Lake Park Boulevard Area Improvements & Flowway Restoration Pre-Design Study

Final Report







Collier County

Lago Consulting and Services

GradyMinor

Collier Environmental Consultants

April 2023

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Executive Summary

This pre-design study was conducted as part of the Collier County Project No. 60246.1 - 60246.1.2 and is titled "Lake Park Blvd. Capital Improvements & Water Quality Flow Way Pre-Design". The project was assigned to Lago Consulting and Services, LLC (Lago) under Professional Services Library Civil Engineering Category, contract No. 18-7432-CE. The project team includes Q. Grady Minor & Associates, P.A. (GradyMinor), responsible for developing pre-design plans for road improvements and utility upgrades, and Collier Environmental Consultants for assisting with the vegetation FLUCCs code mapping and the exotic vegetation assessment.

Project Overview

The Lake Park project area is a low lying, poorly drained residential neighborhood located south of US-41 in southern Collier County. It contains Auto Ranch Road and Lake Park Boulevard as the two main streets, as well as a total of 7 side streets. Side streets serve as access to mobile homes. The project area is bounded on the west side by Estancia at Fiddler's Creek (under construction) and on the east side by Royal Palm Golf Estates.



The objectives of the project are to evaluate upgrades to the existing infrastructure and services (i.e., drainage, sewer, potable water, and roadways) and to improve water quality and restore historic flow ways to Rookery Bay Estuary, which is an Outstanding Florida Water (OFW).

The project was divided in 7 tasks, as listed below.

- Task 1. Data collection and field reconnaissance
- Task 2. Existing Conditions Stormwater Model
- Task 3. Potential Stormwater Management Improvements
- Task 4. Conversion from Septic to Sewer system of wastewater disposal, and Potable Water Distribution Improvements
- Task 5. Roadway Improvements
- Task 6. Flowway Restoration and Preservation
- Task 7. Pre-design Report

Six technical memorandums (TMs) were produced for individual tasks from 1 through 6, which are included as appendices. This document is the final pre-design report delivered as part of Task 7. The following subsections summarize the hydrologic, hydraulic, and pre-design engineering efforts performed, as well as the improvements recommended under each of the project tasks.

Drainage System Improvements

Problem Identification and Remedial Measures

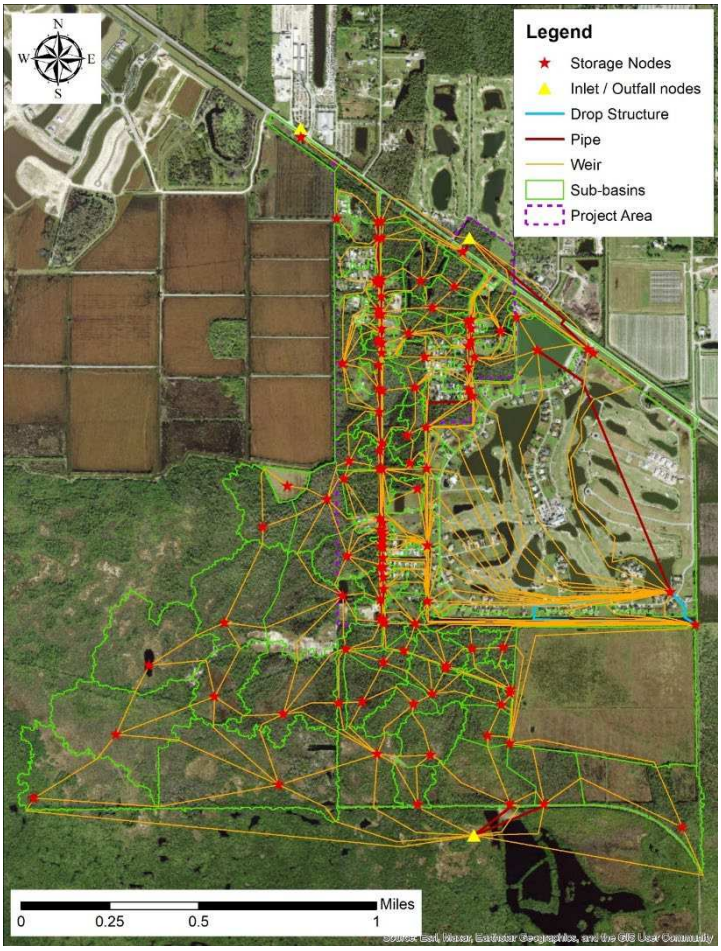
The table below shows examples of the problems detected in the drainage system during the field reconnaissance and the recommended remedial measures. Other photos of the drainage features and past flooding in the project area were included in Task 1 TM.

Photo	Problem	Recommended measures
	One of the cross pipes at Auto Ranch Rd. is partially blocked with concrete.	Remove obstruction.
	Collapsed cross pipe at Lake Park Blvd. CMP pipes crossing side streets at Blue Heron Mobile Home Park are collapsed.	Replace collapsed pipes and use mitered end to avoid smashing from the cars running over the pipe ends.
	Missing driveway pipe at Auto Ranch Rd.	Install driveway pipe to improve connectivity.

Photo	Problem	Recommended measures
	Blocked driveway pipe at Lake Park Blvd. There are several driveway pipes blocked in the project area	Clean or replace blocked pipes.
	Auto Ranch Road and its side streets were flooded during Hurricane Ian. Those roads suffer frequent floods.	Raise the road crown elevation. Increase drainage system conveyance. Prevent tidal backflows into the area by using flap gates or other method.

Storm Water Modeling and Water Quality Analysis

A comprehensive stormwater management model was developed for the project area in ICPR, as detailed in Task 2 TM. The model used mapped basins to compute the runoff and infiltration and the groundwater component for simulating water table levels in the model area. All the current drainage pipes in the project area were included explicitly in the model.



Water level data collected as part of this project during the 2022-year wet season (from 6/21/22 through 9/30/22) was used to impose boundary conditions at the north and to verify the model performance. Boundary conditions at the outfall node used the tidal time series stage data adapted from DBHYDRO station HC1_T. The Existing Condition model was also used to conduct design storm simulations. Model results were processed to obtain stage and flow hydrographs, as well as water depth maps.

A total of six (6) stormwater improvement scenarios were incorporated into the Existing Conditions Model of the project area to evaluate their relative performances, as detailed in Task 3 TM. The scenarios included increasing drainage conveyance, raising road elevations, and the use of dropbox structures with positive flow devices, among others.

The evaluation of the scenarios under the 25-year design storm rainfall with normal tidal conditions suggests that the proposed improvements will generate only slight variations in peak stages but will benefit with significant reduction in the durations of the peak flood stages in the north and central areas.

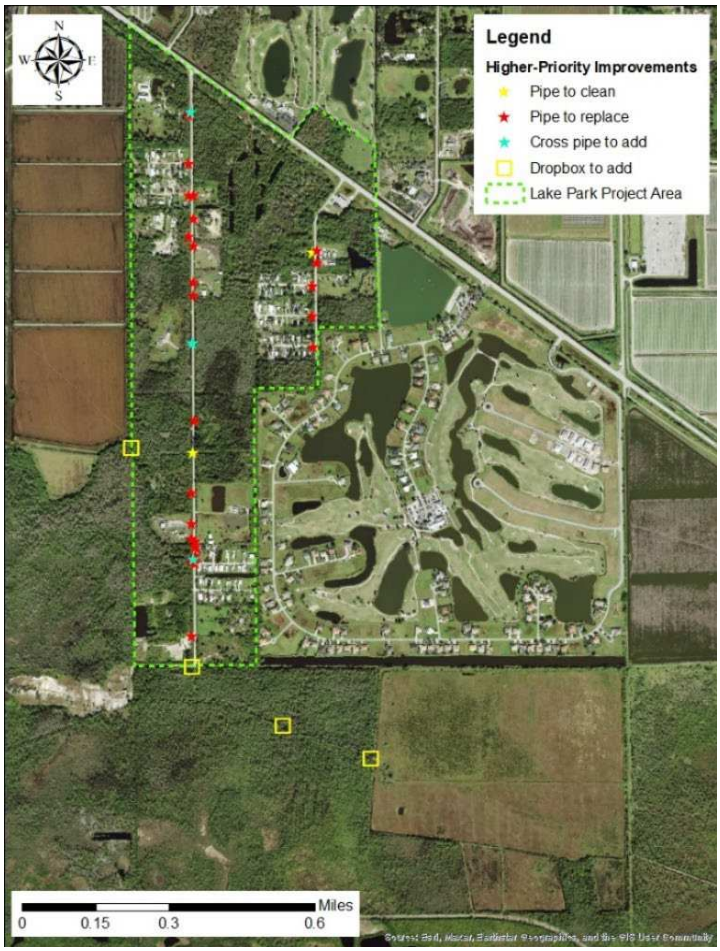
Simulations during the wet season period suggested that the use of drop box structures at the downstream outlets will not only maintain and improve the wetland hydroperiods in the project area, but they will also increase the retention or residence time, which will enhance the water quality treatment of the discharges into the Outstanding Florida Waters of the Rookery Bay Estuarine Reserve.

Water quality loading calculations were conducted using two methods, as described in Task 3 TM. In particular, the PLET method allowed the estimation of the loads from septic tank systems as more than half of the total load. The substantial contaminant load in the Lake Park project area due to the septic systems will be eliminated after the proposed conversion from septic to central sewer system.

Higher Priority Drainage Improvements

Model results from the scenarios showed higher sensitivity (in terms of flow and head drop) at some of the proposed improvements in the drainage system. This allowed us to select the drainage improvements with higher beneficial impacts. Improvements were also proposed related to the maintenance of pipes and the functioning of wetland hydrology in the project area. The drainage improvements that need more attention (or with a higher priority) contain the following cases.

- Pipes with sediment or other obstructions to be cleaned (maintenance).
- Small-diameter pipes to be replaced by larger ones.
- Damaged pipes to be replaced, as documented during field visits (maintenance).
- Cross pipes to be added along Auto Ranch Road.
- Dropbox structures to be added to maintain or enhance wetlands hydroperiods at upstream areas.



The probable cost estimation for the higher priority drainage improvements is detailed in Task 3 TM and totalized $0.88 M.

Conversion From Septic to Sewer

Central sanitary sewer is not currently available within the Lake Park project area; each of the developed lots are served by an individual, privately owned and operated septic system. In low lying coastal areas with high groundwater, individual septic systems likely do not adequately treat human waste. Additionally, due to the age and condition of the majority of the existing septic systems and the likely failure rates of the septic systems that may be a contributing source of water quality contaminants, it is recommended to convert this region to a central sanitary sewer collection system and eliminate the private septic systems, as detailed in the Task 4 TM.



The Task 4 TM discusses several options with pros and cons for providing central sanitary sewer to the Lake Park project area. There were two options recommended for the central sanitary sewer collection system, as follows.

1. Traditional gravity system with pump station(s) for side streets with mobile homes and higher density and a low-pressure system along Auto Ranch Road including a grinder pump station at each of the developed lots.
2. Traditional gravity system with pump station(s) for side streets with mobile homes and higher density. This option does not include the low-pressure system with grinder pump stations, but it should be noted that the developed lots will have the option to install their own private grinder pump station and connect to the force main along Auto Ranch Road.

Option 1 would eliminate all septic systems within the project area, thereby improving water quality. As detailed in the Task 4 TM, the low-pressure system would, however, result in additional responsibility and overall maintenance costs to the property owners. On the other hand, Option 2 would eliminate the majority of the septic systems, but it would not include the construction and installation of the low-pressure system along the larger developed lots along Auto Ranch Road. A traditional gravity system with a pump station is recommended in the Lake Park Boulevard area.

Although we recommend the conversion from septic to sewer, it is important to address the costs and impacts to the property owners and residents. Generally, the property owners are responsible for the cost to connect to the central sewer and for the abandonment of their existing septic system. Additionally, the property owners will be responsible for impact fees and their utility bill. There are multiple private costs and maintenance responsibilities associated with the low-pressure type of system. This area is a lower income area, and these additional costs may not be affordable for some of the property owners.

The probable cost estimation for the septic to sewer conversion is detailed in Task 4 TM and totalized $10.29 M.

Grant Funding Opportunities

The current Legislation is supporting septic to sewer conversion projects in Florida. As a result, there are multiple funding opportunities available, a few of which are listed below.

- State Legislative Funding https://protectingfloridatogether.gov/state-action/grants-submissions
- Big Cypress Basin Cooperative Funding https://www.sfwmd.gov/doing-business-with-us/coop-funding
- FDEP 319 Grant Program https://floridadep.gov/wra/319-tmdl-fund

Potable Water Distribution Improvements

The Lake Park Boulevard area is served with potable water by Collier County Utilities, but the infrastructure has met its useful life and is in need of replacement. There is no potable water service along Auto Ranch Road, except for the two southeast side streets. The potable water serving these streets ties into the County's distribution system in Royal Palm Golf Estates, and there is a bank of meters on east end of each side street. Privately owned and maintained pipes run from the bank of meters and backflows to each individual property.



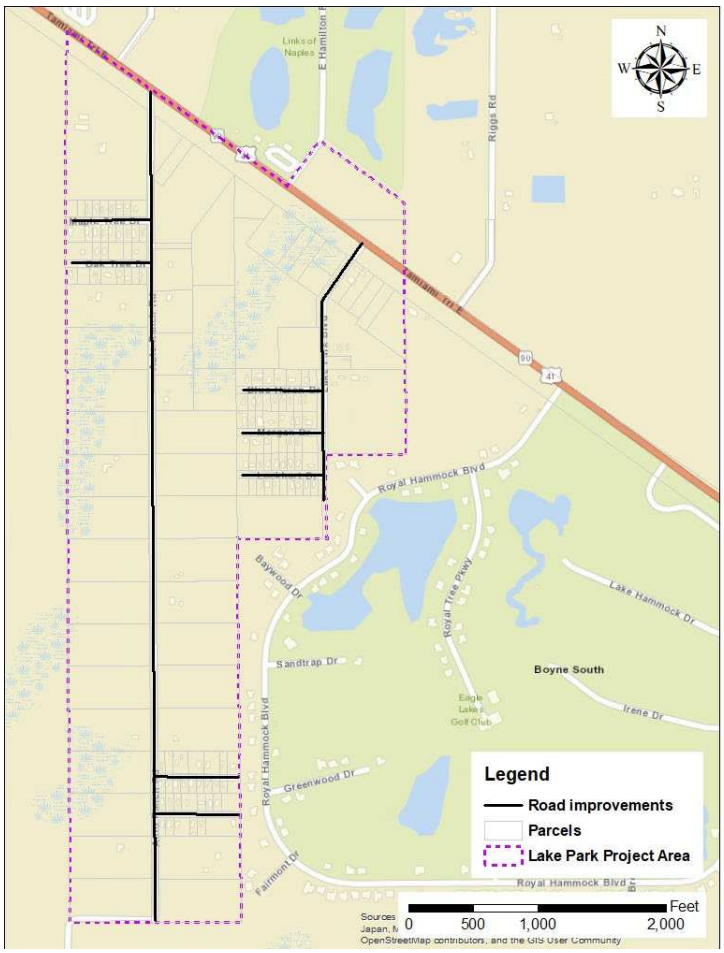
The recommendations provided in Task 4 TM for potable water distribution include:

- replacing existing infrastructure in the Lake Park Boulevard area,
- providing potable water to Auto Ranch Road area residents, and
- to consider permanent distribution system looping opportunity Royal with Palm Golf Estates.

The probable cost estimation for the potable water distribution improvements is detailed in Task 4 TM and totalized $1.87 M.

Roadway Improvements

All of the roadways within the project area classified as local roadways in Collier County. Preliminary design considerations discussed in the Task 5 TM include enhanced travel lanes and shoulder widths, raising the elevation of the roadway, sidewalks, curb and gutter, drainage improvements, centering the roadway in the right-of-way (ROW), and ROW acquisition or conversion as necessary.



Auto Ranch Road and Lake Park Boulevard are dedicated public ROW and maintained by the County. The side streets off of Lake Park Boulevard are public ROW, they currently have potable water, but they are privately maintained. The side streets off of Auto Ranch Road are all private. It should also be noted that the majority of the side streets are in poor condition.

The recommendations provided in Task 5 TM to improve roadways include:

- widening the travel lanes, including the addition of a shoulder,
- raising the roads to prevent frequent flooding of the roads,
- constructing a sidewalk along Auto Ranch Road and potentially along the side streets,
- drainage improvements, and
- centering the roadway in the ROW if feasible.

The recommended minimum crown road elevations are 4.9 and 4.2 feet NAVD88 for main and side streets, respectively. The lowest crown elevation along Auto Ranch Road is currently 3.3 feet NAVD88.

Pre-design plans for the upgraded roadways were produced in Task 5 TM for two options:

- Option 1: Roadway improvements mentioned above but maintaining the open swales to minimize wetland impacts.
- Option 2: Roadway improvements mentioned above, but also including sidewalks on the side streets and a combination of swales and an enclosed drainage system.

ROW or easement acquisition will be necessary to implement the recommended roadway and infrastructure improvements. The status of the ROW or easements in the project area is summarized below.



- Auto Ranch Road and all of Lake Park Boulevard area have ROW/Easements for access, maintenance, utilities, etc.
- Maple Tree Drive, Oak Tree Drive, and Auto Ranch Road South have private access easements for adjacent property owners.
- Auto Ranch North has no easement or ROW, and the existing roadway is located through southern parcels, as shown in the figure to the left.

There are existing wetlands along Auto Ranch Road that may be impacted if a sidewalk is constructed in order to properly grade the connection between the back-of-sidewalk and the swale. The wetlands along the roadway are part of the flowway project, and it is beneficial not to disturb them if possible. If the County desires, it may be feasible to build a boardwalk-type sidewalk in some areas to avoid wetland impacts. However, boardwalks can be costly, and they require more maintenance than a typical concrete sidewalk. An alternative option is to construct a gravity wall adjacent to the sidewalk and build a railing along the sidewalk. This would allow for steeper slopes adjacent to the sidewalk to maintain the majority of current wetland conditions.

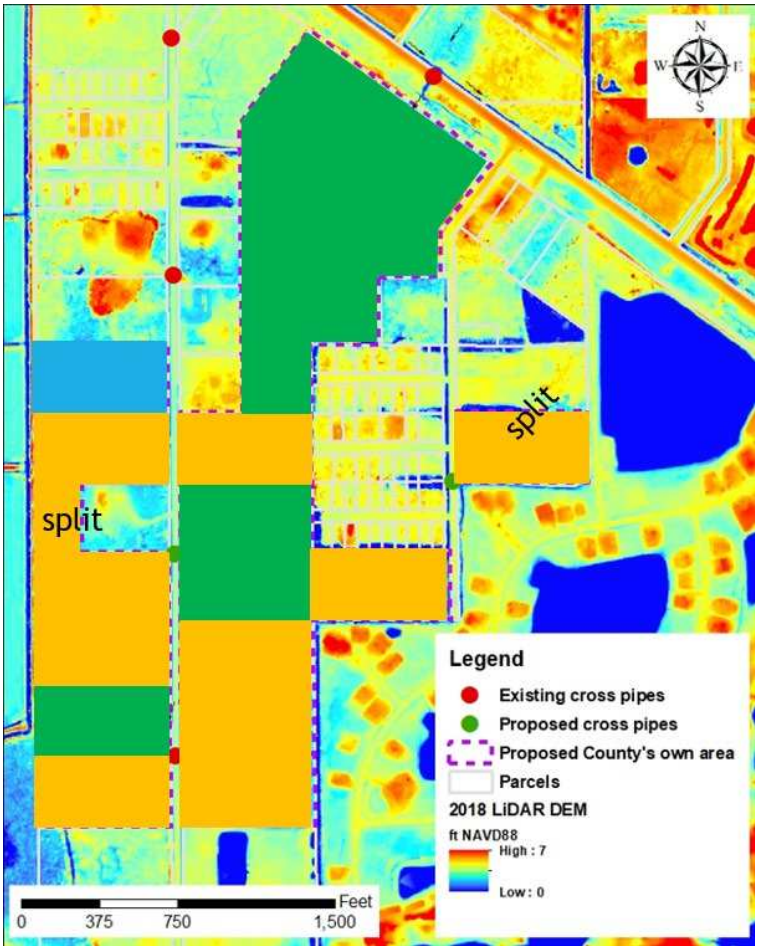
The probable cost estimation for the roadway improvements is detailed in Task 5 TM and totalized $10.33 M.

Flowway Restoration

The rise in residential and commercial development in southern Collier County may be contributing to the impairment of the historic flowways to the Rookery Bay Estuary. Encroachment by exotic vegetation has also been responsible for wetland degradation. A flowway restoration plan is detailed in Task 6 TM. The recommendations include land acquisition of parcels in wetland areas, as well as other activities such as regrading disturbed areas, exotic vegetation removal, and surface water management.

Land Acquisition

Collier County has already acquired various parcels of sensitive land in the flow way, which are colored in green in the map to the right. However, there are still private parcels with wetland areas in the flowway that need to be acquired.



The recommendations provided in Task 6 TM for land acquisition are as follows.

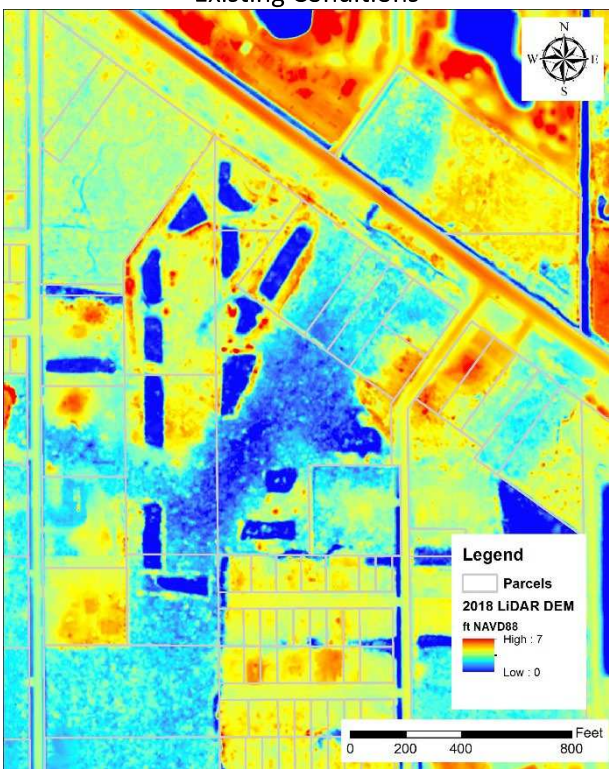
- Secure an easement agreement with Fiddler's Creek (which is the blue colored parcel in the map).
- Acquire other parcels areas (which are colored in orange in the map) via negotiation or condemnation.
- Complete a lot split in two parcels to exclude higher elevated area with existing houses.

The probable cost estimation for the land acquisition is detailed in Task 6 TM and totalized $3.60 M for a total of 50 acres.

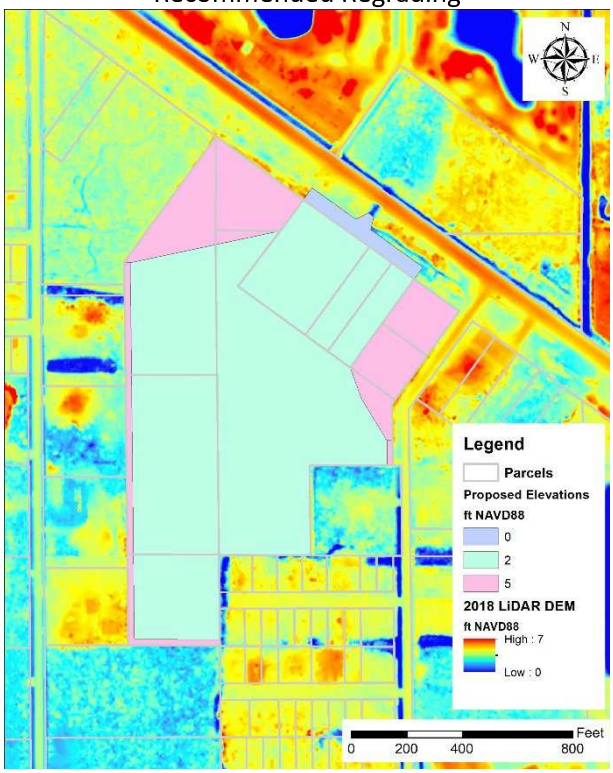
Regrading Disturbed Areas

Collier County acquired parcels south of US-41 that contain small ponds likely from an old fish farm operation. The material excavated from the existing ponds was likely used as fill to elevate the average ground around the ponds and to isolate most of them from the flowway. Moreover, those parcel areas are mostly covered with exotic vegetation.

Existing Conditions



Recommended Regrading



The recommendations provided in Task 6 TM for this area are:

- perform a regrading operation to create a spreader swale, a filter marsh of 24 acres, elevated areas on the side, and perimeter berms on the west and the south, as well as
- plant native vegetation, and
- build new water control structures to control water levels in the Filter marsh at 2.9 ft NAVD88.

The probable cost estimation for the regrading of disturbed areas is detailed in Task 6 TM and totalized $2.56 M.

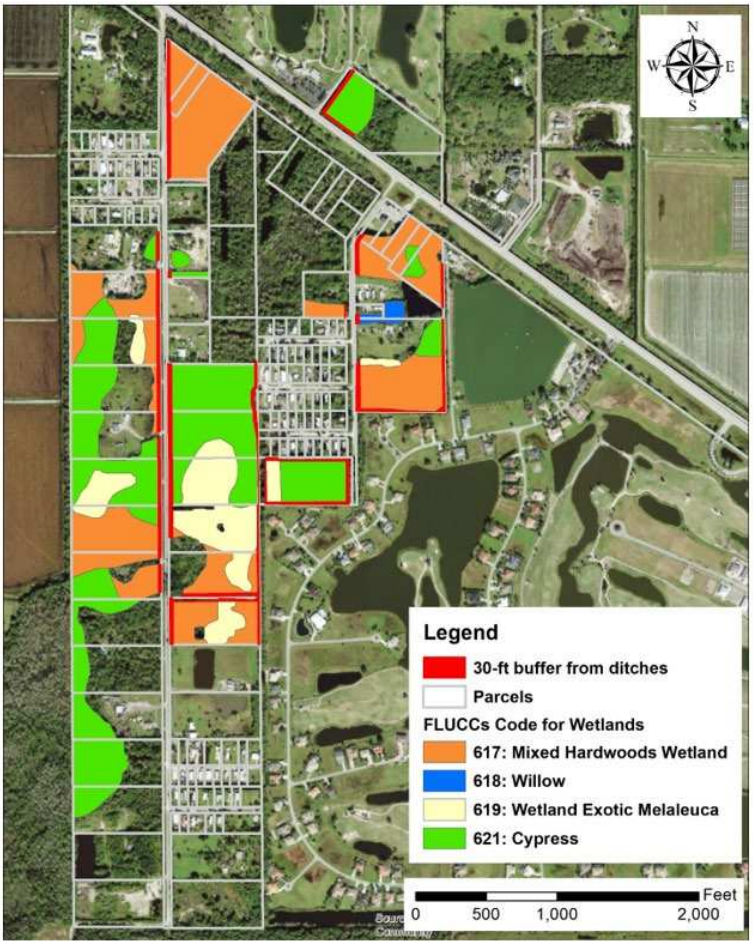
Exotic Vegetation Removal

The present habitats along Auto Ranch Road and Lake Park Blvd, both wetlands and upland habitats, are infested with exotic vegetation throughout the entire area.

The recommendation provided in Task 6 TM is to remove the exotic vegetation by using the following methods.

- Cut and haul off within 30 ft from the ditch banks.
- Treat/poison in place, otherwise.

The probable cost estimation for the removal of exotic vegetation in wetland areas was based on the FLUCCs Code map (shown to the left) and is detailed in Task 6 TM. The total estimated cost is $0.22 M.

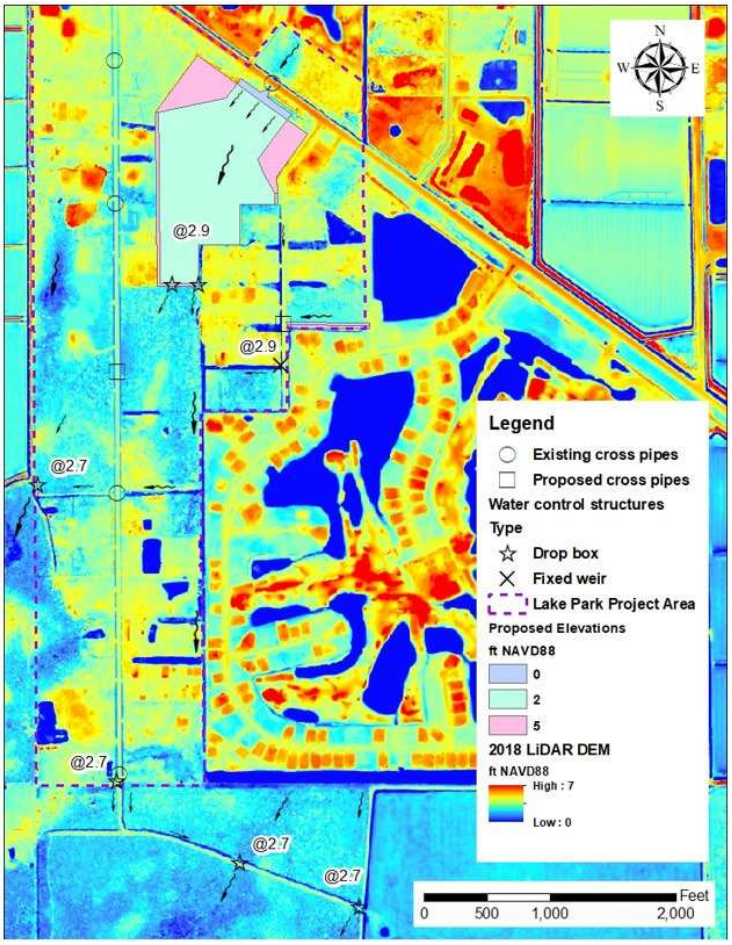


Surface Water Management

In the Task 6 TM, it is recommended to manage the surface water in the project area at two control elevations of 2.9 and 2.7 ft NAVD88 for north and south areas, respectively.

The control elevation of 2.9 at the north is not expected to have a backwater effect for the inflow through the US-41 culvert.

The control elevation of 2.7 at the south will produce an increase in wetland hydroperiods but also in retention time, which will benefit the water quality of the discharges into the Outstanding Florida Waters of the Rookery Bay Estuarine Reserve.



Total Estimated Costs

The summary of all the probable costs for the all the improvements features recommended for this project is presented in the table below, which gives a total of around $30 M. All recommended improvement features for roads, septic-to-sewer conversion, stormwater management, and restoration of the historic flowways are integral to the overall achievement of the objectives of the Lake Park Area Improvement project.

Included in:	Description of proposed improvement	Costs ($)
Task 3 TM, Table 8	Drainage improvements, which included four new drop box structures, pipe replacements and new pipe installations.	876,575
Task 4 TM, Tables 6.5.1 and 6.5.2	New potable water distribution systems to the Auto Ranch Road and Lake Park Boulevard areas.	1,869,875
Task 4 TM, Tables 6.1 and 6.3	Septic to Sewer Conversion, which considers the combination of gravity sewer and low-pressure system on Auto Ranch Road and the traditional gravity system on Lake Park Boulevard Area. This will eliminate all septic tanks in the project area.	10,278,309
Task 5 TM, Appendix D	Road upgrades, which include widening and raising the roadways, constructing a defined shoulder and swales, and a sidewalk on Auto Ranch Road.	10,330,778
Task 6 TM, Table 3	Land acquisition of parcels in the flowway	3,601,611
Task 6 TM, Table 5	Regrading disturbed areas just south of US-41 and planting native vegetation to build a filter marsh.	2,563,002
Task 6 TM, Table 6	Removal of Exotic vegetation in wetlands.	219,892
	Total	**29,740,042**

Appendix A. Technical Memorandum for Task 1. Data Collection and Field Reconnaissance

To: Daniel Roman, PE, PMP; Rick Orth, PG.
Stormwater Management Section, Collier County

From: Marcelo Lago, PhD; Ananta Nath, PE; Maria C. Bravo, PE, PhD;
Lago Consulting and Services, LLC;
Allyson Holland, PE; Justin Frederiksen, PE; GradyMinor
Marco Espinar; Collier Environmental Consultants, Inc

Date: November 7th, 2022

Re: Lake Park Boulevard Capital Improvements and Water Quality Flowway Pre-Design Study.
Task 1. Data Collection and Field Reconnaissance.
Collier County PO No. 4500218524

Background

Collier County has contracted Lago Consulting & Services to conduct a pre-design study to identify and evaluate the feasibility of potential stormwater management improvements, conversion of conventional septic systems of waste disposal to a municipal sewer, roadway improvements, restoration of historic flowways to the Rookery Bay estuaries and preservation of related natural resources within the project area. The study area is outlined in **Figure 1**.

This technical memorandum summarizes the Task 1 activities of the project related to the data collection and field reconnaissance.



Figure 1. Project area.

Task 1.1. Data collection and review

Topography

The latest LiDAR-based digital elevation model (DEM) files around the project area were collected from the USGS[1]. The DEM pixel size is 1 meter, and the LiDAR was flown between May and October of 2018. **Figure 2** displays the DEM around the project area.

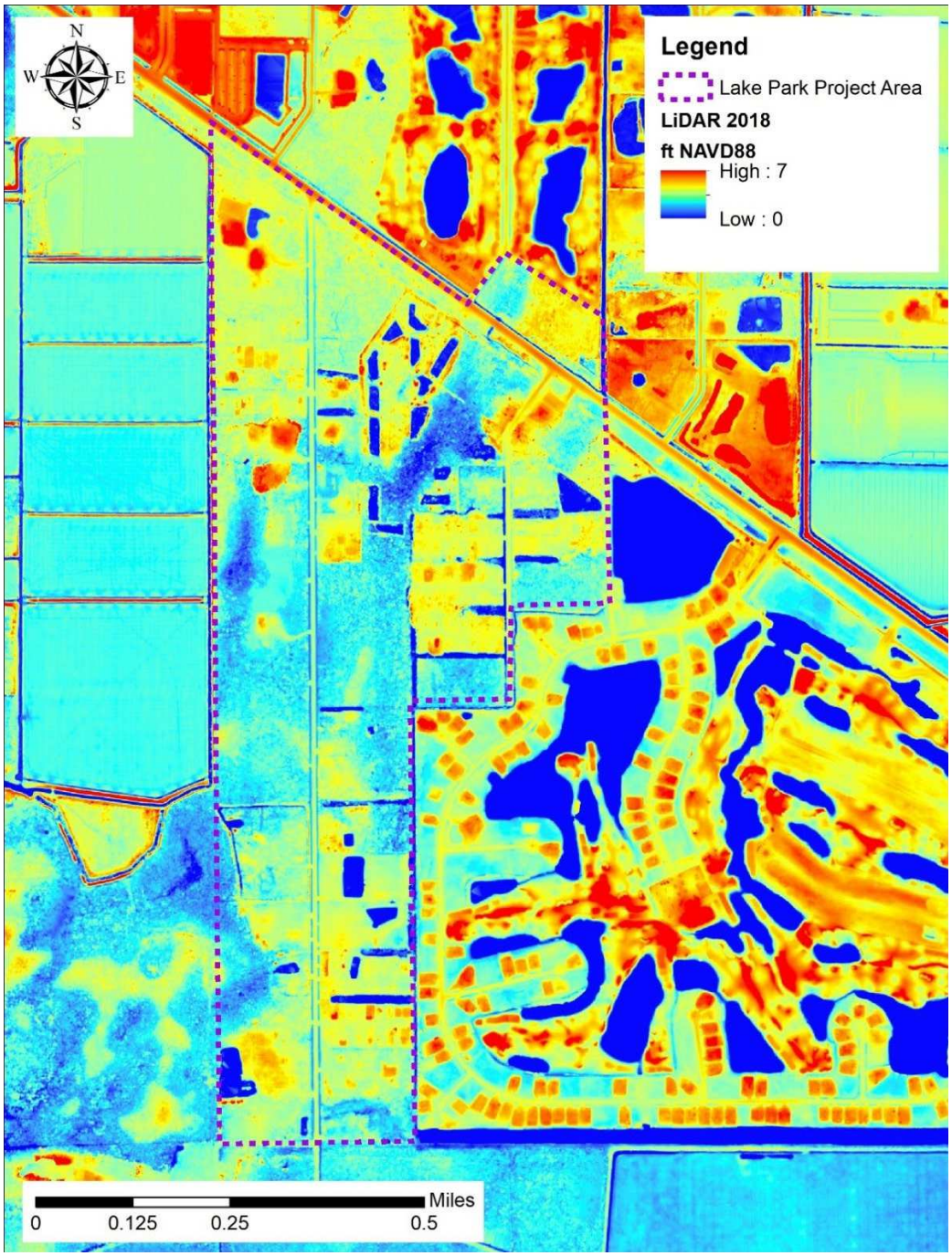


Figure 2. LiDAR based DEM from year 2018

[1] https://apps.nationalmap.gov/lidar-explorer/#/

Land Use and Land Cover

The South Florida Water Management District (SFWMD) has been updating land use / land cover GIS coverage polygon shape files approximately every two years. The latest published data revised on 6/20/2022 corresponding to the land use of the Lake Park area for years 2017-2019[2] is presented in **Figure 3**. A more detailed (Level 4) classification is listed in **Table 1**. This land use/ land cover map was regenerated as part of this project as described in a later section and presented in **Figure 51**.

Table 1. Land use/ land cover classification in the project area by the SFWMD for the period 2017-2019

	Land use		Land cover		
Figure 3 Code	FLUCCS code	Description	FLUCCS code	Description	Area (acres)
1	1130	Mixed Units, Fixed and Mobile Home Units	1130	Mixed Units, Fixed and Mobile Home Units	3.4
2	1180	Rural Residential	3100	Herbaceous (Dry Prairie)	19.5
3	1220	Mobile Home Units	1220	Mobile Home Units	38.8
4	1230	Mixed Units, Fixed and Mobile Home Units	1230	Mixed Units, Fixed and Mobile Home Units	27.0
5	1400	Commercial and Services	1400	Commercial and Services	1.4
6	1900	Open Land	3100	Herbaceous (Dry Prairie)	1.2
7	3100	Herbaceous (Dry Prairie)	3100	Herbaceous (Dry Prairie)	8.1
8	4110	Pine Flatwoods	4110	Pine Flatwoods	11.6
9	4340	Upland Mixed Coniferous / Hardwood	4340	Upland Mixed Coniferous / Hardwood	14.1
10	5300	Reservoirs	5300	Reservoirs	4.5
11	6170	Mixed Wetland Hardwoods	6170	Mixed Wetland Hardwoods	12.6
12	6172	Mixed Shrubs	6172	Mixed Shrubs	15.4
13	6191	Wet Melaleuca	6191	Wet Melaleuca	13.5
14	6200	Wetland Coniferous Forests	6200	Wetland Coniferous Forests	8.1
15	6210	Cypress	6210	Cypress	20.7
16	6250	Wet Pinelands Hydric Pine	6250	Wet Pinelands Hydric Pine	19.4
17	6300	Wetland Forested Mixed	6300	Wetland Forested Mixed	53.8

The future land use map[3] available from Collier County is reproduced in **Figure 4**. In this map, the project area is located in an Agricultural/Rural Designated area and is classified as "Neutral Lands" within the Rural Fringe Mixed Use District.

[2] https://geo-sfwmd.hub.arcgis.com/datasets/sfwmd::sfwmd-land-cover-land-use-2017-2019-2/explore?layer=0&location=26.538434%2C-81.167570%2C8.42

[3] https://www.colliercountyfl.gov/home/showpublisheddocument/99753/637811212200900000

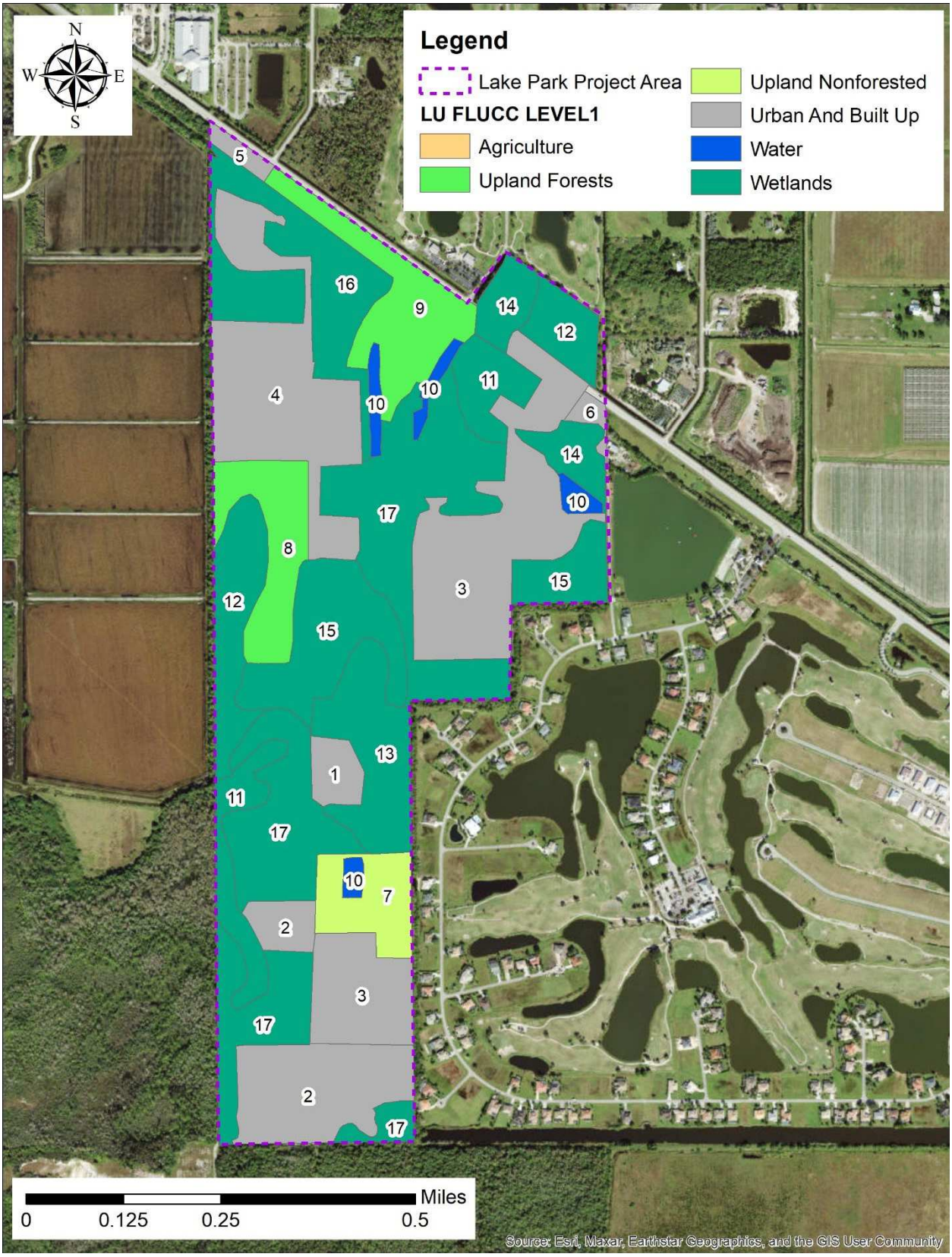


Figure 3. Land use level 1 map from the SFWMD for the period 2017-2019. Numbers in the map are detailed in Table 1.

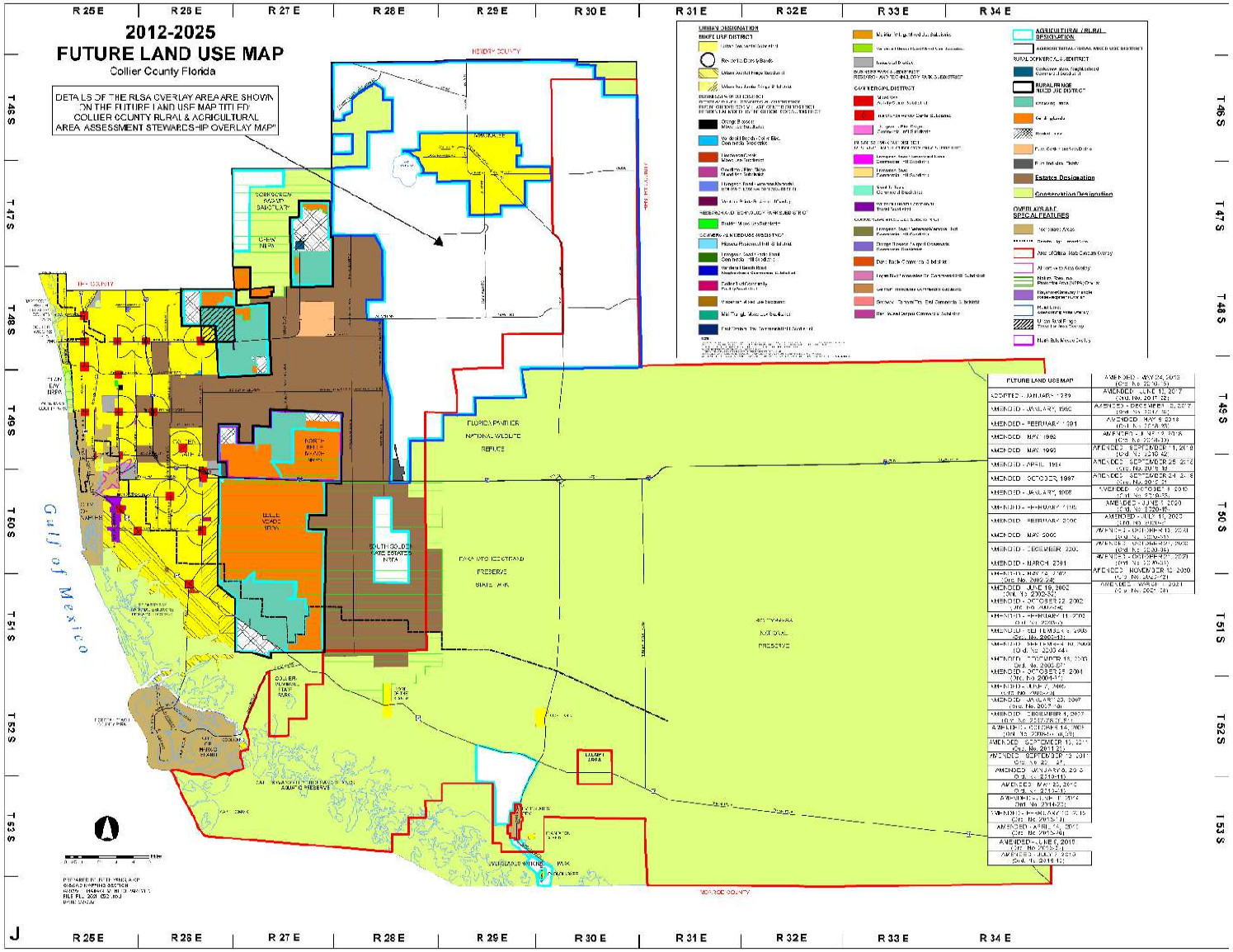


Figure 4. Future landuse map 2012-2025 as published by Collier County

TDR Program

The lands in the Lake Park project area fall within the Rural Fringe Mixed Use District (RFMD) under the Collier County's Transfer of Development Rights (TDR) program of land use control for protection of natural lands while optimizing land use for human habitation and economic development. The TDR program classifies lands in the RFMD as Sending, Neutral and Receiving. Sending Lands are those lands that have the highest degree of environmental value and sensitivity and generally include significant wetlands, uplands, and habitat for listed species. By selling their development rights, landowners may voluntarily achieve an economic gain on their property while still being allowed certain limited permitted and conditional uses, as provided for in Collier County's Land Development Code's Sub-Section 2.03.07 and 2.03.08.[4]

[4] https://www.colliercountyfl.gov/government/growth-management/divisions/planning-and-zoning-division/comprehensive-planning-section/rural-fringe-mixed-use-district/tdr-program-rural-fringe-mixed-use-district-rfmud

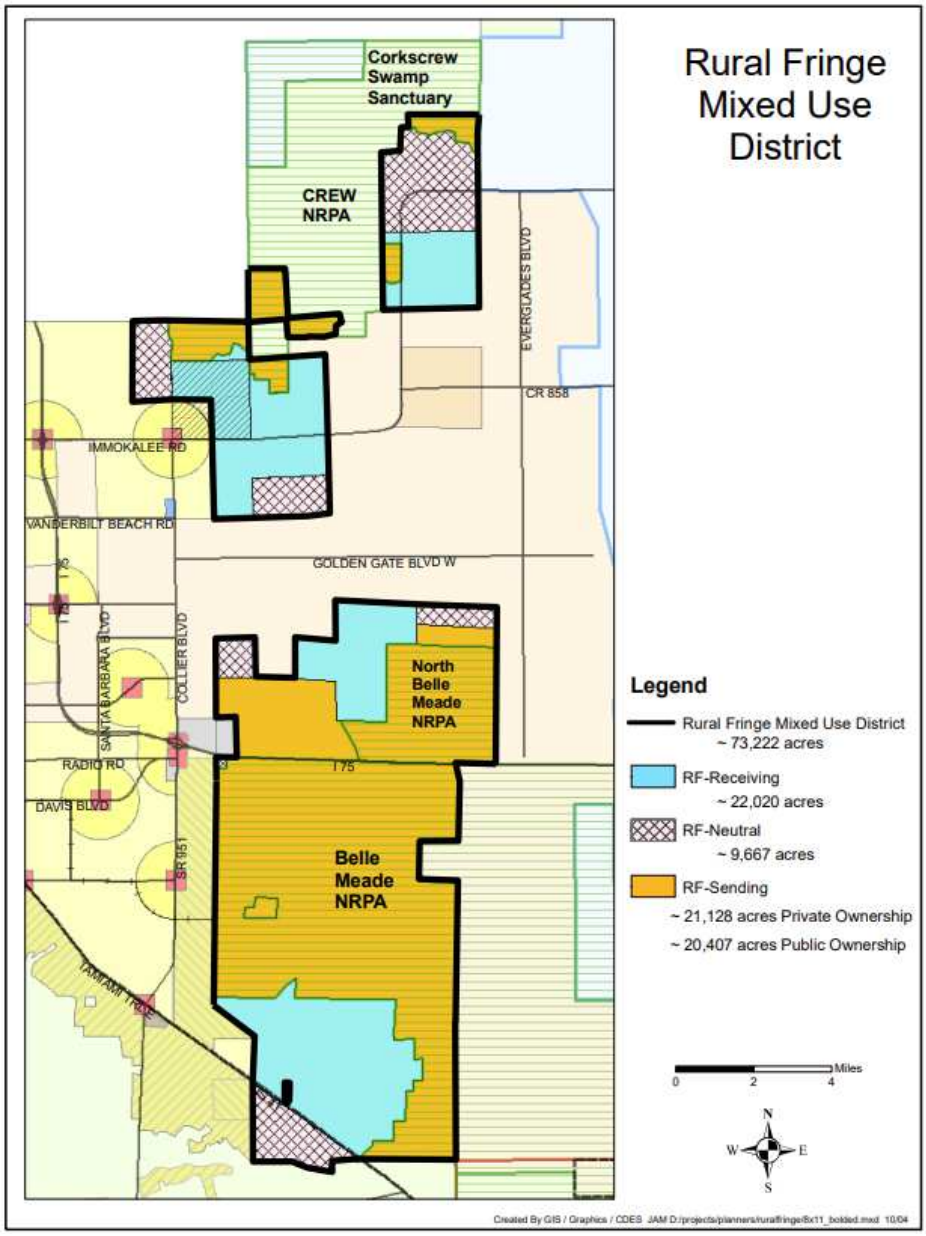


Figure 5. Rural Fringe Mixed Use District (RFMD) Map[5]

The Lake Park project area is classified as Neutral, as can be inferred from **Figure 5**. Neutral lands have a high ratio of native vegetation, and thus higher habitat values, than Receiving Lands, but does not approach levels of Sending Lands. They are identified for limited semi-rural residential development. There are no Transfers (either from or to) allowed in Neutral Lands.[4]

If the land parcels to be identified in the flowway restoration plan of this study cannot be acquired by fee title purchase from willing landowners, it is recommended the inclusion of the flowway area in the 'Receiving Lands' category of the TDR rules. However, such rulemaking change will require approval of the Collier County Planning Commission with final authorization from the Board of County Commissioners.

[5] https://www.colliercountyfl.gov/home/showpublisheddocument/415/635883137282070000

Historic Aerial Images

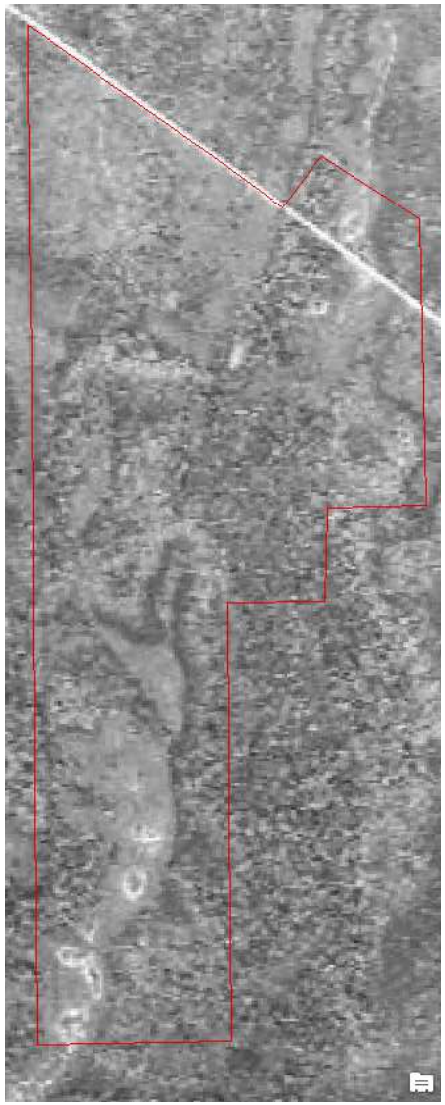
Historic aerial images were collected from the County[6] for years 1952, 1962, 1973, 1981, and 1989. The aerial images were georeferenced, and the sequence is shown in **Figure 6** with overlays of the project area. Google Earth application shows more recent aerial images, beginning from year 1995.

The Tamiami Trail (that later would become the US-41 road) opened in 1928[7] and is visible in all photos in Figure 6. Notice also from the sequence of historical images from the County that the urban development in the project area started primarily between years 1962 and 1973.

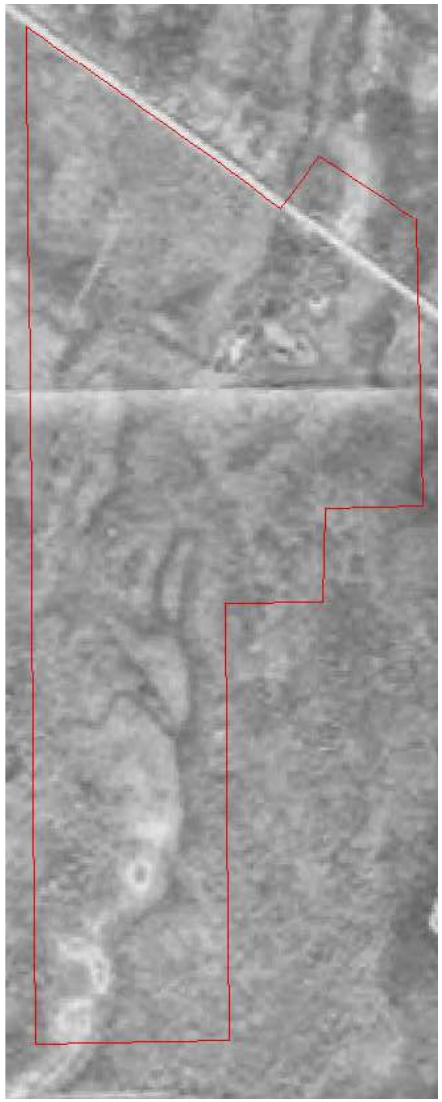
Ponds south of the US-41 road were constructed between years 1973 and 1981. The DEM presented previously in Figure 2 indicates that the fill extracted from those ponds was likely left onsite, which suggest that the ponds were part of a fish farm.

[6] Jon Voiles, Collier County Property Appraiser, personal communication.
[7] https://archive.naplesnews.com/news/state/tamiami-trail-changed-the-course-of-florida-history-ep-895579331-335705141.html/

1952



1962



1973



Figure 6. Historical aerial images received from Collier County.

1981



1989



2022



Figure 6. Historical aerial images received from Collier County. (continuation)

Soil

The soil coverage within the project area was downloaded from the NRCS Soil Survey databases[8]. The most recent data was published on 8/25/2021 and is presented in **Figure 7**. Soil parameters for the different classes are listed in **Table 2**.

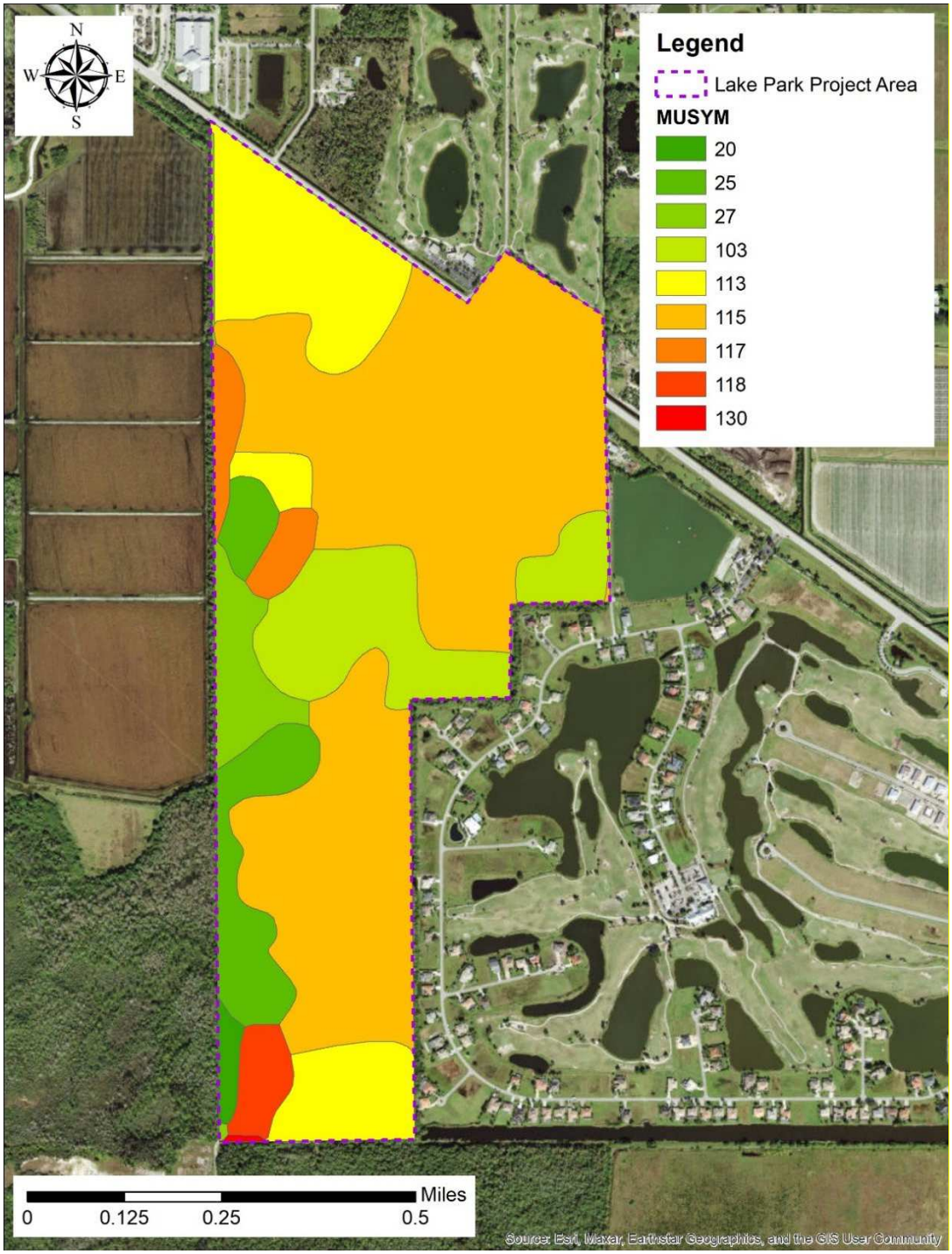


Figure 7. NRCS soil coverage

[8] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Table 2. NRCS soil classes and depth-averaged parameters that correspond to Figure 7.

MUSYM	MUName	MUKey	HSG	Clay (%)	Sand (%)	Organic Matter (%)	Kv-sat (ft/day)	Sy	Area (acres)
20	Ft. Drum-Malabar, high association, 0 to 2 percent slopes	3045926	B/D	4.3	93.1	0.29	23.2	0.305	2.4
25	Cypress Lake-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 percent slopes	3045904	A/D	3.3	94.0	0.48	23.3	0.314	20.1
27	Holopaw fine sand, 0 to 2 percent slopes	1413473	A/D	6.4	87.4	0.42	22.0	0.282	11.4
103	Cypress Lake-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes	3045903	A/D	3.3	94.0	0.48	23.3	0.314	32.7
113	Holopaw fine sand-Urban land complex, 0 to 2 percent slopes	3045895	A/D	6.4	87.4	0.42	22.0	0.282	46.0
115	Holopaw-Basinger-Urban land complex, 0 to 2 percent slopes	3045907	A/D	2.4	95.6	0.44	22.0	0.282	148.0
117	Immokalee fine sand-Urban land complex, 0 to 2 percent slopes	3045897	B/D	6.4	87.4	0.42	20.5	0.303	8.3
118	Immokalee-Oldsmar, limestone substratum-Urban land complex, 0 to 2 percent slopes	3045909	B/D	1.7	97.5	1.2	20.5	0.303	5.5
130	Pomello fine sand-Urban land complex, 0 to 2 percent slopes	3045900	A	1.7	97.5	1.2	30.7	0.315	0.3

Soils in the project area have a content of sand ≥ 87.4% and clay ≤ 6.4%, which correspond to sandy soils according to the USDA textural classification chart[9]. The typical hydrologic soil group (HSG) is A/D, which means that the soil has the highest infiltration rates under initial dry conditions but will infiltrate at much lower rates under wet conditions. In wet conditions, the water table is close to, and in some areas above the ground surface.

[9] Soil Mechanics Level I. Module 3 – USDA Textural Soil Classification. Study Guide. USDA-NRCS. February 1987. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044818.pdf

The Department of Health (DOH) establishes a soil texture limitation for septic systems by restricting the soil percolation rate in the range between 2 to 30 minutes per inch[10]. Such a range of percolation rates will be equivalent to saturated vertical conductivities (Kv-sat) in the allowable range from 4 to 60 ft/day. All soil classes in the project area as presented in Table 2 have average vertical conductivities within the allowable range and seem to be suitable for septic systems. It should be noted, however, that the vertical conductivities in Table 2 are typical average values for the different soil classes, and therefore, the percolation rate obtained from a local percolation tests may differ.

[10] State of Florida, Department of Health, Chapter 64E-6, Florida Administrative Code, Standards for Onsite Sewage Treatment and Disposal Systems, effective July 31, 2018. https://www.floridahealth.gov/environmental-health/onsite-sewage/forms-publications/_documents/64e-6.pdf

Drainage Patterns

The County maintains a database of the storm water management facilities that can be accessed online[11], as shown in the print screen of **Figure 8**. Although the County's GIS database is useful, some of the information has not been updated. The presence of pipes and their hydraulic parameters (i.e., shape, size, material, and invert elevation) were verified during field visits.

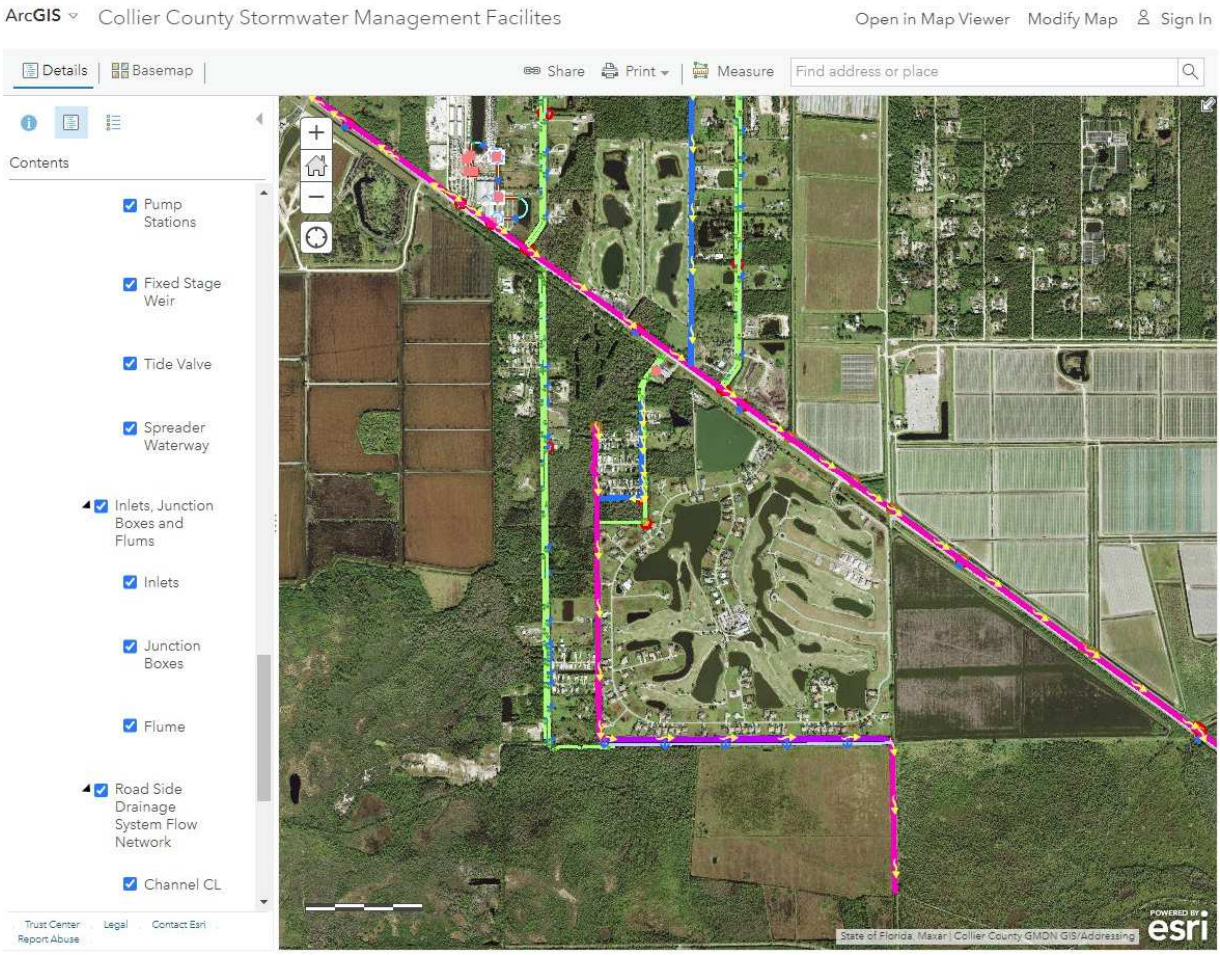


Figure 8. Collier County Stormwater Management Facilities.

In general, surface water from the US-41 north ditch enters in the project area mainly through the twin 5'x9' box culverts under the US-41 (located approximately midway between Auto Ranch Road and Lake Park Boulevard), and together with the local runoff, continue south through different paths.

The conveyance capacity of the Royal Palm West Bypass Ditch was improved in recent years. The Collier County contractor (under contract #18-7459) removed exotic vegetation and vegetation debris at the ditch during the period from 2/26/19 through 5/15/21. See project location in **Figure 9**. It is likely that this improvement allowed higher flows through that ditch and reduced the flooding in the project area.

This project will propose changes in the stormwater facilities that will improve significantly the Level of service for flood protection, the water quality, and the flow way restoration.

[11] https://www.arcgis.com/home/webmap/viewer.html?webmap=bc31da23d7f84be2a88a40916a88a763&extent=-81.863,25.9638,-80.8489,26.4572

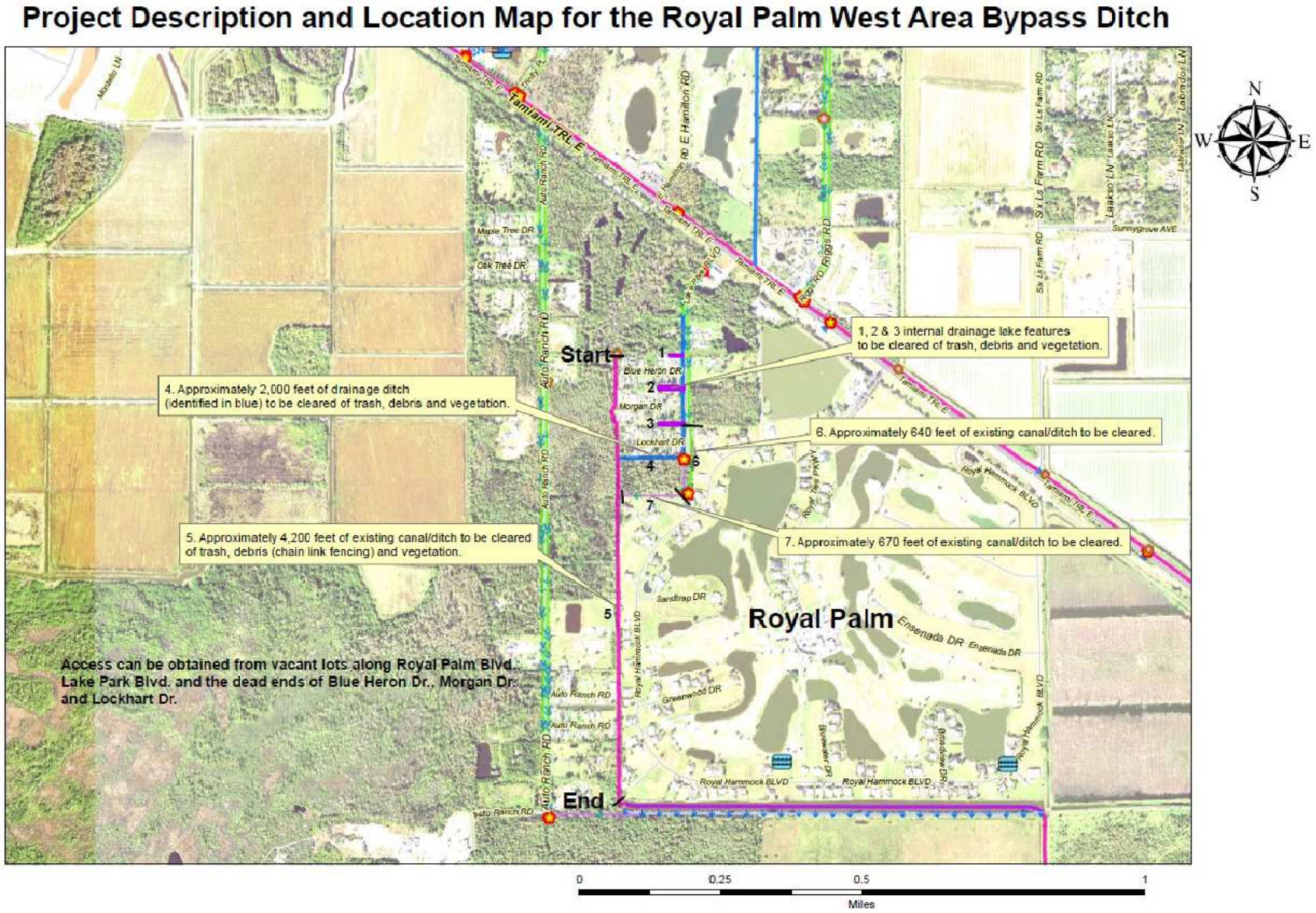


Figure 9. Project for clearing the Royal Palm West Bypass Ditch

Historic Rainfall

NEXRAD rainfall data has been reported in Florida since January of 1996. The data contain hourly or 15-minute interval rainfall values for each pixel in the NEXRAD grid and can be downloaded from the SFWMD hydrologic database DBHYDRO[12]. The grid cells are approximately 2 kilometers in size, and they are presented in **Figure 10** around the project area. The project area intersects pixels 47283 and 46809.

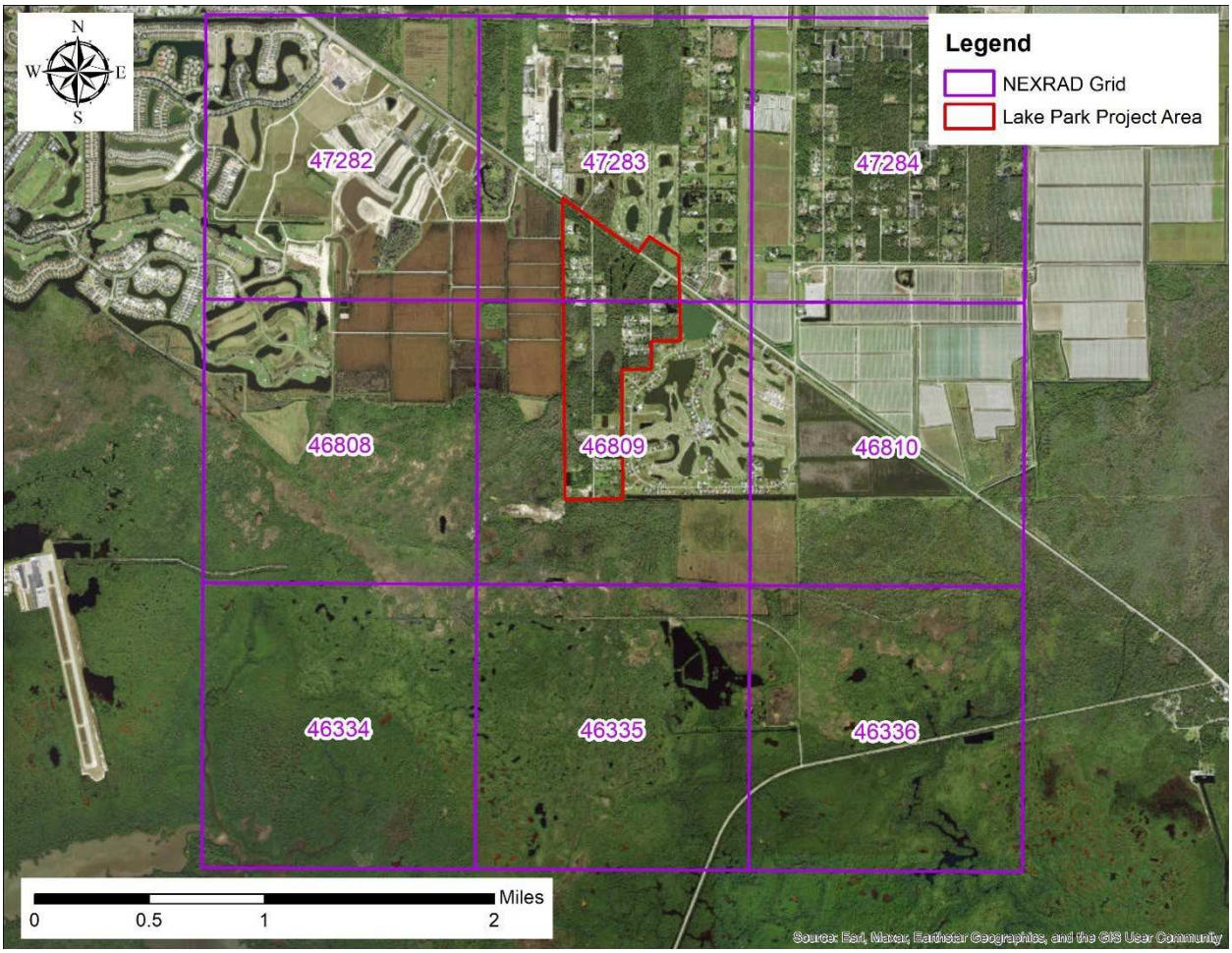


Figure 10. NEXRAD grid around the project area.

[12] https://apps.sfwmd.gov/nexrad2/nrdmain.action

The NEXRAD rainfall data was downloaded from DBHYDRO for the two intersecting pixels during the current wet season and processed into daily values, which are shown **Figure 11**. Notice that there was a heavy storm on June 3, 2022, with a rainfall depth of 6.4 inches. Rainfall was non-stop that day from 3AM until midnight with a peak intensity of 1.7 inches/hour at around 3PM.

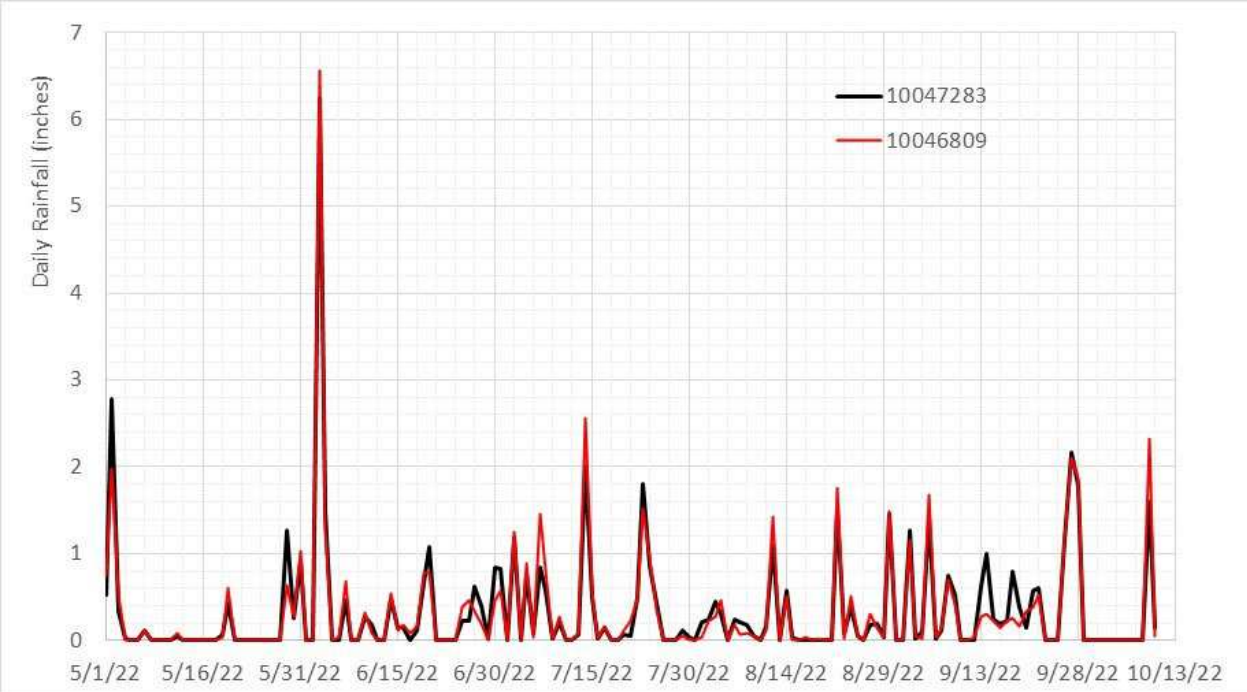


Figure 11. Daily NEXRAD rainfall during the wet season of 2022

The annual rainfall computed at the two intersecting pixels for the period of record is presented in **Figure 12**.

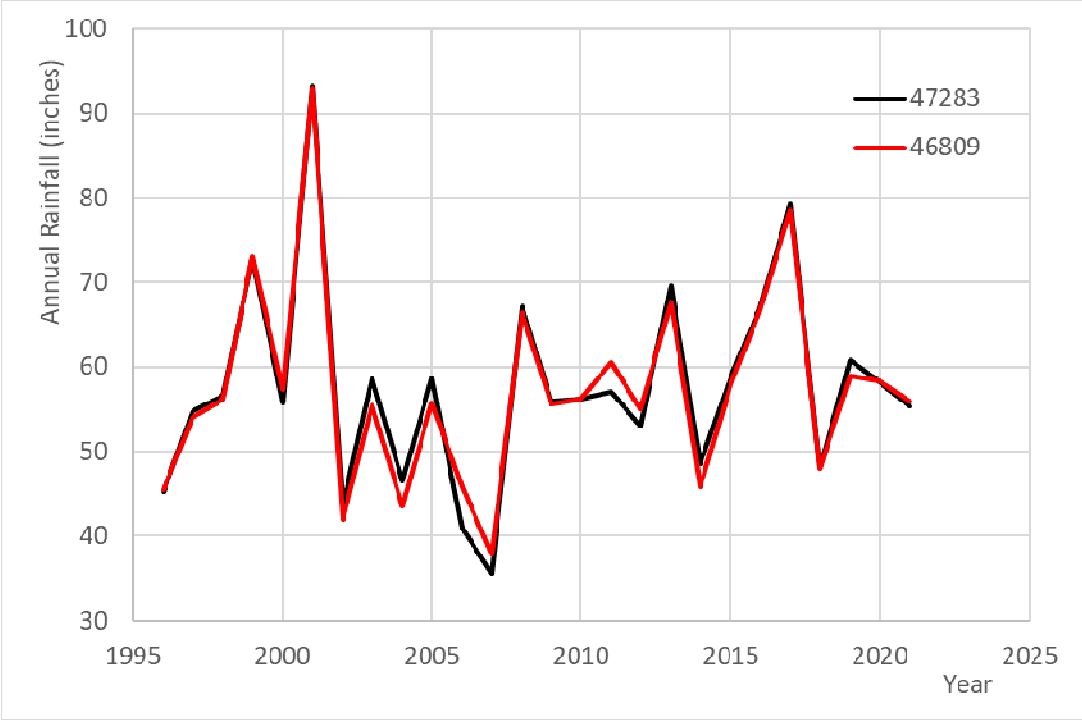


Figure 12. Annual rainfall computed from NEXRAD data

Design Storm Rainfall

Cumulative rainfall as a function of the return periods and the duration in South Florida are available from the SFWMD isohyetal maps[13]. **Table 3** shows the cumulative rainfall values extracted from those isohyetal maps at the center of the project area. Notice that according to this table, the value of 6.4 inches in a day shown Figure 11 has a return period between 5 and 10 years.

Table 3. Cumulative rainfall as a function of the return period and the duration

Duration (days) ->	1	3
Return period (years)	Cumulative rainfall in inches	
3	4.5	–
5	5.5	–
10	7	10
25	8	12.2
100	11	15.4

In order to compare the SFWMD values in Table 3 against the available NEXRAD rainfall data, the NEXRAD data was processed to extract the annual maximum of the 24-hour cumulative rainfall, which are shown in **Figure 13**. Notice that the 24-hour cumulative rainfall maximum of 11.2 inches for year 2017 occurred during Hurricane Irma, and it is an outlier according to the variations shown in other years in Figure 13. This high value has a return period of around 100 years as shown in Table 3.

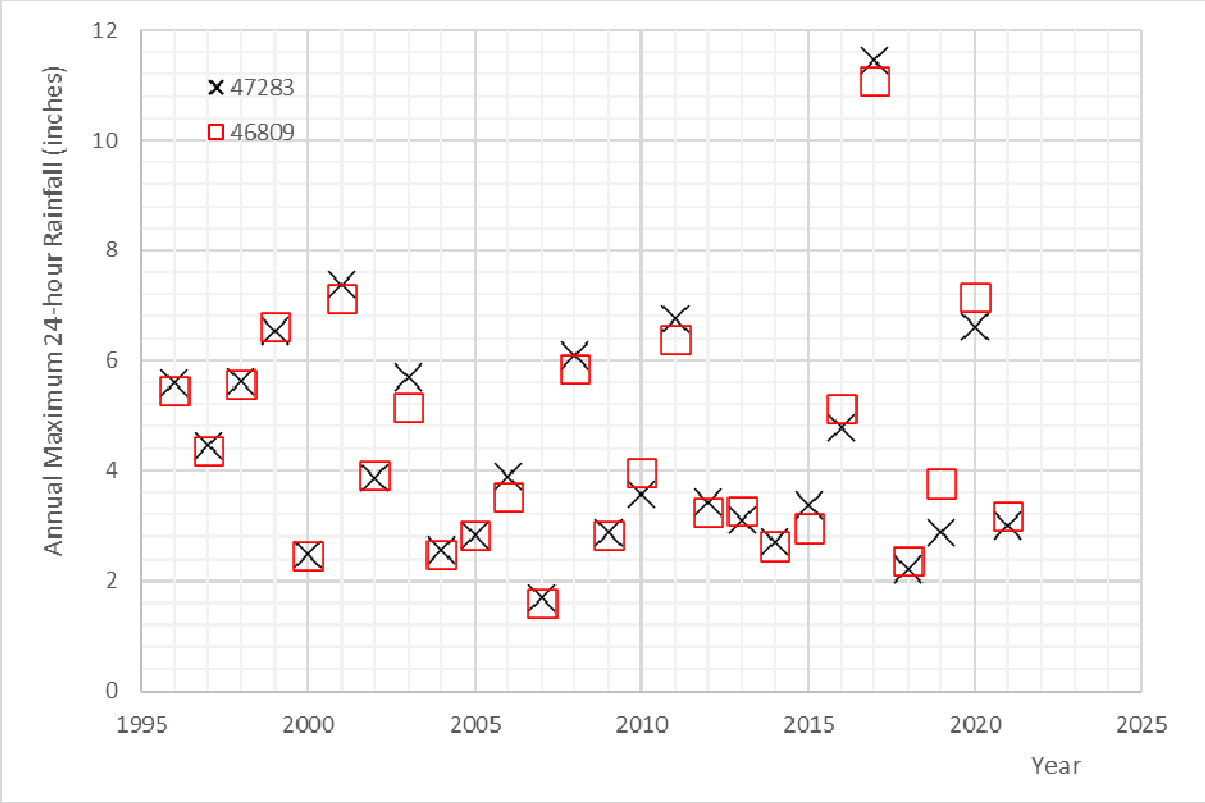


Figure 13. Annual maximum 24-hour rainfall from NEXRAD data

[13] Environmental Resource Permit Information Manual Volume IV. Water Resource Regulation Department. SFWMD Memorandum dated on July 1, 2010.

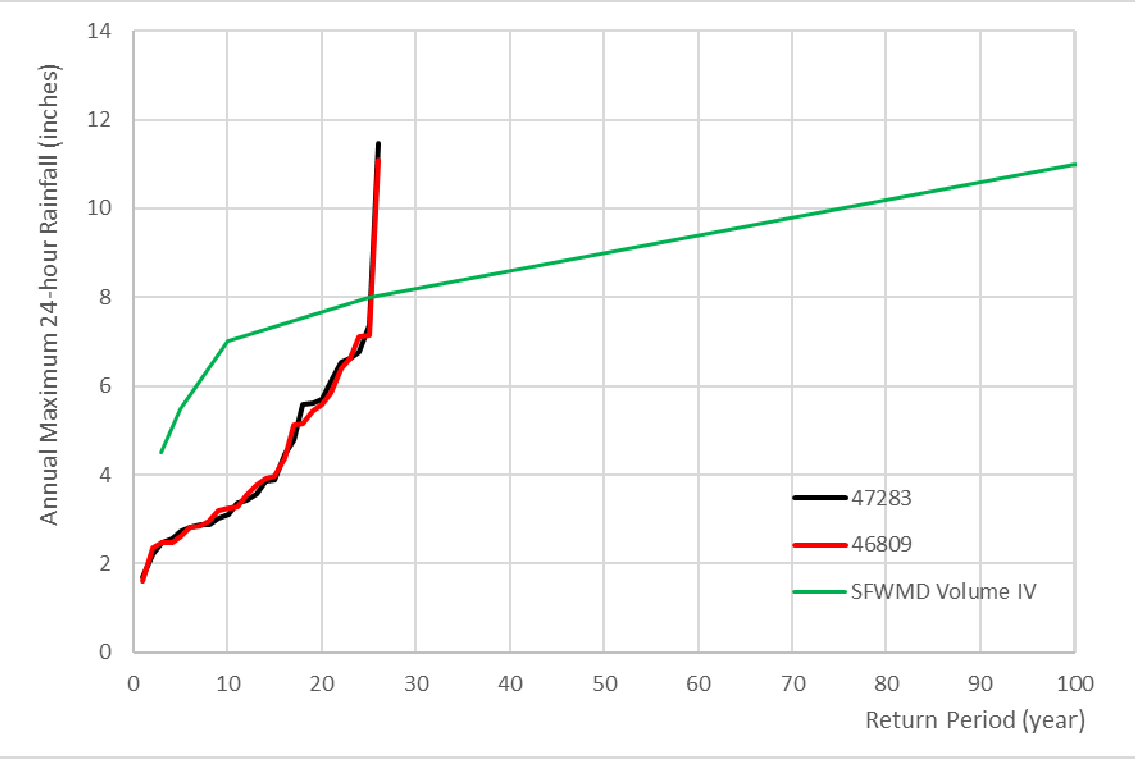


Figure 14. Comparison of the annual maximum 24-hour rainfall from NEXRAD data and the ones reported by the SFWMD

The annual maximum of the 24-hour cumulative rainfall values from NEXRAD data were sorted from low to high values and are compared with the values in Table 3 in **Figure 14**. Notice that the NEXRAD data processing estimates the 24-hour cumulative rainfall for the 25-year return period as 7.2 inches, which is close to the value of 8 inches presented in Table 3.

Flooding History

Report from February 2, 2016

Due to low relief topography and poor drainage characteristics of the land, the area is subject to frequent flooding, not only during the wet season, but also from large rainfall events during the dry season. The Collier County staff has documented one recent flooding event in the project area caused by the dry season storms preceding February 2, 2016. The field investigation notes[14] reported the following.

"The culvert under US 41 … both inlet and outlets nearly submerged with water depth in box culvert at 3.8'. Significant sheet flow is coming to the canal from the wetlands. Good velocity of flow through the culvert. Measured velocity at surface – approximate half a foot per second; estimated flow ~36 cfs. The flow at tailwater of culvert moving southwest toward Auto Ranch Road." See photo in **Figure 15**.

"Near the junction of Auto Ranch Rd at US41, water is coming from both directions, east and west." See photos in **Figure 16**.



Figure 15. Photo taken at the US-41 culvert looking south





Figure 16. Photos taken at Auto Ranch Road near the US-41 intersection, looking south.

[14] Auto Ranch Road Area Flooding. Field Investigation Notes on February 2, 2016, by Ananta Nath and Robert Wiley.

"The elevations of east-west roads meeting Auto Ranch Road (Maple Tree Dr, Oak Tree Dr) are lower than Auto Ranch Rd, and have deeper water. Many of the homes on these two roads are manufactured buildings. A resident (Fireman at North Naples Fire District) on Maple Tree Drive showed a depth of ~1.5 ft near his mailbox. He indicated that water entered his living room and he placed about 40 sandbags near the entrance to his house". See water standing on Auto Ranch Road in the photo of **Figure 17**.

"As we drove southward on Auto Ranch Rd, there were patches of dry road with water on both sides. At the southerly terminus of the road, near the locked entrance gate to the salvaged auto parts operation, the ground is higher with vegetations of palmettos, Brazilian peppers etc., and no flooding was observed beyond there."



Figure 17. Photo taken at Auto Ranch Road, looking south near the Maple Tree Dr. intersection.

"The flooding was obviously the result of a strong El Nino induced above normal rain in January, exacerbated by the saturated antecedent soil moisture conditions coming out of a wet year 2015."

"The area thus had an average total of 11.97" of rainfall in January, a whopping 10 inches above the long-term average of 1.72" for the month."

To take a closer look at the rainfall during that time, the NEXRAD rainfall data during the month of January 2016 was downloaded and processed. Daily values presented in **Figure 18** show two daily accumulates of 3.2 inches on the 22nd and the 27th. The cumulative rainfall plot presented in **Figure 19** confirms that by the time of the field visit (i.e., Feb. 2, 2016), there was 11.4 inches of rainfall accumulated since January 1st, 2016.

The Collier County Road Maintenance Division has received frequent calls throughout the years from the Auto Ranch Road area residents on flooding of the roads and yards. County staff have cleared vegetation and removed other obstructions in the ditches with little success on preventing or reducing flooding in the project area for the long term[15]. This project is tasked to propose solutions to mitigate flooding in the area while restoring the flowway.

[15] Comments from the Collier County Road Maintenance Division staff during meeting held on August 26, 2022.

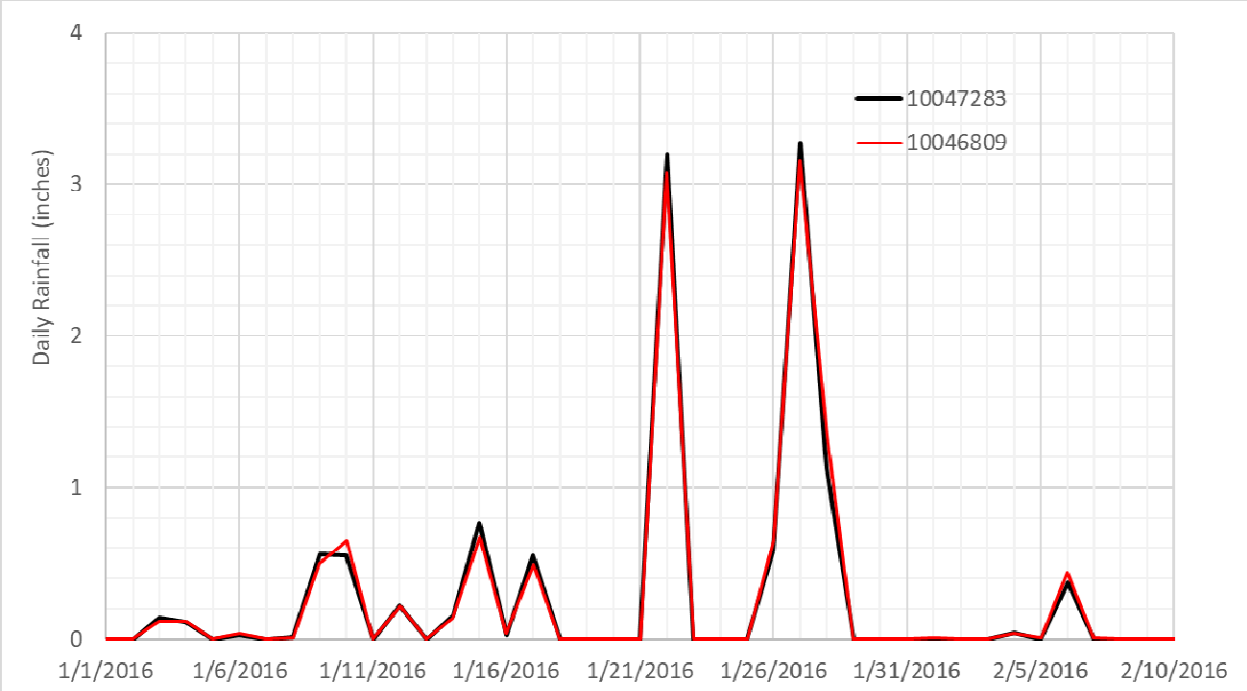


Figure 18. Daily NEXRAD rainfall during January 2016

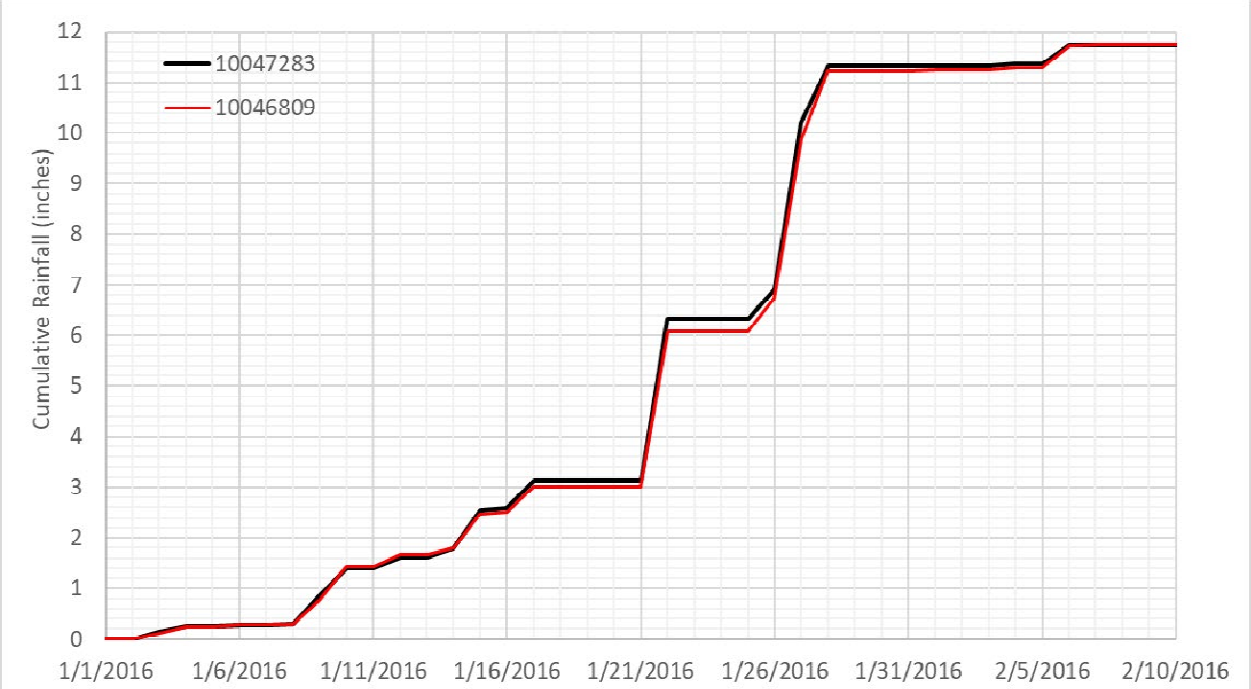


Figure 19. Cumulative NEXRAD rainfall after January 1st, 2016.

Review of Hurricane Ian impacts on flooding (Field Visit on September 30, 2022)

The Hurricane Ian produced a total of about 5 inches in 3 days (from September 26 through 28, 2022) according to the NEXRAD rainfall data presented in Figure 11. As much as the impact of wind and storm surge was devastating for the region, the total rainfall depth or the intensity of rainfall from Ian appeared not to be of historic magnitude compared to the amounts of recent tropical cyclone events affecting the region.

The wet season of 2022 has been extremely wet, and water levels measured at the US-41 culvert before the hurricane were high (i.e., about 3.6 ft NAVD88 on 9/26/22) as shown in a later section in Figure 38. As a consequence, the peak water level at the US-41 culvert during the hurricane reached the value of 4.4 ft NAVD88 on around midnight of 9/28/22, which corresponds to a return period of more than 10 years according to a later analysis in Table 7.

The flooding in the project area was also caused by an extremely high tide that produced a peak stage of about 4.6 ft NAVD88 on 9/28/22 at 8PM at the southeast corner of the project area (see Figure 43 in a later section) and produced south to north flows through the Royal Palm West Bypass Ditch for an estimated period of 3.0 hours.

Figure 20 presents photos of the flooding observed at Auto Ranch Road almost 2 days after the hurricane, which shows water levels of up to about 2 inches above the crown road.

The measured water levels at the US-41 culvert and at the southeast corner of the project area were equated at about 4.2 ft NAVD88 on 9/28/22 at 10:45PM (see Figure 43). Thus, the peak stage throughout the project area was 4.6’ near the southeast corner, 4.4’ near the US-41 Road culvert, and with a minimum value of 4.2’ in between.

The crown of Auto Ranch Road at Maple Tree Drive intersection is about 4.0 ft NAVD88 according to the LiDAR-based DEM and independent survey. Thus, the 0.2’ water depth observed by the project staff at that intersection during the visit and noted in Figure 20 corresponds to a stage of about 4.2 ft NAVD88. A resident of Maple Tree Drive communicated to the project staff during the site visit that the water levels stayed at about the current level (i.e., about 4.2 ft NAVD88) during the Hurricane Ian.

During the field visit on September 30, 2022, it was noticed an eastward flow over Auto Ranch Road, north from the Maple Tree Drive intersection. This indicates that there was water coming into the project area at the northwest corner and that the upstream water levels should be at or higher than about 4.2 ft NAVD88.

At Auto Ranch Road, west from Blue Heron Drive. Left photo is looking north.



At Maple Tree Drive intersection. Left photo is looking north.



Figure 20. Photos taken at Auto Ranch Road on 9/30/22 at 3PM, after Hurricane Ian.

FEMA Data

The flooding related information from the FEMA Flood Insurance Rate maps (FIRM) available from the Collier County webpage[16] are shown in **Figure 20**. Most of the project area is classified as AE with a base flood elevation (BFE) of 6.0 ft NAVD88.

