CHAPTER 8: EXISTING NATURAL SYSTEMS CONDITIONS

8.1 Overview

The Rocky/Brushy Creek watershed area encompasses 38,201 acres in Hillsborough County. The watershed contains plant communities, both terrestrial and aquatic, that provide a variety of important environmental functions, including habitat for listed species and other wildlife, stability for stream banks and lake shores, improvement of water and air quality, protection of coastal shorelines from storm surges, and moderation of water and air temperatures. However, plant communities have undergone several periods of significant alteration since the 1830's as land use in the watershed changed from original conditions to agriculture to the current suburban/urban uses. Land use shifts have left the watershed with substantially less acreage in native plant communities, impaired water quality in streams, degradation of all plant communities by non-native invasive plants, highly disturbed stream banks and lake shores, and a reduction of length of coastal shoreline protected by marshes. Most populations of native wildlife have been reduced and/or eliminated.

One of the objectives of this watershed management plan is to identify opportunities to restore and protect natural systems in the Rocky/Brushy Creek watershed which are important in preventing excessive runoff volumes and pollutant loads, restoring and/or maintaining terrestrial and aquatic biodiversity, protecting stream channel stability, and reducing stream bank erosion. The first step toward this goal is to describe the historical and existing natural systems in the Rocky/Brushy Creek watershed and to identify specific key factors that prove useful in assessing watershed ecosystem quality. The evaluation of the key factors is done by means of a prioritization matrix which ranks the subwatersheds with respect to environmental quality. A discussion of the overall trends in environmental quality is provided early in the chapter, followed by more discussion of the significant issues for habitats and wildlife within the Rocky/Brushy Creek watershed.

8.2 Data Sources/Literature Review

Several reports were reviewed for this report, and a list appears in the Bibliography in Section 8.9. Further, Geographic Information System (GIS) databases were utilized from the following organizations:

- Florida Department of Environmental Protection (FDEP)
- Florida Department of Transportation (FDOT)
- Florida Fish and Wildlife Conservation Commission (FFWCC)
- Hillsborough County Streamwatch Program

- Florida Natural Areas Inventory (FNAI)
- Hillsborough County Environmental Protection Commission (EPC)
- Hillsborough County Environmental Lands Acquisition and Protection Program (ELAPP)
- Hillsborough County Planning Commission
- Hillsborough River Greenways Task Force (HRGTF)
- Southwest Florida Water Management District (SWFWMD)
- Natural Resources Conservation Service (NRCS)
- U.S. Fish and Wildlife Service (USFWS)
- University of Florida, Geoplan Center, Florida Geographic Data Library (FGDL)
- University of Florida Lakewatch Program
- University of South Florida, Florida Center for Community Development and Design

8.3 Overall Trends and Summary

There are numerous ecological factors and relationships that define the condition of a natural system, and therefore the "level of service" that can be provided by that system. To evaluate and score the watershed, a series of parameters were considered which represented important ecological functions, extent of human development/impacts, and the presence/absence of important wildlife species. The data that were used to develop quantitative parameter scores were processed and generated from a library of information and staff experience, in addition to existing GIS data provided by the SWFWMD and Hillsborough County. Most of these data are presented in subsequent subsections of this chapter. The parameters used in this are described as follows:

- historical and existing land use – expressed as a percent, this factor describes the change in land uses in the watershed area over the period from the 1950 to 2004;
- loss of natural lands
    - habitat fragmentation – describes the impact to the watershed area of the splitting up and isolation of wildlife habitat;
    - riparian buffers – describes the losses of forested systems in stream floodplains and their significance to ecosystem quality in the watershed area;
- hydrologic alterations – describes the impact to environmental quality and function resulting from physical alterations to streams and lakes such as channelization, diversion, filling, and encroachment;
- exotic flora and fauna – describes the impact to native plant and animals in the watershed area of the invasion and establishment of exotic species;
- strategic habitat conservation areas – describes the identification by FFWCC of areas that are particularly important to preserve in terms of wildlife conservation; and
- land held in public ownership – describes the land acreage currently acquired by public resource conservation agencies that provides important natural environmental functions in the watershed area.

Using the data described in the following sections of this chapter, a natural systems evaluation matrix was developed to provide a comparative tool for measuring the quality and quantity of existing natural habitats within the watershed. This tool can be used to evaluate the overall condition of the watershed so that future efforts to protect or restore natural systems can be prioritized and implemented effectively either as stand-alone projects or in conjunction with flood and/or water quality improvement activities. An overall score was calculated based on the sum of scores for each habitat parameter (Table 8-1). Using a scoring technique similar to the water quality level of service evaluation, the overall natural system evaluation matrix score was based on the ratio of the total watershed score divided by the maximum possible score. The watershed was then given a grade based on the following ratios: *1.0 to 0.8 = A, 0.79 to 0.6 = B, 0.59 to 0.4 = C, 0.39 to 0.20 = D, <0.2 = F*.

Based on criteria relating to conservation lands, intactness of riparian buffers, contiguity of natural habitats, amount of natural habitat remaining, and the identification of Strategic Habitat Conservation Areas, the Rocky/Brushy Creek watershed received a grade of D. No watershed in the Northwest Hillsborough County area scored an “A” or a “B,” indicating the overall degraded nature of natural systems in the area.

Table 8-1 Natural Systems Evaluation Matrix - Rocky/Brushy Creek Watershed

HABITAT PARAMETER	SCORE
Habitat fragmentation	0
Riparian buffer rating	2
Natural habitat remaining	1
Strategic Habitat Conservation Areas	1
Public ownership for conservation/restoration purposes	1
Overall score	D

The status of the natural systems in the Rocky/Brushy Creek watershed as a whole is described in this report section. Detailed descriptions of the conditions and an assessment of the natural systems are included in the following sections.

8.4 Historical and Existing Habitats

This section discusses, in broad terms, the historical (pre-1900) natural systems conditions in general terms based on information derived from the General Land Office Survey Notes. This description is presented as background for detailed discussion of the land use patterns and natural systems areal coverages existing in the 1950's and currently (2004). Information on the 1950's and 2004 land uses were obtained from SWFWMD. The following tables have collapsed the Level III FLUCFCS (2004) land use codes to Level I to enhance comparisons among the pre-1900, 1950's, and 2004 time periods. The figures illustrating land uses retain the Level III coding. The narratives following the tables provide details of the Level III land use cover types included in the Level I listings in the tables.

Historical (pre-1900) land uses and cover types – Prior to the permanent settlement of Hillsborough County in the first half of the 19th century, approximately 70% of the land in the Rocky Creek - Brushy Creek watershed was occupied by soils that supported two land cover types: pine flatwoods (FLUCFCS 411) and longleaf pine-xeric oak (FLUCFCS 412). The remainder of the land in the watershed was occupied by cypress swamps (FLUCFCS 621), stream and lake swamp (FLUCFCS 615), bay swamps (FLUCFCS 611), wetland forested mixed (FLUCFCS 630), lakes (FLUCFCS 520), freshwater marshes and wet prairies (FLUCFCS 641 and 643), saltwater marshes (FLUCFCS 642), tidal flats/submerged shallow platform (FLUCFCS 651, and Mangrove swamps (FLUCFCS 612). The swamps bordering the channels, the large areas of cypress swamp, and the saltwater marshes adjacent to the channel in the lower reaches of Rocky Creek were significant contiguous wetlands in the watershed. By 1910, Hillsborough was the most populous county in the state, and considerable development of roads and railroads had occurred. By 1916, in the Rocky Creek - Brushy Creek watershed, major roadways (Old Memorial Highway, Van Dyke Road, Lutz-Lake Fern Road, US 41) were hard surface facilities, and numerous secondary roads were in place. Over 200 homes and buildings had been constructed, and the Tampa and Gulf Coast Railroad had several lines through the watershed. Several small communities and villages (Stemper, Citrus Park, Tarpon Junction, Blockton, Lutz, Cosme) had grown up around roadway intersections and rail lines. By 1938, agriculture had become well established on the uplands (longleaf pine-xeric oak, pine flatwoods) in the central and northern regions of the watershed. Cattle, row crops, and citrus were the dominant commodities. By 1950, agriculture accounted for 19.5% of the lands in the watershed, while uplands were reduced to 51% of the watershed. By 2004, the percent coverage of the watershed by native uplands was further reduced to 5.4%.

Land uses and cover types from the 1950's - Table 8-2 provides a list and the acreages of land uses and cover types existing in 1950; each land use is compared to the total watershed area. Figure 8-1 illustrates the 1950 land uses and cover types in the Rocky/Brushy Creek watershed.

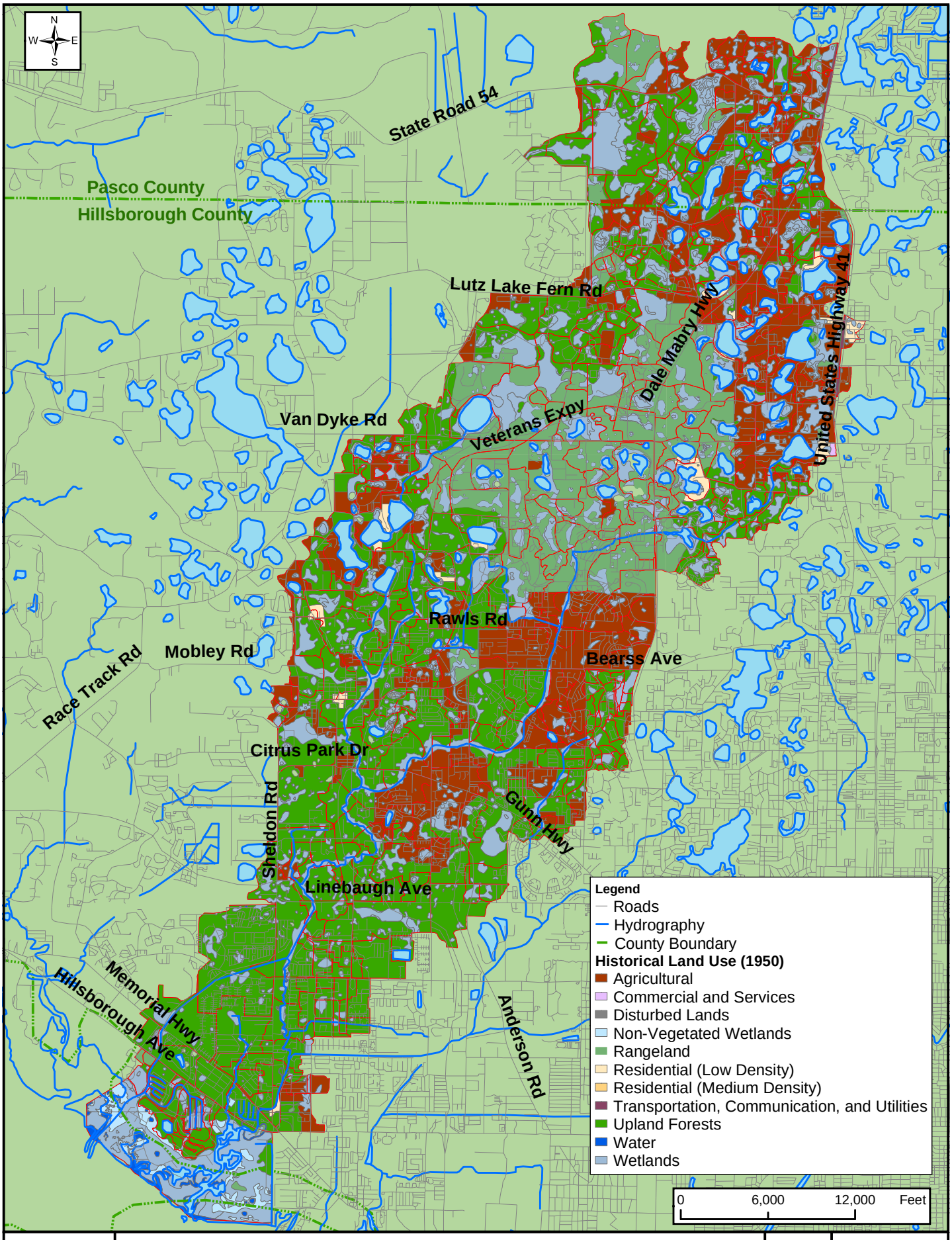
Table 8-2 Land Use in the Rocky/Brushy Creek Watershed, 1950

Land Use	Total Area (acres)	% of Watershed
Uplands	19,351	51
Herbaceous wetlands	2,063	5.4
Forested wetlands	7,149	18.7
Agriculture	7,443	19.5
Lakes	1,616	4.2
Low/Medium Density Residential	280	0.7
Commercial, Utilities, Transportation, Institutional	628	0.1
Total	38,530	100%

2004 land uses and cover types - Table 8-3 provides a list and the acreages of land uses and cover types existing in 2004; each land use is compared to the total watershed area. Figure 8-2 illustrates the 2004 land uses and cover types in the Rocky/Brushy Creek watershed.

Table 8-3 Land Use in the Rocky/Brushy Creek Watershed, 2004

Land Use	Total Area (acres)	% of Watershed
Uplands	2,060	5.4
Wetlands	7,728	20
Agricultural	3,350	8.7
Water	3,794	10
Open Land / Recreational	2,132	5.6
Low/Medium Density Residential	8,035	21
High Density Residential	7,819	21
Commercial, Utilities, Transportation, Institutional	3,209	8.4
Total	38,127	100%



Historical Land Use (1950s) in the Rocky/Brushy Creek Watershed

Figure 8-1

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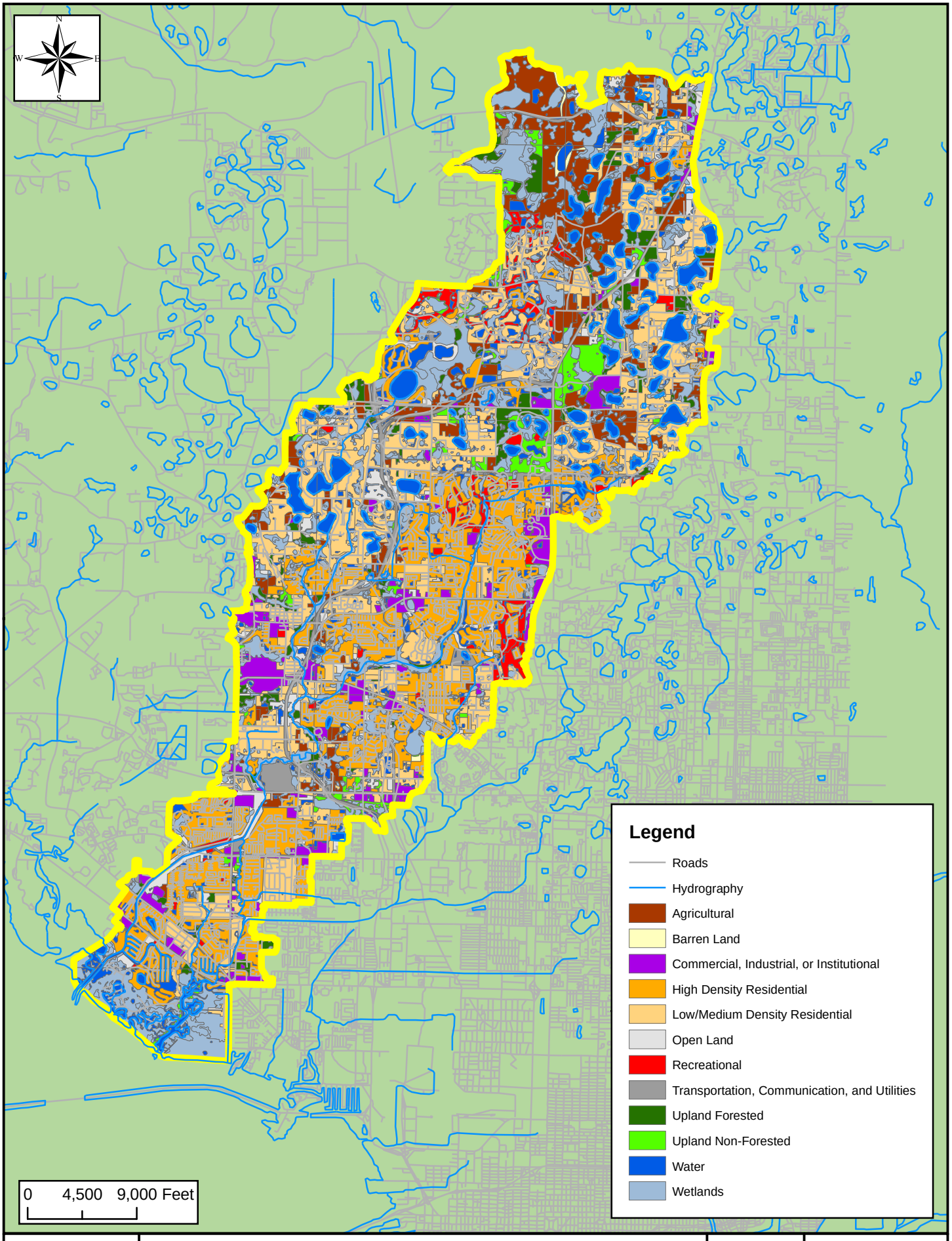

Land Use in the Rocky/Brushy Creek Watershed (2004)

Figure 8-2

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8.4.1 Upland Natural Systems

The following upland habitat descriptions are based on the information contained in Harper (1921), Carlisle et al. (1978), Florida Department of Transportation's FLUCFCS Manual (1999), and the Soil Surveys of Hillsborough County from 1916, 1958, and 1989. In the plant community descriptions below, only the species that are most characteristic of the plant community in the Rocky/Brushy Creek watershed are mentioned as being present; however, the natural plant communities that still remain in the watershed are highly diverse and contain many more species than are mentioned in this report. For ease of reading, only common names of plants are used in the report narrative, but Section 8.10 provides a list of all scientific names of plants and animals included in the report.

Pine flatwoods (411)

The most common upland plant community in the state and in the Rocky Creek - Brushy Creek watershed is the pine flatwoods community which is associated with Malabar fine sands and Immokalee fine sands. The primary canopy species common to pine flatwoods is slash pine with some longleaf pine, while the shrubby understory is dominated by saw palmetto with some gallberry, staggerbush, blueberry, and tarflower. Herbaceous ground cover is sparse and includes wiregrass, several species of bluestem, and goldenrod. This community occurs on flat, moderately to poorly drained terrain composed of acid sands overlying an organic/clayey hardpan. Even on better drained terrain, flatwoods can experience periods of inundation when rainfall amounts are in the normal to above normal range. On less well drained terrain, a wet phase of pine flatwoods occurs in which obligate to facultative-wet plant species can be found flatwoods regularly. These species include trees: sweetbay, gordonia, red maple; shrubs: wax myrtle, gallberry, fetterbush; and herbs: spikerush, redroot, bog buttons, pink sundews, and yellow-eyed grass. Pine flatwoods is a fire-maintained community that will transition to a hardwood-dominated community with very dense canopy dominated by live oak, laurel oak, and pignut hickory if fire is excluded. In the Rocky Creek - Brushy Creek watershed, pine flatwoods have been used for pasture, row crops, and (with drainage) some citrus. Pine flatwoods now occupies only 1% of the watershed.

Longleaf pine-xeric oak (412)

The longleaf pine - xeric oak plant community, also known as sandhill, is associated with Norfolk fine sands in the Rocky Creek - Brushy Creek watershed. Natural canopy vegetation is dominated by longleaf pine, and characteristically has a mid-canopy of bluejack oak, turkey oak, sand live oak. The understory contains a medium to low density shrub community consisting of shiny blueberry, Darrow's blueberry, gopher apple, Adam's needle, and beautyberry. Herbs compose the ground cover and include: wiregrass, sky-blue lupine, drumheads, Carolina elephant's foot, dwarf pawpaw, and eastern milk pea. This community also is a fire-maintained community that will transition to a hardwood-dominated community with few to no pines and a very dense canopy dominated by sand live oak, turkey oak, bluejack oak if fire is excluded. This plant community was largely replaced by citrus by 1950. Currently (2004), this community occupies 0.3% of the watershed.

Hardwood conifer mixed forest (434)
In a hardwood-conifer mixed forest, neither upland conifers nor hardwoods attain more than 66% dominance in the canopy. By definition, these areas typically occur on well-drained but non-droughty soils and are often the result of fire suppression in pine flatwoods. Mixed forests are often successional to upland hardwood forests. This community has the same species as the longleaf pine-xeric community (*FLUCFCS 412)* except that neither the pines nor the oaks dominate. The percent coverage of this community increased from 0.2% to 1.15% between 1950 and 2004, probably as a result of natural successional activity.

Shrub and brushland (320)

Shrub and brushland occurs on the same soils as pine flatwoods and longleaf pine-xeric oak communities. However, it is dominated by herbs and shrubs; few to no trees are present. Typical species include saw palmetto, gallberry, wax myrtle, species of bluestem, other woody scrub plant species, and various short herbs and grasses. It often develops following the clearing of pines for timber or on long-fallow cropland. This community occupied 13.3% of the watershed in 1950 and 2% by 2004. The decrease in areal cover of this community is likely related to the conversion of these lands to residential or commercial uses.

Mixed rangeland (330)
Mixed rangeland is defined by FLUCFCS as rangeland where there is more than 33% mixture of grassland and shrub-brushland range species exists. This community was not recognized in the land use mapping of 1950, but it occupies 0.14% of the watershed currently (2004).

8.4.2 Wetland/Aquatic Natural Systems

The following wetland habitat descriptions are based on the information contained in Carlisle et al. (1978), Florida Department of Transportation's FLUCFCS Manual (1999), and the Soil Surveys of Hillsborough County from 1916, 1958, and 1989. For information on lakes and Rocky Creek - Brushy Creek, SWFWMD's Directory of Lakes (SWFWMD, 2005) and the USF Hillsborough Watershed Atlas (http://www.hillsborough.wateratlas.usf.edu) were consulted. In the plant community descriptions below, only the species that are most characteristic of the plant community in the Rocky Creek - Brushy Creek watershed are mentioned as being present; however, the natural plant communities that still remain in the watershed are highly diverse and contain many more species than are mentioned in this report. For ease of reading, only common names of plants are used in the report narrative, but Section 8.10 provides a list of all scientific names of plants and animals included in the report.

Cypress swamp (621)

Cypress swamp is the most common wetland community in the watershed. Formerly (1950) occupying 10.3% of the land in the Rocky Creek - Brushy Creek watershed, the cypress swamp community currently (2004) covers 8.8% of the watershed. It is associated with several soils, including: Myakka fine sand, Basinger, Holopaw, Samsula depressional soils, that are located on the margins of most of the 38 lakes in the watershed. These natural systems are typically large basins characterized by peat substrates, seasonal to year-round inundation, still water, and occasional fire. They may be associated with the channel of the Creek or isolated during the dry season. The typical vegetation canopy species is pond cypress which is associated with swamp black gum, southern red maple, laurel oak, and dahoon holly. The understory is shrubby and is composed of fetterbush, Virginia willow, and buttonbush. The herbaceous understory includes a variety of ferns (royal fern, cinnamon fern, netted chain fern, Virginia chain fern, and toothed mid-sorus fern) associated with alligator flag, water hoarhound, false nettle. Endangered and threatened species such as butterfly orchid, Spanish moss, and ball moss occur occasionally in cypress swamps.

Bay Swamp (611)

Not recognized in the 1950 mapping, the bay swamp community currently (2004) covers 0.2% of the watershed. Canopy trees include loblolly bay, sweetbay, swamp bay, slash pine, and loblolly pine. Understory vegetation is typically dense and composed of gallberry, fetterbush, wax myrtle, and titi.

Stream and Lake swamp (615)

Formerly (1950) occupying 3.6% of the land in the Rocky Creek - Brushy Creek watershed, the stream and lake swamp community currently (2004) covers 2.03% of the watershed. The community is also referred to as bottomland hardwood forests and is associated with the stream channel. Canopy tree species include red maple, water oak, sweetgum, swamp black gum, pond cypress, and some tall Carolina willows. The subcanopy and understory in this community are typically of open aspect except in forests where the hydroperiod (depth and duration of inundation) has been reduced, which has allowed a tangle of shrub species to become established on the forest floor invade and close the understory. In such cases, shrubs such as fetterbush and buttonbush make the forest virtually impenetrable.

Mangrove swamps (612)

The areal coverage of this habitat has decreased from 1.6% of the watershed to 1.3% over the period 1950-2004. Remaining habitat exists in the estuary of the Creek where considerable disturbance from transportation facilities, trash disposal, invasion by Brazilian pepper, and untreated stormwater runoff has occurred. This land cover type is especially important in that it provides cover and foraging habitat for invertebrates and fish, roosting and nesting habitat for birds, and shoreline protection.

Wetland coniferous forest (620)

In the Rocky Creek - Brushy Creek watershed, the wetland coniferous forest is a wetland forest dominated by pond cypress but which has other coniferous species (slash pine, bald cypress, red cedar) as common associates. The wetland coniferous forest formerly (1950) covered 0.1% of the land in the Rocky Creek - Brushy Creek watershed, and currently (2004), it covers 0.16% of the watershed.

Wetland Forested Mixed (630)

Wetland forested mixed is a wetland forest where neither hardwoods nor conifers achieve a 66% dominance of the crown canopy composition. Formerly (1950) occupying 3.1% of the land in the Rocky Creek - Brushy Creek watershed, the stream and lake swamp community currently (2004) covers 3% of the watershed. Species common to this community are those described Stream and Lake Swamp community (FLUCFCS 615).

Freshwater marsh (641)

The areal coverage of freshwater marsh in the Rocky Creek - Brushy Creek watershed remained the same over the period 1950 – 2004. In 1950, this land cover type represented 2.5% of the watershed, while it occupied 2.47% of the watershed in 2004. This habitat is typically characterized by large basins with peat substrates, seasonal to year-round inundation, and infrequent fire. Freshwater marshes usually occur as open expanses of grasses, sedges, rushes, and other herbaceous species in soils that are usually saturated or covered with surface water for two or more months during the year (Brown et al., 1990). Freshwater marsh is highly diverse and marshes may differ significantly from one another even though located in

geographic proximity. In The Rocky Creek - Brushy Creek watershed, typical species include: sawgrass, cattail, arrowhead, maidencane, buttonbush, cordgrass, soft rush, and fire flag. The species composition of freshwater marsh habitat often occurs in zones and is dependent upon soil type, hydroperiod, water depth, and successional stage (Wolfe and Drew, 1990).

Saltwater marsh (642)

The areal coverage of this habitat has remained stable at about 1.1% of the watershed over the period 1950-2004. This land cover type is particularly valuable as habitat for invertebrates and juvenile fish and as a protective barrier from storm surges. In Rocky Creek - Brushy Creek watershed, saltwater marshes exist in the Creek's estuary where by far the most common plant species is black needle rush; some cordgrass is also present. Significant habitat for juvenile fish and invertebrates of commercial importance, the saltwater marsh in the Rocky Creek - Brushy Creek estuary has been impacted by transportation facilities and untreated stormwater runoff.

Wet prairies (643)

Formerly (1950) occupying 0.9% of the land in the Rocky Creek - Brushy Creek watershed, the wet prairie community currently (2004) covers 0.6% of the watershed. Wet prairies are usually open, mixed grass-sedge associations, which occur in areas of periodic flooding and are distinguished from marshes as having shorter herbaceous species and longer, drier hydroperiods (Wolfe and Drew, 1990). Like freshwater marshes, wet prairies support a diversity of species, and each system may be different from a neighboring system. Important species in the Rocky Creek - Brushy Creek watershed wet prairie systems include: spike rushes, beak rushes, St. John's wort, yellow-eyed grass, whitetop sedge, pink sundew, early whitetop fleabane, and meadow beauty.

Emergent aquatic vegetation (644)

The areal coverage of emergent aquatic vegetation in the Rocky Creek - Brushy Creek watershed increased from 0.1% to 0.4% of the watershed over the period 1950 – 2004. Typically, this habitat is associated with the deepwater portions of freshwater marshes and includes species such as water lettuce, spatterdock, water hyacinth, duckweed, and water lilies.

Tidal flats/submerged shallow platform (651)

This habitat type occupies the lower reaches of Rocky Creek - Brushy Creek. It represents a challenging, but biologically productive area that is important as habitat for animals that are critical links in the estuarine food webs. Vegetation occurring here is very sparse, and the area may

consist solely of mud into which animals burrow. The areal coverage of this habitat has remained stable at about 0.7% of the watershed.

Streams and waterways (510)

While Rocky Creek - Brushy Creek is a major landscape feature and the only linear waterway in the watershed, it is not identified in either the 1950 land use mapping due to its channel and flow characteristics. The 2004 mapping recognizes this community as occupying 0.2% of the watershed. The channel of Brushy Creek is narrow along its entire length, while that of Rocky Creek is narrow in its upper reaches but widens as the Creek approaches the bay. A segment of Rocky Creek was channelized and a diversion canal, Channel A, was constructed off of Rocky Creek east of Sheldon Road. Channel A empties into the bay west of the original channel of Rocky Creek. The increase in Streams and Waterways in the 2004 mapping to 0.2% reflects the construction of Channel A. The plant community supported on the Creek banks in its upper reaches is included under the Stream and Lake Swamp community description (FLUCFCS 615); in the lower reaches, the land cover types include tidal flats/submerged shallow platform (FLUCFCS 651). Saltwater marshes (FLUCFCS 642) occupy the channel banks in these areas. However, the Creek itself should be recognized for its habitat and habitat support functions. Although flow is not continuous along the entire Creek channel all year, the Creek does support plant species valuable for water quality and wildlife food and habitat purposes.

Lakes (520)/Reservoirs (530)

Lakes are defined by FLUCFCS as inland water bodies excluding reservoirs. In the Rocky Creek - Brushy Creek watershed, lakes are water bodies ranging in surface area from less than 12 acres to 52 acres. The larger lakes in the watershed are: Fairy (52 ac), Hixon (21 ac), and Glass Lake (18 ac). These water features are permanently inundated, although water elevations rise and fall as a result of rainfall. Most lakes have undergone some degree of development on bordering lands; however, some cypress swamp and wetland coniferous forests remain on lake margins. The lakes also support in-lake plant communities that are valuable in terms of fish production and water quality functions. Plant communities include emergent aquatic species along the shallow lake margins and rooted submerged aquatic species in the deeper zones of the lakes. The areal coverage of lakes in the watershed has increased from 1.1% in 1960 to 4.4% in 2004.

Reservoirs are artificial impoundments of water. Not recognized in the land use mapping of 1950, this community type occupies (2004) 4% of the watershed. These water features have been constructed in association with agricultural and residential development in the watershed; residential reservoirs are managed to provide aesthetic or stormwater management functions.

8.4.3 Urban Altered Land Use

The following land use descriptions are based on the 2004 land use map of the Rocky Creek - Brushy Creek watershed, the corresponding descriptions FLUCFCS, and staff knowledge of the area.

Residential [Low (110), Medium (120), High (130)], Density

Residential land uses occupied less than 1% in 1916 and less than 1% of the watershed in 1950. By 2004, they accounted for 41% of the watershed, reflecting much more rapid growth in the last half of the 20th century. In 2004, 7.8% is in low density uses (< 2 units/acre), while 13% is occupied by medium density uses (2-5 units/acre). A total of 20.5% of the residential use is in high density use (>5 units/acre). The majority of the residential development has occurred in the lower reaches of the watershed and at major crossroads where native upland habitat has been replaced by dwelling units.

Commercial and Services (140)

Commercial areas and services is a land use that is predominantly associated with the distribution of products and services. This category is composed of a large number of individual types of commercial land use, which often occur in complex combinations. This category often includes a main building and the integral areas that support the main structure. In the 1950 mapping, commercial land uses occupied 0.1% of the watershed, while 3% of the watershed currently (2004) is devoted to commercial activities. Land uses present in the watershed that fall into the Commercial areas and Services category include: service stations and convenience stores, retail facilities, restaurants, manufacturing facilities, and boat and auto repair shops.

Institutional (170)

In the Rocky Creek - Brushy Creek watershed, Institutional land uses include schools, churches, and small office facilities. At least three churches and a school were present in the early 1900's, but the category was absent from the 1950 land use mapping. Currently (2004), this category occupies 1.4% of the watershed.

Recreational (180)

Recreational land uses were absent in the1950 land use mapping but were reported as occupying 0.8% of the watershed in 2004 which represent community recreational facilities, historic sites, and area parks, including Lake Park south of Van Dyke Road and west of Dale Mabry Highway.

Open land (190)

Open Land includes undeveloped land within urban areas and inactive land with street patterns but without structures. Open land normally does not have any structures or any indication of intended

use. Urban inactive land is often in a transitional state and will eventually be developed into one of the typical urban land uses. Absent in 1950, open land increased in areal coverage slightly to 3%.

Cropland and Pastureland (210)
Formerly occupying 12.4% of the watershed in 1950, this land use category has decreased to 6.1% of the watershed in 2004. Included here are chiefly pastures with some vegetable and small fruit crops.

Tree Crops (220)
In the Rocky Creek - Brushy Creek watershed, this category includes citrus groves which are located chiefly in the central region of the watershed. Citrus production was well established by 1938 and occupied 6.9% in 1950; it decreased to 0.9% of the watershed by 2004 as lands were converted from citrus to residential and commercial uses.

Nurseries and Vineyards (240)
This category, composed of nurseries, was absent in the 1950 land use mapping but now occupies 0.4% of the watershed and is represented facilities supplying plants for residential landscaping.

Specialty Farms (250)
Specialty farms currently occupy 0.4% of the watershed and include kennels.

Other Open Lands (260)
Other open lands are agricultural land with a use that cannot be determined from available imagery. In 1950, 0.1% of the watershed fell into this category. By 2004, this category occupied 0.9% of the watershed and represents lands that are resting between crops.

Disturbed Land (740)
Representing 0.2% of the watershed, disturbed lands are areas that have been changed primarily due to human activities other than mining and include rural lands in transition to residential land uses, and temporary spoil sites.

Transportation (810)
In the Rocky Creek - Brushy Creek watershed, railroads and paved roadways have occupied the watershed since the late 1890's and early 1900's. This land cover type increased from 0.1% of the watershed in 1950 to 2.7% in 2004 as early facilities were expanded and new facilities were constructed.

Communications (820)
In the Rocky Creek - Brushy Creek watershed, this category includes microwave towers. It was absent in the 1950 mapping, and it occupied 0.07% of the watershed in 2004.

Utilities (830)
In the Rocky Creek - Brushy Creek watershed, this category includes: water treatment and transmission facilities, and electrical transmission facilities. It was absent in the 1950 mapping, and it occupied 0.9% of the watershed in 2004. Utilities have existed in the watershed since the 1920's.

8.4.4 Natural Systems Trends

This section identifies the historical and remaining upland, wetland, and aquatic natural systems in the Rocky/Brushy Creek watershed and summarizes the relative loss of natural habitat between 1950 and 2004 land cover. Existing land use classifications other than natural systems, such as reservoirs and developed and altered lands, were not included in the habitat loss analysis. Historical and existing land use types were consolidated into general habitats of uplands and wetlands for the purpose of estimating percent habitat loss. An exact analysis of "type for type" habitat loss is not possible due to differences in the classification of vegetation communities, as well as inaccuracies inherent in the historical land use data.

Table 8-4 demonstrates the historical and existing upland and wetland acreage, the relative habitat loss of each based on the total available area of the natural systems.

Historical and Existing Land Cover Changes
The areal coverage of native uplands in the Rocky/Brushy Creek watershed in the pre-development period as estimated from the 1916 Soil Survey of Hillsborough County was approximately 26,740 acres. The areal coverage of uplands in the Rocky/Brushy Creek watershed in 1950 is estimated at 19,351 acres, and existing uplands are estimated at 2,060 acres.

The difference between these periods represents a 90% net loss as native upland communities were converted to agricultural and urban land uses and supporting infrastructure. The most attractive areas for citrus production were lands occupied by the longleaf pine-xeric oak community, while pine flatwoods were the primary upland community displaced for pasture cultivation and cattle production. Residential development and transportation facilities also are preferentially located on lands supporting these two plant communities. Remaining upland communities have been degraded by land use practices on adjacent agricultural and urban lands and/or by encroachment on the margins of uplands. Most uplands now are remnants of a once larger habitat.

The areal coverage of historical wetlands was estimated at 11,065 acres, and the coverage by wetlands today (2004) is approximately 7,728 acres, which represents a net loss of native wetlands of 30% between the 1950 and 2004. Remaining wetlands have been degraded by physical disturbances associated with agricultural practices, the construction of transportation facilities, and residential development. Wetlands located within citrus groves generally have been rim-ditched to

enhance drainage for rows of trees adjacent to the wetland. In the case of wetlands located in pastures, pasture grass is planted and cattle graze up to and through the wetland itself. Consequently, wetlands have no protective buffer zones; they are invaded by pasture grass species and other non-wetland plants; and they are the receiving waters for stormwater and irrigation runoff containing pesticides and fertilizers. Many wetlands are remnants of once larger habitats.

Native uplands and wetlands have been replaced by urban land uses (residential + commercial) and by agricultural land uses (Figures 8-3 and 8-4).

Table 8-4 Change of Uplands and Wetlands in the Rocky/Brushy Creek Watershed

	Acres in 1950	Acres in 2004	Acre Reduction	% Reduction
Uplands	19,351	2,060	17,291	90%
Wetlands	11,065	7,728	3,337	30%

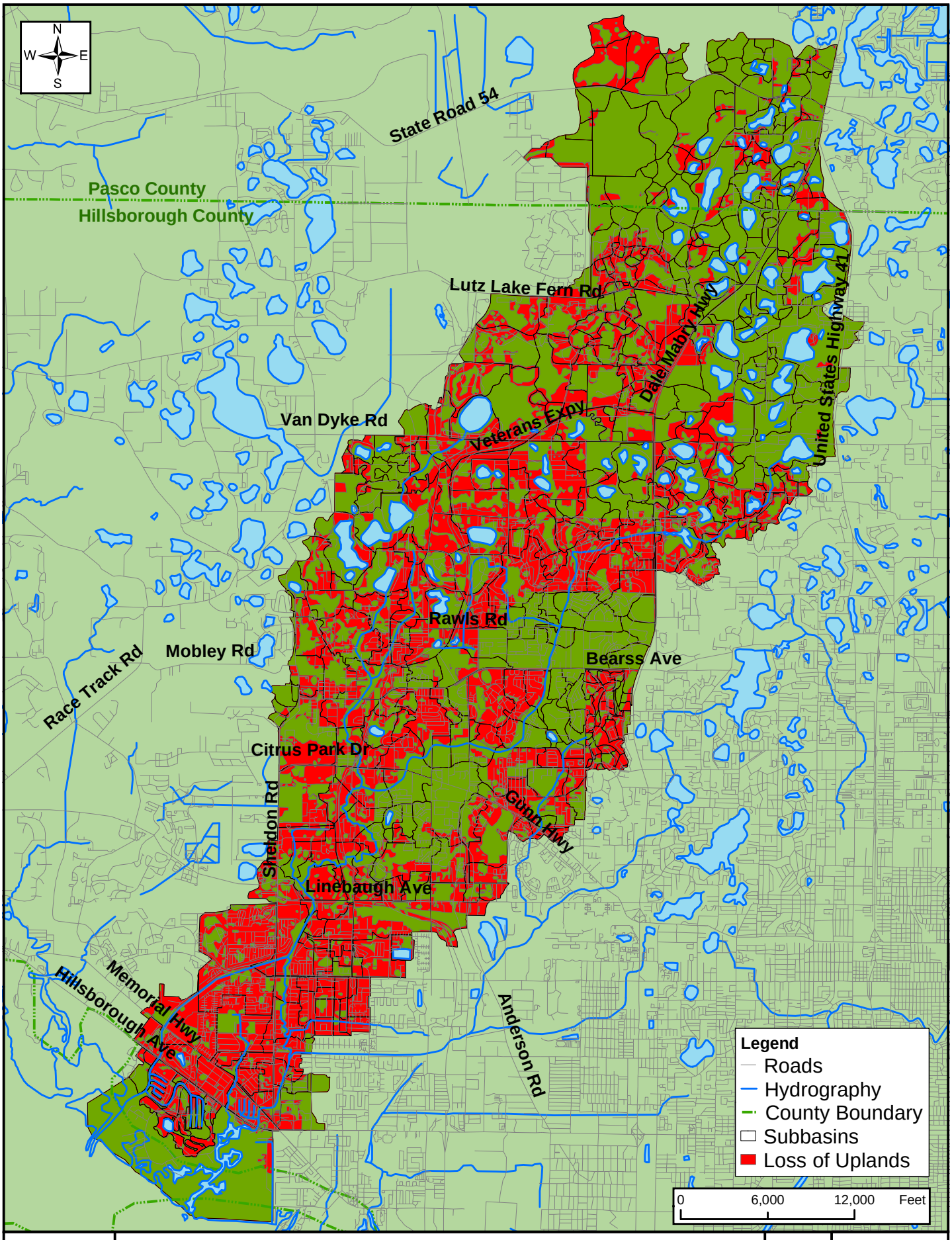
8.4.5 Prioritization of Restorable Habitat Types

Uplands

Based on the ecological value and rarity within the watershed currently, Longleaf pine-Xeric oak (FLUCFCS 412) was identified as a priority upland habitat for re-establishment.

