3.12 Long Term Maintenance Plan

3.12.1 Engineering/Hydrologic Improvements Maintenance Plan

In this section, the long-term maintenance costs for the Levy Nuclear Plant mitigation site are provided, specifically the cost associated with low water crossings and culverts along with other non-engineered maintenance on the mitigation sites, relative to the following road maintenance service objective.

Road Maintenance Service Objective

The proposed road service objective is maintenance for pickup trucks, with some sections that are native and some gravel surfaces. Annual average daily traffic is 10 vehicles or less, mainly for security monitoring along with the wetland mitigation monitoring and maintenance.

General Site Maintenance

All mitigation features shall be visually inspected on a once a month basis. This inspection shall include the following items:

- roadbed thickness inspections;
- inspection and maintenance of erosion and sedimentation controls;
- vegetation removal; and
- debris removal.

Inspection schedule: Once every month.

Low Water Crossing Maintenance

All low water crossings shall be visually inspected on a once a month basis. This inspection shall include the following items:

- inspection of stream flow across low water crossing;
- removal of debris, branches, and soil deposits;
- inspection of the gravel roadbed and bedding for erosion;
- review of structural integrity of the low water crossing; and
- review of thickness of roadway through the low water crossing.

Inspection schedule: Once every other month.
Useful life of the culvert system: 30 years

Costs for Maintenance

Mitigation Activity/Site	Annual Operation and Maintenance Costs	Design Life (yrs)	Total Operations and Maintenance Costs for Design Life
Low Water Crossing 2-A3	$2,743.33	30	$82,299.90
Low Water Crossing 2-A4	$2,553.33	30	$76,599.90

See the Overall Mitigation Area Maintenance Costs Schedule in Appendix B.

3.12.2 Long Term Invasive/Exotic Species Management Plan

The Florida Exotic Pest Plant Council (FLEPPC) categorizes invasive and exotic species as the following: Exotic-a species introduced to Florida, purposefully or accidentally, from a natural range outside of Florida; Naturalized exotic-an exotic that sustains itself outside cultivation, i.e., it is still exotic and has not become native; Invasive exotic-a exotic that has not only naturalized, but is expanding on its own in Florida native plant communities. These species have been further categorized as Category I or Category II, based on the documented ecological damage that has occurred.

The mitigation construction activities can lead to conditions for the establishment of invasive and exotic species within these disturbed areas. This long-term maintenance plan will detail the invasive/exotic species that could potentially populate within the proposed plant site. The plan will also discuss the most appropriate and effective treatment methodology(ies) for each species.

Below is a list of the common invasive and exotic species potentially found within the proposed mitigation sites, as well as recommended treatment methodologies, preventative measures and monitoring criteria.

Upland Species List

1. Cogon grass (*Imperata cylindrica*). This is a grass species that typically grows in disturbed upland areas such as roadway edges and recently timbered sites. This plant contains rhizomes and in order to successfully eradicate, the rhizomes must be fully destroyed. The cogon grass seed is typically spread through wind or wildlife movement and is very difficult to contain.

Recommended Treatment: Mechanical removal or regular foliar application of herbicide.

2. Chinaberry (*Melia azedarach*). Chinaberry is a tree that can grow up to 50 ft. tall and is commonly found in disturbed areas mostly in uplands, but can be found within wetlands. It often forms thickets and can reproduce quickly by spreading numerous seeds through bird and other wildlife movement. Due to the woody nature of the stem, chemical treatments are the most effective.

Recommended Treatment: Mechanical cutting and cut stump application of herbicide.

3. Camphor tree (*Cinamomum camphora*). The camphor tree can reach heights of 65 feet and produce an abundance of seeds on a regular basis. Theses seeds are spread quickly by wildlife and are quick to mature. Camphor tree is typically found within drier disturbed sites, but can eventually populate within natural areas.

Recommended Treatment: Mechanical cutting and cut stump application of herbicide for mature species, foliar application of herbicide for juveniles.

Wetland Species List

1. Chinese tallow (*Sapium sebiferum*). Chinese tallow tree can grow as tall as 50 feet and often has multi-stemmed trunks that can quickly shade out competing species. It is typically found in wetter, disturbed areas but can also thrive in well drained upland areas in addition to fresh and saline soil types. The species can quickly overtake a habitat due to its broad leaf coverage, shading and high seed output. The young juvenile species can be easy to treat and prevent from spreading, but once the species matures, it becomes very difficult to fully eradicate. Physical removal of juvenile species is sometimes an option, but can be costly and time consuming.

Recommended Treatment: Foliar application of herbicide for juveniles, frill girdle and cut stump application of herbicide for mature individuals

2. Peruvian primrose willow (*Ludwigia peruviana*). This species of Ludwigia typically grows into a large shrub approximately 6-8 feet high. It typically grows on pond edges or other areas of shallow standing water. It is also very advantageous and will populate quickly in disturbed areas.

The plant blooms all year, so it generates very quickly and if left uncontrolled, can quickly overtake an area and shade out desirable wetland groundcover and other emergent plants.
Recommended Treatment: Foliar application of herbicide

3. Brazilian pepper (*Schinus terebinthifolius*). Brazilian pepper is a highly invasive, destructive species that can grow as tall as 40 feet and typically has numerous trunks and branches that form tangled masses as they mature. These masses ultimately shade out desirable wetland groundcover species as well as juvenile shrub and tree species. It also has very high seed output and quickly spreads in disturbed areas and road edges, as well as undisturbed natural areas. The plant also produces allelopathic agents which suppress other competing plants from growing. Once established, mature species are very difficult to eradicate.

Recommended Treatment: Foliar application of herbicide for juveniles, frill girdle and cut stump application of herbicide for mature individuals.

4. Torpedo grass (*Panicum repens*). Torpedo grass is a low growing, aquatic grass that can reach as high as 3 feet. This species will establish in or near shallow waters and quickly form a monoculture that will displace native vegetation. The plant reproduces through rhizome extension and fragmentation, so mowing, cutting or disking is not effective and often makes the problem worse. Regular foliar application that eventually kills the rhizome is the most effective treatment method.

Recommended Treatment: Foliar application of herbicide.

5. Japanese climbing fern (*Lygodium japonicum*). The Japanese climbing fern is a vine that can grow up to 90 feet long. It is typically found in both sunny and shady disturbed areas such as yards and roadsides, but can also be found along less disturbed edges of swamps and marshes. The vine grows quickly and forms tangled masses over groundcover and shrub and juvenile tree species which smothers seedlings and prevents further forest growth. Physical removal may be applicable in some cases, so as not to harm the desirable species that are present, but this option is only viable for small populations.

Recommended Treatment: Foliar application of herbicide.

6. Old World climbing fern (*Lygodium microphyllum*). The Old World climbing fern is very similar to the Japanese climbing fern and has the same growth, production and habitat characteristics. The treatment for

both species uses the same approach and regular foliar treatment is usually the best option. Physical removal may be applicable in some cases, so as not to harm the desirable species that are present, but this option is only viable for small populations.

Recommended Treatment: Foliar application of herbicide.

Nuisance Species of Concern

1. Cattails (*Typha* spp.). Cattails are not listed as Category I or II invasive/exotic species, however, in the warmer southern climates where the species is not regulated by annual freezes, it can quickly establish a monoculture in disturbed wetland areas. Due to its aggressive spreading nature through rhizome establishment and wind and water transport of the seed, the species is often treated as an invasive species. While it does provide some beneficial wetland habitat, it often ends up out competing other desirable herbaceous species. The most effective treatment for cattails is foliar application before the plant begins to seed.

Recommended Treatment: Mechanical removal or foliar application of herbicide.

2. Willow (*Salix* spp.). Much like cattails, willow is not listed as a Category I or II invasive/exotic species. However, it too can exhibit similar qualities and can establish a monoculture in disturbed wetland areas. Most will species are trees that can grow very quickly and contain large, thickly vegetated limbs. These limbs spread out from the main trunk and often end up shading other desirable species.

Recommended Treatment: Mechanical cutting, frill girdle and cut stump application of herbicide

Treatment Methodologies

1. Mechanical. Mechanical treatment includes the use of heavy machinery such as a bulldozer or back hoe, small machinery such as a bushhog or tractor and hand tools such as weed eaters and pruning tools. This methodology is best utilized when access to the treatment area is not an issue and will not cause further damage. In addition, species such as cogon grass and torpedo grass often have shallow root systems that a bulldozer or backhoe can completely remove. Other species such as the Chinese tallow are often not suited to mechanical removal due to their deep root system as established trees and high incidence of seeds within

the surrounding soil. Mechanical removal can be very effective under the right conditions, but can often be expensive and time consuming due to disposal of removed material.

2. Manual. Manual treatment is often the most labor intensive and least productive treatment method. It involves physically removing the invasive species and is only applicable for certain species.

3. Chemical. Chemical treatment involves applying approved herbicides directly to the target plant through a variety of application techniques. Specific herbicides are produced that disrupt the growth process of the plant and ultimately kill it. Different herbicides are designed to target specific plant types and it's important to use the proper herbicide on the correct plant in order to yield the best results. Herbicide application methodologies include three different techniques: Foliar, frill girdle and cut stump. Foliar application involves diluting the herbicide with water and applying the mixture directly to the plant's leaves and stems. Frill girdle application (also known as hack-and-squirt) is primarily used on tree species and involves cutting several notches in the base of the tree and injecting an herbicide directly into the interior of the tree. The tree's natural process then distributes the herbicide throughout, which ultimately kills the tree. Cut stump application is also used primarily on tree species and involves cutting down the target tree and "painting" the cut stump with an herbicide mixture to prevent the stump from re-sprouting.

The use of any herbicides will be conducted by a Florida Department of Agriculture licensed pesticide applicator, who is certified for herbicide application in the categories of "Natural Areas Weed Management" and "Aquatic Pest Control". In addition, during the use of any herbicide, all application rates and handling will be conducted in strict accordance with the associated product label to achieve the best results and remain in compliance with Florida law.

Preventative Measures

Once construction commences, DEF will introduce preventative measures where possible to help curb the establishment or spreading of any invasive or exotic species. These measures will be determined on-site as the clearing and impacts occur. In some cases, preventative measures may not be available or practical.

When possible preventative measures that may include planting, seeding or hydro-mulching will be applied to help control the establishment of

invasive/exotic species. Each area will be assessed prior to and immediately after any clearing activities to determine the extent of the clearing that occurred and any potential invasive/exotic species that may be present or nearby that could result in contamination.

Monitoring

Monitoring is an important aspect of long-term control of invasive and exotic species as it ensures that the on-going maintenance efforts are effective and achieving the desired results. Many treatment methodologies require numerous follow up events in order to successfully eradicate the target species. A regular monitoring plan allows for documentation of the maintenance efforts and provides for a way to determine how effective the efforts have been. A detailed monitoring plan is important to ensure that the maintenance efforts are successful.

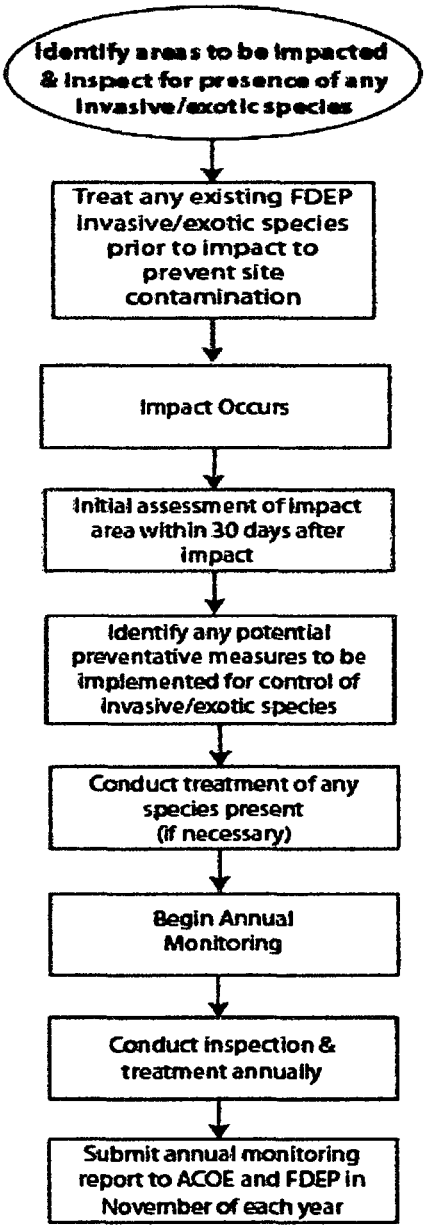
The mitigation activities will impact the existing vegetation during the construction process. These disturbed areas will provide for potential habitat for the establishment of invasive and exotic species. These areas will be inspected both before and during the clearing and installation process to determine the presence and extent of any existing populations of listed species. During this time, if any invasive and exotic species are identified a treatment event prior to disturbance may be conducted in order to help prevent further spread of the species. Each disturbed area will be inspected on an annual basis in order document any changes or need for additional treatment events. This documentation will include the recording of the location and prevalence of any listed species observed, any potential alternative treatment options and photo documentation.

Specific monitoring stations will be established within each mitigation area. The location of these monitoring stations will be determined in the field based on the areas that supported invasive and exotic species and/or require the most treatment. In some cases, it may be appropriate to establish monitoring plots within a particular treatment area depending on the size of the area. Each area will be assessed for what type of species is present, the recommended treatment method, success of any previous treatments and any other conditions worth noting. A baseline habitat map will be established for each treatment area that will detail the existing populations of both desirable and invasive/exotic species prior to the impacts occurring. This habitat map will be updated after each treatment event to determine any changes from the previous event.

Annual reports of the maintenance and monitoring plan will be submitted during November of each year. Each report will include the dates of each maintenance and monitoring event, results, photographic documentation, maps and recommendations.

Please see the following page for a flow chart that details the proposed inspection, treatment and monitoring plan for the LNP project.

Invasive/Exotic Species Managment Plan



4.0 WITHLACOOCHEE AND HILLSBOROUGH WATERSHEDS – MULTIPLE MITIGATION BANKS

4.1 Introduction

In order to satisfy the Functional loss accumulated within the Withlacoochee and Hillsborough Watersheds, Duke is proposing the purchase of wetland mitigation bank credits from multiple mitigation banks located within these two watersheds. Below is a description of each bank and the total number of credits required from each bank.

Green Swamp Mitigation Bank

The Green Swamp Mitigation Bank (GSMB) is a 632 +/- acre property located within Section 10, Township 25 South and Range 25 East at latitude 28.324887 N and longitude -81.797940 W (approximate center point) in the north-central portion of Polk County, Florida. The GSMB is located approximately 2.42 miles east of U.S. Highway 33, 4.15 miles north of Deen Still Road and north of Van Fleet Drive. The GSMB is connected to the Withlacoothee River System via the Smokey Sutton Canal. The Green Swamp ecosystem is identified as an Outstanding Florida Water (OFW) and is a critical headwater tributary to four major rivers: the Ocklawaha River, Withlacoothee River, Hillsborough River, and the Peace River. A total of 9.2 Freshwater forested credits will be purchased to offset the impacts associated within the Withlacoochee Watershed.

Withlacoochee Mitigation Bank

The Withlacoochee Mitigation Bank (WWMB) is a 734.5 acre property located within Sections 2, 3, 10, 11, 14, 15, and 23, Township 26 South, and Range 25 East at latitude 28.230064° and longitude -81.782733° northeast of Polk City in Polk County, Florida. More specifically, the WWMB is located north of Fussell Road at the intersection of Stagecoach Road. Historically, the property was used for agricultural purposes and impacted the forested wetlands and pine flatwoods through the practices of sod production and cattle farming. The goals of the WWMB are to restore the historically forested and herbaceous wetlands and to restore upland areas to pine flatwoods. A total of 9.8 freshwater forested credits will be purchased to offset the impacts associated within the Withlacoochee Watershed.

Hillsborough River Mitigation Bank

The Hillsborough River Mitigation Bank (HRMB) is a ± 1,109-acre property located within Sections 12, 13, 24, and 25, Township 25 South and Range 19 East; Section 18, Township 25 South and Range 20 East, at latitude 28.3042 N and Longitude -82.3570 W. More specifically, the property is located 1 mile west of I-75, south of State road 52. The HRMB has a large presence of exotic/invasive plant species which has greatly impacted the overall ecological function of the property. Some of the main goals of the HRMB are

to eradicate these plant species, implement a prescribed fire management plan, and restore historic water flow through the floodplain. A total of 15.9 freshwater forested credits will be purchased to offset the impacts associated within the Hillsborough River Watershed.