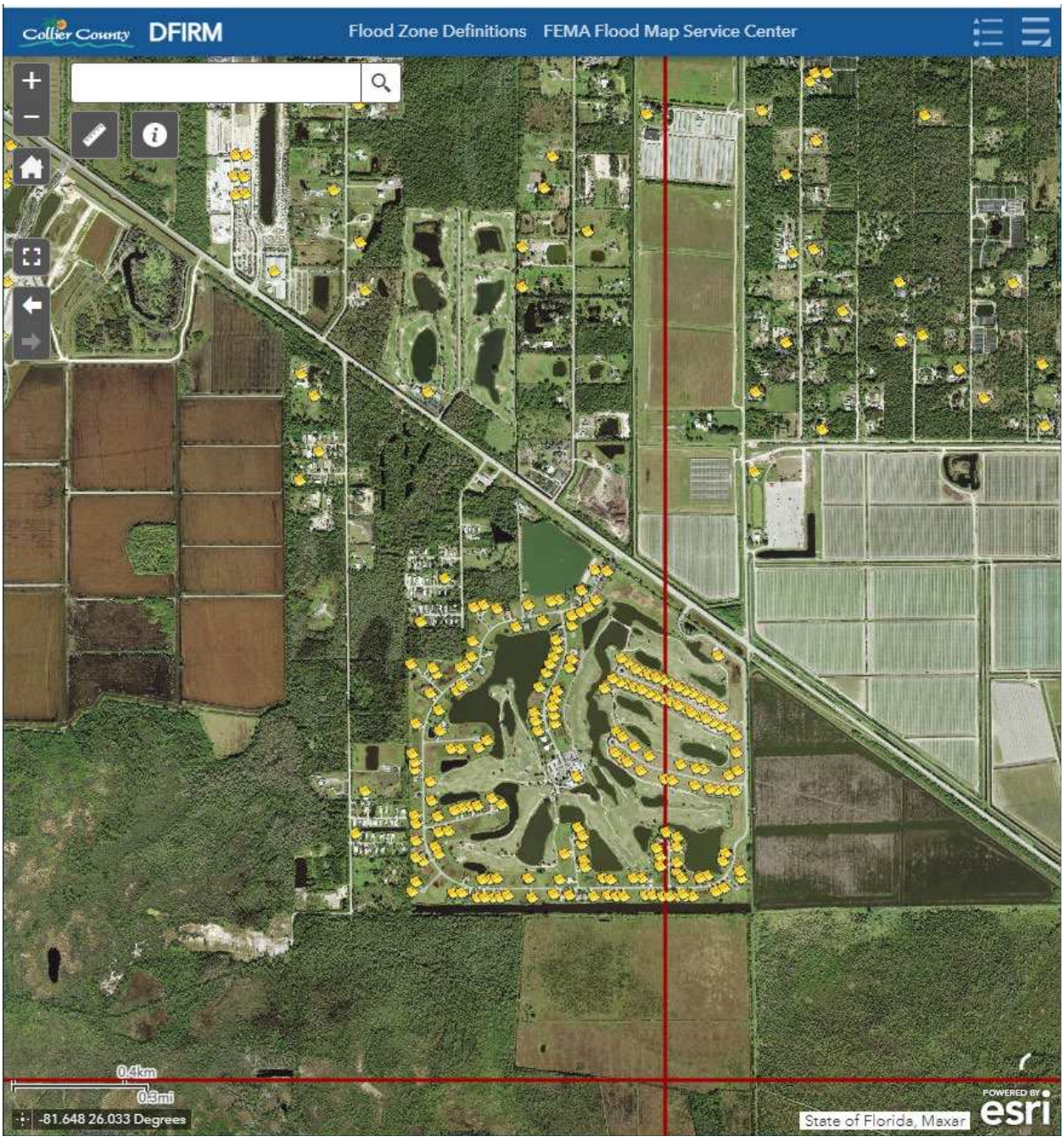


Figure 21. Collier County DFIRM Webpage

[16] Collier County DFIRM. Flood Zone Definitions. FEMA Flood Map Service Center. https://colliercountygmd.maps.arcgis.com/apps/webappviewer/index.html?id=cb9fd4f9e0624d549386f304e2533c11

The DFIRM webpage allows access to the available flood elevation certificates, which are the yellow symbols in Figure 20. The elevation certificates contain the first floor elevation, which are presented in **Figure 21**.

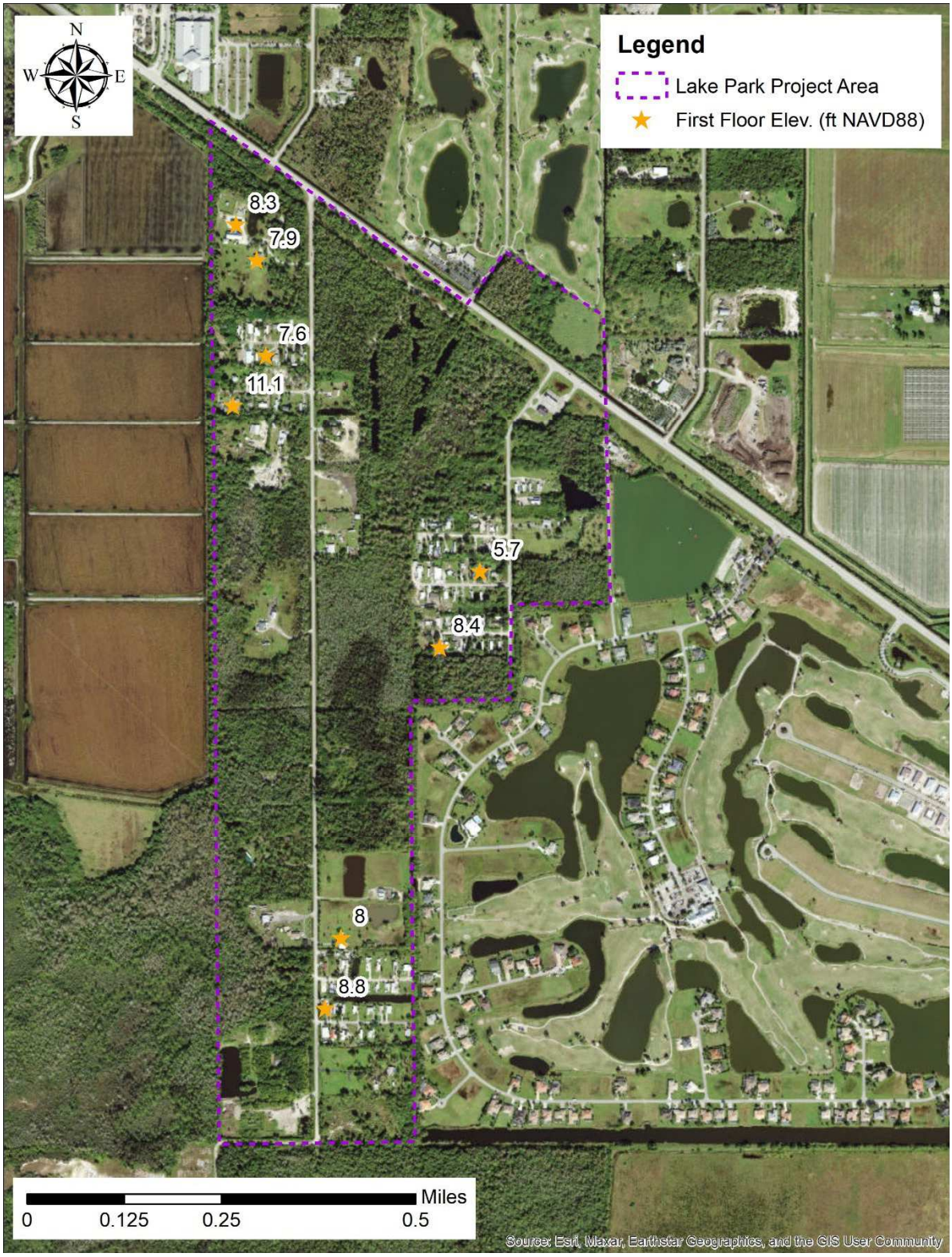


Figure 22. First floor elevations extracted from the flood elevation certificates in the project area.

Reference Evapotranspiration

Reference Evapotranspiration (RET) data is available for downloading from the USGS[17]. The data files available for download are separated by year, and they can be downloaded for specific counties or, as a much bigger file, for the entire State of Florida.

The RET rates are computed at a 2-kilometer spatial resolution and a daily timestep for the State of Florida. The data currently covers the period from the year 1985 thru 2020, and the 2-km grid is the same as it is used to report the NEXRAD rainfall by pixels, which presented in previous Figure 10 around the project area.

In the case of the state file for 2018, the pixel numbering used was different, and a crosswalk table was used to refer to the same NEXRAD pixel numbering as used for all the previous years. The data for years 2019 and 2020 were available as a NetCDF (*.nc) file, which was converted to the previously used text file format using a MATLAB script.

The missing RET data for small gaps of up to 6 days were interpolated linearly by using the previous and next days with data. Julian day average values can be used to extrapolate the data for years after 2020. **Figure 22** shows the Julian day average values from the 36-year data period for the two NEXRAD pixels intersecting the model area.



Figure 23. Seasonal trend of the RET estimated at two NEXRAD pixels from the USGS data.

[17] https://www.usgs.gov/centers/car-fl-water/science/reference-and-potential-evapotranspiration

Water Quality Conditions

There are no area specific data of water quality (WQ) parameters measured in surface waters within the project area. Potential water quality concerns within the project area are identified below.

1. Nutrients and other contaminants in surface water enter the project area through the US-41 ditch and also in the runoff that is generated inside the area. Septic systems can be a source of pollution in these low lying areas, especially at mobile homes areas. High nutrient concentrations may cause overgrowth of algae and aquatic plants.

2. The presence of solid residues (like plastic and metal objects) in ditches and wetlands.

The SFWMD map[18] of the DBHYDRO water quality monitoring stations around the project area is illustrated in **Figure 23**. Most of the measurements are in water extracted from wells, as in stations labeled as "021-##" and USGS stations C-1063 and C-1064. The measurements at stations labeled as "021-##" and at the canal station "AGCANAL" are old, prior to year 2000. The closest surface water WQ station with recent data is "TAMTOM".

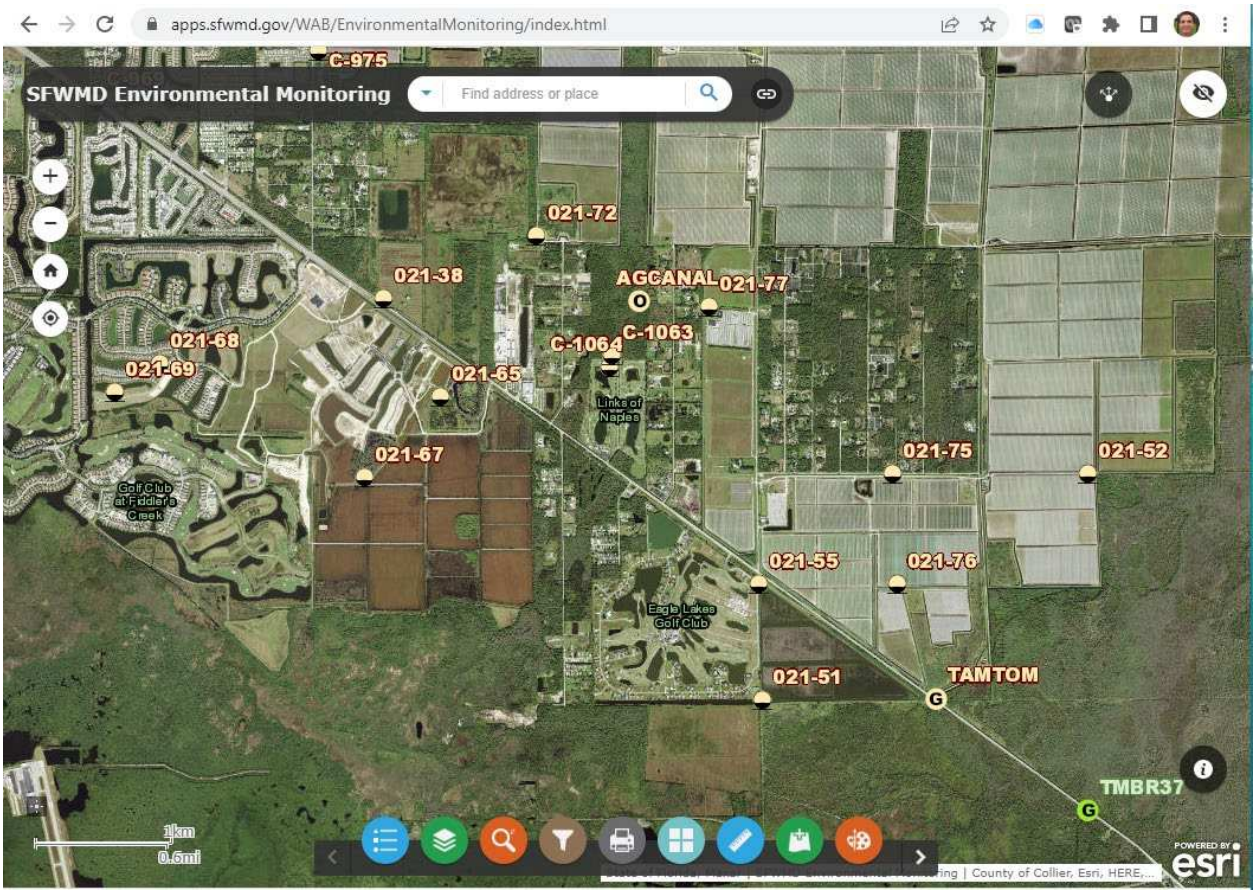


Figure 24. SFWMD Environmental Monitoring Stations

[18] https://apps.sfwmd.gov/WAB/EnvironmentalMonitoring/index.html

Figure 24 shows the values of TN, TP, and DO as reported in DBHYDRO at TAMTOM station for the period of record.

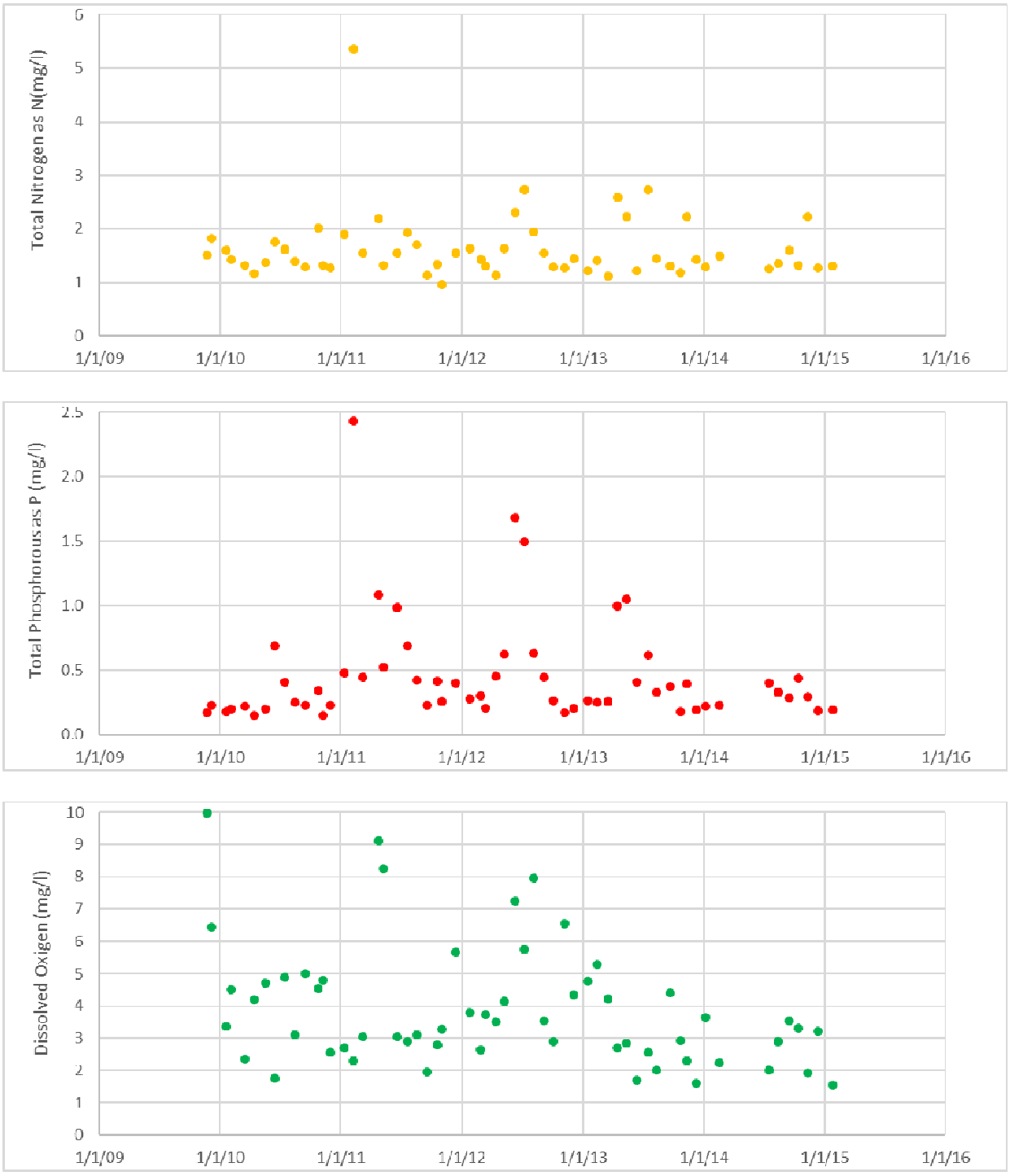


Figure 25. TN, TP, and DO measurements reported at TAMTOM station.

It is uncertain if the US-41 north ditch at the project area would have similar concentrations as the ones measured at TAMTOM. The County is planning to conduct some WQ sampling in the project area as a separate project.

The project team observed the presence of nuisance solid wastes (like plastic and metal objects) in ditches and wetlands during field visits. A hot spot is the mobile homes area at Lake Park Blvd, as shown in the photo in **Figure 25**.



Figure 26. Photo of fridge parts floating at the intersection of Lake Park Blvd. and Blue Heron Dr., taken on 7/15/2022.

Environmental Conditions

The project area is located approximately (5) five miles south of the intersection of SR 951 and US 41 and on the south side of US 41. It is mostly bordered by US 41 to the north, an agricultural field to the west and Boyne South PUD (Royal Palm Golf Estates) to the east.

Some of the parcels within the project area have been developed as single-family use and/or are undeveloped. Most of the soils consist of hydric soils. Development of some of these parcels obtained permits through either The Florida Department of Environmental Protections (FDEP) and/or South Florida Water Management District (SFWMD). Most of the undeveloped parcels consist of Jurisdictional wetlands. These wetlands are hydrologically functioning. The entire area, both the wetlands and uplands, are infested with exotic vegetation.

The upland areas are primarily vegetated with Slash pines (Pinus elliotti), Cabbage palms (Sabal palmetto) and myrsine (Myrsine floridana). These areas are infested with exotics such as Ear leaf acacia (Acacia auriculiformis), Brazilian pepper (Schinus terebinthifolius) and Air potato (Dioscorea bulbifera). The wetlands are dominated with either Cypress (Taxodium spp.) or Melaleuca (Melaleuca quinquenervia). The Melaleuca wetland areas are almost entirely impenetrable strands of Melaleuca. The ground cover in the wetland areas is dominated with Swamp fern (Blechnum serrulatum) and Saw grass (Cladium jamaicense). These wetlands areas are also heavily infested with exotics such as Java plum (Syzygium cumini), Ear leaf acacia (Acacia auriculiformis), Air potato (Dioscorea bulbifera) and Brazilian pepper (Schinus terebinthifolius). A few strands of Australian pines (Casuarina equisetifolia) were found in both the upland and wetland areas. Both the Cypress and Melaleuca wetlands are the dominate habitat within this study area.

Wildlife utilization is quite limited. Some wading birds could be seen actively feeding along the roadside swales. The project area still does have some recognizable character to support some limited foraging by some common small mammals and birds. Songbirds could be seen traversing the project site area. Use by large or medium mammals is very limited because of neighboring development and the heavy presence of exotic vegetation.

Collier County is known for its black bear population. **Figure 26** shows black bear nuisance calls reported by the Florida Fish and Wildlife Conservation Commission (FWC)[19]. Numerous nuisance calls have been documented within the project's boundaries. It may be recommended that the County mail to all the residents within the project area the FWC brochure "A guide to living in bear country"[20].

County staff believe that black bears and raccoons are in part responsible for spreading the garbage in the project area[21]. FWC encourage Florida counties, municipalities, and homeowners' associations in black bear range to pass ordinances or bylaws that require garbage be secured from black bears[22].

[19] Black Bear Related Calls in Florida from Florida Fish and Wildlife Conservation Commission
https://www.arcgis.com/home/item.html?id=a27014d0f6e84e3082da209995a1285f
[20] Living in Bear Country
https://myfwc.com/media/1891/livinginbearcountrybrochure.pdf
[21] Personal communication with Richard Orth
[22] Resolution from FWC
https://myfwc.com/media/16666/fwc-waste-management-resolution-june-2015_signed.pdf

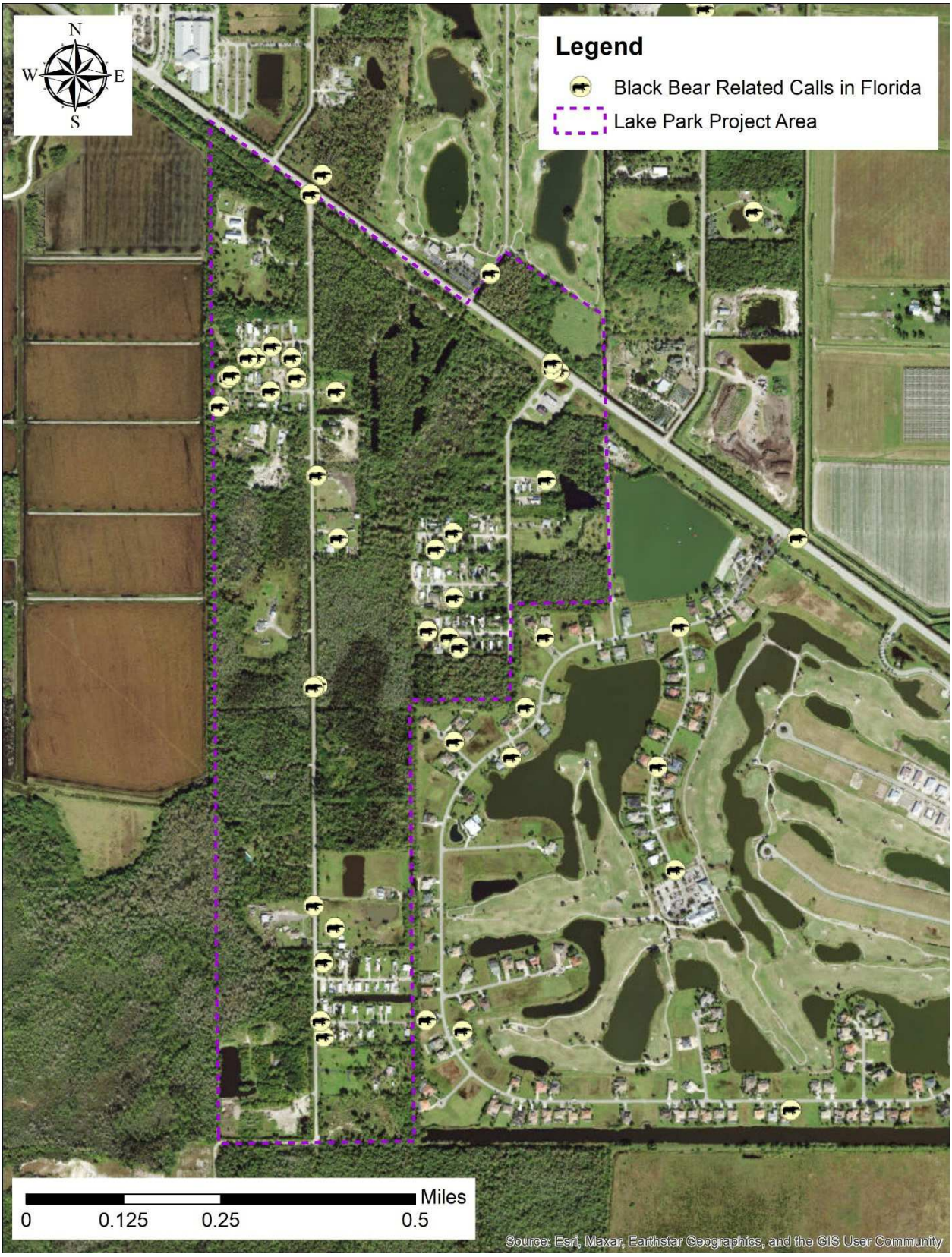


Figure 27. Black bear related calls in and around the project area. Last update on 8/5/2022.

Figure 27 shows the Florida Panther Consultation zone[23]. The majority of this project's boundaries are outside of the FWC Consultation Zone. The north side of US 41 is considered Secondary Consultation Zone. Development impacts in either Primary or Secondary zones should seek Technical Assistance with US Fish and Wildlife Service for said impacts.

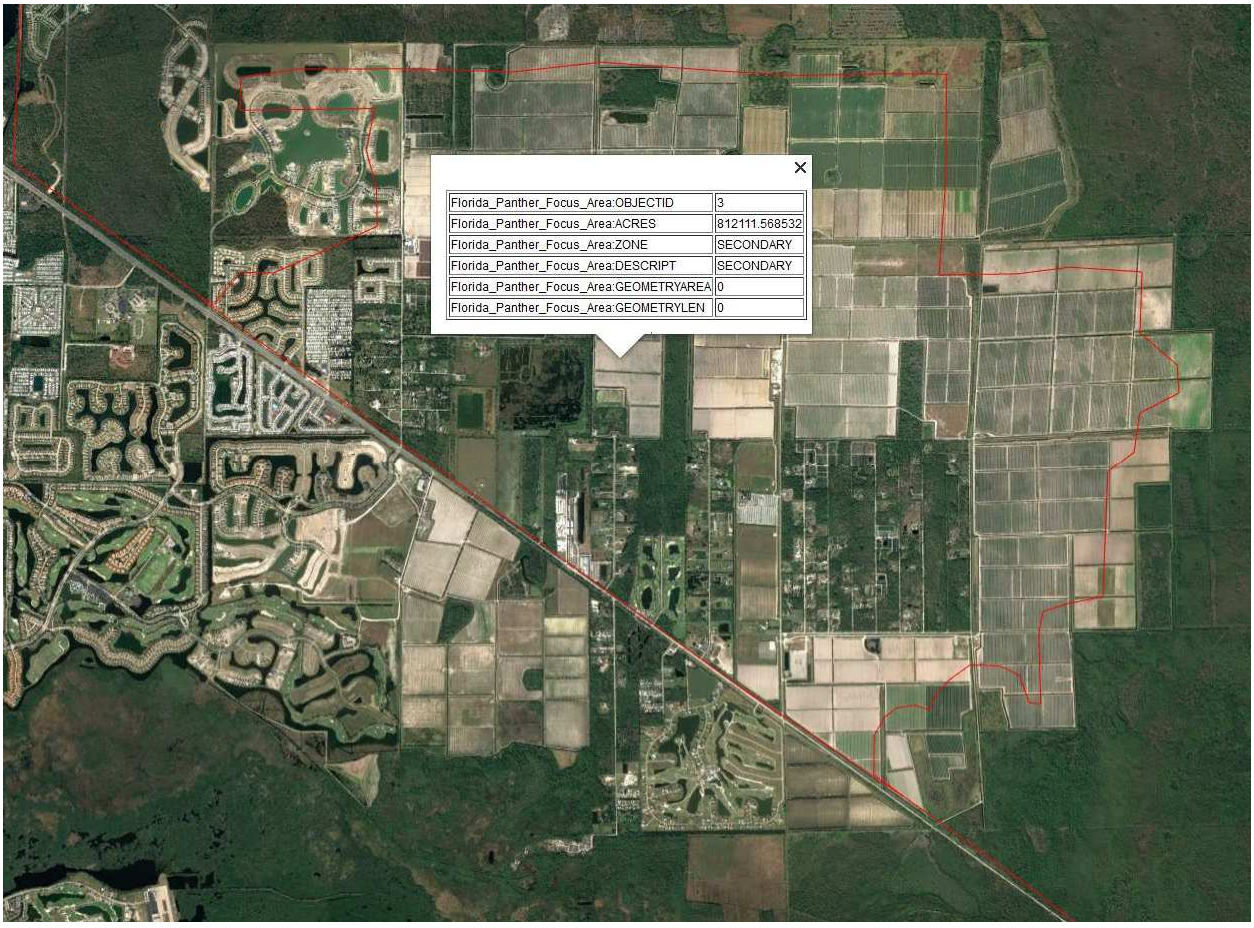


Figure 28. Florida Panther consultation zone by FWC.

[23] Florida Panther Focus Area from FDEP
https://geodata.dep.state.fl.us/datasets/FDEP::florida-panther-focus-area-1/about

Figure 28 was generated from the Audubon's Bald Eagle Watch[24] documenting active bald eagle nests. There are no known bald eagle nests near this project boundaries. Several nests are identified far from the project boundaries.



Figure 29. Neighboring bald eagle nests to project site.

[24] Bald Eagle Nest Locations documented by FWC
https://audubon.maps.arcgis.com/apps/webappviewer/index.html?id=9ade9794b8494d2b84c8dea339ea1428

Surface Water Management and Water Use Permits

The SFWMD permit webpage[25] shows only a few permits inside the project area, as shown in **Figure 29**. Environmental Resource Permits (ERPs) and Water Use Permits inside and around the project area were downloaded and compiled to extract relevant information.



Figure 30. SFWMD permits in and around the project area.

FDOT permit documents along the US-41 were also requested and reviewed by the project team.

[25] https://apps.sfwmd.gov/WAB/SFWMDMapping/index.html

Land Parcels Data

A GIS shape file with land parcel boundaries dated on 5/4/2022 was received from Collier County and is mapped in **Figure 30**. Parcels owned by Collier County, by the Fire District, and to be purchased soon by the County are highlighted.

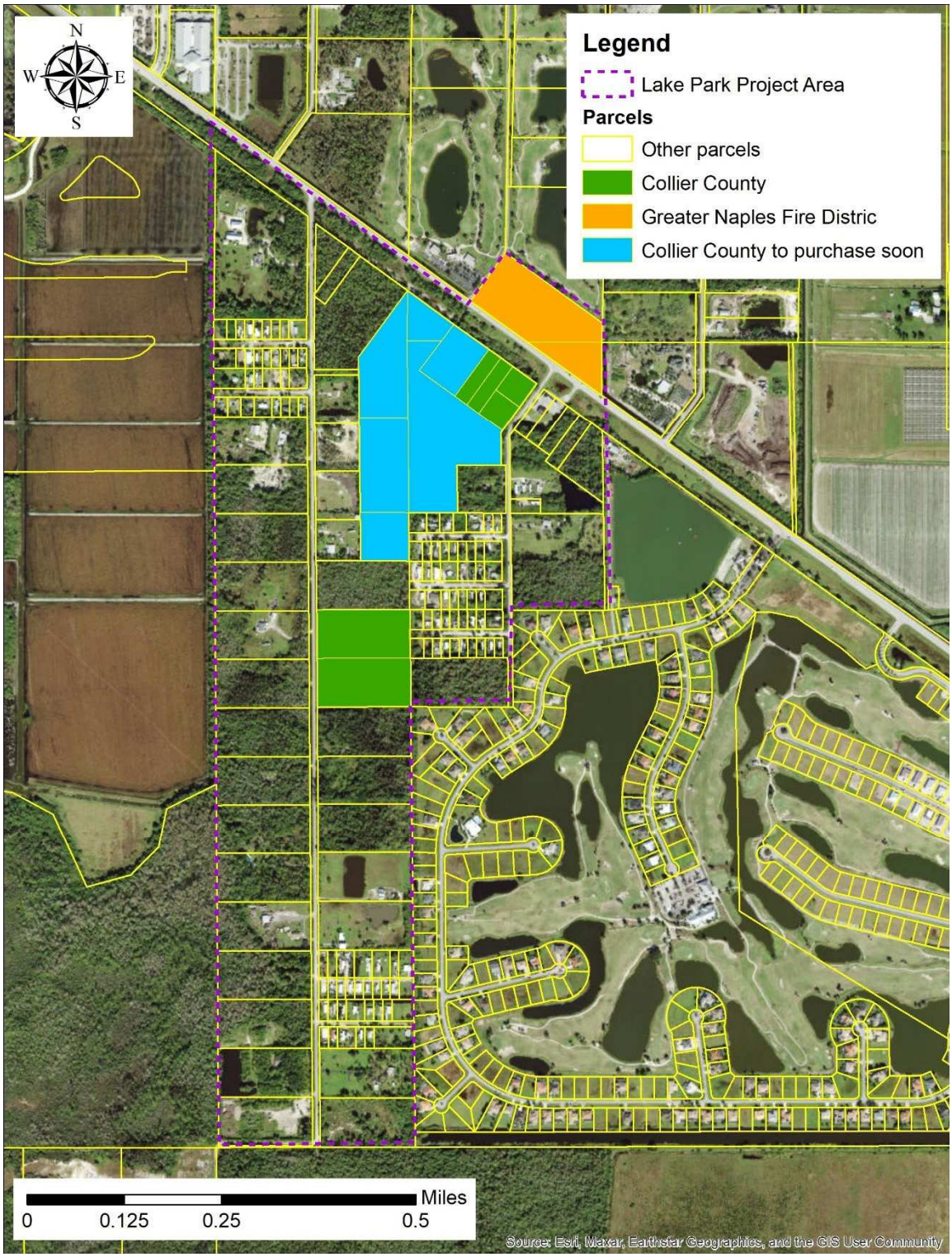


Figure 31. Parcels around the project area.

Easement and Right-of-Way Limits

The Quit Claim Deeds for Auto Ranch Road and Lake Park Boulevard (included in Appendix A) dedicate the right-of-way (ROW) to Collier County, and Road Maintenance staff has confirmed that they are responsible for maintenance of Auto Ranch Road and Lake Park Boulevard. Collier County Public Utilities own and maintain the water distribution system on Lake Park Boulevard.

The three side streets off of Lake Park Boulevard (i.e., Blue Heron Drive, Morgan Drive, and Lockhard Drive) are part of an unrecorded Plat called Blue Heron Lake Park. Blue Heron Drive, Morgan Drive, and Lockhard Drive are dedicated public right-of-way pursuant to the Quit Claim Deeds, however, these roads are not maintained by Collier County as they have never gone through the process of being added to the County roads inventory for operation and maintenance purposes. The Quit Claim Deeds conveying the rights-of-way to Collier County can be found in Appendix A. The potable water distribution system on these roads is owned and maintained by Collier County Public Utilities. According to the map presented in **Figure 31,** there is a 60' right-of-way easement at streets. There is also a drainage easement along the West Royal Hammock bypass ditch[26].

The two side streets off of the northern part Auto Ranch Road (i.e., Maple Tree Drive and Oak Tree Drive) are private ingress and egress easements reserved for the owners of the property contiguous to the private easement. Collier County has confirmed they do not maintain these roads, nor do they have Collier County Public utilities in this area. Based on review of property deeds, Maple Tree Drive and Oak Tree Drive appear to be part of an unrecorded Plat called Mirra Park, but we are unable to locate the map. The individual parcels are described by metes and bounds legal descriptions, but some do mention lot numbers in the unrecorded plats.

The two side streets off of the southern portion of Auto Ranch Road (also referred to as Auto Ranch Road) are private roadways. The southern side street has a private ingress and egress easement reserved for the owners of the property contiguous to the private easement. The northern street does not appear to have an easement; the individual parcels are described by metes and bounds legal descriptions that include the roadway. These properties are served potable water by Collier County Public Utilities, but the water is fed to these streets from the community to the east. There is a bank of water meters on the east end of the roads, the water services run from the meters to each home. Collier County only owns and maintains the potable water in this area up to the water meters, they are not responsible for the service lines that run to the homes.

[26] Personal communication with Rick Orth.



Figure 32. Easements around The Blue Heron Mobile Home Park as provided by County staff[26].

Road Maintenance

The Collier County Road Maintenance Division maintains the main roads in the project area (i.e. Auto Ranch Road and Lake Park Boulevard), which includes clearing vegetation from the ditches. There are other road segments in the project area (a total of 7 road segments, as shown in **Figure 32**) that are gravel roads and not maintained by the County.

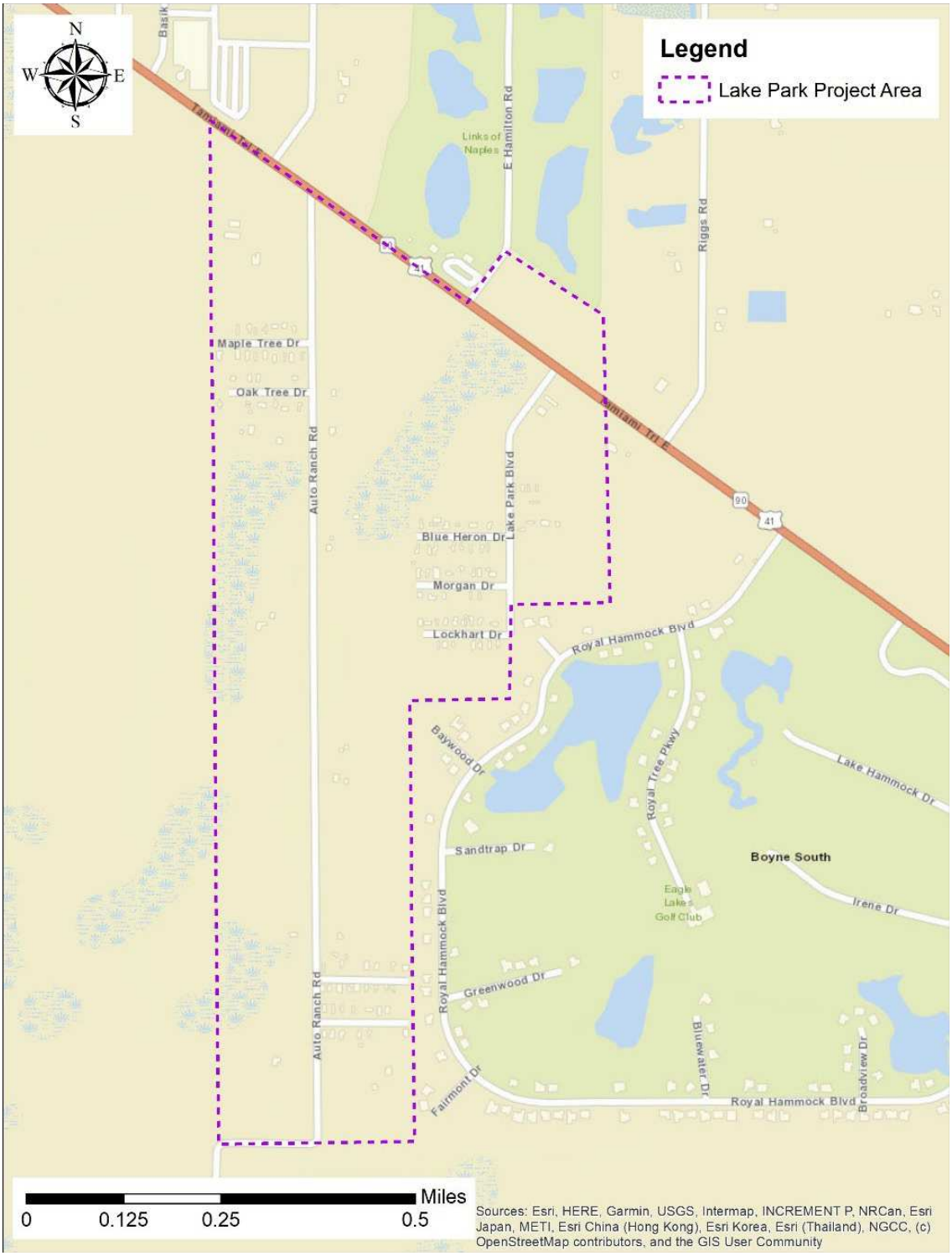


Figure 33. Street view map inside and around the project area

Task 1.2. Field reconnaissance

Storm Drainage Features

Storm drainage features in and around the project area were visited to document pipe shape, size, material, and invert elevation with respect to nearby ground, as well as their present physical conditions (i.e., smashed or fill with sediment). Appendix B contains photos from the field visits. **Figure 33** shows the location of all photos taken during field visits to observe stormwater path and features.



Figure 34. Location of photos taken during field visits

Figure 34 presents the storm drainage features in and around the project area. The feature details are listed in **Table 4**.



Figure 35. Storm drainage features in and around the project area. Some field visit site numbers are

displayed.



Figure 34. Storm drainage features in and around the project area. Some field visit site numbers are displayed. (zoomed in view)

Table 4. List of storm drainage features in and around the project area

Site	Field Visit Photos	ICPR Link	Dimensions	Type	Permit	Collier County Stormwater ID	Notes
3	Figure 52	P009B	2 x 18" RCP	Circular		SMPC-48674 SMPC-48675	Auto Ranch Rd. crossing
4	Figure 53	P019A	2 x 15" HDPE	Circular		SMPC-47730 SMPC-47731	Auto Ranch Rd. crossing
5	Figure 54	P043A	18" RCP	Circular		SMPC-49161	Auto Ranch Rd. crossing. Blocked 70% on the east side (concrete bag)
6	Figure 55	P066	18" RCP	Circular		SMPC-49206	Auto Ranch Rd. crossing
8	Figure 56	P071	12" HDPE	Circular			
9	Figure 57	P073	24" Cast Iron	Circular			
11	Figure 58	P003	2 x 5’x9'	Rectangular	SFWMD ERP: 11-01368-P	SMPC-37243 SMPC-37244	US-41 Crossing
17	Figure 59	P001B	12" CMP	Circular		SMPC-48673	
18	Figure 60	P009A	12" RCP	Circular		SMPC-48676	Maple Tree Dr. crossing
19	Figure 61	P011	12" RCP	Circular		SMPC-48671	Oak Tree Dr. crossing
20	Figure 62	P002	12" RCP	Circular		SMPC-48672	
21	Figure 63	P018	12" RCP	Circular		SMPC-47728	
22	Figure 64	P017	12" HDPE	Circular		SMPC-47729	
23	Figure 65	P019B	12" HDPE	Circular			
24	Figure 66	P027	15" HDPE	Circular		SMPC-47732	
25	Figure 67	P026	24" CMP	Circular		SMPC-47735	
26	Figure 68	P029	12" RCP	Circular		SMPC-47736	

Site	Field Visit Photos	ICPR Link	Dimensions	Type	Permit	Collier County Stormwater ID	Notes
27	Figure 69	P030	Obstruction	Circular		SMPC-48065	Blocked 100%
28	Figure 70	P028	18" HDPE	Circular		SMPC-49156	
29	Figure 71	P031	18" HDPE	Circular		SMPC-49157	
30	Figure 72	P032	18" HDPE	Circular		SMPC-49158	
31	Figure 73	P039	15" HDPE	Circular		SMPC-49160	
32	Figure 74	P033	12" RCP	Circular		SMPC-49159	
33	Figure 75	P042	12" RCP	Circular		SMPC-49162	
34	Figure 76	P043B	24" CMP	Circular		SMPC-49163	
35	Figure 77	P048	12" RCP	Circular		SMPC-48351	Blocked 90% and 70% (sediment)
36	Figure 78	P050	18" RCP	Circular		SMPC-48352	
37	Figure 79	P049	12" RCP	Circular		SMPC-49165	Blocked 50% (sediment)
38	Figure 80	P052	12" RCP	Circular		SMPC-49164	
39	Figure 81	P054	12" RCP	Circular		SMPC-49168	
40	Figure 82	P055	12" RCP	Circular		SMPC-49167	
41	Figure 83	P053	12" RCP	Circular		SMPC-49168	
42	Figure 84	P056	12" RCP	Circular		SMPC-49169	Dirt road crossing
43	Figure 85	P059	12"x18" ERCP	Horizontal Ellipse		SMPC-49170	
44	Figure 86	P058	18" RCP	Circular		SMPC-49171	
45	Figure 87	P060	18" RCP	Circular		SMPC-49172	Dirt road crossing
46	Figure 88	P062	30" HDPE	Circular			
47	Figure 89	P063	18" RCP	Circular		SMPC-49203	
48	Figure 90	P061	18" RCP	Circular		SMPC-48839	Blocked 80% (sediment)

Site	Field Visit Photos	ICPR Link	Dimensions	Type	Permit	Collier County Stormwater ID	Notes
49	Figure 91	P067	2 x 18" RCP	Circular		SMPC-49204 SMPC-49205	
52	Figure 92	P006A	3 x 42" RCP	Circular	SFWMD ERP: 11-01368-P	SMPC-37245 SMPC-37246 SMPC-37247	US-41 Crossing
53	Figure 93	P021	30" RCP	Circular		SMPC-1210 / MCB-15-S0130-1	Blocked 30% (sediment)
54	Figure 94	P004	15" CMP	Circular		SMPC-47726	Blocked 90% (sediment)
55	Figure 95	P022	15" CMP	Circular		SMPC-47727	Blocked 90% (sediment and smashed)
56	Figure 96	P024	15" RCP	Circular		SMPC-47734	
57	Figure 97	P023	48" CMP	Circular		SMPC-1211 / MCB-15-S0120	Blue Heron Dr. crossing. Blocked 50% (smashed)
58	Figure 98	P035	48" CMP	Circular		SMPC-1193 / MCB-15-S0110	Morgan Dr. crossing. Blocked 50% (smashed)
59	Figure 99	P037	48" CMP	Circular		SMPC-1194 / MCB-15-S0100	Lockhart Dr. crossing. Blocked 50% (smashed)
70	—	P079B	36" RCP	Circular			
71	Figure 100	P079A	24" HDPE	Circular			
86	Figure 101	DS001A	2 boxes 4'x7'	Rectangular		SMPC-226 / S2S-01-S0100	US-41 Crossing
87	Figure 102	P006B	2 x 48" HDPE	Circular			Royal Hammock Blvd. crossing. Recently replaced
96	—	P015	2 x 18” RCP	Circular	SFWMD: 11-02383-P		Blocked 50% (sediment)
—	—	DS016A	65”x40”ACCMP	Drop box Structure			Royal Palm Drainage outlets

Site	Field Visit Photos	ICPR Link	Dimensions	Type	Permit	Collier County Stormwater ID	Notes
—	—	DS016B	65”x40”ACCMP	Drop box Structure	SFWMD: 11-02383-P		

Ground Elevation Survey

Existing ground elevation survey was conducted mostly at road crowns and water edges at selected locations, which are shown in **Figure 35**. Surveyed geographic coordinates and elevations are listed in **Table 5**.

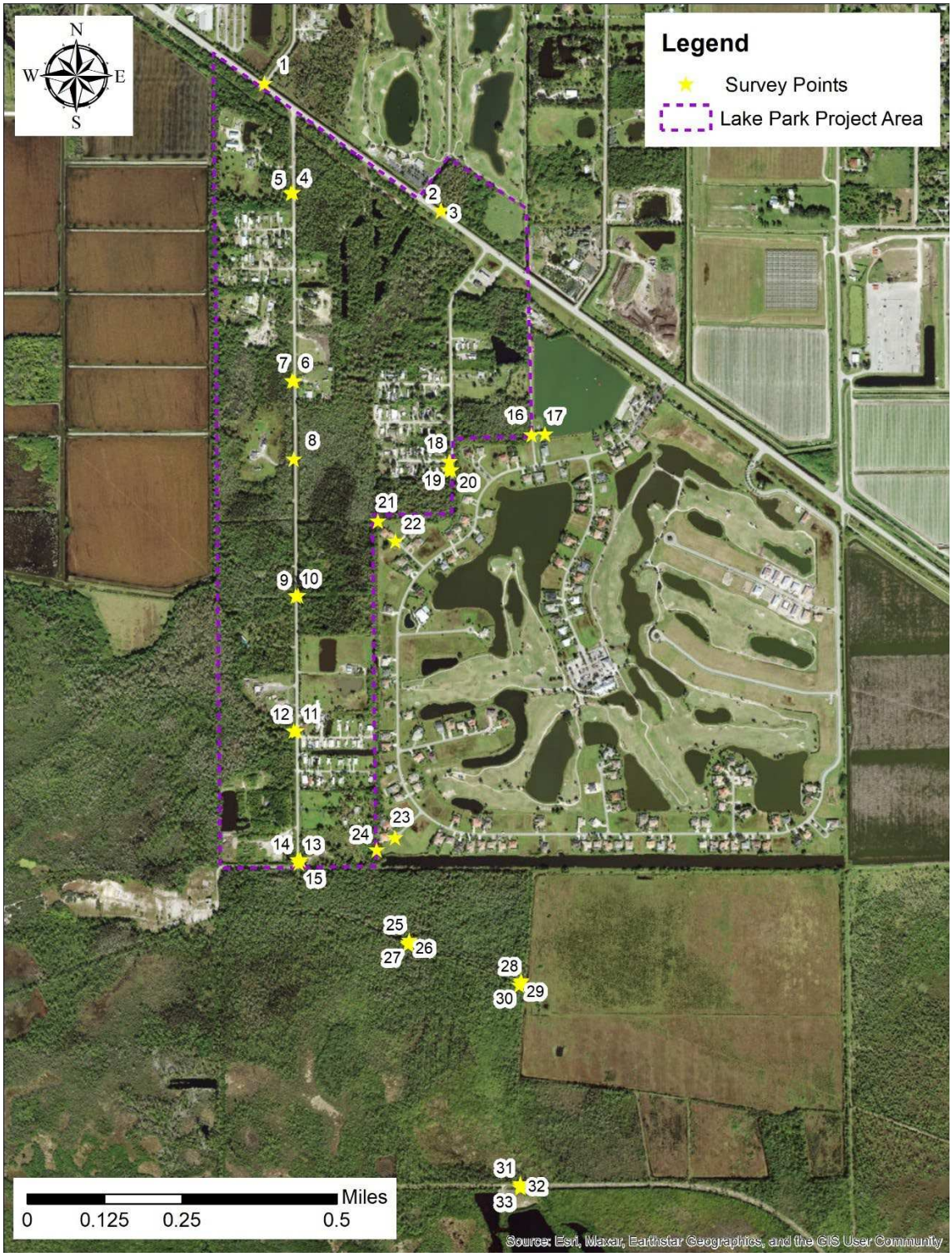


Figure 36. Elevation survey locations

Table 5. List of surveyed points on 8/16/2022 from 7:00 to 11:00 a.m.

ID in Figure 35	Lat	Lon	Survey Elevation (ft NAVD88)	LiDAR Elevation (ft NAVD88)	Elevation Difference (ft)	Description
1	26.023740	-81.637123	5.80	5.80	0.00	Centerline Road
2	26.020781	-81.632523	3.23			Top of Water
3	26.020778	-81.632524	6.32	6.37(*)	-0.05	Top Headwall
4	26.021231	-81.636371	4.06	4.19	-0.13	Centerline Road
5	26.021225	-81.636419	2.60			Edge of Water
6	26.016798	-81.636316	3.53	3.56	-0.03	Centerline Road
7	26.016793	-81.636362	3.09			Edge of Water
8	26.014919	-81.636323	3.26	3.31	-0.05	Centerline Driveway Edge of Pavement
9	26.011535	-81.636249	3.79	3.72	0.07	Centerline Road
10	26.011536	-81.636212	2.71			Edge of Water
11	26.008642	-81.636214	4.03	4.20	-0.17	Centerline Road
12	26.008636	-81.636260	2.68			Edge of Water
13	26.005561	-81.636127	2.55			Edge of Water
14	26.005562	-81.636173	3.78	3.97	-0.19	Centerline Road
15	26.005469	-81.636138	3.55	3.92	-0.37	Centerline Road at Edge Dirt Road
16	26.015524	-81.630148	4.14	4.20	-0.06	Centerline Road
17	26.015468	-81.629801	2.41			Edge of Water
18	26.014893	-81.632275	3.85	3.88	-0.03	Centerline Road at Edge Dirt Road
19	26.014672	-81.632269	2.61			Edge of Water
20	26.014669	-81.632229	4.24	4.23	0.01	Centerline Road
21	26.013453	-81.634127	2.61			Edge of Water
22	26.013017	-81.633662	4.60	4.67	-0.07	Centerline Road
23	26.006075	-81.633651	3.91	3.97	-0.06	Centerline Road
24	26.005658	-81.634077	2.54			Edge of Water
25	26.003613	-81.633271	3.80	3.72	0.08	Centerline Dirt Road
26	26.003634	-81.633279	2.10			Edge of Water
27	26.003586	-81.633268	1.66			Edge of Water
28	26.002652	-81.630366	2.70	2.67	0.03	Centerline Dirt Road
29	26.002677	-81.630355	2.44			Edge of Water
30	26.002640	-81.630366	2.22			Edge of Water
31	25.997900	-81.630332	1.51			Edge of Water
32	25.997924	-81.630342	2.63	2.45	0.18	Centerline Dirt Road
33	25.997945	-81.630342	1.46			Edge of Water

Note: (*) elevation reported for the NGS[27] monument AJ7742

[27] National Geodetic Survey (NGS) Data Explorer: https://www.ngs.noaa.gov/NGSDataExplorer/

Surveyed elevations at roads are compared with the elevations extracted from the 2018 LiDAR DEM in Table 5. The surveyed elevation of the top of the headwall at the US-41 main culvert (ID=3) was compared with the elevation reported at the NGS monument. The monument is slightly elevated from the headwall, which may account for the difference at that location.

In general, the LiDAR elevations at roads match very well with the surveyed elevations. Elevation differences in 11 out of 16 points are in the range of [-0.07,0.08] ft. The median difference is -0.04'. This comparison between surveyed and LiDAR elevations indicates a high accuracy of the LiDAR DEM at roads.

The edge of water elevations in Table 5 are mapped in **Figure 36**. Water levels in the ditches were distributed almost uniformly around 2.6 ft NAVD88 at the time of the survey. The higher water level of 3.2 ft NAVD88 at the US-41 culvert indicate that the surface water at the culvert at this level is not in hydraulic communication with other ditches in project area. This is likely a consequence of a rise in the ground elevation downstream of the culvert, which is visible in the DEM of previous Figure 2.

The measured water level of 3.1 ft NAVD88 at point ID=7 at Auto Ranch Road seems erroneous since this point in the ditch appears to be in hydraulic communication with points with ID=5 and ID=10 via ditches and pipes.



Figure 37. Water levels measured on 8/16/2022 from 7:00 to 11:00 a.m. during the survey.

Water Level Monitoring

In order to capture water levels during intense storms that may occur during the duration of this project, Lago installed temporary water level loggers to automatically and continuously record fluctuations in water levels. The level loggers were installed at the three locations shown in **Figure 37**. More details about the installation are included in Appendix C.

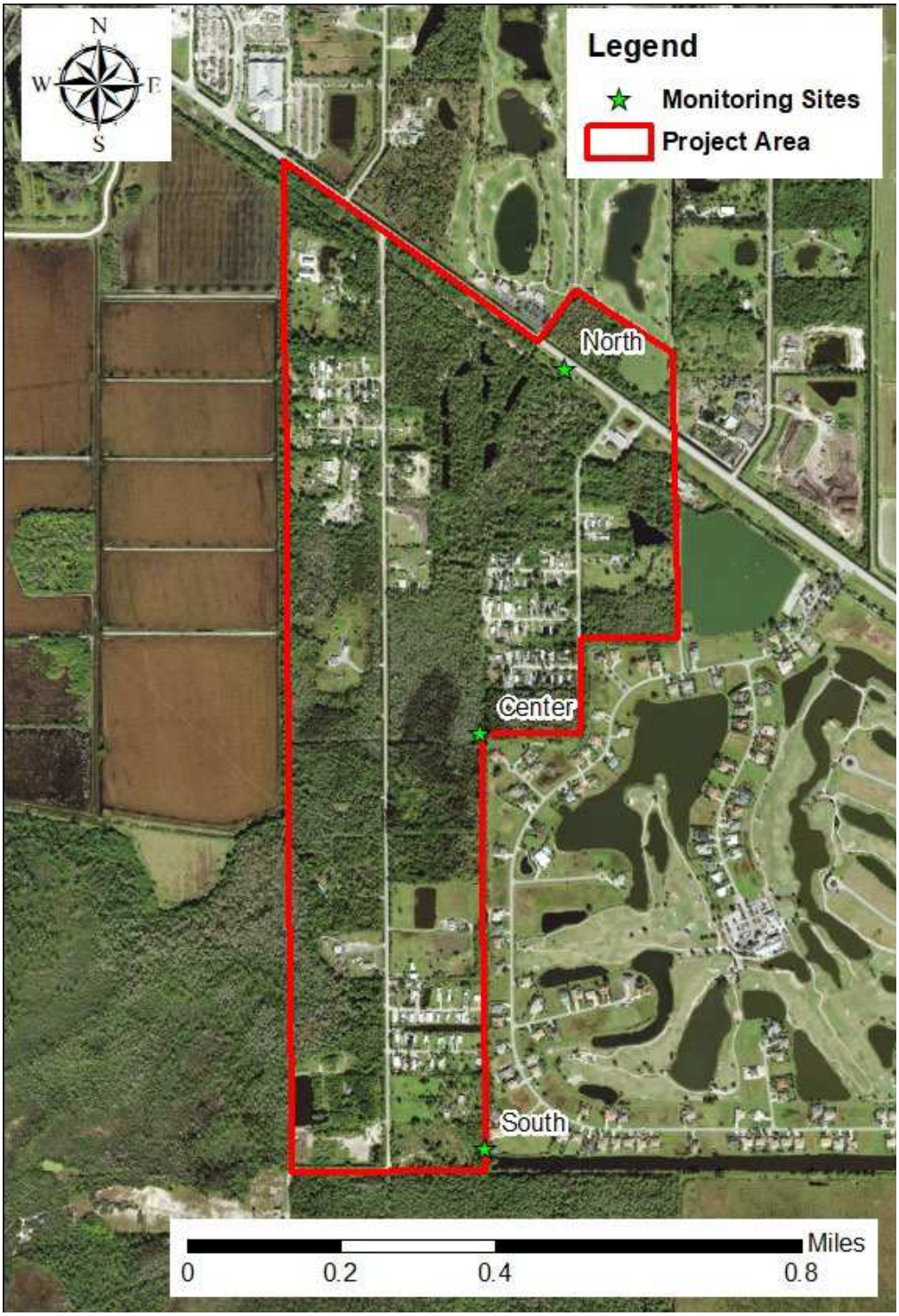


Figure 38. Monitoring Station Locations

Figure 38 shows the stages recorded by Lago so far at the three monitoring stations as well as the stages reported at the DBHYDRO station TAMIATOM. Unfortunately, the water level logger installed at the center location was lost or stolen after the first set of data was collected. The stage variations correlate well with the daily rainfall plot presented previously in Figure 11. There is a visible stage gradient from north to south. The stages at TAMIATOM and north stations correlate well during wetter periods.

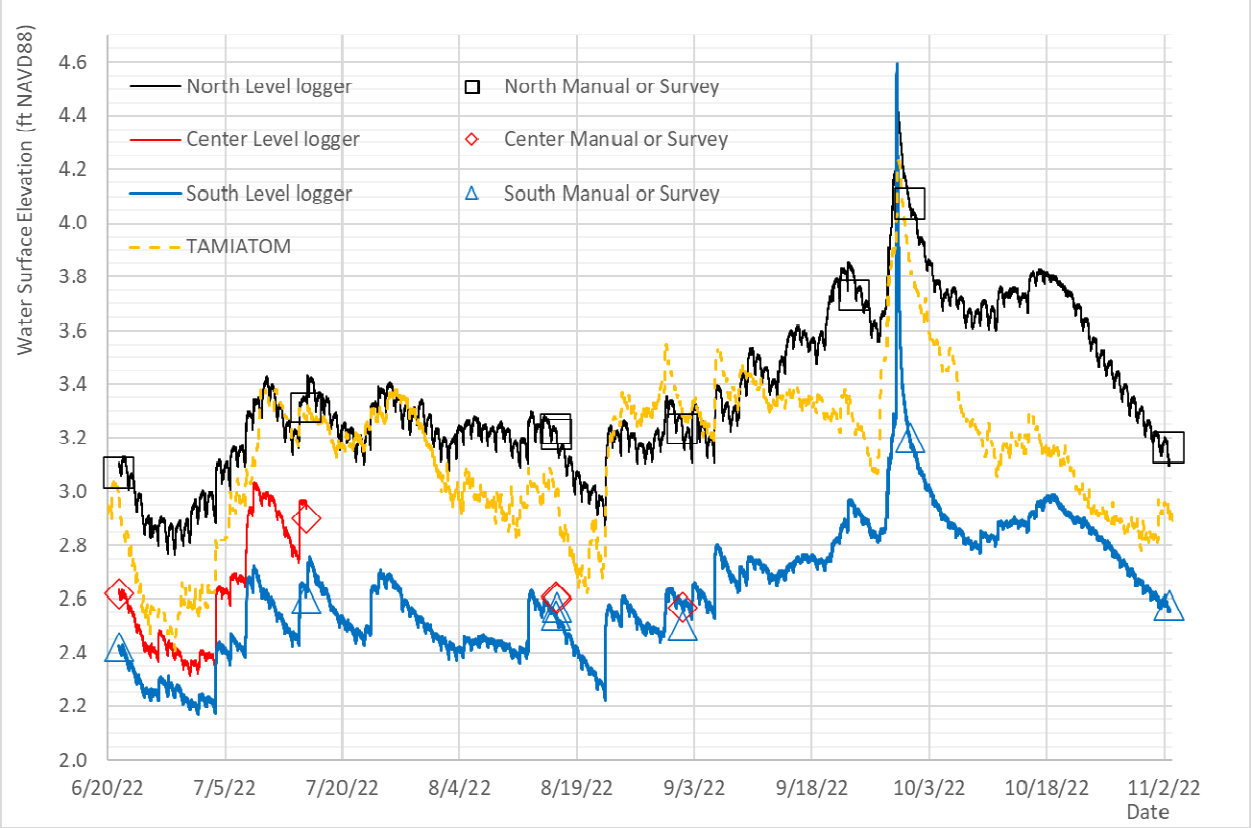


Figure 39. Stages at monitoring stations.

Edge of water survey measurements from 8/26/22 included in Figure 38 show a difference of 0.07' between center and south locations, which is smaller than the differences of 0.2' and 0.3' observed during the period when the center level logger was recording. It is likely that vegetation in the Royal Palm West Bypass Ditch was removed manually or flushed out by the flow during the period between field visits (i.e., from 7/15/22 to 7/28/22), which may have increased the ditch conveyance and may explain the disappearance of the center level logger.

Peak Stage and Flow at the US-41 Culvert

Estimations of peak stages and flows at the US-41 cross culvert (2 boxes of 5'x9') located between Auto Ranch Road and Lake Park Boulevard for different return periods were included in the ERP permit 11-03368-P[28] and are presented in **Table 6**. Those estimations are relevant for the design storm simulations to be conducted during Task 2 of this project.

Table 6. Peak discharges and stages estimated[28] at the US-41 culvert.

Flood label	Return period (years)	Peak discharge (cfs)	Peak stage (ft NAVD88)
Design	50	310	5.47
Base	100	315	5.49
Greatest	500	497	6.22

On the other hand, there was a high water mark (HWM) visible during the field visits at the north side of the US-41 culvert, as shown in the photos of **Figure 39**. The HWM elevation was estimated as 1.40' below the NGS monument AJ7742 at elevation 6.36 ft NAVD88, which means a HWM elevation of 4.96 ft NAVD88.

Photo taken on May 13, 2022 Photo taken on July 15, 2022



Figure 40. Photos of the high water mark visible at the north side of the US-41 culvert.

It is uncertain when the HWM at the north side of the US-41 culvert was originated. Figure 38 shows typical water levels during the 2022 wet season below 3.5 ft NAVD88 at that location. A possibility is that the HWM was originated during Hurricane Irma on September 2017, which generated a 100-year return period 24-hour duration rainfall according to previous Table 3 and Figure 13. In any case, the HWM elevation of 5.0 ft NAVD88 is close to the estimated peak stage of 5.5 ft NAVD88 for 50-year and 100-year return periods, as presented in Table 6.

[28] SFWMD ERP: 11-03368-P, Application No.: 140130-13, Permittee: FDOT, date issued: 12/22/2014. Exhibit No. 2.0. Page 8 of 46. File: 140130-13_Permit.pdf

Figure 40 shows the interpolated trend of the peak water levels at the US-41 culvert as a function of the return period. The plot included the three points from the ERP permit in Table 6, the HWM elevation of 4.96 ft NAVD88 by assuming a return period of 100 years, and the maximum observed stage of 3.43 ft NAVD88 in Figure 38 by assuming a return period of 1 year. Peak stages extracted from the interpolated trend in **Figure 40** for different return periods are also presented in **Table 7**.

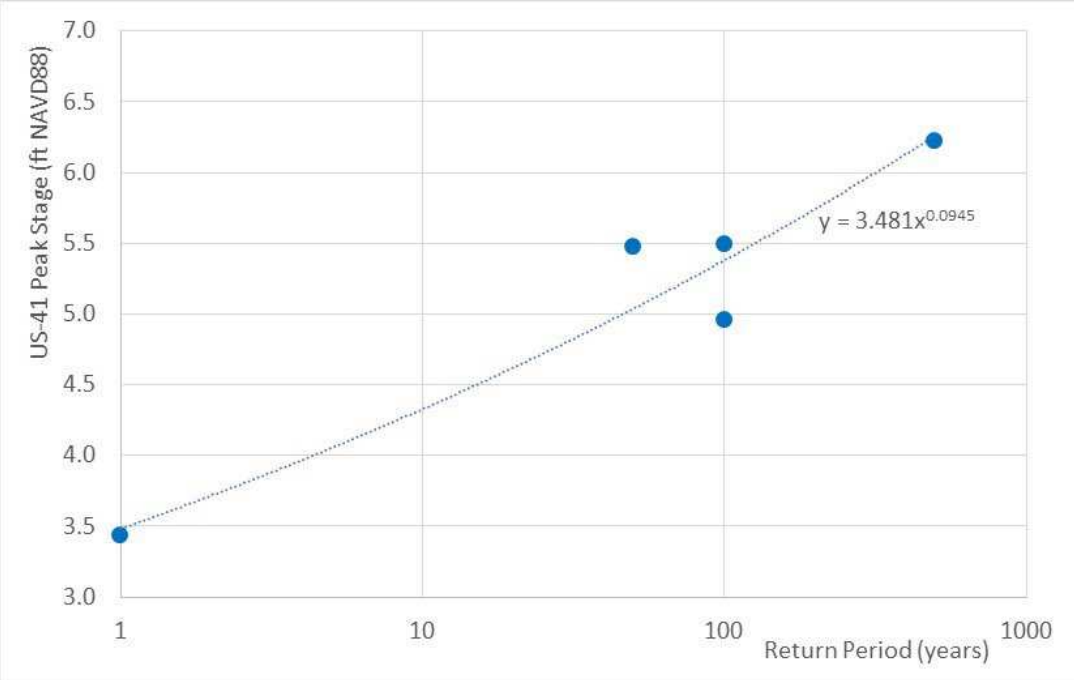


Figure 41. Peak stages at the US-41 culvert

Table 7. Peak stages at the US-41 culvert as extracted from interpolated trend in Figure 40.

Return period (years)	Peak stage (ft NAVD88)
5	4.05
10	4.33
25	4.72
50	5.04
100	5.38
500	6.26

Figure 41 presents the water level measured at the US-41 culvert and the 15-minute NEXRAD rainfall as reported by the SFWMD around the storm occurred in the afternoon of 8/22/2022. From this figure, the lag time or delay of the peak stage since the rainfall peak is approximately one hour.

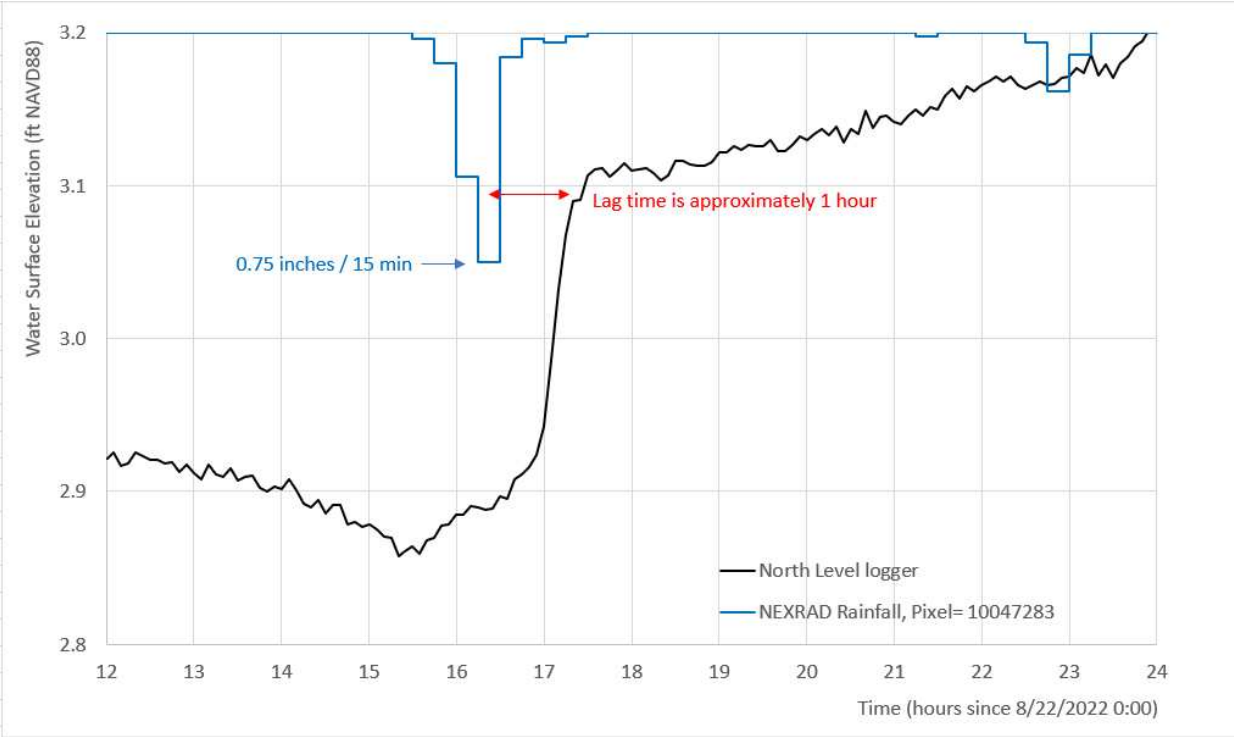


Figure 42. Estimation of the lag time between rainfall and stage peaks at the US-41 culvert in the afternoon of 8/22/2022.

Tidal Stages

Hurricane Irma

The closest near shore tidal station to the project area is the station number 8725110 at Naples, FL; which is maintained by National Oceanic and Atmospheric Administration (NOAA). **Figure 42** shows the water levels recorded at that tidal station[29], as well as at other two DBHYDRO stations during Hurricane Irma. The station locations are shown in **Figure 44.** During Hurricane Irma, sustained winds pushed the tidal water away from the coast while the eye of the hurricane was approaching the Naples station from the south. Once the eye went north from the NOAA station, the winds pushed the water in the other direction (i.e., against the coast). Thus, the hurricane sustained winds caused the tidal water levels in Figure 42 to go from -5 to 5 ft NAVD88.

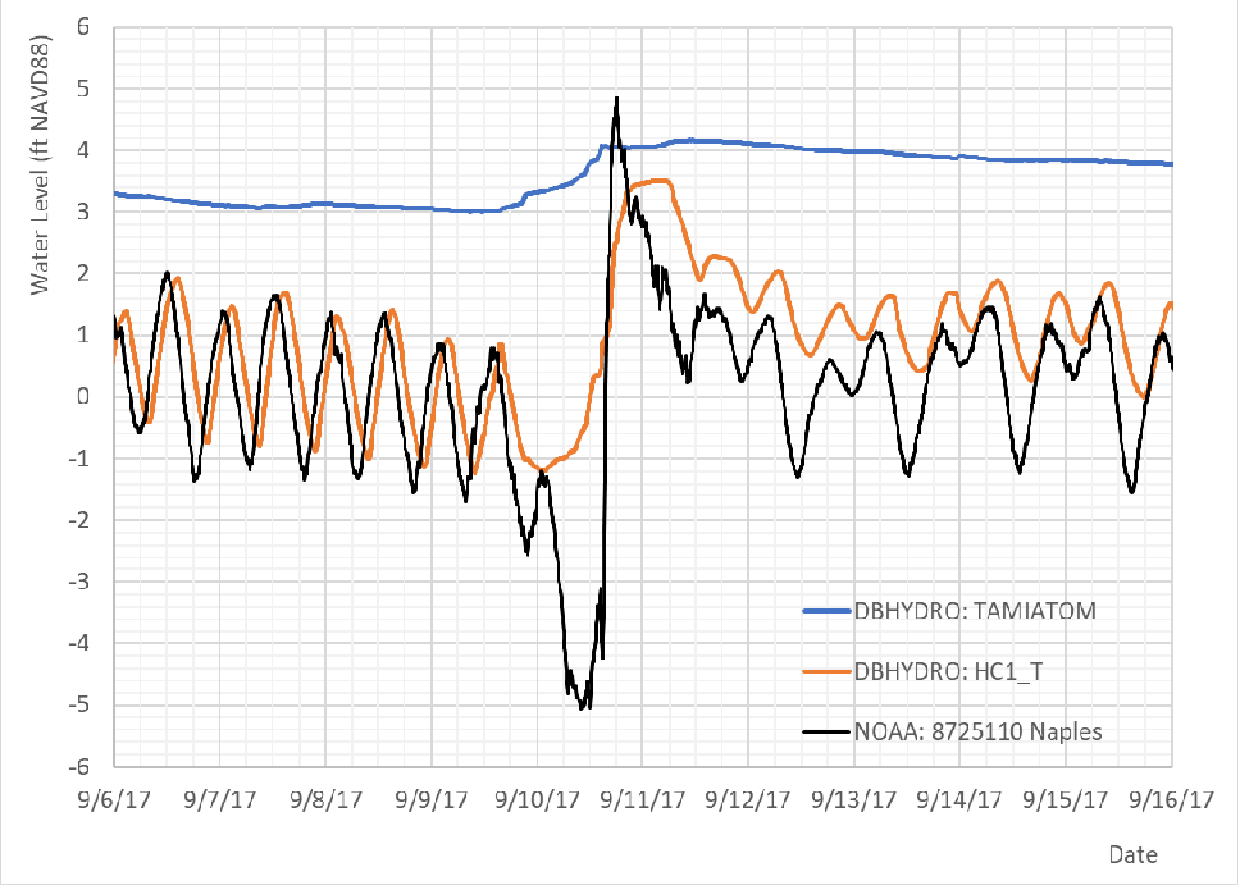


Figure 43. Water levels recorded at different stations during Hurricane Irma.

The DBHYDRO station HC1_T (or HENDTAMI_T) also exhibits tidal oscillations in Figure 42, which is not the case of TAMIATOM station. HC1_T is located in the tail waters of Henderson Creek and the US-41 Road, and it is about 9 miles southeast from the Naples station. In normal conditions, the maximum tidal water levels at HC1_T and Naples stations are similar with a lag time of about 3 hours. During Hurricane Irma, however, HC1_T reached a maximum value of about 3.5 ft NAVD88, which is about 1.4' lower than in the Naples Station.

[29] NOAA station No. 8725110 at Naples, Gulf of Mexico, FL
https://tidesandcurrents.noaa.gov/waterlevels.html?id=8725110&units=standard&bdate=20170901&edate=20170921&timezone=LST&datum=NAVD&interval=6&action=



Figure 44. Location of stations presented in Figure 42.

Hurricane Ian

Figure 43 shows water levels recorded during the recent Hurricane Ian. In this case, the tidal level at Naples NOAA station reached a maximum of 6.8 ft NAVD88 before the station stopped recording. The maximum tidal recorded level at HC1_T station and at the south level logger were 5.3 and 4.6 ft NAVD88, respectively.

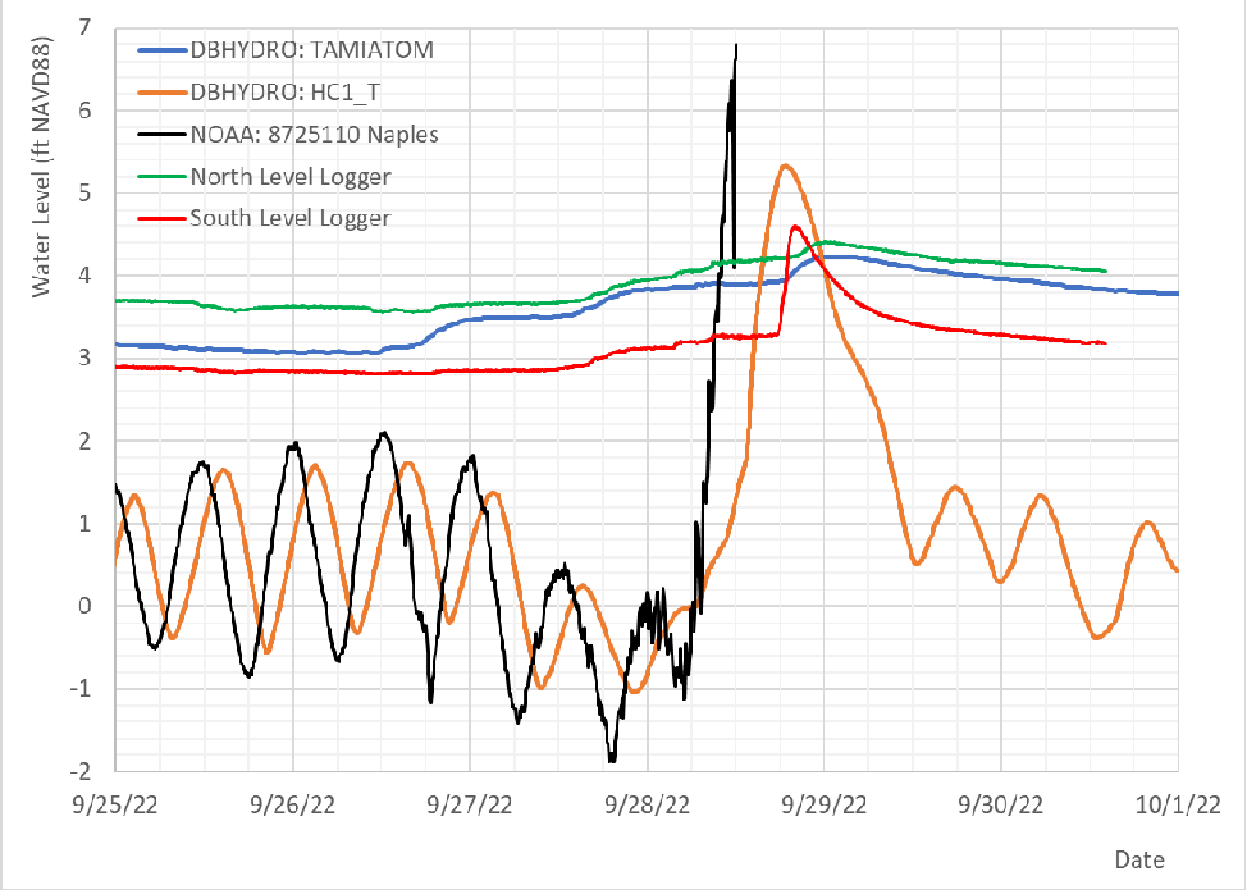


Figure 45. Water levels recorded at different stations during Hurricane Ian

The neighbor at the south level logger location (at address: 18349 Fairmont Dr, Naples, FL 34114) reported during the project staff visit on September 30th that they had seen the normal southerly flow through the Royal Palm West Bypass Ditch as the hurricane was approaching. However, in the night of the 28th, the ditch flow direction changed to the north, and their yard was flooded around the house and up to the street, which is at elevation 4.0 ft NAVD88 according to the LiDAR-based DEM. The duration of the water flowing north can be estimated from Figure 43 (as the period during which the south level logger recorded higher levels than the north level logger at the US-41 Road) as 3.0 hours.

The Lake Park project area is not directly connected by a direct tidal inlet like the Henderson Creek, but this entire area south of US 41 is interspersed with tidal wetlands influenced by the tides experienced in the Rookery Bay estuary. This may explain why the peak stage at the south level logger in Figure 43 is 0.7' below the peak at the HC1_T station.

Annual Exceedance Probability

The NOAA reports the annual exceedance probability levels at Naples tidal station as shown in **Figure 45**. The levels are computed relative to the National Tidal Datum Epoch (1983-2001), and then converted to the more recent year 2018.

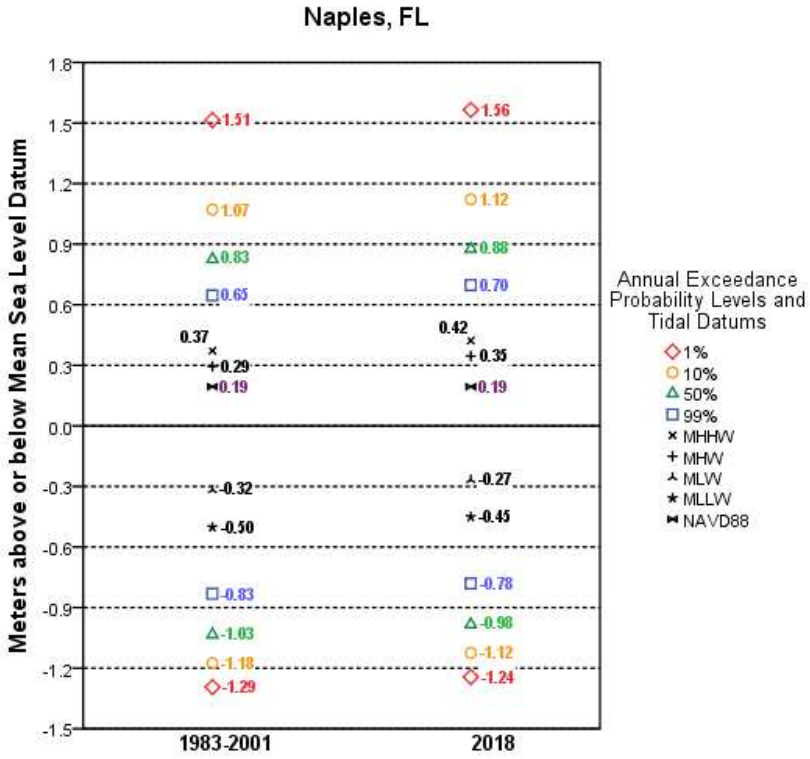


Figure 46. Annual exceedance probability levels at Naples Tidal Station[30].

The peak tidal levels in Figure 45 were summarized in **Table 8** and plotted in **Figure 46** as a function of the return period. A logarithmic interpolation was conducted to obtain peak levels at other return periods.

Table 8. Annual exceedance probability levels at Naples Tidal Station from Figure 45 and interpolated.

		Peak tidal level (2018)		
Annual Exceedance (%)	Return period (years)	m MSL	ft MSL	ft NAVD88
1	100	1.56	5.12	5.7
2	50	–	–	5.3
4	25	–	–	4.9
10	10	1.12	3.67	4.3
20	5	–	–	4.0
50	2	0.88	2.89	3.5
99	1	0.70	2.30	2.9

[30] https://tidesandcurrents.noaa.gov/est/stickdiagram.shtml?stnid=8725110

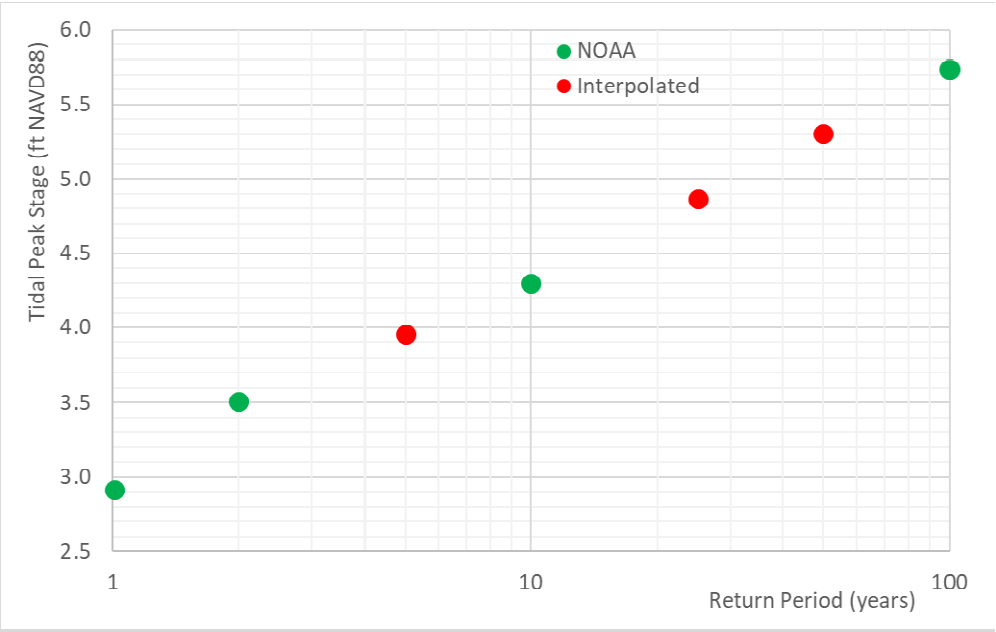


Figure 47. Annual exceedance probability levels at Naples Tidal Station from Table 8.

Existing Utilities: Water and Wastewater

Figure 47 presents the existing utilities in the project area.



Figure 48. Location of sewer and water main features.

The project area lies within the Collier County Water and Wastewater Service Areas. There are no existing potable water mains on Auto Ranch Road. However, Collier County Water Distribution confirmed that the County extended a potable water main to the southern portion of Auto Ranch Road from Royal Hammock Blvd. All the properties on the two streets on the south end of Auto Ranch Road are served potable water by this water main extension. It is uncertain if a utility easement exists for the water main extension. The Lake Park Boulevard area is served potable water by Collier County. It is uncertain if utility easements exist for the side streets (private roadways). Collier County Water Distribution has confirmed that replacement of the potable water distribution system in the Lake Park Boulevard area is warranted at this time. If the potable water distribution system is replaced, it is also recommended that the County acquire utility and access easements if they do not currently exist.

The properties within the project area (Auto Ranch Road and Lake Park Boulevard) are not currently provided Collier County sanitary sewer service, each developed property utilizes onsite sewage treatment and disposal systems, commonly referred to as septic systems. There are approximately 66 parcels within the Auto Ranch Road project area and 50 parcels within the Lake Park Boulevard project area with structures (home or trailer home). Septic system permits are required through the Florida Department of Health (DOH), but it should be noted that some of the properties may have been constructed prior to permitting requirements. At the time this report was prepared, only nine (9) DOH septic system permits have been located, as shown in **Figure 48**. A records request for all permits in this area has been submitted.

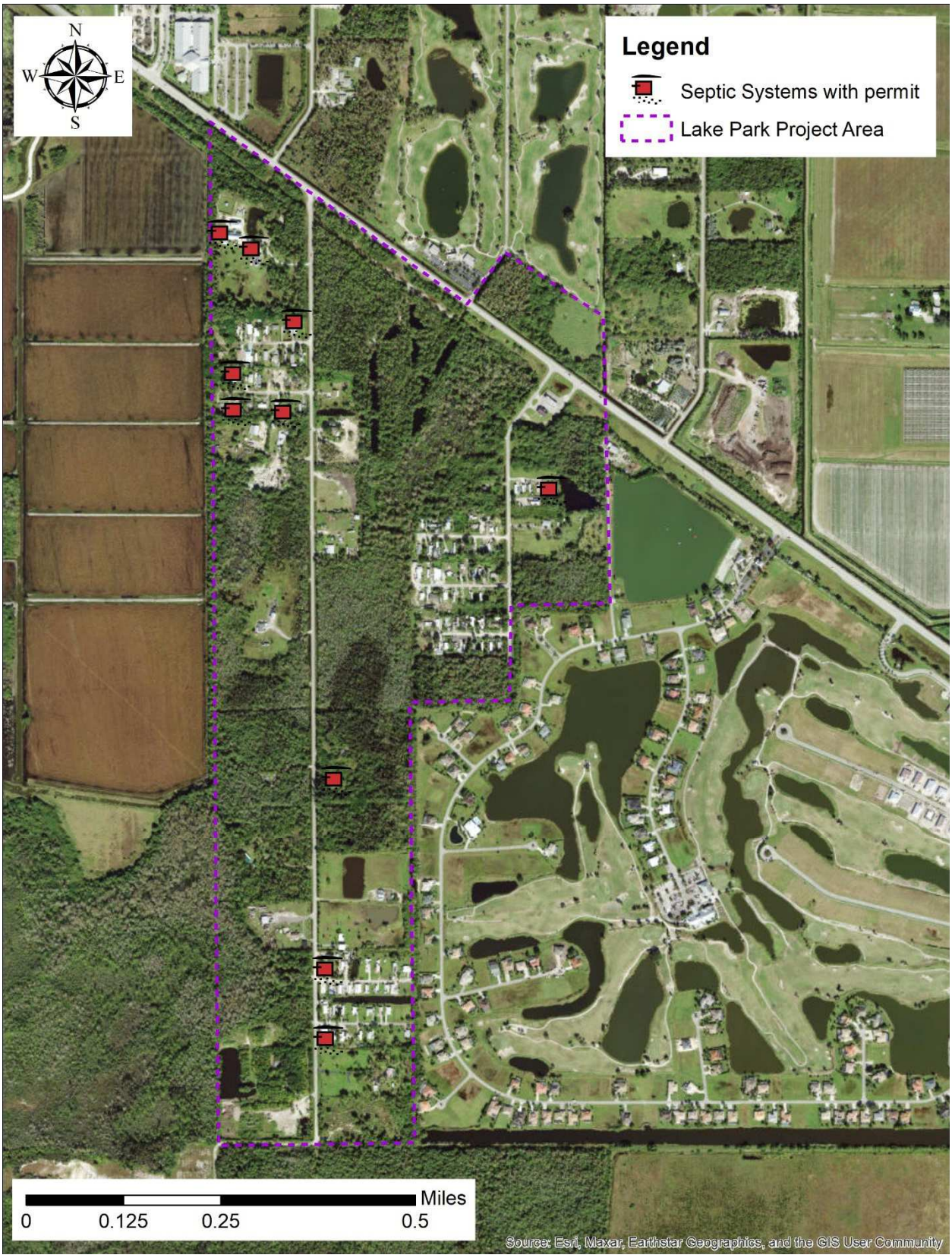


Figure 49. Location of DOH septic system permits.

In low coastal areas with a high groundwater table, individual septic systems likely do not adequately treat human waste, including removal of viruses, fecal matter, pharmaceuticals, and nutrients such as nitrogen and phosphorous, all of which present health risks and degradation of our water ways. Due to the close proximity of this project area to Rookery Bay Estuary (with ultimate outfall to the Gulf of Mexico), because of the high water table, the age and depth of the majority of the septic systems, and the likely failure rates, it is recommended to eliminate the private septic systems and convert this region to a central sewer system.

GradyMinor conducted a utility assessment study of the project area for Collier County in 2015[31]. The scope of the project included evaluating neighborhoods within the Collier County Water and Sewer Service Area without water and sewer service. The recommendations for both Auto Ranch Road and Lake Park Boulevard are included in Appendix 18 and 19, respectively. Please note that GradyMinor only included recommendations for potable water on Auto Ranch Road per Collier County's direction at that time. This project explores the potential for a central sanitary sewer collection system in greater depth within both the Auto Ranch Road and Lake Park Boulevard Areas and recommended improvements will be discussed in Task 4.

[31] Utility Assessment Study (Utility Enclaves). Report prepared by GradyMinor for Collier County Public Utilities on March 2015. Appendix No. 18 Auto Ranch Road. Appendix No. 19 Lake Park Boulevard.

Task 1.3. Wetland and exotic vegetation mapping.

Drone Aerial Photos

Aerial photos of the project area were captured by a drone at 100-meter altitude with an overlap of 75%. Six rectangular flight areas were planned originally. However, the drone had to be returned prematurely to base in two instances and sent back to complete the coverage, which resulted in higher overlap. The location of the 2529 photos taken is presented in **Figure 49**.

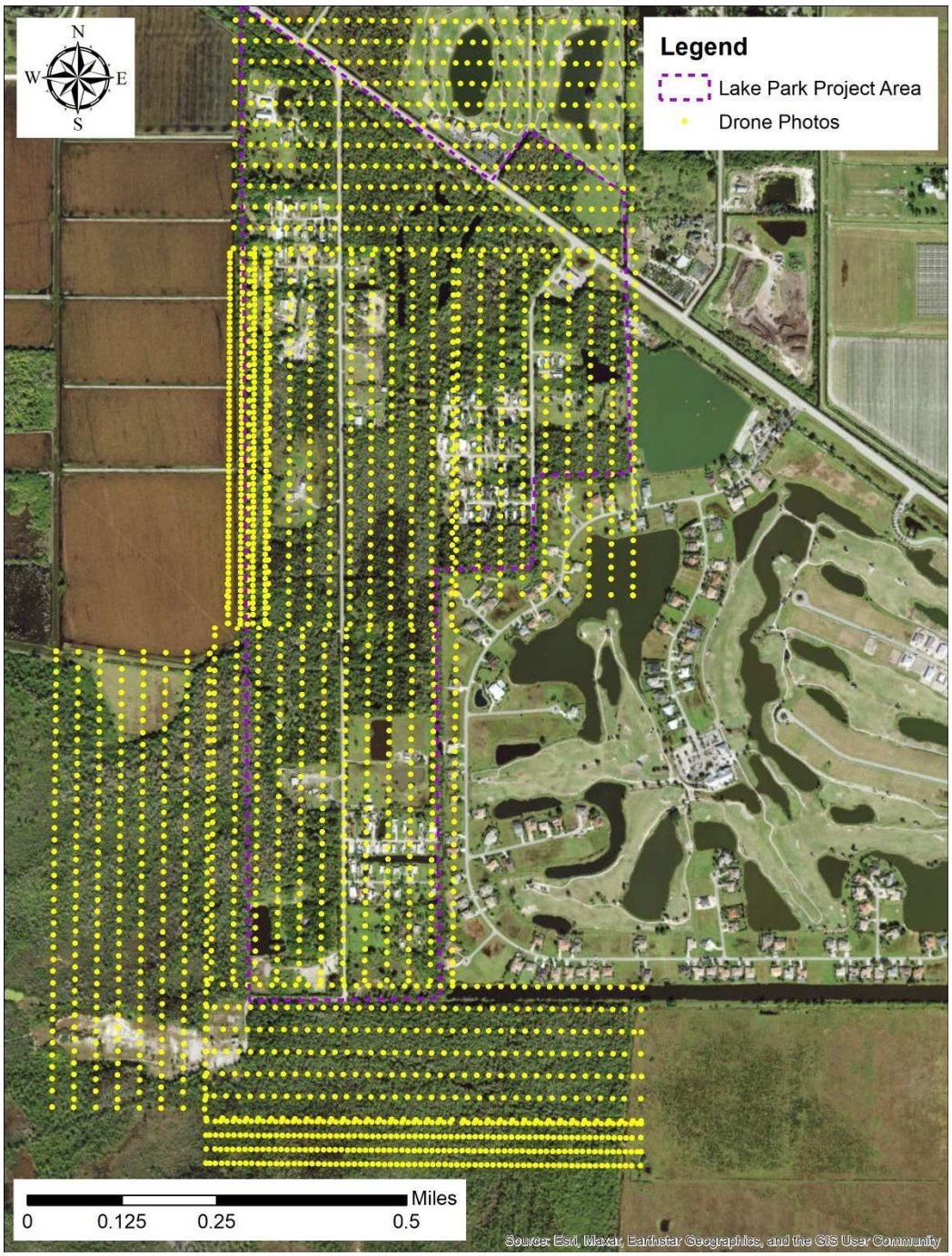


Figure 50. Location of the drone photos on 7/28/2022.

The aerial photos from the drone have higher spatial resolution than the aerial images available from Google, as can be inferred from the comparison presented in **Figure 50**. The higher resolution of the drone photos is a better tool for the biologist to map the vegetation in the project area.

Aerial image from Google



Drone Photo

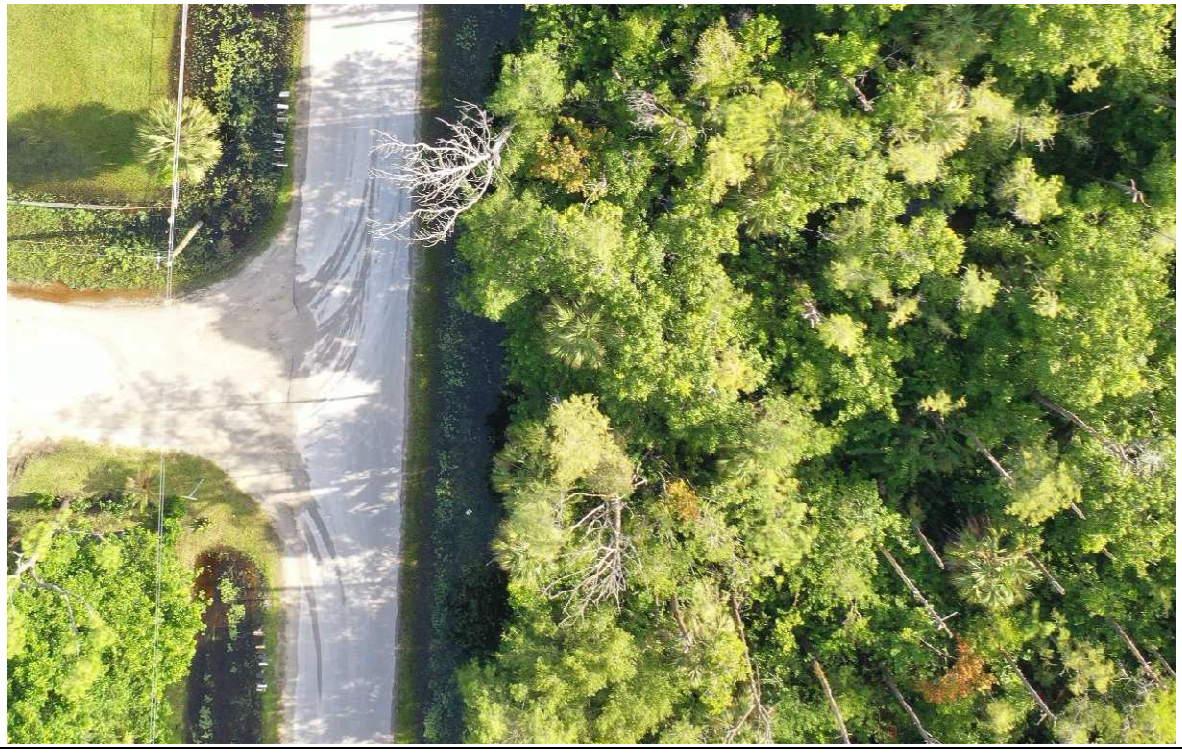


Figure 51. Drone photo versus Google aerial image near Auto Ranch Rd. and Maple Tree Dr.

Several attempts were made to stitch together the drone photos into a single higher-resolution aerial image for the project area. Two software applications, Pix4D mapper[32] and ArcGIS Drone2Map[33], were used for that purpose. In both software applications, the approximate geolocations of the images were used to ortho-rectify them. Then, unique locations are found in overlapping areas to create a point cloud for all images. This is done automatically, but it also accepts manual inputs. After that, a series of ortho-mosaic images is created and merged into a single image.

Three problems were observed in the single aerial image obtained after processing the drone photos.

1. There is a slight loss of resolution in comparison with the original photos.

2. The overlapping areas of the photos appear to be blurry at some locations. This happened more frequently in dense vegetated areas where there is not much contrast from one area to the next. This does not seem to be the case in Google imagery. Changes in color at North-South or East-West segments suggest that Google image tiles were not overlapped but placed adjacent to the neighbor one without overlap. Neither of the two software applications offered this option.

3. The location of the image was shifted. The shift from the National Geodetic Survey (NGS) monument at the US-41 culvert was about 8 feet, which was roughly the shift elsewhere with respect to the google aerial image.

As a result, project staff decided to provide all the original drone photos to the biologist for the vegetation analysis. The only transformation performed was a rotation in 90-degree increments in order for all the images to face north at the top.

[32] https://www.pix4d.com/product/pix4dmapper-photogrammetry-software
[33] https://www.esri.com/en-us/arcgis/products/arcgis-drone2map/overview

Vegetation Mapping

The vegetation mapping was conducted by a biologist as part of the data collection task. Desktop evaluations were necessary by using historic and current aerial images, LiDAR DEM, and high-resolution aerial photos captured by the drone. Field verifications were limited since most of the properties are private. The resulting FLUCCS code map is presented in **Figure 51** and the corresponding descriptions in **Table 9**.

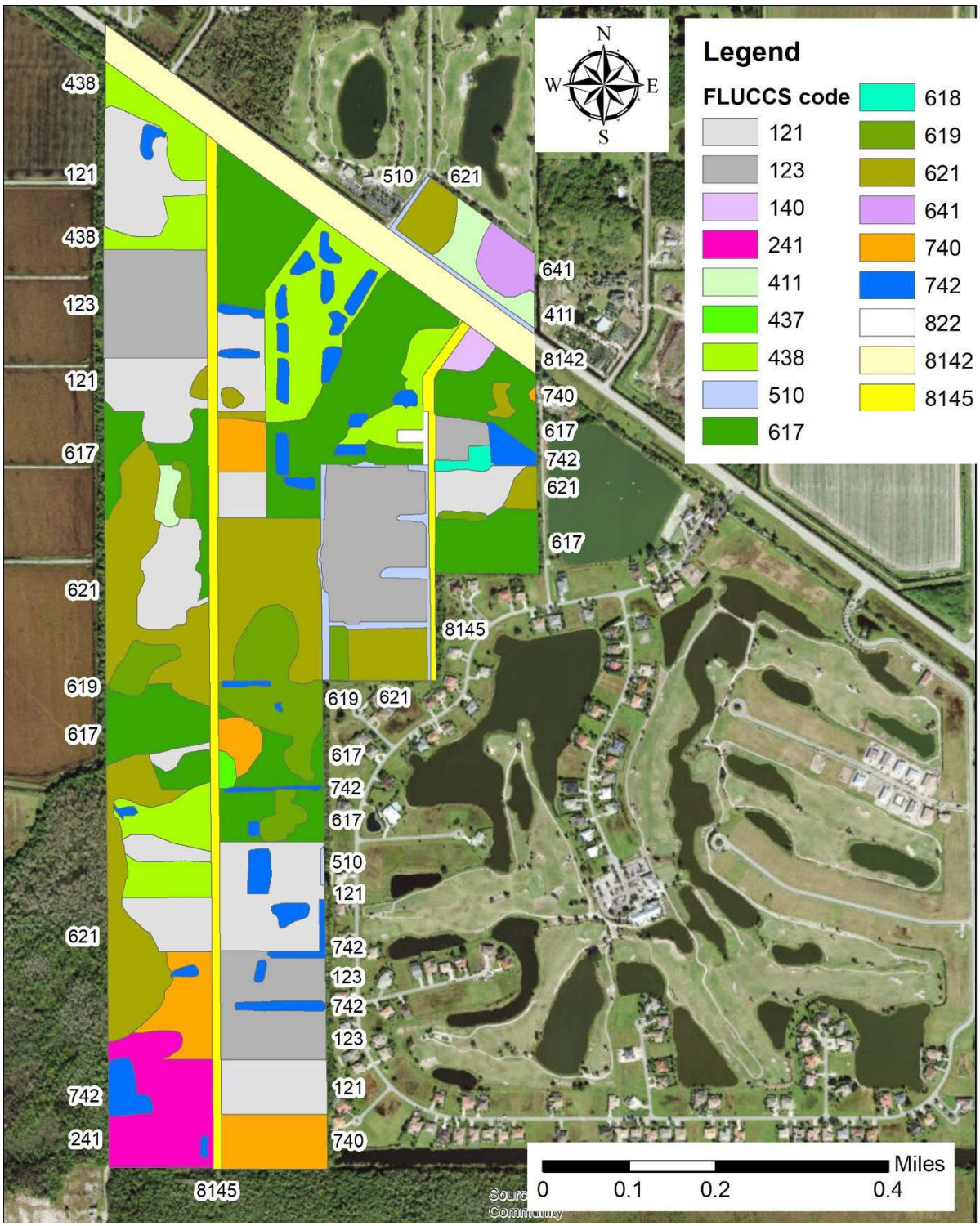


Figure 52. Land use classification map from this study.

