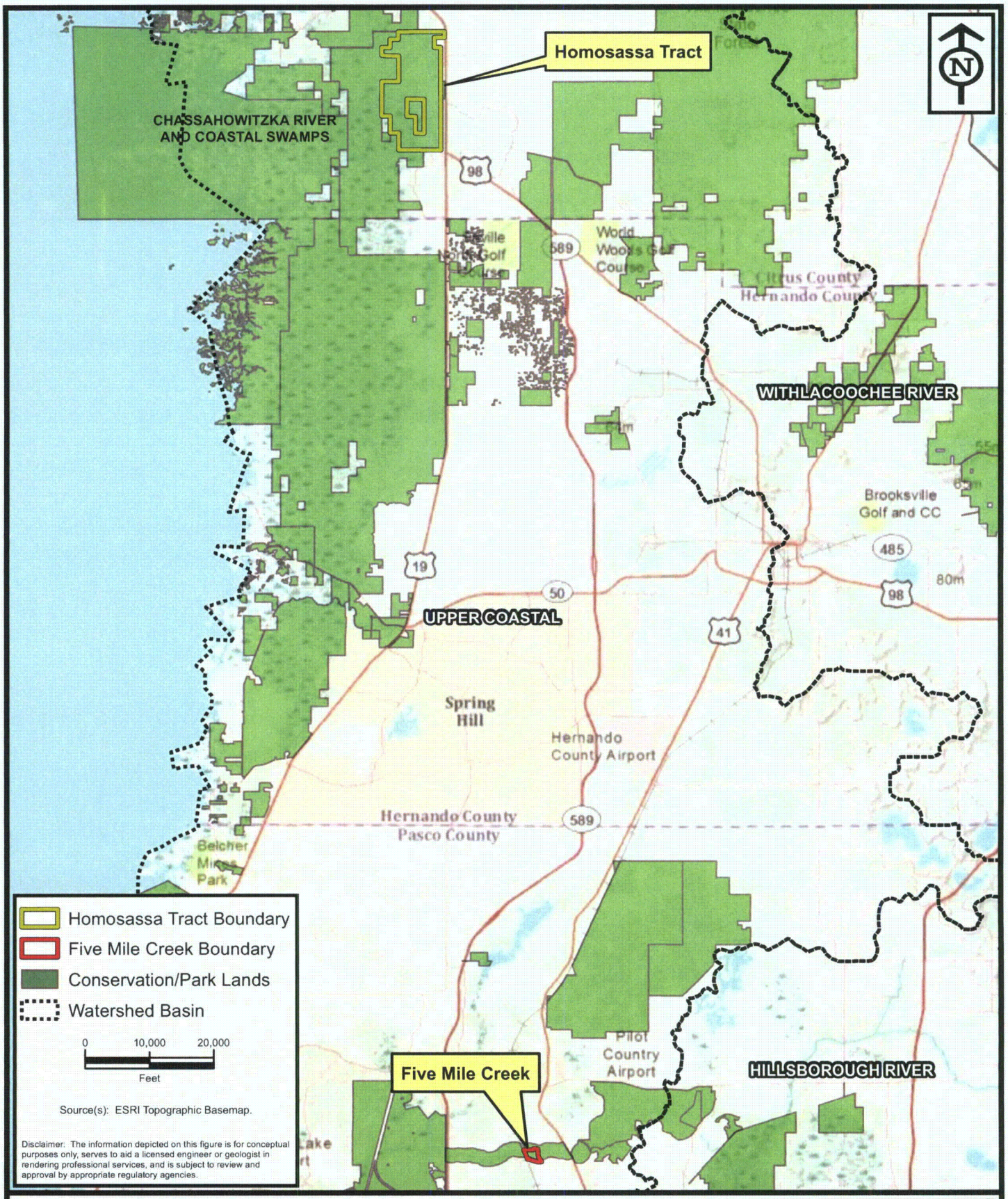
6.0 UPPER COASTAL WATERSHED – HOMOSASSA TRACT, WITHLACOOCHEE STATE FOREST

6.1 Introduction

The proposed wetland impacts for LNP are summarized in Table 1-1 and the mitigation plan for the 78.6 acres of impact (-34.3 UMAM units; -5.2 herbaceous units and -29.1 forested units) in the Upper Coastal Basin is partially contained in this section. Mitigation for the impacts within the Upper Coastal basin will occur on two sites – FMC and the Homosassa Tract (HT) within the Withlacoochee State Forest (Figure 6-1). FMC will produce 5.8 UMAM credits (5.5 wetland herbaceous, 0.2 wetland forested, 0.1 upland) and 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.

Impacts to forested wetlands within the Upper Coastal Watershed total 70.1 acres and are associated with linear facilities, including pipelines and transmission lines. Mitigation for the impacts to forested wetlands within the Upper Coastal Watershed for the LNP transmission lines and pipelines will occur mainly on the HT of the Withlacoochee State Forest, with the exception of 0.2 forested credits generated at FMC. Herbaceous and open water impacts within the Upper Coastal Watershed will be offset with preservation and restoration/enhancement activities at Five Mile Creek as outlined in Section 5. The HT will produce 55.6 UMAM credits utilizing forested wetland restoration via the restoration of historic hydric conditions and restoration of a wet prairie.

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 6-2). 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.



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Upper Coastal Watershed - Proposed Mitigation Sites

Homosssa Tract

Citrus County, Florida

Project:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JGB/JRN
Figure:	6-1

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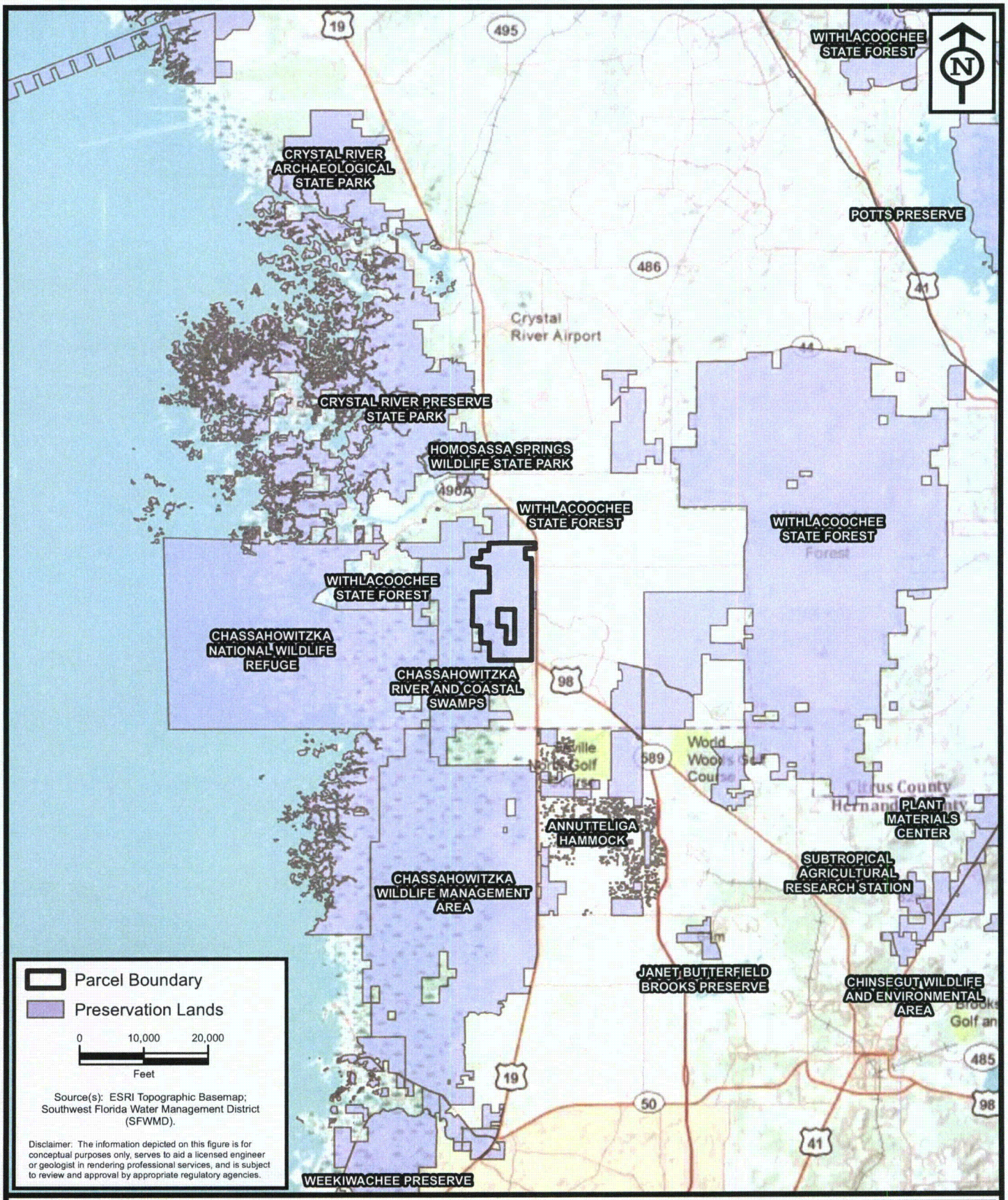

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Regional Preservation Land

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JRN/SRJ
Figure:	6-2

Path: Q:_Projects\EJ\2011\021\00\fig\Homosassa\Report\reg_preservation.mxd Date: 7/19/2011 11:15:13 PM

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.

6.2 Impact Summary

The wetland impacts within the Upper Coastal Watershed for LPN off-site transmission line impacts total approximately 78.6 acres. These impacts will generate a total loss of 34.3 functional units (-5.2 herbaceous and -29.1 forested). The impact summary is provided on Table 6-1 (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 6.6 provides details of the UMAM scores). Please note that an "excess" of 27.2 units is being provided for use on future projects in the Upper Coastal Watershed. Preliminary discussions with FFS have revealed priorities for unfunded wetland rehabilitation and hydrologic restoration work which differed from the original wetland mitigation proposal. However, the revised plan will yield significant UMAM functional lift with installation of LWC which require far less maintenance than culverts and will restore historic hydrological conditions within mixed forested wetland and basin swamp systems. Therefore, this mitigation plan is consistent with the goals and management objectives established by the FFS for the HT and will also satisfy FDEP and ACOE mitigation requirements.

Table 6-1. Upper Coastal Watershed wetland impacts by UMAM functional loss and acreage

Area	Herbaceous Wetland Acreage (including open water)	Herbaceous Wetland Functional Loss	Forested Wetland Acreage	Forested Wetland Functional Loss	Total Acres	Total Functional Loss
Permanent Fill	8.5 acres	-5.2 units	11.8 acres	-7.9 units	20.3	-13.1
Permanent Clearing	None	None	58.3 acres	-21.2 units	58.3	-21.2
Total					**78.6**	**-34.3**

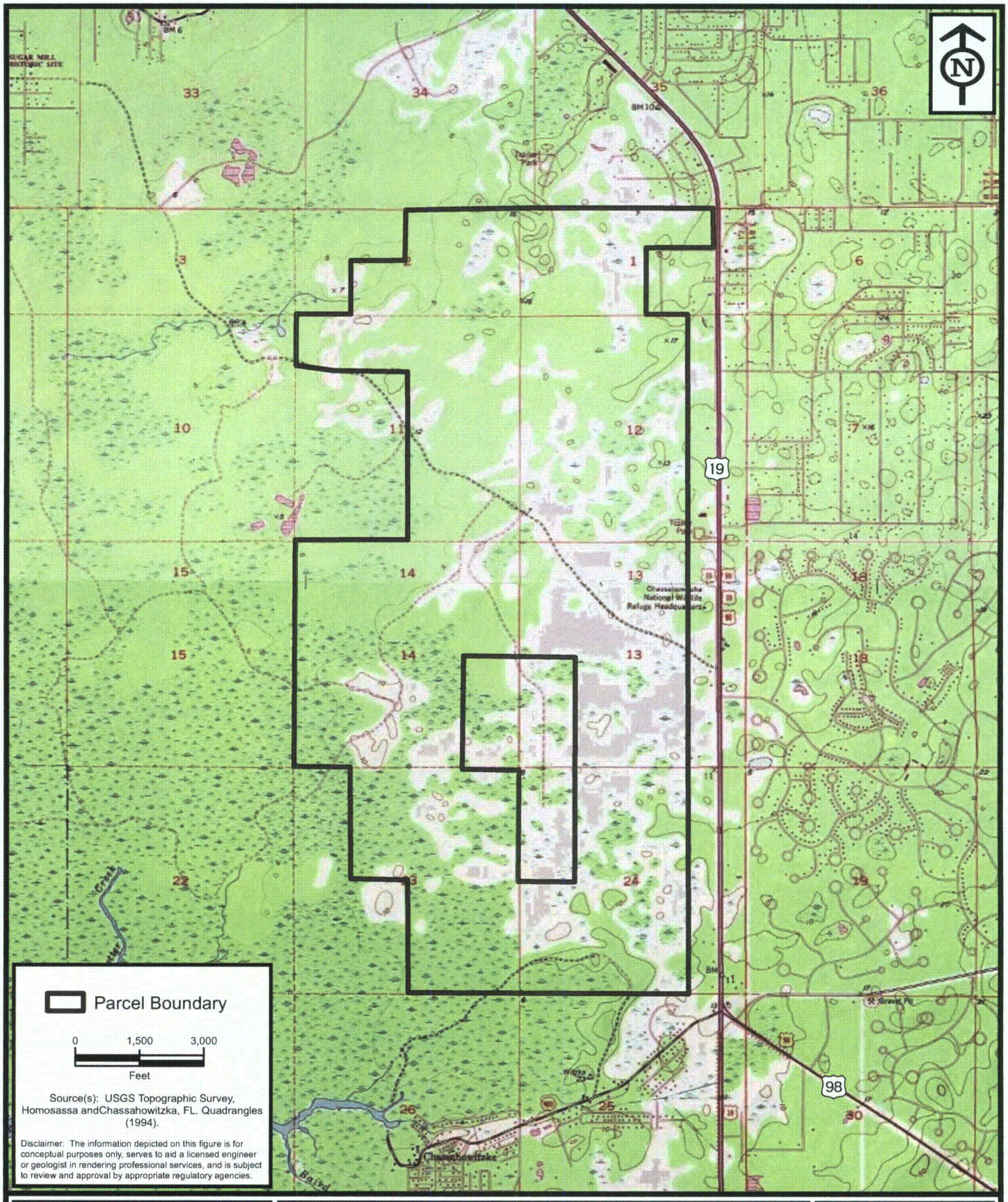
6.3 Site Description

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 6-3). 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 6-4).

6.3.1 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 6-4), 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:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JRN/SRJ
Figure:	6-3

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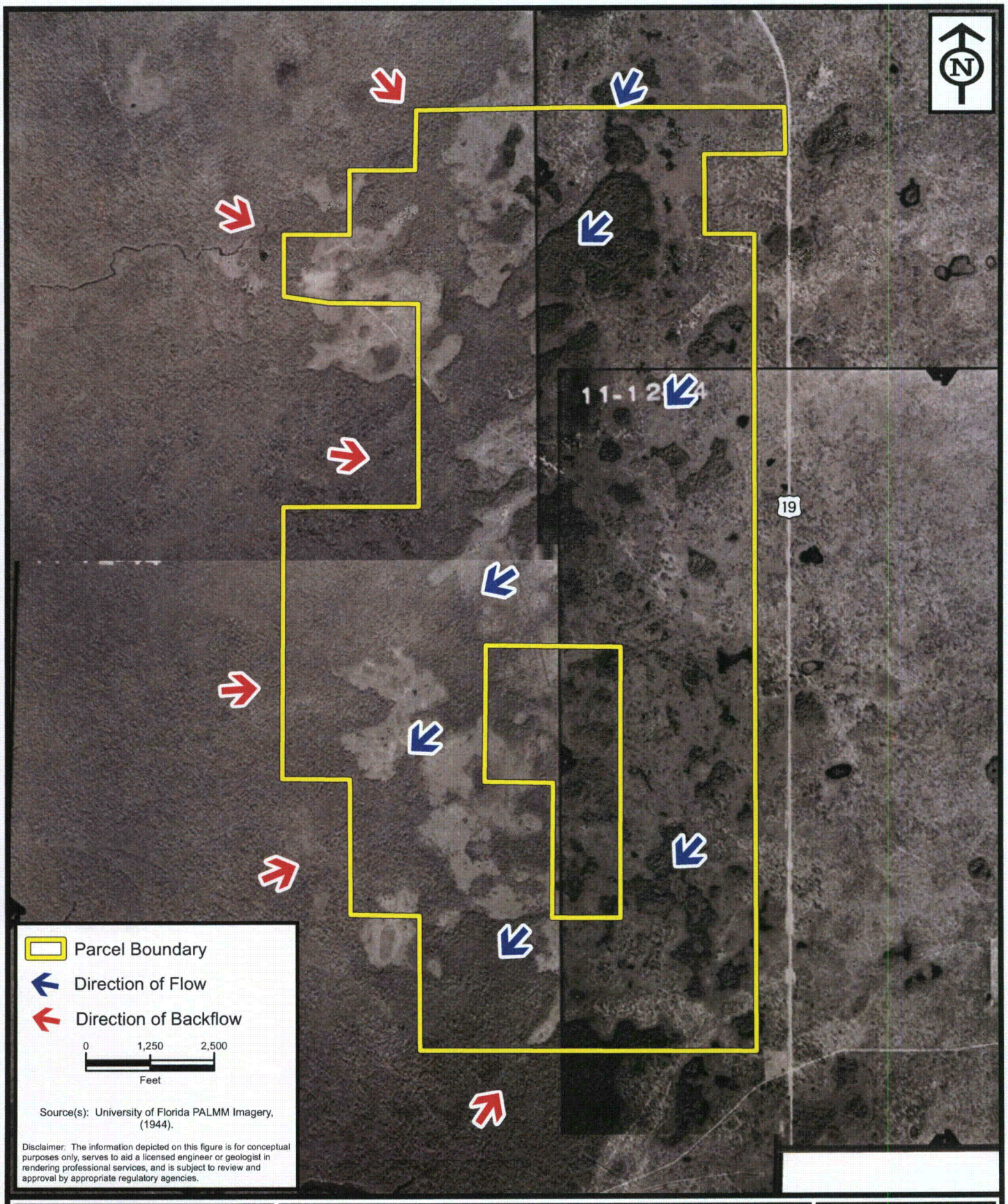

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1944 Historic Aerial Imagery

Homosassa Tract

Citrus County, Florida

Project:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JGB/JRN
Figure:	6-4

Path: Q:_Projects\EJ\2011\021\00\fig\Homosassa\Report\historic.mxd Date: 7/19/2011 11:09:18 PM

6.3.2 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 6-5) for details of specific community locations. Please refer to Figure 6-7 and the information below for details of the specific community types associated with the mitigation activity areas of HT.

Uplands

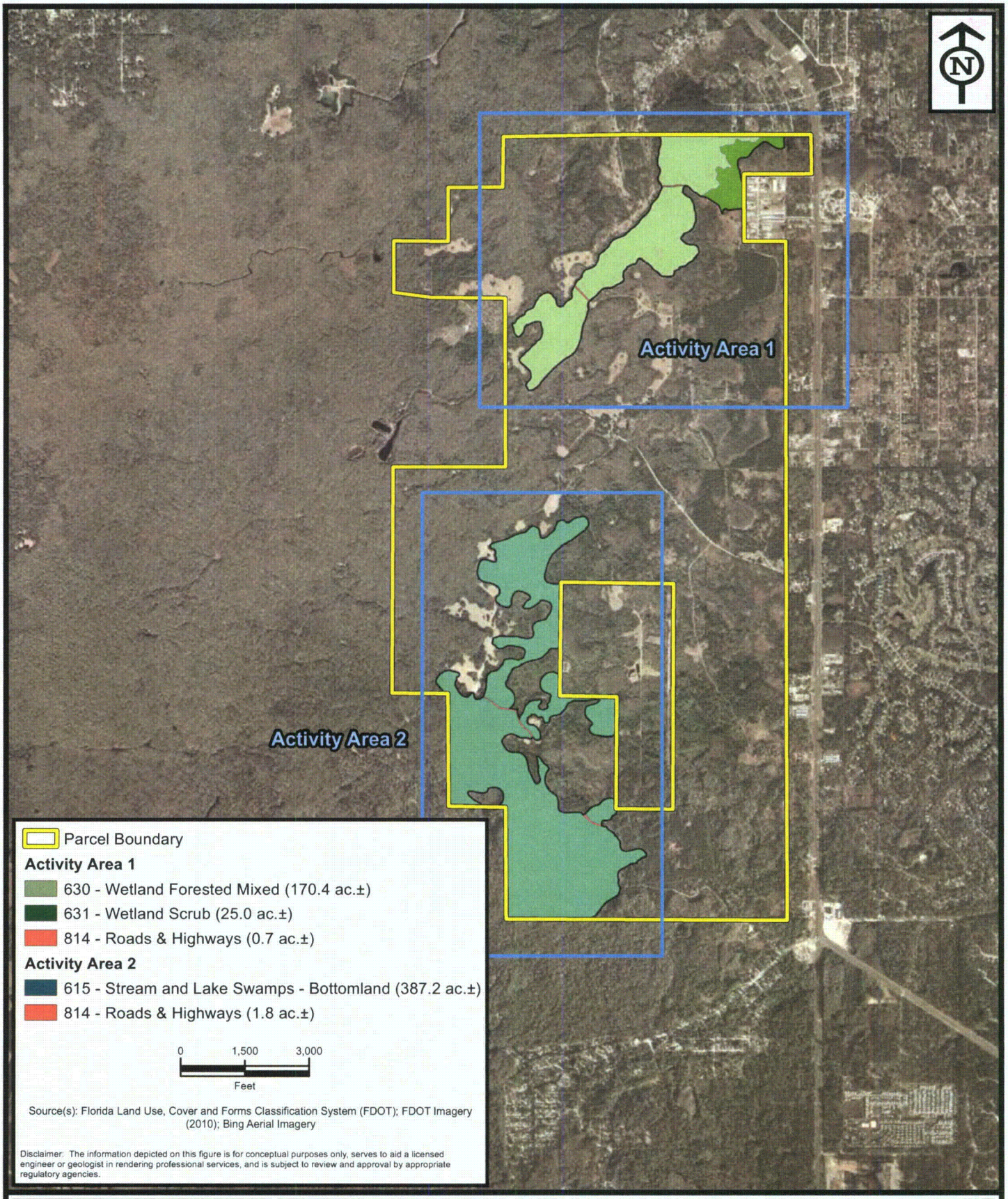
1. Trailroads (FLUCFCS 814). This community type is made up of cleared areas that were graded and drained for ease of mobility throughout the site. Trailroads are present in both activity areas. In many cases, these trail roads are elevated and culverted. Nevertheless, the trail roads placed through 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.