The above proposed mitigation bank credits will total 19.0 credits to offset impacts within the Withlacoochee Watershed and 15.9 credits to offset impacts within the Hillsborough River Watershed. The Hillsborough River Mitigation Bank will offset a portion of the impacts associated with the Hillsborough River Watershed with the remaining Functional Loss Units to be offset with some of the additional Functional Gain Units generated in Withlacoochee Basin on the LNP site or in the Upper Coastal Basin on the Homosassa Tract.

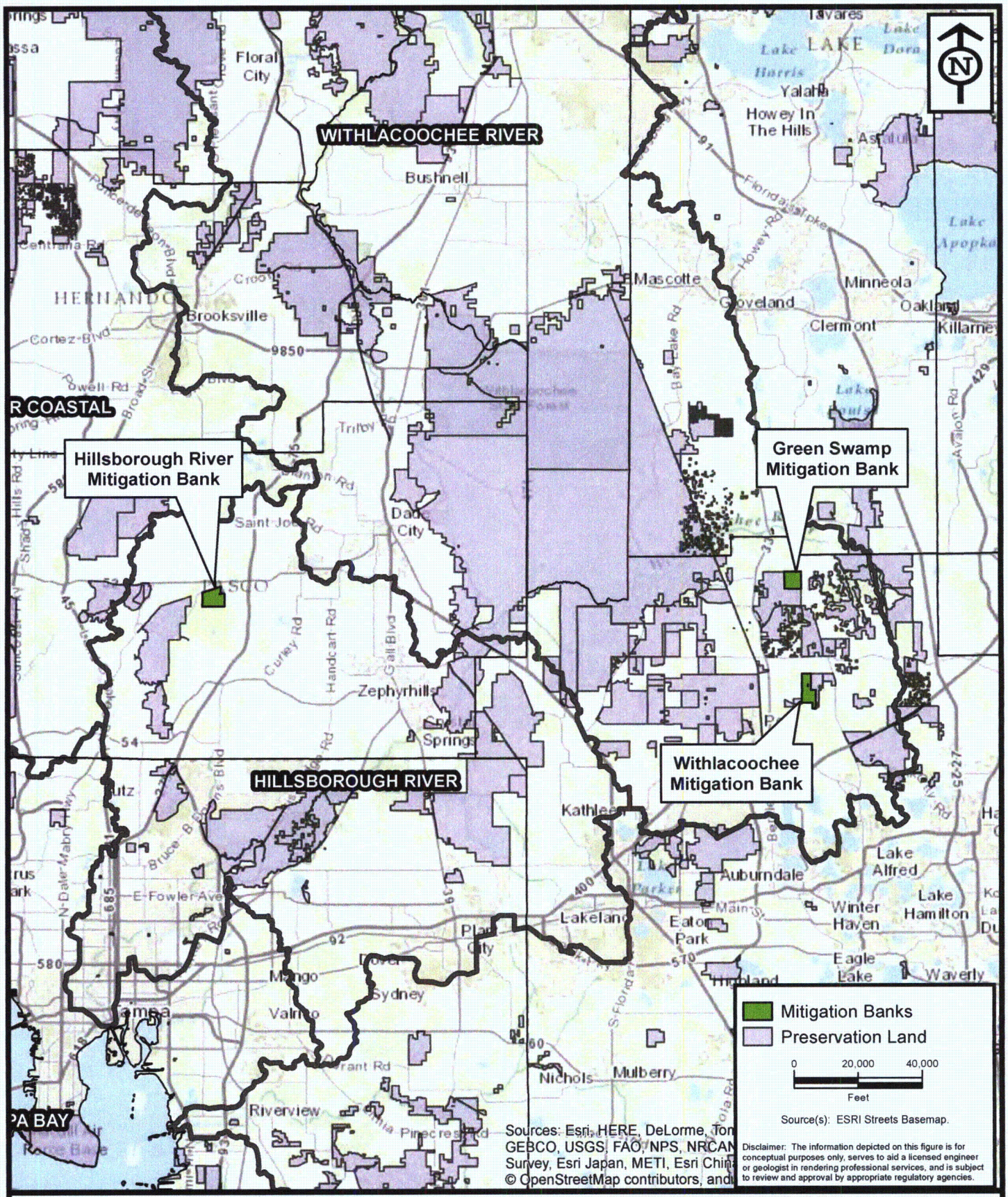
4.2 Impact Summary

The wetland impacts within the Withlacoochee Watershed for the LNP project total approximately 194.1 acres for ACOE and 195.9 acres for FDEP. These impacts will generate a total loss of 44.5 functional units for ACOE (-3.9 herbaceous and -44.6 forested) and 52.9 functional units for FDEP (-10.7 herbaceous and -42.2 forested). The wetland impacts within the Hillsborough River Watershed total approximately 73.8 acres for ACOE and 55.7 acres for FDEP. These impacts will generate a total loss of 20.3 functional units (-17.3 herbaceous and -0.9 forested) for FDEP and 16.2 units of functional loss for ACOE (-15.4 herbaceous and -0.8 forested). The impact summary is provided on Table 4-1. The majority of these impacts will be the result of permanently clearing and/or filling existing herbaceous and forested wetlands. Along with some indirect impacts, the proposed mitigation from mitigation banks will provide for 19.0 functional units of lift within the Withlacoochee River Watershed and 15.2 functional units of lift within the Hillsborough Watersheds.

Although the mitigation bank credits are for forested impacts out-of-kind mitigation is allowed under the watershed approach outlined in Part 325, 33 CFR Chapter II. The mitigation rule also indicates that the use of mitigation banks is the preferred option for compensatory mitigation. In these watersheds herbaceous credits are not available. Therefore the use of out-of-kind mitigation within the watershed provides the best mitigation opportunity available in these watersheds.

Table 4-1. Withlacoochee and Hillsborough Watersheds (Mitigation Banks) Wetland Impacts by UMAM Functional Loss

	ACOE Herbaceous Wetland Functional Loss	ACOE Forested Wetland Functional Loss	ACOE Total Functional Loss	FDEP Herbaceous Wetland Functional Loss	FDEP Forested Wetland Functional Loss	FDEP Total Functional Loss
Withlacoochee UMAM Units	-3.9	-40.6	-44.5	-10.7	-42.2	-52.9
Hillsborough UMAM Units	-15.4	-0.8	-16.2	-17.3	-0.9	-18.2
Total	**-19.3**	**-41.4**	**-60.7**	**-28.0**	**-43.1**	**-71.1**



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Watersheds and Adjacent Conservation and State Lands

Proposed Levy Nuclear Plant Project

Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	4-1

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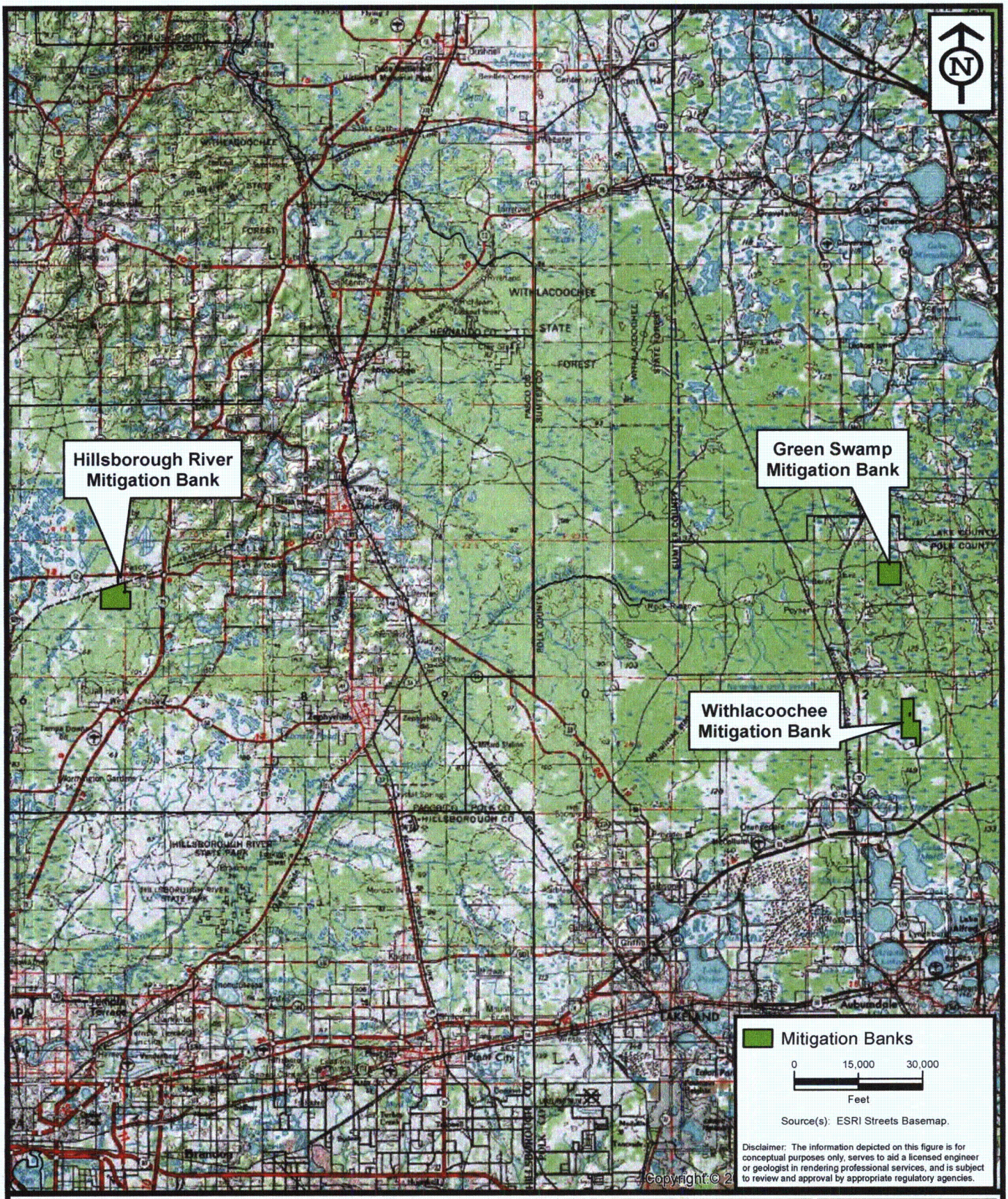

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Mitigation Bank Locations

Proposed Levy Nuclear Plant Project

Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	4-2

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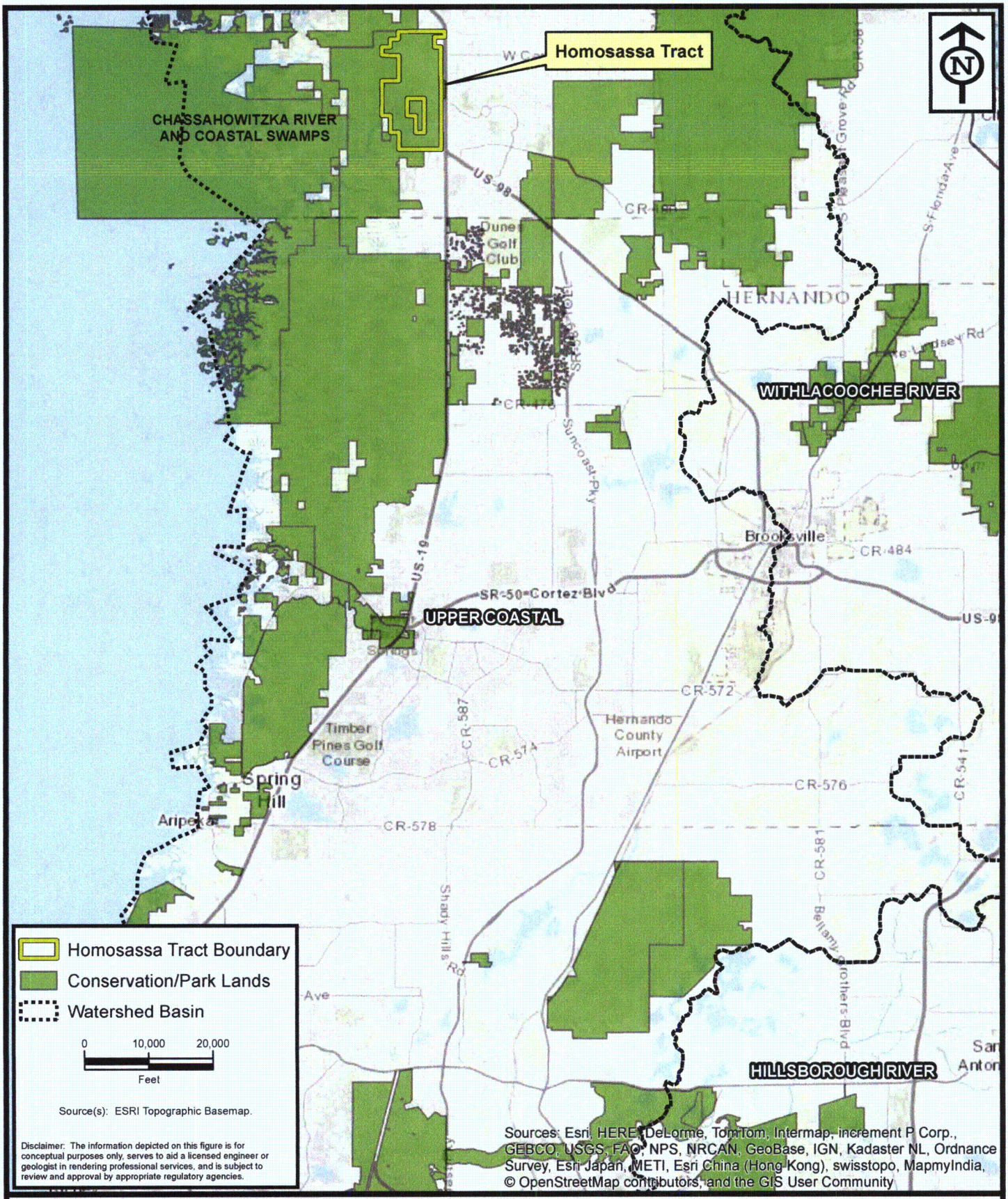
5.0 UPPER COASTAL WATERSHED – HOMOSASSA TRACT, WITHLACOOCHEE STATE FOREST

5.1 Introduction

The proposed wetland impacts for LNP are summarized in Tables 1-1A and 1-1B will have 89.3 acres of impact for ACOE and 86.0 acres for FDEP in the Upper Coastal basin. These will have the functional loss for FDEP: -33.6 UMAM units total; -3.7 herbaceous units and -29.9 forested units, ACOE: -30.1 UMAM units; -2.0 herbaceous units and -28.1 forested units in the Upper Coastal Basin. Mitigation for the impacts within the Upper Coastal basin will occur on the Homosassa Tract (HT) within the Withlacoochee State Forest (Figure 5-1). The HT will produce 55.6 UMAM credits (3.5 wetland herbaceous, 52.1 wetland forested). This section of the overall mitigation plan provides the details for the HT within the Withlacoochee State Forest.

The HT mitigation site is located on state owned lands managed by the FFS in Citrus County, Florida. This 5,529 acre parcel is part of the larger 157,479 acre Withlacoochee State Forest which is made up of 7 tracts. The parcel is located just west of U.S. 19 and lies between the Homosassa River and the Chassahowitzka River. It is situated in close proximity to other public conservation lands such as the Chassahowitzka National Wildlife Refuge, Chassahowitzka Wildlife Management Area, Crystal River Preserve State Park, Crystal River Archaeological State Park, and Homosassa Springs Wildlife State Park. It is adjacent to the Chassahowitzka Riverine Swamp Sanctuary (Figure 5-2). The HT is also adjacent to but not within an aquatic preserve or Area of Critical State Concern and the Chassahowitzka National Wildlife Refuge has designated a Migratory Bird Sanctuary in a portion of the Refuge that adjoins the HT.

The restoration activities proposed at HT will improve wetland and ecosystem functions between two physiographic zones, the coastal swamp and Gulf coastal lowlands. The forest wetland and hydrologic restoration will improve historic hydrological flow associated with the Chassahowitzka Swamp, the largest coastal hardwood swamp along the Gulf Coast of Florida south of the Suwannee River. The tract also encompasses floodplain portions of Mason Creek and Otter Creek. The herbaceous restoration will recreate natural conditions that have transitioned into wetland shrub.