Wetlands

Based on their ecological value, Stream and Lake Swamp (FLUCFCS 615), Cypress (FLUCFCS 621), Mangrove Swamp (FLUCFCS 612), and Saltwater Marsh (FLUCFCS 642) were identified as high priority for restoration.



Loss of Uplands in the Rocky/Brushy Creek Watershed

Figure 8-3

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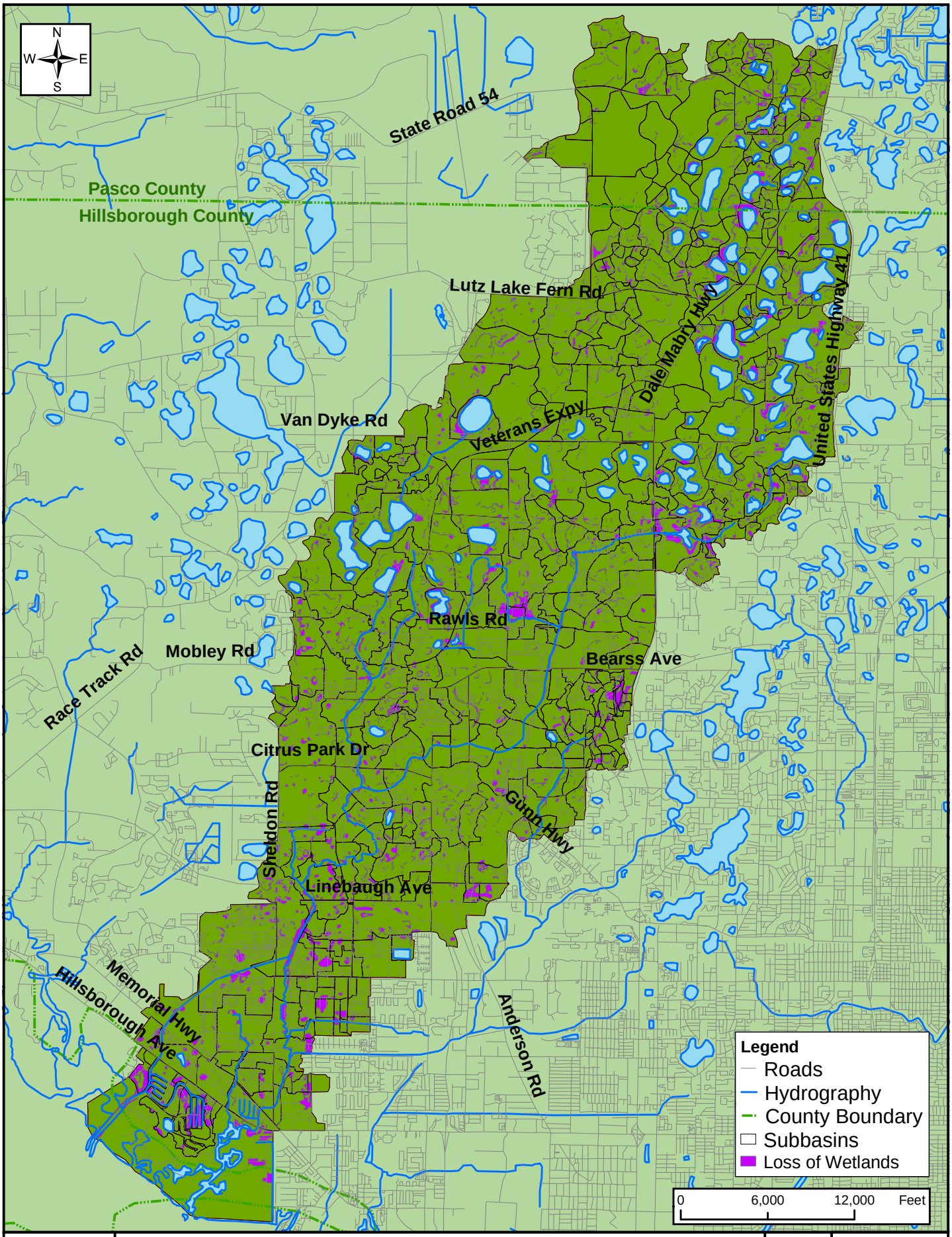

Loss of Wetlands in the Rocky/Brushy Creek Watershed

Figure 8-4

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8.5 Natural Systems Issues and Areas of Concern

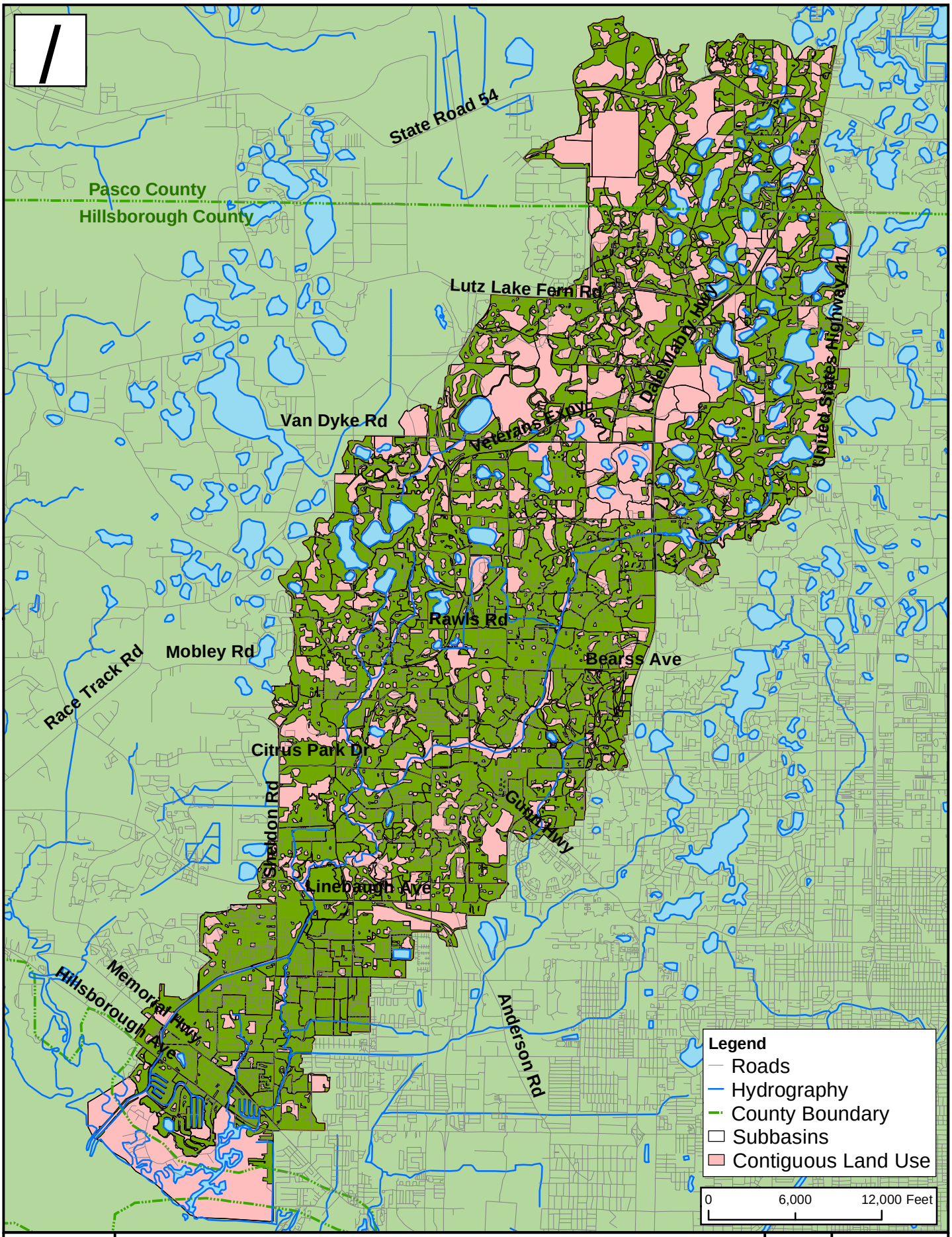
8.5.1 Habitat Loss, Degradation, and Fragmentation

As described above, the Rocky/Brushy Creek watershed was once composed of a variety of upland and wetland habitats. Within the last century, many large tracts have been converted from natural land features to agricultural uses, predominantly in the northeastern and southern portions of the watershed. Based on 2004 SWFWMD land use data, approximately 64% of the watershed has been altered by human activities with approximately 8.7% of the watershed impacted by agricultural activities and approximately 46% developed for urban, suburban, commercial, industrial, and mining uses. Lands in a near-natural condition (uplands, wetlands) comprise an estimated 36% of the watershed, although most native habitats are disturbed and degraded to some degree by agricultural practices, urban development, or water production activities in the watershed.

Despite these alterations and impacts to natural systems, some large tracts containing freshwater wetlands, hardwood swamp, and saltwater marsh remain undeveloped in the watershed. Protection is provided by means of regulatory programs of SWFWMD and EPC and by the acquisition of 2,416 acres (6% of the watershed) critical to preservation and restoration.

Habitat Fragmentation

Habitat fragmentation is defined as the break-up of a continuous landscape containing large patches into smaller, numerous, less connected patches. To measure habitat fragmentation within the watershed, ArcView was used to join contiguous natural habitat polygons from SWFWMD's 2004 land use layer. The polygons with FLUCFCS code of 3000, 4000, 5000, 6000, and 7000 (natural systems designations) were dissolved to form contiguous polygons throughout each watershed. The areas of these contiguous polygons were then calculated and compared to the overall area of a given watershed. If one or more contiguous polygons represented a significant proportion of a watershed (i.e., greater than 75%), the watershed was categorized as having relatively little fragmentation. Alternately, if a watershed was comprised of several small contiguous natural systems polygons and few large contiguous polygons, then the area was categorized as being highly fragmented. Large numbers of small polygons represent a high level of fragmentation, while small numbers of large polygons represent a low level of fragmentation (Table 8-5).



Contiguous Land Use in the Rocky/Brushy Creek Watershed

Figure 8-5

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The watershed has a total of 1264 contiguous natural areas, none of which represent more than 25% of the watershed. Therefore, the degree of habitat fragmentation in the watershed can be described as high and a score of 0 assigned (Table 8-5).

Table 8-5 Distribution of Contiguous Natural Systems Polygons within the Rocky/Brushy Creek Watershed

	Contiguous Natural Polygons			
Score = 0	<25 %	=>25% but <50%	=>50% but <75%	=>75%
Degree of fragmentation	High	Moderate	Low	Very Low
Number of polygons	1264	0	0	0

8.5.2 Wildlife Corridors

Wildlife corridors are naturally existing or restored native linear landscape features connecting two or more larger tracts of habitat functioning as a dispersal route for native flora and fauna, and for the occurrence of the natural ecological processes such as fire (Harris, 1991). With the continuing need for land development to support an increasing human population, wildlife habitats are cleared and destroyed to meet human needs. In the Rocky/Brushy Creek watershed where urbanization, agriculture, and deforestation have fragmented natural habitats, there is a need to reserve natural pathways for the movement and migration for wildlife to prevent inbreeding or overexploitation of prey. The Hillsborough County Comprehensive Plan defines wildlife corridors as “contiguous stands of Significant Wildlife Habitat which facilitate the natural migratory patterns, as well as other habitat requirements (e.g., breeding, feeding) of wildlife.” The need for and use of wildlife corridors became apparent as early as the 1930s (Edmisten, 1963) and corridors have been used widely ever since for the benefit of game species (McElfres, et al. 1980) as well as non-game animals (Maher, 1990).

Regulatory Component

Wildlife corridors are one of the many avenues that support the Biodiversity Treaty proposed by the United Nations and signed by President Clinton, but not ratified by the United States Congress. In 1992, the United Nations published the Global Diversity Assessment for the purpose of implementing the Global Biodiversity Treaty and Agenda 21. Section 10.4.2.1.2 of the Global Biodiversity Assessment sets forth the criteria for protected areas stating that, “Representative areas of all major ecosystems in a region need be reserved, blocks should be as large as possible,

buffer zones should be established around core areas, and corridors should connect these areas." These core areas and buffer zones would then be connected by wildlife corridors, in accordance with the Wildlands Project. The goal is to allow animals to travel from one core habitat to another through wildlife corridors without anthropogenic obstruction or interference. The remaining areas will be utilized for human habitats conforming to the principles of sustainable development as supported by Executive Order 94-54 that created the Governor's Commission for a Sustainable Florida and Section 163.3244 F.S. (Sustainable Community Demonstration Project). Establishment of wildlife corridors is consistent with the Hillsborough Comprehensive Plan (CARE Policy 14.2) and the Hillsborough County Land Development Code.

Wildlife Corridors in the Rocky/Brushy Creek Watershed

As discussed in the previous section, significant habitat fragmentation has occurred throughout the watershed. Nevertheless, wildlife refuge and corridors remain at several locations: on public lands (Lake Park, the Bower Tract, and Rocky Creek Preserve; along reaches of Rocky Creek between the Channel A cutoff and Sheldon Road (except the Waters Avenue crossing); along the reach of Brushy Creek between Ehrlich Road and Gunn Highway; and the wetlands northeast of Lake Carlton (Turkey Ford Lake) and Avignon Avenue. There are opportunities to improve and expand these few remaining corridors and refuges by modifying channel crossings at major roadways to be more wildlife friendly.

The identification and protection of remaining wildlife corridors is essential to restoring natural areas in this watershed. The Rocky/Brushy Creek watershed has areas of development where wildlife corridors and greenways have been identified through the Hillsborough Comprehensive Plan, Land Development Code, and Hillsborough Greenways Task Force as supported by the Hillsborough County Natural Resources Regulation. Approximately 35% (13,581 acres) of the watershed remains undeveloped, although even the undeveloped uplands and wetlands have been disturbed and encroached upon, diminishing their ecological value.

Conservation Development

Conservation development is a concept proposed for urban watersheds that focuses on residential development designs that utilize conservation strategies such as inter-connected networks of permanent open space. The method allows residential developments that maximize open space conservation without reducing overall building density. The same method could be applied to commercial and industrial developments. The Conservation Development concept is consistent with Hillsborough County Natural Resources Regulation, serving as an avenue to identify areas that may serve as wildlife corridors and/or areas that should be protected and preserved as core habitats or environmentally sensitive lands. Basically, development with wildlife preservation considered within the overall site plan will allow for innovative and creative land use and design for new urban communities. Additionally, the FWC is committed to working with land use planners, developers, and homeowners to assist them with development designs that offer homes for both humans and wildlife. Clustering, designing corridor trails away from critical wildlife areas, and designing wildlife crossings all contribute to increased wildlife habitat. Throughout Florida, several innovative and creative wildlife crossings have been constructed. For example, the FDOT has

constructed numerous underpasses for black bears, Pinellas County has constructed fish bridges allowing fish migration through weirs, and the City of Clearwater has constructed a wildlife bridge across a fast flowing channel, allowing small mammals to cross.

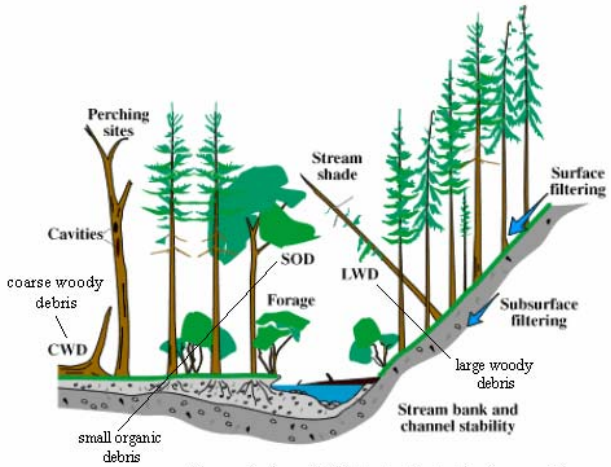
Criteria for significant wildlife habitat minimum widths and sizes are contained in Appendix B of the Hillsborough County Natural Resources Regulation. Existing studies have established a definitive link between habitat area size and species diversity (Miller and Schaeffer, 1998). The Hillsborough County Natural Resources Regulation sets a 75-acre minimum based on wildlife research review that concluded that species diversity rapidly declines below 60 acres, while another study determined 50 to 74 acres as the optimum minimum habitat. Although wildlife corridors do not have to follow these criteria for size and width, reserving 75 acres or more of significant wildlife habitat should be taken into consideration as core habitat or as the basis for a wildlife corridor.

Although wildlife corridors can help conserve habitat dependent species affected by encroaching urbanization, it is important to consider that the total amount of available habitat is the critical factor and that no amount of corridors connecting isolated habitat areas will replace extensive loss of habitat. Wildlife corridors allow for the linkage and preservation of isolated wildlife habitats in the competition for space with humans.

8.5.3 Identification of Existing Riparian Buffer Areas

Measures of ecosystem health can play an important role in the linkage between land use practices, ecological integrity, and water quality. The loss of natural riparian vegetation due to agriculture and development impair the functional role of riparian buffers, strongly influencing the diversity and productivity of both the aquatic and terrestrial biota, and the physical stability of the streambank and channel. A critical component of the riverine ecosystem, riparian buffers function ecologically to:

- regulate sediment storage and transport, stream flow characteristics;
- maintain bank and channel stability by provision of solid root mass and ground cover, regulate stream temperature;
- regulate instream biological production by determining the inputs of small organic debris (SOD);
- buffer streams from fine sediments;
- provide wildlife habitat features, including coarse woody debris (CWD), large woody debris (LWD), and nest and perch sites; and
- provide summer and winter forage for terrestrial fauna.



Source: Province of BC Watershed Restoration Program; BC Ministry of Environment, Lands and Parks

Factors such as the width of riparian (streamside vegetation) zones and the abundance and diversity of plant and macroinvertebrate communities can serve as biological indicators of environmental stress and water quality. Table 8-6 summarizes a rating system that was used in this plan to evaluate existing environmental conditions within the Rocky/Brushy Creek watershed. This rating scheme was used to assess the existing riparian habitats within each of the subwatersheds within the Rocky/Brushy Creek watershed. Unfortunately, detailed macroinvertebrate or water quality data were not available for the watershed, and the analyses were restricted to the vegetation component of this rating system (riparian buffer widths and percent of riparian buffer as developed land use).

A number of agencies throughout the U.S. have developed stream buffer protection ordinances (Baltimore County, Rhode Island Coastal Resources Management Council, City of Napa – California, Portland Metro). More detailed buffer zone analyses have been performed in Florida, specifically in the Wekiva River basin and the east central Florida region (Brown et al., 1987; Brown and Schaefer, 1990). The purpose of the Florida studies were to develop methodologies for determining buffer zone widths for regionally significant wetland systems that could then be used for the purposes of establishing minimum criteria for future land use planning. The buffer zone widths developed by Brown et al. (1987) are similar to those used in this riparian buffer rating system described above with minimum buffer widths ranging from 24m to 98m (Table 8-7).

Table 8-6 Rating of Stream Water Quality and Health based on existing vegetation and development activities within a watershed
(modified from Office of the Commissioner for the Environment, Victoria, Australia, 1988)

Rating	Vegetation
Excellent	Streamside vegetation intact for minimum 100m width from the bank, with continuous cover essentially unmodified and with few exotic plants. Watershed vegetation substantially uncleared. Less than 10% of watershed developed.
Good	Existing streamside vegetation communities intact, with cover essentially unmodified for, at a minimum, 30m width for over 80% of each stream segment. Infrequent exotics. Largely undisturbed by roadways. Limited permanent clearing of watershed vegetation.
Fair	Existing streamside vegetation communities predominantly intact and exotics infrequent. Riparian zone intact for 30m width, at minimum, for over 60% of watershed.
Poor	Existing streamside vegetation largely fragmented and exotics frequent. Riparian zone of 30m width intact for less than 60% of watershed, and frequently disturbed by roadways/development. Watershed largely cleared of native vegetation.
Degraded	Little remnant streamside vegetation. Surviving patches fragmented. Exotics frequent. Riparian zone of 30m width intact for less then 25% of watershed, and frequently disturbed by roadways & development. Watershed substantially cleared of native vegetation.

Table 8-7 Recommended Buffer Widths (in meters) for protection of water quality and quantity and wetland-dependent wildlife habitat (from Brown and Schaefer, 1987)

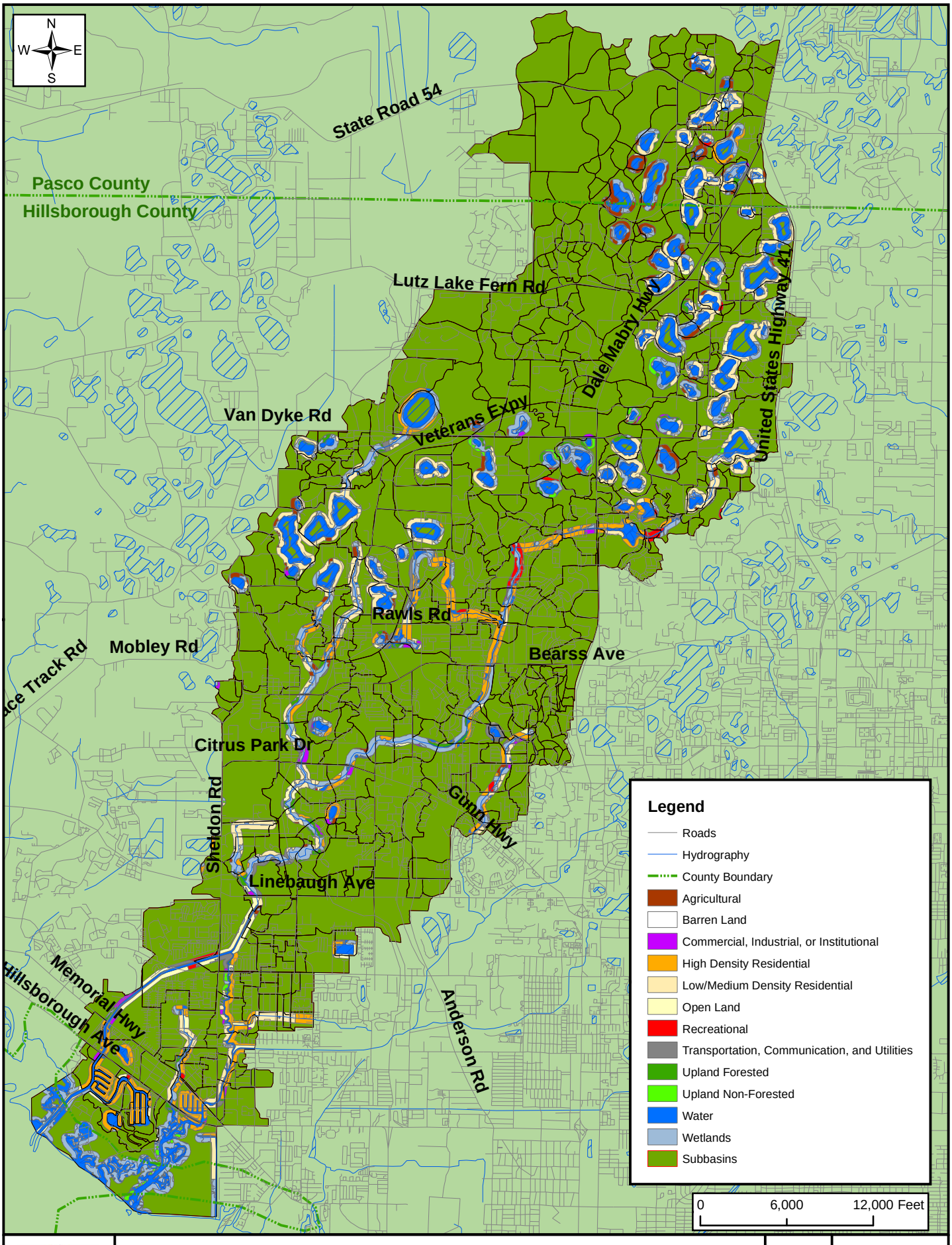
	Protect Water Quantity *Minimize Groundwater Drawdown*		Protect Water Quality *Control Sedimentation*		Protect Wildlife Habitat	
Landscape Association (Habitat Type)	Min.	Max.	Min.	Max.	Min.	Max.
Flatwoods/isolated wetlands	30	168	23	114	98	168
Flatwoods/flowing-water wetlands	30	168	23	114	98	168
Flatwoods/hammocks/hardwood swamps	15	76	23	114	N/A	168
Sandhills/wetlands	6	76	23	114	98	223
Flatwoods/salt marshes	30	168	23	114	98	N/A
Coastal hammocks/salt marshes	30	168	23	114	98	N/A
AVERAGE	***24***	***137***	***23***	***114***	***98***	***182***

To calculate riparian zone widths and percentages of riparian zones that have been converted to development in the Rocky/Brushy Creek watershed area, the ArcView buffer extension was used. First, 30m and 100m buffer zones were created around the stream network coverage that was created during the hydrologic analysis. From this coverage, the 2004 land use data were clipped for each of the buffer zones and evaluated to determine percent of natural land cover within each clipped area to develop a rating score (Figures 8-6 to 8-7). These scores were then converted to numerical values and used in a natural systems evaluation matrix.

Within the 100 m buffer encompassing 7923 acres, 46% (3,660 acres) of the land has been developed for agricultural, commercial, or residential purposes, leaving 54% of the buffer area in native habitats. Within the 30 m buffer (2640 acres), 28% (742 acres) of the land has been developed for agricultural, commercial, or residential purposes, leaving 72% of the buffer area in native habitats. It should be noted that much of the remaining native habitats have undergone disturbance and encroachment, reducing their ecological value. Based on the riparian zone analyses, rating scores were developed for the Rocky/Brushy Creek watershed (Table 8-8). The score for the watershed was 2, giving the watershed a “fair” rating.

Table 8-8 Riparian Buffer Measures within the Rocky/Brushy Creek Watershed

		Excellent	Good	Fair	Poor	Degraded
Score	*Vegetation Intact within 100m buffer?*	*<10% watershed developed*	*30m buffer intact for >80% of stream*	*30m buffer intact for >60% of stream*	*30m buffer intact for <60% of stream*	*30m buffer intact for <25% of stream*
Fair (2)	no	no		72%		



100m Riparian Buffer in the Rocky/Brushy Creek Watershed

Figure 8-6

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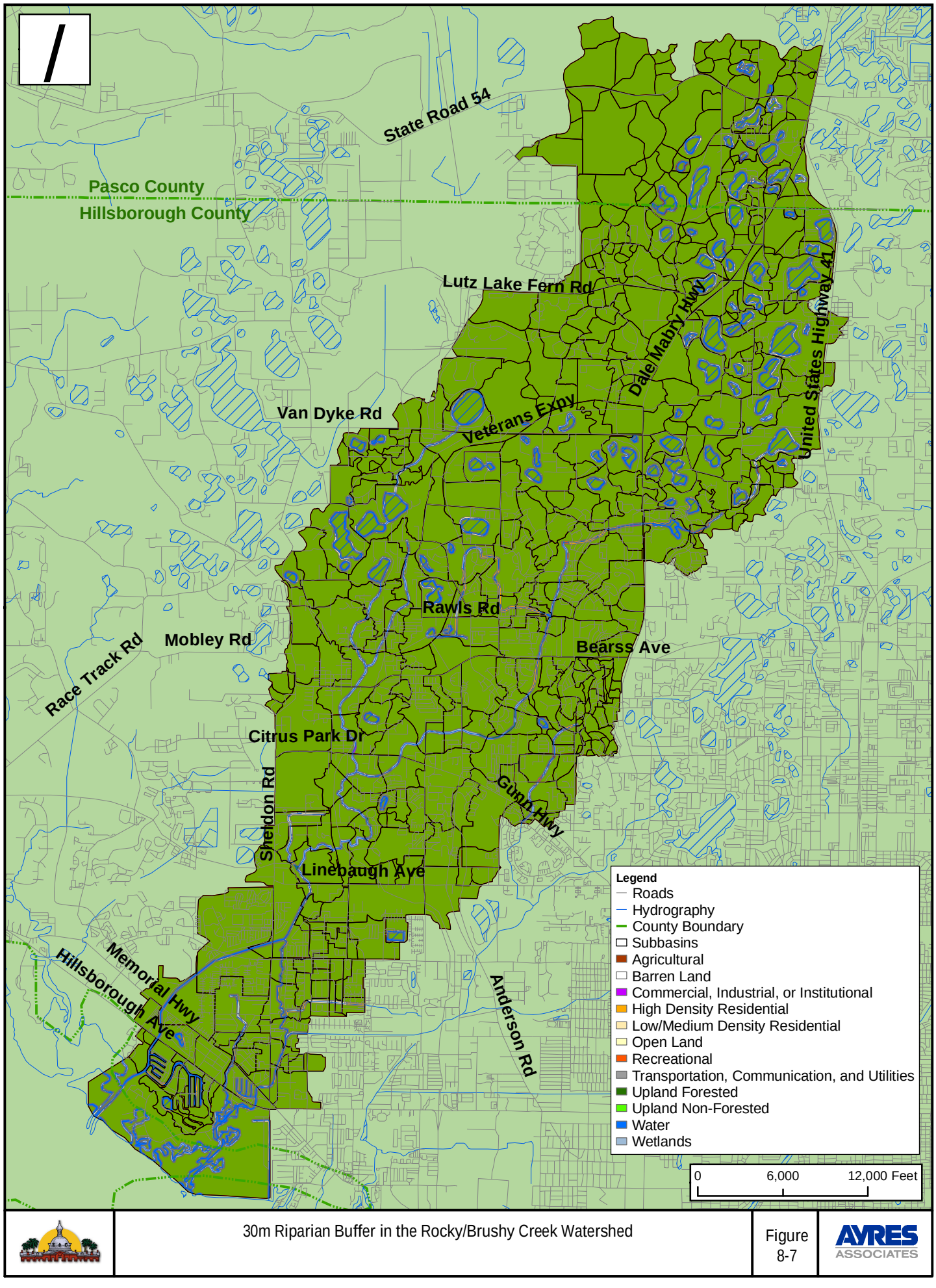

30m Riparian Buffer in the Rocky/Brushy Creek Watershed

Figure 8-7

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8.5.4 Biological Indicators of Ecosystem Health

The ability to evaluate the "health" of an ecosystem can be extremely complex due to the variability of chemical, physical, and meteorological processes that occur over time and space and also the diversity of habitat types that may be present within a watershed. One ongoing program is currently evaluating measures of ecosystem health--FDEP's Biological Reconnaissance (BioRecon) program.

The FDEP's bioassessment program involves field sampling of aquatic biological communities to characterize community structure (i.e. diversity, pollution tolerance). The BioRecon program includes measurements of water quality indicators such as dissolved oxygen, evaluating habitat conditions, and determining the health of aquatic insect communities. Many common insects spend their juvenile life within aquatic systems including dragonflies, mayflies, beetles, black flies, and mosquitoes. These organisms show the effects of physical habitat alterations, point and nonpoint source contaminants, and cumulative pollutants over their life cycle. To determine if a community has been negatively impacted by human activities, data are compared to reference communities (believed to be natural or relatively unimpacted by humans).

The BioRecon program has not collected macroinvertebrate data in the Rocky Creek - Brushy Creek watershed. The BioRecon procedure is a screening tool that evaluates three metrics including: the total number of macroinvertebrate taxa; number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) or EPT; and a Florida Index which represents taxa intolerant of stream perturbations. The sampling methodology involves three sweeps of a dip net for a given stream sampling location and the identification of all organisms within the net. Scores for three categories are tabulated based on this data and if two of three exceed threshold values the stream is rated as "healthy," if less than two meet the thresholds then the stream is rated as "suspected impaired" or "impaired. While useful for the Hillsborough River Watershed Plan, the BioRecon data cannot give an assessment of watershed health in Rocky Creek - Brushy Creek watershed.

8.5.5 Strategic Habitat Conservation Areas

In 1994, the FWC published *Closing the Gaps in Florida's Wildlife Habitat Conservation System*, which identifies habitats that must be conserved and managed to ensure the survival of key components of Florida's biological diversity. The primary objectives of the report are:

1. to identify habitat areas that are essential to the survival of rare and declining species not adequately protected by the current system of conservation areas;
2. to identify areas that are important to several globally endangered species of plants, animals, and plant communities; and
3. to identify regional areas of high biological diversity to assist in local land use planning.

The FWC utilized land cover and vegetation data, public land boundaries, and documented occurrences of species and communities to identify Strategic Habitat Conservation Areas (SHCA).

As previously discussed, the protection and preservation of the remaining natural areas of the watershed are important components of this watershed management plan. These natural lands are critical to the maintenance of local and regional wildlife and the protection of water resources. Approximately 35% (13,581 acres) of the watershed remains undeveloped.

Strategic Conservation Habitat Areas within the Rocky Creek - Brushy Creek watershed
A total of 3,112 acres (8% of the watershed) of Strategic Habitat Conservation Area (SHCA) were identified in the Rocky/Brushy Creek watershed. SHCA was identified for wading birds, many species of which are documented as occurring in the watershed.

8.5.6 Hydrologic Alterations

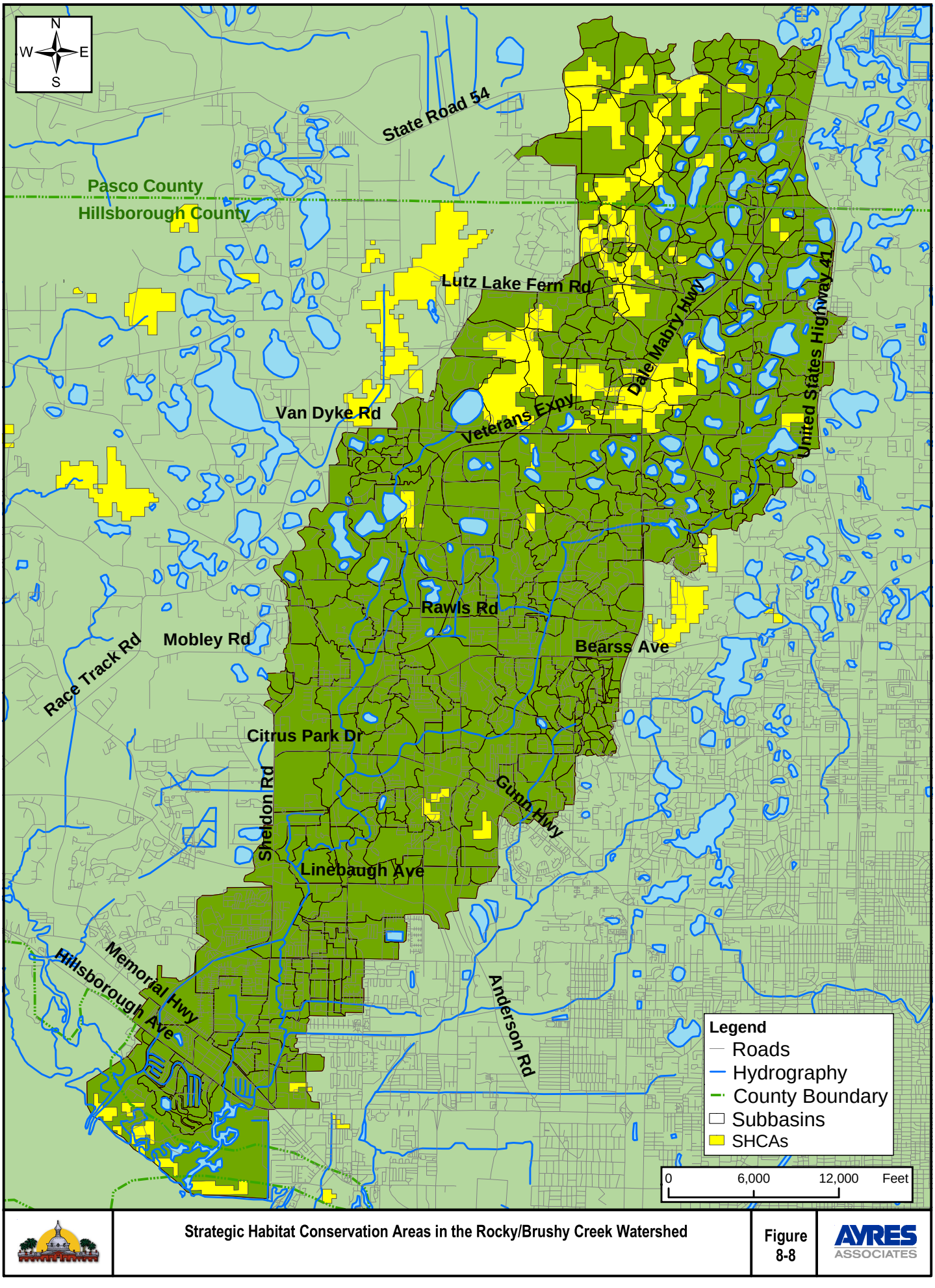
Hydrologic alterations can be defined as any action that would change or affect the water cycle. The Rocky/Brushy Creek watershed and its diverse array of natural systems are affected by hydrological alterations that would upset the watershed's delicate ecological balance.

Development for the purposes of residential, commercial, industrial, institutional, recreational, extractive, and agricultural land use has increased impervious surface area and/or resulted in the channelization and rerouting of surface water flows which has adversely affected the watershed's hydrological cycle.

Development of groundwater supplies in the watershed has affected lake elevations and in-lake wildlife habitat. These hydrological alterations can have results such as:

1. accelerated successional changes of natural systems in both upland and wetland systems;
2. changes in the sizes of faunal populations (Some species are favored and increase in numbers, while others are stressed and decline in numbers and/or viability);
3. reduced biodiversity; and
4. changes in water quality.

Natural plant communities, particularly uplands, have been replaced by agricultural, commercial, or residential development, leaving parcels of smaller size and ecological value. While wetlands have decreased somewhat in areal coverage, the habitat quality of existing systems can be presumed to be less than original conditions due to several factors, including: exotic species invasion, excessive disturbance of wetland margins, elimination of protective upland buffers; trash disposal; rim ditching; and reduced hydroperiod. The elimination and disturbance of natural habitats has resulted in a decline in the number of wild animal species (lowered biodiversity) present in the watershed.



Strategic Habitat Conservation Areas in the Rocky/Brushy Creek Watershed

Figure 8-8

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Channel Alterations

With the growing need for space for human use, natural channels in the watershed have been dredged, straightened, and/or filled to serve as water conveyances for stormwater, resulting in loss or reduction in ecological value. Channelization has also resulted in degraded water quality in streams allowing exotic species like water hyacinth to compete with native species. Increased stormwater runoff and removal of bank vegetation in these ditch systems have resulted in sedimentation and eutrophication, altering the aquatic species that utilize the system. Non-native and/or nuisance aquatic species more tolerant of anoxic or poor water quality conditions dominate these waterways which decreases biological diversity. In the Rocky/Brushy Creek watershed, channel alterations have occurred throughout the watershed at various locations, including: major roadway crossings (Old Memorial Highway, Linebaugh Avenue, Ehrlich Road, Waters Avenue, Veterans Expressway, Sheldon Road); minor crossings in subdivisions; at the Channel A cutoff south of Linebaugh Avenue; at railroad grades south of Linebaugh Avenue; and electrical transmission line and water pipeline exiting Section 21 wellfield.

Water Supply Impacts

Components of one water production facility are located in the Rocky Creek - Brushy Creek watershed: wells, pipelines, and the pumping facility associated with the Cosme-Odessa Wellfield. The primary impacts have been: (1) habitat disturbance and elimination to accommodate the wellfield, (2) reduction of hydroperiods in nearby wetlands, and (3) reduction in water elevations in nearby lakes.

8.5.7 Wildlife

The information for this section was developed from previous surveys conducted by Hillsborough County and ELAPP staff, FFWCC (1992) FNAI Species Occurrence records, and staff experience in the area. Review of compiled fauna indicates that 25 species of fish, 38 species of amphibians and reptiles, 169 species of birds, and 39 species of mammals potentially utilize the watershed. Notable species include the protected species listed in Table 8-9.

8.5.8 Protected Species

Many native fauna and flora are protected from activities that harm or interfere with them or their habitat by federal, state, and local regulations. Fauna and flora are federally protected by the USFWS under Title 50 Code of Federal Regulations (CFR) 17 and 23. Federally protected species are categorized as threatened or endangered. State protection of fauna is administered by the FWC under F.A.C., Rules 39-27.003, 39-27.004, and 39-27.005. The Florida Department of Agriculture and Consumer Services administers F.A.C., Chapter 5B-40. State protected floral species are categorized as commercially exploited, threatened, or endangered. Management strategies still needed to be developed to protect these species, including coordination efforts with Florida Natural Areas Inventory (FNAI), FWC, and USFWS. Hillsborough County EPC indirectly protects these species by protecting wetland habitats essential to the survival of these species. In addition, the County's upland habitat ordinance provides protection of essential habitats.

