Sarasota County Watershed Model Conversion and Maintenance

(RPS202061 MN)

Lemon Bay Model Update Report

August 2024

Prepared For:
Sarasota County
1001 Sarasota Center Boulevard
Sarasota, Florida 34240

Under Contract 2021-269

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1. Introduction

Collective Water Resources (Collective) performed an update of the Interconnected Pond and Routing Version 4 (ICPR4) model and associated Geographic Watershed Information System (GWIS) Version 2.1 geodatabase to include recent developments, incorporate additional overland connections for the 500-year storm event, and address watershed boundary gaps and overlaps with adjacent watersheds for eight Sarasota County watersheds as requested by Sarasota County (County). Collective performed these updates to eight watershed models, as assigned by the County, which includes:

- Dona Bay/Roberts Bay Coastal Fringe,
- Lemon Bay Coastal Fringe,
- Sarasota Bay Coastal Fringe,
- Hudson Bayou,
- Lemon Bay (Alligator Creek, Forked Creek, Woodmere Creek, Gotfried Creek, and Ainger Creek),
- Roberts Bay (Hatchett Creek and Curry Creek),
- Upper Myakka River (Big Slough, Deer Prairie Slough, Howard Creek, and Flatford Swamp), and
- Whitaker Bayou

This report summarizes the model update task and preliminary modeling results for the Lemon Bay (LB) watershed. This is a deliverable under Task 2, Model Update, of Agreement 2021-269 for professional services in support of Watershed Model Conversion and Maintenance. These model updates build upon the work previously completed by Collective under a separate agreement with the Southwest Florida Water Management District (SWFWMD) under Task Work Assignment 20TW0002964 associated with Agreement Number 19CN00001996 in converting the ICPR version 3 model to ICPR4, documented in *WMP-Watershed Management Plan Model Conversion ICPR3 to ICPR4 (P242)* technical memorandum, finalized on December 16, 2020.

2. Developments

Collective reviewed the watershed's GWIS data provided by the County relative to 2020 aerial imagery to identify developments that have been constructed or show groundbreaking as of the 2020 imagery but are not reflected in the model and GWIS data. **Table 1** summarizes the recent developments identified within the watershed having an impact on the intermediate and/or regional hydrology and hydraulics and warranting updates to the watershed model.

Table 1. Summary of Developments included with Model Update

Name	SWFWMD ERP
Park Forest – Phase 6B & 6C	43-941-11
SR 45 (US 41) from River Road to Woodmere Park Boulevard	43-12340-3
Sarasota National – Phase 3	43-28205-20
Sarasota National – Phase 4	43-28205-21
Sarasota National – Pods B, C, & BB	43-28205-22
Sarasota National – Phase 6	43-28205-24
Sarasota National – Phase 7 Sarasota National Pod I Multi Family Phase 2	43-28205-25 43-28205-34
Sarasota National – Phase 8	43-28205-26
Sarasota National – Phase 9	43-28205-28
Boca Royale – Unit 12	43-31612-8
Boca Royale – Unit 13	43-31612-10
Boca Royale – Unit 16	43-31612-12
Datura Ditch Stormwater Modifications	43-35649-1
Rapalo	43-42136-0
Boca Royale – Unit 15	43-43509-0
Park Forest – Phase 6A	44-941-9
Park Forest – Phase 6D	44-941-12

3. Topographic Data Voids

The most recent digital topographic data for the county was published by the United States Geological Service (USGS) in partnership with the Florida Department of Emergency Management (FDEM) reflecting light detection and ranging (lidar) data acquisition between November 30, 2018, and January 10, 2019 (Dewberry 2020). The Sarasota County project was completed as part of the Florida Peninsular 2018 D19 DRRA project. Lidar products include classified LAS point files, breaklines, digital elevation model (DEM) rasters, and associated reports for a total of 694 5,000 feet by 5,000 feet tiles (approximately 622 square miles) of coverage across the county.

The SWFWMD provided enhancements of the Sarasota County lidar products including additional breaklines, features for waterbodies, and building footprints. SWFWMD produced a countywide, DEM raster (as an IMAGINE Image file, floating point, 32-bit, 1 band) with 2.5 feet by 2.5 feet cell size referenced to North American Datum of 1983 with the 2011 Adjustment (NAD83_2011) horizontal datum, Florida State Plane Zone West coordinate system and North American Vertical Datum of 1988 (NAVD88) vertical datum. This 2019 SWFWMD DEM served as the base topographic layer for the model updates performed in the watershed.

Collective reviewed the 2019 SWFWMD DEM against the grading and surface elevations defined in the plans for the developments listed in Table 1 as well as 2020 aerial imagery and found five developments where the DEM does not reflect the ground surface. The elevation differences were significant enough within these five developments to warrant updating the DEM. **Table 2** summarizes the developments where topographic voids were identified.

Table 2. Developments with Topographic Voids

Name	SWFWMD ERP
Sarasota National – Phase 7 Sarasota National Pod I Multi Family Phase 2	43-28205-25 43-28205-34
Sarasota National – Phase 9	43-28205-28
Boca Royale – Unit 16	43-31612-12
Datura Ditch Stormwater Modifications	43-35649-1
Boca Royale – Unit 15	43-43509-0

For each development listed in Table 2, Collective geo-referenced the appropriate as-built plans or, when as-builts were not available, approved construction plans, in GIS; captured elevation features for major site elements such as ponds, roadways, parking lots, lots, building footprints, and/or swales. **Figure 1** represents the types of elevation features that were created by Collective within GIS from the plans for the Boca Royale – Unit 15 development, which were subsequently used to generate a terrain and updated DEM for the site. The updated DEM, compared to the original DEM, is illustrated for the same development in **Figure 2**. Each of the site DEMs were mosaiced into the 2019 SWFWMD DEM to produce an updated, countywide DEM. Additionally, at the request of the County, Collective projected the updated DEM to the North American Datum of 1983 with the HARN Adjustment (NAD83_HARN) horizontal datum.

Figure 1. ERP 43-43509-0, Boca Royale – Unit 15, Elevation Features Captured from Plans

Original, 2019 SWFWMD DEM

Updated DEM

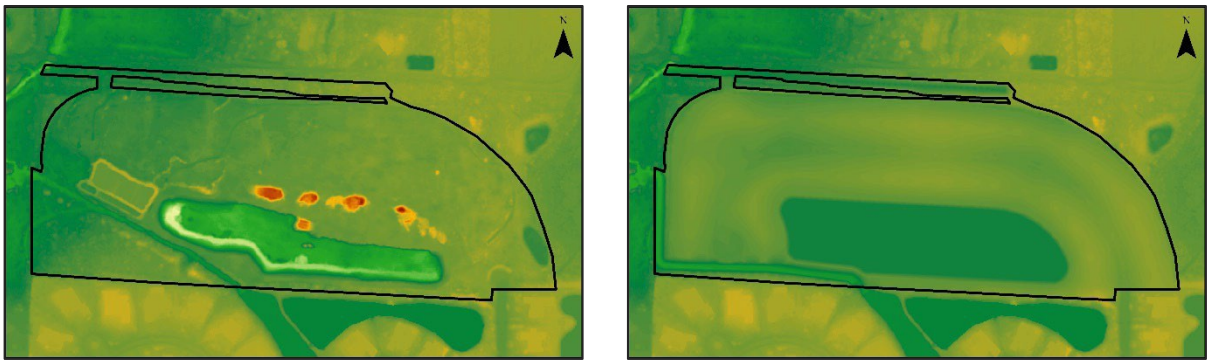


Figure 2. DEM Comparison for ERP 43-43509-0, Boca Royale – Unit 15,

4. Model Development Updates

For each development listed in Table 1, the design plans and other relevant permit information were obtained from the District's Environmental Resource Permit (ERP) data warehouse application – Water Management Information System (WMIS). Additionally, the County provided available plans, exhibits, GIS files, and ICPR version 3 model files associated with the Boca Royale, Park Forest, Rapalo, and Sarasota National developments.

The plans were reviewed to identify the sheets that have relevant information to the GWIS being updated. The plan view sheets and a model schematic (if available in the permit files) were exported to image files (JPEG), clipped to the limits of the development, and georeferenced in ArcMap to make it easier to correlate the existing GWIS features to the modifications shown in the plans.

Next, a new ArcMap MXD file was created with the following data:

- The GWIS to be updated under this task
- The original GWIS - for comparison purposes
- The GWIS of adjacent watersheds, as needed
- The georeferenced plan sheets and permit model schematic
- The 2019 SWFWMD DEM
- Current aerial imagery (2020 and 2022 from the County's image service)
- Current 2020 land use feature class
- County impervious area (IA) feature class

Any modifications/updates to the GWIS were noted in the *Comment* field of the appropriate feature class. The elevation datum of the plans was noted so that, if needed, plan elevations were converted to NAVD88 using a conversion factor of -1.08 feet.

4.1. Hydrologic Parameterization Methodology

Collective's overall hydrologic parameterization approach for model updates is summarized below. Specifics related to individual developments included in this update are presented in Section 4.3.

The design plans and permit information are reviewed to identify any appropriate changes to the basin boundaries. When available, the model schematic from the permit application is used as a guide, considering the permit model may have been developed to a differing level of detail than appropriate for the watershed model. The permit model's basins, hydraulic features, and 2019 DEM are collectively used to perform any needed modifications to the ICPR_BASIN feature class.

Any basins that are modified are reviewed to determine if revisions to the time of concentration (TOC) and IA are required.

TOCs for modified small, urban basins with minimum TOCs (10 minutes) originally assigned are maintained. If the estimated flow path for a revised basin changes by more than 10-percent from the original basin, a revised flow path is digitized and the Natural Resources Conservation Service (NRCS) TR55 methodology is used to calculate new TOC(s), which is/are entered into the *TC [min]* field of the ICPR_BASIN feature class.

If the revised basin area differs by more than one-percent from the original, it is reviewed to determine if changes to the curve number (CN) and IA/directly connected impervious area (DCIA) are needed. If the overall land use remains the same, no adjustment is needed. However, if the land use or the acres of IA/DCIA change, the land use and impervious area mapping are used to update these

values. Where needed, buildings, roads, and other impervious areas are digitized to obtain complete IA coverage for the revised basins.

Next, the IA is assigned as either directly connected or non-directly connected and the acreage of each is determined. The revised curve number is calculated using the County-approved methodology as described below (Sarasota County 2021):

- DCIA is not used to calculate the CN
- Pervious area is assigned a CN of 78
- Non-DCIA is assigned a CN of 98
- Basin CN is calculated using CN = $((A_{pervious} * 78) + (A_{NDCIA} * 98))/ (A_{pervious} + A_{NDCIA})$, where A is the area in acres and the subscript indicates the type of area (pervious or NDCIA).

Any updated *CurveNumber*, *PctImpervious*, and *PctDCIA* fields are entered into the ICPR4_Simple_Basin, ICPR4_CURVE_NUMBER_ZONES, and ICPR4_IMPERVIOUS_ZONES tables of the GWIS geodatabase accordingly.

4.2. Hydraulic Connectivity and Parameterization Methodology

Collective's overall approach to updating hydraulic connectivity and parameterization for new developments is summarized below. Specifics related to the individual developments included in this update are presented in Section 4.3.

The as-built and approved construction plans are reviewed to identify any hydraulic features that should be included in the model, such as:

- Pipes connecting stormwater ponds
- Stormwater system trunk lines
- Control structures
- Outfall pipes
- New/modified channels
- New/modified stormwater ponds

Features that would not typically be included in the watershed model/GWIS include:

- Local drainage systems
- Individual inlets along the trunk lines
- Exfiltration trenches

The georeferenced plan sheets are compared to the existing GWIS to identify differences. Where possible, existing node and link names are maintained, though the location and connectivity may be changed.

Nodes

New nodes are placed at the following locations:

- For stormwater trunklines, new nodes would be placed at manholes/junction boxes where the pipe diameter changes or to divide exceptionally long runs of pipe.
- Stormwater ponds

Where appropriate, basins are subdivided to load to the new nodes. The *INITIAL_STAGE* field of the ICPR_NODE feature class of new or modified nodes is updated to be the elevation of the invert of the lowest connecting pipe or the normal water elevation of a connected water body, whichever is highest.

For nodes associated with basins that are modified, the storage is updated using the ArcHydro Drainage Area Characterization (DAC) tool with the 2019 DEM as the elevation raster input. If a channel link is inside the modified basin, the Storage_Exclusion_Polygon feature class is updated to include the channel and its area excluded from the DAC storage calculations.

Pipe Links

The georeferenced plans are reviewed to identify both new pipes to be added to GWIS and ones that should be modified. Potential updates to pipe links would be:

- Changes in connectivity (upstream and downstream nodes)
- Pipe diameter and material
- Length
- Inverts
- Entrance and exit losses

New pipes are added to the ICPR_LINK feature class and, for both new and modified pipes, the appropriate parameter changes are made to the associated PIPE_BARREL table.

Drop Structure Links

Drop structures have both pipe and weir components and are most commonly used for watershed modeling to simulate control structures. Plans are reviewed to identify new drop structures and existing ones that were modified or differ from current model parameters. New/modified drop structure links are set to use the “interval halving” solution method based on the County’s standard by setting the *Solution* field to “Combined” and the *Increments* field to “0” in the DROP_STRUCTURE table.

The PIPE_BARREL and WEIR tables are modified as needed to capture parameters of the drop structure’s components. WEIR table entry updates would typically include:

- Weir shape
- Weir type
- Weir crest
- Weir span and rise
- Weir discharge coefficient

Structural Weir Links

For purposes of the watershed GWIS updates, structural weirs are manufactured structures controlling flow between two points that do not have an integrated pipe component like a drop structure does. The structural weirs are added to the ICPR_LINK feature class and associated WEIR table entries completed.

Surface Overflow Weirs

Surface overflow weirs (SOWs) simulate flow across basin boundaries. When basins are modified, they are examined to determine if existing SOW(s) cross(es) basin boundary segments that were modified. If so, the cross-section representing the ground elevations of the modified basin segment is generated to replace the existing cross-section and the ArcGIS 3D Analyst Stack Profile tool is used to obtain station/elevation data to define the cross-section's geometry. The associated WEIR table entry is updated with the crest elevation (minimum cross-section elevation) and the ICPR_XSECT_STATIONS table data is replaced with the new data.

Modified basin segments without an existing SOW are reviewed to determine if they are likely to have flow across them for the 500-year/24-hour design storm. If so, a new SOW link is added to the ICPR_LINK feature class, a cross-section is added to the ICPR_XSECT feature class, and the associated WEIR and ICPR_XSECT_STATIONS tables are completed.

Channels

If a development area includes a channel (natural or constructed), it is reviewed to determine if any modifications are necessary to GWIS. Potential modifications may include:

- Existing channel connectivity changing
- Existing channel length, inverts, or geometry changing
- New channel was constructed

For existing channels that are modified, the ICPR_LINK and ICPR_XSECT feature classes and the CHANNEL and ICPR_XSECT_STATIONS tables are modified as appropriate.

For new channels, a new channel link is added to the ICPR_LINK feature class and new channel cross-sections are added to the ICPR_XSECT feature class. The CHANNEL table entries are completed, and design plan data combined with the 2019 DEM are used to complete the ICPR_XSECT_STATIONS table entries.

4.3. ERP 43-941-11, Park Forest – Phase 6B & 6C

The updates for ERP 43-941-11 included modifications to basins, nodes, pipes, surface overflow weirs, and cross-sections as shown in **Figure 3**.

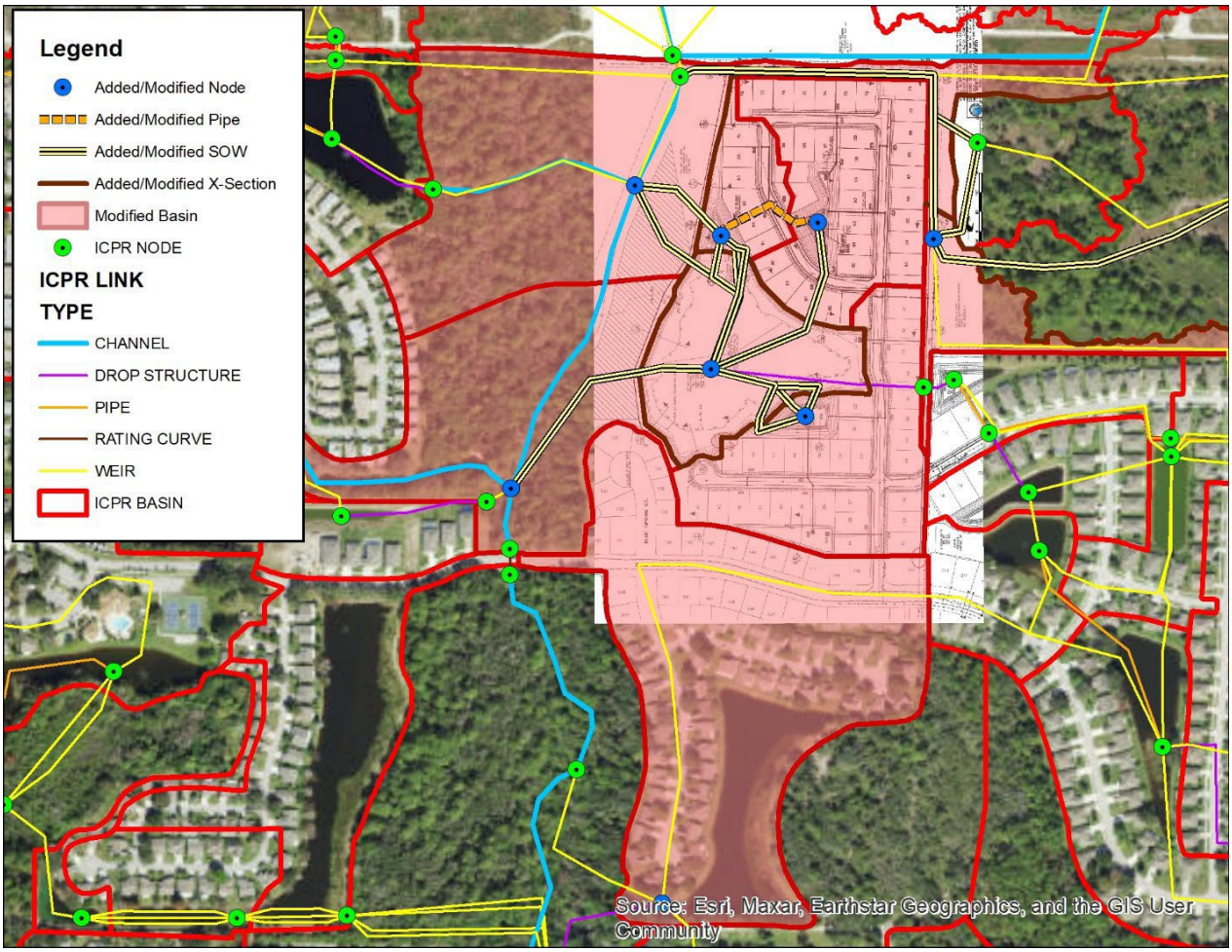


Figure 3. ERP 43-941-11 Updates

The updates included:

- **Basins** – eight basins were added/modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – eight nodes were added/modified
- **Pipes** – one pipe link was added/modified along with the associated pipe barrel table entry
- **Surface Overflow Weirs**– 14 surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.4. ERP 43-12340-3, SR 45 (US 41) from River Road to Woodmere Park Boulevard

Upon inspection of the plans, it was determined that the GWIS would not require updating as the changes to the hydrology and hydraulics were not significant to be reflected in the model.

4.5. ERP 43-28205-20, Sarasota National – Phase 3

ERP 32-28205-20 was reviewed and the basins in GWIS matched those indicated by the permit submittal and were not updated. The pipes and control structures were spot checked, and some

differences were found between the as-builts and GWIS. The as-builts were thoroughly reviewed and updates included modifications to drop structures, structural weirs, and a pipe as shown in **Figure 4**.

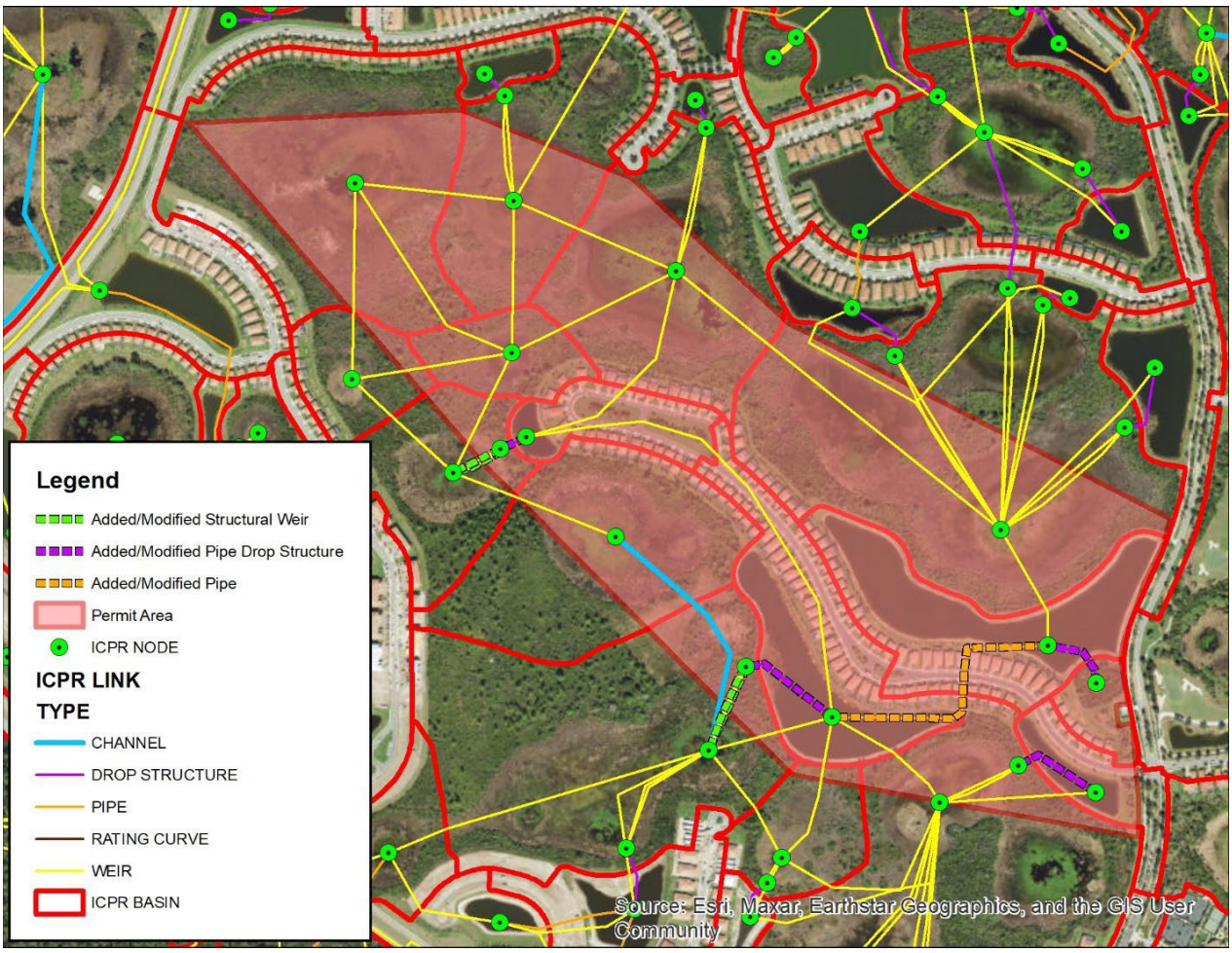


Figure 4. ERP 43-28205-20 Updates

The updates included:

- **Drop Structures** – four drop structure links were added/modified
- **Structural Weirs** – four structural weir links were added/modified along with the associated weir table entries
- **Pipes** – one pipe link was added/modified, and the pipe barrel table updated.

4.6. ERP 43-28205-21, Sarasota National – Phase 4

ERP 43-28205-21 was reviewed and the basins in GWIS matched those indicated by the permit submittal and were not updated. The pipes and control structures were spot checked, and some differences were found between the as-builts and GWIS. The as-builts were thoroughly reviewed and updates included modifications to drop structures, structural weirs, and a pipe as shown in **Figure 5**.

Figure 5. ERP 43-28205-21 Updates

The updates included:

- **Drop Structures** – four drop structure links were added/modified, and the associated pipe barrel and weir tables were updated
- **Structural Weirs** – 14 structural weir links were added/modified, and the weir tables were updated
- **Pipes** – three pipe links were added/modified, and the pipe barrel table was updated.

4.7. ERP 43-28205-22, Park Forest – Pods B, C, & BB

The updates for ERP 43-28205-22 included modifications to basins, nodes, pipes, and drop structures as shown in **Figure 6**. Almost all of the development was already in GWIS and only a few modifications were required.

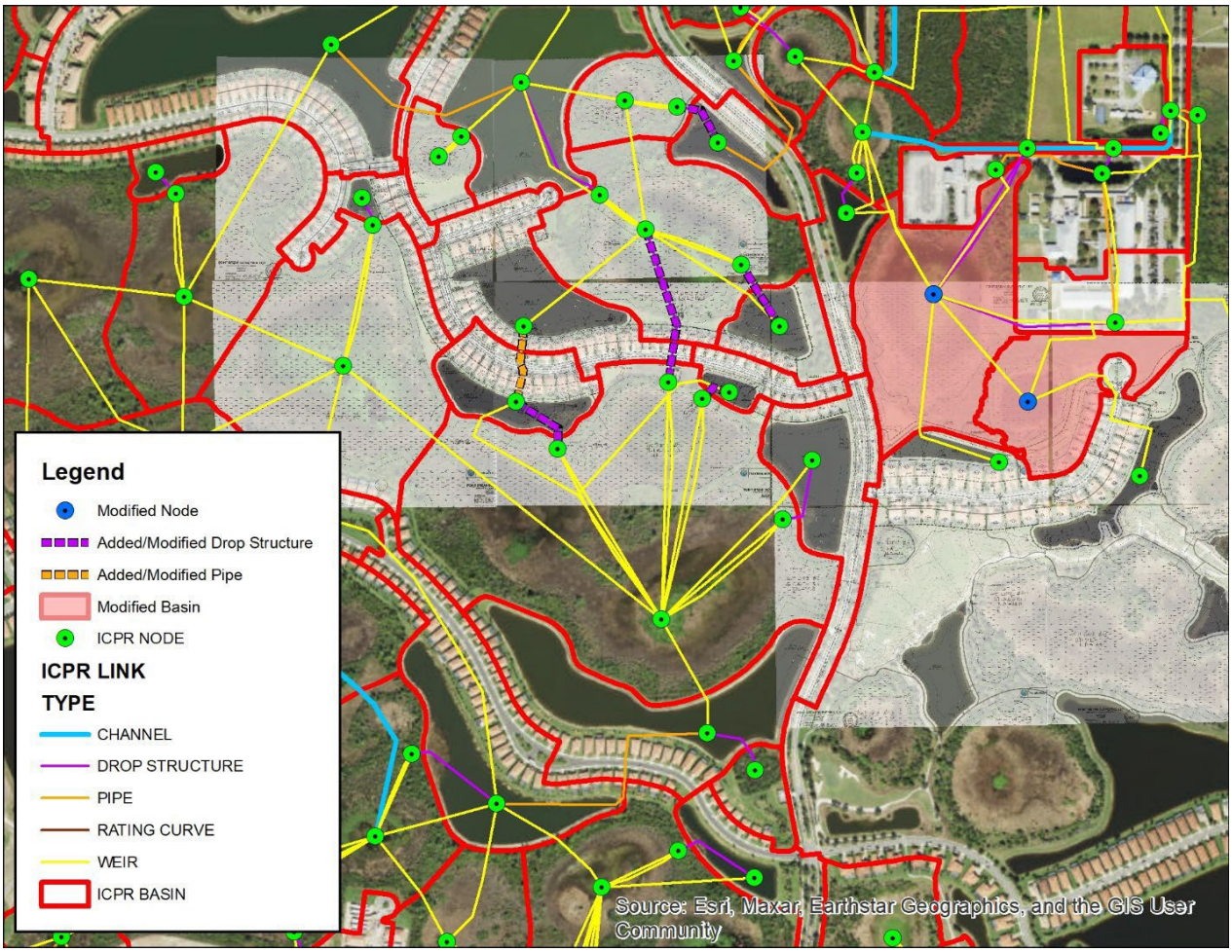


Figure 6. ERP 43-28205-22 Updates

The updates included:

- **Basins** – two basins were slightly modified, and the associated node storage, CN, and IA were updated
- **Nodes** – two nodes were modified
- **Pipes** – one pipe link was modified, and its pipe barrel table entry was updated
- **Drop Structures** – five drop structure links were added/modified along with their associated pipe barrel and weir table entries.

4.8. ERP 43-28205-24, Sarasota National – Phase 6

It was determined that the ERP 43-28205-24 development was already in GWIS, and no modifications were necessary.

4.9. ERP 43-28205-25, Sarasota National – Phase 7

ERP 43-28205-25 was reviewed and the basins in GWIS matched those indicated by the permit submittal and were not updated. The pipes and control structures were spot checked, and some

differences were found between the as-builts and GWIS. The as-builts were thoroughly reviewed and updates included modifications to drop structures, structural weirs, and pipes as shown in **Figure 7**.