5. 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:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JRN/SRJ
Figure:	6-5

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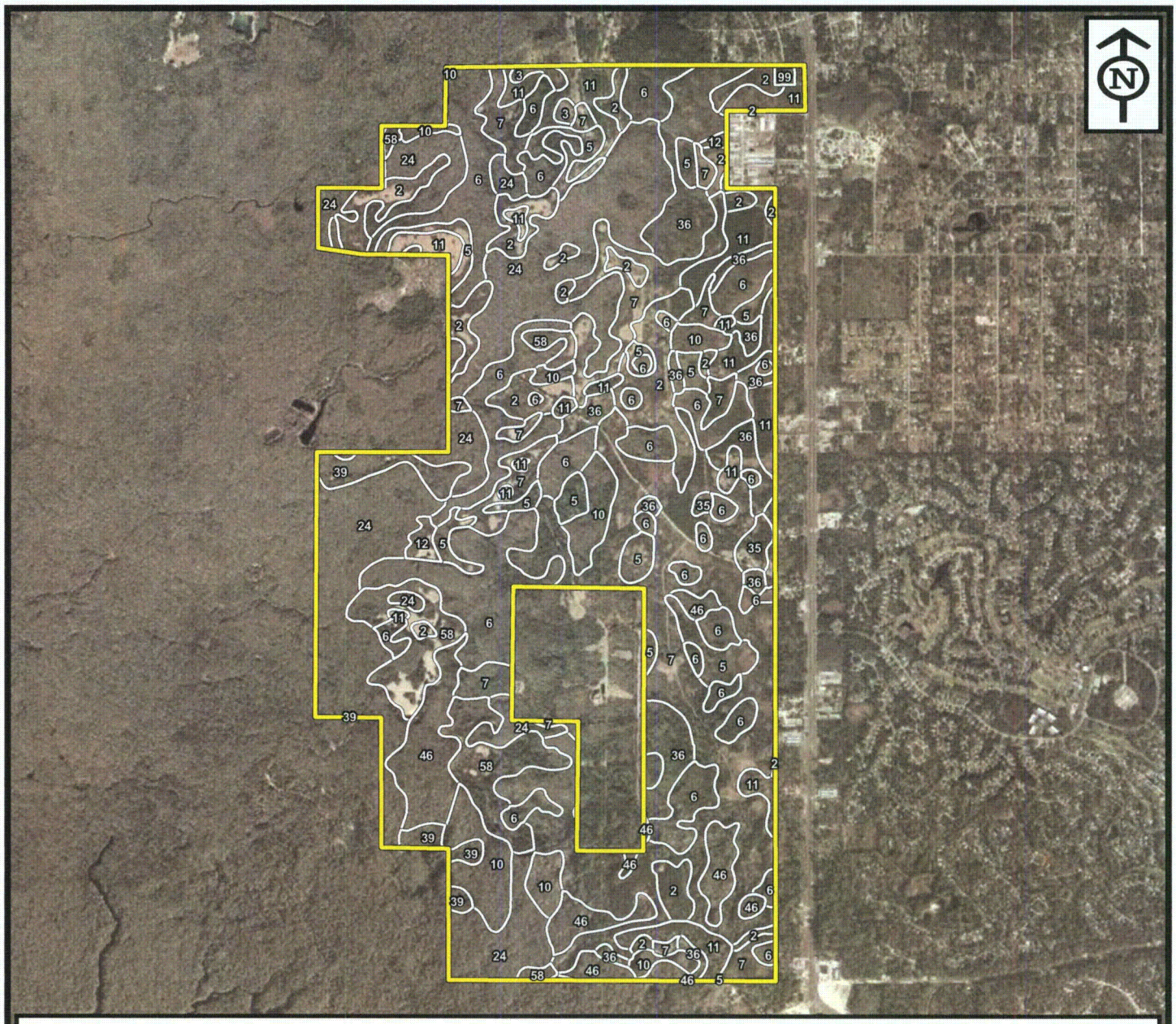
6.3.3 Soils

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

Table 6-2. 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; Bing Imagery

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:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JRN/SRJ
Figure:	6-6

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6.4 Mitigation Plan

The primary mitigation plan for HT (Figure 6-7) 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 6.7 Engineering and Section 6.11 Engineering Detail Drawings.

1. Hydrologic Restoration via LWCs. The proposed hydrologic restoration will be accomplished with 2 LWCs 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 hydrologic restoration of these structures can be found in Section 6.5 Hydrology and Hydraulics, and Section 6.7 Engineering.

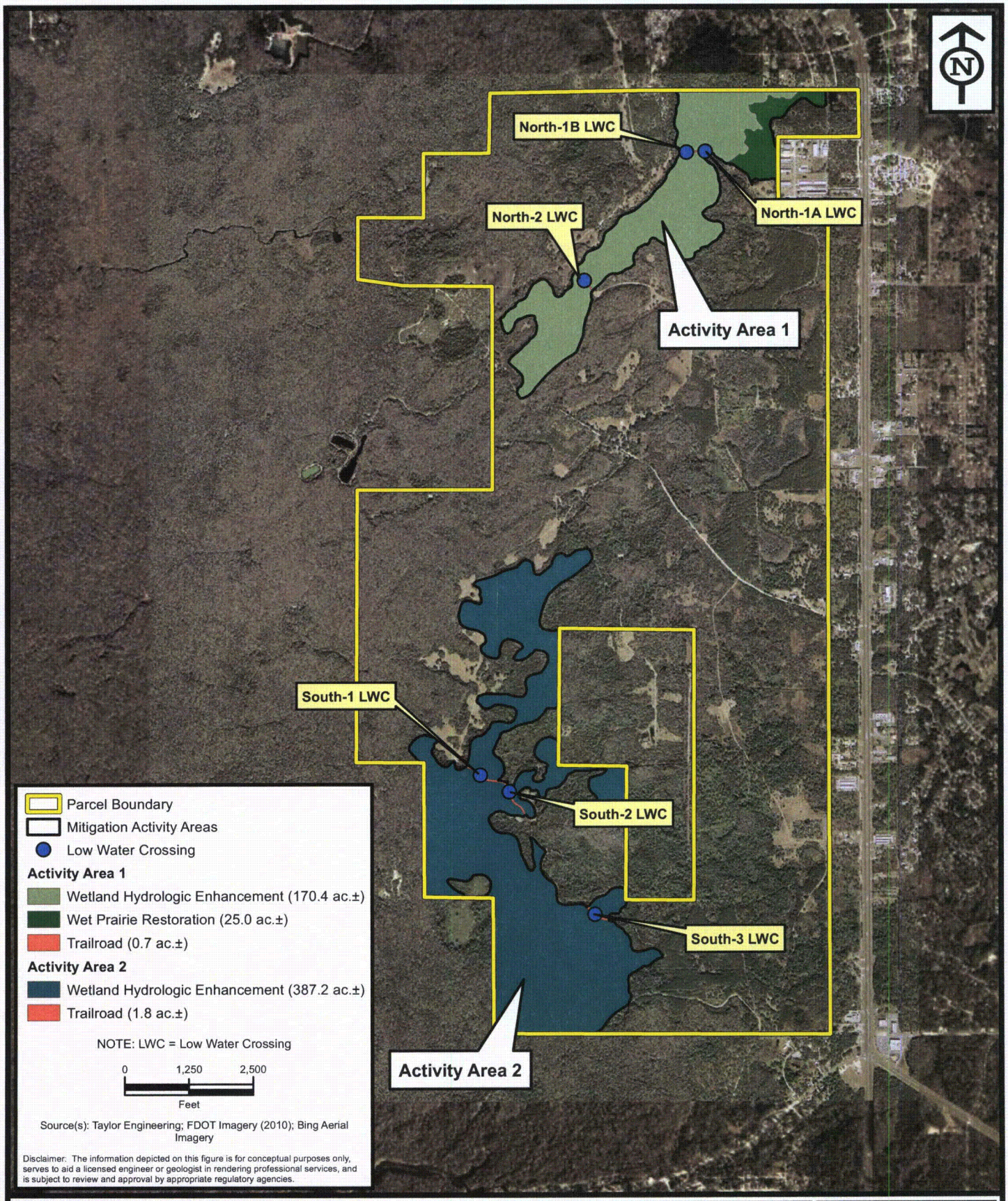
The large wetland forested mixed system in Activity Area 1 will be restored after two LWCs are installed to restore hydrologic flows. Of this large system, It is expected that approximately 170.4 acres of wetland forested mixed will be restored in association hydrologic improvements. Flows will be increased 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 LWC 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 in Activity Area 1 are known as North-1 LWC and North-2 LWC. 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 LWC 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 current roadway is at an elevation of 7.5 feet and will be lowered to 5.5 feet to

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:	EJ11021.00
Date:	July 2011
Drwn/Chkd:	JRN/SRJ
Figure:	6-7

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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.

6.5 Hydrology and Hydraulics

6.5.1 Objective

The hydrologic and hydraulic engineering analysis for the HT simulated existing and proposed project (or mitigation/restoration) conditions. The results demonstrated improved rainfall runoff conveyance and flow patterns that better represent historic, unaltered conditions at sites within the tract. Figure 6-8 shows the HT parcel with five hydrologic restoration areas – North-1 LWC (A and B), North-2 LWC, South-1 LWC, South-2 LWC, and South-3 LWC. Each of these areas involves constructing a LWC 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.

6.5.2 Model Setup

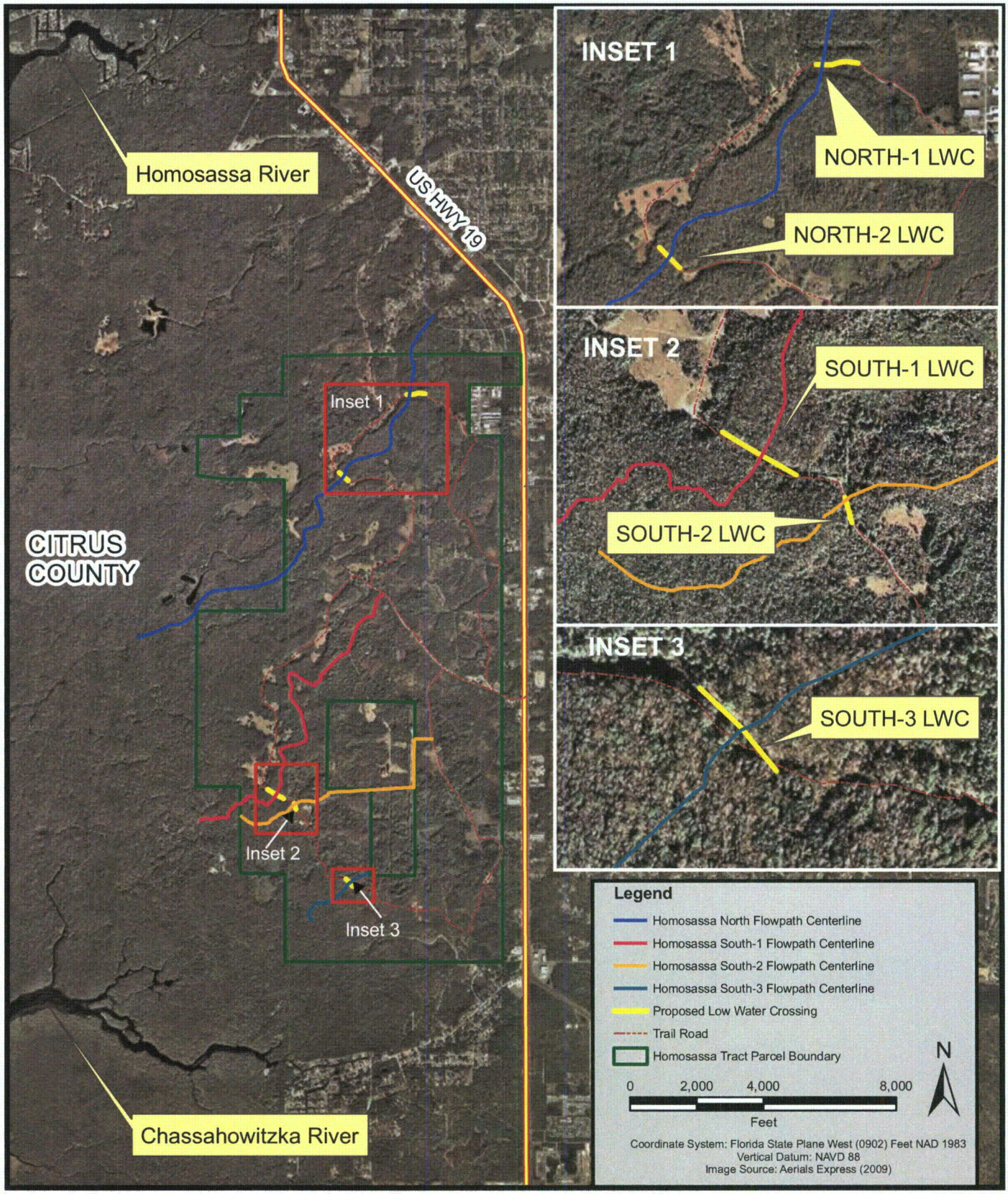
HEC-HMS version 3.4 and HEC-RAS version 4.1 models were used to simulate rainfall runoff, conveyance, and flooding conditions within the HT. SWFWMD provided a preliminary draft of the rainfall-runoff model for the Cardinal Lane watershed (SWFWMD, 2008). The Cardinal Lane watershed is located within the Upper Coastal watershed and encompasses an area of 38,045 acres (see Figure 6-9). The Cardinal Lane watershed includes areas that are within northern portion of the HT. Additionally, a part of the Cardinal Lane watershed drains into the southern portion of the HT. Hence, it is necessary to include the inflows from the Cardinal Lane watershed that drains into the HT mitigation activity areas.

SWFWMD 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 SWFWMD 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 LWC and North-2 LWC restoration areas (Activity Area 1) are part of the same flow-way system, these sites were combined into one model. Individual models were created for each of the remaining restoration 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.



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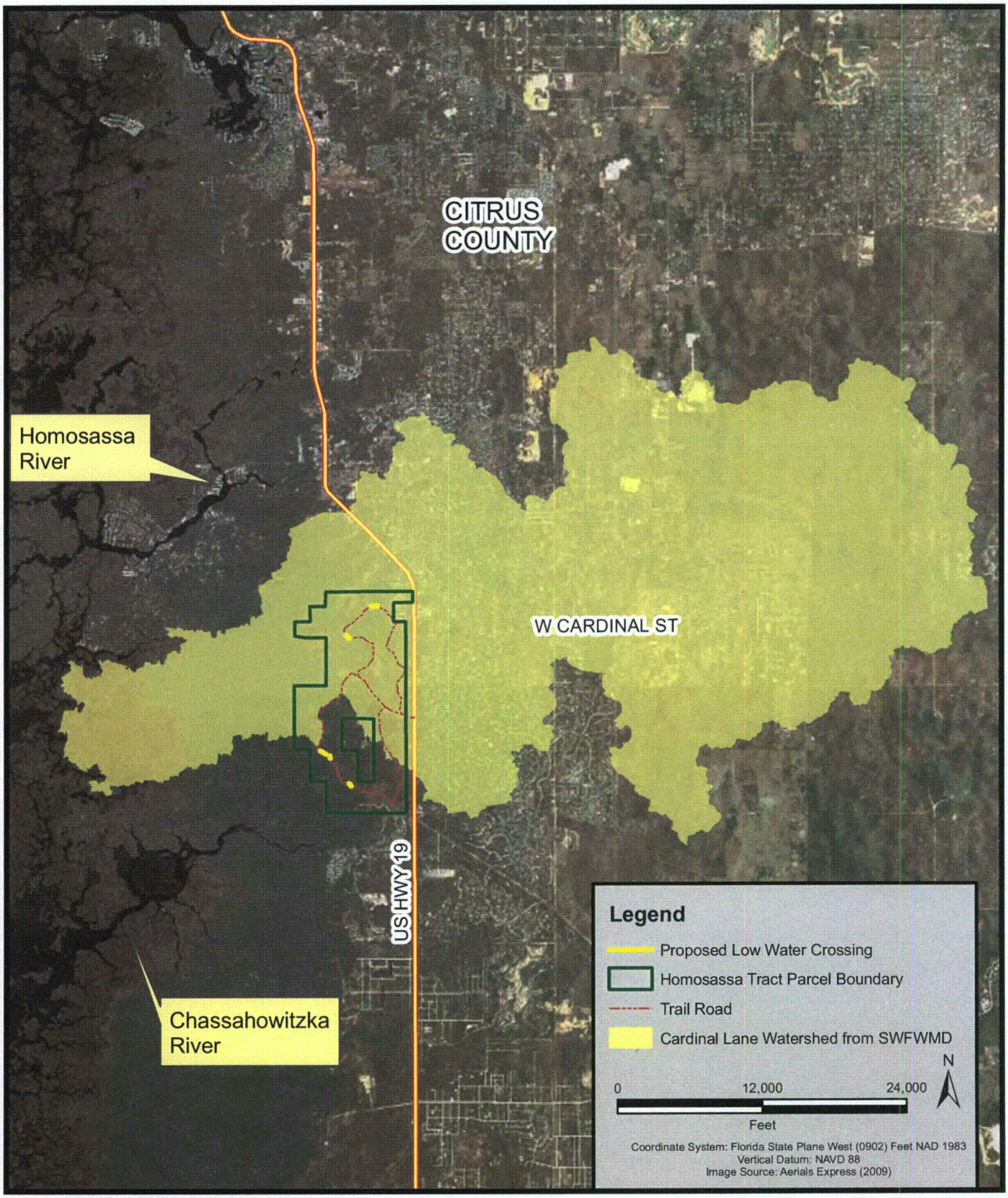
Hydrologic and Hydraulic Study Area
Homosassa Tract Low Water Crossings
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-8
DRAWN BY	RP
DATE	JULY 2011



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Cardinal Lane Watershed
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-9
DRAWN BY	RP
DATE	JULY 2011

Subbasin 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 restoration site by analyzing the topographic LIDAR data (FDEM, 2007). Figure 6-10 to 6-12 shows the sub-basins for North LWC, South-1 LWC, South-2 LWC and South-3 LWC restoration sites, respectively.

Curve Number

The SCS CN generally represents the subbasin'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.

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 subbasin to the outflow. It is a function of the subbasin slope, length, and CN. For each subbasin, 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 subbasin 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 6-3 for the five rainfall events simulated (SWFWMD, 1996).

Table 6-3. 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 6-4 provides the calculated drainage area, curve number, and lag time for sub-basins within each mitigation area.

Table 6-4. HEC-HMS model hydrologic input parameters

Restoration Area	Subbasin Name	Area (acres)	Weighted Curve Number	Lag Time, (min)
North-1 LWC and North-2 LWC	BASIN NA-0570	243.2	89	171
	BASIN NA0190	214.8	85	87
	BASIN NA-0220	707.2	94	324
South-1 LWC	BASIN 1	230.6	92	175
	BASIN 2	55	92	111
	BASIN 3	32	96	121
	BASIN 4	25.6	98	89
South-2 LWC	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 LWC	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 restoration area. 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 6-5 shows the peak flows obtained from the model run for each sub-basin within the restoration areas.

