conservation Easement Tract in Hendry County, Florida”, dated XXXX ("Baseline Documentation"), which consists of reports, maps, photographs, and other documentation that the parties agree provide, collectively, an accurate representation of the Property at the time of this grant, and which is intended to serve as an objective information baseline for monitoring compliance with the terms of this grant. The Baseline Documentation is maintained in the offices DEP and is incorporated by this reference. A copy of the Baseline Documentation is available from the DEP on request.

D. Grantee is an agency authorized under the provisions of §704.06, Florida Statutes, to hold conservation easements for the preservation and protection of land in its natural, scenic, historical, agricultural, forested, or open space condition.

E. Grantee agrees by accepting this grant to honor the intentions of Grantor stated herein and to preserve and protect in perpetuity the conservation values of the Property for the benefit of this generation and the generations to come.

F. The fact that any use of the Property that is expressly prohibited by the terms of this Easement may become greatly more economically valuable than uses allowed by the terms of this Easement, or that neighboring properties may, in the future, be put entirely to uses that are not allowed by this Easement has been considered by Grantor in granting this Easement and by Grantee in accepting it.

To achieve these purposes, and in consideration of $10.00 and other good and valuable consideration, including but not limited to the above and the mutual covenants, terms, conditions, and restrictions contained herein, the receipt and sufficiency of which is acknowledged, and pursuant to the laws of Florida, and in particular §704.06, Florida Statutes, but without intending the validity of this Easement to be dependent on the continuing existence of such laws, Grantor hereby voluntarily grants and conveys to Grantee a conservation easement in perpetuity over the Property of the nature and character and to the extent hereinafter set forth ("Easement").

ARTICLE I. DURATION OF EASEMENT

This Conservation Easement shall be perpetual. It is an easement in gross, runs with the land, and is enforceable by Grantee against Grantor, Grantor's personal representatives, heirs, successors and assigns, lessees, agents, and licensees.

ARTICLE II. PURPOSE OF EASEMENT

It is the purpose of this Easement to assure that the Property will be retained forever in its natural, scenic, wooded condition to provide a relatively natural habitat for fish, wildlife, plants or similar ecosystems, and to preserve portions of the Property as productive farmland and forest land that sustains for the long term both the economic and conservation values of the Property and its environs, through management guided by the following principles:

- Protection of scenic and other distinctive rural character of the landscape;
- Maintenance of soil productivity and control of soil erosion;
- Maintenance and enhancement of wildlife and game habitat;
- Protection of unique and fragile natural areas and rare species habitats;
- Maintenance or creation of a healthy balance of uneven aged timber classes;
- Maintenance or improvement of the overall quality of the timber resource;
- Maintenance of the value of the resource in avoiding land fragmentation;
- Protection of surface water quality, the Floridan Aquifer, wetlands, and riparian areas;
- Maintenance of economically viable agricultural practices that protect the landscape as a working enterprise in harmony with the open space and scenic qualities of the Property;
- Maintenance of existing upland/wetland natural communities;
- Restoration of disturbed upland/wetland natural communities.

The above purposes are hereinafter sometimes referred to as "the Conservation Purposes". Grantor intends that this Easement will confine the use of the Property to such activities as are consistent with the Conservation Purposes of this Easement.

ARTICLE III. RIGHTS GRANTED TO THE GRANTEE

To accomplish the Conservation Purposes of this Easement the following rights are conveyed to Grantee by this Easement:

A. The right to enforce protection of the conservation values of the Property;

B. All future residential, commercial, industrial and incidental development rights that are now or hereafter allocated to, implied, reserved, or inherent in the Property except as may be specifically reserved to Grantor in this Easement. The parties agree that such rights are hereby terminated and extinguished and may not be used on or transferred to other property. Neither the Property nor any portion thereof may be included as part of the gross area of other property not subject to this Easement for the purposes of determining density, lot coverage, or open space requirements, under otherwise applicable laws, regulations or ordinances controlling land use and building density. No development rights that have been encumbered or extinguished by this Easement shall be transferred to any other lands pursuant to a transferable development rights scheme or cluster development arrangement or otherwise. Nor shall any development rights or density credits be transferred onto the Property from other property.

C. The right to enter upon the Property at reasonable times in order to monitor compliance with and

otherwise enforce the terms of this Easement; provided that such entry shall be upon prior reasonable notice to Grantor, and Grantee shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Property.

D. The right to prevent any activity on or use of the Property that is inconsistent with the Conservation Purposes or provisions of this Easement and to require the restoration of or to restore such areas or features of the Property that may be damaged by any inconsistent activity or use, at Grantor's cost.

E. The right of ingress and egress to the Property.

F. The right to have the ad valorem taxes, assessments and any other charges on the Property paid by Grantor.

G. A right to notice of intent to sell. The terms of this right are such that if Grantor intends to sell the Property, or any interest therein or portion thereof, Grantor shall deliver to Grantee notice of such intent, and shall, in good faith, afford Grantee an opportunity to negotiate the acquisition of the Property, or such portion thereof or interest therein that Grantor intends to sell. If Grantee desires to negotiate the acquisition of the Property, or such portion thereof or interest therein, Grantee shall so notify Grantor within 30 days after receipt of Grantor's notice of intent. If Grantor and Grantee are unable, in good faith to agree to terms of an acquisition of the Property, or such interest therein or portion thereof as applicable, within 120 days from said notice to Grantee, Grantor may sell the Property free of the right granted herein. If the Property, or such portion thereof or interest therein as is applicable, has not sold within 18 months after Grantee's notice to Grantor that Grantee does not intend to negotiate acquisition of the property or within 18 months after failure to reach agreement to terms of an acquisition. Any intent to sell the Property thereafter shall require renewed notice to Grantee. This right of notice shall not be triggered by sales or transfers between Grantor and lineal descendants of Grantor; members, shareholders, or partners of Grantor; or entities in which Grantor owns a majority of the controlling interests. The right or notice granted herein applies to the original Grantor and to said original Grantor's, heirs, successors and assigns.

H. The right to be indemnified by Grantor for any and all liability, loss, damage, expense, judgment or claim (including a legally recognizable claim for attorney fees) arising out of any negligent or willful action or activity resulting from the Grantor's use and ownership of or activities on the Property or the use of or activities of Grantor's agents, guests, lessees or invitees on the Property.

I. The right to be indemnified by Grantor for any liability for injury or property damage to persons on the Property arising out of any condition of the Property known to the Grantor to the best of Grantor's knowledge.

J. The right to have the Property maintained as reflected on the Baseline Documentation, as the Property may develop through the forces of nature hereafter, subject only to the exercise of Grantor's Reserved Rights, and the Rights Granted to the Grantee, as described in this Easement.

K. If Grantor fails to cut and remove timber damaged by natural disaster, fire, infestation or the like, then the right, but not the duty, of Grantee, in its sole discretion to cut and remove said timber. Any such cutting and removal by Grantee shall be at the expense of Grantee and all proceeds from the sale of any such timber shall inure to the benefit of Grantee.

ARTICLE IV. PROHIBITED USES

The Property shall be maintained to preserve the Conservation Purposes of this Easement. Without limiting the generality of the foregoing Grantor agrees that the following uses and practices, though not an exhaustive recital of inconsistent uses and practices, are expressly prohibited or restricted:

A. No soil, trash, liquid or solid waste (including sludge), or unsightly, offensive, or hazardous materials, wastes or substances, toxic wastes or substances, pollutants or contaminants, including, but not limited to, those as now or hereafter defined by federal or Florida law defining hazardous materials, wastes or substances, toxic wastes or substances, pollutants or contaminants shall be dumped or placed on the Property. This prohibition shall not be construed to include reasonable amounts of waste generated as a result of allowed activities.

B. The exploration for and extraction of oil, gas, minerals, dolostone, peat, muck, marl, limestone, limerock, kaolin, fuller's earth, phosphate, common clays, gravel, shell, sand and similar substances either directly or indirectly by Grantor or on Grantor's behalf or with the joinder or consent of Grantor in any application for a permit so to do, under and by virtue of the authority of a grant or reservation or other form of ownership of or interest in or control over or right to such substances, except as reasonably necessary to combat erosion or flooding, or except as necessary and lawfully allowed for the conduct of allowed activities.

C. Activities that will be detrimental to drainage, flood control, water conservation, erosion control, soil conservation, or fish and wildlife habitat preservation unless otherwise provided in this Easement. There shall be no dredging of new canals, construction of new dikes, manipulation of natural water courses, or disruption, alteration, pollution, depletion, or extraction on the Property of existing surface or subsurface water flow or natural water sources, fresh water lakes, ponds and pond shores, marshes, creeks or any other water bodies, nor any activities or uses conducted on the Property that would be detrimental to water purity or that could alter natural water level or flow in or over the Property, unless approved by DEP or the water management district ("WMD") for the purposes of environmental benefits through altered hydrology and/or improved water quality. Provided, however, Grantor may continue to operate, maintain, or replace existing groundwater wells and water control structures incident to allowed uses on the Property, subject to legally required permits and regulations. Notwithstanding this restriction, Grantor shall be allowed to install two new wells for agriculture purposes allowed under Article V. In addition, Grantor shall be allowed to maintain and deepen existing watering holes as depicted in the Baseline Documentation.

D. Acts or uses detrimental to the preservation of the structural integrity or physical appearance of any portions of the Property having historical or archaeological significance. Grantor shall notify the Florida Department of Historical Resources or its successor ("FDHR") if historical, archaeological or cultural sites are discovered on the Property, and any sited deemed to be of historical or archaeological significance shall be afforded the same protections as significant sites known to exist at the time of entering into this easement. Grantor will follow the Best Management Practices of the Division of Historic Resources, as amended from time to time.

E. The removal, destruction, cutting, trimming, mowing, alteration or spraying with biocides of trees, shrubs or other natural vegetation except as otherwise specifically provided in this Easement. Except for domestic pasture grasses needed to support allowed grazing activity and approved by the Institute for Food and Agricultural Sciences, no other invasive or non-native plants may be planted on the Property. The Grantor shall, to the extent practical, control and prevent the spread of invasive or non-native plants on the Property. Grantor hereby grants to Grantee the right, in Grantee's sole discretion and at Grantee's expense, to develop and implement an invasive plant removal plan for the eradication of invasive or non-native plants on the Property. Under no circumstances, shall this right conveyed to Grantee be construed to diminish Grantor's responsibilities under this paragraph or as an obligation of the Grantee.

F. Commercial or industrial activity, or ingress, egress or other passage across or upon the Property in conjunction with any commercial or industrial activity including but not limited to swine, sheep, goats and small ruminants, dairy and poultry operations and confined animal feed lot operations.

G. New construction or placing of temporary or permanent buildings, mobile homes or other structures in, on or above the ground of the Property except as may be necessary by Grantor for maintenance or normal operations of the Property or during emergency situations or as may otherwise be specifically provided for hereinafter. For purposes of this paragraph the term "emergency" shall mean those situations that will have an immediate and irreparable adverse impact on the Conservation Purposes.

H. The construction or creation of new roads or jeep trails, except in agricultural areas depicted in the Baseline Documentation.

I. There shall be no operation of motorized vehicles except on established trails and roads unless necessary: (i) to protect or enhance the Conservation Purposes of this Easement, (ii) for emergency purposes, (iii) for livestock ranching purposes, and (iv) to retrieve game that has been hunted legally.

J. Areas currently improved for agricultural activities as established by the Baseline Documentation may continue to be used for those activities. Areas that are currently in improved pasture as depicted in the Baseline

Documentation shall not be converted to more intense agricultural use. Lands that are depicted in the Baseline Documentation as being natural areas shall remain natural areas.

K. If the Property is in a spring recharge area, fertilizer use for agriculture activities shall be in accordance with agricultural best management practices recommended therefor by the Natural Resources Conservation Service or the Florida Department of Agriculture and Consumer Services, whichever is more stringent, as those best management practices may be amended from time to time. No agricultural activities shall occur within a 100-foot buffer around sinkholes and other karst features that are connected to spring conduits.

L. Actions or activities that may reasonably be expected to adversely affect threatened or endangered species.

M. Any subdivision of the land except as may otherwise be provided in this Easement.

N. There shall be no signs, billboards, or outdoor advertising of any kind erected or displayed on the Property, except that Grantee may erect and maintain signs designating the Property as land under the protection of Grantee.

O. There shall be no commercial water wells on the Property.

P. There shall be no mitigation bank established pursuant to sections 373.4135 et seq. Florida Statutes, on the Property.

ARTICLE V. GRANTOR'S RESERVED RIGHTS

Grantor reserves to Grantor, and to Grantor's personal representatives, heirs, successors, and assigns, the following specified rights, which are deemed to be consistent with the Conservation Purposes of the Easement. The exercise of the Reserved Rights shall be in full accordance with all applicable local, state and federal law, as amended from time to time, as well as in accordance with the Conservation Purposes of this Easement.

A. The right to observe, maintain, photograph, introduce and stock fish or wildlife, native to the state of Florida, on the Property; to use the Property for non-commercial hiking, camping, and horseback riding, so long as the same do not constitute a danger to Grantee's employees, agents, officers, directors and invitees, and so long as such activities do not violate any of the prohibitions applicable to the Property or Grantee's rights, as stated above. Grantor reserves, and shall continue to own, the hunting and fishing rights on, or related to, the Property, including the right to construct, locate, and maintain temporary structures typically used for hunting that result in no surface alteration, so long as said structures do not cause impacts adverse to the conservation values of the Property, and Grantor may lease and sell privileges of such rights.

B. The right to conduct controlled or prescribed burning on the Property; provided, however, that Grantor shall obtain and comply with a prescribed fire authorization from the local and state regulatory agencies having jurisdiction over controlled or prescribed burning.

C. The right to mortgage the Property; provided, however, that the Mortgagee's lien shall be inferior to and lower in priority than this Easement.

D. The right to contest tax appraisals, assessments, taxes and other charges on the Property.

E. The right to continue to use, maintain, repair, and reconstruct, but not to relocate or enlarge, all existing buildings, barns, dog pens, outbuildings, fences, roads, ponds, drainage ditches and such other facilities on the Property as depicted in the Baseline Documentation. If any of the now existing facilities on the Property requires reconstruction or replacement due to depreciation, obsolescence, destruction or severe damage, the replacement structures may be increased in size no larger than one hundred twenty-five (125%) percent of the size of the original structure it replaces as such size is documented in the Baseline Documentation and shall be situated at the same site.

F. The right to exclusive use of the improvements depicted in the Baseline Documentation and as otherwise allowed in this Easement.

G. The right to continue existing agricultural practices as depicted in the Baseline Documentation. Grantor may use commonly accepted fertilizers, pesticides and herbicides, so long as Grantor uses agricultural best management practices as may be adopted from time to time by the Florida Department of Agriculture and Consumer Services or its successor.

H. The right to host on the Property relocated endangered or threatened species or species of special concern that are native to the State of Florida.

I. The right to maintain or restore the existing natural upland (wetland/both) communities on the Property, as depicted in the Baseline Documentation; or the right to restore the disturbed upland (wetland/both) to its native condition by engaging in activities that may include, but are not limited to, removal of invasive non-native plant and animal species, implementation of prescribed fire, and the reintroduction of native plant and animal species in consultation with qualified public or private land management agencies.

J. The right to maintain Grantor's commercial cattle operation. The cattle operation shall be conducted in accordance with best management practices for cow/calf operations published by the Florida Department of Agriculture and Consumer Services, as amended from time to time. Grantor reserves the right to introduce other grazing livestock species, after written notice to Grantee specifying the species and area to be grazed and approval by Grantee, provided said grazing operations are conducted in accordance with the best management practices of the Florida Department of Agriculture and Consumer Services.

K. Grantor reserves the right in the silvicultural or agricultural areas as depicted in the Baseline Documentation, to construct such additional agricultural structures as may be required for its agricultural operations, such as stables, equipment barns, and tool sheds, so long as such structures do not significantly impair the conservation values of the Property and do not exceed 10,000 cumulative square feet.

L. The right to utilize brush management practices such as mowing, roller-chopping or aeration to maintain or enhance any natural area provided such activity is conducted in a manner consistent with any best management practices or practice guidelines published by any agency for such management activity. Any brush management seeking to convert habitat to more intensive agricultural use is prohibited.

M. The right to maintain and construct perimeter fencing of the property to protect the property from trespassing and Grantor may add new fencing, cross fencing and pens in the agricultural areas as depicted in the Baseline Documentation for the management of the Grantor's grazing operation, so long as such fencing does not significantly impair the conservation values of the Property.

N. The right to participate in programs or projects that benefit from, enhance and/or manage the environmental attributes or permissible agricultural uses of the Property and which may also be of economic benefit to the Grantor, so long as participation in such programs is consistent or complimentary with the Conservation Purposes.

O. The right to maintain existing food plots for game as indicated in the Baseline Documentation and the right to create new food plots for game only with the approval of the Office of Environmental Services of the Division of State Lands.

P. The right to engage in silviculture in those areas depicted on the Baseline Documentation as silvicultural or agricultural areas in accordance with the best management practices of the Florida Forest Service of the Florida Department of Agriculture and Consumer Services or its successor. There shall be no harvesting in wetlands. Notwithstanding the terms of this paragraph, Grantor shall continue to have the right to prune and thin trees according to accepted forestry practices and to remove trees that are damaged, diseased, or dangerous.

Q. The right to cultivate and harvest hay from the existing pasture or hay area as depicted on the Baseline Documentation in accordance with best management practices published by the Florida Department of Agriculture and Consumer Services, as amended from time to time.

R. The right to construct one (1) new residential structure on the Property, along with access driveways, and appropriate-sized outbuildings such as barns, as more particularly described hereinafter. The residential structure shall be limited to 5,000 square feet, including overhangs, porches and other such non-heated and cooled areas, and have no more than two related outbuildings limited to 2,000 square feet each. The new residential and outbuilding impacts, exclusive of a new pervious access driveway, shall be limited to 2.5 contiguous acres each. All of which shall be located at least 150 feet from any wetland area as identified in the Baseline Documentation.

S. The right to divide the Property for sale or other disposition by Grantor into a total of two (2) parcels, so long as the subdivisions meet the following criteria:
1. The parcels shall be no less than 400 acres each.
2. In advance of recording a deed relating to any subdivision authorized herein, Grantor shall provide legal descriptions and surveys for each parcel at the time of the subdivision.
3. For any subdivided parcels, the allocation of reserved rights for agricultural uses and residential development shall be addressed in a restrictive covenant that shall run with the land and authorize the State to enforce the terms.
4. The provisions of this paragraph shall not be construed as releasing the subdivided lots from the terms of this Easement. The terms of this Easement shall remain in full force and effect over the allowed subdivided lots as well as the remaining area of the Property.

ARTICLE VI. GRANTEE'S REMEDIES

A. **Remedies**. If Grantee determines that Grantor is in violation of the terms of this Easement or that a violation is threatened, Grantee shall give written notice to Grantor of such violation and demand corrective action sufficient to cure the violation and, where the violation involves injury to the Property resulting from any use or activity inconsistent with the Conservation Purposes of this Easement, to restore the portion of the Property so injured. If Grantor fails to cure the violation within thirty (30) days after receipt of notice thereof from Grantee, or under circumstances where the violation cannot reasonably be cured within a 30-day period, fails to begin curing such violation within the 30-day period, or fails to continue diligently to cure such violation until finally cured, Grantee may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Easement, to enjoin the violation, *ex parte* as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of the terms of this Easement or injury to any conservation values protected by this Easement, including damages for the loss of scenic, aesthetic, or environmental values, and to require the restoration of the Property to the condition that existed prior to any such injury. Without limiting Grantor's liability therefore, Grantee, in its sole discretion, may apply any damages recovered to the cost of undertaking any corrective action on the Property. If Grantee, in its sole discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the conservation values of the Property, Grantee may pursue its remedies under this paragraph without prior notice to Grantor or without waiting for the period provided for cure to expire. Grantee's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this Easement, and Grantor agrees that Grantee's remedies at law for any violation of the terms of this Easement are inadequate and that Grantee shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, in addition to such other relief to which Grantee may be entitled, including specific performance of the terms of this Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Grantee's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity.

B. **Grantee's Discretion**. Enforcement of the terms of this Easement shall be at the discretion of Grantee, and any forbearance by Grantee to exercise its rights under this Easement in the event of any breach of any term of this Easement by Grantor shall not be deemed or construed to be a waiver by Grantee of such term or of any subsequent breach of the same or any other term of this Easement or of any of Grantee's rights under this Easement. No delay or omission by Grantee in the exercise of any right or remedy upon any breach by Grantor shall impair such right or remedy or be construed as a waiver.

C. **Waiver of Certain Defenses**. Grantor hereby waives any defense of estoppel, adverse possession or prescription.

D. **Acts Beyond Grantor's Control**. Nothing contained in this Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes.

E. **Hold Harmless**. Grantor shall hold harmless, indemnify, and defend Grantee and its members, directors, officers, employees, agents, and contractors and the heirs, personal representatives, successors, and assigns of each of them (collectively "Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expenses, causes of action, claims, demands, or judgments, including, without limitation, reasonable attorney fees, arising from or in any way connected with: (1) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Property, regardless of cause, unless due solely to the negligence of any of the Indemnified Parties; (2) the obligations specified in paragraph VIII.A. and VIII.B.; and (3) the existence or administration of this Easement.

ARTICLE VII. NO PUBLIC ACCESS

The granting of this Easement does not convey to the public the right to enter the Property for any purpose whatsoever, and Grantee will cooperate with Grantor in the enforcement of this prohibition.

ARTICLE VIII. MISCELLANEOUS

A. **Costs and Liabilities**. Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property, including the maintenance of adequate comprehensive general liability coverage. Grantor shall keep the Property free of any liens arising out of any work performed for, materials furnished to, or obligations incurred by Grantor.

B. **Taxes.** Grantor shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "taxes"), including any taxes imposed upon, or incurred as a result of, this Easement, and shall furnish Grantee with satisfactory evidence of payment upon request. Grantee is authorized but in no event obligated to make or advance any payment of taxes, upon three (3) days prior written notice to Grantor, in accordance with any bill, statement, or estimate procured from the appropriate authority, without inquiry into the validity of the taxes or the accuracy of the bill, statement, or estimate, and the obligation created by such payment shall bear interest until paid by Grantor at the maximum rate allowed by law.

C. **Extinguishment.** If circumstances arise in the future such as render the Conservation Purposes of this Easement impossible to accomplish, this Easement can only be terminated or extinguished, whether in whole or in part, by judicial proceedings in a court of competent jurisdiction, and the amount of the proceeds to which Grantee shall be entitled, after the satisfaction of prior claims, from any sale, exchange, or involuntary conversion of all or any portion of the Property subsequent to such termination or extinguishment, shall be determined, unless otherwise provided by Florida law at the time, in accordance with paragraph VIII.D. Grantee shall use all such proceeds in a manner consistent with the Conservation Purposes of this grant or the purposes of the bond or statutory program under which Grantee obtained the purchase money for this Easement. Grantor believes that any changes in the use of neighboring properties will increase the benefit to the public of the continuation of this Easement, and Grantor and Grantee intend that any such changes shall not be deemed to be circumstances justifying the termination or extinguishment of this Easement. In addition, the inability of Grantor to conduct or implement any or all of the uses allowed under the terms of this Easement, or the unprofitability of doing so, shall not impair the validity of this Easement or be considered grounds for its termination or extinguishment.

D. **Proceeds**. This Easement constitutes a real property interest immediately vested in Grantee, which, for the purposes of paragraph VIII.C., the parties stipulate to have a fair market value determined by multiplying the fair market value of the Property unencumbered by the Easement (minus any increase in value after the date of this grant

attributable to improvements) by the ratio of the value of the Easement at the time of this grant to the value of the Property, without deduction for the value of the Easement, at the time of this grant. For the purposes of this paragraph, the ratio of the value of the Easement to the value of the Property unencumbered by the Easement shall remain constant.

E. **Condemnation**. If the Easement is taken, in whole or in part, by exercise of the power of eminent domain, Grantee shall be entitled to compensation in accordance with applicable law.

F. **Assignment**. This Easement is transferable, but Grantee may assign its rights and obligations under this Easement only to allowed entities under §193.501, Florida Statutes, and §704.06, Florida Statutes, whose purposes include the conservation of land or water areas or the preservation of sites or properties. As a condition of such transfer, Grantee shall require that the Conservation Purposes that this grant is intended to advance continue to be carried out. Additionally, Grantee acknowledges that releases or conveyance of certain rights under this Easement is subject to §193.501, Florida Statutes, and Grantee shall comply with the provision of §193.501, Florida Statutes, to the extent it is applicable to this Easement.

G. **Subsequent Transfers**. Grantor agrees to incorporate the terms of this Easement in any deed or other legal instrument by which Grantor divests any interest in all or a portion of the Property, including, without limitation, a leasehold interest. Grantor further agrees to give written notice to Grantee of the transfer of any interest at least twenty (20) days prior to the date of such transfer. The failure of Grantor to perform any act required by this paragraph shall not impair the validity or priority of this Easement or limit its enforceability in any way.

H. **Notices**. Any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed to the parties as set forth above, or to such other addresses such party may establish in writing to the other.

I. **Recordation**. Grantee shall record this instrument and any amendments in timely fashion in the official records of Hendry County, Florida, and may re-record it at any time as may be required to preserve its rights in this Easement.

J. **Non-Homestead Certification**. Grantor hereby certifies that if a Grantor who is married signs this Easement without the joinder of his or her spouse, the Property is neither the homestead of Grantor nor the primary physical residence of Grantor, nor is the Property contiguous to the homestead or primary physical residence of Grantor.

K. **Amendments.** The terms and provisions of this Easement may be amended by the mutual consent of the parties hereto. No amendment shall be effective until executed with the formality of a deed and recorded in the public records. The Grantor acknowledges that amendments that release or convey certain rights under this Easement may be subject to §193,501, Florida Statutes, and any such amendments shall comply with the provisions of §193.501, Florida Statutes, to the extent it is applicable to such amendment.

L. **Controlling Law**. The laws of the State of Florida shall govern the interpretation and performance of this Easement.

M. **Liberal Construction**. Any general rule of construction to the contrary notwithstanding, this Easement shall be liberally construed in favor of the grant to effect the Conservation Purposes of this Easement and the policy and purpose of §704.06, Florida Statutes. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the Conservation Purposes of this Easement that would render the provision valid shall be favored over any interpretation that would render it invalid.

N. **Severability**. If any provision of this Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Easement, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

O. **No Forfeiture**. Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

P. **Joint Obligation**. The obligations imposed by this Easement upon Grantor shall be joint and several.

Q. **Successors**. The covenants, terms, conditions, and restrictions of this Easement shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as a servitude running in perpetuity with the Property.

R. **Termination of Rights and Obligations**. A party's rights and obligations under this Easement terminate upon transfer of the party's interest in the Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

S. **Captions**. The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation.

TO HAVE AND TO HOLD unto Grantee, its successors, and assigns forever.

IN WITNESS WHEREOF Grantor and Grantee have set their hands on the day and year first above written.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK – SIGNATURE PAGE TO FOLLOW]

GRANTOR

FERGUSON-HOUSE FARMS, INC., a Florida corporation

Witness as to Grantor

Dwayne A. House, President

Printed Name of Witness

Date signed by Grantor

Witness as to Grantor

Phone No. _____
8 a.m. – 5 p.m.

Printed Name of Witness

STATE OF FLORIDA

COUNTY OF_____

The foregoing instrument was acknowledged before me by means of __ physical presence or __ online notarization; this _____ day of_____, 20___ by Dwayne A. House, as President for and on behalf of Ferguson-House Farms, Inc., a Florida corporation. Such person(s) (Notary Public must check applicable box):

[_____] is/are personally known to me.
[_____] produced a current driver license(s).
[_____] produced _____ as identification.

(NOTARY PUBLIC SEAL)

Notary Public

(Printed, Typed or Stamped Name of Notary Public)

Commission No.: _____

My Commission Expires: _____

GRANTEE

BOARD OF TRUSTEES OF THE INTERNAL IMPROVEMENT TRUST FUND OF THE STATE OF FLORIDA

BY DIVISION OF STATE LANDS OF THE STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

BY: _____
NAME: Callie DeHaven
AS ITS: Director, Division of State Lands

_____
Witness as to Grantee

_____
Printed Name of Witness

_____
Witness as to Grantee

_____
Date signed by Grantee

_____
Printed Name of Witness

Approved as to Form and Legality

By: _____

Date: _____

STATE OF FLORIDA

COUNTY OF LEON

The foregoing instrument was acknowledged before me by means of __ physical presence or __ online notarization; this _____ day of _____, 20____ by Callie DeHaven, Director, Division of State Lands, Department of Environmental Protection, as agent for and on behalf of the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida. She is personally known to me.

(NOTARY PUBLIC SEAL)

_____
Notary Public

_____
(Printed, Typed or Stamped Name of Notary Public)

Commission No.: _____

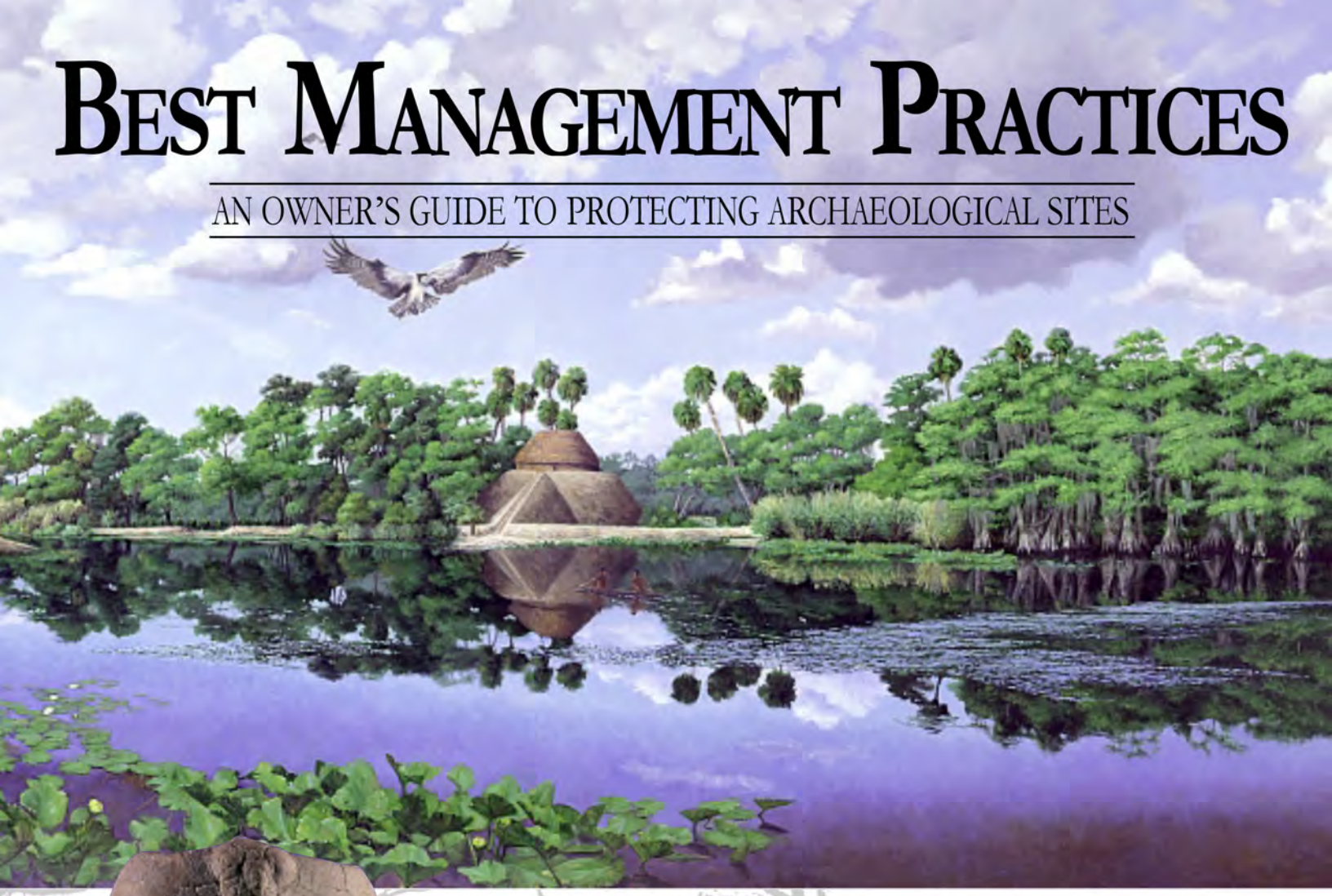
My Commission Expires: _____

EXHIBIT “A”
LEGAL DESCRIPTION OF PROPERTY

Appendix L
Best Management Practices

Best Management Practices

An Owner's Guide to Protecting Archaeological Sites





Preserving and Protecting Florida's Archaeological Sites for Future Generations







Florida Heritage



Acknowledgments

The Coastal Management Project was made possible by a subgrant from the Florida Department of Community Affairs, Florida Coastal Management Program, in cooperation with the U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

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Reconstructed pottery vessel recovered from the Velda site. It dates to the village occupation around A.D. 1000-1500.

Below: Cazuela-shaped ceramic vessel dating back to A.D. 1350-1500, Late Mississippian. Johnson Ceremonial Breaking site, Fort Walton Beach, Florida.



Best Management Practices:
An Owner's Guide to Protecting Archaeological Sites

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What is The Purpose of This Guide?

This guide is for owners and managers of archaeological sites. It is written to explain to non-specialists what archaeological sites are like, how they are threatened, and how they can be protected against such threats. It is also written with a few assumptions in mind—

- Few sites are managed by archaeologists.
- A large number of archaeological sites are on private lands.
- The people whose decisions affect archaeological sites over the long term have little experience in site management.
- Anyone can learn how to care for sites.

We hope this guide will help landowners understand and appreciate the valuable historical resources in their stewardship, provide basic information on caring for archaeological sites, and help owners obtain professional help when needed.

What Are Best Management Practices?

Best Management Practices (BMPs) are actions that are considered effective and appropriate. They represent the general knowledge and practice of informed professionals. Best Management Practices are commonly used in agriculture, forestry and other resource management fields, but they have not been widely adopted for archaeology. Here is a short list of some common Best Management Practices for archaeological sites. The rest of this guide explains in detail these and other topics in archaeological site management and provides possible solutions to many common site destabilization problems.

Do:

- document the archaeological site located on your property.
- try to protect the archaeological site by stopping destabilizing actions such as erosion.
- check the condition of the site on a regular basis.
- contact professionals for help in dealing with your archaeological site.

Avoid:

- ground disturbing activities in the area of an archaeological site.
- frequent traffic, either by pedestrians or vehicles, on archaeological sites.
- using untested methods to stabilize your archaeological site – they may do more harm than good. This guide presents several methods that have been tested for site stabilization.

Lake Jackson Indian temple mound, Tallahassee, ca., AD 1000-1500.



Introduction

A few decades ago, American archaeologists began to realize that the *archaeological record*, the total accumulation of archaeological sites of all types and all periods, was rapidly disappearing. Sites were being lost to development, erosion, looting, and other natural and cultural factors, but there was little understanding of the scope of the problem or of possible solutions. The value of archaeological sites and other *historic properties*, as they are called in Florida law, was first established as a national policy in the Antiquities Act of 1906. Since then, a comprehensive system of laws and regulations has been developed at the federal, state and local levels to make sure archaeological resources are considered during planning and permitting of major projects. Additionally, government at all levels has expressed the will of the people to protect these pieces of the past by acquiring sites, managing them for public benefit, and interpreting them for public appreciation and enjoyment. These mandates, and the practices of *cultural resource managers* who implement them, have made a dramatic difference in the rate of loss of archaeological sites, especially on public lands and in large scale projects that require public review and permitting. On private lands, few of these regulations apply to most land uses, so conservation of archaeological sites that are not in public ownership depends on informed and caring landowners.

The tradition of stewardship for private property is well developed in our society, especially among owners of large tracts. The difference between site conservation and site loss usually depends on knowledge and education. Landowners have little difficulty extending their customary care of natural resources to cultural resources, once they understand where the resources are and how they can be protected.

What is Archaeology?

Archaeology is the scientific study of material remains of past human life and activities. *Archaeological sites* are places where people left some sign of their presence. This typically means that *artifacts*, things people made or modified, are present. However, sites can also include changes in the land—a ditch, a levee, a mound. Sites usually contain materials in addition to artifacts, like plant and animal remains, soil, and charcoal.



Portion of an incised pottery bowl, associated with the Ft. Walton culture of northwest Florida, A.D. 1000-1500.

Together, these form an *archaeological deposit*. When people stay in one place for a long time, deposits accumulate, one on top of the other, over decades or centuries. Because people and environments change over time, deposits differ from each other. Moreover, any single deposit may contain evidence of many different activities. Archaeological sites and the artifacts associated with them are messengers from our past. Without archaeological research and excavation, these unique pieces of our history would be lost.

The Value of Archaeological Sites

Archaeological sites are surprisingly common on the landscape and come in all sizes and a variety of types. Archaeological sites in Florida range from large, prominent prehistoric mounds, historic forts and plantations, to smaller sites, such as a historic dump or small scatters of artifacts that represent temporary encampments of Native American people. Regardless of size or complexity, all archaeological sites have the potential to tell us something about people and environments of the past. More than 27,000 different archaeological sites of all periods are already known in



Artist's impression of a Timucuan village located along the St. Johns River, ca., 1450. This scene was modeled after research findings from the Thursby Mound and Hontoon Island, two neighboring archaeological sites.

Florida, and many new sites are recorded in the Florida Master Site File each year. Some archaeological sites are completely buried and remain unknown until accidentally uncovered by digging, or until they are found during an archaeological survey.

Clues to past events and previous ways of life remain in backyards, pastures, forests, hammocks, and streambeds all across the Florida landscape. Pre-European archaeological sites (before A.D. 1500) offer clues to Native American hunting and cooking methods, social organization and family life, artistic and religious expression, and past environments. Archaeological evidence of later cultures, more like our own, also exists. Early European exploration and settlement, and Florida's territorial and statehood growth, left their unique

signatures on and under the ground, creating a Florida landscape that is a mosaic of different natural and historical events.

While the value of archaeological sites is partly scientific, revealing new information about the past, it is also social, providing opportunities for recreation, reflection, and education. Some privately owned sites are unsuitable for visitors; however, there are many alternative ways of interpreting sites for the public. The best-managed sites are not only protected from deterioration, but they are also made available to the public on some basis.

Artifacts in Original Context

The single most important characteristic of archaeological sites is *association*, that is, the relationship between all of its components. Artifacts and other cultural remains that are associated together represent single activities or events that can be revealed through careful excavation and analysis. When artifacts and remains that are from separate time periods or separate events are mixed together, it is difficult or impossible to recreate what happened at the site. This simple fact leads to the most basic principle of archaeological site management. Things should remain



Archaeological feature being excavated with pit contents (potsherds, mica, turtle and deer bone, etc.) left in place to document their context.

in their original location or *context*. When the artifacts and surrounding material are disturbed, archaeological information is destroyed. An artifact might be aesthetic in its own right, but its greatest value—the information about its user that was learned from its context—will be lost if it is removed from its original context. The large part of site management is simple to express, but difficult to achieve—*prevent change.*

Preventing change to preserve original context can require little effort, other than an occasional visit to see that the site is stable and to determine that there is no threat of disturbance. When disturbance occurs, it is often progressive. Minor erosion on a mound is easy to correct in its early stages; but by the time it is a gully much has been lost, and it is more difficult to prevent further damage. A few small holes from unauthorized digging are a sign that further digging is likely, and steps should be taken early to prevent it. In the following sections we will address some of the more common threats to archaeological deposits and show the best management practices for these particular situations.

The Well-Managed Site

The specific characteristics of a well-managed site will vary according to whether the site is owned by a private landowner or managed by a public land manager, since the available resources will be different for each group. The greatest difference will be the level of public accessibility. For this reason, we have separated the discussion of accessibility into two sections, one for public land managers, the other for private landowners.

Documentation

What are the characteristics of a well-managed site? First, a well-managed site is one that has been documented. Site documentation involves a description of a site's horizontal and vertical dimensions, the characteristics by which it is identified (e.g., the remains of brick foundation walls, a shell deposit, etc.), its cultural association, and so forth. This information can help a private landowner protect the site, or it could help a public land manager in developing a site management plan. A record of a site should be filed at the Florida Master Site File in Tallahassee, a central repository for information on historical resources in this state. This database of archaeological and historical sites is used by planners, consultants, government staff, archaeologists, managers, and owners to determine if sites are within the area of proposed projects that might have an adverse effect. If a site is unrecorded, and many are, the site area may not be recognized in the review and permitting process as something worthy of protection. However, if the site is recorded, it is more likely to be investigated further to determine how it might be protected.

Stabilization

Second, a well-managed site is stable. Every part of the ground surface (especially the upper six inches) is always changing due to disturbances caused by vegetative growth and decay, animal activity, and environmental forces, such as wind and rain. Dynamic topsoil is a natural condition, and is the reason the top several inches of an archaeological site lack good association. The underlying zones, however, are much less active, biologically, chemically, and physically,



An archaeologist identifies, for a young onlooker, animal bones recovered from an archaeological site.

since they are protected by the topsoil and humus layers. Many sites are naturally vegetated with trees, shrubs, and ground cover. While tree roots extend through archaeological deposits, their disturbance can usually be sorted out during excavations. The most important part of the vegetative association is ground cover. Where ground cover is missing or not healthy there is a greater risk of erosion, especially on slopes. Ground cover should be repaired or reestablished if exposed soil is unstable.

Public Access and Interpretation and Private Landowners

Private land that contains an archaeological site can be made available for education and recreation. As an owner of an archaeological site, you are not obligated to open your site to the public, but you may choose to do so for a variety of reasons. Visiting archaeological sites can be educational. It gives people first-hand experience with understanding and interpreting the past. This experience can be fun and informative. For example, an archaeological site might be accessed by a bike or walking trail. There are many walking tours that showcase archaeological sites of local interest. By participating in these programs, property owners can contribute to the understanding and appreciation of Florida's cultural heritage. Should a property owner express interest in providing public access to an archaeological site, there are many ways in which information regarding the site can be disseminated. For example, the creation of brochures, pamphlets, web pages, lecture series, and other products can increase public knowledge about archaeological sites in private ownership. These are highly valued by local school systems. While precautions are necessary to insure public safety and to prevent site destruction or damage, the advantages to providing public access to privately owned archaeological sites far outweigh the disadvantages.

Accessibility and the Public Land Manager

A well-managed public archaeological site is accessible to the public, except in certain circumstances. This means that a path or walkway has been established, either planned or unplanned. In the case of the large mounds that visitors wish to climb, this can be a recipe for erosion if protective measures, such as a stairway, are not implemented. Public access also implies some form of interpretation—a message about the site and the people who once lived there. The message can also address proper treatment of the site and set forth rules to prevent disturbance. In some cases, along with public access comes a complex of facilities, such as parking, paths, signage, and perhaps rest rooms and a picnic area. Care should be taken to ensure that construction of these does not damage site deposits, and much thought should be given in advance to direct the flow of people and vehicles to prevent damage over the long term. Consideration should also be given to locating these improvements to avoid or minimize their visual intrusion on any scenic vistas associated with a site.

Preservation

Finally, a well-managed archaeological site is cared for. Signs of vandalism, litter, neglect of facilities, and unkempt grounds all send a subliminal message that this is a place others do not respect, and that the usual rules of responsible behavior do not apply to the visitor. Although it would not be apparent from looking at the site, a well-managed site has a management plan in place that can respond to threats or damage. A site owner or manager should have established contact with local law enforcement, with a local archaeologist, or perhaps a local archaeological society, so that all parties will already be familiar with the site if some action is required. It is helpful to keep a site notebook with information about the site as well as names and telephone numbers of various people to contact when help is needed.

Management Strategies

Threats and Responses

Because many archaeological sites and historic properties on public land receive some level of management, most site destruction occurs on private property. Unintentional site damage is caused through ignorance and without malice. Some examples of unintentional site damage are erosion caused by boat wakes, off road vehicle activity, animal burrowing, and tree falls. Intentional site damage such as looting and vandalism also account for a great loss of archaeological and historic sites. *Looting* is the deliberate destruction of an archaeological site or structure for personal gain. *Vandalism* is deliberate damage to an archaeological site or structure for the sake of causing the property owner distress, or because of misguided political, social, or religious beliefs. The following section addresses the issues of unintentional and intentional site damage. Options for site protection are also provided, but you should also ask an archaeologist for help in determining what threats your archaeological site is exposed to and which protection methods may be appropriate to address the threats.

Best Management Practices in Responding to Threats to Archaeological Sites

1. Identify the cause or the source of the threat
2. Determine potential solutions to the problem
3. Determine whether permits are required
4. Determine with experts whether the proposed solution is likely to be effective over the long term
5. Make sure the solution does not cause more damage than it fixes
6. Determine whether the proposed solution is cost effective
7. Monitor the site to determine whether the solution continues to be effective over the long term
8. As appropriate, document site damage using a Florida Master Site File "Changing of Status" form

Erosion

Many archaeological sites are near water, because people have always chosen such desirable locations for activities and settlements. Erosion is one of the most serious threats to archaeological sites. Because of the great negative effects of erosion, we need to recognize the basic processes, understand which can be modified, and assess whether erosion control efforts will be appropriate in each unique situation.

We think of erosion as something unusual, some kind of natural calamity that befalls us, and something that we should be able to control or prevent. In fact, erosion is constant on the earth's surface. It is the geologic force that levels mountains over millions of years and that cuts canyons and valleys on a continental scale. On a smaller scale, at a local level and over years instead of millennia, we can have some effect on erosion. Perhaps we can prevent it from occurring at some particular location, or perhaps we can slow its rate.

Costs and Benefits

Steps to control erosion may range from inexpensive to very costly. They may have unintended consequences that also need to be considered as costs. In some of the erosion control strategies listed below, like re-vegetation and armoring with sandbags or old tires, construction costs can be minimal. However, placement of imported stone or construction of concrete structures can be very expensive, especially in remote or inaccessible areas. In areas where it is not possible to navigate a barge or other vessel laden with project construction material, clearing a road to transport equipment and supplies may cause greater damage than would be addressed by the proposed control plan. Some site loss must be accepted, and the most cost-effective response may be archaeological excavation before more erosion occurs.

Stream Erosion

Stream erosion includes many kinds of events, from sheet flow across normally dry lands, to lakeside erosion due to changes in water level, to bank erosion in the largest rivers. Stream erosion occurs most frequently when there is some change in the normal equilibrium of a flow of water in its normal course. Erosion might be due to altered vegetation within, along, or near a stream,



Example of river erosion causing tree fall, exacerbating erosion until the obstruction is removed.

a change in the volume of water flow, velocity, and sediment load, or a change in the upstream channel. Streams will respond to any change by trying to establish a new equilibrium or balance. This may mean deposition of sediment in some locations and removal of sediment elsewhere. Over time, streams meander. They change their course within a valley due to the dynamics of flowing water. In the course of thousands of years, streams and rivers move from one side of their valley to another creating oxbows, dead lakes, bank deposits, channel deposits, and bluffs. Whether sites in the valley or on its edges are threatened by stream erosion often depends on long term and large-scale processes of stream flow.

A stream is considered stable when there is no visible evidence of erosion along its banks. Typically, a stable stream is relatively straight or has gentle curves, and is neither silted in nor down cut. In many cases of stream erosion, a recently fallen tree or new upstream construction can often be identified as the cause of redirected stream flow. If the stream bed is changing as a result of a new and permanent obstacle, like a boat ramp, or increased runoff due to a new housing development and related impervious surfaces, then a long term solution should be sought. If the erosion-causing agent is a tree fall or other temporary factor, cooperation with an upstream landowner to remove the obstruction may be all that is necessary. In every case, a cost-benefit analysis should be done to determine if the long or short term benefit merits the money spent to fix the problem, and especially whether the solution will last for a long time or also be lost to continuing erosion.

There are many indicators of erosion evident in and adjacent to streambeds. Some of these are rills, sheet erosion, cracks, bank failure, scour, down cutting, and silting in. Each of these symptoms indicates erosion that can be destructive to archaeological sites. Rills, small gullies running perpendicular to the stream flow, are the result of drainage running into the stream over the top of the bank. They are formed when vegetation has been cut away from the edge of the stream bank, resulting in the ground being unable to absorb the runoff, and, in turn, causing the water to create a new channel to the stream bank. Sheet erosion, small particles of dirt being carried to a stream by rainwater flowing over the ground, is probably the most difficult to detect. Cracks are found parallel to the stream and are caused as large blocks of soil, separating from the surrounding bank, begin to slide into the stream. Bank failure occurs when the bank slides into the stream. Bank failure at a bend in the stream is called a scour. If a stream is attempting to make itself deeper, it is down cutting. On the other hand, when a stream slows and can no longer hold its sediment load, it is silting in.

To apply the best protection measure for stream erosion, an analysis of upstream causes of erosion must be undertaken. This is where the volume and velocity of water are established before it reaches your land. The best solution will focus on the source of the problem rather than its local expression on your land.

There are almost as many ways to prevent and combat stream erosion as there are causes of it. This section discusses the most common erosion defense strategies including vegetation, sandbags and hay bales. The key is to discover what will work best for your situation. Many of these solutions can be employed with little expense, but some require heavy equipment and should not be undertaken without professional guidance. Help can be found through the U.S. Department of Agriculture, Natural Resources Conservation Service, through the state's water management districts, in local government environmental and permitting agencies, and at some university departments. A list of agencies and contacts can be found at the end of this guide.

Control of large-scale erosion is beyond the scope of most private landowners. Placement of fill in wetlands, dredging, and placement of obstructions in navigable waterways are undertakings that require environmental permits. Before considering projects of this type, be sure to consult with local, state and federal environmental agencies that may have jurisdiction over such activities. See the list of agencies and contacts at the end of the guide.

Best Management Options for Preventing Stream Erosion

Vegetation
Sandbags
Hay Bales

Vegetation

Vegetation is fundamental in erosion control. Often when vegetation is well established and undisturbed, the ground surface is stable and erosion is absent. If the ground cover has been removed and soil is exposed, erosion is more likely, especially on slopes. Flowing water will concentrate in areas of least resistance, on bare soil rather than through leaves, stems, roots, and humus. As the loose soil is washed away, the flow is further concentrated.



Planting sod on the surface of a restored mound.

The key to stabilization is to reestablish the ground cover that acts to hold the soil in place and dissipate the force of flowing water. Different plants can be used for different results. Grasses and fast growing plants with short root systems are best for archaeological sites since their root systems are less likely to displace buried features or artifacts. Native species are preferred since they are adapted to local conditions. In fact, for many sites, the best vegetative cover is that which previously existed on the site. Many factors determine which species will thrive at a particular location, and over the long term, these will already have been naturally selected.

The use of non-native species carries some risks. First, it is best to avoid vegetation that requires special attention like watering, fertilization or mowing. Second, some introduced species will thrive at the expense of diverse native plant communities. Brazilian pepper, cogon grass, kudzu, wisteria, australian pine, and Chinese tallow are well known examples of exotics that have displaced natural plant and animal communities. These plants now require very costly removal programs to control their continued spread. Contact a local nursery or the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (address at end of the guide) with specific questions about what species are suitable for your particular needs.

Sandbags

Sandbags are effective for controlling many forms of erosion. They are relatively inexpensive and do not require special equipment to create or install. Sandbags are most effective where the forces of erosion are moderate and where conditions are too unstable to promote growth of vegetation. They can be employed relatively quickly and may afford a temporary or a long-term solution. Properly filled and placed with a protective backing, sandbags can prevent erosion in situations of low energy. Higher volume or velocity, as in storm events, can displace them or cause them to split and spill their contents.

If sandbags are filled with a concrete mixture, they can form a more stable and permanent erosion barrier. When water breaks against a barrier, the brunt of the erosion is borne at the foot or toe of the structure—this is called toe scour. Proper placement of sandbags is essential to prevent toe scour, because water can seep between the bags and erode away the soil behind them, causing destabilization of the entire structure.

Hay Bales

Hay bales can be used in a manner similar to revetments as a short-term solution, and have similar placement considerations. Hay bales can be staked along a low wave-energy shoreline as a temporary erosion protection measure. They should be placed to leave gaps to permit water outflow from overtopping and tidal action. If properly placed, the hay bales will trap sand and provide shoreline vegetation an opportunity to re-establish itself before the hay turns to compost.

Large Scale Erosion Control Options

Other methods such as revetments, gabions and jacks can also be employed for preventing stream erosion. These methods do represent viable responses to erosion, but they can only be implemented in large-scale projects at great expense.

A revetment is a layer of concrete or rock lining a slope to protect it from wave action. Revetments can be constructed from poured cement, rocks, or concrete construction debris. Construction debris or concrete rubble is also a good erosion control device when certain limitations are considered. There are also aesthetic and other safety problems with revetments. They are visually intrusive and pose safety problems for those trying to walk on them. It may be possible to cover revetments with soil, providing a safer setting in which vegetation may be established, thus fortifying erosion protection.

Gabions are metal wire cages filled with rocks and anchored to the shore. They can be an alternative to rock revetments due to the scarcity of stone in many parts of Florida. There are certain disadvantages to their use. Rusty gabions can be dangerous and unattractive. Sometimes the stone in the wire cages rubs off the protective coating causing the underlying metal to corrode. As an alternative to stone, a framework can be built around the base of the wire cage and a layer of concrete poured into it to provide the needed structural weight.

Jacks are another method that can be used to control erosion. Jacks are large-scale steel structures that have a shape similar to children's jacks. They are lowered into the stream channel to reduce the stream's velocity. As the water slows, it has less energy and can carry less sediment. An area of erosion becomes an area of deposition. This can be a very effective method of erosion control that can build up areas previously eroded. However, there can be problems. First, jacks can be an obstruction to navigation. Second, upstream deposition may increase downstream erosion.

Coastal Erosion

In contrast to stream erosion, coastal erosion results from the energy of vast bodies of water acting upon the shoreline at the edge of the continents. This unique energy is expressed in tides, waves, and currents, sometimes mildly in the steady rhythm of the shore, but often wildly in a storm event, such as a hurricane.



Damage to a mound caused by coastal erosion.

Beyond a certain point, coastal erosion is not subject to effective control. The rise in the level of the sea, the movement of the barrier islands, the transgression of the sea in certain sections of the coast, the loss of beachfront property—these are inexorable, despite the expensive efforts of governments and private landowners. A realistic analysis of coastal erosion is essential in determining how to respond to threats to historical resources (both archaeological sites and historic structures) on the coast.

Erosion control on the open Atlantic or Gulf shoreline involves great public effort and expenditure and is far beyond the scope of the average private landowner. Such projects typically cost millions of dollars and involve all levels of government in planning, permitting, and construction efforts that may extend over many years. However, certain coastal shorelines, those within estuaries, lagoons, and bays are sometimes suitable for smaller scale stabilization techniques that are within the scope of a private landowner or a community association. These projects still require considerable expertise as well as permits from various agencies, and are not to be undertaken lightly. Just like stream erosion, wave and tidal action can be detrimental to historic properties. Wave action associated with storms causes some of the most severe damage in the coastal strand. But, like sheet erosion, everyday wave and tidal action is difficult to observe as a cause of erosion. The Atlantic and Gulf coasts are part of a dynamic zone that extends from the toe of the stable dune to a distance of several miles offshore. Within this zone sediments are moving seaward from barrier islands and dunes to beaches to offshore bars.

The only thing permanent about a natural beach zone is change. Over the long-term barrier islands migrate. They move in the direction of the dominant long-shore currents and waves. They also migrate landward as a consequence of on-shore breezes and sea level rise, eroding on the ocean side and accreting on the bay side. Inlets also move along the coast, as they open and close over periods of centuries, or more rapidly as result of storm events.

Most archaeological sites along the coast reflect the human preference for a pleasant place to live. Except in modern times when our substantial dwellings can overcome the harsh conditions of sun, wind, and salt spray, people chose to live away from the beach. Typically, archaeological sites are found on the bay or lagoon shore on the back of barrier islands. Here the vegetation is well established, the microclimate is moderate and stable, and the resources of the estuarine system are nearby. Among the most common sites are middens, the accumulations of living remains like shells, animal bones, and pottery sherds in a dark soil matrix. These are often recognizable along the shore in areas of hammock vegetation as a layer of black soil and shell contrasting with the usual light-colored sandy soils. Middens often extend as small headlands into the bay or lagoon. Midden soils, because they are more compact, organically rich, and favor vegetative growth, are often more resistant to erosion than sandy soils.

Many methods of erosion control can be applied in coastal environments, including vegetation, revetments, hay bales, breakwaters, groins, bulkheads and sea walls, and re-nourishment. All require permitting, but on lagoon and bay shores this need not be so complicated as along the beach itself. Just as with planning erosion protection strategies for streams, it is necessary to involve experienced professionals in design and planning. Erosion control failures are very common, and it is often better to be slow and cautious in one's decisions than to do something wrong. An ill-conceived erosion control structure can cause more damage than it prevents. Some contacts for expert assistance are listed at the end of the guide.

Best Management Options for Preventing Low Energy Coastal Erosion

Vegetation
Hay Bales
Breakwaters
Re-nourishment



An example of a healthy, well-vegetated sand dune.

Vegetation

The best defense against windblown erosion is vegetation. Usually, when vegetation is well established and undisturbed, especially in low wave energy coastal settings, the ground surface is stable and erosion is absent. Sand dunes, the sign of healthy beach upland, are at the greatest risk for erosion when their vegetation is destroyed. The harsh conditions of a sand dune (constant wind, salt spray, excessive soil drainage, and often, a lack of rain) limit the range and variety of species capable of growing on it. Special care must be taken when re-vegetating to ensure that existing plants are not damaged while encouraging new ones to take root. Many native Florida plant species will provide lasting protection without demanding constant care or becoming a nuisance in the future. Salt tolerant species like sea oats, palm, gopher apple, sea grapes, and cord grass vine are all examples of plants suited to the coast. Different regions encourage various species, and a local nursery should be able to help you choose the plants best suited to your needs and location. Florida law prohibits digging up sea oats or sea grapes on public land.

Hay Bales

Hay bales can also be used in the low wave-energy shoreline of a bay or estuary. As a temporary erosion protection measure, hay bales can be staked to the shore. Placed end to end with occasional gaps, or alternatively, individually placed in a spaced line with the bales oriented diagonally to the direction of the prevailing wave surge, they will allow water to outflow from overtopping and tidal action. The hay bales trap sand and provide shoreline vegetation an opportunity to reestablish, before the hay turns to compost.

Breakwaters

Breakwaters are appropriately named, as they break the wave before it reaches the shore, reducing its energy and erosive force. Permanent breakwaters are expensive and difficult to maintain over the long run, and they may cause erosion on adjacent segments of the coast. Temporary breakwaters like hay bales or contained brush are most effective in protecting an area that is newly planted to reestablish vegetation at the adjacent shoreline.

Renourishment

Sediment eroded from a shoreline can be artificially replaced. This process, known as beach renourishment, is a popular response to erosion but is almost always a temporary solution. The same coastal dynamics that removed the sediment in the first place are still at work, with renourishment typically necessary within five years, sooner following storm events. In more protected situations like bays and lagoons, renourishment may have a longer effective life. It is important to plan renourishment carefully, since the characteristics of the new sediment will determine how long it will stay and whether it can reestablish the natural habitat and function of the beach system it replaces.

Large Scale Erosion Control Options

As is true for large-scale stream erosion, there are certain techniques that can only be employed in large-scale coastal erosion prevention projects. All of these techniques involve great expense, professional planning and environmental permitting. A revetment is like coastal armor. This armor is made by placing heavy and large objects like rocks and sandbags along the shoreline to protect less stable soils from the energy of water and wind. Revetments used for coastal erosion protection are of similar design and construction as those mentioned above for stream erosion protection. For stability, revetments need filter cloth underlying the rocks to protect the soil from movement and to stabilize the base or toe to prevent undercutting. In considering installation of a revetment, be sure to involve an experienced professional, and coordinate with permitting agencies.

Groins are a series of parallel revetments that generally run perpendicular to the beach. They work like fingers of a hand extending outward from the shore to catch passing sand. Groins interrupt the normal transport of sand along the beach and cause it to accumulate on the upstream side of the structure. However, the downstream shore becomes starved for sediment and subject to severe erosion as the system attempts to reach equilibrium again. If sediments are brought in to fill the groins at the time of construction, sediment transport is better maintained and down-beach erosion can be reduced.

Bulkheads and sea walls are vertical barriers to the transport of sediment from the shore to the water. They are constructed of interlocking metal sheets, wood planks attached to pilings, or concrete slabs, and are commonly installed to protect buildings and other infrastructure at the shore. Bulkheads and sea walls can be difficult to maintain due to toe scour, which can undermine the wall. Also, sea walls interrupt the natural transition from the upland to the water, and beach transitional zones are often critical habitat areas for marine life.

Critical Beach Erosion Areas

Over the last century or so, a great amount of information has been accumulated about the changing configuration of the coastline. By comparing old surveys, maps, aerial photographs, and other coastal data, it is possible to track the movement of the shore over time.

The Florida Department of Environmental Protection (FDEP) recently surveyed coastal areas (not including bays or estuaries) to determine which were eroding the fastest. These stretches of beach have been called Critical Beach Erosion Areas. Archaeological and historic sites in these areas are in greater danger of being negatively affected by storms as well as ongoing erosive forces.

Incidental Damage

Off road vehicles (ORVs), horses, bikes, and frequent pedestrian traffic can damage archaeological sites. Many parts of archaeological sites are very fragile. In addition to crushing sites and artifacts, ORVs can damage vegetation, contributing to subsequent water and windblown sand erosion. To a lesser extent, horseback riding, bikes, and pedestrian traffic also create erosion



Off road vehicle activity can be very destructive to archaeological sites.

problems. To prevent this unintentional destruction, ORVs should be encouraged to travel around archaeological sites. This can be accomplished either by posting signs to redirect them or by clearing an alternative path, which they can follow. Paths that already cross sites should be closed off by replanting trees, moving a deadfall across the path, or fencing it off. The same should be done for trail bike and horse riding trails. These measures, when properly implemented, can prevent further destruction without advertising the exact location of an archaeological site.

Animal Activity

Animal burrowing and digging, while a natural part of the wild, should be discouraged at archaeological site areas. Burrowing animals displace artifacts by bringing deeply buried material to the surface and allowing surface material to fall into the burrow. In certain sensitive sites, animals like hogs, cattle, gopher tortoises, and armadillos should be excluded. The Florida Fish and Wildlife Conservation Commission may be able to help keep nuisance wildlife under control. Contact the nearest regional office or the Tallahassee office to request brochures or assistance.

Trees



An example of the kind of destruction to archaeological and historical remains caused by tree growth.

Trees, while normally excellent erosion deterrents, can damage a site. When an old tree is blown over, a large root ball is sometimes pulled up, which displaces the dirt and any artifacts that might be in it. Trees located on an archaeological site should be examined routinely for signs of death and disease. Sick trees should be cut off close to the ground, leaving the roots to rot in place. This prevents tree falls and ensures that no further disturbance is done to the site. Consult with a local arborist to determine the best course of action.

Looting and Vandalism

Deliberate destruction of archaeological sites by looting is on the rise. Deterring looters can be a difficult task, but one well worth the effort. Supporting you in this endeavor are federal and state laws and law enforcement officers. If you have difficulty controlling unauthorized access to your property, you can take some positive steps. Law officers are ready to assist you when a law has been broken, but they can also assist you in preventing crimes. Artifacts taken from your property without your permission are legally still yours. Looters who sell these items can be charged with selling stolen property. If looters are caught on your property, they can be charged with trespassing. Trespass laws are more effectively enforced when land is posted with "no trespassing" signs. Looters can also be charged with vandalism and property damage, if they have been digging on your property without your permission.

For further protection, your site may be designated a State Archaeological Landmark or Landmark Zone, which affords private lands the same protection as state lands under chapter 267, F.S. In certain cases, the Archaeological Resource Protection Act of 1979, as amended, (ARPA) can protect sites on private land. ARPA subsection 6(c) includes interstate transportation of stolen items. Thus, violations of a state or local law may give rise to an ARPA violation. In the event a site is looted on private land and the artifacts are taken across state lines, ARPA would apply. In Florida, looting a cemetery or unmarked burial site is a felony.

Contact your local sheriff and ask that a deputy visit your site with you before problems occur so officers will know where to go if their assistance is needed. Best of all, contact an archaeologist and arrange a time for all three of you to meet and tour the property. If a site is looted, the archaeologist can provide a cost estimate on the damaged resource in order to repair it and to help determine what action should be taken. Take pictures of the current condition of your property and start a log documenting (with photographs) damage each time you notice it. Take photographs or make a video tape of the site and any subsequent damage to it. If you are experiencing looting, request the sheriff, or other appropriate law enforcement official, to patrol the area and possibly even stake out the site. Once the looters are caught, the damage estimate provided by the archaeologist can be used in a civil case to determine an appropriate amount of restitution and can be helpful in a criminal case to determine a penalty.

The best way to prevent further looting is to repair the damage. Again, a trained archaeologist can help you. Consider filling in the looter holes with clean dirt that is free of artifacts. Line the insides of the holes with sheet plastic or filter cloth and refill them. Replant ground cover to camouflage the area against future looting.

The deliberate destruction of archaeological sites has become a serious problem in some areas. Unauthorized digging in sites, particularly those containing human burials, has caused the loss of much archaeological information and the desecration of many important sites. There are several things you can do to defend against this senseless disturbance of the past. First, sites are vandalized when it appears no one cares for them. Not only sites in remote areas, but more often sites that show signs of neglect are at high risk for vandalism. Sites that appear cared for, well maintained, clearly interpreted, and frequently visited, are seldom vandalized.

Should you notice signs of vandalism like unauthorized digging, graffiti, late night visitation, unusual vehicles, or other suspicious activities, act quickly to secure the site. Posted signs, lights, and perhaps a visit from local law enforcement can all serve to let others know the site is closely watched. If there is evidence of disturbance of the archaeological site, treat the area as a crime scene. Secure the area from public access, notify local law enforcement, and do not confuse the evidence by introducing new footprints or removing anything.

Protection Strategies

Many site protection strategies defend against deliberate looting and vandalism. Use of signs, fencing, camouflage, site burial, site monitoring, and law enforcement, alone or in combination, can all be effective approaches. Sites in frequently visited, easily viewed, and publicly interpreted settings are among the least looted and vandalized.

Signage

Signs are typically one component of a broader site protection program that includes law enforcement and regular site monitoring. Two types of signs are helpful. The first type guides or interprets; the second advises or warns. Signs that guide or interpret are used to direct, such as trail markers, or to educate, such as historic plaques. The second type of sign makes the viewer aware of the law and the penalty for damaging or endangering a site. Experience has shown that the use of signs generally, but not always, reduces site looting and vandalism. Like a lock, signs keep honest people honest. Signs usually should not be posted at archaeological sites located in remote areas, as they might call attention to sites that cannot be properly protected. On the other hand, highly visible and accessible sites should have prominent signs that both interpret the site and discourage damaging activity. These signs should indicate to visitors how to report unauthorized activities. Signs can also be placed along trails and roads, near campsites, and as part of a wayside exhibit.



Signage warning looters against unauthorized digging and the penalties for disturbing unmarked burials.

Fencing

The use of fencing for archaeological site protection is, like signs, best in a monitored area. Fences in unusual places may call attention to a site that otherwise would be unknown, saying, "loot here." Fences can be used to guide as well as to restrict access and need not be impenetrable to be effective. A simple series of posts connected by a chain or rope can keep visitors in the right area. Fences should be used in highly visible areas to deter the curious from climbing mounds or where there is no stabilized trail.

Camouflage

Hiding a site can offer some protection. Camouflaging a site works best when it is done prior to any looting or vandalism. Planting poison ivy or oak, cactus, or Spanish bayonette and utilizing beehives will

dissuade many potential diggers. Posting signs noting the presence of such species may also be a sufficient deterrent.

Site Burial

Intentional site burial can be an effective deterrent to looters and vandals. In many cases a soil cap can adequately cover surface evidence of archaeological remains. For sites with considerable threat, construction wire, rebar, cement, or other material can be placed over them, followed by a cap of clean sand, and then replanting. Site disturbance will become almost impossible without heavy equipment. This method is not inexpensive, but it does work.

Site Monitoring

The most inexpensive method of site protection is site monitoring. Regular visits to your archaeological site will alert looters that you care about the site and will take steps to protect it. Site monitoring also gives you a chance to keep a log of activities that could be used in court. Authorized visitors, like members of local historical and archaeological groups or scouts, could assist you in monitoring the site. Increased site visitation results in decreased looting and vandalism events.

Responsible Development

The Context of Development

Florida is one of the most rapidly growing states in the nation. The most recent population census shows that Florida's population increases by more than 200,000 people each year, with this figure constantly rising. This has created a demand for new houses, shopping centers, roads, workplaces, and other facilities. As undeveloped lands are converted to more intensive land uses, the land is contoured, scraped, cleared, cut and filled, and otherwise modified. All of these activities have the potential to damage or destroy archaeological resources. Over the past twenty years or so, a legal and practical framework has been established to review certain development projects, determine whether significant archaeological resources may be threatened, and consider options to preserve or protect such properties—or the information they contain.

At the federal, state and local levels, archaeological and historic preservation laws, ordinances, and regulations support a system of cultural resource management that has already protected a great many sites. Typically, a development project with federal involvement, or that falls within the scope of certain state or local government mandates, will be assessed by the Division of Historical Resources' review and compliance staff. Based on the distribution and type of archaeological sites known or predicted to exist on the development property, staff may recommend a range of archaeological activities from protection of known sites, to field survey, to archaeological monitoring to no action. If a survey is recommended, the archaeologist conducting the work will locate, inventory, and assess archaeological sites, then offer recommendations concerning their protection during development, if they are deemed significant.

Through early review, reliable information, and proper advance planning, it is often feasible to arrange for the long-term protection of historic sites. Where this is not possible, or where sites are less important, salvage excavations may be recommended to save information in the site. The best archaeological resource protection opportunities exist when survey is conducted and good information is available far in advance of development. Understanding the location and extent of sites to be preserved is critical before lots and roads are laid out, and especially before property is sold. The most serious archaeological crises occur when significant archaeological sites are discovered after construction begins. Such situations offer few options and little flexibility. If you are involved in developing land, you should acquire a thorough understanding of archaeological sites on your property as early as possible. Some lending institutions are beginning to require archaeological surveys as a condition of financing.

Archaeological resources need not be a liability; they can be an important asset. Knowing in advance not only the location but also the age, type, and function of archaeological sites offers opportunities for interpretation as well as preservation. Archaeological sites can become important greenspace components in a development, and can be developed for public access, education, and recreation. In Florida and elsewhere, such sites are an amenity offering added value to property, and have been featured in marketing and community relations efforts.

Questions You Should Ask Before Developing Land with Archaeological Resources

- *What type of site do I have?*
- *Where is my site located?*
- *How big is my site?*
- *How can I avoid the site during development?*
- *If I have to disturb an area that is archaeologically sensitive, how can I make sure valuable information is properly collected?*

Site Assessment

Before development is ready to proceed, it is first necessary to assess one's archaeological site to help determine the most viable protection measures for it. How big is it? How far does it extend below ground? How important is it? How much damage has occurred in the past? These questions and others can be answered by an archaeologist. If possible, landowners should seek the assistance of a professional who can help advise them in these matters. Sometimes the archaeologist will recommend a survey to map the site, serving both to document it for the archaeological record and to help plan the property development. The Florida Master Site File at the Division of Historical Resources keeps records on all known archaeological sites in Florida. Site File staff can provide information to landowners and planners, which may help significantly in preparing development plans.

Minimizing Site Impact

Having identified the extent and significance of the site and determined that protection is warranted, development should proceed in a fashion that has the least amount of adverse impact to the site. Ground disturbing activities such as the installation of an in-ground pool, septic tank and drainfield, electrical cable, water pipes, or a building foundation should be planned in areas without archaeological remains. There are many appropriate above ground uses of archaeological sites that also serve as a means of protecting them. Landscaping, which can minimize or avoid ground disturbance by using fill or other means is the most obvious. It can also serve to preserve the open space setting of the site. Sites may also be protected by carefully sealing them under properly designed driveways, parking lots, tennis courts, or the like.



Archaeologists at work in the backyard of a home. A screen is employed to help recover small excavated artifacts.

Occasionally, even those devoted to the protection of their archaeological site have to dig a hole. In this case, special care should be taken to record what is observed during such disturbance, such as soil color and consistency, the presence of bone or shells and the artifacts encountered and collected while digging. To recover artifacts sift the dirt through 1/4" or 1/8" mesh hardware cloth, which is like window screen only more durable, attached to the bottom of a rectangular wood frame. Take careful notes, record the depth at which you found each artifact, and draw a map (or use a detailed property map) locating on it each hole in relation to the house, property line, or trees. Place the artifacts from each excavation unit in separately labeled bags. If your digging is associated with a planned project, make your notes on the plans showing where you dug and what was found. If large projects need to be undertaken, like digging a well, swimming pool or sprinkler system, and it is impossible to avoid archaeologically sensitive areas, consider having an archaeologist excavate the area first or monitor any excavations you may undertake, particularly when using heavy equipment. Contact the Bureau of Archaeological Research for help with planning these activities.

In most large cities in Florida there is a local chapter of avocational archaeologists from the Florida Anthropological Society (FAS). The FAS is a non-profit organization whose members have a great interest in local and Florida-wide archaeology. FAS members can give you further information and assist you in identifying the artifacts that you have found. They can also be called to give informal talks about archaeology or sponsor workshops in flint tool and pottery making.

Land Use and Development Issues

Land uses or land modifications like farming, pond and canal dredging and vegetation removal can also be detrimental to archaeological resources. The following discussion outlines various issues in land use and development and offers recommendations for protecting archaeological sites during such activities.

Agriculture

Some of the most interesting and valuable archaeological sites can be found on land suitable for agricultural production. This is not surprising since many Florida Indian tribes, Spanish mission settlements, and later Florida settlers depended heavily on agriculture and chose locations with fertile soils for settlements. These sites are located on land still favored by today's farmers. Although different farming methods were employed in prehistoric and early historic times, many of the same crops continue to be grown. Like many modern farmers, aboriginal farmers lived close to their fields and close to water. These archaeological sites

provide the most information about such early farmers. However, due to the use of heavy machinery to drain and reshape the land as well as the modern use of fertilizers and pesticides, areas that were once marginal for farming, are now being cultivated. Traditional farming methods only disturbed the top 6 to 8 inches of soil, and such shallow plowing only minimally disturbs archaeological sites. With the advent of mechanized farming and deep plowing, now up to 3 feet of soil can be turned. This causes great damage to archaeological sites, as does re-contouring the land to level high spots and fill in low areas or digging ditches for drainage.

There are ways you can preserve the intact underground portion of an archaeological site on your farmland. The best method is to dedicate it to a passive use. The area could be converted to pasture or a woodlot. If the land must be farmed, shallow plowing could be used in this area. Alternatively, you can bury your archaeological site under a cap of clean soil, limiting plowing to the upper layer of soil

Mounds and earthworks are the easiest to protect because they generally represent only a small portion of arable land. These sites should be removed from cultivation.

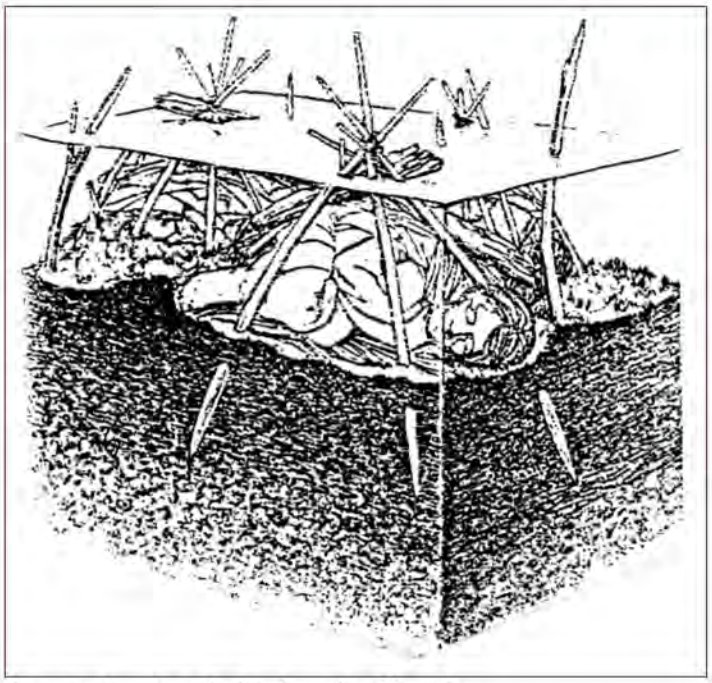
Pond and Canal Dredging

If you are thinking about developing an inundated area of your property, consider consulting with a professional archaeologist. Wetland areas can contain significant archaeological resources because their environment tends to preserve archaeological remains like wood and bone, which are rarely or only poorly preserved in other archaeological sites. One of the most famous sites of this type in Florida is Windover Pond. This small pond, situated between the Indian and St. Johns Rivers, contains one of the most important archaeological finds in the state. The site was discovered during dredging in advance of road construction.

Following the site's discovery, its importance was recognized and professional archaeological excavations were conducted. Deep within the peat deposits of the pond, some 10 feet below the modern pond surface, were found the remains of over 120 individuals buried nearly 8,000 years ago. They are older than the Ice Man found in the Italian Alps and the mummies of Egypt. Similar Archaic burial sites have also been discovered in Hardee and Sarasota counties. Such finds are unique to Florida and demonstrate the potential for underwater burials in unexpected places.

Vegetation Removal

The removal of trees and other vegetation from an archaeological site can cause considerable damage to archaeological resources. For example, tree removal from an archaeological site could damage the site by disturbing artifacts and features located near the root system. If possible, trees should be cut off close to the ground and the stumps left to decompose in place.



An artists' version of a Windover Pond burial.

Landowners should also take special care when removing overgrown vegetation from historic cemeteries. Cemeteries are unique archaeological sites because objects located on the ground surface of cemeteries can be valuable sources of information. Items such as grave offerings or old headstones can provide a more accurate picture of a cemetery and the people it represents. For these reasons, clearing and/or restoring an overgrown cemetery should be done in conjunction with a professional archaeologist or cemetery preservationist. Please feel free to contact the Bureau of Archaeological Research for more information regarding cemetery preservation.

Human Burials

In 1987, Florida's cemetery law was revised to protect unmarked human burials—those graves and burial sites and their contents that occur outside our traditional cemeteries. While unmarked burials usually represent Native Americans who lived in Florida before European contact, there are many examples of more recent rural and ethnic graves that were never clearly marked or whose modest wooden markers have disappeared. Whatever the origin of the human remains, they are all afforded equal protection under Florida law. Under Section 872.02, *Florida Statutes*, it is a felony to willfully and knowingly injure or remove a tomb or

monument or to willfully and knowingly disturb the contents of a tomb or grave. This law applies to Indian burial mounds as well as it applies to church and city cemeteries. Anyone having knowledge of the discovery of unmarked human remains must report the incident to local law enforcement. Whenever human remains are discovered, all activity that could disturb the remains must cease and cannot resume until authorized by the state archaeologist or the medical examiner.

If the remains are involved in a criminal investigation or have been buried less than 75 years, the medical examiner will have jurisdiction and responsibility to authorize activities to resume once the remains are removed or protected. If the remains have been in the ground more than 75 years, responsibility rests with the Division of Historical Resources. Different procedures are followed depending on whether the remains were encountered during an archaeological investigation or not, but the procedures are intended to provide an opportunity to arrange for protection of the remains. The law does not require or prohibit removal of the remains, but preservation in place is the preferred alternative.

If remains for which the Division of Historical Resources has responsibility are removed from the ground, certain steps are followed concerning identification, analysis, and notification of family or community representatives. In the event no living relatives or representatives can be found, a committee of four is appointed to provide advice on final disposition of the remains. If the remains are Native American, two members of the committee are members of tribes recommended by the Florida Governor's Council on Indian Affairs, Inc.

Over the last decade in Florida hundreds of cases of unmarked human remains have been handled under the procedures specified in Chapter 872. If you encounter or have knowledge of unmarked human remains you are required by law to notify a local law enforcement authority. Tell them you are reporting unmarked human remains in accordance with Section 872.05, *Florida Statutes*, and record the name of the person with whom you spoke. Leave your name and telephone number in case it is necessary to inquire further about the site. Do not disturb the remains or the soil containing them. If the remains were exposed by illegal digging, treat the area as a crime scene. Do not disturb any evidence or introduce new footprints or other material to the site. The law enforcement agency will coordinate with the medical examiner and the state archaeologist if appropriate. Discoveries of human remains are given high priority, and someone should be able to visit the site within a day or so to continue the steps outlined in the law.

The Partnership Approach

Protecting archaeological sites requires creativity, cooperation and planning. Landowners have an opportunity to work with all of the partners necessary to protect and compatibly develop their land. Some of these partners include public and private organizations and local, state and federal governments. Through these partnerships, the possibilities for protecting valuable archaeological resources on private lands are numerous. Some methods have been in use for years, others are new and emerging. As more landowners become interested in resource protection, techniques will continue to develop.

Programs for Archaeological Site Protection

There are a number of programs and organizations that private landowners can rely on for site preservation and management. Please feel free to contact the Department of State, Division of Historical Resources for help in deciding which of these programs or organizations may be appropriate for your archaeological site.

Land Acquisition Programs and Organizations

In some cases, private landowners may want to pursue the sale or donation of land that contains an archaeological site. There are organizations and government programs that are established to ensure the permanent protection of cultural resources. Most of the public programs listed below require that a landowner work with a local or state agency or a private nonprofit organization. Private landowners should consult a tax attorney or estate planner to review the tax benefits that may be available through land sale, donations or easements.

Conservation and Recreation Lands (CARL) Program, Florida Department of Environmental Protection

Address: Office of Environmental Services
3900 Commonwealth Blvd.
Mail Station #100
Tallahassee, FL 32399-3000
Phone: (850) 245-2784

Historic Preservation Grants Program, Florida Department of State

Address: Division of Historical Resources,
Bureau of Historic Preservation
R.A. Gray Building
500 South Bronough Street,
Tallahassee, FL 32399-0250
Phone: (850) 245-6333

Office of Greenways and Trails

Address: Florida Department of Environmental Protection
3900 Commonwealth Boulevard
Mail Station 795
Tallahassee, FL 32399-3000
Phone: (850) 245-2052

The Archaeological Conservancy

Address: 5301 Central Avenue NE, Suite 1218
Albuquerque, NM 87108-1517
Phone: (505) 266-1540

The Archaeological and Historical Conservancy

Address: 4800 Sw 64th Ave., Suite 107
Davie, FL 33014
Phone: (954) 792-9776

Land Trusts

Land trusts are private, nonprofit organizations that protect valuable natural and cultural resources through land acquisition. While there is no one program carried out by all land trusts, the work they do involves private lands. Their principal objectives are achieving permanent preservation of lands having at least one of the following qualities: natural, historic, cultural, agricultural, recreational, or scenic significance. Here are a few land trusts you may wish to contact for further information.

National Trust for Historic Preservation

Address: 1785 Massachusetts Avenue, N.W.
Washington, D.C. 20036-2117
Phone: (202) 588-6000

Red Hills Conservation Program

Address: Tall Timbers Research Station
13093 Henry Beadel Drive
Tallahassee, FL 32312-0918
Phone: (850) 893-4153

Trust for Public Land

Address: Southeast Regional Office
306 N. Monroe Street
Tallahassee, FL 32301-7635
Phone: (850) 222-7911

Registry Programs

A registry program recognizes an owner's protection of historic or archaeological sites. Registration is usually voluntary and nonbinding. It is an agreement that can be canceled by either party at any time. Registration involves no payment or receipt of funds. Some registry programs also provide assistance in site management and education. Through a registry program, the owner will usually receive a certificate or plaque that recognizes the owner's site as archaeologically important. There are registry programs at national and state levels. The National Register of Historic Places is the most prominent organization. The State of Florida has several registry options including archaeological landmarks and the Florida Site Steward Agreement.

National Register of Historic Places

Address: National Register, History and Education
National Park Service
1201 Eye St., N.W., 8th Floor (MS 2280)
Washington, D.C. 20005
Phone: (202) 354-2213

State Archaeological Landmark Program

Address: Florida Division of Historical Resources,
Bureau of Archaeological Research
R.A. Gray Building
500 South Bronough Street,
Tallahassee, FL 32399-0250
Phone: (850) 245-6444

Florida Heritage Marker Program

Address: Florida Division of Historical Resources,
Bureau of Historic Preservation,
Survey and Registration Section
R.A. Gray Building
500 South Bronough Street
Tallahassee, FL 32399-0250
Phone: (850) 245-2333

Florida Site Steward Agreement

Address: Florida Division of Historical Resources,
Bureau of Archaeological Research
R.A. Gray Building
500 South Bronough Street,
Tallahassee, FL 32399-0250
Phone: (850) 245-6444

Volunteer Programs and Organizations for Public Support and Education

There is a broad array of archaeological expertise available through various private, state and federal archaeology programs and organizations. Public archaeology programs increase awareness of and respect for the past and explain the importance of archaeological research and the benefits of cultural resources to the public. These programs include formal and informal education approaches and the use of volunteers. Organizations such as the Society for American Archaeology and the Archaeological Institute of America promote archaeology through publications, meetings and various other programs.

Archaeological Resource Management Training Program (ARM)

Address: Florida Division of Historical Resources,
Bureau of Archaeological Research
R.A. Gray Building
500 South Bronough Street,
Tallahassee, FL 32399-0250
Phone: (850) 245-6444

Listing of Education in Archeology Projects (LEAP)

Address: U.S. Department of the Interior
National Park Service
Archeology & Enthography Program
1849 C St., N.W., 7th Floor
Washington, D.C. 20240
Phone: (202) 354-2100

Society for American Archaeology (SAA)

Address: 900 Second Street, N.E., Number 12
Washington, D.C. 20002-3557
Phone: (202) 789-8200

Archaeological Institute of America (AIA)

Address: Boston University
656 Beacon Street
Boston, MA 02215-2006
Phone: (617) 353-9361

Florida Anthropological Society, Inc. (FAS)

Address: P.O. Box 608
St. Petersburg, FL 33731
Internet: http://www.fasweb.org

Register of Professional Archaeologists (RPA)

Address: 5024-R Campbell Boulevard
Baltimore, MD 21236
Phone: (410) 933-3486

Other Organizations:

The following organizations can be contacted to provide reference materials and professional assistance regarding management issues such erosion control and vegetation removal.

Department of Agriculture, Division of Forestry, Bureau of Forest Management

Address: 3125 Conner Boulevard
Tallahassee, FL 32311
Phone: (850) 488-4274

Florida Department of Agriculture and Consumer Services, Division of Plant Industry

Address: P.O. Box 147100
Gainesville, FL 32614-7100
Phone: (352) 372-3505

Department of Community Affairs, Florida Coastal Management Program

Address: 2555 Shumard Oak Blvd.
Tallahassee, FL 32399-2100
Phone: (850) 488-8466

Florida Fish and Wildlife Conservation Commission

Address: 620 S. Meridian St.
Tallahassee, FL 32399-1600
Phone: 1-888-404-FWCC

Natural Resources Conservation Service, Plant Material Center for Florida

Address: 14119 Broad St.
Brooksville, FL 34601
Phone: (904) 796-9600

U.S. Army Corps of Engineers District Office in Florida

Address: 701 San Marco Blvd.
Jacksonville, FL 32207
Phone: (904) 232-2568

Additional Resources

Florida Archaeology

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1993 *Preventing Cultural Resources Destruction: Taking Action Through Interpretation*. U.S. Department of the Interior, National Park Service.



U.S. Department of the Interior

1982 *New Tools for Land Protection: An Introductory Handbook*. U.S. Department of the Interior, Office of the Assistant Secretary for Fish and Wildlife and Parks.

Internet Resources

For information on historical and archaeological resources of the ***Florida Department of State***, see, **http://www.flheritage.com**. This address will take you to various web pages of the Division of Historical Resources including the Bureau of Archaeological Research, the Bureau of Historic Preservation, and the Museum of Florida History.

For information on ***Florida Greenways and Trails***, see, **http://www.dep.state.fl.us/gwt**.

The ***National Park Service's Heritage Preservation Services*** helps citizens and communities identify, evaluate, protect, and preserve historic properties. Their web page is at **http://www.2.cr.nps.gov/**.

Archaeological Institute of America (AIA)
http://www.archaeological.org/

Heritage Preservation
http://www.heritagepreservation.org/

SAA Society for American Archaeology
http://www.saa.org

There are also World Wide Web servers devoted to the field of archaeology. Try ***ARCHNET***, a virtual library for archaeology. This server provides access to archaeological resources available on the Internet. **http://archnet.uconn.edu/**.



Do

- Document your archaeological site
- Stop erosion
- Check on your site on a regular basis
- Contact professionals for help



Avoid

- Ground disturbing activities at your site
- Frequent traffic by people, animals and vehicles
- Untested stabilization methods

Responding to Threats

- Identify the cause
- Consult with experts
- Determine potential solutions
- Determine whether permits are required
- Select a cost effective and long term solution
- Monitor the site

Responding to Looting and Vandalism

- Notify law enforcement
- Secure the area and do not disturb the evidence
- Notify an archaeologist to conduct a damage assessment
- Consider how the site can be protected better in the future

Questions to Ask Before Developing Land With Archaeological Resources

- What type of site do I have?
- Where is my site located?
- How big is my site?
- How can I avoid the site during development?
- If I have to disturb an area that is archaeologically sensitive, how can I make sure valuable information is properly collected?

What to do When Human Burials are Encountered

- Stop any activity that may disturb the burials
- Secure the area
- Notify local law enforcement and mention Chapter 872, Florida Statutes
- Cooperate with the medical examiner or the state archaeologist, whoever has jurisdiction
- Do not remove bones or artifacts
- Make bones and burial artifacts available for proper final disposition

Partners

- Record your site with the Florida Master Site File
- Get to know an archaeologist
- Work with land conservation experts and non-profit organizations
- Consider public access or acquisition for important sites

Thank you for your wise management of Florida's Archaeological Resources.

Guidelines for Users: Florida Master Site File

Background State and federal law mandate that the state maintain an inventory of all known historic structures and archaeological sites. The Florida Master Site File, Bureau of Archaeological Research, Division of Historical Resources, is the office which maintains Florida's inventory. An eighth of a million cultural resources, including 22,000 archaeological sites and 101,000 historical structures, are recorded at this time on the Site File. Roughly 7,000 new records or updates are added annually. These large numbers, however, represent only a small part of the heritage of Floridians, considering that less than 10% of the area of most Florida counties has undergone field survey by qualified archaeologists or architectural historians. More information about the Site File and other activities of the Division of Historical Resources is available on the World Wide Web at *http://www.dos.state.fl.us/dhr/msf/*.

Function The Site File is an archive and information source only, analogous to a public library. Site File staff evaluate neither the historical significance of sites nor the potential impact of development projects, although official and unofficial evaluations by others are included in our records. Consult the Compliance Review Section of the Bureau of Historic Preservation (850-487-2333) if you have inquiries related to preservation aspects of development projects, inquiries related to local government comprehensive planning, or questions dealing with the historical aspects of state lands.

Requesting Information The Florida Master Site File maintains individual paper and computer files on archaeological sites and historic structures reported to this office. We plot the locations of archaeological sites, structures which are listed on or eligible for the National Register, and historical districts on USGS 7.5 minute topographic maps. Research involving more than about 15 minutes of staff time, including photocopying, is normally done by the user. Our office is open Monday through Friday from 8:00 to 5:00 and we have a copier available for public use. We are sometimes able to steer clients to local help if they need extensive photocopying but are not able to get to Tallahassee themselves. We charge $0.15 per page for all photocopies when the total number of copies exceeds 100; there is no charge for smaller totals. Please consult with us well in advance of deadlines, by fax, letter, or e-mail, if possible, not by phone, and plan on a response time of two weeks for routine inquiries. Replies by fax or express mail services are not ordinarily possible. We cannot photocopy sheets larger than 11 x 14 7/8 inches.

We are developing electronic mapping with a Geographic Information System (GIS). Currently GIS data layers are complete for archaeological sites, historical structures, National Register properties, historical bridges, historical cemeteries, and field survey projects (see the Site File document *User's Guide to the GIS of the Florida Master Site File* or contact the Site File for more information).

Helping Us to Search Site or Survey Records Inquiries about sites should, when known, refer to the state file number assigned to each site, historic property, or survey project. For sites and historic properties, file numbers include a two letter county code, a serial number in assignment order within the county, and an optional terminal letter, when applicable, designating spatial or other subdivisions of the site. "LE220" or "LE00220," for example, refers to the 220th site recorded in Florida's Leon County. Searches for all historical structures and archaeological sites in a given area can efficiently be performed by legal survey location—township, range, and section, though many extraneous resources may be listed. Specific historical structures are best searched by full street address and all known historical names. Specific archaeological sites are best searched according to their map location on 1:24,000

Guidelines for Users: Florida Master Site File

topographical maps of the United States Geological Survey. Survey projects and reports are filed in a single statewide sequence, and specific surveys can be searched based on the county, report author, publication date, and report title. Past surveys within a given area can be identified from map location, preferably on 1:24,000 or 1:100,000 USGS contour maps. **We limit, as far as possible, the distribution of location information on sites which are especially susceptible to damage through illegal activities.** If you have very large or complex tracts of land which need to be searched, the Site File's GIS might help; contact the Site File for current information.

Eligibility for Listing on the Florida Master Site File The criteria for listing a property on the Florida Master Site File are that it be adequately documented and normally that it be at least 50 years old. Therefore, entry of a property on the Site File does not necessarily imply that it is especially significant historically, although many listed properties have great significance.

Recording Sites Nonprofessionals as well as professionals have often furnished information useful in understanding and preserving historical sites. Standard Site File forms and manuals are available for recording archaeological sites, historical standing structures, historical bridges, and historical cemeteries. We are developing a form for use with historic districts. A preliminary form is available for recording historic shipwrecks. Supplementary documentation is normally required in addition to the completed form. For instance, for archaeological sites, we require (1) boundaries plotted on a 1:24,000 scale USGS topographic map for all sites, and (2) a detailed site plan at 1:600 scale or better. We encourage site recorders to use the Site File's *SmartForm* program to document cultural resources; state-sponsored surveys resulting in at least 45 forms are required to use *SmartForm*. Various paper forms, manuals, and the *SmartForm* program may be downloaded at *http://www.dos.state.fl.us/dhr/msf/*.

Distributing Computer Database Information The Site File can write the general computer information relating to cultural resources, one county at a time, in a convenient one record per site format. Such "Santa Claus" files can be sent via diskette, CD, or, if you have Web access, FTP download. There are explanatory handouts for each different resource for which we send Santa Claus data. It is easiest to send the data in Microsoft Access format, which can be read by most database systems. Otherwise, we can send the information in fixed column delimited formats—or as a paper listing, if fewer than 200 sites are involved.

GIS (Geographic Information System) Data If you need very large amounts of precise location data, or if the project area is very large or complex, our evolving GIS system may be able to help. Staff limitations prevent us from routine plotting of custom paper maps, but if you have a Geographic Information System, you may be able to download GIS data from our FTP site, depending upon file size and your system. Consult with the GIS Supervisor of the Site File.

Florida Master Site File
Division of Historical Resources
R. A. Gray Building, 500 South Bronough
Tallahassee, Florida 32399-0250
Phone: 850-245-6440; Suncom: 205-6440; Fax: 850-245-6439
E-mail: **fmsfile@dos.state.fl.us**
Site File web page: **http://www.dos.state.fl.us/dhr/msf/**

Forms for Managing Archaeological Resources

The forms on the following pages are for you to cut out or photocopy and use in managing sites on your property.

The **Archaeological Resources Checklist** is a good place to begin to assess your site. It requests information that any archaeologist or manager will want to know to recognize management needs. If you send the form to the Bureau of Archaeological Research, you can receive technical assistance in taking care of your site.

The **Florida Master Site File** is the single place in Florida where information is kept on all the known archaeological and historical sites in the state. The Guidelines for Users provides an introduction to the Site File, and helps explain the context for the Site File forms that follow

The **Florida Master Site File** form (2 sides) is the basic recording form for all archaeological sites in the state, and is the basis for organizing and maintaining information in the site file. It is technical in some places, and you can get help from any archaeologist or by calling the Bureau of Archaeological Research. The main Site File form is supplemented by other forms for other particular kinds of sites like cemeteries.

The **Florida Master Site File Cemetery Form** (2 sides) is designed for recording cemeteries. It requests information that will be helpful for archaeological and historical documentation as well as for responsible management.

The **Florida Master Site File Archaeological Short Form** (2 sides) was created to solicit the most basic information about a site. No special experience or knowledge is necessary to complete the form, and it often serves as the first source of information submitted to the Site File. Often, upon receipt of a Short Form, the Site File will contact the owner to discuss a possible visit by an archaeologist to collect more information.

Recording your site in the Florida Master Site File conveys no rights or interest in your property. Listing in the Florida Master Site File implies no legal status or government control over your property. It does create a public record that can be viewed by others, and will help ensure that knowledge of your site is available for research and management purposes.

Thank you for your stewardship.

Archaeological Resources Checklist

This form is used by the Bureau of Archaeological Research to assist landowners and land managers in archaeological site stewardship. It is designed to identify areas that can be improved in the management of cultural resources. To help the Bureau determine what types of information or technical assistance are appropriate, please photocopy, complete and send this form to:

Bureau of Archaeological Research
500 S. Bronough Street
Tallahassee, FL 32399-0250

A. Background Information

Name of Management Tract/Property_____ County _____

Name/Site Number of Archaeological Sites _____

_____

Yes No

- ☐ ☐ Is the manager/landowner maintaining a cultural resources notebook containing copies of site forms, survey reports, site visit reports, monitoring reports, correspondence from the Division of Historical Resources, and other relevant information?
- ☐ ☐ Are there cultural resource maps showing the locations of all recorded archaeological sites and cultural resources investigation areas within the management tract/property boundary?
- ☐ ☐ Are all of the recorded sites represented by site forms and map locations?
- ☐ ☐ If artifacts have been collected during construction, monitoring activities or by other means, are they stored in plastic bags marked with collection date, site of origin, and other pertinent information?
- ☐ ☐ Have site visits been completed in a timely manner and current site condition and observations recorded in the notebook?
- ☐ ☐ Is a record of site vandalism, unauthorized artifact collection and site excavation maintained, including the names and other identification for individuals given warnings or arrested?
- ☐ ☐ Has a comprehensive cultural resources assessment survey been performed of the management tract/property?
- ☐ ☐ Do the property brochures, signage and other public information notify visitors that archaeological sites should not be disturbed and that artifacts should not be collected?
- ☐ ☐ Has the manager/landowner attended the Cooperative Approach to Archaeological Resource Management workshop sponsored by the Florida Division of Historical Resources (DHR) and the Florida Department of Environmental Protection, Division of Recreation and Parks?

B. Field Evaluation of Archaeological Sites

1. Do any of the sites show evidence of:

Yes	No		If Yes, identify by site numbers/names
☐	☐	Natural erosion	_____
☐	☐	Vehicular damage	_____
☐	☐	Horse or pedestrian damage	_____
☐	☐	Looting activities	_____
☐	☐	Construction activities	_____
☐	☐	Animal damage	_____
☐	☐	Other	_____

2. Comment on any YES answers (for each site). Identify what measures have been taken to correct the problem:

_____

_____

3. If none yet taken, (for each site) what corrective measures are proposed, and what is the schedule to accomplish these measures? _____

_____

4. List the sites accessible to the public: _____

_____

_____

5. What cultural resource interpretive measures are in place, such as park brochures, guidebooks, site brochures, trail side exhibits, visitors center exhibits? (Attach copy or describe) _____

_____

_____

6. What interpretive measures, if any, are proposed? _____

_____

_____

7. If there are known archaeological sites on the property, but no interpretive measures, why are there none?

_____

_____

C. Name of Property Manager/Landowner Providing Information in this Cultural Resource Management Assessment:

Name: _____

Unit/Property Name: _____

Phone: _____ Fax: _____ E-mail: _____

D. Name and Agency or Affiliation of Individual Preparing Assessment:

Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Phone: _____ Fax: _____ E-mail: _____

☐ Original
☐ Update
(give site#)

ARCHAEOLOGICAL SITE FORM
FLORIDA MASTER SITE FILE
Version 2.2 3/97

Consult *Guide to Archaeological Site Form* for detailed instructions.

Recorder Site# _____
Field Date ____/____/____

Site Name(s) _____ *Multiple Listing [DHR only]*
Project Name _____ *FMSF Survey #* _____
Ownership: ☐private-profit ☐private-nonprofit ☐private-individual ☐private-unspecifd. ☐city ☐county ☐state ☐federal ☐foreign ☐Native American ☐unknown
USGS 7.5 Map Name & Date _____ County _____
Township____ Range____ Section _____ ☐ Check if Irregular Section; Qtr. Section (check all that apply): ☐NE ☐NW ☐SE ☐SW
Landgrant _____ Tax Parcel # (s) _____
City / Town (if within 3 mi.) _____ In Current City Limits? ☐yes ☐no ☐unknown
UTM: Zone ☐16 ☐17 Easting _____0 Northing _____0
Address / Vicinity of / Route to _____

Name of Public Tract (e.g., park) _____

TYPE OF SITE (Check all choices that apply; if needed write others in at bottom)

SETTING *

☐ Land - *terrestrial*
☐ Cave/Sink - *subterranean*
- ☐ terrestrial
- ☐ aquatic
- ☐ intermittently flooded

☐ Wetland - *palustrine*
- ☐ usually flooded
- ☐ sometimes flooded
- ☐ usually dry

☐ Lake/Pond - *lacustrine*
☐ River/Stream/Creek - *riverine*
☐ Tidal - *estuarine*
☐ Saltwater - *marine*
- ☐ marine unspecified
- ☐ high energy marine
- ☐ low energy marine

☐ Other _____

STRUCTURES - OR - FEATURES *

☐ aboriginal boat	☐ fort	☐ road segment
☐ agric/farm building	☐ midden	☐ shell midden
☐ burial mound	☐ mill unspecified	☐ shell mound
☐ building remains	☐ mission	☐ shipwreck
☐ cemetery/grave	☐ mound unspecified	☐ subsurface features
☐ dump/refuse	☐ plantation	☐ surface scatter
☐ earthworks	☐ platform mound	☐ well

FUNCTION *

☐ none specified
☐ campsite
☐ extractive site
☐ habitation (prehistoric)
☐ homestead (historic)
☐ farmstead
☐ village (prehistoric)
☐ town (historic)
☐ quarry

HISTORIC CONTEXTS (Check all that apply; use most specific subphases: e.g., if *Glades Ia* only, don't also use *Glades I*)

Aboriginal *

☐ Alachua	☐ Englewood	☐ Glades unspecif.	☐ St. Augustine	☐ Seminole: 2d War To 3d
☐ Archaic, Early	☐ Fort Walton	☐ Hickory Pond	☐ St. Johns Ia	☐ Seminole: 3d War On
☐ Archaic, Middle	☐ Glades Ia	☐ Leon-Jefferson	☐ St. Johns Ib	☐ Seminole unspecified
☐ Archaic, Late	☐ Glades Ib	☐ Malabar I	☐ St. Johns I unspecified	☐ Swift Creek, Early
☐ Archaic unspecified	☐ Glades I unspecif.	☐ Malabar II	☐ St. Johns IIa	☐ Swift Creek, Late
☐ Belle Glade I	☐ Glades IIa	☐ Manasota	☐ St. Johns IIb	☐ Swift Creek, unspecified
☐ Belle Glade II	☐ Glades IIb	☐ Mount Taylor	☐ St. Johns IIc	☐ Transitional
☐ Belle Glade III	☐ Glades IIc	☐ Norwood	☐ St. Johns II unspecified	☐ Weeden Island I
☐ Belle Glade IV	☐ Glades II unspecif.	☐ Orange	☐ St. Johns unspecified	☐ Weeden Island II
☐ Belle Glade unspecif.	☐ Glades IIIa	☐ Paleoindian	☐ Santa Rosa	☐ Weeden Island unspecif.
☐ Cades Pond	☐ Glades IIIb	☐ Pensacola	☐ Santa Rosa-Swift Creek	☐ Prehistoric nonceramic
☐ Deptford	☐ Glades IIIc	☐ Perico Island	☐ Seminole: Colonization	☐ Prehistoric ceramic
	☐ Glades III unspecif.	☐ Safety Harbor	☐ Seminole: 1st War To 2d	☐ Prehistoric unspecified

Nonaboriginal *

- ☐ First Spanish 1513-99
- ☐ First Spanish 1600-99
- ☐ First Spanish 1700-1763
- ☐ First Spanish unspecified
- ☐ British 1763-1783
- ☐ Second Spanish 1783-1821
- ☐ American Territorial 1821-45
- ☐ American Civil War 1861-65
- ☐ American 19th Century
- ☐ American 20th Century
- ☐ American unspecified
- ☐ African-American

☐ Other (Less common phases are not check-listed. For historic sites, also give specific dates if known.) _____

✶ Consult *Guide to Archaeological Site Form* for preferred descriptions not listed above (data are "coded fields" at the Site File).

SURVEYOR'S EVALUATION OF SITE

Potentially eligible for a local register? ☐yes: name register at right ☐no ☐insufficient info Name of local register if eligible: _____
Individually eligible for National Register? ☐yes ☐no ☐insufficient info _____
Potential contributor to NR district? ☐yes ☐no ☐insufficient info
Explanation of Evaluation (Required if evaluated; limit to 3 lines; attach full justification) _____

Recommendations for Owner or SHPO Action _____

DHR USE ONLY ❧❧❧❧❧❧❧ OFFICIAL EVALUATIONS ❧❧❧❧❧❧❧ DHR USE ONLY

NR DATE ____/____/____
DELIST DATE ____/____/____

KEEPER-NR ELIGIBILITY: ☐yes ☐no Date ____/____/____
SHPO-NR ELIGIBILITY: ☐yes ☐no ☐potentially elig. ☐insufficient info. Date ____/____/____
LOCAL DESIGNATION: _____ Date ____/____/____
Local office _____

National Register Criteria for Evaluation ☐a ☐b ☐c ☐d (See *National Register Bulletin 15*, p. 2)

ARCHAEOLOGICAL SITE FORM

Site #8 _____

Consult *Guide to Archaeological Site Form* for detailed instructions.

FIELD METHODS (Check one or more methods for detection and for boundaries)

SITE DETECTION *

☐ no field check ☐ exposed ground ☐ screened shovel
☐ literature search ☐ posthole digger _____
☐ informant report ☐ auger--size:___ _____
☐ remote sensing ☐ unscreened shovel _____

SITE BOUNDARIES *

☐ bounds unknown ☐ remote sensing ☐ unscreened shovel
☐ none by recorder ☐ insp exposed ground ☐ screened shovel
☐ literature search ☐ posthole tests ☐ block excavations
☐ informant report ☐ auger--size:_____ ☐ estimate or guess

Other methods; number, size, depth, pattern of units; screen size (attach site plan) _____

SITE DESCRIPTION

Extent Size (m^2) _____ Depth/stratigraphy of cultural deposit _____

Temporal Interpretation* - Components (check one): ☐ single ☐ prob single ☐ prob multiple ☐ multiple ☐ uncertain ☐ unknown

Describe each occupation in plan (refer to attached large scale map) and stratigraphically. Discuss temporal and functional interpretations: _____

Integrity Overall disturbance*: ☐ none seen ☐ minor ☐ substantial ☐ major ☐ redeposited ☐ destroyed-**document!** ☐ unknown

Disturbances/threats/protective measures _____

Surface: area collected _____ m^2 # collection units _____ ; Excavation: # noncontiguous blocks _____

ARTIFACTS

Total Artifacts #_____(C)ount or (E)stimate? Surface #_____(C) or (E) Subsurface # _____(C) or (E)

COLLECTION SELECTIVITY *

☐ unknown ☐ unselective (all artifacts)
☐ selective (some artifacts)
☐ mixed selectivity

SPATIAL CONTROL*

☐ uncollected ☐ general (not by subarea)
☐ unknown ☐ controlled (by subarea)
☐ variable spatial control

☐ Other_____

ARTIFACT CATEGORIES* and DISPOSITIONS * (*example*: _A_ bone-human)

Pick exactly one *code* from Disposition List ⇨ ⇨ ⇨ ⇨

____ bone-animal
____ bone-human
____ bone-unspecified
____ bone-worked
____ brick/building debris
____ ceramic-aboriginal
____ ceramic-nonaboriginal
____ daub
____ exotic-nonlocal
____ glass
____ lithics-aboriginal
____ metal-nonprecious
____ metal-precious/coin
____ shell-unworked
____ shell-worked
____ Others: _____

Disposition List*

A - category always collected
S - some items in category collected
O - observed first hand, but not collected
R - collected and subsequently left at site
I - informant reported category present
U - unknown

Artifact Comments _____

DIAGNOSTICS (Type or mode, and frequency: e.g., *Suwanee ppk, heat-treated chert, Deptford Check-stamped, ironstone/whiteware*)

1._____ N=___ 5._____ N=___ 9._____ N=___
2._____ N=___ 6._____ N=___ 10._____ N=___
3._____ N=___ 7._____ N=___ 11._____ N=___
4._____ N=___ 8._____ N=___ 12._____ N=___

ENVIRONMENT

Nearest fresh water type* & name (incl. relict source) _____ Distance (m)/bearing _____

Natural community (FNAI category* or leave blank) _____

Local vegetation _____

Topography* _____ Min Elevation____meters Max Elevation____meters

Present land use _____

SCS soil series _____ Soil association _____

FURTHER INFORMATION

Informant(s): Name/Address/Phone/Email _____

Describe field & analysis notes, artifacts, photos. For each, give type*(e.g., notes), curating organization*, accession #s, and short description.

Manuscripts or Publications on the site (Use continuation sheet, give FMSF# if relevant) _____

Recorder(s): Name/Addr./Phone/Email _____

Affiliation* or FAS Chapter _____

✶ Consult *Guide to Archaeological Site Form* for preferred descriptions not listed above (data are "coded fields" at the Site File).

SITE PLAN & USGS REQUIRED At 1"=300' (1:3600) or larger scale, show: site boundaries, scale, north arrow, datum, test/collection units, landmarks, mappers, date.

☐Original
☐Update (give site # at right)

HISTORICAL CEMETERY FORM

Florida Master Site File
Version 3.0: 8/98

Site #8
Recorder #
Field Date _____

*Consult *Guide to the Historical Cemetery Form* for detailed instructions

Form Date _____

LOCATION & IDENTIFICATION

Cemetery Name(s) _____ *Multiple Listing [DHR only]* _____
Project Name _____ FMSF Survey # _____
Address/Vicinity of/Route to _____

Nearest City/Town (within three miles)_____ In Current City Limits? ☐yes ☐no ☐unknown
County _____ Tax Parcel #(s) (optional) _____
Ownership Type (check exactly one) ☐private-profit ☐private-nonprofit ☐private-unspecified ☐city ☐county
☐state ☐federal ☐foreign ☐Native American ☐unknown
Public Tract Enclosing Cem., if any (e.g. park)_____

MAPPING

USGS 7.5 Map Name and Date _____
Township_____ Range_____ Section_____ 1/4 section ☐NW ☐SW ☐SE ☐NE ☐Irregular sec.-name: _____
Township_____ Range_____ Section_____ 1/4 section ☐NW ☐SW ☐SE ☐NE ☐Irregular sec.-name: _____
Landgrant:_____ Plat or Other Map _____

HISTORY

Year Cemetery Established:_____ Estimated Year_____ Ownership History (especially original owners)_____

Year Burials Ceased, if applicable _____ Reason(s) Burials Ceased _____

Range of Death Dates Earliest_____ Most Recent_____ (O)bserved or (R)esearched?_____
Acreage Expansions/Dates:_____
List People Important in Local, State, or National History Buried in Cemetery _____

FDHR Form Number HRXXXXXXX-98 Computer Document File P:\FSF\DOCS\FORMS\CM_V30ms.doc

Previous Attempts at Repair, Cleaning, or Restoration? _____

GENERAL DESCRIPTION OF CEMETERY

Type (Check all that apply) ☐community ☐company town ☐epidemic ☐family ☐fraternal order
☐memorial park ☐military(not national) ☐municipal ☐national ☐potter s field ☐prison
☐religious ☐ Rural Movement ☐other (explain): _____
Ethnic Group(s) Interred (Check all that apply) ☐White non-Hispanic ☐Hispanic ☐Asian ☐Caribbean
☐African American ☐American Indian-tribe: _____ ☐other (explain): _____
Current Status: ☐used for burials ☐maintained but not used ☐abandoned Size: _____ft X _____ft or _____acres
Total # Graves: _____ Does Total # Include Unmarked Graves?: ☐yes ☐no
Evidence/# of Unmarked Graves? _____
Condition: ☐well maintained ☐some areas maintained, others neglected ☐poorly maintained
☐not maintained, but can identify ☐not maintained, hard to identify ☐not identifiable but known to exist (explain):

Cemetery Boundary Type: ☐fence ☐wall ☐hedge ☐other (explain): _____
Describe Cem. Boundary (e.g. cast iron fence , stone or brick wall, etc.) _____

Historical Vegetation (trees, shrubs, flowers)_____
Grave Groupings (Check all that apply) ☐family ☐fraternal order ☐military ☐religious ☐ethnic heritage ☐other (explain):

Groupings Indicated By (Check all that apply) ☐curbing ☐fence ☐hedge ☐wall ☐other (explain):

Public Access ☐Unlimited ☐Restricted: How? _____
Surroundings [use (**N**)one, (**S**)ome, (**M**)ost, (**A**)ll or nearly (**A**)ll] ___Commercial ___Residential ___Institutional ___Undeveloped
Threats (Check all that apply) ☐abandonment☐agriculture ☐desecration ☐public development ☐private development
☐mining or timbering ☐other (explain): _____
Associated Historical Properties/Archaeological (non-cemetery) Remains _____

☐Check if *Historical Structure Form* completed ☐Check if *Archaeological Site Form* completed

HISTORICAL CEMETERY FORM

Site #8 _____

*Consult *Guide to the Historical Cemetery Form* for detailed instructions

GRAVES

If question requests N/S/M/A, estimate proportions by using a letter as follows: (N)one/Very Few, (S)ome, (M)ost, (A)ll/Nearly (A)ll.

Orientation (N/S/M/A) (complete all that apply) ___East/West ___North/South ___Other: (explain):_____

Marked Graves (N/S/M/A) (complete all that apply) ___Headstones ___Marked with objects or plants (no headstone on grave)
___Graves mounded ___Graves depressed

If Other Method(s) of Marking Graves Used, List and Give N/S/M/A_____

Marker Materials (Check all that apply) ☐marble ☐concrete/cement ☐fieldstone ☐granite ☐wrought iron ☐cast iron ☐white bronze/zinc ☐sandstone ☐slate ☐wood ☐other (explain below):

_____

Describe Grave Articles Found in Cemetery _____

_____

_____

Marker Conditions (N/S/M/A) ___Sunken or tilted ___Chipped, cracked, weathered, but standing
___Broken or in fragments ___Deliberately vandalized

Other Notable Conditions Observed and Proportions (N/S/M/A) _____

_____

Inscriptions (N/S/M/A) ___Legible inscriptions ___Illegible inscriptions ___No inscriptions

Distinctive Gravemarkers, Monuments, and/or Architectural Features _____

_____

Signatures of Stone Carvers (Specify name, town if available) _____

_____

RECORDER'S EVALUATION

Potentially Eligible for Local Designation? ☐yes ☐no ☐insufficient information

Name of Local Register if Eligible _____

Individually Eligible for Nat. Register? ☐yes ☐no ☐insufficient information

Potential Contributor to NR District? ☐yes ☐no ☐insufficient information

Areas of Historical Significance (See *National Register Bulletin 15*, p. 8 for categories: e.g. "architecture", "ethnic heritage", etc.):

_____

_____

Explanation of Evaluation (required; limit to three lines; attach full statement on separate sheet):

_____

_____

_____

DOCUMENTATION

Research Methods (Consult **Guide to the Historical Cemetery Form** for detailed instructions) _____

_____

_____

Bibliographic References (Author, date, title, publication information. If unpublished, give FSF Manuscript Number, or location where available): _____

_____

_____

_____

Local **C**ontact: Name/Address/Phone # /Administrative Office _____

_____

Recorder(Name/Address/Phone/Affiliation): _____

_____

Photographs: Required. Request the use of B&W prints no smaller than 3x5. Photographs would be useful to document main gate or entrance, representative general views, representative or unusual monuments or markers, and damage or neglect.