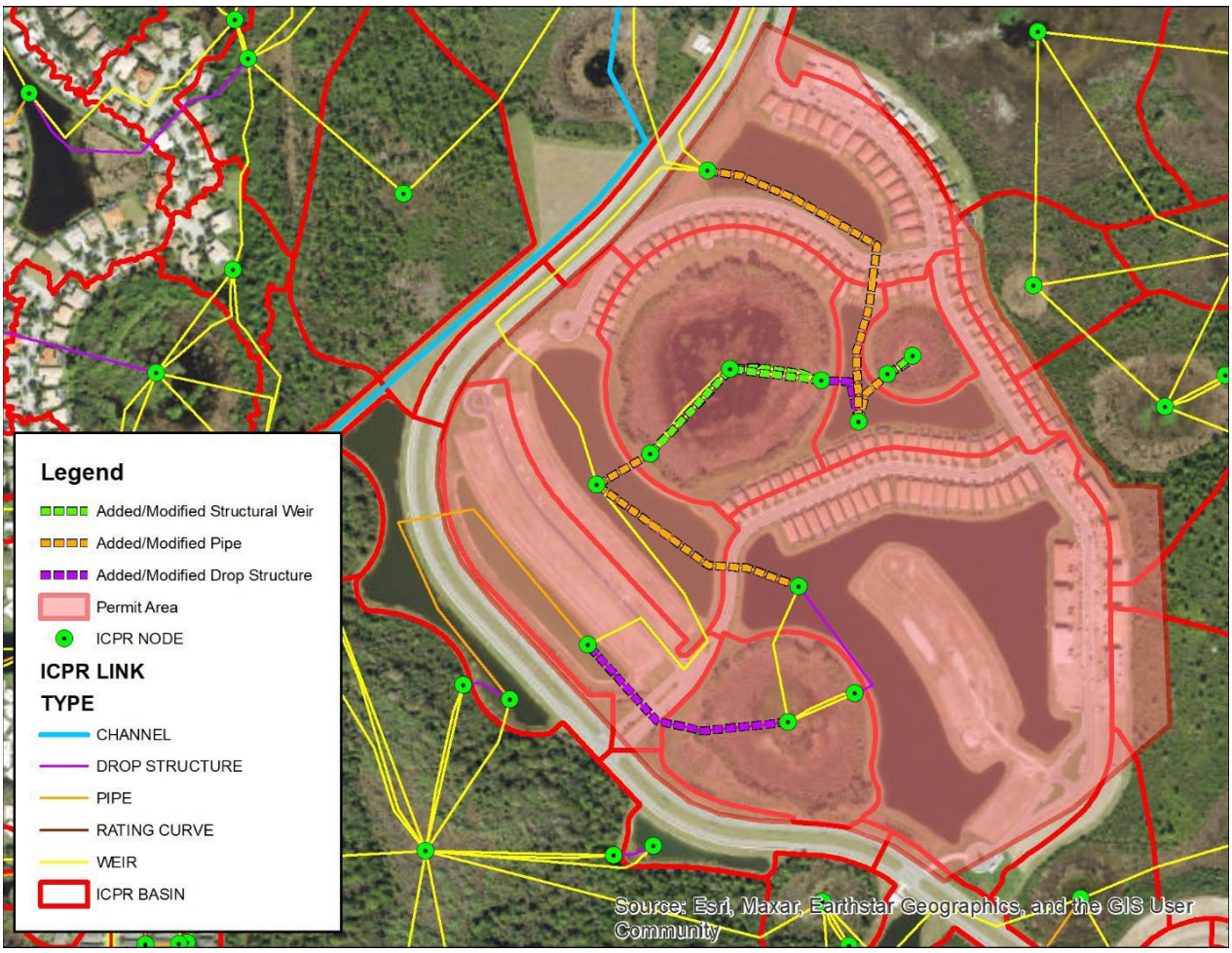


Figure 7. ERP 43-28205-25 Updates

The updates included:

- **Drop Structures** – two drop structure links were added/modified, and the pipe barrel and weir table entries were updated
- **Structural Weirs** – five structural weir links were added/modified along with their weir table entries
- **Pipes** – four pipe links were added/modified, and the pipe barrel table was updated.

4.10. ERP 43-28205-26, Sarasota National – Phase 8

ERP 43-28205-26 was reviewed and the basins in GWIS matched those indicated by the permit submittal and were not updated. The pipes and control structures were spot checked, and some differences were found between the as-builts and GWIS. The as-builts were thoroughly reviewed and updates included modifications to drop structures, and pipes as shown in **Figure 8**.

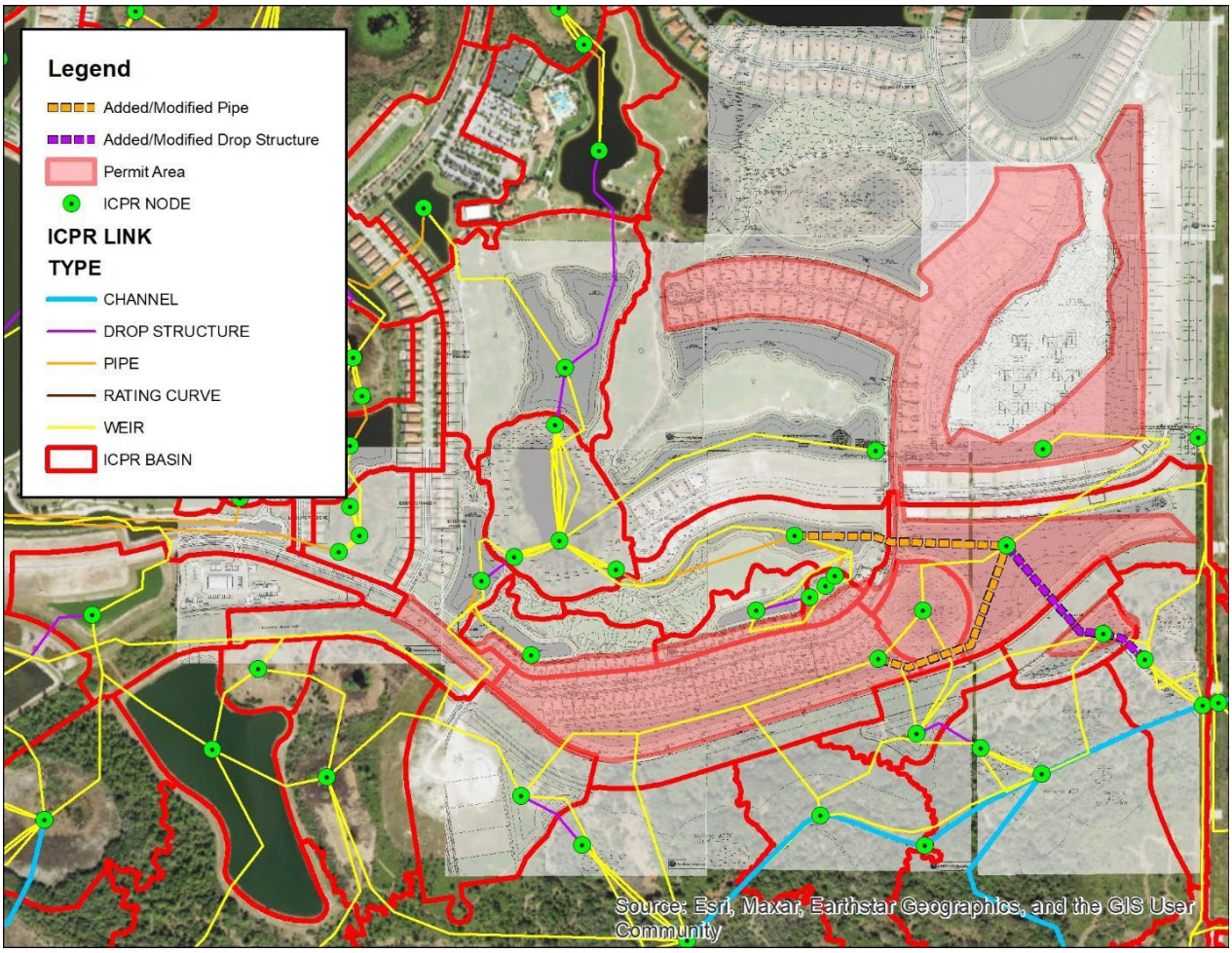


Figure 8. ERP 43-28205-26 Updates

The updates included:

- **Drop Structures** – two drop structure links were added/modified along with the associated pipe barrel and weir table entries
- **Pipes** – two pipe links were added/modified, and the pipe barrel table was updated.

4.11. ERP 43-28205-28, Sarasota National – Phase 9

It was determined that the ERP 43-28205-28 development was already in GWIS, and no modifications were necessary.

4.12. ERP 43-31612-8, Boca Royale – Unit 12

The updates for ERP 43-31612-8 included modifications to basins, nodes, pipes, drop structures, SOWs, and cross-sections as shown in **Figure 9**.

Figure 9. ERP 43-31612-8 Updates

The updates included:

- **Basins** – 15 basins were modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – 16 nodes were modified
- **Drop Structures** – five drop structure links were added/modified, and the associated pipe barrel and weir tables were updated
- **Pipes** – four pipe links were modified, and their pipe barrel table entries were updated
- **Surface Overflow Weirs** – 14 surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.13. ERP 43-31612-10, Boca Royale – Unit 13

The updates for ERP 43-31612-10 included modifications to basins, nodes, pipes, drop structures, structural weirs, SOWs, and cross-sections as shown in **Figure 10**.

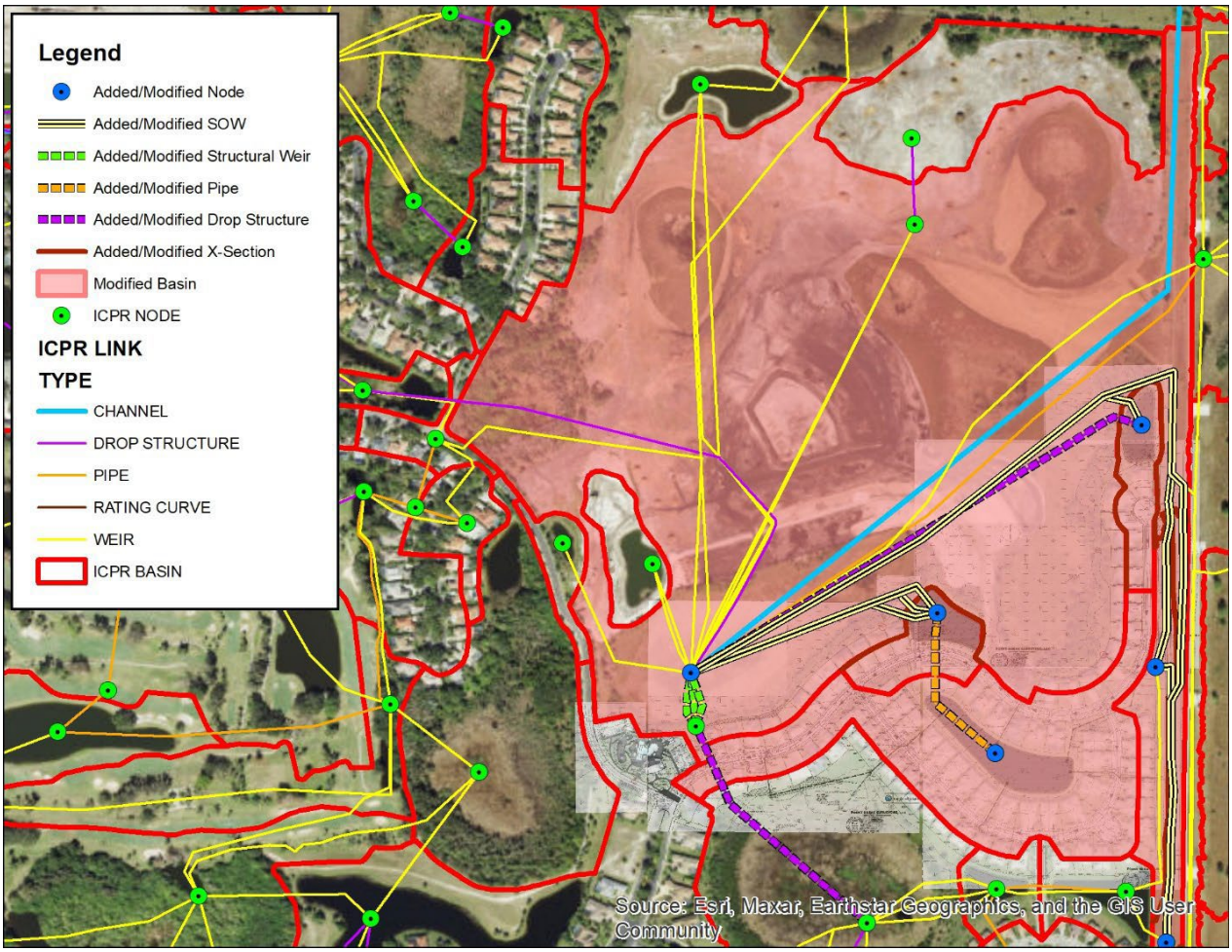


Figure 10. ERP 43-31612-10 Updates

The updates included:

- **Basins** – six basins were modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – six nodes were modified
- **Drop Structures** – two drop structure links were added/modified along with their associated pipe barrel and weir table entries
- **Pipes** – one pipe link was added/modified, and its pipe barrel table entry was updated
- **Structural Weirs** – three structural weir links were added/modified along with the associated weir table entries
- **Surface Overflow Weirs** – eight surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.14. ERP 43-31612-12, Boca Royale – Unit 16

The updates for ERP 43-31612-12 included modifications to basins, nodes, pipes, drop structures, structural weirs, SOWs, and cross-sections as shown in **Figure 11**.

Figure 11. ERP 43-31612-12 Updates

The updates included:

- Basins – nine basins were modified, and the associated node storage, TOC, CN, and IA were updated
- Nodes – 11 nodes were added/modified
- Pipes – four pipe links were added/modified, and the pipe barrel table entries were updated
- Drop Structures – two drop structure links were added/modified, and the pipe barrel and weir table entries were updated
- Structural Weirs – 12 structural weir links were added/modified along with the associated weir table entries.
- Surface Overflow Weirs – five surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.15. ERP 43-35649-1, Datura Ditch Stormwater Modifications

The updates for ERP 43-35649-1 included modifications to basins, nodes, pipes, structural weirs, SOWs, and cross-sections as shown in **Figure 12**.

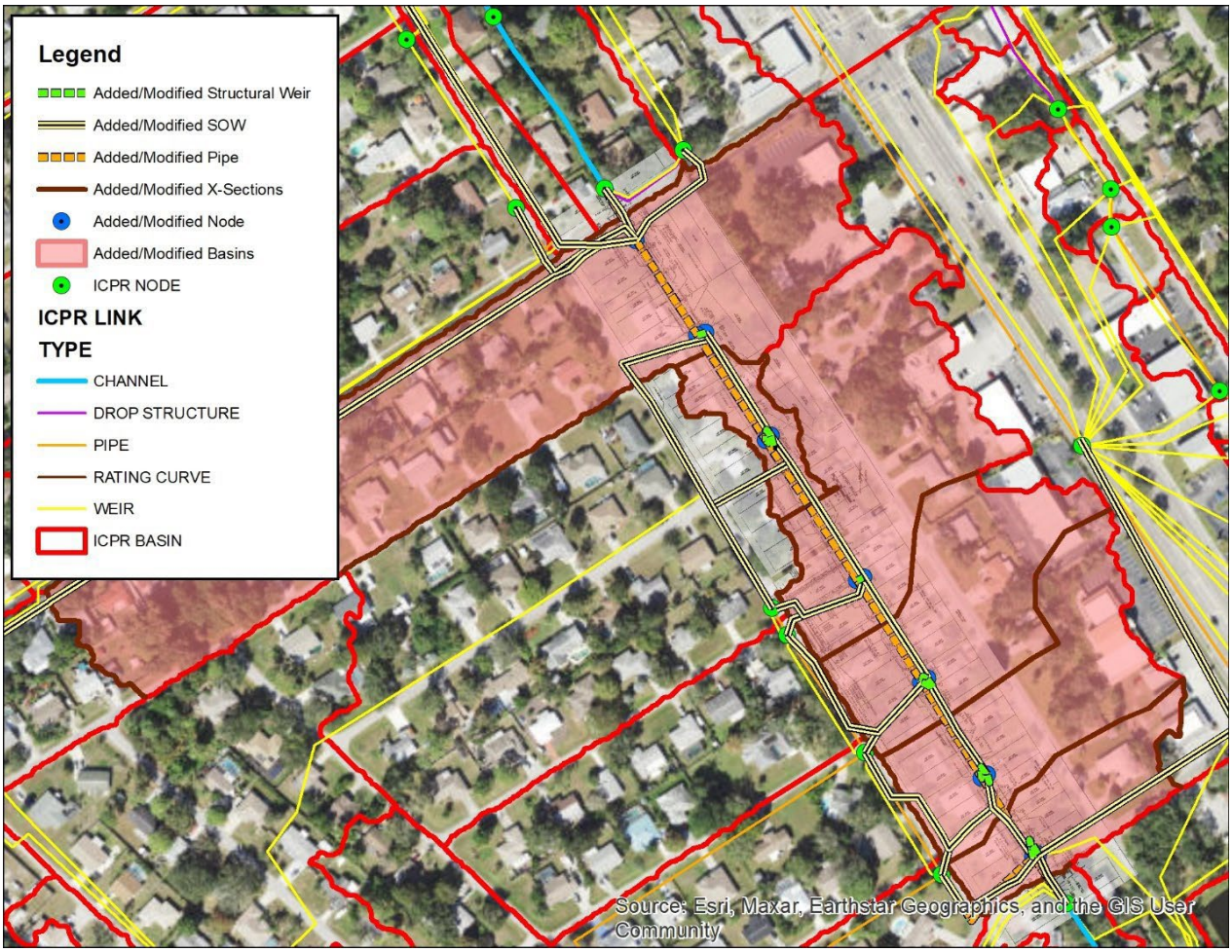


Figure 12. ERP 43-35649-1 Updates

The updates included:

- **Basins** – six basins were added/modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – 13 nodes were added/modified
- **Pipes** – 10 pipe links were added/modified, and the pipe barrel table entries were updated
- **Channels** – several channel links were removed as the existing ditch was converted to a piped system.
- **Structural Weirs** – 15 structural weir links were added/modified along with the associated weir table entries.
- **Surface Overflow Weirs** – 21 surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.16. ERP 43-42136-0, Rapalo

The updates for ERP 43-42136-0 included modifications to basins, nodes, drop structures, structural weirs, SOWs, and cross-sections as shown in **Figure 13**.

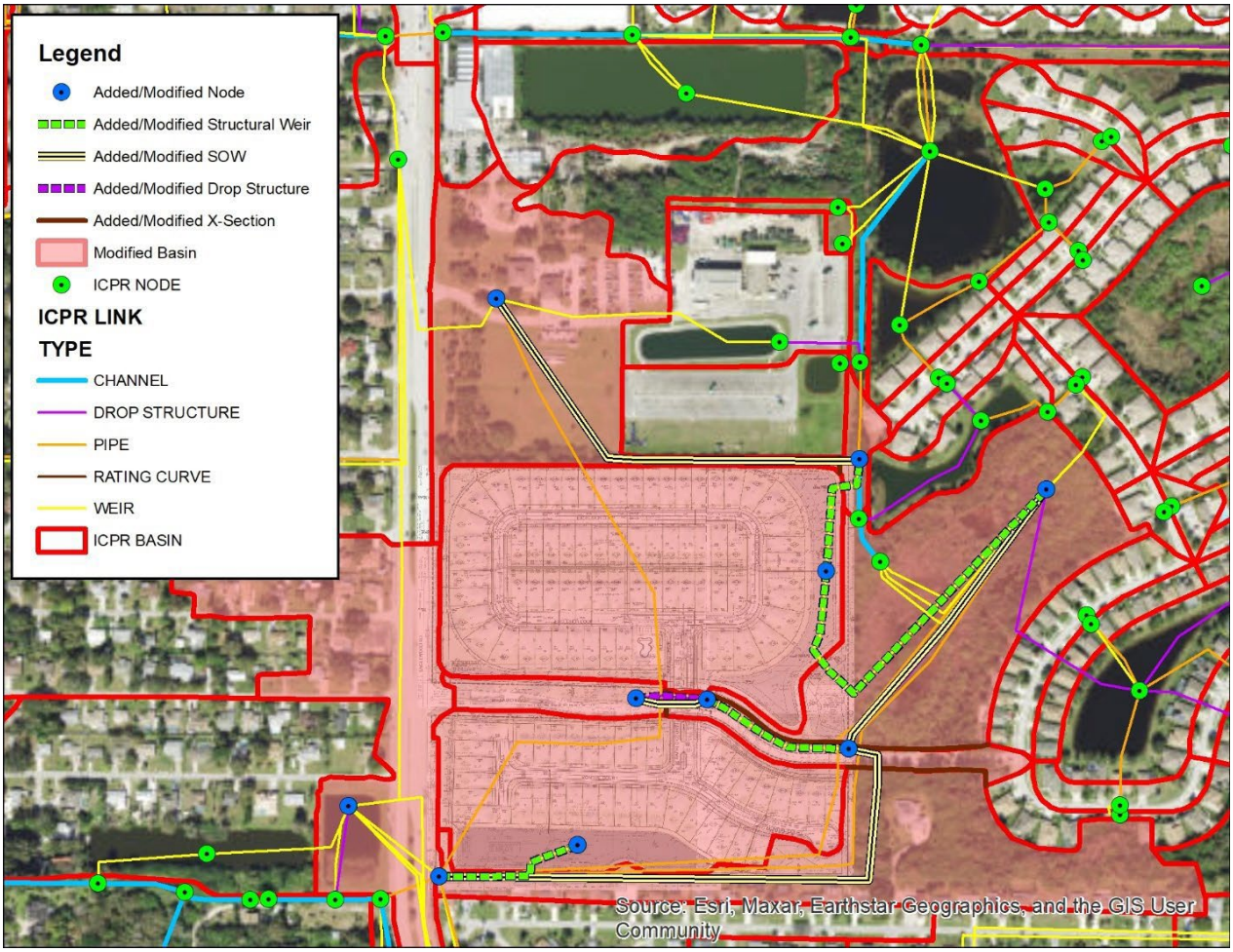


Figure 13. ERP 43-42136-0 Updates

The updates included:

- **Basins** – nine basins were added/modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – 10 nodes were added/modified
- **Drop Structures** – one drop structure link was added/modified, and the pipe barrel and weir table entries were updated
- **Structural Weirs** – four structural weir links were added/modified along with the associated weir table entries
- **Surface Overflow Weirs** – four surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.17. ERP 43-43509-0, Boca Royale – Unit 15

The updates for ERP 43-43509-0 included modifications to basins, nodes, drop structures, channels, SOWs, and cross-sections as shown in **Figure 14**.

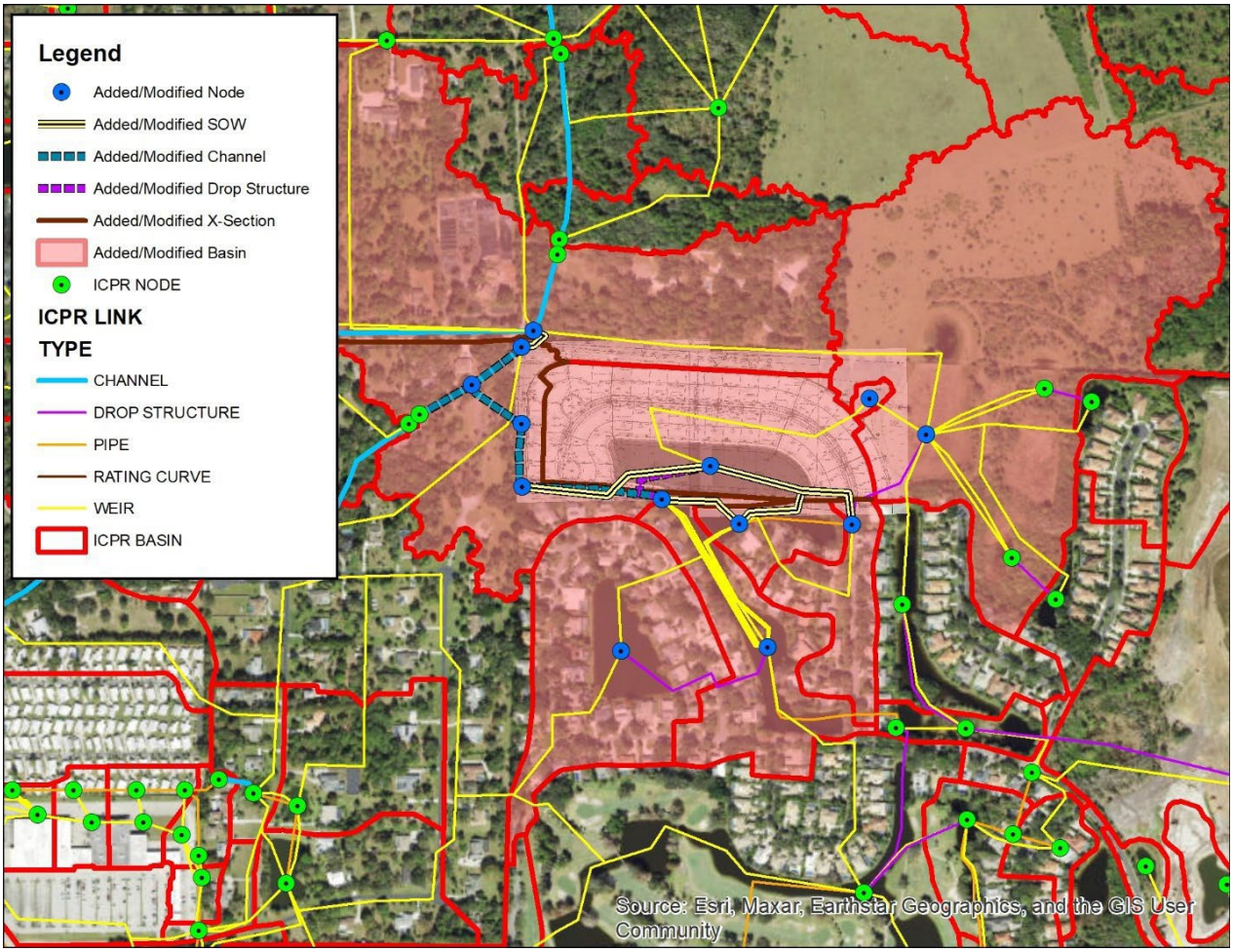


Figure 14. ERP 43-43509-0 Updates

The updates included:

- **Basins** – nine basins were added/modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – 13 nodes were added/modified
- **Drop Structures** – one drop structure link was added/modified along with its pipe barrel and weir table entries
- **Channels** – five channel links were added/modified along with the associated channel table entries.
- **Surface Overflow Weirs** – five surface overflow weir links were added/modified along with their associated cross-sections and weir table entries.

4.18. ERP 44-941-12, Park Forest – Phase 6D

The updates for ERP 44-941-12 included modifications to basins, nodes, drop structures, structural weirs, SOWs, and cross-sections as shown in **Figure 15**.