Table 6-5. HEC-HMS model output peak flows for sub-basins

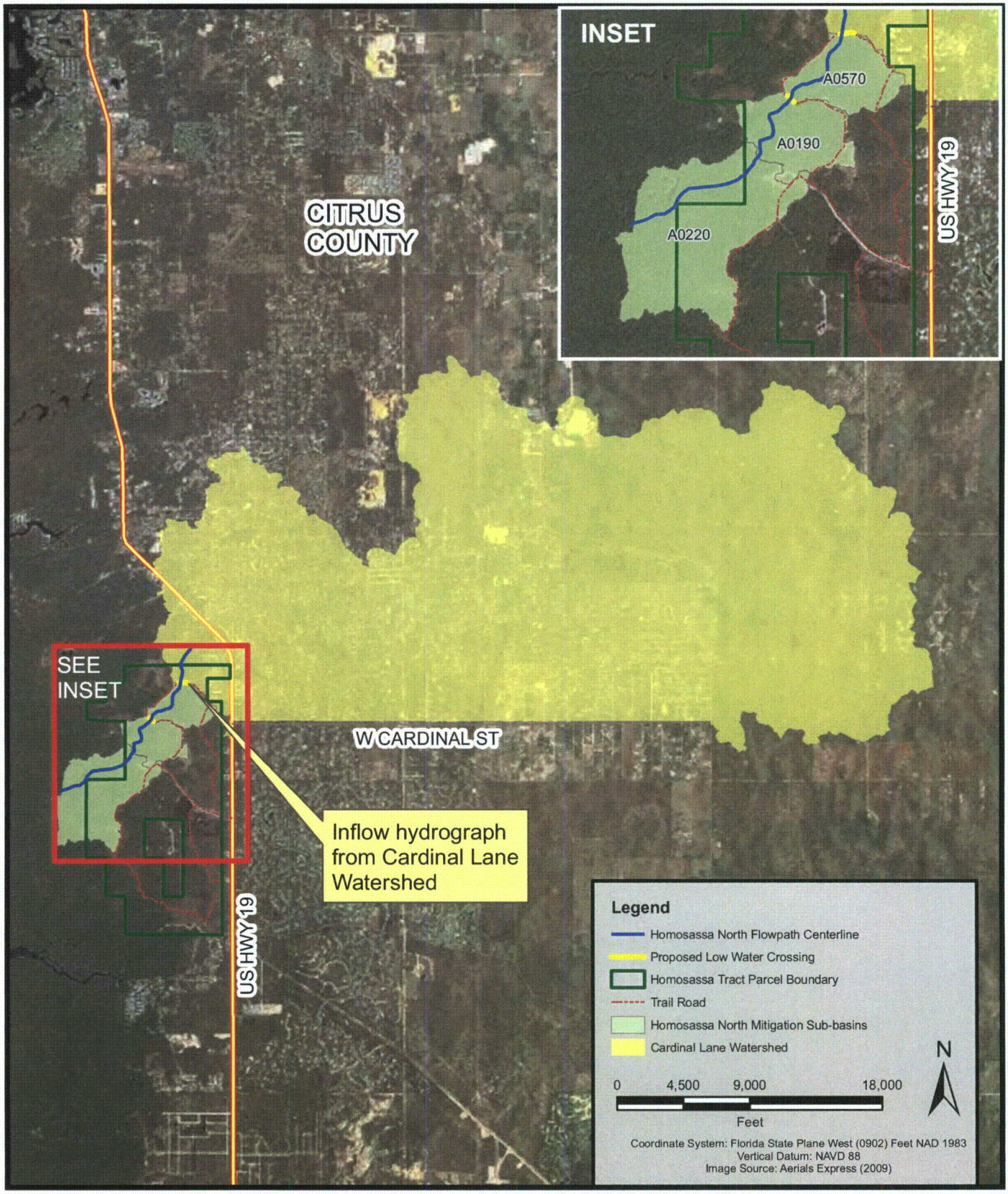
Restoration Area	Sub-basin Name	Peak Flow (cfs)				
		2-yr	10-yr	25-yr	50-yr	100-yr
North-1 LWC and North-2 LWC	BASIN NA-0570	85.6	175	230.2	264	310
	BASIN NA0190	70.3	135.8	176	200.5	233.9
	BASIN NA-0220	148.9	269.3	342.7	387.5	448.5
South-1 LWC	BASIN 1	16	31.7	41.4	47.3	55.4
	BASIN 2	50.3	96.2	124.1	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 LWC	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 LWC	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

SWFWMD's preliminary ICPR model for Cardinal Lane watershed area provides inflow hydrographs for areas that drain upstream of the North LWCs, South-1 LWC, South-2 LWC and South-3 LWC restoration areas. Figure 6-10 shows the basin encompassing an area of 21,952 acres draining into Activity Area 1. Figure 6-11 shows the basin encompassing an area of 4,109 acres draining into the South-1 LWC restoration area. Figure 6-12 shows the basin encompassing an area of 1,100 acres draining into the South-2 LWC restoration area. Figure 6-13 shows the basin area draining ton the South-3 LWC restoration area. These figures also show the location of inflow hydrographs extracted from the ICPR model for the 25- and 100-year storm events. Since SWFWMD's 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 Activity Area 1, 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 Activity Area 2, peak flows were calculated using the 1982 USGS regression equation that requires basin area and percentage of lakes within the basin (USGS, 1982). SWFWMD's 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. Figure 6-14 – 6-16 shows the inflow hydrographs for 2-, 10-, 25-, 50- and 100-year storm event at the North LWCs, South-1 LWC and South-2 LWC restoration areas, respectively.



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

PROJECT	C2011-025
FIGURE	6-10
DRAWN BY	RP
DATE	JULY 2011

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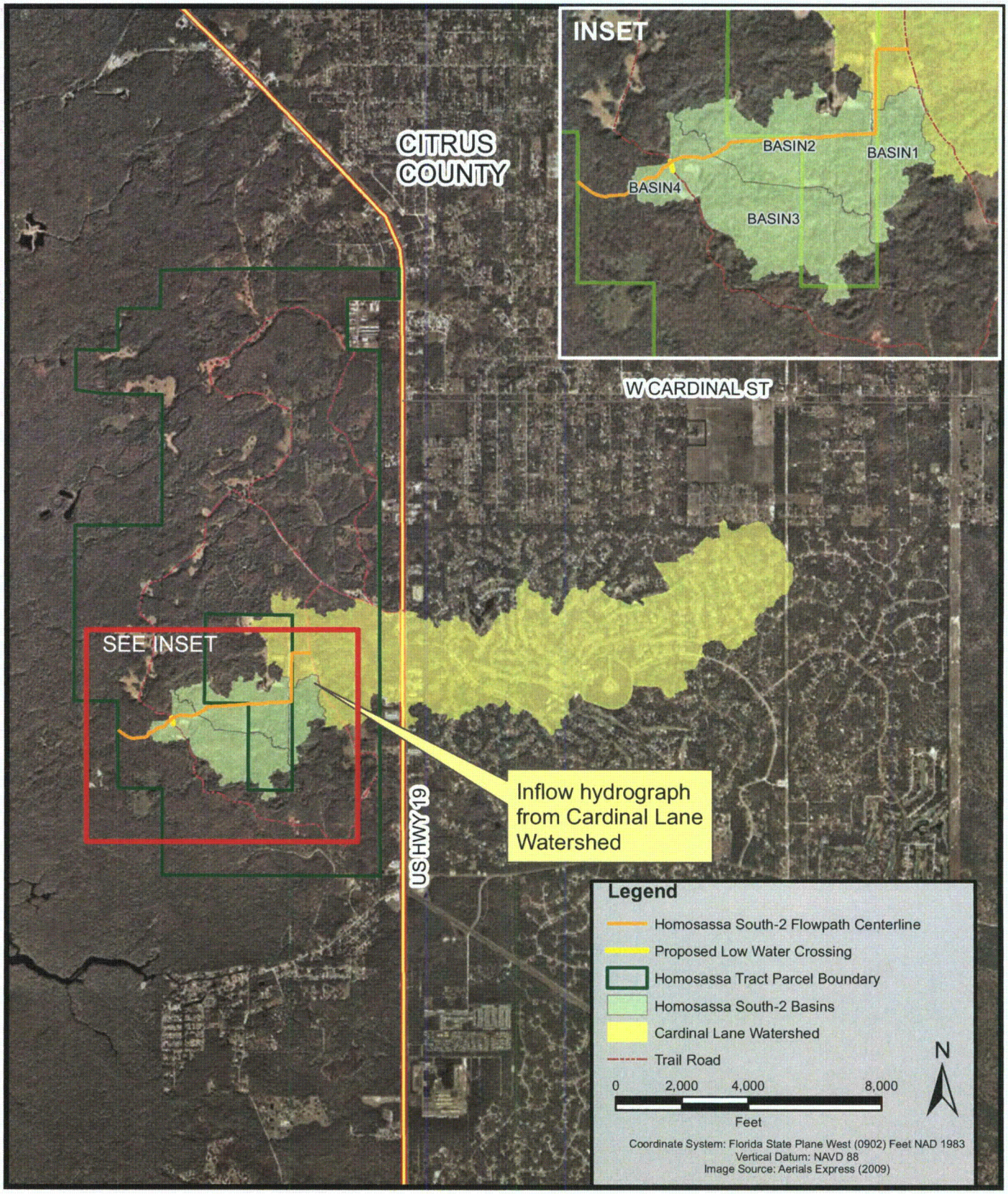
South-1 LWC Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-11
DRAWN BY	RP
DATE	JULY 2011



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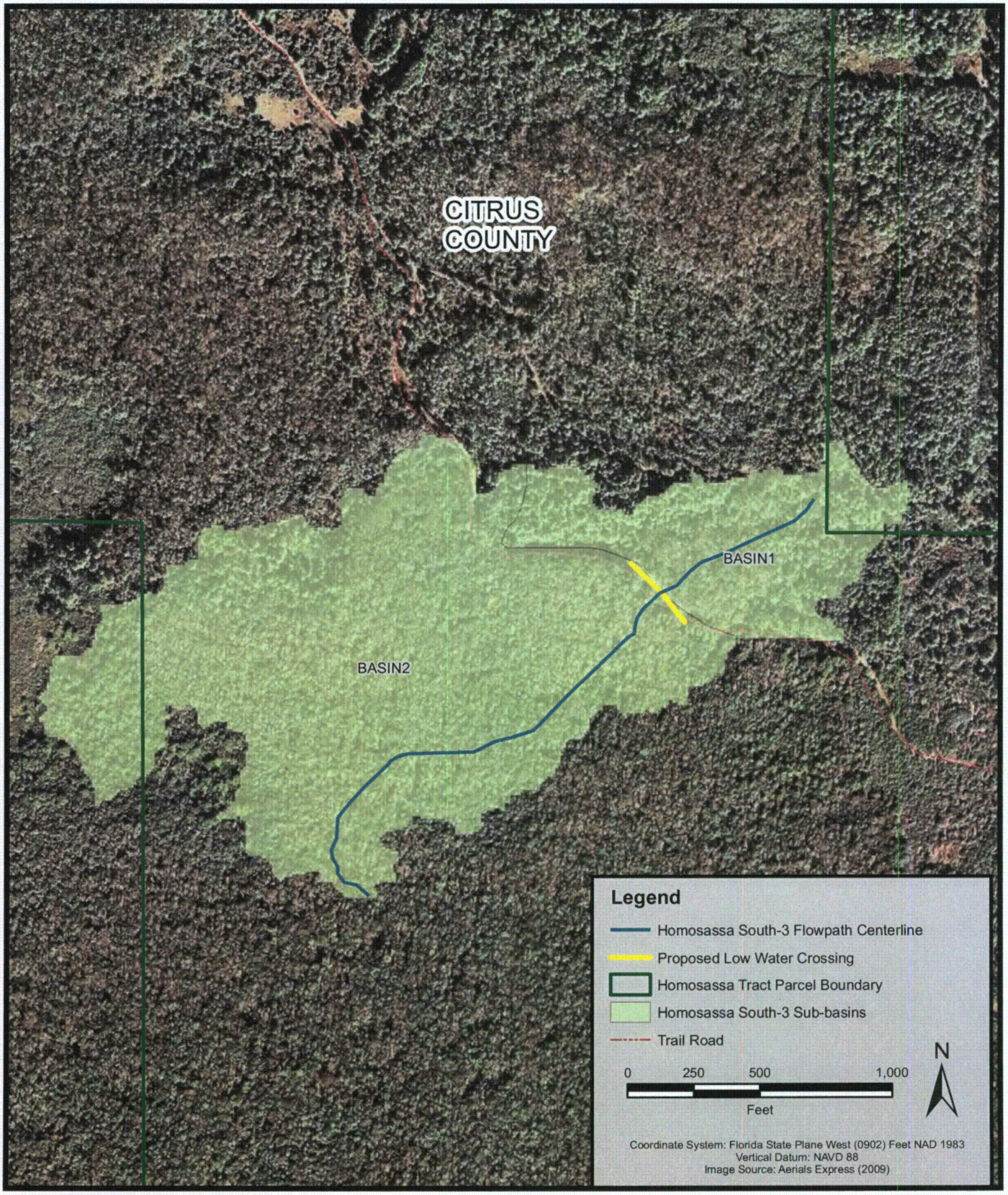
South-2 LWC Sub-basins Map
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-12
DRAWN BY	RP
DATE	JULY 2011



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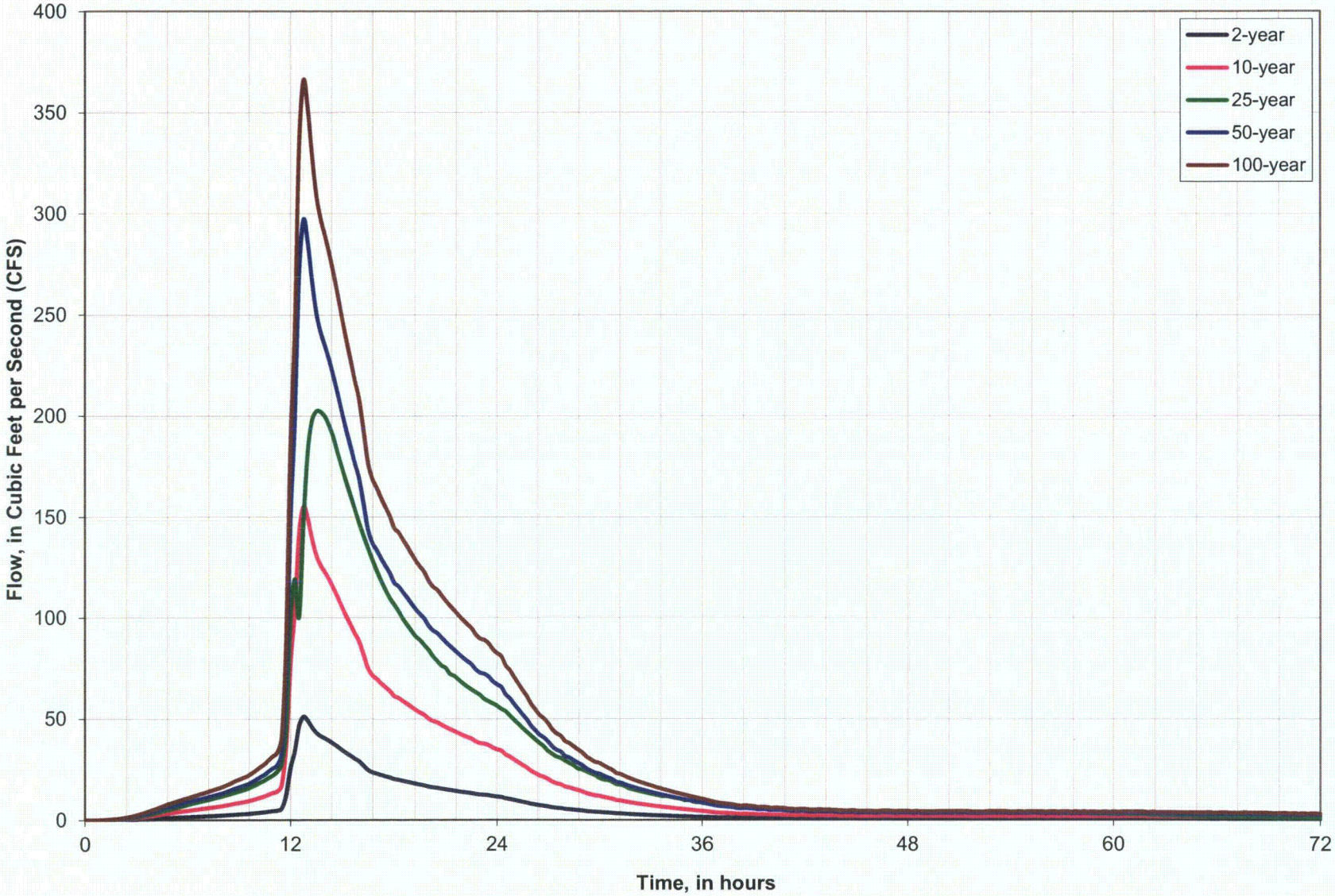
South-3 Sub-basins Map
Homosassa Tract
Citrus County, Florida

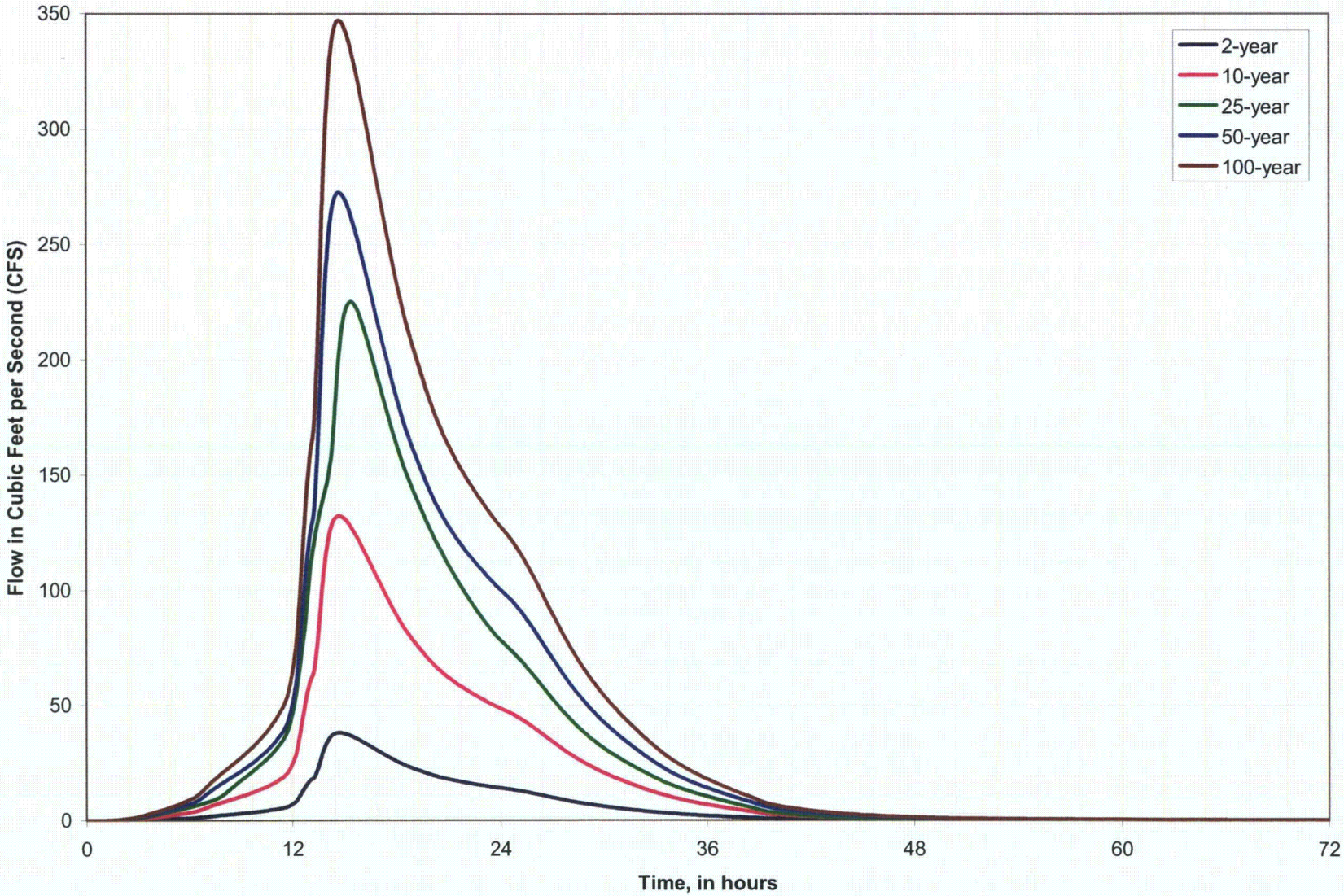
PROJECT	C2011-025
FIGURE	6-13
DRAWN BY	RP
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

North LWCS Inflow Hydrograph
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-14
DRAWN BY	RP
DATE	JULY 2011



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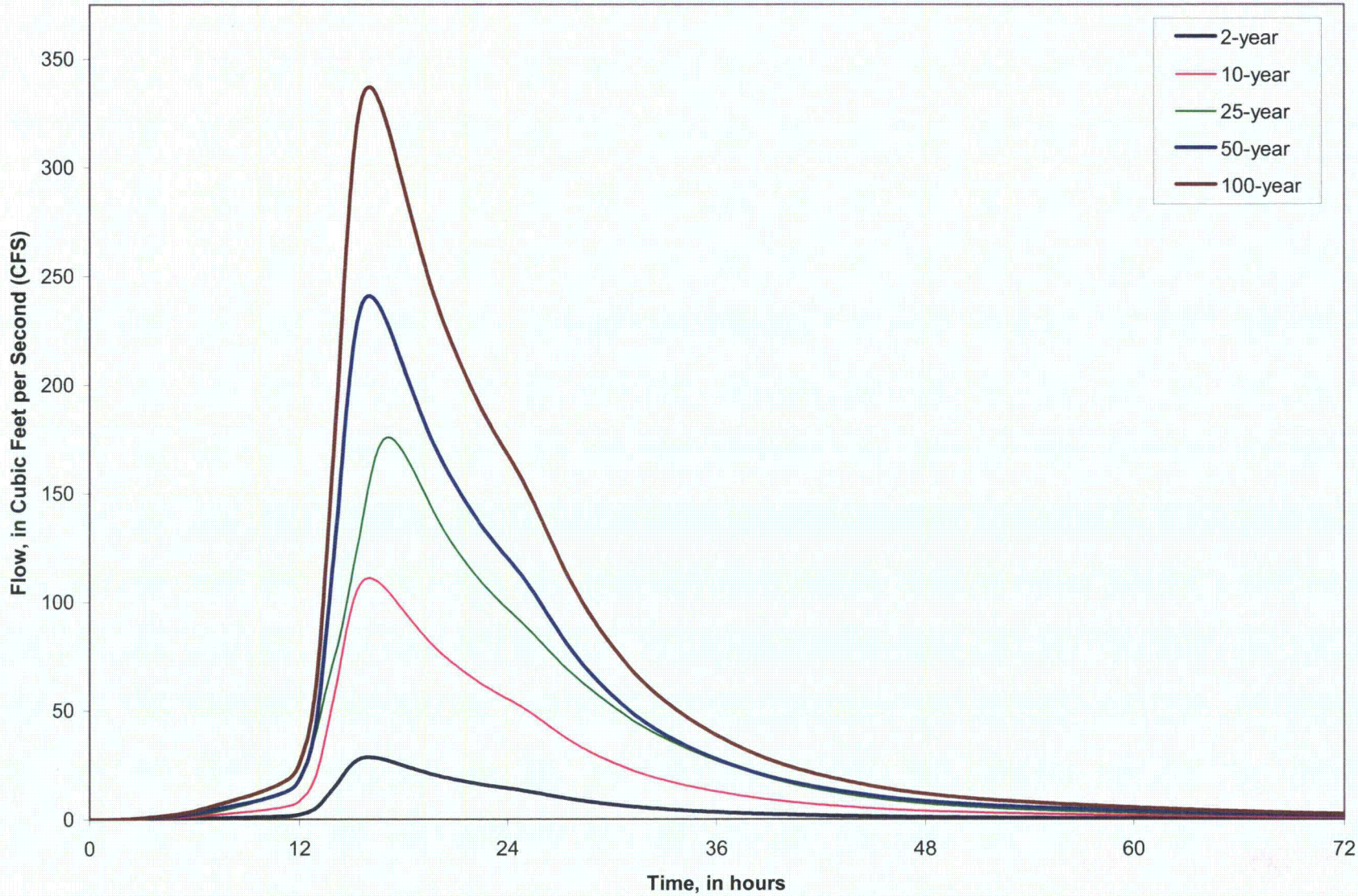
South-1 LWC Inflow Hydrograph
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-15
DRAWN BY	RP
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

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

PROJECT	C2011-025
FIGURE	6-16
DRAWN BY	RP
DATE	JULY 2011

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. Figure 6-17 – 6-20 shows the cross-section layout for the HEC-RAS model for North LWCs, South-1 LWC, South-2 LWC and South-3 LWC restoration areas, 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).

