# COOPER CREEK WATERSHED MODEL UPDATE AND MAINTENANCE

Sarasota County | December 2023

# COOPER CREEK WATERSHED MODEL UPDATE AND MAINTENANCE

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# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# APPENDICES

# 1 PROJECT BACKGROUND

One of Sarasota County's goals is to effectively manage stormwater to minimize damages from flooding and to improve water quality and natural systems for the region. To achieve this goal, the County develops and implements watershed management plans (WMPs). The WMPs provide a framework for the County to model the flooding response of the watershed, identify areas at risk, and develop capital improvements projects aimed at mitigating the flood risks and improving the water quality and natural systems. The stormwater model also helps the County to regulate development within the watershed and gives developers a tool to create designs that will not adversely impact the surrounding areas.

## 1.1 AUTHORIZATION

Sarasota County contracted Jones Edmunds to conduct specific tasks of the WMP for the Cooper Creek Watershed. Tasks for this work are subject to the terms and conditions of Sarasota County Contract No. 2020-099 and Purchase Order No. 201552.

## 1.2 PROJECT LOCATION AND GENERAL DESCRIPTION

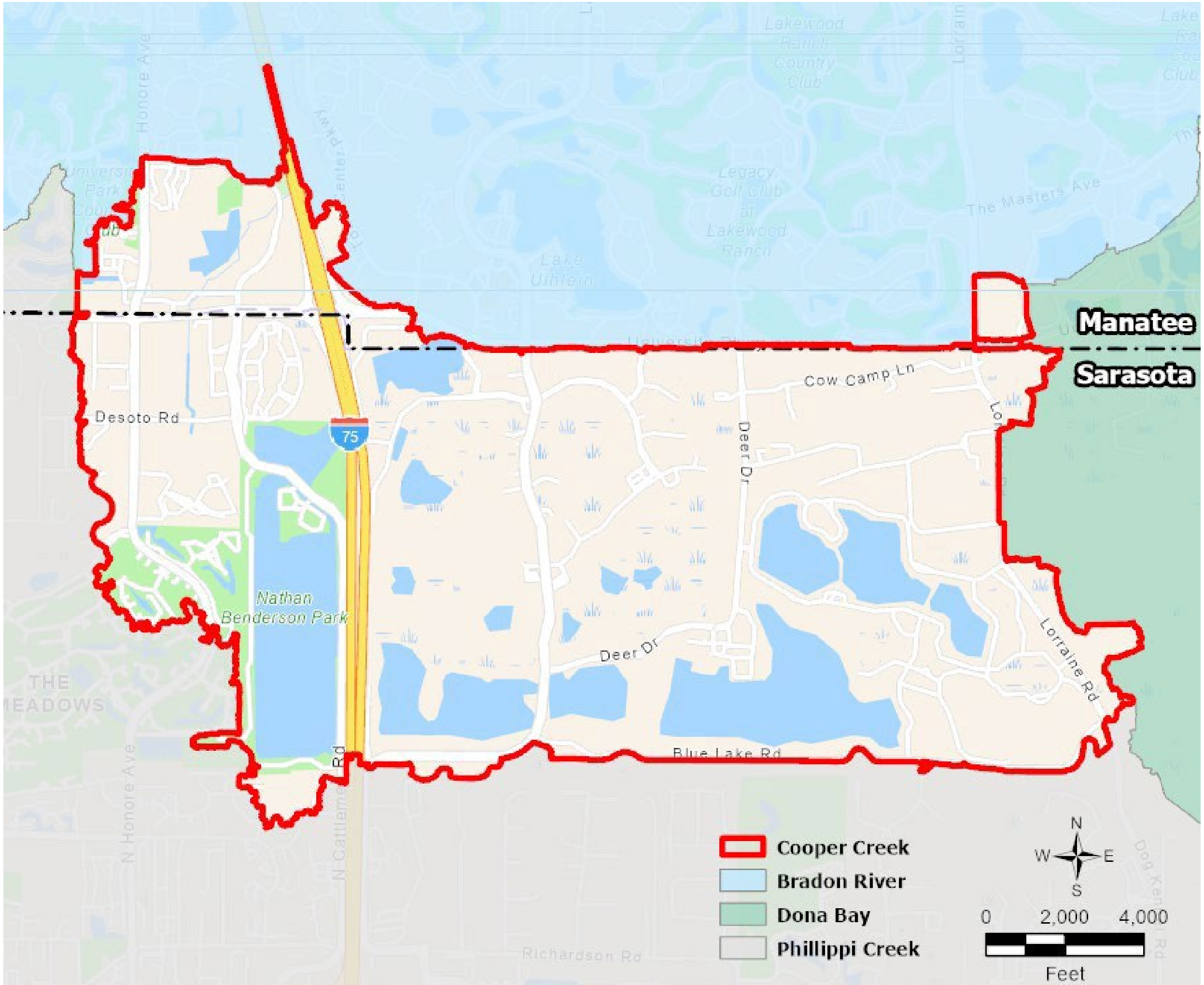
Before this project, the Cooper Creek Watershed did not have a County-approved regulatory watershed model. The watershed was part of the larger Braden River drainage basin, for which the Southwest Florida Water Management District (SWFWMD) developed a watershed scale stormwater model in 2013 as part of their Watershed Management Program. The Braden River Watershed is approximately 59 square miles and the Sarasota County portion is approximately 10 square miles. The Sarasota County area primarily drains via Cooper Creek, which leaves the County by crossing University Parkway approximately 3,500 feet west of Interstate 75.

The Cooper Creek Watershed includes the north portion of Sarasota County that does not drain to Phillippi Creek or Dona Bay. Therefore, the extent of the Cooper Creek Watershed within the County resides between the County boundary to the north, the Phillippi Creek Watershed to the south and west, and the Dona Bay Watershed to the east. Figure 1-1 provides the location map and surrounding watersheds.

North of the County boundary, Cooper Creek continues until joining with Braden River. To best account for potential tailwater impacts from Braden River within the County limits, Jones Edmunds extended the Cooper Creek model extent north of the County boundary to the where Cooper Creek crosses Interstate 75, which is approximately 0.5 mile north of University Parkway.

The area is characterized by freshwater marshes, reservoirs, and open land. The area also has a large mix of commercial, industrial, institutional, and high-density residential land uses. Significant new developments have occurred since the last time the area was modeled. Site-specific stormwater models have also been developed for multiple phased developments in the Cooper Creek Watershed, commonly referred to by the County as Master Development Plan (MDP) stormwater models.

Figure 1-1 Project Location and Adjacent Watersheds




## 1.3 Purpose and Objectives

The Cooper Creek WMP provides a framework for the County to regulate development, to develop capital improvement projects to mitigate flood risks, and to provide a tool for developers to ensure new developments do not adversely impact surrounding areas. The project expanded on the previous work completed for the area by developing a stormwater model using the latest data available from Environmental Resource Permit (ERP) plans, field site visits, new light detection and ranging (LiDAR), and other datasets. Jones Edmunds delineated floodplain areas using the results of the model and determined the flood protection level of service (FPLOS) for roadways and structures. Our specific activities for this project include:

- Convert the previous data and models to the latest Geographic Watershed Information System (GWIS) Version 2.1 database and Interconnected Channel and Pond Routing Version 4 (ICPR4).
- Conduct a hydrologic and hydraulic (H&H) feature inventory.
- Conduct a field reconnaissance and survey of hydraulic structures to determine physical characteristics, including structure type, dimensions, elevations, etc.
- Develop the model schematic.

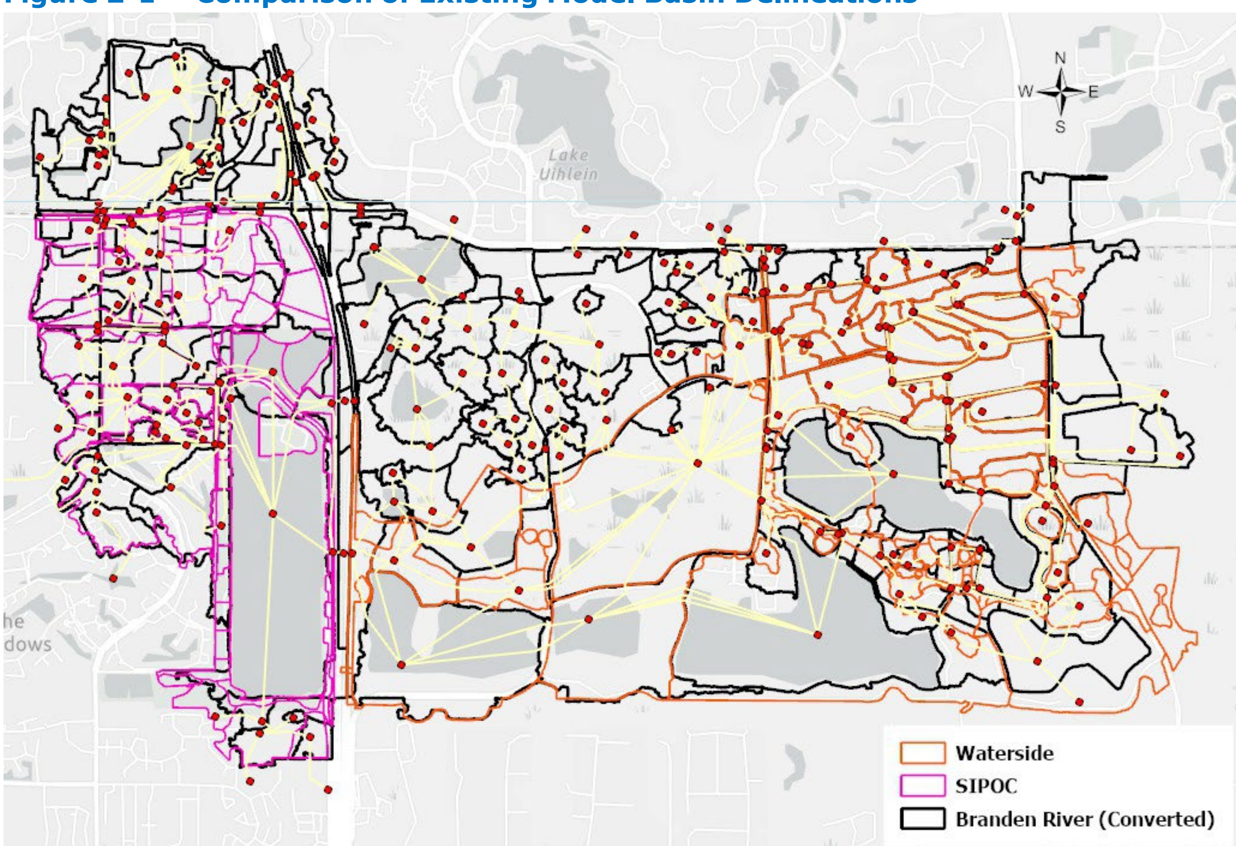
- Use the collected information to parameterize a stormwater model.
- Perform a floodplain analysis, including calibrating and verifying the results of the stormwater model.
- Map the inundated areas.
- Determine the FPLOS for roadways and structures.