The presence of wildlife or plant species is often considered indicative of the presence and health of natural systems. Many animal species, both protected and unprotected, have been observed in the Rocky Creek - Brushy Creek watershed in recent years. A literature search was conducted to determine the floral and faunal composition of the watershed. This search included the review of recent surveys conducted within the watershed by Hillsborough County and ELAPP staff, standard Florida literature references such as the *Rare and Endangered Biota of Florida*, the *Florida Atlas of Breeding Sites for Herons and their Allies*, the FNAI, the FFWCC, and the USFWS. Protected species that have been observed and/or may utilize the watershed are listed in Table 8-9. The table also includes information on their preferred habitat. A species is noted as occurring within the watershed if evidence of their presence was observed through animal tracks, scat, burrows, nests, dens, scratchings, vocalizations, or animal sightings by county or state staff. Eighteen protected species potentially occur in the Rocky/Brushy Creek watershed.

Fish

No protected fish species are expected to utilize habitats in the Rocky/Brushy Creek watershed.

Reptiles and Amphibians

Protected reptiles and amphibians that may occur in the Rocky Creek - Brushy Creek watershed are the American alligator, eastern indigo snake, and gopher tortoise. All have been documented as occurring in the watershed (Table 8-9).

The **American alligator** is a resident of river swamps, lakes, marshes, bayous, and other bodies of water and is prevalent within the watershed. The required habitat of the short-tailed snake is longleaf pine-turkey oak associations and adjacent upland hammocks or sand pine scrub. The Florida gopher frog *(Rana capito)* prefers a xeric upland habitat, but are often found in commensal association with the gopher tortoise (*Gopherus polyphemus*).

Florida gopher frogs breed in habitats that are seasonally flooded, grassy ponds, and cypress heads that lack fish populations.

The **gopher tortoise** prefers dry well-drained soils. Many xeric habitats may be used including sand pine scrub, live oak, or turkey oak communities. The gopher tortoise excavates a long burrow and occupies it semi-permanently.

The **eastern indigo snake** is restricted to the southeastern United States and inhabits a wide variety of habitats from mangrove swamps to xeric pinelands and scrub. It often lives in association with the gopher tortoise where the tortoise burrows provide shelter from desiccating heat and cold winter temperatures. During warmer months, the indigo snake ranges widely, utilizing a territory of 125-250 acres. Wetland edges are preferred foraging areas, where eastern indigo snakes feed on small birds, mammals, fish, and frogs.

Avifauna

Protected birds that occur in the watershed include American oystercatcher, brown pelican, limpkin, little blue heron, Florida sandhill crane, southern bald eagle, southeastern American kestrel, snowy egret, tricolored heron, wood stork, and white ibis. Of these, the limpkin, little blue heron, Florida sandhill crane, snowy egret, tricolored heron, wood stork, and white ibis require relatively shallow water habitats for foraging, although the white ibis and Florida sandhill crane also forage in pastures and lawns. Some of these species nest in estuarine habitats (snowy egret, wood stork, brown pelican), but freshwater habitats including cypress, wetland hardwoods, or shrub swamps are also important nesting habitats. Wood storks more specifically feed in shallow marshes and wet prairies. Degradation of both nesting and foraging habitats has contributed to population declines in these species.

The Florida sandhill crane and limpkin require shallow pickerelweed/maidencane freshwater marshes and adjacent open, low herbaceous uplands (crane) or streams and ponds (limpkin). The apple snail, which may be found in lakes, marshes, broad swales, and impoundments is the most important food limpkins that nest among tall grasses such as bulrush, between the knees of cypress, in vine-covered shrubs, or in the tops of cabbage palms or cypress trees.

Protected birds of prey that occur in the watershed include the bald eagle and southeastern American kestrel. The bald eagle is found in a variety of habitats, but prefers high water-to-land edge ratios where prey is concentrated. The southeastern American kestrel is a secondary cavity-nester, nesting in cavities formed by woodpeckers in long-leaf pine, sand pines, turkey oaks, or live oaks, and requiring open fields for foraging.

The American oystercatcher and brown pelican inhabit estuarine and marine shorelines and open marine waters, respectively. These habitats are present in the lower reaches of the watershed in the Rocky Creek estuary.

Mammals

Listed species of mammals that may occur in the watershed are Sherman's fox squirrel and the West Indian manatee, both of which are documented as occurring in the watershed.

Both the Florida mouse and Sherman's fox squirrel typically inhabit areas of fire-maintained longleaf pine-turkey oak sandhills, and flatwoods (Humphrey, 1992). The fox squirrel was identified by Cox et al. (1994) as an indicator of remaining natural communities including sandhill, mixed pine-hardwood, dry prairie, and open pine flatwoods. The West Indian Manatee has been reported from the Rocky Creek and Channel A and in adjacent coastal areas of the Rocky Creek watershed.

Table 8-9 Protected Animal Species that potentially occur in the Rocky Creek - Brushy Creek Watershed

Species Common Name	FFWCC	USFWS	Observed
AMPHIBIANS REPTILES			
American alligator	SSC	T(S/A)	X
Eastern indigo snake	T	T	X
Gopher tortoise	SSC	-	X
BIRDS			
Roseate spoonbill	SSC	-	X
Florida sandhill crane	T		X
Limpkin	SSC	-	X
Little blue heron	SSC	-	X
Snowy egret	SSC	-	X
Tricolored heron	SSC	-	X
American oystercatcher	SSC	-	X
White ibis	SSC	-	X
Brown pelican	SSC	-	X
Southeastern American kestrel	T	-	X
Sandhill crane	T	-	X
Southern bald eagle	T	T	X
Wood stork	E	E	X
MAMMALS			
West Indian manatee	E	E	X
Sherman's fox squirrel	SSC	-	X

FFWCC-Florida Wildlife Conservation Commission
USFWS-United States Fish and Wildlife Service

E = Endangered T= Threatened SSC = Species of Special Concern
C = Commercially Exploited T(S/A) = Threatened due to similarity of appearance

Flora

Over 500 species of plants are expected to occur in the Rocky/Brushy Creek watershed. The watershed's habitat quality, geographical location, and climate suggest that 83 species that are listed as endangered, threatened, or commercially exploited by the US Department of Agriculture potentially occur there. Both uplands and wetlands support protected species, but with the elimination of much of the native upland habitat, many of the protected species that may still be present in the watershed are species that prefer wetland habitats, for example orchids and ferns.

8.5.9 Exotic Species

Florida is particularly prone to biological invasions due to the widespread disturbance of native habitats as well as its semi-tropical climate, great expanse of waterways, and "island-like habitat" (bounded on three sides by water and the fourth by frost). This section discusses exotic plants and animals that have been observed or have the potential of invading the Rocky/Brushy Creek watershed.

8.5.9.1 Exotic Plants

An exotic plant is a non-indigenous species, or one introduced to this state either purposefully or accidentally. A naturalized exotic is a non-native plant that has reproduced on its own either sexually or asexually.

Approximately 1.7 million acres of Florida's remaining natural areas have been invaded by exotic plant species. These exotic plant invasions degrade and diminish Florida's natural areas. Invasive, non-indigenous plants are non-native plants that have invaded Florida's forests and wetlands. They replace native plant species and often form exotic monocultures. In many cases, these stands of exotic plants are not useful to the state's wildlife, which have evolved to depend on native plants for food and shelter. Native animals are rarely able to adapt to new exotic plants. Animals that depend on native plants will move away or even become extinct if exotic plants replace too many of our native plants. Some of the effects of invasive plant species include:

- decrease in biological diversity of native ecosystems
- poisoning of some wildlife and livestock species
- reduction of aquatic habitat for native fish and wildlife species, including listed species
- decrease in the ecological value of important habitats for native fish and wildlife
- clogging of lakes and waterways and other wetlands, impeding wildlife movements

Exotic Plant Species Control Programs

The FDEP's Bureau of Invasive Plant Management is the lead agency in Florida responsible for coordinating and funding two statewide programs to control invasive aquatic and upland plants on public conservation lands and waterways. Florida's aquatic plant management program, established in the early 1900s, is one of the oldest invasive species removal programs. With the addition of the Upland Invasive Plant Management Program under Florida Statute 369.252, the state addresses the need for a statewide coordinated approach to the upland exotic and invasive plant problem. Additionally, Hillsborough County's Land Development Code requires the removal of exotic species for newly developed areas. The Exotic Pest Plant Council (EPPC) has played a major role in identifying exotic species that pose a threat to natural flora. The EPPC was established in 1984 for the purpose of focusing attention on:

1. impacts to biodiversity from exotic pest plants;
2. impacts of exotic plants to the integrity of native plant community composition and function;
3. habitat loss due to exotic plant infestations;
4. impacts of exotic plants to endangered species primarily due to habitat loss and alteration (e.g., Cape Sable Seaside Sparrow);
5. the need to prevent habitat loss and alteration by comprehensive management for exotic plants;
6. the socioeconomic impacts of exotic pest plants (e.g., increased wildfire intensity and frequency in *Melaleuca*);
7. changes in the seriousness of exotic pest plants and to indicate which are the worst

problems; and
8. informing and educating resource managers about which species deserve to be monitored, and to help managers set priorities for management.

The Council's Florida chapter, the Florida Exotic Pest Plant Council (FEPPC), compiles a list of Florida's most invasive exotic plant species every few years, grouping them according to degree of invasiveness. The most recent compilation can be found at the end of this chapter. The FEPPC has also developed a database map for the Noxious and Exotic Weed Task Team of Category I species throughout the state. A review of this database resulted in the list of FEPPC Category I species occurrence within Hillsborough County, which are described individually below.

This list is based on the definitions of invasive exotic species made by the EPPC Committee:

- Category I are exotic pest plants that invade and disrupt Florida's native plant communities;
- Category II are exotic pest plants that have the potential to invade and disrupt native plant communities as indicated by (1) aggressive weediness; (2) a tendency to disrupt natural successional processes; (3) a similar geographic origin and ecology as Category I species; (4) a tendency to form large vegetative colonies; and/or (5) sporadic, but persistent, occurrence in natural communities;
- (N) indicates a species listed as noxious on the United States Department of Agriculture and the Florida Department of Agriculture and Consumer Services lists; and
- (P) indicates a species listed as prohibited by the Florida Department of Environmental Protection under Rule 62C-52, F.A.C.

Exotic Plants in the Rocky/Brushy Creek Watershed

The Rocky Creek - Brushy Creek watershed has been susceptible to exotic species invasion as a result of the physical disruption of habitats for development purposes, agricultural and industrial operations, and the escape of exotic species from residential landscapes. Information contained in several reports (see Bibliography) and on site visual inspection of the watershed revealed the presence of a total of 39 exotic species in the watershed including: air potato, alligator weed, Australian pine, Brazilian pepper, castor bean, chinaberry tree, Chinese tallow tree, cogon grass, earpod tree, hydrilla, latex plant, lead tree, paper mulberry, parrot's feather, punk tree, skunk vine, water hyacinth, and wild taro. Below is a brief description of the exotic species observed within the Rocky Creek - Brushy Creek watershed. The vegetative descriptions are from the University of Florida's Northeast Region Data Center. The photographs are reprinted from the University of Florida, Institute of Food and Agricultural Sciences Aquatic, Center for Aquatic and Invasive Plants, online Aquatic, Wetland and Invasive Plant Information Retrieval System (APIRS).

Alligator Weed

Alligator weed is an immersed plant that is usually found in water, but can grow in a variety of habitats, including dry land. It may form sprawling mats over the water or along shorelines. Alligator weed stems are long, branched, and hollow. Leaves are opposite,

simple, elliptic, and have smooth margins. Flowers grow on stalks and are whitish and papery, and bloom during the warm months.

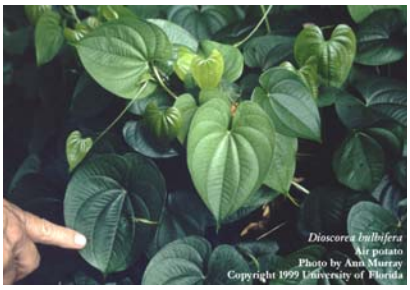
Australian Pine

Several species of Australian pine were introduced into Florida prior to 1920 (Morton, 1980). The three species of Australian pine in Florida are *Casuarina equisetifolia*, *C. glauca*, and *C. cunninghamiana*. Hybridization of these species is extensive and complicates identification (Schardt and Schmitz, 1990). The tree is an emersed hardwood, native to Australia and Malaysia, and occurs along rocky coasts, dunes, sand bars, and islands.

The Australian pine was primarily planted to form windbreaks along coastal areas. The trees can reach 35-m heights and grow at a rate of 1.0 to 1.5 m a year. In southern and central Florida, Australian pines typically produce dense stands and form thick carpets of needles on the ground prohibiting the growth of native vegetation. In dune communities, Australian pine's dense shade and leaf-litter retard the growth of native coastal vegetation (Schardt and Schmitz, 1990). Dense monospecific stands of Australian pine crowd out native vegetation in coastal areas and affect habitat for several listed and non-listed species. It is prevalent on the margins of the saltmarsh in the Rocky Creek - Brushy Creek estuary.

Air Potato

It is believed that air potato was introduced to Florida as an ornamental and food plant around 1905. It was already recognized as a pest plant throughout the state by the 1970s. It is a non-native, invasive vine covered with large handsome leaves. It can quickly grow 60-70 feet in length, which is long enough to overtop (and shade-out) tall trees. A member of the yam family (*Dioscoreaceae*), air potato produces large numbers of aerial tubers, (potato-like growths attached to the stems) that grow into new plants and is a particular problem in the margins of the Stream and Lake Swamp (FLUCFCS 615) land cover type.



Water Hyacinth

The water hyacinth is a floating plant that grows in all types of freshwaters. It has inflated petioles and forms large floating mats that can completely cover lakes, ponds, and streams. It is a prolific tropical weed now naturalized in waterways throughout the state and the frost-free coastal areas of the Southeast (Bell and Taylor, 1982). Water hyacinths vary in size from a few inches to over three feet tall. It has showy lavender flowers. The leaves are rounded and leathery, attached to a spongy and sometimes inflated stalk, and the roots are dark and feathery. It is a problem in backwater areas of Rocky Creek - Brushy Creek in its upper reaches, on the margins of some lakes, and over

the entire surface of some artificial ponds.

Cogon Grass

Cogon grass is a non-native grass with extensive rhizomes, spreading stems from 3-10 feet. It is one of the most aggressive weeds of dry lands in Florida, but can occur in areas that become briefly flooded. It can cover large areas. Native to the warmer regions of the Old World, it was brought to the U.S. as experimental forage. It has spread, partially through its use as a packing material. It is commonly seen along roadsides, ditches, swales, and abandoned land. Difficult to eradicate due to its hardy rhizomes, the plant quickly out competes most native grasses. It is most prevalent along roadsides and abandoned land in the watershed.

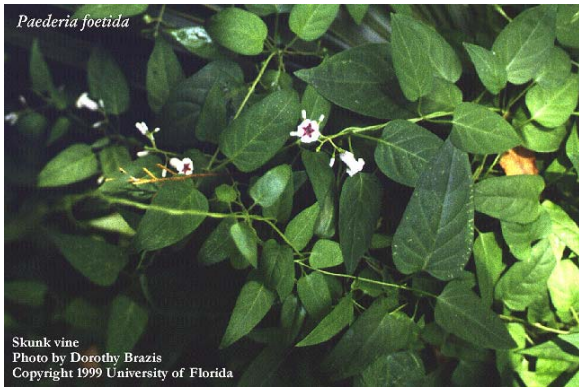
Punk Trees (Melaleuca)

Melaleuca trees, also known as punk trees or paperbark tea trees, are native to Australia, New Guinea, and New Caledonia. Melaleuca is characterized in Florida by a rapid growth rate, efficient reproduction, and the ability to invade a wide variety of habitats (Meskimen, 1962). This exotic tree grows along roadsides, on ditchbanks, in mesic prairies, in sawgrass marshes, and on lake shorelines. Once established, trees form dense stands that are nearly impenetrable (Center and Dray, 1986). More than 4,000 trees per hectare are not uncommon in melaleuca forests. Melaleuca is a pest, especially in the Everglades and surrounding areas, where the trees grow into immense forests virtually eliminating all other vegetation. Although small mammals seem to use these forests, species diversity in wet prairie-marsh ecosystems with dense monocultures of melaleuca decreases by 60-80% (Austin, 1978; Woodall, 1978; Mazzotti et al., 1981). Schortemeyer et al. (1981) reported that only 10% of the bird species in melaleuca stands actually fed there and only 1.5% of their activity involves nesting in these trees. Melaleuca can replace native pond cypress. Punk tree are seen as small clumps distributed in the lower reaches of the watershed in residential areas and on the margins of the salt marsh in the Rocky Creek and Channel A estuaries.

Chinaberry Tree

Chinaberry is a naturalized, fast-growing tree in the southeastern U.S. It is invading the forests, fence lines, and disturbed areas of Florida and elsewhere, including Hawaii. Belonging to the mahogany family of plants, chinaberry is native to Asia. Striking and colorful, chinaberry was widely introduced as an ornamental shade tree because of its large compound leaves, distinctive clusters of lilac-colored flowers, and round yellow fruits. Chinaberry seeds are spread by fruit-eating birds. Chinaberry outgrows,

shades-out, and displaces native vegetation. The bark, leaves, and seeds are poisonous to farm and domestic animals. Chinaberry is a landscape element on residential properties in the watershed.

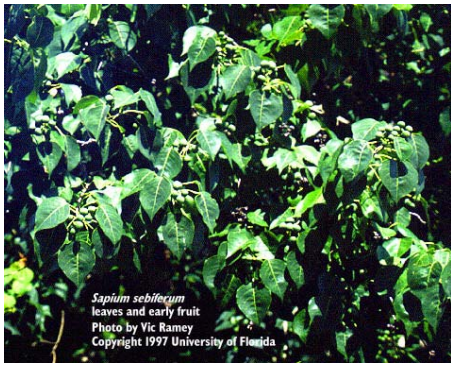


Skunk Vine

Skunk vine, a woody vine from Asia, actually does smell more-or-less skunk-like. The aggressive, competitive plant may grow high into the trees in a variety of habitats, from mesic hammocks to xeric sand hill communities. It appears to prefer sunny floodplains and bottomlands, and can even grow under water. Reportedly introduced in 1897 as a "potential fiber crop", skunk vine now occurs throughout the southeastern U.S. Herbarium records indicate that skunk vine grows in at least 17 counties of central and north central Florida. Its stems root freely. This species is prevalent on the edges of the Stream and Lake Swamp habitat (FLUCFCS 615).

Chinese Tallow

Like melaleuca, the Chinese tallow is a tree that grows and spreads rapidly, is difficult to kill, and tends to take over large areas by out-competing native plants. Chinese tallow is spreading rampantly in large natural areas, including Paynes Prairie State Preserve near Gainesville, state-owned protected lands along the St. Johns River. It is a landscape element on residential property and has escaped into all but the xeric plant communities.



Brazilian Pepper

Brazilian pepper is one of the most aggressive of the invasive non-indigenous plants in Florida. It is invading aquatic and terrestrial habitats, greatly reducing the quality of native biotic communities in the state. Brazilian pepper is from South America, and was probably introduced as an ornamental in the mid 1800s. Since it is not cold hardy, the tree occurs mostly in southern Florida. Brazilian pepper is indigenous to the coast of tropical Brazil, Paraguay, and Argentina (Ewel, 1986). It was present in Florida in the early 1840's (Barkley, 1944) and was re-introduced into Florida in 1898 (Morton, 1978). This plant was once sold as a landscape ornamental because it produced dense masses of scarlet berries. The species is established in mangrove swamps in the Rocky Creek and Channel A estuaries.

Wild Taro

The wild taro is an emergent plant, imported from the Pacific Islands. It occurs in and out of water. The leaves can grow to two feet long and are medium to large in size, arrowhead-shaped with heart-shaped bases. They are dark, velvety green, and water repellant. Wild taro leaves are peltate: the leaf stem attaches more-or-less to the middle of the underside of the leaf. Leaf stems grow to four feet tall, and flowers occur in small fingerlike spikes. It is established in backwater areas of Rocky/Brushy Creek.

Hydrilla, a submerged aquatic plant, grows rooted in the bottom substrate of quiet reaches of the Creek and other freshwater habitats. It escaped from the aquarium trade and is well established in stream reaches of Rocky and Brushy Creeks and in some lakes in the watershed. Control measures include chemical treatment and the introduction of the Chinese grass carp, a plant-eating fish species.

8.5.9.2 Exotic Fauna

An exotic animal is a non-indigenous species introduced to an area either purposefully or accidentally. Exotic, non-indigenous, invasive species compete with native species for space, food, and ecological niche. Activities to prevent and control invasive animal species that severely impact the lands and waters of the United States have become a priority for watershed management. The term invasive species is defined by the Presidential Executive Order 13112. Known as "exotic-invasive" or "alien-invasive" species, these invasive plants and animals cause vast ecological and economic damage, and sometimes, human health impacts in areas that they infest. These species have gained a foothold on public and private lands throughout the nation and in other parts of the world, and range across almost every ecosystem of the country including those found within the Rocky/Brushy Creek watershed. Common methods of introduction include release of pets, escape from pet dealers, or intentional introduction for pest control. USGS, FDEP, UF-IFAS, and Hillsborough County information on non-indigenous species were reviewed to compile a list of exotic species that have been observed or reported in the watershed. Some of the exotic animal species found in the watershed include: Nine-banded armadillo, Cuban tree frog, Greenhouse frog, and Brown anole. These four species arrived in Florida by natural migration (nine-banded armadillo) and by accidental introduction (Cuban tree frog, Greenhouse frog, and Brown anole). Armadillos disturb soils in all habitats, particularly Stream and Lake Swamp, Cypress, and other wetlands during the dry season. The Cuban treefrog is a voracious predator and will attack and devour anything smaller than itself, including native frogs, fish, and invertebrates. The greenhouse frog may be replacing native frogs, particularly in south Florida, while the brown anole competes to some degree with the native Carolina anole (chameleon).

8.6 Conservation and Preservation Programs

Conservation and preservation programs are critical instruments in the protection of natural communities. These programs promote and protect biological diversity which are supported by international treaties, federal regulations, state legislation, local comprehensive management plans, and local ordinances which are discussed in detail in Section 8.7.

Local governments in Florida may use two instruments of preservation: conservation easement as supported by 704 F.S. and 193 F.S. and land acquisition. These Florida Statutes support the following methods of preservation:

- full fee acquisition;
- less than fee acquisition;
- 193 F.S. easement;
- transfer of development rights; and
- purchase of development rights.

8.6.1 Land Acquisition Conservation and Preservation Programs

There are several land acquisition conservation and preservation programs in Florida available to local governments that have jurisdiction over the Rocky/Brushy Creek watershed. These programs are briefly described in the following sections.

Conservation and Recreation Lands Program

The Conservation and Recreational Lands (CARL) program was established in 1979 by the Florida Legislature which expanded the 1972 Environmentally Endangered Lands Program to include resource conservation measures for other types of lands. It is one of Florida's environmental land acquisition programs for the protection and conservation of unique natural areas, endangered species, unusual geologic features, wetlands, and significant archaeological and historical areas. Mineral-extraction severance taxes and documentary stamp fees funded the CARL program until the recent creation of the Preservation 2000 (P2000) program. The CARL program receives approximately $105 million annually from the sale of bonds. Future funding from the sale of bonds is dependent on legislative action, but the Florida Forever program is scheduled to continue until 2010. The Land Acquisition and Restoration Council (ARC) was established by Section 259.035 (1) F.S., and selects and ranks projects on the CARL acquisition list each year. Nine members of ARC represent the following state agencies: Department of Community Affairs, DEP, Division of Forestry of the Department of Agriculture and Consumer Affairs, FWC, Division of Historical Resources of the Department of State, and four appointees of the Governor with backgrounds from scientific disciplines related to land, water, or environmental science.

The FDEP Bureau of Land Acquisition reviews all CARL and P2000 acquisitions and handles land exchanges, negotiates, and acquires lands for the department and other state agencies. Lands acquired under the CARL program are maintained as parks, recreation areas, wildlife management areas, wilderness areas, forests, and greenways.

Florida Forever Program

Established in 1999 by the Florida Legislature, the Florida Forever Program is the principal land acquisition program for Florida. It provides for up to $3 billion statewide over a 10-year period to protect and improve environmental lands, water resources, and urban green space. The allocation to SWFWMD equates to approximately 25% of total funds expected to be provided under the program.

Hillsborough County Environmental Lands Acquisition and Protection Program

The HCELAPP was established by Hillsborough County in 1987 for the purpose of acquiring, preserving, and protecting endangered and environmentally sensitive lands, beaches, parks, and recreational lands. Although resource protection is the primary purpose of acquiring sensitive lands in the county, public use that is compatible with the preservation and protection of such lands has been allowed on select parcels. The program is administered through the county's Parks and Recreation Department and is overseen by an advisory committee composed of both local citizens and public agency staff. Parcels deemed environmentally sensitive are evaluated and ranked on a site-by-site basis through an annual nomination process.

HCELAPP's land acquisition efforts for acquiring environmentally sensitive lands are often in cooperation with FDEP's CARL Program, SWFWMD, the Florida Forever Program, and The Nature Conservancy. HCELAPP has acquired core riverine areas in the Rocky Creek - Brushy Creek watershed. These acquired lands include properties adjoining the Hillsborough River State Park and the Lower Hillsborough Wilderness Park. Only three new sites within Hillsborough County were nominated for acquisition in 1999.

Nature Conservancy

The Nature Conservancy (TNC) is a non-profit international organization whose goals are to conserve biological diversity through habitat conservation. TNC works with the Natural Heritage Inventory scientists and other researchers to set conservation priorities and acquire lands for conservation management.

TNC utilizes acquisition, land exchanges, conservation easements, retained life estates, and other arrangements to work with property owners to protect natural habitats. They also provide landowners with technical assistance on identifying and managing natural resources including rare species and unusual natural communities.

Trust for Public Lands

The Trust for Public Land (TPL) is a national non-profit land conservation organization that was created to protect land for public use and enjoyment. The principal goal of TPL is to acquire lands suitable for open space and parks, and convey them to public agencies for ownership and management. TPL also provides training and technical assistance to private landowners, local land trusts, and government agencies to enhance their land conservation goals.

Wetland Reserve Program

The Wetland Reserve Program (WRP) is administered through the USDA Natural Resources Conservation Service (NRCS). The WRP is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support for conservation easements and wetland restoration in an effort to achieve the greatest wetland functions and values, along with optimum wildlife habitat.

8.6.2 Public Lands in the Rocky/Brushy Creek Watershed

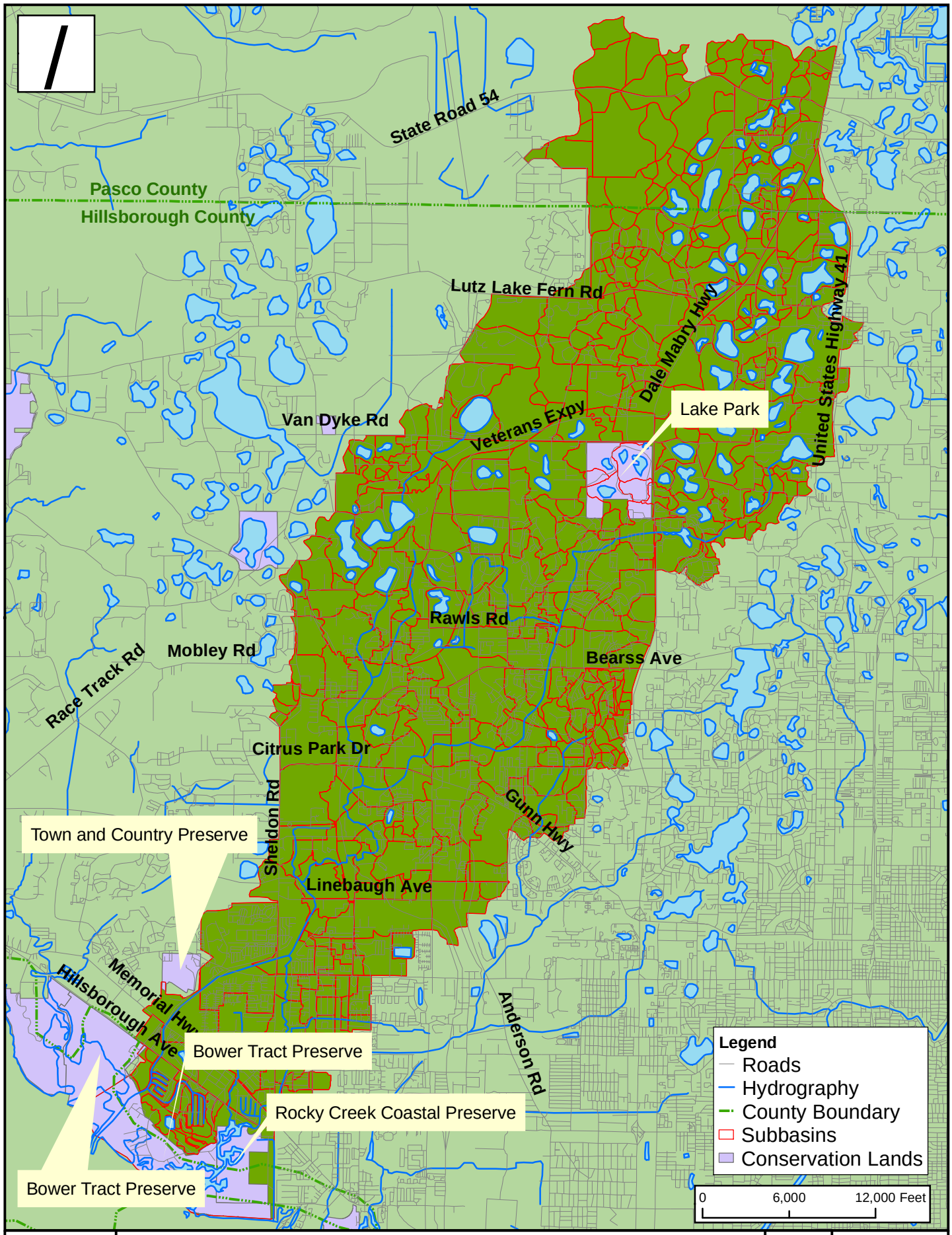
A review of existing public lands within the watershed was conducted utilizing GIS metadata for conservation lands in Florida compiled by the Florida Greenways Planning Team, Department of Landscape Architecture of the University of Florida based on:

- SWFWMD GIS acquired and proposed land data
- CARL, Conservation Lands 2004, and FNAI Managed areas GIS data (FGDL)
- Hillsborough County ELAPP GIS data
- Atlas of Outstanding Florida Waters

Hillsborough County Parks information provided by the Hillsborough Planning Commission was also reviewed and utilized for this report. An analysis of the GIS data layers was performed to approximate proposed and acquired land area. Almost 2,416 acres have been acquired for conservation purposes (Table 8-10). Figure 8-9 shows the 2004 conservation areas identified by SWFWMD.

Table 8-10 Acreages of Lands for Conservation Purposes within the Rocky/Brushy Creek Watershed

Parcel Name	Acres
Rocky Creek Preserve	279
Bower Tract	1548
Lake Park	589
Total	2,416



Conservation Lands in the Rocky/Brushy Creek Watershed

Figure 8-9

AYRES ASSOCIATES

8.6.3 Greenways and Trails

Subsection 260.012(1) (2) F.S. (The Florida Greenways and Trails Act) defines "greenways" as linear open space established along either a natural corridor such as a riverfront, stream valley, or ridgeline, or over land along a railroad right-of-way converted to recreational use, a canal, a scenic road or other route; any natural or landscaped course for pedestrian of bicycle passage; an open space connector linking parks, nature reserves, cultural features, or historic sites with each other and populated areas; or a local strip or linear park designated as parkway or greenbelt. The same statute defines "trails" as a linear corridor and any adjacent support parcel on land or water providing public access for recreation or authorized alternative modes of transportation.

Greenways can be hard surfaced pathways that permit different recreational uses such as walking, jogging, skating, and biking, or they can be natural corridors with a simple path along a stream or riverbank. Many greenways connect destination points such as parks, libraries, schools, and shopping areas. A utility or drainage ROW, or an abandoned railroad corridor can be converted to a pedestrian bike or walkway. Conservation areas protecting a community's natural resources such as rivers, streams, wetlands, wildlife, and floodways are often included in greenways. Greenways benefit the community in many ways by providing opportunities for recreation and alternative transportation, improving environmental protection, providing places for environmental education, and stimulating economic development.

In the Rocky/Brushy Creek Watershed, there are several existing and proposed trails, greenways, and preserves. Existing trails include: (1) the Upper Tampa Bay Trail that has been constructed along Channel A north to Race Track Road and (2) the Town 'N Country Greenway from Sheldon Road east along Channel G to Town 'N Country Park, most of which is in the Lower Sweetwater Creek Watershed.

Proposed trails and greenways include: (1) the Northdale – Lake Park Trail, (2) the Northwest Regional Connector Trail; (3) the extension of the Upper Tampa Bay Trail north to the Suncoast Trail north of Lutz-Lake Fern Road; (4) greenway from the Dale Mabry Highway/Ehrlich Road intersection north to Sheldon Road; (5) greenway from the Linebaugh Avenue/Gunn Highway intersection west to the Upper Tampa Bay Trail, thence to Race Track Road; (6) greenway from Lake Park to Northdale.

Proposed preserves include the riparian system associated with two reaches of Rocky Creek: (1) from Lake Armistead south to Channel A; and (2) from Lake Park south to Old Tampa Bay.

Funding sources for the development of greenways and trails are available from:

1. **Recreational Trails Program** - The Recreational Trails Program (RCT) is a federally competitive grant program that provides, renovates, or maintains recreational trails. The Intermodal Surface Transportation Efficiency Act ISTEA) of 1991 included the National Recreational Trails Fund Act (NRTFA) and established the National Recreational Trails

Funding Program (NRTFP). The National Highway System Designation Act (NHS Act) of 1995 amended and revived the NRTFA. The Transportation Equity Act for the 21st Century (TEA-21) amended the previous legislation and provided six years of funding. In Florida, the RCT is administered by the FDEP in coordination with the U.S. Department of Transportation, Federal Highway Administration.

2. **Florida Recreation Development and Assistance Program** - The Florida Recreation and Development Assistance Program is a competitive program that provides grants for acquisition and development of land for public outdoor recreation use.

3. **FDOT Transportation Enhancement Program** - The Florida Department of Transportation (FDOT) Transportation Enhancement Program provides funds for transportation-related activities designed to strengthen the cultural, aesthetic, and environmental aspects of Florida's intermodal transportation system. The program provides for implementation of a variety of projects including bike and pedestrian facilities. Projects are selected by local metropolitan planning organizations and the FDOT district offices.

4. **Florida Scenic Highways Program** - The Florida Scenic Highways Program is administered by the FDOT. This program works with local governments to identify and protect scenic roadways throughout the state. Designated corridors, including associated greenway and trail projects, may be eligible for increased funding opportunities.

8.6.4 Natural Systems Restoration

The Rocky Creek - Brushy Creek watershed reflects a variety of land uses that have resulted in the both the conversion of natural lands to urban, suburban, commercial, and agricultural development and the degradation of remaining native habitats. Increased future land development will continue to produce adverse impacts to natural systems. Consequences of development have included: reduction in biological diversity, overall habitat quality, abundance, and distribution, as well as habitat fragmentation, species isolation, impairment of water quality, and loss of wildlife corridors.

In order to alleviate the negative impacts of development, it is necessary to protect and restore natural systems within the watershed through land acquisition, conservation methods, public environmental education, exotic plant species removal, replacement of native habitats where they have been eliminated and/or degraded. High quality natural areas are a priority to both the human population and animal populations within the watershed, and the implementation of a meaningful restoration/protection plan will produce substantial ecological and aesthetic benefits.

Restoration - There are several candidate areas for restoration. Chief among these areas are the locations at which Rocky Creek and Brushy Creek have been crossed by major roadways, electrical transmission facilities, and the railroad grade. At all of these locations, the Creeks have been subject to factors that have degraded stream habitat, discouraged wildlife establishment, allowed the invasion of exotic plant species, resulted in trash accumulation in the channel, and negatively affected water quality.

Priority restoration measures at these areas include:

1. Diversion and treatment of untreated stormwater runoff,
2. Exotic species removal.
3. Reshaping channel banks to eliminate erosion and undercutting,
4. Trash removal, and
5. Re-establishing desirable native plant species consistent with the original habitat and compatible with the needs of each transportation facility.

Other candidate areas for restoration include:

1. Lake shores where shoreline vegetation has been completely cleared – Assistance should be provided to willing lakefront property owners to re-establish desirable emergent aquatic plants to promote lake fisheries, reduce erosion potential, and protect lake water quality from fertilizers and pesticides.
2. Roadway rights-of-way where exotic species have become established – Following the removal of exotic species, desirable native species should be planted, and a maintenance program should be implemented to ensure restoration success. Appropriate signage at each restoration site should be erected for public education purposes.
3. Enhancement of habitat on Channel A, where feasible, to promote fisheries and safe public access for fishing and birding.
4. Restoration of native habitats on public lands within the watershed – A detailed assessment of public lands should be performed in which specific areas needing restoration should be identified. Areas should be prioritized according to expected benefits to water resources in the watershed, and projects should be undertaken that improve and protect water quality.

8.7 Regulations Protecting Natural Systems

As part of the development of the Rocky Creek - Brushy Creek watershed management plan, existing regulatory mechanisms that protect natural communities within the watershed and throughout the County were researched and reviewed. Regulations are an important component in the protection, maintenance, preservation, and conservation of natural lands.

HCEPC Wetland Rule

The Hillsborough County Environmental Protection Commission's (HCEPC) Chapter 1-11 (Wetlands) Rule provides standards for the identification, protection, maintenance, and utilization of wetlands in Hillsborough County.

Hillsborough County
Wetlands, uplands, and environmentally sensitive areas are protected by the County Land Development Code (Ordinance No. 00-21, PART 4.01.00) requirements including set backs, buffer zones, and other mechanisms. The Natural Resources regulations protect habitats that are scarce within the county and supports the Endangered Species Act, enforcing protection of listed species and their habitats.

Environmental Resource Permit
The Environmental Resource Permit (ERP) process is administered by the SWFMWD and The FDEP under Part IV of Chapter 373, Florida Statutes (F.S.) and Chapters 40D-4, 40, 45, and 400, Florida Administrative Code (F.A.C.). This permit provides protection for surface water bodies, wetland ecosystems, partially through coordination with the Florida Fish and Wildlife Conservation Commission, NMFS, USFWS, and the USACOE.

Federal Regulation
Federal protection for wetlands is provided under the Section 404 Dredge and Fill Permit administered by the USACOE and the National Pollutant Discharge Elimination System Permit (NPDES) administered by the EPA.

Tampa Bay Comprehensive Conservation Management Plan
The Tampa Bay Estuary Program has developed a Comprehensive Conservation Management Plan that promotes improved land and water management throughout the Tampa Bay watershed, including the protection and restoration of declining natural communities that serve as indicators of the health of Tampa Bay.

Hillsborough County Comprehensive Plan
County comprehensive plans are mandated by Chapter 163 F.S., as amended by the Local Government Comprehensive Planning and Land Development Regulation Act. This act requires the development of a comprehensive plan by each local government within Florida. Chapter 163 F.S. is further defined by Rule 9J-5, F.A.C., which establishes minimum criteria for each element of the comprehensive plan.

The Hillsborough Comprehensive Plan has the following elements:

1. coastal management;
2. conservation and aquifer recharge;
3. future land use;
4. transportation;
5. housing;
6. recreation and open space;
7. economically disadvantaged groups;
8. potable water;
9. sanitary sewage;

10. storm water;
11. solid waste; and
12. capital improvement projects.

Elements that directly affect natural communities within the Rocky Creek - Brushy Creek watershed are coastal management, recreation and open space, potable water, conservation and aquifer recharge, and capital improvement projects.

8.8 Public Education

Public education is one of the most important components of a watershed management plan. Public outreach programs and projects can promote the participation and involvement of local residents, which contributes to the acceptance, approval, and successful implementation of this watershed management plan. The following is a summary of current public education and outreach programs throughout the state that apply to the concerns and goals of the Rocky Creek - Brushy Creek watershed. More specific information pertaining to these programs can be found by contacting the responsible agency by phone or through their web site.

Hillsborough County implements several programs applicable county-wide, including the Rocky Creek - Brushy Creek watershed:

1. **Officer Snook Program** - The Officer Snook Program teaches children about water pollution and its effect on our rivers, ponds, lakes, and streams. Officer Snook provides a fun and educational coloring book for each student, as well as curriculum guides and activity books for teachers who want to continue pollution prevention education in their classrooms.

2. **Stormwater Ecologist** – This program is designed to give students and teachers the power to make responsible decisions about stormwater pollution prevention and to demonstrate how our actions all play a role in the health of the world around us. Stormwater Ecologist not only talks about making a difference, we'll actually help you make one with our hands-on and community projects. This program incorporates aspects of science, politics, and economics, making it appropriate for a wide range of classes.

3. **Hillsborough County's Adopt-A-Pond** - The Adopt-A-Pond program is a public-private partnership helping neighborhoods improve their water quality, wildlife habitat value, and aesthetic value of stormwater ponds. The program is dedicated to improve pond environments. The program offers free education on stormwater runoff, storm drain marking kits, free native wetland plants, technical advice on pond management, and the opportunity to participate in a network of other members of the program. In the watershed, 61 ponds are included in the Program.

