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WETLAND RAPID ASSESSMENT PROCEDURE (WRAP)

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SOUTH FLORIDA WATER MANAGEMENT DISTRICT

ABSTRACT

The Wetland Rapid Assessment Procedure (WRAP) is a rating index developed by the South Florida Water Management District to assist the regulatory evaluation of mitigation sites (created, restored, enhanced or preserved) that are permitted through the District's Management and Storage of Surface Waters or Environmental Resource Permit processes. The objectives of WRAP are: 1. to establish an accurate, consistent, and timely regulatory tool; 2. to track trends over time (land use vs. wetland impacts); and 3. to offer guidance for environmental site plan development. WRAP evaluation is a rapid assessment meant to be used within the limited timeframes of the regulatory process. Test results of the WRAP procedure showed it to be highly repeatable and an effective training tool for biologists. As additional data are collected, further analysis will be conducted in an attempt to establish a relationship between land use and wetland function.

Key Words. wetland assessment, mitigation, wetland function, anthropogenic impacts, wetland evaluation, land use impacts, habitat assessment.

EXECUTIVE SUMMARY

Wetland Rapid Assessment Procedure (WRAP) is a rating index developed to assist in the regulatory evaluation of wetland sites that have been created, enhanced, preserved, or restored through the District's Management and Storage of Surface Waters or Environmental Resource Permit processes. This standardized rating index can be used in combination with professional judgment to provide an accurate and consistent evaluation of wetland sites.

The WRAP rating index establishes a numerical ranking for individual ecological and anthropogenic factors (variables) that can strongly influence the success of mitigation projects. The numerical output for the variables is then used to evaluate the current wetland condition. The rating index can be used to evaluate a wide range of wetland/upland systems (e.g., emergent marsh, wet prairie, hardwood swamp, wet pine flatwoods, etc.) but it is not intended to compare different wetland community types (i.e., marsh to wet prairie) to each other.

Use of the WRAP rating index is intended to accomplish a number of objectives: to establish a simple, accurate, consistent and timely regulatory tool; to track trends over time (land use vs. wetland impacts); and to offer guidance for environmental site plan development.

WRAP is not a substitution for applied research science. It is a tool that is to be used by the regulatory community to ensure consistency and accuracy when evaluating a site during the regulatory process of resource permitting and post permit compliance. WRAP can be used as a tool to document baseline information for a site prior to development activities. WRAP input data consist primarily of field observations and professional experience.

WRAP variables include the following:

- Wildlife Utilization
- Wetland Overstory/Shrub Canopy
- Wetland Vegetative Ground Cover
- Adjacent Upland Support/Wetland Buffer
- Field Indicators of Wetland Hydrology
- Water Quality Input and Treatment Systems

Evaluation of a wetland site requires office preparation as well as the field investigation. Office preparation includes obtaining aerial maps, identifying the project boundaries and adjacent lands uses, and identifying on-site wetland areas. In addition, the evaluator should attempt to locate any references to on-site hydrology, soils, site management, seasonal variability, wildlife studies, rainfall data and any other pertinent information.

Methodology for the Habitat Assessment Variable is a series of discussions - one for each WRAP assessment variable. Following each variable description is a rating index containing a set of calibration descriptions and corresponding score points. A score of 3 is considered the best a system can function and 0 is for a system that is severely impacted and is exhibiting negligible attributes.

Each system must be evaluated on its own attributes and is not to be compared to a different type of system (i.e. wet prairie vs. marsh vs. cypress dome). An evaluator also has the option to score each variable in half (0.5) increments. This provides the flexibility to score a variable that is not accurately described or fitted by the calibration description. Half increments are utilized on the point scale from 0.5 through 2.5. Each applicable variable is scored: the scores are totaled ($\sum V$) and then $\sum V$ is divided by the total of the maximum score for that variable ($\sum V_{max}$). The final rating score for "Habitat Assessment Variables" will be expressed as a number between 0 and 1.

WRAP has been tested statistically and found to be a repeatable procedure. A total of 303 data points was used in the preliminary testing of WRAP. This included 81 different wetland sites with between 3-5 independent evaluators per site, 8 different wetland communities and 19 land use designations. Analysis for multicollinearity among the variables yielded no significant correlation.

Ten land use designations were originally selected in the attempt to determine the degree of impact associated with the wetland variables identified in WRAP. The ten land use designations were as follows:

- Agriculture
- High Intensity Commercial
- Highways
- Industrial
- Institutional
- Low Density Residential
- Low Intensity Commercial
- Multi-Family Residential
- Recreational/open space
- Single-Family Residential

Once the testing of WRAP was complete it became apparent that for most land uses the dataset was inadequate to make any inferences with regard to land use associated with wetland impacts. In addition, the testing of WRAP identified as many as eight additional land uses that were not originally included. The current list of WRAP land use designations now includes:

- Citrus Grove
- Dairy and Feedlot
- Golf Course
- High Intensity Commercial
- Highways (low volume and high volume)
- Improved Pasture
- Industrial
- Institutional
- Low Density Residential
- Low Intensity Commercial
- Mining
- Moderately Intensive Commercial
- Multi-Family Residential
-

- Open space / Natural Undeveloped Areas
- Recreational
- Row Crop
- Single-Family Residential
- Unimproved pasture / Rangeland
- Sugarcane

As additional data are collected, further analysis will be conducted in an attempt to establish a relationship between land use and wetland function.

The overall objective in the development of WRAP is to utilize as much information as possible, both from literature reviews and professional experience, and organize it in the form of a simple but accurate rating index. In order for a functional assessment procedure to be accepted by the regulatory community, the procedure has to be simple enough to use without collecting time-consuming field data and must be able to be completed within a relatively short time period.

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GLOSSARY

Agriculture – the science or art of cultivating the soil, producing crops, or raising livestock.

Anthropogenic activities – relating to, or resulting from the influence of human beings on nature.

Appropriate plant species - plant species which are appropriate for a given community type (i.e., *Rhynchosphora tracyii* in a wet prairie, *Nymphaea odorata* in a deepwater marsh)**.**

Canopy - the plant stratum composed of all woody plants and palms with a trunk four inches or greater in diameter at breast height (4.5'), except vines.

Coppicing – vegetative regrowth from a tree stump (e.g., cypress) after impacts from silvaculture or timbering activities.

Decreased hydroperiod - a decrease in the annual period of inundation, resulting in a change in the plant community composition and structure. The effect is usually an increase of transitional and upland plant species.

Desirable plant species - native plant species that are appropriate for a specific community type and provide benefits to wildlife in the forms of food, cover, and nesting potential.

Direct impacts - physical acts such as dredging or filling of wetlands.

Design protocol – the design of a scientific experiment or treatment.

Dry detention areas - created impoundments with a bottom elevation of at least one foot above control elevation of the area. These impoundments dry out after a specific period of time, typically within 48 hours.

Duration of inundation – period of time inundation occurs on an annual basis.

Exotic plant species - plant species that are non-native, purposefully or accidentally introduced by humans to a geographic area. Many are invasive in nature and disrupt native plant communities.

Freshly mulched created mitigation area - the spreading of hydric soils (with viable native seed bank present) across a graded, newly constructed mitigation area.

Grass swales - a linear depression, usually designed to capture, store, and convey stormwater runoff.

Ground cover - the plant stratum composed of all plants not found in the canopy or subcanopy.

Heavily impacted – impacted by human activities to such a degree as to reduce significantly the functionality of a system.

High intensity commercial - land uses consisting of commercial with high levels of traffic volume. Traffic is constantly moving in and out of the area; including downtown areas, commercial office sites and regional malls.

High intensity land use - intensive agricultural operations such as dairy farming (including feedlots), and high intensity commercial projects. These land uses are significantly disruptive to wetland systems through direct and indirect impacts.

High volume highway - major road facilities (i.e., 4, 6, and 8-lane) such as interstate highways, major arteries and thoroughfares. Moderate to heavy traffic.

Hydroperiod - annual period of inundation.

Hydrological indicators - indicators that may be used as evidence of inundation or saturation when evaluated with meteorological information, surrounding topography, and reliable hydrological data. Indicators include algal mats, aquatic mosses, aquatic plants, aufwuchs (microscopic attached organisms), basal scarring, drift lines, elevated lichen lines, evidence of aquatic fauna, morphological plant adaptations, secondary flow channels, sediment deposition, vegetated tussocks and water marks.

Hydrology - water depth, flow patterns, and duration and frequency of inundation as influenced by precipitation, surface runoff and groundwater.

Impervious surface - surfaces which do not allow for the percolation of water (e.g., asphalt parking lots and roads, rooftops).

Improved pasture – rangeland comprised mostly of introduced pasture grasses. The recommended stocking density for improved pasture is one cow for every five acres of rangeland.

Inappropriate plant species - plant species which are not usually considered nuisance species, however may be indicative of other problems (i.e., improper hydrology) and may dominate a particular stratum (e.g., *Rubus* sp. in a cypress forested wetland). These plant species are not considered appropriate for a particular habitat.

Increased hydroperiod - increase in the annual period of inundation, resulting in a change in the plant community composition and structure, and which can include an increase in the duration and magnitude of inundation.

Indirect impacts - impacts to wetlands such as increased nutrient loading, altered hydrology, impacts to wetland buffer, development of adjacent areas or disturbances by air, light or noise pollution.

Industrial - manufacturing, shipping and transportation operations, sewage treatment plant facilities, water supply plants and solid waste disposal..

Infiltration trench - impoundment in which incoming runoff is temporarily stored until it gradually leaves the basin by infiltrating into the soils.

Institutional – schools, churches, libraries etc. Runoff concentrations are similar to low intensity commercial.

Intensively maintained - mowed, disked or similarly impacted on more than a semi-annual basis.

Invasive exotic plant species - exotic plant species (e.g., punk tree, Australian pine, Brazilian pepper, old-world climbing fern, etc.) that are invading and disrupting native plant communities in Florida.

Landscape setting - the type of land use that surrounds a wetland (i.e., agriculture, residential, commercial/industrial, undeveloped).

Low density residential - areas with lot sizes greater than one acre or less than one dwelling unit per acre.

Low intensity commercial - areas that receive minimal amounts of traffic volume where vehicles are parked for only a portion of the day; such areas include professional office sites and convenience stores.

Low intensity land use - land uses such as low density residential, citrus and low intensity commercial.

Low plant biomass density - minimal accumulation of living or dead plant material due to numerous factors including excessive burning, mowing, grazing, recent vegetation installation, inappropriateness of planted species, improper hydrology (including drought) and other human disturbances such as damage by off-road vehicles.

Low volume highway – minor road facilities (i.e., 2-lane) which include rural and urban arterial and collector roads. Asphalt or dirt roads with light to moderate traffic.

Magnitude of inundation - depth of inundation on an annual basis.

Mining - includes mining excavation, lake construction, and site development activities, resulting in the removal or clearing of vegetation.

Moderately intensive commercial – areas that receive moderate amounts of traffic volume for a portion of the day, such areas include small shopping centers and plazas.

Moderately intensive land use - includes single-family residential, multi-family residential, golf courses and golf course residential communities, industrial projects, highways and agricultural activities such as pasture and row crops.

Multi-family residential - residential land use consisting primarily of apartments, condominiums and cluster homes.

Non-invasive exotic plant species - exotic plant species which have not yet been shown to be invasive to natural communities.

Nuisance plant species - plant species which have the potential to dominate disturbed or created plant communities and form large vegetative colonies (e.g. cattails, spatterdock, primrose-willow).

Open space / natural undeveloped area – areas that are not developed and exhibit minimal human impact, such areas include parks and passive recreational areas.

Pretreatment or MSSW systems - constructed systems designed to pretreat water (i.e., removes suspended solids and reduce nutrient concentrations) prior to discharge. Systems can range in simplicity from grass swales and dry retention to secondary treatment and polishing ponds.

Proc GLM - Procedure General Linear Model.

Recreational – areas which have been developed for active recreational use (e.g., ballfields, soccer fields, tennis and volleyball courts, etc.). These areas typically have intensive ground maintenance programs.

Routinely maintained - mowed or similarly impacted on an annual basis.

Row Crops – agricultural practice of crops planted and harvested on an annual basis, excluding sugar cane (i.e., vegetable farms and plant nurseries).

SAS – Statistical Application Software.

Secondary productivity – macroinvertebrates, fishes and wildlife.

Single-family residential - detached dwelling units with lot sizes less than one acre and dwelling unit densities greater than one dwelling per acre; duplexes constructed on one-third to one-half acre also included.

Subcanopy - the plant stratum composed of all woody plants and palms with a trunk or main stem diameter at breast height (4.5') between one and four inches, except vines.

Undesirable plant species – exotic, nuisance or undesirable plant species for a given habitat.

Unimproved pasture - comprised mostly of native rangeland. The recommended stocking density is one cow per twenty-five acres of rangeland.

Wet detention areas- impoundments in which stormwater runoff is temporarily stored until it gradually leaves through an outflow control structure. A pool of water remains after a specific bleed-down period.

WETLAND RAPID ASSESSMENT PROCEDURE (WRAP)

1.0 INTRODUCTION

The South Florida Water Management District's (District) former Management and Storage of Surface Waters (MSSW) and current Environmental Resource Permit (ERP) permitting processes have evolved to reflect increasing concern over preserving natural resources. Consequently, recently issued permits have contained a wide assortment of special conditions with varying degrees of emphasis on environmental protection. The District's post-permit compliance inspections indicate that determining permit compliance is generally a straight-forward process, but does not necessarily reflect successful enhancement, mitigation or preservation of a wetland/upland site.

Wetland Rapid Assessment Procedure (WRAP) is a rating index developed to assist in the regulatory evaluation of wetland sites that have been created, enhanced, preserved, or restored through the District's MSSW or ERP processes. This standardized rating index can be used in combination with professional judgment to provide an accurate and consistent evaluation of wetland sites. The evaluator must have a good understanding of Florida ecosystems (functions and species identification) in order for WRAP results to be valid. This current version of WRAP is the sixteenth version developed over a period of five years. Earlier versions indicated greater disparities in overall WRAP scores as a result of inadequate calibration descriptions for the variables. Once these disparities were identified, the calibration descriptions were rewritten and the procedure was retested. Over 400 observations were used to field test and refine the descriptions of the variables prior to the final testing of the procedure.

The WRAP rating index establishes a numerical ranking for individual ecological and anthropogenic factors (variables) that can strongly influence the success of mitigation projects. The numerical output for the variables is then used to evaluate the current wetland condition. The rating index can be used to evaluate a wide range of wetland/upland systems (e.g., emergent marsh, wet prairie, hardwood swamp. wet pine flatwoods etc.) but it is not intended to compare different wetland community types to each other (i.e., marsh to wet prairie). Each wetland type is rated according to its attributes and characteristics. Although an interactive association among variables does exist, variables within the rating index have not been individually weighted. Individual variables can be eliminated from the evaluation if the evaluator determines the specific parameter is not applicable.

Use of the WRAP rating index is intended to accomplish a number of objectives: to establish a simple, accurate, consistent and timely regulatory tool; to track trends over time (land use vs. wetland impacts) and to offer guidance for environmental site plan development.

WRAP is not a substitution for applied research science. It is a tool that can to be used by the regulatory community to ensure consistency and accuracy when evaluating a site through the regulatory process of resource permitting and post permit compliance. WRAP can be used as a tool to document baseline information for a site prior to development activities. WRAP input data consist primarily of field observations and professional experience. Some variables, such as exotic and nuisance plant coverage and adjacent upland/wetland buffer, can be quantified through interpretations of aerial photography or visual estimations.

2.0 METHODOLOGY

WRAP incorporates concepts from the U.S. Fish and Wildlife Service's "Habitat Evaluation Procedures" (HEP, 1980) and the South Florida Water Management District's "Save Our Rivers Project Evaluation Rating index" (SOR, 1992).

Ecological communities (i.e., pine flatwoods, wet prairie, cypress dome, etc.) and their associated attributes provide food, cover and breeding sites for a variety of flora and fauna. The holistic concept of HEP is used to evaluate entire systems - both upland and wetland - and their interactive associations. HEP is based on the assumption that the value of a habitat can be evaluated at the species level by using a set of measurable variables that are important for a particular species. The use of HEP is restricted by the number of species models that have been developed and those species chosen for evaluation.

The SOR rating index was developed as a method of evaluating habitats to prioritize the allocation of taxpayer dollars toward acquisition, restoration and management of sensitive lands. The rating index is used to evaluate sites using variables such as water management value, water supply potential, site manageability, habitat and species diversity, connectiveness, rare and endangered species, site vulnerability and human use.

The U.S. Fish and Wildlife Services "Habitat Suitability Index" was utilized in determining specific habitat requirements for the fauna of Florida. This information has been included in Appendix A (Species Habitat Requirement Table) as a resource for evaluating the wildlife utilization variable of WRAP. In addition, community profiles for sites to be evaluated using WRAP are described in Appendix B. Common freshwater fishes and aquatic insect taxa associated with the specific habitats are found in appendices C and D, respectively. Appendix G is a list of Florida Land Use, Cover Forms Classification System (FLUCCS) codes for wetland systems found in Florida.

WRAP variables include the following:

- Wildlife Utilization
- Wetland Overstory/Shrub Canopy
- Wetland Vegetative Ground cover
- Adjacent Upland/Wetland Buffer
- Field Indicators of Wetland Hydrology
- Water Quality Input and Treatment Systems

2.1 METHODOLOGY FOR USING WRAP

OFFICE EVALUATION

The WRAP evaluator completes the following steps before leaving the office:

1. Identify the project site. Acquire an aerial map for field use and delineation of the project boundaries.

2. Identify land uses adjacent to the project site (see Glossary for land use definitions).
    a. Identify developmental encroachment and type.
    b. Identify adjacent natural areas and plant communities using aerial photography.
    c. Identify roads, canals and other features (i.e., wellfields, etc.) potentially isolating or impacting the site.
    d. Identify any water quality pre-treatment systems.
3. Identify wetland areas within the project site.
    a. Label wetland areas for future WRAP scoring.
    b. Utilize soil maps to verify or identify depressional map units that may not be readily apparent from aerial maps.
    c. Identify wetland types (i.e. cypress domes, wet prairie etc.) if possible. Determine Florida Land Use, Cover and Forms Classification System – FLUCCS codes for wetland types (Appendix G). This may need to be done at the time of the site visit.
        1. Polygon assessment can be assigned based similar impacts including hydrology, exotic and nuisance plant coverage and plant species composition.
        2. Polygon assessment is not limited by size (i.e., 1 acre or 100 acres).
        3. Polygon assessment can be based on project boundaries.
    d. Identify access points to wetland areas.
    e. Identify canals and ditches adjacent to the wetland areas.
    f. Set up potential transects through wetland ecotypes. Transects would be warranted if a particular wetland exhibited a number of vegetative community types. The transects could then be used for future monitoring events, if required by the permit.
    g. Identify any wildlife studies that have been conducted on the site or on adjacent areas.

In addition, the evaluator should review on-site hydrology, site management, maintenance plans, seasonal variability, droughts, fire and excessive rainfall and any other pertinent information.

FIELD EVALUATION

1. Walk a minimum of 50% of the wetland perimeter.
2. Visually inspect 100% of the wetland perimeter.
    a. Look for signs of wildlife utilization (tracks, scats etc.) including direct observations.
    b. Identify plant community composition (visual estimate) using predetermined transect (if necessary).
        1. Conduct a visual estimate of the plant species coverage and composition (including exotic and nuisance plants) for the wetland and adjacent areas.
        2. Note any shifts in plant communities such as encroachment of upland or transitional plant species into the wetland.
    c. Identify any hydrologic indicators present (see Glossary for list).
3. Document field observations on field data sheet (Section 2.3.1) to establish baseline information for future reference.

WRAP SCORE

Score each wetland for the six variables using the guidelines presented below.

2.2 METHODOLOGY FOR SCORING AND ASSESSING HABITAT VARIABLES

Methodology for the Habitat Assessment Variable, is a series of discussions - one for each WRAP assessment variable. Following each description is a rating index containing a set of calibration descriptions and corresponding score points. A score of 3 is considered the best a system can function and 0 is for a system that is severely impacted and is exhibiting negligible attributes.