# 2 DATA CONVERSION

The Braden River Watershed Model was developed by Singhofen and Associates, Inc. (SAI) for SWFWMD. Although SAI's work was completed in 2013, the date certain for the Braden River model is 2004. The model elevation data are relative to the North American Vertical Datum of 1988 (NAVD88) and were developed for ICPR Version 3 (ICPR3) with related geographic information system (GIS) data in a modified GWIS Version 1.6 format. Jones Edmunds imported the Braden River Watershed Model GIS data for the Cooper Creek Watershed into a GWIS 2.1.2 schema geodatabase. The SWFWMD GWIS 2.1.2 schema is designed to work with ICPR4 and will be the database schema used for the remainder of the project.

Three MDP models have been created for land development and permitting within the Cooper Creek Watershed – namely the Sarasota Interstate Park of Commerce (SIPOC), Waterside, and Lakewood Ranch Corporate Park. Although these models will be used for reference data during subsequent tasks, the model data were not directly included in the data conversion for Cooper Creek. Figure 2-1 provides a comparison of the modeled basins.

**Figure 2-1 Comparison of Existing Model Basin Delineations**



# 3 HYDROLOGIC AND HYDRAULIC FEATURE INVENTORY

## 3.1 Modeling Approach

The County manages stormwater runoff and flooding resulting from the 100-year/24-hour design storm and expects that models will be developed to accurately simulate design storms up to and including the 500-year storm. Jones Edmunds plans to develop the Cooper Creek Watershed Model to characterize H&H responses at an intermediate scale with minimal local-scale modeling.

The LiDAR-derived digital terrain model (DTM) recently developed for the Florida Department of Emergency Management (FDEM) 2018 to 2019 Statewide LiDAR Project will be used as the project DTM and is the basis of model development for this project. Two DTMs were downloaded from the US Geological Survey (USGS) website on September 28, 2021, for Sarasota County and Manatee County. A project DTM with extents generally limited to the model watershed area is provided with this deliverable and is named Cooper2018. The project DTM includes data from the Sarasota County and Manatee County DTMs.

### 3.1.1 Date Certain

The project DTM was used to derive basin delineations, storage, overland weir elevations, and other parameters during model development. The ground conditions reflected by these data were used to establish the date certain for the Cooper Creek Watershed Model, which was December 2018.

An existing stormwater model in adjacent Manatee County was incorporated into the Cooper Creek Watershed Model to better represent the interaction between Cooper Creek and the downstream effects of Braden River.

### 3.1.2 Ongoing Land Development

Land development within the watershed that was in progress or occurred after December 2018 was not accurately reflected in the project DTM. Areas within the project DTM that do not reflect current ground conditions are commonly referred to as *topovoids*. We identified potential topovoid locations by reviewing aerial imagery from 2017 and 2021. Land development visible in the 2021 imagery but not in the 2017 imagery are likely topovoid locations. The watershed dataset of the GWIS geodatabase named as TOPOVOID features provides the topovoid locations we identified within the Cooper Creek Watershed.

Watershed areas where land development was accurately represented in the project DTM were modeled in the developed condition. Areas where land development occurred after December 2018 (or is planned but has not yet occurred) and was not represented in the project DTM were modeled in the undeveloped condition. Model areas where land development was partially represented in the DTM (i.e., construction activities were on-going in December 2018), were modeled in the developed condition only if the associated stormwater managements systems (most notably stormwater ponds and/or floodplain compensation areas) were reasonably well represented so that model elements can be appropriately developed based on the project DTM. Table 3-1 lists the topovoid locations that we identified using available aerial imagery and our modeling approach.

**Table 3-1 Identified Topovoid Locations and Expected Modeling Approach**

| Development Name | Modeled Area | Modeling Approach |
|---|---|---|
| Waterside | 620 acres | Area was modeled in the developed condition. Stormwater ponds are well represented in the DTM. Final lot grading is not represented for some areas. |
| Waterside Neighborhood 8 | 19 acres | Area was modeled in the undeveloped condition. Stormwater ponds are not represented in the DTM. |
| Desoto Road Apartments | 9 acres | Area was modeled in the undeveloped condition. Stormwater ponds are not represented in the DTM. |
| Sarasota Memorial Hospital Ambulatory Care | 3 acres | Area was modeled in the undeveloped condition. Stormwater ponds are not represented in the DTM. |
| Center Point Medical Center | 9 acres | Area was modeled in the undeveloped condition. Stormwater ponds are not represented in the DTM. |
| Town Center Homes | 4 acres | Area was modeled in the developed condition. Stormwater ponds are well represented in the DTM. Final lot grading is not represented in some areas. |
| Grace Community Church | 8 acres | Area was modeled in the developed condition. Stormwater pond is well represented in the DTM. Final lot grading is not represented. |
| Magnolia Green | 20 acres | Area was modeled in the undeveloped condition. Stormwater ponds are not represented in the DTM. |
| SIPOC | 58 acres | The east portion of this Developments of Regional Impact (DRI) was modeled in the undeveloped condition. Development plans for this area are subject to change. Final grading is not represented. |

### 3.1.3 Model Elements Outside Sarasota County

To best represent the downstream boundary conditions for Cooper Creek, Jones Edmunds included approximately 500 acres in Manatee County within the Cooper Creek Watershed Model area. Model elements within Manatee County were developed based on the Braden River Watershed Model, which was developed by SWFWMD in 2013 using ICPR3 and has a date certain of 2004. Using the Braden River model data will better define the Cooper Creek downstream boundary conditions.

## 3.2 Feature Inventory

We completed a feature inventory to gather pertinent watershed information, gain an understanding of the watershed, and identify potential data needs and conflicts.

Feature inventory GIS data are included within the model and HydroNetwork dataset.

### 3.2.1 Hydrologic Feature Inventory

The physical landscape of the Cooper Creek Watershed is described as Florida coastal lowland. Soils are sandy, but the seasonal-high-water-table elevation is typically near the surface, limiting infiltration potential under normal antecedent conditions. Many large depressional wetlands are present in the watershed. The remaining areas are characterized by urban and suburban residential, commercial, and institutional areas that include manmade stormwater management systems.

The natural ground surface is characterized by gentle slopes and minimal grade change. The watershed generally drains from east to west. By area, approximately 70 percent of the watershed is east of Interstate 75 and drains to Nathan Benderson Park, which includes a 300-acre watersport facility. The park and area west of Interstate 75 form the headwaters of Cooper Creek. The watershed is approximately 10 square miles.

Hydrologic features characterize the runoff response for the watershed in a stormwater model and are represented one-dimensionally in ICPR4 by model basins. Jones Edmunds primarily used the project DTM to revise the basin boundaries. We also used permit and as-built level plan data available from SWFWMD, stormwater inventory GIS data provided by the County, and aerial imagery as needed. We developed approximately 350 model basins with an average basin size of approximately 18 acres.

The hydrologic feature inventory is included within the model dataset represented as ICPR_BASIN features.

### 3.2.2 Hydraulic Feature Inventory

The physical landscape of the Cooper Creek Watershed indicates that rainfall-generated surface drainage is generally attenuated in manmade stormwater ponds or natural depressional wetlands. Discharge from these storage features flows toward Cooper Creek via direct sheet-flow and unnamed feeder creeks. Other significant manmade hydraulic features in the watershed include the stormwater drainage systems associated with Interstate 75 and University Parkway.

Hydraulic features characterize the hydraulic routing for the watershed model. Jones Edmunds inventoried the hydraulic feature data within the watershed, which included the County’s stormwater asset inventory, SWFWMD ERP plans data, and model elements included in SWFWMD’s Braden River Watershed Model. Table 3-2 summarizes the data that we used to complete the inventory.

**Table 3-2 Summary of Source Data Used to Inventory Hydraulic Features**

| Data Source | Description of Use | Description of Available Data |
|---|---|---|
| SWFWMD ERP Data | Permit plans, drainage studies, calculations, and as-builts were used to identify hydraulic features and characterize drainage patterns. Notable plan data include US 41, CR 762, and CR 789. | SWFWMD makes ERP-related data available via the Watershed Management Information System (WMIS). Data can also be requested when not available online. We obtained approximately 300 ERP-related documents from WMIS and by request. |

| Data Source | Description of Use | Description of Available Data |
|---|---|---|
| County Stormwater Inventory Data | The County's inventory data were used to identify hydraulic features and characterize drainage patterns. The data were particularly useful in older residential and commercial areas developed before modern stormwater standards were implemented. | The County has a robust stormwater dataset with over 50,000 individual pipe segments inventoried. Over 900 storm-culvert segments are within the Cooper Creek Watershed, of which approximately 500 are equal to or greater than 24 inches in diameter. The data include private-, County-, and state-owned stormwater infrastructure. |
| Braden River Model Links | SWFWMD's Braden River model links were used to identify potential hydraulic features not readily apparent in other datasets. | The model included over 600 links within the Cooper Creek Watershed. |

Hydraulic feature inventory data are included within the HydroNetwork dataset represented as HYDROJUNCTION and HYDROEDGE features.

Jones Edmunds used the feature inventory as base data to complete development of the ICPR4 model schematic and begin parameterization of the model elements. When duplicative elevation data are available for hydraulic features, we used the data following the priorities listed in Table 3-3 for features within the County, with higher confidence data being used before lower confidence data. When structure elevation data are available from plan data and are used for model parameter development, the plan data were hyperlinked to the appropriate model feature.