Table 9. Land use classes in the project area from this study.

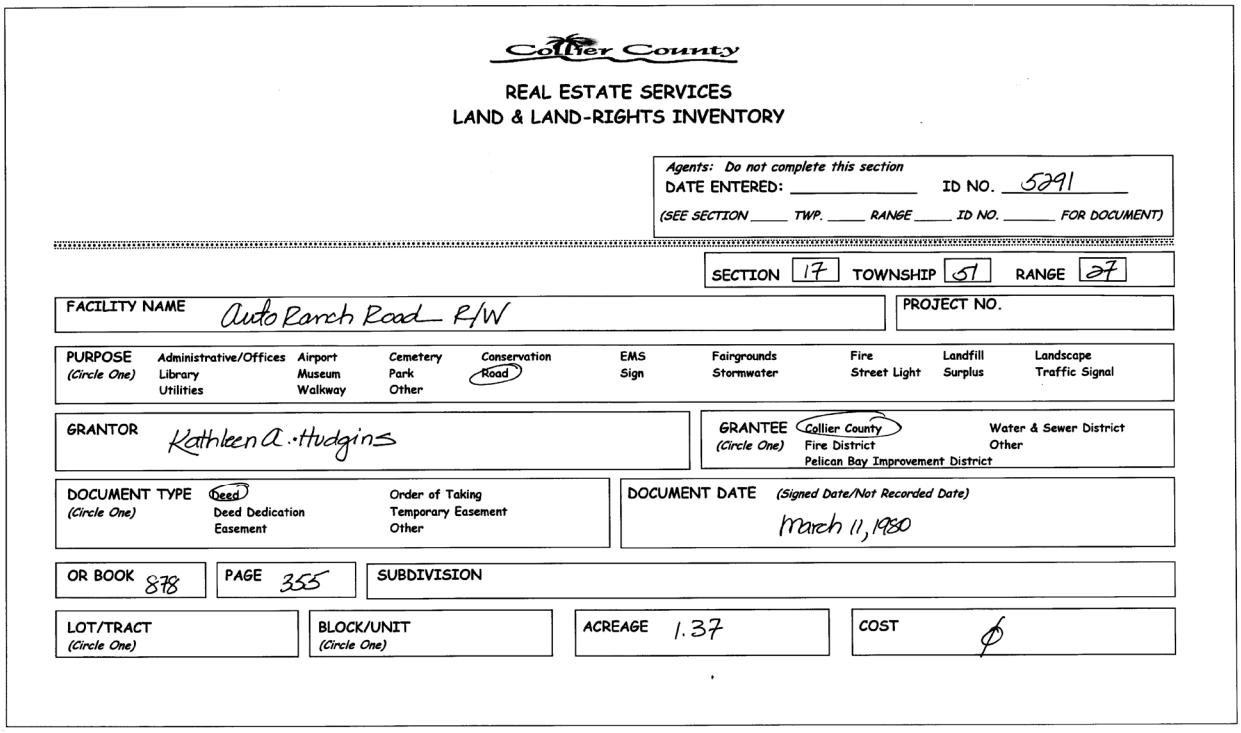
Customized classification in the project adapted from the FDOT manual from 1999 [34]			SFWMD FLUCCS code Level 4 [35]		Area
Code	Label	Description	Code	Label	(acres)
121	Single Family Homes	These are parcels with fixed single-family homes. This code usually has cleared areas with a residential structure and there may be other accessary structures associated with this code. The area has been cleared of native habitat.	1210	Fixed Single Family Units	43.2
123	Mixed Sigle Family / Mobile Homes	This code is associated with either fixed single-family homes and/or mobile homes. There may be other associated accessory structures with this code. This habitat code has been cleared of native habitat.	1230	Mixed Units, Fixed and Mobile Home Units	32.7
140	Commercial	This is associated with a Commercial structure. This is typically associate with the sales of goods and services. This is a cleared, developed area.	1400	Commercial and Services	1.2
241	Palm Nursery	This code is associated with cleared lands with planted palms. Native habitat has been cleared from these areas.	2410	Tree Nurseries	9.5
411	Pine Flatwoods	This is an upland habitat with a Slash pine and cabbage palm canopy. The exotics in this area consisted primarily of Brazilian pepper with some ear leaf acacia. Brazilian pepper forming an almost impenetrable midstory.	4110	Pine Flatwoods	3.9
437	Australian Pines	This is a small group of Australian pines. While some Australian pines can be seen scattered in numerous areas throughout the study area, this is an almost exclusive group of Australian pines.	4370	Australian Pines	0.5
438	Mixed Hardwoods	This habitat is primarily vegetated with Slash pine, cabbage palm, ear leaf acacia, air potato, Brazilian pepper, and Java plum. No one species dominates. The ground cover can be sparse with heavy leaf litter. This area may be considered upland by the regulatory agencies.	4380	Mixed Hardwoods	25.4
510	Ditch	These are areas that have been excavated as swales, canals that either transmit or hold water. These rare usually associated along roadways or developed areas.	5120	Channelized Waterways, Canals	3.8

[34] Florida Land Use, Cover and Forms Classification System. Handbook from January 1999. Department of Transportation Surveying and Mapping, Geographic Mapping Section: https://www.nwfwater.com/content/download/4688/32122/fluccmanual.pdf

[35] 2009 SFWMD Photo Interpretation Key: https://www.sfwmd.gov/sites/default/files/documents/2009_pi-key.pdf

Customized classification in the project adapted from the FDOT manual from 1999 [34]			SFWMD FLUCCS code Level 4 [35]		Area
Code	Label	Description	Code	Label	(acres)
617	Mixed Hardwoods Wetland	This code is associate with wetland areas where no one species dominates the canopy area. This habitat is associated with wetland trees such as cypress, cabbage palms, pop ash and red maples but also have high exotic vegetation presence. This area has a variety of exotics associated with it. The area has exotics species such as Java plum, Brazilian pepper, Melaleuca, Climbing fern and ear leaf acacia. These areas have lower ecological value due to the high level of exotic vegetation.	6170	Mixed Wetland Hardwoods	50.4
618	Willow	This habitat is a slightly depressional area vegetated with Carolina willow and primrose willow. Other species such as cattails may be associated with this code.	6170	Mixed Wetland Hardwoods	0.8
619	Wetland Exotic Melaleuca	This is a wetland habitat that is dominated by Melaleuca. Other wetland species such as cypress, and red maples may also be found in this habitat. The ground cover may range from absent to having sawgrass and swamp fern. This rea would be classified as Jurisdictional wetlands.	6191	Wet Melaleuca	13.0
621	Cypress	This habitat is dominated with cypress. Other associated species such as pop-ash and/or red maples may also be found in this habitat. This habitat may have some exotics but to a much lesser degree. This area would be deemed as Jurisdictional wetlands.	6210	Cypress	38.5
641	Marsh	This code is typically associated with areas having freshwater herbaceous species. This code was used on an area that looks like was slightly excavated by someone ad wetland grasses have migrated in. While this may be man made it currently resembles a freshwater marsh.	6410	Freshwater Marshes	2.6
740	Disturbed Lands	This code is associated with area that have been physically cleared. Some secondary growth can be associated with this code.	7400	Disturbed Land	12.9
742	Borrow Pits	These are Excavated ponds. These can be found throughout the project site. Some of these pits may have been excavated for the fill, to be utilized for other uses. Other borrow pits resemble fishponds.	7420	Borrow Areas	12.6
8142	Federal / State Roadway US 41	This is a divided roadway US 41 also known as Tamiami Trail that handles higher volume use.	8140	Roads and Highways	14.1
8145	Roadway	This is a roadway. This is a small internal residential roadway associated with low volume use.	8140	Roads and Highways	10.4
822	Communication Facility	This is a small structure that looks like a transmitter station.	8220	Communication Facilities	0.5
				Total	275.8

Appendix A. Quit Claim Deeds



Collier County

REAL ESTATE SERVICES
LAND & LAND-RIGHTS INVENTORY

Agents: Do not complete this section
DATE ENTERED: _____ ID NO. 5291
(SEE SECTION ____ TWP. ____ RANGE ____ ID NO. ____ FOR DOCUMENT)

SECTION 17 TOWNSHIP 51 RANGE 27

FACILITY NAME Auto Ranch Road R/W

PROJECT NO.

PURPOSE (Circle One): Administrative/Offices, Library, Utilities, Airport, Museum, Walkway, Cemetery, Park, Other, Conservation, (Road), EMS, Sign, Fairgrounds, Stormwater, Fire, Street Light, Landfill, Surplus, Landscape, Traffic Signal

GRANTOR Kathleen A. Hudgins

GRANTEE (Circle One): (Collier County), Fire District, Pelican Bay Improvement District, Water & Sewer District, Other

DOCUMENT TYPE (Circle One): (Deed), Deed Dedication, Easement, Order of Taking, Temporary Easement, Other

DOCUMENT DATE (Signed Date/Not Recorded Date) March 11, 1980

OR BOOK 878 PAGE 355 SUBDIVISION

LOT/TRACT (Circle One) BLOCK/UNIT (Circle One) ACREAGE 1.37 COST ϕ

#5291, 5292

659511

QUIT-CLAIM DEED — RAMCO FORM 8

O.R. 878 PG 0355

This Quit-Claim Deed, *Executed this* 11TH *day of* MARCH , *A. D. 19* 80 , *by* Kathleen A. Hudgins, 292 Broadland Road, N.W., Atlanta, Georgia 30342

first party, to COLLIER COUNTY, a political subdivision in the State of Florida

whose postoffice address is Collier County Government Complex
Naples, Florida 33942

second party:

(Wherever used herein the terms "first party" and "second party" shall include singular and plural, heirs, legal representatives, and assigns of individuals, and the successors and assigns of corporations, wherever the context so admits or requires.)

Witnesseth, *That the said first party, for and in consideration of the sum of* $ 1.00 , *in hand paid by the said second party, the receipt whereof is hereby acknowledged, does hereby remise, release and quit-claim unto the said second party forever, all the right, title, interest, claim and demand which the said first party has in and to the following described lot, piece or parcel of land, situate, lying and being in the County of* COLLIER *State of* FLORIDA , *to-wit:*

A 60 foot wide strip of land lying in the West one-half of the West one-half of Sections 17 and 20; Township 51 South; Range 27 East; being more particularly described as follows:

Commencing at the Southwest corner of Section 17; Township 51 South; Range 27 East; thence N 0°50'20" along the West line of said section 17 a distance of 1271.72 feet to the southerly right-of-way line of U.S. 41 (Tamiami Trail); thence S 53°55'40" E along said southerly right-of-way line a distance of 810.52 feet to the Point of Beginning of a sixty foot wide strip of land lying 30 feet on each side of the following described centerline; thence S 00°42'50" W to a point on the south line of Section 17, said point bearing S 89°09'40" E 662.12 feet from the Southwest corner of Section 17; thence S 0°12'20" W to a point on the South line of Section 20; Township 51 South; Range 27 East; said point bearing S 89°27'40" E 667.99 feet from the Southwest corner of said Section 20.

RECORDED
OFFICIAL RECORD BOOK
COLLIER COUNTY, FLORIDA
AUG 7 10 33 AM '80

To Have and to Hold *the same together with all and singular the appurtenances thereunto belonging or in anywise appertaining, and all the estate, right, title, interest, lien, equity and claim whatsoever of the said first party, either in law or equity, to the only proper use, benefit and behoof of the said second party forever.*

In Witness Whereof, *The said first party has signed and sealed these presents the day and year first above written.*

Signed, sealed and delivered in presence of:

Deborah A. Waxman — Kathleen A. Hudgins (L.S.)
WITNESS Notary Public, Georgia, State At Large
My Commission Expires Nov. 26, 1983
KATHLEEN A. HUDGINS

(L.S.)

WITNESS

STATE OF ~~FLORIDA~~, GEORGIA
COUNTY OF FULTON

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid to take acknowledgments, personally appeared KATHLEEN A. HUDGINS

to me known to be the person described in and who executed the foregoing instrument and she acknowledged before me that she executed the same.

WITNESS my hand and official seal in the County and State last aforesaid this 11TH day of March A. D. 19 80

Deborah A. Waxman
NOTARY
Notary Public, Georgia, State At Large
My Commission Expires Nov. 26, 1983

(AFFIX SEAL)

This Instrument prepared by: Donald A. Pickworth, Collier County Attorney
Address Collier County Government Complex, Naples, Florida 33942

Board of County Commissioners accepted this document on this 29th day of July, 19 80
By: Virginia Mayer
Deputy Clerk

INFO ENTERED:
File 10/16/92
Map ___/___/___
Data ___/___/___

INVENTORY RECAPITULATION FORM

PARCEL _____

Section 20 Township 51 Range 27 Area ___
Folio # _____

* LIMITED USE ___ (Circle all applicable interests) (ROW) (Drainage) (Util) Maint Access Other _____
* CAPITAL ASSET ___ Purpose Lake Park Blvd. R/W

Project: Dept. _____ Name _____ No. _____ Parcel # _____

LOCATION: (general)

Subdivision _____
Lot _____ Blk _____
Unit _____ Tr _____
Plat Book _____ Page(s) _____
PUD Name _____
Ord. _____.-_____
SDP # _____

APPRAISAL: (See attached Y N)

Value $ _____
Date ___/___/___
Vacant Land Y N
Total Acres 2.66 ✓

Consideration $ —
Donation Y N
Trade Y N

CONVEYANCE: Type Deed Dedication
OR Bk 656 ✓ Pg 909 ✓ Recording Date 7/14/76 ✓
Special Restrictions:
Grantee: Collier County ✓
Grantor: Edward T. Connolly, Jr., Trustee ✓

Special Comments:

4.00
.55
.30

DEDICATION

424914

REC 656 PAGE 909

KNOW ALL MEN BY THESE PRESENTS, THAT Edward L. Connolly, Jr Trustee, the GRANTOR, being the owner of the fee simple title to the lands hereinafter described, does hereby dedicate the following described lands to Collier County for the use and benefit of the general public, for road rights-of-way, utilities and drainage, to the perpetual use of Collier County, to wit:

RECORDED
OFFICIAL RECORD BOOK
COLLIER COUNTY, FLORIDA
JUL 15 9 53 AM '76
MARGARET T. SCOTT
CLERK OF CIRCUIT COURT
COLLIER COUNTY, FLORIDA

Beginning at 1/4 Corner common to Section 20 and 17 Ran S 0°01'20" W 615.43 feet to concrete marker on South R/W of U.S.41. Then N 53°40'50" W 491.32 Set iron rod being point of beginning of East Boundary Line of 60 foot Right of Way Lake Park Blvd. Then ran S 36°19'10" W 400 feet Set iron rod, then S 0°05'00" W 1523.45 feet Set iron rod. Being end of Right of Way Lake Park Blvd. Being 2.66 Acres.

Lee County Electric Coop. Has been Granted R/W for Electric Line Along East Boundary.

East Boundary Line of Lake Park Blvd. Sec. 20, Township 51 S. Range 27 East, Collier County, Florida.

TO HAVE AND TO HOLD the same unto Collier County for the purposes aforesaid forever.

This dedication and the recordation of the same shall not place any duty, burden or liability upon Collier County, by formal act of the governing body, to accept the property herein and hereby dedicated, nor obligate Collier County to improve the aforesaid property in any manner, nor shall acceptance of this dedication by formal act of Collier County obligate Collier County to improve the aforesaid property in any manner.

IN WITNESS WHEREOF, the GRANTOR has hereunto signed _____ name

this 14th day of July, 19 76.

WITNESSES:

Edward L. Connolly, Jr. Trustee

STATE OF FLORIDA,
COUNTY OF COLLIER

I HEREBY CERTIFY that on this day, before me, an officer duly authorized in the State aforesaid and in the County aforesaid to take acknowledgments, personally appeared Edward L. Connolly, Jr.

to me known to be the person described in and who executed the foregoing instrument and he acknowledged before me that he executed the same.

WITNESS my hand and official seal in the County and State last aforesaid this 14th day of July A.D. 19 76

NOTARY PUBLIC, STATE OF FLORIDA AT LARGE
MY COMMISSION EXPIRES JUNE 16, 1978
BONDED THRU GENERAL INSURANCE UNDERWRITERS

Recorded in Official Records of COLLIER COUNTY, FLORIDA
MARGARET T. SCOTT
Clerk of Circuit Court

Appendix B. Photos at Stormwater Features

East pipe end

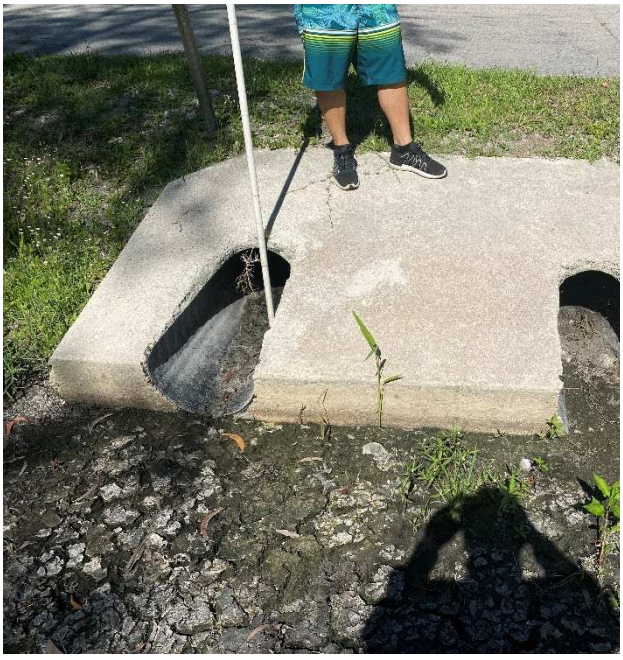


West pipe end



Figure 53. Photos taken at field visit site No. 3 (2 x RCP 1.5', inv=2.6).

East pipe end



West pipe end



Figure 54. Photos taken at field visit site No. 4 (2 x HDPE 1.25', inv=1.4').

East pipe end



West pipe end



Figure 55. Photos taken at field visit site No. 5 (RCP 1.5', inv=1.8', blocked 70%).

East pipe end



West pipe end



Figure 56. Photos taken at field visit site No. 6 (RCP 1.5', inv=1.0').

North pipe end



South pipe end



Figure 57. Photos taken at field visit site No. 8 (HDPE 1', inv=1.3').

North pipe end



South pipe end



Figure 58. Photos taken at field visit site No. 9 (Cast Iron 2', inv=-0.3).

North side of the road south culvert end



South side of the road north culvert end



Figure 59. Photos taken at field visit site No. 11 (2 x Box Culverts 5'x9', inv=-0.8').

North pipe end



South pipe end



Figure 60. Photos taken at field visit site No. 17 (CMP 1', inv=2.2').

North pipe end



South pipe end



Figure 61. Photos taken at field visit site No. 18 (RCP 1', inv=1.9').

North pipe end



South end pipe



Figure 62. Photos taken at field visit site No. 19 (RCP 1', inv=1.9').

North pipe end



South end pipe



Figure 63. Photos taken at field visit site No. 20 (RCP 1', inv=1.9).

North pipe end



South pipe end



Figure 64. Photos taken at field visit site No. 21 (RCP 1', inv=0.8).

North pipe end



South pipe end



Figure 65. Photos taken at field visit site No. 22 (HDPE 1', inv=1.7').

North pipe end



South pipe end



Figure 66. Photos taken at field visit site No. 23 (HDPE 1', inv=1.6').

North pipe end



South pipe end



Figure 67. Photos taken at field visit site No. 24 (HDPE 1.25', inv=1.9').

North pipe end



South pipe end



Figure 68. Photos taken at field visit site No. 25 (CMP 2', inv=1.5').

North pipe end



South pipe end



Figure 69. Photos taken at field visit site No. 26 (RCP 1', inv=1.5').

North pipe end



South pipe end



Figure 70. Photos taken at field visit site No. 27 (blocked pipe).

North pipe end



South pipe end



Figure 71. Photos taken at field visit site No. 28 (HDPE 1.5', inv=1.1').

North pipe end



South pipe end



Figure 72. Photos taken at field visit site No. 29 (HDPE 1.5', inv=1.7').

North pipe end

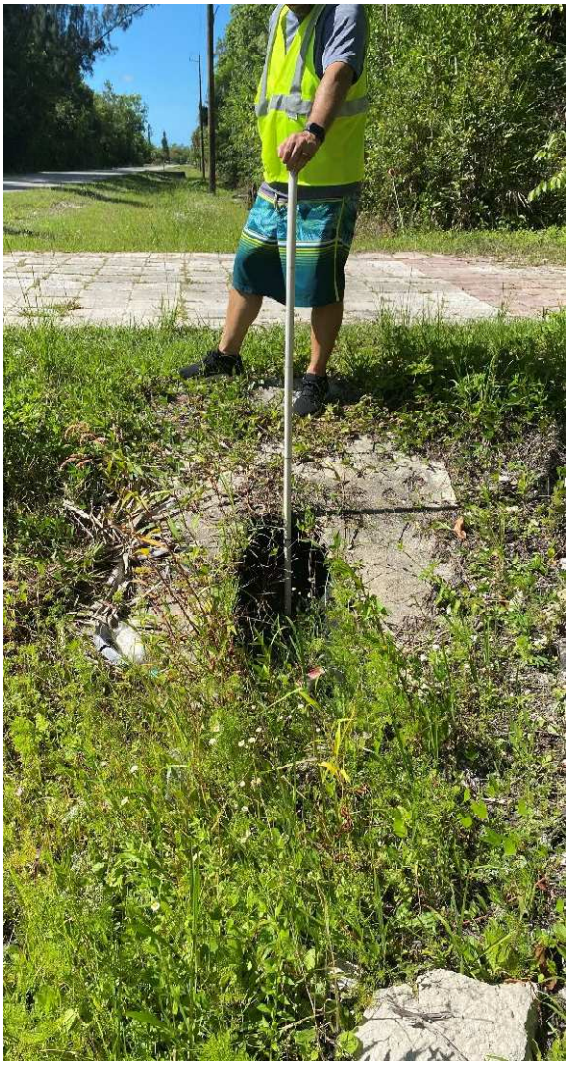


South pipe end



Figure 73. Photos taken at field visit site No. 30 (HDPE 1.5', inv=1.5').

North pipe end



South pipe end



Figure 74. Photos taken at field visit site No. 31 (HDPE 1.25', inv=1.4').

North pipe end



South pipe end



Figure 75. Photos taken at field visit site No. 32 (RCP 1', inv=1.5').

North pipe end



South pipe end



Figure 76. Photos taken at field visit site No. 33 (RCP 1', inv=2.1').

North pipe end



South pipe end



Figure 77. Photos taken at field visit site No. 34 (CMP 2', inv=1.1').

North pipe end



South pipe end



Figure 78. Photos taken at field visit site No. 35 (RCP 1', inv=1.6', blocked 90% and 70%).

North pipe end



South pipe end



Figure 79. Photos taken at field visit site No. 36 (RCP 1.5', inv=2.2').

North pipe end



South pipe end



Figure 80. Photos taken at field visit site No. 37 (RCP 1', inv=2.2', blocked 50%).

North pipe end



South pipe end



Figure 81. Photos taken at field visit site No. 38 (RCP 1', inv=1.8').

North pipe end

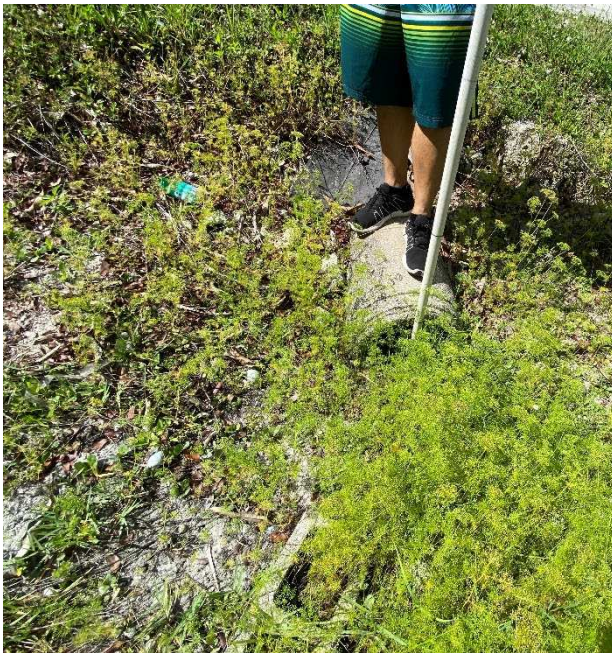


South pipe end



Figure 82. Photos taken at field visit site No. 39 (RCP 1', inv=1.9').

North pipe end

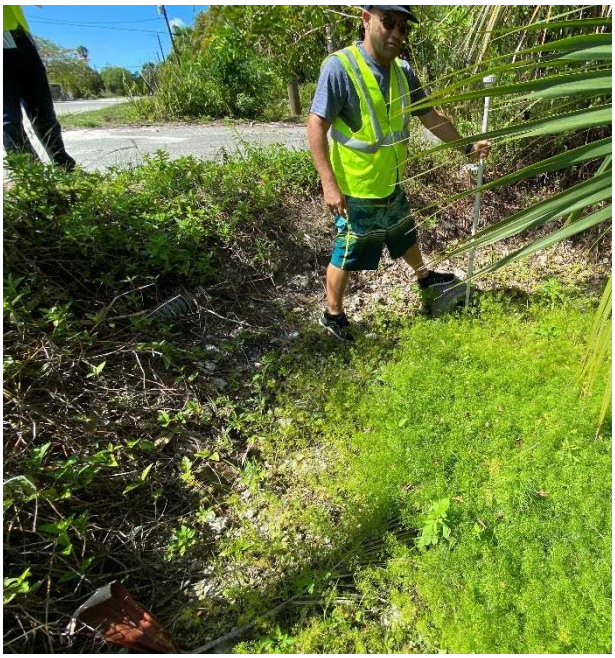


South pipe end



Figure 83. Photos taken at field visit site No. 40 (RCP 1', inv=2.1').

North pipe end

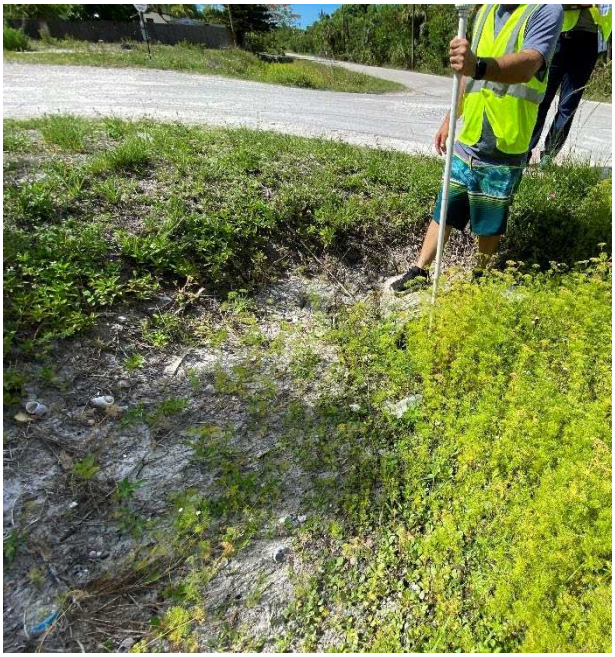


South pipe end



Figure 84. Photos taken at field visit site No. 41 (RCP 1', inv=1.7').

North pipe end



South pipe end



Figure 85. Photos taken at field visit site No. 42 (RCP 1', inv=2.1').

North pipe end



South pipe end



Figure 86. Photos taken at field visit site No. 43 (ERCP 1'x1.5', inv=1.6').

North pipe end



South pipe end



Figure 87. Photos taken at field visit site No. 44 (RCP 1.5', inv=2.0').

North pipe end



South pipe end



Figure 88. Photos taken at field visit site No. 45 (RCP 1.5', inv=2.0').

North pipe end



South pipe end



Figure 89. Photos taken at field visit site No. 46 (HDPE 2.5', inv=1.4').

North pipe end



South pipe end



Figure 90. Photos taken at field visit site No. 47 (RCP 1.5', inv=1.5').

North pipe end



South pipe end



Figure 91. Photos taken at field visit site No. 48 (RCP 1.5', inv=1.9', blocked 80%).

North pipe end



South pipe end



Figure 92. Photos taken at field visit site No. 49 (2xRCP 1.5', inv=0.9').

North side of the US-41



South side of the US-41



Figure 93. Photos taken at field visit site No. 52 (3 x RCP 3.5', inv=-0.5').

North pipe end



South pipe end



Figure 94. Photos taken at field visit site No. 53 (RCP 2.5', inv=0.1', blocked 30%).

North pipe end



South pipe end



Figure 95. Photos taken at field visit site No. 54 (CMP 1.25', inv=2.6', blocked 90%).

North pipe end



South pipe end



Figure 96. Photos taken at field visit site No. 55 (CMP 1.25', inv=2.6', blocked 90%).

North pipe end



South pipe end



Figure 97. Photos taken at field visit site No. 56 (RCP 1.25', inv=2.4').

North pipe end



South pipe end



Figure 98. Photos taken at field visit site No. 57 (CMP 4', inv=0.1', blocked 50%).

North pipe end



South pipe end



Figure 99. Photos taken at field visit site No. 58 (CMP 4', inv=0.8', blocked 50%).

North pipe end



South pipe end



Figure 100. Photos taken at field visit site No. 59 (CMP 4', inv=0.1', blocked 50%).

North pipe end



South pipe end



Figure 101. Photos taken at field visit site No. 71 (HDPE 2', inv=-1).

North culvert end



South culvert end



Figure 102. Photos taken at field visit site No. 86 (2 x box 4'x7').

West pipe end



East pipe end



Figure 103. Photos taken at field visit site No. 87 (2 x HDPE 4').

Appendix C. Stage Monitoring Installation

A total of four water level loggers were deployed on June 21, 2022 and removed on November 2, 2022. The specifications are listed in **Table 10**. Three of them were submerged in water. The remaining logger was set outside the water at the US-41 Road culvert in order to measure barometric pressure. The barometric (absolute) pressure is subtracted from the absolute pressure measured by the submerged loggers, and the pressure difference is converted to water depth by using the freshwater density. Water levels estimated or surveyed independently in the field at a given time are used to compute the offset needed to convert from water depths to water levels in feet NAVD88.

Table 10. Monitoring system specifications

Monitoring system distributed by:	ONSET
Logger type:	U20L-04: HOBO Water Level (13 ft) – U20L Series
Logger measurements:	Absolute pressure and temperature
Logger sampling frequency:	5 min
Logger memory:	21,700 samples (i.e., 75 days at 5-min sampling)
Data reader type:	U-DTW-1: HOBO Waterproof Shuttle
Software for setup, reading, and processing:	BHW-PRO-DLD: HOBOware PRO v.3

Figure 103 through **Figure 105** present some photos taken during the initial installation of the level loggers. After the center location level logger was lost or stolen, a concrete block was used to hold the south location level logger, as shown in **Figure 106**.

Inserting PVC bottom



PVC tube before introducing the loggers



Loggers attached to the cap



After installation



Figure 104. Level loggers installed at the south side of the US-41 Road culvert (i.e., north location) on 6/21/22

Logger ready for deployment



Submerging logger



Figure 105. Level logger installed at the center location on 6/21/22

Erasing logger data before deployment



Submerging logger



Figure 106. Level logger installed at the south location on 6/21/22



Figure 107. Level logger installed later at the south location by using a concrete block on 9/1/22

Appendix B. Technical Memorandum for Task 2. Existing Conditions Stormwater Model

LAGO
Consulting and Services

Technical Memorandum

To: Daniel Roman, PE, PMP; Rick Orth, PG.
Stormwater Management Section, Collier County

From: Marcelo Lago, PhD; Ananta Nath, PE; Maria C. Bravo, PE, PhD;
Lago Consulting and Services, LLC;

Date: November 14th, 2022

Re: Lake Park Boulevard Capital Improvements and Water Quality Flowway Pre-Design Study.
Task 2. Existing Conditions Stormwater Model
Collier County PO No. 4500218524

Background

Collier County has contracted Lago Consulting & Services to conduct a pre-design study to identify and evaluate the feasibility of potential stormwater management improvements, conversion of conventional septic systems of waste disposal to a municipal sewer, roadway improvements, restoration of historic flowways to the Rookery Bay estuaries and preservation of related natural resources within the project area. The study area is outlined in **Figure 1**.

The Task 1 activities of the project related to data collection and field reconnaissance were detailed in a separated technical memorandum submitted earlier to the County[1].

This technical memorandum summarizes the Task 2 activities of the project related to the development of the Existing Conditions Stormwater Model.



Figure 1. Project area.

[1] Lake Park Boulevard Capital Improvements and Water Quality Flowway Pre-Design Study. Task 1. Data Collection and Field Reconnaissance. Collier County PO No. 4500218524. Draft Technical Memorandum prepared by the LAGO Team and submitted to Collier County on November 7, 2022.

Model Conceptualization and Setup

Modeling Software

This stormwater model was developed using the most current version of the Interconnected Pond Routing (ICPR) software, version 4.07.08. Initially, a 1D model was built that used manual basins without utilizing the 2D overland and groundwater flow capabilities. That model version worked with the basic ICPR4 license, also referred as "pro". However, that initial model was improved to include the groundwater component. The final ICPR model presented in this report requires the "expert" license and includes mapped basins as well as overland and groundwater components. This final model, however, can be opened with the "pro" license to view the properties of nodes and links.

Projection and Datum

Spatial coordinates in the ICPR model are based upon the standard SFWMD geographic projection: NAD_1983_HARN_StatePlane_Florida_East_FIPS_0901_Feet

Elevations in the model are referenced to the vertical datum NAVD88. The conversion of elevation data in NGVD29 to NAVD88 in the model domain area was conducted by subtracting 1.32 ft.

Topography

The latest LiDAR-based digital elevation model (DEM) files around the project area were collected from the USGS[2]. The DEM pixel size is 1 meter, and the LiDAR was flown between May and October of 2018. **Figure 2** displays the DEM around the project area.

[2] https://apps.nationalmap.gov/lidar-explorer/#/

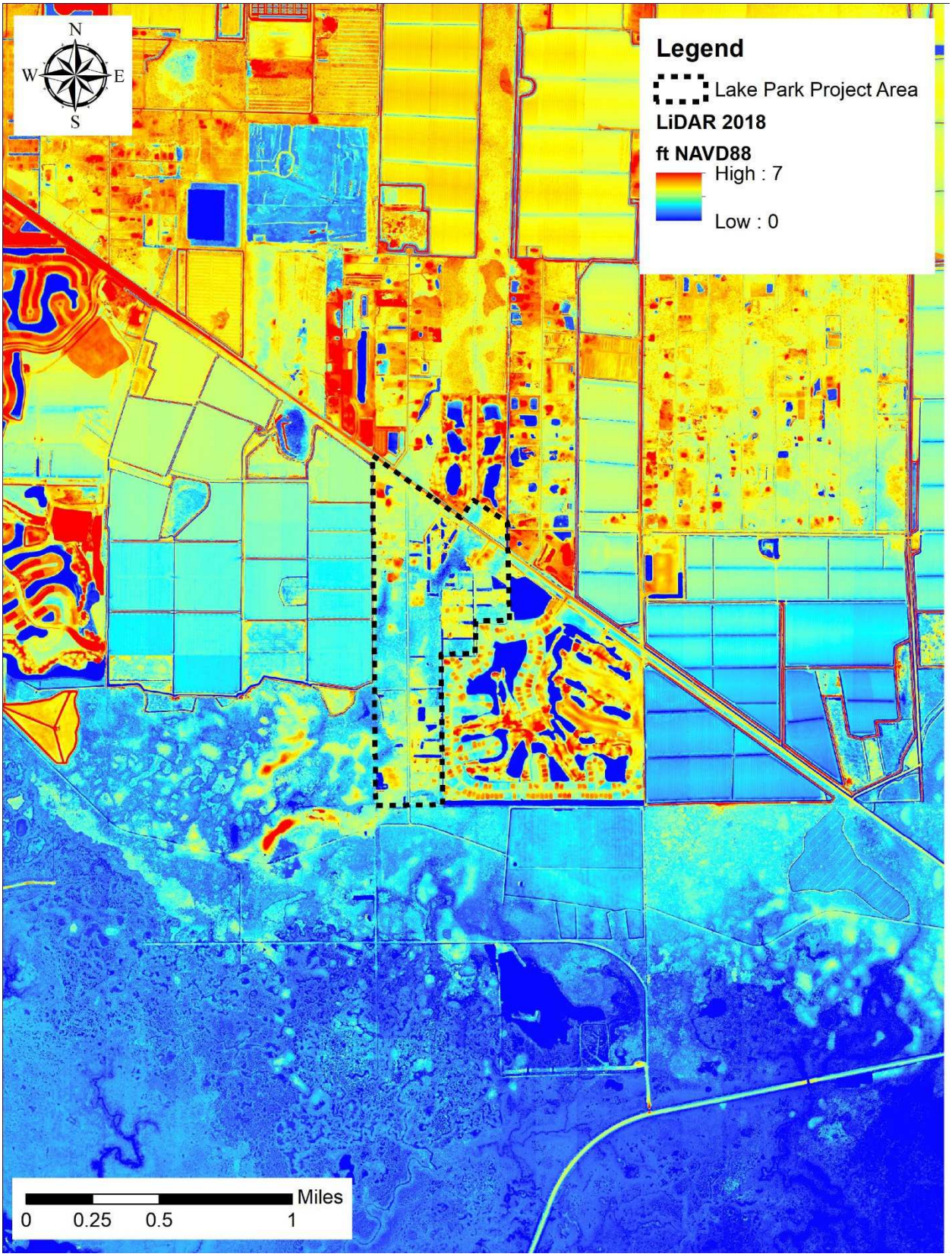


Figure 2. LiDAR based DEM from year 2018

Sub-basin Delineation

A preliminary sub-basin delineation was performed by using ArcHydro tools to find sub-basins boundaries and preferential flow paths. The process was started by entering the LiDAR-based DEM and the layout of the existing drainage pipes in the proprietary Fill Sinks Plus tool[3]. After completing preliminary delineation by using other ArcHydro tools, the boundaries were modified manually to generate the model sub-basins presented in **Figure 3.**

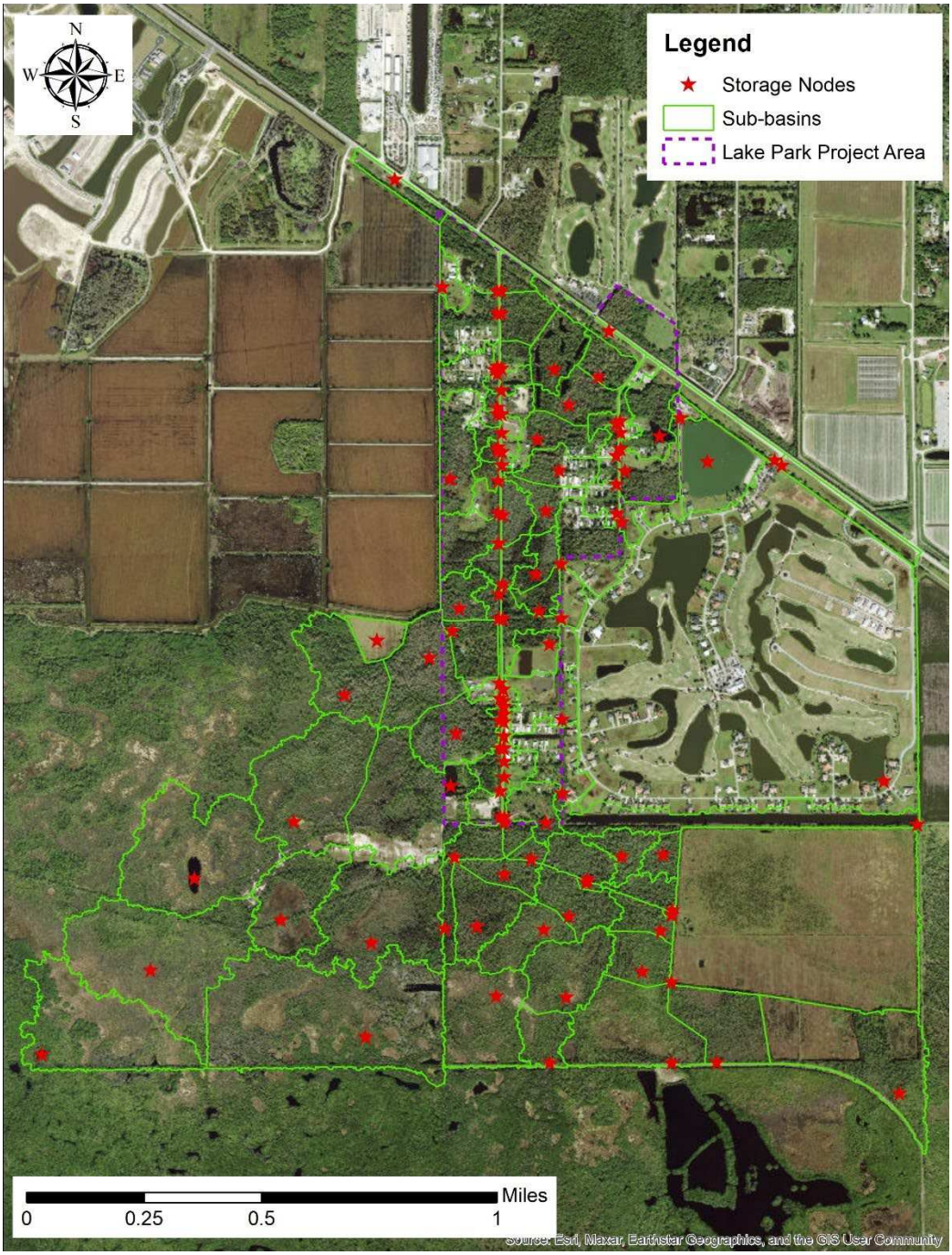


Figure 3. Basin boundaries and storage nodes in the initial 1D ICPR model.

[3] Fill Sinks Plus Tool: https://www.lago-consulting.com/fill-sinks-plus.html

Time of Concentration

The Time of Concentration is defined as the time required for runoff to travel from the hydraulically most distant point in the watershed to the outlet. The estimated longest paths are presented in **Figure 4.** Two flow regimes are assumed: a shallow flow for the first 300 feet or less followed by a concentrated flow. The correlation plot between the time of concentration and the subbasin areas is also included in **Figure 5**.

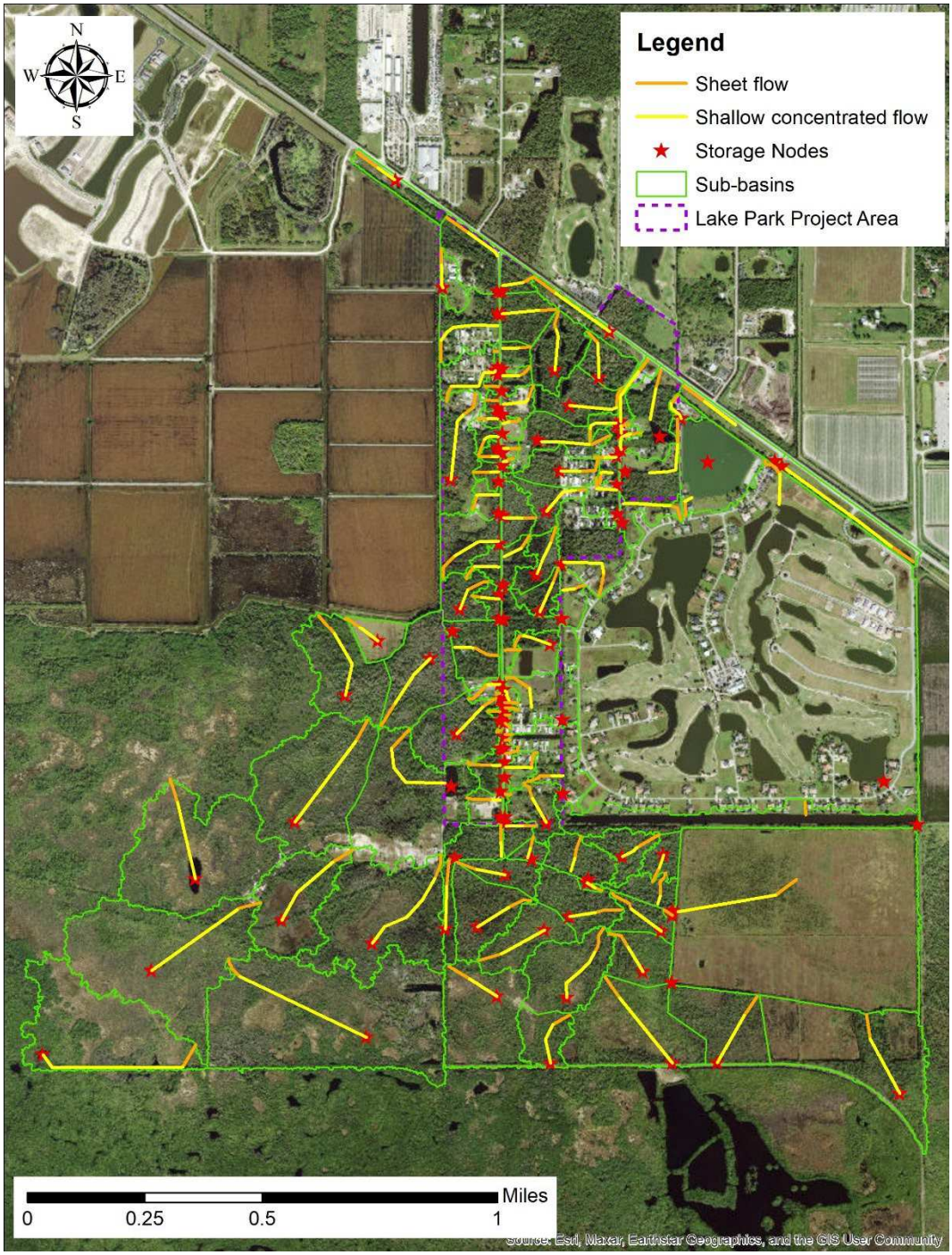


Figure 4. Longest path divided in sheet and concentrated flow, which was used to estimate the time of concentration.

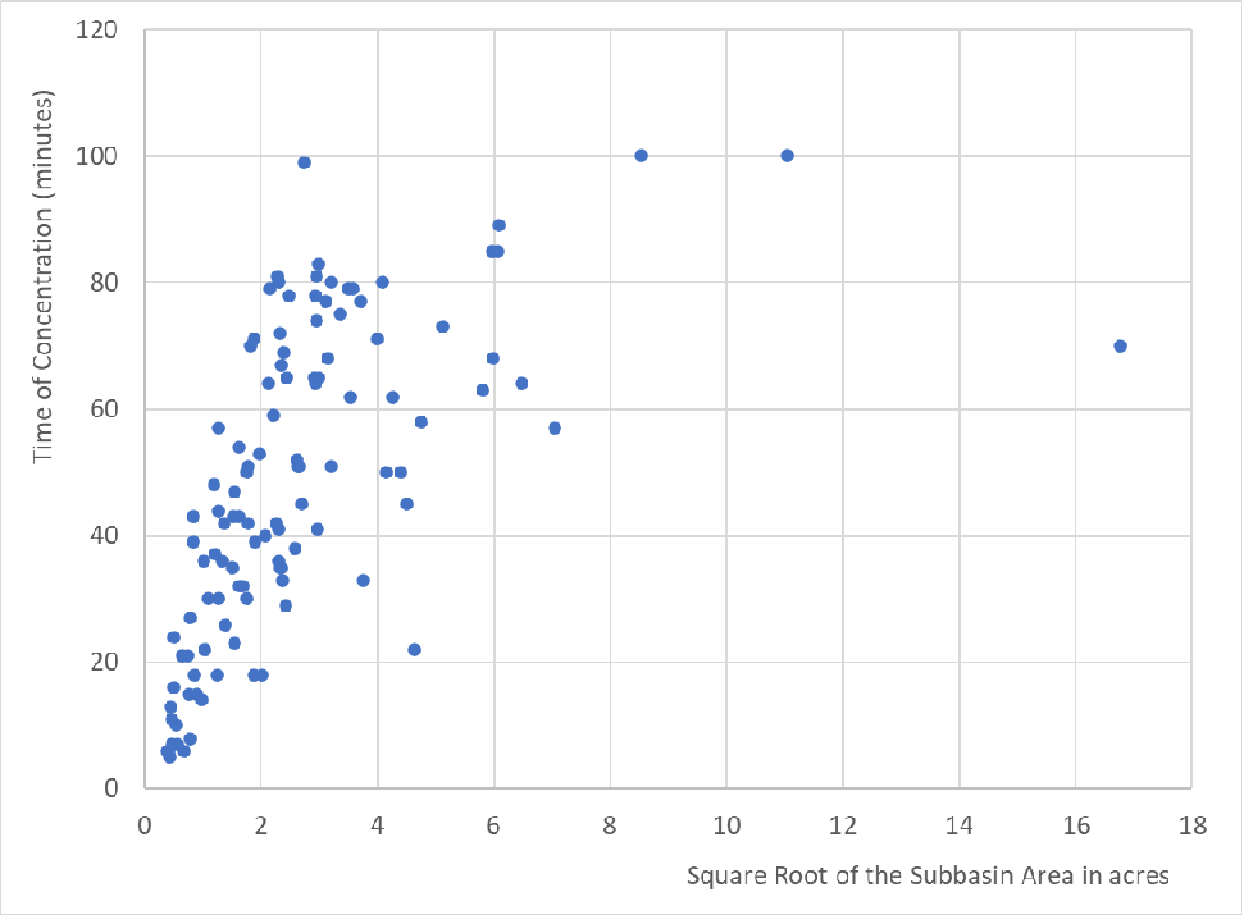


Figure 5. Correlation plot of the time of concentration as a function of the sub-basins area.

Impervious and Pervious Areas

The impervious areas in the model domain are composed mostly of building footprints, driveways, and streets. The impervious and pervious areas for this modeling study were extracted from the file "Collier_County_Buildings_2020.shp" (available from the Collier County) and adjusted from aerial images, as presented in **Figure 6**. Notice that the impervious areas in the model have been divided into two classes: the directly connected impervious areas (DCIA) and the other impervious areas where the runoff is routed to pervious areas (referred in the map legend as Impervious2P). In most of the single-family houses, runoff is routed to pervious areas. Lake and pond areas are also included in Figure 6 separately as "water", but their runoff generation and routing are modeled similar to the DCIAs.

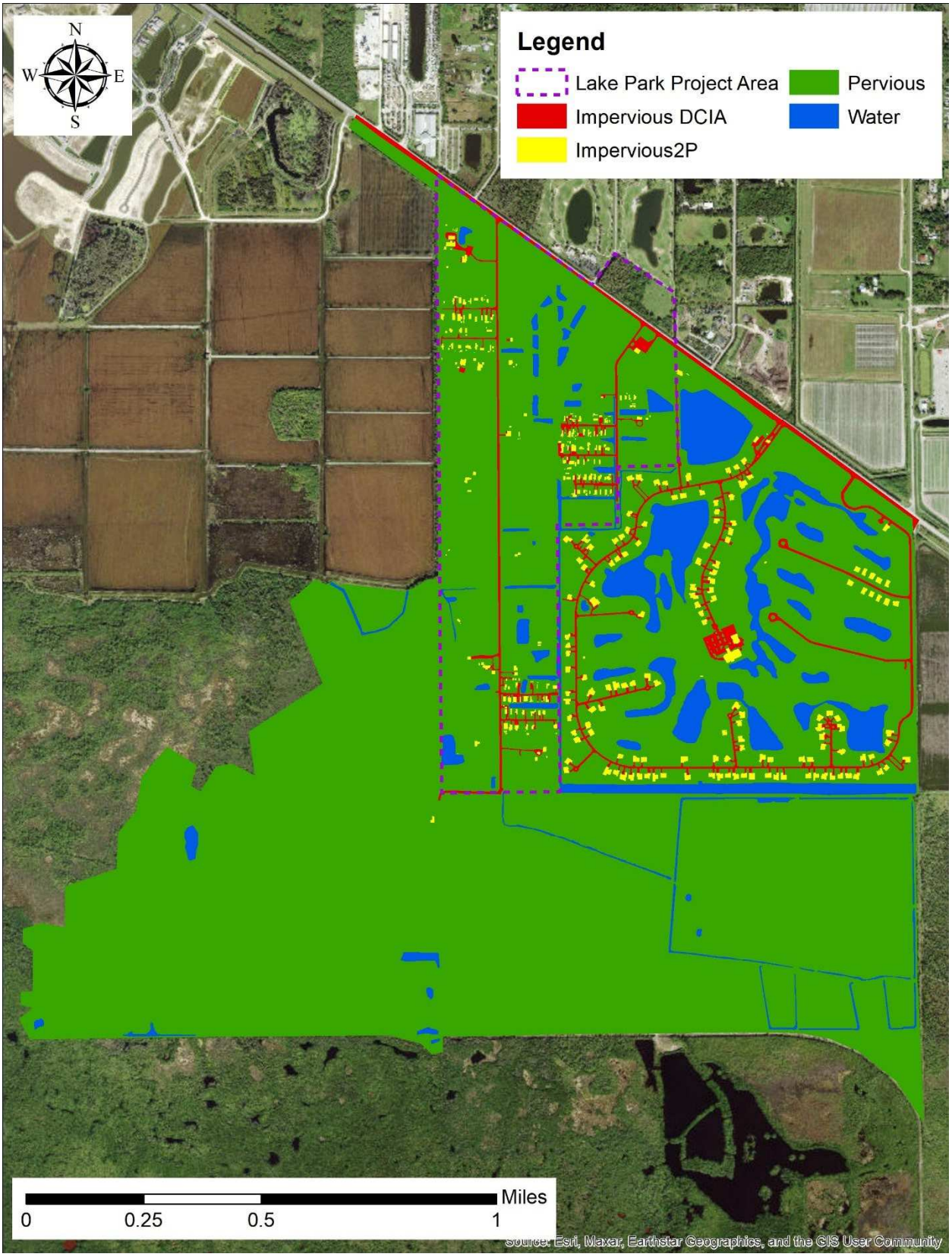


Figure 6 Impervious and pervious areas.

Soils

The soil distribution in the model domain was extracted from the NRCS web soil survey[4] as shown in **Table 1** and **Figure 7**. The Hydrologic Soil Group (HSG) classification, as defined by NRCS, is associated with the infiltration and the runoff of the respective soil type.

Table 1. NRCS Soil classes inside Model Domain

MUSYM	MUKEY	Map Unit Name	Area (acres)	Area (%)	HSG
7	1413459	Immokalee fine sand, 0 to 2 percent slopes	4.2	0.3	B/D
17	1413466	Basinger fine sand, 0 to 2 percent slopes	111.0	8.3	A/D
20	3045926	Ft. Drum-Malabar, high association, 0 to 2 percent slopes	198.0	14.9	A/D
25	3045904	Cypress Lake-Riviera-Copeland fine sands, frequently ponded, association, 0 to 1 percent slopes	48.5	3.6	A/D
27	1413473	Holopaw fine sand, 0 to 2 percent slopes	41.2	3.1	A/D
40	3102957	Durbin and Wulfert mucks, tidal complex, 0 to 1 percent slopes	42.9	3.2	A/D
45	3102967	Paola fine sand, 1 to 8 percent slopes	6.2	0.5	A
53	3102959	Estero and Peckish mucks, tidal, 0 to 1 percent slopes	256.2	19.3	A/D
56	1413497	Basinger fine sand, occasionally flooded	6.6	0.5	A/D
99	1413500	Water	20.4	1.5	
101	3045893	Basinger fine sand-Urban land complex, 0 to 2 percent slopes	0.0	0.0	A/D
103	3045903	Cypress Lake-Riviera-Copeland fine sands, frequently ponded-Urban land association, 0 to 1 percent slopes	35.0	2.6	A/D
113	3045895	Holopaw fine sand-Urban land complex, 0 to 2 percent slopes	62.4	4.7	A/D
115	3045907	Holopaw-Basinger-Urban land complex, 0 to 2 percent slopes	338.1	25.4	A/D
117	3045897	Immokalee fine sand-Urban land complex, 0 to 2 percent slopes	8.6	0.6	B/D
118	3045909	Immokalee-Oldsmar, limestone substratum-Urban land complex, 0 to 2 percent slopes	5.5	0.4	A/D
130	3045900	Pomello fine sand-Urban land complex, 0 to 2 percent slopes	15.0	1.1	A
132	3045902	Riviera, limestone substratum-Copeland fine sand-Urban land association, 0 to 2 percent slopes	129.7	9.8	B/D
		Total	1,329.5	100	

[4] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

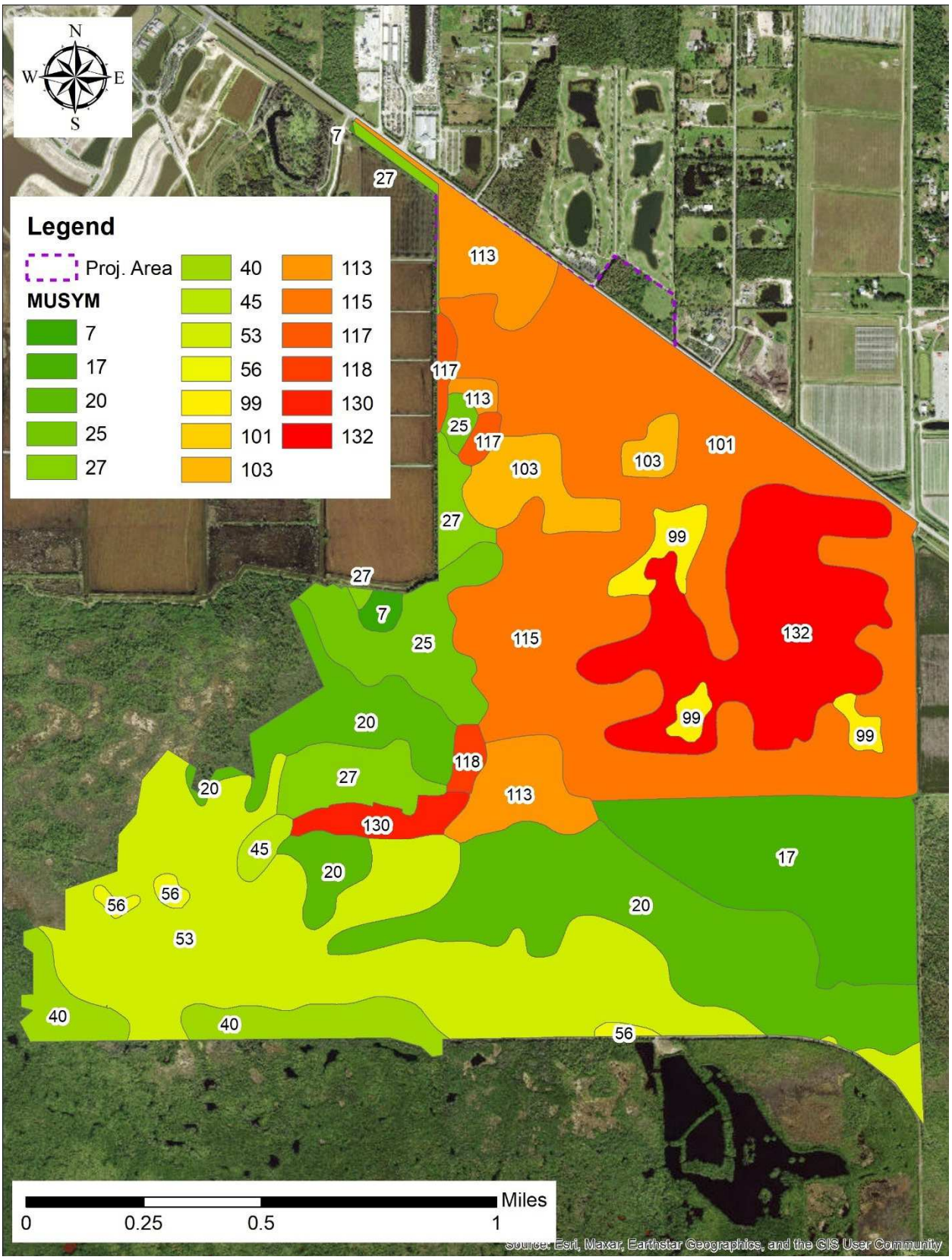


Figure 7. NRCS Soil Distribution

The ICPR software documentation offers a methodology to estimate depth-averaged soil parameters for the different NCRS soil classes used to calculate infiltration by the Green-Ampt method. The processing started by calculating depth-averaged parameters in the NRCS web soil survey for percent clay, percent sand, organic matter, bulk density at 1/3 bar, saturated hydraulic conductivity, water content at 1/3 bar, water content at 15 bar, and depth to water table between June and October. These values were entered in an excel spreadsheet template that used formulas and correlations to compute the Green-Ampt parameters as presented in **Table 2**.

Table 2. Green-Ampt parameters for the NRCS Soil classes inside Model Domain

MUSYM	Saturated hydraulic conductivity (ft/day)	Moisture content at saturation	Moisture content, residual	Moisture content, initial	Moisture content at field capacity	Moisture content at Wilting point	Pore Size Index	Bubble Pressure (in)	Depth to Water Table (ft)
7	21.1	0.395	0.016	0.092	0.092	0.032	0.582	1.583	1.05
17	25.6	0.402	0.012	0.080	0.080	0.023	0.578	1.513	0.95
20	22.5	0.408	0.022	0.113	0.113	0.044	0.519	1.593	0.98
25	17.2	0.437	0.042	0.163	0.163	0.083	0.433	1.612	0.30
27	21.7	0.413	0.027	0.126	0.126	0.053	0.496	1.660	0.95
40	25.0	0.689	0.032	0.363	0.363	0.089	0.576	0.649	0.07
45	68.1	0.384	0.005	0.057	0.057	0.010	0.602	1.751	2.49
53	22.9	0.419	0.026	0.138	0.138	0.052	0.560	1.339	0.00
56	25.9	0.407	0.013	0.071	0.071	0.026	0.569	1.452	0.49
99	1000	1	0.005	0.3	0.011	0.01	0.5	0.01	0
101	25.0	0.388	0.008	0.053	0.053	0.016	0.584	1.647	1.02
103	17.5	0.422	0.033	0.127	0.127	0.065	0.441	1.751	0.36
113	21.6	0.395	0.017	0.077	0.077	0.033	0.506	1.843	0.95
115	23.1	0.399	0.015	0.080	0.080	0.030	0.534	1.679	1.05
117	21.9	0.382	0.010	0.056	0.056	0.020	0.586	1.710	1.08
118	19.5	0.395	0.018	0.081	0.081	0.035	0.542	1.631	1.02
130	31.5	0.382	0.007	0.046	0.046	0.014	0.595	1.757	2.59
132	18.0	0.410	0.028	0.107	0.107	0.056	0.440	2.179	0.75

Stormwater Drainage Network Features

The existing stormwater drainage pipe system was inventoried initially by using the Collier County Data Base, and permit files. The information was completed and verified during field visits. The existing drainage connections are shown in **Figure 8**.

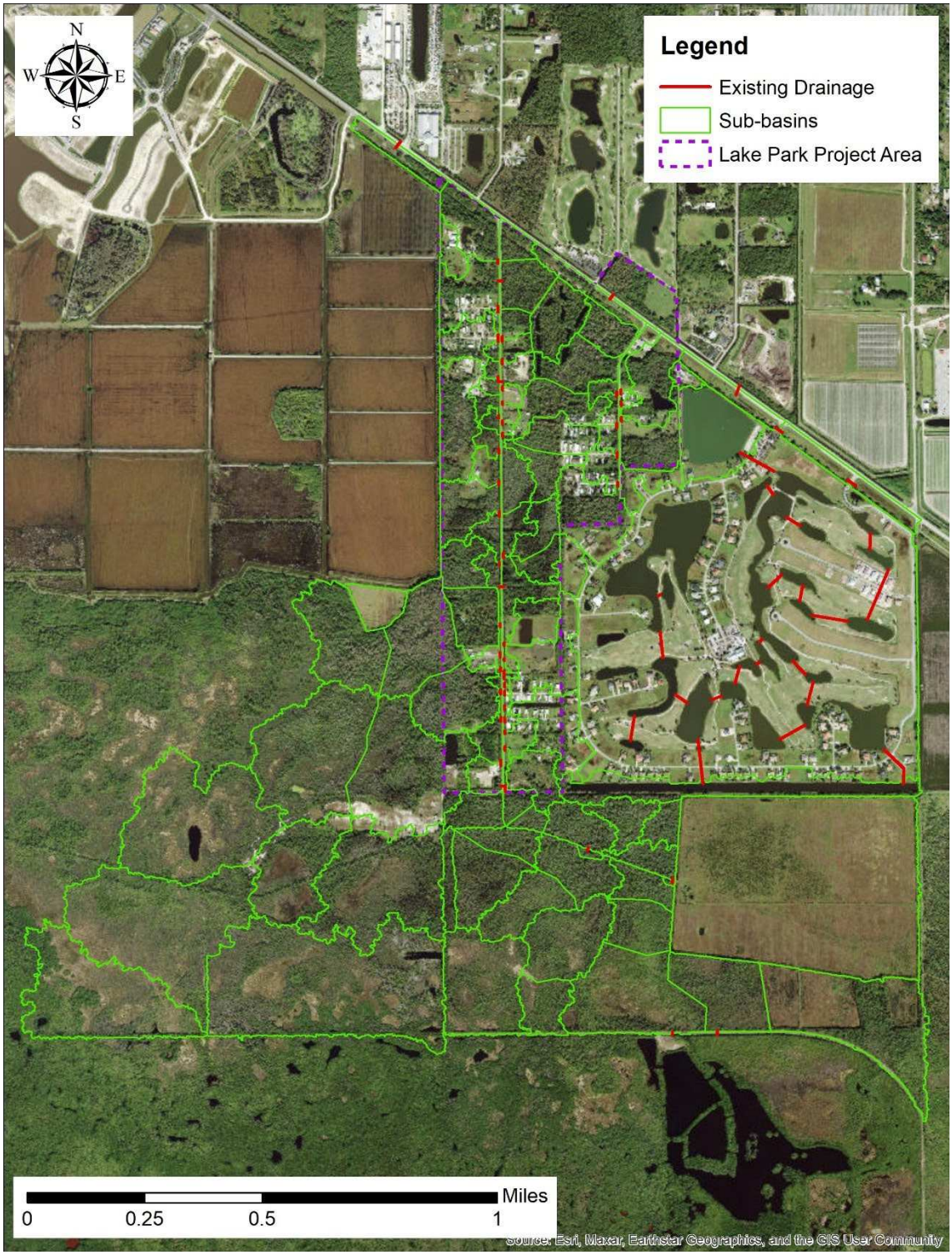


Figure 8. Existing stormwater drainage features.

Model Network of Links and Nodes

The network of nodes and links included in the model is presented in **Figure 9**. In these maps, the weir and pipe connection links are shown using the orange and dark red lines, respectively. A few dropbox links (in cyan color) were also defined.

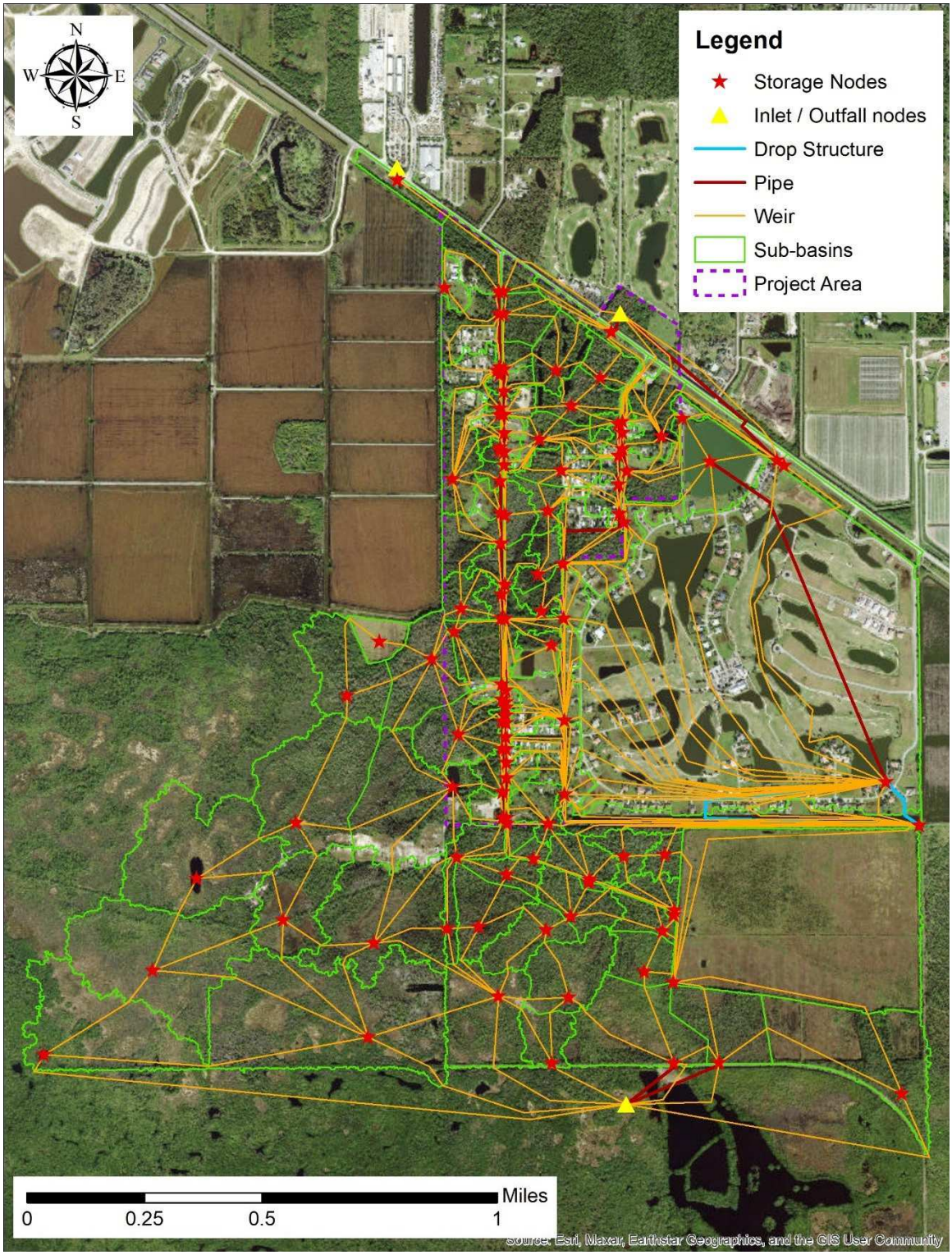


Figure 9. Nodes and Links in the ICPR model.

Irregular Weir Profiles

"Overland" weirs were used extensively in the model to allow for overland flow when the water level is higher than the ground elevation at sub-basin boundaries. **Figure 10** show transect locations where cross-section profiles were extracted from the high-resolution LiDAR-based topography to represent the "overland" weir profiles. Weir discharge coefficients varied from 0.07 to 2.8.

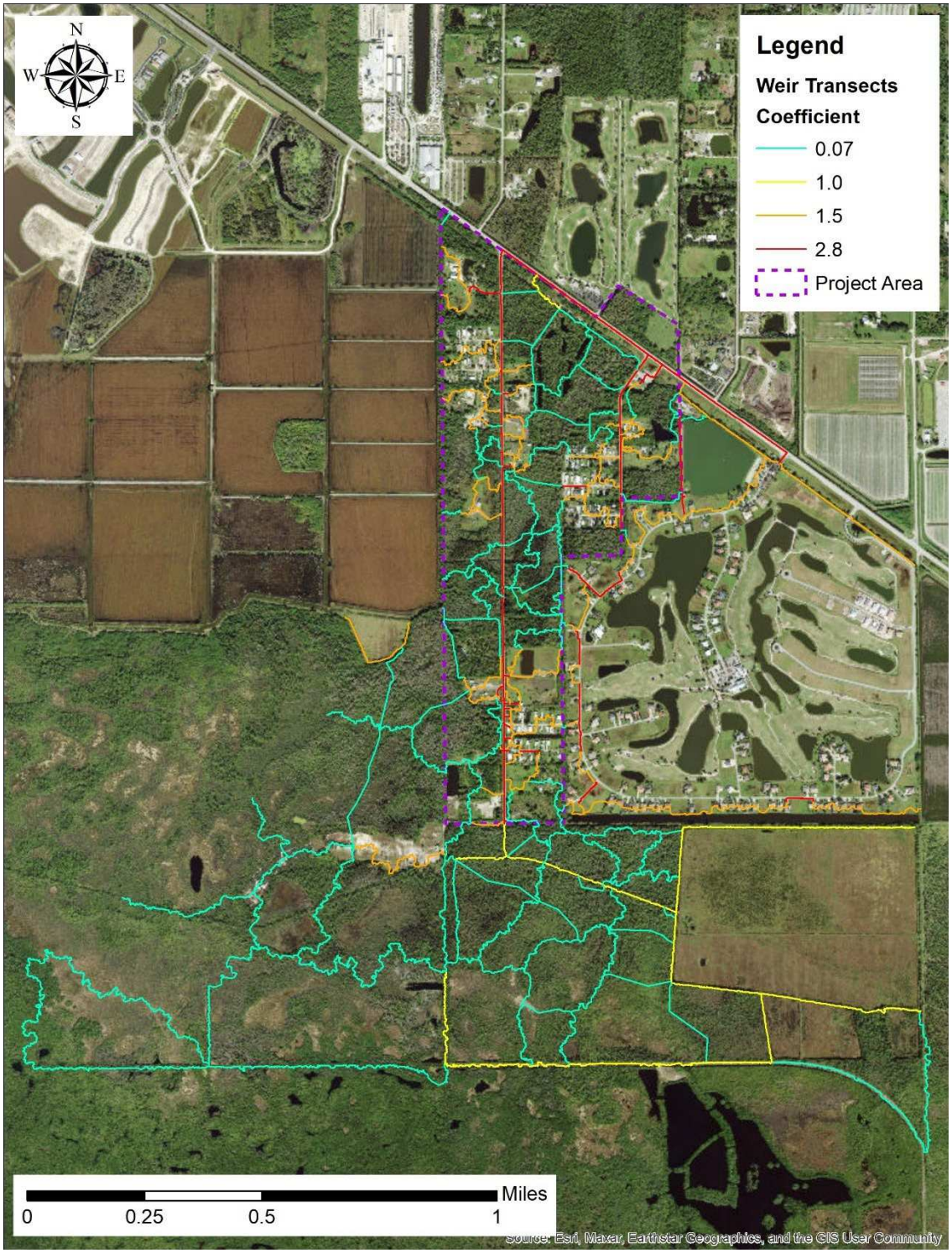


Figure 10. Transect locations used to define irregular weir profiles.

Sub-basin Parameters

The following sub-basin-related parameters were specified in the ICPR model:

- Name: The prefix "B" was used to specify each sub-basin (e.g., B001).
- Area: The sub-basin polygon shape was used to compute the areas inside the ICPR model.
- Stage-area curve: The LiDAR-based DEM and the sub-basin polygon shape was used to compute the stage-area curve within the ICPR model. It is assigned to the storage node where the runoff is allocated. The stage step is 0.25 ft.
- Hydrograph Method: NRCS Unit Hydrograph= UH256, peak factor = 256. This approach is appropriated for the typical flat areas in South Florida.
- Time of Concentration: Estimated from the longest paths as defined in previous Figure 4.
- Land use classification: Sub-basins in the model utilize the landuse classification in the four categories: impervious to pervious, impervious DCIA, pervious, and water areas; as presented previously in Figure 6. A summary of the hydrological parameters used for these classifications is presented in **Table 3**.
- Infiltration Method: Green-Ampt method with soil parameters presented in Table 2. This method is physically based and is expected to produce better infiltration rate estimations than the Curve Number (CN) method.

Table 3. Hydrological parameters assigned to Land Use classes

Landuse classification	% Area Impervious	% DCIA	Ia (inches) Impervious	Ia (inches) Pervious
Pervious	0	0	—	0.1
Impervious DCIA or Water	100	100	0.05	—
Impervious to Pervious	100	0.01	0.05	—

Notes: DCIA: direct connected impervious area, Ia: initial abstraction.

Node Parameters

The following node-related parameters were specified in the ICPR model:

- Name: Storage nodes use prefix "N" (e.g., N001). They are defined as Stage/Area nodes within the ICPR model. Time/stage nodes are here also referred to as inlet or outfall nodes, which are named accordingly.
- Boundary condition stages: Boundary condition (BC) stages are imposed at the two inlet nodes at the north ditch of the US-41 Road and at the outfall node that consider tidal boundary conditions.
- Initial stages: The initial stages were assumed as 1.5', uniformly, when starting the continuous simulation on May 1st, 2022. For design storm simulations, initial stages were taken from the continuous simulation results on September 1st, 2022.

Link Parameters

The following link-related parameters were specified in the ICPR model (see example of ICPR input parameter window in **Figure 11**):

- Name: Links were named by using the prefix "P" for pipes (e.g., P001), "W_" for weirs (e.g., W_001), and "DS" for dropbox structure (i.e., DS001). The link name contains the number of the starting node. The irregular cross section corresponding to an overflow weir starts with "XS_" followed by the start and end nodes labels (e.g., XS_N001_N002_A). A suffix was used to represent the type of surface, such as A for asphalt road, W for wetland vegetation, etc.
- Pipe length: Individual length of the pipes was computed from the polyline shape in GIS.
- Pipe diameter: Diameters were established from the Collier County Data Base, permit files, and field visits.
- Pipe Manning's resistance coefficient (*n*): The Manning's coefficient was assigned according to the pipe material. This is 0.026 for corrugated metal pipes (referred as CMP or ECMP) and 0.013 for other pipe materials such as reinforced concrete (referred as RC, RCP, ERCP), HDPE, PVC, etc.
- Pipe upstream and downstream invert elevations: Inverts were evaluated from the Collier County Data Base, permit files, and field visits. Pipe elevations profiles along Auto Ranch Road and Lake Park Boulevard are shown from **Figure 12** through **Figure 15**. Notice that the head drop at ditch segments is neglected in the model, and the pipe length is exaggerated in the profile view in those figures. Obstructions are represented as gray rectangles.
- Pipe entrance and exit loss coefficients: For the pipes in road ditches, entrance and exit loss coefficients were assumed as 0.3 and 0.5, respectively, which corresponds to the HEC-RAS case labeled as "Typical Bridge Section" in the ICPR Manual. When the pipe is connected to a lake or it is a cross pipe, the loss coefficients were assumed as 0.5 and 1, respectively.
- Weirs and drop structure's dimensions and elevations: Parameters were taken from the permit files or estimated during field visits. For the weirs that represent the overland flow between subbasins, an irregular profile was extracted from the LiDAR-based DEM corresponding to the transects presented previously in Figure 10. A few weir profiles were adjusted manually based on field observations.
- Weir coefficients: The weir coefficients were assumed as a function of the type of surface as shown in **Table 4**. An example of the input parameters for an irregular weir profile is shown in **Figure 16**.

Table 4. Weir coefficients assigned in the model.

Type of surface	Weir Coefficient
Concrete (in dropbox structures)	3.2
Asphalt road	2.8
Grass	1.5
Dirt Road with low-density or short vegetation	1.5
Dirt Road with dense vegetation on the side	1
Vegetated channel	0.07
Wetland (dense) vegetation	0.07

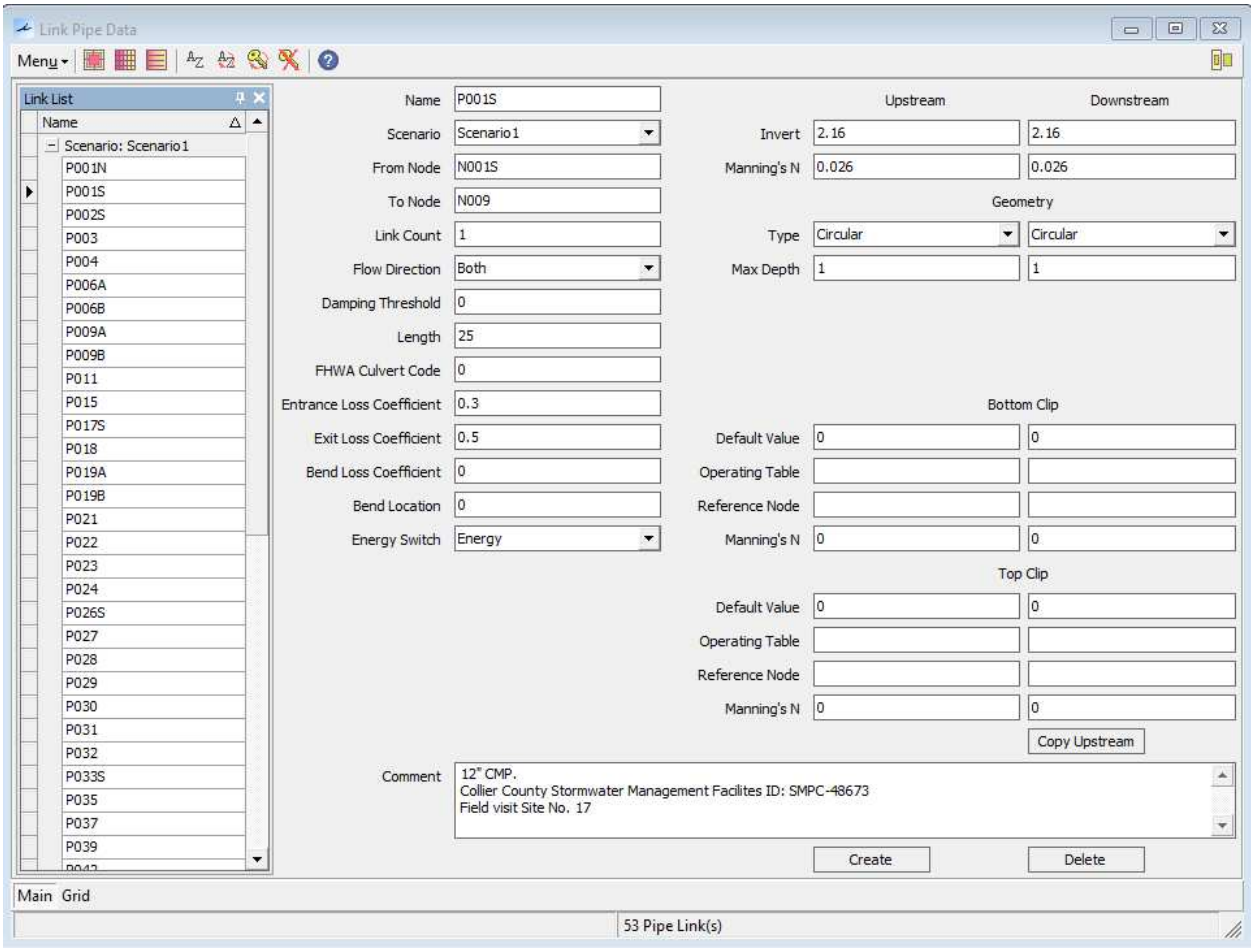


Figure 11. Example of the input parameter window for the links representing pipes.

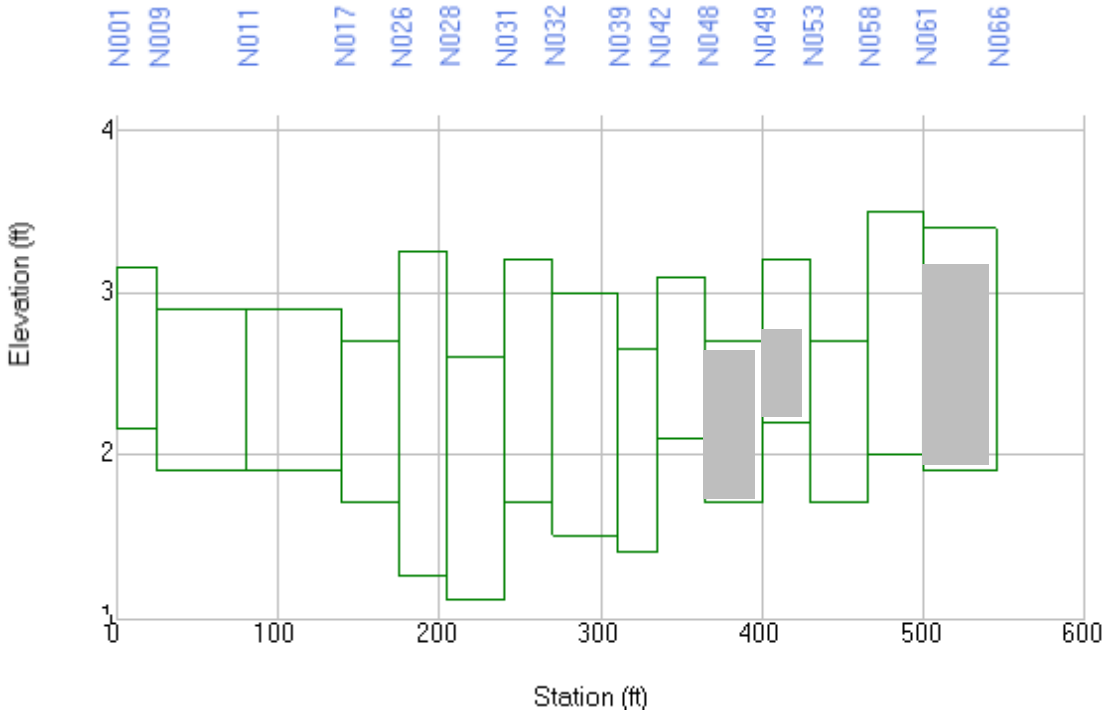


Figure 12. Pipe elevations profile along Auto Ranch Rd, west side ditch.

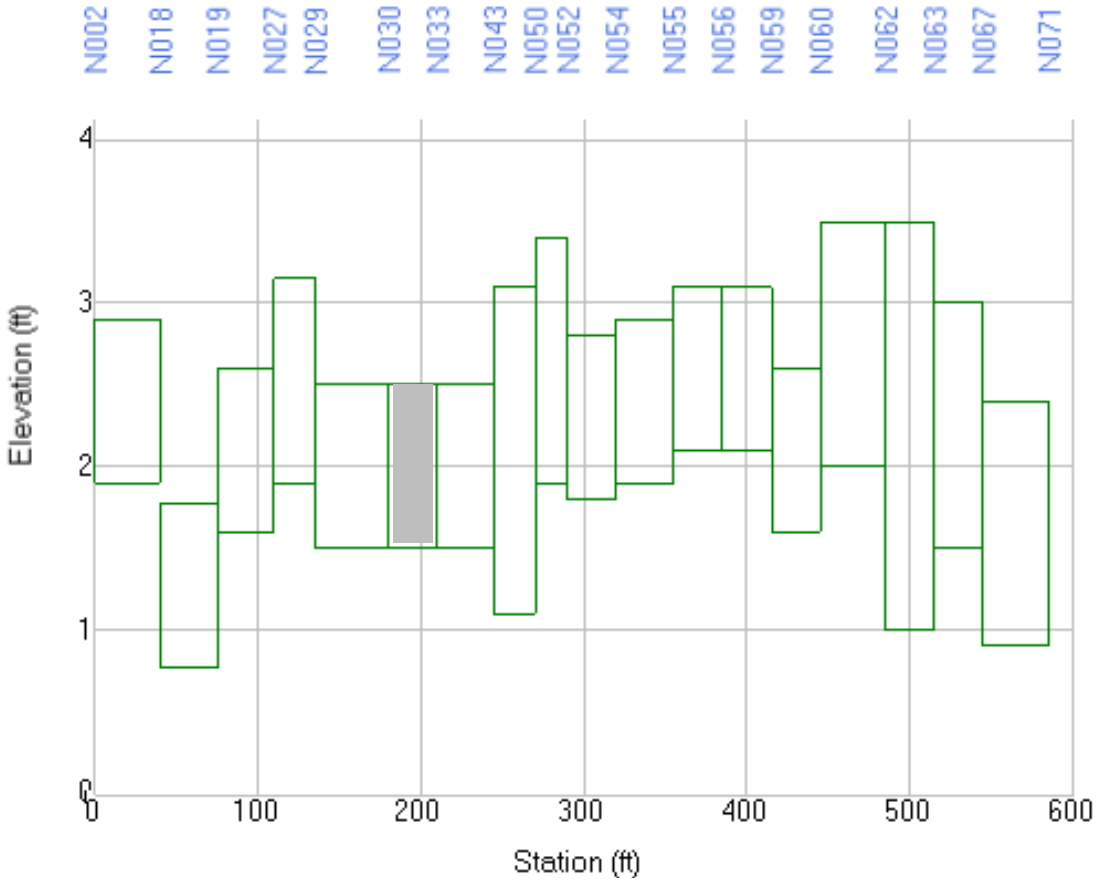


Figure 13. Pipe elevations profile along Auto Ranch Rd, east side ditch.

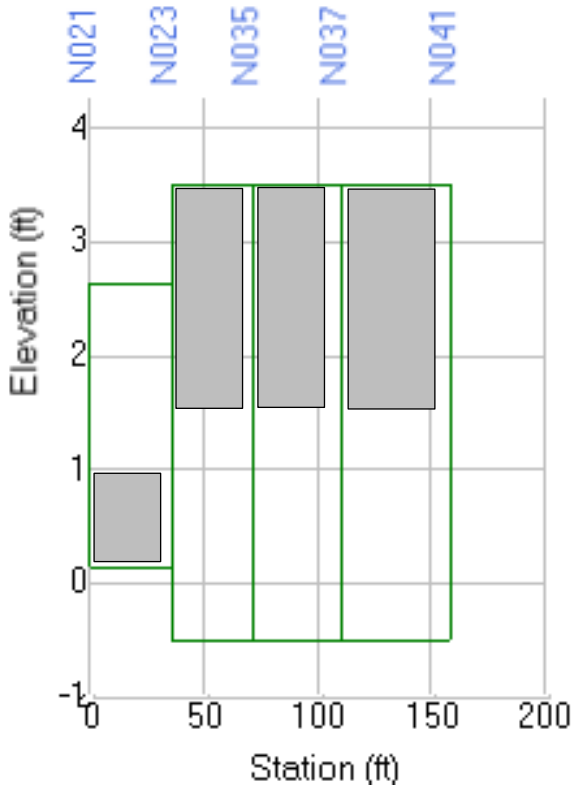


Figure 14. Pipe elevations profile along Lake Park Blvd, west side ditch.

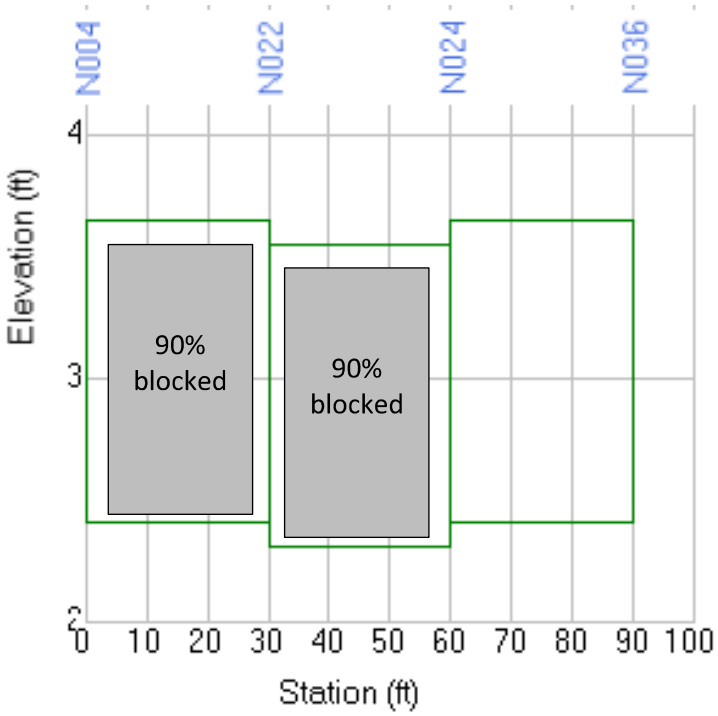


Figure 15. Pipe elevations profile along Lake Park Blvd, east side ditch.

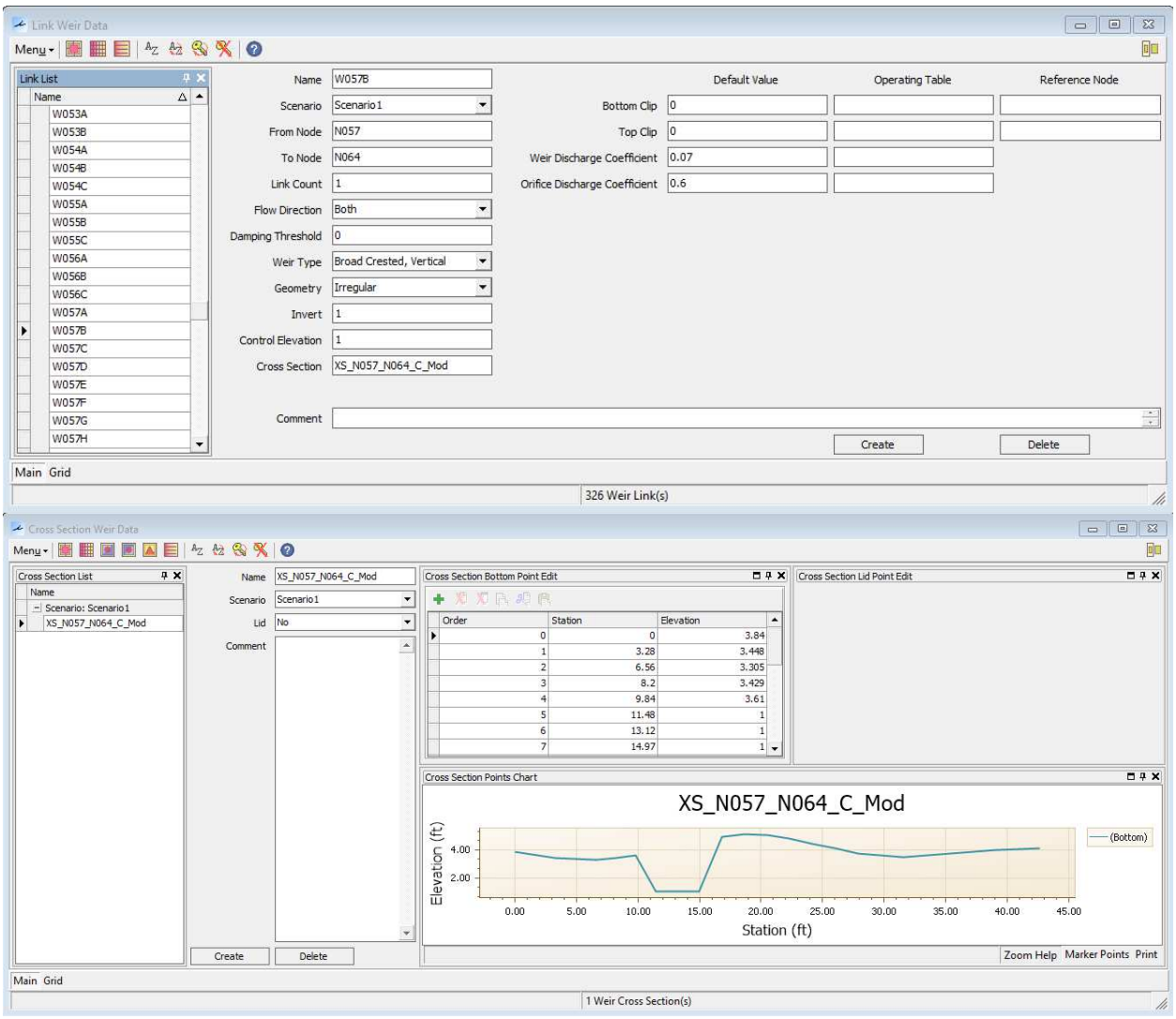


Figure 16. Example of the input parameter windows for the links representing irregular profile weirs.

Overland Region

The overland (OL) region in the ICPR model is set to match the extent of the mapped basins. Pond control volumes are defined by using the same polygons as the mapped basins. In this way, the overland region mesh has all triangles inside the pond control volume features.

One challenge while building the OL mesh was that the original sub-basin polygons in Figure 3 had too many vertices that produced very small triangles. Thus, the sub-basin boundary lines were simplified to have a much smaller number of vertices as shown in **Figure 17**.

Break points spaced every 100 feet in a triangular pattern and away from the basin boundaries by at least 30 feet were used to produce a more uniform mesh in the OL region which is shown in **Figure 18**.

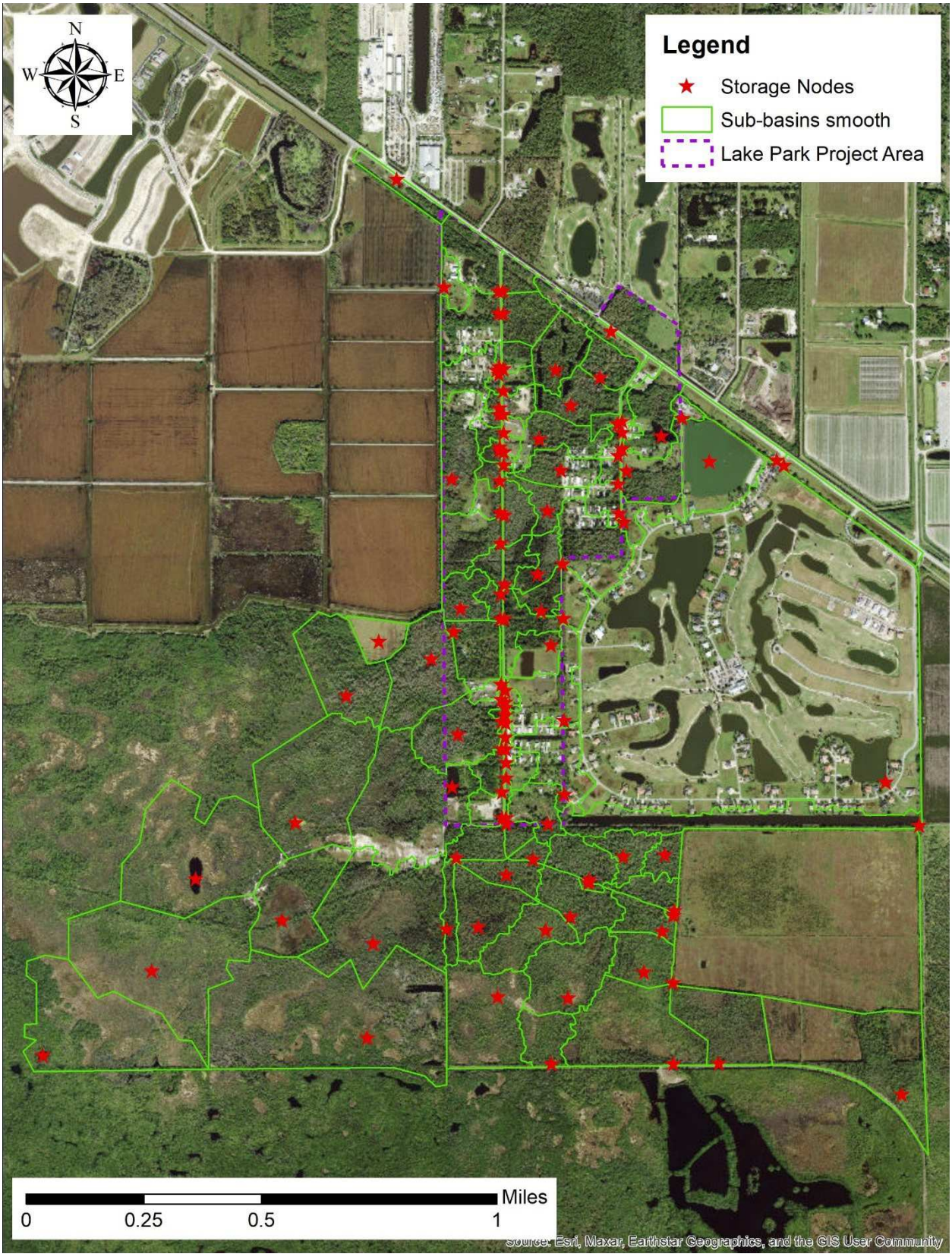


Figure 17. Simpler sub-basin boundaries and storage nodes in the final 2D ICPR model.