This can be interpreted as a score of 3 being equivalent to providing or having 100% functional value, whereas a score of 2 is equivalent to 67% functional value or a 33% functional loss.

Each system must be evaluated on its own attributes and is not to be compared to a different type of system (i.e. wet prairie vs. marsh vs. cypress dome). An evaluator also has the option to score each parameter in half (0.5) increments. This provides the flexibility to score a variable that is not accurately described or fitted by the calibration description. Half increments are utilized on the point scale from 0.5 through 2.5. It should be noted that the bullet items under each descriptor are not listed in any order of importance.

If any variable does not apply to the habitat being rated, then the designation "NA" (not applicable) can be applied. When the designation "NA" is used for a specific variable it is omitted from the final calculations used to rate the habitat.

Each applicable variable is scored: the scores are totaled ($\sum V$) and then $\sum V$ is divided by the total of the maximum score for that variable ($\sum Vmax$). The final rating score for "Habitat Assessment Variables" will be expressed numerically with a number between 0 and 1. The final rating score can be expressed mathematically as follows:

$$\text{WRAP Score} = \frac{\text{sum of the scores for the rated variables (V)}}{\text{sum of maximum possible scores for the rated variables (Vmax)}}$$

also expressed as:

$$\frac{\sum V}{\sum Vmax}$$

2.2.1.1 WILDLIFE UTILIZATION

Introduction

Wetlands provide many species of wildlife with basic life sustaining needs such as water, food (i.e. macroinvertebrates and other wetland dependent species including plants) and nesting and roosting areas. While some animal species prefer uplands for nesting and rearing of young, their primary food sources are found within wetland systems. Water dependent species such as fish, some amphibians and birds have specific requirements with regard to duration and magnitude of hydrologic inundation in order to complete their life cycles. Not all wetland systems (e.g., hydric pines) provide habitat for extended hydroperiod dependent species.

It is important for the evaluator to understand the basic habitat requirements of south Florida fauna to know which species or signs might be observed during site visits. Appendix A lists the habitat requirements for a number of wildlife species found in south Florida. Included are food sources, protective cover, reproductive needs and habitat size. Appendices B (Habitat Community Profiles), C (Common Freshwater Fishes of Southern Florida) and D (Common Aquatic Insect Taxa) list additional wildlife species. In addition to these references, the evaluator should use any pertinent wildlife study with regards to the site or adjacent areas.

Though direct observation of wildlife utilization is ideal, it is not always possible due to the time constraints of the regulatory review process and the secrecy, mobility, habits and seasonality of many species of wildlife. The evaluator must rely on the presence of signs, including scat, tracks, rubs, and nests etc. In some instances an evaluator may have to assume that if habitat needs for a particular species are present then this species probably does frequent the site.

It is recommended that the evaluator use a D-frame dip net to determine if macroinvertebrates are present. Several sweeps through the wetland vegetation, in combination with direct observations of surface dwelling species, should provide an indication of the lower trophic levels. The presence and diversity of macroinvertebrates are quite variable depending on environmental factors such as temperature, pH, predation, and seasonality. During the dry season, the evaluator should look for available signs such as crayfish burrows and remnant exoskeletons of crayfish, dragonflies and apple snail shells. If those signs are not present, the reviewer must utilize the presence of wetland plant species as the primary indicator of on-site hydrology, influencing potential macroinvertebrate populations.

In this procedure, rabbits and rodents are considered small mammals; fox, opossum and raccoon are medium-sized mammals; and bobcat, otter, deer, bear and panther are large mammals. It is recognized that although some species (e.g., raccoon) have adapted well to urban encroachment, they also remain an intricate part of natural communities. Exotic animal species such as feral hogs are considered disruptive to natural systems, but that is not addressed in this procedure.

In order for a score of 3 to be achieved for a wetland site, the system must provide habitat for all levels of the foodchain associated with that particular system.

2.2.1.2 WILDLIFE UTILIZATION RATING INDEX

Objective

The wildlife utilization variable is a measure of observations and signs (i.e. scat, tracks etc.) of wildlife, primarily wetland dependent species. In addition, potential wildlife use through the presence of wildlife food sources, nesting areas, roosting areas, den trees, protective cover and landscape position is also considered.

	Score
EXISTING WETLAND EXHIBITS NO EVIDENCE OF WILDLIFE • Existing wetland is heavily impacted. • No evidence of wildlife utilization. • Little or no habitat for native wetland wildlife species.	0
EXISTING WETLAND EXHIBITS MINIMAL EVIDENCE OF WILDLIFE UTILIZATION • Minimal evidence of wildlife utilization. • Little habitat for birds, small mammals and reptiles. • Sparse or limited adjacent upland food sources. • Site may be located in residential, industrial or commercial developments with frequent human disturbances.	1
EXISTING WETLAND EXHIBITS MODERATE EVIDENCE OF WILDLIFE UTILIZATION • Evidence of wetland utilization by small or medium-sized mammals and reptiles (observations, tracks, scat). • Evidence of aquatic macroinvertebrates, amphibians and/or forage fishes. • Adequate adjacent upland food sources. • Minimal evidence of human disturbance. • Adequate protective cover for wildlife.	2
EXISTING WETLAND EXHIBITS STRONG EVIDENCE OF WILDLIFE UTILIZATION • Strong evidence of wildlife utilization including large mammals and reptiles. • Abundant aquatic macroinvertebrates, amphibians and/or forage fishes. • Abundant upland food sources. • Negligible evidence of human disturbance. • Abundant cover and habitat for wildlife within the wetland or adjacent upland.	3

2.2.2.1 WETLAND OVERSTORY/SHRUB CANOPY

Introduction

The wetland overstory/shrub canopy variable is a measure of the presence, health and appropriateness of wetland shrub and overstory canopy. Canopy is defined as the plant stratum composed of all woody plants and palms with a trunk four inches or greater in diameter at breast height (4.5'), except vines (Department of Environmental Protection, 1994). Subcanopy (which includes shrubs) is that plant stratum composed of all woody plants and palms with a trunk or main stem diameter at breast height (4.5') between one and four inches, except vines (Department of Environmental Protection, 1994). However, WRAP does include species of vines that may impact the overall health of the overstory/shrub canopy (e.g., air potato, old-world climbing fern, grapevine, etc.).

Most of these wetland plant species have adapted to a restricted range of hydrologic regimes (South Florida Water Management District, 1995). Wetland overstory/shrub canopy provides many benefits to wildlife species such as cover, food, nesting and roosting areas. Wetlands can vary dramatically in the composition and density of overstory/shrub canopy species (Appendix B). This variable should be used when there is significant overstory/shrub canopy (i.e., the coverage of canopy/shrub species should exceed twenty percent of the overall wetland acreage). The variable can also be used when there is potential (i.e. immature) canopy present or for a forested wetland that has been clear cut (silviculture).

WRAP categorizes the overstory/shrub canopy species into few, moderate and abundant trees present. Using these categories the reviewer evaluates the Arial coverage and density of the overstory/shrub canopy for a particular wetland.

Certain wetland types characterized as deep-water marsh and wet prairie systems may exhibit limited or no canopy or shrub species (Myers, 1990, and Soil Conservation Service, 1987). In such situations, the variable would be designated "NA" (not applicable) and omitted from the final calculations.

The overall condition of an overstory/shrub canopy can be evaluated by observing indicators such as the presence of a large percentage of dead or dying trees or shrubs, soil subsidence, little or no seedling regeneration and the presence of an inappropriate understory plant species. Although short-term environmental factors such as flooding, drought and fire (Beever, unpublished) can temporarily impact the health of canopy, human activities such as flooding (i.e., stacking water in retention systems) or draining systems via ground water withdrawal and conveyance canals can permanently damage these systems**.** Silvaculture practices, when properly conducted, are considered short-term impacts (i.e., 10-15 years).

Exotic and nuisance (E&N) plant species have become a serious problem in south Florida, outcompeting and replacing native plant communities. Wetlands containing E&N plant species are impacted in various ways depending on the type of wetland and the degree to which it is infested. There are approximately 200 species of exotic plants currently listed by the Florida's Exotic Pest Council's *1995 List of Florida's Most Invasive Species*. WRAP has identified 31 species that most commonly occur in central and southern Florida; the species are listed in Appendix E. Many of the listed species can be found invading Florida wetlands. The predominant E&N species are: melaleuca, Brazilian pepper, old-world climbing fern and cattail.

The punk tree (*Melaleuca quinquenervia*) is an aggressive exotic tree that has infested tens of thousands of acres of south Florida wetlands. As melaleuca infests a wetland it changes the characteristics of the ecological community. Once established, melaleuca greatly reduces and in many cases eliminates the native understory of plant species.

Brazilian pepper (*Schinus terebinthifolius*) is another aggressive exotic tree that is rapidly spread by seed (birds and mammals). The largest populations occur on disturbed sites such as abandoned wet agricultural fields and canal banks. Brazilian pepper grows into dense thickets, reducing nesting areas and foraging areas for wildlife utilization (Myers and Ewel, 1990) and shading out native plant species.

The old-world climbing fern (*Lygodium microphyllum*) can greatly impact wetland groundcover, shrub strata and overstory strata. *Lygodium* can blanket an area, greatly reducing (by shading) or eliminating native plant species and severely impacting wildlife utilization. In addition, the fern can act as a conduit for fire to reach the tree canopy resulting in extensive damage or death of the tree.

2.2.2.2 WETLAND OVERSTORY/SHRUB CANOPY RATING INDEX

Objective

The wetland overstory/shrub canopy variable is a measure of the health and appropriateness of the wetland shrub and overstory canopy**.** The assessment of the canopy variable is objectively evaluated based on food resources, cover, nesting potential, and appropriateness of the vegetative community. The canopy stratum is evaluated based on the habitat type. This variable may not be applicable to freshwater marsh and wet prairie habitats where overstory/shrub canopy is typically not present (less than 20%). By definition, undesirable plant species include exotic and nuisance plant species.

Score

NO DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY TREES PRESENT 0

- No desirable wetland trees or shrub species.
- Negligible or little habitat support (i.e., roosting, nesting and foraging) from seedling trees (if present).
- Site subject to recent clear cutting with no evidence of native canopy plant regeneration.
- Greater than 75% undesirable plant species (including E&N species).

MINIMAL DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY TREES PRESENT 1

- Large amounts (approx.. 50%) of undesirable tree or shrub species.
- Wetland overstory/shrub canopy immature but some potential for habitat support.
- Minimal signs of natural recruitment of native canopy and shrub seedlings, or tree coppicing.
- Few snags, or if many present, it may be an indication of hydrology problems or environmental impacts.
- Disease or insect damage in live canopy trees.

MODERATE AMOUNT OF DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY TREES PRESENT 2

- Few (less than 25%) undesirable canopy trees/shrubs.
- Wetland overstory/shrub canopy is providing habitat support.
- Some evidence of natural recruitment of native canopy/shrub seedlings, or tree coppicing.
- Few snags or den trees.
- Healthy live canopy trees with minimal evidence of disease or insect damage.

ABUNDANT AMOUNT OF DESIRABLE WETLAND OVERSTORY/SHRUB CANOPY TREES PRESENT 3

- No exotic and less than 10% invasive canopy/shrub species present.
- Good habitat support provided by wetland overstory/shrub canopy.
- Strong evidence of natural recruitment of native canopy and shrub seedlings.
- Few snags or den trees.
- Healthy live canopy trees with minimal evidence of disease or insect damage.

2.2.3.1 WETLAND VEGETATIVE GROUND COVER

Introduction

The ground cover variable is a measure of the presence, condition and appropriateness of the wetland ground cover. Ground cover will be defined as the plant stratum composed of all plants not found in the canopy or subcanopy, including vines. Ground cover vegetation can provide a refuge for macro-invertebrates, fish fry, reptiles, amphibians, small mammals and also can provide a food source for small mammals, waterfowl and reptiles.

Ground cover vegetation can be classified into herbaceous, graminoid, non-graminoid and woody species. Ground cover can also be characterized according to growth form such as emergent, floating-leaf, submersed and free-floating surface. Most wetland species have adapted to a restricted range of hydrologic regimes (South Florida Water Management District 1995). Species composition of groundcover varies among ecosystems although many species overlap (Appendix B).

The health and abundance of wetland ground cover (particularly herbaceous) can be significantly affected by extremes in wetland hydrology. Deepwater conditions created by improper wetland control elevations or natural variability can drown wetland plant species. Conversely, drawdown of wetlands (due to wellfields and adjacent canals) and natural variability can reduce the presence of many wetland species and allow for the encroachment of more upland/transitional species. The health of the vegetation can also be evaluated in terms of plant robustness. If the plants are chlorotic or spindly (provided they aren't just planted), it may be a sign of nutrient deficiency, improper soils or hydroperiod response.

Human activities (including hydrologic impacts and extensive nutrient inputs) can promote significant changes in wetland ground cover. Mowing of herbaceous and graminoid wetlands for aesthetics can interfere with seed production of certain plants. Grazing by cattle can influence the species composition of some wetlands due to the introduction of nuisance species of plants (i.e., torpedograss (*Panicum repens*)). and other invasive grasses are tolerant of higher nutrient loads). In addition, cattle grazing and off-road vehicle traffic in wetlands create soil disturbance and compaction, as well as the destruction of native vegetation.

As previously noted, exotic and nuisance plant species have become a serious problem in south Florida by outcompeting and replacing native plant communities. Exotic and nuisance plant species such as torpedograss, primrose willow (*Ludwigia* spp.), old-world climbing fern, and cattail (*Typha* spp.) can be extremely invasive and disruptive to the groundcover of wetland systems. E & N plant species are to be considered when evaluating this variable.

2.2.3.2 WETLAND VEGETATIVE GROUND COVER RATING INDEX

Objective

The vegetative ground cover variable is a measure of the presence, abundance, appropriateness and condition of vegetative ground cover within the wetland. By definition, undesirable plant species include exotic and nuisance plant species.

	Score
NO DESIRABLE VEGETATIVE GROUND COVER IS PRESENT • Ground cover is greater than 75% undesirable vegetation. • Vegetative ground cover is intensively maintained, managed or impacted. • Site a freshly mulched created mitigation area with no evidence of seed germination.	0
MINIMAL DESIRABLE VEGETATIVE GROUND COVER IS PRESENT • Ground cover exhibits large amounts (approx. 50%) undesirable vegetation. • Ground cover routinely managed for either aesthetics or agricultural production. • Site a newly planted mitigation area with low plant biomass density. • Site newly mulched with signs of seed germination.	1
MODERATE AMOUNT OF DESIRABLE VEGETATIVE GROUND COVER IS PRESENT • Few undesirable groundcover plant species are present (less than 25%). • Ground cover slightly impacted (human induced effects). • Mulched or planted areas established with desirable native plant species.	2
ABUNDANT DESIRABLE VEGETATIVE GROUND COVER IS PRESENT • Less than 10% nuisance and inappropriate plant species with no exotic plant species. • Minimal or no disturbances to ground cover. • Area subjected to either managed or natural periodic burns for enhancement of ground cover.	3

2.2.4.1 ADJACENT UPLAND/WETLAND BUFFER

Introduction

The adjacent upland/wetland buffer variable is a measure of the adjacent habitat support for the subject wetland. This variable is evaluated based on the adjacent buffer size and the ecological attributes (i.e., sediment removal, nutrient uptake, cover, food source, and roosting areas) the buffer area is providing for the wetland system that is being assessed.

Wetland systems are subjected to disturbances that originate in adjacent upland areas. These disturbances can impact biological, chemical and physical attributes of wetlands (Castelle, et al, 1994). Buffers are vegetated areas located between the jurisdictional wetland line and adjacent areas subject to human disturbance. Adjacent wetlands also serve as wetland buffers. Buffers may consist of areas that are undisturbed native vegetation, areas wholly or partially cleared and revegetated, or areas with varying degrees of exotic and nuisance vegetation.

The criteria for determining adequate buffer sizes should be partly based on the quality of the wetland and the intensity of the adjacent land use (Castelle, et al, 1992). Smaller buffers are more acceptable when the adjacent land use is low intensity. Larger buffers are necessary when the adjacent land use intensity is high and the quality of the buffer is low. Buffers provide benefits to wetlands through sediment control (Shisler, et al, 1987), removal of excess nutrients and metals from runoff by both physical filtration and plant uptake (Madison, et al, 1992), and maintenance of habitat diversity for animal species that require the adjacent upland buffer to meet specific habitat needs (Naiman, et al, 1988).

Buffers also form a transitional zone between the wetland and the adjacent development. The edge effect theory proposes that the numbers of plant and animal species increase at the edge, due to overlap of adjacent habitats and the creation of unique edge-habitat niches (Castelle, et al, 1994). Finally, buffers can act to reduce direct human impact by reducing access to the wetland and blocking noise and light pollution.

Castelle, et al, (1994) state that buffers less than 15-30 feet provide little protection for aquatic resources. Buffers should be a minimum of 45-90 feet under most conditions. The lower range (45 feet) is necessary for maintenance of physical and chemical protection, while the upper range (90 feet) is a minimum for the protection of biological components. Habitat Suitability Index models have demonstrated the need for buffers between 10 and 350 feet depending on the resource needs of the particular species.

Buffer quality is also very important. A good buffer might contain a mixture of native tree, shrub and ground cover plant species. This would provide a visual and sound barrier for the wetland as well as a food source, cover and nesting habitat for wildlife species. In addition, the ground cover plant species would act as a filtration system for incoming surface water. An example of a low quality buffer would be a ring of dense Brazilian pepper around the wetland. The dense growth of the pepper allows little wildlife utilization. In addition, little or no ground cover can grow in the dense shade.

Large buffers (greater than 300 feet) consisting primarily of pasture grasses may provide spatial protection and some sediment control for wetlands. However, these types of buffers provide less benefit as cover, food source and roosting areas than a good quality buffer.

This procedure considers high volume traffic roads or highways as a severance to existing buffers. Low volume traffic roads (i.e., dirt maintenance or fire break roads) are considered as a continuation to the existing buffer, as well as shallow water bodies (e.g., small ditches and canals).

2.2.4.2 ADJACENT UPLAND /WETLAND BUFFER RATING INDEX

Objective

The adjacent upland /wetland buffer variable is a measure of the area adjacent to the subject wetland and the landscape setting of the wetland. This variable is evaluated based on the adjacent buffer size and the ecological attributes (i.e. cover, food source and roosting areas for wildlife) that this area is providing in association with the wetland that is being assessed.

Score

NO ADJACENT UPLAND/WETLAND BUFFER 0

- Buffer non-existent.

ADJACENT UPLAND/WETLAND BUFFER AVERAGES 30 FEET OR LESS, CONTAINING DESIRABLE PLANT SPECIES 1

- Less than 30 feet average width.
- Mostly desirable plant species which provide cover, food source, and roosting areas for wildlife.
- Not connected to wildlife corridors.
- Greater than 300 feet but dominated (greater than 75%) by invasive exotic or nuisance plant species.

ADJACENT UPLAND/WETLAND BUFFER AVERAGES GREATER THAN 30 FEET BUT LESS THAN 300 FEET, CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES 2

- Greater than 30 feet but less than 300 feet average width.
- Contains desirable plant species which provide cover, food, and roosting areas for wildlife.
- Portions connected with contiguous offsite wetland systems, wildlife corridors.
- Greater than 300 feet but dominated (greater than 75%) by undesirable noninvasive plant species (e.g., pasture grasses).

ADJACENT UPLAND/WETLAND BUFFER AVERAGES GREATER THAN 300 FEET CONTAINING PREDOMINANTLY DESIRABLE PLANT SPECIES 3

- Greater than 300 feet wide average width.
- Contains predominantly desirable plant species (less than 10% nuisance, and no exotic species) for cover, food, and roosting areas for wildlife.
- Connected to wildlife corridor or contiguous with offsite wetland system or areas that are large enough to support habitat for large mammals or reptiles.