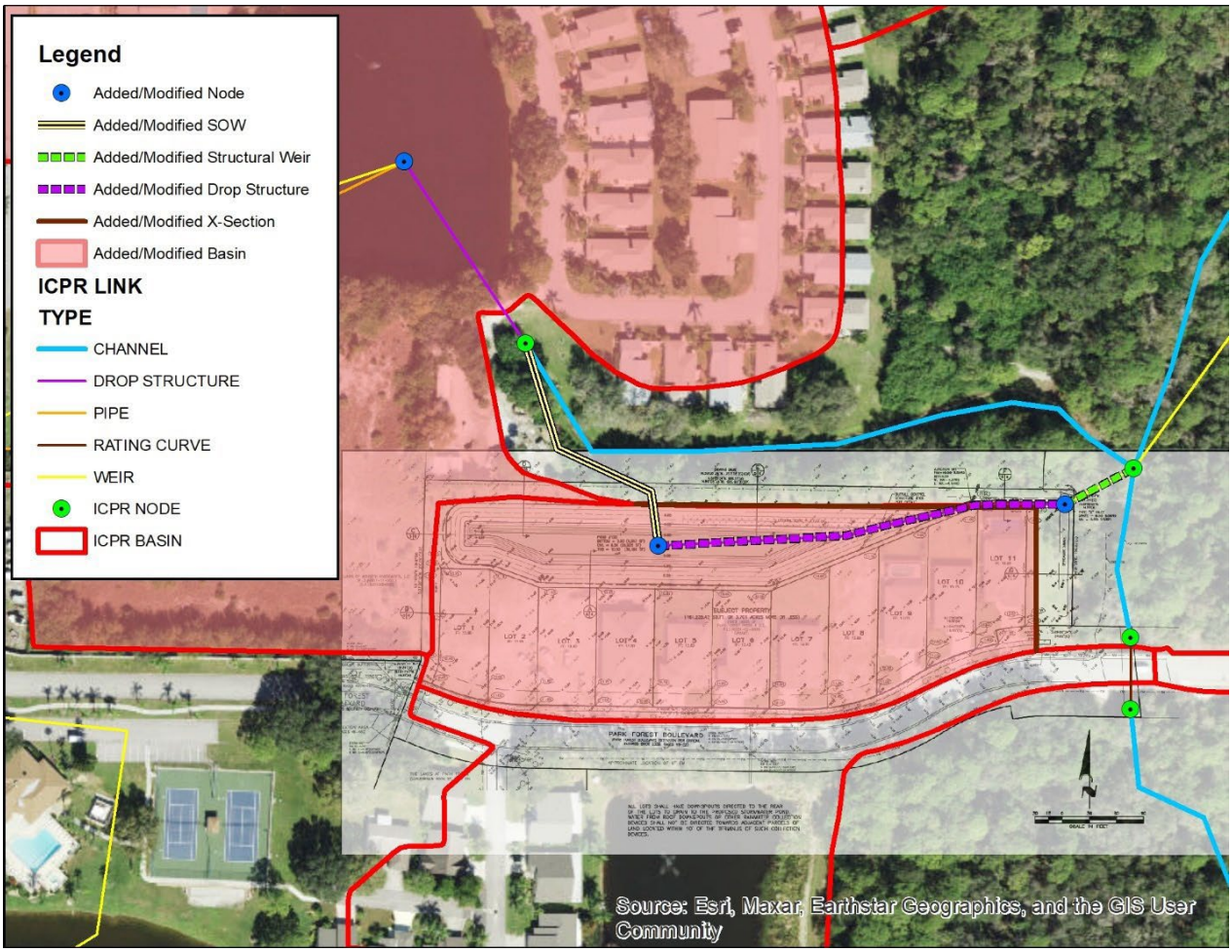


Figure 15. ERP 44-941-12 Updates

The updates included:

- **Basins** – two basins were added/modified, and the associated node storage, TOC, CN, and IA were updated
- **Nodes** – three nodes were added/modified
- **Drop Structures** – one drop structure link was added/modified with its pipe barrel and weir table entries
- **Structural Weirs** – one structural weir link was added/modified along with the associated weir table entries
- **Surface Overflow Weirs** – one surface overflow weir link was added/modified along with the associated cross-section and weir table entries.

4.19. ERP 44-941-9, Park Forest – Phase 6A

The updates for ERP 44-941-9 included modifications to nodes, drop structures, and pipes as shown in **Figure 16**.

Figure 16. ERP 44-941-9 Updates

The updates included:

- **Nodes** – four nodes were added/modified
- **Drop Structures** – two drop structure links were added/modified, and the pipe barrel and weir table entries were updated
- **Pipes** – one pipe link was added/modified along with the associated pipe barrel table entries.

4.20. Miscellaneous Updates

During the GWIS update and ICPR4 modeling process, a link was identified that was causing an excessive number of warnings while running the updated ICPR4 model. The weir link was found to have connectivity issues that were causing water to backup erroneously and was corrected. Another

weir link had inconsistent naming and was re-named to be consistent with the other links connected to the "FROM_NODE".

4.21. QA/QC Process Description

The GWIS/ICPR4 model undergoes quality control/quality assurance (QAQC) checks both during and after the update process. During the update process, when a new feature or table entry was added, the connections to all of the related tables were verified and the data inputs were checked to ensure they matched plan set data.

After the development updates were initially completed, the revised data were reviewed for reasonableness. The GWIS was exported to csv format, imported to ICPR4, and the model simulated for the 100-year/24-hour storm. The model results were reviewed for reasonableness.

Additionally, the GWIS updates were independently reviewed by another member of the project team based on a QAQC checklist prepared by Collective for this model update task and provided as a separate deliverable.

5. Bridge Rating Curve Updates

Within ICPR3, bridge hydraulics can be simulated through a direct integration of WSPRO within the model. However, for ICPR4 Streamline Technologies did not include a specific bridge link type or the associated ability to model bridge hydraulics. In converting bridges from ICPR3 to ICPR4, the bridge links are changed to rating curve links and the family of rating curves generated from the ICPR3-based WSPRO are assigned to the links accordingly.

At the request of the County, Collective developed HEC-RAS models for the bridge links within the LB watershed, and utilizing the geometric pre-processor, developed bridge rating curves to replace the WSPRO-based ones from ICPR3. The development of the one-dimensional HEC-RAS models for the watershed's bridges utilized available parameters from the WSPRO input, GWIS geodatabase, and DEM to supplement bridge opening cross-section overbank data for few cross-sections with guidance from both the HEC-RAS 6.0 Reference Manual (May 2021) and 6.0 User's Manual (May 2021), field verification visits, and desktop investigation of readily available online data.

In general, cross-section placements along the bridge link were adjusted to follow the distance for the recommendations provided in the HEC-RAS User and Reference manuals to model bridges. The spatial location of the cross-sections was included in the GWIS version 1.6 geodatabase, originally provided by SWFWMD, and assumed correct. Cross-section station/elevation data were available in the WSPRO files and were input into the models mostly without adjustments, except some added overbank portions of bridge opening cross-sections that were cut from the DEM. Ineffective flow areas were added to some of the cross-sections within the contraction and expansion portions of the bridge representing cross-sections 4 (most upstream) and 1 (most downstream) in the HEC-RAS bridge conceptual model setup. One-to-one expansion and contraction rates were assumed per the

HEC-RAS reference manual. The bridge pier geometry was input based on the WSPRO data and observations from Collective's field visit on December 17, 2021. The number of piers were based on field observations. **Table 2** summarizes assumptions for each bridge link.

Table 2. Summary of Bridge Link Assumptions

Bridge Link	Comments
14203	High chord measured 2'7" above low chord. Overbanks added using DEM elevations to opening cross-section 142303BR. Used cross-section 14203 as most downstream cross-section, instead of 14203EX, since location is more appropriate for HEC-RAS modeling.
15001	High chord measured in field 8'5" above low chord. Bridge opening of 104' measured in field. Overbanks added using DEM elevations to opening cross-section 15001BR. One pier included in model.
15202	High chord measured in field 5' above low chord and includes the wall along the side street that extends well beyond the channel. Bridge opening of 90' measured in field. Overbanks added using DEM elevations to opening cross-section. Two piers included in the model.
15212	Bridge deck assumed 3' above low chord based on field visit. Bridge opening of 64' measured in field. Overbanks added using DEM elevations to opening/most upstream cross-section 15212BR. One pier included in the model.
16001	High chord measured in field 2'9" above low chord and 2'9" wall that exists for length of channel opening. Bridge opening of 106'6" measured in field. Overbanks added using DEM elevations to opening cross-section. Three piers included in the model.
16006	High chord measured in field 5'6" above low chord and includes 1'11" wall. Bridge opening of 183' measured in field. Overbanks added using DEM elevations to opening cross-section. Three piers included in the model.

Once all relevant geometry data and appropriate coefficients were entered, the HEC-RAS geometry preprocessor was run under the unsteady simulation tab to generate headwater, tailwater, and discharge relationships. These were exported to the ICPR4 model as a rating curve operating table. **Figure 17** illustrates the original WSPRO-generated versus revised HEC-RAS- generated rating curves for bridge link 15202. The GWIS geodatabase was updated accordingly as well.

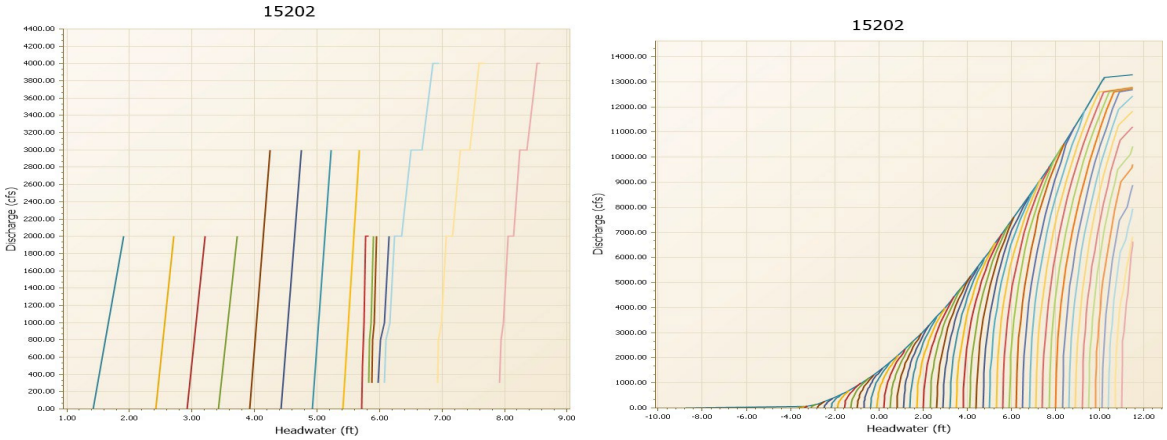


Figure 17. 15202 Bridge WSPRO (left) versus HEC-RAS (right) Generated Rating Curves

The effects of replacing the family of rating curves alone on peak flows for the 100-year/24-hour storm event were evaluated within the final, converted ICPR4 model. Flow plots from ICPR3 for the bridge links were compared against simulation results from the final, converted ICPR4 with both the WSPRO-generated and HEC-RAS-generated rating curves to confirm how the flows compare. As illustrated in **Figure 18** below, there were minimal differences as a result of updating the model with the HEC-RAS-generated rating curves. Peak flow differences are summarized in **Table 3**. For bridge 16006, the large difference in peak flow is attributed to the elimination of flow instabilities within the original ICPR3 model.

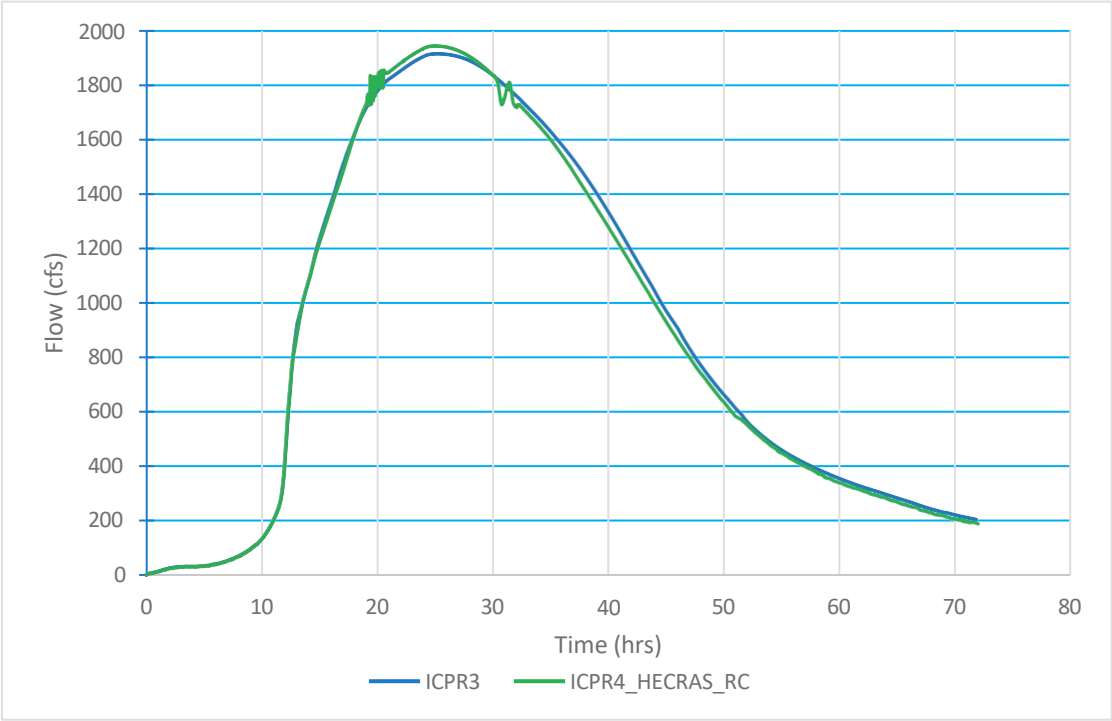


Figure 18. Bridge Link 15202 Flow Chart Comparison

Table 3. Comparison of Peak Flow Differences and Percent Change for Bridge Links

Bridge Link Name	ICPR3 Peak Discharge (cfs)	ICPR4 with HEC-RAS Rating Curves Peak Discharge (cfs)	ICPR3 – ICPR4 (HEC-RAS) Peak Discharge Difference (cfs)	ICPR3 – ICPR4 (HEC-RAS) Peak Discharge Absolute Percent Change
14203	564.85	575.03	-10.18	2%
15001	2,119.06	2,155.05	-35.99	2%
15202	1,912.16	1,940.92	-28.76	2%
15212	1,750.31	1,767.79	-17.48	1%
16001	2,024.56	2,038.78	-14.22	1%
16006	2,038.93	1,646.50	392.43	19%

The impact to peak stage differences associated with replacing the bridge rating curves within ICPR4 was evaluated versus the original ICPR3 model. This analysis utilized the converted, adjusted model produced by Collective under contract with the SWFWMD to perform this analysis. Updating the rating curves within the converted, adjusted ICPR4 model affects peak stage differences by 0.01-ft or more for a total of 87 nodes ranging from -0.12 feet to 0.1 feet, with an average difference of 0.02 feet for these nodes. As reflected in **Table 4** below, overall peak stage differences slightly worsened with the integration of the HEC-RAS rating curves. The decline is associated with 11 nodes where the stage difference exceeds the County's criteria once the HEC-RAS rating curves are used.

While utilizing the updated bridge rating curves impacts stage differences when compared to the County's criteria, the HEC-RAS generated curves are preferred and appropriate since they allow for double interpolation, have the proper shape and overlap, reflect the range of simulated stages and flows, and have a greater level of detail compared to the WSPRO-generated curves within ICPR3.

Table 4. Absolute Peak Stage Differences for Converted, Adjusted ICPR4 with WSPRO Rating Curves and Converted, Adjusted ICPR4 with HEC-RAS Rating Curves Compared to Original ICPR3

Absolute Difference (D, feet)	Converted, Adjusted ICPR4 Model with Original, WSPRO Bridge Rating Curves		Converted, Adjusted ICPR4 Model with HEC-RAS Bridge Rating Curves	
	Number of Nodes Meeting Threshold	Percentage of Nodes Meeting Threshold	Number of Nodes Meeting Threshold	Percentage of Nodes Meeting Threshold
D ≤ 0.05	2157	87.0%	2146	86.6%
0.05 < D ≤ 0.1	215	8.7%	217	8.8%
0.1 < D ≤ 0.2	83	3.3%	91	3.7%
0.2 < D ≤ 0.3	17	0.7%	18	0.7%
0.3 < D ≤ 0.5	5	0.2%	5	0.2%
0.5 < D ≤ 1.0	1	0.04%	1	0.04%
1.0 < D	0	0%	0	0.0%
SUM	**2478**	**100%**	**2478**	**100%**

6. Adjacent Watershed Connectivity and Boundary Updates

Since the County's watershed models have been developed and updated over the course of several decades, relying on the best available data at the time, individual watershed's basin delineations may not match those of adjacent watersheds. Included in the model updates for this project, Collective is tasked to review and update model elements along shared watershed boundaries and will be merging coastal fringe watersheds with their respective mainland model(s). It should be noted that the project scope does not include updating all the basin/watershed boundaries based on the current 2019 DEM.

The LB watershed borders the Coastal Fringe – Lemon Bay (CF_LB), Lower Mayakka (LM), and Roberts Bay (RB) watersheds. The geometric union of the LB's ICPR_BASIN feature class was computed with all the adjacent watersheds' basin feature classes to generate polygons of the gaps and overlaps between the basins. The gaps and overlaps by watershed are listed below.

LB and CF_LB

- Gaps: 5,747
- Overlaps: 178

LB and LM

- Gaps: 186
- Overlaps: 175

LB and RB

- Gaps: 729
- Overlaps: 60

Gaps were reviewed against the 2019 DEM and hydraulic features and assigned to the appropriate watershed. Similarly, the overlaps were reviewed and assigned to be kept in one watershed and removed from the other. The GWIS of each watershed was updated appropriately based on these gap/overlap assignments. Fifteen LB basins had their area changed by more than one-percent as part of the watershed check and had their associated CN, IA, and node storage updated. Three of the basins were modified enough to require an update to the TOC. Seven SOWs and their associated cross-sections were also updated.

Four LB basins (A181199, A181206, A181210, and A181214) were also included in the adjacent LM watershed. Based on an examination of the drainage patterns and connectivity for these basins, Collective recommends that when the watershed models are merged, these four be assigned to the LM watershed.

7. 500-year/24-hour Interconnectivity Updates

Most of the County's watershed models were developed and parameterized to simulate design storm events up to and including the 100-year/24-hour storm. Collective, as directed by the County, developed additional SOW interconnectivity to ensure overland flow routing occurs within the model during the 500-year/24-hour design storm. A preliminary ICPR4 model was generated from the GWIS based on the development and watershed boundary updates completed in the watershed and used to simulate the 500-year/24-hour storm. Preliminary node peak stages were used to generate a level-pool floodplain raster to facilitate the identification of missing overflow weir connectivity. The basins were reviewed to identify locations where:

- The floodplain raster abutted a basin boundary and there was not an associated SOW link
- The floodplain raster abutted a basin boundary with an associated SOW, but the cross-section did not cover the entire basin boundary segment along the floodplain.

Five hundred twenty-nine (529) SOWs and the associated cross-sections were added or modified.

8. Summary of Changes

A total of 203 basins, 126 nodes, and 744 links were added or modified as part of the updates completed by Collective. **Table 5** summarizes the basin, node, link, and cross section changes compared to the converted adjusted ICPR4 model prepared by Collective for the SWFWMD in June 2020. In addition to the changes to these features, associated hydrologic and hydraulic parameters within the LB watershed were updated as previously discussed in this report.

Table 5. Summary of Model Feature Changes

Feature	Converted Adjusted ICPR4 Model (December 2020)	Updated ICPR4 Model (April 2023)	Added/Modified As Part Of Update
ICPR_BASIN	2031	2047	203
ICPR_NODE	2478	2531	126
ICPR_LINK	5388	6000	744
ICPR_XSECT	3646	4203	628

9. Response to Model Update Peer Review Comments

On May 25, 2023, Collective received review comments related to the development, watershed boundary, and 500-year simulation surface overflow weir updates as well as general ICPR4 QAQC comments generated from a tool developed by Jones Edmunds for the County. Comments were provided as peer review comments submitted in a comment geodatabase (56 comments), a technical memorandum, and an Excel spreadsheet summarizing the ICPR4 QAQC tool results. Collective reviewed the provided comments and responded to all. Four of the points within the comment geodatabase were associated with areas outside of the development update areas and outside the scope of this project. Additionally, the majority of the items flagged by the QAQC tool reflect comments outside of the update areas; these are future maintenance items to be addressed in subsequent updates. Those QAQC tool items that fell within updated areas were addressed according to the responses noted in the appended comment geodatabase and spreadsheet.

Additionally, during the process of addressing review comments, Collective adjusted basin boundaries to eliminate remaining gaps and overlaps with the adjacent watersheds and added additional interconnections to be consistent with the surface overflow links represented in these adjacent watersheds.

The total number of model feature changes in response to review comments and additional watershed boundary adjustments slightly decreased compared to the initial development updates since many of the initial surface overflow weirs that were added for the 500-year design storm simulation were removed since the basin boundaries need to be updated under future maintenance to align with the current DEM. **Table 6** summarizes the basin, node, link, and cross-section changes compared to the converted and adjusted ICPR4 model prepared by Collective for the SWFWMD in December 2020.

Table 6. Summary of Model Feature Changes

Feature	Converted Adjusted ICPR4 Model (December 2020)	Updated ICPR4 Model (September 2023)	Added/Modified As Part Of Update
ICPR_BASIN	2031	2047	249
ICPR_NODE	2478	2542	167
ICPR_LINK	5388	5893	678
ICPR_XSECT	3646	4091	520

Revised GWIS geodatabase and ICPR4 model have been provided addressing comments along with updates to both the comment shapefile and QAQC Tool summary spreadsheet noting Collective's responses.

10. Model Verification

Upon addressing peer review comments, Collective performed model verification to compare simulated stages with observed data for two recent and significant storm events. Gauge data and Next Generation Weather Radar (NEXRAD) rainfall data for two historic storms were used as the basis for calibration and validation. As the model had been previously verified, significant and/or numerous model parameter adjustments were not anticipated. A sensitivity analysis of typical calibration parameters was not included in the scope of work nor were specific calibration metrics specified by the County. The following subsections summarize the storm selection, data, calibration adjustments, and simulated versus measured results for the model verification.

10.1. Verification Storm Selection

Collective reviewed daily rainfall records published by SWFWMD for Sarasota County as well as federally declared flooding disaster reports to identify historic storm events within the 2017 to 2022 time-period, which was considered to be recent and generally reflective of the conditions represented in the model. Storm selection was prioritized based on the following characteristics, listed in order of preference:

1. Significant rainfall (i.e., six inches or greater) in one day or over successive days
2. Measured stage data available
3. Isolated storm event, with several days of no rainfall before or after the event
4. Significant amount of rainfall consistent across the County, so the same event could be applied to all verification efforts as part of this project

Collective reviewed the rainfall records at 11 stations throughout the county as illustrated in **Figure 19**:

- Station 25616, Sarasota-Bradenton Airport
- Station 25654, ROMP TR SA-1 Payne Terminal
- Station 940759, Sarasota Center
- Station 25697, ROMP TR 6-1 Siesta Key
- Station 25829, ROMP 22 Utopia
- Station 25608, Myakka River State Park
- Station 25607, ROMP 20 Osprey
- Station 26020, ROMP TR 5-3 Knights Trail
- Station 25605, ROMP TR 5-1 Laurel Park
- Station 25600, ROMP TR 4-1 Caspersen Beach
- Station 25056, ROMP TR 3-3 Lemon Bay

Based on the four storm characteristics, Hurricane Eta (11/10/2020 – 11/12/2020) and Hurricane Ian (9/27/2022 – 9/30/2022) were selected. Hurricane Irma, Tropical Storm Cristobal and Hurricane Elsa were eliminated due to rainfall not being isolated to a specific time period. Storm selection was confirmed with Jone Edmunds who is responsible for verification of other County watersheds including Phillippi Creek, Little Sarasota Bay, and Dona Bay.

Rainfall conditions for the five days prior to these events were reviewed to determine the antecedent moisture condition (AMC), which is also sometimes referred to as the Antecedent Runoff Condition (ARC). Three watershed conditions are defined by the NRCS (dry, average, and wet).

For Hurricane Eta, 2.62 inches of rainfall was recorded at Station 25056 ROMP TR S3-3 Lemon Bay during the preceding month of which 0.86 inches of rainfall fell in the five days prior to storm. For Hurricane Ian, 8.42 inches of rainfall fell during the preceding month, of which 0.01 inches fell during the five days preceding the storm. AMC affects the amount of runoff generated by a storm and influences the CN parameterization applied within the model. Specifics of how the AMC is accounted for within the model are discussed in Section 10.6 below.

Hurricane Ian was selected to serve as the calibration event, given the significant amount of rainfall, and average AMC. Hurricane Eta served as the validation storm event.

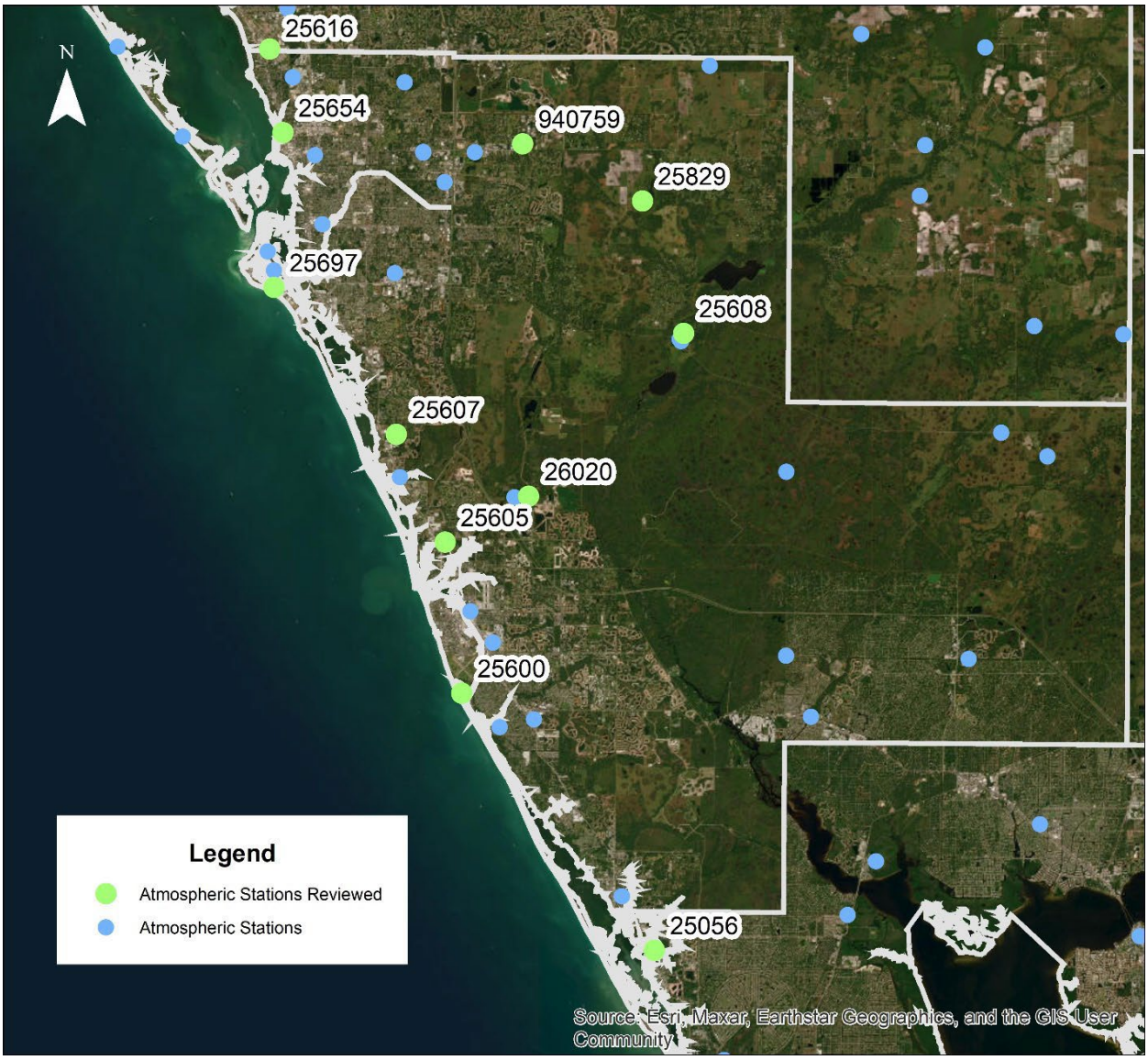


Figure 19. SWFWMD Rainfall Stations

10.2. NEXRAD Data

SWFWMD publishes NEXRAD rainfall data in various time increments for 2-kilometer grid cells from 1995 to present. Collective acquired the NEXRAD data in 15-minute increments for the months of November 2020 and September 2022 for all cells overlapping the watershed. The data were processed to generate the rainfall time series for both Hurricanes Eta (11/10/2020 0:00 – 11/12/2020 23:45) and Ian (9/27/2022 0:00 – 9/29/2022 23:45) for each cell that can be read by ICPR4. **Figures 20 and 21** illustrate the total rainfall distribution across the watershed for Hurricane Eta and Hurricane Ian, respectively, and the location of County monitoring stations within the watershed as discussed in Section 10.3 below. Rainfall exhibits a northwesterly trend across the watershed for

Hurricane Eta, ranging from 3.0 inches to 4.87 inches. For Hurricane Ian, significant rainfall fell across the entire watershed, with a central trend, and depths range from 14.01 to 21.8 inches.