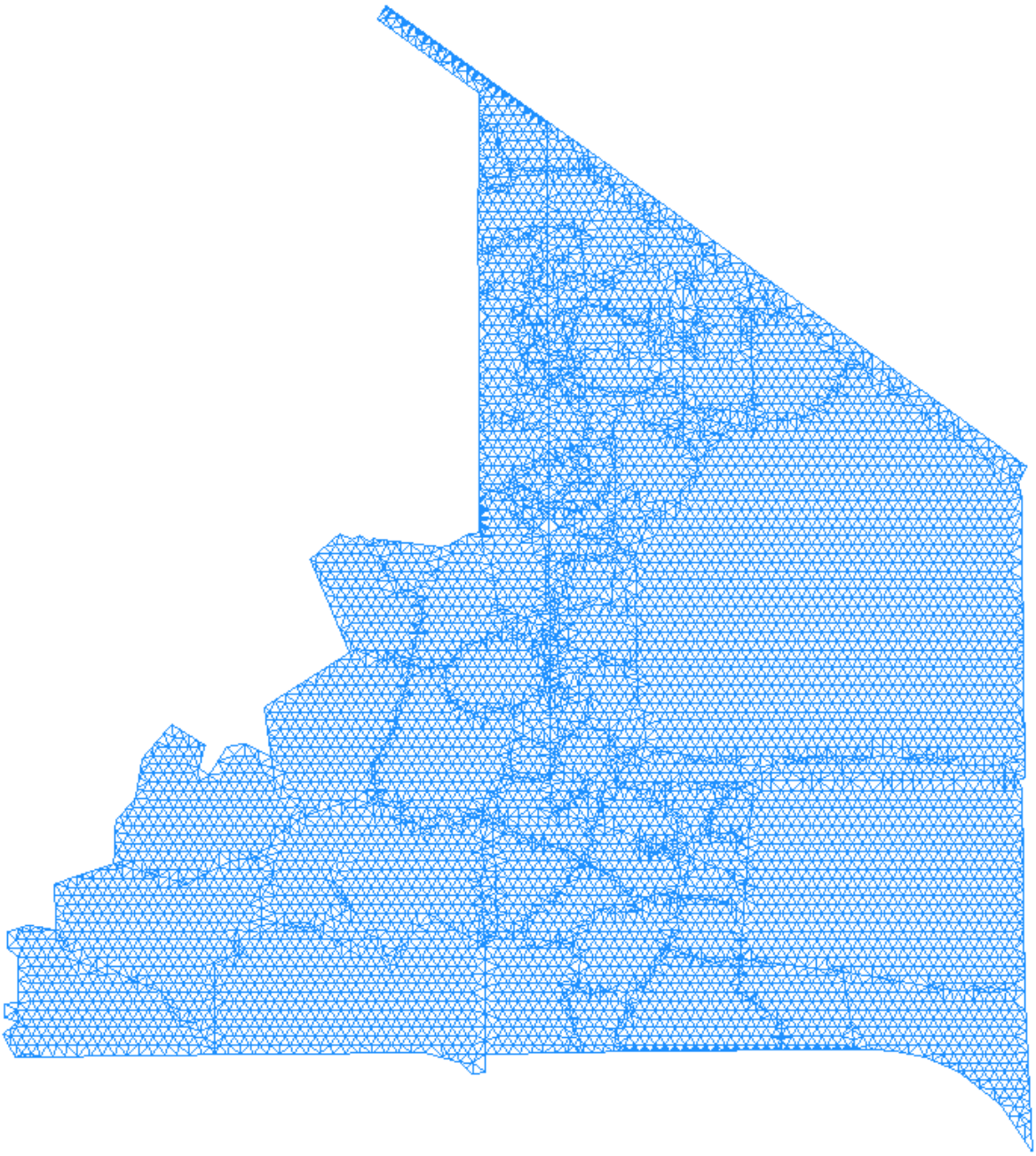


Figure 18. Triangular mesh in the overland region.

Groundwater Region

The groundwater (GW) flow component of the ICPR model was activated for simulating the water table levels in the model area. Tracking the water table level over time is expected to produce a better estimation of the infiltration and runoff rates.

The GW layer parameters are assumed as follows.

- Top layer elevation taken from the LiDAR DEM
- Initial water level = 1.5' NAVD88 (uniformly) for the continuous simulations starting on May 1st, 2022. For design storm simulations starting on September 1st, node stages are used as obtained from the continuous simulation.
- Confining layer top (or layer bottom elevation) = -5' NAVD88.
- Fillable porosity below ground (or specific yield Sy) = 0.25, uniformly. Notice that typical soil Sy values in Table 2 are around 0.3.
- Horizontal Hydraulic Conductivity (Kh) = 50 ft/day, uniformly, which is about two times the typical soil saturated vertical Hydraulic Conductivity (Kv) in Table 2.
- Crop coefficient (Kc) = 0.9, uniformly. Typical range is from 0.7 to 1.1.
- Root depth (Rd) = 2', uniformly. Typical range is from 0.1' to 5'.
- Lateral boundary conditions are assumed closed.

As in the OL region, break points in the GW region were spaced every 100 feet in a triangular pattern and away at least 30 feet from the sub-basin boundaries. This produced the mesh shown in **Figure 19**. The OL and GW meshes are slightly different because the OL triangles follow the internal sub-basins boundaries, which is not needed in the GW mesh.

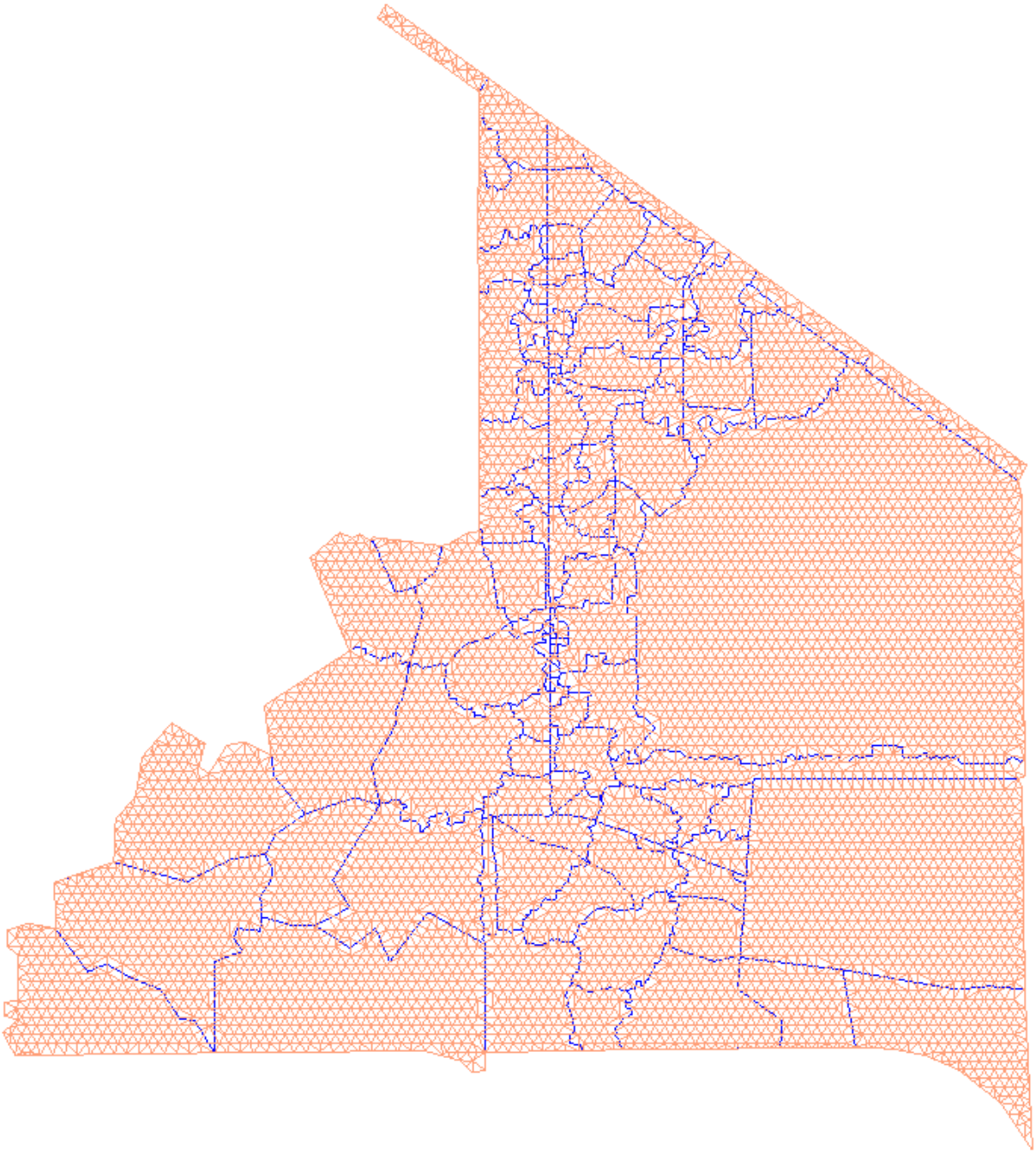


Figure 19. Triangular mesh in the groundwater region.

Design Storm Rainfall

Cumulative rainfall as a function of the return periods and durations in South Florida were adapted from the SFWMD isohyetal maps[5]. **Table 5** shows the cumulative rainfall values extracted from those isohyetal maps at the center of the project area.

Table 5. Cumulative rainfall as a function of the return period and the duration

Duration (days) ->	1	3
Return period (years)	Cumulative rainfall in inches	
3	4.5	–
5	5.5	–
10	7	10
25	8	12.2
100	11	15.4

Historic Rainfall

Historic rainfall data were obtained from NEXRAD rainfall data records with a frequency of 15 minutes. The NEXRAD grid around the model domain is shown in **Figure 10**.

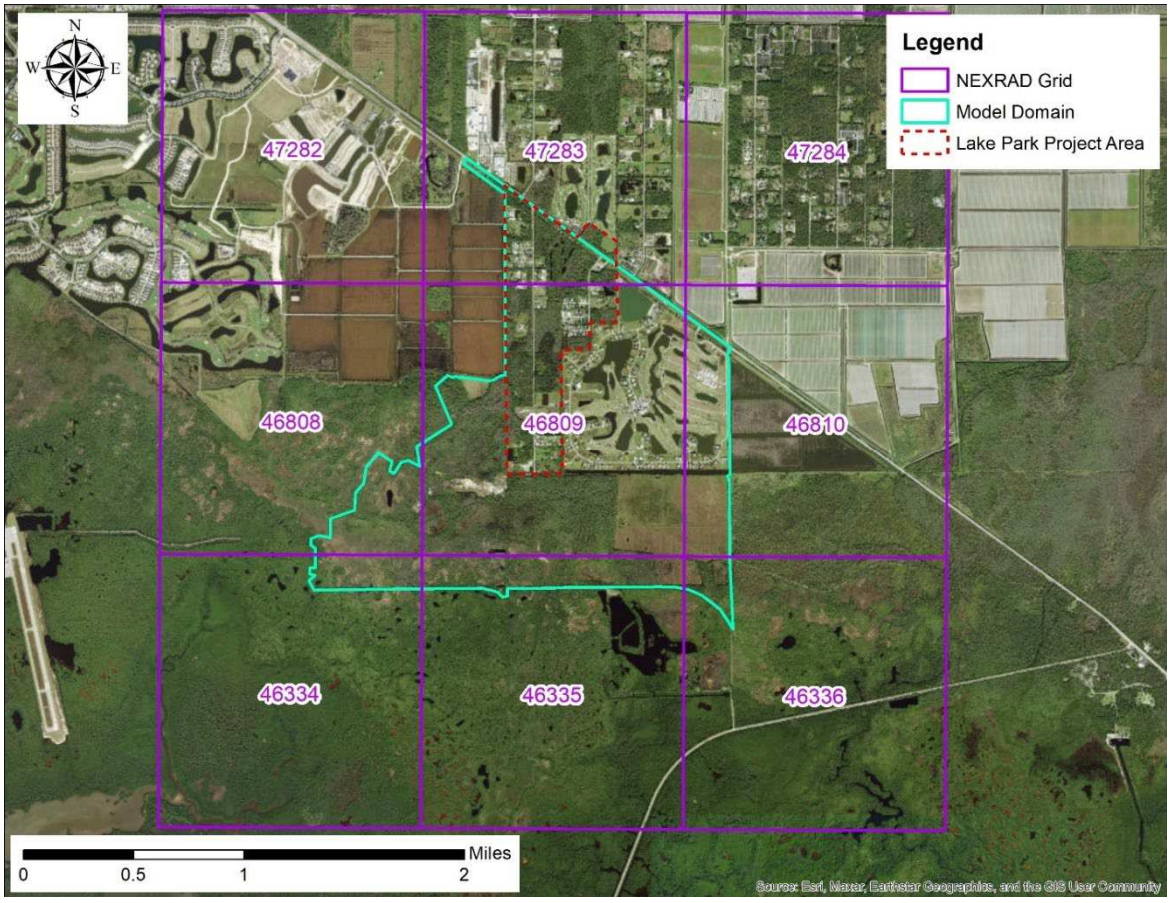


Figure 20. NEXRAD grid around the model domain.

[5] Environmental Resource Permit Information Manual Volume IV. Water Resource Regulation Department. SFWMD Memorandum dated on July 1, 2010.

Figure 21 shows the NEXRAD rainfall data during the 2022 wet season as downloaded from DBHYDRO for the two pixels intersecting the project area and processed into daily values.

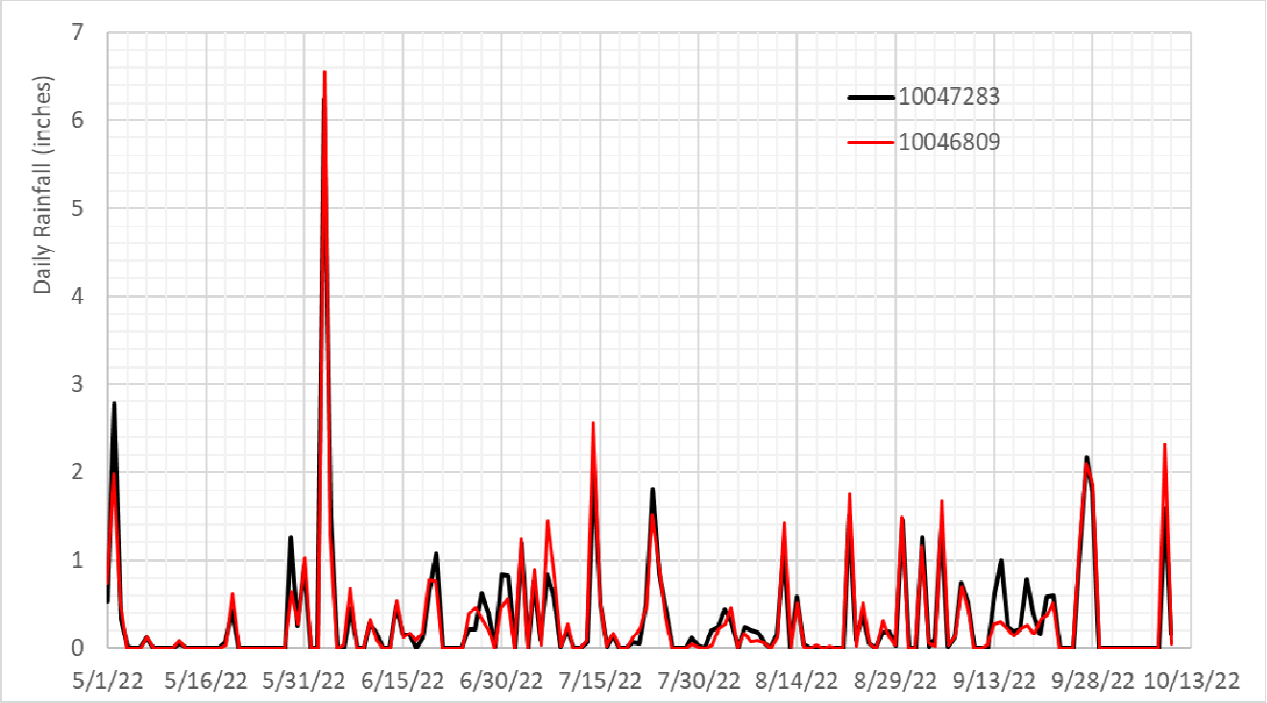


Figure 21. Daily NEXRAD rainfall during the wet season of 2022

Evapotranspiration

The ICPR 2D model estimates the evapotranspiration losses from the reference evapotranspiration (RET) rates, as well as from the vegetation related parameters crop coefficient (Kc) and root depth (Rd).

The RET daily data computed for the NEXRAD grid pixels in the period 1985-2020[6] were obtained from the USGS. An average seasonal variation of RET was estimated by computing the Julian Day averages from the 36-year data period, which is shown in **Figure 22** at two central pixels. The Julian Day average RET was applied for the ICPR simulations.



Figure 22. Seasonal trend of the RET estimated at two NEXRAD pixels from the USGS data.

[6] https://www.usgs.gov/centers/cfwsc/science/reference-and-potential-evapotranspiration

Model Verification

Model Setup

There are no state or federal surface or groundwater stage monitoring sites near the project area. The ICPR model results were verified by using the data collected as part of this project, which included water level collected at monitoring stations, surveyed water edge elevations, and other field observations during field visits. The simulation period for this verification run was 5/1/22 – 9/30/22. NEXRAD 15-minute rainfall was applied in the model for the simulation period and spatially distributed as shown previously in Figure 10.

The initial conditions water levels at nodes for this continuous simulation are assumed uniform and equal to 1.5' NAVD88, which is consistent with the typical dry conditions on May 1st. The period before starting the stage monitoring on 6/21/22 was considered a "warming" period that helped to reduce the influence of the initial conditions assumed.

The data collected at the main US-41 Road culvert (from 6/21/22 through 9/30/22) and shown later in Figure 24 was applied at the main inlet node as boundary condition (BC). A stage value of 2.8' was assumed for the month of May. The node located northwest at the US-41 Road ditch (labeled as Inlet_NW) uses the same BC stage hydrograph, but with an offset of 0.2'. The US-41 Road crossing links were set to "positive flow only", to avoid unrealistic negative flows during the warming period.

The outfall node used the tidal stage time series data adapted from the SFWMD DBHYDRO station HC1_T as boundary condition, as shown in **Figure 23**. The tidal levels were capped below 1.4' NAVD88 by assuming that the existing tidal wetlands between the coast and the outfall node will suppress lower tidal levels during the wet season. The HC1_T time series was also modified by shifting the time in -1.5 hours.

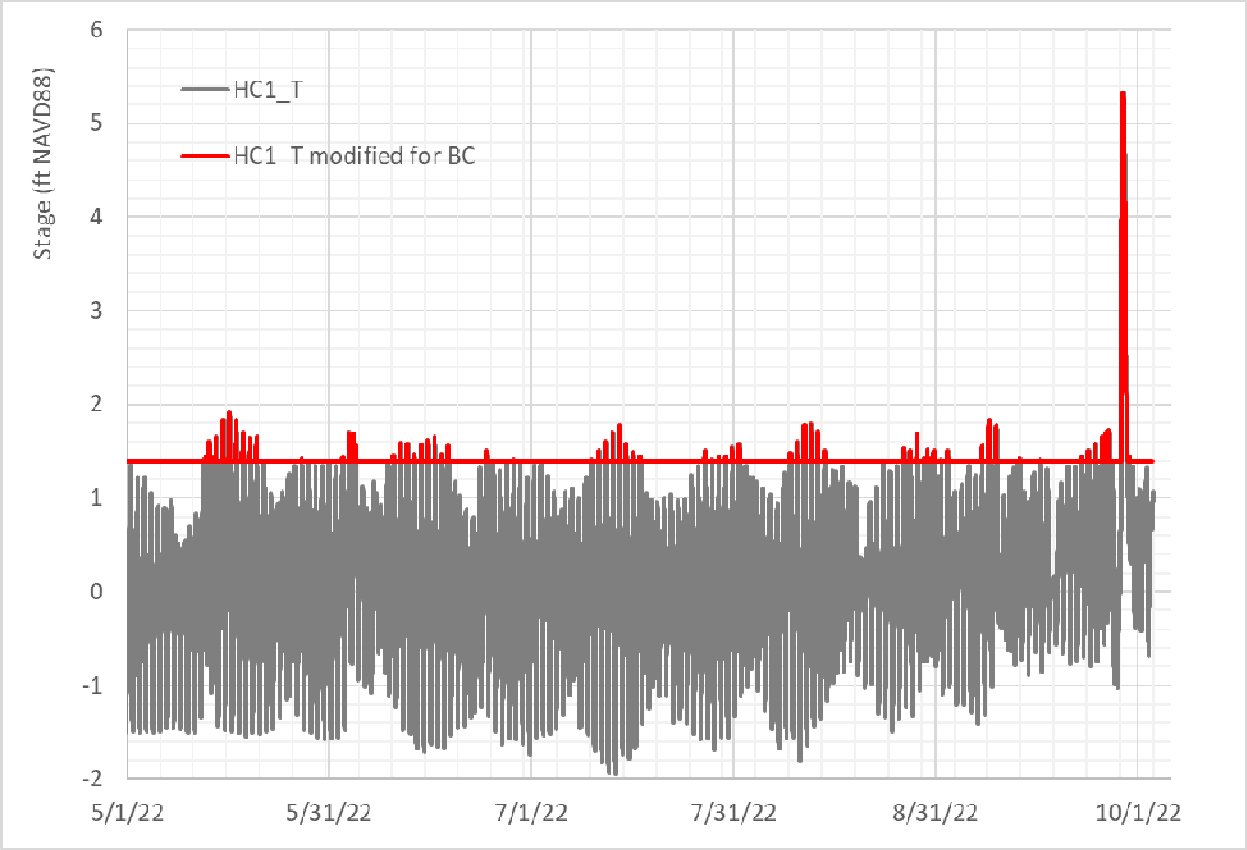


Figure 23. Stage time series at the HC1_T station versus the one used as outfall boundary condition.

The ICPR model time steps used are presented in **Table 6**. These time steps produced expected ground water levels throughout the simulation, small mass balance errors, and reasonable run times.

Table 6. Time steps used in the ICPR model

Component	Time step (seconds)
Hydrology, minimum	120
Surface hydraulics, minimum	0.01
Surface hydraulics, maximum	120
Groundwater, minimum	3600

Stage Comparison

The comparison of stages estimated in the ICPR model with the stages measured at the monitoring stations is presented in **Figure 24**. The observed data suggest that the conveyance in the Royal Palm West Bypass Ditch varies over time due to the variable vegetation coverage and other temporal obstructions at the ditch. However, the ICPR model assumes constant conveyance at the ditch. Notice that the ICPR model differences between center and south locations are higher than the differences observed during the water edge survey on 8/16/22. Thus, the ICPR model results corresponds to intermediate conveyance conditions in the Royal Palm West Bypass Ditch.

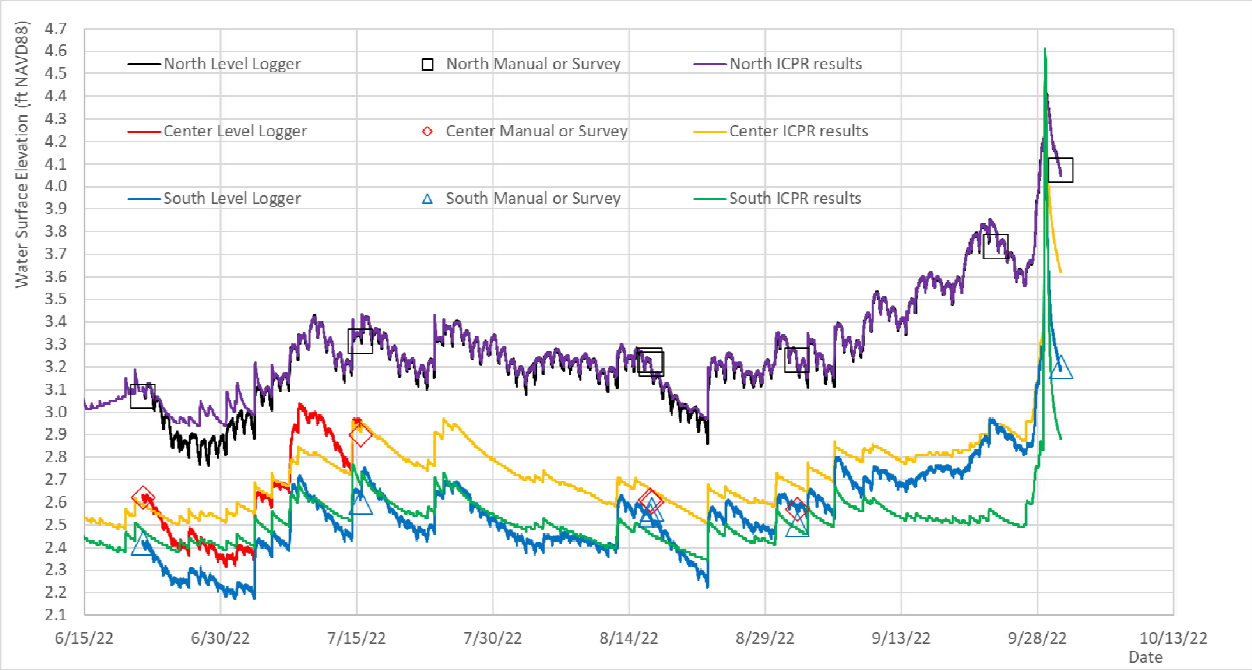


Figure 24. Comparison of the ICPR estimated stages at monitoring stations

At the south location, the differences between model and observed stages in Figure 24 are in the range of [-0.44', 0.66'] with mean error (ME) = -0.04' and root mean square error (RMSE) = 0.14'. Deviations in water levels of 0.5' or lower are considered excellent model performance in storm water modeling.

Figure 25 shows a zoomed in view of the plots in Figure 24 during hurricane Ian. From this figure, it is apparent that the model underestimates the stages at the south location before the hurricane by about 0.4'. However, the observed and model estimated peaks match relatively well after the minor adjustments made to the recorded tidal water levels at HC1_T that were used as outfall boundary conditions.

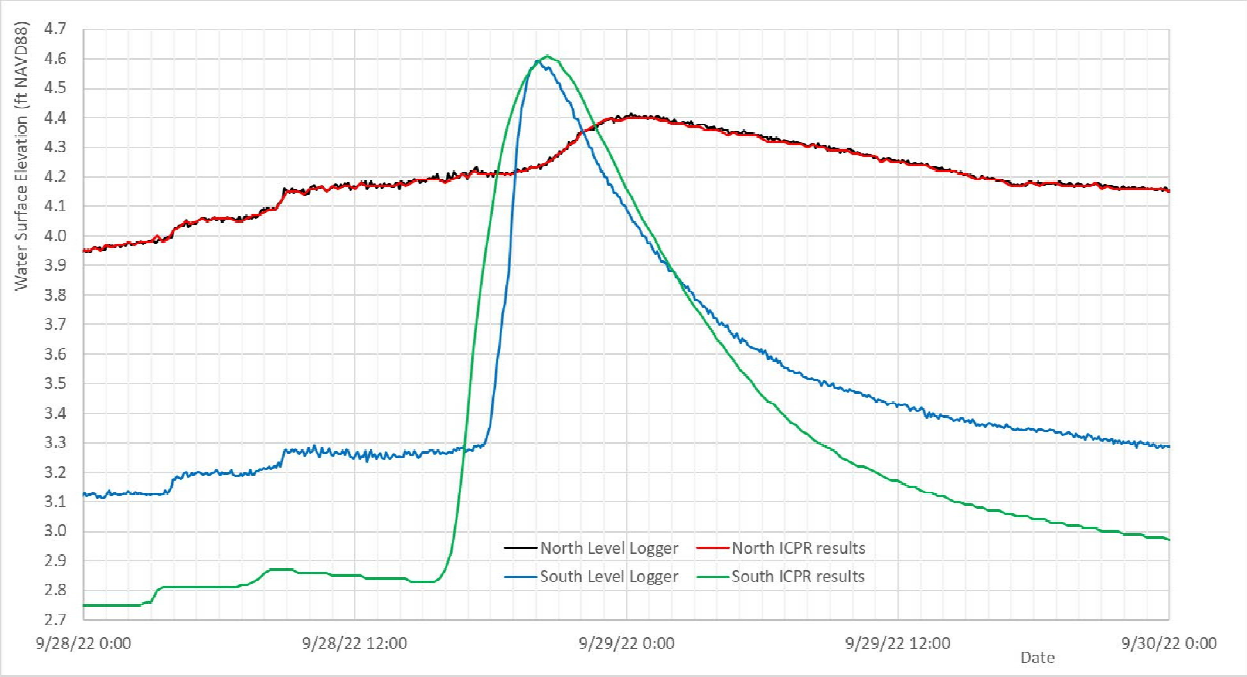


Figure 25. Comparison of the ICPR estimated stages at monitoring stations during Hurricane Ian.

The map in **Figure 26** shows the difference between ICPR estimated water levels on 8/16/22 9:00 AM and surveyed water edge elevations. The differences of -0.40' at Auto Ranch Road and of about 0.3' at the dirt road crossing are likely caused by survey errors. Otherwise, the absolute differences in Figure 26 are lower than 0.1'.



Figure 26. Difference of the ICPR water levels on 8/16/22 9:00 AM and the surveyed water edge elevations.

Flood Maps

Maximum water levels at nodes during the simulation period occurred during Hurricane Ian. They were assigned for the corresponding subbasins, and the LiDAR DEM elevations were subtracted to obtain water depths at each DEM cell. **Figure 27** shows the resulting maximum flood depth map in the model domain. A zoomed in view around the intersection of Auto Ranch Road and Maple Tree Drive is also included in **Figure 28.**

According to the ICPR model results, there was some flooding along Auto Ranch Road and Lake Park Boulevard during Hurricane Ian. The highest water depth at road crown estimated on those roads was of 1.1' and occurred at Auto Ranch Road, west from Morgan Drive. Around the intersection of Auto Ranch Road and Maple Tree Drive, the model predicted a maximum depth at road crown of 0.74'. Roads are not considered drivable if the water depth is more than 0.5'.

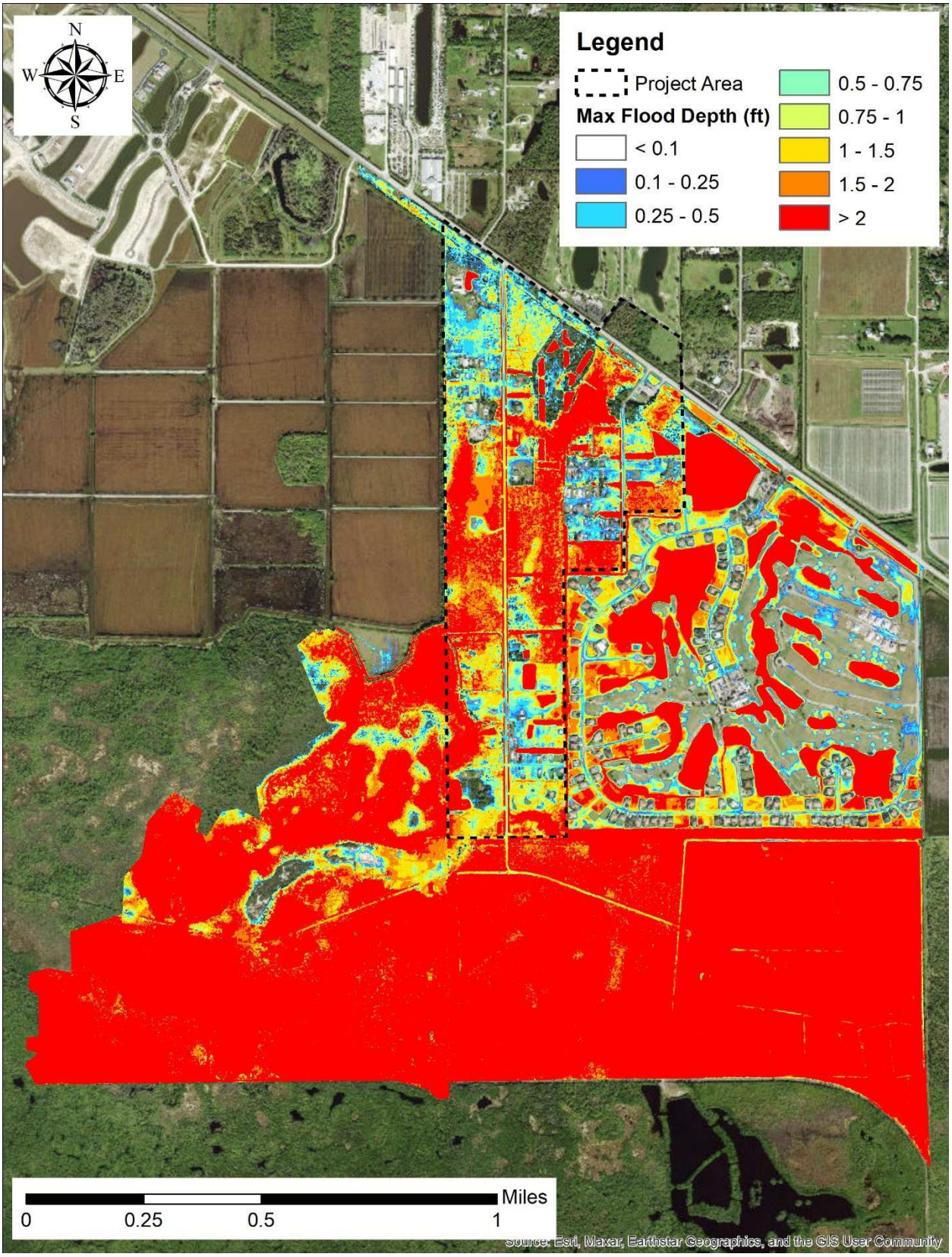


Figure 27. Maximum flood depth map during the simulation period.

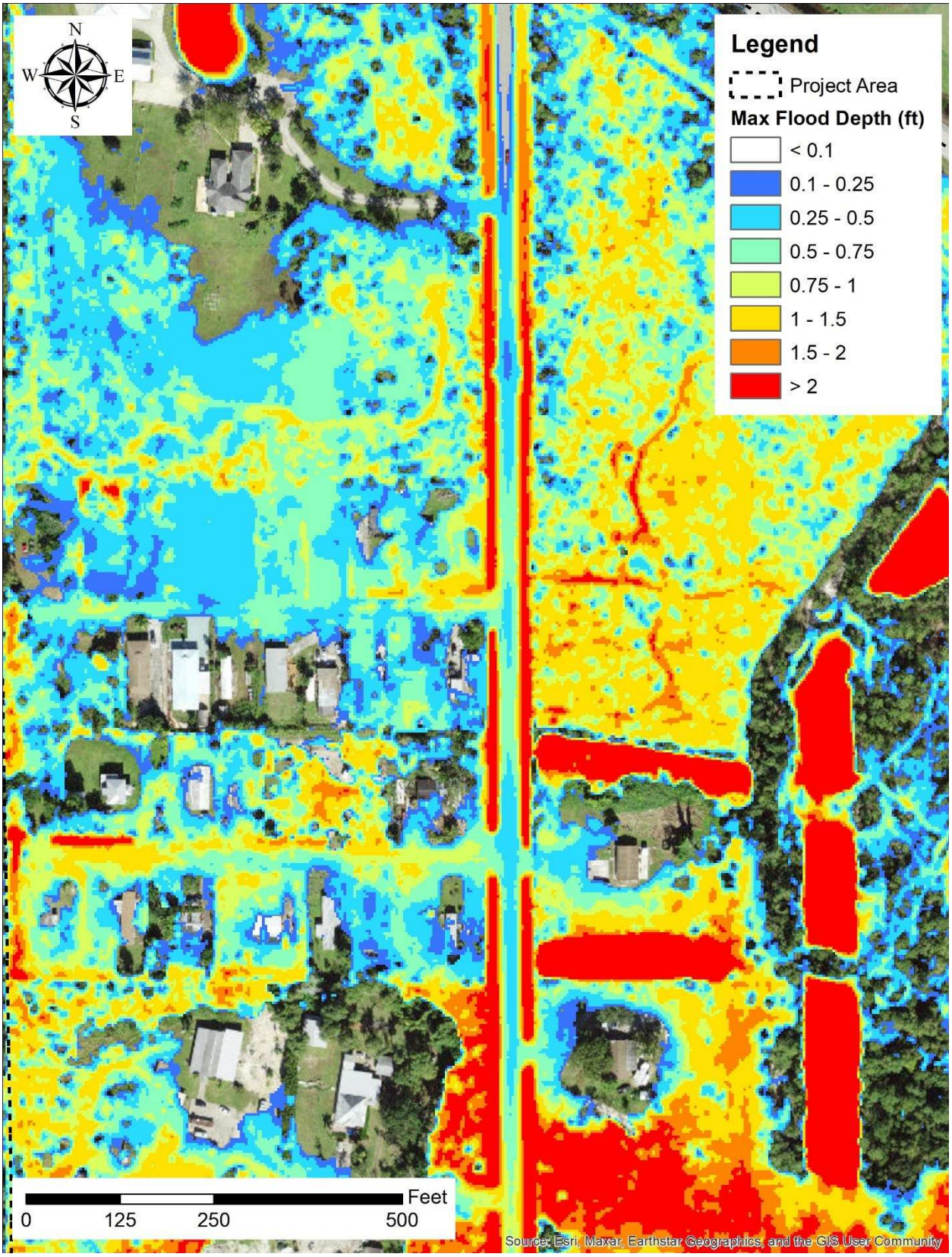


Figure 28. Maximum flood depth map during the simulation period. Zoomed in view around the intersection of Auto Ranch Road and Maple Tree Drive.

Model Flows

The flows computed by the ICPR model at selected locations are presented in **Table 7**. Flow hydrographs after 6/21/22 are also included in **Figure 29**. Notice in this figure that the model predicts continuous wet season outflows to the southwest (link W065B) and to the south (links P071S and P073). Thus, the two pipes under the dirt road control the discharge rate to the south and retain water upstream.

Table 7. ICPR computed flows at selected locations.

			Flow (cfs)	
ID in Figure 31	ICPR link label	Stormwater feature	Peak around 6/3/22	Peak around 9/28/22
1	P003	US-41 Rd Culvert (2 boxes 5' x 9')	—	26.8
2	P001N	US-41 Rd Culvert (2 boxes 4' x 7') at NW	---	12.8
3	W044C	Royal Palm West Bypass Ditch	0.4	1.7, -6.3
4	P043A	Pipe across Auto Ranch Road (18" RCP)	0.0	2.7
5	W065B	Southwest outflow	1.3	26, -79.5
6	P071S	South outflow (12" HDPE pipe)	2.5	3.1, -2.6
7	P073	South outflow (24" cast iron pipe)	2.6	4.5, -5.1

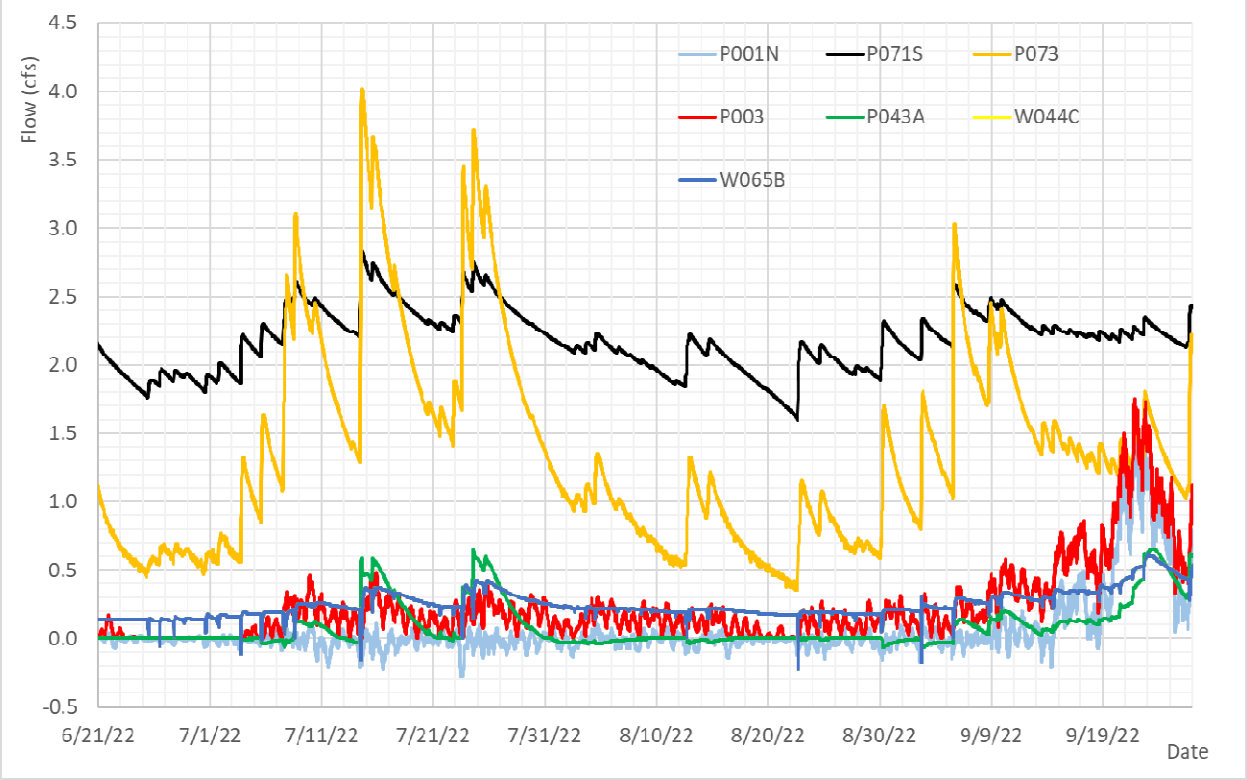


Figure 29. ICPR flow hydrographs for the links in Table 7 for the period 6/21/22 - 9/27/22 (i.e., before Hurricane Ian)

Figure 30 presents flow hydrographs at selected locations during Hurricane Ian. Notice that according to the model estimations, the tidal surge of Hurricane Ian causes a negative flow at the south dirt road (links P71S and P073) up to the central areas (link W065B) for a few hours on September 28, 2022. However, there is always positive flows at the US-41 road inlet culverts.

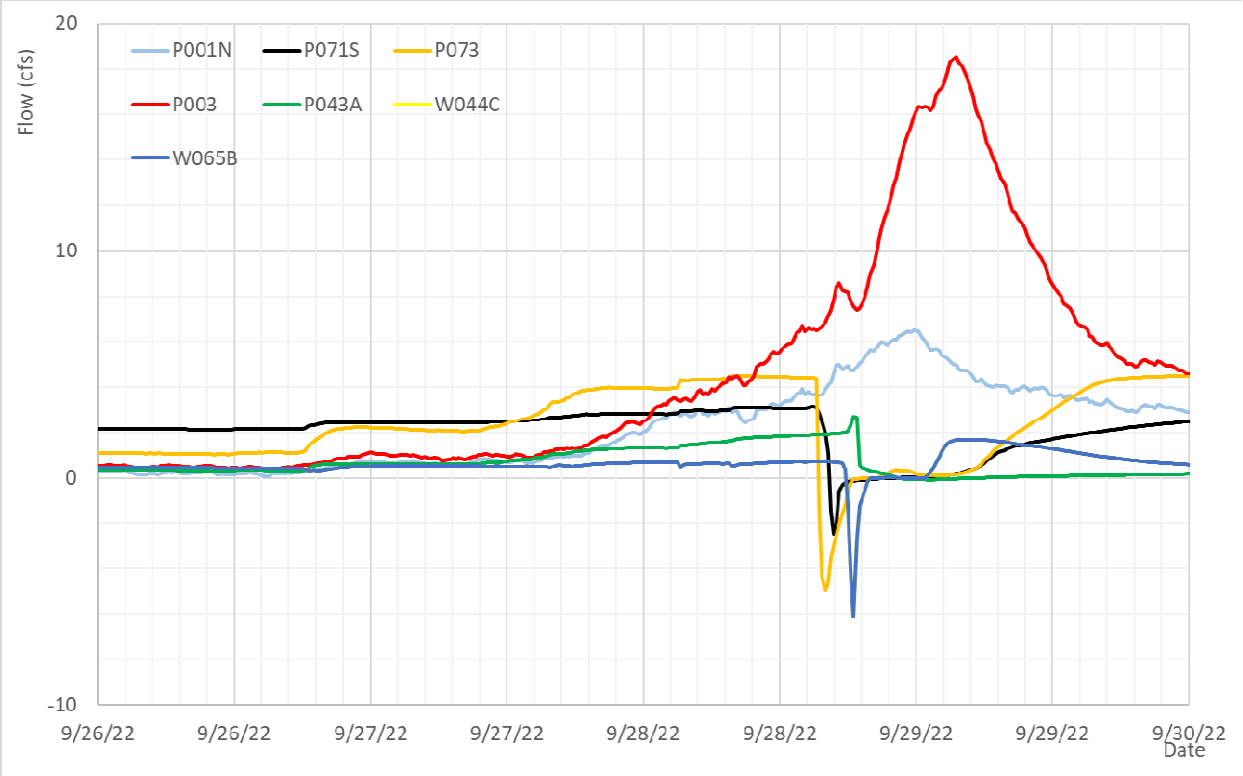


Figure 30. ICPR flow hydrographs for the links in Table 7 for the period 9/26/22 - 9/30/22 (i.e., during Hurricane Ian)

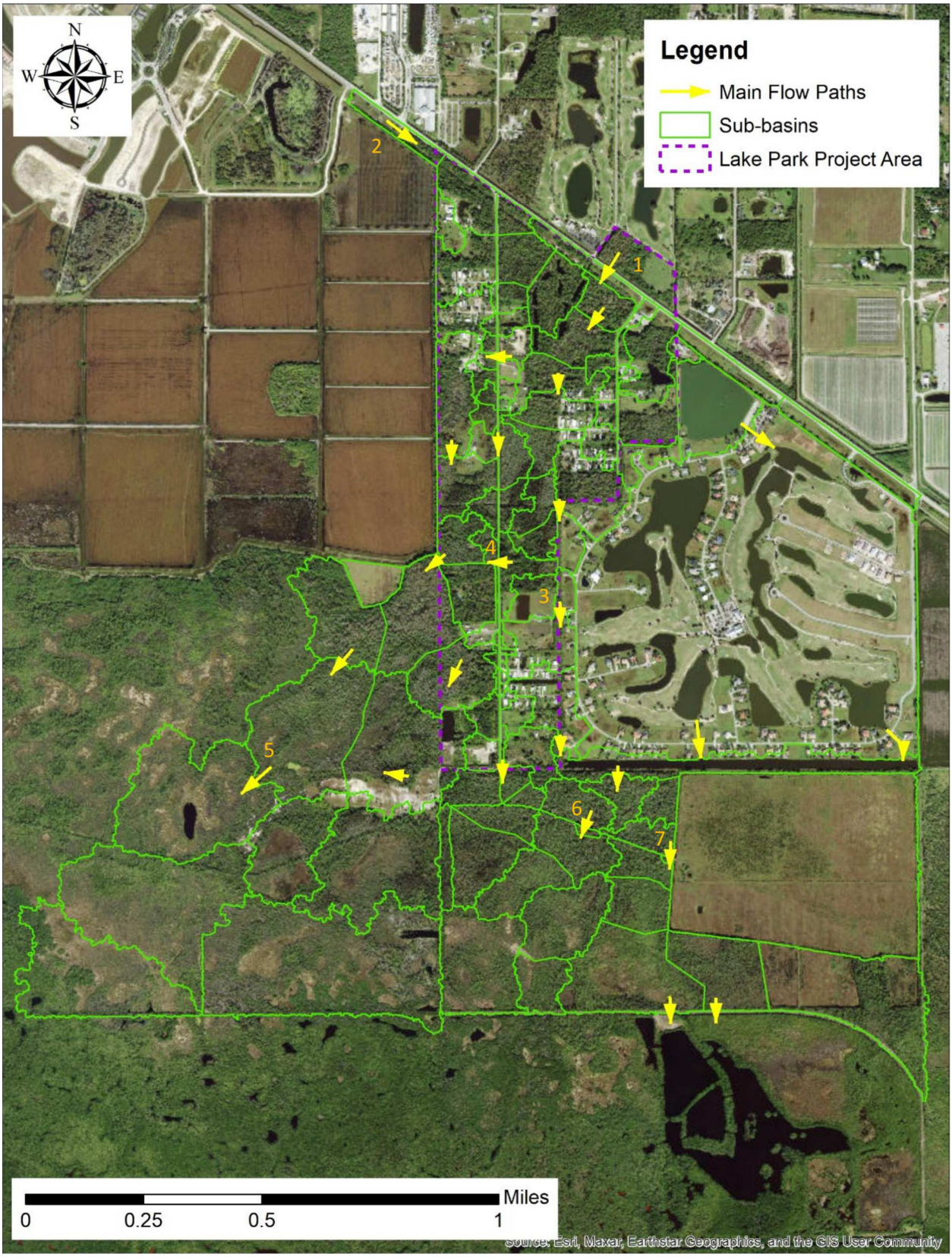


Figure 31. Locations for extracting the ICPR flows as presented in Table 7 and Figure 29

Average Water Depth

Water levels computed by the ICPR model at nodes were averaged for the period 6/21/22 – 9/27/22. Average water levels at nodes were assigned to the corresponding subbasins, and the LiDAR DEM elevations were subtracted to obtain average water depths at each DEM cell. **Figure 32** shows the resulting average water levels above ground inside the model domain.

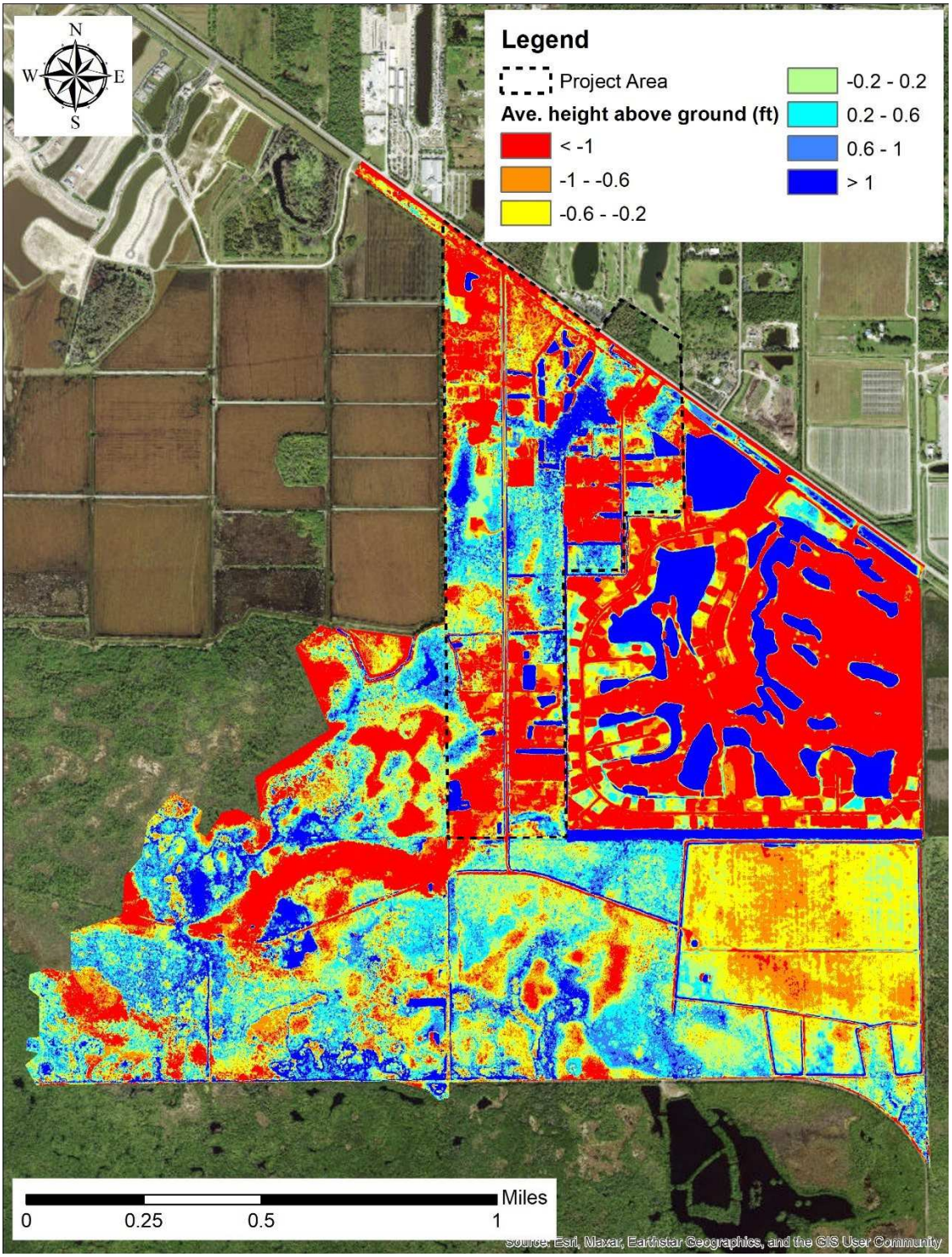


Figure 32. Average water level above the ground for the period 6/21/22 - 9/27/22

Design Storm Simulations

Model Setup

The design storm simulations used the 24-hour duration rainfall normalized hydrograph labeled in the ICPR software as "FLMOD". Return periods of 5, 10, 25, and 100 years were considered by using the 1-day cumulative rainfall amounts listed in previous Table 5.

The initial conditions at nodes were taken from the continuous simulation results on 9/1/2022.

Boundary condition stage hydrograph at the north ditch of the US-41 Road at the main inlet culvert (node labeled as Inlet) was estimated as follows. The first (rising) limb of the normalized rainfall hydrograph FLMOD was used to calculate the stages going from 3.2' to the peak stage for the corresponding return period as listed in **Table 8**. The hydrograph was shifted by using a reasonable lag time of one hour. After the peak, the stage is assumed constant for two hours, and after that, the stage decreases linearly to the initial value of 3.2'. The resulting boundary condition stage hydrographs are plotted in **Figure 33**.

Table 8. Peak stages estimated at the US-41 north ditch as detailed in Task 1 Technical Memorandum[1].

Return period (years)	Peak stage (feet NAVD88)
5	4.05
10	4.33
25	4.72
50	5.04
100	5.38

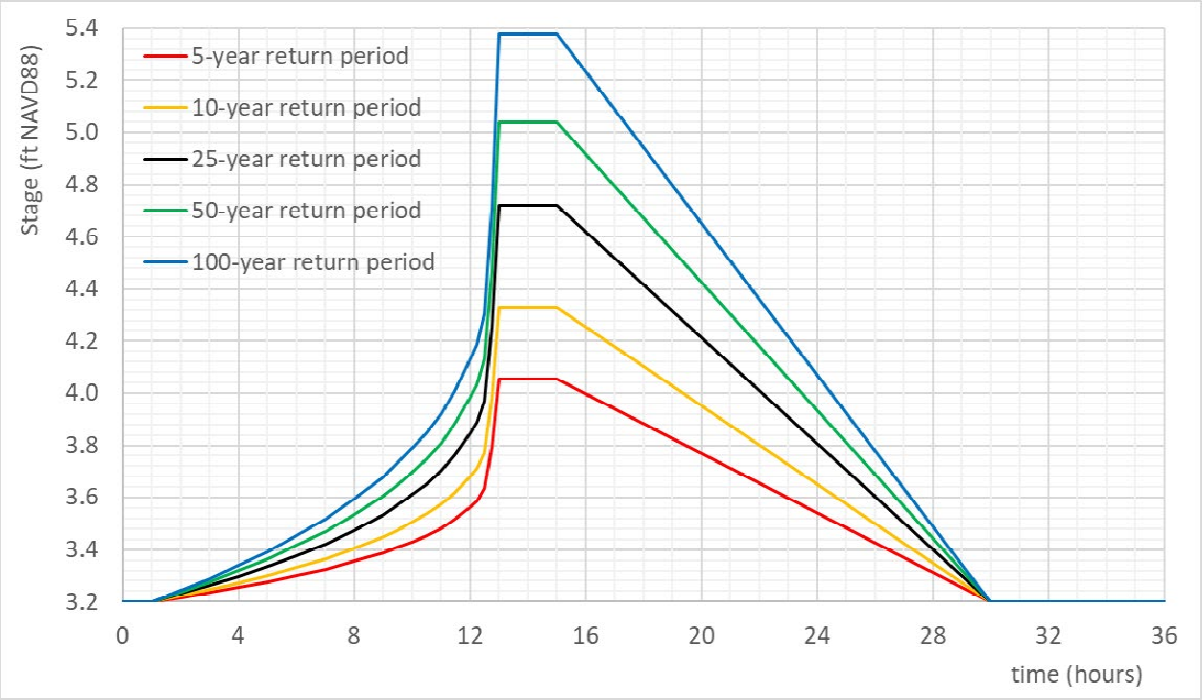


Figure 33. Boundary condition stage hydrographs applied at the north ditch of the US-41 Road.

The node located northwest at the US-41 Road ditch (labeled as Inlet_NW) uses a similar hydrograph by adding an offset of 0.2'.

The links representing the US-41 Road culverts were set to “positive flow only”, to avoid unrealistic negative flows during the simulation.

As in the continuous simulation, boundary conditions at the outfall node use the tidal time series stage data adapted from station HC1_T. Since the design storm simulations start on 9/1/22, normal wet season tidal boundary conditions are applied, and the computed flooding is a consequence primarily from high rainfall and US-41 culvert Inflows.

Flood Maps

Figure 34 shows the maximum flood depth resulting from the 25-year design storm in the model domain. **Figure 35** also shows a zoomed-in view around the interception of Auto Ranch Road and Maple Tree Drive.

According to the ICPR model results, a 25-year maximum depth at road crown of 0.57’ occurs at Auto Ranch Road near Maple Tree Drive. Roads are considered not drivable if the water depth is more than 0.5’.

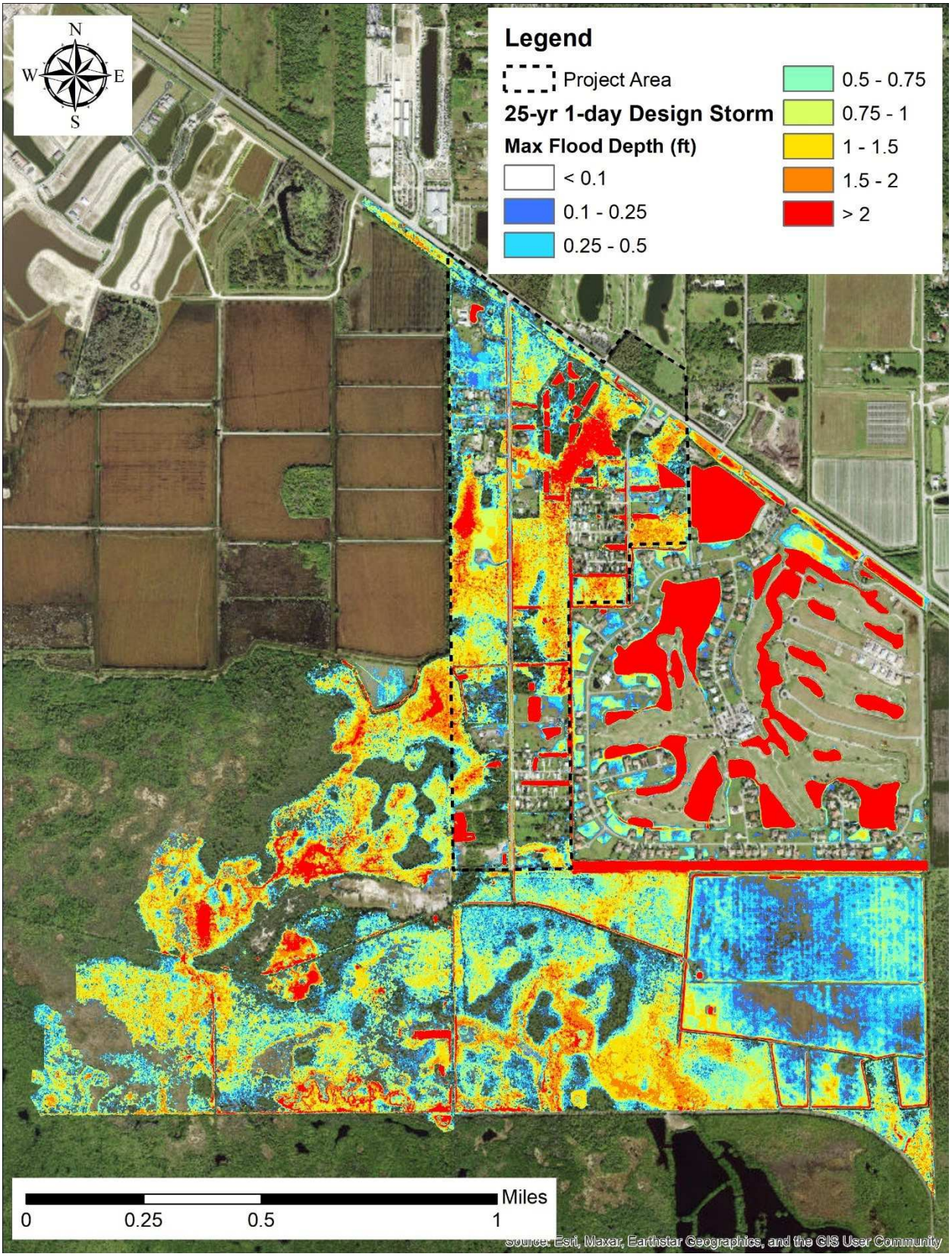


Figure 34. Maximum flood depth from the 25-year return period design storm.

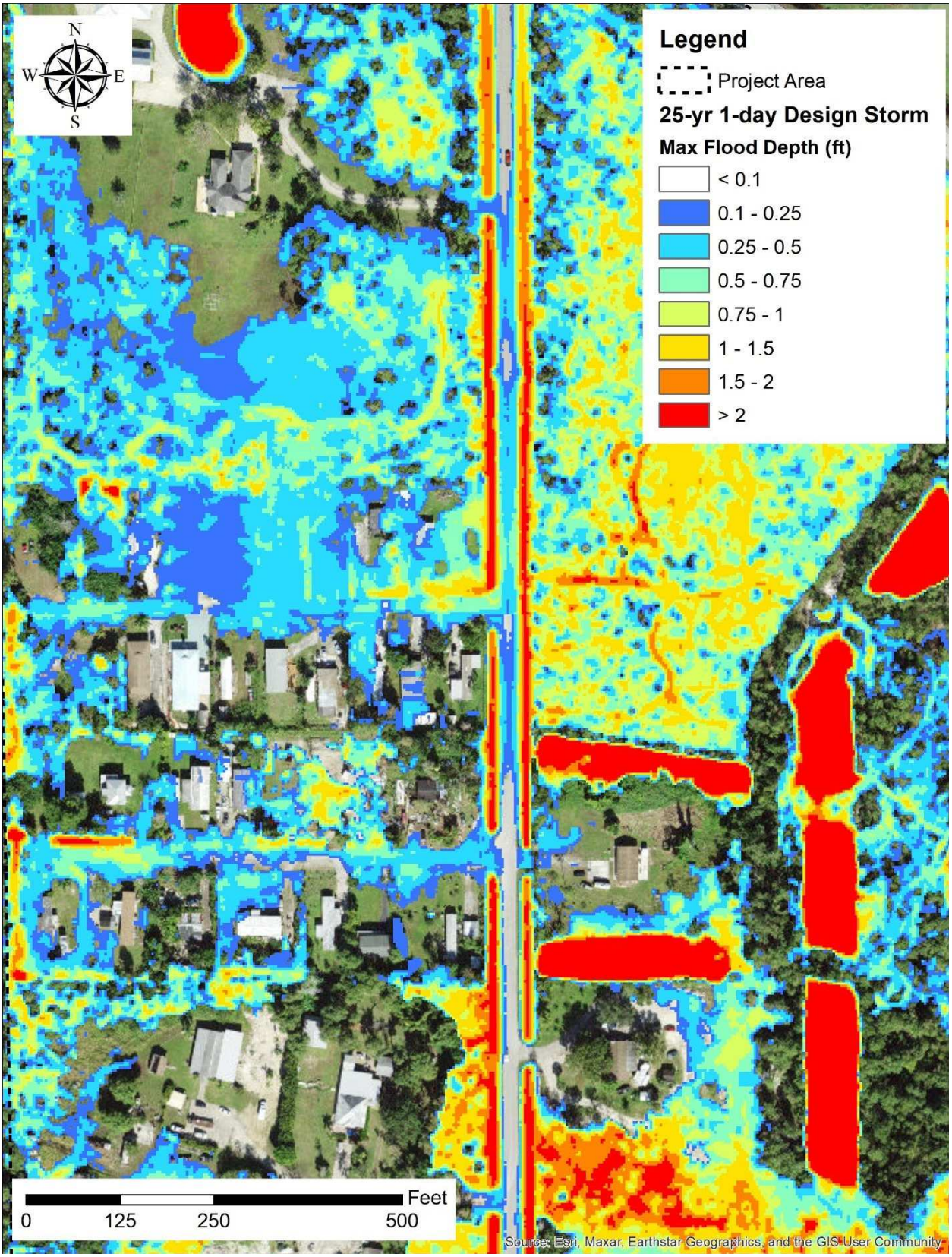


Figure 35. Maximum flood depth from the 25-year return period design storm. Zoomed-in view around the intersection of Auto Ranch Road and Maple Tree Drive.

Model Flows

Model peak flows at selected locations for the different design storms are presented in **Table 9**. The storm surge affected flows during Hurricane Ian are also included in the table.

Table 9. ICPR estimated flows in cfs at selected locations for different design storms.

			Design Storm				Hurricane Ian around 9/28/22
ID in Figure 31	ICPR link label	Stormwater feature	5 year	10 year	25 year	100 year	
1	P003	US-41 Rd Culvert (2 boxes 5' x 9')	33.0	58.6	126.1	255.1	26.8
2	P001N	US-41 Rd Culvert (2 boxes 4' x 7') at NW	25.8	40.8	62.0	94.1	12.8
3	W044C	Royal Palm West Bypass Ditch	0.6	0.8	1.6	2.7	1.7, -6.3
4	P043A	Pipe across Auto Ranch Road (18" RCP)	1.5	2.0	1.9	2.0	2.7
5	W065B	Southwest outflow	3.8	5.8	10.7	19.2	26, -79.5
6	P071S	South outflow (12" HDPE pipe)	3.2	3.5	3.7	3.8	3.1, -2.6
7	P073	South outflow (24" cast iron pipe)	4.5	4.8	4.6	5.0	4.5, -5.1

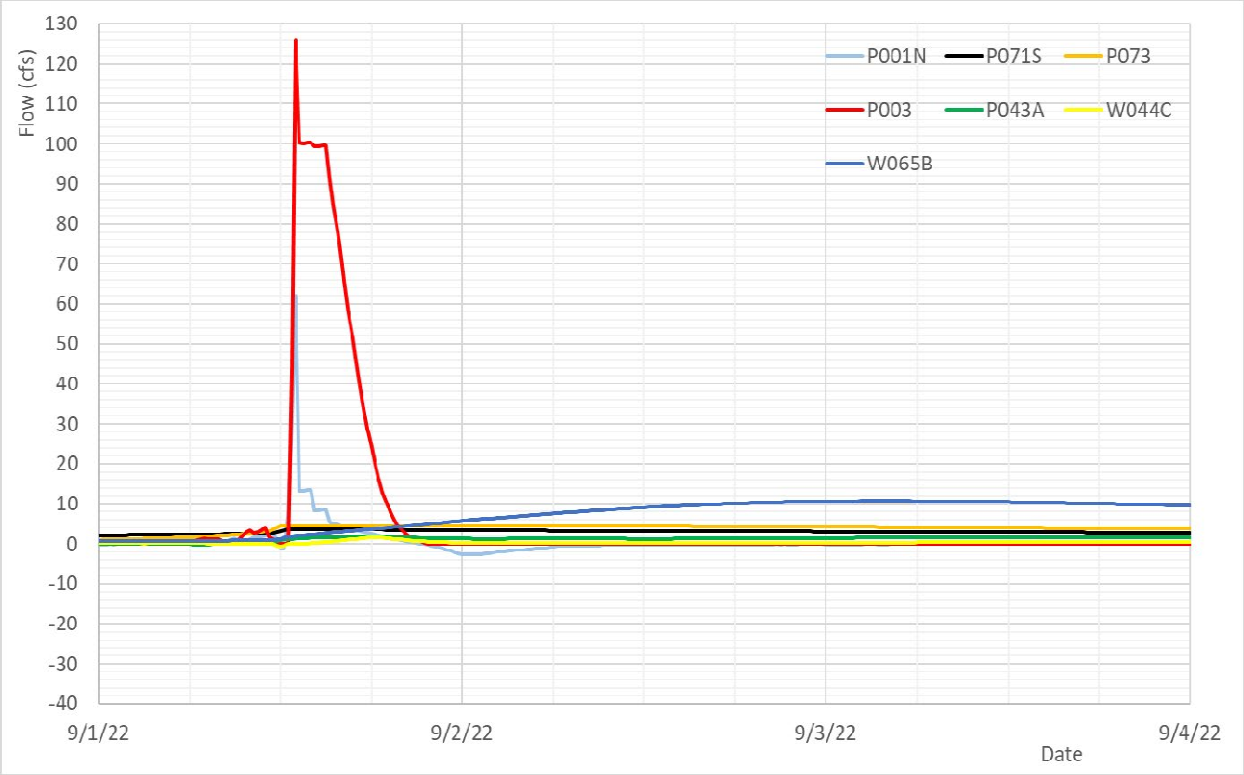


Figure 36. ICPR flow hydrographs for the links in Table 9 from the 25-year design storm simulation

Appendix C. Technical Memorandum for Task 3. Potential Stormwater Management Improvements

LAGO
Consulting and Services

Technical Memorandum

To: Daniel Roman, PE, PMP; Rick Orth, PG.
Stormwater Management Section, Collier County

From: Marcelo Lago, PhD; Ananta Nath, PE; Maria C. Bravo, PE, PhD;
Lago Consulting and Services, LLC;
Allyson Holland, PE; Justin Frederiksen, PE; GradyMinor.

Date: April 3rd, 2023

Re: Lake Park Boulevard Capital Improvements and Water Quality Flowway Pre-Design Study.
Task 3. Potential Stormwater Management Improvements
Collier County PO No. 4500218524

Background

Collier County has contracted Lago Consulting & Services to conduct a pre-design study to identify and evaluate the feasibility of potential stormwater management improvements, conversion of conventional septic systems of waste disposal to a municipal sewer, roadway improvements, restoration of historic flowways to the Rookery Bay estuaries and preservation of related natural resources within the project area. The study area is outlined in **Figure 1**.

The Task 1 activities of the project related to data collection and field reconnaissance were detailed in a separated technical memorandum submitted earlier to the County[1]. An Existing Conditions Stormwater Model for the project area was also developed as part of Task 2[2].

This technical memorandum summarizes the Task 3 activities of the project related to the development and modeling of the proposed stormwater improvements.



Figure 1. Project area.

[1] Task 1. Data Collection and Field Reconnaissance. Draft Technical Memorandum submitted on November 7, 2022.
[2] Task 2. Existing Conditions Stormwater Model. Draft Technical Memorandum submitted on November 14, 2022.

Future Conditions Baseline Model

The first step in the scenario modeling evaluation often involves building a future conditions baseline model by incorporating recent and future changes in the existing conditions model. For this purpose, the ongoing neighboring Fiddler's Creek development known as "Estancia at Fiddlers Creek" and "Esplanade by The Islands" is of interest for developing the future infrastructure improvement features of the Lake Park project. Environmental Resource Permit (ERP) applications submitted to the South Florida Water Management District (SFWMD) in relation to that development are listed in **Table 1**.

Table 1. SFWMD ERP applications related to the Fiddler's Creek development.

Name	Area (ac)	Application No.	Date and status	Permit No.
Estancia at Fiddlers Creek	749.95	150820-2	8/16/16 complete	11-00685-S-09
Estancia at Fiddler's Creek		161202-12	12/23/16 complete	11-00685-S-09
Estancia at Fiddlers Creek		170616-10	6/26/17 complete	11-00685-S-09
Estancia at Fiddlers Creek		171211-6	1/5/18 complete	11-00685-S
Estancia at Fiddlers Creek	811.7	180530-5	8/31/18 Issued	11-00685-S-09
Estancia at Fiddlers Creek	813.64	190827-7	8/29/19 complete	11-107242-P
Fiddler's Creek Estancia	813.64	200522-3517	7/20/20 complete	11-00685-S-09
Esplanade by The Islands	516.28	210324-5706	7/5/22 Complete	11-107242-P
Esplanade by The Islands	516.28	220816-35576	8/16/22 under review	11-107242-P

The plan view in **Figure 2** was extracted from the most recently completed application, and it shows a lake and a berm that will separate the development from the Auto Ranch Road parcels. According to section AA from the plans, the proposed top elevation of the berm is 5 ft NAVD88, and therefore, this berm will create a barrier for the surface water flow, as it is considered in existing conditions.

The berm at the northern end is crossed by an existing double 42" RCP for future FDOT drainage connection, as shown in Figure 2. However, it is unclear what portion of the water that crosses the US-41 near the abandoned mall entrance will flow through the double 42" RCP into the lake in the future. Thus, it is assumed conservatively that the water at the south side of the US-41 culvert near the abandoned mall entrance can only flow east into the Auto Ranch Road areas, as it is considered in the existing conditions.

In summary, it is assumed that the proposed stormwater management features of the Fiddler's Creek development will not cause changes in the surface water flows characteristics of the Auto Ranch Road area under its the existing conditions, and therefore, the existing conditions model without modifications is accepted as the future conditions baseline model of the Lake Park project.

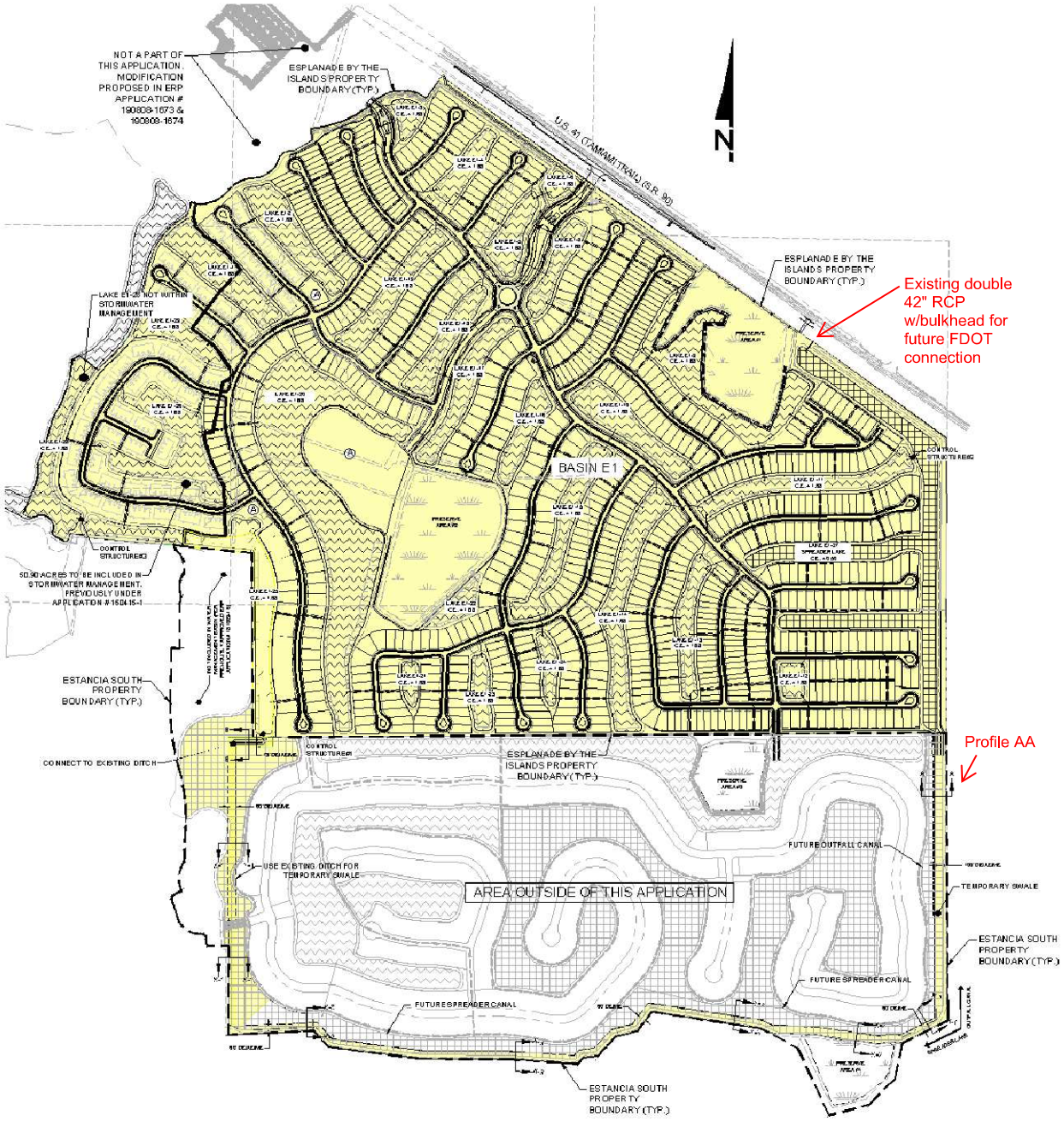


Figure 2. Plans for development Esplanade by The Islands from App. No. 210324-5706

Scenario Evaluation Criteria

Three evaluation criteria as summarized in **Table 2** were utilized to assess the respective performance of the scenarios.

Table 2. Scenario evaluation criteria

Simulation	Model Output	Scenario evaluation criteria
Continuous	Wet season average water depths	Not to decrease wet season average water depths in wetland areas
Continuous	Maximum flood depth and duration during tropical cyclone events like hurricane Ian, which was mainly caused by the extreme high tide.	To decrease flood depth and duration on roads and yards
25-year design storm	Maximum flood depth and duration from the heavy rainfall with normal tide	To decrease flood depth and duration on roads and yards

The performance of each scenario was simulated by introducing the proposed stormwater improvements in the existing conditions model developed in Task 2. The wet season average water depths produced by continuous simulation are shown in **Figure 3**. The improvement scenarios are expected not to decrease the existing wet season water depths and hydroperiod in wetland areas. **Figure 4** shows the wetland areas (i.e., where FLUCCS codes level 1 are equal to 600) in the project area and inside the model domain.

The continuous simulation also generated the maximum flood depth map during hurricane Ian shown in **Figure 5**. This flooding was mostly produced by a combination of high antecedent water levels, rainfall during the storm, high inflows from the US-41 north ditch, and extremely high tidal levels. The proposed improvements are expected to reduce road and yard flooding under these conditions.

The existing condition model developed in Task 2 was also simulated with a 25-year return period design rainfall storm to generate the maximum flood depth map presented in **Figure 6**. The simulation used high antecedent water levels, intense rainfall with a 25-year return period, high inflows from the US-41 north ditch, but normal tidal levels. The scenarios are expected to reduce road and yard flooding in these heavy rainfall conditions.

In summary, the proposed stormwater improvement scenarios are expected to reduce road and yard flooding in conditions of heavy rainfall and high tidal levels, as well as maintain or enhance water depths and hydroperiods in wetland areas.

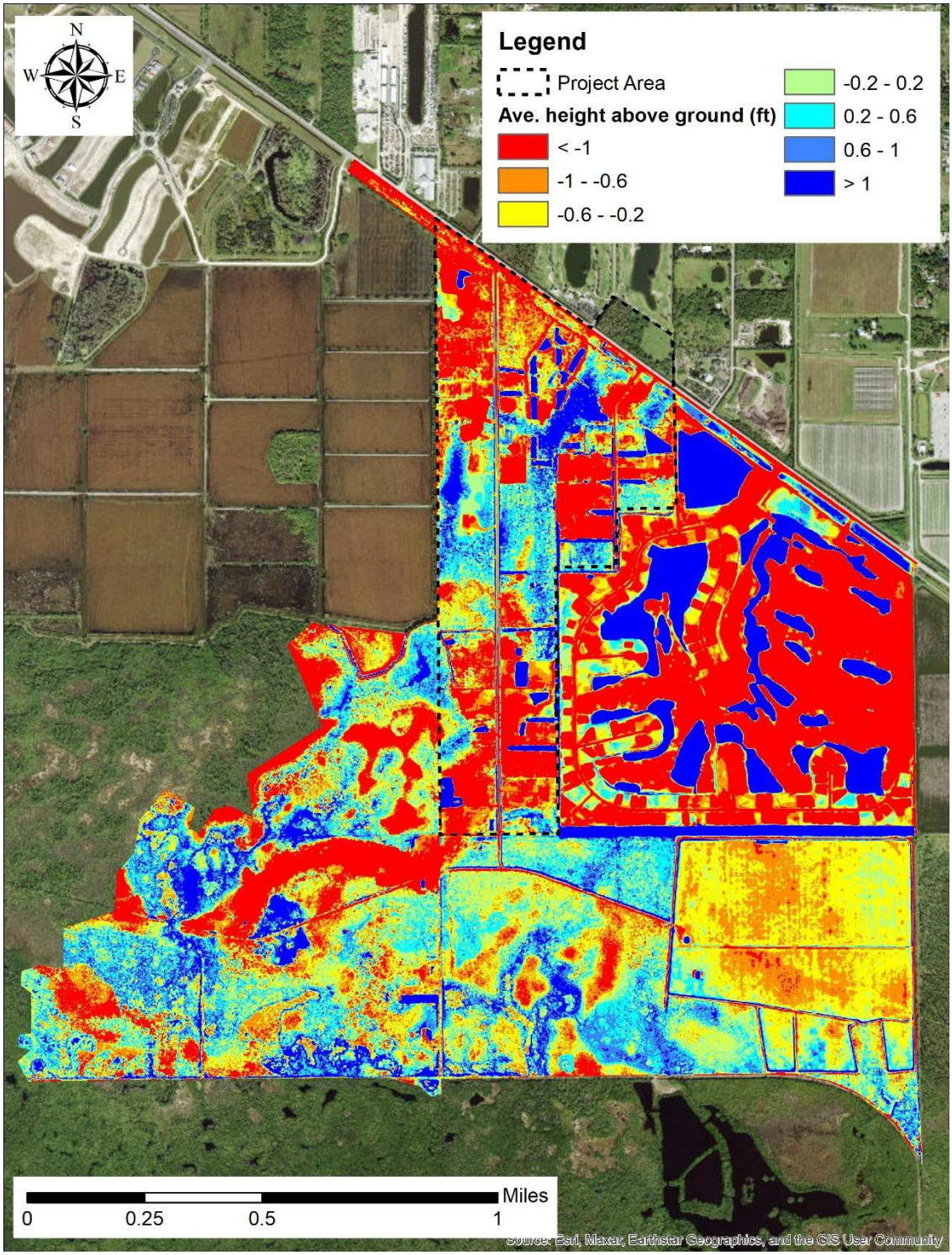


Figure 3. Average water level above the ground for the period 6/21/22 - 9/27/22 from the existing conditions model[3]

[3] Presented as Figure 32 in Technical Memorandum for Task 2.

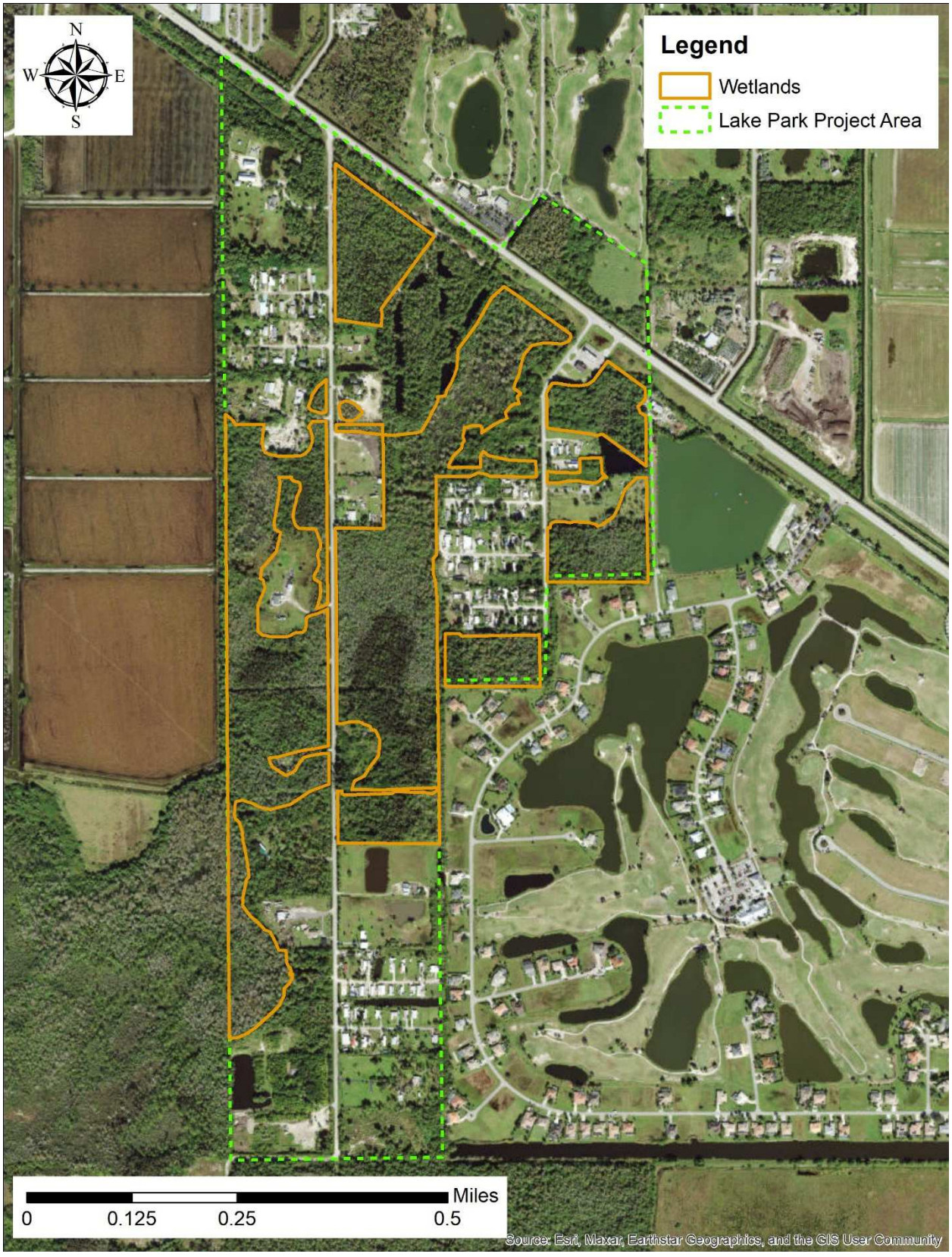


Figure 4. Wetland areas in the project area and inside the model domain.

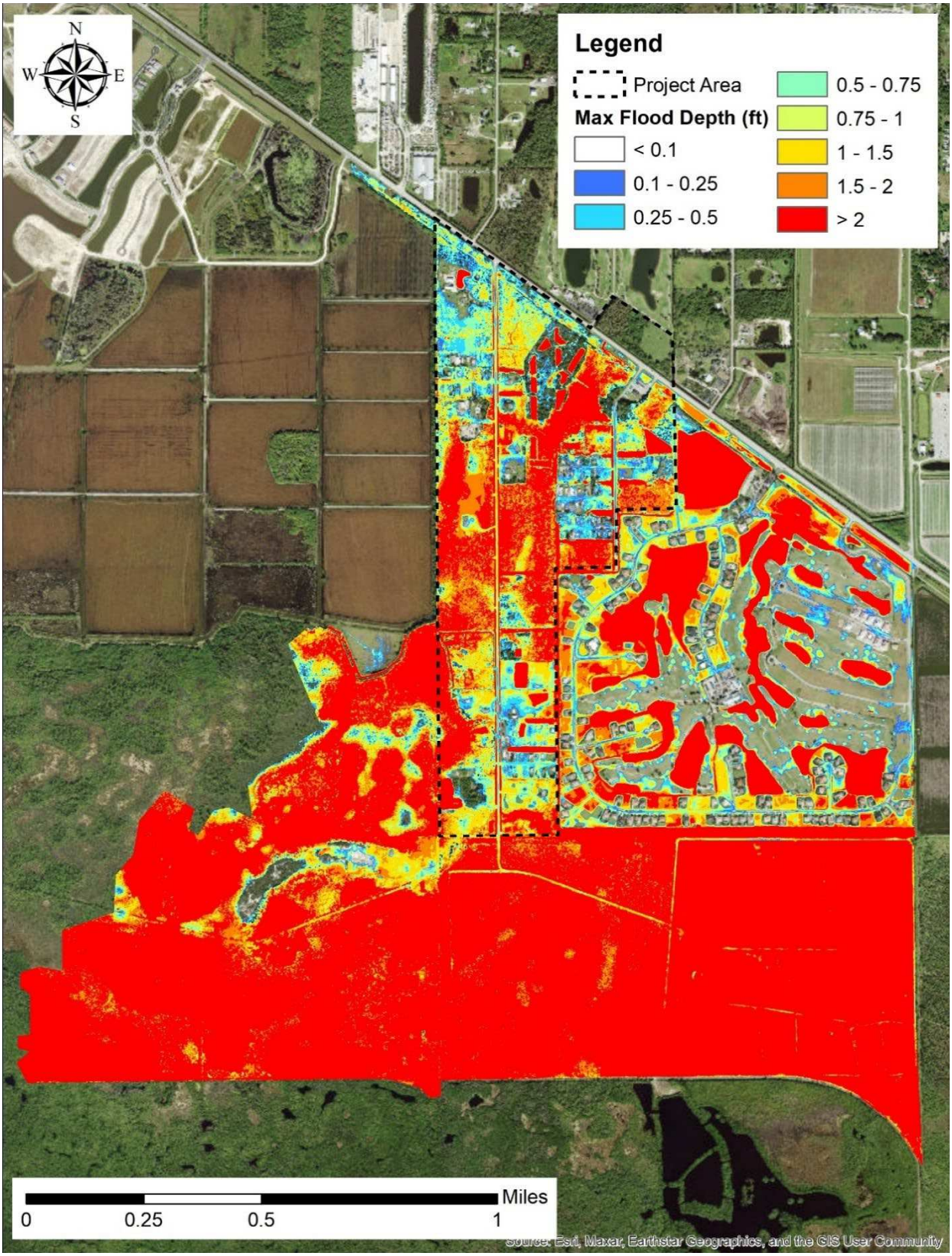


Figure 5. Maximum flood depth map during Hurricane Ian from the existing conditions model[4].

[4] Presented as Figure 27 in Technical Memorandum for Task 2.

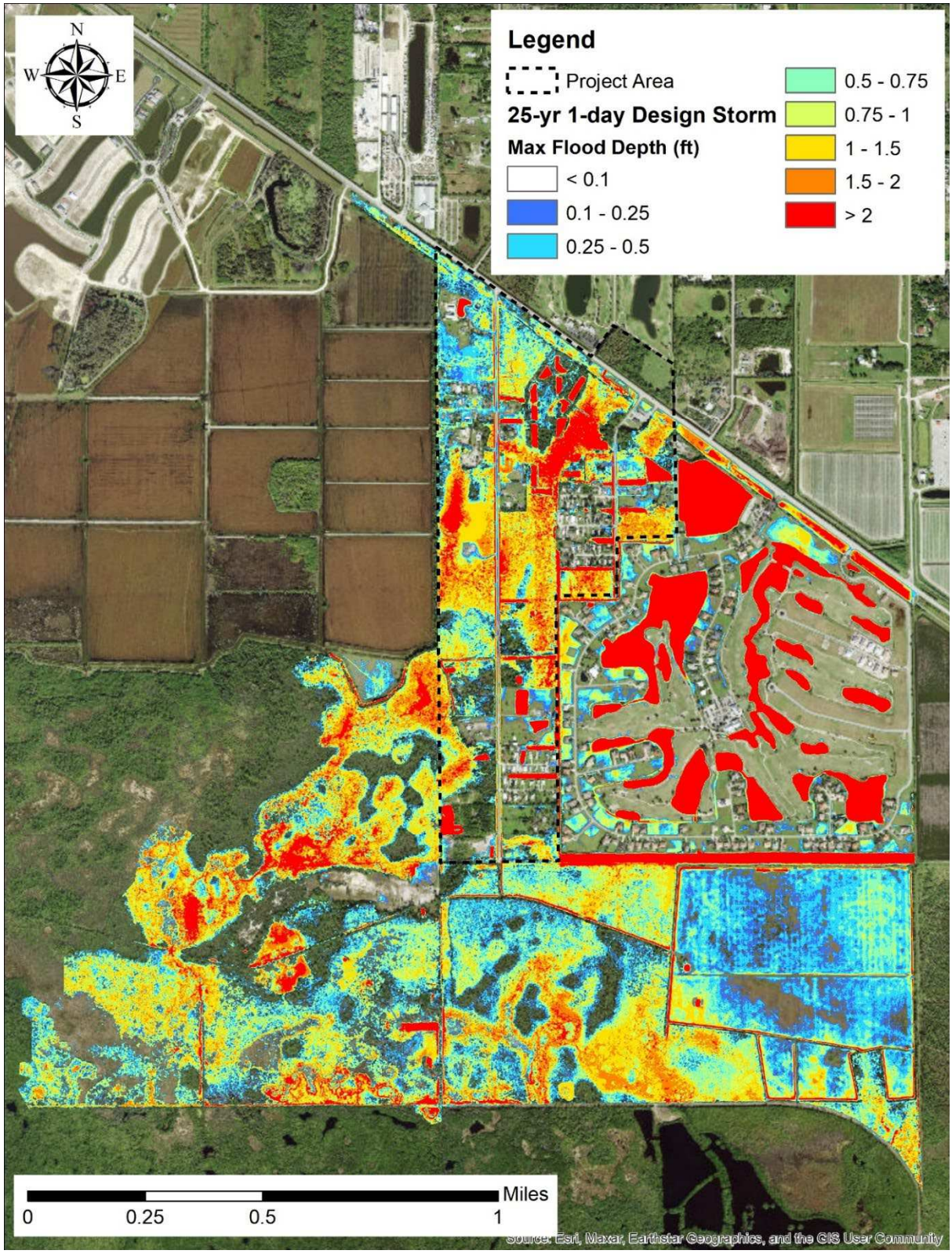


Figure 6. Maximum flood depth from the 25-year return period design storm from the existing conditions model.[5]

[5] Presented as Figure 34 in Technical Memorandum for Task 2.

Scenarios Definition

A total of six (6) stormwater improvement scenarios were incorporated into the Existing Conditions Model of the project area to evaluate their relative performances in achieving the desired objectives of this pre-design and conceptual study.

The scenarios were designed in a progressive way such that Scenario 1 contains improvements with respect to existing conditions, Scenario 2 incorporates further improvements to Scenario 1, and so forth. The scenarios include increasing drainage conveyance, raising road elevations, and the use of dropbox structures with positive flow devices in scenarios 5 and 6, among others. The proposed scenario improvements are detailed in the next sections.

Scenario 1

Starting from the existing conditions, Scenario 1 includes proposed roadway and drainage improvements, as detailed below. Their locations are shown in **Figure 8**.

- Road crowns were raised to a minimum of 4.2 feet NAVD88, which was the Collier County's minimum road elevation criteria in the past[6]. This includes Auto Ranch Road (see profile in **Figure 7**) and Lake Park Boulevard, as well as the seven (7) lateral side streets off of Auto Ranch Road and Lake Park Boulevard.
- Pipe obstructions were removed, and damaged pipes were replaced[7].
- New driveway pipes were installed along lateral street segments. Topographic survey will be required during the final design phase to determine swale dimensions and depths as well as sizes and inverts of driveway culverts. For this evaluation, a driveway pipe diameter of 15" with an estimated invert elevation of 2.0 ft NAVD88 is configured preliminarily.
- An enclosed drainage system with 18" HDPE pipes were installed along some portions of Auto Ranch Road to allow for new sidewalks. Please note that the open swale system with driveway pipes were maintained at the locations where the existing swales interact with wetlands.



Figure 7. Road crown elevation profile along Auto Ranch Road as extracted from the 2018 LiDAR DEM

[6] The 5.5 ft NGVD29 minimum road elevation criteria was removed from the Land Development Code (LDC) by ordinance 06-63 in 2006.

[7] Existing pipe locations and other details were included in Figure 34 and Table 4 in Technical Memorandum for Task 1.

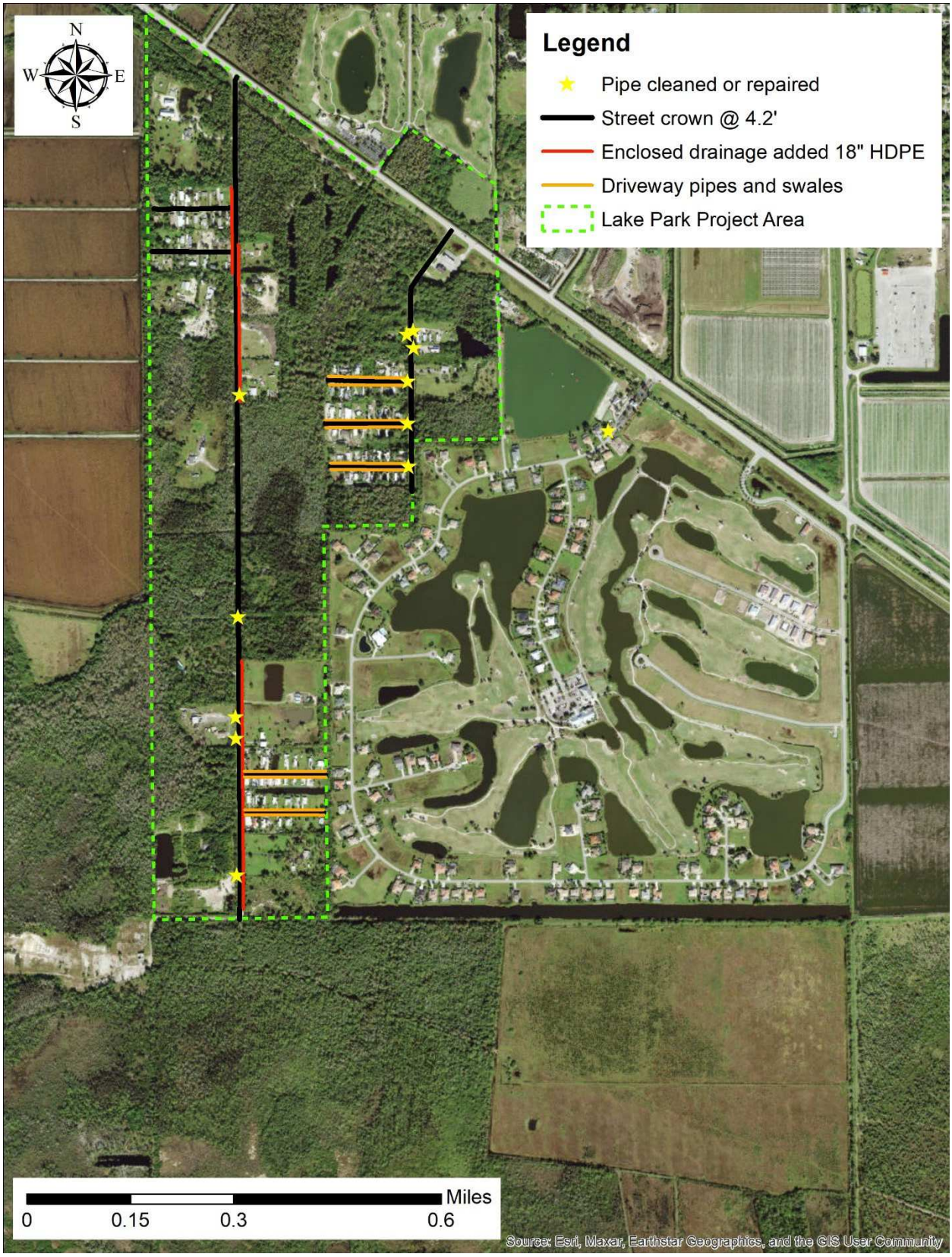


Figure 8. Improvements proposed in Scenario 1.

Scenario 2

Starting from Scenario 1, the Scenario 2 considers also replacing pipes along Auto Ranch Road with diameter smaller than 15”. Pipes used in the replacements have a diameter of 15”, an invert elevation of 2 ft NAVD88, and a Manning’s resistance coefficient of 0.013 (corresponding to HDPE). The locations of those driveway pipes replacements are presented in **Figure 9**.



Figure 9. Improvements proposed in Scenario 2.

Scenario 3

Starting from Scenario 2, the Scenario 3 considers also replacing pipes along Auto Ranch Road with diameter smaller than 18”. Pipes used in the replacement have a diameter of 18”, an invert elevation of 1.7 ft NAVD88, and a Manning’s resistance coefficient of 0.013 (corresponding to HDPE). The locations of those driveway pipes replacements are presented in **Figure 10**.



Figure 10. Improvements proposed in Scenario 3.

Scenario 4

Starting from Scenario 3, the Scenario 4 considers further drainage improvements, as detailed below. Their locations are shown in **Figure 11**

- Pipes along Auto Ranch Road with diameter smaller than 24” were replaced. Pipes used in the replacements have a diameter of 24”, an invert elevation of 1.2 ft NAVD88, and a Manning’s resistance coefficient of 0.013 (corresponding to HDPE).
- The enclosed drainage system pipes (which was proposed along some portions of Auto Ranch Road to allow for new sidewalks) were also increased from 18” to 24” HDPE.
- An existing pipe crossing Auto Ranch Road was replaced from 18" RCP to twin 24" RCPs.
- A 24” HDPE driveway pipe was added at the south end of Auto Ranch Road, on the west side. This pipe allows discharges to a wetland area that seemed drier during field visits compared to the wetland area east of the dirt road. This new pipe also increases the rate of discharge from the Auto Ranch Road area during storm events.
- The existing 12” HDPE pipe crossing the dirt road south of Auto Ranch Road was replaced with a 24" HDPE.

