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<b>To:</b>	Moira Homann, DEP; Chandler Keenan, DEP, Kevin O’Donnell, DEP; Eric Simpson, DEP; Woo-Jun Kang, DEP; Tony Tomalewski, DEP; Diana Turner, DEP
<b>From:</b>	Tetra Tech
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<b>Subject:</b>	Final Task 3. Calibration of the St. Lucie River and Estuary Watershed HSPF Model Hydrology

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## 1.0 INTRODUCTION

The Florida Department of Environmental Protection (DEP) contracted Tetra Tech to develop and calibrate a Hydrological Simulation Program – FORTRAN (HSPF) model for the St. Lucie River and Estuary watershed. A Watershed Water Quality Simulation (WaSh) model was previously developed for the watershed. However, DEP would like an HSPF model to have one consistent modeling platform for the Northern Everglades basin management action plans (BMAPs). In 2017, Tetra Tech completed an update to the Caloosahatchee River and Estuary HSPF model and completed a second update in 2025. The St. Lucie River and Estuary watershed HSPF model was developed using a process that is consistent with the Caloosahatchee River and Estuary HSPF model development.

The goal of this project is to prepare a model that represents total nitrogen (TN) and total phosphorus (TP) loading throughout the watershed to estimate the nutrient load reaching the St. Lucie River and Estuary. DEP will use the model results in a future update to the St. Lucie River and Estuary BMAP. Task 3, which is presented in this memo, documents the calibration results for the simulation period from 2008 through 2023 (using 2008 for model spin up) for the HSPF model hydrology.

## 2.0 HSPF MODEL

The following sections summarize the St. Lucie River and Estuary watershed model hydrology setup, assumptions and data sources.

### 2.1 SUBBASIN DELINEATIONS

The St. Lucie River and Estuary watershed was first divided into the 11 Northern Everglades and Estuaries Protection Program (NEEPP) basins (**Figure 1**) and these boundaries were provided by the South Florida Water Management District (SFWMD). Each NEEPP watershed was further subdivided into subbasins to provide appropriate hydrologic connectivity for the HSPF model and watershed pour points at monitoring stations for calibration and validation. These subdivisions considered City of Port St. Lucie watersheds, Martin County watersheds, Impaired Waters Rule (IWR) Run 66 waterbody identification number (WIBD) boundaries, National Hydrography Dataset (NHD) boundaries, and hydrology and water quality monitoring station coverages. The St. Lucie River and Estuary watershed was delineated into a total of 149 subbasins (**Figure 2**).

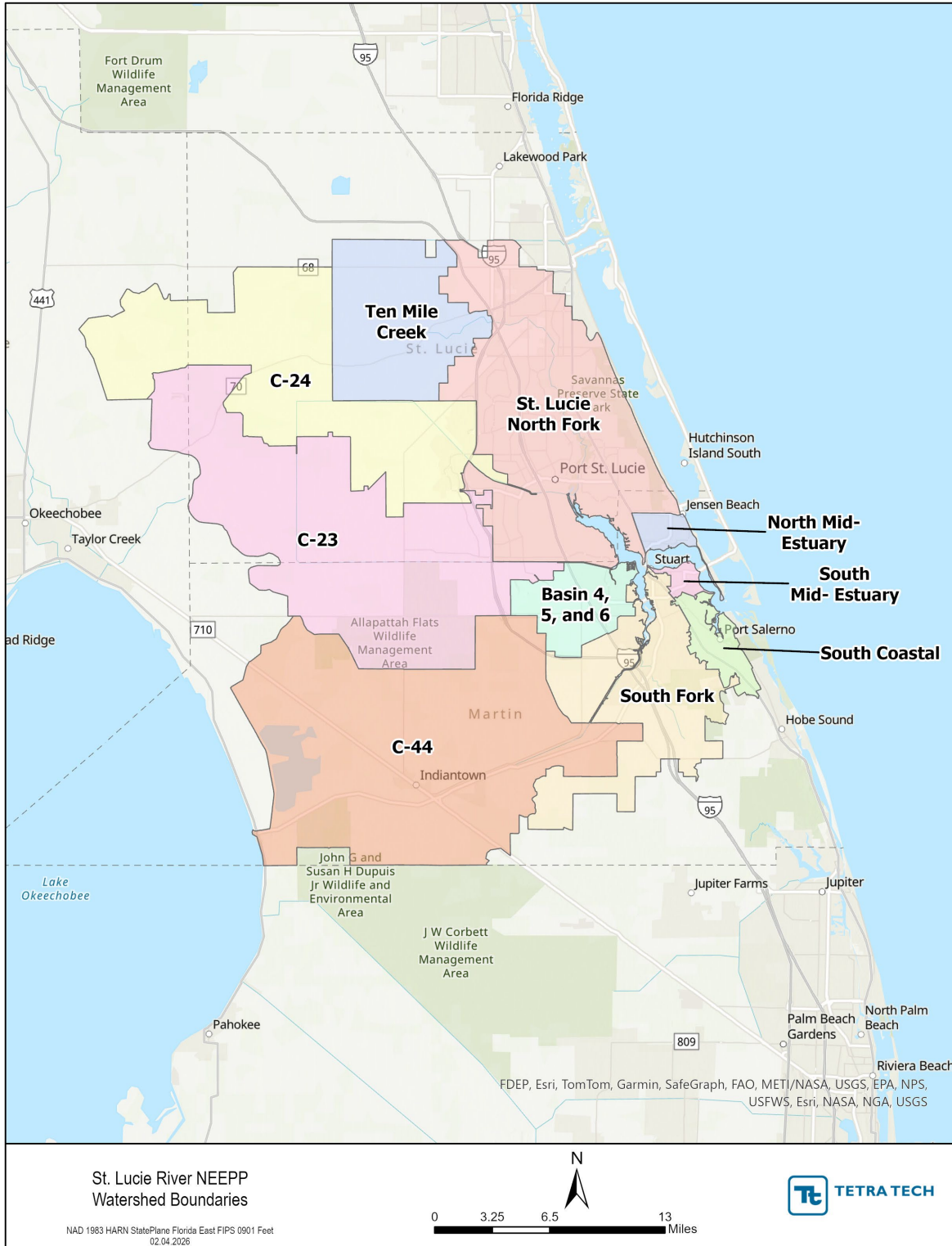


Figure 1. St. Lucie River and Estuary watershed boundaries

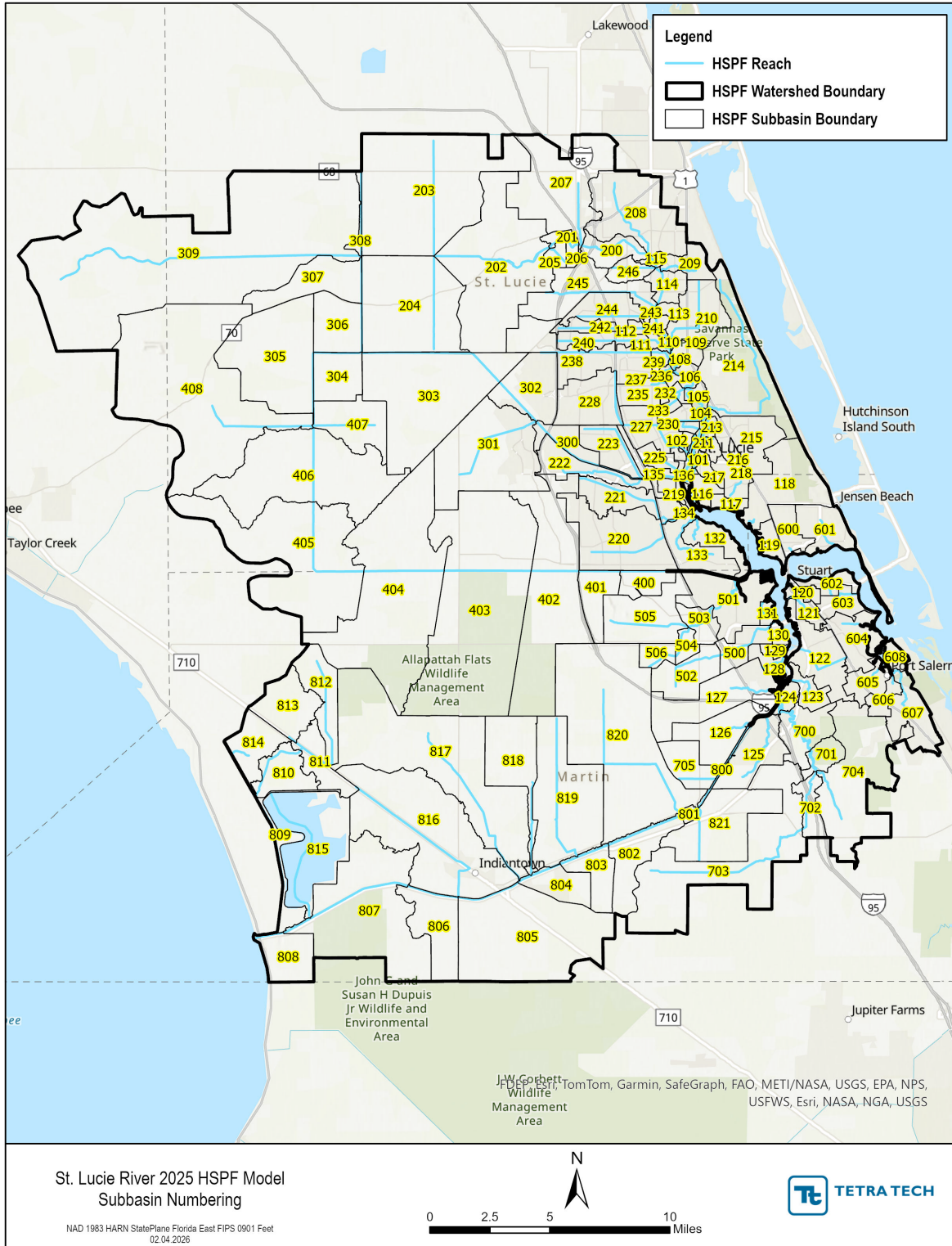
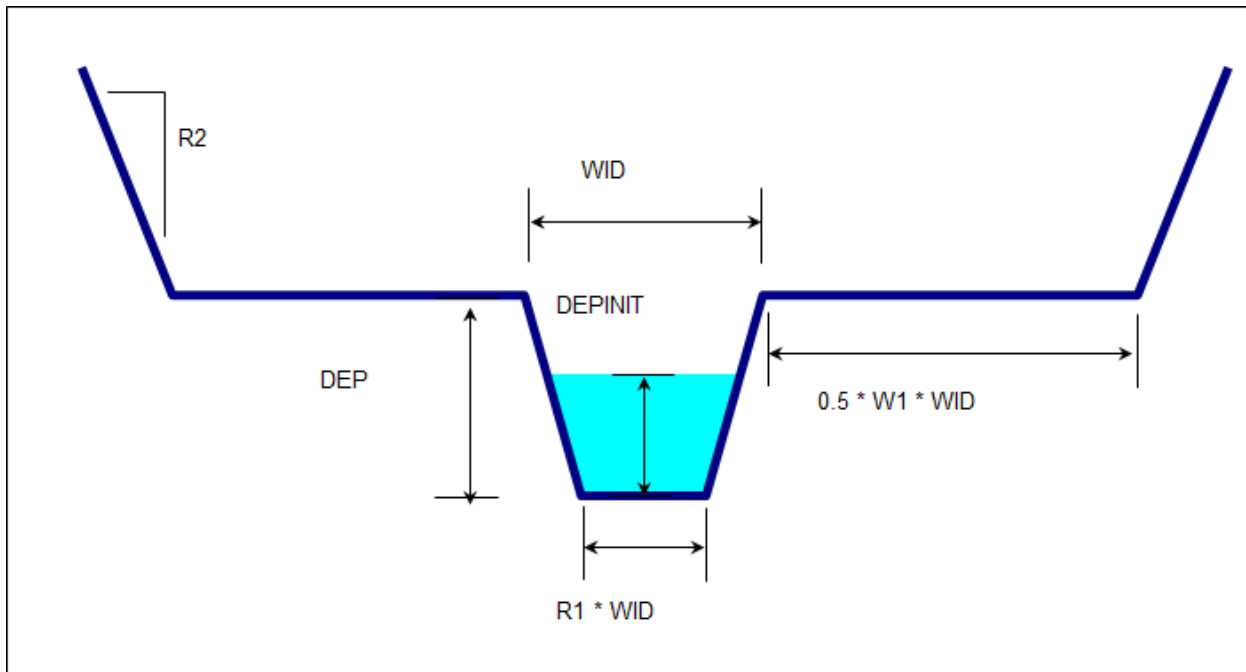


Figure 2. Subbasin delineation for the HSPF Model

## 2.2 REACHES AND FUNCTION TABLES (F-TABLES)

A representative reach was defined for each of the 149 subbasins and assigned a number identical to the subbasin number. Each representative reach was selected from SFWMD Arc Hydro Enhanced Database (AHED) Canals and Streams based on subbasin hydrologic connectivity, (i.e., primary canal before secondary canal before local canal), and the geolocation of the hydrology and water quality monitoring station. For each representative reach an F-TABLE that describes the hydrology of the segment by defining the functional relationship between water depth, surface area, water volume, and outflow in the segment was created. Each F-TABLE was developed by defining characteristics for each reach including the length and slope of the reach and the channel geometry and roughness of the reach. Reach length and slope information were obtained using National Elevation Dataset (NED) and AHED elevation and reach data. Assumed channel geometry (**Figure 3**) was described by bank full width (WID), bank full depth (DEP), a bottom width factor (R1), a floodplain width factor (W1), and floodplain side slope factor (R2). Bank full width and floodplain width were measured from aerial imagery and the NED. Bank full depth, bottom width factor, and floodplain side slope factor were estimated from SFWMD canal operation guidelines and review of current and historic aerial imagery.



**Figure 3.** Schematic for F-TABLE channel cross section geometry

## 2.3 WEATHER DATA

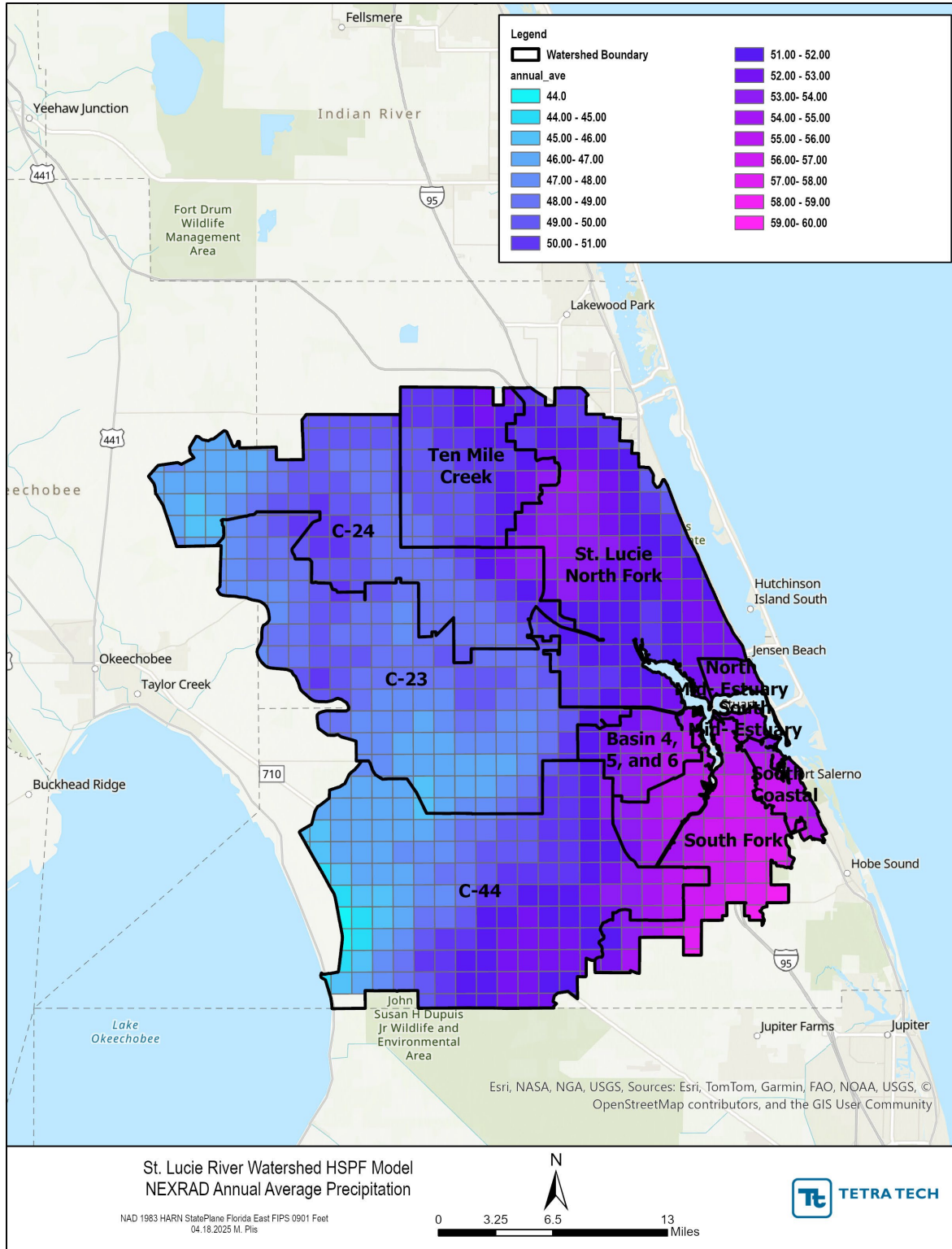
### 2.3.1 Rainmesh Weather Data

Next-Generation Radar (NEXRAD) data estimates the amount of precipitation in an area based on radar measurements from a network of stations. NEXRAD precipitation data were provided by SFWMD for the model simulation period January 01, 2008, through December 31, 2023. The precipitation data were provided at hourly time steps for 649 rainmesh cells, sized 2 kilometers by 2 kilometers, which covered the St. Lucie River and Estuary watershed. The hourly data were summed for each year, and the average annual rainfall was calculated for each cell, with maximum and minimum average annual rainfall of 60.1 inches and 44.1, respectively (**Figure 4**).

Reference evapotranspiration ( $ET_0$ ) was also provided by SFWMD in a daily time step for the model simulation period from January 1, 2008, through December 31, 2023, for the 649 rainmesh grid cells. The daily values were disaggregated to an hourly time step for input into the HSPF model. The disaggregation routine was based on the length of each day.

The NEXRAD annual average precipitation for each cell was used to develop precipitation-based weather regions in the St. Lucie River and Estuary watershed. First, the weighted annual average precipitation depth was calculated for each subbasin. Second, contiguous subbasins having similar (i.e.,  $\pm 1$  to 2 inches) weighted annual average precipitation depth were grouped together and smoothed, as necessary. Based on these groups, 13 weather regions were defined to achieve the best correspondence with the NEXRAD precipitation data (**Figure 5**).

For each weather region unique precipitation and  $ET_0$  timeseries were calculated based on the area of each NEXRAD grid cell within each weather region to develop a weighted average timeseries of the available precipitation and  $ET_0$  data for each zone. **Table 1** provides the 2008 through 2023 average annual precipitation and annual average reference evapotranspiration for each weather zone in the St. Lucie River and Estuary watershed HSPF model.



**Figure 4.** Annual average precipitation from NEXRAD by cell

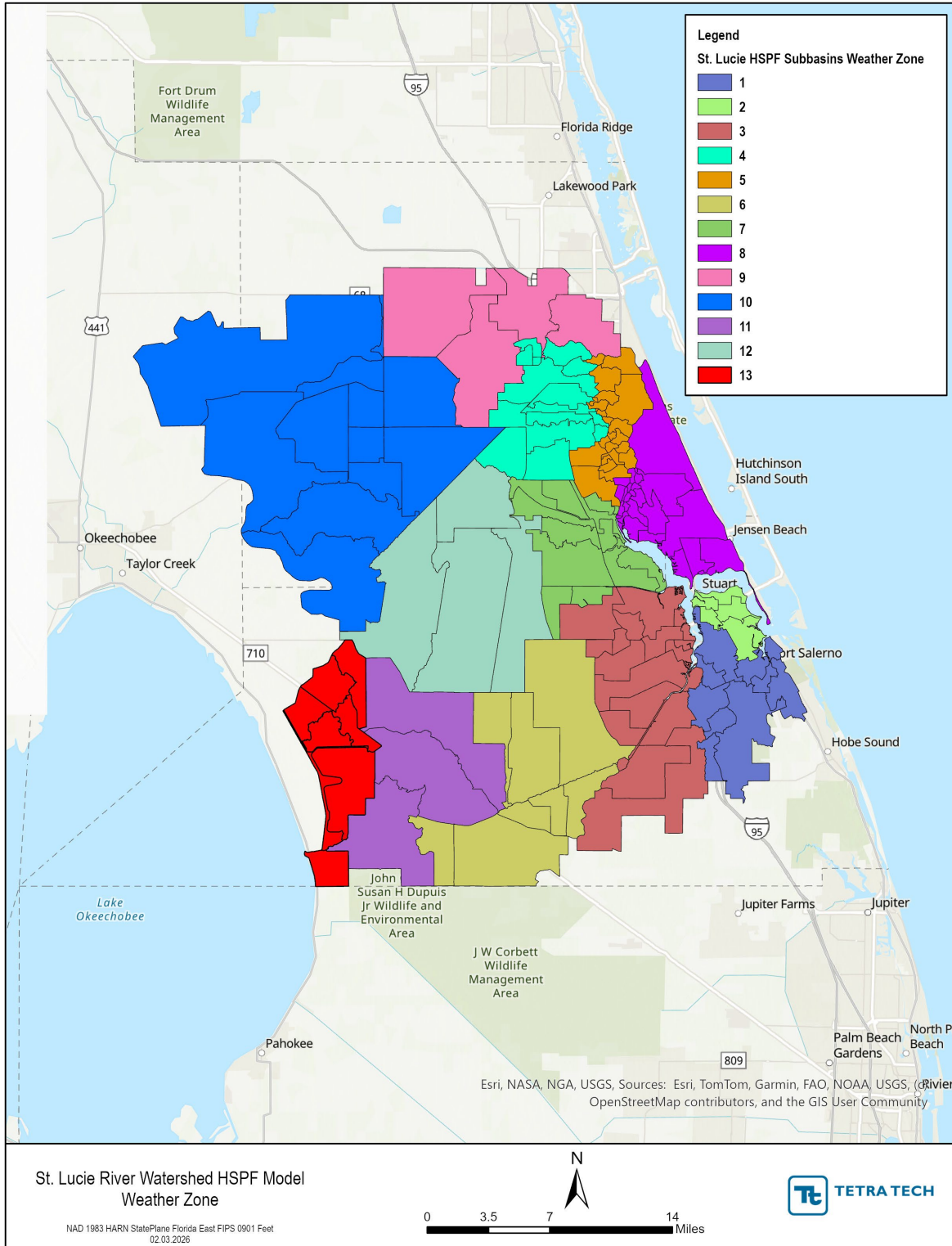


Figure 5. St. Lucie River and Estuary watershed NEXRAD weather zones

**Table 1.** NEXRAD average annual rainfall total (inches) for each weather region in the St. Lucie River and Estuary watershed

Weather Zone	Average Annual Precipitation (in)	Average Annual Reference Evapotranspiration (in)
NEXRAD1	57.1	56.0
NEXRAD2	55.4	57.3
NEXRAD3	55.1	55.2
NEXRAD4	53.8	55.1
NEXRAD5	52.2	56.0
NEXRAD6	52	55.2
NEXRAD7	51.7	55.3
NEXRAD8	52.5	56.9
NEXRAD9	51.5	54.7
NEXRAD10	49.1	54.6
NEXRAD11	48.9	55.5
NEXRAD12	48.6	54.9
NEXRAD13	46.3	57.0

### 2.3.2 Ground-Based Data

A web subscription to the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI)–Local Climatological Data (LCD) was used to obtain Surface Airways (SA) data (NOAA NCEI QCLCD, 2024). SA stations have multiple station ID labels, and the stations are referred to by their five-character Weather Bureau Army Navy Identification (WBAN ID). The international airport located in Fort Pierce in St. Lucie County (WBAN 12895) (**Figure 6**) was selected for air temperature, dew point temperature, wind speed, cloud cover, and solar radiation timeseries development.

Hourly air temperature, dew point temperature, and wind speed observations collected from 2008 through 2023 were reviewed for outliers, missing, or impaired data, and were subsequently repaired. The repairs were performed by averaging the before and after values when data were missing for a short period (less than or equal to three hours), and if a missing period was longer (greater than four hours missing), the timeseries was completed by inserting the unimpaired record from a previous period.

Cloud cover was estimated from the sky condition observations (a verbal description of the cloud cover). Data from the LCD dataset provided cloud cover information as abbreviations presented in **Table 2**. The numerical assignments for the model input listed in the table were used to create a timeseries. The data collected during 2008 through 2023 were reviewed for outliers, missing, or impaired data, and were subsequently repaired. The repairs were performed by averaging the before and after numerical assignments when data were missing for a short period (less than or equal to three hours), or if a missing period was longer (greater than four hours), the timeseries was completed by inserting the unimpaired record from two nearby observation stations, WBAN 92815: Stuart Witham Field Airport, and WBAN 12843: Vero Beach International Airport.

**Table 2.** Numerical cloud cover assignments for model input

Description	Abbreviations	National Weather Service Suggested Numerical Range (Eights)	Numerical Assignments for Model Input (Tenths)
Clear Sky	CLR	0	0.00
Few	FEW	1–2	1.25
Scattered	SCT	3–4	4.38
Broken	BKN	5–7	7.50
Variable	VV	8	10.00
Overcast	OVC	8	10.00

Solar radiation was computed using cloud cover and latitude of the station. The CE-QUAL-W2 method in the Meteorological Data Analysis and Preparation Tool (MetADAPT), developed by Tetra Tech (Tetra Tech, 2007) was used to compute the solar radiation using sun angle relationships and shading from the cloud cover (Cole, 2003).

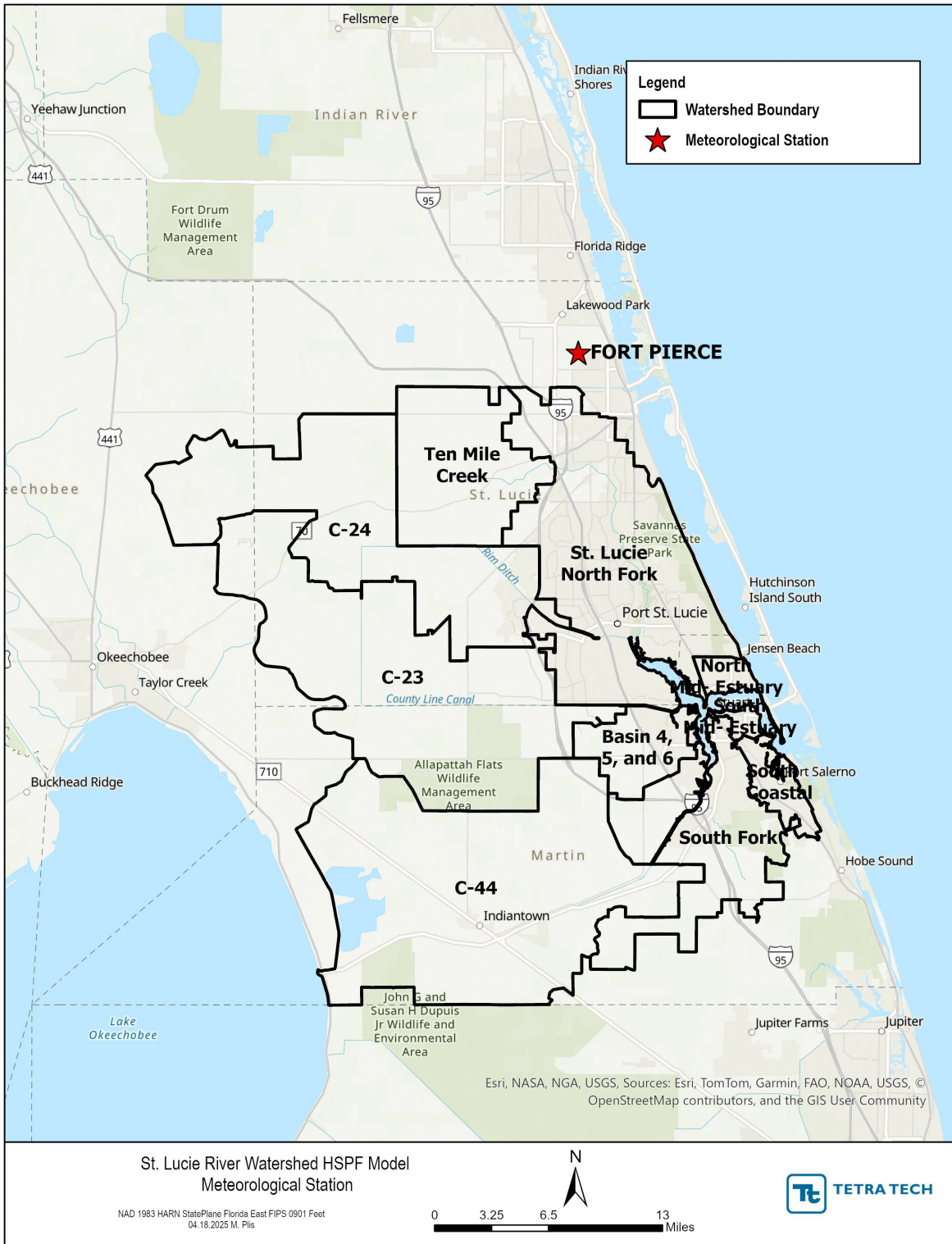


Figure 6. Weather station WBAN 12895 at Fort Pierce International Airport

## 2.4 LAND USE COVERAGE

### 2.4.1 Land Use and Land Cover (LULC)

Tetra Tech downloaded the publicly available LULC 2020–2023 DEP Statewide Land Use Land Cover (DEP, 2025) and 2023 National Land Cover Dataset (NLCD) shapefile coverage for impervious land uses (MRLC, 2023) . Tetra Tech received Florida Statewide Agricultural Irrigation Demand (FSAID)12 directly from the Florida Department of Agriculture and Consumer Services (FDACS) that included updated agricultural land uses. The Florida Department of Transportation (FDOT) provided a shapefile coverage of their roads and rights-of-way (ROW). Tetra Tech combined all four coverages to develop LULC for the St. Lucie River and Estuary HSPF model. Also, for regional projects represented in the HSPF model (**Section 2.9**), the classifications were updated to “water” for storage projects and “wetland” for water quality treatment projects.

Tetra Tech reduced the total number of land use classifications represented in the models by grouping similar land uses (i.e., all SFWMD 1100 level land use classifications were grouped together as Low Density Residential), following the approach used in the Caloosahatchee River and Estuary model (**Table 3**) and FDACS cross walked agricultural land uses to the established numeric land use codes (**Table 4**) for the FSAID12 coverage. A total of 18 separate pervious land uses were identified in the watershed (**Figure 7** and **Table 5**). The reduced land use classifications will be used to assign runoff and nutrient loads. The 18 classifications provide sufficient detail to appropriately capture the watershed characteristics to accurately apportion nutrient loads and calibrate the models. The 18 classifications include seven groups for urban/built up, seven groups for agriculture, and four groups for natural areas.

**Table 3.** DEP statewide land use reduced group reclassification

Code	Description	Numeric Land Use Code	Numeric Land Use Code Description
1100	Residential, Low Density	1	Low Density Residential
1110	Fixed Single Family Units	1	Low Density Residential
1120	Mobile Home Units	1	Low Density Residential
1130	Mixed Units	1	Low Density Residential
1180	Rural Residential	1	Low Density Residential
1190	Low Density Under Construction	1	Low Density Residential
1210	Fixed Single Family Units	2	Medium Density Residential
1220	Mobile Home Units	2	Medium Density Residential
1230	Mixed Units	2	Medium Density Residential
1290	Medium Density Under Construction	2	Medium Density Residential
1300	Residential, High Density	3	High Density Residential
1310	Fixed Single Family Units	3	High Density Residential
1320	Mobile Home Units	3	High Density Residential
1330	Multiple Dwelling Units, Low Rise	3	High Density Residential
1340	Multiple Dwelling Units, High Rise	3	High Density Residential
1350	Mixed Units	3	High Density Residential
1390	High Density Under Construction	3	High Density Residential

Code	Description	Numeric Land Use Code	Numeric Land Use Code Description
1400	Commercial and Services	4	Commercial / Institutional / Transportation
1411	Shopping Centers	4	Commercial / Institutional / Transportation
1423	Wholesale Sales & Services-Junk Yards	4	Commercial / Institutional / Transportation
1460	Oil and Gas Storage	4	Commercial / Institutional / Transportation
1490	Commercial and Services Under Construction	4	Commercial / Institutional / Transportation
1700	Institutional	4	Commercial / Institutional / Transportation
1710	Educational Facilities	4	Commercial / Institutional / Transportation
1730	Military	4	Commercial / Institutional / Transportation
1760	Correctional	4	Commercial / Institutional / Transportation
1830	Race Tracks	4	Commercial / Institutional / Transportation
1850	Parks and Zoos	4	Commercial / Institutional / Transportation
1860	Community Recreation Facilities	4	Commercial / Institutional / Transportation
1870	Stadiums	4	Commercial / Institutional / Transportation
1890	Other Recreational Facilities	4	Commercial / Institutional / Transportation
1500	Industrial	6	Industrial / Extractive
1540	Oil and Gas Processing	6	Industrial / Extractive
1550	Other Light Industry	6	Industrial / Extractive
1560	Other Heavy Industry	6	Industrial / Extractive
1600	Extractive	6	Industrial / Extractive
1610	Strip Mines	6	Industrial / Extractive
1620	Sand and Gravel Pits	6	Industrial / Extractive
1630	Rock Quarries	6	Industrial / Extractive
1640	Oil and Gas Fields	6	Industrial / Extractive
1650	Reclaimed Lands	6	Industrial / Extractive
1660	Holding Ponds	6	Industrial / Extractive
1670	Abandoned Mining Lands	6	Industrial / Extractive
7420	Borrow Areas	6	Industrial / Extractive
7430	Spoil Areas	6	Industrial / Extractive
8100	Transportation	6	Industrial / Extractive
8110	Airports	6	Industrial / Extractive
8113	Private Airports	6	Industrial / Extractive
8120	Railroads and Railyards	6	Industrial / Extractive
8140	Roads and Highways	6	Industrial / Extractive
8150	Port Facilities	6	Industrial / Extractive
8180	Auto Parking Facilities	6	Industrial / Extractive
8200	Communications	6	Industrial / Extractive

Code	Description	Numeric Land Use Code	Numeric Land Use Code Description
8300	Utilities	6	Industrial / Extractive
8310	Electrical Power Facilities	6	Industrial / Extractive
8311	Solar Power Farms	6	Industrial / Extractive
8330	Water Supply Plants	6	Industrial / Extractive
8340	Sewage Treatment	6	Industrial / Extractive
8350	Solid Waste Disposal	6	Industrial / Extractive
8360	Other Treatment Ponds	6	Industrial / Extractive
8370	Transportation, Communication and Utilities – Miscellaneous	6	Industrial / Extractive
1480	Cemeteries	7	Developed Open Space / Disturbed
1800	Recreational	7	Developed Open Space / Disturbed
1810	Swimming Beach	7	Developed Open Space / Disturbed
1820	Golf Course	7	Developed Open Space / Disturbed
1900	Open Land	7	Developed Open Space / Disturbed
1920	Inactive Land	7	Developed Open Space / Disturbed
7200	Sand Other Than Beaches	7	Developed Open Space / Disturbed
7300	Exposed Rock	7	Developed Open Space / Disturbed
7400	Disturbed Land	7	Developed Open Space / Disturbed
7470	Dikes and Levees	7	Developed Open Space / Disturbed
8115	Grass Airports	7	Developed Open Space / Disturbed
8320	Electrical Power Transmission Lines	7	Developed Open Space / Disturbed
2156	Sugar Cane	8	Sugar Cane
2100	Cropland and Pastureland	9	Row and Field Crops
2140	Row Crops	9	Row and Field Crops
2150	Field Crops	9	Row and Field Crops
2160	Mixed Cane	9	Row and Field Crops
2400	Nurseries and Vineyard	10	Nurseries, Ornamentals, and Vineyards
2410	Tree Nurseries	10	Nurseries, Ornamentals, and Vineyards
2420	Sod Farms	10	Nurseries, Ornamentals, and Vineyards
2430	Ornamentals	10	Nurseries, Ornamentals, and Vineyards
2200	Tree Crops	11	Citrus Groves / Other Groves
2210	Citrus Groves	11	Citrus Groves / Other Groves
2230	Other Groves	11	Citrus Groves / Other Groves
2110	Improved Pastures	12	Improved Pasture
2300	Feeding Operations	12	Improved Pasture
2310	Cattle Feed Operations	12	Improved Pasture
2320	Poultry Feeding Operations	12	Improved Pasture

Code	Description	Numeric Land Use Code	Numeric Land Use Code Description
2500	Specialty Farms	12	Improved Pasture
2510	Horse Farms	12	Improved Pasture
2520	Dairies	12	Improved Pasture
2540	Aquaculture	12	Improved Pasture
2120	Unimproved Pastures	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
2130	Woodland Pastures	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
2600	Other Open Lands	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3100	Herbaceous (Dry Prairie)	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3200	Upland Shrub and Brushland	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3210	Palmetto Prairies	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3220	Coastal Shrub	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3230	Abandoned Groves	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
3300	Mixed Rangeland	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
4100	Upland Coniferous Forests	14	Upland Forests
4110	Pine Flatwoods	14	Upland Forests
4120	Longleaf Pine-Xeric Oak	14	Upland Forests
4130	Sand Pine	14	Upland Forests
4140	Pine-Mesic Oak	14	Upland Forests
4200	Upland Hardwood Forests	14	Upland Forests
4210	Xeric Oak	14	Upland Forests
4220	Brazilian Pepper	14	Upland Forests
4240	Melaleuca	14	Upland Forests
4270	Live Oak	14	Upland Forests
4271	Oak-Cabbage Palm Forests	14	Upland Forests
4280	Cabbage Palm	14	Upland Forests
4300	Upland Mixed Forests	14	Upland Forests
4340	Upland Mixed Coniferous/Hardwood	14	Upland Forests
4370	Australian Pine	14	Upland Forests
4400	Tree Plantation	14	Upland Forests
4410	Coniferous Plantations	14	Upland Forests
4420	Hardwood Plantations	14	Upland Forests
4430	Forest Regeneration Areas	14	Upland Forests
1840	Marinas and Fish Camps	15	Wetlands
6100	Wetland Hardwood Forest	15	Wetlands
6110	Bay Swamps	15	Wetlands
6111	Bayhead	15	Wetlands
6120	Mangrove Swamp	15	Wetlands

Code	Description	Numeric Land Use Code	Numeric Land Use Code Description
6150	Stream and Lake Swamps (bottomland)	15	Wetlands
6170	Mixed Wetland Hardwood	15	Wetlands
6172	Mixed Shrubs	15	Wetlands
6180	Cabbage Palm Wetland	15	Wetlands
6191	Wet Melaleuca	15	Wetlands
6200	Wetland Coniferous Forests	15	Wetlands
6210	Cypress	15	Wetlands
6215	Cypress-Domes/Heads	15	Wetlands
6216	Cypress-Mixed Hardwoods	15	Wetlands
6240	Cypress-Pine-Cabbage Palm	15	Wetlands
6250	Wet Pinelands Hydric Pine	15	Wetlands
6260	Pine Savannah	15	Wetlands
6300	Wetland Forested Mixed	15	Wetlands
6400	Vegetated Non-Forested Wetlands	15	Wetlands
6410	Freshwater Marshes	15	Wetlands
6411	Freshwater Marshes-Sawgrass	15	Wetlands
6420	Saltwater Marshes	15	Wetlands
6430	Wet Prairie	15	Wetlands
6440	Emergent Aquatic Vegetation	15	Wetlands
6460	Mixed Scrub-shrub Wetland	15	Wetlands
6500	Non-vegetated Wetland	15	Wetlands
6510	Tidal Flats	15	Wetlands
6530	Intermittent Ponds	15	Wetlands
5110	Natural River, Stream, Waterway	16	Water
5120	Channelized Waterways, Canals	16	Water
5200	Lake	16	Water
5300	Reservoirs	16	Water
5410	Embayment Opening to Gulf	16	Water
5420	Embayment Not Opening to Gulf	16	Water
5430	Saltwater Ponds	16	Water
5600	Slough Waters	16	Water
5710	Atlanta Ocean	16	Water
5720	Gulf of Mexico	16	Water
2240	Abandoned Groves	18	Agriculture Fallow
2610	Fallow Cropland	18	Agriculture Fallow

**Table 4.** FDACS land use reduced group reclassification

Crop	Numeric Land Use Code	Numeric Land Use Code Description
Sugarcane	8	Sugar Cane
Bahiagrass	9	Row and Field Crops
Beans, Peas	9	Row and Field Crops
Bermudagrass	9	Row and Field Crops
Blueberries	9	Row and Field Crops
Cabbage	9	Row and Field Crops
Caladium	e	Row and Field Crops
Cantaloupe	9	Row and Field Crops
Corn	9	Row and Field Crops
Corn, Potatoes	9	Row and Field Crops
Corn, Sorghum, Rye	9	Row and Field Crops
Corn Silage	9	Row and Field Crops
Cropland, Pastureland	9	Row and Field Crops
Dry Beans	9	Row and Field Crops
Field Corn	9	Row and Field Crops
Field Crops	9	Row and Field Crops
Greens	9	Row and Field Crops
Hay	9	Row and Field Crops
Melons	9	Row and Field Crops
Mixed Crops	9	Row and Field Crops
Oats	9	Row and Field Crops
Pasture	9	Row and Field Crops
Peanuts	9	Row and Field Crops
Peppers	9	Row and Field Crops
Perennial Peanuts	9	Row and Field Crops
Potatoes	9	Row and Field Crops
Potatoes, Watermelon	9	Row and Field Crops
Radish, Lettuce	9	Row and Field Crops
Radish	9	Row and Field Crops
Row Crops	9	Row and Field Crops
Small Vegetable	9	Row and Field Crops
Small Vegetable, Tomatoes	9	Row and Field Crops
Small Vegetable Fall, Small Vegetable Spring	9	Row and Field Crops
Strawberries, Tomatoes	9	Row and Field Crops
Sweet Corn	9	Row and Field Crops

Crop	Numeric Land Use Code	Numeric Land Use Code Description
Tomatoes	9	Row and Field Crops
Vegetables	9	Row and Field Crops
Watermelon	9	Row and Field Crops
Bamboo	10	Nurseries, Ornamentals, and Vineyards
Container Nursery	10	Nurseries, Ornamentals, and Vineyards
Field Nursery	10	Nurseries, Ornamentals, and Vineyards
Grapes	10	Nurseries, Ornamentals, and Vineyards
Greenhouse Nursery	10	Nurseries, Ornamentals, and Vineyards
Nursery	10	Nurseries, Ornamentals, and Vineyards
Ornamentals	10	Nurseries, Ornamentals, and Vineyards
Palm Nursery	10	Nurseries, Ornamentals, and Vineyards
Sod	10	Nurseries, Ornamentals, and Vineyards
Tree Nurseries	10	Nurseries, Ornamentals, and Vineyards
Tropical Fruit	10	Nurseries, Ornamentals, and Vineyards
Citrus	11	Citrus Groves / Other Groves
Lemons	11	Citrus Groves / Other Groves
Longan	11	Citrus Groves / Other Groves
Lychee	11	Citrus Groves / Other Groves
Macadamia	11	Citrus Groves / Other Groves
Mangos	11	Citrus Groves / Other Groves
Other Groves	11	Citrus Groves / Other Groves
Peaches	11	Citrus Groves / Other Groves
Pongamia	11	Citrus Groves / Other Groves
Tropical Fruit	11	Citrus Groves / Other Groves
Aquaculture	12	Improved Pasture
Cattle Feeding Operations	12	Improved Pasture
Cropland, Pastureland	12	Improved Pasture
Dairy	12	Improved Pasture
Gator Farm	12	Improved Pasture
Grass Pasture	12	Improved Pasture
Horse Farms	12	Improved Pasture
Improved Pastures	12	Improved Pasture
Livestock	12	Improved Pasture
Poultry	12	Improved Pasture
Poultry, Bees, Tropical Fish	12	Improved Pasture
Poultry Feeding Operations	12	Improved Pasture
Specialty Farms	12	Improved Pasture

Crop	Numeric Land Use Code	Numeric Land Use Code Description
Tropical Fish Farms	12	Improved Pasture
Wildlife Strip Crops	12	Improved Pasture
Brushland, Shrub	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Cropland, Pastureland	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Herbaceous (Dry Prairie)	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Open Lands	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Rangeland	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Tropical Fruit	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Unimproved Pastures	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Woodland Pastures	13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub
Cotton	15	Wetlands
Cropland, Pastureland	15	Wetlands
Seasonal Grazing	17	Agriculture Wetland
Fallow	18	Agriculture Fallow
Fallow Aquaculture	18	Agriculture Fallow
Fallow Avocados	18	Agriculture Fallow
Fallow Blueberries	18	Agriculture Fallow
Fallow Cabbage Palms	18	Agriculture Fallow
Fallow Caladium	18	Agriculture Fallow
Fallow Citrus	18	Agriculture Fallow
Fallow Container Nursery	18	Agriculture Fallow
Fallow Field Corn	18	Agriculture Fallow
Fallow Field Nursery	18	Agriculture Fallow
Fallow Grapes	18	Agriculture Fallow
Fallow Greenhouse Nursery	18	Agriculture Fallow
Fallow Hay	18	Agriculture Fallow
Fallow Horse Farms	18	Agriculture Fallow
Fallow Mangos	18	Agriculture Fallow
Fallow Melons	18	Agriculture Fallow
Fallow Melons, Tomatoes	18	Agriculture Fallow
Fallow Melons, Zucchini	18	Agriculture Fallow
Fallow Nurseries, Vineyards	18	Agriculture Fallow
Fallow Nursery	18	Agriculture Fallow
Fallow Ornamentals	18	Agriculture Fallow
Fallow Palm Nursery	18	Agriculture Fallow
Fallow Peaches	18	Agriculture Fallow
Fallow Potatoes	18	Agriculture Fallow

Crop	Numeric Land Use Code	Numeric Land Use Code Description
Fallow Small Vegetable	18	Agriculture Fallow
Fallow Small Vegetable Fall, Small Vegetable Spring	18	Agriculture Fallow
Fallow Sod	18	Agriculture Fallow
Fallow Sorghum	18	Agriculture Fallow
Fallow Sugarcane	18	Agriculture Fallow
Fallow Sweet Corn	18	Agriculture Fallow
Fallow Tomatoes	18	Agriculture Fallow
Fallow Tree Crops	18	Agriculture Fallow
Fallow Tree Nurseries	18	Agriculture Fallow
Fallow Tropical Fruit	18	Agriculture Fallow
Fallow Vegetables	18	Agriculture Fallow
Fallow Watermelon	18	Agriculture Fallow
Fallow Woodland Pastures	18	Agriculture Fallow

## 2.4.2 Land Use Processing

The land use processing was completed by combining the 2020–2023 SFWMD Statewide geographic information system (GIS) coverage, FDACS FSAID 12 coverage, and FDOT ROW coverage using GIS clipping and intersecting techniques. The SFWMD land use is a complete coverage of the watershed whereas FDACS FSAID 12 and FDOT ROW coverages cover only portions of the watershed. Where the FDACS FSAID 12 and FDOT ROW coverages exist, Tetra Tech used that information to replace the land use type contained in the SFWMD coverage.

The resulting SFWMD, FSAID, and FDOT combined processed land use coverage was then intersected with the 2023 NLCD impervious coverage to determine the total impervious area in the watershed. The impervious areas were classified into seven impervious land use classifications, and impervious areas associated with similar land uses were grouped together. Impervious areas associated with Low Density Residential and Developed Open Space/Disturbed land uses were combined into the Low Density Residential (Impervious) classification. Impervious areas associated with Sugar Cane, Row and Field Crops, Nurseries / Ornamentals / Vineyards, Citrus Groves / Other Groves, Improved Pasture, and Rangeland / Unimproved Pasture / Woodland Pasture / Shrub, and Agricultural Fallow land uses were combined into the Agricultural (Impervious) classification. Impervious areas associated with Upland Forests, Wetlands, Water, and Seasonal grazing/Agricultural Wetland land uses were combined into the Other (Impervious) classification (**Table 5**).

In low and medium density development areas, the effective impervious area (EIA) is the percentage of the mapped impervious coverage (MIA). In low and medium density areas, rooftops and other impervious areas associated with single family residential areas are not always connected to the storm sewer or piped directly to the street curb, and runoff from roads is typically directed to grass swales (Sutherland, 1995). In high density areas, most areas within a basin are directly connected to the storm sewer system. The MIA was converted to the EIA through the following equations (Sutherland, 1995):

- High Density Residential (Impervious) areas are totally connected basins where 100% of the urban area is storm-sewered with all impervious surfaces appearing to be directly connected to the system, and are calculated as:

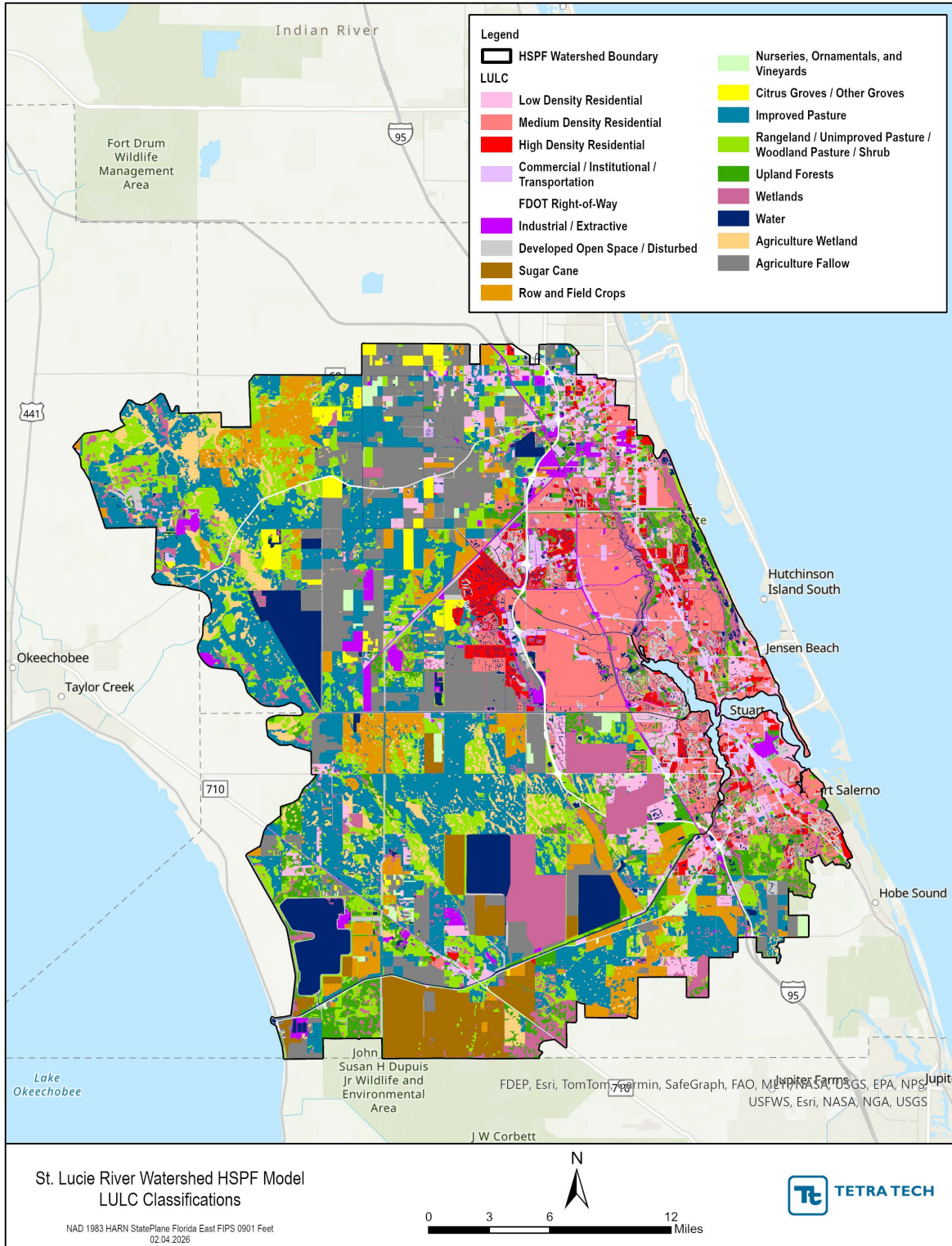
Equation:  $EIA = MIA$

- Medium Density Residential (Impervious) are highly connected basins where the local drainage collector systems for the urban areas are predominately storm sewered with curb and gutters, no dry wells or other drainage infiltration areas are known to exist, and the rooftops are predominately connected to the streets or storm sewer system, and are calculated as:

Equation:  $EIA = 0.4(MIA)^{1.2}$

- All other land uses are average basins where the local drainage collector systems for the urban areas are predominantly storm sewered with curb and gutters, no dry wells or other drainage infiltration areas are known to exist, and the rooftops in the single family residential areas are not connected to the storm sewer or piped directly to the street curb, and are calculated as:

Equation:  $EIA = 0.1(MIA)^{1.5}$



**Figure 7.** Land use classifications for the St. Lucie River and Estuary watershed

**Table 5.** Pervious land use and impervious land use classification in the St. Lucie River and Estuary watershed

HSPF Reclass Code	Description	Land Segment	Total Watershed Area (acre)	Percentage of Watershed
1	Low Density Residential (Pervious)	PERLND	19,065	3.6%
2	Developed Open Space / Disturbed (Pervious)	PERLND	13,074	2.4%
3	Medium Density Residential (Pervious)	PERLND	33,683	6.3%
4	High Density Residential (Pervious)	PERLND	7,387	1.4%
5	Commercial / Institutional / Transportation (Pervious)	PERLND	7,402	1.4%
7	FDOT Right-of-Way (Pervious)	PERLND	4,396	0.8%
6	Industrial / Extractive (Pervious)	PERLND	9,204	1.7%
8	Sugar Cane	PERLND	20,055	3.7%
9	Row and Field Crops	PERLND	33,361	6.2%
10	Nurseries, Ornamentals, and Vineyards	PERLND	4,278	0.8%
11	Citrus Groves / Other Groves	PERLND	6,945	1.3%
12	Improved Pasture	PERLND	103,230	19.3%
13	Rangeland / Unimproved Pasture / Woodland Pasture / Shrub	PERLND	58,789	11.0%
14	Upland Forests	PERLND	28,226	5.3%
15	Wetlands	PERLND	40,135	7.5%
16	Water	PERLND	32,784	6.1%
17	Agriculture Wetland	PERLND	20,249	3.8%
18	Agriculture Fallow	PERLND	56,796	10.6%
1	Low Density Residential (Impervious)	IMPLND	2,713	0.5%
2	Medium Density Residential (Impervious)	IMPLND	13,128	2.5%
3	High Density Residential (Impervious)	IMPLND	6,756	1.3%
4	Commercial / Institutional / Transportation / Industrial / Extractive (Impervious)	IMPLND	8,295	1.5%
5	FDOT Right-of-Way (Impervious)	IMPLND	1,376	0.3%
6	Agriculture (Impervious)	IMPLND	1,505	0.3%
7	Other (Impervious)	IMPLND	2,875	0.5%
-	<b>Total</b>	-	<b>535,707</b>	<b>100%</b>

## 2.5 AGRICULTURAL IRRIGATION

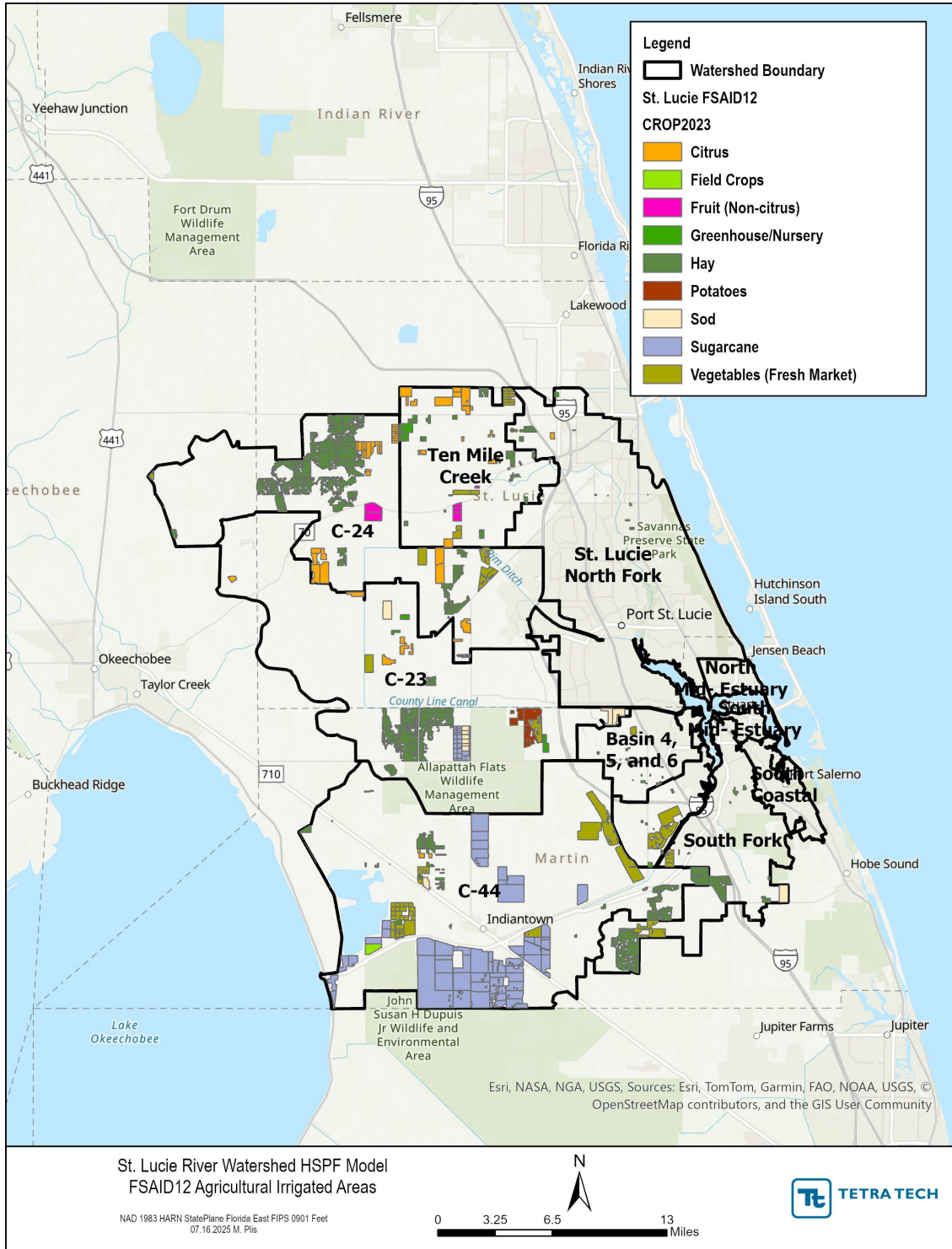
Agricultural irrigation was applied directly to the land surface in the HSPF model. The agricultural irrigation timeseries was developed using crop water demand, growth coefficients, and evapotranspiration data.