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Upper Coastal Watershed - Proposed Mitigation Sites

Homosssa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-1

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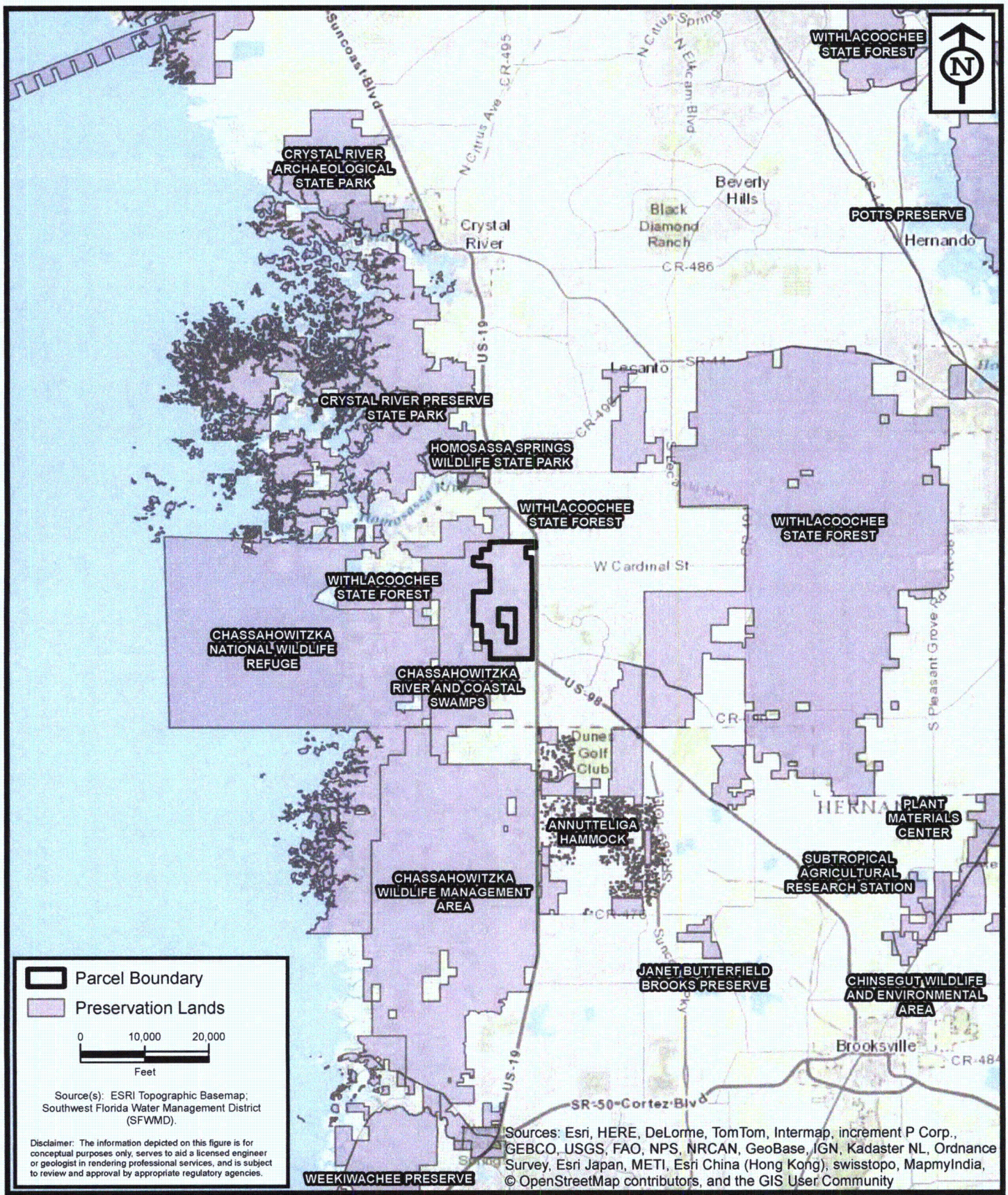

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Regional Preservation Land

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-2

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5.2 Impact Summary

The wetland impacts within the Upper Coastal Watershed for LPN off-site transmission line impacts total approximately 86.0 acres for FDEP and 89.3 acres for ACOE. These impacts will generate a total loss of -33.6 functional units (-3.7 herbaceous and -29.9 forested) for FDEP and for ACOE a total of -30.1 functional units (-2.0 herbaceous and -28.1 forested). The impact summary is provided on Table 5-1 (below). The majority of these impacts will be the result of permanently clearing and/or filling existing herbaceous and forested wetlands. The proposed mitigation plan within the HT site will provide for 55.6 functional units of lift within the Upper Coastal Watershed which includes 52.1 forested and 3.5 herbaceous units from wetland restoration activities. (Section 5.6 provides details of the UMAM scores). Please note that an "excess" of 22 units is being provided to offset the shortage of units in the Hillsborough Basin and for use on future projects in the Upper Coastal Watershed.

Table 5-1. Upper Coastal Watershed Wetland Impacts by UMAM Functional Loss

	ACOE Herbaceous Wetland Functional Loss	ACOE Forested Wetland Functional Loss	ACOE Total Functional Loss	FDEP Herbaceous Wetland Functional Loss	FDEP Forested Wetland Functional Loss	FDEP Total Functional Loss
UMAM Units	-2.0	-28.1	-30.1	-3.7	-29.9	-33.6

5.3 Site Description

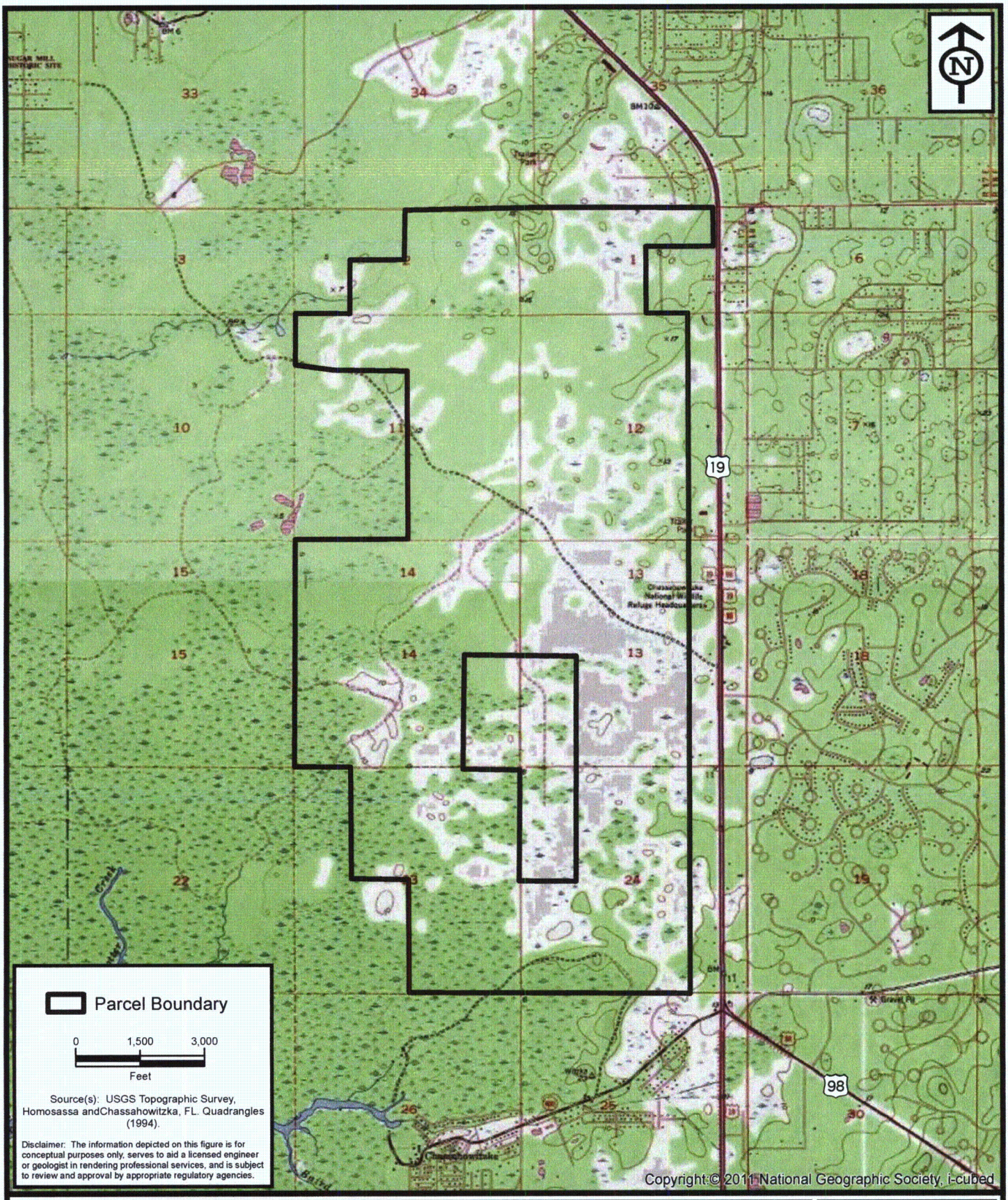
The HT site is located in Sections 1, 2, 11, 12, 13, 14, 23, 24 and 25, Township 20S and Range 17E and is west of U.S. Highway 19 and north of the U.S. Highway 98 and U.S. Highway 19 intersection in Citrus County, FL (Figure 5-3). The total area of the HT parcel is approximately 5,529 acres, but the proposed restoration activities for this project are located primarily in the northeast and southwest portions of the main HT parcel. Water flows within HT primarily from northeast to southwest and enters the property through broad depressions along relic shorelines of the Homosassa and Chassahowitzka Rivers and associated creeks (Otter and Mason Creek). Due to sharp elevation changes, water leaves the site via surface flow toward the creeks and rivers or by groundwater infiltration. It is also important to note that during severe rain events backwater flow from the rivers and creeks may travel west as waters stage and move inland (Figure 5-4).

5.3.1 Historic Conditions

Historically, the property was a mosaic of intertwining forested and herbaceous wetlands grading to upland shrub and brushland, live oak sandhills, and mesic

flatwoods. Historic aerials are primarily indicative of mesic flatwoods, wet flatwoods, and basin swamps with scattered dome swamps, and upland shrub/ brushland and sandhills. Logging swamp species began as early as 1900 when sawmills began processing old growth cypress and red cedar. Aerials from the 1940's show the presence of ditching and wetland fill roads (Figure 5-4), but have not yet significantly altered hydrologic conditions. Over time, upland and wet flatwood vegetation was removed and replaced with improved pasturelands and later planted pine. Land alterations continued as ditching and wetland fill roads were developed to assist with cattle management and logging activities.

After the property was acquired under the Conservation and Recreational Lands (CARL) program, several existing culverts were replaced in many of the wetland fill trail roads to improve hydrology, however, in most cases, these culverts are not large enough or properly placed and additional unfunded work is necessary to fully restore hydrologic conditions. As transitional areas were taken out of silviculture, monocultures of wax myrtle emerged, yet limited funding has prevented land management/restoration activities in these areas.



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Project Location

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-3

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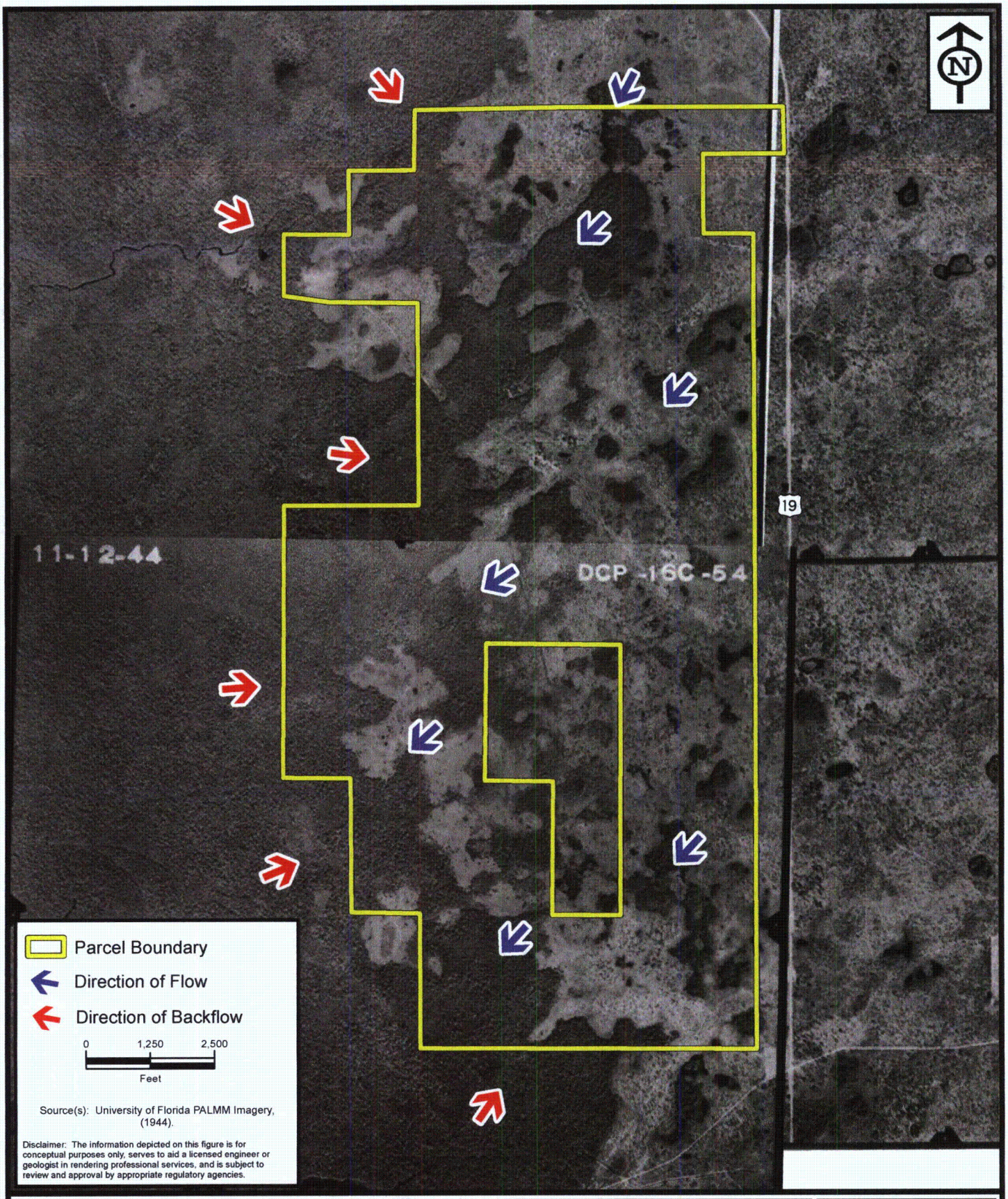

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1944 Historic Aerial Imagery

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JGB/JRN
Figure:	5-4

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5.3.2 Current Conditions

While much of the upland habitat has been converted to improved pasture and silviculture, various upland and wetland habitat types are present at the HT parcel. These habitats include basin swamp, freshwater marsh, dome swamp, wetland shrub, improved pasture, planted pine (upland and wetland), pine flatwoods, live oak/sandhill, and shrub and brushland communities. Most of the existing habitats are altered from historic land disturbances and pine encroachment. However, plant diversity and wildlife utilization appear to be moderate given the extensive natural habitat surrounding this state forest.

FLUCFCS was used to determine the different community types on site. Please refer to the Homosassa Tract Community Map (Figure 5-5) for details of specific community locations. Please refer to Figure 5-7 and the information below for details of the specific community types associated with the mitigation activity areas of HT.