2.2.5.1 FIELD INDICATORS OF WETLAND HYDROLOGY

Introduction

Wetland hydrology can be a difficult variable to evaluate given the limited timeframes associated with the regulatory process. Several field indicators enable an evaluator to make inferences with regard to wetland hydrology. The duration and magnitude of inundation within a wetland system can be estimated based on plant morphological responses, plant community structure and soil morphology.

Plant Morphological Responses - Several wetland plant species have developed morphological adaptations that enable them to survive extended periods of inundation. Many wetland tree and shrub species develop adventitious roots as a response to the duration of inundation. Extended periods of inundation promote the development of these secondary roots along the basal stem of the plant. Adventitious roots are formed when the primary root stock is inundated to the extent that anaerobic conditions severely reduce root oxygen and nutrient transport. In addition, recent cypress tree knee growth is an indication of extended inundation. The bark on the apex of the knee will be spread exposing light brown or tan new growth tissue.

Other indicators include small plant species that colonize on trunks of trees at the seasonal high water line. These hydrologic indicators can be used to assist in the determination of the magnitude of inundation (Hale, 1984). Lichen lines colonize down to the seasonal high water mark. Conversely, moss collars predominantly colonize up to the seasonal high water mark.

Plant Community Structure (PCS) - The plant community structure is a composition of the ground cover and the overstory/shrub canopy. PCS can be used to make inferences about hydrologic impacts resulting from an increased or a reduced hydroperiod. The evaluator uses the PCS to assess the plant species for a specific habitat. Plant community profiles associated with specific wetland habitats for use with this procedure are in Appendix B. Although this list is not inclusive, it includes plant species typically associated with a specific wetland system.

Transitional plant species such as slash pine (*Pinus elliottii*), wax myrtle (*Myrica cerifera*) and saltbush (*Baccharis halimifolia*) encroaching into the wetland can be cautiously used as evidence of recent decreases in the hydroperiod (Rochow, 1994, and Mortellaro, et al, 1995). Evaluation of these transitional tree and shrub species allows an observer to make some inference about the wetland hydroperiod over the last 1 - 3 years. When evaluating the ground cover plant community, the evaluator should remember that transitional changes within the plant community can occur within one year (Thibodeau and Nickerson, 1985). Care must be taken to distinguish effects of recent drought from more permanent impacts on hydrology.

Conversely, some wetland systems can be impacted by an increased hydroperiod. For example, an increased hydroperiod for a wet prairie will result in an extensive die-off of St. Johns Wort. This particular plant species is then replaced with deeper marsh plants such as maidencane (*Panicum hemitomon*), white water lilies (*Nymphaea odorata*) and cattails. In addition, if forested wetland systems are maintaining a proper hydroperiod, then seedling regeneration will be occurring either in openings within the canopy or on the periphery of the systems.

Before making accurate inferences about a reduced or increased hydroperiod, the evaluator should determine that the natural variability (e.g., extended droughts, excessive rainfalls, fires, etc.) is not causing the observed plant community response. Having knowledge of the average annual rainfall for the last 3 - 5 years will assist an evaluator with regard to this variable.

Soil Morphology - Soil morphology is used to evaluate soil development and characteristics. A reduced hydroperiod has a direct impact on organic soil development and can result in soil subsidence due to oxidation (Synder and Davidson, 1994). When significant oxidation occurs there may be tree falls, excessive tree leanings, exposed roots at trunk bases and gaps beneath cypress knees.

Alteration of Wetland Hydrology - Human induced impacts that can alter the hydrology of wetland systems include roads, drainage canals, levees, wellfields and changes to the drainage basin. These alterations typically manifest themselves in a noticeable shift in the wetland vegetative community. Roads can interrupt historical sheetflow patterns and decrease the amount of contributing basin to a wetland system or can block the natural flow and over-inundate the system. Drainage canals and wellfields are designed to move volumes of water from one area to another, whether it is for flood control or consumption. Both systems have hydrological cones of influence. The permeability of soils and the underlying geology in the vicinity of the wetland will determine the amount of drawdown these activities will cause in a wetland.

Changes to the contributing drainage basin can include increasing the amount of impervious surface (i.e., roofs, roads, parking lots, etc.) which in turn can increase the amount of water entering the wetland. This increase in hydrological input is sometimes accompanied by large decreases in the delivery time to the system, which may result in wide fluctuations in water level thus affecting the survivorship or overall health of the plant species. Conversely, project construction can decrease the size of the contributing basin, thus decreasing hydrological inputs.

Wetland systems in agricultural land use settings are sometimes preserved within retention areas. Adverse impacts can occur to these wetlands through the stacking of water (holding water levels above control elevation) or pumping too much water into the system. Both of these activities can drown or shift the species composition of the wetland.

2.2.5.2 FIELD INDICATORS OF WETLAND HYDROLOGY RATING INDEX

Objective

This variable is a measure of the hydrologic regime based on observed field indicators for the subject wetland including hydroperiod duration and magnitude. Wetland hydrology is generally interpreted using vegetative indicators. In addition, hydrologic indicators such as lichen lines, algal mats, adventitious roots and basal scarring are also utilized. Signs of altered hydrology may include encroachment of upland and transitional plant species into the wetland.

Score

HYDROLOGIC REGIME HAS BECOME SEVERELY ALTERED WITH STRONG EVIDENCE OF SUCCESSION TO TRANSITIONAL/UPLAND OR OPEN WATER PLANT COMMUNITY 0

- Wetland hydrology severely altered.
- Hydroperiod inadequate to support wetland plant species for the particular community type.
- Strong evidence that upland plants are encroaching into the historical wetland area as a result of a decreased hydroperiod.
- Die-off of wetland plant species as a result of an increased hydroperiod.
- In sites with an organic soil substrate, there is substantial soil subsidence.

HYDROLOGIC REGIME INADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM 1

- Site hydroperiod inadequate to maintain the system that is being created, enhanced or preserved.
- Succession of wetland plant species into transitional/upland plant species. Appropriate vegetation stressed or dying from too much or too little water.
- In sites with an organic soil substrate, there is evidence of soil subsidence.

HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM. EXTERNAL FEATURES MAY AFFECT WETLAND HYDROLOGY 2

- Wetland hydroperiod adequate, although conditions possibly interfering with or influencing the hydroperiod of site (i.e., canals, ditches, swales, berms, reduced drainage area, culverts, pumps, control elevation and wellfields) present.
- Plant community healthy, although there may be some signs of improper hydrology.
- In sites with an organic soil substrate, there is little evidence of soil subsidence.

HYDROLOGIC REGIME ADEQUATE TO MAINTAIN A VIABLE WETLAND SYSTEM 3

- Plants healthy with no stress resulting from an improper hydroperiod.
- Wetland exhibits a natural hydroperiod.
- Wetland not adjacent to canals, ditches, swales, berms, wellfields or other negative impacts to the wetland within the landscape setting.
- In sites with an organic soil substrate, there is no sign of soil subsidence.

2.2.6.1 WATER QUALITY INPUT AND TREATMENT

Introduction

Evaluating water quality within the limited timeframes of the regulatory process is a very difficult task. Without a long term water quality data-set it is virtually impossible to make any accurate inferences about water quality within a wetland system. However, literature review indicated that relatively comprehensive information was available for several water quality constituents including: total nitrogen, total phosphorus, ortho-phosphorus, BOD, TSS, total lead and total zinc (Harper, 1994).

For these selected constituents, runoff water quality varies with land use (Whalen and Cullum, 1988). The WRAP procedure utilizes nineteen land use categories to evaluate stormwater quality runoff and associated impacts. The land use categories were taken from *Stormwater Loading Rate Parameters for Central and South Florida* (Harper, 1994). The land use categories used in WRAP include the following: low-density residential, single-family residential, multi-family residential, golf course, low-intensity commercial, moderately-intensive commercial, high-intensity commercial, industrial, institutional, highways, citrus grove, sugar cane, row crops, improved pasture, unimproved pasture / rangeland, dairy and feedlot, mining, recreational and, open space/undeveloped natural areas. Each of these categories is defined in the Glossary. Using these land use designations is an important part of applying this Procedure in the field.

Pollutant loading rates from undeveloped natural areas are much lower than any other category. Loading rates for residential land uses increase steadily for each pollutant category from low-density to single-family to multi-family. These land use categories and their associated loading rates have been used within this Procedure to calibrate the water quality variable. The previously mentioned land use designations represent the vast majority of land uses within central and south Florida. The reviewer does have the option of field adjusting pollutant loading scores based on knowledge and/or observed farming practices (i.e., fertilizing and cattle density).

In addition to land use types, the efficiencies associated with different water management systems to remove pollutants must be considered. Treatment for the pollution in stormwater runoff is required in the state of Florida through the regulatory process. There are several possible treatment methods. Wet detention is the most commonly used mechanism, with approximately 70 percent of the water management systems permitted in south Florida being wet detention systems. Dry detention, and/or retention and some form of infiltration/filtration are the other types of treatment mechanisms that are also commonly used (Whalen and Cullum, 1988).

Wet detention systems, which include grass swales achieve up to 90 percent reduction for nutrients and solids. Wet detention basins provide good to excellent pollutant removal efficiencies. The standing water column provides for several physiochemical processes to achieve pollutant removal (Whalen and Cullum, 1988).

Treatment of stormwater by use of dry retention basins is generally considered to be inferior to that achieved by wet detention. The reason for the low removal of pollutants is most likely the absence of a standing water column, which provides a means for more extensive biological treatment (Whalen and Cullum, 1988).

If the treatment system is not operating as designed (i.e., flows bypassing the system, inoperative control structure, non-functional dry retention or impacts from off-road vehicles), the evaluator should consider this information in calculating the variable score.

In wetland systems that are totally isolated (i.e., bermed) from surrounding areas and receive only rainfall as part of the water budget, the evaluator should not consider the surrounding land use or pre-treatment rating index. A water quality score of 2.75 should be assigned under this scenario.

The water quality component of WRAP is used to evaluate the adjacent land use type (LU) and its contribution to the surface water budget for the subject wetland. WRAP does not consider groundwater inputs when calculating the water budget for a wetland system. This is due to the difficulties of quantifying and identifying groundwater sources.

The type of surface water management pretreatment (PT) associated with the subject land use is also considered. Both LU and PT are independently assessed and then summed. The summed total is then divided by two to calculate the water quality input and treatment (WQIT) score. Many times either on-site conditions are not accurately described or a combination of land uses exist adjacent to the subject wetland. In these instances the evaluator must evaluate each of the surrounding land use(s), and the surface water management system associated with each land use. For wetland systems that are wholly contained within a single land use, 100% of the water budget will be attributed to that land use.

The WQIT score is mathematically expressed as follows:

(%* surrounding x LU1) + (%* surrounding x LU2) +… (%* surrounding x LU(*n*)) = LU total

and,

(%* surrounding x PT1) + (%* surrounding x PT2) +… (%* surrounding x PT(*n*)) = PT total

hence,

WQIT = (LU total + PT total)/2

The scores for the PT systems are given with the assumption that the systems are built, operated and maintained in accordance with all applicable regulations and guidelines.

∗ % expressed as a decimal

2.2.6.2 WATER QUALITY INPUT AND TREATMENT RATING INDEX

Objective

The water quality variable of the rating index is a measure of the quality of the surface water flowing into the subject wetland from adjacent land uses (LU). The percent and type of surrounding land uses as well as any on-site pretreatment (PT) of surface waters prior to the discharge into wetlands is considered.

The scores for land use types are as follows:

LAND USE CATEGORY*	**SCORE**
natural undeveloped areas	3
unimproved pasture / rangeland	2.5
citrus grove	2
sugarcane	2
low density residential	2
low intensity commercial	2
low volume highway	2
institutional	2
single-family residential	1.5
recreational	1.5
golf course	1.5
moderately intensive commercial	1.5
high volume highway	1
industrial	1
mining	1
multi-family residential	1
improved pasture	1
row crop	1
high intensity commercial	0.5
dairy and feedlot	0

*see Glossary for definitions

The scoring increments for treatment systems are as follows:

PRE-TREATMENT CATEGORY	**SCORE**
natural undeveloped area	3
wet detention with swales	2.5

PRE-TREATMENT CATEGORY (CONTINUED)	**SCORE**
wet detention with dry detention	2.5
combination grass swales with dry detention	2
grass swales only/ vegetated buffer strip	1
dry detention only	1
no treatment	0

EXAMPLE FORMULA FOR WATER QUALITY INPUT AND TREATMENT VARIABLE (WQIT)

For the WRAP procedure, the permitted land use (or contributing basin) is considered the primary hydrological input to the wetland system. For example, a wetland is surrounded on 75 % of its perimeter by single-family residential (LU1) and 25% by an institutional land use (LU2). The surface water management systems of both projects discharge into the common wetland. The surface water management system for the single-family development consists of grass swales, and dry and wet detention (PT1). The surface water management system for the institutional land use consists of grass swales and dry detention (PT2). Both surface water management systems have been constructed and maintained in accordance with their permits. For the above example the WQIT would be calculated as follows:

Example: (%* surrounding LU1 x land use category score) + (%* surrounding LU2 x land use category score) = LU total

Hence: (.75 x 1.5) + (0.25 x 2.0) = LU total

Therefore: (1.13) + (0.5) = **1.63 = LU total**

plus,

(%* surrounding LU1 x pre-treatment category score) + (%* surrounding LU2 x pre-treatment score = PT total

Hence: (.75 x 2.5) + (0.25 x 2.0) = PT total

Therefore: (1.88) + (0.5) = **2.38 = PT total**

Hence: (LU total + PT total) / 2 = WQIT

Therefore: (1.63 + 2.38) / 2 = **2.0 = WQIT**

- % expressed as a decimal

2.3 DESCRIPTION OF FIELD DATA SHEET

When assessing a wetland system using WRAP it is important that the evaluator document site information and field observations on the field data sheet (section 2.3.1). The following is a description of the information required when filling out the field data sheet.

Permit Number - any identification number for the site, either permit number or application number. This number must be inherent to a specific project so it can be used to identify the project area accurately for future assessments.

Project – the project name or parcel name of the wetlands being evaluated.

Date – the date on which the evaluation was conducted.

Evaluator – the name of the individual who preformed the evaluation.

Wetland Type – the type of wetland system (e.g., wet prairie, cypress dome, etc.) being assessed.

Land use – the permitted land use for the subject project.

Wildlife Utilization – a measure of the wildlife utilization within the subject wetland. Noted signs and observations should be documented within the "Comments" section to support the wildlife utilization assessment.

Wetland Canopy – a measure of the overstory/shrub canopy for the subject wetland. Field observations should be documented in the "Comments" section to substantiate the assessment of the wetland canopy variable.

Wetland Ground Cover - a measure of the wetland ground cover for the subject wetland. Field observations should be documented in the "Comments" section to substantiate the assessment of the wetland ground cover variable.

Habitat Support/Buffer - a measure of the habitat buffer for the subject wetland. Field observations should be documented in the "Comments" section to substantiate the assessment of the habitat support/buffer variable.

Field Hydrology - a measure of the field indicators of hydrology for the subject wetland. Field observations should be documented in the "Comments" section to substantiate the assessment of the field hydrology variable.

WQ Input & Treatment - a measure of the water quality input and surface water pre-treatment for the subject wetland. Field observations should be documented in the "Comments" section to substantiate the assessment of the water quality variable.

FLUCCS – Florida Land Use, Cover and Forms Classification System designation of the particular wetland being evaluated.

WRAP Score – the overall assessment score for the subject wetland. Each variable score is summed and then divided by the total possible maximum score for the variables (See Section 2.2). The final WRAP score is expressed as a number between zero and one.

Wetland Rapid Assessment Procedure

☑ Check one
☐ Existing Conditions ☐ Proposed Conditions (WRAP)

Application Number	Project Name	Date	Evaluator	Wetland Type

Land Use	FLUCCS Code		Wetland Acreage
		Description:	

Wildlife Utilization (WU)

Wetland Canopy (O/S)

Wetland Ground Cover (GC)

Habitat Support / Buffer

Buffer type	(Score)	X (% of area)	=Sub Totals
		TOTAL	

Field Hydrology (HYD)

WQ Input & Treatment (WQ)*

* The value of WQ is obtained by adding the TOTAL scores of Land use Category and Pretreatment category then dividing by 2

Land use Category (LU)

Land use Category	(Score)	X (% of area)	=Sub Totals
		(LU) TOTAL	

Pretreatment Category (PT)

Pretreatment Category	(Score)	X (% of area)	=Sub Totals
		(PT) TOTAL	

WRAP Score

Field Notes:

Wildlife Utilization (WU)
Wetland Canopy (O/S)
Wetland Ground Cover (GC)
Habitat Support / Buffer
Field Hydrology (HYD)
WQ Input & Treatment (WQ)

3.0 OBJECTIVES OF TESTING THE WRAP PROCEDURE

1. Determine the precision and accuracy of the procedure among individual evaluators using a two-way Analysis of Variance (Anova) of unequal class sizes;

2. Determine if collinearity existed between the WRAP variables;

3. Determine graphically if the functional and structural attributes measured in WRAP respond to human activities.

3.1 DESIGN PROTOCOL FOR WRAP VARIABLE CALIBRATION

The goal of establishing a design protocol for WRAP was to verify that attributes of wetland systems that were being measured responded to human actions. Data were collected and then analyzed both statistically and graphically to attempt to link human activity within project sites to responses within the wetland systems.

Ten land use designations were originally selected in the attempt to determine the degree of impact associated with the wetland variables identified in WRAP. The ten land use designations described in WRAP were as follows:

- Agriculture
- High Intensity Commercial
- Highway
- Industrial
- Institutional
- Low Density Residential
- Low Intensity Commercial
- Multi-Family Residential
- Recreational/Open Space
- Single-Family Residential

A design protocol was implemented within three geographical regions of south and central Florida: the Ft. Myers region, the Orlando region and the West Palm Beach region (which coincide with the location of the District's largest service centers). Evaluators from each of the service centers established three sites for each of the ten different land use designations.

Of the three sites selected for each land use, one was evaluated prior to any development activity, while the other two were within completed permitted projects. Altogether 27 sites were evaluated within each geographical region, for a total of 81 sites District-wide in the initial testing of this protocol.

Evaluations of the three sites per land use prior to development will be used to track trends over

time and to document human activities and associated responses of the wetland attributes used in WRAP. In addition, the undeveloped sites will be used to test the validity of WRAP as a predictive tool for evaluating wetland impacts, as a result of project development. The WRAP prediction scores will be validated as each project is completed and as-built WRAP scores are compared to the predicted scores.

The evaluation of the remaining six sites per land use, constructed projects, will be used to validate whether or not the selected wetland attributes show a response to human influences.

The testing protocol required 3 - 5 evaluators per site to collect the proper data for the statistical analysis. A minimum of 250 data points was selected as the goal for the initial testing of WRAP.

In addition, five wetland types were selected in conjunction with the ten land uses for preliminary testing of the WRAP. The types were selected as representative wetland communities that had been typically impacted by development within each geographic region. The wetland types selected per region were as follows:

Service Center	**Wetland Community Type**
West Palm Beach	Wet Prairie, Emergent Marsh
Orlando	Cypress Swamp, Mixed Hardwood
Fort Myers	Wet Prairie, Hydric Pines

WRAP evaluators selected testing sites based on the availability of the regional wetland community types and the ten designated land uses. In the future, additional wetland types and adjacent land uses will be evaluated within each region.

WRAP evaluator training consisted of a two-day course. A half a day was spent introducing the Procedure along with selecting training sites for field evaluation. The selected sites were reviewed in the office using the procedures outlined in WRAP. The remaining day and a half was spent in the field evaluating between 6 – 8 sites in accordance with the field evaluation procedures outlined in WRAP.

The collected data are being evaluated graphically by comparing WRAP scores for individual wetland attributes (y-axis) to specific land use designations (x-axis). This will assist in substantiating the selection of each attribute and the way human activities affect it.

Statistically, a two-way Anova of unequal class sizes was applied to the data set. This Anova design was used for each evaluator at each wetland, and the error associated with differences in evaluator scores estimated as a component of variance. When calculating components of variance from an Anova model the variance is partitioned among each of the sources of variance.