### 2.5.1 Agricultural Irrigation Area

Using FDACS’ FSAID12, the irrigated acreage of each crop category was determined for the St. Lucie River and Estuary watershed model (**Figure 8**). Crops requiring irrigation in the St. Lucie River and Estuary watershed were classified into the following five crop categories: (1) sugarcane, (2) nurseries/ornamentals/vineyards, (3) citrus groves/other groves, (4) all other crops (including blueberries, melons, peppers, small vegetables, and tomatoes), and (5) pasture. **Table 6** summarizes the total areas and irrigated areas by major crop category and growing season for 2023 from FSAID 12 geodatabase (FDACS, 2025) in the St. Lucie River and Estuary watershed.

**Table 6.** Total acreage, irrigated acreage, and growing season for the major crop categories in the St. Lucie River and Estuary watershed in 2023

Crop Category	Crop Sub-category	Growing Season	Irrigated Area (acres)
Sugar Cane	Sugar Cane	Perennial	19,908
Nurseries, Ornamentals, and Vineyards	Container Nursery	Perennial	3,708
	Field Nursery		
	Nursery		
	Ornamentals		
	Palm Nursery		
Citrus Groves / Other Groves	Citrus	Perennial	5,178
	Lemons		
Row and Field Crops	Pongamia	September - March	11,442
	Tropical Fruit		
	Corn		
	Small Vegetable		
	Tomatoes		
Pasture	Potatoes	Perennial	18,367
	Bermudagrass		
	Hay		
	Pasture		
	Improved Pasture		
<b>Total</b>	-	-	<b>58,603</b>



**Figure 8.** Spatial coverage of FSAID agricultural irrigated areas in 2023 in St. Lucie River and Estuary watershed

### 2.5.2 Agricultural Irrigation Water Demand

For each major crop category, an associated monthly crop evapotranspiration coefficient was determined using information from various sources. The SFWMD Water Use Division uses a modified Blaney-Criddle equation to determine irrigation needs (SFWMD, 2000). **Table 7** through **Table 9** show the monthly growth coefficient for perennial and annual crops. The monthly coefficients for perennial crops are based on the water needs of the plant for each growth stage throughout the year, such as bloom, fruit set, fruit development, and fruit maturation (SFWMD, 2000; SFWMD, Accessed 2025a). The coefficients for the annual crops are based on the water demand of the plant at different stages in the three- or four-month growing cycle, such as planting, initiation of flowering, maturity, and harvest (SFWMD, Accessed 2025a).

**Table 7.** Monthly growth coefficient for perennial crops

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Citrus	0.63	0.66	0.68	0.70	0.71	0.71	0.71	0.71	0.70	0.68	0.67	0.64
Sugarcane	0.39	0.30	0.53	0.61	0.70	0.79	0.79	0.84	0.73	0.88	0.72	0.69
Pasture	0.46	0.60	0.63	0.68	0.70	0.53	0.56	0.58	0.52	0.53	0.49	0.44

**Table 8.** Monthly growth coefficients for annual crops – three-month growing season

Crop	Month 1 of Growing Season	Month 2 of Growing Season	Month 3 of Growing Season
Tomatoes	0.50	0.93	0.84
Potatoes	0.54	1.18	1.32
Small Vegetables	0.54	0.81	0.62
Corn	0.57	0.99	1.03

**Table 9.** Monthly growth coefficients for annual crops – four-month growing season

Crop	Month 1 of Growing Season	Month 2 of Growing Season	Month 3 of Growing Season	Month 4 of Growing Season
Tomatoes	0.47	0.76	1.00	0.80
Potatoes	0.46	0.96	1.33	1.30
Small Vegetables	0.48	0.77	0.81	0.57
Corn	0.52	0.85	1.06	1.95

Also, the Agricultural Field-Scale Irrigation Requirements Simulation (AFSIRS) model from the St. Johns River Water Management District (SJRWMD) provided information on the irrigated and total root depths by crops, crop water use coefficients, and allowable water use depletions for perennial and annual crops **Table 10** and **Table 11** (SJRWMD, 1990; SJRWMD, 2007).

**Table 10.** Perennial crops water use coefficient (Kc) data by month from AFSIRS

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Citrus	0.70	0.70	0.70	0.80	0.88	0.97	1.05	1.05	1.05	1.05	1.05	0.80
Sugarcane	0.80	0.60	0.55	0.80	0.95	1.00	1.05	1.05	1.05	1.00	0.95	0.90
Pasture	0.65	0.70	0.75	0.90	0.90	0.95	0.95	0.95	0.90	0.80	0.70	0.65
Container nursery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Field Nursery	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sod	0.92	0.92	0.92	0.98	0.92	0.92	0.88	0.88	0.88	0.88	0.88	0.88

**Table 11.** Root zone and water use coefficient data (Kc) for annual crops from AFSIRS

Crop	Minimum Irrigated Crop Root Depth at Beginning of Growing Season (in)	Maximum Irrigated Crop Root Depth at Peak Growth Stage (in)	Kc for Root Depth at Beginning of Growing Season	Kc for Root Depth at Peak Growth Stage
Tomatoes	9	12	1.05	0.75
Potatoes	12	18	1.05	0.70
Small Vegetables	8	12	1.00	0.85
Corn	12	18	1.05	0.55

Also, the University of Florida – Institute of Food and Agricultural Science (IFAS) reported crop coefficients for perennial and annual crops that are commonly grown in Florida (Kisekka, 2013). **Table 12** and **Table 13** show the crop coefficients for the major perennial and annual crops in Florida, respectively.

**Table 12.** Typical crop coefficient (Kc) for a perennial crop (citrus) in Florida

Month	Citrus
January	0.79
February	0.86
March	0.93
April	0.97
May	1.03
June	1.05
July	1.05
August	1.03
September	1.00
October	0.95
November	0.87
December	0.79

**Table 13.** Typical crop coefficients (Kc) at various growth stages for annual crops commonly grown in Florida

Crop	Initial Stage	Mid-Stage	Late-Stage
Tomatoes	0.4	0.90	0.75
Green pepper	-	1.05	0.90
Strawberries	0.2–0.4	0.50	0.60

For sugar cane and pasture, the monthly crop evapotranspiration coefficients were determined using a monthly average of the data from FDACS and AFSIRS presented in **Table 7** and **Table 10**. For nurseries/ornamentals/vineyards/sod, the monthly crop evapotranspiration coefficients were determined from the AFSIRS data in **Table 10**. For citrus groves/other groves, the monthly evapotranspiration coefficients were determined using a monthly average of the data from FDACS, AFSIRS, and IFAS (**Table 7**, **Table 10**, and **Table 12**).

For all other crops (annual crops), the monthly crop evapotranspiration coefficients were determined using a weighted average of the various crop coefficients (corn, small vegetables, potatoes, and tomatoes) found in **Table 8**, **Table 9**, **Table 11**, and **Table 13**. Since this category includes crops with different growing seasons, only the crops growing in any specific month were used for weighing in that month. **Table 14** summarizes the monthly crop evapotranspiration rates by major crop category.

**Table 14.** Monthly crop coefficients (Kc) rate for major crop categories in the St. Lucie River and Estuary watershed model

Month	Sugar Cane	Nurseries, Ornamentals, Vineyards, and Sod	Citrus Groves/ Other Groves	All Other Crops	Pasture
January	0.60	0.96	0.77	0.76	0.56
February	0.45	0.96	0.71	0.81	0.56
March	0.54	0.96	0.74	0.75	0.65
April	0.71	0.99	0.77	0.74	0.69
May	0.83	0.96	0.82	0.00	0.79
June	0.90	0.96	0.87	0.00	0.80
July	0.92	0.94	0.91	0.00	0.74
August	0.95	0.94	0.94	0.00	0.76
September	0.89	0.94	0.93	0.60	0.77
October	0.94	0.94	0.92	0.70	0.71
November	0.84	0.94	0.89	0.80	0.67
December	0.80	0.94	0.86	0.79	0.60

The FSAID 12 geodatabase provided information on irrigated crop types, irrigation systems, and irrigated acres. Tetra Tech used the efficiency of the seven irrigation methods in the AFRIS model (SJRWMD, 2007) (**Table 15**) to calculate area-weighted irrigation efficiency for each major crop category in the St. Lucie River and Estuary watershed (**Table 16**).

**Table 15.** Irrigation efficiency for the seven irrigation methods used in the AFRIS model

Irrigation System	AFSIRS Efficiency
Center Pivot and Linear	75%
Drip	85%
Micro spray	80%
Impact Sprinkler (Spray Head Sprinkler, Sprinkler, Impact Sprinkler, and Overhead)	75%
Container Nursery	20%
Portable Gun and Traveling Gun	70%
Gravity Systems (Seepage and Flood)	50%

**Table 16.** Area-weighted irrigation efficiency for each major crop category

Crop Category	Irrigation Efficiency
Sugar Cane	50%
Nurseries, Ornamentals, and Vineyards	52%
Citrus Groves / Other Groves	77%
Row and Field Crops	58%
Pasture	51%

The irrigation application volume for each subbasin was determined using crop acreages, crop evapotranspiration timeseries, and the subbasin assigned NEXRAD zone precipitation data. Irrigation application was calculated as the difference between potential ET (in) and effective precipitation ( $P_e$ ).  $P_e$  was calculated using equation 1 and equation 2 (United States Department of Agriculture, 1993).

$$P_e = SF * (0.70917 P_t^{0.82416}) - 0.11556 * (10^{0.02426ET_c}) \tag{Equation 1}$$

$$SF = (0.531747 + 0.295164 D - 0.057697 D^2 + 0.003804 D^3) \tag{Equation 2}$$

where

$P_t$  is the monthly total precipitation (in.),

$D$  is equal to 50% of the available water capacity of the soil (in.), and

$ET_c$  is the monthly crop ET demand (calculated as  $ET_c = K_c * ET_o$  [ $K_c$  is a crop coefficient,  $ET_o$  is reference evapotranspiration provided by SFWMD])

A  $P_e$  of 0.2 inches was defined as the critical amount of rainfall that results in no irrigation on that day or the succeeding day. Available water capacity of the soil was determined on a subbasin basis using Soil Survey Geographic Database coverage for the St. Lucie River and Estuary watershed. To convert the volumetric available water capacity to a unit available water capacity, the volumetric available water capacity was multiplied by the crop root depth (**Table 17**).

**Table 17.** Area-weighted irrigation efficiency for each major crop category

Crop Category	Root Depth (inches)
Sugar Cane	36
Nurseries, Ornamentals, and Vineyards	8

Crop Category	Root Depth (inches)
Citrus Groves / Other Groves	60
Row and Field Crops	12
Pasture	24

### 2.5.3 Agricultural Irrigation Water Supply Sources

Agricultural irrigation water demands were established for the St. Lucie River and Estuary watershed HSPF model based on the methods described above. Irrigation water demand timeseries were developed for each cropland type and NEXRAD precipitation zone represented in the model (e.g., sugar cane fields in NEXRAD Zone 2), and these timeseries were input into the model at a daily time step.

In the HSPF model, water needed to satisfy the irrigation demands can be obtained from external sources (i.e., deep groundwater or neighboring watershed), model simulated shallow groundwater, or model stream reaches. However, the HSPF model has a limitation where the irrigation module allows for water to be withdrawn only from one reach in each NEXRAD zone. In addition, although water withdrawn from internal sources for irrigation removes the associated water quality loads, it does not return the associated water quality loads to the land when the irrigated water is applied.

To establish irrigation sources in the HSPF model, permitted wells and above-ground impoundments (AGIs) (**Figure 9**) in the St. Lucie River and Estuary were reviewed. The permitted wells and boreholes shapefile was downloaded from the SFWMD Geospatial Open Data portal to establish irrigation sources in the model. This dataset provides information on the source of groundwater pumping, such as the Floridan aquifer system, Upper Floridan aquifer, Surficial aquifer, and undefined aquifer. After filtering for wells and boreholes status (active and unknown) and purpose of wells (withdrawal), 50 permitted wells and boreholes were identified in the St. Lucie River and Estuary watershed (**Figure 9**). The information on pump capacity was not provided in the permitted shapefile database. Tetra Tech downloaded the AGI GIS shapefile from the SFWMD portal (SFWMD, 2018). AGIs are surrounded by a dike, and water is pumped into them for temporary storage. The dataset was filtered for agricultural land use, and out of 100 permits, 79 were agricultural permits with active permit status. However, 70 of those reported their final activity date before 2008, and the remaining nine permits reported final activity between 2008 and 2014. Tetra Tech also downloaded water use permit facilities shapefile from SFWMD Geospatial Open Data portal. This facility had information for permit number, user types (individual, general, and blank), Facility types (well, pump, culvert), land use code, pump capacity (units are unknown), pump intake, and source of water.

Because of the limited nature of available pumping data and no information pertaining to the source of irrigation water for each field, as well as the HSPF limitation where the irrigation module allows for water to be withdrawn only from one reach in each NEXRAD zone it was assumed that irrigation water demand was satisfied from an external source. This assumption removes the real-time demand on surface and groundwater resources but ensures that the calculated irrigation demands are fully satisfied. The simulated real time demands imparted by the model on surface and groundwater resources would likely not be reflective of real-world real time demands due to the highly controlled nature of water movement and water storage that are not reflected in the HSPF model.

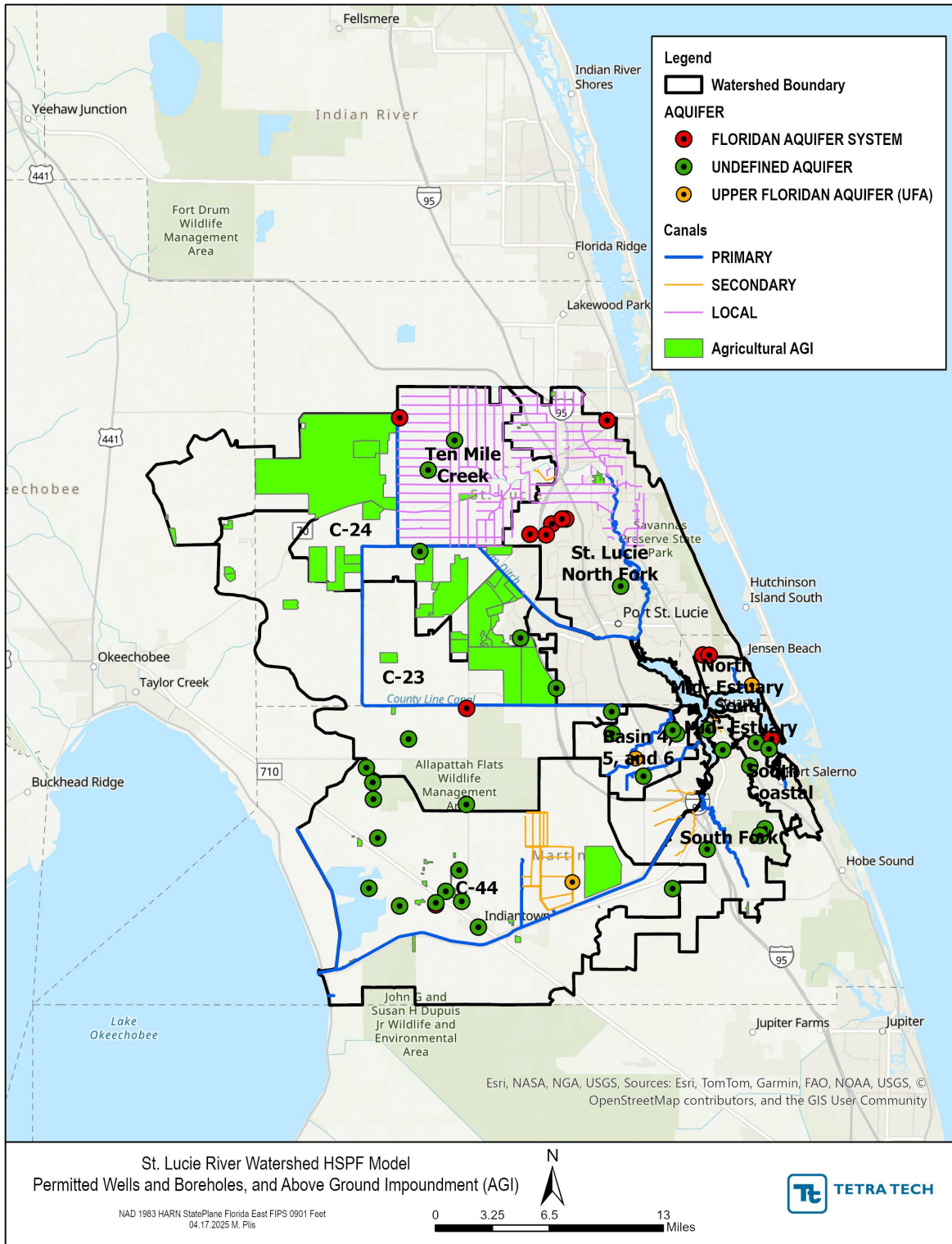


Figure 9. Spatial coverage of permitted wells and boreholes, and AGIs in the St. Lucie River and Estuary watershed

## 2.6 POINT SOURCES AND REUSE FACILITIES

DEP provided Tetra Tech with the list of 50 wastewater facilities including domestic wastewater (DW), industrial wastewater (IW), underground injection control (UIC), concrete batch plant (CBP), and concentrated feeding operation (CFO). The list was filtered for only DW and IW facilities with National Pollutant Discharge Elimination System (NPDES) permits (**Table 18**). Of the eight permitted wastewater treatment facilities (WWTFs), five had a facility status of “Active” and one was “Terminated” based on the discharge monitoring report (DMR) data provided by DEP. No DMR data were found for FL0A00067 (Indiantown MVR Biosolids Facility, LLC) and FL0A00069 (Homegrown Shrimp), as these facilities had a status of “Under Construction.”

Florida Power & Light (FPL) - Martin Power Plant (FL0030988) reported measured daily maximum flow only for three months (12/31/2012, 10/31/2013, and 12/31/2013) from monitoring location EFF-1. Also, daily maximum and monthly average flow were reported for seven months only (6/30/2012, 8/31/2012, 12/31/2012, 2/28/2013, 8/31/2013, 6/30/2014, and 10/31/2014) from monitoring location EFF-3 for that facility. Therefore, Tetra Tech did not include this facility in the HSPF model. Two other facilities, St Lucie County Solid Waste Baling and Recycle Facility (FL0041483) and FPL Indiantown Cogeneration LP (FL0183750), reported flow data and water quality observation as NOD (No Discharge). Therefore, Tetra Tech also did not include these facilities in the HSPF model. The list of NPDES facilities included in the model are summarized in **Table 19** and are shown spatial in **Figure 10**.

**Table 18.** List of permitted NPDES facilities in the St. Lucie River and Estuary watershed

NPDES Permit Number	Facility Name	Type	Facility Status	Design Capacity (million gallons per day [MGD])	Permitted Capacity (MGD)
FL0030988	FPL - Martin Power Plant	IW	A	Not applicable	Not applicable
FL0041483	St Lucie County Solid Waste Baling and Recycle Facility	IW	A	Not applicable	Not applicable
FL0043214	Martin County Utilities Tropical Farms Water Treatment Plant (WTP) and WWTF	DW	A	4.270	5.900
FL0140406	Florida Rock Industries - Fort Pierce Quarry Mine	IW	A	13.820	12.2500
FL0183750	FPL Indiantown Cogeneration LP	IW	T	Not applicable	Not applicable
FL0434698	St. Lucie County Fairgrounds WWTF	IW	A	0.013	0.0134
FL0A00067	Indiantown MVR Biosolids Facility, LLC	DW	U	Not applicable	0.2600
FL0A00069	Homegrown Shrimp	IW	U	Not applicable	Not applicable

**Table 19.** List of permitted NPDES facilities included in the St. Lucie River and Estuary watershed HSPF model

NPDES Permit Number	Facility Name	Type	Design Capacity (MGD)
FL0043214	Martin County Utilities Tropical Farms WTP and WWTF	DW	4.270
FL0140406	Florida Rock Industries - Fort Pierce Quarry Mine	IW	13.820
FL0434698	St. Lucie County Fairgrounds WWTF	IW	0.013

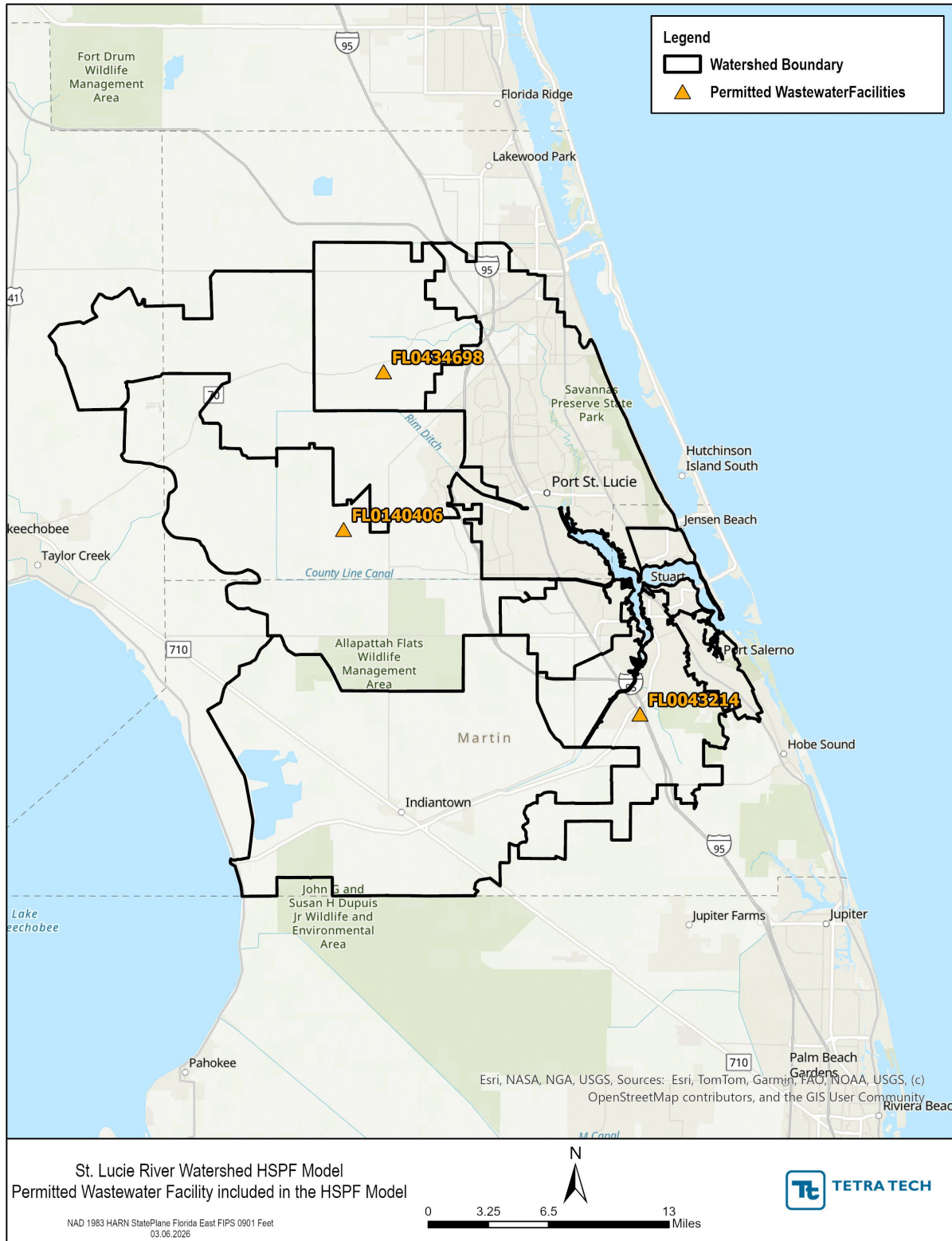


Figure 10. Spatial coverage of permitted WWTFs in the St. Lucie River and Estuary watershed HSPF model

DEP also provided Tetra Tech with the list of permits and DMR data for 15 reuse facilities in the watershed (**Table 20**).

**Table 20.** List of permitted reuse facilities in the St. Lucie River and Estuary watershed

Facility Permit Number	Facility Name	Facility Type	Permitted Capacity (MGD)
FL0027278	Fort Pierce Utility Authority WWTF	DW	10.000
FL0043214	Martin County Tropical Farms WWTF	DW	5.900
FL0139475	SLCUD South Hutchinson Island Water Reclamation Facility	DW	1.600
FLA013859	South Martin Regional WWTP	DW	1.400
FLA013881	Martin Correctional Institute WWTP	DW	0.370
FLA013940	Okeechobee Correctional WWTF	DW	0.200
FLA013969	St Lucie County Utilities Holiday Pines WWTF	DW	0.300
FLA013980	Island Dunes Country Club WWTF	DW	0.120
FLA013982	Meadowood Community Association Inc. WWTF	DW	0.105
FLA013993	St Lucie West Services District	DW	2.600
FLA041459	City of Stuart	DW	4.000
FLA029939	Village of Indiantown WWTF	DW	1.200
FLA043192	Martin County Utilities North WWTF	DW	2.760
FLA139653	Port St Lucie Utility Westport WWTF	DW	6.000
FLA326321	Port St Lucie Utilities Glades WWTF	DW	12.000

Based on the latitude and longitude and the permit information, six facilities (FL0027278, Fort Pierce Utility Authority WWTF; FL0139475, SLCUD South Hutchinson Island Water Reclamation Facility; FLA013859, South Martin Regional WWTP; FLA013969, St Lucie County Utilities Holiday Pines WWTF; FLA013980, Island Dunes Country Club WWTF; and FLA013982, Meadowood Community Association Inc. WWTF) are located outside the watershed boundary and their reuse water not applied within the watershed. The remaining nine facilities were included in the HSPF model. **Table 21** summarizes and **Figure 11** provides a spatial coverage of permitted reuse facilities in the St. Lucie River and Estuary watershed HSPF model.

**Table 21.** List of reuse facilities included in the St. Lucie River and Estuary watershed HSPF model

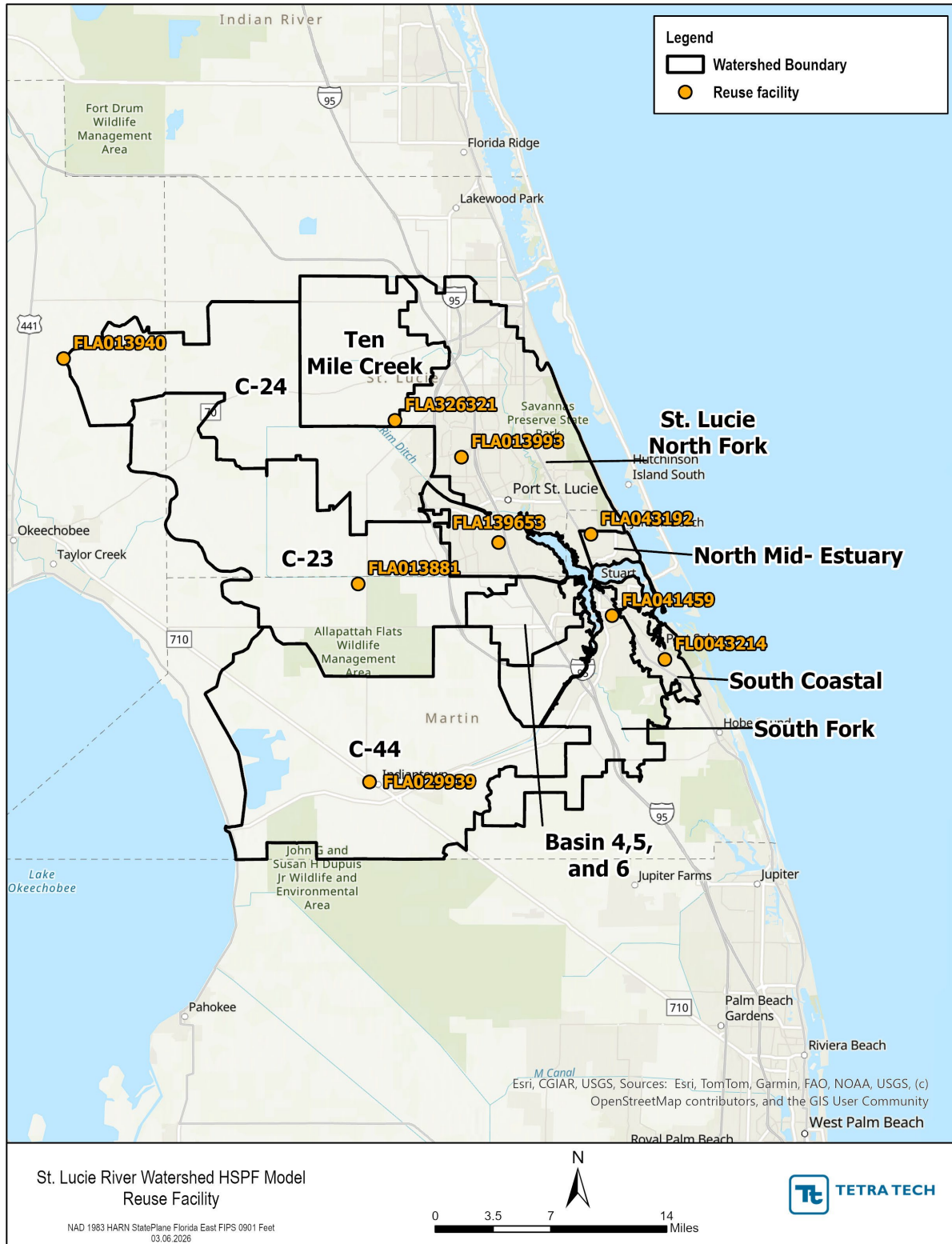
Facility Permit Number	Facility Name	Facility Type	Usage(s)	Permitted Capacity (MGD)
FL0043214	Martin County Tropical Farms WWTF	DW	Irrigation (golf courses, residences, and one park)	5.90
FLA013881	Martin Correctional Institute WWTP	DW	Toilet flushing and laundry, on a spray field or for crop irrigation	0.37
FLA013940	Okeechobee Correctional WWTF	DW	Irrigation	0.20
FLA041459	City of Stuart	DW	Irrigation	4.00

Facility Permit Number	Facility Name	Facility Type	Usage(s)	Permitted Capacity (MGD)
FLA043192	Martin County Utilities North WWTF	DW	Irrigation	2.76
FLA013993	St. Lucie West Services District	DW	Irrigation	2.60
FLA029939	Village of Indiantown WWTF	DW	Percolation ponds	1.20
FLA139653	Port St Lucie Utility Westport WWTF	DW	Irrigation and percolation ponds	6.00
FLA326321	Port St Lucie Utilities Glades WWTF	DW	Most is disposed through an on-site deep injection well. The facility is permitted for urban irrigation.	12.00

### 2.6.1 Available Data

The observed average flow and water quality results for each NPDES WWTF and reuse facility are shown in **Table 22**. The number of end of pipe flow and water quality parameter observations reported by each facility are shown in **Table 23**. For most parameters, results were reported monthly. The period of record for the available data is shown in **Table 24**. The available measured data for these facilities were used to determine the total loading from each facility. The observed data were used to fill short- and long-term gaps in the data records. For example, if a facility had TN data for ten years of the modeling period, the long-term average of the measured data was used to represent the expected TN concentration for the remaining portion of the simulation period, where data were unavailable.

Observed biochemical oxygen demand (BOD) is reported as carbonaceous BOD 5-Day (CBOD5). For the water quality setup, Tetra Tech has assumed that CBOD5 is equal to carbonaceous BOD ultimate (CBODU), which is simulated by the HSPF model. The HSPF model only has a single carbonaceous BOD (CBOD) class, and it can be used as either CBOD5 or CBODU depending, in part, on the residence time in the model. CBOD5 decay is typically faster than CBODU and more representative of conditions in smaller to medium sized watersheds, such as the St. Lucie River and Estuary watershed, and most instream data are CBOD5. CBODU is typically more representative of large, long-residence river systems, such as the Mississippi River. All other organics were classified as refractory organic in the model.



**Figure 11.** Spatial coverage of reuse facilities included in the St. Lucie River and Estuary watershed HSPF model

**Table 22.** Observed average value for available flow and water quality data for NPDES and reuse facilities

Facility Type	Permit	Flow (cubic feet per second [cfs])	Ammonia (NH <sub>3</sub> ) (milligrams per liter [mg/L])	Nitrate + Nitrite (NO <sub>x</sub> ) (mg/L)	Organic Nitrogen (OrgN) (mg/L)	TN (mg/L)	Ortho Phosphorus (PO <sub>4</sub> ) (mg/L)	Organic Phosphorus (OrgP) (mg/L)	TP (mg/L)	CBOD5 (mg/L)	Total Suspended Solids (TSS) (mg/L)	Dissolved Oxygen (DO) (mg/L)	Water Temp (WTEM) (Deg C)
NPDES	FL0030988	0.130**	0.029**	0.017**	-	0.99**	0.008**	-	0.02**	-	3.00**	7.09	27.9**
NPDES	FL0041483	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0043214	0.680	-	-	-	-	-	-	-	-	-	2.61	-
NPDES	FL0140406	7.020	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0183750	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0434698	0.003	-	-	-	1.09	-	-	0.10	6.04	-	8.47	-
NPDES	FL0A00067	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0A00069	-	-	-	-	-	-	-	-	-	-	-	-
Reuse	FL0043214	3.250	-	1.570	-	2.85	-	-	0.82	3.29	3.09**	-	-
Reuse	FLA013881	0.330	-	6.700	-	-	-	-	3.74	2.70	5.29**	-	-
Reuse	FLA013940	0.290	-	7.800**	-	17.27**	-	-	5.26**	3.89	3.59	-	-
Reuse	FLA013993	2.720	-	-	-	-	-	-	-	4.84	3.01**	-	-
Reuse	FLA029939	0.270	-	-	-	-	-	-	-	3.55†	2.95	-	-
Reuse	FLA041459	0.350	-	11.240**	-	-	-	-	2.01**	3.24	6.65**	-	-
Reuse	FLA043192	1.180	-	-	-	4.97	-	-	1.67	4.51	5.63**	-	-
Reuse	FLA139653	1.320	-	0.910**†	-	21.5**	-	-	0.75**	5.32	2.54**	-	-
Reuse	FLA326321	0.740	-	-	-	13.90	-	-	0.76	-	2.07**	-	-

\* Single sample reported in permit application.

\*\* Maximum concentrations reported in permit application.

† Three samples were reported, which were not included in the data processing.

‡ Monthly average and maximum DMR values were both processed.

- No data.

**Table 23.** Number of observations for available flow and water quality data for NPDES and reuse facilities

Facility Type	Permit	Flow (cfs)	NH <sub>3</sub> (mg/L)	NO <sub>x</sub> (mg/L)	OrgN (mg/L)	TN (mg/L)	PO <sub>4</sub> (mg/L)	OrgP (mg/L)	TP (mg/L)	CBOD5 (mg/L)	TSS (mg/L)	DO (mg/L)	WTEM (Deg C)
NPDES	FL0030988	3 (DEP)	3 (DEP)	3 (DEP)	3 (DEP)	3 (DEP)	3 (DEP)	3 (DEP)	3 (DEP)	-	3 (DEP)	3 (DEP)	3 (DEP)
NPDES	FL0041483	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0043214	27 (DEP & ECHO)	-	-	-	-	-	-	-	-	-	3 (ECHO)	
NPDES	FL0140406	105 (DEP & ECHO)	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0183750	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0434698	145 (ECHO)	-	-	-	20 (DEP & ECHO)	-	-	20 (DEP & ECHO)	10 (DEP)	-	17 (DEP)	-
NPDES	FL0A00067	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0A00069	-	-	-	-	-	-	-	-	-	-	-	-
Reuse	FL0043214	109	-	105	-	63	-	-	63	165	166	-	-
Reuse	FLA013881	157	-	137	-	-	-	-	137	167	167	-	-
Reuse	FLA013940	155	-	57	-	57	-	-	58	58	58	-	-
Reuse	FLA013993	136	-	-	-	-	-	-	-	54	188	-	-
Reuse	FLA029939	60	-	-	-	-	-	-	-	57	57	-	-
Reuse	FLA041459	144	-	144	-	-	-	-	144	149	148	-	-
Reuse	FLA043192	146	-	-	-	146	-	-	146	168	167	-	-
Reuse	FLA139653	157	-	3*	-	98	-	-	98	158	187	-	-
Reuse	FLA326321	113	-	-	-	53	-	-	-	53	80	-	-

Note: ECHO = U.S. Environmental Protection Agency’s Enforcement and Compliance History Online database.

**Table 24.** Period of record for available flow and water quality data for NPDES and reuse facilities

Facility Type	Permit	Flow (cfs)	NH <sub>3</sub> (mg/L)	NO <sub>x</sub> (mg/L)	OrgN (mg/L)	TN (mg/L)	PO <sub>4</sub> (mg/L)	OrgP (mg/L)	TP (mg/L)	CBOD5 (mg/L)	TSS (mg/L)	DO (mg/L)	WTEM (Deg C)
NPDES	FL0030988	12/31/2012, 10/31/2013, 12/31/2013	12/31/2012, 10/31/2013, 12/31/2013	12/31/2012, 10/31/2013, 12/31/2013	-	12/31/2012, 10/31/2013, 12/31/2013	12/31/2012, 10/31/2013, 12/31/2013	-	12/31/2012, 10/31/2013, 12/31/2013	-	12/31/2012, 10/31/2013,	12/31/2012, 10/31/2013, 12/31/2013	12/31/2012, 10/31/2013, 12/31/2013
NPDES	FL0041483	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0043214	9/30/2008, 10/30/2008, 6/30/2009, 8/31/2009-10/31/2009, 12/31/2009-12/31/2014	-	-	-	-	-	-	-	-	-	1/31/2008-3/31/2008	-
NPDES	FL0140406	1/31/2008-6/30/2017	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0183750	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0434698	-	-	-	-	9/30/2012, 7/31/2013, 9/30/2013, 1/31/2014, 7/31/2014, 9/30/2014, 5/31/2016, 9/30/2017, 11/30/2017, 5/31/2018, 11/30/2020, 6/30/2021-9/30/2021	-	-	9/30/2012, 7/31/2013, 9/30/2013, 1/31/2014, 7/31/2014, 9/30/2014, 5/31/2016, 9/30/2017, 11/30/2017, 5/31/2018, 11/30/2020, 6/30/2021-9/30/2021	9/30/2017, 11/30/2017, 5/31/2018, 11/30/2020, 6/30/2021-9/30/2021	-	9/30/2012, 7/31/2013, 9/30/2013, 1/31/2014, 7/31/2014, 9/30/2014, 5/31/2016, 9/30/2017, 11/30/2017, 5/31/2018, 11/30/2020, 6/30/2021-9/30/2021	-
NPDES	FL0A00067	-	-	-	-	-	-	-	-	-	-	-	-
NPDES	FL0A00069	-	-	-	-	-	-	-	-	-	-	-	-
Reuse	FL0043214	10/31/2008-11/30/2017	-	10/31/2008-5/31/2012, 12/31/2017-2/28/2023	-	12/31/2017-2/28/2023	-	-	12/31/2017-2/28/2023	8/31/2008-9/30/2022	8/31/2008-9/30/2022	-	-
Reuse	FLA013881	11/30/2010-12/31/2023	-	7/31/2011-12/31/2023	-	-	-	-	7/31/2011 - 12/31/2023	7/31/2009-12/31/2023	7/31/2009-12/31/2023	-	-

Facility Type	Permit	Flow (cfs)	NH <sub>3</sub> (mg/L)	NOx (mg/L)	OrgN (mg/L)	TN (mg/L)	PO <sub>4</sub> (mg/L)	OrgP (mg/L)	TP (mg/L)	CBOD5 (mg/L)	TSS (mg/L)	DO (mg/L)	WTEM (Deg C)
Reuse	FLA013940	12/31/2010-12/31/2023	-	1/31/2011-11/30/2015	-	1/31/2011-11/30/2015	-	-	12/31/2010-11/30/2015	12/31/2010-11/30/2015	12/31/2010-11/30/2015	-	-
Reuse	FLA013993	9/30/2012-12/31/2023	-	-	-	-	-	-	-	1/31/2008-8/31/2012	1/31/2008-12/31/2023	-	-
Reuse	FLA029939	10/31/2012-3/31/2017, 5/31/2017-6/30/2017, 8/31/2017-9/30/2017	-	-	-	-	-	-	-	10/31/2012-2/28/2017, 4/30/2017-7/31/2017	10/31/2012-2/28/2017, 4/30/2017-7/31/2017	-	-
Reuse	FLA041459	1/31/2012-12/31/2023	-	1/31/2012-12/31/2023	-	-	-	-	1/31/2012-12/31/2023	7/31/2011-12/31/2023	7/31/2011-12/31/2023	-	-
Reuse	FLA043192	11/30/2011-12/31/2023	-	-	-	11/30/2011-12/31/2023	-	-	11/30/2011-12/31/2023	1/31/2008-12/31/2021	1/31/2008-11/30/2020	-	-
Reuse	FLA139653	11/30/2010-12/31/2023	-	5/31/2009,6/30/2009, 5/31/2023	-	11/30/2015-12/31/2023	-	-	11/30/2015-12/31/2023	5/31/2009, 11/30/2010-12/31/2023	1/31/2008-12/31/2023	-	-
Reuse	FLA326321	6/30/2014-12/31/2023	-	-	-	8/31/2019-12/31/2023	-	-	8/31/2019-12/31/2023	-	3/31/2017-12/31/2023	-	-

## 2.6.2 Missing Data Assumptions

When available, measured water quality data were used to represent the NPDES and reuse facilities discharge flows and concentrations and to fill gaps in the data record. However, as shown above, measured data were not available for many parameters. Therefore, Tetra Tech identified default assumptions that were used for the NPDES facilities (**Table 25**) and reuse facilities (**Table 26**). These assumptions were based on available data from all facilities in the watershed. One of the NPDES facilities also had a corresponding reuse permit (FL0043214) and only had nutrient data for the reuse system discharge.

**Table 25.** Default assumptions for missing water quality data for NPDES facilities

Constituent	Parameter ID	Minor (<1.0 MGD)	Major (>1.0 MGD)	Rationale
Total Phosphorus	TP	2.0 mg/L	2.0 mg/L	No measured DMR data, based on average TP data from NPDES facilities
Orthophosphate	PO <sub>4</sub>	1.8 mg/L (90% of TP)	1.4 mg/L (70% of TP)	Professional recommendation
Organic Phosphorus	OrgP	0.2 mg/L (10% of TP)	0.6 mg/L (30% of TP)	Professional recommendation
Total Nitrogen	TN	1.0 mg/L (sum of species)	1.0 mg/L (sum of species)	Average of available data = 1.09 mg/L for FL0434698
Ammonia*	NH <sub>3</sub>	0.05 mg/L (5% of TN)	0.05 mg/L (5% of TN)	No measured DMR data, average percent (based on reuse facilities) of TN
Nitrate + Nitrite	NO <sub>x</sub>	0.55 mg/L (55% of TN)	0.55 mg/L (55% of TN)	No measured DMR data, average percent (based on reuse facilities) of TN
Organic Nitrogen**	OrgN	0.4 mg/L (40% of TN)	0.4 mg/L (40% of TN)	Difference between TN and (NO <sub>x</sub> + NH <sub>3</sub> )
Carbonaceous BOD5	CBOD5	6.0 mg/L	6.0 mg/L	Average of available data = 6.04 mg/L for FL0434698
Dissolved Oxygen	DO	6.0 mg/L	6.0 mg/L	Average of available data = 5.5 mg/L; range of 2.61 – 8.47 mg/L
Total Suspended Solids	TSS	4.0 mg/L	4.0 mg/L	No measured DMR data, based on average TSS data from reuse facilities
Water Temperature	WTEM	20.0 °C October through March 30.0 °C April through September	20.0 °C October through March 30.0 °C April through September	Professional recommendation

\* When both TN and NO<sub>x</sub> were available in raw data, ammonia concentrations were calculated as:  $NH_3 = 10\% \times (TN - NO_x)$

\*\* When both TN and NO<sub>x</sub> were available in raw data, organic nitrogen concentrations were calculated as:  $OrgN = 90\% \times (TN - NO_x)$

**Table 26.** Default assumptions for missing water quality data for reuse facilities

Constituent	Parameter ID	Minor (<1.0 MGD)	Major (>1.0 MGD)	Rationale
Total Phosphorus	TP	2.0 mg/L	2.0 mg/L	Average of available data = 1.8 mg/L; range of 0.75 – 3.74 mg/L
Orthophosphate	PO <sub>4</sub>	1.8 mg/L (90% of TP)	1.4 mg/L (70% of TP)	Professional recommendation
Organic Phosphorus	OrgP	0.2 mg/L (10% of TP)	0.6 mg/L (30% of TP)	Professional recommendation
Total Nitrogen	TN	12.0 mg/L (sum of species)	12.0 mg/L (sum of species)	Average of available data = 12.11 mg/L; range of 2.9 – 21.5 mg/L
Ammonia*	NH <sub>3</sub>	0.6 mg/L (5% of TN)	0.6 mg/L (5% of TN)	Average percent of TN
Nitrate + Nitrite	NO <sub>x</sub>	6.0 mg/L (55% of TN)	6.0 mg/L (55% of TN)	Average percent of TN for FL0043214
Organic Nitrogen**	OrgN	5.4 mg/L (40% of TN)	5.4 mg/L (40% of TN)	Difference between TN and (NO <sub>x</sub> + NH <sub>3</sub> )
Carbonaceous BOD5	CBOD5	4.0 mg/L	4.0 mg/L	Average of available data = 3.92 mg/L; range of 2.7 - 5.4 mg/L
Dissolved Oxygen	DO	6.0 mg/L	6.0 mg/L	Professional recommendation
Total Suspended Solids	TSS	4.0 mg/L	4.0 mg/L	Average of available data = 3.91 mg/L; range of 2.1 - 6.7 mg/L
Water Temperature	WTEM	20.0 °C October through March 30.0 °C April through September	20.0 °C October through March 30.0 °C April through September	Professional recommendation

\* When both TN and NO<sub>x</sub> were available in raw data, ammonia concentrations were calculated as:  $NH_3 = 10\% \times (TN - NO_x)$

\*\* When both TN and NO<sub>x</sub> were available in raw data, organic nitrogen concentrations were calculated as:  $OrgN = 90\% \times (TN - NO_x)$

### 2.6.3 Model Implementation

NPDES facilities were set up as direct input timeseries to RCHRES in the EXT SOURCES block in the HSPF model UCI file. The timeseries information was stored in a .WDM file as a daily average value and input into the model at an hourly time step using the in-model DIV transformation. **Table 27** identifies the mapping and ratio assumption between the .WDM file and HSPF model simulation using the same ratios as the Caloosahatchee River and Estuary model.

**Table 27.** NPDES facility constituent mapping and ratio assumption

NPDES Constituent	Parameter ID	HSPF Constituent	Ratio
Flow	Flow	Flow	1
Orthophosphate	PO <sub>4</sub>	Orthophosphate	1
Organic Phosphorus	OrgP	Organic Phosphorus	1

NPDES Constituent	Parameter ID	HSPF Constituent	Ratio
Ammonia	NH <sub>3</sub>	Total Ammonia	1
Nitrate + Nitrite	NOx	Nitrate Nitrite	90% 10%
Organic Nitrogen	OrgN	Organic Nitrogen	1
Carbonaceous BOD5	CBOD5	Carbonaceous BOD Organic Carbon	1 3
Dissolved Oxygen	DO	Dissolved Oxygen	1
Total Suspended Solids	TSS	Sand Silt Clay	10% 50% 40%
Water Temperature	WTEM	Water Temperature	1

The reuse facilities were set up as lateral input timeseries to specific pervious (PERLAND) land uses in the EXT SOURCES block in the HSPF model \*.UCI file. The timeseries information was stored in a .WDM file as a daily average value and the DIV transformation was used to input it into the model at an hourly time step. It was assumed that the Developed Open Space (Pervious) and weather region hydrologic response unit (HRU) containing the reuse facility received the application.

For a lateral input timeseries, the HSPF model required units of inches for flow and pounds/acre for pollutant mass. To transform the input data into the proper units, the PERLND ID area, along with each facility’s flow and constituent load was used to calculate the rate of flow and loading for each pollutant mass (**Table 28**). This helps to represent each facility’s flow volume and constituent load appropriately even though the application area in the model is different from the application area of the facility.

**Table 28.** Reuse facility constituent mapping

Reuse Constituent	Parameter ID	HSPF Constituent
Flow	Flow	Lateral inflow
Orthophosphate	PO <sub>4</sub>	Lateral orthophosphate
Organic Phosphorus	OrgP	Lateral organic matter
Ammonia	NH <sub>3</sub>	Lateral total ammonia
Nitrate + Nitrite	NOx	Lateral nitrate-nitrite
Organic Nitrogen	OrgN	Lateral organic matter
Carbonaceous BOD5	CBOD5	Lateral organic matter
Total Suspended Solids	TSS	Lateral sediment

## 2.7 ONSITE SEWAGE TREATMENT AND DISPOSAL SYSTEMS (OSTDS)

OSTDS, commonly referred to as septic systems, are designed to collect and treat wastewater that is eventually discharged into the surrounding soil, and this loading from OSTDS can increase nutrient loads in waterbodies. Properly functioning OSTDS do not fully remove nutrients from the wastewater supply and these nutrients leach into the local

surface and subsurface waters. Conventional OSTDS, for example, have an average nitrogen removal efficiency of 20% (Swann, 2001) and failing OSTDS can be even less efficient.

Tetra Tech will use ArcGIS-based Nutrient Load Estimation Toolbox in Python (ArcNLET-Py) to simulate the fate and transport of nutrients (TN and TP) from each OSTDS in the St. Lucie River and Estuary watershed. The ArcNLET-Py water quality loads will be aggregated to the subbasin level and incorporated into the HSPF model as static subbasin loads. Static subbasin loads will be represented in the model using the HSPF GENER module. Non-failing OSTDS inputs are loaded directly to the simulated reach. It is assumed that each OSTDS contributes 164 gallons per day (i.e., 59.5 gallons per person per day x 2.75 persons per OSTDS) to baseflow.

## 2.8 SPECIALIZED HYDROLOGIC AND HYDRAULIC REPRESENTATIONS

### 2.8.1 Lake Okeechobee Boundary Conditions

The St. Lucie River and Estuary receive flows and loads from Lake Okeechobee. Water from Lake Okeechobee is released into the St. Lucie River at the S-308 Lock, which the U.S. Army Corps of Engineers (USACE) controls. Water in the St. Lucie River also flows back into Lake Okeechobee through gravity, and this occurred 35% of the time during the data collection period for the model (January 1, 2008, through December 31, 2023). During flow-reverse events, the water flow in the St. Lucie River reverses and moves towards Lake Okeechobee.

The St. Lucie River and Estuary HSPF watershed model incorporated an upstream boundary condition at the S-308 structure, which regulates water flow and quality inputs from Lake Okeechobee into the St. Lucie River (C-44 Canal). Developing an accurate timeseries for this boundary condition is important for representing flow and nutrient contributions to the watershed model from Lake Okeechobee.

#### 2.8.1.1 Available Flow Gauges for Daily Average Flow at S-308 Lock

For the model time period of interest (January 1, 2008, through December 31, 2023), three flow gauges provided a record of daily average flow data relevant to the upstream boundary condition for the St. Lucie River (C-44 Canal):

1. ST. LUCIE RIVER BLW S-308, NR PORT MAYACA (AUX) FL (Site ID: 02276877, U.S. Geological Survey [USGS])
  - This flow gauge is located downstream of the S-308 Lock.
  - The period of record spans the full model simulation period.
  - Recorded streamflow during the simulation period range between a minimum of -3,510 cfs, indicating flow reversal to Lake Okeechobee, and a maximum of 4,680 cfs, with positive flows representing release from Lake Okeechobee to the St. Lucie River.
2. S-308 SPILLWAY AND SECTOR FLOW ON ST. LUCIE RIVER AT LAKE OKEECHOBEE (Site ID: S308\_S, USACE)
  - This station is located at the S-308 structure itself.
  - Data were available for the entire period of interest.
  - Flows recorded at this station range from a minimum of -8,665 cfs to a maximum of 5,669 cfs during the model simulation period. Negative values represent reverse flows back into Lake Okeechobee, while positive values indicate water released into the St. Lucie River.
3. ST. LUCIE RIVER ABV S-80 NR STUART FL (Site ID: 02276998, USGS)
  - Located upstream of the S-80 structure, this gauge provides data starting later in the model period, with a record from July 15, 2017, through December 31, 2023.
  - Streamflow values range from a minimum of -206 cfs to a maximum of 6,430 cfs, capturing both reverse flows and lake releases.

The primary station for the flow boundary condition development was S308\_S (USACE), with data gaps supplemented using flow records from 02276877 (USGS). The third station, 02276998 (USGS), provides valuable supporting data for the more downstream segment of the St. Lucie River starting in mid-2017. Together, these gauges provide a comprehensive coverage of flow dynamics, including periods of flow reversal and significant releases, throughout the St. Lucie River system.

A tabular summary of the three streamflow gauges evaluated for the Lake Okeechobee to St. Lucie River flow boundary condition development is provided in **Table 29**. Additionally, a map displaying the streamflow gaging stations is included in **Figure 12**.

**Table 29.** Summary of streamflow gages evaluated for the Lake Okeechobee to St. Lucie River boundary condition

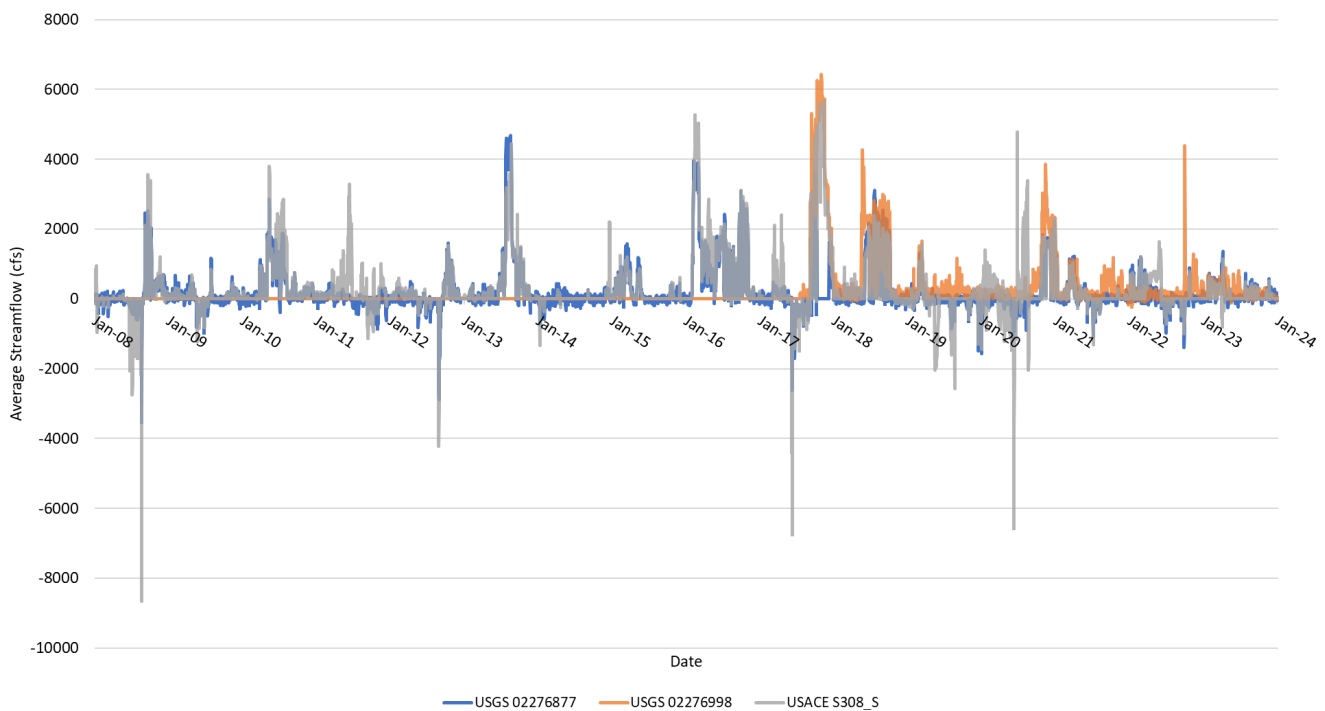
Site Description	Site ID (Org)	Start Date (Within Model Period)	End Date (Within Model Period)	Minimum Streamflow (cfs)	Minimum Positive Streamflow (cfs)	Maximum Streamflow (cfs)
ST. LUCIE RIVER BLW S-308, NR PORT MAYACA (AUX) FL	02276877 (USGS)	1/1/2008	12/31/2023	-3,510	0.01	4,680
S-308 SPILLWAY AND SECTOR FLOW ON ST. LUCIE RIVER AT LAKE OKEECHOBEE	S308_S (USACE)	1/1/2008	12/31/2023	-8,665	0.40	5,669
ST LUCIE CANAL ABV S-80 NR STUART FL	02276998 (USGS)	7/15/2017	12/31/2023	-206	0.53	6,430



### 2.8.1.2 Flow Timeseries Development

The primary source of flow data was the S308\_S station, with gaps filled using flow records from USGS 02276877 for a particular day in the timeseries where the S308\_S station lacked a flow measurement. The data were processed to provide continuity and consistency over the simulation period. Zero flow periods were validated using operational records. The final flow series was aligned temporally to match the model's daily timestep (January 1, 2008, through December 31, 2023).

