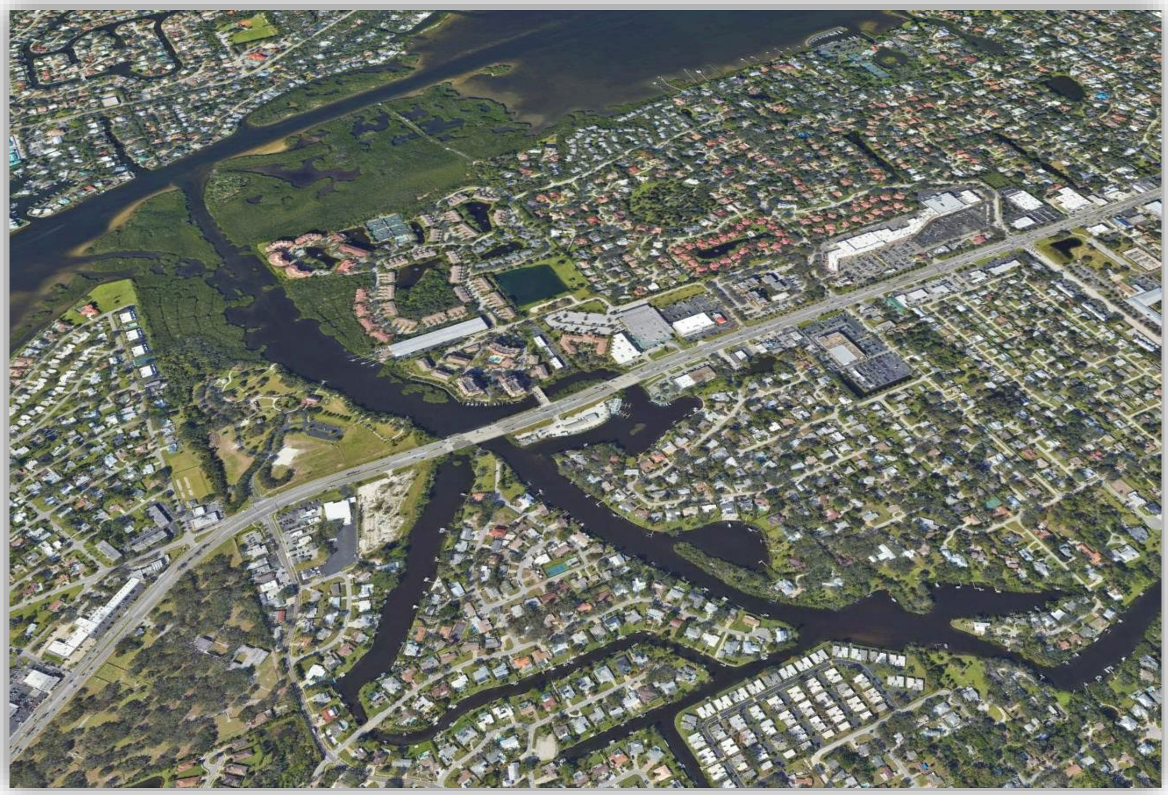
YEARS 1974-2024



PHILLIPPI CREEK WATERSHED MANAGEMENT PLAN MODEL UPDATE

Sarasota County | February 2024

PHILLIPPI CREEK WATERSHED MANAGEMENT PLAN
MODEL UPDATE

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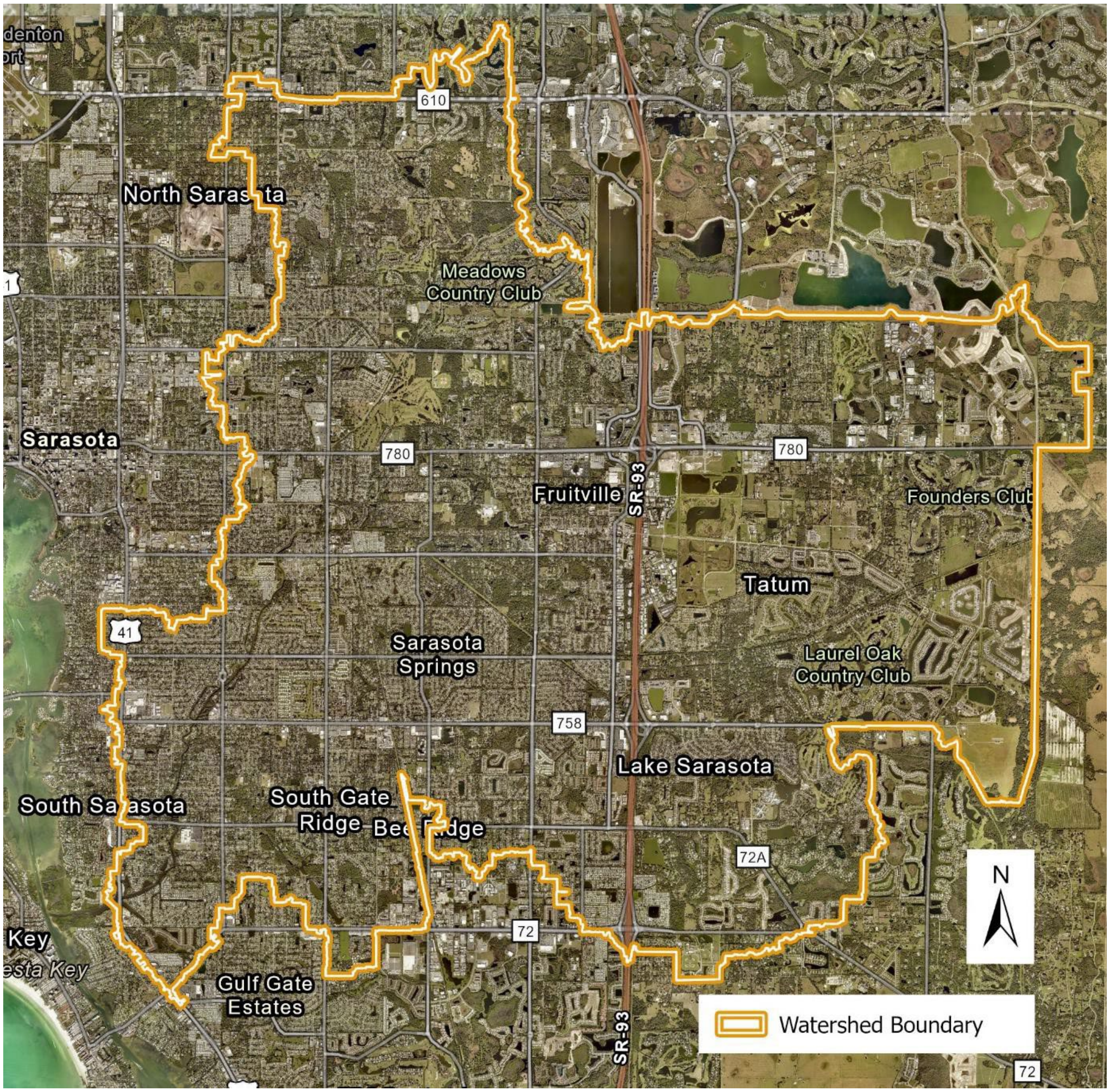
1 PURPOSE AND OBJECTIVES

Sarasota County understands the importance of maintaining up-to-date watershed-scale models for planning purposes. The County has been using the Interconnected Channel and Pond Routing software Version 3 (ICPR3) for stormwater modeling; however, Streamline Technologies, Inc., discontinued support for ICPR3 in 2016. ICPR3 has been replaced by ICPR Version 4 (ICPR4), and the County is converting its watershed models from ICPR3 to ICPR4. The County contracted Jones Edmunds to convert four watershed models from ICPR3 to ICPR4 and update the models for six watersheds under the Request for Professional Services (RPS) #202061MN of Sarasota County Contract No. 2021-268. This Technical Memorandum documents the model update for the Phillippi Creek Watershed Management Plan. Figure 1 illustrates the Phillippi Creek Watershed location.

The Phillippi Creek Watershed Model was previously converted from ICPR3 to ICPR4 by another consultant. Jones Edmunds is updating the watershed model to incorporate developments that have occurred over the years using enhanced 2019 Light Detection and Ranging (LiDAR) data obtained from the Southwest Florida Water Management District (SWFWMD) and addressing watershed boundary gaps and overlaps with adjacent watersheds.

Figure 1 Location Map



2 MODEL UPDATE

The previous Phillippi Creek Watershed Management Plan model update was based on 2007 LiDAR data. Subsequent updates to the watershed incorporated developments that have occurred over the years in the model database using plans and models submitted by developers. For this update, Jones Edmunds used the 2019 LiDAR to refine the watershed boundaries, incorporate new developments, and address gaps and overlaps with adjacent watersheds. The model updates also include a quality-control check of the input parameters to ensure that the information from the previous model is reasonable.

2.1 Topographic Void Update

The 2019 LiDAR reflects the new developments that have occurred as well as the more detailed and refined surface information that results from advanced topographic data capture technologies. Jones Edmunds reviewed the SWFWMD Environmental Resource Permits (ERPs), 2019 LiDAR, and 2020 aerial imagery to identify developments that would have a significant impact on the watershed model. Some of the developments identified for updates are topographic voids in the 2019 LiDAR. Topographic voids are areas in the digital elevation model (DEM) that do not represent actual ground conditions based on aerial imagery review. After reviewing the areas of new development, we identified several topographic void areas where we conducted DEM updates. These areas were large enough to cause notable inaccuracies in model results and floodplain mapping if not addressed. Table 1 lists the developments where we conducted DEM updates.

Table 1 Topographic Void Developments

Project Name	ERP Number
Watercrest Sarasota	ERP_022494_003
Windward	ERP_034558_004 ERP_034558_005
Bergamot on 780	ERP_043688_000

For each area, Jones Edmunds georeferenced the applicable design drawings in a geographic information system (GIS). These drawings were used to digitize ponds, building pads, parking lots, ditches, and any other features that would assist in updating the terrain. Figure 2 illustrates the topographic features used to update the terrain for the Windward development. Figure 3 shows the before and after DEM for the Windward development.

2.2 New Developments Update

Several developments have occurred in the watershed since the model was last updated in 2022. Table 2 lists the developments that have significant impacts on the watershed model and were included in the model update.