The statistical Anova model for WRAP is as follows:

$$\text{WRAP Score} = \text{Wetland}_i + \text{Evaluator}_j + \text{error}_k$$

where: Wetland_i = resource condition at the *ith* wetland

Evaluator_j = effect of the *jth* Evaluator

From this model the variance can be estimated for each component. If the variance resulting from differences in the wetlands is much larger than the variance resulting from different evaluators, then the differences in evaluators are not important. If observer variance is large relative to the associated error or site differences, then the protocol needs to be reevaluated.

3.2 RESULTS

Statistical Summary

A total of 303 data points were used in the preliminary testing of WRAP. This included 81 different wetland sites with an average 3-5 evaluators per site, 8 different wetland communities and 19 land use designations.

The data were found to be normally distributed. Preliminary evaluation of the data using SAS procedure Proc GLM was used to determine procedure repeatability (two-way Anova). The analysis results are shown in Table 1.

Table 1. Summary of two-way Anova statistical analysis of WRAP.

Source of variance	p value	% variance
Site	.00001	98.6
Observer	0.7751	0
Error		1.4
R square = 0.96	Range = 0.31-0.95	Mean = 0.64

The data results indicate the current procedure is highly repeatable among evaluators, with 98.6 % of the variability explained by differences in sites. The variability caused by differences in evaluators was approximately 0. It should be noted that although 3-5 evaluators visited each of the 81 different sites, a total of 17 different evaluators participated in the data collection.

Analysis for multicollinearity and correlation among the variables yielded no significant correlations. Although the testing has indicated no correlation among the variables, the authors have chosen to eliminate the Exotic and Nuisance Plant variable as a separate variable and incorporate its components into the Wetland Overstory/Shrub Canopy, Wetland Vegetative Ground Cover and Adjacent Upland/Wetland Buffer variables. This change will eliminate some of the confusion in using the procedure and in the perception that the presence of exotic and nuisance plant species has been unfairly weighted.

During the development and testing of WRAP it became apparent that this type of procedure is an effective wetland assessment training tool for small groups (< 6 people). In many instances, the groups consisted of individuals with different areas of expertise. This resulted in significant and open discussion about each variable. A comment frequently heard during the testing of WRAP was that the procedure requires the evaluator to evaluate each variable independently. This may assist in eliminating personal bias when evaluating wetland systems.

Additional graph analysis is being used in an attempt to determine how the functional and structural attributes measured in WRAP respond to human induced activities.

4.0 SUMMARY

As indicated by the statistical results, WRAP is a repeatable assessment procedure. The majority (98.6%) of the error associated with the analysis was with differences between sites, not evaluators. The development of any wetland functional assessment procedure requires an iterative process to assess a wide assortment of field conditions.

In addition, each individual variable was shown to be independent. The authors have chosen to eliminate the Exotic and Nuisance Plant variable and incorporate its components into the Wetland Overstory/Shrub Canopy, Wetland Vegetative Ground Cover and Adjacent Upland/Wetland Buffer variables to reduce confusion in using the assessment procedure.

The overall objective in the development of WRAP is to utilize as much information as possible, both from literature reviews and professional experience, and organize it in the form of a simple but accurate rating index. In order for any wetland functional assessment procedure to be accepted by the regulatory community, the procedure has to be simple enough to use without collecting time-consuming field data and must be able to be completed within a relatively short time period.

It is important to follow the office and field procedures outlined in Section 2.1 when applying WRAP. The testing of the Procedure revealed that the majority of the differences (e.g., identifying surrounding land uses, water quality treatment, etc.) resulted from an inadequate review of the project site prior to the actual field visit. A thorough office evaluation of the project site will help reduce these disparities, as well as reveal any on-going maintenance programs or wildlife studies done for the site or adjacent areas.

Field evaluations are used to verify the information obtained from the office review. Frequently, the field inspections reveal that the water quality treatment component has not been implemented or maintained in accordance with permit design. In these cases, the evaluators must adjust their scores accordingly. It is crucial that the evaluator documents, on the field data sheet, the justification for the revised scores. It is recommended that after conducting a WRAP evaluation, the evaluator keeps the score sheet, with field notes and justification for each variable score, for future reference. Good field notes will also be useful when evaluating the system on a long-term basis.

One of the original goals of testing the design protocol was to evaluate wetland function impacts associated with specific land uses. Once the testing of WRAP was complete, it became apparent that for most land uses the data set was inadequate to make any inferences in this regard. However, as additional data are collected, further analysis will be conducted in an attempt to establish a relationship between land use and wetland function.

Finally, the testing of WRAP identified nine additional land uses that were not originally identified in the "Design Protocol for WRAP Variable Calibration" (See Section 3.1). Most were multiple land uses with variations of the original ten land uses.

5.0 SELECTED REFERENCES

Allen, A.W. 1987. *Habitat suitability index models: barred owl.* U.S. Fish and Wildlife Service, Biological Report 82/10.143. 17 pages.

Allen, A.W. 1984. *Habitat suitability index models: Eastern cottontail*. U.S. and Fish Wildlife Service, FWS/OBS-82/10.66. 23 pages.

Allen, A.W. 1982. *Habitat suitability index models: fox squirrel*. U.S. Fish and Wildlife Service, FWS/OBS-82/10.18. 11 pages.

Allen, A.W. 1987. *Habitat suitability index models: gray squirrel*. revised. U.S. Fish and Wildlife Service, Biological Report 82/10.135. 16 pages. [First printed as: FWS/OBS-82/10.19, July 1982].

Armbruster, M.J. 1987. *Habitat suitability index models: greater sandhill crane*. U.S. Fish and Wildlife Service, Biological Report 82/10.140. 26 pages.

Beever, J.W. III and L.B. Beever. *The Effects of Annual Burning on the Understory of a Hydric Slash Pine Flatwoods in Southwest Florida* (unpublished). Florida Game and Fresh Water Fish Commission, Punta Gorda., Florida. 26 pages.

Boyle, K.A. and T.T. Fendley. 1987. *Habitat suitability index models: bobcat.* U.S. Fish and Wildlife Service, Biological Report 82/10.147. 16 pages.

Brinson, M.M. 1993. *A Hydrogeomorphic Classification for Wetlands*. U.S. Army Corps of Engineers, Waterways Experimental Station: Wetland Research Program WRP-DE-4. Vicksburg, Mississippi. 101 Pages.

Broward County Department of Natural Resource Management. 1993. *Wetland Benefit Index.* Ft. Lauderdale, Florida. 4 pages.

Castelle, A.J., C. Conolly , M. Emers, E.D. Metz, S. Meyer, M. Witter, S. Mauermann, T. Erickson, and S.S. Cooke. 1992. *Wetland Buffers: Use and Effectiveness.* Publ. 92-10. Adolfson Association for Shorelands and Coastal Zone Management Program. Washington Department of Ecology, Olympia, Washington. 171 pages.

Castelle, A.J., A.W. Johnson, and C. Conolly. 1994. *Wetland and Stream Buffer Size Requirements - A Review*. Journal of Environmental Quality. Pages 878-882.

Florida Exotic Pest Plant Council. 1995. *Florida Exotic Pest Plant Council's 1995 Most Invasive Species*. Boca Raton, Florida. 10 pages.

Florida Department of Environmental Regulation (DER). 1994. *Delineation of Landward Extent of Wetlands and Surface Waters*. Section 62-340.100, Florida Administrative Code. 49 pages.

Florida Department of Transportation. 1985 (2nd edition). Florida Land Use, Cover and Forms Classification Systems. Procedure No. 550-010-001-a. Pages 33-38.

Graves, B.M. and S.H. Anderson. 1987. *Habitat suitability index models: bullfrog*. U.S. Fish and Wildlife Service, Biological Report 82/10.138. 22 pages.

Hale, M.E., Jr. 1984. *The Lichen Line and High Water Levels in a Fresh Water Stream in Florida.* The Bryologist 37(3), Pages 261-265.

Harper, H.H. 1994. *Stormwater Loading Rate Parameters for Central and South Florida.*. Environmental Research & Design, Inc. Orlando, Florida. 59 pages.

Lodge, T.E., R.B. Darling, D.J. Fall, and H.O. Hillestad. January 15-22, 1994. Seminar entitled "*A Wetland Evaluation Method for the Everglades: Impact to Mitigation. Law Companies.*" A Presentation by Law Companies, Inc. at the Florida Water Policy and Management, Telluride, Colorado.

Lodge, T.E. 1994. *The Everglades Handbook:Understanding the Ecosystem*. St. Lucie Press, Delray Beach, Florida. Pages 25-26.

Lewis, J.C. 1983. *Habitat suitability index models: roseate spoonbill*. U.S. Fish. and Wildlife Service , FWS/OBS-82/10.50. 16 pages.

Madison, C.E., R.L. Blevins, W.W. Frye, and B.J. Barfield. 1992. *Tillage and Grass Filter Strip Effects upon Sediment and Chemical Losses*. Page 331**.** In Agronomy abstracts. American Society of Agronomists**.** Madison, Wisconsin.

Marsh, A. 1994. *Common Freshwater Fishes of Southern Florida* (unpublished). Florida Atlantic University, Boca Raton, Florida. 1 page.

Marsh, A. 1994. *Common Aquatic Insect Taxa* (unpublished). Florida Atlantic University, Boca Raton, Florida.. 2 pages.

Mortellaro, S., S. Krupa, L. Fink, and J. Van Horn. 1995. *Literature Review on the Effects of Groundwater Drawdown on Isolated Wetlands.* Technical Publication No. 96-01. South Florida Water Management District, West Palm Beach, Florida. 44 Pages.

Myers, R. L. and J.J. Ewel (editors). 1990. *Ecosystems of Florida*. University Presses of Florida, Gainesville, Florida. 765 pages.

Naiman, R..J., H. Decamps, J. Pastor, and C.A. Johnson. 1988. *The potential importance of boundaries to fluvial systems.* Journal of North American Benthological Society 7(4):289-306.

Newsom, J.D., T. Joanen, and R.J. Howard. 1987. *Habitat suitability index models: American alligator*. U.S. Fish and Wildlife Service, Biological Report 82/10.136. 14 pages.

Peterson, A. 1985. *Habitat suitability index models: bald eagle.* U.S. Fish and Wildlife Service, Biological Report 82/10.126. 25 pages.

Prose, B.L. 1985. *Habitat suitability index models: belted kingfisher.* U.S. Fish and Wildlife Service, Biological Report 82/10.87. 22 pages.

Rochow, T.F. 1994. *The Effects of Water Table Level Change on Freshwater Marsh and Cypress Wetlands in the Northern Tampa Bay Region.* Southwest Florida Water Management District. Technical Report 1994-1, Brookesville, Florida. 46 Pages.

Schroeder, R.L. 1985. *Habitat suitability index models: pine warbler* 1st rev. U.S. Fish and Wildlife Service, FWS/OBS-82/10.28. 9 pages. [First printed September 1982].

Schroeder, R.L. 1982. *Habitat suitability index models: pileated woodpecker.* U.S. Fish and Wildlife Service, FWS/OBS-82/10.39. 15 pages.

Schoeder, R.L. 1985. *Habitat suitability index models: Eastern wild turkey.* U.S. Fish and Wildlife Service, Biological Report 82/10.106. 33 pages.

Shisler, J.K., R.A. Jordan, and R.N. Wargo. 1987. *Coastal Wetland Buffer Delineation.* New Jersey Department of Environmental Protection, Division of Coastal Resources, Trenton, New Jersey.

Short, H.L. and R.J. Cooper. 1985. *Habitat suitability index models: great blue heron.* U.S. Fish and Wildlife Service, Biological Report 82/10.99. 23 pages.

Short, H.L. 1986. *Habitat suitability index models: white-tailed deer in the Gulf of Mexico and Atlantic coastal plains.* U.S. Fish and Wildlife Service, Biological Report 82/10.123. 36 pages.

Snyder, G.H. and J. M. Davidson. S.M. Davis and J.C. Ogden (editors). 1994. *Everglades Agriculture: Past, Present and Future (in) Everglades: The Ecosystem and its Restoration.* St. Lucie Press, Delray Beach, Florida. Pages 85-115.

Soil Conservation Service of the U. S. Department of Agriculture. Reprinted 1987. *26 Ecological Communities of Florida.* Gainesville, Florida. 296 pages.

Sousa, P.J., and A.H. Farmer. 1983. *Habitat suitability index models: wood duck.* U.S. Fish and Wildlife Service, FWS/OBS-82/10.43. 27 pages.

South Florida Water Management District. 1982. *Save our Rivers Project Evaluation Rating index* (unpublished). West Palm Beach, Florida. 9 pages.

South Florida Water Management District. 1995. *Technical Support for Development of Wetland Drawdown Criteria for Florida's Lower West Coast Part 1. Results of Literature Review Modeling Studies and Expert Opinion.* (unpublished). West Palm Beach, Florida. 431 pages.

Stuber, R.J., G. Gebhart, and O.E. Maughaun. 1982. *Habitat suitability index models: largemouth bass.* U.S. Fish and Wildlife Service, FWS/OBS-82/10.16. 33 pages.

Stuber, R.J., G. Gebhart, and O.E. Maughn. 1982. *Habitat suitability index models: bluegill.* U.S. Fish and Wildlife Service, FWS/OBS-82/10.8. 26 pages.

Thibodeau, F.R., and N. H. Nickerson. 1985. *Changes in Wetland Plant Association Induced by Impoundment and Draining*. Biological Conservation, Vol. 33, Pages 269-279.

Twomey, K.A., G. Gebhart, O.E. Maughan, and P.E. Nelson. 1984. *Habitat suitability index models and instream flow suitability curves: redear sunfish.* U.S. Fish and Wildlife Service, FWS/OBS-82/10.79. 29 pages.

U.S. Fish and Wildlife Service, National Ecology Research Center. 1993. *Habitat Evaluation Procedures Workbook.* revised. 282 Pages. [First Printed 1980].

Van-Miller, S. 1987. *Habitat suitability index models: osprey*. U.S. Fish and Wildlife Service, Biological Report 82/10.154. 58 pages.

Whalen, P.J., and M.G. Cullum. 1988. *An Assessment of Urban Land Use/Stormwater Runoff Quality Relationships and Treatment Efficiencies of Selected Stormwater Management Systems.* South Florida Water Management District, Technical Publication 88-9. West Palm Beach, Florida. 56 pages.

SPECIES HABITAT REQUIREMENT TABLE

Appendix A

SPECIES	FOOD	COVER	REPRODUCTION	HABITAT SIZE
Great Blue Heron (Ardea herodias)	Water is less than 50cm deep, fish, reptiles, and macro-invertebrates.	Not a limiting factor.	Trees 5 - 15 m. Ht. Riparian swamp. Tree islands.	0.4 ha - 4.8 ha.
Bullfrog (Rana cstesbeiana)	Fish, reptiles, macro-invertebrates amphibians.	Groundcover, understory, stumps, logs, and banks	Continuous standing water.	Not a limiting factor.
Barred Owl (strix varia)	Small mammals, reptiles, fish, and macro-invertebrates	Dense forested wetlands Deciduous riparian woodlands.	Trees are larger than 50 cm dbh. Nest cavity greater than 7.6 m from ground.	Greater than 10 ha.
Wood Duck (apix sponsa)	Aquatic plants, fruits, insects, acorns and macro-invertabrates.	Downed timber, dense shrub, canopy riparian forest.	50 - 75% cover (tree cavities, shrubs). 25 - 50% open water.	Greater than 4 ha.
Eastern Cottontail (sylvilagus floridanus)	Grasses, herbs, flowers (usually not a limiting factor).	Shrubby cover adjacent to field edges, savanna prairie, forbs, brambles.	Grasses are less than 20 cm high.	Greater than 4 ha.
Alligator (alligator mississippiensis)	Small mammals, large mammals, birds reptiles, fish, & macro-invertebrates.	Palustrine emergent. Estuarine emergent vegetation.	Sloping banks, with available vegetation	Greater than 5 ha.
Sandhill Crane (Grus camadensis)	Insects, macro-invertebrates, reptiles, amphibians, roots, small mammals.	Roosting site typically within large wetlands (cover typically not a limiting factor).	Large marsh complexes. Scattered marshes, bogs (isolation).	Dependent on isolated wetland.
White-tailed deer (Odocoileus virginianus)	Seeds, fruits, twigs, acorns, shoots, buds, broadleaved herbaceous plants, grasses.	Swamps, thickets, broken mixes of forest & agricultural land. Forested area with limited tree canopy.	See cover	Greater than or equal to 40 ha.

SPECIES	FOOD	COVER	REPRODUCTION	HABITAT SIZE
Bobcat (Felis rufus)	Large, medium & small mammals, reptiles, and birds.	Thickets, hollow stumps, logging debris, bottomland hardwood , mixed grassy areas.	Thickets, hollow stumps, logging debris.	Minimum is greater than 1 km. Opt. is greater than 20 km.
Large mouthed bass (Micropterus Salmoides)	Insects, macroinvertebrates, crustaceans. fish and amphibians.	Some standing water at all times. Riverine- sufficient pools of less than 6 cm per second flow.. Lacustrine and lakes with greater than 25% area less than 6 m depth. Optimal cover 40 - 60% of logs, brush, and debris, in littoral areas or pools.	Nesting area: Gravel, vegetation sand, mud, roots, cobble, 0.15 - 7.5 m depth.	No minimum habitat size established.
Belted Kingfisher (Ceryle alcyon)	Fish, crayfish, frogs, & insects.	Roosts on single limbs about 6 - 7 m above ground. Bare branches, wires for fishing.	Shrub cover (brooding), Nesting borrows in steep banks devoid of vegetation	Greater than 1.0 km of lake shore or stream.
Bald Eagle (Haliaeetus leucocephalus)	Birds, medium to small mammals, fish, reptiles & amphibians, macro-invertebrates	Sheltered timber stands.	Old-growth & second-growth timber. Mature trees, open forest structure within 182 m of a lake or fishable body of water.	8 ha of water surrounded by 1.5 km strip of land.
Fox Squirrel (Sciurus niger)	Seeds, mast, buds, insects, tubers, roots, and birds eggs.	Hardwood or pine flatwoods with little understory. Stands of large trees interspersed with agricultural lands, well-drained bottomlands.	Leaf nests, tree cavaties.	2 ha
Gray Squirrel Sciurus carolinensis)	Mast, fruit, buds, seeds, bark, roots, fungus, and animal matter.	Mature hardwood forest with dense well developed understory. Sawtimber trees greater than 22.8 cm in dbh. trees greater than 22.8 cm in dbh.	Hardwood stands greater than 60 years old, den trees, leaf nests.	Greater than 0.4 ha.

SPECIES	FOOD	COVER	REPRODUCTION	HABITAT SIZE
Redear sunfish Lepomis microlophus)	Juvenile-algae microcrustaceans, Adults-zooplankton, macro-invertabrates and crustaceans.	Lacustrine, palustrine, slow moving rivervine, vegetated shallow areas with brush, stumps and logs.	Depth of water at nest varies 5 cm to 6 m. Vegetative free substrate. Sandy clay, gravel, limestone, shells & mud.	No minimum size established.
Roseate spoonbill Ajaia ajaia)	Fish, crustaceans, macro-invertebrates	Islands, islets, keys, shrubs and forest wetlands, roosting trees, & shrubs 2 - 6 m up to 30m.	Mangrove thickets, horizontal limbs. (See cover requirements). Nest height 0.5 m - 10 m on islands. 3 - 20 m on mainland.	Colonial birds. Important that the island is greater than 4 km from mainland.
Bluegill (Lepomis macrochirus)	Zooplankton, aquatic and terrestrial insects, and plant material.	Lacustrine, palustrine and slow-moving riverine. Fertile water bodies with submerged vegetation, logs, brush.	Vegetated areas & unvegetated areas. Substrate - fine gravel, sand, sandy - cla mud, limestone shells. 1 - 3 m water depth.	No minimum habitate size established.
Pine warbler (Dendroica pinus)	Insects, pine seeds, wild fruits, berries.	Pure stands of seral pine trees. 35 - 100 years old, mature conifers.	Horizontal branches in needles at end of a branch or in a clump of cones. Nests at heights greater than 8 m.	Usually greater than 10 ha.
Pileated woodpecker (Dryocopus pileatus)	Ants, beetles, wild fruit.	Foraging: dense canopies with numerous snags, stumps & logs. Cover: dense forests, mesic habitats.	Cavity nesters. Tall snags. Nests at greater than 51 m off ground.	Greater than 130 ha.
Eastern Wild Turkey (Meleagris gallapavo sylvestris)	Grasses, acorns, seeds, fruits, tubers, bulbs insects, amphibians, crustaceans.	Open mature woodlands, mixture of forests and open lands.	Nests on ground concealed by dense brush, mayfields, fence rows, and utility right-of-ways.	Greater than 900 ha.
	insects, amphibians, crustaceans.	forests and open lands.	brush, mayfields, fence rows, and utility right-of-ways.	