Some discrepancies in flow were noted between the USACE S308\_S and USGS 02276877 measurements. Looking downstream at USGS 02276998, it appears that USACE S308\_S matches the USGS 02276998 timeseries better, although USGS 02276998 displays higher average flow overall (**Figure 13**).



**Figure 13.** Daily mean streamflow comparisons (by station of interest) near the boundary of Lake Okeechobee and St. Lucie River

### 2.8.2 G-81 Structure Transfer of Water Between the C-25 and C-24 Basins

Observed data at G81\_S/G81\_C are limited across most years of the simulation period, with no available data in 2013, 2018, and 2020. Initially, the model was setup without water transfers between the C-25 and C-24 basins. However, at station G81\_S/G81\_C, the model underestimated flow with a -97.1% error in total flow (observed: 12.93 inches/year versus simulated: 0.37 inches/year). The model showed -93.4% error in total lowest 50% flows, -96.5% error in highest 10% flows, and -96.8% error in baseflow. All seasonal flow volumes were underestimated, with summer flows showing the greatest deficit at -97.85%, fall flows underestimated by 88.41%, and spring flows by -96.82%. The Nash-Sutcliffe Efficiency (NSE) was -0.824 and the monthly NSE was -0.177, which confirmed that the model was unable to calibrate at this station because the base model configuration was missing the primary source of water entering this reach.

After introducing G-81 boundary condition timeseries, model performance improved considerably when representing the transfer of water between C-25 and C-24 basins through the G-81 structure. Simulated flows now reproduce the overall magnitude and seasonal variability of observed flows with improved agreement during moderate flows. Total flow error is reduced to 1.96% (simulated of 13.18 inches/year versus observed of 12.93 inches/year). The highest 10% of flows are reproduced with 1.96% error, and summer flows are within 1.48% of observed values. Fall flows show the estimation of 11.12%, while spring flows are near neutral at -1.96%. Total storm volumes are within -2.89% of observed, and summer storm volumes within -3.07%. Baseflow, previously underestimated by -96.8%, now shows only a 6.14% error. The NSE improved from -0.824 to 0.997 and the monthly NSE from -0.177 to 0.999, representing a near perfect agreement with observed flow conditions across all time scales and confirming that the corrective timeseries successfully captures the inter-basin transfer that was entirely absent from the base model.

### 2.8.3 Ten Mile Creek Corrective Flows

Ten Mile Creek corresponds to station GORDY\_S, which located within the Ten Mile Creek watershed. Initial attempts to calibrate this station using standard approaches were unsuccessful. Several model adjustments were tested including flow parameter modifications and drainage area adjustments, but none produced satisfactory results.

Initially at GORDY\_S, the observed runoff depth was approximately 23.78 inches/year, while the simulated runoff depth was approximately half (12.10 inches/year) of the observed value, yielding a total flow error of -49.1%, which indicates a significant volume deficit. Observed unit discharge (cfs per square mile) was substantially higher than simulated unit discharge, particularly during moderate rainfall events. For example, observed events that generate sustained unit discharges on the order of multiple cfs per square mile were simulated at significantly lower magnitudes. With the lowest half of flows underestimated by -79.44%, and baseflow underestimated by -60.44%, the model was unable to simulate the persistent low-level drainage that sustained observed baseflow between storm events. Seasonal deficits were consistent: winter flows were underestimated by -59.62%, fall flows by -52.32%, spring flows by -43.29%, and summer flows by -45.92%. The highest 10% of flows were underestimated by -21.1%, and total storm volumes by -30.05%. The model produced extended periods of near zero simulated flow, while observed flows persisted near 100 cfs, indicating extreme low-flow bias. These differences resulted in low NSE and  $R^2$  values and indicated that runoff generation and drainage efficiency within the contributing area were underrepresented.

Possible explanations for the unusual behavior of Ten Mile Creek were : (1) the presence of unaccounted groundwater contributions, which may influence baseflow conditions; (2) more irrigation water use than what was theoretically calculated; (3) seepage flows from the Ten Mile Creek Water Preserve Area; or (4) other external water inputs that may contribute additional water that is not represented in the model.

To address this issue, a corrective timeseries was developed based on the difference between observed and simulated flows. The difference between the observed and simulated daily flows was calculated for the period January 1, 2008, through December 31, 2023. The resulting timeseries was then grouped by month (January through December), and both monthly mean and median values were computed. Evaluation of the results indicated that the median values provided better representation of the missing flow component. Therefore, the monthly median values (**Table 30**) were selected to develop the corrective timeseries, which was then incorporated into the model through a WDM timeseries.

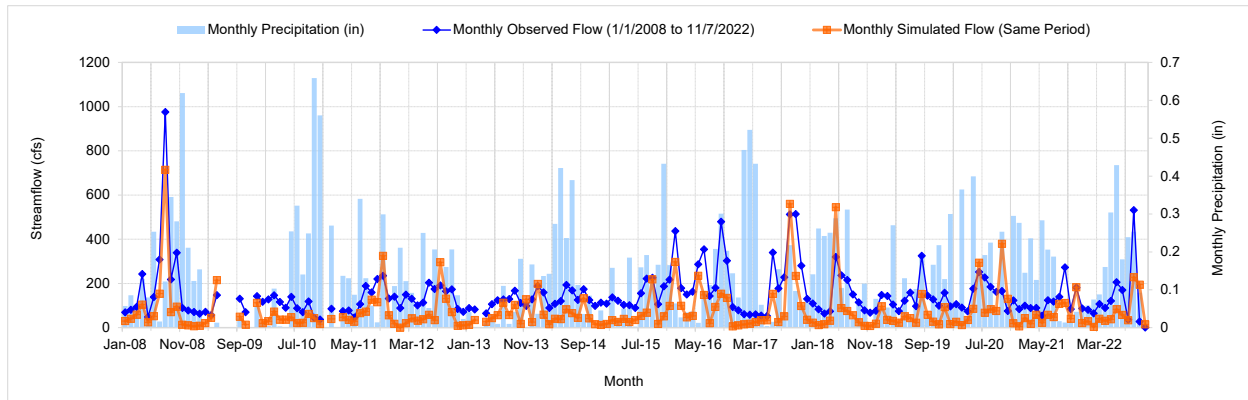
**Table 30.** Monthly Mean and Median Corrective Flows at GORDY\_S Station (Ten Mile Creek)

Month	Month #	Gordy Mean Corrective Flows (cfs)	Gordy Median Corrective Flows (cfs)
January	1	82.99	76.35
February	2	83.97	85.36
March	3	74.90	72.14
April	4	72.25	59.59
May	5	72.36	58.72
June	6	128.44	100.88
July	7	125.87	104.37
August	8	146.04	90.30
September	9	161.78	101.65
October	10	128.87	92.28
November	11	97.59	86.26
December	12	89.63	91.91

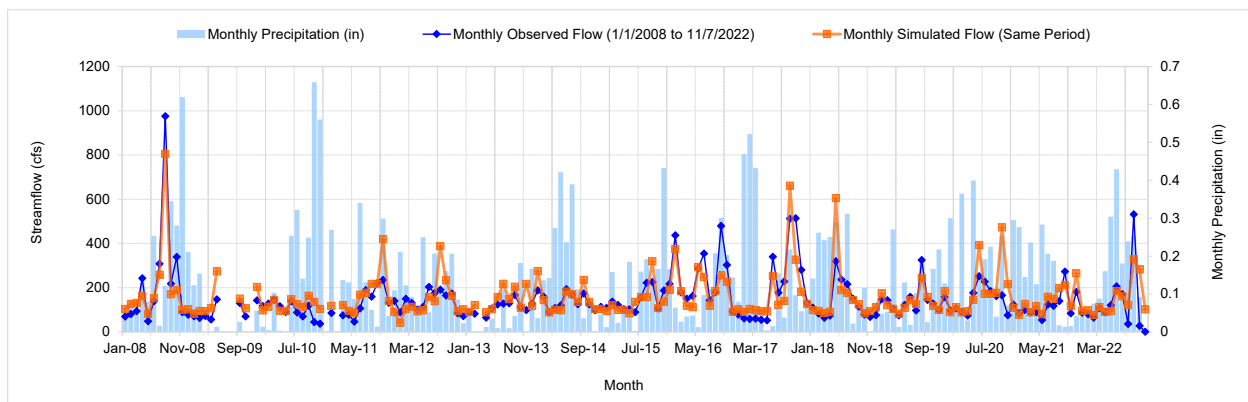
Following implementation, model performance improved markedly. Simulated flows (24.02 inches/year) closely match observed flows (23.78 inches/year), which reduced the total flow error to 1.03% and revealed a strong agreement in total flow volume. Seasonal flows became well reproduced across all periods: summer flows show only -1.28% error, fall flows to 4.17%, winter flows 0.99%, and spring flows 2.08%, which is a dramatic improvement from pre-correction deficits that ranged from -43% to -60% in these seasons. Low flows, previously most of the deficit component, improved substantially with the lowest 50% of flows now overestimated by 20.21% rather than underestimated by -79.44% that confirmed the corrective series successfully restores the missing sustained drainage contribution. Baseflow improved from -60.44% to 17.35%. The monthly NSE improved from 0.469 to 0.792, reflecting the model's improved ability to reproduce the seasonal timing and distribution of flows. In addition, the model now reproduces:

- Sustained low flow conditions, which were previously simulated as near-zero.
- Improved seasonal distribution of flows.
- More realistic event responses and unit discharge values.

**Figure 14** shows that the uncorrected model markedly underestimating both sustained low flows and many event peaks (many near-zero simulated stretches versus persistent observed flows) that produced a ~49% volume deficit and large seasonal and baseflow biases. **Figure 15** demonstrates that adding the monthly-median corrective timeseries restores a persistent, seasonally varying baseline flow and brings simulated peaks and low flows into close agreement with observations, eliminating extended dry periods and reducing total flow error to ≈1% while greatly improving monthly NSE and seasonal performance.



**Figure 14.** Mean monthly flow at GORDY\_S before applying corrective timeseries



**Figure 15.** Mean monthly flow at GORDY\_S after applying corrective timeseries

## 2.8.4 C105 Canal Corrective Flows

The C105 Canal corresponds to station SLT21\_W, which is located within the St. Lucie North Fork basin. Initial attempts to calibrate this station using standard approaches were unsuccessful. Several model adjustments were tested including flow parameter modifications and drainage area adjustments, but none produced satisfactory results.

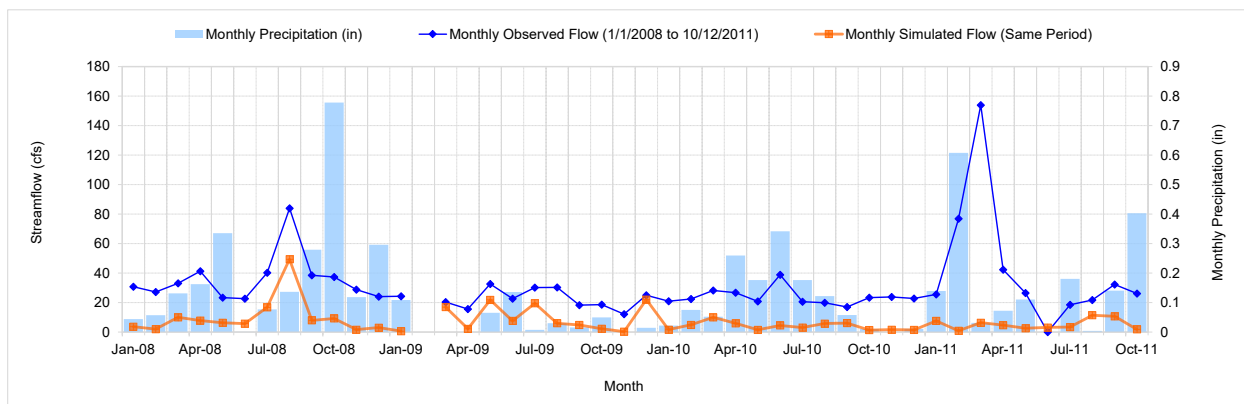
The C-105 Canal watershed (SLT21\_W) has a drainage area of approximately 3.3 square miles with observed runoff of 80.43 inches/year while simulation produced only 20.37 inches/year (-74.7% error). The observed runoff was 6.64 cfs per square mile compared to a simulated 1.68 cfs per square mile. The observed runoff substantially exceeded typical annual precipitation for this region, with observed baseflow alone (68.93 inches/year) exceeding typical annual rainfall of 50–55 inches. The model severely underestimated all flow categories. The simulated runoff was lower than comparable rural stations S49 and S97 despite this being a more urbanized watershed. The extraordinarily high observed flows suggest either: (1) additional baseflow from deep well injection of wastewater discharges were not represented in the model; (2) potential errors in observed flow measurements; or (3) unique hydrologic conditions requiring specialized model representation.

To address this issue, a corrective timeseries of a flow addition of 20 cfs was incorporated into the model through a WDM timeseries. Following this modification, model performance improved substantially. Post-correction results showed simulated flow of 69.52 inches/year that reduced the total flow error from -74.67% to -13.56%. The most improvement

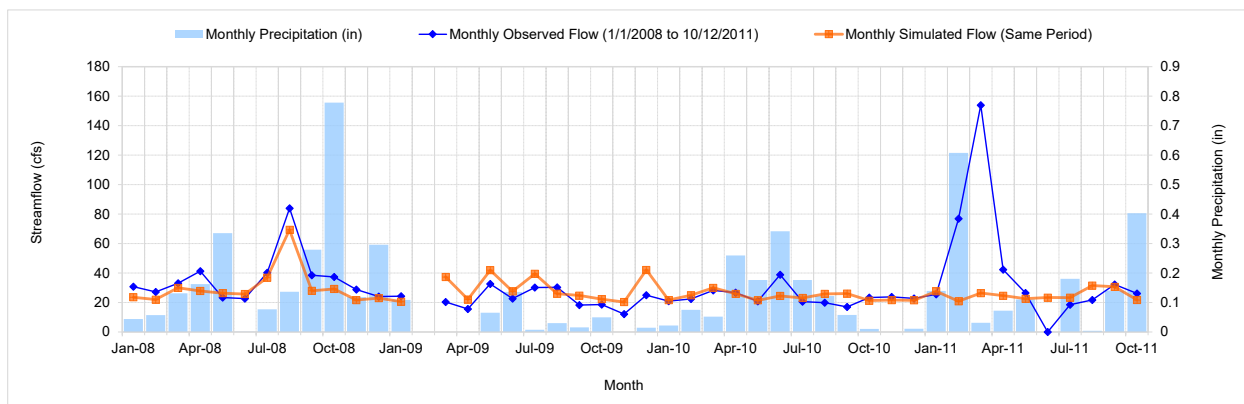
occurred in the seasonal volumes: summer flows became within 0.81% of observed values and fall flows within 2.59%. The model was able to sustain the low-level flows as the lowest 50% of flows improved from -93.78% to 8.56% that were previously absent. Baseflow improved from -86.3% to -15.19%. The NSE improved from -0.51 to 0.061 and the monthly NSE from -0.273 to 0.566.

Post-correction simulations better capture total flow volumes, seasonal variability, and general timings of discharge events. The incorporation of corrective flows significantly improved model performance which resulted in acceptable overall representation of hydrologic behavior at this station.

**Figure 16** (pre-correction) shows the uncorrected model underestimating monthly flows at the C-105 Canal (SLT21\_W): the simulated series (orange) remains very low relative to observations (blue) across nearly all months. **Figure 17** (post-correction) shows that adding the corrective flow raises the simulated baseline and peak magnitudes so simulated and observed monthly flows align much more closely. Remaining discrepancies are mainly in short, high-magnitude peaks and rapid transitions, but the correction substantially restores the missing sustained and seasonal flow components.



**Figure 16.** Mean monthly flow at SLT21\_W before correction



**Figure 17.** Mean monthly flow at SLT21\_W after correction

### 2.8.5 L65 Canal Corrective Flows

The L-65 Canal corresponds to station S153 which is located within the C-44 watershed. Initial model simulations were unable to adequately reproduce observed flows at this station. The discrepancies may be associated with restoration activities, seepage, process, or drainage area changes occurring after 2012. Prior to the introduction of a corrective timeseries, the model performance at this station was poor with flows underestimated across all flow components and seasons, with a total flow error of -58.06% (observed: 19.96 inches/year versus simulated: 8.37 inches/year). The underestimation was not isolated to a single flow regime but was consistent and systematic throughout the simulation period, indicating that the base model configuration was fundamentally missing a source of water at this location. Baseflow was underestimated by -58.54%, so the model did not sustain the low-level flows that characterize this gate-controlled reach between operational release events. The lowest 50% of flows were underestimated by -64.81%, the highest 10% of flows were underestimated by -53.91%, and the volumetric deficit spanned the range of flow conditions. Seasonal deficits were similarly pervasive: fall flows were underestimated by -70.46%, winter flows by -67.37%, summer flows by -54.12%, and spring flows by -39.33%. The model underrepresented both event-driven and sustained contributions at this station as the total storm volumes were underestimated by -56.84% and summer storm volumes by -51.45%. The NSE of 0.236 and monthly NSE of 0.361 reflected limited model skill. The observed flow pattern at S153L\_S is dominated by short-duration, discrete release pulses from the latching gate mechanism, which the continuous-simulation HSPF model cannot dynamically replicate, and the magnitude of the overall deficit points to unrepresented operational releases and hydrologic inputs as the primary cause of model underperformance. Discrepancies may also be associated with restoration activities, seepage, or drainage area changes occurring after 2012.

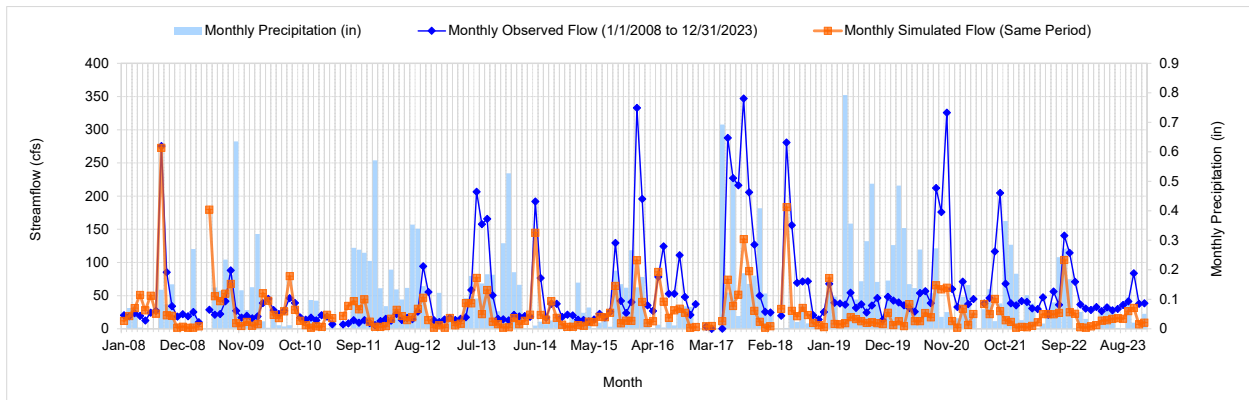
To address this issue, a corrective timeseries was developed based on the difference between observed and simulated flows. The difference between the observed and simulated daily flows was calculated for the period January 1, 2013, through December 31, 2023. The resulting timeseries was then grouped by month (January through December), and both monthly mean and median values were computed. Evaluation of the results indicated that the median values provided better representation of the missing flow component. Therefore, the monthly median values (**Table 31**) were selected to develop the corrective timeseries, which was then incorporated into the model through a WDM timeseries.

**Table 31.** Monthly Mean and Median Corrective Flows at S153L\_S Station

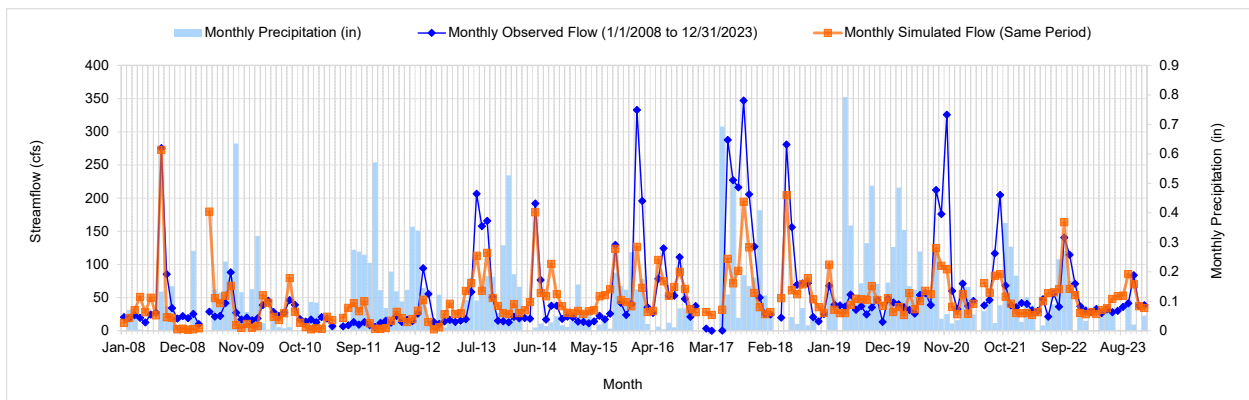
Month	Month #	S153 Mean Corrective Flows (cfs)	S153 Median Corrective Flows (cfs)
January	1	59.390	22.87
February	2	50.270	24.43
March	3	24.490	19.48
April	4	18.341	18.30
May	5	54.003	21.13
June	6	64.898	33.61
July	7	55.188	36.21
August	8	58.309	38.10
September	9	93.460	59.17
October	10	56.770	38.46
November	11	74.254	30.34
December	12	29.629	24.57

Following the incorporation of the corrective timeseries to represent operational releases through the S-153L latching gate, model performance improved noticeably across most flow components. Total flow error was reduced from -58.06% to -24.45% (simulated at 15.08 inches/year versus observed at 19.96 inches/year) that represents a meaningful reduction in the volumetric deficit. The most significant improvement is in the lowest 50% of flows, which shifted from -64.81% underestimation to a +22.9% overestimation. This gives the idea that the corrective timeseries successfully restored the baseline drainage contribution that was absent from the base model. The sustained low-level flow component is better represented as the baseflow improved substantially from -58.54% to -12.28%. Seasonal improvements are apparent across all periods: summer flows improved from -54.12% to -19.55%, fall flows from -70.46% to -33.85%, winter flows from -67.37% to -36.39%, and spring flows from -39.33% to -11.46%. The NSE improved from 0.236 to 0.387, and the monthly NSE improved substantially from 0.361 to 0.643, reflecting the model's improved ability to capture the seasonal timing of flow releases. Residual underestimation persists, particularly for the highest 10% of flows (-44.24%) and total storm volumes (-55.43%), which reflects the fundamental constraint that the HSPF model cannot replicate the brief, high-magnitude discrete release pulses produced by the latching gate mechanism.

**Figure 18** (pre-correction) shows the uncorrected model underestimating monthly flows at S153L\_S, with simulated values (orange) much lower than observed (blue) across nearly all months and flow regimes, producing a -58.06% volumetric bias, severe baseflow and seasonal deficits, and muted peak responses that reflect missing operational releases and other unrepresented inputs. **Figure 19** (post-correction) shows the monthly-median corrective series raises the simulated baseline and event magnitudes so simulated and observed monthly flows align substantially better.



**Figure 18.** Mean monthly flow at S153L\_S before applying corrective timeseries



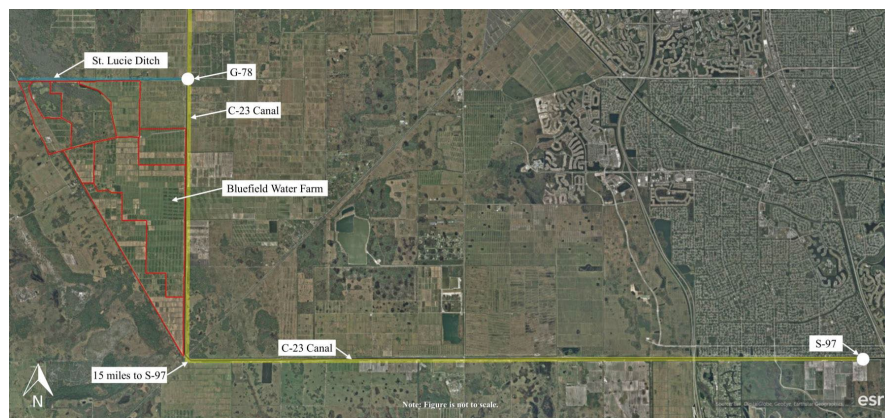
**Figure 19.** Mean monthly flow at S153L\_S after applying corrective timeseries

## 2.9 REGIONAL PROJECT OPERATIONS

SFWMD and FDACS provided information on regional-scale project operations within the St. Lucie River and Estuary watershed. These regional projects will be represented in the HSPF model as described in the following subsections.

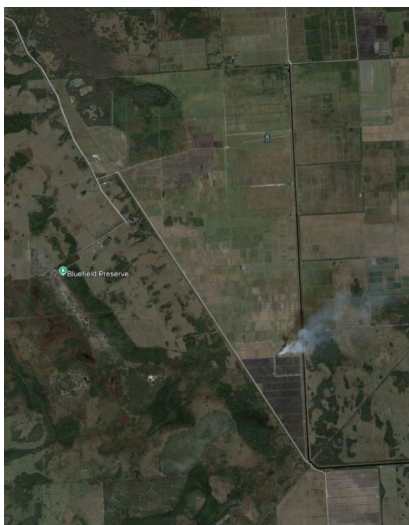
### 2.9.1 Bluefield Water Farm

The Bluefield Water Farm is a 6,104-acre surface water retention project located in the C-23 Basin. The primary purpose is to collect, divert, and store surface water from canals during periods when the discharges of excess water may harm the coastal estuaries. The operational intent of the project is to retain excess water to reduce freshwater discharges to tide through the C-23 Canal. The system includes six storage cells and five pump stations. Water from the C-23 Canal is pumped into Cell 2 using an existing retrofitted pump station (Pump Station 3) that includes two diesel pumps with a combined flow rate of 111 cfs (50,000 gallons per minute [gpm]). Also, a supplemental pump station (Pump Station 5) is equipped with two diesel pumps with a combined flow rate of 111 cfs (50,000 gpm) in the event the primary pump station (Pump Station 3) cannot adequately supply water. Inflow pumping ceases when Cell 2 rises to the service elevation of 26.3 feet National Geodetic Vertical Datum of 1929 (NGVD29) (Hazen, 2021). Construction was completed in 2021 and started full operation in August 2021 ( **Figure 20** ). SFWMD provided Tetra Tech operational inflow volumes for Bluefield Water Farm and indicated that no discharge volumes are recorded for the project.



January 2022

January 2023



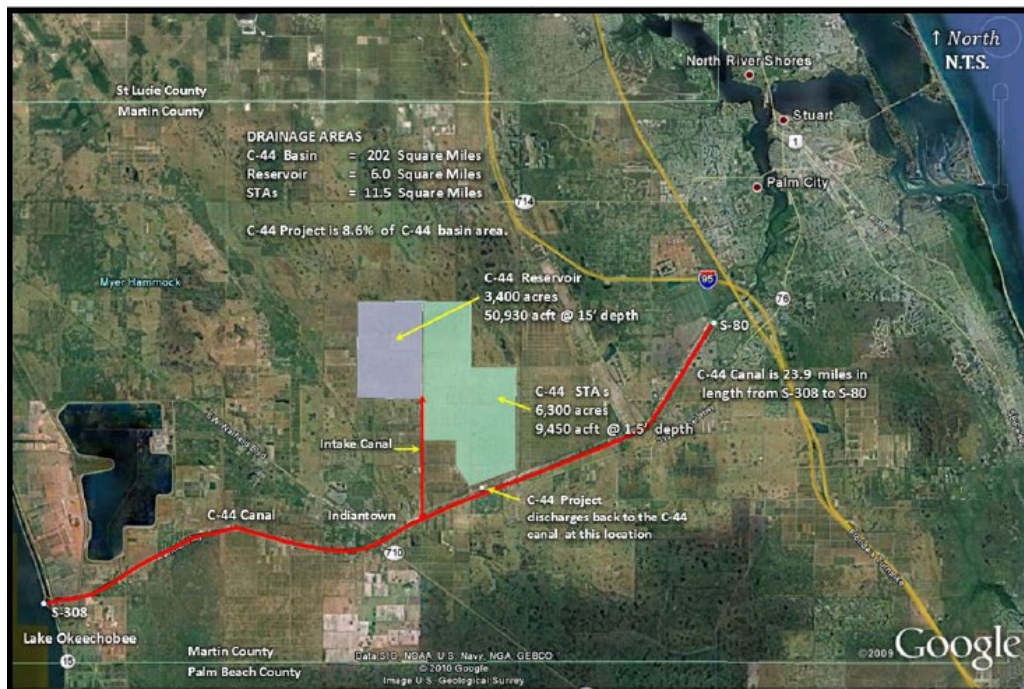
**Figure 20.** Aerial imagery of Bluefield Water Farm (accessed in March 2025)

The Bluefield Water Farm is represented in the HSPF model as a pumped withdrawal that is completely lost from the St. Lucie River and Estuary hydrologic system. The pumped withdrawal timeseries was developed using the combined operation of PS3EAST, PS3WEST, PS5EAST, and PS5WEST. The pumped withdrawal obtained water from RCHRES 405 (C-23 Canal). There is no corresponding release operation defined for this project within the model. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the Bluefield Water Farm.

### 2.9.2 C-44 Reservoir and Stormwater Treatment Area (STA)

The C-44 Reservoir and STA consist of a 3,400 acre above ground reservoir which captures flow from the C-44, and 6,300 acres of STA cells to treat the water before it is released back to the C-44 (SFWMD, 2021). The C-44 Reservoir and STA covers about 8% of the C-44 Basin area and pumps water from the C-44 Canal into the intake canal to attenuate freshwater flows to the St. Lucie Estuary and allow initial treatment of the water (**Figure 21**). Within the project system, water is distributed from the reservoir to the STA via outflow structure and distribution canals for additional treatment. Treated water is released back to the C-44 Canal via the seepage collection canals and outlet canals (SFWMD, 2021). Construction of the reservoir and STA was completed in mid-2021 followed by initial operations with water pumped into the reservoir in early 2022. Subsequently, the project began the operational testing and monitoring phase to allow time to perform as intended before the facility was transferred from USACE to SFWMD for full operations (SFWMD, 2025b).

The C-44 Reservoir and STA are represented in the HSPF model as a pumped withdrawal and return system. The pumped withdrawal timeseries was developed using the combined operation of S401 and S401T. The pumped withdrawal obtained water from RCHRES 804 (C-44 Canal). The defined release, represented as operations from S404, returns water to RCHRES 803 (C-44 Canal) using flow and water quality timeseries developed from S404 monitoring data. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the C-44 Reservoir and wetland for the footprint area of the C-44 STA.



**Figure 21.** Location of C-44 Reservoir and STA

### 2.9.3 Caulkins Water Farm

The objective of Caulkins Water Farm (3,275 acres) is to capture and redirect surface water from the C-44 Canal during times when discharges could negatively impact coastal estuaries. The AGI (permit number: 43-00360-S) created a 3,014-acre water storage area and has been designed to store a maximum of four feet of water. Water from the C-44 Canal is pumped into the AGI using an existing pump station that includes three electric pumps with a combined capacity of approximately 105,000 gpm (464 acre-feet/day or 234 cfs). The farm has been operational since December 2017 and provides water storage and nutrient retention within AGIs (SFWMD, 2020; SFWMD, 2025b). SFWMD provided Tetra Tech operational inflow volumes for Caulkins Water Farm and indicated that no discharge volumes are recorded for the project.

The Caulkins Water Farm is represented in the HSPF model as a pumped withdrawal that is completely lost from the St. Lucie River and Estuary hydrologic system. The pumped withdrawal timeseries was developed using CAUXIN operational data. The pumped withdrawal obtained water from RCHRES 802 (C-44 Canal). There is no corresponding release operation defined for this project within the model. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the Caulkins Water Farm.



**Figure 22.** Aerial imagery of Caulkins Water Farm (accessed in March 2025)

### 2.9.4 C-23/C-24 Interim Storage Section C

The project (Indian River Lagoon AGI permit#56-00042-S) is a shallow depth AGI that will provide interim storage benefits to the C-23/C-24 basins, which contribute water to the St. Lucie Estuary. C-23/C-24 Interim Storage Section C is a public project that actively pumps water from the C-23 Canal into an AGI for storage and treatment (SFWMD, 2025b). With approximately 1,240 acre-feet of static storage (one-time fill), the Section C dispersed water management project is estimated to provide up to 1,700 acre-feet of retention and storage per year (SFWMD, 2016). This project has been operational since 2019 and continues to provide interim water storage and nutrient retention until the land becomes

part of Indian River Lagoon South C-23/C-24 South Reservoir. SFWMD provided Tetra Tech operational inflow volumes for the C-23/C-24 Interim Storage Section C project and indicated that no discharge volumes are recorded for the project.

The C-23/C-24 Interim Storage Section C is represented in the HSPF model as a pumped withdrawal that is completely lost from the St. Lucie River and Estuary hydrologic system. The pumped withdrawal timeseries was developed using SECTIONC operational data. The pumped withdrawal obtained water from RCHRES 305 (C-23 Canal). There is no corresponding release operation defined for this project within the model. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the C-23/C-24 Interim Storage Section C project.

### 2.9.5 Spur Land and Cattle Water Farm

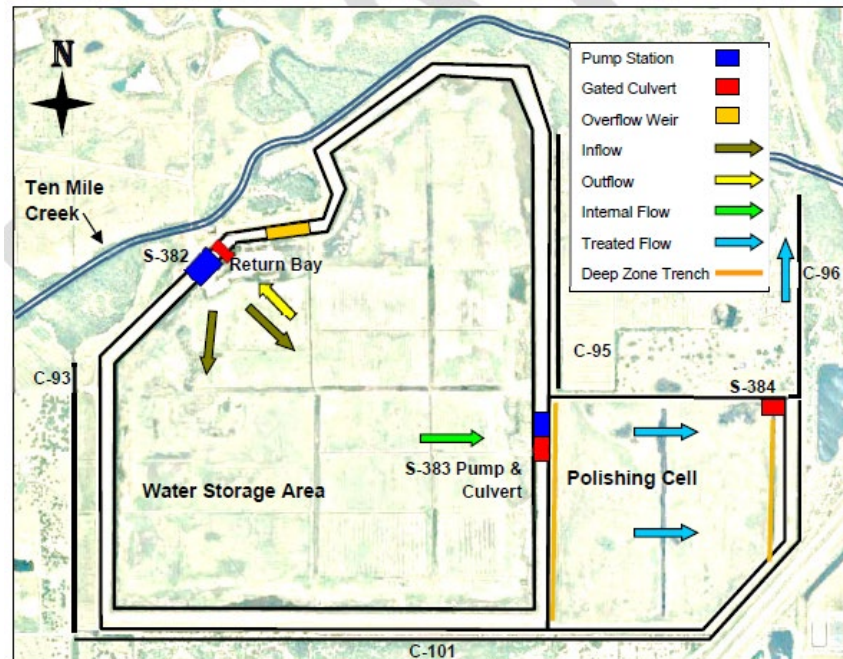
The Spur Land and Cattle Water Farm (Bull Hammock Ranch AGI permit# 43-00062-S) project is an existing water management area totaling 210 acres and consisting of a 60-acre AGI and 150 acres of adjacent marsh wetlands (**Figure 23**). The goal is to create regional storage by collecting direct rainfall and runoff from the Main Ditch, which drains areas south of Martin Highway and Allapattah Parcel C. This approach aims to decrease discharge through PC32 and manage excess water from the C-23 Canal by pumping water from the C-23 Canal to the farm (SFWMD, 2025b). The project is not required to pump more than 1,500 acre-feet per year (SFWMD, 2024). SFWMD provided Tetra Tech operational inflow volumes for Spur Land and Cattle Water Farm and indicated that no discharge volumes are recorded for the project.

The Spur Land and Cattle Water Farm is represented in the HSPF model as a pumped withdrawal that is completely lost from the St. Lucie River and Estuary hydrologic system. The pumped withdrawal timeseries was developed using SPUR operational data. The pumped withdrawal obtained water from RCHRES 405 (C-23 Canal). There is no corresponding release operation defined for this project within the model. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the Spur Land and Cattle Water Farm.

### 2.9.6 Ten Mile Creek Water Preserve Area

The Ten Mile Creek Water Preserve Area covers 658 acres and is located at the outlet of the 30,682-acre Ten Mile Creek Basin in St. Lucie County. The primary operational objective of the Ten Mile Creek Water Preserve Area is to improve the timing of water discharged into the North Fork of the St. Lucie River by capturing and storing stormwater runoff from the Ten Mile Creek Basin. Secondary benefits of the project include reduction of sediment, TP, and TN loads to the St. Lucie River. The captured water is pumped from Ten Mile Creek into the Water Preserve Area via the S-382 pump station on the northern levee adjacent to the creek. The S-383 interior structure delivers the water into the polishing cell by gravity flow through a culvert or via two small pumps. The S-384 box culvert at the polishing cell outfall conveys treated water to the C-96, which flows to and enters Ten Mile Creek immediately downstream of the Gordy Road Structure. The S-382 structure has a return bay (a gated culvert), which provides the ability to discharge from the Water Storage Area to the creek. The return bay's permitted discharge rate of 200 cfs lowers the water storage area by about 0.75 feet per day when it is completely inundated to elevation 22.0 feet (SFWMD, 2019).

The Ten Mile Creek Preserve is represented in the HSPF model as a pumped withdrawal and return system. The pumped withdrawal timeseries was developed using the operation data of S-382. The pumped withdrawal was obtained from RCHRES 202 (Ten Mile Creek). The defined release, represented as operations from S384, returns water to RCHRES 201 (Ten Mile Creek) using flow and water quality timeseries developed from S384 monitoring data. Also, the underlying combined processed land use coverage was reclassified to water for the footprint area of the Ten Mile Creek Water Preserve Area.



**Figure 23.** Ten Mile Creek Water Preserve Area map (SFWM, 2019)

### 2.9.7 Bessey Creek Hybrid Wetland Treatment Technology (HWTT)

The Bessey Creek HWTT project is located downstream of an equestrian community and serves an area of 2,980 acres. Bessey Creek HWTT achieves an average of 89% reduction of phosphorus and 53% reduction of nitrogen (FDACS, 2026). FDACS provided Tetra Tech operational flow volumes for Bessey Creek HWTT. The Bessey Creek HWTT is represented in the HSPF model as a pumped withdrawal and return system. The pumped withdrawal and return timeseries were developed using the operation data provided by FDACS and Tetra Tech assumed inflow equaled outflow. The pumped withdrawal obtained water from RCHRES 505 (Bessey Creek Tributary). The defined release returns water to RCHRES 503 (Bessey Creek) using assumed flow and water quality outflow data provided by FDACS. Also, the underlying combined processed land use coverage was reclassified to wetland for the footprint area of the Bessey Creek HWTT.

### 2.9.8 Danforth Creek HWTT

The Danforth Creek HWTT project serves an area of 3,290 acres and is located downstream of an equestrian community and upstream of an isolated wetland that the project is rehydrating. Danforth Creek HWTT average of 90% reduction of phosphorus and 52% reduction of nitrogen (FDACS, 2026). FDACS provided Tetra Tech operational flow volumes for Danforth Creek HWTT. The Danforth Creek HWTT is represented in the HSPF model as a pumped withdrawal and return system. The pumped withdrawal and return timeseries were developed using the operation data provided by FDACS and Tetra Tech assumed inflow equaled outflow. The pumped withdrawal obtained water from RCHRES 502 (Danforth Creek). The defined release returns water to RCHRES 500 (Danforth Creek) using assumed flow and water quality outflow data provided by FDACS. Also, the underlying combined processed land use coverage was reclassified to wetland for the footprint area of the Danforth Creek HWTT.

### 2.9.9 Ideal Grove HWTT

The Ideal Grove HWTT project treats an abandoned citrus grove that used Class A biosolids and serves an area of 317 acres. Bessey Creek HWTT achieves an average of 91% reduction of phosphorus and 26% reduction of nitrogen (FDACS, 2026). FDACS provided Tetra Tech operational flow volumes for Ideal Grove HWTT. The Ideal Grove HWTT is represented in the HSPF model as a pumped withdrawal and return system. The pumped withdrawal and return timeseries were developed using the operation data provided by FDACS and Tetra Tech assumed inflow equaled outflow. The pumped withdrawal obtained water from RCHRES 307 (Rim Ditch). The defined release returns water to RCHRES 306 (Rim Ditch) using assumed flow and water quality outflow data provided by FDACS. Also, the underlying combined processed land use coverage was reclassified to wetland for the footprint area of the Ideal Grove HWTT.

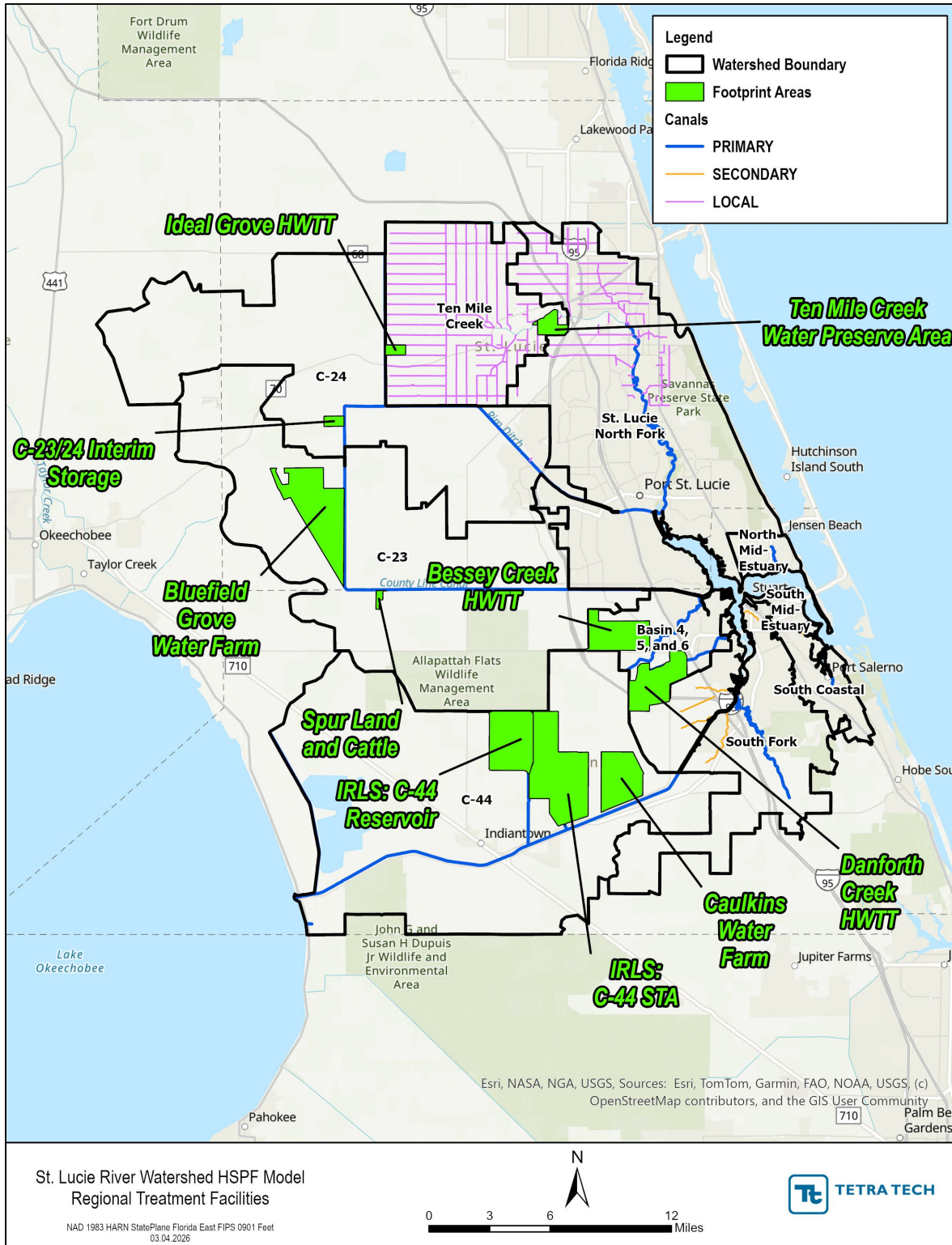
### 2.9.10 Summary of Available Regional Project Information

**Table 32** summarizes the available withdrawal and release data for the regional project discussed above. **Figure 24** illustrates the spatial coverage of recommended pumping and release facilities in the St. Lucie River and Estuary watershed HSPF model.

**Table 32.** Withdrawal and release information for regional projects and recommendations for HSPF model inclusion

Project	Type	Operational Start Date	Period of Available Data	Pumping/Release Facility	Included in HSPF Model
Bluefield Water Farm	Withdrawal	August 2021	-	Pump station 3 and pump station 5	Yes
Bluefield Water Farm	Release	-	-	Culverts/Risers in Cell 2 and 6	No
C-44 Reservoir and STA	Withdrawal	January 2022	January 2022 – December 2023	S-401 and S-401T	Yes
C-44 Reservoir and STA	Release	May 2021	May 2021 – December 2023	S-404	Yes
Caulkins Water Farm	Withdrawal	January 2018	February 2014 – October 2016 (water quality)	CAULK-IN	Yes
Caulkins Water Farm	Release	-	-	CAULK-OUTN, CAULK-OUTS, CAUX-OUT	No
C-23/C-24 Interim Storage Section C	Withdrawal	January 2017	-	Project Culvert (PC-52)	Yes
C-23/C-24 Interim Storage Section C	Release	-	-	-	No
Spur Land and Cattle Water Farm	Withdrawal	December 2014	February 2015 – July 2018	SPURIN	Yes
Spur Land and Cattle Water Farm	Release	-	-	SPUROUT	No
Ten Mile Creek Water Preserve Area	Withdrawal	August 2007	August 2007 – December 2023	S-382	Yes

<b>Project</b>	<b>Type</b>	<b>Operational Start Date</b>	<b>Period of Available Data</b>	<b>Pumping/Release Facility</b>	<b>Included in HSPF Model</b>
Ten Mile Creek Water Preserve Area	Release	October 2015	October 2015 – December 2023	S-384	Yes
Bessey Creek HWTT	Withdrawal	March 2015	March 2015 – December 2023	-	Yes
Bessey Creek HWTT	Release	March 2015	March 2015 – December 2023	-	Yes
Danforth Creek HWTT	Withdrawal	July 2016	July 2016 – December 2023	-	Yes
Danforth Creek HWTT	Release	July 2016	July 2016 – December 2023	-	Yes
Ideal Grove HWTT	Withdrawal	December 2008	December 2008 – December 2023	-	Yes
Ideal Grove HWTT	Release	December 2008	December 2008 – December 2023	-	Yes



**Figure 24.** Spatial coverage of regional treatment facilities with available data for inclusion in the St. Lucie River and Estuary watershed HSPF model

### 3.0 HSPF MODEL CALIBRATION

Tetra Tech calibrated the HSPF Model by comparing the simulated hydrology outputs and the observed flow data at 16 stations. **Table 33** provides a complete list of stations and the observed data periods available during the simulation period.

Several gages in the St. Lucie River and canal system are influenced by tidal effects, which can cause flow reversals and affect measured discharge. These tidal discharge influence gages include USGS 02276998 St. Lucie River above S-80 near Stuart, FL, S80\_S, and downstream St. Lucie River gages influenced by estuarine backwater conditions. USGS applies tidal filtering methods to remove tidal frequencies from the discharge records at these locations. After filtering, negative discharges were observed, indicating upward movement of water during those periods. Negative flows were also observed at other St. Lucie system gages with multi-year records at S308\_S\_1, S308\_S\_2, and S308\_DS, due to operational and downstream hydraulic influences. Because the HSPF model does not simulate bidirectional flow, all negative observed flows were removed from the visual comparisons and statistical analyses presented in the calibration, validation, and verification sections and in Appendix A.

Appendix A includes daily and monthly average temporal comparison plots, frequency distribution curves, regression plots, and relative error and Nash and Sutcliffe (NS) model efficiency statistics for the calibration and validation stations.

**Table 33** lists the hydrologic stations used in the St. Lucie HSPF model and the corresponding periods of observed flow data available for each station. The stations were used in three ways for the St. Lucie HSPF model. Calibration stations were used to adjust model parameters. Validation stations were used to ensure that model parameters were not overfit with the calibration stations. Verification stations are another type of validation station but were downstream of Lake Okeechobee controlled releases. The observed data periods indicate the time frames used for calibration, validation, or verification and vary by station based on data availability and record completeness.

**Table 33.** Calibration stations and the observed data periods

Station ID	Type	Station Name	Observed Data Start Date	Observed Data End Date
S48_S	Calibration	S-48 Spillway on Canal C-23 at Tidewater	7/8/1963	9/25/2024
S49_S	Calibration	S-49 Spillway on Canal C-24 near Florida Turnpike	2/31/1961	1/6/2025
S97_S	Calibration	S-97 Spillway on Canal C-23 near Florida Turnpike	1/29/1964	1/6/2025
GORDY_S	Calibration	Gordy Rd. Bridge N St. Lucie Water Control District Structure 71-1	7/28/1999	1/6/2025
G78_C	Validation	At C-23 canal, about 15 miles southwest of Fort Pierce	6/30/1987	1/6/2025
G79_C	Validation	G79 dividing structure between C23 and C24 (Carlton Road Structure)	11/21/1986	1/7/2025
G81_S/G81_C	Validation	G81 3-gate Spillway structure	7/1/1986	1/1/2025
SLT09_W	Validation	Bessey Creek Weir	12/3/2004	11/6/2011
SLT21_W	Validation	C105 Weir Flow	11/9/2004	11/3/2011
S153L_S	Validation	S-153L (Latching Gate) on Levee L-65 at Canal C-44A	6/29/1985	1/1/2025
S308_S_1	Verification	S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee	9/13/1998	2/12/2014

Station ID	Type	Station Name	Observed Data Start Date	Observed Data End Date
S308_S_2	Verification	S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee	5/1/1996	9/26/2024
S308.DS	Verification	St. Lucie River Below S-308 at Port Mayaca FL	4/1/1931	1/6/2025
02276998	Verification	St. Lucie River Above S-80 NR Stuart FL	7/15/2017	1/6/2025
S80_S	Verification	S-80 Spillway and Sector on St. Lucie River at Tidewater	5/1/1996	1/7/2025

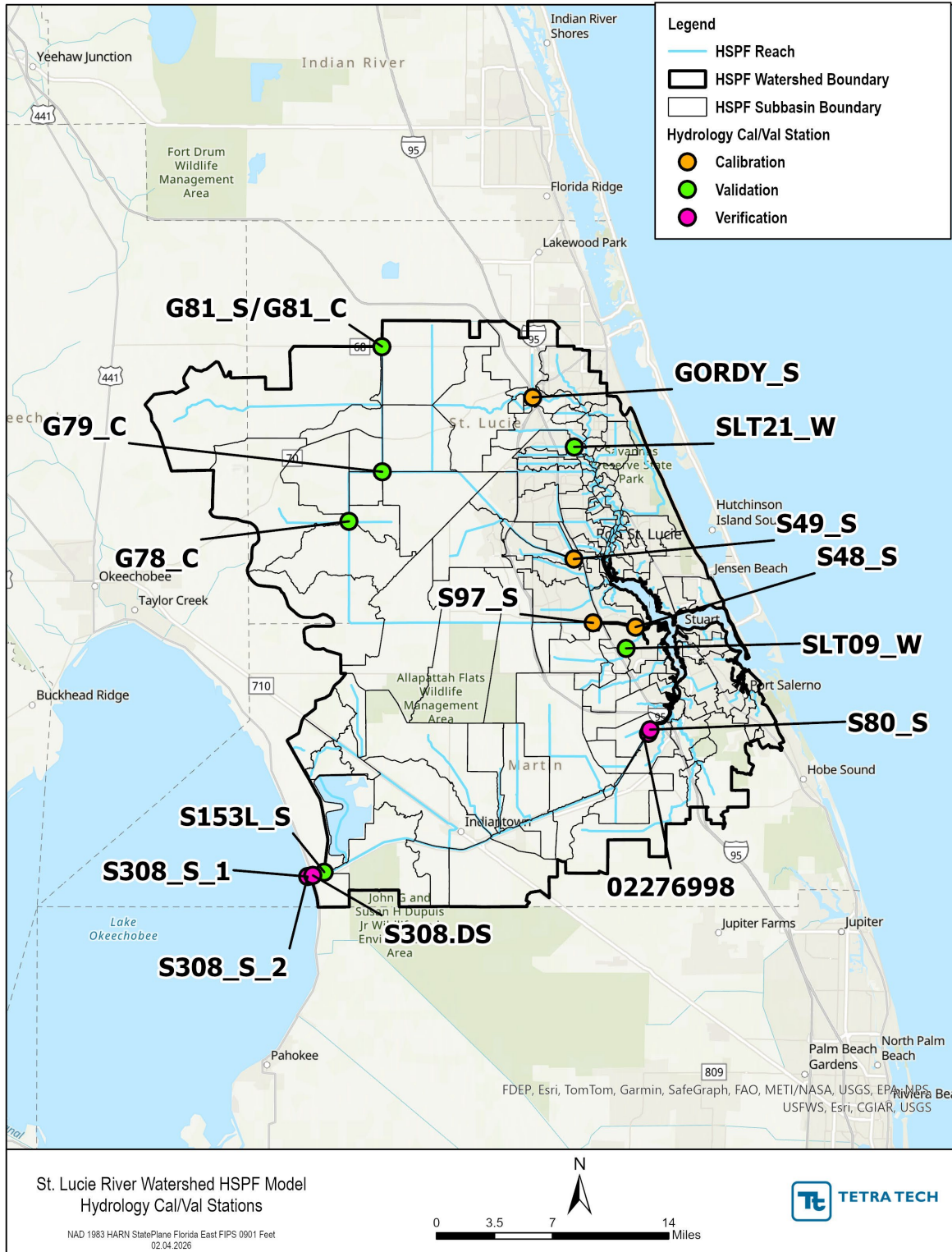


Figure 25. Spatial coverage of HSPF model hydrology calibration and validation stations

### 3.1 HYDROLOGY CALIBRATION PERFORMANCE STATISTICS

Model performance evaluates the goodness-of-fit by comparing the central tendency, timeseries, and data distribution simulated by the model against the available measured data. These comparisons are made through the graphs provided throughout this report and the appendices. In addition to the graphical analyses, several statistics of goodness-of-fit were calculated to evaluate model performance to reproduce different aspects of the hydrologic, hydrodynamic, and water quality observations such as the means, trends, and level of dispersion. Qualitative grades describing the achieved model performance were assigned to the statistic results based on recommended and expected levels of performance from a calibrated model available in the literature. Given the complexity involved in the development of water quality models and different uncertainties impacting the models' performance, such as uncertainties in boundary and forcing conditions, calibrated parameters, and calibration and validation measured data, the grades and statistics should be used as complementary information to assess the model performance. The grades and statistics should not be used as a unique criteria to accept or reject the model. The fundamental purpose of the comparison figures, grades, and statistics is to identify the strengths and limitations of the model to help DEP make informed decisions based on the simulations.