Describe and Give Location/File Nos. of Notes, Records, or Photos:_____

_____

DHR USE ONLY OFFICIAL EVALUATIONS DHR USE ONLY

NR DATE ___/___/____ *KEEPER-NR ELIGIBILITY:* ☐*yes* ☐*no* *Date* ___/___/____

SHPO-NR ELIGIBILITY: ☐*yes* ☐*no* ☐*potentially elig.* ☐*insufficient info.* *Date* ___/___/____

DELIST DATE ___/___/____ *LOCAL DESIGNATION:* _____ *Date* ___/___/____

Local office _____

National Register Criteria for Evaluation ☐*a* ☐*b* ☐*c* ☐*d* (See *National Register Bulletin 15*, p. 2)

REQUIRED: Photocopy or Orig. 7.5' Map with Boundaries in Red

ARCHAEOLOGICAL SHORT FORM

FLORIDA MASTER SITE FILE

Version 3.0 12/95

☐ Original
☐ Update

Site File No. 8 _____
Date of Form _____
Field Dates _____

Site Name(s) _____
Survey Name _____ Site File # if known _____
USGS Map name _____
(A USGS topographic map in the 7.5 minute series, or a photocopy, must be attached to this form)

Ownership ☐ private-profit (corporation) ☐ private-nonprofit (church) ☐ private-individual ☐ private-unspecif
☐ city ☐ county ☐ state ☐ federal ☐ foreign ☐ native american ☐ unknown

Nearest Town _____ in current city limits? ☐y ☐n
County _____ Township ____ Range ____ Section ____
Address / Vicinity Of/Route To _____
_____
_____

Environment (nearest fresh water) _____ Distance (m/ft) _____
Local Vegetation _____
Current Land Use _____

Artifact Categories (If possible, attach photos, sketches, or photocopies of datable and representative artifacts)

☐Stone tools, flakes, chips	☐Glass	☐Bone-animal
☐Ceramics-prehistoric	☐Precious metal/coin	☐Bone-unidentified
☐Ceramics-historic or Euro.	☐Metal	☐Shell
☐Brick/building material	☐Bone-human	☐Other (describe below)

Other _____
DHR Form HR6E04906-92 Computer Document File F:\DOCS\FORMS\ARSHORT

Location (field notes, artifacts, photographs) _____
_____

Contact Person (name) _____
Address/Phone _____
_____
Is Contact Person the landowner? ☐yes ☐no Agreeable to further contact? ☐yes ☐no

NARRATIVE DESCRIPTION: Attach extra sheets with information on site discovery, artifacts observed or collected, history of land use, current condition, apparent threats to the site, current environment, and other pertinent observations.

RECORDER Name _____
Affiliation (FAS Chapter if member)/Address/Phone _____
_____

To learn about a nonprofit organization of amateur and professional archaeologists concerned with preserving and learning about Florida's heritage, write: Membership Secretary, Florida Anthropological Society, P. O. Box 82255, Tampa, Florida 33682.

FURTHER READING

The Florida Master Site File has produced a one page *Bibliography for Archaeology in Florida*.
Write to the address on the bottom of this page.

* * * REQUIRED: USGS MAP OR PHOTOCOPY WITH SITE MARKED * * *
DON'T TRESPASS * DON'T DIG OR COLLECT WITHOUT TRAINING & RECORDS

SHORT FORM INSTRUCTIONS

WHICH FORM TO USE

If you have not had any archaeological training, use this Short Form. If you have had training, use the Site File's standard Archaeological Site Form, with instructions *Guide to the 1992 Archaeological Site Form of the Florida Master Site File*.

WHEN TO COMPLETE A FORM

If material from one category in the margin is found, note it and consider completing a form. If items from two or more categories are found together, always complete a form.

PREHISTORIC MATERIALS

Bone	■ It is a felony in Florida to knowingly disturb ANY human remains without authorization. If you find bone that could be human but that may not be old, call law enforcement. If the bone is human and known to be old, notify law enforcement and call the State Archaeologist at (904) 487-2299. ■ Bone buried deeper than 18" (40 cm). ■ Bone at any level with materials made by humans.
Charcoal or Ash	■ Any concentration not clearly from a recent fire (aluminum cans indicate a recent event). ■ Even scattered pieces of ash, especially if there are any pieces of pottery, shell, or discolored stones or stone flakes that are not obviously part of a stream bed or from bedrock.
Stone	■ Arrowhead or projectile point. ■ Two or more human-altered stone flakes within a 100' (30 meter) diameter area.
Ceramics	■ Two or more pieces of Indian pottery.
Shell	■ More than 4 pieces, clearly old (e.g. moss covered), within 100' diameter area. Note especially conch, oyster, apple snail, and periwinkle shell.

HISTORIC MATERIALS

Fifty years old is a rule of thumb for "historic." Trash dumps can be especially important.

Wood	■ Lumber: More than one piece hand cut or with square nails (for example, the remains of a wall). ■ Logs: Especially if notched or with bark removed. ■ Recognizable object. Example: canoe from lake.
Metal	■ Recognizable hardware or three square cut nails.
Glass	■ More than two pieces of any of these colors/kinds: purple, cobalt blue, white milk, dark amber, or green; glass with dates, writing, or decoration.
Ceramics	■ At least one decorated sherd of European pottery.
Brick or clay	■ Bricks in alignment (for a foundation?) or in a pile. ■ Older bricks, not machine made, are less regular in finish and size, and less likely to contain frogs (recesses and perforations designed into the brick). ■ Burned clay, especially with impressions from other materials.
Concrete	■ Remnants of a foundation or structure, unless it is clearly less than fifty years old.
Other	■ Any buttons, beads, toys, or jewelry.

FIELD BY FIELD INSTRUCTIONS

Original/Update: Mark Original if you have verified with Site File that the site has never been recorded or if you do not know whether it has been recorded; mark Update otherwise and write previous number in the Site File No. 8 field.

Site File No. 8: Omit if not assigned by Florida Master Site File.

Date of Form: When the form was actually completed.

Field Dates: When the site was actually observed; put all dates if more than one day's work was involved.

SITE NAME(S): All commonly used names for the site. If formerly unknown, sites are usually named for natural features, landmarks, or landowners. E.g.: Bryan Homestead, Roy's Mound, Beaver Creek, Hutchins (the word "Site" may be omitted from this field--it is understood).

SURVEY NAME: If the site has been recorded as part of a survey project, give the project name here.

Site File # if known: The Site File assigns survey projects a file number and keeps standard information on them. You will not know this number unless you have had your project, and the written report on it, assigned such a number.

USGS MAP NAME: The name of the USGS 7.5 minute topographic map on which the site appears, including the date of the map's latest revision. Vital! Mark the site area to scale on the map, preferably in red. Ensure that map name and date are written on the copy. USGS topographic maps at the large 1:24,000 scale may be used at large libraries. Purchase from large bookstores, engineering supply stores, or directly from U. S. Geological Survey, Map Distribution, Federal Center, Box 25286, Denver, CO, 80225, phone (303) 236-7477.

OWNERSHIP: If uncertain, mark unknown. Commercial uses including pine plantation are private-profit. Besides trespass laws, note that archaeological sites are legally protected on all state and federal lands, as well as by some local governments.

NEAREST TOWN: Nearest town or none if none within 10 mi.

IN CURRENT CITY LIMITS?: It is important to accurately complete this item from updated local maps. Local governments compile lists of sites from the Site File.

COUNTY: Spell it out. If the site overlaps counties, use the county in which the greater part of the site lies.

TOWNSHIP: North-south surveyor coordinate, red lines on USGS maps. Also shown on Florida Dept. of Transportation, soils, and other maps. Example: 1 South or 1S.

RANGE: The east-west surveyor coordinate as shown on above maps. Examples: 23E, 3W, 16W, etc.

SECTION: A subdivision (usually a square mile) of a given township and range, as read from above maps. On USGS maps, sections are marked by fine red solid or dashed lines.

ADDRESS / VICINITY OF/ROUTE TO: Give address if the site is on a lot with an address. Box/route information is not useful. In any case, explain briefly how to get there. Example: From Main St and US 98 in Bradford, S on US 98, 5.8 mi N; right on dirt rd, 0.5 mi; site S behind house, 100 ft.

Nearest Fresh Water: If named, identify by name: Lake Jones. Otherwise, indicate, e.g., unnamed creek.

Distance: indicate meters or feet and compass direction from site. Example: 120 m NE.

Local Vegetation: Describe (1) dominant trees; (2) nature of ground cover; (3) percent of ground covered. Example: Scrub oak, assorted evergreens and weeds, 75% cover.

Current Land Use: Examples: Cultivated field, old field, planted pine, groves, woods, subdivision under construction, existing residential area, urban redevelopment, right of way (for road, pipeline, powerline, etc.).

ARTIFACT CATEGORIES: Show number of artifacts if known; otherwise, check all the categories that are present. If possible, photograph, sketch, or photocopy artifacts such as arrowheads and decorated pottery. Pottery rims and glazed pottery sherds with designs or stamped or painted patterns are best for dating. Other is for artifacts outside these categories.

LOCATION Field notes, artifacts, photographs: Where are these items kept? This can guide future researchers.

CONTACT PERSON: Who locally knows about the site?

RECORDER: Person completing the form.

FURTHER INFORMATION

PHOTOGRAPHS: Optional, but valuable to document site condition (especially if obviously looted), and to document diagnostic artifacts. B&W prints, at least 3x5, are preferred; label in pencil on the back, including site number and name.

DON'T TRESPASS ** DON'T DIG OR COLLECT WITHOUT RECORDS & TRAINING

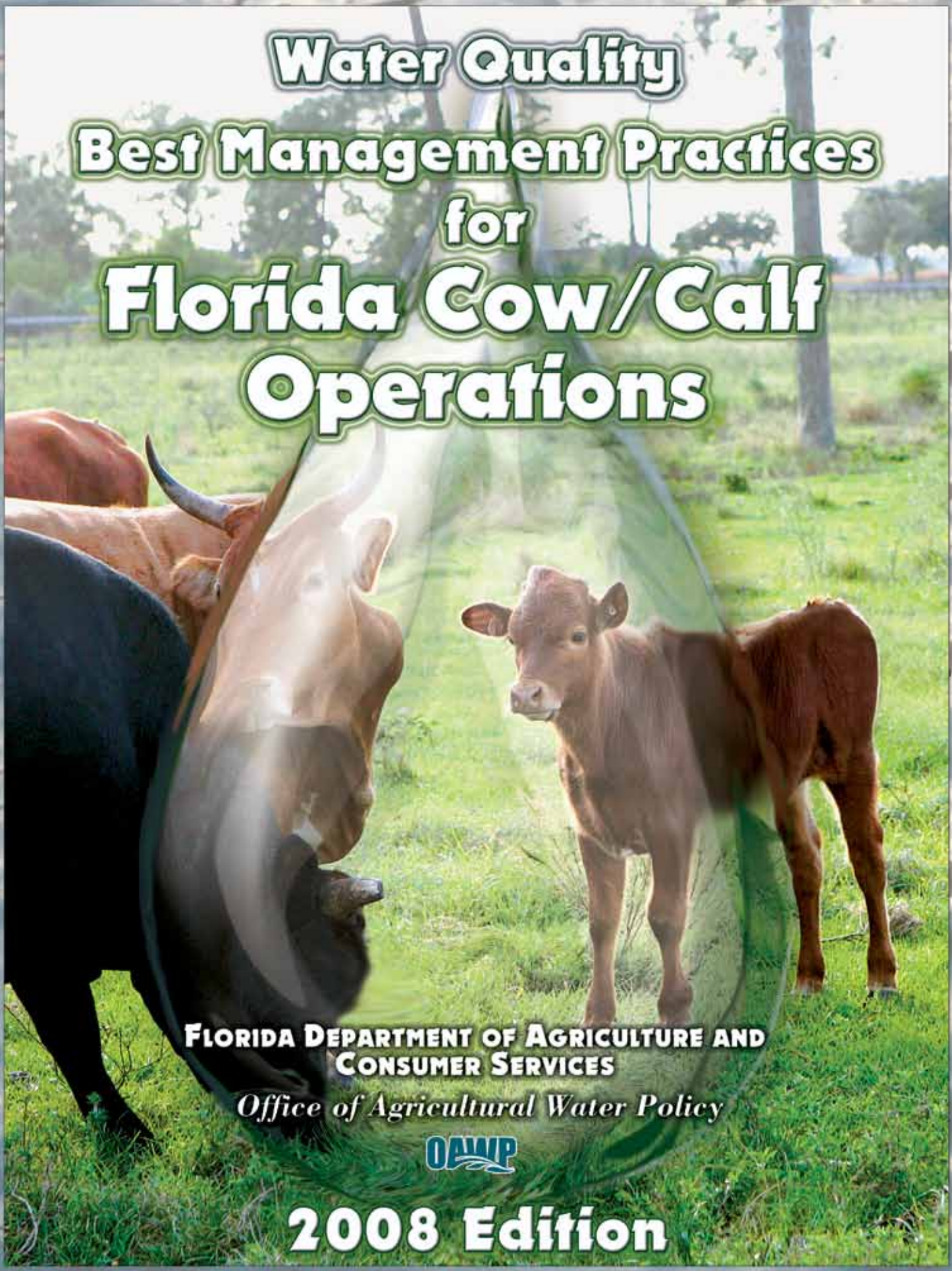


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Water Quality
Best Management Practices
for
Florida Cow/Calf
Operations
Florida Department of Agriculture and
Consumer Services
Office of Agricultural Water Policy
OAWP
2008 Edition

DACS-P-01280

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Tallahassee, Florida 32399-0800

Florida Department of Agriculture and Consumer Services
Commissioner Adam H. Putnam

COMMENTS BY COMMISSIONER ADAM H. PUTNAM

Dear Agricultural Producers:

This manual, *Water Quality Best Management Practices for Florida Cow/Calf Operations*, reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. In general, agricultural lands maintain valuable water recharge areas and preserve open spaces. The BMPs in this manual address water quality and quantity impacts from production activities and help maintain the environmental advantages of keeping the land in agriculture.

While best management practices have been in place for many years in our state, their role in environmental protection was formally established in 1999 with the passage of the Florida Watershed Restoration Act. This legislation provides the framework for implementing Florida's Total Maximum Daily Load program, which sets water quality targets for impaired waters. It also identifies best management practices implementation as the means for agriculture to help meet those targets.

As Florida's population continues to increase, there are more impacts to and competition for Florida's limited water resources. All Floridians must take part in conserving and protecting these resources. This manual represents the industry's commitment to do just that.

As a native Floridian whose family has long been involved in agriculture, I want to thank all who participated with the Department in the development of this important manual. With the active support and participation of so many dedicated people, I am optimistic about the future of Florida's agricultural industry. I trust that you will join me in supporting this valuable water resource protection effort.

Sincerely,



Adam H. Putnam
Commissioner of Agriculture

ACKNOWLEDGEMENTS

A Steering Committee was established in 2007 to update and revise the 1999 cow/calf BMP manual. A technical working group was formed to support the efforts of the Steering Committee, and was charged with developing and reviewing specific BMPs contained in the manual. An effort of this magnitude could not have been accomplished without the tireless dedication of all participants. The following is a list of individuals who participated in the development of this manual. Each of these individuals and their organizations made important contributions to the process, and their work is sincerely appreciated.

Steering Committee

Mike Adams – Adams Ranch

Bill Bartnick – Florida Department of Agriculture and Consumer Services

Pete Deal – USDA/Natural Resources Conservation Service

Wade Grigsby – Private Consultant

Rick Hacht – H & H Liquid Sludge Disposal, Inc.

Jim Handley – Florida Cattlemen's Association

Matt Harrison – Private Rancher

Pat Hogue – University of Florida/IFAS

Clegg Hooks – Florida Department of Agriculture and Consumer Services

Flint Johns – Lykes Bros., Inc.

Billy Kempfer – Kempfer Ranch

Jim Lefils – Lefils Cattle Company

Mike Milicevic – Lykes Bros., Inc.

James Payne – Deseret Ranches of Florida

Wes Williamson – Williamson Cattle Co.

Technical Working Group

Brian Boman – University of Florida/IFAS

Benita Whalen – South Florida Water Management District

Lance Laird – Northwest Florida Water Management District

Mark Luchte – Southwest Florida Water Management District

Vince Singleton – St. Johns River Water Management District

Mike Thomas – Florida Department of Environmental Protection

Glenn Horvath – Suwannee River Water Management District

Additional Contributors

Linda Crane – Florida Department of Agriculture and Consumer Services

Greg Hendricks – USDA/Natural Resources Conservation Service

Terry Pride – Florida Department of Agriculture and Consumer Services

INTRODUCTION

Opening Notes

Best Management Practices (BMPs) are practices or combinations of practices that, based on research, field-testing, and expert review, are determined to be the most effective and practicable means for improving water quality. BMPs are typically implemented as a ***treatment train***. This normally includes a combination of nonstructural and structural practices that are effective in reducing or preventing pollutant discharges. BMPs must be: based on sound science, technically feasible, and economically viable for landowners.

The practices outlined in this manual are intended for use statewide on beef cow/calf operations, and other cattle operations. This manual does not apply to concentrated animal feeding operations, which generally require a permit. The manual can be downloaded at www.floridaagwaterpolicy.com. If ranchers are involved in farming ventures other than cow/calf operations (row crops, sod, and silviculture, they should use the related BMP manuals, which are available at the same website.

Things to keep in mind as you use this manual are:

- Italicized words that appear in ***red*** are defined in the glossary.
- Specific record keeping requirements are noted using a "pencil mark" icon. 
- Remember to fill out the BMP Manual Registration Form inside the front cover and return it to the Florida Department of Agriculture and Consumer Services in order to receive future updates to this manual.

Overview of the Industry

There are more than 11 million acres of total pasture and rangeland in Florida, of which 5 million acres are improved pasture. Florida's grazing lands provide significant benefits to society and the environment. Grazing lands release oxygen to the atmosphere, help to significantly cool surrounding surface temperatures, naturally filter pollutants from runoff water, reduce soil erosion, replenish our water supply, and provide aesthetic and recreational values. One thing to remember is that animals do not produce nutrients, but assimilate and distribute them.

Because of the large amount of pasture acreage, improperly managed pasture runoff may adversely affect the quality of our lakes and streams. The industry remains committed to fostering water resource protection through the implementation of BMPs. This manual, which has been endorsed by the Florida Cattlemen's Association, has been developed to promote BMPs for beef cow/calf operations in Florida. Although these practices are designed primarily to protect water quality, the implementation of certain BMPs will also have water conservation benefits. In addition, the manual addresses other activities that normally occur in conjunction with beef cattle production. Examples include intermittent row cropping and silviculture.

BMP History and Purpose

The 1972 Federal Clean Water Act (FCWA) required states to assess the impacts of nonpoint sources of pollution on surface and ground waters, and establish programs to minimize these impacts. In 1978, Florida established a Nonpoint Source Management Program, which includes the use of structural and nonstructural BMPs to minimize nonpoint source pollution, through both regulatory and non-regulatory means.

Section 303(d) of the FCWA requires states to identify impaired waters and establish total maximum daily loads (TMDLs) for pollutants entering these waters. TMDLs establish the maximum amount of pollutants that can be discharged to a waterbody and still meet designated uses such as swimming, fishing, or as a potable water source. The 1999 Florida Watershed Restoration Act (FWRA) provided the framework for Florida's TMDL program. Under the FWRA, once the Florida Department of Environmental Protection (FDEP) establishes a TMDL, the agency may develop and adopt a Basin Management Action Plan (BMAP), which specifies the activities that watershed stakeholders will undertake to reduce point and nonpoint source pollutant loadings. In watersheds with adopted BMAPs and in some other areas, agricultural producers are statutorily required either to implement FDACS-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district.

The FWRA gives the Florida Department of Agriculture and Consumer Services (FDACS) the authority to develop interim measures, BMPs, cost-share incentives, and technical assistance programs to assist agriculture in reducing pollutant loads in TMDL watersheds and other areas. The law also stipulates that the FDEP must verify that these BMPs are effective in reducing pollutant loading to waters.

Many of Florida's ranchers who produce food, fiber, and livestock on approximately 11 million acres will be required to help meet agricultural pollutant load allocations through BMP implementation.

Pursuant to sections 403.067(7)(c), and 570.085, F.S., implementation, in accordance with FDACS rule, of FDEP-verified and FDACS-adopted BMPs gives ranchers the following advantages:

- A presumption of compliance with state water quality standards
- A release from the provisions of s.376.307(5), F.S., for those pollutants addressed by the BMPs
- Assistance with BMP implementation

However, nothing in this manual shall be construed as restricting the authority of the FDEP or the water management districts (WMD) under Chapters 403 and 373, F.S.

Statutory Exemptions for Agricultural Activities

Under subsection 373.406(2), F.S., any person engaged in the occupation of agriculture may alter the topography of any tract of land for purposes consistent with the practice of agriculture. These activities may not be for the sole or predominant purpose of impounding or obstructing surface waters. Agricultural activities that meet these criteria may qualify for a statutory exemption from an Environmental Resource Permit (ERP).

Pursuant to 373.406(9), F.S., environmental restoration activities on agricultural lands that have minimal or insignificant impacts to water resources may also be exempt from an ERP, upon written request by the producer and written notification from FDEP or the water management district that the proposed activity qualifies for the exemption.

Even if the two exemptions above apply, they do not relieve agricultural producers located within a watershed with an adopted BMAP from either implementing BMPs or conducting monitoring.

Also, persons engaged in the occupation of agriculture have protections under the Florida Right to Farm Act (section 823.14, F.S.). The Act states, with certain exceptions, that no farm which has been in operation for one year or more and was not a nuisance at the time of its established date of operation shall be a public or private nuisance, if the farm operation conforms to generally accepted agricultural and management practices.

BMP ENROLLMENT AND IMPLEMENTATION

This manual contains Level I BMPs that are largely applicable to all ranchers, and Level II and III BMPs that will apply under specific circumstances. The manual includes a self-assessment tool to help ranchers determine which Level II and III BMPs are applicable to their operation. The self-assessment tool also guides ranchers in determining whether they need a formal Conservation Plan, which would be based on conservation practices contained in Section IV of the USDA-NRCS Field Office Technical Guide (FOTG), and would incorporate all the applicable BMPs in this manual.

Level I BMPs

All ranchers must implement the applicable **Level I BMPs** to establish a foundation for environmental protection. Depending on the site-specific conditions or geographical location of the ranch, not all of the Level I BMPs may be applicable to every site.

Advanced-Level BMPs

Ranchers may have to implement additional BMPs, based on their "score" after completing the *Advanced-Level BMP Needs Assessment*. The assessment identifies water quality risk features that require special attention or protection, and also identifies specific groups of BMPs that address these issues. These **Level II and III BMPs** focus on high-intensity areas, livestock use exclusion, address the need for grade stabilization structures for sediment control, and list situations that require comprehensive prescribed grazing management practices.

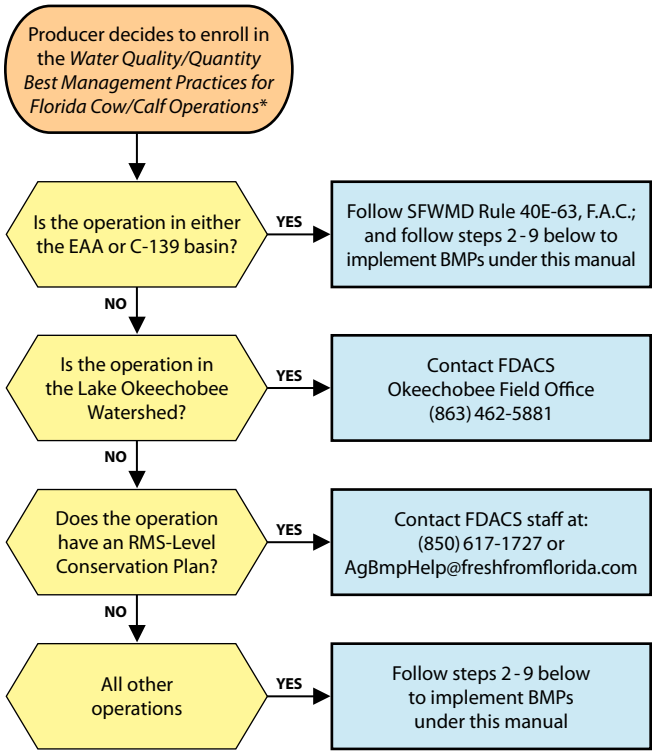
Conservation Plans

Conservation planning is a natural resource problem-solving and management process, with the goal of sustaining natural resources for future generations. A Conservation Plan may be developed for a single operation or for an area that crosses land ownership boundaries. A well-written Conservation Plan addresses landowner goals and objectives, and natural resource concerns. The plan includes strategies to maintain or improve yields, while also protecting soil, water, air, plant, animal, and human resources. Usually, Conservation Plans address all of the major activities on the ranch, but can be developed to target specific challenges. Conservation Plans are particularly well-suited to cow/calf operations and farming operations that produce multiple commodities.

Conservation Plans are developed in accordance with the USDA-NRCS FOTG. Because not all the specific BMPs in this manual may be contained in the FOTG, Conservation Plans must also include the applicable Level I, II, and III BMPs. Assistance in developing a plan can be obtained through the local SWCD, the USDA-NRCS, the Cooperative Extension Service, and private consultants who function as technical service providers. However, the decisions included in the Conservation Plan are the responsibility of the owner or manager of the ranch.

User's Guide to BMP Enrollment and Implementation

1. **Choose the Pathway Applicable to You**: In the flowchart below, identify the circumstances that best apply to you.



* **Note**: *If operation is in an area where a BMAP has been adopted, the producer must implement BMPs for all applicable commodities or monitor water quality. Contact FDACS Field Office for more information.*

2. **Consult the manual**: If you are proceeding with enrollment under this manual, begin by reading the following sections: *Introduction; Keys to Pollution Prevention;* and *General Information for Environmental Protection on Cow/Calf Operations*

3. **Conduct an inventory**: The selection of BMPs begins with a basic inventory of the farm's

natural features, which will help you determine how the operation of your farm may affect environmentally sensitive areas. When developing the inventory, sketch your farm/facility, noting buildings, pastures, cowpens, electrical and plumbing lines, and water sources. Identify areas of particular concern that need to be addressed. These include streams, wetlands, springs, sinkholes, and poorly drained ponded areas, to name a few. You can use this list of concerns in selecting which BMPs are applicable to your farm.

To help you conduct your inventory effectively, the following tools are available:

- √ Aerial photographs (http://earth.google.com/index.html, or other providers)
- √ USDA-NRCS soil survey maps (http://websoilsurvey.nrcs.usda.gov/app/)
- √ USGS topographic maps (http://www.topozone.com/)
- √ National Wetlands Inventory (http://www.fws.gov/wetlands/data/index.html)
- √ Historic rainfall records (http://www.ncdc.noaa.gov/oa/ncdc.html)
- √ Local tax maps from property appraiser (http://www.propertyappraiser.com/)

4. **Take the Needs Assessment**: Complete the *Advanced-Level BMP Needs Assessment* that begins on page 23, to determine whether any Level II and III BMPs are applicable to your operation, or whether you need or would like to develop a Conservation Plan.

5. **Select the applicable BMPs**: Read BMP sections 1.0 through 13.0 and select all of the applicable Level I, II, and III BMPs, based on your farm inventory and on the *Advanced-Level BMP Needs Assessment*. Record the BMPs on the checklist in Appendix 11 of this manual, as described in step 6 below.

6. **File a Notice of Intent to Implement (NOI) BMPs**: Complete and submit to FDACS an NOI, contained in Appendix 11 of this manual. The NOI includes a checklist on which you must identify all the BMPs in the manual that are applicable to your operation and are technologically and economically feasible for you to implement. The checklist includes a column for you to schedule BMP implementation. If you have a Conservation Plan, there is space provided at the end of the checklist for you to list any additional BMPs not covered in the checklist. You must submit a copy of the Conservation Plan with the NOI and checklist. Once received by FDACS, the Notice of Intent formally enrolls your operation under the BMP program. Implementation of the BMPs according to the NOI schedule provides a presumption of compliance with state water quality standards for the pollutants the BMPs address. Implementation includes ongoing record keeping and maintenance of the BMPs

7. **Implement the BMPs**: Implement all applicable Level I BMPs as soon as practicable, but no later than 18 months after submittal of the Notice of Intent to Implement. If you need additional time to implement the following Level I BMPs, you must justify the time needed in the space provided at the end of the checklist: **2.2** *Upland Pond Construction Criteria*; **2.3** *Other Watering Sources*; **5.3** *Installation of Water Control Structures*; **6.3** *Riparian Buffers*. Implement all other BMPs according to the schedule (month/year) you have indicated on the BMP checklist.

8. **Request on-farm technical assistance, as needed**: FDACS, UF-IFAS BMP Implementation Teams, Soil and Water Conservation Districts (SWCD), USDA-NRCS and/or UF-IFAS Extension staff are available to assist ranchers with the mechanics of BMP identification and selection. Contact information for these entities is in Appendix 3 of this manual.

9. **Keep records on BMP implementation**: FDACS rule requires record keeping to document BMP implementation. Fertilizer applications and rainfall amounts are two types of record keeping. Other record-keeping requirements in the manual are highlighted using this figure:  . All BMP records should be accurate, clear, and well-organized. You may develop your own record-keeping form or use the one provided in Appendix 8. You must retain the records for at least 5 years. However, it is desirable to retain records for as long as possible, to address any potential future legal issues. All documentation is subject to inspection.

It is advisable to consolidate your inventory and all your BMP decision-making, including the BMP Checklist, into a simple implementation plan. This plan will serve as a record of scheduled and completed BMPs, including operation and maintenance activities. A well thought-out, written plan enables managers and owners to schedule their activities and accomplish their objectives.

BMP Implementation Follow-Up

FDACS is developing a BMP "implementation assurance" program to help ensure that BMPs are being properly implemented, operated, and maintained. On a staggered schedule by commodity, FDACS will mail surveys to all BMP program participants, and will conduct site visits on selected operations. The benefits of this effort include:

- Demonstrating the level of producer participation in implementing BMPs.
- Identifying needs for additional education and implementation assistance for producers.
- Reinforcing to producers the importance of BMP implementation.
- Evaluating the effectiveness of FDACS BMP programs.
- Updating FDACS NOI records.

KEYS TO POLLUTION PREVENTION

Over the years, the "common-sense" recommendations summarized below have been embraced by many cattle operations in order to help prevent pollution problems. However, these descriptions are provided as an overview, and the formal BMPs appear later in this manual.



Maintain adequate vegetative cover

Vegetative cover helps to filter pollutants from runoff, reduces runoff velocity, and controls soil erosion. Management practices that help maintain vegetative cover usually involve distributing cattle to prevent overgrazing and allow vegetation to recover following a grazing period.

- Use prescribed grazing systems to minimize the impact of grazing on water quality.
- Adjust the stocking rate in sensitive *watersheds*.



Carefully plan your watering and feeding sites

Most nonpoint source pollution problems occur in the vicinity of watering, supplemental feeding, or loafing areas where animals tend to congregate most often. This concentration of livestock can denude vegetation and affect soil conditions so that erosion is more likely and water percolation is diminished.

- Place *supplemental feeding* and mineral stations a reasonable distance away (approximately 100 feet) from streams, drainage canals, lakes, *wetlands*, wells, and sinkholes.
- Develop alternative water sources to attract animals away from streams, drainage canals, and lakes as much as possible.
- Plan your shading facilities to keep cattle away from streams, drainage canals, and lakes as much as possible. Leaving or planting small, scattered clusters of trees in upland areas of pastures can provide shade structures.
- When feasible, move feeding stations, alternative water supplies, or shade structures periodically to prevent areas of concentrated waste accumulation and denuded vegetation.



Carefully plan your temporary holding areas

Concentrated animal areas such as *cowpens* and other temporary holding areas have the potential to produce large pollutant loads.

- Locate new cowpens more than 200 feet away from a canal, stream, or lake, or include a berm to prevent runoff into the *watercourse*.
- For existing concentrated animal areas that are located near a watercourse and can't be relocated, use filter strips, grassed waterways, berms/diversions, or waste management systems to minimize the transport of pollutants.



Use structural techniques to abate pollution

Sometimes it may be impossible to locate supplemental feeding or shade facilities outside of sensitive water quality areas. In such cases, other techniques can be used to help keep sediment, nutrients, and organic matter out of the water.

- When feasible, re-establish natural flow patterns, plug drainage canals, and restore water through internal marshes, cypress ponds, or other natural wetlands that can assimilate nutrients. The plugging of canals and/or some diversion of natural surface flows may require permits under Chapter 373, F.S. Contact your water management district prior to making structural modifications and/or changes. In addition, if you are a USDA program participant, contact them before conducting any clearing, land leveling, excavation, ditches, or similar activity, to ensure that you retain your eligibility for USDA program benefits.
- Use practices such as grassed waterways, filter strips, diversions, sediment traps, swales, and retention and detention ponds.



Minimize offsite discharge

Pollutants are carried offsite by water. By reducing the amount of water leaving your property, you can reduce the offsite water quality impacts.

- Carefully control seepage irrigation to minimize tailwater.
- Use *water control structures*, such as a flashboard riser on culverts, to retard water flow.
- Heavy vegetative cover in ditches should be mechanically removed instead of using herbicides, due to high nutrient releases when the vegetation decomposes.
- When cleaning ditches:

- Pile vegetation and sediment away from the ditch so nutrients don't wash back into the water.
- Use turbidity screens in the water at discharge points so turbid water does not leave your property.

- Plug unnecessary drainage conveyances.
- Use grassed waterways and vegetated areas to clean water before discharging offsite.
- Use man-made ponds or other watering facilities in upland areas to reduce cattle use of natural wetland systems.



Manage nutrients carefully

You can minimize pollutants leaving your property by carefully controlling imported materials that you use and apply on your ranch. Pollutants can come from fertilizers, sludge application, pesticides, chemicals, and fuels. If these materials are properly stored, applied, and disposed of, there is less chance they will be carried offsite in runoff.

- As appropriate, use soil and plant tissue tests to determine fertilization rates.
- Follow University of Florida, Institute of Food and Agricultural Sciences (UF-IFAS) fertilizer recommendations.
- Apply biosolids at agronomic rates, consistent with your FDEP Agricultural Use Plan.
- Do not apply fertilizer, organic fertilizer, or biosolids directly to wetlands or watercourses, or prior to forecasted heavy rainfall.
- Grass clippings from "sod mowing" should be stored away from wetlands and other watercourses.



Waste reduction strategies

You can also minimize pollutants leaving your property by carefully controlling pesticides, chemicals, and fuels. If these materials are properly stored, applied, and disposed of, there is less chance they will be carried offsite in runoff.

- Use pesticides in accordance with the label.
- Use cleaning agents and other chemicals carefully.
- Keep petroleum storage tanks in good working order.
- In the event of a spill, have a spill response plan.



Minimize the potential for erosion

Cows aren't the only ones contributing to soil erosion. Human activities, such as land clearing, culvert installation, road building, ditch and canal maintenance, pasture renovation activities, and production of certain short-term crops (watermelons, sod) can lead to erosion that can increase pollutant loading.

- When land is cleared, quickly plant a vegetative cover.
- Leave vegetated buffer strips during land clearing along drain areas, wetlands, and watercourses.
- During construction, follow erosion and sedimentation control practices.
- Minimize the number of vehicle crossings through streams and canals. If stream crossing cannot be avoided, locate the crossing in the area of least impact, considering habitat, soil types, slopes, streambed characteristics, and bank stability.
- Use stabilized culverts or hard surface crossings. Hard surface crossings can be concrete or geo-textile fabric with rock on top.
- Don't mow canal banks too closely; leave enough leaf area to maintain a healthy vegetative cover.



Develop a ranch Conservation Plan

Results of the Advanced-Level BMP Needs Assessment may indicate that you need to develop a ranch Conservation Plan; however you may wish to do so in any case. Such a plan, developed with help through USDA-NRCS or other technical service providers, can help guide management decisions for improved water quality.



Employee training

Employees whose job duties relate to BMPs should be properly trained prior to implementing the BMPs. Training sessions should be documented in the Employee Training Log in Appendix 9 of this manual.

- Provide annual training on BMPs and record keeping to appropriate employees.
- Keep records to document training activities.
- Review the Conservation Plan with employees, so its goals and priorities are clear.

General Information for Environmental Protection on Cow/Calf Operations

SPECIFIC WATER QUALITY IMPACTS ASSOCIATED WITH RANCHING

Waste from animals grazing on native pastures generally does not increase the nutrient levels in an area, as long as sufficient space is provided for each animal. However, intense grazing on improved pastures with the addition of supplemental feed can increase the risk of dissolved nutrients entering surface waters. This can elevate nutrient levels and disrupt the natural balance, adversely affecting water quality and aquatic flora and fauna. This section discusses some of the typical water quality impacts associated with ranching.

Pollutants and Pollutant Sources

Nutrients

Excess nitrogen and phosphorus are the most common sources of water quality impairments in Florida. These nutrients usually enter waterbodies through stormwater runoff. However, they can be introduced directly into the water from animal waste if livestock are allowed to loaf in wetlands or waterbodies. High levels of nutrients in surface waters result in abnormal plant growth, or *eutrophication*. The nitrogen form most abundant in natural waters is nitrate. Due to its high mobility, nitrate can also leach into groundwater. Ammonia is an inorganic source of nitrogen and originates primarily from urine. Phosphorus is one of the key elements necessary for growth of plants and animals. In terms of freshwater lake ecology, it tends to be the (growth) limiting nutrient. Unlike nitrogen, phosphorus is generally retained in the soil by a complex system of biological uptake, absorption, and mineralization. Phosphorus enters waterbodies as particulate matter via sediment transport, or can be dissolved in water.

Sedimentation

Sedimentation occurs when eroded soils are washed into surface waters, creating a buildup of solids on the bottom and suspended solids in the water column. Sedimentation most commonly associated with cattle grazing comes from the erosion of denuded areas and streambanks. Suspended solids from sediments reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, clog and harm the gills of fish, and can adversely affect shellfish. These effects combine to reduce fish, shellfish and plant populations, and decrease the overall productivity of lakes, streams, estuaries, and coastal waters. Recreation may also be limited because of decreased fish populations and reduced desirability of downstream swimming areas. Deposited sediment also reduces the flow capacity of roadside ditches, streams, rivers, and navigation channels, which can result in more frequent maintenance dredging or flooding. Chemicals, such as some pesticides, phosphorus, and ammonium, may be transported in sediment. Over time, the aquatic environment can cause these chemicals to be released from the sediment into the water column.

Fecal Coliforms

Fecal coliforms are bacteria that can cause disease, and are another source of water quality impairment. While high numbers do not result in eutrophic conditions, they can pose a health hazard to animals and humans. Furthermore, the decomposition of fecal and other organic matter in water can lead to increased biological oxygen demand and lower dissolved oxygen levels. Health impacts to humans and livestock include dysentery, gastrointestinal infections, ear infections, and skin infections, especially in open wounds. Fecal coliforms are an indication of recent contamination, since they have a relatively short survival period in water. The risk of fecal coliform contamination by animals that are allowed direct access to a waterbody is higher, although runoff from high-intensity areas may compound the problem. Spreading uncomposted manure, residuals, or septage as fertilizer may also lead to increased fecal coliform numbers in nearby waterbodies. The likelihood of pollution is increased if these materials are applied in excess of agronomic rates or when wet weather conditions prevail.

Water Quality Degradation Indicators

Algae

Algae are essential to aquatic systems. As a vital part of the food chain, algae provide the nutrition necessary to support all aquatic animal life. Certain types of algae also provide habitat for aquatic organisms. Blue-green algae (which are actually a photosynthetic bacteria known as cyanobacteria) are usually found in freshwater systems, most commonly in calm, warm waters with high levels of nutrients. While cyanobacteria are naturally present in low numbers, increased algal production can cause many problems in a waterbody.

Cyanobacteria can become so abundant that they will cause a scum layer to form on the surface, shading the sunlight-dependent life below and disturbing the food chain. Cyanobacteria produce a small amount of toxin, which is generally harmless to animals and humans when algal populations are under control; however, livestock and pet deaths have been attributed to consumption of water with an abundance of cyanobacteria. The toxin is known to cause liver and nervous system effects in humans as well. Cyanobacteria toxin cannot be eradicated by boiling or ultraviolet irradiation, so untreated surface water (any water not obtained through a public water system) with increased cyanobacteria poses a risk. Potential risks from recreational contact include skin, respiratory, and mucous membrane irritation. Other algal blooms can significantly alter the natural balance of the flora and fauna by causing a waterbody to become anaerobic. This results in a failing or impaired ecosystem. Certain types of noxious weeds or a monoculture of one or two species of plants can indicate an imbalance of nutrients in a waterbody, which can also lead to further problems in the ecosystem.

Dissolved Oxygen

Water systems both produce and consume oxygen. Oxygen is obtained from the atmosphere and from plants through photosynthesis. The presence of algal blooms, noxious weeds, and too many floating aquatic plants can reduce the amount of oxygen available in a waterbody by blocking sunlight necessary for photosynthesis to occur. Respiration by aquatic animals, decomposition of organic material, and various natural chemical reactions consume oxygen. The amount of oxygen consumed by microorganisms in breaking down manure and other wastes is known as the biochemical oxygen demand or BOD. If BOD exceeds the amount of dissolved oxygen in a waterbody, widespread fish kills can occur. If dissolved oxygen levels are already lower due to algal blooms or other flora, the likelihood of a fish kill increases.

Turbidity

Turbid water as a result of excessive sedimentation is another water quality degradation indicator. Great care must be used to prevent livestock-induced erosion of stream banks and the loss of sediments to waterbodies. Soil and sediment can fill in water bodies, clog waterways and affect water clarity. Suspended sediment can have numerous effects on fish; decreased penetration of sunlight can affect the feeding and breeding behaviors of fish, and the sediments themselves can clog gills and cause irritation to the mucous membranes covering the eyes and scales. As the sediment settles, fish eggs are susceptible to suffocation due to burial. Nutrients and toxins can also attach to sediments, which can contribute to downstream eutrophication and pollution.

Strategy to Minimize Water Quality Impacts

Using BMPs to achieve water quality protection while maintaining, or even improving, agricultural productivity is not a new process. However, doing this most effectively requires a business model that includes the following steps:

- Evaluate the existing situation
- Plan what to do, incorporating the applicable BMPs in this manual*
- Implement the plan
- Check to make sure everything is working correctly, and if not
- Go back to the first bullet

As a critical part of this process, ranch operators should conduct an inventory of the farm's natural resource features, as noted in the *BMP Selection and Implementation* chapter. The outcome of this exercise will be a plan – remember to keep it available and update it regularly. The plan will also help you communicate with your employees and your county agent, USDA-NRCS staff, or others.

* Many of the BMPs in this manual will address more than one environmental issue. Therefore, by implementing the BMPs, you usually solve more than one problem.

The sections below describe managing plant nutrients to achieve optimum forage yields while minimizing the movement of nutrients to surface and ground water. Nutrient management considers the amount, source, form, placement, and timing of nutrient applications. All sources of plant nutrients, such as organic and inorganic fertilizers and nutrient reserves within the soil, must be considered when developing a nutrient management program for a field or a ranch.

Source Reduction

Perhaps the first thing to remember when developing plans for nutrient management on grazing land is that animals do not produce nutrients. Animals consume, excrete, move, and retain nutrients. However, they are not the source of the nutrients. All of the nutrients excreted by grazing animals on Florida's ranches come from natural or human sources.

Natural nutrient sources generally include soil mineralization, atmospheric deposition, and nitrogen cycle processes. If the field is not fertilized and no supplemental feeds are given, the cattle will be totally dependent upon naturally occurring sources of nutrients. Fertilizer, supplemental feed, and irrigation water are the major sources of human-imported nutrients. The kind and amount of nutrients imported into a particular field will depend upon feed and pasture management. Nutrients imported into fields can be controlled to a great degree through management decisions.

Although grazing animals do not produce nutrients, they do affect nutrient distribution. Research indicates that grazing animals excrete nutrients in proportion to the amount of time they spend in an area. Research also shows that grazing cattle will spend their day doing three tasks: eating, sleeping, and loafing. When forage is available, cattle spend about eight hours each day on each of these tasks. However, if forage is limited, they may spend as much as ten hours per day grazing. Because cattle in Florida typically loaf and sleep in areas other than those in which they graze, they will transfer nutrients from the grazed area to the loafing and sleeping areas. If the sleeping or loafing area is in or near an environmentally sensitive area, the transfer of nutrients can cause or contribute to water quality problems.

There are four simple steps that can be taken to improve nutrient management and minimize the potential for water quality problems:

- The best method to prevent nutrient contamination of ground or surface water is to reduce the amount of nutrients imported onto a ranch. Therefore, the reduction of feed brought onto the ranch can play a big part in managing nutrients. If supplemental feed is needed, it is best to use feed in areas away from wetlands and other watercourses. This will reduce the potential for manure or unused feed to be washed into surface waters.
- Reduce fertilizer applications in areas where grazing animals congregate. The soil in these areas often contains adequate nutrients for plant growth, so fertilizer applications are unnecessary.
- Avoid applying fertilizer within 50 feet of wetlands and streams. This will reduce the potential for nutrients to be transported offsite during heavy rainfall.
- In order to reduce the potential for nutrients to be transported offsite, do not apply fertilizer to pasture swales and v-ditches that have standing water.
- Ensure that the pH is in the proper range for nutrient uptake by the plants because the acid nature of much of Florida's soils prevents optimum forage growth and limits the effectiveness of the fertilizer.

Nutrient Budget

A nutrient budget should be developed that considers all nutrient sources (soil residual, crop residues, organic and inorganic fertilizer, and irrigation water) and compares them to the forage crop nutrient requirements. Use the Nutrient Budget Worksheet in Appendix 5 to determine whether additional plant nutrients are needed. In general, ranchers can use a combination of soil and tissue testing, and UF-IFAS recommendations, to guide fertilization decisions. The UF-IFAS fertilizer recommendations for forage crops can be found in Fact Sheet SL-129, *Standardized Fertilization Recommendations for Agronomic Crops*, which can be found online at http://edis.ifas.ufl.edu/SS163

Ranchers should consult SL-129 before applying supplemental nutrients. On established bahiagrass pastures, nitrogen should be applied based on the intensity of grazing. Other perennial grasses may need nitrogen in late winter and at other times

throughout the year. Application rates should be based on UF-IFAS recommendations, with an emphasis on phosphorus (P) using three criteria: soil pH levels; available P content as determined by soil test results; and plant tissue testing results.

The nutrient analysis of non-farm organic fertilizer (e.g. municipal sewage sludge) can be obtained from the sludge hauler or waste treatment plant. The nutrient analysis of other organic materials, such as poultry litter and dairy wastes, may be obtained from labs.

Timing of Nutrient Application

To avoid nutrient losses through runoff, apply fertilizers during times when soils are not saturated. When irrigating, refer to the water budget provided by USDA-NRCS for your county to determine the times for the lowest potential for nutrient loss from rainfall. Timing of nutrient applications should coincide as closely as possible with periods of plant growth and nutrient uptake. Remember to maintain proper soil pH, to optimize utilization of applied nutrients and prevent toxic effects from other accumulated elements, such as copper. The pH recommendations are listed by crop in SL-129, and generally range from 5.5 to 6.5.

Preventing Nutrient Movement Offsite

Ranchers should practice erosion control to minimize soil loss and runoff that can carry dissolved and attached (particulate) nutrients to surface waters. Filter strips and other conservation buffers along streams are very effective in reducing the levels of suspended solids and some nutrients. Also, avoid spreading fertilizers in or near ditches and canals. Strategically locate fertilizer loading sites away from watercourses, where spills can contaminate the water.

Manure Management

Manure management for cow/calf operations is a concern due to the possible release of coliform bacteria, phosphorous, or nitrogen to ground and surface waters through seepage and runoff. Ground water may become contaminated by leaching of nitrate or dissolved phosphorus. Phosphorus and nitrogen (N) can be transported in runoff to surface waters in dissolved form, or they may be attached to sediment particles. Both N and P can contribute to the eutrophication of waterbodies.

Common-sense manure management involves simple techniques such as managing manure in concentrated areas, dragging pastures, and excluding cattle from waterbodies near critical discharge points adjacent to waters of the state. These BMPs are addressed later in this manual.

FORAGE PRODUCTION

The sections below describe forage resources, pasture, and grazing management to aid in the overall management of forage production for cow/calf operations in Florida. A productive forage stand is imperative to the success of a cow/calf operation and the protection of water quality. Well-established and managed forage stands effectively reduce soil erosion, absorb nutrients, and provide essential nutrition for livestock.

Forage Resources

In Florida, selection of forage species depends primarily on three major factors: temperature, soil moisture, and soil fertility. The differences in climate, soils, and length of growing season affect not only the types of forage that can be grown, but also affect the overall management system as well. Florida's relatively mild climate, coupled with an average 50 inches of annual rainfall, allows most South Florida ranchers year-round grazing opportunities. However, in most years, some supplemental feed or forage is required statewide during the winter months or dry spring months.

Florida forages are selected primarily based on temperature, due to the wide-ranging climate. South Florida has a climate similar to subtropical regions, while North Florida has subtropical summers but temperate winters. Warm season perennial grasses are the basis for permanent pastures in Florida. Possible perennial grass choices include bahiagrasses and improved hybrid bermudagrasses for North Florida; bahiagrasses, improved hybrid bermudagrasses, and limpograsses for Central Florida; and bahiagrasses, stargrasses, improved hybrid bermudagrasses, limpograss, and rhodesgrass in South Florida.

The table below lists general guidelines for rotational stocking of selected forages:

	Average Height (inches)	
Forage	Begin Grazing	End Grazing
Bahiagrass	6	1-2
Bermudagrass	6	2-4
Bluestem	10-20	8-12
Clovers	6	3
Indiangrass	14	6-10
Limpograss	24	10
Maidencane	24	10
Pearl Millet	14	6
Rhodesgrass	18	8
Ryegrass, annual	6	3-4
Stargrass	12-18	6-8
Small Grains (oats, wheat, rye)	6	4
Switchgrass	18-22	8-12

Ranchers may also want to consider annual species as possible forage alternatives, depending on their objectives. Annual species provide grazing for temporary pastures. Certain annual grasses are used throughout the state in both cool and warm seasons. Rye, oats, wheat, and ryegrass can all be used for winter grazing, while pearl millet and sorghum X sudangrass hybrids can provide summer grazing. Additionally, annual species may be used as a transition crop when renovating pasture.

Florida also has considerable variability in soils. In North Florida, there are clay-loam soils that are quite productive and have good moisture-holding capacity. In peninsular Florida, there are the upland sandy ridges and adjacent flatwoods. In general, flatwoods soils have greater moisture-holding capacity and are more productive than the deep, well-drained sands characteristic of the ridge. Ranchers should identify the intended planting sites' soil characteristics and select forage species compatible with those characteristics.

For more information, see *Florida Forage Handbook* at http://edis.ifas.ufl.edu/AG170 or the *Florida Crop/Pest Management Profile: Beef Cattle* at: http://edis.ifas.ufl.edu/PI043.

Pasture Management

Establishment of new forage is an expensive process that requires detailed planning. The planning process should consider resource concerns such as soil erosion, as well as the increase in management costs to maintain soil fertility and prevent impacts to water quality. A rancher can establish pasture on new ground, following a row crop, or by renovation and replanting of old pasture to new species. Switching from one forage type to a new one can require a renovation program using annual cultivated crops for one to two years before planting new forage. For more information on pasture establishment, see *Florida Cow/Calf Management: Forages* at: http://edis.ifas.ufl.edu/AN118.

Once a pasture has been established, ranchers should manage soil fertility, weed control, insect control, and grazing schedules. Proper management will assist ranchers in maintaining a strong stand of forages regardless of the forage variety or grazing system. Pastures with poor forage stands are more susceptible to erosion, livestock damage, or weed invasion. A thick, healthy pasture is aesthetically pleasing, allows livestock to efficiently graze the forage, and enhances water quality.

Grazing Land Management

Cattle have different nutritional requirements, depending upon the class of animal and general age of the herd. Nutritional considerations include the age and sex of the animal, desired weaning weight, production potential, and the stage of pregnancy. High-quality forage should be available at peak lactation and before breeding season. Production goals must be balanced alongside forage growth to achieve optimum nutrient value from the pasture. Nutritional value is also dependent on maintaining a variety of forages to increase the potential for year round grazing. The intensity and frequency of grazing affects the competition between plant species and affects the diversity of forage plants, forage quality, and the longevity of a forage stand. Desirable forage species can be replaced by weeds or shrubby plants because of poor grazing management, particularly in fenced exclusion areas. To counter these effects, a prescribed grazing system should be implemented to maintain the desired forages and enhance productivity.

An effective grazing-management system ensures that forage use does not exceed the production limitations of the forage. Prescribed grazing systems are used to accomplish this goal and may be used to control the forage, the animals, or both. Successful implementation of any grazing system requires periodic monitoring and adjustments of grazing periods to ensure that goals are met. Grazing systems range from ***continuous grazing*** to ***rotational grazing***.

Continuous grazing is the unrestricted access to a pasture by livestock throughout a year or grazing season. Continuous grazing has advantages such as lower input costs and fewer management decisions. However, over time, improper continuous grazing can be a detriment to all forage resources (tame/improved or native) and can lead to natural resource concerns such as soil erosion, degraded water quality, loss of forage stands, and/or increased weed competition.

Rotational grazing systems are fundamental in managing forage production. Rotational grazing is the grazing of two or more subdivisions of pasture in sequence, followed by a rest period for recovery and re-growth. Rotational grazing has advantages such as improved pasture longevity, more timely utilization of forage, conservation of surplus forage, and increased stocking rates. One particularly useful type of rotational grazing is ***flash-grazing***. A well-designed and properly managed flash-grazing system can be an effective tool for controlling woody and noxious plants, decreasing fuel buildups and facilitating nutrient uptake in exclusion areas along watercourse banks or around wetlands.

The sections below address more common issues associated with pesticides. It is important to note that pesticide application events should target designated pest species, follow the label recommendations, and use only the amount necessary to protect forage and livestock. Where feasible, pesticide application may be eliminated completely if adequate biological controls are available.

Integrated Pest Management

Integrated pest management (IPM) is a method of combining proper plant selection, correct cultural practices, the monitoring of pest and environmental conditions, the use of biological controls, and the judicious use of pesticides to manage pest problems. The goal of IPM is to eliminate or largely reduce the amount of pesticide use through beneficial parasites, predators, and pest-resistant plant varieties. Under Florida law (Chapter 482, F.S.), IPM is defined as the following: *…the selection, integration, and implementation of multiple pest control techniques based on predictable economic, ecological, and sociological consequences, making maximum use of naturally occurring pest controls, such as weather, disease agents, and parasitoids, using various biological, physical, chemical, and habitat modification methods of control, and using artificial controls only as required to keep particular pests from surpassing intolerable population levels predetermined from an accurate assessment of the pest damage potential and the ecological, sociological, and economic cost of other control measures.*

The basic steps of an IPM program are as follows:

- Identify key pests.
- Determine each pest's life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Use cultural, mechanical, or physical methods to prevent problems from occurring; reduce pest habitat; or promote biological control.
- Decide which pest management practice is appropriate, and carry out corrective actions. Direct the control where the pest lives or feeds. Use properly timed preventive chemical applications only when they are likely to control the target pest effectively, while minimizing the economic and environmental costs.
- Determine whether the corrective actions actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.

Pesticide Selection

Pesticides in cow/calf operations should be used only when necessary. Along with problems resulting from normal pesticide use, wastes can be produced from spills at mixing areas, in the field, or from the washing of application equipment.

Pesticide recommendations change frequently. Registrations may be canceled or added at any time. Recommended rates or products that were valid at the start of the growing season may change. Check with your local extension agent for the most recent recommendations, or access the UF-IFAS computer-based Electronic Data Information Source (EDIS) at: http://edis.ifas.ufl.edu/. Base pesticide selection on characteristics such as solubility, toxicity, degradation, and adsorption, considering site-specific characteristics such as soil, geology, depth to water table, proximity to surface water, topography, and climate, so that the potential for pollution of surface and ground water is minimized. Consider whether the proposed pesticide application will have an effect on any beneficial organism(s) that may be present. If so, consider using pesticides that have the least effect on beneficial organisms, as this may allow longer periods between treatments or eliminate the need for re-treatment.

Pesticide Calibration

Waste reduction starts with applying the precise amount of pesticide to targeted pests. To do this, pesticide application equipment must be properly calibrated. Applying too low a rate may be ineffective and promote resistance. Applying too high a rate may harm the forage or the animals, in addition to costing more money for materials. Application rates must be in accordance with the label in order to prevent contamination to the environment. Controlling application rates and calibrating pesticide equipment reduces the potential for pollutant loading to ground and surface waters.

Calibrating should be done with clean water and take place away from wells, sinkholes, or waterbodies. Remember also to calibrate sprayers every time a nozzle is replaced, and to compensate periodically for wear in pumps, nozzles, and metering systems. Proper calibration of equipment will aid in making applications more efficient and save money

on chemical and labor costs.

Application rates are related to the formulation of the pesticide and to the type of equipment used. Pesticides can be applied with hydraulic, tractor-mounted, pull-type, pick-up mounted, or self-propelled sprayers, or spot applied by back-pack or hand-spraying. It is important to follow the manufacturer's recommendations to determine the correct application rate.

Pesticide Mixing and Application

If applying restricted-use pesticides, the applicator must be fully trained and licensed in accordance with Chapter 5E-9.024, Florida Administrative Code, or must hire someone who is appropriately certified. Applicators must read and follow all label directions and the directions on the Material Safety Data Sheets.

Avoid mixing pesticides and loading or rinsing sprayers immediately adjacent to wells or waterbodies, since spills in these areas can easily contaminate water supplies. If the ranch does not have a permanent or temporary mixing and loading facility, use nurse tanks and mix at random sites to prevent a buildup of contamination. If this is not possible, run a long hose (100-200 feet) away and preferably downhill from the supply well to the mix-and-load area and protect the soil from accidental spills. Install anti-siphon devices or ensure that there is an air gap between the hose and the tank when sprayers are filled.

Other pesticide application strategies include:

- Using erosion control practices that minimize soil loss and runoff, thereby reducing the movement of ***adsorbed*** pesticides to surface waters.
- Minimizing field applications of pesticides just prior to periods of anticipated heavy or sustained rainfall to prevent surface water contamination or accelerated leaching to ground water and ineffective control of target organisms.
- Using IPM practices, including cultural, mechanical, biological, and chemical methods.
- Evaluating the effects of the seasonal water budget on potential pesticide loss to surface or ground water and selecting an application method that reduces the potential for runoff or leaching.

Other Important Pesticide Information

There are many other important issues that involve pesticide use. For additional information, refer to *Best Management Practices for Agrichemicals and Farm Equipment Maintenance* which can be accessed online at: http://www.floridaagwater-policy.com/BestManagementPractices.html

Pharmaceuticals

The use and misuse of pharmaceuticals, such as antibiotics and hormones, can have a negative impact on water quality. A recent study found sulfathiazole in a high percentage of samples downstream of cattle and swine sites; however, these were concentrated animal operations and not pasture-based operations. This is an emerging issue of national importance as sampling has revealed detectable amounts of antibiotics, hormones, sterols and other substances in surface waters from various sources. Because of this, it is very important to use these products responsibly. Follow all state and federal regulations and properly dispose of spent needles, expired or unused pharmaceuticals, and pharmaceutical containers.

Proper disposal of spent needles, referred to as "sharps," is regulated by EPA. These regulations require that needles are disposed of in a biomedical container designed for collection of sharps. Spent needles should be collected in these containers to avoid accidental needle sticks of farm workers or animals. Local veterinary offices should be able to provide these containers. Many county solid waste departments will take the sharps containers and properly dispose of them for a small fee, and some counties provide this service for free. Contact the local solid waste office for more information. Operators should check with their county extension office in the event that local ordinances may apply.

The proper disposal of unused pharmaceuticals is necessary for environmental, livestock, and human health. Expired medications can often be returned to the supplier/manufacturer or some veterinary offices. Check with your local municipality to see if they will accept pharmaceuticals during household hazardous waste disposal events.

RANCH WASTE MANAGEMENT

Ranch waste management includes the proper storage and disposal of products and by-products from cow/calf operations. These products generally include pesticide, petroleum, and other synthetic materials. Source control, including careful monitoring of all imported materials, helps to minimize pollutants in the waste stream. Waste management is very important because it reduces wastes, lowers the risk of an accidental discharge of pollutants, and saves money. This section is an introduction to managing a typical ranch waste stream.

Pesticide Waste

Reduce pesticide waste by minimizing the generation of wastewater from cleaning application equipment after use. Rinsing the sprayer is necessary only when changing from one pesticide to another, when moving to a new application site and the pesticide last used in the sprayer is not registered for the new site, or when cleaning the sprayer for storage. This practice will reduce the amount of *rinsate*.

Rinsate can be collected and used in accordance with the label during the next application. Rinsate should be sprayed on fields where the pesticide was originally applied, as long as the maximum application rate for that pesticide is not exceeded. Another option is to store the rinsate and use it to dilute the same pesticide for the next application. Do not dump rinsate on the ground or discharge it to surface waters or septic systems.

Pesticide spills should be cleaned up immediately following an incident. Barriers and absorbent materials are generally used to contain spills. Soil affected by a spill should be collected and stored in a special container, and reused at or below label rates during subsequent applications. Spill clean-up equipment and trained emergency responders should be readily available to handle spill incidents. The quick containment and clean-up of pesticide spills will minimize impacts to the environment and reduce liability should the land be sold.

Synthetic Products Waste

Most of the waste reduction principles described above can be applied when using other synthetic materials, which can include solvents, degreasers, lubricants, paints, and antifreeze. Unnecessary use of synthetic chemicals can result in pollution of the surrounding environment. These products should never be directly poured onto concrete surfaces or soil. Select solvents and degreasers that are non-hazardous to the environment. Compressed air is often a viable alternative to using solvents for cleaning farm equipment.

Most solvents can be reused many times without losing their cleaning properties. If the operation has a shop, consider using a water-based (solvent) reuse system. Used petroleum-based products must be stored in properly marked containers to be recycled or disposed of properly. Properly recycle all waste oil and antifreeze, and let all empty paint cans air dry before disposal.

Keep an inventory of all solvents used and have the Material Safety Data Sheets available nearby should an emergency arise. Remember to **reduce**, **reuse**, and **recycle** all products, as appropriate. This is your best defense against accidentally generating a hazardous waste stream on your ranch.

Gasoline and Diesel Fuel Waste

Ranch waste management must also include the proper management of all petroleum products located onsite, to ensure that ground or surface water is not contaminated. These products typically include unleaded fuel, diesel, motor oil, and heating oil. Very small amounts of these compounds in drinking water may not produce noticeable tastes or smells, but can have serious human health effects. This is why it is important to properly store, contain, and dispense these products.

Proper design and management of fuel-dispensing areas is essential to prevent soil and water contamination. Fuel-dispensing tanks and pumps should be located as far as possible from surface water and drinking water wells. Petroleum storage tanks installed above ground are regulated by FDEP (Rule 62-762, F.A.C.), and must be on an impervious pad with secondary containment to contain accidental spills or leaks. These facilities should be roofed to keep out rainfall and reduce stormwater runoff. All structures over fuel tanks should be designed to meet local building and fire codes. Build the containment structure so that it is tall rather than wide, in order to reduce rainfall accumulation. Never discharge water from the containment area without first checking for and treating an oil sheen.

Underground petroleum storage tanks are also regulated by FDEP (Rule 62-761, F.A.C.), and must have leak-detection and monitoring devices, cor-

rosion protection, and spill or over-fill prevention devices. These devices will limit the contamination of soil and ground water. Above or underground fuel storage tanks may be subject to a Spill Prevention Control and Countermeasure Plan or an alternative plan that specifies the measures that will be taken to mitigate spills.

Used motor oil and oil filters can be disposed of legally by recycling them. Local auto shops may take recycled oil and oil filters. Drain, puncture, and crush used oil filters and store them in a separate container. For large amounts of used oil, contact a permitted used-oil recycling facility.

Ranchers generally deal with a number of other land uses besides cattle production. In terms of environmental protection, it is important to understand how these land and management practices may affect water quality.

Fire Lines

Construction of fire lines is an essential practice for fire prevention, fire suppression and prescribed burning. However, improperly designed and constructed fire lines can result in excessive erosion and water quality degradation. Extra precautions are necessary when constructing fire lines near wetlands.

Fire lines should be plowed only where necessary. When possible, use existing barriers such as roads, watercourses, and other features, or alternatives to plowed lines, such as harrowing, grass strips, or wet lines. Wet lines are fire lines that are maintained and kept wet to prevent fire from spreading. Fire lines should not be plowed through sensitive areas such as wetlands, unless no other options exist and it can be done without adversely impacting the wetland. Always maintain a minimum plow depth during construction of the fire line. Raise the plow when crossing watercourses to prevent plowing through them. Design and construct fire lines so they do not function as drainage systems. This is particularly important for fire lines that might connect to isolated wetlands. A turnout is a useful feature to stabilize fire lines when erosion and sedimentation are likely. Whenever possible, orient fire lines along natural contours to prevent erosion and gully formation.

Construction of Access Roads

Access roads are a potential source of long-term erosion and sedimentation because of the bare soil associated with the road surface and the need for periodic maintenance. Carefully plan the location and desired drainage features prior to road construction, using soil survey maps, topographic maps, and aerial photographs. Place emphasis on minimizing stream and wetland crossings, and avoid construction during wet conditions. Also, focus on balancing cuts and fills to maximize use of local material and enhance roadbed stability.

To reduce road costs and disturbed surface area, minimize the road width consistent with the anticipated use. For fill road construction, keep shoulders at a gentle slope to minimize erosion and accelerate re-vegetation. Stabilize road banks and critical road segments by using mulch, seed, or other methods to keep the road from washing away and to keep sediment out of streams. Avoid directing ditch flow or road runoff into streams, lakes, or other watercourses to prevent soil erosion and turbidity problems.

Some roads will cross ditches, streams, and other watercourses. These roads will require special consideration and proper planning to prevent culverts from washing out, over-drainage of the site, flooding, or other undesirable effects. The local USDA-NRCS office can assist in the proper design and construction to eliminate or minimize undesirable effects.

Culvert crossings, rock crossings, or ***turnouts*** can be used to enhance long-term stability, reduce maintenance and associated costs, and protect water quality. For example, turnouts, vegetation, or ditch plugs can reduce the volume and velocity of flow. Where practical, all road drainage practices that divert ditch flow or road surface runoff should direct the flow onto vegetated areas where it can be dispersed adequately. Water turnouts can be installed periodically to divert flow away from the road, and onto an adjacent vegetated area for treatment. These areas should be adequate in size and have sufficient ground cover to assimilate runoff. Also, install culverts on roads where there is a need to direct ditch flow from one side to the other, underneath the road surface. Base the size of the culvert on the road ditch size and size of the watershed above the culvert. ***(Note: Activities in wetlands or streams may require a permit, so check with the county, water management district, and USDA-NRCS before proceeding)***. Alternatively, a low-water crossing using filter fabric, rock, or concrete to stabilize the road base may be an alternative to installing cross-drain culverts.

Proper maintenance of access roads is very important. All drainage structures should be checked and maintained periodically, especially following excessive rain events. If signs of sediment or turbid discharges are present, take immediate corrective actions as necessary. Ditches and culverts should be kept free of major obstructions, and ditches should be allowed to re-vegetate as much as possible. Also, stabilize critical segments of roads with seeding or mulching to minimize erosion and sediment movement.

Elevated access roads should not be located within 25 feet of wetlands. Avoid directing ditch flow or road runoff into streams, lakes or other watercourses due to possible erosion and turbidity problems.

Silviculture

Many Florida ranchers have diversified their operations by growing trees as a complementary agricultural land use. Ranchers engaged in forest management should follow the most recent version of the *Silviculture Best Management Practices* manual, which can be obtained online at: http://www.floridaagwaterpolicy.com.

Intermittent Row Cropping

Intermittent row crops, such as watermelons, are periodically grown to renovate pastures or supplement income. To reduce the potential for water quality impacts, select pastures with adequate existing drainage features and minimize alterations of the drainage system. Remember to account for the row crop activities in your nutrient management practices. All permits or exemption determination letters must be acquired prior to constructing new ditches or altering existing ditches and/or drainage features, so consult with the proper authorities before proceeding. Ranchers engaged in growing seasonal row crops should follow the most recent version of the *Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops*, which can be obtained online at: http://www.floridaagwaterpolicy.com.

Seasonal Sod Production

Much of the agricultural land in Florida is managed for cattle grazing. Sod production on bahiagrass pasture is generally recognized as a low-intensity agricultural use. When properly managed, this use provides vegetative cover and soil and water benefits. Some ranchers include the harvest of bahiagrass as part of their pasture renovation program. Ranchers engaged in seasonal sod production should follow the most recent version of the *Water Quality/Quantity Best Management Practices for Florida Sod*, which can be obtained online at: http://www.floridaagwaterpolicy.com.

Advanced-Level BMP Needs Assessment

You must complete the Advanced-Level BMP Needs Assessment on the next page to determine which Advanced-Level BMPs are applicable to your operation.

Note: Some of these BMPs may require financial assistance.

ADVANCED-LEVEL BMP NEEDS ASSESSMENT

This tool is to be used in addition to identifying the applicable Level I BMPs for your operation. After answering the questions below, ranchers may be required to address problem areas that require more protection. Your response will determine whether it is necessary to implement additional BMPs (Level II and/or Level III BMPs), and may indicate the need to develop a Conservation Plan for your operation. Based on your score and other onsite risk factors, you may not need to implement the Level II BMPs immediately. The BMP Checklist in Appendix 11 allows ranchers to indicate when they will implement practices.

Scheduling Options for Advanced-Level BMPs: If the Level I BMPs address the resource issues identified by the Needs Assessment, the related Advanced-Level BMPs may not need to be implemented. Therefore, for those Advanced-Level BMPs that you have determined may not be needed because the level one BMPs may adequately address the problem, you may schedule implementation to occur one year after the implementation date for the associated Level I BMPs. If, at the time the Advanced-Level BMPs are scheduled, the Level I BMPs have adequately addressed the resource issue(s) and you decide not to implement the Advanced-Level BMPs, you must notify FDACS which Advanced-Level BMPs are no longer applicable. However, where it is clear that the severity of the problem warrants it, implement the Advanced-Level BMPs as soon as practicable.

Scoring

- Circle the number next to each statement that applies to your operation. Add the numbers within each lettered subsection and place that number in the space labeled "Score." Add the scores together and place that number in the space labeled "Total Score." Divide the total score by the number of sections to get your average score for the section and place that number in the space labeled "Average Score."
- For the Level II BMP assessment questions, if your average score in a section is 2 or greater, implement the corresponding Level II BMPs.
- If your average score is greater than 4 in two or more sections, seek technical assistance to develop a *Resource Management System-Level* **Conservation Plan*** for the entire ranch.
- If your average score for the section on Grade-Stabilization Structures (Level III) is 3 or greater, seek technical assistance to develop a **Conservation Plan*** specific to grade stabilization, regardless of your scores in the Level II Needs Assessment.

* *Note: A Conservation Plan must contain all BMPs in this manual that are applicable to your operation. Depending upon which BMPs are required, it may be in your best economic interest to develop a Resource Management System-Level Conservation Plan for your ranch in order to be eligible for government cost-share, even if your scores do not dictate that you must have a Conservation Plan.*

Level II Needs Assessment

Comprehensive Prescribed Grazing

A. Describe your operation's stocking rates:

- **0** Stocking rates are at or below the forage availability levels or Conservation Plan recommendations.
- **1** Stocking rates are above forage availability or Conservation Plan levels only during the growing season and forage is adequate.
- **4** Stocking rates are above forage availability or Conservation Plan recommended levels for the entire year and forage is short.

Score: _____

B. Describe your operation's grazing system:

- **0** Rotational or prescribed grazing is practiced on 100% of pastures.
- **1** Rotational or prescribed grazing is practiced on 50% of pastures.
- **1** Continuous grazing is practiced and forage is maintained at appropriate heights.
- **2** Continuous grazing is practiced and forage is below minimum heights only during the dry season.
- **4** Continuous grazing is practiced and forage is constantly short.
- **5** Continuous grazing is practiced and several areas in the pasture are denuded of vegetation.

Score: _____

Total Score: _____
(Score A + Score B)

Average Score: _____
(Total Divided by 2)

If your Average Score is 2 or greater, implement the Level II BMPs located in Section 3.2 on page 34.

Check Dams and Sediment Traps

A. Under average hydrologic conditions, have you observed a sand bar at the confluence of your drainage ditches/canals, or at a downstream lake or stream?

- **0** Never
- **1** There is a small sandbar(s) that I can see at really low water.
- **2** There is a small sandbar(s) that I can usually see.
- **4** There is a large sandbar(s) that causes some flow diversion.
- **5** There is a sandbar(s) that I have to clean out regularly.

Score:_____

B. Have you observed ***turbid*** water from high-intensity areas following a storm event?

- **0** Never
- **1** Only following very large storms (more than 2 inches of rain)
- **3** Usually some turbidity following minor storms (more than 1 inch of rain)
- **4** Usually some turbidity (plume of sediment) every time it rains
- **5** Water is always turbid, even when it does not rain.

Score: _____

Total Score: _____
(Score A + Score B)

Average Score: _____
(Total Divided by 2)

If your Average Score is 2 or greater, implement the Level II BMPs located in Sections 4.3 or 4.4 on page 36.

Livestock Use Exclusion

A. Is there soil erosion or denuded areas, due to livestock access, along watercourses that are within 500 feet of waters of the state?

- **0** There is no soil erosion resulting from denuded areas along the banks of these areas.
- **1** Less than 10% of the banks have erosion resulting from denuded areas.
- **3** 10% to 20% of the banks have erosion or denuded areas.
- **4** More than 20% of the banks have erosion resulting from denuded areas.
- **5** Almost all banks have erosion resulting from denuded areas.

Score: _____

B. Describe the condition of the perennial stream or watercourse banks that livestock have access to:

- **0** Livestock do not have access to them.
- **1** Banks have a constant vegetative cover year round.
- **2** There are a few areas on banks denuded of vegetation for less than 30 days with no ***rill erosion***.
- **3** There are a few areas on banks that are constantly denuded of vegetation with some rill erosion.
- **5** The majority of banks are constantly denuded of vegetation and substantial rill erosion is present.

Score: _____

Total Score: _____
(Score A + Score B)

Average Score: _____
(Total Divided by 2)

If your Average Score is 2 or greater, implement the Level II BMPs located in Section 7.3 on page 44.

High-intensity Area Design Retrofits

A. Describe the location of cowpens and their proximity to perennial streams or watercourses:

- **0** Cowpens are greater than 200 feet from perennial streams or watercourses and appropriate measures are taken to control runoff.
- **1** Cowpens are located within 200 feet of perennial streams or watercourses and appropriate measures are taken to control runoff.
- **5** Cowpens are located within 200 feet of perennial streams or watercourses and minimal or no measures are taken to control runoff.

Score: _____

B. If you periodically keep cattle in concentrated, denuded areas within 500 feet of perennial streams or watercourses, do you:

- **0** Prevent all runoff from the area from reaching perennial streams or watercourses
- **1** Route all runoff through filter strips or equivalent treatment areas before it reaches perennial streams or watercourses

2 Route 75% of runoff through filter strips or equivalent treatment areas before it reaches perennial streams or watercourses

3 Route 50% of runoff through filter strips or equivalent treatment areas before it reaches perennial streams or watercourses

4 Route 25% of runoff through filter strips or equivalent treatment areas before it reaches perennial streams or watercourses

5 Allow uncontrolled runoff from the concentrated area directly to perennial streams or watercourses

Score: _____

Total Score: _____
(Score A + Score B)

Average Score: ____
(Total Divided by 2)

If your Average Score is 2 or greater, implement the Level II BMPs located in Section 8.2 on page 45.

Reminder: If your average score is greater than 4 in two or more sections (Level II BMPs), seek technical assistance to develop a Resource Management System-Level Conservation Plan for the entire ranch.

Level III Needs Assessment

Grade Stabilization Structures

A. Is there soil erosion around culverts or other water control structures in canals or ditches?

0 There is no erosion around any water control structures.

1 Less than 10% of culverts have visible erosion around them.

2 20% to 30% of culverts have visible erosion around them.

4 30% to 50% of culverts have visible erosion around them.

5 More than 50% of culverts have visible erosion around them.

Score: _____

B. Under normal wet-season weather conditions, have you ever had a road or culvert "blow out" due to high water levels?

0 Never

1 Once every 5 years

2 Once every 3 years

4 About once every year

5 A few culverts each year

Score: _____

C. Have you observed turbid water leaving your property following a storm event?

0 Never

1 Only following very large storms (more than 2 inches of rain)

3 Usually some turbidity following minor storms (less than 1 inch of rain)

4 Usually some turbidity (plume of sediment) every time it rains

5 Water is always turbid, even when it does not rain

Score: _____

D. Under average weather conditions, have you observed a sand bar at the confluence of your drainage ditches/canals, or at a downstream lake or stream?

0 Never

1 There is a small sandbar(s) that I can see at really low water

3 There is a small sandbar(s) that I can usually see

4 There is a large sandbar(s) that causes some flow diversion

5 There is a sandbar(s) that I have to clean out regularly

Score: _____

Total Score: _____
(Scores A+B+C+D)

Average Score: ____
(Total Divided by 4)

Reminder: If your Average Score for the Level III Needs Assessment *(Grade Stabilization Structures)* is 3 or greater, seek technical assistance to develop a Conservation Plan for this practice (Grade Stabilization Structure, NRCS Code 410), regardless of your scores in the other sections. The plan must contain the BMPs listed in section 4.5 of this manual.

Best Management Practices

Note: All BMPs that follow are Level I, Level II and Level III BMPs.

Reminder: You must complete the Advanced-Level BMP Needs Assessment on page 24 to determine which Advanced-Level BMPs are applicable to your operation.



1.0 NUTRIENT MANAGEMENT

Nutrient management for livestock operations requires a systematic management approach that includes several different, yet related, practices. It is arguably the most important category of BMPs in this manual. It includes managing plant nutrients for optimum forage yields and managing feeding practices to deliver proper nutrition for the animal. It also includes proper animal waste management to protect waterbodies. Nutrient management considers the amount, source, form, placement, and timing of fertilizer application materials. All potential sources of plant nutrients, such as organic and synthetic fertilizer inputs, as well as nutrient reserves within the soil, are identified, inventoried, and addressed.

One of the first steps in developing a sound fertilization management program involves a basic knowledge of soils. Many of Florida's soils naturally contain the required amount of phosphorus, assuming the pH levels are within the range to make this nutrient available. As such, soil testing and analysis is considered to be a cornerstone of any nutrient management program. For most ranches, soil testing should be conducted at a minimum of once every three to five years, or whenever phosphorous fertilizer is used. Nitrogen, which is not analyzed as part of a routine soil test, is a critically important macronutrient for vegetative growth. Plant tissue testing, which can detect plant nitrogen levels, can be used in conjunction with soil testing to diagnose the overall effectiveness of a fertilization program. Tissue testing is especially useful to help a grower fine-tune their fertilizer application program.

Proper animal nutrition and feedstock management for environmental protection must consider the type, blend, and amount of feed to obtain maximum nutrition and animal health. Moreover, supplemental feed, its content and proximity to a waterbody, must also be considered, as it can secondarily affect nonpoint source pollution. In addition, animal waste management is a final consideration in developing an overall nutrient management budget. The principle goal of this BMP is to minimize nutrient loss to the environment because the offsite transport of nutrients to surface waters from various sources has caused most of the water quality impairment issues in Florida's watersheds.

Working Definition:

Nutrient management consists of fertilizer management, animal nutrition, feedstock management, and animal waste management.

1.1 Fertilizer Management

✓ 1. Use a soil test from a lab using the Mehlich-1 or another method approved by the UF-IFAS Extension Soils Testing Laboratory to deter-

mine P fertilization rate. Analyze the need for tissue testing based on the soil test results.

√ 2. If planting legumes or fertilizing with manure or wastewater residuals, use the Nutrient Budget Worksheet in Appendix 5 to determine whether supplemental fertilizer is needed.

√ 3. Follow UF-IFAS-recommended rates in SL-129 for the particular forage. The criteria to determine phosphorus application on established bahiagrass pastures are: a tissue analysis < 0.15 percent phosphorus, soil pH ≥ 5.5, and soil analysis is ***very low (less than 10 ppm)*** or ***low (10 to 15 ppm)*** for phosphorus. If using organic materials or manure, adjust the rate of supplemental fertilizer materials based on the product's nutrient content analysis.

√ 4. Time fertilizer applications with plant growth to maximize nutrient uptake and to minimize leaching and runoff.

√ 5. Prevent spreading fertilizer material in streams, sinkholes, or wetlands by maintaining at least a 50 foot setback from these features.

Maintain records of fertilizer application. Records should include soil test analysis, date of application, fertilizer formulation, application rate, location and acreage, and worksheet results.

1.2 Residuals or Biosolids Application

√ 1. Abide by all applicable regulations in FDEP Rule 62-640, F.A.C., for residuals application, and/or Florida Department of Health (FDOH) Rule 64E-6, F.A.C., for ***septage*** application.

√ 2. Request the calcium carbonate equivalency and nutrient analysis of the product, expressed as a dry weight, for residuals or septage treated by lime stabilization. Use this analysis to determine what amount to apply without adversely affecting soil pH. This is especially important when applying the product to bahia grass, since it is an "acid loving" plant.

√ 3. Obtain a copy of the FDEP Agricultural Use Plan from the hauler/applicator when applying residuals or septage, and abide by all grazing restriction and setback requirements.

1.3 Animal Nutrition and Feedstock

√ 1. If using a high amount of supplemental feed, manage your operation so that nutrients in feed will not lead to high rates of nutrient loads from waste. Keep in mind that livestock generally excrete 60 to 85% of the phosphorus fed to them.

√ 2. Locate any confined feeding areas away from watercourses, wetlands, sinkholes or excessively sloped terrain. Ensure that filter strips or other conservation buffers are maintained between feeding areas and adjacent features.

√ 3. Locate supplemental feeding and mineral stations at least 100 feet away from watercourses, streams, wetlands, wells or sinkholes.

1.4 Animal Waste Management

√ 1. Manage livestock distribution to reduce any concentrated accumulation of wastes that could lead to nutrients contaminating ground water or surface waters.

√ 2. Use onsite concentrated manure sources, if available, as a fertilizer supplement in accordance with soil test results. This will recycle nutrients and reduce the need for inorganic fertilizers.

Operation and Maintenance:

- Maintain and calibrate fertilizer application equipment properly.
- Do not mix or load fertilizers near environmentally sensitive areas.
- Store fertilizers properly and in a safe location.

References:

(1) USDA-NRCS Nutrient Management, Code 590, FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg/

(2) Beef Cattle Production Best Management Practices, LSU Ag Center, http://www.lsuagcenter.com/en/crops_livestock/livestock/beef_cattle/production_management/Beef+Cattle+Production+Best+Management+Practices.htm

(3) Standardized Fertilization Recommendations for Agronomic Crops, UF-IFAS Fact Sheet SL-129, http://edis.ifas.ufl.edu/SS163

(4) USDA-NRCS Waste Utilization, Code 633, FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg/

(5) USDA-NRCS Feed Management, Code 592, FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg/



2.0 ALTERNATIVE CATTLE WATER SOURCES

Beef cattle, like humans, need a reliable source of freshwater in order to survive. Water requirements are influenced by several factors, including rate of gain, pregnancy, lactation, activity, type of diet, feed intake, and air temperature. These requirements are generally met by water originating from wells, surface waters, upland ponds, and natural isolated wetlands, as well as moisture found in feed. Limiting water intake can depress animal performance more quickly than any other nutrient-related deficiency. Domesticated animals can live about 60 days without food, but only seven days without water.

On average, a beef cow's estimated daily intake of freshwater is between 11 and 15 gallons per day, depending upon the time of year and whether lactating cows are present. Hot weather can nearly double the daily water intake requirements, compared to winter months. Lactation can also increase the water intake needs significantly, since water intake during the latter stages of pregnancy can be 30% to 50% higher than normal.

Nonpoint source pollution problems on cattle operations can occur in the vicinity of watering sites and supplemental feed and/or loafing areas, where animals tend to congregate most often. Using stagnant sources of surface water alone can also pose health hazards to livestock. Cattle liver fluke and Leptospirosis are waterborne diseases that can infect other members of the herd. Therefore, providing fresh water and strategically locating supplemental feed facilities away from perennial streams and major discharge canals will help keep livestock out of critical watercourses. Artificial shade structures may also be used to encourage the use of upland sites for shading and loafing. These planning considerations are essential components to avert water quality problems related to livestock distribution. This is especially important when stocking rates are increased and pasture rest periods are minimized. Ultimately, careful planning and site-specific decisions involving alternative cattle water sources can have a significant role in protecting water quality and can preclude the need to install costly exclusion fencing adjacent to natural watercourses.

Working Definition:

Alternative cattle water sources are strategically located freshwater sources such as upland excavated ponds, artesian wells, watering troughs, and/or other surface water sources that provide adequate drinking water away from sensitive water resources.

2.1 Water Needs Inventory

✓ 1. Inventory existing water sources and average herd size to ascertain the estimated water use (daily intake of water), to ensure that a 7-day supply of water is always available in herd management areas.

✓ 2. Review water management district records on regional well water quality data, particularly with regard to total dissolved solids and sulfates, as this may affect animal health.

2.2 Upland Pond Construction Criteria

✓ 1. Construct new ponds by embankment or excavation, keeping the pond size between ¼ and 2 acres, and locating it at least 50 feet away from wetlands, or further based on water management district requirements. Keep side slopes no steeper than a one-to-one horizontal to vertical ratio.

✓ 2. Construct cattle access areas with a minimum slope of three-to-one horizontal to vertical ratio.

2.3 Other Watering Sources

✓ 1. Locate watering troughs and associated shade facilities to keep cattle away from perennial streams or watercourses as much as possible.

✓ 2. Construct troughs or tanks with a stable base to reduce health hazards to livestock.

✓ 3. For piped withdrawals of non-regulated surface water sources, extend pipe at least 100 feet landward from the waterbody.

Operation and Maintenance:

- Maintain all wells, troughs, and other associated structures in good working order.
- If you suspect the animals are affected by a waterborne illness, carefully monitor animal health and conduct water quality sampling and analysis.
- Clean watering troughs frequently with dilute bleach.

References:

(1) USDA-NRCS Pond, Code 378; Watering Facility, Code 614; Pipeline Code, 516; and Livestock Shade Structure, Code 717, FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Beef Cattle Production Best Management Practices, LSU Ag Center, http://www.lsuagcenter.com/en/crops_livestock/livestock/beef_cattle/production_management/Beef+Cattle+Production+Best+Management+Practices.htm

(3) Livestock and Water, North Dakota State University, AS-954, http://www.ag.ndsu.edu/pubs/ansci/livestoc/as954w.htm

(4) Water for Livestock Using Solar Generated Electricity, UF-IFAS Fact Sheet EES-97, http://www.p2pays.org/ref%5C08/07682.pdf



3.0 PRESCRIBED GRAZING

Before land was deeded to private ownership, historical ranching in Florida consisted of native range grazing practices. The knowledge and wisdom gained by early cowboys driving cattle over a vast expanse is still evident today. Some operations still practice the age-old art of native range grazing, whereby natural grasslands, scrublands, and savannas provide adequate forage for low-density stocking rates. In these operations, livestock are normally grazed at a rate of one ***animal unit*** to more than six acres, depending on the condition of the range site. Given today's financial constraints, grazing systems generally fall under the ***prescribed grazing*** category. All grazing systems have advantages and disadvantages. The requirements of a grazing system and the goals of the ranch manager should be matched to provide environmentally and economically sound options.

The potential for non-point source pollution from rangeland livestock depends primarily on stocking rate, length of grazing period, season of use, manure deposition sites and location. Normally, well-managed pastures and rangeland present little to no water quality problems from cattle excrement alone. In this scenario, most of the available phosphorus from excrement decomposition is re-used in the system via the phosphorus cycle. Problems may occur in cases where animals congregate for feeding, watering, and resting in close proximity to surface waters; however, most of the problems associated with high phosphorus discharge are generally linked to soil erosion and sediment transport stemming from these activities. To counter this, pasture and rangeland water quality can be effectively managed by proper distribution of cattle, along with the strategic placement of supplemental feeding, mineral stations, and alternative water sources away from surface waters. Installing fences and subdividing large pastures to exert more control over the frequency and timing of grazing can also improve grazing distribution. Poor grazing management will lead to nutrient losses and invasion of undesirable plant species. Good planning and management on pastures, using rotational grazing principles, can effectively sustain the herd and prevent pollution problems.

Working Definition:

Prescribed grazing is managing the harvest of vegetation with grazing and/or browsing animals.

3.1 Prescribed Grazing Guidelines

✓ 1. Manage forage grazing of pastures or ***paddocks*** based on established stubble heights to maintain plant vigor, prevent soil erosion, and maintain soil moisture levels. Base prescribed grazing schedules on the rate of plant growth, available forage and

utilization, not on calendar dates. Carefully monitor available forage to ensure it is adequate to meet animal demand.

√ 2. Use rotational grazing or other measures to give concentrated areas time for re-growth between grazing periods, and to achieve a more even manure distribution across the pasture.

√ 3. Incorporate a flash grazing system in established wetland exclusion areas to manage the existing vegetation without degrading the resource.

Maintain grazing records by pasture, and develop a contingency plan for floods and droughts in order to adjust the required grazing demands.

Note: *Do the Advanced-Level BMP Needs Assessment to determine whether to implement the BMPs below.*

3.2 Level II - Comprehensive Prescribed Grazing

√ 1. Initiate grazing only after the predominant forages have reached acceptable plant height(s), and rotate or remove livestock when grazing results in minimum leaf length(s) per NRCS recommendations in Code 528. Plan the rest periods for predominant forages based on the season of the year.

√ 2. Incorporate cross-fencing to subdivide larger pastures so that rotational grazing is more effective.

Keep records on stocking numbers, grazing days, and length of rest periods for each pasture or field.

Operation and Maintenance:

- Maintain all fences, wells, troughs and other associated structures in good working order.
- Review and revise grazing management plans as needed, or at least annually.

References:

(1) USDA-NRCS Prescribed Grazing, Code 528; Pasture and Hayland Planting, Code 512; Range Planting, Code 550; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Beef Cattle Production Best Management Practices, LSU Ag Center, www.lsuagcenter.com/en/crops_livestock/livestock/beef_cattle/production_management/Beef+Cattle+Production+Best+Management+Practices.htm

(3) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/



4.0 SEDIMENT AND EROSION CONTROL MEASURES

Some farm practices may inadvertently affect the quality of water discharged offsite. Removal of natural vegetation and topsoil increases the potential for soil erosion, which can change runoff characteristics and result in loss of soil and increased turbidity and sedimentation in waterbodies. Sediments along with ***sorbed*** nutrients and pesticides may be carried in runoff, and can negatively affect adjacent surface waters.

The first step in preventing erosion and sediment transport is to limit the amount of land that is cleared of vegetation. When clearing vegetation to develop new pastures, re-vegetation should occur as quickly as possible to limit erosion. Whenever possible, land clearing activities should be planned and conducted during the dry season. The second step in preventing erosion and sediment transport involves the use of BMPs, as discussed below. However, keep in mind that installing some of these may require technical assistance.

Whenever ranchers are conducting activities that create a significant risk to water resources, they should use the most appropriate BMPs based on site-specific conditions. The use of more common erosion-control practices (e.g., vegetation, mulch, land leveling) and sediment control devices (e.g., silt fences, check dams, sediment traps) should be employed in progression. Consider using the more passive erosion control measures first, in order to prevent sediment transport. If more protection is needed, sediment control devices can be used next to capture sediment-laden water and allow enough time for larger particles to settle out. By following these practices, ranchers can prevent erosion and sedimentation impacts, which will not only protect the water resources, but also will ensure long-term productivity of agricultural farmland.

Working Definition:

Sediment and erosion control measures are permanent or temporary practices to prevent sediment loss from fields, ***attenuate*** water flow, and/or trap and collect debris and sediments in runoff water.

4.1 General Erosion and Sediment Control Measures

√ 1. Minimize the amount of vegetation that is cleared when doing construction work.

√ 2. Perform land clearing during the dry season.

√ 3. Vegetate new road banks and other disturbed areas within 14 days of construction. As an alternative to seeding, consider using bermudagrass plugs, sprigs, or sod.

√ 4. Use rock crossings when constructing roads across streams and creeks that have low-flow conditions.

√ 5. Manage livestock to prevent significant erosive trails from developing.

If more protection is needed to control particulate matter, use the two BMP groups below to enhance the level of protection for your operation. They are listed and used progressively (least to most protective) to provide an increasing level of protection.

4.2 Silt Fences

√ 1. Use silt fences when protection is needed for 3 months or less. They can intercept and detain small amounts of sediment and can decrease the velocity of water under sheet-flow conditions. Use them during construction activities and install them at property boundary lines when a discrete point of discharge exists. Silt fences must be properly trenched in, backfilled and compacted in accordance with the Florida Stormwater, Erosion, and Sediment Control Inspector's Manual referenced below.

Note: *Do the Advanced-Level BMP Needs Assessment to determine whether to implement the BMPs below.*

4.3 LEVEL II - Check Dams

√ 1. Install check dams in drainage ditches that have defined flow and experience recurring sedimentation problems. Install them downstream from the disturbed area, perpendicular to the direction of flow. These devices can be created using a variety of materials such as rock, rip rap, or sand bags. Space check dams so that the bottom of the uphill dam is the same height as the top of the downstream dam, or implement BMP 4.4 below.

4.4 LEVEL II - Sediment Traps

√ 1. Install sediment traps within canals or near cowpens when conditions warrant. Clean out traps periodically, as sediment will accumulate.

√ 2. Maintain or replace associated flashboard riser water control structure(s) when a drainage outlet exists, and you have experienced significant recurring erosion problems.

4.5 LEVEL III – Grade Stabilization Structures

√ 1. Remove all vegetative debris and other objectionable material so that it will not interfere with the construction or proper functioning of the grade stabilization structure.

√ 2. Vegetate disturbed areas within 14 days of construction. As an alternative to seeding, use plugs or sprigs for quick cover.

√ 3. Fence the area around the structure to exclude livestock, which can cause erosion and sedimentation problems at the structure.

√ 4. Install structures during dry conditions, and properly de-water the site beforehand.

√ 5. Place fill in horizontal layers, not to exceed four inches in thickness, and compact the fill. Spread or dispose excess fill material in a manner not to interfere with the functioning of the structure.

√ 6. Make provisions to prevent damage from overtopping the structure, and to divert excess flows away from the structure. On structures with drainage areas of 3 acres or less, overtopping of the structure is permitted only if damage will be minor.

√ 7. On pipe island-type or side-inlet drainage structures where the effective height is less than 10 feet and the vertical drop is less than 10 feet from natural ground to normal water level, ensure that earth embankments at or around the structures have side slopes no steeper than 2 horizontal to 1 vertical.

√ 8. Contact USDA-NRCS or FDACS for technical assistance and/or structure design guidance.

Operation and Maintenance:

- Remove any sediment deposits on screens when they reach one half the height of the barrier.
- Keep heavy equipment off of newly vegetated areas until they are established.
- Consider reusing sediment basin water for routine irrigation needs, so long as water volumes and quality warrant.

References:

(1) USDA-NRCS Sediment Basin, Code 350; Fence, Code 382; Grade Stabilization Structure, Code 410; Animal Trails and Walkways, Code 575; Water and Sediment Control Basin, Code 638; Structure for Water Control, Code 587; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Farming for Clean Water in South Carolina: A Handbook of Conservation Practices, http://www.epa.gov/owow/nps/bestnpsdocs.html#agriculture

(3) The Florida Stormwater, Erosion, and Sediment Control Inspector's Manual, FDEP, http://www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

(4) USDA Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater, http://www.abe.msstate.edu/csd/p-dm/index.php

(5) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/



5.0 WATER RESOURCES MANAGEMENT

Florida receives an average of 53 inches of rain per year. However, rainfall amount varies across the state by region, season, and year. Average rainfall tends to decrease as you move toward the central and southeastern parts of the state, and increase as you move toward the northwestern part of the state. In general, rainfall tends to occur more frequently during the summer months in Florida, especially in the central and southern areas of the state.

Water management and nutrient loading to surface waters are linked. For most cattle operations in Florida, key water resources management issues involve:

1. Properly planning for water supply needs for irrigation of forage and/or supplemental cattle watering.
2. Following good construction practices if using swales, ditches and/or canals for drainage in improved pastures.
3. Evaluating the potential to install or manage existing water control structures to hold water onsite, as much as possible.

All three of the above items affect the hydrologic conditions and runoff potential of pastures. Ranches typically have lower nutrient concentrations, but may experience higher volume discharges, due to large land areas. Leaving boards in water control structures will reduce the volume of discharge and sediments, and improve water quality.

Alteration of the land, which may include construction of impervious surfaces such as roads, driveways, parking lots and agricultural structures increases stormwater runoff during rainfall events. Soil compaction in high-traffic areas can reduce soil permeability and increase stormwater runoff. Improper stormwater management leads to onsite and offsite flooding, increased pollutant loading to surface and ground waters, erosion and sedimentation, and the loss of valuable fresh water resources. The need to address these stormwater impacts has led to the implementation of a comprehensive stormwater management program that is implemented cooperatively by FDEP and the water management districts to minimize flooding and stormwater pollution. All new development activities, and some agricultural activities, especially those that alter onsite hydrology, are required to obtain an Environmental Resource Permit (ERP). Some farms may already have an ERP or other WMD surface water management permit that incorporates onsite stormwater management requirements.

While cow/calf operations generally do not lead to stormwater problems, there may be individual farm circumstances that create the need for specific stormwater management practices. Appendix 10 contains guidance and planning considerations to

address these circumstances. The construction of a stormwater management system (e.g., retention or detention pond) may require an ERP or other WMD surface water management permit. Therefore, please check with your WMD before beginning construction of any stormwater management system.

Working Definition:

Water resources management includes good planning and water use practices, and strategic placement of water control structures to manage surface water resources effectively.

5.1 Water Supply

√ 1. Know the quantity and quality of the irrigation water source.

√ 2. Determine the general water requirements for primary forage grasses in improved pastures. Crop water requirements refer to the actual water needs for *evapotranspiration* (ET) and plant growth, and generally depend on crop-specific and climatic factors. Adjust irrigation amounts to forage plant needs.

5.2 Ditch Construction And Maintenance

√ 1. Follow appropriate grades and plans during ditch excavation. Deposit *spoil* material in a manner so it cannot be reintroduced into the ditch or canal. Keep in mind that ditches have an engineered limit or *conveyance capacity* that governs how much water the ditch can store or convey.

√ 2. Use appropriate setback distances when constructing drainage ditches close to wetlands to avoid *hydraulic drawdown* impacts.

√ 3. Protect canal or ditch banks from erosion in areas subject to high water velocities, using *rip-rap*, concrete, headwalls, or other buffering materials. Take the appropriate steps to prevent livestock from damaging ditch banks.

√ 4. Selectively control broadleaf vegetation on ditch banks to maintain a vegetative cover that is compatible with existing pasture vegetation.

√ 5. Maintain all main ditch features regularly by removing unconsolidated sediments to retain the designed, cross-sectional area.

Keep records of all ditch maintenance activities, and keep any records that relate to ditch design cross-sectional area.

5.3 Installation of Water Control Structures

√ 1. If economically feasible, install water control structures at ranch outfalls, and/or the outfall of historically drained isolated or contiguous wetlands. Doing this will rehydrate these wetlands and provide onsite water quality treatment opportunities. A fixed weir is one device that may be used to help maintain *normal pool* water levels within these wetlands.

√ 2. Maintain boards in all structures to reduce discharge volume, and especially use boards at the end of the dry season to keep the first flush of nutrients onsite.

Before installing new (non-replacement) water control structures, contact FDACS, USDA-NRCS, the applicable water control district and/or your water management district to see if technical assistance or permitting may be required.

5.4 Grassed Waterways

√ 1. Install a grassed waterway to divert runoff from upland pasture areas around any concentrated areas such as cowpens that are near watercourses, streams, wetlands, or sinkholes. Design the grassed waterway in accordance with USDA-NRCS specifications.

Operation and Maintenance:

- Replace dilapidated water control structures with structures matching original specifications and use good sediment control measures.
- Routinely remove any accumulated aquatic weeds at the control structure(s) to maintain proper drainage and prevent secondary environmental impacts. Use a combination of physical control (e.g. floating barriers, screens, etc.), biological control (e.g. herbivorous fish), and chemical control (e.g. selective herbicides labeled for aquatic applications) to suppress and reduce aquatic weed problems.

References:

(1) USDA-NRCS Irrigation Field Ditch, Code 388; Grassed Waterway, Code 412; Structure for Water Control, Code 587; Surface Drainage (Field Ditch), Code 607; and Surface Drainage (Main or Lateral), Code 608; FOTG-Section IV http://www.nrcs.usda.gov/technical/efotg

(2) Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas, American Society of Agricultural and Biological Engineers, Standard EP 302.4,

(3) American Society of Agronomy: Drainage for Agriculture, http://www.agronomy.org

(4) The Florida Stormwater, Erosion, and Sedimentation Control Inspectors' Manual, FDEP, http://www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

(5) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/



6.0 CONSERVATION BUFFERS

For the purposes of this manual, conservation buffers include field borders, filter strips and *riparian* buffers. They are generally non-tilled areas and can be selectively used in cow/calf operations to provide an additional level of water quality treatment, especially near sensitive discharge areas. Field borders are strips of permanent vegetation, either natural or planted, at the edge or perimeter of fields. They function primarily to help reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Filter strips are areas of permanent vegetation between farm fields and adjacent to environmentally sensitive areas. Their main purpose is to decrease the velocity of runoff water and remove sediment particles before they reach surface waters. Riparian buffers are areas of trees, shrubs and/or grasses located adjacent to natural streams, which help reduce excessive amounts of sediment, organic material, nutrients, and pesticides in surface water sheetflow. Riparian buffers are most effective on highly sloped lands when positioned next to perennial or intermittent streams with high ground water recharge potential.

Working Definition:

Conservation buffers are permanently vegetated, non-cultivated areas that function to retain water and soil onsite to help reduce pollutants in surface water runoff.

6.1 Field Borders

√ 1. When creating new improved pastures on previously idle land adjacent to urban areas, install or maintain field borders around the perimeter or, at a minimum, in areas where runoff enters or leaves the pasture.

√ 2. Plant borders during the time of year that will assure the most success for survival, and consider using native species and/or overseeding the border with legumes for plant diversity and wildlife benefits.

6.2 Filter Strips

√ 1. Install a filter strip to treat runoff from concentrated livestock areas, such as feed areas or cowpens that are directly adjacent to wetlands and sinkholes.

√ 2. Design the filter strip based on peak discharge from the concentrated waste area, and generally base this calculation on a 2-year, 24-hour rainfall event. Construct the treatment area wide enough to convey the flow at a depth of 0.5 feet or less, with the length sufficient to provide at least 15 minutes of flow-through time.

6.3 Riparian Buffers

√ 1. Install or maintain a riparian buffer or filter strip

on pasture areas that exceed 1% slope and discharge directly to streams. Specifically:

- Maintain an existing riparian buffer as an alternative to fencing when conditions warrant. Refer to the Fence Installation BMP in this manual for more information.
- Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function. Refer to USDA-NRCS Stream Crossing, Code 578 for design criteria.
- Select shrub and tree species based on their compatibility in growth, water, and shade tolerance.

Contact FDACS, USDA-NRCS or a Technical Service Provider approved by the USDA-NRCS for assistance in properly designing the riparian buffer in accordance with USDA-NRCS Codes 390 and/or 391 in the Key References section below.

Operation and Maintenance:

- Inspect conservation buffers periodically, and restore as needed in order to maintain their intended purpose.
- Do not overuse fertilizers, pesticides, and other chemicals in maintaining buffers.
- Repair rills and small channels that may develop across the buffers, and reseed as necessary.
- Use proper grazing or haying management practices to maintain the integrity of grassed waterways, if applicable.
- If rollerchopping, conduct these activities in accordance with USDA-NRCS guidelines and use prescribed burns as necessary to maintain the native vegetation within the buffer and to discourage the establishment of nuisance exotic vegetation.

References:

(1) USDA-NRCS Field Border, Code 386; Riparian Herbaceous Cover, Code 390; Riparian Forest Buffer, Code 391; Filter Strip, Code 393; and Grassed Waterway, Code 412; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/

(3) General Specifications for Establishing Riparian Forest Buffers, USDA-NRCS FL Technical Note Forestry FL-17, http://www.usda.nrcs.gov/

(4) Farming for Clean Water in South Carolina: A Handbook of Conservation Practices, http://www.epa.gov/owow/nps/bestnpsdocs.html#agriculture

(5) Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Universal Soil Loss Equation, USDA Agricultural Research Service, Agricultural Handbook No. 703, http://www.ars.usda.gov/Research/docs.htm?docid=5974



7.0 FENCE INSTALLATION

Fences are usually installed across pasture lands and around the perimeter to allow for rotation, deferment, and resting of grazing lands. Exclusion fencing is sometimes required adjacent to ***perennial streams*** to prevent cattle from entering these waters. This helps reduce the occurrence of animals standing in water, streambank erosion problems, and water quality degradation.

Nonpoint source pollution from rangeland livestock depends primarily on stocking rate, length of grazing period, season of use, concentrated manure deposition sites, and proximity of livestock to the nearest watercourse. Receiving waters, particularly areas that may be defined as ***waters of the state*** should be reasonably protected from point source discharges (via structures) resulting from livestock. This is especially true in summer time when livestock have a tendency to congregate in natural waterbodies or artificially dug watering areas to cool off. If the number of animals and frequency of occurrence are high, this may result in adverse stream bank damage, erosion, and/or nutrient and bacterial loadings. Livestock may also gravitate towards deep-water wetland habitats that have standing water during most of the year, such as swamps and marshes. Some of these wetlands may be hydrologically connected to downstream watercourses. Consequently, it is important to calculate your livestock's water needs and assess whether the available water resources are adequate to provide a year-round freshwater supply for the herd without the resources being adversely affected.

Large-scale exclusion fencing may be logistically impractical or cost-prohibitive. Before installing exclusion fencing, ranchers should consider all alternative approaches. In many cases, exclusion of livestock from watercourses and associated riparian areas can be accomplished using riparian buffers and proper grazing management, and/or placing feed, water, and shade structures in upland areas. Ranchers dealing with this issue should first use all reasonable methods in the **Alternative Cattle Water Sources** and **Conservation Buffer** (Riparian Buffer) BMPs as an option to installing exclusion fencing.

Once fences are installed, it is very important to maintain them. Regular inspection of fences should be part of an ongoing management program. Inspection of fences after major storm events and wildfires is recommended to maintain their intended use. The location and construction of all fences and storage of fence materials should comply with local, state, and federal laws. Landowners are encouraged to consult with water management district staff and USDA-NRCS prior to conducting land clearing activities and associated fencing projects in surface waters or wetlands, to ensure that proper authorization is obtained, if needed.

Working Definition:

Fence installation is a method of managing cattle in an area to maintain, or improve the quantity and quality of the natural resources.

7.1 General Fence Installation

√ 1. Perform land clearing before fence installation. Minimize vegetation removal and soil disturbance.

√ 2. Use compatible fencing material based on the site's soil and water properties, and construct fences or barriers so they are structurally adequate for their intended purpose.

√ 3. Adjust stocking rates to ensure uniform grazing, or subdivide larger pastures using fencing.

√ 4. Stabilize stream banks, then either: provide adequate alternative cattle water sources, such as watering troughs or upland excavated ponds; or install and maintain exclusion fencing to control cattle access when cattle graze in predominately improved pastures that contribute runoff to perennial streams.

√ 5. As an alternative to fence installation, provide or maintain a riparian buffer to create a natural barrier landward of the stream when cattle graze in predominately native or semi-improved pastures that contribute runoff to perennial streams.

7.2 Fence Installation In Wetlands

√ 1. When installing fences in wetlands, minimize the use of mechanical equipment, and keep the cleared area no wider than 12 feet on average on either side of the fence. Do not dredge or fill within the wetland.

√ 2. Perform all work during the dry season, when there is no standing water in the wetland.

Note: *Do the Advanced-Level BMP Needs Assessment to determine whether to implement the BMPs below.*

7.3 LEVEL II - Livestock Use Exclusion

√ 1. For cattle grazing in areas regulated by a water management district surface water permit, install and maintain exclusion fencing on each side of and across the ranch drainage canal at a minimum distance of 300 feet (or greater if required by permit) from outfall(s) that connect offsite to waters of the state. This distance only applies to the measurement taken from the outfall to a point upstream 300 feet.

√ 2. For cattle grazing in areas not regulated by a water management district surface water permit, install and maintain exclusion fencing on each side of and across the ranch drainage canal at a minimum distance of 500 feet from outfall(s) that connect offsite to waters of the state. This distance only applies to the measurement taken from the outfall to a point upstream 500 feet.

√ 3. Install and maintain permanent or temporary exclusion fencing along areas directly adjacent to perennial streams when these areas have significant rill or *gully erosion*.

Operation and Maintenance:

- Maintain all fences, watering troughs, and shade structures in good working order to prevent animals from congregating in waterbodies.
- Repair rill and gully erosion when installing an exclusion fence.

References:

(1) USDA-NRCS Fence, Code 382; and Use Exclusion, Code 472; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Beef Cattle Production Best Management Practices, LSU Ag Center http://www.lsuagcenter.com/en/crops_livestock/livestock/beef_cattle/production_management/Beef+Cattle+Production+Best+Management+Practices.htm

(3) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/

(4) Streamside Livestock Exclusion, Virginia Tech Cooperative Extension, Publication No. 442-766, http://www.ext.vt.edu/pubs/bse/442-766/442-766.html



8.0 HIGH-INTENSITY AREAS

High-intensity areas, where livestock are confined or congregate for extended periods of time, can adversely impact both the environment and the animal's health. Feeding areas, holding or cow pens, watering troughs, and shaded or covered shelter areas may create high-intensity areas. Proper management of these areas will alleviate environmental concerns, support livestock health, and improve the overall aesthetics of the cow/calf operation.

Working Definition:

High-intensity areas are parts of a cow/calf operation used intensively by livestock for short periods of time, resulting in denuded ground cover.

8.1 High-Intensity Area Management

√ 1. Locate new cowpens a minimum 200 feet away from watercourses, streams, wetlands, wells or sinkholes, and construct a berm to prevent runoff.

√ 2. Direct runoff from high-intensity areas away from watercourses, streams, wetlands, wells or sinkholes using grassed waterways or swales. This can be used as part of a treatment train in conjunction with sediment traps.

Note: *Do the Advanced-Level BMP Needs Assessment to determine whether to implement the BMPs below.*

8.2 LEVEL II – Design Retrofits

√ 1. Apply aggregate surfaces such as crushed rock or gravel in and around these areas to prevent erosion.

√ 2. Install filter strips, conservation buffers, or berms/diversions to treat discharges into watercourses, streams, wetlands, wells or sinkholes.

Operation and Maintenance:

- Inspect fencing and structures regularly and make necessary repairs.
- Periodically clean or remove excess manure from these areas.
- Inspect these areas after severe weather events to ensure runoff has been properly contained or diverted.
- Use agronomic practices to re-vegetate denuded areas.

References:

(1) USDA-NRCS Heavy Use Area Protection, Code 561; FOTG-Section IV http://www.nrcs.usda.gov/technical/efotg

(2) Effect of Stocking Rate on Measures of Cow-Calf Productivity and Nutrient Loads in Surface Water Runoff, UF-IFAS AN-14, http://edis.ifas.ufl.edu/

(3) National Management Measures for the Control of Nonpoint Pollution from Agriculture, EPA Document No. 841B03004, http://www.epa.gov/nps/agmm/



9.0 ANIMAL MORTALITY

Animal carcasses contain microorganisms. Some of these organisms may be pathogenic (disease causing), either to animals of the same species or to different animal species. Proper management of animal carcasses will prevent the movement of pathogenic organisms to surface or ground water and therefore reduce the risk of transmitting diseases to healthy livestock. Proper management of carcasses will also protect surface waters from unwanted organic loads that can lower dissolved oxygen levels and kill fish. In addition, odor and nutrient enrichment problems can be prevented.

Carcass management will vary around the state, but viable alternatives include rendering, burning, burial, or hauling the carcass to an upland site away from other animals and water sources. Keep in mind that FDEP Rule, 62-701, F.A.C., for *Solid Waste Management Facilities* may apply if operators are faced with a catastrophic die-off of livestock, and have to dispose of these animals in accordance with state rule.

Working Definition:

Animal mortality BMPs involve the judicious management and disposal of dead animals to protect water quality and to provide increased protection to livestock and humans.

9.1 Sanitation And Disease Control Measures

✓ 1. Transport carcasses in a sanitary manner to prevent spreading infection.

✓ 2. Clean and disinfect any mechanical equipment surfaces that were in contact with the carcasses, especially if you suspect a more virulent disease organism to be the cause of death.

✓ 3. Report any of the dangerous diseases listed below to the State Veterinarian per the requirements in section 585.18, F.S.

Anthrax	Heartwater
Bont Tick infestation (Amblyomma)	Lumpy skin Disease
Bovine Piroplasmosis (Cattle Tick Fever)	Peste des Petits Ruminants
Bovine Spongiform Encephalopathy	Pseudorabies (Aujeszky's Disease)
Brucellosis (B. abortus, B. suis)	Rabies
Southern Cattle Tick infestation (Boophilus)	Rift Valley Fever
Contagious Bovine or Caprine Pleuropneumonia	Rinderpest
Foot and Mouth Disease	Salmonella Enteritidis
	Scabies
	Screwworm infestation
	Tuberculosis
	Vesicular Stomatitis

9.2 Disposal

√ 1. Move carcasses to an upland area away from watercourses, streams, wetlands, wells, or sinkholes.

√ 2. If a suitable site is available, locate any burial site at least 50 feet away from adjacent property owners, and at least 200 feet away from watercourses, streams, wetlands, wells or sinkholes. Identify this area on a map and keep the map handy for future reference.

9.3 Rendering And Incineration

√ 1. Use a licensed rendering or incineration facility, if one exists locally.

Operation and Maintenance:

- Maintain soil stabilization practices until vegetation is re-established on top of burial sites.
- If composting, remember that animal carcasses are very high in nitrogen and have an average C:N ratio of 5:1. Because of this, they will likely require a supplemental carbon source to decompose properly.

References:

(1) Beef Cattle Production Best Management Practices, LSU, http://www.lsuagcenter.com/en/crops_livestock/livestock/beef_cattle/production_management/Beef+Cattle+Production+Best+Management+Practices.htm

(2) USDA-NRCS Animal Mortality Facility, Code 316; Composting Facility, Code 317; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(3) Composting Animal Mortality, Minnesota Department of Agriculture, http://www.mda.state.mn.us/animals/animals/composting.htm

(4) Chapter 585, Florida Statutes



10.0 WELLHEAD PROTECTION

With the majority of Florida's water supply originating from underground sources, or ***aquifers***, it is extremely important that ranchers make every effort to protect source waters. Successful wellhead protection ultimately involves the use of regulations and common-sense measures that address well placement and agricultural practices near wells. For new well construction, the initial focus should be on appropriate well location and sound well-construction practices. For all wells, it is important to conduct management activities near the wellhead that are aimed at reducing the potential for contamination. Wellhead protection is one of the most effective ways of protecting ground water quality and preventing human exposure to accidental contamination.

Working Definition:

Wellhead protection is the establishment of protection zones and safe land use practices around wells to protect source waters from accidental contamination.

10.1 Well Planning and Protection

√ 1. Construct new wells up-gradient as far as possible from likely pollutant sources such as petroleum storage tanks, septic tanks, chemical mixing areas, and livestock confinement facilities.

√ 2. Contact your regional water management district to see if the well requires a consumptive use or water use permit. Wells that serve public water systems must also meet the rule requirements of Chapter 62-521, F.A.C.

√ 3. Cap or valve any existing ***artesian*** (flowing) wells, in accordance with water management district requirements.

√ 4. For potable wells, exclude livestock within a 75-foot radius of the wellhead. This radius can be reduced if well construction records demonstrate well casing depths that extend through confining layers.

10.2 Well Construction and Operation

√ 1. Use a licensed Florida water well contractor and drill new wells according to local government code and water management district well construction permit requirements.

√ 2. At a minimum, surround new wells with a concrete slab approximately four (4) inches thick with a two (2) foot radius. Extend the casing above the ground surface a minimum of 12".

√ 3. Retrofit existing functional wells with a concrete collar with a one (1) foot radius or fence to protect them from damage.

✓ 4. Use backflow prevention devices at the wellhead to prevent contamination.

Maintain records of new well construction or modifications to existing wells. Proper records are important for future reference, in case problems arise with the well.

Operation and Maintenance:

- Try to maintain permanent vegetation within a 75-foot radius around wells.
- Inspect wellheads and pads regularly for leaks or cracks, and make any necessary repairs.
- Consider testing drinking water wells annually for coliform bacteria contamination to protect public health.

References:

(1) USDA-NRCS Water Well, Code 642; and Diversion, Code 362; FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Farm-A-Syst Program, http://www.uwex.edu/farmasyst

(3) Aquifer Protection Program, SJRWMD, http://www.sjrwmd.com/technicalreports/pdfs/SP/SJ91-SP9_vol1.pdf

(4) Water Well Permitting and Construction Requirements, FDEP Rule 62-532, F.A.C., http://www.dep.state.fl.us/legal/Rules/rulelistnum.htm



11.0 WETLANDS AND SPRINGS PROTECTION

Wetlands and springs are important components of Florida's water resources. They often serve as spawning areas and nurseries for many species of fish and wildlife, perform important flood-storage roles, cycle nutrients in runoff water, contribute moisture to the hydrologic cycle, add plant and animal diversity, provide flash grazing opportunities, and offer valuable recreational opportunities for the public.