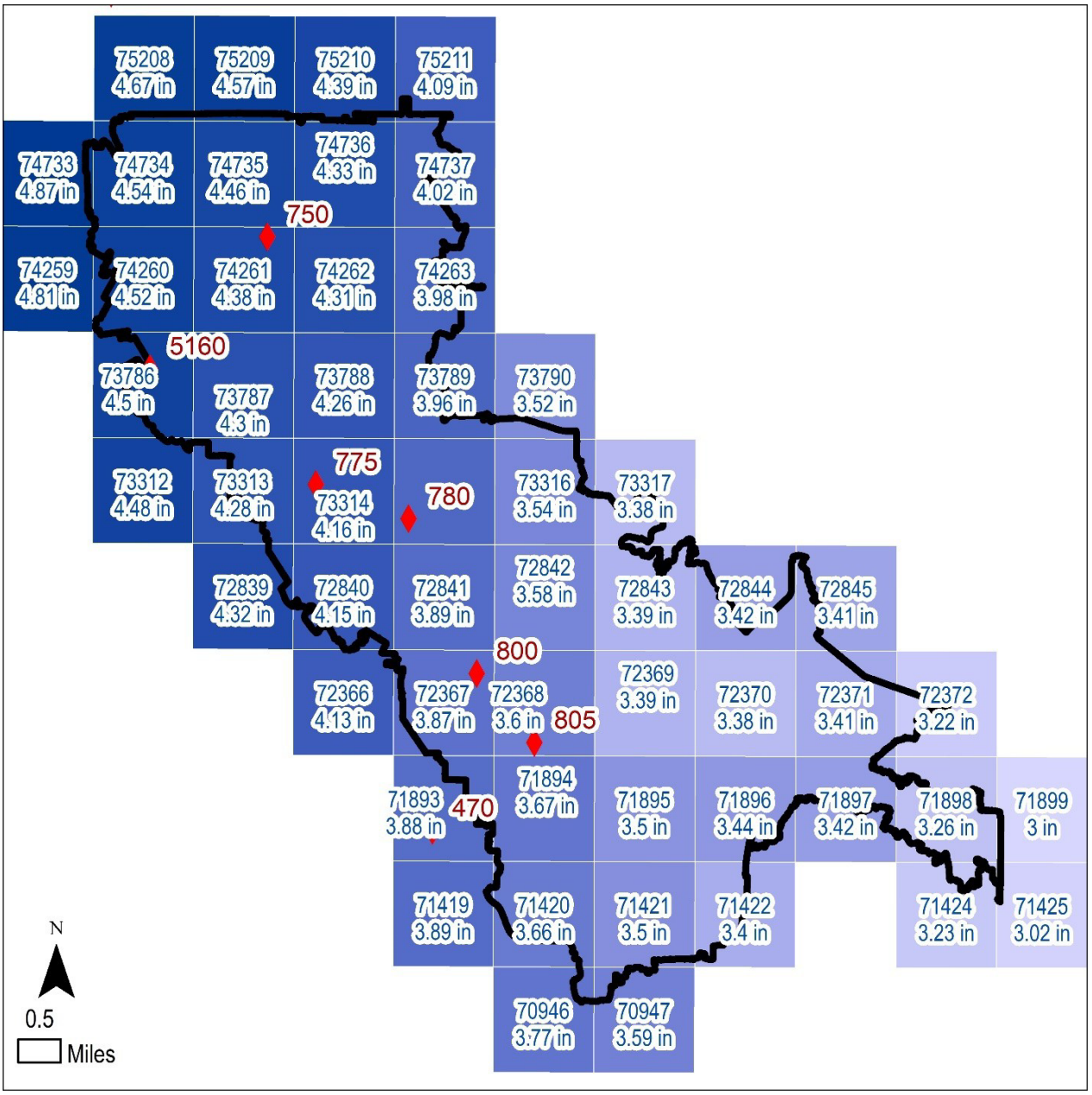


Figure 20. NEXRAD Rainfall Totals, Hurricane Eta

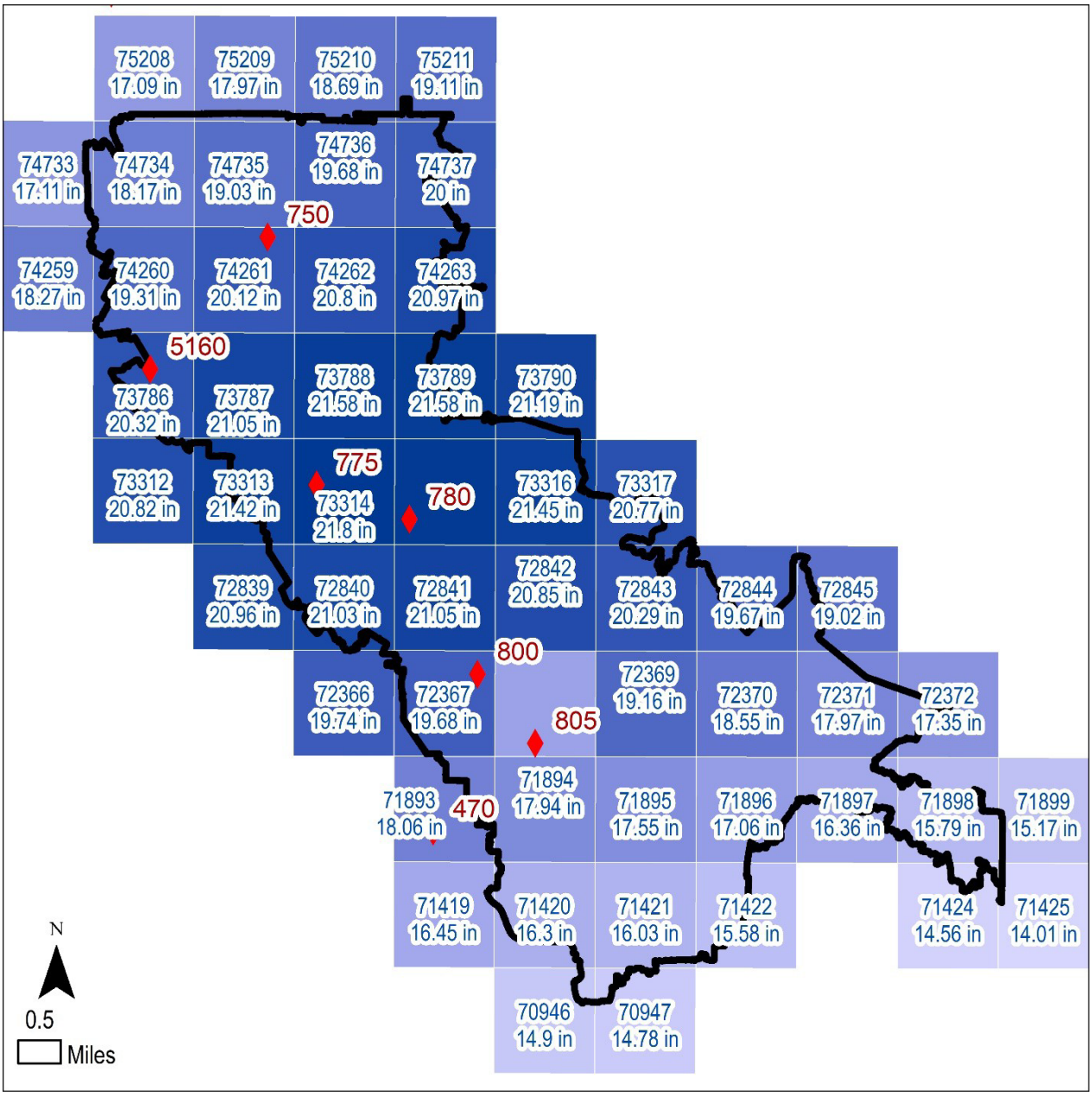


Figure 21. NEXRAD Rainfall Totals, Hurricane Ian

10.3. Measured Rainfall and Stage Data

Sarasota County monitors rainfall amounts and water levels in multiple locations within the watershed as part of its Automated Rainfall Monitoring System (ARMS):

- Station 750, AL-1 Jacaranda Bridge
- Station 775, FRK-1 Donavan Road
- Station 780, FRK-2 Stoner Road
- Station 800, GOT-1 Tangerine Woods

The location of each station, relative to the watershed boundary and NEXRAD cells is shown in Figures 20 and 21 above**.** For each of the storm events, rainfall and stage data were downloaded from the Sarasota County Water Atlas maintained by the University of South Florida, which is the publicly available source of ARMS data. Three additional ARMS stations exist in the watershed (Station 470, CST-3 Indian Mound Park; Station 5160, Lemon Bay Canal; Station 805, GOT-2 Park Forest) but water level data are not available for either verification event. **Table 7** summarizes the peak stage and total rainfall measured at each station for Hurricanes Eta and Ian. The rainfall data for Stations 750, 755, and 800 are incomplete for Hurricane Ian. It is unclear if the precipitation reported at Station 780 is reflective of the full period of time; rainfall amounts are not recorded after 21:49 on 9/28/2022 until 0:00 9/29/2022. A significant gap in measured water levels exists for Hurricane Ian within the Water Atlas datasets for Stations 750, 775, 780, and 800; however, Collective was able to collect the complete data records from the County directly and the peak stages in the table below reflect the County's datasets.

Table 7. Sarasota ARMS Measured Peak Stages and Total Rainfall for Hurricanes Eta and Ian

Station ID, Name	Hurricane Eta		Hurricane Ian	
	Peak Stage (ft, NAVD88)	Total Rainfall (inches)	Peak Stage (ft, NAVD88)	Total Rainfall (inches)
750, AL-1	3.87	4.03	10.72	*
775, FRK-1	5.64	3.54	9.57	*
780, FRK-2	9.07	2.7	11.53	14.73
800, GOT-1	4.96	4.12	9.25	*

*Missing or suspect data within storm period

Comparing the total observed rainfall amounts to the NEXRAD data for the same periods, the NEXRAD data reflects less variation in rainfall amounts compared to the Sarasota ARMS stations. At Station 780, there is an over 1.2-inch difference between the measured rainfall and the associated NEXRAD cell. Stations 750, 755, and 800 appear to replicate the same northwesterly trend in rainfall for the watershed as the NEXRAD. Unfortunately, given the quality of the rainfall data at most of the stations during Hurricane Ian, no conclusions can be made with respect to the NEXRAD data. Station 780 appears to have measured a considerable amount of additional rainfall (over 7.6 inches) compared to the associated NEXRAD cell's total amount.

Figures 22 through **25** graph the observed stages and rainfall for each station for the validation event, Hurricane Eta. Stations 750 and 800 exhibit a response in water levels to the rainfall; however, there is a very muted if no response to rainfall at Station 780. Water levels at Station 780 increased about half an inch at the onset of the rainfall on 11/11/2020 to the peak stage.

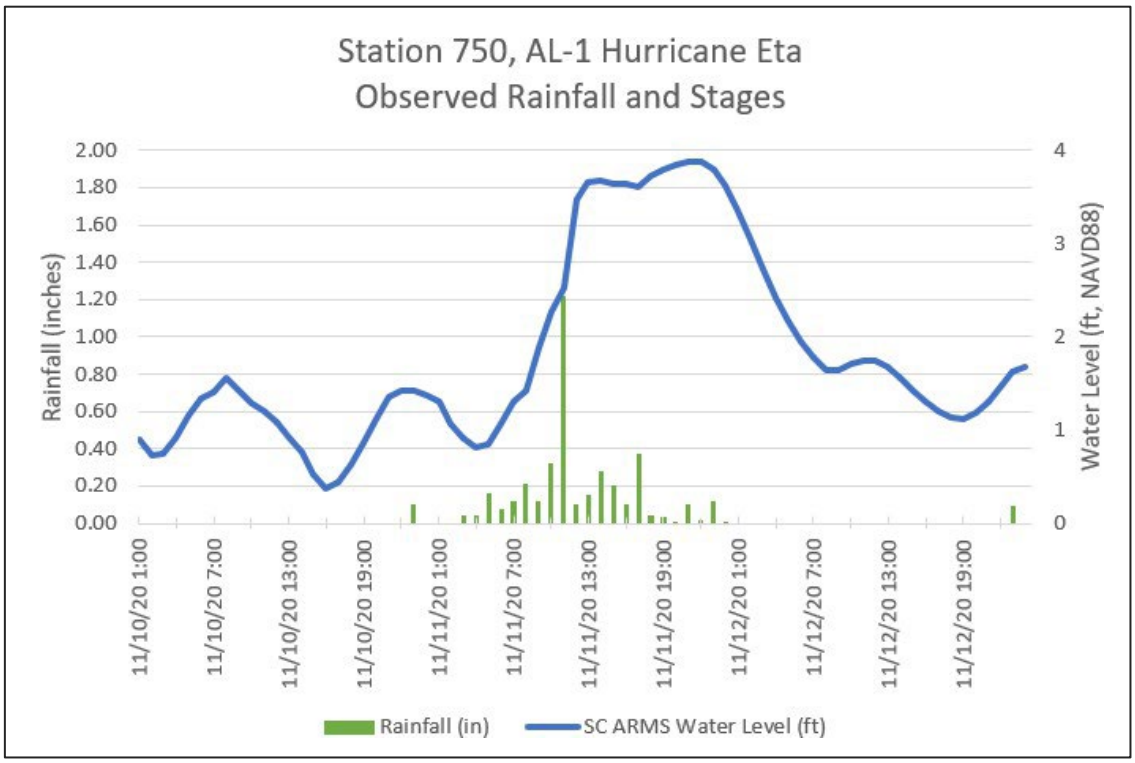


Figure 22. Station 750 Stage and Rainfall 11/10/2020 – 11/12/2020

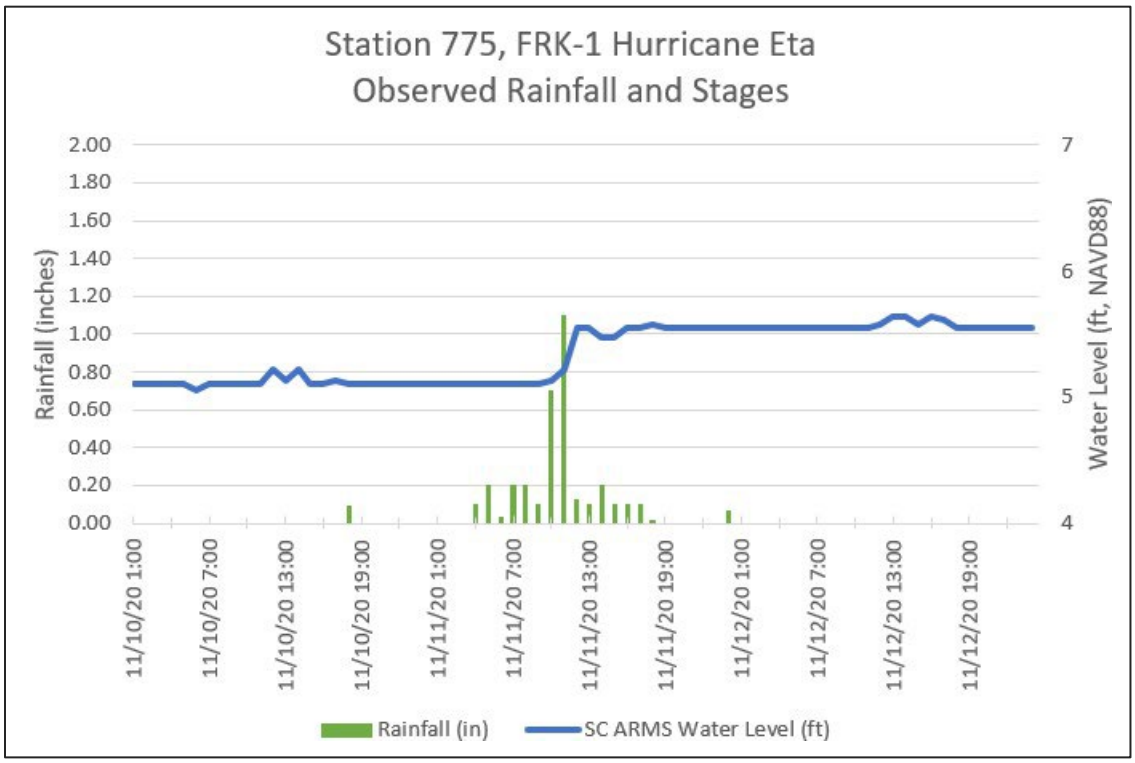


Figure 23. Station 775 Stage and Rainfall 11/10/2020 – 11/12/2020

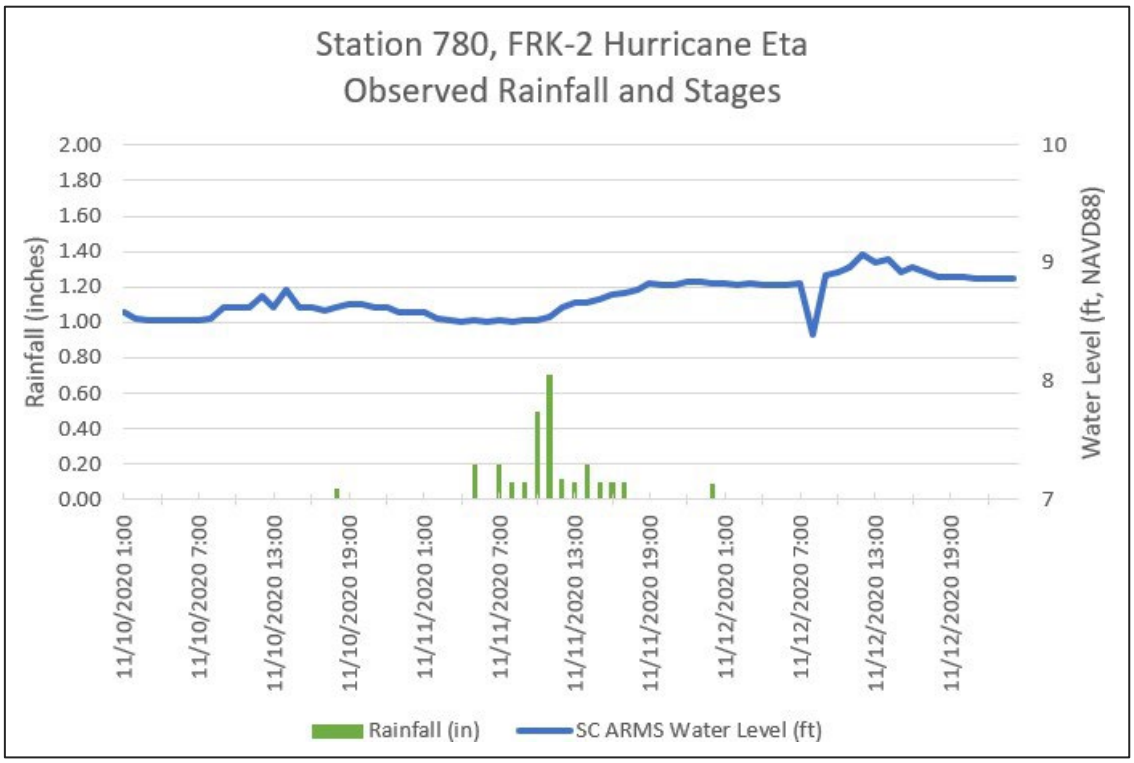


Figure 24. Station 780 Stage and Rainfall 11/10/2020 – 11/12/2020

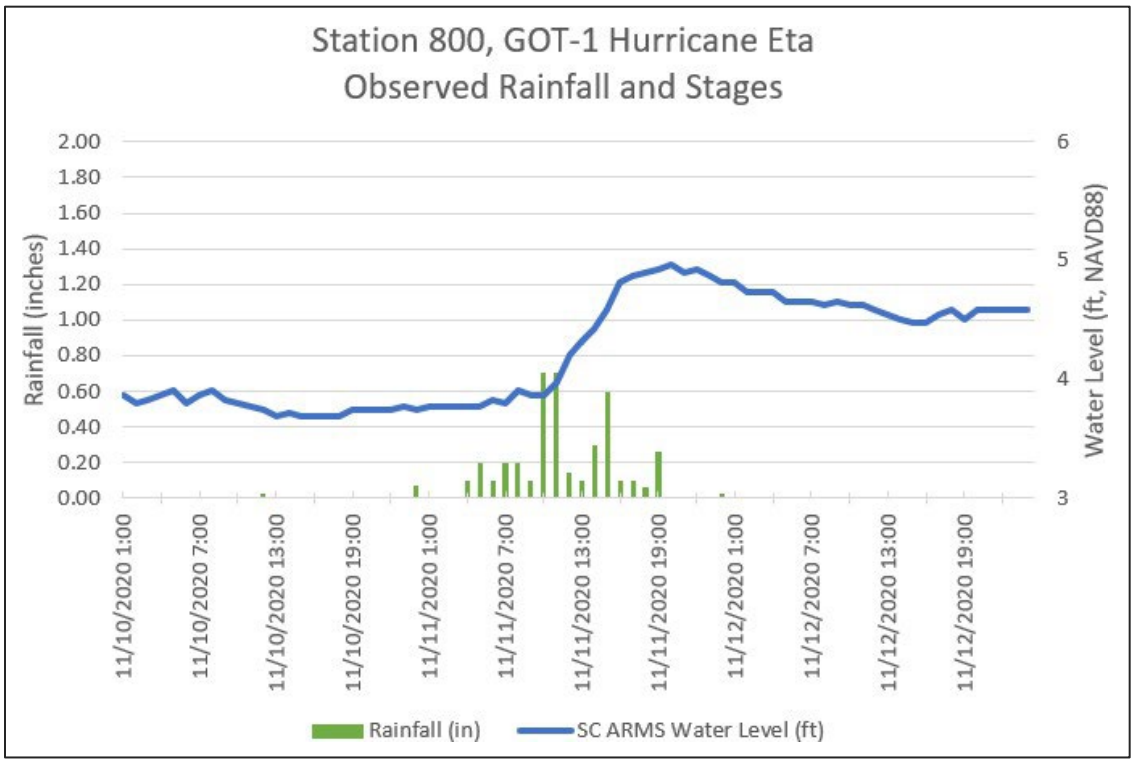


Figure 25. Station 800 Stage and Rainfall 11/10/2020 – 11/12/2020

Figures 26 through **29** graph the observed stages and rainfall for each station for the calibration event, Hurricane Ian. As discussed previously, the rainfall data is incomplete for Hurricane Ian because rainfall amounts were not recorded on 9/29/2022.However, it does appear that at stations 750, 775, 780, and 800, water levels increased with the increase in rainfall recorded.

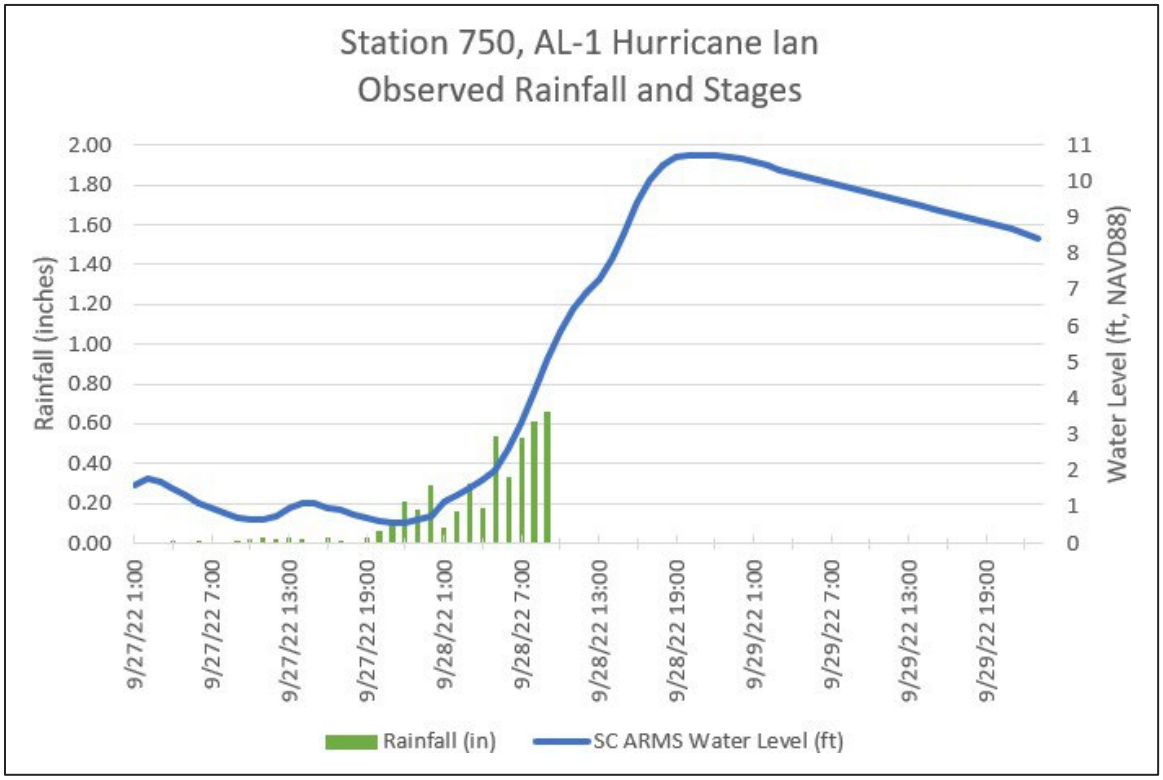


Figure 26. Station 750 Stage and Rainfall 9/27/2022 – 9/29/2022

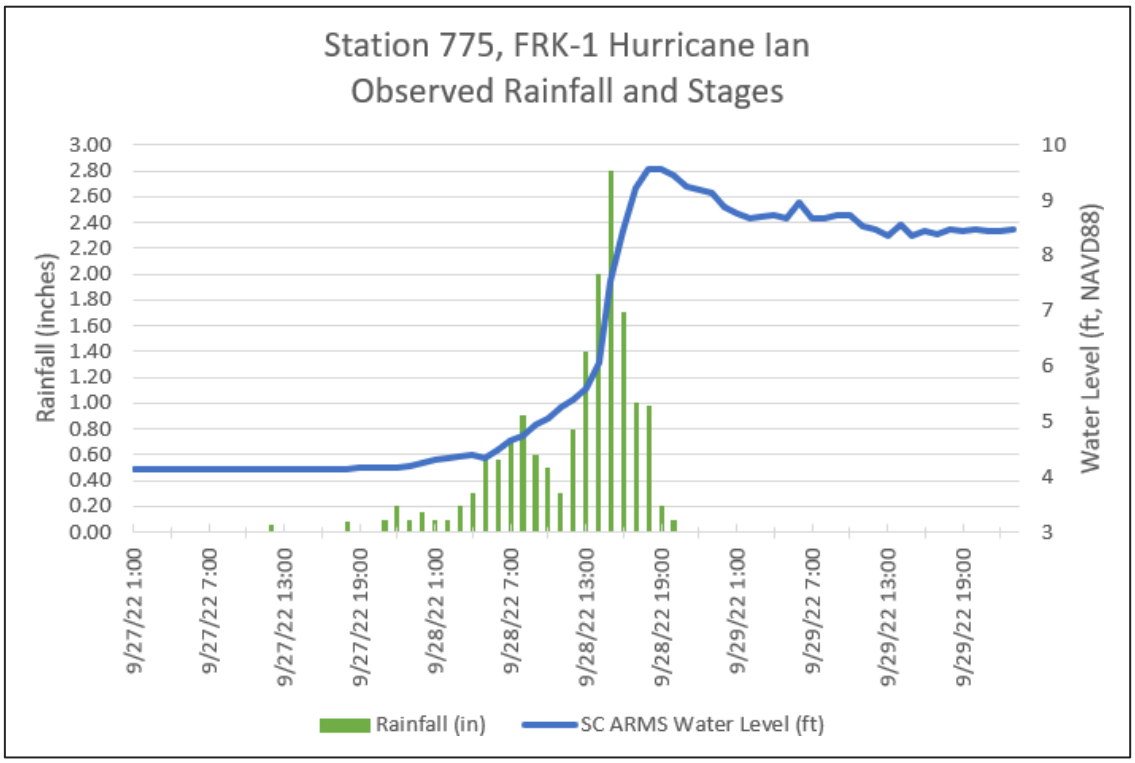


Figure 27. Station 775 Stage and Rainfall 9/27/2022 – 9/29/2022

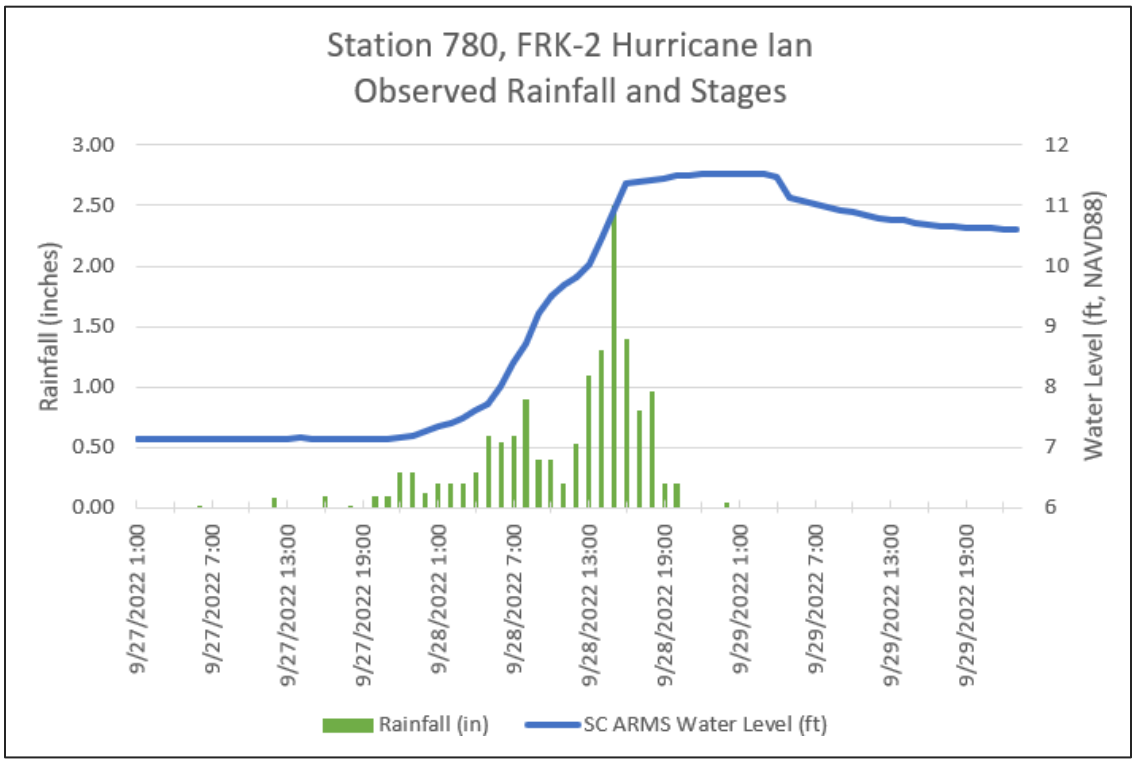


Figure 28. Station 780 Stage and Rainfall 9/27/2022 – 9/29/2022

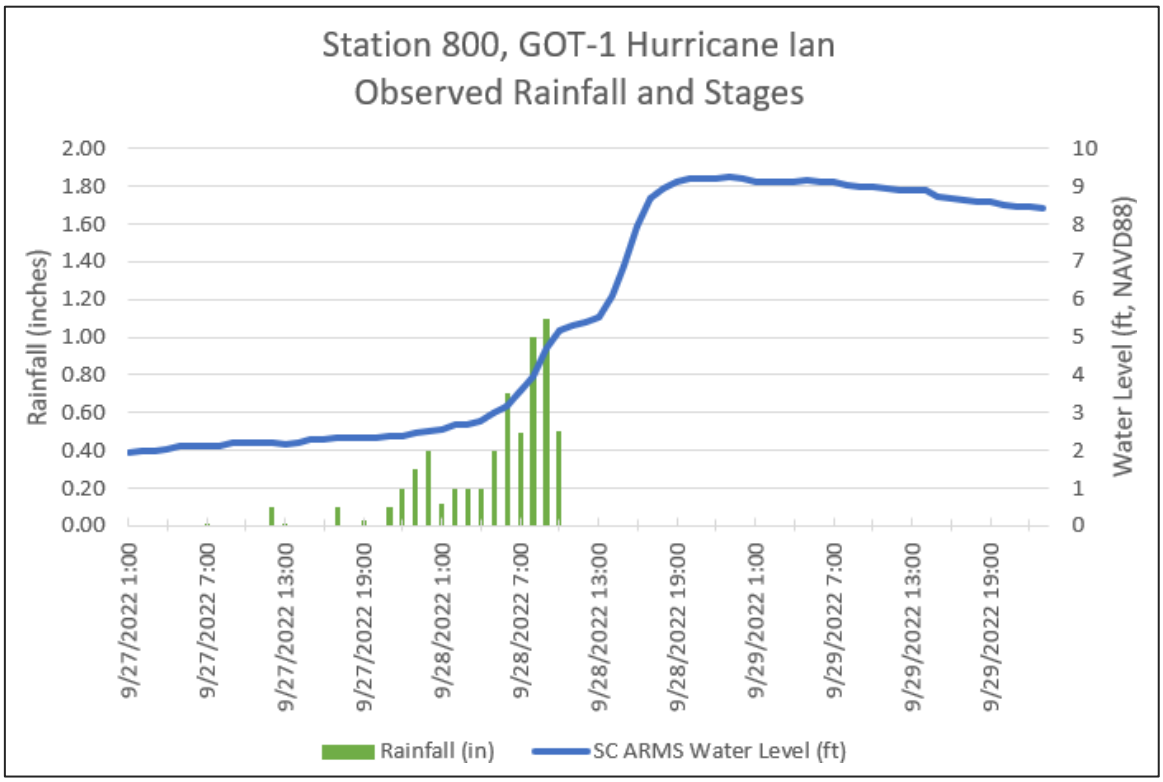


Figure 29. Station 800 Stage and Rainfall 9/27/2022 – 9/29/2022

10.4. Boundary Conditions for Verification Events

Tidal

For both storm events, the 15-minute measure water levels at the Curry Creek, USGS gage 02299734, were utilized as the tidal boundary condition.