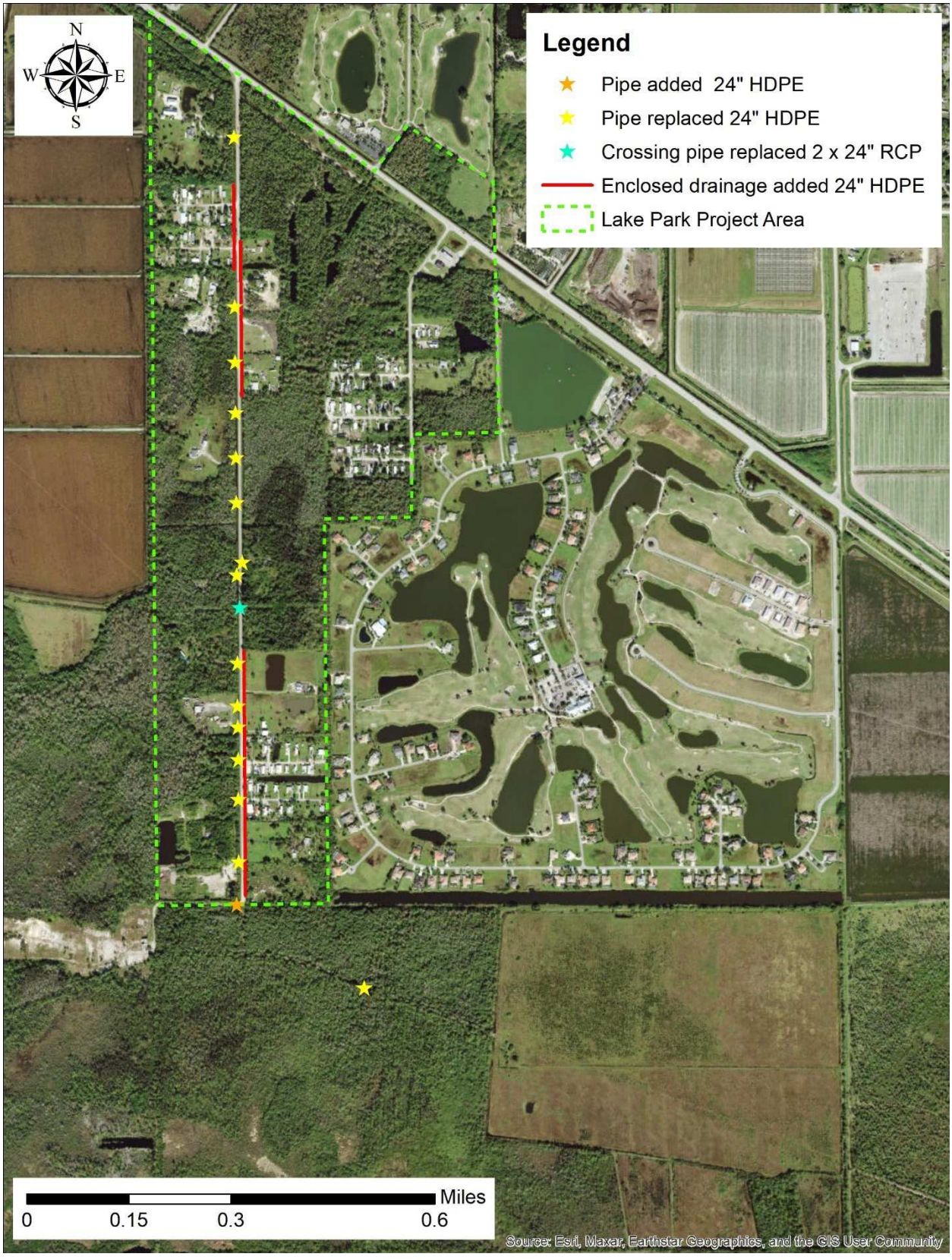


Figure 11. Improvements proposed in Scenario 4.

Scenario 5

Starting from the Scenario 4, the Scenario 5 considers further drainage improvements, as detailed below. Their locations are shown in **Figure 12.**

- Drop box structures were added to control discharges to the south and west. Control elevation at the drop boxes was set to 2.7 ft NAVD88 to maintain or enhance wetlands hydroperiods at upstream areas. Positive flow restriction devices (e.g., flap gates) were also added at the outlet pipes of the droboxes to prevent/reduce tidal backflow. Dropbox structures contained a 24" HDPE pipe, unless it is specified differently in Figure 12.
- The existing dirt road in the area south of Auto Ranch Road was improved by modeling this as a paved road with a crown elevation of 4.2 ft NAVD88.
- The county is planning to purchase the parcel of land at the "throat" that controls discharge from the project area to the southwest. Thus, a berm and drop box structure was proposed in that location. The berm top elevation was set to 4.2 ft NAVD88.
- The number of pipes were increased at some locations to increase conveyance. This included the enclosed drainage near the north end of Auto Ranch Road, as well as other places identified in Figure 12.

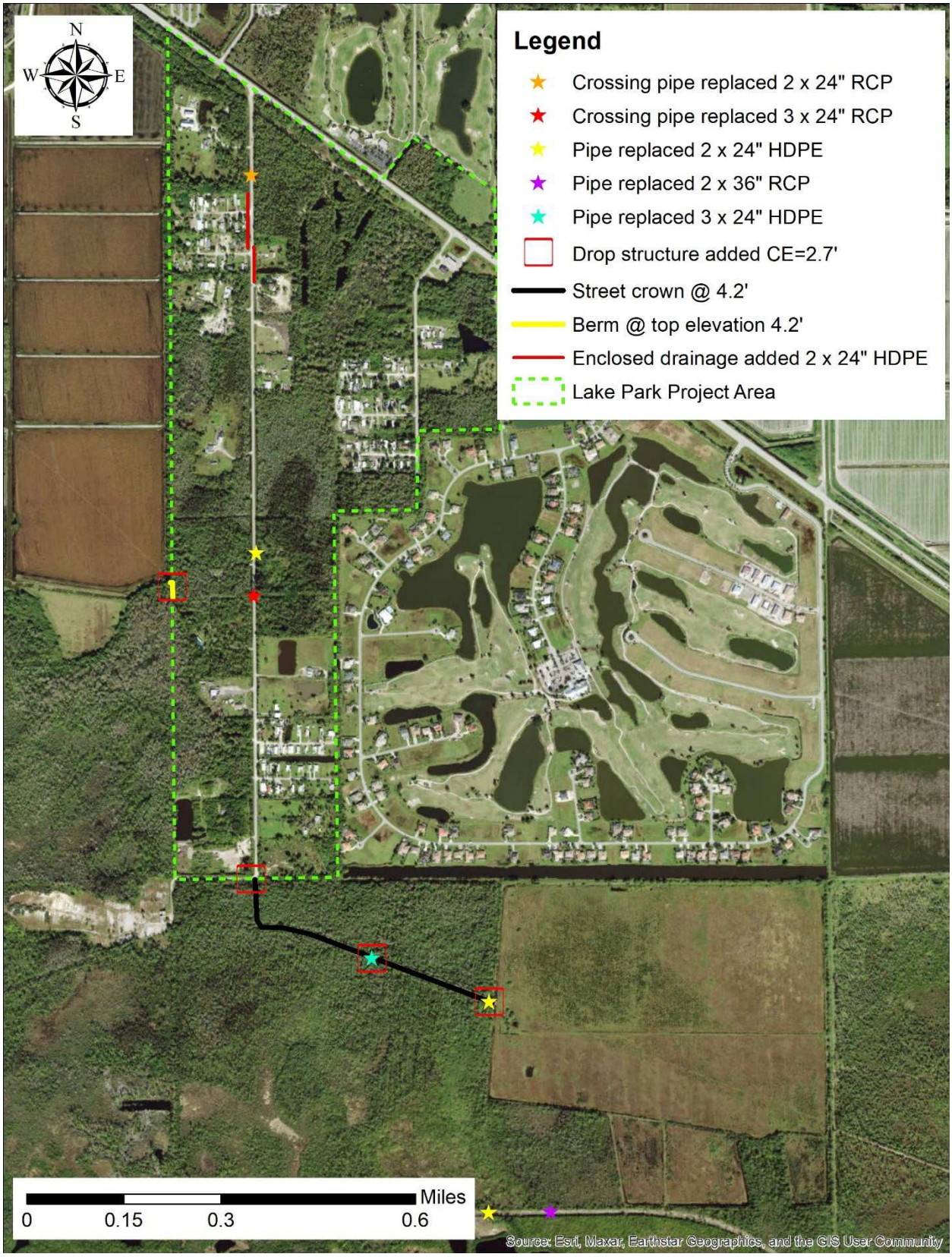


Figure 12. Improvements proposed in Scenario 5.

Scenario 6

Starting from Scenario 5, the Scenario 6 considers further drainage and roadway improvements, as detailed below. Their locations are shown in **Figure 13**.

- Road crowns at Auto Ranch Road and Lake Park Boulevard were raised even more to elevation 4.9 ft NADV88. This is expected to reduce the water depths on the main roads for high tidal surge induced stages such as those experienced in Hurricane Ian conditions. However, the main road crowns continued to be below the FEMA base flood elevation (BFE) for the area of 6 ft NADV88 and below the crown elevation of the US-41 Road. It should be noted that the proposed road crown elevation of 4.9 ft NAVD88 is consistent with the minimum road crown elevation in the nearby Fiddler's Creek residential development to the west of the project area. This was confirmed with Q. Grady Minor and Associates, the engineer of record for Fiddler's Creek.
- The dirt road in the area south of Auto Ranch Road was set to a crown elevation of 4.9 ft NADV88 to prevent/reduce tidal backflow during conditions similar to those that occurred during Hurricane Ian.
- In the case of the southwest boundary of the project area, the proposed berm was also raised to 4.9 ft NADV88. The existing private berm south of it was repaired and raised to the same elevation.
- Three new cross pipes (i.e., 24" RCPs) were added at Auto Ranch Road to better equalize water levels at both sides of the road.
- The number of pipes was increased at three locations, as specified in Figure 13.
- The grates in three out of four drop box structures were increased from a size of 6'x4' to a size of 8'x4' to allow for higher discharge flows above the control elevation of 2.7 ft NADV88.

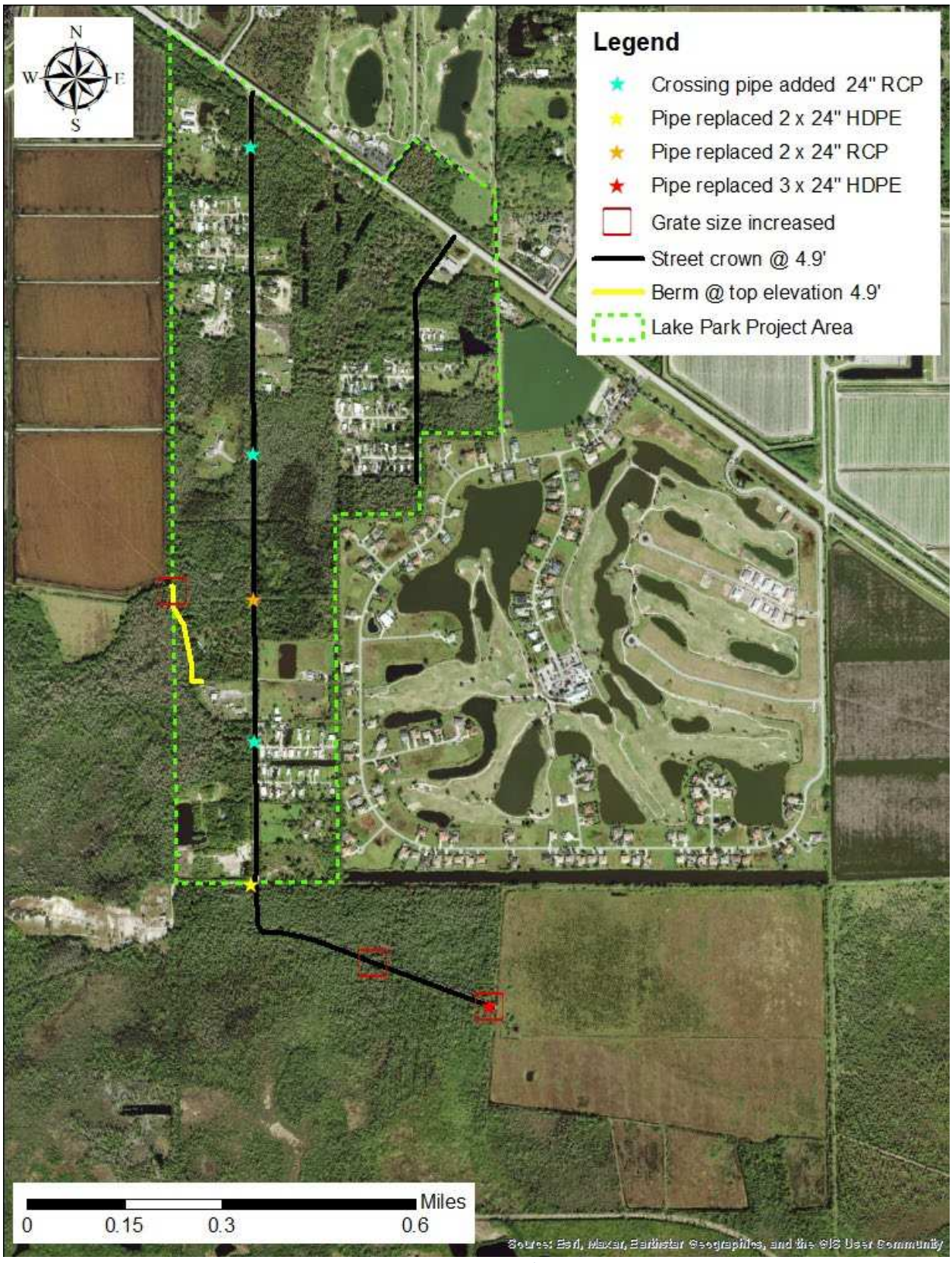


Figure 13. Improvements proposed in Scenario 6.

Scenario Results and Discussion

The hydraulic configurations of each of the six (6) stormwater improvement scenarios as detailed in the previous sections were incorporated into to the existing condition (EC) model for simulations under two hydrological conditions:

- Historic rainfall and stage boundary conditions recorded for the wet season of 2022 (i.e., 5/1/22 – 9/30/22).
- Design storm rainfall (i.e., 25-year return period and 1-day duration) and normal tidal boundary conditions.

A few nodes were used to extract and compare the different model results. They cover wetland areas as well as other locations, as shown in **Figure 14**.

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Figure 14. Selected node locations.

25-year Design Storm

A comparison of 25-year return period peak stages at selected nodes is presented in **Table 3**. From this table, it is apparent that the proposed drainage and roadway improvements only produced slight changes in peak water levels in the range of [-0.2, 0.1] feet. The reason for the low sensitivity of the peak stages is likely the flatness (or the low relief topography) of the project area with a significant portion that can store surface water. Thus, proposed conveyance variations created only slight changes in stages.

Table 3. Comparison of peak stages from the 25-year return period design storm at selected nodes.

	25-year Peak Stages (feet NAVD88)							Differences from EC (feet)					
Nodes	EC	Sc1	Sc2	Sc3	Sc4	Sc5	Sc6	Sc1	Sc2	Sc3	Sc4	Sc5	Sc6
N009	4.22	4.22	4.22	4.22	4.18	4.10	4.11	0.00	0.00	0.00	-0.04	-0.12	-0.11
N041	3.61	3.70	3.70	3.70	3.65	3.64	3.63	0.09	0.09	0.09	0.04	0.03	0.02
N042	3.43	3.24	3.23	3.24	3.33	3.36	3.35	-0.19	-0.20	-0.19	-0.10	-0.07	-0.08
N043	3.56	3.60	3.60	3.61	3.49	3.49	3.52	0.04	0.04	0.05	-0.07	-0.07	-0.04
N067	3.07	3.08	3.08	3.08	3.08	3.10	3.07	0.01	0.01	0.01	0.01	0.03	0.00
N069N	3.07	3.07	3.07	3.07	3.05	3.08	3.07	0.00	0.00	0.00	-0.02	0.01	0.00
N071S	3.04	3.04	3.04	3.05	3.01	3.04	3.02	0.00	0.00	0.01	-0.03	0.00	-0.02

Another indicator to evaluate flooding improvements is the duration of the high water level conditions in the project area. For this evaluation, the half-peak elevation was estimated as the midpoint between the initial stage at control elevation (CE) and the 25-year peak stage from the existing conditions (EC) model. The duration of the stage above that half-peak elevation is compared in **Table 4** for the different scenarios. In this case, there is a significant reduction of the half-peak duration in the north and central areas (i.e., at nodes N009, N041, N042, and N043). However, there is an increase of the half-peak duration at node N067, meanwhile it remains about the same at nodes N069N and N071S.

Table 4. Comparison of the duration above half-peak elevation from the 25-year design storm.

	Initial stage at CE (ft)	Peak stage (ft)	Half-peak stage (ft)	Stage duration above half-peak stage from the 25-year design storm (hours)						
Nodes	EC	EC	EC	EC	Sc1	Sc2	Sc3	Sc4	Sc5	Sc6
N009	2.71	4.22	3.47	36	33	33	32	22	18	18
N041	2.68	3.61	3.15	60	60	60	60	46	41	43
N042	2.68	3.43	3.06	53	50	48	47	44	44	47
N043	2.67	3.56	3.12	60	60	60	60	40	39	42
N067	2.5	3.07	2.90	21	29	31	33	36	45	34
N069N	2.5	3.07	2.90	19	22	22	22	19	23	21
N071S	2.47	3.04	2.90	17	19	20	20	15	20	18

In summary, the evaluation of the scenarios under the 25-year design storm rainfall with normal tidal conditions suggests that the proposed improvements produce only slight variations in peak stages, but a significant reduction in the duration of the peak flood stage in the north and central areas.

Hurricane Ian

A comparison of peak stages at selected nodes during Hurricane Ian is presented in **Table 5**. From this table, it is apparent that the proposed drainage and roadway improvements in Scenario 6 are not enough to stop the tidal water from entering the project area. Despite raising the road crowns, the berms at the southwest, and the positive flow devices; tidal water still enters through the southwest boundary (south from the proposed berm) and through the area south of the spreader canal that may be converted to a low-income housing development in the future. Thus, further improvement features (like higher berms and pipes with positive flow devices) would be necessary in those borders to prevent tidal inflows into the Lake Park project area during Hurricane Ian conditions.

Table 5. Comparison of peak stages during Hurricane Ian at selected nodes.

	Peak Stages (feet NAVD88)						Differences from EC (feet)				
Nodes	EC	Sc1	Sc3	Sc4	Sc5	Sc6	Sc1	Sc3	Sc4	Sc5	Sc6
N009	4.39	4.34	4.32	4.26	4.37	4.18	-0.05	-0.07	-0.13	-0.02	-0.21
N041	4.57	4.57	4.57	4.55	4.60	4.61	0.00	0.00	-0.02	0.03	0.04
N042	4.52	4.53	4.53	4.51	4.55	4.17	0.01	0.01	-0.01	0.03	-0.35
N043	4.52	4.54	4.54	4.52	4.56	4.61	0.02	0.02	0.00	0.04	0.09
N067	4.61	4.62	4.62	4.60	4.64	4.64	0.01	0.01	-0.01	0.03	0.03
N069N	4.61	4.62	4.62	4.60	4.64	4.65	0.01	0.01	-0.01	0.03	0.04
N071S	4.64	4.65	4.65	4.63	4.67	4.65	0.01	0.01	-0.01	0.03	0.01

The duration of the stages above half-peak elevation is also compared in Table 6 for the different scenarios in Hurricane Ian conditions. In this case, the proposed improvements in scenarios 5 and 6 produce some reductions of half-peak durations in the north areas (i.e., at node N009). However, there are increases of the half-peak durations in the south areas (i.e., at nodes N067, N069N, and N071S).

Table 6. Comparison of the duration above half-peak elevation at Hurricane Ian conditions.

	Half-peak stage (ft) from Table 4	Stage duration above half-peak stage at Hurricane Ian conditions (hours)					
Nodes	EC	EC	Sc1	Sc3	Sc4	Sc5	Sc6
N009	3.47	45	31	40	27	28	28
N041	3.15	47	41	40	29	40	41
N042	3.06	29	30	30	30	40	41
N043	3.12	45	39	40	30	31	40
N067	2.90	31	35	37	31	54	45
N069N	2.90	32	32	32	32	45	42
N071S	2.90	32	32	32	31	37	35

Average Wet Season Water Levels

Average water levels during the 2022 wet season (specifically from June 21 through September 27, 2022) were computed at wetland nodes and are presented in **Table 7**. It is apparent from this table, that by increasing conveyance in the drainage system in scenarios 1 through 4, the average wet season water levels dropped in the wetlands up to about 0.3 feet. Dropbox structures proposed in Scenarios 5 and 6 demonstrated that they are necessary to restore average wet season water levels modeled at the existing conditions. Moreover, the dropbox in the southwest boundary of the project area increased the average water level by about 0.5 feet with respect to existing conditions.

Table 7. Comparison of average wet season stages in wetland areas.

	Average wet season water levels (ft NAVD88)						Differences from EC (feet)				
Nodes	EC	Sc1	Sc3	Sc4	Sc5	Sc6	Sc1	Sc3	Sc4	Sc5	Sc6
N002C	2.77	2.66	2.64	2.48	2.77	2.79	-0.11	-0.13	-0.28	0.01	0.02
N020N	2.74	2.66	2.64	2.52	2.77	2.78	-0.09	-0.11	-0.22	0.03	0.04
N025	2.72	2.62	2.61	2.45	2.75	2.77	-0.10	-0.12	-0.27	0.03	0.04
N040N	2.72	2.64	2.62	2.46	2.76	2.77	-0.09	-0.10	-0.26	0.04	0.05
N046N	2.12	2.06	2.05	2.02	2.62	2.72	-0.06	-0.07	-0.10	0.50	0.61

Southwest Discharges

A potential concern from the Fiddlers Creek development on the west side of the project area is that the proposed drainage and roadway improvements in the Lake Park Project area may increase the peak discharges through its southwest boundary that may limit their capacity to discharge to the southern areas.

In order to address this concern, the results from the 25-year design storm simulations were extracted at node N046C, which receives the discharges through the southwest boundary of the Lake Park Project area, as shown in Figure 14. The stage time series from the different scenarios are compared with the existing condition results in **Figure 15**. These plots show that the peak stage only increases slightly by about 0.02 feet in scenarios 5 and 6 with respect to existing conditions, which is considered small and not expected to limit the capacity to discharge from the Fiddler's Creek development.

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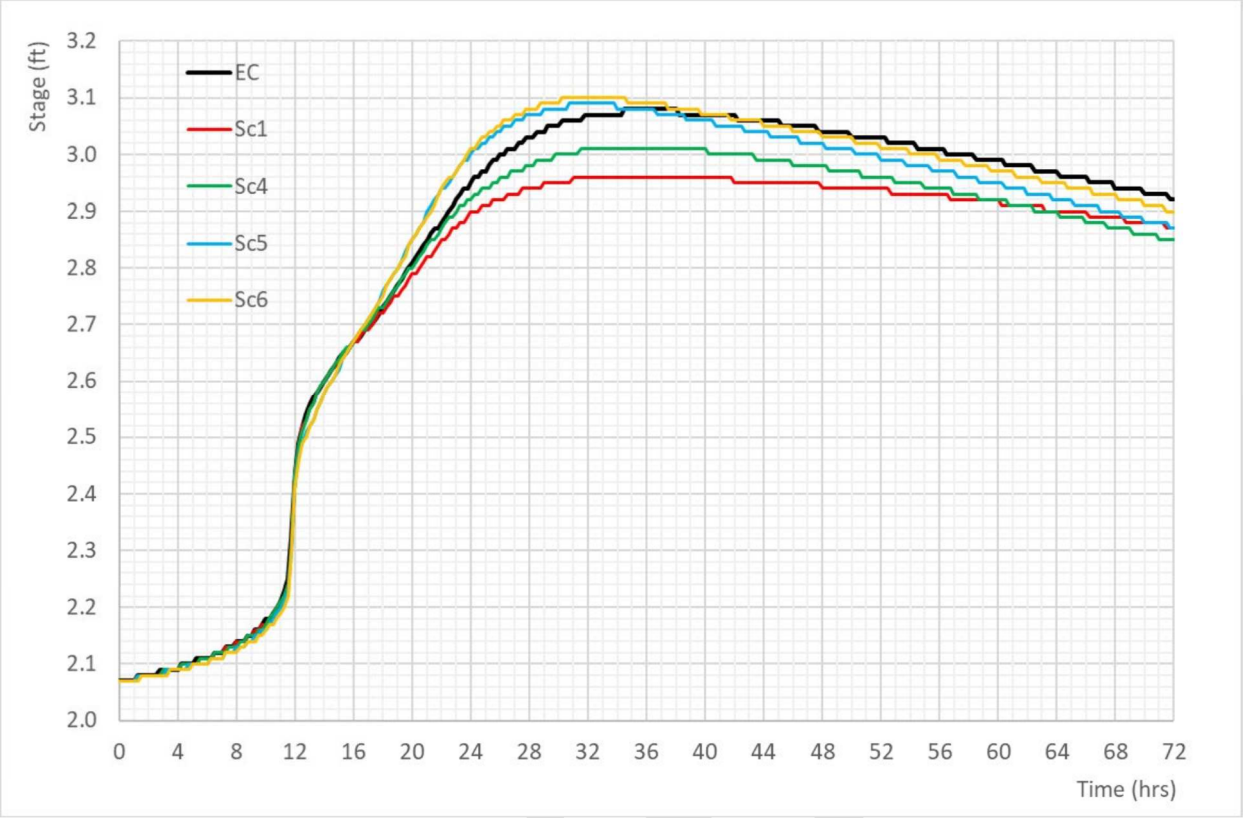


Figure 15. 25-year design storm stage hydrographs just outside of the southwest boundary of the Lake Park Project area (i.e., at node N046C in Figure 14).

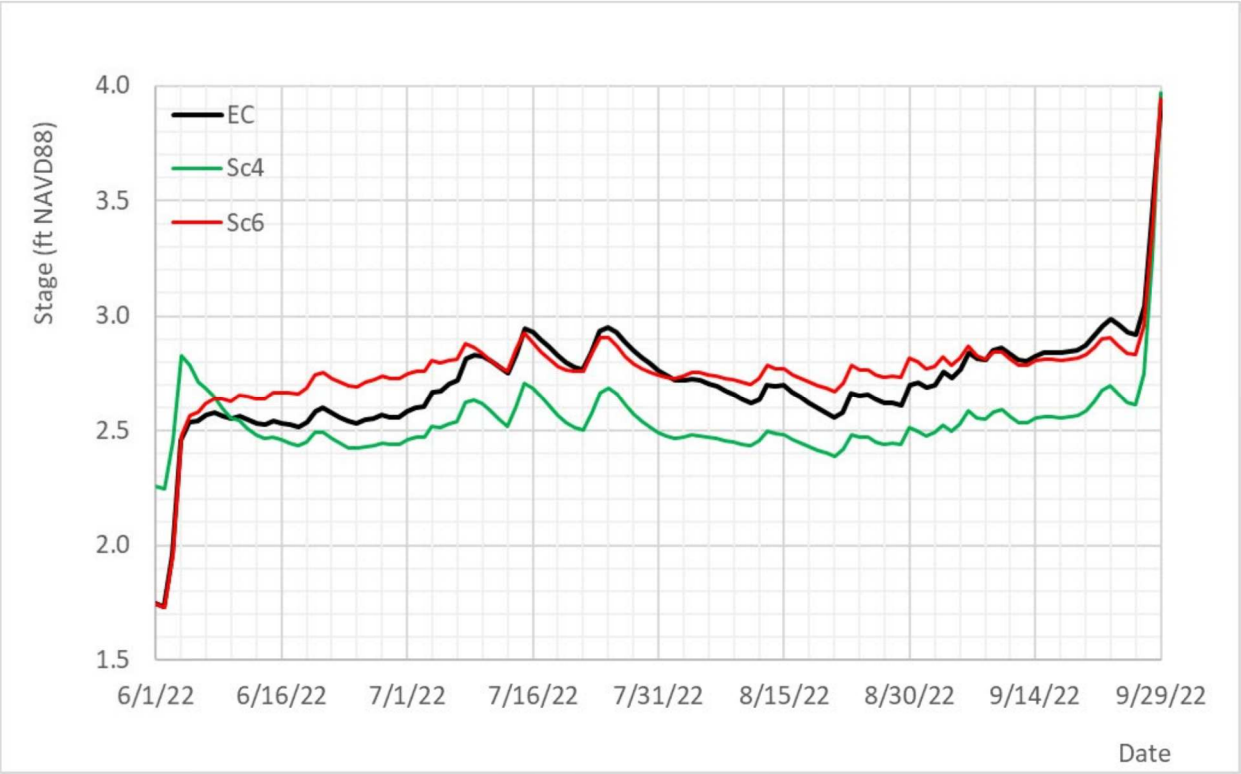
Retention Time

The retention time of the surface water in wetlands, ditches, ponds is an indicator of the water quality treatment occurred at those features. In general, higher retention times are beneficial for the denitrification and nutrient uptake processes, as well as for the reduction of suspended sediments.

The retention time was estimated from the model results for the 2022 wet season at three locations, which correspond to the nodes N020N, N046N, and N064 (see Figure 14). Daily average values of the volume of water at a given node was divided by the node outflows to estimate the hydraulic retention or residence time plots presented in **Figure 16** through **Figure 18**. Plots for node stages are also included. Notice that only three model cases were plotted: existing conditions, scenario 4, and scenario 6.

In general, the scenario 4 with larger drainage conveyances produce lower stages (and water volumes) at nodes with respect to the existing conditions. The scenario 6 raises stages during some periods due to the proposed drop boxes controlling at 2.7 feet NAVD88. The higher water volumes at nodes in scenario 6 is the likely cause for the higher estimated retention times with respect to existing conditions. Thus, the use of drop box structures at the downstream outlets will not only maintain and improve the wetland hydroperiods in the project area, but it will also enhance the water quality treatment of the discharges into the Outstanding Florida Waters of the Rookery Bay Estuarine Reserve[8].

[8] https://floridadep.gov/rcp/nerr-rookery-bay/locations/rookery-bay-national-estuarine-research-reserve



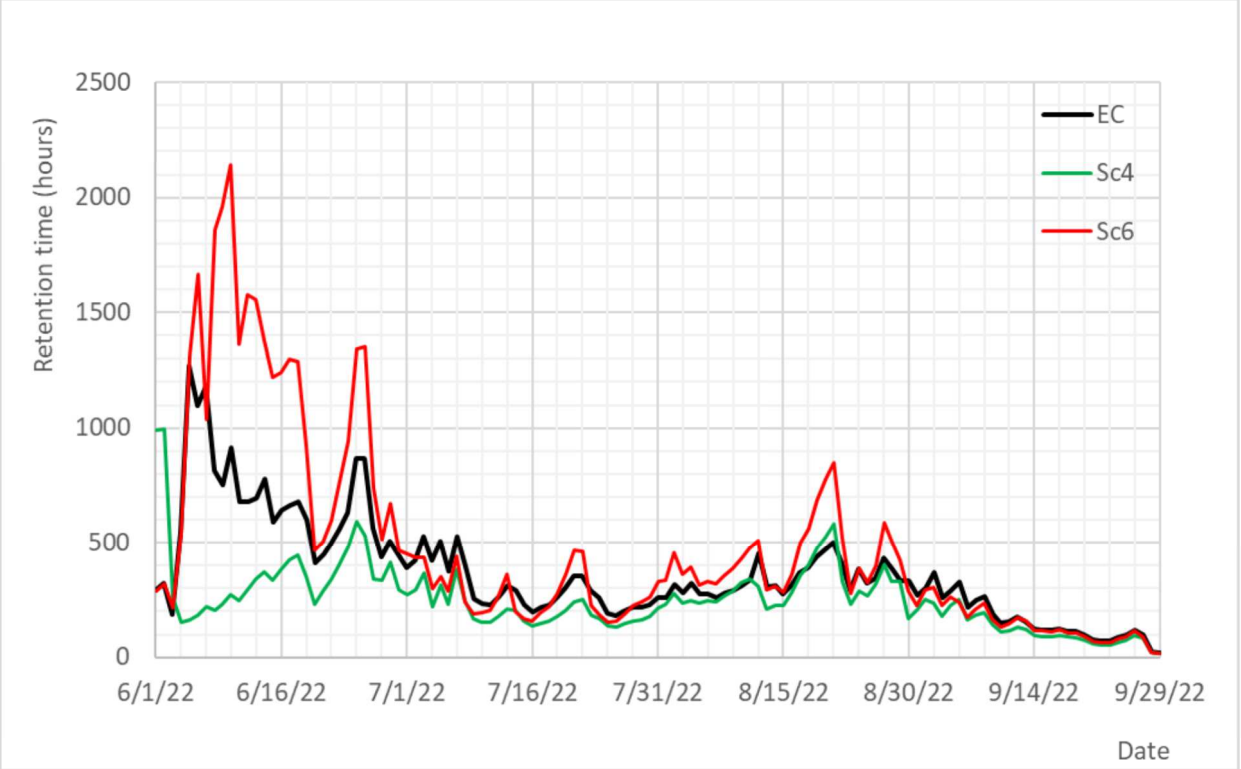
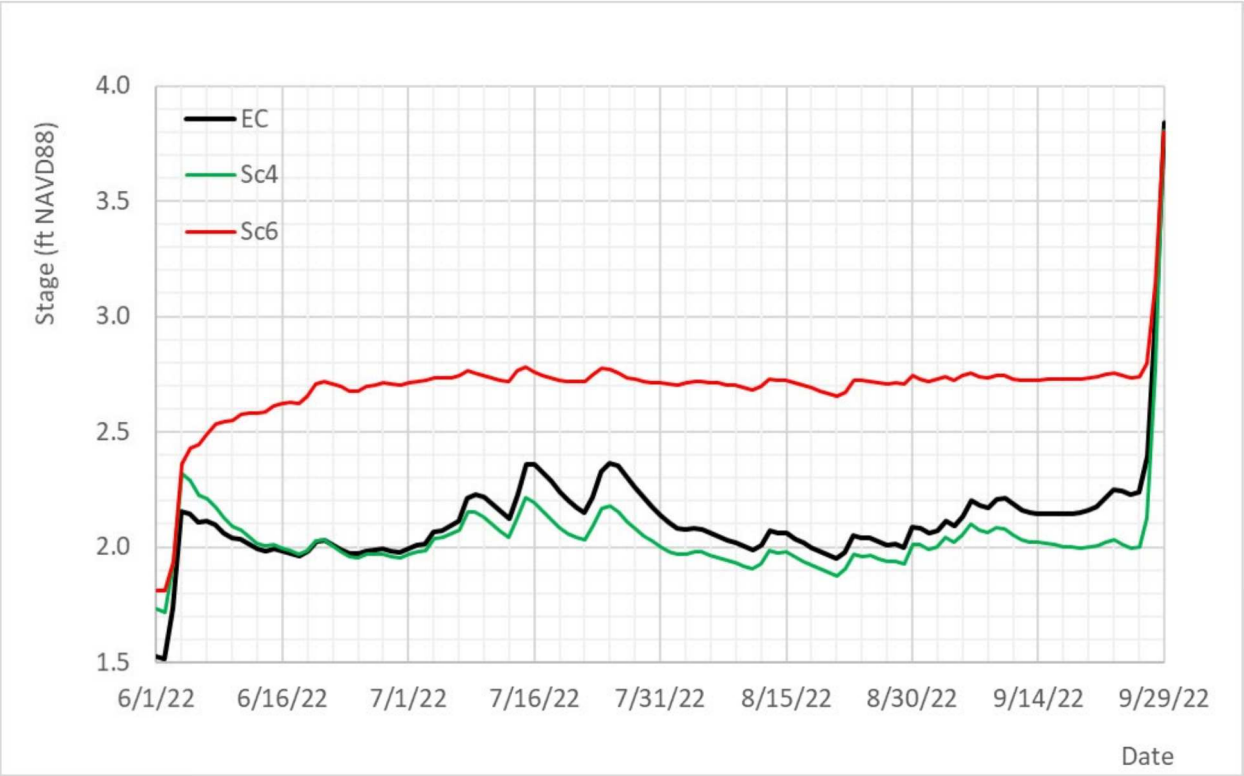


Figure 16. Daily averaged stages and retention times estimated at node N020N.



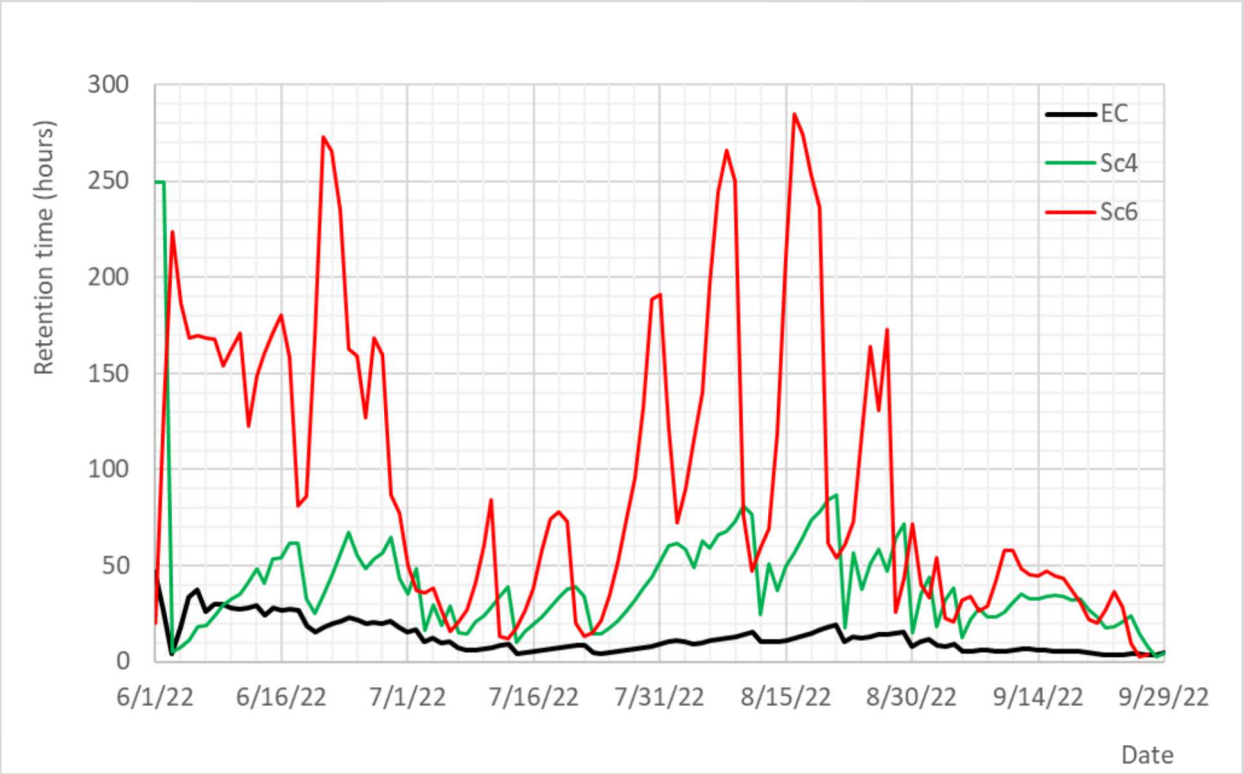
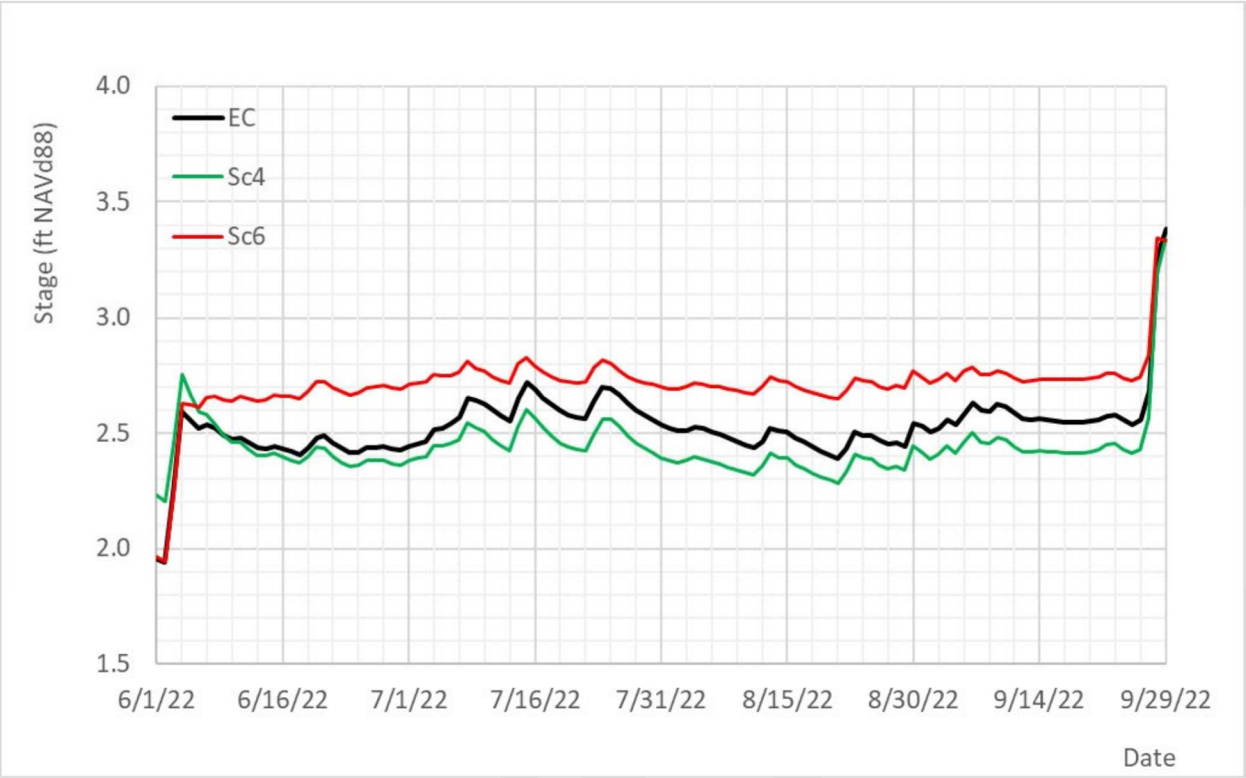


Figure 17. Daily averaged stages and retention times estimated at node N046N.



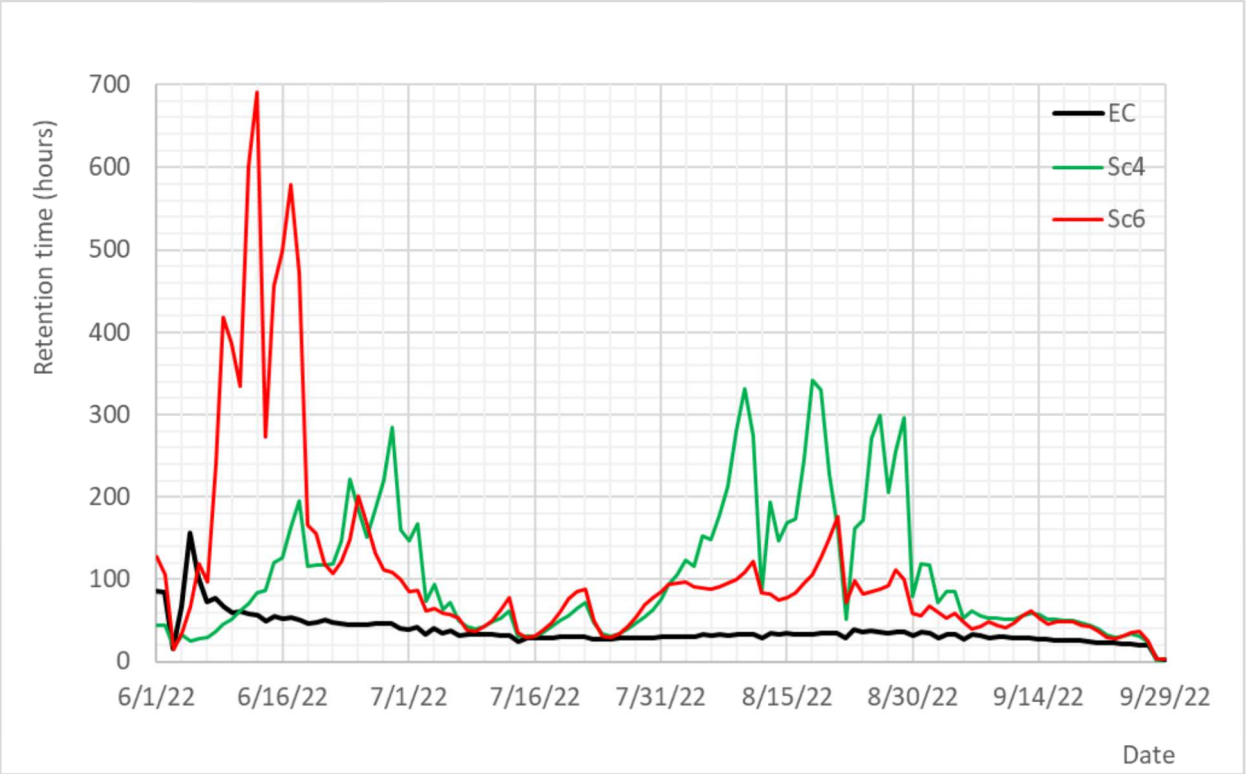


Figure 18. Daily averaged stages and retention times estimated at node N064.

Higher-Priority Drainage Improvements

Model results from the scenarios showed higher sensitivity (in terms of flow and head drop) at some of the proposed improvements in the drainage system. This allows to select the drainage improvements with higher beneficial impacts. There are also proposed improvements related to the maintenance of pipes in the project area and to the wetland hydrology. Thus, the drainage improvements that need more attention (or with a higher priority) contain the following cases.

- Pipes with sediment or other obstructions to be cleaned.
- Small-diameter pipes to be replaced by larger ones.
- Damaged pipes to be replaced, as documented during field visits[9].
- Cross pipes to be added along Auto Ranch Road.
- Dropbox structures to be added to maintain or enhance wetlands hydroperiods at upstream areas.

Figure 19 shows the location of the higher-priority drainage improvements from the modeling evaluation and the observations during field visits. Notice that some of the driveway pipe replacements along Auto Ranch Road would be superseded in the case that an enclosed drainage system is built. Conceptual design drawings of the proposed pipes and structures are included in Appendix A. An estimate of the probable costs is also presented in ***Table* 8**. These costs are from preliminary engineering level estimate only, and they will be revised during the design phase.

Table 8. Probable cost of higher-priority drainage improvements

Item	Quantity	Unit	Unitary cost ($)	Cost($)
Furnish & Install Type H DBI w/Concrete Weir and 3'-4.5"x8'-8.3125" Grate (Includes 60' of 24" HDPE)	3	EA	38,100	114,300
Furnish & Install Type H DBI w/Concrete Weir and 3'-4.5" x 6'-4.625" Grate (Includes 60' of 24" HDPE)	1	EA	34,100	34,100
Clean Existing 18" RCP	1	LS	1,000	1,000
Clean Existing 30" RCP	1	LS	2,000	2,000
Removal Existing Stormwater Main	1,503	LF	25	37,575
Furnish & Install 18" HDPE Driveway Culvert w/ MESs	1,325	LF	345	457,125
Furnish & Install 18" RCP	130	LF	150	19,500
Furnish & Install 36" RCP	123	LF	220	27,060
Furnish & Install Berm (110 ft length w/ top elevation at 6 ft NAVD88 at southwest outlet)	261	CY	15	3,915
Contingencies, mobilization, and additional items not identified	1	TM	180,000	180,000
			Total	**876,575**

Note: costs of roadway improvements are not included.

[9] Technical Memorandum for Task1 included a drainage pipe inventory in Table 4.

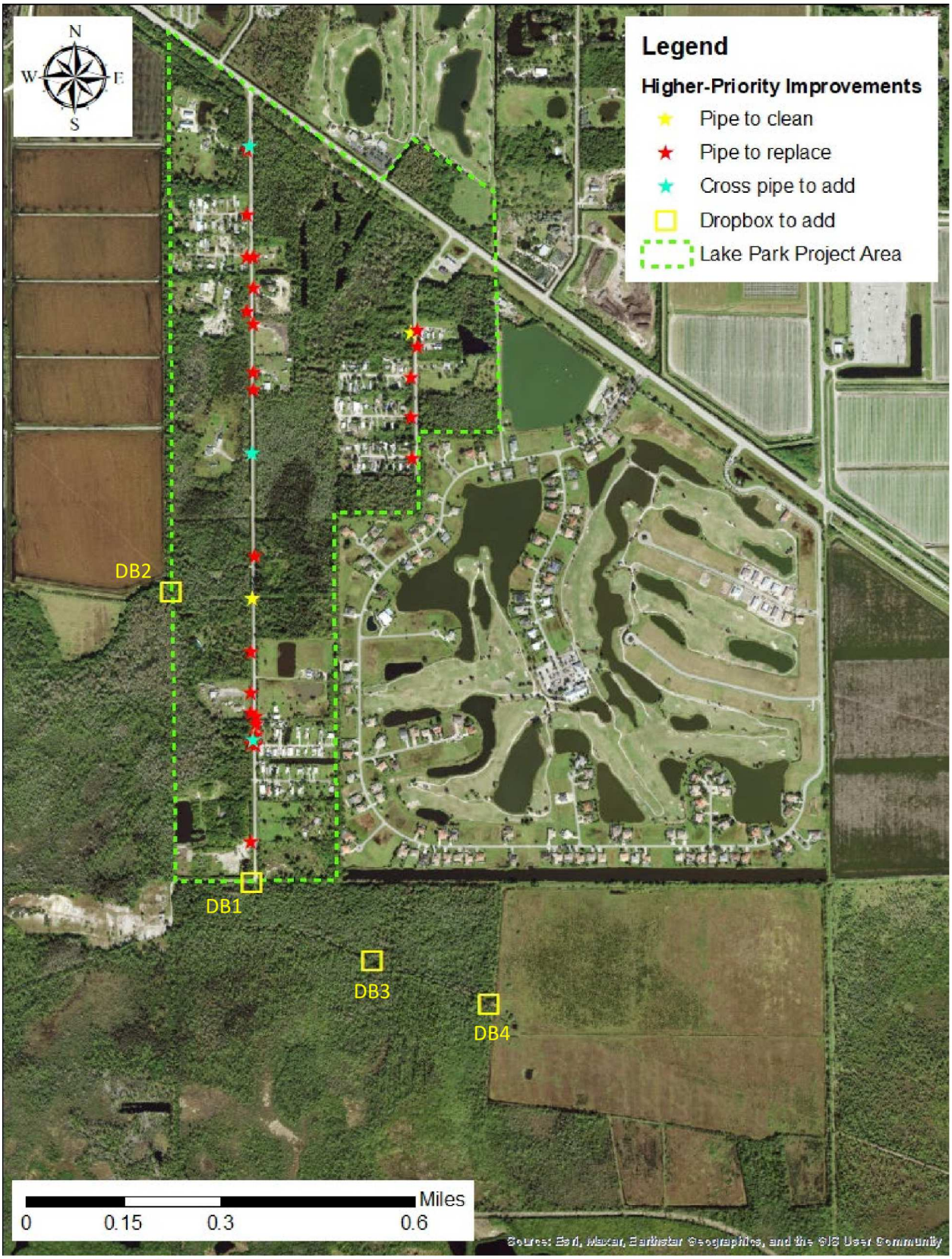


Figure 19. Higher-priority drainage improvements from the modeling evaluation and the field visits.

Conceptual Design Plans

Figure 20 and **Figure 21** present conceptual design plans for typical driveway and cross pipes, respectively. A conceptual design plan for the proposed dropbox structures in **Table 9** is also shown in **Figure 22**. Other conceptual design plans are included in the Roadway Improvements Technical Memorandum corresponding to Task 5.

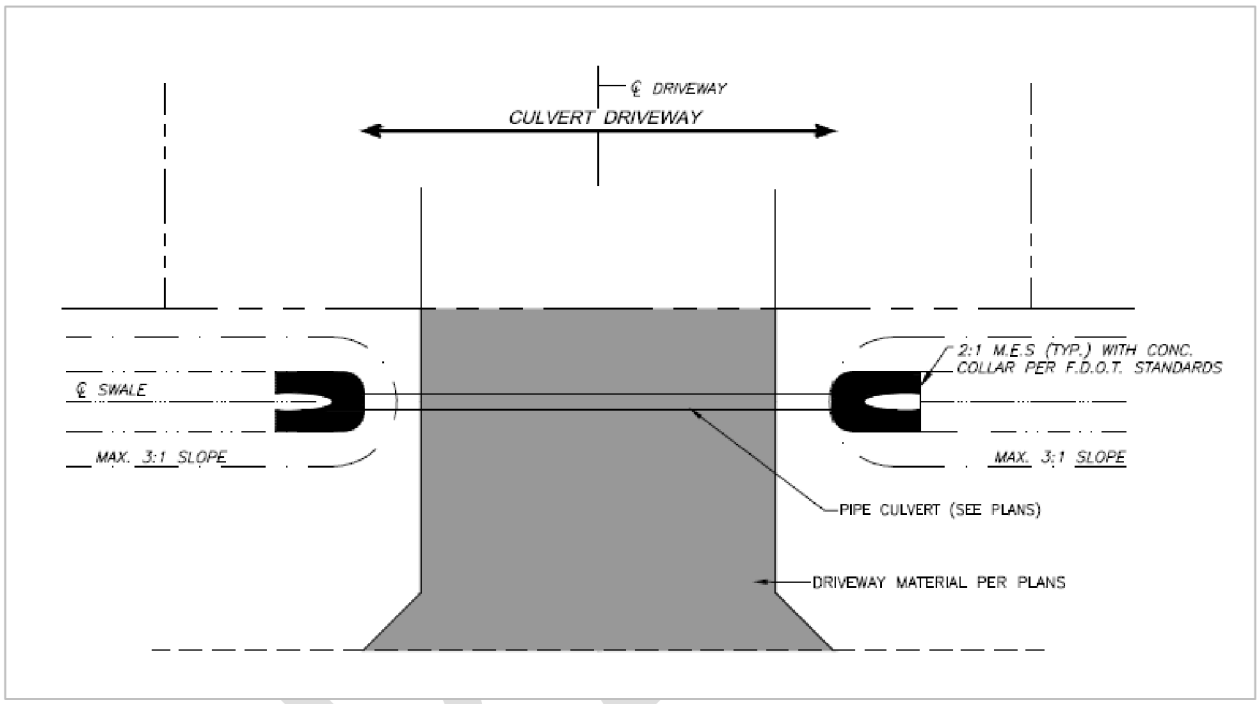


Figure 20. Typical residential driveway pipe design plan.

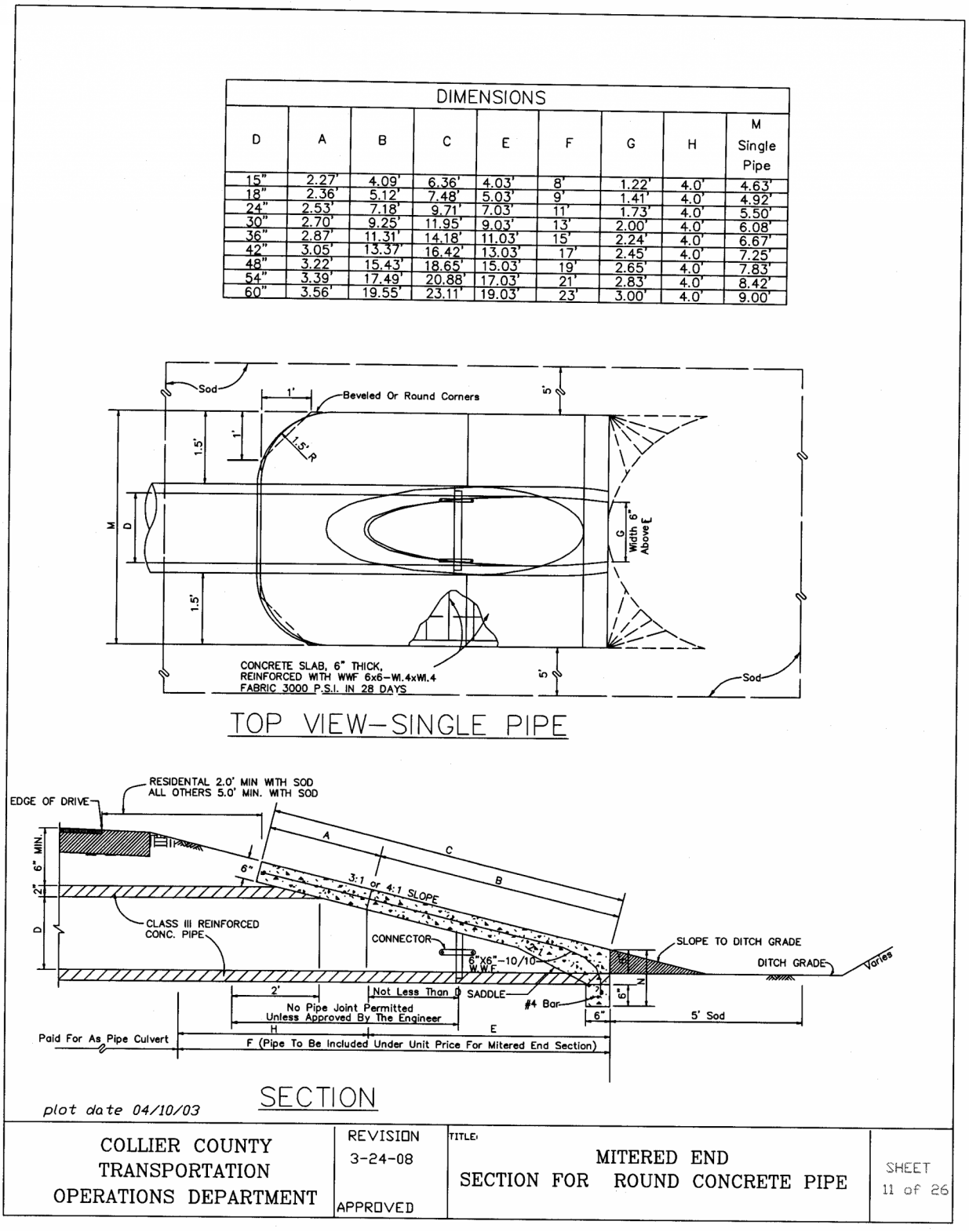


Figure 21. Collier County's standard design plan for cross pipes.

Table 9. Proposed dropbox structures.

Name	Location (see Figure 19)	Ditch Bottom Inlet	Type Outlet Pipes
DB1	South end of Auto Ranch Road	FDOT Type C	24" RCP, invert elevation: 1.2 ft NAVD88
DB2	West Outlet	FDOT Type H (4-grate inlet)	3 x 24" RCPs, invert elevation: 1.2 ft NAVD88
DB3	South Outlet (currently a 12" HDPE pipe)		
DB4	South Outlet (currently a 24" cast iron pipe)		

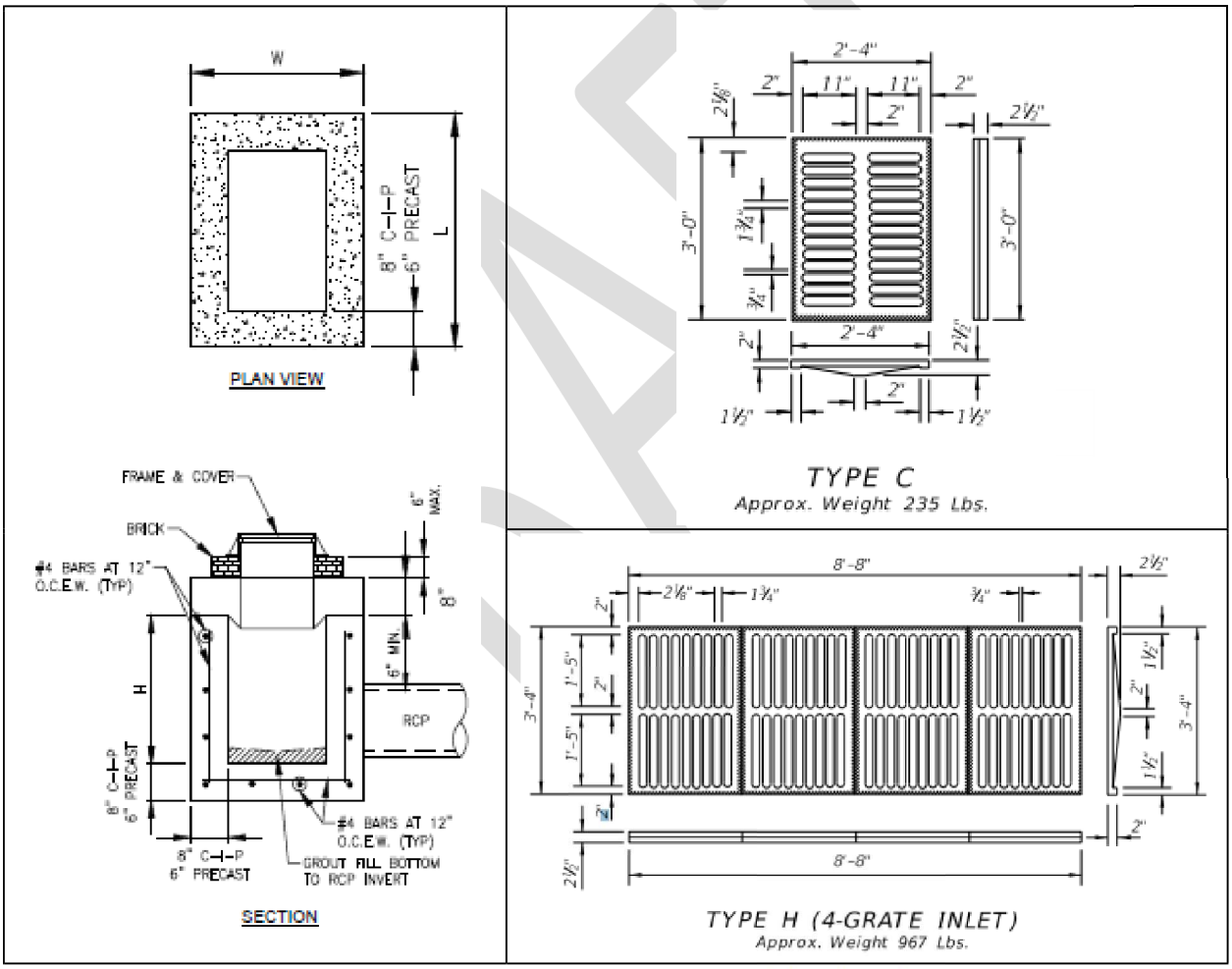


Figure 22. Conceptual design plan for proposed dropbox structures.

Water Quality Loading Calculations

This section presents the estimation of the pollutant loading in the Lake Park project area by using the Harvey Harper[10] and the EPA Pollutant Load Estimation Tool[11] Methods.

Harvey Harper Method

The Harvey Harper Method is a widely used and FDEP approved analytical tool to estimate the loading rates of priority pollutants like Total Nitrogen, Total Phosphorus, BOD, TSS, Cu, Pb, Zn from stormwater runoff.

Land Use

The landuse FLUCCs codes from the FDOT and the SFWMD inside the project area were correlated with the Harvey Harper classification as detailed in **Table 10**.

Table 10. Landuse FLUCCs codes versus Harvey Harper classes in the project area.

FDOT		SFWMD FLUCCS		Harvey Harper Classes	Area
Code	Label	Code	Label	Label	(acres)
121	Single Family Homes	1210	Fixed Single Family Units	Low-Density Residential (Rural, 15% impervious)	43.2
123	Mixed Single Family / Mobile Homes	1230	Mixed Units, Fixed and Mobile Home Units	Single-Family Residential (40% impervious)	32.7
140	Commercial	1400	Commercial and Services	Commercial (80% impervious)	1.2
241	Palm Nursery	2410	Tree Nurseries	Undeveloped/Rangeland/ Forest Land	9.5
411	Pine Flatwoods	4110	Pine Flatwoods	Undeveloped/Rangeland/ Forest Land	3.9
437	Australian Pines	4370	Australian Pines	Undeveloped/Rangeland/ Forest Land	0.5
438	Mixed Hardwoods	4380	Mixed Hardwoods	Undeveloped/Rangeland/ Forest Land	25.4
510	Ditch	5120	Channelized Waterways, Canals	Open Water/Lakes	3.8
617	Mixed Hardwoods Wetland	6170	Mixed Wetland Hardwoods	Wetlands	50.4
618	Willow	6170	Mixed Wetland Hardwoods	Wetlands	0.8

[10] Harper, 2007. Evaluation of Current Stormwater Design Criteria within the State of Florida. Final Report Prepared for FDEP by Harvey H. Harper at Environmental Research & Design, Inc. on June 2007.
[11] https://www.epa.gov/nps/plet

FDOT		SFWMD FLUCCS		Harvey Harper Classes	Area
Code	Label	Code	Label	Label	(acres)
619	Wetland Exotic Melaleuca	6191	Wet Melaleuca	Wetlands	13.0
621	Cypress	6210	Cypress	Wetlands	38.5
641	Marsh	6410	Freshwater Marshes	Wetlands	2.6
740	Disturbed Lands	7400	Disturbed Land	Undeveloped/Rangeland/ Forest Land	12.9
742	Borrow Pits	7420	Borrow Areas	Open Water/Lakes	12.6
8142	Federal / State Roadway US 41	8140	Roads and Highways	Highway/Transportations (50% impervious)	14.1
8145	Roadway	8140	Roads and Highways	Highway/Transportations (50% impervious)	10.4
822	Communication Facility	8220	Communication Facilities	Single-Family Residential (25% impervious)	0.5
				Total	**275.8**

Table 11. Area covered by the Harvey Harper landuse classes inside the project area.

Land use classification by Harvey-Harper	Area (acres)
Low-Density Residential (Rural, 15% impervious)	43.2
Single-Family Residential (25% impervious)	0.5
Single-Family Residential (40% impervious)	32.7
Commercial (80% impervious)	1.2
Highway/Transportations (50% impervious)	24.4
Undeveloped/Rangeland/Forest Land	52.1
Wetlands	105.2
Open Water/Lakes	16.5
Total	**275.8**

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The coverage of the Harvey Harper landuse classes inside the project area is included in **Figure 23**. The area estimated for each landuse class is also presented in **Table 11**.

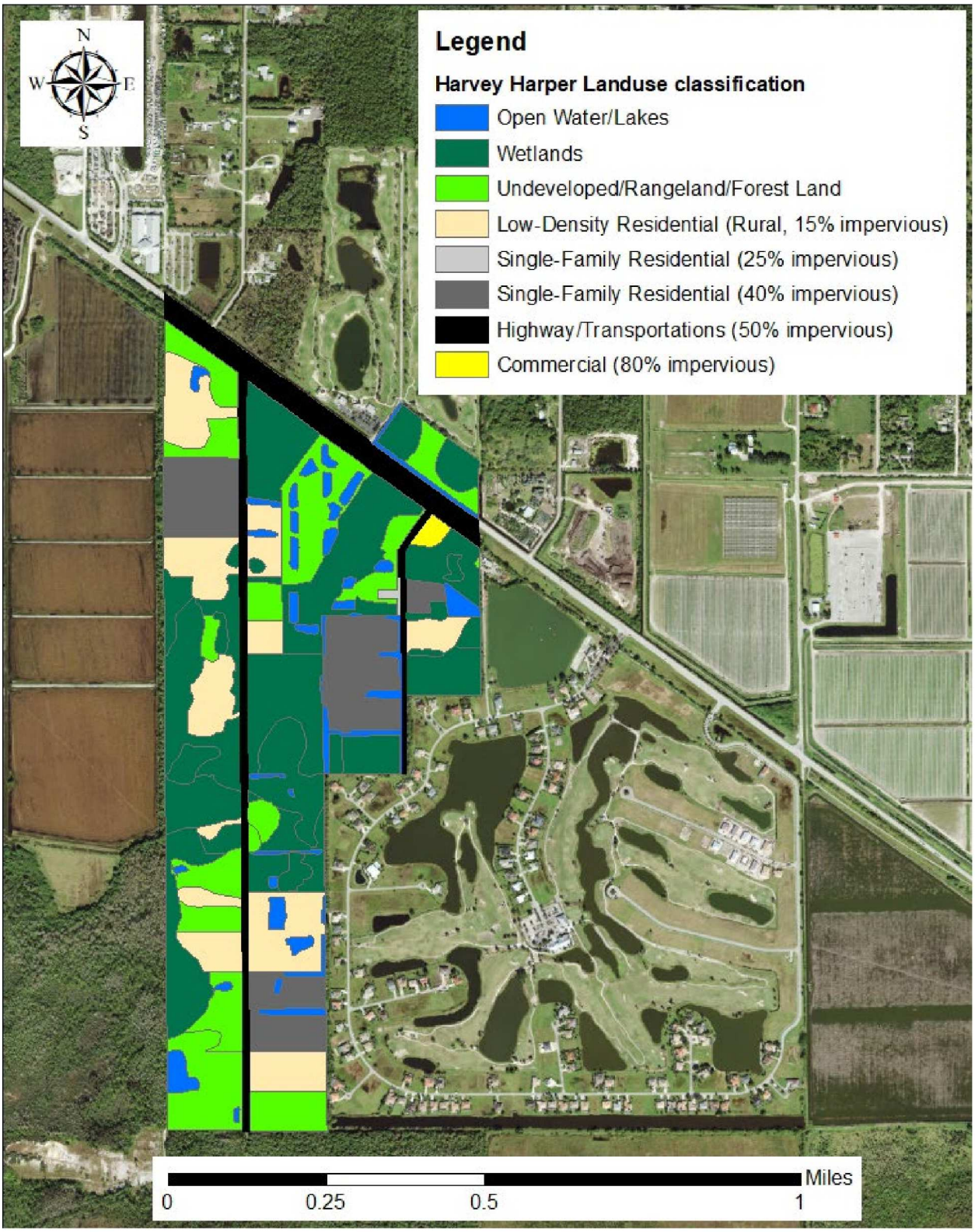

Figure 23. Harvey Harper landuse classification inside the Lake Park project area.

Soil

The Hydrologic Soil Group (HSG) classification as reported by the NRCS is mapped inside the project area in **Figure 24**.

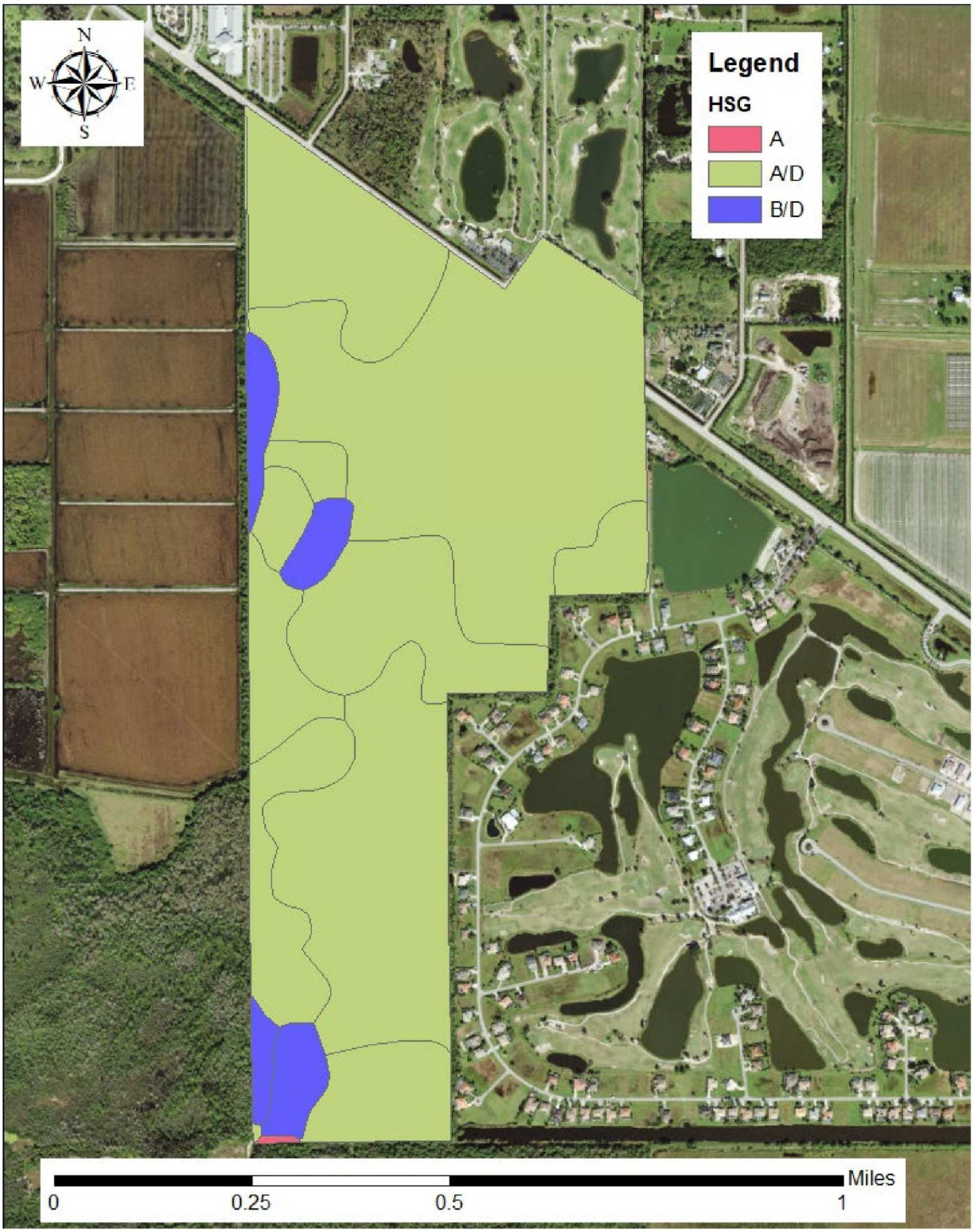

Figure 24. Hydrologic Soil Group (HSG) coverage.

Runoff Volume

The Harvey Harper Method uses the runoff coefficients from Table 4-24 (reproduced below), which are a function of the landuse classification and the hydrologic soil group (HSG). Lake Park area is in Collier County, which corresponds to the case cluster = 4 in that table.

TABLE 4-24

SUMMARY OF MEAN RUNOFF COEFFICIENTS FOR EACH CLUSTER AS A FUNCTION OF LAND USE AND HYDROLOGIC SOIL GROUP

LAND USE	HYDROLOGIC SOIL GROUP	CLUSTER				
		1	2	3	4	5
Undeveloped Land	A	0.015	0.007	0.013	0.011	0.018
	B	0.064	0.039	0.052	0.050	0.067
	C	0.126	0.087	0.103	0.105	0.127
	D	0.176	0.128	0.143	0.149	0.173
Low-Density Residential Areas	A	0.092	0.069	0.081	0.079	0.093
	B	0.166	0.126	0.140	0.144	0.164
	C	0.238	0.187	0.200	0.210	0.232
	D	0.294	0.237	0.248	0.262	0.284
Single-Family Residential Areas (25% Impervious)	A	0.155	0.136	0.143	0.144	0.151
	B	0.206	0.173	0.184	0.188	0.202
	C	0.268	0.223	0.235	0.243	0.260
	D	0.313	0.262	0.272	0.285	0.302
Single-Family Residential Areas (40% Impervious)	A	0.245	0.220	0.227	0.231	0.237
	B	0.294	0.257	0.266	0.273	0.284
	C	0.350	0.303	0.312	0.324	0.337
	D	0.391	0.339	0.347	0.362	0.375
High-Density Residential Areas	A	0.455	0.423	0.424	0.436	0.435
	B	0.490	0.450	0.453	0.467	0.469
	C	0.529	0.483	0.485	0.503	0.506
	D	0.556	0.508	0.509	0.529	0.531
Commercial Areas	A	0.648	0.613	0.609	0.628	0.618
	B	0.664	0.625	0.622	0.642	0.633
	C	0.683	0.641	0.637	0.658	0.651
	D	0.697	0.653	0.649	0.671	0.664
Highway Areas (50% Impervious)	A	0.444	0.415	0.416	0.427	0.425
	B	0.481	0.442	0.445	0.459	0.460
	C	0.517	0.473	0.476	0.492	0.495
	D	0.546	0.498	0.500	0.519	0.522
Highway Areas (75% Impervious)	A	0.647	0.612	0.608	0.627	0.616
	B	0.665	0.626	0.623	0.642	0.634
	C	0.683	0.641	0.638	0.659	0.651
	D	0.698	0.654	0.650	0.672	0.665

Once the runoff coefficient (C) is determined from Table 4-24, the annual runoff volume in the Harvey Harper Method is calculated as

$$Annual\ Runoff\ Volume\ (ac\text{-}ft) =$$

$$Area\ (acres)\ x\ Mean\ Annual\ Rainfall\ (inches)\ x\ C\ Value\ x\ \frac{1\ ft}{12\ in}$$

The mean annual rainfall for the Lake Park project area was estimated from the historic NEXRAD rainfall data for the pixels 47283 and 46809[12]. The 26-year period of record from 1996 through 2021 produces mean annual rainfall values of 57.6 and 57.4 inches, respectively. For this calculation, a mean annual rainfall value of 57.5 inches is used.

The estimated annual runoff volumes from the Harvey Harper Method are included in **Table 12**. The runoff coefficient in the case of hybrid HSG classes A/D and B/D were estimated simply as the mean value of the individual classes. In wetlands and open water areas, the runoff coefficient was assumed as 0.5 and 1.0 respectively. The "total" runoff coefficient is estimated from the total area, the annual rainfall, and the annual runoff.

Table 12. Annual runoff volume for each landuse and HSG class.

Land use	HSG	Area (ac)	Runoff Coefficient C	Annual Runoff Volume (acre*ft)
Low-Density Residential (Rural, 15% impervious)	A/D	40.9	0.203	39.8
Low-Density Residential (Rural, 15% impervious)	B/D	2.3	0.080	0.9
Single-Family Residential (25% impervious)	A/D	0.5	0.215	0.5
Single-Family Residential (40% impervious)	A/D	30.8	0.297	43.7
Single-Family Residential (40% impervious)	B/D	1.9	0.100	0.9
Commercial (80% impervious)	A/D	1.2	0.318	1.8
Highway/Transportations (50% impervious)	A/D	24.1	0.650	74.9
Highway/Transportations (50% impervious)	B/D	0.4	0.500	0.9
Undeveloped/Rangeland/Forest Land	A	0.3	0.171	0.3
Undeveloped/Rangeland/Forest Land	A/D	45.2	0.473	102.4
Undeveloped/Rangeland/Forest Land	B/D	6.6	0.500	15.9
Wetlands	A/D	101.9	0.489	238.7
Wetlands	B/D	3.3	1.000	15.9
Open Water/Lakes	A/D	14.9	0.011	0.8
Open Water/Lakes	B/D	1.5	1.000	7.4
	Total	**275.8**	**----**	**544.8**
	Average	**----**	**0.412**	**----**

Pollutant Load

The Event Mean Concentration (EMC) is related to the total annual pollutant load as

$$emc = \frac{total\ \ annual\ \ pollutant\ \ load\ \ for\ \ a\ \ given\ \ parameter}{total\ \ annual\ \ runoff\ \ volume}$$

The Harvey Harper Method suggest the use of the typical runoff concentrations from Table 4-17 (reproduced below).

[12] see pixel locations in Figure 10 of Technical Memorandum for Task 1

TABLE 4-17

SUMMARY OF LITERATURE-BASED RUNOFF CHARACTERIZATION DATA FOR GENERAL LAND USE CATEGORIES IN FLORIDA

LAND USE CATEGORY	TYPICAL RUNOFF CONCENTRATION (mg/l)						
	TOTAL N	TOTAL P	BOD	TSS	COPPER	LEAD	ZINC
Low-Density Residential[1]	1.61	0.191	4.7	23.0	0.008[4]	0.002[4]	0.031[4]
Single-Family	2.07	0.327	7.9	37.5	0.016	0.004	0.062
Multi-Family	2.32	0.520	11.3	77.8	0.009	0.006	0.086
Low-Intensity Commercial	1.18	0.179	7.7	57.5	0.018	0.005	0.094
High-Intensity Commercial	2.40	0.345	11.3	69.7	0.015	--	0.160
Light Industrial	1.20	0.260	7.6	60.0	0.003	0.002	0.057
Highway	1.64	0.220	5.2	37.3	0.032	0.011	0.126
Agricultural							
Pasture	3.47	0.616	5.1	94.3	--	--	--
Citrus	2.24	0.183	2.55	15.5	0.003	0.001	0.012
Row Crops	2.65	0.593	--	19.8	0.022	0.004	0.030
General Agriculture[2]	2.79	0.431	3.8	43.2	0.013	0.003	0.021
Undeveloped / Rangeland / Forest	1.15	0.055	1.4	8.4	--	--	--
Mining / Extractive	1.18	0.15	7.6[3]	60.0[3]	0.003[3]	0.002[3]	0.057[3]

1. Average of single-family and undeveloped loading rates
2. Mean of pasture, citrus, and row crop land uses
3. Runoff concentrations assumed equal to industrial values for these parameters
4. Value assumed to be equal to 50% of single-family concentration

The total annual rate of pollutant loading for the priority constituents were estimated in **Table 13** by using the EMCs in Harvey Harper Table 4-17 and the total annual runoff volumes in Table 12. It is to be noted that that the total pollutant load (last row in the table) only considers the classes where the EMCs are reported, and therefore, it excludes the contributions from wetlands and open water classes as well as from Undeveloped/Rangeland/Forest Lands in some of the constituents. In other words, the last row in Table 13 is an incomplete estimation of the total pollutant load in the entire project area.

Finally, it is also to be noted that this pollutant load estimation by using the Harvey Harper Method does not consider two important prevailing pollutant sources in the project area:

1. The old septic tanks not meeting the current DOH permit requirements. In the case of the Blue Heron Mobil Home Park, there has been detected some septic tanks with direct (or almost direct) discharges into the lakes.
2. Inflows from the US-41 north ditch that may contain nutrients from the agricultural areas among other constituents.

Table 13. Total annual pollutant load calculation

	Area acres	TN	TP	BOD	TSS	Cd	Cr	Cu	Fe	Ni	Pb	Zn
		Event Mean Concentration (mg/l)										
Low-Density Residential (Rural, 15% impervious)	43.2	1.61	0.191	4.65	22.95	0.003	0.012	0.016	0.32	0.019	0.004	0.062
Single-Family Residential (25% impervious)	0.5	2.07	0.327	7.9	37.5	0.003	0.012	0.016	0.32	0.019	0.004	0.062
Single-Family Residential (40% impervious)	32.6	2.07	0.327	7.9	37.5	0.003	0.012	0.016	0.32	0.019	0.004	0.062
Commercial (80% impervious)	1.2	1.18	0.179	7.7	57.5	0.006	0.013	0.018	1.14	0.028	0.005	0.094
Highway/Transportations (50% impervious)	22.5	1.64	0.22	5.2	37.3	0.004	0.007	0.032	0.57	0.013	0.011	0.126
Undeveloped/Rangeland/Forest Land	51.5	1.15	0.055	1.4	8.4	–-	–-	–-	–-	–-	–-	–-
Wetlands	103.9	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-
Open Water/Lakes	16.3	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-
	Annual runoff											
	Volume (acre*ft)	TN	TP	BOD	TSS	Cd	Cr	Cu	Fe	Ni	Pb	Zn
		Pollutant amount (kg/year)										
Low-Density Residential (Rural, 15% impervious)	35.7	71	8.4	205	1009	0.1	0.5	0.7	14.1	0.8	0.2	2.7
Single-Family Residential (25% impervious)	0.5	1	0.2	5	24	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Single-Family Residential (40% impervious)	46.6	119	18.8	454	2154	0.2	0.7	0.9	18.4	1.1	0.2	3.6
Commercial (80% impervious)	3.6	5	0.8	34	257	0.0	0.1	0.1	5.1	0.1	0.0	0.4
Highway/Transportations (50% impervious)	51.0	103	13.9	327	2349	0.3	0.4	2.0	35.9	0.8	0.7	7.9
Undeveloped/Rangeland/Forest Land	20.3	29	1.4	35	210	–-	–-	–-	–-	–-	–-	–-
Wetlands	249.0	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-
Open Water/Lakes	78.1	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-	–-
Total	**484.8**	**328**	**43.4**	**1060**	**6003**	**0.6**	**1.7**	**3.7**	**73.6**	**2.9**	**1.1**	**14.7**

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Pollutant Load Estimation Tool

The Pollutant Load Estimation Tool (PLET) is a method used by the U.S. Environmental Protection Agency (EPA) to calculate nutrient and sediment loads from stormwater runoff for different land uses. One difference from the Harvey Harper method is that it includes the septic tank systems and prevailing groundwater contributions.

According to the web-based tool, the Lake Park Project area is located in watershed 030902040700 Henderson Creek-Barron River Frontal. The weather station selected is FL082850 Everglades, FL.

The tool does not work with hybrid Hydrologic Soil Groups (HSG), such as A/D and B/D. Thus, for this estimation, the areas with HSG classified as A/D (or B/D) were assigned as 50 % in A (or in B) and 50% in D.

The tool uses a slightly different landuse classification compared to the Harvey Harper method, as shown in **Table 14**. Contributions from open water and wetland areas are ignored in this method as they were in the Harvey Harper Method.

Table 14. Land use classification cross walk assumed in the PLET

Harvey Harper Classification	PLET Classification	
Undeveloped/Rangeland/Forest Land	Forest	
Low-Density Residential (Rural, 15% impervious)	Urban	Open space
Single-Family Residential (25% impervious)	Urban	Single Family
Single-Family Residential (40% impervious)	Urban	Single Family
Commercial (80% impervious)	Urban	Commercial
Highway/Transportations (50% impervious)	Urban	Transportation
Wetlands		
Open Water/Lakes		

Table 15 and **Table 16** show the areas entered in the PLET for the different landuse and HSG classes. Table 15 also shows the 165 septic tanks in the project area distributed among the HSG classes.

The annual sediment load is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The Universal Soil Loss Equation (USLE)[13] is A= R*K*L*S*C*P, where

A: mean annual soil loss,
R: rainfall and runoff factor or rainfall erosivity factor,
K: soil erodibility factor,
L: slope length factor,
S: slope steepness factor,
C: cover and management factor, and
P: support practice factor.

Table 17 through **Table 24** contain other parameters assumed in the PLET calculation for the project area.

[13] See for example https://hess.copernicus.org/articles/22/6059/2018/

Table 15. Watershed land use distribution in the project area.

HSG	Urban (ac)	Forest (ac)	Total (ac)	Annual rainfall (in)	Rain days	Average Rain Event	Septic number	Septic population per system	Septic failure rate (%)
A	47.73	22.6	70.33	54.57	112.82	0.84	82	2	25
B	2.29	3.3	5.59	54.57	112.82	0.84	2	2	25
D	50.01	25.6	75.61	54.57	112.82	0.84	81	2	25

Table 16. Urban land use distribution.

HSG	Urban (ac)	Commercial (%)	Transportation (%)	Single family (%)	Open space (%)	Total (%)
A	47.73	1.2	22.5	33.1	43.2	100
B	2.29	0	8.0	41.8	50.2	100
D	50.01	1.2	23.2	32.7	42.9	100

Table 17. Reference septic overcharge

Parameter	Avg Conc	Remarks
Total Nitrogen	60	mg/L (range of 20 to 100)
Total Phosphorus	23.5	mg/L (range of 18 to 29)
Organics (BOD)	245	mg/L (range of 200 to 290)
Typical septic overcharge flow rate	70	gal/day/person (range of 45 to 100)

Table 18. Reference wastewater per capita

Parameter	Wastewater	Remarks
Total Nitrogen	40	mg/L (range of 20 to 85)
Total Phosphorus	8	mg/L (range of 4 to 15)
Organics (BOD)	220	mg/L (range of 110 to 400)
Typical septic overcharge flow rate	75	gal/day/person (range of 75 to 125)

Table 19. Nutrient concentration in runoff (mg/l)

Landuse	N	P	BOD	E. Coli
Forest	0.2	0.1	0.5	0

Table 20. Nutrient concentration shallow groundwater (mg/l)

Landuse	N	P	BOD	E. Coli
Urban	1.5	0.063	0	0
Forest	0.11	0.009	0	0

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*Table 21. Forest **USLE** factors.*

WATERSHED	R	K	LS	C	P
030902040700 Henderson Creek-Barron River Frontal	434.6	0.108	0.086	0.003	1

Table 22. Soil nutrient and E. Coli concentration in %.

WATERSHED	N	P	BOD	ECOLI
030902040700 - Henderson Creek-Barron River Frontal	0.08	0.0308	0.16	0

Table 23. Reference runoff curve numbers.

	HSG			
Landuse	A	B	C	D
Urban	83	89	92	93
Forest	39	60	73	79

Table 24. Detailed urban reference runoff curve number.

	HSG			
Urban landuse	A	B	C	D
Commercial	89	92	94	95
Transportation	98	98	98	98
Single-Family	57	72	81	86
Open Space	49	69	79	84

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Pollutant Load

The results from the PLET method are summarized in **Table 25** and **Table 26**. In general, the urban loads from this PLET are in the same order of magnitude as the loads calculated by using the Harvey-Harper Method in Table 13. The TSS load estimations show the largest relative differences.

The contribution estimated from the septic tanks is more than half of the total load. The failure rate assumed as 25 % in Table 15 is uncertain, but it is based on the field observations by the County staff in the Blue Heron Mobil Home Park. In any case, the substantial contaminant load in the Lake Park project area due to the septic systems will be eliminated after the proposed conversion from septic to sewer system of sewage collection and treatment.

Table 25. Total load by source.

Sources	N Load (kg/yr)	P Load (kg/yr)	BOD Load (kg/yr)	Sediment Load (kg/yr)
Urban	438	70	1461	21,233
Forest	8	4	21	322
Septic	479	188	1955	0.0
Groundwater	117	5	0	0.0
Total	**1042**	**266**	**3437**	**21,555**

Table 26. Total load by soil and land use

	Urban				Forest			
HSG	N Load (kg/yr)	P Load (kg/yr)	BOD Load (kg/yr)	Sediment Load (kg/yr)	N Load (kg/yr)	P Load (kg/yr)	BOD Load (kg/yr)	Sediment Load (kg/yr)
A	168	27	544	8,230	1	1	3	138
B	6	1	20	270	0	0	1	28
D	265	41	897	12,733	7	3	16	155
Total	**438**	**70**	**1461**	**21,233**	**9**	**4**	**21**	**322**

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Summary and Conclusions

This report presented the evaluations of six different scenarios with proposed drainage and road improvements in the Lake Park Project Area. The existing conditions model without modifications is used as the future conditions baseline model for these evaluations.

The performances of each of the scenarios were evaluated with respect to the existing conditions according to the following criteria:

1. Not to decrease wet season average water depths in wetland areas.
2. To decrease maximum flood depth and duration during hurricane Ian conditions (which was primarily caused by the extreme high tide) on roads and yards.
3. To decrease flood depth and duration from heavy rainfall (i.e., from a 25-year design storm) with normal tides on roads and yards.

The scenarios were designed in a progressive way such that Scenario 1 contains improvements with respect to existing conditions, Scenario 2 includes additional improvements to Scenario 1, and so forth. Scenario improvements include increasing drainage conveyance, raising road elevations, and the use of dropbox structures with positive flow devices in scenarios 5 and 6, among others.

Model results from the 25-year design storm showed that the proposed drainage and roadway improvements only produced slight changes in peak water levels in the range of [-0.2, 0.1] feet. The reason for the low sensitivity of the peak stages is likely the flatness (or the low relief topography) of the project area with a significant portion that can store surface water. Thus, proposed conveyance variations created only slight changes in stages.

The durations of the high-water level conditions in the project area were also estimated from the 25-year storm simulations as durations of the stages above the half-peak elevations. In this case, there is a significant reduction of the half-peak duration in the north and central areas. However, the half-peak duration remains about the same with slight increases at the nodes in the south areas.

In summary, the evaluation of the scenarios under the 25-year design storm rainfall with normal tidal conditions suggests that the proposed improvements will generate only slight variations in peak stages but will benefit with significant reduction in the durations of the peak flood stages in the north and central areas.

Peak stages from the different scenarios were also compared during Hurricane Ian conditions. In this case, the proposed drainage and roadway improvements in Scenario 6 were not significant enough to prevent the high tidal waters from entering the project area. Thus, further improvement features (like higher berms and pipes with positive flow devices) would be necessary at other places to prevent tidal inflows into the Lake Park project area during Hurricane Ian conditions.

Average water levels during the 2022 wet season were computed at wetlands inside the Lake Park Project area. The average wet season water levels in the wetlands dropped with increased conveyance in the drainage system. Dropbox structures proposed in Scenarios 5 and 6 were necessary to restore average wet season water levels simulated for the existing conditions. Moreover, the dropbox in the southwest boundary of the project area raised the average water levels in the wetlands by about 0.5 feet with respect to existing conditions.

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The results from the 25-year design storm simulations were extracted at the location that is currently receiving discharges through the southwest boundary of the Lake Park Project area. The peak stage there rose only slightly by about 0.02 feet above existing conditions in Scenarios 5 and 6, which is considered insignificant and not expected to impact the capacity to discharge from the Fiddler's Creek development.

The retention or residence time estimated from the model results suggests that the use of drop box structures at the downstream outlets will not only maintain and improve the wetland hydroperiods in the project area, but it will also enhance the water quality treatment of the discharges into the Outstanding Florida Waters of the Rookery Bay Estuarine Reserve.

A selection of higher-priority proposed drainage improvements was made based on the modeling evaluation and the observations during field visits. The selection included pipes to be cleaned or replaced, cross pipes to be added along Auto Ranch Road, as well as dropbox structures to be added to maintain or enhance wetlands hydroperiods. An estimate of the probable cost for these improvements is included.

An estimation of the loading rates of the priority pollutants in the Lake Park project area was conducted by using two independent methods: by Harvey Harper and from the PLET. Both methods excluded contributions from wetlands and open water classes. The urban loads estimated from both methods are in the same order of magnitude. The TSS load estimations show the largest relative differences.

The PLET method allowed the estimation of the loads from septic tank systems as more than half of the total load. The failure rate of the septic system in the area was assumed as 25 % in the calculations. This failure rate value is uncertain, but it was based on the field observations by the County staff in the Blue Heron Mobil Home Park area. In any case, the substantial contaminant load in the Lake Park project area due to the septic systems will be eliminated after the proposed conversion from septic to sewer system.

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Appendix A Conceptual design drawings

Driveway Pipes

- 15” or 24” diameter pipe per Collier County Engineering design standards

New cross pipes at Auto Ranch Road

- Use 24” RCPs. Minimum road crown = 4.9 ft NAVD88 and pipe crown = 1.5’ below road crown.

Cross Pipes at the side streets of Lake Park Boulevard

- Replace existing damaged 48” CMPs by 30” RCPs, mitered to slope. Minimum road crown = 4.9 ft NAVD88 and pipe crown = 1.5’ below road crown.

Dropbox Structures

- A total of four (4) dropbox structures in **Figure 19** to control at elevation 2.7 ft NAVD88. Water will only enter via horizontal grate (i.e., no slots or orifices). Parameters of the horizontal grate and the outlet pipes are listed in the table below. A one-directional flow feature (i.e., a flap gate) will be installed at the pipe end to prevent tidal backflows.

Location	Horizontal Grate	Outlet Pipes
South end of Auto Ranch Road	FDOT Type E Approximate dimensions: 3.3’x4’	24” RCP Invert elevation: 1.2 ft NAVD88
West outlet	FDOT Type H (4-grate inlet) Approximate dimensions: 3.3’x8.6’	24” RCPs Invert elevation: 1.2 ft NAVD88 Number of barrels: 3
South outlet (currently with a 12” HDPE pipe)		
South outlet (currently with a 24” iron cast pipe)		

DRAFT

Appendix D. Technical Memorandum for Task 4. Conversion from Septic to Sewer system of wastewater disposal, and Potable Water Distribution Improvements

GradyMinor

Civil Engineers • Land Surveyors • Planners • Landscape Architects

TECHNICAL MEMORANDUM

TO: Marcelo Lago, PhD

FROM: Allyson Holland, PE

SUBJECT: Lake Park Blvd/Auto Ranch Rd Septic to Sewer Discussion

DATE: December 2022

1.0 Introduction

Q. Grady Minor & Associates, P.A. (GradyMinor) has been authorized as partnering sub-consultant to Lago Consulting and Services to assist with Task 4 for the Lake Park Boulevard Capital Improvements & Water Quality Flow Way Pre-Design Project. Task 4 activities include an evaluation for converting the project area from septic to sewer system of wastewater disposal and for extending potable water supply to the sections not presently served by Collier County Public Utilities. The study area is located south of US 41 and both Auto Ranch Road and Lake Park Boulevard are north-south traversing dead-end roadways that connect to US 41. The proposed study area consists of residential, agricultural, and commercial use properties along Auto Ranch Road and Lake Park Boulevard including multiple side streets off of Auto Ranch Road and Lake Park Boulevard. The majority of the residential land use in this area consists of mobile homes. An aerial map of the project area can be found in Figure 1.

The entire project area is currently unsewered; each of the developed lots are served by an individual, privately owned and operated septic system. All of the properties within the Lake Park Boulevard area are currently served potable water by Collier County (County). The two side streets on the south end of Auto Ranch Road (also called Auto Ranch Road) are served potable water by Collier County, but service is from the existing residential development to the east. There is a bank of water meters on the east end of the side streets. Private water services extend to each of the properties from the water meters, but Collier County's ownership and maintenance ends at the water meters. All other properties on Auto Ranch Road do not have potable water service from the County.

Auto Ranch Road, Lake Park Boulevard, and the three (3) side streets off of Lake Park Boulevard (Blue Heron Drive, Morgan Drive, and Lockhard Drive) have dedicated 60-ft wide public right-of-way (ROW) pursuant to the Quit Claim Deeds. Collier County maintains Auto Ranch Road and Lake Park Boulevard. Collier County does not maintain Blue Heron Drive, Morgan Drive, or Lockhard Drive. All of the side streets off of Auto Ranch Road are private roadways. Maple Tree Drive and Oak Tree Drive, on the north end of Auto Ranch Road, have 60-ft wide ingress and egress easements reserved for the owners of the property contiguous to the private easement. The southernmost side street on the south end of Auto Ranch Road (also

named Auto Ranch Road) has a 40-ft wide ingress and egress easement reserved for the owners of the property contiguous to the private easement. The north side street on the south side of Auto Ranch Road (also named Auto Ranch Road) doesn't have a dedicated ROW or ingress and egress easement. If the County intends to install and/or replace utilities within the entire project area, new utility and access easements will be required for the four (4) side streets off of Auto Ranch Road.

The majority of the developed properties within the project area contain mobile homes. In the Auto Ranch Road Area, there are 98 properties total, and 68 of them are developed (30 are vacant lots). In the Lake Park Boulevard Area, there are 67 properties total, and 51 of them are developed (16 are vacant lots). GradyMinor has confirmed that 28 Department of Health (DOH) Septic System Permits were issued in this project area for septic repairs or new septic systems since 1999. Pursuant to recent coordination with the DOH, they are confident that the remaining properties have permits, but the permit was likely issued prior to the establishment of their electronic database. Due to the age of the majority of the septic systems, it is reasonable to assume that they are not constructed in conformance with today's standards (i.e. elevation and size, etc.). DOH also confirmed multiple violations associated with the existing septic systems. GradyMinor field verified that there are some septic systems not functioning properly. Inadequate maintenance and proper care of the septic systems can cause failures in in the septic systems resulting in untreated sewage that may be released to the surface of the ground or could back up in pipes in the structures.

In low-lying coastal areas with high groundwater, individual septic systems likely do not adequately treat human waste, including removal of viruses, fecal matter, pharmaceuticals, and nutrients such as nitrogen and phosphorus, all of which present health risks and degradation of local water ways. Due to the close proximity of this neighborhood to the Florida Designated Outstanding Waters of the Rookery Bay National Estuarine Research Reserve (with ultimate outfall to the Gulf of Mexico), and the age and condition of the majority of the existing septic systems, the likely failure rates of the existing septic systems, and the potential infrastructure improvements associated with this study, it is recommended to convert this region to a central sewer system and eliminate the private septic systems in the near future.

There are several challenges faced within this unsewered area. The existing ground elevations and high ground water table create a challenge for the design and construction of gravity sewer. Additionally, the residential lots along Auto Ranch Road and Lake Park Boulevard are very big lots (over 4-acres) and over 600-ft in depth. This could result in deeper gravity sewer installation to accommodate for the minimum slope requirements of the sanitary laterals from the existing structure to the County's cleanout at the ROW. Contributing to construction issues, specifically trenching and dewatering challenges, this is a tidally influenced area with a high ground water table. Furthermore, the pump station (PS) wetwell and the control panel pad are required to be constructed above the FEMA base flood elevation (BFE). The BFE in this area is 6.0 ft-NAVD. Based on the location of the pump station, this could result in an elevated PS wetwell and control panel pad, approximately 4-ft higher than the existing ground elevation.

This memorandum discusses several options with pros and cons for providing central sanitary sewer to the Auto Ranch Road and Lake Park Boulevard areas.