4. **Hillsborough County Stream Waterwatch** - The Stream Waterwatch program is a cooperative effort between Hillsborough County, Hillsborough County Community College, FWC, and the SWFWMD. The goal of this program is to ensure clean and healthy streams. Volunteers are trained to collect water quality samples, to take field measurements of physical parameters, and to collect, sort, and identify macroinvertebrates. Volunteers collect monthly stream samples and measurements. They also participate in stream clean-ups, restoration projects, and related activities.

5. **Hillsborough County Lake Management Program** - The Lake Management Program (LaMP) is a cooperative program involving Hillsborough County, University of Florida LAKEWATCH, and the University of Florida. Volunteers take monthly samples and learn about aquatic plants, water quality, and the wildlife that utilize their lakes. Citizens learn what they can do in their households and yards to improve the health of their lakes. Collected data is entered in a web-based database maintained by the University of South Florida (http://www.hillsborough.wateratlas.usf.edu/).

6. **Nature's Classroom at the Wilderness Park** - The Nature's Classroom is located within the Wilderness Park, an award winning outdoor educational facility for sixth graders in Hillsborough County. Nearly 10,000 students and faculty have experienced the Hillsborough River first hand by viewing animals and plants in their natural habitats. The SWFWMD's Hillsborough River Basin Board for flood control and water quality protection originally purchased the Wilderness Park.

University of Florida/Hillsborough County Cooperative Extension Service

The Cooperative Extension Service (CES) is an educational service of the University of Florida and Hillsborough County that provides research-based information to the public through workshops, publications, and mass media. The CES offers assistance on creating and maintaining a Florida yard, composting, creating wildlife habitat, xeriscaping, water conservation with micro-irrigation, butterfly gardening, and landscaping for beginners. Several programs are implemented in Hillsborough County:

1. **Master Gardener Program** - The CES offers the Master Gardener Program that provides gardeners with training and the opportunity to improve their horticultural knowledge and skills. Through organized volunteer activities, gardeners then share their experience with the public. Master gardeners help to educate the community by helping gardeners solve their plant problems, promoting environmental responsibility through water conservation and pest control, beautifying Hillsborough County by teaching about appropriate plants for its climate, and working with school and community gardens.

2. **Backyard Wildlife Habitat Program** - The CES offers the Backyard Wildlife Habitat Program, which promotes the use of native plants. The program teaches that the right selection of native plants can provide a natural food source year-round. When used correctly the plants will require less water, fertilizer, and pesticides.

3. **Florida Yards and Neighborhoods Program** - The CES offers the Florida Yards and Neighborhoods Program (FYNP). The FYNP is a partnership of concerned citizens, members of the landscape industry, the University of Florida's Cooperative Extension Service, the National Estuary Program, Florida Sea Grant College Program, and numerous environmental agencies. The program was developed to address serious problems of pollution and disappearing habitats by enlisting homeowners to help save our waterways. The program provides special education and outreach activities in the community by assisting residents to reduce pollution and enhance their environment by improving home and landscape management.

SWFWMD Environmental Education Programs

SWFWMD implements several programs throughout it 16-county service area that includes Hillsborough County:

1. Xeriscape - The xeriscape program promotes water conservation through creative landscaping. Landscapes that conserve water will save the homeowner money on water, energy, and maintenance bills, and will help preserve valuable fresh water resources and provide wildlife habitat. The program guides homeowners through a seven-step process including 1) design, 2) plant selection, 3) improving the soil, 4) wise utilization of turf, 5) efficient irrigation, 6) using mulch, and 7) maintenance.

2. SWFWMD In-School Education Programs - The In-School Education Program helps achieve the SWFWMD's goal of preserving and protecting water resources and related ecosystems through educational materials for teachers and students from Kindergarten through grade 12.

3. SWFWMD Mini-Grants is a program that offers teachers funding to do classroom projects on water quality, water supply, water conservation, or watersheds. Applications are available through the SWFWMD at http://www.swfwmd.state.fl.us/infoed/educators/minigrants/hillsboroughmg.pdf.

4. SWFWMD Teacher workshops provide teachers information on water resources in the Rocky Creek - Brushy Creek watershed, as well as hands-on activities and strategies for the best instructional methods on water issues.

5. Project WET is an inter-disciplinary water education program for teachers and other educators working with young people in Kindergarten through grade 12. The program can be integrated into existing curricula of a school, museum, or community organization. The goal of the project is to facilitate and promote appreciation, awareness, knowledge, and stewardship of water resources though the development of classroom-ready teaching aids and the through the establishment of internationally and state-sponsored Project WET programs. The Project WET Curriculum and Activity Guide is a collection of over 90

innovative, interdisciplinary activities that are hands-on, easy to use, and fun. Designed with a commitment to state and national education standards, Project WET activities cover diverse topics and disciplines. The Project WET Curriculum and Activity Guide activities promote critical thinking and problem-solving skills. These activities help provide young people with the knowledge and experience they will need to make informed decisions regarding water resource management.

6. The *Envirothon* is a problem-solving, natural resource education program for high school students. Student team to solve problems and conduct hands-on investigations about forestry, soils, aquatics, wildlife, and current environmental issues. SWFWMD sponsors an annual *Envirothon* in Hillsborough County inviting local high schools to compete against each other in solving problems in various disciplines.

7. Florida Waters Project Teacher's Guides is a set of activities and background information designed to encourage students to investigate and explore the water systems in their communities, to learn more about water issues and land resources in their communities, and to take an active role in the protection and preservation of our precious water resources.

8. SWFWMD Water Matters is a set of multi-disciplinary activities and background information designed to help students learn about the process of water management and how they can be involved with the process. Water Matters is available to the public.

9. My Water Activity Book is full of fun activities to help students from kindergarten through 2nd grade learn about water resources by coloring and completing mazes, word games, dot-to-dot, and puzzles. This book is available to teachers and students.

10. SWFWMD Splash! Water Education Packet is a colorful, multidisciplinary middle school packet containing fact and activity sheets on wetlands, the hydrologic cycle, desalination, water use, water conservation, community planning, and water management. The packet is free to educators.

11. Water Drops Newsletter is a water resource newsletter available to teachers from grades 3 through 5. Newsletter issues come with a teacher's guide on water conservation, water cycle, and a visit to a nature park. The newsletter was designed to assist teachers discuss water related issues with their students.

12. The Watershed Education Resources Box is a collection of puppets, poetry, fiction, and non-fiction available to teachers to help students understand watersheds and the importance of watersheds.

13. The Watershed Excursion Tabloid includes information about watersheds found throughout the SWFWMD, explains to students why watersheds are important to Florida's ecosystems, and how we can all work to keep our watersheds clean and healthy.

14. The Water Education Week Publications were created and distributed in conjunction with the Newspaper In-Education Program. This 16-page newspaper tabloid with teacher's guide focuses on a particular water topic each year. Materials are designed for grades 4 to 7. The booklets on water quality, habitats, water management and use, technology, and sustainability are available as class sets and are free to educators.

15. The Water From the Ground Up is a full curriculum available to teachers that includes text, a teacher's guide, an activity book, and basic District hydrologic information for students in grades 3 to 5. The curriculum includes topics on surface water and groundwater sources in west central Florida, water quality, water use, floods, droughts, and water conservation.

16. The Water Watchers is a video and teacher's guide available to kindergarten through grade 3 teachers that includes classic children's songs with water resource lyrics. It also features simple experiments to illustrate such concepts as the hydrologic cycle, water pollution, saltwater intrusion, etc.

17. Who Gets the Water*?* is an interdisciplinary curriculum available to middle school teachers that provides a basic understanding of the environmental and economic concepts necessary to make good decisions in the face of limited resources.

Florida Department of Education, Office of Environmental Education, Environmental Program

The Florida Department of Education has divided Florida into several Environmental Education Regional Service Areas. The Rocky Creek - Brushy Creek watershed is within Regional Service IV that covers Charlotte, De Soto, Glades, Hardee, Hendry, Hernando, Highlands, Hillsborough, Lee, Manatee, Pasco, Pinellas, Polk, and Sarasota counties. Each regional service area has several environmental projects, including the promotion of "Teaching Naturally." This is an interdisciplinary guide using activities to make education real for students by using the environment as an integral concept across subject areas for all grade levels. The mission of Regional Service Projects (RSP) is to assist their region's pre-K through 12 schools, colleges, and universities in improving teaching and learning through environmental education. The RSP IV functions include:

- Conducting assessments of educational needs of teachers and students that environmental education can meet.
- Soliciting and brokering resources to match the needs of teachers, preservice educators, and students that environmental education can meet.
- Publishing and distributing Regional Resource Guides that cover a broad spectrum of regional, state, and national resources for educator use.

- Developing and supporting a cadre of skilled facilitators, most of whom are classroom teachers, to deliver workshops.
- Developing materials and workshops that link environmental education with Sunshine State Standards.
- Collaborating with Area Centers for Educational Enhancement to improve teaching and enhance student performance.
- Assisting post-secondary educators in integrating environmental education concepts and methods in their teaching.

Materials developed by the program of the Office of Environmental Education are distributed at no cost to the public.

Florida Fish and Wildlife Conservation Commission implements several programs state-side, including Hillsborough County and the Rocky Creek - Brushy Creek watershed:

1. **Project WILD** is a supplementary, interdisciplinary instructional program for teachers of kindergarten through high school age students. It is a way for teachers to incorporate concepts related to people, wildlife, and a healthy environment into major school subjects and skill areas. WILD activities are organized around a conceptual framework that addresses awareness and appreciation of wildlife, human values and wildlife, wildlife and ecological systems, wildlife conservation, cultural and social interaction with wildlife, wildlife issues and trends, and responsible human actions. Project WILD is one of the most widely used conservation and environmental education programs among educators. It is based on the premise that young people and educators have a vital interest in learning about our natural world. The program emphasizes on wildlife because of its intrinsic and ecological values, as well as its importance as a basis for teaching how ecosystems function. Project WILD addresses the need for human beings to develop as responsible citizens of our planet.

2. **FWC Schoolyard Wildlife Project** is an environmental education program that teaches teachers, parents, and students how to turn school grounds into an effective outdoors classroom. The Schoolyard Wildlife Project's resources help incorporate Florida's natural history into school curricula to teach environmental awareness, problem-solving, basic biology, and ecological principles. Two types of hands-on, interactive, one-day workshops are offered: Schoolyard Activities & Ecology and Schoolyard Ecosystems. A combination weekend workshop is offered twice a year. The *Schoolyard Activities & Ecology* workshop provides teachers with high quality, Florida-specific natural history and ecology lessons, and natural science explorations. This four- to six-hour workshop targets educators in grades K-6. The *Schoolyard Ecosystems* workshop teaches educators about local ecosystems and how to involve their students in the creation, restoration, or enhancement of native wildlife habitats on school grounds. This six-hour workshop targets educators in grades K-12. The Schoolyard Wildlife Activity Guide and Schoolyard Ecosystems book can be received only by attending the workshop.

Florida Wildlife Federation Backyard Wildlife Habitat Program - The Florida Wildlife Federation, together with the National Wildlife Federation, offers all Florida residents an opportunity to take part in the Backyard Wildlife Habitat Program. The program's goal is to promote and expand gardening for wildlife in Florida. This program promotes the use of native plants, wildlife habitat creation, water conservation, and the use of fewer fertilizers and pesticides to result in less water pollution. As a result, the homeowner trades time-consuming lawn care for hours spent watching birds, butterflies, and small mammals.

Tampa Audubon Society Audubon Resource Center

The Tampa Audubon Society is a non-profit organization dedicated to preserving Florida's resources and unique habitats. It is one of 45 chapters in Florida that assist members and other community leaders in taking on the challenges of local environmental conservation, education, and advocacy. The Tampa Audubon Society offers conservation education and outreach programs to students, providing solid, science-based curricula and site-based programs in subjects as far reaching as aquifer function and wetland conservation. Outdoor and experience-based conservation education is the heart of Audubon's work in Tampa. By giving children, families, and adults the opportunity to experience Florida's natural resources and identify wildlife and habitat types, the Audubon helps to create and nurture a culture of conservation.

Within the Tampa Bay area, factors such as the elimination of wetlands development, decreased water quality, and an increase in population make it essential for residents to understand the Tampa Bay ecosystem so that growth and development can proceed in harmony with nature. Being intimately involved with these issues, the Audubon Society has developed a unique partnership with the Hillsborough County Parks and Recreation Department. Through this partnership, an Audubon Resource Center (ARC) was established in April 1998 at Lettuce Lake Park. The purpose of the ARC is to help foster a "culture of conservation" and an environmental ethic in the Tampa Bay region that will encourage community involvement as part of the Audubon mission. The Hillsborough River borders the 240-acre urban park and visited by 650,000 people each year, including school classes, clubs, inner-city youth, minorities, and families.

The ARC at the Lettuce Lake Park is designed to enhance Audubon's education and community involvement goals and helps citizens develop an appreciation, awareness, and understanding of the natural world and the interplay of forces that affect living things. The ARC is a multi-faceted hub for conservation and utilizes guided tours, educational brochures and materials, and hands-on activities like nest box building and habitat enhancement to reach its goals. The Center includes a natural history exhibit, nature store, and resource center full of books and informational materials. The exhibit shows wildlife of Tampa Bay and the Hillsborough River in their natural setting, giving students, young and old, a close look at the interrelationship of the ecosystem.

8.9 Bibliography

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8.10 List of Common and Scientific Names for Plants and Animals Mentioned in Report

Trees

Australian pine, Casuarina equisetifolia
Bald cypress, Taxodium distichum
Bluejack oak, Quercus incana
black gum, Nyssa sylvatica var sylvatica
Brazilian pepper, Schinus terebinthifolius
Carolina holly, Ilex ambigua
Carolina willow, Salix caroliniana
castor bean, Ricinus communis
chinaberry tree (Melia azedarach),
Chinese tallow tree (Sapium sebiferum),
dahoon, Ilex cassine
laurel oak, Quercus laurifolia
lobllolly bay, Gordonia lasianthus
loblolly pine, Pinus taeda
longleaf pine, Pinus palustris
Pond cypress, Taxodium ascendens

punk tree (Melaleuca quinquenervia),
red maple, Acer rubrum
sand live oak, Quercus geminata
slash pine, Pinus elliottii
southern red maple,
swamp bay, Persea palustris
sweetbay, Magnolia virginiana
Turkey oak, Quercus laevis

Shrubs

Beautyberry, Callicarpa Americana
Buttonbush, Cephalanthus occidentalis
Darrow's blueberry, Vaccinium darrowii
Fetterbush, Lyonia lucida
Gallberry, Ilex glabra
Gopher apple, Licania michauxii
saw palmetto, Serenoa repens
shiny blueberry, Vaccinium myrsinites
staggerbush, Lyonia ferruginea
tarflower, Bejaria racemosa
titi, Cyrilla racemosa
Virginia willow, Itea virginiana
Wax myrtle (southern bayberry), Myrica cerifera

Herbs

Adam's needle, Yucca filamentosa
air potato, Dioscorea bulbifera
alligator flag (fire flag), Thalia geniculata,
Alligator weed, Alternanthera philoxeroides
Arrowhead, Sagittaria lancifolia
ball moss, Tillandsia recurvata
Beak rush, Rhyncospora sp.
Bearded grasspink, Calopogon barbatus
bladderwort, Utricularia purpurea
bladderwort, Utricularia inflata
bog buttons, Lachnocaulon anceps
bushy bluestem, Andropogon glomeratus
Butterfly orchid, Encyclia tampensis
Cardinal airplant, Tillandsia fasciculata
Carolina elephant's foot, Elephantous carolinianus
Catesby's lily, Lillium catesbaei
Cattail, Typha, latifolia
Cattail, Typha domingensis

Chinese laddere brake, Pteris vittata
Cinnamon fern, Osmunda cinnamomea
cogon grass, Imperata cylindrical/I. brasiliensis,
drumheads, Polygala cruciata
duckweed, Spirodela punctata
dwarf pawpaw, pygmaea
eastern milk pea, Glactia regularis
false nettle, Boehmeria cylindrica
fire flag (alligator flag), Thalia geniculata
giant airplant, Tillandsia utriculata
golden polypody, Phlebodium aureum
goldenrod, Solidago fistulosa.
greenvein ladies' treeses, Spiranthes praecox
maidencane, Panicum hemitomon
marsh fern, Thelypteris palustris
early whitetop fleabane, Erigeron vernus
meadow beauty, Rhexia sp.
meadow spikemoss, Selaginalla apoda
netted chain fern, Woodwardia areolata
parrot's feather, Myriophyllum heterophyllum
Pink sundew, Drosera capillaris
redroot, Lachnanthes caroliana.
royal fern, Osmunda regalis
sand cordgrass, Spartina bakeri
sawgrass, Cladium jamaicensis
skunk vine, Paederia foetida
sky-blue lupine, Lupinus diffusus
southern needleleaf, Tillandsia simulate
Southern shield fern, Thelypteris kunthii
Small butterwort, Pinguicula pumila
Soft rush, Juncus effuses
Spanish moss, Tillandsia usneoides
Spatterdock, Nuphar luteum
spike rush, Eleocharis sp.
Spring ladies' treeses, Spiranthes vernalis
St John's wort, Hypericum fasciculatum
toothed mid-sorus fern
tropical soda apple, Solanum viarum
Virginia chain fern, Woodwardia virginica
Water hoarhound, Lycopus rubellus
water hyacinth, Eichhornia crassipes
Water lettuce, Pistia stratoides
water spangles, Salvinia minima

whitetop sedge, Rhynchospora colorata
white water lily, Nyphaea odorata
wild taro, Colocasia esculenta
wiregrass, Aristida beyrichiana
yellow butterwort, Pinguicula lutea
yellow-eyed grass, Xyris sp.

ANIMAL SPECIES

Reptiles
American alligator, Alligator mississippiensis
eastern indigo snake, Drymarchon corais couperi
gopher tortoise, Gopherus polyphemus

Birds
Florida burrowing owl, Athene cunicularia
Florida scrub jay, Aphelocoma coerulescens
Little blue heron, Egretta caerulea
Limpkin, Aramus guarauna
Peregrine falcon, Falco peregrinus
Reddish egret, Egretta rufescens
Roseate spoonbill, Ajaia ajaja
Sandhill crane, Grus canadensis
Southeastern American kestrel,
Snowy egret, Egretta thula
Tricolored heron, Egretta tricolor
White ibis, Eudocimus albus
Wood stork, Mycteria americana

Mammals
Sherman's fox squirrel, Sciurus niger shermani
West Indian manatee, Trichechus manatus latirostris

CHAPTER 8: EXISTING NATURAL SYSTEMS CONDITIONS

8.1 Overview

The Rocky/Brushy Creek watershed area encompasses 38,201 acres in Hillsborough County. The watershed contains plant communities, both terrestrial and aquatic, that provide a variety of important environmental functions, including habitat for listed species and other wildlife, stability for stream banks and lake shores, improvement of water and air quality, protection of coastal shorelines from storm surges, and moderation of water and air temperatures. However, plant communities have undergone several periods of significant alteration since the 1830's as land use in the watershed changed from original conditions to agriculture to the current suburban/urban uses. Land use shifts have left the watershed with substantially less acreage in native plant communities, impaired water quality in streams, degradation of all plant communities by non-native invasive plants, highly disturbed stream banks and lake shores, and a reduction of length of coastal shoreline protected by marshes. Most populations of native wildlife have been reduced and/or eliminated.

One of the objectives of this watershed management plan is to identify opportunities to restore and protect natural systems in the Rocky/Brushy Creek watershed which are important in preventing excessive runoff volumes and pollutant loads, restoring and/or maintaining terrestrial and aquatic biodiversity, protecting stream channel stability, and reducing stream bank erosion. The first step toward this goal is to describe the historical and existing natural systems in the Rocky/Brushy Creek watershed and to identify specific key factors that prove useful in assessing watershed ecosystem quality. The evaluation of the key factors is done by means of a prioritization matrix which ranks the subwatersheds with respect to environmental quality. A discussion of the overall trends in environmental quality is provided early in the chapter, followed by more discussion of the significant issues for habitats and wildlife within the Rocky/Brushy Creek watershed.

8.2 Data Sources/Literature Review

Several reports were reviewed for this report, and a list appears in the Bibliography in Section 8.9. Further, Geographic Information System (GIS) databases were utilized from the following organizations:

- Florida Department of Environmental Protection (FDEP)
- Florida Department of Transportation (FDOT)
- Florida Fish and Wildlife Conservation Commission (FFWCC)
- Hillsborough County Streamwatch Program

- Florida Natural Areas Inventory (FNAI)
- Hillsborough County Environmental Protection Commission (EPC)
- Hillsborough County Environmental Lands Acquisition and Protection Program (ELAPP)
- Hillsborough County Planning Commission
- Hillsborough River Greenways Task Force (HRGTF)
- Southwest Florida Water Management District (SWFWMD)
- Natural Resources Conservation Service (NRCS)
- U.S. Fish and Wildlife Service (USFWS)
- University of Florida, Geoplan Center, Florida Geographic Data Library (FGDL)
- University of Florida Lakewatch Program
- University of South Florida, Florida Center for Community Development and Design

8.3 Overall Trends and Summary

There are numerous ecological factors and relationships that define the condition of a natural system, and therefore the "level of service" that can be provided by that system. To evaluate and score the watershed, a series of parameters were considered which represented important ecological functions, extent of human development/impacts, and the presence/absence of important wildlife species. The data that were used to develop quantitative parameter scores were processed and generated from a library of information and staff experience, in addition to existing GIS data provided by the SWFWMD and Hillsborough County. Most of these data are presented in subsequent subsections of this chapter. The parameters used in this are described as follows:

- historical and existing land use – expressed as a percent, this factor describes the change in land uses in the watershed area over the period from the 1950 to 2004;
- loss of natural lands
    - habitat fragmentation – describes the impact to the watershed area of the splitting up and isolation of wildlife habitat;
    - riparian buffers – describes the losses of forested systems in stream floodplains and their significance to ecosystem quality in the watershed area;
- hydrologic alterations – describes the impact to environmental quality and function resulting from physical alterations to streams and lakes such as channelization, diversion, filling, and encroachment;
- exotic flora and fauna – describes the impact to native plant and animals in the watershed area of the invasion and establishment of exotic species;
- strategic habitat conservation areas – describes the identification by FFWCC of areas that are particularly important to preserve in terms of wildlife conservation; and
- land held in public ownership – describes the land acreage currently acquired by public resource conservation agencies that provides important natural environmental functions in the watershed area.

Using the data described in the following sections of this chapter, a natural systems evaluation matrix was developed to provide a comparative tool for measuring the quality and quantity of existing natural habitats within the watershed. This tool can be used to evaluate the overall condition of the watershed so that future efforts to protect or restore natural systems can be prioritized and implemented effectively either as stand-alone projects or in conjunction with flood and/or water quality improvement activities. An overall score was calculated based on the sum of scores for each habitat parameter (Table 8-1). Using a scoring technique similar to the water quality level of service evaluation, the overall natural system evaluation matrix score was based on the ratio of the total watershed score divided by the maximum possible score. The watershed was then given a grade based on the following ratios: *1.0 to 0.8 = A, 0.79 to 0.6 = B, 0.59 to 0.4 = C, 0.39 to 0.20 = D, <0.2 = F*.

Based on criteria relating to conservation lands, intactness of riparian buffers, contiguity of natural habitats, amount of natural habitat remaining, and the identification of Strategic Habitat Conservation Areas, the Rocky/Brushy Creek watershed received a grade of D. No watershed in the Northwest Hillsborough County area scored an “A” or a “B,” indicating the overall degraded nature of natural systems in the area.

Table 8-1 Natural Systems Evaluation Matrix - Rocky/Brushy Creek Watershed

HABITAT PARAMETER	SCORE
Habitat fragmentation	0
Riparian buffer rating	2
Natural habitat remaining	1
Strategic Habitat Conservation Areas	1
Public ownership for conservation/restoration purposes	1
Overall score	D

The status of the natural systems in the Rocky/Brushy Creek watershed as a whole is described in this report section. Detailed descriptions of the conditions and an assessment of the natural systems are included in the following sections.

8.4 Historical and Existing Habitats

This section discusses, in broad terms, the historical (pre-1900) natural systems conditions in general terms based on information derived from the General Land Office Survey Notes. This description is presented as background for detailed discussion of the land use patterns and natural systems areal coverages existing in the 1950's and currently (2004). Information on the 1950's and 2004 land uses were obtained from SWFWMD. The following tables have collapsed the Level III FLUCFCS (2004) land use codes to Level I to enhance comparisons among the pre-1900, 1950's, and 2004 time periods. The figures illustrating land uses retain the Level III coding. The narratives following the tables provide details of the Level III land use cover types included in the Level I listings in the tables.

Historical (pre-1900) land uses and cover types – Prior to the permanent settlement of Hillsborough County in the first half of the 19th century, approximately 70% of the land in the Rocky Creek - Brushy Creek watershed was occupied by soils that supported two land cover types: pine flatwoods (FLUCFCS 411) and longleaf pine-xeric oak (FLUCFCS 412). The remainder of the land in the watershed was occupied by cypress swamps (FLUCFCS 621), stream and lake swamp (FLUCFCS 615), bay swamps (FLUCFCS 611), wetland forested mixed (FLUCFCS 630), lakes (FLUCFCS 520), freshwater marshes and wet prairies (FLUCFCS 641 and 643), saltwater marshes (FLUCFCS 642), tidal flats/submerged shallow platform (FLUCFCS 651, and Mangrove swamps (FLUCFCS 612). The swamps bordering the channels, the large areas of cypress swamp, and the saltwater marshes adjacent to the channel in the lower reaches of Rocky Creek were significant contiguous wetlands in the watershed. By 1910, Hillsborough was the most populous county in the state, and considerable development of roads and railroads had occurred. By 1916, in the Rocky Creek - Brushy Creek watershed, major roadways (Old Memorial Highway, Van Dyke Road, Lutz-Lake Fern Road, US 41) were hard surface facilities, and numerous secondary roads were in place. Over 200 homes and buildings had been constructed, and the Tampa and Gulf Coast Railroad had several lines through the watershed. Several small communities and villages (Stemper, Citrus Park, Tarpon Junction, Blockton, Lutz, Cosme) had grown up around roadway intersections and rail lines. By 1938, agriculture had become well established on the uplands (longleaf pine-xeric oak, pine flatwoods) in the central and northern regions of the watershed. Cattle, row crops, and citrus were the dominant commodities. By 1950, agriculture accounted for 19.5% of the lands in the watershed, while uplands were reduced to 51% of the watershed. By 2004, the percent coverage of the watershed by native uplands was further reduced to 5.4%.

Land uses and cover types from the 1950's - Table 8-2 provides a list and the acreages of land uses and cover types existing in 1950; each land use is compared to the total watershed area. Figure 8-1 illustrates the 1950 land uses and cover types in the Rocky/Brushy Creek watershed.

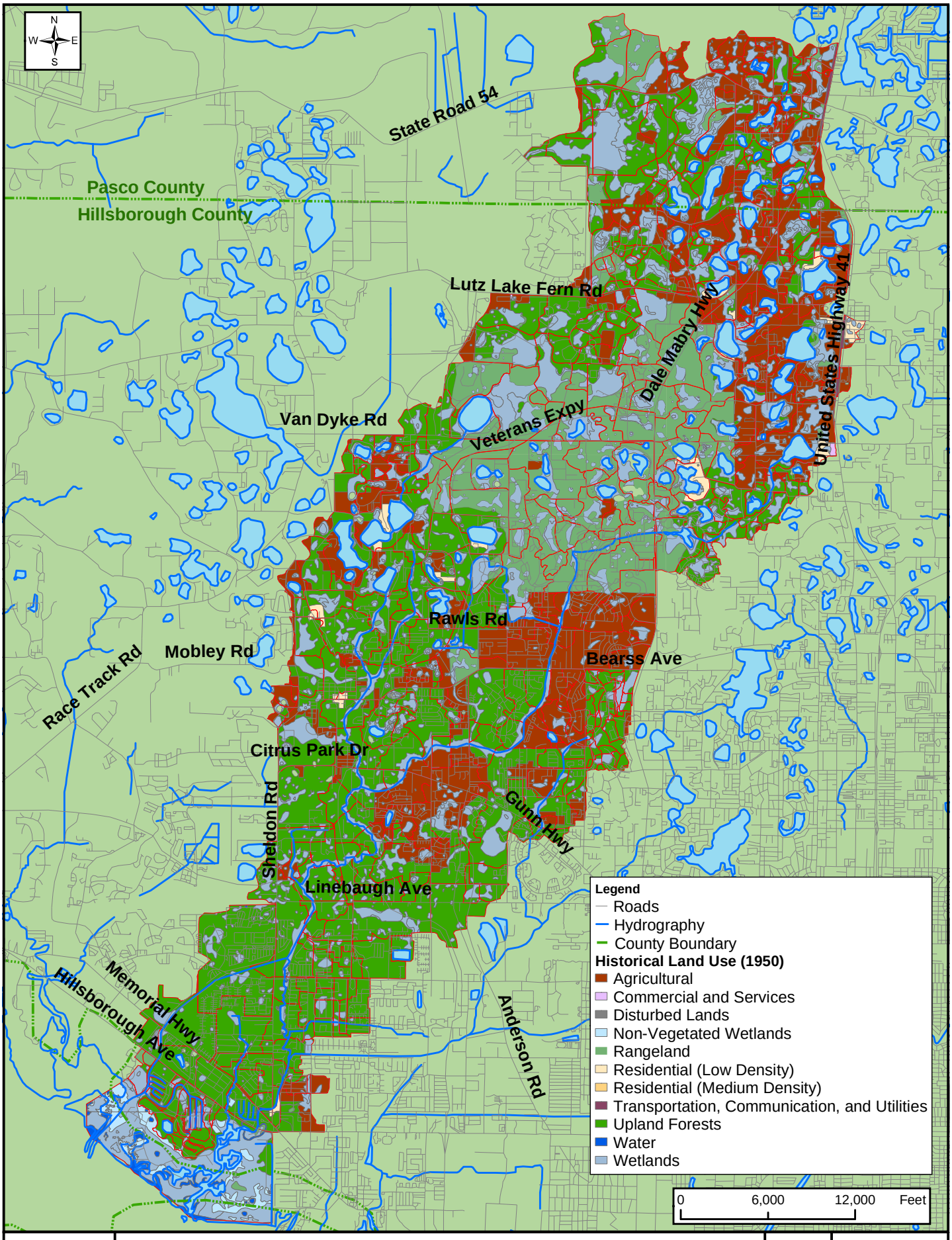
Table 8-2 Land Use in the Rocky/Brushy Creek Watershed, 1950

Land Use	Total Area (acres)	% of Watershed
Uplands	19,351	51
Herbaceous wetlands	2,063	5.4
Forested wetlands	7,149	18.7
Agriculture	7,443	19.5
Lakes	1,616	4.2
Low/Medium Density Residential	280	0.7
Commercial, Utilities, Transportation, Institutional	628	0.1
Total	38,530	100%

2004 land uses and cover types - Table 8-3 provides a list and the acreages of land uses and cover types existing in 2004; each land use is compared to the total watershed area. Figure 8-2 illustrates the 2004 land uses and cover types in the Rocky/Brushy Creek watershed.

Table 8-3 Land Use in the Rocky/Brushy Creek Watershed, 2004

Land Use	Total Area (acres)	% of Watershed
Uplands	2,060	5.4
Wetlands	7,728	20
Agricultural	3,350	8.7
Water	3,794	10
Open Land / Recreational	2,132	5.6
Low/Medium Density Residential	8,035	21
High Density Residential	7,819	21
Commercial, Utilities, Transportation, Institutional	3,209	8.4
Total	38,127	100%



Historical Land Use (1950s) in the Rocky/Brushy Creek Watershed

Figure 8-1

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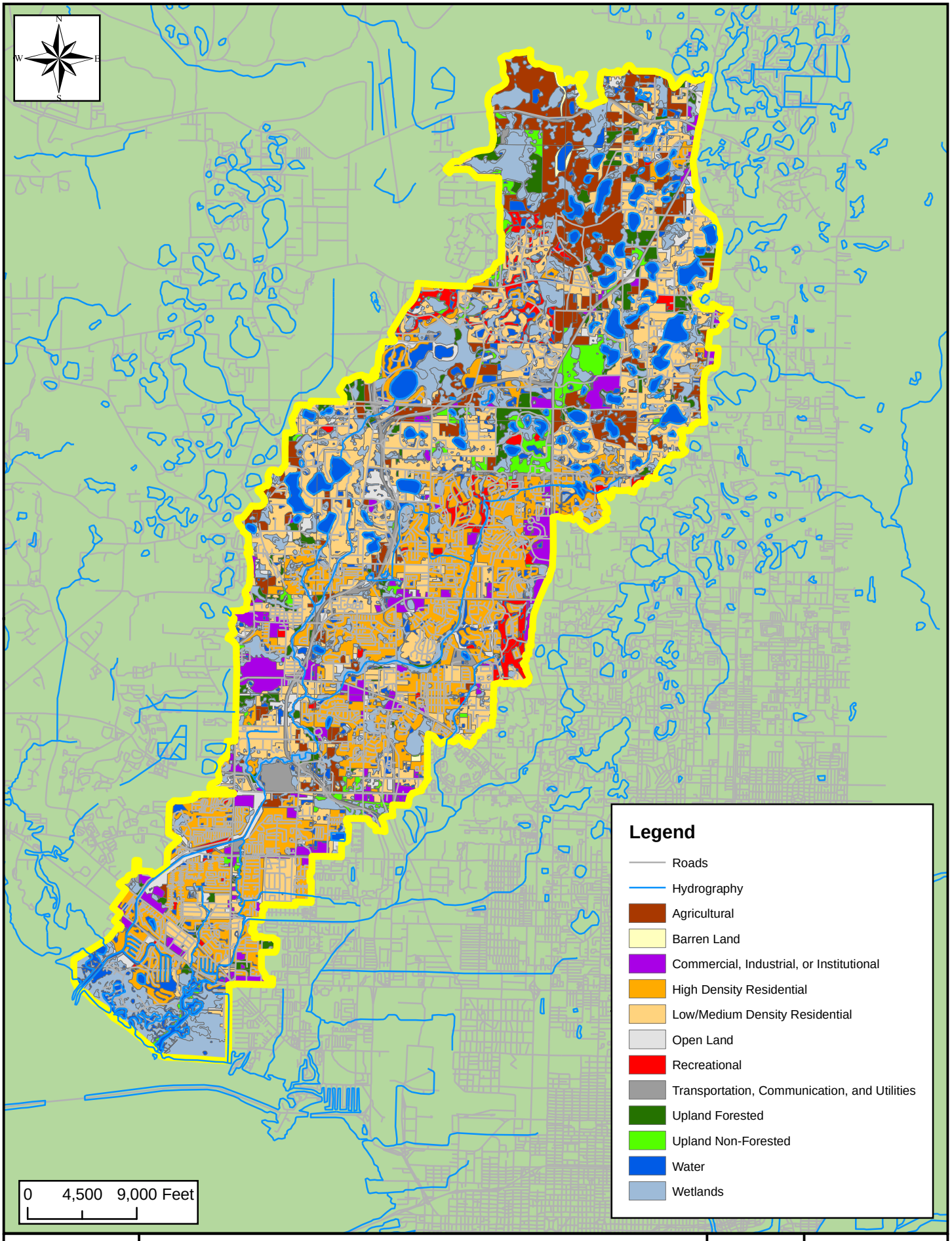

Land Use in the Rocky/Brushy Creek Watershed (2004)

Figure 8-2

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8.4.1 Upland Natural Systems

The following upland habitat descriptions are based on the information contained in Harper (1921), Carlisle et al. (1978), Florida Department of Transportation's FLUCFCS Manual (1999), and the Soil Surveys of Hillsborough County from 1916, 1958, and 1989. In the plant community descriptions below, only the species that are most characteristic of the plant community in the Rocky/Brushy Creek watershed are mentioned as being present; however, the natural plant communities that still remain in the watershed are highly diverse and contain many more species than are mentioned in this report. For ease of reading, only common names of plants are used in the report narrative, but Section 8.10 provides a list of all scientific names of plants and animals included in the report.

Pine flatwoods (411)

The most common upland plant community in the state and in the Rocky Creek - Brushy Creek watershed is the pine flatwoods community which is associated with Malabar fine sands and Immokalee fine sands. The primary canopy species common to pine flatwoods is slash pine with some longleaf pine, while the shrubby understory is dominated by saw palmetto with some gallberry, staggerbush, blueberry, and tarflower. Herbaceous ground cover is sparse and includes wiregrass, several species of bluestem, and goldenrod. This community occurs on flat, moderately to poorly drained terrain composed of acid sands overlying an organic/clayey hardpan. Even on better drained terrain, flatwoods can experience periods of inundation when rainfall amounts are in the normal to above normal range. On less well drained terrain, a wet phase of pine flatwoods occurs in which obligate to facultative-wet plant species can be found flatwoods regularly. These species include trees: sweetbay, gordonia, red maple; shrubs: wax myrtle, gallberry, fetterbush; and herbs: spikerush, redroot, bog buttons, pink sundews, and yellow-eyed grass. Pine flatwoods is a fire-maintained community that will transition to a hardwood-dominated community with very dense canopy dominated by live oak, laurel oak, and pignut hickory if fire is excluded. In the Rocky Creek - Brushy Creek watershed, pine flatwoods have been used for pasture, row crops, and (with drainage) some citrus. Pine flatwoods now occupies only 1% of the watershed.

Longleaf pine-xeric oak (412)

The longleaf pine - xeric oak plant community, also known as sandhill, is associated with Norfolk fine sands in the Rocky Creek - Brushy Creek watershed. Natural canopy vegetation is dominated by longleaf pine, and characteristically has a mid-canopy of bluejack oak, turkey oak, sand live oak. The understory contains a medium to low density shrub community consisting of shiny blueberry, Darrow's blueberry, gopher apple, Adam's needle, and beautyberry. Herbs compose the ground cover and include: wiregrass, sky-blue lupine, drumheads, Carolina elephant's foot, dwarf pawpaw, and eastern milk pea. This community also is a fire-maintained community that will transition to a hardwood-dominated community with few to no pines and a very dense canopy dominated by sand live oak, turkey oak, bluejack oak if fire is excluded. This plant community was largely replaced by citrus by 1950. Currently (2004), this community occupies 0.3% of the watershed.

Hardwood conifer mixed forest (434)
In a hardwood-conifer mixed forest, neither upland conifers nor hardwoods attain more than 66% dominance in the canopy. By definition, these areas typically occur on well-drained but non-droughty soils and are often the result of fire suppression in pine flatwoods. Mixed forests are often successional to upland hardwood forests. This community has the same species as the longleaf pine-xeric community (*FLUCFCS 412)* except that neither the pines nor the oaks dominate. The percent coverage of this community increased from 0.2% to 1.15% between 1950 and 2004, probably as a result of natural successional activity.

Shrub and brushland (320)

Shrub and brushland occurs on the same soils as pine flatwoods and longleaf pine-xeric oak communities. However, it is dominated by herbs and shrubs; few to no trees are present. Typical species include saw palmetto, gallberry, wax myrtle, species of bluestem, other woody scrub plant species, and various short herbs and grasses. It often develops following the clearing of pines for timber or on long-fallow cropland. This community occupied 13.3% of the watershed in 1950 and 2% by 2004. The decrease in areal cover of this community is likely related to the conversion of these lands to residential or commercial uses.

Mixed rangeland (330)
Mixed rangeland is defined by FLUCFCS as rangeland where there is more than 33% mixture of grassland and shrub-brushland range species exists. This community was not recognized in the land use mapping of 1950, but it occupies 0.14% of the watershed currently (2004).

8.4.2 Wetland/Aquatic Natural Systems

The following wetland habitat descriptions are based on the information contained in Carlisle et al. (1978), Florida Department of Transportation's FLUCFCS Manual (1999), and the Soil Surveys of Hillsborough County from 1916, 1958, and 1989. For information on lakes and Rocky Creek - Brushy Creek, SWFWMD's Directory of Lakes (SWFWMD, 2005) and the USF Hillsborough Watershed Atlas (http://www.hillsborough.wateratlas.usf.edu) were consulted. In the plant community descriptions below, only the species that are most characteristic of the plant community in the Rocky Creek - Brushy Creek watershed are mentioned as being present; however, the natural plant communities that still remain in the watershed are highly diverse and contain many more species than are mentioned in this report. For ease of reading, only common names of plants are used in the report narrative, but Section 8.10 provides a list of all scientific names of plants and animals included in the report.

Cypress swamp (621)

Cypress swamp is the most common wetland community in the watershed. Formerly (1950) occupying 10.3% of the land in the Rocky Creek - Brushy Creek watershed, the cypress swamp community currently (2004) covers 8.8% of the watershed. It is associated with several soils, including: Myakka fine sand, Basinger, Holopaw, Samsula depressional soils, that are located on the margins of most of the 38 lakes in the watershed. These natural systems are typically large basins characterized by peat substrates, seasonal to year-round inundation, still water, and occasional fire. They may be associated with the channel of the Creek or isolated during the dry season. The typical vegetation canopy species is pond cypress which is associated with swamp black gum, southern red maple, laurel oak, and dahoon holly. The understory is shrubby and is composed of fetterbush, Virginia willow, and buttonbush. The herbaceous understory includes a variety of ferns (royal fern, cinnamon fern, netted chain fern, Virginia chain fern, and toothed mid-sorus fern) associated with alligator flag, water hoarhound, false nettle. Endangered and threatened species such as butterfly orchid, Spanish moss, and ball moss occur occasionally in cypress swamps.