Adjacent Watersheds

Model simulations representing the verification events were not performed for adjacent watershed CF_LB, LM, or RB. Boundary conditions utilized design storm simulated stages: 100-year/24-hour boundary conditions for Hurricane Ian/calibration, and 25-year/24-hour boundary conditions for Hurricane Eta/validation. Boundary stages were adjusted for the most recent model update peer review response version of the RB model. Since the LM model only had boundary stages available for the 100-year/24-hour simulation, a 4-inch design storm simulation was performed by Collective to estimate boundary conditions for Hurricane Eta.

10.5. Calibration Adjustments

Collective took an iterative approach to adjusting model parameters to improve the goodness of fit of simulated stages at each gauge. The design storm model, reflecting the response to peer review comments, was modified to apply the spatially distributed NEXRAD rainfall data and updated to

reflect the tidal boundary conditions. After the initial simulation, initial stages for nodes upstream and downstream of the stations were adjusted but provided no benefit for overall goodness of fit to measured stages during the peak storm response for either event. Therefore, initial stages from the design storm model were kept the same. Other adjustments that were performed but provided no benefit for predicting the peak stage or timing include: adjusting percent impervious area and time of concentrations for basins reflecting development updates that have not been constructed as well as routing the channel upstream of Station 775 through the pipe link at node 14255 to better reflect hydraulic conditions at this location.

Manning's n parameters were adjusted for channel cross sections upstream and downstream of all stations based on reviews of aerial imagery and Google Streetview. Exit loss coefficients were adjusted to 1.0 for numerous pipe links where outfalls became submerged. Numerous surface overflow weirs that had been added by Collective to support the 500-year/24-hour simulation were turned off as well as one surface overflow weir that appears to no longer reflect current topography. Specific issues with Stations 775 and 800 are discussed in Section 10.7 below that Collective determined prevented further adjustments given the uncertainty in the measured values.

10.6. Validation Adjustments

The validation simulation applies the Hurricane Eta boundary conditions and rainfall to the calibrated model as well as an additional adjustment to the CN values to account for the dry AMC of the area at the time of the event. The design storm model was developed based on average rainfall conditions, or AMC II, and CNs were corrected to AMC I by Collective using a published and accepted conversion method (Feyereisen et al., 2008).

10.7. Simulated Versus Observed Comparison

Goodness of fit comparisons confirm the adjusted model's runoff response is reasonable for Stations 750 and 780; however, the ARMS data appears to have fundamental differences with elements of the model and simulated values do not compare well with observed levels at Stations 775 and 800. **Table 8** compares the simulated peak stage at each station to the observed peak stage. Hydrograph comparison of simulated results against measured stages at Stations 750, 775, 780, and 800 are presented below in **Figures 30, 31, 32** and **33,** respectively, for the calibration event. The invert elevation of the link (according to the model input) associated with each station is also included in the graphs for comparison purposes.

For Station 750, the calibrated model reflects the observed timing, shape, and peak stage as shown in Figure 30. The percentage difference in peak stages is 2.4-percent.

As can be seen in Figure 31, at Station 775 the overall shape and timing of the simulated hydrograph compares well with observed conditions. However, the simulated stages exceed measured during the peak. Reviewing the measured water levels at this location, Collective determined from the period of record numerous water levels recorded below the channel invert at this location according to the model (3.95 ft). A recorded low stage of 2.52 ft was reported on 7/16/2020. Other low water level

measurements were recorded in May 2018 (2.62 ft) and May 2019 (2.59 ft). An offset difference of 1.43 ft (measured stage of 2.52 ft subtracted from the channel invert elevation of 3.95 ft) was applied to the measured water levels for calibration comparisons. The adjusted, measured peak water level is 11.00 ft, which is 0.06 ft less than the simulated peak. The adjusted percent difference in peak stages is 0.5-percent.

It should be noted that based on the historic range of water levels for the full period of record (1/25/2004 to present) there are measurements less than the low of 2.52 ft, with the lowest being -1.97 ft (recorded in January and February of 2004) and another, more recent group of measurements as low as 0.15 ft (recorded in January and February of 2023). These lower measurements do not appear in context with other stages in the same time-frame. The water level measurements that appear consistent with the overall water level trends were given preference. Without resolving the elevation differences between Station 775 measurements and the hydraulic elevations within the model, it is unclear how well the model replicates actual conditions.

Additionally, in the course of reviewing the sub-watershed upstream of Station 775, Collective determined the model schematic directly upstream does not reflect a significant culvert that Forked Creek passes through based on the current DEM and several development updates that are included in the model that have yet to be constructed. Collective prepared a model scenario approximating adjustments of hydrologic parameters upstream of this station to represent current/2022 conditions and the hydraulic network. However, these adjustments resulted in very minor changes to the simulated hydrograph.

For Station 780, the calibrated model reflects the observed timing, shape, and the peak stage as shown in Figure 32. The percent difference in peak stages is 3.2-percent. It should be noted that there are significant development changes associated with the Villages of Manasota Beach occurring upstream of this Station at the time of Hurricane Ian that are not reflected in the updated model.

Lastly, for Station 800 the overall shape and timing of the simulated hydrograph compares well with observed conditions. However, the simulated stages exceed measured during the peak. Similar to Station 775, Collective determined from the period of record numerous water levels recorded below the channel invert at this location according to the model (2.46 ft). The lowest recorded stage of 0.47 ft was reported on 1/16/2016. A total of 335 daily water levels are reported at this station below the model's channel invert elevation – ranging from the low of 0.47 ft to 0.81 ft. An offset difference of 1.99 ft (measured stage of 0.47 ft subtracted from the channel invert elevation of 2.46 ft) was applied to the measured water levels for calibration comparisons. The adjusted, measured peak water level is 11.24 ft, which is 0.12 ft more than the simulated peak. The adjusted percent difference in peak stages is 1.1-percent. The elevation differences between Station 800 measurements and the hydraulic elevations within the model need to be resolved to accurately determine how well the model replicates actual conditions.

Collective recommends the Forked Creek channel and culvert at Englewood Road (link 14252) near Station 775 and the culvert at Tangerine Woods Boulevard (link 15407) associated with Station 800 be surveyed to determine if the data within the model are reflective of actual conditions. Additional field review of the hydraulic network upstream and downstream of Station 775 is also recommended so the model can be updated accordingly.

Table 8. Peak Stages Comparison for Hurricane Ian

Station ID, Name	Observed Peak Stage (ft, NAVD88)	Simulated Peak Stage (ft, NAVD88)	Difference (*Simulated* – *Observed*, ft)	Percent Difference (%)	Adjusted Difference (ft)	Adjusted Percent Difference (%)
750, AL-1	10.72	10.46	-0.26	2.4	--	--
775, FRK-1	9.57	11.06	1.49*	15.6	0.06❶	0.5
780, FRK-2	11.53	11.9	0.37	3.2	--	--
800, GOT-1	9.25	11.12	1.87*	20.2	-0.12❷	1.1

*Measured water levels conflict with model's hydraulic invert elevations
❶ Adjustment of 1.43 ft applied based on difference between measured low and channel invert
❷ Adjustment of 1.99 ft applied based on difference between measured low and channel invert

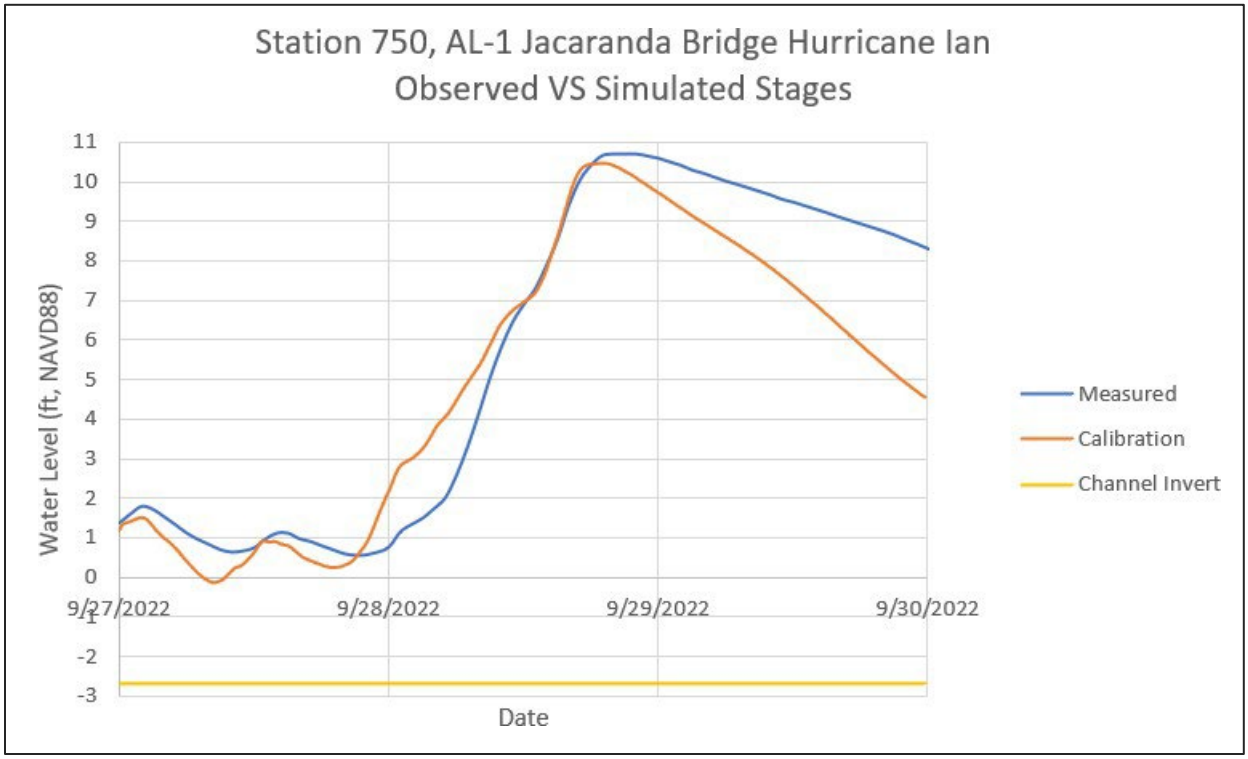


Figure 30. Station 750, AL-1 Simulated Stages, 9/27/2022 – 9/29/2022

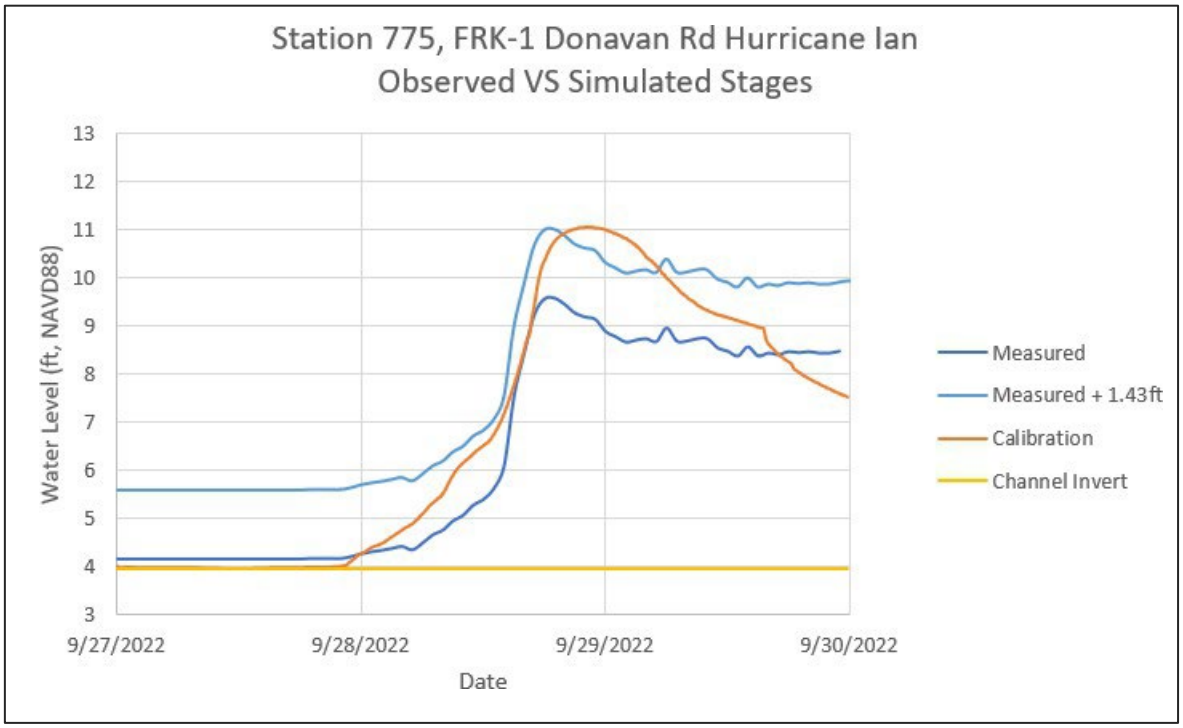


Figure 31. Station 775, FRK-1 Simulated Stages, 9/27/2022 – 9/29/2022

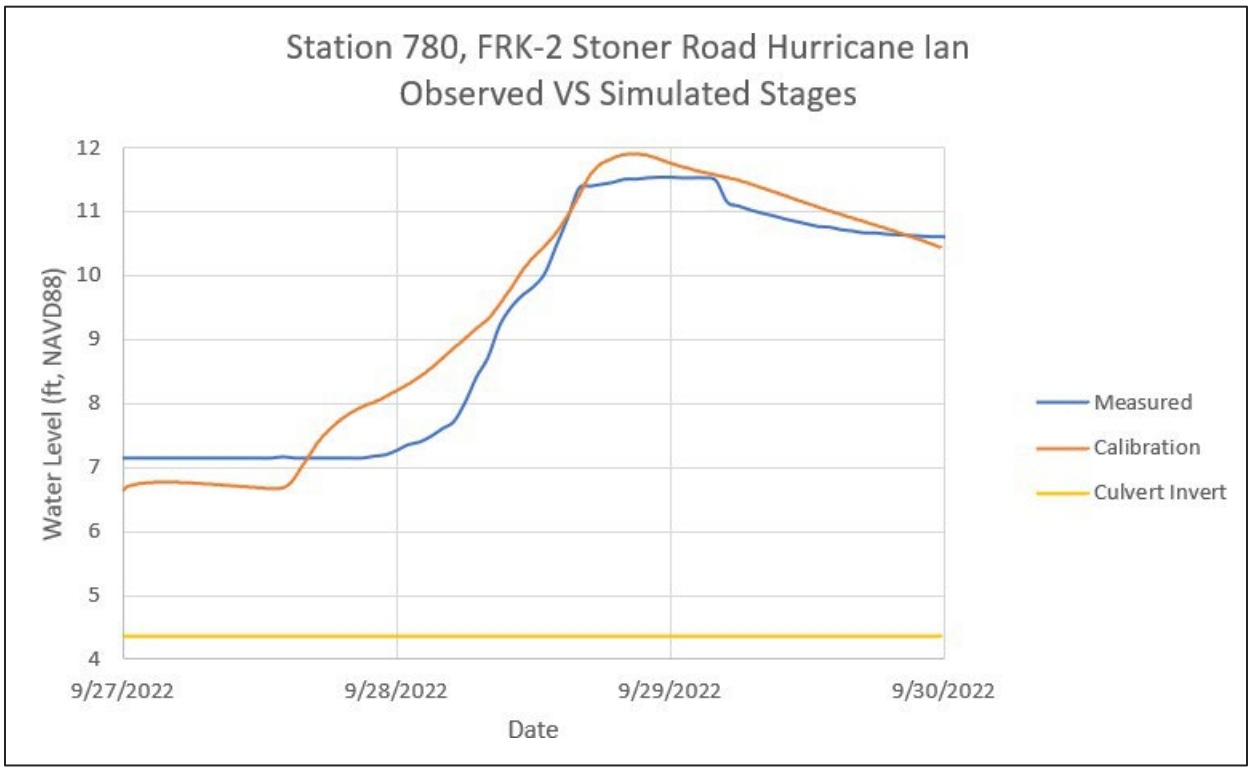


Figure 32. Station 780, FRK-2 Simulated Stages, 9/27/2022 – 9/29/2022

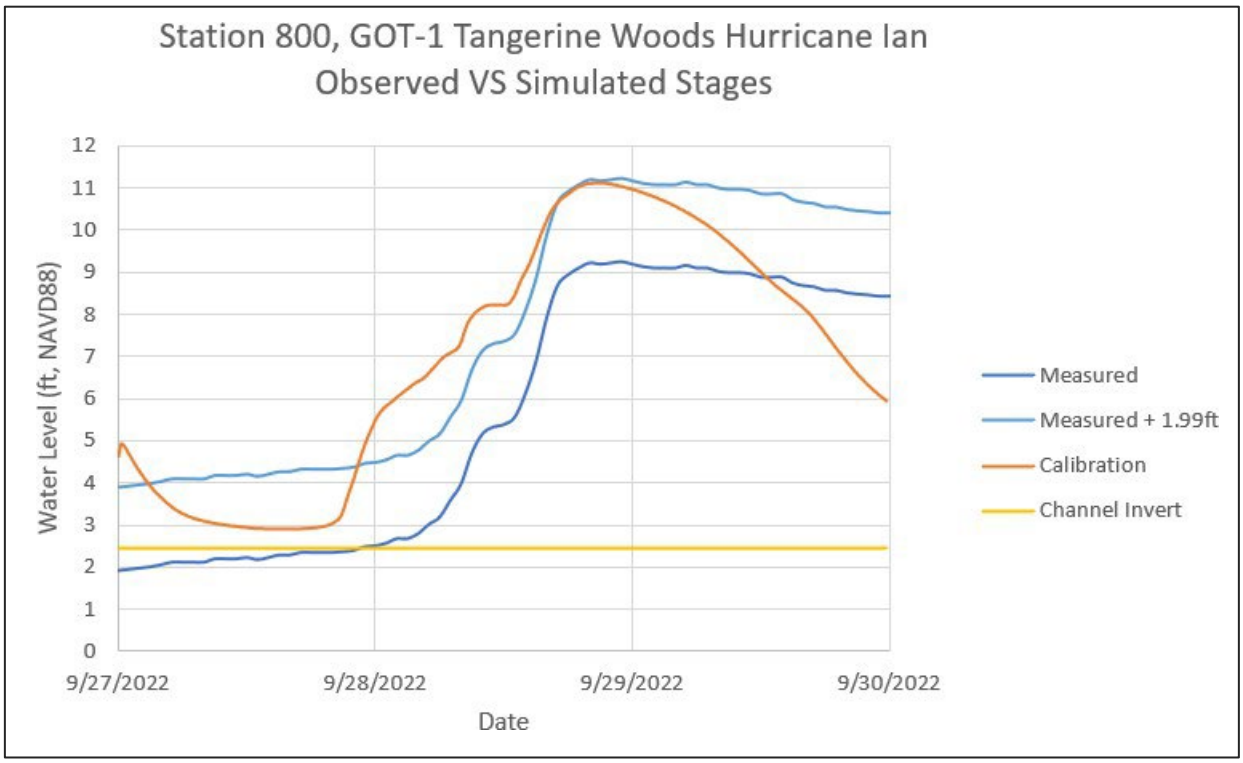


Figure 33. Station 800, GOT-1 Simulated Stages, 9/27/2022 – 9/29/2022

Table 9 compares the simulated peak stage at each station to the observed peak stage for the verification event, Hurricane Eta. Comparison of simulated results against measured stages at all stations are illustrated below in **Figures 34, 35, 36** and **37** for the validation event. For Station 750, the model reflects the overall shape and timing well, but the peak stage is overpredicted by the model by 0.79 ft. The same offsets were applied to the measured water levels at both Stations 775 and 800 to better compare observations versus predictions; however, as illustrated by Figures 35 and 37 the model results do not compare as well for the validation event as compared to calibration. Again, given the uncertainty related to the water level measurements compared against the channel geometry in this area, the actual peak stage difference is unknown. For Station 780, the simulated peak stage is less than 0.2 ft (about 2.1-percent difference); however, the near constant stage observed at this location is not simulated by the model.

Table 9. Peak Stages Comparison for Hurricane Eta

Station ID, Name	Observed Peak Stage (ft, NAVD88)	Simulated Peak Stage (ft, NAVD88)	Difference (*Simulated* – *Observed*, ft)	Percent Difference (%)	Adjusted Difference (ft)	Adjusted Percent Difference (%)
750, AL-1	3.87	4.66	0.79	20.4	--	--
775, FRK-1	5.64	5.12	-0.52*	9.2	-1.95❶	28
780, FRK-2	9.07	8.88	-0.19	2.1	--	--
800, GOT-1	4.96	5.7	0.74*	14.9	-1.25❷	18

*Measured water levels conflict with model's hydraulic invert elevations

❶ Adjustment of 1.43 ft applied based on difference between measured low and channel invert

❷ Adjustment of 1.99 ft applied based on difference between measured low and channel invert

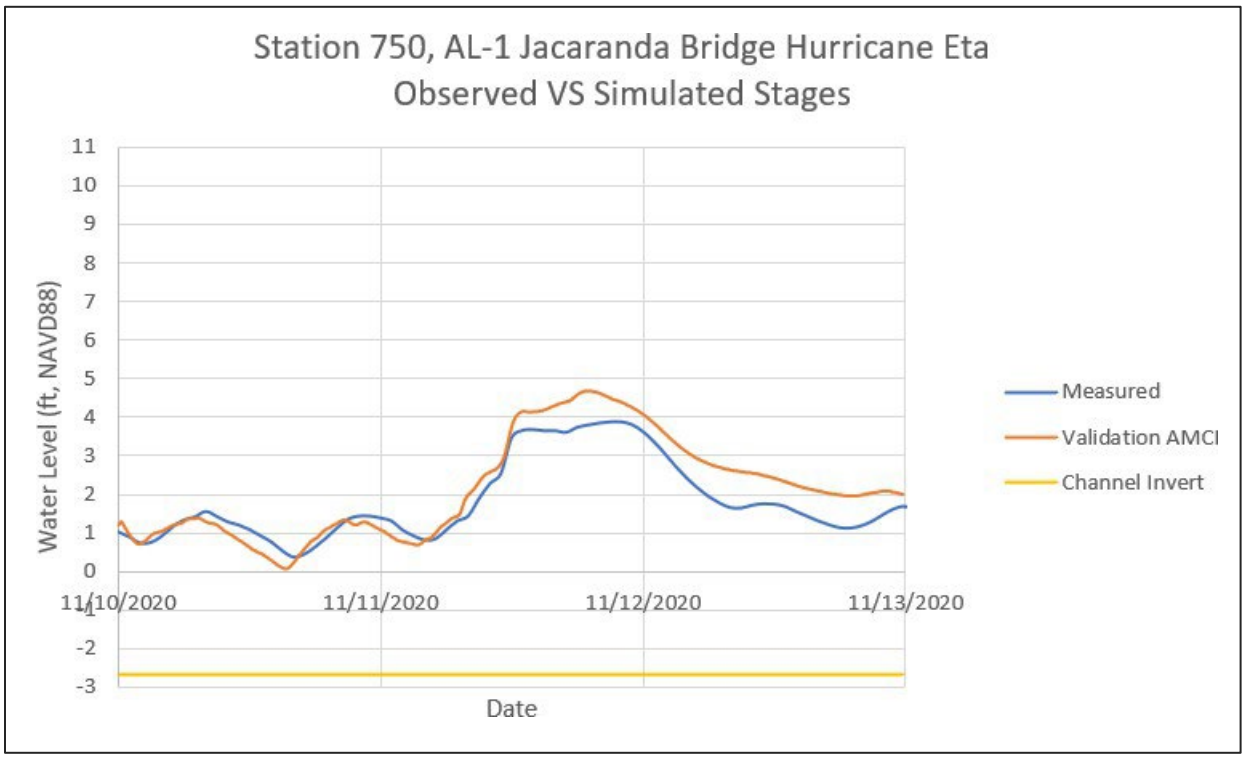


Figure 34. Station 750, AL-1 Observed versus Simulated Stages, 11/10/2020 – 11/12/2020