Figure 2 Windward Development DEM Update Features

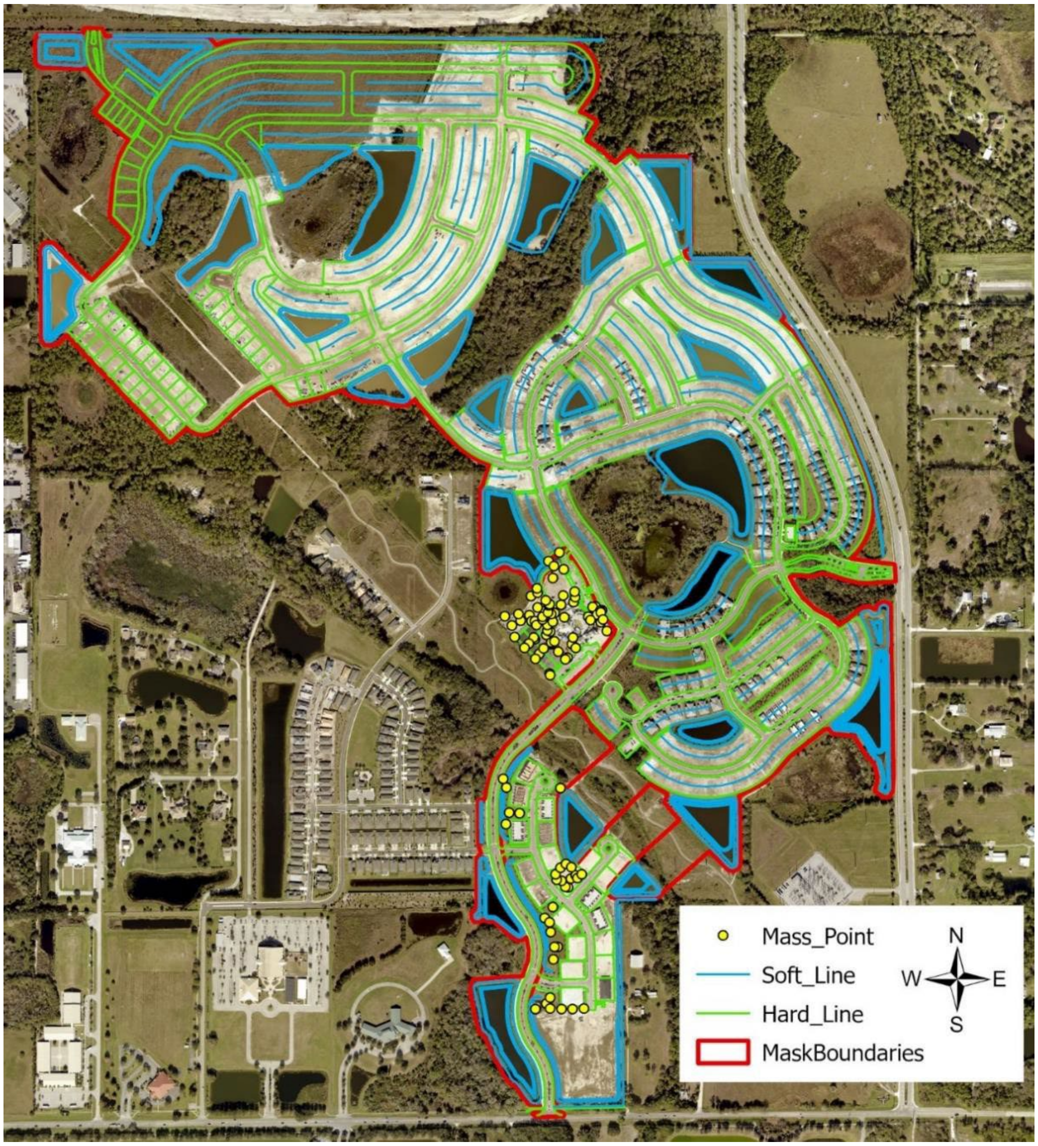


Figure 3 Windward Topographic Void DEM Comparison

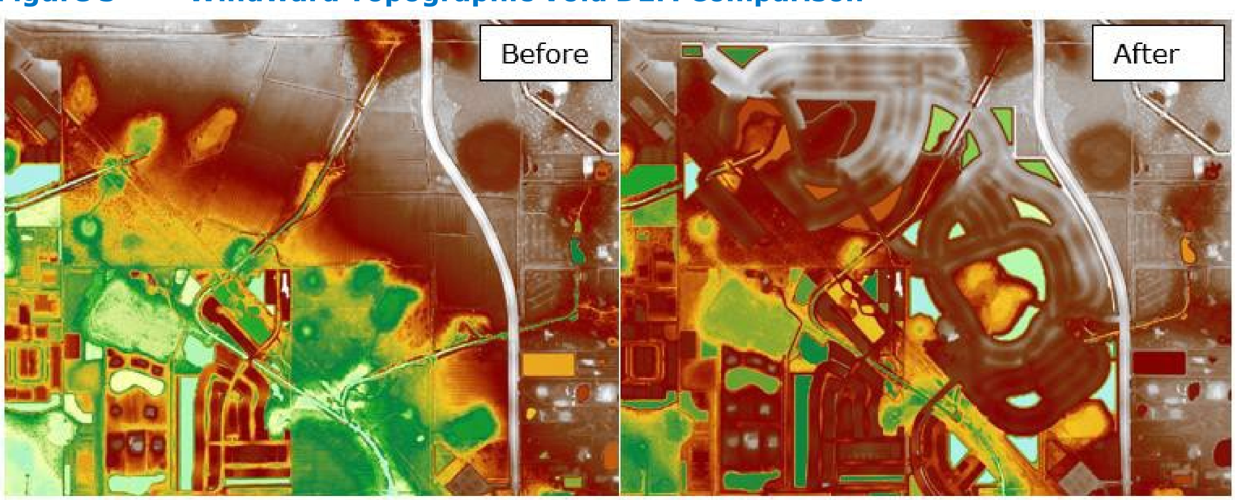


Table 2 Significant Developments in the Phillippi Creek Watershed

Project Name	ERP Permit Plans
Watercrest Sarasota	ERP_022494_003_Permitted_Plans
Hammock Place	ERP_007892_005_Submitted_Asbuilt_Plans
Windward	ERP_034558_004_Permitted_Plans ERP_034558_005_Permitted_Plans
Fox Trace Subdivision	ERP_042955_002_Approved_Asbuilt_Plans
Bergamot on 780	ERP_043688_000_Submitted_Asbuilt_Plans
Porter Industrial	ERP_013614_005_Permitted_Plans
Lorraine Road Extension	ERP042331_000_Asbuilts_Plans

Jones Edmunds reviewed the development plans and compared the design elevations and topographic data to the LiDAR data. Each development was reviewed for:

- Drainage patterns and catchment delineations.
- Hydraulically significant structures.
- Elevations and profiles.
- Topography.
- Initial stages.

Based on our review, we re-delineated the model catchments, incorporated new or revised hydraulic structures, and parameterized the watershed model according to the design data. In areas adjacent to the new developments, we updated curve numbers (CNs), impervious areas, times-of-concentration (Tc), storage, overland weirs, and cross sections. Table 3 compares the model input data of the previous version of the model (existing model) and the updated version of the model.

Table 3 Comparison of Existing and Updated Model Elements

Model Element	Existing Model (count)	Updated Model (count)
Basin	2,884	2,925
Node	3,529	3,615
Drop Structure	794	1,271
Pipe	1,815	1,855
Channel	808	818
Weir	2,928	2,979
Rating Curve	34	34
Watershed Area	35,571.13 acres	35,422.22 acres

2.3 Watershed Boundary Update

Since the previous development of the Phillippi Creek Watershed Management Plan, updates to other adjacent watershed models in the County have occurred. Surrounding watersheds that have been updated include Whitaker Bayou, Hudson Bayou, Little Sarasota Bay, and Coastal Fringe Roberts Bay North. Jones Edmunds is also developing the Cooper Creek

Watershed Model for the County. These updates required that the boundaries along the Phillippi Creek Watershed also be updated to be consistent with the adjacent watersheds to represent the interflow between the areas more accurately. Jones Edmunds revised the Phillippi Creek Watershed boundary catchments to be consistent with the 2019 LiDAR and the surrounding watersheds. The revisions included updating the storage, CNs, and Tc characteristics of the newly revised catchments.

Jones Edmunds also ensured that the hydraulic connections were consistent between the watershed models (i.e., a conduit leaving one watershed is connected to the appropriate node of the adjacent watershed and that the parameter data are identical).

2.4 Quality Assurance/Quality Control

Jones Edmunds develops watershed models using defined procedures for quality assurance. Many tasks associated with model development and/or model conversion are captured in our Standard Operating Procedures (SOPs) to ensure consistency and accuracy. We also have many tools to aid in quality control of watershed products, including tools for parameterizing, automated checking of model inputs, and floodplain delineating that meet Federal Emergency Management Agency (FEMA) standards for floodplain mapping.

Jones Edmunds performed a quality-control check of the input parameters to ensure that the information from the previous model was accurately represented. While checking the model inputs for reasonableness, we identified and corrected several issues with the previous model. These issues included:

- The maximum area in the stage-storage data exceeded the basin area.
- The modeled acreage does not match the acreage derived from the GIS data.
- The pipe size for drop structure 39810_DS was not reasonable. We determined that the size was incorrectly entered as inches when it was intended to be in feet. The pipe size was revised from a 0.804-inch pipe to a 10-inch pipe. The pipe size was also confirmed using the ERP plans.
- Initial stages were revised to eliminate unintended initial flows.
- Federal Highway Codes equal to 0 were revised.
- Pipe and weir dimensions were rounded to two decimal places to remove the extraneous digits that resulted when converting from ICPR3 to ICPR4. For example: 9.99996 to 10.
- The elliptical and arch pipe spans do not represent the actual physical dimensions. During the previous conversion from ICPR3 to ICPR4, the span for elliptical pipes was calculated using predefined ratios for elliptical pipes in ICPR4. The dimensions for the elliptical pipe were revised to include the actual pipe size. This change does not impact the model results since ICPR4 uses the rise to calculate the span internally.
- The drop structure solution was changed to interval halving to be consistent with other watershed models in the County.
- *From Node* and *To Node* were revised to properly route inflows.

3 VERIFICATION

After updating the Phillippi Creek Watershed Model, Jones Edmunds conducted model calibration and verification. The goal of a calibration/verification is to ensure that the model accurately reflects observed conditions of historical storm events and can be reliably used to predict system performance under design storm conditions. The purpose of the model calibration process is to modify the model input parameters (generally coefficients) within an acceptable engineering range until the model results best match the actual recorded data. The model verification simulation is to verify that the model "setup" matches the recorded data (hydrograph) for a separate storm event. An ideal verification event would have a different depth and/or duration than the calibration storm event. A model is considered calibrated and verified when the same model setup produces results that reasonably match both storm events in terms of peak, timing, and volume. Once the model's validity is confirmed, the model can be relied on as a tool to develop accurate flood risk data, analyze the flood protection level-of-service (FPLOS), and analyze proposed conditions. The following subsections document the model calibration/verification approach and results for the updated ICPR4 Phillippi Creek Watershed Model.

3.1 Model Calibration and Verification Approach

The Phillippi Creek Watershed Model was previously calibrated and verified during model updates in 2016 and 2022. The task in this Contract was to validate the previous calibration and verification efforts or update the calibration by adjusting the model hydraulic parameters, if required, to ensure that the model still simulates the system hydrologic and hydraulic responses after conducting the model updates.

The approach assumed that the model input parameters (in particular, the Manning's n values) were largely accurate and that this effort was primarily conducted to identify any model updates that could change the model simulation performance, potential model inaccuracies, and/or calibrate any locations/tributaries in the model that were not previously calibrated. No rating curve (flow) data are available for any of the streamflow gauge locations, which limits our ability to calibrate the model along channel reaches. Because of these aspects, no large-scale changes were made to the Manning's n values unless clearly required. However, several gauges are available with recorded water elevations, which we used to compare to the model results. Section 3.5.3 discussed the specifics regarding the actual model parameter adjustments.

3.2 Historical Storm Event(s) Selection

Selecting the historical storm events to be used for the calibration and verification considered several factors:

- Magnitude of the storm events(s).
- Availability of rainfall and water-level data.
- Antecedent moisture conditions (AMC).
- Recency of the storm event.
- Temporally isolated rainfall.
- Needs from adjacent watersheds for boundary conditions.

We considered all of the previously noted items to determine the most appropriate storm events to use for the Phillippi Creek Watershed, although the most important considerations are the first two, i.e., event magnitude and data availability. We used these two factors to initially filter the gauge data. We graphed and reviewed the water-level data for the period of record for the highest peak stages at each gauge. We reviewed the rainfall data associated with those events having the highest peaks to determine the time of year, temporal distribution, and magnitude of the rainfall data. We used this information to determine if the rainfall data were appropriate for model calibration/verification. The remaining factors were considered with emphasis given to more recent events.

Based on the data, Hurricane Ian in September 2022 and Tropical Storm (TS) Eta in November 2020 were the most suitable storm events for the Phillippi Creek Watershed calibration and verification. However, because watershed models are being updated and calibrated across the entire County, the selection of calibration/verification events across all watersheds was considered prudent. To do this, we coordinated with Collective Water Resources (who is conducting the calibration/verification for half of the County) and performed a cursory review of the gauge and rainfall data for the other half of the County watersheds. Based on these efforts, both consultants determined that these two events could be used to calibrate and verify model results for all County watersheds.

3.3 Available Gauge Data

During the calibration process, Jones Edmunds assessed the suitability and reliability of gauge data for making model parameter changes. The selected storm events were thoroughly reviewed, and data that were deemed unsuitable or unreliable were disregarded.

3.3.1 Recorded Water-Level Data

The Sarasota County Automated Rainfall Monitoring System (ARMS) program is equipped with a network of remote monitoring stations throughout the County that record rainfall and water-level information. Thirteen gauging stations are within the Phillippe Creek Watershed. Of the 13, three stations have recently been deactivated and one station has elevation data that do not correspond to the elevation data at the gauge location. Nine stations remain where the available data are suitable for one or both selected events. Table 4 summarizes the ARMS gauge sites with the suitability of their usage for the verification process. Figure 4 shows the locations of the ARMS gauge sites.

Table 4 Sarasota County ARMS Gauges

Station ID	Station Name	Data Usable for Model Calibration (Ian)	Data Usable for Model Verification (Eta)
PH-1	Hidden Forest Battery	No	Yes
PH-2	Meadows G.C. Battery	Yes	Yes
PH-3	B. Jones Battery	Yes	Yes
PH-4	Pine Craft Battery	Yes	Yes
PH-5	Bahia Vista Battery	Yes	Yes
PH-6	CF S-10 C Battery	Yes	Yes
PH-7	Palmer East Battery	Yes	Yes
PH-8	Phillippi C ICW Battery	N/A*	N/A*

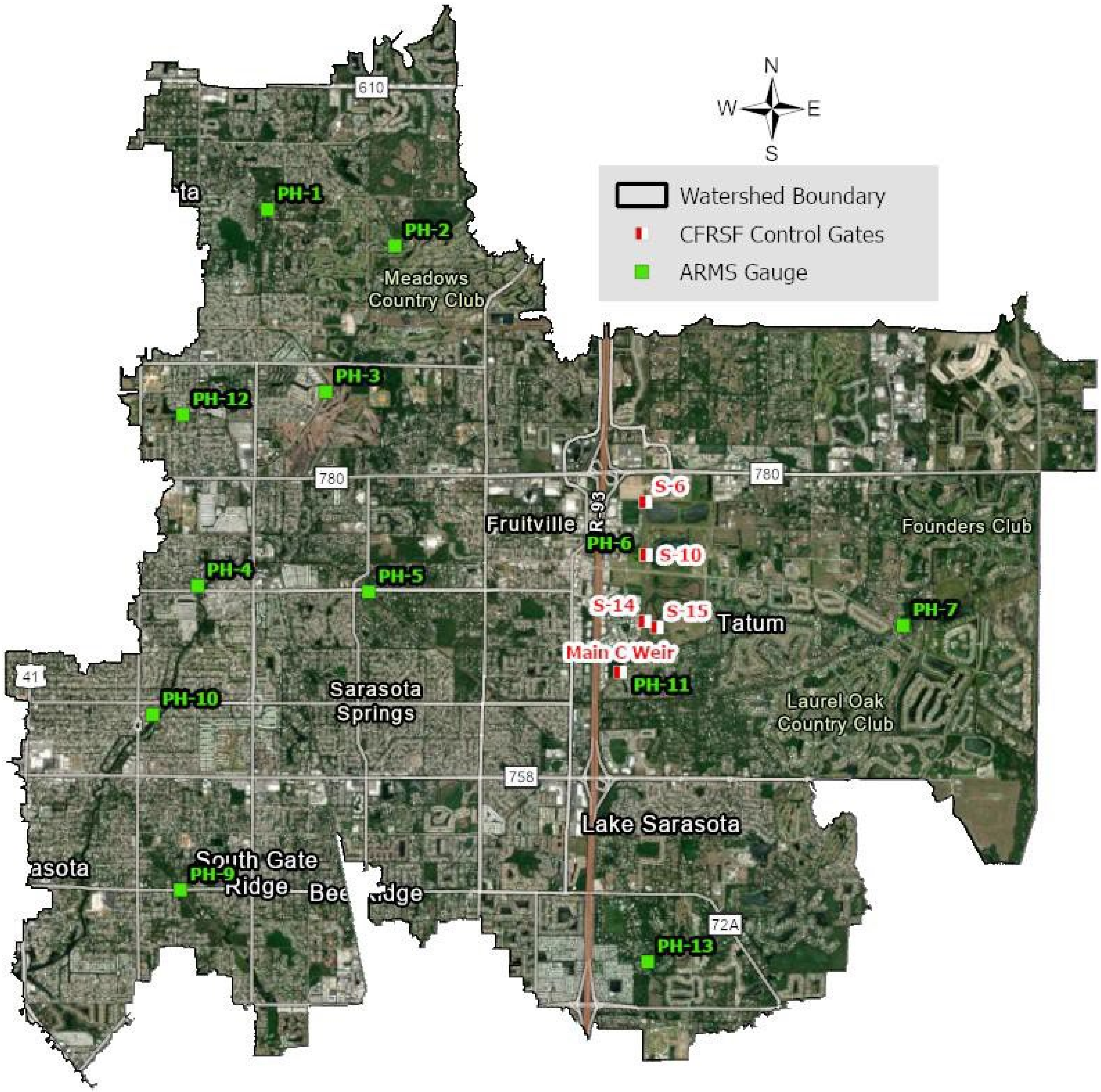
Station ID	Station Name	Data Usable for Model Calibration (Ian)	Data Usable for Model Verification (Eta)
PH-9	Red Bug S. Battery	No	Yes
PH-10	South Gate Cir Battery	N/A**	N/A**
PH-11	Main C Weir Battery	Yes	No
PH-12	Brink Avenue	N/A***	N/A***
PH-13	Ashley Pkwy Battery	N/A***	N/A***

*Station deactivated in 2019.