Wetlands are complex transitional ecosystems that provide a link between aquatic and terrestrial environments. Under Florida Law, "wetlands" are defined as areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. They generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

Chapter 62-340, F.A.C., entitled "Delineation of the Landward Extent of Wetlands and Surface Waters" contains the methodology that must be used by all state and local governments in Florida to determine the boundary between wetlands and uplands and other surface waters. The federal government (U.S. Army Corps of Engineers and USDA-NRCS) uses the "1987 Manual" to determine the boundary between uplands and waters of the United States, which includes wetlands in natural areas. The Food Security Act manual is used by USDA-NRCS to determine wetlands on agricultural lands. In most cases, the boundaries determined by both methodologies are the same or very close. Unauthorized impacts to wetlands may jeopardize USDA-NRCS cost-share benefits pursuant to the Food Security Act's Swampbuster provisions.

Springs, spring runs, and associated sinks are unique freshwater systems that emerge from the underlying limestone that is at or near the land surface. Springs are unique natural resource features and deserve special protection. Prior to substantial development in Florida, wetlands and spring systems once covered about half of the state's surface. That area has been greatly reduced, primarily because early water management efforts in Florida focused on draining wetlands to facilitate urban and agricultural lands development.

Working Definition:

Wetlands (defined in the glossary of this manual) are typically low landform areas with seasonal or permanent standing water that provide wildlife habitat and natural filtration. *Springs* are mostly

clear surface waters that are naturally low in nutrients and originate from ground water that emerges to the land surface.

11.1 Wetlands Protection and Impact Avoidance

√ 1. Use a county soil survey map to help identify "wetland" or hydric soil types and/or other depressional or frequently flooded areas.

√ 2. Use preservation, practical design alternatives, or modifications to eliminate or reduce adverse impacts to wetlands and springs

√ 3. Maintain a minimum 25-foot vegetative buffer exterior to the landward extent of all wetlands that meet the state's delineation methodology. If you have a water management district permit (ERP, MSSW), you must follow the buffer requirements in the permit.

√ 4. Obtain a USDA-NRCS wetland determination prior to conducting activities in a wetland. Failure to do so may jeopardize your federal cost-share eligibility.

11.2 Water Quality Treatment and Field Discharges

√ 1. Minimize adverse water quality impacts to receiving wetlands by using pretreatment practices such as filter strips, conservation buffers, swales, or holding water onsite. This can substantially reduce pollutants, especially suspended solids, and allow the wetland to more naturally assimilate nutrients.

√ 2. Rotate livestock through the wetland grazing system at an accelerated pace when excessive rainfall or mud becomes a persistent problem.

√ 3. Use spreader swales or other means to encourage sheetflow through the wetland buffer prior to discharging water from existing pasture ditches.

11.3 Special Criteria for First and Second Magnitude Springs

√ 1. Maintain a 100-foot vegetative buffer from springs, spring runs, and wet sinks.

√ 2. Use split-applications for fertilizers on pasture areas that contribute surface water directly to springs, spring runs, and wet sinks.

Operation and Maintenance:

- Limit the use of pesticides and fertilizers in and around wetlands and springs, and be careful to avoid spray drift impacts.

References:

(1) USDA-NRCS Wetland Enhancement, Code 659; Prescribed Grazing, Code 528; Nutrient Management, Code 590; Filter Strip, Code 393; and Diversion, Code 362; FOTG-Section IV, 659, http://www.nrcs.usda.gov/technical/efotg

(2) Water Management District's Environmental Resource Permitting Rule and Basis of Review, http://www.dep.state.fl.us/water/waterpolicy/districts.htm

(3) Protecting Florida's Springs: Land Use Planning Strategies and Best Management Practices, Department of Community Affairs, www.dca.state.fl.us/fdcp/DCP/publications



12.0 PRESCRIBED BURNING

Burning is a natural phenomenon in the flatwoods, marshes, and sloughs that make up the major rangeland areas in the state. Controlled use of fire is a valuable management tool, and is a natural component in forming plant communities and their structure. Prescribed burning suppresses many undesirable plant species to maintain their natural balance, and enhances the palatability and nutritional value of edible plants for wildlife and livestock. Reducing overpopulated brush and woody components in pastures and rangeland increases herbaceous vegetation, resulting in better forage and water-filtering capability. Furthermore, when prescribed burning is used to recycle accumulated litter and excessive brush in a beneficial way, the threat of wildfire is reduced.

Rangeland plant communities that depend upon periodic fires will quickly shift into transitional plant communities dominated by woody species when burning is suppressed. This shift will often reduce the usable area for wildlife and livestock. This is compounded as shading from woody plants inhibits the growth of grasses and other herbaceous plants. In addition, increased soil moisture uptake as a result of the woody plant overstory limits the available water needed for production of forage and ground water recharge.

Working Definition:

Prescribed burning is a cost-effective tool to reduce fuel buildup that can cause dangerous wildfire conditions, thus providing improved habitat for range management and increased protection to people, their homes, and the forest.

12.1 Burn Preparation

√ 1. Develop and implement a burn prescription plan that includes emergency contingencies, or enlist the help of a Certified Prescribed Burn Manager to conduct prescribed burns. Courses are available for training in the basics and regulations of burning.

√ 2. Ensure no burning bans are in effect, and that the proper permits, certification, and landowner permission are obtained prior to burning. Prescribed burns must be conducted in accordance with Florida Forest Service rules and section 590.125, Florida Statutes.

√ 3. Use burning in conjunction with roller chopping when developing pastures in native areas that have an abundance of palmettos.

√ 4. Burn only when weather conditions are favorable. Check wind conditions to ensure smoke from the burn will not adversely impact roadways or neighboring properties. Never leave a burn unattended.

12.2 Construction Of Fire Lines

√ 1. Carefully select fireline locations and avoid constructing them in wetlands. For firelines that are constructed with fencing through wetlands, follow the criteria in the "Fence Installation" BMPs.

√ 2. Use alternatives to plowed firelines, such as harrowed strips, wet lines, or grass strips. Existing barriers such as roads, ditches or canals can also be used as firelines.

√ 3. Construct firelines with the contour to minimize soil erosion.

12.3 Fire Safety And Control

√ 1. Ensure that adequate fire equipment is on hand and that the fire does not burn too hot. An intense burn can overexpose the ground floor, leading to erosion and destruction of valuable habitat.

√ 2. Ensure the fire is completely out before leaving the site.

Operation and Maintenance:

- Maintain soil stabilization practices until vegetation is re-established.
- Check fence posts and other infrastructure for integrity after intense burns.
- Grazing should be deferred for 30-90 days after a burn during the growing season. This will help ensure that new growth is able to re-establish.

References:

(1) USDA-NRCS Prescribed Burning Code 338, FOTG-Section IV, http://www.nrcs.usda.gov/technical/efotg

(2) Prescribed Burning Fact Sheet, USDA-NRCS

(3) BMPs for Prescribed Burning, South Carolina Forestry Commission, http://www.state.sc.us/forest/rbpb.htm

(4) Wisconsin DNR Water Quality BMP Field Manual http://www.wi.gov/forestry/usesof/bmp/bmptoc.htm

(5) Prescribed Burning Regulations in Florida, UF-IFAS FOR-67, http://edis.ifas.ufl.edu/FR055

(6) Section 590.125, Florida Statutes



13.0 INTEGRATED PEST MANAGEMENT AND PHARMACEUTICALS

Integrated pest management (IPM) is the approach of using scientific principles to manage problem pests. IPM does not mean that pesticides will be excluded. Instead, it means that pesticides are just one of many tools used to manage pests; however, pesticides should be used judiciously and only when needed. The goals of an IPM program are improved control of pests, more efficient pesticide management, more economical forage production, and reduction of potential hazards to humans and the environment through reduced pesticide exposure. IPM accomplishes these goals through the use of resistant plant species, improved cultural practices, biological control agents (parasitoids, predators), and selective use of pesticides. Although detailed IPM programs have not been developed for all types of cropping systems, IPM principles can be applied in many cases using applied science and logic. It is also important to predict economic losses and risks so the cost of various treatments can be compared to the potential losses.

Pharmaceutical misuse and waste handling, involving antibiotics and hormones, can have a negative impact on water quality and is an issue of increasing national concern. It is very important to use these products responsibly; therefore, follow all state and federal regulations and properly dispose of spent needles, expired or unused pharmaceuticals, and pharmaceutical containers.

Working Definition:

IPM is a broad, interdisciplinary approach to pest management using a variety of methods to systematically control pests.

13.1 General IPM Practices

✓ 1. Store pesticides in a roofed structure with a lockable door, at least 100 feet from surface waters.

✓ 2. When practical, construct a permanent mix/load facility with an impermeable surface, and locate it away from wells and/or surface waters. Where permanent facilities are not practical, use portable mix/load stations. When field mixing is necessary, loading activities should be conducted at random locations in the field with the aid of nurse tanks, if applicable. Use a check valve or air gap separation to prevent backflow into the tank when filling a sprayer.

✓ 3. Practice IPM and use all pesticides in accordance with the label. When applying a pesticide close to a stream, canal, pond or other sensitive waterbody, choose a pesticide with an active ingredient that has a lower toxicity to aquatic organisms.

✓ 4. Rinse, recycle, or dispose of empty pesticide containers following federal, state, and/or local regulations.

13.2 Pharmaceutical Use and Disposal

✓ 1. Use FDA-approved products and only mix enough product to administer to affected cattle, which will result in little to no waste product.

✓ 2. Follow label and dosing instructions to ensure that the proper dose is administered.

✓ 3. Dispose of spent needles and unused pharmaceutical products in a responsible manner. Contact a veterinarian to obtain a puncture-proof container that is labeled "Biohazard". Dispose of spent needles in accordance with EPA guidelines and follow local solid waste regulations.

References:

(1) Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance, FDACS and FDEP. http://www.floridaagwaterpolicy.com/BestManagementPractices.html

(2) Integrated Pest Management Program at the University of Florida. http://ipm.ifas.ufl.edu/

(3) Use Management Practices to Protect Groundwater from Agricultural Pesticides, UF-IFAS, PI 1. http://edis.ifas.ufl.edu/PI001

(4) Arsenic Contamination from Cattle-Dipping Vats, UF-IFAS, SL152. http://edis.ifas.ufl.edu/SS205

(5) Management Practices to Protect Surface Water from Agricultural Pesticides, UF-IFAS, PI 22. http://edis.ifas.ufl.edu/PI014

(6) Florida Cow-Calf and Stocker Beef Safety and Quality Assurance Handbook: Quality Control Points, UF-IFAS, Publication AN173. http://edis.ifas.ufl.edu/AN173

(7) Disposal of Medical Sharps, EPA, www.epa.gov/osw/nonhaz/industrial/medical/disposal.htm

APPENDICES

APPENDIX 1. GENERAL BMP REFERENCES

The documents listed below are very good sources of information for producers to consult on agricultural and environmental issues.

General BMP References

(1) *National Management Measures for the Control of Nonpoint Pollution from Agriculture*, U.S. Environmental Protection Agency, July 2003.

This manual provides guidance to States and the public regarding management measures that may be used to reduce nonpoint source pollution from agricultural activities. Chapter 4 deals with animal feeding operations and grazing management.

http://www.epa.gov/nps/agmm/

(2) *Best Management Practices for Agrichemical and Farm Equipment Maintenance*, Florida Department of Agriculture and Consumer Services, Florida Department of Environmental Protection, February 2000.

This manual lists responsible handling and use of pest control products, and pollution prevention actions that can be implemented at farm maintenance areas that protect the environment.

http://www.floridaagwaterpolicy.com/BestManagementPractices.html

(3) *Protecting Louisiana's Waters Using Best Management Practices*, Louisiana State University Agricultural Center, 2001.

This publication includes information on five main areas: nutrient management, pesticide management, soil and water management, pasture management and general farm BMPs.

http://www.lsuagcenter.com/en/environment/conservation/bmps/Protecting+Louisianas+Waters+Using+Best+Management+Practices.htm

(4) *Protecting Florida's Springs: Land Use Planning Strategies and Best Management Practices*, Florida Department of Community Affairs and Florida Department of Environmental Protection, November 2002.

This guide provides an introduction on the hydrologic importance of springs, comprehensive planning strategies, other information to manage development impacts, and specific criteria for other industries.

http://www.dca.state.fl.us/fdcp/DCP/publications

(5) *Beneficial Management Practices: Environmental Manual for Alberta Cow/Calf Producers*, Alberta Agriculture, Food and Rural Development, June 2004.

This manual was developed to inform and educate producers on beneficial management practices that can enhance soil, water, air and biodiversity. These BMPs protect the environment while keeping production practical and within the law.

http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/epw8724

University of Florida – Institute of Food and Agricultural Sciences References

Standardized Fertilization Recommendations for Agronomic Crops, UF-IFAS, Fact Sheet SL-129

This publication presents in abbreviated form the fertilization recommendations for agronomic crops based on soil tests performed by the UF/IFAS Extension Soil Testing Laboratory (ESTL). It contains the basic information from which ESTL soil-test reports and fertilization recommendations are generated.
http://edis.ifas.ufl.edu/SS163

Integrated Pest Management Strategies, UF-IFAS, Circular 1149

This circular describes the principles of integrated pest management (IPM) and advises strategies for implementation.

http://edis.ifas.ufl.edu/LH080

Florida Crop/Pest Management Profile: Beef Cattle, UF-IFAS, Circular 1259

This circular gives an overview of Florida's beef cattle industry and contains good information about pest control practices.

http://edis.ifas.ufl.edu/PI043

USDA – Natural Resources Conservation Service References

All references below accessed at:
http://www.nrcs.usda.gov/technical/efotg

(1) Conservation Practice Standard No. 314 (Brush Management)

(2) Conservation Practice Standard No. 338 (Prescribed Burning)

(3) Conservation Practice Standard No. 342 (Critical Area Planting)

(4) Conservation Practice Standard No. 382 (Fence)

(5) Conservation Practice Standard No. 393 (Filter Strip)

(6) Conservation Practice Standard No. 412 (Grassed Waterway)

(7) Conservation Practice Standard No. 472 (Use Exclusion)

(8) Conservation Practice Standard No. 528 (Prescribed Grazing)

APPENDIX 2. SETBACKS TABLE

Reference Table for Recommended Setbacks			
BMP #	**Practice**	**Setback (Feet)**	**Hydrologic Feature Type**
1.1.5	Fertilizer spreading	50	Wetlands, streams or sinkholes
1.3.3	Supplemental feeding and mineral stations	100	Watercourses, streams, wetlands, wells or sinkholes
2.2.1	Watering ponds	50*	Wetlands
2.3.3	Piped withdrawal of watercourses	100	Waterbody
8.1.1	New cowpens	200	Watercourses, streams, wetlands, wells or sinkholes
10.1.4	Livestock exclusion	75	Wellhead (potable wells)
11.1.3	Vegetative buffer	25	Wetlands
11.3.1	Vegetative buffer	100	Springs, spring runs, and wet sinks

** Check with the water management district to see if a greater setback is required.*

APPENDIX 3. CONTACT INFORMATION

EMERGENCY INFORMATION

Emergency Reporting Numbers		
State Warning Point *Division of Emergency Management - contact in case of oil or hazardous substance spill*	24 hours/ Toll-Free	**1-800-320-0519**

Emergency Information and Follow-Up Numbers		
State Emergency Response Commission *For follow-up reporting only.* *For an emergency, call the State Warning Point.*	Toll-Free	1-800-635-7179
State Warning Point Information Line	Monday - Friday, 8:00 AM - 5:00 PM	(850) 413-9900
DEP Emergency Response	Monday - Friday, 8:00 AM - 5:00 PM	(850) 245-2010

NON-EMERGENCY INFORMATION

Florida State Agency Numbers		Toll Free
Department of Agriculture and Consumer Services		
Office of Agricultural Water Policy	(850) 617-1727	
Division of Agricultural and Environmental Services	(850) 488-3731	
Bureau of Pesticides	(850) 487-0532	
Bureau of Compliance Monitoring	(850) 488-8731	
Division of Animal Industry	(850) 410-0900	
Department of Environmental Protection		
Nonpoint Source Management Section	(850) 245-7508	
Hazardous Waste Management Section	(850) 245-8707	
Northwest District Office (Pensacola)	(850) 595-8300	
Northeast District Office (Jacksonville)	(904) 807-3300	
Central District Office (Orlando)	(407) 894-7555	
Southeast District Office (West Palm)	(561) 681-6600	
Southwest District Office (Tampa)	(813) 632-7600	
South District Office (Ft. Myers)	(941) 332-6975	
Water Management Districts		
Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. John's River (Palatka)	(904) 329-4500	1-800-451-7106
Southwest Florida (Brooksville)	(352) 796-7211	1-800-423-1476
South Florida (West Palm)	(561) 686-8800	1-800-432-2045

Other Helpful Numbers - Main offices, call to obtain local contact information	
USDA-NRCS - Florida Main Office (Gainesville)	(352) 338-9500
UF/IFAS Extension Administration	(352) 392-1761
Association of Florida Conservation Districts *Soil and Water Conservation Districts*	(407) 321-8212

APPENDIX 4. ACRONYM LIST AND GLOSSARY

Adsorbed – Adhesion to a surface in a thin layer.

Animal Unit (AU) – Considered to be one mature cow of approximate 1000 pounds, either dry or with calf up to 6 months of age, or their equivalent, based on a standardized amount of forage consumed.

Aquifers – Soil or rock formations that contains ground water and serves as a source of water that can be pumped to the surface.

Artesian Well – A well from which water is forced out naturally under pressure. Artesian wells are bored where water in a layer of porous rock is sandwiched between two layers of impervious rock. Water flows up to the surface because distant parts of the aquifer are higher than the well-head.

Attenuate – To weaken or reduce in force, intensity, effect, quantity, or value.

Best Management Practice (BMP) – A practice or combination of practices determined by the coordinating agencies, based on research, field-testing, and expert review, to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality in agricultural and urban discharges. Best management practices for agricultural discharges shall reflect a balance between water quality improvements and agricultural productivity.

BMAP – Basin Management Action Plan.

BOD – Biochemical Oxygen Demand.

C:N – Carbon to Nitrogen ratio.

Continuous Grazing – The grazing of a specific unit by livestock throughout the year or for that part of the year during which grazing is feasible.

Conveyance Capacity – The amount of flow (generally expressed in cubic feet per second) that a canal/ditch can carry based on the size, shape, slope, and condition of the canal/ditch.

Cowpens – Fenced structure used to temporarily confine cattle for examination, medication, vaccination, administering parasite control, weighing, sorting, and /or identification. Confinement is commonly less than 12 hours, but occasionally cattle may be retained for up to one week. Pens are denuded of vegetation if heavily used, but contain vegetation when lightly used.

C-139 Basin – A SFWMD regulatory sub-basin wholly contained within Hendry County.

EAA – Everglades Agricultural Area

EDIS – Electronic Document Information System.

EPA – Environmental Protection Agency.

ERP – Environmental Resource Permit.

Eutrophication – A process whereby watercourse, such as lakes, estuaries, or slow-moving streams receive excess nutrients that stimulate excessive plant growth.

Evapotranspiration (ET) – The water lost to the atmosphere by evaporation and transpiration. Evaporation is the loss from open bodies of water and transpiration is the loss from living-plant surfaces.

FCWA – Federal Clean Water Act.

FDACS – Florida Department of Agriculture and Consumer Services.

FDEP – Florida Department of Environmental Protection.

FDOH – Florida Department of Health.

Flash-Grazing – The concept of grazing a normally excluded area with a large number of cattle for a short period of time, generally not exceeding three days.

FOTG – Field Office Technical Guide.

F.S. – Florida Statutes.

FWRA – Florida Watershed Restoration Act.

Gully Erosion – The erosion process whereby water accumulates in narrow channels and, over a short period time, removes the soil from this narrow area to considerable depths, ranging from one to two feet deep.

Hydraulic Drawdown – The amount by which the water level in an aquifer or water table is further lowered, when the water from that aquifer or water table is continually removed by man-made means (pumps, canals/ditches).

IPM – Integrated Pest Management.

MSSW – Management and Storage of Surface Waters.

N – Nitrogen.

NOI – Notice of Intent.

Normal Pool – A water level elevation based on consideration of biological indicators of sustained inundation, using reasonable scientific judgment used to standardize measurements of water levels and facilitate comparison among wetlands.

P – Phosphorus.

Paddocks – A subdivision of a pasture designed to provide short-duration grazing followed by an appropriate (related to species, soil type and weather conditions) rest period for regrowth and stand maintenance.

Perennial Streams – Streams or rivers that flow in a well-defined channel throughout most of the year under typical climatic conditions.

PPM – Parts per Million.

Prescribed Grazing – The controlled harvest of vegetation with grazing or browsing animals managed with the intent to achieve a planned objective(s).

Resource Management System-Level Conservation Plan – is a record of the decisions and supporting information for treatment of a unit of land or water consistent with the NRCS Field Office Technical Guide (FOTG) quality criteria for soil, water, air, plants, and animals, and takes into account economic and social considerations. The plan must be consistent with the NRCS National Planning Procedures Handbook, as amended, be approved by NRCS or an authorized technical service provider, and specify the schedule of operations and activities needed to address identified natural resource issues. For purposes of this definition, the plan must be updated at least every five years.

Rill Erosion – An erosion process in which numerous small channels only several inches deep are formed, occurs mainly on recently cultivated fields, cuts and fills and canal banks. Rills are smaller than gullies and can be driven across.

Rinsate – The solution remaining after rinsing something.

Riparian – Vegetated ecosystems along a watercourse through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent watercourse.

Rip-rap – Large, loose angular stones that serve as a permanent erosion-resistant ground cover.

Rotational Grazing – Rotational grazing is the grazing of two or more subdivisions of pasture in sequence, followed by a rest period for recovery and re-growth.

Septage – A mixture of sludge, fatty materials, human feces, and wastewater removed during the pumping of an onsite sewage treatment and disposal system.

Sorbed – The action of a substance which is either adsorbed or absorbed onto another substance.

Spoil – The soil material obtained from excavating an area to construct such works as canals/ ditches and /or ponds. This material is typically used to build berms and/or dikes along or in the vicinity of the excavation site.

Supplemental Feeding – Supplying feed to range

animals when available forage is too limited to meet their minimum daily requirement.

SWCD – Soil and Water Conservation District.

TMDL – Total Maximum Daily Load.

Treatment Train – A combination of nonstructural and structural practices which have been determined to be effective for reducing or preventing pollution.

Turbid – In relation to water, it is described by having an opaque and cloudy appearance and containing suspended solids or other pollutants that may limit light penetration.

Turnout – The extension of a road ditch into a vegetated area to provide for the dispersion and filtration of stormwater runoff.

UF-IFAS – University of Florida, Institute of Food and Agricultural Sciences.

USDA-NRCS – United States Department of Agriculture, Natural Resources Conservation Service.

USGS – United States Geological Survey.

Water Control Structures – Any structure used to regulate surface or subsurface water levels.

Watercourse(s) – Any natural or man-made (ditch or canal) water feature that flows continuously or intermittently. For the purposes of this manual, watercourses do not include wetlands as part of their definition.

Watersheds – Described as drainage basins or regions of land where surface water drains downhill into a specified body of water.

Waters of the State – Defined in section 403.031(13), Florida Statutes, to include, but not limited to, rivers, lakes, streams, springs, impoundments, wetlands, and all other waters or bodies of water, including fresh, brackish, saline, tidal, surface, or underground waters. Waters owned entirely by one person other than the state are included only in regard to possible discharge on other property or water. Underground waters include, but are not limited to, all underground waters passing through pores of rock or soils or flowing through in channels, whether manmade or natural. Solely for purposes of s. 403.0885, waters of the state also include navigable waters or waters of the contiguous zone as used in s. 502 of the Clean Water Act, as amended, 33 U.S.C. ss. 1251 et seq., as in existence on January 1, 1993, except for those navigable waters seaward of the boundaries of the state set forth in s. 1, Art. II of the State Constitution.

Wetlands – As defined in section 373.019(25), Florida Statutes, wetlands means those areas that are inundated or saturated by surface water or groundwater at a frequency and a duration sufficient to support, and 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 generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

WMD – Water Management District.

APPENDIX 5. NUTRIENT BUDGET WORKSHEET

Land User:	County:	Date:
Prepared By:	Field #(s):	

Table 1 – Field Conditions and Recommendations

Crop sequence/rotation (circle current crop)	Expected yield

Current soil test levels (ppm)			
P	K	pH	

Recommended nutrients/amendments to meet expected yield			
N	P_2O_5	K_2O	Lime

Table 2 – Nutrient Sources

	Pounds per acre		
Credits	**N**	**P_2O_5**	**K_2O**
1. Nitrogen credits from previous legume crop			
2. Residual from long-term manure application			
3. Irrigation water			
4. Other *(e.g., atmospheric deposition)*			
5. Total credits			
Plant available nutrients applied to field	**N**	**P_2O_5**	**K_2O**
6. Credits *(from row 5, above)*			
7. Fertilizer			
8. Manure/organic material			
9. Subtotal *(sum of lines 6, 7, and 8)*			
10. Nutrients recommended *(from table 1)*			
11. Nutrient status *(subtract line 10 from line 9)*			
If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.			
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.			

Nutrient Management Specifications						
Amount to be applied (lb/ac)	N		P_2O_5		K_2O	
Method, form, and timing of application:						

Instructions to Complete the Nutrient Budget Worksheet

1. Table 1 – Field Conditions and Recommendations

- Enter the crop rotation and circle the current crop (Ex: Bermudagrass, hay or bahiagrass, grazed).
- Enter expected yield (Ex: 5 tons/ac if the crop was bermudagrass, hay or 20 animal unit month (AUM) if the crop was bahiagrass, grazed).
- Enter current soil test levels (ppm). These test levels should be from a Mehlich 1 test, which is what the UF/IFAS soil testing lab uses. A current soil test for phosphorus application should be one that is no more than 1 year old. If applying nutrients at maintenance levels on pasture and hayland, then a soil test should be no older than 5 years.
- Enter recommended nutrients/amendments to meet expected yield. If applying commercial fertilizers the recommendations will come from the UF/IFAS Circular SL-129 – Standardized Fertilization Recommendations for Agronomic Crops dated June 2007. If applying manures or organic by-products (i.e., municipal or sewage sludge), the recommendations will come from crop uptake rates from UF/IFAS research or from book values in the USDA-NRCS Agricultural Waste Management Handbook, Chapter 6. The lime value will come from the soil test results sheet.

2. Table 2 – Nutrient Sources

- Line 1 – Enter credits from previous legume crop. This credit is the amount of estimated nitrogen in pounds per acres that a legume (i.e., clovers, perennial peanut, soybeans) will add to the soil, so the preceding crop can use it. Amounts of nitrogen can be obtained from UF/IFAS research publications such as: Nitrogen Fixation and Inoculation of Forage Legumes, SS-AGR-56.
- Line 2 – Enter residual from long-term manure application. This credit is the amount of nitrogen in pounds per acre from manure application. The amount of nitrogen that becomes available depends on the rate of mineralization or decay and this decay depends on the type of manure and the length of time that it is on the field. For example fresh cow manure that is incorporated into the soil daily has a decay rate of 0.75; 0.15; 0.10; 0.05. This means that 75 percent of the incorporated nitrogen becomes available the first year, 15 percent of the remaining nitrogen becomes available in the second year, 10 percent of the remainder in the third year, and so on. So, with enough time 100 percent will become available for the plant to use. Book values for the mineralization can be found in the NRCS Agricultural Waste Management Handbook, Chapter 11 or from UF/IFAS research.
- Line 3 – Enter nutrient amounts from irrigation water. The irrigation water will need to be tested to determine what nutrient levels are present.
- Line 4 – Enter other credits. These can come from items such as atmospheric deposition, which only accounts for about 3 lbs of N, .35 lbs of P_2O_5, and .48 lbs of K_2O.
- Line 7 – Enter the nutrient amounts for commercial fertilizer.
- Line 8 – Enter the nutrient amounts for manure/organic material. These amounts will come from the analysis of the manure or organic material.
- Line 9 – Enter the sum of the credits, commercial fertilizer, and the manure/organic material.
- Line 10 – Enter the nutrients that were recommended to meet the expected yield from Table 1.
- Line 11 – Subtract the nutrients recommended from the sum of the credits, fertilizer, and manure. If this number is negative then additional nutrients need to be applied to meet the crop recommendation. If this number is positive then the available nutrients exceed the crop requirements and adjustments need to be made to limit overloading of nutrients.

3. Nutrient Management Specifications

- Enter the amount of the nutrients to be applied, which will come from the calculations in Table 2.
- Enter a description of the application method (i.e., broadcast with a spreader, applied through an irrigation system), form of the fertilizer (i.e. liquid, granular, or manure), and the timing of the application (i.e. date of application, growth stage of the crop).

(Adapted from USDA-NRCS literature)

EXAMPLE (BAHIAGRASS) WORKSHEET

Land User:	County:	Date:
Prepared By:	Field #(s):	

Table 1 – Field Conditions and Recommendations

Crop sequence/rotation (circle current crop)	Expected yield
Bahiagrass, graze	100 AUM

Current soil test levels (ppm)			
P	K	pH	
20 ppm	30 ppm	5.5	

Recommended nutrients/amendments to meet expected yield			
N	P_2O_5	K_2O	Lime
50 (Low – N option)	0	0	0

Table 2 – Nutrient Sources

	Pounds per acre		
Credits	N	P_2O_5	K_2O
1. Nitrogen credits from previous legume crop	0		
2. Residual from long-term manure application	0		
3. Irrigation water	0	0	0
4. Other *(e.g., atmospheric deposition)*	0	0	0
5. Total credits	0	0	0
Plant available nutrients applied to field	**N**	**P_2O_5**	**K_2O**
6. Credits *(from row 5, above)*	0	0	0
7. Fertilizer	50	0	0
8. Manure/organic material	0	0	0
9. Subtotal *(sum of lines 6, 7, and 8)*	50	0	0
10. Nutrients recommended *(from table 1)*	50	0	0
11. Nutrient status *(subtract line 10 from line 9)*	0	0	0
If line 11 is a negative number, this is the amount of additional nutrients needed to meet the crop recommendation.			
If line 11 is a positive number, this is the amount by which the available nutrients exceed the crop requirements.			

Nutrient Management Specifications						
Amount to be applied (lb/ac)	N	50	P_2O_5	0	K_2O	0
Method, form, and timing of application: Broadcast 147 lbs/ac of ammonium nitrate (34-0-0) granules.						
Apply in the early spring and incorporate into the soil immediately after application.						

APPENDIX 6. SOIL AND TISSUE TESTING INFORMATION

Soil Testing

The soil testing process comprises four major steps, and understanding each one clearly will increase the reliability of the process tremendously. The steps in the soil testing process are:

- soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

Soil Sampling: Soil samples need to be representative of the field and soil types and the soil analysis results will be only as good as the submitted sample is. Samples collected from areas that differ from typical characteristics of the farm should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area on the farm that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the IFAS Extension Fact Sheet SL181 for further information on soil sampling strategies. Ranchers can use the soil test sheet on page 71 when they have bahia grass in a phosphorus. For other forages and bahia grass in areas that are not phosphorus-limited, use the soil test sheet which can be found at: http://edis.ifas.ufl.edu/pdffiles/SS/SS18600.pdf.

Sample Analysis: The soil samples that are submitted to the testing laboratories undergo a series of physical and chemical processes that are specific to the soil types, crops, and management regimes. Once the soil samples are homogenized through grinding and/or sieving, a precise volume of the sample will be extracted for plant nutrient through an extraction procedure. The following standard methods are approved by the IFAS Soil Testing Laboratories for different soils in Florida:

a) Mehlich-1 extraction - this method is performed on all acid-mineral soils up to a soil pH of 7.3.

b) AB-DTPA extraction - this method is performed on alkaline (calcareous) soils with a pH of 7.4 and above.

c) Water extraction - this method is used for extraction of P in all organic soils.

d) Acetic acid extraction - this method is performed on all organic soils for extraction of K, Mg, Ca, Si, and Na.

It is extremely important that procedures used at the laboratories are well understood before submitting the samples since most BMPs are tied to the standardized procedures used by the labs at the land-grant universities in the state such as UF/IFAS. Similarly, it is also very important to note that the IFAS laboratory does not offer any test for N since there is no reliable test for plant available N under Florida conditions. N recommendations are based on crop nutrient requirements found in the research literature. More information regarding the procedures used at the IFAS Extension Soil Testing Laboratory in Gainesville can be found in the extension publication, Circular 1248.

Interpretation of Test Results: The primary goal of state laboratories in offering the soil testing service is to provide interpretation of the soil test results based on soil test-crop response trials and field calibration of the test results with the optimum economic yields of the various plant species. Economic yield increases resulting from added nutrients cannot be obtained once the test results are interpreted as 'High' resulting in no recommendation for that particular nutrient. The interpretations provided are specific to the soil and plant species.

Current interpretation tables can be obtained from SL 189 - IFAS extension fact sheet.

Tissue Testing

Tissue testing is the analysis and diagnosis of the plant's nutritional status based on its chemical composition. It is commonly performed as analyses on dried blades, leaves or dried *petioles* or on sap from fresh petioles, with results compared to recommended nutrient ranges.

Efficient fertilizer management is important to reduce costs, conserve natural resources, and to minimize potential impacts on the environment. These goals can be achieved through optimum management of the fertilizer component. Timely tissue testing is an important tool used in fertilizer management through monitoring the plant's nutritional status, and such testing is also used in diagnosing suspected problems like nutritional deficiency, toxicity or imbalance. As a management tool, tissue testing can increase a rancher's return by preventing deficiencies that can reduce yield(s), market quality, and profitability.

Methodology: Begin sampling soon after the crop is established and continue at regular intervals (weekly or biweekly). Individual plants, even side-by-side, may have different nutritional status.

Therefore, by sampling a sufficiently large number of plants, the effect of this error due to inherent variability should be minimized. It is preferable to include a soil sample together with a tissue sample when submitting samples to a diagnostic lab, since the soil sample may indicate other factors - such as pH - that may influence crop growth, nutrient availability, and uptake. Avoid plant tissue testing if the field has received foliar nutrient sprays containing micronutrients or nutrient-containing pesticides. Also, avoid sampling plants damaged by pests, diseases, or other chemicals when trying to monitor the nutritional status of the sod.

Whole-leaf sampling will be most useful early in the season, while later in the season, it can help to point to changes in fertilization practices that are needed for the next season. Fresh petiole sap testing for N and K, practiced regularly throughout the season, can help manage the current crop as well as provide guidance for the next crop. Sample a recently matured leaf blade. Collect enough leaf material so that the sample is representative of the crop stand, and that the sample is large enough to perform the required analyses.

If a deficiency is suspected, collect one *composite sample* from the area exhibiting the disorder and a second sample from an otherwise "normal" section for comparison when trying to diagnose a nutrient deficiency. Separate and properly label the "disorder" sample and the "normal" sample in order to make a valid comparison after analyses. Keep notes on condition of the sod and stage of growth, weather, and other variables for future reference.

Be careful not to crush or damage samples during cleansing. Avoid using tap water to rinse blade samples, since it can be high in nutrients such as calcium, iron, magnesium, or sulfate sulfur. Use distilled water instead. In most situations, cleansing is not needed. Blot the samples dry with absorbent paper after rinsing, and air-dry the samples several hours before shipment. Wrap the samples in absorbent paper and place them in a large envelope if a plant analysis kit is not available, and mail immediately.

Select a reputable laboratory that provides interpretations and recommendations based upon test results appropriate for your growing region. Interpretation guidelines should be based on actual field research, not on "typically observed" or historical lab databases. The laboratory should be reliable and certified and also offer a routine turnaround of less than 48 hours.

For more information please see SL 131, Plant Tissue Information Sheet, Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Last revised July 2005. http://edis.ifas.ufl.edu/SS182.

References:

Sartain, J.B. 2001. Soil Testing and Interpretation for Florida Turfgrasses. SL181. Soil and Water Science, Cooperative Extension Service. IFAS, p. 2. http://edis.ifas.ufl.edu/SS317.

Mylavarapu, R.S. and E.D. Kennelley. 2002. UF/IFAS Extension Soil Testing Laboratory Analytical Procedures and Training Manual. Soil and Water Science, Circular 1248, Cooperative Extension Service, IFAS, http://edis.ifas.ufl.edu/SS312.

Mylavarapu, R.S. 2002. The Process of Standardized Nutrient Recommendation Development for Successful Crop Production and Environmental Protection. SL 189, Soil and Water Science, Cooperative Extension Service, IFAS. http://edis.ifas.ufl.edu/SS401.

IFAS Analytical Services Laboratories
Extension Soil Testing Laboratory

PO Box 110740 / Wallace Building 631, UF / Gainesville, FL 32611-0740
EMAIL: SOILSLAB@IFAS.UFL.EDU WEBSITE: SOILSLAB.IFAS.UFL.EDU

Producer Bahia Test Information Sheet

Note: This Lab only tests samples from the State of Florida.

Mailing Address (please print)

Name _____ **Phone** _____

Address _____

City _____ **FL** **Zip** _____

Date _____ **E-Mail *** _____

*** In order to expedite reporting of results; please provide an e-mail address if possible.**

- **This form can be downloaded from our website.**
- **Detailed information on this test can be obtained from SL129 accessed at edis.ifas.ufl.edu**
- **For further information contact your local county Extension Agent**

Fill in all requested information, using one line per sample and additional sheets for more than 5 samples.

Lab Use only	County	Test(s) Requested (see Page 2 or back)	Acreage	Sample ID For Soil	Sample ID For Leaf Tissue	Cost

Check _____ **Money Order** _____ **Cash** _____ **Total** _____

Important Information for Soil Sample Collection and Submission

Before Sampling:

1. Develop a soil sampling plan of your field. Samples should represent the area being tested, so collect samples from areas that are of the same soil type, appearance, or cropping history. Sample problem areas separately, if needed. From this plan, count the number of samples you will collect.
2. Soil sample bags, addressed shipping boxes, and information sheets are available free from your county Cooperative Extension office. Obtain the materials you need to complete your sampling plan.

Collecting Samples:

1. Collect soil from 20 or more spots within each area, mixing these samples in a clean plastic bucket.
2. Sample from soil surface to depth of tillage, usually 0 to 6 inches. For pastures, sample from 0 to 4 inch depth.
3. Spread the composited material on clean paper or other suitable material to air dry. Do not send wet samples.
4. Mix the dry soil, and place about one pint of soil in a labeled sample bag.

Sending samples to the Extension Soil Testing Laboratory:

1. Enter each sample's identification on its sample bag and in the Soil Sample Identification column. List each sample separately.
2. Lime and fertilizer recommendations are provided only if the crop code(s) is listed.
3. Include the analysis code for each desired test.
4. Enter costs from the Analysis Cost list found on page 2 of this form.
5. Sum the costs of all samples and analyses. Make check or money order payable to: **University of Florida**.
6. Include the completed Producer Bahia Test Information Sheet and the check or money order in the shipping box with the sample(s).

Test results:

A soil test report will be emailed / mailed to you within 5 to 10 days after your sample arrives at the Extension Soil Testing Laboratory. Contact your county Extension office if you have questions concerning the Bahia Test Report.

Revised February 2009

How To Take, Prepare, and Submit Plant Tissue Samples (for Analysis B1)

1. Ensure that each sample contains at least a generous handful of plant material (around half a gallon).
2. Do not sample leaves contaminated with soil or sprays. If all tissue is dusty or spray contaminated, wash leaves gently with flowing distilled water.
3. Do not sample disease-, insect-, or mechanically damaged plant tissue.
4. Place tissue samples directly into a clean paper or cloth bag or envelope. Do not use plastic containers. If the plant tissue is wet or succulent, allow plant material to air dry for at least one day, before mailing.
5. When sampling suspected nutrient-deficient plants, two samples are recommended; one sample from normal plants, and another sample from abnormal plants.
6. When sampling, the plant part and plant maturity are important factors. Be sure to collect the proper plant part at the recommended time. A general rule of thumb is to sample the youngest, fully mature leaves during the growth cycle, or just prior to fruit set.
7. Please do not provide any roots along with the sample.

Important Information

There are three types of tests available for Bahiagrass pastures in Florida (see Table below for details)

Phosphorus Testing and Recommendation for Bahiagrass

- Soil tests alone are not adequate for determining P fertilization needs of Bahiagrass.
- A tissue and soil test must be submitted together to determine P fertilization needs.
- Phosphorus should not be applied if tissue P is at or above 0.15% even if soil tests Very Low or Low for P.
- If P recommendations are not desired and the producer only is interested in K, Mg, Ca levels and pH then a Standard Producer Soil Test will apply. This WILL NOT include P fertilizer recommendations.

Analysis Test Code	Analysis Name	Determinations Made	Analysis Cost
B1	Standard Soil and Tissue Test	pH, lime requirement, P, K, Ca, Mg	$15.00
1	Standard Soil Test	pH, lime requirement, K, Ca, Mg and P test value only	$7.00
2	pH and Lime Requirement	pH and lime requirement	$3.00
3	Micronutrient Test	Cu, Mn, Zn	$5.00

APPENDIX 7. INCENTIVE PROGRAMS FOR QUALIFYING FARMS

The implementation of Best Management Practices can reduce non-point sources of pollution, conserve valuable soil and water resources, and improve water quality. The implementation of these management practices can also be expensive and, in some cases, may not be economically feasible for agricultural producers. To reduce the financial burden associated with the implementation of selected practices, several voluntary cost-share programs have been established. These programs are designed to conserve soil and water resources and improve water quality in receiving watercourses. The narrative below is intended to provide basic information regarding the primary federal, state, and regional cost-share programs. Sources of additional information have also been included, and ranchers are encouraged to contact the identified agencies or organizations for current information about each program.

I. Programs Administered by USDA - Farm Services Agency (FSA):

Conservation Reserve Program (CRP): This program encourages farmers to convert highly erodible cropland or other environmentally sensitive lands to vegetative cover including grasses and/or trees. This land use conversion is designed to improve sediment control and provide additional wildlife habitat. Program participants receive annual rental payments for the term of the contract in addition to cost share payments for the establishment of vegetative cover. CRP generally applies to highly erodible lands and is more applicable to North Florida.

Conservation Reserve Enhancement Program (CREP): CREP uses a combination of federal and state resources to address agricultural resource problems in specific geographic regions. This program (which is not limited to highly erodible lands) is designed to improve water quality, minimize erosion, and improve wildlife habitat in geographic regions that have been adversely impacted by agricultural activities.

Emergency Conservation Program (ECP): The ECP provides financial assistance to farmers and ranchers for the restoration of farmlands on which normal farming operations have been impeded by natural disasters. More specifically, ECP funds are available for restoring permanent fences, terraces, diversions, irrigation systems, and other conservation installations. The program also provides funds for emergency water conservation measures during periods of severe drought.

For further information on CRP and CREP, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at www.fsa.usda.gov.

II. Programs Administered by USDA - NRCS:

Environmental Quality Incentives Program (EQIP): EQIP provides financial assistance for the implementation of selected management practices. Eligibility for the program requires that the farm have a USDA-NRCS approved Conservation Plan. Practices eligible for EQIP cost share are designed to improve and maintain the health of natural resources and include cross-fences, water control structures, brush management, prescribed burning, prescribed grazing, nutrient management and other erosion control measures.

Conservation Security Program (CSP): CSP is a voluntary conservation program that supports ongoing stewardship on private lands. It rewards farmers and ranchers who are meeting the highest standards of conservation and environmental management. Its mission is to promote the conservation and improvement of soil, water, air, energy, plant and animal life.

Wetlands Reserve Program (WRP): WRP is a voluntary program designed to restore wetlands. Program participants can establish easements (30-year or perpetual) or enter into restoration cost-share agreements. In exchange for establishing a permanent easement, the landowner usually receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. Under the 30-year easement, land and restoration payments are generally reduced to 75 percent of the perpetual easement amounts. In exchange for the payments received, landowners agree to land use limitations and agree to provide wetland restoration and protection.

Wildlife Habit Incentives Program (WHIP): The Wildlife Habitat Incentives Program provides financial incentives for the development of fish and wildlife habitat on private lands. Program eligibility requires that landowners develop and implement

a Wildlife Habitat Development Plan. Participants enter multiyear (5 to10 year) agreements with USDA-NRCS.

For further information on these programs, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at the following web site: www.nrcs.usda.gov

III. Programs Administered by State and Regional Entities:

Soil and Water Conservation Districts: In order to assist agricultural producers in the implementation of BMPs, the Florida Department of Agriculture and Consumer Services has executed a number of cost-share contracts with several of the state's Soil and Water Conservation Districts and Resource Conservation and Development Councils, Inc. Many of these cost-share contractors administer cost-share programs using *Applicant's Handbooks* which include reimbursement rates and rancher selection criteria.

Water Management District Cost Share Memoranda: The Department of Agriculture and Consumer Services has executed Memoranda of Agreement (MOA) with certain Water Management Districts to provide coordination for BMP cost-share programs. Each MOA will identify the primary program areas within the District's geographical boundaries, and designates the agency responsible for program administration.

For further information on these programs, including eligibility criteria, please contact your regional Water Management District, local Soil and Water Conservation District or the Florida Department of Agriculture and Consumer Services. Information and links to other sites are also available on the Internet at the following web site: www.floridaagwaterpolicy.com

APPENDIX 8. EXAMPLE RECORD KEEPING FORMS

Ranchers are required to keep accurate records to document BMP implementation. Record keeping also aids ranchers in operating and maintaining BMPs, and is required for the following BMP Groups:

1.1 **Fertilizer Management** - Maintain records of fertilizer application. Records should include soil test analysis, date of application, fertilizer formulation, application rate, location and acreage, and worksheet results

3.1 **Prescribed Grazing** - Maintain grazing records by pasture, and develop a contingency plan for floods and droughts in order to adjust the required grazing demands.

3.2 **Comprehensive Prescribed Grazing** - Keep records on stocking numbers, grazing days, and length of rest periods for each pasture or field.

5.2 **Ditch Construction and Maintenance** - Keep records of all ditch maintenance activities, and keep any records that relate to ditch design cross-sectional area.

10.2 **Well Construction and Operation** - Maintain records of new well construction or modifications to existing wells. Proper records are important for future reference, in case problems arise with the well.

The tables below correspond to of all the record-keeping requirements contained in this manual. They serve as a set of templates to develop your own record-keeping system. You may maintain your records as hard copies or in an electronic format, depending on your preference. You may use these tables, develop your own, or choose commercially available record-keeping software suited to your commodity.

Soil Sample Records				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Tissue Sample Records				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Fertilization/Nutrient Records						
Date	Location	Acreage Covered	Type[1]	Formulation[2]	Analysis[3]	Rate (Lbs/Acre)

Rainfall (in.)											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.

Well Records					
Location	Year Constructed	Constructed By	Last Modified	Modified By	Records Location

Ditch/Waterway Records				
Location	Design Cross-Section[4]	Current Cross-Section[1]	Date of Last Cross-Section Inspection	Records Location

Grazing Rotations					
Pasture Location	Pasture Size	Stocking Rate (Head/Acre)	Forage Type	# of Days Grazed	Date Last Grazed

[1] Organic, Inorganic, Chemical [2] Granular, Water Soluble, etc. [3] e.g. 10-10-10 [4] Ditch Invert and side slopes

APPENDIX 9. EMPLOYEE TRAINING POINTS

Good Housekeeping and Pollution Prevention

- Stress the importance of protecting water quality and the environment, as stewards of the land
- Stress the importance of ranch and facility appearance
- Have a schedule or plan for mowing or grazing grassed waterways and filter strips
- Plan for maintenance activities on access roads
- Have a schedule or plan to remove mineral or feeding areas
- Properly maintain cowpen runoff management areas
- Properly store potential pollutants in a designated area
- Secondary containment for above ground storage tanks (fuel, oil, etc.)
- Discuss proper storage, use and disposal of solvents and degreasers, as well as paints, used oil, anti-freeze and batteries
- Discuss ways to handle potential pollutants to reduce the chance of a spill

Animal Mortality Management

- Movement of dead animals away from waterbodies
- Proper disposal methods for your operation
- Reduction of third party inquiries due to improper management

Nutrient Management and Spreading

- Proper forage tissue and soil analysis (apply only what the plant needs)
- Discuss timing of fertilizer application
- Discuss locations to avoid when spreading fertilizer materials
- Discuss proper storage, loading and calibration of equipment

Proper Operation and Maintenance of Facilities

- Inform employees about filter strips, grassed waterways, and waste storage ponds
- Discuss the preventive maintenance schedule for all control facilities (dams, dike, terraces, diversions, berms)
- Discuss facility inspections
- Discuss proper procedures for reporting and repairing problems with control facilities
- Record rainfall using rain gauges
- Have a measuring device in retention ponds
- Have a wastewater discharge plan

Documentation and Records Retention

- Stress importance of record keeping
- Have a schedule for retaining records
- List activities and events that should be documented

  For example:
  - ➢ Fertilizer rate/location/date
  - ➢ Irrigation amounts applied and rainfall
  - ➢ Well construction
  - ➢ Pesticide spraying
  - ➢ Hazardous waste disposal
  - ➢ Ditch maintenance activities
  - ➢ Grazing days and rest periods

EMPLOYEE TRAINING RECORD

Date: _____

Topic(s) Discussed:

_____

_____

_____

_____

_____

Employee(s)	Present Responsibility
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Trainer: _____

Signature: _____

APPENDIX 10. GUIDANCE FOR STORMWATER MANAGEMENT

- Contact your local NRCS District Conservationist to obtain information about the soil types for the proposed location. The District Conservationist can identify soil types that are historically prone to flooding or standing water. Evaluate the storage capacity, size, and elevations of existing ditches, ponds, creeks, rivers, and wetlands, and the size, layout, and elevations of the fields. You should also contact your county or water management district to obtain maps (FEMA, FIRM) or other information related to flooding issues at the proposed or existing location. You can access this information via the web at http://www.fema.gov/hazard/map/firm.shtm.
- Determine the maximum storm size for which you want to provide flood protection. The flood control design storm addressed by WMD ERP regulations varies from a 25-year, 24-hour storm to a 100-year, 3-day storm. For example, a 25-year, 24-hour storm produces from 8 to 10 inches of rainfall in a 24-hour period. Generally, the larger the design storm event used, the more extensive the stormwater management system needs to be. Factors that will affect this decision include land availability, the existence of internal natural features such as creeks, rivers, ponds, or wetlands, the potential to flood downstream property owners, and costs.
- Consult with a public or private agricultural engineer to discuss your stormwater management needs and considerations, especially if you are farming on poorly drained lands. Find an engineer qualified to provide an appropriate stormwater runoff analysis for your site.
- Include both nonstructural pollution prevention BMPs and structural BMPs, as needed and feasible to meet desired stormwater management objectives. If structural BMPs are needed, determine what is appropriate for your farm characteristics and stormwater management objectives. Each of the WMD ERP regulations and handbooks include specific design guidelines for various structural stormwater BMPs. The construction of a stormwater management system (e.g., retention or detention pond) may require an ERP or other WMD surface water management permit. Therefore, please check with your water management district before beginning construction of any stormwater management system. Typical structural BMPs include:
  - Retention basins that capture stormwater and allow it to percolate into the soil, evaporate, or transpire. These infiltration BMPs are used in areas with sandy soils and a wet-season water table that is at least two feet beneath the bottom of the retention basin. Special designs are needed in Karst areas or springsheds to minimize movement of pollutants, especially nutrients, into the ground water.
  - Wet detention ponds that capture stormwater, detain it, and slowly release the runoff to downstream waters or stormwater systems. Wet ponds are used in areas with a high water table.
  - Grassed waterways used to convey stormwater to structural BMPs. Grassed waterways also help filter runoff and, in many cases, allow stormwater to infiltrate.
  - Typical nonstructural BMPs include field buffers, riparian buffers, nutrient management, minimizing soil compaction and impervious areas.

APPENDIX 11

Notice of Intent and BMP Checklist

ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

FDACS- OAWP
1203 Governor's Sq. Blvd.
Suite 200
Tallahassee. FL 32301

NOTICE OF INTENT TO IMPLEMENT
WATER QUALITY BMPs FOR FLORIDA COW/CALF OPERATIONS (2008)

Rule 5M-11.004, F.A.C.

- **Complete all sections of the Notice of Intent** (NOI). Each NOI may list only properties that are within the same county and are owned or leased by the same person or entity, and on which applicable BMPs will be identified and implemented under this manual.
- Submit the **NOI**, along with the **BMP Checklist**, to the Florida Department of Agriculture and Consumer Services (FDACS), at the address below.
- **Keep a copy of the NOI and the BMP checklist in your files** as part of your BMP record keeping.

You can visit http://www.freshfromflorida.com/onestop/forms/01520.pdf to obtain an electronic version of this Notice of Intent to Implement (NOI) form.

If you would like assistance in completing this NOI form or the BMP Checklist, or with implementing BMPs, contact FDACS staff at (850) 617-1727 or AgBmpHelp@freshfromflorida.com.

Mail this completed form and the BMP Checklist to: **FDACS Office of Agricultural Water Policy**
1203 Governor's Square Boulevard, Suite 200
Tallahassee, Florida 32301

Person To Contact

Name: _____

Business Relationship to Landowner/Leaseholder: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

☐ **Landowner or** ☐ **Leaseholder Information** *(check all that apply)*

NOTE: If the Landowner/Leaseholder information is the same as the Contact Information listed above, please check: ☐ **Same as above**. If not, complete the information below.

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

Complete the following information for the property on which BMPs will be implemented under this NOI. You may list multiple parcels if they are located within the same county and are owned or leased by the same person or entity.

Operation Name: _____

County: _____

Tax Parcel Identification Number(s) from County Property Appraiser

Please submit a copy of your county tax bill(s) for all enrolled property, with owner name, address, and the tax parcel ID number(s) clearly visible. **If you cannot provide a copy of the tax bill(s), please write the parcel owner's name and tax parcel ID number(s) below in the format the county uses**. Attach a separate sheet if necessary *(see form provided)*.

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

☐ Additional parcels are listed on separate sheet. *(check if applicable)*

Total # of acres of all parcels listed *(as shown property tax records)*: _____

Total # of acres on which BMPs will be implemented under this NOI: _____

In accordance with section 403.067(7)(c)2, Florida Statutes, I submit the foregoing information and the BMP Checklist as proof of my intent to implement the BMPs applicable to the parcel(s) enrolled under this Notice of Intent.

Print Name: _____

(check all that apply) ☐ **Landowner** ☐ **Leaseholder** ☐ **Authorized Agent** *(see below)**

*Relationship to Landowner or Leaseholder: _____

Signature: _____ Date: _____

Name of Staff Assisting with NOI:

NOTES:

1. You must keep records of BMP implementation, as specified in the BMP manual. All BMP records are subject to inspection.
2. You must notify FDACS if there is a full or partial change in ownership with regard to the parcel(s) enrolled under this NOI.
3. Please remember that it is your responsibility to stay current with future updates of this manual. Visit the following website periodically to check for manual updates: www.floridaagwaterpolicy.com

Additional Tax Parcel Listings

Operation Name: _____

County: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

FLORIDA COW/CALF WATER QUALITY BMP CHECKLIST

Checklist Instructions:

Note: Before you fill out this checklist, follow the section on BMP Enrollment and Implementation, which begins on page 3 of this manual. You must read the BMPs in Sections 1.0 - 13.0 before filling out the checklist, in order to know what the practices entail. The checklist summaries are for identification purposes only.

1. Check "In Use" for each BMP that you are currently practicing and will continue to practice. If you have a Conservation Plan, enter the FOTG code number in the "In Use" column for all currently implemented practices contained in the plan that are covered in the checklist, and place a check mark in the column for currently implemented practices not contained in the plan.

2. For the applicable BMPs you do not implement currently but will implement, enter the month and year you plan to implement them in the "Planned" column. Where relevant, enter the FOTG code number and month/year of planned implementation in the "Planned" column. Schedule BMPs to be implemented as soon as practicable. FDACS rule requires that applicable Level I BMPs in the manual be implemented as soon as practicable, but not later than 18 months after submittal of the Notice of Intent (NOI) to Implement. This timeline applies to all practices in a Conservation Plan that are identified under the Level I BMPs in the checklist. If you need additional time to implement the following Level I BMPs, you must justify the time needed in the space provided at the end of the checklist: 2.2 Upland Pond Construction Criteria; 2.3 Other Watering Sources; 5.3 Installation of Water Control Structures; 6.3 Riparian Buffer.

3. If you have a Conservation Plan, make sure you identify in the checklist all applicable BMPs that are in the plan and those that are not in the plan. If the plan contains practices that are not covered in the BMP checklist, list the FOTG code number and the names of those practices in the space provided at the end of the checklist.

4. For BMPs you will not implement, check all of the following that apply under "Will Not Implement":
- NA = Not Applicable (you do not have a resource concern that requires use of the BMP)
- TNF = Technically Not Feasible
- ENF = Economically Not Feasible
- Other – If you select "Other," please explain your reason in the comments section at the end of the form.

5. Make sure you are aware of and follow the record-keeping requirements. BMP groups that include record keeping are marked by the following pencil icon: 

6. Mail this BMP checklist with your NOI form to FDACS, and keep a copy of both documents in your files. If you have developed a Conservation Plan, submit a copy of the plan along with the NOI and checklist.

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement *(check reason below)*			
		Check below/ Enter FOTG #	**Enter month/ year**	**NA**	**TNF**	**ENF**	**Other**
1.0 Nutrient Management							
1.1.	**Level I - Fertilizer Management** 						
1.	Use Mehlich-1 soil test results or equivalent to determine P application rate						
2.	Determine supplemental fertilizer needs using appendix 5 worksheet						
3.	Use IFAS publication SL-129 to determine fertilization rates						
4.	Time fertilizer applications for maximum nutrient uptake						
5.	Prevent spreading fertilizer material within 50′ of streams, sinkholes, or wetlands						

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement (check reason below)			
		Check below/ Enter FOTG #	Enter month/ year	NA	TNF	ENF	Other
1.2. Level I - Residuals or Biosolids Application							
1.	Follow FDEP/FDOH regulations for residuals/septage application						
2.	Request the Calcium Carbonate Equivalency and nutrient analysis of treated biosolids						
3.	Obtain copy of FDEP "Agricultural Use Plan"						
1.3. Level I - Animal Nutrition and Feedstock							
1.	Manage supplemental feed to avoid high nutrient loads						
2.	Locate confined feeding areas away from sensitive features						
3.	Locate mineral and supplemental feed 100' from sensitive features						
1.4. Level I - Animal Waste Management							
1.	Manage livestock distribution to reduce waste accumulation						
2.	Use concentrated on-site manure sources for fertilizer						
2.0 Alternative Cattle Water Sources							
2.1. Level I - Water Needs Inventory							
1.	Inventory existing water sources and compare to livestock demand						
2.	Review water management district records on regional well water quality data						
2.2. Level I - Upland Pond Construction Criteria							
1.	Construct ponds less than 2 acres and locate at least 50' from wetlands, or further based on water management district requirements						
2.	Construct cattle access areas with minimum 3:1 slope						
2.3. Level I - Other Watering Sources							
1.	Locate troughs/shade to keep cattle from streams or watercourses						
2.	Construct troughs/tanks with stable base						
3.	Extend pipe at least 100' from waterbody						
3.0 Prescribed Grazing							
3.1. Level I - Prescribed grazing guidelines 							
1.	Manage forages/pastures to promote plant vigor, prevent erosion and maintain soil moisture						
2.	Use rotational grazing or other measures for regrowth						
3.	Manage wetlands through flash grazing or exclusion						
3.2. Level II - Comprehensive Prescribed Grazing 							
1.	Develop grazing schedules based on NRCS Code 528						
2.	Incorporate cross-fencing in larger pastures						

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement *(check reason below)*			
		Check below/ Enter FOTG #	Enter month/ year	NA	TNF	ENF	Other
4.0 Sediment and Erosion Control Measures							
4.1.	**Level I - General Erosion and Sediment Control Measures**						
1.	Minimize vegetation clearing during construction						
2.	Clear land during dry season						
3.	Vegetate road banks and disturbed areas within 14 days of construction						
4.	Use rock crossings for low flow streams						
5.	Manage livestock to prevent erosive trails						
4.2.	**Level I - Silt Fences**						
1.	Use silt screens (less than 3 months) for sheet flow						
4.3.	**Level II - Check Dams**						
1.	Install check dams perpendicular to flow						
4.4.	**Level II - Sediment Traps**						
1.	Install sediment traps within conveyance system or near cowpens						
2.	Retrofit associated sediment trap structures with flashboard risers						
4.5.	**Level III - Grade Stabilization Structures**						
1.	Clear construction area of debris						
2.	Vegetate disturbed areas within 14 days of construction						
3.	Fence around structure to exclude livestock						
4.	Install structures during the dry season						
5.	Follow criteria for fill placement and spreading per this BMP						
6.	Prevent damage from overtopping the structure, and divert excess flows						
7.	Follow earth embankment side slope specifications per this BMP						
8.	Obtain technical assistance as needed						
5.0 Water Resources Management							
5.1.	**Level I - Water Supply**						
1.	Know quantity/quality of irrigation source						
2.	Determine water requirements for forage grasses						
5.2.	**Level I - Ditch Construction and Maintenance** 						
1.	Follow appropriate grades and plans during ditch excavation						
2.	Use appropriate setbacks to avoid hydraulic drawdown impacts to wetlands						
3.	Use structural control measures in areas with high water velocity						
4.	Control broadleafs to maintain permanent vegetative cover						
5.	Remove unconsolidated sediments from ditches						

BMP #	BMP Group (See body of manual for full description)	In Use/CP# Check below/ Enter FOTG #	Planned Enter month/ year	Will not implement (check reason below) NA	TNF	ENF	Other
5.3.	**Level I - Installation of Water Control Structures**						
1.	If economically feasible, install water control structures to rehydrate wetlands that have offsite flows						
2.	Maintain boards in all structures to reduce discharge volume						
5.4.	**Level I - Grassed Waterways**						
1.	Install grassed waterways per USDA-NRCS specifications						
6.0	**Conservation Buffers**						
6.1.	**Level I - Field Borders**						
1.	Install and maintain field borders at perimeter on new improved pastures						
2.	Time planting borders for plant survival and consider using native species						
6.2.	**Level I - Filter Strips**						
1.	Install filter strip to treat runoff from concentrated livestock areas						
2.	Follow filter strip construction criteria in this BMP						
6.3.	**Level I - Riparian Buffers**						
1.	Install and maintain riparian buffer if > 1% slope, and follow NRCS criteria						
7.0	**Fence Installation**						
7.1.	**Level I - General Fence Installation**						
1.	Minimize soil and vegetative disturbances while clearing land						
2.	Select materials based on purpose and site conditions						
3.	Adjust stocking rates or subdivide larger pastures						
4.	Stabilize streambanks and provide alternative water sources in improved pastures, or install exclusion fencing						
5.	Provide riparian buffer in native or semi-improved pastures that runoff to perennial streams						
7.2.	**Level I - Fence Installation in Wetlands**						
1.	Minimize use of mechanical equipment, and limit clearing to 12′ on either side of fence						
2.	Perform work during the dry season						
7.3.	**Level II - Livestock Use Exclusion**						
1.	In area regulated by water management district, install exclusion fencing 300′ from discharge point						
2.	In area not regulated by water management district, install exclusion fencing 500′ from discharge point						
3.	Install exclusion fencing adjacent to perennial streams where significant erosion occurs						

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement *(check reason below)*			
		Check below/ Enter FOTG #	**Enter month/ year**	**NA**	**TNF**	**ENF**	**Other**
8.0 High-Intensity Areas							
8.1.	**Level I - High-Intensity Area Management**						
1.	Locate new cowpens 200′ from sensitive features; use berm						
2.	Direct runoff from high-intensity areas away from sensitive features						
8.2.	**Level II - Design Retrofits**						
1.	Use aggregate materials to prevent erosion						
2.	Treat discharges occurring into sensitive features						
9.0 Animal Mortality							
9.1.	**Level I - Sanitation and Disease Control Measures**						
1.	Transport carcasses in a sanitary manner						
2.	Clean equipment that comes into contact with carcasses						
3.	Report dangerous diseases to the state veterinarian (refer to list in this BMP)						
9.2.	**Level I - Disposal**						
1.	Move carcasses to upland areas						
2.	Locate burial sites at least 200′ from sensitive features and 50′ from adjacent property						
9.3.	**Level I - Rendering and Incineration**						
1.	Use a licensed rendering/incinerating facility						
10.0 Wellhead Protection for Drinking Water Wells							
10.1.	**Level I - Well Planning and Protection**						
1.	Construct new wells upgradient from likely pollutant sources						
2.	Research well permit requirements						
3.	Cap or valve free-flowing wells						
4.	Keep livestock 75′ from potable wells						
10.2.	**Level I - Well Construction and Operation** 						
1.	Use a Florida-licensed water well contractor						
2.	Follow pad and casing specifications in this BMP						
3.	Retrofit existing wells with concrete collar and fence						
4.	Use backflow prevention devices at the wellhead						
11.0 Wetlands and Springs Protection							
11.1.	**Level I - Wetland Protection and Impact Avoidance**						
1.	Identify wetland or hydric soil types using soil survey						
2.	Eliminate or reduce adverse impacts to wetlands						
3.	Maintain a 25′ vegetative buffer from wetlands, or follow buffers prescribed in your WMD permit						
4.	Obtain a USDA-NRCS wetland determination prior to conducting activities in a wetland						

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement *(check reason below)*			
		Check below/ Enter FOTG #	Enter month/ year	NA	TNF	ENF	Other
11.2. Level I - Water Quality Treatment and Field Discharges							
1.	Use pretreatment practices to protect wetlands						
2.	Rotate livestock through wetlands at accelerated pace						
3.	Use spreader swales or other means to encourage sheetflow						
11.3. Level I - Special Criteria for First and Second Magnitude Springs							
1.	Maintain a 100' vegetative buffer around spring features						
2.	Use split applications of fertilizers on pasture areas that discharge to spring features						
12.0 Prescribed Burning							
12.1. Level I - Burn Preparation							
1.	Develop and implement a burn prescription plan, or use a Certified Prescribed Burn Manager						
2.	Obtain burn permit from DOF and heed burning bans						
3.	Use burning in conjunction with roller chopping in areas with an abundance of palmettos						
4.	Burn only when weather conditions are favorable						
12.2. Level I - Construction of Firelines							
1.	Carefully select fireline locations and avoid constructing them in wetlands						
2.	Use alternatives to plowed firelines						
3.	Construct firelines with the contour to minimize soil erosion						
12.3. Level I - Fire Safety and Control							
1.	Have adequate fire equipment and control burn temperature						
2.	Ensure fire is completely out before leaving the site						
13.0 Integrated Pest Management and Pharmaceuticals							
13.1. Level I - General IPM Practices							
1.	Store pesticides in roofed structure with lockable door, at least 100' from surface water						
2.	Use appropriate mix/load sites and measures, per this BMP						
3.	Practice IPM and use all pesticides in accordance with label						
4.	Rinse, recycle, or dispose of empty pesticide containers following all applicable regulations						
13.2. Level I - Pharmaceutical Use and Disposal							
1.	Use FDA-approved products, and mix only the amount needed						
2.	Follow label and dosing instructions						
3.	Dispose of spent needles and unused pharmaceutical products responsibly						

List additional BMPs you are implementing per your conservation plan that are not listed in the above checklist.

		In Use/CP #	Planned
FOTG #	**Practice Name/Description**	*Check Below*	*Enter mo./yr.*

BMP #	Comments: Please enter "other" reasons below for not implementing BMPs.

BMP Group	Justification for additional time to implement specified Level I BMPs
2.2	
2.3	
5.3	
6.3	

Water Quality/Quantity

Best Management Practices for Florida Sod







2008 Edition

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The Capitol
400 South Monroe Street
Tallahassee, Florida 32399-0800

Florida Department of Agriculture and Consumer Services
Commissioner Adam H. Putnam

COMMENTS BY COMMISSIONER ADAM H. PUTNAM

Dear Agricultural Producers:

This manual, *Water Quality/Quantity Best Management Practices for Florida Sod*, reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. In general, agricultural lands maintain valuable water recharge areas and preserve open spaces. The BMPs in this manual address water quality and quantity impacts from production activities and help maintain the environmental advantages of keeping the land in agriculture.

While best management practices have been in place for many years in our state, their role in environmental protection was formally established in 1999 with the passage of the Florida Watershed Restoration Act. This legislation provides the framework for implementing Florida's Total Maximum Daily Load program, which sets water quality targets for impaired waters. It also identifies best management practices implementation as the means for agriculture to help meet those targets.

As Florida's population continues to increase, there are more impacts to and competition for Florida's limited water resources. All Floridians must take part in conserving and protecting these resources. This manual represents the industry's commitment to do just that.

As a native Floridian whose family has long been involved in agriculture, I want to thank all who participated with the Department in the development of this important manual. With the active support and participation of so many dedicated people, I am optimistic about the future of Florida's agricultural industry. I trust that you will join me in supporting this valuable water resource protection effort.

Sincerely,

Adam H. Putnam
Commissioner of Agriculture

ACKNOWLEDGEMENTS

A Steering Committee was established in 2005 to guide the development of BMPs and the overall structure of this BMP manual. Additionally, a technical working group was formed to support the efforts of the Steering Committee, and this group was charged with developing and reviewing specific BMPs associated within their area of expertise. It should be noted that an effort of this magnitude could not have been accomplished without the tireless dedication of all participants. The following is a list of individuals who participated in the development of this manual. Each of these individuals and their organizations made important contributions to the process, and their work is sincerely appreciated.

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DISCLAIMER

The mention of a specific product or company is for information purposes only and does not constitute an endorsement of that product or company.

INTRODUCTION

Florida's sod growers contribute approximately $300 million to the state's economy, and can positively impact the environment as well. In fact, scientific research has documented the many benefits of modern turfgrass production to our environment. Sod farm fields and associated home lawns release oxygen to the atmosphere, help to significantly cool surrounding surface temperatures, naturally filter pollutants from runoff water, reduce soil erosion, purify and replenish our water supply, and provide other aesthetic or recreational values. The industry is proud of these attributes and remains committed to fostering water resources protection through the implementation of BMPs.

Things to keep in mind as you use this manual are:

- Italicized words that appear in red are defined in the Glossary, and specific recordkeeping requirements are noted using a "pencil mark" icon. 
- Remember to fill out the BMP Manual Registration Card inside the front cover and return it to the Florida Department of Agriculture in order to receive future updates to this manual.

General Applicability of this Manual

The practices outlined in the manual are intended to be applied statewide by sod growers, regardless of the variety or species grown. This manual does not apply to golf courses, home lawns, athletic fields, or other recreational facilities. This manual can be downloaded from the internet at: www.floridaagwaterpolicy.com.

BMP History and Purpose

With the passage of the Federal Clean Water Act (FCWA) in 1972, states were required to assess the impact of nonpoint sources of pollution on surface and ground waters, and establish programs to minimize them. Florida's Nonpoint Source Management Program was established in 1978 and has undergone numerous changes over the years. The program includes the use of structural and nonstructural BMPs to minimize nonpoint source pollution, either through traditional regulations (i.e., Environmental Resource Permits) or through other voluntary measures (i.e., implementation of BMPs).

Section 303(d) of the FCWA also requires states to identify impaired water bodies and establish total maximum daily loads (TMDLs) for pollutants entering these water bodies. TMDLs establish the maximum amount of pollutants that can be discharged to a water body and still have it meet its designated uses such as swimming, fishing, or as a potable water use. To address TMDLs, the Florida legislature passed the 1999 Florida Watershed Restoration Act (FWRA). Under the Act, once the Florida Department of Environmental Protection (FDEP) establishes a TMDL, an implementation plan may be developed that specifies the activities that watershed landowners and other stakeholders will undertake to reduce point and nonpoint source pollutant loadings. Many of Florida's 44,000 commercial farmers who produce food, fiber, and livestock on approximately 10 million acres will be required to meet specific pollutant load allocations. The FWRA gives the Florida Department of Agriculture and Consumer Services (FDACS) the authority to develop interim measures, BMPs, cost-share incentives, and other technical assistance programs to assist agriculture in reducing pollutant loads in target watersheds. The law also stipulates that the FDEP must verify that these BMPs are effective at reducing pollutant loading to waters.

BMPs are a practice or combination of practices determined by the coordinating agencies, based on research, field-testing, and expert review, to be the most effective and practicable on-location means for improving water quality. BMPs are typically implemented as a *treatment train*. This normally includes a combination of nonstructural and structural practices which have been determined to be effective for reducing or preventing pollution. BMPs must be: technically feasible, economically viable, socially acceptable, and based on sound science.

Implementation of BMPs will generally lead to:

- A better managed operation where management has an enhanced awareness of the cost and efficiency of production
- An improved public image (environmental stewardship) to capitalize on global business opportunities

Pursuant to sections 403.067(7)(c), and 570.085, F.S., implementation, in accordance with FDACS rule, of FDEP-verified and FDACS-adopted BMPs gives ranchers the following advantages:

- A presumption of compliance with state water quality standards
- A release from the provisions of s.376.307(5), F.S., for those pollutants addressed by the BMPs
- Assistance with BMP implementation

Statutorily Exempt Agricultural Activities

Under subsection 373.406(2), F.S., any person engaged in the occupation of agriculture may alter the topography of any tract of land for purposes consistent with the practice of agriculture. These activities may not be for the sole or predominant purpose of impounding or obstructing surface waters. As such, agricultural activities that meet these criteria may qualify for a statutory exemption from an Environmental Resource Permit (ERP).

Pursuant to 373.406(9), F.S., environmental restoration activities on agricultural lands that have minimal or insignificant impacts to water resources may also be exempt from an ERP, provided that written notification is received beforehand.

Even if the two exemptions above apply, these provisions do not relieve agricultural producers from implementing BMPs or conducting monitoring if they are located within a watershed with an adopted BMAP.

Also, persons engaged in the occupation of agriculture have protections under the Florida Right to Farm Act (section 823.14, F.S.). The Act states, with certain exceptions, that no farm which has been in operation for one year or more and was not a nuisance at the time of its established date of operation shall be a public or private nuisance, if the farm operation conforms to generally accepted agricultural and management practices.

BMP EVALUATION AND IMPLEMENTATION

General Information

Florida law defines a process for the development of TMDLs by FDEP for impaired waters and authorizes FDACS to identify and adopt appropriate agricultural BMPs by rule once FDEP has verified that these BMPs are effective at reducing pollutant loading. Participating growers then benefit by receiving a "presumption of compliance" with state water quality standards, and are eligible to apply for cost-share monies to implement selected BMPs.

If the proper implementation of BMPs does not meet water quality targets, then FDACS will be required to revise or develop additional BMPs over time.

BMP Identification and Selection

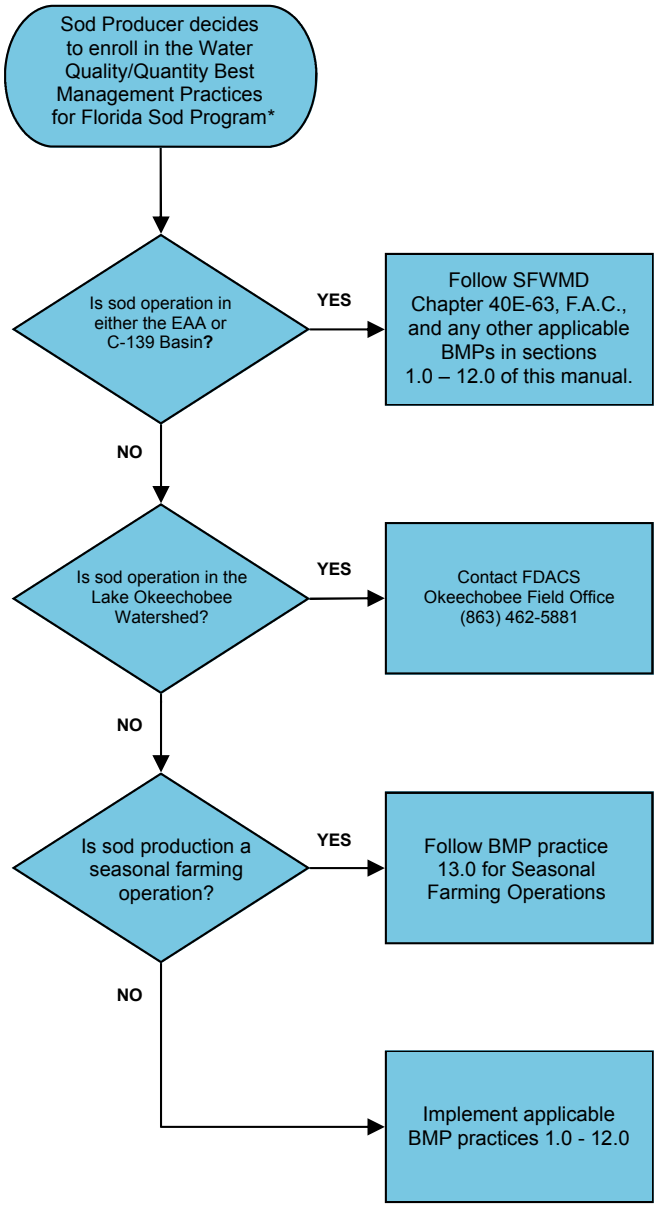
Selecting BMPs for multiple sod species in different production regions is a difficult process. In general, it involves the following steps:

1. Choose the applicable practices from the set of BMPs for sod farms and implement them within the first 12 months.
2. Use the BMP Decision-Tree which identifies additional BMP requirements for specific circumstances.
3. Request on-farm technical assistance, as needed.

Sod growers shall implement the applicable BMPs in the "Best Management Practices for Sod Farms" chapter to establish a foundation for environmental protection. The goal of the BMPs is to reduce agricultural pollutants discharged offsite and to provide an equivalent level of waste treatment applied to other facilities other than agriculture. Depending on your farm's site specific conditions or geographical location, all of the BMPs may not need to be implemented. In addition, growers must also use the **BMP Decision-Tree** to help accurately identify other BMPs that are applicable to their farming operation. This tool identifies more specific BMP requirements that may apply in certain cases. For instance, growers who are temporary or seasonal sod farming operations may have fewer BMPs; while those who farm in springs recharge basins and/or special regulatory areas (i.e., EAA), may have additional BMPs that apply. Finally, sod growers should avail themselves of **On-farm assistance** when available. This will help them identify all appropriate BMPs for implementation. FDACS Ag-Team, UF-IFAS BMP Implementation Team and/or UF-IFAS Extension staff are available to assist growers with the mechanics of BMP identification and selection.

Additional BMP Requirements

As mentioned in the preceding section, growers should use the BMP Decision-Tree to help accurately select all BMPs applicable to their farming operation. This tool is intended to be used like a standard flow chart, in that users start at the top and work their way through all "decision steps" until an endpoint is reached. The flow chart addresses special considerations that may apply to your operation. Once completed, growers should also use the Sod Production BMP Checklist which is in the appendix of this manual. This checklist will provide growers with a complete list of BMPs that will be submitted to FDACS with the Notice of Intent form mentioned below.



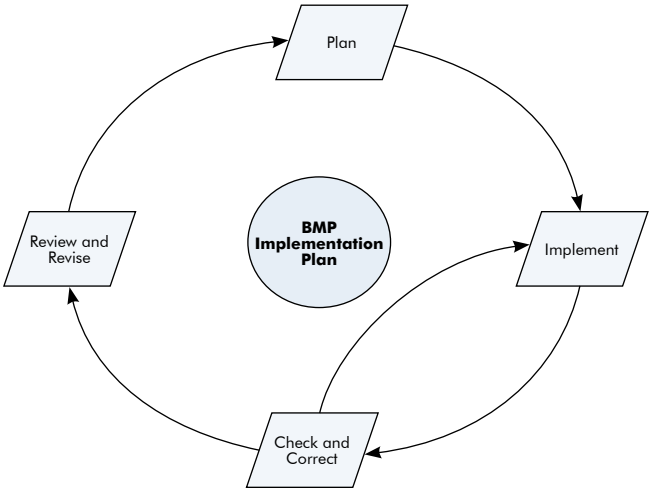
* Note: If operation is in an area where a BMAP has been adopted, producer must implement BMPs or monitor water quality. Contact FDACS Field Office for more guidance.

Required Documentation

The first key documentation item is the Notice of Intent to Implement form which contains a checklist of BMPs being or to be implemented. The form is in the appendix of this manual. Once received by FDACS, the Notice of Intent enrolls your operation in the BMP program.

BMPs generally require some level of recordkeeping. When required, growers should keep accurate written records and retain them for at least five (5) years. Fertilizer application and rainfall amounts are two examples of recordkeeping. Other recordkeeping requirements are highlighted in this manual using this figure:  . A simple recordkeeping form can be used to assist you in this endeavor. FDACS has co-located field staff positions in all five water management districts to assist growers and to verify that BMPs are being properly implemented, operated and maintained as part of a quality assurance program. A quality assurance program is very important to ensure that BMP implementation is occurring on track and that meaningful water quality improvements are being made in affected basins. It also provides overall program credibility and additional assurance that BMPs are constructed and installed as designed in accordance with the Notice of Intent submittal.

It is advisable to consolidate all of your BMP decision-making, including the BMP Checklist, into a simple implementation plan. These plans then become the basis for other important management decisions associated with BMPs, including operation and maintenance activites. A well thought-out, written plan enables managers and owners to schedule their activities and accomplish their objectives.



BMP Effectiveness Summary

The table below has been developed to give sod growers an awareness of how good a particular type of BMP is at reducing various types of pollutants from leaving their fields. This table was developed using existing literature values and agency best professional judgment in order to establish the anticipated impact on water quality and quantity. The BMPs are arranged in the order which they appear in this manual, and the primary resource protection categories are Nutrients, Erosion and Water Conservation. There is also a profitability column to give users a sense of economic effects associated with the BMP. The rating system defines practices as *high*, *medium* and *low* in terms of how effective the BMP is in reducing a potential pollutant. Profitability is either *positive* or *neutral* for all BMPs and is adapted from USDA-NRCS documents. The assumptions made as a part of this table are based on the fact that each practice is applied independently of others.

BMP Category	Resource Protection Categories			Profitability
	Nutrients	Erosion	Water Conservation	
Nutrient Management	H	L	--	Positive
Irrigation Scheduling	H	H	H	Positive
Irrigation System Maintenance & Evaluation	M	L	M	Neutral
Sediment & Erosion Control Measures	M	H	M	Positive
Integrated Pest Management	L	--	M	Positive
Well Head Protection	H	--	--	Neutral
Wetlands and Springs Protection	M	M	M	Positive
Ditch Construction & Maintenance	L	M	M	Positive
Conservation Buffers	M	H	M	Positive
Flood Protection	L	M	--	Neutral
Access Roads	--	M	--	Positive
Mowing Management	L	L	M	Neutral
Seasonal Farming	M	M	M	Positive

-- denotes little to no effect

BMP NEEDS ASSESSMENT

The following assessment questions are designed to assist growers in choosing the appropriate BMPs for implementation on their farms. The results of this assessment should be kept in mind when reading *BMPs for Sod Farms* in this manual and completing the *BMP Checklist* located in the appendix.

The questions below are arranged by BMP category. Based on your responses, if you need more information about a BMP category, please read the related text in this manual under *General Information for Environmental Protection on Sod Farms*. This text provides important background about BMPs and directs you to reference materials for more information. Additional references are contained in *BMPs for Sod Farms*, at the end of each BMP category section.

It is important to remember that agricultural BMPs evolve over time, and it is critical that growers stay current with the latest information and technology.

Instructions:

- Answer "Yes", "No" or "S/W" in the space provided after each question. S/W stands for somewhat, and should be used if you are only somewhat familiar with the content.
- As needed, read *General Information for Environmental Protection on Sod Farms*, and consult the applicable references listed there and in the relevant sections under *BMPs for Sod Farms*.
- Retain this BMP Needs Assessment for your use – You do not need to submit it with the Notice of Intent to Implement that you submit to enroll your farm with FDACS.

1.0 NUTRIENT MANAGEMENT

(Y) (N) (S/W) Are you familiar with the relationship between soil type and water quality?

(Y) (N) (S/W) Have you conducted a soil survey to determine your soil type(s) and identify the environmentally sensitive areas on your farm?

(Y) (N) (S/W) Are you familiar with the procedures and benefits of soil and tissue testing and how to use the results?

(Y) (N) (S/W) Are you aware of the effects of pH on the availability of nutrients?

(Y) (N) (S/W) Are you familiar with IFAS recommended crop nutrition requirements for N and P and other essential nutrients?

(Y) (N) (S/W) Do you manage nutrients carefully in coarse, sandy soils and address the special needs of managing P on *uncoated sands*?

(Y) (N) (S/W) Are you familiar with the benefits of splitting soluble fertilizer applications or using controlled release fertilizers during field establishment or in sensitive areas?

(Y) (N) (S/W) Have you considered the effects of heavy rains after making soluble fertilizer applications? Are you familiar with the guidelines for supplemental applications after leaching rains?

(Y) (N) (S/W) Are you familiar with the use of fertigation and when it should be used?

(Y) (N) (S/W) If reclaimed water, manure, or biosolids are used on your operation do you adjust your fertilizer applications accordingly?

2.0 IRRIGATION SCHEDULING

(Y) (N) (S/W) Have you determined your field's available soil moisture content and how to maintain the field within the recommended range?

(Y) (N) (S/W) Do you understand how soil moisture devices are used, tested, and calibrated?

(Y) (N) (S/W) Are you familiar with how to calculate your rainfall contribution and use evapotranspiration levels to guide irrigation decisions?

(Y) (N) (S/W) Do you use water meters or other methods to determine how much irrigation is being applied during applications?

(Y) (N) (S/W) Are you aware of the importance of not exceeding the amount of irrigation that can be stored in the root zone?

(Y) (N) (S/W) Are you familiar with methods to minimize irrigation losses, such as irrigating in the morning, afternoon, or when cloud cover is abundant and wind speed is minimal?

(Y) (N) (S/W) Do you take into consideration how the maturity level of the sod affects irrigation needs?

3.0 IRRIGATION SYSTEM MAINTENANCE AND EVALUATION

(Y) (N) (S/W) Are you familiar with the procedures for testing your irrigation system for maximum efficiency?

(Y) (N) (S/W) Do you understand the importance of maintaining irrigation uniformity throughout the field?

(Y) (N) (S/W) Are you familiar with preventative maintenance procedures and how to develop a preventative maintenance plan for your irrigation system, including periodic inspection and replacement of broken sprinkler nozzles?

(Y) (N) (S/W) Have you considered sampling your irrigation water quality annually?

(Y) (N) (S/W) Do you understand the importance of water control structures, maintaining the land level, and keeping ditches and canals free of debris and vegetation?

4.0 SEDIMENT AND EROSION CONTROL MEASURES

(Y) (N) (S/W) Are you planning to convert native lands to new sod fields, or construct new canals or ditches?

(Y) (N) (S/W) Have silt screens been constructed to standards referenced in the Florida Stormwater, Erosion, and Sediment Control Inspector's Manual?

(Y) (N) (S/W) Have you considered using filter strips and/or flashboard water control structures to aid in the reduction of erosion?

(Y) (N) (S/W) Are erosion problems severe enough to warrant the installation of sediment traps, sediment basins, or the use of chemical soil amendments?

5.0 INTEGRATED PEST MANAGEMENT

(Y) (N) (S/W) Have your key pests been identified by qualified scouts?

(Y) (N) (S/W) Do you know what preventative practices to use and when to minimize pest re-emergence?

(Y) (N) (S/W) Do you understand the benefits of using lower toxicity chemicals and periodically switching pesticide products to delay pest resistance problems?

(Y) (N) (S/W) Have you considered using portable mix-load stations throughout the field to reduce potential contamination?

(Y) (N) (S/W) Are all empty pesticide containers rinsed and disposed of properly?

6.0 WELLHEAD PROTECTION

(Y) (N) (S/W) Have you properly inventoried all existing water wells and assessed their vulnerability to contamination? Have all abandoned or artesian wells been properly plugged or capped?

(Y) (N) (S/W) Will all new wells be constructed by a licensed Florida water well contractor and located up gradient, away from pollutants such as fuel tanks, chemical mixing areas, and septic tanks?

7.0 WETLANDS AND SPRINGS PROTECTION

(Y) (N) (S/W) Have you properly inventoried all wetlands, springs, and sinks within your farm boundaries using a soil survey or other mapping tools?

(Y) (N) (S/W) Are you familiar with the use of buffers between farm fields and watercourses or wetlands to reduce potential adverse impacts?

(Y) (N) (S/W) Have you considered the benefits of using filter strips, buffers, swales, or on-site ponds to provide additional treatment sources?

(Y) (N) (S/W) Have you considered routinely using controlled release fertilizer within areas that drain directly to wetlands, springs, or wet-sinks?

8.0 DITCH CONSTRUCTION AND MAINTENANCE

(Y) (N) (S/W) Did you research topographic maps, soil survey maps, seasonal high water table limitations, and/or natural drainage outlets before constructing your ditch system?

(Y) (N) (S/W) Have you considered the use of lateral ditches to provide additional drainage?

(Y) (N) (S/W) Are sediments routinely cleaned from ditches and do ditch banks have vegetative cover, to maintain proper function?

(Y) (N) (S/W) Have you considered using basic survey techniques to record the ditch cross-sectional area? This can be a beneficial record for future maintenance.

9.0 CONSERVATION BUFFERS

Y N S/W Does the farm have a field border that can be used as a turn row for equipment? Does the border also function as a diversion feature to redirect concentrated water flows?

Y N S/W Have you considered creating riparian buffers on fields that have more than a 1% slope?

Y N S/W Have you explored whether conservation buffers may be eligible for cost-share by federal or state agencies?

10.0 STORMWATER MANAGEMENT

Y N S/W Have you experienced recurring flooding problems on your farm? If so, have you evaluated the natural and/or manmade features on your farm to determine what drainage features may be needed or added?

Y N S/W Have you explored whether any FEMA floodplain maps exist for your location?

Y N S/W Have you discussed your decisions with an engineer to back-up your decision?

11.0 ACCESS ROADS

Y N S/W Are you contemplating constructing any new roads within the farm boundaries? If so, are you able to maintain a 25-foot setback from wetlands?

Y N S/W Are you planning to construct your road using porous materials to minimize runoff?

Y N S/W Can you ensure that road construction can be completed before the rainy season begins?

Y N S/W Do road shoulders or grassed waterways have a gentle slope and/or vegetation to prevent erosion?

Y N S/W Do any elevated roads impede the natural flow of surface water?

12.0 MOWING MANAGEMENT

Y N S/W Do you mow at a frequency that allows you to maintain optimum plant health?

Y N S/W If clippings are removed are they disposed of using environmentally acceptable practices?

13.0 SEASONAL FARMING OPERATIONS

Y N S/W Do you harvest sod on a three-year rotation and maintain vegetative cover during fallow periods?

Y N S/W Have you determined the carbon-to-nitrogen ratio of any residual material incorporated into the soil, and do you understand its implications?

Y N S/W Are you aware of the need to maintain appropriate wetland setbacks to protect water quality?

General Information for Environmental Protection on Sod Farms

AGRONOMIC AND TURF SPECIES ISSUES

Agronomic Issues

Before a new sod field can be established the ground must be properly prepared. In general, land preparation activities include tilling, leveling, liming, and fumigation. However, other actions may be needed depending on the land's use prior to sod production.

Tillage can be accomplished with a moldboard or chisel plow to break up any hardpan layers. A depth of up to ten inches may be necessary, and will give the sod more air and water movement and deeper rooting. Rocks and stumps should be removed from the field as well. Growers using subsurface irrigation may not need to till deeper than the hardpan in order to facilitate capillary action. This, of course, depends upon the turf variety and the need to develop an extensive root system.

Leveling is necessary to achieve uniform cutting during harvesting. Leveling also facilitates drainage and uniform water distribution to sod fields. A laser plane may be used for the most precise leveling.

Liming can be used to adjust the pH of the field and to supply essential nutrients like calcium and magnesium if they are naturally deficient in soils. Calcitic and dolomitic limes are two of the more commonly used liming materials. Except for the flatwoods areas of Florida which are generally acidic, most organic soils are near neutral pH, so a pH test should be performed before lime is added. Also factor in that different sod species have different pH requirements. Bahiagrass and centipedegrass should not be limed if it would create a soil pH greater than 6.0.

Preplant fumigation will help eliminate pernicious weeds before the initial sod planting. This is especially necessary if the field had been used for pasture in the past. Methyl bromide fumigation is being phased out, but other chemicals can be used.

Species Issues

Sod species selection and planting is largely determined by the local market. Beyond the market's influence, there are several reasons why different species should be considered for your operation based on a number of factors specific to your location. Soil type, tolerance to pests, drought, climate, and maintenance level are all factors to consider when starting a new field. The species most commonly grown for commercial sod production in Florida include St. Augustinegrass, centipedegrass, bahiagrass, bermudagrass, and zoysiagrass. As mentioned, your location within the state and the demands of the local market are most often what influences what will be grown, but the following general information about the more common species can help a grower make a sound business decision and grow sod in an environmentally compatible fashion.

St. Augustine species are usually started from sod or plugs. They can be grown anywhere in the state on a wide range of soil types. Most species are given a moderate rating for maintenance, but irrigation and pest control needs vary by species. It is recommended that St. Augustinegrass be fertilized every 6 to 8 weeks during the growing season with the caution that too much nitrogen (greater than 50 lbs N/acre per application) can promote chinch bug infestation and grey leaf-spot disease. St. Augustinegrass is popular for lawns in much of Florida, and some of its species are shade tolerant.

Centipedegrass is known for its low maintenance properties, and therefore is popular for home lawns and businesses. It will grow on most soils including acidic types, and in general is fertilized less often than other sod species. Fertilization at low rates of nitrogen should be used to prevent thatch buildup and general turf decline, and the application of potassium should be used to encourage rooting during the fall.

Bahiagrass is generally grown from seed for use on lawns and roadside right-of-ways. Like centipedegrass, it will grow on acidic soils and is very low maintenance. It is drought tolerant and has little trouble with pests, with one exception being mole crickets. Bahiagrass is fertilized on a schedule similar to centipedegrass, but is not likely to have similar rooting and thatch problems.

Bermudagrass has a fine blade, excellent wear tolerance, and is most commonly used for golf courses and athletic fields. It must be mowed often and responds to frequent fertilization for optimal growth. Bermudagrass is not shade tolerant and can be susceptible to pests and disease so vigilance is necessary. It is fairly drought tolerant.

Zoysiagrass grows in slowly and is most often started from sod or plugs but some seeded varieties are also available. It can be grown anywhere in

the state, and is usually used for lawns and golf courses. Some varieties can require moderate to high maintenance with their fertilization schedule and pest control needs, but zoysiagrass is prized for its appearance and drought and wear tolerances. Empire zoysiagrass, a popular variety, is known for its ability to grow in the hot humid climate of Florida more rapidly than some of the slower growing zoysia species. It also typically requires less maintenance than other species.

Seashore paspalum is a species known for thriving along the coasts where salinity can be a problem for most grasses. It is usually started from sod or sprigs, and once its roots are established it will spread quickly by both rhizomes and stolons. Seashore paspalum has a fine-medium blade, and currently is used mostly for athletic fields and golf courses.

The table below summarizes some of the species described above. More information is found throughout this manual concerning the specific needs of these species. Also, please be aware that other species of sod are grown in Florida but these are the most common and widely demanded.

Comparison of Common Sod Species Grown in Florida

	St. Augustinegrass	Centipedegrass	Bermudagrass	Bahiagrass	Zoysiagrass	Seashore Paspalum
Recommended Soil pH	6.0-7.5	5.0-6.0	5.0-7.0	5.0-6.0	5.5-7.0	4.0-9.8
Texture	Coarse-Med	Medium	Med-Fine	Coarse-Med	Med-Fine	Coarse-Fine
Tolerance to:						
Drought	Good	Good	Excellent	Excellent	Excellent	Excellent
Shade	Good (species dependent)	Fair	Poor	Fair	Good	Poor
Wear	Poor	Poor	Excellent	Fair	Excellent	Excellent
Mowing Height (in.)	2-4 (species dependent)	1-2	0.5-1	3	0.5-2 (species dependent)	0.5-2
Mowing Frequency (days)	7	10	3	7	10	3-5
Maintenance Level	Moderate	Low	High	Low	Moderate-High	Moderate-High
Major Use	Lawns	Lawns	Golf courses, athletic fields	Lawns, roadsides	Lawns/golf courses	Lawns/golf courses

General Fertilization Principles

Proper fertilization for sod production normally reflects the need for grass growth and re-growth following establishment or cutting of the prior crop. Nitrogen (N) is the most important nutrient for this response. Generally, higher rates and frequencies of nitrogen application reduce the production time for a crop; however, excessive nitrogen rates force excessive top growth at the expense of the roots, thus reducing the "liftability" of the sod. Economics also dictate, to an extent, the amount and frequency of nitrogen use. A balance needs to be maintained between all major and minor elements since the unavailability of any nutrient may affect other plant processes. Environmental concerns also need to be carefully weighed, since applying macronutrients such as nitrogen and phosphorus in excess of plant nutrient uptake can cause *eutrophication* of nearby water bodies. The result may be low dissolved oxygen levels which negatively affect aquatic organisms. Therefore, sod managers should conduct soil tests before planting and yearly thereafter to monitor pH and nutrient levels, and should remain cognizant of the needs of the particular grass being grown.

Some of Florida's soils naturally provide adequate phosphorous and near neutral soil pH levels. On the other hand, some of the sandier, highly leached soils may not contain adequate phosphorus levels to support optimum plant growth. Given these variables, growers need to use soil and/or tissue testing to determine what fertilizer formulations are appropriate for their site. Growers commonly use fertilizer materials that contain both nitrogen and phosphorous sources. These, along with potassium (K), are the most prevalent macronutrients. Examples of such fertilizer sources include di-ammonium phosphate or mono-ammonium phosphate. In general, phosphorous and liming materials (if necessary) are applied prior to planting, and nitrogen is applied during the growing season in multiple or spilt applications. Phosphorous is also commonly available as concentrated super phosphate or triple super phosphate. A fertilizer with a nitrogen:potassium ratio of 1:1 or 2:1 is generally recommended to increase the turf's stress tolerance level and to promote better rooting. Subsequent fertilizer applications are often made following the second mowing, with continued applications made based on observation, experience and/or tissue testing until the grass develops into a complete ground cover.

Fertilization practices must also be considered in conjunction with soil pH. The optimum soil pH for St. Augustinegrass, bermudagrass, and zoysiagrass is approximately 6.0 to 6.5. Centipedegrass and bahiagrass have an optimum soil pH of 5.0 to 6.0. Near neutral soil pH levels help to facilitate cation exchange in soils and minimize potential leaching or mobility of certain cation nutrients such as ammonium which is a positively charged molecule. Developing a basic understanding of the chemical and colloidal properties of your soil type will make you a better environmental steward.

Macronutrients

The three macronutrients most relevant to plant growth are N, P, and K. Sod uses significantly less P than N and/or K. Responses to P fertilization are most typically observed during establishment, rooting development and seed head production, especially in soils that have a P deficiency. Because P has been implicated as a cause of increased algae and noxious weed growth in surface waters, proper P fertilization management is imperative. Therefore, the goal in P management should be to apply the correct amount based on soil and tissue testing results.

Nitrogen, which is important for plant protein synthesis and vegetative growth, has the potential to be leached to groundwater by rainfall or over-irrigation on sandy soils, and may move laterally into surface waters. Under proper application, sod will use most of the available nitrogen. The rate of nutrient application, particularly N, depends on a number of factors: soil type, sod species, the location in the state where the sod is being grown, time of year, and type of fertilizer source being used (soluble or controlled-release). Thus, a single annual rate of N application is not recommended, rather split applications are key. Nitrogen is often applied in a water soluble form such as urea, ammonium nitrate or ammonium sulfate. Leaching losses can be minimized by making frequent, low-rate applications of soluble fertilizers, using controlled-release nitrogen sources, or applying a combination of the two fertilizer materials. Low-rate applications are usually made using soluble fertilizers, whether applied as a liquid during fertigation or as a granular product. To limit the environmental impact of your fertilization program, it is recommended that no more than 50 pounds of

soluble N per acre be applied in a normal application, and less when root coverage is incomplete.

Of the three primary nutrients, K is second only to N in utilization by sod. Large responses in sod growth are not typically observed in response to K fertilization, and proper K nutrition has been linked to reduced disease incidence, increased drought and cold tolerance, and enhanced root growth. The K fertilization rate is often tied to the N fertilization level, generally in a 2:1 or 1:1 ratio. Ideally, sod K fertilization should be based on soil test recommendations. Because of its high mobility in sandy soils, K fertilization should be made as soon after soil testing as possible. Fortunately, K is not considered a pollutant, but prudent application of K fertilization is essential for economic and resource conservation reasons. Excessive K fertilization can contribute to high soil electrical conductivity (EC) levels that may limit root growth and sod tolerance to drought. Keep in mind that K is considered to be a soluble salt constituent, and combined with other "salts" such as sodium and chloride ions can result in plant toxicity effects.

For a detailed fertilization guide for Florida sod, see IFAS Publication SL-52, *Fertility Considerations for Sod Production*, at: http://edis.ifas.ufl.edu/SS164

Micronutrients

Most soil testing laboratories usually analyze and make recommendations for copper (Cu), manganese (Mn), and zinc (Zn). Of these three micronutrients, sod responses have only been observed for Mn. In most Florida soils, extractable Cu and Zn levels are adequate for optimum sod growth, except for Cu in organic soils. No analysis or recommendation is made for Fe in Florida soils due to limited information on the correlation between soil and tissue levels, and sod growth response. A greening in response to the application of Fe and/or Mn will most likely be obtained on sod grown on soils having a pH of 7.0 or greater or on sod irrigated with alkaline water. The application of iron sulfate as a foliar spray usually produces the desired response. This response is generally short-lived, however, and reapplication may be required. Sod growers are well-advised to eliminate a micronutrient deficiency first, before simply applying excessive amounts of N in order to overcome a problem. Doing this out of "habit" without the benefit of understanding the entire nutrient picture will lead to increased nutrient-related impacts of water resources.

Sod Fertilization Management

One of the first steps in developing a sound sod fertilization management program involves a basic knowledge of the soils on which the sod is being grown. This knowledge can be acquired by observing and evaluating the soil's physical and chemical properties. Most Florida soils are sands and therefore retain limited quantities of water and nutrients. Individuals with only limited training in soils can discern whether a soil is mostly sand or predominately clay, and whether the soil contains flakes of free calcium carbonate or shell. The "feel and appearance method" has been promoted for years by the USDA-Natural Resources Conservation Service, and it can also be used to estimate soil moisture levels. Keep in mind that soil properties may significantly affect a sod fertilization management program.

Chemical properties such as soil pH, lime requirement, extractable levels of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and selected micronutrients such as manganese (Mn), copper (Cu), and zinc (Zn) can be determined through proper soil and tissue testing. Florida soils are not analyzed for nitrogen (N) because this element is highly mobile in sandy soils. Since reliable correlations between turfgrass growth and soil test N have not been developed, sod N fertilization is based on scientific research results for the turfgrass species being grown.

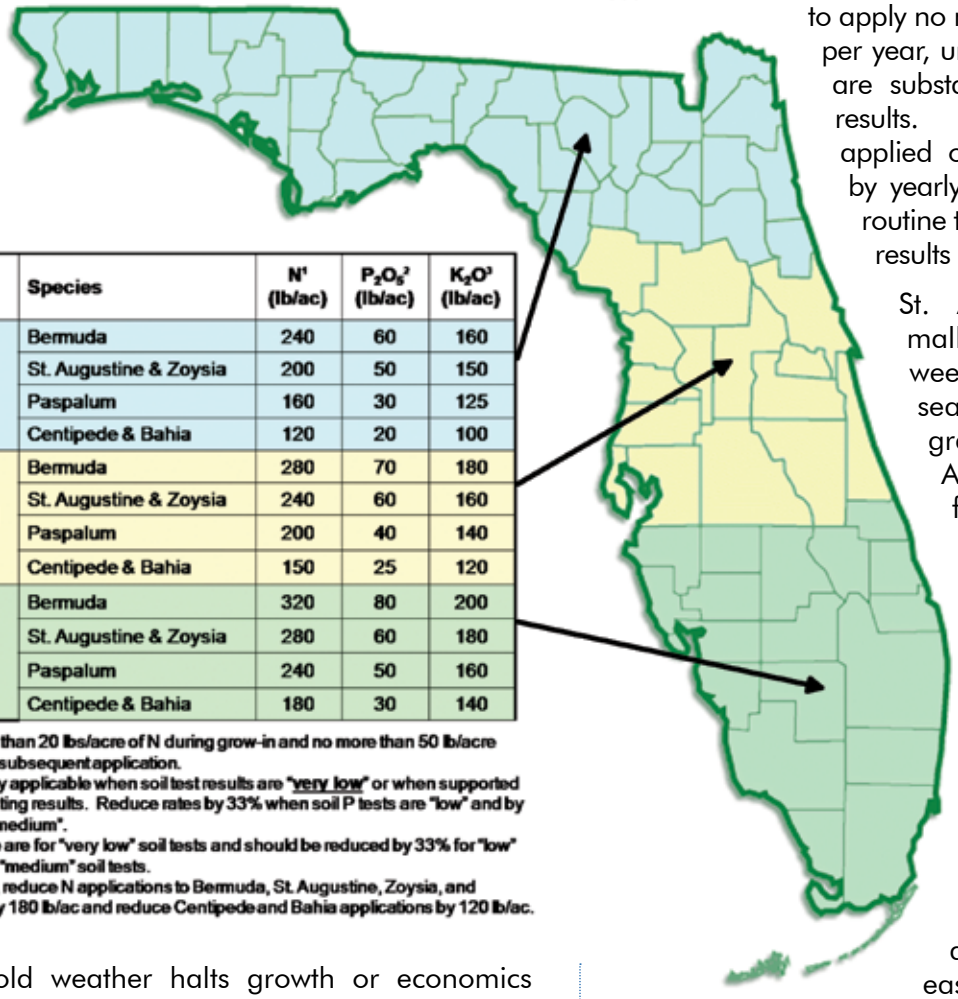
Scheduling and Rates

One of the most important principles of fertilization timing is avoiding fertilizer application to dormant or non-growing turfgrass. During dormancy, turfgrasses take up very small quantities of nutrients, and applied nutrients are much more likely to leach. Slow-release sources also influence the timing of fertilization, in that fertilization is required less frequently. In either case, do not apply fertilizer when heavy rains are imminent.

Once the sod has grown into a full cover, fertilizer scheduling is largely dictated by economics. Obviously, if sod orders are strong, the grass needs to be actively fertilized to minimize production time. Conversely, if sales are slow, sod should be fertilized less to save on fertilizer and maintenance costs such as mowing and watering. Bermudagrass and zoysiagrass respond exceptionally well to fertilization. Once full cover is achieved, quickest turn-around of these grasses generally occurs with fertilization at the equivalent rate of 50 lbs N/acre per application. This schedule should continue

Fertilization Guidelines for Florida Sod Production

(adapted from: J. B Sartain. 2007. Fertility Considerations for Sod Production. Univ. of Florida, IFAS. Exten. Fact Sheet SL-52. 9 pp)



Location	Species	N[1] (lb/ac)	P_2O_5[2] (lb/ac)	K_2O[3] (lb/ac)
North	Bermuda	240	60	160
	St. Augustine & Zoysia	200	50	150
	Paspalum	160	30	125
	Centipede & Bahia	120	20	100
Central	Bermuda	280	70	180
	St. Augustine & Zoysia	240	60	160
	Paspalum	200	40	140
	Centipede & Bahia	150	25	120
South[4]	Bermuda	320	80	200
	St. Augustine & Zoysia	280	60	180
	Paspalum	240	50	160
	Centipede & Bahia	180	30	140

[1]Apply no more than 20 lbs/acre of N during grow-in and no more than 50 lb/acre during each subsequent application.
[2]P rates are only applicable when soil test results are "very low" or when supported by tissue testing results. Reduce rates by 33% when soil P tests are "low" and by 66% when "medium".
[3]K rates in table are for "very low" soil tests and should be reduced by 33% for "low" and 66% for "medium" soil tests.
[4]On muck soils, reduce N applications to Bermuda, St. Augustine, Zoysia, and Paspalum by 180 lb/ac and reduce Centipede and Bahia applications by 120 lb/ac.

unless cold weather halts growth or economics dictate otherwise.

During re-establishment from ribbons, the volume of roots in a field can vary by species. Therefore, fertilization during this period should be reduced to account for the limited root mass. Incrementally increase fertilizer application rates in proportion to increased rooting as the stolons and/or rhizomes grow. Precision application equipment can be used to apply variable rates of fertilizer, or to apply a banded fertilizer application to the ribbon area only. The equipment may be controlled remotely, either via global positioning units that utilize geographical information systems technology, or by electronic sensors mounted on the equipment. Growers should take note that applying nitrogen fertilizer at the rate of 20 lbs/acre to 40% of the area along the ribbon is equivalent to broadcasting 50 lbs/acre. The same concentration of nitrogen will be available in the root zone. Precision application equipment cost-share reimbursement programs may available in some parts of the state, so check into this first. Also, a 2:1 or 1:1 ratio of nitrogen to potassium fertilizer should be used with each application to encourage strong rooting. In general, depending on species, sod growers are encouraged to apply no more than 300 lbs N/acre per year, unless additional quantities are substantiated by tissue testing results. Phosphorus should be applied only when recommended by yearly soil test results or more routine tissue testing analysis if the results indicate the need.

St. Augustinegrass is normally fertilized every 6 to 8 weeks during the growing season. As with bermudagrass and zoysiagrass, St. Augustinegrass should be fertilized with a 2:1 or 1:1 ratio of nitrogen to potassium fertilizer and phosphorus added as suggested by soil test results. If over-fertilized in summer with a soluble or quickly available nitrogen source, St. Augustinegrass can become more susceptible to chinch bug infestation and grey leaf-spot disease. The best defenses against these problems are small, frequent applications of nitrogen. Additionally, these problems can be minimized by using controlled-release nitrogen sources and supplemental iron applications.

Bahiagrass and centipedegrass are generally fertilized less than the other sod species. Bahiagrass is sometimes fertilized yearly with 100 to 200 lbs N/acre, but may be fertilized more for higher maintenance turf production settings; however, to avoid environmental problems, no more than 50 pounds of soluble N per acre should be applied in a normal application, assuming full cover is present. Again, economics and desired sod turn-around time dictate which rate range is to be used. Two applications per year are acceptable if 100 pounds of 50 percent slow release nitrogen is used and equally divided between early spring (April-May) and summer (July-August).

Centipedegrass has a very specific fertilization schedule. If over-fertilized long-term with nitrogen, centipedegrass will develop thatch, decreased winter

survival and reduced rooting. The end result, referred to as "centipedegrass decline," is characterized as death or extremely weak spots that develop as the grass resumes growth in spring. Normally, centipedegrass decline does not develop until several years after establishment. Established centipedegrass should be fertilized only 2 to 3 times per year, with an average of 25 to 50 lbs N/acre per application. In North Florida, an additional 45 lbs K/acre should be considered in early fall to encourage proper rooting prior to winter. Remember that all sod species have a specific crop nutrient requirement and that fertilization practices beyond this range will typically be lost to the environment, thus increasing the risk of water and air pollution.



Soil Probe

Zoysiagrass and Bermudagrass respond quickly to proper fertilization. The recommended rate is 50 lbs N/acre per application once the sod is fully established, and less during the ribbon grow-out period. Nitrogen application should also be cut back during winter dormancy and when economics dictates. Strong rooting is encouraged by a 2:1 or 1:1 ratio of nitrogen to potassium fertilizer. Soil testing should indicate if phosphorus is needed.

Soil Testing and Interpretation

Soil testing is an applied science and can be used as one of the tools in the maintenance of healthy sod production. Proper fertilization recommendations and minimizing the nonpoint source pollution risk are the hallmarks of a routine soil testing program. For the effective management of nutrients, soil testing should be used in conjunction with tissue testing. Soil test recommendations are based on a correlation between the level of a given nutrient extracted from the soil and the anticipated plant response. The amount of nutrients extracted by a particular extractant is only an index relative to crop response. It is not a direct measure of actual plant nutrient availability. The levels of extracted P, K, and Mg are divided into five categories: very low, low, medium, high, and very high. For more information, see your county Cooperative Extension Service agent or IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*, at: http://edis.ifas.ufl.edu/SS317.

A soil analysis supplies a wealth of information on the nutritional status of a soil and can detect potential problems that limit plant growth. To reiterate, a routine soil analysis supplies information on soil pH and the extractable P, K, Ca, and Mg status of the soil. The University of Florida Soils Lab in Gainesville currently uses Mehlich-1 as an extractant on all the acidic mineral soils and AB-DTPA (Ammonium Bicarbonate-DTPA) extractant on soils with pH above 7.3 (calcareous soils).

The table below presents general interpretation ranges for soil test levels of P, K, Mg, Mn, Zn, and Cu.

Suggested ranges for Mehlich-1 extractable soil nutrient levels for turfgrasses

Macronutrients* (ppm)			Micronutrients** (ppm)		
P	K	Mg	Mn	Zn	Cu
16-30	36-60	20-30	3-9	0.5-3	0.1-0.5

* Medium ranges of Mehlich-1 extractable P, K, and Mg when in 25 percent of the cases a response to applied fertilization would be expected.

** Soils testing below these levels of micronutrients are expected to respond to applied micronutrients. The interpretation of soil test micronutrient levels is based on soil pH. The smaller number is for soils with a pH of less than 6.0, and the larger number is for soils with a pH of 7.0 or greater. Mehlich-1 extractable micronutrient levels are only determined when requested and require an additional charge.

Tissue Testing

Because of the mobility of most essential nutrients in soils, one of the best indicators of appropriate fertilization and plant health is tissue analysis. Since sod is a perennial crop, historical logs of tissue composition can be used to fine-tune a sod fertilization program for optimum plant growth and minimum environmental impact. Leaf analysis, along with sod appearance and soil analysis, can be used to diagnose the effectiveness of a fertilization program, especially for micronutrient deficiencies. Soil analysis for some nutrients - because it is a snapshot of what is present at the time of sampling - does not always indicate their availability to plants. Potential nutrient deficiencies can be detected with leaf analysis before visual symptoms appear. Also, leaf analysis may provide information on induced deficiencies and inferences on plant uptake.

Sufficiency ranges of tissue N concentration for selected turfgrasses

Grass	N (%)
St. Augustine	2.0 - 3.0
Zoysia	2.0 - 3.0
Bermuda	2.5 - 3.5
Centipede	1.5 - 2.5
Bahia	1.5 - 2.5
Rye	3.5 - 5.5

Sufficiency levels of essential nutrients in the various sod species do not vary much among the various species, except for N. The sufficiency of tissue N concentration can vary from a low of 1.5 percent for centipedegrass or bahiagrass to a high of 3.5 percent in cool-season, overseeded ryegrass. The table above contains a list of the sufficiency ranges for tissue N concentration for the various turfgrasses. In most cases, tissue N concentrations below the minimum of the range would be deficient and above the range would be excessive.

The concentration of other macro and micronutrients in the tissue does not vary greatly among the various species of sod. The sufficiency ranges listed in the table below are applicable to most of Florida's sod species. All of these values are on a dry weight basis. These values represent the range over which a particular nutrient might vary across the various species of sod. They represent sufficiency ranges, which suggest that levels below the range may indicate a deficiency or above the range may represent excessive fertilization or toxicity.

Sufficiency concentration ranges for selected macro and micronutrients in turfgrass tissue

Parameter	Range	Units
P	0.15 - 0.50	%
K	1.0 - 3.0	%
Ca	0.5 - 1.0	%
Mg	0.2 - 0.5	%
Fe	50 - 250	ppm
Cu	5 - 30	ppm
Mn	25 - 100	ppm
Zn	20 - 250	ppm
B	5 - 20	ppm

Water Supply

Proper water management planning must consider all uses of water, ranging from the source of irrigation water to a plant's water use requirements. It is very important to differentiate between crop water requirements and irrigation water requirements. Crop water requirements refer to the actual water needs for *evapotranspiration* (ET) and plant growth, and primarily depend on crop-specific development and climatic factors. Irrigation water requirements are primarily determined by soil storage capacity and crop water requirements, but also depend on the characteristics of the irrigation system. It is extremely important that the irrigation system is designed properly so that the crop will get the right amount of water when it needs it the most. This will help maximize both crop yield and profit, while preventing wasteful water application.

Water taken from a reliable source and delivered to a crop via an irrigation system is known as water supply. With the exception of South Florida, most of the irrigation water used in Florida agriculture is withdrawn from underground, aquifer sources. Regardless of the source's origin, it is important to know the quantity and quality of the water source before designing and installing an irrigation system. This is particularly important if you intend to use a sprinkler type system. Water quality analyses are performed at a number of private and public labs and can provide valuable clues to determine the potential for irrigation plugging problems, fertigation compatibility, and/or salinity trends. Settling ponds or basins may be used to remove large inorganic particles and can also be used for aeration of groundwater containing high amounts of iron or manganese.

It is important to ensure that the water source does not become contaminated. Florida law requires backflow prevention assemblies on all irrigation systems injecting chemicals into irrigation water. For detailed information on these requirements, refer to IFAS Extension Bulletin 258, *Causes and Prevention of Emitter Plugging in Microirrigation Systems* which can be found at: http://edis.ifas.ufl.edu/AE032. Appropriate backflow prevention should include a check valve upstream from the injection device to prevent backward flow; a low-pressure drain to prevent seepage past the check valve; a vacuum relief valve to ensure that a siphon cannot develop; and, a check valve on the injection line.

Water management districts are responsible for projecting future water demand over a twenty-year time period for each major water use category. Where demand is expected to exceed available supplies, the districts develop regional water supply plans that identify water sources and water resource development projects sufficient to meet the expected needs. An effective water supply planning process is especially important to agriculture as they are typically "self-suppliers" of all water used on the farm. *Florida's Agricultural Water Policy Document (July 2003)* contains more details on water supply and planning and can be found at: www.floridaagwaterpolicy.com.