**Table 3-3 Ranking Available Elevation Data for Hydraulic Features**

| Elevation Data Source | Confidence Level (1 = Highest) | Additional Source Information |
|---|---|---|
| Project Survey | 1 | Data are collected after field reconnaissance and will be targeted to fill elevation data gaps. |
| ERP As-Builts | 2 | Data are used when a site-survey is not available. Locations will be reviewed to ensure that no on-site modifications have occurred since the as-built date. |
| ERP Non-As-Built Plans | 3 | Data are used when site-survey and as-built data are not available. Locations will be reviewed to ensure that the development was built in accordance with the plans as practical without additional survey. |
| Braden River Model Data | 4 | Data are used when no site-survey or plan data are available. Locations will be reviewed to ensure as practical that feature modifications have not occurred since the model date certain, which was 2004. |

| Elevation Data Source | Confidence Level (1 = Highest) | Additional Source Information |
| --- | --- | --- |
| FDEM 2018 LiDAR | 5 | These data were published by USGS in September 2021. SWFWMD is developing an enhanced digital elevation model (DEM) based on these data, which is scheduled for completion in 2022; however, for schedule reasons, the USGS DEM will be used for this model update. |

# 4 FIELD RECONNAISSANCE AND SURVEY

## 4.1 IDENTIFICATION OF FIELD RECONNAISSANCE NEEDS

Jones Edmunds identified potential data needs and conflicts while completing the feature inventory that required field investigation. The locations were identified through analyses of the project DTM, aerial imagery, County asset data, and site development plans. During field reconnaissance, we confirmed drainage divides, drainage patterns, and the presence or absence of hydraulic features.

For accessible and significant hydraulic features, we documented structural and functional characteristics of the feature to aid the County's maintenance planning. We identified approximately 50 points of interest for field data collection. Field reconnaissance points of interest are included within the HydroNetwork dataset represented as POINT_TO_VISIT features.

## 4.2 FIELD RECONNAISSANCE DATA

Jones Edmunds collected field reconnaissance data primarily in March 2021. We documented the results of our reconnaissance effort within attributes of the POINTS_TO_VISIT feature class. Table 4-1 describes the categories for the reconnaissance types conducted for each location visited.

**Table 4-1 Summary of Field Reconnaissance**

| Category | Description of Reconnaissance |
|---|---|
| Collect Information on Stormwater Structure | We visited the location of a known hydraulic feature and collected information on the feature. Approximately 50 locations. |
| Verify Connectivity | We visited the location of a potential hydraulic feature to determine if a feature was present. If a feature was present, we collected information on the feature. Approximately 30 locations. |
| Verify Drainage Patterns/Basin Boundary | We visited the location to determine drainage patterns and investigated potential modifications to model basin boundaries. Approximately 35 locations. |
| Verify Topovoid | We visited the location to determine the status of construction activities related to new site development. Approximately five locations. |

If we encountered a hydraulic feature during field reconnaissance, we collected information on the feature including digital photographs, attributes to be used in model parameterization, and maintenance conditions. Documented model parameters included structure dimensions, geometry, material, and end treatments.

## 4.3 IDENTIFICATION OF SURVEY NEEDS

Table 4-2 lists the elevation data sources that Jones Edmunds reviewed to help identify where survey collection was needed for hydraulic features. We identified approximately 25 hydraulic features where the available elevation data were insufficient for model parameterization.

**Table 4-2 Available Elevation Data Sources for Hydraulic Features**

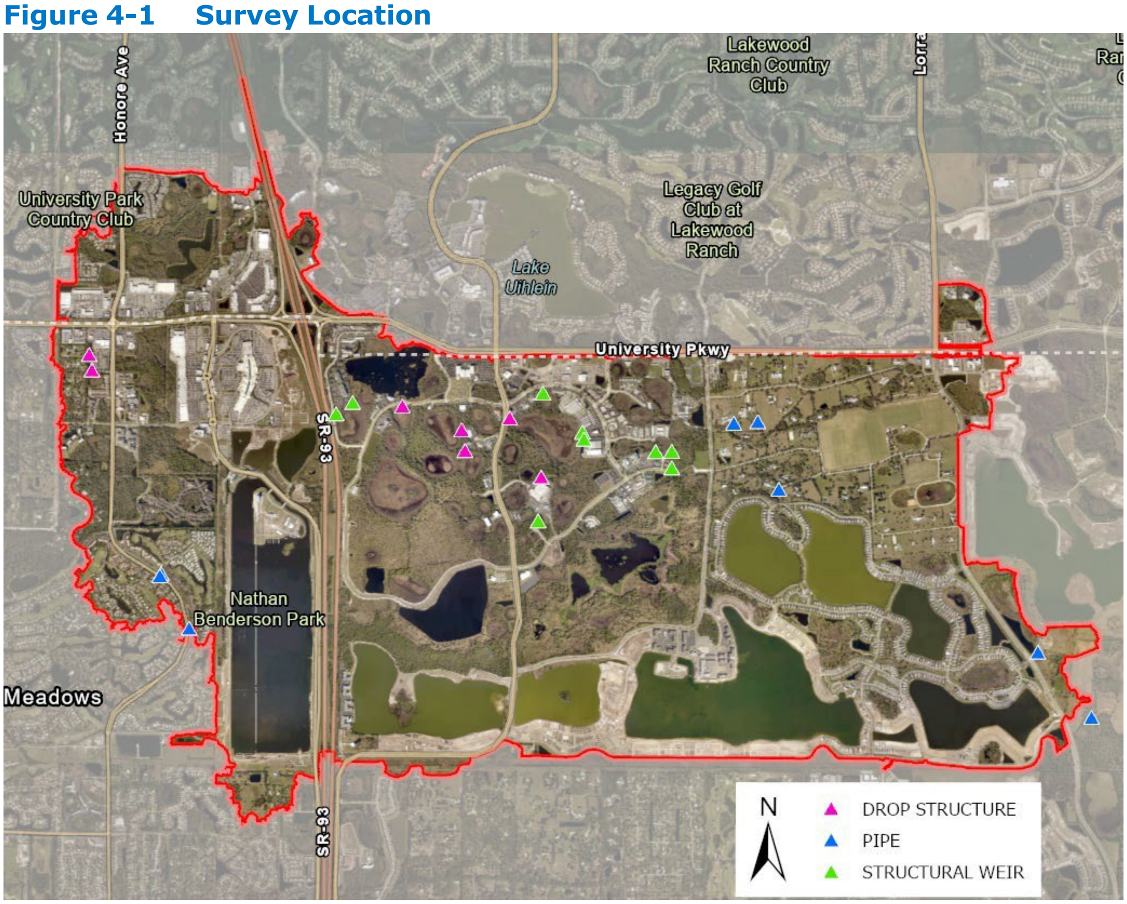
| Elevation Data Source | Additional Source Information |
|---|---|
| ERP As-Built | Data will be used when site-survey data are not available. Locations will be reviewed to ensure that no on-site modifications have occurred since the as-built date. |
| ERP Non-As-Built Plan | Data will be used when site-survey and as-built data are not available. Locations will be reviewed to ensure that the development was built in accordance with the plans as practical without additional survey. |
| Braden River Model Data | Data will be used when no site-survey or plan data are available. Locations will be reviewed to ensure as practical that feature modifications have not occurred since the model date certain, which was 2004. |

## 4.4 Survey Data

Hyatt Survey Services, Inc. collected the project survey data using conventional ground surveying methods and a Real Time Kinematic Global Positioning System to capture horizontal and vertical position data. They collected survey data in June and July 2021.

Appendix A includes a copy of the Hyatt Surveyor's Report. The watershed dataset represented as PROJECT_SURVEY features provides the collected survey data. Figure 4-1 shows the survey location.

**Figure 4-1 Survey Location**



# 5 MODEL SCHEMATIC

## 5.1 MODEL ELEMENTS

The Cooper Creek Watershed Model is a one-dimensional ICPR4 model; the model elements representing the watershed's runoff-response are basins. The model elements representing the watershed's hydraulic routing in ICPR4 are nodes and links. Model elements are collectively referred to as the model schematic. Appendix B provides the model schematic.

### 5.1.1 HYDROLOGIC MODEL ELEMENTS (BASINS)

Model basins delineate runoff-response areas that will be used to generate a watershed runoff-response. We developed 393 model basins with an average area of approximately 16 acres. Thirty-seven model basins characterizing approximately 500 acres are outside Sarasota County, but are included to better establish model boundary conditions. All model basins are included within the model dataset represented as ICPR_BASIN features.

### 5.1.2 HYDRAULIC MODEL ELEMENTS (NODES AND LINKS)

Nodes define storage areas within the model and are locations of water-elevation predictions. Links define conveyance flow-paths within the model and allow stormwater to move between nodes. Links typically represent hydraulic features such as channels, pipes, and weirs. The node-link connectivity is commonly referred to as the model network. We developed 476 nodes and 857 links. Fifty-seven nodes and 82 links are outside Sarasota County but are included to better establish model boundary conditions. Model nodes and links are included within the model represented as ICPR_NODE and ICPR_LINK features.

## 5.2 MODEL SCHEMATIC CONNECTIVITY

To complete the model schematic connectivity, we attributed the model elements for flow direction, enforced element topology, and established hydraulic connections to adjacent watershed models.

### 5.2.1 CONNECTIVITY ATTRIBUTES

We attributed model basins to a model node. This assignment determines the location within the model network that ICPR4 will load the hydrologic runoff-response. Typically, only one node is present within a model basin and that node is assigned to the basin. However, approximately 20 percent of our model basins contain two or more nodes. In these cases, the model basin is assigned to the most hydrologically representative node location within the model network. We also attributed model links with to-node and from-node to define the flow direction. The established direction of flow for the link, from-node-to-to-node, also matches the direction that the link was digitized in GIS.

### 5.2.2 MODEL SCHEMATIC TOPOLOGY

Table 5-1 lists the topology rules that we adhered to when generating the model schematic data in GIS. These topology rules are consistent with SWFWMD GWIS guidance.

**Table 5-1 Summary of Model Element Topology**

| Model Element | Element Topology Requirements |
|---|---|
| Basin | ▪ Basins are polygon features.<br>▪ No overlapping polygons are allowed.<br>▪ No gaps between polygons are allowed except at the watershed boundary. |
| Node | ▪ Nodes are point features.<br>▪ Nodes are located at the termination point of links. |
| Link | ▪ Links are polyline features.<br>▪ Links originate and terminate at nodes.<br>▪ Links do not intersect other links except at nodes (or when otherwise unavoidable due to flow direction). |

Nodes were typically in the low spot of the associated storage area. When not at a low spot, nodes were at a hydraulically representative location such as a hydraulic structure. Links were digitized to represent the real-world flow path, upstream-to-downstream, with small deviations allowed for visual clarity when viewing the model network in GIS.