**Elevation data are inconsistent with ground elevation data.

***Station deactivated in 2016.

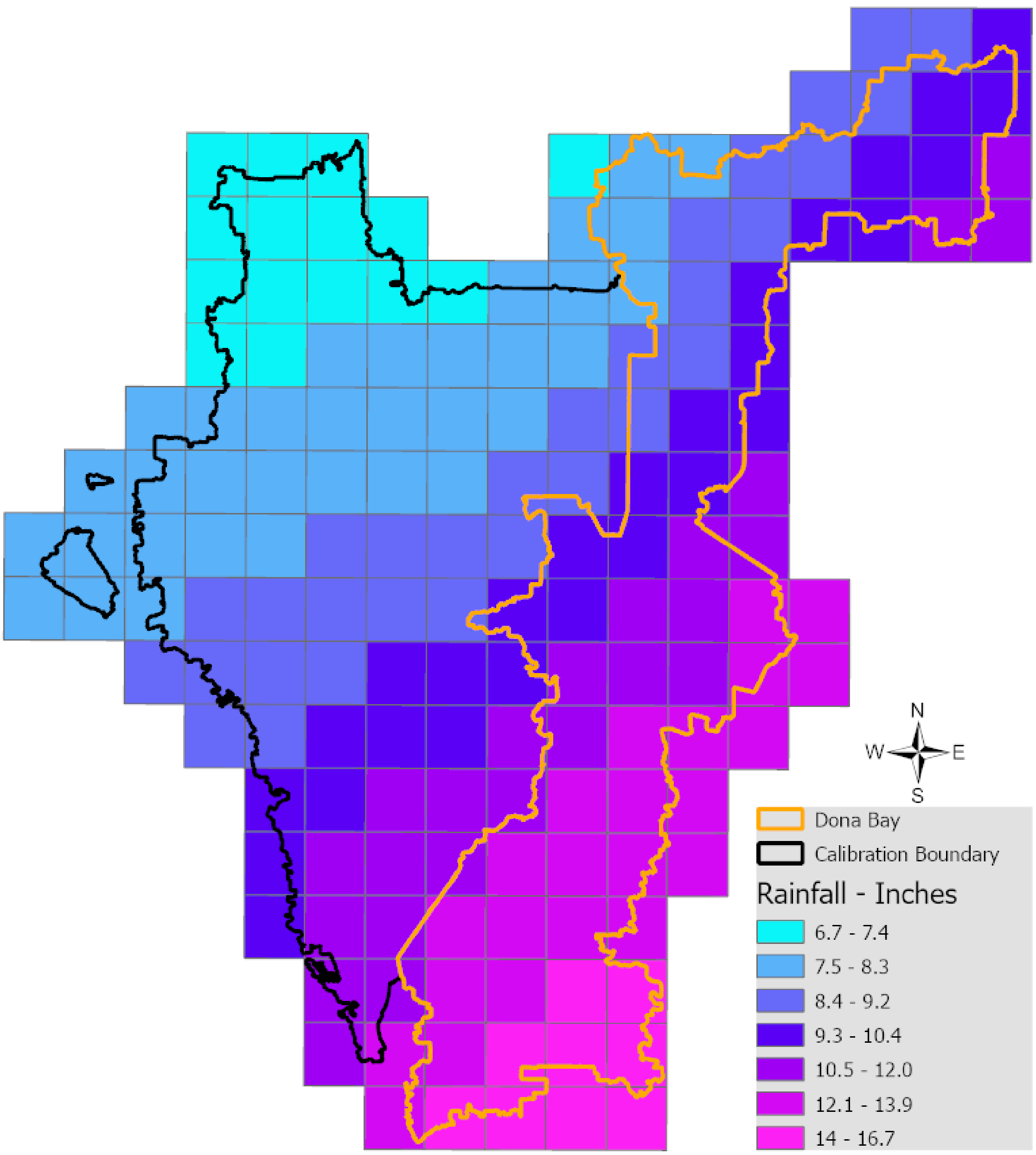
Figure 4 Sarasota County ARMS Gauge Locations



3.3.2 Rainfall Data

Jones Edmunds obtained the Next Generation Weather Radar (NEXRAD) rainfall data from SWFWMD. The data are quantified through a 2-kilometer (km) grid with each cell containing rainfall-depth distributions at 15-minute intervals. The rainfall distribution grid was intersected with the model subbasins, and each subbasin received the rainfall distribution (and depth) for the grid cell that contained the centroid of the subbasin polygon. Figure 5 depicts the NEXRAD grid cells used for Phillippi Creek and the surrounding watersheds, showing the range of rainfall depth totals for cells used in the model calibration event. NEXRAD rainfall totals were also compared to the ARMS rainfall data totals to verify the accuracy of the NEXRAD data. Overall, the data compared within reasonable limits with no discrepancies to warrant any rainfall data changes.

Figure 5 Hurricane Ian Modeled Calibration Rainfall Totals



3.4 STRUCTURE OPERATIONS

The Phillippi Creek Watershed contains four operable water-control structures within its drainage area. These operable structures are all within the Celery Fields Regional Stormwater Facility (CFRSF). The CFRSF primarily functions to mitigate flooding but also provides water-quality treatment during its normal (non-storm) function. The operable structures that control the stages and outflows for the CFRSF are S-6, S-10, S-14, and Main C. Figure 4 illustrates these structure locations in red.

The structures are operated pre-storm and during large storm events. The structures are opened completely before a large storm event (i.e., hurricane or tropical storm) to drain the system and maximize the available flood storage volume. Once the stage in the Main A creek (Phillippi Creek) at the Bahia Vista Road bridge (Node 31791) reaches elevation 10.0 feet North American Vertical Datum of 1988 (ft NAVD88), the structures are closed. The Main C structure is left open if the peak stage downstream is higher than the stage upstream of the structure to allow backwater into the lower CFRSF pools. The structure is closed after the event or if no backwater effects are seen. The actual structure operational protocol is slightly more detailed and is described in the County's SOP for the CFRSF, which can be obtained from the County Stormwater Operations. The general operation rules are also shown in *Celery Fields Regional Stormwater Facility: Standard Operating Procedures and Maintenance Guidelines* (Kimley-Horn and Associates. Inc., 2014).

The structure operations for the calibration and verification simulations were conducted the same way. The simulation considered the S-6, S-10, S-14, and Main C structures to be completely open at the beginning of the storm event. The model was set up to automatically close the structures based on a downstream stage-trigger elevation at Node 31791. Based on our review of the recorded data, the gates appeared to have operated in accordance with the CFRSF SOP. Requests were made for the actual structure operations, but the data were not obtained.

3.5 MODEL CALIBRATION

After updating the Phillippi Creek Watershed Model with new developments, Jones Edmunds simulated a real storm to compare the model-predicted results with known stage observations and estimated flows at the gauges in the watershed. We compared the model results to the gauge data and reviewed/adjusted the appropriate model parameters to obtain a reasonable stage hydrograph match for the Hurricane Ian storm event. The following subsections describe the model calibration details.

3.5.1 CALIBRATION STORM – HURRICANE IAN

Hurricane Ian was a Category 4 storm that made landfall just south of Punta Gorda, Florida, at 4:30 PM, September 28, 2022. In addition to Category 4 winds, it brought heavy rainfall. Rainfall depths in Sarasota County ranged from approximately 17 inches in Dona Bay to approximately 6 inches to the north. Figure 5 shows the rainfall depths across the calibration model boundary, including Phillippi Creek and the Sarasota Bay basin area. Advantages of using this event for calibration include:

1. **Recent Storm:** This event occurred recently and reflects current land use conditions.

2. **Regional Storm:** This event was regional in nature; therefore, the entire watershed contributed to the observed flows.
3. **Uniform AMC:** This event began with uniform soil moisture conditions across the watershed.

3.5.2 Calibration Storm – Event-Specific Model Input Data

To perform a calibration event, specific model input data must be reviewed to determine if modifications need to be made that differ from the standard design storm model setup. These typically include boundary conditions, initial conditions (initial stages and/or flows), and sometimes the soil AMC. The Phillippi Creek Watershed Model has one model boundary condition since the model has been combined with Little Sarasota Bay, Dona Bay, Coastal Fringe Roberts Bay North, and Coastal Fringe Little Sarasota Bay. Flow exchanges between Phillippi Creek to Hudson Bayou and Whitaker Bayou are considered negligible. This approach more accurately represents interflows between basin models. The tidal boundary condition, which is represented as a constant elevation of 1.42 ft NAVD88 in the design models, was replaced with the recorded water level at the Venice Inlet at Crow's Nest Marina.

Initial conditions in the system were left the same as the design events. We considered the flows in the Phillippi Creek channel systems negligible based on a review of the data. Lastly, the rainfall data preceding the Hurricane Ian event showed that the soil conditions appear suitable for conducting model simulations with CNs for an AMC II condition.

3.5.3 Parameter Adjustments

This task was to verify and/or adjust the model parameters to provide the best reasonable match between simulated and measured stages. After the initial model run, the model peak stages compared reasonably well for most gauges. Notable differences were observed with the gauges next to the CFRSF operable weir structures. Jones Edmunds reviewed the model and the operational protocol data discussed in Section 3.4. We subsequently contacted the maintenance operations staff to request event-specific operating information for the event periods. No detailed log could be obtained; therefore, we used the operating manual and recorded gauge data to best estimate the opening and closing of the operable weirs. The operating table that is represented by the bottom clip table in the model was revised to match the estimated operating times. The structure closings were set for the time that the stage at Bahia Vista reached elevation 10 feet NAVD88, but the structure openings were estimated based on the gauge data. The openings of the major structure gate, which happen in sequence every few hours, would cause clear and sharp stage changes. Although the structure operations for the calibration event may differ slightly (gate openings) from the actual operation protocol, model design-event operations will more closely match the SOP. In addition, the opening of the gate occurs after the peak of the storm and therefore will not impact the peak-stage of the model.

3.5.4 Calibration Results

Figures 6 through 12 present the stage hydrographs for the gauge locations with viable data (refer to Table 4). The figures show that model calibration stage hydrographs match well with the recorded gauge data regarding timing and peak stage, though in most of the comparisons the model recession limb consistently falls quicker and lower. Several possible reasons for this include that the elevated groundwater elevations from the storm event increase groundwater recharge into the channels, which is the most likely reason and is expected in this area. This process cannot be simulated in a CN-based model. In these model simulations, the water lost to infiltration using the CN method cannot be simulated as recharge. This recharge process is typically more pronounced in channels that have been historically dredged well below the water table as seen in many of the channels in the Phillippi Creek Watershed; therefore, a faster recession is expected in this watershed. Generally, the model shows a reasonable response to rainfall runoff.

Figure 6 Calibration Stage Hydrograph Comparison – PH-2 at Meadows G.C.