Uplands

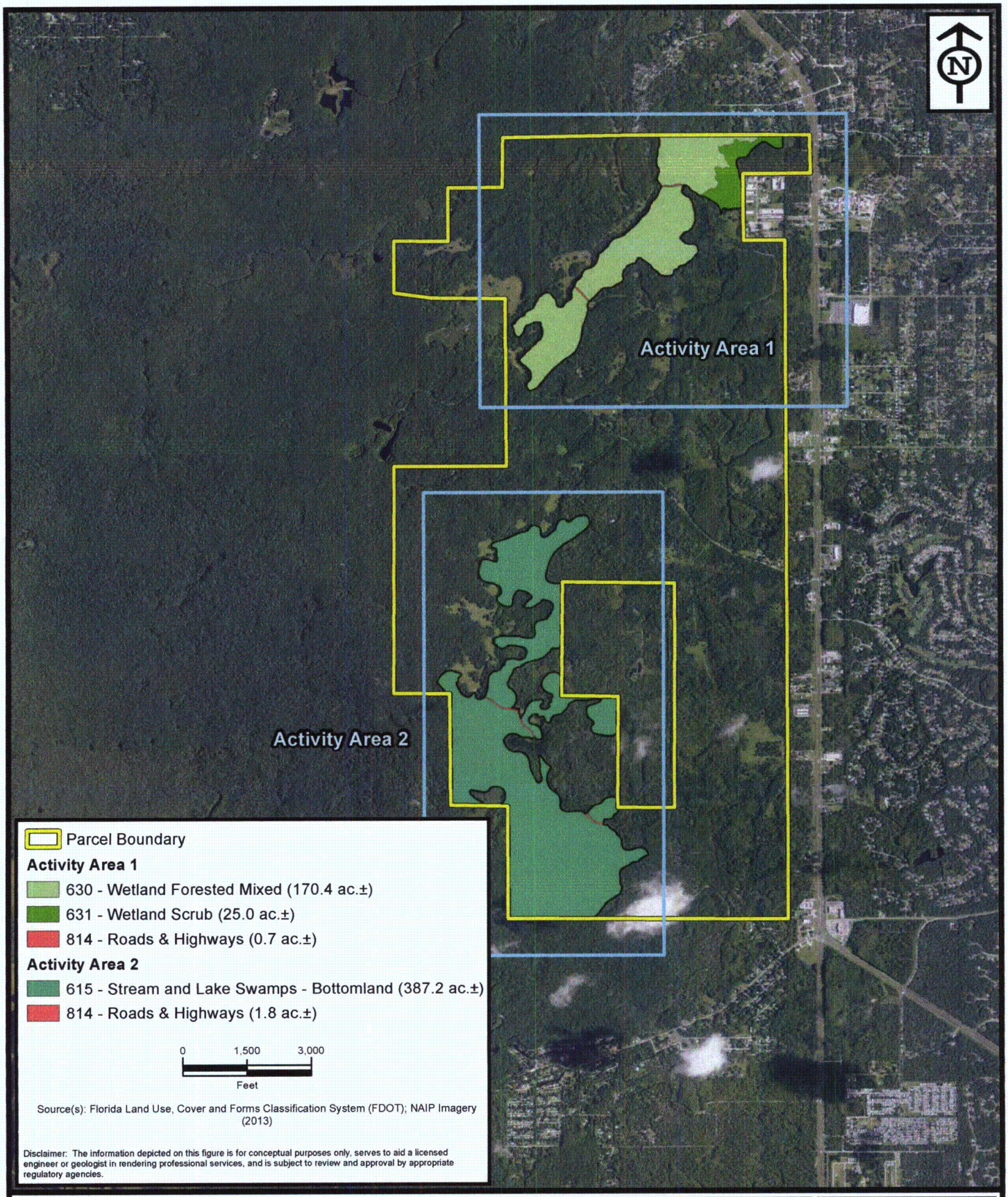
1. Trailroads (FLUCFCS 814). This community type is made up of cleared areas that were graded and drained for ease of mobility throughout the site. Trailroads are present in both activity areas. In many cases, these trail roads are elevated and culverted. Nevertheless, the trail roads placed through wetlands have significantly altered hydrology over time. In some cases, the holding back of water has increased soil subsidence and increased wetland acreage, especially in the southern portion of the property. Much of the mitigation on this site will encompass LWC to restore historic hydrology, reduce maintenance and vehicular traffic, and restore wetlands and native habitats.

Wetlands

1. Stream and Lake Swamps/Bottomland (FLUCFCS 615). Much of this deep swamp wetland community is located in the southern portion of the HT site (Activity Area 2) and is associated with Otter and Mason Creek which flow to the Chassahowitzka River. Three LWCs are proposed in this area. Typical canopy species include red maple, cypress, sweetgum, water hickory (*Carya aquatica*), American elm (*Ulmus americana*), and to a lesser extent sweet bay. The understory is generally sparse but does contain buttonbush, wax myrtle, with deep wet pockets containing pickerelweed and saw grass. Much of this habitat type will be restored via LWCs that will restore hydrologic conditions.

2. Wetland Forested Mixed (FLUCFCS 630). The wetland forested mixed community makes up the two large wetland restoration areas in Activity Area 1 located on the northern portion of the site. Two LWCs will restore hydrologic conditions and therefore assist with restoration of this community type. These areas are composed of red maple, laurel oak, sweetgum, sweetbay, cypress, and swamp tupelo. Pine has also encroached into some areas. Understory vegetation contains dahoon holly, cabbage palm, wax myrtle, and fetterbush. Ground cover species include various fern species, saw grass, and pickerelweed and fire flag in deeper areas with regular inundation. Soil oxidation was observed in many of the areas likely due to fill roads impeding flow. Therefore, two LWCs are proposed to restore hydrology and restore these forested wetlands.

3. Wetland Scrub (FLUCFCS 631). This community type consists primarily of wax myrtle and blackberry, along with various grasses and is associated with Activity Area 1 in the northeastern portion of the HT. The major difference between the upland category of shrub and brushland is that these conditions are mesic and there is a lack of saw palmetto. Most of the manipulated on-site wetlands consist of opportunistic colonizers that are indicative of disturbed sites resulting in wetlands considered to be of moderate to low quality. The northeastern corner of the HT site will be roller chopped to eliminate the dominance of wax myrtle and allow for prescribed burning and wetland herbaceous species regeneration.



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Existing Communities Map

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-5

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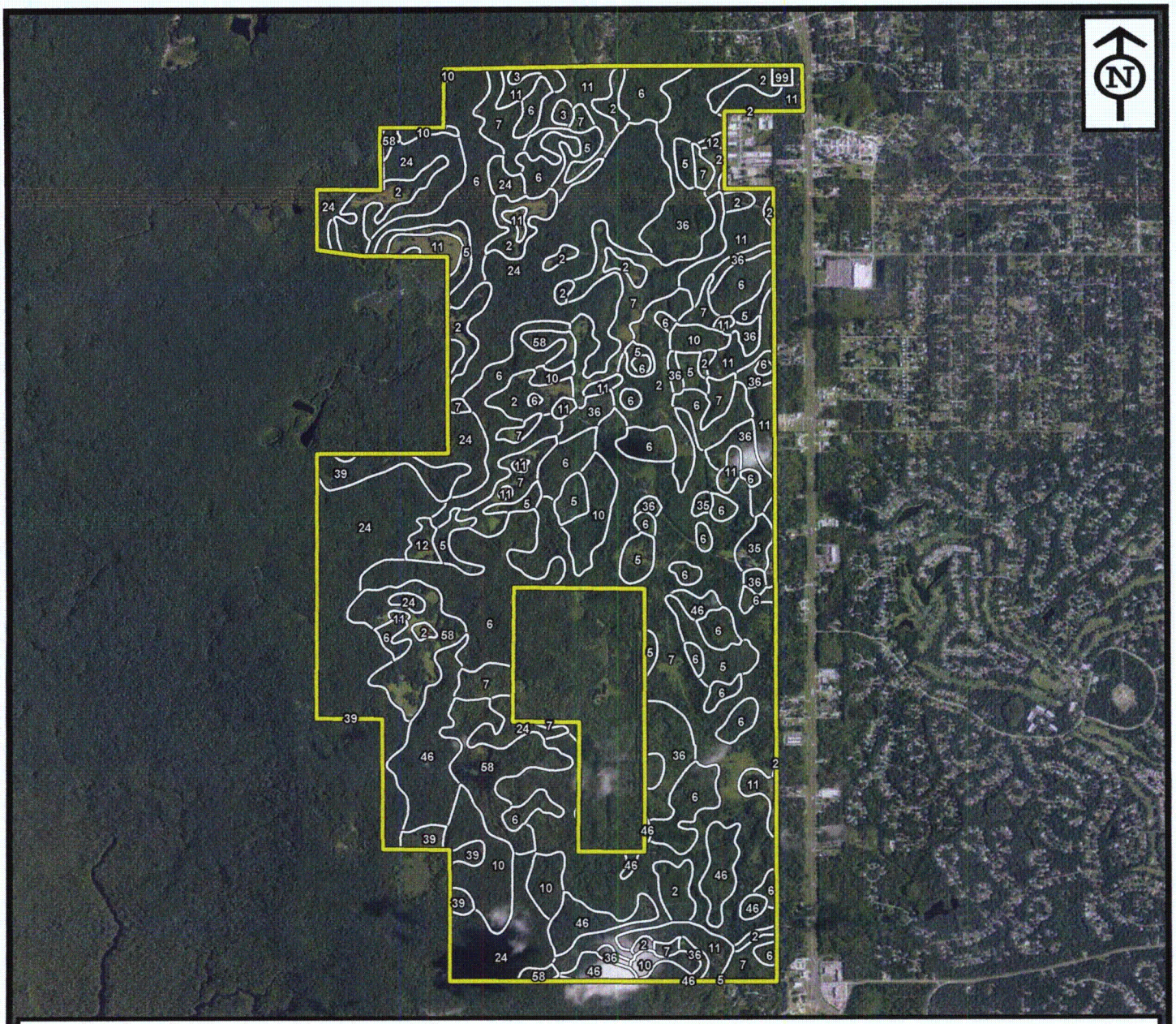
5.3.3 Soils

According to the NRCS soil map for Citrus County, fourteen soil types and water are present on the HT site (Figure 5-6).

Table 5-2. Homosassa Tract Soil Types

NRCS Soil Type	Hydric	Acreage
2 Adamsville Fine Sand	No	218.7
3 Candler Fine Sand, 0-5% slopes	No	10.4
5 Basinger Fine Sand	Yes	131.8
6 Basinger Fine Sand, depressional	Yes	509.6
7 Myakka Fine Sand	Yes	666.7
10 Pompano Fine Sand, depressional	Yes	131.2
11 Tavares Fine Sand, 0-5% slopes	No	191.7
12 Immokalee Fine Sand	Yes	11.8
24 Okeelanta-Lauderhill-Terra Ceia Mucks	Yes	579.4
35 Sparr Fine Sand, 0-5% slopes	No	16.8
36 Eaugallie Fine Sand	Yes	186.7
39 Hallandale-Rock Outcrop Complex, rarely flooded	Yes	51.7
46 Eaugallie Fine Sand, depressional	Yes	146.7
58 Myakka, Limestone Substratum-Eaugallie, Limestone Substratum Complex	Yes	150.6
99 Water	N/A	3.4



Parcel Boundary

Soils

- 2 - Adamsville Fine Sand (218.7 ac.±)
- 3 - Candler Fine Sand, 0 to 5 Percent Slopes (10.4 ac.±)
- 5 - Basinger Fine Sand (131.8 ac.±)
- 6 - Basinger Fine Sand, Depressional (509.6 ac.±)
- 7 - Myakka Fine Sand (666.7 ac.±)
- 10 - Pompano Fine Sand, Depressional (131.2 ac.±)
- 11 - Tavares Fine Sand, 0 to 5 Percent Slopes (191.7 ac.±)
- 12 - Immokalee Fine Sand (11.8 ac.±)
- 24 - Okeelanta-Lauderhill-Terra Ceia Mucks (579.4 ac.±)
- 35 - Sparr Fine Sand, 0 to 5 Percent Slopes (16.8 ac.±)
- 36 - Eaugallie Fine Sand (186.7 ac.±)
- 39 - Hallandale-Rock Outcrop Complex, Rarely Flooded (51.7 ac.±)
- 46 - Eaugallie Fine Sand, Depressional (146.7 ac)
- 58 - Myakka, Limestone Substratum-Eaugallie, Limestone Substratum Comples (150.6 ac.±)
- 99 - Water (3.4 ac.±)

0 1,500 3,000
Feet

Source(s): USDA Soil Survey, Citrus County, Florida; NAIP Imagery (2013)

Disclaimer: The information depicted on this figure is for conceptual purposes only, serves to aid a licensed engineer or geologist in rendering professional services, and is subject to review and approval by appropriate regulatory agencies.

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NRCS Soils

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-6

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5.4 Mitigation Plan

The primary mitigation plan for HT (Figure 5-7) is hydrologic enhancement to restore flow patterns to forested wetland systems and herbaceous wetland restoration within two activity areas (Activity Area 1 and Activity Area 2). The details of the proposed mitigation are described below, and the proposed hydrologic restoration plans for HT can be found within Section 5.7 Engineering and Section 5.11 Engineering Detail Drawings.

1. Hydrologic Restoration via LWCs and Culvert Replacement. The proposed hydrologic restoration will be accomplished with 2 LWCs and one area of culvert replacement/improvement in Activity Area 1 of the HT site and 3 LWCs in Activity Area 2 of the HT tract. More detailed descriptions of the LWC and culvert replacement hydrologic restoration of these structures can be found in Section 5.5 Hydrology and Hydraulics, and Section 5.7 Engineering.

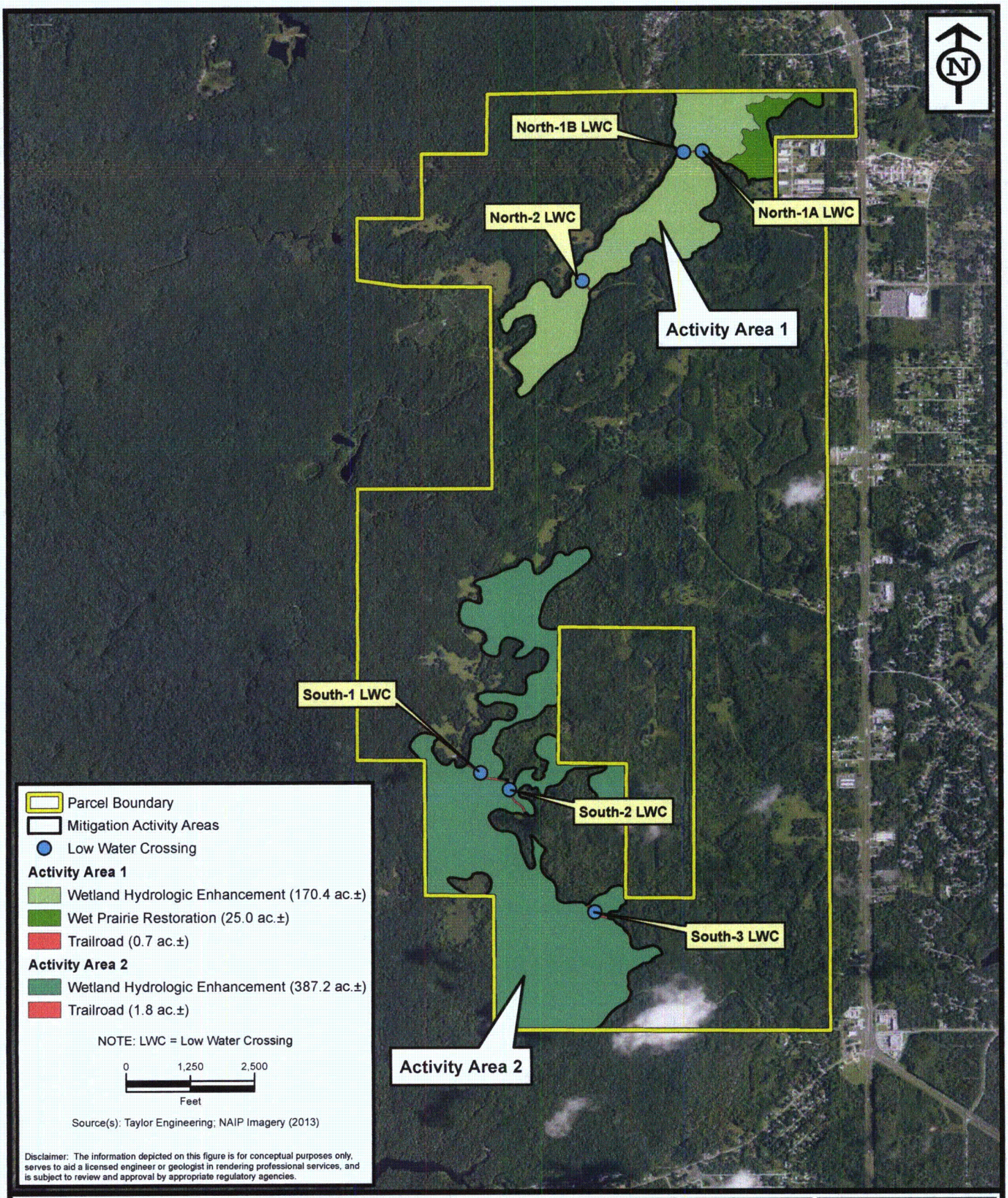
The large wetland forested mixed system in Activity Area 1 will be restored after two LWCs are installed and one area of culvert replacement/improvement to restore hydrologic flows. Of this large system, it is expected that approximately 170.4 acres of wetland forested mixed habitat will be restored in association hydrologic improvements. Flows will be increased downstream alleviating soil oxidation issues. The upstream conditions do not suffer the same extent of soil oxidation; however, hydroperiods were historically longer. The addition of North-1 LWC (which has two stepped sections for maximizing flow) and North-2 Culvert Replacement will eliminate the damming effect and allow more water to enter the system during heavy rain events thereby increasing flow and allowing for longer hydroperiods in the deeper pockets of the system. Longer hydroperiods and increased flow may also reduce some of the pine encroachment into the areas with slightly higher elevations. Overall, wetland quality will be improved.