### 5.2.3 Boundary Connections

The watershed includes connectivity with adjacent watershed models within Sarasota County including Phillippi Creek and Dona Bay. The preliminary schematic includes nine time-stage nodes, which represent the expected hydraulic responses of the adjacent watersheds.

# 6 MODEL PARAMETERIZATION

Building on the model schematic and H&H feature inventory described in previous sections of this report, this Section documents the engineering methodologies, approaches, and assumptions used to develop the model parameters.

## 6.1 HYDROLOGIC PARAMETERIZATION

Jones Edmunds calculated the runoff volume for this project using the Soil Conservation Service (SCS) Curve Number (CN) method, and the resulting volume was applied to an SCS Unit Hydrograph to determine the runoff rate at each time-step throughout the storm duration. Information required at the subbasin level to run this hydrology method in ICPR4 includes the drainage area, storm duration, depth, distribution, Time-of-Concentration (Tc), CN, directly connected impervious area (DCIA), impervious area other than DCIA (non-DCIA), and peaking factor.

### 6.1.1 RAINFALL DURATION, DEPTH, AND DISTRIBUTION

Jones Edmunds modeled the 10-, 25-, 50-, 100-, and 500-year-frequency 24-hour-duration storm events using the SCS *Type-II Florida-Modified Rainfall Distribution*. Table 6-1 shows the rainfall depths that we derived for these storms from rainfall isohyet maps provided in SWFWMD's *Guidelines and Specifications (G&S)* (2020).

**Table 6-1 Design Storm Rainfall Depths using 24-Hour Duration and Type II Florida-Modified Distribution**

| Return Frequency (Years) | Rainfall Depth (Inches) |
|---|---|
| 10 | 7.0 |
| 25 | 8.0 |
| 50 | 9.0 |
| 100 | 10.0 |
| 500 | 12.4 |

### 6.1.2 TIME OF CONCENTRATION

The Tc for a subbasin is defined as the time it takes for runoff to travel from the hydraulically most representative distant point of the subbasin to a point of interest within the subbasin. The Tc influences the shape and peak of the runoff hydrograph for a given subbasin. Jones Edmunds calculated the Tc values using the Natural Resources Conservation Service (NRCS) *Technical Release 55* (TR-55). We determined the longest flow path in each subbasin using a combination of GIS techniques and manual review.

The Cooper Creek Watershed terrain is flat with extensive underground stormwater infrastructure. Therefore, the Tc lines developed by the GIS tools did not always represent the true flow patterns. We manually developed the Tc lines using the DTM, information from available ERPs, stormwater inventories, aerial photography, and the lines developed by the GIS tools as guides. We excluded the length from storage and conveyance areas that are considered in the hydraulic model to avoid routing flow in the H&H components of the model. We assumed the first 100 feet of the flow path to be sheet flow and segmented the rest of the flow path based on the applicable flow regime (shallow-concentrated, open-channel, or piped flow). We assigned roughness values for sheetflow and open-channel flow based on average surface characteristics visible from aerials. We assigned pervious/ impervious classifications to shallow concentrated portions of the flow path. For piped flow segments, we assumed a velocity of 2 feet/second. We calculated travel times using the methods described in TR-55 – kinematic solution for sheetflow, regression equation relating velocity to slope and type of channel for shallow concentrated flow, and Manning's equation for open-channel flow. We applied a minimum slope of 0.001 foot/foot, a minimum velocity of 0.1 foot/second, and used a minimum travel time of 10 minutes.

### 6.1.3 Runoff CN and DCIA

Jones Edmunds calculated CN and DCIA parameters for each subbasin in ArcGIS using impervious area polygons developed from data provided by Sarasota County, SWFWMD land use, and aerial imagery. We classified these polygons into the following categories: building footprints, roads, waterbodies, and pavement. The impervious surface polygons were obtained from the Sarasota County *Impervious Area Geodatabase*. Using the 2018 aerials, we updated the impervious database to include new development as well as large impervious areas not previously mapped. We also used the SWFWMD land use dataset to incorporate the wetland and waterbody features into the impervious area polygons.

All pervious areas had a CN value of 78, which is consistent with Sarasota County's standard practice. We assumed DCIA areas to be all roads, waterbodies, wetlands, and DCIA-classified pavement areas and buildings associated with a stormwater facility. Non-DCIA areas were assumed to be building footprints not associated with a stormwater facility and other impervious areas not classified as DCIA. We added 10 percent to the building footprint area to represent sidewalks, pools, and driveways.

### 6.1.4 Unit Hydrograph

The NRCS Unit Hydrograph Method was used to distribute runoff volume over the duration of the storm. Runoff rates and timing are controlled by the hydrograph shape factor and the Tc. We used the standard peak factor of 256 for all subbasins, which is consistent with adjacent County watersheds and reasonable because of the watershed's high development intensity.

## 6.2 Hydraulic Parameterization

Jones Edmunds developed the ICPR4 hydraulic parameters in GIS by incorporating the information compiled from the desktop hydraulic feature inventory, field data, and survey data. We used information from the DTM to supplement the hydraulic data, including parameterization of the storage facilities and overland weir connections.

### 6.2.1 Storage Areas

The ICPR4 model typically represents storage areas as a stage-area relationship associated with a node. These relationships represent flood storage associated with lakes, wetlands, stormwater ponds, and other depressional or overbank storage.

Jones Edmunds developed the stage-area relationships for the nodes by using a Python script, which we also developed. This script has been used on projects throughout the state including other Sarasota County models. Several models that used this stage-area process were peer reviewed by consultants and SWFWMD staff. In each case, the script's logic and results were reviewed and accepted.

The script extracts area and volume from the DTM at user-specified intervals. We extracted the stage-area at 0.1-foot intervals. We excluded storage areas accounted for by channels for nodes that have channel connections. The stage-area data are then thinned to keep only the general shape of the storage curve while preserving the volume.

For nodes not associated with storage areas (e.g., channel nodes, confluence nodes, manholes), nominal storage was provided to ensure that mass balance is achieved during the ICPR4 simulations. Typically, this nominal storage is small enough (approximately 0.001 acre) to not affect the model results.

### 6.2.2 Channel Storage

The storages associated with channel and bridge links are allotted dynamically in the ICPR4 model according to the channel link length, upstream and downstream cross-sections, channel inverts, and water-surface elevations. We excluded this dynamically allotted storage from the stage-area relationship developed for the node storage areas since that would double-count the storage already associated with the channel. We developed the channel polygons to exclude those areas from being included in the stage-area data developed by the Python tool described earlier.

### 6.2.3 Initial Stage

Jones Edmunds mapped the initial inundations to evaluate the reasonableness of the initial stages in the model. We compared these inundation extents to several data sources, including the NCRS *Soil Survey*, *National Wetland Inventory* data, and aerial photography captured at different periods. We evaluated the initial stages to ensure that no initial flows occur at the beginning of the simulations. In newly developed areas, we set the initial stage for a wet depression at the pond outfall structure control elevation. We set the initial stage for a dry depression at the lowest elevation in the DTM for that area.

### 6.2.4 Culverts

Jones Edmunds derived data for culverts from the field and survey data including information from previous studies and construction plans. We assigned Manning's roughness values based on material type and assumed a clear, well-maintained pipe. We assigned corrugated metal pipes a Manning's roughness value of 0.024 and concrete pipes a Manning's roughness value of 0.013. We assigned high-density polyethylene (HDPE) and polyvinyl chloride (PVC) pipes that had smooth bores a Manning's *n* value of 0.011.

We derived the data for Federal Highway Administration (FHWA) Culvert Codes and entrance, exit, and bend losses from the typical values reported in the FHWA *Hydraulic Design of Highway Culverts* (also available in ICPR help). We set exit losses ranging from 0 to 1.0.

### 6.2.5 CHANNELS

Jones Edmunds identified significant channels using information from the aerial photography and DTM. Cross-sections were generated from the DTM to characterize the channel geometry.

We assigned Manning's roughness coefficients to each channel. This coefficient represents the degree of hydraulic resistance (friction) of a channel to convey water and is influenced by factors such as the channel bottom material, vegetation in the channel, channel alignment, and other types of obstructions. Roughness values were assigned based on engineering judgment and experience. Channel roughness determination methodology and typical values can be found in many literature resources, such as the *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains* (Arcement and Schneider, 1990), which was used as a guide for this study. Manning's roughness coefficients were evaluated by reviewing the aerial photography, street view, and survey pictures. In addition, we defined the roughness coefficients for a sufficient distance from the channel banks into the floodplain and evaluated overbank roughness coefficients based on aerial photography, street view, and survey photographs.

### 6.2.6 WEIRS

Jones Edmunds collected data for weirs, including weir structures and other control structures, during field reconnaissance. We surveyed the invert elevations for these structures and incorporated data from plans when available.

Overland flows occur at saddles along basin boundaries, over manmade berms, or over roads. We estimated that flows over these landscape features with the weir equation. Weirs in ICPR4 representing subbasin saddles are linked to irregular cross-sections developed using the LiDAR-based DTM. A Jones Edmunds GIS-based tool was used to extract the cross-sections that represent the geometry of the saddle captured in the LiDAR. We developed the cross-section lines from the subbasin boundaries, which were typically delineated along the ridge between subbasins and would provide inter-basin connections during extreme storm events. We then extracted elevations along the lines from the 2.5-foot-by-2.5-foot DEM. Next, we exported the station-elevation relationship for each cross-section. We thinned (generalized) the station-elevation data using the Douglas-Peucker technique with a tolerance of 0.1 foot, which reduced the number of points needed to characterize each cross-section. As a quality control (QC) measure, we compared the cross-sectional area before and after thinning to confirm that no significant changes occurred in the cross-sectional area. We also reviewed a plot comparing the original cross-section and the thinned cross-section to confirm that no errors occurred during the thinning process and that cross-sectional geometry remained essentially the same.

### 6.2.7 BOUNDARY CONDITIONS

The Cooper Creek Watershed contains one main outfall and several interconnected outfalls with adjacent watersheds. The main outfall is Cooper Creek downstream of Interstate 75. Jones Edmunds obtained the main outfall tailwater conditions from the time/stage results of the 2013 Braden River Watershed ICPR3 Model. The interconnection outfalls account for hydraulic connections and overflows to the adjacent watershed. We obtained the interconnected outfall boundary conditions from the 2013 Braden River, 2021 Dona Bay, and 2018 Phillippi Creek Watershed Models.