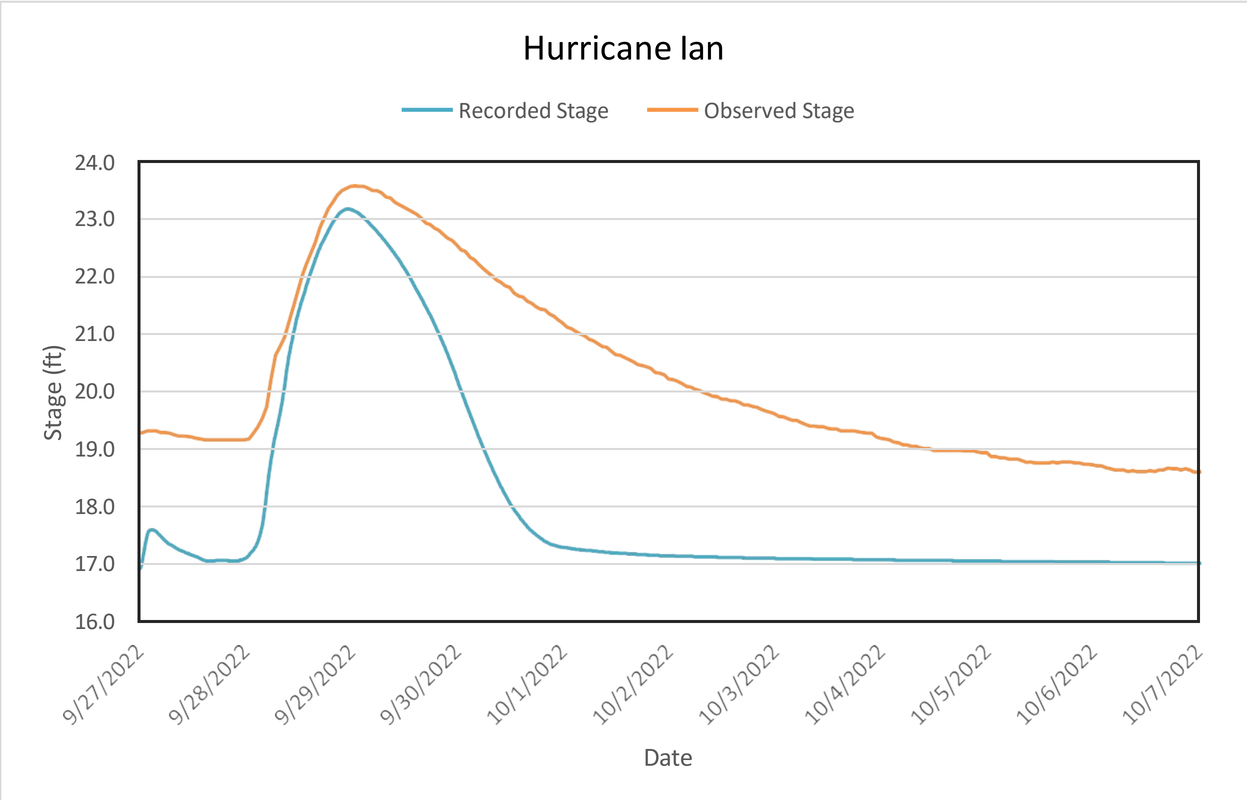


Figure 7 Calibration Stage Hydrograph Comparison – PH-3 at B. Jones Golf

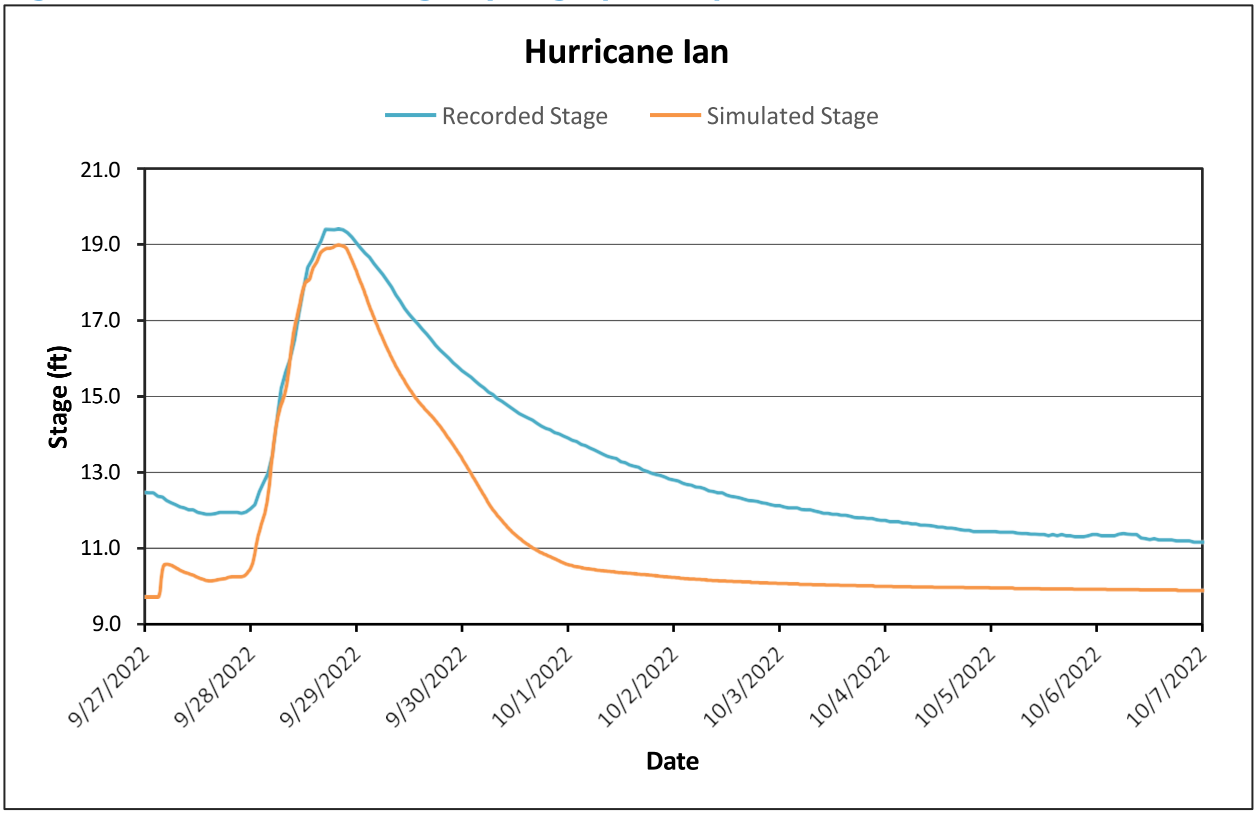


Figure 8 Calibration Stage Hydrograph Comparison – PH-4 at B. Jones Golf

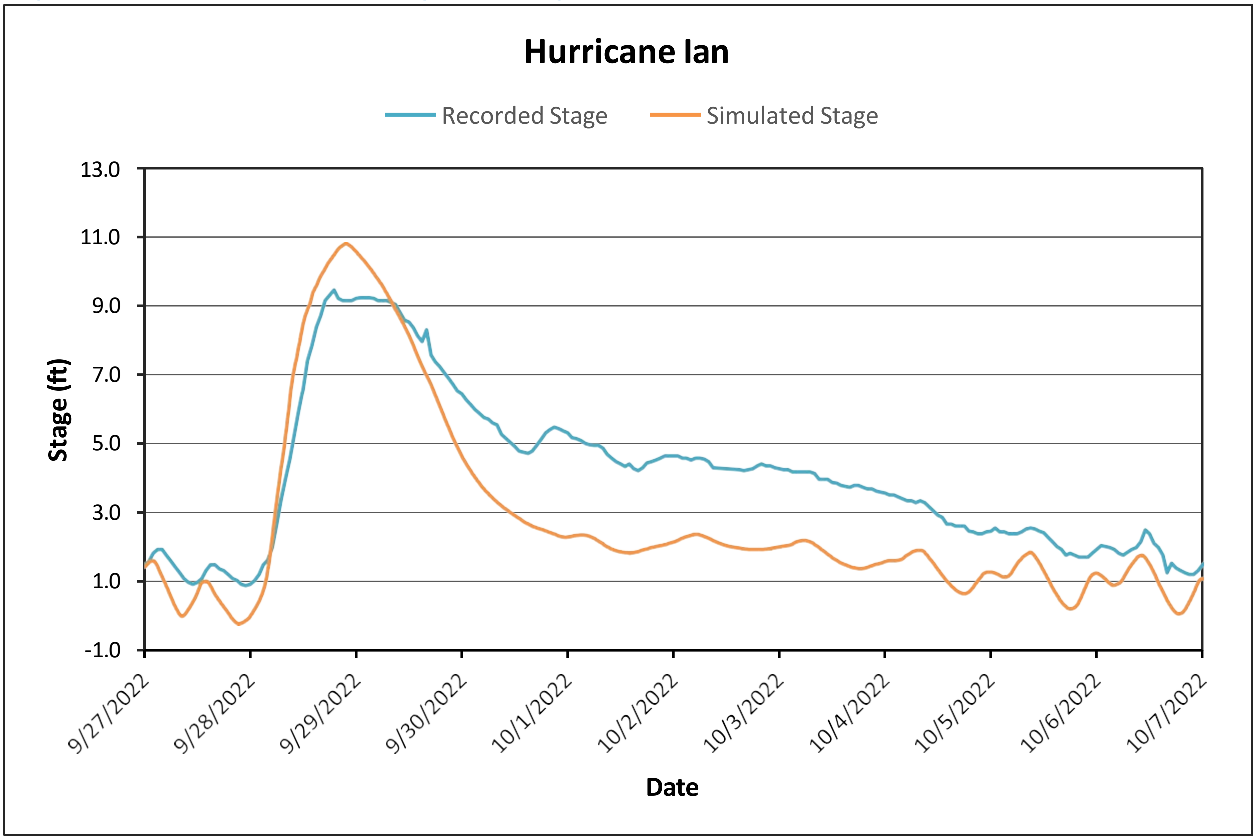


Figure 9 Calibration Stage Hydrograph Comparison – PH-5 at Bahia Vista

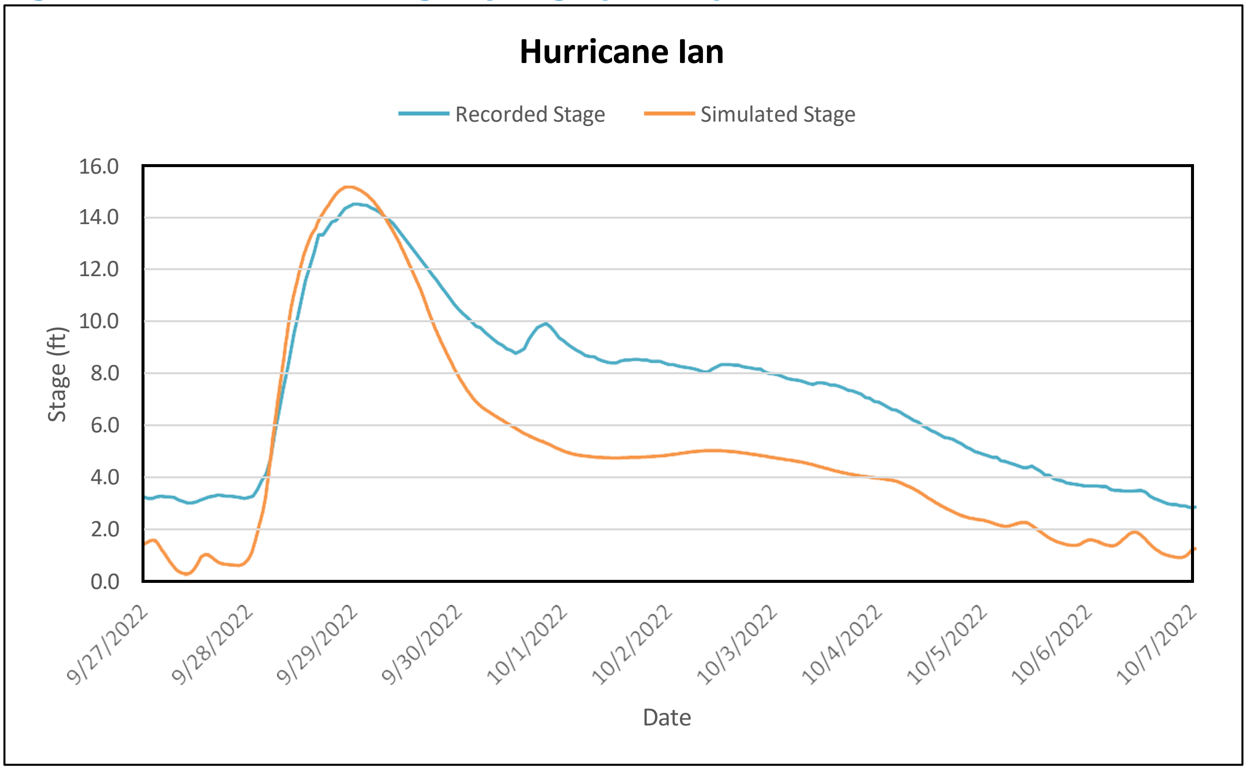


Figure 10 Calibration Stage Hydrograph Comparison – PH-6 at Main C

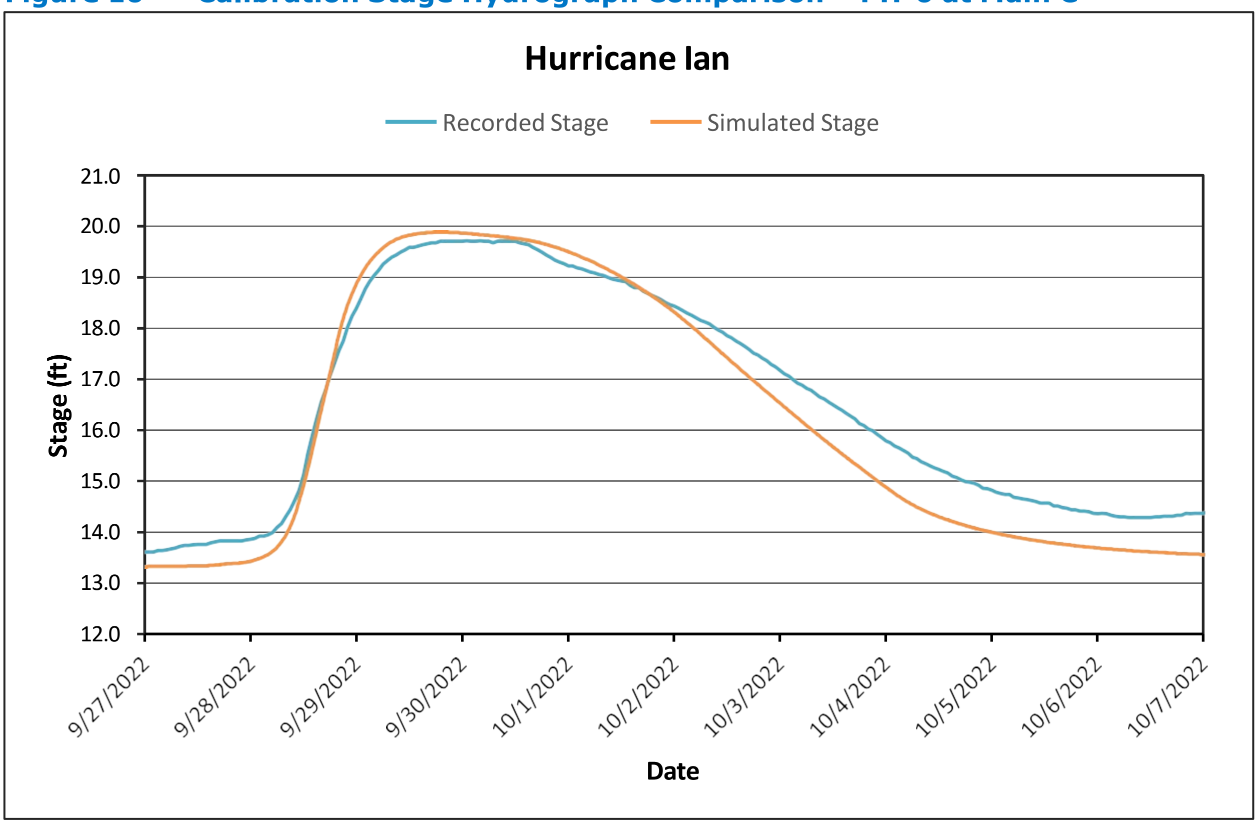


Figure 11 Calibration Stage Hydrograph Comparison – PH-11 at Main C Weir

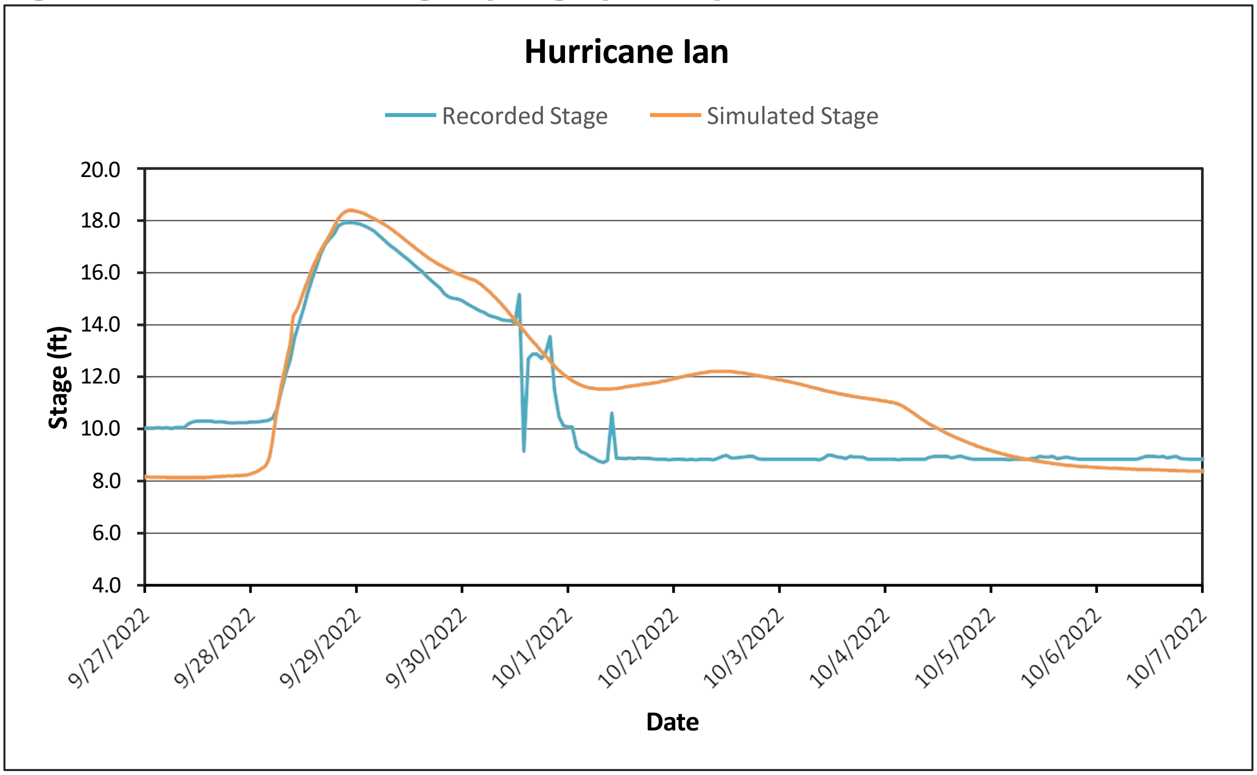


Figure 12 Calibration Stage Hydrograph Comparison – PH-7 at Palmer East

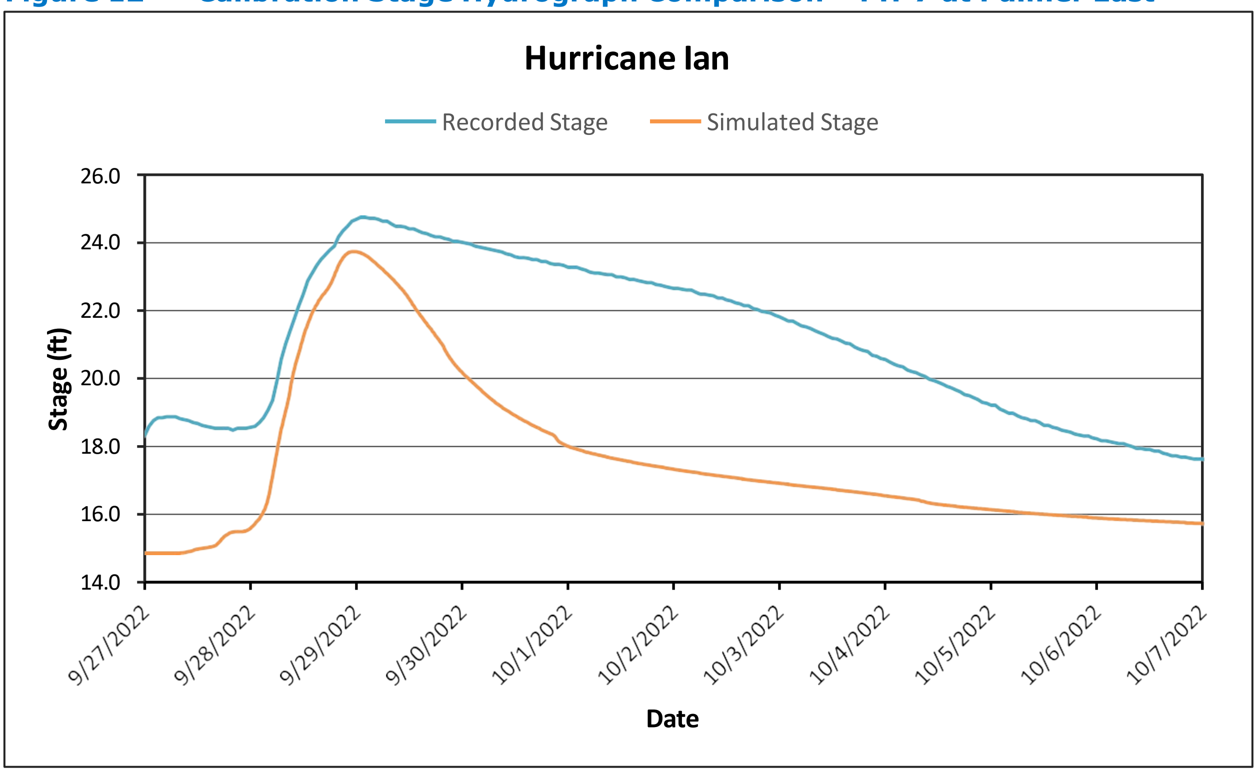


Figure 8 (PH-4) and Figure 12 (PH-7) show two hydrograph comparisons that are not good matches. The recorded data in Figure 9 appear to show that the gauge data recorder likely

had problems during the peak of the event. The assumption is based on the gauge upstream, PH-5, which does not show the same flattening at the peak.

Figure 12 (PH-7) shows the only gauge that does not compare well to the recorded data. Jones Edmunds investigated this thoroughly, and the cause does not appear to be a deficiency in the model. Based on our review of the stages in the Dona Bay Watershed just east of this gauge, the recorded flows in the channel that are causing the extended peak stage may be from elevated water levels on the east side of the large berm that separates the Phillippi Creek Watershed from