The temporal analyses were performed using Microsoft Excel. Plots were created to compare the observed flows to the model predictions for mean monthly flows, mean daily flows, flow exceedance, and monthly flow regression. Excel was also used to generate the following goodness-of-fit statistics where  $P$  represents the timeseries of model predictions and  $O$  the timeseries of observations:

$$\text{Correlation coefficient: } R^2 = \frac{(n \sum_{i=1}^n (P_i \times O_i)) - (\sum_{i=1}^n O_i \times \sum_{i=1}^n P_i)}{\sqrt{[n \sum_{i=1}^n (P_i^2) - \sum_{i=1}^n (P_i)^2] \times [n \sum_{i=1}^n (O_i^2) - \sum_{i=1}^n (O_i)^2]}}$$

$$\text{Nash-Sutcliffe Formula: } NS = 1 - \frac{\sum_{i=1}^N (O_i - P_i)^2}{\sum_{i=1}^N (O_i - \bar{O})^2}$$

$$\text{Percent Error (PE) Formula: } PE = \frac{\bar{O} - \bar{P}}{\bar{O}}$$

The correlation coefficient ( $R^2$ ) measures the degree of linear correlation between the trends of two timeseries, in this case the series of observations and model predictions. It can range from  $-1$  to  $1$ , with negative values indicating that the observed and predicted values tend to vary inversely. It should be recognized that even if the correlation is close to  $1$ , the predicted and observed values may not match each other; they only tend to vary similarly (Stow et al. 2003).

The NS coefficient (Nash and Sutcliffe 1970) is defined as one minus the sum of the squared differences between the observed and predicted timeseries normalized by the variance of the observations. The NS coefficient is a global measure of goodness of fit and provides an estimate of how good the variance of measurements is explained by the model predictions. The NS ranges from minus infinity to one. A NS equal to one represents a perfect fit while values of NS lower than zero indicate that the mean of the observations is a better prediction of the observations compared to the model predictions. This coefficient is widely used in hydrological sciences and is considered one of the most important statistics for the evaluation of continuous-hydrograph simulation programs.

PE is a measure of the relative deviation of the simulations from the observations. The smaller the magnitude of PE, the better the agreement between the means of the observations and simulations. Over predictions or under predictions of the simulations relative to the observations are reflected by negative and positive values of PE, respectively. PE were calculated for key flow statistics, including total volume, low flows, high flows, and seasonal volume error.

The performance criteria proposed by Donigan (2002) for flow were implemented in this project. **Table 34** and **Table 35** list the grades of model performance for the predictions of flow based on the percent difference (**Table 34**) and  $R^2$

statistics (**Table 35**) computed between the simulated and observed values. While important, a limitation of the performance criteria listed in **Table 34** and **Table 35** is that they only apply for the percent difference and  $R^2$  statistics.

**Table 34.** Donigan 2002 calibration/validation targets or tolerances for percent difference between modeled observed results for hydrologic parameters

Category	Range
Very Good	<10%
Good	10% - 15%
Fair	15% - 25%
Poor	>25%

**Table 35.** Donigan 2002  $R^2$  and NSE ranges for model performance

Category	Range
Very Good	>0.8
Good	0.7 - 0.8
Fair	0.6 - 0.7
Poor	<0.6

### 3.2 HYDROLOGY CALIBRATION PARAMETERIZATION

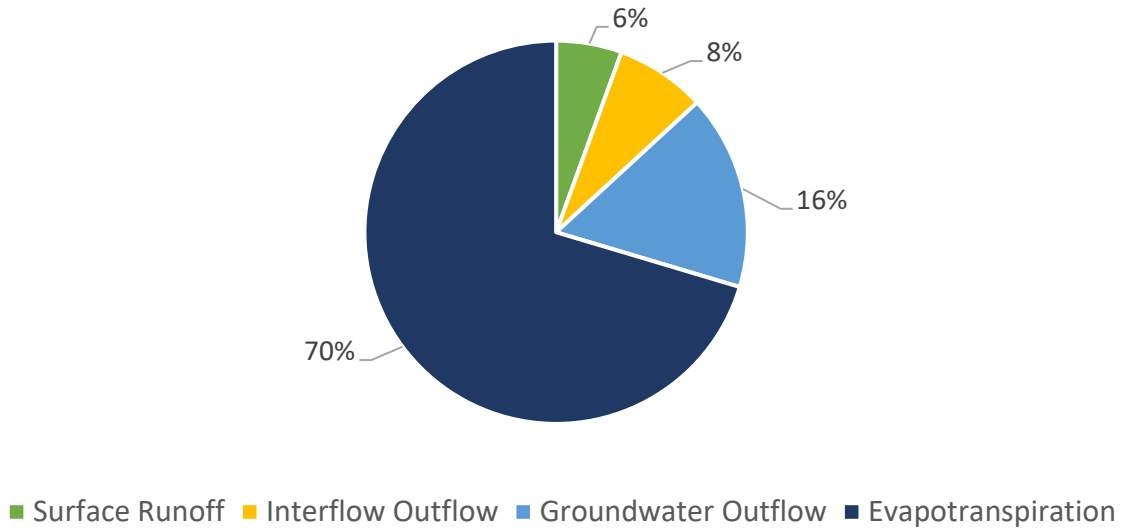
Initial hydrology parameters were obtained from the Caloosahatchee River and Estuary HSPF model. The parameters were adjusted as necessary for the St. Lucie River and Estuary watershed. The draft calibration parameters for the HSPF model PWATER and IWATER modules are presented in **Table 36**.

**Table 36.** HSPF model parametrization for hydrology parameters

Land Use	LZSN	INFILT	AGWRC	BASETP	AGWETP	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
Low Density Residential (Pervious)	3	0.147	0.851	0.1	0	0.01 - 0.09	0.35	0.23	3	0.75	0.24 - 0.55
Developed Open Space/Disturbed (Pervious)	2	0.147	0.851	0.1	0	0.01 - 0.03	0.195	0.23	3	0.75	0.08 - 0.32
Medium Density Residential (Pervious)	2.5	0.147	0.851	0.1	0	0.01 - 0.06	0.195	0.21	3	0.75	0.08 - 0.32
High Density Residential (Pervious)	2.5	0.147	0.851	0.1	0	0.01 - 0.06	0.195	0.14	3	0.75	0.08 - 0.32
Commercial/ Institutional/ Transportation (Pervious)	2.5	0.147	0.879	0.1	0	0.01 - 0.06	0.195	0.12	3	0.75	0.08 - 0.32
Industrial/Extractive (Pervious)	2.5	0.147	0.879	0.1	0	0.01 - 0.06	0.195	0.12	3	0.75	0.17 - 0.31
FDOT Right-of-Way (Pervious)	2.5	0.147	0.879	0.1	0	0.01 - 0.06	0.195	0.12	3	0.75	0.08 - 0.32
Sugar Cane	2	0.147	0.869	0.1	0	0.02 - 0.1	0.245	0.25	3	0.75	0.54 - 0.81
Row and Field Crops	2	0.147	0.869	0.1	0	0.02 - 0.1	0.245	0.25	3	0.75	0.54 - 0.81
Nurseries, Ornamentals, and Vineyards	2	0.147	0.869	0.1	0	0.02 - 0.1	0.245	0.25	3	0.75	0.54 - 0.81
Citrus Groves/Other Groves	3	0.147	0.907	0.1	0	0.1 - 0.25	0.245	0.25	3	0.75	0.68 - 0.98
Improved Pasture	3	0.147	0.879	0.1	0	0.01 - 0.05	0.5	0.25	3	0.75	0.55 - 0.8
Rangeland/ Unimproved Pasture/ Woodland Pasture/ Shrub	3	0.147	0.879	0.1	0	0.01 - 0.05	0.5	0.25	3	0.75	0.55 - 0.8
Upland Forests	3	0.147	0.907	0.1	0	0.1 - 0.25	0.5	0.27	3	0.75	0.68 - 0.98
Wetlands	3.25	0.035	0.936	0.1	0.7	0.03 - 0.3	0.75	0.01	3	0.75	0.68 - 0.98
Water	3.25	0.035	0.936	0.1	0	0	1	0.01	3	0.75	0.68 - 0.98
Agricultural Wetland	3.25	0.035	0.936	0.1	0.7	0.03 - 0.3	0.75	0.01	3	0.75	0.68 - 0.98
Agricultural Fallow	3	0.147	0.907	0.1	0	0.1 - 0.25	0.245	0.25	3	0.75	0.68 - 0.98

### 3.3 WATER BALANCE

The overall water balance estimated by the model for the study area is summarized in **Figure 26**. The major component of outflow is ET and the fraction of supply going to ET is in range for this ecoregion (Sanford & Selnick, 2013). Approximately 70% of precipitation is returned to the atmosphere through ET, while 30% becomes streamflow.



**Figure 26.** Upland water balance

### 3.4 HYDROLOGY CALIBRATION PERFORMANCE

The statistical summary of calibration results for the HSPF model is provided in **Table 37**. A summary of the draft hydrology calibration at each station, along with potential calibration issues, are provided in the sections below.

**Table 37.** Statistical summary of the HSPF Model hydrological calibration

Station ID	Station Name	R <sup>2</sup> (monthly)	R <sup>2</sup> Rating	NSE	NSE Rating	NSE (monthly)	NSE (monthly) Rating	Total Volume % Error	Total Volume % Error Rating
S48_S	S-48 Spillway on Canal C-23 at Tidewater	0.75	Good	0.625	Fair	0.799	Good	14.85	Good
S49_S	S-49 Spillway on Canal C-24 near Florida Turnpike	0.74	Good	0.684	Fair	0.846	Very Good	-20.20	Fair
S97_S	S-97 Spillway on Canal C-23 near Florida Turnpike	0.76	Good	0.586	Poor	0.837	Very Good	6.77	Very Good
GORDY_S	Gordy Rd. Bridge N St. Lucie Water Control District Structure 71-1	0.63	Fair	0.088	Poor	0.792	Good	1.03	Very Good
G78_C	At C-23 canal, about 15 miles southwest of Fort Pierce	0.01	Poor	-2.071	Poor	-0.240	Poor	30.35	Poor
G79_C	G79 dividing structure between C23 and C24 (Carlton Road Structure)	0.52	Poor	0.467	Poor	0.560	Poor	-40.35	Poor
G81_S/G81_C	G81 3-gate Spillway structure	1.0	Very Good	0.997	Very Good	0.999	Very Good	1.96	Very Good
SLT09_W	Bessey Creek Weir	0.64	Fair	-13.85	Poor	-4.914	Poor	150.23	Poor
SLT21_W	C105 Weir Flow	0.09	Poor	0.061	Poor	0.566	Poor	-13.56	Good
S153L_S	S-153L (Latching Gate) on Levee L-65 at Canal C-44A	0.58	Poor	0.387	Poor	0.643	Fair	-24.45	Fair
02276998	St. Lucie River Above S-80 NR Stuart FL	0.89	Very Good	0.830	Very Good	0.941	Very Good	0.66	Very Good
S80_S	S-80 Spillway and Sector on St. Lucie River at Tidewater	0.74	Good	0.719	Good	0.910	Very Good	9.81	Very Good
S308_S_1	S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee	0.97	Very Good	0.279	Poor	0.771	Good	25.49	Poor
S308_S_2	S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee	1	Very Good	1	Very Good	1	Very Good	0.07	Very Good

Station ID	Station Name	R <sup>2</sup> (monthly)	R <sup>2</sup> Rating	NSE	NSE Rating	NSE (monthly)	NSE (monthly) Rating	Total Volume % Error	Total Volume % Error Rating
S308.DS	St. Lucie River Below S-308 at Port Mayaca FL	0.84	Very Good	0.765	Good	0.876	Very Good	7.27	Very Good

### 3.4.1 USGS Gage Calibration

Hydrology calibration summary for the four stations are provided in this section.

- S48\_S, S-48 spillway on canal C-23 at Tidewater (7/8/1963 – 9/25/2024):
  - This gage represents a highly regulated spillway where flows are primarily controlled by operational releases.
  - Simulated flows reproduce the overall magnitude and seasonal variability of observed flows.
  - NSE and monthly  $R^2$  values indicate good calibration performance, particularly for moderate and high flows.
  - Minor differences between simulated and observed flows are attributed to gate operations and operational variability not explicitly represented in the model.
  - Total simulated flow volume is consistent with observed records which can indicate a calibrated system at this location.
  - No corrective flow was applied at station S48\_S, and the pre-correction run and the post-correction run produce identical results at this station that confirmed that the upstream corrective flows introduced in other stations in the watershed do not influence this structure.
- S49\_S, S-49 spillway on canal C-24 near Florida Turnpike (2/13/1961 – 1/6/2025):
  - Model captures the timing and magnitude of observed flows, especially during higher flow events.
  - NSE and  $R^2$  statistics demonstrate strong agreement between simulated and observed data.
  - Some under-simulation of low flows is present and is likely related to operational control at the structure and localized upstream drainage influences.
  - Overall, the model provides a reliable representation of flow behavior at this station.
  - No corrective flow was applied at station S49\_S, and model results are nearly identical between the pre-correction run and the post-correction run, with only marginal differences attributable to the indirect influence of upstream corrective flows in the broader canal network.
- S97\_S, S-97 spillway on canal C-23 near Florida Turnpike (1/29/1964 – 1/6/2025):
  - Simulated flows align well with observed discharge patterns across most flow conditions.
  - NSE and  $R^2$  values indicate reliable calibration performance.
  - Minor differences during extended low-flow periods are attributed to structure operations and canal storage effects.
  - Model adequately represents both flow magnitude and temporal variability at this station.
  - No corrective flow was applied at station S97\_S, and model results are identical between the pre-correction run and the post-correction run that confirmed no additional flow sources were required at this location.
- GORDY\_S, GORDY Rd. bridge N St. Lucie Water Control District Structure 71-1 (7/28/1999 – 1/6/2025):
  - Initial simulations underestimated flows at this station referring to missing hydrologic input processes.
  - Simulated flows (24.02 in/yr) closely match observed flows (23.78 in/yr) and represents there is strong agreement in total flow volume.
  - Remaining discrepancies are likely associated with unmodeled groundwater contributions or external inflows influencing the system.
  - Results at this section were improved through the application of corrective flow timeseries based on median monthly differences between observed and simulated flows. Pre-correction simulations significantly underestimated observed discharge, while post-correction simulations show substantial improvement in flow magnitude and distribution. Details of the corrective flow development and implementation are provided in Section 2.8.3 (Ten Mile Creek).
  - NSE and  $R^2$  values indicate improved calibration performance following the corrections.

### 3.4.2 USGS Gage Validation

Hydrology validation summary for the six stations are provided in this section.

- G78\_C At C-23 canal, about 15 miles southwest of Fort Pierce (6/30/1987 – 1/6/2025):
  - Validation results indicate moderate agreement between simulated and observed flows.
  - NSE and  $R^2$  values demonstrate that the model captures general flow trends, but performance is reduced compared to calibration stations.
  - Minor discrepancies during low-flow periods are associated with upstream operational controls which are not represented in the model.
  - No corrective was applied at station G78\_C, and model results are identical between the pre-correction run and the post-correction run.
- G79\_C, G79 dividing structure between C-23 and C-24 (Carlton Rd. Structure) (11/21/1986 – 1/7/2025):
  - Model reproduces the general distribution of flows between canals C-23 and C-24 systems, however, quantitative agreement with observed flows is limited.
  - NSE and  $R^2$  values indicate moderated model performance.
  - Differences are primarily associated with structure-controlled diversions and operational decisions not represented in the model.
  - Overall, the model provides a reasonable conceptual representation, but with notable limitations in accurately reproducing observed flow magnitudes due to structure-controlled diversions and operational decisions.
  - No corrective was applied at station G79\_C, and model results are identical between the pre-correction run and the post-correction run.
- G81\_S/G81\_C, G81 3-gate spillway structure (7/1/1986 – 1/1/2025):
  - Simulated flows reproduce observed discharge patterns well during moderate and high flow events.
  - NSE and  $R^2$  values indicate very good model performance after model adjustments.
  - Some over-simulation of low flows may be related to simplified gate operation assumptions.
  - Results at this station were improved through the implementation of boundary conditions. Pre-correction simulations did not adequately represent observed flows, whereas post-correction simulations demonstrate improved agreement. Additional details regarding this structure and boundary condition development are provided in section 2.8.2 (G-81 Structure Transfer).
- SLT09\_W, Bessey Creek Weir (12/3/2004 – 11/6/2011):
  - Model captures storm driven flow responses at this location.
  - NSE and  $R^2$  values indicate poor correlation between simulated and observed flows.
  - Increased variability during low flow periods reflect sensitivity of the weir to small changes in stage.
  - Differences influenced by hydrologic variability and small-scale processes not resolved in the model.
  - No corrective was applied at station SLT09\_W, and model results are identical between the pre-correction run and the post-correction run.
  - No observed flow data is available after January 6, 2011, limiting the evaluation period relative to other stations.
- SLT21\_W, C105 Weir Flow (11/9/2004 – 11/3/2011):
  - Initial simulations significantly underestimated observed discharge, including runoff, baseflow, and seasonal flow volumes.
  - This indicated the presence of additional water inputs not represented in the base model configuration.
  - Results at this station were fit using a corrective timeseries to account for unrepresented flows. Pre-correction simulations significantly underestimated observed flows, while post-correction simulations provided improved agreement in total volume and seasonal distribution. Further details are provided in Section 2.8.4 (C-105 canal).
  - Despite improvements, uncertainties remain due to the complexity of anthropogenic inputs, groundwater interactions and potential measurement uncertainties at this station.

- S153L\_S, S-153L (Latching Gate) on Levee L-65 at canal C-44A (6/29/1985 – 1/1/2025):
  - Model reproduces overall discharge trends and general flow behavior at this gate structure.
  - NSE and  $R^2$  values indicate moderate agreement between simulated and observed flows.
  - Differences are attributed to latching gate operations and episodic managed release.
  - Results at this station were improved through the application of corrective timeseries to account for unrepresented operational releases and hydrologic inputs. Pre-correction simulations showed notable discrepancies, while post-correction simulations demonstrated improved agreement with observed data. Additional details are provided in Section 2.8.5 (L-65 Canal discussion).
  - Remaining discrepancies reflect operational variability and limitations in representing discrete gate controls.

### 3.4.3 USGS Gage Verification

Hydrology verification summary for the five stations is provided in this section.

- USGS 02276998 St. Lucie River above S-80 NR Stuart, FL (7/15/2017 – 1/6/2025):
  - Verification results indicate strong agreement between simulated and observed flows.
  - High NSE and  $R^2$  values demonstrate robust model performance at this location.
  - Model captures both seasonal variability and event-driven flow responses effectively.
  - Overall, the model provides a reliable representation of watershed-scale hydrology at this location.
- S80\_S, S-80 spillway and sector on St. Lucie River at Tidewater (5/1/1996 – 1/7/2025):
  - Simulated flows closely match observed discharge, particularly during high flow release events.
  - NSE and  $R^2$  statistics indicate strong verification performance.
  - Minor discrepancies during low-flow periods reflect operational release schedules and gate controls that are not explicitly simulated.
  - Model adequately represents regulated flow dynamics at this structure.
- S308\_S\_1, S-308 spillway and sector flow on St. Lucie River at Lake Okeechobee (9/13/1998 – 2/12/2014):
  - Model reproduces observed operational releases from Lake Okeechobee with reasonable accuracy.
  - NSE and  $R^2$  values indicate good agreement between simulated and observed flows.
  - Differences are associated with operational timing and flow reversals.
  - Overall performance is reliable for representing managed discharge conditions.
- S308\_S\_2 (5/1/1996 – 9/26/2024):
  - Flow magnitude and timing are consistently well represented across the verification period.
  - NSE and  $R^2$  statistics support stable and reliable model performance.
  - Minor deviations occur during low-flow operational periods.
  - Model effectively captures both regulated releases and broader flow patterns.
- S308.DS, St. Lucie River below S308 at Port Mayaca, FL (4/1/1931 – 1/6/2025):
  - Downstream routing of Lake Okeechobee releases is well represented in the model.
  - NSE and  $R^2$  values indicate strong verification performance.
  - Differences are primarily related to routing effects and operational variability.
  - Model provides a reliable representation of downstream hydrologic conditions.

## 3.5 CALIBRATION ISSUES

### 3.5.1 Station SLT09\_W (Bessey Creek) Overestimation of Flow

At SLT09\_W, simulated flows occasionally exceed observed flows during high-flow events, resulting in overestimation of storm volumes. Annual rainfall events are well represented, and simulated low-flow behavior generally aligns with observed data. Differences are attributed to localized storage, backwater effects, or weir hydraulics that are not explicitly represented in the model. The negative NSE and monthly NSE indicate very poor performance.

### 3.5.2 Limited Calibration Reliability at G78\_C Due to Data Constraints

G78\_C has limited observed flow data and is likely influenced by pumping operations due to having both positive and negative flows in the observed timeseries. Simulated flows generally follow observed trends in the positive flows; however, discrepancies are present during low-flow periods. There is uncertainty about water movement in this area, and the model may be incorrectly routing water or generating excessive baseflow contributions.

### 3.5.3 Flow Distribution Variability at G79\_C Associated with Structural Routing and Limited Data

G79\_C is a dividing structure between canals C-23 and C-24 with limited observed flow records and no pumping influence. At station G79\_C, the model underestimates flow with a -40.4% error in total flow (observed: 17.82 inches/year versus simulated: 10.63 inches/year). The model shows -59.0% error in total lowest 50% flows and -49.9% error in baseflow. All seasonal flow volumes are underestimated, with summer flows showing -46.4% error. Similar to G78\_C, there is uncertainty about water movement in this area. The observed runoff seems reasonable, but the model may not be properly representing the watershed's hydrologic processes or water sources.

## 4.0 REFERENCES

- Cole, T. M. (2003). A Two-Dimensional, Laterally Average Hydrodynamic and Water Quality Model, Version 3.1. User Manual, A-87-A-98.
- DEP. (2025). *Statewide Land Use Land Cover*. Retrieved from <https://geodata.dep.state.fl.us/datasets/FDEP::statewide-land-use-land-cover/about>
- FDACS. (2025). *Florida Department of Agriculture and Consumer Services, Florida Statewide Agricultural Irrigation Demand Geodatabase*.
- FDACS. (2026). Florida Department of Agriculture and Consumer Services, NEEPP\_HWTT\_FAVT\_boundary\_20260113 shapefile.
- Hazen. (2021, March 10). *Bluefield Water Farm Operational Plan*.
- Kisekka, I. K. (2013). Evapotranspiration-Based Irrigation for Agriculture: Crop Coefficients of Some Commercial Crops in Florida.
- MRLC. (2023). *Multi-Resolution Land Characteristics Consortium, 2023 Fractional Impervious Surface (CONUS)*. Retrieved from <https://www.mrlc.gov/data?f%5B0%5D=category%3AFractional%20Impervious%20Surface>
- NOAA NCEI QCLCD. (2024). *National Centers for Environmental Information, National Oceanic and Atmospheric Administration*. Retrieved from <https://www.ncei.noaa.gov/access/search/data-search/local-climatological-data>
- Sanford, W. E., & Selnick, D. L. (2013). Estimation of evapotranspiration across the conterminous United States. *Journal of the American Water Resources*, 49(1): 217-230.
- SFWMD. (2000). *Modified Blaney-Criddle for Excel, Calculation of irrigation Requirements*. Retrieved from <http://sfrpc.com/dri/Parkland/RevisedQues/AppendixVI.pdf>
- SFWMD. (2016). *Operational Plan for Section C Dispersed Water Management Project*.

- SFWMD. (2018). *South Florida Water Management District, Above Ground Impoundments*. Retrieved from [https://geo-sfwmd.hub.arcgis.com/datasets/4dd80b176a1243c894079523d79d551e\\_0/explore?location=27.194539%2C-80.689536%2C9.72](https://geo-sfwmd.hub.arcgis.com/datasets/4dd80b176a1243c894079523d79d551e_0/explore?location=27.194539%2C-80.689536%2C9.72)
- SFWMD. (2019). *Ten Mile Creek Water Preserve Area Operation Plan*.
- SFWMD. (2020). *Caulkins Water Farm Expansion Operational Plan*.
- SFWMD. (2021). *Comprehensive Everglades Restoration Plan, C-44 Reservoir/Stormwater Treatment Area Project, Preliminary Project Operation Manual*.
- SFWMD. (2024). *Spurland Operations Plan - Exhibit B-1, Operations and Maintenance Plan*.
- SFWMD. (2025b). *2025 South Florida Environmental Report, Volume 1, Chapter 8C*.
- SFWMD. (Accessed 2025a). *Water use Management System Design and Evaluation Aids- PART B*. Retrieved from [https://www.sfwmd.gov/sites/default/files/documents/cuptech\\_wu\\_design\\_aid\\_supp\\_crops.pdf](https://www.sfwmd.gov/sites/default/files/documents/cuptech_wu_design_aid_supp_crops.pdf)
- SJRWMD. (1990). *Technical Manual Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) Model, v5.5*. Retrieved from <https://static.sjrwmd.com/sjrwmd/secure/technicalreports/SP/SJ2008-SP17.pdf>
- SJRWMD. (2007). *Revisions of AFSIRS Crop Water Simulation Model*. Retrieved from <https://static.sjrwmd.com/sjrwmd/secure/technicalreports/SP/SJ2008-SP19.pdf>
- Sutherland, R. (1995). Methodology for Estimating the Effective Impervious Area of Urban Watersheds. Technical Note 58. *Watershed Protection Techniques*, 2(1): pp 282-284.
- Swann, C. (2001). The Influence of Septic Systems at the Subwatershed Level. *Watershed Protection Techniques*, 3(4): 821-834.
- Tetra Tech. (2007). *MetDAPT User Manual. Meterological Data Analysis and Preparation Tool*.
- United States Department of Agriculture, N. R. (1993). *National Engineering Handbook Chapter 2 Part 623 Irrigation Water Requirements*. Washington, D.C. Retrieved from [https://www.nrcs.usda.gov/wps/portal/nrcs/detail/?cid=nrcs141p2\\_024573](https://www.nrcs.usda.gov/wps/portal/nrcs/detail/?cid=nrcs141p2_024573)

# APPENDIX A: HSPF MODEL HYDROLOGY RESULTS

## A-1 HYDROLOGY CALIBRATION

### S-48\_S Spillway on Canal C-23 At Tidewater

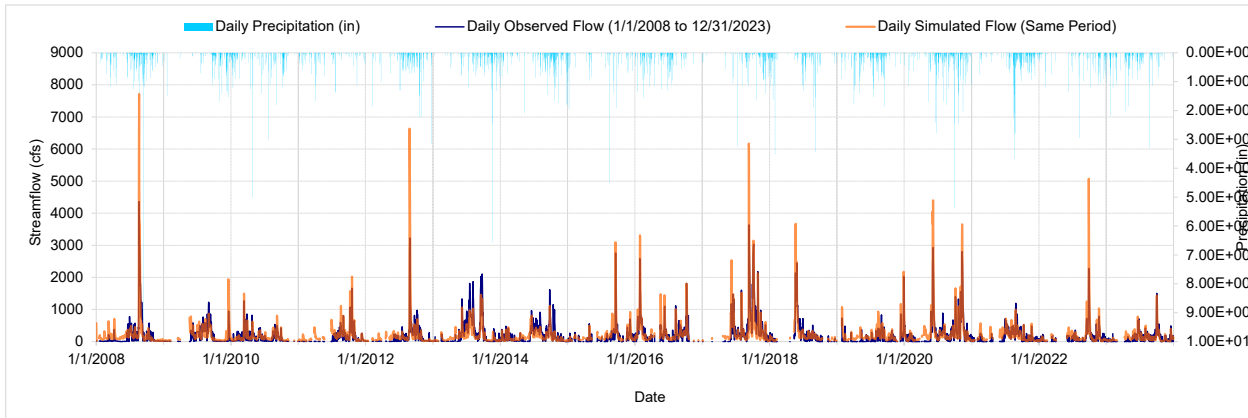


Figure A-27. Mean daily flow: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

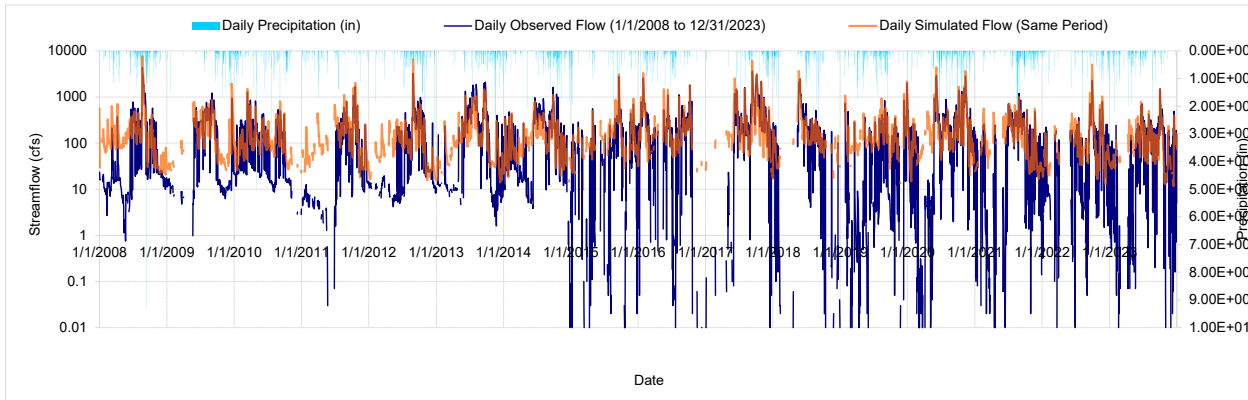


Figure A-28. Log Scale Mean daily flow: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

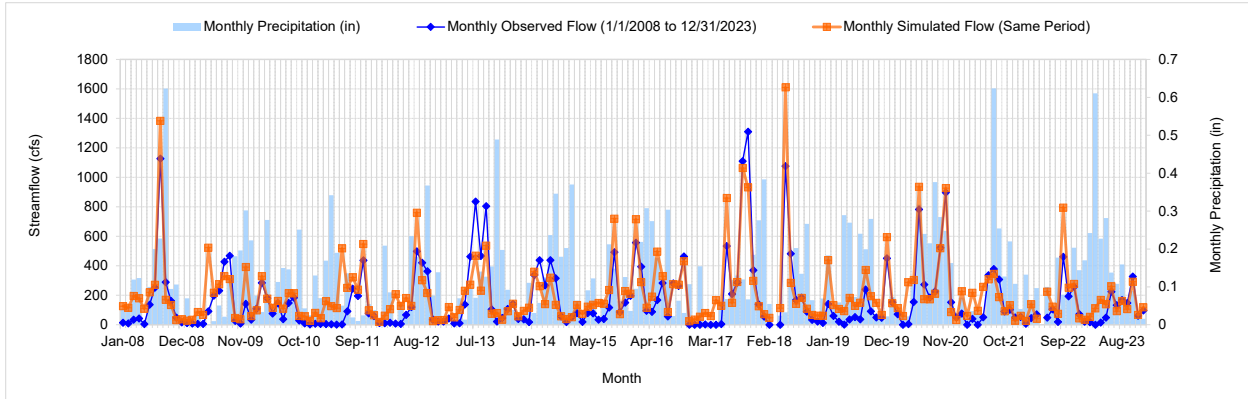


Figure A-29. Mean monthly flow: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

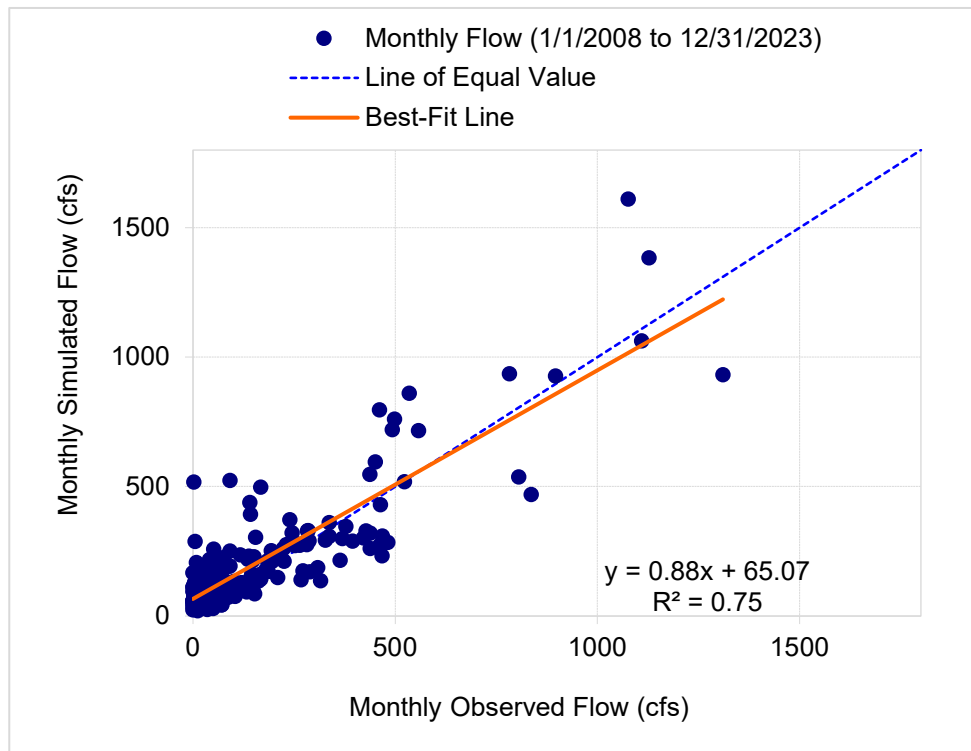


Figure A-30. Monthly flow regression and temporal variation: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

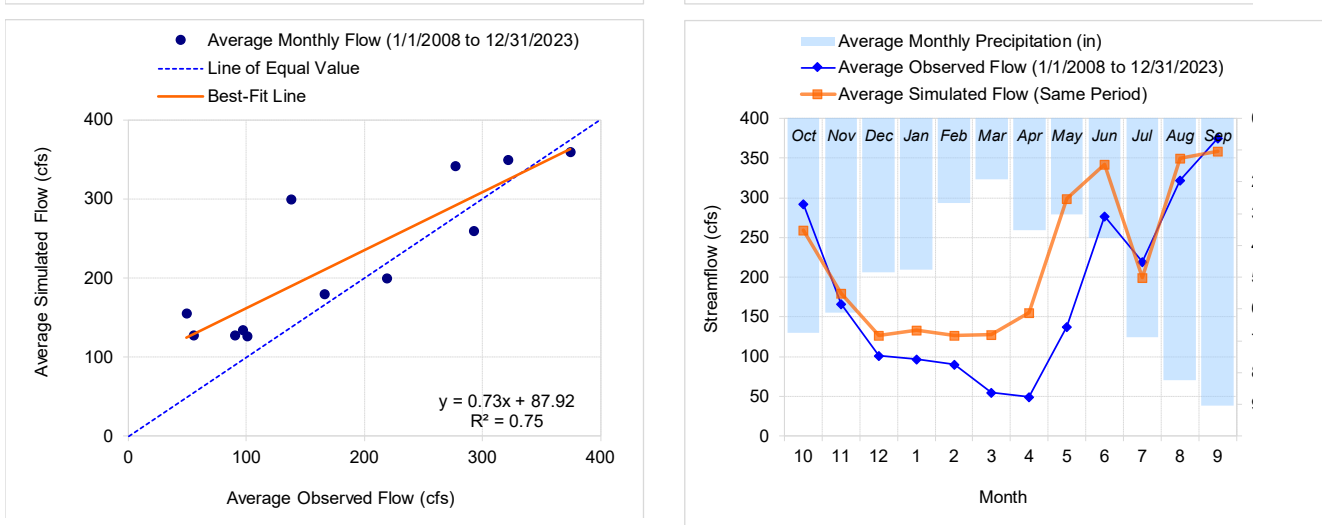


Figure A-31. Seasonal regression and temporal aggregate: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

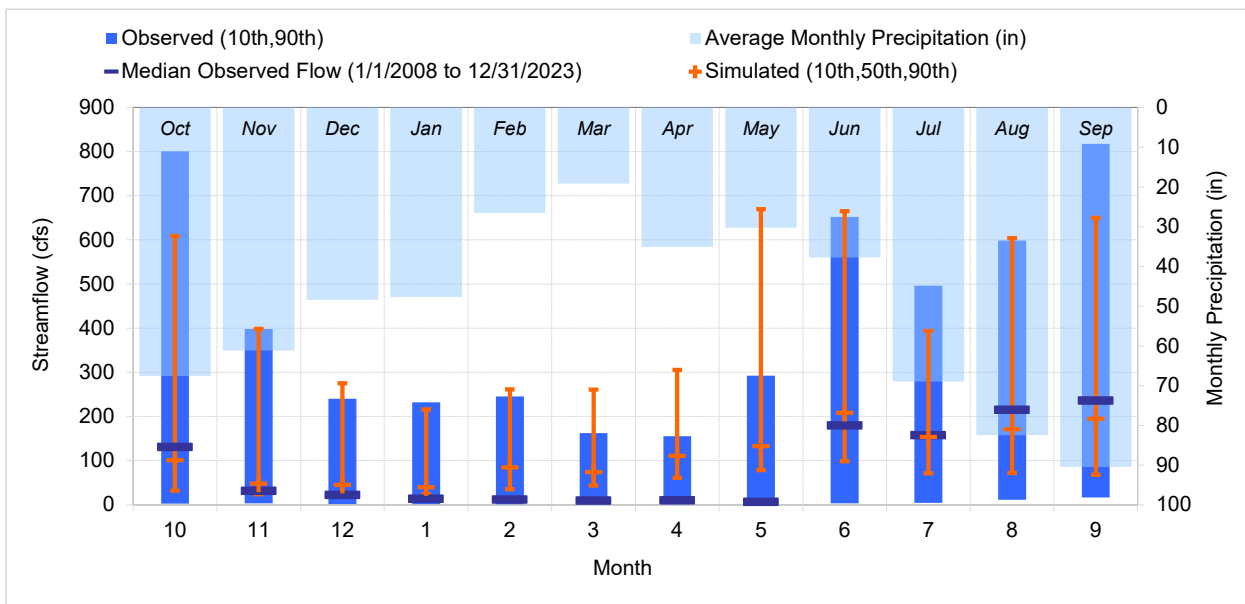


Figure A-32. Seasonal medians and ranges: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

Table A-38. Seasonal summary: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	292.72	131.56	2.40	800.49	259.06	100.80	32.15	608.61
Nov	166.38	31.98	3.49	398.30	179.89	47.98	23.77	398.55
Dec	100.96	22.66	1.48	240.25	126.65	45.14	18.20	275.39
Jan	97.30	14.44	1.15	232.18	133.79	39.82	23.98	216.22
Feb	90.02	12.54	0.44	245.49	127.14	84.72	35.39	261.30
Mar	55.32	10.39	0.05	162.25	127.53	74.37	43.30	260.72
Apr	49.30	10.78	0.26	155.41	155.09	110.89	61.15	305.57
May	138.12	7.53	0.48	292.47	299.22	132.77	78.31	669.76
Jun	277.25	180.20	3.00	652.17	341.99	208.23	98.73	665.21
Jul	218.87	158.52	4.10	496.51	199.65	153.70	71.32	393.87
Aug	321.72	215.89	11.20	598.38	349.20	171.47	72.10	603.96
Sep	374.62	236.79	16.57	817.64	358.82	194.98	68.20	649.84

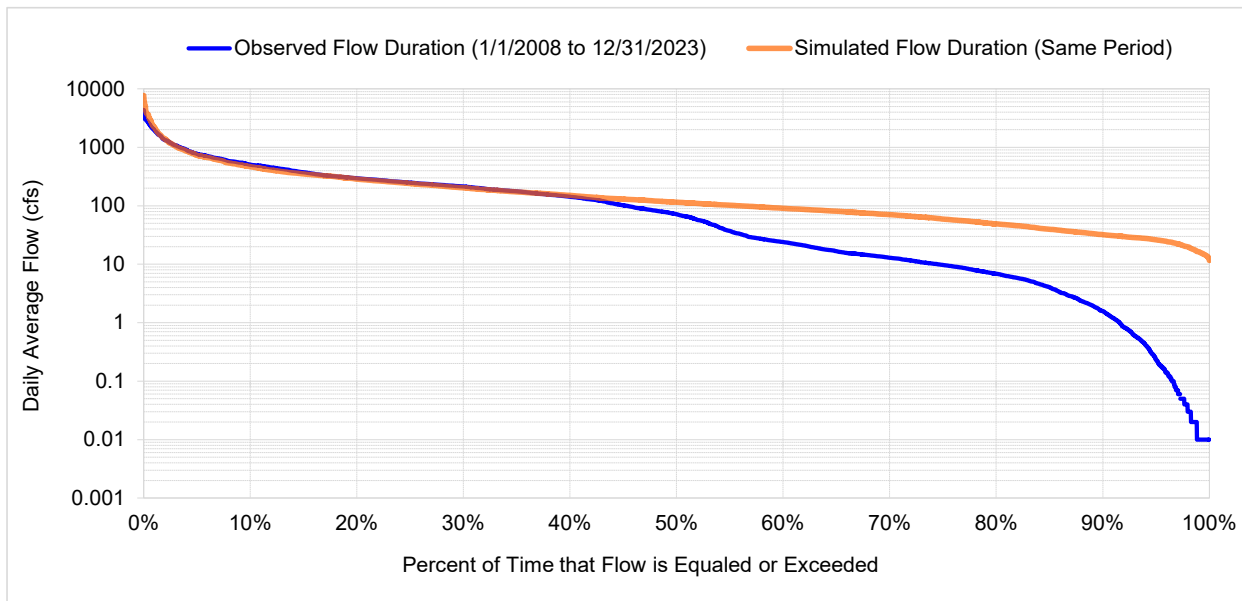


Figure A-33. Flow exceedance: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

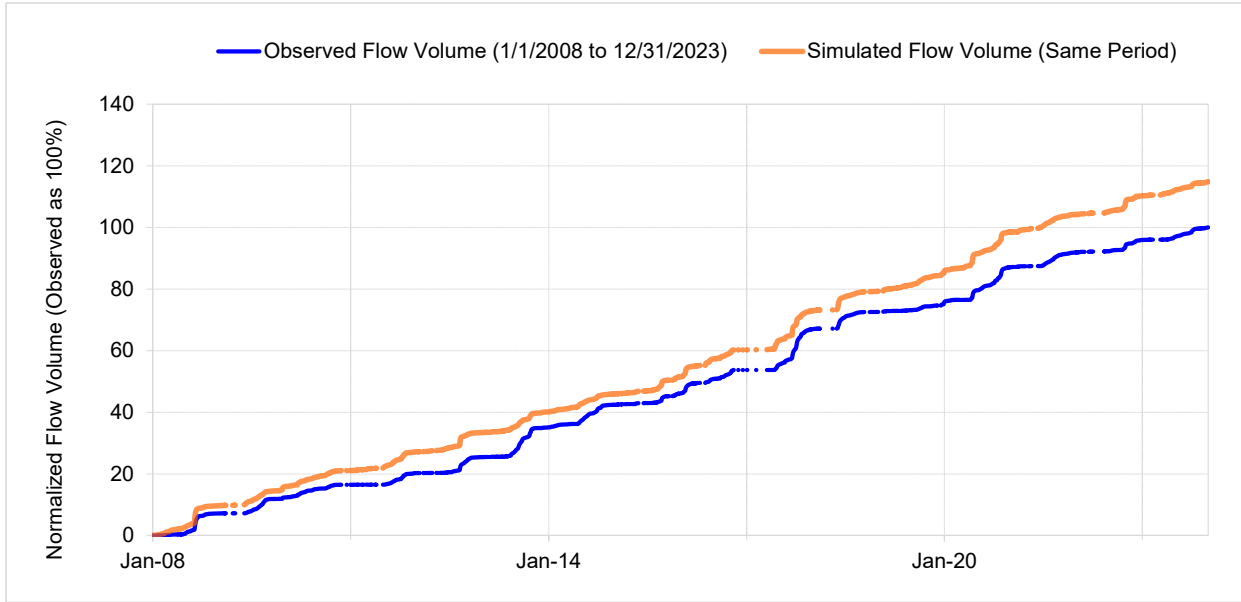


Figure A-34. Flow accumulation: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

Table A-39. Summary statistics: Model vs. S-48 Spillway on Canal C-23 At Tidewater (2008/01/01 - 2023/12/31)

**S-48 Spillway on Canal C-23 at Tidewater (ID - S48\_S)**

Drainage Area (sq-mi): 173

Analysis Period: 1/1/2008 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	12.22	14.03	14.85	10
Total lowest 50% flows	0.44	1.85	321.04	10
Total highest 10% flows	6.26	6.72	7.35	15
Summer flow volume (months 7-9)	5.87	5.82	-0.80	30
Fall flow volume (months 10-12)	3.16	3.15	-0.22	30
Winter flow volume (months 1-3)	1.02	1.59	57.03	30
Spring flow volume (months 4-6)	2.18	3.47	59.17	30
Total storm volume	6.43	6.09	-5.31	20
Summer storm volume (7-9)	2.82	2.50	-11.50	50
Baseflow	5.79	7.94	37.27	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.625	0.7
Baseline adjusted coefficient (Garrick), E'			0.420	0.5
Monthly NSE			0.799	0.8

**S-49 Spillway on Canal C-24 near Florida Turnpike**

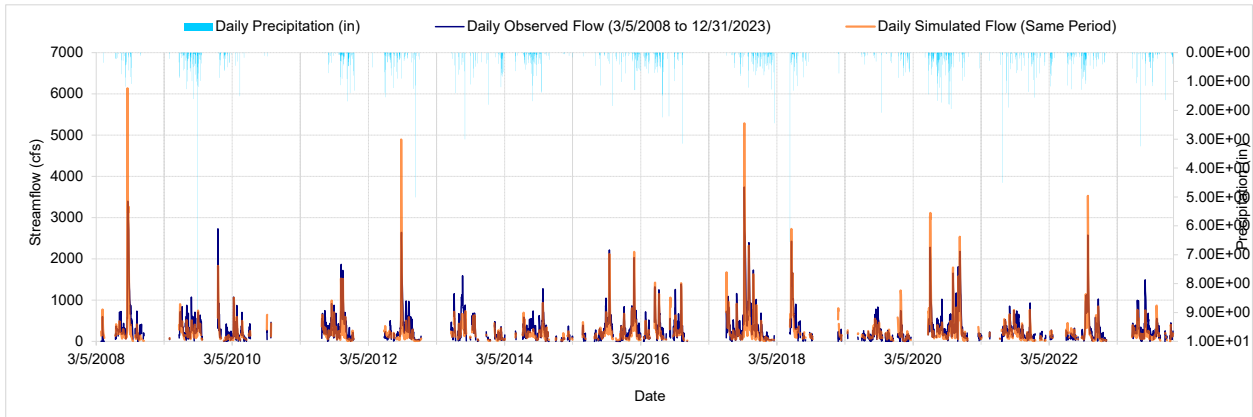


Figure A-35. Mean daily flow: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

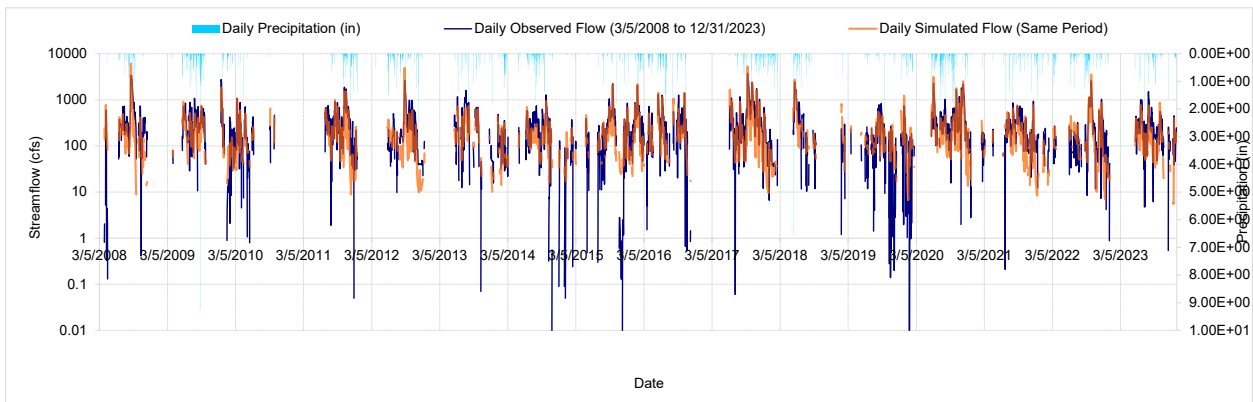


Figure A-36. Log Scale Mean daily flow: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

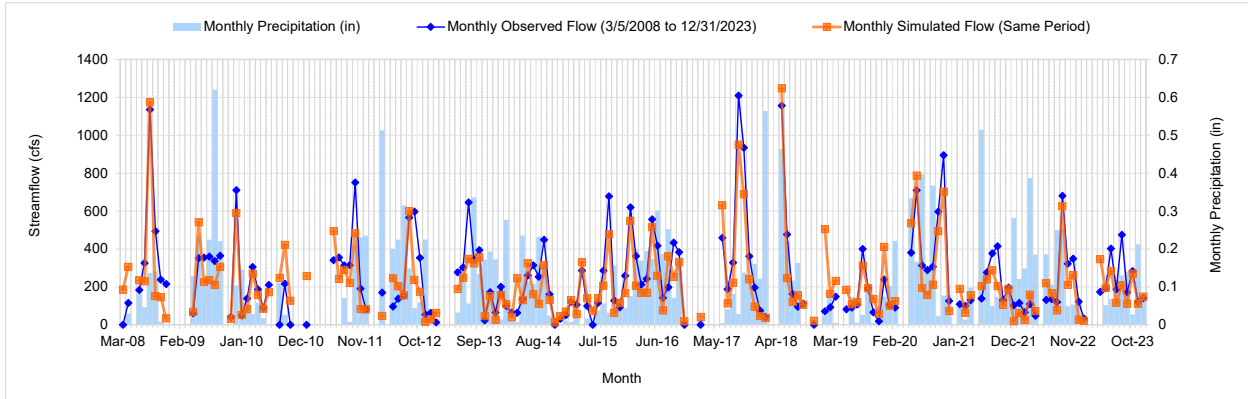


Figure A-37. Mean monthly flow: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

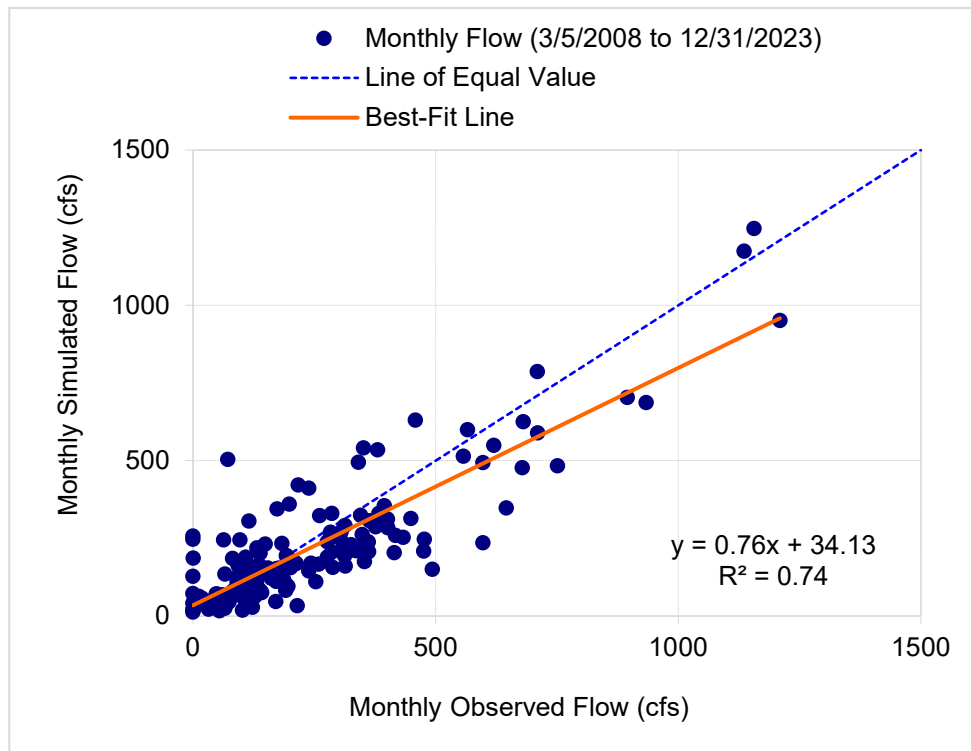


Figure A-38. Monthly flow regression and temporal variation: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

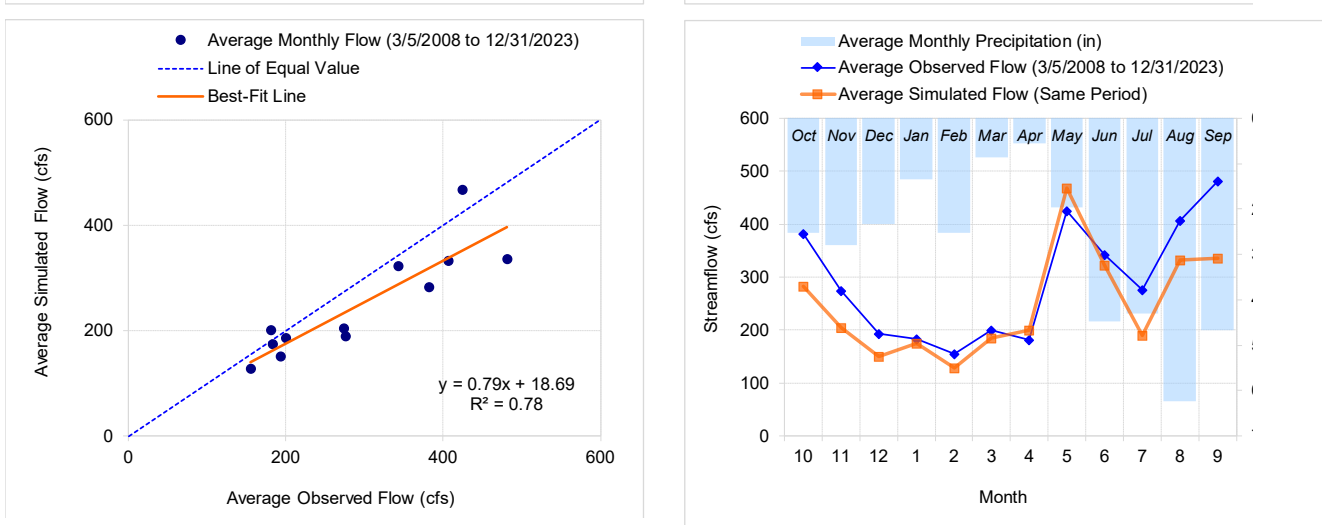


Figure A-39. Seasonal regression and temporal aggregate: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

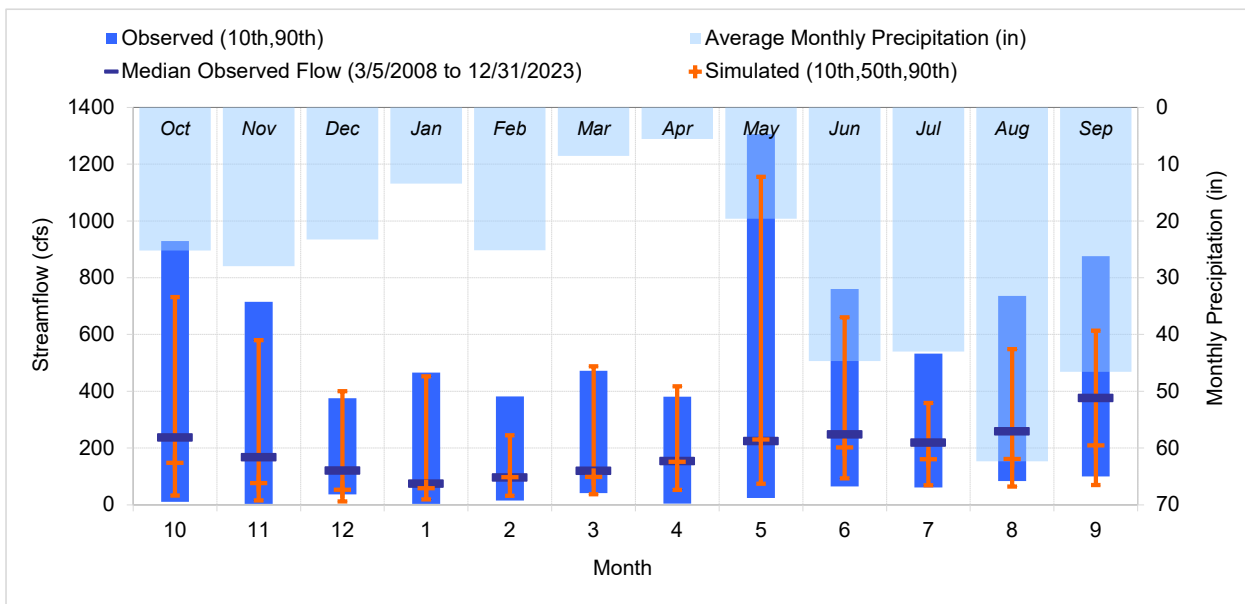


Figure A-40. Seasonal medians and ranges: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