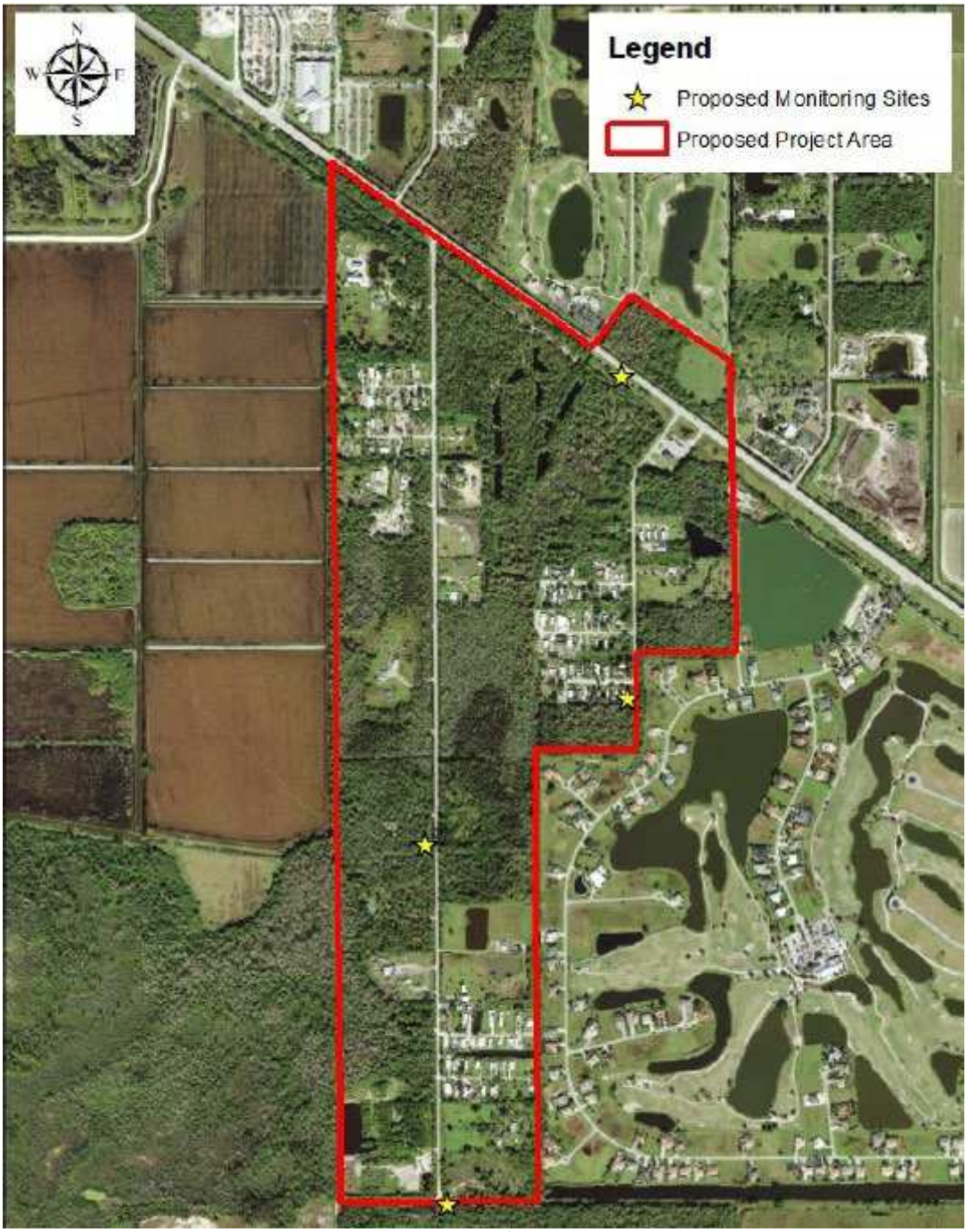

Figure 1 - Aerial map of the Project Area.

2.0 Central Sanitary Sewer System Options

There are no existing sanitary sewer PSs close enough to gravity flow new central sanitary sewer to from the project area. Collier County's master pump station (MPS) 317.00 is located on the north side of US 41 in between Auto Ranch Road and Lake Park Boulevard, but the MPS is not deep enough to accept gravity sanitary sewer from the project area. An existing 6-inch force main that serves the Collier Seminole-State Park PS runs along the south side of US 41 (crosses Lake Park Boulevard) and discharges to MPS 317.00. An existing 12-inch force main discharges from MPS 317.00 and flows to MPS 318.00 (after increasing in size near Greenway Road). Based on discussions with Collier County Wastewater Collections, MPS 317.00 currently has the capacity to accept additional sanitary sewer flows from the project area and the future affordable housing development that may be constructed southeast of Auto Ranch Road. However, a capacity analysis will need to be completed for MPS 317.00 and MPS 318.00 if this project moves forward. Estimated wastewater flow calculations are included in Appendix A. Options are discussed below to provide central sanitary sewer to the project area. Auto Ranch Road and Lake Park Boulevard would each have their own wastewater collection system as the roadways are not contiguous and existing ROW and/or easements do not exist between the two roadways.

2.1 New Pump Station(s) with Gravity Sewer System

In a gravity sewer system, sewer mains are installed on a slope, which conveys wastewater by gravity from the properties to a central pump station. Gravity sewer mains are designed with straight alignment and uniform slopes to maintain self-cleansing velocities. Gravity sewer mains are typically installed along the center of the roadway and at minimum and maximum depths per Utilities Standards and Specifications. The gravity sewer mains flow to a centralized pump station that collects and pumps the wastewater through a force main with eventual discharge to a wastewater treatment facility. Typically, in Collier County, the County owns and maintains the gravity sewer system up to the cleanout at the property/ROW line, including the pump station. Commonly, in areas that are converted from privately owned septic systems to a municipal gravity sewer system, it is the property owner's responsibility for the abandonment of the existing septic system and connection to the cleanout. However, the County could choose to administer the connection and abandonment process. New utility and access easements will be required along the four (4) side streets off of Auto Ranch Road.

- Pros:
  - No maintenance costs to property owners, compared to the responsibility of a privately owned septic system.
  - Central gravity sewer and pump stations are an industry standard.
  - The County owns multiple parcels within the project area that could potentially be utilized for the necessary PSs.
- Cons:
  - The construction costs are high.
  - The construction of the system will be challenging due to the deep sewer systems in a tidal area with a high ground water table and possible Infiltration and Inflow(I&I) issues.

- The depth of the large residential lots along Auto Ranch Road and Lake Park Boulevard would result in deeper gravity sewer to accommodate for the minimum slope requirements for the sewer laterals.
- The installation of a gravity system requires open-cut construction, which requires open excavations that is very impactful in built-out neighborhoods.
- The wet well and control panel for the new PS(s) are required to be above the base flood elevation (BFE), which is 6.0 ft-NAVD. This would result in a raised wetwell (as high as 4 feet above grade depending on the location of the PS) and the depth of the wetwell could exceed 25-feet deep (including the necessary storage in the wetwell). This will create construction challenges with respect to dewatering.
- If central gravity sewer is available to the property owner, they are required to connect to the system within 365 days after written notice is provided by the utility that the system is available for connection. The property owners are responsible for utility impact and application fees that accompany the sewer connection (in addition to the potential connection and abandonment fees). The project area appears to be a low-income area and the additional costs associated with central sewer may not be affordable for the property owners. Long-term payment schedules of utility impact fees assessed with annual property taxes may, however, be available.

2.2 Low Pressure System

A low pressure system would be comprised of smaller grinder pump stations at each individual property that would convey wastewater through a small diameter force main to a shallow buried shared force main installed along Auto Ranch Road and Lake Park Boulevard that would follow the ground profile. This shared force main could be installed via open cut or directional drill. The force main would tie into the existing 6" force main on US 41 that flows to MPS 317.00. The small grinder pump stations would be located on private property and require a power source. Typically, the grinder pump stations are owned and maintained by the property owner. A low pressure system would be cost effective for the large lots with great depths along Auto Ranch Road and Lake Park Boulevard, thereby reducing excavation and construction costs. New utility and access easements will be required along the four (4) side streets off of Auto Ranch Road.

- Pros:
  - Lower construction cost compared to gravity sewer systems with PSs presented in Section 2.1.
  - Less destructive and less impactful construction, no need to impact the roadways, as the shallow force main would be installed approximately with the topography of the land.
  - The sewer force main is a pressure pipe, which can be directionally bored resulting in lower restoration costs.
  - Although the property owner pays for the electricity to operate the grinder pump station, the resulting increase in electric bills is typically small.
  - A low pressure system eliminates the cost and maintenance to the County for a central PS and collection system.

- Property owners have the option to connect to the low pressure system, but they are not required to connect.

- Cons:
  - Long term responsibility and cost to property owners including power, pump maintenance, pump replacements, etc.
  - Power outages can result in wastewater system overflows if standby power generators are not available.
  - If the property owners connect to the system, they are responsible for utility impact and application fees that accompany the sewer connection (in addition to the potential connection and abandonment fees). The project area appears to be a low-income area and the additional costs associated with central sewer may not be affordable for the property owners. Long-term payment schedules of utility impact fees assessed with annual property taxes may, however, be available.

2.3 Combination Low Pressure System and Gravity System with Pump Station

The Auto Ranch Road project area could be designed and constructed with a combination of both a low pressure system and a gravity sewer with multiple PSs.

Due to the density of the lots off of the side streets on Auto Ranch Road, it is feasible to install a traditional gravity sewer system along the side streets and install PSs along Auto Ranch Road. This traditional gravity sewer system would result in two (2) small PSs along Auto Ranch Road; one to serve the dense properties on Maple Tree Drive and Oak Tree Drive, and one to serve the two (2) side streets in the southern project area (also named Auto Ranch Road). Although two (2) PSs may result in higher costs than a single station, the depth of the gravity sewer systems and PS wetwells would not be as deep, thereby saving reducing construction cost and impacts to the neighborhood.

In the less dense areas, with large lots, it is feasible to install a low pressure sanitary sewer system with smaller grinder pump stations at each individual property that would convey wastewater through a small diameter force main to a shallow buried shared force main installed along Auto Ranch Road that would follow the ground profile. This shared force main could also serve the two PSs for the traditional gravity sewer systems.

The combination system would be beneficial to the property owners on the side streets off of Auto Ranch Road as there would be no maintenance fees or responsibilities once the system is connected (but they would still have a utility bill). The combination system would result in a shallower gravity system and may ease the challenges associated with the construction. The combination of the two may also be more cost effective for this area as eliminating long runs of deep gravity sewer would reduce excavation and construction costs. A low pressure system would be the most feasible option along Auto Ranch Road due to the size of the lots and the distance between them. In addition, many of the large lots are vacant and there would be no need to provide a sewer connection at this time.

A combination of the two central sewer systems also gives the County the option to require whether or not the low pressure customers connect to the system. Although requiring customers to connect where the low pressure system is available would eliminate septic systems thereby improving water quality, the low pressure system has several disadvantages to property owners as discussed above, and the County may not want to place that encumbrance on the property owners in this area. However, the shared force main would be in place which would give the property owners along Auto Ranch Road the opportunity to connect if they choose to do so. The combination of the gravity and low pressure systems would still require new utility and access easements along the four (4) side streets off of Auto Ranch Road.

3.0 Potable Water

The entire Lake Park Boulevard project area is currently served potable water by Collier County. Pursuant to discussions with Collier County Water Distribution, the potable water distribution system has met its useful life and is in need of replacement. It would be beneficial to replace the potable water distribution system in conjunction with the roadway, stormwater, and/or sanitary sewer improvements in a singular effort if the County decides to move forward with the proposed infrastructure improvement in this area. All applicable easements are currently in place for access and maintenance.

Auto Ranch Road and the northern two (2) side streets currently do not have potable water supplied by Collier County. The two (2) southern side streets (Auto Ranch Road) are served Collier County potable water from the residential community to the east. If the County moves forward with infrastructure and roadway improvements along Auto Ranch Road, they should consider installing potable water mains and services throughout this area. There is a potential looping opportunity available at the southern end of Auto Ranch Road to the residential community that currently serves the two (2) southern side streets potable water. New utility and access easements would be required along the four (4) side streets off of Auto Ranch Road.

Installing a new potable water distribution system to the project areas where potable water is currently not available would require that the property owners connect and pay all applicable fees (and they would have a monthly utility bill from Collier County). These additional costs may not be affordable by some of the residents. Additionally, if the community to the east does not agree to a utility easement to facilitate looping the water main, this would result in a long dead-end water main.

4.0 Fiddler's Creek Affordable Housing Project

The existing Fiddler's Creek community is located west of the Project area. Fiddler's Creek is currently in the process of re-zoning vacant land located southeast of Project area that may bring 750 multi-family affordable house units to this area in the future. The potential affordable housing project would utilize Auto Ranch Road as the only means of ingress and egress. Fiddler's Creek is coordinating with Collier County with respect to improvements to Auto Ranch Road that would be required as a result of the increased traffic along this corridor.

With respect to utilities, the affordable housing project will require both potable water and sanitary sewer. There are cost-sharing opportunities available as a result of the affordable housing project.

If the County moves forward with infrastructure and roadway improvements within the Project area, communication with the potential Fiddler's Creek project is essential. The preliminary utility layouts included with this memorandum include potable water and wastewater force main proposed to the south end of Auto Ranch Road for future utilities for the potential Fiddler's Creek affordable housing project.

5.0 Recommendations

GradyMinor recognizes that this Project involves a Flowway Restoration, Water Quality, and Flood Protection Improvement Study. As mentioned in the Introduction, in low-lying coastal areas with high groundwater, individual septic systems likely do not adequately treat human waste, including removal of viruses, fecal matter, pharmaceuticals, and nutrients such as nitrogen and phosphorus, all of which present health risks and degradation of local water ways. Due to the close proximity of this neighborhood to the Florida Designated Outstanding Waters of Rookery Bay National Estuarine Research Reserve (with ultimate outfall to the Gulf of Mexico), because of the age and condition of the majority of the existing septic systems, the likely failure rates of the existing septic systems (including the septic tank leachates that cause harmful water quality impacts), and the potential infrastructure improvements, it is recommended that this region be converted to a central sewer system and the private septic systems be eliminated in the near future.

Although we recommend the conversion from septic to sewer, it is important to address the costs and impacts to the property owners and residents. Generally, the property owners are responsible for the cost to connect to the central sewer and for the abandonment of their existing septic system. Additionally, the property owners will have to pay the Collier County utility bill for both water and sewer. There are multiple private costs and maintenance responsibilities associated with the low pressure type of system.

GradyMinor recommends meeting with property owners in a group setting or individually to discuss the options to receive feedback. It would also be beneficial to meet with Collier County Water Distribution and Wastewater Collections Divisions prior to making a final decision regarding infrastructure improvements in this area.

If the County decides to proceed with the septic to sewer conversion, GradyMinor recommends the following:

5.1 Auto Ranch Road Area – Option 1

GradyMinor recommends the combination of gravity sewer and low pressure system on Auto Ranch Road. The traditional gravity system would serve the dense residential side streets and this would include two (2) pump stations; one (1) serving the side streets to the north and one (1) serving the side streets to the south. The low pressure system would serve the large residential lots on Auto Ranch Road. A schematic utility layout of Auto Ranch Road – Option 1 is included in Appendix B.

As detailed in the sections above, the combined system will best suit the area and provide a cost savings to the County while improving regional water quality. Although the low pressure system will result in additional responsibility and overall

maintenance costs to the property owners, the cost and difficulties of constructing and maintaining a gravity sewer and pump station system along Auto Ranch Road may outweigh the negatives of a low pressure system. In addition, the low pressure system is a low maintenance option for the County. The County will be required to obtain access and utility easements if gravity sewer is proposed within the (4) side streets off of Auto Ranch Road. This option would convert the entire Auto Ranch Road Area from septic to sewer.

GradyMinor also recommends installing potable water throughout the Auto Ranch Road Area. As mentioned earlier in this memorandum, extending both potable water and sewer force mains to the south end of Auto Ranch Road for the future Fiddler's Creek affordable housing project should be included with infrastructure improvements and cost sharing opportunities should be discussed with Fiddler's Creek representatives.

5.2 Auto Ranch Road Area – Option 2

GradyMinor's alternative recommendation in the Auto Ranch Road Area is to only install the traditional gravity system to serve the dense residential side streets off of Auto Ranch Road. The dense residential side streets represent the majority of the single family lots in this area and this option would include two (2) pump stations; one (1) serving the side streets to the north and one (1) serving the side streets to the south. GradyMinor also recommends installing a sewer force main along Auto Ranch Road, which is required due to the two (2) pump stations, but also extending it to the south end of the road for future connection to the potential Fiddler's Creek affordable housing. A schematic utility layout of Auto Ranch Road – Option 2 is included in Appendix C.

Since the force main will be installed along Auto Ranch Road, this will present an opportunity for the property owners to install their own grinder pump stations at their homes and tie into the force main along the roadway to eliminate their septic system, but the connection will not be required (i.e. low pressure system). Option 2 will eliminate the majority of the septic systems along Auto Ranch Road, thereby improving water quality. The County will be required to obtain access and utility easements if gravity sewer is proposed within the side streets off of Auto Ranch Road.

GradyMinor also recommends installing potable water throughout the Auto Ranch Road Area. As mentioned earlier in this memorandum, extending both potable water and sewer force mains to the south end of Auto Ranch Road for the future Fiddler's Creek affordable housing project should be included with infrastructure improvements and cost sharing opportunities should be discussed with Fiddler's Creek representatives.

5.3 Lake Park Boulevard Area – Option 1

GradyMinor recommends the traditional gravity system only throughout the Lake Park Boulevard Area. The dense residential lots on Blue Heron Drive, Morgan Drive, and Lockhart Drive comprise the majority of the lots in this area. Since there are only eight (8) other lots adjacent to Lake Park Boulevard, the traditional gravity system will best suit the area while improving water quality. A schematic utility layout of Auto Ranch Road – Option 2 is included in Appendix D.

Additionally, if the County moves forward with a central sewer system, GradyMinor also recommend replacing the potable water system in conjunction with the infrastructure improvements.

6.0 Cost Estimates

Provided below are preliminary cost estimates for each option discussed above to provide a central sanitary sewer collection system to the Auto Ranch Road and Lake Park Boulevard project areas. The cost estimates for each option were prepared using the most recent construction cost data available. The General Requirements and Restoration line items were estimated at a percentage of the sum of the wastewater items, excluding the private property sewer connection and abandonment of existing septic system line item. The line item for the private property sewer connection and abandonment of the existing septic system is included in the cost estimate in case the County chooses to fund this cost; this cost is typically the responsibility of the property owner.

6.1 Auto Ranch Road Option 1

Gravity Sewer & Low Pressure	Quantity	Unit	Unit Price	Total
6" PVC Force Main	5,355	LF	$75	$401,625
8" PVC Gravity Main	3,128	LF	$215	$672,520
Manhole (polymer concrete)	14	EA	$50,000	$700,000
Pump Station	2	EA	$750,000	$1,500,000
Low Pressure Collection System	14	EA	$20,000	$280,000
6" Sewer Lateral and Cleanout	69	EA	$4,000	$276,000
Private Prop. Sewer Connection & Abandonment of Ex. Septic Tank	69	EA	$5,000	$345,000
General Requirements	1	%	20%	$766,029
Restoration	1	%	35%	$1,340,551
Total				**$6,281,125**

6.2 Auto Ranch Road Option 2

Gravity Sewer side streets only	Quantity	Unit	Unit Price	Total
6" PVC Force Main	5,355	LF	$75	$401,625
8" PVC Gravity Main	3,172	LF	$215	$681,980
Manhole (polymer concrete)	14	EA	$50,000	$700,000
Pump Station	2	EA	$750,000	$1,500,000
6" Sewer Lateral and Cleanout	69	EA	$4,000	$276,000
Private Prop. Sewer Connection & Abandonment of Ex. Septic Tank	69	EA	$5,000	$345,000
General Requirements	1	%	20%	$711,921
Restoration	1	%	35%	$1,245,862
Total				**$5,862,388**

6.3 Lake Park Boulevard Option 1

Gravity Sewer	Quantity	Unit	Unit Price	Total
4" PVC Force Main	1,292	LF	$75	$96,900
8" PVC Gravity Main	3,051	LF	$215	$655,965
Manhole (polymer concrete)	12	EA	$50,000	$600,000
Pump Station	1	EA	$750,000	$750,000
6" Sewer Lateral and Cleanout	59	EA	$4,000	$236,000
Private Prop. Sewer Connection & Abandonment of Ex. Septic Tank	51	EA	$5,000	$255,000
General Requirements	1	%	20%	$467,773
Restoration	1	%	40%	$935,546
Total				**$3,997,184**

6.4 Property Owner Costs

If a low pressure system is constructed, property owners will be responsible for the electricity to operate the grinder pump station; the resulting increase in electric bills is typically small (+/- $15/bill). Long term responsibility and cost to property owners also includes pump replacements and maintenance. As mentioned earlier, it is commonly the property owner's responsibility for the abandonment of the existing septic system and connection to the cleanout, this cost is estimated at a one-time fee of approximately $5,000. The County could choose to administer the connection and abandonment process. The property owner is also responsible for sewer impact fees ($3,314/property).

6.5 Potable Water Cost Estimate

Provided below are preliminary cost estimates for new potable water distribution systems to the Auto Ranch Road and Lake Park Boulevard project areas. The cost estimates for each option were prepared using the most recent construction cost data available.

6.5.1 Auto Ranch Road Potable Water

Potable Water	Quantity	Unit	Unit Price	Total
6" PVC Water Main	3,165	LF	$90	$284,850
12" PVC Water Main	6,360	LF	$140	$890,400
Fire Hydrant Assembly	17	EA	$8,500	$144,500
Permanent Bacterial Sample Point	2	EA	$4,500	$9,000
Automatic Flushing Device	5	EA	$5,000	$25,000
Connect to ex. 12" Water Main	1	EA	$8,000	$8,000
Grout and Abandon ex. Water Main	1	LS	$5,000	$5,000
Total				**$1,366,750**

6.5.2 Lake Park Boulevard Potable Water

Potable Water	Quantity	Unit	Unit Price	Total
6" PVC Water Main	1,875	LF	$90	$168,750
8" PVC Water Main	2,025	LF	$115	$232,875
Fire Hydrant Assembly	7	EA	$8,500	$59,500
Permanent Bacterial Sample Point	2	EA	$4,500	$9,000
Automatic Flushing Device	3	EA	$5,000	$15,000
Connect to ex. 12" Water Main	1	EA	$8,000	$8,000
Grout and Abandon ex. Water Main	1	LS	$10,000	$10,000
Total				**$503,125**

7.0 Grant Funding Opportunities

There are multiple grant funding opportunities available for septic to sewer projects. Potential funding sources include:

- Legislative funding
- Big Cypress Basin Cooperative Funding
- FDEP funding through the 319 grant – applicable for private property connections only

GradyMinor is willing to work with County staff to remain positioned for pursuing the grant funding opportunities at the forefront of application deadlines and technical data requirements.

Appendix A

Wastewater Flow Calculations

Q. Grady Minor Associates, P.A.
3800 Via Del Ray Bonita Springs, FL
(239) 947-1144

Project: **Lake Park Blvd Water Quality Study**
Project No.: LLPWQ
Calculated By: AMH
Checked By: JAF

Date: 10/26/2022

Task: Determine the wastewater flows generated per **Collier County** for **Auto Ranch Road**

Calculations:

Population = **0.245** *Total Population / 1000*

(Eq. 1) Peak Factor = $\frac{18 + (P)^{1/2}}{4 + (P)^{1/2}}$ *where P = Population*

Peak Factor = **4.1**

Project Assumptions: Commercial business private pump station flow (when unavailable) determined from FAC 64E-6.001

A = Type of Service Connection	B = # of Service Connect	C = Average Occupancy per Dwelling	D = Capita Flow (GPD)	E = Avg Daily Sewer Flow (GPD) [BxCxD]+[*f*]	F = Total Population [E/D]	G=Avg Daily Sewer Flow (GPM) [F/24/60]	L = Peak Hourly Factor	M = Peak Hr Flow (GPM) [GxH]
Single Family Residential (Unsewered)	98	2.50	100.0	24,500	245.0	17.0	4.1	70.01
		2.50	100.0	0	0.0	0.0	4.1	0.00
Total	--	--	--	24,500	245.0	17.0	--	70.01

Assumptions:

B) Number of lots within Auto Ranch Road with ability to connect (including vacant lots)
D) 100 gallon/capita/day (from Recommended Standards for Wastewater Works, 2004)
L) Peak Hourly Factor: See Eq. 1 (from Recommended Standards for Wastewater Works, 2004)

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Q. Grady Minor Associates, P.A.
3800 Via Del Ray Bonita Springs, FL
(239) 947-1144

Project: **Lake Park Blvd Water Quality Study**
Project No.: LLPWQ
Calculated By: AMH
Checked By: JAF

Date: 10/26/2022

Task: Determine the wastewater flows generated per **Collier County** for **Lake Park Boulevard**

Calculations:

Population = **0.168** *Total Population / 1000*

(Eq. 1) Peak Factor = $\frac{18 + (P)^{1/2}}{4 + (P)^{1/2}}$ *where P = Population*

Peak Factor = **4.2**

Project Assumptions: Commercial business private pump station flow (when unavailable) determined from FAC 64E-6.001

A = Type of Service Connection	B = # of Service Connect	C = Average Occupancy per Dwelling	D = Capita Flow (GPD)	E = Avg Daily Sewer Flow (GPD) [BxCxD]+[*f*]	F = Total Population [E/D]	G=Avg Daily Sewer Flow (GPM) [F/24/60]	L = Peak Hourly Factor	M = Peak Hr Flow (GPM) [GxH]
Single Family Residential (Unsewered)	67	2.50	100.0	16,750	167.5	11.6	4.2	48.56
		2.50	100.0	0	0.0	0.0	4.2	0.00
Total	--	--	--	16,750	167.5	11.6	--	48.56

Assumptions:

B) Number of lots within Lake Park Boulevard with ability to connect (including vacant lots)
D) 100 gallon/capita/day (from Recommended Standards for Wastewater Works, 2004)
L) Peak Hourly Factor: See Eq. 1 (from Recommended Standards for Wastewater Works, 2004)

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Q. Grady Minor Associates, P.A.
3800 Via Del Ray Bonita Springs, FL
(239) 947-1144

Project: **Lake Park Blvd Water Quality Study**
Project No.: LLPWQ
Calculated By: AMH
Checked By: JAF

Date: 10/26/2022

Task: Determine the wastewater flows generated per **Collier County** for **Fiddler's Creek**

Calculations:

Population = **1.875** *Total Population / 1000*

(Eq. 1) Peak Factor = $\frac{18 + (P)^{1/2}}{4 + (P)^{1/2}}$ *where P = Population*

Peak Factor = **3.6**

Project Assumptions: Commercial business private pump station flow (when unavailable) determined from FAC 64E-6.001

A = Type of Service Connection	B = # of Service Connect	C = Average Occupancy per Dwelling	D = Capita Flow (GPD)	E = Avg Daily Sewer Flow (GPD) [BxCxD]+[f]	F = Total Population [E/D]	G=Avg Daily Sewer Flow (GPM) [F/24/60]	L = Peak Hourly Factor	M = Peak Hr Flow (GPM) [GxH]
Multi-family Affordable Housing	750	2.50	100.0	187,500	1,875.0	130.2	3.6	469.72
		2.50	100.0	0	0.0	0.0	3.6	0.00
Total	--	--	--	187,500	1,875.0	130.2	--	469.72

Assumptions:

B) Number of proposed multi-family affordable housing units
D) 100 gallon/capita/day (from Recommended Standards for Wastewater Works, 2004)
L) Peak Hourly Factor: See Eq. 1 (from Recommended Standards for Wastewater Works, 2004)

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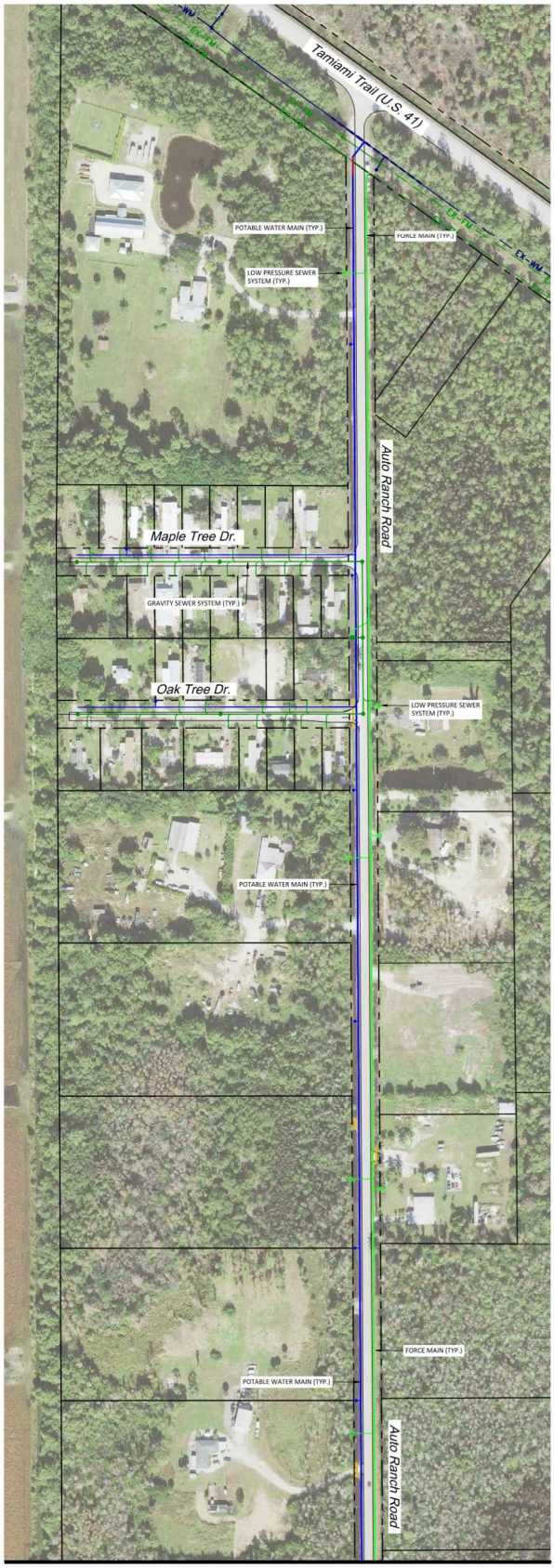
Appendix B

Auto Ranch Road Area – Option 1



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GradyMinor

Civil Engineers • Land Surveyors • Planners • Landscape Architects

Cert. of Auth. EB 0005151 Cert. of Auth. LB 0005151 Business LC 26000266

Bonita Springs: 239.947.1144 www.GradyMinor.com Fort Myers: 239.690.4380

Q. Grady Minor and Associates, P.A.
3800 Via Del Rey
Bonita Springs, Florida 34134

AUTO RANCH ROAD

APPENDIX B
(OPTION 1)

ELEVATIONS SHOWN HEREON ARE BASED UPON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD '88)
CONVERSION FACTOR TO NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD '29) IS (+)

ALLYSON M. HOLLAND, P.E.
FLORIDA P.E. LICENSE NO. 70177

SCALE: NOT TO SCALE
JOB CODE: LLPWQ
DATE: OCTOBER, 2022
FILE NAME: LLPWQ-APPEND B
SHEET 1 OF 3

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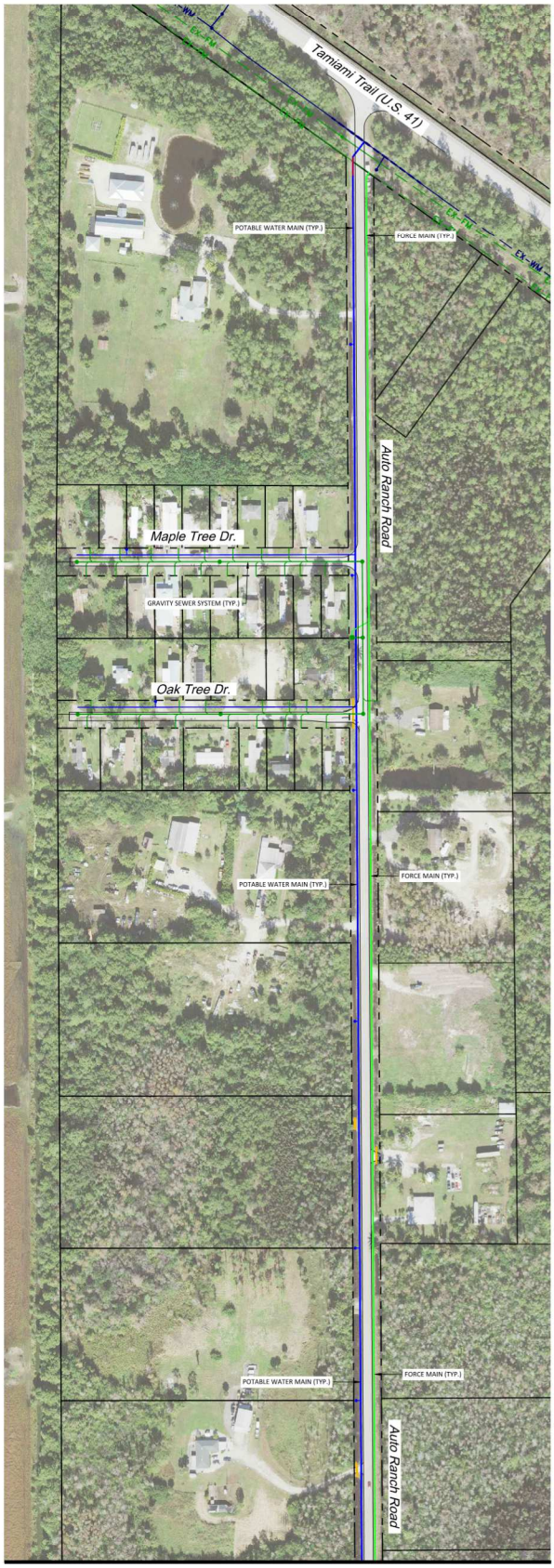
Appendix C

Auto Ranch Road Area – Option 2



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Bonita Springs, Florida 34134

AUTO RANCH ROAD

APPENDIX C
(OPTION 2)

ELEVATIONS SHOWN HEREON ARE BASED UPON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD '88)
CONVERSION FACTOR TO NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD '29) IS (+)

ALLYSON M. HOLLAND, P.E.
FLORIDA P.E. LICENSE NO. 70177

SCALE: NOT TO SCALE
JOB CODE: LLPWQ
DATE: OCTOBER, 2022
FILE NAME: LLPWQ-APPEND B
SHEET 2 OF 3

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Appendix D

Lake Park Area – Option 1



LEGEND

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Bonita Springs, Florida 34134

LAKE PARK BLVD.

APPENDIX D
(OPTION 1)

ELEVATIONS SHOWN HEREON ARE BASED UPON NORTH AMERICAN VERTICAL DATUM 1988 (NAVD '88)
CONVERSION FACTOR TO NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD '29) IS (+)

ALLYSON M. HOLLAND, P.E.
FLORIDA P.E. LICENSE NO. 70177

SCALE: NOT TO SCALE
JOB CODE: LLPWQ
DATE: OCTOBER, 2022
FILE NAME: LLPWQ-APPEND B
SHEET 3 OF 3

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Appendix E. Technical Memorandum for Task 5. Roadway Improvements

GradyMinor

Civil Engineers • Land Surveyors • Planners • Landscape Architects

TECHNICAL MEMORANDUM

TO: Marcelo Lago, PhD

FROM: Allyson Holland, PE

SUBJECT: Lake Park Boulevard/Auto Ranch Road Roadway Improvements

DATE: April 2023

1.0 Introduction

Collier County (County) has contracted Lago Consulting & Services (LAGO) to conduct a pre-design study to identify and evaluate the feasibility of potential stormwater management improvements, conversion of conventional septic systems of waste disposal to a municipal sewer, roadway improvements, restoration of historic flowways to the Rookery Bay estuaries and preservation of related natural resources within the project area. The study area is outlined in Figure 1.



Figure 1 – Project Area

Q. Grady Minor & Associates, P.A. (GradyMinor) has been authorized as partnering sub-consultant to Lago Consulting and Services to assist with the Proposed Roadway Improvements (Task 5). This technical memorandum summarizes the Task 5 activities including the review of the existing conditions of the roadways including pavement, swales, and shoulders, and reviewing the cross drainage features. This task also includes preliminary design for upgrades to the roadways taking into consideration the County's level of service (LOS) criteria. Official record documents and deeds were reviewed to determine the width of the existing right-of-way (ROW) and determine if there is sufficient room for upgrades within the ROW. This task also considers the potential Fiddler's Creek affordable housing project to be located southeast of Auto Ranch Road. Probable construction costs of road upgrades are also discussed.

2.0 Existing Roadway Conditions

All of the roadways within the project area are classified as Local Roadways in Collier County. Pursuant to Section 110-122 of the Collier County Land Development Code (LDC), Local Roadways shall mean any street or roadway which primarily serves to provide access to adjacent land and service to travel over relatively short distances as compared to Collector Roadways or Arterial Roadways, per the Federal Functional Classification Map maintained by the State of Florida Department of Transportation District Office, as amended. The existing conditions of roadways within the project area were measured, photographed, and documented below. Measurements of the existing roadways were taken using a measuring wheel and measuring the width of the roadway from the edge-of-pavement to edge-of-pavement in multiple locations. Pictures were taken of each street to further illustrate and corroborate measurements taken in the field.

1. Auto Ranch Road Existing Conditions
   a. Auto Ranch Road:
      i. Road material - asphalt
      ii. Road width - 18 feet
      iii. +/-1-foot-wide grassed shoulder on the east and west side of the road
      iv. ROW width - 60 feet (Quit Claim Deed to Collier County, O.R. 878 PG 0355)
      v. Maintained by Collier County
      vi. Roadway approximately centered in ROW
      vii. Existing constrained conditions: Overhead utility poles may need to be relocated, existing wetlands within ROW that may require mitigation, extensive vegetation in ROW.



Figure 2- Auto Ranch Road

   b. Maple Tree Drive:
      i. Road material – gravel (in poor condition)
      ii. Road width – Ranges from 16 to 18 feet
      iii. ROW width - 60 feet (30-ft Private Ingress Egress Easement adjacent to each parcel, 60-ft total easement width)
      iv. Not maintained by Collier County

v. Roadway approximately centered in ROW
vi. Existing constrained conditions: Some areas with extensive vegetation in the ROW, also existing fences and ancillary structure (shed) in ROW



Figure 3- Maple Tree Drive

c. Oak Tree Drive:
   i. Road material – gravel with some asphalt (in poor condition)
   ii. Road width – Ranges from 16 to 18 feet
   iii. ROW width - 60 feet (30-ft Private Ingress Egress Easement adjacent to each parcel)
   iv. Not maintained by Collier County
   v. Roadway approximately centered in ROW
   vi. Existing constrained conditions: Some areas with extensive vegetation in the ROW



Figure 4- Oak Tree Drive

d. Auto Ranch Road North:
   i. Road material – gravel (in poor condition)
   ii. Road width - 16 feet (narrower in multiple locations)
   iii. ROW width – No legal documentation found to-date
   iv. Not maintained by Collier County, but properties served with potable water from bank of water meters on east end of roadway
   v. Roadway not centered in ROW

vi. Existing constrained conditions: Overhead utility poles may need to be relocated, small pond exists just north of existing edge of pavement (EOP) and may require partial filling, multiple mobile homes were observed and measured to be as close as 7 feet from the EOP, vegetation near pavement, road meanders and centering the road in the proposed ROW may be challenging due to existing conditions, ROW may need to be acquired for roadway improvements.



Figure 5 - Auto Ranch Road N

e. Auto Ranch Road South:
   i. Road material – asphalt (several potholes)
   ii. Road width - 16 feet
   iii. ROW width – 40 feet (40-ft Private Ingress Egress Easement)
   iv. Not maintained by Collier County, but properties served with potable water from bank of meters on east end of roadway
   v. Roadway approximately centered in ROW
   vi. Existing constrained conditions: Overhead utility poles may need to be relocated, existing vegetation and hardscape in Private Easement, ROW may need to be acquired for roadway improvements.



Figure 6 - Auto Ranch Rd S

2. Lake Park Boulevard Existing Conditions
    a. Lake Park Boulevard:
        i. Road material - asphalt
        ii. Road width - 20 feet
        iii. ROW width – 60 feet (Quit Claim Deed to Collier County, O.R. 656 PG 909)
        iv. Maintained by Collier County and has existing potable water supply lines within ROW
        v. Roadway not centered in ROW
        vi. Existing constrained conditions: Very large (wide and deep) swales along the majority of the west side of the roadway, some swales appear to be small ponds.



Figure 7 - Lake Park Boulevard

    b. Blue Heron Drive:
        i. Road material – gravel (several potholes)
        ii. Road width – 18 feet
        iii. ROW width - 60 feet (Unrecorded Plat and Quit Claim Deed)
        iv. Not maintained by Collier County, but has existing potable water supply lines within ROW
        v. Roadway approximately centered in ROW



Figure 8 - Blue Heron Drive

c. Morgan Drive:
    i. Road material – asphalt
    ii. Road width - 20 feet
    iii. ROW width - 60 feet (Unrecorded Plat and Quit Claim Deed)
    iv. Not maintained by Collier County, but has existing potable water supply lines within ROW
    v. Roadway approximately centered in ROW



Figure 9 - Morgan Drive

d. Lockhart Drive:
    i. Road material – gravel (in poor condition)
    ii. Road width - 20 feet
    iii. ROW width – 60 feet (Unrecorded Plat and Quit Claim Deed)
    iv. Not maintained by Collier County, but has existing potable water supply lines within ROW
    v. Roadway approximately centered in ROW
    vi. Existing constrained conditions: Edge of existing gravel roadway is undefined, the gravel appears to have spread out, making the roadway appear wider.



Figure 10 - Lockhart Drive

Collier County has observed historical roadway inundation and roadside ponding throughout the project area following summer rain events and also after occasional high rainfall events in winder. GradyMinor and LAGO met with Collier County Road Maintenance staff in August of 2022 to discuss their observations and documented flooding complaints within the project area. The majority of the complaints received are along Auto Ranch Road and some on the side streets off of Auto Ranch Road. There are no documented complaints of flooding within the Lake Park Boulevard project area. Please reference Appendix A for the map and spreadsheet documenting historical flooding complaints within the entire project area provided by Collier County Road Maintenance. The Task 1 Technical Memorandum includes a discussion about two previous heavy rain/flooding events and how this area was affected.

3.0 Collier County Level of Service Discussion

GradyMinor coordinated with Collier County Transportation Planning and Growth Management Staff regarding LOS standards for existing roadway improvement requirements. All of the existing roadways within the project area are considered "local roads." Collier County staff confirmed that LOS categorization is not applicable for local roads because LOS is a performance measure that looks at operational conditions within a traffic stream. County staff confirmed that the LOS for local roads can be determined by the applicant/engineering firm by performing their own analysis.

GradyMinor and LAGO coordinated with County staff to discuss the desired upgrades proposed. Section 4.0 below describes the design considerations associated with the roadway upgrades.

4.0 Preliminary Design Considerations

The following preliminary design considerations are discussed below:

- Travel lane and shoulder width
- Raising the elevation of the roadway
- Adding a sidewalk to one or both sides of the road
- Adding valley gutter to one or both sides of the road
- Improving the existing swales for water quality
- Drainage improvements
- Centering the roadway in the existing ROW
- ROW acquisition or conversion as necessary
- Required Building Setbacks

The Collier County LDC Appendix B – Typical Street Sections and Right-of-Way Design Standards includes a typical section for local roadways. Although the typical section is intended for new local roadways, this can be used to support improvements to existing roadways. Please reference Figure 11 below for the Typical Street Section for a Local Street.

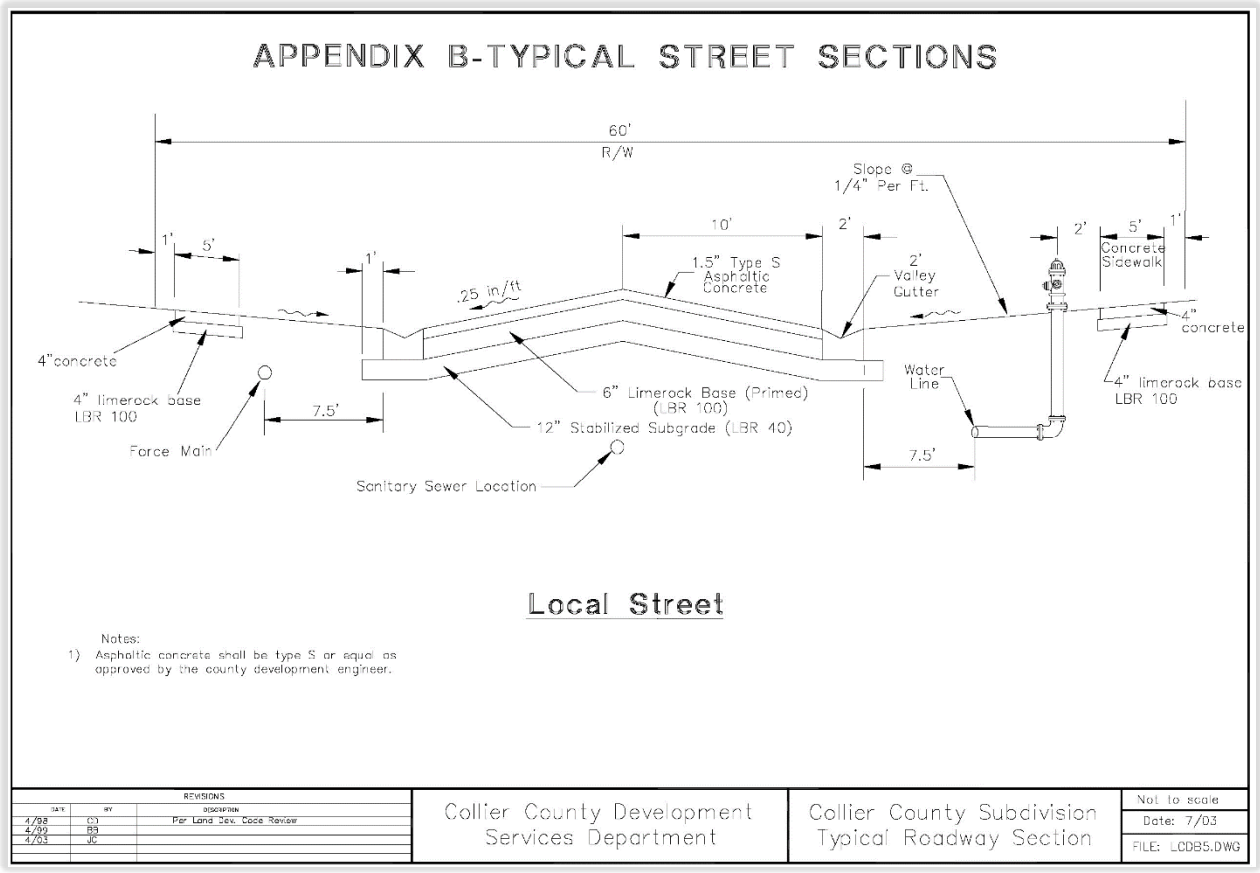

Figure 11 – Typical Street Section for Local Street

Additionally, the following design criteria has been derived based upon standard engineering practice and the successful application of regulatory standards and guidelines:

- American Association of State Highway & Transportation Officials (AASHTO):
  - Minimum 9'-12' lane width for Rural/Local Roads
- Manual of Uniform Minimum Standards for Design, Construction, and Maintenance for Streets and Highways – *Florida Greenbook*:
  - Recommended Width 9'-12' for Rural Local Roads
  - Recommended Width 10' for Urban Local Roads
  - Preferred minimum 10' width (only where less than 10% truck traffic, < 40 mph)
  - Minimum 11' width for new construction

Roadway and Shoulder Width

Auto Ranch Road and Lake Park Boulevard are local roadways, but they serve as the spine road for the side streets with the dense mobile homes. Since these Auto Ranch Road and Lake Park Boulevard generate more traffic than the side streets, widening these roadways may be beneficial. A travel lane width of 10-feet (minimum) is desirable in this area (20-feet of pavement, minimum). Since the side streets with the mobile homes currently have narrower pavement (20-feet or less), maintaining the narrower travel lanes is suitable and has been reconstructed similarly elsewhere in Collier County (Naples Park, for example). These side streets are currently private (not maintained by Collier County) and are typically only travelled on by the local residents.

Both Auto Ranch Road and Lake Park Boulevard currently have narrow (+/-1-ft wide) unpaved (grassed) shoulders on both sides of the road prior to the swales. A 2 to 3-ft minimum unpaved shoulder is recommended with the roadway improvements. Shoulders provide space for emergency stops, recovery space for errant vehicles, space for maintenance operations, and other functions. The side streets off of both Auto Ranch Road and Lake Park Boulevard do not appear to have defined shoulders. The side streets area relatively flat and the area beyond the gravel or asphalt road is relatively flat as well. The majority of the side streets are gravel roads, many in poor condition with very large potholes throughout.

Road Crown Elevations

The existing roadway elevations on Auto Ranch Road range from 3.4 to 4.4 ft-NAVD. The roadway has a typical road crown section, although some areas have become relatively flat over time. The side streets off of Auto Ranch Road were not surveyed, but they are all at lower elevations than Auto Ranch Road. The Lake Park Boulevard area is similar to the Auto Ranch Road area. Lake Park Boulevard is slightly higher than the side streets. It is recommended to raise the elevation of all the roadways to a minimum road crown elevation of 4.2 ft-NAVD (5.5 ft-NGVD) which was previously the minimum road elevation required by Collier County. The 5.5 ft-NGVD minimum road elevation criteria was removed from the Land Development Code (LDC) by Ordinance in 2006 (Ordinance 06-63, found in Appendix B, see pages 37 and 38 of the Ordinance). Local engineering firms typically continue to adhere to the previous minimum roadway elevation requirements, in addition to stormwater modeling results consistent with South Florida Water Management District (SFWMD) requirements.

Additionally, it is recommended to raise the elevation of Auto Ranch Road and Lake Park Boulevard to a minimum road crown elevation of 4.9 ft-NAVD. The proposed stormwater ICPR modeling that was performed in Task 3 shows that if the roads are raised to 4.9 ft-NAVD, this will result in little to no standing water on the roadways during and after storm events. It should also be noted that a road crown elevation of 4.9 ft-NAVD is consistent with the roadways within the adjacent residential developments.

Sidewalks

Sidewalks provide many benefits including safety, mobility, and healthier communities. Collier County and the Collier Metropolitan Planning Organization (MPO) fund sidewalk design and construction annually. Although Collier County and the Collier MPO have not identified the Auto Ranch Road or Lake Park Boulevard areas as roadways in need of sidewalks, it is beneficial to consider constructing sidewalks as part of the project improvements, or plan for future sidewalks in this area.

GradyMinor recommends a sidewalk on one side of Auto Ranch Road for this project. This is consistent with the Fiddler's Creek Affordable Housing project discussed later in this memorandum. There are existing wetlands along Auto Ranch Road that may be impacted if a sidewalk is constructed in order to properly grade the connection between the back-of-sidewalk and the swale. The wetlands along the roadway are part of the flowway project and it is beneficial not to disturb them if possible. If the County desires, it may be feasible to build a boardwalk-type sidewalk in some areas to avoid wetland impacts. However, boardwalks can be costly

and they require more maintenance than a typical concrete sidewalk. An alternative option is to construct a gravity wall adjacent to the sidewalk and build a railing along the sidewalk. This would allow for steeper slopes adjacent to the sidewalk to maintain the majority of current wetland conditions.

GradyMinor recognizes that sidewalks are desirable to many areas in Collier County, but funding is not readily available. The roadway improvement plans include options showing sidewalk along the roadways, where feasible, within the project area. If funding is available, the sidewalks can be constructed in accordance with the roadway improvements.

Location of Road in ROW

Typically, roadways are designed and constructed in the center of the ROW. This allows for adequate space on either side of the road for storm drainage, utilities, sidewalks/paths, and a safe recovery area for vehicles that leave the road surface. There are several roadways within the project area that are not centered within the ROW. It is recommended that the majority of the roads be reconstructed in the center of the ROW as part of this improvement project, but due to existing constraints, at least two of the roadways will remain off-centered in the ROW.

The majority of the Lake Park Boulevard roadway is offset toward the east side of the ROW. The west side of the ROW contains drainage features including swales and small ponds. It is not feasible to reconstruct the road in the center of the ROW and GradyMinor recommends leaving the roadway in its existing location.



Figure 12 - Lake Park Boulevard

Auto Ranch Road North, the east/west roadway located on the south end of Auto Ranch Road, is located within the individual lots and not within an easement or ROW. If this roadway is improved, it will likely need to be relocated so that the center of the roadway bisects the existing property lines. It will also require an easement or ROW for the construction and maintenance of the utilities, drainage, and roadway features.



Figure 13 - Auto Ranch Road North

Drainage Improvements and Permitting

It is recommended to provide drainage improvements in accordance with the recommendations in the Task 3 memorandum. This includes upsizing the cross drains, replacing and upsizing driveway culverts, and additional drainage improvements at the outfall. The drainage improvements will maintain the existing swales and create new swales and/or pipes where they currently do not exist or may have been filled in over time. An enclosed drainage system with shallow swales may be required adjacent to the proposed sidewalk. The County has expressed an interest in potentially enclosing the drainage system on both sides of the roadway.

Although one of the objectives of this project is to enhance the flowway and minimize wetland impacts, it is inevitable that some of the existing wetlands along the roadway within the ROW will be impacted as a result of the roadway and drainage improvements. The proposed improvements will likely require permitting through the South Florida Water Management District (SFWMD). The magnitude of the type of permitting that is required will depend upon the extent of improvements and the total area of wetland impacts. The type of application anticipated will be one of the three listed below.

1. Request for Verification of an Exemption
2. General Permit
3. Individual Permits

Activities Exempt from Permitting

Section 62-330.051 of the Florida Administrative Code (F.A.C.) discusses activities that are exempt from permitting. Rule 62-330.051(4)(c) F.A.C. includes an exemption for sidewalks as part of minor roadway construction, with additional provisions such as no wetland impacts and no reductions in the capacity of existing swales. Based on the existing conditions and the proposed improvements, it is not likely that this project would qualify for an exemption.

General Permit

This project may qualify for one of the General Permits detailed in the F.A.C. Rule 62-330.447 F.A.C. is a General Permit to the Florida Department of Transportation, Counties, and Municipalities for Minor Activities with Existing Rights-of-Way or Easements. This General Permit allows up to a half-acre of wetland impacts, but only 500 square feet (SF) for each activity. There is also a General Permit for stormwater retrofits in 62-330.451 F.A.C. that allows a half-acre of wetland impacts with no limit on SF per activity.

Individual Permit

If major roadway and drainage improvements are proposed, this may trigger an Individual Permit. The SFWMD requires wetland compensation for wetland impacts by preserving, restoring, enhancing, or creating wetlands onsite or at an offsite mitigation location, or by purchasing credits from a mitigation bank. SFWMD also requires the applicant to adhere to their water quality and water quantity requirements. This could result in an offsite pond or wet/dry detention/retentions area to treat the stormwater water runoff prior to discharge. It is recommended to schedule a pre-application meeting with SFWMD early in the design stage of the roadway and drainage improvements to receive input from the SFWMD on which permit will be required for this project.

Road Maintenance and Access

As mentioned previously, presently the only roadways Collier County has legal rights to access and maintain are Auto Ranch Road and Lake Park Boulevard. Collier County Public Utilities has the legal right to access and maintain the existing potable water mains on Lake Park Boulevard and the side streets off of Lake Park Boulevard (Blue Heron, Morgan, and Lockhart Drives). It is our understanding that the County has the right, but not the responsibility, to maintain the side streets off of Lake Park Boulevard. Therefore, the County will be able to perform roadway improvements on the side streets off of Lake Park Boulevard. If the County wants to take over maintenance responsibilities, additional steps will be required, as discussed below.

The side streets off of Auto Ranch Road are all private and Collier County does not currently have legal rights to access or maintain the roadways, or install, access, and maintain utilities. Should any improvements be made on these roadways, the County will need to acquire easements or ROW to do so. The ROW acquisition process involves several departments within Collier County. Based on GradyMinor's understanding of the process, the County will need to acquire the ROW, Road Maintenance will need to be involved as their budget will be affected because this will add more roadways for them to maintain, the County needs to agree to maintaining the roads, the roads will need to be brought up to County standards, and the Board of County Commissioners will need to accept the maintenance of the roads.

Required Setbacks

The Collier County LDC requires principal structure setbacks based on the zoning district. Please reference the table below for the required front yard building setbacks from the property line within the project area. It is important to note that some of the mobile homes currently do not adhere to the required setbacks. Some of the mobile homes are within seven (7) feet of the existing roadway. This may present challenges for proposed roadway and drainage improvements. Collier County requires the roadways be brought up to Code before they will assume ownership and maintenance responsibilities.

Principal Structure Setbacks:		
Zoning District	**Street**	**Minimum Front Yard (ft)**
VR - Village Residential	Maple Tree Dr Oak Tree Dr	Single Family / Mobile Homes: 20
		Duplex: 35
		Multi-Family: 35
MH - Mobile Home	Lake Park Blvd Blue Heron Dr Morgan Dr Lockhart Dr Auto Ranch Rd N & S	25
A - Rural Agricultural	Auto Ranch Rd	50

5.0 Existing Constrained Conditions

There are several existing constrained conditions observed during site visits that are worth mentioning. They are included below by street name.

Auto Ranch Road – Existing overhead utility poles are relatively close to the existing EOP near the north end of the roadway on the west side. Relocation of the utility poles may be necessary for the roadway improvements. There are existing wetlands within the 60-foot ROW. Wetland mitigation may be required to accommodate for roadway and utility improvements. There is extensive vegetation in the ROW and some of the vegetation may need to be cleared for the recommended improvements.

Auto Ranch Road North – No existing ROW or easement exists. The existing roadway is located within the northern portion of the southern lots. There is a pond within five (5) feet north of the existing road and a few of the existing mobile homes are within seven (7) feet south of the existing road. This roadway will likely need to be relocated if the County moves forward with improvements because utility and roadway improvements are not feasible in the roadway's current location. The minimum front yard setback (25 feet) may not be achievable on this roadway even if the road is shifted to the north. If the road is relocated, this will result in impacts to the front yards of the northern lots and a portion of the pond will need to be filled in.

Auto Ranch Road South – Overhead utility poles may need to be relocated. ROW or easement is required as the existing private easement is dedicated to the adjacent property owners.

Lake Park Boulevard –The existing drainage design on the west side of the roadway includes large swales and possible ponds (depth of drainage features is unknown). The existing drainage design limits the use of that portion of the ROW. The existing paved roadway is located toward the east side of the ROW. This could be challenging with respect to utilities and additional utility easements may be necessary.

6.0 Fiddler's Creek Multifamily with Workforce Housing Project

The existing Fiddler's Creek community is located west of the Project area. Fiddler's Creek is currently in the process of re-zoning and permitting a parcel of land located southeast of Project area that may bring 750 multi-family units with affordable work force housing to this area in the future. The potential multifamily with workforce housing project would utilize Auto Ranch Road as the only means of ingress and egress. Fiddler's Creek is coordinating with Collier County with respect to improvements to Auto Ranch Road that would be required as a result of the increased traffic along this corridor.

With respect to roadway improvements, the multifamily with workforce housing project will result in additional traffic/generated trips along Auto Ranch Road and possibly a Collier Area Transit (CAT) route and bus stop. If the project moves forward, the roadway improvements associated with the Fiddler's Creek multifamily with workforce housing project will extend beyond the recommended improvements associated with the Lake Park Area Flowway Restoration Study. There are cost-sharing opportunities available as a result of the affordable housing project. If the County moves forward with infrastructure and roadway improvements within the Project area, communication and coordination with the potential Fiddler's Creek project is essential.

7.0 Recommendations

GradyMinor recommends roadway improvements throughout the project area. The proposed improvements will benefit the residents who drive on the roads and also emergency services, garbage trucks, and delivery trucks including US mail. The proposed improvements include widening and raising the roadways, constructing a defined shoulder and swales, a sidewalk on Auto Ranch Road, and drainage improvements. Drainage improvements correlate directly with the recommendations discussed in Task 3.

In accordance with the Collier County LDC, AASHTO, and the Florida Greenbook, we recommend a minimum paved lane width for a two-way local, residential road of 9 to 10 feet. This allows cars passing in each direction to comfortably pass without needing to pull to one side. In addition, the extra width allows for a vehicle to temporarily park within the roadway, while still allowing a full lane width for another car to pass. Please note that the recommendations for pavement widening as they vary throughout the project. Several of the two-way roadways were found to be narrower than the minimum 18-feet (two 9-foot lanes).

Existing driveways will be sawcut back to the width of the widening. The landscaping and other improvements within the ROW will be removed. Irrigation systems will be capped off and mailboxes will be relocated adjacent to their current location. The widened and raised roadway will be the standard crowned section, sloped away from the road to allow the runoff to flow to the adjacent grassed area.

Improvements to each of the roadways are discussed below and preliminary design plans for two options are included in Appendix C. General roadway improvements are included in the Option 1 preliminary design plans.

The Option 2 preliminary design plans include additional improvements including sidewalks and enclosed drainage in certain areas, as discussed below.

7.1 Auto Ranch Road

GradyMinor recommends raising the road crown elevation to 4.9 ft-NAVD, widening the road to 20 feet (10-foot travel lanes), including a 2 to 3 foot shoulder on each side of the road, including a hammerhead or small roundabout at end of road to allow vehicles to turn around, constructing a sidewalk on one side of the road, constructing swales to provide water quality, and drainage improvements in accordance with recommendations previously discussed in Task 3. We recommend maintaining the existing wetlands if possible, but due to the proposed utility, drainage, and roadway improvements, wetland disturbance is anticipated. The Auto Ranch Road Option 1 Preliminary Design Plans illustrate this option.

An alternative recommended design includes an enclosed drainage system on the east side of the roadway where the sidewalk is proposed. An enclosed drainage system would facilitate the area to be graded to provide a safe and sound environment for pedestrians. The enclosed drainage system would require the wetlands to be removed (mitigated) on the east side of the roadway.

With a detailed survey prior to the final design of the roadway improvements, it may be feasible to design a combination of the open swale system with the enclosed drainage design in certain areas along the roadway. The intent of the combination design would be to conserve the majority of the functioning wetlands, however, this may not be possible due to inabilities to maintain safe swale slopes beyond the back of sidewalk. A gravity wall or a railing may still be required adjacent to the sidewalk. The Auto Ranch Road Option 2 Preliminary Design Plans illustrate this option.

It is important to note that the existing grade elevations at US 41 are higher than both the existing and proposed grade elevations on Auto Ranch Road. This will require additional survey data to properly regrade the intersection at US 41. A turn lane on US 41 may also be proposed with the Fiddlers Creek Affordable Housing Project.

7.2 Maple Tree Drive and Oak Tree Drive

GradyMinor recommends raising the road crown elevation to 4.2 ft-NAVD, widening the road to 18 feet (9-foot travel lanes), and including a hammerhead or small roundabout at end of road to allow vehicles to turn around. Drainage improvements include an open swale drainage system and driveway culverts. The Auto Ranch Road Option 1 Preliminary Design Plans illustrate this option.

Pursuant to coordination with Collier County, sidewalks may be desirable in this area, therefore the preliminary design plans include an option for a 5-ft wide sidewalk on both sides of the street on both Maple Tree Drive and Oak Tree Drive. The Auto Ranch Road Option 2 Preliminary Design Plans illustrate this option.

7.3 Auto Ranch Road North

GradyMinor recommends relocating the roadway on Auto Ranch Road North to the north of its existing location in an effort to construct the road in the middle of the existing lots/mobile homes, similar to Auto Ranch Road South. The existing road is relatively close to the homes on the south side of the existing roadway, as close as seven (7) feet in several cases. Although the location of the proposed roadway is generally consistent with

Collier County's standards for roadway design, the proposed roadway location would affect a portion of the front yards of the northern lots for roadway and infrastructure purposes.

GradyMinor recommends raising the road crown elevation to 4.2 ft-NAVD, widening the road to 18 feet (9-foot travel lanes), and including a hammerhead or small roundabout at end of road to allow vehicles to turn around. The existing bank of water meters located at the east end of the street will be relocated to the property/ROW line at each individual parcel as part of the water main improvements. Drainage improvements include an open swale drainage system and driveway culverts. The Auto Ranch Road Option 1 Preliminary Design Plans illustrate this option.

Pursuant to coordination with Collier County, sidewalks may be desirable in this area, so the preliminary design plans include an option for a 5-ft wide sidewalk on both sides of the street on both Auto Ranch Road North. Please note that the proposed 40-ft wide ROW is a narrow corridor to construct sidewalks on both sides of the street. The Auto Ranch Road Option 2 Preliminary Design Plans illustrate this option.

It is also worth noting that the mailboxes for this roadway are currently located on the west end of the roadway in a mailbox bank off of the main Auto Ranch Road. The County may want to consider renaming this road in the future to delineate this side street from the main Auto Ranch Road and also coordinate with the United States Postal Service to possibly relocate the mailboxes in front of each parcel once the roadway improvements are completed.

7.4 Auto Ranch Road South

GradyMinor recommends raising the road crown elevation to 4.2 ft-NAVD, widening the road to 18 feet (9-foot travel lanes), and including a hammerhead or small roundabout at end of road to allow vehicles to turn around. The existing bank of water meters located at the east end of the street will be relocated to the property/ROW line at each individual parcel as part of the water main improvements. Drainage improvements include an open swale drainage system and driveway culverts. The Auto Ranch Road Option 1 Preliminary Design Plans illustrate this option.

Pursuant to coordination with Collier County, sidewalks may be desirable in this area, so the preliminary design plans include an option for a 5-ft wide sidewalk on both sides of the street on both Auto Ranch Road South. Please note that the proposed 40-ft wide ROW is a narrow corridor to construct sidewalks on both sides of the street. The Auto Ranch Road Option 2 Preliminary Design Plans illustrate this option.

It is also worth noting that the mailboxes for this roadway are currently located on the west end of the roadway in a mailbox bank off of the main Auto Ranch Road. The County may want to consider renaming this road in the future to delineate this side street from the main Auto Ranch Road and also coordinate with the United States Postal Service to possibly relocate the mailboxes in front of each parcel once the roadway improvements are completed.

7.5 Lake Park Boulevard

GradyMinor recommends raising the road crown elevation to 4.9 ft-NAVD, maintaining the width of the road at 20 feet (10-foot travel lanes) in its current location, and constructing a hammerhead or small roundabout at

end of road to allow vehicles to turn around. GradyMinor recommends maintaining the existing drainage design on the west side of Lake Park Boulevard, but replacing drainage pipes as needed. Although a sidewalk would be desirable in this area, due to the limited room in the ROW, a traditional on-grade sidewalk is likely not feasible. There is not enough room to construct a sidewalk on the east side of the roadway, and if the County preserves the drainage features on the west side of the roadway, a boardwalk-type sidewalk could be considered. The Lake Park Boulevard Option 1 Preliminary Design Plans illustrate this option.

7.6 Blue Heron Drive, Morgan Drive, and Lockhart Drive

GradyMinor recommends raising the road crown elevation to 4.2 ft-NAVD, widening/maintaining the road to 20 feet (10-foot travel lanes), and including a hammerhead or small roundabout at end of the road to allow vehicles to turn around. Drainage improvements include an open swale drainage system and driveway culverts. The Lake Park Boulevard Option 1 Preliminary Design Plans illustrate this option.

An alternative recommended design includes installing valley gutter along both sides of the roadway and sloping the roadway and drainage system to the existing drainage system to the west. This would eliminate the need for the open swale drainage system and driveway culverts. The Lake Park Boulevard Option 2 Preliminary Design Plans illustrate this option.

Pursuant to coordination with Collier County, sidewalks may be desirable in this area, but since a sidewalk is likely not feasible on Lake Park Boulevard, it doesn't make sense to propose sidewalks on the side streets off of Lake Park Boulevard because they will not have connectivity.

8.0 Cost Estimates

All of the roadway improvements for the above-mentioned roads, including such elements as the driveway culverts, are integral to the overall achievement of the objectives of the Lake Park Area Flowway Restoration project. Appendix D includes the Preliminary Construction Cost Estimate for the roadway improvements only. The preliminary cost estimate is very general and includes the majority of the recommended roadway improvements and design considerations that are included in the preliminary design plans Options 1 and 2. A detailed survey is required during the final design to accurately determine the quantity and cost for fill to raise the roads. The estimates include a 20% contingency line item.

Appendix A

Collier County Road Maintenance
Historical Flooding Documentation

Auto Ranch Rd - Stormwater Request History



August 25, 2022

All Requests

1:21,460

0 0.15 0.3 0.6 mi

Stormwater Request History - Auto Ranch Road Area

Entry Date	Request ID	Status	Issue	Address Number	Street	Request Description	Notes
6/7/2022	27628	Closed	Drainage	11750	RIGGS RD	Entire road is having problems with draining. She lives 11750 Riggs Rd. Stated that 4 L's Farm has blocked off drainage and also can we open the nearby weir?	On 6/8/22 I went to check this roads, water level on swales are getting low, I noticed on Tamiami water level still the same, this is a state rd. On 6/7/22 I went to investigate about this drainage issue on Riggs Rd, there is a water on swales, water is slowly running through Tamiami Trail canal. water level on Tamiami trail canal is high, road is clear of water. I called Thomas, he will call back. Thomas called back, he said, Six Ls farm are discharging water in the canal, now Riggs Rd is holding a lot of water, he said he has a video when Six Ls were discharging water, they have the water pumps running all day causing this flooding issues, he needs help, because this water is contaminated, he was asking for pollution control telephone number, I told him, we take care of Riggs Rd, and road maintenance does not have access to the back canal. He said thank you for calling back, because no body wants to listen about this problem. Supervisor Geo, send a Email to pollution control, and they respond about this issue.
9/23/2021	25943	Closed	Flooding	15090	MAPLE TREE DR	Water is over roadway. The school bus will not go down it is so bad.	On 9/24/21 I went to investigate this drainage issue, there is a road section under water, water is flowing , I noticed by Tamiami trail, there are vacant lots and they have a lot of water flowing to Auto Ranch Rd. At the end of Street, there is no outfall, and we have no access to this property, I will discuss this issue with Storm Water Manager. I called Susan, no answered, left a message to call back for any questions.(There are 2 water over the road signs in this road.)
9/20/2021	25882	Closed	Culverts - Blocked	11750	RIGGS RD	FW: 11750 Riggs Rd Culvert Code received a complaint that this property is causing drainage issues for Riggs Rd. There is an active permit to replace the culverts for the property. Is there anything they need to do to improve the flow of water at this time?	On 9/21/21 Robert Marsh, went to investigate this drainage issue, water is on swales, water in Tamiami trail canal is full, no issues on the road way, I called Joseph Mucha, left a message, to call back if he has any questions. Completed.
7/28/2021	25414	Closed	Canal / Drainage Ditch-Aquatics	18355	FAIRMONT DR	Royal Palm Golf Estates SW corner Received earlier today: Hi Pav, This is Janet Zasada, 18349 Fairmont Dr., Naples FL 34114. These are the pictures where the waterways connect… hope you'll be able to break the dam thank you… 239-250-6836 Please respond to Mrs. Zasada and schedule a crew if necessary to remove the obstruction. Thanks. Pawel Brzeski Senior Field Inspector Stormwater Management 239 252 2927 pawel.brzeski@colliercountyfl.gov	On 7/28/21 I received this request from Pav about a complainant concern about a small island of debris blocking the channel behind her property at Royal palm development, I pay a visit to the location with the marshal and spoke to the lady and she showed us the location. We told her we were going to spray the channel and monitor the area to see if is just overgrown floating vegetation and take it from there. Will talk to Nick and have him add this channel to the spraying list this coming cycle. Request now closed.
2/22/2021	24229	Closed	Drainage	656	AUTO RANCH RD	Do we have Auto Ranch Rd scheduled for ditch cleaning before the rainy season? They usually get water over the road.	2/23/21 Marshal miller called and no answer. -Talked with principle project engineer Kurtz in storm water who is planning a project in that area. Will let the requester know about that and to to contact Stormwater for more details. 2/25/21 Marshal Miller called and left a message for the requester to please call back. - The Requester, John, called back and i explained that we had planned to work with stormwater to look into the area and found they are planning a stormwater project in tat area. I let him know we did not have the details, but to call storm water. He said that sounded great and he would, he knew who Jerry Kurtz was, said he calls about every year. Closing Request.
2/3/2021	24086	Closed	Investigate	445	AUTO RANCH RD	water over roadway temporary sign has been put in the ROW of Auto Ranch Rd & Oak Tree Dr. Signs need to be picked up so they are not laying in the ROW anymore. If the signs are not Road Maintenance please call citizen back so she can contact the correct dept.	2/3/21 Marshal Miller Called requester and no answer. 2/5/21Marshal Miller Called requester, Tabatha, and let her know we got the signs on Autoranch Rd and on the side street. She thanked us for the call back. Closing request.

12/15/2020	23741	Closed	Drainage - Faulty	307	AUTO RANCH RD	Mr. Foth is a repeat caller. He is owns property there and wants to build, but says it stays under water. Wants to know if anyone has come up a plan to keep from flooding. I am starting with you to decide if it needs to go to stormwater.	12/16/20 Marshal Miller made a site visit and while the swales have water, there is nothing road maintenance can do about the flooding on the private property. There is no relief for the swales, so they shed water through percolation. - Called the requester and left a message to please call back so we could discuss this. 12/17/20 Marshal Miller called requester and no answer. Left a message with a brief detail that I would send in a email to him and to please call back if needed. -Email sent and attached below, 3rd call made with no contact. Closing request.
9/16/2020	23102	Closed	Culverts - Damaged	11750	RIGGS RD	Joseph.Mucha@colliercountyfl.gov FW: CEROW20200010034 - 11750 Riggs Rd. Good Morning, We got a complaint about a broken culvert for 11750 Riggs Rd that could be possible causing drainage issues for the street. Could we have someone confirm if that is the issue? Thanks	TS Sally 9/16/20 Marshal Miller made a site visit and cannot see the culverts. Will return to check culvert when waters recede. 9/24/20 Marshal Miller made a site visit, all water levels in swales are even and still high. Closing Request. 10/8/20 Marshal Miller made another site visit water is lower in swale but still 3/4 full. Water levels are still level and checked address and addresses nearby culverts seems operational. Email sent and attached. Closing request. 10/8/20 Request reopened, address was wrong, is now updated in the system. Will make a site visit tomorrow. 10/9/20 Marshal Miller made a site visit again at the right address and found that the culvert pipe is completely blocked with debris over it. I talked with the resident and let him know it was was code case and to get it cleaned off as soon as possible. 10/15/20 Marshal Miller got a call from Code Ryan Cathey and explained my findings, he said he would handle it from there and thanked me for the info.
9/14/2020	23063	Closed	Drainage - Faulty	11551	RIGGS RD	Message I am in Naples on a 5 acre parcel at 11551 Riggs Rd. Naples FL 34114. The property just to the north of us at 11441 Riggs has been filling in a large pond with massive amounts of concrete. I am concerned about flooding issues on our property. We have a residential home and live here. Next door does not have a house, they use the property for a large storage garage. When the garage was built right on top of the set back line, they installed gutters and downspouts that direct large amounts of runoff onto our property and flood one side of our 5 acres. Now that the pond is getting substantially filled in, we fear this issue is going to become progressively worse. An overhead shot on your map shows the beginnings of this filling, but it is now likely at least 1/3 filled in. We have spoken to Collier County, but there has been nothing they can do about the flooding off of the large garage building or the filling of the pond. Someone suggested that S FL Water Management may have some jurisdiction above and beyond the County. I can be reached at 239-821-0283 for further discussion. With thanks in advance, Jennifer and Gary Drake jen.drake@juno.com	9/16/20 Marshal Miller called the requester, Jennifer, Who explained that she didn't really want the request to go to Roads and bridges, she was looking for Dept. of Environmental Protection or DEP. I let know i was sorry that i could not help, she let me know that she had reached out to multiple agencies within the county and thanked me for the call back. Closing request.
12/12/2019	21038	Closed	Drainage - Faulty	307	AUTO RANCH RD	Auto Ranch Road floods when it rains. There are some big ditches that may need to be cleared. Even with a little rain, the water goes over the roadway.	1-1-4-20 Frank Laco passed this on to Amy Patterson so she could update the resident on where things stand going forward and what if anything is planned in this area. 1-14-20 Frank Laco has a meeting with Storm water today and will discuss with the storm water team. 12/12/19 Marshal Miller spoke with the requester about his situation with the drainage problems on Auto ranch. I let him know I had crews out there at this time cutting back vegetation on the swales and cleaning them out. He thanked me for the cleaning of the drainage channels but needs help with the drainage. I let him know I would try to reach out and see if I could get someone to help with this. 1/9/2020 Marshal Miller is transferring this request to Superintendent Frank to see if it can be elevated to someone in storm water to check out the drainage problems in that area. Transfer Email sent.

10/18/2019	20657	Closed	Swale	656	AUTO RANCH RD	The vegetation in the swale is completely overgrown and the entire street floods. He said it used to be clear and water was able to flow.	10/18/19 Alan Booker returned call and left message to contact Mr Miller who is the area Supervisor. 10/23/19 Marshal Miller made a site visit. Nothing has changed since last site visit. The swales are scheduled for maintenance and called Requester with no answer. 10/25/19 Marshal Miller called requester again with no answer and left a second message around 3:50 pm to please call back to discuss his request. 10/25/19 Marshal Miller had a call back from the requester John and talked about the drainage problems since the gold course moved next to them pushing all the water over to Auto Ranch. I explained that we will be cleaning and clearing the swales on a schedule in the next 90 days and then shoot grades to see if we could reshape them if needed. John asked me to find out if Storm water was aware of there situation and I told him I would call back when I had more information. 10/31/19 Marshal Miller called John to explain that After a conversation with Director English I was to let him know that our upper management is aware and is talking to storm water about these drainage problems. No answer and message left to call back. 10/31/19 Marshal Miller received a call back from John and I explained that this is being looked at a higher level then just maintenance and our upper management is aware and trying to find a solution with Storm water for the drainage problem. He thanked me for the call. Closing Request.
8/29/2019	20170	Closed	Swale	307	AUTO RANCH RD	Requester stated that the swales all along the entire street Auto Ranch Rd are full and not draining and she is concerned with the storm coming.	8/29/19 Marshal Miller called the requester back at around 12:30 pm. The requester, Sandy, just wanted us to know that there is water filling the swales due to new construction in the area and wanted to make sure we are aware of their situation. I let Sandy know that I had met with some residents a few weeks ago and am currently trying to reach out to SWFM to help them look into a solution and that the county ill also be going out there in the dry season to do Swale maintenance. Sandy accepted the response.
8/12/2019	19974	Closed	Flooding	1050	AUTO RANCH RD	Requester stated that there is flooding on her road. Called Scott and he is aware of the situation	8/12/19 Scott Pickens called Ms. Nickerson to let her know that we received her request and the appropriate supervisor would go to the site and investigate the issue. 8/13/19 Marshal Miller left a message at approximately 11 am for the requester to call back during the hours of 7am to 5pm or leave me a message for a better time to talk to her or a good time to meet onsite to discuss the drainage problems on Auto Ranch Rd. Requester called back a hour later and I explained that Auto ranch is in between private property and State property. I also explained that I would try to find someone at the state to contact to see f they can help the situation on the state side of Auto ranch, but other than that all I can do is schedule swale maintenance during the dry season as it is too dangerous to use heavy machinery on the roadway while the water level is high. The swales have debris and vegetation growth in and over it.
8/9/2019	19947	Closed	Flooding	1050	AUTO RANCH RD	Requester states that there is a very bad flooding issue on the whole road. She states that there is 8 inches of water. Also she stated that there is debri in the ditches along the road and storm drainage issues	This request has been closed and added to 19884 per Marshals' request-JS
8/5/2019	19890	Closed	Drainage	15082	MAPLE TREE DR	Issues with drainage on Maple Tree Drive. Auto Ranch already under water. What is county going to do.	8/6/19 Marshal miller called requester Susan at approximately 5:30 pm and left a message that I will be on site on 8/8 at 9pm to meet with a resident on Auto Ranch Rd. 8/9/19 Marshal Miller made a site visit and left a message again at approximately 1:45pm letting the requester know that Maple tree Dr is a private road but if they have any questions about Auto Ranch Rd to call back.

8/5/2019	19884	Closed	Water on Road	615	AUTO RANCH RD	8/26/19: Raquel Pines calling for Marshal M. to follow up / Auto Ranch Meeting? 2nd Call on Auto Ranch 8/9/19--Requester states that there is a very bad flooding issue on the whole road. She states that there is 8 inches of water. Also she stated that there is debris in the ditches along the road and storm drainage issues-Raquel Pines-1050 AUto Ranch-239-777-3136 Water 4-6 inches over Auto Ranch Rd. This happens every year and we always have a new supervisor before the issues are resolved. He would like to discuss this issue with the new Area Supervisor.	8/6/19 Marshal Miller made contact with the resident at approximately 11:30am and the resident explained the history of the road flooding and would like to meet Friday 8/9 at 1 pm. 8/9/19 Marshal Miller made a site visit to meet with residents in the area. None were present to discuss the road flooding. I tried to call the residents and requesters at approximately 1pm and again at 1:30 pm and got no answer. I left messages to call back to discuss the flooding. The issue is not county maintenance, it is the removal or Change in stormwater design at SR 41. The water is going over the roadway on Auto Ranch Rd do too capacity issues within the county swales. The swales are full and cannot get across SR 41 to the canal, the culverts were removed by the state a long time ago when work was done to SR 41. I will advise them to report this to the States storm water section and make contact myself to see if they are aware of the situation. 8/9/19 Marshal Miller placed water over roadway barricades along Auto Ranch road in both directions. Pictures taken.
5/20/2019	19195	Closed	Canal Maintenance	11881	RIGGS RD	The canals along 41 on the east trail from 6L to Collier Blvd. have not been cleaned. He was told (on previous request #16579) that the state was responsible. They did not do anything. He wants us to contact them to get it done. Please call him back to let him know.	Mark Martin call property owner and left message to return my call.5-20-19 @ 3pm) Jose returned my call and requested I call the stste, I called the state contractor and spoke with Heather advising her to contact the property owner , she was supplied with the contact info for Jose and advised they would contact Jose with there plans. Jose called back 5-22-19 looking for a contact number for FDOT, I supplied him with Brian Birds # . H eis looking for a copy of the contract hoping to reslove his issue with the 41 caanal.
9/10/2018	17187	Closed	Drainage	980	AUTO RANCH RD	Auto Ranch Rd is flooding when it rains. He said the culvert pipe that was put in is not doing anything to help this. He also said the paving patch is sinking in and needs to be repaired.	Citizen was called and he complained about the overall flooding/sheetflow of that portion of the county. After a few minutes, citizen was referred to the Stormwater Section for further information of current plans for stormwater control.
7/10/2018	16591	Closed	Drainage	307	AUTO RANCH RD	She said Auto Ranch Rd needs the swales checked. Every year this road drains into her road (Maple Tree). She wants the swales dug out to prevent this. She called last year and nothing was done (see prior request 15121)	Bob Dorta called the given telephone number and left a message that we will schedule RM personnel to go out and check the elevations of the swales. Dorta investigated the site, and the road was not flooded, nor was water exiting the banks of the swales. Nothing follows.
7/9/2018	16579	Closed	Canal Maintenance	11866	RIGGS RD	Some of the drainage canals near Riggs Rd & US 41 East have been cleaned but the one running along 41 has not. He said it is full of trees and debris. He would like to know when this will be cleaned out.	Mark Martin advised Jose on 7-9-18 at 4 pm that Broad Spectrum has responsibility for questioned canal. Jose was going to make contact with them.
8/23/2013	7360	Closed	Drainage	470	AUTO RANCH RD	Is convinced that there is something we can do to eleviate the flooding on autoranch rd. also states that the drain next to his house is blocked and causing the water to not drain, thinks the golf course is pumping water onto the roadway	Todd wright was dispatched to check all the drainage in Auto Ranch RD
7/9/2013	7138	Closed	Flooding	1050	AUTO RANCH RD	Citizen stated that the culvert and the ditch along the middle of the road, water is over road. Updated by D Wolfe based on photo sent by caller.	On-call services completed
10/12/2012	6473	Closed	Drainage	601	AUTO RANCH RD	Mr Duquet is a realtor who has two properties for sale on autoranch rd. He states this road is always flooding and wanted to know if there was anything we could do or did we have any plans to add fill to the roadway	I called Mr.Duquet and explained to him that we have no plans to add any fill to the road and the drainage pipes are all clear.
10/9/2012	6455	Closed	Flooding	1050	AUTO RANCH RD	flooded, golf course may be pumping water onto rd, but not sure, thinks that the drainage may be blocked besides and that may be contributing to the problem, cannot drive roadway	I called Ms. Pines and told her that we are going to send a crew to check all culverts and unplug them

Appendix B

Collier County Ord. 06-63



ORDINANCE NO. 06-63

AN ORDINANCE OF THE BOARD OF COUNTY COMMISSIONERS OF COLLIER COUNTY, FLORIDA, AMENDING ORDINANCE NUMBER 04-41, AS AMENDED, THE COLLIER COUNTY LAND DEVELOPMENT CODE, WHICH INCLUDES THE COMPREHENSIVE LAND REGULATIONS FOR THE UNINCORPORATED AREA OF COLLIER COUNTY, FLORIDA, BY PROVIDING FOR: SECTION ONE, RECITALS; SECTION TWO, FINDINGS OF FACT; SECTION THREE, ADOPTION OF AMENDMENTS TO THE LAND DEVELOPMENT CODE, MORE SPECIFICALLY AMENDING THE FOLLOWING: CHAPTER 1 - GENERAL PROVISIONS, INCLUDING SEC. 1.08.01 ADDING ABBREVIATIONS, SECTION 1.08.02 ADDING DEFINITIONS; CHAPTER 2 - ZONING DISTRICTS AND USES, INCLUDING, SECTION 2.03.01 RESIDENTIAL ZONING DISTRICTS, SECTION 2.03.06 PLANNED UNIT DEVELOPMENT DISTRICTS, SECTION 2.03.07 OVERLAY ZONING DISTRICTS INCLUDING MAPS, SECTION 2.04.03 TABLE OF LAND USES IN EACH ZONING DISTRICT; SECTION 2.06.01 GENERALLY; CHAPTER 3 - RESOURCE PROTECTION, INCLUDING SECTION 3.02.10 STANDARDS FOR SUBDIVISION PLATS, SECTION 3.03.05 SEA LEVEL RISE, SECTION 3.05.02 EXEMPTIONS FROM REQUIREMENTS FOR VEGETATION PROTECTION AND PRESERVATION, SECTION 3.05.10 LITTORAL SHELF PLANTING AREA; CHAPTER 4 – SITE DESIGN STANDARDS, INCLUDING SECTION 4.01.01 ELEVATION REQUIREMENTS FOR ALL DEVELOPMENTS, SECTION 4.02.16 DESIGN STANDARDS FOR THE BMUD NEIGHBORHOOD COMMERCIAL SUBDISTRICT, SECTION 4.02.17 DESIGN STANDARDS FOR DEVELOPMENT IN THE BMUD WATERFRONT SUBDISTRICT, SECTION 4.02.18 DESIGN STANDARDS FOR DEVELOPMENT IN THE BMUD RESIDENTIAL SUBDISTRICT (R1), SECTION 4.02.23 SAME - DEVELOPMENT IN THE ACTIVITY CENTER #9 ZONING DISTRICT, SECTION 4.02.35 DESIGN STANDARDS IN THE GTMUD MIXED USE SUBDISTRICT (MXD), SECTION 4.02.36 DESIGN STANDARDS FOR DEVELOPMENT IN THE GTMUD RESIDENTIAL SUBDISTRICT (R), ADDING SECTION 4.02.38 SPECIFIC DESIGN CRITERIA FOR MIXED USE DEVELOPMENT WITHIN C-1 THROUGH C-3 ZONING DISTRICTS, SECTION 4.03.05 SUBDIVISION DESIGN REQUIREMENTS, SECTION 4.04.02 ACCESS MANAGEMENT, SECTION 4.06.02 BUFFER REQUIREMENTS, SECTION 4.06.05 GENERAL LANDSCAPING REQUIREMENTS, SECTION 4.07.04 SPECIAL REQUIREMENTS FOR MIXED USE PLANNED UNIT DEVELOPMENTS CONTAINING A COMMERCIAL COMPONENT; CHAPTER 5 - SUPPLEMENTAL STANDARDS INCLUDING SECTION 5.03.06 DOCK FACILITIES, SECTION 5.05.08 ARCHITECTURAL AND SITE DESIGN STANDARDS, SECTION 5.06.02 PERMITTED SIGNS, SECTION 5.06.03 DEVELOPMENT STANDARDS FOR SIGNS, SECTION 5.06.04 SIGN STANDARDS FOR SPECIFIC SITUATIONS, SECTION 5.06.06 PROHIBITED SIGNS; CHAPTER 6 - INFRASTRUCTURE IMPROVEMENTS AND ADEQUATE PUBLIC FACILITIES REQUIREMENTS INCLUDING, SECTION 6.02.02 MANAGEMENT AND MONITORING PROGRAM, SECTION 6.06.02 SIDEWALKS AND BIKE LANE REQUIREMENTS; CHAPTER 8 - DECISION-MAKING AND ADMINISTRATIVE BODIES INCLUDING, SECTION 8.06.03 POWERS AND

Words ~~struck through~~ are deleted, words underlined are added

Mechanical clearing is defined as clearing that would impact or disturb the soil or sub-soil layers or disturb the root systems of plants below the ground.

6. After a **right-of-way** for an electrical transmission line or public utility distribution line has been established and constructed, a local government may not require any clearing permits for vegetation removal, maintenance, tree pruning or trimming within the established and constructed **right-of-way**. Trimming and pruning shall be in accordance with subsection 4.06.05.J.1 of the Code. All needed environmental permits must be obtained from the appropriate agencies and management plans must comply with agency regulations and guidelines. These may include but are not limited to permits for wetland impacts and management plans for listed species protection.

7. After a publicly owned road **right-of-way** has been legally secured, a local government may not require any clearing permits for vegetation removal, maintenance, tree pruning or trimming within the established road **right-of-way**. Trimming and pruning shall be in accordance with subsection 4.06.05.J.1 of the Code. All needed environmental permits or management plans have been obtained from the appropriate local, state and federal agencies. These permits may include but are not limited to permits for **wetland** impacts or for listed species protection.

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SUBSECTION 3. O. AMENDMENTS TO SECTION 3.05.10 Littoral Shelf Planting Area (LSPA)

SECTION 3.05.10 Littoral Shelf Planting Area (LSPA), of Ordinance 04-41, as amended, the Collier County Land Development Code, is hereby amended to read as follows:

3.05.10 Littoral Shelf Planting Area (LSPA)

The purpose and intent of a littoral shelf planting area (LSPA) is to establish a planted area within an excavated lake serving as a wet detention pond as part of a stormwater management system that will support wetland plants, improves the water quality within the lake and provides habitat for a variety of aquatic species including wading birds and other waterfowl. Contained within such a lake, this area will typically function as a freshwater marsh. Accordingly, the following requirements have been established in order for the LSPA to be designed and maintained to accomplish this stated purpose and function.

A. *Design requirements.*

* * * * * * * * * * * * *

7. *Required information.* The planting plan for the LSPA shall provide the following information:
   a. Calculation table showing the required area (square feet) for the LSPA and its percentage of the total area at control elevation ~~(NGVD)~~;
   b. Control elevation ~~(NGVD)~~ and dry season water table ~~(NVGD)~~;
   c. Maximum water depth (feet) and estimated number of months of **flooding** for the range of planted elevations within the LSPA;
   d. A plant list to include the appropriate range of elevations for each specified plant species, spacing requirements, and plant size;
   e. Planting locations of selected plants.

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SUBSECTION 3. P. AMENDMENTS TO SECTION 4.01.01 Elevation Requirements For All Developments

SECTION 4.01.01 Elevation Requirements For All Developments, of Ordinance 04-41, as amended, the Collier County Land Development Code, is hereby amended to read as follows:

4.01.01 Elevation Requirements for All Developments

The elevation of all **building** sites and public or private roadways included within a **subdivision** or **development** for which a use other than conservation or recreation is proposed shall be not less than ~~five and one-half (5 1/2) feet NGVD when completed, or to~~ such minimum elevations ~~above the established NGVD datum~~ as adopted by the BCC, FEMA/FIRM, or South Florida Water Management District (SFWMD) criteria. All lawful regulations with reference to **bulkhead lines**, saltwater barrier lines, and other appropriate regulations regarding land filling, conservation, excavations, demolition, and related regulations shall be observed during the construction of any improvements within Collier County.

* * * * * * * * * * * * *

SUBSECTION 3. Q. AMENDMENTS TO SECTION 4.02.16 Design Standards for Development in the BMUD - Neighborhood Commercial Subdistrict

SECTION 4.02.16 Design Standards for Development in the BMUD - Neighborhood Commercial Subdistrict, of Ordinance 04-41, as amended, the Collier County Land Development Code, is hereby amended to read as follows:

4.02.16 Design Standards for Development in the BMUD - Neighborhood Commercial Subdistrict

* * * * * * * * * * * * *

A. Dimensional Standards

Table 11. Design Standards for the BMUD Neighborhood Commercial Subdistrict.

Design Standards	
front yard build-to-line	5 feet from the property line to the **building** footprint.
The **front build-to-line** shall also apply to any new **buildings or structures** in the C-1 through C-5 zoning districts which underlay the BMUD Neighborhood Commercial Subdistrict.	1. Eighty percent of the **structure** must be located at the required **front yard build-to-line**; the remaining 20 percent must be behind the **front yard build-to-line** within the range of 3 to 10 feet.* 2. **Buildings** containing commercial or residential uses are required to have a minimum depth of 35 feet from the **front yard build-to-line** on all floors. The remaining depth of the **lot** may be used for parking. 3. **Buildings** ~~which face~~ on **lots** that **abut** Bayshore and intersecting side **streets** shall have the same **front yard build-to-line** as the **front yard build-to-line** for Bayshore. * [This is to allow for an entry courtyard or additional landscaping, if desired].
* * * * * * * * *	

* * * * * * * * * * * * *

B. Special Requirements for **Accessory** Uses.

1. Uses and structures that are accessory and incidental to the permitted uses allowed within this subdistrict are allowed unless otherwise prohibited in this subdistrict.

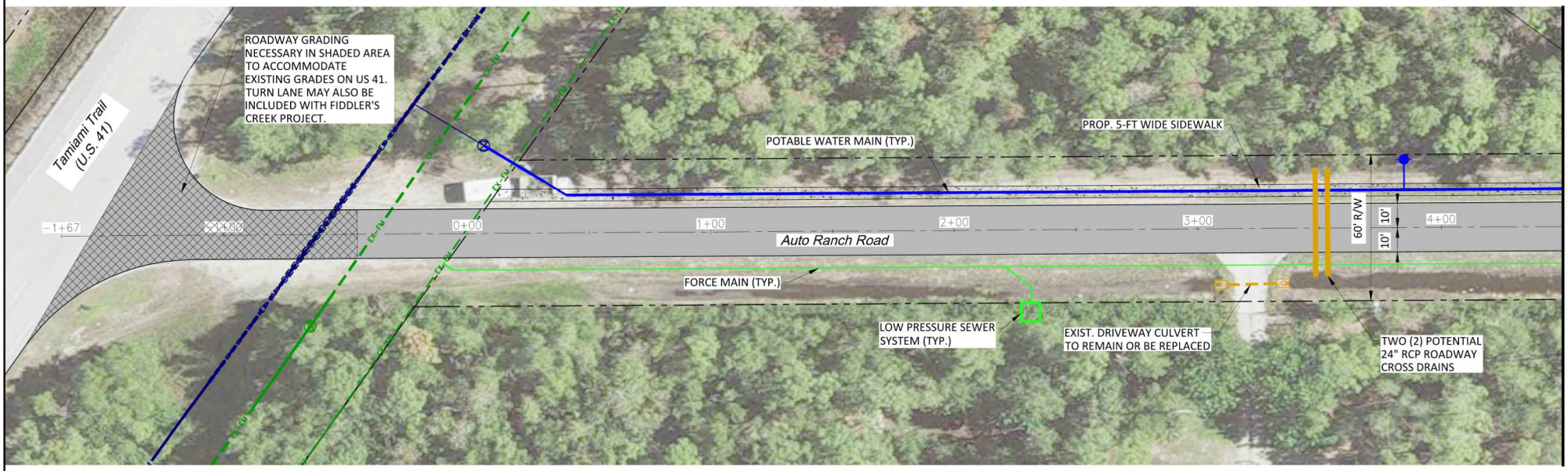
2. BMUD-NC land ~~immediately adjacent to~~ **abutting** Haldeman Creek may engage in boat rental operations.