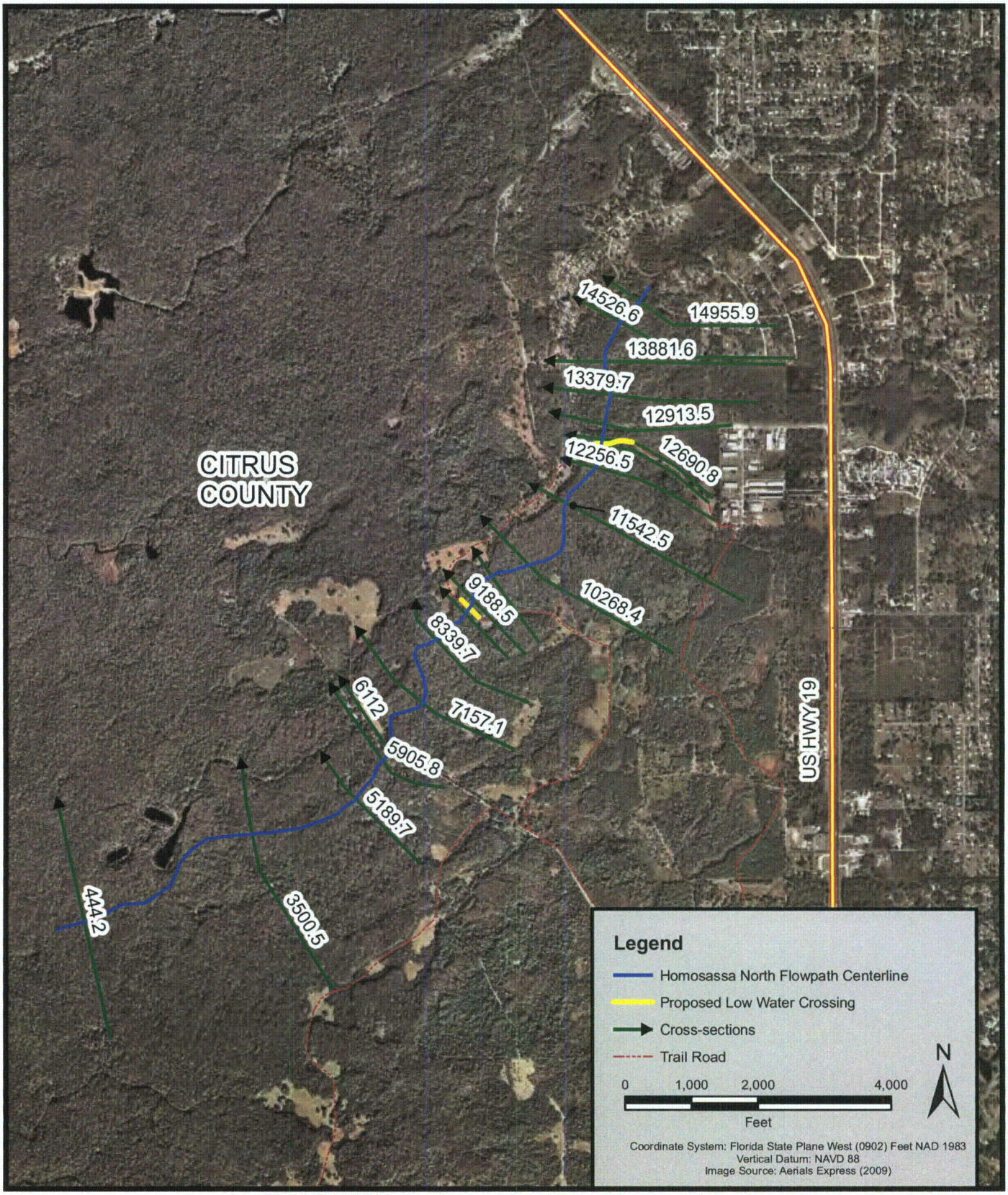
Boundary Conditions

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 LWC 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 SWFWMD's ICPR model and USGS regression equations (see Figure 6-14 – 6-16). These inflow hydrographs were applied at the upstream end of the model boundary. All LWC sites use this boundary condition except for South-3 LWC. South-3 LWC uses the sub-basin inflow hydrograph as a boundary condition.

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

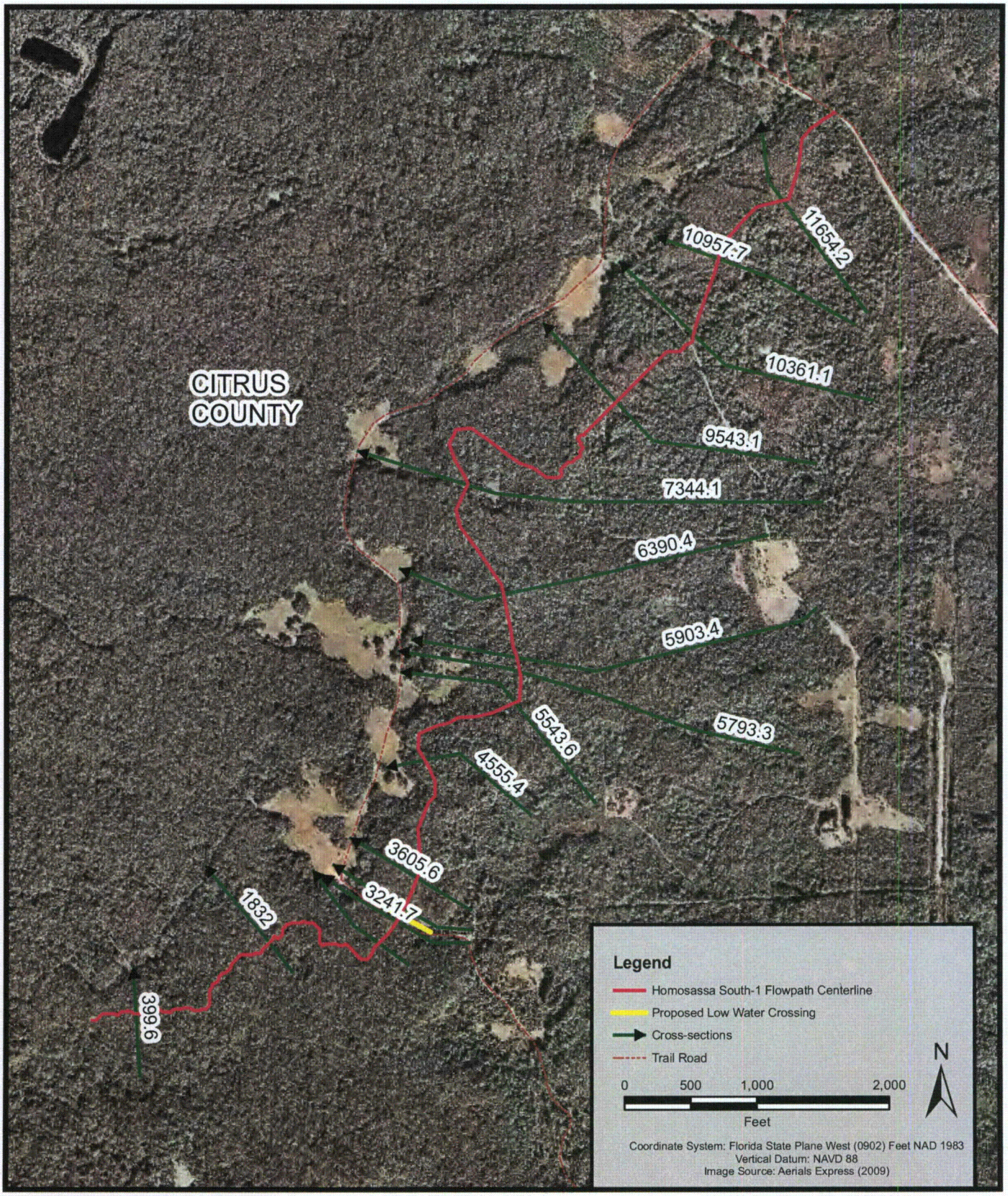
The HEC-RAS model routes the flows from these flow hydrographs to estimate the flow and stage at different cross-sections within the model domain.



TAYLOR ENGINEERING, INC.

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

PROJECT	C2011-025
FIGURE	6-17
DRAWN BY	RP
DATE	JULY 2011



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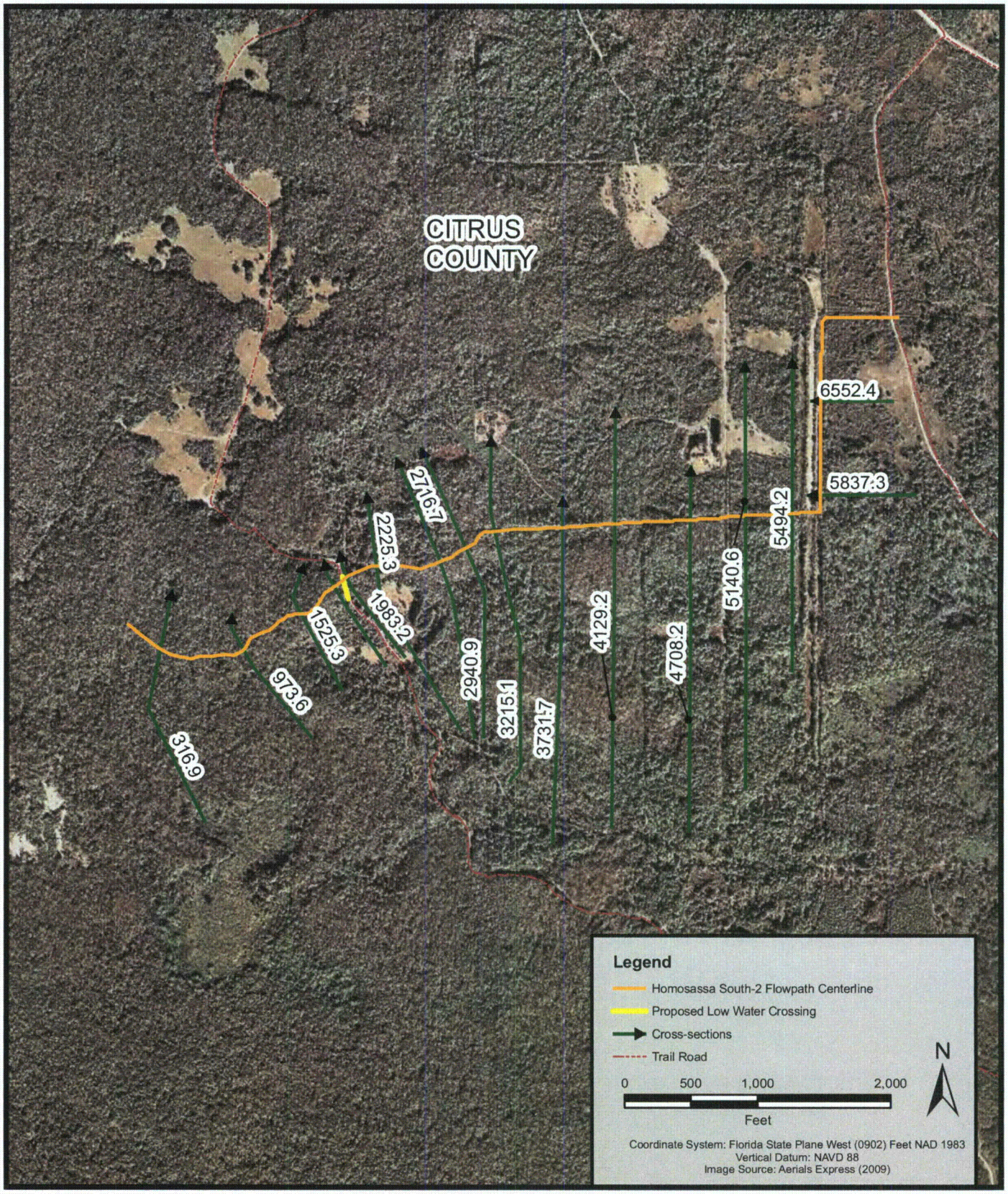
South-1 LWC HEC-RAS Model Layout
Homosassa South-1 Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-18
DRAWN BY	RP
DATE	JULY 2011



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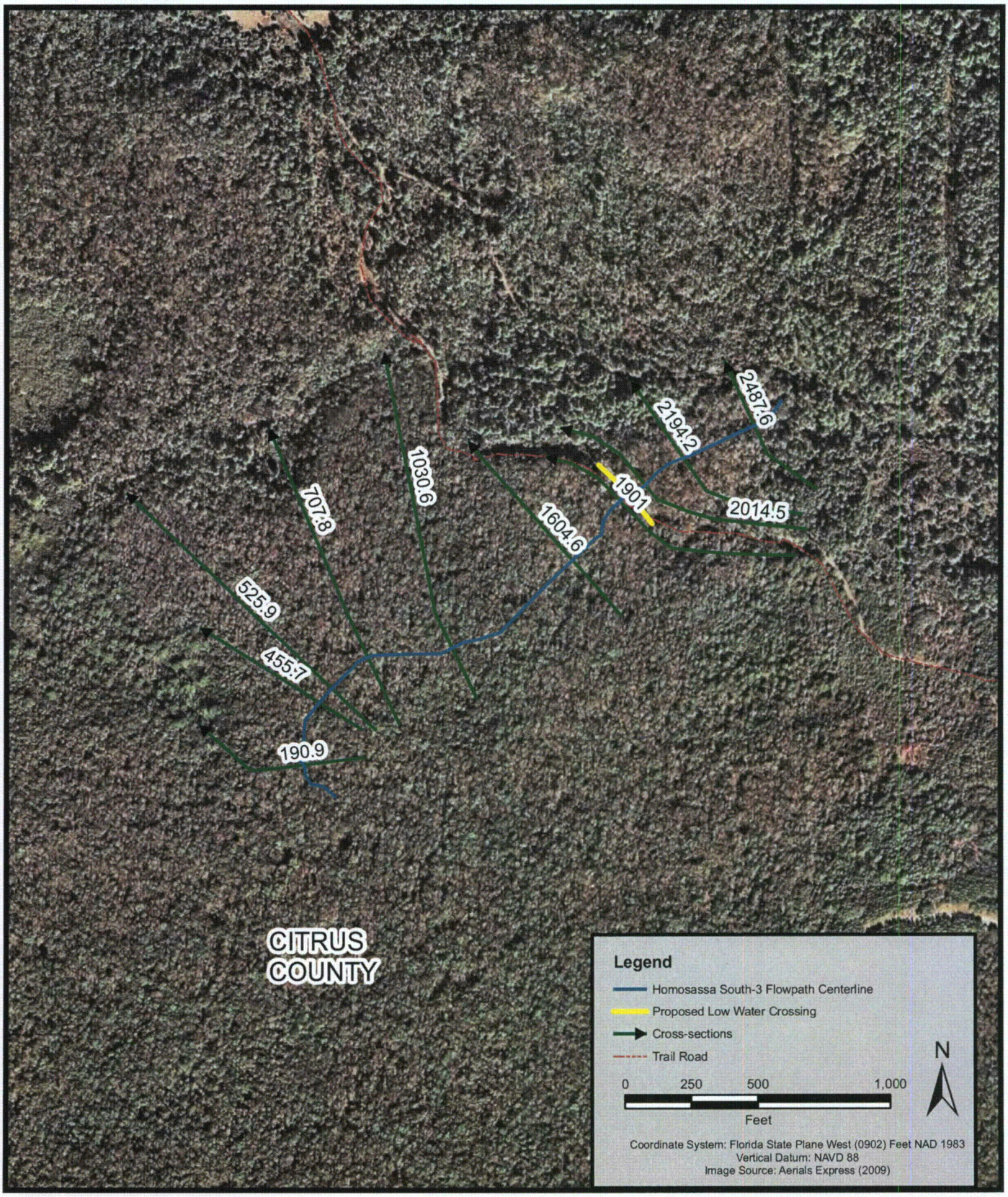
South-2 LWC HEC-RAS Model Layout
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-19
DRAWN BY	RP
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

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

PROJECT	C2011-025
FIGURE	6-20
DRAWN BY	RP
DATE	JULY 2011

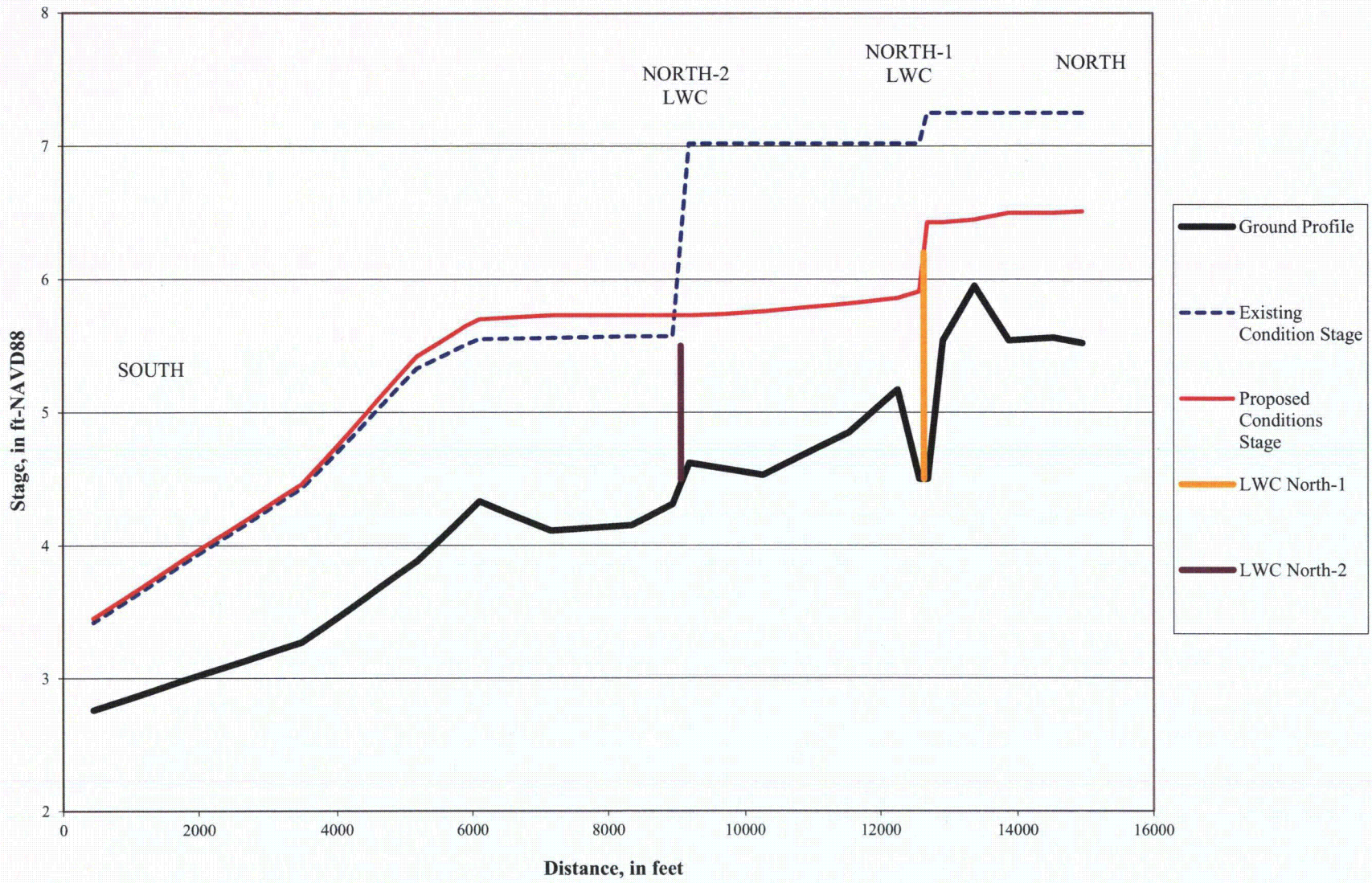
6.5.3 Model Application Results

The HEC-RAS model was applied to the each restoration area for five rainfall events representing the 2-, 10-, 25-, 50-, and 100-year return periods. The model was applied to both existing and proposed (mitigation or post-construction) conditions. The post-construction conditions represent the proposed LWC at each site within the system (more details about the modifications are provided in Section 6.7 Engineering). Comparison of the pre- and post-construction model results at each restoration area demonstrate the improved flow conveyance gained from the construction of LWC. A detailed description of the results for each restoration area is described in the following sections.