the Dona Bay Watershed seeping through and under the berm. In the combined model, water stages on the Dona Bay side of the berm are simulated as inundated above ground for almost 3 days and with depths up to 4 feet. The model also shows a 7-foot head gradient between the stage in Palmer Branch on the Phillippi Creek side of the berm and the stage on the Dona Bay side just 100 feet to the east. The verification results match well and are further discussed in subsequent sections. Based on these reasons, we made no changes to the model at or around this location.

Table 5 summarizes the modeled peak stages compared to the simulated peak stages. PH1, PH-8, PH-12, and PH-3 are not shown due to no data being available. Omitting the peak stage differences for PH-4 and PH-7, the average peak stage difference is 0.42 foot (absolute value), which is within an acceptable range.

Table 5 Observed Stages Compared to Simulated Peak Stages – Hurricane Ian Calibration Event

ARMS Gauge	Recorded Stage (ft NAVD88)	Simulated Stage (ft NAVD88)	Difference (foot)
PH-2	23.57	23.17	-0.4
PH-3	19.4	18.99	-0.41
PH-4	9.46	10.80	1.34
PH-5	14.46	15.13	0.67
PH-6	19.71	19.87	0.16
PH-7	24.74	23.73	-1.01
PH-11	17.92	18.38	0.46

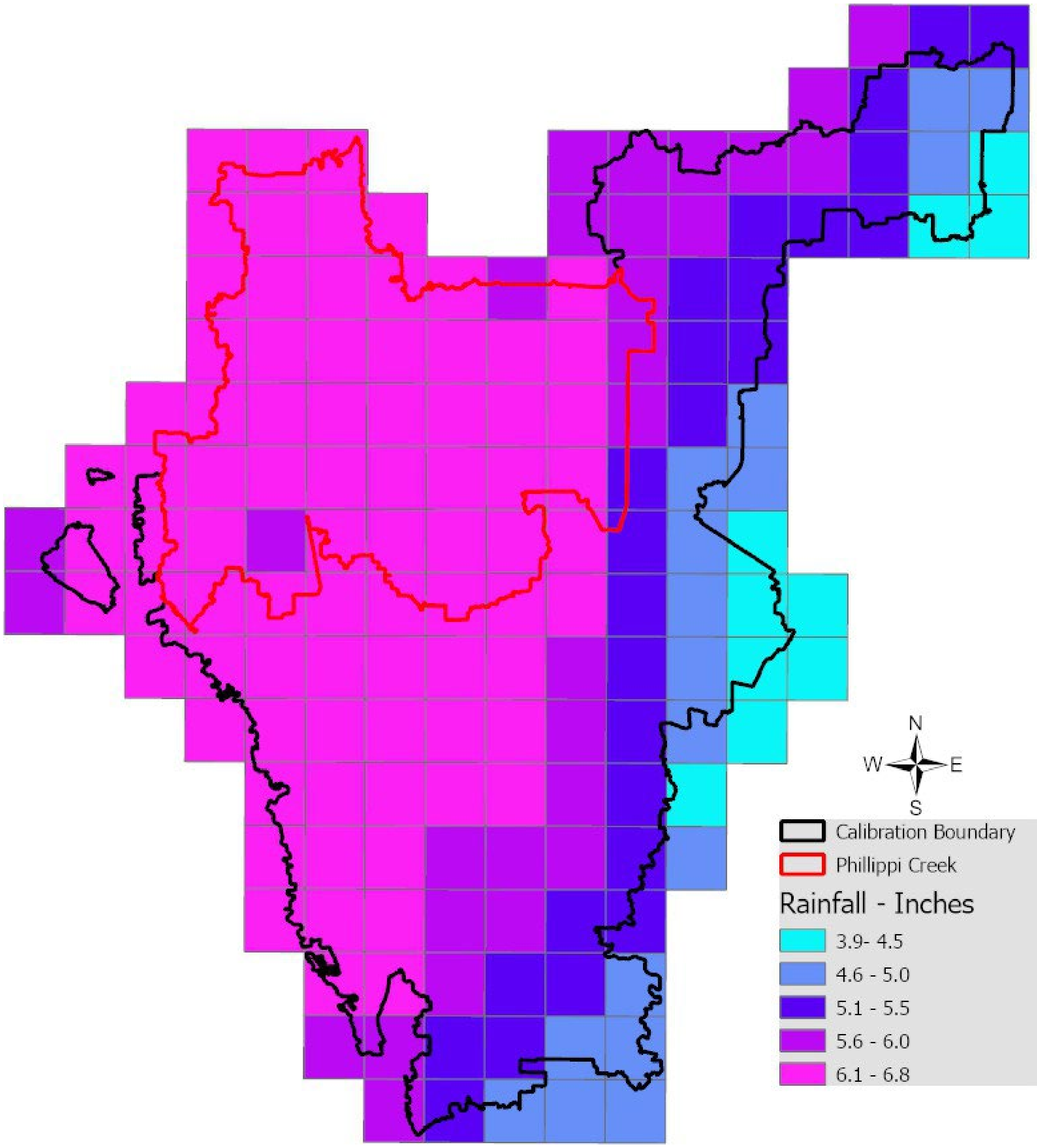
3.6 Model Verification

After calibration, Jones Edmunds verified the model by simulating a second real storm to provide confidence that the calibrated model adequately simulates the watershed hydrologic and hydraulic response to a separate and different storm. We selected TS Eta.