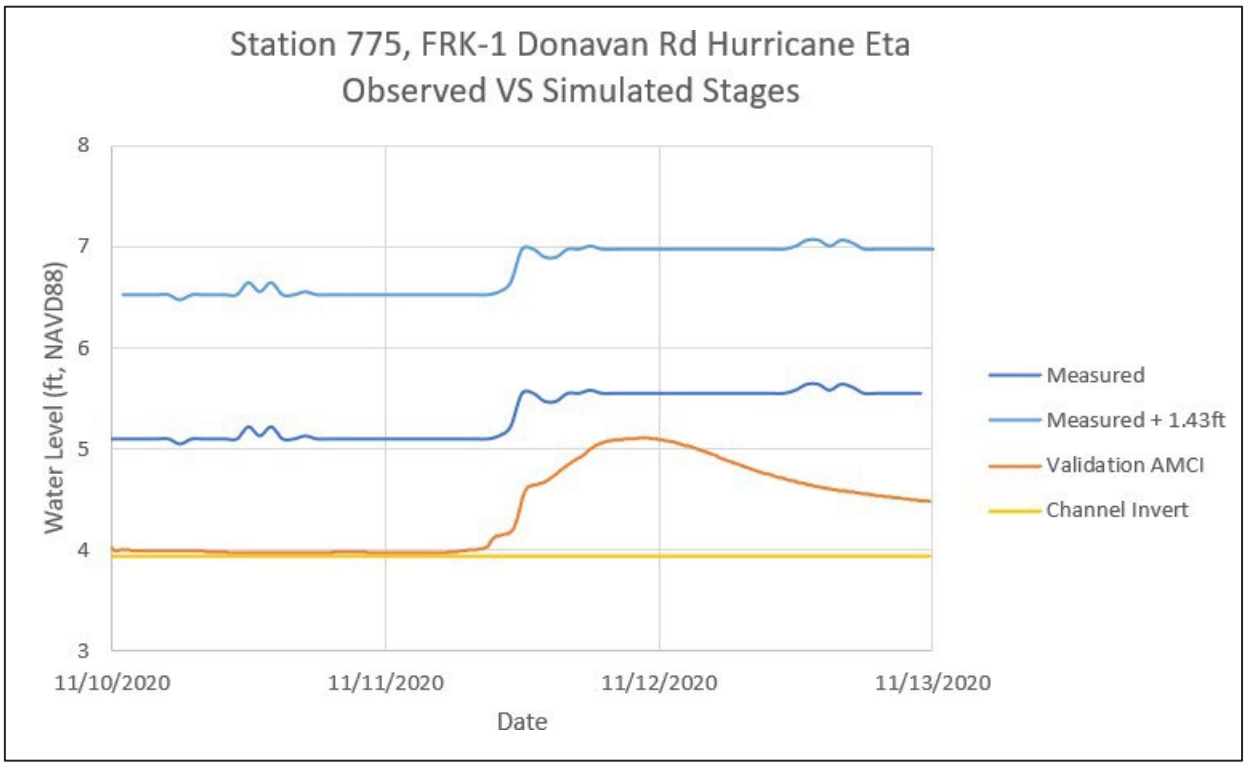


Figure 35. Station 775, FRK-1 Observed versus Simulated Stages, 11/10/2020 – 11/12/2020

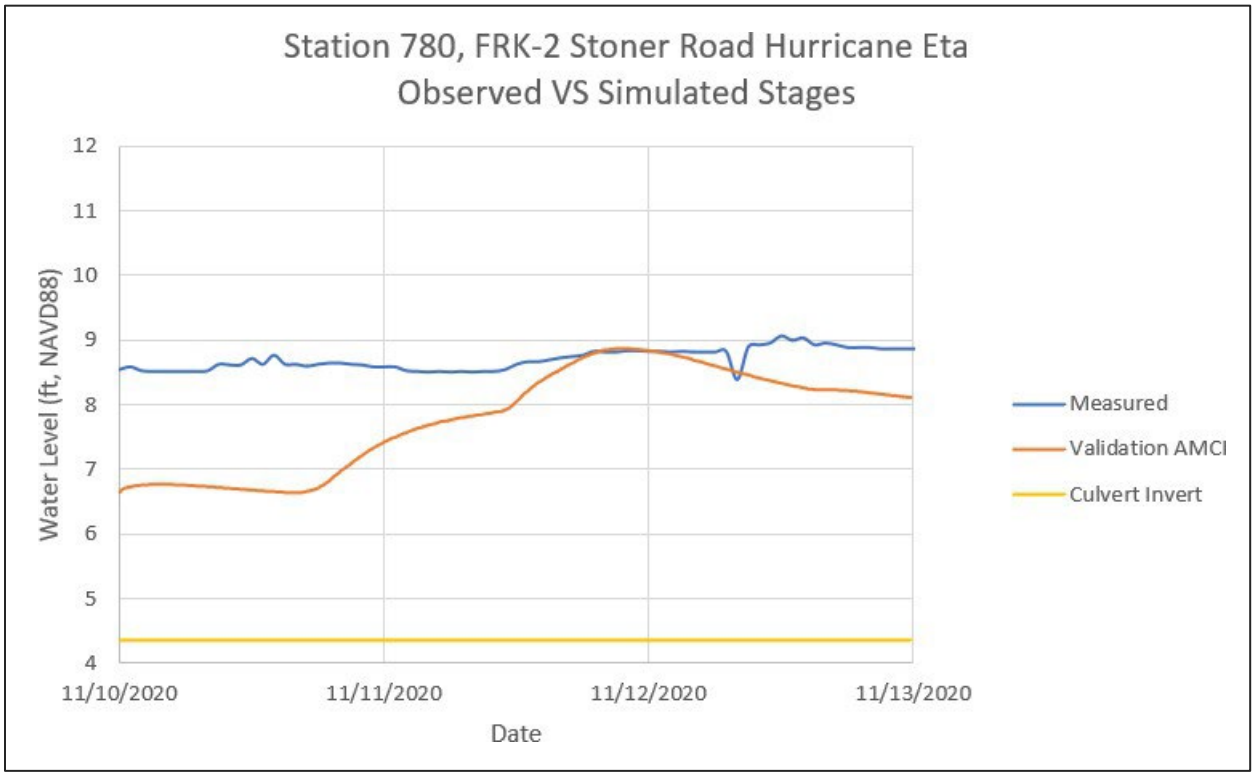


Figure 36. Station 780, FRK-2 Observed versus Simulated Stages, 11/10/2020 – 11/12/2020

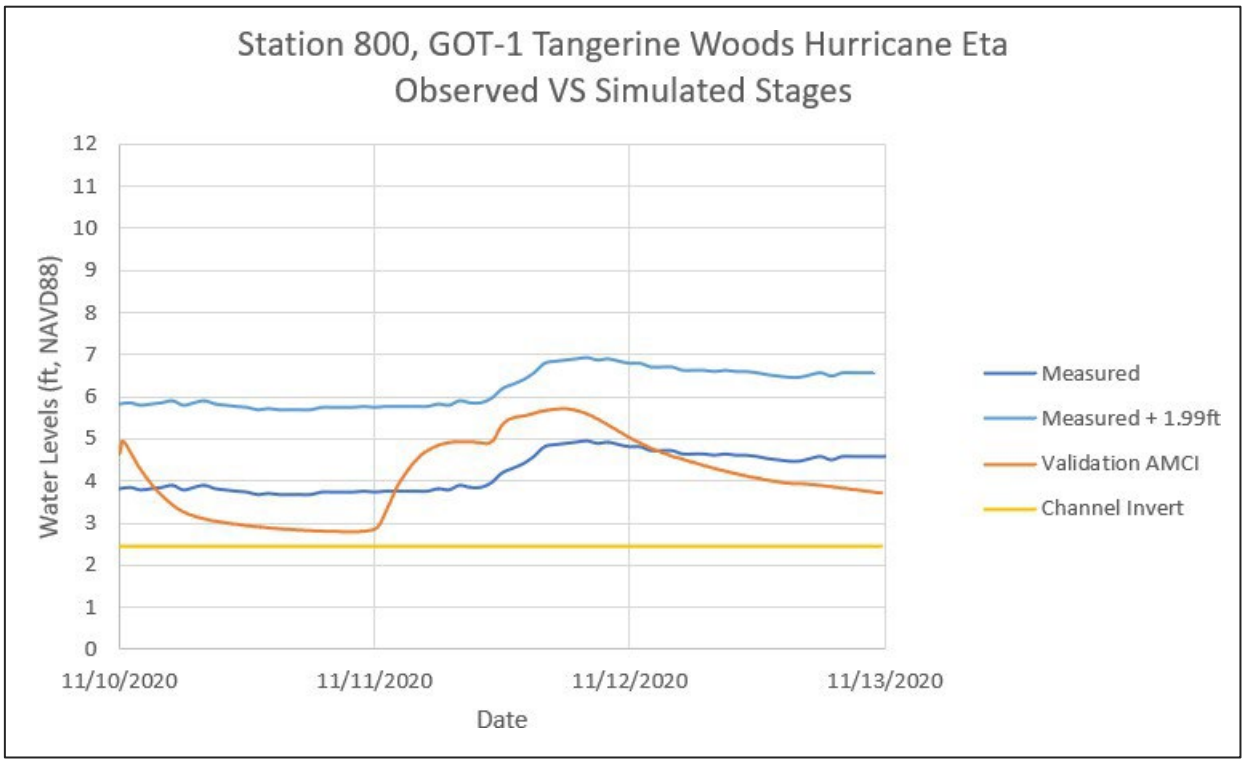


Figure 37. Station 800, GOT-1 Observed versus Simulated Stages, 11/10/2020 – 11/12/2020

11. Watershed Merge

The calibration adjustments were applied by Collective to the design storm model. Then as requested by the County, Collective merged the adjacent CF_LB watershed GWIS and model into the LB GWIS/ICPR4 model. Original names for all model elements have been maintained with the merger. The CF_LB watershed is adjacent to both Dona Bay/ Roberts Bay Coastal Fringe (CF_DBRB) and RB watersheds. CF_LB model elements were assigned to LB based on hydrology (adjoining basins) and hydraulics. A summary of the model conversion and maintenance efforts performed by Collective for the CF_LB watershed is documented in the separate *Lemon Bay Coastal Fringe Model Update Report* (2024) prepared by Collective as part of this same project.

As part of the merge efforts, basin, node, and link topologies were reviewed and corrected to address basin gaps and overlaps as well as snapping links to nodes. Additionally, boundary stage conditions were updated to include boundary stage sets and associated draft data for both the 25-year/24-hour and 500-year/24-hour simulations. The boundary stage data will be updated under the next task based on the countywide model simulation results.

12. Model Boundary Conditions Updates

The merged LB watershed boundary and boundary interconnections required additional updates to be consistent with adjacent watersheds. Collective coordinated with Jones Edmunds to update basin

boundaries to resolve basin gaps and overlaps and connectivity with LM. Additionally, basins and interconnections were reviewed and updated with the adjacent RB watershed, which Collective is updating a part of this project, too. As needed, associated node storage, TOC, CN, and IA were updated for revised LB basins. Hydraulic links were reviewed by Collective to ensure consistency with adjacent watersheds, which required both adding and modifying link features and updating parameter data (e.g., to/from nodes, etc.).

Since all County watersheds are being updated concurrently, the LB watershed was merged into a countywide watershed model by Jones Edmunds to establish boundary conditions efficiently and consistently for all watersheds at once. During the process of merging the watersheds into the countywide master model, Jones Edmunds performed the following (Jones Edmunds 2024):

- Additional updates to basin delineations to eliminate gaps and overlaps
- Renamed nodes and links to eliminate duplicate names between watersheds
- Addressed link/node topology errors
- Updated spatial features to match model inputs
- For features represented in adjacent models but reflecting mismatched information, reviewed and retained the features with the more credible source

Jones Edmunds provided Collective the merged, countywide GWIS 2.1 geodatabase and ICPR4 model with simulation results for the 10-year/24-hour, 25-year/24-hour, 50-year/24-hour, 100-year/24-hour, and 500-year/24-hour design storm events. The Type II Florida-Modified rainfall distribution was maintained for all watersheds. Rainfall amounts for each storm event applied to all watersheds are summarized in **Table 10**.

Table 10. Design Storm Rainfall Depths for Countywide Model

Rainfall Return Period and Duration	Rainfall Depth (inches)
10 years/24 hours	7.0
25 year/24 hours	8.0
50 years/24 hours	9.0
100 years/24 hours	10.0
500 years/24 hours	12.4

Collective extracted the LB watershed from the countywide master model into a new, separate GWIS 2.1 geodatabase. Based on the County's request, watershed assignments were modified for several basins:

- **Added to LB watershed from RB**: 112030, 1146517, 1146518, 1146520, 1146521, J0090, J0100, J0110, J0120, J0130, J0140, J0170, J0190, J0210, J0240, J0370, J0400, J0410

Additionally, boundary stage time series were assigned based on the results of the countywide model for all storm events. An ICPR4 model was generated by Collective from the extracted, LB geodatabase and all simulations were executed. Collective performed a review of the results of the extracted model to confirm consistency with the countywide model.

13. Floodplain Development

Node peak results of the 100-year/24-hour simulation and the previously discussed 2019 DEM (see Section 3) were used by Collective to generate level-pool floodplains for the LB watershed with Sarasota County. Additional processing was performed to remove gaps and holes and delete insignificantly small inundation polygons applying a threshold of 2,500 square feet. Results were compared with preliminary floodplain information developed by Collective after responding to model update peer review comments (see Section 9) as well as 2017 flood zone type "AE" mapping provided by SWFWMD with the original LB GWIS geodatabase.

14. Response to Verification, Boundary Conditions Updates and Floodplain Peer Review

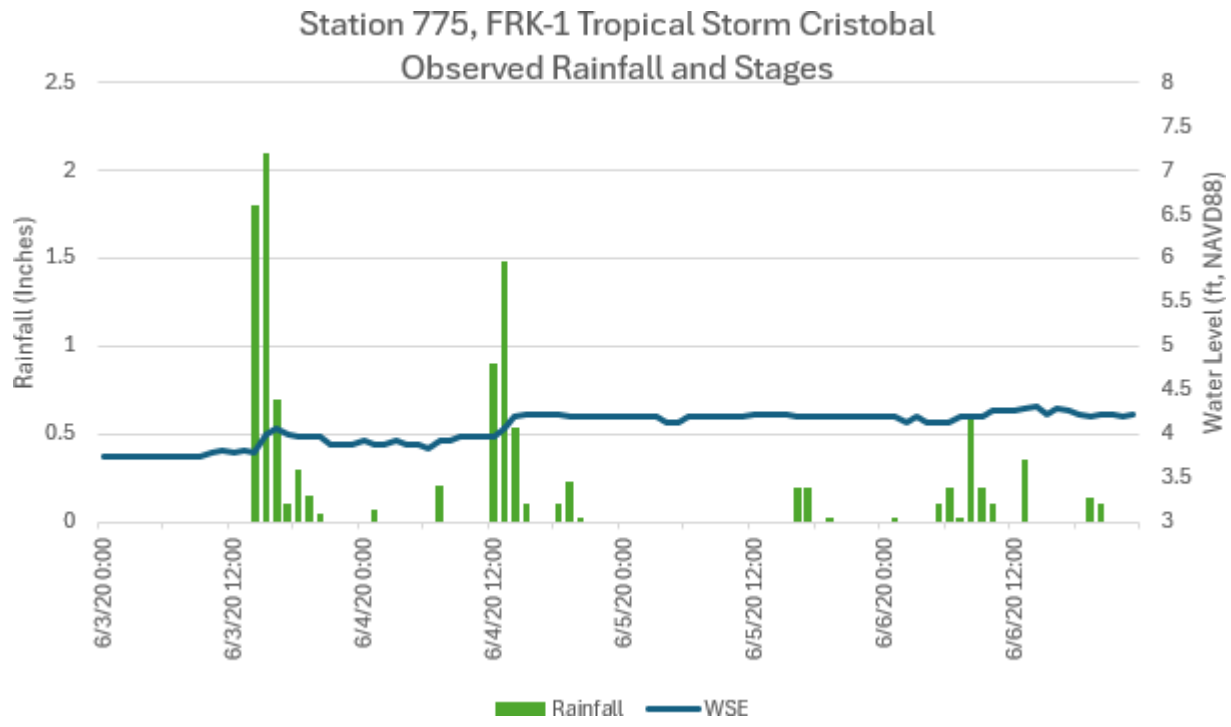
On March 19, 2024, Jones Edmunds provided peer review comments related to the verification, boundary condition updates and floodplain delineation performed by Collective. **Table 11** summarizes the comments received and Collective's responses.

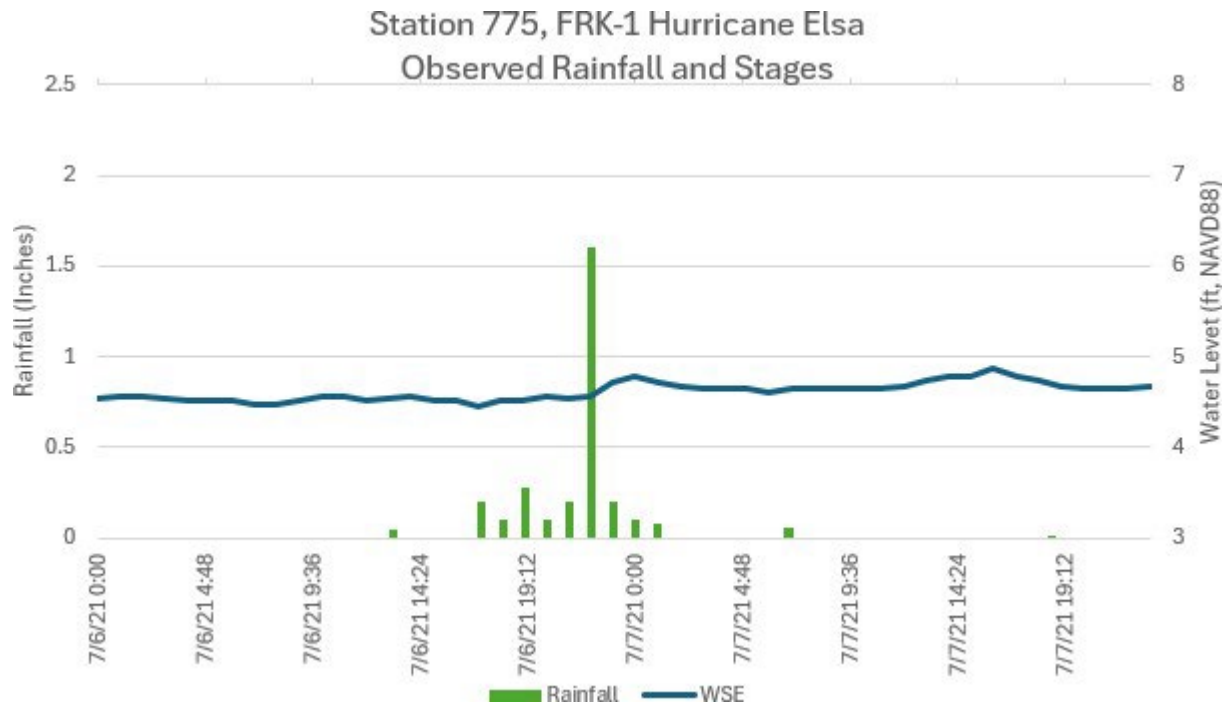
Table 11. Peer Review Comments and Responses Related to Boundary Condition Updates and Floodplain Mapping

Peer Review Comment	Response
Surface overflow weirs that no longer reflect the current topography should be removed from the final model	*Collective assumes this comment is in reference to two of the weirs that were turned off for the calibration adjustments since they were found to no longer reflect current topography. These two weirs (16789-W1 and 12852-W1) have now been removed.*

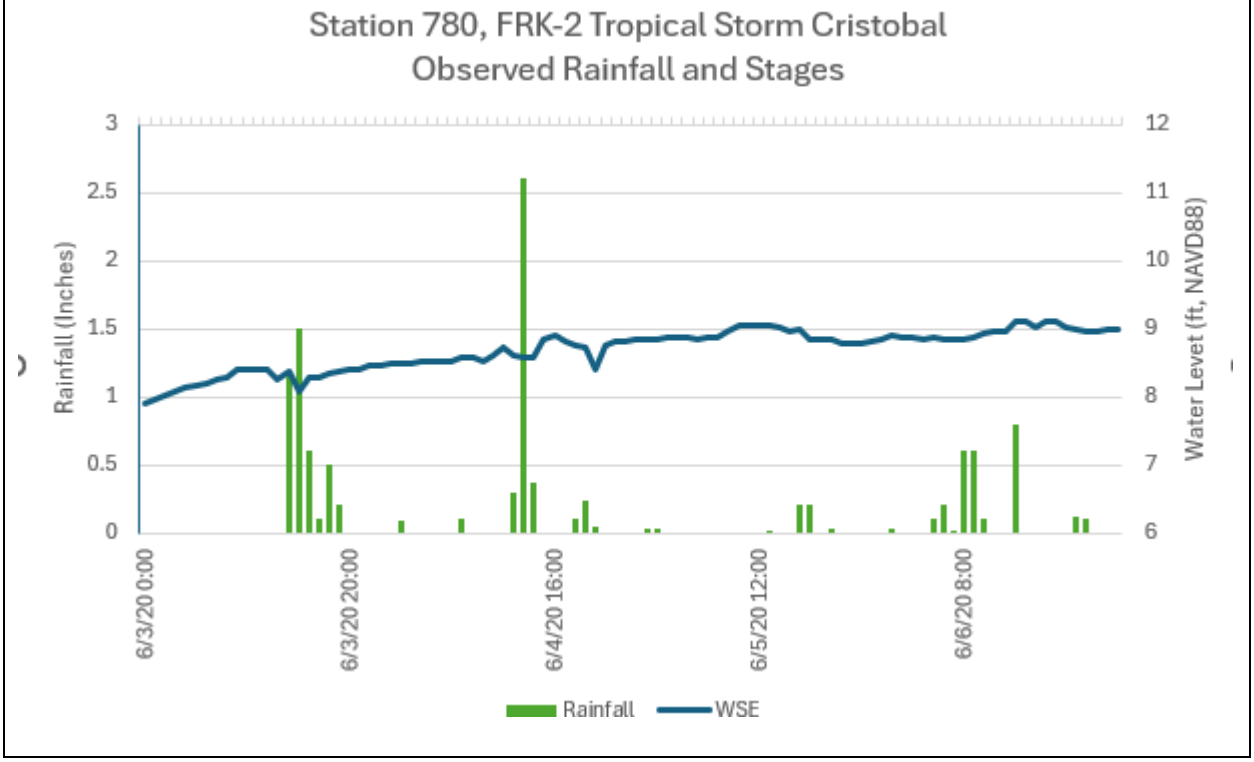
Peer Review Comment	Response
No justification was made as to why the 500-year/24-hour overflow weirs were turned off and how the change impacted the validity of the model.	*These 500-year/24-hour overflow weirs that had been added by Collective were turned off (and now removed) since the basin boundaries associated with these weirs do not reflect topographic ridges based on the current DEM and the associated overflow weirs were artificially generating significant flows at the onset of the calibration simulation. For the 26 basins associated with these removed weirs, Collective recommends the basin delineations, node storage, and all surface overflow weirs should be updated to match the current topography.*
Station 750 – AL-1: The timing, shape, and peak stage match well for the ascending limb of the calibration and verification events. There is a disparity in the recession for the calibration event and further investigation may be required to ensure it does not impact downstream elevations.	*Disparity in the recession for the calibration event is likely due to system blockages, prevalent throughout the County from this major event.*
Station 775 – FRK-1: Further investigation is required to justify the adjustment factor used for this gauge; the data presented in the report do not correlate with the adjustment factor. Further investigation may be required to determine the reason for the disparity in the duration of the peak. The gauge data showed a lack of response (change in stage) to rainfall. Jones Edmunds recommends the County verify the gauge data as well as model parameters in this area in future updates. Another verification event should be simulated to verify the validity of the model.	*Concur. A field survey is required to resolve the differences between the data in the model and the Station 775 measurements.* *The limited stage response to Hurricane Eta rainfall is similar to other events around the same time period. For Tropical Storm Cristobal, which produced significant rainfall in the area but minimal surge (measured 11.6 inches of total rainfall between 6/3/2020 and 6/7/2020), the change in measured stage was 0.59 feet. For Hurricane Elsa, which generated 3.0 inches of rainfall between 7/6/2021 and 7/7/2021, the change in measured stage was 0.43 feet.*

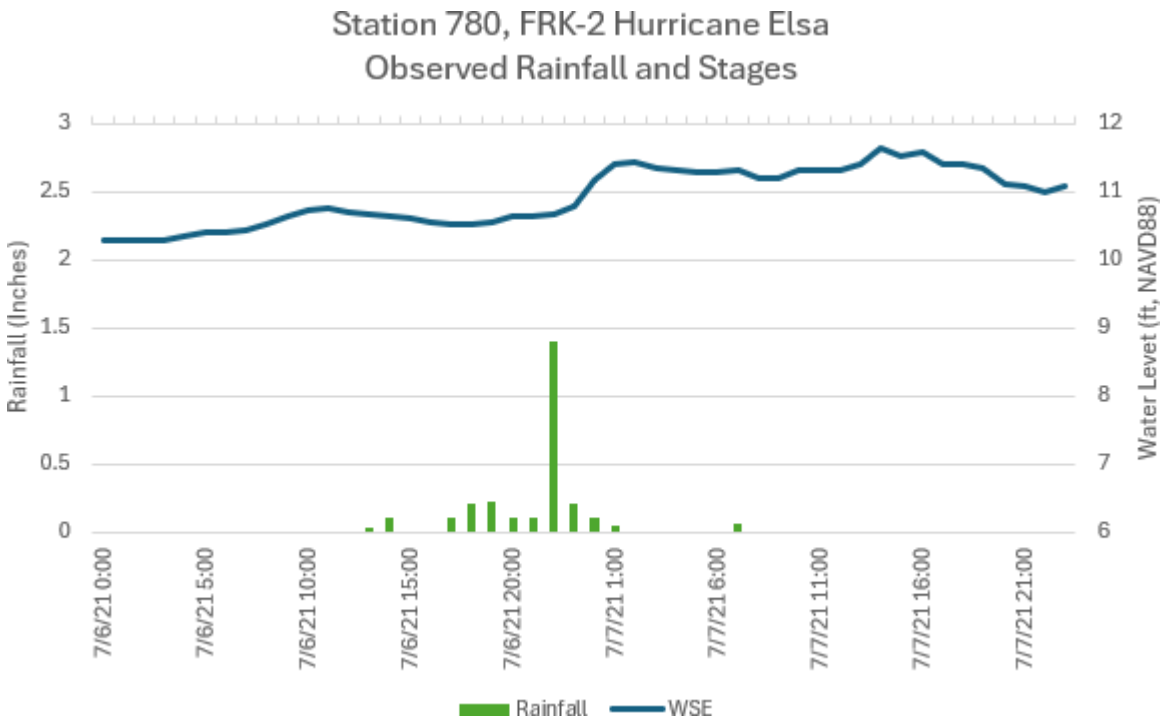
Peer Review Comment	Response

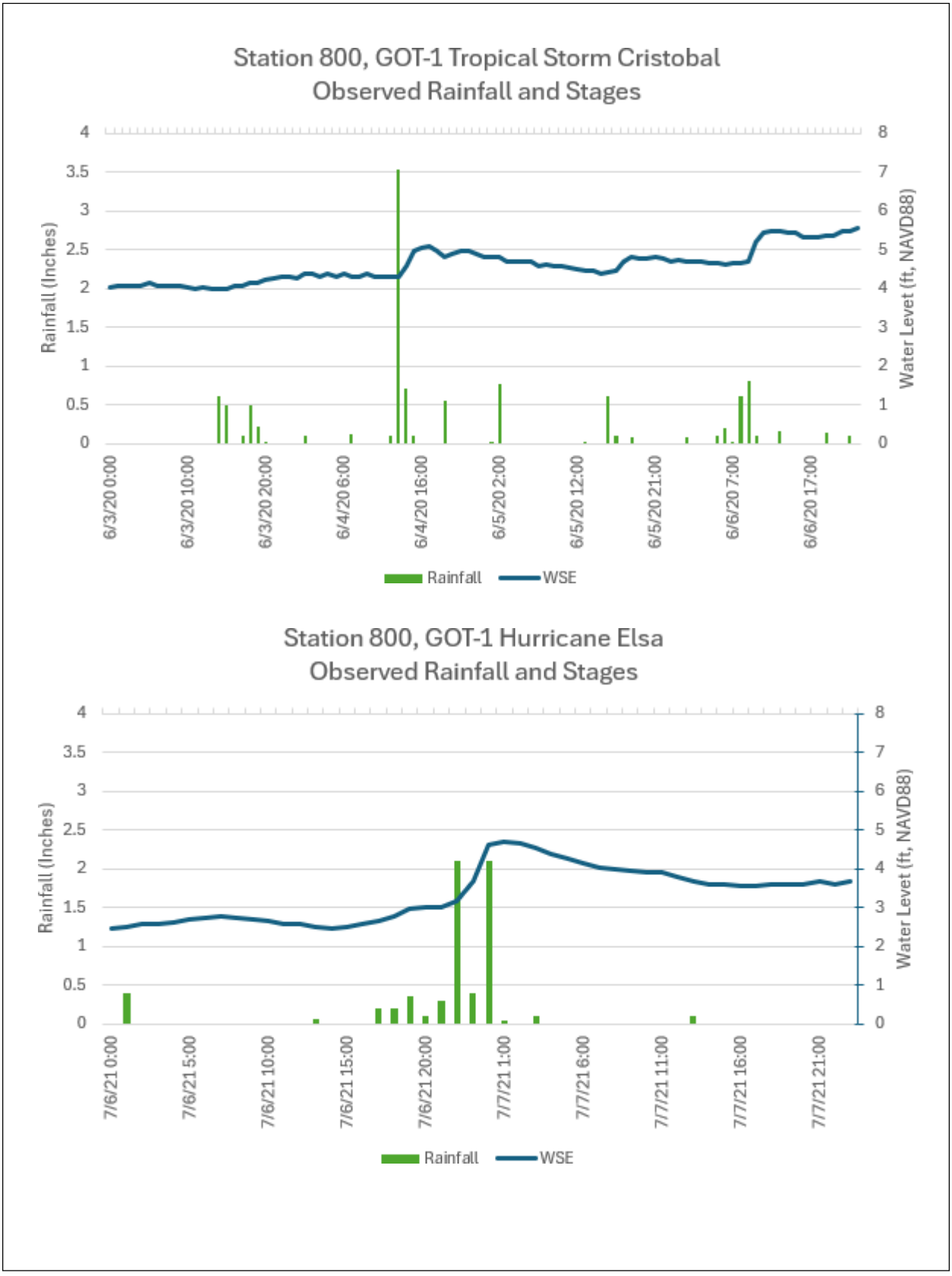


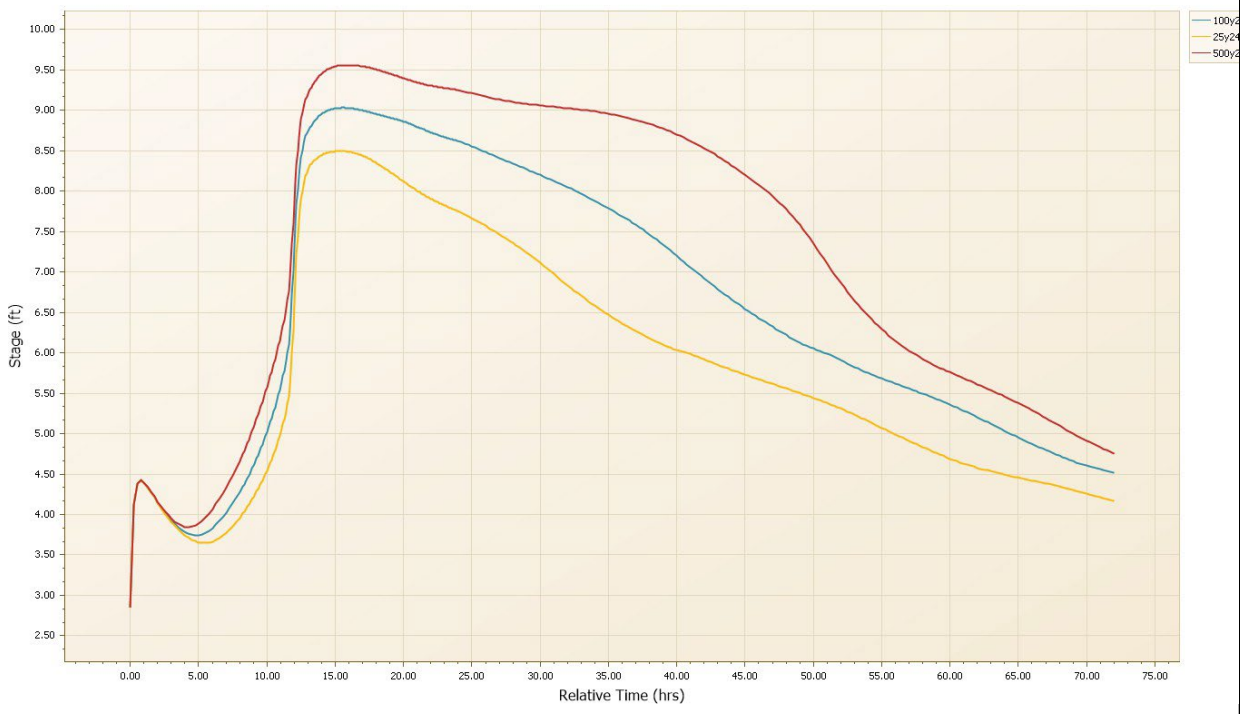


Peer Review Comment	Response
Station 780 – FRK-2: The calibration event matches well in timing, shape, and peak. The gauge data showed a lack of response to rainfall for the verification event. Jones Edmunds recommends a different verification event be simulated in the future to confirm the validity of the model results.	*Concur. The limited stage response to Hurricane Eta rainfall is like other tropical events around the same time period. For Tropical Storm Cristobal, which produced 11.1 inches of rainfall between 6/3/2020 and 6/7/2020 according to station's records, the change in measured stage was 1.21 feet. For Hurricane Elsa, which generated 2.6 inches of rainfall between 7/6/2021 and 7/7/2021, the change in measured stage was 1.56 feet.*