## 6.3 Quality Assurance/Quality Control Process

Throughout the model parameterization, Jones Edmunds' Senior Project Engineers reviewed the parameters for compliance with standard engineering practice and the *G&S* (SWFWMD, 2020), as applicable. Once parameterization was complete, we ran the Sarasota County *ICPR4 Data Input Quality Control Checks Tool* to check for potential initial flows, overland flow discharging before drop structures, and model parameter reasonableness.

The Senior Project Manager performed a final review that included the following elements:

- Subbasin sizes are at an appropriate level of detail consistent with study objectives.
- Subbasin boundaries appear reasonable related to the DEM.
- Tc is reasonable based on subbasin size and geometry and previous WMPs.
- CN and DCIA parameters are appropriate.
- Subbasin runoff and other inflows are properly routed to nodes.
- Storage characteristics are properly developed.
- Initial water-surface elevation is at or above the lowest elevation of the node-storage data.
- Initial water-surface extent is reasonable compared with the aerial photography, NRCS soil layer, and *National Wetland Inventory* data.
- Channel and overbank roughness coefficients are reasonable.

# 7 MODEL SIMULATION, CALIBRATION, AND VERIFICATION

## 7.1 MODEL SIMULATION

Jones Edmunds exported the GIS features to the ICPR4 modeling application to simulate the 10-, 25-, 50-, 100-, and 500-year storms.

### 7.1.1 NUMERICAL STABILITY

We reviewed the models for numerical stability, which included evaluating the resulting mass balance and reviewing the node time-stage hydrographs, link hydrographs, and other model statistics.

The resulting time-stage hydrographs for the nodes were stable. Some link hydrographs did show minor oscillations that do not appear to impact the model results. These oscillations may occur as the model tries to converge to these small, negligible flows. We also reviewed the node extrapolation, mass balance, and link velocities and found them to be acceptable.

### 7.1.2 MODEL INTERCONNECTIVITY ADJUSTMENTS

After determining that the models were reasonably stable, Jones Edmunds generated preliminary-level pool (LP) floodplains for the 500-year/24-hour storm event to identify and add missing overland interconnections in the model.

### 7.1.3 MODEL RESULTS

Peak water-surface elevations for each modeled node are in the ICPR_NODE_RESULT table of the model database.

## 7.2 CALIBRATION AND VERIFICATION

No gauges are within the watershed. However, SWFWMD and Sarasota County keep data pertaining to high-water elevations and recent flooding complaints for the area. The data provide valuable information to gauge the reasonableness of the flood models. Jones Edmunds verified the model results using SWFWMD's high-water geodatabase and Sarasota County's high-water marks collected after Hurricane Ian. The model produces reasonable results when compared to Hurricane Ian's high-water mark and SWFMWD's Historical Water Level data, as described in the following subsections.

### 7.2.1 SARASOTA COUNTY HIGH-WATER MARK

Hurricane Ian made landfall in Fort Myers on September 28, 2022, bringing heavy rainfall across Sarasota County. Rainfall depths ranged from 27 inches in the south to 5 inches in the north portions of the County. The two closest County gauges, PH-14 BoB – 416 and PH-2 Meadows G.C – 420, recorded approximately 7 inches of rainfall within 24 hours. The County surveyed a high-water mark from Hurricane Ian at the Nathan Benderson Park and recorded it at 22.1 feet NAVD88. Using SWFWMD Next Generation Weather Radar (NEXRAD) rainfall data, Jones Edmunds simulated Hurricane Ian to compare the model-predicted results with the County's high-water mark. The model peak stage at the high-water location is 22.64 feet. The model appears to reasonably predict the flooding in this area, and the small difference between the model result and the high-water mark is expected due to factors such as the timing of when the high-water elevation was collected, and unknown water-surface elevations at the start of the event. Figure 7-1 shows the County's high-water mark collected at the Nathan Benderson Park.

**Figure 7-1 County High-Water Mark**

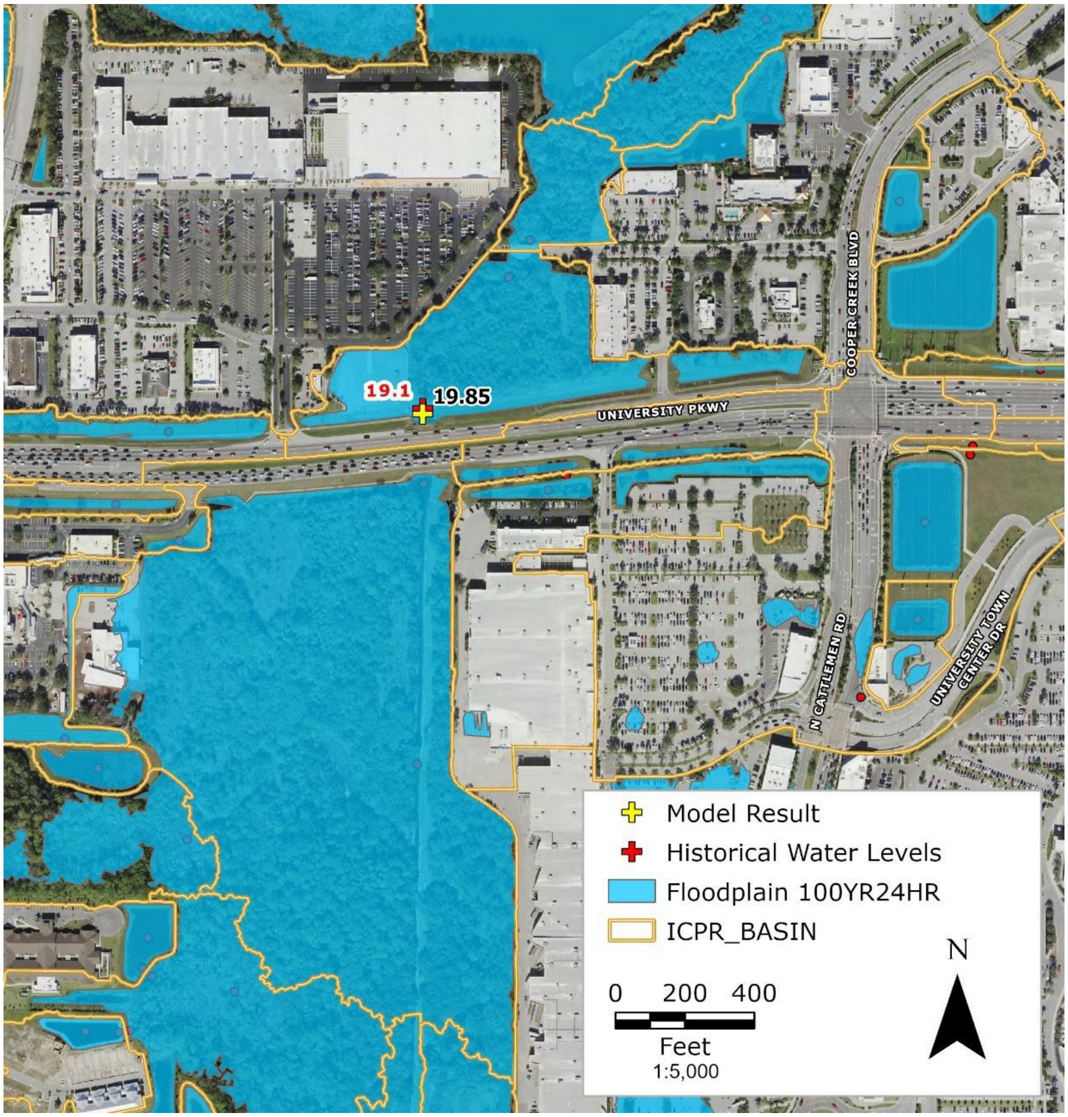

## 7.2.2 SWFWMD Historical Water Levels

SWFWMD has one historical high-water mark within Cooper Creek at University Parkway. The high-water mark was associated with an event on June 26, 1992. On June 23, 1992, Tropical Depression One produced 100-year floods in portions of Southwest Florida. The high-water mark recorded by SWFWMD was 19.1 feet NAVD88. The Cooper Creek 100-year/24-hour peak stage for this location is 19.85 feet. The difference is reasonable and likely due to the varied rainfall distributions throughout the County and unknown starting water-surface elevations. Figure 7-2 shows the SWFMWD high-water mark compared to the 100-year/24-hour peak-stage result.

## 7.2.3 SWFWMD Flooding Complaints

The SWFMWD high-water database contains one flooding complaint dated July 16, 2015. Flooding was reported in the Lakewood Ranch Corporate Park Unit 2. However, Jones Edmunds reviewed surrounding rainfall gauges and found no major rain events at this time.

**Figure 7-2 SWFWMD High-Water Mark compared to the 100-Year/24-Hour Peak Stage Result**



# 8 FLOODPLAIN DELINEATION

Jones Edmunds developed floodplains for the 100-year/24-hour design storm event. Floodplain extents were delineated using the 2019 SWFMWD enhanced ground-surface DTM, existing conditions model results, and aerial photography. Mapped floodplain water-surface elevations were determined based on peak water-surface elevations at model nodes.

We delineated two general types of floodplains depending on the landscape and model configuration – LP floodplains and sloped water-surface (SWS) floodplains. LP floodplains were delineated for inundated areas with little or no change in slope across the water surface. We also delineated the LP floodplains in drainage basins with low relief (very small water-surface slope) and in closed basins (no water-surface slope) that tend to fill up like a bathtub (e.g., a stormwater pond). Water-surface elevations are a constant value in an LP floodplain. We delineated SWS floodplains in open drainage basins for areas inundated by channel flow. Water-surface elevations vary across an SWS floodplain, decreasing in a downstream direction.

In areas of natural land cover (e.g., forest), floodplain generation using high-resolution terrain data typically results in delineation of numerous small polygons or holes within polygons. The small polygons or holes are generated because of small variations in elevation sometimes caused by objects such as fallen trees, vegetation debris under the tree canopy, or other conditions where the DTM may not reflect the bare-earth elevation. We excluded inundated areas less than 2,500 square feet ($ft^2$) from final delineations. We also considered gaps in flooded areas less than 2,500 $ft^2$ from final delineations negligible (potential artifacts of the DTM) and consequently filled for the final delineations.

Following standard practice, we modeled overland water flow across basin boundaries as weir flow; therefore, sloped-surface floodplain delineation is not achievable from model results since weirs only define water depth at a single point rather than sloped along the flow path alignment. We identified areas of potential shallow sheet flow across basin boundaries by inspecting all overland weir links with peak flows greater than 50 cubic feet per second. We manually delineated an SWS floodplain in these areas of shallow sheet flow on a case-by-case basis using the terrain, model output, and professional judgment.