APPENDIX B

HABITAT COMMUNITY PROFILES

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP.	HYDROLOGY
Everglades	Five Lined Skink	Slash Pine	Sawgrass	Inundation 2-6 months
	(Eumeces inexpectatus)	*(Pinus elliotti var. densa)*	*(Cladium jamaicense)*	
Rocky Glades	Pygmy Rattlesnake	Cabbage Palm	Camphor Weed	
	(Sistrurus miliarius)	*(Sabal palmetto)*	*(Pluchea spp.)*	
	Hawk Guild	Gallberry	Snowberry	
	(Buteo spp.)	*(Ilex galbra)*	*(Chiococca alba)*	
	Carolina Wren	Myrsine	Beak Rush	
	(Thyothorus ludovicianus)	*(Myrsine spp.)*	*(Rhynchospora spp.)*	
	* Pine Warbler	Poisonwood	Wire Grass	
	(Dendroica pinus)	*(Metopium toxiferum)*	*(Aristida spp.)*	
	Opposum	Dahoon Holly	Muhly Grass	
	(Didelphis virginiana)	*(Ilex cassine)*	*(Muhlenbergia capillaris)*	
	Marsh Rabbit	Saltbus	Periphyton	
	(Sylvilagus palustris)	*(Baccharis spp.)*	*(Blue-green algae, etc.)*	
	Cotton Rat	Carolina willow	White-top Sedge	
	(Sigmodon spp.)	*(Salix caroliniana)*	*(Rhynchospora colorata)*	
	Cotton Mouse	Swamp bay	Mermaid-weed	
	(Peromyscus gossypinus)	*(Persea palustris)*	*(Proserpinaca spp.)*	
	Racoon		Glades lobelia	
	(Procyon lotor)		*(Lobelia glandulosa)*	
	* Bobcat			
	(Lynx rufus)			
	* Deer			
	(Odocoileus virginianus)			

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP	HYDROLOGY
Everglades	Cricket Frog *(Acris gryllus dorsalis)*	Slash Pine *(Pinus elliottii var. densa)*	Sawgrass *(Cladium jamaicense)*	Inundation > 4 months
Marl Glades	Squirrel treefrog *(Hyla squirella)*	Cabbage Palm *(Sabal palmetto)*	Spike Rush *(Eleocharis cellulosa)*	
	Leopard Frog *(Rana sphenocephala)*	Dahoon Holly *(Ilex cassine)*	Swamp Lily *(Crinum americanum)*	
	Pig frog *(Rana grylio)*	Poisonwood *(Metopium toxiferum)*	Beak Rush *(Rhynchospora spp.)*	
	Cotton Mouth *(Agkistrodon piscivorus)*	Pond Cypress *(Taxodium ascendens)*	Periphyton *(Blue-green Algae, etc)*	
	Water Snake *(Nerodia pp.)*		Muhly Grass *(Muhlenbergia capillaris)*	
	Aquatic Turtle guild		Flat Sedge *(Cyperus elegans)*	
	* Heron and Egret guild		Flat Sedge *(Cyperus haspan)*	
	Hawk Guild *(Buteo spp.)*			
	White Ibis *(Guara alba)*			
	* Bobcat *(Lynx rufus)*			
	* Deer *(Odocoileus virginianus)*			
	Marsh Rabbit *(Sylvilagus palustris)*			
	Racoon *(Procyon lotor)*			

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP	HYDROLOGY
Everglades	Pig frog	Cypress	Sphagnum moss	Inundation > 9 months
	(Rana grylio)	*(Taxodium spp.)*	*(Sphagnum spp.)*	Saturated 12 months/yr
Organic Glades	Cricket Frog	Slash Pine	Pickerel Weed	
	(Acris gryllus dorsalis)	*(Pinus elliottii var. densa)*	*(Pontederia spp.)*	
	Little Grass Frog	Red Bay	Duck Potato	
	(Limnaoedus ocularis)	*(Persea palustris)*	*(Sagittaria spp.)*	
	Aquatic turtle guild	Sweet Bay	Beak Rush	
	* American Alligator	*(Magnolia virginiana)*	*(Rhynchospora spp.)*	
	(Alligator mississippiensis)	Fetterbush	Fragrant Water Lily	
	Crayfish snake	*(Lyonia lucida)*	*(Nymphaea odorata)*	
	(Regina alleni)	Buttonbush	Spike Rush	
	* Barred Owl	*(Cephalanthus occidentalis)*	*(Eleocharis spp.)*	
	(Strix varia)	Wax Mrytle	Swamp Lily	
	* Pileated Woodpecker	*(Myrica cerifera)*	*(Crinum americanum)*	
	(Hylatomus pileatus)		Maidencane	
	White Ibis		*(Panicum hemitomon)*	
	(Guara alba)		Sawgrass	
	Heron and Egret guild		*(Cladium jamaicense)*	
	Hawk Guild			
	* Barred Owl			
	(Strix varia)			
	* Pileated Woodpecker			
	(Hylatomus pileatus)			
	River Otter			
	(Lutra canadensis)			
	* Bobcat			
	(Lynx rufus)			
	* Deer			
	(Odocoileus virginianus)			

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP.	HYDROLOGY
Cypress Swamp	* Deer *(Odocoileus viriginianus)* River Otter *(Lutra canadensis)* Raccoon *(Procyon lotor)* * Barred Owl *(Strix varia)* * Heron Guild *(Ardea spp., etc.)* Limpkin *(Aramus guaruana pictus)* Great Horned Owl *(Bubo virginianus)* Barn Owl *(Tyto alba pratincola)* Woodstork *(Mycteria americana)* * Wood Duck *(Aix sponsa)* * Bobcat *(Lynx rufus)* Cricket Frog *(Acris gryllus dorsalis)* Liitle Grass Frog *(Limnaoedus ocularis)* * American Alligator *(Alligator mississippiensis)* Aquatic Turtle Guild	Bald/Pond Cypress *(Taxodium spp.)* Coastal Plain Willow *(Salix caroliniana)* Blackgum *(Nyssa sylvatica var. biflora)* Red Maple *(Acer rubum)* Button Bush *(Cephalanthus occidentalis)* Wild Coffee *(Pyschotria nervosa)* Virginia-willow *(Itea virginica)* Wax Myrtle *(Myrica cerifera)* Fetterbush *(Lyonia lucida)*	Royal Fern *(Osmunda regalis)* Cinnamon Fern *(Osmunda cinnamomea)* Swamp Fern *(Blechnum serrulatum)* Chain Fern *(Woodwardia spp.)* Shield Fern *(Thelypteris spp.)* Arrow Arum *(Peltandra virginica)* Lizard Tail *(Saururus cernuus)* Pickerel Weed *(Pontederia spp.)* Sphagnum Moss *(Sphagnum spp.)*	Hydroperiod 120-360 days Depth of Inundation +2' (wet) Depth of Inundation -4' (dry)

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP.	HYDROLOGY
Wet Flatwoods	Oak Toad *(Bufo quercicus)* Chorus Frog *(Pseudacris nigrata)* Cricket Frog *(Acris gryllus dorsalis)* Black Racer *(Coluber c. priapus)* Diamondback Rattlesnake *(Crotalus adamanteus)* Pygmy Rattlesnake *(Sistrurus milliarius)* Hawk Guild *(Buteo spp.)* Bobwhite Quail *(Colinus virginianus)* Opossum *(Didelphis virginiana)* Cotton Rat *(Sigmodon spp.)* Raccoon *(Procyon lotor)* Striped Skunk *(Mephitis mephitis)* * Bobcat *(Lynx rufus)* * Deer *(Odocoileus virginianus)* * Cottontail Rabbit *(Sylvilagus floridanus)*	Slash Pine *(Pinus elliottii var. densa)* Sabal Palm *(Sabal palmetto)* Dahoon Holly *(Ilex cassine)* Red Bay *(Persea palustris)* Wax Myrtle *(Myrica cerifera)* Saw palmetto *(Serenoa repens)*	Blue Maidencane *(Amphicarpum mulhenbergianum)* Wire Grass *(Aristida spp.)* Beak Rush *(Rhynchospora spp.)* Maidencane *(Panicum hemitomon)* Nut Rush *(Scleria spp.)* Redroot *(Lachnanthes caroliniana)* Yellow Eyed Grass *(Xyris spp.)* Pickerel Weed *(Pontederia cordata)* Colic Root *(Aletris lutea)* Sundew *(Drosera spp.)* Milkwort *(Polygala spp.)* St. Johns Wort *(Hypericum spp.)* Marsh Pink *(Sabatia spp.)* Hatpins *(Eriocaulon spp.)*	Wet Season: Hydroperiod 1-4 months/yr. Depth of inundation 1'-2' above the surface Dry Season: Depth of inundation -3' below the surface

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP	HYDROLOGY
Wet Prairie -#	Leopard Frog (Rana sphenocephala) Cricket Frog *(Acris gryllus dorsalis)* Black Racer *(Coluber c. priapus)* Aquatic Turtle guild Pygmy Rattlesnake *(Sistrurus milliarius)* Hawk guild Heron and Egret guild White Ibis *(Eudocimus albus)* Killdeer *(Charadrius v. vociferus)* Red Winged Blackbird *(Agelaius phoeniceus)* Marsh Rabbit *(Sylvilagus palustris)* Cotton Rat *(Sigmondon spp.)*	* Slash Pine *(Pinus elliottii var. densa)* * Wax Myrtle *(Myrica cerifera)* Dahoon Holly *(Ilex cassine)* * Groundsel bush *(Baccharis hamilfolia)*	Wire Grass *(Aristida spp.)* Beak Rush *(Rhynchospora spp.)* Maidencane *(Panicum hemitomon)* Blatterwort *(Utricularia spp.)* St. Johns Wort *(Hypericum fasciculatum)* Marsh Pink *(Sabatia spp.)* Hatpins *(Eriocaulon spp.)* Sundew *(Drosera capillaris)* Yellow Eyed Grass *(Xyris spp.)* Water Drop-wort *(Oxypolis filiformis)* Queen's Delight *(Stillingia aquatica)* Mermaid-weed *(Proserpinaca spp.)* Giant plumegrass *(Erianthus giganteus)*	Duration of Inundation +0.7' for 2-5 months/yr.A

* - Species will invade during reduced hydroperiods or extended droughts.

-This term is used to describe shallow-depressional wetlands with sandy soils typically found in pine flatwoods communities. Others have used "wet prairie" to describe several different wetland communities in south Florida (e.g., Lodge, 1996).

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP	HYDROLOGY
Emergent Freshwater Marsh & Ponds	Cricket Frog (Acris gryllus dorsalis) Leopard Frog *(Rana utricularia)* * Bullfrog *(Rana catesbeiana)* Aquatic Turtle Guild Water Snake *(Natrix fasciata)* Cottonmouth *(Agkistrodon piscivorus)* Ribbon Snake *(Thamnophis spp.)* * American Alligator *(Alligator mississippiensis)* *Heron and Egret Guild Florida Duck *(Anas fulvigula)* Snail Kite *(Rostrhamus sociabilis)* River Otter *(Lutra canadensis)*	Carolina Willow *(Salix caroliniana)* Elderberry *(Sambucus canadensis)* Cypress *(Taxodium spp.)* Dahoon Holly *(Ilex cassine)* Blackgum *(Nyssa sylvatica var. biflora)* Buttonbush *(Cephalanthus occidentalis)* Pond apple *(Annona glabra)*	Pickerel Weed *(Pontederia spp.)* Cattail *(Typha spp.)* Arrowhead *(Sagittaria spp.)* Fire-flag *(Thalia genticulata)* Bulrush *(Scirpus spp.)* Maidencane *(Panicum hemitomon)* Ludwigia *(Ludwigia spp.)* St. Johns Wort *(Hypericum spp.)* Beak Rush *(Rhynchospora spp.)* Sawgrass *(Cladium jamaicensa)* Spike Rush *(Eleocharis spp.)* Soft Rush *(Juncus spp.)* Lake Rush *(Fuirena spp.)* Water Drop Wort *(Oxypolis filiformis)* Sedges *(Cyperus spp.)* Smartweed *(Polygonum spp.)*	Period of Inundation 7-10 months/yr.

* - See Appendix A

HABITAT TYPE	WILDLIFE UTILIZATION	OVERSTORY/SHRUB SPP	GROUNDCOVER SPP.	HYDROLOGY
Mixed Hardwood Swamps	Cricket Frog *(Acris gryllus dorsalis)*	Bald/Pond Cypress *(Taxodium spp.)*	Royal Fern *(Osmunda regalis)*	Hydroperiod 4-11 months
	Liitle Grass Frog *(Limnaoedus ocularis)*	Pond Apple *(Annona glabra)*	Cinnamon Fern *(Osmunda cinnamomea)*	Depth of Inundation +2.5' (we
	* American Alligator *(Alligator mississippiensis)*	Blackgum *(Nyssa sylvatica var. biflora)*	Swamp Fern *(Blechnum serrulatum)*	Depth of Inundation -5' (dry)
	Aquatic Turtle Guild	Red Maple	Chain Fern	
	Eastern Mud Snake *(Farancia abacura)*	*(Acer rubum)*	*(Woodwardia spp.)*	
	Cottonmouth	Button Bush	Shield Fern	
	(Agkistrodon piscivorus)	*(Cephalanthus occidentalis)*	*(Thelypteris spp.)*	
	* Barred Owl	Water Ash	Arrow Arum	
	(Strix varia)	*(Fraxinus caroliniana)*	*(Peltandra virginica)*	
	Swallow-tailed Kite	Slash Pine	Lizard Tail	
	(Elanoides f. forficatus)	*(Pinus elliottii var. densa)*	*(Saururus cernuus)*	
	* Pileated Woodpecker	Wax Myrtle	Pickerel Weed	
	(Hylatomus pileatus)	*(Myrica cerifera)*	*(Pontederia spp.)*	
	Great Horned Owl	Fetterbush	Sphagnum Moss	
	(Bubo virginianus)	*(Lyonia lucida)*	*(Sphagnum spp.)*	
	Woodstork	Virginia Willow	Sawgrass	
	(Mycteria americana)	*(Itea virginica)*	*(Cladium jamaicense)*	
	* Wood Duck	Carolina Willow	Poison Ivy	
	(Aix sponsa)	*(Salix caroliniana)*	*(Toxicodendron radicans)*	
	* Deer	American Elm		
	(Odocoileus viriginianus)	(Ulmus americana)		
	River Otter	Sweetgum		
	(Lutra canadensis)	(Liquidambar styraciflua)		
	Raccoon	Swamp Laurel Oak		
	(Procyon lotor)	(Quercus laurifolia)		
	Black Bear	Sweet Bay		
	(Ursus americanus)	*(Magnolia virginiana)*		
	* Bobcat	Swamp Bay		
	(Lynx rufus)	*(Persea palustris)*		

* - See Appendix A

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APPENDIX C

COMMON FRESHWATER FISHES OF SOUTHERN FLORIDA
(List compiled by Dr. Alex Marsh, Department of Biological Sciencies, Florida Atlantic University, Boca Raton, FL)

Scientific name	Common name
Adinia xenica	Diamond Killifish
Amia calva	Bowfin
Anguilla rostrata	American Eel
Astronotus ocellatus *	Oscar
Belonesox belizanus *	Pike Killifish
Centropomus undecimalis	Snook
Cichla ocellaris *	Peacock Cichlid
Cichlasoma bimaculatum *	Black Acara
Cichlasoma citronellum *	Midas Cichlid
Cichlasoma octofasciatum *	Jack Dempsey
Cichlasoma uropthalmus *	Mayan Cichlid
Clarias bartrachus *	Walking Catfish
Cyprinodon variegatus	Sheepshead Minnow
Diapterus plumieri	Striped Mojarra
Elassoma evergladei	Everglades Pigmy Sunfish
Enneacanthus gloriosus	Bluespotted Sunfish
Erymizon sucetta	Lake Chubsucker
Esox niger	Chain Pickeral
Etheostoma fusiforme	Scalyhead Darter
Fundulus chrysotus	Golden Topminnow
Fundulus confluentus	Marsh Killifish
Fundulus seminolis	Seminole Killifish
Gambusia affinis	Mosquitofish
Hemichromis letourneauxi *	American Jewelfish
Heterandria formosa	Least Killifish
Ictalurus natalis	Yellow bullhead
Jordonella floridae	Flagfish
Labidesthes sicculus	Brook Silverside
Lepisosteus platyrhyncus	Florida Gar
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lepomis marginatus	Dollar Sunfish
Lepomis microlophus	Redear Sunfish
Lepomis punctatus	Spotted Sunfish
Lucania goodei	Bluefin Killifish
Micropterus salmoides	Largemouth Bass
Notemigonus crysoleucas	Golden Shiner
Noturus gyrinus	Tadpole Madtom
Poecilia latipinna	Sailfin Molly
Pterygoplichthys multiradiatus	Sailfin Catfish
Oreochromis mariae *	Blue Tilapia
Oreochromis mossambicus *	Mozambique Tilipia
Tilapia mariae *	Spotted Tilipia

(* Exotic species)

APPENDIX D

COMMON AQUATIC INSECT TAXA
(Compiled by Dr. Alex Marsh, Department of Biological Sciences, Florida Atlantic University, Boca Raton, FL)

Order	Plecoptera	Stoneflies
Order	Ephemeroptera	Mayflies
Order	Odonata	
	Suborder Anisoptera	Dragonflies
	Suborder Zygoptera	Damselflies
Order	Hemiptera	
	Family Hebridae	Velvet water bugs
	Family Hydrometridae	Water measurers
	Family Mesoveliidae	Water treaders
	Family Gerridae	Water striders
	Family Veliidae	Broad-shouldered water striders
	Family Notonectidae	Backswimmers
	Family Pleidae	Pigmy backswimmers
	Family Naucoridae	Creeping water bugs
	Family Nepidae	Water scorpions
	Family Belostomatidae	Giant water bugs
	Family Corixidae	Water boatmen
Order	Megaloptera	
	Family Sialidae	Alderfly
	Family Corydalidae	Hellgrammite
Order	Neuroptera	Spongilla flies
Order	Trichoptera	Caddis flies
Order	Lepidoptera (Pyrallidae)	Aquatic caterpillars
Order	Coleoptera	
	Family Haliplidae	Crawling water beetles
	Family Dystiscidae	Predaceous diving bettles
	Family Gyrinidae	Whirligig beetles
	Family Hydrophilidae	Water scavengers
	Family Psephenidae	Water pennies
	Family Elmidae	Riffle beetles
	Family Helodidae	Marsh beetles
	Family Noteridae	Burrowing water beetles
	Family Chrysomelidae	Leaf beetles
	Family Dryopidae	Long-toed water beetles
Order	Diptera	
	Family Blepharoceridae	Net-winged midges
	Family Tipulidae	Crane flies
	Family Ptychopteridae	Phatom crane flies
	Family Psychodidae	Moth flies
	Family Dixidae	Dixa midges

Order Diptera (Cont.)