Table A-40. Seasonal summary: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	382.12	237.86	10.04	929.15	282.18	148.51	32.69	731.88
Nov	273.76	168.55	3.25	715.01	204.49	76.63	15.66	579.71
Dec	193.78	121.55	36.44	375.66	150.90	53.34	11.71	400.02
Jan	183.53	75.10	3.56	465.75	175.01	58.49	19.34	452.44
Feb	155.09	96.93	14.70	381.53	128.00	98.01	31.86	245.26
Mar	200.56	120.89	41.51	471.98	185.71	98.82	37.19	488.03
Apr	181.35	155.37	4.48	381.12	200.56	151.53	51.98	417.58
May	424.71	225.79	23.88	1306.16	467.43	230.77	74.36	1155.38
Jun	343.18	248.83	64.67	760.39	322.54	202.35	93.29	660.12
Jul	276.31	219.62	61.42	532.46	189.63	160.45	68.86	359.04
Aug	406.46	260.06	83.77	735.48	331.84	161.43	63.79	548.54
Sep	481.22	376.85	99.51	876.25	336.26	209.96	70.00	613.18

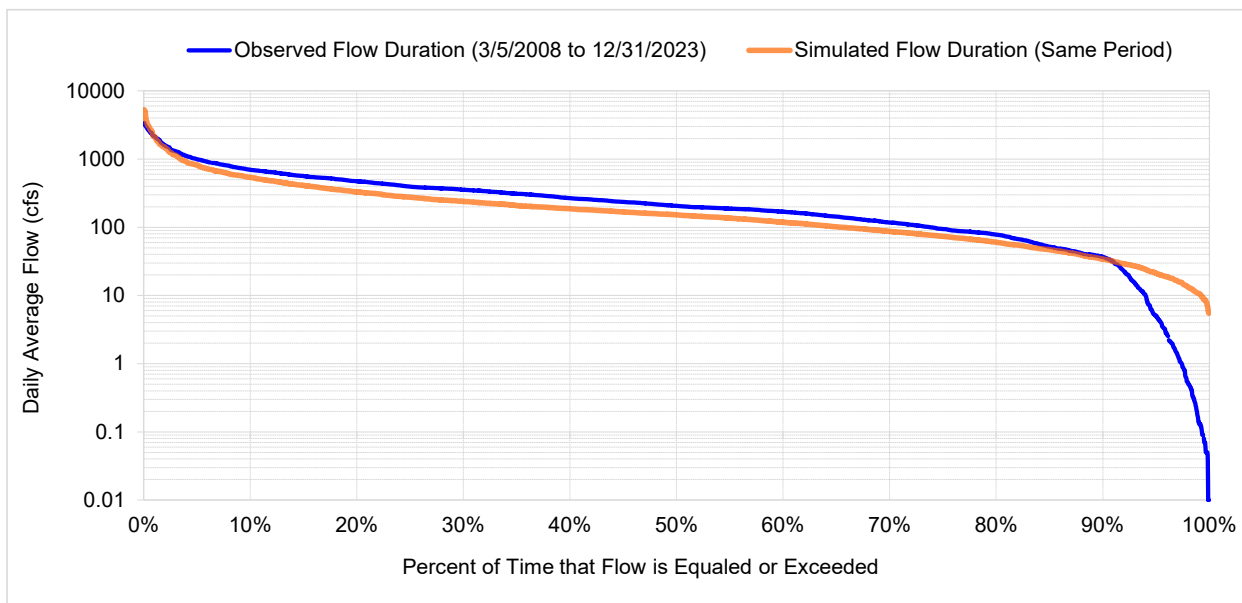


Figure A-41. Flow exceedance: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

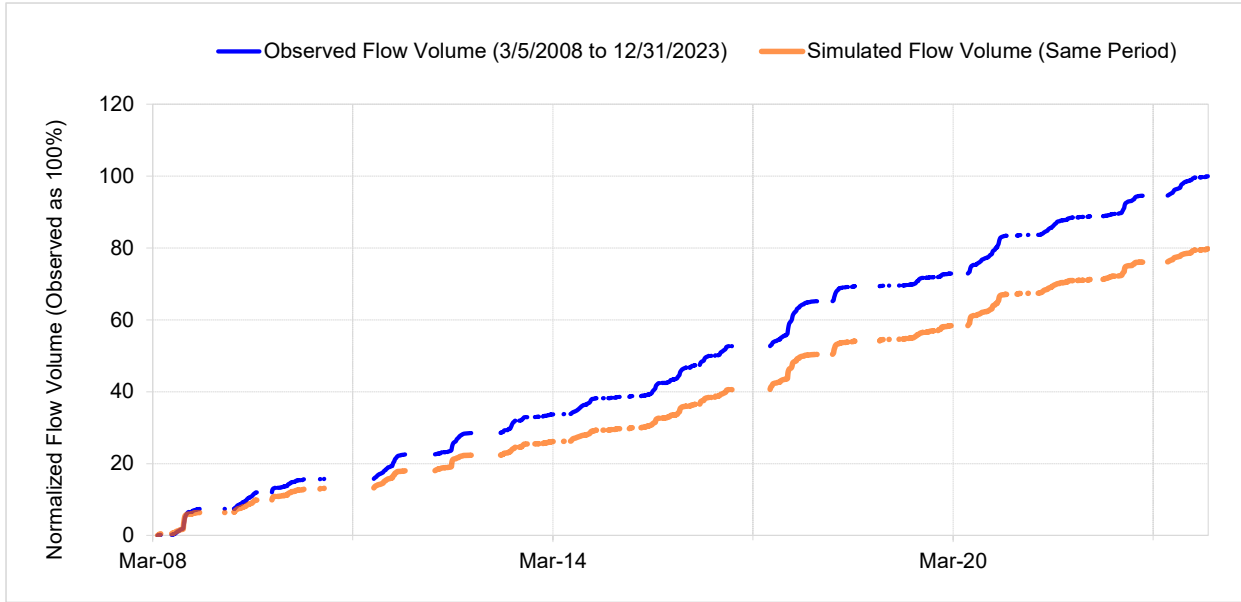


Figure A-42. Flow accumulation: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

Table A-41. Summary statistics: Model vs. S-49 Spillway on Canal C-24 Near Florida Turnpike (2008/03/05 - 2023/12/31)

**S-49 Spillway on Canal C-24 Near Florida Turnpike (ID - S49\_S)**

Drainage Area (sq-mi): 130

Analysis Period: 3/5/2008 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	16.14	12.88	-20.20	10
Total lowest 50% flows	2.44	1.88	-22.81	10
Total highest 10% flows	6.14	5.66	-7.76	15
Summer flow volume (months 7-9)	7.98	5.88	-26.37	30
Fall flow volume (months 10-12)	4.10	3.07	-25.20	30
Winter flow volume (months 1-3)	1.22	1.10	-9.51	30
Spring flow volume (months 4-6)	2.83	2.83	-0.17	30
Total storm volume	7.42	5.96	-19.60	20
Summer storm volume (7-9)	3.34	2.57	-23.30	50
Baseflow	8.72	6.91	-20.71	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.684	0.7
Baseline adjusted coefficient (Garrick), E'			0.440	0.5
Monthly NSE			0.846	0.8

**S-97 Spillway on Canal C-23 near Florida Turnpike**

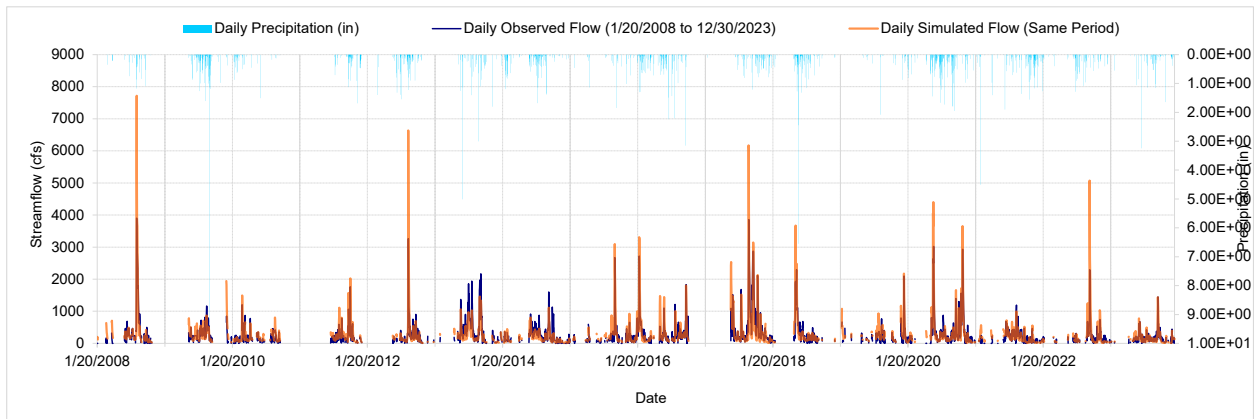


Figure A-43. Mean daily flow: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

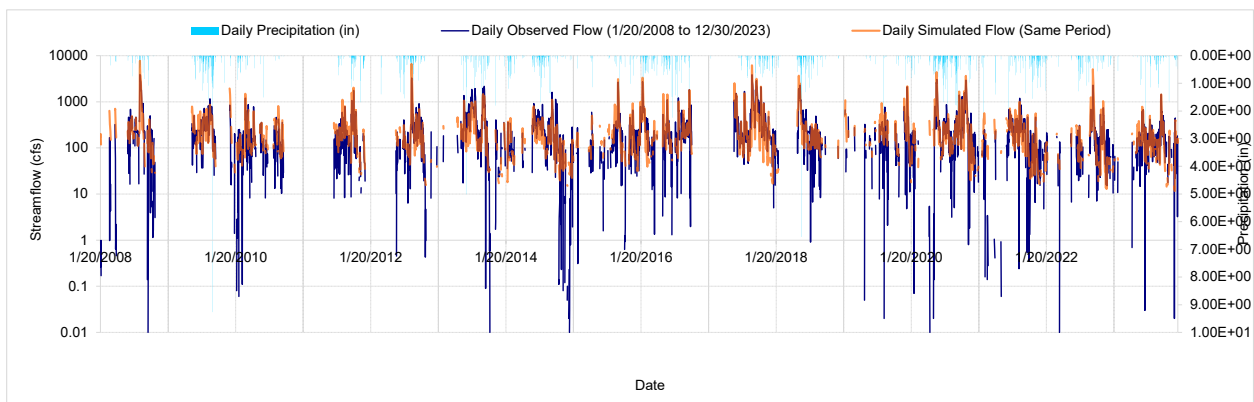


Figure A-44. Log Scale Mean daily flow: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

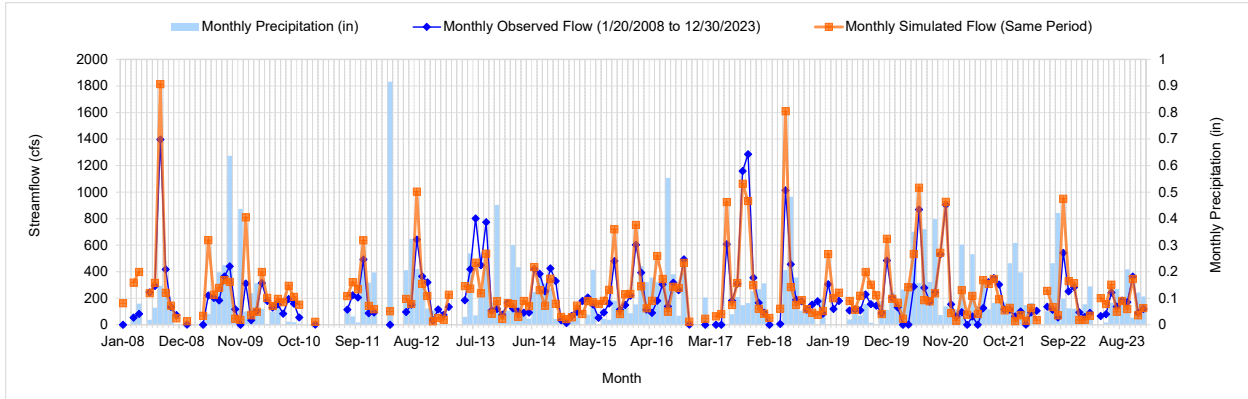


Figure A-45. Mean monthly flow: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

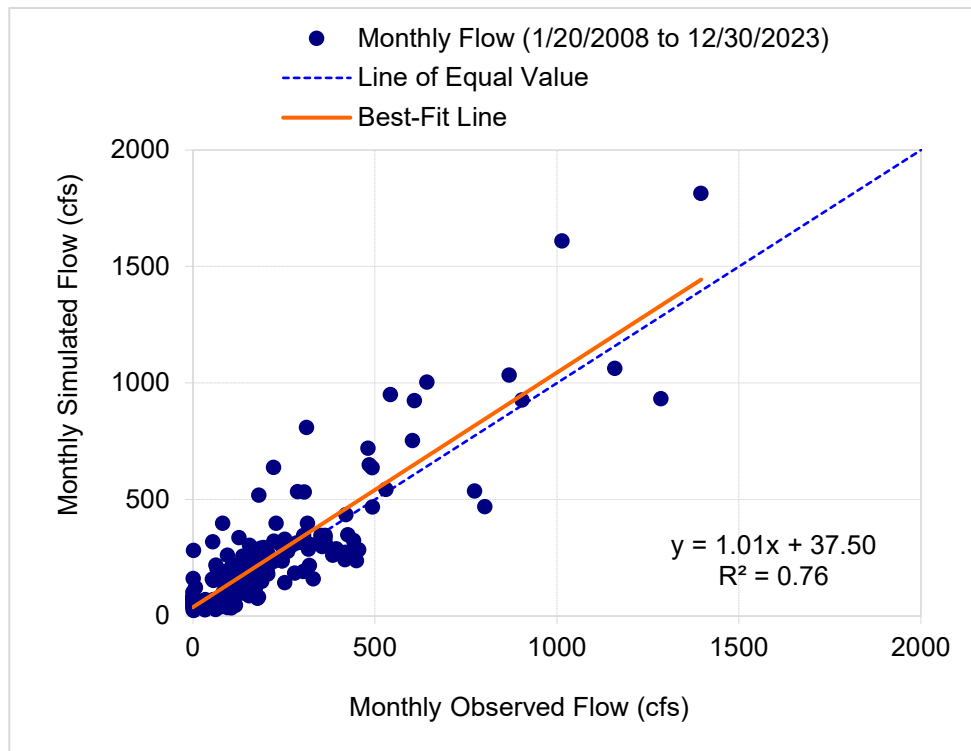


Figure A-46. Monthly flow regression and temporal variation: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

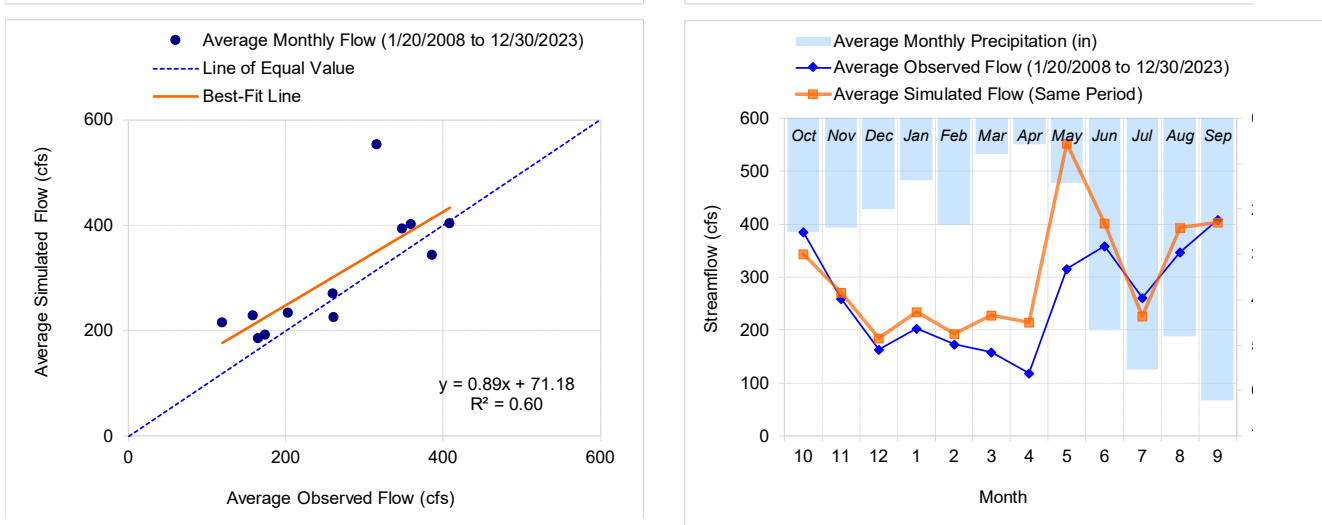


Figure A-47. Seasonal regression and temporal aggregate: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

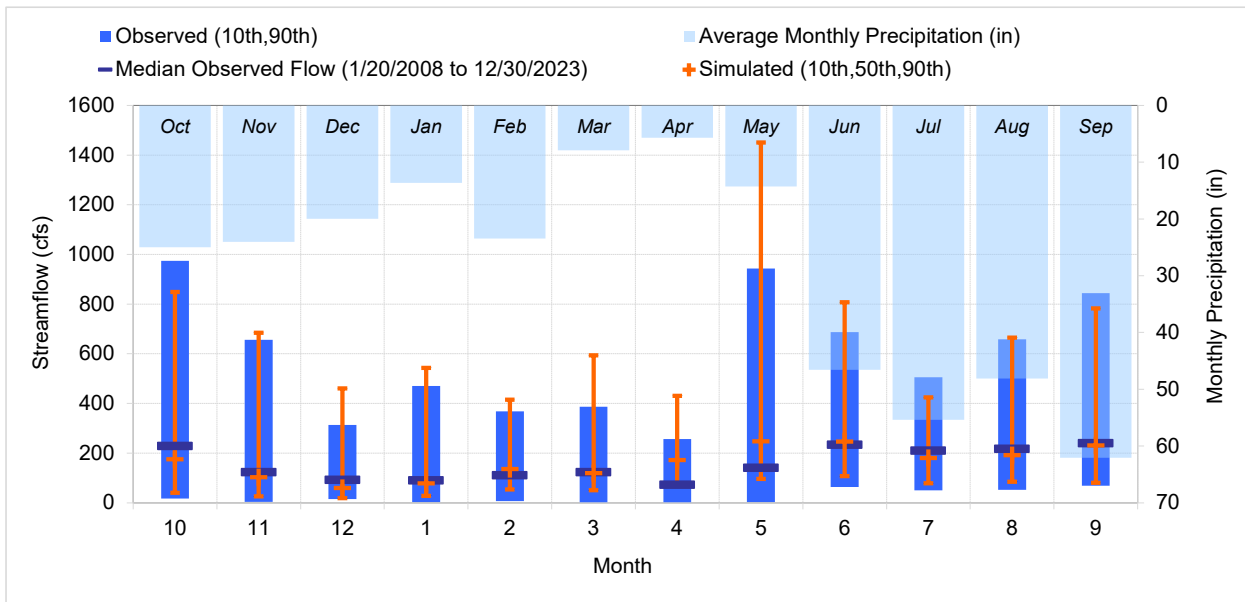


Figure A-48. Seasonal medians and ranges: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

Table A-42. Seasonal summary: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	385.69	229.65	17.48	974.37	344.11	175.57	39.84	848.29
Nov	259.41	123.93	3.14	656.56	271.70	103.66	26.28	684.88
Dec	164.14	93.47	15.28	313.84	185.65	60.31	18.34	460.86
Jan	202.75	91.07	2.64	469.81	234.62	78.79	27.87	543.45
Feb	172.99	112.01	6.78	368.48	192.93	135.90	53.87	415.56
Mar	158.13	124.04	0.51	386.38	228.52	119.51	50.52	593.52
Apr	119.00	73.45	0.54	256.55	215.58	172.41	77.69	430.41
May	315.24	142.27	3.03	943.34	553.48	247.43	95.74	1450.86
Jun	359.33	234.74	63.40	686.85	402.71	247.06	107.81	807.11
Jul	261.11	211.37	50.26	505.02	225.62	181.08	78.55	424.68
Aug	347.63	218.60	52.42	658.65	394.11	192.08	84.65	664.89
Sep	408.48	241.31	68.40	844.16	403.86	230.92	80.98	782.22

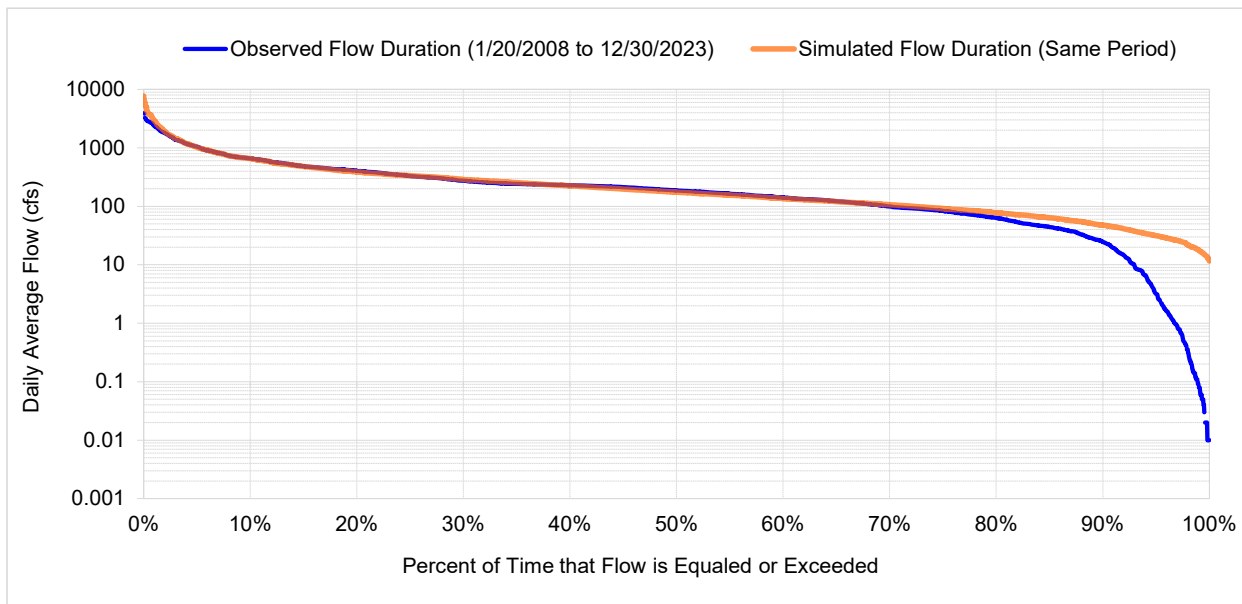


Figure A-49. Flow exceedance: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

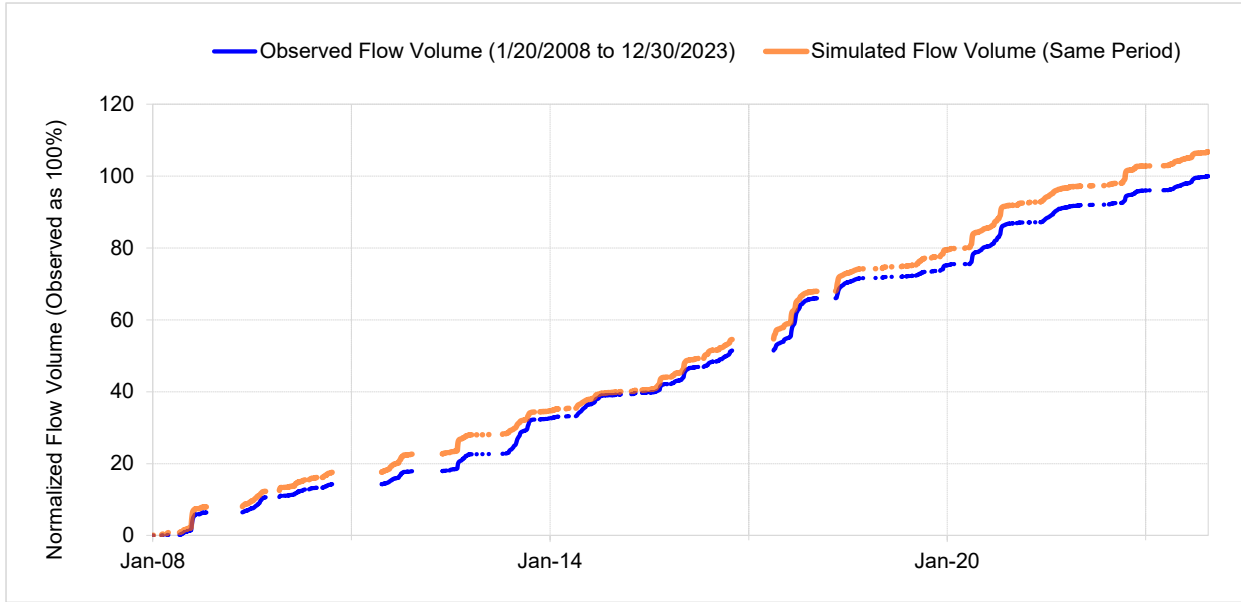


Figure A-50. Flow accumulation: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

Table A-43. Summary statistics: Model vs. S-97 Spillway on Canal C-23 Near Florida Turnpike (2008/01/20 - 2023/12/30)

**S-97 Spillway on Canal C-23 Near Florida Turnpike (ID - S97\_S)**

Drainage Area (sq-mi): 173

Analysis Period: 1/20/2008 to 12/30/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	11.15	11.91	6.77	10
Total lowest 50% flows	1.55	1.71	10.52	10
Total highest 10% flows	4.79	5.44	13.56	15
Summer flow volume (months 7-9)	5.40	5.46	1.10	30
Fall flow volume (months 10-12)	2.91	2.83	-2.83	30
Winter flow volume (months 1-3)	0.87	1.04	19.36	30
Spring flow volume (months 4-6)	1.97	2.58	30.86	30
Total storm volume	5.76	5.58	-3.22	20
Summer storm volume (7-9)	2.57	2.44	-5.27	50
Baseflow	5.39	6.33	17.44	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.586	0.7
Baseline adjusted coefficient (Garrick), E'			0.410	0.5
Monthly NSE			0.837	0.8

**Gordy Rd. Bridge N St. Lucie Water Control District Structure 71-1**

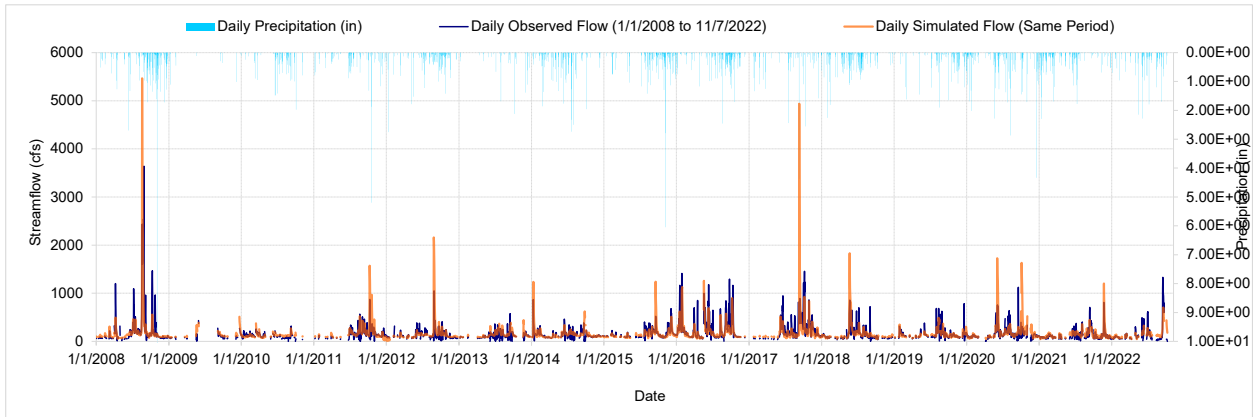


Figure A-51. Mean daily flow: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

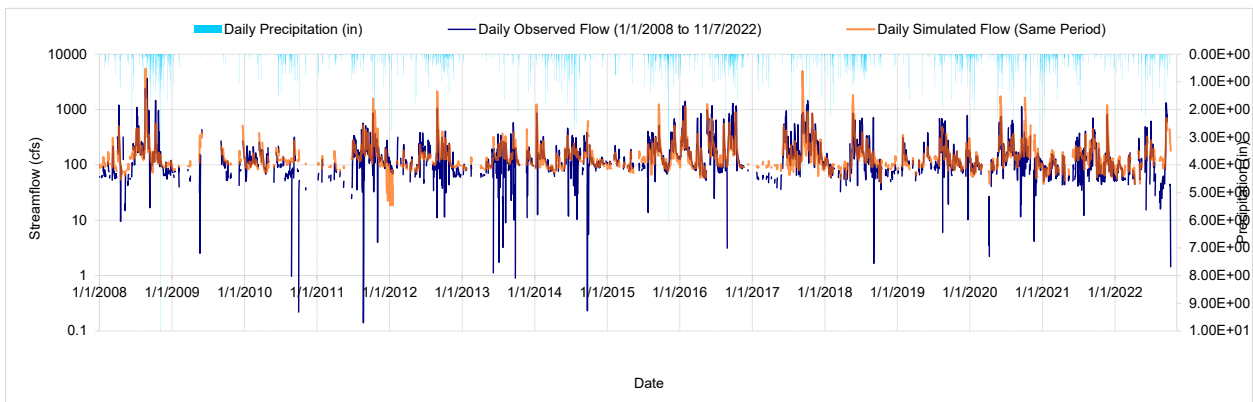


Figure A-52. Log Scale Mean daily flow: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

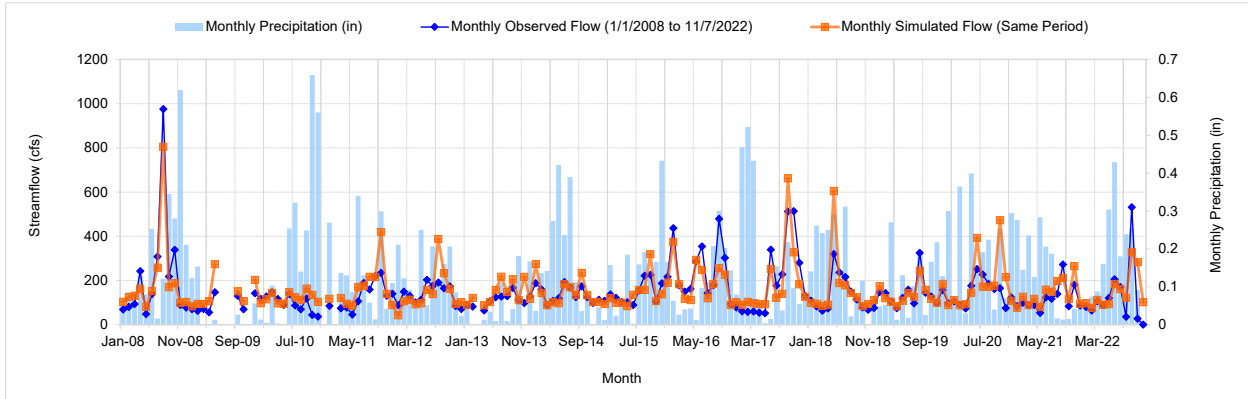


Figure A-53. Mean monthly flow: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

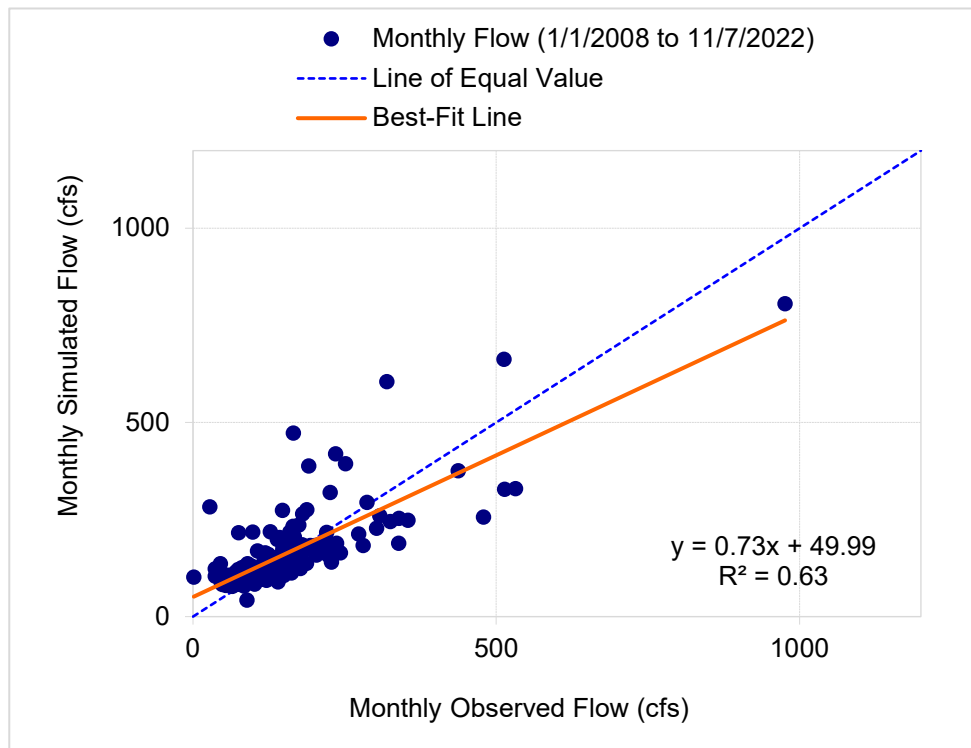


Figure A-54. Monthly flow regression and temporal variation: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

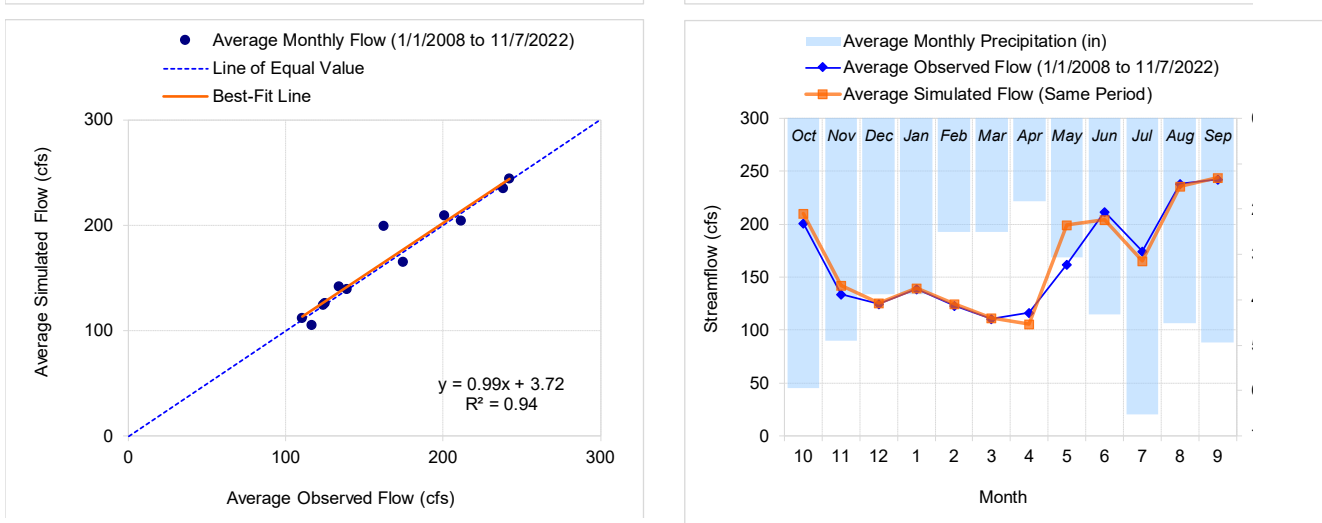


Figure A-55. Seasonal regression and temporal aggregate: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

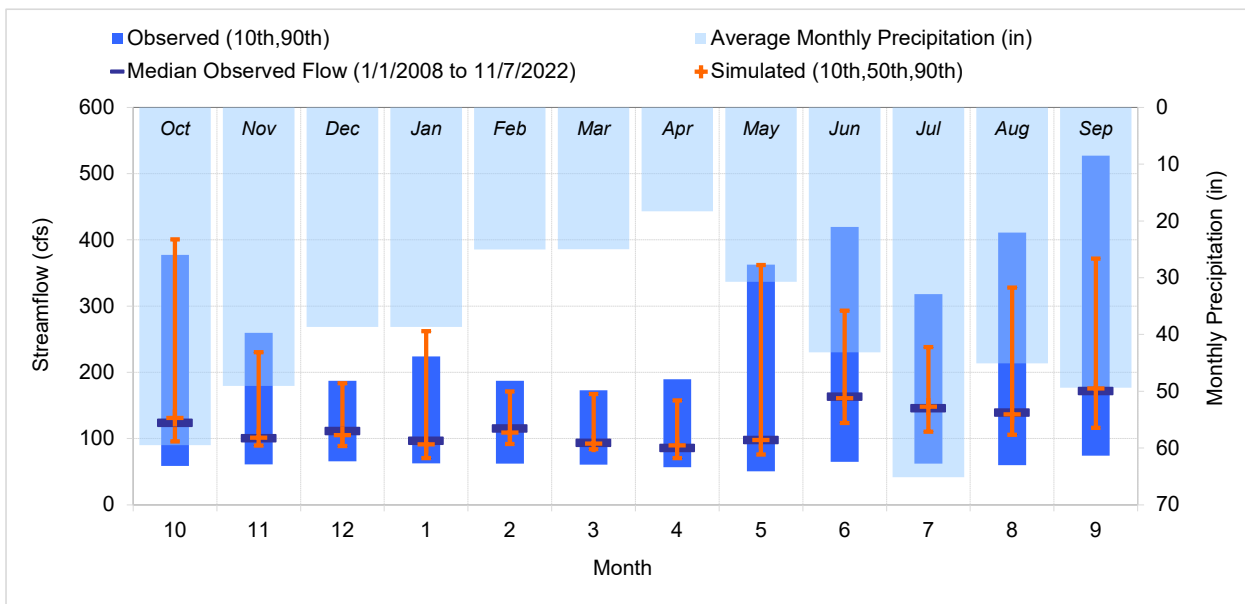


Figure A-56. Seasonal medians and ranges: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

Table A-44. Seasonal summary: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	200.85	124.16	58.85	377.15	209.85	131.33	95.69	400.81
Nov	133.55	100.83	60.93	259.60	142.37	101.30	89.45	230.20
Dec	124.55	111.62	65.60	187.26	126.01	105.22	88.75	183.35
Jan	138.70	96.80	62.40	224.01	139.89	91.52	70.45	262.15
Feb	123.43	115.47	62.02	187.12	124.51	109.32	91.77	171.23
Mar	110.40	93.94	60.41	172.74	111.95	92.66	84.15	167.15
Apr	116.60	86.23	56.86	189.50	105.58	89.98	70.31	157.50
May	162.07	98.25	50.44	362.66	199.31	97.86	75.84	361.84
Jun	211.43	163.59	65.05	419.34	204.70	161.20	123.36	293.28
Jul	174.65	146.15	61.97	317.92	165.68	148.40	110.32	238.02
Aug	238.01	139.45	59.69	410.87	235.59	136.80	105.65	327.84
Sep	242.05	172.29	74.12	527.16	244.30	175.60	115.98	371.72

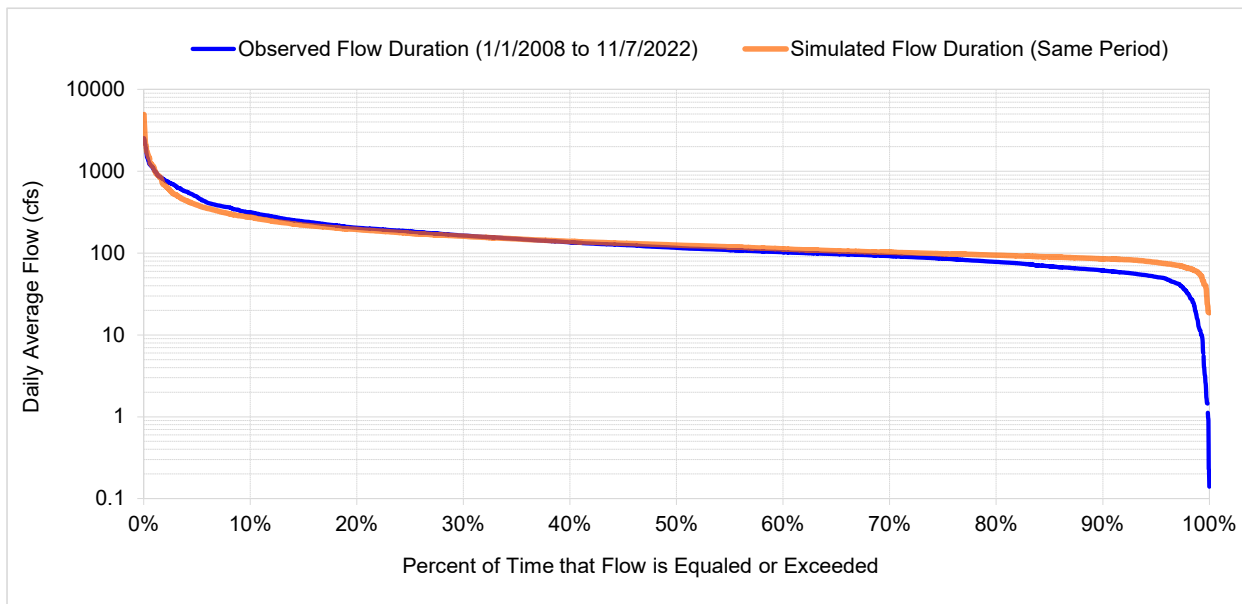


Figure A-57. Flow exceedance: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

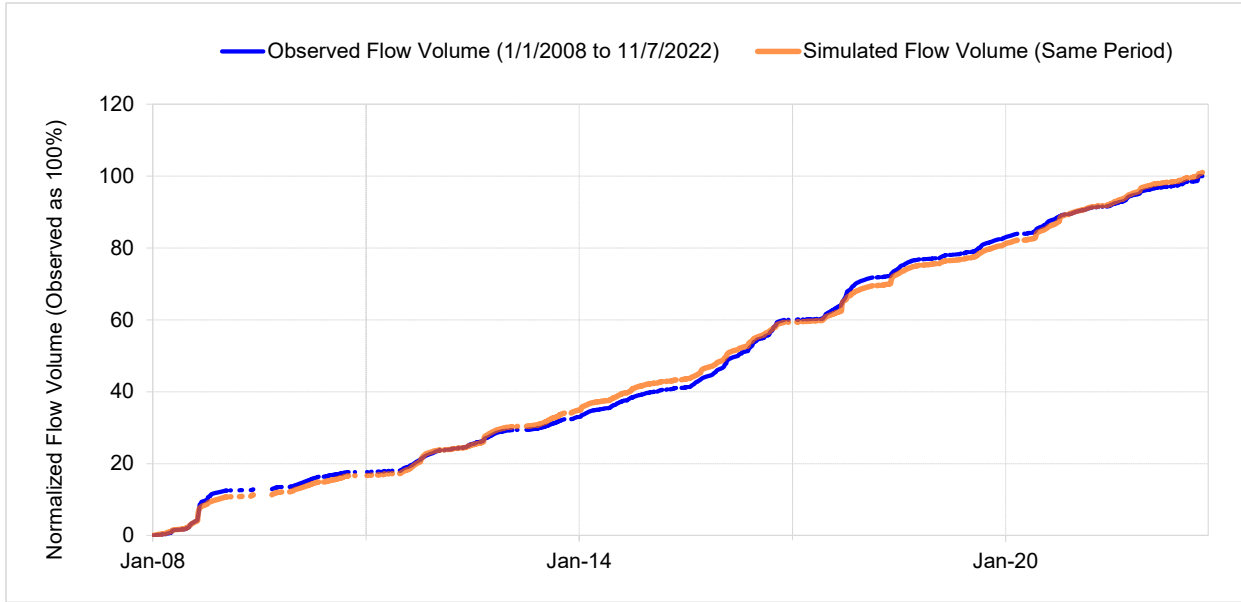


Figure A-58. Flow accumulation: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

Table A-45. Summary statistics: Model vs. GORDY Rd. Bridge N St. Lucie Water Ctl Dist. Structure 71-1 (2008/01/01 - 2022/11/07)

**GORDY Rd. Bridge N St. Lucie water ctl dist. Structure 71-1 (ID - GORDY\_S)**

Drainage Area (sq-mi): 64

Analysis Period: 1/1/2008 to 11/7/2022

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	23.78	24.02	1.03	10
Total lowest 50% flows	5.58	6.71	20.21	10
Total highest 10% flows	8.45	7.92	-6.32	15
Summer flow volume (months 7-9)	9.76	9.64	-1.28	30
Fall flow volume (months 10-12)	5.72	5.96	4.17	30
Winter flow volume (months 1-3)	3.72	3.75	0.99	>> 30
Spring flow volume (months 4-6)	4.58	4.67	2.08	30
Total storm volume	8.88	6.54	-26.36	20
Summer storm volume (7-9)	4.13	2.80	-32.19	50
Baseflow	14.90	17.49	17.35	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.088	0.7
Baseline adjusted coefficient (Garrick), E'			0.327	0.5
Monthly NSE			0.792	0.8

## A-2 HYDROLOGY VALIDATION

### G78\_C: At C-23 canal, about 15 miles southwest of Fort Pierce

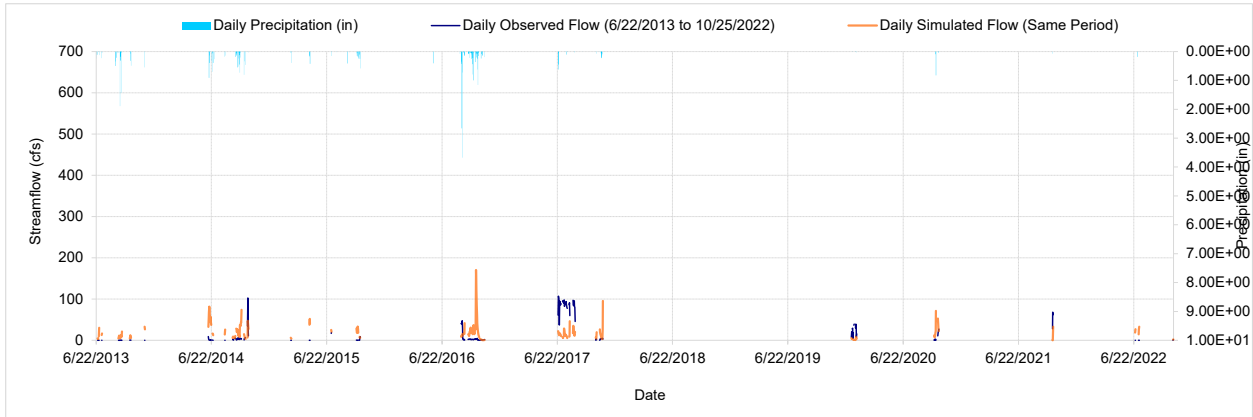


Figure A-59. Mean daily flow: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

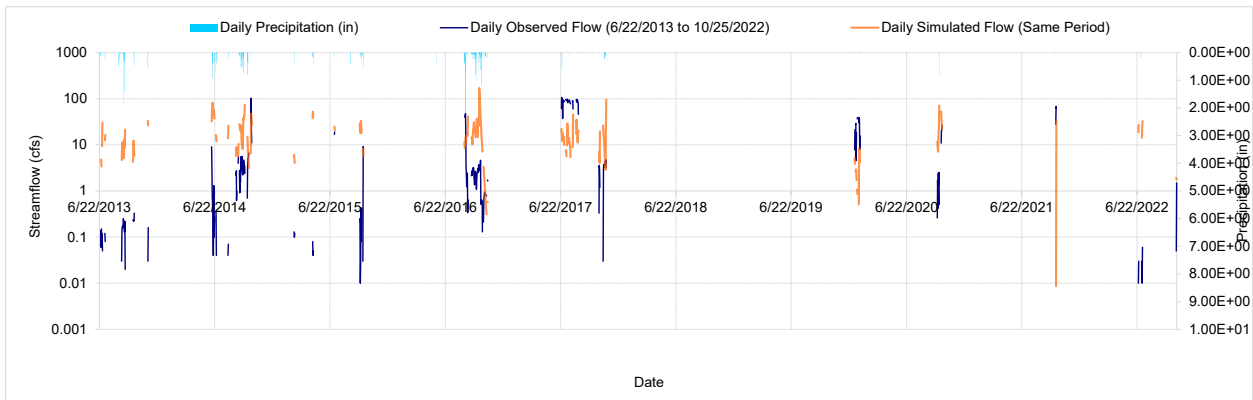


Figure A-60. Log Scale Mean daily flow: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

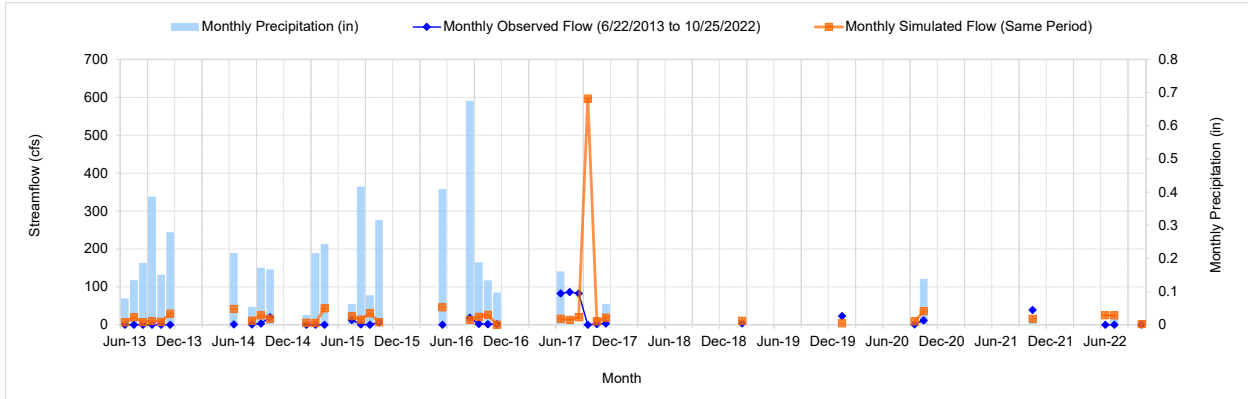


Figure A-61. Mean monthly flow: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

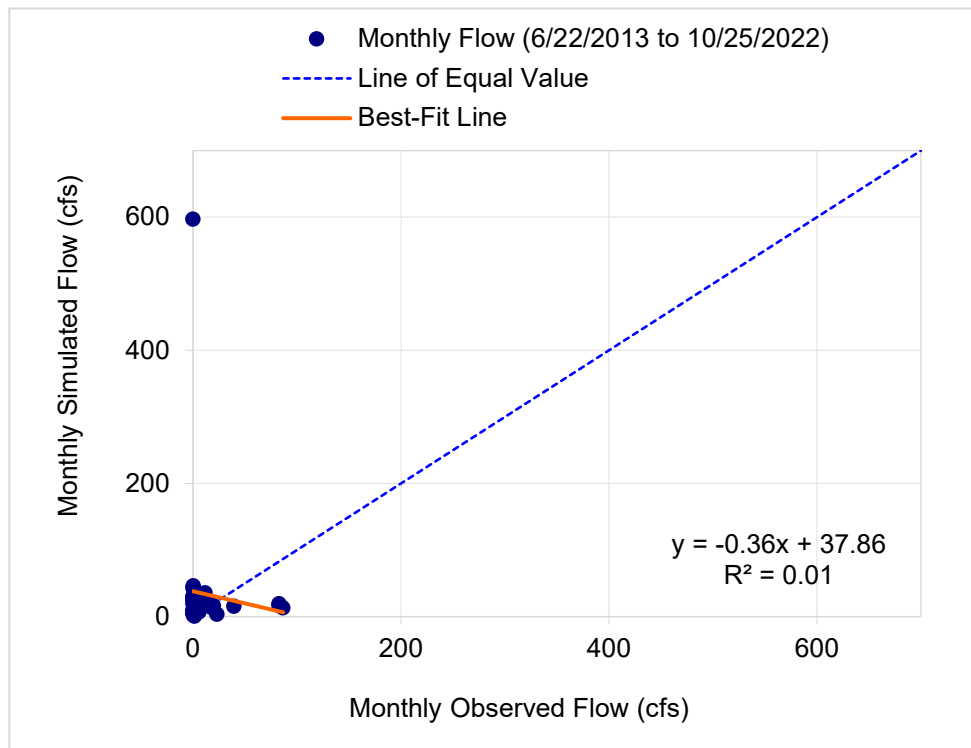


Figure A-62. Monthly flow regression and temporal variation: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

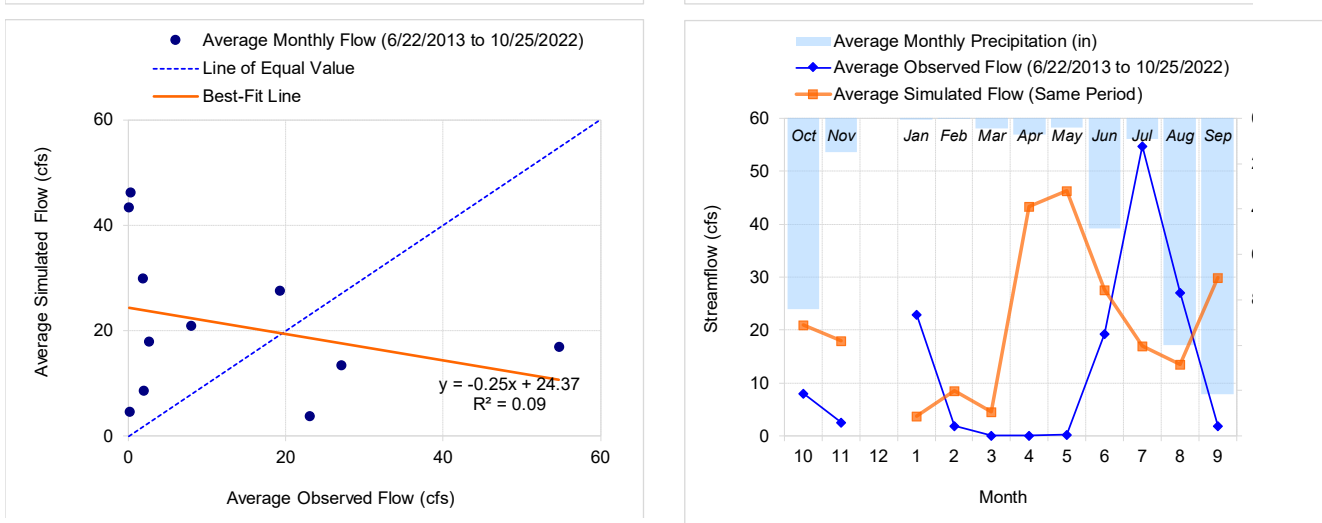


Figure A-63. Seasonal regression and temporal aggregate: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

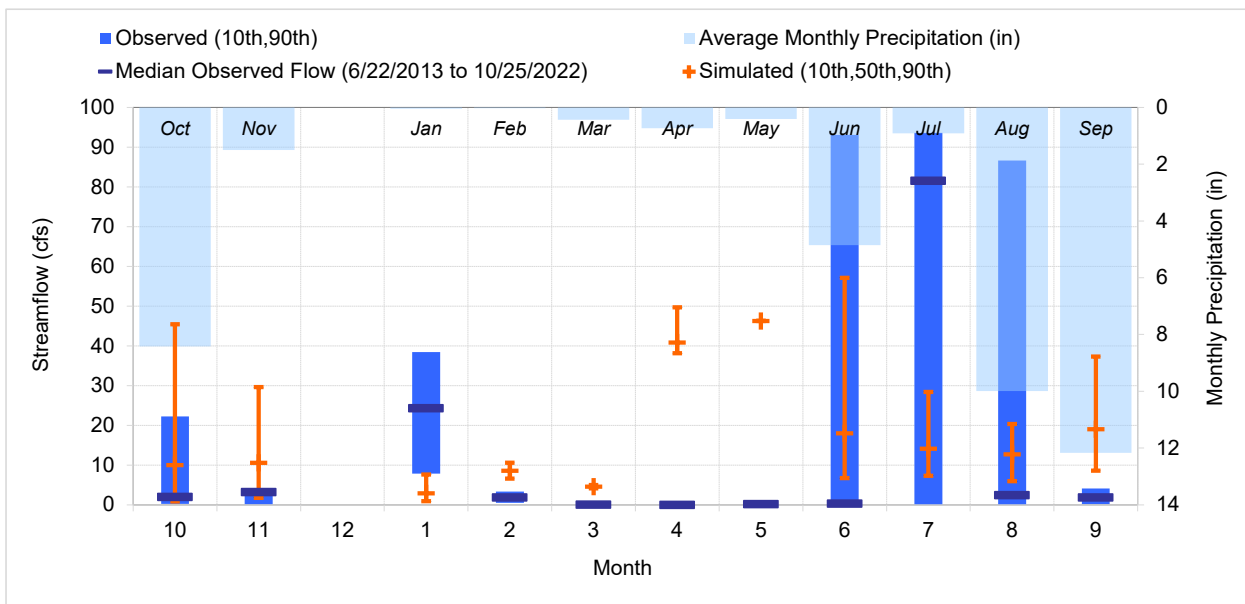


Figure A-64. Seasonal medians and ranges: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