North-1 LWC and North-2 LWC (Activity Area 1)

In the existing conditions, the elevation of the trail road at both restoration areas is between 7.2' NAVD and 7.5' NAVD. The surrounding grade is at least 2'- 3' lower than the road elevation. As a result, water back-ups behind the trail road and impedes the sheet flow of water that existed before the construction of the trail road. Modifications at North-1 LWC restoration area include a multi-step LWC. Details on the multi-step LWC can be found in Section 6.7 Engineering. The LWCs for this site have been shown as North 1A LWC and North 1B LWC in Section 6.11 Engineering Detail Drawings, to allow for ease of review. The multi-step LWC consists of two LWCs – a 75' wide crossing at an elevation of 6.2' NAVD (North-1A LWC) and another one is an 82' wide crossing at an elevation of 6.6' NAVD (North-1B LWC). Modifications at North-2 LWC restoration area site include a 375' wide LWC at an elevation of 5.5' NAVD.

Figure 6-21 to 6-25 shows the water surface profile for the 2-, 10-, 25-, 50-, and 100-year storm events in existing and proposed conditions. As seen from Figure 6-21, by constructing the LWC, the head loss across the road decreases from 1.5' to 0.1' for the 2-year storm event at the North-2 LWC restoration area.



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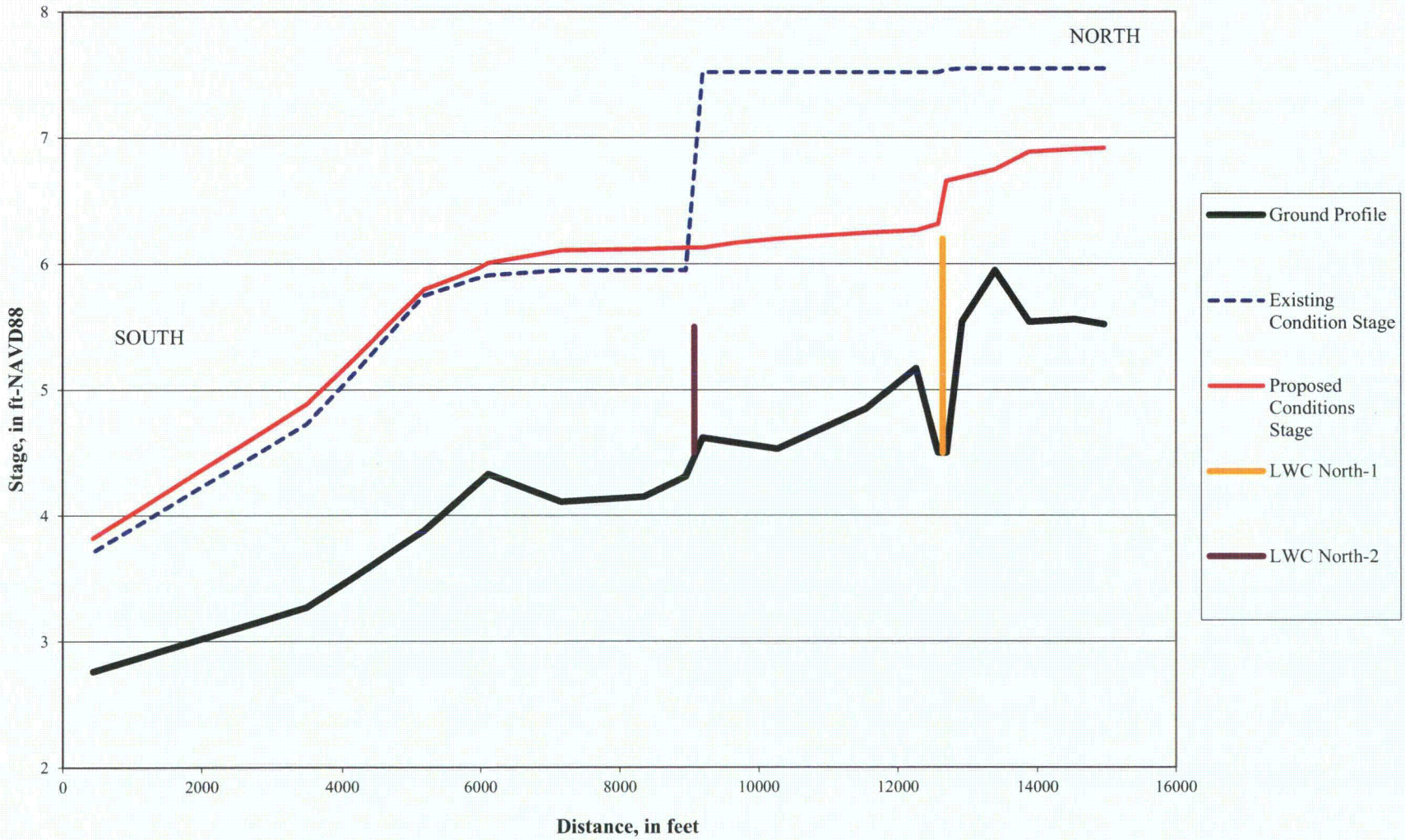
North LWCS Profile of peak stages in Existing and Proposed Conditions for the 2-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-21
DRAWN BY	APS
DATE	JULY 2011



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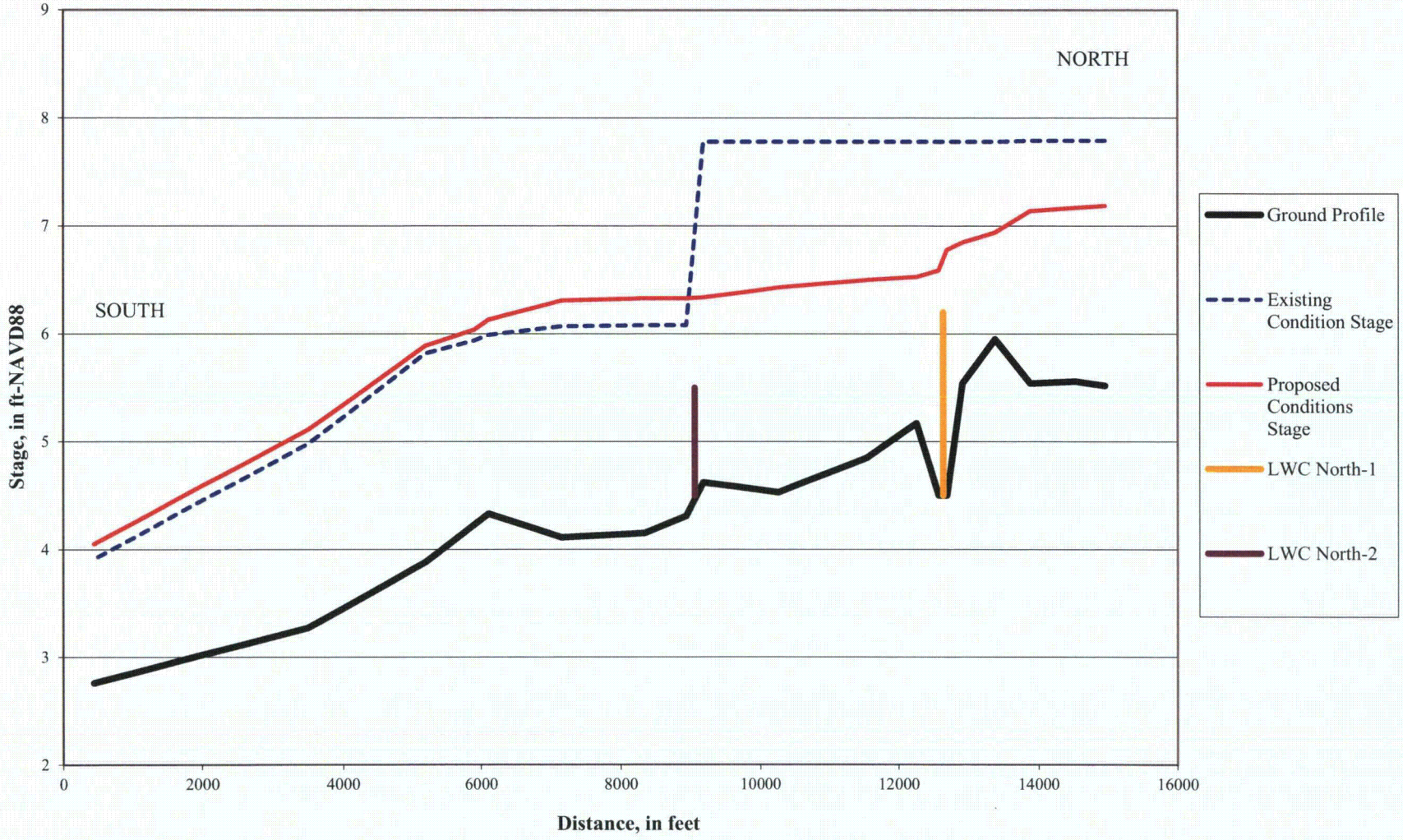
North LWCS Profile of peak stages in Existing and Proposed Conditions for the 10-year storm event
Homosassa Tract
Citrus County, Florida

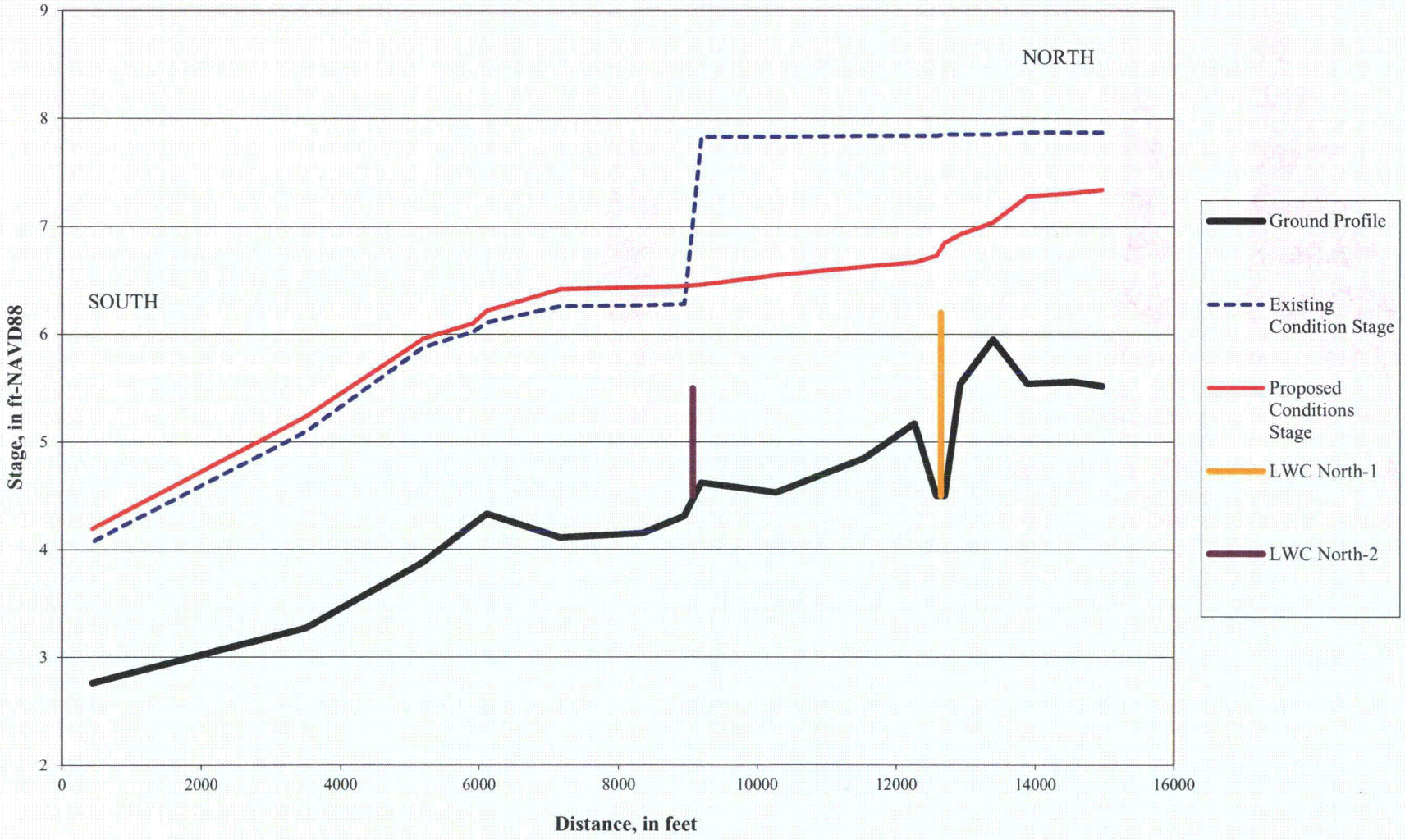
PROJECT	C2011-025
FIGURE	6-22
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

North LWCS Profile of peak stages in Existing and Proposed Conditions for the 25-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-23
DRAWN BY	APS
DATE	JULY 2011



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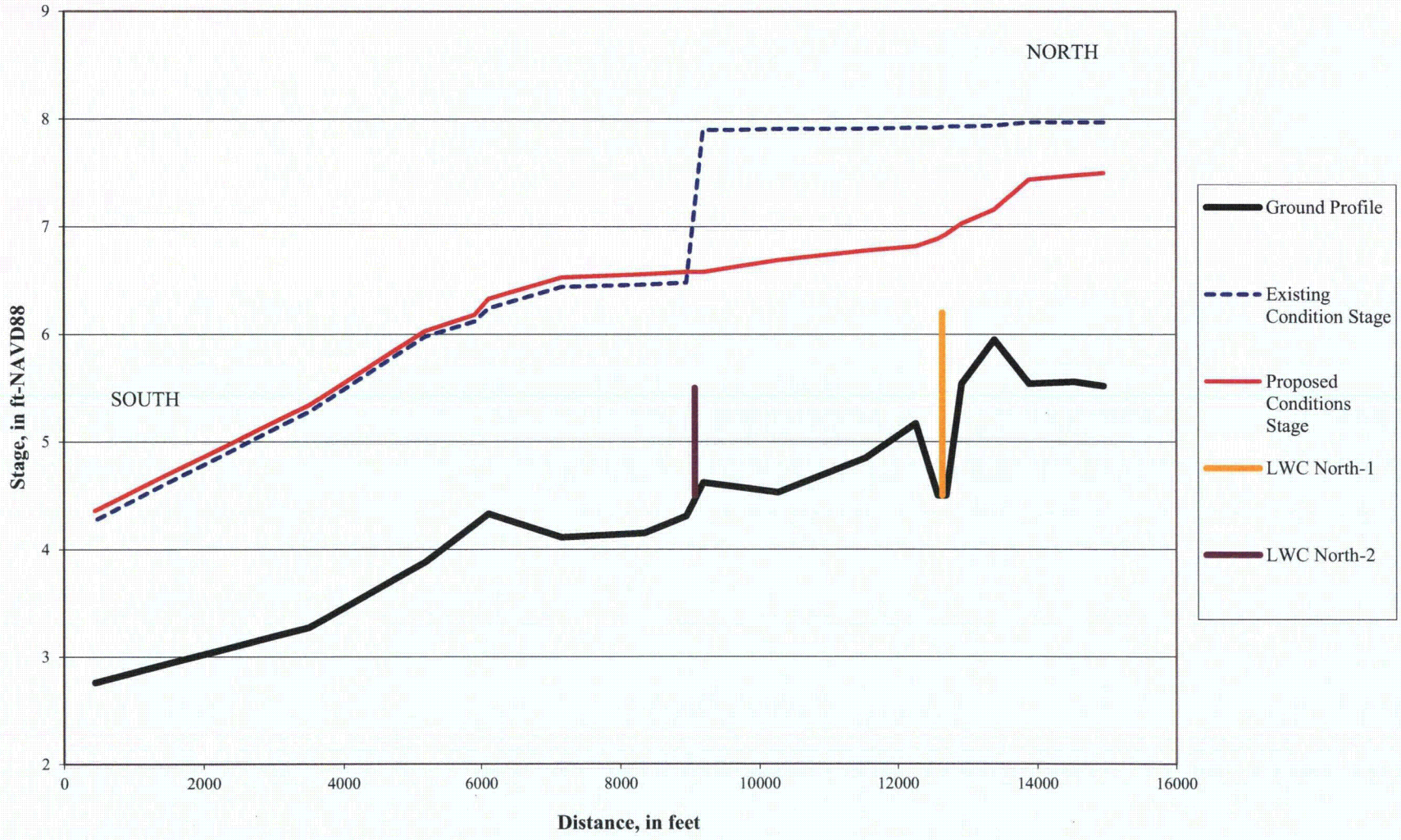
North LWCS Profile of peak stages in Existing and Proposed Conditions for the 50-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-24
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

North LWCS Profile of peak stages in Existing and Proposed Conditions for the 100-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-25
DRAWN BY	APS
DATE	JULY 2011

Table 6-6 presents the peak flows along the proposed North-2 LWC restoration area in the existing and proposed conditions. As seen from this table, by constructing the LWC, the peak flow increases for by 246% for a 10-year storm event.

The LWC allows for additional volume of water to pass over the trail road to restore the natural sheet flow and, thereby reducing the back-up of water upstream of the trail road.

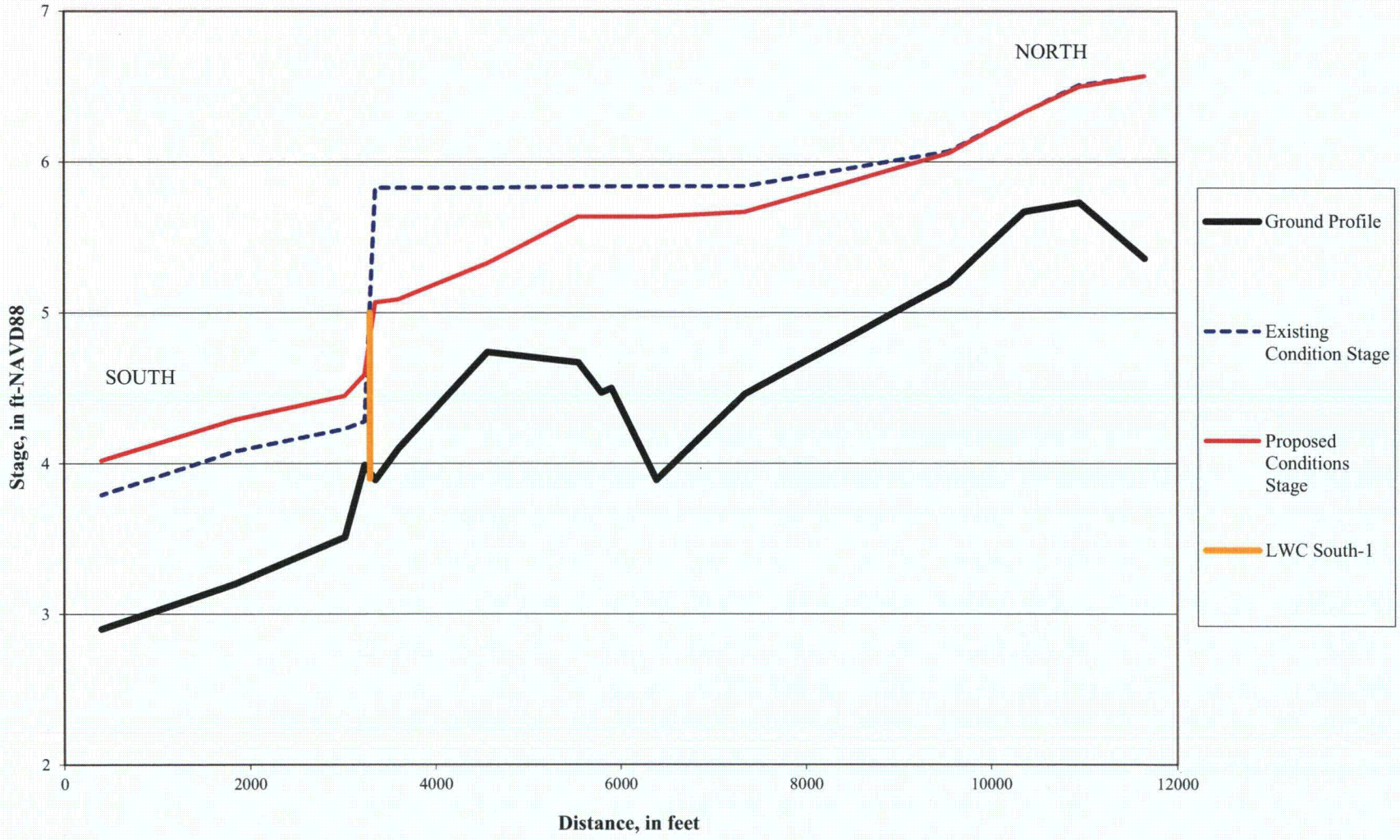
Table 6-6. Peak flows over the road at North-2 LWC in the existing and proposed conditions

	Peak flow for storm events (cfs)				
	2-year	10-year	25-year	50-year	100-year
Existing Conditions	15.2	25.7	56.9	107.8	169.1
Proposed Conditions	48.4	88.9	123.9	159.7	204.6
Increase	218%	246%	118%	48%	21%

South-1 LWC (Activity Area 2)

In the existing conditions, the elevation of the trail road at the South-1 LWC restoration area is at 6.9' NAVD. The surrounding grade is at least 3' lower than the road elevation. As a result, water back-ups behind the trail road and impedes the historic sheet flow. Modifications at South-1 LWC restoration area include a 550' wide LWC at an elevation of 5' NAVD.