LWCs and culvert replacement/improvement in Activity Area 1 are known as North-1 LWC and North-2 Culvert Replacement. North-1 LWC is located north of the central mixed forested wetland in the northern portion of the tract and is made up of a step approach with two flow areas. The elevated trail road is between 7.2 and 7.5 NVGD, and while culverted, the roadway has created a damming effect after heavy rainfall as the wetlands are 2 to 3 feet lower. The proposed stepped crossing will be set at an elevation of 6.2 and 6.6. The mixed forested wetland immediately to the south had historically wetter hydroperiods. Improving the flow to this wetland should restore historic hydrological conditions to the extent practicable. North-2 Culvert Replacement is located in the southwest corner of this same wetland system in Activity Area 1. The elevated trail road contains culverts, some of which are broken or blocked, that

have altered historic flow across this entire wetland area by channelizing flows. The culverts in this area will be replaced with four 3'x6' box culverts. The box culverts are each 30' long with upstream inverts at +4.70' NAVD and downstream inverts at +4.55' NAVD and are centered on the historical flow path. The box culvert will allow continuous flow across the entire area and restore hydroperiods downstream.

The stream and lake swamp/bottomlands are part of the floodplain associated with Otter and Mason Creek in Activity Area 2. The installation of the three southern LWCs will aid in wetland floodplain restoration of approximately 387.2 acres. Restoration of historic flows will increase hydroperiods downstream and assist with alleviating soil oxidation issues, therefore improving wetland quality and function. The LWCs will also eliminate channelized flow through culverts, thereby restoring historic conditions upstream and allowing for vegetative recruitment in the understory.

South-1 LWC and South-2 LWC are located west of the existing outparcel. The current trailroad at South-1 LWC is elevated at 6.9 NVGD while the surrounding wetlands are at least 3 feet lower. The existing grade of the road will be set at an elevation of 5 feet. This will increase water flow and restore hydroperiods downstream, while historic hydrologic conditions will also be restored upstream. South-2 LWC is just south of South-1 LWC and has become an artificial channel at an elevation of 6.7 NVGD. The wetlands are 2 to 3 feet lower. This portion of the road will be lowered to an elevation of 5.2 feet and will increase flows and restore hydroperiods downstream while also restoring historic hydrologic conditions upstream. South-3 LWC is located southwest of the southwestern corner of the outparcel. This elevated road is at an elevation of 6.5 NVGD while surrounding wetlands are 1.5 feet lower. The LWC will be set at 5.5 feet. This road removal will also restore hydroperiods and historic hydrological flows by eliminating the damming effect of the elevated road by allowing greater flow downstream.



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Mitigation Activity

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.03
Date:	July 2014
Drwn/Chkd:	JRN/GKH
Figure:	5-7

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2. Wet Prairie Restoration. A wet shrub area exists in the northeast corner of the HT site as part of Activity Area 1 and has become a monoculture of wax myrtle. This area was historically wet prairie dominated by grasses adjacent to larger forested systems. The area to be restored is 25.0 acres. Restoration will be accomplished by roller chopping the area to eliminate the monoculture. Herbaceous seed sources already exist in the area; therefore, reducing the shading effect of the wax myrtle will allow for greater natural regeneration. Upon completion of the initial maintenance, the FFS will then reinstate their prescribed burn regime (whenever possible) to maintain the herbaceous areas as outlined in their overall management plan. The area will also be reseeded if natural regeneration and recruitment are not adequate to restore this wet prairie system. No planting is proposed with this mitigation activity, however vegetative maintenance is proposed quarterly to ensure success.

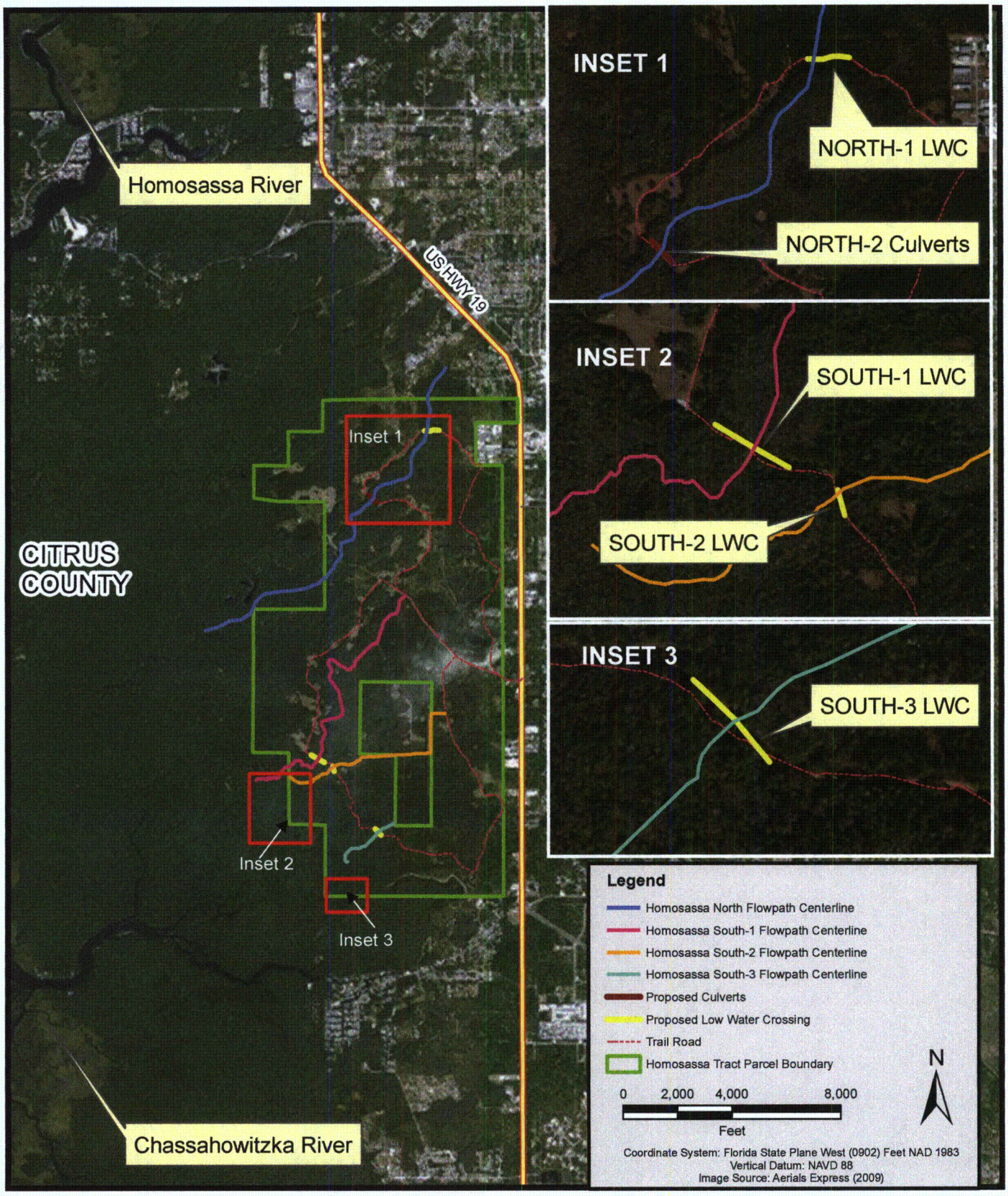
5.5 Hydrology and Hydraulics

5.5.1 Objective

The hydrologic and hydraulic engineering analysis for the Homosassa Tract simulated existing and proposed project (or mitigation) conditions. The results demonstrated improved rainfall runoff conveyance and flow patterns that better represent historic, unaltered conditions at sites within the tract. Figure 5-8 shows the Homosassa Tract parcel with five mitigation areas: North-1, North-2, South-1, South-2, and South-3. Each of these mitigation areas involves constructing a low-water crossing to restore the historical sheet flow that existed within the tract. To demonstrate improved water movement, hydrologic and hydraulic modeling analysis was conducted as described below.

5.5.2 Model Setup

The U.S Army Corps of Engineers Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS version 3.4) and River Analysis System (HEC-RAS version 4.1), were used to simulate rainfall runoff, conveyance, and flooding conditions within the Homosassa Tract. South West Florida Water Management District (SWFWMD or District) provided a preliminary draft of the rainfall-runoff model for the Cardinal Lane watershed (SWFWMD, 2008). The Cardinal Lane watershed is located within the Upper Coastal watershed and encompasses an area of 38,045 acres (see Figure 5-9). The Cardinal Lane watershed includes areas that are within northern portion of the Homosassa Tract. Additionally, a part of the Cardinal Lane watershed drains into the southern portion of the Homosassa Tract. Hence, it is necessary to include the inflows from the Cardinal Lane watershed that drains into the Homosassa Tract's mitigation sites.



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Hydrologic and Hydraulic Study Area
Homosassa Tract Low Water Crossings
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-8
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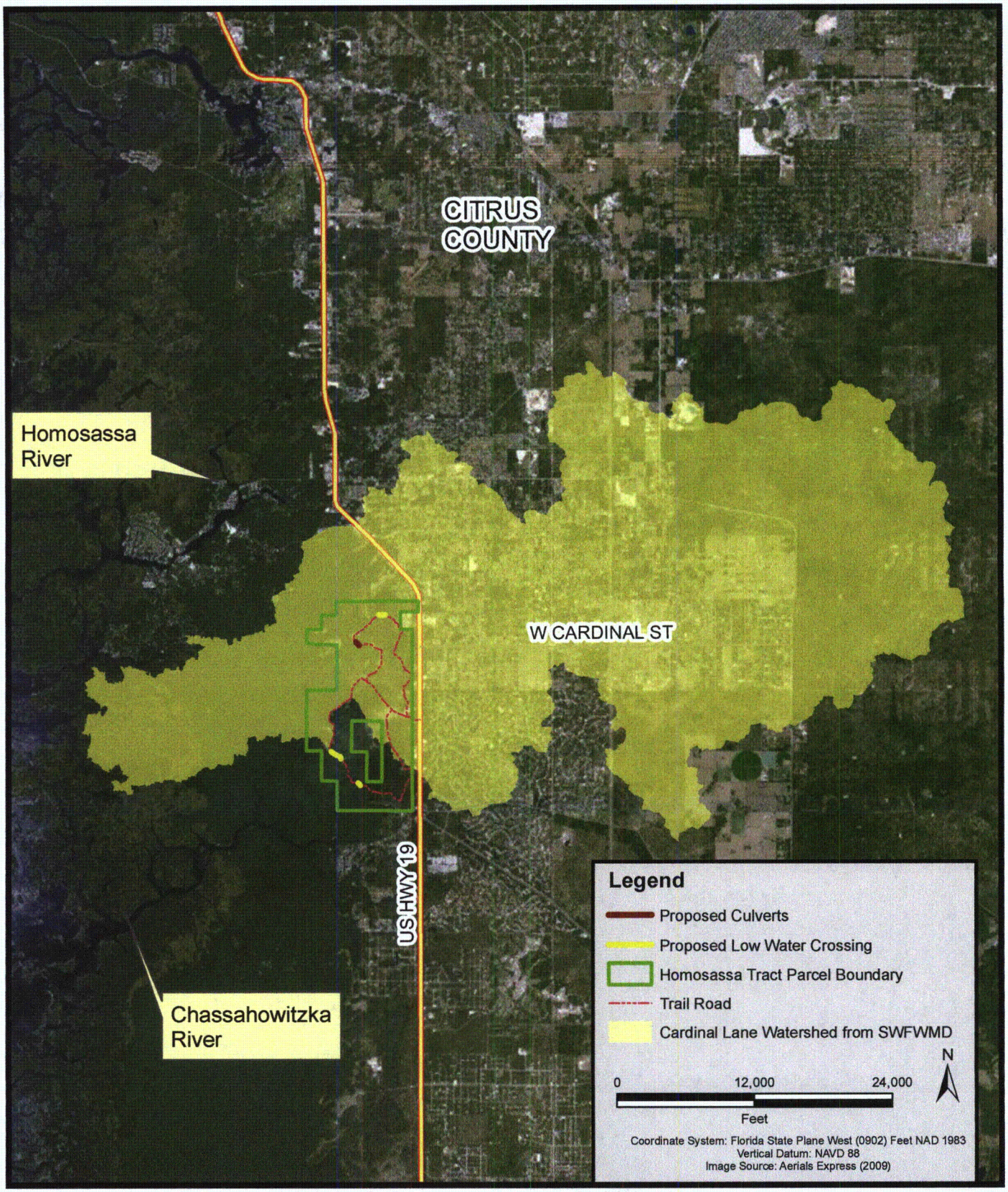
DATE	AUGUST 2014



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Cardinal Lane Watershed
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-9
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DATE	AUGUST 2014

The District utilized a one- dimensional dynamic rainfall-runoff simulation model – Interconnected Channel and Pond Routing (ICPR) - to model the hydrologic and hydraulic conditions within the Cardinal Lane watershed. The ICPR model provided the 25- and 100-year inflow hydrographs for areas located upstream of the mitigation sites. However, the District model did not include flow hydrographs for the 2-, 10- and 50-year storm events. Inflow hydrographs for the 2-, 10-, and 50-year events were derived by using peak inflows obtained from Florida-based USGS regression equations and by using the shape of the ICPR's 100-year hydrograph.

Since North-1 and North-2 mitigation sites are part of the same flow-way system, these sites were combined into one model (referred to as North mitigation site). Individual models were created for each of the remaining mitigation sites.