Irrigation System Design and Installation

Irrigation system design is a complex issue and should be handled by trained professionals. These professionals use existing standards and criteria, as well as manufacturers' recommendations, to design the most appropriate system for a location.

The irrigation design for a site depends on a number of factors, including location, soils, vegetation, water supply, and water quality. An irrigation system needs to be designed to meet a site's peak water requirements. However, it should also be flexible enough to adapt to various water demands and local restrictions. The two main types of irrigation systems are surface irrigation, which involves channeling water through canals and ditches to raise or lower the water table, and pressurized systems, such as sprinklers.

An irrigation system consists of four main components:

1. Water supply -- this consists of a water source, pumps, filters, and valves (including backflow valves), and, for surface irrigation, water gates and level controls
2. Water conveyance -- in surface systems, these are canals and main ditches. Pressurized systems generally include a mainline, manifold, lateral lines, and isolation valves
3. Distribution devices -- these include center pivots, lateral movers, traveling guns, and solid set systems. Field ditches are used to distribute water in surface water irrigation systems

4. Control system – these may be manual or automatic and can be locally or remotely controlled, and may include float switches, computerized control systems, weather stations, soil moisture sensors, etc.

The design must account for different site characteristics and topographies. Adequate pressure (head) is important for irrigation systems to function properly. The design operating pressure must not exceed the available source pressure or the capacity of the water supply. The irrigation design should also account for any additional water that may be periodically needed to leach salt buildup caused by poor-quality irrigation water.

In pressurized systems, backflow prevention devices are needed to protect the water source from contamination. Water conveyance systems should be designed with thrust blocks and air release valves to prevent system damage. Water conveyance pipelines should provide the appropriate pressure required for maximum irrigation uniformity. Distribution devices should be designed for optimum uniform coverage and must have precipitation rates that do not exceed the ability of the soil to absorb and retain the water applied during any one application.

Surface systems may be able to use gravity feed from the water source, or water may need to be pumped into a reservoir to provide adequate head. Tailwater recovery systems should also be considered to recover runoff from the site to be pumped back into the irrigation system for beneficial reuse. The proper design and installation of the components listed above optimizes their efficiency and decreases any off-site impacts.

Irrigation System Operation

Plants don't waste water, people do. Using proper irrigation system design, installation, water management, and maintenance practices provides a multitude of benefits. An efficient irrigation system translates into cost savings and protection of Florida's water resources.

Irrigation management is the cornerstone of water conservation and reduced nutrient and pesticide movement. It includes both scheduling the amount and frequency of water applied and the maintenance of system components, both preventive and corrective. Irrigation scheduling must take plant water requirements and soil moisture capacity into account to prevent excess irrigation water that could lead to leaching and runoff. Plant water needs are determined by evapotranspiration rates, recent rainfall, recent temperature extremes, and soil moisture. Whenever possible, cultural practices should be used to minimize plant stress and the amount of water needed. For example, sod growers can use mowing, nutrition, and other cultural practices to control water loss and to encourage conservation.

Irrigation Scheduling

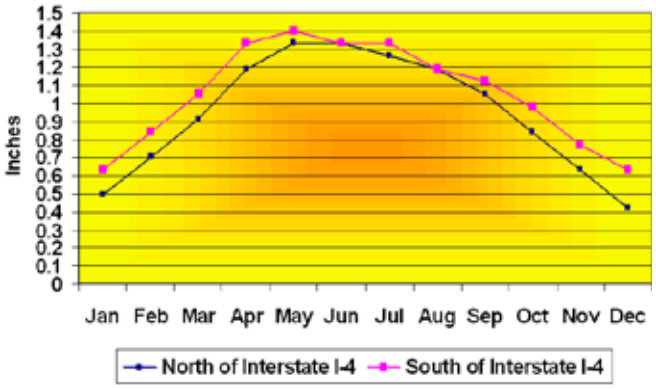
Before a grower can properly develop an irrigation schedule, the system must be audited, or calibrated, so that the rate at which water is applied to each field is known. Once the water delivery rate is known, determining when and how much to water is the next important step. Irrigation should not occur on a calendar-based schedule but should be based on ET rates (see chart on next page) and soil moisture replacement. Rain gauges are necessary measurement tools to track how much rain has fallen throughout the farm. The use of soil moisture probes, inspections for visual symptoms such as wilting turf, computer models, and tensiometers will enhance the efficiency of an irrigation scheduling program.

Water loss rates decrease with reduced solar radiation, minimal wind, high relative humidity, and low air temperatures. A grower can take advantage of these factors by irrigating when conditions do not favor excessive evaporation. Irrigation should occur in the early morning hours before air temperatures rise and relative humidity drops. Irrigating at this time also removes dew from leaf blades and allows sufficient time for infiltration into the soil but does not encourage disease development.

Determining how much water to apply is the next step in water management. Enough water should be applied to wet the entire root zone. Wetting below the root zone is generally inefficient and promotes leaching. Also, irrigating too often encourages shallow rooting, increases soil compaction, and favors pest outbreaks. For sod, the majority of roots are in the top 4 to 6 inches of soil. Soil moisture estimates can be determined by using a soil probe to feel the depth of moisture and show the depth of the root zone.

It is important to keep in mind that, while new technology makes many tasks easier or less labor intensive, it is the principles discussed in this BMP manual that are important. These principles may be applied to any farm at almost any level of technology.

Potential evapotranspiration (ETp) levels for two regions of Florida



Irrigation System Maintenance

Irrigation system maintenance on a sod farm involves four major efforts: calibration or auditing, preventive maintenance, corrective maintenance, and recordkeeping. Maintenance is necessary on any irrigation system, whether it be center pivot, linear sprinkler irrigation, or seepage irrigation. Uniformity of water application, efficiency, water conservation, and reduction of operation and maintenance costs are some of the benefits of a regular maintenance program. The overall goal is to maximize system performance. Maintenance programs vary according to the type of irrigation system. In general, all sod farms should follow a regular, well documented, maintenance routine.

If an irrigation system is in disrepair or coverage is obviously poor, then time is wasted doing a detailed audit. A visual inspection should first be conducted to identify any necessary repairs or corrective actions, and it is essential to make any repairs before carrying out other levels of evaluation. A visual inspection should be part of ongoing maintenance procedures.

In many areas of the state, Mobile Irrigation Labs are available to perform these audits at no charge. If such service is available, free audits are recommended. After the audit is complete, implement all repairs needed to improve distribution uniformity and adjust the irrigation schedule as needed based on the lab's recommendation.

Detailed information on calibrating an irrigation system is provided in the Florida Irrigation Society's *Urban Irrigation Auditor Certification Manual* (2002). Copies of the manual may be obtained by calling FIS at 1-800-441-5341.

Personnel charged with maintaining any irrigation system face numerous challenges. This is particularly true for those with older or outdated equipment. Good system management starts with good preventive maintenance procedures and recordkeeping. Maintaining a system is more than just fixing heads. It also includes documenting system and maintenance-related details so that potential problems can be addressed before expensive repairs are needed. It also provides a basis for evaluating renovation or replacement options.

Maintenance of flood or seepage systems includes operational checks of pump stations and structures, including cleaning and maintaining all ditches. It is important to maintain optimum pressure ranges for pump station equipment. Water control structures like risers and culverts should be kept clean and operational to assist with water conservation. Maintenance programs for pressurized pipe systems (center pivot, lateral moves and traveling guns) generally involve filtration, chlorination/acidification, flushing, repair or replacement of clogged emitters, and observation. Nozzles need to be replaced when worn out, and replacements should have the same flow and pressure characteristics as the original design.

Visual Inspection Elements

With the system on, inspect for the following:

- Mainline breaks,
- Low pressure at the pump,
- Head to head spacing,
- Interference with water distribution,
- Broken heads,
- Misaligned heads,
- Rain sensor present and functioning,
- Backflow device in place and in good repair,
- Turf quality and plant health for indications of irrigation malfunction or need for scheduling adjustments, and
- Make adjustments and repairs on items diagnosed during the visual inspection before conducting pressure and flow procedures

In summary, the benefits of maintaining your irrigation system in good condition include uniform sod growth, water conservation, and reduced operation and maintenance costs. For more information on this topic, refer to the *Irrigation System Maintenance and Evaluation BMP* in this manual.

Stormwater Management

Stormwater is defined as the runoff from impervious surfaces and water-saturated surfaces, trans-

porting sediments and dissolved chemicals into nearby waters. This runoff can be a major cause of nonpoint source pollution which negatively affects Florida's rivers, streams, and springs often leading to problems from turbidity and eutrophication. Clippings, fertilizers, and pesticides can also contribute to stormwater runoff problems on a sod operation.

There are many mechanisms for stormwater treatment and control. A BMP "train" approach yields excellent results and is often the preferred method. In this approach, water is conveyed from one treatment practice to another by conveyances which also contribute to the treatment process. For example, runoff can be directed across a vegetated filter strip into a wet detention pond, and then through a swale into a constructed or natural wetland. Vegetative buffers and swales are excellent sources of sediment and pesticide filtration.

The best solution to stormwater runoff is to prevent it in the first place. Land should be kept vegetated as much as possible to hold soil in place. When land is left uncovered, which is the case during establishment of a new sod field, sedimentation barriers like silt screens should be employed. The banks of canals and ditches should be kept planted to hold soil in place. This helps to maintain the integrity of the bank side-slope thus preventing unnecessary erosion. Low maintenance vegetation is the best choice for vegetative buffers. Usually, these buffers do not need to be mowed or fertilized, as this practice may compound stormwater runoff issues. To prevent the movement of fertilizers and pesticides into water bodies, "no spray" zones should be established within a set distance of the water. Application should never be conducted right up to the water line, unless allowed by the label.

Another solution to stormwater runoff can be to develop a tailwater recovery system. This system can conserve water and improve water quality by collecting and re-using irrigation water or rainfall that runs off the surface of sod fields. A tailwater recovery system should be located at the low end of a field(s), so that water collection can be done by gravity. Capacity of tailwater recovery systems shall be determined by analysis of the expected runoff rate, the planned storage pond capacity, and the irrigation application rate(s) if the recovery pond is to supply irrigation water. The stored tailwater should be analyzed for nutrient content and then adjust the sod's fertigation program accordingly. Unfortunately, the water collected from fields may also contain disease-causing fungal spores and bacteria. Dilute tailwater earmarked for reuse with fresh water to lower disease concentrations if this is of concern.

Permitting Considerations

Florida's five water management districts have the primary regulatory authority for issuing well construction, water use and surface water permits for agriculture. Well construction permits, which are sometimes delegated and issued by county governments, are required prior to the drilling, construction and/or repair of a well. These permits ensure that wells are constructed by qualified, licensed contractors to meet safety, durability and resource protection standards. A water use permit allows the user to withdraw a specified amount of water, either from a groundwater well or from a surface water source. Statewide, Florida agriculture uses approximately 50 percent of all permitted freshwater withdrawals, and this figure is expected to remain relatively constant for the next twenty years. In general, before a user can receive a new permit to withdraw water, the permit applicant must establish that the proposed water use satisfies a three-prong test in Section 373.223, F.S., which requires:

- The proposed use is reasonable and beneficial;
- The proposed use will not interfere with any existing legal use of water; and,
- The proposed use is consistent with the public interest.

Almost all users who withdraw water from wells or surface water bodies require a water use permit. Whether the required permit is a general water use permit issued by rule or an individual water use permit issued by the Water Management District Governing Board or staff depends upon the location and the annual average daily allocation requested. Generally, permits are issued from ten to twenty years depending upon the specific technical circumstances that prevail. These circumstances focus on items such as subsurface drawdown impacts, saltwater intrusion, and/or wetland hydrology impacts. Water use permits are important because they provide growers with a legal right or "instrument" to use the water for supplemental irrigation purposes and other related agricultural uses (e.g., livestock watering, frost protection, crop cooling, etc.). All permits have conditions placed upon them, and may also have specific reporting requirements. Pumping reports are usually required on some frequency, especially if the use is in a Water Resource Caution Area.

An Environmental Resource Permit is sometimes required for agriculture, especially if the activity affects wetlands, alters surface water flows, or contributes significantly to water quality pollution. These permits are fairly complicated, and require engineering analyses to demonstrate that the proposed design meets all permitting criteria.

Lastly, the water management districts have special drought/water shortage restrictions that govern the amount and timing of irrigation. It is important to know the water shortage category and type of restrictions for your farm; although, many agricultural users on low volume irrigation systems are exempt from these restrictions.

Besides water, growers need to be aware of other permitting issues. Petroleum storage tanks may require registration and, if so, must meet FDEP rule criteria for secondary containment. Growers should also be aware of all potential on-site waste streams, including spent solvents and degreasers, as these may be classified as hazardous wastes and require FDEP permitting for the proper storage and disposal of the used material.

Pesticide Use

Pesticides are designed to kill or alter the behavior of pests. If they are not used wisely, pesticides may pose health risks to pesticide applicators and others, and may create long-term environmental problems. There are many facets to pesticide use: targeting problem pests, inventory and storage of pesticide product, mixing and loading of pesticides for application, handling spills, properly calibrating application equipment, licensing requirements of applicators, applying the product at the labeled rate, staying abreast of worker safety issues and performing key recordkeeping functions.

A pest-control strategy should be used only when the pest is causing or is expected to cause more damage than what can be reasonably and economically tolerated. A control strategy should be implemented that reduces the pest numbers to an acceptable level while minimizing harm to non-targeted organisms. The strategy of Integrated Pest Management or IPM centers on prevention (keeping a pest from becoming a problem) and suppression (reducing pest numbers or damage to an acceptable level).

It's important to balance pesticide efficacy with environmental, health and safety issues. The most obvious method to reduce risk from pesticides is to use them only when necessary. Growers must determine which pesticides are the most useful and least environmentally harmful for a given situation. Apply them properly and effectively to minimize costs and the effects on public health and the environment while maintaining plant health. Give particular attention to the vulnerability of the site to groundwater or surface water contamination from leaching or runoff. Lastly, always follow the directions on the label. These directions have been developed after extensive research and field studies on the chemistry, biological effects, and environmental fate of the pesticide. The label is the single most important document in the correct use of a pesticide, and state and federal pesticide laws require strict adherence to label directions. For more specific information on pesticide use for sod producers, please refer to the IPM BMP in this manual.

Sod Pests

Weeds

Unchecked weeds compete with turfgrass for space, water, light and nutrients, and can harbor insect pests and diseases. The predominant weed species change from season to season in Florida. Because weed populations can explode if not kept in check, the amount of pressure from these pest plants remains consistently high.

Weeds reproduce from seed, root pieces, and special vegetative reproductive organs such as tubers, corms, rhizomes, stolons, or bulbs. Many of the weeds that show up in sod fields come from seeds. Weed control is important for good quality sod. In general, weakened turf or bare areas result from: (a) poor selection of turf species not adapted to the local environmental conditions; (b) damage from turfgrass pests such as diseases, insects, nematodes and animals; c) improper timing of agrichemicals; (d) improper turf management practices such as improper mowing height or mowing frequency and improper soil aeration; and, (e) physical damage and compaction from excessive traffic. Unless factors which contribute to the decline of the turf are corrected, continued problems with weed encroachment can be expected. For more information, see IFAS Publication ENH-884, *Weed Management in Home Lawns* at http://edis.ifas.ufl.edu/EP141, or ENH-1039, *New Options for Managing Weeds in the Landscape* at: http://edis.ifas.ufl.edu/EP296.

Insects and Other Organisms

Less than one percent of all insects are harmful to plants and many are actually beneficial, acting as predators or parasites of harmful insects and assisting in the cross-pollination of certain plants. Remember that disease, nutritional deficiencies, cultural treatments, and environmental conditions can cause a plant to appear unhealthy or discolored, so it is important to diagnose a problem correctly before corrective measures are taken. Consider all of the control options available under IPM before using a chemical control method for an active pest infestation. Monitoring or scouting is the most important element of a successful IPM program. Scouting enables a grower to monitor pest presence and development throughout the growing season. By observing turf conditions regularly (daily, weekly, or monthly, depending on the pest) and noting which pests are present, an intelligent decision can be made regarding which pests are present,

how damaging they are, and what possible control strategy is necessary. Keep in mind that pests may be present for some time before damage occurs or is noticed. It is essential to record the results of scouting and monitoring in order to develop historical information, document patterns of pest activity, and document successes and failures.

In general, IPM calls for pesticides to be applied as needed when plants have an active infestation and significant damage is likely. However, some pest problems may be best handled with preventive measures, such as biological-control techniques, and these should be based on professional knowledge of the control agent or method, the pest's life cycle, environmental conditions, and historical data. Use preventive chemical applications only when your professional judgment indicates that properly timed, preventive applications are likely to control the target pest effectively while minimizing economic costs and environmental effects.

For more information on IPM and insect pests, go to:

- IFAS Circular 1149, *Integrated Pest Management Strategies*, at http://edis.ifas.ufl.edu/LH080
- IFAS Publication ENH-300, *Insect Pest Management on Turfgrass*, at http://edis.ifas.ufl.edu/IG001
- Featured Creatures at http://creatures.ifas.ufl.edu

Plant Parasitic Nematodes

Nematodes are small, unsegmented roundworms, generally transparent and colorless; most are slender, with bodies up to 1/8 inch long. Only about 10 percent of nematodes are estimated to be plant parasites. Nematodes affect plants by damaging the roots, thus reducing their ability to function.

For more information on nematodes, go to:

- IFAS Publication ENY010, *Nematode Management for Sod Production in Florida*, at http://edis.ifas.ufl.edu/IN125
- IFAS Fact Sheet RF-LH053, *Nematodes: What They Are, How They Live, What They Do to Turf*, at http://edis.ifas.ufl.edu/LH053

Plant Diseases

Plant pathology is the study of plant diseases. Diseases result in infected turfgrass and are caused by microorganisms such as fungi, bacteria, and viruses. Some disease symptoms, such as leaf spots and wilting, are easily seen or measured. Others are difficult to observe (e.g., root decay) or are very subtle (e.g., shorter growth flushes). Normally, *abiotic* plant disorders are not included in the study of diseases, but it is still important to recognize them. These disorders include nutrient imbalances, temperature extremes, toxic chemicals, mechanical injury, water imbalances, and air pollution. Most environmentally induced problems tend to be more uniform, whereas disease may show up in spots and patches throughout a field.

For more information on plant disease, go to:

- IFAS Publication LH064, *Key for Identification of Landscape Turfgrass Diseases*, at http://edis.ifas.ufl.edu/LH064
- IFAS Publication LH040, *Turfgrass Disease Management*, at http://edis.ifas.ufl.edu/LH040
- IFAS publication PDMG-VG-01, *Characteristics of Plant Disease*, at http://edis.ifas.ufl.edu/PG001
- IFAS Rapid Turfgrass Diagnostic Service, at http://turf.ufl.edu/turf_diagnosis/index.html

Pesticide Management

Careful management of pesticide products and application to target crops is critical. Readers are encouraged to refer to the document entitled "*Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance*" for more specific information on pesticide BMPs. These documents can be found at www.floridaagwaterpolicy.com. Key areas of pesticide management are excerpted below to provide some basic information.

Pesticide Record Keeping and Licensure Requirements

Proper records of all pesticide applications should be kept according to state and federal requirements. These records help to establish proof of proper use, facilitate the comparison of results of different applications, or find the cause of an error. Sample record keeping forms can be found at the FDACS Bureau of Compliance Monitoring at: http://www.flaes.org/complimonitoring/pesticidecertification.html.

Certain pesticides are classified as restricted use pesticides (RUPs). The Florida pesticide law requires certified (licensed) applicators to keep records of all RUP use. Florida regulations require that information on RUPs be recorded within two working days of the application and maintained for two years from the application date.

Pesticide Storage

Pesticide storage areas must be properly constructed and maintained to prevent problems or an expen-

sive cleanup in the event of an accident. The best way to minimize storage problems is to minimize the amount you store. Purchase only the amount of product that you can use within a reasonable time frame. Do not store large quantities of pesticides for long periods. Adopt the "first in–first out" principle, using the oldest products first to ensure its use within the product's shelf life. If you have to store pesticides, follow these general guidelines:

- Design and build pesticide storage structures to keep pesticides secure and isolated from the surrounding environment
- Store pesticides in a roofed concrete or metal structure with a lockable door
- Keep pesticides in a separate facility, or at least in a locked area separate from areas used to store other materials, especially fertilizers, feed, and seed
- Do not store pesticides near flammable materials, hot work (welding, grinding), or in shop areas
- Do not allow smoking in pesticide storage areas
- Store personal protective equipment (PPE) where it is easily accessible in an emergency, but not in the pesticide storage area. Remember that PPE may not provide full protection in emergency response situations.

Store pesticides in their original containers and do not put pesticides in other containers that might cause children and others to mistake them for food or drink. Keep all containers securely closed and inspect them regularly for splits, tears, breaks, or leaks. All pesticide containers should be labeled, legible, and arranged so that the labels are clearly visible.

Segregate herbicides, insecticides, and fungicides to prevent cross-contamination and minimize the potential for misapplication. Cross-contaminated pesticides often cannot be applied in accordance with the label of each of the products. This may make it necessary to dispose of the cross-contaminated materials as wastes and could require the services of a consultant and hazardous waste contractor.

Note that cancelled, suspended, or unusable pesticides must be disposed of properly. Storage for long periods can lead to leaking containers or other costly problems. The FDEP and FDACS may operate a program in your area for the free disposal of these materials (Operation Cleansweep). For more information, contact the FDACS Bureau of Compliance Monitoring at (850) 488-3314. If this program is not available, a licensed hazardous waste disposal contractor should be contacted.

Lastly, plans and specifications for pesticide storage buildings are available from several sources, including the USDA-NRCS, the Midwest Plan Service, and the UF/IFAS Publications Office.

Mixing and Loading Activities

In most cases, the mixing and loading of pesticides into application equipment should be done adjacent to the application site. If pesticides are routinely mixed and loaded at a shop or storage site, spilled material can accumulate and expensive cleanup may be required. Instead, consider installing a permanent chemical mixing center or rotate your mix and load activities to various sites within the farm. Also, use extreme caution when handling concentrated chemicals and locate operations well away from groundwater wells and areas where runoff may carry spilled pesticides into surface waterbodies. Areas around public water supply wells should receive special consideration and may be designated as wellhead protection areas. Before mixing or loading pesticides in such areas, consult with state and local government officials to determine if special restrictions apply. Most importantly, for your own safety, always use all personal protective equipment required by the pesticide label.

Pesticide Equipment Calibration and Loading

It is critically important to keep application equipment properly calibrated and in good working order. Compliance with the pesticide label reduces the risks to applicators, workers, and the environment, saves you money, and is required by law.

Calibrate application equipment using clean water and do not calibrate equipment near wells, sinkholes, or surface waterbodies. Measure all pesticide and *diluent* materials accurately. The proper application of pesticides helps to reduce costs and increase profits. Improper application can result in wasted chemicals, marginal pest control, excessive carryover, and/or damage to sod.

Sprayers should be calibrated when first purchased or when nozzles are replaced, and then monitored as nozzles will wear which may cause the rate of flow to increase rapidly. Wettable powder formulations may accelerate nozzle tip erosion. Routine re-calibration of equipment compensates for wear in pumps, nozzles, and metering systems. Consult the operator's manual for detailed information on a particular sprayer.

Several different calibration methods can be

found in IFAS Publication SM38, *Spray Equipment and Calibration*. It is available from IFAS at: http://ifasbooks.ufl.edu/merchant2/merchant.mv.

Pesticide Application Equipment Wash Water

Wash water from pesticide application equipment must be managed properly, since it may contain pesticide residues. Wash the application equipment in a designated wash area. The water hose should have an on/off valve and a water-reducing nozzle. Use the least amount of water possible to wash the equipment adequately. Spray equipment can be rinsed of pesticides residues over sod production areas when the *rinsate* will be used according to the product label. These practices prevent unwanted pesticide residues from being washed onto non-targeted areas. Avoid conducting washing operations near the vicinity of wells or surface waterbodies.

For most application equipment, the inside of the application tank should be rinsed. This is often done by using tank cleaner chemicals, filling the tank with a minimal amount of water and then applying the rinse water in the same manner and at the same site as the original pesticide. For larger equipment that is loaded at a central facility, the inside of the application equipment should be washed on the mix/load pad. This rinsate may be applied as a pesticide (preferred) or stored for use as make-up water for the next compatible application.

Pesticide Spill Management

Growers should have a spill clean-up kit available and clean up spills as soon as possible. Unmanaged spills may quickly move into surface waters and adversely affect natural systems. It is essential to be prepared for major or minor spills. The sooner you can contain, absorb, and dispose of a spill, the less chance there is that it will cause harm. Always use the appropriate personal protective equipment as indicated on the Material Safety Data Sheet and the label for a particular chemical. In addition, follow the following four steps:

- CONTROL actively spilling or leaking materials by setting the container upright, sealing off leak(s), or shutting the valve
- CONTAIN the spilled material using barriers and recognized absorbent materials
- COLLECT spilled material, absorbents, and leaking containers and place them in a secure, properly labeled container. Some contaminated materials could require disposal as hazardous waste
- STORE the containers of spilled material until they can be applied as a pesticide or appropriately disposed of

Remember to comply with all applicable federal, state, and local regulations regarding spill response training for employees, spill reporting requirements, spill containment, and cleanup procedures.

If a spill occurs for a pesticide covered by certain state and federal laws, you may need to report any accidental release if the spill quantity exceeds the "reportable quantity" of active ingredient specified in the law. Only a few of the pesticides routinely used in sod production are covered under these requirements. A complete list of pesticides and reportable quantities is available at the following website: http://www.floridadisaster.org/cps/SERC/htc1.htm.

Best Management Practices for Sod Farms



1.0 NUTRIENT MANAGEMENT [1]

Modern fertility programs are complex in nature, resulting from the interaction of many factors. One important factor is fertilizer cost, which comprises an increasingly large portion of the total sod production expense. Because of this and the potential for nutrient-related adverse environmental effects on water resources, growers must understand the specific crop nutrient requirement (CNR) for their particular variety of turfgrass and are encouraged to fertilize wisely using scientific principles.

One of the first steps in developing a sound turfgrass fertilization management program involves a basic knowledge of soils. Many of Florida's soils naturally contain the required amount of phosphorus, assuming the pH levels are within the range to make this element available. As such, routine soil testing and analysis is considered to be a cornerstone of any nutrient management program. Nitrogen, which is not analyzed as part of a routine soil test, is a critically important macronutrient for vegetative growth. Plant tissue testing, which can detect plant nitrogen levels, can be used in conjunction with soil testing to diagnose the overall effectiveness of a fertilization program. It is especially useful to help a grower fine-tune their fertilizer application program.

Working Definition:

Nutrient management is the judicious application of fertilizers to meet the crop nutrient requirement without adding excess nutrients that may cause water quality problems.

1.1 Soil and Tissue Testing BMPs

Refer to Appendix 4 for important information on soil and tissue sampling.

- ✓ 1. Use a soil test from a lab using the Mehlich-1 or another method approved by UF-IFAS, Extension Soils Testing Laboratory to determine P fertilization rate..
- ✓ 2. Use tissue testing to diagnose the effectiveness of a fertilization program and to determine the need for supplemental fertilizer applications.
- Maintain records of all soil and tissue test results and sample locations.

Set realistic yield and maturity goals. Some growers believe that N fertilization is the key to quicker maturity and, therefore, set maturity goals at unrealistic and rarely achieved levels. Excessive N can force excessive sod top growth and reduce "liftability" of the sod.

[1] **According to FDACS rule, applicable nutrient management practices must be implemented as soon as practicable after submittal of the *Notice of Intent*.**

1.2 Standard Fertilization Practice BMPs

√ 1. Know the CNR for N and P as specified in IFAS fertilization recommendations or other credible research and target this amount for total crop fertilization. In addition to specific fertilizer recommendations in this section, follow the general fertilizer application rates in the *Fertilization Guidelines for Sod Production* table on page 14 of this manual.

√ 2. Calibrate fertilizer application equipment. To the extent practicable, match the fertilizer bulk density to the equipment for maximum distribution uniformity.

√ 3. When applying soluble fertilizers, use smaller, more frequent applications to minimize potential for leaching.

√ 4. Avoid soluble fertilizer applications that exceed 50 lbs N/acre, and continue fertilizing throughout the season as needed. For newly planted fields or re-establishing ribbons, apply no more than 20 lbs soluble N/acre until the roots and grass begin to grow. Consider the use of precision application equipment to achieve this rate and to maximize production potential. Use extreme caution during this time as the sod's root system is not fully developed to intercept all available nutrients. Incrementally increase the fertilizer application rate in proportion to plant uptake potential.

√ 5. When possible, locate fertilizer loading activities away from ground water wells, ditches, canals, wetlands, sinkholes, and other sensitive areas.

√ 6. Only apply a supplemental application of N and/or K, when rainfall exceeds 3 inches in 3 days, or 4 inches in 7 days, when the results of a tissue analysis fall below the standard sufficiency ranges, or when documented plant stress results from saline water conditions.

Maintain records of the amount and type of fertilizer used per application.

1.3 Special Fertilizer Application BMPs

√ 1. Apply micronutrients only when a specific deficiency has been clearly diagnosed. Use foliar applications of micronutrients, including Fe, Mn, and B, especially on calcareous soils that tend to fix micronutrients in unavailable forms.

√ 2. Obtain a soil survey and identify whether the soil series in the table below exist on the property. These soils are very prone to leaching P and are more common in areas of Central and South Florida.

Common Uncoated Soils			
Archbold	EauGallie	Myakka	Ridgeland
Allanton	Eglin	Narcoosee	Satellite
Ankona	Estero	Nettles	St. Lucie
Basinger	Hallandale	Oldsmar	Smyrna
Broward	Hobe	Palm Beach	Valkaria
Canaveral	Immokalee	Pepper	Wabasso
Dade	Jonathan	Pomello	Wauchula
Deland	Lawnwood	Pomona	Waveland
Duette	Leon	Pompano	Zolfo

√ 3. Use a mixture of controlled-release and soluble N fertilizer sources during sod establishment and around environmentally sensitive areas such as springsheds, sinkholes, and wetlands.

√ 4. If using fertigation, apply after the root system has pegged-down or advanced into the inter-ribbon area.

1.4 Other Fertilizer Sources

√ 1. If using reclaimed water, adjust nitrogen and phosphorous fertilization rates as appropriate.

√ 2. Adjust fertilizer rate if using composted manures, treated domestic wastewater residuals, or other biosolids. Analyze these products before using them, to determine their nutrient concentrations.

Operation and Maintenance

- Store nitrogen-based fertilizers separately in a secure building away from solvents, fuels and pesticides. Many fertilizers are oxidants and can accelerate a fire.
- Excessive irrigation can result in fertilizer leaching. Remember that fertilizer and water management programs are linked. Maximum fertilizer efficiency is achieved only with close attention to water management.

Key References:

(1) UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops, http://edis.ifas.ufl.edu/SS163

(2) Agronomic Crops and Forages, http://jefferson.ifas.ufl.edu/ag_pages/cropspage.htm

(3) UF/IFAS Agronomy Department, http://agronomy.ifas.ufl.edu/AGPUBS.HTML

(4) Fertilization of Agronomic Crops, http://edis.ifas.ufl.edu/AA130

(5) Soil and Plant Nutrition, http://edis.ifas.ufl.edu/MG091

(6) Sod Production in Florida, http://edis.ifas.ufl.edu/LH066

(7) Best Management Practices for Alabama Sod Production. Alabama Agricultural Experiment Station, Auburn University, Auburn, Alabama 36849 July 2002

(8) UF/IFAS Fertility Considerations for Sod Production, http://edis.ifas.ufl.edu/pdffiles/SS/SS16400.pdf

(9) UF/IFAS Soil Testing and Interpretation for Florida Turgrasses, http://edis.ifas.ufl.edu/SS317

(10) UF/IFAS Selected Fertilizers used in Turfgrass Fertilization, http://edis.ifas.ufl.edu.SS318

(11) NRCS Conservation Practice Standard No. 590



2.0 IRRIGATION SCHEDULING

Irrigation scheduling consists of a collection of technical procedures developed to forecast the timing and amount of irrigation events. Often, irrigation scheduling decision-making is not based solely on technical procedures, but also on local experience and other limitations introduced by irrigation system infrastructure. Technical approaches to irrigation scheduling are complex because they require an understanding of many factors, including: turfgrass species water needs, soils, climate, irrigation method(s), management objectives, and regulatory constraints. Most irrigation scheduling methods are ultimately based on two approaches: (1) monitoring soil and/or plant water status, and (2) determining a soil water budget that forecasts irrigation scheduling events based on estimated water depletion in the root zone.

Bear in mind that with the exception of muck land sod production areas, Florida's sandy and course-textured soils have low water holding capacities and generally cannot store more than a few days worth of a crop's water needs.

Working Definition:

Irrigation scheduling is a planning and decision-making tool that the farm manager uses to best determine the sod farm's irrigation water needs.

2.1 Monitoring Soil and Plant Water Status

√ 1. Determine the available soil moisture content and maintain soil moisture within the recommended range for the crop and soil type. If soil moisture consistently remains near field capacity, over irrigation and nutrient leaching will likely occur.

√ 2. If soil moisture sensors are used, test and calibrate them as recommended per the manufacturer, place them in representative areas of the field, and use the appropriate device for the crop and soil type.

2.2 Forecasting Crop Water Needs

√ 1. Always manage irrigation and fertilization together. Poor irrigation management may undermine a well-designed fertilization program.

√ 2. Determine the daily potential evapotranspiration (ETp) levels and use these to help guide irrigation event decisions. For real-time ETp information, go to the website http://fawn.ifas.ufl.edu.

√ 3. Use water meters or equivalent measuring devices to determine how much water is actually applied.

- Keep records of irrigation amounts applied and total rainfall received. Use rain gauges to measure rainfall amounts.

2.3 Irrigation Scheduling

✓ 1. When irrigating, do not apply more water than the root zone can store. In general, apply no more than ½ to ¾ inches of water to established sod fields. Adjust irrigation timing and amount to account for rainfall events and growth stage of the turfgrass.

✓ 2. Minimize application losses due to evaporation and wind drift by irrigating early in the morning or late in the afternoon. Losses are also minimized when cloud cover is abundant and wind speed is minimal.

✓ 3. When sub-surface irrigation is used, maintain the water table at the lowest practical level.

✓ 4. Avoid excessive irrigation that leads to runoff for high use irrigation activities, such as new sod establishment and/or irrigation of ribbons for re-establishment.

Key References:

(1) ASABE Standard EP458, December 1994

(2) Irrigation Scheduling for Water & Energy Conservation in the 80's, ASAE Publ.23-81, Am. Soc. Agric. Engr., St. Joseph, MI.

(3) Water Use and Irrigation Management of Agronomic Crops, http://edis.ifas.ufl.edu/AA131

(4) Basic Irrigation Scheduling in Florida, http://edis.ifas.ufl.edu/AE111

(5) Efficiencies of Florida Agricultural Irrigation Systems, http://edis.ifas.ufl.edu/AE110

(6) Tensiometers for Soil Moisture Measurement and Irrigation Scheduling, http://edis.ifas.ufl.edu/ AE146

(7) NRCS Conservation Practice Standard No.449, http://www.nrcs.usda.gov

(8) ASCE, Evaporation and Irrigation Water Requirements, www.pubs.asce.org

(9) Florida Green Industries Best Management Practices for Protection of Water Resources in Florida



3.0 IRRIGATION SYSTEM MAINTENANCE AND EVALUATION

Many Florida sod growers use center pivot, linear sprinkler, or seepage as their primary means of irrigation. The irrigation system should be well-maintained, and operated at the highest practicable level of irrigation efficiency and uniformity. Without proper maintenance, system efficiency and uniformity of water application tend to decrease over time because of aging, weathering, and component breakdown.

Maintenance programs vary according to the type of irrigation system. For example, maintenance of flood or seepage systems may be limited to operational checks of pump stations and structures, including cleaning and maintaining ditches. Maintenance programs for pressurized pipe systems generally involve filtration, chlorination/ acidification, flushing, and repair or replacement of clogged emitters. Efficiently managed irrigation systems help ensure uniform sod growth, conserve water, and reduce operation and maintenance costs.

Working Definition:

Irrigation system evaluation and maintenance are management activities designed to maintain irrigation system components in good working condition, so that the entire system can perform according to design specifications.

3.1 General Irrigation Maintenance

To maintain your irrigation system successfully, you must know its potential peak efficiency, and its operating efficiency at the time of system evaluation. You can contact a Mobile Irrigation Lab technician or FDACS representative to schedule an evaluation of the irrigation system. MIL services are available free of charge, and provide an irrigation system evaluation with recommendations regarding system upgrades, irrigation scheduling, and other maintenance items. Below are key BMPs applicable to all irrigation systems:

√ 1. Determine the normal operating values for the irrigation system and its components.

√ 2. Periodically check system uniformity, defined as the degree to which an irrigation system can apply equal amounts of water at different locations throughout a field.

√ 3. Establish a written schedule for inspection and maintenance of all irrigation system components.

√ 4. Test water quality at least once each year. Changes in water quality may affect maintenance and fertilization requirements.

3.2 System-Specific Irrigation Maintenance

As applicable to your irrigation system:

✓ 1. Inspect overhead sprinkler nozzles for wear and malfunction, and replace them as necessary. Also, check nozzles to ensure that the correct combination of spacing, operating pressure, and type exists for proper overlap. Ensure that all replacement nozzles and other parts have identical flow and pressure characteristics.

✓ 2. Clean and maintain pump station and associated filtration equipment, so they operate at optimum levels.

✓ 3. Remove debris and control weeds in irrigation ditches and canals, to maintain desired water flow and direction. Use erosion-control measures to prevent sedimentation problems. Maintain water-level control structures (such as culverts and risers) to conserve water.

✓ 4. As needed, maintain land level design grade by re-grading.

Keep records on potential peak efficiency of the irrigation system, operating efficiency of the system, system-uniformity values, the evaluation and maintenance schedule, and maintenance performed.

Key References:

(1) Efficiencies of Florida Agricultural Irrigation Systems, http://edis.ifas.ufl.edu/AE110

(2) IFAS Extension Bulletin 217, http://edis.ifas.ufl.edu

(3) IFAS Extension Bulletin 248, Backflow Requirements When Using Public Water Supplies, http://edis.ifas.ufl.edu/

(4) Agricultural Engineering Fact Sheet AE-73, Potential Impacts of Improper Irrigation System Design, http://edis.ifas.ufl.edu/

(5) Design of Agricultural Irrigation Systems in Florida, http://edis.ifas.ufl.edu/AE064

(6) NRCS Conservation Practice Standard Nos. 442 and 351, http://www.nrcs.usda.gov/

(7) ASABE Standard Practice No.: S395, S436.1, S447, and EP458, http://asae.frymulti.com/default.asp

(8) IFAS Extension Bulletin 247, Efficiencies of Florida Agricultural Systems, http://edis.ifas.ufl.edu/ AE110

(9) The Irrigation Association, http://www.irrigation.org

(10) Florida Irrigation Society (FIS), http://www.fisstate.org/features.htm

(11) USDA NRCS Irrigation Web Page, http://www.wcc.nrcs.usda.gov/nrcsirrig/



4.0 SEDIMENT AND EROSION CONTROL MEASURES

The implementation of certain on-farm practices may inadvertently affect the quality of water discharged off-site. Removal of natural vegetation and/or topsoil in areas prone to soil erosion can change runoff characteristics and result in the loss of soil and increased sedimentation in water bodies. Other site sensitivity characteristics such as clay-type soils and/or sloped terrain can significantly increase the risk of erosion and offsite sediment transport. The end result is that sediments along with *adsorbed* nutrients and pesticides can increase the risk of contamination to surface waters or groundwater.

The first step in preventing erosion and sediment transport is to limit the amount of land that is cleared of vegetation and limit the loss of soil from sod fields. Examples of these types of BMPs which can help to accomplish this include conservation tillage, terraces, proper bed preparation, the use of silt screens, and critical area planting. The second step in preventing erosion and sediment transport involves the use of BMPs to limit the movement of sediments. Examples of these types of BMPs include sediment basins and diversions/terraces. Collectively, these management practices will reduce the mass load of sediment reaching a waterbody which will help improve water quality.

The use of more common erosion-control devices like silt screens, sediment traps, and sediment basins are described below. These BMPs should be employed progressively, meaning that whenever sod growers are establishing new sod farm fields or cutting sod during the rainy season; the appropriate BMPs should be used based on prevailing land features and risks to water resources. Use vegetated buffers first and subsequently employ silt screens, sediment traps or sediment basins as the need arises. By following these practices, sod growers can do their part to prevent erosion and sedimentation impacts, which will not only protect the water resources but also will ensure long-term productivity of agricultural farmland.

Silt screens are temporary barriers used to provide physical removal of solids. Sediment traps are small excavated areas that temporarily slow irrigation tailwater to allow settling. They should be used when silt screens alone do not provide adequate water quality protection. Sediment basins temporarily trap runoff water and allow sediments to slowly settle out. These small "catchment basins" are typically constructed before or after a control structure and help keep surface waters clean by keeping sediments and other potential pollutants out of waterways. Settling of sediments and suspended material on the bottom of these basins will also tie up many nutrients and/or pesticides present in runoff, which also improves surface water quality. From a design standpoint, sediment basins differ from water management district permitted storm-

water treatment systems because of their smaller size and focus on sediment removal. In the case of most sod farms, they may be used as a stand-alone feature when sediment traps do not provide adequate water quality protection.

Anionic polyacrylamides, commonly referred to as "PAM", are the most common chemical soil amendments for erosion control. They are water soluble high molecular weight polymers made up of many repeating subunits or monomers. "Polyacrylamide" and "PAM" are generic terms. The properties of various PAMs are very dependant on the size of the polymer. A familiar analogy in nature is the way simple glucose monomers are progressively polymerized into polysaccharides, pectins, starches, and cellulose. Anionic PAM is generally classified as an environmentally safe industrial flocculent and is widely used in municipal water treatment, paper manufacturing, food processing and other treatment applications.

The NRCS published an interim conservation practice standard for PAM use in January 1995. In that year about 50,000 acres were treated with PAM, realizing an estimated savings of up to one million tons of soil. The current Florida NRCS Conservation Practice Standard is Code 450. Use of anionic PAM is a BMP for both urban construction sites and agricultural lands to minimize irrigation or rainfall induced soil erosion.

4.1 Filter Strip Design and Construction

√ 1. Install filter strips if needed. Design filter strips in accordance with USDA-NRCS specifications.

4.2 Silt Screen Design and Construction

√ 1. Use silt screens when effective control is needed for 3 months or less. They are especially useful in sheet flow conditions but do not work in channelized flow conditions.

√ 2. Install silt screens below disturbed areas and install them perpendicular to the direction of water flow. Trench in, backfill and compact silt screens in accordance with the Florida Stormwater, Erosion, and Sediment Control Inspector's Manual in the reference section below.

4.3 Sediment Trap Design and Construction

√ 1. Install sediment traps within the water conveyance system when recurring sedimentation problems occur.

√ 2. Retrofit water control structures associated with sediment traps with flashboard risers.

4.4 Sediment Basin Design and Construction

√ 1. Design the basin so that its storage capacity shall equal or exceed the volume of sediment that is expected to be trapped during the planned useful life of the basin.

√ 2. Provide emergency drainage for safety and disease vector (e.g. mosquito) control.

√ 3. Design the basin and outfall control structure to handle a 10-year storm event (discharge). The embankment should have a minimum top width of 4 feet, and at least 2 horizontal to 1 vertical side slopes.

4.5 Chemical Soil Amendments

√ 1. Consider using PAM on non-peat soils, particularly in the non-vegetated areas such as roads, pivot wheel tracks or after harvest until ribbons have fully grown-in. This is especially important on heavier soils that are susceptible to erosion.

√ 2. Contact your PAM supplier to conduct "jar tests" to match the specific properties of the PAM polymer to your site before application. The effectiveness of flocculent activity is very dependent on the properties of the specific soil type.

√ 3. Adjust application rates based on soil properties, slope and type of erosion targeted and do not exceed 10 ppm. Because the use of PAM may result in an increase in infiltration on heavier soils, consider adjusting irrigation scheduling and/or tillage practices accordingly.

√ 4. For seepage irrigation, consider using the product once during the advance phase which is the time until the "wetted front" has reached the end of the row. For sprinkler systems, multiple applications may be needed in order to maintain erosion control.

Operation and Maintenance

- Reuse sediment basin water for routine irrigation needs, so long as water volumes and quality warrant.
- Install safety fencing around sediment basins, especially if near highly urbanized areas.
- Remove any sediment deposits on silt screens when they reach one half the height of the barrier.

Key References:

(1) USDA-NRCS Conservation Practice Standard Codes 350, 393, 450,468, 638, 587, and 601 http://www.nrcs.usda.gov/

(2) Farming for Clean Water in South Carolina: A Handbook of Conservation Practices http://www.epa.gov/owow/nps/bestnpsdocs.html#agriculture

(3) The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, http://www.dep.state.fl.us/water/nonpoint/ero_man.htm

(4) USDA Planning and Design Manual for the Control of Erosion, Sediment, and Storm water http://www.abe.msstate.edu/Tools/csd/p-dm/index.php

(5) FDEP and FDOT Design and Construction Manual



5.0 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) is a philosophy of managing pests that aims to reduce farm expenses, conserve energy, and protect the environment. IPM does not mean that pesticides will be excluded. Instead, it means that pesticides are just one of many tools used to manage pests. Pesticides should be used judiciously and only when needed. The goals of an IPM program are improved control of pests, more efficient pesticide management, more economical sod protection, and reduction of potential hazards to humans and the environment through reduced pesticide exposure.

IPM accomplishes these goals through the use of resistant plant species, improved cultural practices, biological control agents (parasitoids, predators), and selective use of pesticides. Although detailed IPM programs have not been developed for all types of cropping systems, IPM principles can be applied in many cases using logic.

Working Definition:

IPM is a broad, interdisciplinary approach to pest management using a variety of methods to systematically control pests which adversely affect sod production and quality.

5.1 Planning Steps for an IPM Program

Predict economic losses and risks so the cost of various treatments can be compared to the potential losses. When possible, select disease- and pest-resistant varieties.

✓ 1. Identify key pests and beneficial organisms, their life cycles, and factors affecting their populations.

✓ 2. Select preventive cultural practices to minimize pests and enhance biological control strategies. These practices may include soil preparation, crop rotation, resistant species, modified irrigation methods, and augmenting beneficial insects, if applicable.

5.2 Specific IPM Practices

✓ 1. Routinely monitor or scout sod fields, borders, and adjacent vegetation for pests and disease activity. Conduct scouting at the appropriate time of the day and year to better observe pest *signs* and *symptoms*.

✓ 2. Select pesticides that will control target pests, and use them responsibly because they can also harm beneficial insects. Rotate use of insecticide and fungicide classes to delay resistance development.

✓ 3. Evaluate the feasibility of spraying certain pes-

ticides at night to protect day-active (diurnal) beneficial insects.

✓ 4. Choose a chemical compound that has lower toxicity to aquatic organisms when applying a pesticide close to a stream, canal or pond and observe appropriate buffer requirements.

✓ 5. Coordinate pesticide applications with appropriate soil moisture conditions, weather forecasts, and irrigation scheduling requirements for effective application.

Maintain records to measure the effectiveness of IPM strategies.

5.3 Mix - Load Activities

✓ 1. Store crop protection products in a roofed concrete or metal structure with a lockable door, and locate this structure at least 50 feet from other structures and 100 feet from surface waters.

✓ 2. When practical, construct a permanent mix/load facility with an impermeable surface, and locate it away from wells and/or surface waters. Where permanent facilities are not practical, use portable mix/load stations. When field mixing is necessary, loading activities should be conducted at random locations in the field with the aid of nurse tanks. Use a check valve or air gap separation to prevent backflow into the nurse tank when filling a sprayer.

✓ 3. Develop and implement procedures to appropriately rinse, recycle, or dispose of empty crop protection product containers.

Key References:

(1) Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance by the Florida Department of Agriculture and Consumer Services and the Florida Department of Environmental Protection, http://www.floridaagwaterpolicy.com/BestManagementPractices.html

(2) Integrated Pest Management Program at the University of Florida, http://ipm.ifas.ufl.edu/

(3) USDA Regional Pest Management Centers Information System, http://www.ipmcenters.org

(4) Southern Region Pest Management Center, http://www.pmcenters.org/southern/

(5) Integrated Pest Management in the Southern Region, http://ipm-www.ento.vt.edu/nipmn/

(6) Biocontrol Web Site, http://cmave.usda.ufl.edu/biocontrol/

(7) University of Florida, Entomology and Nematology Department, http://entnemdept.ifas.ufl.edu/

(8) IFAS Circular PI-1, Use Management Practices to Protect Groundwater from Agricultural Pesticides, http://edis.ifas.ufl.edu/PI001

(9) IFAS Circular 1149, Integrated Pest Management Strategies, http://edis.ifas.ufl.edu/LH080

(10) IFAS Pest Control Guide for Turfgrass Managers http://jefferson.ifas.ufl.edu/ag_pages/2006TurfPestControlGuide.pdf

(11) NRCS Conservation Practice Standard Nos. 595, 702, 703



6.0 WELLHEAD PROTECTION

With the majority of Florida's existing water supply coming from groundwater sources (aquifers), coupled with the increases in demand that have been projected, it is extremely important that growers make every effort to protect this valuable resource. Wellhead protection, which involves the use of regulations and common-sense measures related to well placement and practices near wells, is one of the most important ways to protect the quality of groundwater sources. Over-pumping of high capacity agricultural irrigation wells may result in unforeseen problems, such as salt water intrusion, cross contamination of different aquifers, and/or inadvertent movement of potential contaminants within the well's zone of influence.

Working Definition:

Well head protection is the establishment of protection zones and safe land use practices around water supply wells in order to protect aquifers from accidental contamination. These practices are mandated by rule for public and private drinking water wells, but should be considered BMPs for all wells.

6.1 Well Planning

√ 1. Review your local comprehensive plan to see if land uses within wellhead protection areas conform to local codes.

√ 2. Contact your regional water management district to see if the well requires a consumptive use or water use permit. Wells that serve public water systems must also meet FDEP rule requirements in Chapter 62-521, F.A.C.

√ 3. Properly plug or valve abandoned or flowing wells before constructing any new wells.

√ 4. Construct wells as far as possible upgradient from likely pollutants such as fuel tanks, septic tanks or chemical mixing areas. Ensure that fuel tanks are properly designed, contained and registered.

6.2 Well Drilling and Operation

√ 1. Use a licensed Florida water well contractor and drill new wells according to local government code and water management district well construction permit requirements.

√ 2. Shallow wells should be properly screened, and deep wells should be cased at least 10 feet into the aquifer bed.

√ 3. Surround new wells with a concrete slab that is at least 4 inches thick and 2 feet wide in all directions. Extend casing above ground surface a minimum of 12 inches.

√ 4. Use backflow prevention devices when fer-

tigating or chemigating in accordance with state regulations.

- Maintain records of well construction. Proper records are important in case problems arise with the well.

Operation and Maintenance

- When feasible, verify the integrity of older wells. Many existing wells have no construction records and logging these wells can verify proper casing depths and integrity. Where possible, retrofit existing wells with a small concrete pad, as specified in 6.2.3, to protect the area around the casing.
- Inspect wellheads and pads regularly for leaks or cracks and repair them promptly.

Key References:

(1) NRCS Conservation Practice Standard No. 642, http://www.nrcs.usda.gov/technical/efotg

(2) Farming for Clean Water in South Carolina: A Handbook of Conservation Practices

(3) SJRWMD Aquifer Protection Program, http://sjr.state.fl.us/

(4) FDEP Rule 62-532, F.A.C.



7.0 WETLANDS AND SPRINGS PROTECTION

Wetlands and springs are important components of Florida's water resources. They often serve as spawning areas and nurseries for many species of fish and wildlife, perform important flood-storage roles, cycle nutrients in runoff water, contribute moisture to the hydrologic cycle, add plant and animal diversity, and provide valuable recreational opportunities for the public. Wetlands are complex transitional ecosystems between aquatic and terrestrial environments.

Springs, spring runs, and associated sinks are unique freshwater systems that emerge from the underlying limestone which is at or near the land surface. Prior to substantial development in Florida, wetlands and spring systems once covered about half of the state's surface. Today, that area has been greatly reduced, primarily because early water management efforts in Florida focused on draining wetlands to facilitate urban and agricultural lands development.

Under Florida Law, "wetlands" are defined as areas that are inundated or saturated by surface water or groundwater at a frequency and a duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps and marshes, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto. Chapter 62-340, F.A.C., entitled "Delineation of the Landward Extent of Wetlands and Surface Waters" contains the methodology that must be used by all state and local governments in Florida to determine the boundary between wetlands and uplands and other surface waters. The federal government (U.S. Army Corps of Engineers) uses the "1987 Manual" to determine the boundary between uplands and waters of the United States. In most cases, the boundaries determined by both methodologies are the same or very close.

Working Definition:

Wetlands are waters of the state and are defined in section 373.019(25), F.S. They are typically low landform areas with seasonal or permanent standing water that provide wildlife habitat and natural filtration. Springs are mostly clear surface water bodies that are naturally low in nutrients and originate from groundwater that emerges to the land surface.

7.1 Wetland Protection and Impact Avoidance

✓ 1. Use a county soil survey to help identify wetland soil types and/or other depressional areas – both of which may be unsuitable for crop cultivation.

√ 2. Use preservation, practical design alternatives, or modifications to eliminate or reduce adverse impacts to wetlands and other surface waters. Use the buffers prescribed below, unless the sod farm has an existing water management district permit. In this case, follow the buffer requirements set forth in permit.

√ 3. Maintain a minimum 25-foot undisturbed upland buffer exterior to the landward extent of all perennial watercourses and associated adjacent wetlands.

√ 4. Maintain a minimum 15-foot undisturbed upland buffer exterior to the landward extent of all on-site isolated wetlands.

7.2 Water Quality Treatment and Field Discharges

√ 1. Minimize adverse water quality impacts to receiving wetlands by using a treatment train concept. Pretreatment practices such as filter strips, buffers, swales, or holding water onsite can substantially reduce pollutants, especially suspended solids, and allow the wetland to more naturally assimilate nutrients.

√ 2. On steep slopes with a history of sedimentation impacts, consult with NRCS or FDACS staff to design and install upland sediment sumps landward of upland buffers to prevent scouring and minimize sediment transport.

√ 3. Use spreader swales and other means to encourage sheet flow through the upland buffer prior to discharging into wetlands, and maintain pre-development point(s) of discharge.

7.3 Special Criteria for First and Second Magnitude Spring Basins

√ 1. Create and maintain a 100-foot upland buffer from springs, spring runs and wet sinks.

√ 2. Develop and implement a written Irrigation and Nutrient Management Plan that incorporates measures to reduce the release of nutrients.

√ 3. Use controlled-release fertilizer and/or split applications on production areas that contribute surface water directly to springs, spring runs, and wet sinks.

Operation and Maintenance

- Limit the use of pesticides and fertilizers in and around wetlands and springs and be careful to avoid spray drift impacts.
- Do not impact any wetlands without first contacting USDA-NRCS staff, so that you will not jeopardize any federal program benefits.

Key References:

(1) NRCS Conservation Practice Standard Nos. 326 and 659, http://www.nrcs.usda.gov/technical/efotg

(2) Farming for Clean Water in South Carolina: A Handbook of Conservation Practices

(3) Water Management Districts' Environmental Resource Permitting Rule and Basis of Review

(4) Department of Community Affairs, Protecting Florida's Springs, Land Use Planning Strategies and Best Management Practices. www.dca.state.fl.us/fdcp/DCP/publications

(4) FGS Bulletin 66, Springs of Florida www.dep.state.fl.us/geology/geologictopics/springs/bulletin66.htm



8.0 DITCH CONSTRUCTION AND MAINTENANCE

Agricultural ditches and/or grassed waterways are essential components of the sod-field site plan and layout. As such, they can vary from field ditches to laterals and mains, which are sometimes connected to larger canal systems. Depending upon their configuration, ditches have an engineered limit or *conveyance capacity* that governs how much water the ditch can store or convey. It is important to know the type of turfgrass you are growing and its specific water requirements so that you can capitalize on existing soil moisture conditions before designing ditches.

An effective sod-field ditch network functions primarily to convey and distribute water without causing excessive erosion, water losses, and/or degradation of water quality to the downstream receiving system. Properly designed and constructed agricultural ditches are very important; however, equally important is the implementation of an appropriate maintenance program to ensure that the ditches function as designed.

Working Definition:

Agricultural ditches are constructed trenches dug for the purpose of removing excess water from the land and/or providing irrigation water for use by the crop(s).

8.1 Planning and Design

√ 1. Use mapping tools such as topographic maps, soil survey maps, and basic knowledge of the landscape to identify land contours, seasonal high watertable limitations and/or natural drainage outlets in order to plan the proposed ditch system.

√ 2. Use appropriate setback distances when drainage ditches are located close to jurisdictional wetlands to avoid lowering the water table.

8.2 Ditch Construction

√ 1. Stake the proposed ditch run and remove obstacles beforehand as needed. Construct ditches with spacing, depth, and side-slope consistent with on-site soil types. Refer to the USDA-NRCS Florida Drainage Guide for information on recommended construction based on specific soil types.

√ 2. Follow appropriate grades and plans, as specified during ditch excavation. *Spoil* material should be deposited in an upland location or reused on the farm field.

√ 3. During ditch construction, use temporary sediment and erosion control BMPs to minimize erosion and prevent water quality degradation.

√ 4. Stabilize bare soils and newly constructed ditch

banks through the permanent establishment of sod, native grasses, or other appropriate vegetative cover.

✓ 5. Install lateral ditches as needed to maintain adequate drainage, crown sod field beds, and create drainage outlets to discharge excess water. If installing grassed waterways as an alternative to ditches, design and construct them in accordance with USDA-NRCS specifications.

8.3 Systematic, Routine, and Custodial Maintenance

✓ 1. Routinely maintain ditches. Sediments in ditches reduce the cross-sectional area, increase the water velocity, and can lead to sediment deposition downstream. Spread sediment material back on field upland areas or roads.

✓ 2. Maintain a permanent vegetative cover where shallow water furrows are used. Selectively control broadleaf vegetation on ditch banks to maintain a grass cover compatible with turfgrass selection. Do not fertilize or use agrichemicals which are not labeled for aquatic use in these areas.

✓ 3. Protect ditch banks from erosion in areas subject to high water velocities, using *riprap*, concrete, headwalls, or other buffering materials.

✓ 4. Keep permanent records of the design cross-sectional area using basic survey techniques to define the ditch profile. This is especially important for large ditches that have a tendency to "fill in" over time, and may assist you in dealing with regulatory agencies having jurisdiction over surface waters.

8.4 Floating Aquatic Weed Control

✓ 1. Routinely remove any accumulated aquatic weeds at the riserboard control structure(s) to maintain proper drainage and prevent secondary environmental impacts.

✓ 2. Use a combination of physical control (e.g. floating barriers, screens, etc.), biological control (e.g. herbivorous fish), and chemical control (e.g. selective herbicides labeled for aquatic applications) to suppress and reduce weed problems.

Operation and Maintenance

- Maintain ditch bank side slopes per the applicable soil type. When side slopes exceed design standards or vegetation is absent, growers should install other site-specific BMPs to minimize erosion.

Key References:

(1) NRCS Conservation Practice Standard Nos. 388, 412, 607 and 608, http://www.nrcs.usda.gov/

(2) American Society of Agricultural and Biological Engineers (ASABE) Standard EP 302.4, Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas

(3) American Society of Agronomy: Drainage for Agriculture, http://www.agronomy.org

(4) The Florida Stormwater, Erosion, and Sedimentation Control Inspectors' Manual, http://www.dep.state.fl.us/water/nonpoint/ero_man.htm

(5) Water Management Districts' Environmental Resource Permitting Rule and Basis of Review



9.0 CONSERVATION BUFFERS

Conservation buffers include field borders, riparian buffers, and other non-production areas to conserve soil and water resources. Field borders are strips of permanent vegetation, either natural or planted, at the edge(s) of sod production fields. Field borders function primarily to reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Field borders can also be used as a management tool to help reduce harmful insect populations and can provide turning areas for farm equipment. A *riparian* buffer consists of natural shrub or forested vegetation adjacent to a watercourse to help reduce excessive amounts of sediment, organic material, nutrients, and pesticides in surface runoff from production areas. Riparian buffers also help to reduce excess nutrients and other chemicals in groundwater *lateral flow* that contributes to a receiving stream system's base flow. Riparian buffers are most effective on highly sloped lands when positioned next to perennial or intermittent streams, and areas with high groundwater recharge potential.

Working Definition:

Conservation buffers are permanently vegetated areas that function to conserve water and soil on site. A field border is a strip of permanent vegetation established at the edge of or around the perimeter of a farm field. A riparian buffer is generally an area of trees and/or shrubs located adjacent to natural watercourses.

9.1 Field Border Design and Construction

√ 1. Plan and design your fields so that the field borders are wide enough to allow them to function as turn rows for equipment.

√ 2. Locate borders around the entire perimeter of the field for optimal benefit or, at a minimum, in areas where runoff enters or leaves the field.

√ 3. Where needed, construct berms or other diversions to break up or redirect concentrated water flow within the borders.

√ 4. Plant borders using native species that are adapted to your climate and soil. Include herbaceous plants that attract beneficial insects and provide wildlife food and cover. Consider over-seeding the border with legumes for plant diversity and wildlife benefits.

9.2 Riparian Buffer Design and Construction

√ 1. Install a riparian buffer on sod production areas that exceed 1% slope and discharge to perennial or intermittent watercourses.

√ 2. Include a zone (identified as zone 1) that begins at the normal water line, or at the top of the bank, and extends a minimum distance of 15 feet landward.

√ 3. Include a zone (identified as zone 2) that

begins at the edge or landward extent of zone 1 and extends a minimum distance of 20 feet, and expand this distance up to 30% of the active floodplain width, as applicable. An additional zone 3 may be needed to address concentrated flow erosion.

✓ 4. Locate and size watercourse crossings to minimize impacts to buffer vegetation and function.

✓ 5. Construct buffers in accordance with USDA-NRCS Conservation Practice Nos. 390 or 391, as appropriate. Contact USDA-NRCS or FDACS to determine whether the installation of riparian buffers may be eligible for cost-share.

✓ 6. Use two or more native shrub and tree species based on their compatibility in growth, water and shade tolerance. Select species that re-sprout when establishing buffers nearest to watercourses.

Operation and Maintenance

- Remove sediment when 6 inches or more have accumulated at the field border.
- Repair rills and small channels that may develop across the border, and reseed as necessary.
- Control grazing if livestock have access to field borders.
- Inspect the buffer periodically, and restore as needed in order to maintain the intended purpose(s).
- Any use of fertilizers, pesticides and other chemicals to assure buffer function shall not compromise the intended purpose.
- Removal of tree and shrub products is permitted in all zones in accordance with recognized Florida BMPs. Replace dead trees or shrubs and carefully control undesirable vegetation to reduce competition.

Key References:

(1) NRCS Conservation Practice Standard Nos. 386, 390, 391, 393 and 412, http://www.nrcs.usda.gov/technical/efotg

(2) NRCS FL Technical Note Forestry FL-17, General Specifications for Establishing Riparian Forest Buffers, USDA, 1979, http://www.usda.nrcs.gov/

(3) Management For Wildlife, A Supplement to Wildlife Standard and Specifications for Florida. Gainesville, FL.

(4) Florida Forest Service Silviculture BMP Manual, 2000.

(5) Best Management Practices for Alabama Sod Production. Alabama Agricultural Experiment Station, Auburn University, Auburn, Alabama 36849 July 2002

(6) Farming for Clean Water in South Carolina – A Handbook of Conservation Practices.

(7) Predicting Soil Erosion by Water, A Guide to Conservation Planning with the Universal Soil Loss Equation (RUSLE). 1997. USDA Agricultural Research Service, Agricultural Handbook No. 703.



10.0 STORMWATER MANAGEMENT

Florida receives an average of 53 inches of rain per year. However, rainfall amount varies across the state by region, season, and year. Average rainfall tends to decrease as you move toward the central and southeastern parts of the state, and increase as you move toward the northwestern part of the state. In general, rainfall tends to occur more frequently during the summer months in Florida, especially in the central and southern areas of the state.

Alteration of the land, which may include construction of impervious surfaces such as roads, driveways, parking lots, urban and agricultural structures, etc., increases stormwater runoff during rainfall events. Improper stormwater management leads to on-site and offsite flooding, increased pollutant loading to surface and ground waters, erosion and sedimentation, and the loss of valuable fresh water resources. The need to address these stormwater impacts has led to the implementation of a comprehensive stormwater management program that is implemented cooperatively by FDEP and the water management districts (WMDs) to minimize flooding and stormwater pollution. Additionally, local governments and property owners have specific stormwater management responsibilities.

All new development activities, and some agricultural activities, especially those that alter on-site hydrology, are required to obtain an Environmental Resource Permit (ERP). The construction of a stormwater management system (e.g., retention or detention pond) may require an ERP or other WMD surface water management permit. Therefore, please check with your water management district before beginning construction of any stormwater management system.

While sod farming generally does not lead to stormwater problems, there may be individual farm circumstances that create the need for specific stormwater management practices. Some farms may already have an ERP or other WMD surface water management permit that incorporates onsite stormwater management requirements. However, if stormwater problems exist and are not addressed by a WMD permit, it is important that a sod grower develop and implement a stormwater management plan suited to the farm's unique circumstances.

Working Definition:

Stormwater management is the on-site management of rainfall and runoff through the use of nonstructural and structural BMPs to provide flood protection and water quality protection in the most cost-effective manner.

10.1 Stormwater Management Planning and Implementation

√ 1. If stormwater problems exist and are not

addressed by an ERP or other WMD surface water management permit, develop and implement a written stormwater management plan that specifically addresses various levels of rainfall, with the goal of reducing the volume of off-site discharge while maintaining an adequately drained root zone. Include guidelines for regular inspection of BMPs, and steps to implement operation and maintenance provisions.

√ 2. Operate and maintain the stormwater management system to meet design performance criteria.

√ 3. Evaluate the effectiveness of the plan, and make adjustments as needed.

In developing a stormwater management plan:

- Contact your local NRCS District Conservationist to obtain information about the soil types for the proposed or existing sod farm location. The District Conservationist can identify soil types that are historically prone to flooding or standing water. Evaluate the storage capacity, size, and elevations of existing ditches, ponds, creeks, rivers, and wetlands, and the size, layout, and elevations of the fields. You should also contact your county or water management district to obtain maps (FEMA, FIRM) or other information related to flooding issues at the proposed or existing location. You can access this information via the web at http://www.fema.gov/hazard/map/firm.shtm.
- Determine the maximum storm size for which you want to provide flood protection. The flood control design storm addressed by WMD ERP regulations varies from a 25-year, 24-hour storm to a 100-year, 3-day storm. For example, a 25-year, 24-hour storm produces from 8 to 10 inches of rainfall in a 24-hour period. Generally, the larger the design storm event used, the more extensive the stormwater management system needs to be. Factors that will affect this decision include land availability, the existence of internal natural features such as creeks, rivers, ponds, or wetlands, the potential to flood downstream property owners, and costs.
- Consult with a public or private agricultural engineer to discuss your stormwater management needs and considerations, especially if you are farming on marginal lands. Find an engineer qualified to provide an appropriate stormwater runoff analysis for your site.
- Include both nonstructural pollution prevention BMPs and structural BMPs, as needed.

Key References:

(1) NRCS Conservation Practice Standard Nos.554 and 570, http://www.nrcs.usda.gov/technical/Standards/nhcp.html

(2) Water Management Districts ERP Manuals, Basis of Review, Appendices

- NWFWMD http://www.nwfwmd.state.fl.us/permits/ruleform.htm
- SFWMD https://my.sfwmd.gov/portal/page?_pageid=734,1456414,734_1456346&_dad=portal&_schema=PORTAL&navpage=regulatoryguidance
- SWFWMD http://www.swfwmd.state.fl.us/rules/files/40d_basis_of_review.pdf
- St. Johns WMD http://www.sjrwmd.com/govboard/pdfs/ERP_gen_conditions.pdf
- Suwannee River WMD http://www.srwmd.state.fl.us/resources/40b-4-+atvofficialupdate10-25-05_2_.pdf

(3) ASABE Standard No. EP302.4 http://asae.frymulti.com/abstract.asp?aid=14738&t=2

(4) Florida Engineering Society Directory and Guide, http://www.fleng.org/pubs.cfm#FICEdandg



11.0 ACCESS ROADS

Agricultural access roads provide a fixed route for vehicles and farm equipment, and offer both ingress and egress for associated sod farms. Access roads range from seldom used "trails" to more substantial all-weather roads that offer greater year-round accessibility. Permanent sod farms require well-constructed roads to support the necessary vehicle weight associated with the transport of cut sod to market.

Properly constructed access roads help prevent water quality impacts by eliminating the formation of gullies; however, improperly constructed access roads are a potential source of long-term erosion and sedimentation problems. Moreover, access roads that are constructed entirely in uplands, constructed at or near grade, and that meet a minimum set of specifications will generally result in little to no impacts on water resources. Lastly, construction of access roads that result in the alteration of flow patterns may require a permit from the water management district, so check with them before proceeding.

Working Definition:

Agricultural access roads are generally upland constructed travel lanes designed to provide all-weather field entry without causing significant erosion and water quality impacts.

11.1 Road Planning

√ 1. Plan the location of the road and desired drainage features before construction, using soil survey maps, *topographic maps*, and/or available aerial photography in order to minimize watercourse crossings.

√ 2. Locate elevated access roads a minimum of 25 feet from regulated wetlands and other watercourses, except at crossings.

√ 3. Provide a turnaround area at the end of dead-end access roads.

11.2 Road Construction and Drainage

√ 1. Construct the road during dry conditions, use pervious construction materials, and try to complete construction several months before the rainy season begins and before the road is to be used.

√ 2. Balance cuts and fills to maximize the use of local materials, and to provide for good roadbed stability.

√ 3. Minimize road widths consistent with the type and size of vehicles.

√ 4. Keep road shoulders at a gentle slope for fill road construction in order to minimize erosion and to ensure adequate vegetative cover of

road shoulders. Slopes should not be steeper than 2:1 (horizontal to vertical) side slopes on cuts or fills.

✓ 5. Maintain pre-development hydrologic conditions or follow permit requirements as applicable. Use adequately sized and designed culverts, cross ditches, turnouts, and gravel crossings consistent with sound engineering principles.

✓ 6. Do not exceed 10 percent grades and use surface crowning to help direct road runoff into associated roadside swales. When access roads are adjacent to canals, wetlands, or other waterbodies, the roads should be sloped towards field production areas.

✓ 7. Stabilize soils with vegetation or armor around the culverts to prevent erosion when crossing watercourses.

Operation and Maintenance

- Check drainage structures periodically to maintain their function.
- Regularly repair soft spots, ruts and potholes in roads.
- Maintain vegetative cover on road banks and re-seed and mow as needed.

Key References:

(1) NRCS Conservation Practice Standard No. 560, http://www.nrcs.usda.gov/

(2) FDEP Stormwater and Erosion Control BMPs for Developing Areas, Chapter 6

(3) Florida Stormwater Erosion & Sediment Control Inspection Manual, http://www.dep.state.fl.us/water/nonpoint/ero_man.htm

(4) Florida Forest Service Silviculture BMP Manual, 2000.



12.0 MOWING MANAGEMENT

Mowing is an essential activity in sod production to control sod growth and inhibit weeds. Mowing encourages lateral growth and careful attention to it will result in a high-quality sod. It is important to set up a mowing schedule and to properly maintain equipment to minimize turf stress. Clippings from mowing must be managed to prevent negative impacts to water quality.

Working Definition:

Mowing is the cutting of sod fields to a specific height on a regular schedule in order to inhibit weed growth and promote lateral growth of the turf.

12.1 Mowing

When proper mowing frequency is followed, clipping removal in sod production operations is typically not necessary. Increased mowing frequency promotes more rapid establishment and minimizes duration of bare soil exposure.

√ 1. Select mowing equipment appropriate for the sod variety and field conditions.

√ 2. Establish a mowing frequency to maintain optimal turf growth. Increased mowing frequency promotes more rapid establishment and minimizes duration of bare soil exposure.

√ 3. Recycle, compost, or dispose of clippings in an environmentally acceptable fashion. Use care to minimize the build-up of clippings in waterways and irrigation ditches. Sweepers or vacuums may be used to prevent grass clippings from collecting within the sod.

Operation and Maintenance

- Mowers should be cleaned regularly and between fields if possible to reduce the spread of diseases, grass species, or pests.
- Keep mower blades sharp and well maintained to avoid damaging the sod.
- Sod being grown for seed production (for example, centipede) will be mowed less frequently. When the seed harvest is complete, collect and compost clippings.

Key References:

(1) Best Management Practices for Alabama Sod Production. Alabama Agricultural Experiment Station, Auburn University, Auburn, Alabama 36849 July 2002

(2) UF/IFAS Sod Production in Florida, http://edis.ifas.ufl.edu/LH066

(3) Florida Green Industries, Best Management Practices for Protection of Water Resources in Florida, June 2002

(4) Best Management Practices for Enhancement of Environmental Quality on Florida Golf Courses, 2007



13.0 SEASONAL FARMING OPERATIONS

Sod farmers typically operate year round. However, some sod farmers may also conduct associated ranching operations and practice a type of rotational farming where pastures are periodically renovated and planted in grass cover. Much of the agricultural land in South, South-Central and Southwest Florida is managed for cattle grazing. As such, ranching and compatible agricultural production systems such as sod farming are generally recognized as low-intensity agricultural uses. When properly managed, this type of operation provides year-round vegetative cover, thus benefitting soil and water properties overall. Some sod producers will harvest bahia grass from their pastures every fifth year or so, and this practice coincides with the establishment of improved pasture grasses.

Cow/calf operations with periodic rotations of sod should follow the criteria set forth in this chapter; and, during cattle-grazing periods, owners should follow the BMP practices in the *"Water Quality Best Management Practices for Cow/Calf Operations in Florida"*. Sod farmers not engaged in associated cow/calf operations should follow the BMPs prescribed elsewhere in this manual.

Working Definition:

Seasonal or temporary farms include planned and sequenced agricultural activities on relatively defined project areas for a limited time period. These farms, following completion of harvest, generally practice hydrologic restoration (return to pre-development conditions) and cover cropping.

13.1 Crop Planning and Design

✓ 1. Grow sod in a planned, regular scheme and rotation. Select appropriate species adapted to the local climate and soil conditions. Certain grasses such as bahiagrass are particularly suited when used in conjunction with cattle rotations.

✓ 2. Select cover or rotational crops that can add organic matter to the soil.

✓ 3. Know the carbon to nitrogen (C:N) ratio of any residue being incorporated into the soil. In general, materials that have a C:N ratio higher than 20:1 may temporarily immobilize inorganic nitrogen and produce nitrogen deficiencies in subsequent crops.

13.2 Fallow Requirements and Field Abandonment

✓ 1. Incorporate an average three-year sod rotation interval and follow minimum *fallow* requirements. If soil tests show a decreasing organic matter trend, then follow USDA-NRCS residue index recommendations.

✓ 2. Use appropriate wetland setbacks as referenced in the *Wetlands and Springs Protection* BMP in this manual.

✓ 3. Restore all agricultural surface water management system features (ditches) to predevelopment hydrologic conditions.

Keep permanent records of crop history, rotation intervals, etc.

13.3 Clippings Management

✓ 1. Adjust mowing height to promote an increase in turf density, root health, and less clippings. In general, a grass that spreads horizontally can usually be mowed shorter than an upright, bunching grass. Mow bahia grass to a height of 3 to 4 inches.

✓ 2. If clumping occurs, use equipment to lightly rake and distribute clippings over the entire sod field.

✓ 3. Store removed clippings on upland areas that have less than a 3 percent slope.

✓ 4. Compost the clippings and/or use the clippings for livestock feed.

Operation and Maintenance

- Use nutrient management practices. Conduct soil tests, follow the recommendations, and include the nitrogen contribution of legumes if planted.
- Incorporate crop residues into the soil to increase infiltration, reduce runoff, and improve soil moisture holding ability.
- Use irrigation management practices, as applicable.

Key References:

(1) NRCS Conservation Practice Standard No. 328 http://www.nrcs.usda.gov/technical/efotg

(2) Farming for Clean Water in South Carolina – A Handbook of Conservation Practices

(3) Best Management Practices for Alabama Sod Production

(4) Florida Green Industries, Best Management Practices for Protection of Water Resources in Florida

(5) Southwest Florida Water Management District, Agricultural Ground and Surface Water Management Program

(6) UF-IFAS Standardized Fertilization Recommendations for Agronomic Crops, SL-129

APPENDICES

APPENDIX 1. ADDITIONAL BMP REFERENCES

General BMP References

(1) *Best Management Practices for Alabama Sod Production*, Auburn University, July 2002.

This manual provides an overview of agronomic issues of sod production, various environmental protection practices, pest and pesticide issues, as well as information on species selection and warm season species. Currently, this manual does not reside on any website.

(2) *Best Management Practices for Agrichemical and Farm Equipment Maintenance*, Florida Department of Agriculture and Consumer Services, Florida Department of Environmental Protection, February 2000

This manual lists responsible handling and use of pest control products, and pollution prevention actions that can be implemented at farm maintenance areas that protect the environment.

http://www.floridaagwaterpolicy.com/BestManagementPractices.html

(3) *Florida Green Industries Best Management Practices for Protection of Water Resources in Florida*, Florida Department of Environmental Protection, Florida Turfgrass Association, June 2002

This manual provides information and guidance on turfgrass and landscape management practices to protect Florida's water resources. It is designed as an education guide for professional service providers.

http://www.dep.state.fl.us/water/nonpoint/pubs.htm#URBAN%20POLLUTION%20PREVENTION

(4) *Protecting Florida's Springs: Land Use Planning Strategies and Best Management Practices*, Florida Department of Community Affairs and Florida Department of Environmental Protection, November 2002.

This guide provides an introduction on the hydrologic importance of springs, comprehensive planning strategies, other information to manage development impacts, and specific criteria for other industries. http://www.dca.state.fl.us/fdcp/DCP/publications

(5) *The Florida Irrigator's Pocket Guide*, National Center for Appropriate Technology, USDA-Natural Resources Conservation Service, 2005

This guide lists both water management and equipment management practices and includes a schedule of common maintenance tasks. The guide also focuses on conserving and protecting water, soil, energy and natural resources. Currently, this guide does not reside on any website.

(6) *Water Quality/Quantity Best Management Practices for Florida Vegetable and Agronomic Crops*, Florida Department of Agriculture and Consumer Services, University of Florida – IFAS, Florida Department of Environmental Protection, 2005 Edition.

This manual provides a comprehensive list of 49 Best Management Practices which are used statewide for vegetables and agronomic crops. Nutrient and irrigation management practices are combined in one chapter, as these measures are inextricably linked for most row crop activities.

http://www.floridaagwaterpolicy.com/BestManagementPractices.html

(7) *Best Management Practices for Enhancement of Environmental Quality on Florida Golf Courses*, 2007.

This 136 page book discusses possibilities for environmental stewardship and pollution prevention at golf courses. It supersedes and expands upon the 1995 BMP document. This new document was written by FDEP in coordination with the Florida Golf Course Superintendents Association, Audubon International, the University of Florida, and many others. It is designed for used by superintendents, managers, and employees; developers and designers; planners and regulators; and concerned citizens. For convenience, the checklist, (Appendix E), is available separately.

University of Florida – Institute of Food and Agricultural Sciences References

Fertility Considerations for Sod Production, UF-IFAS, Fact Sheet SL-52

This fact sheet contains information about the macro and micronutrient needs of sod. It also contains recommended rates and scheduling for sod production.

http://edis.ifas.ufl.edu/pdffiles/SS/SS16400.pdf

Integrated Pest Management Strategies, UF-IFAS, Circular 1149

This circular describes the principles of integrated pest management (IPM) and advices strategies for implementation.

http://edis.ifas.ufl.edu/LH080

Sod Production in Florida, UF-IFAS, Bulletin 260

This bulletin gives an overview of sod production in Florida and contains general information about land preparation, species characteristics, fertilization, irrigation, pest control, and harvesting.

http://edis.ifas.ufl.edu/LH066

USDA – Natural Resources Conservation Service References

(1) Conservation Practice Standard No. 314 (Brush Management)

(2) Conservation Practice Standard No. 330 (Contour Farming)

(3) Conservation Practice Standard No. 342 (Critical Area Planting)

(4) Conservation Practice Standard No. 362 (Diversion)

(5) Conservation Practice Standard No. 464 (Irrigation Land Leveling)

(6) Conservation Practice Standard No. 460 (Land Leveling)

(7) Conservation Practice Standard No. 412 (Grassed Waterway)

(8) Conservation Practice Standard No. 393 (Filter Strip)

APPENDIX 2. CONTACT INFORMATION

Emergency Reporting

State Warning Point (24hrs.).....800-320-0519

Nat'l Response Center (24hrs.) 800-424-8802
Federal law requires the NRC to be immediately notified when a reportable quantity of a hazardous substance is released into the environment.

State Emergency Response Commission
(NOT a 24 hr No.) 800-635-7179
(For state spill reporting requirements. This is for follow-up reporting. In an emergency, call the State Warning Point. If Federal reporting is required, also call the National Response Center.)

Help line numbers for chemical hazard information and regulatory questions

CHEMTREC Hot Line
(Emergency only, 24 hrs) 800-424-9300
SARA Title III help line 800-535-0202
CERCLA / RCRA help line 800-424-9346

Non-Emergency Numbers

Florida Sod Growers Cooperative, Inc. 863-675-2144
Email: flspdgrpwers@aol.com
Web: www.floridasodgrowers.com

FDEP

FDEP Stormwater/Nonpoint Source Management Section (Tallahassee) 850-245-7513
FDEP Hazardous Waste Management Section (Tallahassee) 850-245-8705

FDACS

Bureau of Pesticides 850-487-0532
Bureau of Compliance Monitoring ...850-488-3314
Division of Agriculture and Environmental Services 850-488-3731
Office of Ag Water Policy.....850-617-1700
www.floridaagwaterpolicy.com

OAWP Field Offices

West Palm Beach 561-682-2845
Okeechobee.....863-462-5881
Sarasota.....800-320-3503
Tampa.....800-863-0797
Palatka.....386-329-4812
Live Oak 800-226-1066
Mariana 850-482-9914
Bartow 863-519-8472

National Pesticide Telecommunications Network
800-858-7378
Provides information on pesticides and pesticide poisonings. (24 hours a day, 365 days a year.)

University of Florida

Pesticide Information Office
(Gainesville) 352-392-4721
Agricultural Law Policy Office
(Gainesville) 352-392-1881
BMP Implementation Teams ... 772-468-3922 x122

USDA, Natural Resources Conservation Service
Gainesville 352-338-9500
web: www.fl.nrcs.usda.gov

Agricultural Mobile Irrigation Labs

Big Cypress Basin (U)
Bill Gaddis
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U = Urban Lab
A = Agricultural Lab
N = Nursery Lab

APPENDIX 3. GLOSSARY

Adsorbed – Adhesion to a surface in a thin layer.

Conveyance capacity – The amount of flow (generally expressed in cubic feet per second) that a canal/ditch can carry based on the size, shape, slope, and condition of the canal/ditch.

Denitrification – Microbial conversion of nitrate to gasses (N2 and N2O) under anaerobic conditions.

Diluent – A diluting substance.

Eutrophication – A condition where a water body is characterized by an overabundance of nutrients that feed a dense growth of algae and other organisms, and often results in oxygen depletion of the water body as the algae decays.

Evapotranspiration – The combined process of water evaporation and the loss of water from plants.

Fallow - To be left uncultivated or unplanted.

Hydrologic conditions – The status of water-related parameters in an area; those parameters are typically rainfall, and water levels above (ponds/lakes/reservoirs) and below (aquifers) ground.

Landward – Inland of the high water line of a stream or waterbody.

Lateral flow – The movement of water below ground along or parallel to a soil layer.

Perennial – Appearing every year.

Rinsate - Any solution containing pesticide residue which is generated from washing or flushing of pesticide containers and pesticide equipment.

Rip-rap – Large, loose angular stones that serve as a permanent erosion-resistant ground cover.

Riparian – Belonging or relating to the bank of a river or stream; of or on the bank.

Scout – Routinely monitoring fields, borders, and adjacent vegetation for insects and disease activity.

Signs – Evidence of disease in plants as indicated by the presence of disease-producing organisms or of any of their parts.

Soil water tension – The magnitude of the suction (negative pressure) the plant roots have to create to free soil water from the attraction of the soil, and move it into the root cells.

Spoil – The soil material obtained from excavating an area to construct such works as canals/ ditches and/or ponds. This material is typically used to build berms and/or dikes along or in the vicinity of the excavation site.

Symptoms – Evidence of disease in plants as expressed by the reaction of the plants to the presence of the irritating factor or organism.

Topographic maps – Detailed, graphic representation of the land surface elevations of a region.

Treatment train – A combination of best management practices picked because they work best with the characteristics of the site and are best suited to achieving the storm-water quality and quantity goals.

Uncoated sands – Sand particles that lack clay and organic matter coating, and have poor water and nutrient holding capacities.

APPENDIX 4. SOIL AND TISSUE TESTING INFORMATION

Soil Testing

Often the benefits of a soil test are assumed. The soil testing process comprises four major steps and understanding each one clearly will increase the reliability of the process tremendously. The steps in the soil testing process are:

- soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

Soil Sampling:

√ Divide your farm into areas for sampling. Separate sample areas with different crop growth, history or patterns, soil color, or lime or fertilizer histories. The sample you collect should represent the average for a uniform portion of the area sampled, and should be taken in a consistent fashion each year.

√ Use the proper sampling tools, such as a sampling tube or soil auger. If it is necessary to use a shovel or trowel, dig a V-shaped hole in the soil and slice a small slab from one side of the hole.

√ Identify samples by letter or number and keep a record of where the samples were taken.

√ Use a competent soil testing laboratory that uses calibrated soil test methodologies. Not all laboratories can provide accurate fertilizer recommendations for Florida soils. The Mehlich-1 soil test has been calibrated for sandy soils in Florida.

Soil samples need to be representative of the field and soil types and the soil analysis results will be only as good as the submitted sample is. Samples collected from areas that differ from typical characteristics of the farm should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area on the farm that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the IFAS Extension Fact Sheet SL181 for further information on soil sampling strategies.

Sample Analysis:

The soil samples that are submitted to the testing laboratories undergo a series of physical and chemical processes that are specific to the soil types, crops, and management regimes. Once the soil samples are homogenized through grinding and/or sieving, a precise volume of the sample will be extracted for plant nutrient through an extraction procedure. The following standard methods are followed at the IFAS Soil Testing Laboratories for different soils in Florida:

a) Mehlich-1 extraction - this method is performed on all acid-mineral soils up to a soil pH of 7.3.

b) AB-DTPA extraction - this method is performed on alkaline (calcareous) soils with a pH of 7.4 and above.

c) Water extraction - this method is used for extraction of P in all organic soils.

d) Acetic acid extraction - this method is performed on all organic soils for extraction of K, MG, Ca, Si, and Na.

It is extremely important that procedures used at the laboratories are well understood before submitting the samples since most BMPs are tied to the standardized procedures used by the labs at the land-grant universities in the state such as UF/IFAS. Similarly, it is also very important to note that the IFAS laboratory does not offer any test for N since there is no reliable test for plant available N under Florida conditions. N recommendations are based on crop nutrient requirements found in the research literature. More information regarding the procedures used at the IFAS Extension Soil Testing Laboratory in Gainesville can be found in the extension publication, Circular 1248.

Interpretation of Test Results:

The primary goal of state laboratories in offering the soil testing service is to provide interpretation of the soil test results based on soil test-crop response trials and field calibration of the test results with the optimum economic yields of the various plant species. Economic yield increases resulting from added nutrients cannot be obtained once the test results are interpreted as 'High' resulting in no recommendation for that particular nutrient. The interpretations provided are specific to the soil and plant species.

Current interpretation tables can be obtained from SL 189 - IFAS extension fact sheet.

Nutrient Recommendations:

To reiterate, nutrient recommendations based on soil test results are formulated based on the opti-

mum economic crop response to an added nutrient to the soil.

Tissue Testing

Tissue testing is the analysis and diagnosis of the plant's nutritional status based on its chemical composition. It is commonly performed as analyses on dried blades, leaves or dried *petioles* or on sap from fresh petioles, with results compared to recommended nutrient ranges.

Efficient fertilizer management is important to reduce costs, conserve natural resources, and to minimize potential impacts on the environment. These goals can be achieved through optimum management of the fertilizer component. Timely tissue testing is an important tool used in fertilizer management through monitoring the plant's nutritional status, and such testing is also used in diagnosing suspected problems like nutritional deficiency, toxicity or imbalance. As a management tool, tissue testing can increase a grower's return by preventing deficiencies that can reduce yield(s), market quality, and profitability.

Methodology:

Begin sampling soon after the crop is established and continue at regular intervals (weekly or biweekly). Individual plants, even side-by-side, may have different nutritional status. Therefore, by sampling a sufficiently large number of plants, the effect of this error due to inherent variability should be minimized. It is preferable to include a soil sample together with a tissue sample when submitting samples to a diagnostic lab, since the soil sample may indicate other factors - such as pH - that may influence crop growth, nutrient availability, and uptake. Avoid plant tissue testing if the field has received foliar nutrient sprays containing micronutrients or nutrient-containing pesticides. Also, avoid sampling plants damaged by pests, diseases, or other chemicals when trying to monitor the nutritional status of the sod.

Whole-leaf sampling will be most useful early in the season, while later in the season, it can help to point to changes in fertilization practices that are needed for the next season. Fresh petiole sap testing for N and K, practiced regularly throughout the season, can help manage the current crop as well as provide guidance for the next crop. Sample a recently matured leaf blade. Collect enough leaf material so that the sample is representative of the crop stand, and that the sample is large enough to perform the required analyses.

If a deficiency is suspected, collect one composite *sample* from the area exhibiting the disorder and a second sample from an otherwise "normal" section for comparison when trying to diagnose a nutrient deficiency. Separate and properly label the "disorder" sample and the "normal" sample in order to make a valid comparison after analyses. Keep notes on condition of the sod and stage of growth, weather, and other variables for future reference.

Be careful not to crush or damage samples during cleansing. Avoid using tap water to rinse blade samples, since it can be high in nutrients such as calcium, iron, magnesium, or sulfate sulfur. Use distilled water instead. In most situations, cleansing is not needed. Blot the samples dry with absorbent paper after rinsing, and air-dry the samples several hours before shipment. Wrap the samples in absorbent paper and place them in a large envelope if a plant analysis kit is not available, and mail immediately.

Select a reputable laboratory that provides interpretations and recommendations based upon test results, which are appropriate for your growing region. Interpretation guidelines should be based on actual field research, not on "typically observed" or historical lab databases. The laboratory should be reliable and accredited and also offer a routine turnaround of less than 48 hours.

For more information please see SL 131, Plant Tissue Information Sheet, Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Last revised July 2005.

http://edis.ifas.ufl.edu/SS182.

References:

Sartain, J.B. 2001. Soil Testing and Interpretation for Florida Turfgrasses. SL181. Soil and Water Science, Cooperative Extension Service. IFAS, p. 2. http://edis.ifas.ufl.edu/SS317.

Mylavarapu, R.S. and E.D. Kennelley. 2002. UF/IFAS Extension Soil Testing Laboratory Analytical Procedures and Training Manual. Soil and Water Science, Circular 1248, Cooperative Extension Service, IFAS, http://edis.ifas.ufl.edu/SS312.

Mylavarapu, R.S. 2002. The Process of Standardized Nutrient Recommendation Development for Successful Crop Production and Environmental Protection. SL 189, Soil and Water Science, Cooperative Extension Service, IFAS. http://edis.ifas.ufl.edu/SS401.

APPENDIX 5. INCENTIVE PROGRAMS FOR QUALIFYING FARMS

The implementation of Best Management Practices can reduce non-point sources of pollution, conserve valuable soil and water resources, and improve water quality. The implementation of these management practices can also be expensive and, in some cases, may not be economically feasible for agricultural producers. To reduce the financial burden associated with the implementation of selected practices, several voluntary cost-share programs have been established. These programs are designed to conserve soil and water resources and improve water quality in receiving water bodies. The narrative below is intended to provide basic information regarding the primary federal, state, and regional cost-share programs. Sources of additional information have also been included, and growers are encouraged to contact the identified agencies or organizations for current information about each program.

I. Programs Administered by USDA - Farm Services Agency (FSA)

Conservation Reserve Program (CRP) This program encourages farmers to convert highly erodible cropland or other environmentally sensitive lands to vegetative cover including grasses and/or trees. This land use conversion is designed to improve sediment control and provide additional wildlife habitat. Program participants receive annual rental payments for the term of the contract in addition to cost share payments for the establishment of vegetative cover. CRP generally applies to highly erodible lands and is more applicable to North Florida.

Conservation Reserve Enhancement Program (CREP) CREP uses a combination of federal and state resources to address agricultural resource problems in specific geographic regions. This program (which is not limited to highly erodible lands) is designed to improve water quality, minimize erosion, and improve wildlife habitat in geographic regions that have been adversely impacted by agricultural activities.

For further information on CRP and CREP, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at www.fsa.usda.gov.

II. Programs Administered by USDA - NRCS

Environmental Quality Incentives Program (EQIP) EQIP provides financial assistance (generally up to 75 percent cost share) to farmers for the implementation of selected management practices. Eligibility for the program requires that the farm have a NRCS approved Conservation Plan. Practices eligible for EQIP cost share are designed to improve and maintain the health of natural resources and include water control structures, conversion of seep to overhead irrigation systems, nutrient management and other erosion control measures. The 2002 Farm Bill made numerous improvements to the program and significantly increased available funding.

Emergency Conservation Program (ECP):
The ECP provides financial assistance to farmers and ranchers for the restoration of farmlands on which normal farming operations have been impeded by natural disasters. More specifically, ECP funds are available for restoring permanent fences, terraces, diversions, irrigation systems, and other conservation installations. The program also provides funds for emergency water conservation measures during periods of severe drought.

Small Watershed Program (PL-566)
The Small Watershed Program works through local government sponsors to help participants solve natural resource problems in watersheds of 250,000 or fewer acres. Technical and financial assistance is available for flood prevention, sediment control, water supply, water quality, fish and wildlife habitat enhancement, and wetlands creation and restoration.

Wetlands Reserve Program (WRP)
WRP is a voluntary program designed to restore wetlands. Program participants can establish easements (30-year or perpetual) or enter into restoration cost-share agreements. In exchange for establishing a permanent easement, the landowner usually receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. Under the 30-year easement, land and restoration payments are generally reduced to 75 percent of the perpetual easement amounts. In exchange for the payments received, landowners agree to land use limitations and agree to provide wetland restoration and protection.

Wildlife Habit Incentives Program (WHIP)
The Wildlife Habitat Incentives Program provides financial incentives for the development of fish and wildlife habitat on private lands. Program eligibility requires that landowners develop and implement a Wildlife Habitat Development Plan. Participants enter multi-year (5 to10 year) agreements with USDA-NRCS.

For further information on these programs, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at the following web site: www.nrcs.usda.gov

III. Programs Administered by State and Regional Entities:

Soil and Water Conservation Districts
In order to assist agricultural producers in the implementation of BMPs, the Florida Department of Agriculture and Consumer Services has executed a number of cost-share contracts with several of the state's Soil and Water Conservation Districts and Resource Conservation and Development Councils, Inc. Many of these cost-share contractors administer cost-share programs using *Applicant's Handbooks* which include reimbursement rates and grower selection criteria.

Water Management District Cost Share Memoranda: The Department of Agriculture and Consumer Services has executed Memoranda of Agreement (MOA) with certain Water Management Districts to provide coordination for BMP cost-share programs. Each MOA will identify the primary program areas within the District's geographical boundaries, and designates the agency responsible for program administration.

For further information on these programs, including eligibility criteria, please contact your local Water Management District, Soil and Water Conservation District or the Florida Department of Agriculture and Consumer Services. Information and links to other sites are also available on the Internet at the following web site: www.floridaagwaterpolicy.com

APPENDIX 6. EXAMPLE RECORD KEEPING FORMS

Producers are required to keep accurate records to document BMP implementation. Record keeping also aids producers in operating and maintaining BMPs. The tables below correspond to of all the mandatory record-keeping requirements contained in this manual. They serve as both a reference sheet and a set of templates to develop your own record-keeping system. You may maintain your records as hard copies or in an electronic format, depending on your preference. You may use these tables or choose commercially available record-keeping software suited to your commodity. However, at a minimum, your records should include the information categories in these tables.

Soil Sample Records				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Tissue Sample Records				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Fertilization/Nutrient Records						
Date	**Location**	**Acreage Covered**	**Type[1]**	**Formulation[2]**	**Grade[3]**	**Rate (Lbs/Acre)**

Rainfall (in.)											
Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**

[1] Organic, Inorganic, Chemical [2] Granular, Water Soluble, etc. [3] e.g. 10-10-10

Well Records

Location	Year Constructed	Constructed By	Last Modified	Modified By	Records Location

Irrigation Events

Date	Location	Amount Applied (Gal.)	Run Time (Hr.)	Conditions[1]

Irrigation Maintenance

Date	Location	Last Inspected	Motor Values[2]	Withdraw Rate (GPM)	Pump Values[3]	Current System Efficiency[4]	Records Location

Crop Yield and Rotations

Season	Location	Crop	Yield

Integrated Pest Management

Date	Location	Acreage Covered	Crop	Total Amount[5]	Formulation[6]	Pesticide Class[7]	Pest Targeted[8]

[1] Temperature, Wind Speeds, Cloud Cover, Time of Day [2] Energy Consumption (KwH) and Motor Amperage (Amps)
[3] Discharge Rate (GPM) and PSI (lb/in^2) [4] Source Withdraw vs. Crop Available (V_1:V_2) [5] Lbs/ac, gal/ac, etc.
[6] Dry, Liquid, Aerosol [7] Nematicide, Fungicide, etc. [8] Be Specific, e.g. Thrips

ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

FDACS–OAWP
1203 Governor's Sq. Blvd.
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Tallahassee. FL 32301

NOTICE OF INTENT TO IMPLEMENT
WATER QUALITY/QUANTITY BMPS FOR FLORIDA SOD

Rule 5M-9.004, F.A.C.

- **Submit a separate NOI for each county in which you are enrolling property.**
- Submit this **Notice of Intent to Implement (NOI)**, along with the **BMP Checklist**, to the Florida Department of Agriculture and Consumer Services (FDACS), as provided below.
- **Keep a copy of the NOI and the BMP Checklist in your files.** These documents must be completed, maintained, and available for inspection by FDACS, as one of the conditions for a presumption of compliance with state water quality standards. A submitted NOI and checklist are also required to be eligible for some sources of BMP cost-share funding.

If you would like assistance in completing this NOI form or the BMP Checklist, or in implementing BMPs, contact FDACS staff at (850) 617-1727 or AgBmpHelp@freshfromflorida.com.

Mail or fax this completed form and the BMP Checklist to:
FDACS Office of Agricultural Water Policy
1203 Governor's Square Boulevard, Suite 200
Tallahassee, Florida 32301
Fax: (850) 617-1701

☐ **Landowner or** ☐ **Leaseholder Information**

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Telephone: _____ FAX: _____

Email: _____

Authorized Contact Information

NOTE: If the Authorized Contact is the same as the landowner/leaseholder listed previously, please check:
☐ **Same as above.** If not, complete the authorized contact information below.

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Telephone: _____ FAX: _____

Email: _____

Complete the following information for the property associated with this NOI. You may list multiple parcels located within the same county.

Farm Name(s): _____

County: _____

Total Acres on which BMPs will be implemented: _____

Tax Parcel Identification Number(s) from County Property Appraiser

Please submit a copy of your county tax bill(s) for the enrolled property, with your name, address, and the tax parcel ID number(s) clearly visible. If you cannot provide a copy of your tax bill(s), please write the tax parcel ID number(s) below in the format the county uses.

Parcel No.: _____

Parcel No.: _____

Parcel No.: _____

(If necessary, use an additional sheet to complete your list of parcel identification numbers within the county.)

All or part of this property is already enrolled by me or a previous owner/operator under one or more existing NOI(s) in a FDACS BMP program.

☐ **Yes - Program(s):** _____

Enrolled Owner/Operation: _____

☐ **No, not already enrolled** ☐ **I don't know whether it is already enrolled**

In accordance with section 403.067(7)(c)2, Florida Statutes, I submit the foregoing information and the BMP Checklist as proof of my intent to implement the BMPs applicable to the parcel(s) enrolled under this Notice of Intent.

Print Name: _____

☐ **Landowner** ☐ **Leaseholder** ☐ **Authorized Agent** *(check one)*

Signature: _____ Date: _____

Name of IFAS or FDACS Staff Assisting with NOI:

NOTES:

1. You must keep records of BMP implementation, as specified in the BMP manual.
2. Please remember that it is your responsibility to stay current with future updates of this manual. Visit the following website periodically to check for manual updates: www.floridaagwaterpolicy.com.
3. You must notify FDACS if any of the following circumstances occur with regard to the parcel(s) enrolled under this NOI:
   a. Full or partial change in ownership following a real estate transaction
   b. Change in BMPs or BMP implementation schedule, including non-implementation of BMPs

FLORIDA SOD WATER QUALITY/QUANTITY BMP CHECKLIST

Instructions:

1. Refer to the manual and check "yes" for each BMP that you are currently practicing and will continue to practice.
2. For those BMPs that you plan to implement in the near future, enter the year you plan to implement them in the "Planned" column.
3. If a BMP is not applicable to your operation, check N/A. For BMPs you will not implement, check all of the following that apply under "No": TNF = technically not feasible, ENF = economically not feasible, or "Other". Explain checkmarks entered under the "Other" in the comments section at the end of this form.
4. According to FDACS rule, applicable nutrient management practices (1.0) must be implemented as soon as practicable after submittal of the Notice of Intent (NOI). All other BMPs identified in the NOI should be implemented as soon as practicable within the first year after the NOI is submitted.
5. Submit this BMP Checklist with your Notice of Intent (NOI) form, and keep a copy in your files.

	Yes	Planned	No *(check reason below)*			
BMP # / BMP Group (see body of manual for full description)	**Check below**	**Enter Year**	**NA**	**TNF**	**ENF**	**Other***
1.0 Nutrient Management						
1.1. Soil and Tissue Testing BMPs						
1. Use Mehlich-1 soil test results or equivalent to determine P application rate						
2. Use tissue testing to determine need for supplemental fertilizer application						
1.2. Standard Fertilization Practice BMPs						
1. Target fertilizer using table on page 14						
2. Calibrate fertilizer equipment properly						
3. Use split applications						
4. Avoid soluble N > 50 lbs/acre/application and <20 lbs on ribbons						
5. Fertilizer loading activities conducted in proper areas						
6. Supplemental N for leaching rain events						
1.3. Special Fertilizer Application BMPs						
1. Micronutrients applied when deficiencies exist						
2. Special P management for uncoated sands						
3. CRF used around sensitive areas						
4. Fertigate only after sod has pegged or advanced to inter-ribbon						
1.4. Other Fertilizer Sources						
1. Adjust fertilizer rates when using reclaimed water						
2. Adjust fertilizer rates when bio-solids are used						
2.0 Irrigation Scheduling						
2.1. Monitoring Soil and Plant Water Status						
1. Determine soil moisture content						

* Please enter "other" reasons for not implementing BMPs in the space provided at the end of the checklist.

BMP # / BMP Group (see body of manual for full description)	Yes	Planned	No *(check reason below)*			
	Check below	**Enter Year**	**NA**	**TNF**	**ENF**	**Other***
2. Test and calibrate soil moisture equipment						
2.2. Forecasting Crop Water Needs						
1. Manage irrigation and fertilization together						
2. Determine evapotranspiration levels						
3. Determine irrigation application amounts						
2.3. Irrigation Scheduling						
1. Base events on rainfall, soil capacity, and growth stage.						
2. Minimize application losses by early A.M. or late P.M. irrigation						
3. Maintain water table at lowest level for sub-irrigation						
4. Irrigate establishment fields and ribbons appropriately						
3.0 Irrigation System Maintenance and Evaluation						
3.1. General Irrigation Maintenance						
1. Determine system operating values and efficiency range						
2. Check irrigation system uniformity periodically						
3. Establish a maintenance schedule						
4. Test water quality annually						
3.2. System Specific Irrigation Irrigation Maintenance						
1. Inspect and replace sprinkler nozzles						
2. Maintain high pump station efficiency						
3. Clean and maintain ditches and water control structures						
4. Maintain land level design grade						
4.0 Sediment and Erosion Control Measures						
4.1. Filter Strip Design and Construction						
1. Use filter strips if needed						
4.2. Silt Screens Design and Construction						
1. Use silt screens (less than 3 months) for sheet flow						
2. Install silt screens properly						
4.3. Sediment Traps Design and Construction						
1. Install traps within conveyance system						
2. Retrofit associated structures with flashboard risers						
4.4. Sediment Basin Designs and Construction						
1. Storage capacity ≥ sediment volume						
2. Provide emergency drainage						
3. Design for 10-year storm event						
4.5. Chemical Soil Amendments						
1. Use PAM in non-vegetated areas						
2. Conduct jar tests with supplier						
3. Adjust application rates based on soil properties						

* Please enter "other" reasons for not implementing BMPs in the space provided at the end of the checklist.

BMP # / BMP Group (see body of manual for full description)	Yes	Planned	No (check reason below)			
	Check below	Enter Year	NA	TNF	ENF	Other*
4. Use correct application technique						
5.0 Integrated Pest Management						
5.1. Planning Steps for an IPM Program						
1. Identify key pests and life cycles						
2. Select preventive cultural practices						
5.2. Specific IPM Practices						
1. Use qualified scouts and monitor pest and disease activity						
2. Select pesticides for target pests and rotate accordingly						
3. Spray at night for certain pests						
4. Use less toxic products around water						
5. Coordinate applications with atmospheric and soil conditions						
5.3. Mix-Load Activities						
1. Store products in proper facility > 100′ from waters						
2. Use appropriate mix/load activities						
3. Dispose of containers appropriately						
6.0 Wellhead Protection						
6.1. Well Planning						
1. Review local comprehensive plan						
2. Research permit needs						
3. Cap or valve free flowing wells						
4. Construct new wells upgradient						
6.2. Well Drilling and Operation						
1. Use a licensed water well contractor						
2. Follow shallow well construction specifications						
3. Follow pad and casing specifications						
4. Use backflow prevention devices						
7.0 Wetlands and Springs Protection						
7.1. Wetland Protection and Impact Avoidance						
1. Identify wetlands using soil survey						
2. Eliminate or reduce adverse impacts to wetlands						
3. Maintain 25 foot upland buffer from watercourses						
4. Maintain 15 foot upland buffer from isolated wetlands						
7.2. Water Quality Treatment and Field Discharges						
1. Use a treatment train system						
2. Use sediment sumps on steep slopes with history of erosion						
3. Use swales to encourage sheet flows						
7.3. Special Criteria for First and Second Magnitude Springs Basins						

* Please enter "other" reasons for not implementing BMPs in the space provided at the end of the checklist.

BMP # / BMP Group (see body of manual for full description)	Yes	Planned	No (check reason below)			
	Check below	Enter Year	NA	TNF	ENF	Other*
1. Maintain 100 foot upland buffer around spring features						
2. Implement a written nutrient and irrigation management plan						
3. Use CRF or split applications on contributing areas						
8.0 Ditch Construction and Maintenance						
8.1. Planning and Design						
1. Use technical resources to plan ditch system						
2. Avoid hydraulic drawdown impacts to wetlands						
8.2. Ditch Construction						
1. Construct ditches consistent with soil type						
2. Follow appropriate plans and grades						
3. Use temporary erosion controls during construction						
4. Stabilize bare soils and newly constructed ditch banks						
5. Maintain adequate field drainage with lateral ditches and grassed waterways						
8.3. Systematic, Routine, and Custodial Maintenance						
1. Routinely remove sediment from ditches						
2. Maintain permanent vegetative cover and control broadleafs						
3. Use structural control measures in high water velocity areas						
4. Keep records of ditch cross sectional area						
8.4. Floating Aquatic Weed Control						
1. Remove aquatic weeds at water control structures						
2. Control problem aquatic weeds						
9.0 Conservation Buffers						
9.1. Field Border Design and Construction						
1. Plan and design field borders for equipment turning						
2. Locate and optimize field borders						
3. Assess the need for berms to redirect concentrated flows						
4. Plant borders using native species						
9.2. Riparian Buffer Design and Construction						
1. Install riparian buffer if > 1% slope						
2. Include zone 1						
3. Include zone 2						
4. Locate crossings to minimize impacts to buffers						
5. Use USDA-NRCS riparian buffer specifications						
6. Use native shrubs and trees in buffers						

* Please enter "other" reasons for not implementing BMPs in the space provided at the end of the checklist.

BMP # / BMP Group (see body of manual for full description)	Yes	Planned	No (check reason below)			
	Check below	Enter Year	NA	TNF	ENF	Other*
10.0 Stormwater Management						
10.1. Stormwater Management Planning an Implementation						
1. If stormwater problems exist develop a written plan						
2. Operate and maintain your stormwater system						
3. Adjust plan to render it effective						
11.0 Access Roads						
11.1. Road Planning						
1. Plan road location using technical resources						
2. Use 25 foot setbacks from wetlands for elevated roads						
3. Maintain a turnaround area at dead end roads						
11.2. Road Construction and Drainage						
1. Construct during dry conditions and use pervious materials						
2. Balance cuts and fills						
3. Minimize road widths consistent with vehicle use						
4. Keep slope on shoulders < 2:1						
5. Maintain pre-development hydrologic conditions						
6. Do not exceed 10% grades and slope roads toward fields						
7. Stabilize soils to prevent erosion around culverts						
12.0 Mowing Management						
12.1. Mowing						
1. Use mowing equipment tailored to variety and conditions						
2. Establish a mowing schedule						
3. Properly dispose of clippings						
13.0 Seasonal Farming Operations						
13.1. Crop Planning and Design						
1. Plan production based on variety and soil conditions						
2. Select cover crops to add organic matter to soil						
3. Know the carbon to nitrogen ratio of incorporated residue						
13.2. Fallow Requirements and Field Abandonment						
1. Use a three year rotation interval						
2. Use appropriate wetland setbacks						
3. Restore surface water features to pre-development						
13.3. Clippings Management						
1. Adjust mowing height and mow bahia 3-4 in						
2. Rake clippings if clumping occurs						
3. Place clippings in upland area with < 3% slope						
4. Compost or feed clippings to livestock						

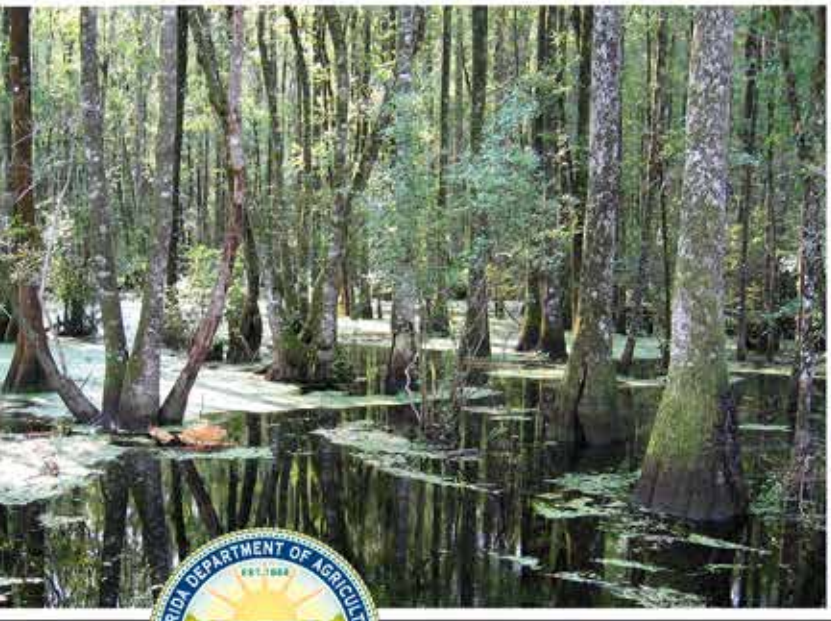
* Please enter "other" reasons for not implementing BMPs in the space provided at the end of the checklist.

Please enter "other" reasons below for not implementing BMPs.

BMP	Reason for not implementing BMP

Silviculture
Best Management Practices





Florida Department of Agriculture and Consumer Services
Adam H. Putnam, Commissioner

Acknowledgements

In the Fall of 1991, a 22 member Technical Advisory Committee began a process to review and revise the Silviculture Best Management Practices for Florida. That process which is currently on going includes many hours of study, much debate and discussion, and visits to the field, all of which contributed to and are reflected in this revision of the BMP Manual. In that regard, this Manual represents the Committee's collective best efforts to establish and maintain sound, responsible, guiding principles for silviculture operations in the State of Florida.

For commitment and numerous contributions toward the development of this document, the following agencies, organizations or companies, are most gratefully acknowledged:

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Committee Vice-Chairman

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Foreword



Introduction

This manual establishes the Best Management Practices (BMPs) for silviculture operations in Florida. These practices are designed as the minimum standards necessary for protecting and maintaining the State's water quality as well as certain wildlife habitat values, during forestry activities. As such, they represent a balance between overall natural resource protection and forest resource use.

In addition, these practices were developed specifically for silviculture and are intended to be applied on all such operations. However, they are not intended for use during tree removal or land clearing operations associated with development or other activities that have non-forestry objectives.

Best Management Practices for Silviculture in Florida were first established in the mid 1970's in response to the Federal Clean Water Act of 1972. Those original BMPs were designed exclusively to protect Florida's streams and lakes from potential sources of pollution associated with forestry activities.

In 1991, Florida's Agriculture Commissioner established a BMP Technical Advisory Committee which included representatives from state and federal government, university, forest industry and environmental groups. This committee was directed to review the existing BMP Manual and revise the practices where necessary to reflect the scientific, social and economic changes that have taken place since the original BMP development.

With this revision, some of the original practices have been retained as part of the continuing strategy to achieve water quality goals. However, many of these practices have been expanded to address additional water resource features such as sinkholes, smaller lakes, canals and wetlands. In addition, general ecological considerations and wildlife habitat values have been included in specific BMP objectives, resulting in expanded versions of original BMP concepts such as Special Management Zones, as well as new ones such as BMPs for wetlands, and cypress harvesting.

Although many of the relationships between silviculture activities and impacts to natural resources have been well quantified, many others have not. Consequently, as significant new information has become available, it has been incorporated into the practices in this Manual. To that end, the BMP Technical Advisory Committee will continue to meet biennially, in concert with BMP compliance monitoring, to evaluate the status and progress of BMP implementation and effectiveness.

Because of the extensive revisions to this document, some of the technical terms used in the Manual have specific definitions that may differ from conventional or traditional meanings. The reader is strongly advised to review the Glossary of terms prior to reading the Manual or implementing the practices.



BMP Monitoring and Regulatory Requirements

Since 1981 the Florida Forest Service has monitored BMP implementation by conducting a biennial Compliance Survey. Like BMPs in general, the Survey has traditionally been heavily oriented toward forestry activities involving intensive pine management, near streams and lakes. With the new and expanded practices in this Manual, BMP compliance monitoring was also revised. Following the development of this Manual in 1993, a BMP Monitoring Task Force revised the Compliance Survey making it compatible with the new BMPs, and more technically and statistically sound. The revised Survey was first used in 1995 and includes significant procedural changes such as a numerical scoring system for determining BMP compliance, special criteria for identifying a significant risk to water quality, and an expansion of the Survey into all Florida counties. The Survey has determined a statewide, long-term average of 94% compliance with silviculture BMPs.

In addition, a BMP Effectiveness Study was completed using the Survey as a measure of BMP compliance and using stream bio-assessment techniques to measure water quality. The study concluded that where silviculture BMPs were properly applied water quality, aquatic habitat and overall stream ecosystem health were protected.

The BMPs in this Manual are intended for implementation on all silviculture operations regardless of whether or not the operation is subject to other regulatory standards or permits. Anyone who desires to conduct silviculture activities that are not in compliance with this Manual must necessarily seek and obtain a permit from the appropriate local, state and/or federal government agency prior to conducting the operation. In addition, the maintenance of State water quality standards is required during all silviculture operations.

For the purposes of this Best Management Practices Manual, the cutting and removal of timber and associated activities to prepare land for development are not considered silviculture (see Glossary) and are controlled by other governmental permitting processes.

Special Management Zones



Introduction

The Special Management Zone (SMZ) is a BMP which consists of a specific area associated with a stream, lake, or other waterbody that is designated and maintained during silviculture operations. The purpose of the SMZ is to protect water quality by reducing or eliminating forestry related inputs of sediment, nutrients, logging debris, chemicals and water temperature fluctuations that can adversely affect aquatic communities. SMZs provide shade, streambank stability and erosion control, as well as detritus and woody debris which benefits the aquatic ecosystem in general. In addition, the SMZ is designed to maintain certain forest attributes that will provide specific wildlife habitat values. Snags, den and cavity trees as well as mast producing trees, left in the SMZ, are necessary to meet habitat requirements for certain types of wildlife.