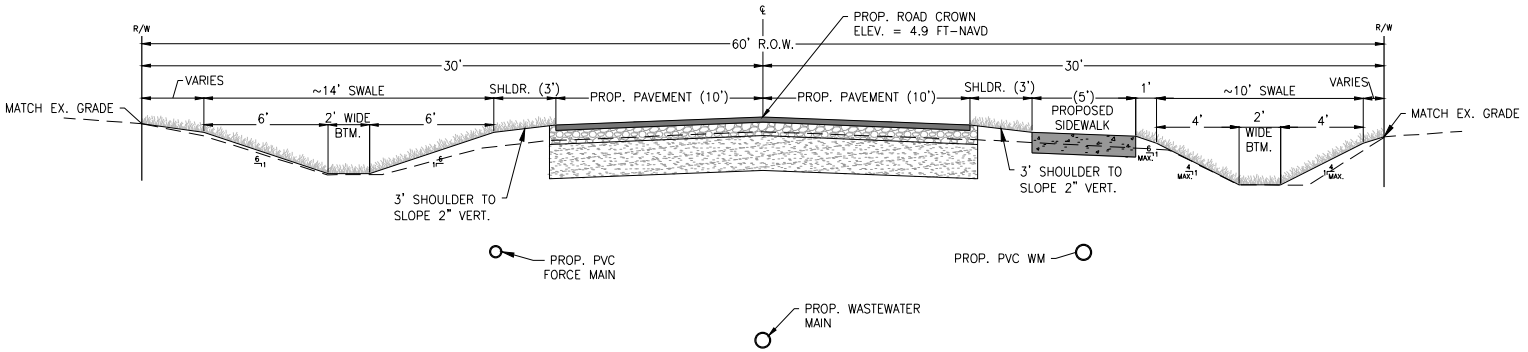
Appendix C

Preliminary Roadway Design Plans

Auto Ranch Road Option 1

Preliminary Roadway Design Plans





TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 1

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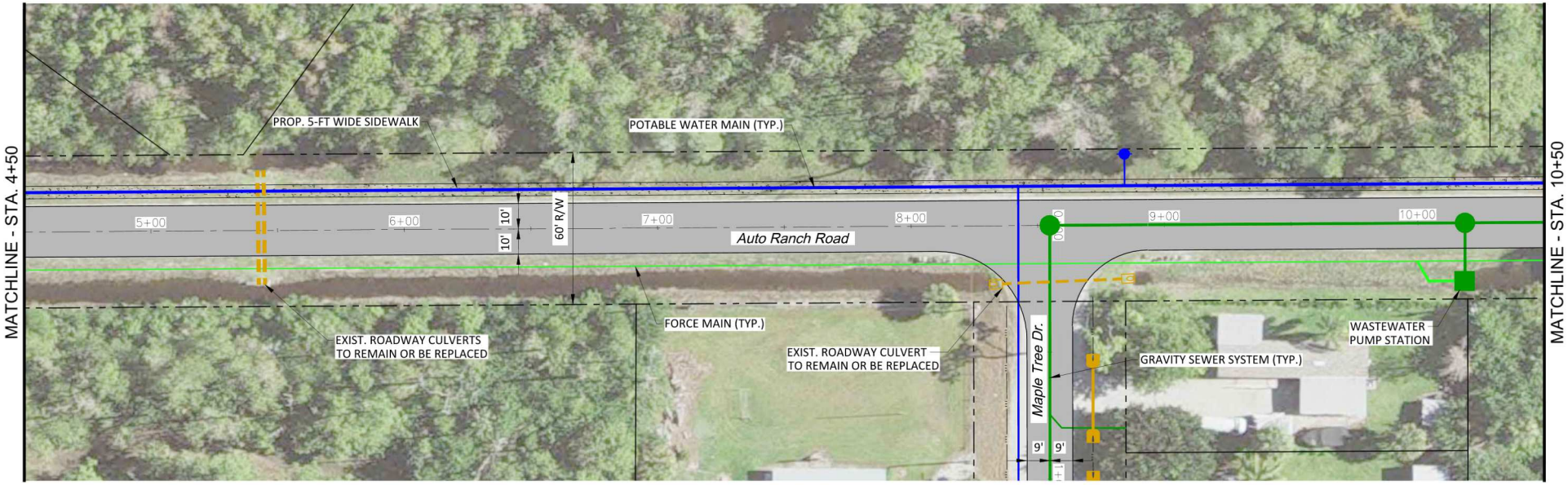

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 2

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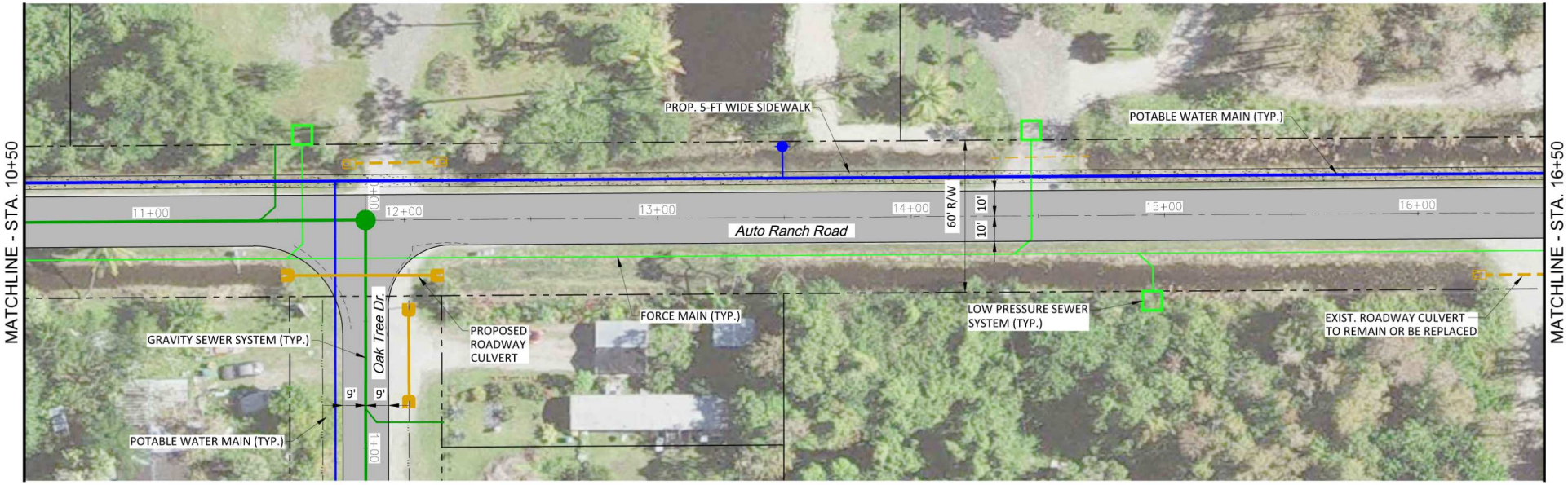

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 3

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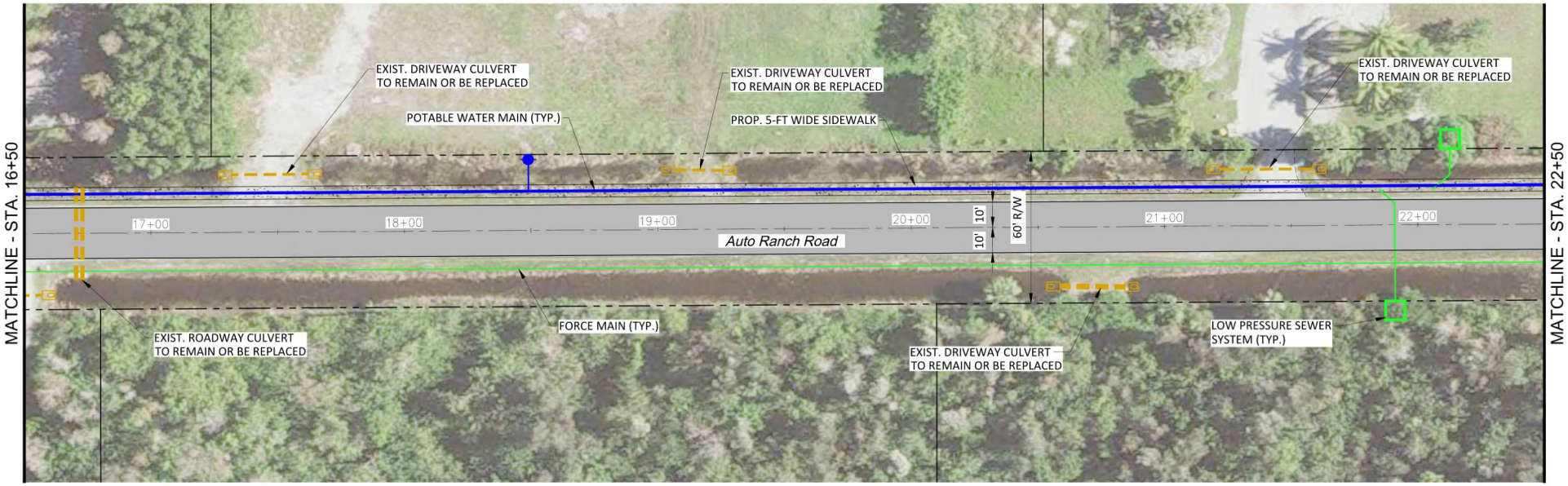

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 4

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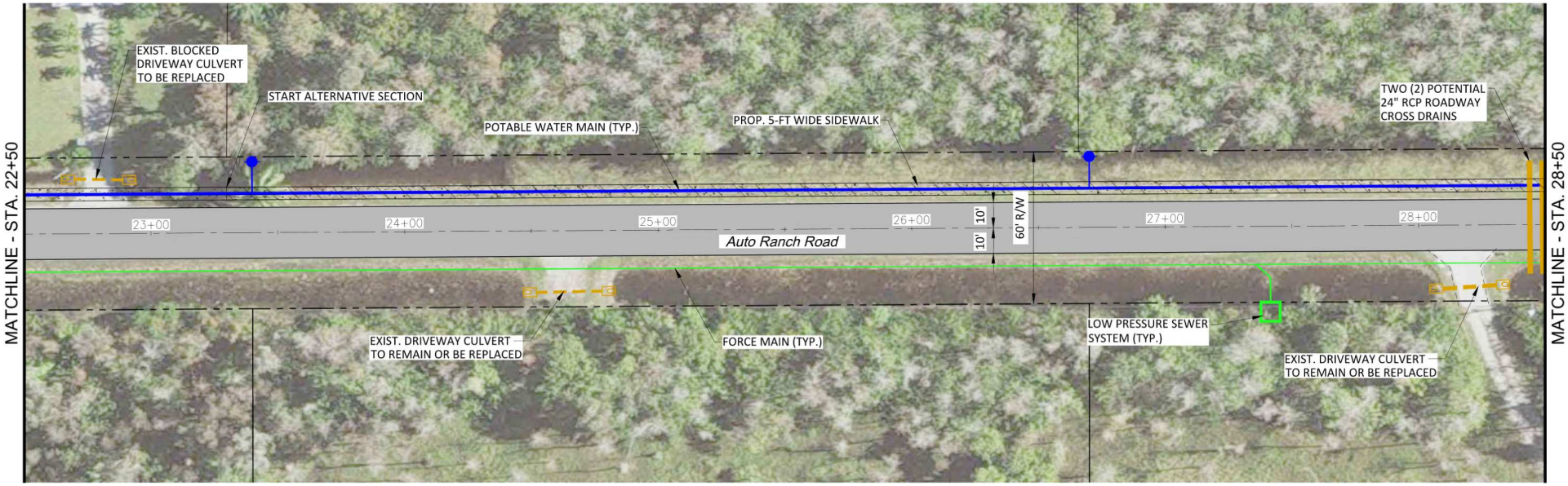

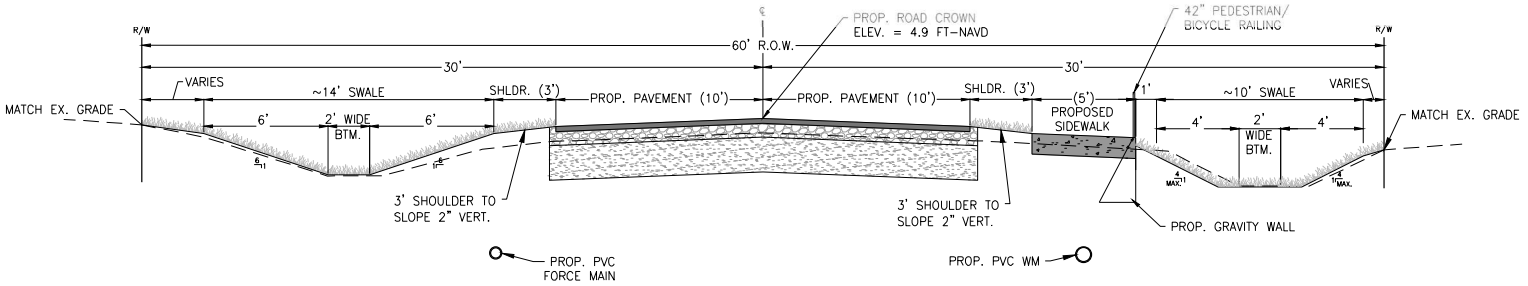

ALTERNATIVE TYPICAL SECTION
(TO DECREASE WETLAND IMPACTS)
APPROX. 1982 LF

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 5

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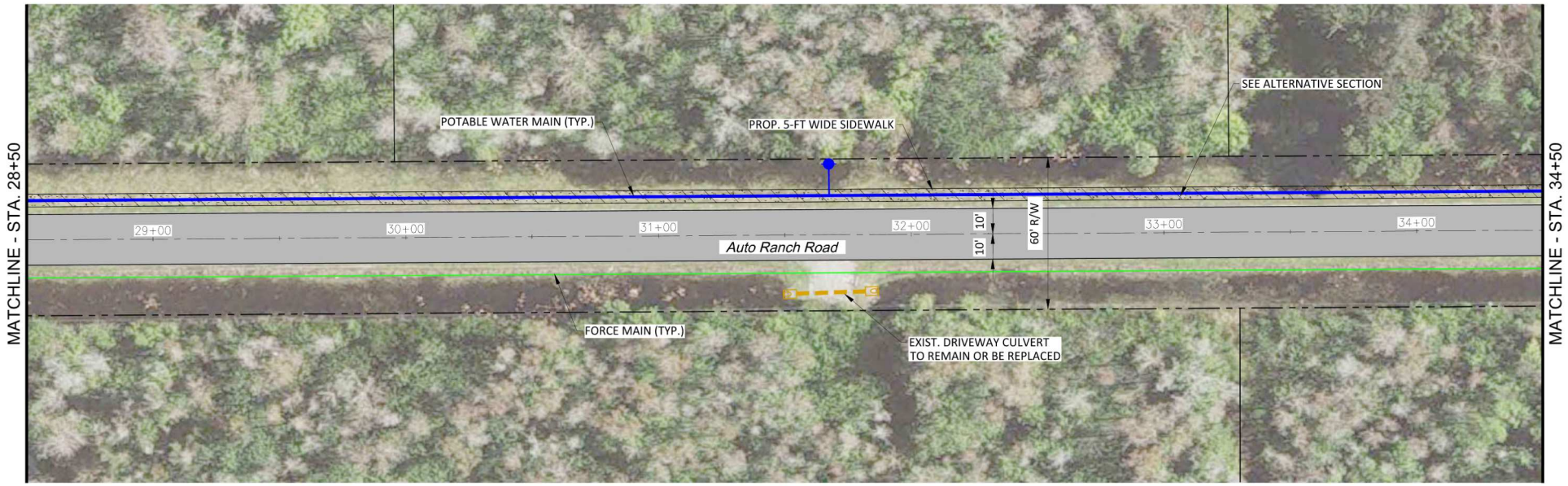

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 6

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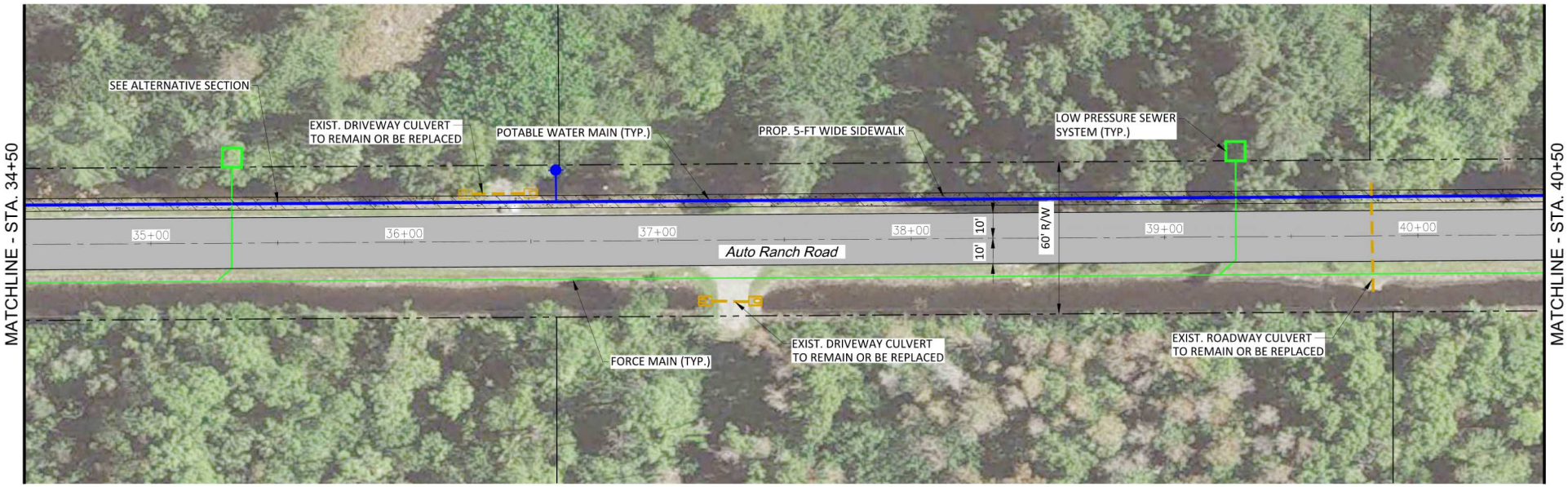

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 7

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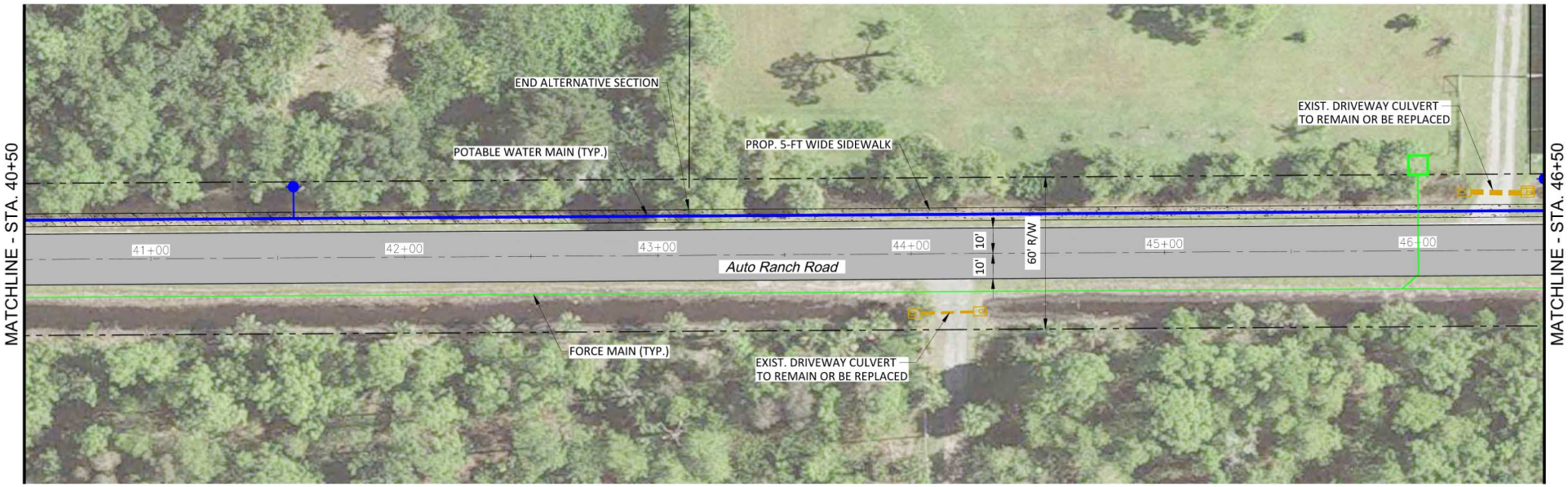

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 8

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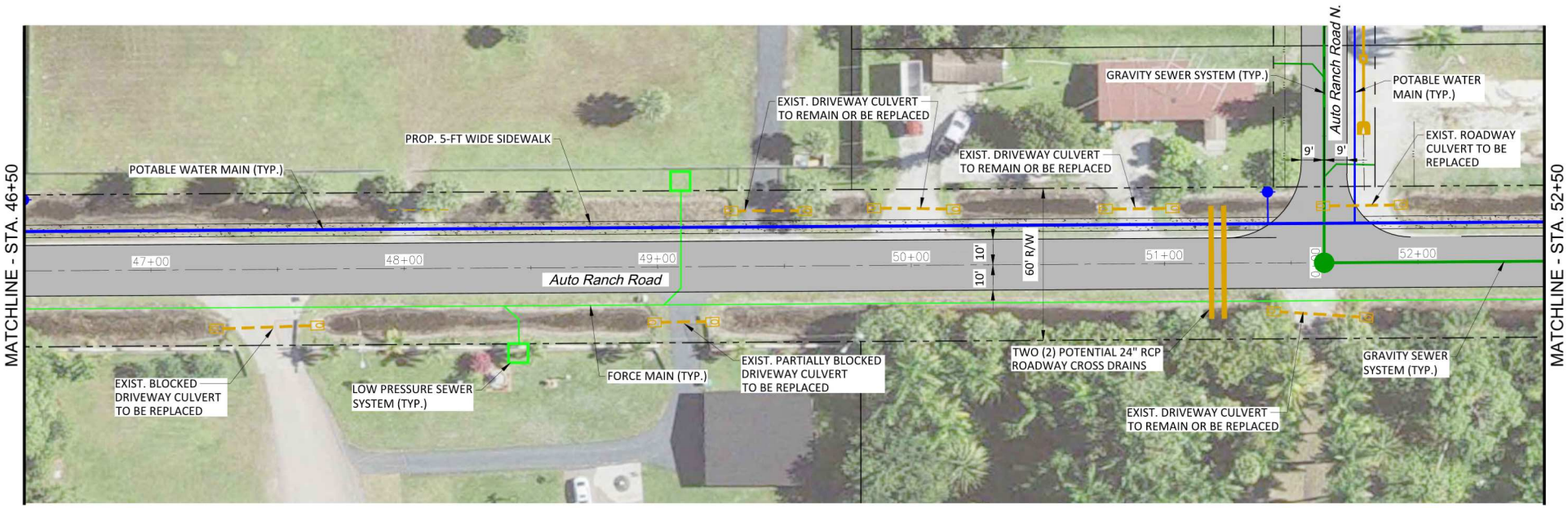

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 9

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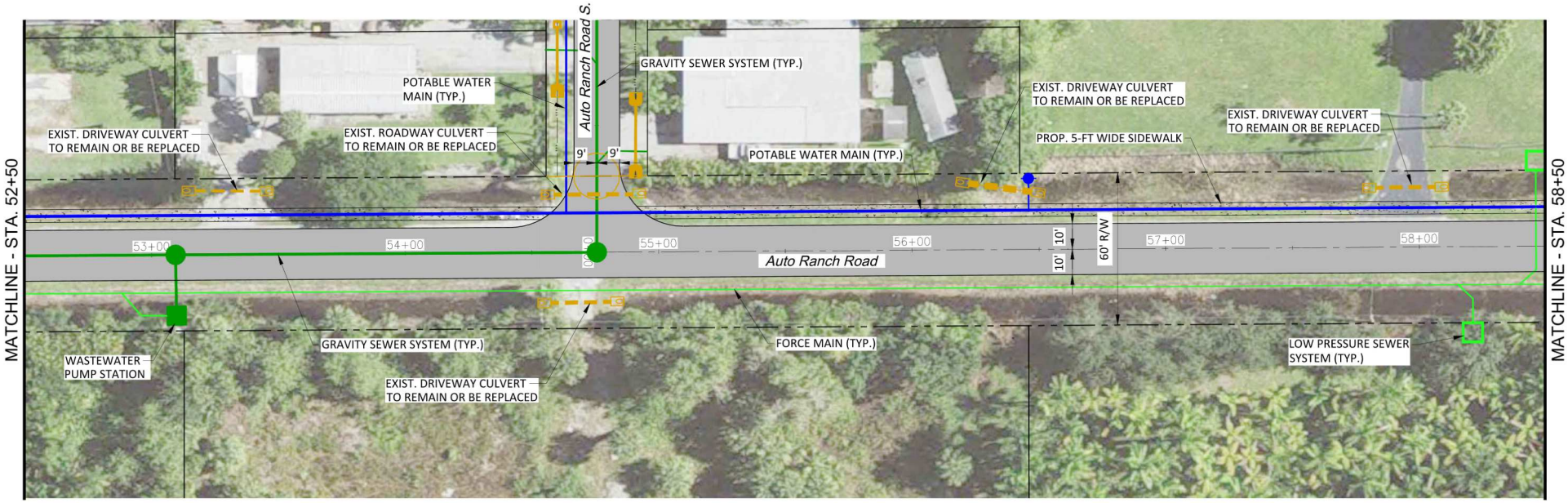

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 10

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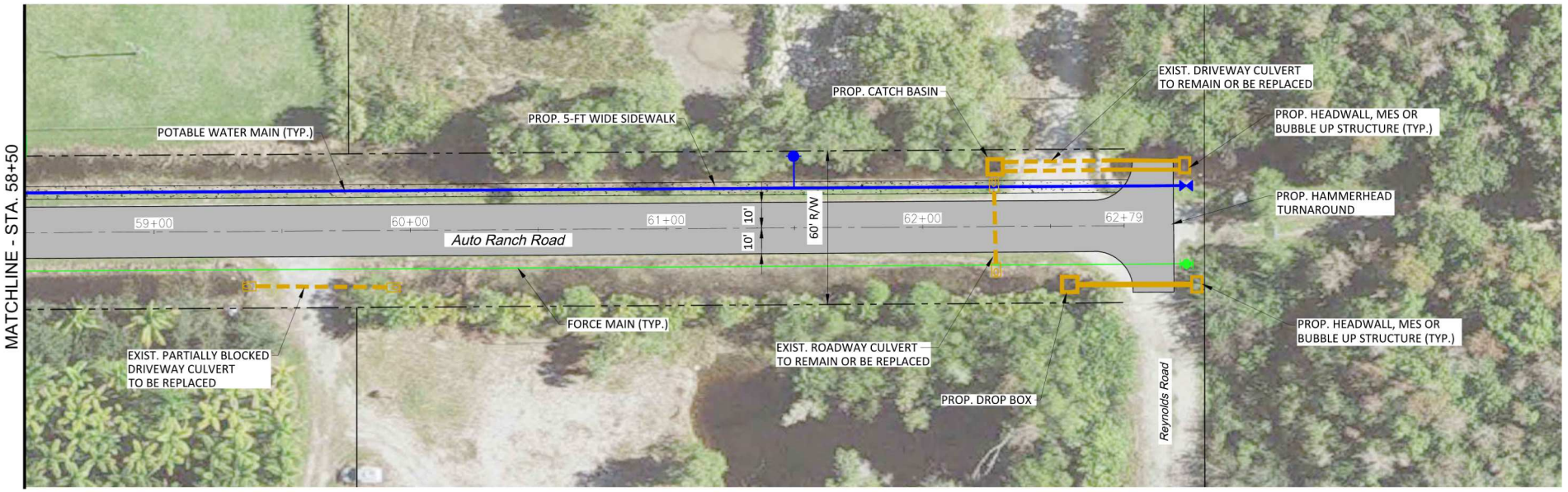

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 11

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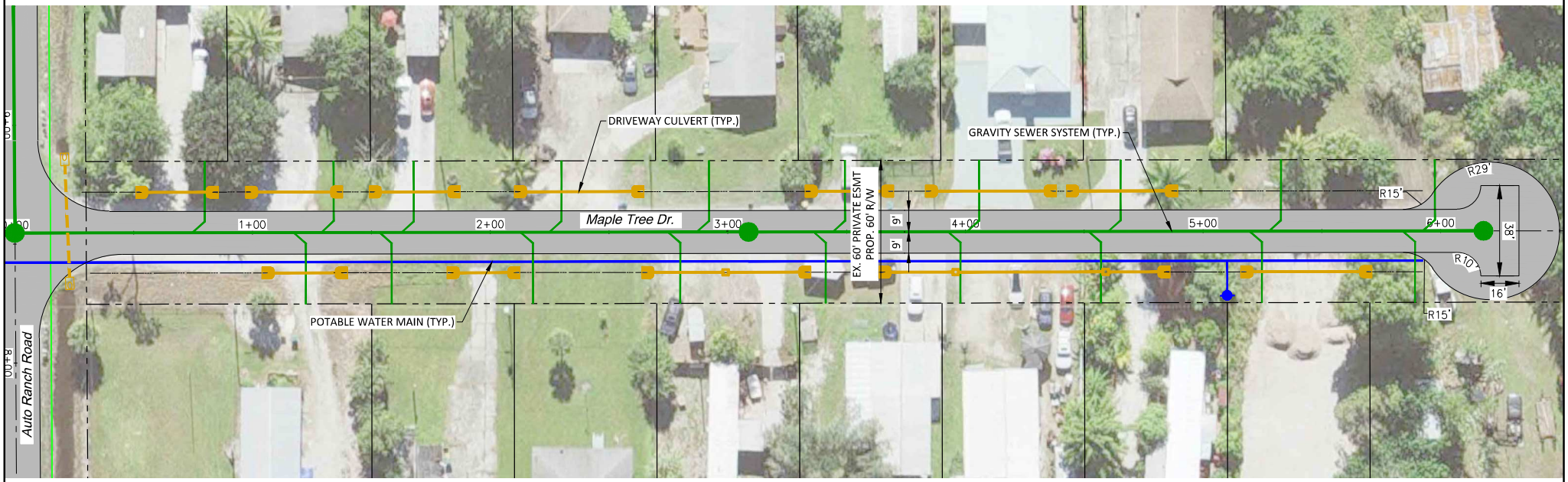

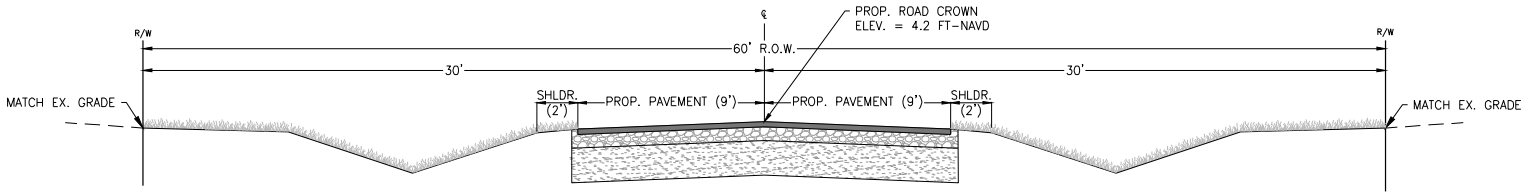

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

MAPLE TREE DIRVE

PLAN VIEW – 1

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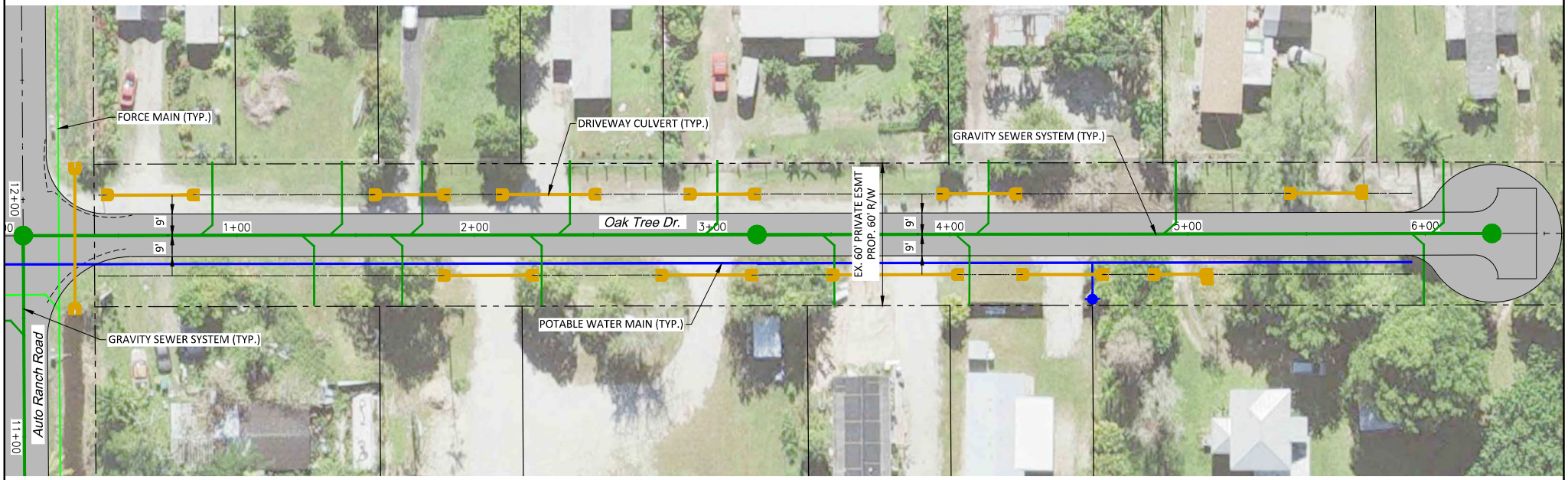

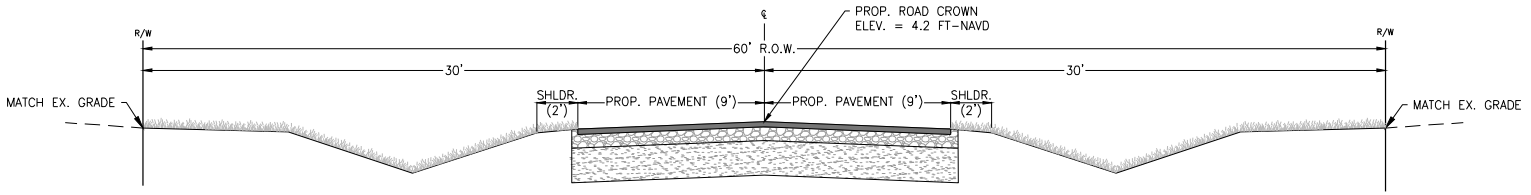

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

OAK TREE DRIVE

PLAN VIEW – 1

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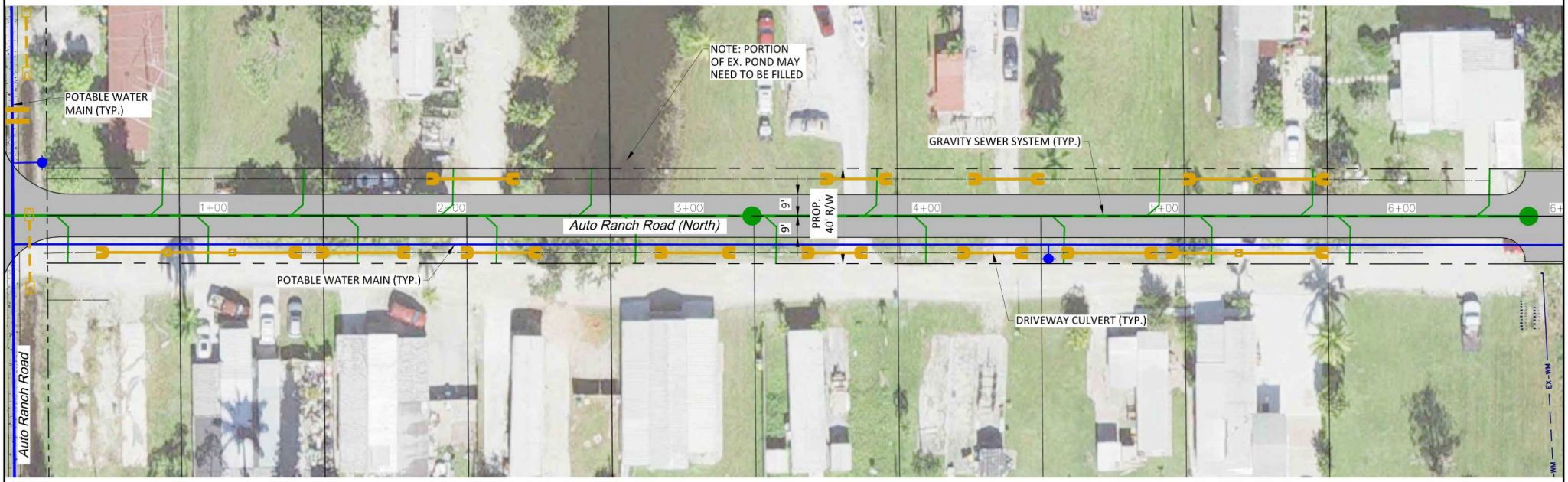

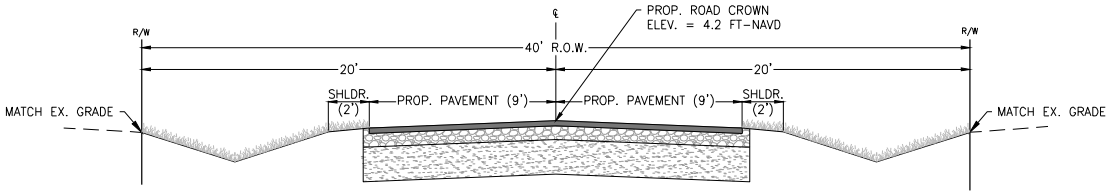

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD (NORTH)

PLAN VIEW – 1
43 of 83

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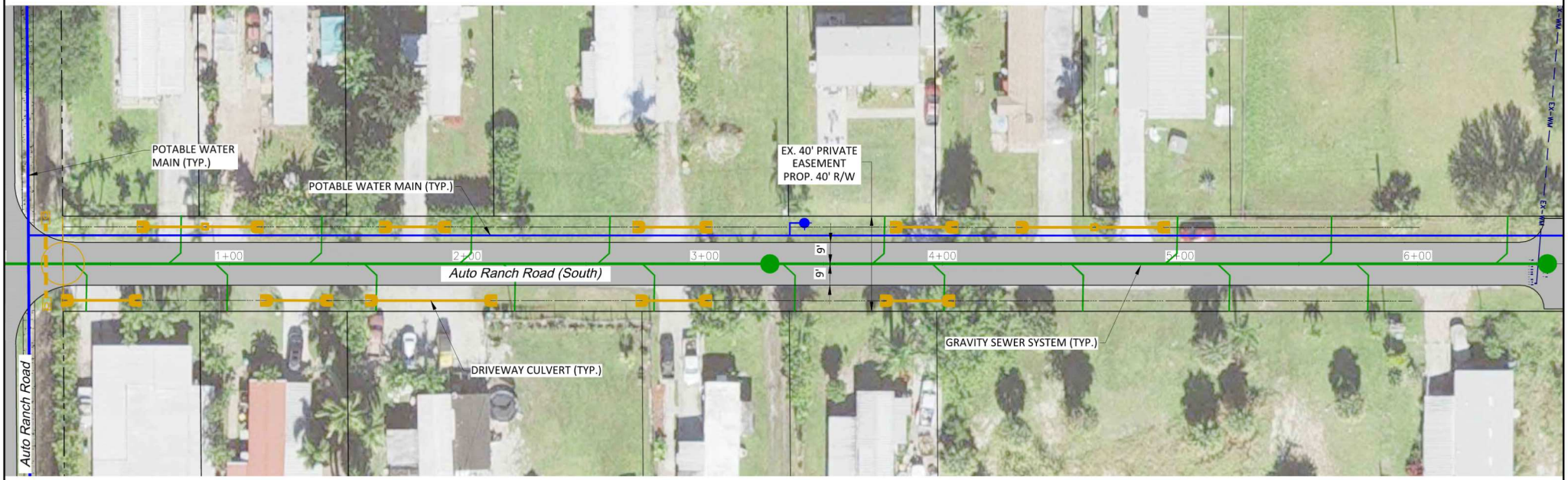

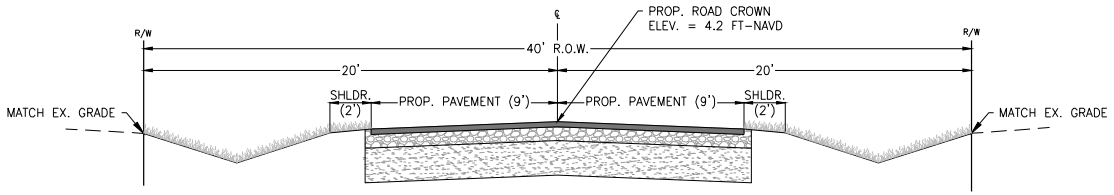

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD (SOUTH)

PLAN VIEW – 1
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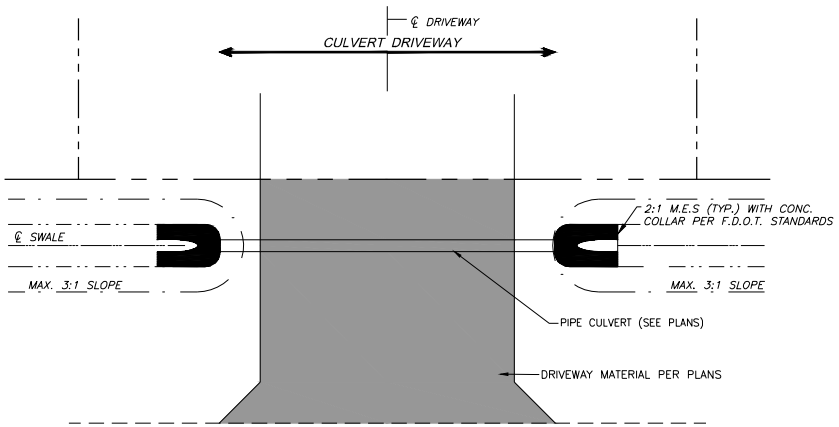
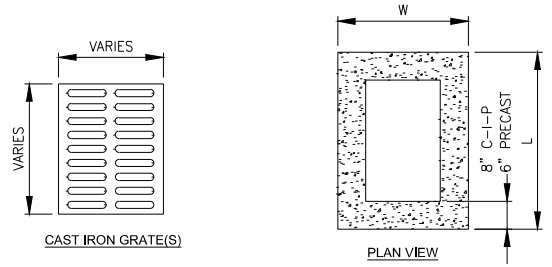
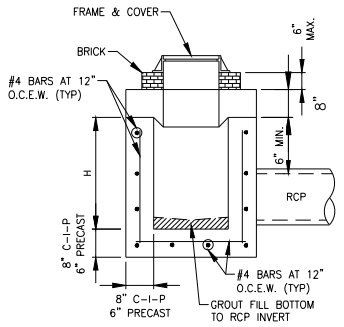
Name and Location	Ditch Bottom Inlet Type	Outlet Pipes
DB 1: South end of Auto Ranch Road	FDOT Type C	24" RCP invert elevation: 1.2 ft NAVD88
DB 2: West Outlet	FDOT Type H (4-grate inlet)	3 - 24" RCPs invert elevation: 1.2 ft NAVD88
DB 3: South Outlet (currently 12" HDPE pipe)		
DB 4: South Outlet (currently 24" cast iron pipe)		

NOTE: SEE NEXT PAGE FOR DROP BOX (DB) LOCATIONS



RESIDENTIAL DRIVEWAY DETAIL
NOT TO SCALE





DROP BOX DETAIL
N.T.S.

DETAILS
45 of 83

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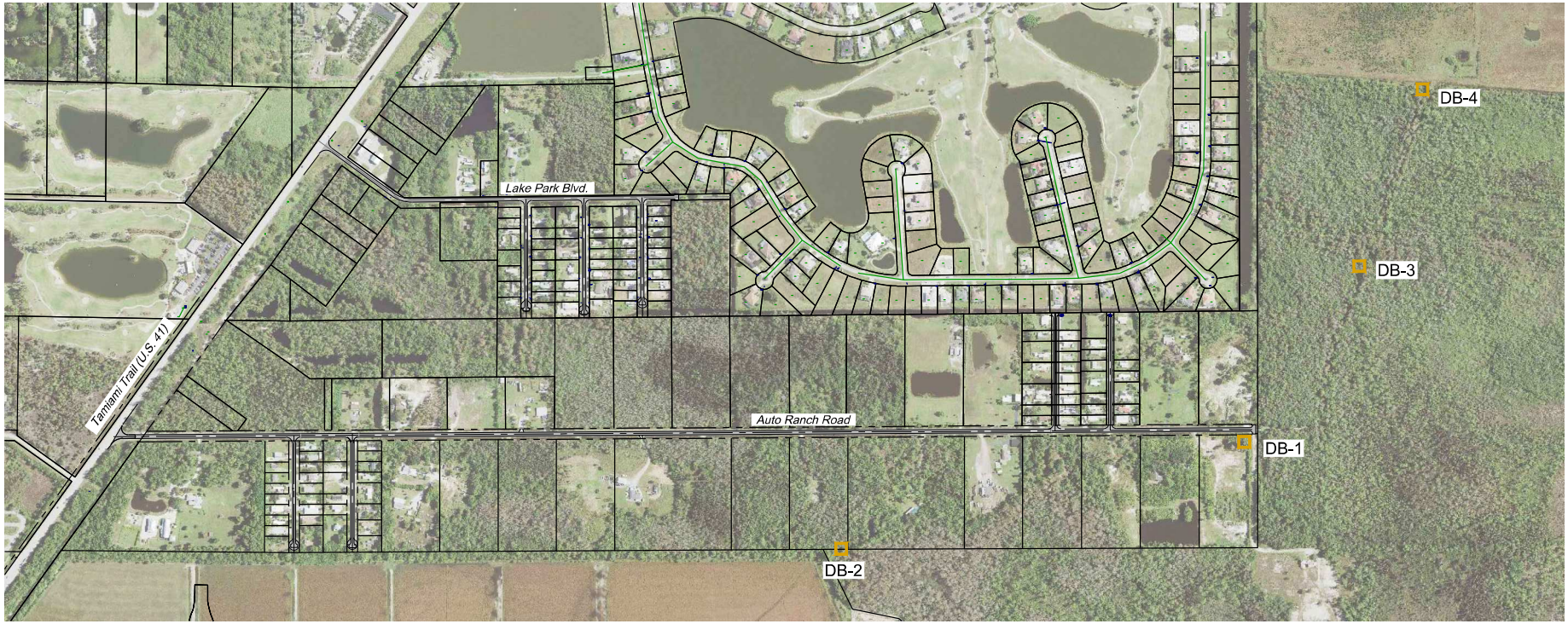

N

0 300' 600'

11x17 SCALE: 1" = 600'

DROP BOX LOCATION MAP
46 of 83

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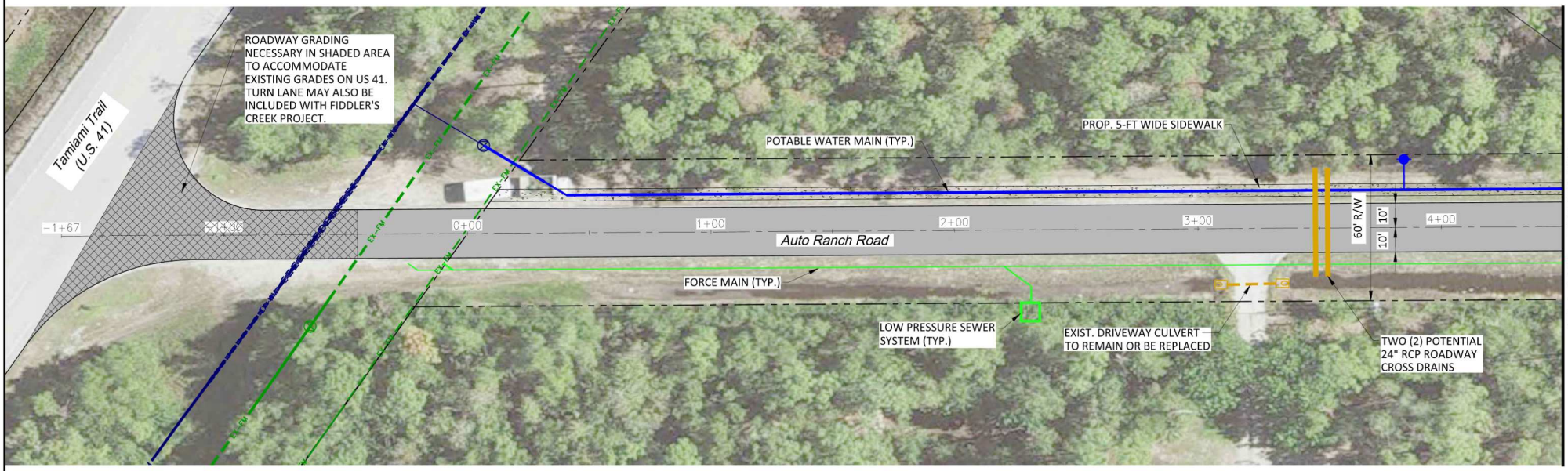
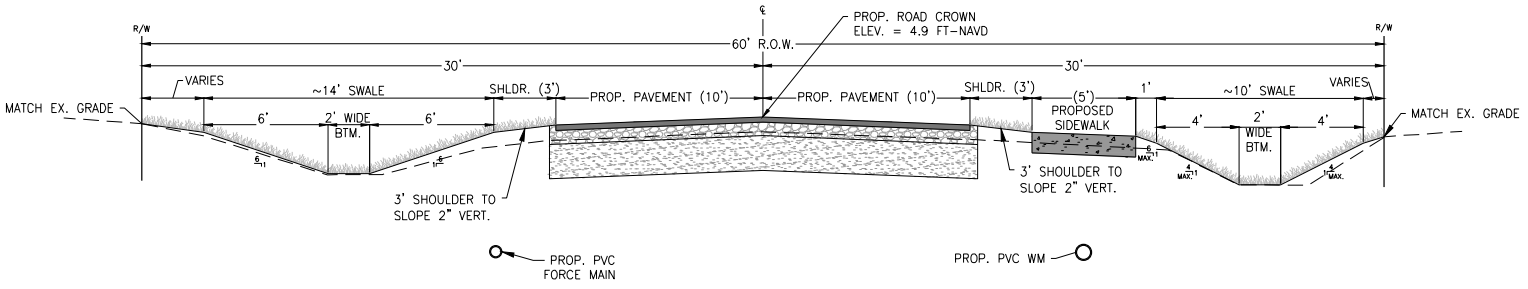
Auto Ranch Road Option 2

Preliminary Roadway Design Plans





TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 1 48 of 83

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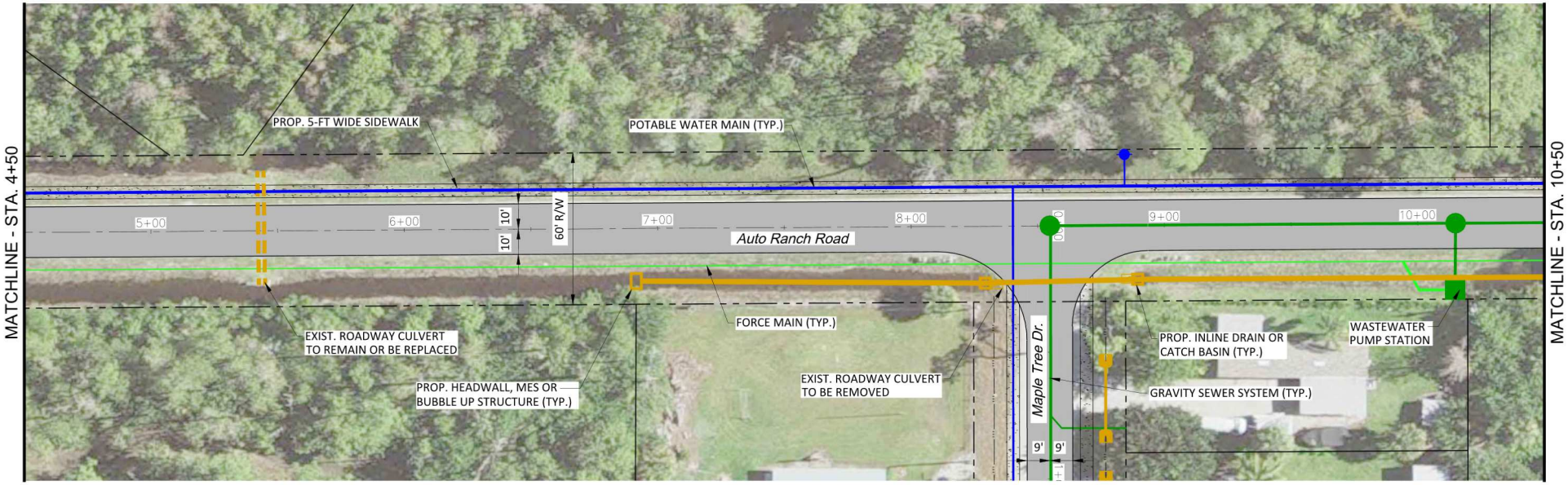

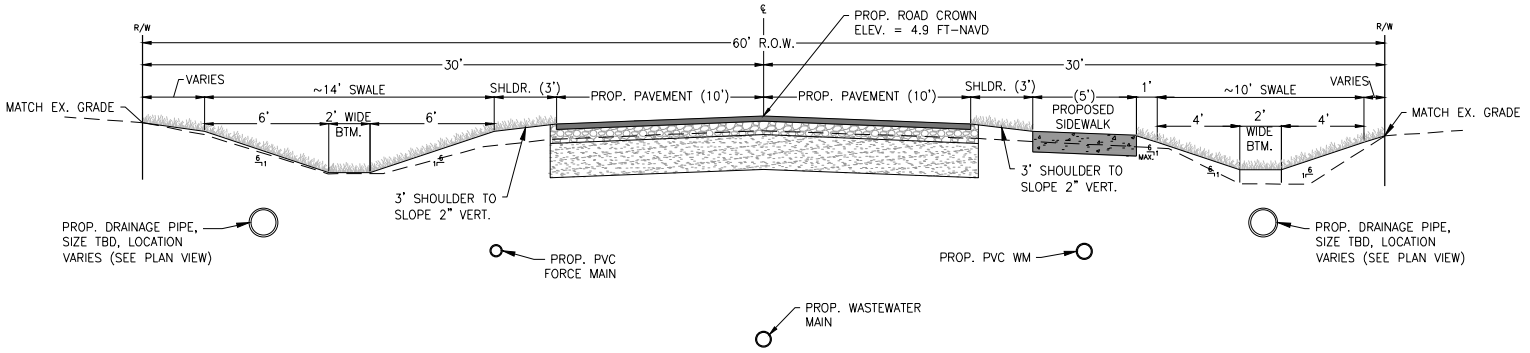

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 2
49 of 83

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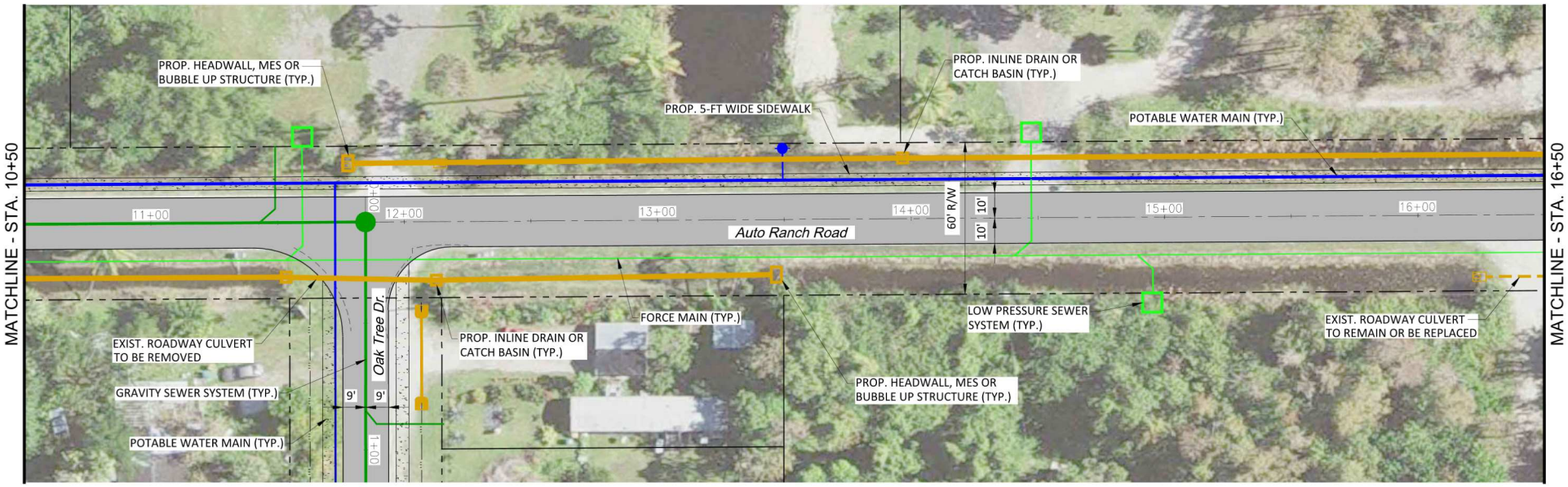

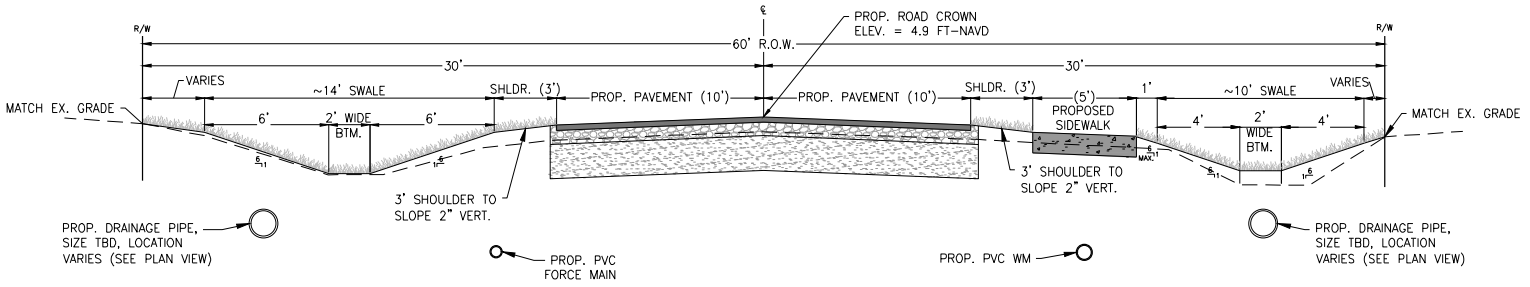

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 3
50 of 83

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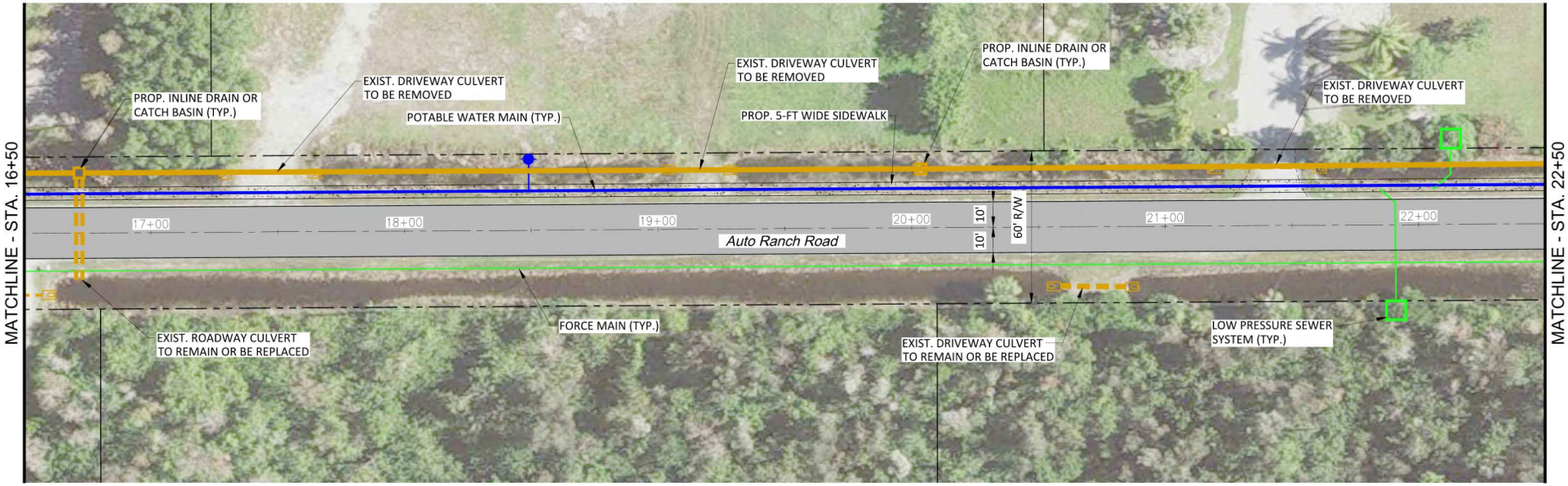

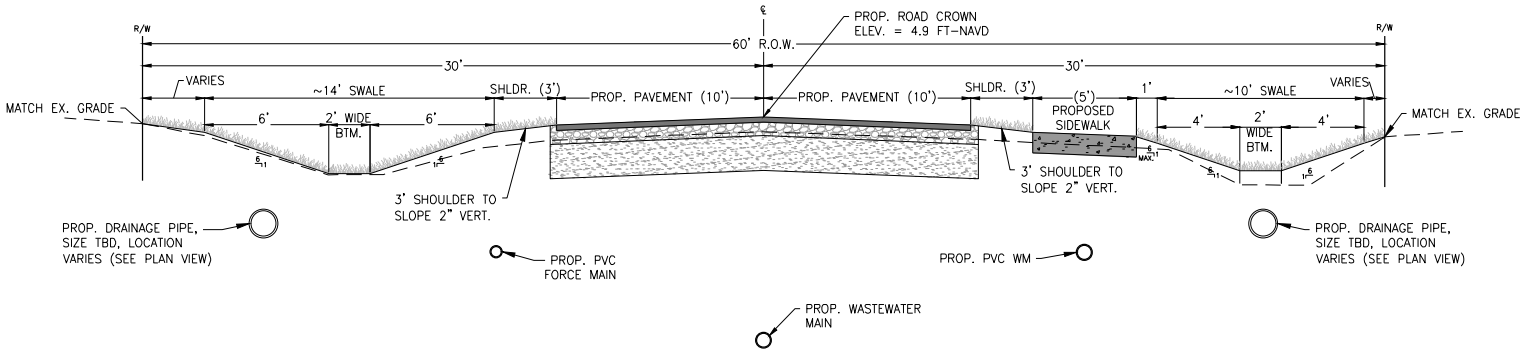

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 4
51 of 83

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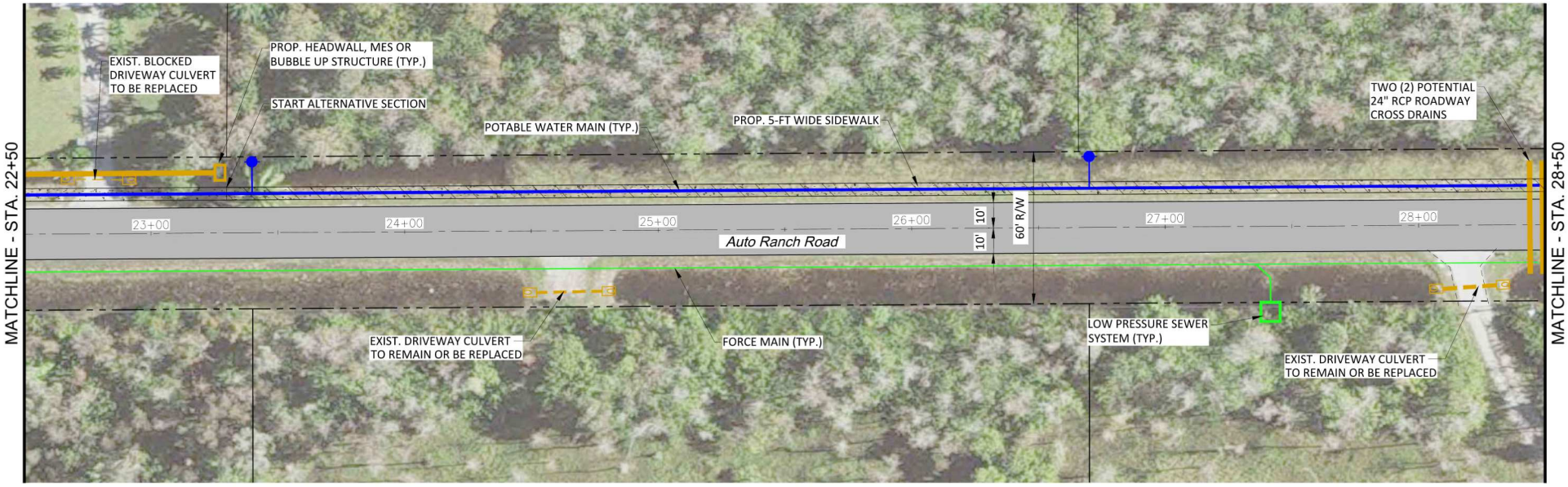

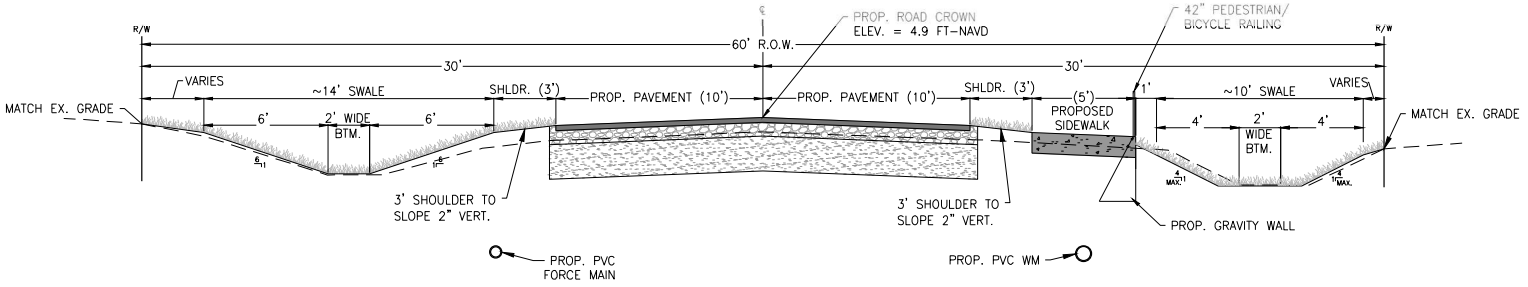

ALTERNATIVE TYPICAL SECTION
(TO DECREASE WETLAND IMPACTS)
APPROX. 1982 LF

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD
PLAN VIEW – 5 52 of 83

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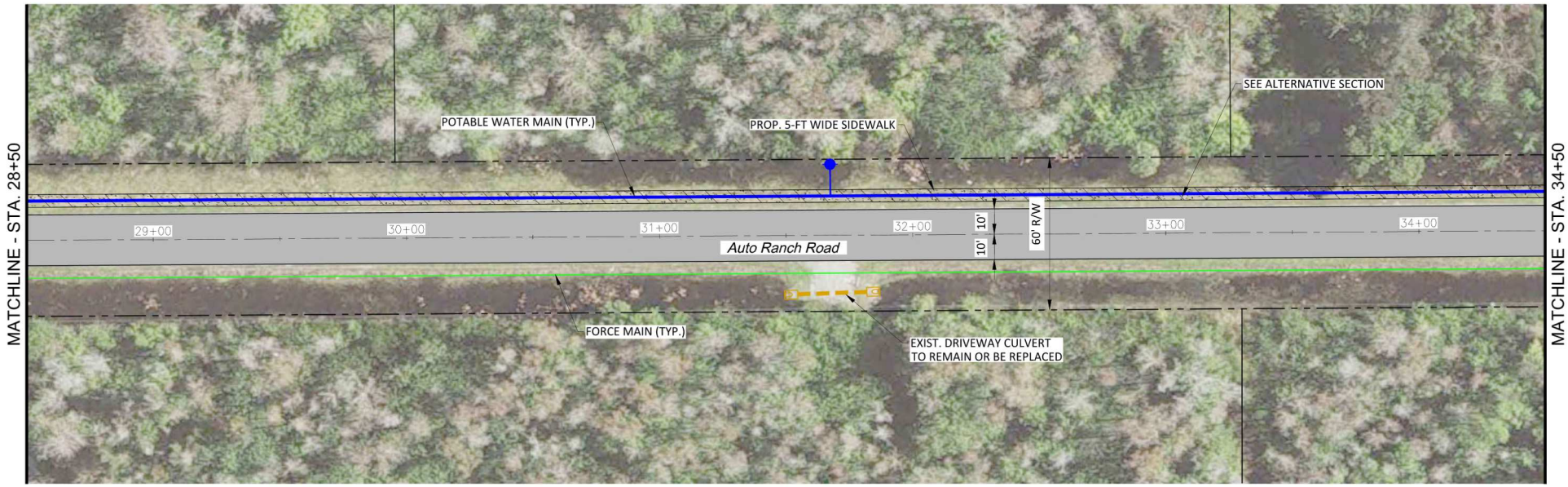

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 6
53 of 83

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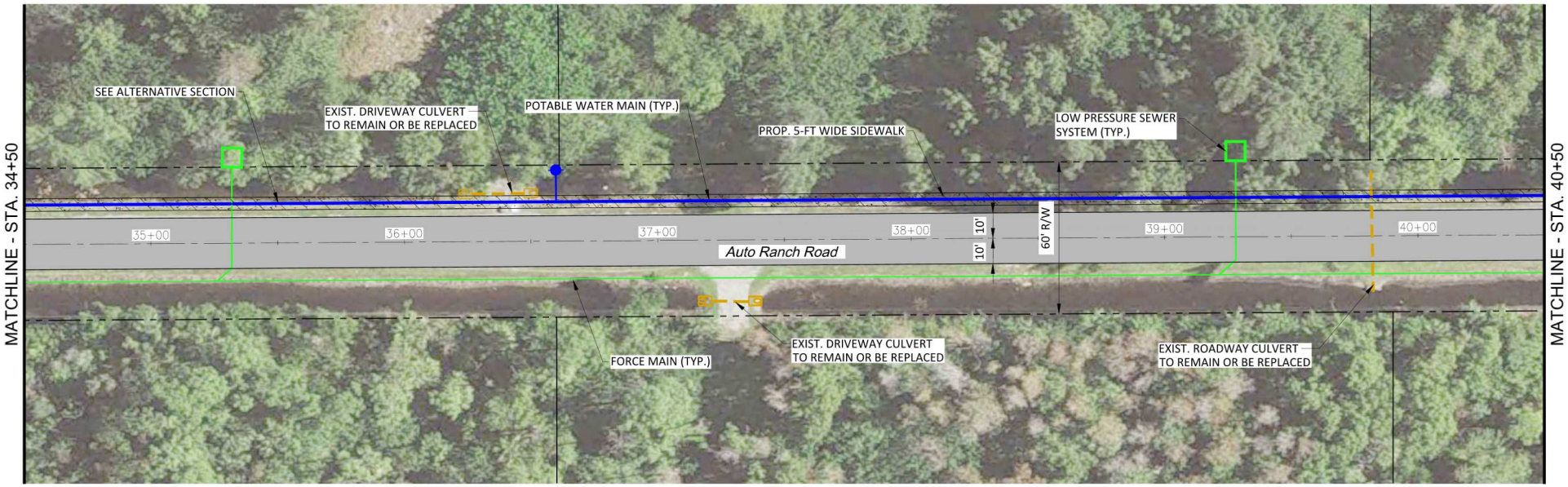

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 7
54 of 83

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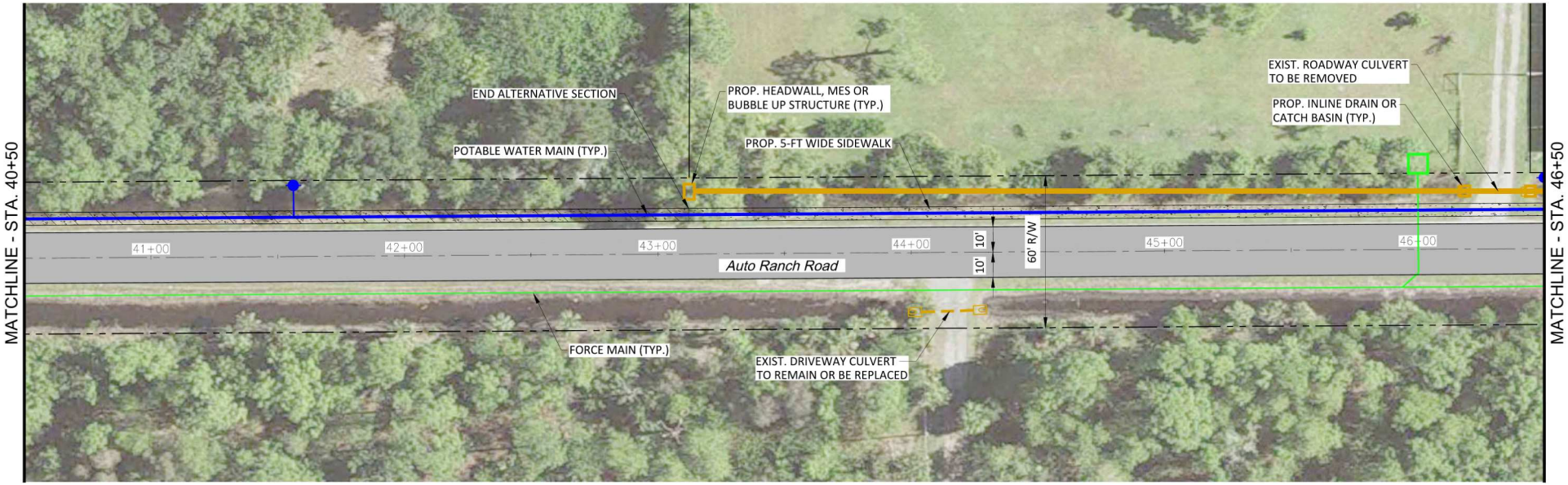

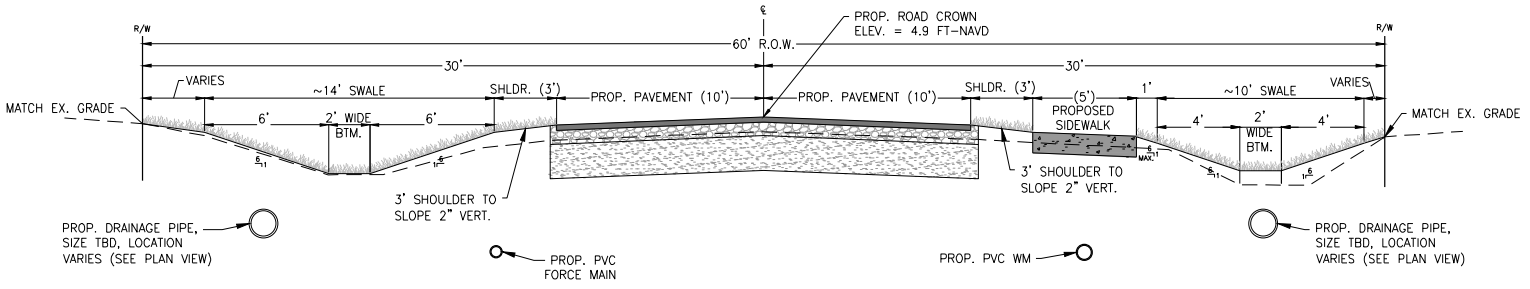

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 8
55 of 83

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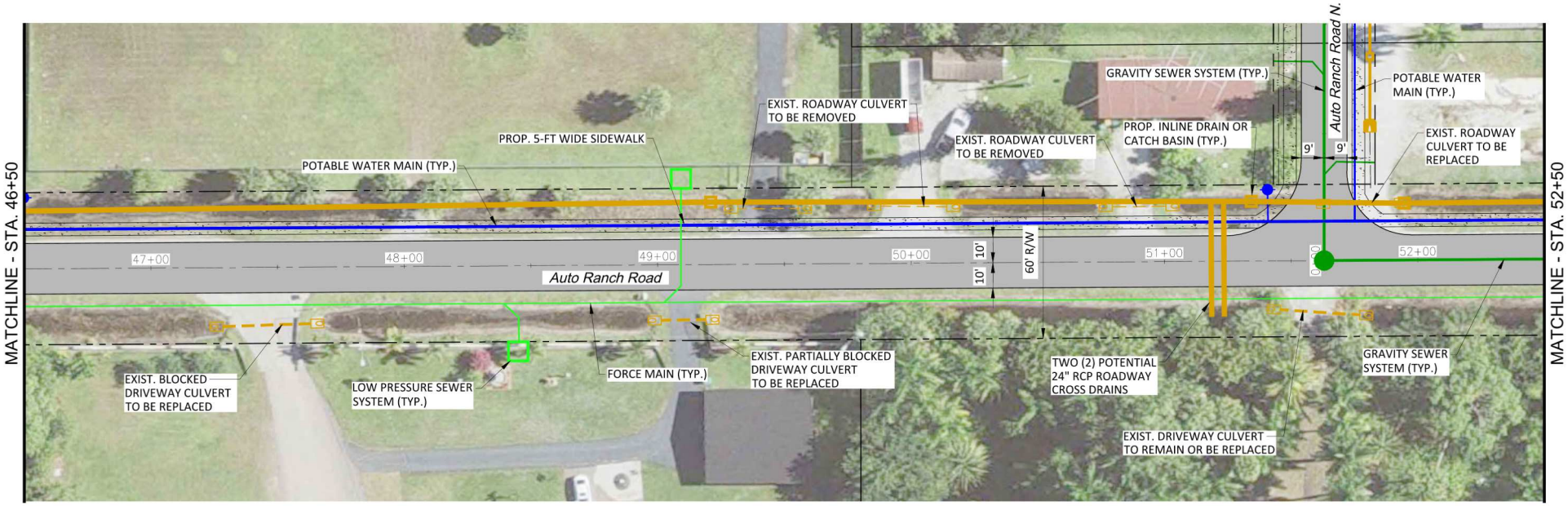

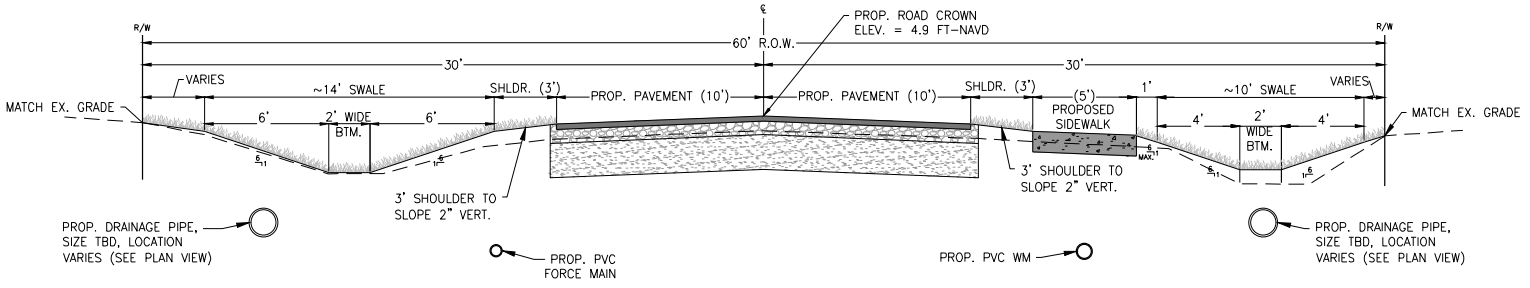

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 9
56 of 83

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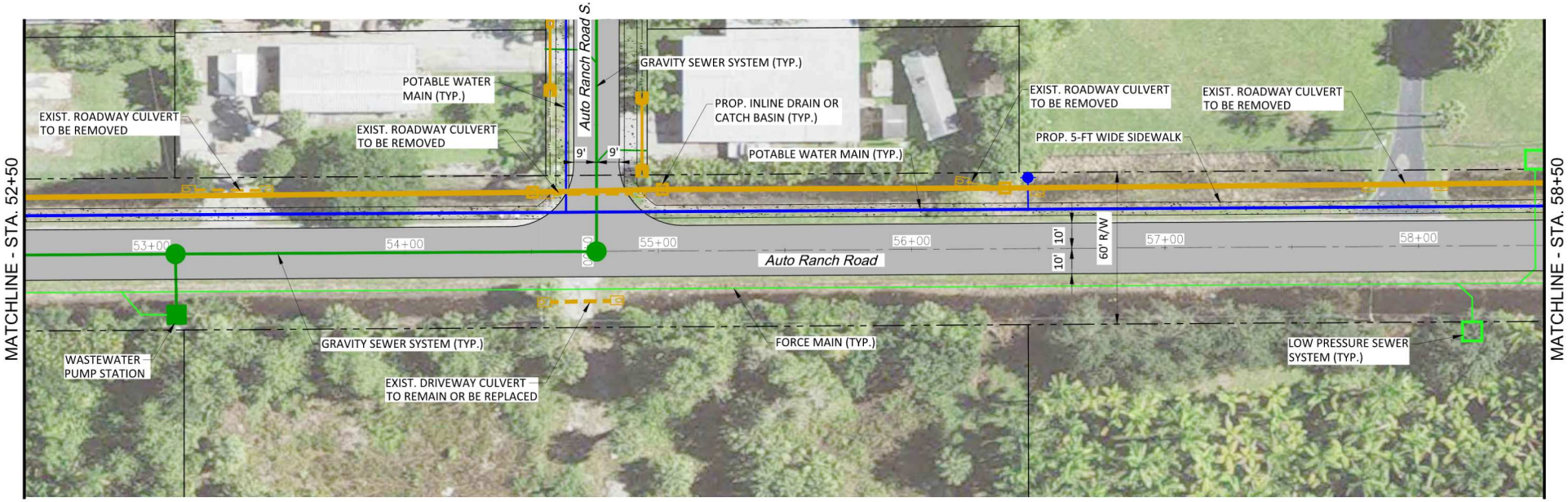

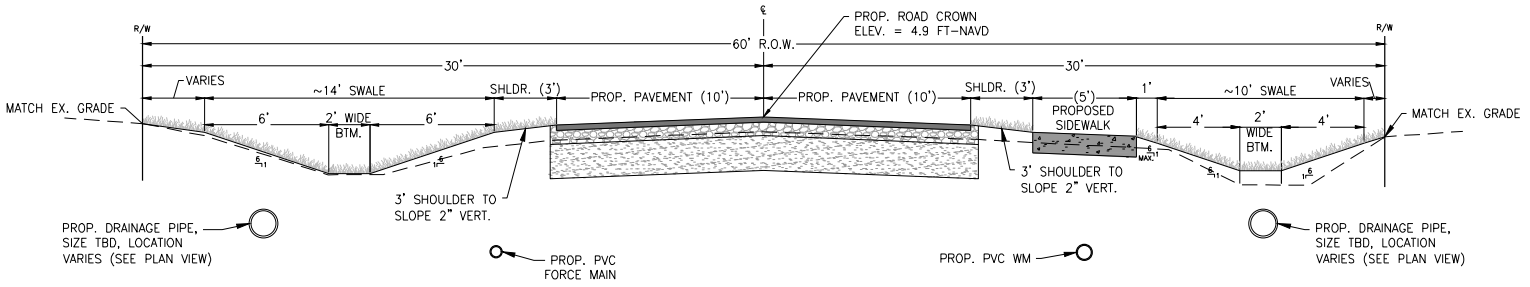

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 10
57 of 83

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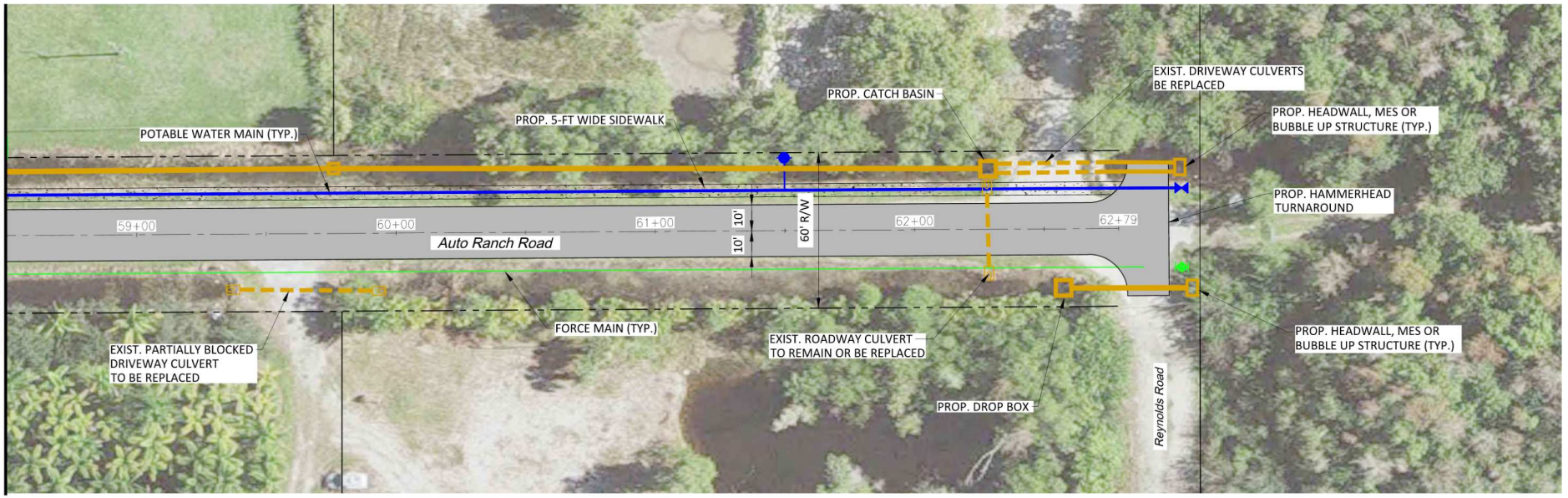

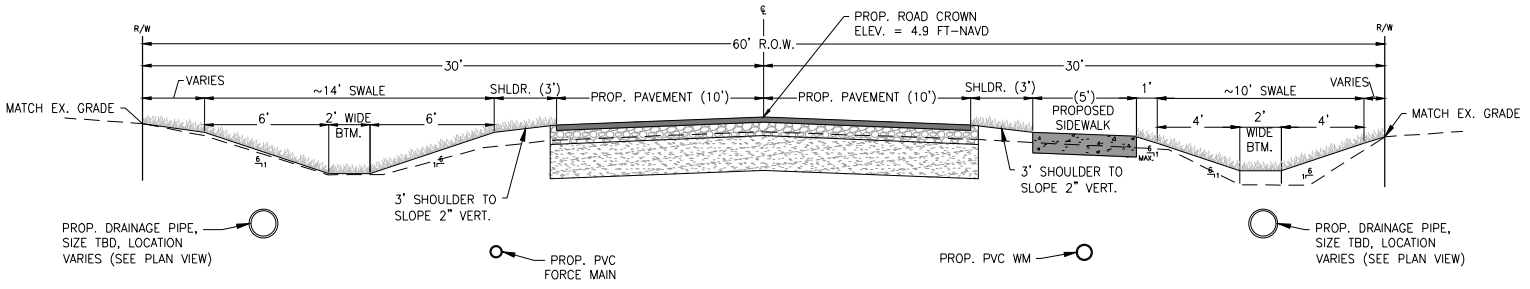

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD

PLAN VIEW – 11
58 of 83

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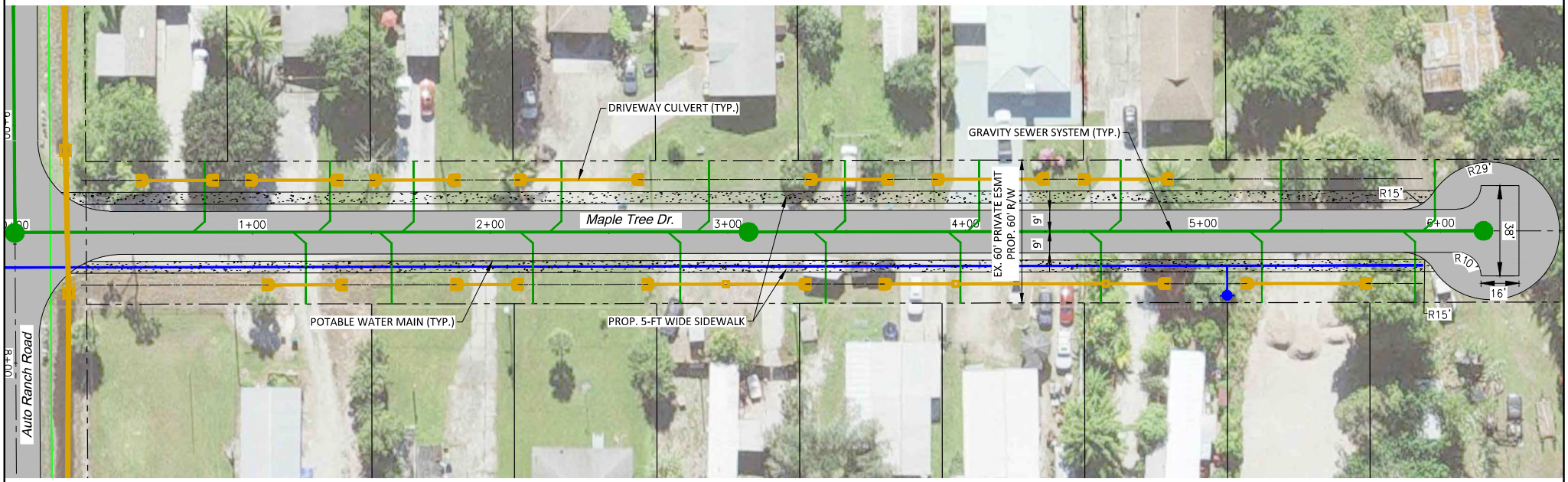

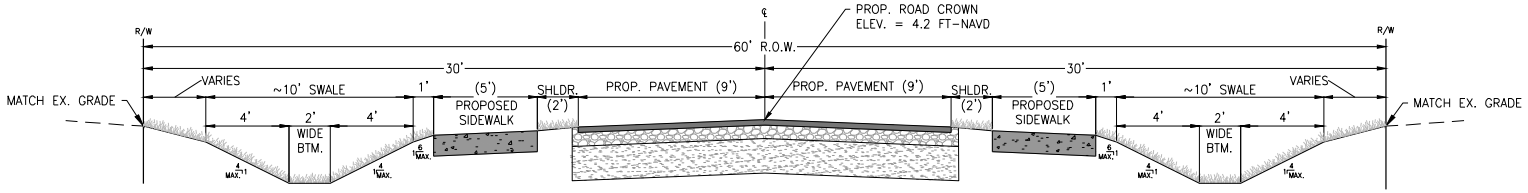

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

MAPLE TREE DIRVE

PLAN VIEW – 1
59 of 83

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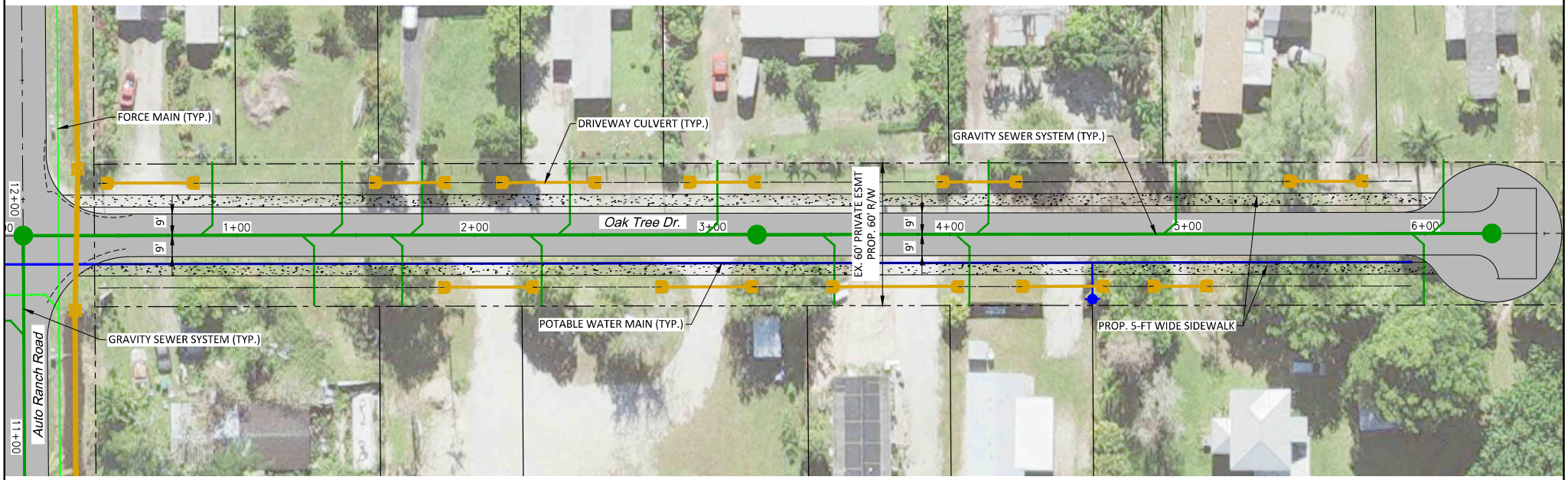

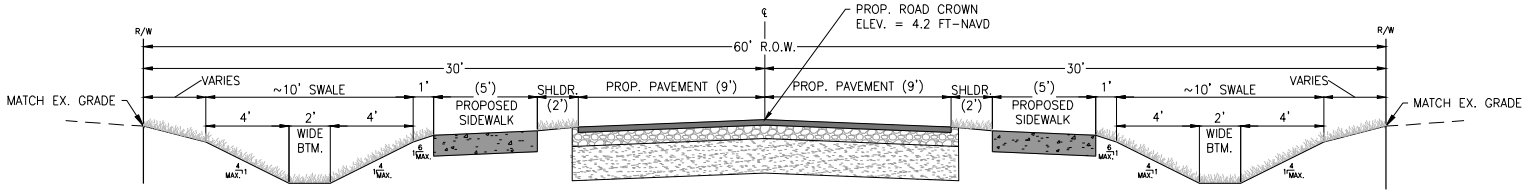

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

OAK TREE DRIVE

PLAN VIEW – 1
60 of 83

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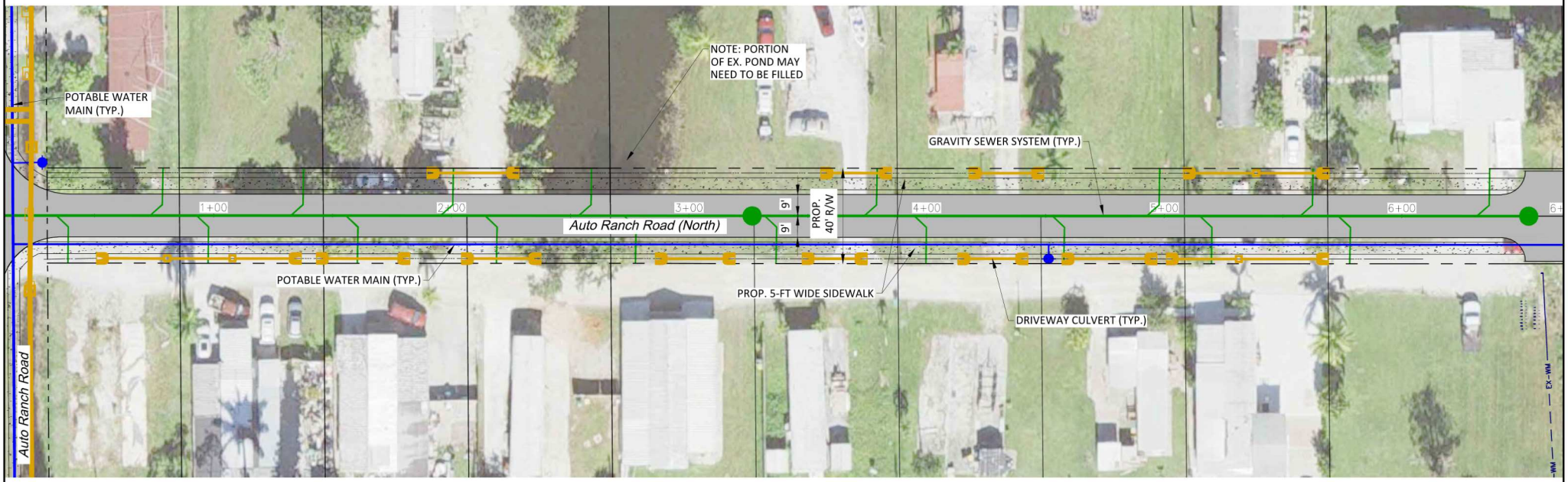

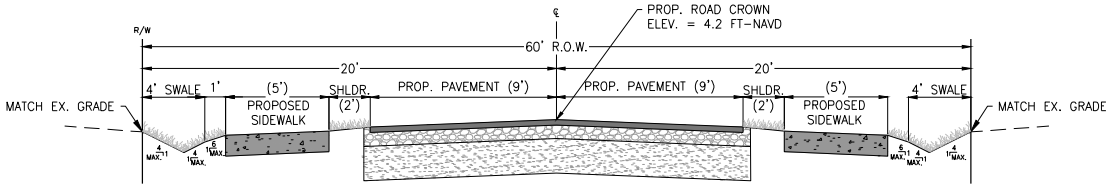

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD (NORTH)

PLAN VIEW – 1
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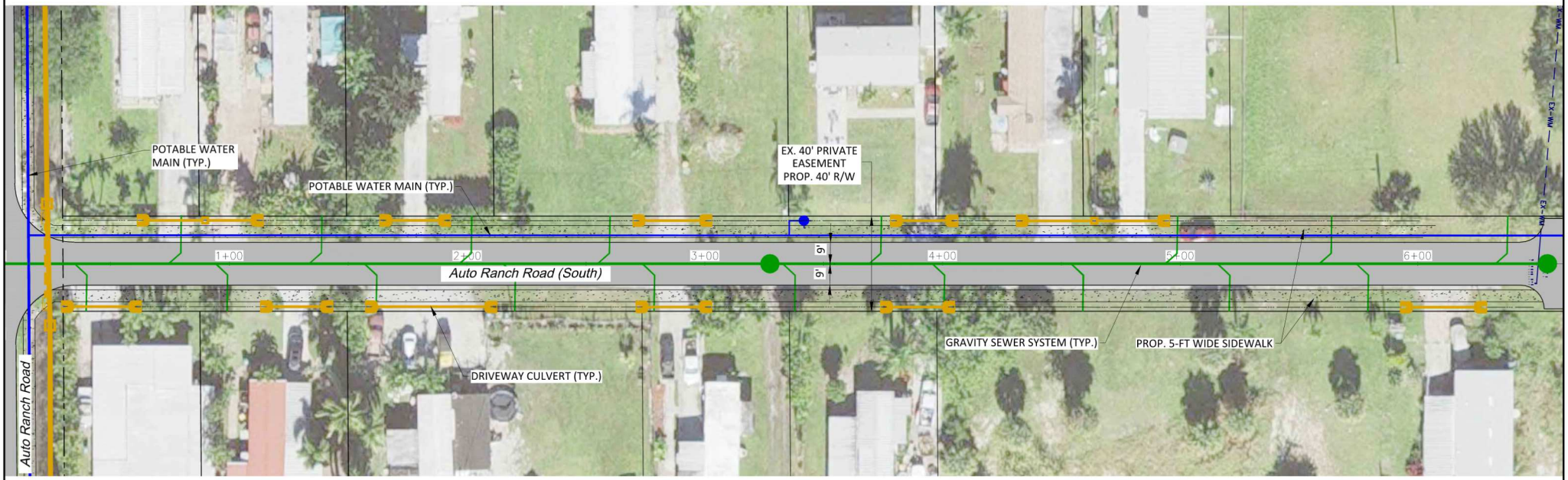

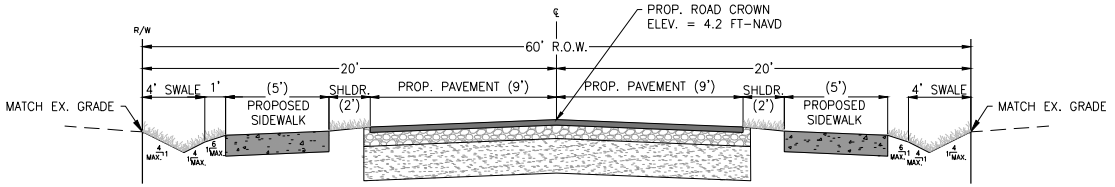

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

AUTO RANCH ROAD (SOUTH)

PLAN VIEW – 1
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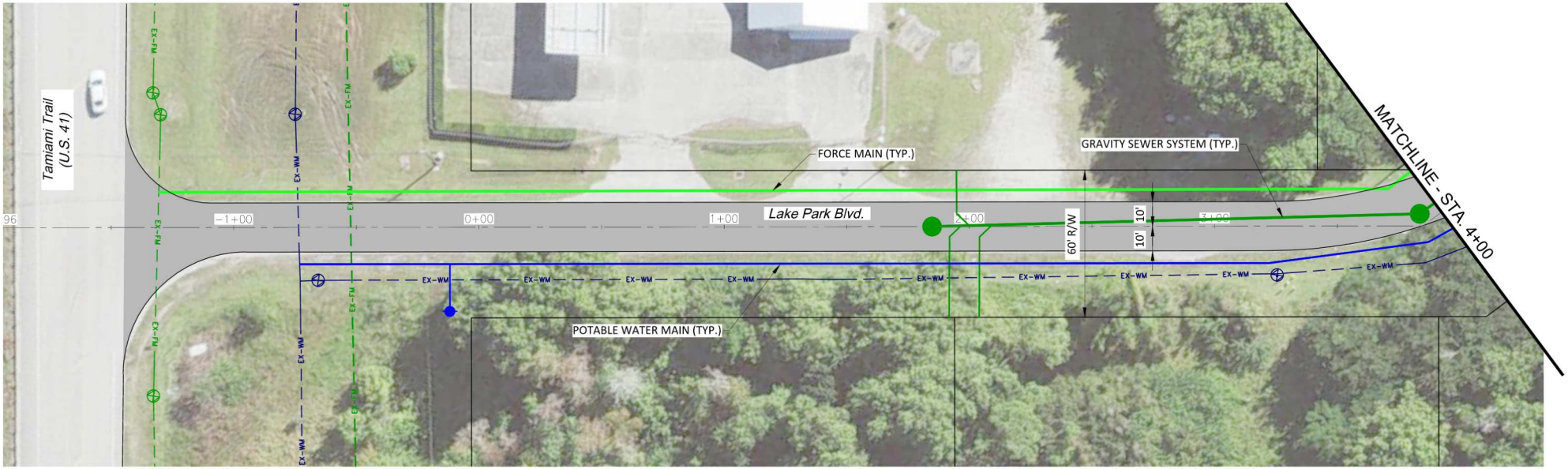
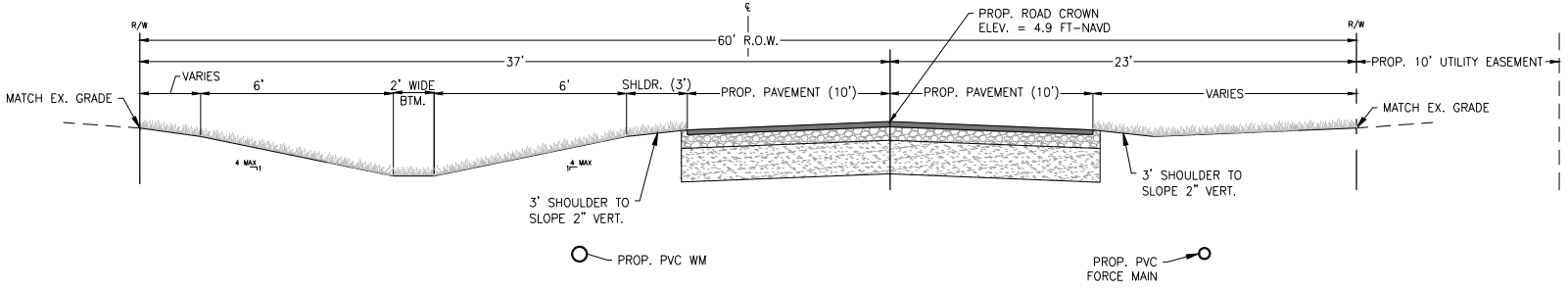
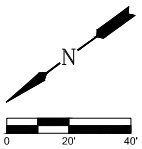
Lake Park Boulevard Option 1

Preliminary Roadway Design Plans





TYPICAL SECTION



11x17 SCALE: 1" = 40'

LAKE PARK BLVD.
PLAN VIEW – 1 64 of 83

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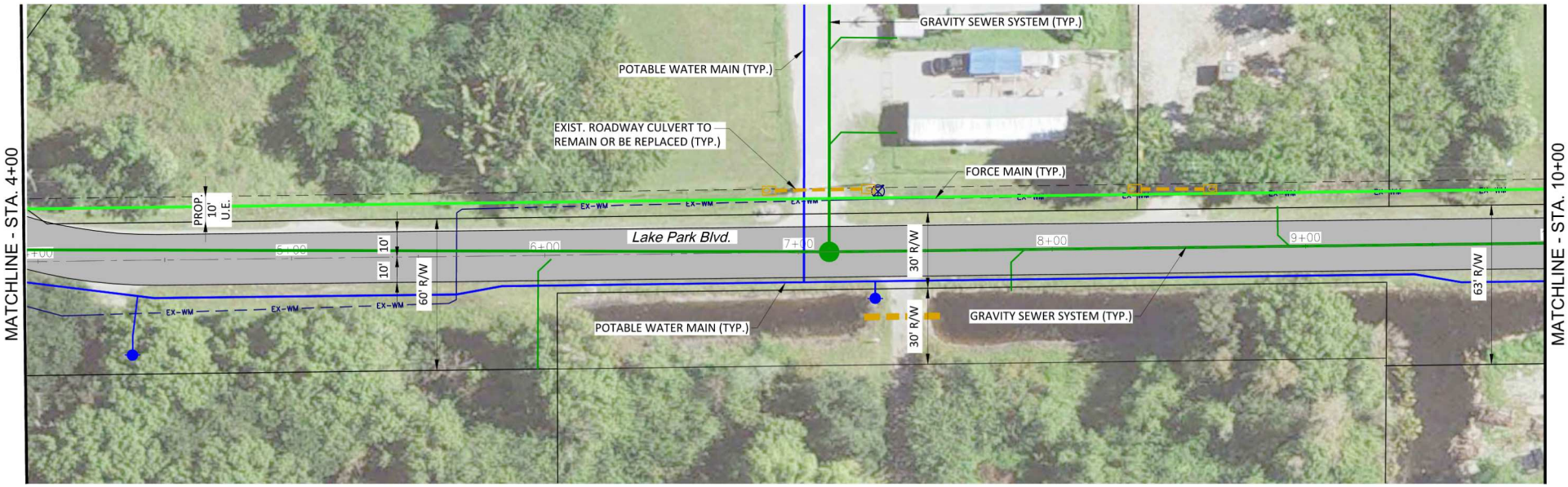

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 2
65 of 83

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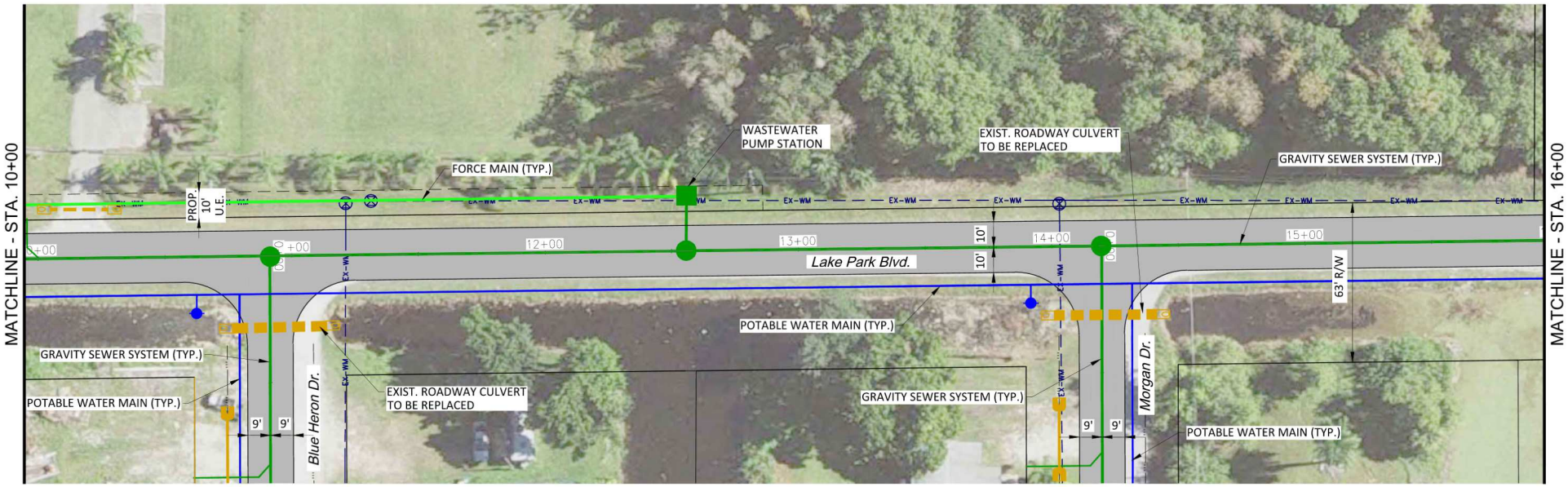