Figure 6-26 to 6-30 shows the water surface profile for the 2-, 10-, 25-, 50-, and 100-year storm events in existing and proposed conditions. As seen from Figure 6-26, by constructing the LWC, the head loss across the road decreases from 1.5' to 0.5' for the 2-year storm event.



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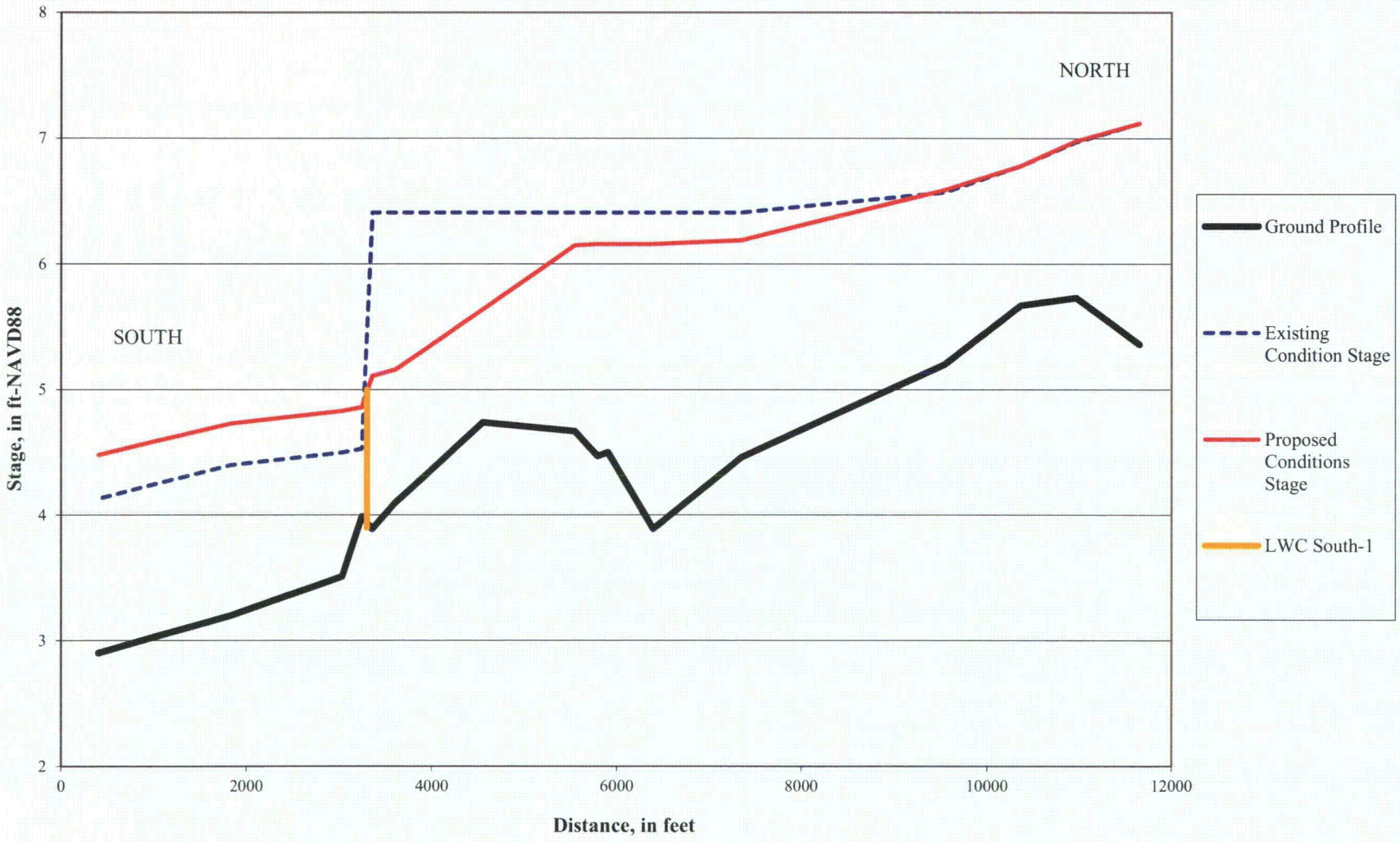
South-1 LWC Profile of peak stages in Existing and Proposed Conditions for the 2-year storm event
Homosassa Tract
Citrus County, Florida

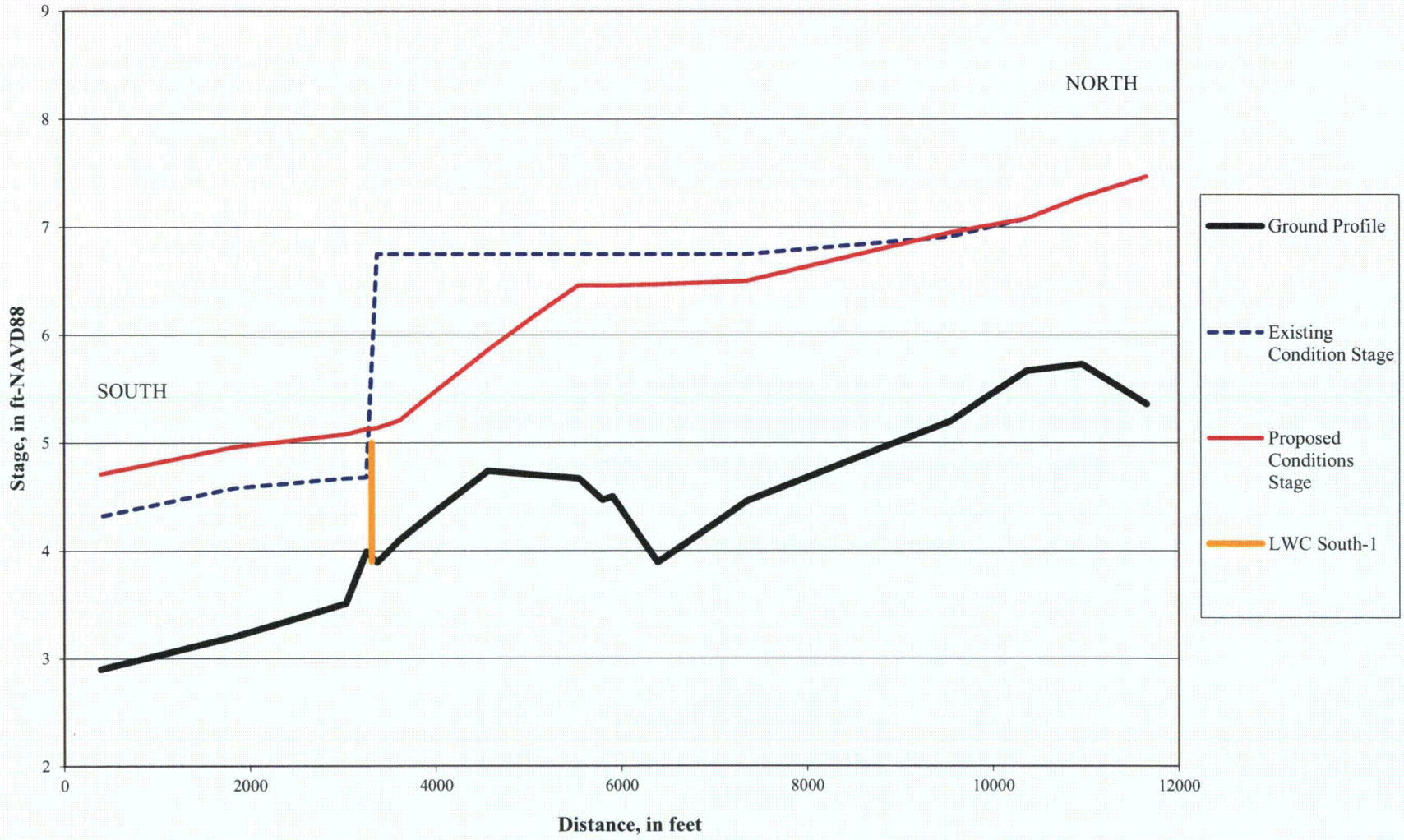
PROJECT	C2011-025
FIGURE	6-26
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-1 LWC Profile of peak stages in Existing and Proposed Conditions for the 10-year storm event
Homosassa Tract
Citrus County, Florida

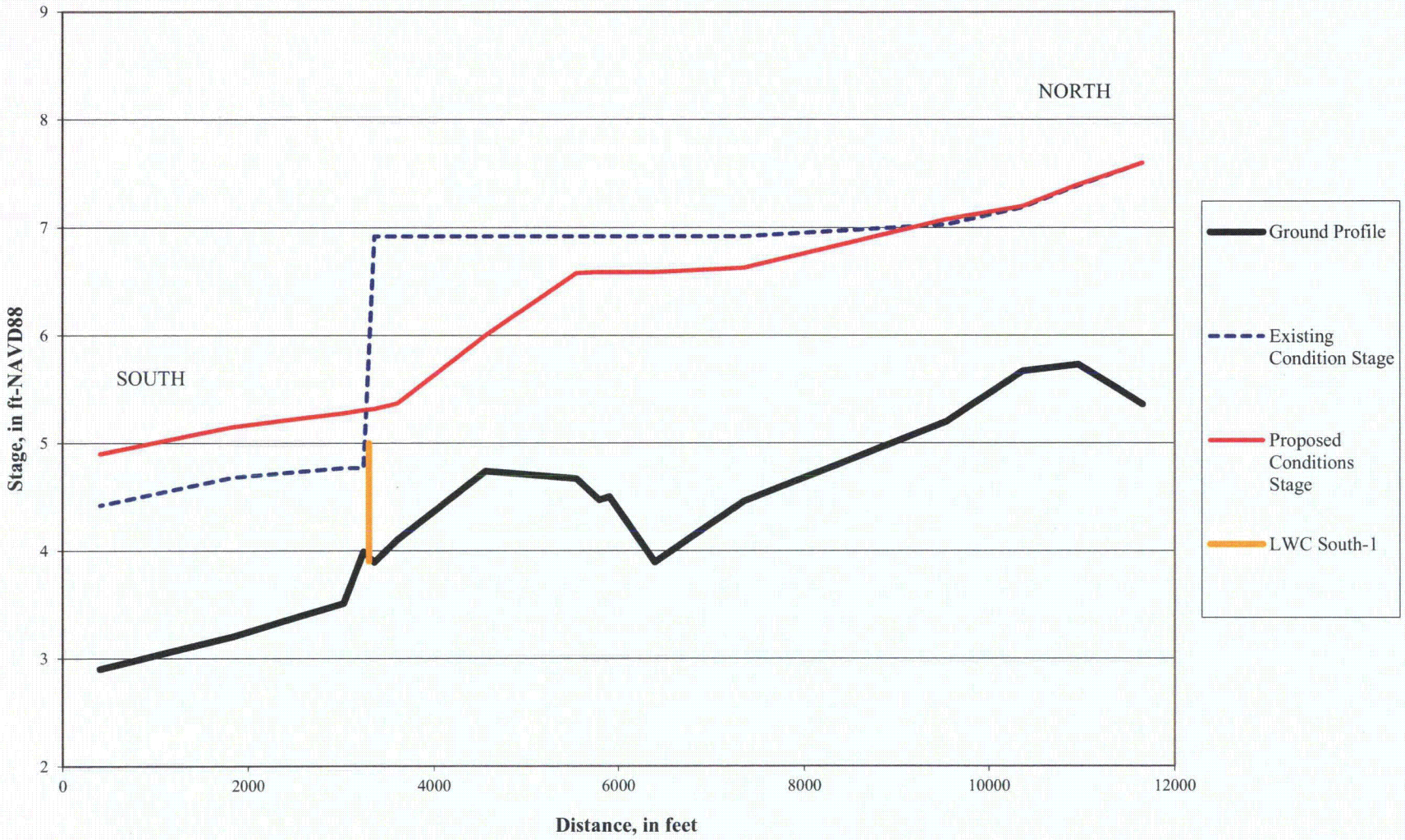
PROJECT	C2011-025
FIGURE	6-27
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-1 LWC Profile of peak stages in Existing and Proposed Conditions for the 25-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-28
DRAWN BY	APS
DATE	JULY 2011



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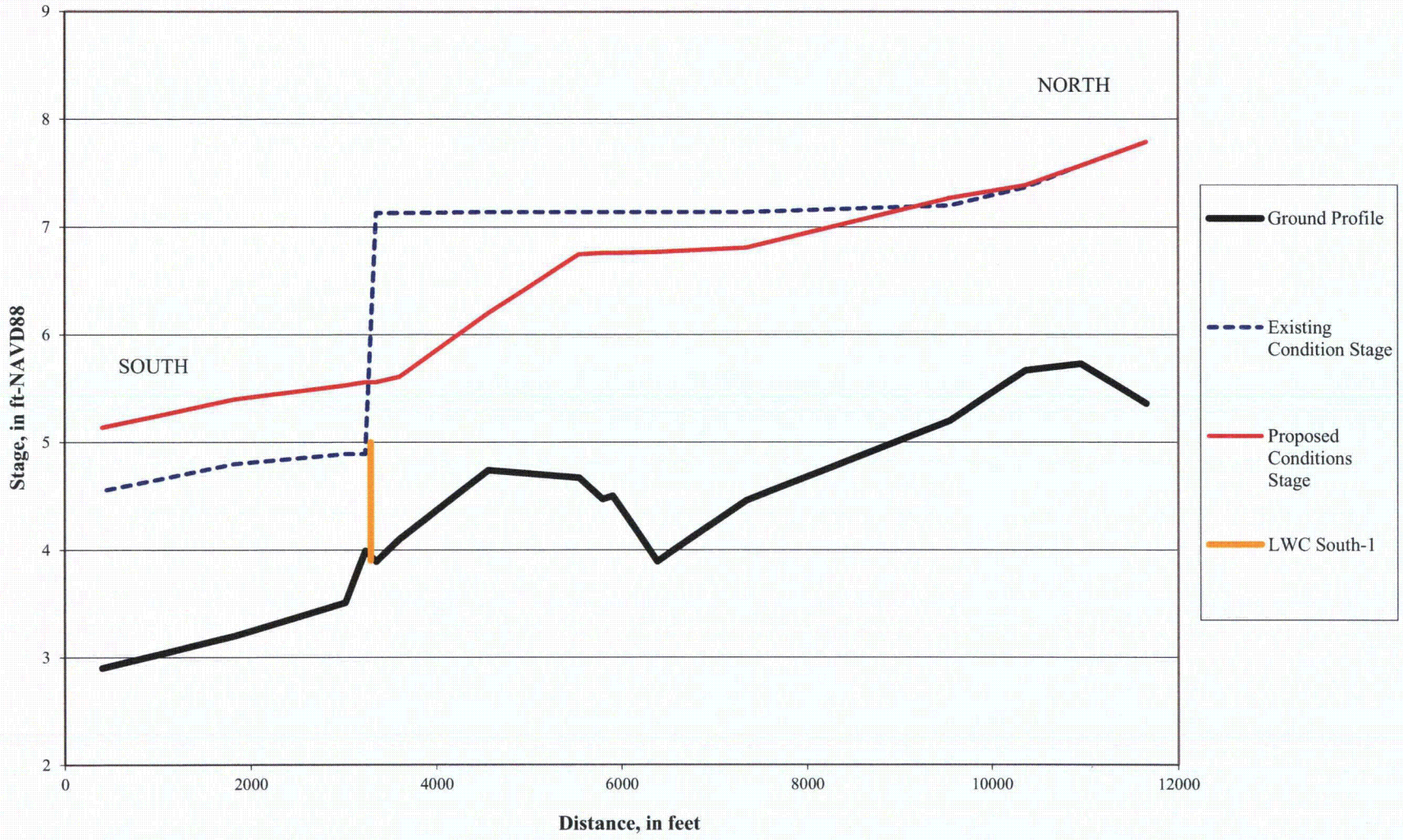
South-1 LWC Profile of peak stages in Existing and Proposed Conditions for the 50-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-29
DRAWN BY	APS
DATE	JULY 2011



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South-1 LWC Profile of peak stages in Existing and Proposed Conditions for the 100-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-30
DRAWN BY	APS
DATE	JULY 2011

Table 6-7 presents the peak flows along the proposed South-1 LWC restoration area in the existing and proposed conditions. As seen from this table, by constructing the LWC, the peak flow increases for by 478% for a 10-year storm event.

The LWC allows for additional volume of water to pass over the trail road to restore the natural sheet flow and, thereby reducing the back-up of water upstream of the trail road.

Table 6-7. Peak flows over the road at South-1 LWC in the existing and proposed conditions

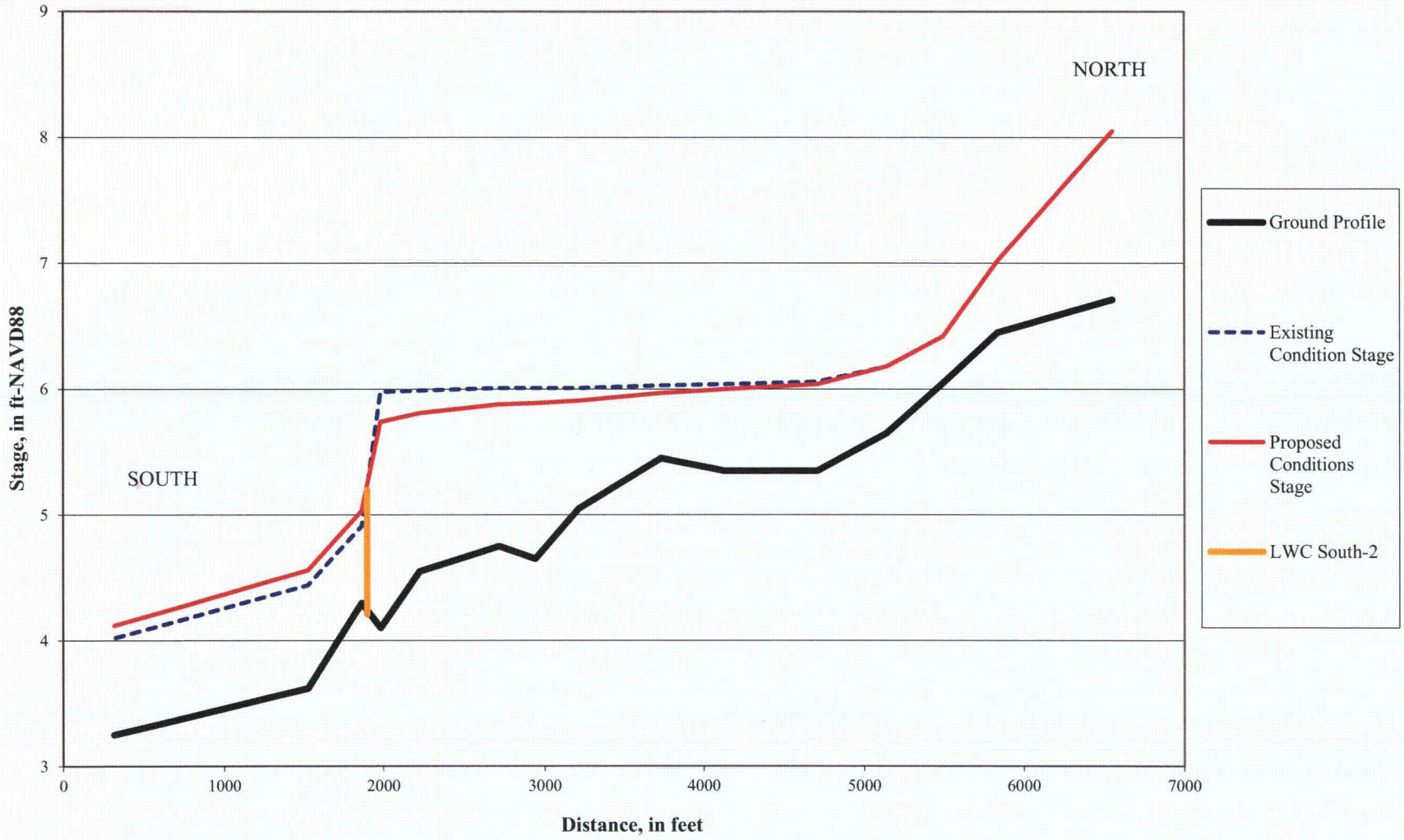
	Peak flow for storm events (cfs)				
	2-year	10-year	25-year	50-year	100-year
Existing Conditions	4.9	9.2	12	15.9	24.4
Proposed Conditions	27.8	53.2	69.3	84.2	111.5
Increase	467%	478%	478%	430%	357%

South-2 LWC (Activity Area 2)

In the existing conditions, the elevation of the trail road at the South-2 LWC restoration area is at 6.7' NAVD. The surrounding grade is at least 2-3' lower than the road elevation. The existing four 24-inch pipe culverts under the trail road are highly silted and are unable to pass adequate flow during normal rainfall conditions. As a result, water back-ups behind the trail road and impedes the sheet flow of water. Modifications at South-1 LWC mitigation site involve removing the existing culverts and constructing a 140' wide LWC at an elevation of 5.2' NAVD.