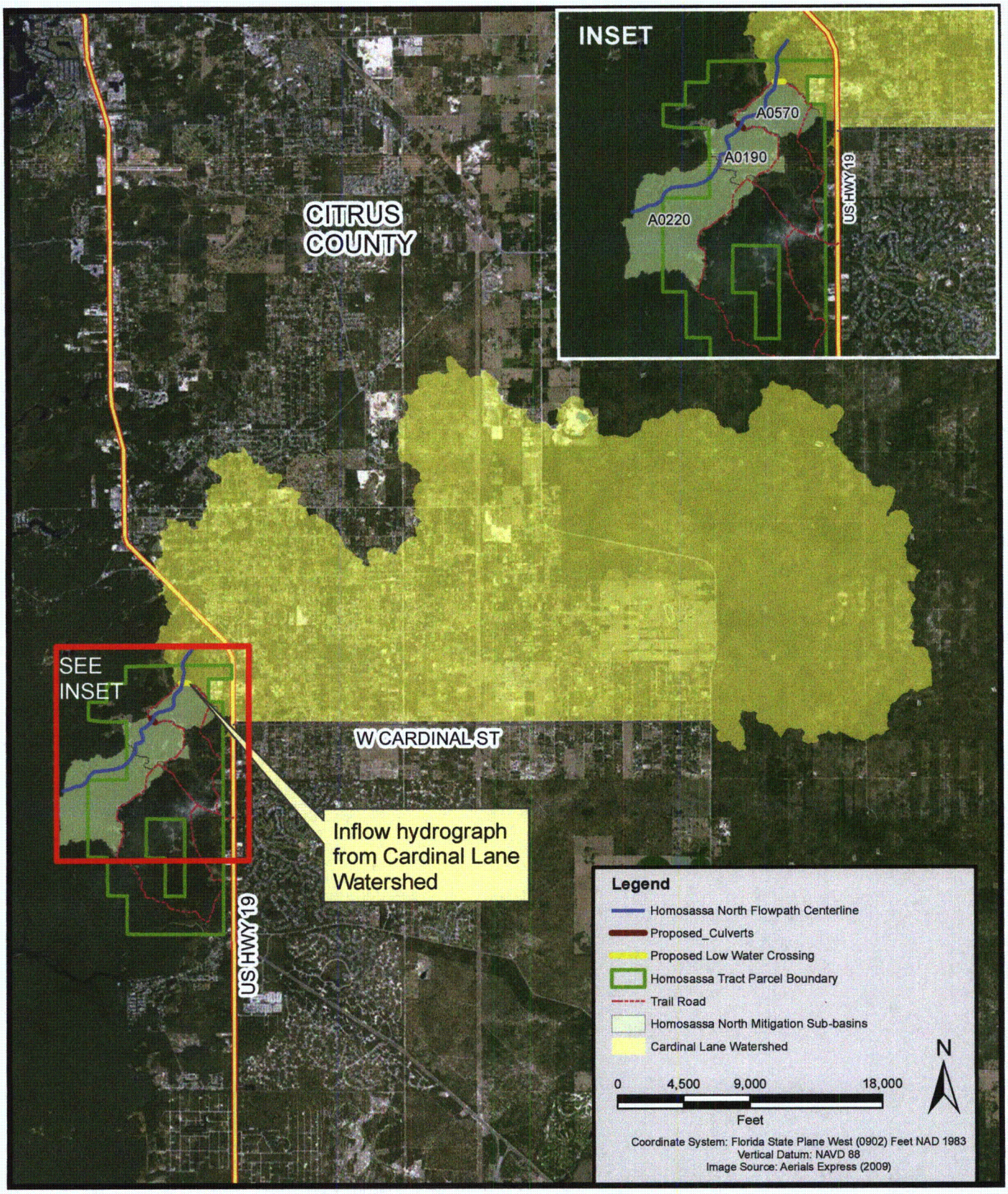
This section describes the calculation of HEC-HMS and HEC-RAS input parameters including sub-basin area, time of concentration, curve numbers, rainfall data, hydrology model setup, inflow hydrographs, hydraulic model geometry, and boundary conditions.

Sub-basin Area

Contributing basin boundaries and areas were determined from a combination of SWFWMD GIS basin coverage for areas located upstream of mitigation sites, and from the delineation of sub-basins within the mitigation sites. Sub-basins were delineated within the mitigation site by analyzing the topographic LIDAR data (FDEM, 2007). Figures 5-10 to 5-13 show the sub-basins for North, South-1, South-2 and South-3 mitigation sites, respectively.

Curve Number

The U.S. Soil Conservation Service Curve Number (CN) generally represents the sub-basin's rainfall runoff properties – its ability to store or shed rainfall – and is a function of the soil properties as well as land cover/use. GIS tools were applied to SWFWMD digital soil and land use coverages to calculate the CNs. The CN calculation assumes an antecedent rainfall condition corresponding to SCS Type II – or typical, mean conditions.



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North LWCS Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-10
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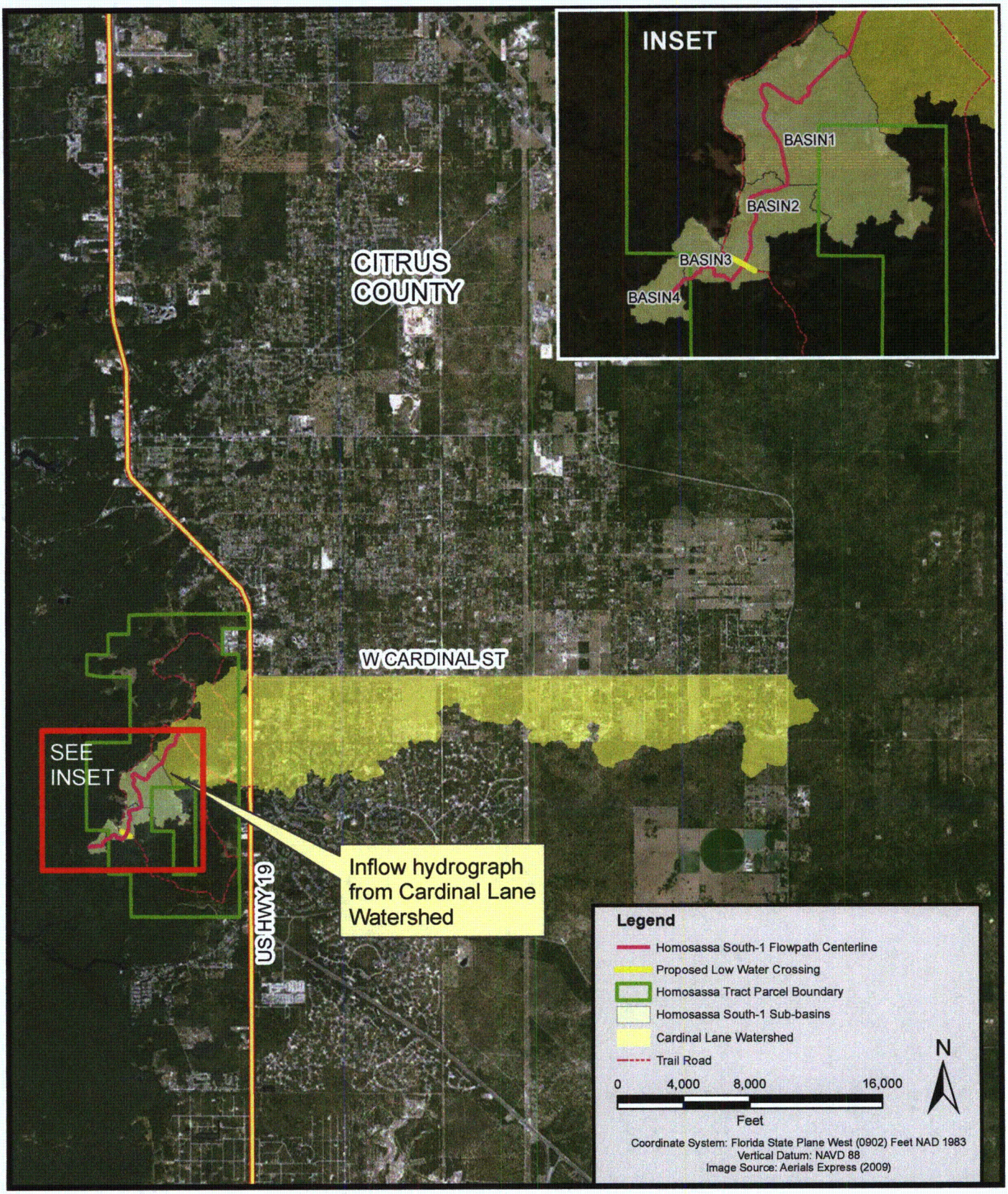

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South-1 LWC Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-11
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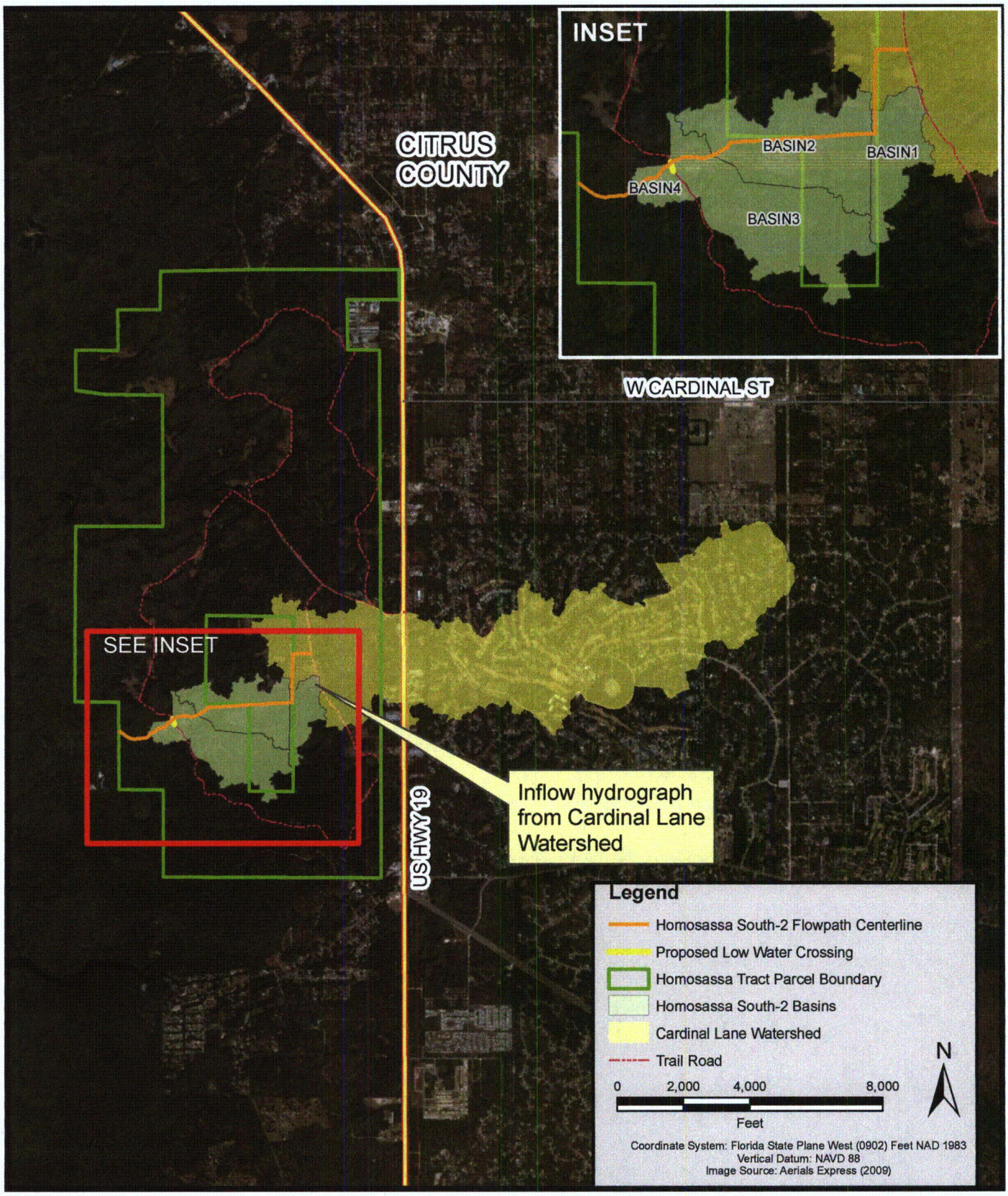
DATE	AUGUST 2014



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South-2 LWC Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-12
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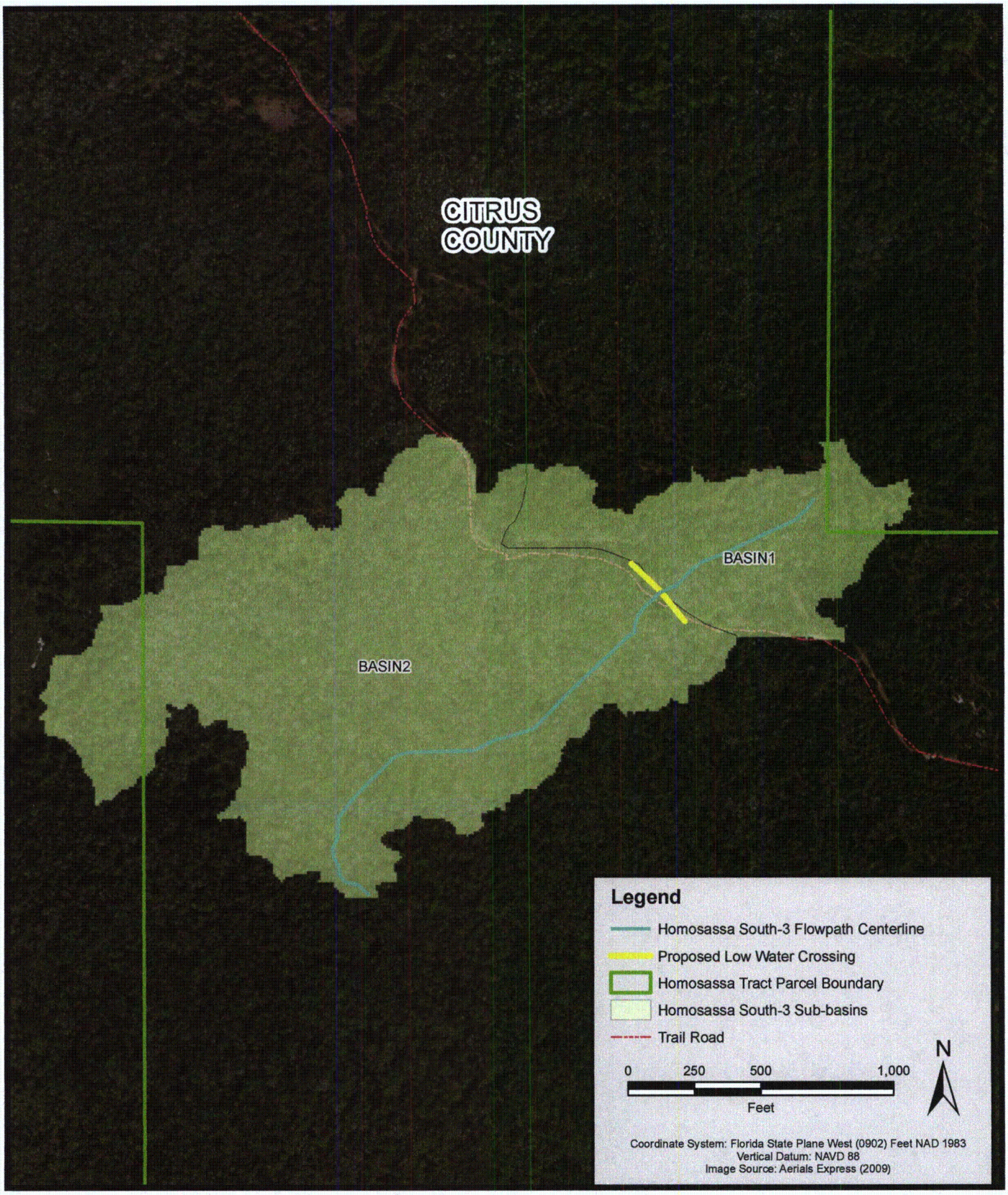

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South-3 Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-13
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DATE	AUGUST 2014

Time of Concentration

Time of concentration is a characteristic of the response of a watershed to a rainfall event and represents the time required for a drop of water to travel from the most hydrologically remote location within a sub-basin to the outflow. It is a function of the sub-basin slope, length, and CN. For each sub-basin, the average watershed slope was calculated based on LiDAR topographic data. Lag time was calculated from the SCS lag time equation with this slope.

Rainfall Data

The hydrologic model (HEC-HMS) requires rainfall depths (volume and temporal distribution) at each sub-basin for estimating the infiltration and runoff volumes. The SCS Type II, Florida Modified, 24-hour distribution was applied with the 24 hour rainfall depths shown in Table 5-3 for the five rainfall events simulated (SWFWMD, 1996).

Table 5-3. Homosassa Tract Model 24-hour Rainfall Depths

Recurrence Interval (years)	Rainfall Depth (inches)
2	4.25
10	7.2
25	9.0
50	10.1
100	11.6

Table 5-4 provides the calculated drainage area, curve number, and lag time for sub-basins within each mitigation area.