In some cases, adjacent subbasins share a flow connection where the methodology previously described generates preliminary floodplains that reach the shared boundary from one direction but not the reciprocal direction. The preliminary floodplain in these cases did not accurately reflect the sloping flow pattern between adjacent basins. In such cases, the downstream basin will experience flooding from active overflow from the upstream basin. To map these occurrences, when the boundary connecting adjacent subbasins was overtopped by at least 0.5 foot of significant flow, we manually delineated the *transition zone* floodplains extending into the downstream subbasin based on the expected flow path between the flood pools.

Jones Edmunds evaluated the floodplains to classify the flood zones as defined by the Federal Emergency Management Agency (FEMA). These included the following zones:

- **Zone AE – Floodplains with Base Flood Elevations (BFE)**: We derived the BFE values from the LP water-surface elevations or the resulting node elevations along a channel.
- **Zone A – Floodplains with no BFE**: These areas in the watershed usually represent transition zones, small depressional areas, or wet areas (i.e., ponds, small wetlands, etc.) that were not explicitly modeled in detail.

In addition to the FEMA flood zone designations, we also classified certain floodplains as local floodplains. These floodplain polygons may be maintained as part of Sarasota County's Community Flood Hazard Areas (CFHA) but do not have to be designated as FEMA flood zones. These areas usually represent small, flooded depressions or local drainage systems designed to convey flood waters. Appendix C-1 shows the preliminary 100-year/24-hour floodplain extent including transition zones. Appendix C-2 shows the 500-year/24-hour LP floodplain.

# 9 FLOOD PROTECTION LEVEL OF SERVICE

Jones Edmunds evaluated the stormwater FPLOS for all subbasins in the Cooper Creek study area in accordance with methods described in Sarasota County's *Unified Development Code (UDC)*, Appendix C14 (Sarasota County Government, 2023). The supporting data used for evaluating the FPLOS include:

- 2019 Hydro-enhanced DEM raster.
- Cooper Creek floodplain polygons.
- Cooper Creek inundation depth grid for the 100-year/24-hour design storm.
- Sarasota County building footprint polygons.
- Sarasota County *Streets*.
- Sarasota County *2040 Future Thoroughfare Plan Roads*.
- 2022 aerial imagery.

## 9.1 FPLOS CRITERIA

The FPLOS designations characterize flooding due to rainfall events. The model results do not consider potential effects from tidal surges – tidal storm surge analysis requires a separate type of modeling and is not part of this study.

The FPLOS criteria adopted by Sarasota County are:

- Category I – Structures. Building finished-floor elevations (FFEs) are at or above the 100-year/24-hour flood elevation.
- Category II - Road Access. Roads shall be passable during flooding. Passable is defined as roadway flooding less than 6 inches in depth at the outside edge of pavement during a specific design storm. Table 9-1 describes the road access design storm criteria by roadway classifications.

**Table 9-1 Category II – Road Access Design Criteria**

| Road Category | Storm Design |
|---|---|
| A. Evacuation Route | >100-Year* |
| B. Arterial | 100-Year |
| C. Collector | 25-Year |
| D. Neighborhood | 10-Year |

* For Evacuation Route, 0 inch of flooding is allowed for the 100-year storm event.

## 9.2 FPLOS METHODOLOGY

This Section explains the methodology that Jones Edmunds used to assess the FPLOS for roadways and structures in the Cooper Creek Watershed.

### 9.2.1 STRUCTURES

Jones Edmunds used the County-provided *BuildingFootprints* geodatabase to identify structures with FFEs that are below the 100-year/24-hour flood elevation (i.e., FPLOS deficient). According to the metadata for the GIS features, the building footprints were derived using photogrammetry. The data were updated to include elevations. The elevation dataset was last updated in 2014. Since then, more building footprints were added to the data as recently as November 2022. However, the building footprints that were added did not have the FFEs attributed.

Jones Edmunds reviewed the elevation data for the building footprints and found the information to be significantly inconsistent with the 2019 LiDAR. Jones Edmunds re-evaluated the FFE for the building footprints using the new LiDAR data to ensure higher accuracy and consistency with the model information (the LiDAR was also used to parameterize the floodplain model).

New building footprints were also available that were generated from the 2019 LiDAR. The geometry of these footprints was not as refined as the previous dataset. However, they are more consistent with the new LiDAR. These footprints were used as the basis to determine the FFE from the new LiDAR. Results of the analysis were assigned to the more refined building footprints. The following steps summarize the procedures for determining the FFE for buildings.

1. Buffer the building footprints sourced from the 2019 LiDAR by 5 feet.
2. Determine the mean and maximum elevations in the buffer area.
3. Calculate the average of the mean and maximum elevations to estimate the FFE for buildings other than mobile or manufactured homes.
4. For mobile or manufactured homes, add 1 foot to estimate the FFE.
5. Assign the FFE to the more refined building footprints.

The above approach was compared with available survey data for reasonableness. FFE values were then compared to the flood depth grid to determine if the building is FPLOS deficient. Non-habitable structures were removed from the list of deficient structures.

The Cooper Creek Watershed contains one deficient structure. Table 9-2 describes the deficient structure. Appendix D-1 shows the location of the deficient structure within the Cooper Creek Watershed.

**Table 9-2 FPLOS-Deficient Structure**

| Structure Type | Address | FFE | NODE | Stage 100YR | Stage 25YR | Stage 10YR |
|---|---|---|---|---|---|---|
| Single-Family Detached | 4096 Lyndhurst Court | 26.43 | NL1700 | 26.45 | 26.35 | 26.28 |

### 9.2.2 ROADWAY

Jones Edmunds determined the Roadway FPLOS by evaluating the flood depth at each segment for the different classes of roads within the study area. Sarasota County maintains a GIS road centerlines dataset called *Streets* using Sarasota County (SARCO) street classes. The roads are classified according to their function. The County also maintains a *Thoroughfare* polyline feature class that defines Evacuation Routes and a Thoroughfare spreadsheet that contains all major road functional classes. Using the evacuation routes and the *Thoroughfare* spreadsheet, the Sarasota County streets were reclassified to the appropriate FPLOS roadway classifications consistent with the County's UDC (Table 9-1).

Table 9-3 describes how each street class was reclassified to be consistent with the FPLOS roadway classifications.

**Table 9-3 SARCO Street Class**

| SARCO Thoroughfare | FPLOS Road Class |
|---|---|
| Freeway/Expressways | Evacuation[1] |
| Major Arterials | Arterial or Evacuation[1] |
| Minor Arterials | Arterial or Evacuation[1] |
| Major Collectors | Collectors or Evacuation[1] |
| Minor Collectors | Collectors |
| Significant Local Roads | Neighborhood |

[1] A road designated as an evacuation route according to the County's Thoroughfare polyline feature class was then reclassified to be an evacuation route; otherwise, it was reclassified as Arterial, Collector, or Neighborhood.

The allowable flood depth for each roadway classification is based on the depth of flooding at the edge-of-pavement resulting from the 100-year/24-hour storm event. Jones Edmunds assumed that the edge-of-pavement is 3 inches lower than the road center line (i.e., crown of road), which corresponds to the average roadway width of 24 feet, with a 2-percent cross-slope from the crown of the road. This assumption is for the initial identification of FPLOS-deficient roadway segments.

Jones Edmunds employed GIS processing to evaluate the depth, duration, and extent of flooding along each road segment to identify the portions of the road in which the edge-of-pavement would be under water and the corresponding depth. This information, along with the roadway classification, determined whether that portion of the road was deficient or not. We also visually checked the deficient roadways for reasonableness of results and isolated deficient segments of streets less than 25 feet that were not considered FPLOS deficient. Table 9-4 summarizes the results from the street FPLOS evaluation by roadway class. Table 9-5 presents the roadways not meeting FPLOS design criteria. Appendix D-2 shows the roadway FPLOS extents.

**Table 9-4 Roadway FPLOS Summary**

| FPLOS Roadway Classification | FPLOS Deficient | Linear Feet | Percent |
|---|---|---|---|
| Evacuation | No | 38,198 | 94 |
| | Yes | 2,411 | 6 |
| Arterial | No | 0 | N/A |
| | Yes | 0 | N/A |
| Collector | No | 0 | N/A |
| | Yes | 0 | N/A |
| Neighborhood | No | 190,107 | 96 |
| | Yes | 7,038 | 4 |

**Table 9-5 Depth, Duration, and Extent of Roadway Not Meeting FPLOS Design Criteria**

| Street_ID | Full Name | From Address | To Address | Road Classification | Length (ft) | NODE | EOP | Stage 100YR | Stage 25YR | Stage 10YR | Depth (ft) | Duration (hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ST_12092014_046437 | N Cattlemen Road | 300 | 998 | Evacuation | 175 | NL1860 | 22.78 | 23.11 | 22.27 | 21.86 | 0.33 | 1.25 |
| ST_02032017_112809 | N Cattlemen Road | 0 | 0 | Evacuation | 170 | NL1860 | 22.72 | 23.11 | 22.27 | 21.86 | 0.39 | 4 |
| ST_102012_032245 | University Parkway | 6900 | 7098 | Evacuation | 106 | NL5180 | 27.98 | 28.16 | 27.85 | 27.59 | 0.18 | 0.5 |
| ST_102012_031353 | Chanteclaire | 5448 | 5458 | Neighborhood | 60 | NL1700 | 25.24 | 26.45 | 26.35 | 26.28 | 1.04 | 4.75 |
| ST_102012_031665 | Chanteclaire | 5430 | 5446 | Neighborhood | 54 | NL1700 | 25.07 | 26.45 | 26.35 | 26.28 | 1.21 | 5.75 |
| ST_102012_031390 | Chanteclaire | 5416 | 5428 | Neighborhood | 56 | NL1700 | 25.24 | 26.45 | 26.35 | 26.28 | 1.04 | 4.75 |
| ST_102012_031390 | Chanteclaire | 5416 | 5428 | Neighborhood | 93 | NL1700 | 25.42 | 26.45 | 26.35 | 26.28 | 0.86 | 3.75 |
| ST_102012_031353 | Chanteclaire | 5448 | 5458 | Neighborhood | 27 | NL1700 | 25.38 | 26.45 | 26.35 | 26.28 | 0.9 | 4 |
| ST_102012_031510 | Chanteclaire | 5476 | 5498 | Neighborhood | 28 | NL1700 | 25.42 | 26.45 | 26.35 | 26.28 | 0.86 | 3.75 |
| ST_102012_032410 | Lyndhurst Court | 3700 | 4198 | Neighborhood | 497 | NL1700 | 24.72 | 26.45 | 26.35 | 26.28 | 1.56 | 9.5 |

# Appendix A

# Survey Report

**SURVEYOR'S REPORT**

**Cooper Creek Hydraulic Structures**
**Topographic Survey**
**Sarasota County, Florida**

**Requested By:**

**Jones Edmunds**
**Engineer's Project # 19006-066-01-2004**

**Prepared By:**

**Hyatt Survey Services, Inc.**
**2012 Lena Road**
**Bradenton, Florida 34211**
**Phone #: (941) 748-4693**
**Licensed Business No. 7203**

**Project Location:** The project site is located in Sarasota County, Florida contained within sections 1,2, and 4 in Township 36 south, Range 18 east; also including sections 4, 5, 6, 7, 8, 9, and 10 in Township 36 south, Range 19 east.