Family	Culicidae	Mosquitoes, Phantom midges
Family	Simulidae	Blackflies
Family	Tendipedidae	Midges
Family	Ceratopongidae	Biting midges
Family	Stratiomyiidae	Soldierflies
Family	Tabanidae	Horseflies, deerflies
Family	Rhagionidae	Snipe flies
Family	Syrphidae	Rat-tailed maggots
Family	Tetanoceridae	Marsh flies
Family	Ephydridae	Shore flies

Appendix E

SOME COMMON EXOTIC AND NUISANCE PLANT SPECIES
FOUND IN WETLANDS OF SOUTHERN FLORIDA
(Includes Partial List of the Florida Exotic Pest Plant
Council's 1999 Most Invasive Species)

COMMON NAME	SCIENTIFIC NAME	PLANT FORM
alligator weed	*Alternantera philoxeroides*	herb
shoebutton ardisia	*Ardisia elliptica*	shrub, small tree
bishopwood	*Bischofia javanica*	tree
para grass	*Brachiaria mutica*	grass
Australian pine	*Casuarina equisetifolia*	tree
taro	*Colocasia esculenta*	herb
carrotwood	*Cupaniopsis anacardioides*	tree
air-potato	*Dioscorea bulbiflora*	vine
water hyacinth	*Eichornia crassipes*	herb
Surinam cherry	*Eugenia uniflora*	shrub, small tree
Hydrilla	*Hydrilla verticillata*	submersed herb
West Indian marsh grass	*Hymenachne amplexicaulis*	grass
water primrose	*Ludwigia octovalvis*	herb
primrose willow	*Ludwigia peruviana*	herb
Japanese climbing fern	*Lygodium japonicum*	vine
old world climbing fern	*Lygodium microphyllum*	vine
climbing hempweed	*Mikania scandens*	vine
melaleuca	*Melaleuca quinquenervia*	tree
torpedo grass	*Panicum repens*	grass
bahia grass	*Paspalum notatum*	grass
water lettuce	*Pistia stratiotes*	herb
guava	*Psidium guajava*	tree
downy rose myrtle	*Rhodomyrtus tomentosa*	shrub
Chinese tallow	*Sapium secunotatum*	tree
Brazilian pepper	*Schinus terebinthifolius*	tree
climbing cassia	*Senna pendula*	shrub
Java plum	*Syzygium cumini*	tree
seaside mahoe	*Thespesia populnea*	tree
cattail	*Typha* spp.	herb
Caesar's weed	*Urena lobata*	herb
wedelia	*Wedelia trilobata*	herb

Appendix F **WRAP Dataset**

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
4390018	WEST JENSEN	06/11/96	BG	WP/24	UNDEV	2.50	N/A	2.00	3.00	2.00	3.00	3.00	0.86
4390018	WEST JENSEN	06/11/96	BN	WP/24	UNDEV	3.00	N/A	2.50	2.50	2.00	3.00	3.00	0.89
4390018	WEST JENSEN	06/11/96	RM	WP/24	UNDEV	2.50	N/A	2.00	3.00	2.00	3.00	3.00	0.86
4300672	HIDDEN OAKS	06/11/96	BG	HM/CREATED	INSTIT.	2.00	N/A	1.50	1.50	1.00	2.00	1.60	0.53
4300672	HIDDEN OAKS	06/11/96	BN	HM/CREATED	INSTIT.	1.00	N/A	1.50	1.50	2.00	2.00	1.70	0.54
4300672	HIDDEN OAKS	06/11/96	RM	HM/CREATED	INSTIT.	1.50	N/A	1.50	1.00	1.50	2.00	1.70	0.51
4300196	HIGH MEADOWS	06/01/96	RM	MM/CREATED	HIGHWAY	1.50	2.00	2.00	1.00	2.50	2.00	1.00	0.57
4300196	HIGH MEADOWS	06/01/96	BN	MM/CREATED	HIGHWAY	1.50	2.00	2.50	1.00	2.50	2.00	1.00	0.59
4300196	HIGH MEADOWS	06/01/96	BG	MM/CREATED	HIGHWAY	1.50	1.00	2.50	0.50	3.00	3.00	1.00	0.59
N/A	DWP-STUMP	07/23/96	LMG	HM	AG/PASTURE	1.50	N/A	1.50	2.00	2.00	2.50	2.00	0.64
N/A	DWP-STUMP	07/23/96	BG	HM	AG/PASTURE	2.00	N/A	1.50	2.00	1.50	2.00	1.50	0.58
N/A	LLK2-TCP	07/25/96	BG	WP	UNDEV/CITRUS	2.50	N/A	2.00	2.50	3.00	3.00	3.00	0.89
N/A	LLK2-TCP	07/25/96	LMG	WP	UNDEV/CITRUS	3.00	N/A	2.50	3.00	3.00	3.00	2.80	0.96
MIT.BANK	LLGSMB	07/24/96	LMG	MH	AG/CITRUS	2.50	3.00	3.00	2.00	3.00	3.00	1.00	0.83
MIT.BANK	LLGSMB	07/24/96	BG	MH	AG/CITRUS	2.00	3.00	3.00	2.00	3.00	2.50	1.50	0.81
50-	FOREST HILL NRS	11/25/96	RM	MM	AG/ROW	1.50	1.50	2.00	1.00	2.00	2.00	1.75	0.56
50-	FOREST HILL NRS	11/25/96	BR	MM	AG/ROW	1.50	2.00	2.00	1.00	2.00	2.00	1.75	0.58
50-	FOREST HILL NRS	11/25/96	BG	MM	AG/ROW	1.50	1.50	2.00	1.00	2.00	2.00	1.75	0.56
5001161	PB PK OF COMM	11/25/96	RM	EM	IND	2.00	N/A	2.00	1.50	2.00	2.00	1.75	0.62
5001161	PB PK OF COMM	11/25/96	BR	EM	IND	2.50	N/A	2.00	2.00	2.00	2.00	1.75	0.68
5001161	PB PK OF COMM	11/25/96	BG	EM	IND	2.00	N/A	1.50	2.00	2.00	2.00	1.75	0.63
5000618	SARATOGA/WLB	11/25/96	RM	WP	SF/RES	2.00	N/A	2.00	1.00	2.00	2.00	2.80	0.66
5000618	SARATOGA/WLB	11/25/96	BR	WP	SF/RES	1.50	N/A	2.00	2.00	2.00	2.00	2.80	0.68
5000618	SARATOGA/WLB	11/25/96	BG	WP	SF/RES	1.50	N/A	2.00	1.00	2.50	2.00	2.80	0.66
5000618	SARATOGA/115AC	11/25/96	RM	MM	SF/RES	2.00	2.00	2.50	2.50	1.50	2.50	2.80	0.75
5000618	SARATOGA/115AC	11/25/96	BR	MM	SF/RES	2.50	1.50	2.00	2.50	1.00	2.00	2.80	0.68
5000618	SARATOGA/115AC	11/25/96	BG	MM	SF/RES	2.00	2.00	2.50	2.00	1.50	2.50	2.80	0.73
5001161	PK OF COMM/C8	11/25/96	RM	EM	IND	2.00	N/A	2.50	3.00	2.50	2.50	3.00	0.86
5001161	PK OF COMM/C8	11/25/96	BR	EM	IND	2.00	N/A	2.00	2.50	2.50	2.50	3.00	0.81
5001161	PK OF COMM/C8	11/25/96	BG	EM	IND	2.00	N/A	2.00	3.00	2.50	3.00	3.00	0.86
5600573	LK. HEATHERWD	11/22/96	RM	EM	SF/RES	1.50	N/A	1.50	0.50	1.50	2.00	2.00	0.50
5600573	LK. HEATHERWD	11/22/96	BR	EM	SF/RES	2.00	N/A	1.50	0.50	1.00	2.00	2.00	0.50
5600573	LK. HEATHERWD	11/22/96	BG	EM	SF/RES	1.00	N/A	1.50	0.50	1.00	2.50	2.00	0.47
5600573	LK. HEATHERWD	11/22/96	BN	EM	SF/RES	1.00	N/A	1.50	0.50	1.00	2.00	2.00	0.45
	W. JENSEN/WL24	11/22/96	BG	WP	SF/RES/GC	2.00	N/A	2.50	1.00	2.50	2.50	2.50	0.72
	W. JENSEN/WL24	11/22/96	BN	WP	SF/RES/GC	2.50	N/A	2.50	2.00	2.50	2.50	2.50	0.81
	W. JENSEN/WL24	11/22/96	BR	WP	SF/RES/GC	2.00	N/A	2.50	2.00	2.50	2.00	2.50	0.75
	W. JENSEN/WL24	11/22/96	RM	WP	SF/RES/GC	2.50	N/A	2.00	1.50	2.00	2.50	2.50	0.72
5600573	SCHOOL CCC	11/22/96	RM	EM/CREATED	INST.	2.00	N/A	2.50	0.50	2.00	2.00	0.50	0.53
5600573	SCHOOL CCC	11/22/96	BR	EM/CREATED	INST.	2.50	N/A	2.00	1.00	2.00	2.00	0.50	0.56
5600573	SCHOOL CCC	11/22/96	BG	EM/CREATED	INST.	1.50	N/A	2.50	1.00	2.50	2.50	0.50	0.58
5600573	SCHOOL CCC	11/22/96	BN	EM/CREATED	INST.	1.50	N/A	2.00	1.00	2.00	2.50	0.50	0.53
4300196	HIGH MED. AVE	11/22/96	RM	FORESTED/PRES	HWY	2.00	2.00	2.00	0.50	2.50	2.00	1.50	0.59
4300196	HIGH MED. AVE	11/22/96	BR	FORESTED/PRES	HWY	1.00	1.00	2.00	1.00	2.50	2.00	1.50	0.52
4300196	HIGH MED. AVE	11/22/96	BG	FORESTED/PRES	HWY	1.00	1.00	2.00	0.50	2.50	2.50	1.50	0.52
4300196	HIGH MED. AVE	11/22/96	BN	FORESTED/PRES	HWY	1.50	1.50	2.00	1.00	2.00	2.00	1.50	0.55
4300196	HIGH MED. AVE	11/22/96	BR	MM/CREATED	HWY	2.50	2.50	3.00	1.00	3.00	2.00	1.50	0.73
4300196	HIGH MED. AVE	11/22/96	RM	MM/CREATED	HWY	1.50	1.50	2.50	1.00	2.50	2.50	1.50	0.62
4300196	HIGH MED. AVE	11/22/96	BG	MM/CREATED	HWY	1.50	2.00	3.00	0.50	3.00	2.50	1.50	0.66
4300196	HIGH MED. AVE	11/22/96	BN	MM/CREATED	HWY	1.50	2.00	2.50	1.00	2.50	2.00	1.50	0.62
	HIDDEN OAKS	11/22/96	RM	EM/CREATED	INST	2.00	N/A	1.50	1.50	2.00	2.00	1.95	0.61

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
	HIDDEN OAKS	11/22/96	BN	EM/CREATED	INST	1.50	N/A	2.00	1.50	2.00	2.00	1.95	0.61
	HIDDEN OAKS	11/22/96	BR	EM/CREATED	INST	2.50	N/A	2.00	1.50	2.00	2.00	1.95	0.66
	HIDDEN OAKS	11/22/96	BG	EM/CREATED	INST	1.50	N/A	2.00	1.00	2.00	2.50	1.95	0.61
	E. ORG. CO.	12/10/96	LM	FORESTED	WASTEWATER	2.50	1.50	1.50	2.50	1.00	1.50	0.75	0.54
	E. ORG. CO.	12/10/96	LG	FORESTED	WASTEWATER	3.00	1.50	1.50	3.00	1.00	1.50	0.75	0.63
	E. ORG. CO.	12/10/96	BG	FORESTED	WASTEWATER	2.50	1.00	1.00	3.00	1.50	1.00	0.75	0.51
	MEAD GARDENS	12/10/96	BG	FORESTED/BAY	REC	1.50	1.00	1.50	1.50	1.00	2.50	0.69	0.46
	MEAD GARDENS	12/10/96	LG	FORESTED/BAY	REC	2.00	1.50	1.00	1.50	1.00	2.50	0.69	0.44
	MEAD GARDENS	12/10/96	LM	FORESTED/BAY	REC	2.00	2.00	1.00	1.50	0.00	2.50	0.69	0.47
	LK. ADAIR/DITCH	12/10/96	BG	CHNNL STREAM	SF/HWY	1.00	N/A	1.00	0.50	2.00	2.00	0.63	0.40
	LK. ADAIR/DITCH	12/10/96	LG	CHNNL STREAM	SF/HWY	0.50	N/A	0.50	1.50	2.00	2.00	0.63	0.40
	LK. ADAIR/DITCH	12/10/96	LM	CHNNL STREAM	SF/HWY	0.50	N/A	0.50	1.00	2.00	2.00	0.63	0.37
	LK. ADAIR	12/10/96	BG	LAKE	SF/HWY	1.00	2.00	1.50	0.50	2.00	2.00	0.63	0.46
	LK. ADAIR	12/10/96	LM	LAKE	SF/HWY	2.00	2.00	0.50	1.00	2.00	2.00	0.63	0.48
	LK. ADAIR	12/10/96	LG	LAKE	SF/HWY	2.00	1.50	0.50	0.50	2.50	2.50	0.63	0.48
	E. ORG. CO.	12/10/96	BG	EM	WASTE WATER	2.50	N/A	1.00	2.50	1.00	1.50	0.75	0.51
	E. ORG. CO.	12/10/96	LG	EM	WASTE WATER	2.50	N/A	1.00	3.00	0.50	2.00	0.75	0.54
	E. ORG. CO.	12/10/96	LM	EM	WASTE WATER	2.00	N/A	1.00	2.00	0.50	2.00	0.75	0.46
	E. ORG. CO.	12/10/96	LM	MH/CONTROL	WASTE WATER	2.50	2.50	3.00	3.00	3.00	2.50	3.00	0.93
	E. ORG. CO.	12/10/96	BG	MH/CONTROL	WASTE WATER	2.50	2.50	3.00	3.00	3.00	2.50	3.00	0.93
	E. ORG. CO.	12/10/96	LG	MH/CONTROL	WASTE WATER	3.00	3.00	3.00	3.00	2.50	3.00	3.00	0.98
	E.W. EXPWY	12/10/96	LM	MM/RESTOR.	HWY	1.50	1.50	2.50	1.50	2.50	1.50	2.38	0.64
	E.W. EXPWY	12/10/96	LG	MM/RESTOR.	HWY	1.00	1.00	2.00	1.00	3.00	1.50	2.38	0.57
	E.W. EXPWY	12/10/96	BG	MM/RESTOR.	HWY	1.50	1.00	2.50	1.50	2.50	2.00	2.38	0.64
	E.W EXP/ROUSE	12/10/96	LM	CYP	HWY	1.00	3.00	3.00	0.50	3.00	2.50	1.30	0.68
	E.W EXP/ROUSE	12/10/96	LG	CYP	HWY	1.50	3.00	3.00	1.00	3.00	2.00	1.30	0.70
	E.W EXP/ROUSE	12/10/96	BG	CYP	HWY	1.00	2.00	2.00	1.00	2.50	2.00	1.30	0.56
	CNTRY CRK J&K	12/11/96	LM	RIP/FOREST	REC	2.50	2.50	1.50	2.50	2.00	3.00	2.25	0.73
	CNTRY CRK J&K	12/11/96	CG	RIP/FOREST	REC	2.00	2.50	1.50	2.50	2.00	3.00	2.25	0.75
	CNTRY CRK J&K	12/11/96	LG	RIP/FOREST	REC	2.50	2.50	1.50	2.50	2.00	3.00	2.25	0.73
	CNTRY CRK J&K	12/11/96	BG	RIP/FOREST	REC	2.50	2.50	1.50	2.50	2.00	3.00	2.25	0.77
	LK. LOTUS	12/11/96	BG	MH	RES	2.50	3.00	3.00	3.00	2.50	3.00	2.50	0.93
	LK. LOTUS	12/11/96	LM	MH	RES	2.50	3.00	3.00	3.00	3.00	3.00	2.50	0.95
	LK. LOTUS	12/11/96	CG	MH	RES	2.70	3.00	2.70	2.70	2.70	3.00	2.50	0.92
	LK. LOTUS	12/11/96	LG	MH	RES	3.00	3.00	3.00	2.50	3.00	3.00	2.50	0.95
	LK. COMO	12/11/96	CG	EM	RES/SF	2.00	N/A	1.50	1.00	1.50	2.00	1.69	0.54
	LK. COMO	12/11/96	LM	EM	RES/SF	2.00	N/A	1.50	1.00	2.00	2.00	1.69	0.57
	LK. COMO	12/11/96	LG	EM	RES/SF	2.00	N/A	1.50	1.50	1.00	2.50	1.69	0.57
	LK. COMO	12/11/96	BG	EM	RES/SF	2.00	N/A	1.50	1.00	1.00	3.00	1.69	0.57
	CHASE GROVE	12/11/96	BG	MH	RES/MF	1.00	3.00	2.50	1.50	2.50	2.50	2.13	0.72
	CHASE GROVE	12/11/96	LM	MH	RES/MF	1.50	3.00	2.50	2.00	2.50	3.00	2.13	0.79
	CHASE GROVE	12/11/96	CG	MH	RES/MF	1.50	3.00	2.00	1.00	3.00	3.00	2.13	0.73
	CHASE GROVE	12/11/96	LG	MH	RES/MF	1.00	3.00	2.50	1.50	2.00	2.00	2.13	0.67
	ALHAMBRA	12/19/96	BR	EM	RES/SF	0.50	N/A	1.00	0.00	2.00	1.50	1.25	0.35
	ALHAMBRA	12/19/96	GS	EM	RES/SF	0.50	N/A	1.00	0.00	3.00	2.00	1.25	0.43
	ALHAMBRA	12/19/96	RM	EM	RES/SF	0.50	N/A	1.00	0.00	2.50	2.00	1.25	0.40
	ALHAMBRA	12/19/96	DB	EM	RES/SF	0.50	N/A	0.50	0.50	1.50	2.00	1.25	0.34
	ALHAMBRA	12/19/96	BG	EM	RES/SF	0.50	N/A	1.00	0.50	2.00	2.00	1.25	0.40
0601978	ESTANCIA/ENTR	12/19/96	BR	MM	RES/SF	1.00	1.00	2.00	0.50	2.00	2.00	2.00	0.50
0601978	ESTANCIA/ENTR	12/19/96	BG	MM	RES/SF	1.00	1.00	2.00	0.50	2.00	2.00	2.00	0.50
0601978	ESTANCIA/ENTR	12/19/96	RM	MM	RES/SF	1.00	1.50	2.00	1.00	2.00	1.50	2.00	0.52
0601978	ESTANCIA/ENTR	12/19/96	DB	MM	RES/SF	1.00	1.00	2.00	1.00	2.00	2.50	2.00	0.54