Table 5-4. HEC-HMS Model Hydrologic Input Parameters

Mitigation Site	Sub-basin Name	Area (acres)	Weighted Curve Number	Lag Time, (min)
North-1 and North-2	BASIN NA-0570	243.2	89	171
	BASIN NA0190	214.8	85	87
	BASIN NA-0220	707.2	94	324
South-1	BASIN 1	230.6	92	175
	BASIN 2	55	92	111
	BASIN 3	32	96	121
	BASIN 4	25.6	98	89
South-2	BASIN 1	41	87	90
	BASIN 2	100.5	89	77
	BASIN 3	108.8	88	217
	BASIN 4	15.4	92	23
South-3	BASIN 1	14.2	88	36.4
	BASIN 2	53.7	95	79.9

Hydrologic Model (HEC-HMS) Setup and results

The HEC-HMS model requires the area of each sub-basin, curve numbers, lag-time and rainfall data as input parameters. Individual HEC-HMS models were created for each mitigation site. The model uses SCS curve number and SCS unit hydrograph methods to estimate the runoff volume generated from each storm event. The SCS unit hydrograph method uses Delmarva's peak rate factor of 284 to transform the excessive rainfall into runoff. Each model was executed with a 2-, 10-, 25-, 50- and 100-year storm rainfall depth for a period of 48 hours to capture the falling and rising limb of the flow hydrographs. Table 5-5 shows the peak flows obtained from the model run for each sub-basin within the mitigation sites.

Table 5-5. HEC-HMS Model Output Peak Flows for Sub-basins

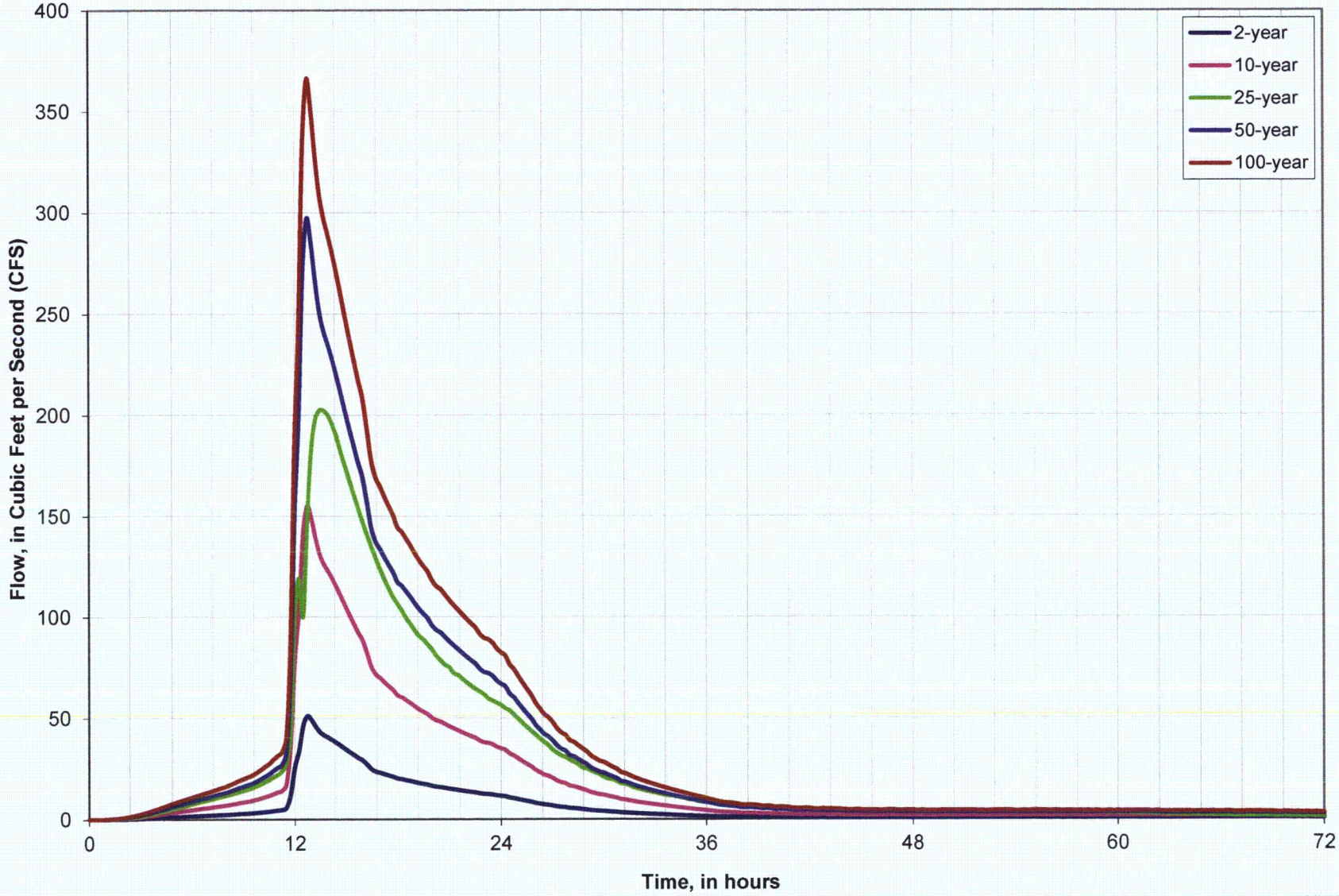
Mitigation Site	Sub-basin Name	Peak Flow (cfs)				
		2-yr	10-yr	25-yr	50-yr	100-yr
North-1 and North-2	BASIN NA-0570	85.6	175	230.2	264	310
	BASIN NA0190	70.3	135.8	176	200.5	233.9
	BASIN NA-0220	148.9	269.3	342.7	387.5	448.5
South-1	BASIN 1	16	31.7	41.4	47.3	55.4
	BASIN 2	50.3	96.2	124.1	141.1	164.3
	BASIN 3	25.5	50	65.1	74.4	87
	BASIN 4	12.2	22.2	28.2	31.9	36.9
South-2	BASIN 1	16	31.7	41.4	47.3	55.4
	BASIN 2	50.3	96.2	124.1	141.1	164.3
	BASIN 3	25.5	50	65.1	74.4	87
	BASIN 4	12.2	22.2	28.2	31.9	36.9
South-3	BASIN 1	16	31.7	41.4	47.3	55.4
	BASIN 2	50.3	96.2	124.1	141.1	164.3

Inflow Hydrographs

The District's preliminary ICPR model for Cardinal Lane watershed area provides inflow hydrographs for areas that drain upstream of the North, South-1 and South-2 mitigation sites. Figure 5-10 shows the basin encompassing an area of 21,952 acres draining into the North mitigation sites. Figure 5-11 shows the basin encompassing an area of 4,109 acres draining into the South-1 mitigation site. Figure 5-12 shows the basin encompassing an area of 1,100 acres draining into the South-2 mitigation site. These figures also show the location of inflow hydrographs extracted from the ICPR model for the 25- and 100-year storm events. Since the District model did not include the 2-, 10- and 50-year storm events, appropriate USGS regression equations for the State of Florida provided the peak flows for these missing storm events.

For the North mitigation site, peak flows were calculated using the 2001 USGS regression equations that require basin area, channel slope and percentage of lakes within the basin (USGS, 2001). For the south mitigation sites, peak flows were calculated using the 1982 USGS regression equation that requires basin area and percentage of lakes within the basin (USGS, 1982). The Districts sub-basin layer for Cardinal Lane watershed provided the basin areas. Assessment of aerial photographs provided an approximate percentage of lakes within the basin. Adjustments to the percentage of lake within the watershed were conducted to ensure the peak flows for 25- and 100-year storm events from the regression equations were within +/-15% of the ICPR peak flows.

The flow hydrographs for the 2-, 10- and 50-year storm events were obtained by multiplying the USGS peak flows for these events with the ratio obtained by dividing the 100-year peak flow from ICPR model with the flow values for each time-step. Figures 5-14 – 5-16 shows the inflow hydrographs for 2-, 10-, 25-, 50- and 100-year storm event at the North, South-1 and South-2 mitigation sites, respectively.



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North LWCS Inflow Hydrograph
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-14
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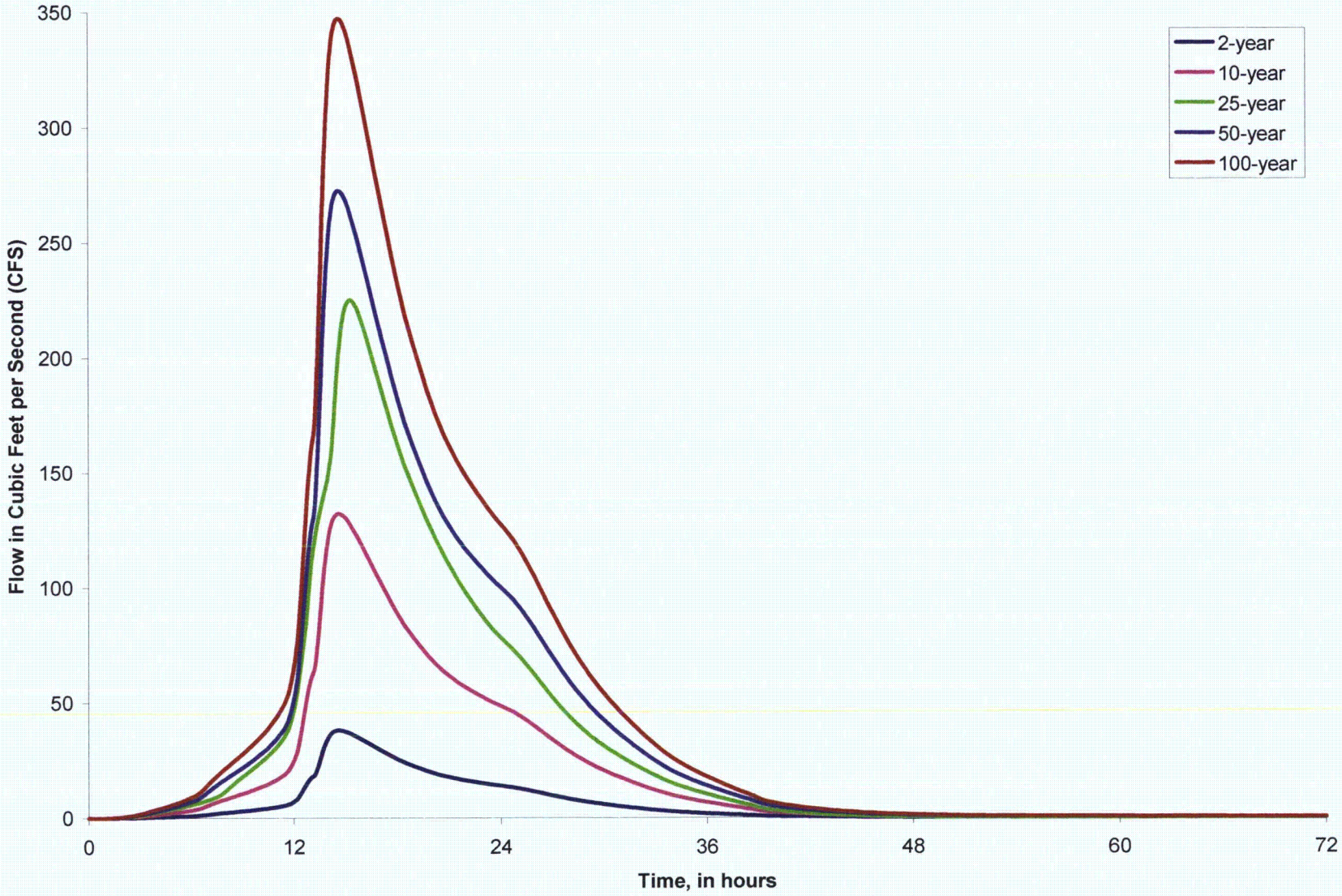
DATE	AUGUST 2014



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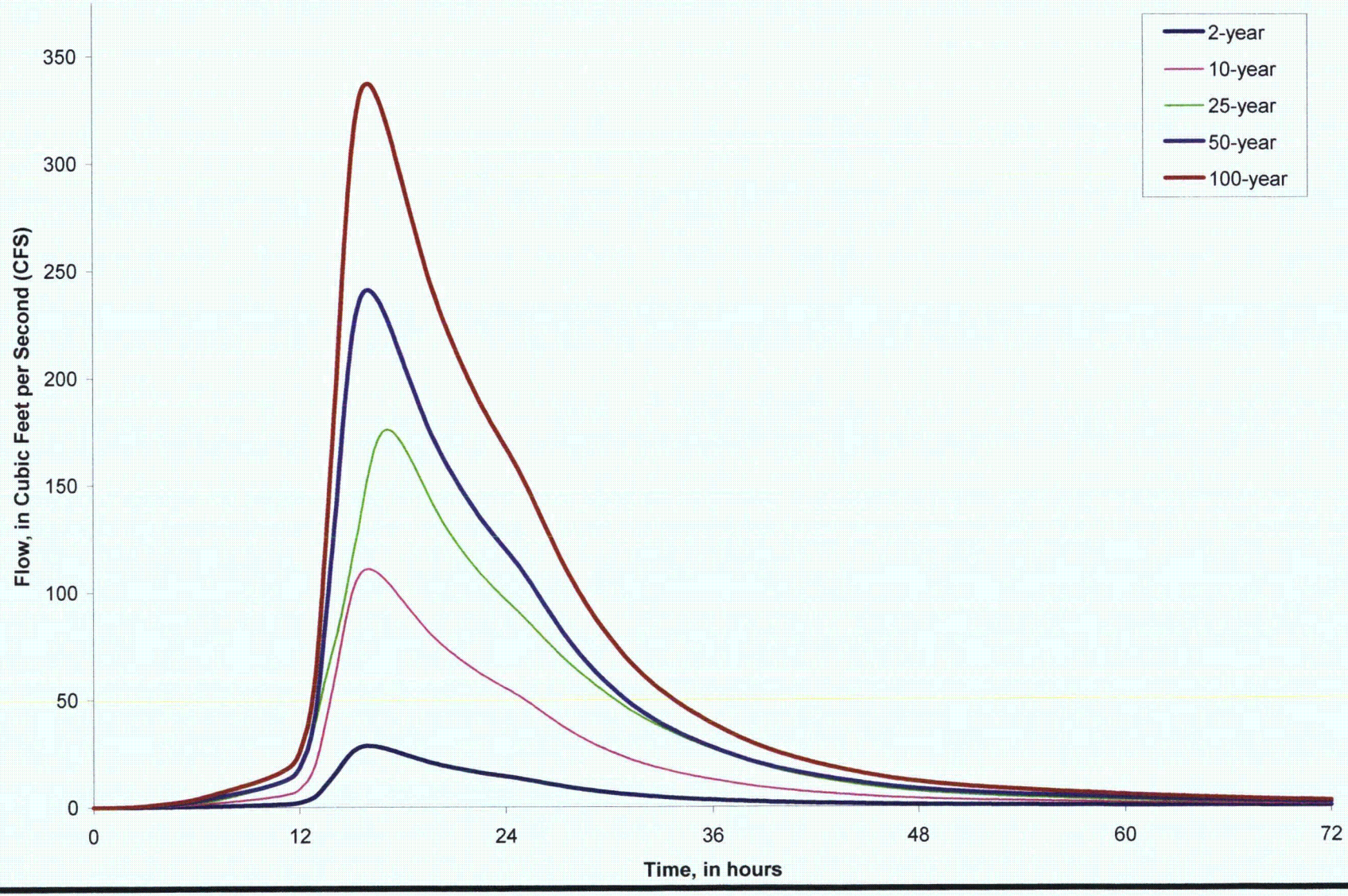
South-1 LWC Inflow Hydrograph
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-15
DRAWN BY	RP
DATE	AUGUST 2014



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South-2 LWC Inflow Hydrograph
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-16
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Hydraulic Model (HEC-RAS) Geometry

The HEC-RAS model applies a defined flow path with cross sections at specified distances. The cross section elevations assigned within the model reflect the LIDAR data collected by Florida Division of Emergency Management in 2007 (FDEM, 2007) and survey data collected by Pardue Land Surveyors. Figures 5-17 – 5-20 show the cross-section layout for the HEC-RAS model for North, South-1, South-2 and South-3 mitigation sites, respectively. Typical values of overland roughness co-efficient (also referred to as Manning's N co-efficient) for the various land use segments within our study area were obtained from widely published USGS report on Manning's N co-efficient (UGSS, 1989).