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 3
66 of 83

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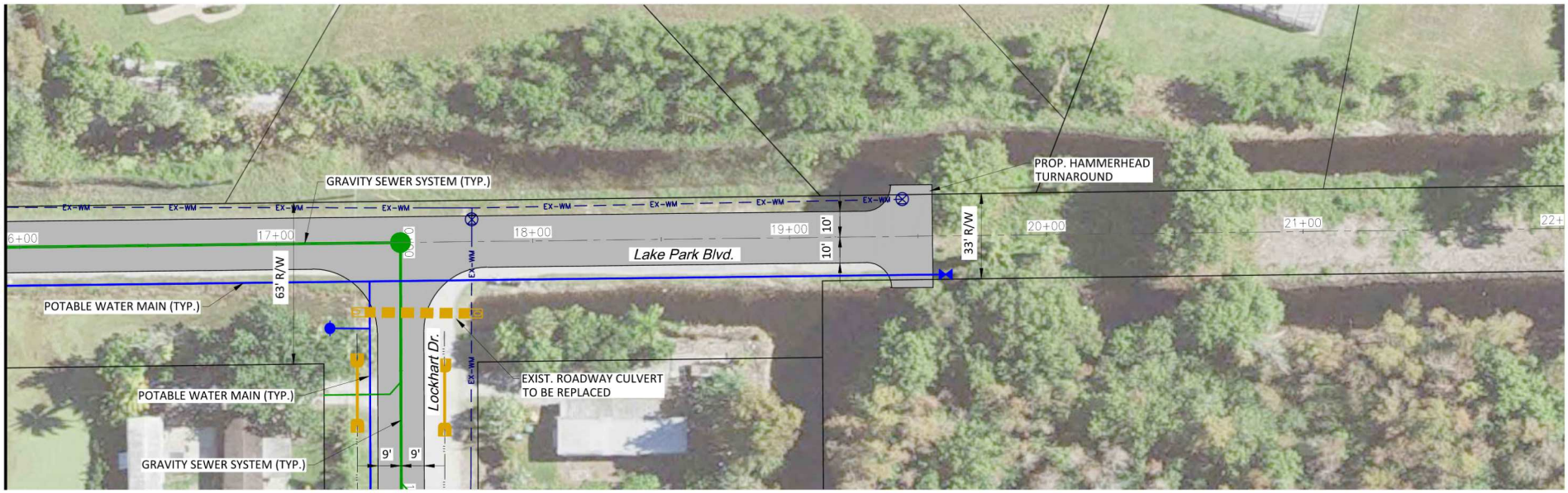

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 4
67 of 83

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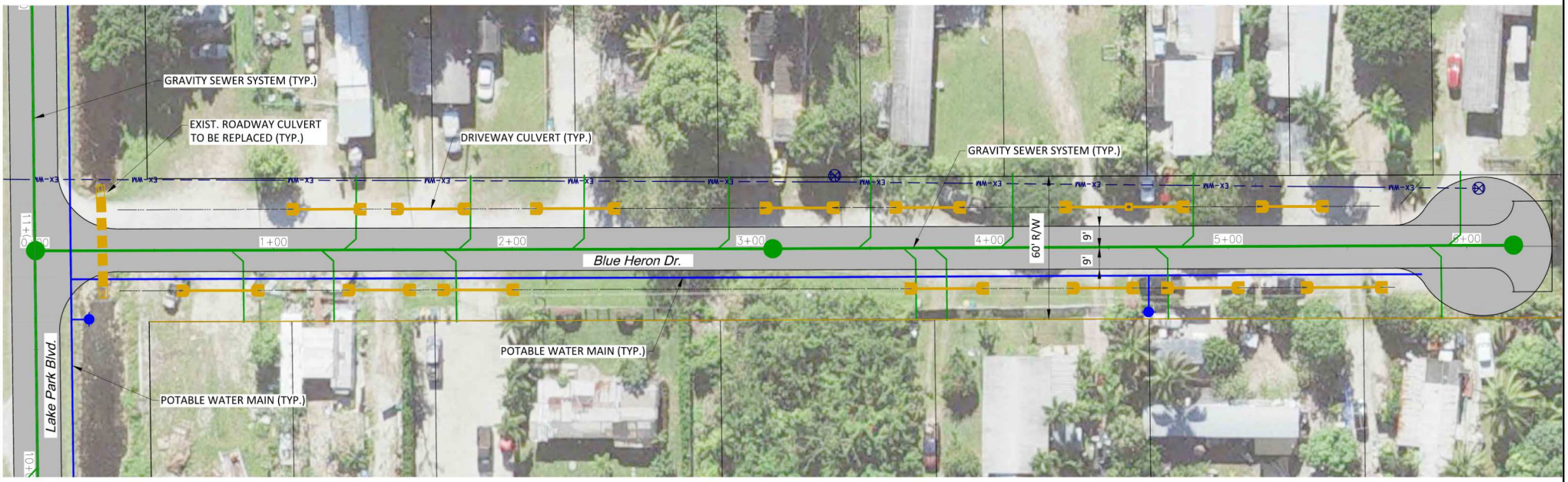

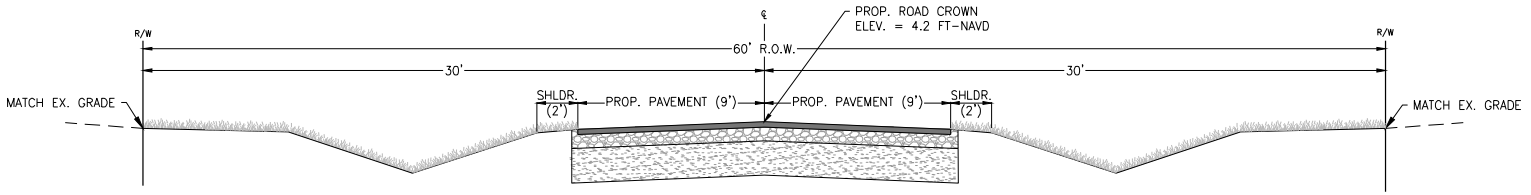

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

BLUE HERON DRIVE

PLAN VIEW – 1
68 of 83

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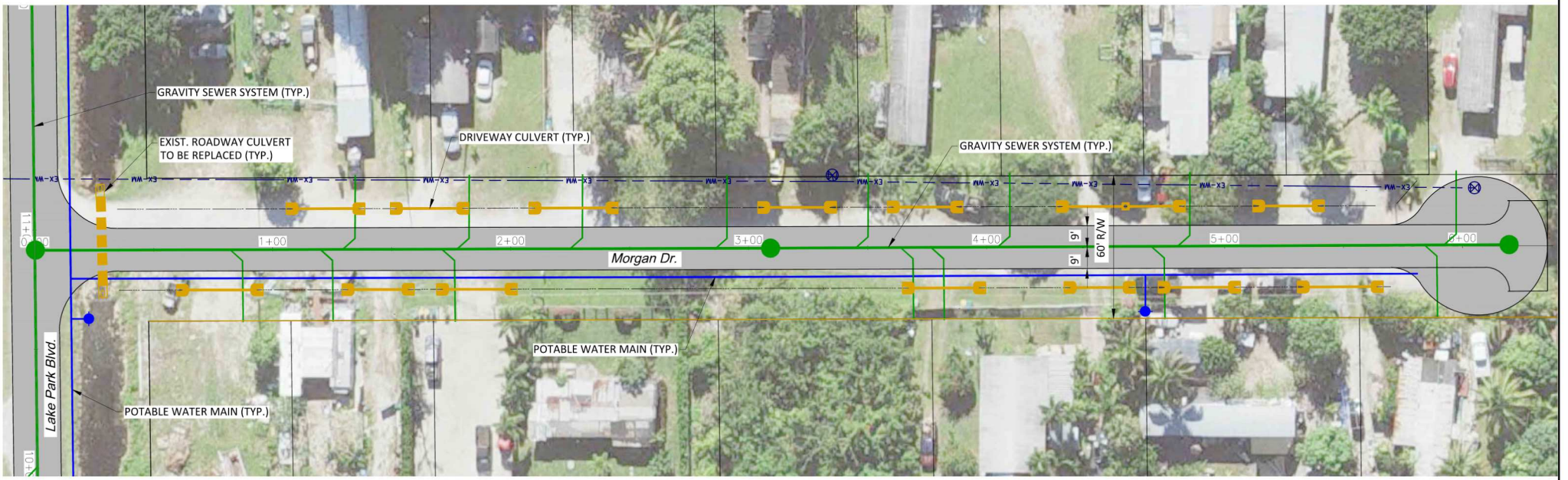

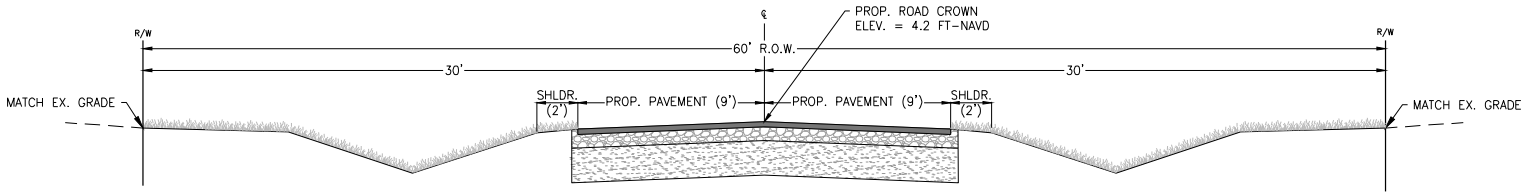

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

MORGAN DRIVE
PLAN VIEW – 1 69 of 83

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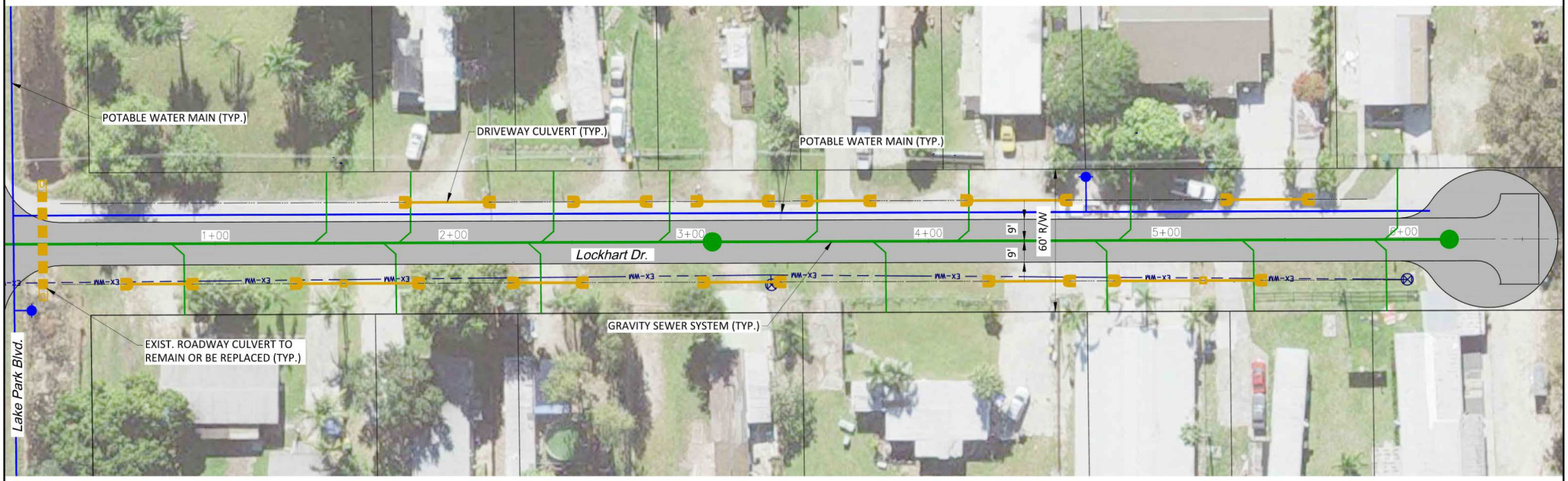

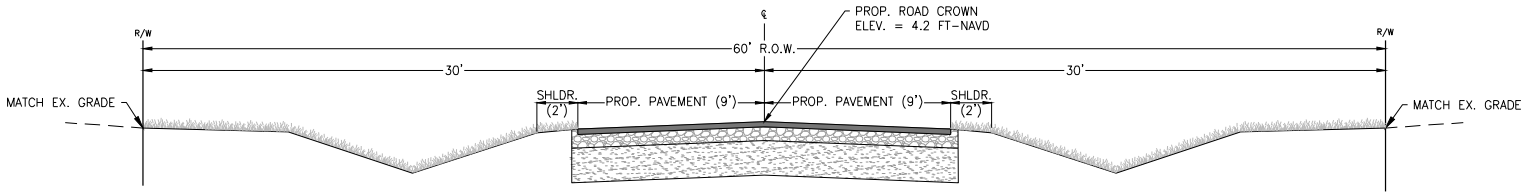

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

LOCKHART DRIVE

PLAN VIEW – 1
70 of 83

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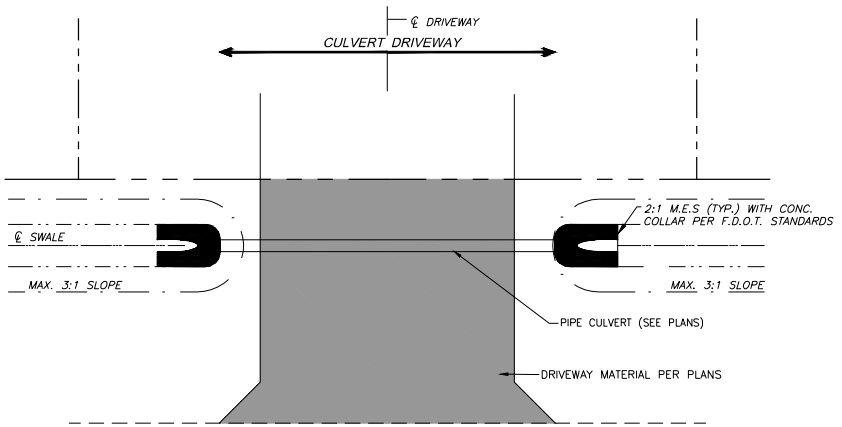

RESIDENTIAL DRIVEWAY DETAIL

NOT TO SCALE

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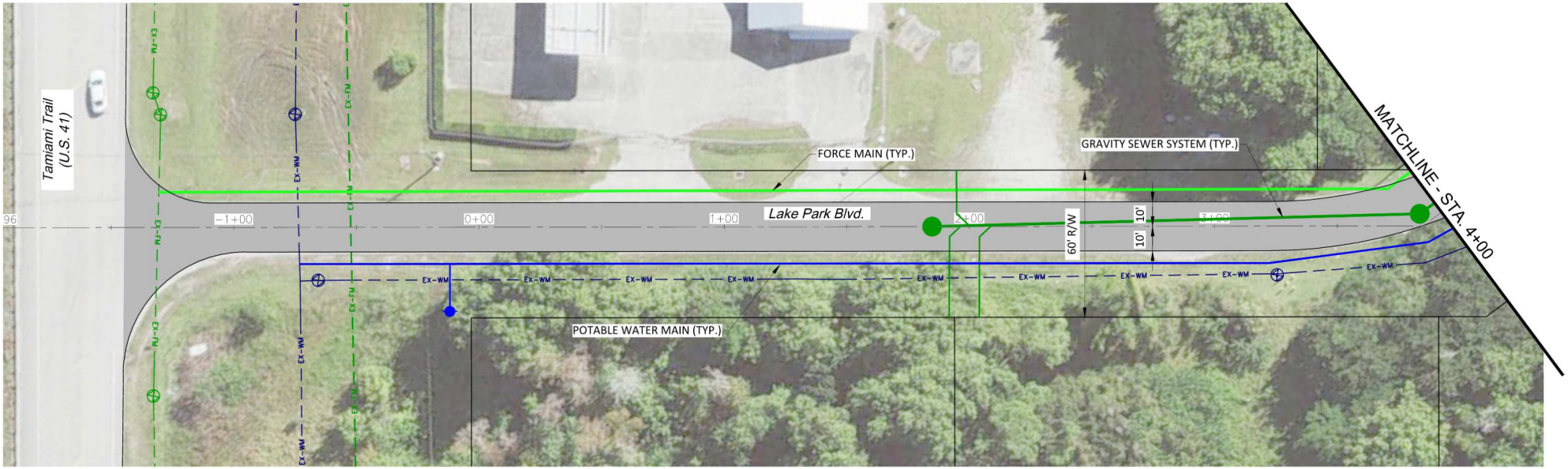
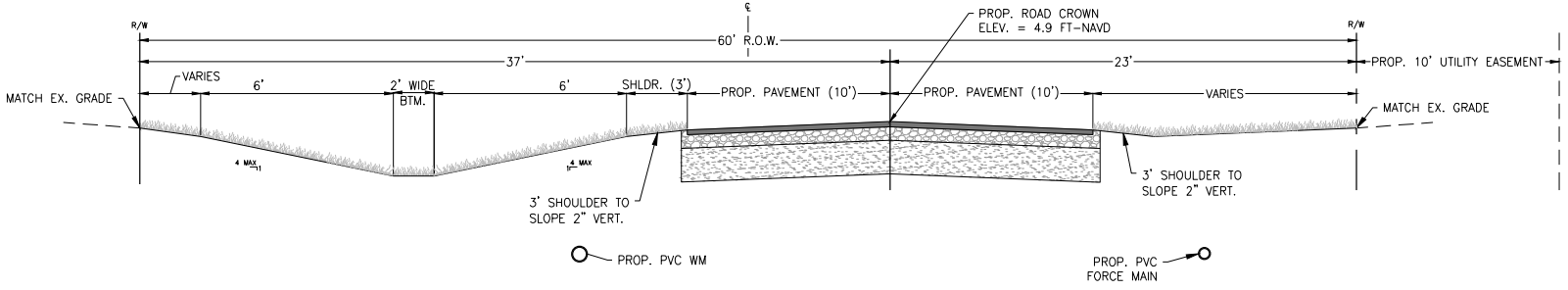
Lake Park Boulevard Option 2

Preliminary Roadway Design Plans





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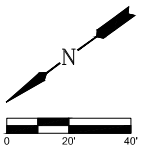

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.
PLAN VIEW – 1 73 of 83

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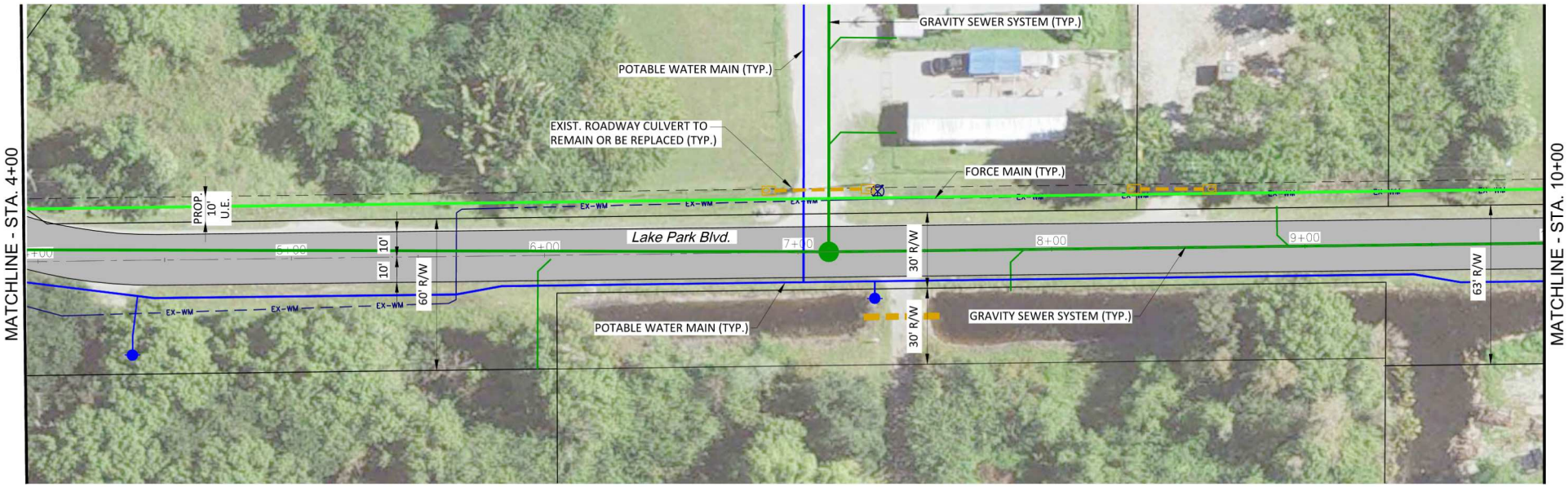

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 2
74 of 83

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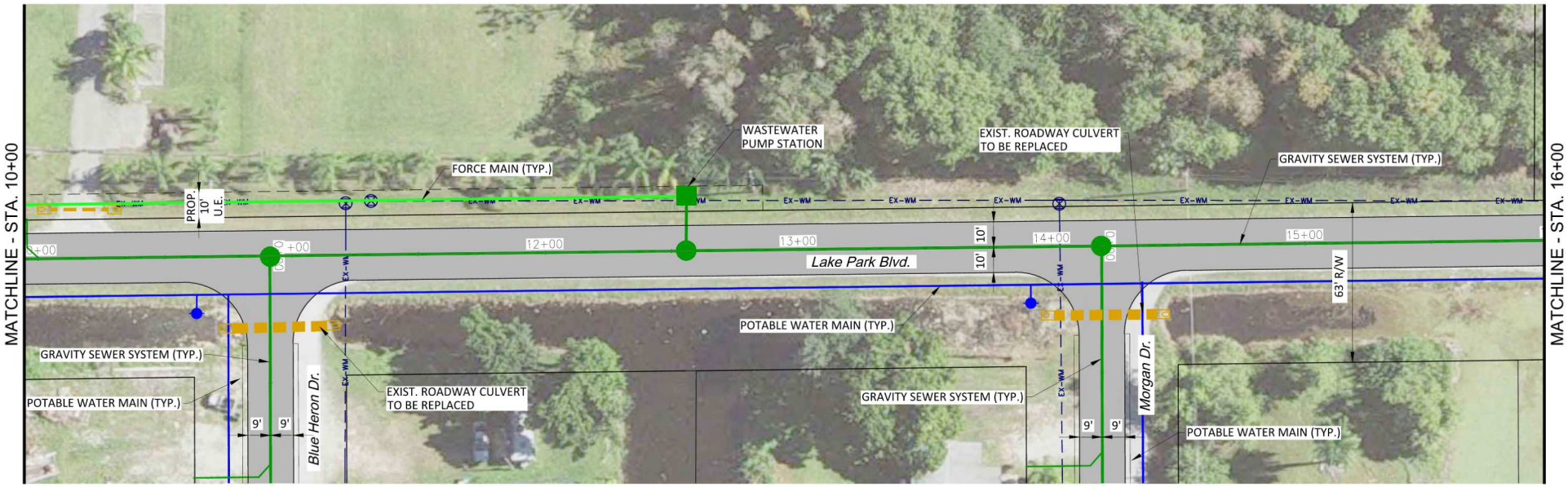

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 3
75 of 83

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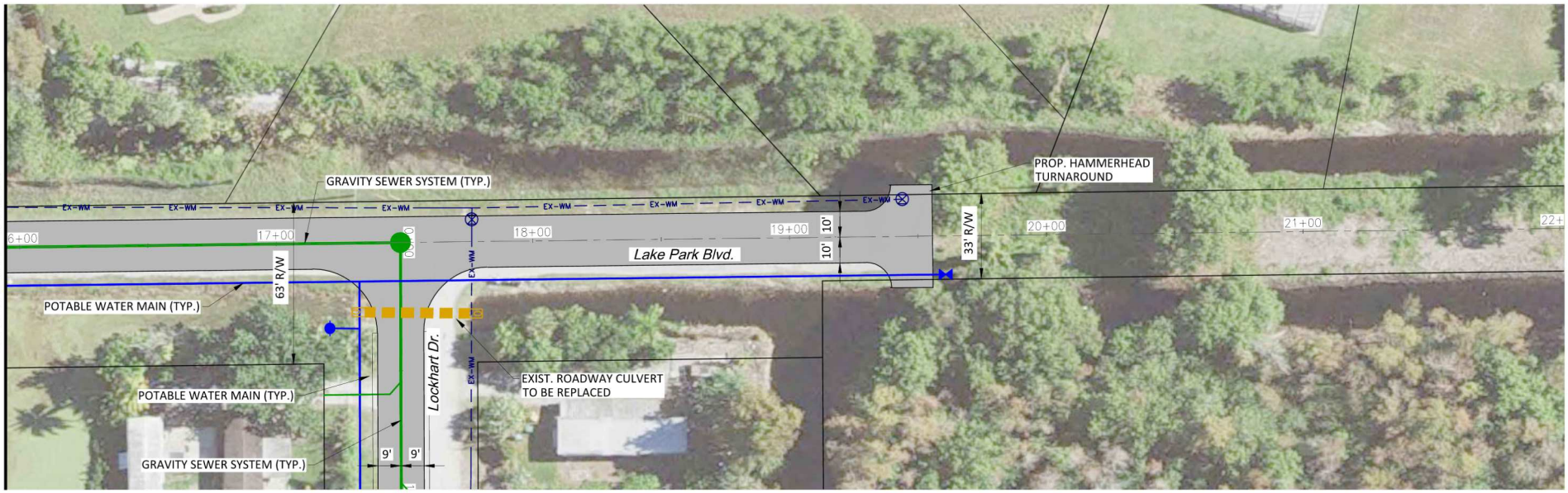

N

0 20' 40'

11x17 SCALE: 1" = 40'

LAKE PARK BLVD.

PLAN VIEW – 4
76 of 83

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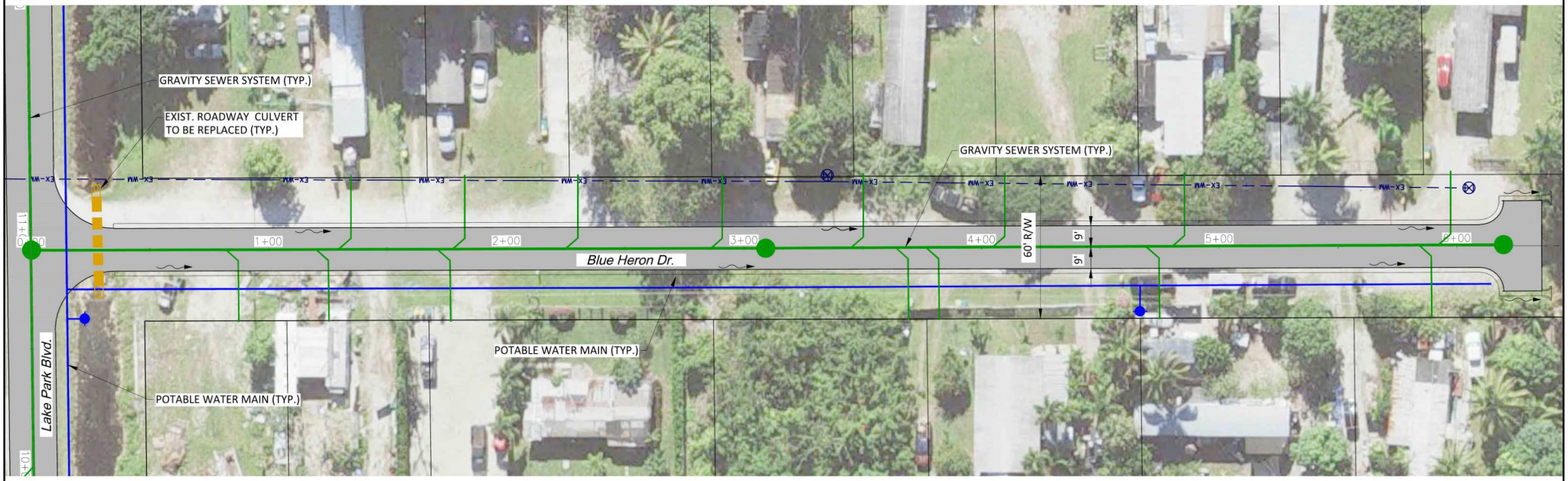

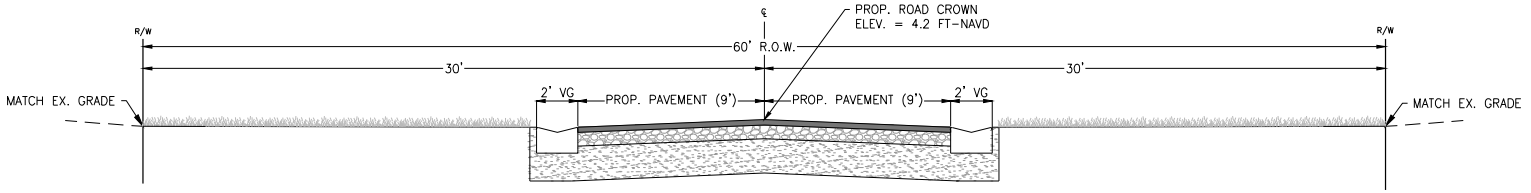

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

BLUE HERON DRIVE

PLAN VIEW – 1
77 of 83

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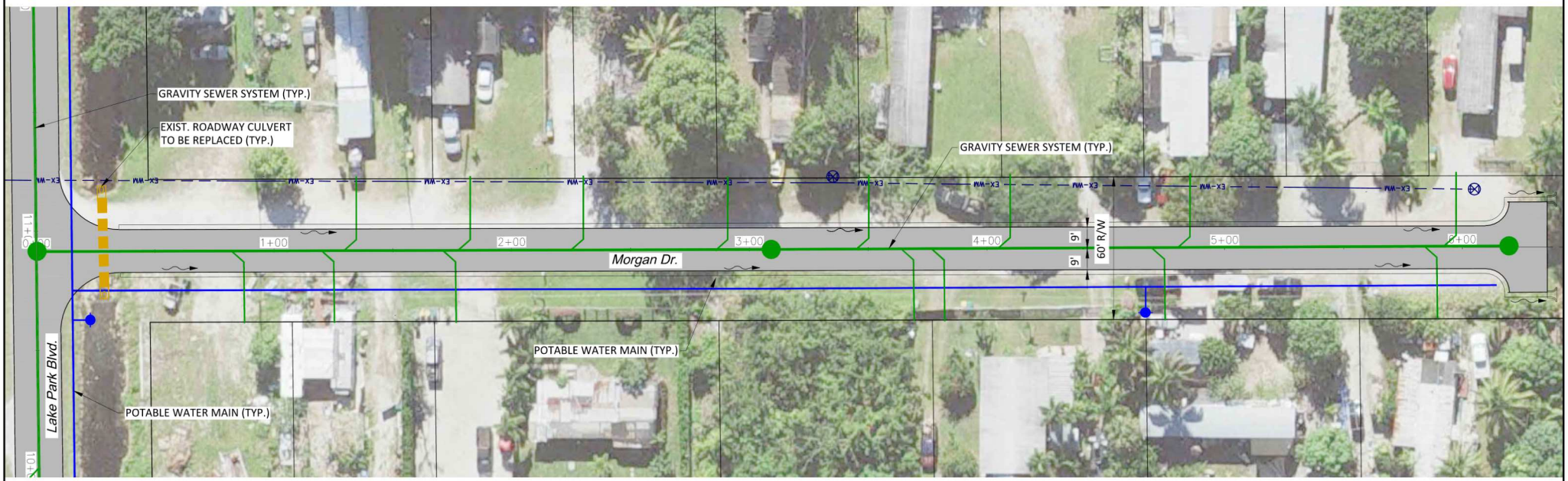

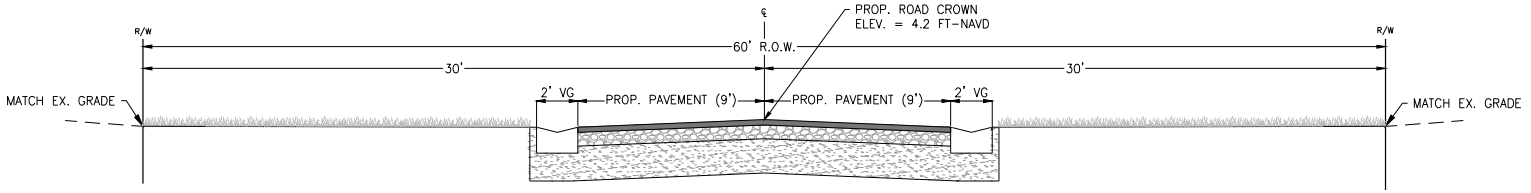

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

MORGAN DRIVE

PLAN VIEW – 1
78 of 83

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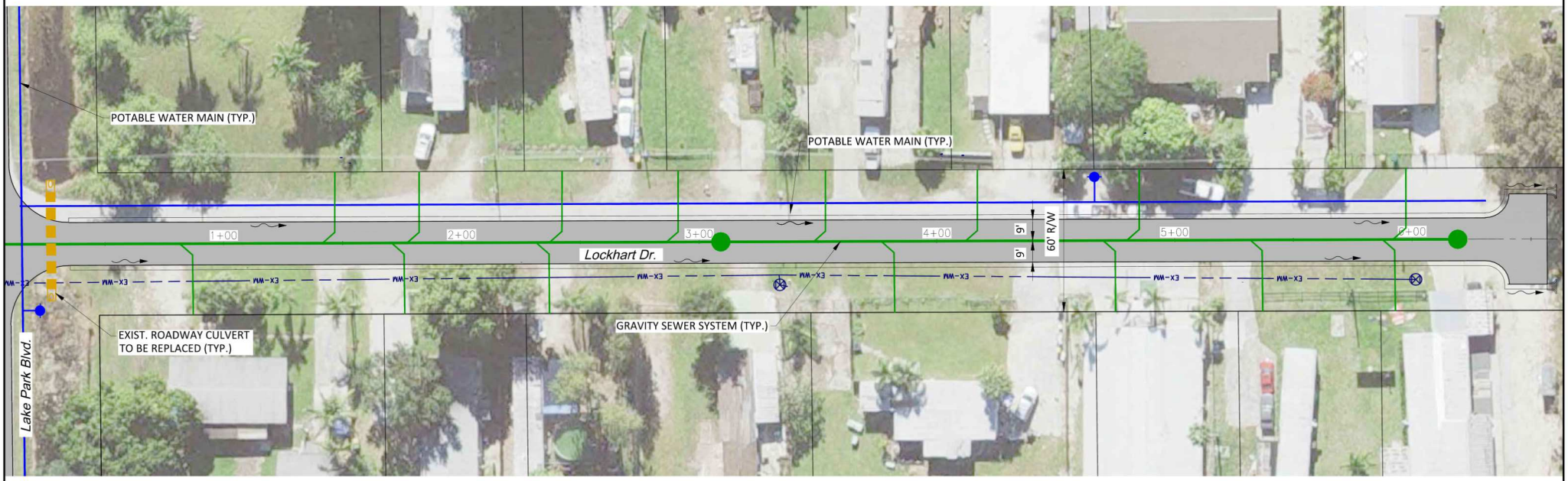

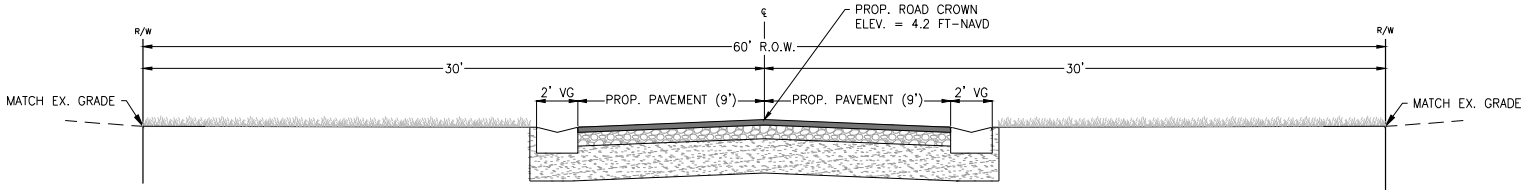

PROP. PVC WM

PROP. WASTEWATER MAIN

TYPICAL SECTION

N

0 20' 40'

11x17 SCALE: 1" = 40'

LOCKHART DRIVE

PLAN VIEW – 1
79 of 83

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Appendix D

Preliminary Construction Cost Estimate

GradyMinor
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Q. Grady Minor and Associates, P.A., 3800 Via Del Rey, Bonita Springs, FL 34134
(239) 947-1144 | www.GradyMinor.com

Date: 3/20/2023
Project: Roadway Improvements Construction Cost Estimate
Job Code: LLPWQ

General Conditions	Unit	Quantity	Price	Total
Mobilization	LS	1	$ 500,000.00	$ 500,000.00
Maintenance of Traffic	LS	1	$ 200,000.00	$ 200,000.00
			Sub-Total	**$ 700,000.00**

Auto Ranch Road	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	14,540	$ 4.00	$ 58,160.00
12" Stabilization (LBR 40)	SY	15,267	$ 5.00	$ 76,335.00
2"-16" Asphaltic Base (B-12.5)	SY	18,418	$ 135.00	$ 2,486,405.43
1" Friction Course (FC-9.5)	SY	14,540	$ 11.00	$ 159,940.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 5,000.00	$ 5,000.00
5' Concrete Sidewalk (6" Thick)	SY	3,500	$ 77.00	$ 269,500.00
General Restoration	LS	1	$ 500,000.00	$ 500,000.00
			Sub-Total	**$ 3,556,340.43**

Maple Tree Drive	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,512	$ 4.00	$ 6,048.00
12" Stabilization (LBR 40)	SY	1,588	$ 5.00	$ 7,938.00
2"-16" Asphaltic Base (B-12.5)	SY	1,915	$ 135.00	$ 258,558.80
1" Friction Course (FC-9.5)	SY	1,512	$ 11.00	$ 16,632.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	670	$ 77.00	$ 51,590.00
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 442,766.80**

Oak Tree Drive	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,500	$ 4.00	$ 6,000.00
12" Stabilization (LBR 40)	SY	1,575	$ 4.00	$ 6,300.00
2"-16" Asphaltic Base (B-12.5)	SY	1,900	$ 135.00	$ 256,506.75
1" Friction Course (FC-9.5)	SY	1,500	$ 11.00	$ 16,500.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	670	$ 77.00	$ 51,590.00
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 438,896.75**

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Auto Ranch Road North	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,392	$ 4.00	$ 5,568.00
12" Stabilization (LBR 40)	SY	1,462	$ 5.00	$ 7,308.00
2"-16" Asphaltic Base (B-12.5)	SY	1,763	$ 135.00	$ 238,038.26
1" Friction Course (FC-9.5)	SY	1,392	$ 11.00	$ 15,312.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1.00	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	720	$ 77.00	$ 55,440.00
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 423,666.26**

Auto Ranch Road South	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,389	$ 4.00	$ 5,556.00
12" Stabilization (LBR 40)	SY	1,458	$ 5.00	$ 7,292.25
2"-16" Asphaltic Base (B-12.5)	SY	1,759	$ 135.00	$ 237,525.25
1" Friction Course (FC-9.5)	SY	1,389	$ 11.00	$ 15,279.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	720	$ 77.00	$ 55,440.00
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 423,092.50**

Lake Park Boulevard	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	4,786	$ 4.00	$ 19,144.00
12" Stabilization (LBR 40)	SY	5,025	$ 5.00	$ 25,126.50
2"-16" Asphaltic Base (B-12.5)	SY	6,062	$ 135.00	$ 818,427.54
1" Friction Course (FC-9.5)	SY	4,786	$ 11.00	$ 52,646.00
Valley Gutter	LF	-	$ 40.00	$ -
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 5,000.00	$ 5,000.00
5' Concrete Sidewalk (6" Thick)	SY	-	$ 77.00	$ -
General Restoration	LS	1	$ 400,000.00	$ 400,000.00
			Sub-Total	**$ 1,321,344.04**

Blue Heron Drive	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,463	$ 4.00	$ 5,852.00
12" Stabilization (LBR 40)	SY	1,536	$ 5.00	$ 7,680.75
2"-16" Asphaltic Base (B-12.5)	SY	1,853	$ 135.00	$ 250,179.58
1" Friction Course (FC-9.5)	SY	1,463	$ 11.00	$ 16,093.00
Valley Gutter	LF	1,260	$ 40.00	$ 50,400.00
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	-	$ 77.00	$ -
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 432,205.33**

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Morgan Drive	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,521	$ 4.00	$ 6,084.00
12" Stabilization (LBR 40)	SY	1,597	$ 5.00	$ 7,985.25
2"-16" Asphaltic Base (B-12.5)	SY	1,927	$ 135.00	$ 260,097.84
1" Friction Course (FC-9.5)	SY	1,521	$ 11.00	$ 16,731.00
Valley Gutter	LF	1,290	$ 40.00	$ 51,600.00
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	-	$ 77.00	$ -
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 444,498.09**

Lockhart Drive	Unit	Quantity	Price	Total
Mill 3/4" Existing Pavement	SY	1,444	$ 4.00	$ 5,776.00
12" Stabilization (LBR 40)	SY	1,516	$ 5.00	$ 7,581.00
2"-16" Asphaltic Base (B-12.5)	SY	1,829	$ 135.00	$ 246,930.50
1" Friction Course (FC-9.5)	SY	1,444	$ 11.00	$ 15,884.00
Valley Gutter	LF	1,200	$ 40.00	$ 48,000.00
Signage	LS	1	$ 1,000.00	$ 1,000.00
Pavement Markings (Thermoplastic)	LS	1	$ 1,000.00	$ 1,000.00
5' Concrete Sidewalk (6" Thick)	SY	-	$ 77.00	$ -
General Restoration	LS	1	$ 100,000.00	$ 100,000.00
			Sub-Total	**$ 426,171.50**

Total	**$**	**8,608,981.71**
20% Contingency	**$**	**1,721,796.34**
Grand Total	**$**	**10,330,778.05**

Appendix F. Technical Memorandum for Task 6. Flowway Restoration and Preservation

To: Daniel Roman, PE, PMP; Rick Orth, PG.
Stormwater Management Section, Collier County

From: Marcelo Lago, PhD; Ananta Nath, PE; Maria C. Bravo, PE, PhD;
Lago Consulting and Services, LLC;
Marco Espinar; Collier Environmental Consultants, Inc.
Allyson Holland, PE; Justin Frederiksen, PE; GradyMinor.

Date: April 21st, 2023

Re: Lake Park Boulevard Capital Improvements and Water Quality Flowway Pre-Design Study.
Task 6. Flowway Restoration and Preservation. Collier County PO No. 4500218524

Background

Collier County has contracted Lago Consulting & Services to conduct a pre-design study to identify and evaluate the feasibility of potential stormwater management improvements, conversion of domestic septic systems of wastewater disposal to a municipal sewer, roadway improvements, restoration of historic flowways to the Rookery Bay estuaries and preservation of related natural resources within the project area. The study area is outlined in **Figure 1**.



Figure 1. Project area.

The Task 1 activities of the project related to data collection and field reconnaissance were detailed in a separated technical memorandum submitted earlier to the County[1]. An Existing Conditions Stormwater Model for the project area was also developed as part of Task 2[2]. The model was used in Task 3[3] to evaluate recommended stormwater improvement options. The conversion from Septic to Sewer Systems was also evaluated as part of Task 4[4]. Finally, Roadway improvements in the project area were contemplated as part of Task 5[5].

[1] Task 1. Data Collection and Field Reconnaissance. Draft Technical Memorandum submitted on November 7, 2022.
[2] Task 2. Existing Conditions Stormwater Model. Draft Technical Memorandum submitted on November 14, 2022.
[3] Task 3. Potential Stormwater Management Improvements. Draft Technical Memorandum submitted on April 3, 2023.
[4] Task 4. Conversion from Septic to Sewer. Draft Technical Memorandum submitted on February 15, 2022.
[5] Task 5. Roadway Improvements. Draft Technical Memorandum submitted on April 21, 2023.

This technical memorandum summarizes the land acquisition activities performed and planned by the County for implementing a sound stormwater management for the Lake Park area and to restore the historic flowways to the Rookery Bay Estuary.

Land Acquisition Plan

The Collier County Staff identified a number of parcels that would be beneficial to acquire to facilitate the maintenance and restoration of the Lake Park Flow Way. The parcels of interest were numbered consecutively from 101FEE through 123FEE, and their locations are presented in **Figure 2**. Two other parcels were also identified as part of the flowway, and they were labeled as 124FEE and 125FEE in Figure 2.

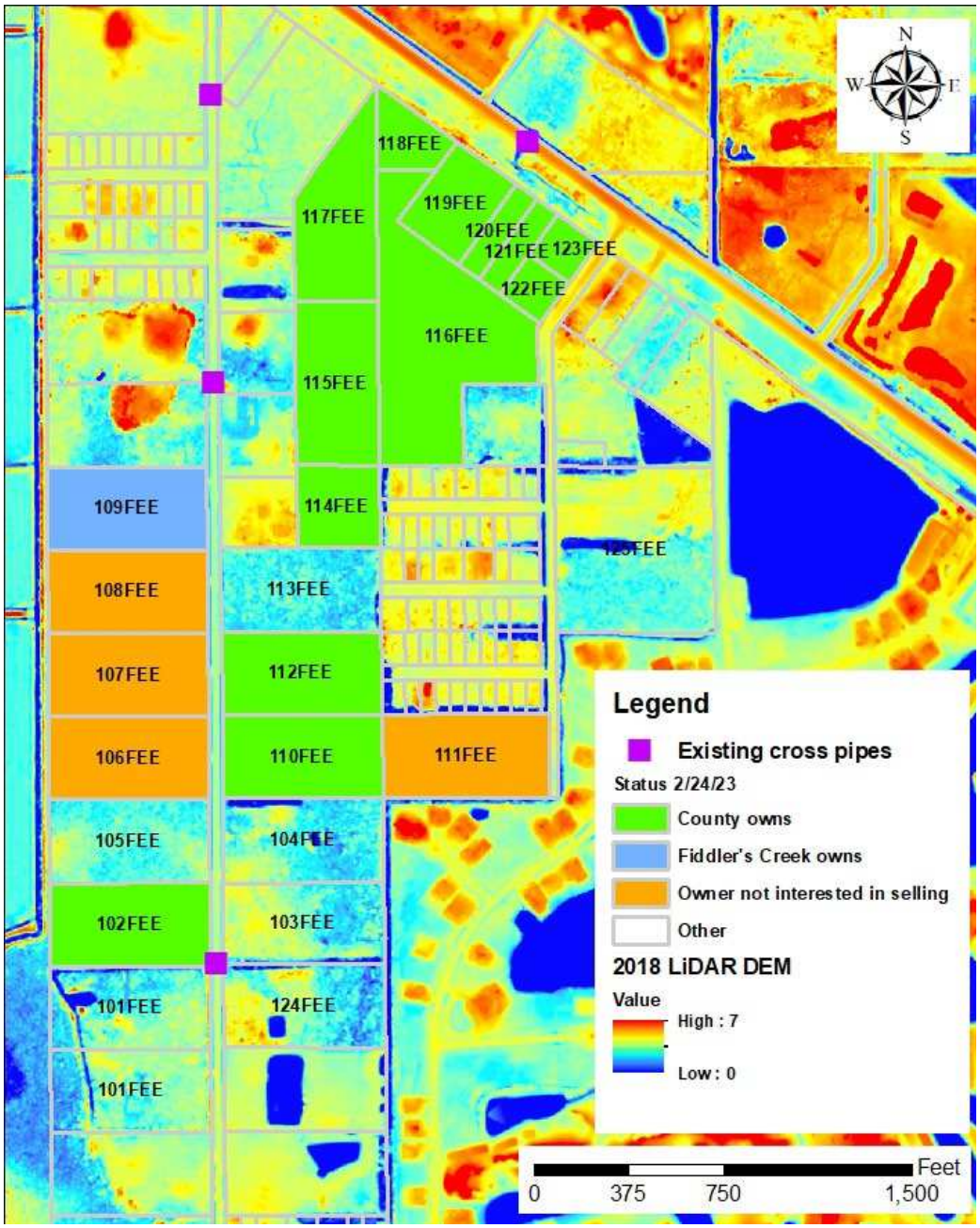

Figure 2. Ownership status of parcels identified for flow way restoration.

Table 1 lists the 2022 market value of the parcels that are not owned by the County in Figure 2, as extracted from the Collier County Property Appraiser webpage[6]. According to this table, the County's 2022 market value of an undeveloped parcel in the project area is around $24k/acre.

Table 1. 2022 Market Value of parcels that are not owned by the County.

Parcel No.	Folio No.	Owner	Area acres	Mean Ground Elevation ft NAVD88	Market Value 2022	
					$	$ / acre
101FEE	767920009	Tooley, Karl J	9.61	2.9 (south) 2.7 (north)	$230,665	$24,003
103FEE	766200005	Tran, Linh Nhat	4.80	3.0	$115,200	$24,000
104FEE	768960000	Hsalkhli LLC	4.81	2.5	$122,367	$25,440
105FEE	766440001	Herbello, Glenda	4.81	2.8	$115,440	$24,000
106FEE 107FEE	770080606	Baltazar, Jose *	9.60	2.2	$362,857	$37,798
108FEE	764240009	Baltazar, Jose *	4.80	2.1	$115,200	$24,000
109FEE	764320000	Fiddler's Creek	4.80	2.6	$115,200	$24,000
111FEE	764440003	Naples Golf Club South LLC *	4.80	2.2	$114,480	$23,850
113FEE	764600005	Lemus, Carlos M & Gregoria L	4.80	2.4	$115,200	$24,000
124FEE	767880000	Kulawik, Eugeniusz	4.80	2.8	$115,200	$24,000
125FEE	765120005	Moore, John R	9.82	3.2	$241,031	$24,545
		Total	67.45	—	$1,762,840	$26,136

Note: * owners are not interested on selling

The topographic data based on the 2018 LiDAR was used to estimate the average ground elevation of the parcels, which is added as a column in Table 1. Parcels with the lowest ground elevation in the range from 2.1 to 2.2 ft NAVD88 (i.e., parcels 106FEE, 107FEE, 108FEE, and 111FEE) are composed mostly of wetland areas that would be important to preserve as part of the flowway, but the owners may not be interested in selling. In particular, the owner of the parcels 106FEE, 107FEE, and 108FEE informed the County's acquisition team on 12/14/22 that a building permit was issued recently to construct another home. However, the County's Growth Management Department could not find any record of recent building permit approved for those parcels during a call on 3/22/23.

Parcel 107FEE has a structure built on it. In order to preserve the wetland area located at the west portion of the parcel and to assure connectivity to the wetlands north and south from the parcel, it is recommended the lot to be split and the undeveloped portion of the lot be acquired.

Parcels 104FEE and 113FEE with ground elevations ranging from 2.4 to 2.5 ft NAVD88 also contain substantial wetlands areas. Preserving the wetlands in these parcels will provide connectivity to the flowway path between County owned parcels 114FEE and 102FEE. Moreover, the south parcels 103FEE

[6] https://www.collierappraiser.com/

and 124FEE located on the east side of Auto Ranch Road contain wetlands (in about half of the parcel area) that are part of the flowway. On the east side of Auto Ranch Road, parcels 101FEE (north), 102FEE, 105FEE, 106FEE, 107FEE, 108FEE, and 109FEE form a connected wetland system that is part of the flowway.

The south portion of parcel 125FEE is a wetland that is connected by a ditch to the parcel 101FEE. There are also connected wetlands areas on the north side. If a negotiated purchase can be achieved for the south portion of parcel 125FEE, the area could be connected to the ditch that runs along the west side of Lake Park Blvd by installing a new cross pipe. A south berm could be built to isolate surface water in the 125FEE wetland area from the south areas. Thus, surface water in the 125FEE wetland area could be maintained at the same control elevation as the surface water west of Lake Park Blvd.

It should be mentioned that acquiring parcels with some portion of upland areas is also beneficial for the restoration since those elevated areas would provide habitat for wildlife during the wet season.

In summary, based on the existing ground elevations of the parcels, the location of the existing and planned residential structures, and the need for wetland preservation/restoration and flowway connectivity, it is recommended the acquisition of nine (9) parcels: 101FEE north, 103FEE, 104FEE, 105FEE, 106FEE, 108FEE, 111FEE, 113FEE, and 124FEE. It is also recommended to acquire wetland areas in portion of two (2) parcels: 107FEE and 125FEE via lot split. Since parcel 109FEE is owned by Fiddler's Creek Development, it is recommended a share easement agreement be pursued for utilizing the parcel for wetland preservation/restoration and flood displacement. The coverage of the County owned parcels plus the parcel areas recommended for acquisition or to utilize by easement agreement for the flowway preservation/restoration is shown in **Figure 3**.

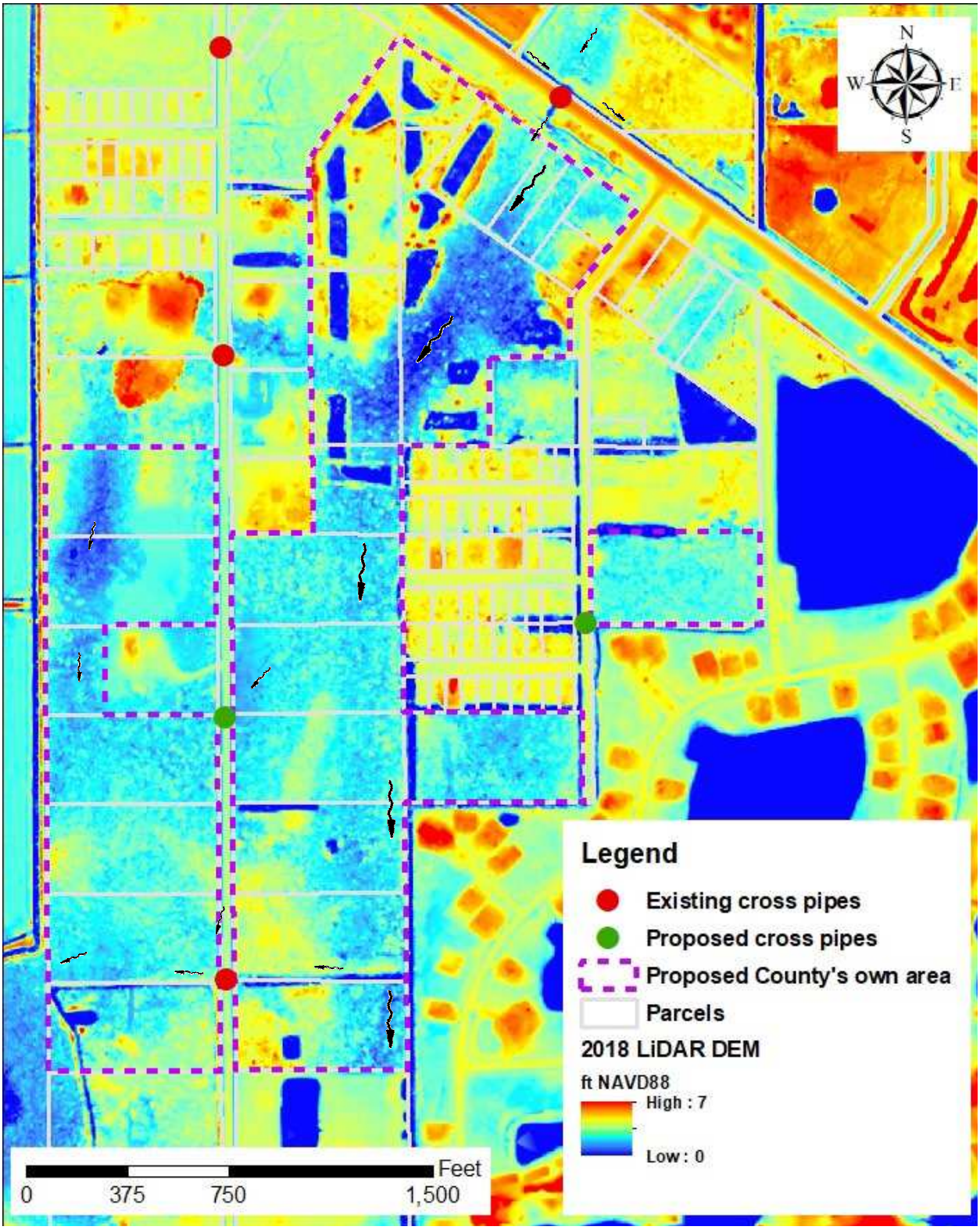

Figure 3. Area of parcels owned by the County plus the ones recommended to acquire or to utilize by easement agreement.

Land Acquisition Costs

Table 2 summarizes recent relevant purchases of parcels. From this table, it is apparent that the sale price has ranged from $30k to $90k per acre. Since the parcels listed in Table 1 are not located directly adjacent to US-41, it is likely that a up-to-date fair price of an undeveloped parcel is around $46k/acre, which is almost twice the 2022 Market Values of about $24k/acre from Table 1.

Table 2. Recent relevant purchases

Parcel No.	Folio No.	Purchased by	Purchase date	Area acres	Sale price[6]	
					$	$ / acre
102FEE	768880009	Collier County	6/15/22	4.8	$220,000	$45,833
109FEE	764320000	Mark J Woodward Trust[7]	1/10/20	4.8	$117,500	$24,479
110FEE	765720007	Collier County	8/5/21	4.8	$144,200	$30,042
112FEE	769000008	Collier County	8/2/21	4.8	$144,200	$30,042
114FEE 115FEE 116FEE 117FEE 118FEE 119FEE 120FEE 121FEE 122FEE 123FEE	766160006 766080005 764400001 766120004 760040009 767200004 764000003 770080208 766320008 766280009	Collier County	8/11/22	30.0	$ 1,850,000	$61,667
	760160002	Greater Naples Fire Rescue	6/20/22	8.8	$790,000	$89,773

[7] Mark J. Woodward is a real estate attorney and the Director of Fiddler's Creek Management Inc

Table 3 shows the estimated acquisition costs for the recommended parcels with a total area close to 50 acres, which give a total of around $3.6 millions.

Table 3. Costs of acquiring the recommended parcels by assuming $46k/acre.

Parcel No.	Folio No.	Owner	Parcel area (acres)	Area to acquire (acres)	Estimated value
101FEE North	767920009	Tooley, Karl J	4.81	4.81	$221,260
103FEE	766200005	Tran, Linh Nhat	4.80	4.80	$220,800
104FEE	768960000	Hsalkhli LLC	4.81	4.81	$221,260
105FEE	766440001	Herbello, Glenda	4.81	4.81	$221,260
106FEE	770080606	Baltazar, Jose	4.80	4.80	$220,800
107FEE	770080606	Baltazar, Jose	4.80	1.65 (split)	$75,900
108FEE	764240009	Baltazar, Jose	4.80	4.80	$220,800
109FEE	764320000	Fiddler's Creek	4.80	0 (agreement)	$0
111FEE	764440003	Naples Golf Club South LLC	4.80	4.80	$220,800
113FEE	764600005	Lemus, Carlos M & Gregoria L	4.80	4.80	$220,800
124FEE	767880000	Kulawik, Eugeniusz	4.80	4.80	$220,800
125FEE	765120005	Moore, John R	9.82	4.99 (split)	$229,540
		Total	62.65	49.87	$2,294,020
Condemnation and other acquisition expenses, assuming 57% of the land costs[8]					$1,307,591
				Total Acquisition Cost	$3,601,611

[8]On April 6, 2023, Lisa Barfield at the Transportation Engineering Division of Collier County estimated the condemnation costs and other acquisition expenses for five (5) parcels 101FEE North, 104FEE, 105FEE, 106FEE and 113FEE as 57 % of the land cost estimated as $46k/acre. This percentage was assumed for the other parcels.

Other Restoration Activities

Other restoration activities are also recommended to restore predevelopment hydrologic conditions in the project area, such as removal of exotic vegetation, re-grading disturbed areas, and measures to manage surface water elevations for enhancement of wetland hydroperiods and water quality.

Regrading Disturbed Areas

Parcels acquired by the County south of US-41 contain small ponds likely from an old fish farm operation, as shown on the left-hand side of **Figure 4**. The material excavated from the existing ponds was likely used as fill to elevate the average ground around the ponds and to isolate most of them from the flow way. Moreover, those parcel areas are mostly covered with exotic vegetation.

As part of the flow way restoration, it is recommended to regrade the parcel areas at two levels of elevation: 2 and 5 ft NAVD88, as shown on the right-hand side of Figure 4. The cut and fill volumes to create the proposed high and low elevated areas results in a net fill volume of 2,271 CY that must be hauled out from the site. This fill volume estimation based on the LiDAR DEM, however, does not consider the additional volume of debris and mulch generated from clearing the existing exotic vegetation. During the design phase of this project, the coverage of the proposed high-elevated areas could be reduced to increase the wetland area, which would result in a higher volume of fill available for use in other projects.

After the recommended regrading, flows entering through the US-41 culvert would be distributed via a deeper spreader swale with a proposed bottom elevation of 0 ft NAVD88. The flow would enter the extended 23.8-acre wetland to be treated for a travel path of about 1,600 feet. Water depth in the wetland area is expected to be around one foot for six to eight months of the year, which can support Florida native wetland vegetation (such as Cypress). Elevated areas on both sides of the flowway would have recreational value for residents and travelers along US-41. The berm recommended on the west and the south boundaries could be used for maintenance vehicles along the perimeter and would prevent offsite impacts. Control structures are recommended at the south berm to control water levels in the wetland above 2.9 ft NAVD88, which is not expected to create a backflow effect at the US-41 culvert during the wet season.

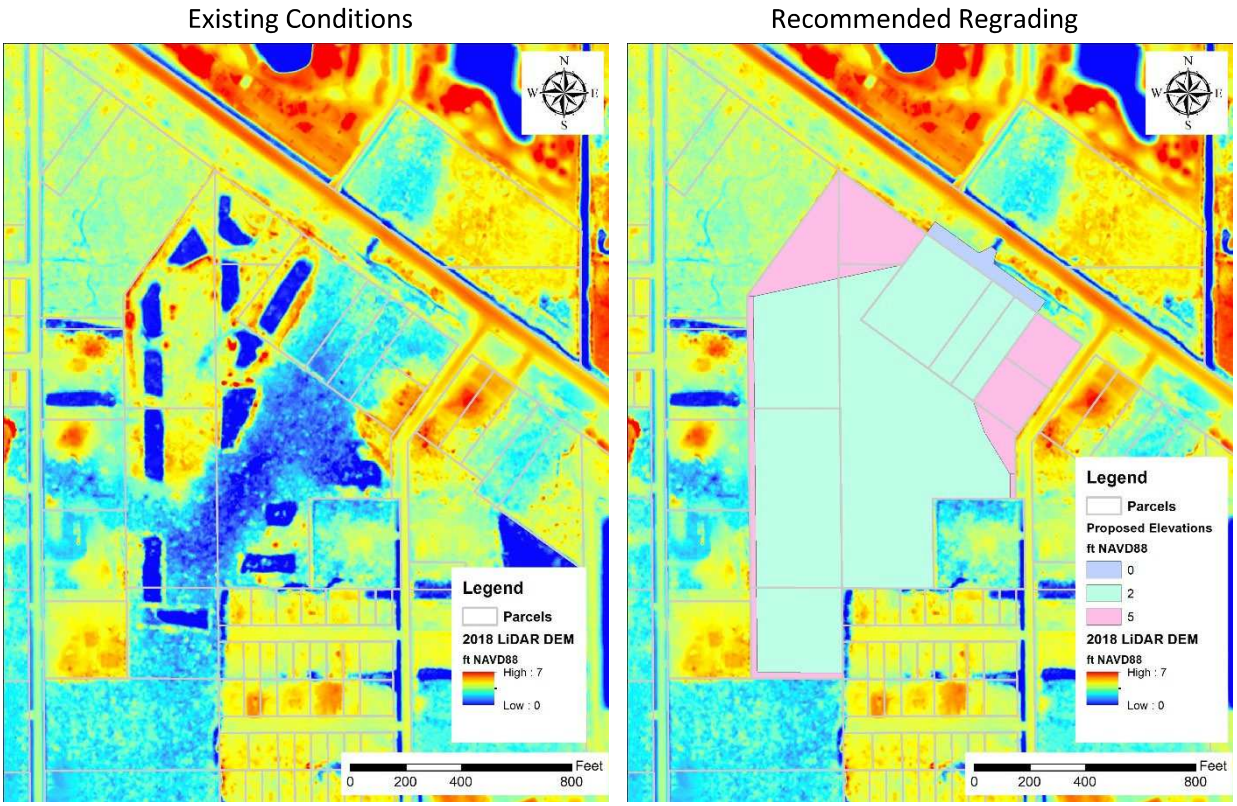

Figure 4. Existing elevations and recommended regrading south of the US-41

Filter Marsh Design

The recommended 23.8-acre wetland shown as cyan colored area on the right-hand side of Figure 4 would function as a filter marsh.

Filter marshes can accomplish numerous functions. Regional filter marshes can serve water management functions such as attenuation of peak flood stages and retention for water quality improvements. They also can serve as passive recreational parks for the community and provide beneficial ecological functions for wildlife. They can be valuable foraging habitats for wading birds if properly designed. A properly designed filter marsh can provide all these functions.

Fish traps can be created easily and cost effectively within the filter marsh system. They are elongated depressions approximately 12 to 24 inches deep scattered throughout the filter marsh. When the water level drops during the dry season, these depressions will trap small fish and become suitable foraging areas for wading birds. These areas should have low canopy coverage. Canopy should be sparse (less than 30 % coverage) for the wading birds to take flight quickly to avoid predators.

Plant species suggested for the filter marsh area are listed in **Table 4**. One or two trees and approximately five to six ground cover species should be selected based on cost and commercial availability.

Table 4. Vegetation recommended to be planted at the filter marsh area.

Common Name	Scientific Name	Water depth below control elevation[9]
Trees		
Bald cypress	*Taxodium distichum*	2 - 3’
Pop ash	*Fraxinus caroliniana*	3‘ or deeper
Pond apple	*Annona glabra*	3‘ or deeper
Shrubs		
Buttonbush	*Conocarpus erectus*	1 - 2’
Ground cover		
Redroot	*Lanchnanthes caroliniana*	0 - 1’
Sand cordgrass	*Spartina bakerii*	0 - 1’
Fakahatchee grass	*Tripsacum dactyloides*	0 - 1’
Maidencane	*Panicum hemitomon*	1 - 2’
Waterhyssops	*Bacopa caroliniana*	1 - 2’
Spikerush	*Eleocharis interstincta*	2 - 3’
Muhley grass	*Muhlenbergia capillaris*	0 - 1’
Canna lily	*Canna flaccida*	1 - 2’
Swamp lily	*Crinum Americanum*	1 - 2’
Pickerelweed	*Pontederi cordata*	1 - 2’
Arrowhead	*Sagittaria lancifolia*	1 - 2’
Fireflag	*Thalia geniculata*	3 ‘ or deeper
Sawgrass	*Cladium jamimaicense*	2 - 3’
Soft-stemed Bulrush	*Scirpus Validus*	2 - 3’
Leather fern	*Acrostichum danaeifolium*	3‘ or deeper

Proposed Measures to Control Surface Water Levels

Figure 5 summarizes the water control structures recommended for the project area. As mentioned in the previous section, the recommended regrading in the parcels south of the US-41 culvert creates an opportunity to control water levels at 2.9 ft NAVD88 in those parcels without creating a backflow effect at the US-41 culvert during the wet season (as can be inferred from **Figure 6**). The wetland area would discharge through two drop box structures located at the south berm. Since the filter marsh would also be connected to the road ditch on the west side of Lake Park Boulevard, a fixed concrete weir with crest elevation of 2.9 ft NAVD88 it is recommended near the south end of the road ditch (see sketch of the weir in **Figure 7**).

[9] Design Guidelines for County required Littoral Shelf Planting Area (LSPA). Collier County Pollution Control, June 2021.

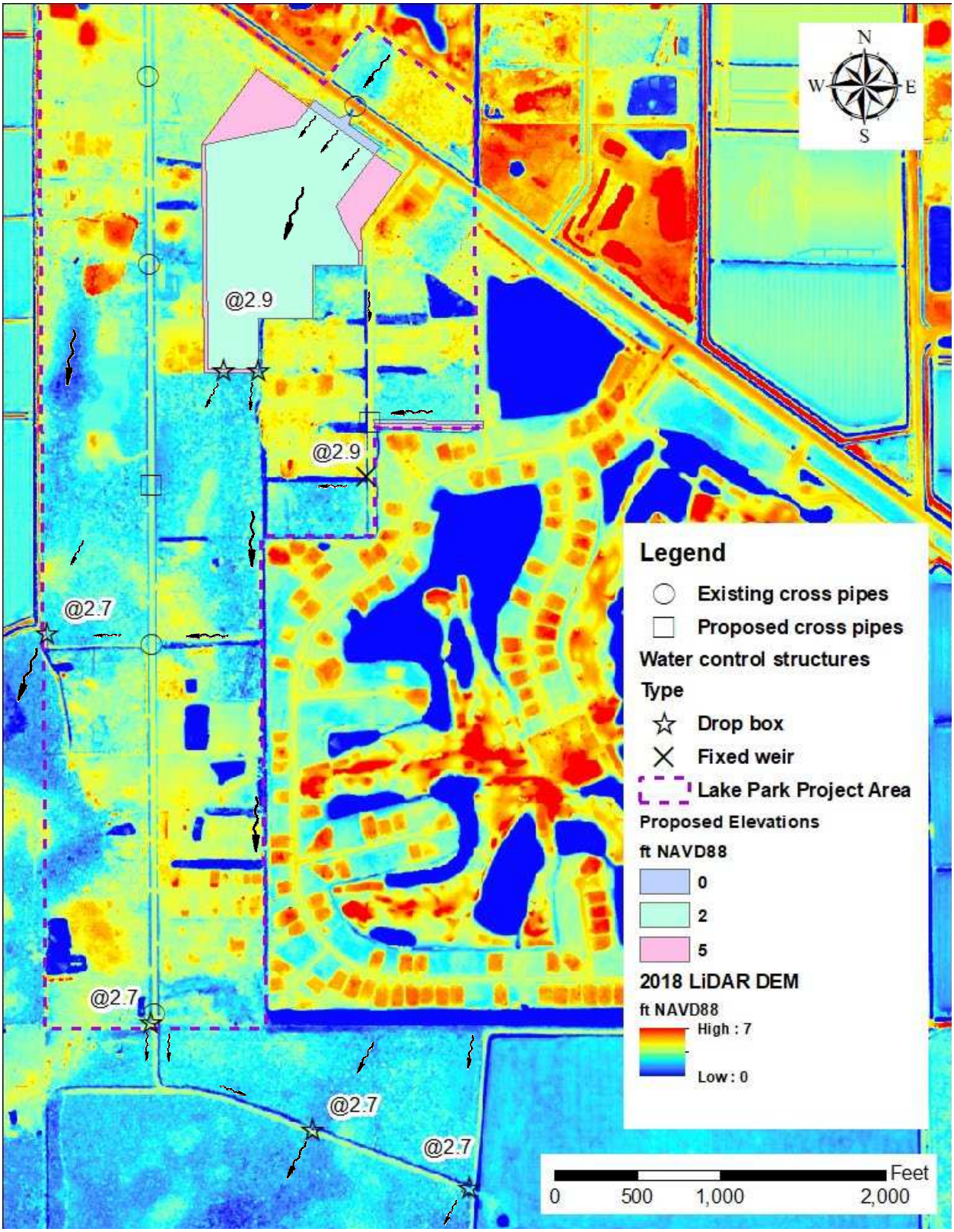

Figure 5. Proposed measures to control water levels.

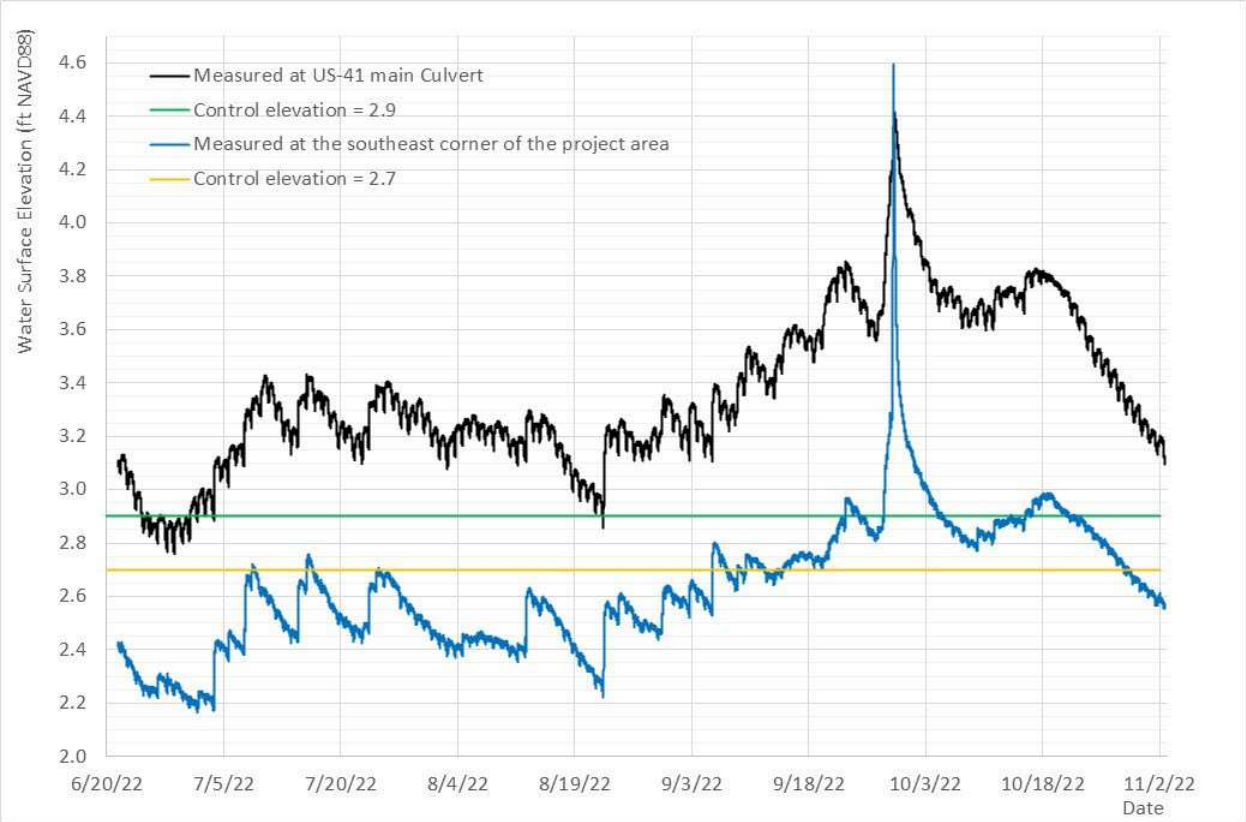

Figure 6. Measured water levels at the project site versus proposed control elevations.

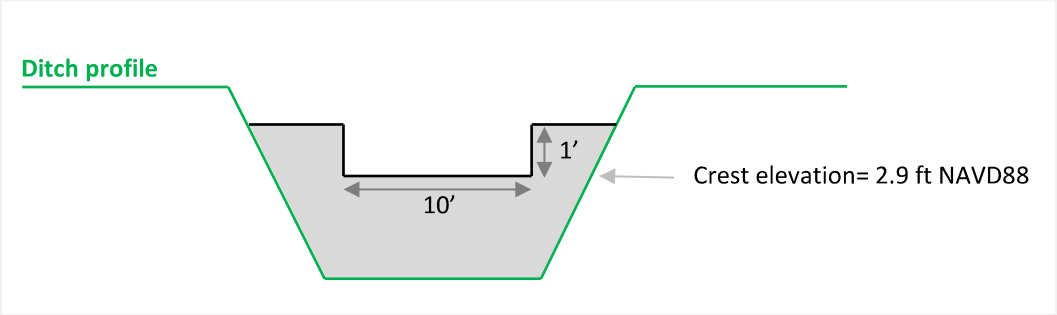

Figure 7. Sketch of the fixed concrete weir proposed near the south end of Lake Park Blvd.

Downstream of the areas controlled at 2.9 ft NAVD88, four additional drop box structures are recommended to control water levels at 2.7 ft NAVD88, as shown in Figure 5. **Figure 8** shows the water depth at control elevation, as estimated from the 2018 LiDAR DEM.

In general, the recommended water control structures would not only maintain and improve the wetland hydroperiods in the project area, but they would also increase the retention or residence time of the primary pollutants in stormwater, and consequently, enhance the water quality treatment of the discharges into the Outstanding Florida Waters of the Rookery Bay Estuarine Reserve.

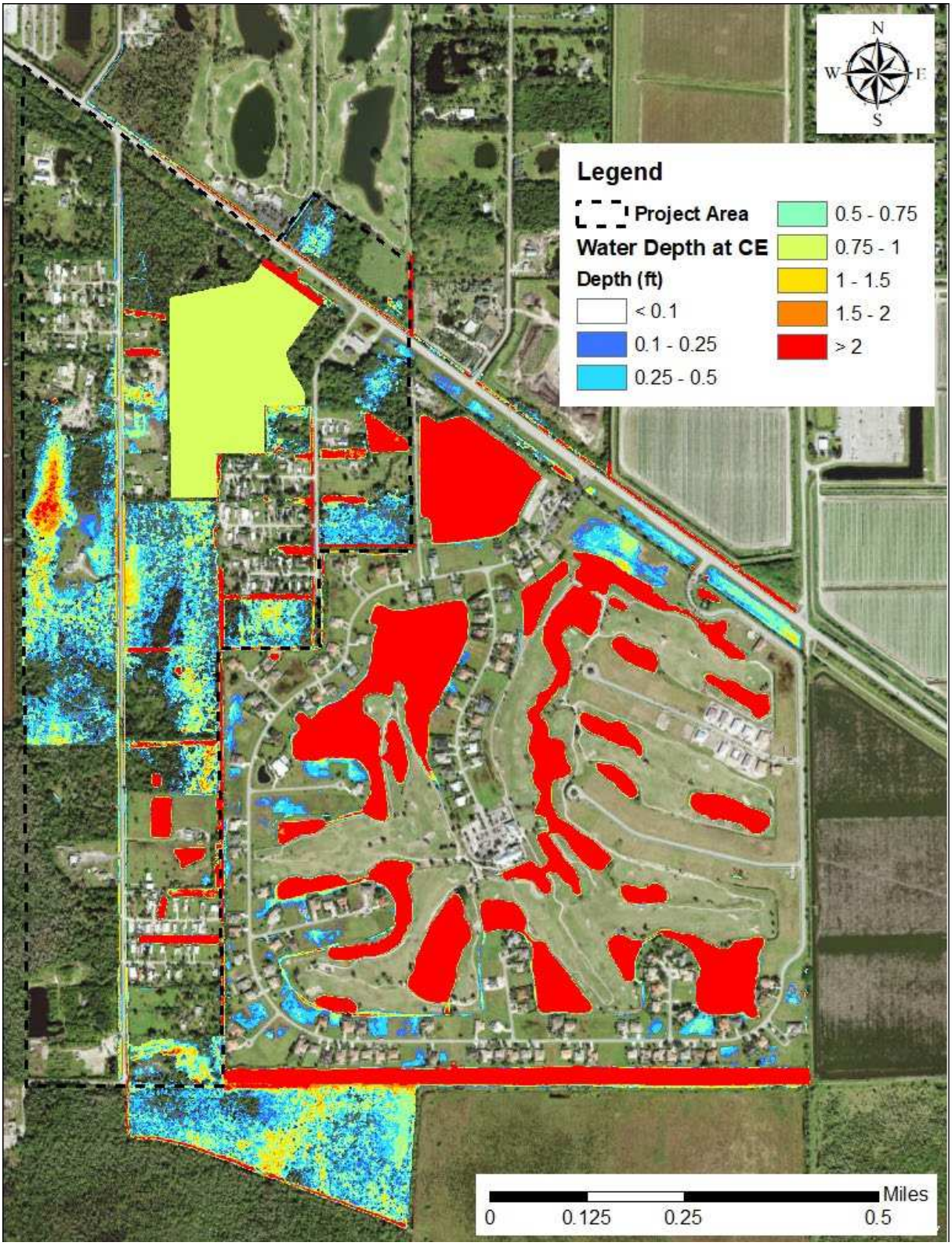

Figure 8. Water depth at proposed control elevations (CEs) in Figure 5.

From the types of permitting listed in Task 5 TM, it is likely that an individual permit will be needed during the design phase for the roadway improvements in the project area. The application for an Environmental Resource Permit with the SFWMD may require that the runoff from the improved roadway is treated before being discharged into the wetlands in the flowway. This treatment could be achieved by isolating the segments of the ditches along the roads for collecting the road runoff and discharging into the wetlands only above certain water elevation. The sketch below shows a case of cross pipes at Auto Ranch Road that connect the wetlands on both sides of the road. In this sketch, the runoff collected from the road into the ditches is discharged via weir into the flow way.

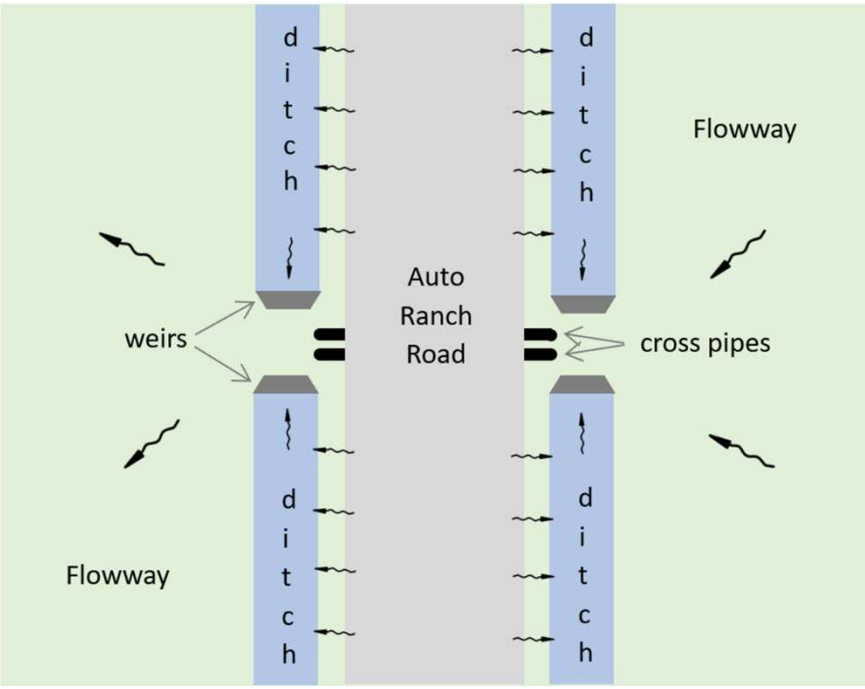

Figure 9. Sketch of cross pipes at Auto Ranch Road in the case that the ditches are used for water quality treatment of the road runoff.

Existing ditches at lower ground elevated areas may need to be converted into two parallel ditches: the one closest to the road for Water Quality (WQ) treatment and the other to preserve the existing drainage/flow path in the areas adjacent to the road.

If the County chooses to move forward with the enclosed drainage system along Auto Ranch Road, ponds or retention areas may be required to treat the runoff collected from the road. Some parcels proposed to be acquired by the County contain portions of elevated areas that could be used to build a pond or retention area.

The use of some of the existing ditches in the project area only for WQ treatment may slightly change the way that the surface water flows. Thus, for example, it is possible that additional weirs controlling at 2.9 ft NAVD88 may need to be added at the west berm of the proposed filter marsh.

The specific sizes and locations of the road runoff WQ treatment features have not been configured at this time, and hence, the probable costs associated with these elements were not estimated.

Probable Costs of Conversion to an Extended Filter Marsh

The probable costs of clearing the existing vegetation, regrading, and planting new vegetation in the area on the right-hand side of Figure 4 are presented in **Table 5**. This table also includes the costs of the three (3) hydraulic structures recommended to control the discharge from the filter marsh.

According to the cost estimates in Table 5, converting the County parcels south of US-41 to a native-vegetated area (as outlined in the right-hand side of Figure 4) with an extended wetland (or filter marsh) with controlled water levels would cost around $2.6 millions.

Table 5. Probable costs of clearing, regrading, and planting the area on the right-hand side of Figure 4, as well as creating the outlet hydraulic structures.

Item	Quantity	Unit	Unitary cost ($)	Cost ($)
Clearing existing vegetation leaving mulch on site[10]	30.7	Ac	16,000	491,200
Earth work (cut + fill) as estimated from the 2018 LiDAR DEM	72,254	CY	15	1,083,810
Planting native vegetation in high-elevated areas • Upland trees: size= 3G, 15-ft spacing, area= 5.4 acres, berm length= 1,800 ft. • Upland shrubs: size= 1G, 3-ft spacing, area= 1.1 acres • Upland groundcover: size= LR/BR equivalent, 3-ft spacing, area= 5.2 acres	1	LS	1	144,000
Planting native vegetation in filter marsh area • Marsh groundcover: size= LR/BR equivalent, 3-ft spacing, area= 23.8 acre.	1	LS	1	266,000
Dropbox structure at the south berm controlling water levels at 2.9 ft NAVD88 at the filter marsh: • Furnish & Install Type H DBI w/Concrete Weir and 3'-4.5" x 6'-4.625" Grate (Includes 60' of 24" HDPE)	2	EA	38,100	76,200
Vertical concrete weir near the south end of Lake Park Boulevard controlling water levels at 2.9 ft NAVD88 at the west side ditch, as sketched in Figure 7.	1	EA	10,000	10,000
Cross pipe (2 x 24" RCP) at Lake Park Blvd to connect east wetland at the south portion of parcel 125FEE	74	LF	130	9,620
Earth work to build the berm along south boundary of parcel 125FEE	3,667	CY	15	55,005
			Sub total	2,135,835
Contingencies	20	%	—	427,167
			Total	**2,563,002**

[10] Approximate price of $12k/acre was provided by local company: OC Land Clearing, LLC. Need to see site for better price estimation. Price negotiable. Contact info: Orlando Camacho, (863) 673-6632. Estimated price for county vendors was assumed as $16k/acre.

Removal of Exotic Vegetation

The present habitats along Auto Ranch Road and Lake Park Blvd were examined. Both wetlands and upland habitats are infested with exotic vegetation throughout the entire area. The dominant exotic plant is Brazilian pepper. Other exotics identified include Melaleuca, ear leaf acacia, Java plum, Australian pines, air potato, wedelia, and old-world climbing fern. Other species, mostly nuisance plants such as primrose and Carolina willows, were also identified.

It is recommended that the exotics along all swales and drainage ditches are physically removed, and the stumps treated. The removal of exotics along swales and drainage ditches will reduce leaf litter and help prevent blockage with improved water quality and habitat functions.

Section 3.05.08 of the Collier County Land Development Code includes the County's requirement for Removal of Prohibited Exotic Vegetation. This section of the code provides a comprehensive list of prohibited exotic vegetation species and corresponding control measures.

The following outlines our recommendations for the area along Auto Ranch Road.

- Exotic vegetation removal and maintenance shall require that all FLEPPC Category I exotics be removed along all swales and ditches. All exotics within the first 30 feet of the outer edge along all swales, ditches should be physically removed or cut to grade and the stump treated with an approved herbicide. Exotics further than 30 feet should be treated in place, to minimize any impacts to the habitat. The reason for physical removal is to reduce detritus from dying vegetation from falling into the swales.
- Maintaining the swales and ditches free from exotics will help prevent the spread of seeds via the stormwater system. In addition, as previously stated, this will help the transmission of water and improve water quality. Exotic vegetation unabated may potentially clog, impede, and reduce the quantity of water flow.
- When prohibited exotic vegetation is removed but the base of the vegetation remains, the base shall be treated with an approved US EPA approved herbicide with a tracer dye.
- All exotic vegetation shall be poisoned with an approved herbicide (poison) and a tracer dye. Exotic control is recommended to be conducted on an annual basis or more frequently when required. Non-native and nuisance plants as well as prohibited exotics are recommended to be removed from the Rights-of-way in perpetuity. This should be done under the supervision of an Environmental Professional.
- Arsenal herbicide is a non-selective herbicide that contains the active ingredient Imazapyr[11]. It is recommended that this poison NOT be used. There is a tendency for this chemical to leach out into the soil killing non targeted species. It is recommended that Garlon 4A[12] be used.

Probable Costs of Exotic Vegetation Removal

We have reached out to three reputable companies that remove and control exotic vegetation. All three have requested not to use their names and price quotes due to competitive bidding. All three stated that cutting and hauling debris increases the cost versus treating in place. As previously stated, we recommend that at least the first 10 yards (30 feet) be cut, treated, and the debris hauled off.

[11] See for example https://www3.epa.gov/pesticides/chem_search/ppls/000228-00570-20100104.pdf
[12] See for example https://www3.epa.gov/pesticides/chem_search/ppls/062719-00527-20080414.pdf

Two of the three companies are local. One company is not from this area but performs work in Collier County.

Company A is a local company. They stated that treating in place is cheaper than cutting and hauling off the debris. Their cost was $2,500 - $5,000 per acre.

Company B is a local company. They stated that a fair price would be around $3,000 - $5,000 per acre for the perimeter removal and $300 - $500 per acre for interior Kill in Place. They would add another $1,000 - $1,500 per acre fee for disposal of any horticultural debris from the perimeter removal.

Company C is not a local company, but they perform work in this County. They stated that a good average number for exotic vegetation removal is between $2,500 to $ 5,000 per acre.

The exotic coverage is ranked in four classes as E1 (0-25%), E2 (26-50%), E3 (51-75%) and E4 (76-100 %). The prices per acre as provided above correspond to an exotic coverage rank between E1 and E2. Moreover, those prices are competitive private rates and not rates from the Collier County contract vendors for exotic vegetation removal. County vendors have insurance and other responsibilities that may increase the costs.

The Florida Land Use Cover Classification System (FLUCCS) map produced as part of Task 1 of this project is reproduced in **Figure 9**. The label and description of each code were included in Table 9 in the Technical Memorandum for Task 1. Codes in the six hundreds correspond to wetland vegetation. However, there are only four wetland vegetation codes in the flowway, which are 617, 618, 619, and 621.

Table 6 shows the coverage rank of exotic vegetation assumed in the wetland vegetation classes for cost estimation purposes. The cost of exotic removal per acre is also included in this table for the cases of cutting and hauling off and of treating in place.

Table 6. Rank of exotic vegetation coverage in wetland vegetation classes and costs of removal

FLUCCs Code	Label	Exotic Coverage Rank	Cost of cutting and hauling off ($/acre)	Cost of treating in place ($/acre)
617	Mixed Hardwoods Wetland	E3 (51 -75 %)	15,000	1,500
618	Willow (nuisance)	E1 (0 – 25 %)	5,000	500
619	Wetland Exotic Melaleuca	E4 (76 - 100 %)	20,000	2,000
621	Cypress	E3 (51 – 75 %)	15,000	1,500

For the County owned parcels just south of US-41, it is recommended to regrade the area to convert it into a filter marsh, as detailed in the previous section. During this regrading process, all exotic vegetation would be reduced to mulch and become part of the organic soil. However, for other wetland areas with exotic vegetation (as shown in **Figure 10**), it is recommended to cut and haul off all exotic vegetation within 30 feet of swales and ditches, and outside of the 30 feet distance, treating in place with an approved herbicide. The estimated costs for removing exotic vegetation are detailed in **Table 7**, which give a total of around $220k.

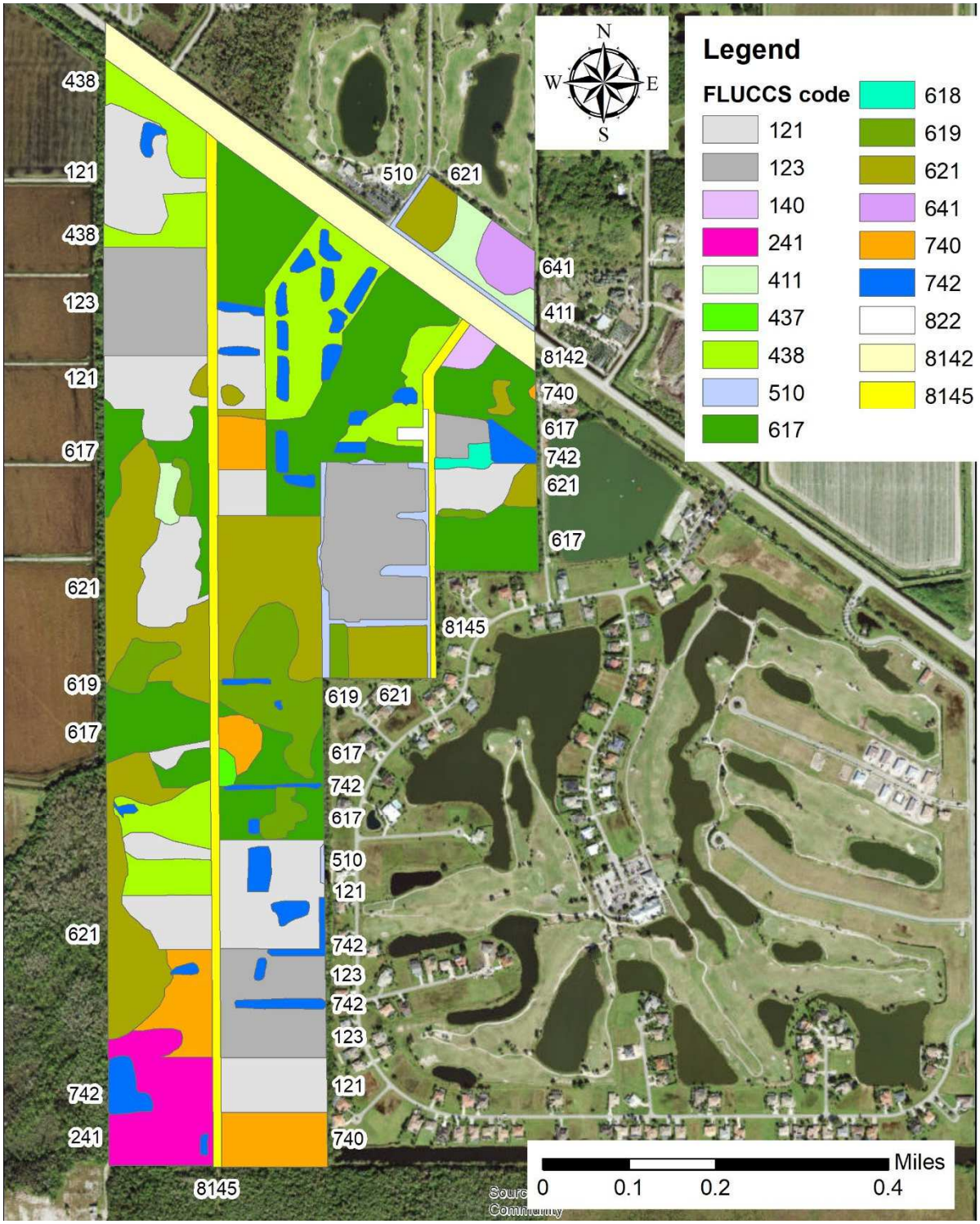

Figure 10. Land use classification map from this study.

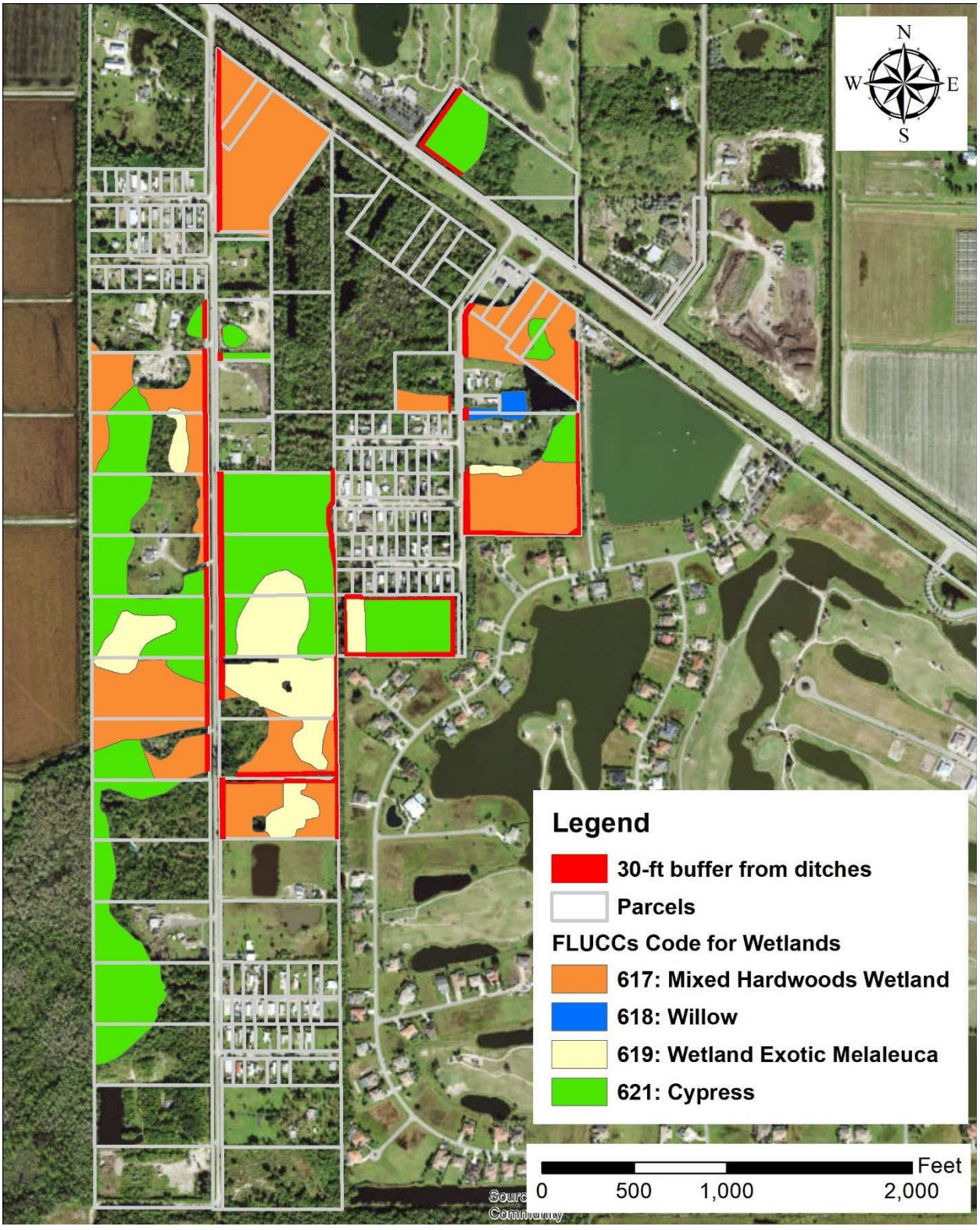

Figure 11. Wetland areas subject to removal of exotic vegetation.

Table 7. Probable costs of removing exotic vegetation in the wetland areas shown in Figure 10.

Parcel Ownership	Area (acres)	Area within 30-ft from swales and ditches?	Wetland vegetation code	Wetland area (acres)	Cost of removal per acre from Table 6	Cost of removing Exotic vegetation
Collier County and Greater Naples Fire Rescue	16.10	Yes	617	0.13	15,000	$15,557
			619	0.00	20,000	
			621	0.91	15,000	
		No	617	2.64	1,500	$24,267
			619	3.34	2,000	
			621	9.08	1,500	
Private parcels recommended to be acquired by Collier County	19.58	Yes	617	0.17	15,000	$15,498
			619	0.17	20,000	
			621	0.64	15,000	
		No	617	3.90	1,500	$30,617
			619	5.41	2,000	
			621	9.29	1,500	
Other private parcels	53.30	Yes	617	2.80	15,000	$58,595
			618	0.05	5,000	
			619	0.23	20,000	
			621	0.79	15,000	
		No	617	27.12	1,500	$75,357
			618	0.72	500	
			619	3.84	2,000	
			621	17.76	1,500	
Total	88.98	—	—	88.98	—	**$219,892**

Summary of Probable Costs

The summary of all the probable costs for the all the improvements features recommended for this project is presented in **Table 8**, which gives a total of around $30 millions. All recommended improvement features for roads, septic-to-sewer conversion, stormwater management, and restoration of the historic flowways are integral to the overall achievement of the objectives of the Lake Park Area Improvement project.

Table 8. Summary of probable costs for all the improvements proposed in this project.

Included in:	Description of proposed improvement	Costs ($)
Task 3 TM, Table 8	Drainage improvements, which included four new drop box structures, pipe replacements and new pipe installations.	876,575
Task 4 TM, Tables 6.5.1 and 6.5.2	New potable water distribution systems to the Auto Ranch Road and Lake Park Boulevard areas.	1,869,875
Task 4 TM, Tables 6.1 and 6.3	Septic to Sewer Conversion, which considers the combination of gravity sewer and low-pressure system on Auto Ranch Road and the traditional gravity system on Lake Park Boulevard Area. This will eliminate all septic tanks in the project area.	10,278,309
Task 5 TM, Appendix D	Road upgrades, which include widening and raising the roadways, constructing a defined shoulder and swales, and a sidewalk on Auto Ranch Road.	10,330,778
Task 6 TM, Table 3	Land acquisition of parcels in the flowway	3,601,611
Task 6 TM, Table 5	Regrading disturbed areas just south of US-41 and planting native vegetation to build a filter marsh.	2,563,002
Task 6 TM, Table 6	Removal of Exotic vegetation in wetlands.	219,892
	Total	**29,740,042**