**Project Purpose:** Jones Edmunds tasked Hyatt Survey Services with the location and detail of twenty-six (26) drainage control structures in the Cooper Creek watershed area.

**Project Duration:** The fieldwork for the topographic survey was initiated in June, 2021 and was completed in July, 2021.

**Project Control:**

1. **Horizontal Datum:** The topographic survey is referenced to a grid projection of the Florida state plane coordinate system (U.S. survey feet, NAD 1983/2011 adjustment).
2. **Vertical Datum:** The following Manatee County vertical control monument was recovered and utilized for all elevations shown on the topographic survey:

| | | |
|---|---|---|
| "GIS 018" | ALUMINUM DISK ON METAL ROD | NAVD 1988 ELEVATION = 44.22 |

**Project Methods and Procedures (Field Work):**

1. Real Time Kinematic Global Positioning System (RTK GPS) observations with RTK corrections provided by Trimble VRS NOW were utilized for the horizontal and vertical positions of the survey control.
2. Trimble Robotic Total Stations were utilized for the location of topographic data in obscured areas.
3. Horizontal and vertical control checks were made throughout each field day to ensure data quality.
4. All data was collected via Trimble TSC3 data collectors running Trimble Survey Controller Software. All electronic data collection files were downloaded and stored in the digital project file on a daily basis.
5. All field notes were scanned.

**Project Methods and Procedures (Office Work):**

1. AutoCAD 2019 Civil 3D software was utilized to analyze and process each day's field work and to prepare all CAD files.

**Deliverables:**

1. Jones Edmunds was provided with the following:
   a. A ".dwg" file including all control points and collected structures
   b. A ".pdf" file for each structure depicting the structure with detailed measurements and elevations
   c. A minimum of two photos of each structure.

## CERTIFICATION

This is to certify that this report and survey have been performed in accordance with the Standards of Practice as set forth by the Florida Board of Surveyors and Mappers per Florida Administrative Code Chapter 5J-17. The map associated with this report is by reference made a part hereof and the map is not valid without this report and vice versa.

Signed & dated ______________________________

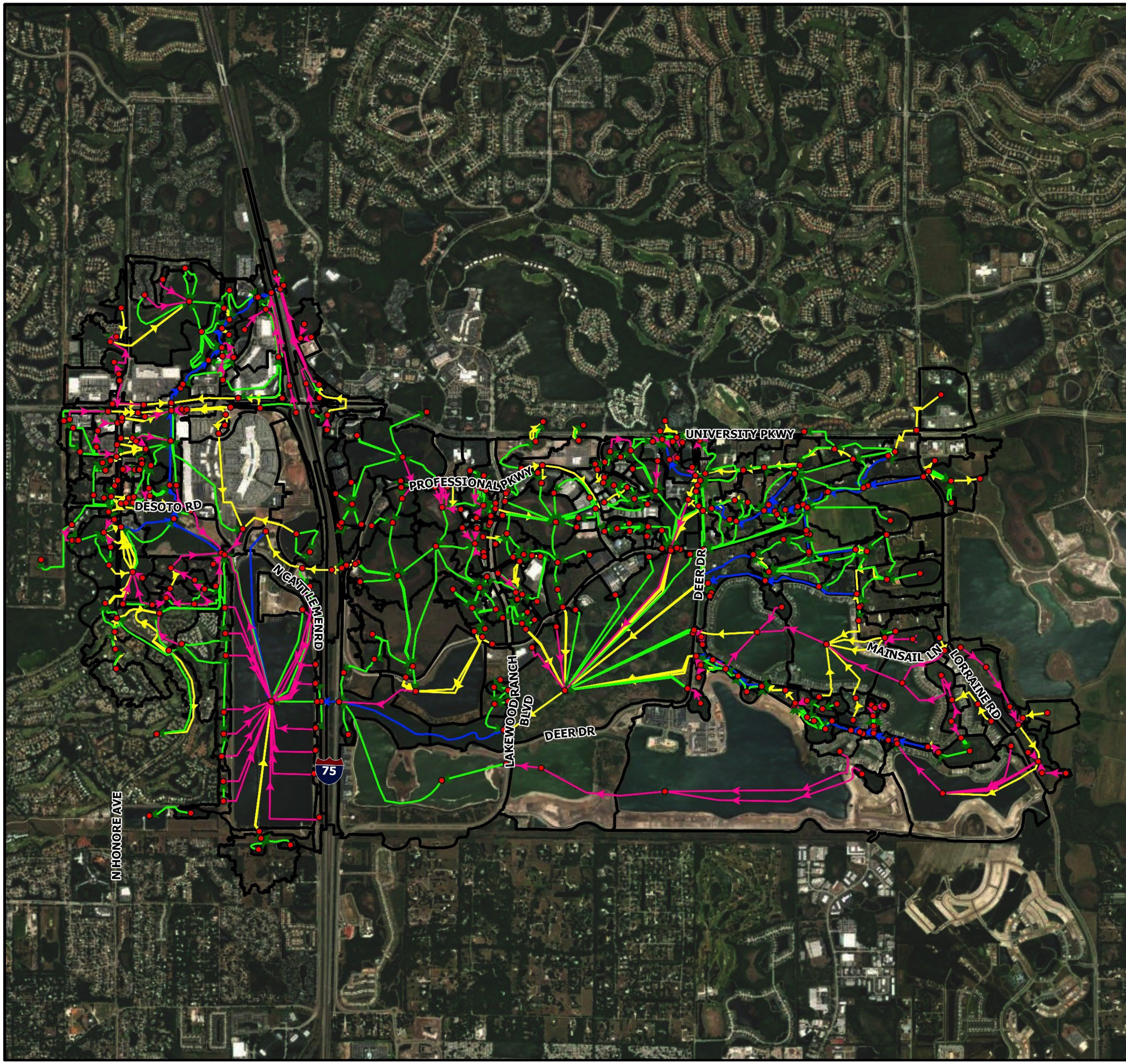
Russell P. Hyatt, P.S.M No. 5303

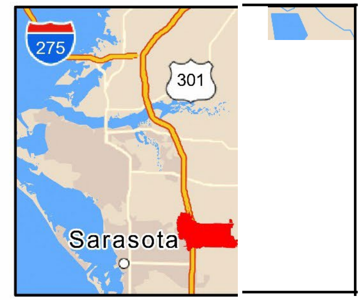
*Not valid unless signed and sealed by a Florida Licensed Surveyor and Mapper*

# Appendix B

# Model Schematic

**Appendix B**
**Model Schematic**
Cooper CreekWMP




ICPR_NODE
PIPE
CHANNEL
WEIR
DROPSTRUCTURE
BRIDGE
ICPR_BASIN

N
W+E
S

0 2,000 4,000
Feet
1:45,000

Sarasota County

JanesEdmund

# Appendix C
# Floodplain Data

# Appendix C-1

# Preliminary 100-Year/24-Hour Floodplain Extent Including Transition Zones

**Appendix C-1**

**Proposed Floodplain**

**100YR/24HR**

Cooper Creek WMP



Watershed

Floodplain - 100YR24HR

N

W+E

S

0 2,000 4,000

Feet

1:44,000

Sarasota County

JonesEdmund

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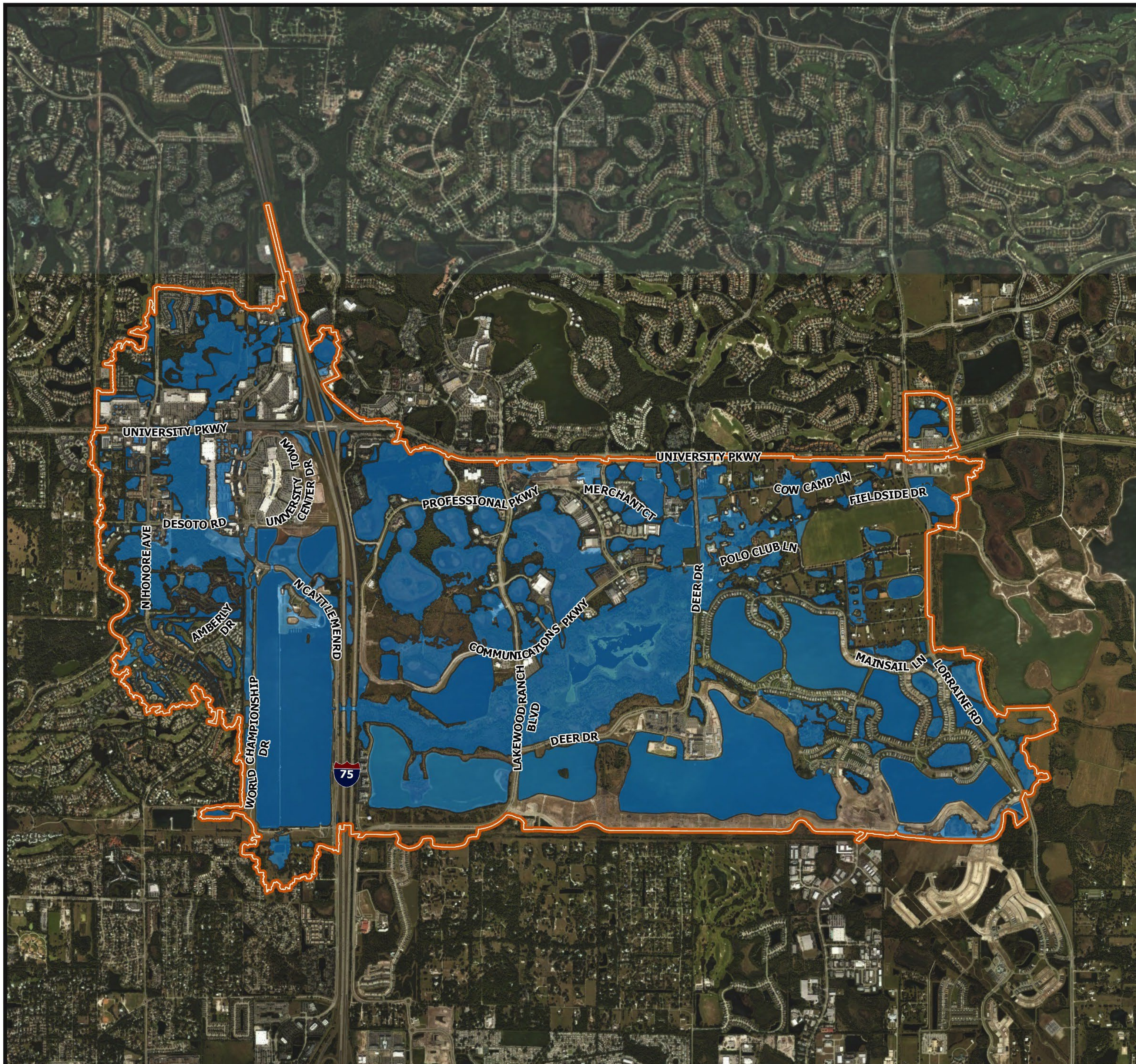
# Appendix C-2