Table A-46. Seasonal summary: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	8.02	2.01	0.22	22.24	20.94	9.99	0.85	45.42
Nov	2.60	3.24	0.10	4.21	17.98	10.56	1.72	29.64
Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jan	23.03	24.39	7.87	38.41	3.72	2.88	0.92	7.62
Feb	1.91	1.91	0.49	3.33	8.60	8.60	6.59	10.60
Mar	0.11	0.11	0.10	0.12	4.56	4.56	4.15	4.96
Apr	0.06	0.05	0.04	0.07	43.41	40.86	38.16	49.67
May	0.24	0.24	0.24	0.24	46.27	46.27	46.27	46.27
Jun	19.30	0.34	0.04	93.11	27.64	18.01	6.74	57.09
Jul	54.71	81.63	0.06	93.63	16.93	14.10	7.28	28.40
Aug	27.08	2.46	0.03	86.60	13.50	12.71	5.93	20.32
Sep	1.88	1.93	0.13	4.11	29.91	19.04	8.59	37.27

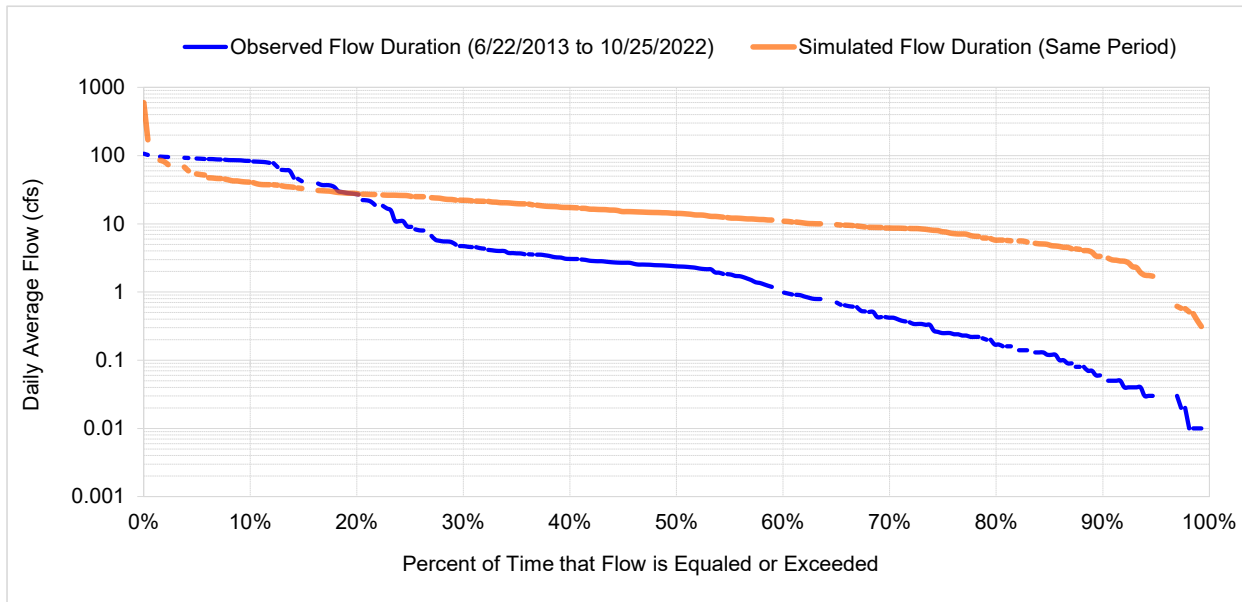


Figure A-65. Flow exceedance: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

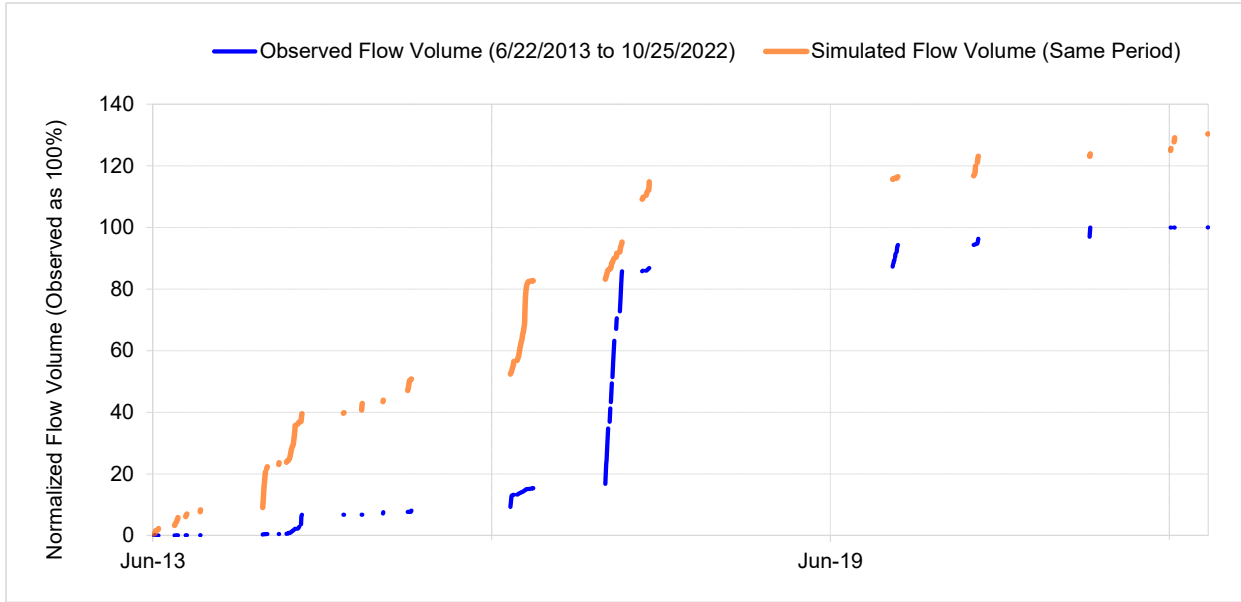


Figure A-66. Flow accumulation: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

Table A-47. Summary statistics: Model vs. At C-23 Canal, About 15 Miles Southwest of Fort Pierce (2013/06/22 - 2022/10/25)

**At C-23 canal, about 15 miles southwest of Fort Pierce (ID - G78\_C)**

Drainage Area (sq-mi): 1

Analysis Period: 6/22/2013 to 10/25/2022

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	17.33	22.59	30.35	10
Total lowest 50% flows	0.30	3.78	1145.91	10
Total highest 10% flows	9.54	8.88	-7.00	15
Summer flow volume (months 7-9)	11.44	11.69	2.15	30
Fall flow volume (months 10-12)	2.21	6.48	193.29	30
Winter flow volume (months 1-3)	1.30	0.31	-75.97	30
Spring flow volume (months 4-6)	2.38	4.11	72.63	30
Total storm volume	4.47	9.28	107.75	20
Summer storm volume (7-9)	1.65	5.07	206.54	50
Baseflow	12.87	13.32	3.49	20
Nash-Sutcliffe Coefficient of Efficiency, E			-2.071	0.7
Baseline adjusted coefficient (Garrick), E'			-0.292	0.5
Monthly NSE			-0.240	0.8

**G79\_C dividing structure between C23 and C24 (Carlton Rd. Structure)**

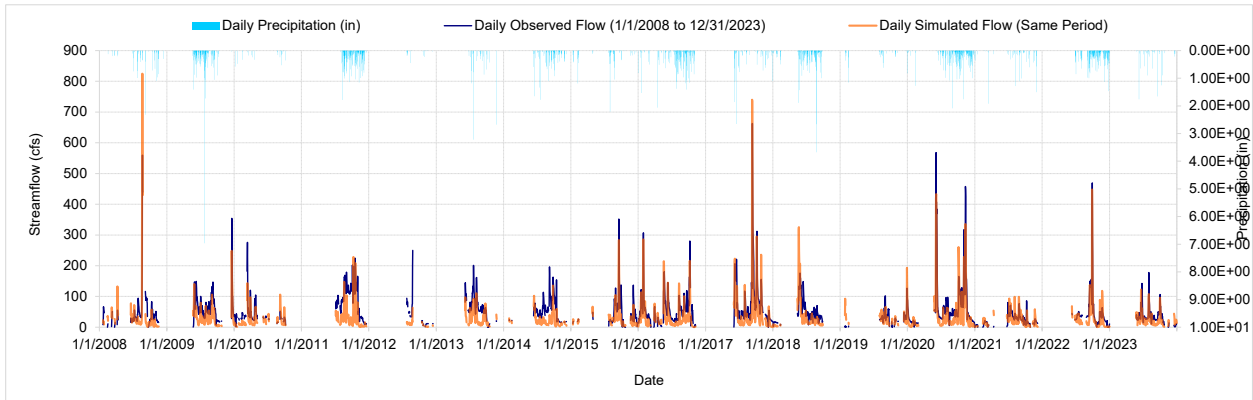


Figure A-67. Mean daily flow: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

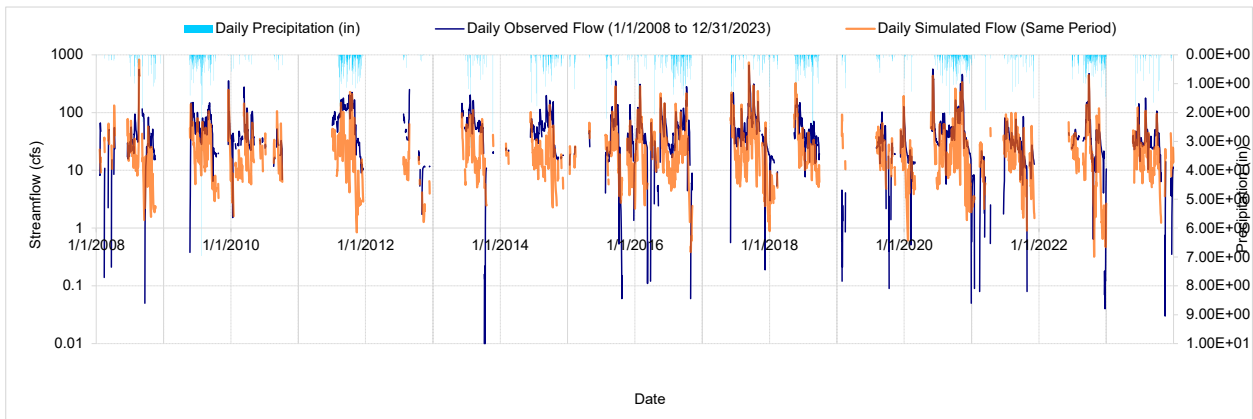


Figure A-68. Log Scale Mean daily flow: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

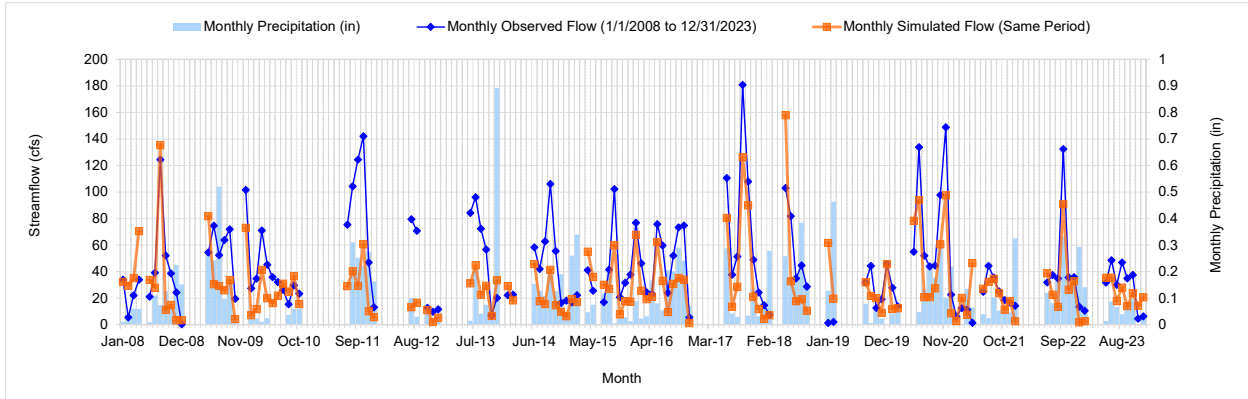


Figure A-69. Mean monthly flow: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

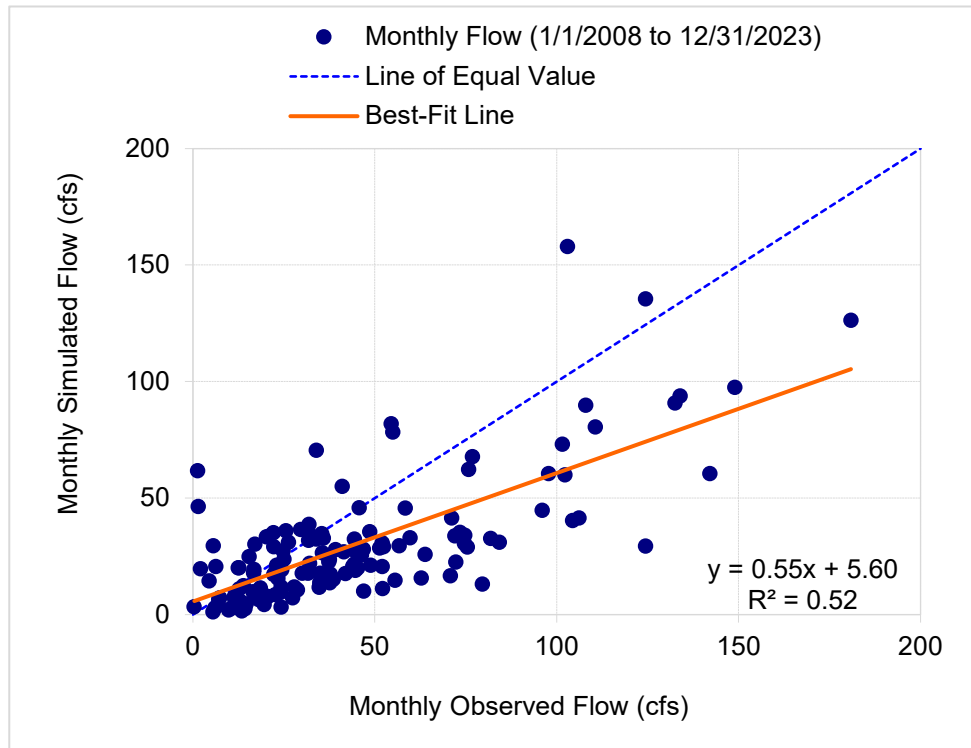


Figure A-70. Monthly flow regression and temporal variation: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

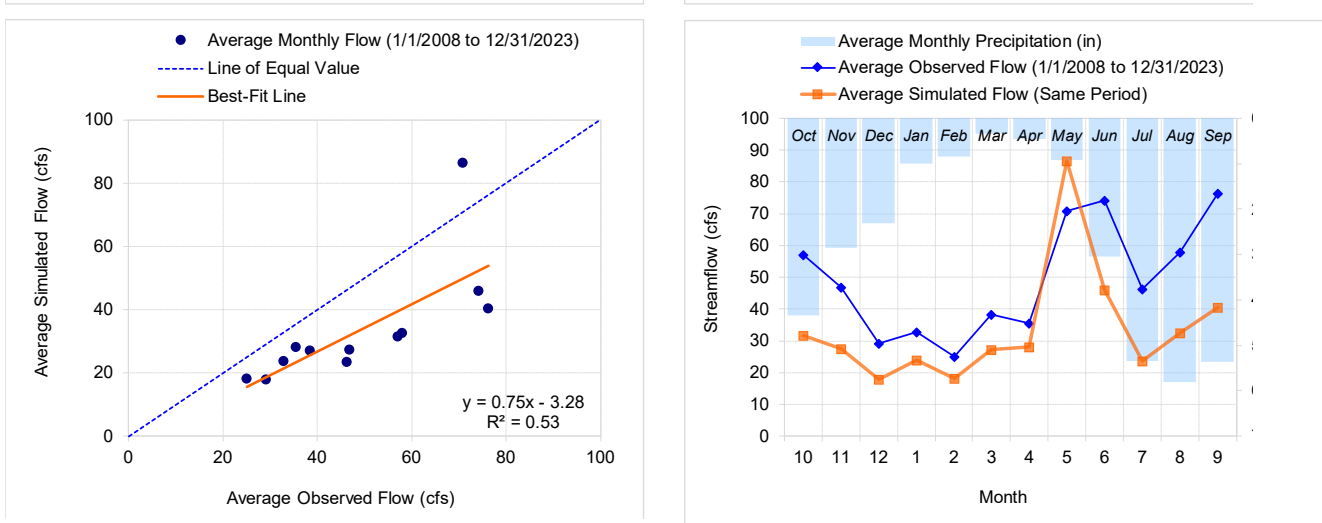


Figure A-71. Seasonal regression and temporal aggregate: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

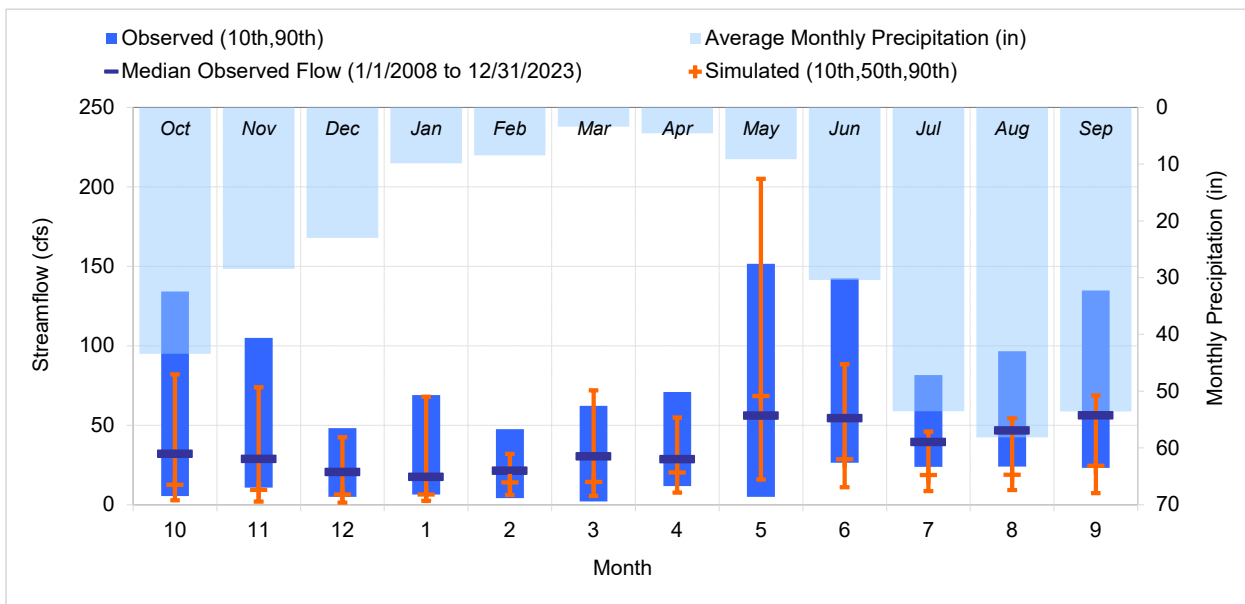


Figure A-72. Seasonal medians and ranges: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

Table A-48. Seasonal summary: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	56.95	32.14	5.37	134.09	31.68	12.51	2.78	81.93
Nov	46.78	28.93	10.74	104.88	27.46	9.35	1.91	73.92
Dec	29.11	20.68	4.99	48.19	17.91	6.51	1.35	42.46
Jan	32.78	17.70	6.32	69.03	23.91	6.48	2.41	67.94
Feb	25.02	21.48	4.09	47.50	18.19	14.11	6.07	31.88
Mar	38.32	30.53	1.99	62.20	27.15	14.43	5.50	71.90
Apr	35.42	28.75	11.68	70.85	28.10	20.28	7.53	54.91
May	70.82	56.17	4.96	151.53	86.51	68.33	15.81	205.06
Jun	74.09	54.56	26.44	142.35	46.09	28.78	10.95	88.44
Jul	46.30	39.68	23.82	81.55	23.55	18.65	8.58	45.90
Aug	57.96	46.89	24.02	96.48	32.58	18.84	9.16	54.38
Sep	76.25	56.34	23.16	134.79	40.54	24.53	7.28	68.78

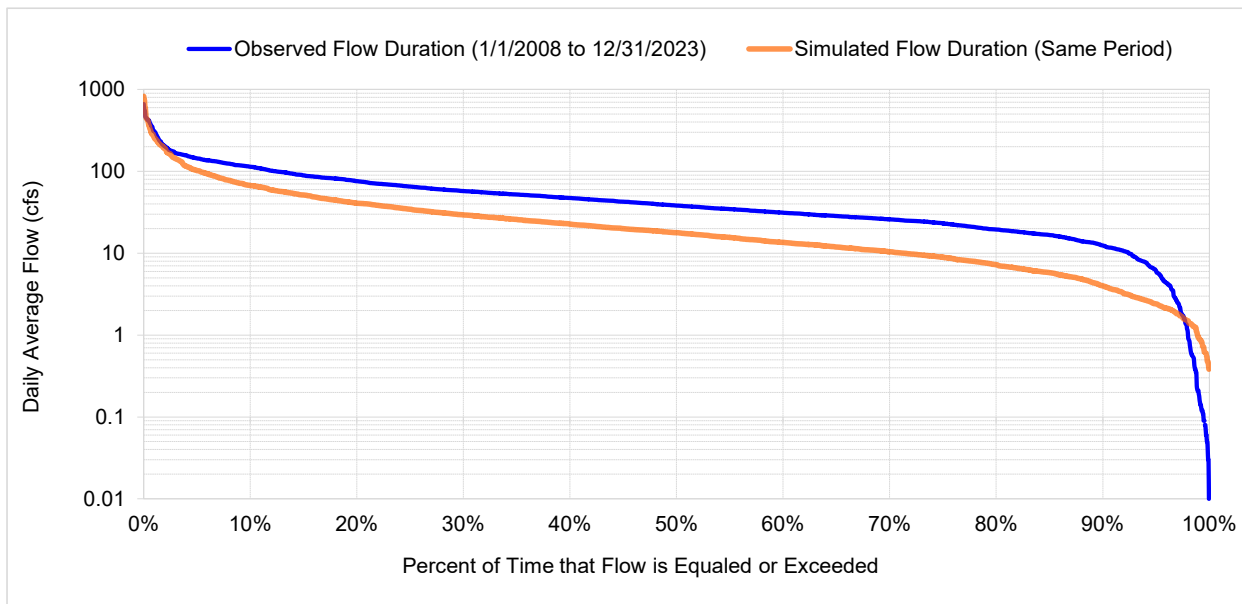


Figure A-73. Flow exceedance: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

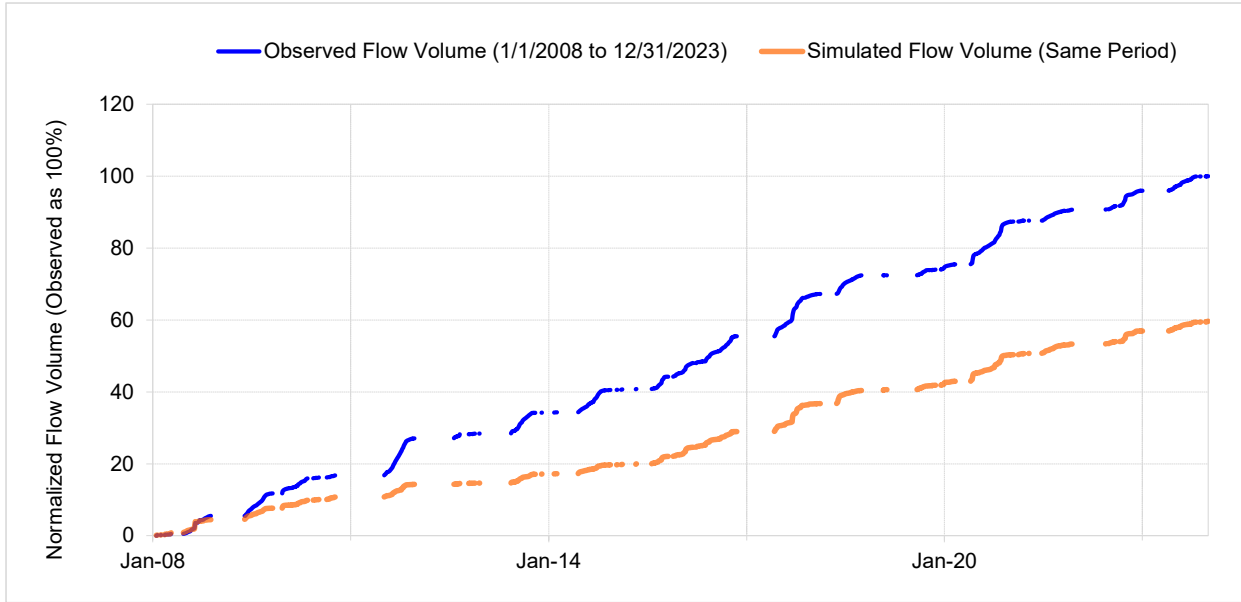


Figure A-74. Flow accumulation: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

Table A-49. Summary statistics: Model Output at G79\_C vs. G79 dividing structure Between C23 And C24 (2008/01/01 – 2023/12/31)

**G79 diving structure between C23 and C24 (ID - G79\_C)**

Drainage Area (sq-mi): 18.5

Analysis Period: 1/1/2008 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	17.82	10.63	-40.35	10
Total lowest 50% flows	3.57	1.46	-58.96	10
Total highest 10% flows	5.93	4.78	-19.41	15
Summer flow volume (months 7-9)	9.05	4.85	-46.38	30
Fall flow volume (months 10-12)	4.38	2.52	-42.55	30
Winter flow volume (months 1-3)	1.25	0.90	-27.65	>> 30
Spring flow volume (months 4-6)	3.14	2.36	-24.97	30
Total storm volume	3.15	3.28	4.23	20
Summer storm volume (7-9)	1.39	1.44	3.47	50
Baseflow	14.67	7.35	-49.92	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.467	0.7
Baseline adjusted coefficient (Garrick), E'			0.172	0.5
Monthly NSE			0.560	0.8

**G81\_S/G81\_C: G81 3-gate Spillway Structure**

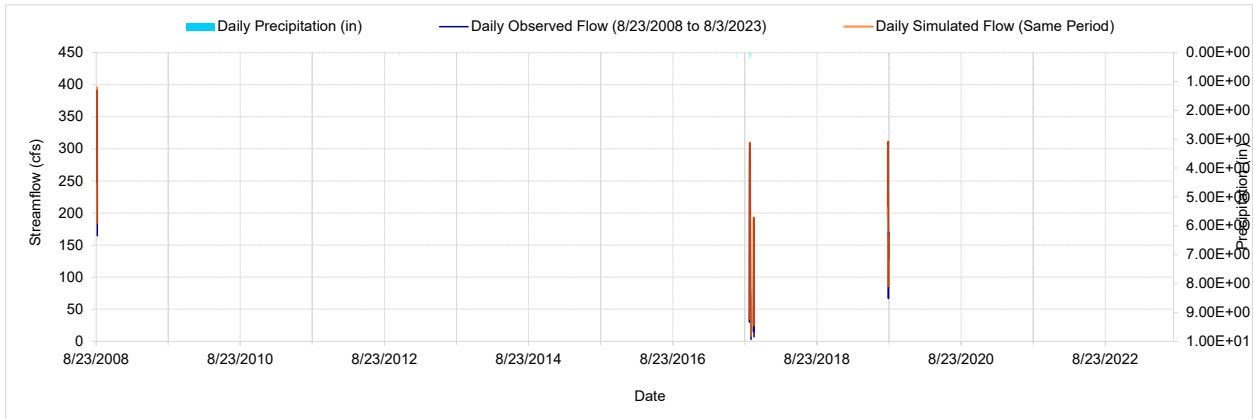


Figure A-75. Mean daily flow: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

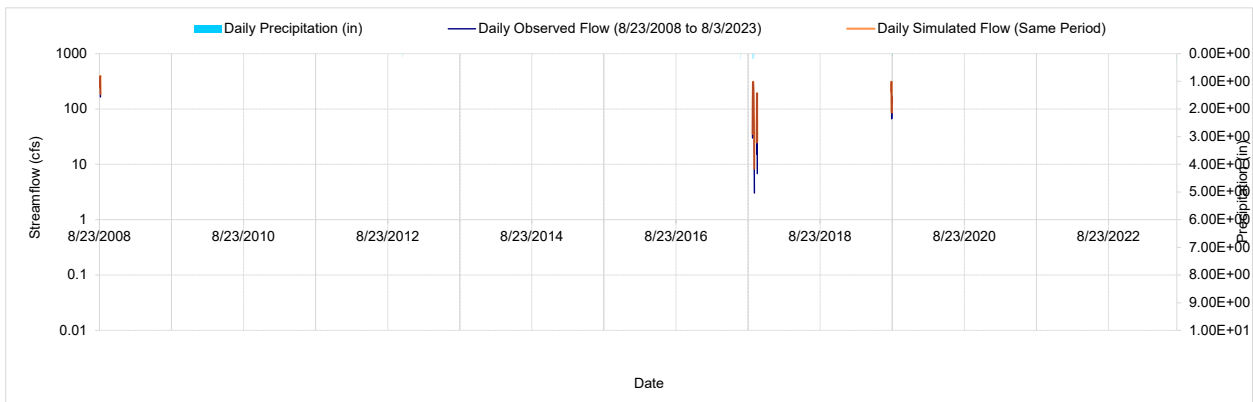


Figure A-76. Log Scale Mean daily flow: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

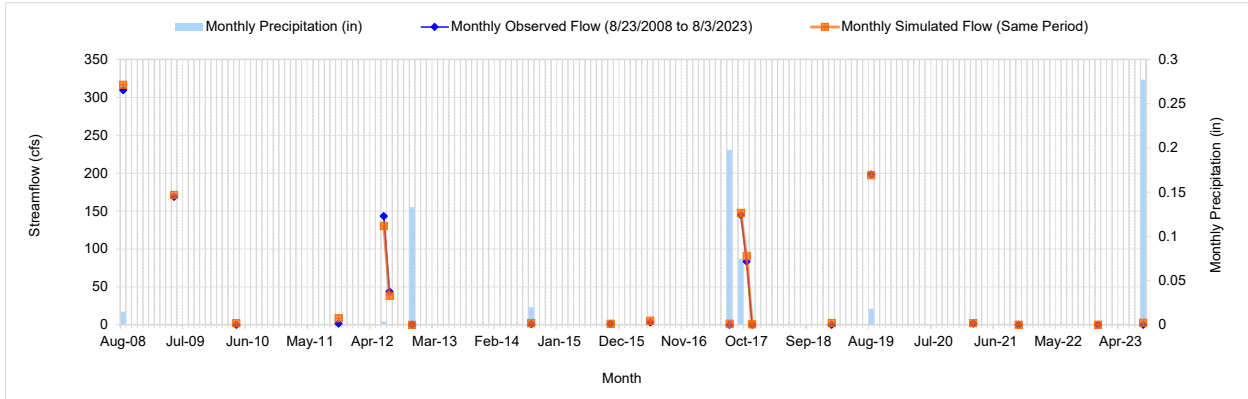


Figure A-77. Mean monthly flow: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

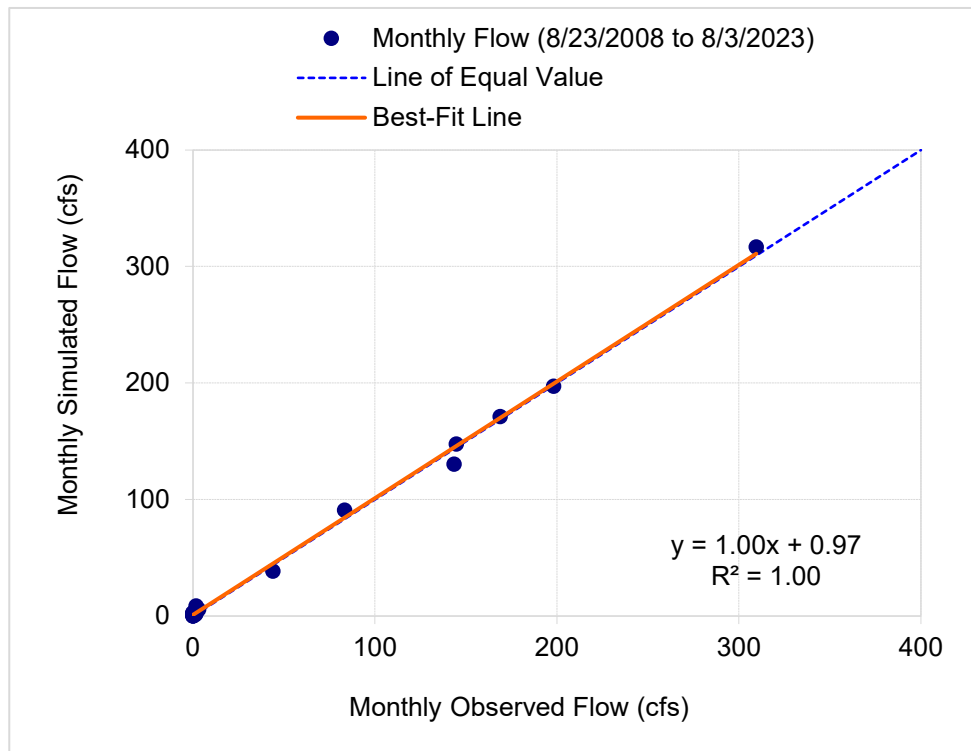


Figure A-78. Monthly flow regression and temporal variation: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

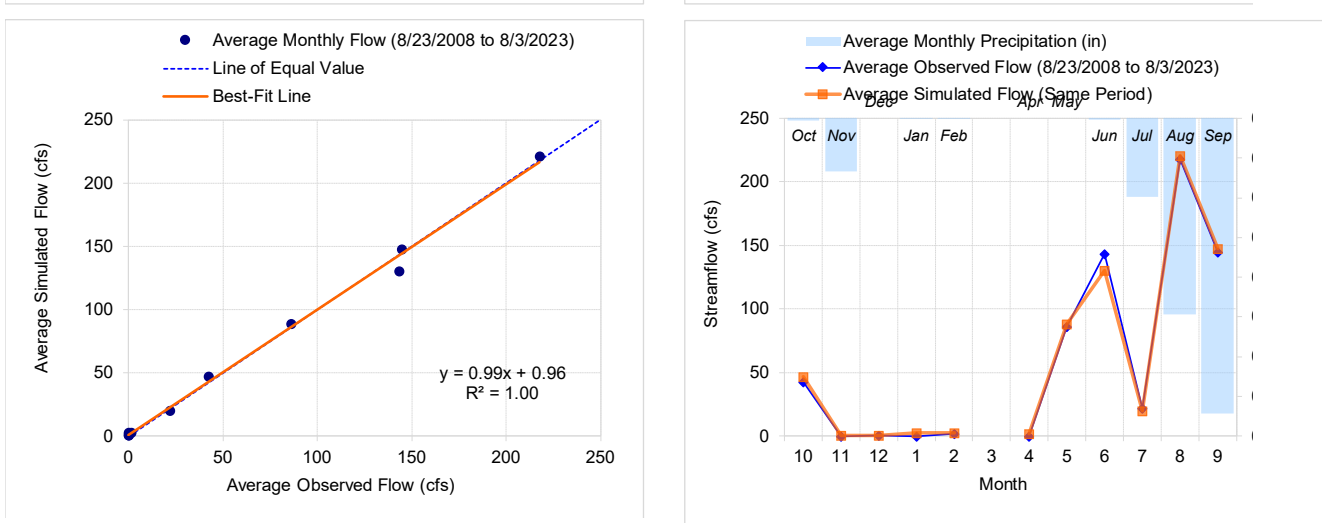


Figure A-79. Seasonal regression and temporal aggregate: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

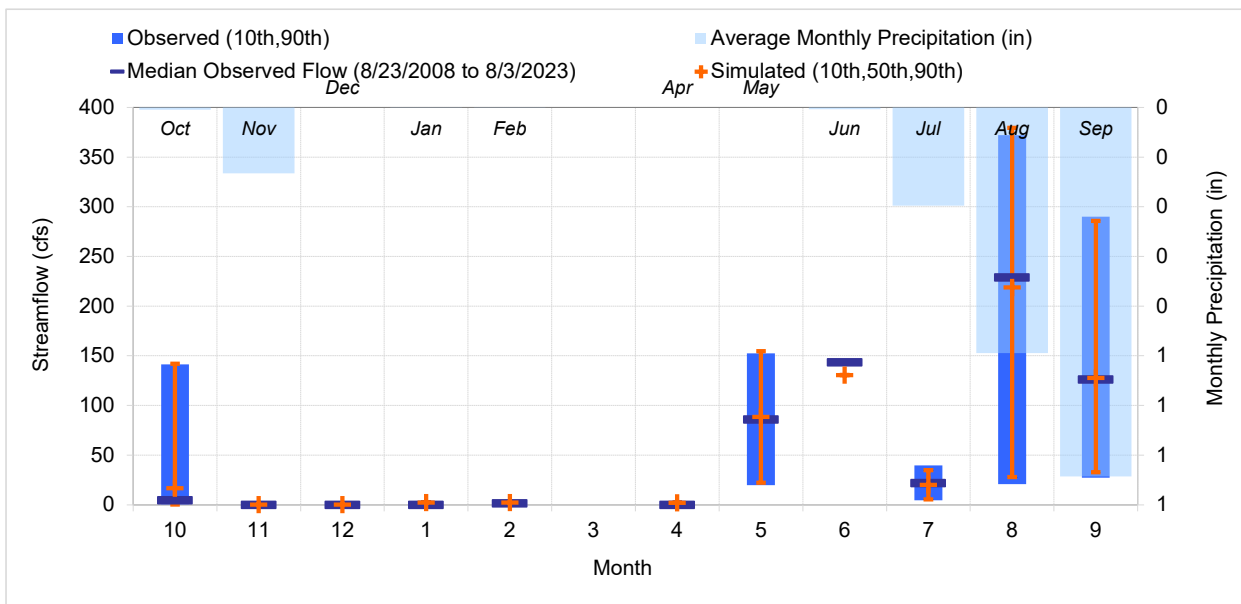


Figure A-80. Seasonal medians and ranges: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

Table A-50. Seasonal summary: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	42.31	4.85	0.02	141.30	46.96	16.73	0.21	142.09
Nov	0.08	0.08	0.02	0.13	0.26	0.26	0.10	0.43
Dec	0.15	0.15	0.15	0.15	0.23	0.23	0.23	0.23
Jan	0.03	0.03	0.03	0.03	2.33	2.33	2.33	2.33
Feb	1.71	1.71	1.71	1.71	2.41	2.41	2.41	2.41
Mar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apr	0.04	0.04	0.04	0.04	2.09	2.09	2.09	2.09
May	86.08	86.08	19.77	152.38	88.45	88.45	22.17	154.74
Jun	143.52	143.52	143.52	143.52	130.51	130.51	130.51	130.51
Jul	21.96	21.96	4.40	39.52	20.15	20.15	5.41	34.88
Aug	217.70	229.01	20.76	372.18	220.70	219.01	27.80	379.56
Sep	144.79	126.36	27.17	290.05	147.69	127.80	32.69	285.70

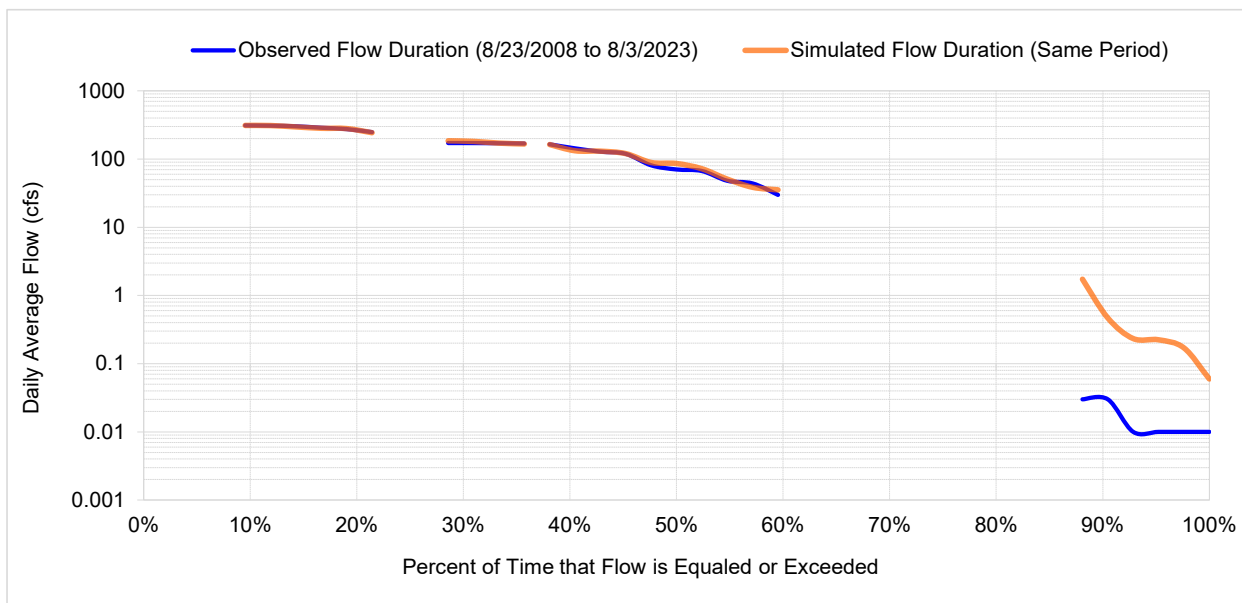


Figure A-81. Flow exceedance: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

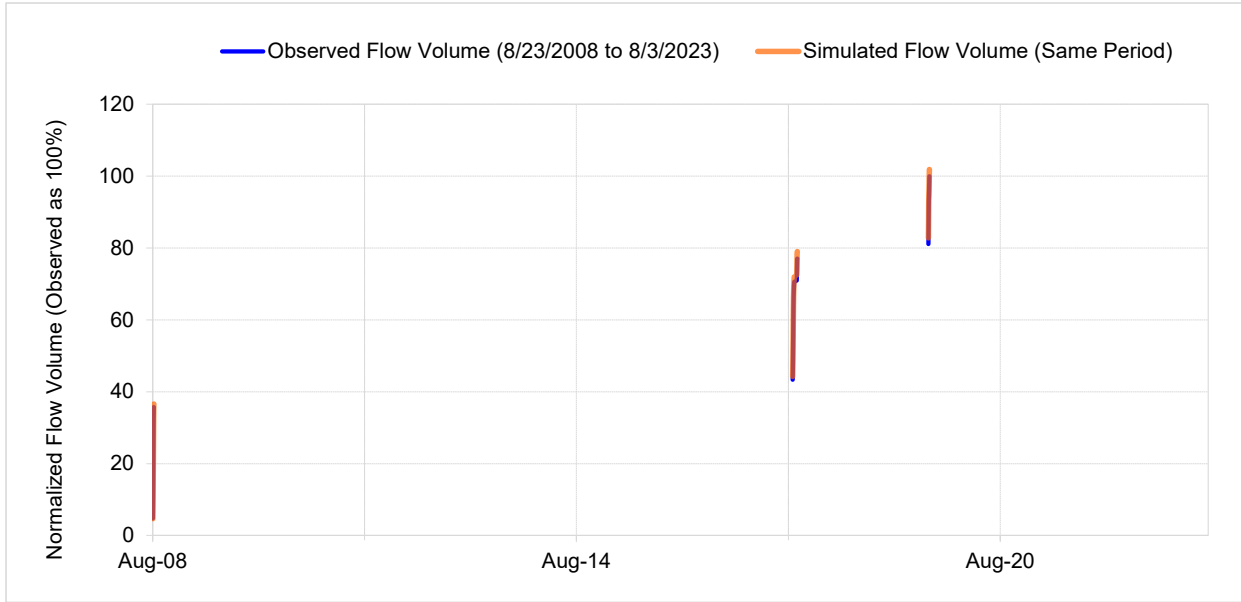


Figure A-82. Flow accumulation: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

Table A-51. Summary statistics: Model vs. G81 3-Gate Spillway Structure (2008/08/23 - 2023/08/03)

**G81 3-Gate Spillway Structure (ID - G81\_S/G81\_C)**

Drainage Area (sq-mi): 1

Analysis Period: 8/23/2008 to 8/3/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	12.93	13.18	1.96	10
Total lowest 50% flows	0.56	0.72	27.99	10
Total highest 10% flows	3.59	3.67	1.96	15
Summer flow volume (months 7-9)	11.30	11.47	1.48	30
Fall flow volume (months 10-12)	0.84	0.94	11.12	30
Winter flow volume (months 1-3)	0.00	0.01	172.70	30
Spring flow volume (months 4-6)	0.79	0.77	-1.96	30
Total storm volume	5.98	5.81	-2.89	20
Summer storm volume (7-9)	4.41	4.28	-3.07	50
Baseflow	6.95	7.38	6.14	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.997	0.7
Baseline adjusted coefficient (Garrick), E'			0.953	0.5
Monthly NSE			0.999	0.8

**SLT09\_W: Bessey Creek Weir**

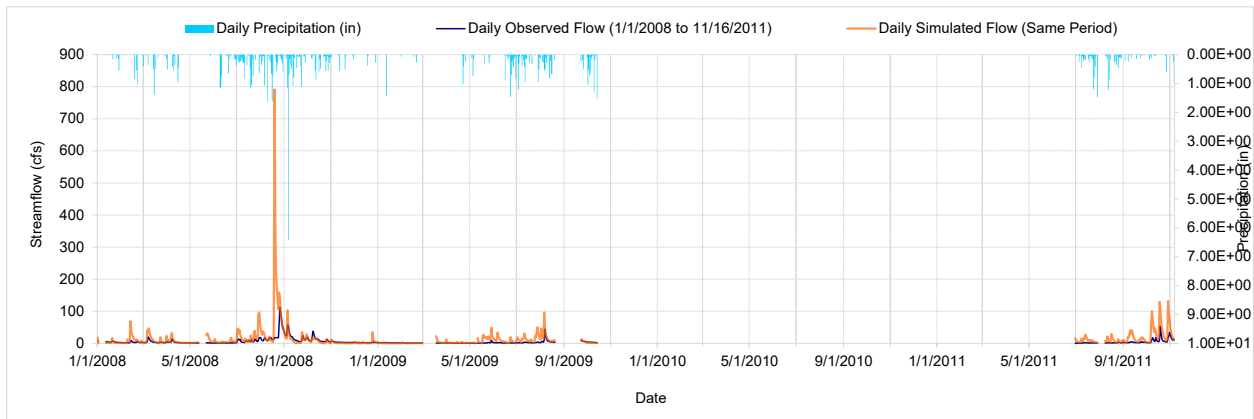


Figure A-83. Mean daily flow: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

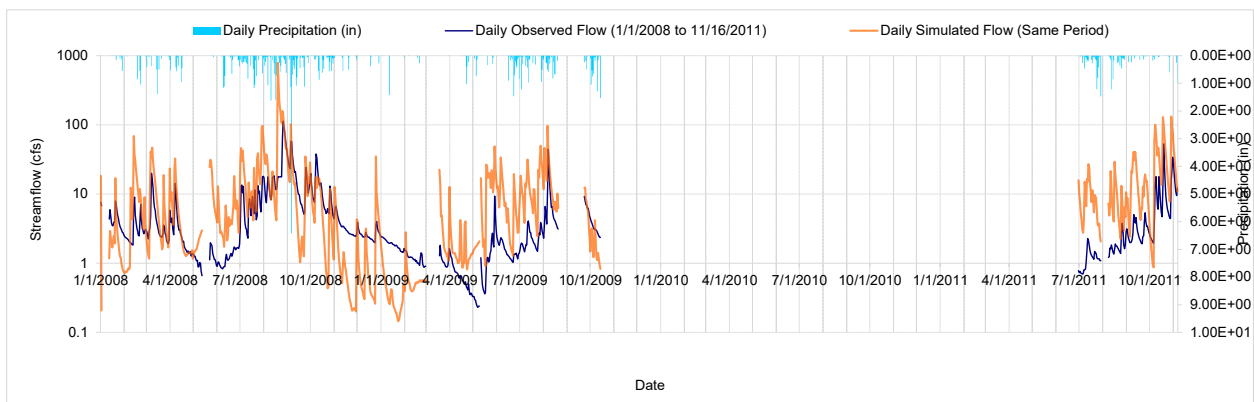


Figure A-84. Log Scale Mean daily flow: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

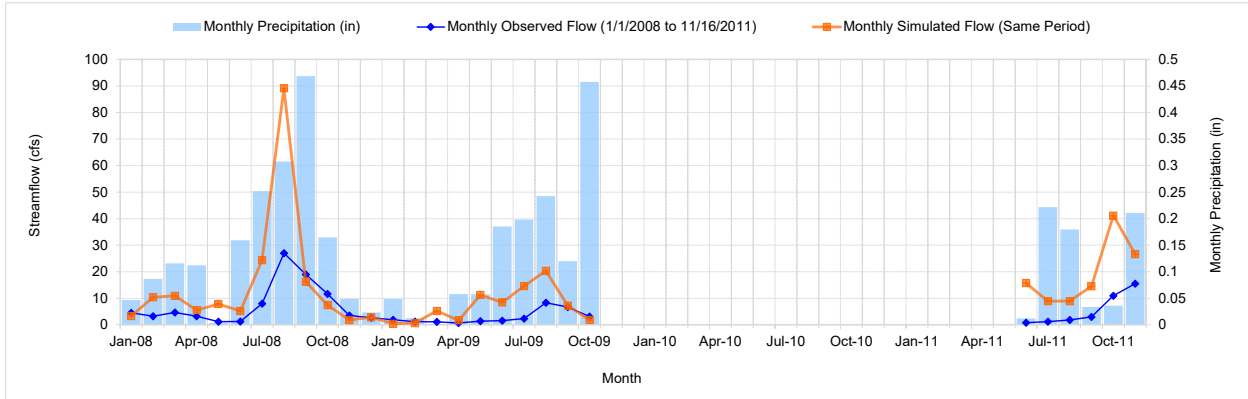


Figure A-85. Mean monthly flow: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

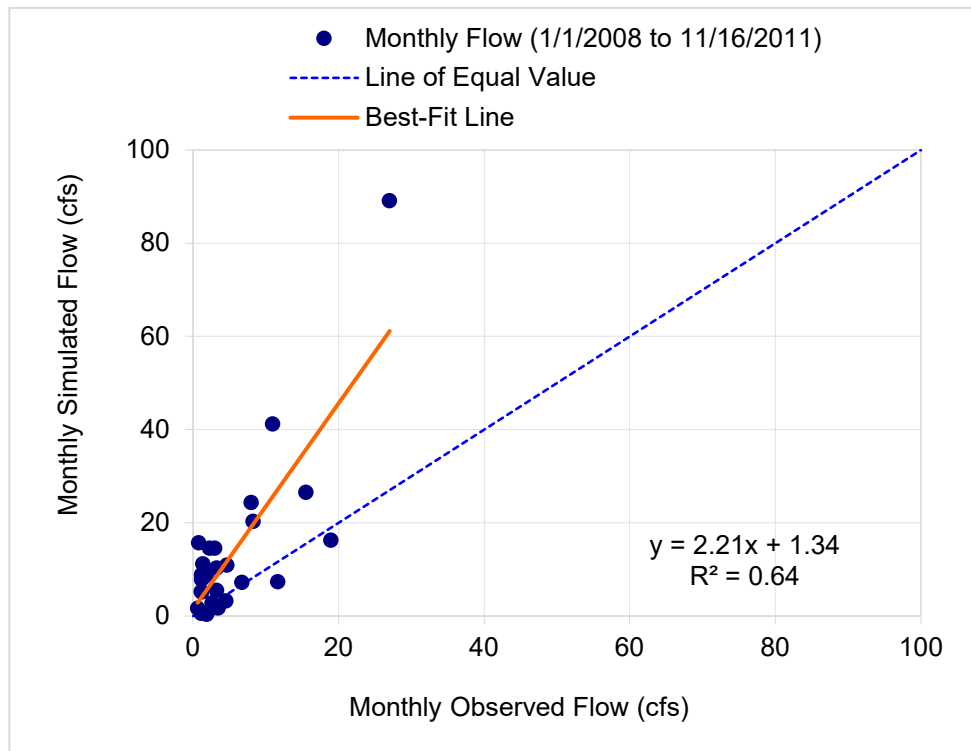


Figure A-86. Monthly flow regression and temporal variation: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

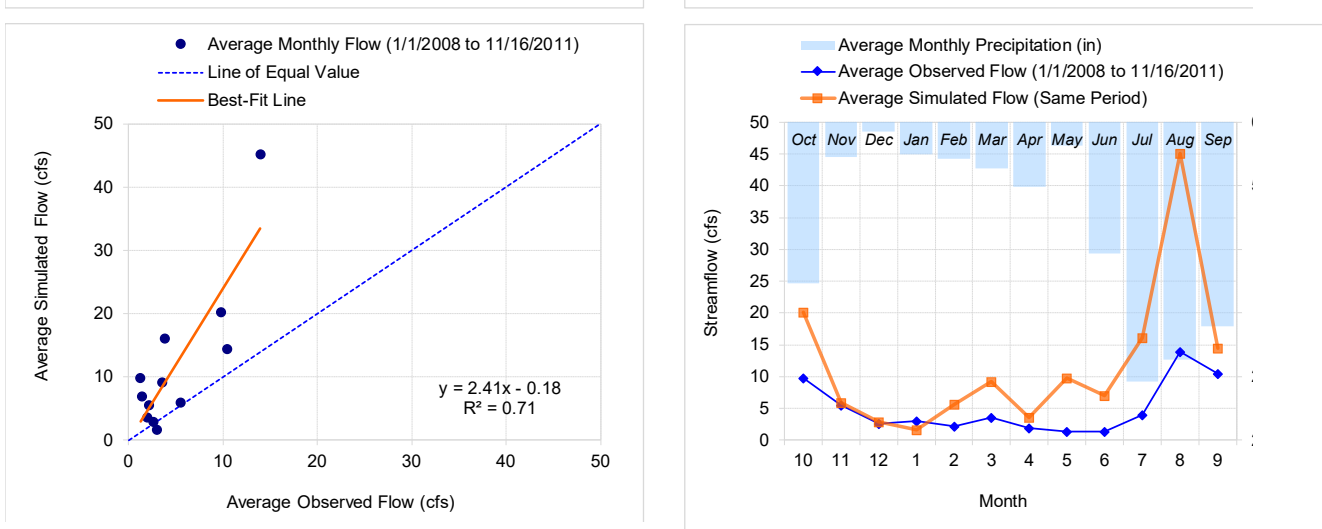


Figure A-87. Seasonal regression and temporal aggregate: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

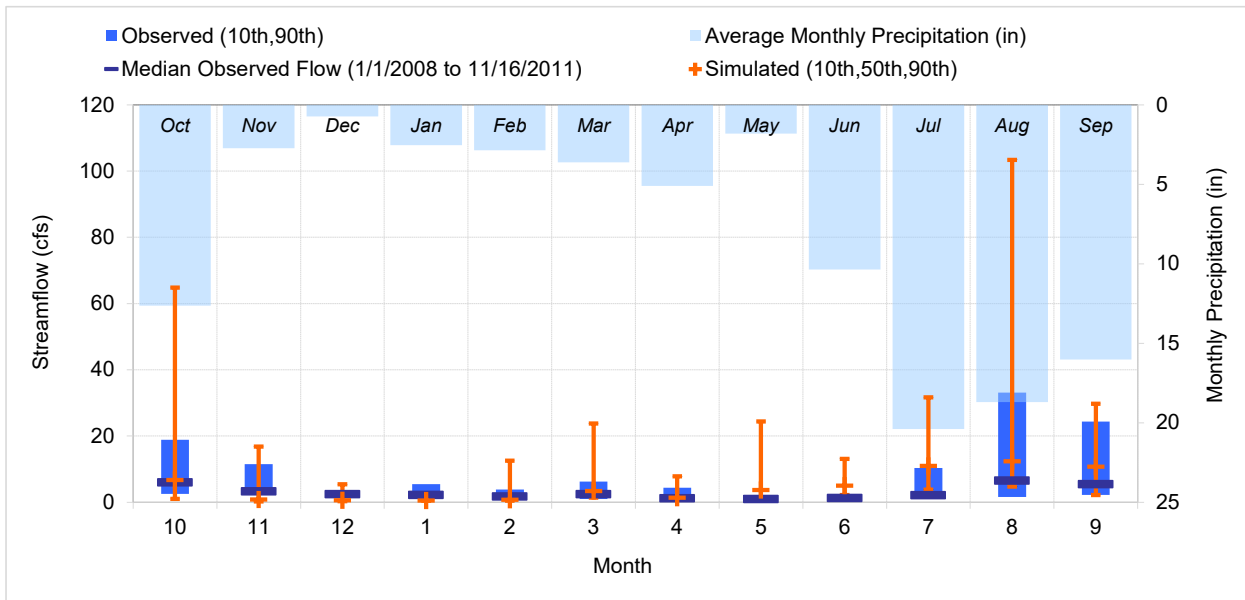


Figure A-88. Seasonal medians and ranges: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