Figure 6-31 to 6-35 shows the water surface profile for the 2-, 10-, 25-, 50-, and 100-year storm events in existing and proposed conditions. Table 6-8 presents the peak flows along the proposed South-2 LWC restoration area in the existing and proposed conditions. Model results indicate that by constructing the LWC, the peak flow increases for by 106% for a 10-year storm event.

The LWC allows for additional volume of water to pass over the trail road to restore the natural sheet flow and, thereby reducing the back-up of water upstream of the trail road.



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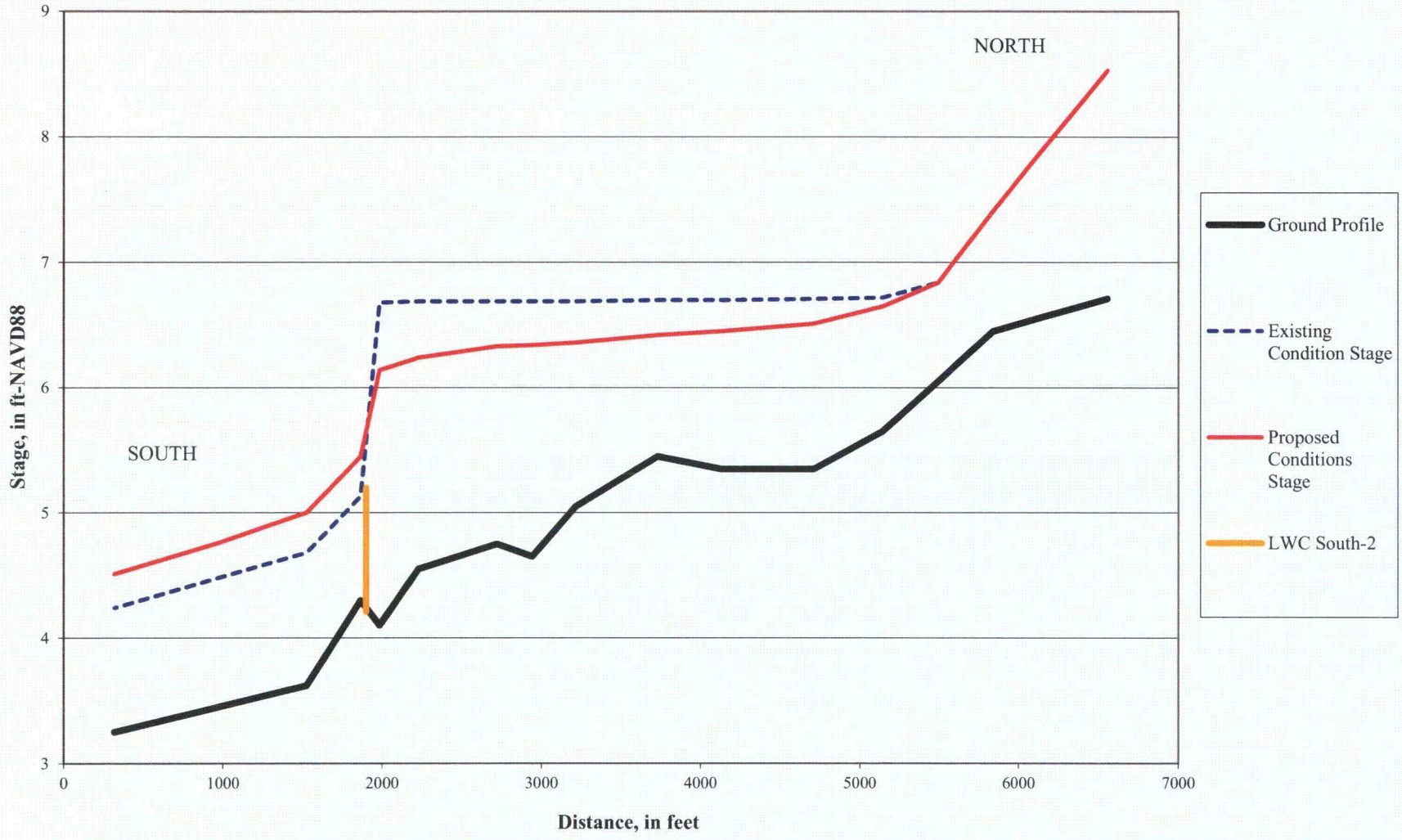
South-2 LWC Profile of peak stages in Existing and Proposed Conditions for the 2-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-31
DRAWN BY	APS
DATE	JULY 2011



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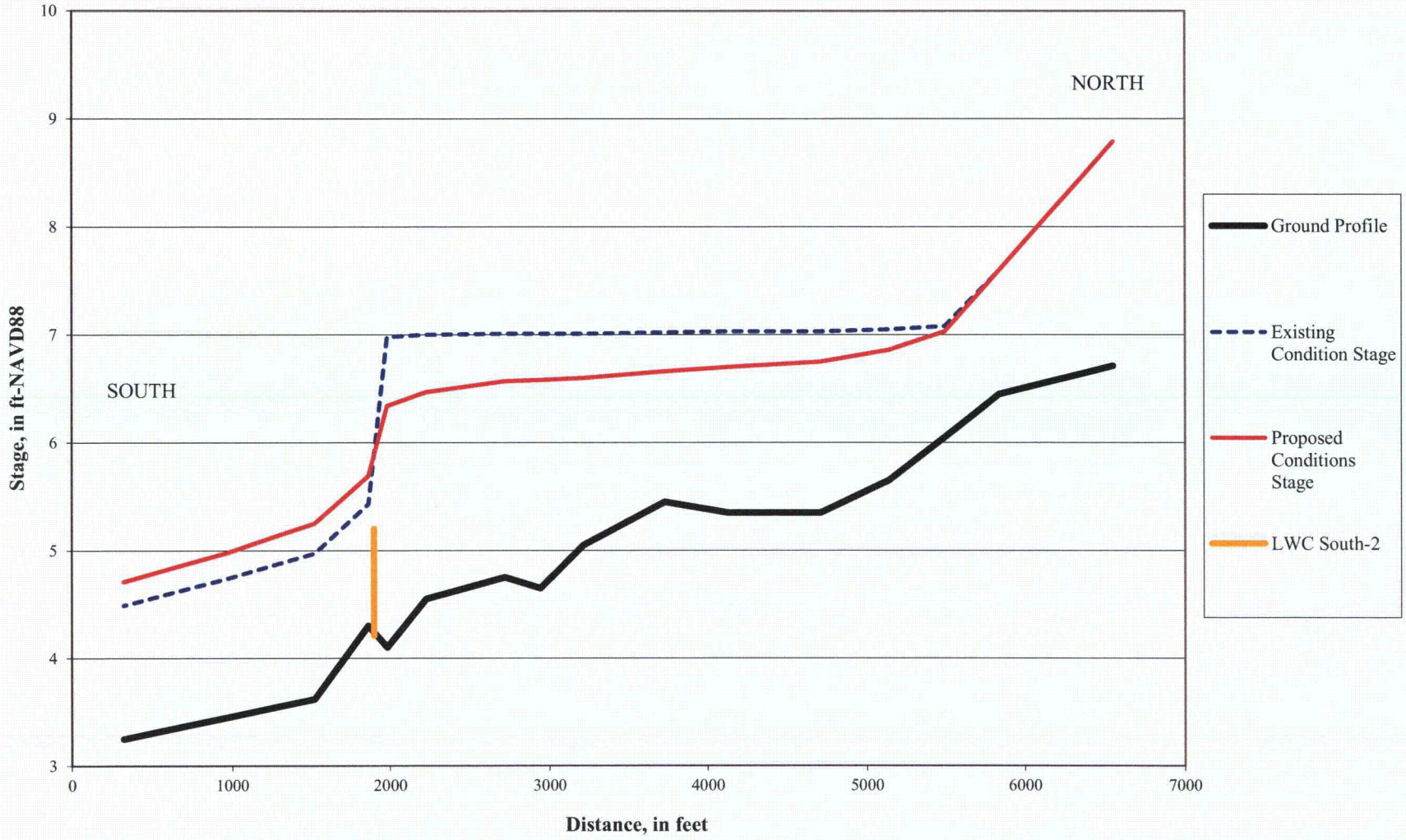
South-2 LWC Profile of peak stages in Existing and Proposed Conditions for the 10-year storm event
Homosassa Tract
Citrus County, Florida

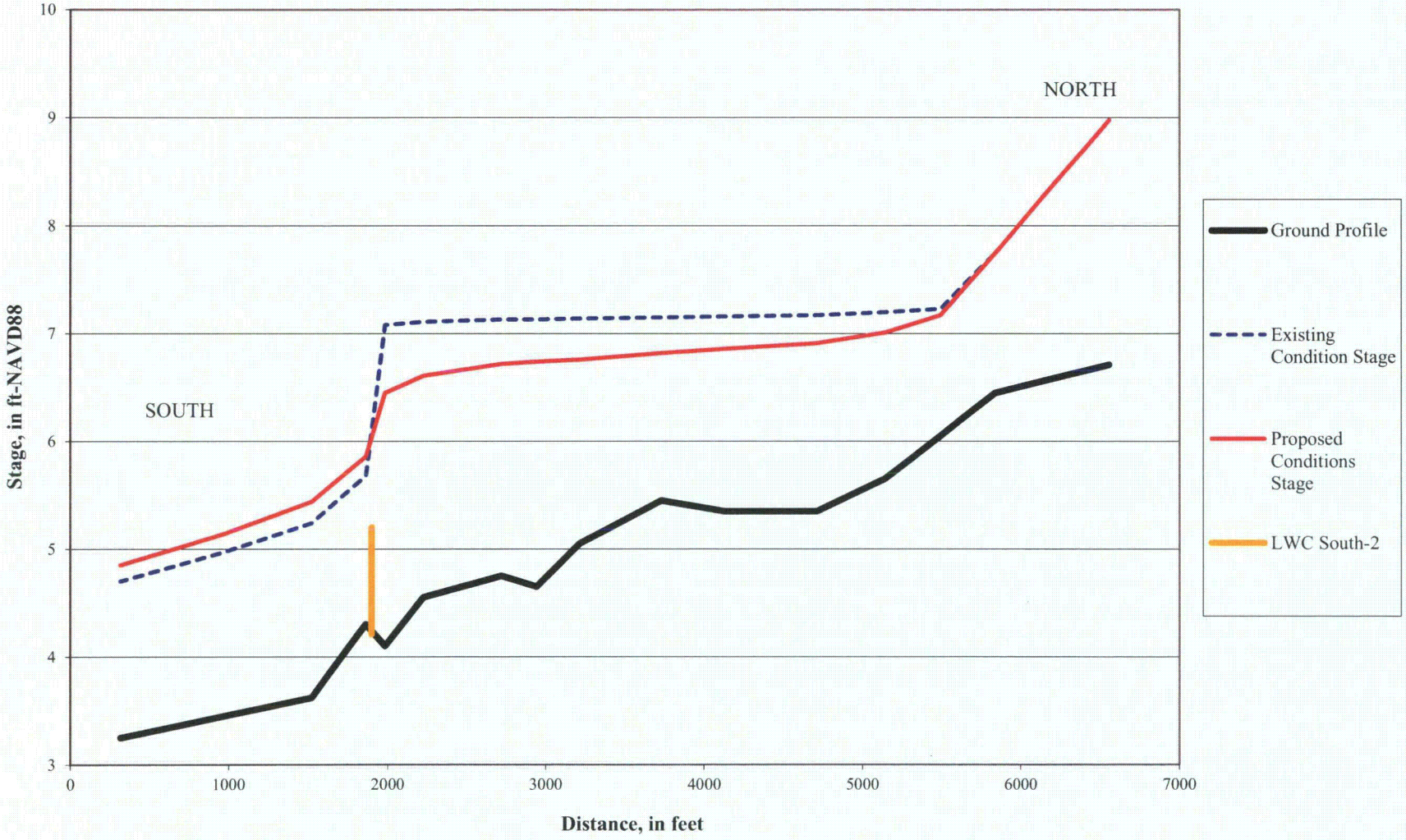
PROJECT	C2011-025
FIGURE	6-32
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-2 LWC Profile of peak stages in Existing and Proposed Conditions for the 25-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-33
DRAWN BY	APS
DATE	JULY 2011



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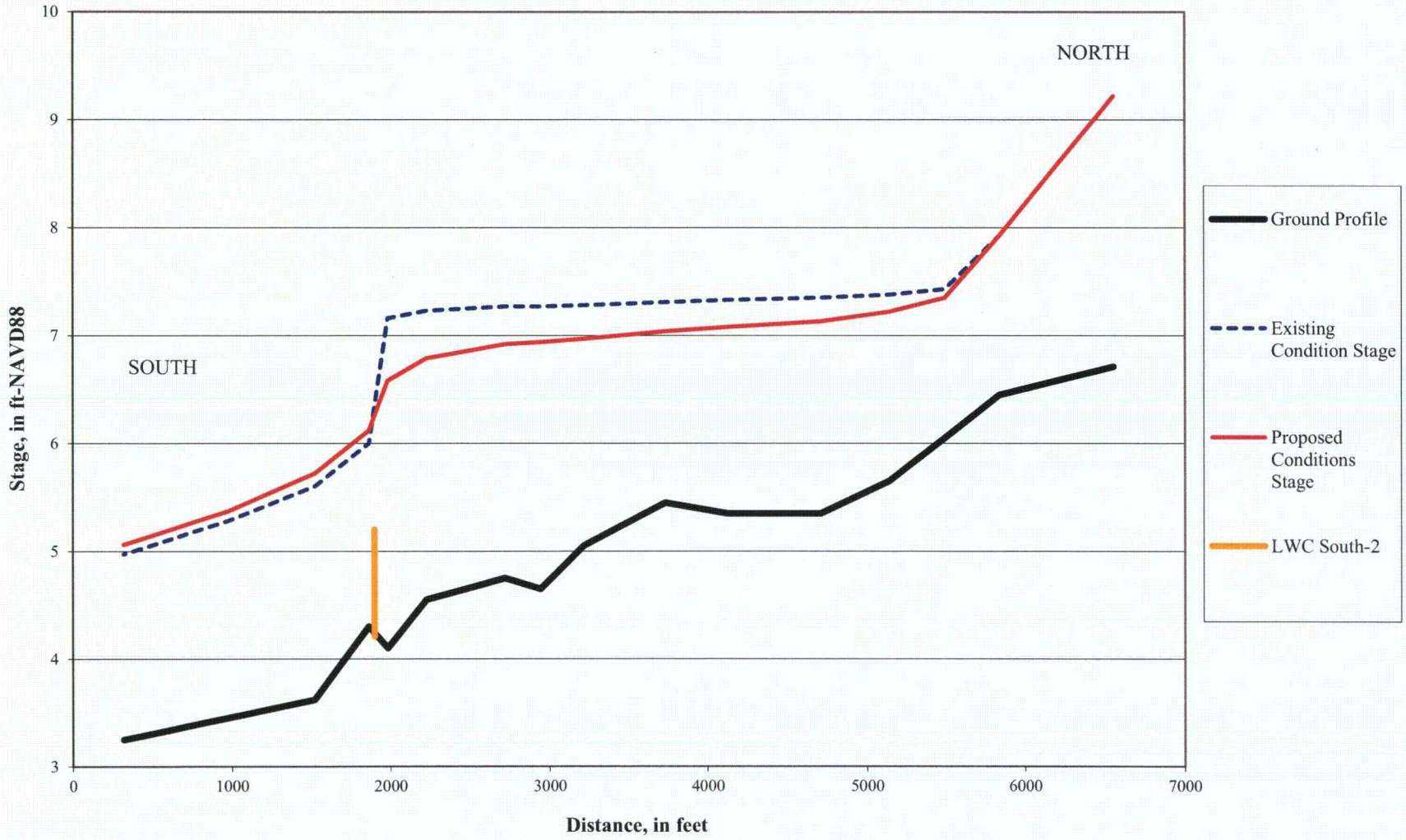
South-2 LWC Profile of peak stages in Existing and Proposed Conditions for the 50-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-34
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-2 LWC Profile of peak stages in Existing and Proposed Conditions for the 100-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-35
DRAWN BY	APS
DATE	JULY 2011

Table 6-8. Peak flows over the road at South-2 LWC in the existing and proposed conditions

	Peak flow for storm events (cfs)				
	2-year	10-year	25-year	50-year	100-year
Existing Conditions	34.4	60.9	118.4	180.3	287.5
Proposed Conditions	49.9	125.7	186.9	241.1	330
Increase	45%	106%	58%	34%	15%

South-3 LWC (Activity Area 2)

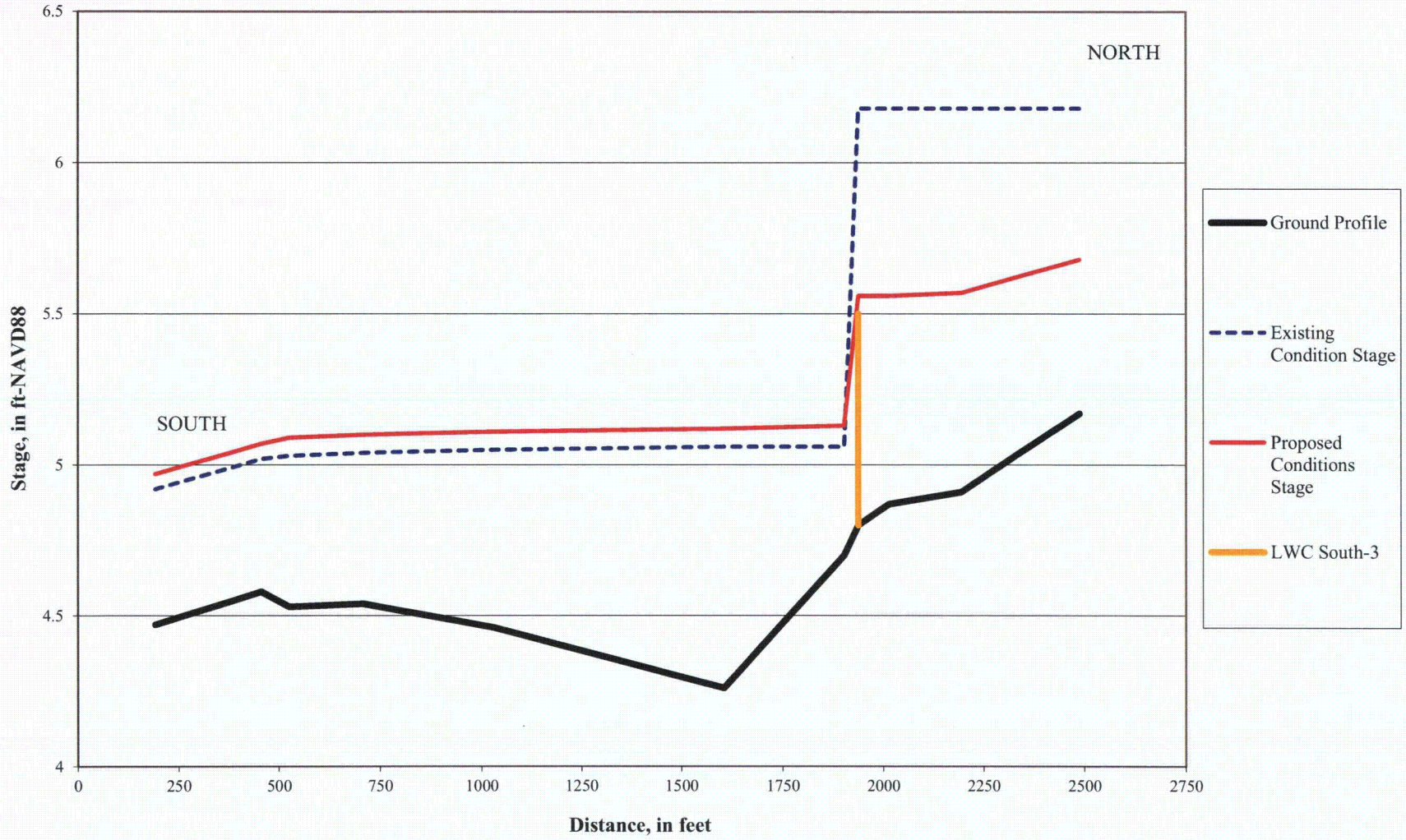
In the existing conditions, the elevation of the trail road at the South-3 LWC restoration area is at 6.5' NAVD. The surrounding grade is at least 1.5' lower than the road elevation. As a result, water back-ups behind the trail road and impedes the sheet flow of water. Modifications at South-3 LWC mitigation site involve removing the existing culverts and constructing a 300' wide LWC at an elevation of 5.5' NAVD.