Peer Review Comment	Response
	
Station 800 – GOT-1: It was assumed that there was a systemic error in the observed gauge readings. As part of calibrating the model, an adjustment factor was applied to better match the observed gauge readings. The gauge adjustment value for the calibration event does not translate well to the verification event. The shape, timing, and peak stage for the calibration event match well; however, the verification event does not show a good match in timing, shape, or stage. Jones Edmunds recommends the gauge be verified to confirm the validity of the adjustment value. The node hydrographs for both events also indicate initial condition issues in this area.	*Concur. A field survey is required to resolve the differences between the data in the model and the Station 800 measurements. As exhibited in the Tropical Storm Cristobal and Hurricane Elsa plots of measured data (below), this location does appear to exhibit a consistent response to rainfall.* *Initial condition issues have been present in the model along Gottfied Creek from the original, conversion of the ICPR3 model (as illustrated in the node time series plot below) and need to be addressed in a future update.*


Station 800, GOT-1 Tropical Storm Cristobal
Observed Rainfall and Stages
Rainfall (Inches)
Water Levet (ft, NAVD88)
4
3.5
3
2.5
2
1.5
1
0.5
0
8
7
6
5
4
3
2
1
0
6/3/20 0:00
6/3/20 10:00
6/3/20 20:00
6/4/20 6:00
6/4/20 16:00
6/5/20 2:00
6/5/20 12:00
6/5/20 21:00
6/6/20 7:00
6/6/20 17:00
Rainfall
WSE
Station 800, GOT-1 Hurricane Elsa
Observed Rainfall and Stages
Rainfall (Inches)
Water Levet (ft, NAVD88)
7/6/21 0:00
7/6/21 5:00
7/6/21 10:00
7/6/21 15:00
7/6/21 20:00
7/7/21 1:00
7/7/21 6:00
7/7/21 11:00
7/7/21 16:00
7/7/21 21:00
Rainfall
WSE


Node: 15408
Stage (ft)
Relative Time (hrs)
100y2
25y24
500y2

Peer Review Comment	Response
The model and geodatabase are missing links RF5210E and RF5210E that were in the previous submittals.	*Addressed; links **RF3310A** and RF5210E (both pipe links) have been restored to both the geodatabase and the model.*
There are minor differences in the model results compared to the geodatabase.	*Addressed; ICPR_NODE_RESULT table has been updated to match peak stages reported from the model.*
All standard pipe sizes should be updated with the original pipe sizes (e.g., 11.8-inch-x-18.4-inch should be 12-inch-x-18-inch).	*Justification for this request is needed. Pipe dimensions were adjusted for model conversion to account for differences in how ICPR3 and ICPR4 non-standard pipes geometries are determined and to satisfy peak stage metrics for model conversion, per scope of work. Reverting these dimensions to original, non-standard sizes is a considerable effort, not within Collective's current scope of work, and will impact stages throughout the model.*
Jones Edmunds reviewed the level-pool floodplains for the 100-year/24-hour design storm event. The mapped floodplains are generally consistent with the peak water-surface elevations at the model nodes; however, the post-processing appears to overestimate the floodplain extent in some locations. An example is shown in Figure 1 where the lighter blue polygon illustrates the level-pool extent and the dark blue polygon is the raster that depicts the inundation cells.	*Post-processing of floodplain to remove minor floodplain areas and fill minor gaps is consistent with the approach employed by Jones Edmunds for other Sarasota County watersheds. Raw, level-pool floodplain can be provided as well, if County desires.*

15. Flood Protection Level of Service

Collective performed an existing conditions, stormwater quantity Level of Service (LOS) analysis of all basins in the LB watershed that are within the County limits in accordance with the LOS and design criteria described in the County's Unified Development Code (UDC), Appendix C14 (Sarasota County, 2023). More specifically, Collective evaluated the LOS for buildings and road access based on the criteria summarized in **Table 12**. Site flooding was not included in the analysis.

Table 12. Sarasota County Stormwater Quantity LOS Design Criteria

Category	Type	Storm Design
Building	All	Finished floor elevation greater than or equal to 100-year/24-hour peak flood elevation
Road Access	Evacuation	No flooding at outside edge of pavement from 100-year/24-hour design storm
	Arterial	Less than 6-inches of flooding at outside edge of pavement from 100-year/24-hour design storm
	Collector	Less than 6-inches of flooding at outside edge of pavement from 25-year/24-hour design storm
	Neighborhood	Less than 6-inches of flooding at outside edge of pavement from 10-year/24-hour design storm

The methodology to assess LOS within the watershed is similar in approach to previous assessments performed for the County. The following sections detail the supporting data and methodology used by Collective to evaluate both buildings and roadway access.

15.1 Building LOS Methodology

Collective utilized the *BuildingFootprint* feature class published by Sarasota County and available from ArcGIS Online to identify buildings where the estimated finished floor elevations (FFE) are below the 100-year/24-hour flood elevations. FFEs were estimated for all buildings as follows:

- Building polygons were buffered to the outside by five feet.
- The mean and maximum surface elevations within the five-foot buffer polygon were determined from the 2019 SWFWMD DEM.
- For all buildings except mobile and manufactured housing, the average of the mean and maximum elevations was used to establish the FFEs.
- For mobile and manufactured housing, one foot was added to average of the mean and maximum elevations to establish the FFEs.

Each building was intersected with associated basin(s) and the FFE compared to the associated basin's 100-year/24-hour flood elevation. Each building where the FFE is less than the flood elevation was flagged as deficient and compared to the flood depth grid. Non-habitable structures, defined as having a square footage of less than 400 square feet (ICC, 2023), were removed from the list. Additionally, buildings no longer visible in recent aerial imagery (i.e., 2020 and 2023) were removed. Lastly, buildings constructed after 2018, which are not reflected in the updated DEM and aerials indicating a topographic void, were not flagged. **Appendix A** includes a table summarizing the LOS

deficient structures for the County's portion of the watershed as well as a map illustrating the locations. A total of 44 buildings within Sarasota County's portion of the watershed have been identified as stormwater LOS deficient.

15.2 Road Access LOS Methodology

For the road access assessment, Collective utilized the *Streets* feature class published by Sarasota County and available from ArcGIS Online to identify roadway segments within the County's portion of the watershed that do not meet the access criteria established by the County. The Street feature class was supplemented with information from the County's *Thoroughfare* feature class (also available via ArcGIS Online) to classify the *Streets* segments as Evacuation, Arterial (both major and minor arterials not identified as Evacuation routes), or Collector (both major and minor collectors not identified as Evacuation routes). Remaining segments were classified as Neighborhood roads.

For this analysis, Collective assumed the *Streets* layer reflects the roadway centerlines. Edge of pavement elevation for each road segment was estimated assuming the centerline represents the crown elevation, and the edge of pavement is 12-feet offset with a 2-percent cross slope from the crown (equivalent to 0.24-feet below crown elevation). The *Streets* layer, along with the 2019 DEM, floodplain mapping and depth rasters for the 10-year/24-hour, 25-year/24-hour, and 100-year/24-hour storm events were used by Collective to identify the segments of roadways where the flooding depth exceeds the LOS criteria and flagged these as deficient. Small (i.e., less than 25 linear feet), isolated segments of roadways were removed from the list. Additionally, flagged roadways were visually reviewed for reasonableness. Lastly, Collective performed a visual review to identify any roadway segments where EOP estimates (depth and/or width) did not flag deficient roadways. Street segments that were constructed post-2020, and not reflected in the model updates and associated DEM, were not flagged. Duration of flooding for each deficient segment was estimated as well. There are two segments with durations equivalent to the entire simulation period (96 hours) due to initial stages exceeding the edge of pavement elevation. Node initial stages need to be revised in a future update and the level of service deficiency assignments re-evaluated accordingly.

Table 13 summarizes by road classification and LOS status the length of roadway and percentage of total length with the County's portion of the watershed. **Appendix B** includes a detailed list identifying each road segment not satisfying the County's design criteria as well as a figure illustrating their locations. Lengths represent roadway segments as defined by the County's mapping, not the length of edge of pavement inundated by the specific storm event.

Table 13. Road Access LOS Summary by Roadway Classification

LOS Roadway Classification	Meets Stormwater LOS Criteria	Linear Feet	Percent of Total LOS Roadway Classification
Evacuation	Yes	46,765	23.2
	No	154,983	76.8
Arterial	Yes	2,856*	9.1
	No	28,372	90.9
Collector	Yes	5,105	6.4
	No	75,120	93.6
Neighborhood	Yes	64,658*	3.5
	No	1,776,041	96.5

*Includes segments where the duration of flooding is 96 hours. These level of service deficiency need to be re-evaluated once an update with revised initial stages is completed.

16. Response to Level of Service Peer Review

<This section is not included under this deliverable and will be completed with a future submittal>

17. Conclusions and Recommendations

<This section is not included under this deliverable and will be completed with a future submittal>

18. References

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Appendix A

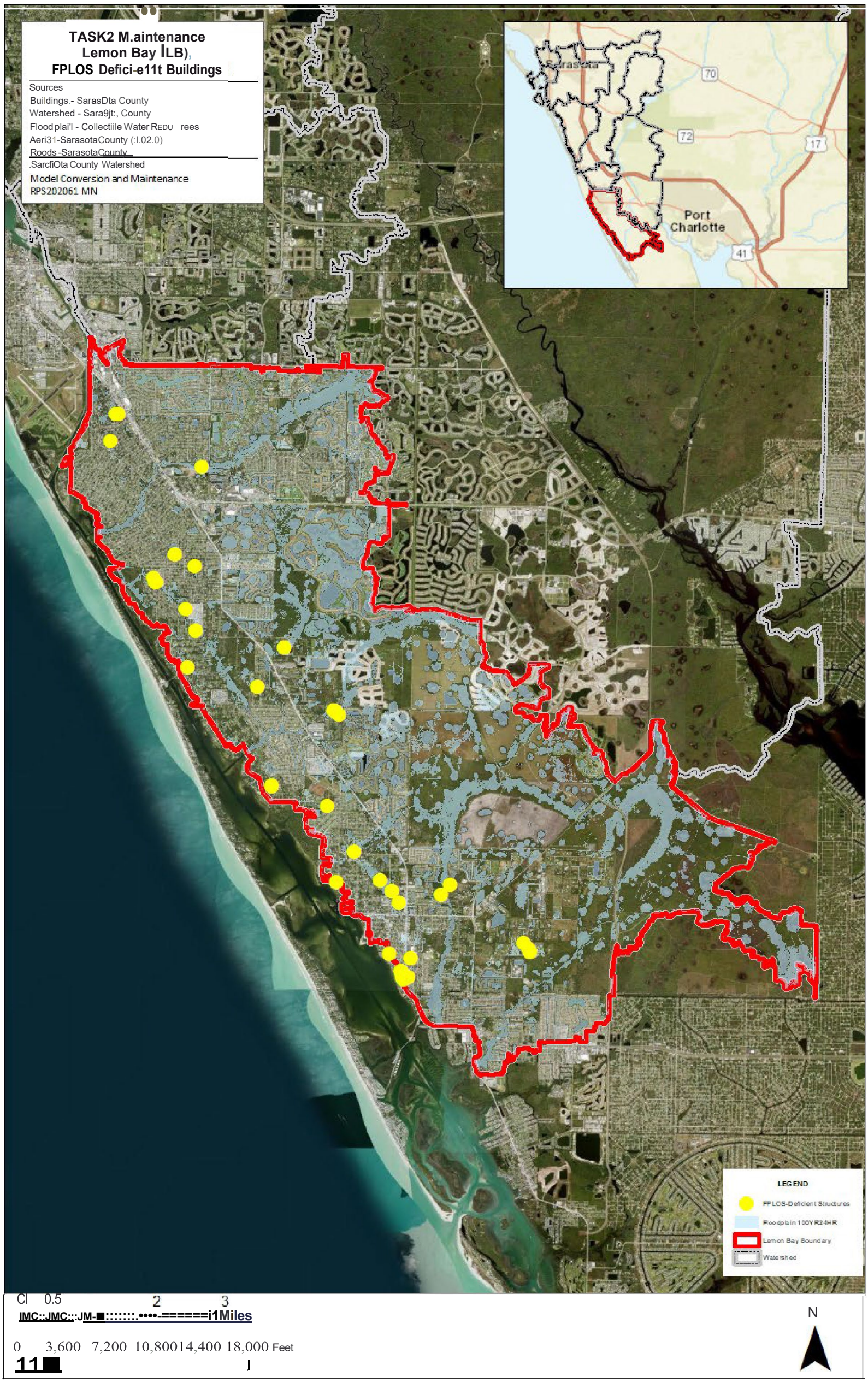
Stormwater LOS Deficient Buildings

Table A-1. Stormwater LOS Deficient Buildings

FACILITY ID	Address	Building Type	FFE (ft, NAVD88)	Node	Stage 100YR (ft, NAVD88)	Stage 25YR (ft, NAVD88)	Stage 10YR (ft, NAVD88)
BF_08182016_349353	201 DRAGON RD VENICE FL, 34293	Single Family Detached	13.64	12131	**13.85**	13.55	13.29
BF_08182016_349357	2440 GENTIAN RD VENICE FL, 34293	Single Family Detached	13.39	12131	**13.85**	**13.55**	13.29
BF_08182016_354023	2981 QUINCY RD VENICE FL, 34293	Single Family Detached	13.47	12125	**13.66**	13.23	12.95
BF_08182016_358966	3951 WOODMERE PARK BLVD VENICE FL, 34293	Parks - Community	6.53	12188N	6.58	5.88	5.42
BF_08182016_378646	AZURE RD VENICE FL, 34293	Misc. Res - no living unit	11.33	12030F	**11.59**	11.07	10.79
BF_08182016_381344	430 PONDEROSA RD VENICE FL, 34293	Single Family Detached	11.05	13091	**11.18**	10.77	10.52
BF_08182016_383771	1031 AUBURN RD VENICE FL, 34293	Single Family Detached	5.47	13510	**6.18**	**6.08**	**6.01**
BF_08182016_384376	HERON RD VENICE FL, 34293	Residential vacant site	4.58	13510	**6.18**	**6.08**	**6.01**
BF_08182016_384465	HERON RD VENICE FL, 34293	Residential vacant site	4.63	13510	**6.18**	**6.08**	**6.01**
BF_08182016_385561	N/A VENICE FL, 34293	Manufactured 1-Fam Res	7.89	13570	**7.94**	7.62	7.45
BF_08182016_386571	6131 TEAHOUSE RD VENICE FL, 34293	0005	8.16	13605	**8.47**	**8.18**	7.96
BF_08182016_386961	1507 E MANASOTA BEACH RD ENGLEWOOD FL, 34223	Single Family Detached	10.06	14295	**10.73**	**10.36**	**10.13**
BF_08182016_387300	1727 LARSON ST ENGLEWOOD FL, 34223	Single Family Detached	7.71	NE1010	**7.91**	7.60	7.43
BF_08182016_387653	2110 W DOLPHIN DR ENGLEWOOD FL, 34223	Single Family Detached	11.01	14224	**11.13**	10.97	10.87
BF_08182016_388321	905 KEYWAY RD ENGLEWOOD FL, 34223	Multiple Single Fam Dwellings	9.22	14546	**9.68**	8.78	8.31
BF_08182016_388359	905 KEYWAY RD ENGLEWOOD FL, 34223	Multiple Single Fam Dwellings	7.61	14549	**10.10**	**9.42**	**9.00**
BF_08182016_388479	1840 WHISPERING PINES CIR ENGLEWOOD FL, 34223	Residential vacant site	9.88	14549	**10.10**	9.42	9.00
BF_08182016_391188	1181 LARCHMONT DR ENGLEWOOD FL, 34223	Single Family Detached	8.68	NF3030	**9.01**	**8.89**	**8.81**
BF_08182016_391203	1181 LARCHMONT DR ENGLEWOOD FL, 34223	Single Family Detached	8.12	NF3030	**9.01**	**8.89**	**8.81**
BF_08182016_391689	855 BAYSHORE DR ENGLEWOOD FL, 34223	Single Family Detached	12.90	NF3270	**13.20**	**13.06**	**13.01**
BF_08182016_392959	598 ARTISTS AVE ENGLEWOOD FL, 34223	Single Family Detached	9.99	15454	**10.06**	9.57	9.29
BF_08182016_394157	425 N ELM ST ENGLEWOOD FL, 34223	Single Family Detached	10.14	15378	**10.55**	**10.30**	**10.17**
BF_08182016_394214	868 HARVARD ST ENGLEWOOD FL, 34223	Single Family Detached	3.19	NF4240	**3.25**	3.17	3.13
BF_08182016_394282	380 N OXFORD DR ENGLEWOOD FL, 34223	Single Family Detached	5.47	15263	**5.86**	**5.77**	**5.75**

FACILITY ID	Address	Building Type	FFE (ft, NAVD88)	Node	Stage 100YR (ft, NAVD88)	Stage 25YR (ft, NAVD88)	Stage 10YR (ft, NAVD88)
BF_08182016_394514	293 N MCCALL RD ENGLEWOOD FL, 34223	Single Family Detached	10.42	15379	**10.72**	**10.60**	**10.52**
BF_08182016_394644	265 STRATFORD RD ENGLEWOOD FL, 34223	Single Family Detached	2.54	15206	**2.93**	2.26	1.96
BF_08182016_394987	151 NEW YORK AVE ENGLEWOOD FL, 34223	Single Family Detached	10.19	15389	**10.72**	**10.21**	9.82
BF_08182016_396514	MORNINGSIDE DR ENGLEWOOD FL, 34223	Residential vacant site	9.07	16149	**9.11**	8.82	8.63
BF_08182016_396656	920 MORNINGSIDE DR ENGLEWOOD FL, 34223	Single Family Detached	7.47	16139	**9.12**	**8.82**	**8.63**
BF_08182016_396734	920 MORNINGSIDE DR ENGLEWOOD FL, 34223	Single Family Detached	8.59	16139	**9.12**	**8.82**	**8.63**
BF_08182016_396793	417 S MCCALL RD ENGLEWOOD FL, 34223	Single Family Detached	7.58	NF5220	**7.71**	7.55	7.39
BF_08182016_396920	545 SPRUCE ST ENGLEWOOD FL, 34223	Single Family Detached	11.32	NF5490	**11.49**	**11.42**	**11.38**
BF_08182016_397252	665 S MCCALL RD ENGLEWOOD FL, 34223	3-Family Dwelling	8.31	NF5210	**8.40**	8.30	8.15
BF_08182016_397265	665 S MCCALL RD ENGLEWOOD FL, 34223	3-Family Dwelling	8.18	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397322	695 MCCALL RD ENGLEWOOD FL, 34223	Single Family Detached	8.16	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397377	INDIANA AVE ENGLEWOOD FL, 34223	Residential vacant site	8.12	NF5210	**8.40**	**8.30**	**8.15**
BF_08182016_397416	717 MCCALL RD ENGLEWOOD FL, 34223	Single Family Detached	8.30	NF5210	**8.40**	8.30	8.15
BF_08182016_397419	744 SPRUCE ST ENGLEWOOD FL, 34223	Single Family Detached	8.95	NF5320	**8.97**	8.92	8.88
BF_08182016_397424	772 S INDIANA AVE ENGLEWOOD FL, 34223	Single Family Detached	8.30	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397431	727 MCCALL RD ENGLEWOOD FL, 34223	Single Family & Other Bldg	8.26	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397436	744 SPRUCE ST ENGLEWOOD FL, 34223	Single Family Detached	8.96	NF5320	**8.97**	8.92	8.88
BF_08182016_397457	747 S MCCALL RD ENGLEWOOD FL, 34223	Single Family & Other Bldg	8.18	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397459	747 S MCCALL RD ENGLEWOOD FL, 34223	Single Family & Other Bldg	8.29	NF5210	**8.40**	**8.30**	8.15
BF_08182016_397543	785 S MCCALL RD ENGLEWOOD FL, 34223	Single Family Detached	8.39	NF5200	**8.60**	**8.53**	**8.49**

Figure A-1. Location Map of LOS Deficient Buildings



Appendix B

Stormwater LOS Deficient Roadways

Table B-1. Stormwater LOS Deficient Roads

Lengths represent roadway segments as defined by the County's mapping layer, not the length of edge of pavement inundated by the specific storm event.

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_102012_026476	KEYWAY RD	801	1161	800	1160	Arterial	2855.85	14540Z01	8.65	100 Year	10.97	10.92	10.89	2.32	96.00
ST_102012_000650	SHAMROCK BLVD	701	799	700	798	Collector	626.26	12641	11.90	25 Year	13.08	12.96	12.88	1.06	4.75
ST_102012_000795	W DEARBORN ST	301	349	300	348	Collector	351.58	NF4620	8.17	25 Year	9.61	9.47	9.31	1.30	1.5
ST_102012_001209	SHAMROCK DR	2301	2399	2300	2398	Collector	256.44	12139	15.20	25 Year	16.17	16.04	15.95	0.84	1.75
ST_102012_001766	W DEARBORN ST	351	399	350	398	Collector	326.34	NF4600	8.44	25 Year	9.61	9.46	9.3	1.02	1.25
ST_102012_021988	ROCKLEY BLVD	400	598	401	599	Collector	1278.57	181177	10.94	25 Year	11.94	11.5	11.18	0.56	8
ST_102012_022789	VENICE EAST BLVD	301	399	312	398	Collector	1051.48	12446	9.60	25 Year	10.76	10.46	10.11	0.86	2.25
ST_102012_026219	SHAMROCK BLVD	623	699	620	698	Collector	565.13	12641	11.96	25 Year	13.08	12.96	12.88	1.00	4.25
ST_102012_026980	W DEARBORN ST	101	199	100	198	Collector	648.70	NF5720	9.81	25 Year	10.89	10.75	10.59	0.94	3.75
ST_102012_000132	ENGLEWOOD RD	4501	4599	0	0	Evacuation Route	891.96	12770NN	12.44	100 Year	13.34	12.86	12.66	0.90	13
ST_102012_000141	ENGLEWOOD RD	0	0	4600	4798	Evacuation Route	931.99	13160	12.56	100 Year	13.13	12.16	11.79	0.57	4.75
ST_102012_000272	N INDIANA AVE	1252	1298	1253	1299	Evacuation Route	1262.76	15438	11.05	100 Year	12.05	11.75	11.59	1.00	6.75
ST_102012_000290	ENGLEWOOD RD	0	0	5352	5398	Evacuation Route	251.49	13131Z01	12.65	100 Year	13.7	13.54	13.48	1.05	14.75
ST_102012_000516	US 41 BYP S	0	0	1290	1498	Evacuation Route	1195.26	1146520	13.04	100 Year	14.37	14.21	14.1	1.33	4.5

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_102012_001806	N INDIANA AVE	100	148	101	149	Evacuation Route	269.77	151085	10.78	100 Year	10.81	10.43	10.13	0.03	1.25
ST_102012_000572	S INDIANA AVE	21	99	32	98	Evacuation Route	331.58	151024	9.76	100 Year	10.47	10.17	9.94	0.71	2.25
ST_102012_001880	S TAMIAMI TRL	0	0	1700	1798	Evacuation Route	2201.29	12211C	13.22	100 Year	13.81	13.29	13.03	0.59	1.75
ST_102012_000329	ENGLEWOOD RD	0	0	5300	5350	Evacuation Route	248.83	13131Z01	12.78	100 Year	13.7	13.54	13.48	0.92	13.5
ST_102012_000355	S TAMIAMI TRL	0	0	2200	2298	Evacuation Route	1280.77	12341	10.81	100 Year	12.29	12.12	12.04	1.48	26.00
ST_102012_000495	N INDIANA AVE	212	220	213	221	Evacuation Route	193.29	151084	10.23	100 Year	10.81	10.42	10.12	0.58	7
ST_102012_000674	S INDIANA AVE	201	299	200	298	Evacuation Route	655.87	NF5430	9.42	100 Year	10.62	10.48	10.36	1.20	3.25
ST_102012_000727	S INDIANA AVE	453	499	400	498	Evacuation Route	293.27	NF5420	9.35	100 Year	10.19	10.13	10.04	0.84	2.75
ST_102012_000731	S TAMIAMI TRL	2271	2299	0	0	Evacuation Route	213.41	12344	11.07	100 Year	12.29	12.12	12.04	1.22	23.00
ST_102012_000753	S TAMIAMI TRL	2301	2363	0	0	Evacuation Route	611.72	12353	11.06	100 Year	12.36	12.15	12.07	1.30	22.75
ST_102012_000806	ENGLEWOOD RD	0	0	5400	5448	Evacuation Route	247.10	13131Z01	13.05	100 Year	13.7	13.54	13.48	0.65	9.75
ST_102012_000811	N INDIANA AVE	1200	1250	1201	1251	Evacuation Route	330.19	15431	10.95	100 Year	11.69	11.24	10.69	0.74	5.00