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
0601978	ESTANCIA/ENTR	12/19/96	GS	MM	RES/SF	1.00	1.00	2.00	1.00	2.50	1.50	2.00	0.52
0601978	ESTANCIA/PRES.	12/19/96	RM	MM	RES/SF	2.00	1.00	2.00	0.50	1.50	2.00	2.00	0.52
0601978	ESTANCIA/PRES.	12/19/96	BG	MM	RES/SF	1.50	0.50	1.50	0.50	1.50	2.00	2.00	0.45
0601978	ESTANCIA/PRES.	12/19/96	DB	MM	RES/SF	1.50	1.50	1.50	1.50	2.00	2.00	2.00	0.57
0601978	ESTANCIA/PRES.	12/19/96	GS	MM	RES/SF	1.50	1.00	2.00	1.00	2.00	2.00	2.00	0.55
0601978	ESTANCIA/PRES.	12/19/96	BR	MM	RES/SF	2.00	1.50	1.50	0.50	1.50	1.50	2.00	0.50
0601401	WALDEN LK. W.	12/19/96	BR	EM	RES/SF	1.50	N/A	2.00	0.50	2.00	2.00	2.00	0.56
0601401	WALDEN LK. W.	12/19/96	DB	EM	RES/SF	1.50	N/A	1.50	0.50	2.00	2.00	2.00	0.53
0601401	WALDEN LK. W.	12/19/96	GS	EM	RES/SF	1.50	N/A	2.00	0.00	3.00	2.50	2.00	0.61
0601401	WALDEN LK. W.	12/19/96	BG	EM	RES/SF	1.00	N/A	2.00	0.00	2.50	2.00	2.00	0.52
0601401	WALDEN LK. W.	12/19/96	RM	EM	RES/SF	1.00	N/A	2.00	0.00	2.50	2.00	2.00	0.53
3600258	McMGR BAPT, CH.	11/12/96	KF	MM	INST	2.50	2.00	3.00	2.50	2.50	3.00	2.94	0.88
3600258	McMGR BAPT, CH.	11/12/96	SB (COE)	MM	INST	2.00	2.00	2.50	2.00	2.00	3.00	2.94	0.78
3600258	McMGR BAPT, CH.	11/12/96	DD	MM	INST	2.00	2.00	2.50	2.50	2.00	3.00	2.94	0.81
3602271	N. RIVER EST.	11/07/96	KF	EM	RES/LD	2.50	N/A	3.00	3.00	3.00	3.00	2.30	0.93
3602271	N. RIVER EST.	11/07/96	HH	EM	RES/LD	3.00	N/A	2.50	3.00	3.00	2.50	2.30	0.90
3602271	N. RIVER EST.	11/07/96	JM	EM	RES/LD	3.00	N/A	2.50	2.50	3.00	3.00	2.30	0.90
3602271	N. RIVER EST.	11/07/96	SD	EM	RES/LD	3.00	N/A	3.00	2.00	3.00	3.00	2.30	0.90
1100737	COLLIERS PRES.	10/24/96	KF	HP	RES/SF	3.00	3.00	2.50	2.00	2.50	2.50	2.33	0.85
1100737	COLLIERS PRES.	10/24/96	DM	HP	RES/SF	2.00	2.50	2.50	2.00	2.50	2.00	2.33	0.75
1100737	COLLIERS PRES.	10/24/96	HH	HP	RES/SF	2.50	2.50	2.00	2.00	2.50	2.00	2.33	0.78
1100737	COLLIERS PRES.	10/24/96	JM	HP	RES/SF	2.50	3.00	2.00	2.00	2.50	2.50	2.33	0.80
3602618	DEL PRADO BLVD	09/26/96	DD	EM	HWY	2.50	N/A	3.00	2.50	2.50	3.00	3.00	0.92
3602618	DEL PRADO BLVD	09/26/96	SD	EM	HWY	3.00	N/A	2.50	3.00	2.50	3.00	3.00	0.94
3602618	DEL PRADO BLVD	09/26/96	KF	EM	HWY	3.00	N/A	2.50	2.50	2.50	3.00	3.00	0.92
3602618	DEL PRADO BLVD	09/26/96	HH	EM	HWY	3.00	N/A	3.00	2.50	2.50	3.00	3.00	0.94
3600853	J. JASSEY VEG.	11/21/96	HH	CYP/MIT	AG/ROW	1.50	0.50	1.50	2.00	1.00	2.00	1.38	0.47
3600853	J. JASSEY VEG.	11/21/96	SD	CYP/MIT	AG/ROW	1.50	0.50	1.50	2.00	1.00	3.00	1.38	0.52
3600853	J. JASSEY VEG.	11/21/96	KF	CYP/MIT	AG/ROW	2.00	0.50	2.00	2.00	1.00	3.00	1.38	0.57
3600853	J. JASSEY VEG.	11/21/96	DM	CYP/MIT	AG/ROW	1.50	0.50	2.00	2.00	1.00	2.50	1.38	0.52
3602411	SIX MILE OMNI	11/21/96	DM	CYP	AG/FALLOW	2.00	2.00	2.00	1.00	2.50	2.00	0.50	0.57
3602411	SIX MILE OMNI	11/21/96	SD	CYP	AG/FALLOW	2.00	2.00	2.00	1.00	2.00	3.00	0.50	0.60
3602411	SIX MILE OMNI	11/21/96	HH	CYP	AG/FALLOW	2.00	2.00	2.00	2.00	2.00	2.00	0.50	0.55
3602411	SIX MILE OMNI	11/21/96	KF	CYP	AG/FALLOW	2.00	2.50	2.50	0.50	2.00	3.00	0.50	0.62
3601077	OLDE HICKORY	11/21/96	SD	WP	RES/MF	2.00	N/A	3.00	1.00	2.50	2.00	2.25	0.71
3601077	OLDE HICKORY	11/21/96	DM	WP	RES/MF	1.50	N/A	1.50	1.00	2.50	2.50	2.25	0.63
3601077	OLDE HICKORY	11/21/96	HH	WP	RES/MF	1.50	N/A	2.00	1.50	2.50	2.50	2.25	0.68
3601077	OLDE HICKORY	11/21/96	KF	WP	RES/MF	1.50	N/A	2.50	1.00	2.50	2.50	2.25	0.68
3601223	COLONIAL BLVD	11/21/96	KF	CYP/MIT	HWY	2.00	0.50	2.00	2.50	1.50	3.00	3.00	0.69
3601223	COLONIAL BLVD	11/21/96	HH	CYP/MIT	HWY	2.50	1.00	1.50	2.50	2.00	2.00	3.00	0.69
3601223	COLONIAL BLVD	11/21/96	SD	CYP/MIT	HWY	2.00	0.50	1.50	2.50	1.00	3.00	3.00	0.64
3601223	COLONIAL BLVD	11/21/96	DM	CYP/MIT	HWY	2.00	1.00	2.00	2.50	1.00	3.00	3.00	0.69
3601634	R. POWELL AG	10/10/96	KF	CYP/MIT	AG	2.00	0.50	2.50	3.00	2.00	1.50	2.75	0.68
3601634	R. POWELL AG	10/10/96	HH	CYP/MIT	AG	1.50	1.00	2.00	2.00	1.00	2.00	2.75	0.58
3601634	R. POWELL AG	10/10/96	SD	CYP/MIT	AG	2.00	1.50	1.50	2.50	2.00	2.50	2.75	0.70
3601634	R. POWELL AG	10/10/96	DD	CYP/MIT	AG	1.50	0.50	2.50	3.00	1.50	1.50	2.75	0.63
3601267	AIRSIDE PLAZA	10/10/96	KF	MM/MIT	LICOMM	2.50	2.00	2.50	2.00	2.00	2.00	2.38	0.73
3601267	AIRSIDE PLAZA	10/10/96	SD	MM/MIT	LICOMM	1.50	1.50	2.50	3.00	2.00	3.00	2.38	0.70
3601267	AIRSIDE PLAZA	10/10/96	HH	MM/MIT	LICOMM	2.50	2.00	2.50	2.00	2.00	1.50	2.38	0.71
3601267	AIRSIDE PLAZA	10/10/96	DD	MM/MIT	LICOMM	2.00	1.50	2.50	2.50	2.50	3.00	2.40	0.78
3601396	HERONS GLEN	09/26/96	KF	WP	RES/SF	2.50	N/A	2.50	2.00	1.00	2.50	2.80	0.74
3601396	HERONS GLEN	09/26/96	HH	WP	RES/SF	2.00	N/A	2.50	2.00	2.00	2.50	2.80	0.77

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
3601396	HERONS GLEN	09/26/96	SD	WP	RES/SF	2.00	N/A	3.00	2.00	2.00	3.00	2.80	0.74
3601396	HERONS GLEN	09/26/96	DD	WP	RES/SF	2.50	N/A	2.50	2.00	1.50	3.00	2.80	0.80
3602926	SHELL PIT INC.	09/26/96	KF	WP	IND	1.50	N/A	2.50	2.50	1.50	2.50	3.00	0.75
3602926	SHELL PIT INC.	09/26/96	HH	WP	IND	2.00	N/A	2.50	2.50	2.00	2.50	3.00	0.81
3602926	SHELL PIT INC.	09/26/96	DD	WP	IND	1.50	N/A	2.50	2.50	1.50	3.00	3.00	0.78
3602926	SHELL PIT INC.	09/26/96	SD	WP	IND	1.50	N/A	3.00	3.00	1.00	3.00	3.00	0.81
3601396	HERONS GLEN	09/26/96	KF	EM	RES/SF/GC	2.50	2.00	2.50	0.50	1.50	2.00	1.13	0.58
3601396	HERONS GLEN	09/26/96	SD	EM	RES/SF/GC	3.00	2.00	2.00	0.50	1.00	1.00	1.13	0.51
3601396	HERONS GLEN	09/26/96	DD	EM	RES/SF/GC	2.00	1.50	2.00	0.50	1.50	2.00	1.13	0.51
3601396	HERONS GLEN	09/26/96	HH	EM	RES/SF/GC	2.50	2.00	2.00	0.50	1.00	2.00	1.13	0.59
3602736	WALMART	11/07/96	SD	EM	HICOMM	2.00	1.50	2.00	1.50	1.50	2.00	1.70	0.58
3602736	WALMART	11/07/96	HH	EM	HICOMM	1.00	1.50	2.50	1.50	1.50	2.00	1.70	0.56
3602736	WALMART	11/07/96	KF	EM	HICOMM	1.50	2.00	2.50	1.50	2.50	2.00	1.70	0.65
3602736	WALMART	11/07/96	JM	EM	HICOMM	1.50	1.50	2.50	1.00	2.50	1.50	1.70	0.58
	ENERGY RECOVR	11/07/96	KF	MH/MIT	IND	2.00	0.00	2.00	2.50	2.50	1.50	2.10	0.60
	ENERGY RECOVR	11/07/96	JM	MH/MIT	IND	2.50	0.50	2.50	2.50	2.50	1.50	2.10	0.67
	ENERGY RECOVR	11/07/96	HH	MH/MIT	IND	2.50	0.50	2.00	3.00	2.00	2.00	2.60	0.70
	ENERGY RECOVR	11/07/96	SD	MH/MIT	IND	2.00	0.00	3.00	2.00	2.00	3.00	2.60	0.70
1101367	TURTLE CREEK	10/24/96	KF	HP	RES/MF	2.50	2.50	2.50	3.00	2.50	2.50	2.75	0.87
1101367	TURTLE CREEK	10/24/96	DM	HP	RES/MF	2.50	3.00	3.00	3.00	2.50	2.50	2.75	0.92
1101367	TURTLE CREEK	10/24/96	HH	HP	RES/MF	2.50	2.50	2.50	2.50	2.50	2.50	2.75	0.85
1101367	TURTLE CREEK	10/24/96	JM	HP	RES/MF	2.50	3.00	3.00	2.50	2.50	2.50	2.75	0.89
1100900	RAILHD. IND. PK.	10/24/96	KF	WP	IND	2.00	N/A	3.00	2.50	2.50	3.00	2.70	0.87
1100900	RAILHD. IND. PK.	10/24/96	DM	WP	IND	2.00	N/A	2.50	2.50	2.50	2.50	2.70	0.82
1100900	RAILHD. IND. PK.	10/24/96	HH	WP	IND	2.00	N/A	2.50	2.50	2.50	3.00	2.70	0.84
1100900	RAILHD. IND. PK.	10/24/96	JM	WP	IND	2.00	N/A	2.50	2.50	2.50	2.50	2.70	0.82
1100556	951 COMM. CTR.	10/03/96	KF	WP	LICOMM	2.50	N/A	2.50	2.00	0.50	2.50	2.25	0.74
1100556	951 COMM. CTR.	10/03/96	JM	WP	LICOMM	1.50	N/A	2.00	1.50	1.50	2.50	2.25	0.63
1100556	951 COMM. CTR.	10/03/96	HH	WP	LICOMM	1.50	N/A	2.00	1.50	2.50	2.00	2.25	0.65
1100556	951 COMM. CTR.	10/03/96	DD	WP	LICOMM	2.00	N/A	2.50	1.50	1.50	2.50	2.38	0.69
9604125	HERON PK. APTS.	10/03/96	JM	CYP/PN	RES/MF	0.50	1.00	0.50	1.50	1.00	2.00	1.94	0.40
9604125	HERON PK. APTS.	10/03/96	HH	CYP/PN	RES/MF	1.50	1.50	1.50	2.00	1.00	1.50	2.00	0.53
9604125	HERON PK. APTS.	10/03/96	KF	CYP/PN	RES/MF	1.50	0.50	0.50	1.50	1.00	1.50	1.94	0.40
9604125	HERON PK. APTS.	10/03/96	DD	CYP/PN	RES/MF	0.50	1.00	0.50	1.50	1.00	2.50	1.94	0.43
3600142	LEHIGH ACRES	11/07/96	HH	EM	HICOMM	2.50	2.00	3.00	2.50	3.00	3.00	2.50	0.88
3600142	LEHIGH ACRES	11/07/96	JM	EM	HICOMM	2.50	2.00	3.00	2.50	3.00	3.00	2.50	0.88
3600142	LEHIGH ACRES	11/07/96	SD	EM	HICOMM	2.00	2.00	3.00	2.00	2.00	3.00	2.50	0.79
3600142	LEHIGH ACRES	11/07/96	KF	EM	HICOMM	2.00	2.50	3.00	2.50	3.00	3.00	2.50	0.88
9608123	THE CLUB EST.	10/03/96	KF	CYP/PN	RES/SF/UNDEV	1.50	2.00	2.00	2.00	0.50	2.00	2.63	0.60
9608123	THE CLUB EST.	10/03/96	DD	CYP/PN	RES/SF/UNDEV	1.50	2.00	2.50	2.50	1.00	2.00	2.63	0.67
9608123	THE CLUB EST.	10/03/96	JM	CYP/PN	RES/SF/UNDEV	1.50	2.00	2.00	2.00	1.00	2.00	2.63	0.62
9608123	THE CLUB EST.	10/03/96	HH	CYP/PN	RES/SF/UNDEV	1.50	2.00	2.00	2.50	0.50	2.00	2.63	0.63
3600033	DANIELS PKWY	10/10/96	KF	WP/MIT	HWY	2.00	N/A	1.50	3.00	2.00	2.50	3.00	0.78
3600033	DANIELS PKWY	10/10/96	HH	WP/MIT	HWY	1.00	N/A	2.00	2.50	1.00	2.00	3.00	0.64
3600033	DANIELS PKWY	10/10/96	DD	WP/MIT	HWY	2.50	N/A	2.00	3.00	1.00	2.00	3.00	0.75
3600033	DANIELS PKWY	10/10/96	SD	WP/MIT	HWY	2.50	N/A	1.50	3.00	2.50	2.50	3.00	0.83
9608197	RIVER BRIDGE	11/12/96	DD	MM	RES/GC	0.50	2.00	2.00	2.50	0.50	2.50	3.00	0.62
9608197	RIVER BRIDGE	11/12/96	SB(COE)	MM	RES/GC	0.50	2.00	3.00	3.00	0.50	3.00	3.00	0.67
9608197	RIVER BRIDGE	11/12/96	KF	MM	RES/GC	1.00	1.00	1.50	2.00	1.00	2.00	3.00	0.55
3602915	NFM COMM. PK.	10/10/96	KF	EM	REC	1.50	1.00	0.50	2.00	2.50	0.50	2.70	0.51
3602915	NFM COMM. PK.	10/10/96	DD	EM	REC	1.50	1.00	1.50	2.00	2.00	1.00	2.70	0.56
3602915	NFM COMM. PK.	10/10/96	SD	EM	REC	1.00	1.00	1.00	2.00	2.00	0.00	2.70	0.46
3601809	CRISAFULLI SERV	10/03/96	KF	MM	HICOMM	0.50	0.50	0.50	1.50	0.00	0.50	2.75	0.30

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
3601809	CRISAFULLI SERV	10/03/96	HH	MM	HICOMM	0.50	1.00	0.50	2.00	1.00	0.50	2.75	0.39
3601809	CRISAFULLI SERV	10/03/96	JM	MM	HICOMM	0.50	1.00	0.50	2.00	0.50	0.50	2.75	0.37
3601809	CRISAFULLI SERV	10/03/96	DD	MM	HICOMM	0.50	1.00	0.50	2.00	0.00	0.50	2.75	0.34
3602643	MANATEE PK.	10/10/96	KF	MH	REC	2.00	1.00	0.50	0.50	0.50	0.50	2.50	0.36
3602643	MANATEE PK.	10/10/96	SD	MH	REC	1.00	1.00	0.00	0.50	1.00	0.50	2.50	0.31
3602643	MANATEE PK.	10/10/96	DD	MH	REC	1.50	1.00	1.00	0.50	1.00	0.50	2.50	0.38
2600535	MILLS RANCH 31-2	01/21/97	RM	EM	AG/SUGAR	2.50	N/A	2.00	2.50	2.00	2.00	2.25	0.74
2600535	MILLS RANCH 31-2	01/21/97	BG	EM	AG/SUGAR	2.50	N/A	2.00	2.50	2.50	3.00	2.25	0.82
2600535	MILLS RANCH 31-2	01/21/97	BR	EM	AG/SUGAR	2.50	N/A	2.50	2.50	2.00	2.00	2.25	0.76
2600535	MILLS RANCH 31-2	01/21/97	BN	EM	AG/SUGAR	2.50	N/A	2.00	2.00	2.00	2.50	2.25	0.74
2600299	DEVILS G. DET-3	01/21/97	RM	CYP	AG/CITRUS	2.50	2.00	1.00	1.00	2.00	1.50	2.00	0.57
2600299	DEVILS G. DET-3	01/21/97	BN	CYP	AG/CITRUS	2.00	2.50	1.00	0.50	1.50	2.00	2.00	0.55
2600299	DEVILS G. DET-3	01/21/97	BG	CYP	AG/CITRUS	2.00	2.50	1.00	2.00	1.50	1.50	2.00	0.60
2600299	DEVILS G. DET-3	01/21/97	BR	CYP	AG/CITRUS	2.50	2.50	1.00	2.00	1.50	1.50	2.00	0.62
2600535	MILLS RANCH 19-7	01/21/97	RM	EM	AG/SUGAR	1.50	N/A	2.00	2.00	1.00	2.00	2.25	0.60
2600535	MILLS RANCH 19-7	01/21/97	BG	EM	AG/SUGAR	2.00	N/A	2.00	2.00	1.50	2.00	2.25	0.65
2600535	MILLS RANCH 19-7	01/21/97	BN	EM	AG/SUGAR	2.00	N/A	1.50	1.00	1.50	1.50	2.25	0.54
2600535	MILLS RANCH 19-7	01/21/97	BR	EM	AG/SUGAR	3.00	N/A	1.50	2.50	1.00	1.00	2.25	0.63
2600535	MILLS RANCH 20-14	01/21/97	BN	EM	AG/SUGAR	2.50	N/A	2.50	1.00	2.50	2.50	2.25	0.74
2600535	MILLS RANCH 20-14	01/21/97	RM	EM	AG/SUGAR	2.00	N/A	2.00	1.50	2.00	2.50	2.25	0.68
2600535	MILLS RANCH 20-14	01/21/97	BG	EM	AG/SUGAR	2.00	N/A	2.50	1.50	2.50	2.50	2.25	0.74
2600535	MILLS RANCH 20-14	01/21/97	BR	EM	AG/SUGAR	2.00	N/A	2.50	2.00	2.50	2.00	2.25	0.74
2600535	MILLS RANCH 20-13	01/21/97	BR	EM	AG/SUGAR	2.50	N/A	2.50	1.50	2.50	2.00	2.25	0.74
2600535	MILLS RANCH 20-13	01/21/97	BG	EM	AG/SUGAR	2.50	N/A	3.00	1.50	3.00	2.50	2.25	0.82
2600535	MILLS RANCH 20-13	01/21/97	BN	EM	AG/SUGAR	2.50	N/A	2.50	1.00	2.50	2.50	2.25	0.74
2600535	MILLS RANCH 20-13	01/21/97	RM	EM	AG/SUGAR	2.50	N/A	3.00	0.50	2.50	3.00	2.25	0.79
2600299	DEVILS G. #2	01/21/97	RM	EM	AG/CITRUS	2.50	N/A	1.00	1.50	2.00	1.50	2.00	0.58
2600299	DEVILS G. #2	01/21/97	BG	EM	AG/CITRUS	2.00	N/A	1.50	1.50	1.50	2.00	2.00	0.58
2600299	DEVILS G. #2	01/21/97	BR	EM	AG/CITRUS	2.50	N/A	2.00	1.50	2.00	1.00	2.00	0.61
2600299	DEVILS G. #2	01/21/97	BN	EM	AG/CITRUS	2.50	N/A	1.50	0.50	1.50	2.00	2.00	0.56
	ACME COMPLEX	01/22/97	RM	MM	INST	0.50	0.50	0.00	1.50	0.00	0.50	3.00	0.33
	ACME COMPLEX	01/22/97	BN	MM	INST	0.50	0.50	0.50	1.00	0.00	0.50	3.00	0.33
	ACME COMPLEX	01/22/97	BR	MM	INST	0.50	0.50	0.50	1.00	0.50	0.50	3.00	0.36
	CRIMINAL COMPLX	01/22/97	RM	EM	INST	1.50	1.00	1.50	1.50	1.50	1.00	2.00	0.48
	CRIMINAL COMPLX	01/22/97	BG	EM	INST	1.50	1.00	1.50	1.50	1.00	1.50	2.00	0.48
	CRIMINAL COMPLX	01/22/97	BN	EM	INST	1.50	1.00	1.00	1.00	1.00	1.50	2.00	0.43
	CRIMINAL COMPLX	01/22/97	BR	EM	INST	2.00	1.00	1.50	0.50	1.00	1.50	2.00	0.45
5002754	FEST. SHOPPES	01/22/97	RM	MM	REC	2.00	1.50	2.00	2.50	2.50	2.50	3.00	0.76
5002754	FEST. SHOPPES	01/22/97	BN	MM	REC	2.00	1.50	2.00	2.50	2.50	2.50	3.00	0.75
5002754	FEST. SHOPPES	01/22/97	BG	MM	REC	2.00	1.50	2.00	2.50	2.00	2.50	3.00	0.74
5002754	FEST. SHOPPES	01/22/97	BR	MM	REC	2.00	2.00	2.00	3.00	1.50	2.50	3.00	0.76
5003078	JUP COMM PK	01/22/97	BR	MM	REC	1.50	1.50	1.50	2.00	2.00	2.00	3.00	0.64
5003078	JUP COMM PK	01/22/97	RM	MM	REC	2.00	1.50	1.00	2.50	1.00	2.00	3.00	0.62
5003078	JUP COMM PK	01/22/97	BG	MM	REC	2.00	1.00	1.50	2.50	1.50	2.50	3.00	0.64
5003078	JUP COMM PK	01/22/97	BN	MM	REC	2.00	1.50	1.00	2.50	2.00	2.50	3.00	0.67
5003356	SCHOOL HHH	01/22/97	RM	MM	INST	1.50	1.50	2.00	1.00	2.50	2.00	2.25	0.70
5003356	SCHOOL HHH	01/22/97	BN	MM	INST	1.50	1.50	2.00	1.00	2.00	2.00	2.25	0.68
5003356	SCHOOL HHH	01/22/97	BR	MM	INST	1.50	2.00	2.00	1.00	2.00	2.00	2.25	0.71
4300848	FLORIDA CLUB	01/30/97	BG	EM/CREATED	RES/GC	1.50	N/A	2.00	0.50	2.00	2.50	1.25	0.54
4300848	FLORIDA CLUB	01/30/97	BN	EM/CREATED	RES/GC	1.50	N/A	2.00	1.50	2.00	2.00	1.25	0.57
4300848	FLORIDA CLUB	01/30/97	RM	EM/CREATED	RES/GC	1.50	N/A	1.50	1.50	2.00	2.50	1.25	0.57
4300848	FLORIDA CLUB	01/30/97	BG	EM/12	RES/GC	2.00	N/A	2.50	1.50	2.00	2.50	1.50	0.67
4300848	FLORIDA CLUB	01/30/97	RM	EM/12	RES/GC	2.00	N/A	2.50	1.50	2.00	2.50	1.50	0.67