Bay Swamp (611)

Not recognized in the 1950 mapping, the bay swamp community currently (2004) covers 0.2% of the watershed. Canopy trees include loblolly bay, sweetbay, swamp bay, slash pine, and loblolly pine. Understory vegetation is typically dense and composed of gallberry, fetterbush, wax myrtle, and titi.

Stream and Lake swamp (615)

Formerly (1950) occupying 3.6% of the land in the Rocky Creek - Brushy Creek watershed, the stream and lake swamp community currently (2004) covers 2.03% of the watershed. The community is also referred to as bottomland hardwood forests and is associated with the stream channel. Canopy tree species include red maple, water oak, sweetgum, swamp black gum, pond cypress, and some tall Carolina willows. The subcanopy and understory in this community are typically of open aspect except in forests where the hydroperiod (depth and duration of inundation) has been reduced, which has allowed a tangle of shrub species to become established on the forest floor invade and close the understory. In such cases, shrubs such as fetterbush and buttonbush make the forest virtually impenetrable.

Mangrove swamps (612)

The areal coverage of this habitat has decreased from 1.6% of the watershed to 1.3% over the period 1950-2004. Remaining habitat exists in the estuary of the Creek where considerable disturbance from transportation facilities, trash disposal, invasion by Brazilian pepper, and untreated stormwater runoff has occurred. This land cover type is especially important in that it provides cover and foraging habitat for invertebrates and fish, roosting and nesting habitat for birds, and shoreline protection.

Wetland coniferous forest (620)

In the Rocky Creek - Brushy Creek watershed, the wetland coniferous forest is a wetland forest dominated by pond cypress but which has other coniferous species (slash pine, bald cypress, red cedar) as common associates. The wetland coniferous forest formerly (1950) covered 0.1% of the land in the Rocky Creek - Brushy Creek watershed, and currently (2004), it covers 0.16% of the watershed.

Wetland Forested Mixed (630)

Wetland forested mixed is a wetland forest where neither hardwoods nor conifers achieve a 66% dominance of the crown canopy composition. Formerly (1950) occupying 3.1% of the land in the Rocky Creek - Brushy Creek watershed, the stream and lake swamp community currently (2004) covers 3% of the watershed. Species common to this community are those described Stream and Lake Swamp community (FLUCFCS 615).

Freshwater marsh (641)

The areal coverage of freshwater marsh in the Rocky Creek - Brushy Creek watershed remained the same over the period 1950 – 2004. In 1950, this land cover type represented 2.5% of the watershed, while it occupied 2.47% of the watershed in 2004. This habitat is typically characterized by large basins with peat substrates, seasonal to year-round inundation, and infrequent fire. Freshwater marshes usually occur as open expanses of grasses, sedges, rushes, and other herbaceous species in soils that are usually saturated or covered with surface water for two or more months during the year (Brown et al., 1990). Freshwater marsh is highly diverse and marshes may differ significantly from one another even though located in

geographic proximity. In The Rocky Creek - Brushy Creek watershed, typical species include: sawgrass, cattail, arrowhead, maidencane, buttonbush, cordgrass, soft rush, and fire flag. The species composition of freshwater marsh habitat often occurs in zones and is dependent upon soil type, hydroperiod, water depth, and successional stage (Wolfe and Drew, 1990).

Saltwater marsh (642)

The areal coverage of this habitat has remained stable at about 1.1% of the watershed over the period 1950-2004. This land cover type is particularly valuable as habitat for invertebrates and juvenile fish and as a protective barrier from storm surges. In Rocky Creek - Brushy Creek watershed, saltwater marshes exist in the Creek's estuary where by far the most common plant species is black needle rush; some cordgrass is also present. Significant habitat for juvenile fish and invertebrates of commercial importance, the saltwater marsh in the Rocky Creek - Brushy Creek estuary has been impacted by transportation facilities and untreated stormwater runoff.

Wet prairies (643)

Formerly (1950) occupying 0.9% of the land in the Rocky Creek - Brushy Creek watershed, the wet prairie community currently (2004) covers 0.6% of the watershed. Wet prairies are usually open, mixed grass-sedge associations, which occur in areas of periodic flooding and are distinguished from marshes as having shorter herbaceous species and longer, drier hydroperiods (Wolfe and Drew, 1990). Like freshwater marshes, wet prairies support a diversity of species, and each system may be different from a neighboring system. Important species in the Rocky Creek - Brushy Creek watershed wet prairie systems include: spike rushes, beak rushes, St. John's wort, yellow-eyed grass, whitetop sedge, pink sundew, early whitetop fleabane, and meadow beauty.

Emergent aquatic vegetation (644)

The areal coverage of emergent aquatic vegetation in the Rocky Creek - Brushy Creek watershed increased from 0.1% to 0.4% of the watershed over the period 1950 – 2004. Typically, this habitat is associated with the deepwater portions of freshwater marshes and includes species such as water lettuce, spatterdock, water hyacinth, duckweed, and water lilies.

Tidal flats/submerged shallow platform (651)

This habitat type occupies the lower reaches of Rocky Creek - Brushy Creek. It represents a challenging, but biologically productive area that is important as habitat for animals that are critical links in the estuarine food webs. Vegetation occurring here is very sparse, and the area may

consist solely of mud into which animals burrow. The areal coverage of this habitat has remained stable at about 0.7% of the watershed.

Streams and waterways (510)

While Rocky Creek - Brushy Creek is a major landscape feature and the only linear waterway in the watershed, it is not identified in either the 1950 land use mapping due to its channel and flow characteristics. The 2004 mapping recognizes this community as occupying 0.2% of the watershed. The channel of Brushy Creek is narrow along its entire length, while that of Rocky Creek is narrow in its upper reaches but widens as the Creek approaches the bay. A segment of Rocky Creek was channelized and a diversion canal, Channel A, was constructed off of Rocky Creek east of Sheldon Road. Channel A empties into the bay west of the original channel of Rocky Creek. The increase in Streams and Waterways in the 2004 mapping to 0.2% reflects the construction of Channel A. The plant community supported on the Creek banks in its upper reaches is included under the Stream and Lake Swamp community description (FLUCFCS 615); in the lower reaches, the land cover types include tidal flats/submerged shallow platform (FLUCFCS 651). Saltwater marshes (FLUCFCS 642) occupy the channel banks in these areas. However, the Creek itself should be recognized for its habitat and habitat support functions. Although flow is not continuous along the entire Creek channel all year, the Creek does support plant species valuable for water quality and wildlife food and habitat purposes.

Lakes (520)/Reservoirs (530)

Lakes are defined by FLUCFCS as inland water bodies excluding reservoirs. In the Rocky Creek - Brushy Creek watershed, lakes are water bodies ranging in surface area from less than 12 acres to 52 acres. The larger lakes in the watershed are: Fairy (52 ac), Hixon (21 ac), and Glass Lake (18 ac). These water features are permanently inundated, although water elevations rise and fall as a result of rainfall. Most lakes have undergone some degree of development on bordering lands; however, some cypress swamp and wetland coniferous forests remain on lake margins. The lakes also support in-lake plant communities that are valuable in terms of fish production and water quality functions. Plant communities include emergent aquatic species along the shallow lake margins and rooted submerged aquatic species in the deeper zones of the lakes. The areal coverage of lakes in the watershed has increased from 1.1% in 1960 to 4.4% in 2004.

Reservoirs are artificial impoundments of water. Not recognized in the land use mapping of 1950, this community type occupies (2004) 4% of the watershed. These water features have been constructed in association with agricultural and residential development in the watershed; residential reservoirs are managed to provide aesthetic or stormwater management functions.

8.4.3 Urban Altered Land Use

The following land use descriptions are based on the 2004 land use map of the Rocky Creek - Brushy Creek watershed, the corresponding descriptions FLUCFCS, and staff knowledge of the area.

Residential [Low (110), Medium (120), High (130)], Density

Residential land uses occupied less than 1% in 1916 and less than 1% of the watershed in 1950. By 2004, they accounted for 41% of the watershed, reflecting much more rapid growth in the last half of the 20th century. In 2004, 7.8% is in low density uses (< 2 units/acre), while 13% is occupied by medium density uses (2-5 units/acre). A total of 20.5% of the residential use is in high density use (>5 units/acre). The majority of the residential development has occurred in the lower reaches of the watershed and at major crossroads where native upland habitat has been replaced by dwelling units.

Commercial and Services (140)

Commercial areas and services is a land use that is predominantly associated with the distribution of products and services. This category is composed of a large number of individual types of commercial land use, which often occur in complex combinations. This category often includes a main building and the integral areas that support the main structure. In the 1950 mapping, commercial land uses occupied 0.1% of the watershed, while 3% of the watershed currently (2004) is devoted to commercial activities. Land uses present in the watershed that fall into the Commercial areas and Services category include: service stations and convenience stores, retail facilities, restaurants, manufacturing facilities, and boat and auto repair shops.

Institutional (170)

In the Rocky Creek - Brushy Creek watershed, Institutional land uses include schools, churches, and small office facilities. At least three churches and a school were present in the early 1900's, but the category was absent from the 1950 land use mapping. Currently (2004), this category occupies 1.4% of the watershed.

Recreational (180)

Recreational land uses were absent in the1950 land use mapping but were reported as occupying 0.8% of the watershed in 2004 which represent community recreational facilities, historic sites, and area parks, including Lake Park south of Van Dyke Road and west of Dale Mabry Highway.

Open land (190)

Open Land includes undeveloped land within urban areas and inactive land with street patterns but without structures. Open land normally does not have any structures or any indication of intended

use. Urban inactive land is often in a transitional state and will eventually be developed into one of the typical urban land uses. Absent in 1950, open land increased in areal coverage slightly to 3%.

Cropland and Pastureland (210)
Formerly occupying 12.4% of the watershed in 1950, this land use category has decreased to 6.1% of the watershed in 2004. Included here are chiefly pastures with some vegetable and small fruit crops.

Tree Crops (220)
In the Rocky Creek - Brushy Creek watershed, this category includes citrus groves which are located chiefly in the central region of the watershed. Citrus production was well established by 1938 and occupied 6.9% in 1950; it decreased to 0.9% of the watershed by 2004 as lands were converted from citrus to residential and commercial uses.

Nurseries and Vineyards (240)
This category, composed of nurseries, was absent in the 1950 land use mapping but now occupies 0.4% of the watershed and is represented facilities supplying plants for residential landscaping.

Specialty Farms (250)
Specialty farms currently occupy 0.4% of the watershed and include kennels.

Other Open Lands (260)
Other open lands are agricultural land with a use that cannot be determined from available imagery. In 1950, 0.1% of the watershed fell into this category. By 2004, this category occupied 0.9% of the watershed and represents lands that are resting between crops.

Disturbed Land (740)
Representing 0.2% of the watershed, disturbed lands are areas that have been changed primarily due to human activities other than mining and include rural lands in transition to residential land uses, and temporary spoil sites.

Transportation (810)
In the Rocky Creek - Brushy Creek watershed, railroads and paved roadways have occupied the watershed since the late 1890's and early 1900's. This land cover type increased from 0.1% of the watershed in 1950 to 2.7% in 2004 as early facilities were expanded and new facilities were constructed.

Communications (820)
In the Rocky Creek - Brushy Creek watershed, this category includes microwave towers. It was absent in the 1950 mapping, and it occupied 0.07% of the watershed in 2004.

Utilities (830)
In the Rocky Creek - Brushy Creek watershed, this category includes: water treatment and transmission facilities, and electrical transmission facilities. It was absent in the 1950 mapping, and it occupied 0.9% of the watershed in 2004. Utilities have existed in the watershed since the 1920's.

8.4.4 Natural Systems Trends

This section identifies the historical and remaining upland, wetland, and aquatic natural systems in the Rocky/Brushy Creek watershed and summarizes the relative loss of natural habitat between 1950 and 2004 land cover. Existing land use classifications other than natural systems, such as reservoirs and developed and altered lands, were not included in the habitat loss analysis. Historical and existing land use types were consolidated into general habitats of uplands and wetlands for the purpose of estimating percent habitat loss. An exact analysis of "type for type" habitat loss is not possible due to differences in the classification of vegetation communities, as well as inaccuracies inherent in the historical land use data.

Table 8-4 demonstrates the historical and existing upland and wetland acreage, the relative habitat loss of each based on the total available area of the natural systems.

Historical and Existing Land Cover Changes
The areal coverage of native uplands in the Rocky/Brushy Creek watershed in the pre-development period as estimated from the 1916 Soil Survey of Hillsborough County was approximately 26,740 acres. The areal coverage of uplands in the Rocky/Brushy Creek watershed in 1950 is estimated at 19,351 acres, and existing uplands are estimated at 2,060 acres.

The difference between these periods represents a 90% net loss as native upland communities were converted to agricultural and urban land uses and supporting infrastructure. The most attractive areas for citrus production were lands occupied by the longleaf pine-xeric oak community, while pine flatwoods were the primary upland community displaced for pasture cultivation and cattle production. Residential development and transportation facilities also are preferentially located on lands supporting these two plant communities. Remaining upland communities have been degraded by land use practices on adjacent agricultural and urban lands and/or by encroachment on the margins of uplands. Most uplands now are remnants of a once larger habitat.

The areal coverage of historical wetlands was estimated at 11,065 acres, and the coverage by wetlands today (2004) is approximately 7,728 acres, which represents a net loss of native wetlands of 30% between the 1950 and 2004. Remaining wetlands have been degraded by physical disturbances associated with agricultural practices, the construction of transportation facilities, and residential development. Wetlands located within citrus groves generally have been rim-ditched to

enhance drainage for rows of trees adjacent to the wetland. In the case of wetlands located in pastures, pasture grass is planted and cattle graze up to and through the wetland itself. Consequently, wetlands have no protective buffer zones; they are invaded by pasture grass species and other non-wetland plants; and they are the receiving waters for stormwater and irrigation runoff containing pesticides and fertilizers. Many wetlands are remnants of once larger habitats.

Native uplands and wetlands have been replaced by urban land uses (residential + commercial) and by agricultural land uses (Figures 8-3 and 8-4).

Table 8-4 Change of Uplands and Wetlands in the Rocky/Brushy Creek Watershed

	Acres in 1950	Acres in 2004	Acre Reduction	% Reduction
Uplands	19,351	2,060	17,291	90%
Wetlands	11,065	7,728	3,337	30%

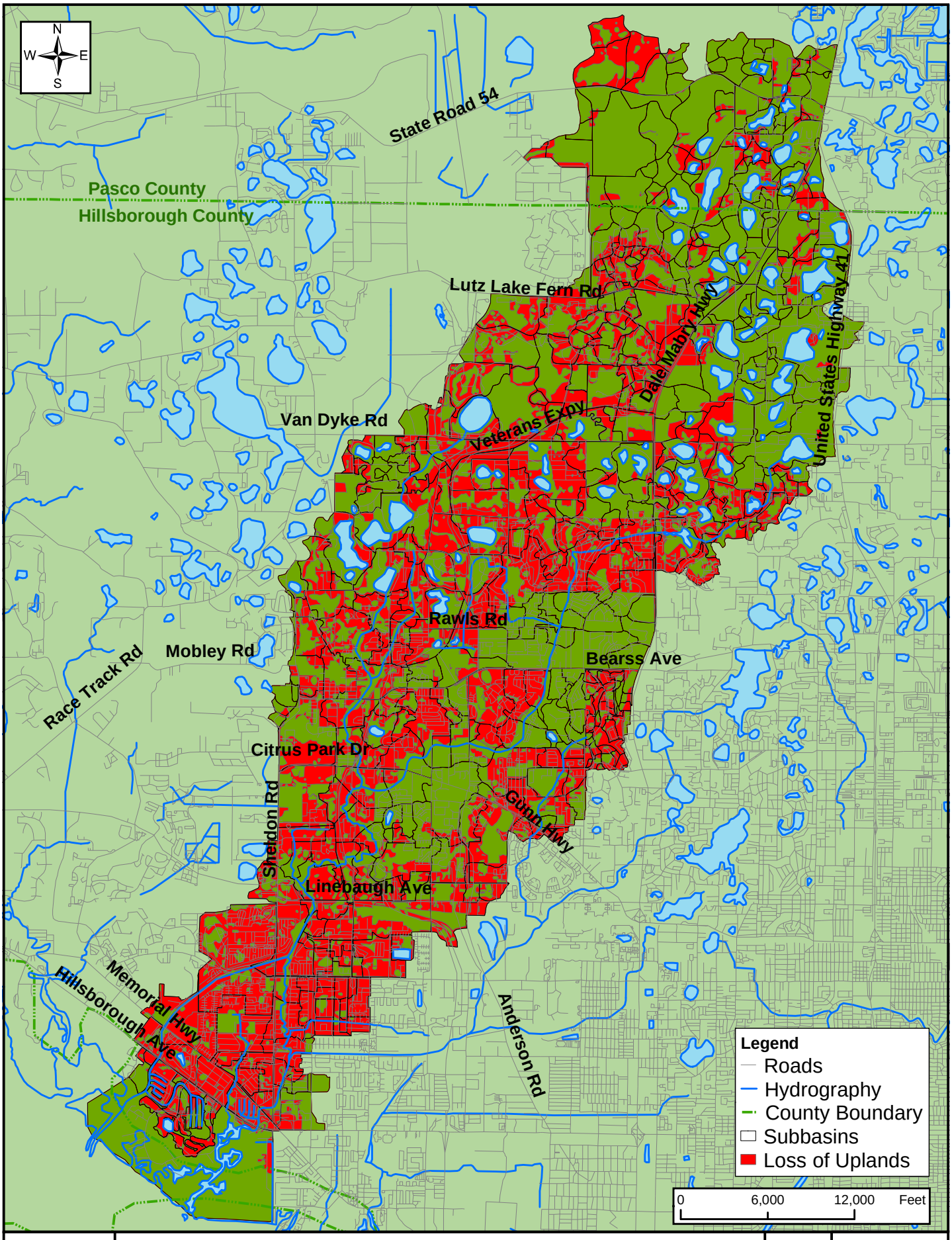
8.4.5 Prioritization of Restorable Habitat Types

Uplands

Based on the ecological value and rarity within the watershed currently, Longleaf pine-Xeric oak (FLUCFCS 412) was identified as a priority upland habitat for re-establishment.

Wetlands

Based on their ecological value, Stream and Lake Swamp (FLUCFCS 615), Cypress (FLUCFCS 621), Mangrove Swamp (FLUCFCS 612), and Saltwater Marsh (FLUCFCS 642) were identified as high priority for restoration.



Loss of Uplands in the Rocky/Brushy Creek Watershed

Figure 8-3

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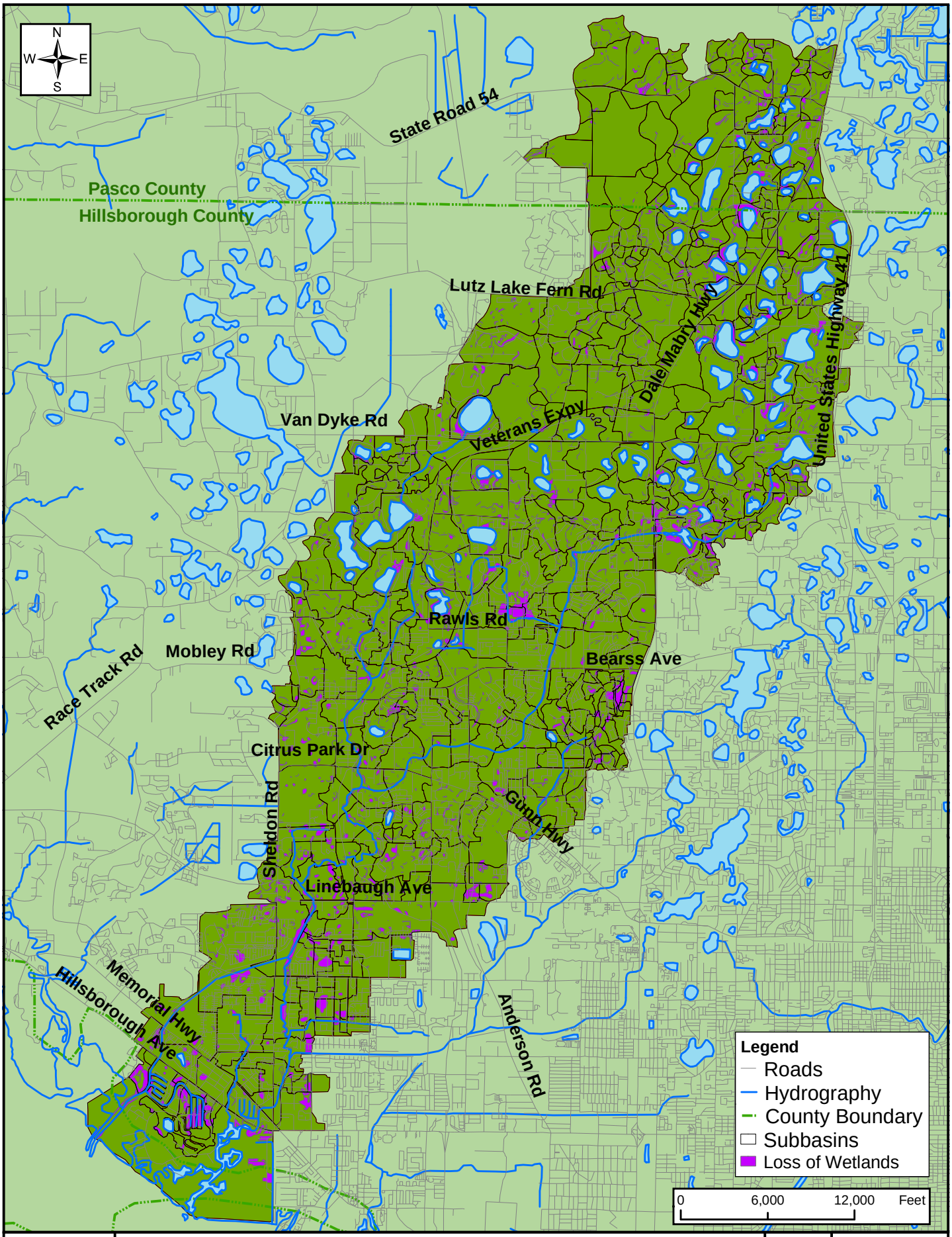

Loss of Wetlands in the Rocky/Brushy Creek Watershed

Figure 8-4

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8.5 Natural Systems Issues and Areas of Concern

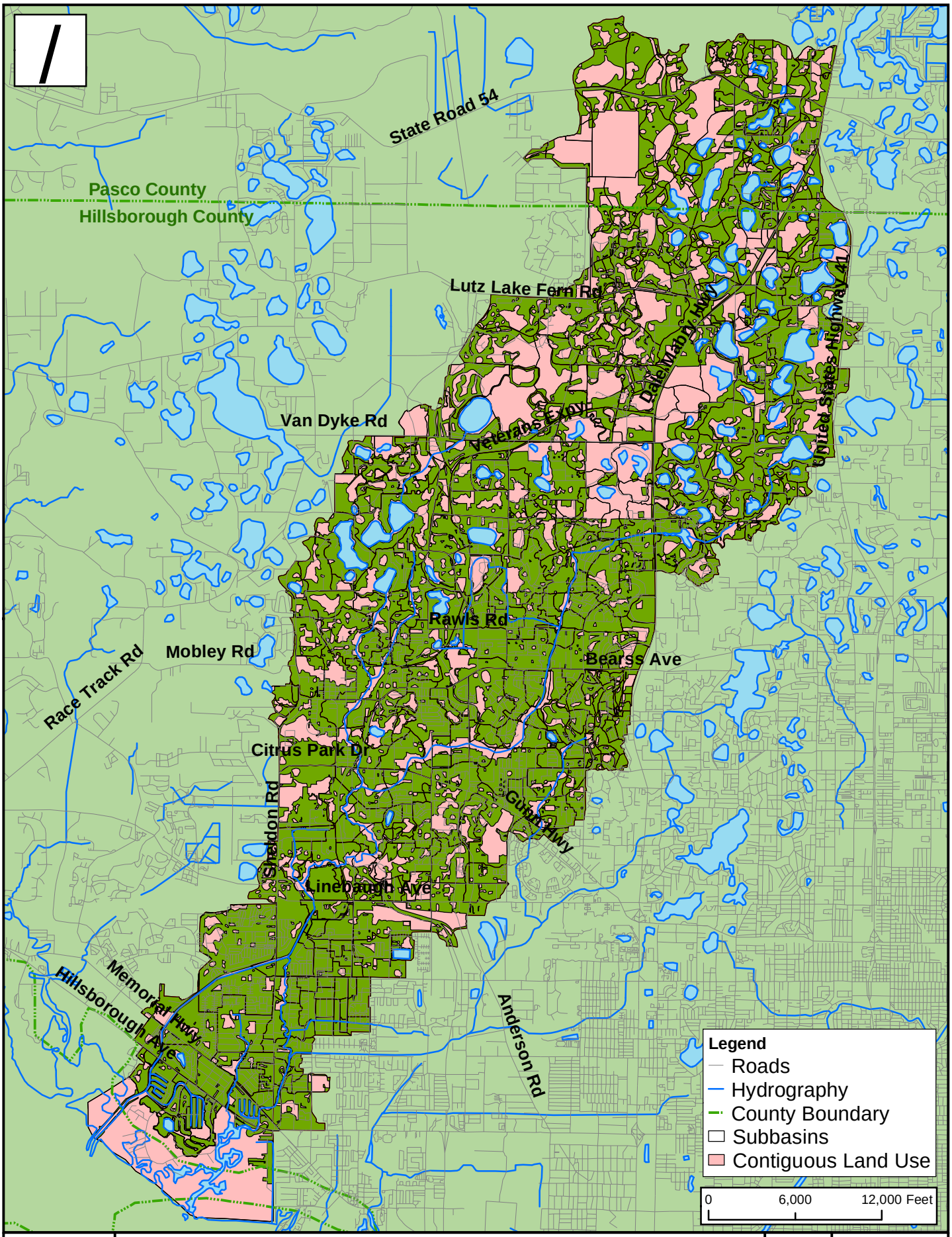
8.5.1 Habitat Loss, Degradation, and Fragmentation

As described above, the Rocky/Brushy Creek watershed was once composed of a variety of upland and wetland habitats. Within the last century, many large tracts have been converted from natural land features to agricultural uses, predominantly in the northeastern and southern portions of the watershed. Based on 2004 SWFWMD land use data, approximately 64% of the watershed has been altered by human activities with approximately 8.7% of the watershed impacted by agricultural activities and approximately 46% developed for urban, suburban, commercial, industrial, and mining uses. Lands in a near-natural condition (uplands, wetlands) comprise an estimated 36% of the watershed, although most native habitats are disturbed and degraded to some degree by agricultural practices, urban development, or water production activities in the watershed.

Despite these alterations and impacts to natural systems, some large tracts containing freshwater wetlands, hardwood swamp, and saltwater marsh remain undeveloped in the watershed. Protection is provided by means of regulatory programs of SWFWMD and EPC and by the acquisition of 2,416 acres (6% of the watershed) critical to preservation and restoration.

Habitat Fragmentation

Habitat fragmentation is defined as the break-up of a continuous landscape containing large patches into smaller, numerous, less connected patches. To measure habitat fragmentation within the watershed, ArcView was used to join contiguous natural habitat polygons from SWFWMD's 2004 land use layer. The polygons with FLUCFCS code of 3000, 4000, 5000, 6000, and 7000 (natural systems designations) were dissolved to form contiguous polygons throughout each watershed. The areas of these contiguous polygons were then calculated and compared to the overall area of a given watershed. If one or more contiguous polygons represented a significant proportion of a watershed (i.e., greater than 75%), the watershed was categorized as having relatively little fragmentation. Alternately, if a watershed was comprised of several small contiguous natural systems polygons and few large contiguous polygons, then the area was categorized as being highly fragmented. Large numbers of small polygons represent a high level of fragmentation, while small numbers of large polygons represent a low level of fragmentation (Table 8-5).



Contiguous Land Use in the Rocky/Brushy Creek Watershed

Figure 8-5

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The watershed has a total of 1264 contiguous natural areas, none of which represent more than 25% of the watershed. Therefore, the degree of habitat fragmentation in the watershed can be described as high and a score of 0 assigned (Table 8-5).

Table 8-5 Distribution of Contiguous Natural Systems Polygons within the Rocky/Brushy Creek Watershed

	Contiguous Natural Polygons			
Score = 0	<25 %	=>25% but <50%	=>50% but <75%	=>75%
Degree of fragmentation	High	Moderate	Low	Very Low
Number of polygons	1264	0	0	0

8.5.2 Wildlife Corridors

Wildlife corridors are naturally existing or restored native linear landscape features connecting two or more larger tracts of habitat functioning as a dispersal route for native flora and fauna, and for the occurrence of the natural ecological processes such as fire (Harris, 1991). With the continuing need for land development to support an increasing human population, wildlife habitats are cleared and destroyed to meet human needs. In the Rocky/Brushy Creek watershed where urbanization, agriculture, and deforestation have fragmented natural habitats, there is a need to reserve natural pathways for the movement and migration for wildlife to prevent inbreeding or overexploitation of prey. The Hillsborough County Comprehensive Plan defines wildlife corridors as “contiguous stands of Significant Wildlife Habitat which facilitate the natural migratory patterns, as well as other habitat requirements (e.g., breeding, feeding) of wildlife.” The need for and use of wildlife corridors became apparent as early as the 1930s (Edmisten, 1963) and corridors have been used widely ever since for the benefit of game species (McElfres, et al. 1980) as well as non-game animals (Maher, 1990).

Regulatory Component

Wildlife corridors are one of the many avenues that support the Biodiversity Treaty proposed by the United Nations and signed by President Clinton, but not ratified by the United States Congress. In 1992, the United Nations published the Global Diversity Assessment for the purpose of implementing the Global Biodiversity Treaty and Agenda 21. Section 10.4.2.1.2 of the Global Biodiversity Assessment sets forth the criteria for protected areas stating that, “Representative areas of all major ecosystems in a region need be reserved, blocks should be as large as possible,

buffer zones should be established around core areas, and corridors should connect these areas." These core areas and buffer zones would then be connected by wildlife corridors, in accordance with the Wildlands Project. The goal is to allow animals to travel from one core habitat to another through wildlife corridors without anthropogenic obstruction or interference. The remaining areas will be utilized for human habitats conforming to the principles of sustainable development as supported by Executive Order 94-54 that created the Governor's Commission for a Sustainable Florida and Section 163.3244 F.S. (Sustainable Community Demonstration Project). Establishment of wildlife corridors is consistent with the Hillsborough Comprehensive Plan (CARE Policy 14.2) and the Hillsborough County Land Development Code.

Wildlife Corridors in the Rocky/Brushy Creek Watershed

As discussed in the previous section, significant habitat fragmentation has occurred throughout the watershed. Nevertheless, wildlife refuge and corridors remain at several locations: on public lands (Lake Park, the Bower Tract, and Rocky Creek Preserve; along reaches of Rocky Creek between the Channel A cutoff and Sheldon Road (except the Waters Avenue crossing); along the reach of Brushy Creek between Ehrlich Road and Gunn Highway; and the wetlands northeast of Lake Carlton (Turkey Ford Lake) and Avignon Avenue. There are opportunities to improve and expand these few remaining corridors and refuges by modifying channel crossings at major roadways to be more wildlife friendly.

The identification and protection of remaining wildlife corridors is essential to restoring natural areas in this watershed. The Rocky/Brushy Creek watershed has areas of development where wildlife corridors and greenways have been identified through the Hillsborough Comprehensive Plan, Land Development Code, and Hillsborough Greenways Task Force as supported by the Hillsborough County Natural Resources Regulation. Approximately 35% (13,581 acres) of the watershed remains undeveloped, although even the undeveloped uplands and wetlands have been disturbed and encroached upon, diminishing their ecological value.

Conservation Development

Conservation development is a concept proposed for urban watersheds that focuses on residential development designs that utilize conservation strategies such as inter-connected networks of permanent open space. The method allows residential developments that maximize open space conservation without reducing overall building density. The same method could be applied to commercial and industrial developments. The Conservation Development concept is consistent with Hillsborough County Natural Resources Regulation, serving as an avenue to identify areas that may serve as wildlife corridors and/or areas that should be protected and preserved as core habitats or environmentally sensitive lands. Basically, development with wildlife preservation considered within the overall site plan will allow for innovative and creative land use and design for new urban communities. Additionally, the FWC is committed to working with land use planners, developers, and homeowners to assist them with development designs that offer homes for both humans and wildlife. Clustering, designing corridor trails away from critical wildlife areas, and designing wildlife crossings all contribute to increased wildlife habitat. Throughout Florida, several innovative and creative wildlife crossings have been constructed. For example, the FDOT has

constructed numerous underpasses for black bears, Pinellas County has constructed fish bridges allowing fish migration through weirs, and the City of Clearwater has constructed a wildlife bridge across a fast flowing channel, allowing small mammals to cross.

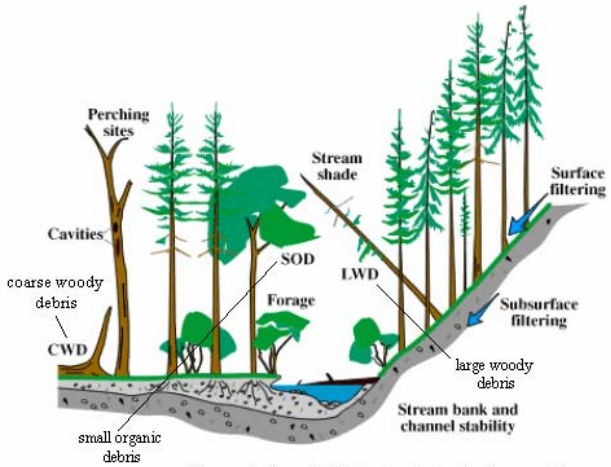
Criteria for significant wildlife habitat minimum widths and sizes are contained in Appendix B of the Hillsborough County Natural Resources Regulation. Existing studies have established a definitive link between habitat area size and species diversity (Miller and Schaeffer, 1998). The Hillsborough County Natural Resources Regulation sets a 75-acre minimum based on wildlife research review that concluded that species diversity rapidly declines below 60 acres, while another study determined 50 to 74 acres as the optimum minimum habitat. Although wildlife corridors do not have to follow these criteria for size and width, reserving 75 acres or more of significant wildlife habitat should be taken into consideration as core habitat or as the basis for a wildlife corridor.

Although wildlife corridors can help conserve habitat dependent species affected by encroaching urbanization, it is important to consider that the total amount of available habitat is the critical factor and that no amount of corridors connecting isolated habitat areas will replace extensive loss of habitat. Wildlife corridors allow for the linkage and preservation of isolated wildlife habitats in the competition for space with humans.

8.5.3 Identification of Existing Riparian Buffer Areas

Measures of ecosystem health can play an important role in the linkage between land use practices, ecological integrity, and water quality. The loss of natural riparian vegetation due to agriculture and development impair the functional role of riparian buffers, strongly influencing the diversity and productivity of both the aquatic and terrestrial biota, and the physical stability of the streambank and channel. A critical component of the riverine ecosystem, riparian buffers function ecologically to:

- regulate sediment storage and transport, stream flow characteristics;
- maintain bank and channel stability by provision of solid root mass and ground cover, regulate stream temperature;
- regulate instream biological production by determining the inputs of small organic debris (SOD);
- buffer streams from fine sediments;
- provide wildlife habitat features, including coarse woody debris (CWD), large woody debris (LWD), and nest and perch sites; and
- provide summer and winter forage for terrestrial fauna.



Source: Province of BC Watershed Restoration Program; BC Ministry of Environment, Lands and Parks

Factors such as the width of riparian (streamside vegetation) zones and the abundance and diversity of plant and macroinvertebrate communities can serve as biological indicators of environmental stress and water quality. Table 8-6 summarizes a rating system that was used in this plan to evaluate existing environmental conditions within the Rocky/Brushy Creek watershed. This rating scheme was used to assess the existing riparian habitats within each of the subwatersheds within the Rocky/Brushy Creek watershed. Unfortunately, detailed macroinvertebrate or water quality data were not available for the watershed, and the analyses were restricted to the vegetation component of this rating system (riparian buffer widths and percent of riparian buffer as developed land use).

A number of agencies throughout the U.S. have developed stream buffer protection ordinances (Baltimore County, Rhode Island Coastal Resources Management Council, City of Napa – California, Portland Metro). More detailed buffer zone analyses have been performed in Florida, specifically in the Wekiva River basin and the east central Florida region (Brown et al., 1987; Brown and Schaefer, 1990). The purpose of the Florida studies were to develop methodologies for determining buffer zone widths for regionally significant wetland systems that could then be used for the purposes of establishing minimum criteria for future land use planning. The buffer zone widths developed by Brown et al. (1987) are similar to those used in this riparian buffer rating system described above with minimum buffer widths ranging from 24m to 98m (Table 8-7).

Table 8-6 Rating of Stream Water Quality and Health based on existing vegetation and development activities within a watershed
(modified from Office of the Commissioner for the Environment, Victoria, Australia, 1988)

Rating	Vegetation
Excellent	Streamside vegetation intact for minimum 100m width from the bank, with continuous cover essentially unmodified and with few exotic plants. Watershed vegetation substantially uncleared. Less than 10% of watershed developed.
Good	Existing streamside vegetation communities intact, with cover essentially unmodified for, at a minimum, 30m width for over 80% of each stream segment. Infrequent exotics. Largely undisturbed by roadways. Limited permanent clearing of watershed vegetation.
Fair	Existing streamside vegetation communities predominantly intact and exotics infrequent. Riparian zone intact for 30m width, at minimum, for over 60% of watershed.
Poor	Existing streamside vegetation largely fragmented and exotics frequent. Riparian zone of 30m width intact for less than 60% of watershed, and frequently disturbed by roadways/development. Watershed largely cleared of native vegetation.
Degraded	Little remnant streamside vegetation. Surviving patches fragmented. Exotics frequent. Riparian zone of 30m width intact for less then 25% of watershed, and frequently disturbed by roadways & development. Watershed substantially cleared of native vegetation.

Table 8-7 Recommended Buffer Widths (in meters) for protection of water quality and quantity and wetland-dependent wildlife habitat (from Brown and Schaefer, 1987)

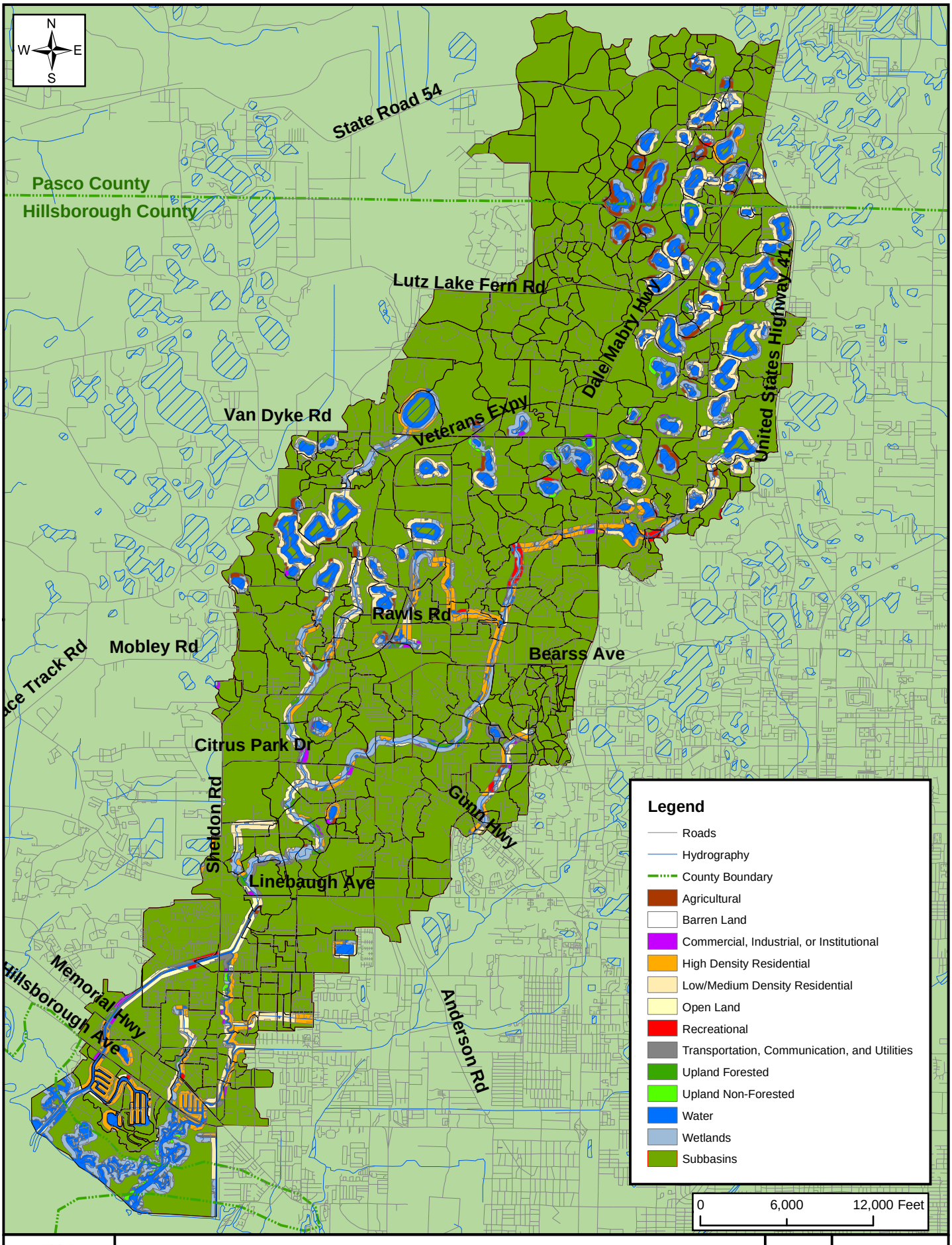
	Protect Water Quantity *Minimize Groundwater Drawdown*		Protect Water Quality *Control Sedimentation*		Protect Wildlife Habitat	
Landscape Association (Habitat Type)	Min.	Max.	Min.	Max.	Min.	Max.
Flatwoods/isolated wetlands	30	168	23	114	98	168
Flatwoods/flowing-water wetlands	30	168	23	114	98	168
Flatwoods/hammocks/hardwood swamps	15	76	23	114	N/A	168
Sandhills/wetlands	6	76	23	114	98	223
Flatwoods/salt marshes	30	168	23	114	98	N/A
Coastal hammocks/salt marshes	30	168	23	114	98	N/A
AVERAGE	***24***	***137***	***23***	***114***	***98***	***182***

To calculate riparian zone widths and percentages of riparian zones that have been converted to development in the Rocky/Brushy Creek watershed area, the ArcView buffer extension was used. First, 30m and 100m buffer zones were created around the stream network coverage that was created during the hydrologic analysis. From this coverage, the 2004 land use data were clipped for each of the buffer zones and evaluated to determine percent of natural land cover within each clipped area to develop a rating score (Figures 8-6 to 8-7). These scores were then converted to numerical values and used in a natural systems evaluation matrix.