As described in the following sections, the SMZ is subject to specific criteria, that defines operational restrictions, and special management objectives. In addition, the SMZ has a specific width which is based on the size and type of waterbody involved, and on the Site Sensitivity Class (SSC). The SSC is based on the local soil type and slope percent, which indicate the general potential for erosion and sedimentation. For determining the SSC, Florida soils have been classified as A, B or C, with A being stable and C being highly erodible. Percent ground slope has also been classified as 1 through 6, with 1 being relatively flat and 6 being very steep (Appendices 2 and 3).

The SSC for a given site is a combination of soil and slope percent and is expressed as A1 through C6. For example, an A1 site would have stable soils and flat topography, whereas a C6 site would have highly erodible soil and steep slopes. Likewise, the SMZ width associated with an A1 site would be relatively narrow compared to the SMZ associated with a C6 site (Appendix 1).

The Special Management Zone has three principal components - the Primary Zone, the Secondary Zone and the Stringer. One or more of these components may apply on a given forestry operation, depending on the SSC and on the type and size of waterbodies on site. The following sections provide a detailed description of the three SMZ components and the practices that are acceptable or prohibited within each one. Practices that are acceptable within all components of the SMZ include direct seeding, hand planting or machine planting on the contour of the land, prescribed burning for site preparation on slopes less than 18%, and basal application of herbicides and insecticides.



Primary Zone

The Primary Zone applies to perennial streams, perennial lakes, sinkholes with perennial water, Outstanding Florida Waters (OFW), Outstanding National Resource Waters (ONRW), Class I Waters, and in some cases wetlands (see Wetlands Section). Although forestry activities are allowed, this Zone has significant timber harvesting restrictions, and varies in width from 35 to 200 feet per side, depending on the type and size of the waterbody (see Appendix 1 and Application of SMZs). The Primary Zone provides water quality protection to adjacent waterbodies by maintaining shade, and by reducing the disturbance to ground cover vegetation and leaf litter. In addition, this Zone also provides important wildlife habitat values particularly for those species that require snags, cavities, tall trees and other characteristics generally associated with older and less disturbed forest conditions.

Selective timber harvesting and other forestry operations are allowed in the Primary Zone, subject to the specific management criteria listed below. However, selective harvesting within this Zone is intended to be conducted in conjunction with harvesting of a specific adjacent area. In addition, forestry operations, particularly harvesting and skidding, within the Primary Zone should exercise special precautions to maintain as much of the natural forest condition as possible. A decision not to harvest at all within this Zone may provide additional natural resource benefits.

Primary Zone • Management Criteria

A) Clearcut harvesting is prohibited in the Primary Zone except for special conditions described in Appendix 11.

B) Clearcut harvesting is always prohibited within 35 feet of all perennial waters and within 50 feet of all waterbodies designated as OFW, ONRW or Class I Waters.

C) Selective harvesting may be conducted to the extent that 50% of a fully stocked stand is maintained. The residual stand should conform to the following:

- **1)** Trees should be left to maintain the approximate proportion of diameter classes and species present prior to harvesting, except that oaks (other than water oaks) and den trees may be favored. However, in mixed pine/hardwood forests the residual stand may be composed of up to 90% hardwood and 10% pine, and den trees may be favored.
- **2)** Repeated entry into a harvested Primary Zone in short time intervals for additional harvesting is prohibited.
- **3)** No trees will be harvested in stream channels or on the immediate stream bank.

D) Special emphasis should be given to the following, within the Primary Zone of the SMZ:

- **1)** Protection of very large trees and/or old trees.
- **2)** Protection of snags and cavity trees.



3) Protection of trees where any part of the canopy overhangs the water.

E) The following forestry activities are prohibited within the Primary Zone of the SMZ:

1) Mechanical site preparation.
2) Loading decks or landings, and log bunching points.
3) Main skid trails, except to approach a designated stream crossing.
4) Aerial application, mist blowing or operational application (See Glossary) of pesticides or fertilizer, including any drift from nearby applications.
5) Cleaning spray equipment or discharging rinse water from pesticide or fertilizer applications.
6) New road construction except when crossing a waterbody.
7) Site preparation burning on slopes of 18% or greater.
8) No plowed pre-suppression firelines.

Secondary Zone

The Secondary Zone applies to all intermittent streams, intermittent lakes and sinkholes with intermittent water. In addition, for perennial waterbodies, OFWs, ONRWs and Class I Waters, the Secondary Zone may apply as an "add-on" to the Primary Zone (Figure 1 and Appendix 1).

For intermittent waterbodies, the Secondary Zone is always at least 35 feet wide on each side of a stream or around the circumference of lakes and sinkholes. Depending on the SSC, the width of the Secondary Zone for intermittent waterbodies may be as much as 300 feet (See Figure 2 and Appendix 1).

The SSC is used to determine the width of the Secondary Zone, in the case of intermittent waters, as well as the necessity for the Secondary Zone, in the case of perennial waters, OFWs, ONRWs and Class I waters. Generally, the more erodible the soil and the steeper the slope, the wider the Secondary Zone, and/or the wider the entire SMZ. Appendix 1 lists the SSC for all combinations of soil and slope conditions, and provides the width requirements for the applicable Special Management Zone under each condition.

The Secondary Zone has **no timber harvesting limitations** - unrestricted selective harvesting and clearcut harvesting are both permissible anywhere within the Secondary Zone. However, the following operational restrictions apply:

Secondary Zone • Operational Restrictions

1) No mechanical site preparation.
2) No main skid trails (except for stream crossings), loading decks or landings.
3) Do not clean spray equipment or discharge rinse water from pesticide and fertilzer applications.
4) No new road construction except for stream crossings.
5) No plowed firelines except during fire suppression.
6) No site preparation burning on slopes of 18% or greater.



Stringer

The Stringer applies only to intermittent streams, intermittent lakes and sinkholes with intermittent water, and is composed of trees left on or near the bank along both sides of these waterbodies. The Stringer can provide limited food, cover, nesting and travel corridors for a number of animals, especially birds.

Stringers are most beneficial when connected to larger Special Management Zones where they provide benefits to water quality by reducing the risk of sedimentation and bank damage. The presence of a Stringer provides a physical barrier, helping to ensure that heavy equipment operation in and around the water is minimal. Stringers also foster the use of designated crossings, and help equipment operators locate and identify streams and other water bodies during site preparation and skidding.

There are no specific requirements for species, size or spatial distribution of trees left in the Stringer. However, trees left in the Stringer should favor hardwood species, potential den trees and snags, and to the extent possible, provide a continuous, connected canopy except for designated stream crossings. All trees which occupy the immediate stream bank should be included in the Stringer.

Application of SMZs: Perennial Streams

Perennial streams are those that have a well defined channel and maintain flow or continuous pools of water throughout most of the year under typical climatic conditions. This includes natural streams that have been altered by dredging and/or straightening (see Canal Section). For perennial streams, the overall Special Management Zone is composed of a Primary Zone and, depending on the SSC, possibly a Secondary Zone. The Primary Zone for perennial streams ranges in width from 35 to 200 feet, depending on stream width or type, as shown in Table 1. Primary Zone widths in Table 1 are given for one side of the stream only. However, the Zone is applied to both sides of the stream. In addition, where the stream is connected to the inflow and/or discharge point of a flowing wetland, the Zone extends an additional 50 feet beyond the defined channel into the wetland (Figure 4). The Primary Zone is measured from the stream, beginning at the break in slope at the top of the stream bank, out to the designated width. Stream width is the typical bank to bank width of the stream within the harvest unit, measured in feet.

Table 1: Primary Zone Widths for Perennial Streams

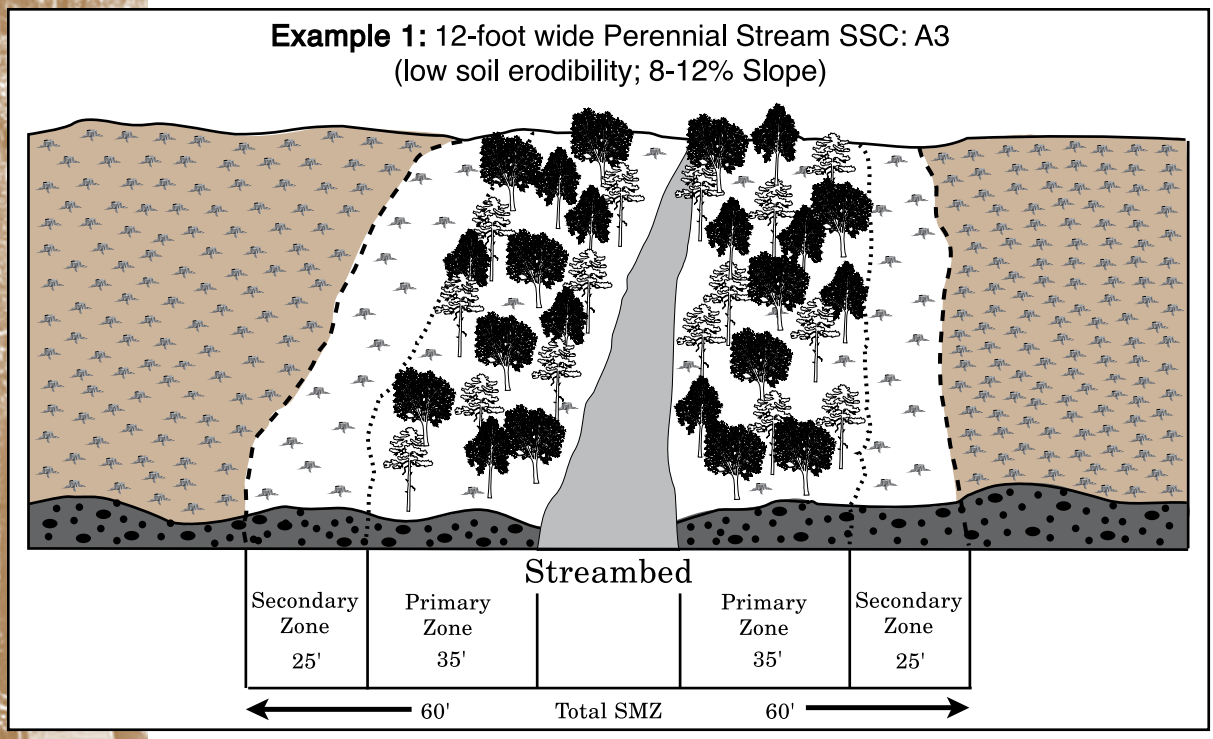
Stream Width/Type	Primary Zone
<20'	35' per side
20-40'	75' per side
>40'	200' per side
OFW	200' per side
Class I	200' per side
ONRW	200' per side

Selective timber harvesting is allowed within the Primary SMZ, consistent with the Primary Zone -Management Criteria. Clearcut harvesting is prohibited in the Primary SMZ, unless the operation qualifies as an **exception** as described in Appendix 11.

Depending on the SSC of the harvest unit, a Secondary Zone may also be required. If so, the Secondary Zone width is measured beginning at the outer boundary of the Primary Zone and continuing landward for the required distance as determined by the SSC (Appendix 1). Figure 1 shows examples of Primary and Secondary Zones on several different perennial streams, each with a different SSC. Note that where there is no Secondary Zone required, the Primary Zone is the total SMZ. Likewise, where the SSC is such that a Secondary Zone is required, the total SMZ width is the sum of the Primary Zone and Secondary Zone, up to a maximum of 300 feet.



Figure 1


Example 1: 12-foot wide Perennial Stream SSC: A3
(low soil erodibility; 8-12% Slope)
Streambed
Secondary Zone 25'
Primary Zone 35'
Primary Zone 35'
Secondary Zone 25'
60'
Total SMZ
60'

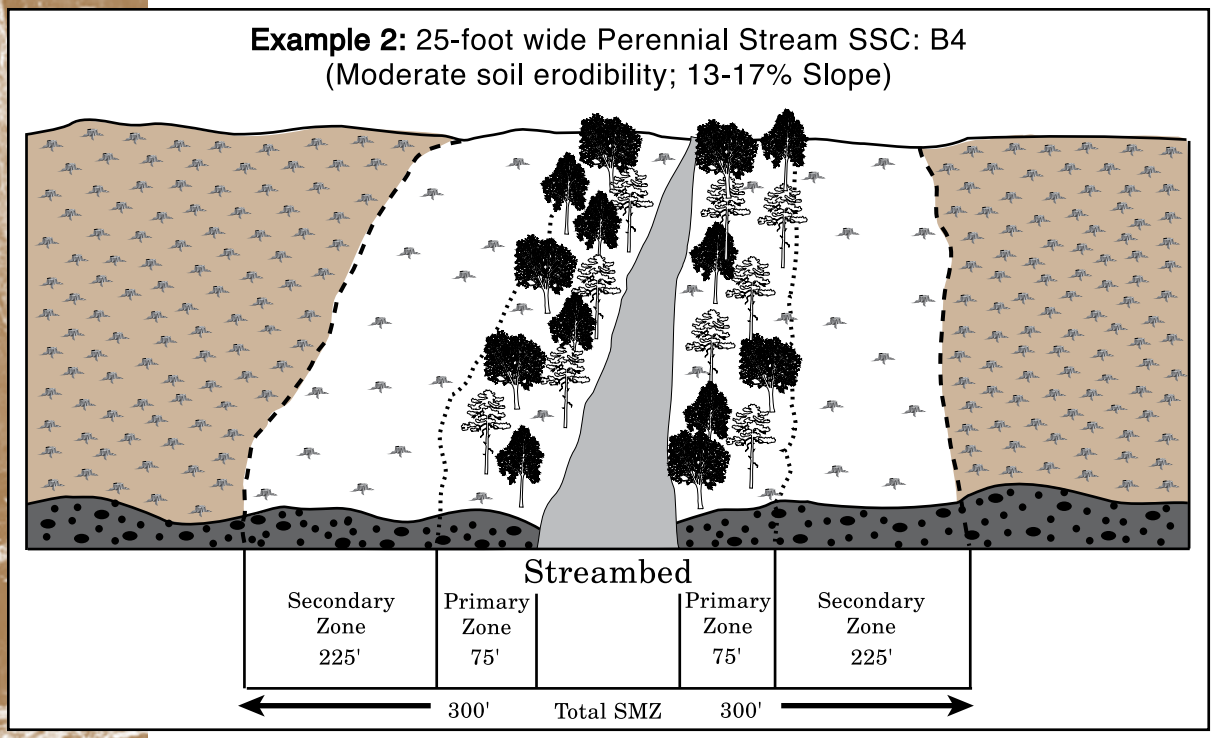
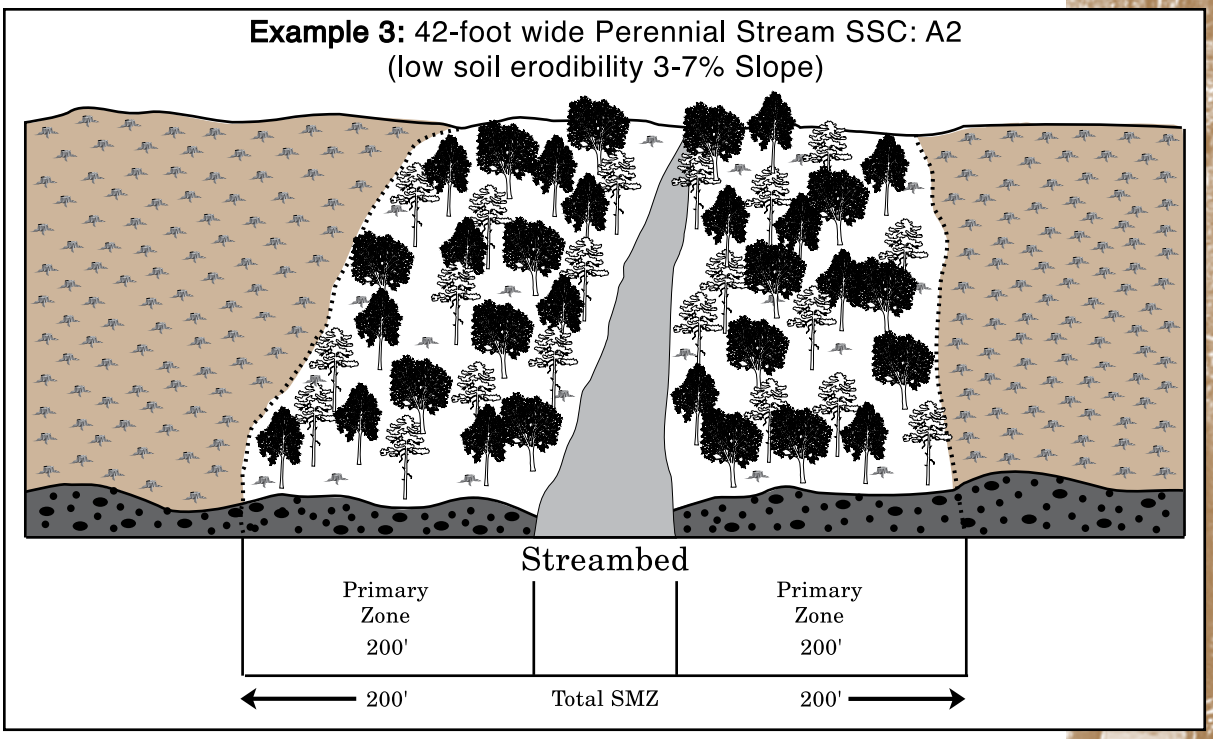
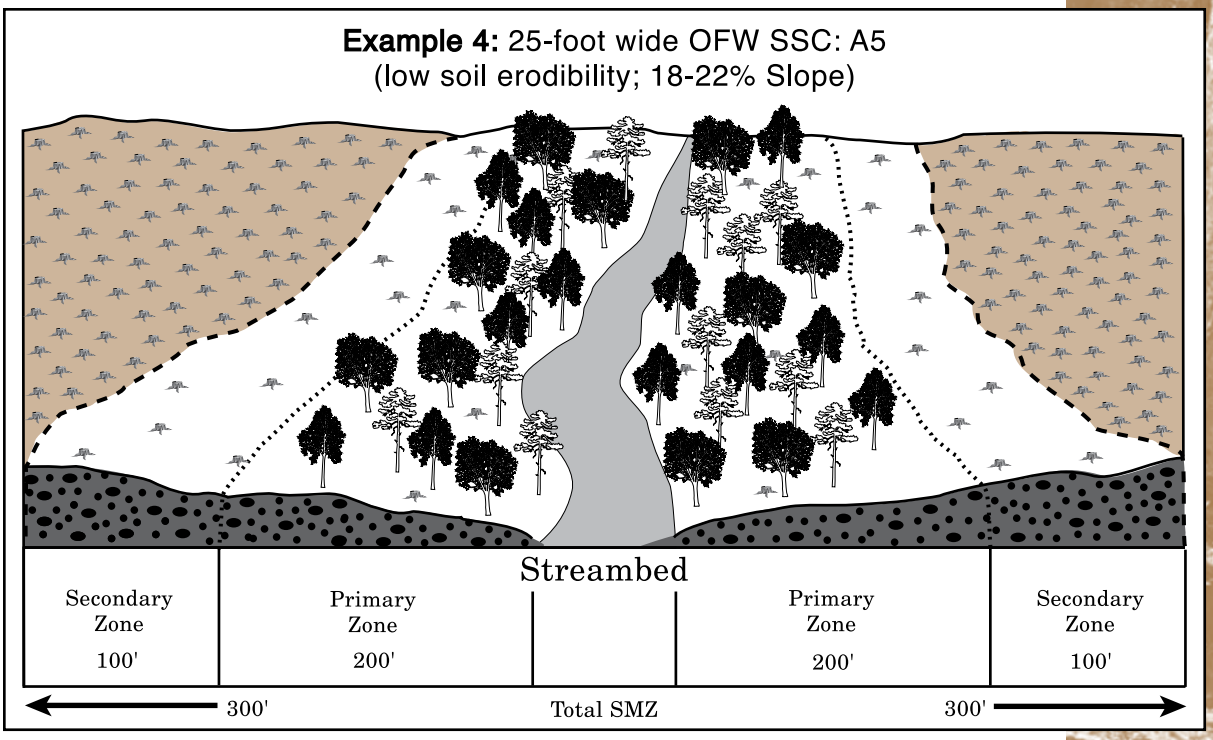

Example 2: 25-foot wide Perennial Stream SSC: B4
(Moderate soil erodibility; 13-17% Slope)
Streambed
Secondary Zone 225'
Primary Zone 75'
Primary Zone 75'
Secondary Zone 225'
300'
Total SMZ
300'

Figure 1 (continued)







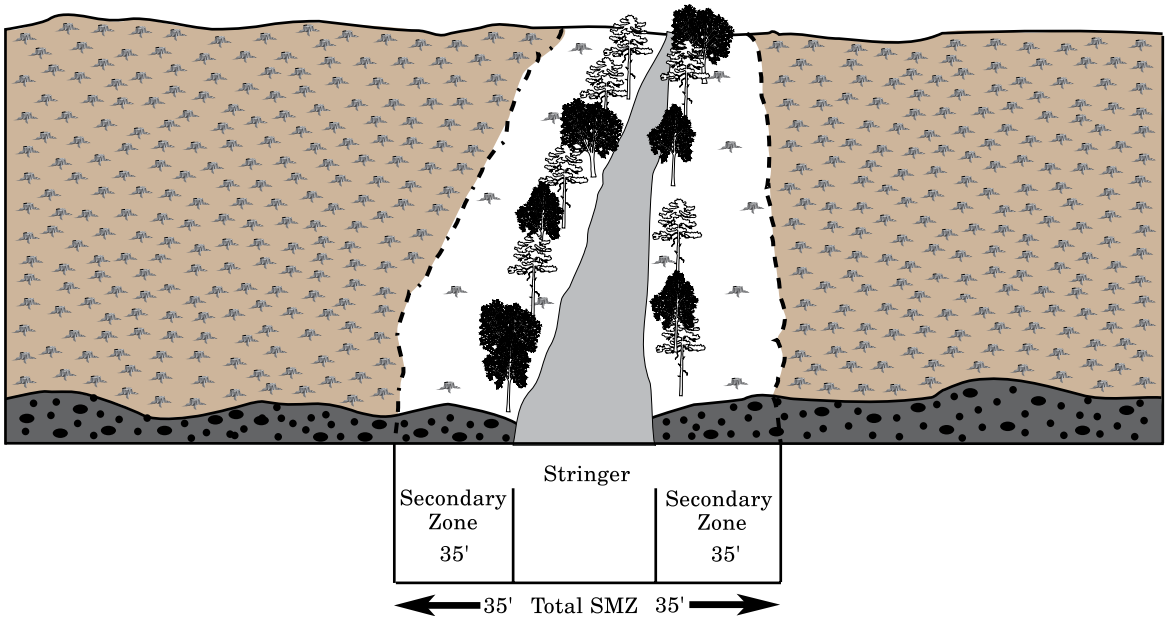
Application of SMZs: Intermittent Streams

Intermittent streams are those that have a well defined channel but maintain only seasonal flow under typical climatic conditions. This includes natural streams that have been altered by dredging and/or straightening (see Canal Section). For all intermittent streams, the Stringer is required. The total SMZ for intermittent streams consists of the Stringer, which occupies the immediate stream bank, and the Secondary Zone. The Secondary Zone, like the Primary Zone, is measured from the stream, beginning at the break in slope at the top of the stream bank, out to the designated width. In addition, where the stream is connected to the inflow and/or discharge point of a flowing wetland, the Zone extends an additional 50 feet beyond the defined channel into the wetland (Figure 4).

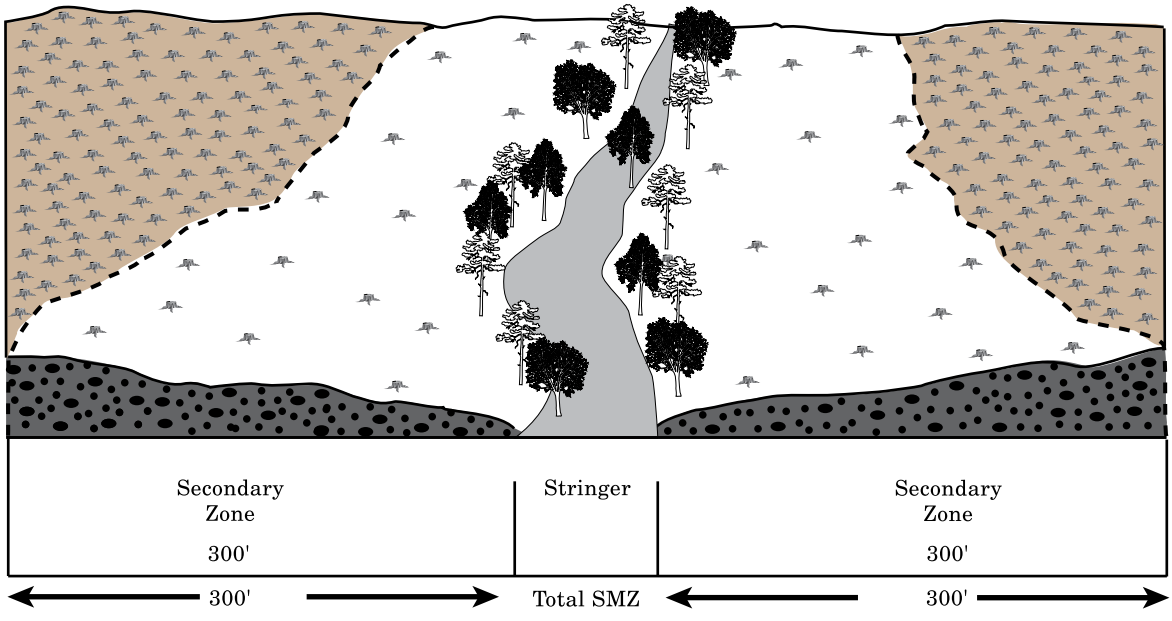
All intermittent waterbodies are afforded a Stringer and a Secondary Zone of at least 35 feet, regardless of the SSC. However, depending on the SSC, an intermittent stream could have a Secondary Zone as wide as 300 feet (Appendix 1). Figure 2 shows examples of Secondary Zones on several different intermittent streams, each with a different SSC. Note that the total SMZ is composed of the Stringer and the Secondary Zone - no Primary Zone applies to intermittent streams.

Figure 2

Example 1: 25-foot wide Intermittent Stream SSC: A1
(low soil erodibility; 0-2% Slope)



Example 2: 25-foot wide Intermittent Stream SSC: A6
(low soil erodibility; 22+% Slope)





Application of SMZs: Lakes, Sinkholes and Special Waters

Perennial Lakes and Sinkholes

A Primary Zone of 35' applies to all perennial lakes that are 2 acres or larger in size, and to sinkholes that maintain perennial surface waters. This Zone is measured from the lake or sinkhole, beginning at the break in slope at the top of the shoreline, out to the designated width. In addition, a Secondary Zone may apply to these waterbodies depending on the SSC associated with the harvest unit (Table 2). The Secondary Zone, if required, would begin at the outer boundary of the Primary Zone and continue outward from the lake or sinkhole the specified distance (See Appendix 1).

Intermittent Lakes and Sinkholes

A Stringer and a Secondary Zone of at least 35 feet apply to all intermittent lakes that are 2 acres or larger in size and to sinkholes that maintain intermittent surface waters (Figure 3). Depending on the SSC associated with the project site, the Secondary Zone could extend out as much as 300 feet (Appendix 1).

Table 2: SMZ Widths for Lakes, Sinkholes & Special Waters

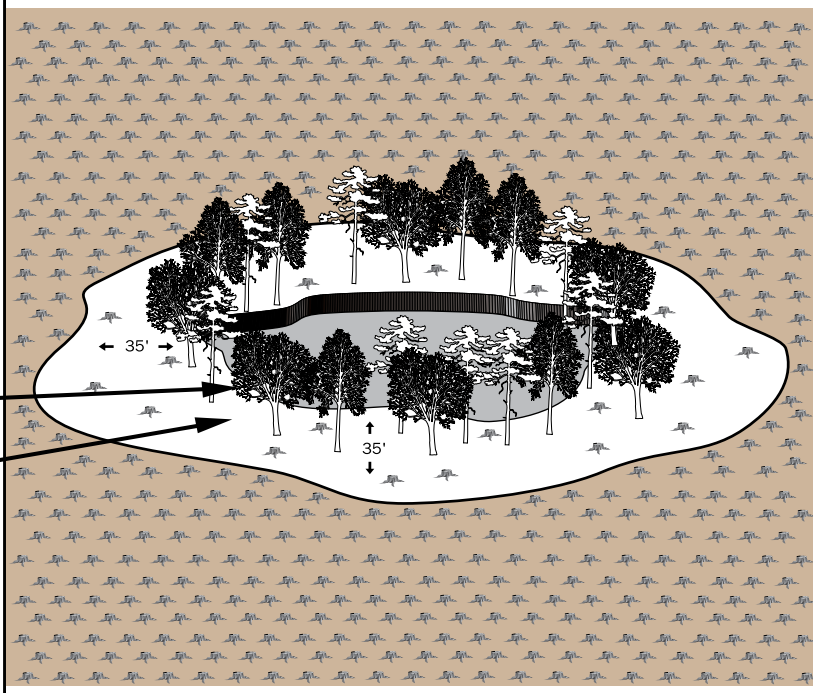
	Perennial		Intermittent	
	Primary Zone	*Secondary Zone*	*Primary Zone*	*Secondary Zone*
Lakes	35’	varies with SSC	(Stringer)	min. 35’
Sinkholes	35’	varies with SSC	(Stringer)	min. 35’
OFW	200’	varies with SSC	200’	varies with SSC
ONRW	200’	varies with SSC	200’	varies with SSC
Class I	200’	varies with SSC	200’	varies with SSC

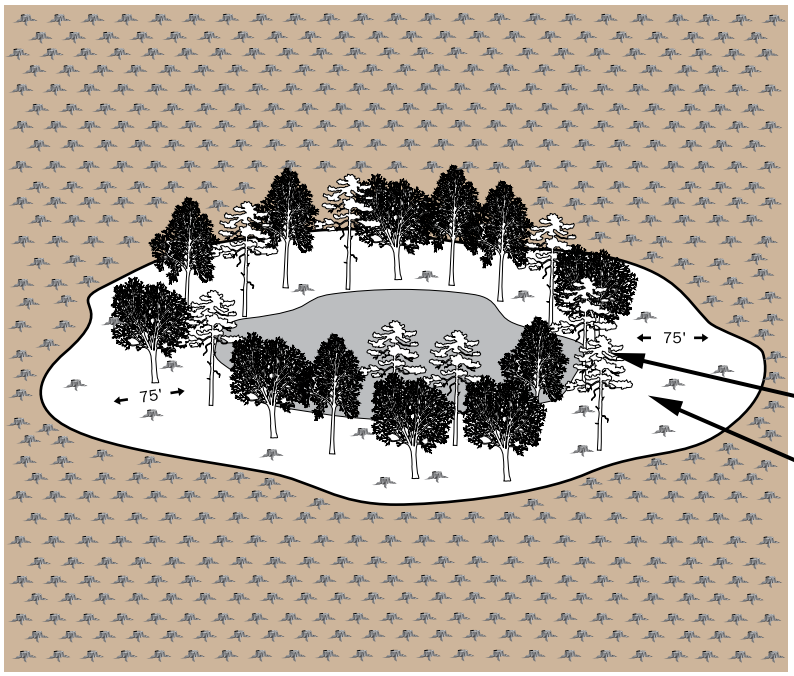
Outstanding Florida Waters, Outstanding National Resource Waters and Class I Waters

Outstanding Florida Waters (OFWs) and Outstanding National Resource Waters (ONRWs) are waterbodies that have been identified as having unique and/or exceptional values and therefore are afforded extra protection from potential sources of pollution. Class I Waters are those that have been designated as a drinking water supply and are also afforded extra water quality protection. For these reasons, a 200 foot Primary Zone applies to all OFWs, ONRWs and Class I Waters, regardless of the type or size of the waterbody. A list and location of these waterbodies is provided in Appendix 4.

Figure 2 (continued)

Example 3:
Intermittent Sinkhole,
5 acres in size;
SSC: A1



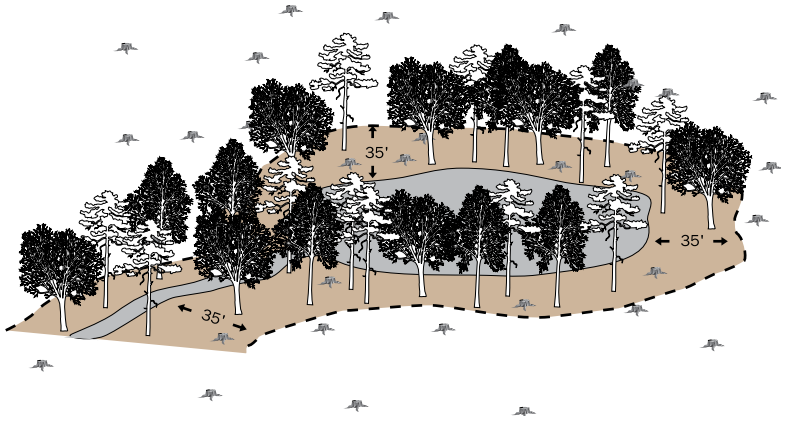


Example 4:
Intermittent Lake,
5 acres in size;
SSC: B3

Stringer

Secondary Zone

Figure 3

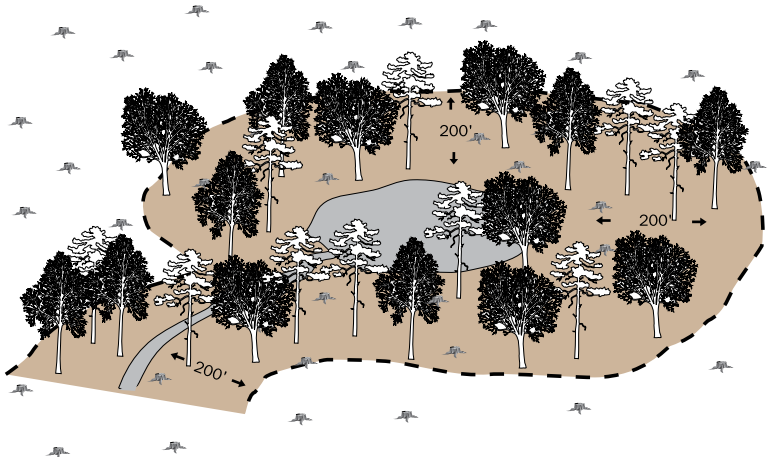


Example 1:
Perennial Lake,
5 acres in size;
SSC: A1

Primary Zone

Example 2:
Perennial Lake,
5 acres in size;
OFW Designation
SSC: A1

Primary Zone



Best Management Practices

Introduction

The following sections of this Manual provide the listing and application of Best Management Practices established for silviculture operations in Florida. The BMPs are arranged by specific application to various land types, waterbody types, forestry activities and special conditions. It should be noted that the Special Management Zone concept, described in the previous section, is also a BMP and is frequently referenced under the various BMP applications.

The Best Management Practices in this Manual are generally presented as individual practices within a particular category. However, the basic BMP concept is the implementation of all practices that apply to a given forestry operation. In that regard, no single practice is designed to accomplish the total BMP objective. For example, applying the SMZ criteria to a stream within a forestry operation without regard for other applicable BMPs, could significantly reduce the effectiveness of the SMZ to protect water quality. On a given forestry operation, the effectiveness of any particular practice, as well as overall BMP effectiveness, is largely dependent upon the implementation of all applicable BMPs throughout all aspects of the operation.





Application of BMPs: Public Lands

Unlike forest management on private lands, the need to derive economic return may not be the dominant force that leads to public land ownership or drives public land management. Often, the acquisition and management of public land has as its objective, to maximize ecological restoration, preserve existing natural resources and facilitate optimum public use.

When such is the case, the BMPs in this manual must be considered as minimum standards that, by themselves, will not always achieve public land management goals. Consequently, public land management agencies charged with developing and implementing management plans for public lands should do so in conformance with this Manual, and to the greatest extent practical, with the following enhancements:

Areas within the Special Management Zone designated as a Primary Zone should be managed as a no-cut zone. Any timber harvesting within these no-cut zones should be limited to operations that are in association with ecological restoration or wildlife habitat enhancement practices. However, isolated wetlands and intermittent streams on state forests shall be exempt from OFW derived Primary Zones. Each individual state forest, within the forest management plan, shall prescribe management practices for isolated wetlands and intermittent streams on a case by case basis.

The Special Management Zone is only one of the BMP concepts that may warrant additional consideration by land managers prior to implementation on public lands. Public land management agencies are advised and encouraged to augment the BMPs where appropriate, particularly on lands that are managed for non-forestry objectives. Protection of forested wetlands within these lands should be given special consideration.

In addition, such agencies should maintain environmental/ecological inventories of public lands and actively implement and study alternatives that exceed the BMPs in this manual. Results should be well documented to help facilitate future BMP revisions. Copies of enhanced management plans or any such studies should be forwarded to the Florida Department of Agriculture and Consumer Services, Florida Forest Service.

Note: *Public land management agencies must often adhere to specific legislative provisions or policies when developing and implementing management plans on certain public lands. In particular, the USDA Forest Service is constrained by the Clean Water Act, the National Forest Management Act, and National Environmental Policy Act to develop and implement a Land and Resource Management Plan that will govern management of certain federally-owned forested land. Similar constraints may occur in legislation that governs acquisition and management of lands owned or controlled by local, regional, or state agencies.*

To the extent that adherence to these BMPs do not conflict with legislatively established management goals, objectives, requirements, or mandates, public agencies are required to incorporate these BMPs into management plans. In addition, to the greatest extent practical, public agencies are encouraged to incorporate the above BMP enhancements wherever applicable.

Application of BMPs: Wetlands



For regulatory purposes, wetlands are defined by the presence or absence of specific types of vegetation, soils and hydrologic conditions. However, it is not the intent nor within the scope of this Manual, to define wetlands for regulatory purposes or to use any particular regulatory definition. Wetlands, for the purpose of this Manual, are listed by type in Appendix 5.

In addition, areas of pine flatwoods may contain certain wetland types listed in this Manual, such as cypress ponds. However, for the purpose of this Manual, pine flatwoods are not considered wetlands. Conversely, the presence of pine species within swamps, sloughs or floodplains does not necessarily make these areas "pine sites."

Because of the generally wet soil conditions associated with forested wetlands, some of these areas can be very sensitive to forestry activities, particularly during flooding or periods of soil saturation. For silviculture operations in general, wetlands are probably most susceptible to changes in hydrology or hydroperiod, which can result from improper forest road construction, logging operations, and certain types of site preparation activities.

In general, the BMPs that apply to any other land type also apply to wetlands. For example, a stream within a wetland area would receive a SMZ, and a road or stream crossing constructed within a wetland would be required to apply the appropriate BMPs. However, because of the sensitivity of some types of wetlands to certain forestry related activities, the following special BMPs also apply.

Drainage and Conversion

- Ditching in association with road construction and maintenance, fireline plowing or other activities in wetlands, must not significantly change the hydrologic condition of wetlands or the overall drainage pattern of the site.
- Do not significantly alter the natural drainage or flow patterns on forest lands immediately adjacent to wetlands, particularly isolated wetlands, such as cypress ponds or gum ponds. Logging slash must not be pushed into or piled around ponds or other isolated wetlands.
- Do not conduct intensive mechanical site preparation such as bedding, raking and windrowing in wetlands.
- Avoid fireline plowing in wetlands (see Fireline Construction).

Roads

- When constructing roads in wetlands, refer to the Roads section of the manual in addition to the following BMPs.
- Avoid fill road construction, especially in floodplains or other wetlands



with flowing water. Roads constructed at ground level are less likely to restrict flowing water.

- Do not construct permanent roads in wetlands except to serve large and frequently used areas, provide access for a crossing, or provide fire protection.
- When crossing wetlands, insure that fill roads are properly and adequately culverted and do not act to impound or divert normal stormflow, flood flow or sheet flow (see Stream Crossings).

Harvesting

- For harvesting timber in wetlands: **wetland area** means the acres of each contiguous wetland within a contiguous ownership; **selectively cut** means to harvest in accordance with the Management Criteria for the Primary Zone of the SMZ (see Special Management Zones); **leave trees** are large, mast producing and/or cavity trees that represent the older age classes within the stand. For stands where cypress trees are predominant, cypress trees should be selected for leave trees to the extent that safety and harvesting operations allow, and the number of leave trees per acre should be the upper limit of the ranges listed below. In addition, pond cypress trees should be cut at a point on the stem that approximates the average high water mark (except for skid trails or roads). The average high water mark can usually be identified by the water stain line, the lichen line or the area at which the stem begins to swell (buttress).

A) Harvesting in a wetland area less than 200 acres must meet the following criteria:

1) Retain all snags within the wetland area, to the extent that safety and harvesting operations allow; and,

2a) Retain at least 3 to 5 leave trees per acre: if a wetland flow-way is present, leave trees should be left along it's center line; otherwise leave trees should be randomly distributed throughout the wetland; **or**,

b) Retain at least 10% of the harvest area as selectively cut: the 10% area may be left anywhere on-site. However, for wetlands with a well defined stream, an SMZ (as specified in the SMZ section) will be required for the stream, and may be used as part or all of the 10%; for flowing wetlands the 10% should be left along the center line of the wetland flow-way to the greatest extent possible.

Note: 2b) is the preferred option where it is applicable

B) Harvesting in a wetland area 200 acres and larger must meet the following criteria:

1) Retain all snags within the wetland area, to the extent that safety and harvesting operations allow; and,



2) Retain at least 1 to 2 leave trees per acre: leave trees should be left along the center line of the wetland flow-way if applicable; otherwise leave trees should be randomly distributed throughout the wetland.
3) Clearcut areas cannot exceed 160 acres in size.
4) Clearcuts should be separated from any other clearcut by a 200' selectively cut buffer or by a 200' wide area which has an average tree height of at least 20 feet. However, multiple clearcuts within any 160 acre harvest unit may be separated by a 100 foot buffer. Limited timber harvesting is allowed within the 100 foot buffer provided that trees left in the buffer are equivalent to the number and size specified in the leave tree requirements described above. Under this scenario, the trees left in the 100 foot buffer will satisfy the "leave tree" requirements for the clearcut area associated with it, and no other leave trees would be required. For wetlands with a well defined stream(s), the Primary Zone left along the stream may be used to contribute toward the 200' requirement. For flowing wetlands, trees left along the center line of the wetland flow-way should be used to separate clearcut areas where applicable.

C) A harvest unit which contains five or more small isolated wetlands, each less than two acres in size, must retain 20% of the number of isolated wetlands unharvested[1]. For example, if the harvest unit contains ten, two acre cypress ponds, eight may be clearcut and two must be left uncut until the regenerated stands on the other eight attain an average tree height of at least 20 feet.

Skidding

- Minimize skidder and other heavy equipment operation in wetlands during wet conditions to avoid widespread excessive soil rutting. Although some minor rutting may occur in a typical wetland harvesting operation, skidders and other heavy equipment operations should be planned for dry seasons and/or dry periods as much as possible. When excessively wet harvesting conditions are unavoidable, low ground pres sure equipment such as dual-tire skidders, tracked machines or special techniques such as "mat-logging" or "shovel-logging" should be employed where practical and economically feasible.

- To the greatest extent possible: forestry operations in wetlands which exhibit seasonal inundation or saturation should be limited to dry conditions only, and forestry operations in wetlands which are continually saturated or inundated should be limited to low-water conditions.

- When skidding in wetlands with organic soils, concentrate skid trails to as small an area as possible, and minimize the number of trails on a given site (see Timber Harvesting).



Mat (Shovel) Logging:

- Minimize the width of skid trail mats – mats should not exceed 20 feet in width, on the average, except for sections of the trail where it is necessary for equipment to pass – in these sections the minimum width may be doubled.
- Minimize the number of skid trail mats – typically, trails should not be spaced closer than 200 feet, on the average. Where conditions prohibit tracked machines from operating off the mat, spacing may be reduced to 50 feet in order to minimize site disturbance. However, under no conditions should skid trail mats exceed 25% of the harvest area.
- Timber for skid trail mats should be laid down in the direction of the trail under normal conditions.
- Use only one layer of timber for skid trial mats, except where multiple layers are necessary to prevent site disturbance.
- Where multiple layers of timber are necessary to construct the skid trail mat, the bottom layer may be laid down perpendicular to the trail, and may exceed 20 feet in width to maximize weight distribution.
- Merchantable material in skid trail mats should be removed after logging operation is complete.
- For stream crossings with skid trail mats, refer to the stream crossing section of the BMP Manual.

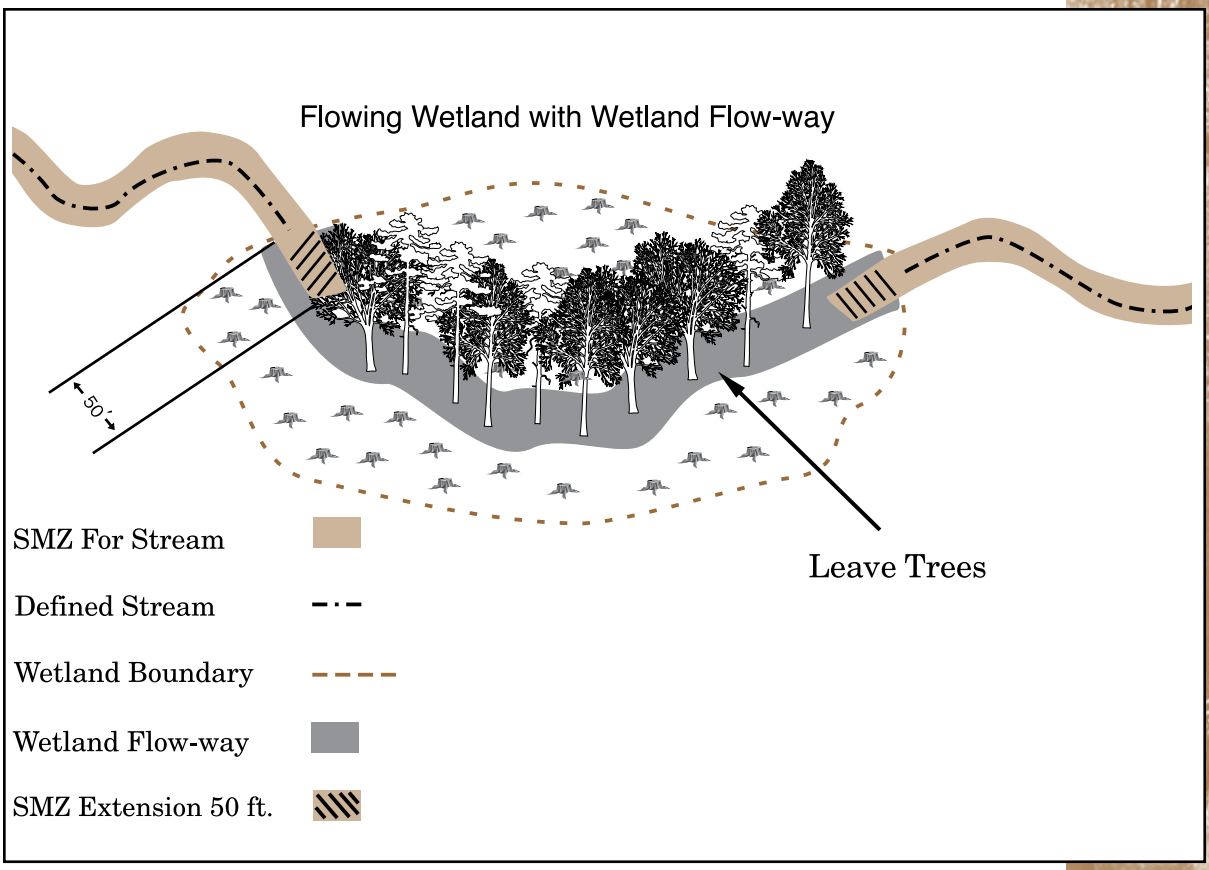
Note: *Ditching and drainage activities as well as the placement of fill material in wetlands generally requires a permit from regulatory agencies. Individuals engaged in such activities are advised to contact the appropriate agency for specific guidance (Appendices 13 and 14). In addition, state water quality standards may apply to wetlands that are connected to streams, lakes, or other waterbodies.*

Note: *Typically, cypress planting is not necessary on a large scale basis; however, where site conditions or other factors conducive to natural regeneration of stands are limited, planting of cypress seedlings may augment reforestation efforts.*

[1]Retaining isolated wetlands that have the following characteristics may improve the habitat value for wetland dependent species within the landscape:

Intermittent surface water.
Wetland margin dominated by native wetland plants.
High species and age class diversity in standing timber.
Presence of snags and den trees.
Unique plant communities.
Where natural hydrology is least disturbed.

Figure 4


Flowing Wetland with Wetland Flow-way
50'
Leave Trees
SMZ For Stream
Defined Stream
Wetland Boundary
Wetland Flow-way
SMZ Extension 50 ft.



Application of BMPs: Canals

Best Management Practices for canals are designed to provide additional protection to Florida's water resources. Since canals are often connected to streams, lakes or other waterbodies, forestry activities adjacent to canals have the potential to impact water quality through such connections.

For the purposes of this Manual, the term canal does not include natural streams that have been hydrologically modified by dredging or straightening to enhance their efficiency to transport water. Although such "modified streams" may have been significantly altered, they are still geographically located to receive and transport storm water and thus are connected directly to other waters. In most cases, they continue to perform important natural stream functions particularly if they have associated wetlands. For these reasons, BMPs for modified streams (including SMZ criteria) are identical to those for any other naturally occurring perennial or intermittent stream, except for maintenance activities (see Canal Maintenance section).

Canals, for the purposes of this manual, are totally man-made and generally independent from natural drainage features. As artificial systems, canals exhibit only periodic and limited characteristics of natural streams and usually receive periodic maintenance. Canals do not include forestry road-side ditches or upland field ditches.

BMPs for Canals

- During normal silvicultural operations, do not operate heavy equipment within canals or in such a manner as to result in damage to the canal bank.
- Avoid canal crossings when possible. Where necessary, construct crossings in accordance with the Stream Crossings section of this manual.
- Do not conduct bedding, chopping or other site preparation activities in such a way that results in direct surface water discharge into a canal.
- Avoid dropping logging slash in canals; remove significant amounts of logging slash from canals.
- Do not discharge pesticides not approved for aquatic use, fertilizer, or other pollutants into canals. Do not dispose of chemical containers and/or equipment rinse water in canal waters.



Canal Maintenance

- Maintenance for modified streams and canals should be minimized. When necessary, conduct canal re-dredging during periods of low flow. Minimize disturbance to canal banks and retain as much "streamside" vegetation as possible.
- Use appropriate erosion, sediment and turbidity control practices to reduce sediment transport.
- When conducting road maintenance adjacent to a canal, do not discharge road spoil on the canal-side of the road.

Note: *Before conducting canal maintenance, contact the appropriate regulatory agency(s) - such activities normally require authorization and/or permits (Appendix 13).*



Application of BMPs: Sinkholes

Sinkholes are important waterbodies because geologically and hydrologically active sinks may form a direct connection between the land surface and groundwater with little or no filtration through soil layers. Consequently, any pollutants that enter a sinkhole have the potential to contaminate groundwater. Sinkholes support a unique combination of plants and animals that are very sensitive to pollution, temperature and sunlight changes and may depend on leaf litter and organic debris for food sources.

In addition to the water resource concerns for sinkholes, there are also safety concerns. Ground conditions near sinkholes may be very unstable geologically and prone to collapse. Heavy equipment operation in and around these areas could result in damage to or loss of equipment, structures, and physical harm to workers and operators.

BMPs for Sinkholes

- For sinkholes with perennial or intermittent open water, or which connect to an intermittent or perennial stream, apply the appropriate Special Management Zone to the sinkhole (See Application of SMZs).
- Do not place any debris, trash, or waste in any sinkhole or in any surface drainage feature that flows into a sinkhole.
- Avoid mechanical operations such as harvest or site preparation, fertilization, or pesticide use in sinkholes.
- When working adjacent to sinkholes, do not alter land surface slope to direct surface drainage into the sinkhole - apply mechanical site preparation such as bedding on the contour.

Application of BMPs: Forest Roads



Forest roads represent the single greatest potential for severe, long term erosion and sedimentation from forestry activities. The nature of roads generally involves maintaining a "bare soil" condition on the road surface and periodic maintenance of both the surface and any associated ditches.

Permanent access roads are often accompanied by permanent drainage ditches or other drainage structures designed to transport stormwater. Serious road deterioration can result if ditch or drainage structure capacity is exceeded during storm events. This can lead to flooding of the road and surrounding area, scouring of the road and ditch surface, blowing out of roads and culverts, all of which may ultimately result in sediment delivery into streams or other waterbodies. To properly design, build, drain and maintain forest roads, the following BMPs are provided.

BMPs for Forest Roads

Road Planning

- Carefully plan the location and the desired drainage features before construction, using soil survey maps, topographic maps and aerial photographs.
- Plan construction activities for dry periods.
- New road construction is not permitted within the Special Management Zone, except for stream crossings.
- Minimize stream and wetland crossings. Roads will be less costly to build and maintain, equipment "down time" will be reduced and the water resource will be protected.

Road Construction

- Avoid construction operations during wet conditions - If possible, complete construction several months before heavy usage. This will reduce surface scour and decrease sediment transport.
- Balance cuts and fills to maximize use of local material and to maximize roadbed stability.
- To reduce both road costs and disturbed surface area, minimize the road width consistent with the anticipated type and amount of traffic.
- For fill road construction, keep road shoulders at a gentle slope to minimize erosion and accelerate revegetation.
- Stabilize road banks and critical road segments using mulch, seed and fertilizer, or other methods to keep the road from washing and to keep sediment out of streams (Appendix 6).

Road Drainage

- Drain road systems using culverts, cross ditches, turnouts, etc., to encourage long term stability, reduce maintenance, and protect water quality (Appendices 7, 8, and 9).



- Where applicable, use practices such as turnouts or ditch plugs, to reduce the volume and velocity of ditch flow.
- All road drainage practices that divert ditch flow or road surface runoff, must direct such flow onto vegetated areas where it can be adequately dispersed - do not direct ditch flow or road runoff into streams, lakes or other waterbodies.
- Use cross-drain culverts on roads where there is a need to direct ditch flow from one side of a road to the other, underneath the road surface.
- Use cross-ditches on roads where there is a need to channel ditch or road surface drainage from one side of the road to the other, over the surface of the road.
- Base the size of the culvert or cross-ditch on the road ditch size, type and slope of the road and the expected volume of water to be handled during storm events.
- Use water turnouts to periodically turn ditch flow out and away from the road, and onto an adjacent vegetated area for dispersal of road runoff and sediment. Vegetated areas used for water turnouts must be adequate in size and have sufficient ground cover to assimilate discharges.
- Use broad base dips on permanent roads for dispersion of road surface drainage in the absence of road ditches - the use of a broad base dip provides exceptional drainage and virtually unlimited trafficability. This road drainage practice is best suited for new road construction and on especially critical road segments designed for all-weather traffic and heavy use.
- Use water bars for temporary access roads, firelines and skid trails, where a physical barrier is needed to disrupt and disperse runoff and sediment. Since water bars vary from 1 - 3 feet in height, they are gen erally not suitable for high speed or heavy traffic loads, but can be used to effectively close a road to vehicular traffic.

Road Maintenance

- All drainage structures should be periodically checked and maintained, especially following excessive rainfall events. If signs of sediment and/or turbid discharges are present, take immediate corrective actions for any problem.
- Ditches and culverts should be kept free of major obstructions and ditches should be allowed to revegetate as much as is practicable.

- Close or restrict traffic on roads whenever possible - this will allow roads to stabilize and revegetate.
- Seeding and fertilizing, mulching or otherwise stabilizing critical segments of temporary and permanent roads will accelerate revegetation, ensure road utility in the future and protect nearby watercourses. Seeding rates and types are listed in Appendix 6.

Note: *Spacing recommendations for cross-drain culverts, cross-drain ditches, water turnouts, broad base dips and water bars have been computed for a wide range of road slopes and are provided in Appendix 7. Appendix 8 provides illustrations of the design and installation for each of these drainage practices.*





Application of BMPs: Stream Crossings

Stream crossings represent the point at which a forest road or skid trail comes in contact with a waterbody. Consequently, some type of planned crossing is necessary to protect water quality. Careful consideration should be given to determining the type of crossing to be used, and in constructing the project. The principal objectives of a stream crossing are to provide a dry surface crossing even during periods of stormflow, and to provide adequate conveyance of flow beneath the road fill **so that impounding of flow does not occur.** BMPs for stream crossings are provided below.

BMPs for Stream Crossings

In General

- Minimize the number of crossings on a given stream, and cross streams perpendicular to the flow at the most narrow section. This minimizes the area of disturbance and simplifies construction.
- Any erodible fill material or other areas normally exposed to flowing water should be stabilized with rip-rap, vegetation or other appropriate material following construction.
- Avoid planning construction of crossings for wet periods - avoid construction during high water conditions.

Culverts

The use of a culvert is the most common method for constructing stream crossings associated with forestry activities. Culverts are well suited for crossing both perennial and intermittent streams as well as other wet areas. However, several other types of stream crossings are also well suited for forestry related stream crossings under certain conditions.

- Place culverts in a section of the stream channel that is relatively straight and free from curves, meandering or major obstructions.
- Place the bottom of the culvert at the same elevation as the bottom of the stream, and at approximately the same slope.
- Keep the height of the entire structure (culvert plus fill) as low as possible to reduce the potential for impounding large areas of water.
- Use a culvert diameter that is sufficient to carry the normal flow expected. Culvert sizing for permanent installations should be based on the size and nature of the stream channel being crossed, or on the size and nature of the watershed above the crossing. Appendix 9 provides two possible methods for determining culvert diameter.
- When crossing broad channels or wetlands, several small culverts, spaced



throughout the crossing, are normally preferable to a single large one. This arrangement maintains a lower road surface elevation and does not artificially concentrate the flow into one small segment of the channel.

- For temporary stream crossings, a culvert may be sized to reflect seasonal flow conditions. For example, during normally dry periods a small culvert may provide adequate stormflow capacity on a temporary basis. However, a culvert sized under such conditions must be removed immediately following the activity, or replaced with a size that will accommodate normalyear-round flows.
- Periodically inspect all culverts to prevent clogging, plugging and eventual failure. Remove any debris or sediment deposits that have the potential to cause culvert clogging.

Hard Surface Crossings

Hard surface crossings or fords are commonly used for stream crossings during forestry operations. These crossings consist of lining the stream channel with rock, brick, logs, concrete, or other such material. In some cases, the stream bottom may be naturally armored and may accommodate light traffic without artificial substrate.

Hard surface crossings may be constructed on both perennial and intermittent streams, and offer some important advantages over culverted crossings. In many cases, a hard surface crossing may cost considerably less than a culvert crossing, depending on the availability of surfacing material. Also, hard surface crossings are virtually maintenance free and normally do not become clogged or plugged because they maintain the natural shape of the stream channel. This is a particularly important feature in areas with beaver populations.

The material used in hard surface crossings is relatively large and stable. Consequently, these type crossings usually do not fail or blow-out the way other structural crossings can. As long as the armoring material does not significantly impound flow or cause erosive currents, these crossings can accommodate normal streamflow while providing good access at very low risk to water quality.

The major disadvantage of hard surface crossings is the limited access during periods of high flow. For that reason, these crossings are best suited for relatively small, well defined channels that tend to have “flashy” stormflow characteristics. Also, hard surface crossings are usually not well suited for high speed, main haul-road applications.

- Use clean material that will not rapidly degrade and that is heavy enough to stay in place during high flow conditions, i.e., lime rock, railroad rock, bricks, etc.



- Do not use asphalt or other petroleum based materials.
- Do not construct a hard surface crossing on streams where the bottom is mucky, muddy or otherwise unstable, or if down-stream water quality standards violations occur under normal operating conditions.
- Do not use logs or logging slash as a permanent hard surface crossing material. Logs may be used to facilitate temporary crossings but must be removed from the channel upon completing the operation.
- Keep the height of the surfacing material at a minimum; hard surface crossings must not significantly restrict normal streamflow.

Note: *Make sure that crossings are in compliance with other standards and regulations that apply - all types of stream crossings may be subject to permitting by regulatory agencies.*

Application of BMPs: Timber Harvesting



Timber harvesting activities should be conducted carefully, especially on steeper slopes and near streams, lakes, sinkholes, wetlands or other waterbodies. **When harvesting timber in close proximity to a waterbody, follow the specific criteria provided in the Special Management Zone section of this manual**. Depending on conditions, timber harvesting in these areas may be significantly limited.

BMPs for Timber Harvesting

Skid Trails

- Locate skid trails along the contour whenever practical to promote revegetation and reduce soil erosion. If skidding must be done up or down the slope, the operator should skid uphill and avoid long, continuous skid trails.
- After skidding activities are complete, stabilize skid trails where necessary by installing water bars or similar structures at recommended intervals - seeding and fertilizing skid trails will accelerate stabilization on erodible soils and/or steep slopes.
- When skidding in muck or peat (organic) soils such as in swamps, bogs or similar wetlands, concentrate skidding to as few trails as possible - this will confine soil compaction to small areas.
- When skidding on mineral soils, such as in uplands, skidding should be dispersed so that soil compaction is minimal even in individual trails.
- Keep main skid trails out of all Special Management Zones except to approach a designated crossing.
- Keep loading decks or landings out of all Special Management Zones. In addition, keep all log bunching points out of the Primary Zone of the SMZ.

Slash Disposal

- Logging slash, such as tops and limbs, which are incidental to timber harvesting activities may be left in place, as long as such material is not left in a waterbody.
- Remove logging slash from all waterbodies including both intermittent and perennial streams, lakes and sinkholes.
- Do not pile or push logging slash into cypress ponds or strands, swamps, marshes, grassy ponds, or waterbodies such as streams, lakes, sinkholes or similar water resource features.



Application of BMPs: Site Preparation & Planting

Although site preparation activities are part of the reforestation operation, these activities can temporarily create large areas of bare soil. Depending on soil types and slope, mechanical site preparation in particular, may have the potential for significant erosion and sedimentation. For these reasons, mechanical site preparation may be restricted or prohibited near streams, lakes, sinkholes and other waterbodies. **When conducting site preparation activities near surface waters, follow the specific criteria provided in the Special Management Zone section of this manual.**

BMPs for Site Preparation and Planting

- Plan site preparation and planting procedures prior to timber harvesting activities.
- Select only the site preparation techniques that are necessary to establish seedlings and minimize vegetative competition - do not needlessly disturb the ground surface or expose the topsoil.
- Do not conduct mechanical site preparation within any part of the Special Management Zone.
- Do not conduct intensive mechanical site preparation such as bedding, raking and windrowing in wetlands.
- When chopping, pull chopper perpendicular to a waterbody to orient soil indentations along the contour (not necessary if chopping is followed by bedding or if the waterbody is separated from the chopped area by windrows or a similar barrier to overland flow).
- Arrange windrows and soil beds parallel to a waterbody or wetland in order to provide a barrier to overland flow, prevent concentration of run-off and reduce erosion.
- When using a blade to shear, push, or pile debris, keep the blade above the soil surface. This will minimize erosion and facilitate rapid site recovery and tree growth.
- Do not pile or push logging slash into cypress ponds or strands, swamps, marshes, grassy ponds, or waterbodies such as streams, lakes or similar water resource features.
- Do not conduct site preparation burning within the SMZ where slopes are 18% or greater.

Application of BMPs: Fireline Construction

Fireline construction is an integral component of both fire suppression and prescribed burning. However, firelines can result in excessive erosion and water quality degradation. Lines plowed in wetlands can also result in excessive drainage and possibly conversion of wetlands to non-wetland systems. Extra precautions are necessary when constructing firelines near surface waters and wetlands.

BMPs for Firelines

- Construct firelines only where necessary, making use of existing barriers such as roads, waterbodies, etc.
- Where possible, use alternatives to plowed lines such as harrowing, foam lines, wet lines or permanent grass.
- Do not plow lines through sensitive areas such as wetlands, marshes, prairies and savannas unless absolutely necessary. Avoid these areas or use alternative line construction methods.
- Maintain minimum plow depth at all times.
- When crossing waterbodies, raise the equipment to prevent connecting the line directly to the waterbody.
- Do not construct firelines which act as drainage systems, particularly those that might connect or drain isolated wetlands.
- Avoid constructing plowed firelines in the Special Management Zone, particularly the Primary Zone.
- Use water bars, turnouts and/or vegetation to stabilize firelines when erosion and sedimentation might otherwise result.
- When revegetating firelines, use native species when possible.
- Orient firelines along the contour wherever possible to prevent erosion and gullying.
- Do not prescribe burn for site preparation purposes within the Special Management Zone when the slope of the site is 18% or greater (SSCs 5 and 6). Burning for ecological purposes on steep slopes is not restricted.





Application of BMPs: Pesticide & Fertilizer Use

Pesticide and fertilizer application is a common silvicultural management technique in some areas of Florida. Pesticides and fertilizer are usually applied near tree planting time or shortly after. Occasionally, nitrogen fertilizer and some types of pesticides may be added later in the rotation.

These chemicals generally do not pose a threat to water quality as long as they are applied according to the label and in compliance with the following BMPs.

BMPs for Pesticide and Fertilizer Use

Pesticides

- Choose equipment that directs the chemical only to the target area. Misdirected or excessive amounts of pesticides are wasteful, expensive and can pose a serious threat to water quality and aquatic life.
- Do not conduct aerial application, mist blowing or operational application (See Glossary) of pesticides within the Primary Zone of the SMZ, including any drift from nearby applications.
- Do not leave pesticide containers on site - these should be rinsed and disposed of according to the directions on the label.
- Do not rinse spray equipment or discharge rinse water in waterbodies, wetlands or within the Special Management Zone.

Fertilizer

- Do not conduct aerial application, or operational application (See Glossary) of fertilizer or locate fertilizer transfer/loading areas within the Primary Zone of the SMZ, including any drift from nearby applications.
- Whenever practical, apply fertilizer to maximize the uptake of nutrients, which might otherwise move off-site; consider the use of slow release fertilizer when conditions are appropriate.

Fertilizer Application Limits

Good nutrient management is essential for healthy forest production and environmental protection. The key to success is identifying the needs of target plants and matching fertilization operations to those needs. One way to accomplish this is to develop and implement a nutrient management plan based on soil, water, plant and organic material sample analyses, along with expected or desired timber yields (see Florida Extension Service Circular 1230). This should result in fertilizer application rates that minimize the amount of available nutrients while optimizing growth and yield.



In addition, it should be understood that not all silviculture strategies require, or can benefit from, forest fertilization. Where forest fertilization is conducted, such operations should be planned and implemented with consultation from a knowledgeable professional, and in accordance with all applicable BMPs or other measures that reduce nutrient delivery to water resources.

To that end, the following BMP represents fertilizer application limits not to be exceeded during forest fertilization operations (these are not recommended rates of application):

Elemental Nitrogen

- No more than a 1000 lbs/acre over any 20-year period.
- No more than 250 lbs/acre for any 3-year period.
- No more than 80 lbs/acre during the first 2-years of newly established plantations.

Elemental Phosphorus

- No more than 250 lbs/acre over any 20-year period.
- No more than 80 lbs/acre for any 3-year period.

Note: *Some pesticides require the applicator to be certified by the Florida Department of Agriculture and Consumer Services. Also, pesticide labels may have additional restrictions for application near open waters or wetlands.* **Read and follow the label.** *Failure to comply with requirements of pesticide labels can result in civil and/or criminal penalties under state and federal law.*



Application of BMPs: Waste Disposal

Heavy equipment such as tractors, skidders and large trucks are commonly used in forestry activities. Consequently, routine maintenance activities including oil changes, often take place at the work site, i.e. “in the woods”. Proper collection and disposal of used oil is necessary to prevent soil and water contamination and to promote oil recycling.

Florida Law prohibits the discharge of pollutants both on the ground and in waterbodies. Pollutants include petroleum products of all kinds, including used oil. The discharge itself and the failure to report the discharge may be subject to penalties under Florida Law and Federal Law. Discharges or spills should be reported in accordance with the requirements of the Department of Environmental Protection rules.

BMPs for Waste Disposal

Used Oil

- During equipment maintenance, used oil should be collected and stored until properly disposed.
- Do not discharge used oil or other pollutants on the ground, in sinkholes, or in waterbodies of any kind (including wetlands and canals).
- Do not mix used oil with other materials such as degreasing solvents, carburetor cleaners, etc. Such mixing may render the used oil unsuitable for recycling and therefore unacceptable at recycling centers.

Solid Waste

- Do not dispose of solid wastes, such as trash, litter, containers, etc. into waterbodies of any kind.
- Remove trash, litter and other solid wastes from project areas. In particular, remove and properly dispose of all chemical containers, hydraulic fluid and oil containers, oil filters, batteries, and tires.

Note: *For information concerning oil spill reporting requirements, contact the local Department of Environmental Protection office. There is a 25 gallon threshold for petroleum spills on pervious surfaces (soil): Less than 25 gallons - self clean up. Contaminated soil can be disposed of at any Class I landfill (typically this would be a county landfill). There would be a charge. Twenty-five gallons or more, call DEP from any telephone. This will reach the "State Warning Point", at which time the caller identifies the problem. For petroleum spills, DEP would send out a "response team" to handle the situation.*

Note: *Most counties in Florida maintain a used oil collection facility which will accept used oil and hydraulic fluid. Contact your County Landfill Operation for the nearest location of such a facility.*

Application of BMPs: Wet Weather Operations



Creek and river floodplains and isolated wetlands are periodically inundated, which can result in large areas of flowing and/or "standing" water. Heavy equipment operation, such as skidding, in flowing water or in standing water that is contiguous with nearby flowing water is likely to cause the discharge of sediment or turbid runoff into waters of the State. Discharges of this nature can cause numerous problems to the water resource and may also constitute a State water quality standards violation.

In addition, heavy equipment operation during flooded or saturated soil conditions can cause excessive rutting, which may result in significant soil compaction. If such rutting is widespread, overall reforestation of the site may be severely limited.

The best alternative for logging during wet weather conditions is to postpone the operation until drier conditions prevail. However, when operations must be conducted, the following BMPs apply.

BMPs for Wet Weather Operations

- Avoid heavy equipment operations, especially skidding, during flooded or wet soil conditions. Under certain conditions, special low-ground pressure equipment or other alternatives to conventional skidding may be necessary.
- Do not operate heavy equipment, especially skidders, in floodplains when they are flooded or during conditions of flowing or standing floodwater.
- Minimize skidder and other heavy equipment operation in wetlands during wet conditions to avoid widespread excessive soil rutting. Although some minor rutting may occur in a typical wetland harvesting operation, skidders and other heavy equipment operation should be planned for dry seasons and/or dry periods as much as possible.
- Confine skid trails to as small an area as possible when working in organic or muck soils, especially during wet conditions.

Note: *Wet weather forestry operations have the potential for creating water quality standards violations. Such operations that generate an offsite discharge of visibly turbid water above natural background levels, are likely to be in violation of State water quality standards.*



Application of BMPs: Emergency Operations

In the event of a wildfire, insect or disease outbreak, exotic/invasive tree infestation, or other catastrophe, a Best Management Practice may be temporarily relaxed to aid fire suppression, to conduct appropriate salvage techniques, and to promote rapid site recovery. Harvesting guidelines which apply to Wetlands and the Special Management Zone may be relaxed to allow tree removal for the control of exotic/invasive trees and/or the salvage of damaged or downed timber.

BMPs During Emergencies

Wildfire

- Firelines, road construction and stream crossings will be unrestricted during emergencies, but stabilized according to Best Management Practices following the salvage and revegetation process (see Fireline Construction section).

- When necessary, mechanical site preparation techniques may be conducted within the Special Management Zone to help return the site to a productive, protective condition.

Insect and Disease

- During insect or disease epidemics, appropriate pesticides and/or harvesting may be used within the Special Management Zone to protect and maintain the health of the affected and surrounding forest.

Exotic/Invasive Trees

- For areas where exotic/invasive tree infestations are present, the exotic/invasive trees may be harvested without regard to the leave-tree criteria that would otherwise apply to Wetlands and Special Management Zones. BMPs other than the leave-tree critera would still apply to the operation. This section does not apply to cultivated species such as eucalyptus.

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Appendix 1 Site Management Recommendations • SSC A1

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	35	35
Perennial (<20 ft.)	35	none	35
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	35	35
Perennial	35	none	35
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	35	35
Perennial	35	none	35

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	none 200 none
Temp. Roads/Skid Trails	0-300	Water Bars	250
Firelines	0-300	Water Bars	250

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	**A1**	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC A2

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	45	45
Perennial (<20 ft.)	35	10	45
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	45	45
Perennial	35	10	45
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	45	45
Perennial	35	10	45

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	200 120 180
Temp. Roads/Skid Trails	0-300	Water Bars	135
Firelines	0-300	Water Bars	135

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	**A2**	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC A3

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	60	60
Perennial (<20 ft.)	35	25	60
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	60	60
Perennial	35	25	60
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	60	60
Perennial	35	25	60

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	150 100 140
Temp. Roads/Skid Trails	0-300	Water Bars	80
Firelines	0-300	Water Bars	80

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	**A3**	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC A4

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	125 75 125
Temp. Roads/Skid Trails	0-300	Water Bars	60
Firelines	0-300	Water Bars	60

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	**A4**	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC A5

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	100 50 120
Temp. Roads/Skid Trails	0-300	Water Bars	45
Firelines	0-300	Water Bars	45

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	**A5**	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC A6

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	75 40 110
Temp. Roads/Skid Trails	0-300	Water Bars	30
Firelines	0-300	Water Bars	30

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	**A6**
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B1

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	35	35
Perennial (<20 ft.)	35	none	35
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	35	35
Perennial	35	none	35
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	35	35
Perennial	35	none	35

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	none 150 none
Temp. Roads/Skid Trails	0-300	Water Bars	250
Firelines	0-300	Water Bars	250

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	**B1**	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B2

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	60	60
Perennial (<20 ft.)	35	25	60
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	60	60
Perennial	35	25	60
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	60	60
Perennial	35	25	60

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	200 120 180
Temp. Roads/Skid Trails	0-300	Water Bars	135
Firelines	0-300	Water Bars	135

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	**B2**	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B3

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	75	75
Perennial (<20 ft.)	35	40	75
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	75	75
Perennial	35	40	75
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	75	75
Perennial	35	40	75

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	150 100 140
Temp. Roads/Skid Trails	0-300	Water Bars	80
Firelines	0-300	Water Bars	80

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	**B3**	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B4

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	125 75 125
Temp. Roads/Skid Trails	0-300	Water Bars	60
Firelines	0-300	Water Bars	60

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	**B4**	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B5

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	100 50 120
Temp. Roads/Skid Trails	0-300	Water Bars	45
Firelines	0-300	Water Bars	45

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	**B5**	B6
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC B6

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	75 40 110
Temp. Roads/Skid Trails	0-300	Water Bars	30
Firelines	0-300	Water Bars	30

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	**B6**
High	≥0.28	C1	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC C1

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	35	35
Perennial (<20 ft.)	35	none	35
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	35	35
Perennial	35	none	35
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	35	35
Perennial	35	none	35

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	none 150 none
Temp. Roads/Skid Trails	0-300	Water Bars	250
Firelines	0-300	Water Bars	250

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	**C1**	C2	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC C2

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	60	60
Perennial (<20 ft.)	35	25	60
Perennial (20-40 ft.)	75	none	75
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	60	60
Perennial	35	25	60
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	60	60
Perennial	35	25	60

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	200 120 180
Temp. Roads/Skid Trails	0-300	Water Bars	135
Firelines	0-300	Water Bars	135

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	**C2**	C3	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC C3

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	80	80
Perennial (<20 ft.)	35	45	80
Perennial (20-40 ft.)	75	5	80
Perennial (>40+ ft.)	200	none	200
OFW, ONRW, Class I Waters	200	none	200
LAKES			
Intermittent	Stringer	80	80
Perennial	35	45	80
OFW, ONRW, Class I Waters	200	none	200
SINKHOLES			
Intermittent	Stringer	80	80
Perennial	35	45	80

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	150 100 140
Temp. Roads/Skid Trails	0-300	Water Bars	80
Firelines	0-300	Water Bars	80

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	**C3**	C4	C5	C6

Appendix 1 Site Management Recommendations • SSC C4

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	125 75 125
Temp. Roads/Skid Trails	0-300	Water Bars	60
Firelines	0-300	Water Bars	60

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	**C4**	C5	C6

Appendix 1 Site Management Recommendations • SSC C5

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	100 50 120
Temp. Roads/Skid Trails	0-300	Water Bars	45
Firelines	0-300	Water Bars	45

SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	**C5**	C6

Appendix 1 Site Management Recommendations • SSC C6

SPECIAL MANAGEMENT ZONES (Each Side)

Stream Class	Primary (ft.)	Secondary (ft.)	Total SMZ (ft.)
STREAMS			
Intermittent (All)	Stringer	300	300
Perennial (<20 ft.)	35	265	300
Perennial (20-40 ft.)	75	225	300
Perennial (>40+ ft.)	200	100	300
OFW, ONRW, Class I Waters	200	100	300
LAKES			
Intermittent	Stringer	300	300
Perennial	35	265	300
OFW, ONRW, Class I Waters	200	100	300
SINKHOLES			
Intermittent	Stringer	300	300
Perennial	35	265	300

ROAD CONSTRUCTION AND MAINTENANCE DRAINAGE RECOMMENDATIONS

Structure	Zone Width (ft.)	Treatments Allowed	Spacing (ft.)
Permanent Roads	0-300	Culvert or Cross Ditch Water Turnouts Broad-base Dips	75 40 110
Temp. Roads/Skid Trails	0-300	Water Bars	30
Firelines	0-300	Water Bars	30

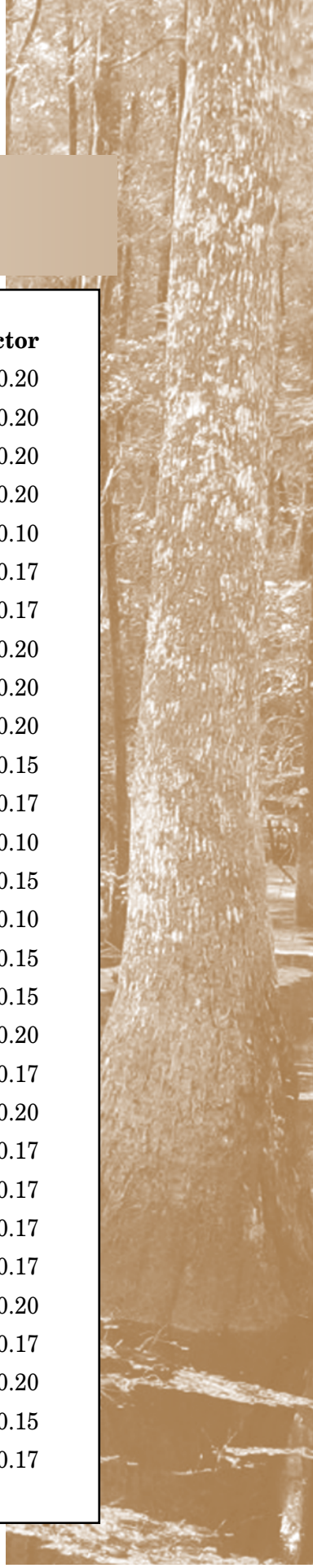
SITE SENSITIVITY CLASSIFICATION (SSC) INDEX

Soil Erodibility	K-Factor	Slope %					
		0-2	3-7	8-12	13-17	18-22	22+
Low	≤0.20	A1	A2	A3	A4	A5	A6
Moderate	0.21 - 0.27	B1	B2	B3	B4	B5	B6
High	≥0.28	C1	C2	C3	C4	C5	**C6**

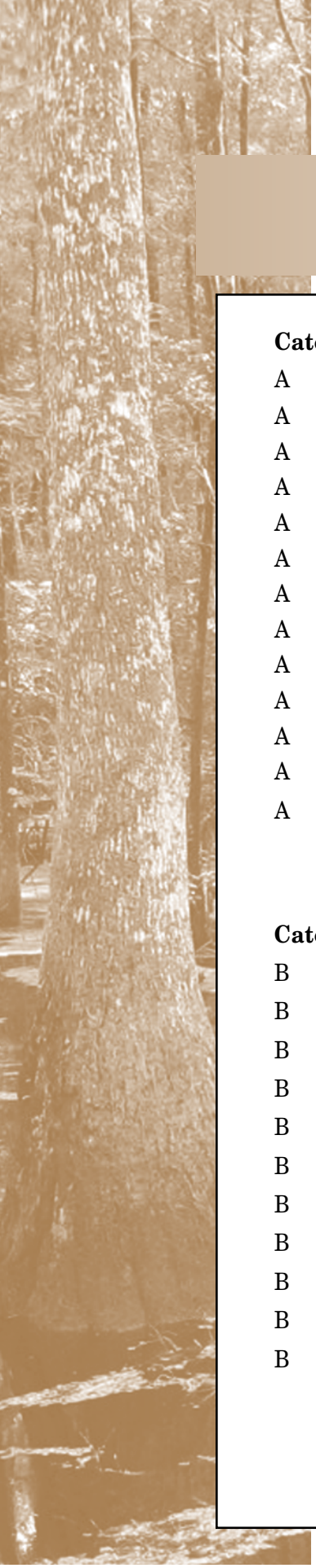
Appendix 2 Soil Erodibility and K-Factors of Florida Soils

Soil Erodibility Category A

Category	Soil Name	K-Factor	Category	Soil Name	K-Factor
A	Adamsville	0.10	A	Chipley	0.17
A	Alachua	0.17	A	Cocoa	0.17
A	Alaga	0.17	A	Copeland	0.17
A	Alapaha	0.17	A	Dade	0.17
A	Albany	0.17	A	Delks	0.17
A	Alpin	0.10	A	Delray	0.17
A	Americus	0.17	A	Eaton	0.17
A	Anclote	0.17	A	Eau Gallie	0.17
A	Apopka	0.17	A	Electra	0.15
A	Arredondo	0.17	A	Ellabelle	0.17
A	Arzell	0.10	A	Elred	0.17
A	Astatula	0.15	A	Eulonia	0.20
A	Astor	0.17	A	Eustis	0.17
A	Barth	0.17	A	Evinston	0.15
A	Basinger	0.10	A	Felda	0.17
A	Bibb	0.20	A	Floridana	0.17
A	Blanton	0.17	A	Fort Drum	0.20
A	Blichton	0.20	A	Fort Meade	0.17
A	Boca	0.20	A	Fox Worth	0.17
A	Bonifay	0.17	A	Fuquay	0.20
A	Bradenton	0.20	A	Gainesville	0.17
A	Broward	0.17	A	Goldboro	0.20
A	Canaveral	0.15	A	Hague	0.17
A	Candler	0.10	A	Hallandale	0.17
A	Cassia	0.15	A	Holopaw	0.15
A	Chaires	0.10	A	Huckabee	0.17
A	Charlotte	0.15	A	Hurricane	0.10
A	Chiefland	0.15	A	Immokalee	0.15



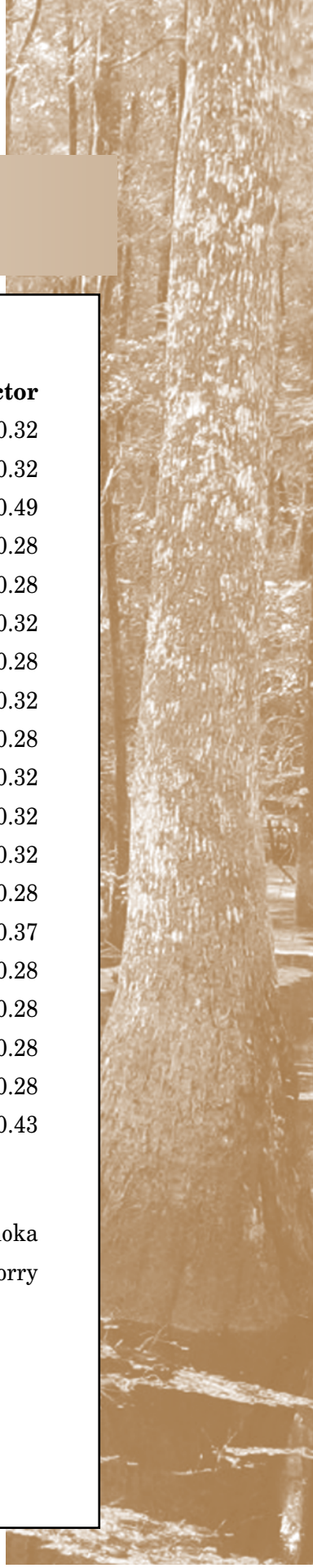
Category	Soil Name	K-Factor	Category	Soil Name	K-Factor
A	Johns	0.20	A	Matmon	0.20
A	Jonesville	0.17	A	Maxton	0.20
A	Jumper	0.20	A	Micanopy	0.20
A	Jupiter	0.17	A	Myakka	0.20
A	Kalmia	0.20	A	Newnan	0.10
A	Kanapaha	0.15	A	Ochopee	0.17
A	Kendrick	0.17	A	Ocilla	0.17
A	Kennansville	0.15	A	Oldsmar	0.20
A	Keri	0.17	A	Olustee	0.20
A	Kershaw	0.15	A	Ona	0.20
A	Klej	0.15	A	Orlando	0.15
A	Klej (Shallow Variant)	0.17	A	Orsino	0.17
A	Kureb	0.17	A	Ortega	0.10
A	Lake	0.15	A	Osier	0.15
A	Lakeland	0.17	A	Otela	0.10
A	Lakewood	0.15	A	Palm Beach	0.15
A	Leefield	0.20	A	Paola	0.15
A	Leon	0.20	A	Parkwood	0.20
A	Lochloosa	0.20	A	Pedro	0.17
A	Lucy	0.17	A	Pelham	0.20
A	Lutterloh	0.10	A	Pineda	0.17
A	Lynn Haven	0.20	A	Pinellas	0.17
A	Lynne	0.20	A	Placid	0.17
A	Magnolia	0.20	A	Plummer	0.17
A	Malabar	0.20	A	Poarch	0.20
A	Manatee	0.20	A	Pomello	0.17
A	Margate	0.17	A	Pomona	0.20
A	Marlboro	0.20	A	Pompano	0.15
A	Mascotte	0.20	A	Portsmouth	0.17



Category	Soil Name	K-Factor
A	Red Bay	0.20
A	Ridgeland	0.20
A	Rimini	0.10
A	Riviera	0.17
A	Rutlege	0.17
A	Satellite	0.15
A	Scranton	0.15
A	Sellers	0.15
A	Smyrna	0.10
A	Sparr	0.16
A	St Johns	0.20
A	St Lucie	0.15
A	Stilson	0.20
A	Surrency	0.20
A	Tavares	0.17
A	Tifton	0.20
A	Toole	0.10
A	Troup	0.17
A	Valkaria	0.15
A	Wabasso	0.20
A	Wacahoota	0.20
A	Wagram	0.15
A	Wauchula	0.20
A	Welaka	0.15
A	Winder	0.20
A	Zuber	0.20

Soil Erodibility Category B

Category	Soil Name	K-Factor
B	Archer	0.24
B	Ardilla	0.24
B	Boardman	0.24
B	Bowie	0.24
B	Bushnell	0.24
B	Carnegie	0.24
B	Chobee	0.24
B	Cowarts	0.24
B	Coxville	0.24
B	Cuthbert	0.24
B	Elmeralda	0.24
B	Eureka	0.24
B	Greenville	0.24
B	Hannahatchee	0.24
B	Myatt	0.24
B	Notcher	0.24
B	Panasoffkee	0.24
B	Pantego	0.24
B	Peace River	0.24
B	Rains	0.24
B	Robertsdale	0.24
B	Savannah	0.24
B	Sunsweet	0.24
B	Weston, dark subsoil	0.24



Soil Erodibility Category C

Category	Soil Name	K-Factor	Category	Soil Name	K-Factor
C	Angie	0.32	C	Irvington	0.32
C	Bayboro	0.43	C	Izagora	0.32
C	Binnsville	0.37	C	Leaf	0.49
C	Bladen	0.32	C	Lynchburg	0.28
C	Blakely	0.37	C	Martel	0.28
C	Bluff	0.37	C	Meggett	0.32
C	Congaree	0.32	C	Norfolk	0.28
C	Dothan	0.28	C	Okitibbeha	0.32
C	Dunbar	0.28	C	Orangeburg	0.28
C	Duplin	0.32	C	Paisley	0.32
C	Esto	0.32	C	Pansey	0.32
C	Faceville	0.32	C	Perrine	0.32
C	Fellowship	0.28	C	Ruston	0.28
C	Flamingo	0.37	C	Sawyer	0.37
C	Flemington	0.32	C	Shubuta	0.28
C	Grady	0.37	C	Stough	0.28
C	Gritney	0.32	C	Susquehanna	0.28
C	Hialeah	0.37	C	Vaucluse	0.28
C	Iberia	0.37	C	Wahee	0.43

Not Applicable - Organic Soils

Brighton	Montverde	Pamlico	Everglades	Oklawaha	Tomoka
Canova	Ocoee	Plantation	Lauderhill	Pahokee	Torry
Dania	Okeechobee	Sanibel	Micco		
Dorovan	Okeelanta	Terra Ceia			

Appendix 3 Guide for Estimating Soil K-Factors

Soil Surface Texture	Hydrologic Soil Group A	B	C	D
	Estimated Soil Factor			
Clays	0.24	0.28	0.32	0.37
Clay Loams	0.28	0.32	0.37	0.43
Loams	0.32	0.37	0.43	0.49
Sandy Loams	0.20	0.24	0.32	0.37
Sands	0.15-0.17	0.20	0.24	0.28

Group A Soils having high infiltration rates when thoroughly wetted. These consist chiefly of deep, well-to-excessively drained sands or gravels with a high rate of water transmission which produces a low surface runoff potential. The entire solum has a very low content of clay and typically includes loose sands through loamy sandy soils.

Group B Soils having moderate infiltration rates when thoroughly wetted. These consist chiefly of moderately deep to deep, moderately well-to-well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C Soils having slow infiltration rates when thoroughly wetted. These soils consist of two groups; (1) those with moderately fine to fine texture and a slow infiltration rate or, (2) those with a layer that impedes the downward movement of water. Both groups results in a slow rate of water transmission. These soils are “heavy”, and range from silt loams through the silty clay loams.

Group D Soils having very slow infiltration rates when thoroughly wetted. These soils consist of (1) clay soils with a clay pan or clay layer at or near the surface of the ground or, (2) shallow soils overlaying nearly impervious materials.

Appendix 3 Guide for Estimating Slope Category

Estimating Slope from Topographic Map Contours			
Slope		**Number of Contour Lines within a 300 ft. Zone**	
Category	**Average %**	**5 ft. Contours**	**10 ft. Contours**
1	0%	0	0
	2%	1	-
2	3%	2	1
	5%	3	-
	7%	4	2
3	8%	5	-
	10%	6	3
	12%	7	-
4	13%	8	4
	15%	9	-
	17%	10	5
5	18%	11	-
	20%	12	6
	22%	13	-
6	23%	14	7

Appendix 4 Special Waterbodies

Class I Waters in Florida

(Excerpted from 62-302.400, F.A.C.)
Waterbodies that are designated for use as a potable water supply.

1. **Bay County**
   Bayou George and Creek – Impoundment to source.
   Bear Creek - Impoundment to source.
   Big Cedar Creek - Impoundment to source.
   Deer Point Impoundment – Dam to source.
   Econfina Creek – Upstream of Deer Point Impoundment.

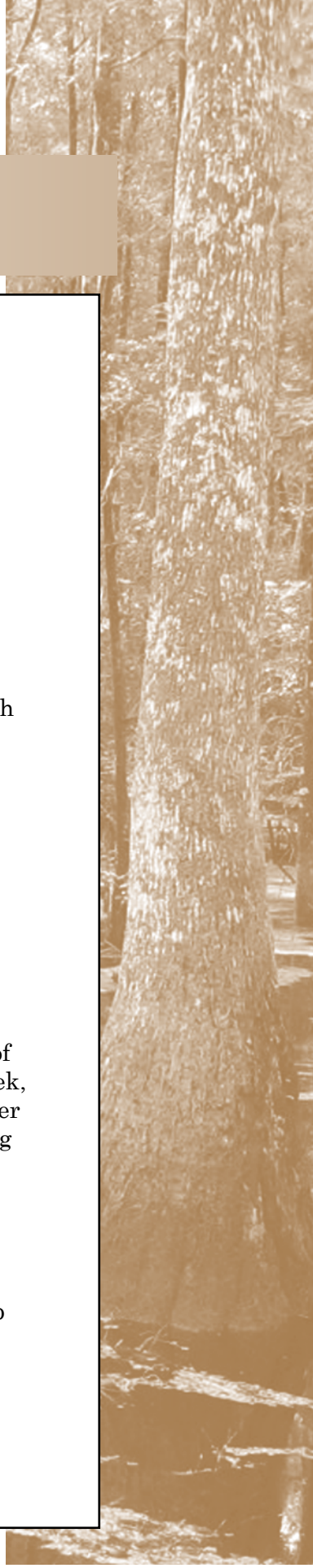
2. **Brevard County**
   St. Johns River and Tributaties – Lake Washington Dam south through and including Sawgrass Lake, Lake Hellen Blazes, to Indian River County Line.

3. **Calhoun County**
   Bear Creek.
   Econfina Creek.

4. **Charlotte County**
   Alligator Creek – North and South Prongs from headwaters to the water control structure downstream of SR 765-A.
   Port Charlotte Canal System – Surface waters lying upstream of, or directly connected to, Fordham Waterway upstream of Conway Boulevard. Prairie Creek – DeSoto County Line and headwaters to Shell Creek.
   Shell Creek – Headwaters to Hendrickson Dam (east of Myrtle Slough, in Section 20, T40S, R24E).

5. **DeSoto County**
   Horse Creek – From the northern border of Section 14, T38S, R23E, southward to Peace River.
   Prairie Creek – Headwaters to Charlotte County Line.

6. **Gadsden County**
   Holman Branch – SR 270-A to source.
   Mosquito Creek – U.S. Highway 90 north to Florida State Line.
   Quincy Creek – SR 65 to source.



7. **Glades County**
   Lake Okeechobee.

8. **Hendry County**
   Lake Okeechobee.

9. **Hillsborough County**
   Cow House Creek – Hillsborough River to source.
   Hillsborough River – City of Tampa Water Treatment Plant Dam to Flint Creek.

10. **Indian River County**
    St. Johns River and Tributaries – Brevard County Line south through and including Blue Cypress Lake to SR 60.

11. **Jackson County**
    Econfina Creek – Bay County Line to source.

12. **Lee County**
    Caloosahatchee River – E. County Line to South Florida Water Management District Structure 79.

13. **Manatee County**
    Manatee River – From Rye Bridge Road to the sources thereof, including but not limited to the following tributaries: the East Fork of the Manatee River, the North Fork of the Manatee River, Boggy Creek, Gilley Creek, Poley Branch, Corbit Branch, Little Deep Branch, Fisher Branch, Ft. Crawford Creek, Webb Branch, Clearwater Branch, Craig Branch, and Guthrey Branch.
    Lake Evers – (Ward Lake) and Braden River – City of Bradenton Water Treatment Dam to SR 675, excluding upland cut irrigation or drainage ditches and including the following tributaries:

	Tributary	Upstream Limit(s)
a.	Rattlesnake Slough	Lockwood Ridge Road in Section 28, Township 35 South, Range 18 East.
b.	Cedar Creek West Branch	Whitfield Avenue in Section 27, Township 35 South, Range 18 East.



	Central Branch	Country Club Way in Section 34, Township 35 South, Range 18 East.
	East Branch	To a point where an east-west line tying 1200 feet south of the section line between Sections 23 and 26 (Township 35 South, Range 18 East) crosses the tributary.
c.	Cooper Creek West Branch (Foley Branch)	South Boundary of Section 1, Township 36 South, Range 18 East.
	East Branch	East Boundary of Section 31, Township 35 South, Range 19 East.
d.	Nonsense Creek	To a point where an east-west line lying 800 feet North of the Section line between Sections 14 and 23 (Township 35 South, Range 18 East) crosses the creek.
e.	Hickory Hammock	To a point where an east-west line lying 1000 feet South of the section line between Sections 17 and 20 (Township 35 South, Range 19 East) crosses the creek.
f.	Wolf Slough	East Boundary of Section 16, Township 35 South, Range 19 East.
g.	Unnamed Tributary 1	To a point where an east-west line lying 2300 feet south of the section line between Sections 21 and 28 (Township 35 South, Range 19 East) crosses the tributary.
h.	Unnamed Tributary 2	East Boundary of Section 14, Township 35 South, Range 19 East.
i.	Unnamed Tributary 3	West Boundary of Section 25, Township 35 South, Range 19 East.



j. Unnamed Tributary 4 To a point where north-south line lying 200 feet East of the section line between Sections 23 and 24 (Township 35 South, Range 19 East) crosses the tributary.

14. **Martin County**
Lake Okeechobee.

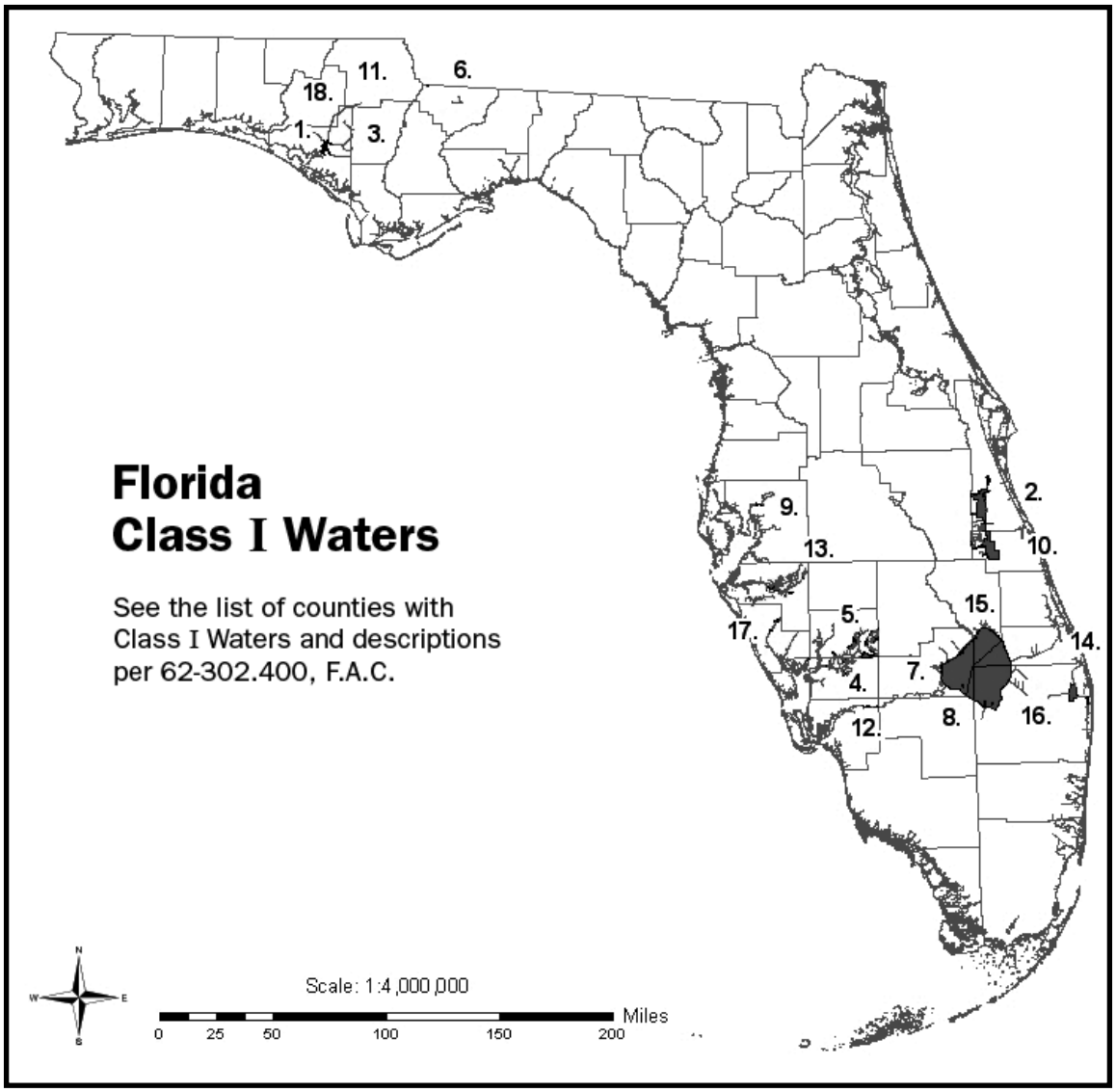
15. **Okeechobee County**
Lake Okeechobee.

16. **Palm Beach County**
Canal C-18 (freshwater portion).
City of West Palm Beach Water Catchment Area.
Clear Lake, Lake Mangonia, and the waterway connecting them.
Lake Okeechobee.
M-Canal – L-8 to Lake Mangonia.

17. **Sarasota County**
Big Slough Canal – South to U.S. 41.
Cooper Creek (Foley Branch) upstream to the South boundary of Section 1, Township 36 South, Range 18 East.
Myakka River – From the Manatee County line southwesterly through Upper and Lower Myakka Lakes to Manhattan Farms (north line of Section 6 T39S, R20E).

18. **Washington County**
Econfina Creek.

62-302.400, F.A.C.
April 30, 2012



From DEP April 30, 2012



From 62-302, Surface Water Quality Standards 8-5-07
List of OFWs from 62-302.700, F.A.C.:

(9) Outstanding Florida Waters:

(A) Waters within National Parks and National Memorials

	National Park or National Memorial	County
1.	Biscayne National Park (as mod. 5-14-86; 8-8-94)	Dade
2.	Dry Tortugas National Park (10-4-90)	Monroe
3.	Everglades National Park	Monroe/Dade
	(as mod. 8-8-94)	Collier
4.	Fort Caroline National Memorial (8-8-94)	Duval

(B) Waters within National Wildlife Refuges

	Wildlife Refuge	County
1.	Archie Carr (8-8-94) Indian River/	Brevard
2.	Caloosahatchee	Lee
3.	Cedar Keys (as mod. 5-14-86, 4-19-88)	Levy
4.	Chassahowitzka (as mod. 5-14-86, 4-19-88)	Citrus/Hernando
5.	Chinsegut	Hernando
6.	Crocodile Lake (12-1-82; as mod. 5-14-86, 4-19-88; 8-8-94)	Monroe
7.	Crystal River (5-14-86; as mod. 10-4-90)	Citrus
8.	Egmont Key	Hillsborough
9.	Florida Panther (10-4-90; as mod. 8-8-94)	Collier
10.	Great White Heron (as mod. 5-14-86, 4-19-88)	Monroe
11.	Hobe Sound (as mod. 5-14-86,4-19-88; 8-8-94)	Martin
12.	Island Bay	Charlotte
13.	J. N. "Ding" Darling (as mod. 5-14-86, 4-19-88; 8-8-94)	Lee
14.	Key West	Monroe
15.	Lake Woodruff (as mod. 8-8-94)	Volusia/Lake
16.	Lower Suwannee (12-1-82; as mod. 8-8-94)	Dixie/Levy
17.	Loxahatchee	Palm Beach
18.	Matlacha Pass (as mod. 8-8-94)	Lee
19.	Merritt Island	Volusia/Brevard
20.	National Key Deer (as mod. 5-14-86, 4-19-88, 10-4-90; 8-8-94)	Monroe
21.	Okefenokee (Florida Portion)	Baker
22.	Passage Key	Manatee



23.	Pelican Island (as mod. 8-8-94)	Indian River
24.	Pine Island (as mod. 8-8-94)	Lee
25.	Pinellas	Pinellas
26.	St. Johns (including Bee Line Unit) (as mod. 5-14-86, 4-19-88)	Brevard
27.	St. Marks (as mod. 10-4-90; 8-8-94)	Jefferson/ Wakulla Taylor
28.	St. Vincent (including Pig Island Unit)	Franklin/Gulf

(C) Waters within State Parks, State Wildlife Parks, and State Recreation Areas

	State Park or State Recreation Area	**County**
1.	Amelia Island State Recreation Area (5-14-86)	Nassau
2.	Anastasia State Recreation Area (as mod. 4-19-88)	St. Johns
3.	Avalon State Recreation Area (4-19-88; as mod. 8-8-94)	St. Lucie
4.	Bahia Honda State Park (as mod. 5-14-86)	Monroe
5.	Bear Creek State Recreation Area (12-1-82)	Gadsden
6.	Big Lagoon State Recreation Area (12-1-82; as mod. 5-14-86, 8-8-94)	Escambia
7.	Big Talbot Island State Park (5-14-86; as mod. 4-19-88, 8-8-94)	Duval
8.	Bill Baggs Cape Florida State Recreation Area	Dade
9.	Blackwater River State Park	Santa Rosa
10.	Blue Spring State Park	Volusia
11.	Bulow Creek State Park (5-14-86; as mod. 4-19-88)	Flagler/Volusia
12.	Caladesi Island State Park	Pinellas
13.	Cayo Costa State Park (12-1-82; as mod. 5-14-86, 4-19-88, 10-4-90, 8-8-94)	Lee
14.	Collier-Seminole State Park	Collier
15.	Dead Lakes State Recreation Area	Gulf
16.	DeLeon Springs State Recreation Area (5-14-86); as mod. 10-4-90)	Volusia
17.	Delnor-Wiggins Pass State Recreation Area (12-1-82)	Collier
18.	Don Pedro Island State Recreation Area (5-14-86); as mod. 4-19-88)	Charlotte
19.	Dr. Julian G. Bruce St. George Island State Park (12-1-82)	Franklin



20.	Edward Ball Wakulla Springs State Park (4-19-88)	Wakulla
21.	Falling Waters State Recreation Area	Washington
22.	Faver-Dykes State Park	St. Johns
23.	Florida Caverns State Park (as mod. 8-8-94)	Jackson
24.	Fort Clinch State Park(as mod. 4-19-88; 8-8-94)	Nassau
25.	Fort Cooper State Park (12-1-82)	Citrus
26.	Fort Pierce Inlet State Recreation Area (12-1-82; as mod. 5-14-86)	St. Lucie
27.	Fred Gannon Rocky Bayou State Recreation Area	Okaloosa
28.	Gamble Rogers Memorial State Recreation Area at Flagler Beach	Flagler
29.	Gasparilla Island State Recreation Area (5-14-86; as mod. 4-19-88, 10-4-90)	Lee
30.	Grayton Beach State Recreation Area (as mod. 4-19-88)	Walton
31.	Guana River State Park (5-14-86; as mod. 4-19-88)	St. Johns
32.	Henderson Beach State Recreation Area (5-14-86)	Okaloosa
33.	Highlands Hammock State Park (as mod. 8-8-94)	Highlands/Hardee
34.	Hillsborough River State Park	Hillsborough
35.	Homosassa Springs State Wildlife Park (10-4-90)	Citrus
36.	Honeymoon Island State Recreation Area (12-1-82; as mod. 5-14-86)	Pinellas
37.	Hontoon Island State Park	Volusia/Lake
38.	Hugh Taylor Birch State Recreation Area	Broward
39.	Ichetucknee Springs State Park	Columbia/Suwannee
40.	John D. MacArthur Beach State Park (12-1-82)	Palm Beach
41.	John Pennekamp Coral Reef State Park (as mod. 5-14-86, 4-19-88)	Monroe
42.	John U. Lloyd Beach State Recreation Area	Broward
43.	Jonathan Dickinson State Park	Martin
44.	Lake Arbuckle State Park (5-14-86)	Polk
45.	Lake Griffin State Recreation Area	Lake
46.	Lake Kissimmee State Park	Polk
47.	Lake Louisa State Park (12-1-82)	Lake
48.	Lake Manatee State Recreation Area (12-1-82)	Manatee
49.	Lake Rousseau State Recreation Area (12-1-82)	Citrus/Levy Marion



50.	Lake Talquin State Recreation Area (12-1-82; as mod.5-14-86)	Leon
51.	Little Manatee River State Recreation Area (12-1-82)	Hillsborough
52.	Little Talbot Island State Park	Duval
53.	Long Key State Recreation Area	Monroe
54.	Lovers Key State Recreation Area (5-14-86)	Lee
55.	Manatee Springs State Park (as mod. 10-4-90)	Levy
56.	Mike Roess Gold Head Branch State Park (as mod. 5-14-86, 4-19-88; 8-8-94)	Clay
57.	Myakka River State Park	Manatee/Sarasota
58.	North Peninsula State Recreation Area (5-14-86; as mod. 4-19-88, 10-4-90)	Volusia
59.	Ochlockonee River State Park	Wakulla
60.	O'Leno State Park (as mod. 5-14-86)	Alachua/Columbia
61.	Oleta River State Recreation Area (12-1-82)	Dade
62.	Oscar Scherer State Park (as mod. 8-8-94)	Sarasota
63.	Peacock Springs State Recreation Area (4-19-88)	Suwannee
64.	Perdido Key State Recreation Area (12-1-82)	Escambia
65.	Ponce de Leon Springs State Recreation Area	Holmes/Walton
66.	Port Charlotte Beach State Recreation Area (12-1-82)	Charlotte
67.	Rose Sink (addition to Ichetucknee Springs State Park) (1-9-06)	Columbia
68.	St. Andrews State Recreation Area (as mod. 5-14-86, 4-19-88)	Bay
69.	Sebastian Inlet State Recreation Area	Indian River Brevard
70.	Silver River State Park (4-19-88; as mod. 10-4-90; 8-8-94)	Marion
71.	Suwannee River State Park (as mod. 10-4-90)	Hamilton Madison/Suwannee
72.	Three Rivers State Recreation Area	Jackson
73.	T. H. Stone Memorial St. Joseph Peninsula State Park	Gulf
74.	Tomoka State Park	Volusia
75.	Torreya State Park	Liberty
76.	Wekiva Springs State Park (as mod. 4-19-88)	Orange/Seminole

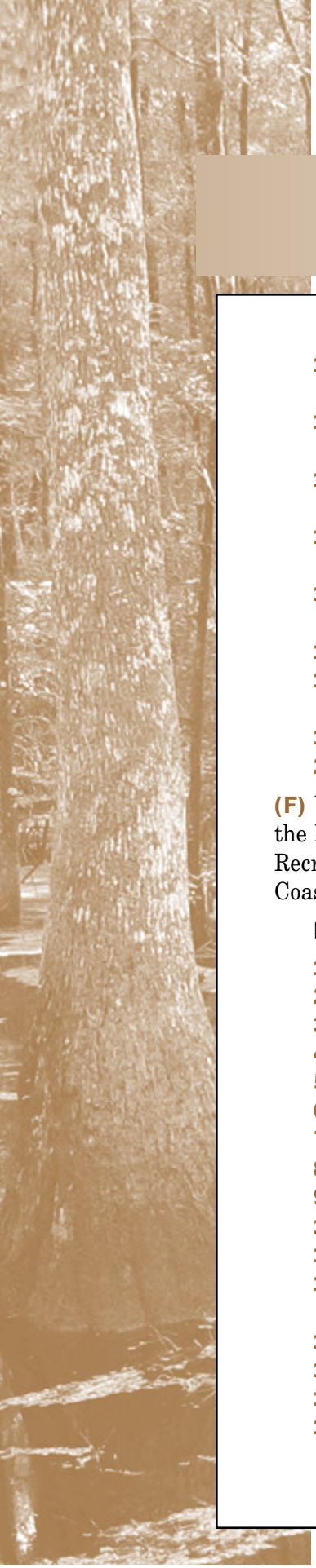


(D) Waters within State Ornamental Gardens, State Botanical Sites, State Historic Sites, and State Geological Sites

State Ornamental Gardens, State Botanical Site, State Historic Site, or State Geological Site	County
1. Alfred B. Maclay State Gardens	Leon
2. Devils Millhopper State Geological Site (10-4-90)	Alachua
3. Eden State Gardens	Walton
4. Fort Zachary Taylor State Historic Site (10-4-90)	Monroe
5. Indian Key State Historic Site (10-4-90)	Monroe
6. Key Largo Hammock State Botanical Site (5-14-86)	Monroe
7. Koreshan State Historic Site (10-4-90)	Lee
8. Lignumvitae Key State Botanical Site (5-14-86)	Monroe
9. Marjorie Kinnan Rawlings State Historic Site (10-4-90)	Alachua
10. Natural Bridge Battlefield State Historic Site (10-4-90)	Leon
11. Paynes Creek State Historic Site (10-4-90)	Putnam
13. San Marcos de Apalachee State Historic Site (10-4-90)	Wakulla
14. Washington Oaks State Gardens (as mod. 5-14-86)	Flagler
15. Windley Key Fossil Reef State Geological Site (10-4-90)	Monroe

(E) Waters within State Preserves, State Underwater Archaeological Preserves, and State Reserves

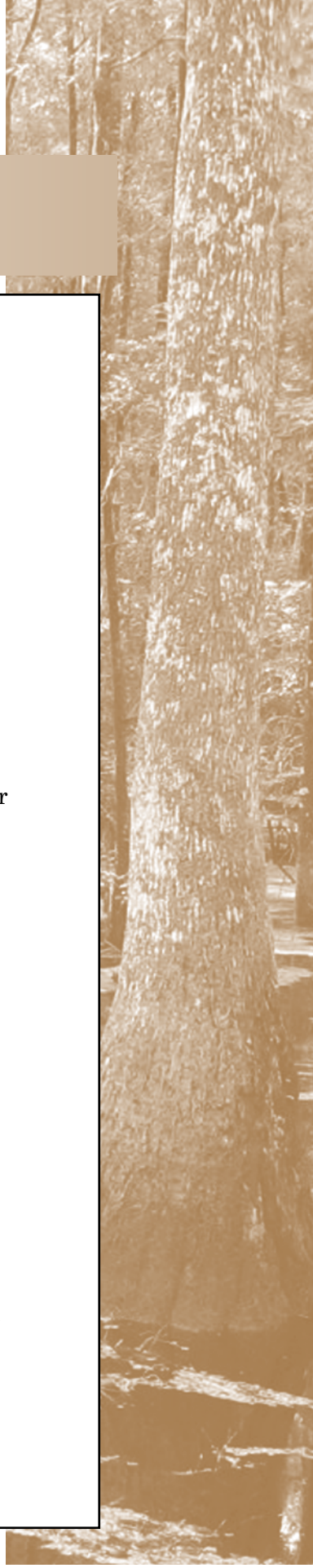
State Preserve or State Reserve	County
1. Anclote Key State Preserve (12-1-82)	Pasco/Pinellas
2. Cape St. George State Reserve (12-1-82)	Franklin
3. Cedar Key Scrub State Reserve (12-1-82; as mod. 4-19-88)	Levy
4. Charlotte Harbor State Reserve (as mod. 4-19-88)	Charlotte
5. Crystal River State Reserve (5-14-86; as mod. 4-19-88)	Citrus
6. Fakahatchee Strand State Preserve (12-1-82; as mod. 5-14-86, 4-19-88, 10-4-90, 8-8-94)	Collier
7. Haw Creek State Preserve (12-1-82)	Flagler Putnam/Volusia
8. Lower Wekiva River State Reserve (12-1-82)	Lake/Seminole
9. Nassau Valley State Reserve (12-1-82)	Duval/Nassau
10. Paynes Prairie State Preserve (as mod. 10-4-90, 8-8-94)	Alachua
11. Prairie-Lakes State Preserve	Osceola



12.	River Rise State Preserve (12-1-82; as mod. 8-8-94)	Alachua Columbia
13.	Rock Springs Run State Reserve (5-14-86; as mod. 4-19-88)	Orange
14.	San Felasco Hammock State Preserve (12-1-82; as mod. 5-14-86; 4-19-88)	Alachua
15.	San Pedro State Underwater Archaeological Preserve (10-4-90)	Monroe
16.	Savannas State Reserve (12-1-82; as mod. 5-14-86, 10-4-90, 8-8-94)	Martin/St. Lucie
17.	St. Lucie Inlet State Preserve (12-1-82)	Martin
18.	Waccasassa Bay State Preserve (12-1-82; as mod. 4-19-88)	Levy
19.	Weedon Island State Preserve (12-1-82)	Pinellas
20.	William Beardall Tosohatchee State Reserve (12-1-82)	Orange

(F) Waters within Areas Acquired through Donation, Trade, or Purchase Under the Environmentally Endangered Lands Bond Program, Conservation and Recreation Lands Program, Land Acquisition Trust Fund Program, and Save Our Coast Program

	Program Area	**County**
1.	Andrews Tract (5-14-86; as mod. 4-19-88; 8-8-94)	Levy
2.	Apalachicola Bay (8-8-94)	Franklin
3.	Barefoot Beach (12-1-82)	Collier
4.	Beker Tracts (10-4-90)	Manatee
5.	Big Bend Coastal Tract (4-19-88; as mod. 10-4-90)	Dixie/Taylor
6.	Big Shoals (4-19-88)	Hamilton
7.	B.M.K. Ranch (8-8-94)	Lake/Orange
8.	Bower Tract (5-14-86; as mod. 4-19-88)	Hillsborough
9.	Caravelle Ranch (8-8-94)	Putnam
10.	Carlton Half-Moon Ranch (8-8-94)	Sumter
11.	Catfish Creek (8-8-94)	Polk
12.	Chassahowitzka Swamp (5-14-86; as mod. 4-19-88, 8-8-94)	Hernando/Citrus
13.	Coupon Bight (10-4-90; as mod. 8-8-94)	Monroe
14.	Crystal River (10-4-90)	Citrus
15.	Curry Hammock (8-8-94)	Monroe
16.	Deering Hammock/Estate (5-14-86); as mod. 4-19-88, 8-8-94)	Dade



17.	East Everglades (5-14-86)	Dade
18.	Econfina River (8-8-94)	Taylor
19.	Emerson Point (8-8-94)	Manatee
20.	Escambia Bay Bluffs (5-14-86)	Escambia
21.	Estero Bay (8-8-94)	Lee
22.	Florida First Magnitude Springs (8-8-94)	Levy
23.	Ft. George Island (10-4-90)	Duval
24.	Ft. Mose (8-8-94)	St. Johns
25.	Ft. San Luis (5-14-86; as mod. 8-8-94)	Leon
26.	Gateway (5-14-86)	Pinellas
27.	Gills Tract (8-8-94)	Pasco
28.	Green Turtle Beach (4-19-88)	St. Lucie
29.	Guana River (5-14-86; as mod. 4-19-88)	St. Johns
30.	**Homosassa Reserve/Walker Tract Withlacoochee State Forest**	Citrus
31.	Indian River North Beach (5-14-86)	Indian River
32.	ITT/Hammock (5-14-86)	Dade
33.	Josslyn Island (10-4-90)	Lee
34.	**Goethe State Forest**	Levy
35.	Letchworth Mounds (8-8-94)	Jefferson
36.	**Little Big Econ State Forest**	Seminole
37.	Martin County Tracts (5-14-86)	Martin
38.	Mashes Sands (5-14-86)	Wakulla
39.	Miami Rockridge Pinelands (8-8-94)	Dade
40.	Milton to Whiting Field (8-8-94)	Santa Rosa
41.	North Beach (5-14-86)	Broward
42.	North Key Largo Hammock (5-14-86; as mod. 4-19-88, 10-4-90, 8-8-94)	Monroe
43.	Placid Lakes (8-8-94)	Highlands
44.	**Point Washington State Forest**	Walton
45.	Port Bougainville (10-4-90)	Monroe
46.	Rainbow River/Springs (8-8-94)	Marion
47.	Rookery Bay (10-4-90; as mod. 8-8-94)	Collier
48.	Rotenberger (as mod. 4-19-88; 8-8-94)	Palm Beach
49.	Saddle Blanket Lakes Scrub (8-8-94)	Polk
50.	Save Our Everglades (10-4-90; as mod. 8-8-94)	Collier
51.	Sea Branch (8-8-94)	Martin
52.	**Seminole State Forest**	Lake
53.	Snake Warrior Island (Oaks of Miramar) (8-8-94)	Broward



54.	Spring Hammock (4-19-88; as mod. 10-4-90)	Seminole
55.	Spruce Creek (4-19-88; as mod. 8-8-94)	Volusia
56.	St. Martins River (8-8-94)	Citrus
57.	Stark Tract (10-4-90)	Volusia
58.	Stoney-Lane (10-4-90)	Citrus
59.	Surfside Additions (5-14-86)	St. Lucie
60.	Three Lakes/Prairie Lakes (as mod. 8-8-94)	Osceola
61.	Topsail Hill (8-8-94)	Walton
62.	**Jennings State Forest**	Clay
63.	**Tiger Bay State Forest**	Volusia
64.	Wacissa/Aucilla Rivers (10-4-90)	Jefferson/Taylor
65.	Wekiva River Buffers (8-8-94)	Seminole
66.	Westlake (5-14-86; as mod. 4-19-88)	Broward
67.	Wetstone/Berkovitz (8-8-94)	Pasco
68.	**Withlacoochee State Forest**	Sumter

(G) Waters within National Seashores

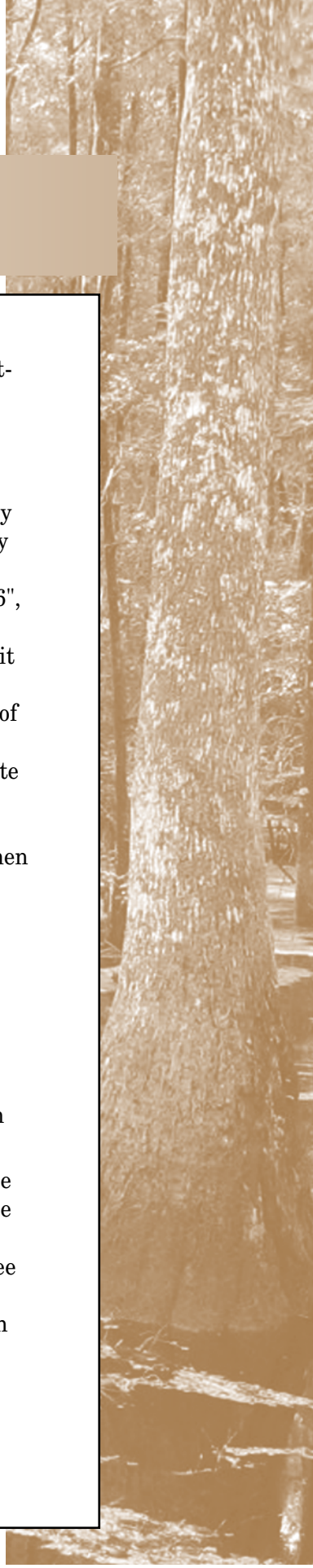
	National Seashores	**County**
1.	Canaveral	Brevard/Volusia
2.	Gulf Islands	Escambia Santa/Rosa

(H) Waters within State Aquatic Preserves

	Aquatic Preserves	**County**
1.	Alligator Harbor	Franklin
2.	Apalachicola Bay	Franklin
3.	Banana River (as mod. 8-8-94)	Brevard
4.	Big Bend Seagrasses	Wakulla/Taylor Jefferson/Dixie Levy

except for the following areas;

- **a.** Keaton Beach, Taylor County - Begin at 29°49'50" N. Lat., 83°35'24"W. Long. then west to 29°49'45", 83°35'50"; then south to 29°49'04", 83°35'48"; then east to 29°49'04", 83°35'24"; then north to the point of beginning.
- **b.** Steinhatchee, Taylor County - Begin at 29°40'35", 83°22'10"; then west to 29°40'35", 83°23'10"; then north to 29°41', 83°23'10"; then west to 29°41', 83°24'10"; then south to the Taylor County-Dixie County boundary; then eastward along the boundary to 29°39'55", 83°22'10"; then north to the point of beginning.



c. Suwannee, Dixie County - Begin at 29°20'30", 83°08'10"; then west to 29°20'30", 83°08'25"; then south to 29°20'05", 83°08'25"; then southwesterly along SR 349 to 29°19'51", 83°08'35"; then west to 29°19'51", 83°08'45"; then southwesterly to 29°19'40", 83°09'12"; then south to 29°19'30", 83°09'12"; then northeasterly to 29°19'39", 83°08'53"; then southeasterly to 29°19'25", 83°08'41"; then southwesterly to 29°19'20", 83°08'49"; then southeasterly to 29°19'14", 83°08'41"; then northeasterly along the bank of the Suwannee River to and along the bank of Demory Creek to 29°19'45", 83°08'10"; then north to the point of beginning.

d. Cedar Key unincorporated airport area, Levy County - Begin at 29°08'26", 83°03'17"; then south to 29°07'34", 83°03'17", then northeasterly to 29°07'48", 83°02'33"; beginning northerly and tracing the corporate limit of Cedar Key to the point of beginning.

e. Cedar Key unincorporated causeway area, Levy County - That portion of Section 20 lying within 1000 feet of the centerline of SR 24 and lying north of a line 500 feet northeast of and parallel to the northern corporate limit of Cedar Key.

f. Cedar Key channel, Levy County - Begin at 29°08'58", 83°01'17"; then west to 29°08'58", 83°01'24"; then south to 29°08'05", 83°01'26"; then northeasterly to 29°08'08", 83°01'17"; then northerly to the point of beginning.