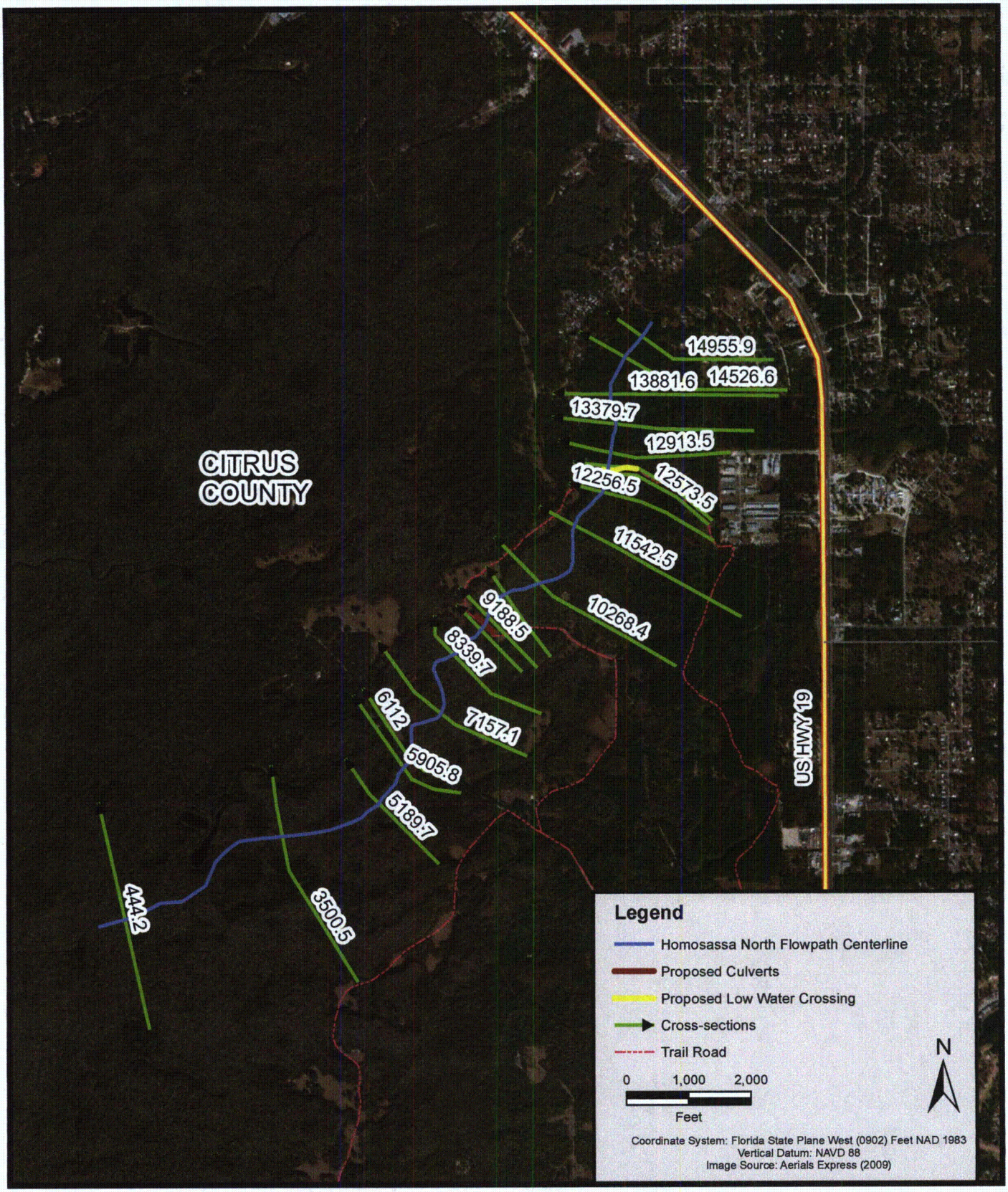
Boundary Conditions

Three types of boundary conditions were applied within the HEC-RAS model. One boundary condition was the tailwater condition at the model outlet. It was assumed that the areas draining south of each mitigation site would not affect the downstream boundary condition. Hence, a normal depth boundary condition corresponding to the slope of downstream area was used as a boundary condition at the model outlet.

The second boundary condition is the inflow hydrograph obtained from the District's ICPR model and USGS regression equations (see Figures 5-14 – 5-16). These inflow hydrographs were applied at the upstream end of the model boundary. All mitigation sites use this boundary condition except for the South-3 mitigation site. The South-3 mitigation site uses the sub-basin inflow hydrograph as a boundary condition.

The third boundary condition is the flow hydrographs from sub-basins located within the mitigation sites. These inflow hydrographs were added as lateral inflow hydrographs at appropriate cross-sections within the model domain.

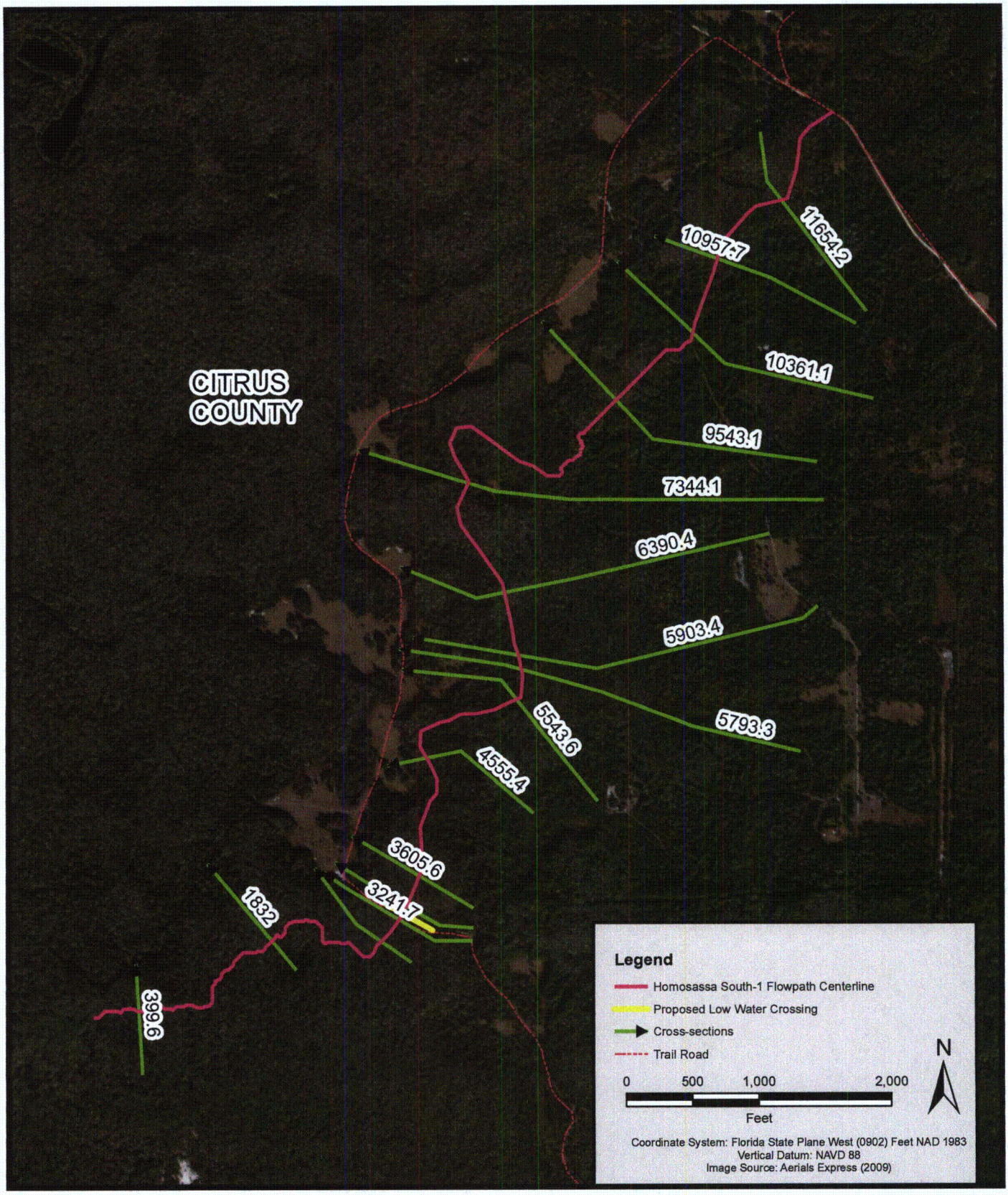
The HEC-RAS model routes the flows from these flow hydrographs to estimate the flow and stage at different cross-sections within the model domain.



TAYLOR ENGINEERING, INC.

North LWCS HEC-RAS Model Layout
Homosassa Tract
Citrus County, Florida

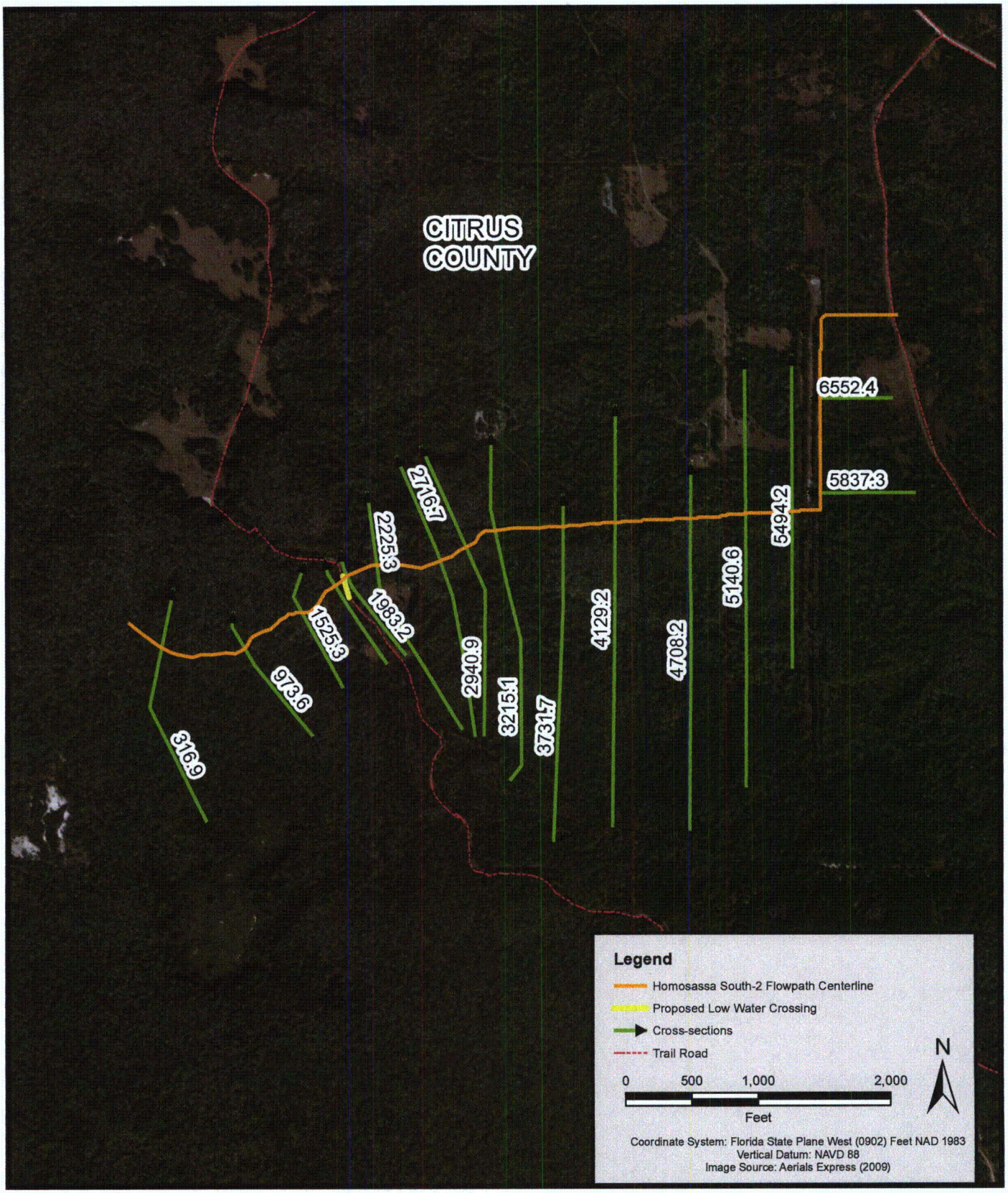
PROJECT	C2011-025
FIGURE	5-17
DRAWN BY	RP
DATE	AUGUST 2014



TAYLOR ENGINEERING, INC.

South-1 LWC HEC-RAS Model Layout
Homosassa South-1 Tract
Citrus County, Florida

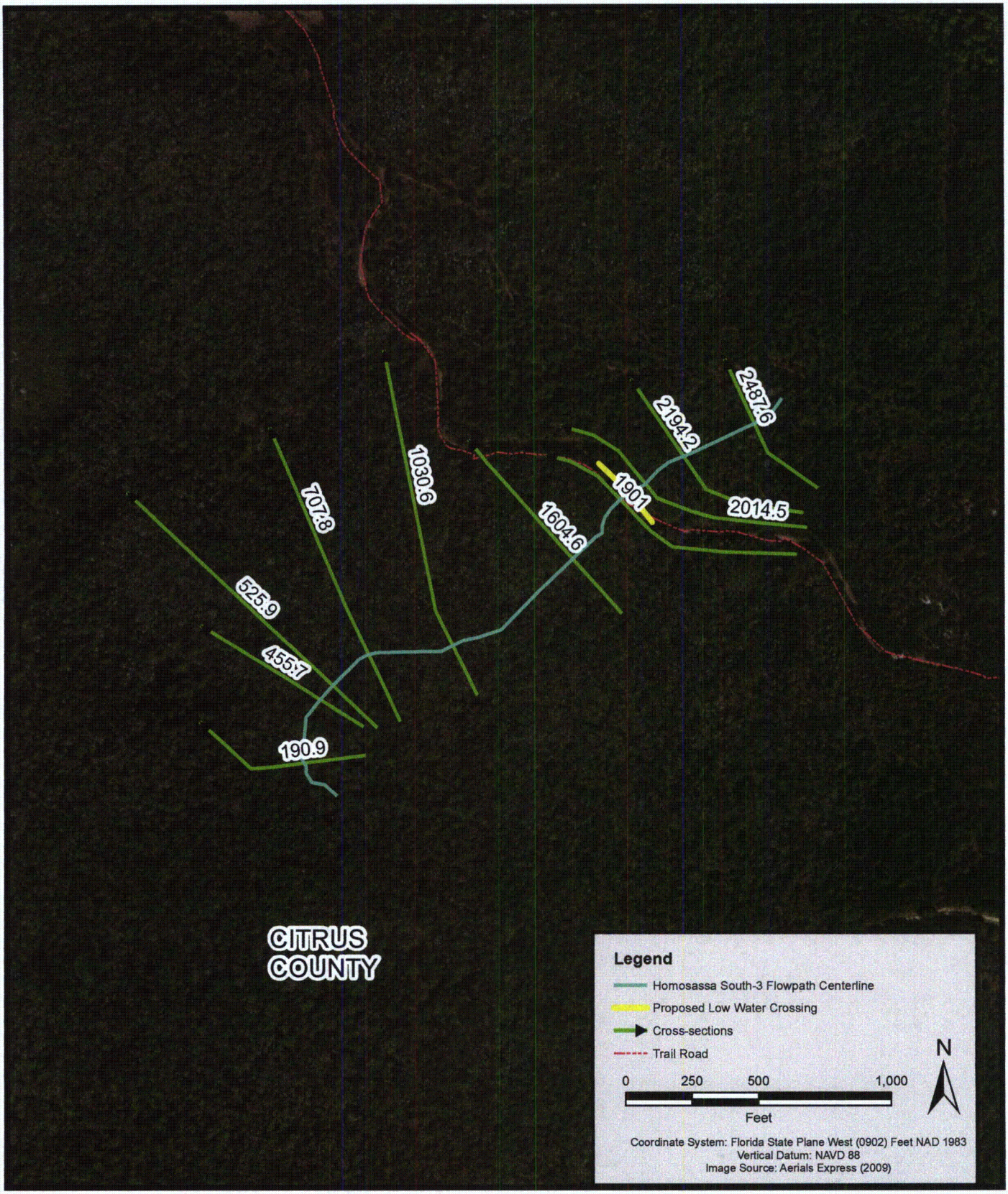
PROJECT	C2011-025
FIGURE	5-18
DRAWN BY	RP
DATE	AUGUST 2014



TAYLOR ENGINEERING, INC.

South-2 LWC HEC-RAS Model Layout
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-19
DRAWN BY	RP
DATE	AUGUST 2014



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South-3 LWC HEC-RAS Model Layout
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	5-20
DRAWN BY	RP
DATE	AUGUST 2014