PERMIT NO.	PROJECT	DATE	EVALUATOR	WETLAND TYPE	LANDUSE	WU	O/S	GC	BUFF	E&N	HYD	WQ	WRAP
4300848	FLORIDA CLUB	01/30/97	BN	EM/12	RES/GC	2.00	N/A	2.50	2.00	2.00	2.50	1.50	0.69
4300848	FLORIDA CLUB	01/30/97	RM	EM/14G	RES/GC	2.50	N/A	2.50	2.00	2.00	2.50	2.13	0.76
4300848	FLORIDA CLUB	01/30/97	BN	EM/14G	RES/GC	2.50	N/A	2.00	2.50	2.00	2.00	2.13	0.73
4300848	FLORIDA CLUB	01/30/97	BG	EM/14G	RES/GC	2.00	N/A	2.50	2.50	2.00	2.50	2.13	0.76
4300529	SOUTHWOOD	01/30/97	BG	EM	RES/SF	2.00	N/A	2.50	2.00	2.00	2.50	2.46	0.75
4300529	SOUTHWOOD	01/30/97	RM	EM	RES/SF	1.50	N/A	2.50	2.00	2.00	2.00	2.46	0.69
4300529	SOUTHWOOD	01/30/97	BN	EM	RES/SF	2.00	N/A	2.00	1.50	2.00	2.50	2.46	0.69
4300115	JENSEN PK. EST.	01/30/97	BG	EM/CREATED	RES/SF	1.50	N/A	2.00	1.00	1.50	2.00	1.25	0.51
4300115	JENSEN PK. EST.	01/30/97	RM	EM/CREATED	RES/SF	1.50	N/A	2.00	1.00	1.50	2.00	1.25	0.51
4300115	JENSEN PK. EST.	01/30/97	BN	EM/CREATED	RES/SF	1.50	N/A	1.50	0.50	1.50	2.00	1.25	0.46
5601136	OAKS @ I.R.	01/30/97	BN	MM	RES/SF	2.00	1.50	1.50	1.50	1.00	2.00	2.65	0.58
5601136	OAKS @ I.R.	01/30/97	RM	MM	RES/SF	1.50	1.00	2.00	2.00	1.50	2.00	2.65	0.55
5601136	OAKS @ I.R.	01/30/97	BG	MM	RES/SF	1.50	1.00	2.00	2.00	1.00	2.00	2.65	0.58
5600274	MIDPORT PARK	01/30/97	RM	EM	REC	2.00	N/A	1.00	2.00	1.00	1.50	2.25	0.54
5600274	MIDPORT PARK	01/30/97	BG	EM	REC	1.50	N/A	1.50	2.00	1.00	1.50	2.25	0.54
5600274	MIDPORT PARK	01/30/97	BN	EM	REC	1.50	N/A	1.50	2.00	1.00	1.50	2.25	0.54
5600680	OUTLET MALL	01/30/97	RM	EM/3	HICOMM	1.50	N/A	1.50	1.00	1.50	2.00	1.25	0.49
5600680	OUTLET MALL	01/30/97	BG	EM/3	HICOMM	1.50	N/A	1.50	1.00	2.00	2.00	1.25	0.51
5600680	OUTLET MALL	01/30/97	BN	EM/3	HICOMM	1.50	N/A	1.50	1.50	2.00	2.00	1.25	0.54
5600680	OUTLET MALL	01/30/97	BN	EM/2	HICOMM	1.00	N/A	1.50	0.50	1.50	2.00	0.75	0.40
5600680	OUTLET MALL	01/30/97	RM	EM/2	HICOMM	1.00	N/A	1.50	0.50	1.00	2.00	0.75	0.38
5600680	OUTLET MALL	01/30/97	BG	EM/2	HICOMM	1.00	N/A	1.50	0.50	1.50	2.00	0.75	0.40
3603165	CALOOSA. RIV.PK.	01/24/97	KF	EM/POND	REC	3.00	2.50	2.00	2.50	2.00	2.50	2.13	0.79
3603165	CALOOSA. RIV.PK.	01/24/97	HH	EM/POND	REC	2.50	2.50	2.50	2.50	2.00	2.00	2.40	0.78
3603165	CALOOSA. RIV.PK.	01/24/97	DD	EM/POND	REC	3.00	2.50	2.50	2.50	2.00	2.50	2.40	0.83
3603165	CALOOSA. RIV.PK.	01/24/97	JM	EM/POND	REC	3.00	2.50	2.00	2.50	2.00	2.00	2.40	0.78
3603165	CALOOSA. RIV.PK.	01/24/97	DM	EM/POND	REC	3.00	2.50	3.00	2.50	2.00	2.00	2.40	0.83
3603165	CALOOSA. RIV.PK.	01/24/97	HY	EM/POND	REC	3.00	2.00	2.00	3.00	2.00	2.00	2.40	0.78
960110-14	6 MILE MIT. BNK.	01/24/97	HH	FORESTED	REC	1.00	0.50	1.50	1.50	0.50	1.00	1.75	0.37
960110-14	6 MILE MIT. BNK.	01/24/97	KF	FORESTED	REC	0.50	1.00	1.00	2.00	0.00	1.00	2.00	0.36
960110-14	6 MILE MIT. BNK.	01/24/97	DD	FORESTED	REC	0.50	1.00	1.50	1.50	0.00	1.00	2.00	0.36
960110-14	6 MILE MIT. BNK.	01/24/97	JM	FORESTED	REC	0.50	0.50	1.50	2.00	0.50	1.50	1.75	0.39
960110-14	6 MILE MIT. BNK.	01/24/97	DM	FORESTED	REC	0.50	0.50	1.00	2.00	0.00	1.50	1.75	0.34
960110-14	6 MILE MIT. BNK.	01/24/97	SB	FORESTED	REC	1.00	0.00	2.50	2.00	0.00	2.00	1.00	0.40
960110-14	6 MILE MIT. BNK.	01/24/97	MB	FORESTED	REC	0.50	0.50	1.00	1.00	0.00	1.00	2.00	0.24
960110-14	6 MILE MIT. BNK.	01/24/97	HY	FORESTED	REC	2.00	1.00	0.00	1.00	0.00	0.00	2.00	0.28
960110-14	LEE CO. MIT. BANK	01/24/97	DM	MF	REC	2.50	3.00	3.00	2.00	2.50	2.50	2.40	0.85
960110-14	LEE CO. MIT. BANK	01/24/97	DD	MF	REC	2.00	3.00	3.00	2.50	2.50	2.50	2.40	0.85
960110-14	LEE CO. MIT. BANK	01/24/97	JM	MF	REC	2.00	3.00	3.00	2.50	2.00	2.50	2.40	0.82
960110-14	LEE CO. MIT. BANK	01/24/97	KF	MF	REC	2.00	3.00	3.00	1.50	2.50	2.50	2.40	0.80
960110-14	LEE CO. MIT. BANK	01/24/97	HH	MF	REC	1.50	2.50	2.50	2.50	2.50	2.50	2.40	0.78
960110-14	LEE CO. MIT. BANK	01/24/97	SB	MF	REC	2.00	3.00	3.00	2.50	2.50	2.50	2.75	0.87
960110-14	LEE CO. MIT. BANK	01/24/97	MB	MF	REC	2.50	3.00	3.00	1.50	2.50	2.50	2.40	0.83
960110-14	LEE CO. MIT. BANK	01/24/97	HY	MF	REC	2.00	3.00	3.00	2.00	2.00	2.50	3.00	0.83

Appendix G - Florida Land Use, Cover and Forms Classification System

Introduction

The Florida Land Use, Cover and Forms Classification System (FLUCCS) is a land use classification system originally developed by the Florida Department of Transportation (FDOT). Its primary purpose is to clarify, in some detail, the land use / cover / forms annotations assigned to various polygons which make up a land use map. This coding system is routinely utilized by agencies such as Division of Forestry, Florida Department of Environmental Protection, the Water Management Districts, and many other departments, bureaus and universities throughout the state of Florida.

FLUCCS codes specifically for Wetlands (600) are listed below, along with their specific description criteria.

610 Wetland Hardwood Forests

Wetland Hardwood Forests are those wetland areas which meet the crown closure requirements for forestland (i.e., minimum 10 percent closure). To be included in the Wetland Hardwood Forest category, the stand must be 66 percent or more dominated by wetland hardwood species, either salt or freshwater.

611 Bay Swamps

This category is composed of dominant trees such as loblolly bay, sweetbay, red bay, swamp bay, slash pine and loblolly pine. Large gallberry, fetterbush, wax myrtle and titi are included in the understory vegetation.

612 Mangrove Swamps

This coastal hardwood community is composed of red and/or black mangrove which is pure or predominant. The major associates include white mangrove, buttonwood, cabbage palm and sea grape.

613 Gum Swamps

This forest community is composed of swamp tupelo (blackgum) or water tupelo (tupelogum) which is pure of predominant. Associate species include bald cypress and a great variety of wet site tolerant hardwood species widely variant in composition.

614 Titi Swamps

This community is composed of often extremely dense stands of black titi and cyrilla which are either pure or predominant species. Major associated species include bay, cypress, tupelos and a great variety of wetland hardwoods.

615 Stream and Lake Swamps

This community, often referred to as bottomland or stream hardwoods, is usually found on but not restricted to river, creek and lake flood plain or overflow areas. It is a conglomeration of a wide variety of predominantly hardwood species of which some of the more common components include red maple, river birch water oak, sweetgum, willows, tupelos, water hickory, bays, water ash and buttonbush. Associated species include cypress, slash pine, loblolly pine and shortleaf pine.

616 Inland Ponds and Sloughs

These communities are associated with depressions and drainage areas that are not associated with streams or lakes. One or a combination of the following species will generally be predominant: pond cypress, swamp tupelo, water tupelo, titi or willows.

617 Mixed Wetland Hardwoods

This category is reserved for those wetland hardwood communities which are composed of a large variety of hardwood species tolerant of hydric conditions yet exhibit an ill defined mixture of species.

620 Wetland Coniferous Forests

Wetland coniferous forests are wetlands, which meet the crown closure requirements for coniferous forests (i.e., 66 percent closure by conifers) and are a result of natural generation. These communities are commonly found in the interior wetlands in such places as river flood plains, bogs, bayheads and sloughs.

621 Cypress

This community is composed of pond cypress or bald cypress which is either pure of predominant. In the cases of pond cypress, common associates are swamp tupelo, slash pine and black titi. In the case of bald cypress, common associates are water tupelo, swamp cottonwood, red maple, American elm, pumpkin ash, Carolina ash, overcup oak and water hickory. Bald cypress may be associated with laurel oak, sweetgum and sweetbay on less moist sites, Note that some authorities do not distinguish between the two varieties of cypress.

622 Pond Pine

This category is composed of pond pine, which is either pure or predominant. Its major associates include sweetbay, loblolly bay, red bay and swamp tupelo.

623 Atlantic White Cedar

In this community, Atlantic White Cedar is the indicator species although it may not always be the most abundant. Its common associates include slash pine, cypress, swamp tupelo, sweetbay, red bay, loblolly bay, black titi and red maple.

624 Cypress – Pine – Cabbage Palm

This community includes cypress, pine and/or cabbage palm in combinations in which neither species achieves dominance. Although not strictly a wetlands community, it forms a transition between upland and hydric states.

630 Wetland Forested Mixed

This category includes mixed wetland forest communities in which neither hardwoods nor conifers achieve a 66 percent dominance of the crown canopy composition.

640 Vegetated Non-Forested Wetlands

Vegetated, non-forested wetlands include marshes and seasonally flooded basins and meadows. These communities are usually confined to relatively level, low-lying areas. This category does not include areas which have tree cover meet the crown cover is less that the threshold for forested categories. When the forest crown cover is less than the threshold for wetland forest or is non-woody, it will be included in this category. Sawgrass and cattail are the predominant species in freshwater marshes while spartina and needlerush are the predominant species in the saltwater marsh communities.

641 Freshwater Marshes

The communities included in this category are characterized by having one or more of the following species predominate:

Sawgrass	-*Cladium jamaicensis*
Cattail	-*Typha domingensis*
	Typha latifolia
	Typha angustifolia
Arrowhead	-*Sagittaria* sp.
Maidencane	-Panicum hemitomon
Buttonbush	-Cephalanthus occidentalis
Cordgrass	-Spartina bakeri
Switchgrass	-Panicum virgatum
Bulrush	-Scirpus americanus
	Scirpus validus
	Scirpus robustus

Needlerush	-Juncus effusus
Common reed	-*Phragmites communis*
	Phragmites australis
Arrowroot	-*Thalia dealbata*
	Thalia geniculata

If the community is 66 percent or more dominated by a single species by cover, on of the following level IV classifications will be employed.

6411 Sawgrass

6412 Cattail

6413 Spikerush

6414 Maidencane

6415 Dog fennel and low marsh grasses

6416 Arrowroot

642 Saltwater Marshes

The communities included in this category will be predominated by one or more of the following species:

Cordgrasses	-*Spartina alterniflora*
	Spartina cynosuroides
	Spartina patens
	Spartina spartinae
Needlerush	-*Juncus roemerianus*
Seashore Saltgrass	-*Distichlis spicata*
Saltwort	-*Batis maritima*
Glassworts	-*Salicornia* sp.
Fringerush	-*Fimbristylis castanea*
Salt Dropseed	-*Sporobolus virginicus*
Seaside Daisy	-*Borrichia frutescens*
Salt Jointgrass	-*Paspalum vaginatum*

If the community is 66 percent or more dominated by a single species by cover, one of the following level IV classifications will be employed.

6421 Cordgrass

6422 Needlerush

643 Wet Prairie

This classification is composed of dominantly grassy vegetation on wet soils and is usually distinguished from marshes by having less water and shortage herbage. These communities will be predominated by one or more of the following species:

Sawgrass	-*Cladium jamaicensis*
Maidencane	-*Panicum hemitomon*
Cordgrasses	-*Spartina bakeri*
	Spartina patens
Spikerushes	-*Eleocharis* sp.
Beach Rushes	-*Rhycosphora* sp.
St. Johns Wort	-*Hypericum* sp.
Spiderlily	-*Hymenocallis palmeri*
Swamplily	-*Crinum americanum*
Yellow-eyed Grass	-*Xyris ambigua*
Whitetop Sedge	-*Dichromena colorata*

644 Emergent Aquatic Vegetation

This category of wetland plant species includes both floating vegetation and vegetation, which is, found either partially or completely above the surface of the water.

6441 Water Lettuce – *Pistia stratiotes*

6442 Spatterdock – *Nuphar* sp.

6443 Water Hyacinth – *Eichhornia* sp.

6444 Duck Weed – *Lemna* sp.

6445 Water lily - Nymphaeaceae

645 Submergent Aquatic Vegetation

This category of wetland vegetation is composed of those aquatic species or communities found growing completely below the surface of the water.

6451 Hydrilla – *Hydrilla verticillata*

650 Non-Vegetated

Non-vegetated wetlands are those hydric surfaces on which vegetation is found lacking due to the erosional effects of wind and water transporting the surface material so rapidly that the establishment of plant communities is hindered or the

fluctuation of the water surface level is such that vegetation cannot become established. Additionally, submerged or saturated materials often develop toxic conditions of extreme acidity. Tidal flats, shorelines and intermittent ponds are the main components of this category.

651 Tidal Flats

This category is composed of that portion of the shore environment protected by wave action, as in the case of estuaries, comprised primarily of muds transported by tidal channels. An important characteristic of the tidal flat environment is its alternating tidal cycle of submergence and exposure to the atmosphere.

652 Shorelines

This category is normally defined as the interface between the land mass and a water body. Shorelines are formed primarily by physical or biological agents resulting in environments such as coral reefs and barrier beaches. The shore is defined as the zone extending from the low tide mark to the farthest point inland to which wave action transports beach materials.

653 Intermittent Ponds

This category of wetland is defined as a waterbody which exists for only a portion of the year. It may be referred to as a seasonal waterbody. Its existence relies upon water received directly from precipitation, runoff or spring flow.

654 Oyster Bars