# 500-year/24-hour LP Floodplain




**Appendix C-2**
**Proposed Floodplain**
**S00YR/24HR**
Cooper Creek WMP


Watershed
Floodplain - S00YR24HR

N
W+E
S

0 2,000 4,000
Feet
1:48,000

SarasotaCounty

JonesEdmund

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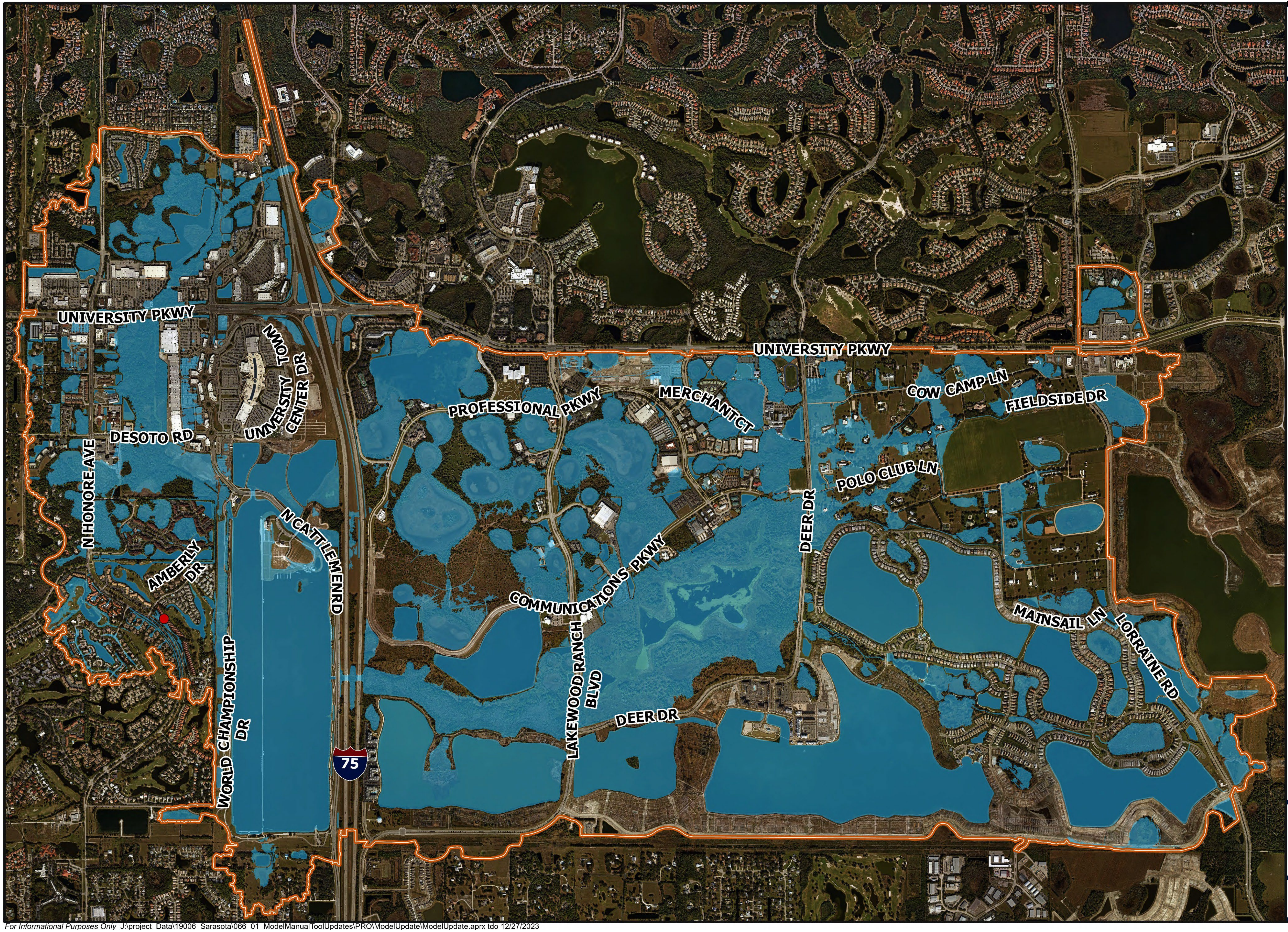
# Appendix D

# Level of Service

# Appendix D-1

# Location of the Deficient Structure within the Cooper Creek Watershed

**Appendix D-1**
**FPLOS Deficient - Structures**
Cooper Creek
Watershed Management Plan





FPLOS Deficient Structures
Floodplain - 100YR24HR
Watershed

N
W+E
S
0 1,000 2,000
Feet
1:24,000

Sarasota County

JonesEdmund

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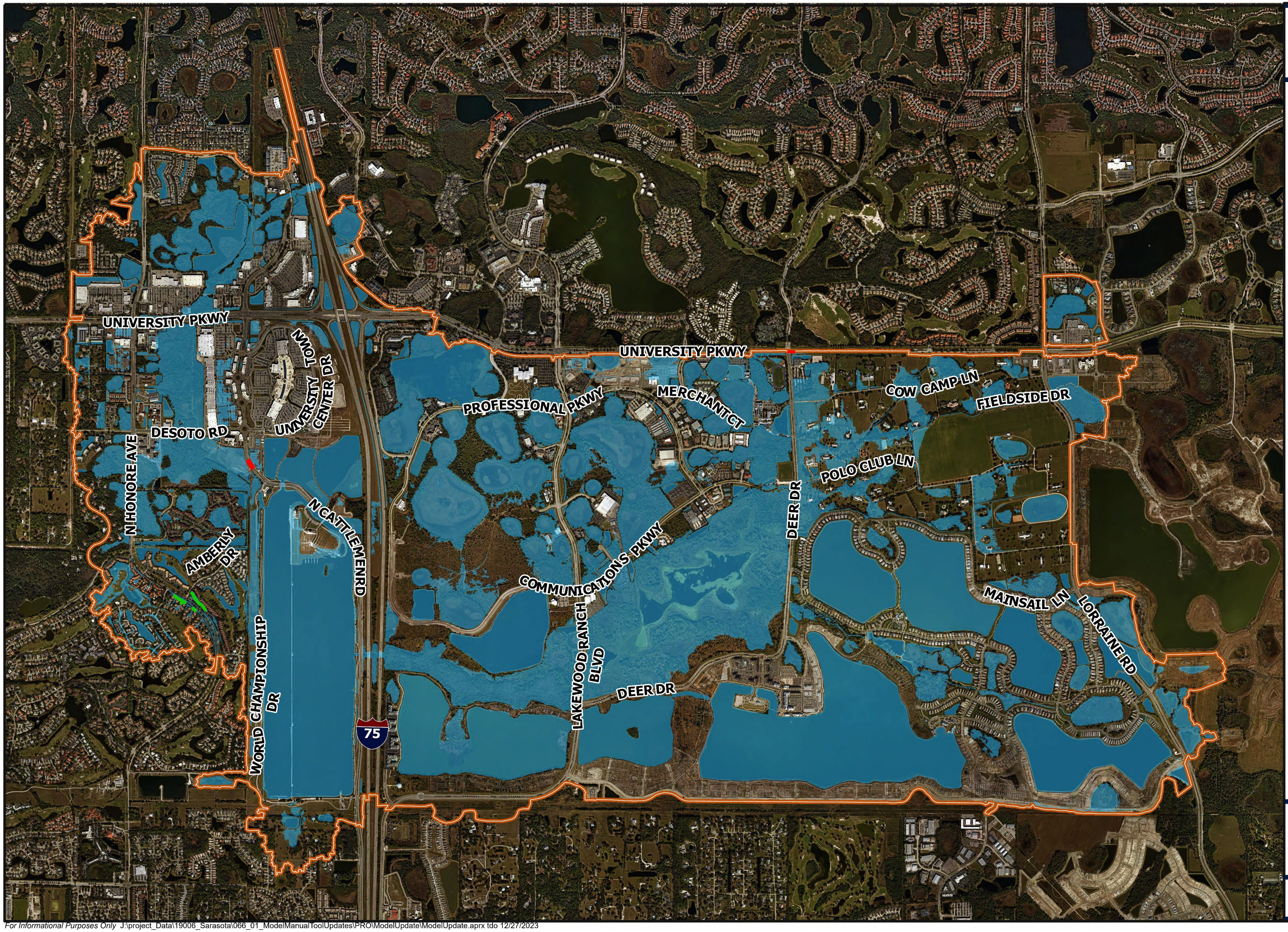
# Appendix D-2
# Roadway FPLOS Extents

**Appendix D-2**

**FPLOS Deficient - Roadways**

Lyons Bay

Watershed Management Plan





Watershed

Floodplain - 100YR24HR

FPLOS Deficient Roadways

- Evacuation
- Arterial
- Collector
- Neighborhood

N
W E
S

0 1,000 2,000

Feet

1:26,000

Sarasota County

JonesEdmund

For Informational Purposes Only J:\project_Data\19006_Sarasota\066_01_ModelManualToolUpdates\PRO\ModelUpdate\ModelUpdate.aprx tdo 12/27/2023