3.6.1 Verification Storm – TS Eta

TS Eta began to impact southwest Florida on November 8, 2020. Although much of the rainfall occurred on November 11, the model was simulated from November 10 through 21. During this period, rainfall averaged 6.7 inches across all gauges in the Phillipi Creek Watershed. Figure 13 shows the model verification event rainfall depths for the entire combined model, including the Phillippi Creek Watershed. As with the calibration, NEXRAD rainfall distributions were applied to each basin based on the intersection of the basin's centroid with the NEXRAD grid cells.

Figure 13 Rainfall Verification Map – TS Eta Rainfall Totals



3.6.2 VERIFICATION STORM – EVENT-SPECIFIC MODEL INPUT DATA

As with the calibration event, specific model input data were reviewed to determine if modifications were needed that differed from the standard design storm model setup, including boundary conditions, initial conditions (initial stages and/or flows), and soil AMC. The model boundary conditions were set up identically to the calibration event. Our approach to setting up the initial conditions in the system was also the same as the calibration event.

The big difference in the model input data setup for the verification event was the soil conditions. Because the event was in November, the rainfall data preceding the TS Eta event was reviewed since in the event occurred outside the Florida “wet” season. Our review of the 5-day period preceding November 11 revealed an average of 0.43 inch of rain fell across the Phillippi Creek Watershed. Table 6 shows that the AMC is determined by the previous 5-day rainfall total based on accepted Soil Conservation Service (SCS) methodology.

Table 6 SCS Runoff Guide for Selection of AMC

AMC	Total 5-Day Antecedent Rainfall (inches)	
	Dormant Season (November – May)	Growing Season (June – October)
I	< 0.5	< 1.4
II	0.5 to 1.1	1.4 to 2.1
III	> 1.1	> 2.1

Source: Technical Publication No. 85-5, *A Guide to SCS Runoff Procedures* (Suphunvorranop, 1985).

Based on the rainfall data and the criteria above, the proper AMC to use for the TS Eta verification event is AMC I. Jones Edmunds used the widely accepted SCS method for modifying CNs from AMC II to AMC I and used this to update the model input.

We simulated the model using AMC I and AMC II CNs to allow a thorough review of the verification model considering that AMC I CNs are not frequently used. We conducted the AMC II simulation first, which initially showed over-predicted stages; however, we reviewed the hydrologic conditions leading up to the verification event and determined that the AMC built into the standard CNs that we used were too high for this event period, so we simulated the model using AMC I as well.

3.6.3 Verification Results

Figures 14 through 21 present stage hydrographs comparisons for the gauge locations with viable data (Table 3). Verification event data were available for two of the gauge locations that were missing from the calibration simulation (PH-1 – Hidden Forest and PH-9 – Red Bug Slough). However, data were not available for the PH-11 gauge (Main C) for the verification event. The comparison graphs include stage hydrograph data from both model AMC simulations for context. The figures show that model stage hydrographs match well with the recorded gauge data for the AMC I model simulation, particularly in the timing and peak stages. In almost every gauge comparison, the model ascension limb and peak match exceptionally well. The gauges that have the largest discrepancies are PH-4, PH5, and PH-6. These gauges represent the stage in the center cell of the CFRSF and Phillippi Creek (Channel Main A) at two locations downstream of the Main C tributary, which includes the CFRSF. Because the actual gate structure operations were not obtained, the operations were estimated and likely account for the discrepancy at PH-6 and contribute to the differences at PH-5 and PH-4. When the gauge data comparisons were reviewed as a whole, the simulated verification event appeared to confirm that the model’s response rainfall runoff was within reasonable ranges.

Table 7 summarizes the recorded gauge peak stages compared to the model simulated peak stages. Even including the CFRSF and Channel A stage comparisons, the average peak stage difference for the gauge comparisons is 0.5 foot (absolute value).

Figure 14 Verification Stage Hydrograph Comparison – PH-1 at Hidden Forest

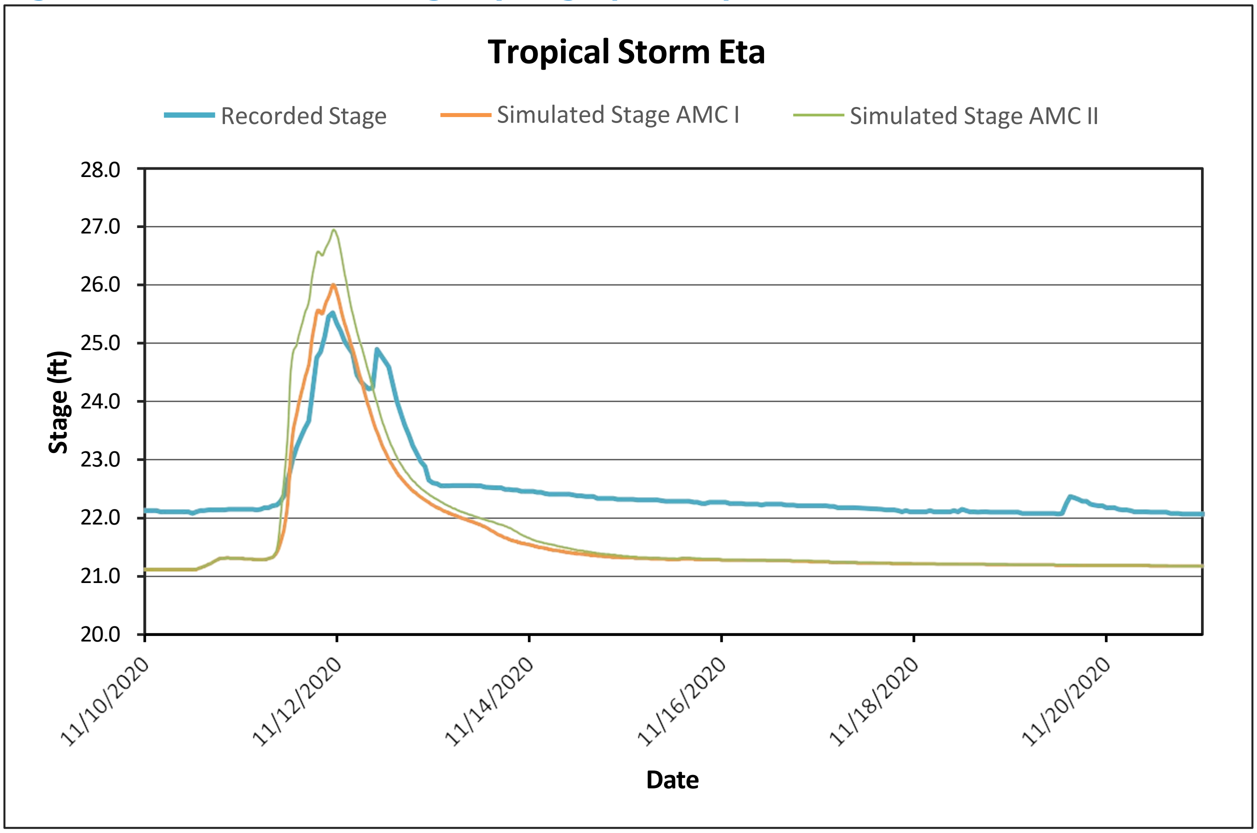


Figure 15 Verification Stage Hydrograph Comparison – PH-2 at Meadows G.C.