Figure 6-36 to 6-40 shows the water surface profile for the 2-, 10-, 25-, 50-, and 100-year storm events in existing and proposed conditions. Table 6-9 presents the peak flows along the proposed South-3 LWC restoration area in the existing and proposed conditions. Model results show, as seen in this table, by constructing the LWC, the peak flow increases for by 1740% for a 10-year storm event.

The LWC allows for additional volume of water to pass over the trail road to restore the natural sheet flow and, thereby reducing the back-up of water upstream of the trail road.

Table 6-9. Peak flows over the road at South-3 LWC in the existing and proposed conditions

	Peak flow for storm events (cfs)				
	2-year	10-year	25-year	50-year	100-year
Existing Conditions	0	1	2.8	5	8.8
Proposed Conditions	9.4	18.4	23.8	27.1	31.7
Increase	N/A	1740%	750%	442%	260%



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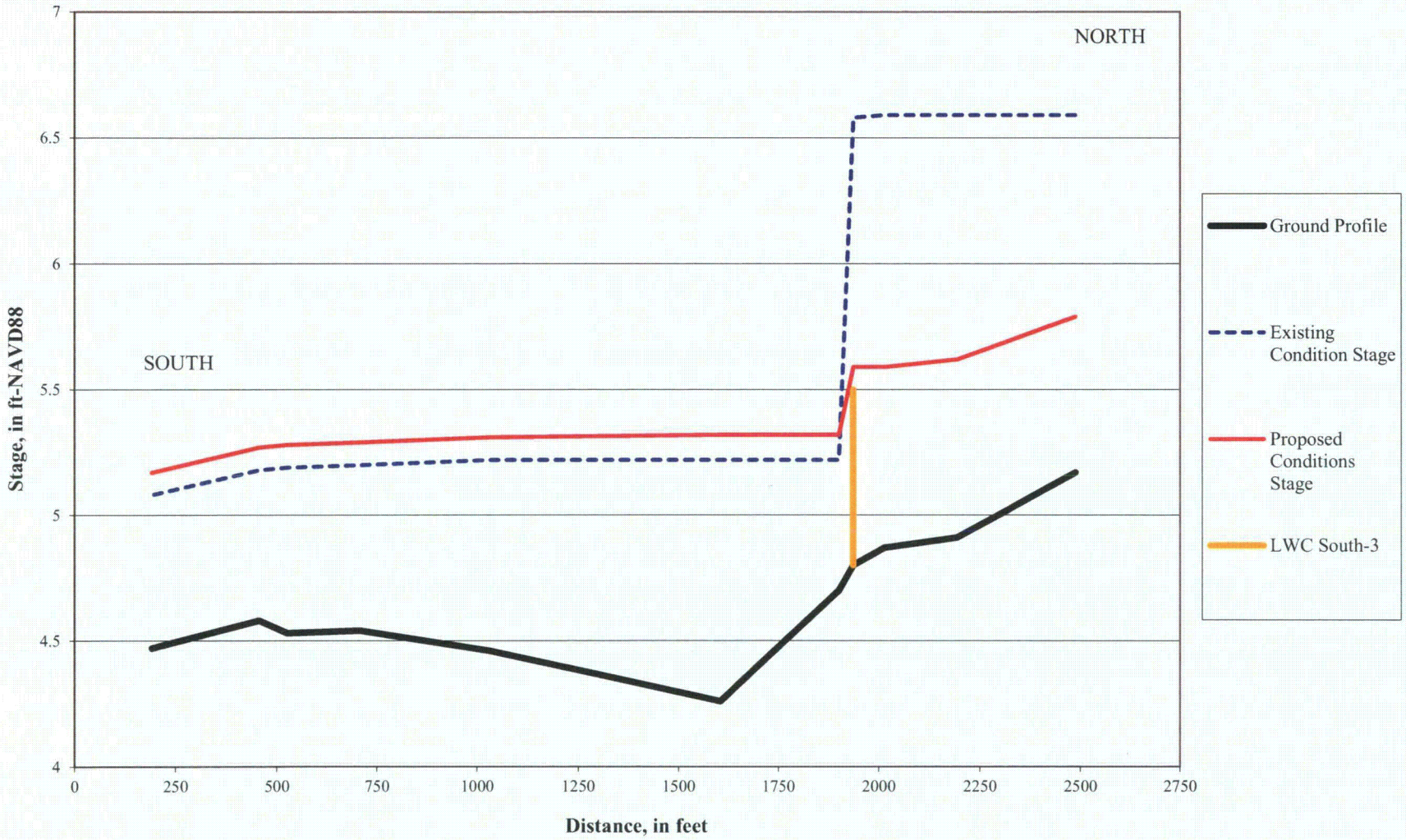
South-3 LWC Profile of peak stages in Existing and Proposed Conditions for the 2-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-36
DRAWN BY	APS
DATE	JULY 2011



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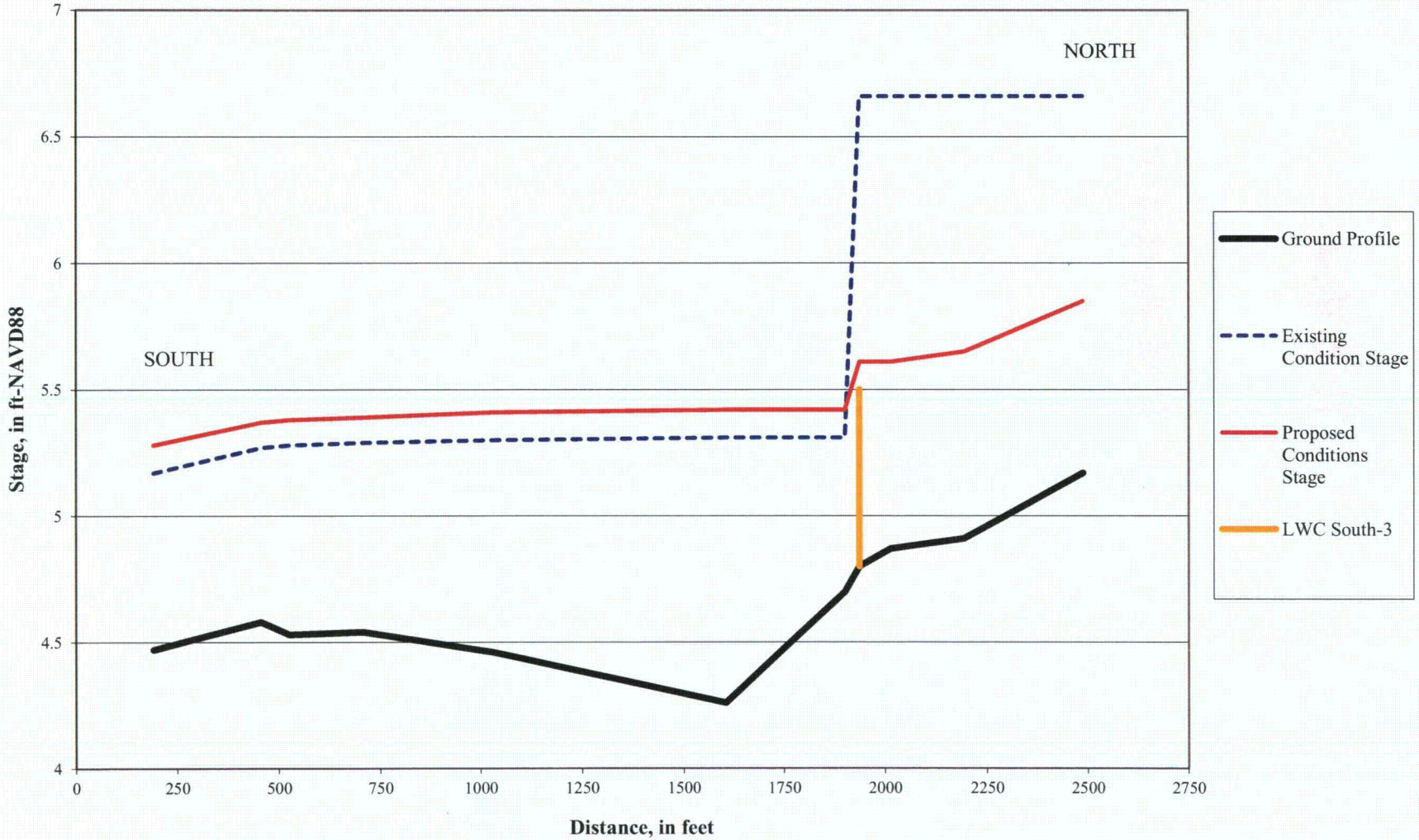
South-3 LWC Profile of peak stages in Existing and Proposed Conditions for the 10-year storm event
Homosassa Tract
Citrus County, Florida

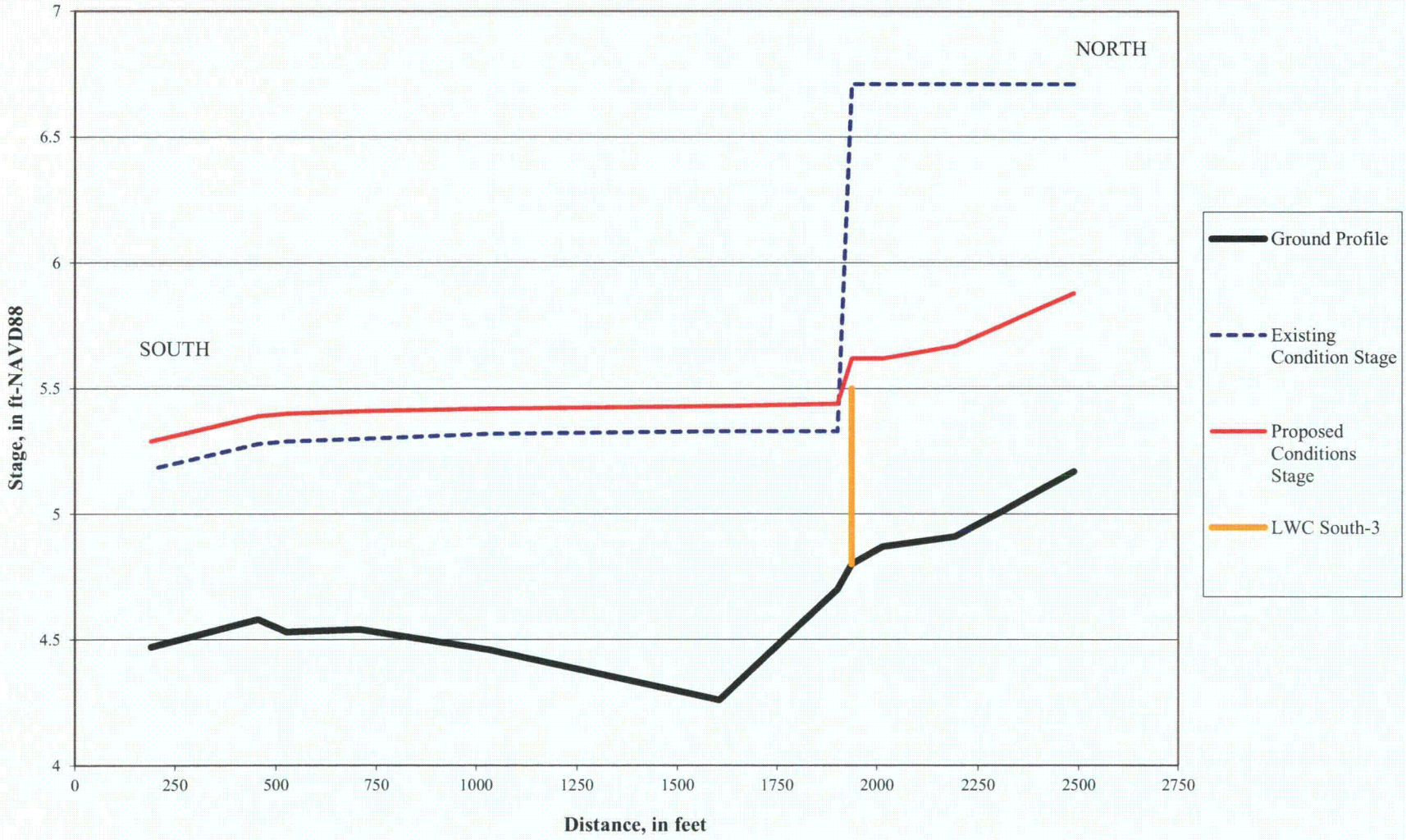
PROJECT	C2011-025
FIGURE	6-37
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-3 LWC Profile of peak stages in Existing and Proposed Conditions for the 25-year storm event
Homosassa Tract
Citrus County, Florida

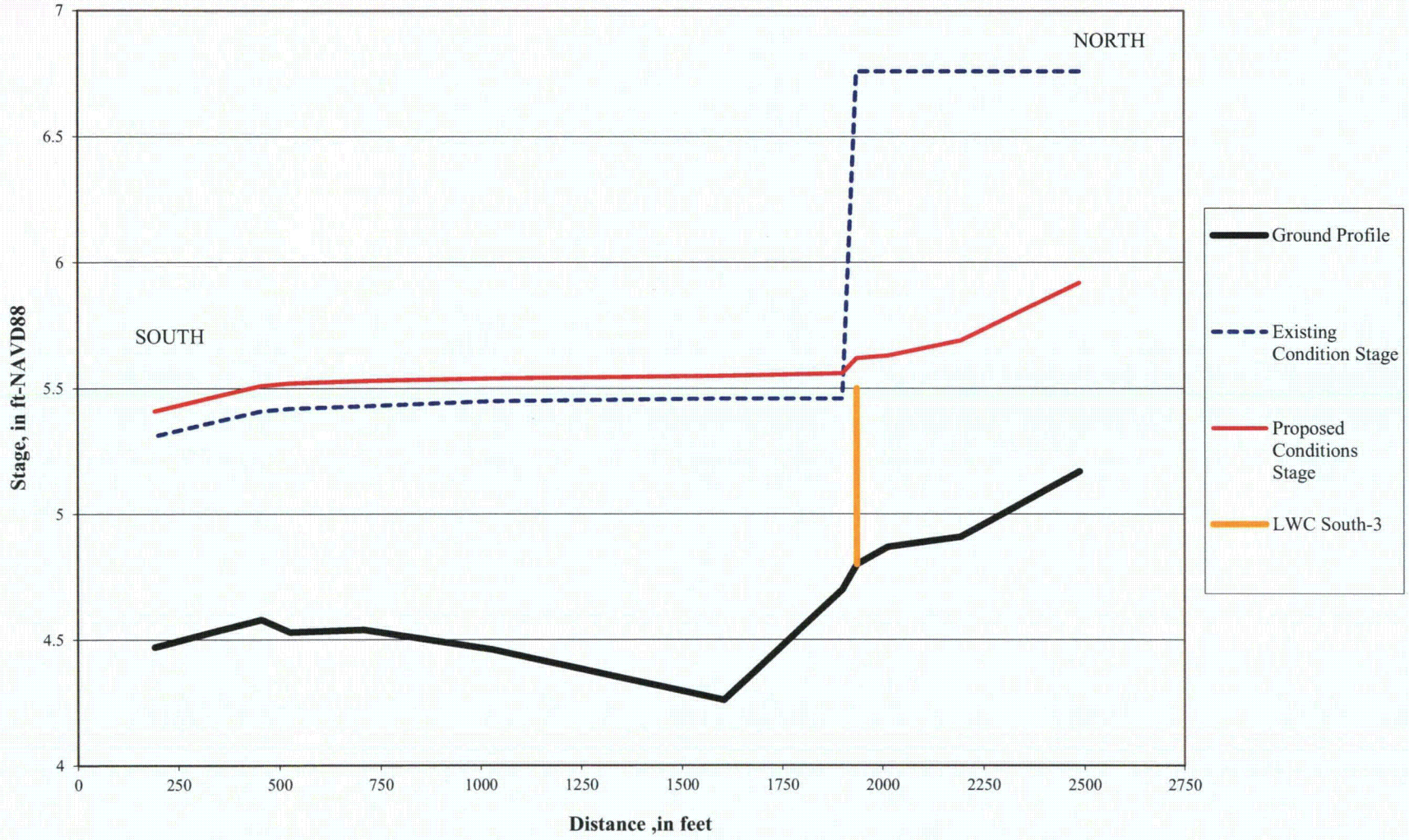
PROJECT	C2011-025
FIGURE	6-38
DRAWN BY	APS
DATE	JULY 2011



TAYLOR ENGINEERING, INC.

South-3 LWC Profile of peak stages in Existing and Proposed Conditions for the 50-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-39
DRAWN BY	APS
DATE	JULY 2011



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South-3 LWC Profile of peak stages in Existing and Proposed Conditions for the 100-year storm event
Homosassa Tract
Citrus County, Florida

PROJECT	C2011-025
FIGURE	6-40
DRAWN BY	APS
DATE	JULY 2011

6.6 UMAM Score

The proposed mitigation plan for HT will provide for 55.6 units of functional lift to offset the forested impacts and a portion of herbaceous impacts within the Upper Coastal Watershed (Table 6-10), while the balance of the impacts will be mitigated for at the Five Mile Creek Site. The scoring system utilized during the UMAM process is outlined in the UMAM handbook and its scoring requirements.

Scores for existing communities that were assessed ranged from 4 to 7, pursuant to the UMAM process described above. Target UMAM scores presented in Table 6-10 ranged from 7 to 8 in accordance with the UMAM scoring parameters based on the target results of each of the mitigation activities outlined in this plan.

For Location and Landscape Support, the proposed scores were given a 7, (no change) based on the UMAM scoring methodology. These scores were derived by assessing the existing communities on site and identifying the main characteristics that these habitats were deficient in, such as habitat availability, wildlife access barriers, land use impacts and several others. This information was then used to incorporate those criteria into the proposed mitigation activities.

For the Water category, all proposed scores are 7 to 8. A score of 7 represents that the assessment area will provide adequate habitat for both aquatic vegetation and wildlife, will aid in the hydroperiod of the area and assist in storage capacity and attenuation, will increase water flow through the area resulting in better water quality and that the area will remain inundated under normal circumstances so that the other improvements will function as designed. A score of 8 represents that the assessment area will provide more than adequate habitat for both aquatic vegetation and wildlife, will aid in the hydroperiod of the area and also assist in storage capacity and attenuation, will increase water flow through the area resulting in better water quality and that the area will remain inundated under normal circumstances so that the other improvements will function as designed.

The Community Structure assessment areas were all assigned a score of 8. The community structure will be improved in all habitat types as hydroperiods are restored and plant diversity/retention will be increased from the reduction of soil oxidation. The PEF plan will provide for additional habitat for aquatic vegetation and wildlife and will represent improvement over existing conditions. The wet prairie system was increased from a score of 4 to an 8 due to the fact that as an existing monoculture of wax myrtle, the restoration of this area to herbaceous wetland grasses will increase vegetative diversity and allow for more frequent prescribed burning to maintain the habitat type. Given the hydroperiods of the area it may be necessary to seed these areas at times, and therefore, the score reflects these potential concerns.

Risk and Time Lag were the other parameters assessed during the UMAM scoring of the HT mitigation site. The Risk parameter is examined to assess the potential risk the proposed activity has of not fully maturing and developing into the proposed habitat. Factors such as the project's location in proximity to other existing structures such as housing developments or major roadways, access to the site (both public and private), general environmental conditions compared to the proposed activity, and the amount of effort required to build and maintain a functioning habitat are all considered when assessing the Risk for a particular project. Due to the limited access to the HT, the relative location amongst various conservation lands, and the general nature of the proposed work, the score of 1.00 was assigned to all proposed hydrologic and forest restoration at HT. The proposed work will not significantly alter the existing habitat or wildlife utilization in these areas, however it will restore historic flow patterns and hydroperiods, so the 1.00 score represents a conservative but realistic expectation of the proposed work. A score of 1.25 was given to the herbaceous restoration area as increased initial maintenance may be required. Long term management may also require burning and seeding, and therefore the risk is slightly greater.

Time Lag is examined to determine an appropriate time frame that can be expected for a given activity to reach its full potential and provide the functions and values of a mature system. Forested communities typically take longer to establish, given the complex structure of a hardwood wetland community, though the existing systems within the HT are already intact. Conversely, herbaceous systems typically become well established in a shorter time frame due to the limited complexity of habitat structure and the general hardiness of the plants found within. However, in this case, shrub components must be controlled in order for the herbaceous plants to become dominant. Scores for the HT site ranged from 1.07 for the hydrologic and forested wetland restoration to 1.14 for the proposed herbaceous community. The 1.07 score for the hydrologic and forested restoration represents the lowest time lag, because these are established systems that will be restored with the completion of the low water crossings, indicating that the proper conditions currently exist to support such a community. Therefore, the proposed herbaceous habitats received a time lag of 1.14 as the initial maintenance and establishment of this community will be slightly longer to fully establish.

Table 6-10. Homosassa Tract mitigation plan proposed UMAM score summary

Area	Location		Water		Community		Acreage	Risk	Time Lag	RFG[1]	FG[2]
	Current	With	Current	With	Current	With					
Activity Area 1											
Wetland Hydrologic Enhancement	7	7	6	8	7	8	170.4	1.00	1.07	0.09	15.9
Wet Prairie Restoration	7	8	6	7	4	8	25.0	1.25	1.14	0.14	3.5
Activity Area 2											
Wetland Hydrologic Enhancement	7	7	6	8	7	8	387.2	1.00	1.07	0.09	36.2
Subtotal	Herbaceous						25.0				3.5
Subtotal	Forested						557.1				52.1
Total							**582.6**				**55.6**

[1]Relative Functional Gain
[2]Functional Gain