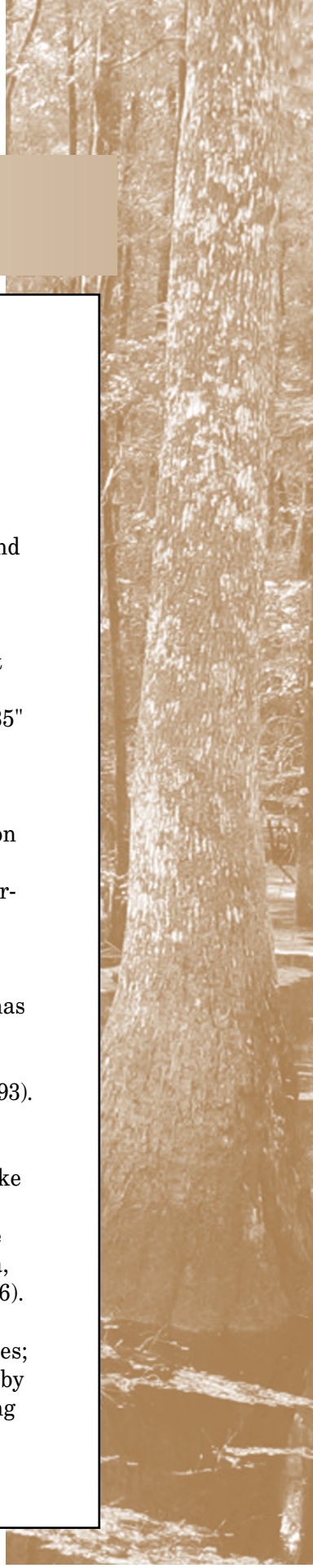
g. Keaton Beach navigation channel, Taylor County - Begin at 29°49'02", 83°35'30"; then west to 29°49'02", 83°37'58"; then south to 29°48'45", 83°37'58"; then east to 29°48'45", 83°35'30"; then north to the point of beginning.

h. Keaton Beach local channels, Taylor County - Begin at 29°49'01", 83°35'38"; then southeast to 29°48'55", 83°35'15"; then northeast to 29°48'59", 83°35'13"; then northwest to 29°49'06", 83°35'36"; then south west to the point of beginning. (10-29-86)

5. Biscayne Bay (Cape Florida)	Dade/Monroe
6. Biscayne Bay (Card Sound) (12-1-82)	Dade/Monroe
7. Boca Ciega Bay	Pinellas
8. Cape Haze	Charlotte/Lee
9. Cape Romano-Ten Thousand Islands	Collier
10. Cockroach Bay	Hillsborough
11. Coupon Bight	Monroe
12. Estero Bay (as mod. 4-19-88)	Lee
13. Fort Clinch State Park	Nassau
14. Fort Pickens State Park	Santa Rosa Escambia



15.	Gasparilla Sound-Charlotte Harbor (as mod. 10-4-90)	Charlotte/Lee
16.	Guana River Marsh (8-8-94)	St. Johns
17.	Indian River Malabar to Vero Beach	Brevard Indian River
18.	Indian River Malabar to Vero Beach (additions), except those portions of Sebastian Creek and Turkey Creek upstream of U.S. Highway 1 (1/26/88)	Brevard Indian River
19.	Indian River Vero Beach to Ft. Pierce (as mod. 10-4-90)	Indian River St. Lucie
20.	Jensen Beach to Jupiter Inlet (as mod. 10-4-90)	Martin/Palm Beach/St. Lucie
21.	Lake Jackson	Leon
22.	Lemon Bay (4-19-88; as mod. 10-4-90)	Charlotte Sarasota
23.	Lignumvitae Key	Monroe
24.	Loxahatchee River-Lake Worth Creek (as mod. 8-8-94)	Martin Palm Beach
25.	Matlacha Pass	Lee
26.	Mosquito Lagoon	Volusia Brevard
27.	Nassau River-St. Johns River Marshes	Nassau/Duval
28	North Fork, St. Lucie	St. Lucie Martin
29.	Oklawaha River (10-4-90)	Marion
30.	Pellicer Creek	St. Johns Flagler
31.	Pine Island Sound	Lee
32.	Pinellas County	Pinellas
33.	Rainbow Springs (4-19-88)	Marion
34.	Rocky Bayou State Park	Okaloosa
35.	Rookery Bay (12-1-82; as mod. 11-24-87, 7-11-91)	Collier
36.	St. Andrews State Park	Bay
37.	St. Joseph Bay	Gulf
38.	St. Martins Marsh (as mod. 8-8-94)	Citrus
39.	Terra Ceia (5-22-86)	Manatee
40.	Tomoka Marsh	Volusia/Flagler
41.	Wekiva River (12-1-82)	Lake/Orange Seminole
42.	Wekiva River Addition, except that portion of the	Lake/Seminole



St. Johns River between Interstate Highway 4 and the Wekiva River confluence (12-28-88) — Volusia

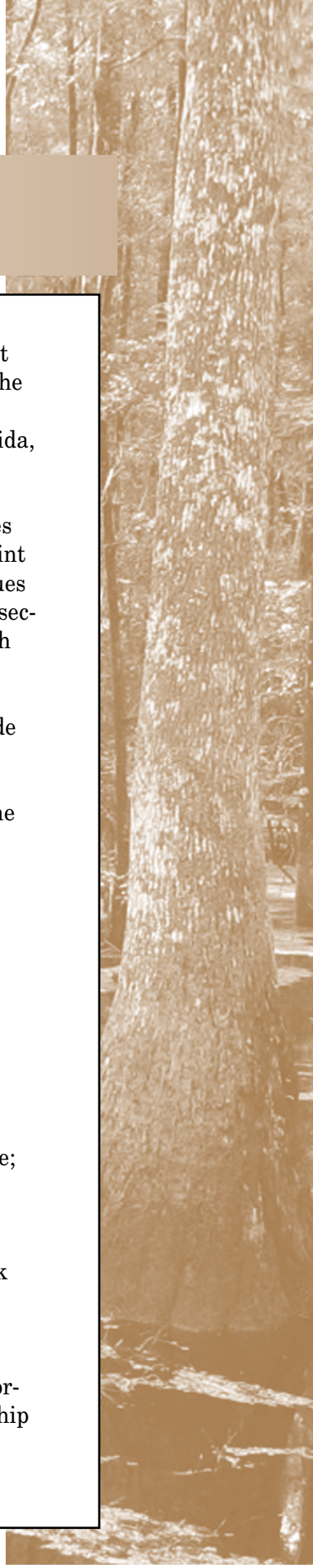
43. Yellow River Marsh — Santa Rosa

(l) Special Waters

1. Apalachicola River except for the following areas:
   a. From a point 50 feet north of the northern boundary of the Jackson County Port Authority Slip, and including the slip itself, downstream to a point about four-tenths of a mile downstream, and specifically identified by navigation mile 103 on the 1982 U.S. Geological Survey Quadrangle Map of Sneads, Florida; and
   b. From 850 feet downstream of the U.S. Army Corps of Engineers Blountstown Navigation Gage in Calhoun County, north to a point approximately 2,700 feet upstream of the Gage, and specifically identified by the line passing through 30°25'45" N. Lat. and 85°1'35" W. Long.; and 30°25'38" N. Lat. and 85°1'20" W. Long. (12-11-84).
2. Aucilla River
3. Blackwater River
4. Butler Chain of Lakes - consisting of Lake Butler, Lake Down, Wauseon Bay, Lake Louise, Lake Palmer (also known as Lake Isleworth), Lake Chase, Lake Tibet, Lake Sheen, Pocket Lake, Fish Lake, and the waterways which connect these lakes (3-1-84), and Lake Blanche and its connecting waterway (2-18-87).
5. Chassahowitzka River System including: Potter, Salt, Baird, Johnson, Crawford, Ryle, and Stevenson Creeks, and other tributaries to the Chas sahowitzka River; but excluding artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (1-5-93).
6. Chipola River
7. Choctawhatchee River
8. Clermont Chain of Lakes - consisting of Lake Louisa (also known as Lake Louise), Lake Susan, Lake Crescent, Lake Minnehaha, Lake Winona, Lake Palatlakaha, Lake Hiawatha, Lake Minneola, Lake Wilson, Lake Cook, Cherry Lake, Lake Hunt, Lake Stewart, Lake Lucy, Lake Emma, and the waterways that interconnect Clermont Chain of Lakes (5-28-86).
9. Crooked Lake in Polk County including the area known as Little Crooked Lake and the connecting waterway between these waterbodies; less however, artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Section 62-312.020(3), F.A.C. (4-9-87).
10. Crystal River, including Kings Bay (2-1-83).



11. Econlockhatchee River System - consisting of the Econlockhatchee River and the following tributaries:
    a. Little Econlockhatchee River upstream to Michaels Dam in Jay Blanchard Park; and
    b. Mills Creek upstream to Mills Lake; and
    c. Southerly branch of Mills Creek upstream to Fort Christmas Road in Section 2, Township 22 South, Range 32 East; and
    d. Silcox Branch (branch of Mills Creek) upstream to Lake Pickett; and
    e. Long Branch upstream to the eastern section line of Section 34, Township 22 South, Range 32 East; and
    f. Hart Branch upstream to the Old Railroad Grade in Section 18, Township 23 Soputh, Range 32 East; and
    g. Cowpen Branch upstream to the southernmost bifurcation of the creek in Section 20, Township 23 South, Range 32 East; and
    h. Green Branch upstream to the western section line of Section 29, Township 23 South, Range 32 East; and
    i. Turkey Creek upstream to Weewahootee Road in Section 5, Township 24 South, Range 32 East, and to the west section lines of Section 5, Township 24 South, Range 32 East, and Section 32, Township 23 South, Range 32 East; and
    j. Little Creek upstream to the eastern section line of Section 22, Township 24 South, Range 32 East; and
    k. Fourmile Creek upstream to the southern line of the NE1/4 of Section 28, Township 24 South, Range 32 East; and
    i. Econlockhatchee River Swamp upstream to State Road 532;
    m. but excluding all other tributaries and artificial water bodies, defined as any water body created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (6-18-92).
12. Estero Bay Tributaries including: Hendry Creek to State Road 865, Big Bayou, Mullock Creek to U.S. 41 (State Road 45); Mud Creek; Estero River (north and south branches) to I-75 Halfway Creek to State Road 41; Spring Creek to Business Route 41 (State Road 887, old State Road 41), and the unnamed south branch of Spring Creek in Sections 20 and 29; Imperial River to the eastern line of Section 31, Range 26 East, Township 47 South, Oak Creek, and Leitner Creek; except for Tenmile Canal and any artificial water bodies, defined as any water body created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (10-4-90).



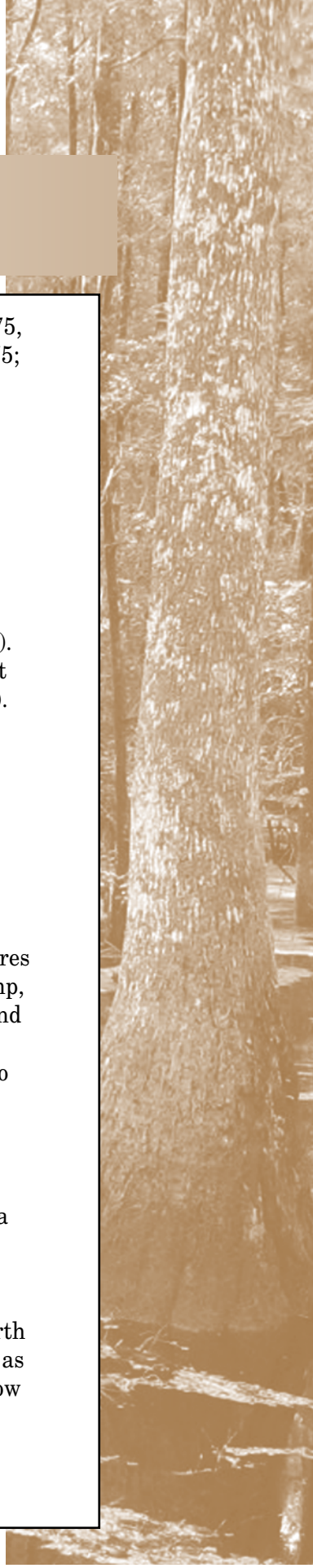
13. Florida Keys, including channels as defined in Rule 62-312.020(4), F.A.C.,and described as follows: Commence at the northeasterly most point of Palo Alto Key and run due north to a point at the center of the channel of Broad Creek as the point of beginning, thence due east to the eastern boundary of the jurisdictional waters of the State of Florida, thence meander southerly along said eastern boundary to a point due south of the westernmost point of the island of Key West; thence westerly, northerly and easterly along the arc of a curve three leagues distant from the westernmost point of the island of Key West to a point due north of the island of Key West; thence northeasterly three leagues distant from the most northerly land of the Florida Keys to the intersection with the boundary of the Everglades National Park; thence southeasterly, northeasterly and northwesterly along the boundary of the Everglades National Park to the intersection with the Dade County - Monroe County line; thence northeasterly and easterly along the Dade County - Monroe County line to the point of beginning; less however, three areas:
    a. Key West Sewage Outfall, being a circle 150 feet in radius from the point of discharge located at approximately 24°32'13" N. Latitude and 81°48'55" W. Longitude; and
    b. Stock Island Power Plant Mixing Zone; being a circle 150 feet in radius from the end of the power plant discharge canal; and
    c. Artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (5-8-85).
14. Hillsborough River from Fletcher Avenue (State Road 582A) in Hillsborough County upstream to the Withlacoochee River Overflow in Pasco County, and the following tributaries:
    a. Crystal Springs; and
    b. Blackwater Creek westward of the Hillsborough - Polk County line; and
    c. Cypress Creek, Thirteenmile Run eastward of Livingston Avenue, and Big Cypress Swamp upstream to and including the Cypress Creek Wellfield, as delineated in the maps entitled "Cypress Creek OFW Boundary Maps," incorporated herein by reference; and
    d. Trout Creek upstream to Bruce B. Downs Boulevard (State Road 581);
    e. but excluding all other tributaries as well as the proposed transportation corridor, which crosses Cypress Creek in Section 21, Township



27 South, Range 19 East, as identified in the Adopted 2010 Long Range Transportation Plan of the Metropolitan Planning Organization, dated May 26, 1993.

f. A copy of the maps referenced in subparagraph c. above may be obtained from the Department of Environmental Protection, Bureau of Surface Water Management, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400 (4-12-95).

15. Homosassa River System including: Halls River, Turtle, Otter, Battle, and Price Creeks, and other tributaries to the Homosassa River; but excluding artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (1-5-93).
16. Kingsley Lake and Black Creek (North Fork) downstream to the northern line of Section 23, Township 5 South, Range 23 East, including all tributaries along this segment of Black Creek (11-8-90).
17. Lake Disston – Specifically including Lake Disston plus contiguous wetlands within the following areas: Township 14 South, Range 29 East, Sections 21, 20, 19, 18, 17, 16, 9, 8 and 7 in Flagler County; and Township 14 South, Range 28 East, Sections 13 and 24 in Volusia County except:
    a. artificial water bodies defined as any water body created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C.; and
    b. any natural water bodies connected by artificial water bodies to the above-described system (4-4-01).
18. Lake Powell, Phillips Inlet, and all tributaries to Lake Powell as bounded by the following described line: Begin at the Northwest corner of Section 26, Township 2 South, Range 18 West; thence East to the Northwest corner of Section 29, Township 2 South, Range 17 West; thence South to the Northwest corner of the SW1/4 of Section 29, Township 2 South, Range 17 West; thence East to the West line of Section 27, Township 2 South, Range 17 West, thence South to the mean high water line of the Gulf of Mexico; thence meander Northwest along the mean high water line to the West line of Section 35, Township 2 South, Range 18 West; thence North to the point of beginning (8-18-91).
19. Lemon Bay Estuarine System - from Boca Grande Causeway northward to approximately two thousand feet northwest of the mouth of Alligator Creek, specifically identified as the East line of Section 31, Township 39 South, Range 19 East, including Placida Harbor, Gasparilla Pass, Kettle Harbor, Bocilla Lagoon, Bocilla Pass, Knight Pass, Stump Pass, Lemon Bay, Buck Creek upstream to County Road 775, Oyster Creek upstream



to County Road 775, Ainger (Rock) Creek upstream to County Road 775, and Godfrey (Godfried, Gottfried) Creek upstream to County Road 775; but excluding:

a. Alligator Creek, Forked Creek, Lemon Creek, and all other tributaries; and
b. Artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Section 62-312.020(3), F.A.C. (4-29-86).

20. Little Manatee River - from its mouth to the western crossing of the river by S.R. 674, including Hayes, Mill and Bolster Bayous, but excluding South Fork, Ruskin Inlet and all other tributaries (10-1-82).
21. Lochloosa Lake (including Little Lochloosa Lake, Lochloosa Lake Right Arm, and Lochloosa Creek upstream to County Road 20A) (12-15-87).
22. Myakka River between State Road 771 (El Jobean Bridge) and the Charlotte - Sarasota County line, except for artificial waterbodies, de fined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (4-19-88).
23. Ochlockonee River
24. Oklawaha River between the eastern line of Section 36, Township 15 South, Range 23 East, and Eureka Lock and Dam, including Turkey Creek, Strouds Creek, Dead River (the water body so named near Gores Landing), Cedar Creek, and Fish Creek, but excluding Marshall Swamp, the Dead River (the water body so named exiting Marshall Swamp), and all other tributaries (12-20-89).
25. Orange Lake up to the U.S. Highway 301 bridge, the River Styx up to Camps Canal, and Cross Creek (4-9-87).
26. Perdido River
27. Rainbow River, including Indian Creek, but excluding all other tributaries (1-17-85).
28. Santa Fe River System - consisting of the Santa Fe River, Lake Santa Fe, Little Lake Santa Fe, Santa Fe Swamp, Olustee Creek, and the Ichetucknee River below S.R. 27, but excluding all other tributaries (8-16-84).
29. Sarasota Bay estuarine system - generally extending from Venice north to the Hillsborough - Manatee County line and specifically described as follows: Commence at the northern tip of Anna Maria Island and follow a line running to the southern tip of Egmont Key until intersecting the boundary between Hillsborough and Manatee Counties; thence run easterly and northeasterly along the county boundary until



intersecting the Intracoastal Waterway; thence proceed southerly until intersecting a line between the southern tip of Mullet Key and the western tip of Snead Island; thence proceed southeasterly along said line to the western tip of Snead Island; thence to De Soto Point; and thence westerly and southerly including all of the Sarasota Bay e stuarine system southward to the northernmost U.S. Highway Business Route 41 bridge over the Intracoastal Waterway in Venice, including Anna Maria Sound, Passage Key Inlet, Perico Bayou, Palma Sola Bay, Long boat Pass, Sarasota Bay, New Pass, Big Sarasota Pass, Roberts Bay, Little Sarasota Bay, Dryman Bay, Blackburn Bay, Lyons Bay, Venice Inlet, Dona Bay upstream to the U.S. Highway 41 bridge, and Roberts Bay upstream to the U.S. Highway 41 bridge; less however, the following areas:

- **a.** All tributaries, including Palma Sola Creek, Bowlees Creek, Whitaker Bayou, Hudson Bayou, Phillippi Creek, Catfish Creek, North Creek, South Creek, Shakett Creek, Curry Creek; and
- **b.** A circle 1500 feet in radius from the mouth of Whitaker Bayou; and
- **c.** A circle 1500 feet in radius from the mouth of Phillippi Creek; and
- **d.** Artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (4-29-86).
- **e.** The designation shall not affect the consideration by the Department of an application for Site Specific Alternative Criteria for the discharge of the City of Bradenton's Municipal Sewage Treatment Plant being built under Department of Environmental Protection Construction Permit No. DC41-81224. The application will be processed under the regulations of the Department existing on February 18, 1986.

30. St. Marks River - except that part between Rattlesnake Branch and the confluence of the St. Marks and Wakulla Rivers.

31. Shoal River

32. Silver River (Marion County) (4-9-87)

33. Spruce Creek upstream to State Road 40A, and the following tributaries:

- **a.** Unnamed tributary upstream to the Southern section line of Section 4, Township 17 South, Range 33 East; and
- **b.** Unnamed tributary upstream to the Northern section line of Section 20, Township 16 South, Range 33 East; and
- **c.** Unnamed tributary upstream to the Northern section line of Section 23, Township 16 South, Range 32 East (right fork), and to the Western line of the NE 1/4 of Section 27, Township 16 South, Range 32 East; and



d. Unnamed tributary upstream to the Western section line Section 35, Township 16 South, Range 32 East; and
e. Strickland Bay; and Turnbull Bay and Turnbull Creek upstream to the Northwestern section line of Section 43, Township 17 outh, Range 33 East;
f. and Murray Creek upstream to the Town of Ponce Inlet municipal limits; and
g. waters east from U.S. Highway 1 following the northerly and southerly municipal limits of the Town of Ponce Inlet to its inter section with the western boundary of the Intracoastal Waterway and including Rose Bay upstream to Nova Road (State Road 5A);
h. but excluding all other tributaries (7-11-91).

34. Suwannee River
35. Tomoka River upstream to Interstate Highway 4; and the following tributaries:
    a. Priest Branch upstream to the Western and Southern section lines of Section 6, Township 15 South, Range 32 East; and
    b. Little Tomoka River and its tributaries as bounded by the following described line: Begin at the Southwestern point of confluence between the Tomoka River and the Little Tomoka River; thence meander upstream along the Little Tomoka River to the Western section line of Section 25, Township 14 South, Range 31 East; thence South to the Southwest corner of Section 25, Township 14 South, Range 31 East; thence West to the Southwest corner of Section 28, Township 14 South, Range 31 East; thence North to the Northwest corner of ection 28, Township 14 South, Range 31 East; thence East to the West section line of Section 25, Township 14 South, Range 31 East; thence South to the Northern shore of the Little Tomoka River; thence meander easterly to the confluence with the Tomoka River; thence South to the point of beginning; and
    c. Groover Branch upstream to the Northern section line of Section 24, Township 14 South, Range 31 East; and
    d. Misner's Branch upstream to the Northern section line of Section 29, Township 14 South, Range 32 East; and
    e. Thompson Creek and Strickland Creek upstream to the Northern section line of Section 40, Township 14 South, Range 32 East;
    f. but excluding all other tributaries (7-11-91).
36. Wacissa River
37. Wakulla River
38. Weekiwachee Riverine and Spring System – consisting of the Weekiwachee Springs and River, Mud Springs and River, Jenkins Creek, Salt Spring



and Creek, the Weekiwachee Swamp, and all tributaries and contiguous wetlands within the following sections: Township 23 South, Range 17 East, Sections 2-9; Township 22 South, Range 17 East, Sections 20, 21, and 27-35, together with that portion of Section 19 that is southerly of CR 550 (Cortez Blvd.); Township 22 South, Range 16 East, Sections 25 and 36; including any and all waters, and wetlands contiguous to the tributaries located southerly of the north line of Section 25, Township 22 South, Range 16 East and westerly projection thereof and easterly of the west line of Section 36, Township 22 South, Range 16 East and northerly projection thereof, and easterly of a line through latitude 28º 32' 52" North, longitude 82º 39' 23" West, and through latitude 28º 31' 47" North, longitude 82º 39' 52" West (North American Datum of 1983). This OFW excludes artificial waters defined as any water body created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in subsection 62-312.020(3), F.A.C. (12-11-03).

39. Wekiva River System - consisting of the Wekiva River, Rock Springs Run and its tributary Sulphur Spring, the Little Wekiva River south to its confluence with the southernmost run of Sanlando Springs, Black Water Creek and Swamp (up to Lake Dorr), Lake Norris, Seminole Springs and Creek, Seminole Swamp, Sulphur Spring and Run, and Messant Spring and Creek, but excluding all other tributaries (12-28-88).
40. Wiggins Pass Estuarine Area and the Cocohatchee River System - the estuarine and marine waters from the Lee/Collier County line south ward through and including Water Turkey Bay to 50 feet north of S.R. 846 (Bluebill Ave.) 1995 right-of-way; the Cocohatchee River down stream from 50 feet West of U.S. 41 1995 right-of-way; and Wiggins Pass; but excluding maintenance dredging as authorized by Section 403.813(2)(f), F.S., in the following areas:
    a) Wiggins Pass from the Gulf of Mexico eastward for 200 linear feet (as measured from the southwestern point of Little Hickory Island);
    b) the channel (South Channel, Vanderbilt Channel), that connects Wiggins Pass with Vanderbilt Lagoon through Water Turkey Bay; and
    c) East Channel (for purposes of this designation described as the East Channel from its confluence with South Channel to Vanderbilt Drive, including all waters surrounding the spoil islands know as Conklin Point and Island Marina) (7-16-96).
41. Withlacoochee Riverine and Lake System, including:
    a. The Withlacoochee River downstream of State Road 33 in Lake County to eastern section line of Section 33, Township 16 South, Range 18 East; and



b. The lower Withlacoochee River, from the Gulf of Mexico to the Cross Florida Barge Canal By-Pass Spillway, but not including that portion of the river between Lake Rousseau and the Cross Florida Barge Canal; and
c. The Little Withlacoochee River; and
d. Jumper Creek downstream of State Road 35, including Jumper Creek Swamp; and
e. Gum Springs, Gum Slough (Dead River), and Gum Swamp; and
f. Lake Panasoffkee, Outlet River, Little Jones Creek, Big Jones Creek, and Rutland Creek; and
g. Shady (Brook, Panasoffkee) Creek downstream of State Road 468, including Warm Spring Hammock; and
h. Lake Tsala Apopka;
i. but excluding all other tributaries and artificial waterbodies, defined as any waterbody created by dredging, or excavation, or by the filling in of its boundaries, including canals as defined in Rule 62-312.020(3), F.A.C. (4-10-89).

(j) Waters within Rivers Designated Under the Florida Scenic and Wild Rivers Program, federal Wild and Scenic Rivers Act of 1968 as amended, and Myakka River Wild and Scenic Designation and Preservation Act

River Segment	County
1. Loxahatchee National Wild and Scenic River Segment (5-14-86)	Martin Palm Beach
2. Myakka Florida Wild and Scenic River Segment (5-14-86)	Sarasota
3. Wekiva Florida Scenic and Wild River Segment (12-1-82)	Lake/Seminole

(k) Waters within National Preserves

National Preserve	County
1. Big Cypress National Preserve as mod. 5-14-86, 4-19-88, 8-8-94)	Collier/Dade Monroe
2. Timucuan Ecological and Historic Preserve (8-8-94)	Duval

(i) Waters within National Marine Sanctuaries

Marine Sanctuary	County
1. Key Largo	Monroe
2. Looe Key (12-1-82)	Monroe

(m) Waters within National Estuarine Research Reserves

National Estuarine Research Reserve	County
1. Apalachicola (12-1-82; as mod. 5-14-86, 4-19-88) Gulf	Franklin
2. Rookery Bay (as mod. 5-14-86, 4-19-88)	Collier

(n) Certain Waters within the Boundaries of the National Forests

National Forest	County
1. Apalachicola	Wakulla/Leon
a. Sopchoppy River (9-1-82)	Franklin
b. Big Dismal Sink (9-1-82)	
2. Ocala	Putnam
Marion	
a. Alexander Springs (9-1-82)	Lake
b. Alexander Springs Creek (9-1-82)	
c. Juniper Springs (9-1-82)	
d. Juniper Creek (9-1-82)	
e. Salt Springs (9-1-82)	
f. Salt Springs Run (9-1-82)	
g. Lake Dorr (9-1-82)	
h. Lake Kerr (9-1-82)	
i. Little Lake Kerr (9-1-82)	
3. Osceola	Baker/Columbia
a. Deep Creek (9-1-82)	
b. Robinson Creek (9-1-82)	
c. Middle Prong - St. Marys River (9-1-82)	
d. Ocean Pond (9-1-82)	
e. Falling Creek (9-1-82)	

(0). Outstanding National Resource Waters:

a. The Commission designates the following waters as Outstanding National Resource Waters:

1. Biscayne National Park, as described in the document entitled "Outstanding National Resource Waters Boundary Description and Map for Biscayne National Park", dated June 15, 1989, herein adopted by reference.
2. Everglades National Park, as described in the document entitled "Outstanding National Resource Waters Boundary Description and Map for Everglades National Park", dated June 15, 1989, herein adopted by reference.

Appendix 5 Wetland Types

*COMMON WETLAND TYPES **

Bay Heads

Bogs

Bottomland Hardwood Swamps

Cypress Strand Swamps

Cypress Domes

Cypress Ponds

Flag Ponds

Freshwater Tidal Swamps

Grass Ponds

Gum Ponds

Gum Swamps

Hydric Hammock

Pitcher Plant Bogs

River & Creek Floodplain Swamps

Sawgrass Marshes

Seasonal Marshes

Seepage Slopes

Seepage Swamps

Sloughs

Strand Swamps

Wet Prairie

Willow Head

***NOTE:** For purposes of BMP implementation, Pine Flatwoods is not considered a wetland although sites of this nature may exhibit some of the same charateristics of the wetlands listed above.

Appendix 6 Seeding Rates for Vegetative Stabilization
Roads, Stream Crossings & Landings

Planting Dates and Seeding Rates

Seed	Planting Dates	Seeding Rates per acre Broadcast (lb)
Aeschynomene	Mar. 30 - Jun. 30	6 - 8 (dehulled)
Pensacola Bahiagrass	Feb. 15 - Aug. 15	15 - 20
Common Bermudagrass	Feb. 15 - July 31	8 - 10
Arrowleaf Clover	Oct. 1 - Nov. 15	8 - 10
Crimson Clover	Oct. 1 - Nov. 15	20 - 26
Hairy Indigo	Apr. 1 - Jun. 30	6 - 8
Browntop Millet	Feb. 15 - Aug 15	5 - 10
Italian Ryegrass	Oct. 1 - Nov. 15	20-30

Source: E.E. Whitty and C.G. Chambliss, IFAS SSAGR 150 March 2005

Fertilizer Application

Fertilizer	Lbs./Ac.
10-10-10	800
Limestone*	2000

Source: Carl DeFazio, Soil Conservation Service, 1977.

**Where needed*

Example: Multiply appropriate acreage value of road by the recommended seed mixture or fertilizer in Lbs./Ac.

e.g.: A section of 12 ft. wide by 750 ft. long road would require 4.2 lbs. of Pensacola Bahiagrass (0.21ac. X 20 lbs./ac.)

Road Acreage Table

Road Length in Feet	Road Width in Feet				
	10	12	14	18	25
50	0.01	0.01	0.02	0.02	0.03
100	0.02	0.03	0.03	0.04	0.06
250	0.06	0.07	0.08	0.10	0.15
500	0.12	0.14	0.16	0.21	0.29
750	0.17	0.21	0.24	0.31	0.44
1000	0.24	0.28	0.32	0.41	0.58
1500	0.34	0.41	0.48	0.62	0.87
2000	0.48	0.56	0.64	0.83	1.15
5000	1.15	1.38	1.61	2.07	2.87
5280	1.21	1.45	1.70	2.18	3.04

Source: U.S.D.A. Forest Service

Appendix 7 Drainage Structures

Recommended Spacing for Drainage Structures

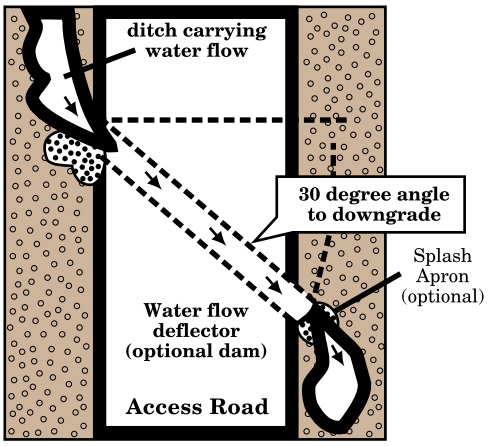
Drainage Systems	Site Sensitivity Class A1	A2	A3	A4	A5	A6
Permanent Roads						
Culverts and Cross Ditches	None	200	150	125	100	75
Water Turnouts	200	120	100	75	50	40
Broad Base Dips	None	180	140	125	120	110
Firelines, Skid Trails & Temporary Roads						
Water Bars	250	135	80	60	45	30

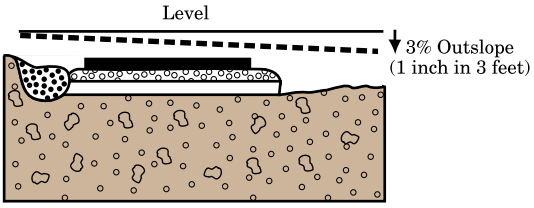
Drainage Systems	Site Sensitivity Class B1	B2	B3	B4	B5	B6
Permanent Roads						
Culverts and Cross Ditches	None	200	150	125	100	75
Water Turnouts	200	120	100	75	50	40
Broad Base Dips	None	180	140	125	120	110
Firelines, Skid Trails & Temporary Roads						
Water Bars	250	135	80	60	45	30

Drainage Systems	Site Sensitivity Class C1	C2	C3	C4	C5	C6
Permanent Roads						
Culverts and Cross Ditches	None	200	150	125	100	75
Water Turnouts	200	120	100	75	50	40
Broad Base Dips	None	180	140	125	120	110
Firelines, Skid Trails & Temporary Roads						
Water Bars	250	135	80	60	45	30

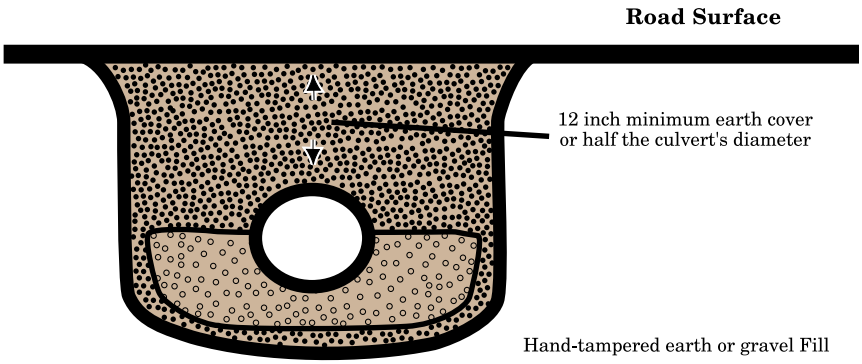
Appendix 8 Access Roads

Cross-drain Culvert

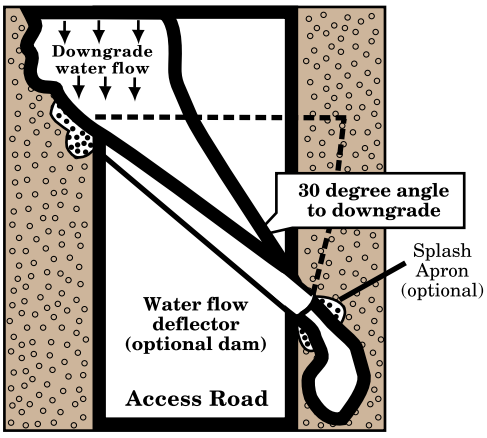


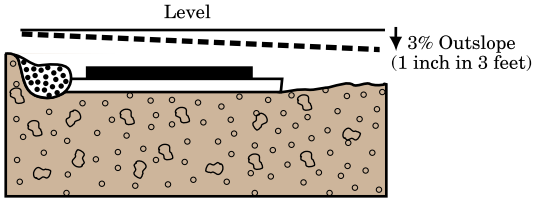


Road Surface and Culvert pitch

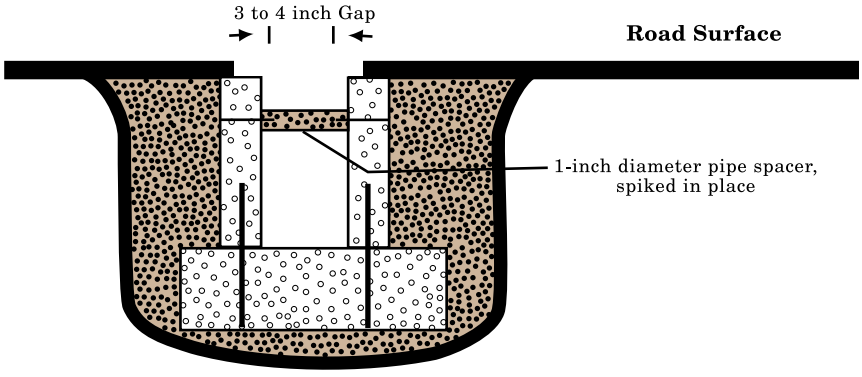


Open Box Culvert



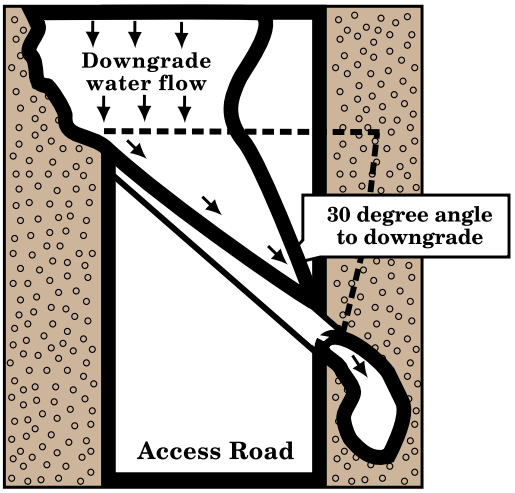


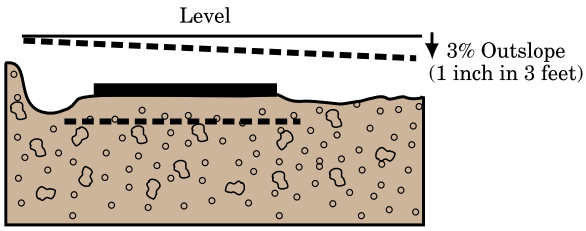
Road Surface and Open Box Culvert pitch



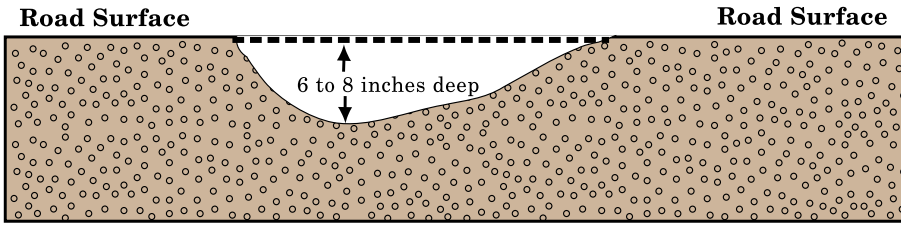
A pair of 3 X 8 planks set on a base 3 X 12
to form an Open Box Culvert

Cross Ditch

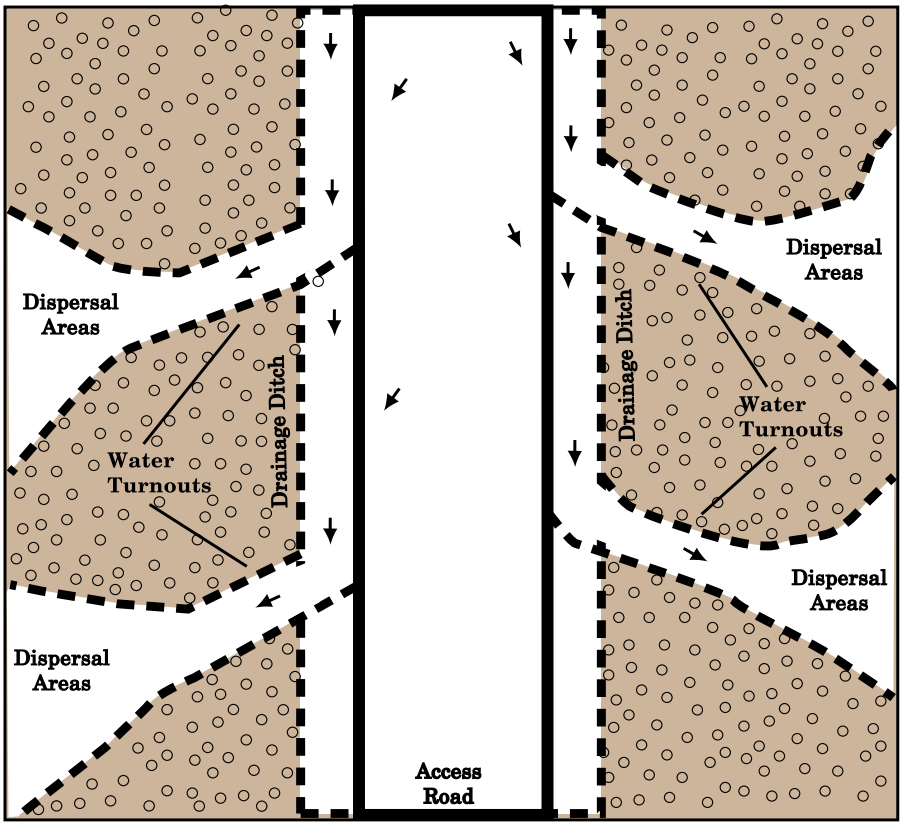


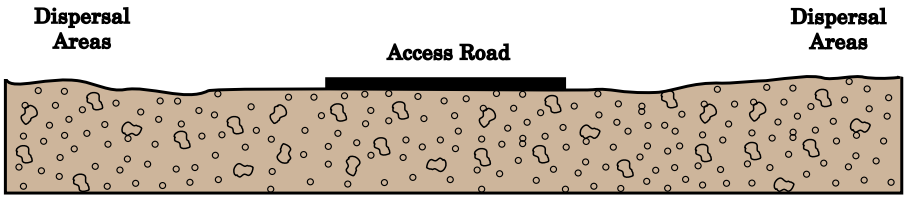


Road Surface and Cross Ditch Pitch

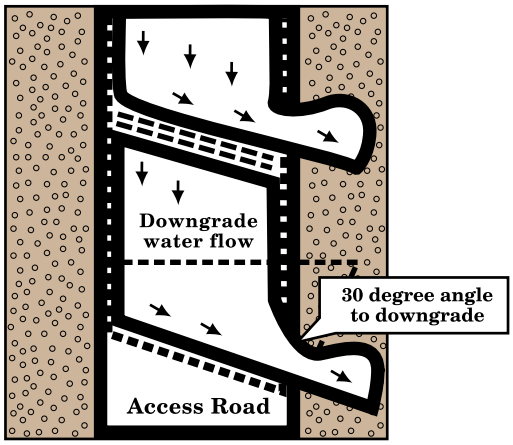


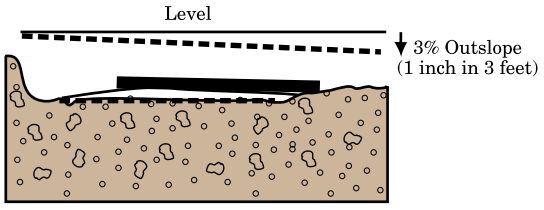
Water Turnouts



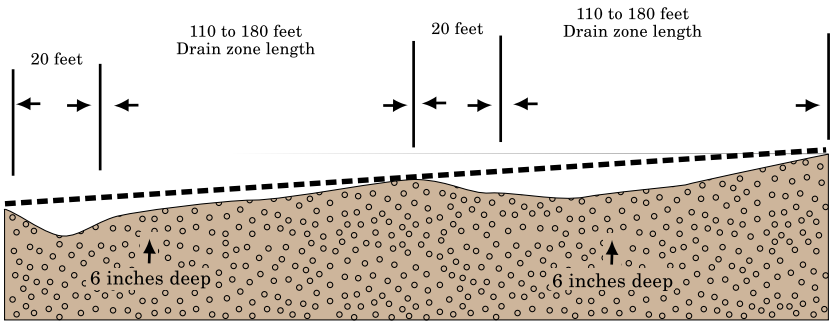


Broad Base Dip

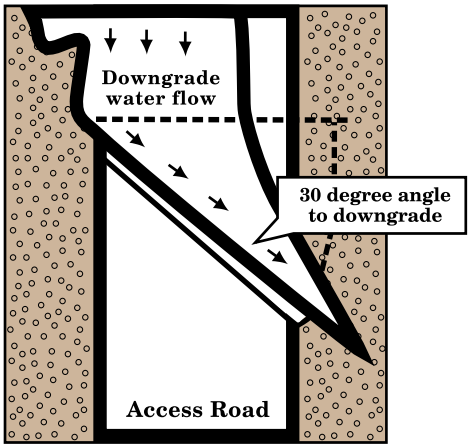


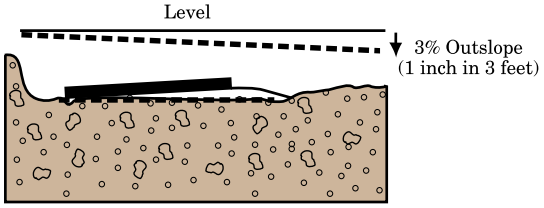


Road Surface and Broad Base Dip pitch

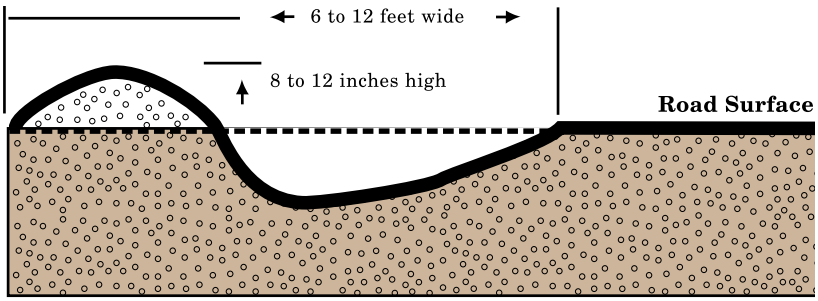


Water Bar





Road Surface and Water Bar pitch



Appendix 9 Culvert Sizing

Stream Size/Site Condition Method

Procedure:

1) Measure bottom channel width (W) and channel depth (D) from bottom to top of bank.

2) Determine whether slope upstream is flat, moderately or extremely hilly and refer to appropriate Table (A-C) on the following pages.

For areas with no perceptible change in elevation upstream of the culvert area, choose (FLAT) slope.

In moderately hilly areas, such as a rise of two (2) feet for every 100 feet of run, choose Moderate (MOD) slope.

In extremely hilly areas, with an approximate rise of ten (10) feet or more for every 100 feet of run, choose critical (CRIT) slope.

3) Read corresponding culvert size based on width and depth of stream channel.

Assumptions:

Roughness factors:	**Slope:**
n = 0.030 for channel	FLAT = 0.05%
n = 0.024 for CMP culvert	MOD = 2.00%
	CRIT = 10.00 %

Calculations assume corrugated Metal Pipes (CMP) which project slightly out of fill.

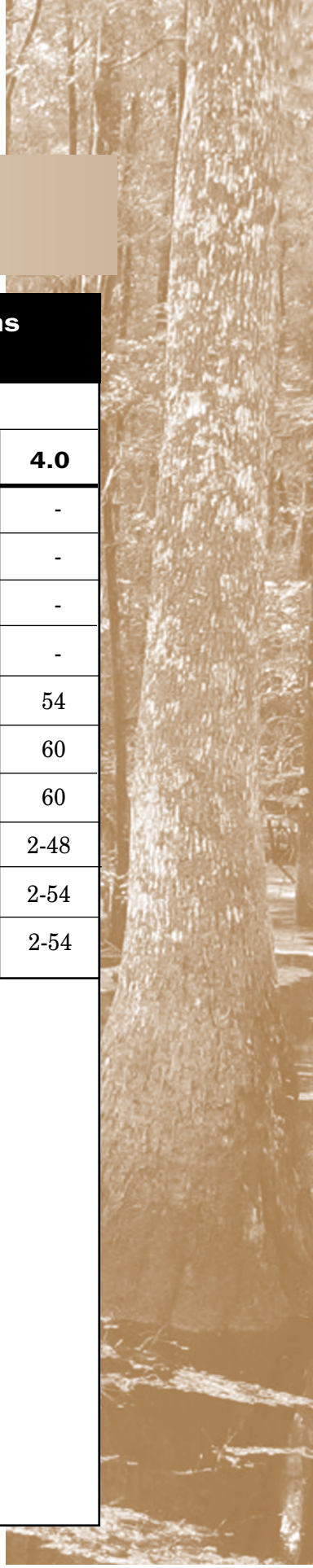


Table A: Culvert Diameters (Inches) for Flat Conditions Slopes Upstream 0-0.05%								
Stream Width (Ft.)	Stream Depth (Ft.)							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
1	12	12	-	-	-	-	-	-
2	12	12	18	24	-	-	-	-
3	12	15	18	24	30	36	-	-
4	12	18	21	27	33	36	42	-
5	12	18	21	30	36	42	48	54
6	12	21	24	33	42	42	54	60
7	15	21	24	36	42	48	60	60
8	15	24	30	36	42	54	60	2-48
9	15	24	33	42	48	54	60	2-54
10	18	27	36	42	48	60	2-42	2-54

Table B: Culvert Diameters (Inches) for Moderate Hilly Conditions Slopes Upstream 2-10%								
Stream Width (Ft.)	Stream Depth (Ft.)							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
1	12	21	-	-	-	-	-	-
2	15	27	36	48	-	-	-	-
3	18	33	42	54/2-42	54	3-54/4-42	-	-
4	21	36	48	2-48/3-36	3-48/4-42	4-48	*	-
5	27	42	54	2-48/3-42	3-48/4-42	4-54	*	*
6	30	42	60	2-54/3-42	4-48	*	*	*
7	30	48	60	3-48/4-42	4-54	*	*	*
8	33	54	2-54/3-48	3-54/4-48	4-54	*	*	*
9	36	54	2-54/3-48	3-54/4-48	*	*	*	*
10	42	60	3-48/4-42	4-54	*	*	*	*

* Where flows were determined to cause the culvert size to exceed four 60-inch pipes, no size is provided. This table provides for most temporary installations in Northwest Florida. For larger sizes of channels, bridge works may prove more economical.



Table C: Culvert Diameters (Inches) for Extreme Hilly Conditions Slopes Upstream > 10%

Stream Width (Ft.)	Stream Depth (Ft.)							
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
1	15	30	-	-	-	-	-	-
2	21	42	54	2-54/3-42	-	-	-	-
3	27	48	2-48/3-42	3-48	4-54	*	-	-
4	33	54	2-54/3-42	3-54/4-48	*	*	*	-
5	36	60	2-60/3-48	4-54/5-48	*	*	*	*
6	42	60	3-54/4-48	*	*	*	*	*
7	42	2-48/4-36	3-54/4-48	4-60	*	*	*	*
8	48	2-54/3-48	4-54/5-54	*	*	*	*	*
9	54	2-60/3-48	4-60/5-54	*	*	*	*	*
10	54	3-54/4-48	*	*	*	*	*	*

* Where flows were determined to cause the culvert size to exceed four 60-inch pipes, no size is provided. This table provides for most temporary installations in Northwest Florida. For larger sizes of channels, bridge works may prove more economical.

Watershed Size Method

Procedure:

1) From Table D below, for the given watershed area, soil, and slope conditions, read corresponding drainage area i. e., cross-section area of pipe required for 2 1/2 inches of rainfall per hour.

2) Select culvert size from Table E (next page) that has **at least** the required area determined above.

Table D: Drainage for 2 1/2 Inches/Hour Rainfall (Sq. Ft.)*

Watershed Acres	Site Conditions (Soil Type & Slopes)				
		Steep (25%+)	Moderate (15-25%)	Gentle (0-15%)	Flatland
Soils	Impervious	Heavy	Moderate	Light	Sandy
10	3.4	2.6	1.9	1.2	0.7
20	5.8	4.3	3.2	2.0	1.2
30	8.0	5.9	4.4	2.8	1.6
40	9.9	7.3	5.4	3.5	2.0
50	11.6	9.7	6.4	4.1	2.3
60	13.4	10.1	7.4	4.7	2.7
70	15.0	11.2	8.3	5.3	3.0
80	16.6	12.4	9.2	6.3	3.3
90	18.2	13.6	10.1	6.3	3.6
100	19.7	14.7	10.8	6.8	3.9
200	33.2	24.9	18.4	11.7	6.6
300	45.7	33.6	27.1	15.8	9.0
400	56.0	42.0	30.5	19.5	11.2
500	66.8	49.4	36.6	23.2	13.2
1000	113.0	88.9	62.1	39.4	22.4

*Modified from Talbot's Formula for a 2 1/2-inch/hr. rainfall event.

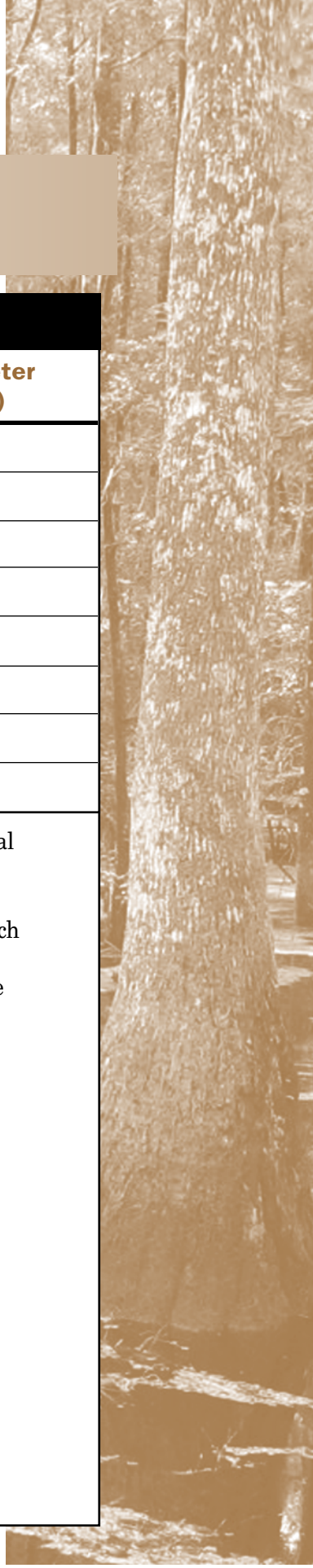


Table E: Culvert Pipe Size Required for Drainage Area*			
X-Section Area (Sq. Ft)	Diameter (In.)	X-Section Area (Sq. Ft.)	Diameter (In.)
0.55	10	12.60	48
0.79	12	15.90	54
1.25	15	19.60	60
1.80	18	23.80	66
3.10	24	28.30	72
4.90	30	33.20	78
7.10	36	38.50	84
9.60	42	44.20	90

*King's Handbook on Hydraulics, modified by Forestry BMP Handbook Technical Advisory Committee (Courtesy of Rayonier).

Note: For watersheds that require more than 44.2 square feet of pipe (a 90-inch pipe), multiple pipe combinations should be used to meet the requirements. It is generally preferable to use multiple pipes of the same size and the pipes should be spaced leaving a distance of 1/2 the pipe diameter between the pipes.
For example, if two 72-inch pipes are required, the pipes should be spaced 36 inches apart.

Appendix 10 Special Management Zone Acreage

Special Management Zone Acreage			
Stream Length (Ft.)	Area of Primary SMZ, Each Side (Acres)		
	35 Foot SMZ	75 Foot SMZ	200 Foot SMZ
25	0.02	0.04	0.11
50	0.04	0.09	0.23
75	0.06	0.13	0.34
100	0.08	0.17	0.46
200	0.16	0.34	0.92
300	0.24	0.52	1.38
400	0.32	0.69	1.84
500	0.40	0.86	2.30
750	0.60	1.29	3.44
1000	0.80	1.72	4.59
1500	1.21	2.58	6.89
2000	1.61	3.44	9.18
5000	4.02	8.61	22.96
5280	4.24	9.09	24.24

Note: Where both sides of waterbody are owned by the same landowner, multiply acreage from Table by 2.

Appendix 11 Exceptions to Primary Zone Management Criteria

1) No individual tract or tracts-in-contiguous-ownership may be required to designate more than 10% of the total tract area as Primary Zone, provided that no clearcutting takes place within 35 feet of any perennial waterbody or within 50 feet of any OFW, ONRW, or Class I Water (See Exception #1).

2) No Primary Zone may be required beyond 35 feet from a perennial waterbody or 50 feet from any OFW, ONRW or Class I Water, where the trees have been traditionally managed for the purpose of pine production and, where there is an existing predominance of pine trees with no significant component of large sized or merchantable hardwood trees (See Exception #2).

3) Where Exceptions 1 or 2 do not apply, clearcut harvesting in the Primary Zone is permissible provided that no clearcutting takes place within 35 feet of any perennial waterbody or within 50 feet of any OFW, ONRW or Class I Water, and where :

   a) The total acreage clearcut does not exceed 25% of the area designated as Primary Zone, and the number of acres clearcut are added-on to the Pri mary Zone, acre for acre. These additional acres added-on to the Primary Zone, must be directly connected to the Primary Zone boundary within the harvest unit, may not extend out beyond that boundary more than 200 feet, and must be managed in accordance with the Primary Zone - Man agement Criteria (See Exception #3a); or,

   b) The basal area of overstory trees within the SMZ is 30 square feet per acre or less, and other hardwood species present are of such low quality (physiologically or ecologically) that total stand removal would provide a greater long term wildlife and/or forestry benefit. However, the total area clearcut under this exception may not equal more than 10% of the Primary Zone, and any given clearcut parcel must not be greater than 500' in length, as measured along the stream (See Exception #3b).

***See figures on following pages for examples of exceptions.**

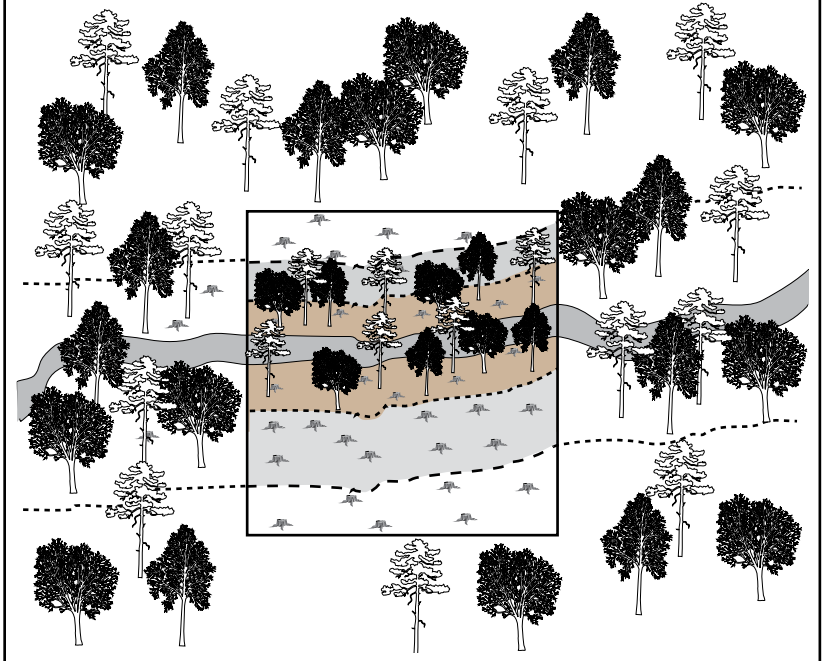
Note: Exceptions 2 and 3 are applicable only to timber harvesting operations and do not apply to other forest operations including site preparation activities.

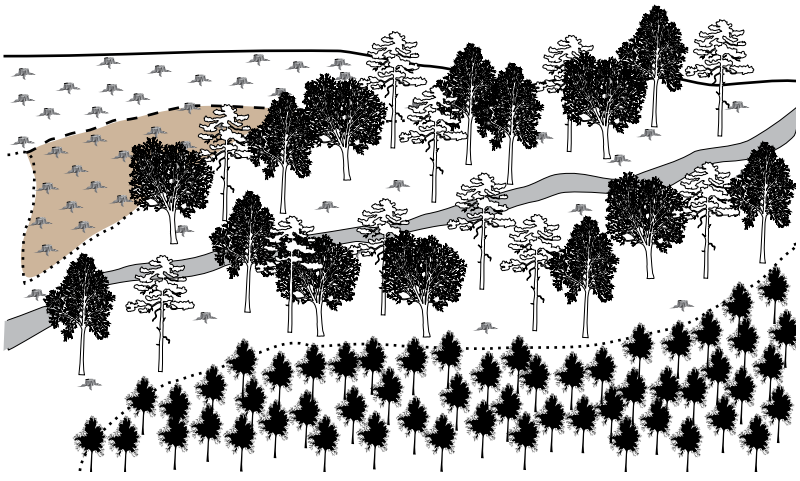
Exception #1:

If the required SMZ area exceeds 10% of the tract area, the SMZ may be reduced (down to 10%) by narrowing the SMZ width.

Reduced Primary SMZ

Original Primary SMZ





Exception #2:

In areas of existing pine management, the Primary SMZ is not required to be more than 35' wide (50' for OFW, ONRW and Class I waters)

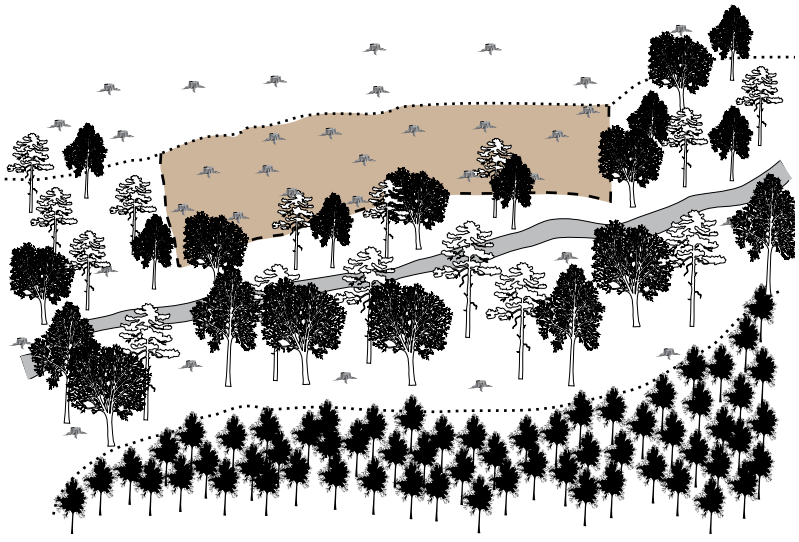
Existing Pine Management Area

Exception #3a:

A: Clearcut area within Primary SMZ: 2 acres

B: Area returned outside Primary SMZ: 2 acres





Exception #3b:

Low Quality Hardwood Area Clearcut within Primary SMZ

Appendix 12 Florida Forest Service Field Offices

FIELD UNIT	CENTER	AREA CODE	PHONE NUMBER
BFC	**Blackwater Forestry Center (Munson)**	850	957-6140
D-2	**Chipola Forestry Center**	850	872-4175
D-4	**Tallahassee Forestry Center**	850	681-5950
D-5	**Perry District Office**	850	838-2299
D-6	**Suwannee Forestry Center**	386	758-5700
D-7	**Jacksonville District Office**	904	266-5001
D-8	**Waccasassa Forestry Center**	352	955-2005
D-10	**Bunnell District Office**	386	446-6786



FIELD UNIT	CENTER	AREA CODE	PHONE NUMBER
WFC	**Withlacoochee Forestry Center (Brooksville)**	352	797-4100
D-12	**Orlando District Office**	407	856-6512
D-14	**Lakeland District Office**	863	648-3163
D-15	**Myakka River District Office (Bradenton)**	941	751-7627
D-16	**Okeechobee District Office**	863	462-5160
D-17	**Caloosahatchee Forestry Center (Ft. Myers)**	239	690-3500
D-18	**Everglades District Office (Ft. Lauderdale)**	954	475-4120

Appendix 13 Florida Water Management District Offices

Northwest Florida Water Management District
81 Water Management Drive
Havana, Florida 32333-9700
(850) 539-5999

Suwannee River Water Management District
9225 County Road 49
Live Oak, Florida 32060
(386) 362-1001

St. Johns River Water Management District
P.O. Box 1429
Palatka, Florida 32178-1429
(386) 329-4500

Southwest Florida Water Management District
2379 Broad Street
Brooksville, Florida 34604-6899
(352) 796-7211

South Florida Water Management District
P.O. Box 24680
3301 Gun Club Road
West Palm Beach, FLorida 33406-4680
(561) 686-8800

Appendix 14 U.S. Army Corps of Engineers District Offices

Big Pine Key Regulatory Office
CESAJ-RD-FT-B
P.O. Box 1619
Big Pine Key, FL 33043-0633
(305) 872-3205

Crystal River Regulatory Office
CESAJ-RD-NF-C
P.O. Box 387
Crystal River, FL 34423
(352) 795-1078

Fort Myers Regulatory Office
CESAJ-RD-FT-F
2180 West First Street
Fort Myers, FL 33901-3217
(813) 694-3438

Jacksonville Regulatory Division Field Operations Branch
CESAJ-RD-F
P.O. Box 4970
Jacksonville, FL 32232-0019
(904) 232-2502

Merritt Island Regulatory Office
CEDAJ-RD-FI
2460 North Courtney Square Blvd.
Courtney Square Building
Suite 216
Merritt Island, FL 32952
(407) 453-7655

Miami Regulatory Field Office
CESAJ-RD-FM
8410 NW 53rd Terrace, Ste. 225
Miami, FL 33166
(305) 591-1302

Palatka Regulatory Office
CESAJ-RD-FK
P.O. Box 1317
Palatka, FL 32178-1317
(904) 325-2028

Panama City Regulatory Field Office
CESAJ-RD-NC
P.O. Box 151
Panama City, FL 32402-0151
(850) 763-0717

Pensacola Regulatory Office
CESAJ-RD-FP
160 Government Center
Pensacola, FL 32501-5794
(850) 436-8300

Tampa Regulatory Field Office
CESAJ-RD-CT
P.O. Box 19247
Tampa, FL 33686-9247
(813) 840-2908

Vero Beach Regulatory Office
CESAJ-RD-CT-V
2001 9th Avenue, Suite 212-C
Vero Beach, FL 32960
(407) 567-1496

Glossary

Basal Area Forestry term used to refer to the density of a stand of trees, expressed in square feet/acre. On a per tree basis, the basal area is the cross-sectional area of the tree at breast height.

Bedding A technique whereby a small continuous ridge of surface soil is formed to provide an elevated planting area or seed bed. In Florida, it is used primarily on wet sites to improve soil drainage and aeration for seedlings.

Borrow Pit An active or abandoned excavation site to provide fill material necessary for forestry related activities such as road construction.

Broad-Base Dip A reversal in the grade of a permanent access road for the purpose of intercepting and diverting surface water flow without seriously impeding vehicular traffic.

Cavity Tree (Den Tree) Mature hardwood and softwood trees that are hollow and typically of the older age classes that are used by certain birds and other small wildlife species for shelter and habitat.

Canal A man-made waterbody; does not include natural streams that have been modified by dredging or straightening.

Chopping A mechanical treatment whereby vegetation is chopped by blades on a roller drum implement, pulled by tracked or rubber tired equipment. The "chopping" of this vegetation facilitates: more control of prescribed burning, decreases rough vegetation conditions, provides some level of control on competing vegetation, improves tree planting conditions.

Class I Waters Waterbodies that serve as sources of potable water supply; designated by the State for additional water quality protection.

Clearcutting A silvicultural system in which all merchantable timber is harvested within a specified area in one operation.

Cross Ditch A shallow depression built diagonally across a road or trail for the purpose of diverting water off the road surface.

Cross-Drain Culvert A metal, wooden, plastic or concrete conduit through which surface water runoff is directed underneath the road surface to the opposite side.

Detritus Natural woody debris such as leaves, branches, etc., provided by trees – serves as a food source for certain aquatic insects.

Ditch Plug Material used to partially or completely obstruct the flow of water in a ditch.

Erodible Soils Those soils identified as being subject to erosion based on soil texture, composition and topography.

Erosion The process by which soil particles are detached and transported by water, wind or gravity to some down slope.

Fertilizers Any substance or combination of substances used primarily as a source of plant nutrition or soil amendment.

Firelines Constructed barriers typically established by plowing and/or harrowing to contain fires within a specific area.

Glossary

Flowing Wetland A wetland (listed in appendix 5) that has a surface connection to a well defined stream channel at one or more points, and has a definite stormwater inflow and/or outflow.

Foam Line Type of fireline that incorporates the use of fire-resistant foam material in lieu of, or in addition to, plowing or harrowing.

Low Water Hard Surface Crossings (Fords) Rock, brick, logs, and other stable materials place on the bottom of certain perennial or intermittent stream channels to accommodate traffic during periods of low water flow.

Harrowing (Disking) A mechanical means of scarifying the soil to reduce competing vegetation and to prepare a site to be seeded or used as a fire break.

Harvest Unit Refers to an area of specific size and location where timber harvesting operations are being performed.

Haul (Spur) Roads Temporary forest roads constructed to facilitate the transport of timber or other forestry related activities.

Hydric Soils Soils exhibiting a considerably wet nature, typically characterized by a dark color and associated with wetlands.

Hydrology The scientific study of the properties, distribution and effect of water on the earth's surface, in the soil and underlying rocks and in the atmosphere.

Hydroperiod Period of time during which soils, waterbodies, and sites are saturated.

Impoundment Areas Those areas within which water is stored by artificial means such as a dike or dam.

Intensive Mechanical Site Preparation Mechanized operations to control vegetative competition and facilitate forest seedling survival. Examples of intensive site preparation include the following individual operations or combinations of these operations: shearing with a K-G blade, raking, disking, harrowing, windrowing, bulldozing, bedding, and scalping.

Intermittent Stream A stream that has a well defined channel but maintains only seasonal flow under typical climatic conditions.

K-Factor An index representing the potential erodibility of a soil, by water, based on soil texture.

Lake A natural or artificial inland body of standing water which is contained within a discernable shoreline; and does not include active borrow pits or runoff retention/detention ponds.

Leave Trees Large mast producing and/or cavity trees which are representative of the older age classes of the stand and are considered valuable for wildlife, or related ecological purposes.

Logging Debris The unused and generally unmarketable accumulation of woody material, such as limbs, tops, cull logs and stumps, that remain as residue after timber harvesting.

Mast-Producing Trees Various species of trees considered valuable for the production of food for wildlife.

Mat Logging Sometimes referred to as "shovel logging" - a technique used on wet sites where logs are temporarily placed in skid trails, creating a log "mat" upon which the skidders operate.

Glossary

Modified Stream A natural watercourse which has been dredged or straightened.

Non-intensive Mechanical Site Preparation Mechanized operations to control vegetative competition and facilitate forest seedling survival. Examples of non-intensive site preparation include the following individual operations or combinations of these operations: drum chopping, bush hogging, mulching, and gyro-track mowing.

Non-Point Source (NPS) Water pollution which is not traceable to any discrete or identifiable source, but rather is generated by activities within a diffuse treatment area.

OFWs Outstanding Florida Waters Waterbodies which exhibit unique characters in terms of quality and value designated by the State for additional protection from further pollution and degradation.

ONRWs Outstanding National Resource Waters Waterbodies which exhibit characteristics that meet specific water quality standards for national designation for protection from pollution and degradation.

Operational Application Method by which pesticides and fertilizer are applied, using commercial type equipment such as skidders or tractors and large boom equipment. Does not refer to hand-held spreaders or small scale equipment (4-wheelers).

Perennial Streams A watercourse that flows in a well-defined channel throughout the year under typical climatic conditions.

Pesticides Chemical substances, either liquid or granular, that are used for the control or eradication of undesirable insects, diseases, vegetation, animals and other organisms. Herbicides, Insecticides, Fungicides and Nematicides are all considered pesticides.

Pollutants Natural or man-made waste material that contaminates air, soil or water.

Public Lands Those lands which are wholly owned and managed by any unit of local, regional, state or federal government. Lands not wholly owned (i.e., lease, wildlife management agreement, easement, life estate, purchase agreement, etc.) may limit the terms of control by a unit of government.

Raking Component of site preparation in which non-merchantable trees, some stumps, roots, and logging slash are piled and/or pushed into individual piles or windrows by heavy equipment with rake-like blades.

Refuse Inorganic waste materials such as metal, rubber, plastic and glass.

Regeneration The young tree crop that either artificially (machine/hand planting) or naturally follows a stand of older trees.

Rip-rap Aggregate material placed on potentially erodible sites to reduce the impact of rain or surface runoff from these areas.

Rotation The period of time required to establish, grow, and harvest a crop of trees at a specified stage of maturity.

Sediment Soil particles which have been detached and transported by water during the process of erosion.

Seed Tree Cut Method of timber harvesting that provides for the natural regeneration of a site by leaving single, or small groups of seed-bearing trees distributed throughout the harvest area.

Selection Cut Removal of select trees within a forest stand based on some economic or physiological criteria. Generally results in uneven aged stands.

Glossary

Shelterwood Cut Removal of mature timber within a forest stand in a series of harvests which extend over a relatively short portion of the rotation in order to encourage the establishment of even-aged reproduction under the partial shelter of seed trees.

Silviculture A process, following accepted forest management principles, whereby the trees constituting forests are tended, harvested and reproduced.

Site Preparation (Prescribed) Burning The silviculture practice of using regulated fires to reduce or eliminate debris and vegetation in preparation for tree planting.

Site Sensitivity Class (SSC) An index of an area's susceptibility to erosion and sedimentation, based on soil type and slope.

Skid Moving of logs or felled trees from the harvest area to the loading point.

Skidder Heavy equipment designed for transporting logs and felled trees within the harvest area – operated on skid trails.

Skid Trails A temporary trail used only by logging equipment such as skidders, for the skidding of logs from the harvest area to the loading point.

Slash The unused and generally unmarketable accumulation of woody material, such as limbs, tops, cull logs and stumps, that remain as residue after timber harvesting.

Slope An index of the change in elevation of a land area. Often referred to as a ratio of rise over run; normally expressed in percent.

Snag Trees Typically isolated standing dead trees characterized by hollow trunks and/or limbs which may provide habitat for wildlife.

Stand A contiguous group of trees sufficiently uniform in species composition, arrangement of age classes and condition to be a homogeneous and distinguishable unit.

Stringer Narrow strip of trees with a more or less continuous canopy left on and/or near the banks of intermittent streams, lakes and sinkholes for purposes of stabilization, water quality protection, and wildlife habitat.

Special Management Zone (SMZ) An area of varying width adjacent to a watercourse in which special precautions are necessary to protect water quality and other natural resources.

Swale A manmade trench which has a top width to depth ratio equal to or greater than 6:1, or side slopes equal to or greater than 3 feet horizontal to 1 foot vertical, flows only following a rainfall event, has vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake, and is designed to take into account soil erodibility, soil percolation, slope, slope length, and drainage area so as to prevent erosion and reduce pollutant concentration of any discharge.

Turbidity An optical measurement of the relative clarity of water.

Water Bar A mound of soil built across a light-duty road, skid trail, or fireline, for the purpose of diverting surface water.

Waterbody Any river, creek, slough, canal, lake, reservoir, pond, sinkhole or other natural or artificial watercourse which flows within a defined channel or is contained within a discernable shoreline.

Water Control Structure Any structure used to regulate surface or subsurface water levels.

Glossary

Water Turnout The extension of a road ditch into a vegetated area to provide for the dispersion and filtration of stormwater runoff.

Wetland For the purpose of this Manual, wetlands are not defined by any regulatory method, and consist of typical swamplands such as those listed in Appendix 5. The presence of pine trees doesn't necessarily indicate that a site is non-wetland, but pine dominated sites are not considered wetlands even though they may be "jurisdictional."

Wetland Flow-way That area of a flowing wetland where stormwater moves within variable dimensions instead of a well defined channel. The area of flow in this case has enough general confinement to exhibit some stormflow characteristics, and is evidenced by, but not limited to: drift lines/racks, sediment deposits, soil and root scour, absence of litter/ground cover – all in a generally linear position.

Wildfire Any fire other than a controlled, prescribed fire.

Windrow Logging debris and unmerchantable woody vegetation, piled in rows on the contour of the land.















Florida Friendly Best Management Practices for Protection of Water Resources by the Green Industries



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
A Florida–Friendly Landscape Publication



I am pleased to present this new edition of the Florida Department of Environmental Protection's (DEP) guide for the professional turf and landscape industry. In the past six years, more than 100,000 books were distributed, in both English and Spanish, and thousands of workforce members have received formal training. *Florida Friendly Best Management Practices for the Protection of Water Resources by the Green Industries* reflects the collaborative efforts of DEP, the University of Florida, several state and local agencies, as well as numerous stakeholders and private industry partners. The guide represents a collective commitment to assist the turf and landscape industry to protect the environment through the implementation of educational programs. I encourage you to follow the recommendations contained in the publication; they will help conserve water, protect our natural resources, minimize the need for regulation, and continue Florida's commitment of sound environmental stewardship.

MICHAEL W. SOLE, SECRETARY
Florida Department of Environmental Protection



GOALS OF THE MANUAL

This manual provides information and guidance on turfgrass and landscape management practices to minimize Nonpoint Source Pollution in order to conserve and protect Florida's water resources. These practices cover both the establishment of new turf and landscapes and the care of existing turf and landscapes, including construction activities, irrigation, nutrient management, and pest management.

This manual is designed to be an educational guide for professional service providers and other interested parties. It does not substitute for the services of a landscape architect, engineer, or other design professional. Design issues are discussed as they apply to the service industry and their clients.

This document is intended to enhance the professional knowledge and judgment of turfgrass and landscape workers. Plants are living systems, and these practices should not be rigidly applied in all cases. Workers should use the guidance provided, but measures that are more restrictive may be required in specific situations to protect sites that are at particularly high risk for adverse effects on surface water and ground water. State laws and local ordinances always take precedence.

More information on Stormwater Management, Low Impact Development, and Florida Friendly Landscape Maintenance Practices is available from the Florida Department of Environmental Protection, the University of Florida Cooperative Extension Service, water management districts, universities and community colleges, and professional associations.



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Chapter 1: Introduction

USING BEST MANAGEMENT PRACTICES TO REDUCE POLLUTION AND CONSERVE WATER

The protection of water resources is enhanced through turf- and landscape-care practices that make the best use of technology and the practical experience of professionals. These practices address specific concerns, including the protection of water resources where pesticides and nutrients enter ground water and surface water as a result of nonpoint source pollution.

University studies throughout the country, including Florida, have shown that properly managed turfgrass and landscapes do not significantly contribute to nonpoint source pollution. Pollution occurs when less-than-adequate management techniques are used. Developing low-risk irrigation, fertilizer, and pesticide programs, and ensuring that these programs are properly administered and periodically reviewed, reduces the possibility of nutrient movement off-site. Whenever possible, professionals should educate their clients on landscape best management practices (BMPs) that encourage water conservation and pollution prevention.

The goals of the FDEP Green Industry BMPs are to reduce nonpoint source pollution and promote the efficient use of water, as follows:

- Reduce the off-site transport of sediment, nutrients, and pesticides through surface water or ground water.
- Use appropriate site design and plant selection.
- Use appropriate rates and methods of applying fertilizer and irrigation.
- Use integrated pest management (IPM) to minimize pests and apply chemicals only when appropriate.

BMPs should integrate selection, irrigation, fertilization, and pest management in a manner that minimizes environmental impacts, yet meets clients' and customers' expectations. Irrigation practices influence how often we need to fertilize and this can affect the occurrence of pest problems. Weigh these and other factors when making landscape management decisions.

The first edition of this manual was published in the summer of 2002. By the end of 2007, more than 80,000 manuals had been distributed, in both English and Spanish versions. More than 50,000 glove box sized summary booklets have also been distributed. In the first five years, more than 2600 people obtained formal certification through DEP or UF-IFAS sponsored training, and many of these people have taught others about the BMPs, but they did not obtain formal certification through the University.



Figure 1. With proper BMPs, our water resources can successfully coexist with residential landscapes.

Since the original publication of this BMP manual, several new laws have been passed, new research completed, and new products developed. Therefore, this 2008 version contains new information in many areas, especially concerning irrigation systems and fertilizer use, along with many other suggestions received from dozens of landscapers and others seeking to improve this book. This revision would not be as good without their ideas and contributions.

This manual provides specific examples of how BMPs might work in typical situations. These examples are not meant to minimize concerns associated with other turfgrass or pest problems. Although certain rules are mentioned, this publication is an educational, not a regulatory, document. Always check with state and local authorities, because local ordinances may be more restrictive than federal or state regulations.

ENVIRONMENTAL ISSUES

Many areas of the state are running low on freshwater supplies. Water conservation is one of the most crucial issues facing Florida in the future, and applying the BMPs described in this manual will help to conserve our precious fresh water.

Since the passage of the Clean Water Act and the formation of the U.S. Environmental Protection Agency, tremendous strides have been made in cleaning up our air and water. Most of this cleanup has been accomplished through permitting and the regulation of point sources of pollution such as factory smokestacks and sewage discharges.

In contrast, nonpoint source pollution comes from diffuse sources and is associated with the long-term effects of everyday activities. It is carried primarily by rainfall and irrigation water, which cause pollutants that have accumulated on the land surface to run off into surface waters or to leach into ground water. Water is the primary mechanism for the transport of dissolved chemicals through the soil. Nonpoint source pollution may not be obvious until a rainfall event occurs, leading to stormwater runoff from roads, parking lots, suburban areas, and farms. As Florida's population has soared, this type of pollution has become an increasingly important issue in the state.

Many of Florida's water resources are particularly susceptible to pollution because of the state's unique geology and climate. Floridians obtain most of their drinking water from ground water via wells. Ground water supplies often lie near the surface and may be covered by nothing but sandy soil. Surface waters in Florida are very sensitive to even small additions of pollution, which have caused widespread ecosystem changes in our sensitive estuaries, lakes, rivers, and the Everglades.

In order to prevent potential leaching and runoff; users of fertilizers and pesticides need to consider the weather conditions, proper application rates of products and calibration of equipment, soil properties, the distance to the water table, the slope of the land, and the distance to surface waters and storm drains; all of this, in addition to plant nutrition, disease, and pest factors.

Remember, an ounce of prevention is worth many dollars of cure.



Figure 2. Grassy stormwater retention areas can add to a lawn and protect our environment.

IMPORTANCE OF MAINTAINING HEALTHY LANDSCAPES AND TURF

Well-planned, healthy landscapes designed with Florida-friendly landscape practices usually include trees, ornamentals, and a lawn of turfgrass or other ground cover. Native and well-adapted, noninvasive ornamentals contribute beauty and balance to a property, provide shade and wildlife habitat, and help to control erosion by diminishing the force of rainfall. Both the lawn and other landscape plantings reduce noise and glare, and modify temperatures.

A healthy and vigorous turf with good plant density provides many benefits. Healthy grass is viewed as an aesthetic asset, and a growing body of evidence points to the positive health and environmental contributions made by lawns and other turf areas. Turfgrass plays a significant role in reducing water runoff in urban and suburban environments that have significant areas of impervious surfaces such as parking lots, sidewalks, and driveways. Dense turf reduces the velocity of runoff and allows greater infiltration into both the thatch and root zone, where microbes can begin breaking down the water contaminants. The turfgrass root zone is a unique soil system. A healthy root zone does the following:

- Improves soil structure and reduces soil compaction, allowing greater infiltration of rain or irrigation water;
- Improves soil processes that facilitate the biodegradation (breakdown) of various types of organic pollutants, air contaminants, and pesticides used in lawn care;
- Encourages soil-building processes through the decomposition of organic matter and formation of humus, and contributes to easier lawn care with fewer weeds and insects and less disease.

CULTURAL PRACTICES FOR HEALTHY LANDSCAPES

Plant selection and location are the most important factors in planning a lawn and landscape. After weather, cultural practices are the biggest factors in determining how well an agronomic or horticultural program performs. The amount of pesticides, fertilizers, and water required often directly correlate with cultural practices and how well they are carried out.

Landscape professionals have a responsibility to supply their customers with educational material on their role in keeping turf and other landscape plants healthy. This includes (as appropriate) information on irrigation, mowing, plant selection, aeration, and traffic control. Few landscaping and lawn care companies have total control over all aspects of the properties they maintain. It is not uncommon for mowing, fertilization, pest management, and irrigation maintenance to be performed by two or more companies, or the homeowner may do one or more jobs themselves. It is of the utmost importance to educate customers about wise cultural practices so they can see that they are performed properly.

Cultural practices include irrigation, fertilization, mowing and pruning, aeration and dethatching. When each of

these is performed properly, the need for pesticides is reduced because plants and turfgrasses are healthier and more resistant to pest problems.

The concept of Integrated Pest Management (IPM) emphasizes proper cultural practices along with selecting plant species, varieties and cultivars that are less susceptible to insects, nematodes, and diseases, and best adapted to the environmental conditions of the site and geographic part of the state.

Mowing height has a tremendous impact on the severity of weed, insect, and disease pests. In general, lowering the height increases weed, insect, and disease pressure on turfgrasses by causing turf stress. There are exceptions: dwarf varieties, centipedegrass and improved bermudagrasses have lower mowing heights than the standard often used for lawn and commercial turfgrasses. Still, even these lower-growing varieties will suffer stress if mowed too short.

Pruning is an important task in maintaining a landscape. Through the selective removal of shoots and branches, pruning a plant can improve its health, control its growth, and enhance its fruiting, flowering, or appearance. Improper pruning, on the other hand, may weaken a plant, open it to invasion by disease or insect pests, or even lead to premature death of the plant. Incorrect disposal of material may lead to the spreading of diseases or pests, or of the spreading of invasive species.

Time fertilizer applications to maximize plant use and minimize adverse environmental impacts. Plants use the most nitrogen during periods of high growth, and less when dormant. However, it is important to avoid fertilizer applications if heavy rain is expected before the nutrients are immobilized. In theory, frequent, very light applications or "spoon feedings" of turf and landscapes are ideal to avoid leaching a large amount at one time due to a heavy rain event, but this is difficult to achieve safely without special management, such as for golf course greens. Slow release fertilizers attempt to match this ideal profile. Both quick- and slow-release fertilizers have a place in a sound management program.

Fertilization of plants can result in additional growth and production of leaves, stems, branches and roots. However, additional growth can result in more maintenance and yard trimming, so it is important to determine if heavy growth is the desired result. Fertilization is usually desirable when trying to establish newly installed landscape plants. In addition, adding fertilizer can help plants get off to a quick start so they fill the planted area.

Inadequate nutrition results in thin, weak plants that may be more susceptible to insects, weeds, and diseases. In addition, weakened plants do not hold the soil as well as healthy dense stands and can lead to soil erosion and water pollution. Certain diseases, such as rust and dollar spot, can occur in turf maintained under low-nutrient conditions. Under-fertilized landscape plants may require a higher than normal rate of nitrogen or other nutrients in order to return to a healthy condition.

Over-fertilization can also enhance plant susceptibility to pests and diseases. Several pesticide applications may be required to alleviate problems that would not have been as prevalent under a proper nutrition program.

Remember that plants don't waste water, people do. In a typical urban environment where soils and habitat have been modified, supplemental irrigation is necessary for the survival of many turf and ornamental plants during periods of severe moisture deficiency. However, overwatering may increase insect, weed, and disease pressures. For example, excessive moisture encourages the development of dollarweed and fungal pathogens. Conversely, some weeds such as spurge and Florida pusley thrive under dry conditions and can outcompete turfgrass suffering from drought stress. A balance is necessary to keep the landscape strong and healthy.

The average volume of rainfall in Florida ranges from 40 inches annually in Key West to about 53 inches in the central and northern peninsula and over 60 inches in the Panhandle west of Tallahassee and along the southeast



Figure 3. Poor fertilization technique wastes fertilizer, causes unsightly stains, and pollutes our waterbodies.

coast below Lake Okeechobee. In parts of the central and southern peninsula, more than half of Florida's total annual rainfall is concentrated between June and September. During the winter and spring, or during

severe drought years, the lack of rainfall may seriously compromise plant health. Landscape plants, including turfgrass, that are growing in soils with a limited capacity to retain moisture can benefit from supplemental irrigation during periods of low rainfall. Even during the rainy season, evapotranspiration (water loss from plants and soil) occurs between showers and may necessitate supplemental watering while plants are becoming established.

Determining and controlling the rate, amount, and timing of irrigation can minimize soil erosion, runoff, and fertilizer and pesticide movement. The irrigation system should be designed to have an application rate that is less than the infiltration capacity of the soil so that no surface pooling occurs and water percolates with maximum efficiency. Rain sensors or soil moisture sensors eliminate irrigation when nature has supplied sufficient water. A correctly installed and operating rain sensor, which is required by law on all systems installed after 1991, can save up to 30% or more over a timer-only system. If you notice a defective rain sensor while performing other work on a property, try to notify the owner so they can get it repaired.

The use of pesticides for controlling pests remains an important part of landscape plant management in Florida. The key to reducing pesticide use is to combine genetic, cultural, and biological management practices into an IPM program that focuses on the prevention of pest problems. When suppression is necessary, it is easier to suppress a pest when conditions exist that do not favor its development. For example, diseases can be hard to manage during periods of heavy rains but if overwatering is promoting disease, cutting back irrigation will help suppress fungus much more effectively than fungicide applications alone.

BMPs to protect water quality can be affordable and easily implemented, and are effective in reducing the off-site transport of sediment, nutrients, and pesticides. Select pesticides that are the least toxic, least water soluble, least volatile, and most effective. The best defense against the movement of pesticides and fertilizer nutrients off-site or through the soil is a thick, vigorously growing stand of turf or other landscape plants.

Pesticides must be correctly applied. Spray when conditions for drift are minimal, avoid application when heavy rain is expected, and irrigate with appropriate volumes of water per label instructions. Granular applications should be targeted away from impervious surfaces and bodies of water. The landscape manager should check the proper calibration of equipment before every pesticide application.

Always follow the label directions for disposing of pesticide containers.

EMPLOYEE TRAINING

The effectiveness of any program is only as good as the understanding of the personnel responsible for final application. BMPs are no exception. For BMPs to be effective, the technicians in the field must understand their role in protecting our water resources. This understanding can only come from the development and implementation of employee-training programs.

Employees should be given pertinent information relating to their job duties, especially job safety. The Green Industry is very diverse. Companies range in size from one or two individuals to very large corporations. Firms of any size may choose to avail themselves of horticultural and practical training available through professional associations, governments, or the county Cooperative Extension Service.

In addition to the BMPs, it is recommended that managers, salespeople, and supervisors take advantage of Florida Yards and Neighborhoods (FYN) training events where they are provided by their local IFAS Extension office. While consistent with the Green Industry BMPs, FYN training is geared to homeowners, and in some areas to retailers and homebuilders. While FYN is the "homeowner" BMP guide and applies to maintenance of all types of yards found in Florida, it also addresses design of diverse landscapes that minimize use of irrigation, supplemental fertilizers, and corrective pest control. FYN classes also focus considerable attention on specific plant selection, placement, and care. This information is tailored to local conditions and soils, topics beyond the scope of this manual. There is a growing demand for people to install and service these yards properly, and this may provide an opportunity to expand your client base.

If you are doing planting or irrigation work, or any other digging, find out where utility lines are buried before you dig in order to protect yourself and your crew from injury and prevent damage to underground utility lines. Train your employees that a call to 811 starts the process of getting underground utility lines marked for free. Calling 811 in Florida routes you to Sunshine State One Call. Utility companies then send a professional locator to the location to mark underground lines within two full business days. Once the lines are marked, you will know the approximate location of the utility lines and can dig more safely. However, One Call member utilities typically locate only those underground facilities they own. Customer wiring and piping within the lot are not marked by One Call.

Employees whose job duties include activities related to BMPs should be properly trained to perform those activities before going in the field. Applicable personnel at all levels of responsibility should receive refresher training annually on the general components and goals of the

BMPs, job safety, and the specific BMPs that apply to their jobs.

Documenting an employee's participation is an integral part of a successful training program. Employee training should be documented in an employee training log. This documentation provides the business with a tool to ensure the effective delivery of BMPs. It not only allows the company to track an employee's education and competence, but also provides a record in case of accident to show that the company provided the employee with the proper training to do his or her job. Records should have the name and signature of the employee, the provider or trainer, subject, date, and hours (time in/time out).

As time goes on, some local governments are passing ordinances to regulate the Green Industry. Many of these ordinances may require education in order to obtain an occupational license or to provide services to the public. Maintaining training records shows that your business meets these requirements.

Remember . . .

- **Train employees about BMPs and job safety.**
- **Retrain annually and when changes are made.**
- **Train employees to document and retain records of activities.**

Finally, consider real nature of your business. It is probably not the sale of pesticides, fertilizers, or gasoline. It is more likely that your real business is maintaining your customers' yards at a level that pleases them, at the lowest expense to you. Do not spend money applying materials that are not needed, or that are wasted by poor application practices or improper equipment calibration. Do not waste materials and time fighting the symptoms of problems you have no control over. Collaborate with other trades that have expertise you do not provide, such as an irrigation contractor. Then, if the irrigation system is causing fungal problems and dry spots, you can provide the customer with repairs; fix the real cause of the trouble; and save money on fungicide, insecticide, fertilizer and labor. Using Best Management Practices minimizes both the environmental and financial costs of maintaining a healthy and attractive landscape.

Chapter 2: Best Management Practices for Design and Installation of Landscapes

Bare soils and slopes without proper plant cover are highly susceptible to erosion. Sediment resulting from erosion is the leading cause of waterbody impairment and pollution. Sediment destroys fish-spawning beds, reduces useful storage volumes in reservoirs, and increases filtration costs for municipal water supplies. Pesticides and nutrients such as nitrogen and phosphorus can bind with sediments and be moved by running water. A healthy stand of turf and/or other landscape plants can help to control erosion and reduce runoff, but must be properly established and maintained to protect water quality.

It is important to design the landscape before installing the irrigation system. This allows the irrigation system to be designed to meet the needs of the plants instead of the other way around.

Florida Statutes 125.568(3), 166.048(3), and 373.185(3) provide that **a deed restriction or covenant entered after October 1, 2001, or local government ordinance, may not prohibit any property owner from implementing Xeriscape or Florida-friendly landscape practices on his or her land.** Any restrictions created after this date are void.

In many communities, construction and design documents and permits require the signature and seal of a design professional. To protect the public, landscape architects and professional engineers are licensed by the state. Contact your local authorities if you are not sure what is required. For more information on landscape architecture, see http://www.myfloridalicense.com/dbpr/pro/larch/, or to learn more about engineering services go to http://www.fbpe.org/.

SITE EVALUATION AND LANDSCAPE DESIGN

The long-term value of a landscape depends on how well it performs for its particular objectives. Performance is often directly related to matching a site's characteristics and a client's desires with plant requirements. Therefore, the first step in selecting plants for a landscape is to conduct a site evaluation, which may consist of studying planting site characteristics such as the amount of sun or shade, salt spray exposure, soil type, pH, soil compaction, slope and water drainage. These characteristics will most likely differ between areas on the same property. For example, the area on one side of a structure may have significantly different light conditions than an area on the other side. Construction activities may have produced severe compaction, and non-native soils may have been used as fill in some areas. Such soils may need aerification or amendment to be suitable for planting. The second step is to select plants with attributes that match the characteristics of the planting site. The design professional should always provide the owner with a record drawing identifying each plant or bed and the recommended irrigation requirements.



Figure 4. Narrow strips are difficult to maintain.

For more information, see IFAS Circular 536, *Basic Principles of Landscape Design*, at http://edis.ifas.ufl.edu/MG086.

FLORIDA FRIENDLY LANDSCAPE DESIGN STANDARDS

In 2004, the Florida legislature created section 373.228 Florida Statutes, directing the Department of Environmental Protection, the Water Management Districts, and several stakeholder groups to devise standards for Landscape Irrigation and Florida-Friendly landscape design. These standards were adopted in December 2006. Local governments must use these standards when adopting local ordinances after that date.

The nine principles of Florida-friendly landscaping include planting the right plant in the right place, efficient watering, appropriate fertilization, mulching,

These landscape and irrigation design Standards shall be used by local governments when developing landscape irrigation and xeriscape (Florida-Friendly) ordinances, pursuant to section 373.228, F.S.

I. Landscape and Xeriscape (Florida-Friendly) Design Standards

A. Low impact site design practices, such as preserving existing native trees and vegetation, shall be used if feasible. Where established natural vegetation is incorporated into the landscape design, irrigation of those areas shall not be required.

B. The plant palette and irrigation system shall be appropriate for site conditions, taking into account that, in some cases, soil improvement can enhance water use efficiency.

C. Plants shall be grouped together by irrigation demand.

D. The percentage of landscaped area in irrigated high water use hydrozones should be minimized. Local government ordinances shall address the percentage of irrigated landscaped area that may be included in high water use hydrozones. These high water use limits should not apply to landscaped areas requiring large amounts of turf for their primary functions, e.g., ballfields and playgrounds.

attraction of wildlife, responsible management of yard pests, recycling yard waste, reduction of stormwater runoff, and waterfront protection. Additional components of Florida-friendly landscape include planning and design, soil analysis, the use of solid waste compost, practical use of turf, and proper maintenance.

This BMP manual for professionals and the Florida Yards and Neighborhoods (FYN) programs for homeowners, homebuilders and developers, and retailers are based on these nine principles, differing only in focusing on the needs of their target audience. All are part of the Florida Friendly Landscapes program, a partnership between the Florida Department of Environmental Protection, the UF-IFAS Environmental Horticulture Department and Center for Landscape Conservation and Ecology, and the five water management districts.

PLANT SELECTION

Because many of the plants used in Florida vary widely in their adaptation, consideration should be given to choosing grasses and other plants that are suited to their particular environment.

SELECTING A TURFGRASS FOR A FLORIDA LAWN

Selecting the correct grass is critical to maintaining a lawn successfully. Table 1 can help you choose the grass that is best suited to a particular customer, location, and use.

To select the right grass, the following questions should be asked:

- ***What type of lawn is desired or expected and what level of maintenance can be provided?*** The level of maintenance required is closely related to cost and time, with high-maintenance turf costing the most and taking the most time to maintain. Homeowners should understand realistically what their options are and what each entails.

- ***What are the environmental conditions at the planting site?*** Most importantly, what are the soil type, pH, drainage, and other soil characteristics? Has it been

Table 1: Common lawn grass species used in Florida. Some of the species may vary by cultivars for characteristics listed.

Environment	Bahiagrass	Bermudagrass	Centipedegrass	Seashore Paspalum	St. Augustinegrass	Zoysiagrass
Area Adapted To	Statewide	Statewide	N. Florida and Panhandle (one cultivar adapted to South Florida)	Statewide	Statewide	Statewide
Mowing Height	3"-4"	Cultivar Dependent 0.5"-1.5"	1.5"-2.0"	0.5"-2"	Cultivar Dependent 1.5"-4"	Cultivar Dependent 0.5"-2"
Soil	Acid, sandy	Wide range	Acid, infertile	Wide range	Wide range	Wide range
Leaf Texture	Coarse-medium	Cultivar Dependent Fine-medium	Medium	Fine-medium	Cultivar Dependent Coarse-medium	Cultivar Dependent Fine-medium
Salt Tolerance	Poor	Good	Poor	Excellent	Good	Good
Shade Tolerance	Poor	Poor	Fair	Poor	Good	Good
Wear Tolerance	Poor	Good- excellent	Poor	Good-excellent	Poor	Good-excellent
Nematode Tolerance	Very good	Poor	Poor	Good	Good	Good
Maintenance Level	Low	Cultivar Dependent Medium-High	Low	High	Medium	Medium-High
Establishment Methods	Seed, sod	Sod, sprigs, plugs, seed	Seed, sod, sprigs, plugs	Sod, plugs, sprigs, seed	Sod, plugs, sprigs	Sod, plugs, sprigs, seed

compacted by construction activity? Does the site contain low fertility subsoils brought in for fill? Is the site irrigated? Can it be easily mowed? Is it shaded or in full sun? Will it be shaded in a few years? What is the quality and the expected quantity of the water available for irrigation? What pests are prevalent in the area? Are pest-resistant cultivars available? Reclaimed water may contain high levels of chloride, leading to salt accumulation in the soil. When planning or renovating a landscape, check with the reclaimed water provider regarding chloride levels, and if necessary choose plants that are salt-tolerant.

SELECTING TREES, SHRUBS, AND GROUND COVERS

The plants selected should be suited to the characteristics of the site that were determined during an earlier site analysis. Good landscape design requires that plants serve particular functions. They should reduce cooling and heating costs and improve the appearance or usefulness of the landscape. Plants should be selected and positioned to provide a transition between the structure and the landscape, a screen for privacy, shade for comfort, and wildlife habitat, or to direct traffic flow onto and within the property. Select plants that will not outgrow their allotted space. Even though smaller cultivars of landscape plants may take longer to reach the desirable size, they will not have to be pruned as frequently and are less likely to need replacing in a few years.

See http://hort.ifas.ufl.edu/woody/index.html for information on individual plants.

PLANTING

PREPARING TO PLANT A LAWN

Proper soil preparation before grass planting is critical to ensure the establishment of quality turf. Preparation determines how quickly the lawn becomes established and its long-term maintenance requirements. The general guidelines for preparing to plant a lawn are as follows:

- Call 811 before you dig (or 800-432-4770 or www.callsunshine.com)—before installing any and/or all plant material.
- Clean and rough grade—remove debris and level the area to make it suitable for mowing.
- Install irrigation—if you are including an irrigation system, install it prior to planting.
- Soil analysis—determine soil pH and phosphorus and potassium concentrations. Contact your county Cooperative Extension Service for information on how to do this.
- Soil amendments—add these prior to planting if you need to improve the soil's physical and chemical properties.
- Deep tillage—this loosens compacted soil and improves the establishment of turf. Tilling sand is unnecessary.
- Weed control—use a nonselective herbicide such as glyphosate to aid in weed control before planting. Several applications may be necessary.
- Final grading—a final leveling makes mowing easier and safer.

For more information, see *Preparing To Plant a Florida Lawn*, IFAS Publication ENH-02, at http://edis.ifas.ufl.edu/LH012.

LANDSCAPE PLANT INSTALLATION

Before digging the hole, 1) remove all soil from above the topmost root, and 2) measure the distance between the topmost root and the bottom of the root ball. Dig the hole about 10 percent shallower than this depth and as wide as possible (at least one and a half times the width of the ball and even wider in compacted soils). The root ball should be positioned in the hole shallowly enough so that the finished grade of the backfill soil and landscape soil is lower than the top of the root ball. In other words, leave the upper portion of the sides of the root ball exposed to the air. Then apply mulch so that it covers the sides of the root ball. Be sure that when you are finished planting, there is NO SOIL, and little or no mulch, over the top of the root ball. Soil (as well as thick mulch layers more than 3 or 4 inches deep) over the root ball can prevent water and air from entering the root ball.

When finished planting, you should be able to see the topmost root in the root ball originating from the trunk at the soil surface. In other words, the trunk flare (root flare) should be visible. Soil should be packed firmly between the root ball and existing soil to eliminate air pockets where roots can dry out. Air pockets can be removed when planting large specimens by inserting a running hose between the root ball-soil interface several times until all the soil settles around the root ball.

CARE DURING PLANT ESTABLISHMENT

Even the healthiest landscape plants installed in the most ideal circumstances may need a substantial amount of time, care, and proper irrigation to become established. During the establishment period, the roots are expanding out into the landscape soil, and the shoots and trunk grow more slowly than they did before transplanting. In most instances, established, drought-tolerant landscape plants have a root system substantial enough to keep them alive with little or no supplemental irrigation. Establishment occurs more rapidly when irrigation is supplied in the correct quantity and frequency.

In addition to requiring special attention to irrigation, during their establishment period trees benefit from

mulching and may require staking or guying. Pruning and fertilizing may also benefit landscape plants while they are becoming established.

For more information, see the following:

IFAS Publication ENH 860, *Fertilization and Irrigation Needs for Florida Lawns and Landscapes*, at http://edis.ifas.ufl.edu/EP110.

IFAS Publication ENH 857, *Irrigating Landscape Plants During Establishment*, at http://edis.ifas.ufl.edu/EP113.

IFAS Circular 853, *Pruning Landscape Trees and Shrubs*, at http://edis.ifas.ufl.edu/MG087.

IFAS tree pruning website, *Pruning Shade Trees in the Landscape*, at http://hort.ifas.ufl.edu/woody/pruning/.

ENVIRONMENTAL STRESSES ON LAWNS

Florida lawn grasses are subjected to many environmental stresses as a result of prolonged exposure to shade, drought, nutrient deficiency, the effects of vehicle and foot traffic, salinity, and occasional cold temperatures. Biotic stresses result from living organisms such as insects, diseases, or nematodes.

Environmental stresses can be managed in two ways: 1) choosing the most stress-tolerant species or cultivar for a particular area, and 2) using proper cultural and management practices to alleviate the effects of the stress. Practices that reduce environmental stresses include the following:

- **Moderating nitrogen fertility.** Nitrogen encourages the plant to form new tissue and grow. When nitrogen is applied in excess, more energy reserves are used to form new tissue than can be replaced by photosynthesis, and the grass becomes more vulnerable to stresses. Less reserves are then available for recovery from, or avoidance of other problems.

- **Mowing at proper heights.** Mowing below recommended heights removes a large portion of the shoot tissue available for photosynthesis. This leaves the grass less able to support itself or recover from injury.

- **Irrigating when the grass needs water.** Over irrigating leads to the failure of many lawns by increasing fungal problems and limiting the root system to the top few inches of soil.

Many environmental stresses lead to increased disease or insect problems, which are often treated chemically without changing the cultural practices that initially caused the problem. **Chemical treatment in these cases will not take care of the problem until the cultural factors are handled correctly.**

SHADE CONSIDERATIONS FOR TURF

Most landscapes include shaded areas, with shade coming from either trees or buildings. This shade can drastically affect turfgrass growth, depending on the degree and duration of shade. In many landscape settings, grass receives a minimum amount of light for enough of the day to maintain adequate growth, even if an area is shaded for other portions of the day. In some situations, however, a grassed area may be shaded for most or all of the day, making it difficult for the grass to obtain either an adequate intensity or duration of light for growth.

Under shaded conditions, turfgrasses have elongated leaf blades and stems as they attempt to obtain sunlight by outgrowing their neighbors. This reduces their overall health and vigor. Coverage is also reduced, and the bare ground that results is conducive to weed growth. It is generally not advisable to grow turfgrass in heavy shade. Other ground covers or mulch should be used in these sites. For areas receiving moderate amounts of shade, however, certain species and cultivars are able to maintain suitable growth. Specific management practices also encourage better turfgrass health under shaded conditions.

Some species are particularly well suited for use in shaded areas. Within these species, certain cultivars sometimes maintain considerable advantages when grown in a shaded environment. These species and cultivars include the following:

St. Augustinegrass is somewhat better than others for growth in partial shade, although it also performs well in full sunlight. Cultivars that exhibit the most shade tolerance include 'Seville' and 'Delmar.' 'Floratam,' 'Floratine,' and 'Floralawn' exhibit somewhat less shade tolerance.

Zoysiagrass is another good choice for partially shaded areas. Like St. Augustinegrass, it also does well in full sunlight. Generally, any cultivar of zoysiagrass performs well in partial shade.

Bahiagrass is not recommended for use in shaded conditions, but centipedegrass tolerates some partial shade. **Seashore paspalum** and **bermudagrass** do not do well in shaded situations.

The following management practices produce better turfgrass growth in shaded situations:

- **Increase the mowing height** for grasses growing in the shade. For instance, if you normally cut St. Augustinegrass at a 3-inch height, increase the cutting height to 4 inches. This allows for more leaf area to intercept as much available light as possible. In addition, leaf blades are longer and narrower in the shade, and a lower cutting height excessively reduces leaf length, which is not good for the grass. Increased mowing height also

promotes deeper rooting, which is one of the key mechanisms of stress tolerance for turfgrasses.

- **Reduce fertilizer applications to turf growing in shade.** The grass grows more slowly in a shaded environment, which reduces fertility needs. Too much nitrogen fertilizer depletes carbohydrates and produces a weaker turf system. If you normally apply 4 pounds of nitrogen per 1,000 square feet yearly, apply 2.5 to 3 pounds to turf growing in the shade. Limit any single fertility application to no more than 0.5 pounds of nitrogen per 1,000 square feet at any one time.

- **Water use is substantially reduced under shaded conditions, so adjust irrigation accordingly.** If the irrigation system covers an area that is partially shaded and partially in sun, consider removing the sprinkler heads from the shaded areas and irrigate by hand when rainfall is inadequate.

- **Avoid the effects of vehicle and foot traffic.** The grass is more easily injured by traffic if growing in shade, and may not be able to recover adequately. Also, traffic in shady areas may damage a tree's roots, resulting in the decline or death of the tree.

- **Monitor for weed pressure.** Weeds are able to outcompete turf in certain situations, and will seek out those opportunities. In a shaded environment, lateral turfgrass growth and ground cover may be sparse, leaving bare ground suitable for certain weeds. Treatment with a pre- or post-emergence herbicide may be necessary. Use caution, however, when applying any chemical treatment to a shaded lawn, as there is a greater chance of phytotoxicity (toxicity to plants) when a grass is under stress. Also, many herbicides can damage landscape trees and shrubs.

- **Monitor for disease pressure.** In many shaded environments, there is less air movement and more humidity, which may increase the possibility of disease. Again, use caution if applying pesticides to a turf that is already under environmental stress.

In particularly troublesome areas, consider other ground covers besides turf. Examples include ivies *(Hedera spp.)*, liriope *(Liriope spp.)*, mondo grass *(Ophiopogon spp.)*, and Asiatic jasmine *(Trachelospermum asiaticum)*.

Remember, the key to a successful landscape is *"Right Plant, Right Place."*

Chapter 3: Irrigation Best Management Practices

Using proper irrigation system design, installation, management, and maintenance practices provides a multitude of benefits. These benefits include saving money, using irrigation efficiently, a healthy and more drought and pest-resistant landscape, and protecting the state's water resources. Green Industry workers need to be aware of the different irrigation processes and system components because irrigation is a major factor in the success of their industry. By understanding the irrigation system, they can save the company and the client money and help protect ground water supplies and water quality.