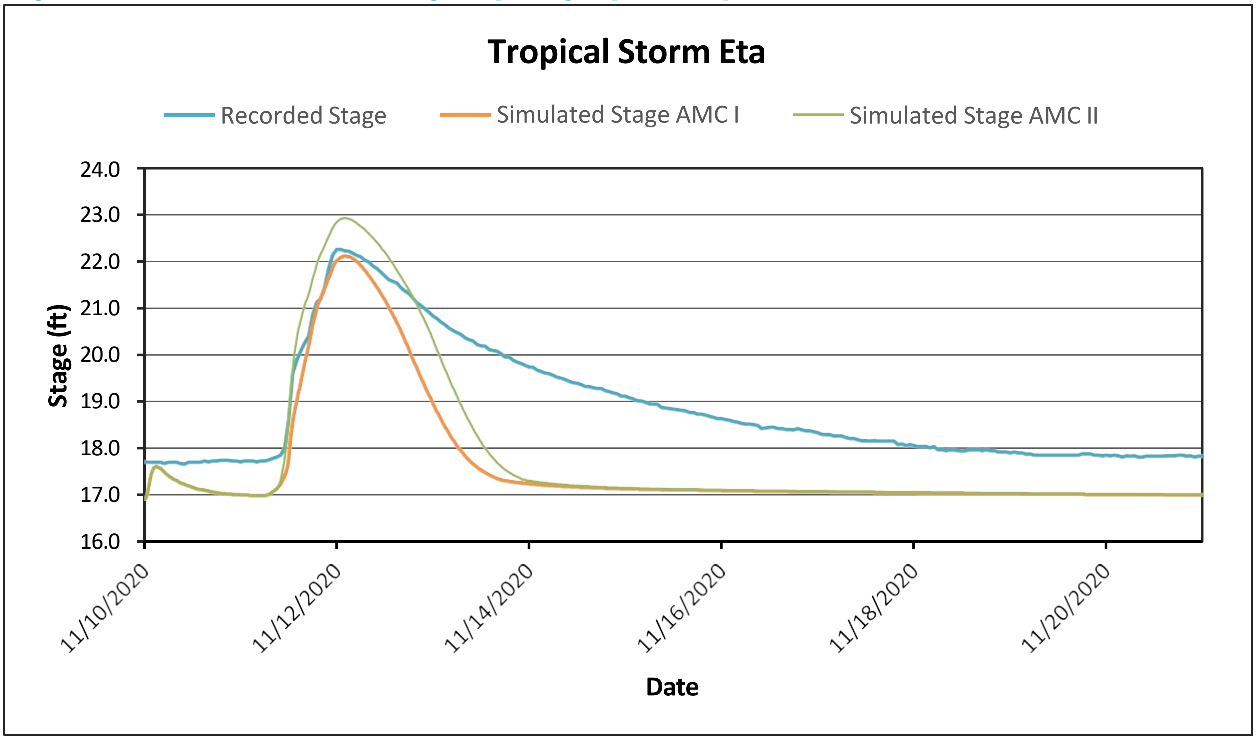


Figure 16 Verification Stage Hydrograph Comparison – PH-3 at B. Jones Golf

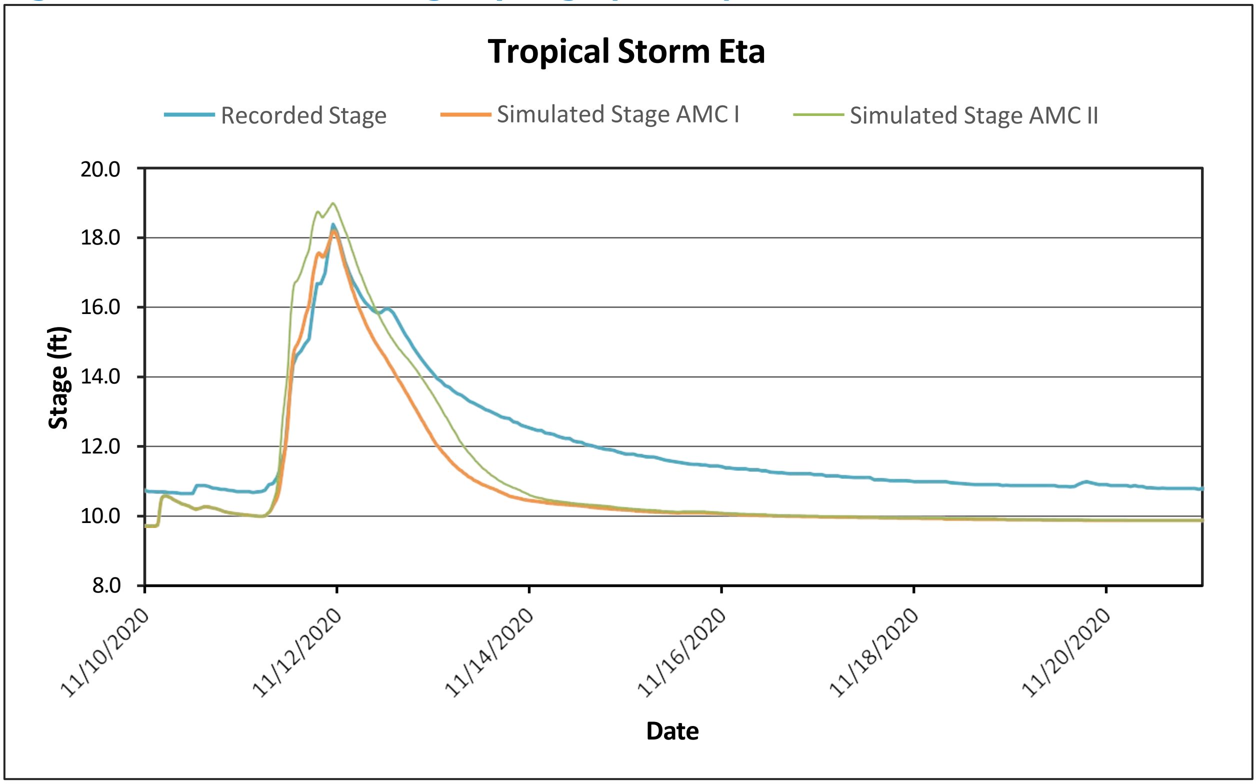


Figure 17 Verification Stage Hydrograph Comparison – PH-4 at Pine Craft

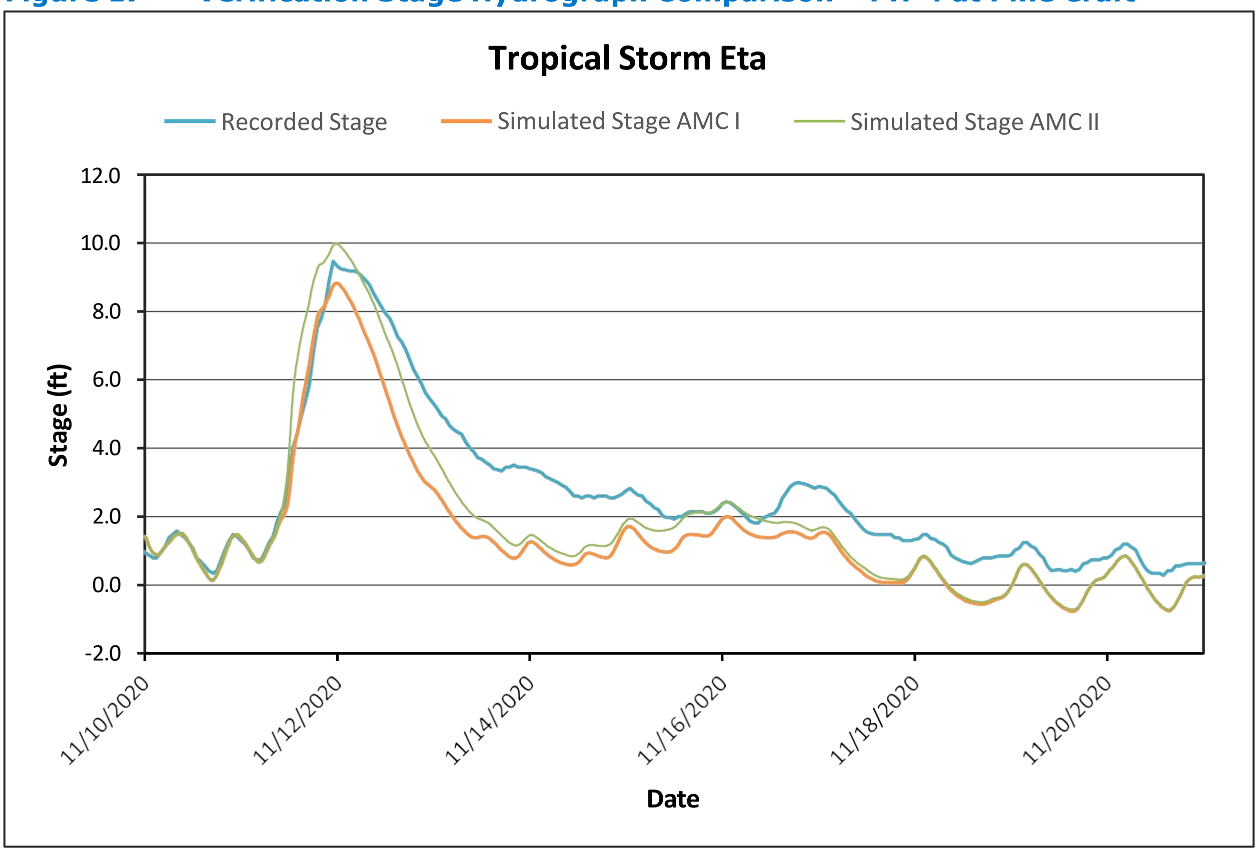


Figure 18 Verification Stage Hydrograph Comparison – PH-5 at Bahia

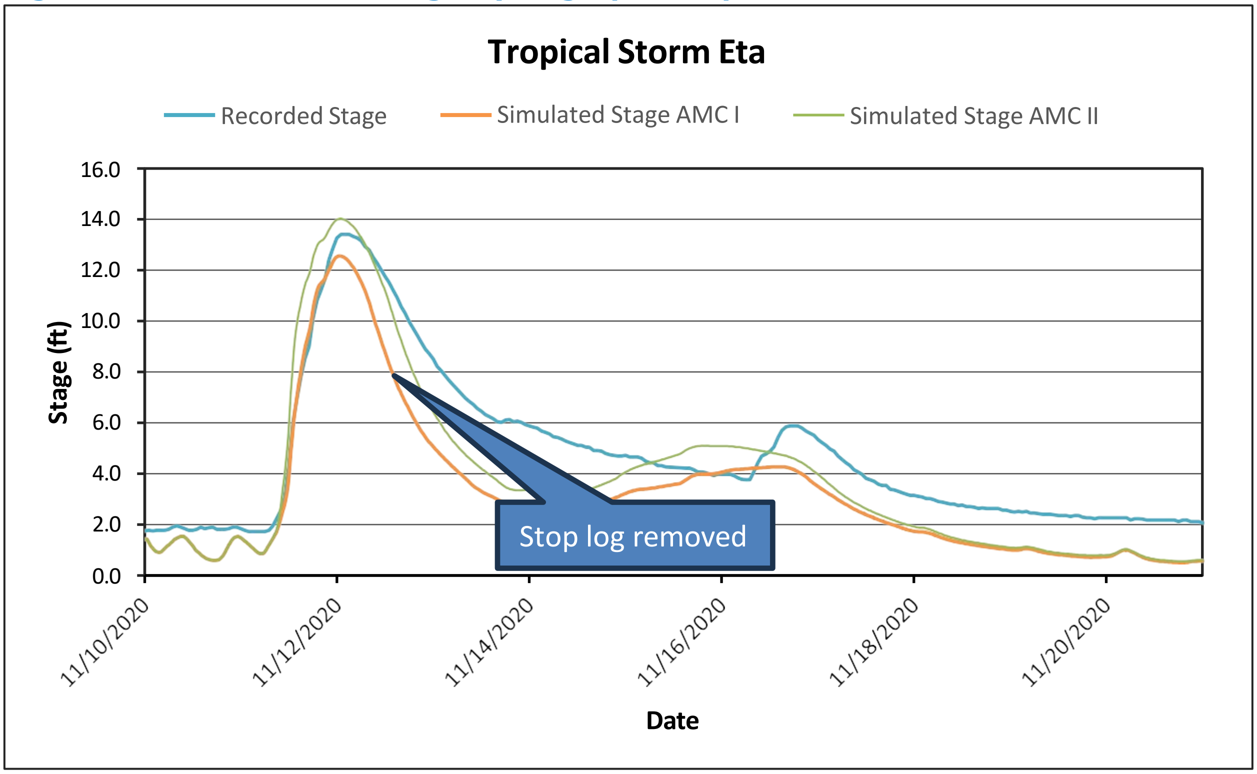


Figure 19 Verification Stage Hydrograph Comparison – PH-6 at Main C

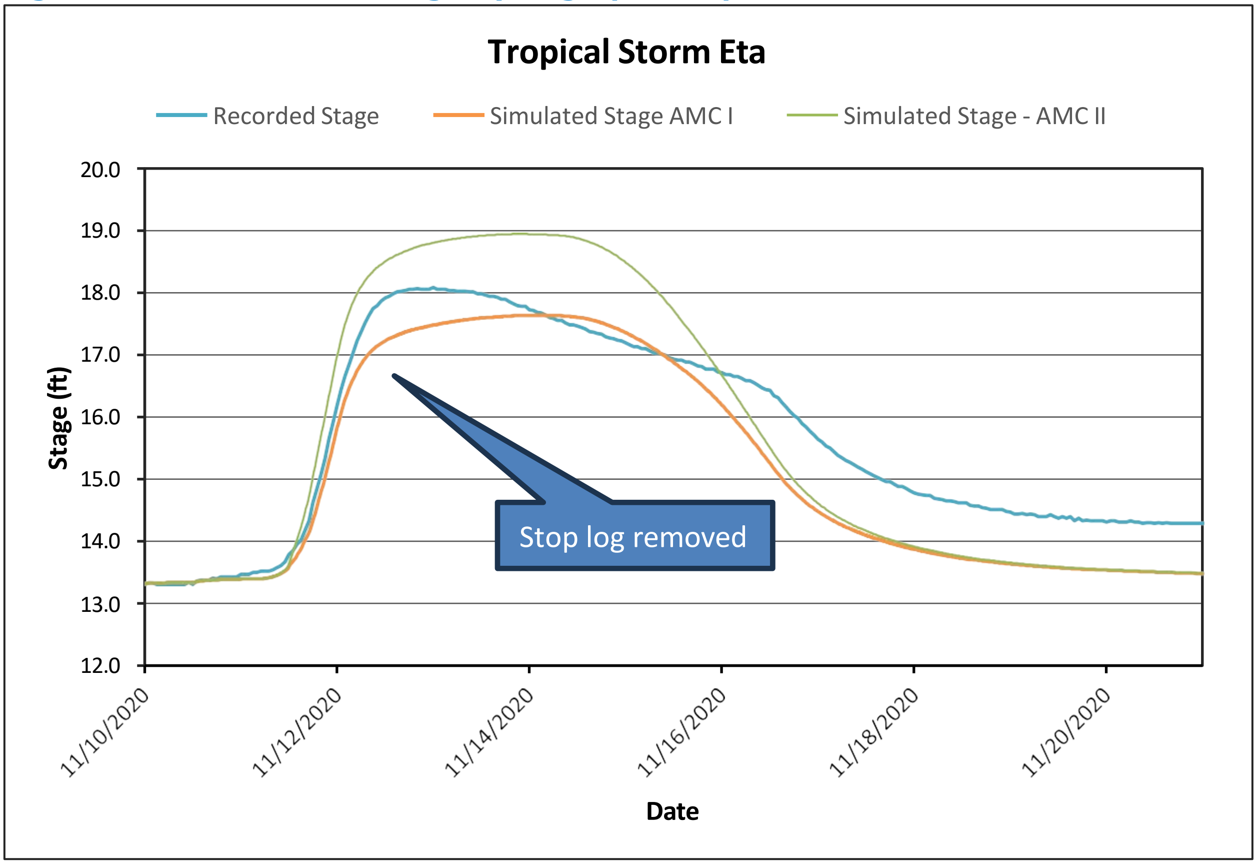


Figure 20 Verification Stage Hydrograph Comparison – PH-7 at Palmer East

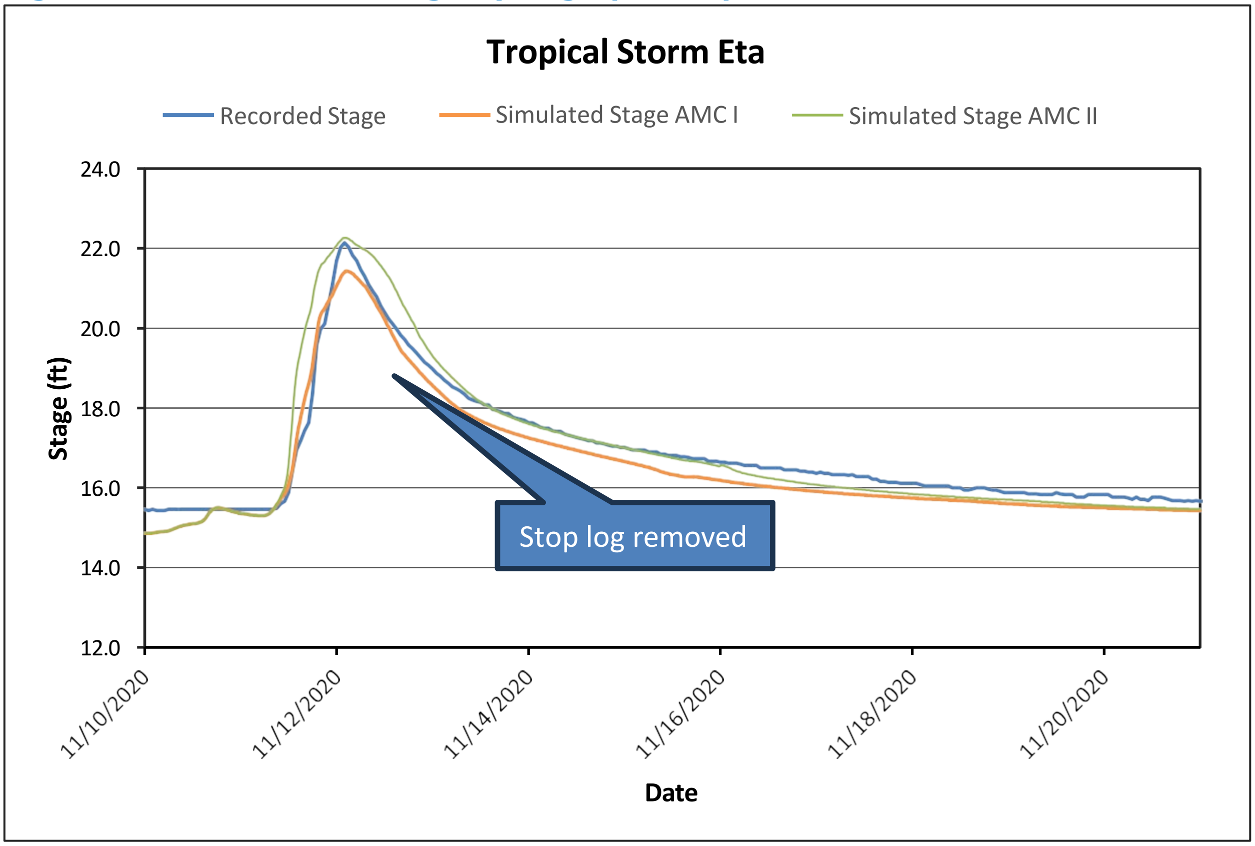


Figure 21 Verification Stage Hydrograph Comparison – PH-9 at Red Bug Slough

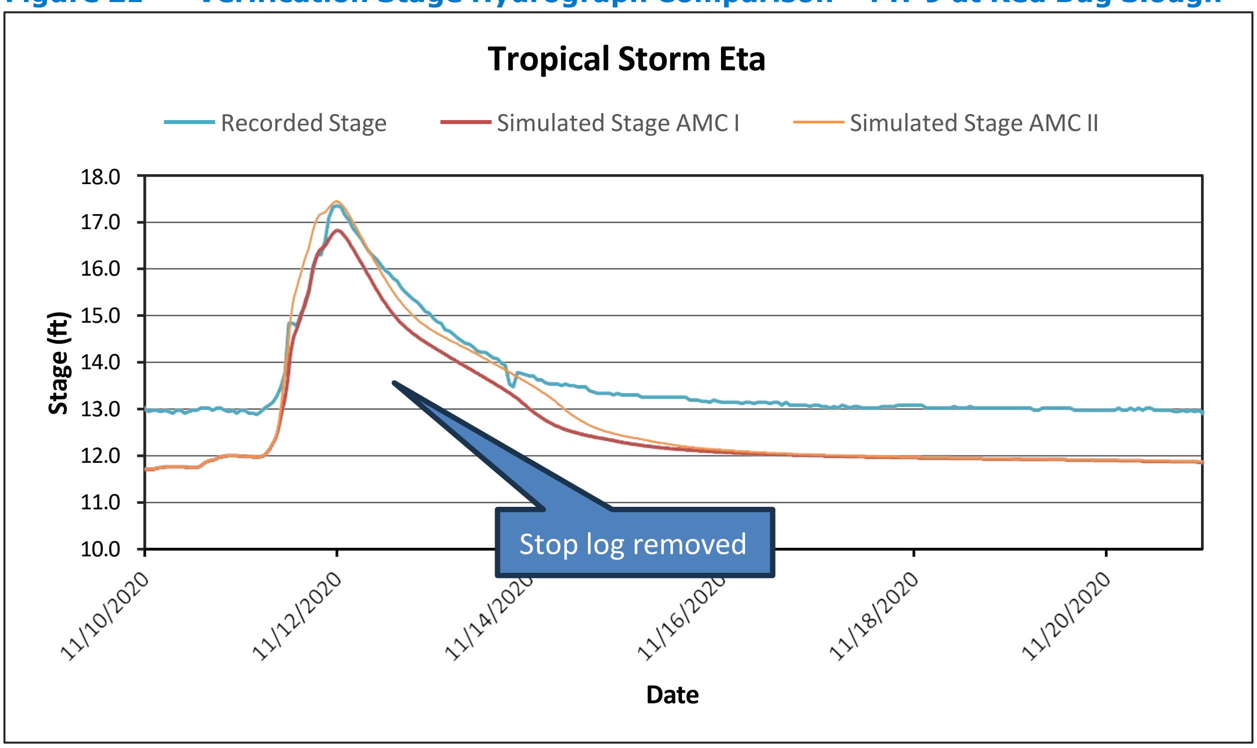


Table 7 Observed Peak Stages Compared to AMC I Simulated Peak Stages – Tropical Storm Eta Verification Event

ARMS Gauge	Recorded Peak Stage Ft NAVD88	Simulated Stage Ft NAVD88	Difference Foot
PH-1	25.52	26	0.48
PH-2	22.25	22.11	-0.14
PH-3	18.38	18.18	-0.2
PH-4	9.46	8.82	-0.64
PH-5	13.4	12.55	-0.85
PH-6	18.08	17.63	-0.45
PH-7	22.14	21.43	-0.71
PH-9	17.35	16.82	-0.53

4 BOUNDARY CONDITIONS UPDATE

Since the model for the Phillippi Creek Watershed as well as the adjacent watersheds are concurrently being updated along their boundaries, it is important that the boundary conditions reflect the changes within each watershed. Historically, developing the boundary conditions is an iterative process of updating the time-stage data of adjacent watersheds until both watershed models produce consistent results. The new ICPR4 engine has improved the computation time. This improvement, along with advancements in computer hardware and memory management, made simulating countywide models feasible. Therefore, Jones Edmunds merged all the County's watershed geodatabases into one geodatabase. Figure 22 illustrates the extent of the countywide watershed model. Updates made during the merge include:

- Updating the basin delineation to eliminate gaps and overlaps.
- Renaming nodes and links to ensure no duplicates exist.
- Updating link features to ensure the polyline feature originates and terminates at nodes.
- Link spatial features were updated to match the model inputs.
- Where there is mismatched information for the same feature, the feature that has a credible source (survey, as-built, etc.) was retained.