Table A-52. Seasonal summary: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	9.79	6.10	2.53	18.82	20.15	6.77	1.02	64.83
Nov	5.49	3.37	2.55	11.52	5.90	0.87	0.22	16.78
Dec	2.63	2.50	2.14	3.29	2.86	0.65	0.31	5.45
Jan	2.98	2.29	1.62	5.49	1.61	0.54	0.19	2.47
Feb	2.22	1.83	0.99	3.85	5.56	0.75	0.43	12.58
Mar	3.56	2.51	0.98	6.22	9.17	3.41	1.36	23.78
Apr	1.95	1.32	0.44	4.39	3.61	1.41	1.01	7.82
May	1.28	1.08	0.29	1.96	9.81	3.68	1.51	24.42
Jun	1.39	1.33	0.89	1.98	6.97	5.04	2.13	13.11
Jul	3.89	2.18	1.02	10.35	16.12	10.99	3.83	31.68
Aug	13.96	6.61	1.57	33.11	45.13	12.37	4.71	103.37
Sep	10.47	5.54	2.18	24.38	14.45	10.76	2.18	29.73

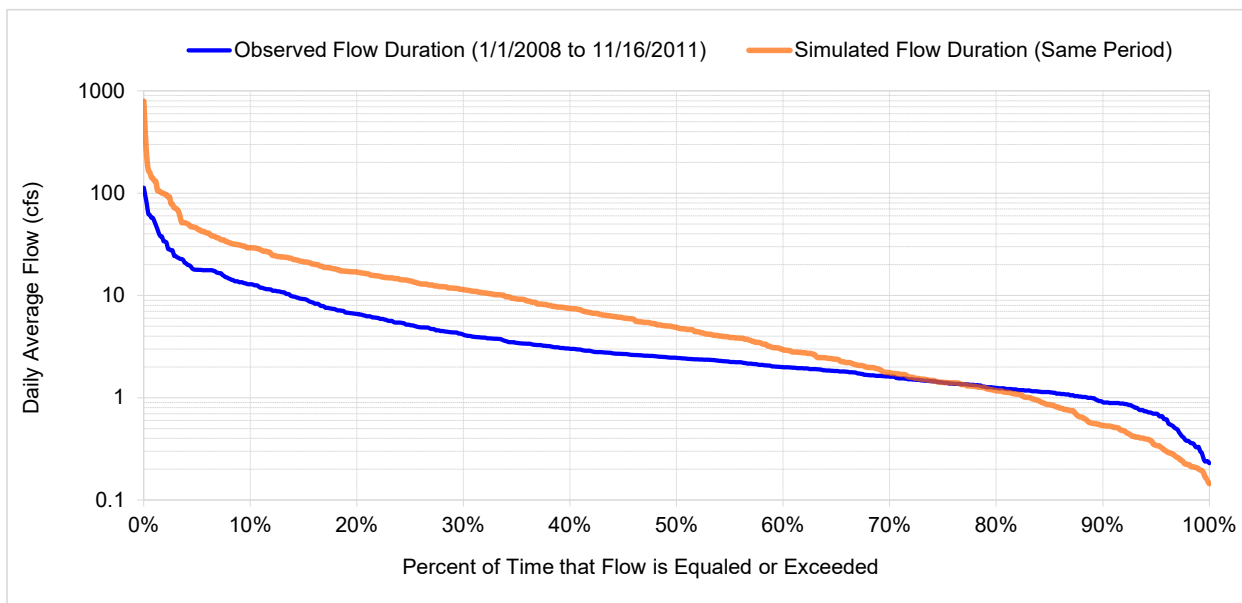


Figure A-89. Flow exceedance: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

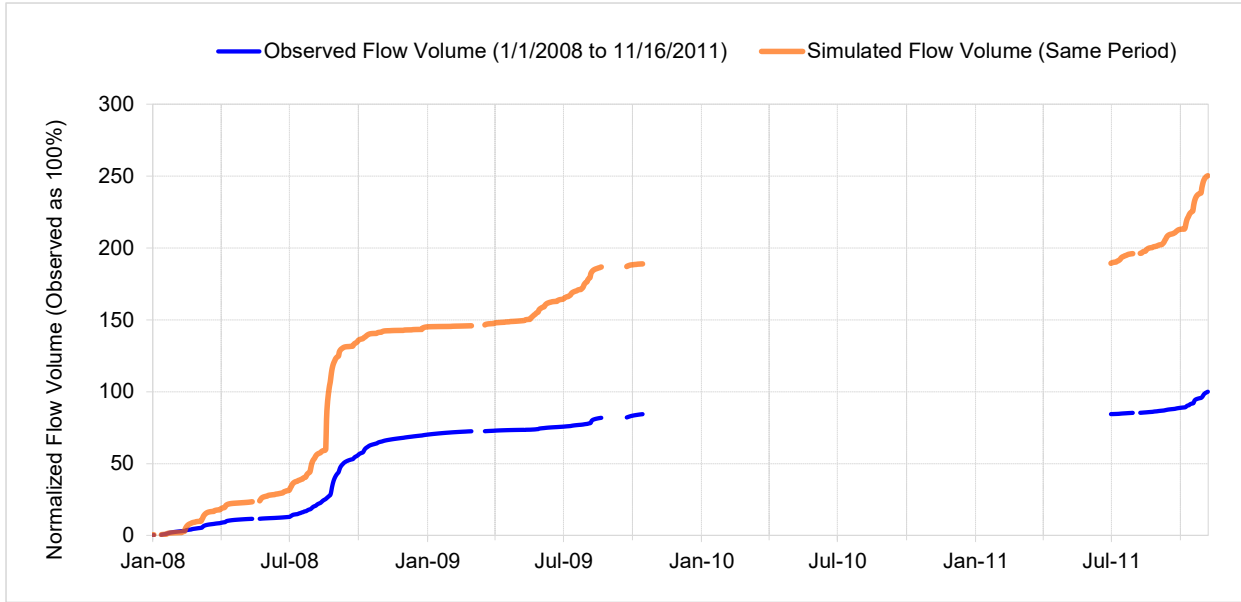


Figure A-90. Flow accumulation: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

Table A-53. Summary statistics: Model vs. Bessey Creek Weir (2008/01/01 - 2011/11/16)

**Bessey Creek Weir (ID - SLT09\_W)**

Drainage Area (sq-mi): 11.3

Analysis Period: 1/1/2008 to 11/16/2011

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	3.29	8.24	150.23	10
Total lowest 50% flows	0.43	0.53	22.93	10
Total highest 10% flows	1.60	4.61	188.49	15
Summer flow volume (months 7-9)	1.81	4.99	176.07	30
Fall flow volume (months 10-12)	0.88	1.57	79.04	30
Winter flow volume (months 1-3)	0.38	0.70	83.32	30
Spring flow volume (months 4-6)	0.23	0.99	329.19	30
Total storm volume	0.78	3.42	338.52	20
Summer storm volume (7-9)	0.44	2.11	378.89	50
Baseflow	2.51	4.82	91.81	20
Nash-Sutcliffe Coefficient of Efficiency, E			-13.850	0.7
Baseline adjusted coefficient (Garrick), E'			-0.979	0.5
Monthly NSE			-4.914	0.8

**SLT21\_W: C105 Weir Flow**

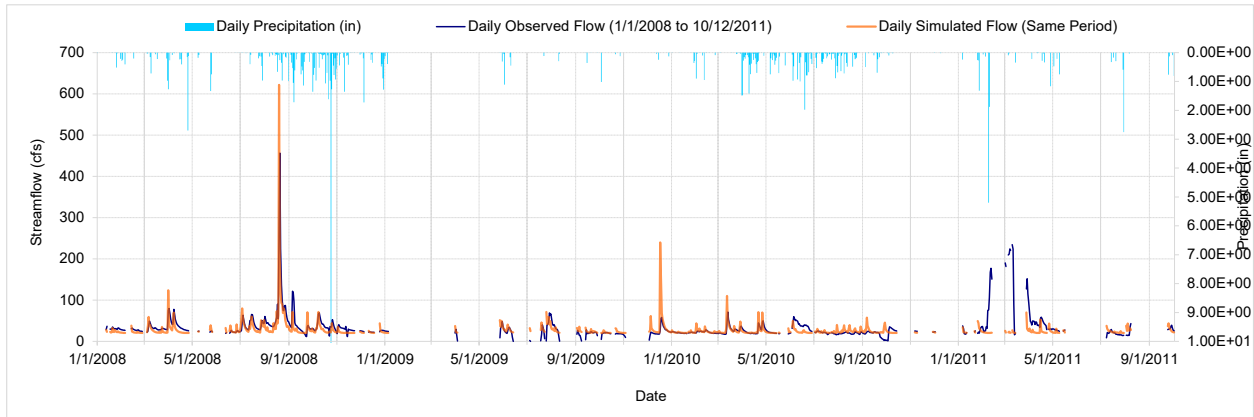


Figure A-91. Mean daily flow: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

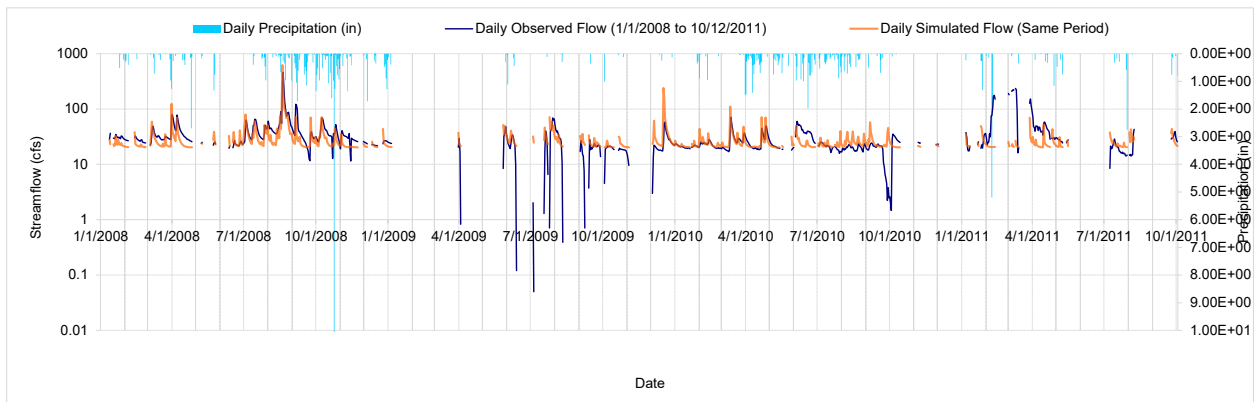


Figure A-92. Log Scale Mean daily flow: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

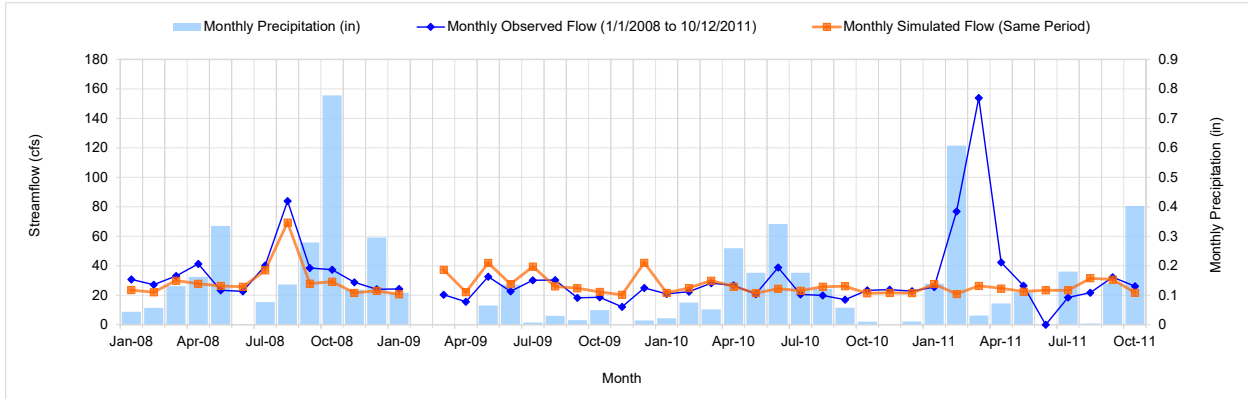


Figure A-93. Mean monthly flow: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

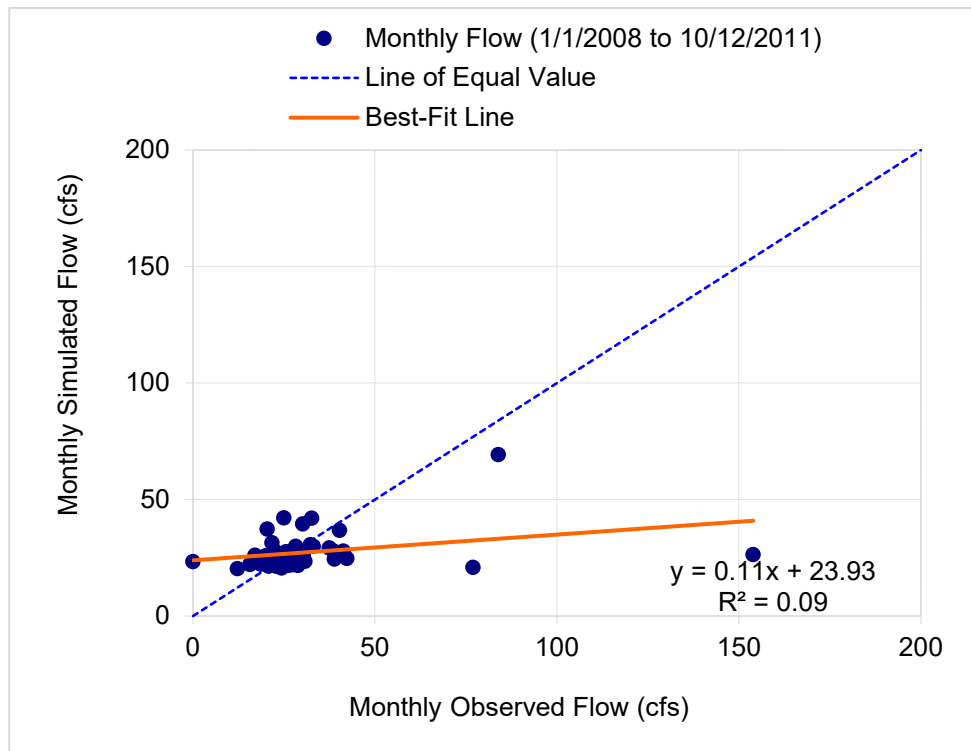


Figure A-94. Monthly flow regression and temporal variation: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

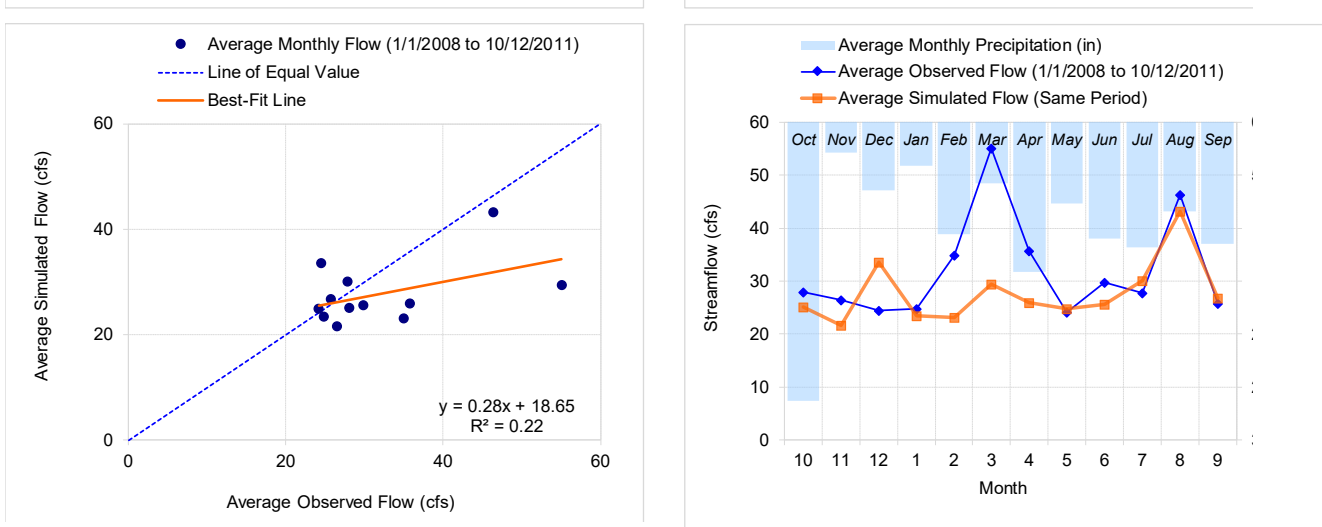


Figure A-95. Seasonal regression and temporal aggregate: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

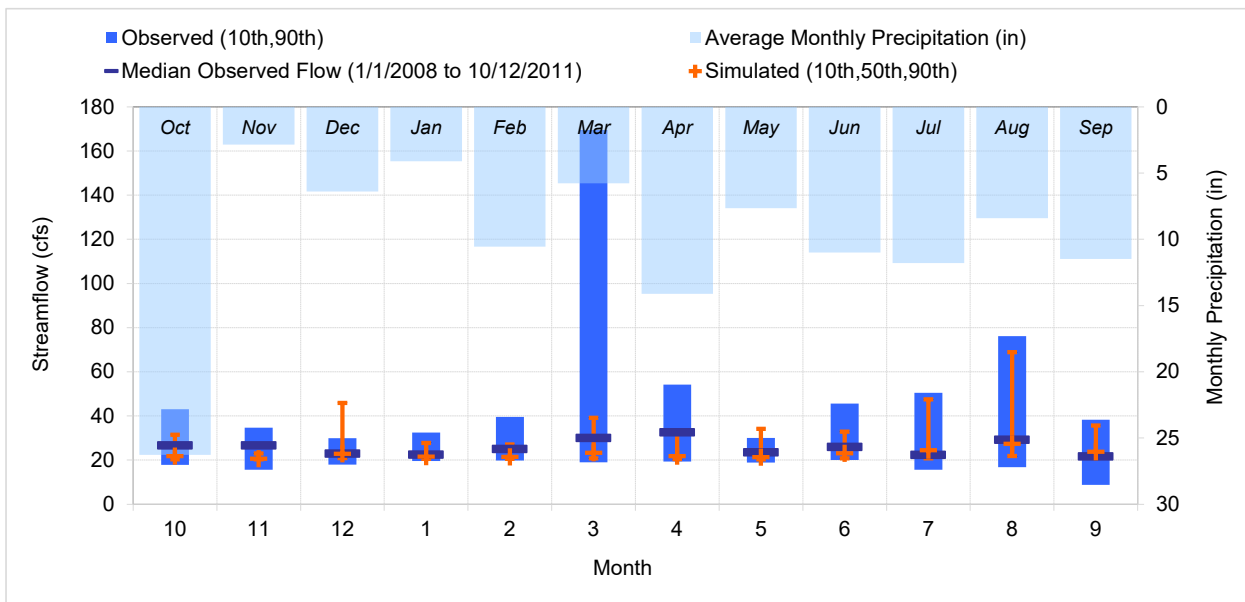


Figure A-96. Seasonal medians and ranges: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

Table A-54. Seasonal summary: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	28.02	26.81	17.79	43.02	25.14	21.84	20.32	31.49
Nov	26.45	26.75	15.64	34.68	21.60	20.68	20.36	23.02
Dec	24.52	23.11	17.99	29.89	33.60	22.89	20.91	45.84
Jan	24.81	22.65	19.53	32.51	23.44	21.64	20.55	27.80
Feb	34.98	25.12	19.81	39.55	23.17	21.45	20.54	27.05
Mar	55.08	30.19	18.94	169.51	29.41	23.31	20.81	39.19
Apr	35.80	32.66	19.38	54.21	25.98	21.85	20.43	33.32
May	24.17	23.62	18.86	30.02	24.87	21.43	20.29	34.11
Jun	29.83	26.13	20.08	45.54	25.57	23.07	20.76	32.84
Jul	27.81	22.52	15.61	50.45	30.06	24.56	20.84	47.53
Aug	46.33	29.29	16.77	76.11	43.25	27.44	21.86	68.84
Sep	25.71	21.74	8.79	38.23	26.79	23.77	20.86	35.65

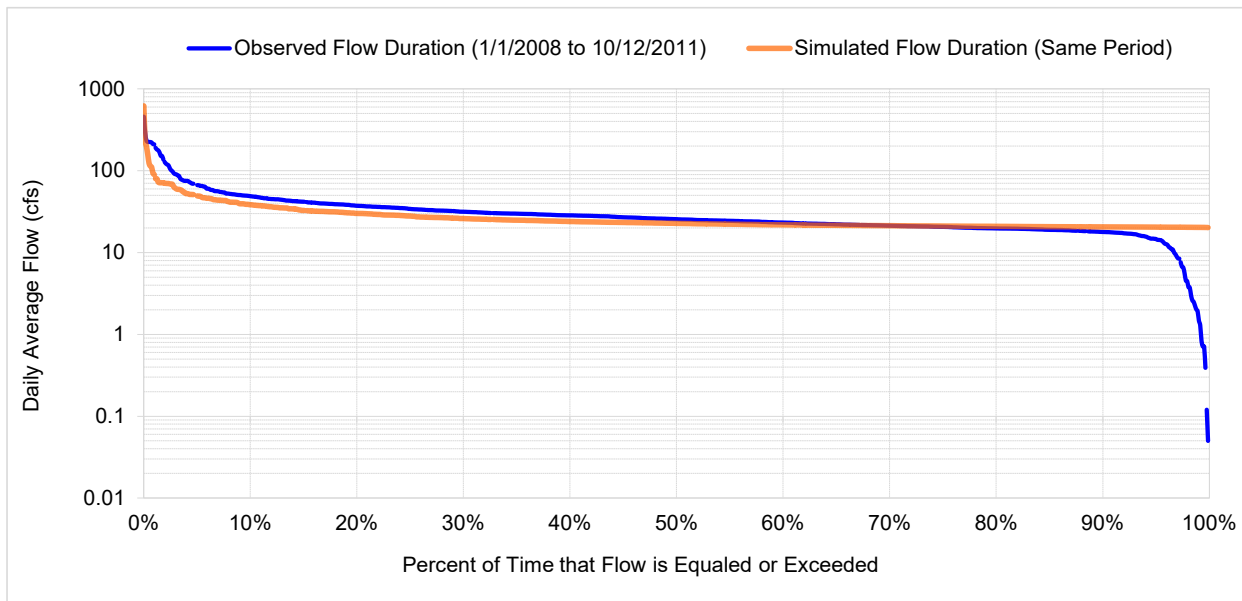


Figure A-97. Flow exceedance: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

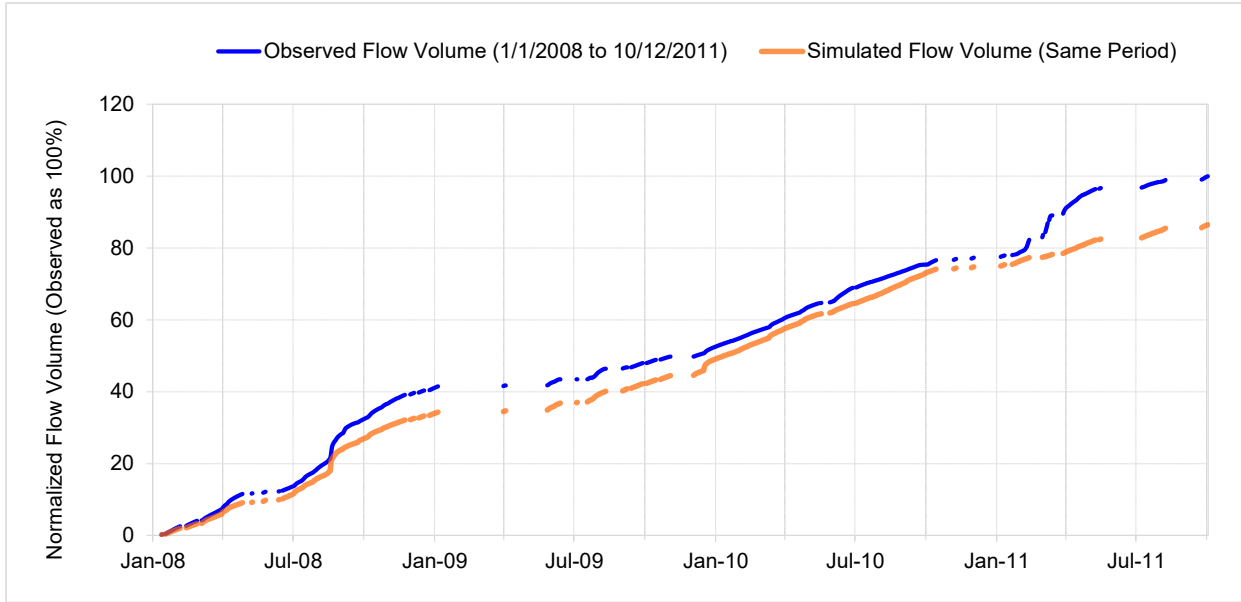


Figure A-98. Flow accumulation: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

Table A-55. Summary statistics: Model vs. SLT21\_W, C105 Weir Flow (2008/01/01 - 2011/10/12)

**C105 Weir Flow (ID - SLT21\_W)**

Drainage Area (sq-mi): 3.3

Analysis Period: 1/1/2008 to 10/12/2011

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	80.43	69.52	-13.56	10
Total lowest 50% flows	23.97	26.02	8.56	10
Total highest 10% flows	23.62	16.45	-30.33	15
Summer flow volume (months 7-9)	26.28	26.49	0.81	30
Fall flow volume (months 10-12)	12.43	12.75	2.59	30
Winter flow volume (months 1-3)	23.79	15.59	-34.45	30
Spring flow volume (months 4-6)	17.93	14.69	-18.09	30
Total storm volume	11.49	11.06	-3.78	20
Summer storm volume (7-9)	5.08	5.45	7.22	50
Baseflow	68.93	58.46	-15.19	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.061	0.7
Baseline adjusted coefficient (Garrick), E'			0.168	0.5
Monthly NSE			0.566	0.8

**S153L\_S: S153L (Latching Gate) on Levee L-65 at Canal C-44A**

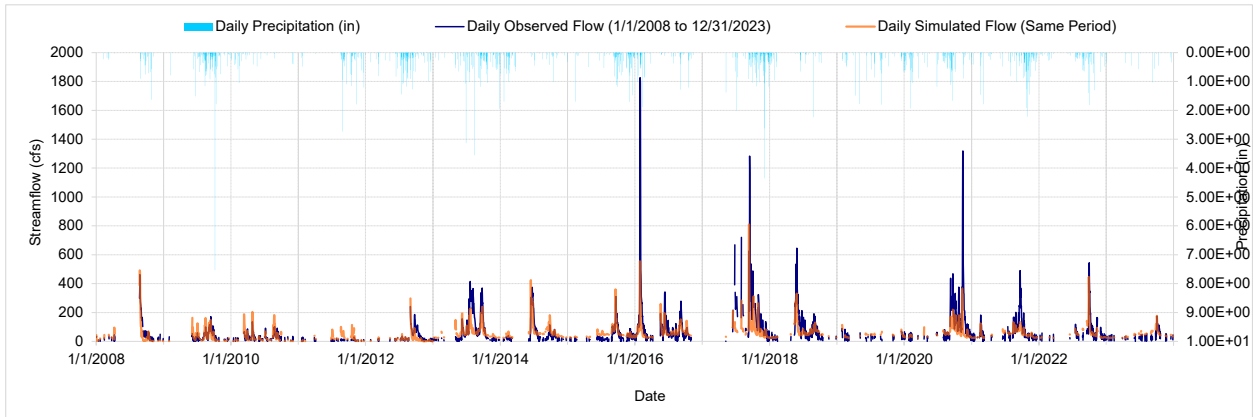


Figure A-99. Mean daily flow: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

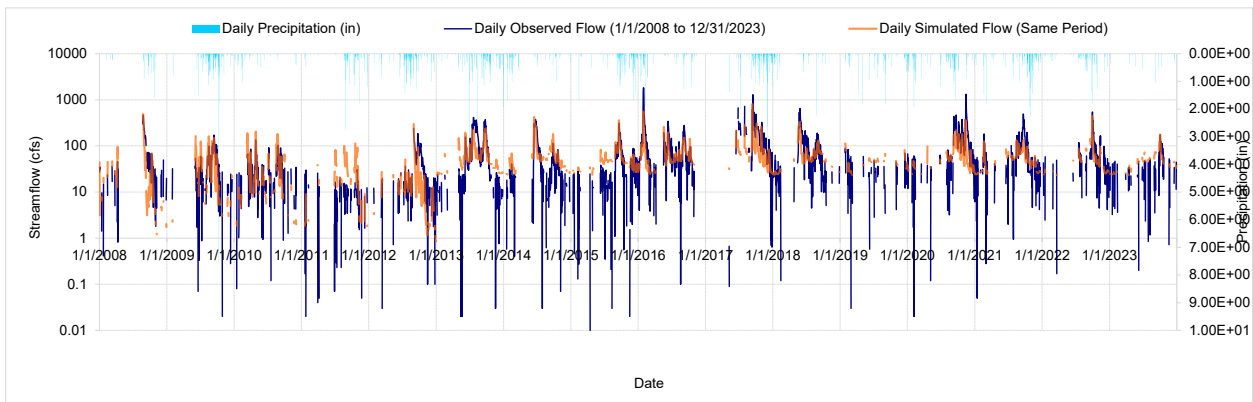


Figure A-100. Log Scale Mean daily flow: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

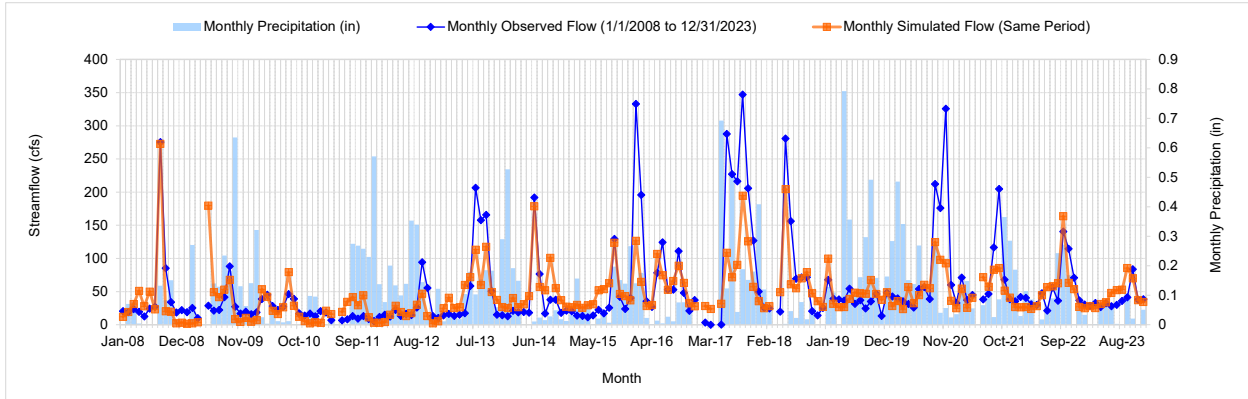


Figure A-101. Mean monthly flow: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

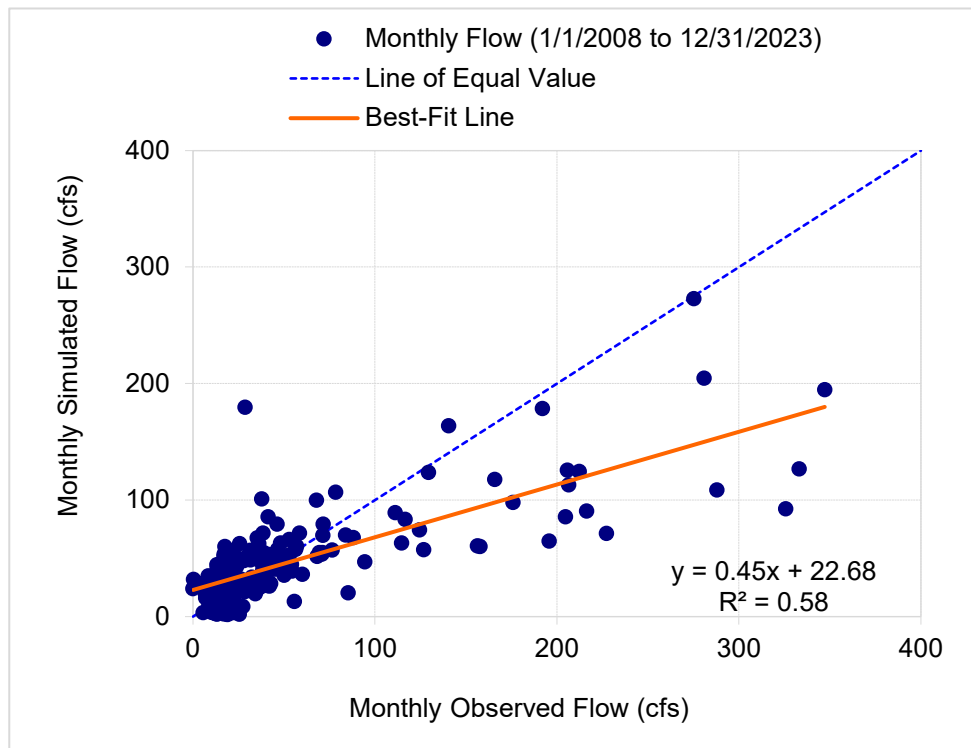


Figure A-102. Monthly flow regression and temporal variation: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

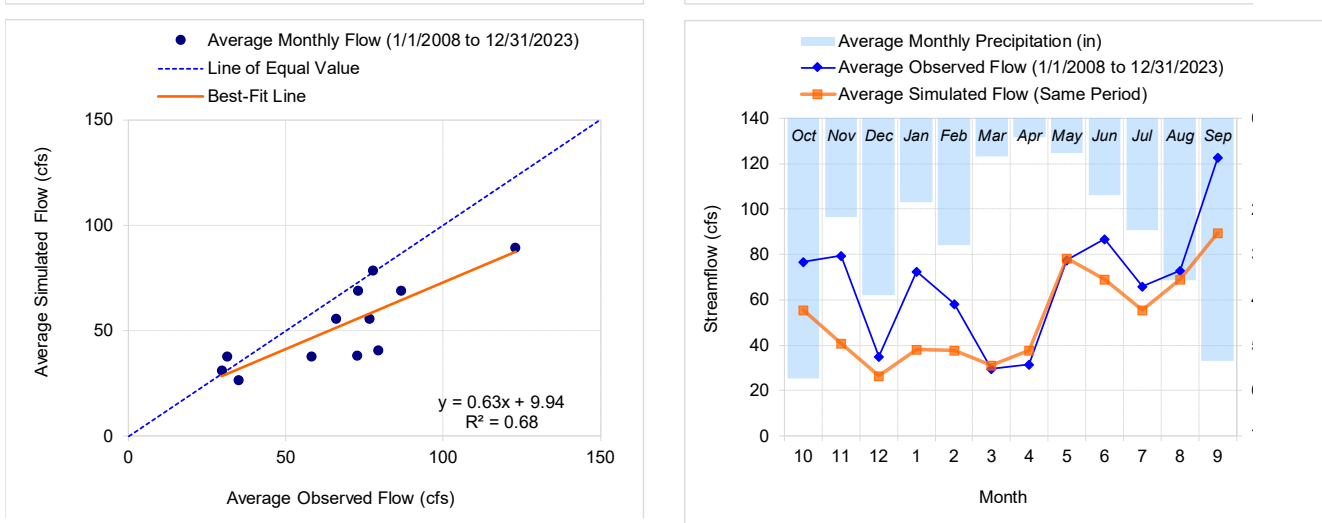


Figure A-103. Seasonal regression and temporal aggregate: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

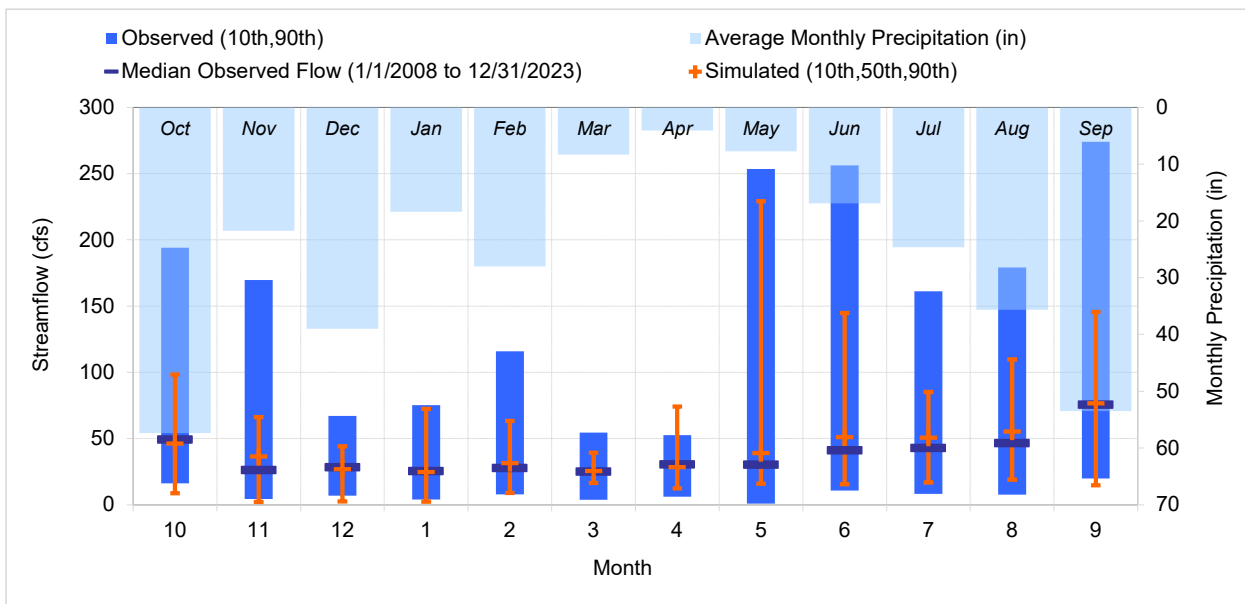


Figure A-104. Seasonal medians and ranges: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

Table A-56. Seasonal summary: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	76.69	49.44	16.16	194.10	55.54	46.32	8.64	98.44
Nov	79.32	26.33	4.34	169.73	40.83	36.55	2.20	66.18
Dec	34.88	28.59	6.79	67.09	26.58	26.97	2.45	44.05
Jan	72.65	25.56	3.93	75.25	38.09	24.87	2.39	72.42
Feb	58.20	28.07	7.88	115.84	37.59	31.59	8.83	63.38
Mar	29.62	25.22	3.78	54.57	31.07	25.51	16.39	39.40
Apr	31.44	30.69	6.15	52.57	37.66	28.54	12.37	74.10
May	77.75	30.43	0.96	253.56	78.52	39.10	15.79	229.31
Jun	86.67	41.35	10.69	256.31	69.05	51.14	15.53	144.87
Jul	66.00	43.01	8.27	161.17	55.60	50.78	16.80	85.14
Aug	72.86	46.80	7.72	179.26	68.96	55.35	19.01	109.77
Sep	122.97	75.85	19.80	273.95	89.38	76.74	14.65	145.55

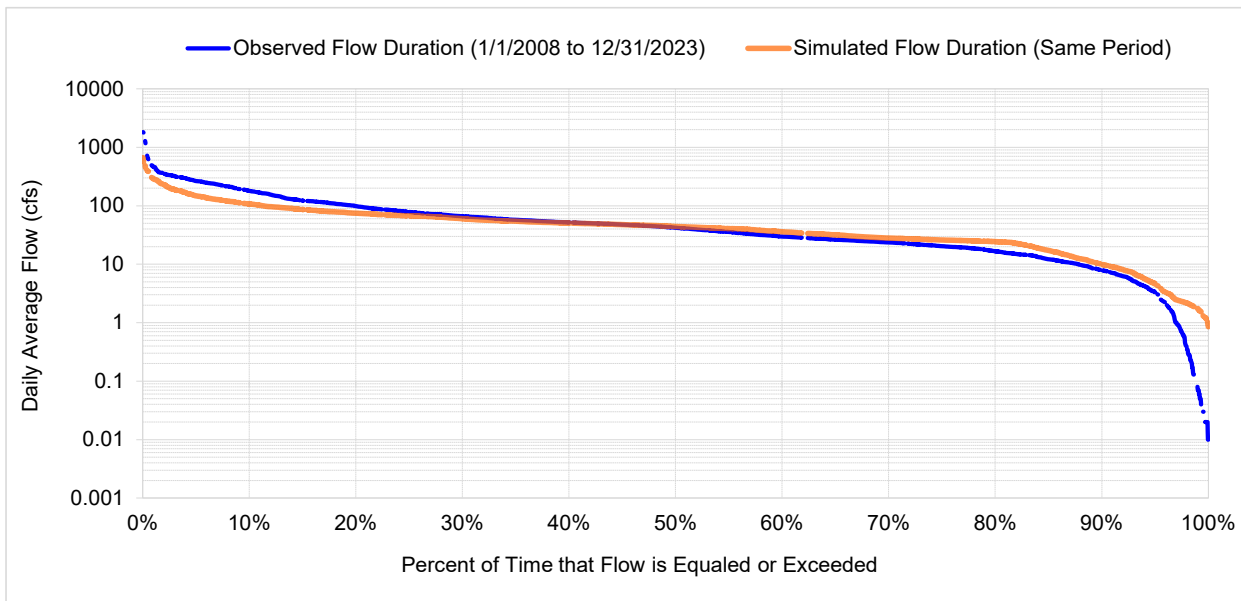


Figure A-105. Flow exceedance: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

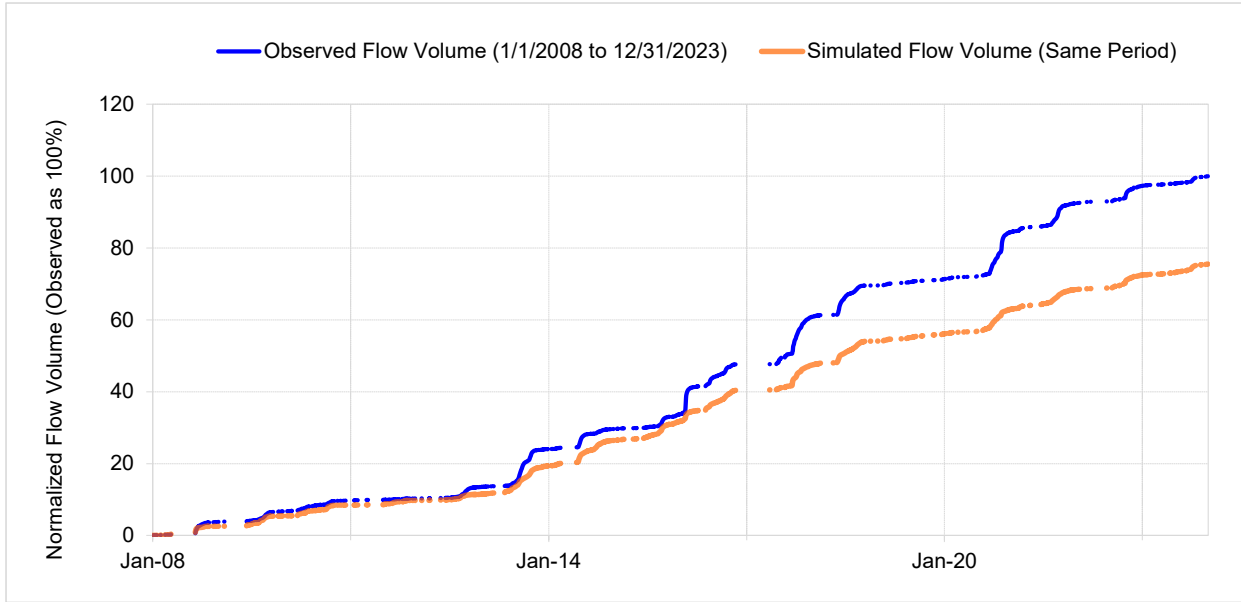


Figure A-106. Flow accumulation: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

Table A-57. Summary statistics: Model vs. S-153L (Latching Gate) On Levee L-65 At Canal C-44A (2008/01/01 – 2023/12/31)

**S-153L (Latching Gate) on Levee L-65 at Canal C-44A (ID - S153L\_S)**

Drainage Area (sq-mi): 23

Analysis Period: 1/1/2008 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	19.96	15.08	-24.45	10
Total lowest 50% flows	2.63	3.23	22.93	10
Total highest 10% flows	8.86	4.94	-44.24	15
Summer flow volume (months 7-9)	8.75	7.04	-19.55	30
Fall flow volume (months 10-12)	5.45	3.61	-33.85	30
Winter flow volume (months 1-3)	2.67	1.70	-36.39	>> 30
Spring flow volume (months 4-6)	3.09	2.74	-11.46	30
Total storm volume	5.63	2.51	-55.43	20
Summer storm volume (7-9)	2.30	1.16	-49.66	50
Baseflow	14.33	12.57	-12.28	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.387	0.7
Baseline adjusted coefficient (Garrick), E'			0.349	0.5
Monthly NSE			0.643	0.8

### A-3 HYDROLOGY VERIFICATION

#### S80 (USGS 02276998): St. Lucie Canal abv S-80 NR Stuart, FL

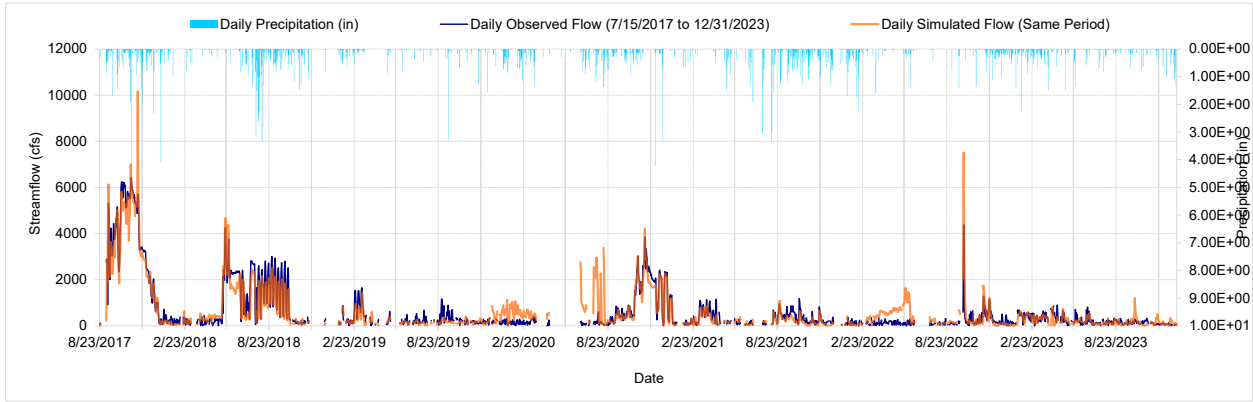


Figure A-107. Mean daily flow: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

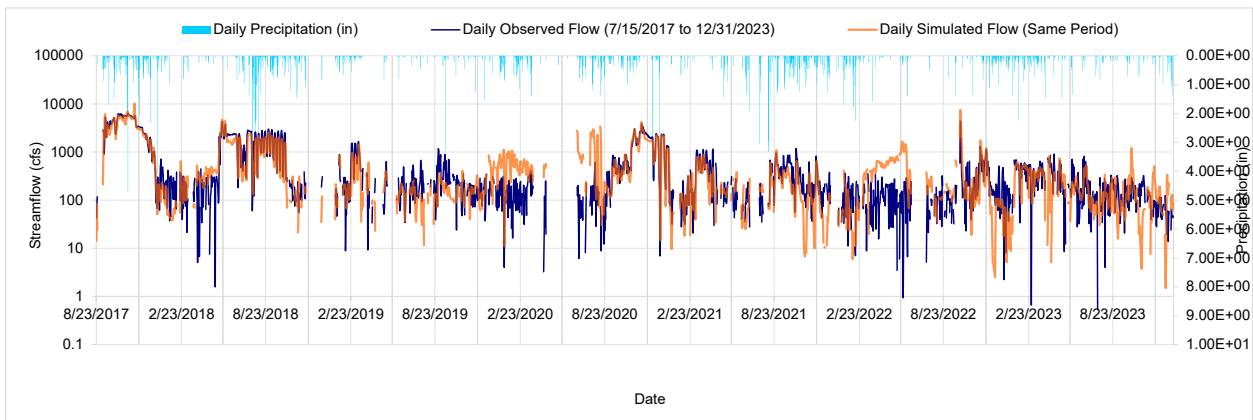


Figure A-108. Log Scale Mean daily flow: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

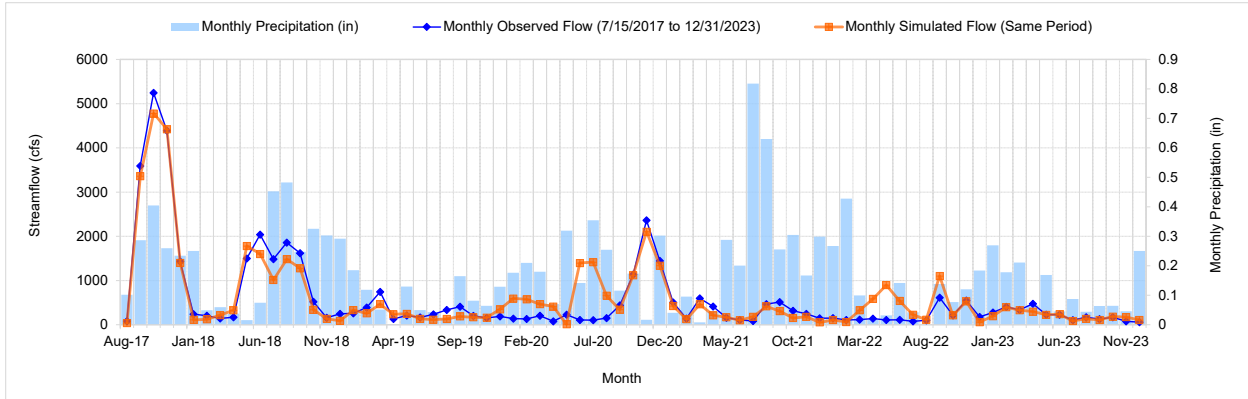


Figure A-109. Mean monthly flow: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

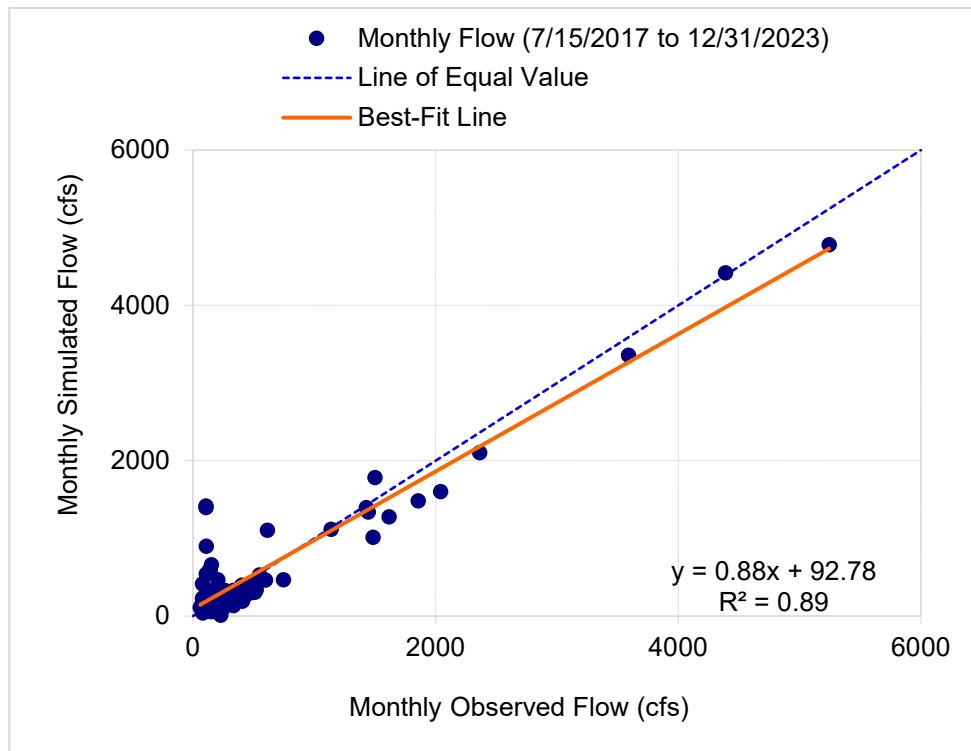


Figure A-110. Monthly flow regression and temporal variation: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

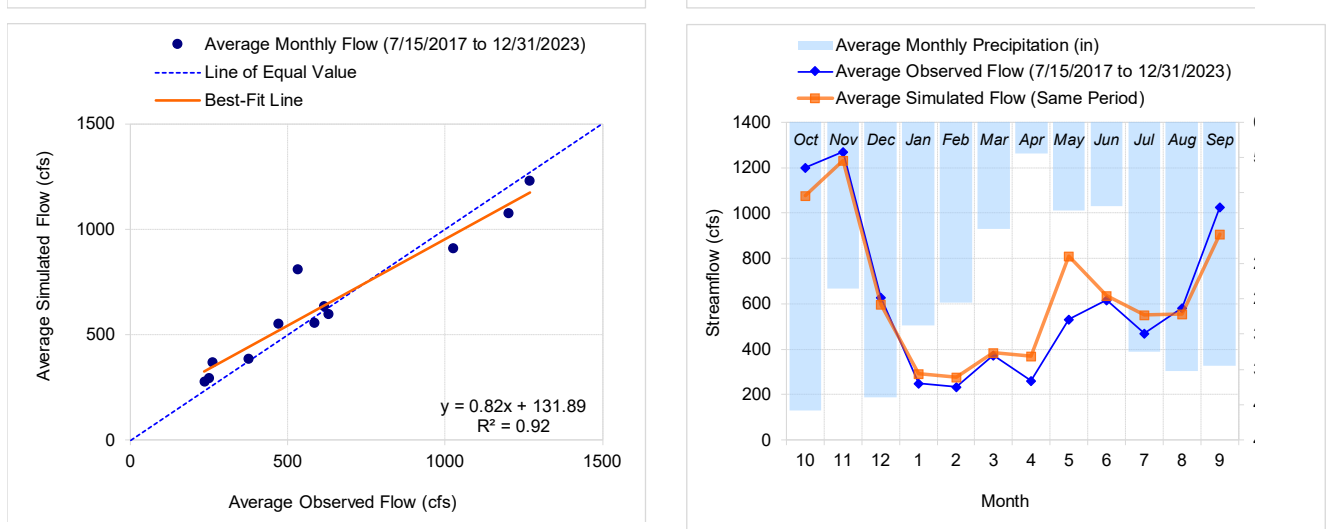


Figure A-111. Seasonal regression and temporal aggregate: Model vs. St Lucie Canal Abv S-80 Nr Stuart Fl (2017/07/15 – 2023/12/31)

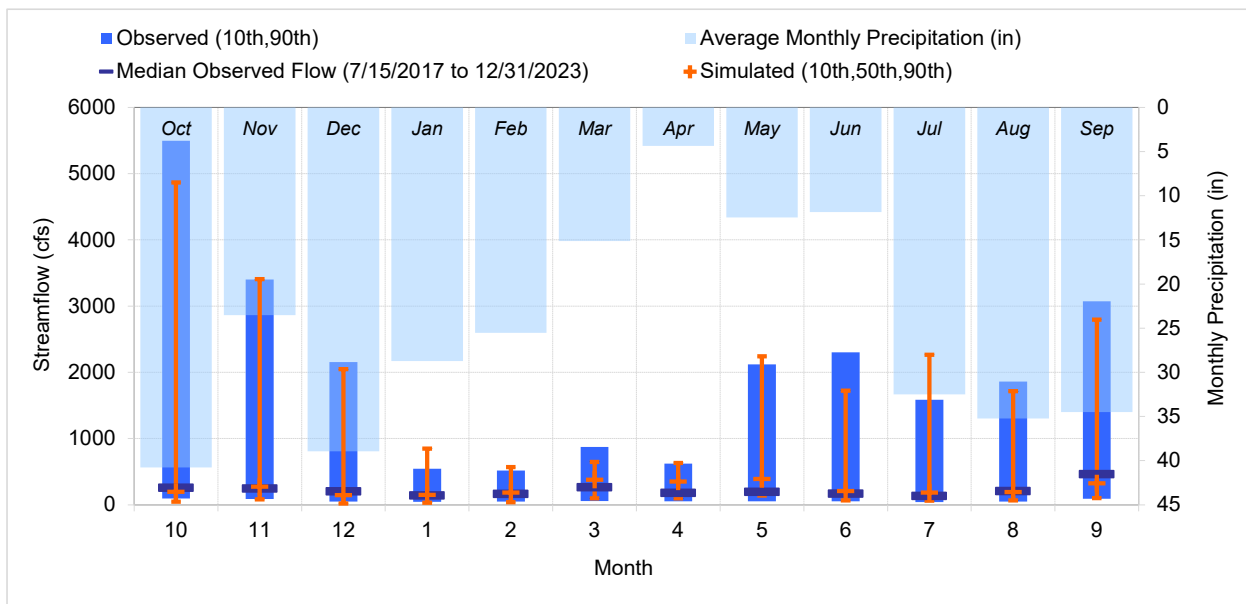


Figure A-112. Seasonal medians and ranges: Model vs. St Lucie Canal Abv S-80 Nr Stuart Fl (2017/07/15 – 2023/12/31)