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_102012_000857	JACARANDA BLVD	2200	2398	2201	2399	Evacuation Route	1596.39	12706	10.38	100 Year	11.53	10.3	9.91	1.15	11.5
ST_102012_001095	ENGLEWOOD RD	4601	4899	0	0	Evacuation Route	1225.85	13160	12.18	100 Year	13.13	12.16	11.79	0.95	6.75
ST_102012_001106	N INDIANA AVE	1152	1198	0	0	Evacuation Route	341.47	15431	10.68	100 Year	11.69	11.24	10.69	1.01	5.75
ST_102012_001175	S INDIANA AVE	701	799	700	798	Evacuation Route	792.06	NF5300	7.89	100 Year	8.64	8.57	8.52	0.75	3.25
ST_102012_001225	S INDIANA AVE	1	19	2	30	Evacuation Route	339.95	151023	9.05	100 Year	10.27	9.82	9.58	1.22	2.50
ST_102012_001251	S TAMIAMI TRL	2365	2369	0	0	Evacuation Route	772.22	12373	12.11	100 Year	12.95	12.7	12.51	0.84	9
ST_102012_001290	S INDIANA AVE	581	599	580	598	Evacuation Route	255.27	NF5370	9.84	100 Year	10.05	9.87	9.64	0.21	0.5
ST_102012_001305	N INDIANA AVE	232	298	231	299	Evacuation Route	258.86	151084	10.46	100 Year	10.81	10.42	10.12	0.35	5.25
ST_102012_001338	JACARANDA BLVD	2400	2410	2401	2411	Evacuation Route	478.73	12706	10.66	100 Year	11.53	10.3	9.91	0.87	9.5
ST_102012_001379	S TAMIAMI TRL	1701	1799	0	0	Evacuation Route	2249.85	12211C	13.15	100 Year	13.81	13.29	13.03	0.66	1.75
ST_102012_001618	N INDIANA AVE	180	198	181	199	Evacuation Route	154.11	151085	10.01	100 Year	10.81	10.43	10.13	0.80	8.25
ST_102012_001623	N INDIANA AVE	222	228	223	229	Evacuation Route	67.42	151084	10.11	100 Year	10.81	10.42	10.12	0.70	7.50

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_102012_001718	ENGLEWOOD RD	0	0	5252	5298	Evacuation Route	249.03	13131Z01	13.18	100 Year	13.7	13.54	13.48	0.52	8
ST_102012_001780	ENGLEWOOD RD	0	0	5100	5250	Evacuation Route	706.09	13131Z01	12.89	100 Year	13.7	13.54	13.48	0.81	12.25
ST_102012_001836	ENGLEWOOD RD	1500	1598	1501	1599	Evacuation Route	773.01	14048	11.51	100 Year	12.14	11.85	11.64	0.63	54
ST_102012_001871	S INDIANA AVE	301	399	300	348	Evacuation Route	338.40	NF5430	10.03	100 Year	10.62	10.48	10.36	0.59	2.75
ST_102012_009387	PINE ST	201	399	200	398	Evacuation Route	1786.04	15038	6.87	100 Year	7.42	6.79	6.34	0.55	5.5
ST_102012_010844	PINE ST	701	799	700	798	Evacuation Route	703.93	15020	5.20	100 Year	6.08	5.84	5.66	0.88	17.75
ST_102012_017177	PINE ST	401	699	400	698	Evacuation Route	1482.60	15027	5.24	100 Year	6.08	5.84	5.63	0.84	15.75
ST_102012_019921	PINE ST	801	899	800	898	Evacuation Route	696.11	15023	5.88	100 Year	6.21	5.88	5.71	0.33	3.5
ST_102012_022011	S TAMIAMI TRL	2207	2269	0	0	Evacuation Route	974.07	12326	10.70	100 Year	11.39	10.99	10.78	0.69	4.75
ST_102012_022019	ENGLEWOOD RD	5301	5551	0	0	Evacuation Route	1247.73	13131Z01	12.61	100 Year	13.7	13.54	13.48	1.09	15.25
ST_102012_022021	ENGLEWOOD RD	1400	1498	1401	1499	Evacuation Route	967.65	14048	11.51	100 Year	12.14	11.85	11.64	0.63	54
ST_102012_022777	N INDIANA AVE	1090	1150	0	0	Evacuation Route	685.35	15430	10.53	100 Year	11.09	10.27	9.95	0.56	3.75

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_102012_022801	S INDIANA AVE	401	451	350	398	Evacuation Route	338.55	NF5420	9.27	100 Year	10.19	10.13	10.04	0.92	2.75
ST_102012_023991	US 41 BYP S	1277	1499	0	0	Evacuation Route	1223.20	1146518	13.15	100 Year	14.37	14.22	14.1	1.22	4.5
ST_102012_024561	S INDIANA AVE	653	699	652	698	Evacuation Route	427.67	NF5310	8.02	100 Year	8.85	8.81	8.78	0.83	3.25
ST_102012_025349	S INDIANA AVE	601	651	600	650	Evacuation Route	288.77	NF5370	9.51	100 Year	10.05	9.87	9.64	0.54	1
ST_102012_026083	N INDIANA AVE	500	598	501	599	Evacuation Route	516.78	151080	11.44	100 Year	11.81	11.27	10.89	0.37	1.75
ST_102012_026087	N INDIANA AVE	700	798	701	799	Evacuation Route	928.68	15443	10.81	100 Year	11.82	11.03	9.65	1.01	0.75
ST_102012_026207	ENGLEWOOD RD	0	0	4500	4598	Evacuation Route	867.73	12770NN	12.68	100 Year	13.34	12.86	12.66	0.66	10.75
ST_102012_026208	ENGLEWOOD RD	5101	5299	0	0	Evacuation Route	955.85	13131Z01	12.79	100 Year	13.7	13.54	13.48	0.91	13.5
ST_102012_026223	E DEARBORN ST	2	98	1	99	Evacuation Route	673.68	151022	8.82	100 Year	9.33	9.19	8.99	0.51	2.50
ST_102012_027771	N INDIANA AVE	600	698	601	699	Evacuation Route	710.08	151082	11.14	100 Year	12.14	11.72	11.32	1.00	2.50
ST_102012_028154	US 41 BYP S	0	0	1500	1698	Evacuation Route	1595.86	ND1210	13.89	100 Year	14.5	14.08	13.48	0.61	0.5
ST_102012_028158	US 41 BYP S	1501	1699	0	0	Evacuation Route	1661.15	ND1210	13.55	100 Year	14.5	14.08	13.48	0.95	0.5

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ST_102012_029021	N INDIANA AVE	300	498	301	499	Evacuation Route	1554.19	151080	10.88	100 Year	11.81	11.27	10.89	0.93	3.5
ST_102012_027765	N INDIANA AVE	800	1088	801	1089	Evacuation Route	2375.25	15441	8.53	100 Year	9.24	8.69	8.37	0.71	13
ST_09062013_039526	N INDIANA AVE	0	0	1151	1199	Evacuation Route	374.96	15431	10.47	100 Year	11.69	11.24	10.69	1.22	6.75
ST_09062013_039527	N INDIANA AVE	0	0	1091	1151	Evacuation Route	659.45	15430	10.56	100 Year	11.09	10.27	9.95	0.53	3.5
ST_102012_000357	N INDIANA AVE	150	178	151	179	Evacuation Route	257.42	151085	9.96	100 Year	10.81	10.43	10.13	0.85	8.5
ST_102012_001076	S INDIANA AVE	101	149	100	148	Evacuation Route	337.78	151024	9.67	100 Year	10.47	10.17	9.94	0.80	2.50
ST_102012_001222	N INDIANA AVE	200	210	201	211	Evacuation Route	105.07	151085	10.59	100 Year	10.81	10.43	10.13	0.22	3.75
ST_02032017_093654	S INDIANA AVE	853	899	854	898	Evacuation Route	359.89	NF5300	7.14	100 Year	8.64	8.57	8.52	1.50	4
ST_102012_002501	W PALM GROVE AVE	0	0	0	0	Neighborhood	188.56	NF5430	9.56	10 Year	10.62	10.48	10.36	0.80	1.5
ST_102012_005500	DRIFTING SANDS DR	1	99	2	98	Neighborhood	296.75	13230	12.73	10 Year	14.04	13.84	13.68	0.95	13.25
ST_102012_003139	S BUENA VISTA AVE	32	48	25	33	Neighborhood	473.94	14034	8.96	10 Year	12.08	11.86	11.65	2.69	83.75
ST_102012_003721	GROVE RD	101	199	100	198	Neighborhood	556.89	12345	10.77	10 Year	12.29	12.12	12.04	1.27	17.25

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ST_102012_003995	S ESPLANADE ST	2	98	1	99	Neighborhood	556.01	14034	10.12	10 Year	12.08	11.86	11.65	1.53	82.75
ST_102012_004924	DRIFTING SANDS DR	101	199	100	198	Neighborhood	289.08	13240	12.79	10 Year	14.04	13.84	13.68	0.89	12.00
ST_102012_005223	S DE LAS PALMAS ST	2	98	1	99	Neighborhood	564.23	14034	9.61	10 Year	12.08	11.86	11.65	2.04	83.25
ST_102012_005960	ALAMEDA GRANDE	0	0	0	0	Neighborhood	153.33	14036	9.48	10 Year	12.07	11.85	11.65	2.17	83.75
ST_102012_006091	ALAMEDA GRANDE	0	0	0	0	Neighborhood	189.84	14036	10.31	10 Year	12.07	11.85	11.65	1.34	83.00
ST_102012_006247	S FLORA VISTA ST	2	98	1	99	Neighborhood	556.05	14031	10.53	10 Year	12.08	11.86	11.65	1.12	82
ST_102012_006283	OSCEOLA BLVD	1001	1099	1000	1098	Neighborhood	481.17	NF3370	10.11	10 Year	11.1	10.98	10.9	0.79	2.25
ST_102012_006317	ALLEY	0	0	0	0	Neighborhood	337.34	NF5470	9.44	10 Year	10.63	10.48	10.36	0.92	1.5
ST_102012_006488	N ESPLANADE ST	43	53	42	52	Neighborhood	189.23	14036	10.58	10 Year	12.07	11.85	11.65	1.07	81.75
ST_102012_006575	BAL HARBOUR DR	1601	1647	1600	1646	Neighborhood	117.63	12666C	11.19	10 Year	13.13	13	12.93	1.74	94.75
ST_102012_006645	N BUENA VISTA AVE	1	7	2	6	Neighborhood	321.49	14036	9.58	10 Year	12.07	11.85	11.65	2.07	83.75
ST_102012_006697	N FLORA VISTA ST	1	17	2	18	Neighborhood	529.57	14036	10.55	10 Year	12.07	11.85	11.65	1.10	81.75
ST_102012_006770	TEAHOUSE RD	6101	6179	6100	6178	Neighborhood	319.08	13605	6.76	10 Year	8.47	8.18	7.96	1.20	6
ST_102012_006774	TOMOKA DR	457	477	458	476	Neighborhood	381.45	15231A	8.46	10 Year	9.54	9.36	9.26	0.80	7
ST_102012_007001	S ORANGE ST	1	99	2	98	Neighborhood	339.13	NF4810	8.47	10 Year	9.15	9.09	9.04	0.57	0.5
ST_102012_007126	PEBBLE ROCK DR	101	199	100	198	Neighborhood	289.42	13260	12.72	10 Year	14.05	13.85	13.68	0.96	13.25
ST_102012_008690	N ESPLANADE ST	11	41	12	40	Neighborhood	385.29	14036	9.97	10 Year	12.07	11.85	11.65	1.68	83.50
ST_102012_008774	HOURGLASS DR	67	87	66	86	Neighborhood	335.27	13230	12.74	10 Year	14.04	13.84	13.68	0.94	13.00

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ST_102012_008825	N ESPLANADE ST	55	65	54	64	Neighborhood	189.74	14036	10.65	10 Year	12.07	11.85	11.65	1.00	81.5
ST_102012_008931	SANDSTONE CIR	101	199	100	198	Neighborhood	811.71	13240	12.75	10 Year	14.04	13.84	13.68	0.93	12.50
ST_102012_010296	MAGNOLIA AVE	51	99	50	98	Neighborhood	331.54	NF5020	6.67	10 Year	7.24	7.2	7.19	0.52	0.5
ST_102012_010386	ALLEN AVE	901	999	900	998	Neighborhood	193.27	NF4020	5.66	10 Year	6.85	6.76	6.72	1.06	87.25
ST_102012_010922	OBERLIN RD	1	299	2	298	Neighborhood	1366.16	13111Z01	12.31	10 Year	13.1	12.98	12.91	0.60	0.75
ST_102012_011132	HOURGLASS DR	27	27	26	26	Neighborhood	25.16	13260	13.04	10 Year	14.05	13.85	13.68	0.64	7.5
ST_102012_011674	ALAMEDA GRANDE	0	0	0	0	Neighborhood	173.17	14036	9.33	10 Year	12.07	11.85	11.65	2.32	83.75
ST_102012_011856	S BUENA VISTA AVE	64	70	0	0	Neighborhood	190.52	14031	10.64	10 Year	12.08	11.86	11.65	1.01	81.5
ST_102012_012425	S BUENA VISTA AVE	72	78	0	0	Neighborhood	191.17	14031	10.48	10 Year	12.08	11.86	11.65	1.17	82.25
ST_102012_012734	PINEHURST LN	900	998	901	999	Neighborhood	425.81	12618	8.75	10 Year	10.27	9.86	9.54	0.79	12
ST_102012_012880	BAL HARBOUR DR	2101	2333	2100	2318	Neighborhood	1023.24	12641	11.93	10 Year	13.08	12.96	12.88	0.95	3.75
ST_102012_013569	ALAMEDA GRANDE	0	0	0	0	Neighborhood	189.50	14036	10.44	10 Year	12.07	11.85	11.65	1.21	82.25
ST_102012_013872	N GRANADA PLZ	1	99	2	98	Neighborhood	528.91	14036	10.50	10 Year	12.07	11.85	11.65	1.15	82
ST_102012_015590	LAKESIDE DR	1503	1521	1502	1520	Neighborhood	201.01	12641	12.09	10 Year	13.08	12.96	12.88	0.79	2.5
ST_102012_014532	HOURGLASS DR	29	49	28	48	Neighborhood	331.52	13230	12.78	10 Year	14.04	13.84	13.68	0.90	12.00
ST_102012_014924	E RIVERVIEW AVE	2	48	1	49	Neighborhood	116.30	NF5300	5.91	10 Year	8.64	8.57	8.52	2.61	3.75
ST_102012_015012	HOURGLASS DR	89	99	88	98	Neighborhood	153.66	13230	12.75	10 Year	14.04	13.84	13.68	0.93	13.00
ST_102012_015049	ELWOOD AVE	901	999	900	998	Neighborhood	662.32	NF4030	7.83	10 Year	9.12	9.02	8.94	1.11	89.25
ST_102012_015713	N ESPLANADE ST	1	9	2	10	Neighborhood	313.43	14036	10.41	10 Year	12.07	11.85	11.65	1.24	82.50

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ST_102012_016146	CORONADO DR	2	98	1	99	Neighborhood	684.91	14038	9.42	10 Year	12.08	11.86	11.65	2.23	83.25
ST_102012_017105	ALAMEDA GRANDE	0	0	0	0	Neighborhood	189.84	14036	10.51	10 Year	12.07	11.85	11.65	1.14	82
ST_102012_017728	CHAPIN BLVD	901	999	900	998	Neighborhood	459.51	NF4210	2.30	10 Year	3.25	3.17	3.13	0.83	1.75
ST_102012_018467	INNISBROOK CT	1905	1917	1904	1916	Neighborhood	622.35	12618	8.95	10 Year	10.27	9.86	9.54	0.59	7.25
ST_102012_017869	BAL HARBOUR DR	1701	2099	1700	2098	Neighborhood	612.47	12641	11.22	10 Year	13.08	12.96	12.88	1.66	6
ST_102012_017925	N MARINA PLZ	1	15	2	16	Neighborhood	339.52	14036	10.42	10 Year	12.07	11.85	11.65	1.23	82.50
ST_102012_018446	ALAMEDA GRANDE	0	0	0	0	Neighborhood	194.66	14036	9.92	10 Year	12.07	11.85	11.65	1.73	83.50
ST_102012_023075	W RIVERVIEW AVE	1	99	2	98	Neighborhood	48.50	NF5300	7.33	10 Year	8.64	8.57	8.52	1.19	2.25
ST_102012_018862	S BROADWAY	301	399	300	398	Neighborhood	362.11	15095	8.01	10 Year	9.64	9.54	9.46	1.45	1.5
ST_102012_019141	MARINA ISLES PKWY	0	0	0	0	Neighborhood	472.22	14028	8.94	10 Year	10.98	10.89	10.81	1.87	17.50
ST_102012_019653	STEWART ST	401	499	400	498	Neighborhood	591.11	15377	9.22	10 Year	10.55	10.3	10.17	0.95	18.00
ST_102012_023777	CHURCH AVE	0	0	0	0	Neighborhood	193.07	NF5450	9.03	10 Year	10.19	10.12	10.04	1.01	1.25
ST_102012_020282	QUAILS RUN BLVD	0	0	0	0	Neighborhood	75.55	15091	7.38	10 Year	9.31	8.9	8.51	1.13	7.75
ST_102012_020581	LORD ST	901	999	900	998	Neighborhood	708.63	NF3370	8.97	10 Year	11.1	10.98	10.9	1.93	7.45
ST_102012_021380	PINE HOLLOW CIR	301	599	300	598	Neighborhood	1922.32	15160	7.39	10 Year	9.32	9.2	9.14	1.75	17.5
ST_102012_021433	S MARINA PLZ	1	3	2	2	Neighborhood	233.93	14036	10.43	10 Year	12.07	11.85	11.65	1.22	82.25
ST_102012_021451	SCENIC DR	2400	2498	2401	2499	Neighborhood	178.75	12139	14.80	10 Year	16.17	16.04	15.95	1.15	2
ST_102012_021559	WATERFORD DR	2	98	1	99	Neighborhood	1518.61	14028	9.76	10 Year	10.98	10.89	10.81	1.05	5
ST_102012_022061	HARVARD ST	801	899	800	898	Neighborhood	593.74	NF4300	2.32	10 Year	3.24	3.17	3.13	0.81	1.75
ST_102012_022262	MORRISON AVE	701	799	700	798	Neighborhood	780.70	NF4110	9.11	10 Year	10.04	9.98	9.94	0.83	3.5

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ST_102012_022596	MAGNOLIA AVE	157	199	156	198	Neighborhood	239.82	NF5150	5.13	10 Year	5.83	5.75	5.7	0.57	0.5
ST_102012_022859	OSCEOLA BLVD	1101	1199	1100	1198	Neighborhood	400.36	NF3370	8.91	10 Year	11.1	10.98	10.9	1.99	8.25
ST_102012_023023	ALAMEDA GRANDE	0	0	0	0	Neighborhood	193.98	14036	10.04	10 Year	12.07	11.85	11.65	1.61	83.50
ST_102012_023052	SPRUCE ST	501	599	500	598	Neighborhood	716.60	NF5490	10.51	10 Year	11.49	11.42	11.38	0.87	4.75
ST_102012_023698	CHAPIN BLVD	801	899	800	898	Neighborhood	241.94	NF4210	2.12	10 Year	3.25	3.17	3.13	1.01	2.50
ST_102012_023998	OSCEOLA DR	801	975	800	974	Neighborhood	2712.90	NF3140	10.67	10 Year	12.26	12.22	12.2	1.53	86.50
ST_102012_024025	OXFORD HEIGHTS CT	1500	1598	1501	1599	Neighborhood	664.01	15017	4.51	10 Year	5.93	5.74	5.59	1.08	13.25
ST_102012_024052	INNISBROOK CT	1919	1999	1918	1998	Neighborhood	825.81	12618	8.82	10 Year	10.27	9.86	9.54	0.72	10.50
ST_102012_024124	PARK FOREST BLVD	260	278	261	279	Neighborhood	684.84	15261	8.01	10 Year	9.12	8.9	8.71	0.70	11.25
ST_102012_024245	S BUENA VISTA AVE	2	30	1	23	Neighborhood	817.14	14038	8.90	10 Year	12.08	11.86	11.65	2.75	83.75
ST_102012_024501	CENTER CT	101	399	100	398	Neighborhood	1660.02	NJ0400	13.32	10 Year	14.42	14.3	14.21	0.89	4.00
ST_102012_024502	N FLORA VISTA ST	19	25	20	24	Neighborhood	392.47	14036	10.35	10 Year	12.07	11.85	11.65	1.30	82.75
ST_102012_024703	PEBBLE BEACH CT	1917	1999	1916	1998	Neighborhood	744.02	12618	8.88	10 Year	10.27	9.86	9.54	0.66	9
ST_102012_024718	ENGLEWOOD ISLES PKWY	101	149	0	0	Neighborhood	413.51	14028	9.16	10 Year	10.98	10.89	10.81	1.65	14
ST_102012_024805	LAKESIDE DR	1303	1501	1302	1500	Neighborhood	1190.43	12641	11.92	10 Year	13.08	12.96	12.88	0.96	3.75
ST_102012_024976	VAN GOGH RD	700	898	701	899	Neighborhood	1323.65	15466	8.00	10 Year	10.06	9.58	9.29	1.29	16
ST_102012_026317	ENGLEWOOD ISLES PKWY	0	0	100	134	Neighborhood	366.23	14028	9.28	10 Year	10.98	10.89	10.81	1.53	12.00

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ST_102012_025029	ENGLEWOOD ISLES PKWY	151	153	136	152	Neighborhood	269.54	14028	9.61	10 Year	10.98	10.89	10.81	1.20	6.75
ST_102012_025241	PINE HOLLOW DR	101	299	100	298	Neighborhood	880.09	15160	7.71	10 Year	9.32	9.2	9.14	1.43	13.00
ST_102012_026329	S BUENA VISTA AVE	80	98	35	99	Neighborhood	222.55	14031	10.47	10 Year	12.08	11.86	11.65	1.18	82.25
ST_102012_026434	N ORANGE ST	2	48	1	49	Neighborhood	338.76	NF4620	8.58	10 Year	9.61	9.47	9.31	0.73	0.5
ST_102012_026472	DEL PRADO DR	2	98	1	99	Neighborhood	772.00	14039	10.05	10 Year	12.08	11.86	11.65	1.60	83.25
ST_102012_026685	SAVONA AVE	2	98	1	99	Neighborhood	948.96	14039	10.20	10 Year	12.08	11.86	11.65	1.45	83.00
ST_102012_026662	BAY PARK DR	600	698	601	699	Neighborhood	183.81	NF4020	5.73	10 Year	6.85	6.76	6.72	0.99	87.25
ST_102012_027045	N BUENA VISTA AVE	9	99	8	98	Neighborhood	402.52	14036	10.06	10 Year	12.07	11.85	11.65	1.59	83.50
ST_102012_027297	N FLORA VISTA ST	27	99	26	98	Neighborhood	840.96	14037Z01	10.06	10 Year	12.07	11.86	11.65	1.59	96.00
ST_102012_027506	QUAILS RUN BLVD	0	0	0	0	Neighborhood	65.00	15095	8.61	10 Year	9.64	9.54	9.46	0.85	0.5
ST_102012_027576	CAPLES ST	953	999	952	998	Neighborhood	374.95	NF3370	9.90	10 Year	11.1	10.98	10.9	1.00	3.5
ST_102012_027701	MICHIGAN DR N	601	699	600	698	Neighborhood	483.53	12666C	11.50	10 Year	13.13	13	12.93	1.43	91.75
ST_102012_027871	S GRANADA PLZ	2	98	1	99	Neighborhood	555.09	14031	10.51	10 Year	12.08	11.86	11.65	1.14	82
ST_102012_028053	N DE LAS PALMAS ST	1	99	2	98	Neighborhood	477.21	14036	9.39	10 Year	12.07	11.85	11.65	2.26	83.75
ST_102012_028310	5TH ST	1101	1599	1100	1598	Neighborhood	1451.56	14236	11.29	10 Year	12.53	12.43	12.36	1.07	27.50
ST_102012_029700	TOMOKA DR	401	455	400	456	Neighborhood	915.39	15231A	8.44	10 Year	9.54	9.36	9.26	0.82	7.25
ST_102012_015685	BAL HARBOUR DR	1661	1699	1660	1698	Neighborhood	266.90	12641	12.11	10 Year	13.08	12.96	12.88	0.77	2.5
ST_102012_006363	LORD ST	1001	1099	1000	1098	Neighborhood	369.60	NF3340	8.96	10 Year	10.16	10.05	9.97	1.01	2.75
ST_102012_019963	BAY VISTA BLVD	0	0	0	0	Neighborhood	49.01	NF3350	9.12	10 Year	10.17	10.05	9.98	0.86	2

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ST_102012_022370	MORNINGSIDE DR	752	1098	753	1099	Neighborhood	2700.93	16099	7.78	10 Year	9.12	8.82	8.63	0.85	14.00
ST_05312013_032548	CARYL RD	5001	5099	5000	5098	Neighborhood	449.66	13091	9.45	10 Year	11.18	10.77	10.52	1.07	1.75
ST_05312013_032550	PONDEROSA RD	417	481	432	498	Neighborhood	249.94	13094	9.65	10 Year	11.18	10.77	10.52	0.87	1.50
ST_102012_003463	S BUENA VISTA AVE	50	56	0	0	Neighborhood	186.38	14034	9.57	10 Year	12.08	11.86	11.65	2.08	83.25
ST_102012_003723	TEAHOUSE RD	5901	5949	5900	5950	Neighborhood	179.43	13590	6.80	10 Year	8.46	8.16	7.94	1.14	4.50
ST_102012_008089	TEAHOUSE RD	5951	5999	5952	5998	Neighborhood	187.74	13590	6.72	10 Year	8.46	8.16	7.94	1.22	4.75
ST_102012_010717	CIRCLEWOOD DR	1	51	2	48	Neighborhood	762.14	13247	13.01	10 Year	14.04	13.85	13.68	0.67	8
ST_102012_009404	TEAHOUSE RD	6001	6049	6000	6050	Neighborhood	191.15	13590	6.74	10 Year	8.46	8.16	7.94	1.20	4.75
ST_102012_011022	S BUENA VISTA AVE	52	62	0	0	Neighborhood	192.60	14034	10.10	10 Year	12.08	11.86	11.65	1.55	82.75
ST_102012_012941	TEAHOUSE RD	6051	6099	6052	6098	Neighborhood	179.85	13590	6.74	10 Year	8.46	8.16	7.94	1.20	4.75
ST_102012_020564	GLORIOSA DR	690	798	691	799	Neighborhood	642.72	13580	6.45	10 Year	8.35	8	7.8	1.35	5
ST_102012_021830	DELPHINIUM DR	600	698	601	699	Neighborhood	464.61	13590	6.77	10 Year	8.46	8.16	7.94	1.17	4.50
ST_102012_027220	CHRYSANTHEMUM DR	700	798	701	799	Neighborhood	468.74	13590	6.71	10 Year	8.46	8.16	7.94	1.23	4.75
ST_102012_016492	BAL HARBOUR DR	1649	1653	1648	1652	Neighborhood	251.00	12666C	11.90	10 Year	13.13	13	12.93	1.03	86.50
ST_102012_021163	CAPLES ST	901	951	900	950	Neighborhood	428.09	NF3370	10.06	10 Year	11.1	10.98	10.9	0.84	2.5
ST_102012_023641	PIERCE DR	1400	1410	1401	1411	Neighborhood	249.28	13740	12.22	10 Year	13.61	13.22	12.95	0.73	3.75
ST_102012_025734	BAY VISTA BLVD	1101	1199	1100	1198	Neighborhood	428.72	NF3340	9.37	10 Year	10.16	10.05	9.97	0.60	0.75
ST_102012_026038	MONROE RD	5801	5899	5800	5898	Neighborhood	975.78	13740	12.23	10 Year	13.61	13.22	12.95	0.72	3.50
ST_102012_030027	COLONIAL RD	1152	1198	1153	1199	Neighborhood	341.80	13000B2	1.04	10 Year	2.94	2.65	2.46	1.42	17.75
ST_102012_030205	MADDER LN	0	0	500	598	Neighborhood	320.87	15454	4.71	10 Year	10.06	9.57	9.29	4.58	88.25

Street ID	Full Street Name	From Address Left	To Address Left	From Address Right	To Address Right	FPLOS_Road Class	Road Centerline Length (feet)	NODENAME	EOP (feet)	FPLOS Design Storm	Max Stage 100yr/24hr (feet)	Max Stage 25yr/24hr (feet)	Max Stage 10yr/24hr (feet)	FPLOS Depth (feet)	Duration (hours)
ST_05312013_032549	PONDEROSA RD	401	415	400	430	Neighborhood	118.60	13094	9.51	10 Year	11.18	10.77	10.52	1.01	1.75
ST_01242020_164130	SPARTINA DR	24000	24398	24001	24399	Neighborhood	4978.63	14321	13.43	10 Year	15.14	14.91	14.78	1.35	88.50
ST_11032021_210957	MARINA ISLES PKWY	0	0	149	149	Neighborhood	202.69	14028	8.59	10 Year	10.98	10.89	10.81	2.22	27.75

Figure B-1. Location Map of LOS Deficient Roadways