This section of the document includes background information and irrigation BMPs for the Green Industry. Some of the BMPs mentioned are not usually considered the responsibility of mowing and trimming services or route based service businesses. However, many Green Industry workers, who may be directly employed by property owners, associations or municipalities, are often responsible for operation and maintenance of an irrigation system. For complete BMPs specific to the Irrigation Industry please refer to:

- Florida Irrigation Association (www.fisstate.org)
- Irrigation Association (www.irrigation.org)
- The University of Florida's Institute of Food and Agricultural Sciences (IFAS) (http://edis.ifas.ufl.edu/)

Irrigation is an age-old art and is defined as the application of supplemental water to a soil for plant growth. It also provides a mechanism for nutrients to move from the soil into a plant. Other uses include salt leaching, chemigation, system flushing, seed germination, and climate modification.

On average, Florida receives more than 50 inches of rain per year. However, the distribution and amounts of this rainfall are not always adequate to meet a plant's water demands. Providing the amount of water that a plant needs at the correct time is the key to resource conservation, reduced pollutant loading, and optimum plant growth.

This chapter describes irrigation concepts to help explain the fundamentals of good irrigation. The green industry can use this information to assist them in their daily operations and to help their clients to save water, improve plant health and reduce the flushing of fertilizer nutrients from a plant's root zone. In addition, this chapter identifies specific irrigation BMPs for the Green Industry. Throughout the chapter, the term "plant" refers to both turf and landscape plants, including trees.

PERMITTING AND REGULATIONS

Many agencies have jurisdiction over an irrigation project before, during, and after construction. For example, Florida's five water management districts, Florida Department of Health, Florida Department of Environmental Protection, or local governments may require well permits. Typically, for large projects the water management districts issue water use permits, which are usually calculated for drought conditions rather than for normal irrigation. To prevent potential fines, it is important to identify and abide by all regulatory requirements.

Besides water use permits, some water management districts have special year-round water conservation measures and drought/water shortage restrictions that govern the amount and timing of irrigation. It is important to know the restrictions for a site and to set timers/controllers to those conditions. Since water shortage restrictions change with the severity of a drought, it is important to be aware of and to abide by current restrictions. If a site's irrigation system cannot be adjusted to meet the restrictions, the system should be upgraded as soon as possible, but in the interim, there are methods to obtain variances. These variances need to be obtained in writing, before irrigating.

Since 1991, Florida Law has required an operating rain-activated cutoff switch on all automatically controlled irrigation systems. In 2004, the Florida legislature created section 373.228 Florida Statutes directing the Department of Environmental Protection,

> 373.62 Water conservation; automatic sprinkler systems. Any person who purchases and installs an automatic lawn sprinkler system after May 1, 1991, shall install, and must maintain and operate, a rain sensor device or switch that will override the irrigation cycle of the sprinkler system when adequate rainfall has occurred.

the Water Management Districts, and several stakeholder groups to devise standards for Landscape Irrigation and Florida-Friendly landscape design. These standards were adopted in December 2006. *Local governments must use these standards when adopting local ordinances after that date.* The irrigation standards are based on Appendix F of the Florida Building code. See the shadow box in the *Irrigation Design* section for more details.

The following permitting and regulatory guidelines should be followed for all irrigation projects:

- Contact local and state regulatory agencies (such as the county, city, Florida Department of Environmental

Protection, water management districts, and health department) to determine current irrigation regulations and criteria.

- Obtain all permits before construction.
- Abide by all permit conditions and current water restrictions when operating the irrigation system.
- Obtain any desired regulatory variances before irrigating.

The use of irrigation BMPs promotes proper irrigation system design, construction, and management. This leads to reduced water use, the protection of aquatic resources, better plant development, economic savings to the end user, and efficient fertilizer use. Irrigation knowledge and education is a critical part of meeting the intent of the Green Industry's irrigation BMPs.

RECLAIMED WATER USE

Many urban areas use reclaimed wastewater for their irrigation water source. While this offers many benefits, it also can lead to landscaping and pollution problems if not properly managed. Nutrient levels in reclaimed water may vary by a factor of 10 or more, depending on the treatment plant supplying the water. Contact the supplier to get information on nutrient content. When applying fertilizers to a site that irrigates with reclaimed water, consider the amount of nutrients in the water, and reduce fertilization appropriately. Reclaimed water may contain high levels of chloride, leading to salt accumulation in the soil. Additional considerations, such as water for flushing salts, may be needed.

Nutrient pollution may occur if the user over-irrigates, because both reclaimed water that runs off on the surface, and the water and nutrients that move below the root zone, are lost. Maintenance of a high level of distribution uniformity is critical to prevent leaching of these nutrients. Irrigation managers should also pay close attention to all cross-connection controls and backflow prevention devices. **All reclaimed water piping, heads, valves, fixtures, etc. are required by law to be color-coded purple, and labeled "Do not drink this water."** As long as field capacity is not exceeded when irrigating, reclaimed water is a safe and reliable irrigation source.

IRRIGATION SYSTEM DESIGN

Irrigation system design is a complex issue and should be performed by trained professionals. These professionals should use existing standards and criteria, as well as the manufacturer's recommendations, to design the most appropriate system for a location. In addition to the *Landscape Irrigation and Florida-Friendly Design Standards*, a list of sources for current standards and criteria can be found at the end of this chapter. Many communities require construction and design documents and permits that require the signature and seal of a registered design professional. Members of the Green Industry should be able to visually identify system design problems to help their clients irrigate more efficiently, save water, reduce the need to add fertilizers or other chemical treatments, and improve plant health and water quality.

The irrigation design for a site depends on a number of factors including location, soils, landscape vegetation, water supply, and water quality. An irrigation system needs to be designed to meet a site's peak water requirements. In addition, to prevent irrigation runoff, a system's application rate must not exceed the ability of the soil to absorb and retain the water applied during any one application. The irrigation system should also have enough flexibility to adapt to various water demands and local restrictions.

Design operating pressure must not exceed the source pressure. The design operating pressure should account for low pressure during periods of high use (i.e., mornings) and for project buildout when all of a development's landscaping is in place. Plants should be grouped in irrigation zones based on similar water use requirements. Irrigation systems designed to service both turf and landscape areas should have enough zones to meet each area's individual water needs. In some regions, the irrigation design should account for the extra water required to periodically leach salt buildups that may accumulate due to high chloride levels in some sources of irrigation water.

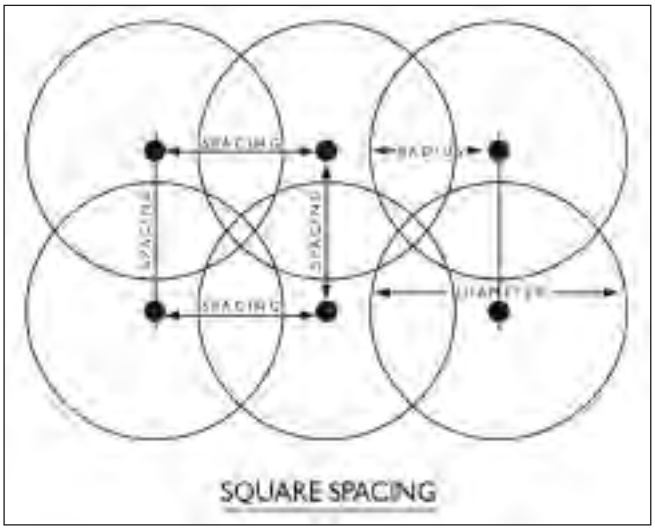
An irrigation system consists of three main components: water supply (consisting of a water source, pump, filters, and valves), water conveyance (made up of a mainline, manifold, lateral, and spaghetti tubes) and a distribution device (such as an impact sprinkler, oscillating sprinkler, rotary sprinkler, spray, or drip emitter). The proper design and installation of these components optimizes their use and decreases any off-site impacts. Irrigation design must also account for different site characteristics, such as soils and topography.

Hand-moved irrigation systems should have enough flexibility to provide sufficient coverage (see the manufacturer's recommendations) after each move. Microirrigation systems for shrubs and other landscape plants should be designed to cover at least 50 percent of the root systems. Microirrigation is rarely used for turf in Florida, and is prohibited in some places, but if used should be designed to cover 100 percent of the grass's root system.

To provide for peak water demands and have enough flexibility to reduce supply for different demand requirements, irrigation systems need to be designed with various control devices, rain shut-off devices, and backflow

prevention. Water conveyance systems should be designed with devices to protect against blowouts. The water conveyance pipelines should provide the system with the appropriate pressure required for maximum irrigation efficiency, uniformity, and the distribution devices should be designed for optimum uniform coverage. In addition, the distribution system should not include the irrigation of non-planted areas (such as driveways, parking lots, roads, sidewalks, underneath roof overhangs, and natural buffer zones).

To ensure optimum uniformity, permanent irrigation sprinklers, spray jets, and other distribution devices should be spaced according to the manufacturers' recommendations. Typically, this spacing is based on average wind conditions and operating pressures during irrigation.



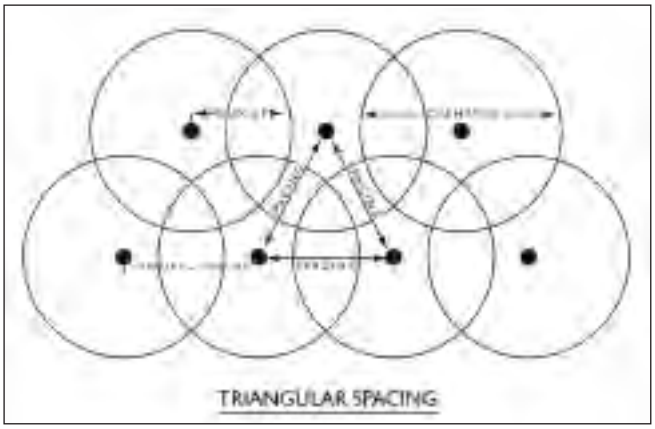


Figure 5. Sprinkler layouts.

If site-specific wind conditions are different than published averages, check with the local IFAS extension office, USDA NRCS or the Florida Irrigation Society for their recommendations. **Table 2** is provided as a general guideline. Spacing should not exceed the percentages in the table below. After the system is constructed and operating, periodic "catch can" uniformity tests should be performed (see the section on Irrigation Maintenance later in this chapter) to ensure that the system is continuing to function as designed.

Table 2. Irrigation Spacing

Wind	Square Coverage	Triangular Coverage
Miles Per Hour	Percentage of Diameter of Coverage	
0–5*	55%	60%
5–10	50%	55%
10+	45%	50%

* For many locations, the 0-5 mph wind condition occurs very infrequently and this spacing recommendation should only be used after careful consideration and site investigation.

MICROIRRIGATION FOR LANDSCAPE PLANTS

When designed and operated correctly, microirrigation, also known as drip or low-volume irrigation, is one of the most efficient methods of irrigation. It is highly manageable and provides small quantities of water directly to the plant's root zone. Low-pressure sprinklers, sprayers or drippers are also known as emitters, and they slowly release water into the soil around a plant. This saves water because only the main feeder roots receive water, and less water evaporates from the surface of the soil.

Typically, with drip irrigation in a sandy soil, water moves laterally only 10 to 12 inches. Drip irrigation is ideal when such precision is desirable or for narrow strip plantings, such as hedgerows. Because of the nature and location of drip irrigation it is difficult to determine if the emitters are providing enough water. Visual inspection of the landscape may identify clogging (dry spots, dead plants, and wilted plants) or excessive watering (soggy soil, weeds, excessive plant growth) problems from a drip irrigation system.

Overall, spray-jets (either microsprayers or microsprinklers) are more desirable than drip emitters for most landscape applications. This is because they cover larger areas and have fewer clogging problems. Clogging and excess water problems can be seen either by careful examination of the irrigation system or by looking at the landscape. Spray jets should not be designed or operated to irrigate non-planted areas

Regardless of the type of microirrigation system, clogging can be a problem if the water supply is not filtered before entering the irrigation system or if the filtration system is not cleaned. The safest and easiest way to maintain the emitters in a microirrigation system is to keep a small supply of clean backups on hand.

Clogged devices can be easily replaced with clean units, then placed in a small container of the cleaning fluid appropriate for the clogging material. Replacement emitters should always have the same operating characteristics (i.e., operating pressure and discharge rate) as the original emitters.

For more information, see the following:

IFAS Fact Sheet AE-254, *Microirrigation in the Landscape*, at http://edis.ifas.ufl.edu/AE076.

IFAS Bulletin 333, *Flushing Procedures for Microirrigation Systems*, at http://edis.ifas.ufl.edu/WI013.

Turf and Landscape Irrigation Best Management Practices, April 2005. The Irrigation Association, at http://www.irrigation.org.

From the December 2006 publication Landscape Irrigation and Florida-Friendly Design Standards:

Pursuant to section 373.228, F.S, these landscape and irrigation design Standards shall be used by local governments when developing landscape irrigation and xeriscape (Florida-Friendly) ordinances.

II. Irrigation System Design Standards

A. Irrigation systems shall be designed to meet the needs of the plants in the landscape (not the other way around).

B. When feasible, irrigation systems shall be designed to separately serve turf and non-turf areas.

C. The irrigation system plans and specifications shall identify the materials to be used and the construction methods.

D. The design shall consider soil, slope, and other site characteristics in order to minimize water waste, including overspray, the watering of impervious surfaces and other non-vegetated areas, and off-site runoff.

E. The system shall be designed to minimize free flow conditions in case of damage or other mechanical failure.

F. The system shall be designed to use the lowest quality water feasible.

G. Rain switches or other devices, such as soil moisture sensors, to prevent unnecessary irrigation, shall be incorporated. (Section 373.62, F.S.)

H. A recommended seasonal operating schedule and average precipitation rates for each irrigation zone for both establishment and maintenance conditions shall be provided.

I. Control systems shall provide the following minimum capabilities:
   1) Ability to be programmed in minutes, by day of week, season and time of day,
   2) Ability to accommodate multiple start times and programs,
   3) Automatic shut off after adequate rainfall,
   4) Ability to maintain time during power outages for a minimum of three days, and
   5) Operational flexibility to meet applicable year-round water conservation requirements and temporary water shortage restrictions.

J. Recommended maintenance activities and schedules shall be included.

K. Precipitation rates for sprinklers and all other emitters in the same zone shall be matched, except that microirrigation emitters may be specified to meet the requirements of individual plants.

L. Irrigation systems shall be designed to maximize uniformity, considering factors such as:
   1) Emitter types.
   2) Head spacing.
   3) Sprinkler pattern.
   4) Water pressure at the emitter.

M. Irrigation systems with main lines larger than two inches or designed to supply more than seventy gallons per minute shall incorporate a means to measure irrigation water use, at a minimum of ninety-five percent accuracy across the flow range.

N. Irrigation system plans and specifications shall require the system installer to conduct final testing and adjustments to achieve design specifications prior to completion of the system and acceptance by the owner or owner's representative.

O Irrigation system plans and specifications shall require that the installer provide property owners and users with post-construction documentation, including as-constructed drawings, recommended maintenance activities and schedules, operational schedule, design precipitation rates, instructions on adjusting the system to apply less water after the landscape is established, maintenance schedule, water source, water shut-off method, and the manufacturer's operational guide for their irrigation controller. To the extent feasible, similar information should be made available for subsequent property transfers.

IRRIGATION SYSTEM INSTALLATION

Only professionals who are trained, certified, appropriately licensed for irrigation installation by the appropriate agency, bonded, and insured should handle irrigation installation. These individuals must follow the designer's plans and use recognized standards and criteria such as those promulgated by the American Society of Agricultural and Biological Engineers (ASABE, formerly ASAE), Florida Irrigation Society (FIS), Irrigation Association (IA), U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), or the manufacturer's recommendations. The designer must approve any changes to the design.

To prevent system failures, waste, and property damage, construction materials must meet appropriate standards, such as those from ASABE, the American Society of Civil Engineers (ASCE), or the American Society of Testing Materials (ASTM). Plan all construction practices according to standard safety practices. Before construction, the contractor should identify and flag all underground pipes, cables, and other elements. **Call before you dig.** Call 811 (or 800-432-4770 or www.callsunshine.com) for free Sunshine State One Call locator service. The contractor should clean the site of any construction materials before the job is complete and at the end of construction, provide the owner with a copy of the as-built plans, operating manuals, recommended operating schedules for both plant establishment and supplemental irrigation of mature plants, and warranties. For new construction, the job should include a follow-up site visit to reset the controller, rain shut off device, and soil moisture sensor (if installed) after the landscape is established.

IRRIGATION MANAGEMENT

Irrigation management (knowing when and how much to irrigate) is the cornerstone of water conservation and reducing nonpoint source pollution. It encompasses the amount of water applied and the frequency of application. To prevent excess water use that could lead to chemical leaching and runoff, fungal infestation, and disease; irrigation scheduling should take into account plant water requirements, recent rainfall, recent temperature extremes, and soil characteristics. In addition, the irrigation system must be properly designed and maintained, so that all of the plants in a given zone receive the same amount of water. See the Irrigation Maintenance section of this chapter for information about measuring distribution uniformity.

Under ideal conditions, the water required for a plant is equal to the water used during plant growth. This water goes to soil evaporation and plant transpiration. Typically, both processes are combined and called evapotranspiration (ET).

A plant's water requirements (ET) vary with its growth cycle and climatic conditions. The limiting ET factors are the amount of soil moisture to be transpired by the plant, solar energy reaching the plant (affected by latitude, season, cloud cover, and shade), the temperature and relative humidity of the air, and wind speed. If a soil is at field capacity, 100% canopy coverage is present to absorb radiation, and other factors are equal, the amount of water transpired varies little between plant types. Plant irrigation requirements will differ based on a plant's ability to extract soil moisture (i.e., root zone depth) and its physiological ability to deal with reduced availability of moisture.

Plants require more water during seed, flower, and fruit production, but will not require very much when they are dormant. During the colder months, or those with shorter periods of daylight, most turfgrasses and landscape plants are not actively growing, thus use less soil moisture and may not require irrigation.

Many established, drought-tolerant landscape trees and shrubs require little or no irrigation, provided the soils do not obstruct root development. Plants such as azaleas, copperleaf, impatiens, or other bedding plants that lack drought tolerance may require irrigation during extended drought periods.

In humid regions such as Florida, irrigation is considered supplemental because it supplements natural rainfall. Proper irrigation management must account for rainfall. Since rainfall varies from location to location, the proper use of rain gauges, rain shut-off devices, flow meters, soil moisture sensors, and/or other irrigation management devices should be incorporated into the site's irrigation schedule.

Using an irrigation schedule can help prevent wasteful over-irrigation, the leaching of fertilizers/pesticides, and promote root development for drought conditions. No more than 1/2 to 3/4 inch of water should be applied for a single irrigation event. The exact amount of irrigation needed for each event will depend on a plant's needs for growth, fruiting, dormancy for that time of year and soil characteristics (soil moisture, infiltration rates, soil root zone depth and water holding capacities). In addition, water management districts and local requirements should be considered before irrigating. A properly working, installed and calibrated rain shutoff device prevents the irrigation system from turning on if adequate rainfall has occurred. Rain shutoff devices are required by law on all automatic irrigation systems built after 1991.

Irrigation management and control devices need to be installed correctly for proper irrigation management. Rain shut-off devices and rain gauges should be placed in open areas to prevent erroneous readings. Flow meters should have a straight enough run of pipe both downstream and upstream to prevent turbulence and bad readings. Soil moisture sensors and other irrigation management tools should be installed in representative locations and be maintained to help make good irrigation

management decisions. When mechanical/electronic devices are not available for irrigation management, the following visual indicators should be used as guidelines to determine the need for irrigation:

- The grass has a dull, bluish-gray coloring.
- Foot tracks remain in the grass.
- Leaf blades are folded in half on at least one-third of the site.
- Soil samples from the root zone are dry and crumbly.
- Indicator landscape plants (such as impatiens and azaleas) have drooping leaves.

There are several ways to prevent excess irrigation. Visual observations of runoff or puddles are simple indications. A system's timer/clock/controller can be adjusted to meet a plant's seasonal water requirements. Flow meters can be used to determine how much water is applied and when to turn off the irrigation system. Rain gauges, cans, or other containers can be used to measure how much water has been applied.

Rain shutoff devices, which, as mentioned earlier, are already required by law on all automatic systems installed since 1991, can save up to 30% or more over a timer-only system. However, many systems that should have sensors do not, either because they were not installed as required or because they have failed or been removed. Those who are responsible for overseeing an irrigation system should check the operation of the rain shutoff device at least once per year, and replace the unit if it is not operating correctly. Other workers who may notice a system irrigating shortly after a good rain event should attempt to notify their client of a possible problem with the rain shut off device so they can have it repaired.

One of the most effective and efficient methods of irrigation control is the use of properly installed and maintained soil moisture sensors with a specialized controller. There are two basic types of systems, direct control, where soil moisture sensors actually call for irrigation; and bypass control, where regularly scheduled irrigations are bypassed if sufficient moisture is present. Direct control systems are more expensive and require considerable management expertise, such as may be present at a golf course. Bypass systems are much less expensive and easier to install. Most bypass systems work with the existing controller.

Although soil moisture levels are the preferred method to determine irrigation quantities, in the absence of soil data, calculated ET methods may be used. Current calculated potential evapotranspiration (ETp) rates are available at http://fawn.ifas.ufl.edu. This site also includes a landscape irrigation scheduling tool and rainfall data. Rainfall can make up some or all of the ET, especially during the cooler months. Total rainfall is not the same as effective rainfall. Florida soils generally have low water holding capacity, so a two-inch rain may have little more effect on reducing landscape irrigation than a typical irrigation event in any given month.

An alternative irrigation scheduling method often used by homeowners and on some commercial landscapes is to assume that on average 1 inch of water wets the top 12 inches of a sandy soil. Typically most roots grow in the top 6-12 inches of soil, and 1/2 to 3/4 inch is needed for replenishment of moisture every 2 to 3 days during warm periods of active growth, and every 10 to 14 days during less active growth periods. This water can come from rainfall or be provided by the irrigation system. Again, soil characteristics (infiltration rates and water holding capacities) water management districts and local requirements should be considered before irrigating.

Another method of irrigation scheduling and timer or controller adjustments for sites without specific information is to use the weekly ET values in Figure 6 as a general guideline. The graph divides the state into northern and southern regions roughly around Interstate I-4.

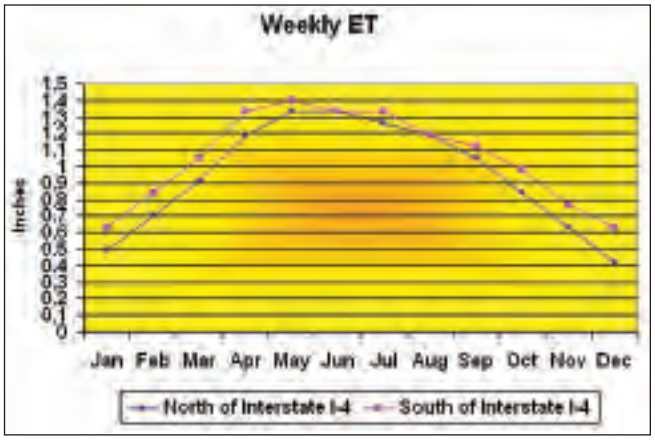


Figure 6. Approximate weekly evapotranspiration (ET).

Although irrigation management is a complex process, it can be boiled down to a simple checkbook (or water balance) process, where the irrigation amount consists of the difference between a plant's need for water and the effective rainfall (rainfall stored in a plant's root zone, for plant use). When possible, the timing of an irrigation event should be planned to increase irrigation efficiency, by reducing evaporative losses due to climatic conditions (for example, high temperature, low humidity, windy conditions) and by maintaining high irrigation uniformity.

Several irrigation management techniques help to improve a plant's health and reduce water use. Delayed irrigation and deficit irrigation promote root development and provide a level of drought tolerance. Delayed irriga-

tion promotes deeper root development by postponing irrigation until wilt is observed. Deficit irrigation calls for managing irrigation quantities so that there is always soil storage to take advantage of any possible rainfall.

When leaching salts, which is necessary in some soils due to poor water quality, always wait until the nutrient level in the soil is depleted to avoid leaching of fertilizer nutrients with the salt.

For more information, see the following:

IFAS Publication ENH 158, *Tips for Maintaining Landscapes During Drought*, at http://edis.ifas.ufl.edu/EP091.

IFAS Circular 807, *Managing Your Florida Lawn Under Drought Conditions*, at http://edis.ifas.ufl.edu/EP078.

Field Guide to Soil Moisture Sensor Use in Florida, at http://www.sjrwmd.com/floridawaterstar/pdfs/SMS_field_guide.pdf.

IRRIGATION SYSTEM MAINTENANCE

Proper maintenance extends the life of an irrigation system and helps it to perform optimally. Maintenance begins with a visual observation of the system and the plants. Check for proper functioning of rain sensors and controllers, leaks, broken/cracked lines, proper rotation, and damaged sprinkler heads. Also, check for obstacles that may interfere with irrigation uniformity. Brown spots, unnaturally green grass, certain types of weeds, and soggy spots are indicators of problems. Many types of businesses do not have control over the irrigation system, nor the expertise or contractual duty to address irrigation issues, but every effort should be made to inform the client when problems are noted and to explain the importance of proper operation and prompt repairs.

Damaged or defective systems should be repaired as soon as possible. Replacement parts should always have the same characteristics (that is, discharge-pressure relationship, jet size/colors) as the original components. Otherwise, the replacement might cause more harm than the bad component.

Evaluating a system's uniformity and efficiency (an irrigation audit) reduces water use and fertilizer/pesticide leaching. There are many procedures (such as NRCS, IFAS, ASABE, IA, and FIS) for irrigation system evaluation, all of which can be traced to a process published by Miriam and Keller. By following any of these methods, you can ensure that a system is operating at optimum levels.

Common irrigation efficiency problems include leaks, sprinkler head plugging, poor irrigation uniformity caused by nozzle wear, and poor system pressure. Some problems (such as repairing leaks and replacing nozzles) can be repaired at a minimal cost, while others (such as poor system design) might, at first glance, be very costly, but will pay off in the end. Problems need to be corrected as soon as possible to prevent wasted water and the leaching of fertilizers and other chemicals. In the long term, the investment made to improve the irrigation system pays off in reduced fertilizer, chemical and water bills.

Distribution Uniformity is a measurement of how evenly water is distributed over a given area, and should be considered when managing irrigation. This measurement is an indication of the system's hydraulic performance and can be used to identify deep percolation. Typically distribution uniformity is identified with the infiltration of the lowest 25% (low quarter) of irrigated area and can be determined by a "catch can" test. Baby-food jars, tuna cans, or other straight-sided containers are evenly placed around sprinklers. The system is turned on for a fixed amount of time, and the water collected in each container is measured and recorded.

The Distribution Uniformity, which is a percentage, is calculated by dividing the average depth of water collected in the lowest 25% of containers with the average depth of water in all the containers. This is multiplied by 100 to convert the value into a percentage. The Irrigation Association has published a range and rating of distribution uniformities for different irrigation methods. Recent work in Florida indicates that most landscape irrigation systems are below these published values.

Higher uniformities occur when spacing is adequate and sprinkler nozzles are matched. Poor application uniformity leads to localized over irrigation or under irrigation, brown spots in the grass, fertilizer or pesticide leaching or runoff, and the waste of irrigation water. Many of these problems can be solved and the site's owner can

Table 3: Irrigation Association Distribution Uniformities

Rating of Lower Quarter Distribution Uniformity (DULQ) for Sprinkler Zones					
Type of Zone	Excellent	Very Good	Good	Fair	Poor
	(%)	(%)	(%)	(%)	(%)
Fixed Spray	75	65	55	50	40
Rotor	80	70	65	60	50
Impact	80	70	65	60	65
Predicting and Estimating Landscape Water Use. The Irrigation Association, Oct. 2001.					

reduce water costs. Distribution uniformity is not a measurement of irrigation efficiency. For more information, see IFAS Publication AE 144, Turf Irrigation for the Home, at http://edis.ifas.ufl.edu/AE144.

For micro irrigation systems, Emission Uniformity is used instead of Distribution Uniformity to determine the uniformity of irrigation. Emission Uniformity is calculated by comparing the volume of water from the emitters to the statistical differences in the total volume. An Emission Uniformity of 90% or higher is considered excellent. For more information, see IFAS Publication AE094, Field Evaluation of Microirrigation Water Application Uniformity, at http://edis.ifas.ufl.edu/AE094.

Water Application Efficiency is a component of irrigation system efficiency and indicates how well a system is providing water to the plant's root system. Irrigation Application Efficiency is another form of irrigation system efficiency and it compares the amount of water delivered to an area by the amount of water beneficially used.

To help with irrigation efficiency, water management districts or other local agencies may provide mobile irrigation lab (MIL) services. MIL staff will evaluate an irrigation system and make recommendations to improve system efficiency and help with irrigation scheduling. Contact your local water management district for more information about these services in your area.

Irrigation requirements represent the amount of water an irrigation system needs to apply to meet a plant's water needs. This quantity is a function of the plant's water requirements, soil moisture, and the system's efficiency. For more information, see IFAS Publication AE110, *Efficiencies of Florida Agricultural Irrigation Systems*, at http://edis.ifas.ufl.edu/AE110.

IRRIGATION SYSTEM ERRORS

The following figures depict some examples of improper irrigation system design or installation.



Figure 7. Poor design; sprinkler does not match area.



Figure 8. Poor design; system does not match irrigation requirements. The area needs to be rezoned with landscape and turf separated.



Figure 9. Overirrigation, runoff. Small turf area should be irrigated with spray heads, not sprinklers.



Figure 10. Object is interfering with spray pattern, resulting in poor distribution uniformity

SOURCES FOR IRRIGATION STANDARDS

The following publications contain current irrigation standards:

- *Landscape Irrigation and Florida-Friendly Design Standards*, December 2006, Florida Department of Environmental Protection. http://www.dep.state.fl.us/water/waterpolicy/docs/LandscapeIrrigationFloridaFriendlyDesign.pdf.



Figure 11. Water gushing from broken head.

- *ASABE Standards*–2007. Standards, engineering practices, and data developed and adopted by the American Society of Agricultural and Biological Engineers. 2007. American Society of Agricultural and Biological Engineers, 2950 Niles Rd., St. Joseph, MO 49085. Telephone (269) 429-0300. http://www.asabe.org/standards/searchpur.html.

- *Florida Building Code—Plumbing, Appendix F*. International Code Council 900 Montclair Rd. Birmingham AL, 35213-1206 (205) 599-9871 http://www.floridabuilding.org/BCISOld/bc/default.asp or http://www.iccsafe.org.

- *National Engineering Handbook Series 210-VI*. November 1997. U.S. Department of Agriculture, Natural Resources Conservation Service, Washington D.C., 20013. http://directives.sc.egov.usda.gov/.

- *Standards and Specifications for Turf and Landscape Irrigation Systems, Fifth Edition*. December 2005. Florida Irrigation Society, (800) 441-5341, Address: 9340 56th Street N. Suite 105, Temple Terrace, FL 33617 , Florida. http://www.fisstate.org/standardsrevision3.pdf.

- *Turf and Landscape Irrigation Best Management Practices*, April 2005. The Irrigation Association. (703) 536-7080, 6540 Arlington Blvd., Falls Church, VA 22042-6638 http://www.irrigation.org.

GREEN INDUSTRY IRRIGATION BMPS

The principal BMPs for all of the Green Industry include:

- Call before you dig. Call 811 for free Sunshine State One Call locator service.
- When possible, the application of fertilizers, herbicides, or other chemicals that needed to be watered, should coincide with an irrigation event.
- Proper cultural practices (such as mowing) to promote healthy, deep root development and reduce irrigation requirements.
- Account for the nutrients in reclaimed water when making fertilizer calculations. Knowing the nitrate levels in reclaimed water can reduce your fertilizer purchases. The application of 1 inch of reclaimed water containing 20 ppm nitrate-Nitrogen adds about 4.5 pounds of nitrogen per acre (lb. N/acre) to the soil. If you irrigate 40 inches per year, that works out to a little over 4 lb. per 1,000 square feet.
- Repair any irrigation devices broken while servicing a site. Replacement parts should have the same characteristics as the original components.
- Visually observe site problems associated with irrigation (i.e., wet, dry spots, excessive weeds in specific location) or system components (leaks, broken equipment) and report problems to the client.
- When leaching salts, which is necessary in some soils due to poor water quality, always wait until the nutrient level in the soil is depleted to avoid leaching of fertilizer nutrients with the salt.

Additional BMPs for those with ownership/management responsibility:

- Group plants by similar water requirements (i.e., Hydrozones)
- Irrigation controllers/timers should be reset seasonally to account for plant growth requirements and local climatic conditions.
- Properly calibrated flow meters, soil moisture sensors, rain shut-off devices, and/or other automated methods should be used to manage irrigation.
- Irrigation rates should not exceed the maximum ability of the soil to absorb and hold the water applied in any one application.
- Implement a preventive maintenance program to replace worn components before they cause water, fertilizer and chemical waste.
- Perform weekly (or at each site visit) visual inspections to identify leaks, broken rain sensors or sprinkler heads, and other system malfunctions.
- Replace or repair all broken or worn components before the next scheduled irrigation.
- Distribution uniformity should be checked annually.

Chapter 4: Mulching, Mowing, and Pruning

LANDSCAPE MULCHES

Mulch is any material applied to the soil surface to protect or improve the area covered. Mulches are frequently applied around plants to modify the soil environment and enhance plant growth. They may consist of organic material such as bark, wood chips, leaves, pine needles, or grass clippings; or they can be inorganic material such as gravel, pebbles, polyethylene film, or woven ground cloth. Mulch can be applied to the soil surface but should not rest against the stems of landscape plants.

BENEFITS OF MULCHING

Mulching has the following beneficial effects on the soil and plants:

- Mulches can prevent the loss of water from the soil by evaporation. Moisture moves by capillary action to the surface and evaporates if the soil is not covered by a mulch.
- Mulches suppress weeds when the mulch material itself is weed-free and applied deeply enough (2 to 3 inches after settling) to prevent weed germination or to smother existing small weeds.



Figure 12. Mulch, not grass, should be used here.

- A more uniform soil temperature can be maintained by mulching. The mulch acts as an insulator that keeps the soil cool under intense sunlight and warm during cold weather.



Figure 13. Never build volcanoes. This crown will rot and the roots are smothered.

- Most mulches prevent crusting of the soil surface, thus improving absorption and percolation of water into the soil and, at the same time, reducing erosion.
- Organic materials used as a mulch can improve soil structure and tilth. As mulch decays, the material becomes topsoil. Decaying mulch may also add nutrients to the soil.
- Mulches add to the beauty of the landscape by providing a cover of uniform color and an interesting surface texture.
- Mulched plants produce roots in and directly under the mulch that surrounds them. The plants produce these roots in addition to the roots in the soil. As a result, mulched plants have more roots than plants that are not mulched.

For more information, see IFAS Publication ENH 103, *Mulches for the Landscape*, at http://edis.ifas.ufl.edu/MG251.

MULCHING BMPS

- When feasible, use mulches made from environmentally friendly sources or recycled materials.
- Do not pile mulch against a tree or around the bases of shrubs. Burying the crowns can lead to crown and root rot. Leave a clear space for air to reach the trunk.
- Maintain a 2"-3" depth of mulch after settling.

MOWING THE FLORIDA LAWN

Mowing is an important maintenance operation. Mowing at the correct height increases turf density and root health and suppresses weeds. A dense turf impedes stormwater runoff. A healthy root system ensures that water and nutrients are absorbed and not wasted. Fewer weeds mean less need for herbicides.

Clippings contain nutrients and should be recycled on the lawn. The nutrients in clippings are pollutants when they end up in stormwater systems and waterbodies.



Figure 14. This is BAD! Never direct clippings into the street where they can enter the storm drain system.

Growth rates and mowing height have the most influence on mowing frequency. As a rule of thumb, mowing should be done often enough so that no more than one-third of the leaf blade is removed at any one mowing. For example, if a St. Augustinegrass lawn is mowed at a height of 3 inches, it should be mowed when it grows to a height of 4 to 4.5 inches. Following this practice minimizes the effect of mowing on photosynthesis and helps to maintain the high percentage of leaf surface necessary for healthy root development. Research shows that returning grass clippings to the surface, sometimes referred to as grass recycling, does not increase thatch buildup on turf. Clippings have significant nutrient value and decompose rapidly, returning some fertilizer and organic matter to the soil.



Figure 15. Always remove clippings from impervious surfaces. These nutrients are going straight to a water body.

Mowing equipment and string trimmers can damage trees. Tree trunks that are bumped by mowers, or trees that are used as pivot points for turns, are injured via contact. Mechanical damage to trees can cause progressively bigger wounds, since the trees are hit in the same general area repeatedly over time. The damage eventually progresses through the phloem, cambium, and xylem of the tree. In a worst-case scenario, the tree is girdled and dies. Those trees not killed are stressed and the wounds end up as an entry point for disease and insect infestation. The whipping action of the nylon string on a trimmer can debark a young tree quickly, causing its demise.

The careful use of string trimmers and mowers in the landscape is imperative, and there is no reason to use them around trees. Replacing the grass around the base of trees with mulch provides a buffer zone. The larger the mulched area, the less the turf near the tree is stressed by shade, the more room the lawn mower has to maneuver with ease, and the less the string trimmer needs to be used. Mulch also confers other benefits, such as reduced competition from weeds and water conservation.

The growth habit and leaf width of a turfgrass species determines the optimum cutting height, frequency, and preferred mower type (Table 4). A grass that spreads

Table 4: Suggested mowing heights and mower types for Florida home lawns

Turfgrass Species	Optimal Mowing Height (inches)	Mowing Frequency (days)	Preferred Mower Type
Bahiagrass	3.0-4.0	7-17	Rotary/flail
Bermudagrass	0.5-1.5	3-5	Reel
Centipedegrass	1.0-2.0	10-14	Rotary
Seashore Paspalum	1.0-2.0	5-10	Rotary/reel
St. Augustinegrass "Dwarfs"*	3.0-4.0 1.5-2.5	5-14 5-14	Rotary Rotary
Zoysiagrass	1.0-3.0	10-14	Reel

* Dwarf varieties of St. Augustinegrass ('Seville,' 'Jade,' 'Palmetto,' 'Delmar') are the only cultivars of this species that should be mowed at less than 3 inches.

MOWING BMPS

- Adjust the cutting height by setting the mower on a driveway or sidewalk and using a ruler to measure the distance between the ground and the blade.
- Do not mow wet turf because it can promote disease and fungus, and clippings can clog the machine. Mow only when the turf is dry.
- Sharpen the mower blade frequently enough to prevent a ragged appearance to the turf.
- Mow in a different direction every time the lawn is cut. This prevents wear patterns, reduces the grain (grass laying over in the same direction), and reduces the possibility of scalping.
- Use the highest acceptable mowing height for the grasses being grown.
- Do not remove more than one-third of the foliage at one time.
- Do not direct clippings into bodies of water or onto impervious surfaces. Remove any clippings that are blown onto sidewalks, driveways, and other impervious areas.
- Do not remove clippings. If clumping occurs, distribute the clippings by re-mowing or by lightly raking. You can also use a leaf blower to distribute clippings.
- Clean the mower after use to reduce rusting and weed seed movement.
- Practice grass recycling and return nutrients to the soil.
- If you must collect clippings, compost them. Use the compost as a soil modifier or mulch.
- Avoid mechanical damage to trees and shrubs from string trimmers, mowers, and other equipment.

horizontally can usually be mowed shorter than an upright-growing, bunching grass. Grasses with narrow blades can generally be mowed closer than grasses with wide blades. Bermudagrass is mowed at very low heights because of its numerous narrow leaf blades and low growth habit. On the other hand, bahiagrass needs to be mowed higher because of its open, upright growth habit.

Turfgrass undergoes physiological stress with each mowing, particularly if too much leaf tissue is removed. The effects of this "scalping" can produce long-term damage to the turf and leave it susceptible to numerous other stresses, such as insects, disease, drought, and sunscald. It is always important to leave as much leaf surface as possible for photosynthesis to provide food for regrowth.

For mowing safety, be sure to follow these tips:

- Pick up all stones, sticks, and other debris before mowing to avoid damaging the mower or injuring someone with flying objects.
- Never fill a hot mower with gasoline.
- Always wear heavy leather shoes when mowing the lawn.
- Check your mower every time it is used. Follow the manufacturer's recommendations for service and adjustments.

PRUNING OF LANDSCAPE PLANTS

Pruning is another important landscape maintenance task. Through the selective removal of shoots and branches, pruning a plant can improve its health, reduce the risk of failure, control growth, and enhance fruiting, flowering or appearance. Pruning should be a part of routine maintenance and should not be delayed until the landscape is overgrown. However, close attention should be paid to proper timing, depending on the needs of various plants. Proper plant selection can eliminate many pruning requirements, especially for shrubs.

Trees should not be pruned without a clearly defined objective. Objectives can include 1) reducing the risk of failure by improving structure and removing dead branches, 2) raising or reducing the crown to provide clearance, and 3) thinning the crown to increase air and light penetration. Removing the correct stems and branches to accomplish the specified objectives is as important as making the correct pruning cuts. If the wrong branches, or too many branches, are removed even with proper pruning cuts, nothing of merit has been accomplished.

For more information, see the following:

IFAS Circular 853, *Pruning Landscape Trees and Shrubs*, at http://edis.ifas.ufl.edu/MG087 or *Pruning Shade Trees in the Landscape*, at http://hort.ifas.ufl.edu/woody/pruning/.

MANGROVES

Three species of mangroves are native to Florida: red mangrove *(Rhizophora mangle)*, black mangrove *(Avicennia germinans)*, and white mangrove *(Laguncularia racemosa)*.

Red mangroves are easily identified by their "prop roots," which are tangled, reddish, aerial roots that originate from the trunk and branches. Their leaves are 1 to 5 inches long, broad and blunt on the tip, shiny deep green on top, and paler on the underside.

Black mangroves can be identified by numerous fingerlike projections, called pneumatophores, that protrude from the soil around the tree's trunk. Black mangrove leaves are oblong, shiny green on top, and very pale on the underside. Black mangroves are usually found at slightly higher elevations, upland from red mangroves.

White mangroves have no visible aerial root system, as do red and black mangroves. The easiest way to identify white mangroves is by their leaves. These are up to 3 inches long, elliptical (rounded at both ends, often with a notch at the tip), and yellowish in color, with two distinguishing glands at the base of each leaf blade where the stem begins. White mangroves are usually found at higher elevations and farther upland than either red or black mangroves.

The 1996 Mangrove Trimming and Preservation Act, Sections 403.9321-403.9333, Florida Statutes, governs the trimming and alteration of mangroves. The Florida Department of Environmental Protection (FDEP) and several delegated local governments implement the mangrove program. Mangrove trimming and alteration may be done by property owners under certain exemptions, as specified in Section 403.9326, Florida Statutes. Other trimming requires the services of a professional mangrove trimmer and may require an FDEP permit. Section 403.9329, Florida Statutes, governs who may be considered a professional mangrove trimmer.

The mangrove preservation act's major provisions include the following:

- The difference between "trimming" and "alteration" of mangroves is defined.
- Mangroves may not be reduced to a height below 6 feet from the substrate and often may not be legally trimmed down to 6 feet.
- Mangrove roots, including aerial and prop roots (red mangroves) and pneumatophores (black mangroves), may not be trimmed.
- Under certain conditions, a professional mangrove trimmer must conduct or supervise the trimming.
- **Dead mangrove trees are covered by the same regulations as living mangrove trees;** contact the closest Florida Department of Environmental Protection office for specific information on dealing with dead mangrove trees on your client's property.

It is especially important that Green Industry professionals understand that, under the act, **homeowners and the individuals they hire to trim their mangroves are jointly and severally responsible for the appropriate trimming of mangroves**.

All trimming should be done in a manner that does not result in the removal, defoliation, or death of the mangroves. Red mangroves are particularly sensitive to inappropriate trimming. In general, the canopy of red mangroves should not be trimmed, and no more than 25 percent of the canopy of black and white mangroves should be removed. Preferably, views should be obtained by thinning the canopy, creating "windows," and "uplifting," compared with hedging (which can be particularly damaging to red mangroves).

- The booklet *Mangrove Trimming Guidelines for Homeowners* is available at FDEP's district offices throughout the state. You may wish to obtain several copies to give your clients. Before trimming mangroves, homeowners and landscapers should read the publications cited in this section, or call the Environmental Resource Permitting staff at FDEP's district offices to avoid violating the mangrove preservation act.

For more information about the mangrove program, call (850) 245-8482 or go to http://www.dep.state.fl.us/water/wetlands/mangroves/.

DISPOSING OF LANDSCAPE MATERIAL

Never sweep grass clippings, leaves, or other debris into a storm sewer. This pollutes our waterbodies and may, in some cases, clog the system and contribute to flooding.

Be careful with yard waste! Careless disposal may spread invasive non-native plants to areas where they don't belong. Lawn and landscape maintenance involves the removal of leaves, clippings, whole landscape plants, and even unwanted houseplants. Given contact with soil and sufficient water, these materials may become established at the disposal site. Dispose of them carefully, so plants that are unwanted in one location don't unintentionally become established elsewhere. Contact your county waste management utility or Cooperative Extension Service agent for information about local disposal sites in your area that are designated for plant waste. Educate your customers about proper plant disposal and how it enhances the protection of natural areas.



Figure 16. Illegal dumping of plant material.

Sometimes landscape waste materials are disposed of in accessible locations on someone else's property, either public or private. Illegal dumping has allowed several species to become established in natural areas. Wax begonia, pothos, heavenly bamboo, ardisia, golden bamboo, and arrowhead vine are among the species that have moved into wild areas through this mechanism. This spread of non-native species into protected sites is threatening the plant and animal species those sites were purchased to conserve.

Awareness of how a species is likely to become established is important. A plant's relative ease of propagation may provide valuable insight into its potential to spread. Pruned material from a species that is quickly propagated from cuttings, such as wedelia or lantana, may take root without appropriate precautions. The timing of maintenance activities can reduce the potential for discarded plants to become established where they shouldn't.

Depending on the situation and local ordinances, several options are available to dispose of plant material. Living plant tissue can be destroyed on-site through burning, composting in bins, or putting it in or under heavy plastic. Material may also be dumped in designated disposal areas.

The following tips can reduce the accidental propagation of non-native species:

- Plants can be pruned before the fruit is mature, and leaf raking can be done before the seeds of surrounding plants have dropped.
- Whenever practical, and if the homeowner is amenable, yard wastes should be composted on-site and retained for use as mulch. This also avoids transportation and disposal costs and reduces the need for purchased materials.

Chapter 5: Fertilization

FERTILIZER TERMS

"Fertilizer" means any substance that contains one or more recognized plant nutrients and promotes plant growth, or controls soil acidity or alkalinity, or provides other soil enrichment, or provides other corrective measures to the soil.

"Fertilizer grade or analysis" is the percent nitrogen, phosphorus, and potassium guaranteed by the manufacturer to be in the fertilizer. For historical reasons, nitrogen is expressed as Total N, available phosphate as P_2O_5, and soluble potash as K_2O. The percent sign is not used, but instead the numbers are separated by dashes, and the order is always N, P_2O_5, and K_2O (for example, 15-0-15). In this chapter, the abbreviations N, P, and K, respectively, are used for nitrogen, phosphate, and potash.

Many fertilizer terms are officially defined by the Association of American Plant Food Control Officials (AAPFCO), http://www.aapfco.org/.

FERTILIZER ANALYSIS

The Florida fertilizer label is detailed and intended to be highly informative. By law, the product's label is required to provide the following basic information: the brand and grade, manufacturer's name and address, guaranteed analysis, sources from which the guaranteed primary and secondary nutrients are derived, and net weight.
In addition to the grade of the fertilizer, the label also identifies the breakdown of Total N as either Nitrate-N, Ammoniacal-N, Water Soluble or Urea-N, and Water Insoluble-N. This N breakdown supplies information on the immediate availability and/or leachability of the N in the bag. Slow- or controlled-release fertilizer is defined by the Association of American Plant Food Control Officials (AAPFCO) as a fertilizer containing a plant nutrient in a form that delays its availability for plant uptake and use after application, or that extends its availability to the plant significantly longer than a reference "rapidly available nutrient fertilizer" such as ammonium nitrate or urea, ammonium phosphate, or potassium chloride.

Such delay of initial availability or extended time of continued availability may occur by a variety of mechanisms. These include the controlled water solubility of the material (by semipermeable coatings, occlusion, or the inherent water insolubility of polymers, natural nitrogenous organics, protein materials, or other chemical forms); by the slow hydrolysis of water-soluble, low molecular weight compounds; or by other unknown means.

In most cases, the higher the Water Insoluble-N percentage in the mix, the longer lasting the fertilizer. This is the portion where most of the N from natural organic and slow-release N sources appears. A fertilizer that contains all of its N as Nitrate-N, Ammoniacal-N, and/or Water Soluble N is referred to as a soluble N fertilizer, which has a high potential for leaching and should not be applied at rates greater than 0.5 lbs. N/1000 square feet.

A fertilizer label also contains a "derived from" section that identifies the materials from which the fertilizer was formulated.

For more information, see IFAS Circular CIR-1262, *Selected Fertilizers Used in Turfgrass Fertilization*, at http://edis.ifas.ufl.edu/SS318.

Secondary and micronutrients are identified in the lower portion of the label and are expressed in the elemental form. Sulfur (S) is expressed as "combined" (usually expressed as SO_4) and as "free" (elemental S form). The reason for this distinction is that "free" S is very acidifying when placed in the soil. Magnesium (Mg), Iron (Fe), Copper (Cu), Manganese (Mn), and Zinc (Zn) must be expressed as Total and/or Soluble or Water Soluble depending on the source materials formulated in the fertilizer. Chelated elements are guaranteed separately when a chelating agent is denoted in the derivation statement below the guaranteed analysis. For additional information, see IFAS Publication SL-3, *The Florida Fertilizer Label*, at http://edis.ifas.ufl.edu/SS170.

URBAN TURF FERTILIZER RULE

In 2007, the Florida Department of Agriculture and Consumer Services adopted rule 5E-1.003(2), labeling requirements for urban turf fertilizers. The complete rule, as first adopted in 2007, is presented in the Appendix. The rule limits the amount of nitrogen and phosphorus that the manufacturer may recommend for application on urban turf and lawns in Florida. It also directs the manufacturer to recommend the use of BMPs for professional applicators and golf course or athletic field managers.

While this rule only applies to the manufacturer's label for fertilizer, many local government ordinances, and future state requirements, may require that applicators abide by the recommendations on the label. In addition, weed and feed products are legally pesticides. **For pesticide – fertilizer combination products the label recommendation carries the full force of state and federal law**.

TURF FERTILIZATION MANAGEMENT

One of the first steps in developing a turfgrass fertilization management program involves a basic knowledge of the soils on which the turfgrasses are being grown. This knowledge can be acquired by observing and evaluating the soil's physical and chemical properties. Most Florida



Figure 17. Streaking on a lawn caused by poor application technique.

soils are sands and therefore retain limited quantities of water and nutrients. Individuals with only limited training in soils can discern whether a soil is mostly sand or predominately clay, and whether the soil contains flakes of free calcium carbonate or shell. These properties may significantly affect a turfgrass fertilization management program.

Chemical properties such as soil pH, lime requirement, extractable levels of P, K, calcium (Ca), Mg, and selected micronutrients such as Mn, Cu, and Zn can be determined through soil testing. Florida soils are not analyzed for N because it is highly mobile in sandy soils. Since reliable correlations between turfgrass growth and soil test N have not been developed, turfgrass N fertilization is based on the requirements of the individual turfgrass being grown.

Additional information on soil testing for turfgrasses can be found later in this chapter or in IFAS Publication SL 181, *Soil Testing and Interpretation for Florida Turfgrasses*, at http://edis.ifas.ufl.edu/SS317.

NITROGEN MANAGEMENT

Fertilizer Sources

Matching the fertilizer source and rate with the growth phase of the turfgrass is one of the keys to nutrient management. For example, you may shift from 1 lb total N of 15-0-15 slow release to a 1/2 lb N of 5-0-20 for a fall fertilization as dormancy approaches. Leaching losses of nitrogen can be minimized by using controlled-release nitrogen sources, making frequent, low-rate applications of soluble fertilizers, or applying a combination of the two fertilizer materials. Low-rate applications are usually made using soluble fertilizers, whether applied as a liquid or granular product.

Quick Release Sources

One of the most common nitrogen fertilizers is urea (46 percent N), which is a water-soluble, synthetic organic nitrogen fertilizer with quick N-release characteristics. Urea can be applied as either liquid or granules, and is subject to volatilization, or loss of nitrogen to the atmosphere. If urea is applied to a turfgrass surface and not incorporated through proper irrigation, significant quantities of N can be lost through volatilization. Therefore, it is imperative that the proper quantity of water be applied following the application of urea fertilizer, unless rainfall is anticipated within 8 to 12 hours. Recall that one inch of applied water moves the water front 12 inches through a Florida sandy soil; therefore, do not apply excessive irrigation. Application of 1/4 inch of water should be sufficient to solubilize most of the urea and move it into the turfgrass root zone.

If urea is applied and followed by rainfall of an inch or greater within 8 to 12 hours after application, urea-N may move below the turfgrass root zone because of its non-ionic nature and be lost through leaching. Although urea does not leach as rapidly or uniformly as nitrate-N significant loss of N can occur if excessive irrigation or rainfall occurs shortly after application. Once the urea has been exposed to soil or turfgrass thatch layer for a short time, it is converted by the enzyme urease to the ammonium-N form, which is more likely to be retained by the soil. This conversion of urea is usually complete within the first 24 hours after application. Thus, a heavy rainfall 2 to 3 days after an application of urea should not be as influential on N movement.



Figure 18. Weigh fertilizer to get accurate results.

Recently some new types of stabilized N fertilizer materials have been commercialized. These products contain urease inhibitors, which slow the conversion of urea to ammonium and reduce the volatilization loss of N. Therefore, these products can be left on the surface longer without significant loss of N through volatilization. This delay in urea conversion is usually 3 to 5 days, which means that the N remains in the urea form for a longer period of time and subjects the urea to leaching losses if heavy rainfall occurs during this period. In most

cases, these stabilized N materials also contain nitrification inhibitors, which slow the nitrification process as well. Recent research suggests that these stabilized N materials extend the N availability to turfgrass for 10 to 14 days over that of quick release products.

Recent research has shown that some slow-release N materials may leach more urea than applications of quick release urea. This is thought to be due to the slow-release urea product leaching through the soil without being degraded by urease. Small quantities of urea (less than 10% of the total released N) have been detected in the leachate from some slow-release N sources during the first 7 to 10 days after application. However, by 14 days after application no urea was detected in the leachate regardless of the N source applied; only nitrate N remained after this period.

Ammonium Nitrate (AN) and Ammonium Sulfate (AS) are two other soluble, quick-release N sources commonly used by professional lawn-care services. These two materials are not as high in N as urea. AN (33.5 percent N) and AS (21 percent N), however, have a higher salt index and burn potential than urea on a per-pound-of-N basis. AS is also a very acidifying N source. For each pound of N applied as AS, 5.35 pounds of acidity are produced due to the ammonium-ion content. AS is often the preferred N source on high pH soils due to its acidifying properties.

Urea and AN are often formulated as liquid N sources for application in solution form through the irrigation system (fertigation) or direct application. Lawn-care professionals often use solution fertilizers because of application uniformity and efficiency. Solution fertilizers do not leach more readily than similar granular fertilizers once they have reacted with the soil components.

Slow Release Sources

There are many sources of slow release nitrogen. Several of the definitions provided by AAPFCO are listed below.

- *Slow or controlled release fertilizer* is a fertilizer containing a plant nutrient in a form which delays its availability for plant uptake and use after application, or which extends its availability to the plant significantly longer than a reference "rapidly available nutrient fertilizer" such as ammonium nitrate or urea, ammonium phosphate, or potassium chloride. Such delay of initial availability or extended time of continued availability may occur by a variety of mechanisms. These include controlled water solubility of the material (by semi-permeable coatings, occlusion, or by inherent water insolubility of polymers, natural nitrogenous organics, protein materials, or other chemical forms), by slow hydrolysis of water soluble low molecular weight compounds, or by other unknown means. (AAPFCO, Official 1985)

- *Enhanced Efficiency* is a term describing fertilizer products with characteristics that allow increased plant uptake and reduce the potential of nutrient losses to the environment such as gaseous losses, leaching or runoff, as compared to an appropriate reference product. (AAPFCO, Official 2008)

- *Ureaform Fertilizer Materials* (sparingly soluble) are reaction products of urea and formaldehyde which contain at least thirty-five percent (35%) nitrogen, largely in insoluble but slowly available form. The water insoluble content shall be at least sixty percent (60%) of the total nitrogen. The water insoluble nitrogen in these products shall have an activity index of not less than forty percent (40%) when determined by the appropriate AOAC International method. (AAPFCO, Official 1984)

- *Urea-Formaldehyde Products* (sparingly soluble) are reaction products of urea and formaldehyde which contain less than thirty-five percent (35%) nitrogen, largely in insoluble but slowly available form. They shall have the percentage of total nitrogen as part of the product name; for example: 20% N Urea-Formaldehyde. The water insoluble nitrogen (AOAC Int. Method 945.01) shall be at least sixty percent (60%) of the total nitrogen. The activity index of the water insoluble nitrogen shall be either (1) not less than forty percent (40%) by the AOAC International method for Urea-formaldehyde Products (#955.05) or (2) not less than fifty percent (50%) by the AOAC International alkaline permanganate method (#920.07) or eighty percent (80%) by the neutral permanganate method(#920.06). (AAPFCO, Official 1984)

- *Isobutylidene Diurea(IBDU)* is a condensation product of isobutyraldehyde and urea having a minimum total nitrogen content of thirty percent (30%). It is a source of slowly available nitrogen by virtue of particle size, solubility decreasing with increase in particle size. Material conforming to the description of a "granular fertilizer" will have ninety percent (90%) of its nitrogen content in the water insoluble form prior to grinding as tested by AOAC International Method 945.01 (15th Edition). (AAPFCO, Official 1986)

- *Sulfur Coated Urea (SCU)* is a coated slow release fertilizer consisting of urea particles coated with sulfur. The product is usually further coated with a sealant (2% to 3% of total weight) and a conditioner (2% to 3% of total weight). It typically contains about thirty percent (30%) to forty percent (40%) nitrogen and about ten percent (10%) to thirty percent (30%) sulfur. (AAPFCO, Official 1980)

- *Urea-Formaldehyde Products* (water soluble) are reaction products of urea and formaldehyde which contain at least thirty percent (30%) nitrogen, largely in water

soluble form. Some slowly available nitrogen products are present. Stable aqueous solutions may be prepared from these materials. The reaction products shall contain a maximum of fifty-five percent (55%) free urea, with the remainder of the urea being chemically combined as methylolureas, methylolurea ethers, and/or methylenediurea (MDU) and dimethylenetriurea (DMTU). (AAPFCO, Official 1984)

- *Methylenediurea (MDU)* is a water soluble condensation product resulting from the reaction of one molecule of formaldehyde with two molecules of urea, with the elimination of one molecule of water. It has a minimum total nitrogen content of forty-two percent (42%) and is a source of slowly available nitrogen. (AAPFCO, Official 1984)

- *Dimethylenetriurea (DMTU)* is a water soluble condensation product resulting from the reaction of two molecules of formaldehyde with three molecules of urea, with the elimination of two molecules of water, and having a minimum total nitrogen content of forty-one percent (41%). It is a source of slowly available nitrogen. (AAPFCO, Official 1984)

- *Dicyandiamide (cyanoguanidine)* is a water soluble organic compound of formula $C_2H_4N_4$ which contains at least sixty-five percent (65%) nitrogen. It is a source of slowly available nitrogen. It is a nitrification inhibitor.(AAPFCO, Official 2000)

- *Polymer Coated Urea (PCU)* is a coated slow release fertilizer consisting of urea particles coated with a polymer (plastic) resin. It typically contains about forty percent (40%) nitrogen. It is a source of slowly available nitrogen. (AAPFCO, Official 1990)

- *Triazone* is a water soluble compound of formula $C_5H_{11}N_5O_2$ [5-(N-methyl)-urea-1,3,5-triazin-2-one or 5-methyleneureido-2-oxohexahydro-s-triazine] which contains at least forty percent (40%) total nitrogen. (AAPFCO, Official 1989)

- *Urea-Triazone Solution* is a stable solution resulting from controlled reaction in aqueous medium of urea, formaldehyde, and ammonia which contains at least twenty-five percent (25%) total nitrogen. The solution shall contain no more than forty percent (40%) nor less than five percent (5%) of total nitrogen from unreacted urea and not less than forty percent (40%) from triazone. All other nitrogen shall be derived from water soluble, dissolved reaction products of the above reactants. It is a source of slowly available nitrogen. (AAPFCO, Official 1990)

- *Methylene Urea(s)* (MU, polymethylene urea(s)) is a product obtained by the reaction of urea with formaldehyde and contains oligomers of urea bonded together by methylene ($-CH_2-$) linkages. It is chiefly composed of cold-water soluble fractions from methylenediurea (MDU) and dimethylenetriurea (DMTU), hot water soluble fractions from trimethylenetetraurea (TMTU) and tetramethylenepentaurea (TMPU) and hot-water insoluble fractions from longer chain oligomers. It is generally free of methylolureas and methyol ethers. It is a source of slowly available nitrogen. (AAPFCO, Official 2001)



Figure 19. Slow or quick release, this fertilizer is going to a water body. Keep fertilizer away from impervious surfaces and water bodies.

Urea is often formulated using a chemical reaction or coating to produce fertilizers with slow-release characteristics, such as ureaformaldehyde (UF or Nitroform), isobutylidene diurea (IBDU), and sulfur- or polymer-coated urea. These fertilizers depend on microbial action, soil moisture, and/or a chemical reaction for the release of N for use by turfgrass. It is important to know when to use a given slow-release N source in order to obtain maximum effectiveness from the material. This is due to environmental influences on the N-release mechanisms of slow-release N sources.

The N-release mechanism for methylene urea–type products (Ureaformaldehyde, UF, Nitroform, Nutralene, Methex, or CoRon) is microbial. Because temperature

influences the activity of the soil microbial population, these materials release N more slowly and are less effective during the cool season.

Particle size and rate of hydrolysis control the N release from IBDU; thus, this product should not be used during periods of heavy rainfall. However, it is one of the more effective materials in the cool season when precipitation levels decrease.

N release from sulfur-coated urea (SCU) products is controlled by the coating thickness and the degree of imperfection in the coating. SCU products typically induce a somewhat mottled appearance when used during the cool season, but are generally very effective during the high-rainfall, warm-season growth period. **Because of the fragile nature of the sulfur coating on most SCU materials, they should not be applied using a drop-type spreader.**

Other products include polymer-coated, controlled-release fertilizers that use a polymer coating to encapsulate nutrient granules. A polymer membrane is chemically bonded to the substrate resulting in a fertilizer with release governed largely by soil temperature, provided adequate moisture is present. The release mechanism is osmotic diffusion. Some systems consist of multiple layers of polymer, and may include other intermediate coatings. Product longevity may be controlled by coating thickness and blending ratios.

Organic fertilizers are another source of nitrogen that is slowly made available through microbial degradation. In this case, the release rates depend on nature of the product and the prior treatment that it has received as well as temperature and moisture. Organic fertilizers, including biosolids from wastewater treatment plants, generally have low N:P_2O_5 ratios, which means that it is difficult or impossible to meet the nitrogen needs of the turf without exceeding the annual maximum allowable P_2O_5, unless other nitrogen sources are added. Some manufacturers do blend in other N sources to overcome this and provide a more balanced product that preserves the benefits of nutrient recycling.

In conclusion, a wide variety of slow-release materials is available. Under typical Florida conditions, slow-release N sources are likely to leach less than an equal amount of soluble N sources. However, leaching can still take place and some slow-release products may be subject to runoff of the nutrient-containing slow release particles. Judicious use of professional judgment and a mixture of soluble and slow-release N sources are recommended.

For more information on N sources for lawn fertilization, see IFAS Publication CIR-1262, *Selected Fertilizers Used in Turfgrass Fertilization*, at http://edis.ifas.ufl.edu/SS318, or Publication SP141, *Florida Lawn Handbook: An Environmental Approach to Care and Maintenance of Your Lawn*, Second Edition.

Nitrogen Rate and Frequency

The rate of nutrient application, particularly N, depends on a number of factors: turfgrass species, turfgrass maintenance level goals, the location in the state where the turfgrass is being grown, time of year, and type of fertilizer source being used (soluble or slow release). Thus, a single rate of application cannot be recommended. The frequency of fertilization also depends on all the factors listed above for N rate. To limit the environmental impact of your fertilization program, **it is recommended that no more than 0.5 pounds of water-soluble N per 1,000 square feet be applied in a normal application.** Total N should be limited to 1 lb./1000 ft^2, per the Urban Turf Rule. **Table 5** is from the Florida Fertilizer Rule, 5E-1.003(2). In areas irrigated with reclaimed water, check with the reclaimed water supplier for estimates of the N applied per year in the reclaimed water, and recommendations to adjust the fertilization. A study for the Tampa Bay Estuary program (April 2008) estimated 0.6 to 5.3 lb N/1000ft^2 was applied annually to lawns from several different wastewater treatment systems.

For a detailed fertilization guide for Florida turfgrasses, see IFAS Publication SL-21, *General Recommendations for Fertilization of Turfgrasses on Florida Soils*, at http://edis.ifas.ufl.edu/LH014.

Table 5: Fertilization guidelines for established turfgrass lawns in three regions of Florida

Nitrogen recommendations (lbs N / 1000 ft^2 / year)*			
Species	**North**	**Central**	**South**
Bahia	2-3	2-4	2-4
Bermuda	3-5	4-6	5-7
Centipede	1-2	2-3	2-3
St. Augustine	2-4	2-5	4-6
Zoysia	3-5	3-6	4-6

* North Florida is north of Ocala. Central Florida is defined as south of Ocala to a line extending from Vero Beach to Tampa. South Florida includes the remaining southern portion of the state.

Timing and Season

The timing of fertilization is tied to the turfgrass species, maintenance level goal, season of the year, the location in the state where the turfgrass is being grown, and the fertilizer source being used. One of the most important principles of fertilization timing is avoiding fertilizer application to dormant or non-growing turfgrass. During dormancy, turfgrasses take up very small quantities of nutrients, and applied nutrients are more likely to leach or run off site in the next thunderstorm. Slow-release sources also influence the timing of fertilization, in that fertilization is required less frequently.

Rainfall that exceeds the ability of the soil to retain moisture in the root zone may lead to runoff into surface waters or leaching through the soil to ground water. **Do not apply fertilizer when the National Weather Service has issued a flood, tropical storm, or hurricane watch or warning, or if heavy rains[1] are likely**. While only about 3 to 5% of Florida rain events exceed two inches,[2] caution should always be used to avoid runoff or leaching from saturated or compacted soils or in other high-risk situations. Additional information on storms and weather may be found at http://severe.worldweather.org/rain/, http://www.wrh.noaa.gov/sew/MediaGuide/TermsOutlooks_Watches_Warnings.pdf, and http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/SW_TreatmentReportFinal_71907.pdf.

Location in the State

Based on seasonal differences, changes in soil types, and the predominant turfgrass species used on lawns, the state is divided into three regions: south, central, and north. The dividing line between north and central Florida is a straight east-west line from coast to coast through Ocala, and the dividing line between central Florida and south Florida is a line from coast to coast through Tampa and Vero Beach.

For tables providing fertilization guidelines for the various turfgrass species by maintenance level in a given region of the state, see IFAS Publication SL-21, *General Recommendations for Fertilization of Turfgrasses on Florida Soils*, at http://edis.ifas.ufl.edu/LH014.

Soil Types and Turfgrass Species

Most of the soils in Florida are classified as sands (96 percent), but within these soil types the chemical properties of the soils vary according to the region of the state in which they occur.

Soils in south Florida tend to contain higher levels of free calcium carbonate (lime or shell) and have a higher pH than the rest of the state. Generally speaking, St. Augustinegrass grows better on high pH soils than do bahiagrass or centipedegrass; thus, one finds more lawns with St. Augustinegrass in south Florida. In fact, approximately 85 percent of the residential and commercial lawns in Florida use one of the several cultivars of St. Augustinegrass. For the recommended soil pH for the various turfgrasses used in Florida, see IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*, at http://edis.ifas.ufl.edu/SS317.

Due to the potential for ammonia volatilization, **the surface application of ammonium-N and/or urea-containing fertilizers to these high pH soils without watering in (with 0.25 inch of irrigation) is not recommended. Central Florida soils** contain less calcium carbonate and tend to be more acidic, with a pH of between 5.5 and 7.5. Except for areas where limestone outcroppings occur, most of the turfgrass species can be grown. Since bahiagrass and centipedegrass do not grow well on high pH soils, their establishment on soils with a pH of greater than 7.0 should be avoided. Soils in north Florida tend to contain higher quantities of clay and to be more acidic than soils in the rest of the state. Therefore, bahiagrass and centipedegrass are used more commonly for lawns in this part of the state.

Zoysiagrass is not used extensively as a lawn grass in Florida, but when used it grows best under the same soil and fertilization conditions as St. Augustinegrass. Bermudagrasses require high maintenance and specialized equipment, but can be grown under a broad array of soil conditions. They are typically grown under intensively managed golf course conditions. Bermudagrass maintenance is not covered in this manual but is included in *Best Management Practices for Enhancement of Environmental Quality on Florida Golf Courses*, published by FDEP in 2007. Available: http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/glfbmp07.pdf. Seashore paspalum produces a high quality turfgrass with minimal fertility requirements and a high tolerance for salinity. This is a relatively new grass in Florida and may be very sensitive to cultural practices. For up-to-date information, contact your cooperative extension service or see *Seashore Paspalum for Florida Lawns* at: http://edis.ifas.ufl.edu/ EP059.

PHOSPHORUS FERTILIZATION

Because P has been implicated as a cause of increased algae growth in surface water impoundments, proper P fertilization management is imperative. Therefore, the goal in P management should be to apply the correct amount based on soil test recommendations. Since the first publication of this manual, the Urban Turf Fertilizer Rule, 5E-1.003(2) has been enacted. In addition to the

[1] World Meteorological Organization definition of heavy rain: Rainfall greater than or equal to 50 mm (2 inches) in a 24 hour period.
[2] Data from "Evaluation of Current Stormwater Design Criteria within the State of Florida" (Harper and Baker, 2007, FDEP Contract S0108).

nitrogen restrictions discussed earlier, there are changes to phosphorus application limits. The rule limits phosphate application to no more than 0.25 lb. P_2O_5 /1000ft^2 per application, not to exceed 0.5 lb. P_2O_5 /1000ft^2 per year, without a soil test. A one-time only application of up to 1.0 lb. P_2O_5 /1000ft^2 is permitted for establishment of new turf. This BMP manual strongly recommends soil testing before any initial P_2O_5 application and annually if applications are being made based on previous testing. Where subdivisions have been determined to have relatively similar soils, this may be reduced to testing 1/2 to 1/3 of the customers each year, rotating the testing so all are tested every 2 or 3 years. For more information, see IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*, at http://edis.ifas.ufl.edu/SS317.

Turfgrasses use significantly less P than N and/or K. Some Florida soils are high in native P, and turfgrasses grown on these soils require only limited P fertilization or none at all. Soil or tissue testing should always be used in these situations. Responses to P fertilization are most typically observed for rooting enhancement during establishment and where soils have a P deficiency.

The off-site transport of P is often associated with soil erosion from unvegetated and thin turfgrass areas. Research shows that runoff from a healthy turfgrass area is minimal, but thin and/or poor quality turfgrass has much a higher erosion and runoff potential. Because P can be a significant contributor to eutrophication, the proper management of P on turfgrass is just as important to the environment as N management.

Another source of P is in reclaimed water. Turf irrigated with reclaimed water may receive an excess of P, compared to the maximum amounts recommended in the Urban Turf Rule. Do not add phosphorus to a site irrigated with reclaimed water without a soil test recommendation to do so.

By using the following simple measures, you can properly manage the P fertilization of your turfgrasses:

- P fertilization should always be based on reliable soil or tissue test recommendations. Many Florida soils are high in extractable P and may never require P fertilization for optimum turfgrass growth. Never exceed the amounts allowed by the Florida Fertilizer Label without a soil or tissue test recommendation.

- Since unvegetated slopes or thin, low-quality turfgrass areas are more likely to produce runoff and off-site P contamination than healthy, well-maintained turfgrass areas, it is important to properly maintain your turfgrass.

POTASSIUM FERTILIZATION

Of the three primary nutrients (N, P, and K), K is second only to N in utilization by turfgrasses. Large responses in turfgrass growth are not typically observed in response to K fertilization, but K has been linked to reduced disease incidence, drought and cold tolerance, and enhanced root growth. The K fertilization rate is often tied to the N fertilization level, generally in a 3:1, 2:1, or 1:1 ratio. Recent research on Bermudagrasses suggests that optimum growth and tissue K levels can be attained at a 3:1 or 2:1 ratio.

Ideally, turfgrass K fertilization should be based on soil test recommendations. Because of high mobility in sandy soils, K fertilization should be made as soon after soil testing as possible. However, K is often applied without a prior soil test, based on the requirements of the turfgrass. Fortunately, K is not considered a pollutant, but prudence in K fertilization is essential for economic and resource conservation reasons. Excessive K fertilization can contribute to high soil electroconductivity (EC) levels that may limit root growth and turfgrass tolerance to drought.

SECONDARY NUTRIENT FERTILIZATION

Ca, Mg, and S are referred to as secondary plant nutrients, not because they are of secondary importance, but because they are typically used in smaller quantities than the primary nutrients. Of these three, the Extension Soil Testing Laboratory (ESTL) makes recommendations only for Mg. Mehlich-1 extractable Mg levels are typically low, and responses have been observed when the soil Mg status drops below 40 pounds per acre. For more information, see IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*,at http://edis.ifas.ufl.edu/SS317.

Due to the presence of apatite and/or residuals from previous P fertilizations, the Mehlich-1 extractant may dissolve higher levels of Ca than are plant available; therefore, no interpretation is made for the extracted soil Ca. Generally, plant-available Ca levels of Florida soils are high and no responses to applied Ca have been observed. You may increase Ca levels by applying irrigation water containing high levels of Ca.

Consistent and reliable correlation data do not exist for soil test S levels and turfgrass growth; thus, the ESTL does not analyze or make recommendations for S. Fortunately, S is often an accompanying anion in N, K, Mg, and micronutrient sources and is not often deficient for turfgrass growth.

MICRONUTRIENTS

The ESTL analyzes and makes recommendations for Cu, Mn, and Zn. Of these three micronutrients, turfgrass responses have only been observed for Mn. In most Florida soils, extractable Cu and Zn levels are adequate for optimum turfgrass growth, except for Cu on organic soils under sod production. No analysis or recommendation is made for Fe in Florida soils due to limited information on the correlation between soil and tissue levels, and turfgrass growth response. A greening in response to the application of Fe and/or Mn will most

likely be obtained on turfgrasses grown on soils having a pH of 7.0 or greater or irrigated with alkaline water. The application of 2 ounces of iron sulfate per 1,000 square feet as a foliar spray usually produces the desired response. This response is generally short-lived, however, and reapplication may be required. For additional information, see IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*,at http://edis.ifas.ufl.edu/SS317.

FERTILIZING GRASS FOR ESTABLISHMENT OR RECOVERY

Establishment and recovery are special situations. The goal is to get the environmental benefits of a solid cover of turfgrass as quickly as possible and this may require fertilization above what established turf requires. N and K are used to promote a thick, vigorous stand of turf. Use P only when a soil test indicates there is a need. The BMP for retaining nutrients on the lawn is a dense stand of turf.

The following measures can be used to fertilize grass for establishment or recovery:

- New sod should not be fertilized with nitrogen for the first 30 days, until it has firmly rooted into soil. Plugs can be fertilized at the time of installation to encourage the runners to spread. A quick, complete ground cover is the ultimate goal.
- Newly seeded areas should not receive nitrogen fertilization until a cover has been established and roots have pegged down, usually about 30 days.
- For new turf establishment only, soil test results may indicate a one time application of up to 1 lb. P_2O_5 /1000ft^2 is needed to encourage root growth. This should not be applied until 30 days after planting.
- Newly established turf often requires a different fertility schedule to grow and develop a dense stand. Both rates and timing may be different.
- Weakened turf may be stimulated back to health by N fertilization.
- N rates should be adjusted to meet the needs of the turf.
- Soluble fertilizer may be necessary to provide a rapid response on weakened turf.
- Lower total rates of soluble fertilizer can produce desired turf improvement when applied frequently.
- Fe and Mn can be used to supplement lower rates of soluble fertilizer. Micronutrients provide an initial color response, while soluble N thickens the turf and improves root development.
- Slow-release fertilizer may be an advantage when nutrients cannot be applied as frequently.

There is no significant difference between liquid or dry applications. Turfgrasses take up N in the form of nitrate and ammonium, and all dry fertilizers have to be dissolved by water before they benefit the turf. In terms of BMPs for environmental protection, the proper application of fertilizer is more important than the type of product.

UNTREATED BUFFERS NEAR BODIES OF WATER

Except when adjacent to a protective seawall, always leave a "**Ring of Responsibility**" around or along the shoreline of canals, lakes, or waterways, so that you do not get fertilizer into a body of water. When fertilizing, it is important to **ensure that fertilizers and other lawn chemicals do not come into direct contact with the water or with any structure bordering the water or a storm drain such as a sidewalk, brick border, driveway, or street. If any materials do get onto these impervious surfaces, sweep them into the vegetated landscape or otherwise clean them up.**



Figure 20. Leave a "Ring of Responsibility" to prevent pollution. Also note the swale and berm.

This untreated buffer protects the water quality of the waterway by ensuring no prills or droplets enter the water. When applying liquid fertilizers, the Ring of Responsibility should be at least 3 feet from the edge of the water.

The same is true for applying granular fertilizers with a broadcast fertilizer spreader that features a deflector shield. A deflector shield only allows fertilizer to be distributed on one side. This half-circle application (instead of the typical full-circle application of most fertilizer spreaders) allows for a more accurate fertilizer application.

If you are broadcasting fertilizer without a deflector shield, the Ring of Responsibility should extend at least 10 feet from the edge of the water, since the prills may be thrown up to 7 feet.



Figure 21. Spreaders with deflector shields.

The "Ring of Responsibility," is a preventative buffer, which protects against accidental direct contamination when fertilizing, and is the responsibility of the applicator. Some communities may require larger treatment buffers, which are intended to absorb pollutants from stormwater flowing across the land. Land development codes in these communities require developers and builders to leave native vegetation or other riparian buffers or filter strips to protect the water from the broader effects of upland development. These areas usually do not require fertilization, or need it only during an initial establishment period. The applicator should understand and respect the nature of these areas.

IMPERVIOUS SURFACES

Most urban landscapes are surrounded by impervious surfaces such as sidewalks, driveway and streets. An impervious surface that drains to a water body or the stormwater system is called a Directly Connected Impervious Area (DCIA). Fertilizer inadvertently applied on these surfaces has ready access to our water resources through storm drains. This is why it is so important to keep fertilizer off impervious surfaces and to remove any that is spilled on them and deposit it back into the landscape.



Figure 22. Fertilizer on sidewalks runs off into storm drains. Sweep it into the grass.

If using a broadcast spreader, deflector shields should always be used when applying fertilizer adjacent to these surfaces.

FERTIGATION

Fertigation is the application of liquid fertilizer thorough irrigation systems. While fertigation is not widely practiced in residential or commercial lawn and landscape care, some systems are available. For effective nutrient management to be achieved, a fertigation system should be designed, installed, and maintained by a qualified irrigation specialist. Proper and legal backflow prevention devices must be used so that fertilizer does not back-siphon into the water supply. Apply minimum quantities of fertilizer. Due to the hazards of direct deposition on streets, driveways, and sidewalks; and potential over-application by misadjusted irrigation systems; FDEP does not recommend use of fertigation for residential use unless the entire system is under an operation and maintenance contract with a reputable contractor who is fully responsible for any pollution due to improper operation of the fertigation equipment or the associated irrigation system.

FERTILIZING LANDSCAPE PLANTS

WHY FERTILIZE?

Clearly, plants grow in the wild without any help from humans. However, our modern urban landscape is not the same as the one where our native plants evolved. Subdivisions filled with subsoils, forests cut down, and drainage modifications all combine to make an urban landscape a very different environment. In addition, we have learned that some plants respond to fertilizers in ways that we may consider desirable, such as faster growth or improved appearance. The value of these outcomes is subjective. For example, faster growth may be desired in one circumstance but may lead to unwanted pruning in another. Improved appearance is important to some and unimportant to others.

Thus, the reason for fertilizing plants should be to supply nutrients to achieve a clearly defined objective, such as the following:

- Increasing shoot growth, root growth, flowering, or fruiting;
- Establishing newly planted trees and shrubs;

- Enhancing foliage color and plant appearance;
- Correcting or preventing nutrient deficiencies.

RECOMMENDATIONS AND BASIC PRINCIPLES FOR FERTILIZING LANDSCAPE PLANTS

The recommendations in this section do not pertain to products containing insecticides, herbicides, or other pesticides. By law, such products are considered pesticides. For-hire applicators must be licensed and the label instructions must be followed (see Chapter 6 on pest control for more information).

Important recommendations and principles for fertilizing landscape plants are as follows:

- Prior to fertilizing, a soil and/or foliar nutrient analysis should be used to determine whether any need exists for phosphorus fertilizer.
- Before fertilizing, pests may need to be controlled and/or soil modified to improve nutrient uptake or plant responses to fertilizer.
- Plants with pests or other problems that could increase to damaging levels with fertilization should be fertilized only in conjunction with a treatment program. Without a treatment program, fertilizer may increase the severity of the damage.
- Soil pH should be considered when selecting a fertilizer.
- The amount of fertilizer applied should be the minimal amount needed to achieve the defined objective.
- Read and follow **all** label instructions and safety precautions.
- The types and rate of fertilizer should be specified, aswell as the timing, method, and location of application. Slow-release fertilizers are often preferred. High levels of nitrogen fertilizer may reduce flowering in some plants.

WHEN TO FERTILIZE

Fertilization MAY be justified in the following situations:

- If trees and shrubs are newly planted (thus justifying fertilization until established);
- If homeowners or clients desire more or faster growth;
- If landscape beds have been leached of nutrients by flooding or overirrigation;
- If trees and shrubs are NOT near fertilized turfgrass;
- If established plants are lacking in foliage color or density for the homeowners' or clients' purposes;
- If plants exhibiting nutrient deficiencies are in situations where they cannot be replaced with better-adapted species.

Fertilization may NOT be required in the following situations:

- If homeowners or clients are pleased with the appearance of their landscape plants;
- If plants are established;
- If plants are flowering or fruiting, since exposure to high nitrogen at this stage may impede development;
- For tees, unless nutrient deficiencies exist.

If landscape plants exhibit nutrient deficiency symptoms, they may not be suited to the site due to soil pH, soil drainage, soil salts, limited soil volume, irrigation water quality, or mineral content of the soil. Consider replacing such plants with others adapted to the site's conditions.

HOW MUCH TO FERTILIZE

General Recommendations

When it has been determined that fertilization is necessary, most established landscape plants should be fertilized at rates within the ranges shown in **Table 6**.

Table 6: Landscape plant nitrogen fertilization rates.

Level of Maintenance	**Amount of Nitrogen Fertilizer**		
	pounds N/1000 ft^2/year	per 3' diameter plant/yr*	
		Oz.**	Tablespoons**
Basic	0 – 2	0 – 2	0 – 4
Moderate	2 – 4	2 – 4	4 – 9
High	4 – 6	4 – 6	9 – 13

* Typical, assumes 15% N 50% slow release, Approx 7 sq. ft. root zone.
** 1 lb. N rate is about 1.5 oz. or 3 Tablespoons per 10 ft^2 per application.

The P content of the fertilizer should be zero unless a soil or tissue test indicates a need for additional phosphorus. Historically, the ratio of N to K for landscape plants has been in the range of 1:1 to 2:1. Since magnesium (Mg) deficiency occurs in certain landscape plants in many parts of the state, up to 2.5 pounds Mg/1000 ft^2/year may be applied to address this problem. Micronutrients can be applied at specified rates and timing to achieve fertilization objectives.

In general, slow release fertilizers are horticulturally and environmentally preferable for landscape plantings. Water-soluble fertilizers should be applied at a rate of no more than 0.5 pounds N/1000 ft^2 per application. The maximum application rates for controlled-release fertilizers depend on the percent that is water soluble and the release rates of the product. Never broadcast fertilizers on newly bedded plants. Apply the appropriate amounts to the individual plant within the area under the plant canopy, which usually indicates the major root area.

For additional information on landscape plants grown in soil, see IFAS Publication SL-141, IFAS *Standardized Fertilization Recommendations for Environmental Horticulture Crops*, at http://edis.ifas.ufl.edu/CN011.

Palms

Palms have different nutritional requirements than most other landscape plants. In Florida's rock, muck, and sandy soils, palms may be especially prone to K, Mg, Mn, Fe, and B deficiencies. If you suspect deficiencies in a palm tree, take a leaf to your Cooperative Extension Service agent for assistance. In general, fertilizers or supplements should be applied to supply N, P, K, and Mg at about an 8:2:12:4 ratio. The N, K and Mg should be in a slow-release form. In addition, 1 to 2 percent Fe and Mn, and trace amounts of Zn, Cu, and B, may be needed.

For more information on palms and palm deficiencies, see *Fertilization of Field-grown and Landscape Palms in Florida*, http://edis.ifas.ufl.edu/EP261 or *Nutrient Deficiencies of Landscape and Field-grown Palms in Florida*, http://edis.ifas.ufl.edu/EP273.

WHERE AND HOW TO FERTILIZE

Fertilizer should be broadcast uniformly over the desired areas of the landscape. Root location, fertilization objectives, and plant species should be considered. Areas where tree or shrub fertilization zones overlap with lawn fertilization zones should receive one, not two, fertilizations. Start with the lowest recommended rate and slowly increase to amount up to the maximum recommendation only if the plant requires it. Foliar applications, injections, or implants should only be used when the soil application of fertilizer is impractical or ineffective in achieving fertilization objectives. When applying foliar fertilizer, the fertilizer solution should be thoroughly sprayed to cover the affected foliage at the proper stage of growth to achieve objectives.

Make sure your fertilizer spreader is properly calibrated and on the correct setting to deliver the desired amount of fertilizer for the area being treated. This is discussed in more detail in the section on calibrating pesticide spreaders in the next chapter and in the publication below. For more information, see the following:

IFAS Publication *How to Calibrate Your Fertilizer Spreader*, IFAS Publication ENH 62, 2003. Available at: http://edis.ifas.ufl.edu/LH024.

IFAS Publication *Fertilization Recommendations for Landscape Plants*, G.W. Knox, T. Broschat, and R.J. Black, IFAS Publication ENH 858, 2002. http://edis.ifas.ufl.edu/EP114.

FERTILIZER STORAGE AND LOADING

If not handled properly, fertilizers can alter or degrade the environment. Nutrients such as N and P in fertilizers can lead to the excessive growth of algae and noxious plants in estuaries, lakes, and streams.

Mishandling of fertilizers containing nitrates may result in excessively high levels of nitrate in drinking-water supplies (greater than 10 parts per million [ppm]of NO_3-N). This has been linked to health problems such as blue baby syndrome (methemoglobinemia) in infants. Because the state's aquifers and surface waters are extensively interconnected, Florida requires all potentially potable ground water to meet drinking-water standards. For nitrate, federal and state regulations set the drinking-water standard at 10 ppm NO_3-N. Shallow wells (less than 50 feet in depth) and old wells with faulty casings are at the highest risk for nitrate contamination.

STORAGE

Always store nitrate-based fertilizers separately from solvents, fuels, and pesticides, since nitrate fertilizers are oxidants and can accelerate a fire. Ideally, fertilizer should be stored in a concrete building with a metal or other flame-resistant roof.

Take care when storing fertilizer to prevent the contamination of nearby ground water and surface water. Always store fertilizer in an area that is protected from rainfall. Storing dry bulk materials on a concrete or asphalt pad may be acceptable if the pad is adequately protected from rainfall and from water flowing across the pad. The secondary containment of stationary liquid fertilizer tanks is addressed in Florida Department of Environmental Protection Rules 62-761 and 62-762, Florida Administrative Code (F.A.C.). Even where not required, the use of secondary containment is sound practice.

LOADING

Load fertilizer into application equipment away from wells or surface waterbodies. A concrete or asphalt pad with rainfall protection is ideal, as it permits the easy recovery of spilled material. If this is not feasible, loading at random locations in the field can prevent a buildup of nutrients in one location. Fertilizers contaminated with pesticides may damage plants or generate hazardous wastes.

Clean up spilled fertilizer materials immediately. Collected material may be applied as a fertilizer. At fixed sites, the area can be cleaned by sweeping or vacuuming (or with a shovel or loader, if a large spill), or by washing down the loading area to a containment basin specifically designed to permit the recovery and reuse of the wash water. Wash water generated should be collected and applied to the target crop. Discharging this wash water to waterbodies, wetlands, storm drains, or septic systems is illegal.

For more information, see *Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance*, published by the Florida Department of Agriculture and Consumer Services and the Florida Department of Environmental Protection, May 1998.

SOIL TESTING

Although it may not be an essential practice for the everyday maintenance of a healthy landscape, testing to determine the soil's chemical properties before installing turfgrass or landscape plants is a recommended practice. Through soil testing, the initial soil pH and P level can be determined. Soil pH is important in determining which turfgrass is most adapted to initial soil conditions (bahiagrass and centipedegrass are not well adapted to soil with a pH greater than 7.0). Since it is not easy to reduce the pH of soil on a long-term basis, you should use St. Augustinegrass or bermudagrass on high-pH soils.

After initial soil testing, additional testing may only be required when fertility problems arise and the responses to fertilization are poor.

Soil testing is an applied science and can be used as one of the tools in the maintenance of healthy turfgrass and landscapes. For the effective management of nutrients, soil testing should be used in conjunction with tissue testing. Soil test recommendations are based on a correlation between the level of a given nutrient extracted from the soil and the anticipated plant response. The amount of nutrients extracted by a particular extractant is only an index relative to crop response. It is not a direct measure of actual plant nutrient availability.

The levels of extracted P, K, and Mg are divided into five categories: very low, low, medium, high, and very high.



Figure 23. Taking a soil sample.

For more information, see your county Cooperative Extension Service agent or IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*, at http://edis.ifas.ufl.edu/SS317.

SOIL SAMPLING METHODOLOGY

The soil test and resulting recommendations are only as representative as the sample itself. Therefore, it is imperative that the soil sample be taken and handled properly. The sample should be obtained by taking 15 to 20 small plugs at random over the entire area where information is desired. Avoid any unusual areas or areas with a specific identifying appearance. Areas with identifying characteristics should be sampled separately. For turfgrass, since most of the roots are in the top 4 inches of soil, limit the sampling depth to 4 inches. For landscape plants, the sampling depth should be no more than 6 inches.



Figure 24. Soil Core.

Place the plugs that have been collected into a

plastic container, mix them thoroughly, and send approximately 1 pint of the mixed sample to the Extension Service Testing Laboratory (ESTL) for chemical analysis. Several commercial laboratories also offer the same service in Florida. You should use the same laboratory on a continued basis to establish a historical log of your soil properties. Laboratories across the state do not use the same extractant, so if you change labs often you may be comparing results obtained by different methods.

SOIL TEST INTERPRETATION

A soil analysis supplies a wealth of information on the nutritional status of a soil and can detect potential problems that limit plant growth. A routine soil analysis supplies information on soil pH and the extractable P, K, Ca, and Mg status of the soil. The ESTL currently uses Mehlich-1 as an extractant on all the acidic mineral soils in the state and AB-DTPA (Ammonium Bicarbonate-DTPA) extractant on soils with pH above 7.3 (calcareous soils).

The IFAS Everglades Extension Soils Laboratory currently uses acetic acid to extract nutrients from all organic soils. Therefore, the extractants are calibrated to different soil types. These extraction procedures must be ascertained when approaching any laboratory for a soil analysis. The routine analysis includes a lime requirement determination if the soil pH is below 6.0. N is not determined, because in most soils it is highly mobile and its soil status varies greatly with rainfall and irrigation events.

Table 7 presents interpretation ranges for soil test levels of P, K, Mg, Mn, Zn, and Cu. For detailed explanations of soil tests and interpretation, see IFAS Publication SL-181, *Soil Testing and Interpretation for Florida Turfgrasses*,at http://edis.ifas.ufl.edu/SS317.

Note that there is no interpretation made for soil test Ca or Fe. No interpretation is made for Mehlich-1 extractable Ca levels because the extractant dissolves Ca compounds, which may not be readily plant available. Thus, the amount of plant-available Ca can be erroneously interpreted. In most cases, Ca levels are adequate for turfgrass growth because Florida soils are inherently high in Ca, have a history of Ca fertilization, or receive Ca regularly through irrigation with high-Ca water. The soil test level for Mehlich-1 extractable Ca is used only to determine the type of limestone needed when lime is recommended. For most soils and turfgrasses, liming to ensure an adequate soil pH ensures more-than-adequate Ca. Research has shown no turfgrass response to added Ca, from either liming materials or gypsum, when the Mehlich-1 extractable Ca level is above 250 ppm.

The ESTL does not analyze for extractable Fe because definitive interpretation data are lacking. Significant correlation of soil test Fe levels with plant tissue levels is also lacking. The testing procedures tend to produce highly variable results. Most soils, except those having a pH greater than 7.0, generally contain adequate levels of Fe for optimum growth. Turfgrasses grown on soils with pH greater than 6.5 exhibit a greening response to Fe applied as a foliar spray. Unfortunately, reapplication may be required on a frequent basis to sustain the desired color.

For more information on fertilizing landscape plants, see IFAS publication SL-141, *Standardized Fertilization Recommendations for Environmental Horticulture Crops*, at http://edis.ifas.ufl.edu/CN011.

TISSUE TESTING

Because of the mobility of most essential nutrients for landscape plant and turfgrass growth in Florida soils, one of the best indicators of appropriate fertilization and plant health is tissue analysis. Since turfgrass is a perennial crop, historical logs of tissue composition can be used to fine-tune a turfgrass fertilization program for optimum plant growth and minimum environmental impact. Leaf analysis, along with appearance and soil analysis, can be used to diagnose the problems and the effectiveness of a fertilization program, especially for micronutrient deficiencies. Soil analysis for some nutrients, because it is a snapshot of what is present at the time of sampling, does not always indicate their availability to plants. Potential nutrient deficiencies can be detected with leaf analysis before visual symptoms

Table 7: Suggested ranges for Mehlich-1 extractable soil nutrient levels for Florida turfgrasses.

Macronutrients*			**Micronutrients****		
P	K	Mg	Mn	Zn	Cu
Parts per million (ppm)					
16–30	36–60	20–30	3–9	0.5–3	0.1–0.5

* Medium ranges of Mehlich-1 extractable P, K, and Mg when in 25 percent of the cases a response to applied fertilization would be expected.

** Soils testing below these levels of micronutrients are expected to respond to applied micronutrients. The interpretation of soil test micronutrient levels is based on soil pH. The smaller number is for soils with a pH of less than 6.0, and the larger number is for soils with a pH of 7.0 or greater. Mehlich-1 extractable micronutrient levels are only determined when requested and require an additional charge.

appear. Leaf analysis may provide information on induced deficiencies and inferences on plant uptake.

TISSUE SAMPLING METHODOLOGY

Clippings can be collected during regular mowing practices for tissue analysis. It is essential that the clippings are free of sand and fertilizer contamination. Do not harvest clippings immediately after fertilization, top-dressing, or any other cultural practice that results in significant mower pickup. Place approximately a handful of well-mixed clippings in a paper bag. Do not place the clippings in a plastic bag because the clippings may begin fermenting prior to drying.

If facilities exist at your location, dry the collected clippings at approximately 70°C (158°F) for 24 hours and then mail them to your favorite analytical laboratory for analysis. If you do not have dry facilities, ship them, preferably overnight, to the analytical laboratory. Even if placed in a paper bag, if the sample is allowed to sit for more than a couple of days the tissue will begin to ferment and the value of the sample for analytical purposes will be lost.

SAMPLE CONTAMINATION

Turfgrass clippings that have been recently sprayed with micronutrients for fungicidal or nutritional purposes should not be used for micronutrient analysis. Washing recently unsprayed clippings to remove soil and dust particles is recommended prior to sending the samples to the lab for analysis. If you wash one collection of clippings and not all, the nutritional analyses may not be comparable because the concentration of some nutrients in tissue, such as K, is highly mobile and a portion of the K may be removed during washing. Unwashed samples may appear to have a much higher concentration than the washed samples, and you may suspect a deficiency in the washed samples when in fact an adequate supply of K exists.

INTERPRETATION OF RESULTS

Sufficiency levels of essential nutrients in the various turfgrass species do not vary much among the various species, except for N. The sufficiency tissue N concentration can vary from a low of 1.5 percent for centipedegrass or bahiagrass to a high of 3.5 percent in cool-season, overseeded ryegrass. **Table 8** lists the sufficiency ranges for tissue N concentration for the various turfgrasses used in lawns. In most cases, tissue N concentrations below the minimum of the range would be deficient and above the range would be excessive.

The concentration of other macro and micronutrients in the tissue does not vary greatly among the various species of turfgrasses. The sufficiency ranges in **Table 9** are applicable to most of Florida's turfgrass species. All of these values are on a dry weight basis.

These values represent the range over which a particular nutrient might vary across the various species of turfgrasses. They represent sufficiency ranges, which suggests that levels below the range may indicate a deficiency or above the range may represent excessive fertilization or toxicity.

The sufficiency ranges in the tables show the most current interpretation for nutrient concentrations in turfgrass tissue. If analytical test results are in the deficiency range or below the sufficiency range, an increase in fertilization for that nutrient is recommended. Alternatively, if test results fall above the sufficiency range, the fertilization program should be adjusted downward. If a change in fertilization is indicated, the adjustment should be reasonable. The intent is to find the correct nutrient management level that maintains turfgrass tissue nutrient concentration within the optimum range, but does not lead to over-fertilization and possible adverse environmental and economic results.

SUMMARY

Fertilization is one of the key management practices in establishing and maintaining healthy, actively growing turfgrass. The desires of the individual lawn owner or turfgrass manager often dictate the level of fertility management. Due to environmental concerns, some

Table 8: Sufficiency ranges of tissue N concentration for selected lawn turfgrasses.

	St. Augustine	Zoysia	Bermuda	Centipede	Bahia	Rye
N (%)	2.0 - 3.0	2.0 - 3.0	2.5 - 3.5	1.5 - 2.5	1.5 - 2.5	3.5 - 5.5

Table 9: Sufficiency concentration ranges for selected macro and micronutrients in turfgrass tissue

P	K	Ca	Mg	Fe	Cu	Mn	Zn	B
Percent (%)				ppm				
0.15 - 0.50	1.00 - 3.00	0.5 - 1.0	0.20 - 0.50	50 - 250	5 - 30	25 - 100	20 - 250	5 - 20

think that less fertilization is always best, but research shows that fewer nutrients are lost from the surface or leached through a healthy, well-maintained turfgrass than an unhealthy, sparsely established turfgrass.

The importance of proper irrigation during fertilization cannot be overemphasized. Excessive irrigation after fertilization may cause leaching or runoff, and a lack of irrigation may result in volatilization and inefficient use of fertilizer.

Due to the prevalence of streets, driveways, and other impervious areas, it is very important to ensure no fertilizers are left where they can run off into stormwater systems or water bodies. Deflector shields should always be used near boundaries with water or impervious areas.

BMPS FOR TURFGRASS AND LANDSCAPE FERTILIZATION

- Do not fertilize if a heavy rainfall is expected, especially tropical or frontal weather systems.
- Avoid both leaching and surface runoff. Match the product to the situation. Remember that all fertilizers, even slow release products, contain nutrients and can cause pollution if allowed to escape the root zone.
- Correct other deficiencies first. Be aware of the effects soil pH, shade, overwatering, or other stresses may have on the plants. Be sure fertilizer is the correct response to the problem.
- Remember that rate and timing of N fertilization depends on the turfgrass species, season of the year, level of maintenance desired, source of N applied, and location in the state.
- Limit water-soluble (quick release) Nitrogen applications to 0.5 lb./1000 ft^2. This includes the water soluble part of slow-release blends. Limit total N to 1 lb./1000ft^2 per the Urban Turf Rule.
- P application should be limited to soils that require additional P based on soil or tissue testing.
- Limit N and P fertilization at establishment to one time 30 days after seeding/sodding. Do not add N or P before installation, but amend the soil as needed with lime or organic matter.
- Always leave a Ring of Responsibility near water bodies or impervious surfaces. Always use deflector shields on broadcast or rotary spreaders when applying fertilizer near water or sidewalks, driveways and streets.
- Sweep any fertilizer left on impervious areas back into the vegetated area.
- Become proficient in reading and understanding the fertilizer label.
- Know the exact square footage of the area where fertilizer is being applied and make sure the spreader/application equipment is properly calibrated and set to deliver the correct amount of fertilizer to that area.
- Become knowledgeable in soil sampling procedures and soil test interpretation.
- When fertilizing (other than when watering restrictions apply), irrigate with 1/4 inch of water following fertilization to avoid the loss of nitrogen and increase uptake efficiency. If water restrictions apply, you may irrigate as you are allowed, but more than 1/2 inch may cause some nitrogen to be leached past the root zone.
- Use Fe and/or Mn instead of N to enhance turfgrass color on soils having a pH greater than 7.0, especially during times of enhanced rainfall.
- Maintain a healthy, actively growing turfgrass to minimize the environmental impact of fertilizer and pesticide application, erosion, and stormwater runoff.
- There is no significant difference between liquid or dry applications of similar products. In terms of BMPs for environmental protection, *the proper application of fertilizer is more important than the type of product.*

Chapter 6: Pest Control

LEGAL ISSUES

DEFINITIONS

A pest is anything that competes with humans, domestic animals, or desirable plants for food or water; injures humans, animals, desirable plants, structures, or possessions; spreads disease to humans, domestic animals, wildlife, or desirable plants; or annoys humans or domestic animals.

Types of pests include the following:

- Arthropods such as insects and arachnids;
- Microbial organisms such as bacteria, fungi, viruses, and Mycoplasma;
- Weeds, which are plants growing in an area where they are not wanted;
- Nematodes;
- Mollusks such as snails and slugs; and
- Vertebrate pests.

Under Florida law (Chapter 482 Florida Statutes), integrated pest management (IPM) is defined as the following:

> *. . . the selection, integration, and implementation of multiple pest control techniques based on predictable economic, ecological, and sociological consequences, making maximum use of naturally occurring pest controls, such as weather, disease agents, and parasitoids, using various biological, physical, chemical, and habitat modification methods of control, and using artificial controls only as required to keep particular pests from surpassing intolerable population levels predetermined from an accurate assessment of the pest damage potential and the ecological, sociological, and economic cost of other control measures.*

LICENSING REQUIREMENTS FOR PESTICIDE USE IN LAWN AND LANDSCAPE MAINTENANCE

Not only should pesticides be used carefully, existing laws regarding pesticide applications and licensing requirements for conducting a business should also be complied with. There are three categories of licenses, (local occupational license, limited certification for commercial landscape maintenance license, or a pest control business license and a certified operators certificate) that could apply to persons who practice landscape maintenance as a business.

In most cases, if a person or company is providing services that only include mowing, edging, landscaping, and fertilizing, only a county or municipal occupational license is needed. (**This does not apply to "weed and feed" or "insect control" applications.**)

- If a person or company also applies any herbicide (even a granular product of a pesticide coated onto fertilizer), fungicide, or insecticide, to residential lawns or plant beds, a license for pesticide application is required from the Florida Department of Agriculture and Consumer Services (FDACS) Bureau of Entomology and Pest Control. Failure to obtain a license can result in fines up to $5,000. **This includes the application of "weed and feed" or "insect control" pesticide/fertilizer mixtures to lawns**.
- If the only pesticides applied by a person or business are herbicides and "caution"-labeled insecticides applied to plant beds or along the edges of pavement, then a limited certification for commercial landscape maintenance license is needed from the Bureau of Entomology and Pest Control. For this category, each applicator must have a license. **This does NOT allow the application of pesticides to turf or the use of insecticides labeled "Warning" or "Danger," or the application of "weed and feed" or "insect control" pesticide/fertilizer mixtures to lawns**.
- If any application of any pesticide is made to a lawn as part of a service provided by a person or business, then a pest control business license and a certified operators certificate are needed from the Bureau of Entomology and Pest Control. **This includes the application of "weed and feed" or "insect control" pesticide/fertilizer mixtures to lawns**.
- Government employees and private business employees who are applicators also need a pesticide license to make any applications to lawns or ornamental plants. **This includes the application of "weed and feed" or "insect control" pesticide/fertilizer mixtures to lawns.**
- Information on how to obtain these licenses can be obtained from FDACS Bureau of Entomology and Pest Control at (850) 921-4177 or at http://www.flaes.org/aes-ent/.
- Applications of restricted use pesticides made to parks, cemeteries, and golf courses require a license obtained through FDACS Bureau of Compliance Monitoring at (850) 488-3314 or at http://www.flaes.org/complimonitoring/index.html.

PESTICIDE RECORD KEEPING

Proper records of all pesticide applications should be kept according to state or federal requirements. These records

help to establish proof of proper use, facilitate the comparison of results of different applications, or find the cause of an error. Records that provide this information may include the following:

- The date and time of application;
- Name of applicator;
- Person directing or authorizing the application;
- Weather conditions at the time of application;
- Target pest;
- Pesticide used (trade name, active ingredient, amount of formulation, amount of water);
- Adjuvant/surfactant and amount applied, if used;
- The area treated (acres or square feet) and location;
- Total amount of pesticide used;
- Application equipment;
- Additional remarks, such as the severity of the infestation or life stage of the pest; and
- Follow-up to check the effectiveness of the application.

RESTRICTED USE PESTICIDES

Certain pesticides are classified as restricted use pesticides (RUPs). Very few pesticides in this category are routinely used in turf maintenance, but if you happen to use one of them, certain record-keeping requirements apply. The Florida pesticide law requires certified applicators to keep records of all restricted use pesticides. To meet your legal responsibility and to document your treatment methods, you need to maintain accurate pesticide records.

Florida regulations require that information on RUPs be recorded within 2 working days of the application and maintained for 2 years from the application date. Federal worker protection standards (WPSs) only apply to pesticide applications made by producers of agricultural products and do not affect Green Industry pesticide applicators.

NOTE: Florida law requires RUP record keeping. See FDACS Bureau of Entomology and Pest Control regulations for specifics on the regulation. In addition, record keeping is required to comply with the federal Superfund Amendments and Reauthorization Act (SARA, Title III), which contains emergency planning and community right-to-know legislation.

INTEGRATED PEST MANAGEMENT

The philosophy of IPM was developed in the 1950s because of concerns over increased pesticide use, environmental contamination, and the development of pesticide resistance. The objectives of IPM include reducing pest management expenses, conserving energy, and reducing the risk of exposure to people, animals, and the environment. Its main goal, however, is to reduce pesticide use by using a combination of tactics to control pests, including cultural, biological, genetic, and chemical controls.

The **cultural component** consists of the proper selection, establishment, and maintenance (such as mowing/pruning, fertilization, and irrigation) of turf and landscape plants. Keeping lawns and landscapes healthy reduces their susceptibility to diseases, nematodes, and insects, thereby reducing the need for chemical treatment. In the service industry, unfortunately, many of the cultural components of IPM are not under the control of the pesticide application professional. It is essential that customers be made aware of their responsibility for cultural factors, whether in doing their own work or in selecting qualified professionals for third-party activities such as irrigation and mowing.

The **biological component** involves the release and/or conservation of natural enemies (such as parasites, predators, and pathogens) and other beneficial organisms (such as pollinators). Natural enemies (including

Florida law requires that you record the following items to comply with the restricted use pesticide record-keeping requirement.

- Brand or product name.
- U.S. Environmental Protection Agency registration number.
- Total amount applied.
- Location of application site.
- Size of area treated.
- Crop/variety/target site.
- Month/day/year/time of application.
- Name and license number of applicator (if applicator is not licensed, record his or her name and supervisor's name and license number).
- Method of application.
- Name of person authorizing the application, if the licensed applicator does not own or lease the property.

ladybird beetles, green lacewings, and mantids) may be purchased and released near pest infestations. However, the landscape can also be modified to attract natural enemies, provide habitat for them, and protect them from pesticide applications. For example, flowering plants may provide parasitoids with nectar, or sucking insects (aphids, mealybugs, or soft scales) may provide a honeydew source when growing on less-valuable plants.

The **genetic component** relies on the breeding or genetic engineering of turfgrasses and landscape plants that are resistant to key pests. Such resistance could increase a plant's tolerance to damage and weaken or kill the pests. Pests may also develop more slowly on partially resistant plants, thereby increasing their susceptibility to natural enemies or "softer" pesticides. Selecting resistant cultivars or plant species when designing a landscape is a very important part of IPM. Although turfgrass and landscape managers often work with established plant material, they can still recommend changes. Every opportunity should be taken to educate builders, developers, landscape architects, sod producers, and others on which plants are best suited to their areas.

Chemical controls include a wide assortment of conventional, broad-spectrum pesticides and more selective, newer chemicals, such as microbial insecticides and insect growth regulators. IPM is not antipesticide, but it does promote the use of the least-toxic and most selective alternatives when chemicals are necessary. Pesticides are only one weapon against pests and should be used responsibly and in combination with other, less-toxic control tactics.

To determine which pesticides are most appropriate for use, and when and how to use them, consult the appropriate pesticide selection guides produced by IFAS. Whenever practical, limit treatment to infected areas. Spot spraying lessens pesticide use, saving the application service money and lowering risk to beneficial organisms, pets, homeowners, and the environment. Consult with county Cooperative Extension Service agents, chemical distributors, product manufacturers, or independent turf or landscape maintenance consultants.

IPM is commonly used in agricultural crop production, where the economic thresholds for key pests have been determined. Using IPM in the urban environment, however, has been more challenging. The Green Industry is sensitive to aesthetic damage, and customers are often intolerant of anything that could affect the appearance of ornamental plants. Increased education of growers, consumers, and maintenance personnel could raise the aesthetic threshold and allow for minor damage without compromising plant health and beauty.

Another important aspect of a successful IPM program is pest monitoring. This includes understanding the life cycle of a pest and knowing which plants and conditions it may prefer. Monitoring populations, understanding historical trends, and knowing where a pest is most likely to occur can target control practices to a specific pest in a specific location. Maintaining records and histories of pest populations can help a manager forecast pest occurrence and apply pesticides wisely.

The monitoring of pest populations presents special difficulties for the service industry, because the service professional may only be on-site one day per month or less. While spot applications are generally preferable, in certain situations preventative measures may be necessary. This is particularly true where experience has determined that less pesticide, or a less toxic pesticide, may be needed when a preventative control is used.

The basic steps for IPM programs are as follows:

- Identify key pests on key plants.
- Determine the pest's life cycle, and know which life stage to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Use cultural, mechanical, or physical methods to prevent problems from occurring (for example, prepare the site, select resistant cultivars), reduce pest habitat (for example, practice good sanitation, carry out pruning and dethatching), or promote biological control (for example, provide nectar or honeydew sources).
- Decide which pest management practice is appropriate and carry out corrective actions. Direct control where the pest lives or feeds. Use preventative chemical applications only when your professional judgment indicates that properly timed preventative applications are likely to control the target pest effectively while minimizing the economic and environmental costs.
- Determine if the "corrective actions" actually reduced or prevented pest populations, were economical, and minimized risks. Record and use this information when making similar decisions in the future.

For more information on IPM, see IFAS Publication ENY-336, *Integrated Pest Management in the Commercial Ornamental Nursery*, at http://edis.ifas.ufl.edu/IG144.

PESTICIDE USE

Pesticides are designed to kill or alter the behavior of pests. When, where, and how they can be used safely and effectively is a matter of considerable public interest. If they are not used wisely, pesticides may pose risks to pesticide applicators and other exposed people, and may create long-term environmental problems.

The best way to manage pesticide storage and disposal is to reduce the amount of pesticide left over after applications through proper planning and equipment calibration. Faulty or improperly managed storage facilities may result in direct runoff or leaching of pesticides into surface water and ground water. Users may be held liable for damage caused by improperly stored or disposed pesticides.

Pesticide spills can be especially problematic. Even pesticides designed for rapid breakdown in the environment can persist for years if present in high concentrations. The results can be the contamination of drinking water, fish kills and other impacts to nontargeted organisms, and administrative fines and legal remedies. It is important that pesticide users protect themselves from all of these hazards.

The most obvious method to reduce the risk from pesticides is to use them only when necessary. Determine which pesticides are the most useful and least environmentally harmful for a given situation. Apply them properly and effectively to minimize costs and the effects on public health and the environment while maximizing plant response. Give particular attention to the vulnerability of the site to ground water or surface water contamination from leaching or runoff.

A pest-control strategy should be used only when the pest is causing or is expected to cause more damage than what can be reasonably and economically tolerated. A control strategy should be implemented that reduces the pest numbers to an acceptable level while minimizing harm to nontargeted organisms. The strategy of IPM is as follows

- Prevention—keeping a pest from becoming a problem, and then, if needed,
- Suppression—reducing pest numbers or damage to an acceptable level.

Always follow the directions on the label. These directions have been developed after extensive research and field studies on the chemistry, biological effects, and environmental fate of the pesticide. The label is the single most important document in the use of a pesticide. **State and federal pesticide laws require following label directions!**

GENERAL PESTICIDE BMPS

The following general BMPs should always be used for pesticides:

- **Develop** – and implement a quality IPM program.
- **Labels** – Observe all directions, restrictions, and precautions on pesticide labels. It is dangerous, wasteful, and illegal to do otherwise.
- **Storage** – Store pesticides behind locked doors in original containers with label intact, separate from seed and fertilizer.
- **Rate** – Use pesticides at the correct application rate and recommended intervals between applications to avoid injury to plants and animals.
- **Handling** – Never eat, drink, or smoke when handling pesticides, and always wash with soap and water after use.
- **Rinsing** – Triple-rinse containers into the spray tank. Never pour pesticides down a drain or into an area exposed to humans, animals, or water.
- **Disposal** – Dispose of used containers in compliance with label directions so that water contamination and other hazards will not result.
- **Clothing** – Always wear protective clothing when applying pesticides. At a minimum, wear a long-sleeved shirt, long-legged pants, rubber gloves, boots (never go barefoot or wear sandals), eye protection, and a wide-brimmed hat. Additional protective gear may be listed on the pesticide label.

PESTICIDE SELECTION

Identifying or recognizing pests is essential to proper pesticide application and selection. Once the pest has been identified, the best control method must be chosen. If a pesticide is to be used, the applicator must know the proper application technique and read the label thoroughly. Pesticides should be evaluated on effectiveness against the pest, mode of action, life stage of the pest, personnel hazards, non-target effects, leaching or runoff potential, and cost.

PESTICIDE SELECTION BMPS

- Develop and implement a quality IPM program.
- Train employees in proper pest identification and pesticide selection techniques.
- Choose the product most appropriate for the problem or pest.
- Mix only the quantity of pesticide needed in order to avoid disposal problems, protect non-targeted organisms, and save money.
- Spot treat pests whenever appropriate.
- Read and follow all label directions. The label is a legal document.
- Make note of any ground water advisories on the label.

PESTICIDE STORAGE

If you store pesticides for your operation, this storage must be properly constructed and maintained to prevent problems or an expensive cleanup in the event of an accident. **The best way to minimize storage problems is to minimize the amount you store.** Purchasing only small amounts that you can use quickly is the best approach for many turf management professionals. If you have to store pesticides, follow these guidelines:

- Design and build pesticide storage structures to keep pesticides secure and isolated from the surrounding environment.
- Store pesticides in a roofed concrete or metal structure with a lockable door.
- Keep pesticides in a separate facility, or at least in a locked area separate from areas used to store other materials, especially fertilizers, feed, and seed.
- Do not store pesticides near flammable materials, hot work (welding, grinding), or in shop areas.
- Do not allow smoking in pesticide storage areas.



Figure 25. Pesticide storage areas should be locked.

Store personal protective equipment (PPE) where it is easily accessible in an emergency, but not in the pesticide storage area (since that may make it unavailable during an emergency). Check the label and the Material Safety Data Sheet (MSDS) to determine the required safety equipment for each chemical used in the operation. Keep a written pesticide inventory and the MSDS file for the chemicals on site. Do not store this information in the pesticide storage room itself. Remember that PPE is specified for normal application and handling activities. Regular PPE may not be protective in emergency situations, such as fires or reactions with other spilled chemicals.

Depending on the products stored and the quantity, you may need to register the facility with the Florida Department of Community Affairs and your local emergency response agency. Check with your pesticide dealer about community right-to-know laws for the materials that you purchase. An emergency response plan should be in place and familiar to personnel before an emergency occurs, such as a lightning strike, fire, or hurricane. Individuals conducting emergency pesticide cleanups should be properly trained under the requirements of the federal Occupational Safety and Health Administration (OSHA). For reporting chemical spills, see the section on spill reporting requirements later in this chapter.

Do not store large quantities of pesticides for long periods. Adopt the "first in–first out" principle, using the oldest products first to ensure that the product shelf life does not expire.