Within the 100 m buffer encompassing 7923 acres, 46% (3,660 acres) of the land has been developed for agricultural, commercial, or residential purposes, leaving 54% of the buffer area in native habitats. Within the 30 m buffer (2640 acres), 28% (742 acres) of the land has been developed for agricultural, commercial, or residential purposes, leaving 72% of the buffer area in native habitats. It should be noted that much of the remaining native habitats have undergone disturbance and encroachment, reducing their ecological value. Based on the riparian zone analyses, rating scores were developed for the Rocky/Brushy Creek watershed (Table 8-8). The score for the watershed was 2, giving the watershed a “fair” rating.

Table 8-8 Riparian Buffer Measures within the Rocky/Brushy Creek Watershed

		Excellent	Good	Fair	Poor	Degraded
Score	*Vegetation Intact within 100m buffer?*	*<10% watershed developed*	*30m buffer intact for >80% of stream*	*30m buffer intact for >60% of stream*	*30m buffer intact for <60% of stream*	*30m buffer intact for <25% of stream*
Fair (2)	no	no		72%		



100m Riparian Buffer in the Rocky/Brushy Creek Watershed

Figure 8-6

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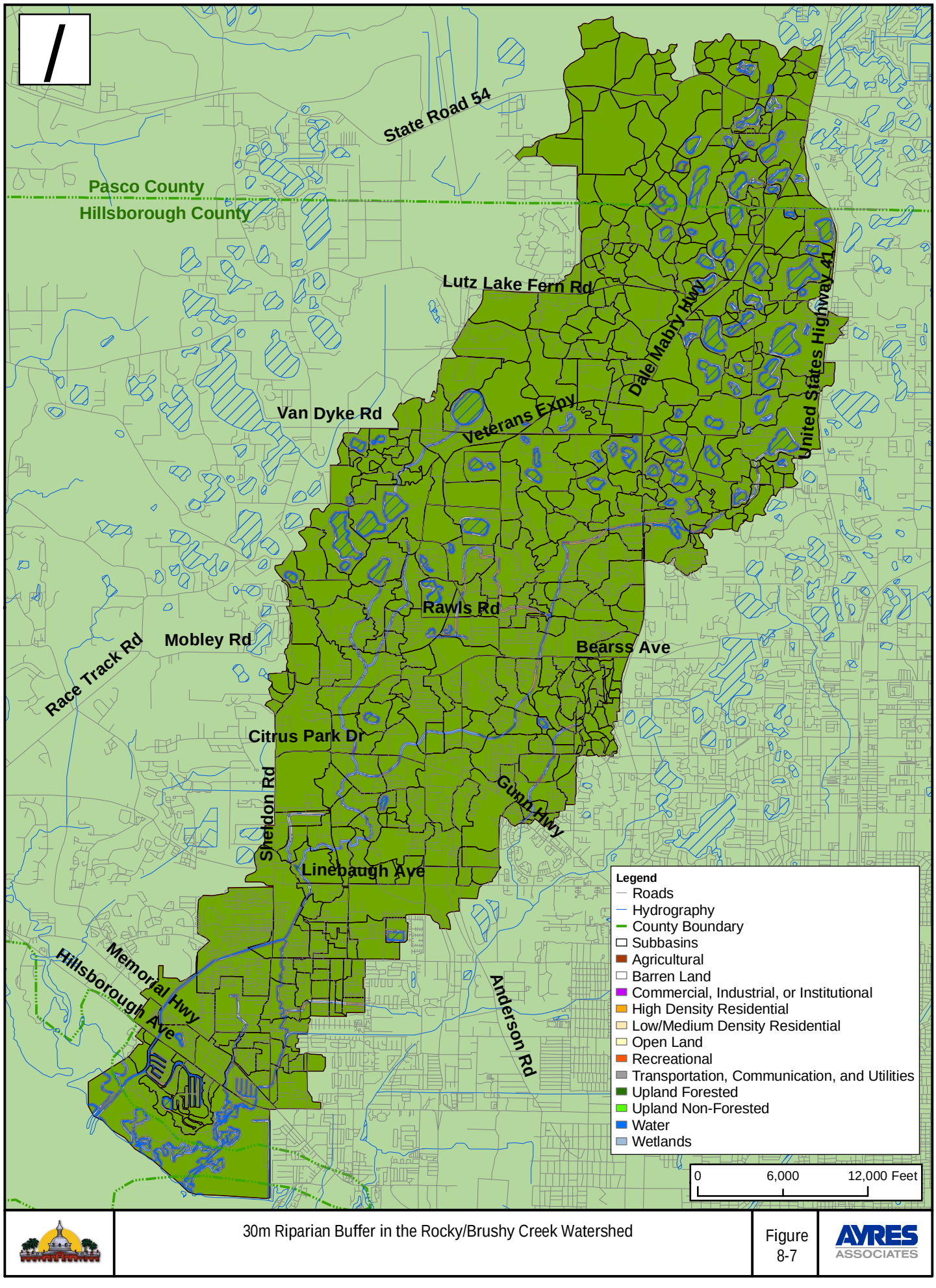

30m Riparian Buffer in the Rocky/Brushy Creek Watershed

Figure 8-7

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8.5.4 Biological Indicators of Ecosystem Health

The ability to evaluate the "health" of an ecosystem can be extremely complex due to the variability of chemical, physical, and meteorological processes that occur over time and space and also the diversity of habitat types that may be present within a watershed. One ongoing program is currently evaluating measures of ecosystem health--FDEP's Biological Reconnaissance (BioRecon) program.

The FDEP's bioassessment program involves field sampling of aquatic biological communities to characterize community structure (i.e. diversity, pollution tolerance). The BioRecon program includes measurements of water quality indicators such as dissolved oxygen, evaluating habitat conditions, and determining the health of aquatic insect communities. Many common insects spend their juvenile life within aquatic systems including dragonflies, mayflies, beetles, black flies, and mosquitoes. These organisms show the effects of physical habitat alterations, point and nonpoint source contaminants, and cumulative pollutants over their life cycle. To determine if a community has been negatively impacted by human activities, data are compared to reference communities (believed to be natural or relatively unimpacted by humans).

The BioRecon program has not collected macroinvertebrate data in the Rocky Creek - Brushy Creek watershed. The BioRecon procedure is a screening tool that evaluates three metrics including: the total number of macroinvertebrate taxa; number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) or EPT; and a Florida Index which represents taxa intolerant of stream perturbations. The sampling methodology involves three sweeps of a dip net for a given stream sampling location and the identification of all organisms within the net. Scores for three categories are tabulated based on this data and if two of three exceed threshold values the stream is rated as "healthy," if less than two meet the thresholds then the stream is rated as "suspected impaired" or "impaired. While useful for the Hillsborough River Watershed Plan, the BioRecon data cannot give an assessment of watershed health in Rocky Creek - Brushy Creek watershed.

8.5.5 Strategic Habitat Conservation Areas

In 1994, the FWC published *Closing the Gaps in Florida's Wildlife Habitat Conservation System*, which identifies habitats that must be conserved and managed to ensure the survival of key components of Florida's biological diversity. The primary objectives of the report are:

1. to identify habitat areas that are essential to the survival of rare and declining species not adequately protected by the current system of conservation areas;
2. to identify areas that are important to several globally endangered species of plants, animals, and plant communities; and
3. to identify regional areas of high biological diversity to assist in local land use planning.

The FWC utilized land cover and vegetation data, public land boundaries, and documented occurrences of species and communities to identify Strategic Habitat Conservation Areas (SHCA).

As previously discussed, the protection and preservation of the remaining natural areas of the watershed are important components of this watershed management plan. These natural lands are critical to the maintenance of local and regional wildlife and the protection of water resources. Approximately 35% (13,581 acres) of the watershed remains undeveloped.

Strategic Conservation Habitat Areas within the Rocky Creek - Brushy Creek watershed
A total of 3,112 acres (8% of the watershed) of Strategic Habitat Conservation Area (SHCA) were identified in the Rocky/Brushy Creek watershed. SHCA was identified for wading birds, many species of which are documented as occurring in the watershed.

8.5.6 Hydrologic Alterations

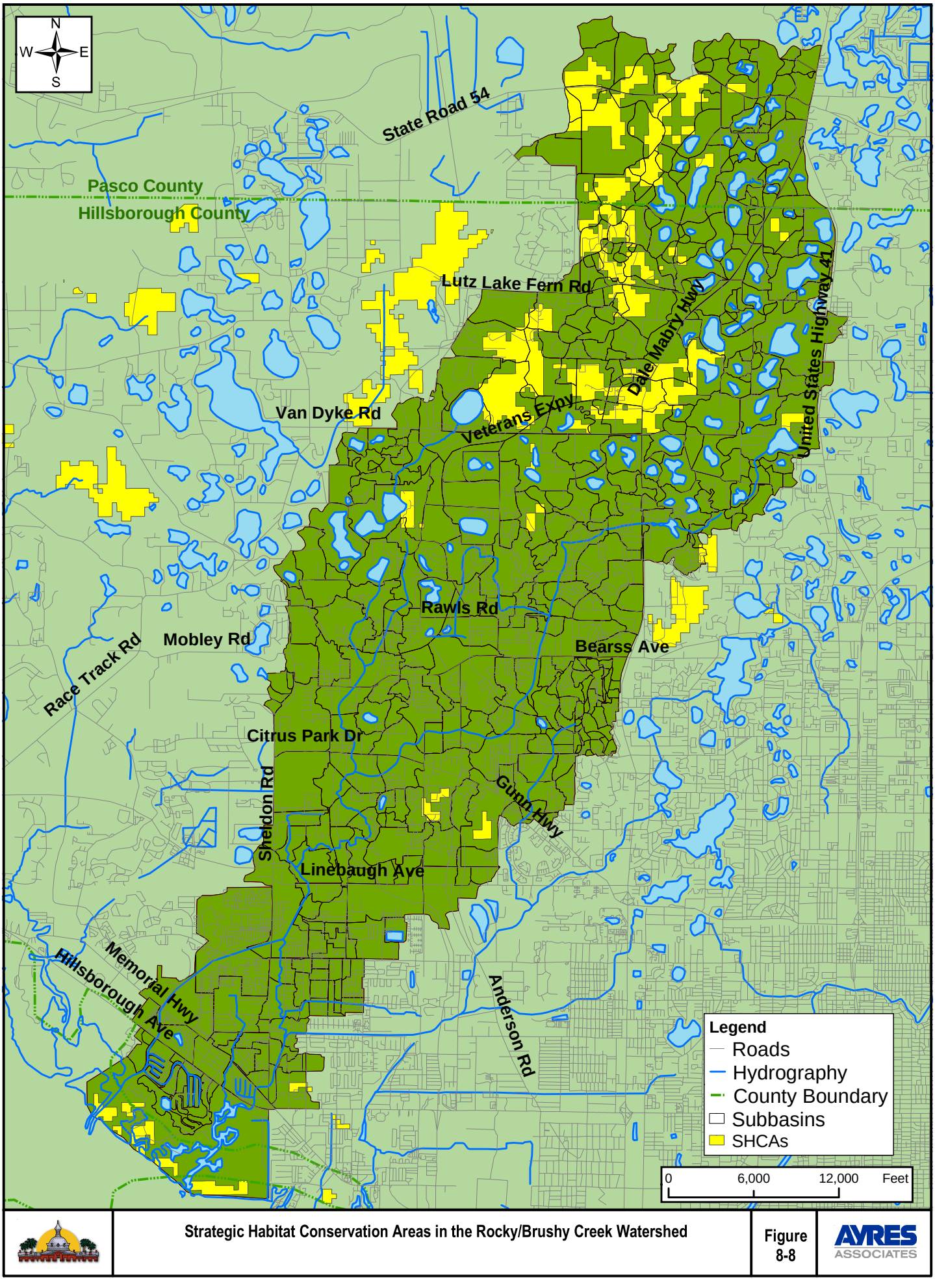
Hydrologic alterations can be defined as any action that would change or affect the water cycle. The Rocky/Brushy Creek watershed and its diverse array of natural systems are affected by hydrological alterations that would upset the watershed's delicate ecological balance.

Development for the purposes of residential, commercial, industrial, institutional, recreational, extractive, and agricultural land use has increased impervious surface area and/or resulted in the channelization and rerouting of surface water flows which has adversely affected the watershed's hydrological cycle.

Development of groundwater supplies in the watershed has affected lake elevations and in-lake wildlife habitat. These hydrological alterations can have results such as:

1. accelerated successional changes of natural systems in both upland and wetland systems;
2. changes in the sizes of faunal populations (Some species are favored and increase in numbers, while others are stressed and decline in numbers and/or viability);
3. reduced biodiversity; and
4. changes in water quality.

Natural plant communities, particularly uplands, have been replaced by agricultural, commercial, or residential development, leaving parcels of smaller size and ecological value. While wetlands have decreased somewhat in areal coverage, the habitat quality of existing systems can be presumed to be less than original conditions due to several factors, including: exotic species invasion, excessive disturbance of wetland margins, elimination of protective upland buffers; trash disposal; rim ditching; and reduced hydroperiod. The elimination and disturbance of natural habitats has resulted in a decline in the number of wild animal species (lowered biodiversity) present in the watershed.



Strategic Habitat Conservation Areas in the Rocky/Brushy Creek Watershed

Figure 8-8

AYRES ASSOCIATES

Channel Alterations

With the growing need for space for human use, natural channels in the watershed have been dredged, straightened, and/or filled to serve as water conveyances for stormwater, resulting in loss or reduction in ecological value. Channelization has also resulted in degraded water quality in streams allowing exotic species like water hyacinth to compete with native species. Increased stormwater runoff and removal of bank vegetation in these ditch systems have resulted in sedimentation and eutrophication, altering the aquatic species that utilize the system. Non-native and/or nuisance aquatic species more tolerant of anoxic or poor water quality conditions dominate these waterways which decreases biological diversity. In the Rocky/Brushy Creek watershed, channel alterations have occurred throughout the watershed at various locations, including: major roadway crossings (Old Memorial Highway, Linebaugh Avenue, Ehrlich Road, Waters Avenue, Veterans Expressway, Sheldon Road); minor crossings in subdivisions; at the Channel A cutoff south of Linebaugh Avenue; at railroad grades south of Linebaugh Avenue; and electrical transmission line and water pipeline exiting Section 21 wellfield.

Water Supply Impacts

Components of one water production facility are located in the Rocky Creek - Brushy Creek watershed: wells, pipelines, and the pumping facility associated with the Cosme-Odessa Wellfield. The primary impacts have been: (1) habitat disturbance and elimination to accommodate the wellfield, (2) reduction of hydroperiods in nearby wetlands, and (3) reduction in water elevations in nearby lakes.

8.5.7 Wildlife

The information for this section was developed from previous surveys conducted by Hillsborough County and ELAPP staff, FFWCC (1992) FNAI Species Occurrence records, and staff experience in the area. Review of compiled fauna indicates that 25 species of fish, 38 species of amphibians and reptiles, 169 species of birds, and 39 species of mammals potentially utilize the watershed. Notable species include the protected species listed in Table 8-9.

8.5.8 Protected Species

Many native fauna and flora are protected from activities that harm or interfere with them or their habitat by federal, state, and local regulations. Fauna and flora are federally protected by the USFWS under Title 50 Code of Federal Regulations (CFR) 17 and 23. Federally protected species are categorized as threatened or endangered. State protection of fauna is administered by the FWC under F.A.C., Rules 39-27.003, 39-27.004, and 39-27.005. The Florida Department of Agriculture and Consumer Services administers F.A.C., Chapter 5B-40. State protected floral species are categorized as commercially exploited, threatened, or endangered. Management strategies still needed to be developed to protect these species, including coordination efforts with Florida Natural Areas Inventory (FNAI), FWC, and USFWS. Hillsborough County EPC indirectly protects these species by protecting wetland habitats essential to the survival of these species. In addition, the County's upland habitat ordinance provides protection of essential habitats.

The presence of wildlife or plant species is often considered indicative of the presence and health of natural systems. Many animal species, both protected and unprotected, have been observed in the Rocky Creek - Brushy Creek watershed in recent years. A literature search was conducted to determine the floral and faunal composition of the watershed. This search included the review of recent surveys conducted within the watershed by Hillsborough County and ELAPP staff, standard Florida literature references such as the *Rare and Endangered Biota of Florida*, the *Florida Atlas of Breeding Sites for Herons and their Allies*, the FNAI, the FFWCC, and the USFWS. Protected species that have been observed and/or may utilize the watershed are listed in Table 8-9. The table also includes information on their preferred habitat. A species is noted as occurring within the watershed if evidence of their presence was observed through animal tracks, scat, burrows, nests, dens, scratchings, vocalizations, or animal sightings by county or state staff. Eighteen protected species potentially occur in the Rocky/Brushy Creek watershed.

Fish

No protected fish species are expected to utilize habitats in the Rocky/Brushy Creek watershed.

Reptiles and Amphibians

Protected reptiles and amphibians that may occur in the Rocky Creek - Brushy Creek watershed are the American alligator, eastern indigo snake, and gopher tortoise. All have been documented as occurring in the watershed (Table 8-9).

The **American alligator** is a resident of river swamps, lakes, marshes, bayous, and other bodies of water and is prevalent within the watershed. The required habitat of the short-tailed snake is longleaf pine-turkey oak associations and adjacent upland hammocks or sand pine scrub. The Florida gopher frog *(Rana capito)* prefers a xeric upland habitat, but are often found in commensal association with the gopher tortoise (*Gopherus polyphemus*).

Florida gopher frogs breed in habitats that are seasonally flooded, grassy ponds, and cypress heads that lack fish populations.

The **gopher tortoise** prefers dry well-drained soils. Many xeric habitats may be used including sand pine scrub, live oak, or turkey oak communities. The gopher tortoise excavates a long burrow and occupies it semi-permanently.

The **eastern indigo snake** is restricted to the southeastern United States and inhabits a wide variety of habitats from mangrove swamps to xeric pinelands and scrub. It often lives in association with the gopher tortoise where the tortoise burrows provide shelter from desiccating heat and cold winter temperatures. During warmer months, the indigo snake ranges widely, utilizing a territory of 125-250 acres. Wetland edges are preferred foraging areas, where eastern indigo snakes feed on small birds, mammals, fish, and frogs.

Avifauna

Protected birds that occur in the watershed include American oystercatcher, brown pelican, limpkin, little blue heron, Florida sandhill crane, southern bald eagle, southeastern American kestrel, snowy egret, tricolored heron, wood stork, and white ibis. Of these, the limpkin, little blue heron, Florida sandhill crane, snowy egret, tricolored heron, wood stork, and white ibis require relatively shallow water habitats for foraging, although the white ibis and Florida sandhill crane also forage in pastures and lawns. Some of these species nest in estuarine habitats (snowy egret, wood stork, brown pelican), but freshwater habitats including cypress, wetland hardwoods, or shrub swamps are also important nesting habitats. Wood storks more specifically feed in shallow marshes and wet prairies. Degradation of both nesting and foraging habitats has contributed to population declines in these species.

The Florida sandhill crane and limpkin require shallow pickerelweed/maidencane freshwater marshes and adjacent open, low herbaceous uplands (crane) or streams and ponds (limpkin). The apple snail, which may be found in lakes, marshes, broad swales, and impoundments is the most important food limpkins that nest among tall grasses such as bulrush, between the knees of cypress, in vine-covered shrubs, or in the tops of cabbage palms or cypress trees.

Protected birds of prey that occur in the watershed include the bald eagle and southeastern American kestrel. The bald eagle is found in a variety of habitats, but prefers high water-to-land edge ratios where prey is concentrated. The southeastern American kestrel is a secondary cavity-nester, nesting in cavities formed by woodpeckers in long-leaf pine, sand pines, turkey oaks, or live oaks, and requiring open fields for foraging.

The American oystercatcher and brown pelican inhabit estuarine and marine shorelines and open marine waters, respectively. These habitats are present in the lower reaches of the watershed in the Rocky Creek estuary.

Mammals

Listed species of mammals that may occur in the watershed are Sherman's fox squirrel and the West Indian manatee, both of which are documented as occurring in the watershed.

Both the Florida mouse and Sherman's fox squirrel typically inhabit areas of fire-maintained longleaf pine-turkey oak sandhills, and flatwoods (Humphrey, 1992). The fox squirrel was identified by Cox et al. (1994) as an indicator of remaining natural communities including sandhill, mixed pine-hardwood, dry prairie, and open pine flatwoods. The West Indian Manatee has been reported from the Rocky Creek and Channel A and in adjacent coastal areas of the Rocky Creek watershed.

Table 8-9 Protected Animal Species that potentially occur in the Rocky Creek - Brushy Creek Watershed

Species Common Name	FFWCC	USFWS	Observed
AMPHIBIANS REPTILES			
American alligator	SSC	T(S/A)	X
Eastern indigo snake	T	T	X
Gopher tortoise	SSC	-	X
BIRDS			
Roseate spoonbill	SSC	-	X
Florida sandhill crane	T		X
Limpkin	SSC	-	X
Little blue heron	SSC	-	X
Snowy egret	SSC	-	X
Tricolored heron	SSC	-	X
American oystercatcher	SSC	-	X
White ibis	SSC	-	X
Brown pelican	SSC	-	X
Southeastern American kestrel	T	-	X
Sandhill crane	T	-	X
Southern bald eagle	T	T	X
Wood stork	E	E	X
MAMMALS			
West Indian manatee	E	E	X
Sherman's fox squirrel	SSC	-	X

FFWCC-Florida Wildlife Conservation Commission
USFWS-United States Fish and Wildlife Service

E = Endangered T= Threatened SSC = Species of Special Concern
C = Commercially Exploited T(S/A) = Threatened due to similarity of appearance

Flora

Over 500 species of plants are expected to occur in the Rocky/Brushy Creek watershed. The watershed's habitat quality, geographical location, and climate suggest that 83 species that are listed as endangered, threatened, or commercially exploited by the US Department of Agriculture potentially occur there. Both uplands and wetlands support protected species, but with the elimination of much of the native upland habitat, many of the protected species that may still be present in the watershed are species that prefer wetland habitats, for example orchids and ferns.

8.5.9 Exotic Species

Florida is particularly prone to biological invasions due to the widespread disturbance of native habitats as well as its semi-tropical climate, great expanse of waterways, and "island-like habitat" (bounded on three sides by water and the fourth by frost). This section discusses exotic plants and animals that have been observed or have the potential of invading the Rocky/Brushy Creek watershed.

8.5.9.1 Exotic Plants

An exotic plant is a non-indigenous species, or one introduced to this state either purposefully or accidentally. A naturalized exotic is a non-native plant that has reproduced on its own either sexually or asexually.

Approximately 1.7 million acres of Florida's remaining natural areas have been invaded by exotic plant species. These exotic plant invasions degrade and diminish Florida's natural areas. Invasive, non-indigenous plants are non-native plants that have invaded Florida's forests and wetlands. They replace native plant species and often form exotic monocultures. In many cases, these stands of exotic plants are not useful to the state's wildlife, which have evolved to depend on native plants for food and shelter. Native animals are rarely able to adapt to new exotic plants. Animals that depend on native plants will move away or even become extinct if exotic plants replace too many of our native plants. Some of the effects of invasive plant species include:

- decrease in biological diversity of native ecosystems
- poisoning of some wildlife and livestock species
- reduction of aquatic habitat for native fish and wildlife species, including listed species
- decrease in the ecological value of important habitats for native fish and wildlife
- clogging of lakes and waterways and other wetlands, impeding wildlife movements

Exotic Plant Species Control Programs

The FDEP's Bureau of Invasive Plant Management is the lead agency in Florida responsible for coordinating and funding two statewide programs to control invasive aquatic and upland plants on public conservation lands and waterways. Florida's aquatic plant management program, established in the early 1900s, is one of the oldest invasive species removal programs. With the addition of the Upland Invasive Plant Management Program under Florida Statute 369.252, the state addresses the need for a statewide coordinated approach to the upland exotic and invasive plant problem. Additionally, Hillsborough County's Land Development Code requires the removal of exotic species for newly developed areas. The Exotic Pest Plant Council (EPPC) has played a major role in identifying exotic species that pose a threat to natural flora. The EPPC was established in 1984 for the purpose of focusing attention on:

1. impacts to biodiversity from exotic pest plants;
2. impacts of exotic plants to the integrity of native plant community composition and function;
3. habitat loss due to exotic plant infestations;
4. impacts of exotic plants to endangered species primarily due to habitat loss and alteration (e.g., Cape Sable Seaside Sparrow);
5. the need to prevent habitat loss and alteration by comprehensive management for exotic plants;
6. the socioeconomic impacts of exotic pest plants (e.g., increased wildfire intensity and frequency in *Melaleuca*);
7. changes in the seriousness of exotic pest plants and to indicate which are the worst

problems; and
8. informing and educating resource managers about which species deserve to be monitored, and to help managers set priorities for management.

The Council's Florida chapter, the Florida Exotic Pest Plant Council (FEPPC), compiles a list of Florida's most invasive exotic plant species every few years, grouping them according to degree of invasiveness. The most recent compilation can be found at the end of this chapter. The FEPPC has also developed a database map for the Noxious and Exotic Weed Task Team of Category I species throughout the state. A review of this database resulted in the list of FEPPC Category I species occurrence within Hillsborough County, which are described individually below.

This list is based on the definitions of invasive exotic species made by the EPPC Committee:

- Category I are exotic pest plants that invade and disrupt Florida's native plant communities;
- Category II are exotic pest plants that have the potential to invade and disrupt native plant communities as indicated by (1) aggressive weediness; (2) a tendency to disrupt natural successional processes; (3) a similar geographic origin and ecology as Category I species; (4) a tendency to form large vegetative colonies; and/or (5) sporadic, but persistent, occurrence in natural communities;
- (N) indicates a species listed as noxious on the United States Department of Agriculture and the Florida Department of Agriculture and Consumer Services lists; and
- (P) indicates a species listed as prohibited by the Florida Department of Environmental Protection under Rule 62C-52, F.A.C.

Exotic Plants in the Rocky/Brushy Creek Watershed

The Rocky Creek - Brushy Creek watershed has been susceptible to exotic species invasion as a result of the physical disruption of habitats for development purposes, agricultural and industrial operations, and the escape of exotic species from residential landscapes. Information contained in several reports (see Bibliography) and on site visual inspection of the watershed revealed the presence of a total of 39 exotic species in the watershed including: air potato, alligator weed, Australian pine, Brazilian pepper, castor bean, chinaberry tree, Chinese tallow tree, cogon grass, earpod tree, hydrilla, latex plant, lead tree, paper mulberry, parrot's feather, punk tree, skunk vine, water hyacinth, and wild taro. Below is a brief description of the exotic species observed within the Rocky Creek - Brushy Creek watershed. The vegetative descriptions are from the University of Florida's Northeast Region Data Center. The photographs are reprinted from the University of Florida, Institute of Food and Agricultural Sciences Aquatic, Center for Aquatic and Invasive Plants, online Aquatic, Wetland and Invasive Plant Information Retrieval System (APIRS).

Alligator Weed

Alligator weed is an immersed plant that is usually found in water, but can grow in a variety of habitats, including dry land. It may form sprawling mats over the water or along shorelines. Alligator weed stems are long, branched, and hollow. Leaves are opposite,

simple, elliptic, and have smooth margins. Flowers grow on stalks and are whitish and papery, and bloom during the warm months.

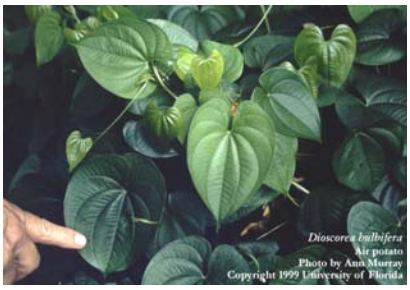
Australian Pine

Several species of Australian pine were introduced into Florida prior to 1920 (Morton, 1980). The three species of Australian pine in Florida are *Casuarina equisetifolia*, *C. glauca*, and *C. cunninghamiana*. Hybridization of these species is extensive and complicates identification (Schardt and Schmitz, 1990). The tree is an emersed hardwood, native to Australia and Malaysia, and occurs along rocky coasts, dunes, sand bars, and islands.

The Australian pine was primarily planted to form windbreaks along coastal areas. The trees can reach 35-m heights and grow at a rate of 1.0 to 1.5 m a year. In southern and central Florida, Australian pines typically produce dense stands and form thick carpets of needles on the ground prohibiting the growth of native vegetation. In dune communities, Australian pine's dense shade and leaf-litter retard the growth of native coastal vegetation (Schardt and Schmitz, 1990). Dense monospecific stands of Australian pine crowd out native vegetation in coastal areas and affect habitat for several listed and non-listed species. It is prevalent on the margins of the saltmarsh in the Rocky Creek - Brushy Creek estuary.

Air Potato

It is believed that air potato was introduced to Florida as an ornamental and food plant around 1905. It was already recognized as a pest plant throughout the state by the 1970s. It is a non-native, invasive vine covered with large handsome leaves. It can quickly grow 60-70 feet in length, which is long enough to overtop (and shade-out) tall trees. A member of the yam family (*Dioscoreaceae*), air potato produces large numbers of aerial tubers, (potato-like growths attached to the stems) that grow into new plants and is a particular problem in the margins of the Stream and Lake Swamp (FLUCFCS 615) land cover type.



Water Hyacinth

The water hyacinth is a floating plant that grows in all types of freshwaters. It has inflated petioles and forms large floating mats that can completely cover lakes, ponds, and streams. It is a prolific tropical weed now naturalized in waterways throughout the state and the frost-free coastal areas of the Southeast (Bell and Taylor, 1982). Water hyacinths vary in size from a few inches to over three feet tall. It has showy lavender flowers. The leaves are rounded and leathery, attached to a spongy and sometimes inflated stalk, and the roots are dark and feathery. It is a problem in backwater areas of Rocky Creek - Brushy Creek in its upper reaches, on the margins of some lakes, and over

the entire surface of some artificial ponds.

Cogon Grass

Cogon grass is a non-native grass with extensive rhizomes, spreading stems from 3-10 feet. It is one of the most aggressive weeds of dry lands in Florida, but can occur in areas that become briefly flooded. It can cover large areas. Native to the warmer regions of the Old World, it was brought to the U.S. as experimental forage. It has spread, partially through its use as a packing material. It is commonly seen along roadsides, ditches, swales, and abandoned land. Difficult to eradicate due to its hardy rhizomes, the plant quickly out competes most native grasses. It is most prevalent along roadsides and abandoned land in the watershed.

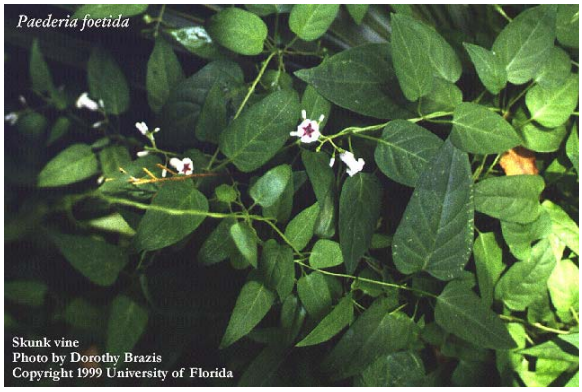
Punk Trees (Melaleuca)

Melaleuca trees, also known as punk trees or paperbark tea trees, are native to Australia, New Guinea, and New Caledonia. Melaleuca is characterized in Florida by a rapid growth rate, efficient reproduction, and the ability to invade a wide variety of habitats (Meskimen, 1962). This exotic tree grows along roadsides, on ditchbanks, in mesic prairies, in sawgrass marshes, and on lake shorelines. Once established, trees form dense stands that are nearly impenetrable (Center and Dray, 1986). More than 4,000 trees per hectare are not uncommon in melaleuca forests. Melaleuca is a pest, especially in the Everglades and surrounding areas, where the trees grow into immense forests virtually eliminating all other vegetation. Although small mammals seem to use these forests, species diversity in wet prairie-marsh ecosystems with dense monocultures of melaleuca decreases by 60-80% (Austin, 1978; Woodall, 1978; Mazzotti et al., 1981). Schortemeyer et al. (1981) reported that only 10% of the bird species in melaleuca stands actually fed there and only 1.5% of their activity involves nesting in these trees. Melaleuca can replace native pond cypress. Punk tree are seen as small clumps distributed in the lower reaches of the watershed in residential areas and on the margins of the salt marsh in the Rocky Creek and Channel A estuaries.

Chinaberry Tree

Chinaberry is a naturalized, fast-growing tree in the southeastern U.S. It is invading the forests, fence lines, and disturbed areas of Florida and elsewhere, including Hawaii. Belonging to the mahogany family of plants, chinaberry is native to Asia. Striking and colorful, chinaberry was widely introduced as an ornamental shade tree because of its large compound leaves, distinctive clusters of lilac-colored flowers, and round yellow fruits. Chinaberry seeds are spread by fruit-eating birds. Chinaberry outgrows,

shades-out, and displaces native vegetation. The bark, leaves, and seeds are poisonous to farm and domestic animals. Chinaberry is a landscape element on residential properties in the watershed.

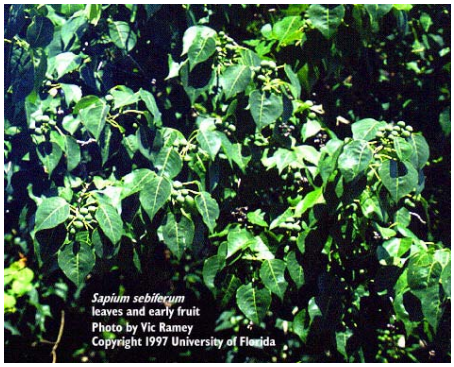


Skunk Vine

Skunk vine, a woody vine from Asia, actually does smell more-or-less skunk-like. The aggressive, competitive plant may grow high into the trees in a variety of habitats, from mesic hammocks to xeric sand hill communities. It appears to prefer sunny floodplains and bottomlands, and can even grow under water. Reportedly introduced in 1897 as a "potential fiber crop", skunk vine now occurs throughout the southeastern U.S. Herbarium records indicate that skunk vine grows in at least 17 counties of central and north central Florida. Its stems root freely. This species is prevalent on the edges of the Stream and Lake Swamp habitat (FLUCFCS 615).

Chinese Tallow

Like melaleuca, the Chinese tallow is a tree that grows and spreads rapidly, is difficult to kill, and tends to take over large areas by out-competing native plants. Chinese tallow is spreading rampantly in large natural areas, including Paynes Prairie State Preserve near Gainesville, state-owned protected lands along the St. Johns River. It is a landscape element on residential property and has escaped into all but the xeric plant communities.



Brazilian Pepper

Brazilian pepper is one of the most aggressive of the invasive non-indigenous plants in Florida. It is invading aquatic and terrestrial habitats, greatly reducing the quality of native biotic communities in the state. Brazilian pepper is from South America, and was probably introduced as an ornamental in the mid 1800s. Since it is not cold hardy, the tree occurs mostly in southern Florida. Brazilian pepper is indigenous to the coast of tropical Brazil, Paraguay, and Argentina (Ewel, 1986). It was present in Florida in the early 1840's (Barkley, 1944) and was re-introduced into Florida in 1898 (Morton, 1978). This plant was once sold as a landscape ornamental because it produced dense masses of scarlet berries. The species is established in mangrove swamps in the Rocky Creek and Channel A estuaries.

Wild Taro

The wild taro is an emergent plant, imported from the Pacific Islands. It occurs in and out of water. The leaves can grow to two feet long and are medium to large in size, arrowhead-shaped with heart-shaped bases. They are dark, velvety green, and water repellant. Wild taro leaves are peltate: the leaf stem attaches more-or-less to the middle of the underside of the leaf. Leaf stems grow to four feet tall, and flowers occur in small fingerlike spikes. It is established in backwater areas of Rocky/Brushy Creek.

Hydrilla, a submerged aquatic plant, grows rooted in the bottom substrate of quiet reaches of the Creek and other freshwater habitats. It escaped from the aquarium trade and is well established in stream reaches of Rocky and Brushy Creeks and in some lakes in the watershed. Control measures include chemical treatment and the introduction of the Chinese grass carp, a plant-eating fish species.

8.5.9.2 Exotic Fauna

An exotic animal is a non-indigenous species introduced to an area either purposefully or accidentally. Exotic, non-indigenous, invasive species compete with native species for space, food, and ecological niche. Activities to prevent and control invasive animal species that severely impact the lands and waters of the United States have become a priority for watershed management. The term invasive species is defined by the Presidential Executive Order 13112. Known as "exotic-invasive" or "alien-invasive" species, these invasive plants and animals cause vast ecological and economic damage, and sometimes, human health impacts in areas that they infest. These species have gained a foothold on public and private lands throughout the nation and in other parts of the world, and range across almost every ecosystem of the country including those found within the Rocky/Brushy Creek watershed. Common methods of introduction include release of pets, escape from pet dealers, or intentional introduction for pest control. USGS, FDEP, UF-IFAS, and Hillsborough County information on non-indigenous species were reviewed to compile a list of exotic species that have been observed or reported in the watershed. Some of the exotic animal species found in the watershed include: Nine-banded armadillo, Cuban tree frog, Greenhouse frog, and Brown anole. These four species arrived in Florida by natural migration (nine-banded armadillo) and by accidental introduction (Cuban tree frog, Greenhouse frog, and Brown anole). Armadillos disturb soils in all habitats, particularly Stream and Lake Swamp, Cypress, and other wetlands during the dry season. The Cuban treefrog is a voracious predator and will attack and devour anything smaller than itself, including native frogs, fish, and invertebrates. The greenhouse frog may be replacing native frogs, particularly in south Florida, while the brown anole competes to some degree with the native Carolina anole (chameleon).

8.6 Conservation and Preservation Programs

Conservation and preservation programs are critical instruments in the protection of natural communities. These programs promote and protect biological diversity which are supported by international treaties, federal regulations, state legislation, local comprehensive management plans, and local ordinances which are discussed in detail in Section 8.7.

Local governments in Florida may use two instruments of preservation: conservation easement as supported by 704 F.S. and 193 F.S. and land acquisition. These Florida Statutes support the following methods of preservation:

- full fee acquisition;
- less than fee acquisition;
- 193 F.S. easement;
- transfer of development rights; and
- purchase of development rights.

8.6.1 Land Acquisition Conservation and Preservation Programs

There are several land acquisition conservation and preservation programs in Florida available to local governments that have jurisdiction over the Rocky/Brushy Creek watershed. These programs are briefly described in the following sections.