- Table 9 summarizes the hydrologic and hydraulic features within the Countywide geodatabase.

Table 9 Countywide Hydrologic and Hydraulic Features

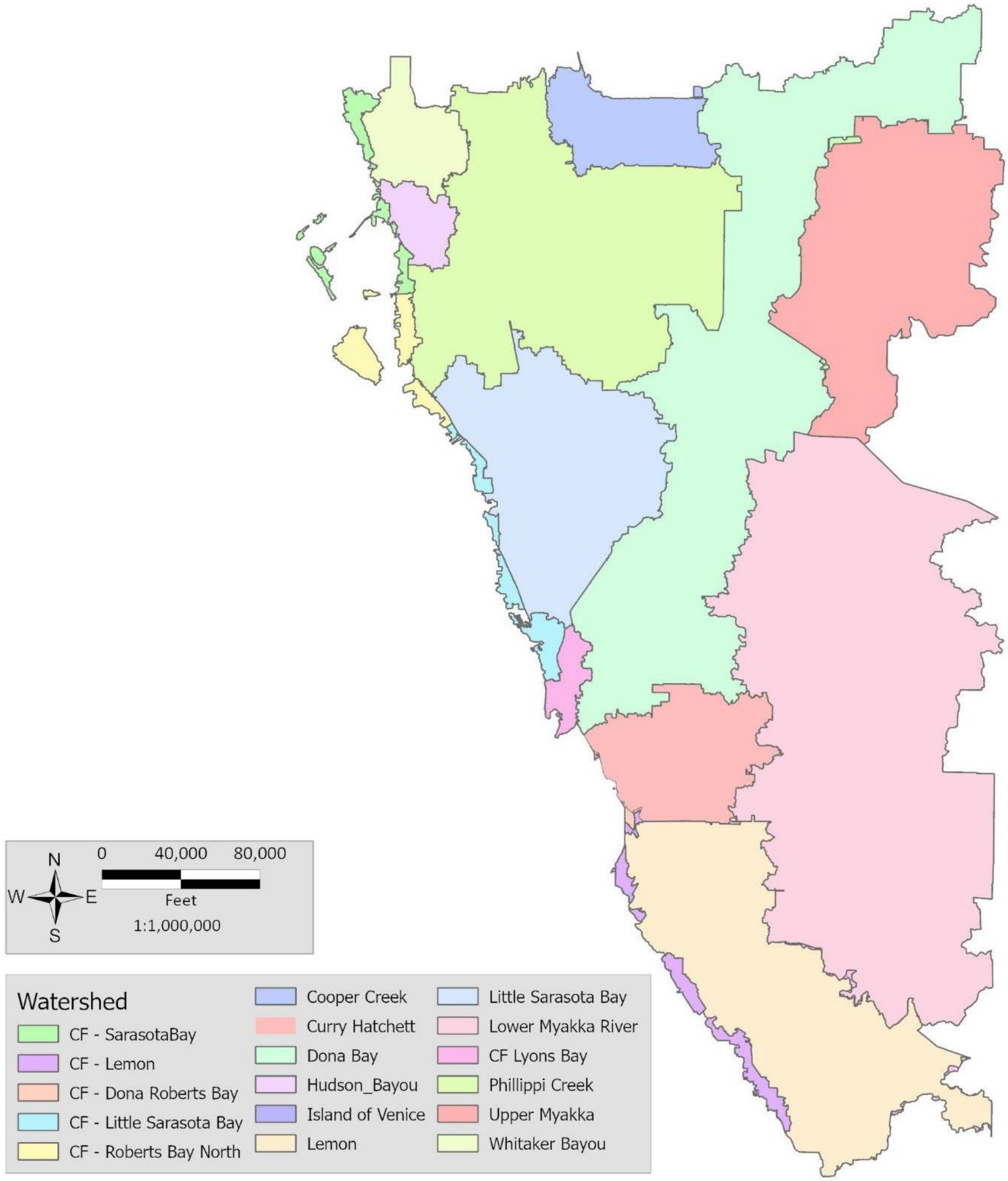
Basins	Nodes	Rating Curves	Pipes	Channels	Weirs	Drop Structures
17,320	20,083	123	9,549	3,425	26,928	3,248

Jones Edmunds created the countywide model using Streamline Technologies' toolbox to export the model data from SWFWMD's Geographic Watershed Information System (GWIS) 2.1 geodatabase and import it into the ICPR4 model. We simulated the 10-, 25-, 50-, 100-, and 500-year storm events using the SCS Type-II Florida-Modified Rainfall Distribution. Table 10 shows the rainfall depths that we derived for these storms from rainfall isohyet maps provided in SWFWMD's *Guidelines and Specifications (G&S)* (2020).

Table 10 Design Storm Rainfall Depths Using 24-Hour Duration and Type II Florida-Modified Distribution

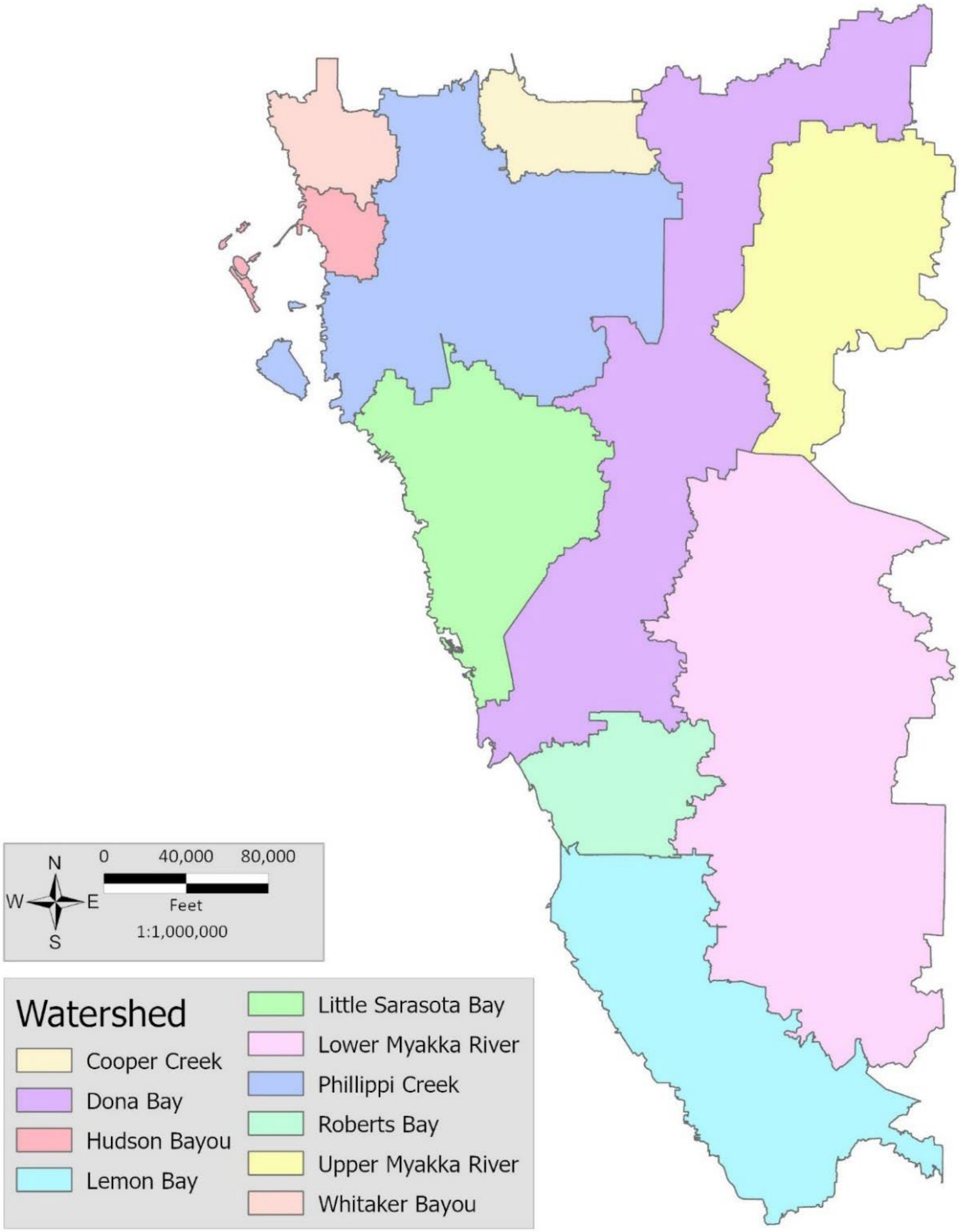
Return Frequency (years)	Rainfall Depth (inches)
10	7.0
25	8.0
50	9.0
100	10.0
500	12.4

Figure 22 Sarasota County's Watershed Model Boundaries



The County maintains 16 models; six models are coastal models that were developed with the intent to be merged with the adjacent riverine watersheds. Under the County's guidance, Jones Edmunds combined the coastal basins into the appropriate watershed. Figure 23 illustrates the resulting 10 watershed boundaries.

Figure 23 Sarasota County Watershed Boundaries



Using the countywide watershed model, Jones Edmunds extracted the Dona Bay Watershed into a separate geodatabase. We updated the boundary nodes for Dona Bay with the time-stage data from the countywide model, and we simulated the 10-, 25-, 50-, 100-, and 500-year storm events for the Dona Bay Watershed. Jones Edmunds verified that the results of the Dona Bay Watershed model was consistent with the overall countywide model.

5 FLOODPLAIN DELINEATION

Jones Edmunds developed level pool floodplains for the 100-year/24-hour design storm event. We delineated the floodplain extents using the 2019 SWFWMD enhanced ground-surface digital terrain model (DTM) and existing conditions model results. We determined the mapped floodplain water-surface elevations based on peak water-surface elevations at the model nodes.

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