Store pesticides in their original containers. Do not put pesticides in containers that might cause children and others to mistake them for food or drink. Keep the containers securely closed and inspect them regularly for splits, tears, breaks, or leaks. All pesticide containers should be labeled. Arrange pesticide containers so that the labels are clearly visible, and make sure that the labels are legible. Refasten all loose labeling using non-water soluble glue or sturdy, transparent packaging tape. Do not refasten labels with rubber bands (which quickly rot and easily break) or nontransparent tapes such as duct tape or masking tape (which may obscure important product caution statements or label directions for product use). If a label is damaged, immediately request a replacement from the pesticide dealer or formulator. As a temporary supplement to disfigured or badly damaged labels, fasten a baggage tag to the container handle. On the tag write the product name, formulation, concentration of active ingredient(s), "signal word," the statement "Keep Out of Reach of Children," and the date of purchase. If there is any question about the contents of the container, set it aside for proper disposal.

Dry bags should be raised on pallets to ensure that they do not get wet. Do not store liquid materials above dry materials. Store flammable pesticides separately from nonflammable pesticides.

Segregate herbicides, insecticides, and fungicides to prevent cross-contamination and minimize the potential for misapplication. Cross-contaminated pesticides often cannot be applied in accordance with the labels of each of the products. This may make it necessary to dispose of the cross-contaminated materials as wastes and could require the services of a consultant and hazardous waste contractor.

Use shelving made of plastic or reinforced metal. Keep metal shelving painted (unless made of stainless steel) to avoid corrosion. If you use wood shelving, paint it with an enamel or waterproof paint to minimize any absorption of spilled pesticide materials. It is best to replace wood shelving with metal or plastic.

Construct floors of seamless metal or concrete sealed with a chemical-resistant paint. For concrete, use a water-cement ratio no higher than 0.45:1 by weight, and leave a rough finish to provide adhesion for the sealant. Equip the floor with a continuous curb to retain spilled materials. While a properly sealed sump may be included to help recover spilled materials, do not install a drain, as it can release spilled material into the environment. If you have a drain in a storage area, seal it as soon as possible to prevent uncontrolled releases. Provide sloped ramps at the entrance to allow handcarts to safely move material in and out of the storage area.

When designing the facility, keep in mind that temperature extremes during storage may reduce safety and affect pesticide efficacy. Provide automatic exhaust fans and an emergency wash area. The emergency wash area should be outside the storage building. Local fire and electrical codes may require explosion-proof lighting and fans. The light/fan switches should be outside the building, and both switches should be turned on before people enter and should remain on until after they have left the building.

The BMPs discussed in the next section often address the ideal situation of newly constructed, permanent facilities. However, you are encouraged to apply these principles and ideas to existing facilities.

Plans and specifications for pesticide storage buildings are available from several sources, including the the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), the Midwest Plan Service, and the IFAS Publications Office. These organizations' publications also contain recommended management practices for pesticide storage facilities.

Note that cancelled, suspended, or unusable pesticides must be disposed of properly. Storage for long periods can lead to leaking containers or other costly problems. The Florida Department of Environmental Protection and the Florida Department of Agriculture and Consumer Services (FDACS) operate a program for the free disposal of these materials (Operation Cleansweep, ph. 877-851-5285 toll-free, or 386-418-5525). For more information, go to www.dep.state.fl.us/waste/categories/cleansweep-pesticides. If this program is not available, a licensed waste disposal contractor should do the disposal.

A good storage facility should have the following features:

- A secure area where unauthorized persons are restricted from entering.
- Proper labeling on exterior doors, such as signs that say "NO SMOKING" and "WARNING: PESTICIDE STORAGE." No-smoking regulations need to be enforced.
- No opportunity for water to enter.
- Temperature control to avoid excessive cold or heat.

BMPS FOR PESTICIDE STORAGE AND DISPOSAL

The following BMPs should be used for storing and disposing of pesticides:

- Maintain and follow labels on all pesticide containers.
- Store pesticides only in their original containers or make sure the new containers are properly labeled.
- Store similar pesticides together; for example, store herbicides with herbicides, and insecticides with insecticides.
- Store dry pesticides above liquids.
- Keep containers closed tightly.
- Inspect inventory frequently and watch for damaged containers.
- Store separately any pesticides that may be flammable.
- Limit the amount of inventory, and purchase only the amounts needed.
- Triple-rinse, puncture, and crush empty containers. Clean all visible chemical from the container, including the container cap and cap threads. Follow the label directions for container disposal.
- Apply unused chemical mixtures or rinsate to a legal target at or below the label rate, or save it to use as make-up water for later applications of compatible materials.
- For cancelled, suspended, or unusable pesticides, contact the FDACS Bureau of Compliance Monitoring at (850) 488-3314 or go to http://www.flaes.org/complimonitoring/index.html for guidance.

- Nonporous floors.
- Not located close to a body of water, sinkhole, or wellhead.
- Adequate lighting and ventilation.
- The ability to contain runoff from spills.
- A source of clean water with prevention of backflow of chemicals into the water supply.
- Freedom from combustible materials or debris.
- Storage shelves and cabinets of nonporous material that will not absorb pesticides.
- Shelves or other means of keeping chemicals off wet floors.
- Materials and equipment to contain and clean up pesticide spills.
- Clean, readily available personal protective equipment and emergency telephone numbers or other means of securing assistance in an emergency.
- Appropriate fire extinguishers.

MIXING AND LOADING ACTIVITIES

In most cases, the mixing and loading of pesticides into application equipment should be done adjacent to the application site. If chemicals are routinely mixed and loaded at a shop or storage site, spilled material can accumulate and expensive cleanup procedures may be required.

Use extreme caution when handling concentrated chemicals. Spills could result in an expensive hazardous waste cleanup. It is important to understand how mixing and loading operations can pollute vulnerable ground water and surface water supplies if conducted improperly and at the wrong site. Locate operations well away from ground water wells and areas where runoff may carry spilled pesticides into surface waterbodies. Areas around public water supply wells should receive special consideration and may be designated as wellhead protection areas. Before mixing or loading pesticides in such areas, consult with state and local government officials to determine if special restrictions apply.

To prevent problems when mixing chemicals on-site, use a mixing tray or portable pad to avoid spillage that could be transported to non-targeted areas. Should a chemical spill onto the mixing tray, the material should then be rinsed into the applicator equipment and used according to the product label.

For your own safety, always use all personal protective equipment required by the label.

PESTICIDE EQUIPMENT CALIBRATION AND LOADING

Keep application equipment properly calibrated and in good repair. Correct measurement keeps you in compliance with the label; reduces the risks to applicators, workers, and the environment; and saves you money.



Figure 26. Calibrate spreaders frequently.

Calibrate using clean water and do not calibrate equipment near wells, sinkholes, or surface waterbodies. Measure pesticides and diluents accurately to avoid improper dosing, the preparation of excess or insufficient mixture, or the preparation of a tankload of mixture at the wrong strength.

The proper application of pesticides helps to reduce costs and increase profits. Improper application can result in wasted chemicals, marginal pest control, excessive carryover, or damage to turf or landscape ornamentals. As a result, inaccurate application is usually very expensive.

Be aware of the proper application methods, chemical effects on equipment, equipment calibration, and correct cleaning methods. **Sprayers should be calibrated when new or when nozzles are replaced** and recalibrated after a few hours of use, as new nozzles may wear and the rate of flow may increase rapidly. For example, wettable powders may erode nozzle tips, causing an increase in application rates after spraying as few as 50 acres. Recalibrate equipment periodically to compensate for wear in pumps, nozzles, and metering systems.

The amount of chemical solution applied per unit of surface area depends on the forward speed, system

pressure, size of nozzle, and spacing of nozzles on the boom. A change in any one of these will change the rate of application. Consult the operator's manual for detailed information on a particular sprayer. Backpack sprayers and hand sprayers also can and should be calibrated, and applicators should be "calibrated" to determine how much chemical is being applied during a broadcast application while walking across a lawn.

Calibration should be performed by measuring the amount of pesticide applied to a small area (for example, 1,000 square feet) and calculating how much would be applied to a large area. For equipment with more than one nozzle, be sure to check the flow rates of all nozzles on the sprayer so they are similar. Equipment suppliers and pesticide suppliers often supply calibration equipment or assistance at low or no cost. If you calculate the return on investment for time spent calibrating equipment, you will see that even a small improvement in calibration accuracy can save a significant amount of money spent on pesticide that was wasted because it was over applied.

BMPS FOR LOADING AND CALIBRATING PESTICIDE EQUIPMENT

- Mix the pesticide and load the spreader or sprayer carefully to avoid spills.
- Mix and load pesticides on an impervious mix/load pad with provisions for collecting and reusing spilled or waste material.
- Use excess pesticide mixtures on a site that is specified on the label.
- Consider closed systems for loading and mixing.
- Triple-rinse containers, pour the rinsate into the spray tank, and use the excess according to the product label.
- Calibrate your spreader or sprayers.

Florida law requires an air gap or back-siphoning device between the water supply and the application equipment to prevent backflow into the water supply. **Never submerge the end of a water supply hose in a tank.** This can lead to the costly contamination of a water supply.

PESTICIDE APPLICATION EQUIPMENT WASH WATER

Wash water from pesticide application equipment must be managed properly, since it could contain pesticide residues. Ensuring that no pesticide spills occur on the vehicle by mixing all pesticides over mixing trays eliminates potential pesticide hazards. Sweep any granular products that have spilled onto the vehicle or non-targeted areas into labeled bags for later use.

Wash the vehicle in a designated wash area. The water hose should have an on/off valve and a water-reducing nozzle. Use the least amount of water possible to wash the equipment adequately. Motorized spray equipment can be rinsed of pesticides residues over turf areas at the job site where the rinsate will be used according to the product label. These practices prevent unwanted pesticide residues from being washed onto non-targeted areas. **Avoid conducting such washing in the vicinity of wells or surface waterbodies.**

For most turf application equipment, the inside of the application tank should be rinsed. This is done by filling it with water and then applying the rinse water in the same manner and at the same site as the original pesticide. For larger equipment that is loaded at a central facility, the inside of the application equipment should be washed on the mix/load pad. This rinsate may be applied as a pesticide (preferred) or stored for use as make-up water for the next compatible application. Otherwise it must be treated as a (potentially hazardous) waste. After washing the equipment and before an incompatible product is handled, the sump should be cleaned of any liquid and sediment.

PESTICIDE SPILL MANAGEMENT

Clean up spills as soon as possible. Unmanaged spills may quickly move into surface waters and injure plants and animals. It is essential to be prepared for major or minor spills. The sooner you can contain, absorb, and dispose of a spill, the less chance there is that it will cause harm. Always use the appropriate personal protective equipment as indicated on the MSDS and the label for a chemical. In addition, follow the following four steps:

- **CONTROL actively spilling or leaking materials** by setting the container upright, plugging leak(s), or shutting the valve.
- **CONTAIN the spilled material** using barriers and absorbent material. For small spills, use kitty litter, vermiculite, shredded newspaper, absorbent pillows, clean sand, or pads. Use dikes to direct large spills away from ditches, storm drains, ponds, sinkholes, or woods. You can also use products such as "Soak Up" to absorb spilled materials. These types of products allow the absorbed material to be diluted into the spray mixture and applied as usable pesticide.
- **COLLECT spilled material**, absorbents, and leaking containers and place them in a secure, properly labeled container. Some contaminated materials could require disposal as hazardous waste.
- **STORE the containers of spilled material until they can be applied as a pesticide** or appropriately disposed of.

Small liquid spills may be cleaned up by using an absorbent such as cat litter, diluting it with soil, and then applying the absorbent to the target site as a pesticide in accordance with the label instructions.

SPILL REPORTING REQUIREMENTS

Comply with all applicable federal, state, and local regulations regarding spill response training for employees, spill reporting requirements, spill containment, and cleanup. **Keep spill cleanup equipment available when handling pesticides or their containers.**

If a spill occurs for a pesticide covered by certain state and federal laws, you may need to report any accidental-release if the spill quantity exceeds the "reportable quantity" of active ingredient specified in the law. See **Appendix A** for important telephone numbers for reporting pesticide spills. Very few of the pesticides routinely used in turf management are covered under these requirements. A complete list of pesticides and reportable quantities is available at http://www.floridadisaster.org/cps/SERC/htc1.htm.

Table 10 provides reportable quantities for some common pesticides, but it is your responsibility to determine if a pesticide you use has a reportable quantity. The list in the table should not be used as a substitute for a review of the official Section 304 list provided at the website above.

Table 10: Reportable quantities for certain pesticides

Chemical Name	Brand Name	CAS Number	EHS RQ	CERCLA RQ
Atrazine	AAtrex	1912249	N/A	N/A
Fenoxycarb	Logic	74490-01-8	N/A	N/A
Hydramethylnon	Maxforce	67485-29-4	N/A	N/A
Malathion	Cythion	121-75-5	N/A	100
Methiocarb	Mesurol	2032-65-7	10	10
Simazine	Princep	122-34-9	N/A	N/A
Trifluralin	Treflan	1582098	N/A	10

(For a complete list call (850) 413-9970, or go to http://www.floridadisaster.org/cps/SERC/htc1.htm). Reportable quantities are given in pounds of active ingredient.

Public Law 96-510 and Public Law 92-5000 (CERCLA) require immediate notification of the appropriate U.S. governmental agency when oil or hazardous substances are discharged. The law states, "Any such person who fails to notify immediately such agency of such discharge shall, upon conviction, be fined not more than $10,000 or imprisoned for not more than one year, or both."

Under Chapters 376 and 403, Florida Statutes:

- Any owner or operator of a facility who has knowledge of any release of a hazardous substance from a facility in a quantity equal to or exceeding the reportable quantity (see the MSDS sheet) in a 24-hour period shall immediately notify the State Warning Point.
- The owner or operator having a discharge of petroleum products exceeding 25 gallons on a pervious surface (or any amount in a waterbody) must report such discharge to the Florida Department of Environmental Protection or the State Warning Point.

The penalty is not in reporting a spill; it is in failing to report a spill.

REPORT THE FOLLOWING INFORMATION

- Name, address, and telephone number of person reporting.
- Name, address, and telephone number of person responsible for the discharge or release, if known.
- Date and time of the discharge or release.
- Type or name of the substance discharged or released.
- Estimated amount of the discharge or release.
- Location or address of the discharge or release.
- Source and cause of the discharge or release.
- Size and characteristics of the area affected by the discharge or release.
- Containment and cleanup actions taken to date.
- Other persons or agencies contacted.

MANAGEMENT OF PESTS IN THE LANDSCAPE

WEED MANAGEMENT

Florida law defines a weed as a plant growing where it is not wanted. Plants often earn their reputations as weeds if they grow without care or cultivation and despite efforts to get rid of them. Weeds compete with desired plants for space, water, light, and nutrients and can harbor insect pests and diseases. The predominant weed species change from season to season in Florida. Because weed populations can explode if not kept in check, the amount of pressure from these pest plants remains consistently high.

Weeds reproduce from seed, root pieces, and special vegetative reproductive organs such as tubers, corms, rhizomes, stolons, or bulbs. People, animals, birds, wind, and water can distribute seeds. Many of the weeds that show up in landscape beds come from seeds. Weeds also arrive in landscape beds when their reproductive tissues and organs are in the soil of transplants. Weed rhizomes or stolons can also creep into a landscape bed from an adjacent infested area. Plastic or metal edging that penetrates several inches into the ground around the perimeter of the bed reduces the likelihood of weed infestations from rhizomes or stolons.

Preventative weed control is important. Removing established weeds from landscape beds can be time consuming and/or expensive. Weed infestations will probably have to be removed by hand, as there are a limited number of herbicides available that can be safely applied over the top of and around most landscape plants. For Green Industry service personnel, the application of most herbicides must be done by licensed pest-control professionals. For more information, see the IFAS website: http://edis.ifas.ufl.edu/TOPIC_Ornamental_Pests.

INSECTS AND OTHER ORGANISMS

Fewer than 1 percent of all insects are harmful to plants and many are actually beneficial, acting as predators or parasites of harmful insects and assisting in the cross-pollination of certain plants. Remember that disease, nutritional deficiencies, cultural treatments, and environmental conditions can cause a plant to appear unhealthy or discolored, so it is important to diagnose a problem correctly before remedial measures are taken. Some plants in the urban landscape are oversprayed, resulting in unnecessary environmental contamination and often upsetting the natural predator/parasite–pest balance.

Think about all of the control options available under IPM. Before using a chemical control method for an active pest infestation, look around the landscape to see if predatory or parasitic insects are present to control your pest problem. If you must spray, use the least-toxic remedy possible and exercise great care to avoid contaminating yourself and other living creatures.

In general, IPM calls for pesticides to be applied as needed when plants have an active infestation and significant damage is likely. However, some pest problems may be best handled with preventative measures, such as the use of residual Imidacloprid to target chinch bug nymphs as they emerge from their eggs. Preventative application measures should not be routine but should be based on your professional knowledge of the control agent or method, the pest's life cycle, environmental conditions, and historical data. Use preventative chemical applications only when your professional judgment indicates that properly timed, preventative applications are likely to control the target pest effectively while minimizing economic and environmental costs.

In addition to Florida's abundance of native pests, landscape workers need to be aware of imported plant pests, their identification and control. In the last several years, these pests have caused substantial economic damage and an increase in the use of pesticides. The effects caused by citrus canker and greening are just two examples of diseases that have devastated a sector of Florida's economy. Insect examples in the landscape include the Asian cycad scale, pink hibiscus mealybug, Chilli Thrips, Lobate Lac Scale, Ficus whitefly, and many others.

Florida's tropical climate and international status predisposes us to imported plant pests. We have a history of the rapid spread of these imported pests to landscape plants. The normal problems of pest control are made worse by:

- No populations of beneficial predators,
- Poor or slow problem identifications,
- No basis for control product selection
- It requires the constant awareness that new pest problems are likely.

Employers and employees must be vigilant and seek additional training from IFAS, which is the key source of diagnostic and control information for these exotic pests.

For more information on IPM and insect pests, see the following:

- IFAS Publication ENY-337, *Commercial Applications of Insecticides and Miticides in the Green Industry*, at http://edis.ifas.ufl.edu/IG145.
- IFAS Publication ENY-338, *Insect Management on Landscape Plants*, at http://edis.ifas.ufl.edu/IG013.
- IFAS Publication ENH-300, *Insect Pest Management on Turfgrass*, at http://edis.ifas.ufl.edu/IG001.
- Featured Creatures at http://creatures.ifas.ufl.edu.

PLANT NEMATODES

Nematodes are small, unsegmented roundworms, generally transparent and colorless; most are slender, with bodies from 1/100 to 1/8 inch long. Only about 10 percent of nematodes are estimated to be plant parasites. Nematodes affect plants by damaging the roots, reducing their ability to function. For more information, see:

- *Nematode Management in Residential Lawns*, IFAS Publication ENY-006, http://edis.ifas.ufl.edu/NG039.
- *Nematode Management for Perennial Landscape Plants*, IFAS Publication ENY-051, http://edis.ifas.ufl.edu/IN469.
- The IFAS website: http://edis.ifas.ufl.edu/TOPIC_Ornamental_Pests.

PLANT DISEASES

Plant pathology is the study of plant diseases. Diseases are caused by microorganisms such as fungi, bacteria, and viruses. Some disease symptoms, such as leaf spots and wilting, are easily seen or measured. Others are difficult to observe (for example, root decay) or are very subtle (for example, shorter growth flushes). Detecting the less-obvious symptoms is more difficult when the diseased plant is the only specimen of its kind in the landscape and cannot be compared with a healthy one.

Normally, nonparasitic plant disorders are not included in the study of diseases, but it is still important to recognize them. These disorders include improper planting depth, nutrient imbalances, temperature extremes, toxic chemicals, mechanical injury, water imbalances, and air pollution. Most environmentally induced problems tend to be uniform, whereas disease may show up in spots throughout a field.

For more information on plant disease, see the following:

- IFAS Publication LH064, *Key for Identification of Landscape Turfgrass Diseases*, at http://edis.ifas.ufl.edu/LH064.
- IFAS Publication LH040, *Turfgrass Disease Management*, at http://edis.ifas.ufl.edu/LH040.

DIAGNOSTIC ASSISTANCE

The primary role of the Florida Extension Plant Diagnostic Clinics (FEPDC) is to determine whether symptoms in submitted plant samples involve an infectious causal agent, e.g. fungus, bacterium or virus, or other cultural or environmental factor that causes similar symptoms. The goal of the FEPDC system is to educate clientele by providing plant disease and disorder diagnoses and recommendations for preventative and therapeutic measures. The FEPDC is a fee-based service provided to any Florida resident by the Plant Pathology Department of the Institute of Food and Agricultural Sciences (IFAS), University of Florida, in conjunction with the Cooperative Extension Service. For more information, the nearest laboratory, and fees, see *Sample Submission Guide for Plant Diagnostic Clinics of the Florida Plant Diagnostic Network*. Available at: http://edis.ifas.ufl.edu/SR007.

The UF-IFAS Rapid Turfgrass Diagnostic Service was designed and implemented for managers of high quality turfgrass in Florida. The biggest distinction between this and the standard services provided by the Plant Disease Clinic is the turn-around time for sample results, the direct involvement of the UF Extension Turfgrass Pathologist, and the price charged for the service. The price is $75 (in 2008) and reflects the added costs associated with a full time student dedicated to turfgrass diagnostics with rapid turn-around time. http://turfpath.ifas.ufl.edu/turfgrass/rapiddiag.shtml.

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UF-IFAS Rapid Turfgrass Diagnostic Service. http://turfpath.ifas.ufl.edu/turfgrass/rapiddiag.shtml.

Aquatic Plant Removal Permits: Florida Fish and Wildlife Conservation Commission Invasive Plant Management Section. http://myfwc.com/nonnatives/InvasivePlants/index.htm.

FDEP NPS Publications Page. http://www.dep.state.fl.us/water/nonpoint/pubs.htm.

Regulation of Landscape Architecture: http://www.myfloridalicense.com/dbpr/pro/larch/.

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ENVIRONMENTAL STRESSES

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Growing Turfgrass in the Shade, L.E. Trenholm, IFAS Publication ENH-151. http://edis.ifas.ufl.edu/EP072.

Minimizing Traffic Damage to Your Florida Lawn, L.E. Trenholm, IFAS Publication ENH-152. http://edis.ifas.ufl.edu/EP071.

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Managing Your Florida Lawn under Drought Conditions, H.C. Jones, C.S. Lippi, and L.E. Trenholm, IFAS Publication ENH-157. http://edis.ifas.ufl.edu/EP078.

Tips for Maintaining Landscapes During Drought, R.J. Black, IFAS Publication ENH 158. http://edis.ifas.ufl.edu/EP091.

IRRIGATION REFERENCES

STANDARDS

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APPENDIX A: IMPORTANT TELEPHONE NUMBERS

REPORT THE FOLLOWING INFORMATION

- Name, address, and telephone number of person reporting.
- Name, address, and telephone number of person responsible for the discharge or release, if known.
- Date and time of the discharge or release.
- Type or name of the substance discharged or released.
- Estimated amount of the discharge or release.
- Location or address of the discharge or release.
- Source and cause of the discharge or release.
- Size and characteristics of the area affected by the discharge or release.
- Containment and cleanup actions taken to date.
- Other persons or agencies contacted.

EMERGENCY REPORTING TELEPHONE NUMBERS

For Ambulance, Fire, or Police
Dial 911

State Warning Point
24 hours Toll-Free • 1 (800) 320-0519

Department of Community Affairs, or Division of Emergency Management
(850) 413-9911

National Response Center
24 hours Toll-Free • 1 (800) 424-8802

(Federal law requires that anyone who releases into the environment a reportable quantity of a hazardous substance [including oil when water is or may be affected], or a material identified as a marine pollutant, must immediately notify the NRC).

FDEP Emergency Response

Jacksonville
(904) 807-3246

Orlando
(407) 893-3337

Ft. Lauderdale
(954) 958-5575

Ft. Myers
(239) 332-6975

Tampa
(813) 744-6462

Panama City
(850) 872-7650

Pensacola
(850) 595-8300

Tallahassee
(850) 245-2010

HELP LINE TELEPHONE NUMBERS

(For chemical hazard information)
CHEMTREC HOTLINE (Emergency only)
24 hours Toll-Free • 1 (800) 424-9300

NON-EMERGENCY TELEPHONE NUMBERS

State Emergency Response Commission

(NOT a 24-hour number) 1 (800) 635-7179

(This telephone number is for follow-up reporting under state spill reporting requirements. In an emergency, call the State Warning Point [see Emergency Reporting Telephone Numbers on the preceding page]. If federal reporting is required, also call the National Response Center [see Emergency Reporting Telephone Numbers on the preceding page.)

Florida Friendly Landscapes Program

University of Florida (352) 392-1831 x330

Florida Department of Agriculture and Consumer Services

Bureau of Entomology and Pest Control	(850) 921-4177
Bureau of Pesticides	(850) 487-0532
Bureau of Compliance Monitoring	(850) 488-8731

Florida Department of Environmental Protection

Stormwater/Nonpoint Source Management Section (Tallahassee)	(850) 245-7508
Hazardous Waste Management Section	(850) 245-8707
Mangrove Trimming Section	(850) 245-8482

Florida Department of Environmental Protection District Offices

Northwest (Pensacola)	(850) 595-8300
Northeast (Jacksonville)	(904) 807-3300
Central (Orlando)	(407) 894-7555
Southeast (West Palm Beach)	(561) 681-6600
Southwest (Tampa)	(813) 632-7600
South (Ft. Myers)	(239) 332-6975

Water Management Districts

	Local	Toll-free
Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. Johns River (Palatka)	(386) 329-4500	1-800-451-7106
Southwest Florida (Brooksville)	(352) 796-7211	1-800-423-1476
South Florida (West Palm Beach)	(561) 686-8800	1-800-432-2045

Sunshine State One Call (locator service)

811 or 800-432-4770 www.callsunshine.com

APPENDIX B: FLORIDA COOPERATIVE EXTENSION SERVICE TELEPHONE NUMBERS

County	City	Telephone
Alachua	Gainesville	(352) 955-2402
Baker	Macclenny	(904) 259-3520
Bay	Panama City	(850) 784-6105
Bradford	Starke	(904) 966-6224
Brevard	Cocoa	(321) 633-1702
Broward	Davie	(954) 370-3725
Calhoun	Blountstown	(850) 674-8323
Charlotte	Punta Gorda	(941) 764-4340
Citrus	Inverness	(352) 527-5700
Clay	Green Cove Springs	(904) 284-6355
Collier	Naples	(239) 353-4244
Columbia	Lake City	(386) 752-5384
Dade	Homestead	(305) 248-3311
Desoto	Arcadia	(863) 993-4846
Dixie	Cross City	(352) 498-1237
Duval	Jacksonville	(904) 387-8850
Escambia	Pensacola	(850) 475-5230
Flagler	Bunnell	(386) 437-7464
Franklin	Apalachicola	(850) 653-9447
Gadsden	Quincy	(850) 875-7255
Gilchrist	Trenton	(352) 463-3174
Glades	Moore Haven	(863) 946-0244
Gulf	Wewahitchka	(850) 639-3200
Hamilton	Jasper	(386) 792-1276
Hardee	Wauchula	(863) 773-2164
Hendry	LaBelle	(863) 674-4092
Hernando	Brooksville	(352) 754-4433
Highlands	Sebring	(863) 386-6540
Hillsborough	Seffner	(813) 744-5519
Holmes	Bonifay	(850) 547-1108
Indian River	Vero Beach	(772) 770-5030
Jackson	Marianna	(850) 482-9620
Jefferson	Monticello	(850) 342-0187
Lafayette	Mayo	(386) 294-1279
Lake	Tavares	(352) 343-4101
Lee	Ft. Myers	(239) 533-4327

Leon	Tallahassee	(850) 606-5200
Levy	Bronson	(352) 486-5131
Liberty	Bristol	(850) 643-2229
Madison	Madison	(850) 973-4138
Manatee	Palmetto	(941) 722-4524
Marion	Ocala	(352) 671-8400
Martin	Stuart	(772) 288-5654
Monroe	Key West	(305) 292-4501
Nassau	Callahan	(904) 879-1019
“	Yulee	(904) 548-1116
Okaloosa	Crestview	(850) 689-5850
“	(alt- phone)	(850) 729-1400 x5850
Okeechobee	Okeechobee	(863) 763-6469
Orange	Orlando	(407) 254-9200
Osceola	Kissimmee	(321) 697-3000
Palm Beach	West Palm Beach	(561) 233-1700
Pasco	Dade City	(352) 521-4288
“	New Port Richey	(727) 847-8177
Pinellas	Largo	(727) 582-2100
Polk	Bartow	(863) 519-8677
Putnam	East Palatka	(386) 329-0318
St. Johns	St. Augustine	(904) 209-0430
St. Lucie	Fort Pierce	(772) 462-1660
“	Port St. Lucie	(772) 337-5684
Santa Rosa	Milton	(850) 623-3868
Sarasota	Sarasota	(941) 861-5000
Seminole	Sanford	(407) 665-0311
Sumter	Bushnell	(352) 793-2728
Suwannee	Live Oak	(386) 362-2771
Taylor	Perry	(850) 838-3508
Union	Lake Butler	(386) 496-2321
Volusia	DeLand	(386) 822-5778
“	Daytona Beach	(386) 257-6012
“	New Smyrna Beach	(386) 423-3368
Wakulla	Crawfordville	(850) 926-3931
Walton	DeFuniak Springs	(850) 892-8172
Washington	Chipley	(850) 638-6180

APPENDIX C: RULE 5E-1.003(2) LABELING REQUIREMENTS FOR URBAN TURF FERTILIZERS

Effective Dec. 31, 2007

(2) FERTILIZER LABEL REQUIREMENTS FOR URBAN TURF, SPORTS TURF OR LAWNS.

(a) Definitions

1. "Urban Turf" or "Lawns" means non agricultural land planted in closely mowed, managed grasses except golf courses, parks and athletic fields.

2. "Sports Turf" means non agricultural land planted exclusively for golf courses, parks and athletic fields.

3. "No Phosphate Fertilizer" means fertilizer products with phosphate levels below 0.5% intended for established urban turf or lawns.

4. "Low Phosphate Fertilizer" means fertilizer products intended for new or established urban turf or lawns, with phosphate levels equal to or above 0.5% or as provided in paragraph (2)(b).

5. "Starter Fertilizer" means a fertilizer formulated for a one-time application at planting or near that time to encourage root growth and enhance the initial establishment.

6. "Established Urban Turf" means urban turf older than 12 months.

7. "New Urban Turf" means urban turf established less than 12 months.

(b) Fertilizer products labeled for use on sports turf, urban turf or lawns shall be no phosphate or low phosphate and have labeling that meets the restrictions set forth in this rule for the application of nitrogen.

1. No phosphate fertilizers shall not contain more than 0.5% of available phosphate expressed as P_2O_5. The "grade" shall indicate a zero guarantee.

2. Fertilizers labeled as Low phosphate shall have use directions that do not exceed an application rate of 0.25 lbs P_2O_5/1000ft^2 per application and not to exceed 0.50 lbs P_2O_5/1000ft^2 per year. Label use directions may be included that allow higher rates if an annual soil sample representative for the site shows the need for a higher application rate.

3. Fertilizers labeled as, or formulated for use as, starter fertilizer shall have use directions that do not exceed an application rate of 1.0 lb of P_2O_5/1,000 ft$_2$ and that subsequent applications shall be made with products meeting the definition of Low or No Phosphate fertilizers. The term "Starter Fertilizer" shall be part of the brand name.

4. Fertilizers labeled as urban turf, sports turf, or lawn fertilizer shall have directions for use for nitrogen that:

a. Are consistent with the recommendations in the following table:

Fertilization Guidelines for Established Turfgrass Lawns in Three Regions of Florida

	Nitrogen recommendations (lbs N / 1000 ft^2 / year)*		
Species	North	Central	South
Bahia grass	2-3	2-4	2-4
Bermuda grass	3-5	4-6	5-7
Centipede grass	1-2	2-3	2-3
St. Augustine grass	2-4	2-5	4-6
Zoysiagrass	3-5	3-6	4-6

North Florida is north of Ocala. Central Florida is defined as south of Ocala to a line extending from Vero Beach to Tampa. South Florida includes the remaining southern portion of the state.

b. Nitrogen shall not be applied at an application rate greater than 0.7 lbs of readily available nitrogen per 1000 ft^2 at any one time based on the soluble fraction of formulated fertilizer, with no more that 1 lb total N per 1000 ft^2 to be applied at any one time and not to exceed the annual nitrogen recommendations in the Fertilization Guidelines for Established Turfgrass Lawns in Three Regions of Florida, set forth herein. Use directions for nitrogen may be included that allow higher rates if an annual tissue sample representative of the site shows the need for a higher application rate.

5. The following language shall appear conspicuously on bags of fertilizer sold at retail: "Do not apply near water, storm drains or drainage ditches. Do not apply if heavy rain is expected. Apply this product only to your lawn/ garden, and sweep any product that lands on the

driveway, sidewalk, or street, back onto your lawn/garden."

(c) Specialty fertilizers labeled for urban turf or lawns shall have directions for use that include:

1. Application rates for phosphorous shall not exceed 0.25 lbs. P_2O_5/1000 ft^2 per application and not exceed 0.50 lbs. P_2O_5/1000 ft^2 per year. Label use directions may be included that allow higher rates if an annual soil sample representative for the site shows the need for a higher application rate.

2. Application rates for nitrogen shall not exceed 0.7 lbs of readily available nitrogen per 1000 ft^2 at any one time based on the soluble fraction of formulated fertilizer, with no more that 1 lb total N per 1000 ft^2 to be applied at any one time and not to exceed the annual nitrogen recommendations in the Fertilization Guidelines for Established Turfgrass Lawns in Three Regions of Florida. Use directions for nitrogen may be included that allow higher rates if an annual tissue sample representative of the site shows the need for a higher application rate.

3. Rates shall be expressed in units of weight or volume per unit of area coverage (where application rates are given in volume, the label shall provide sufficient information to calculate the application rates by weight).

4. Rates shall be expressed per 1000 square feet.

5. Maximum coverage area per container or bag shall be displayed prominently on the front of the container or bag. (i.e. This product covers 5000 square feet; This bag feeds 4000 square feet).

(d) Fertilizers labeled for sports turf at golf courses, parks and athletic fields shall:

1. Have directions for use not to exceed rates recommended in the document titled SL191 "Recommendations for N, P, K and Mg for Golf Course and Athletic Field Fertilization Based on Mehlich I Extractant", dated March 2007, which is hereby adopted and incorporated by reference into this rule. Copies may be obtained from the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611 or the following website: http://edis.ifas.ufl.edu/SS404.

2. Have directions for use in accordance with the recommendations in "BMP's for the Enhancement of Environmental Quality on Florida Golf Courses", published by the Florida Department of Environmental Protection, dated January 2007. Copies may be downloaded from http://www.dep.state.fl.us/water/nonpoint/pubs.htm.

(e) Fertilizers other than specialty fertilizers labeled for urban turf shall:

1. Have directions for use not to exceed rates recommended in the document titled Best Management Practices for Protection of Water Resources in Florida, June 2002, Florida Green Industries., which is hereby adopted and incorporated by reference into this rule. Copies may be obtained from http://www.dep.state.fl.us/water/nonpoint/docs/nonpoint/BMP_Book_final.pdf.

(f) Existing Stock – Licensees are permitted to sell or distribute products that do not meet the label requirements of the rule for one and one-half years after the effective date of the rule. Products at the retail level on or after the effective date of the rule are permitted to be offered for sale.

EMERGENCY REPORTING TELEPHONE NUMBERS

For Ambulance, Fire, or Police		**Dial 911**
State Warning Point	24 hours Toll-Free	1-800-320-0519
Department of Community Affairs, or Division of Emergency Management		(850) 413-9911
National Response Center	24 hours Toll-Free	1-800-424-8802

(Federal law requires that anyone who releases into the environment a reportable quantity of a hazardous substance [including oil when water is or may be affected], or a material identified as a marine pollutant, must immediately notify the NRC).

FDEP Emergency Response

Jacksonville	(904) 807-3246
Orlando	(407) 893-3337
Ft. Lauderdale	(954) 958-5575
Ft. Myers	(239) 332-6975
Tampa	(813) 744-6462
Panama City	(850) 872-7650
Pensacola	(850) 595-8300
Tallahassee	(850) 245-2010

HELP LINE TELEPHONE NUMBERS
(for chemical hazard information)

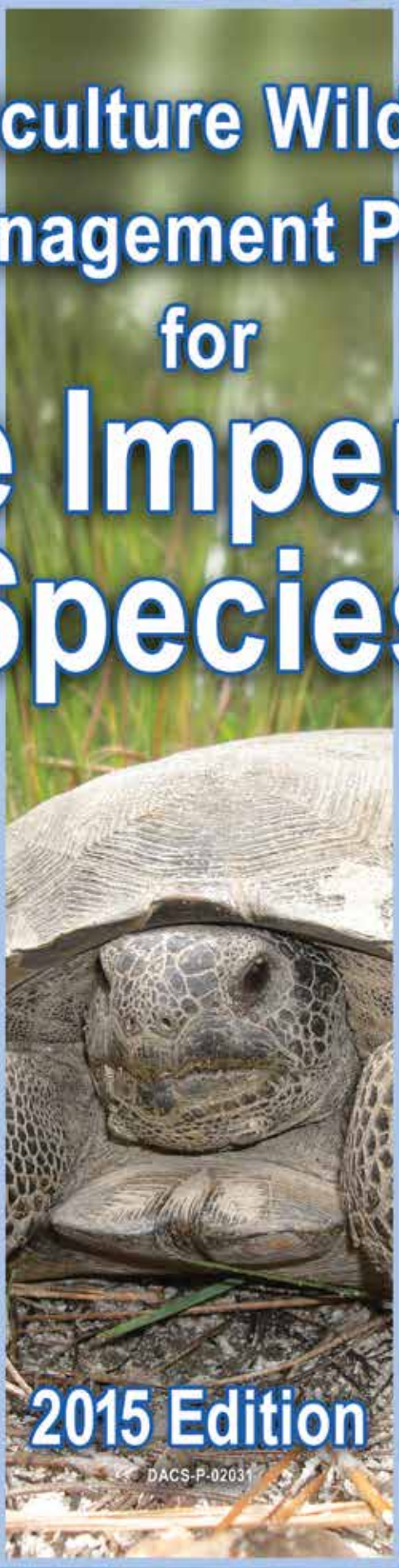
CHEMTREC HOTLINE (Emergency only)	24 hours Toll-Free	1-800-424-9300



UF UNIVERSITY of FLORIDA
IFAS Extension

Agriculture Wildlife Best Management Practices for State Imperiled Species







2015 Edition

DACS-P-02031

Florida Department of
Agriculture and Consumer Services

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ACKNOWLEDGEMENTS

In 2013, the Florida Legislature created Section 570.94, F.S., which authorizes the Florida Department of Agriculture and Consumer Services (FDACS) to work collaboratively with the Florida Fish and Wildlife Conservation Commission (FWC) to enter into a Memorandum of Agreement to develop and adopt by rule voluntary Best Management Practices for State Imperiled Species of wildlife as a voluntary alternative to incidental take permitting. In response to this, the Florida Forest Service, working with FWC, convened their long-standing Technical Advisory Committee to help craft a Forestry Wildlife BMP manual. This manual was approved by the committee and subsequently adopted in rule in 2014. Following this, a similar effort was undertaken by FDACS and FWC to develop Wildlife BMPs for the remaining commodity groups in order to promote sound, responsible practices that foster agricultural land use, promote natural resource conservation, and reduce the potential for incidental take of State Imperiled Species. Toward that end, the Forestry Wildlife BMP manual was used as a starting point, and was revised slightly to accommodate the nuances associated with the other types of farming. This product reflects that effort.

For their commitment and numerous contributions toward the development of this document, the following agencies, organizations and companies are most gratefully acknowledged:

University of Florida

Florida Fish and Wildlife Conservation Commission

U.S. Fish and Wildlife Service

Florida Wildlife Federation

Conservancy of Southwest Florida

Florida Audubon

The Nature Conservancy

Florida Department of Environmental Protection

Florida Nursery Growers and Landscape Association

1000 Friends of Florida

Sierra Club

Florida Farm Bureau Federation

Florida Cattlemen's Association

Florida Fruit and Vegetable Association

Florida Regional Councils Association

Florida Citrus Mutual

Florida Land Council

FOREWORD

Agricultural lands provide a valuable benefit to the conservation of fish and wildlife, including many of the State's Imperiled Species which are integral to the overall ecosystem. This Wildlife Best Management Practices (WBMP) Manual has been developed to enhance agriculture's contribution to the conservation and management of freshwater aquatic life and wildlife in the state, and to provide guidance to landowners and others who choose to implement these important practices. As such, these WBMPs reflect a balance between natural resource conservation and resource utilization, and serve to benefit a multitude of species above and beyond the 16 mentioned in this document.

However, this manual addresses only State Imperiled Species in Florida and not those federally listed by the U.S. Fish and Wildlife Service. Fish and wildlife species currently on the State Imperiled Species list were evaluated for the potential for incidental take to occur during agricultural activities. Based on current knowledge, 16 of the State Imperiled Species were determined to occur in areas where agricultural activities have the potential to influence habitat that supports essential behaviors or directly impact individuals. Therefore, the presumption of compliance for enrollees only applies to the aforementioned 16 species. Nonetheless, this list will be re-visited from time to time to evaluate whether there are any other species that have a specific nexus to agriculture.

These practices have particular application for agricultural lands that are in active production. However, they are not intended for use during tree removal or land clearing operations associated with development activities or changes in land use (e.g., conversion from silviculture to row crop). The practices minimize incidental take of specified State Imperiled Species from agricultural activities – and are not intended as a means of species recovery, expansion or habitat restoration. As such, they represent a practical approach for avoiding and minimizing incidental take of the 16 State Imperiled Species.

Throughout this document, reference will be made to the Florida Department of Agriculture and Consumer Services (FDACS) *Best Management Practices Manuals*. This reference is to acknowledge that many of the existing BMPs that were developed primarily for water quality provide significant wildlife conservation benefits, especially for aquatic species. Therefore, where these existing BMPs are suitable, they will be referenced instead of developing new practices for the WBMP Manual.

Finally, the Wildlife BMPs are voluntary practices that are applied at the discretion of the landowner or other person or entity responsible for conducting activities on the property. Landowners and others are not specifically required to enroll in the FDACS Water Quality BMP programs to participate in the Wildlife BMP program; however, water quality BMPs applicable to specified State Imperiled Species must be implemented as indicated on the Wildlife BMP Notice of Intent (NOI). In addition, applicants who enroll by completing a Wildlife BMP NOI and implement the applicable practices are not required to obtain a permit to authorize the incidental take of the 16 State Imperiled Species associated with their operations (see **Appendix 1**). For NOI participants, random monitoring will be conducted periodically to determine whether or not the WBMPs have been implemented. Such monitoring will be conducted jointly by personnel from both the FWC and the Office of Agricultural Water Policy (OAWP), and will consist of site evaluations on properties that have been voluntarily enrolled in the Wildlife BMP NOI program. Where implementation is not physically observable in the field, personnel will inspect records documenting implementation and maintenance, which may include but is not limited to, documents such as: personal logs, digital photos, contracts, invoices, receipts, maps, or any other documents kept or received in the normal course of business.

AQUATIC STATE IMPERILED SPECIES

A total of 10 aquatic State Imperiled Species are addressed in this manual and are generally associated with flowing streams. Five of the 10 are fish, specifically: the crystal darter, harlequin darter, bluenose shiner, blackmouth shiner, and the tessellated darter. The other five species are the Santa Fe crayfish, Black Creek crayfish, Barbour's map turtle, Florida bog frog and the Georgia blind salamander.

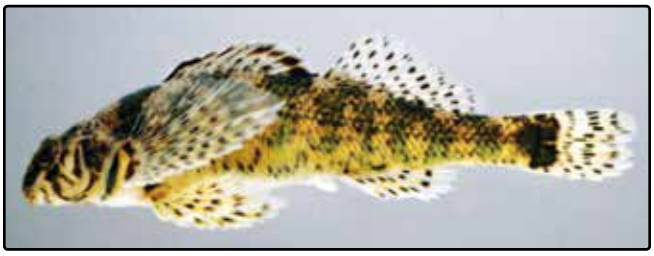
The species general habitat features are listed below (range maps are located in **Appendix 2**):

Crystal darter: this species occupies medium to large rivers in the panhandle that have sand and fine gravel bottoms, and specifically in the Escambia River and tributaries.



Crystal Darter Photograph courtesy of D.G. Bass

Harlequin darter: this species occupies rivers and large creeks in the panhandle that have an abundance of snags and large woody debris, and specifically the Escambia River and tributaries.



Harlequin Darter FWC Photograph

Bluenose shiner: this species occupies blackwater streams and rivers and spring runs that have backwater conditions, and ranges from Escambia to Jackson Counties. This species is also found in the upper tributaries of the St. Johns River.



Bluenose Shiner Photograph courtesy of Todd D. Crail

Blackmouth shiner: this species occupies blackwater streams that have backwater conditions associated with steep, vegetated banks, specifically in the Blackwater River and Yellow River drainages.



Blackmouth Shiner Photograph courtesy of D.G. Bass

Tessellated darter: this species occupies small to medium sized streams, specifically in the Oklawaha River drainage and tributaries.



Tessellated Darter Photograph courtesy of D.G. Bass

Santa Fe crayfish: this species occupies caves associated with rivers and streams in Suwannee and Columbia Counties.



Santa Fe Crayfish Photograph courtesy of Bonnie Stine

Black Creek crayfish: this species occupies tannic-stained rivers and streams with sand bottoms, specifically in Clay, Duval, Putnam and St. Johns Counties.



Black Creek Crayfish FWC Photograph, Eric Nelson and Daniel Gualtieri

Barbour's map turtle: this species occupies rivers, large streams and impoundments that include sand bars, berms and spoil mounds, and specifically in the Apalachicola, Chipola, Choctawhatchee and Ochlocknee River systems.



Barbour's Map Turtle Photograph courtesy of USGS.



Adult Female Barbour's Map Turtle Photograph © Dale R. Jackson

Georgia blind salamander: this species occupies caves associated with rivers and streams in Jackson County.



Juvenile Georgia Blind Salamander Photograph by Nathanael Herrera

Florida bog frog: this species occupies rivers and streams associated with acidic seeps, seepage streams and bogs proximate to sandy uplands, and specifically in Walton, Santa Rosa and Okaloosa Counties.



Florida Bog Frog Some rights reserved by MyFWCmedia

WBMPs for Aquatic State Imperiled Species

The aquatic State Imperiled Species listed above have important habitat needs within streams and stream corridors. These include temperature regulation (shade), large and small woody debris, substrate (sand, gravel vs. silt), channel stability and habitat connectivity. The Georgia blind salamander in particular may be vulnerable to agricultural chemicals and petroleum products. Therefore, the existing FDACS BMPs for water quality are adequate and must be implemented for these species. Water quality BMPs are incorporated by reference in Title 5M, F.A.C., and can be located online as designated in the rules or from the OAWP at the Mayo

Building, 407 South Calhoun Street, Tallahassee, Florida 32399.

While all the BMPs that prevent erosion, sedimentation, groundwater contamination, and protect stream geomorphology are important, the most practical and effective are those associated with maintaining adequate vegetated Conservation Buffers and Stream Crossings:

- Conservation Buffers are permanently vegetated, non-cultivated areas that function to retain water and soil onsite to help reduce pollutants in surface water runoff. Riparian buffers are areas of trees, shrubs and/or grasses located adjacent to natural streams, which help reduce excessive amounts of sediment, organic material, nutrients, and pesticides in surface water sheetflow. In addition to water quality benefits, riparian buffers contribute to temperature moderation, in-stream woody debris, snags, and other important wildlife habitat features.
- Stream Crossing BMPs are designed to minimize the potential for impounding or impeding flow, generally providing for habitat connectivity, and to maintain normal stream flow rates and flow conditions. Key practices for stream crossings are proper sizing and placement of culverts, using the proper material, keeping a low profile on hard-surface crossings and periodic maintenance of all crossing types to ensure functionality.

Buffer and stream crossing BMPs can be found in FDACS BMP manuals incorporated by reference in Title 5M, F.A.C., and can be located online as designated in the rules or from the OAWP at the Mayo Building, 407 South Calhoun Street, Tallahassee, Florida 32399.

STATE IMPERILED SPECIES – BURROWING ANIMALS

Two State Imperiled Species addressed in this manual are burrowing animals which are generally associated with open areas in both forestland and grasslands. Specifically, they are the gopher tortoise and the burrowing owl. Generally, burrows for these animals in their preferred open habitat are visibly apparent and sites/habitat types are relatively easy to identify. Hence, for both species of burrowing animals, burrows do not have to be located prior to conducting normal and necessary agricultural operations, nor does the property in question need to be surveyed for the presence of the animals or their burrows.

The species general habitat features are listed below (range maps are located in **Appendix 2** except for the gopher tortoise which occurs statewide).

Gopher tortoise: this species occupies uplands with well-drained soils with a significant depth to the water table, and may be found in forested or open areas throughout most of the state. The general habitat feature is an underground burrow that has a large open area at the mouth known as the "apron." The apron of the burrow is especially important because the females usually lay and bury their eggs in a shallow nest there, typically during mid-May through mid-June. Incubation lasts 80 to 100 days; therefore, disturbance of the apron should be avoided from early May through September when eggs or hatchlings may be present.



Gopher Tortoise FWC Photograph.



Gopher Tortoise Burrow with Apron Photograph from Wikimedia Commons http://commons.wikimedia.org

Burrowing owl: this species occurs primarily in peninsular Florida, although isolated pairs and small colonies have been found as far west as Eglin Air Force Base. The owl is a small bird, averaging 9 inches in height, with long legs and bright yellow eyes, but lacking the ear tufts of more familiar woodland owls. The owls spend most of their time on the ground, and during the day are usually seen standing erect at the mouth of their underground burrow or on a nearby post. When disturbed, the owl bobs in agitation and utters a chattering or clucking call. In flight, burrowing owls typically undulate as if they are flying an invisible obstacle course, but while hunting can hover in midair. The general habitat feature is an underground burrow, typically found in open habitats such as native dry prairie or modified landscapes such as pasture, agricultural fields, golf courses or other open grassy lands. Females usually lay their eggs in February but the nesting season can extend through July.





Burrowing Owl Some rights reserved by MyFWCmedia

WBMPs for State Imperiled Species – Burrowing Animals

- Locate heavy use or high-intensity areas such as supplemental feeding or water troughs away from known and visibly apparent active burrows.
- Locate concentrated heavy equipment operations (e.g. mix and load areas, agrichemical applicator(s) staging areas, etc.) away from known and visibly apparent active burrows, and especially known concentrations of active burrows. If concentrated heavy equipment operations must be located in such areas: a) identify and mark burrows, and b) avoid damage to the burrow opening and apron especially during the nesting season (May through September for gopher tortoises and February through July for burrowing owls).
- Avoid direct contact year-round with all gopher tortoises and burrowing owls, as well as known and visibly apparent active burrows, and burrow aprons for gopher tortoises when operating heavy equipment. This is especially important during the period between May through September for gopher tortoises; and between February through July for burrowing owls.
- When practical, minimize the use of heavy equipment during September and October in areas of known or visibly apparent gopher tortoises or burrows since hatchlings are more numerous and less visible due to their size during this time.

For both species of burrowing animals, burrows are not required to be located prior to agricultural operations, nor does the property in question need to be surveyed for the presence of the animals or their burrows.

Note: Land management practices that foster herbaceous ground cover on sites with well drained soils, and known and visibly apparent burrowing owl and/or gopher tortoise occupation will enhance habitat for these species and as such represent important conservation measures. The conservation measures listed below foster appropriate vegetation and herbaceous ground cover in such areas. These conservation measures, while encouraged, are not mandatory WBMPs:

- *Maintain important habitat features by carrying out some level of active management on associated uplands. For example, prescribed grazing to maintain appropriate vegetative structure, or other pasture management activities such as roller chopping, mowing or discing.*
- *Thin pine or hardwood stands as appropriate to meet objectives, such as opening up the canopy to provide more sunlight to ground cover.*
- *Prescribe burn where it is appropriate, economically feasible and compatible with overall management objectives, and safety/smoke management considerations.*
- *Where prescribed burning is problematic, use herbicides that target woody or shrub vegetation as an alternative to prescribed burning as appropriate.*
- *When using herbicides to control herbaceous ground cover (herbaceous weed control), a banded application is preferable over broadcast applications.*
- *Leave herbaceous borders along roads, power lines and similar areas where practical and economically feasible.*

STATE IMPERILED SPECIES – NESTING BIRDS

Four State Imperiled Species addressed in this manual are nesting birds and are associated with both wetlands and uplands. Specifically they are the little blue heron, the tricolored heron, the Florida sandhill crane and the southeastern American kestrel. Most instances of incidental take are the result of disturbances to wading bird rookeries (breeding colonies), and southeastern American kestrel or Florida sandhill crane nests during certain periods of the year. Such disturbances include damaging or removing nest trees, excessive noise from machinery in close proximity, and frequent human presence. Nests or rookeries do not have to be located prior to conducting normal and necessary agricultural operations, nor does the property in question need to be surveyed for the presence of nests or rookeries, or the animals themselves.

The species general habitat features are listed below (range maps are located in **Appendix 2**).



Little Blue Heron Some rights reserved by MyFWCmedia

Little blue heron and tricolored heron: The general habitat feature for these species is the presence of rookeries (breeding colonies) in forested wetlands. The little blue heron and tricolored heron typically nest in rookeries of various sizes that may include other wading birds like snowy egret, reddish egret and roseate spoonbill. Nests may occur in a variety of woody vegetation including cypress, willow, red maple, buttonwood and mangroves.



Tricolored Heron Some rights reserved by MyFWCmedia

Florida sandhill crane: this species is a heavy bodied bird with a long neck and legs that is frequently found in open grass lands, pastures and marshes throughout most of the state. Sandhill cranes rely on shallow marshes for roosting and nesting, and open upland habitats for foraging. The general habitat feature for nesting is herbaceous wetlands.





Florida Sandhill Crane Photographs: by Peter Canavan; Some rights reserved by MyFWCmedia

Southeastern American kestrel (aka sparrow hawks): this species occupies open pines, woodland edges, prairies, and pastures throughout most of the state. The general habitat feature for nesting is standing snags. The majority of nest trees in north central Florida are in association with pastures, cultivated farmland, or within areas of longleaf pine-turkey oak woodlands.



Southeastern American Kestrel: some rights reserved by MyFWCmedia.

WBMPs for State Imperiled Species – Nesting Birds

- Avoid heavy equipment operation (except for prescribed burning and related activities) within 330 feet of active, known and visibly apparent little blue and tricolored heron rookeries (two or more nests), from February through May.
- Avoid heavy equipment operation (except for prescribed burning and related activities) within 400 feet of active, known and visibly apparent Florida sandhill crane nests from February through May.
- For southeast American kestrels, leave standing snags where they do not pose a safety issue, as per the Silviculture Best Management Practices Manual adopted in Rule 5I-6.002, F.A.C., and avoid damaging or felling known nest trees.
- Avoid prolonged heavy equipment operation (generally in excess of one day), except for prescribed burning and related activities, within 490 feet of active, known and visibly apparent kestrel nests from March through June.

Nests or rookeries do not have to be located prior to agricultural operations, nor does the property in question need to be surveyed for the presence of nests or rookeries or the animals themselves.

Note: FDACS water quality BMPs represent important conservation measures for wading bird and sandhill crane food sources and foraging habitat. While participation in the water quality BMP program is not required for participation in the WBMP program, several practices contained in the water quality BMP manuals are important conservation measures for wading birds and sandhill cranes. Implementation of those conservation measures are encouraged, but not required, where these species are known to forage.

If you have questions about WBMPs for these birds, consult with a FWC landowner assistance biologist prior to short duration disturbances such as mowing, chopping, tree planting and related activities within this buffer zone.

Exceptions:

1. Documented cases where ongoing agricultural activities were in place prior to the birds nesting, or where nesting birds have acclimated to disturbances and are obviously unaffected by them (indicate intent to use this exception by checking box on the NOI form). Documentation is not required to be provided with NOI submission; however, exceptions should be easily demonstrated via documentation during future implementation surveys.
2. Where consultation with a FWC landowner assistance biologist provides the landowner with a functional alternative to the WBMPs (e.g., hand planting, nest boxes, etc.).

FDACS – Office of Agricultural Water Policy
Attn: Wildlife BMP Program
Mayo Building
407 South Calhoun Street
Tallahassee, FL 32399-1600

or

Florida Fish and Wildlife Conservation Commission
Attn: Wildlife BMP Program
620 South Meridian Street
Tallahassee, FL 32399-1600

ADAM H. PUTNAM
COMMISSIONER

NOTICE OF INTENT TO IMPLEMENT
WILDLIFE BEST MANAGEMENT PRACTICES FOR AGRICULTURE

Rule 5M-18.003, F.A.C.

- **Complete all sections of the Notice of Intent** (NOI). Each NOI may list only properties that are within the same county and are owned or leased by the same person or entity, and the acreage on which applicable WBMPs will be identified and implemented under this manual.
- Submit the **NOI**, along with the **WBMP Checklist**, to the Florida Department of Agriculture and Consumer Services (FDACS), and the Florida Fish and Wildlife Conservation Commission (FWC) at the addresses below.
- **Keep a copy of the NOI and the BMP checklist in your files** as part of your WBMP record keeping.

Applicant: _____

County: _____ Acres: _____ ☐ Parcel list is attached

Parcel ID No.: _____

Property Owner (if different from Applicant): _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ Alt. Phone: _____

Email: _____

In accordance with Sections 570.07(23), 570.94, F.S. and Rule 68A-27.007 (2) (d) F.A.C., I hereby submit this Notice of Intent and WBMP checklist as verification of my intent to implement Wildlife Best Management Practices. Participation in this program and implementation of WBMPs as denoted on the NOI Checklist provides a presumption of compliance with regard to incidental take of State Imperiled Species. In addition, I agree to allow FDACS and FWC personnel to periodically verify WBMP implementation through records inspection and/or on-site evaluations of the property described above. I can opt out of this program at any time after notifying in writing FDACS and FWC.

Print Name: _____

(check one) ☐ **Property Owner** ☐ **Authorized Agent**

Signature: _____ Date: _____

Submit completed NOI and WBMP Checklist to:

FDACS – Office of Agricultural Water Policy
Attn: Wildlife BMP Program
407 South Calhoun Street
Tallahassee, FL 32399-1600
850-617-1727

and

FL Fish and Wildlife Conservation Commission
Attn: Wildlife BMP Program
620 South Meridian Street
Tallahassee, FL 32399-1600
850-488-3831

Implementation[1] Checklist

AGRICULTURE WILDLIFE BEST MANAGEMENT PRACTICES FOR STATE IMPERILED SPECIES

Check All Applicable Boxes Below.

Aquatic State Imperiled Species			
Species Name	My property is located within the aquatic species' known range (see imperiled species range maps[1]).	I am currently implementing all applicable WBMPs (water quality BMPs[2]).	Species is not applicable to the property.
Crystal Darter	☐	☐	☐
Harlequin Darter	☐	☐	☐
Bluenose Shiner	☐	☐	☐
Blackmouth Shiner	☐	☐	☐
Tessellated Darter	☐	☐	☐
Santa Fe Crayfish	☐	☐	☐
Black Creek Crayfish	☐	☐	☐
Barbour's Map Turtle	☐	☐	☐
Georgia Blind Salamander	☐	☐	☐
Florida Bog Frog	☐	☐	☐

State Imperiled Species - Burrowing Animals and Nesting Birds				
Species Name	Species is known to be present on the property.	I am currently implementing all applicable WBMPs for this species[1].	I do not know if this species is currently present on my property but I would implement WBMPs if the species was located in the future.	Species is not applicable to the property
Gopher Tortoise	☐	☐	☐	☐
Burrowing Owl	☐	☐	☐	☐
Little Blue Heron	☐	☐	☐	☐
Tricolored Heron	☐	☐	☐	☐
Florida Sandhill Crane	☐	☐	☐	☐
Southeastern American Kestrel	☐	☐	☐	☐

I am implementing the following WBMP exception(s) for State Imperiled Species of nesting birds:

☐ Documented cases where birds have acclimated to disturbances.

☐ Where consultation with a FWC biologist provided a functional alternative.

1 Consult the Florida Agriculture Best Management Practices for State Imperiled Species, incorporated in Rule 5M-18.001, F.A.C., and appendices for descriptions, range maps, and WBMP practices applicable to the State Imperiled Species listed above. WBMPs pertain only to those ongoing activities that are associated with bona fide agricultural land uses. WBMPs do not apply to tree removal activities preceding a change in agricultural land use. For example, harvesting activities that would convert agricultural lands to mining or development, or silviculture to row crop would not be eligible for the program.

2 Refer to the applicable Florida Department of Agriculture and Consumer Services water quality BMP manual(s), incorporated by reference in Title 5M, F.A.C., and can be located online as designated in the rules or from the OAWP at the Mayo Building, 407 South Calhoun Street, Tallahassee, Florida 32399.

APPENDIX 2: STATE IMPERILED SPECIES RANGE MAPS

(Location indicators represent broad general areas and are not necessarily specific observations)

Southern Tessellated Darter

Etheostoma olmstedi maculaticeps

- Southern Tessellated Darter Collection Locations
- Waterbody
- Outstanding Florida Waters on the Ocklawaha River
- Conservation Lands
- County Boundaries

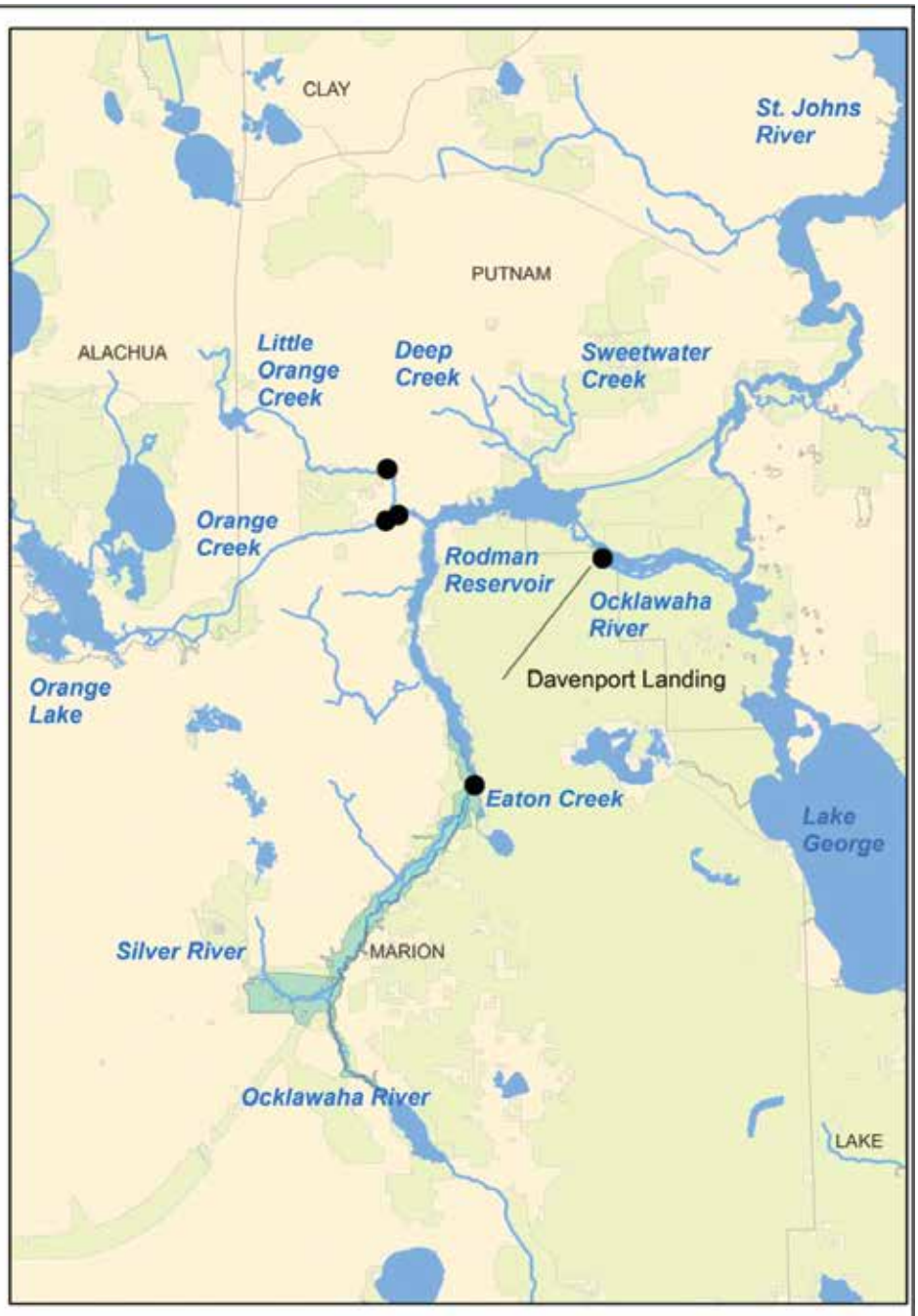


N

0 1.5 3 6 9 12
Miles
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Kilometers

Florida Fish and Wildlife Conservation Commission
Date: 11/30/12
Data Source: FWC, Florida Museum of Natural History

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Harlequin Darter

Etheostoma histrio

- Harlequin Darter Collection Locations
- Harlequin Darter Distribution
- Rivers and Creeks
- Open Water



N

0 2 4 8 12 16

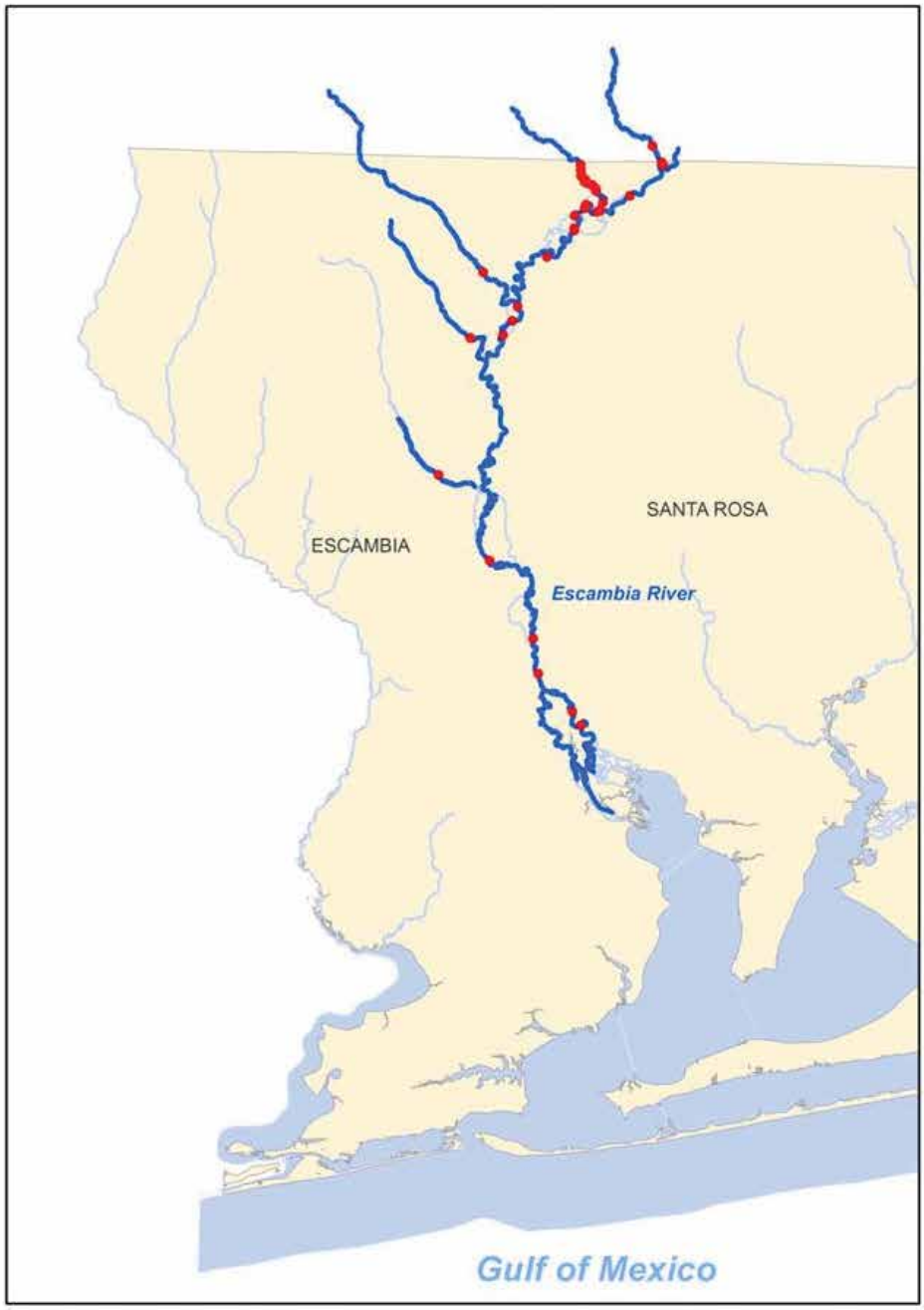
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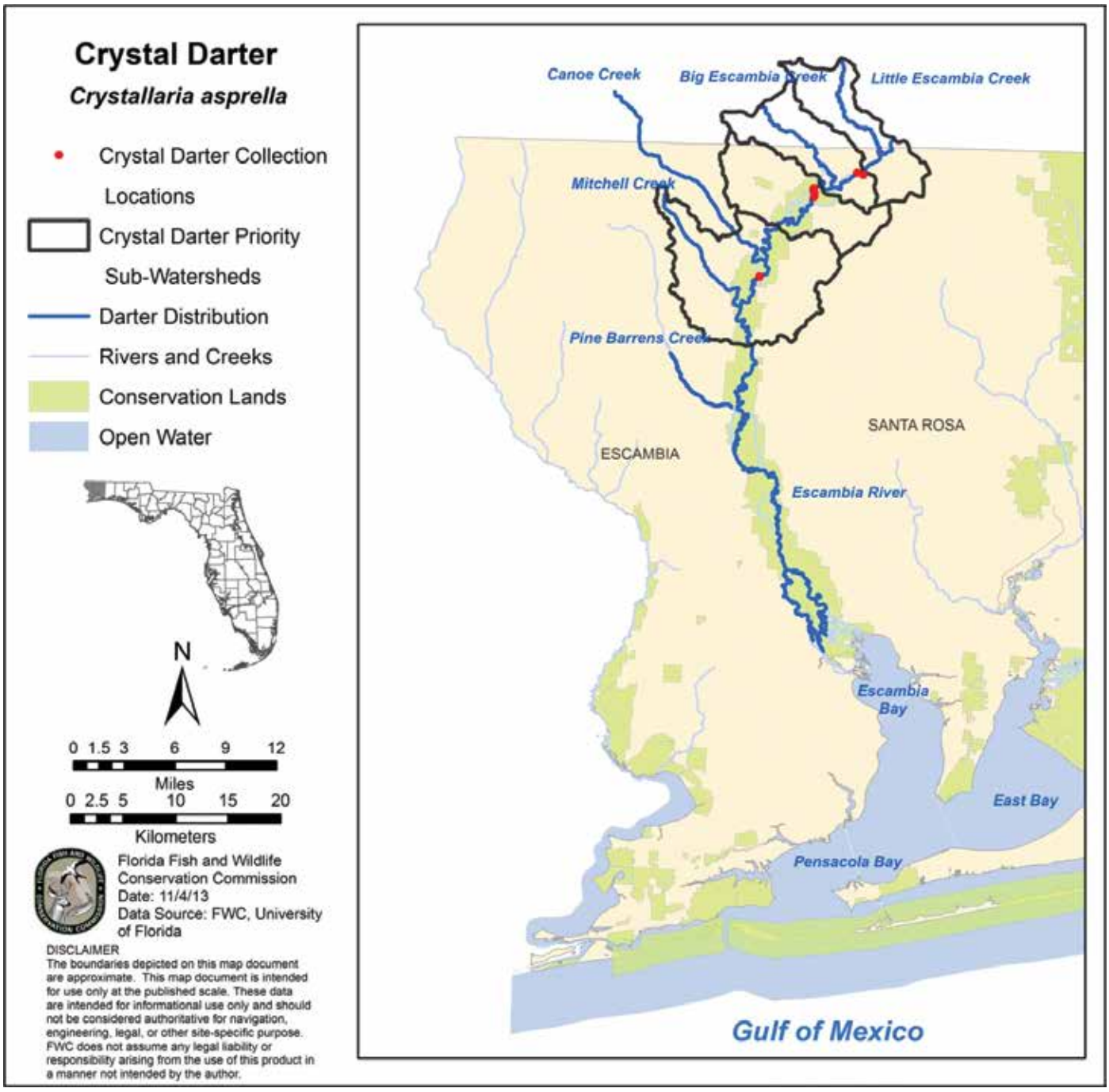
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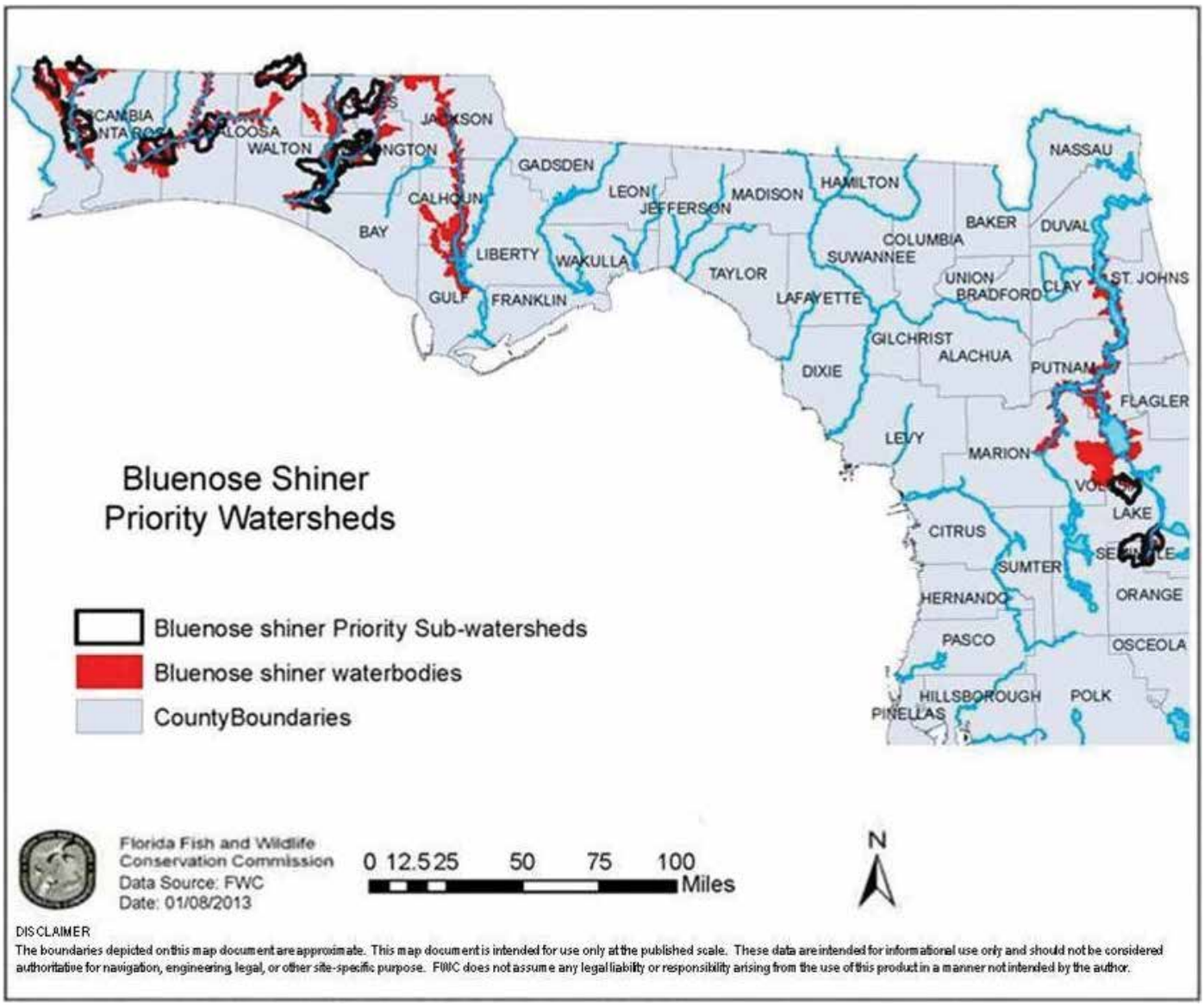
Kilometers

Florida Fish and Wildlife Conservation Commission
Date: 1/9/13
Data Source: FWC, University of Florida

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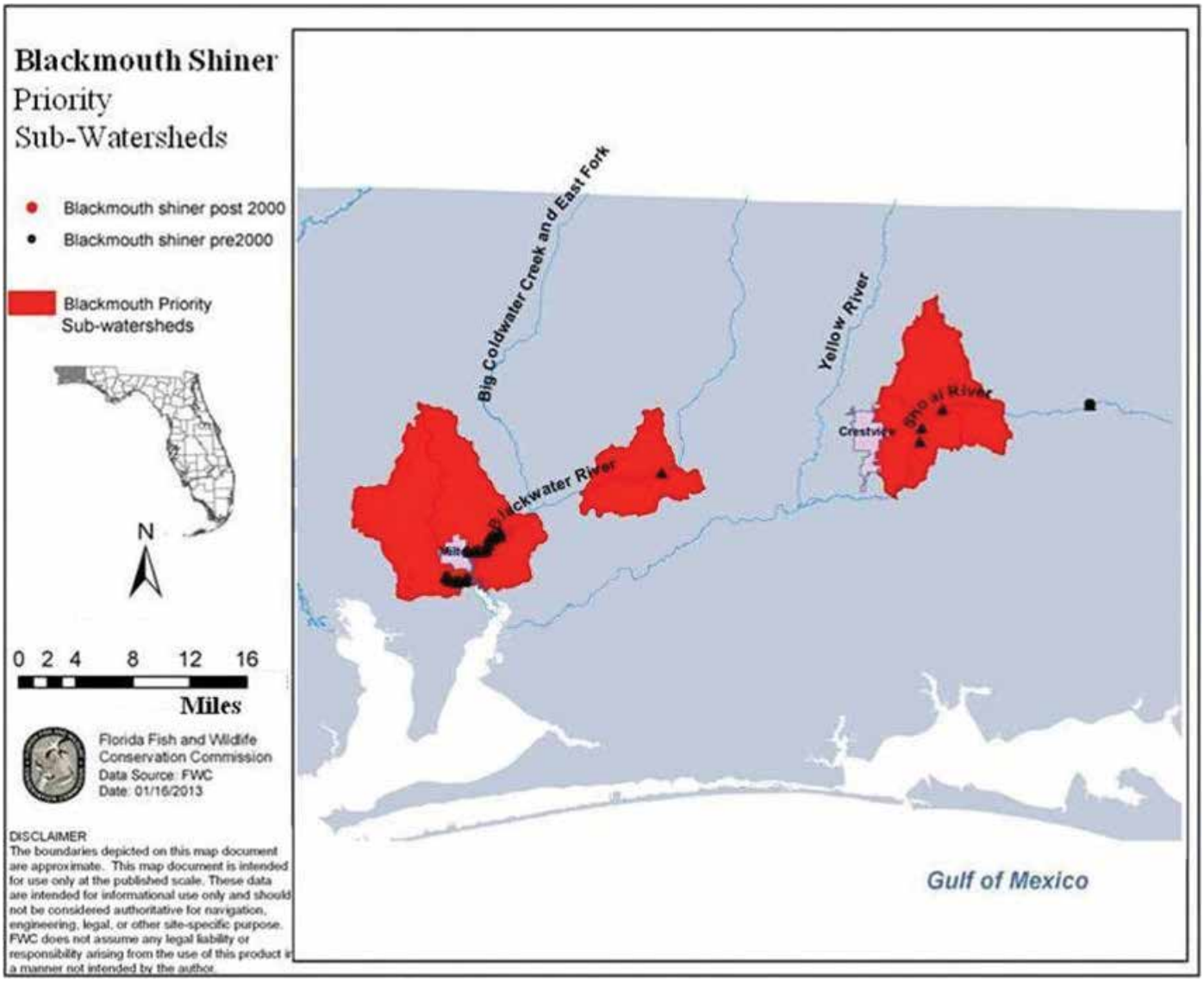


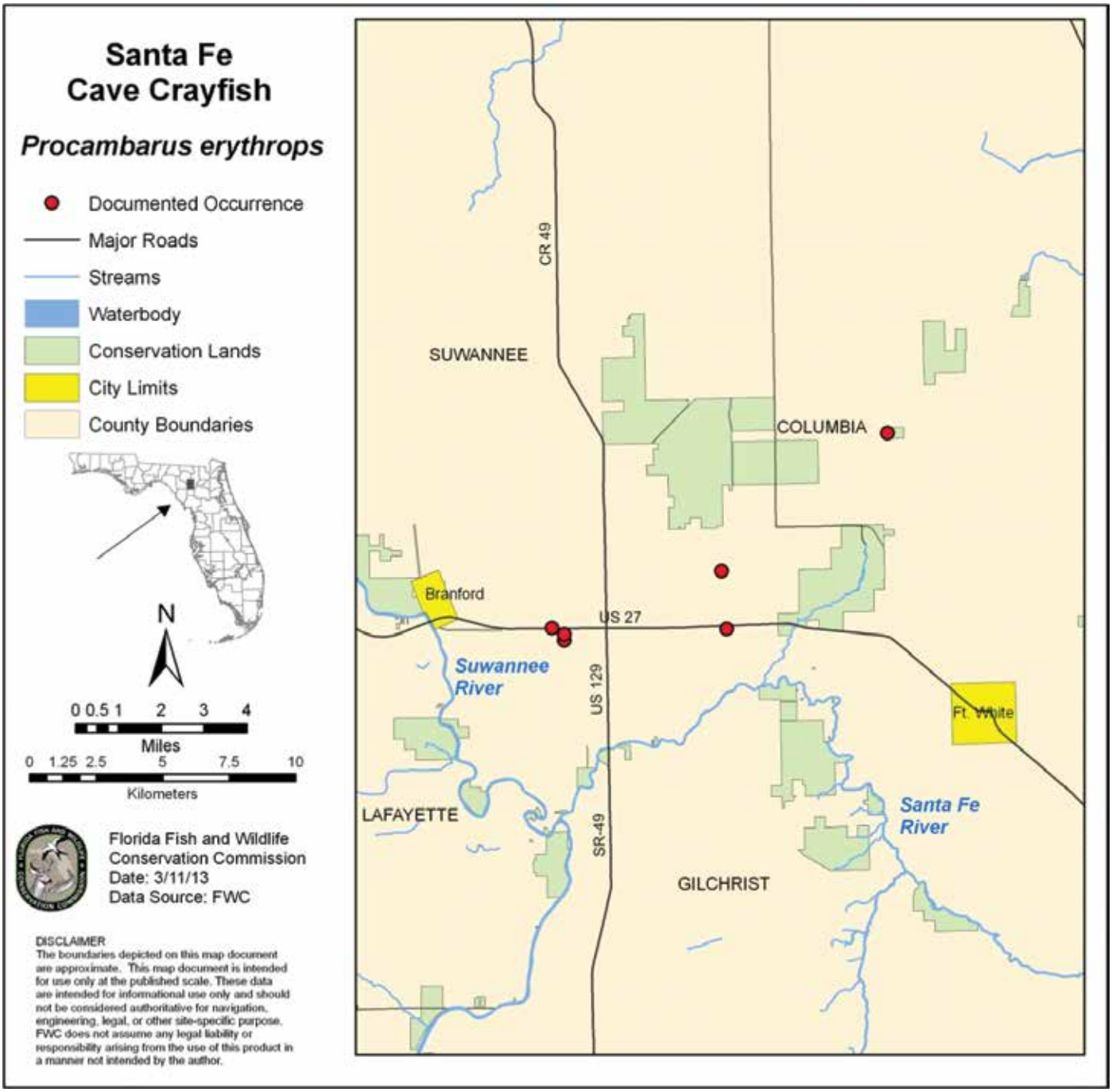

Crystal Darter
Crystallaria asprella
Crystal Darter Collection Locations
Crystal Darter Priority Sub-Watersheds
Darter Distribution
Rivers and Creeks
Conservation Lands
Open Water
N
0 1.5 3 6 9 12
Miles
0 2.5 5 10 15 20
Kilometers
Florida Fish and Wildlife Conservation Commission
Date: 11/4/13
Data Source: FWC, University of Florida
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Canoe Creek
Big Escambia Creek
Little Escambia Creek
Mitchell Creek
Pine Barrens Creek
SANTA ROSA
ESCAMBIA
Escambia River
Escambia Bay
East Bay
Pensacola Bay
Gulf of Mexico

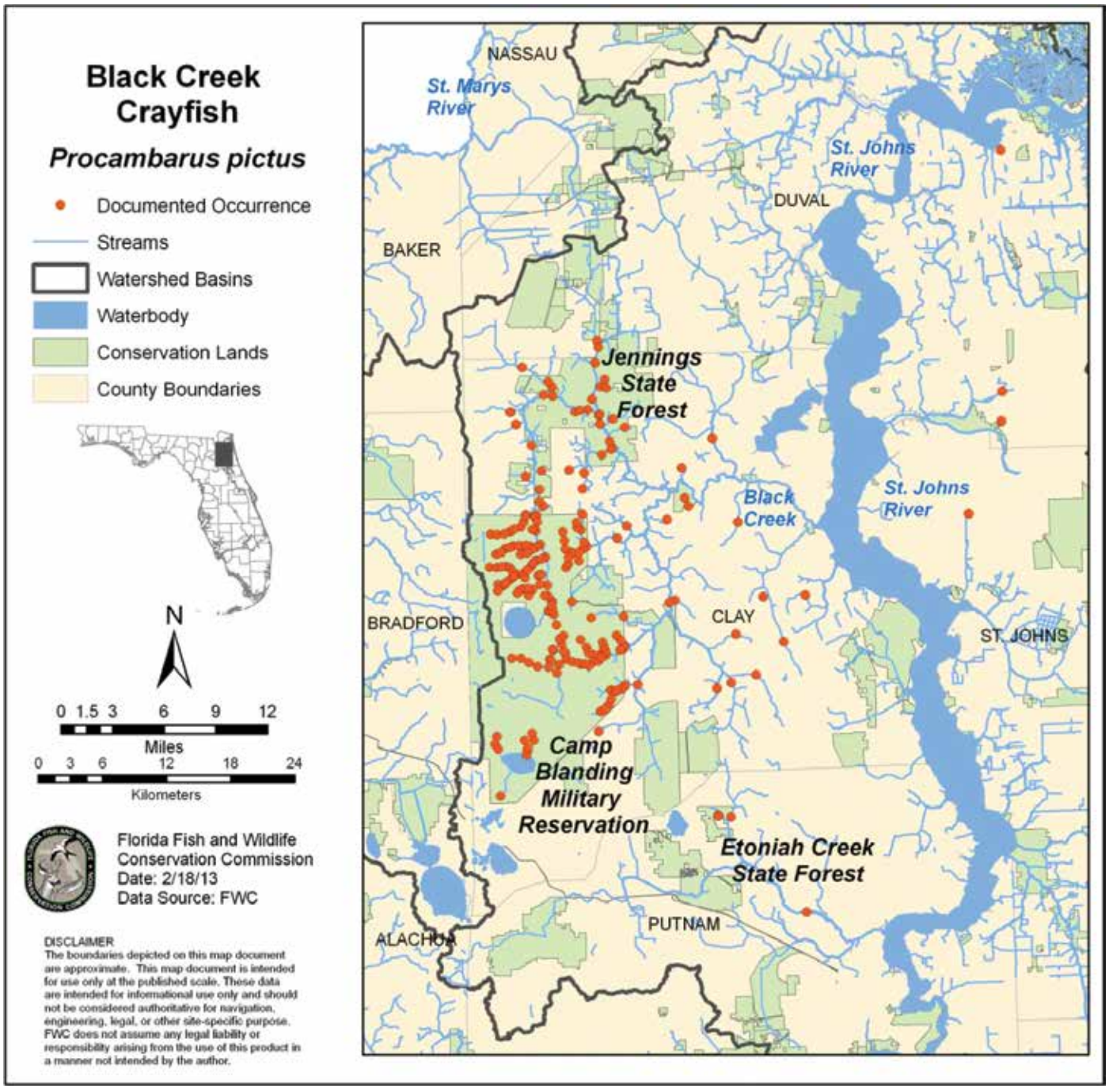


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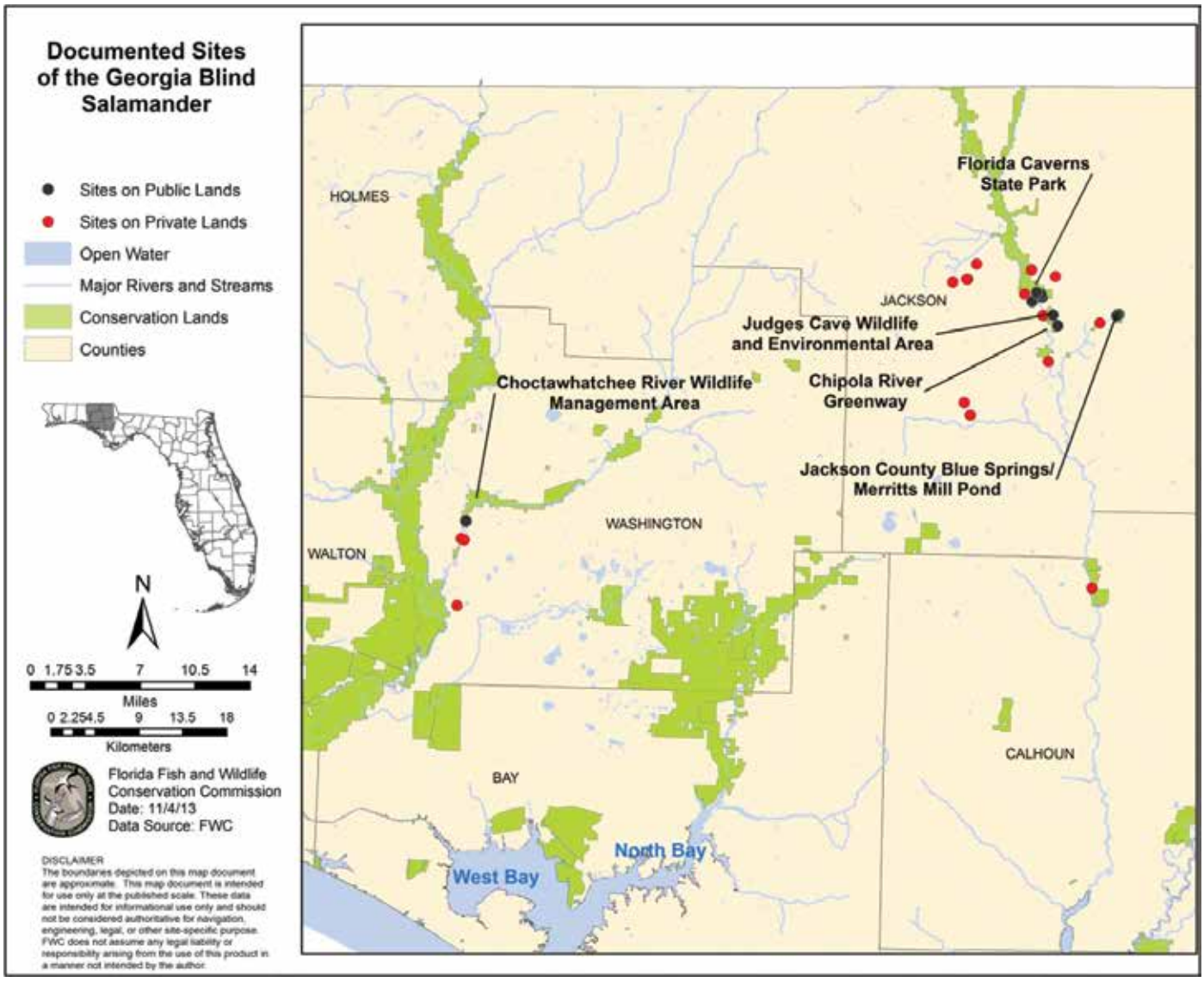
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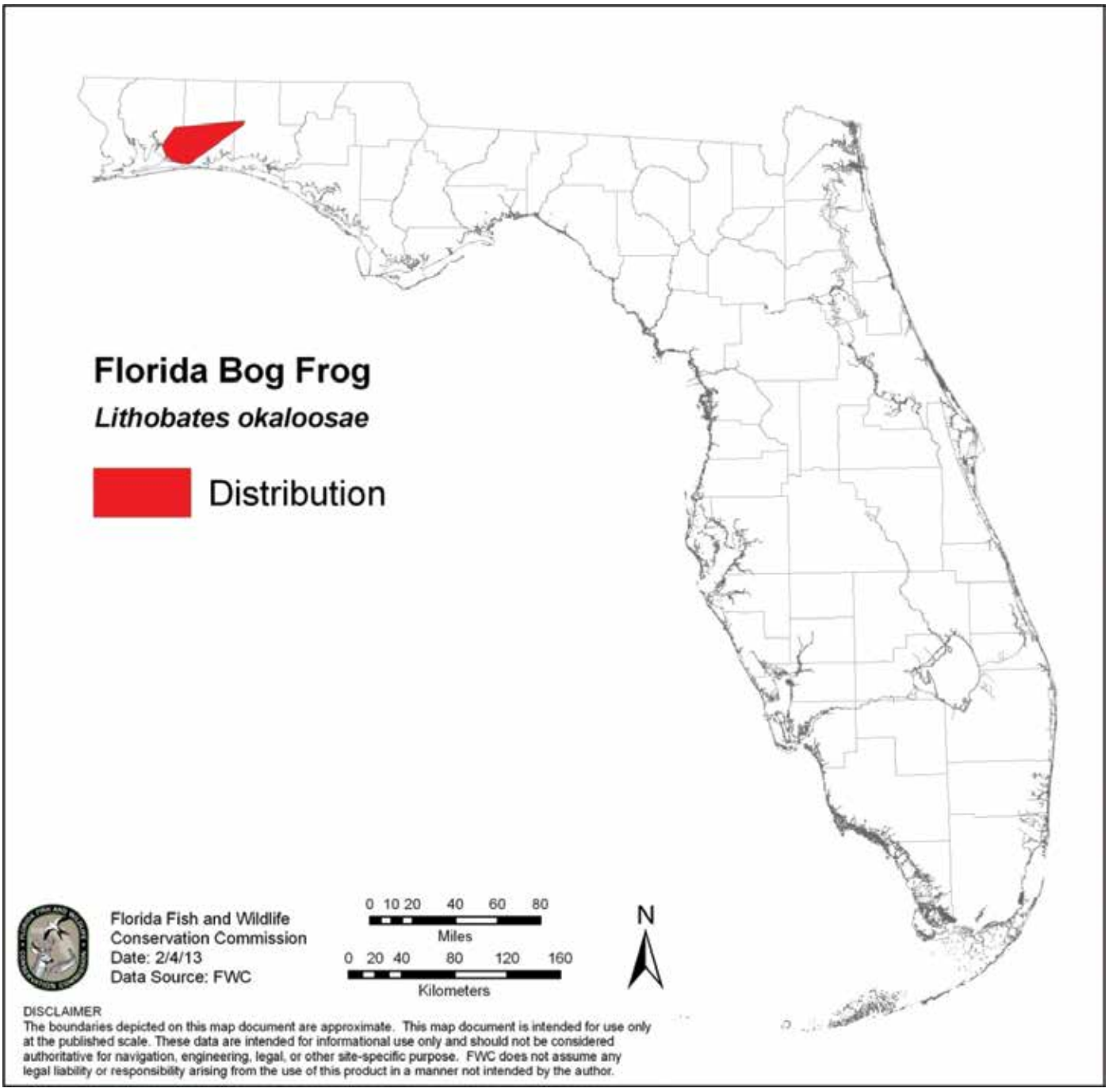

Blackmouth Shiner
Priority
Sub-Watersheds
Blackmouth shiner post 2000
Blackmouth shiner pre2000
Blackmouth Priority
Sub-watersheds
N
0 2 4 8 12 16
Miles
Florida Fish and Wildlife
Conservation Commission
Data Source: FWC
Date: 01/16/2013
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Big Coldwater Creek and East Fork
Yellow River
Blackwater River
Gulf of Mexico

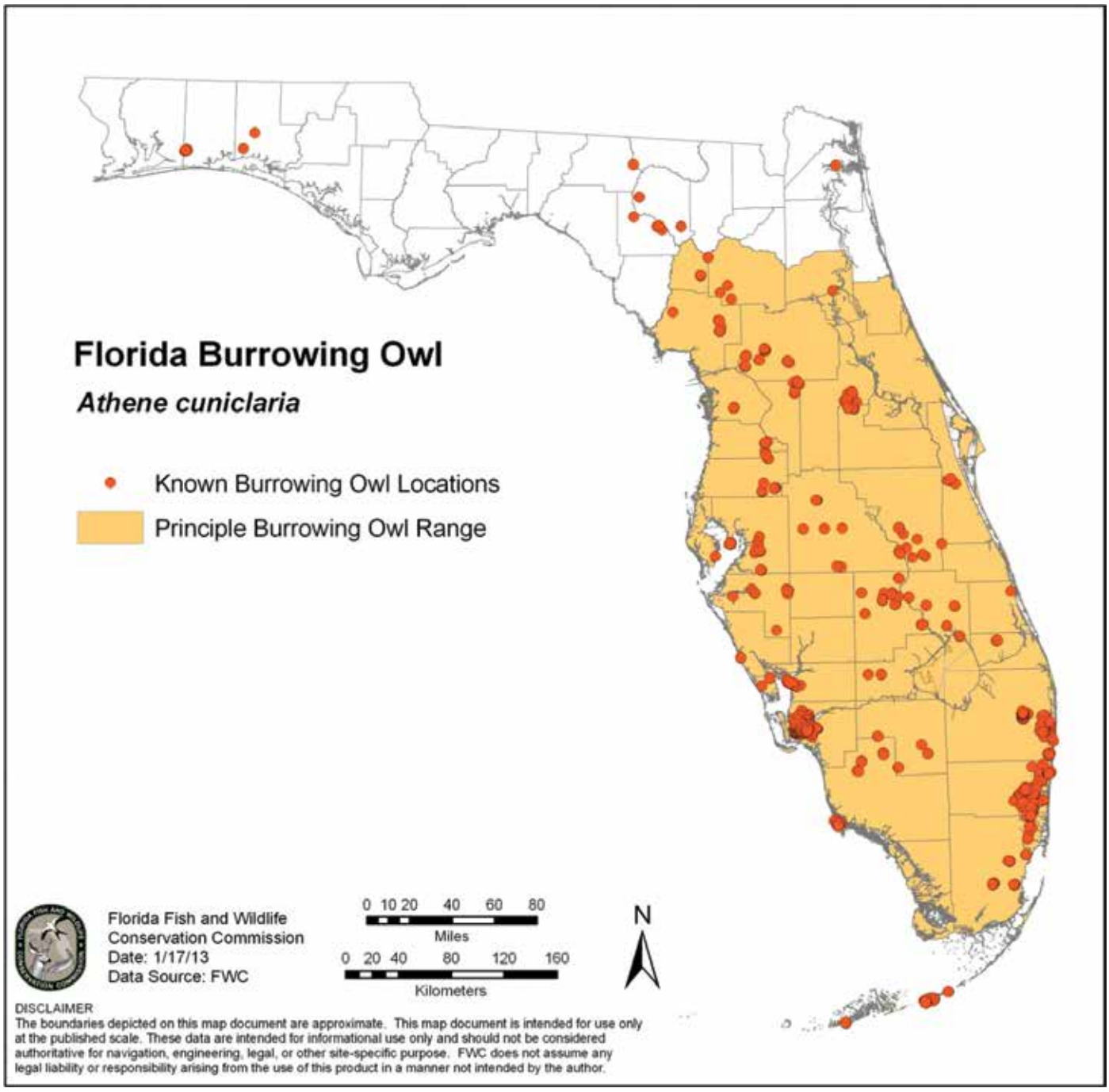

Santa Fe
Cave Crayfish
Procambarus erythrops
Documented Occurrence
Major Roads
Streams
Waterbody
Conservation Lands
City Limits
County Boundaries
N
0 0.5 1 2 3 4
Miles
0 1.25 2.5 5 7.5 10
Kilometers
Florida Fish and Wildlife
Conservation Commission
Date: 3/11/13
Data Source: FWC
DISCLAIMER
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CR 49
SUWANNEE
COLUMBIA
Branford
US 27
Suwannee River
US 129
Ft. White
LAFAYETTE
SR-49
Santa Fe River
GILCHRIST

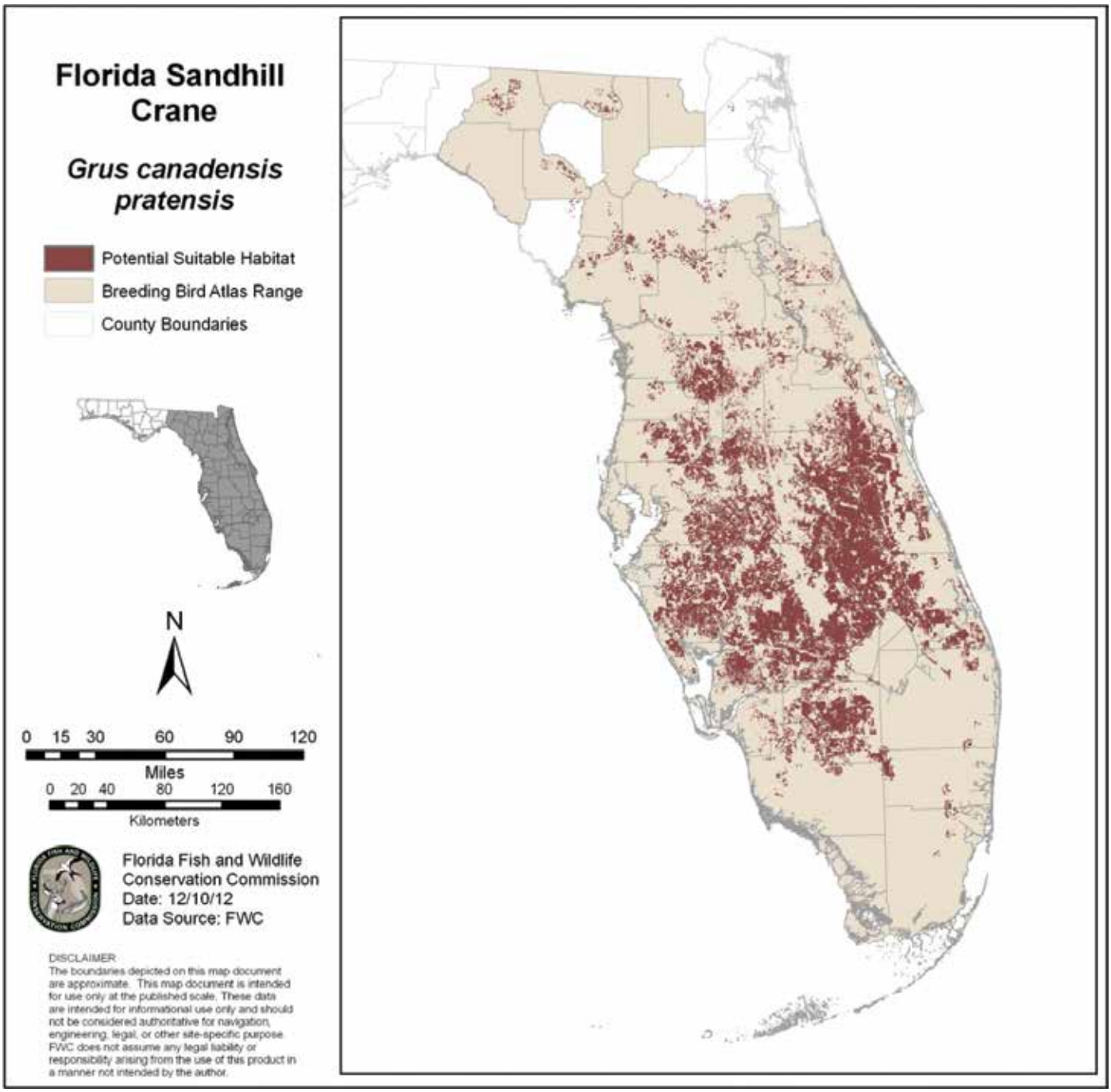

Black Creek Crayfish
Procambarus pictus
Documented Occurrence
Streams
Watershed Basins
Waterbody
Conservation Lands
County Boundaries
N
0 1.5 3 6 9 12
Miles
0 3 6 12 18 24
Kilometers
Florida Fish and Wildlife Conservation Commission
Date: 2/18/13
Data Source: FWC
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NASSAU
St. Marys River
St. Johns River
DUVAL
BAKER
Jennings State Forest
Black Creek
St. Johns River
BRADFORD
CLAY
ST. JOHNS
Camp Blanding Military Reservation
Etoniah Creek State Forest
PUTNAM
ALACHUA

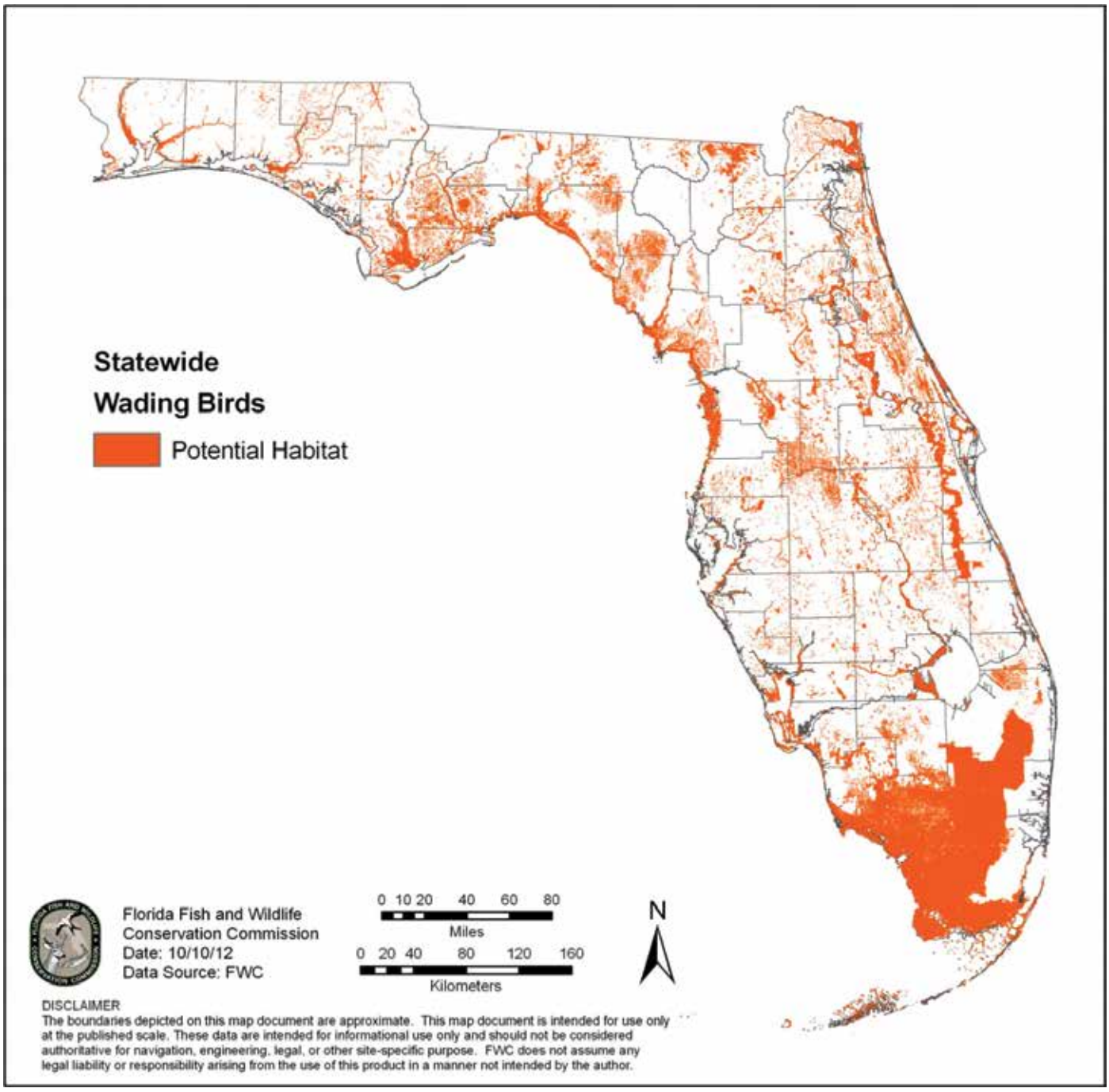

Barbour's Map Turtle
Graptemys barbouri
Specific Records
Inhabited Major Rivers
Other Major Rivers
County Boundaries
Open Water
N
0 3 6 12 18 24
Miles
0 4.5 9 18 27 36
Kilometers
Florida Fish and Wildlife Conservation Commission
Date: 3/18/13
Data Sources: FWC, FNAI, FL Herp Atlas
DISCLAIMER
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HOLMES
JACKSON
WALTON
WASHINGTON
GADSDEN
LEON
JEFFERSON
BAY
CALHOUN
WAKULLA
LIBERTY
TAYLOR
GULF
FRANKLIN
Gulf of Mexico

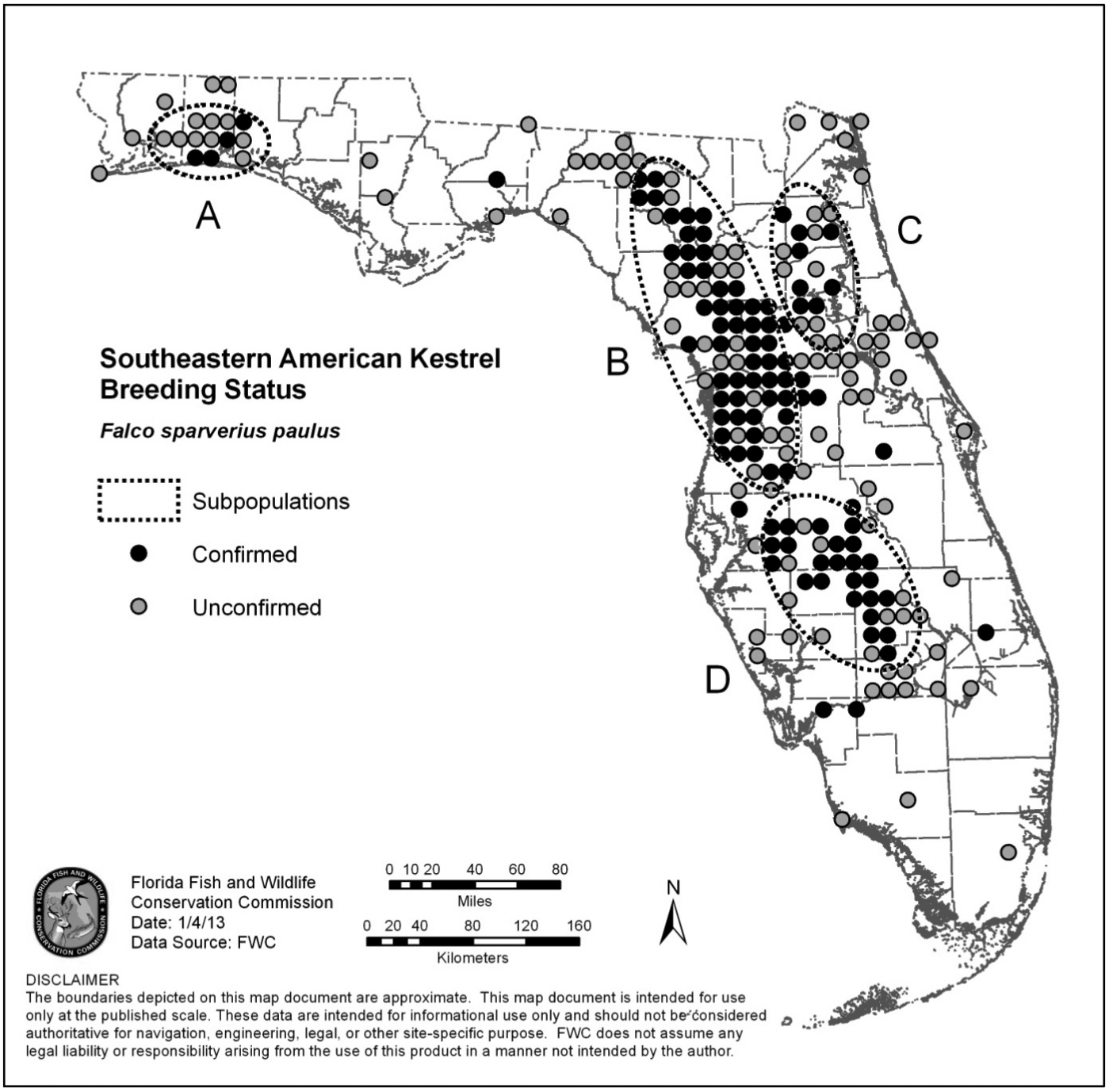

Documented Sites of the Georgia Blind Salamander
Sites on Public Lands
Sites on Private Lands
Open Water
Major Rivers and Streams
Conservation Lands
Counties
N
0 1.75 3.5 7 10.5 14
Miles
0 2.25 4.5 9 13.5 18
Kilometers
Florida Fish and Wildlife Conservation Commission
Date: 11/4/13
Data Source: FWC
DISCLAIMER
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HOLMES
JACKSON
WASHINGTON
WALTON
BAY
CALHOUN
Florida Caverns State Park
Judges Cave Wildlife and Environmental Area
Chipola River Greenway
Choctawhatchee River Wildlife Management Area
Jackson County Blue Springs/ Merritts Mill Pond
North Bay
West Bay


Florida Bog Frog
Lithobates okaloosae
Distribution
Florida Fish and Wildlife
Conservation Commission
Date: 2/4/13
Data Source: FWC
0 10 20 40 60 80
Miles
0 20 40 80 120 160
Kilometers
N
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Florida Burrowing Owl
Athene cuniclaria
Known Burrowing Owl Locations
Principle Burrowing Owl Range
Florida Fish and Wildlife
Conservation Commission
Date: 1/17/13
Data Source: FWC
0 10 20 40 60 80
Miles
0 20 40 80 120 160
Kilometers
N
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Florida Sandhill Crane
Grus canadensis pratensis
Potential Suitable Habitat
Breeding Bird Atlas Range
County Boundaries
N
0 15 30 60 90 120
Miles
0 20 40 80 120 160
Kilometers
Florida Fish and Wildlife Conservation Commission
Date: 12/10/12
Data Source: FWC
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Statewide
Wading Birds
Potential Habitat
Florida Fish and Wildlife
Conservation Commission
Date: 10/10/12
Data Source: FWC
0 10 20 40 60 80
Miles
0 20 40 80 120 160
Kilometers
N
DISCLAIMER
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A
B
C
D
Southeastern American Kestrel
Breeding Status
Falco sparverius paulus
Subpopulations
Confirmed
Unconfirmed
Florida Fish and Wildlife
Conservation Commission
Date: 1/4/13
Data Source: FWC
0 10 20 40 60 80
Miles
0 20 40 80 120 160
Kilometers
N
DISCLAIMER
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GLOSSARY OF TERMS

Active burrow (burrowing owl): active burrows are most easily identified by the presence of an owl standing erect at the entrance. An adult owl may be underground in the burrow even though the bird on the surface has flushed or is on a nearby post.

Active burrow (gopher tortoise): burrow is in good repair, has the classic half-moon shaped entrance and appears to be in use by a tortoise. These burrows generally have tortoise tracks or scrapes from the tortoise shell clearly visible on the burrow floor or on the mound. The burrow floor often contains loose soil caused by tortoise activity. The burrow mound is usually clear of vegetation, and it may contain recently excavated soil. Inactive burrows are in good repair, but do not show recent tortoise use. In contrast, an abandoned burrow appears unused and dilapidated. The burrow is partially or completely filled with leaves or soil, entrance is partially or completely collapsed and burrow collapse does not appear to be caused by recent rains or activity by livestock or humans. There are no trails into the burrow that might indicate that a tortoise recently passed through the leaf litter or that a small tortoise is using a dilapidated, adult burrow.

Rookery (aka breeding colony): a colony of breeding birds, also known as a rookery. A breeding colony will be distinguished from roosting birds by the presence of nests or nesting activity *(as shown below)*.





Photographs by Nicholas Vitale, University of Florida

State Imperiled Species: for the purposes of this program, State Imperiled Species means the 16 species listed in and made part of this manual, which are: Crystal Darter, Harlequin Darter, Bluenose Shiner, Blackmouth Shiner, Tessellated Darter, Santa Fe Cave Crayfish, Black Creek Crayfish, Barbour's Map Turtle, Georgia Blind Salamander, Florida Bog Frog, Gopher Tortoise, Burrowing Owl, Little Blue Heron, Tricolored Heron, Florida Sandhill Crane, and Southeastern American Kestrel (aka Sparrow Hawk). Additional information for all State Listed Species can be found at: http://myfwc.com/wildlifehabitats/imperiled/profiles/.

Incidental take: any taking otherwise prohibited, if such taking is incidental to, and not the purpose of the carrying out of an otherwise lawful activity.

Take: to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in such conduct. The term "harm" in the definition of take means an act which actually kills or injures fish or wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering. The term "harass" in the definition of take means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering.

NOTES