Conservation and Recreation Lands Program

The Conservation and Recreational Lands (CARL) program was established in 1979 by the Florida Legislature which expanded the 1972 Environmentally Endangered Lands Program to include resource conservation measures for other types of lands. It is one of Florida's environmental land acquisition programs for the protection and conservation of unique natural areas, endangered species, unusual geologic features, wetlands, and significant archaeological and historical areas. Mineral-extraction severance taxes and documentary stamp fees funded the CARL program until the recent creation of the Preservation 2000 (P2000) program. The CARL program receives approximately $105 million annually from the sale of bonds. Future funding from the sale of bonds is dependent on legislative action, but the Florida Forever program is scheduled to continue until 2010. The Land Acquisition and Restoration Council (ARC) was established by Section 259.035 (1) F.S., and selects and ranks projects on the CARL acquisition list each year. Nine members of ARC represent the following state agencies: Department of Community Affairs, DEP, Division of Forestry of the Department of Agriculture and Consumer Affairs, FWC, Division of Historical Resources of the Department of State, and four appointees of the Governor with backgrounds from scientific disciplines related to land, water, or environmental science.

The FDEP Bureau of Land Acquisition reviews all CARL and P2000 acquisitions and handles land exchanges, negotiates, and acquires lands for the department and other state agencies. Lands acquired under the CARL program are maintained as parks, recreation areas, wildlife management areas, wilderness areas, forests, and greenways.

Florida Forever Program

Established in 1999 by the Florida Legislature, the Florida Forever Program is the principal land acquisition program for Florida. It provides for up to $3 billion statewide over a 10-year period to protect and improve environmental lands, water resources, and urban green space. The allocation to SWFWMD equates to approximately 25% of total funds expected to be provided under the program.

Hillsborough County Environmental Lands Acquisition and Protection Program

The HCELAPP was established by Hillsborough County in 1987 for the purpose of acquiring, preserving, and protecting endangered and environmentally sensitive lands, beaches, parks, and recreational lands. Although resource protection is the primary purpose of acquiring sensitive lands in the county, public use that is compatible with the preservation and protection of such lands has been allowed on select parcels. The program is administered through the county's Parks and Recreation Department and is overseen by an advisory committee composed of both local citizens and public agency staff. Parcels deemed environmentally sensitive are evaluated and ranked on a site-by-site basis through an annual nomination process.

HCELAPP's land acquisition efforts for acquiring environmentally sensitive lands are often in cooperation with FDEP's CARL Program, SWFWMD, the Florida Forever Program, and The Nature Conservancy. HCELAPP has acquired core riverine areas in the Rocky Creek - Brushy Creek watershed. These acquired lands include properties adjoining the Hillsborough River State Park and the Lower Hillsborough Wilderness Park. Only three new sites within Hillsborough County were nominated for acquisition in 1999.

Nature Conservancy

The Nature Conservancy (TNC) is a non-profit international organization whose goals are to conserve biological diversity through habitat conservation. TNC works with the Natural Heritage Inventory scientists and other researchers to set conservation priorities and acquire lands for conservation management.

TNC utilizes acquisition, land exchanges, conservation easements, retained life estates, and other arrangements to work with property owners to protect natural habitats. They also provide landowners with technical assistance on identifying and managing natural resources including rare species and unusual natural communities.

Trust for Public Lands

The Trust for Public Land (TPL) is a national non-profit land conservation organization that was created to protect land for public use and enjoyment. The principal goal of TPL is to acquire lands suitable for open space and parks, and convey them to public agencies for ownership and management. TPL also provides training and technical assistance to private landowners, local land trusts, and government agencies to enhance their land conservation goals.

Wetland Reserve Program

The Wetland Reserve Program (WRP) is administered through the USDA Natural Resources Conservation Service (NRCS). The WRP is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support for conservation easements and wetland restoration in an effort to achieve the greatest wetland functions and values, along with optimum wildlife habitat.

8.6.2 Public Lands in the Rocky/Brushy Creek Watershed

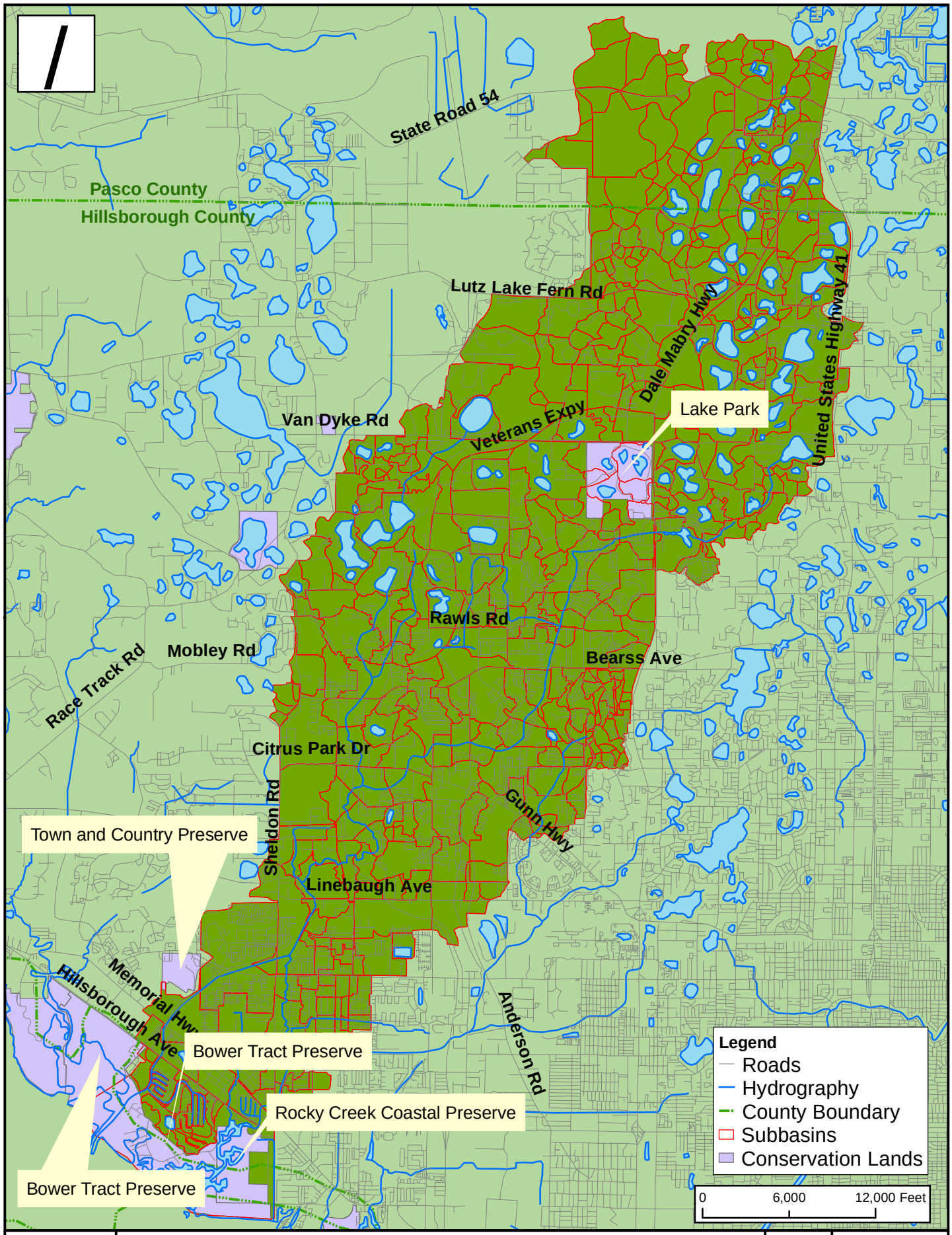
A review of existing public lands within the watershed was conducted utilizing GIS metadata for conservation lands in Florida compiled by the Florida Greenways Planning Team, Department of Landscape Architecture of the University of Florida based on:

- SWFWMD GIS acquired and proposed land data
- CARL, Conservation Lands 2004, and FNAI Managed areas GIS data (FGDL)
- Hillsborough County ELAPP GIS data
- Atlas of Outstanding Florida Waters

Hillsborough County Parks information provided by the Hillsborough Planning Commission was also reviewed and utilized for this report. An analysis of the GIS data layers was performed to approximate proposed and acquired land area. Almost 2,416 acres have been acquired for conservation purposes (Table 8-10). Figure 8-9 shows the 2004 conservation areas identified by SWFWMD.

Table 8-10 Acreages of Lands for Conservation Purposes within the Rocky/Brushy Creek Watershed

Parcel Name	Acres
Rocky Creek Preserve	279
Bower Tract	1548
Lake Park	589
Total	2,416



Conservation Lands in the Rocky/Brushy Creek Watershed

Figure 8-9

AYRES ASSOCIATES

8.6.3 Greenways and Trails

Subsection 260.012(1) (2) F.S. (The Florida Greenways and Trails Act) defines "greenways" as linear open space established along either a natural corridor such as a riverfront, stream valley, or ridgeline, or over land along a railroad right-of-way converted to recreational use, a canal, a scenic road or other route; any natural or landscaped course for pedestrian of bicycle passage; an open space connector linking parks, nature reserves, cultural features, or historic sites with each other and populated areas; or a local strip or linear park designated as parkway or greenbelt. The same statute defines "trails" as a linear corridor and any adjacent support parcel on land or water providing public access for recreation or authorized alternative modes of transportation.

Greenways can be hard surfaced pathways that permit different recreational uses such as walking, jogging, skating, and biking, or they can be natural corridors with a simple path along a stream or riverbank. Many greenways connect destination points such as parks, libraries, schools, and shopping areas. A utility or drainage ROW, or an abandoned railroad corridor can be converted to a pedestrian bike or walkway. Conservation areas protecting a community's natural resources such as rivers, streams, wetlands, wildlife, and floodways are often included in greenways. Greenways benefit the community in many ways by providing opportunities for recreation and alternative transportation, improving environmental protection, providing places for environmental education, and stimulating economic development.

In the Rocky/Brushy Creek Watershed, there are several existing and proposed trails, greenways, and preserves. Existing trails include: (1) the Upper Tampa Bay Trail that has been constructed along Channel A north to Race Track Road and (2) the Town 'N Country Greenway from Sheldon Road east along Channel G to Town 'N Country Park, most of which is in the Lower Sweetwater Creek Watershed.

Proposed trails and greenways include: (1) the Northdale – Lake Park Trail, (2) the Northwest Regional Connector Trail; (3) the extension of the Upper Tampa Bay Trail north to the Suncoast Trail north of Lutz-Lake Fern Road; (4) greenway from the Dale Mabry Highway/Ehrlich Road intersection north to Sheldon Road; (5) greenway from the Linebaugh Avenue/Gunn Highway intersection west to the Upper Tampa Bay Trail, thence to Race Track Road; (6) greenway from Lake Park to Northdale.

Proposed preserves include the riparian system associated with two reaches of Rocky Creek: (1) from Lake Armistead south to Channel A; and (2) from Lake Park south to Old Tampa Bay.

Funding sources for the development of greenways and trails are available from:

1. **Recreational Trails Program** - The Recreational Trails Program (RCT) is a federally competitive grant program that provides, renovates, or maintains recreational trails. The Intermodal Surface Transportation Efficiency Act ISTEA) of 1991 included the National Recreational Trails Fund Act (NRTFA) and established the National Recreational Trails

Funding Program (NRTFP). The National Highway System Designation Act (NHS Act) of 1995 amended and revived the NRTFA. The Transportation Equity Act for the 21st Century (TEA-21) amended the previous legislation and provided six years of funding. In Florida, the RCT is administered by the FDEP in coordination with the U.S. Department of Transportation, Federal Highway Administration.

2. **Florida Recreation Development and Assistance Program** - The Florida Recreation and Development Assistance Program is a competitive program that provides grants for acquisition and development of land for public outdoor recreation use.

3. **FDOT Transportation Enhancement Program** - The Florida Department of Transportation (FDOT) Transportation Enhancement Program provides funds for transportation-related activities designed to strengthen the cultural, aesthetic, and environmental aspects of Florida's intermodal transportation system. The program provides for implementation of a variety of projects including bike and pedestrian facilities. Projects are selected by local metropolitan planning organizations and the FDOT district offices.

4. **Florida Scenic Highways Program** - The Florida Scenic Highways Program is administered by the FDOT. This program works with local governments to identify and protect scenic roadways throughout the state. Designated corridors, including associated greenway and trail projects, may be eligible for increased funding opportunities.

8.6.4 Natural Systems Restoration

The Rocky Creek - Brushy Creek watershed reflects a variety of land uses that have resulted in the both the conversion of natural lands to urban, suburban, commercial, and agricultural development and the degradation of remaining native habitats. Increased future land development will continue to produce adverse impacts to natural systems. Consequences of development have included: reduction in biological diversity, overall habitat quality, abundance, and distribution, as well as habitat fragmentation, species isolation, impairment of water quality, and loss of wildlife corridors.

In order to alleviate the negative impacts of development, it is necessary to protect and restore natural systems within the watershed through land acquisition, conservation methods, public environmental education, exotic plant species removal, replacement of native habitats where they have been eliminated and/or degraded. High quality natural areas are a priority to both the human population and animal populations within the watershed, and the implementation of a meaningful restoration/protection plan will produce substantial ecological and aesthetic benefits.

Restoration - There are several candidate areas for restoration. Chief among these areas are the locations at which Rocky Creek and Brushy Creek have been crossed by major roadways, electrical transmission facilities, and the railroad grade. At all of these locations, the Creeks have been subject to factors that have degraded stream habitat, discouraged wildlife establishment, allowed the invasion of exotic plant species, resulted in trash accumulation in the channel, and negatively affected water quality.

Priority restoration measures at these areas include:

1. Diversion and treatment of untreated stormwater runoff,
2. Exotic species removal.
3. Reshaping channel banks to eliminate erosion and undercutting,
4. Trash removal, and
5. Re-establishing desirable native plant species consistent with the original habitat and compatible with the needs of each transportation facility.

Other candidate areas for restoration include:

1. Lake shores where shoreline vegetation has been completely cleared – Assistance should be provided to willing lakefront property owners to re-establish desirable emergent aquatic plants to promote lake fisheries, reduce erosion potential, and protect lake water quality from fertilizers and pesticides.
2. Roadway rights-of-way where exotic species have become established – Following the removal of exotic species, desirable native species should be planted, and a maintenance program should be implemented to ensure restoration success. Appropriate signage at each restoration site should be erected for public education purposes.
3. Enhancement of habitat on Channel A, where feasible, to promote fisheries and safe public access for fishing and birding.
4. Restoration of native habitats on public lands within the watershed – A detailed assessment of public lands should be performed in which specific areas needing restoration should be identified. Areas should be prioritized according to expected benefits to water resources in the watershed, and projects should be undertaken that improve and protect water quality.

8.7 Regulations Protecting Natural Systems

As part of the development of the Rocky Creek - Brushy Creek watershed management plan, existing regulatory mechanisms that protect natural communities within the watershed and throughout the County were researched and reviewed. Regulations are an important component in the protection, maintenance, preservation, and conservation of natural lands.

HCEPC Wetland Rule

The Hillsborough County Environmental Protection Commission's (HCEPC) Chapter 1-11 (Wetlands) Rule provides standards for the identification, protection, maintenance, and utilization of wetlands in Hillsborough County.

Hillsborough County
Wetlands, uplands, and environmentally sensitive areas are protected by the County Land Development Code (Ordinance No. 00-21, PART 4.01.00) requirements including set backs, buffer zones, and other mechanisms. The Natural Resources regulations protect habitats that are scarce within the county and supports the Endangered Species Act, enforcing protection of listed species and their habitats.

Environmental Resource Permit
The Environmental Resource Permit (ERP) process is administered by the SWFMWD and The FDEP under Part IV of Chapter 373, Florida Statutes (F.S.) and Chapters 40D-4, 40, 45, and 400, Florida Administrative Code (F.A.C.). This permit provides protection for surface water bodies, wetland ecosystems, partially through coordination with the Florida Fish and Wildlife Conservation Commission, NMFS, USFWS, and the USACOE.

Federal Regulation
Federal protection for wetlands is provided under the Section 404 Dredge and Fill Permit administered by the USACOE and the National Pollutant Discharge Elimination System Permit (NPDES) administered by the EPA.

Tampa Bay Comprehensive Conservation Management Plan
The Tampa Bay Estuary Program has developed a Comprehensive Conservation Management Plan that promotes improved land and water management throughout the Tampa Bay watershed, including the protection and restoration of declining natural communities that serve as indicators of the health of Tampa Bay.

Hillsborough County Comprehensive Plan
County comprehensive plans are mandated by Chapter 163 F.S., as amended by the Local Government Comprehensive Planning and Land Development Regulation Act. This act requires the development of a comprehensive plan by each local government within Florida. Chapter 163 F.S. is further defined by Rule 9J-5, F.A.C., which establishes minimum criteria for each element of the comprehensive plan.

The Hillsborough Comprehensive Plan has the following elements:

1. coastal management;
2. conservation and aquifer recharge;
3. future land use;
4. transportation;
5. housing;
6. recreation and open space;
7. economically disadvantaged groups;
8. potable water;
9. sanitary sewage;

10. storm water;
11. solid waste; and
12. capital improvement projects.

Elements that directly affect natural communities within the Rocky Creek - Brushy Creek watershed are coastal management, recreation and open space, potable water, conservation and aquifer recharge, and capital improvement projects.

8.8 Public Education

Public education is one of the most important components of a watershed management plan. Public outreach programs and projects can promote the participation and involvement of local residents, which contributes to the acceptance, approval, and successful implementation of this watershed management plan. The following is a summary of current public education and outreach programs throughout the state that apply to the concerns and goals of the Rocky Creek - Brushy Creek watershed. More specific information pertaining to these programs can be found by contacting the responsible agency by phone or through their web site.

Hillsborough County implements several programs applicable county-wide, including the Rocky Creek - Brushy Creek watershed:

1. **Officer Snook Program** - The Officer Snook Program teaches children about water pollution and its effect on our rivers, ponds, lakes, and streams. Officer Snook provides a fun and educational coloring book for each student, as well as curriculum guides and activity books for teachers who want to continue pollution prevention education in their classrooms.

2. **Stormwater Ecologist** – This program is designed to give students and teachers the power to make responsible decisions about stormwater pollution prevention and to demonstrate how our actions all play a role in the health of the world around us. Stormwater Ecologist not only talks about making a difference, we'll actually help you make one with our hands-on and community projects. This program incorporates aspects of science, politics, and economics, making it appropriate for a wide range of classes.

3. **Hillsborough County's Adopt-A-Pond** - The Adopt-A-Pond program is a public-private partnership helping neighborhoods improve their water quality, wildlife habitat value, and aesthetic value of stormwater ponds. The program is dedicated to improve pond environments. The program offers free education on stormwater runoff, storm drain marking kits, free native wetland plants, technical advice on pond management, and the opportunity to participate in a network of other members of the program. In the watershed, 61 ponds are included in the Program.

4. **Hillsborough County Stream Waterwatch** - The Stream Waterwatch program is a cooperative effort between Hillsborough County, Hillsborough County Community College, FWC, and the SWFWMD. The goal of this program is to ensure clean and healthy streams. Volunteers are trained to collect water quality samples, to take field measurements of physical parameters, and to collect, sort, and identify macroinvertebrates. Volunteers collect monthly stream samples and measurements. They also participate in stream clean-ups, restoration projects, and related activities.

5. **Hillsborough County Lake Management Program** - The Lake Management Program (LaMP) is a cooperative program involving Hillsborough County, University of Florida LAKEWATCH, and the University of Florida. Volunteers take monthly samples and learn about aquatic plants, water quality, and the wildlife that utilize their lakes. Citizens learn what they can do in their households and yards to improve the health of their lakes. Collected data is entered in a web-based database maintained by the University of South Florida (http://www.hillsborough.wateratlas.usf.edu/).

6. **Nature's Classroom at the Wilderness Park** - The Nature's Classroom is located within the Wilderness Park, an award winning outdoor educational facility for sixth graders in Hillsborough County. Nearly 10,000 students and faculty have experienced the Hillsborough River first hand by viewing animals and plants in their natural habitats. The SWFWMD's Hillsborough River Basin Board for flood control and water quality protection originally purchased the Wilderness Park.

University of Florida/Hillsborough County Cooperative Extension Service

The Cooperative Extension Service (CES) is an educational service of the University of Florida and Hillsborough County that provides research-based information to the public through workshops, publications, and mass media. The CES offers assistance on creating and maintaining a Florida yard, composting, creating wildlife habitat, xeriscaping, water conservation with micro-irrigation, butterfly gardening, and landscaping for beginners. Several programs are implemented in Hillsborough County:

1. **Master Gardener Program** - The CES offers the Master Gardener Program that provides gardeners with training and the opportunity to improve their horticultural knowledge and skills. Through organized volunteer activities, gardeners then share their experience with the public. Master gardeners help to educate the community by helping gardeners solve their plant problems, promoting environmental responsibility through water conservation and pest control, beautifying Hillsborough County by teaching about appropriate plants for its climate, and working with school and community gardens.

2. **Backyard Wildlife Habitat Program** - The CES offers the Backyard Wildlife Habitat Program, which promotes the use of native plants. The program teaches that the right selection of native plants can provide a natural food source year-round. When used correctly the plants will require less water, fertilizer, and pesticides.

3. **Florida Yards and Neighborhoods Program** - The CES offers the Florida Yards and Neighborhoods Program (FYNP). The FYNP is a partnership of concerned citizens, members of the landscape industry, the University of Florida's Cooperative Extension Service, the National Estuary Program, Florida Sea Grant College Program, and numerous environmental agencies. The program was developed to address serious problems of pollution and disappearing habitats by enlisting homeowners to help save our waterways. The program provides special education and outreach activities in the community by assisting residents to reduce pollution and enhance their environment by improving home and landscape management.

SWFWMD Environmental Education Programs

SWFWMD implements several programs throughout it 16-county service area that includes Hillsborough County:

1. Xeriscape - The xeriscape program promotes water conservation through creative landscaping. Landscapes that conserve water will save the homeowner money on water, energy, and maintenance bills, and will help preserve valuable fresh water resources and provide wildlife habitat. The program guides homeowners through a seven-step process including 1) design, 2) plant selection, 3) improving the soil, 4) wise utilization of turf, 5) efficient irrigation, 6) using mulch, and 7) maintenance.

2. SWFWMD In-School Education Programs - The In-School Education Program helps achieve the SWFWMD's goal of preserving and protecting water resources and related ecosystems through educational materials for teachers and students from Kindergarten through grade 12.

3. SWFWMD Mini-Grants is a program that offers teachers funding to do classroom projects on water quality, water supply, water conservation, or watersheds. Applications are available through the SWFWMD at http://www.swfwmd.state.fl.us/infoed/educators/minigrants/hillsboroughmg.pdf.

4. SWFWMD Teacher workshops provide teachers information on water resources in the Rocky Creek - Brushy Creek watershed, as well as hands-on activities and strategies for the best instructional methods on water issues.

5. Project WET is an inter-disciplinary water education program for teachers and other educators working with young people in Kindergarten through grade 12. The program can be integrated into existing curricula of a school, museum, or community organization. The goal of the project is to facilitate and promote appreciation, awareness, knowledge, and stewardship of water resources though the development of classroom-ready teaching aids and the through the establishment of internationally and state-sponsored Project WET programs. The Project WET Curriculum and Activity Guide is a collection of over 90

innovative, interdisciplinary activities that are hands-on, easy to use, and fun. Designed with a commitment to state and national education standards, Project WET activities cover diverse topics and disciplines. The Project WET Curriculum and Activity Guide activities promote critical thinking and problem-solving skills. These activities help provide young people with the knowledge and experience they will need to make informed decisions regarding water resource management.

6. The *Envirothon* is a problem-solving, natural resource education program for high school students. Student team to solve problems and conduct hands-on investigations about forestry, soils, aquatics, wildlife, and current environmental issues. SWFWMD sponsors an annual *Envirothon* in Hillsborough County inviting local high schools to compete against each other in solving problems in various disciplines.

7. Florida Waters Project Teacher's Guides is a set of activities and background information designed to encourage students to investigate and explore the water systems in their communities, to learn more about water issues and land resources in their communities, and to take an active role in the protection and preservation of our precious water resources.

8. SWFWMD Water Matters is a set of multi-disciplinary activities and background information designed to help students learn about the process of water management and how they can be involved with the process. Water Matters is available to the public.

9. My Water Activity Book is full of fun activities to help students from kindergarten through 2nd grade learn about water resources by coloring and completing mazes, word games, dot-to-dot, and puzzles. This book is available to teachers and students.

10. SWFWMD Splash! Water Education Packet is a colorful, multidisciplinary middle school packet containing fact and activity sheets on wetlands, the hydrologic cycle, desalination, water use, water conservation, community planning, and water management. The packet is free to educators.

11. Water Drops Newsletter is a water resource newsletter available to teachers from grades 3 through 5. Newsletter issues come with a teacher's guide on water conservation, water cycle, and a visit to a nature park. The newsletter was designed to assist teachers discuss water related issues with their students.

12. The Watershed Education Resources Box is a collection of puppets, poetry, fiction, and non-fiction available to teachers to help students understand watersheds and the importance of watersheds.

13. The Watershed Excursion Tabloid includes information about watersheds found throughout the SWFWMD, explains to students why watersheds are important to Florida's ecosystems, and how we can all work to keep our watersheds clean and healthy.

14. The Water Education Week Publications were created and distributed in conjunction with the Newspaper In-Education Program. This 16-page newspaper tabloid with teacher's guide focuses on a particular water topic each year. Materials are designed for grades 4 to 7. The booklets on water quality, habitats, water management and use, technology, and sustainability are available as class sets and are free to educators.

15. The Water From the Ground Up is a full curriculum available to teachers that includes text, a teacher's guide, an activity book, and basic District hydrologic information for students in grades 3 to 5. The curriculum includes topics on surface water and groundwater sources in west central Florida, water quality, water use, floods, droughts, and water conservation.

16. The Water Watchers is a video and teacher's guide available to kindergarten through grade 3 teachers that includes classic children's songs with water resource lyrics. It also features simple experiments to illustrate such concepts as the hydrologic cycle, water pollution, saltwater intrusion, etc.

17. Who Gets the Water*?* is an interdisciplinary curriculum available to middle school teachers that provides a basic understanding of the environmental and economic concepts necessary to make good decisions in the face of limited resources.

Florida Department of Education, Office of Environmental Education, Environmental Program

The Florida Department of Education has divided Florida into several Environmental Education Regional Service Areas. The Rocky Creek - Brushy Creek watershed is within Regional Service IV that covers Charlotte, De Soto, Glades, Hardee, Hendry, Hernando, Highlands, Hillsborough, Lee, Manatee, Pasco, Pinellas, Polk, and Sarasota counties. Each regional service area has several environmental projects, including the promotion of "Teaching Naturally." This is an interdisciplinary guide using activities to make education real for students by using the environment as an integral concept across subject areas for all grade levels. The mission of Regional Service Projects (RSP) is to assist their region's pre-K through 12 schools, colleges, and universities in improving teaching and learning through environmental education. The RSP IV functions include:

- Conducting assessments of educational needs of teachers and students that environmental education can meet.
- Soliciting and brokering resources to match the needs of teachers, preservice educators, and students that environmental education can meet.
- Publishing and distributing Regional Resource Guides that cover a broad spectrum of regional, state, and national resources for educator use.

- Developing and supporting a cadre of skilled facilitators, most of whom are classroom teachers, to deliver workshops.
- Developing materials and workshops that link environmental education with Sunshine State Standards.
- Collaborating with Area Centers for Educational Enhancement to improve teaching and enhance student performance.
- Assisting post-secondary educators in integrating environmental education concepts and methods in their teaching.

Materials developed by the program of the Office of Environmental Education are distributed at no cost to the public.

Florida Fish and Wildlife Conservation Commission implements several programs state-side, including Hillsborough County and the Rocky Creek - Brushy Creek watershed:

1. **Project WILD** is a supplementary, interdisciplinary instructional program for teachers of kindergarten through high school age students. It is a way for teachers to incorporate concepts related to people, wildlife, and a healthy environment into major school subjects and skill areas. WILD activities are organized around a conceptual framework that addresses awareness and appreciation of wildlife, human values and wildlife, wildlife and ecological systems, wildlife conservation, cultural and social interaction with wildlife, wildlife issues and trends, and responsible human actions. Project WILD is one of the most widely used conservation and environmental education programs among educators. It is based on the premise that young people and educators have a vital interest in learning about our natural world. The program emphasizes on wildlife because of its intrinsic and ecological values, as well as its importance as a basis for teaching how ecosystems function. Project WILD addresses the need for human beings to develop as responsible citizens of our planet.

2. **FWC Schoolyard Wildlife Project** is an environmental education program that teaches teachers, parents, and students how to turn school grounds into an effective outdoors classroom. The Schoolyard Wildlife Project's resources help incorporate Florida's natural history into school curricula to teach environmental awareness, problem-solving, basic biology, and ecological principles. Two types of hands-on, interactive, one-day workshops are offered: Schoolyard Activities & Ecology and Schoolyard Ecosystems. A combination weekend workshop is offered twice a year. The *Schoolyard Activities & Ecology* workshop provides teachers with high quality, Florida-specific natural history and ecology lessons, and natural science explorations. This four- to six-hour workshop targets educators in grades K-6. The *Schoolyard Ecosystems* workshop teaches educators about local ecosystems and how to involve their students in the creation, restoration, or enhancement of native wildlife habitats on school grounds. This six-hour workshop targets educators in grades K-12. The Schoolyard Wildlife Activity Guide and Schoolyard Ecosystems book can be received only by attending the workshop.

Florida Wildlife Federation Backyard Wildlife Habitat Program - The Florida Wildlife Federation, together with the National Wildlife Federation, offers all Florida residents an opportunity to take part in the Backyard Wildlife Habitat Program. The program's goal is to promote and expand gardening for wildlife in Florida. This program promotes the use of native plants, wildlife habitat creation, water conservation, and the use of fewer fertilizers and pesticides to result in less water pollution. As a result, the homeowner trades time-consuming lawn care for hours spent watching birds, butterflies, and small mammals.

Tampa Audubon Society Audubon Resource Center

The Tampa Audubon Society is a non-profit organization dedicated to preserving Florida's resources and unique habitats. It is one of 45 chapters in Florida that assist members and other community leaders in taking on the challenges of local environmental conservation, education, and advocacy. The Tampa Audubon Society offers conservation education and outreach programs to students, providing solid, science-based curricula and site-based programs in subjects as far reaching as aquifer function and wetland conservation. Outdoor and experience-based conservation education is the heart of Audubon's work in Tampa. By giving children, families, and adults the opportunity to experience Florida's natural resources and identify wildlife and habitat types, the Audubon helps to create and nurture a culture of conservation.

Within the Tampa Bay area, factors such as the elimination of wetlands development, decreased water quality, and an increase in population make it essential for residents to understand the Tampa Bay ecosystem so that growth and development can proceed in harmony with nature. Being intimately involved with these issues, the Audubon Society has developed a unique partnership with the Hillsborough County Parks and Recreation Department. Through this partnership, an Audubon Resource Center (ARC) was established in April 1998 at Lettuce Lake Park. The purpose of the ARC is to help foster a "culture of conservation" and an environmental ethic in the Tampa Bay region that will encourage community involvement as part of the Audubon mission. The Hillsborough River borders the 240-acre urban park and visited by 650,000 people each year, including school classes, clubs, inner-city youth, minorities, and families.

The ARC at the Lettuce Lake Park is designed to enhance Audubon's education and community involvement goals and helps citizens develop an appreciation, awareness, and understanding of the natural world and the interplay of forces that affect living things. The ARC is a multi-faceted hub for conservation and utilizes guided tours, educational brochures and materials, and hands-on activities like nest box building and habitat enhancement to reach its goals. The Center includes a natural history exhibit, nature store, and resource center full of books and informational materials. The exhibit shows wildlife of Tampa Bay and the Hillsborough River in their natural setting, giving students, young and old, a close look at the interrelationship of the ecosystem.

8.9 Bibliography

The attached bibliography contains a list of references that was used for this study and additional references which could be cited by readers.

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8.10 List of Common and Scientific Names for Plants and Animals Mentioned in Report

Trees

Australian pine, Casuarina equisetifolia
Bald cypress, Taxodium distichum
Bluejack oak, Quercus incana
black gum, Nyssa sylvatica var sylvatica
Brazilian pepper, Schinus terebinthifolius
Carolina holly, Ilex ambigua
Carolina willow, Salix caroliniana
castor bean, Ricinus communis
chinaberry tree (Melia azedarach),
Chinese tallow tree (Sapium sebiferum),
dahoon, Ilex cassine
laurel oak, Quercus laurifolia
lobllolly bay, Gordonia lasianthus
loblolly pine, Pinus taeda
longleaf pine, Pinus palustris
Pond cypress, Taxodium ascendens

punk tree (Melaleuca quinquenervia),
red maple, Acer rubrum
sand live oak, Quercus geminata
slash pine, Pinus elliottii
southern red maple,
swamp bay, Persea palustris
sweetbay, Magnolia virginiana
Turkey oak, Quercus laevis

Shrubs

Beautyberry, Callicarpa Americana
Buttonbush, Cephalanthus occidentalis
Darrow's blueberry, Vaccinium darrowii
Fetterbush, Lyonia lucida
Gallberry, Ilex glabra
Gopher apple, Licania michauxii
saw palmetto, Serenoa repens
shiny blueberry, Vaccinium myrsinites
staggerbush, Lyonia ferruginea
tarflower, Bejaria racemosa
titi, Cyrilla racemosa
Virginia willow, Itea virginiana
Wax myrtle (southern bayberry), Myrica cerifera

Herbs

Adam's needle, Yucca filamentosa
air potato, Dioscorea bulbifera
alligator flag (fire flag), Thalia geniculata,
Alligator weed, Alternanthera philoxeroides
Arrowhead, Sagittaria lancifolia
ball moss, Tillandsia recurvata
Beak rush, Rhyncospora sp.
Bearded grasspink, Calopogon barbatus
bladderwort, Utricularia purpurea
bladderwort, Utricularia inflata
bog buttons, Lachnocaulon anceps
bushy bluestem, Andropogon glomeratus
Butterfly orchid, Encyclia tampensis
Cardinal airplant, Tillandsia fasciculata
Carolina elephant's foot, Elephantous carolinianus
Catesby's lily, Lillium catesbaei
Cattail, Typha, latifolia
Cattail, Typha domingensis

Chinese laddere brake, Pteris vittata
Cinnamon fern, Osmunda cinnamomea
cogon grass, Imperata cylindrical/I. brasiliensis,
drumheads, Polygala cruciata
duckweed, Spirodela punctata
dwarf pawpaw, pygmaea
eastern milk pea, Glactia regularis
false nettle, Boehmeria cylindrica
fire flag (alligator flag), Thalia geniculata
giant airplant, Tillandsia utriculata
golden polypody, Phlebodium aureum
goldenrod, Solidago fistulosa.
greenvein ladies' treeses, Spiranthes praecox
maidencane, Panicum hemitomon
marsh fern, Thelypteris palustris
early whitetop fleabane, Erigeron vernus
meadow beauty, Rhexia sp.
meadow spikemoss, Selaginalla apoda
netted chain fern, Woodwardia areolata
parrot's feather, Myriophyllum heterophyllum
Pink sundew, Drosera capillaris
redroot, Lachnanthes caroliana.
royal fern, Osmunda regalis
sand cordgrass, Spartina bakeri
sawgrass, Cladium jamaicensis
skunk vine, Paederia foetida
sky-blue lupine, Lupinus diffusus
southern needleleaf, Tillandsia simulate
Southern shield fern, Thelypteris kunthii
Small butterwort, Pinguicula pumila
Soft rush, Juncus effuses
Spanish moss, Tillandsia usneoides
Spatterdock, Nuphar luteum
spike rush, Eleocharis sp.
Spring ladies' treeses, Spiranthes vernalis
St John's wort, Hypericum fasciculatum
toothed mid-sorus fern
tropical soda apple, Solanum viarum
Virginia chain fern, Woodwardia virginica
Water hoarhound, Lycopus rubellus
water hyacinth, Eichhornia crassipes
Water lettuce, Pistia stratoides
water spangles, Salvinia minima

whitetop sedge, Rhynchospora colorata
white water lily, Nyphaea odorata
wild taro, Colocasia esculenta
wiregrass, Aristida beyrichiana
yellow butterwort, Pinguicula lutea
yellow-eyed grass, Xyris sp.

ANIMAL SPECIES

Reptiles
American alligator, Alligator mississippiensis
eastern indigo snake, Drymarchon corais couperi
gopher tortoise, Gopherus polyphemus

Birds
Florida burrowing owl, Athene cunicularia
Florida scrub jay, Aphelocoma coerulescens
Little blue heron, Egretta caerulea
Limpkin, Aramus guarauna
Peregrine falcon, Falco peregrinus
Reddish egret, Egretta rufescens
Roseate spoonbill, Ajaia ajaja
Sandhill crane, Grus canadensis
Southeastern American kestrel,
Snowy egret, Egretta thula
Tricolored heron, Egretta tricolor
White ibis, Eudocimus albus
Wood stork, Mycteria americana

Mammals
Sherman's fox squirrel, Sciurus niger shermani
West Indian manatee, Trichechus manatus latirostris

CHAPTER 9: WATER SUPPLY

9.1 Overview

The combination of increased water demand with the highly karstic nature of the watershed's geology has resulted in the development of a number of critical issues relating to water supply, including:

- lowered average water levels and increased fluctuations in lakes and wetlands
- declines in average elevations of the potentiometric surface and the water table
- increased annual fluctuations in the elevations of the potentiometric surface and the water table
- reduced streamflows in the Rocky/Brushy Creek system
- saltwater contamination of inland and coastal groundwater sources due to lateral saline intrusion and upconing
- reduced reliability of private water supply wells
- increased sinkhole occurrence
- contamination of groundwater resources by septic tanks and stormwater runoff

As a result of these issues, increased emphasis has been placed on the development of alternative water supply sources, reuse, off-line reservoirs, surface water withdrawals, aquifer storage and recovery, and water conservation programs in the region. In 2002, an estimated 36% of the County's water demand was supplied by surface waters, a figure that is 3% higher than in 1993. This entire amount was derived from the Hillsborough River Reservoir system which provides the majority of the City of Tampa's water supply. The reservoir system includes the Hillsborough River, Sulphur Springs, and the Tampa Bypass Canal. Groundwater resources occur throughout the County; however, higher quality groundwater is typically found with increasing distances from the coast.

Sinkhole formation occurs throughout the county with most occurrences reported in northern and western Hillsborough County. Northwest Hillsborough county is considered to be an area of "very numerous" sinkhole formation, particularly the cover – collapse category of sinkholes that occur abruptly. The Florida Department of Environmental Protection (FDEP) Sinkhole Database (2006) lists a total of 84 sinkholes have been reported in the Northwest Hillsborough area, many of which occurred in the vicinity of the Cosme, Section 21, and Eldridge – Wilde Wellfields. For example, within 1 month of increasing the pumping rate at Section 21 wellfield, 64 new sinkholes formed within a 1-mile radius of the well field. Most of the sinkholes were formed in the vicinity of well 21-10, which was pumping at nearly twice the rate of the other wells. Neighboring areas also noticed dramatic declines in lake levels and dewatering of wetland areas. At this point it is recognized that

sinkholes can occur as a result of natural geologic phenomena and by the influence of human activities including groundwater pumping, well construction, building construction, etc. The Rocky/Brushy Creek watershed is located in an area of "highest hazard" for sinkhole formation.

The entire Northwest Hillsborough Watershed area lies within the Northern Tampa Bay Water Use Caution Area (NTBWUCA), an area that includes Pinellas County, western and central Hillsborough County, and western and southern Pasco County. This designation was created in 1989 by the Southwest Florida Water Management District (SWFWMD) in response to the impacts observed in connection with groundwater withdrawals and the anticipated future increases in water demand in the area. Through this designation, the District developed a resource assessment and recovery strategy to be implemented through a combination of regulatory measures, conservation and supply projects, and voluntary compliance. The components of the assessment and recovery strategy are enunciated in *Rule 40D-8, Florida Administrative Code (F.A.C.)* and included:

- "All water use permittees within the Area are addressed by this Rule 40D-80.073, F.A.C. However, Tampa Bay Water …. facilities account for the majority of water withdrawals within the Area. For this reason, these facilities are the primary focus of the portion of the recovery strategy encompassed by this Rule 40D-80.073, F.A.C. Other users ….. are addressed in 40D-80.073(5), F.A.C."

- "Recovery to Wetland and Lake Minimum Levels for wetlands and lakes described in and established in 40D-8 …. is the objective of this Rule 40D-80.073, F.A.C."

- "…the Floridan Aquifer Recovery Management Levels set forth in Table 80-1 below shall be used as long-term guidelines for allocating withdrawals within the Operations Plan, submitted to the District by TBW pursuant to the Agreement, and shall be reevaluated in 2010."

- Based on that analysis and evaluation, on or before December 31, 2010, the District will initiate rulemaking to revise the MFLs…as necessary; adopt rules to implement the existing or the New MFLs…; and incorporate a second phase to this Recovery Strategy.

The Interim Recovery monitoring effort focuses on addressing other (non –Tampa Bay Water) water use, supplemental hydration of lakes and wetlands, and new applications for water use. The portion of the District's recovery strategy embodied within this Rule is the first regulatory phase of a long-term approach toward eventual attainment of the Minimum Flows and Levels Program goals.

All users, including public water supply utilities, are required to incorporate conservation measures as a means of reversing detrimental environmental trends such as lake level declines and adverse wetland impacts. A number of planning efforts have been developed to protect and enhance water supplies in the Northwest Hillsborough watersheds. These include:

Hillsborough County Comprehensive Plan (Conservation and Aquifer Recharge Element) – The purpose of the Conservation and Aquifer Recharge Element of the County's Comprehensive Plan is to provide a plan and policy direction for the preservation, conservation, and management of the natural resources of Hillsborough County. The plan provides guidelines for future governmental programs and decisions related to the protection and enhancement of the County's natural environment, as well as the public health, safety and welfare. The objective of the Conservation and Aquifer Recharge Element is to ensure that the air, land, water and living resources of Hillsborough County remain an asset, rather than become a liability, to the quality of life of all existing and future inhabitants.

Hillsborough County Water Resources Team Goals – The mission of the Hillsborough County Water Resource Team is to address water supply and natural resource protection issues, as they relate to projects proposed or operated in Hillsborough County by Tampa Bay Water. Specifically, the Water Resource Team is to:

- Pro-actively coordinate with Tampa Bay Water to develop new and innovative water supply projects that are sensitive to the protection of natural resources
- Protect the County's environmental resources from adverse impacts that may result from water supply development projects undertaken by Tampa Bay Water
- Evaluate the water supply projects proposed by Tampa Bay Water for public health, ecological sustainability and cost effectiveness, in order to influence Tampa Bay Water to improve the projects in those areas where deficiencies exist
- Evaluate the operation of Tampa Bay Water's existing water supply projects and recommend actions to protect the County's environmental resources from adverse impacts
- Evaluate related proposed plans, rules and other initiatives undertaken by the Southwest Florida Water Management District and the Florida Department of Environmental Protection with the aim of protecting the County's environmental resources and safeguarding the quality of life for citizens of Hillsborough County
- Recommend action to the Board of County Commissioners and the Hillsborough County Environmental Protection Commission that will safeguard the rights of the County, its citizenry and the Environmental Protection Commission

Southwest Florida Water Management District Water Management Plan (DWMP) - The 2005 District Water Management Plan (Plan) was accepted by the Governing Board in July 2005 and represented the second five-year update of the District's "comprehensive plan." The Plan serves as a guide to the District in carrying out all its water resource management responsibilities, including those for Water Supply, Flood Protection, Water Quality and Natural Systems, and also reflects the District's Management Services support activities. It plays a significant role in ensuring coordination and consistency of District planning and management, as well as helping to link the District's activities with the planning and management activities of local governments and other agencies.

Southwest Florida Water Management District Northern Tampa Bay Water Resources Assessment Project (NTBWRAP) and Northern Tampa Bay Phase II Program (NTB II) - The Northern Tampa Bay Water Use Caution Area was designated in 1989, and it precipitated the expansion and development of projects to collect data and assess water resource conditions. In 1996, the District published the final report of a multi-year study which assessed the regional water resources of the Northern Tampa Bay area. This study, known as the Northern Tampa Bay Water Resources Assessment Project, was an effort to better understand the current state of the water resources of the area, as well as to provide the foundation for future, more detailed, hydrogeologic and biologic studies.

Since that time, the District has entered into a Partnership Agreement with Tampa Bay Water and its member governments to reduce groundwater withdrawals in the area from 158 mgd to 90 mgd by 2007. Additionally, the District has established a Minimum Flows and Levels Rule (40D-8), which includes minimum levels for cypress wetlands, lakes, and aquifers.

As a follow-up to previous hydrologic and biologic analyses performed in the Northern Tampa Bay area, the Southwest Florida Water Management District has launched a new program known as the Northern Tampa Bay Phase II program (NTB II). NTB II consists of a series of technical projects in Northern Tampa Bay to support the ongoing development of minimum flows and levels, water resources recovery, water use permitting, and environmental resource permitting.

Southwest Florida Water Management District's Northwest Hillsborough Basin Board – The basin board has approved a total of $6,831,519 for water supply-related projects for FY2006, many of which directly affect the region of northwest Hillsborough covered in this report.

Tampa Bay Water's Master Water Plan - Originally approved in 1995 and revised several times since then, this plan is currently aimed at providing a total capacity of 111 million gallons per day (mgd) of water supply by 2008 and reducing demand through conservation. The Master Water Plan is the blueprint to meet long-term drinking water needs for the people of the Tampa Bay region. This strategic plan studies, analyzes and compares water supply options. The options proven to be technically feasible, environmentally sound and economical are selected and implemented by Tampa Bay Water's Board of Directors (Figures 9-1A and 9-1B).

The first configuration of the Master Water Plan project is nearing completion, with many of the projects having been implemented in the 2002 – 2005 timeframe. This group of water supply projects will meet regional water demands through 2012. Currently, Tampa Bay Water is working on a second configuration of projects to meet future demand in 2012 and beyond.

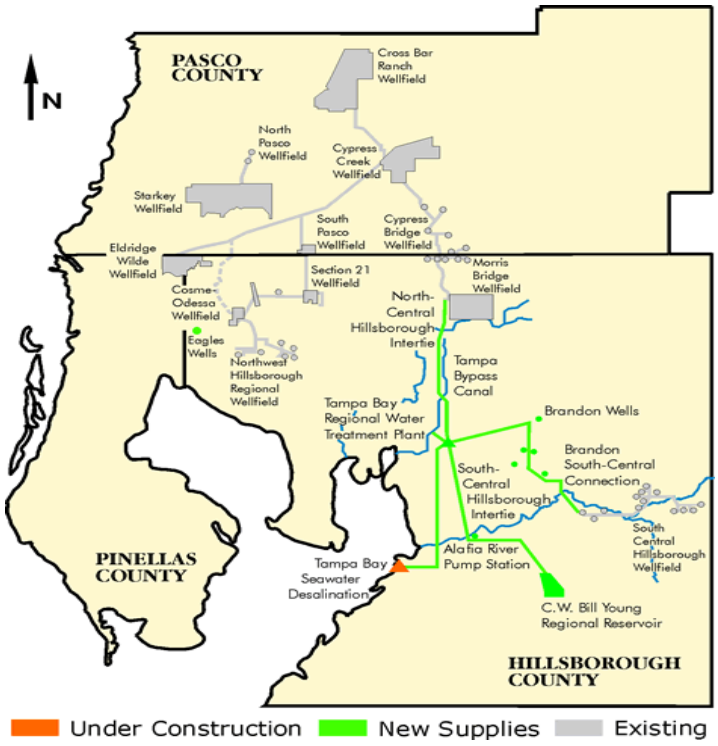


Figure 9-1A Tampa Bay Water Existing Facilities
(Source: Tampa Bay Water, 2006)

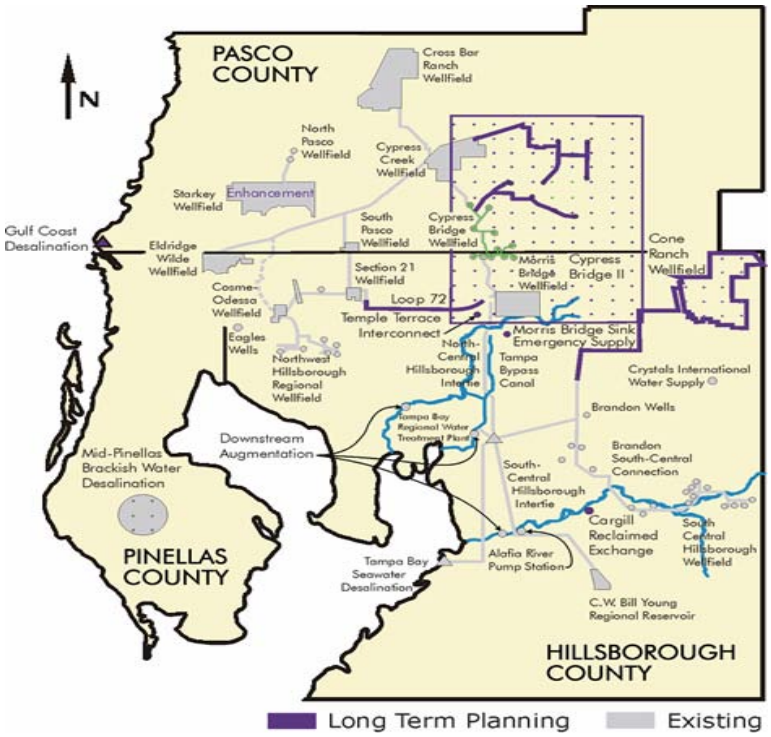


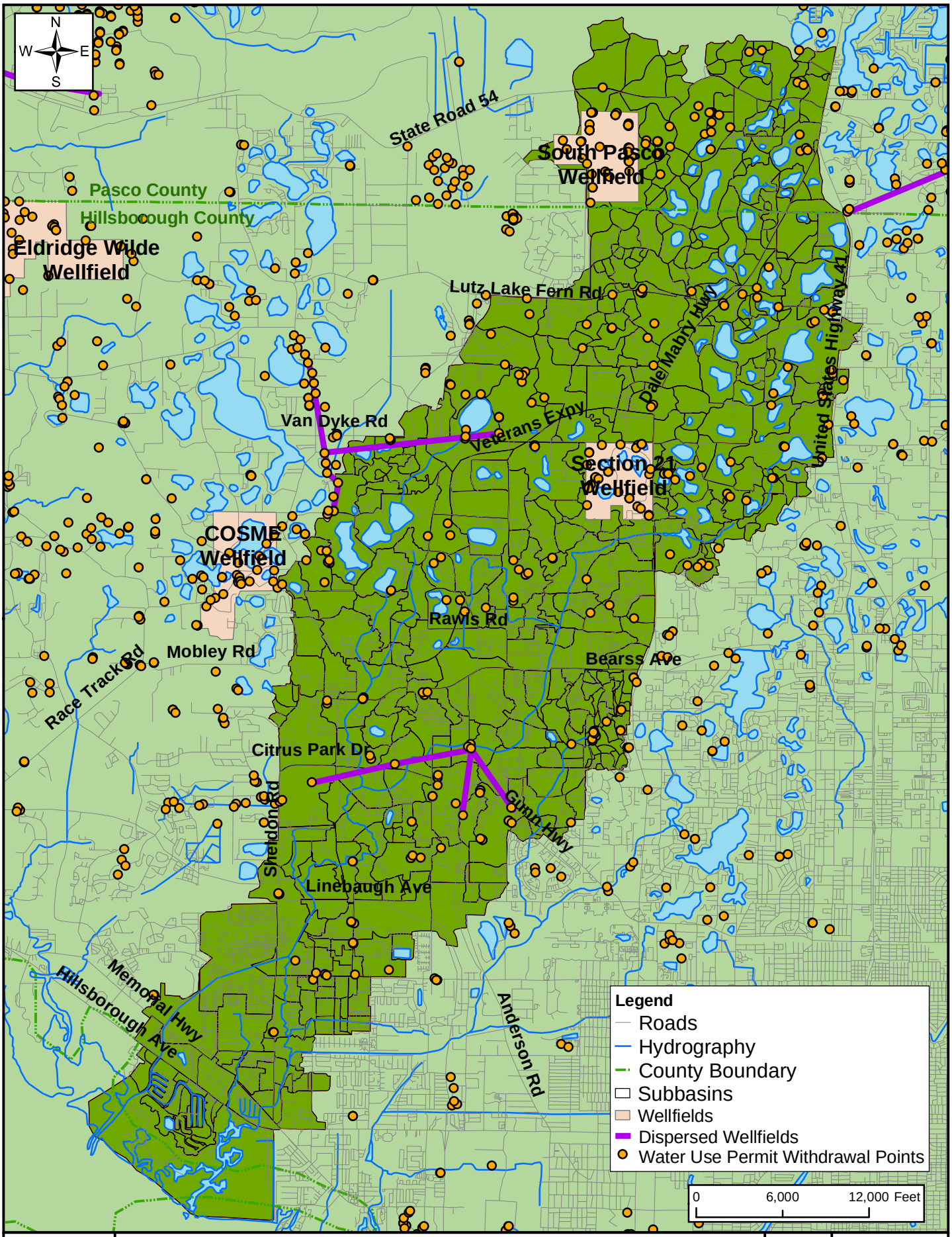
Figure 9-1B Tampa Bay Water Future Infrastructure
(Source: Tampa Bay Water, 2006)

9.2 Groundwater Use

Hydrogeologic Setting - The project area constitutes a hydrogeologic transition zone between the northern and southern regions of the SWFWMD's 16-county service area. The surficial aquifer is composed of unconsolidated deposits of fine-grained sand, silt, and clayey sands having an average thickness of 30 feet. The elevation of the water table ranges from 5 feet NGVD to approximately 50 feet NGVD in the northern portion of Northwest Hillsborough County. In the Rocky/Brushy Creek watershed, the water table ranges from 10 – 50 feet NGVD. Groundwater derived from this aquifer is used most often for lawn irrigation and livestock watering as the aquifer produces yields that typically range around 20 gallons per minute. While of no significance for direct use for potable supply, the surficial aquifer is important in the northeastern portion of the project area as a source of recharge for the Upper Floridan Aquifer via vertical leakage across the semi-confining unit, a vertical zone composed of clays of a thickness ranging from 2 to 60 feet that is discontinuous across the project area. The Rocky/Brushy Creek watershed includes some areas (northern portion of the watershed) that have a recharge rate of 1.0 – 10.0 inches per year and other areas (central and southern portions of the watershed) that are discharge zones. The Upper Floridan Aquifer, composed of a continuous series of carbonate units, ranges from 1000 feet to 1100 feet thick in the project area; in the Rocky/Brushy Creek watershed, the thickness of the Upper Floridan is within that range. The Upper Floridan is very close to the land surface in some areas, and in the Rocky/Brushy Creek watershed, the limerock of the Upper Floridan comes to within 10 feet of the land surface. Because of the Upper Floridan's close proximity to land surface in the Rocky/Brushy Creek watershed and the effects of large-scale groundwater withdrawals in the watershed, the opportunity for contamination of the Upper Floridan is high in the northern portion of the watershed. In the central and southern portions of the watershed, the contamination potential is moderate to low, respectively.

The Section 21 Wellfield, the Northwest Hillsborough Regional Wellfield, the South Pasco Wellfield, some components of the Cosme Wellfield, and numerous potable supply wells are located in the Rocky/Brushy Creek watershed (Figure 9-2).

In the Hillsborough County portion of the NTBWUCA, the estimated withdrawal of groundwater amounted to 92.6 million gallons per day (mgd) in 2002, while the permitted groundwater quantities totaled 116.2 mgd. Over the period 1993 – 2002, actual withdrawals from the four public supply facilities that are located in the geographical limits of the Northwest Hillsborough area (Cosme-Odessa, Eldridge-Wilde, Northwest Hillsborough, and Section 21) have ranged from a low of 51.4 mgd in 1993 to a high of 59.3 mgd in 2000 (Figure 9-3). However, the groundwater withdrawal reduced after 2000 (Figure 9-3). Groundwater withdrawals over that period have shown a very slight increasing trend, although the increase is not statistically significant. For comparison, in all of Hillsborough County, a total of 174.8 mgd was utilized for potable supply (47.5%), agriculture (38.9%), industrial and commercial uses (6.3%), recreational and aesthetic uses (5.9%), and mining/dewatering (1.3%).



Wellfield and Well Locations in the Rocky/Brushy Creek Watershed

Figure 9-2

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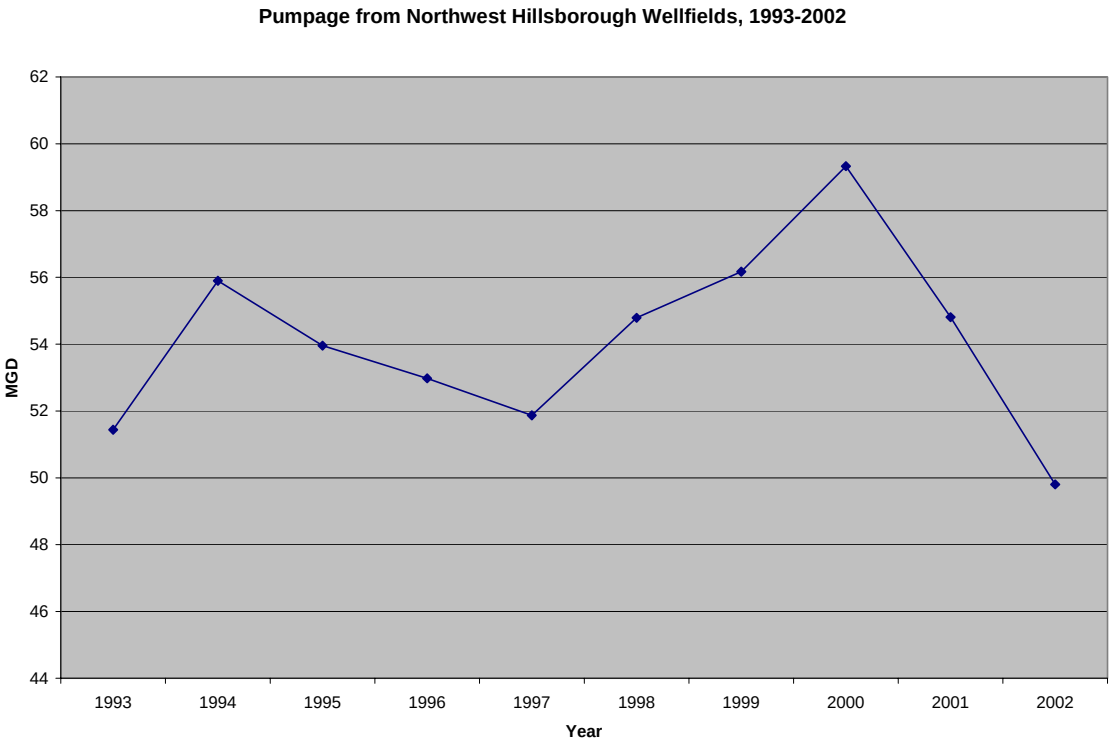


Figure 9-3 Groundwater Withdrawals-Northwest Hillsborough Public Supply Facilities
(Source: SWFWMD, Estimated Water Use, 2002)

Currently, the average production limit for the public supply facilities in the Northwest Hillsborough area totals 57.5 mgd (Table 9-1).

Table 9-1 Average Production Limits (mgd) for the Public Supply Facilities in the Northwest Hillsborough Area

WATER SUPPLY FACILITY	AVERAGE PRODUCTION LIMIT (MGD)	DESTINATION OF WATER PUMPED
Eldridge – Wilde Wellfield	26.5	SK Keller pumping station
Northwest Regional Wellfield	10	Cosme treatment plant and NW Hillsborough treatment facility
Cosme-Odessa	11	Cosme treatment plant
Section 21	10	Lake Park treatment plant
TOTAL	57.5	

Total per capita water use for the period, 1993 – 2002, ranged from a low of 105 gallons per capita per day (gpcd) in 1998 to a high of 154 gpcd in 1995 for both surface and groundwater sources (Figure 9-4). Per capita water use showed a slight decreasing trend over that period, but it was not statistically significant. In 2003, Hillsborough County utilized approximately 70% of its reuse capacity. On a per capita basis, the actual rate of reuse amounted to 30.54 gpcd, while the reuse capacity equaled 43.4 gpcd.

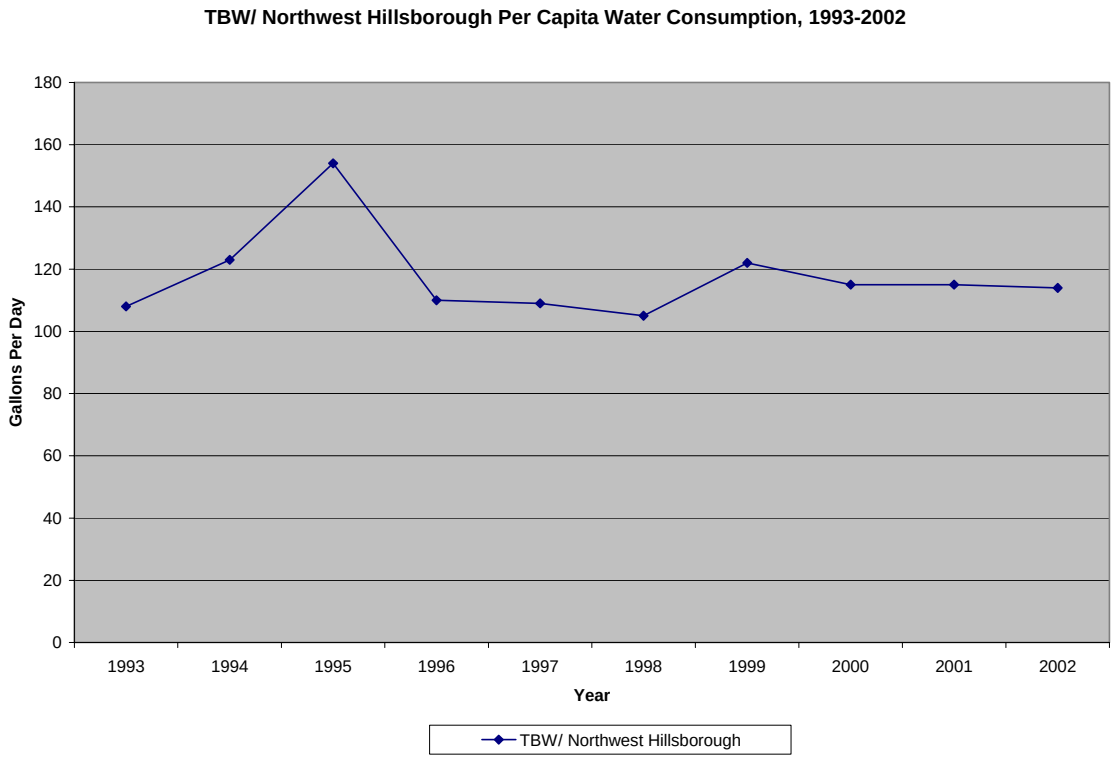


Figure 9-4 Per Capita Water Use in the NTBWUCA
(Source: SWFWMD, Estimated Water Use, 2002)

Figure 9-5 shows the cumulative rainfall (inches) and the "variance from normal" (NOAA) for the period between May 2005 through April 2006 for Tampa International Airport (TIA), while Table 9-2 lists other rainfall stations that are located within the NTBWUCA and operated by SWFWMD. The TIA station reports an above-normal rainfall condition equaling 2.7 inches at that location.

However, due to the nature of rainfall over a large geographic area, the rainfall surplus for the area as a whole as represented by the nine rainfall stations listed in Table 9-2, the rainfall amounts to 0.7 inches over the April 2005 – March 2006 time period. In addition, the average rainfall amount for March 2006 in the Northwest Hillsborough area was 0.13 inches, which represents a departure from the normal March rainfall amount totaling -3.24 inches. Since January 2006, the departure from normal for the time period January – March was 1.49 inches.

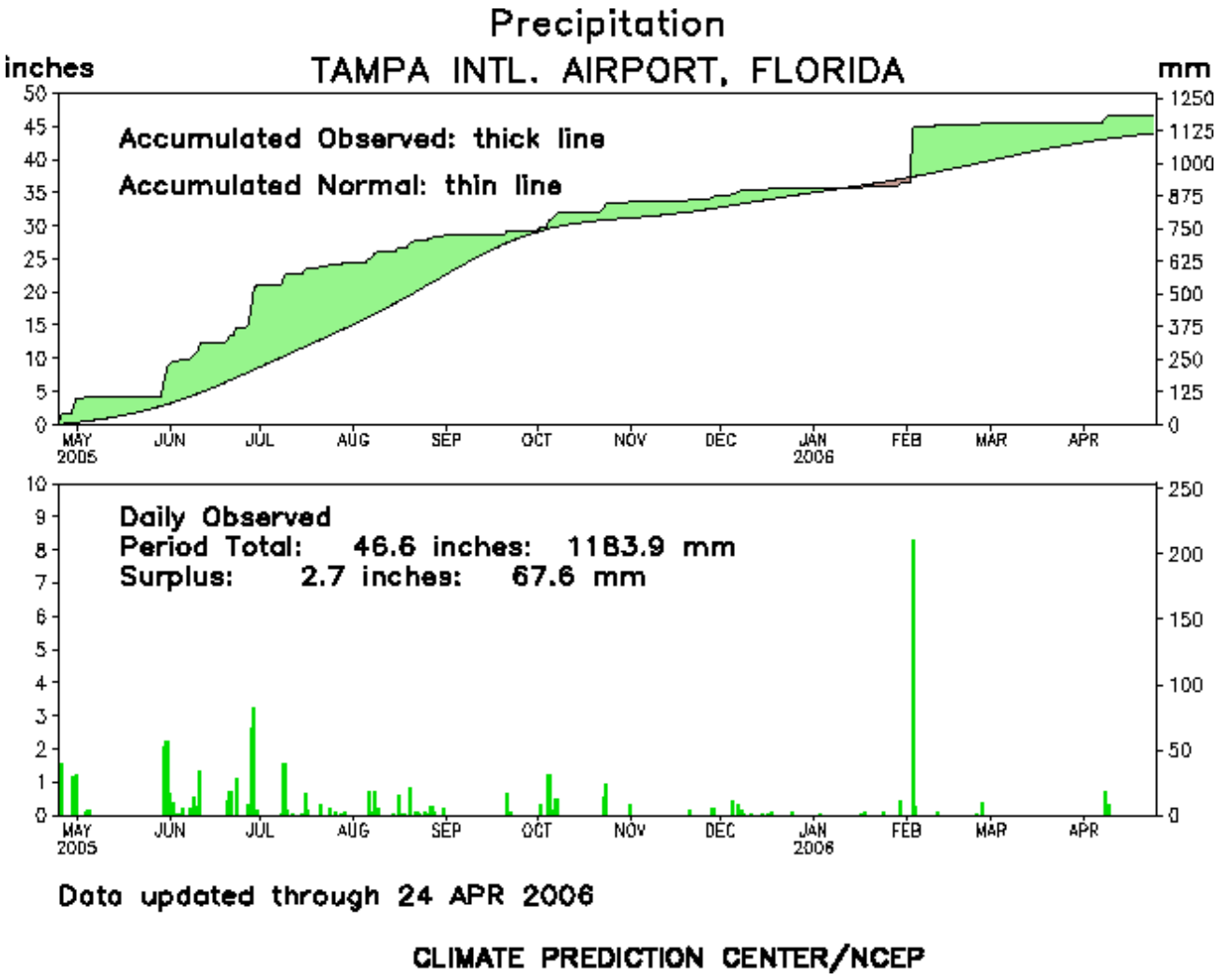


Figure 9-5 Rainfall and Departure from Normal for the Tampa International Airport
(Source: SWFWMD, Estimated Water Use, 2002)

Table 9-2 Rainfall Stations in the Northwest Hillsborough Area
(Source: SWFWMD)

TYPE	SITE	SITE NAME	LATITUDE	LONGITUDE
RNF	313	E-101 (ROMP TR 13-3)	280355.05	823818.34
RNF	390	CRESCENT LAKE	280918.04	823552.34
RNF	394	ISLAND FORD	280909.04	823614.34
RNF	395	BAY LAKE	280410.05	822958.33
RNF	440	LAKE COMO ET	281056.03	822811.33
RNF	503	LAKE HANNA	280830.02	822648.92
RNF	538	ELDRIDGE-WILDE 2N	281011.04	823905.34
RNF	561	ST PETE 42	281036.03	823056.33
RNF	582	ST PETE JACKSON 26 A RAIN	280733.04	823057.33

Groundwater levels in the Northwest Hillsborough area as represented by three monitoring wells, (EWWF 11 FLDN, EWWF 2S DEEP, AND COSME 3-FLDN) indicate that groundwater elevations for March 2006 are declining from those observed in April 2006, but they have not reached the historical low for March (Table 9-3).

Table 9-3 Comparison of Groundwater Elevations (NGVD) in Northwest Hillsborough Area
(Source: SWFWMD, Hydrologic Conditions Report – March 2006)

WELL	WATER LEVEL, MARCH, 2006	CHANGE FROM PRIOR MONTH	MARCH HISTORICAL LOW LEVEL	LOW LEVEL FOR PERIOD OF RECORD
COSME 3 FLDN	21.47	-5.45	20.77	10.94
EWWF 11 FLDN	14.32	-2.57	7.33	0.31
EWWF 2S DEEP	16.45	-2.29	6.62	-1.16

The Northern Tampa Bay Phase II (NTB II) project was initiated by SWFWMD as an outgrowth of the 1989 declaration of the NTBWUCA and the Northern Tampa Bay Water Resource Assessment Project (WRAP) which was completed in 1996. This study will continue through 2010 and will include assessments of the biological and hydrological conditions in Northern Tampa Bay to support the development of minimum flows and levels, water resource recovery, water use permitting, and environmental resource permitting. NTB II consists of a series of technical projects in Northern Tampa Bay to support the ongoing development of minimum flows and levels, water resources recovery, water use permitting, and environmental resource permitting.

The goal of the NTB II project is to enhance the data collection effort, implement projects for the assessment of water supply needs, and to develop a water resources recovery strategy. As of 2005, 30 nested groundwater monitoring sites have been installed and 50 new wetland monitoring sites have been established, many of them in the Northwest Hillsborough area. These projects include detailed assessments of water resources and involve intensive data collection and monitoring to characterize hydrologic conditions and determine the effects of water withdrawals (SWFWMD, 2000).

9.3 Surface Water Use

The majority of the Northwest Hillsborough area relies on groundwater for its water supply, but the Sweetwater Creek and Lower Sweetwater Creek Watersheds together with a portion of the Rocky/Brushy Creek Watershed are within the service area of the City of Tampa for which the primary water source is Hillsborough River Reservoir. In 2002, the Northwest Hillsborough area was supplied with 54.998 mg for public supply from wellfields in the area; in that same year, a total of 85.477 mg was provided from surface water sources.

Lakes and Streams - Fifty-seven named, natural lakes exist in the Rocky/Brushy Creek watershed study area. These lakes range in surface area from 93 acres (Carlton, aka Turkey Ford) to the 15-acres Lake Charles. These water features are permanently inundated, although water elevations rise and fall as a result of rainfall and groundwater pumping rates. Most lakes have been affected by agricultural development followed by urbanization and groundwater withdrawals.

The watershed contains five named streams: Brushy Creek, Rocky Creek, Channel A, Woods Creek, and Pepper Mound Creek. The channel of Brushy Creek is narrow along its entire length, while that of Rocky Creek is narrow in its upper reaches but widens as the Creek approaches the bay. A segment of Rocky Creek was channelized and a diversion canal, Channel A, was constructed off of Rocky Creek east of Sheldon Road. Channel A empties into the bay west of the original channel of Rocky Creek.

Reservoirs - Reservoirs are artificial impoundments of water constructed in association with agricultural and residential development in the watershed; residential reservoirs are managed to provide aesthetic or stormwater management functions. In the Rocky/Brushy Creek watershed, there are 33 named artificial ponds, 14 of which that participate in the County's Adopt-A-Pond program; all are associated with residential properties. While not natural lakes, these surface water bodies are numerous enough to contribute to the watershed's water resources in recharge, water quality, and flood abatement.

9.4 Water Supply Issues / Areas of Concern

With the recent occurrence of widespread drought within the region, many concerns have been raised as to how the future water supply needs will be met. In recent years, several projects have been proposed and initiated to meet the future water needs of the region. However, it remains to be seen whether these new projects will provide sufficient water without causing significant adverse impacts on the environment. Several studies have documented the decline in water levels of wetlands, lakes as well as groundwater (SWFWMD, 1996). The demand for water will continue to increase as population grows and both groundwater and surface water supply needs increase.

Furthermore, with increasing development in the region, there will be less permeable land available for the rainfall to replenish the groundwater.

9.4.1 Aquifer Recharge

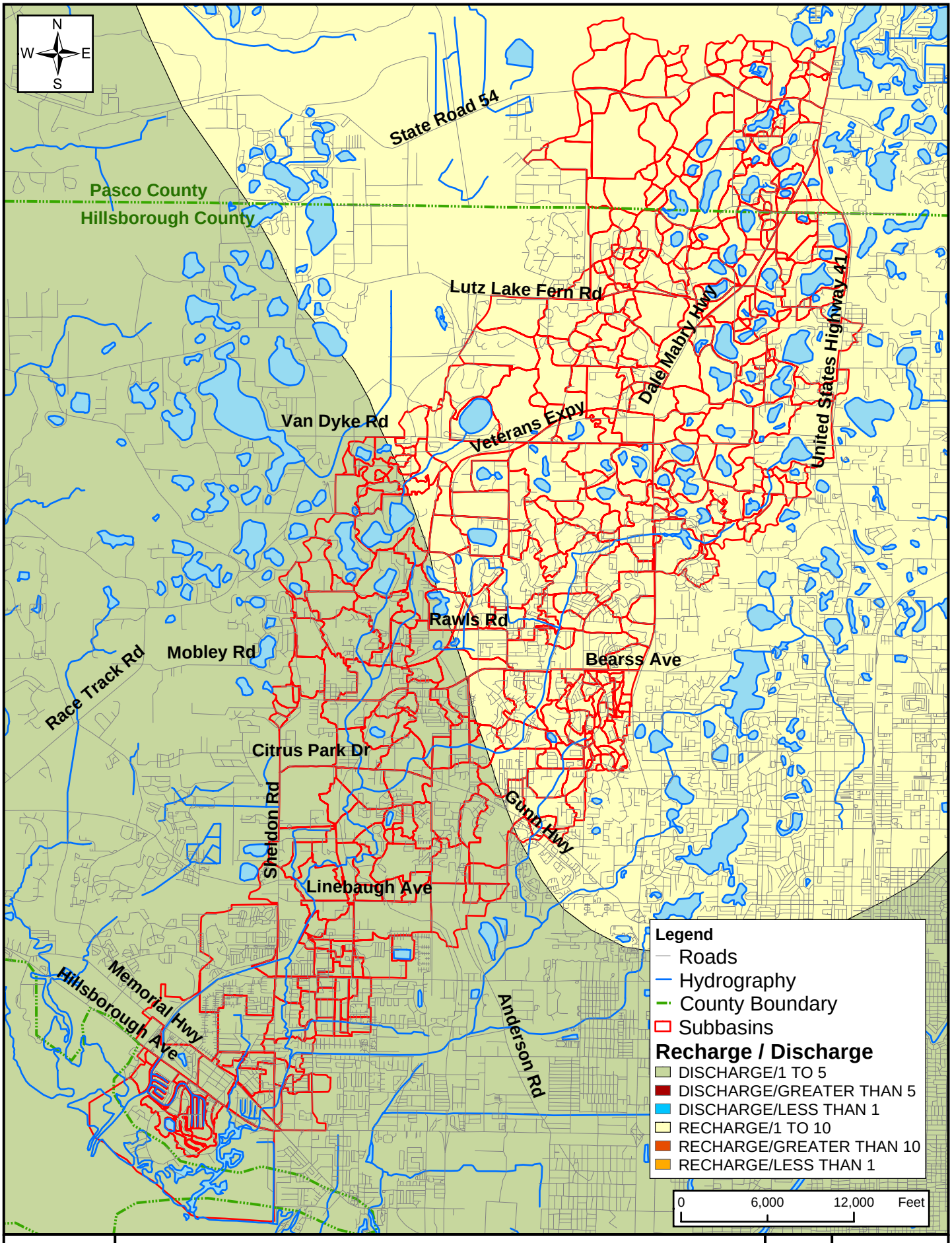
Approximately half of the Northwest Hillsborough area occupies lands where recharge to the Floridan Aquifer occurs at a rate varying from 1.0 inch to 10 inches per year. This area includes the upper reaches of the Rocky/Brushy Creek Watershed. The remainder of the Northwest Hillsborough area is a discharge area that discharges from the Floridan aquifer at an estimated rate of 1 to 5 inches per year (SWFWMD, 1996). Figure 9-6 presents the recharge and discharge rates within the Northwest Hillsborough area. Protection of recharge areas in the watershed is critical to the preservation of the regional groundwater sources and meeting regional water supply demands.

Several management and regulatory strategies have been undertaken in recent years to enhance aquifer recharge in the Northwest Hillsborough area, which include the following:

- Optimization and expansion of existing aquifer storage and recovery systems
- Delineation of recharge/discharge relationship
- Identification of sites for wetlands, lake, and aquifer rehydration
- Identification of opportunities to re-engineer stormwater management systems to enhance groundwater recharge and improve water quality in waterbodies used for drinking water
- Identification of opportunities to use reclaimed water for rehydration
- Improvement of wellhead protection ordinances to include recharge areas and landuse ordinances
- Modification of Environmental Resource Permit (ERP) regulations to enhance aquifer recharge
- Modification of local, state, and District regulations to maintain and enhance groundwater recharge

9.4.2 Impacts Due to Water Withdrawals

The literature describing the effects of groundwater withdrawal on wetland hydroperiods and lake stages dates to 1971. Since that time, the nature of the impacts to wetlands has been documented in wetlands both in and around major wellfields (Rochow, 1998). Generally, symptoms of wetland health decline (e.g., replacement of aquatic plant species by upland species, tree-fall, soil subsidence, loss of wetland-dependent wildlife) have occurred in the vicinity of large-scale groundwater withdrawals (e.g., Section 21, Cosme, Northwest Regional, and Eldridge – Wilde, and South Pasco Wellfields). As a Water Use Permit (WUP) condition, permit holders have been required to monitor water levels and ecological indicators of wetland viability, and annual reports have been prepared describing wetland hydrobiological conditions since the mid-1970s. The link has been made between groundwater withdrawals and reduced hydroperiod in area wetlands. Under the NTB II project, the SWFWMD has established many more wetland monitoring sites, and recovery strategy has been developed.



Generalized recharge or discharge rate of the Floridian Aquifer System (in/yr)

Figure 9-6

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The recovery strategy involves:

- District and Tampa Bay Water (TBW) water level monitoring
- District and TBW biologic monitoring (WAPs)
- TBW annual assessment of wellfields (annual reports)
- District Minimum Flows and Levels (MFL) monitoring
- Environmental Monitoring Plan (EMP) referrals to the Operations Plan

During the first several years of pumpage from the three wellfields in the project area, wetlands within the wellfield's zone of influence exhibited signs of wetland health decline including the replacement of wetland vegetation with upland species. These ecological changes were attributed to sustained groundwater production as well as below normal rainfall conditions. From about 1986 to 1993, overall annual pumpage rates for the wellfields were reduced by nearly 40% compared to the original production period. Recent pumpage data from the area's three wellfields, however, indicates that the production in the wellfields has increased but not significantly.

Several management strategies have been proposed and/or undertaken to minimize the impacts due to water withdrawals, which include:

- Development of operation and management plans to minimize environmental impacts for all permitted water users
- Implementation of projects associated with the NTBWUCA
- Investigation for alternative sources of water
- Development and implementation of aggressive water conservation and water reuse programs
- Continuation of cooperative funding to encourage development of alternative water sources
- Continuation of regulatory requirements/incentives for alternative water sources

9.4.3 Minimum Flows and Levels

Chapter 373.042 (2) F.S., requires the SWFWMD to adopt minimum flows and levels on streams, lakes and aquifer water levels throughout the District. By statute the District must prioritize the adoption of minimum levels in areas of Hillsborough, Pinellas, and Pasco counties which are experiencing or are expected to experience adverse impacts because of groundwater withdrawals. In response to this charge the District has proposed minimum levels in lakes, wetlands, and aquifers in priority areas including the Northwest Hillsborough area.

Establishment of minimum flows and levels (MFLs) constitutes defining the minimum flow regime and water levels necessary to prevent significant environmental impacts to lakes, wetlands, streams, and aquifers. The Hillsborough County Comprehensive Plan (Coastal Management Element) requires cooperation between the County and the SWFWMD to ensure that the minimum freshwater flows needed to support natural, optimal diversity and productivity in estuarine areas are scientifically determined and maintained.

To date in the Northwest Hillsborough area, levels have been set by the District on 15 wetlands, seven wells, and 15 lakes. Lakes having Minimum Levels adopted by SWFWMD's Governing Board include: Alice, Calm, Church, Crescent, Echo, Garden, Horse, Jackson, Juanita, Little Moon, Mound, Rainbow, Sunset, and Taylor.

In addition, Lakes Raleigh and Rogers are scheduled for MFL development in 2006, and Brooker Creek is scheduled in the 2011 – 2018 timeframe.

The key management strategies of the MFL program include:

- Prioritization of areas where determination of minimum flows and levels are needed
- Development of scientific justification for establishing minimum flows and levels
- Development of action plan and permitting strategies to work toward achieving the minimum flows and levels where existing levels are below the minimum levels

Water supply issues are being addressed by SWFWMD, TBW, the City of Tampa, and Hillsborough County in order to balance the protection of water resources with sustainable development. New sources of potable water are being developed by Tampa Bay Water member governments, and projects implemented through these efforts will address improvements to water supplies in concert with water quality, flooding, and natural systems restoration.

9.5 Bibliography

The attached bibliography includes a list of references used for this study and additional references that could be cited by readers.

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