Table A-58. Seasonal summary: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	1201.11	262.50	94.80	5495.00	1076.30	198.44	44.97	4867.15
Nov	1269.53	250.00	86.84	3400.00	1230.64	276.58	81.40	3407.16
Dec	629.10	208.00	46.50	2155.00	597.14	147.70	20.38	2047.55
Jan	248.70	145.50	46.18	544.20	293.31	149.14	29.96	846.37
Feb	235.35	169.50	49.09	518.00	276.41	187.24	39.45	569.62
Mar	374.89	269.00	54.86	872.10	384.47	379.63	98.45	648.42
Apr	260.41	185.00	52.39	622.20	370.70	351.41	98.73	630.66
May	532.00	200.00	51.85	2120.00	811.70	389.44	137.68	2241.19
Jun	616.31	170.50	51.57	2300.00	637.67	207.85	67.43	1721.39
Jul	469.77	136.00	42.00	1585.00	553.18	185.19	61.79	2266.45
Aug	583.42	212.50	47.23	1859.00	554.97	194.21	65.23	1714.62
Sep	1025.89	465.00	91.98	3074.00	908.31	325.52	99.73	2794.38

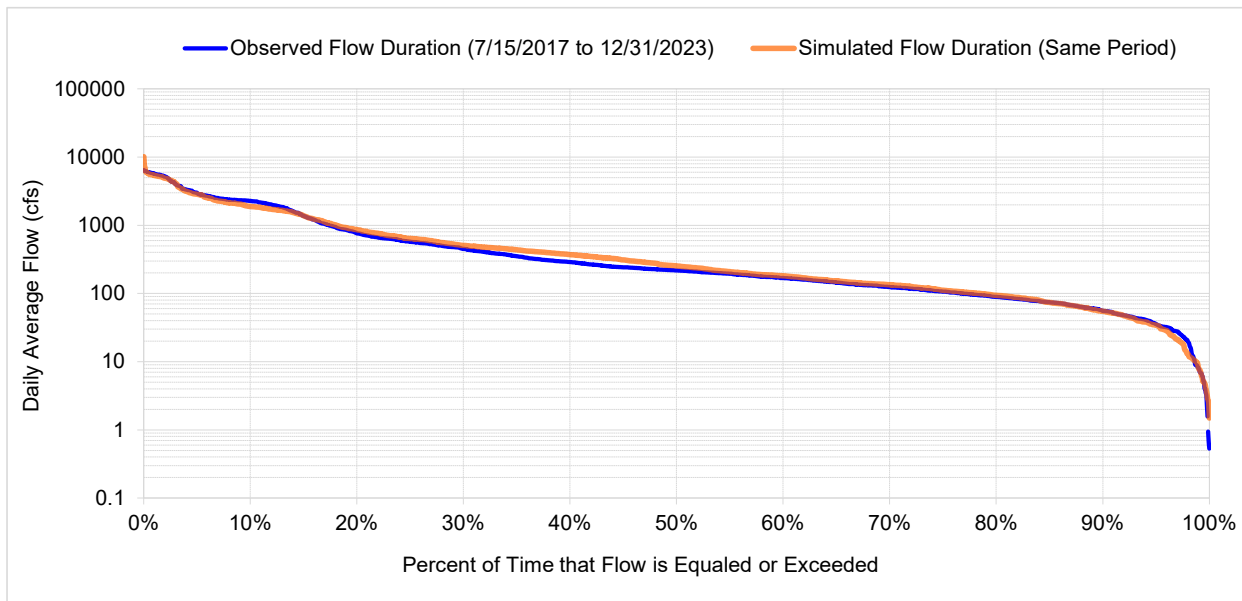


Figure A-113. Flow exceedance: Model vs. St Lucie Canal Abv S-80 Nr Stuart FL (2017/07/15 – 2023/12/31)

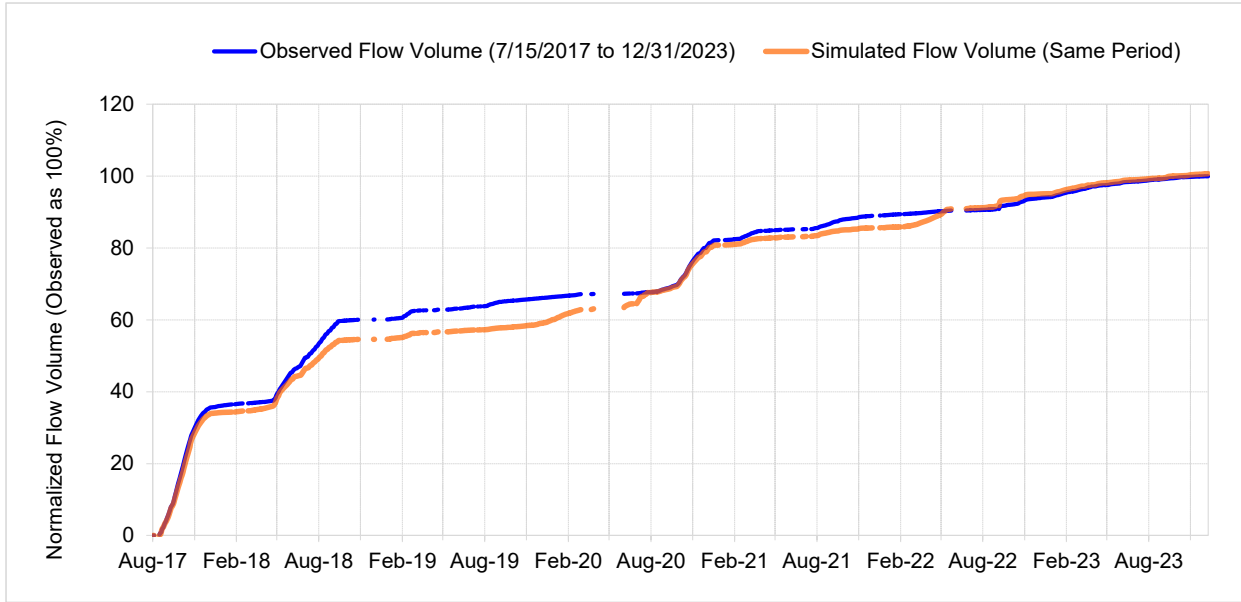


Figure A-114. Flow accumulation: Model vs. St Lucie Canal Abv S-80 Nr Stuart Fl (2017/07/15 – 2023/12/31)

Table A-59. Summary statistics: Model vs. St Lucie Canal Abv S-80 Nr Stuart Fl (2017/07/15 – 2023/12/31)

**St Lucie Canal abv S-80 NR Stuart Fl (ID - S80 (USGS 02276998))**

Drainage Area (sq-mi): 209

Analysis Period: 7/15/2017 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	33.64	33.86	0.66	10
Total lowest 50% flows	2.75	2.93	6.47	10
Total highest 10% flows	17.63	16.91	-4.05	15
Summer flow volume (months 7-9)	9.38	8.94	-4.67	30
Fall flow volume (months 10-12)	16.09	15.06	-6.43	30
Winter flow volume (months 1-3)	3.51	3.89	10.90	30
Spring flow volume (months 4-6)	4.66	5.97	28.20	30
Total storm volume	11.63	11.06	-4.85	20
Summer storm volume (7-9)	4.36	3.96	-9.22	50
Baseflow	22.01	22.80	3.57	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.830	0.7
Baseline adjusted coefficient (Garrick), E'			0.627	0.5
Monthly NSE			0.941	0.8

**S80\_S: S-80 Spillway and Sector on St. Lucie River at Tidewater**

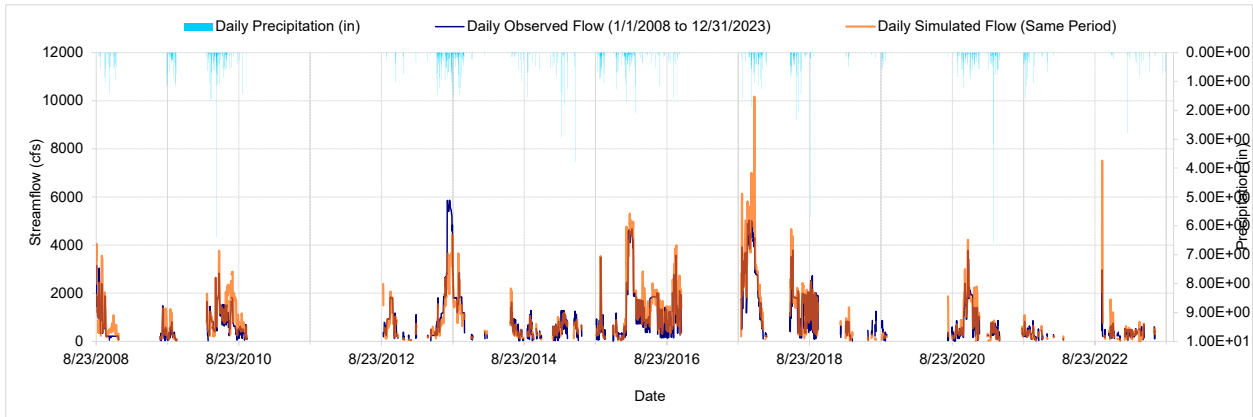


Figure A-115. Mean daily flow: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01- 2023/12/31)

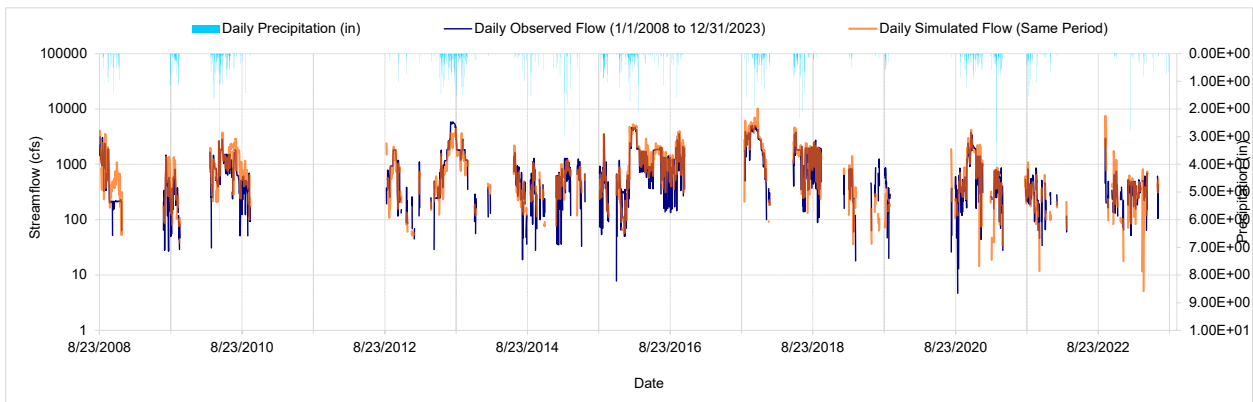


Figure A-116. Log Scale Mean daily flow: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01- 2023/12/31)

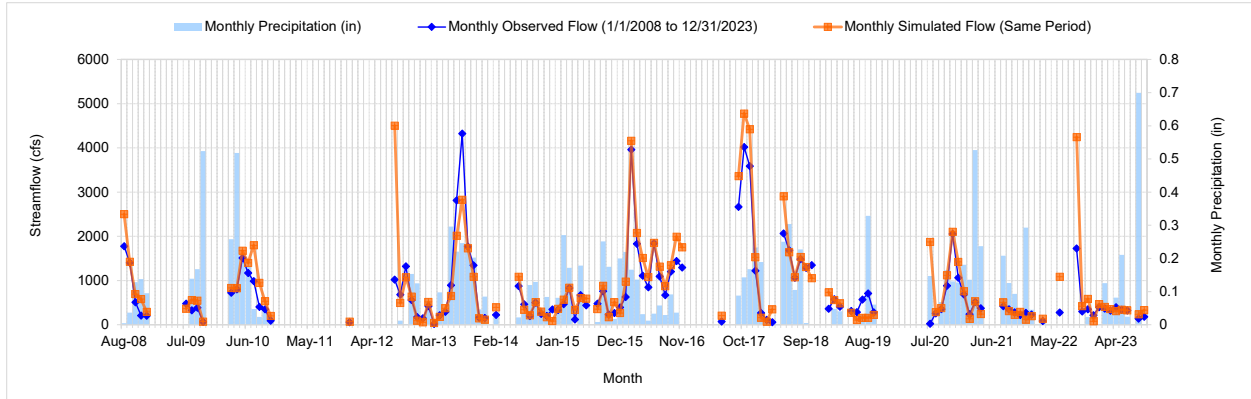


Figure A-117. Mean monthly flow: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01- 2023/12/31)

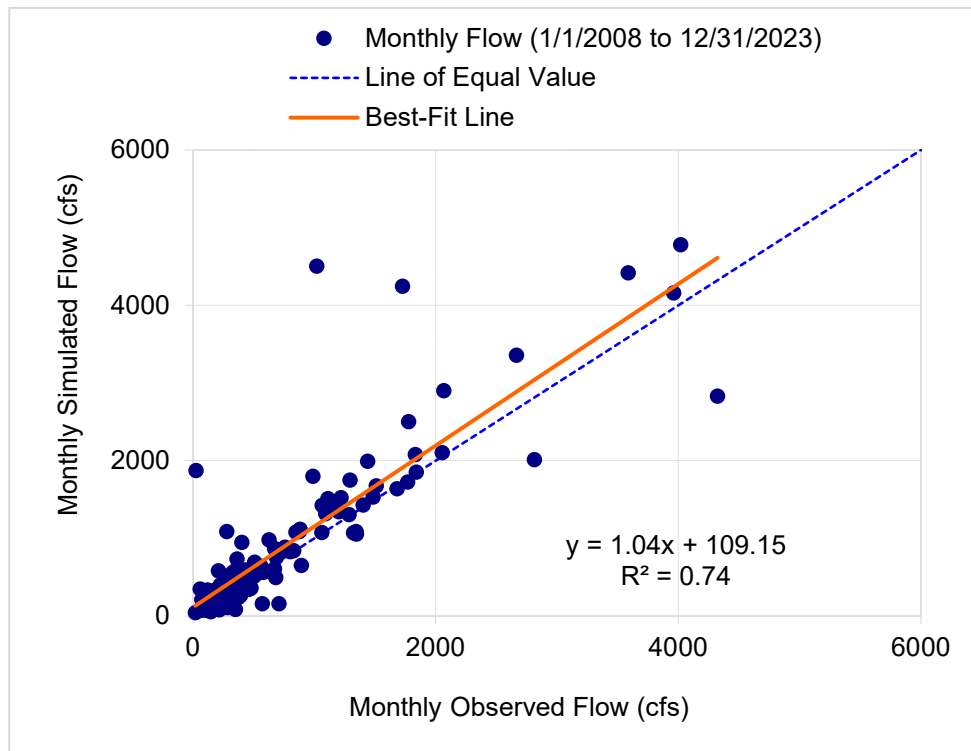


Figure A-118. Monthly flow regression and temporal variation: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

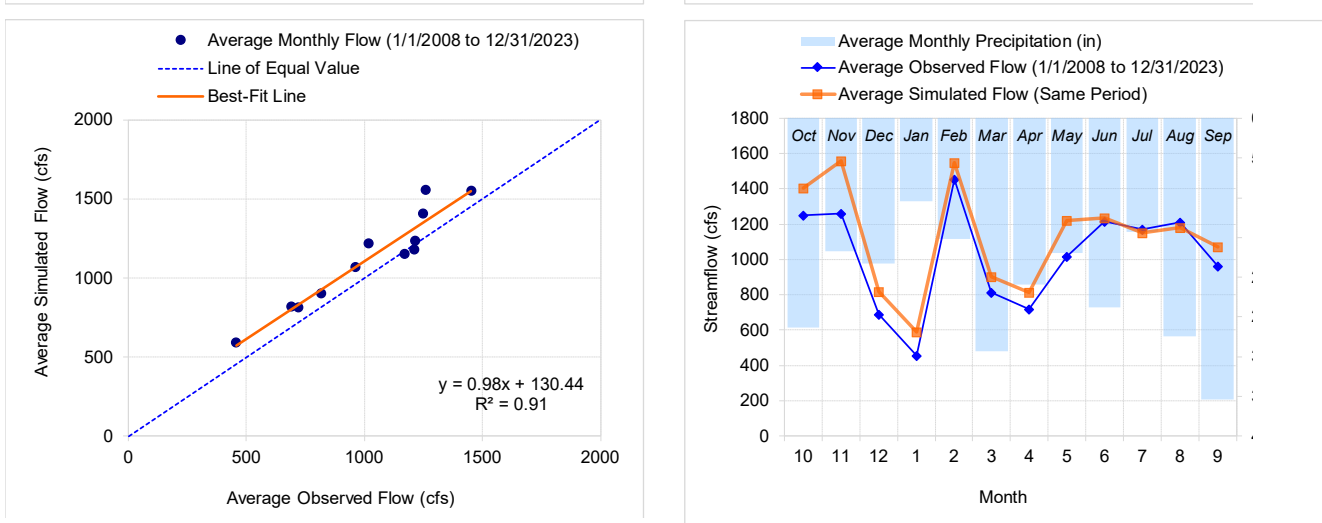


Figure A-119. Seasonal regression and temporal aggregate: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

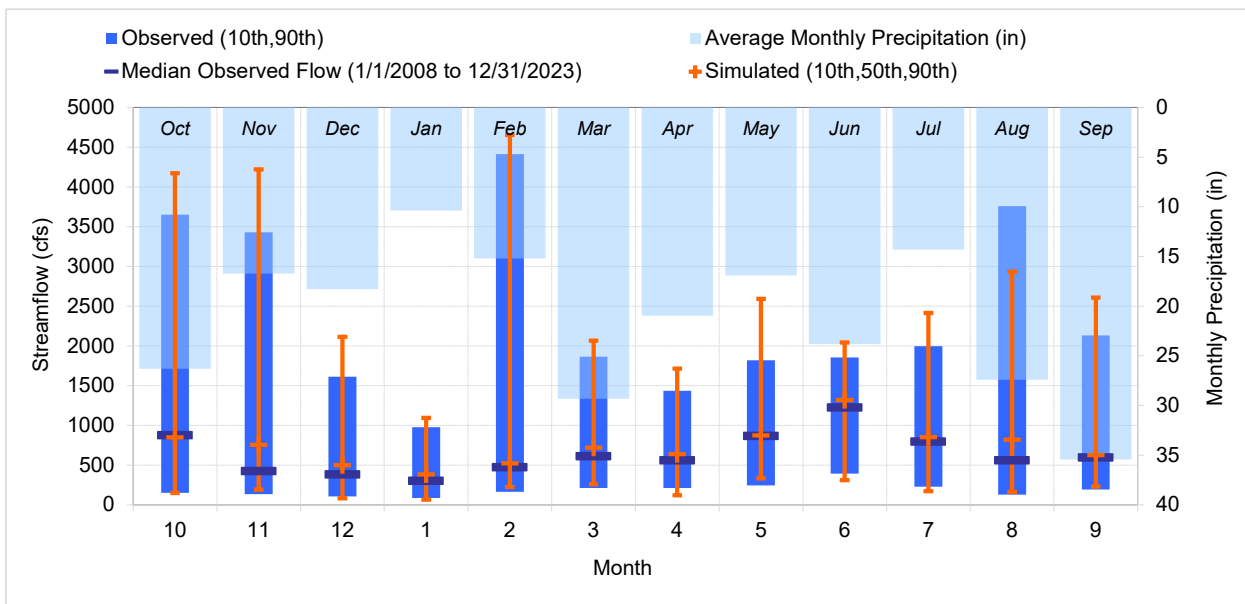


Figure A-120. Seasonal medians and ranges: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

Table A-60. Seasonal summary: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	1248.34	879.00	149.40	3651.40	1407.02	848.42	149.26	4172.46
Nov	1258.42	429.00	134.00	3429.00	1557.08	755.51	190.35	4219.60
Dec	691.50	384.50	103.50	1612.00	817.37	501.18	79.61	2112.16
Jan	455.82	306.00	85.60	976.80	590.43	383.50	64.34	1095.39
Feb	1452.46	474.50	163.00	4413.60	1550.82	522.30	221.18	4651.49
Mar	815.36	614.00	211.00	1864.00	900.77	720.92	257.04	2066.16
Apr	718.09	563.50	212.20	1433.80	812.02	637.90	120.45	1713.33
May	1018.92	869.00	243.90	1818.90	1221.00	875.60	330.89	2589.46
Jun	1216.05	1229.00	393.60	1852.60	1234.80	1320.25	310.64	2041.90
Jul	1170.82	797.00	226.40	1994.80	1151.40	851.11	169.46	2412.74
Aug	1210.87	564.00	126.40	3756.60	1180.17	818.57	162.43	2931.88
Sep	960.79	600.00	190.40	2129.80	1071.04	625.54	229.73	2607.14

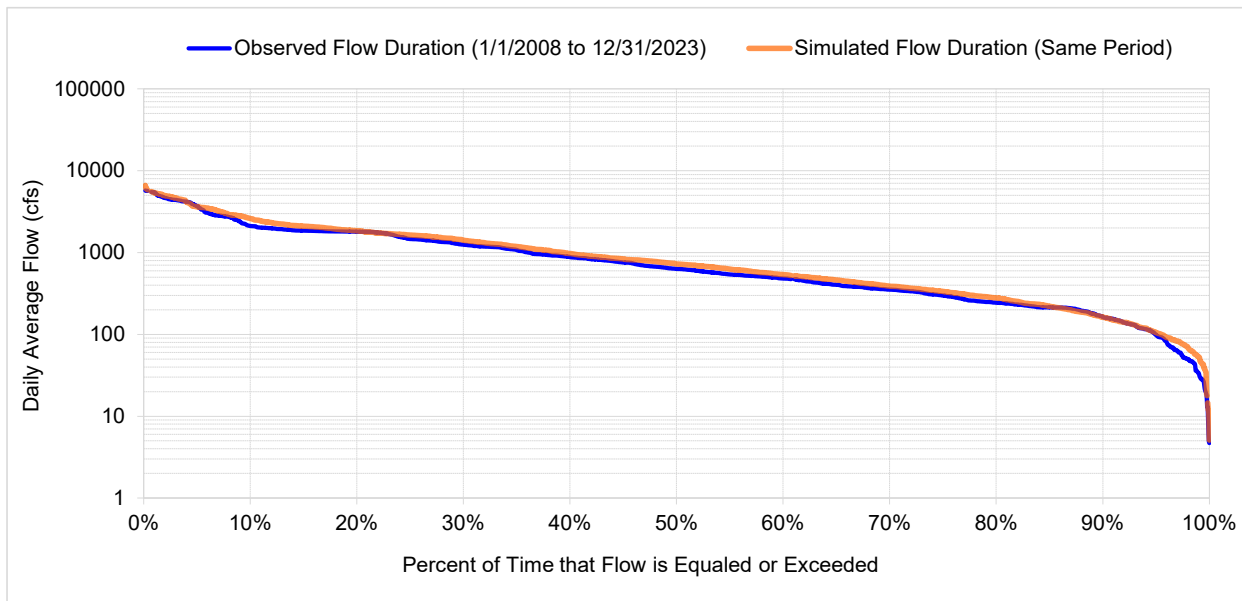


Figure A-121. Flow exceedance: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

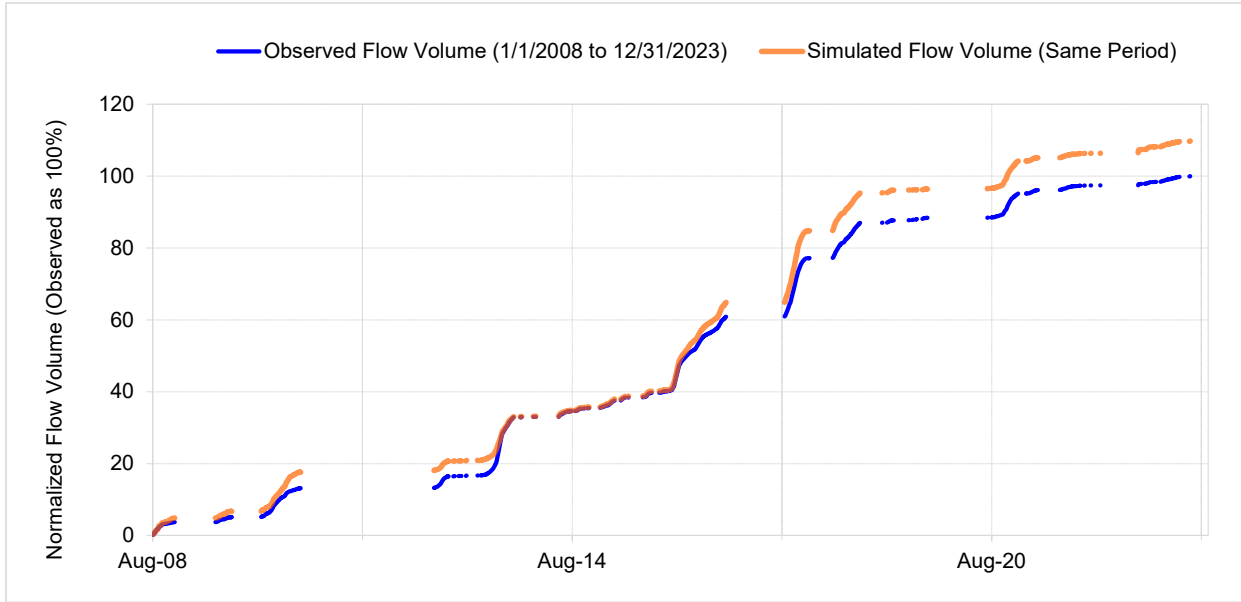


Figure A-122. Flow accumulation: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01 - 2023/12/31)

Table A-61. Summary statistics: Model vs. S-80 Spillway and Sector on St. Lucie At Tidewater (2008/01/01- 2023/12/31)

**S-80 Spillway and Sector on St. Lucie at Tidewater (ID - S80-S)**

Drainage Area (sq-mi): 209

Analysis Period: 1/1/2008 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	24.18	26.55	9.81	10
Total lowest 50% flows	3.59	4.02	11.84	10
Total highest 10% flows	8.55	9.21	7.72	15
Summer flow volume (months 7-9)	9.22	9.56	3.63	30
Fall flow volume (months 10-12)	6.85	8.04	17.32	30
Winter flow volume (months 1-3)	3.59	3.99	11.11	30
Spring flow volume (months 4-6)	4.51	4.96	9.99	30
Total storm volume	7.07	7.92	11.93	20
Summer storm volume (7-9)	3.17	3.39	7.09	50
Baseflow	17.11	18.63	8.93	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.719	0.7
Baseline adjusted coefficient (Garrick), E'			0.552	0.5
Monthly NSE			0.910	0.8

**S308\_S\_1: S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee**

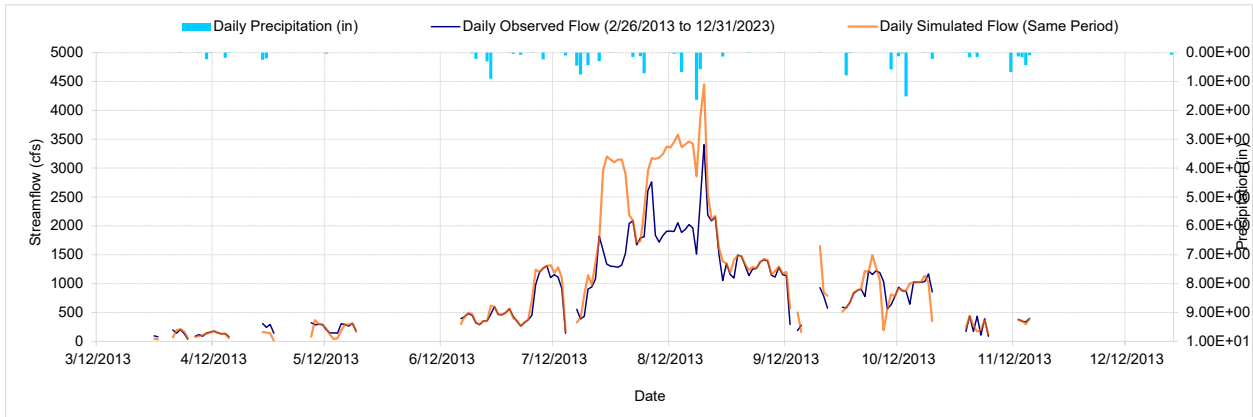


Figure A-123. Mean daily flow: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

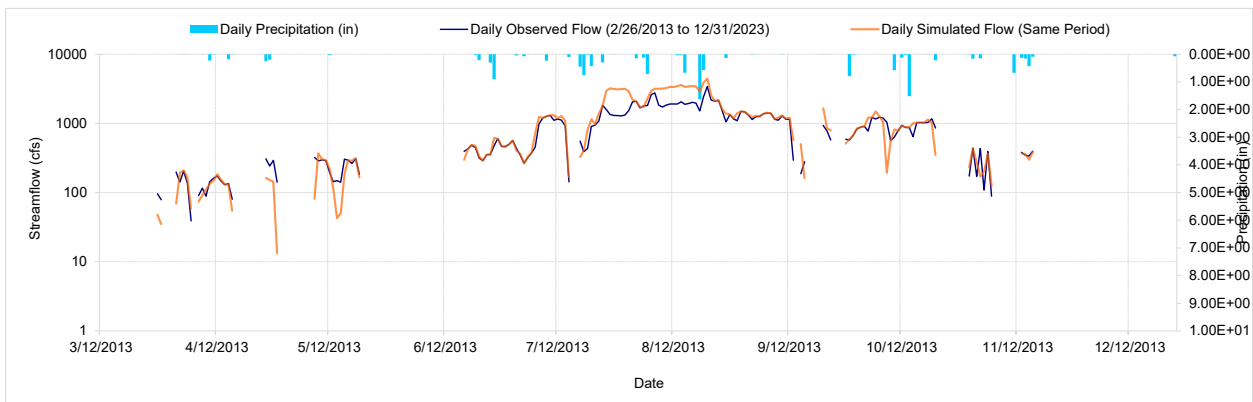


Figure A-124. Log Scale Mean daily flow: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

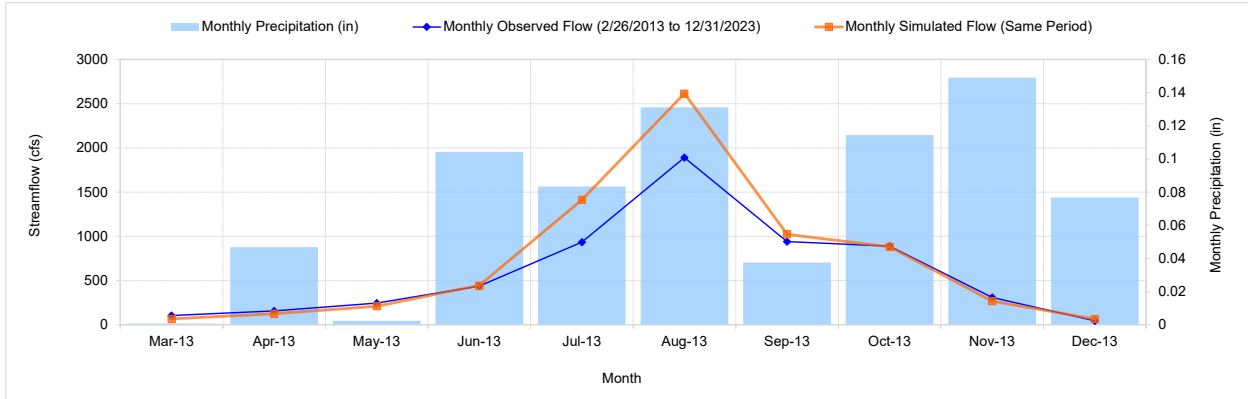


Figure A-125. Mean monthly flow: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

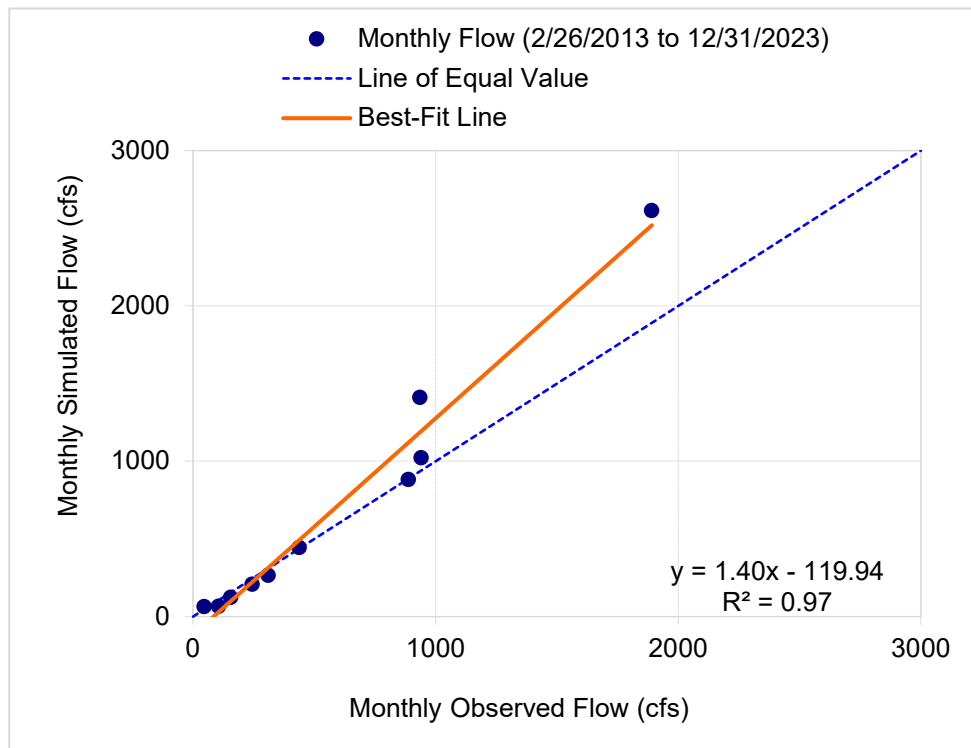


Figure A-126. Monthly flow regression and temporal variation: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

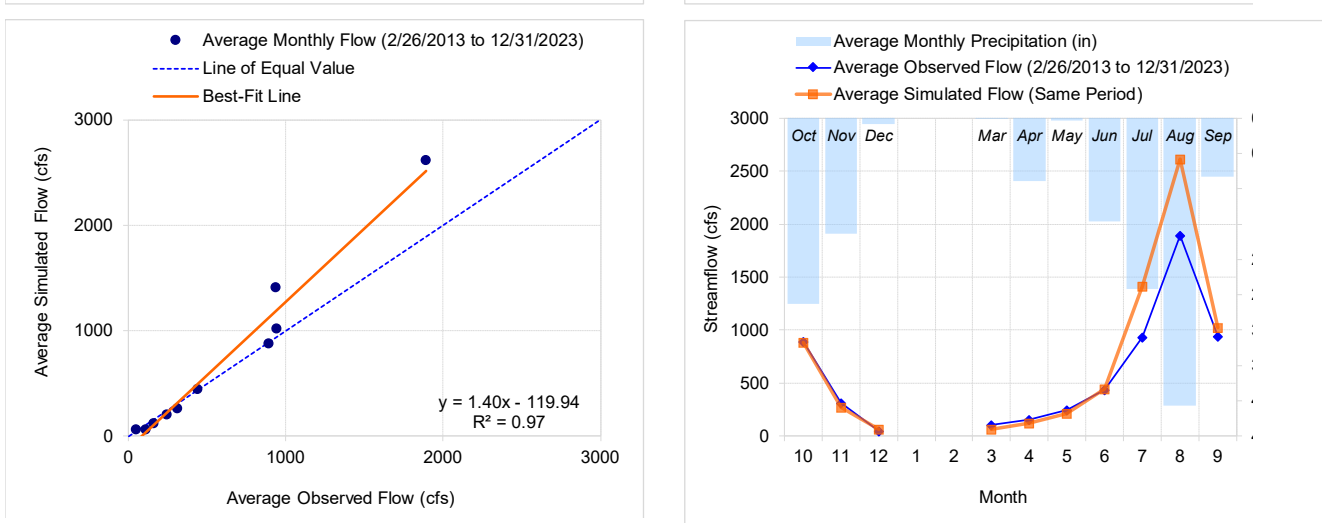


Figure A-127. Seasonal regression and temporal aggregate: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

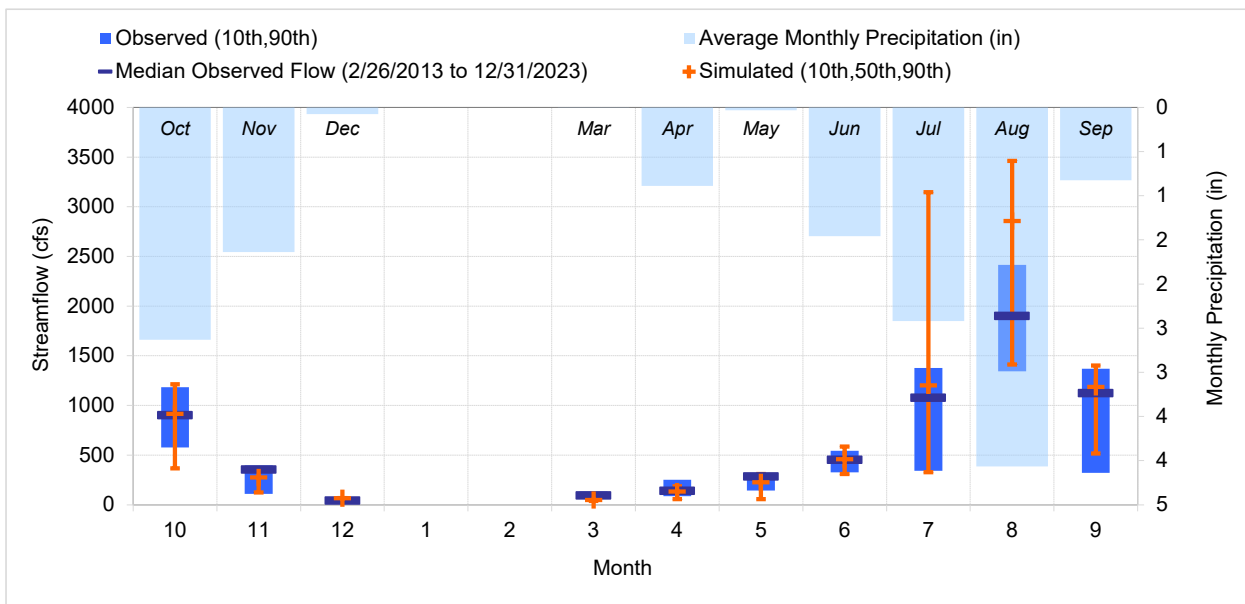


Figure A-128. Seasonal medians and ranges: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

Table A-62. Seasonal summary: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	888.36	905.55	576.94	1183.78	883.11	915.11	366.58	1214.20
Nov	309.75	357.00	108.50	396.00	267.11	276.89	124.40	367.91
Dec	46.00	46.00	46.00	46.00	65.98	65.98	65.98	65.98
Jan	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mar	105.71	96.00	82.24	133.07	66.53	48.02	37.73	102.74
Apr	156.26	142.30	86.88	252.49	125.52	133.77	57.83	186.39
May	244.69	286.63	144.42	308.80	209.97	225.91	56.55	310.95
Jun	438.38	456.62	326.75	543.58	444.55	460.44	309.02	586.46
Jul	936.00	1079.02	341.77	1377.37	1412.10	1202.90	326.92	3146.34
Aug	1891.17	1903.45	1343.69	2415.82	2615.24	2856.80	1411.60	3461.30
Sep	940.62	1125.97	321.80	1370.28	1023.39	1188.45	517.42	1400.55

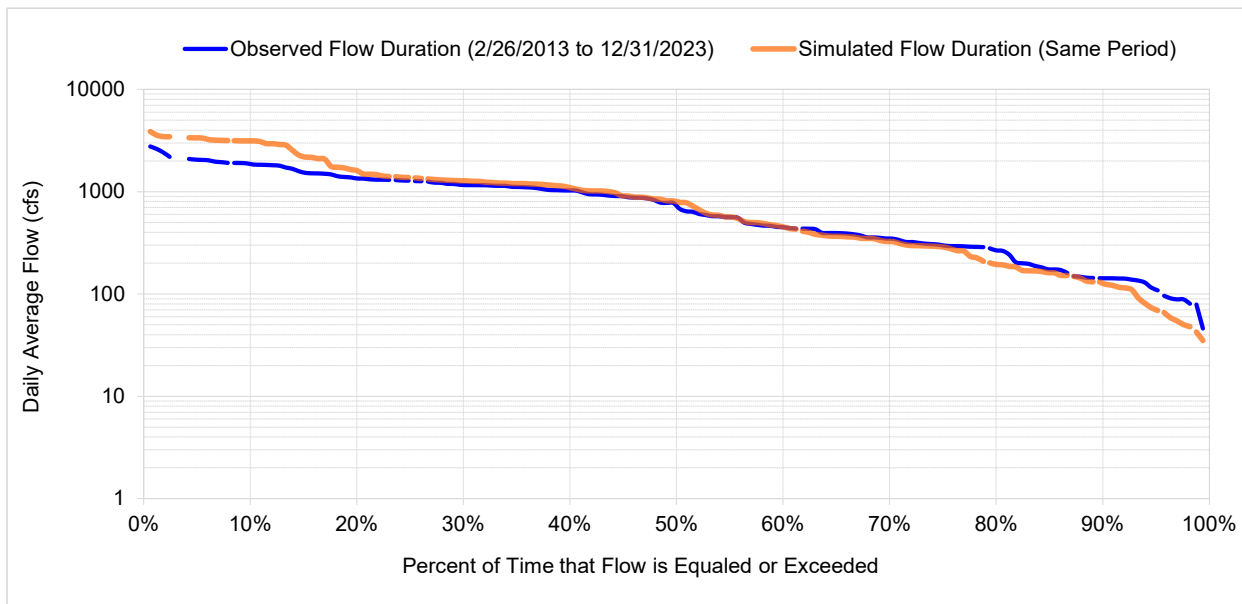


Figure A-129. Flow exceedance: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

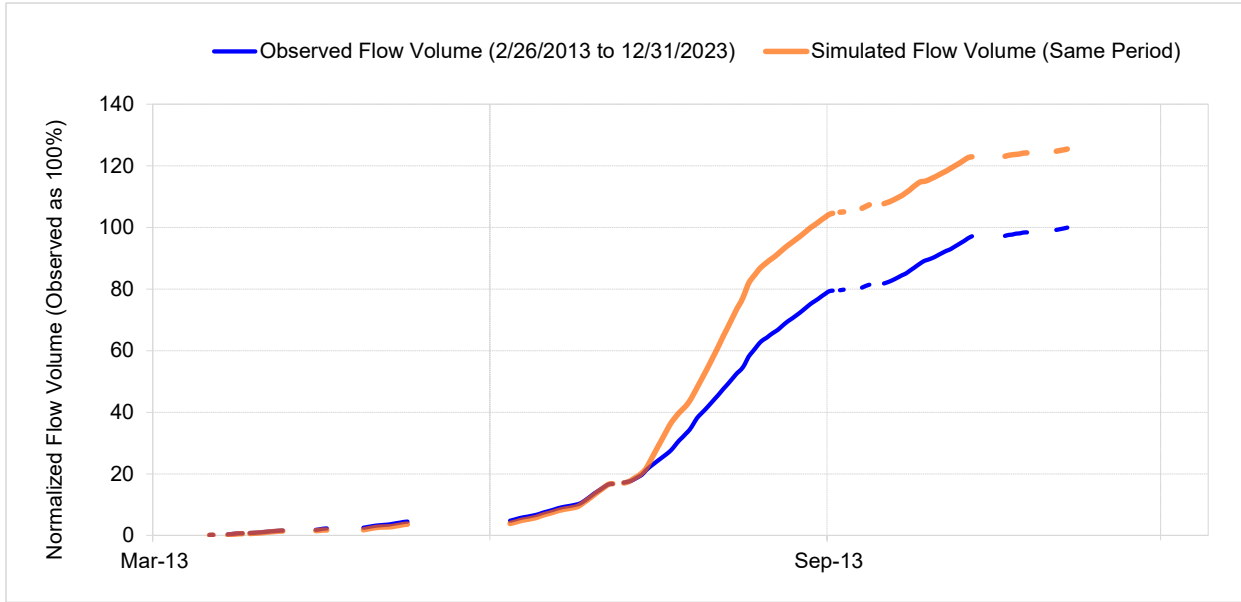


Figure A-130. Flow accumulation: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

Table A-63. Summary statistics: Model vs. S-308 Spillway and Sector Flow on St. Lucie At Lake Okeechobee (2013/02/26 - 2023/12/31)

**S-308 Spillway and Sector Flow on St. Lucie at Lake Okeechobee (ID - S308\_S\_1)**

Drainage Area (sq-mi): 1

Analysis Period: 2/26/2013 to 12/31/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	6765.98	8490.56	25.49	10
Total lowest 50% flows	1202.42	1147.14	-4.60	10
Total highest 10% flows	1677.65	2596.45	54.77	15
Summer flow volume (months 7-9)	5038.92	6840.95	35.76	30
Fall flow volume (months 10-12)	1130.50	1103.53	-2.39	30
Winter flow volume (months 1-3)	15.01	9.45	-37.06	>> 30
Spring flow volume (months 4-6)	581.55	536.63	-7.72	30
Total storm volume	1110.29	1256.00	13.12	20
Summer storm volume (7-9)	754.83	877.82	16.29	50
Baseflow	5655.69	7234.56	27.92	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.279	0.7
Baseline adjusted coefficient (Garrick), E'			0.508	0.5
Monthly NSE			0.771	0.8

**S308\_S\_2: S-308 Spillway and Sector Flow on St. Lucie River at Lake Okeechobee**

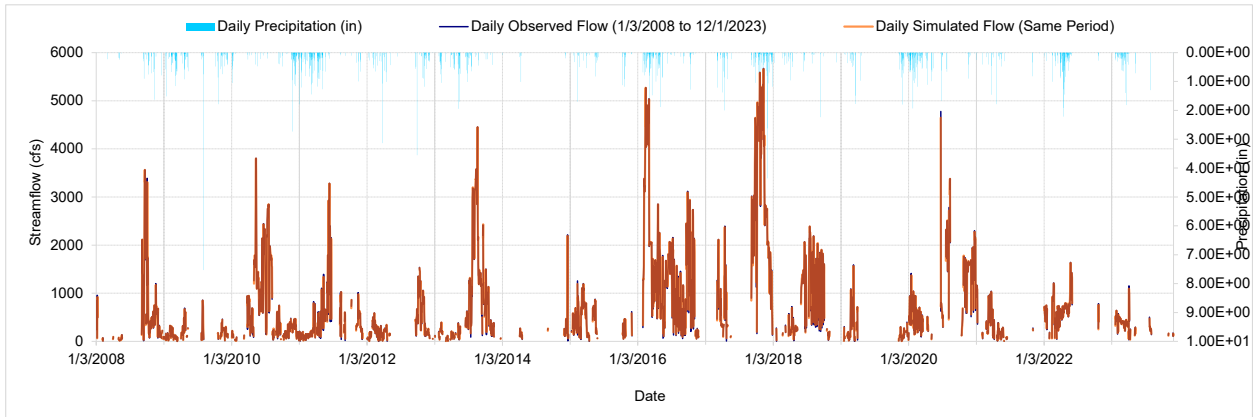


Figure A-131. Mean daily flow: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

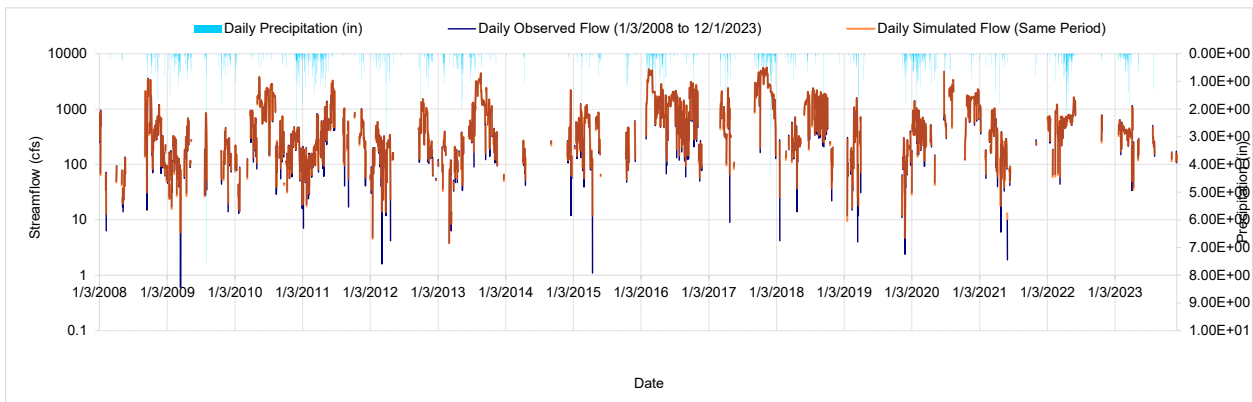


Figure A-132. Log Scale Mean daily flow: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

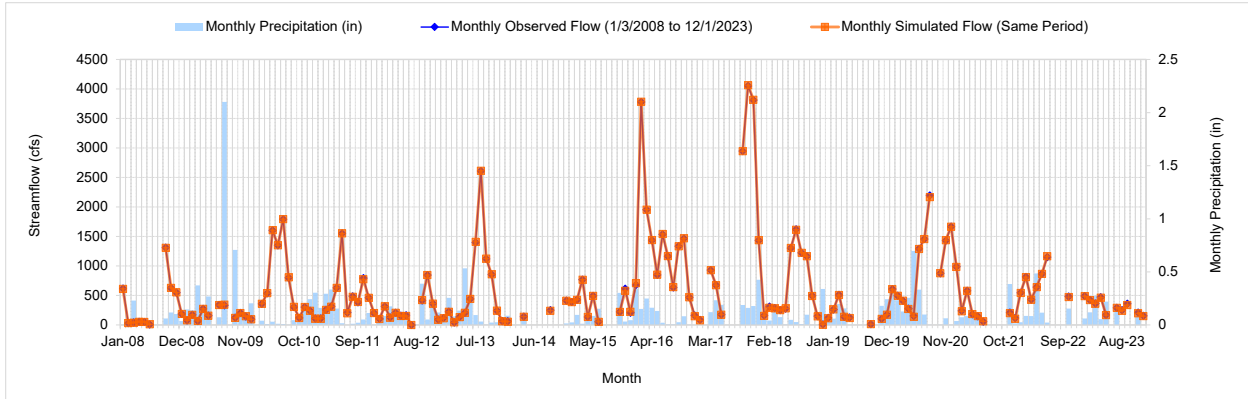


Figure A-133. Mean monthly flow: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

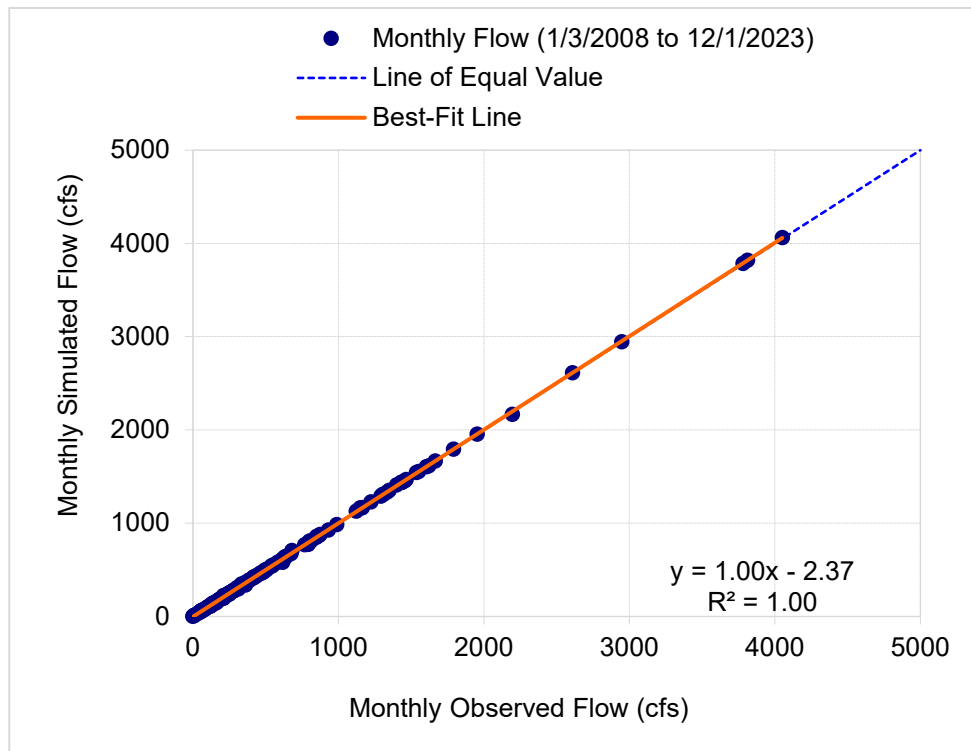


Figure A-134. Monthly flow regression and temporal variation: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

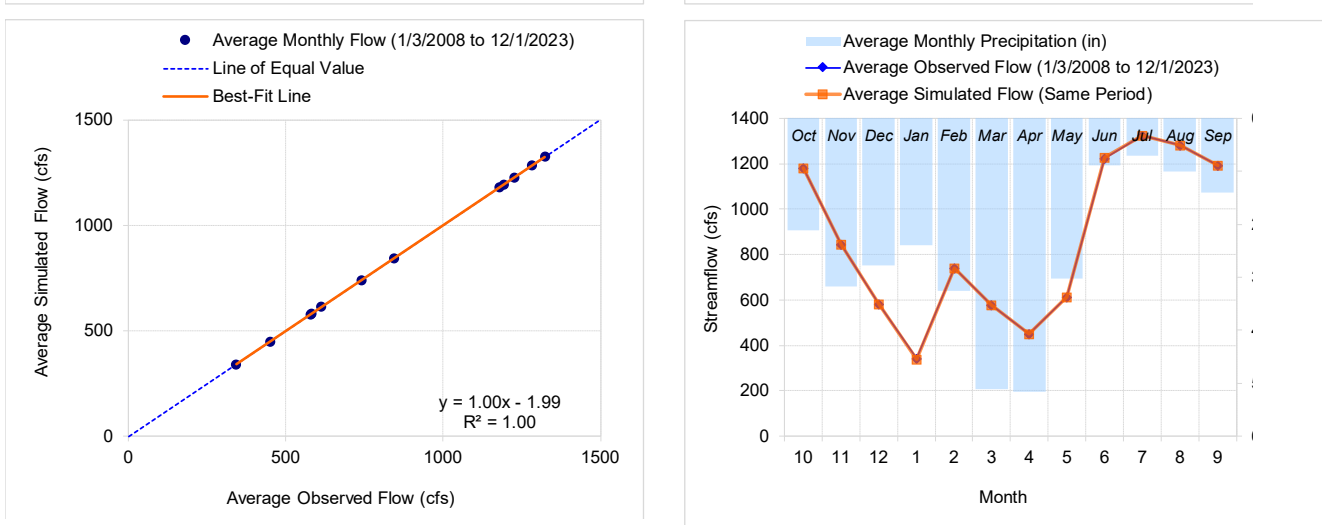
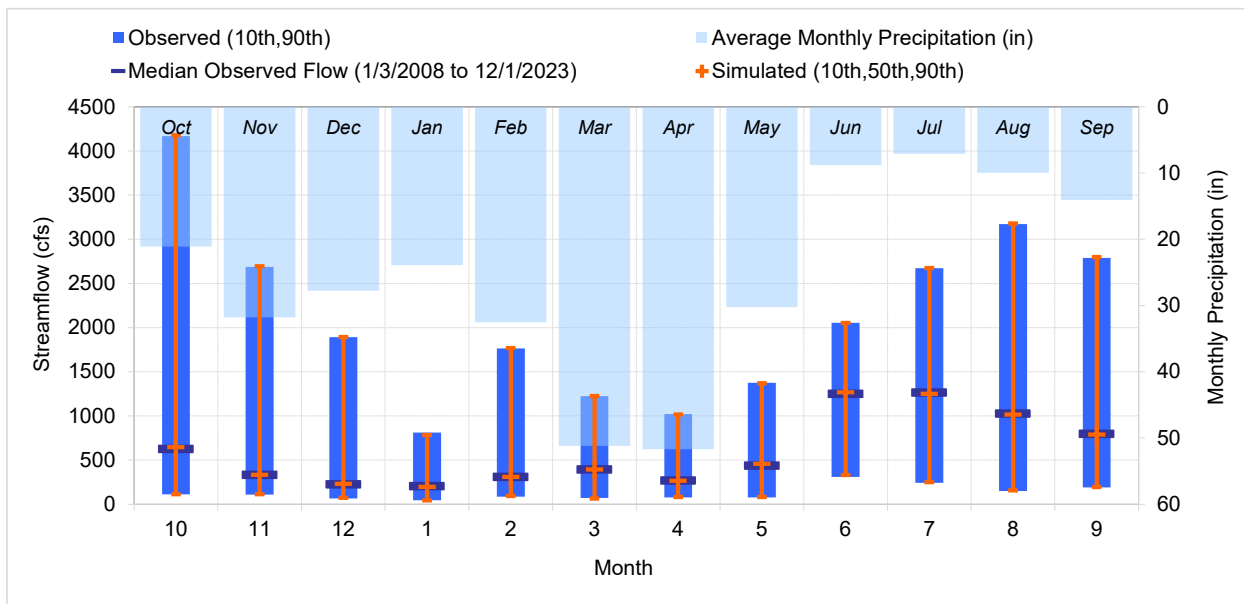


Figure A-135. Seasonal regression and temporal aggregate: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)



A-136. Seasonal medians and ranges: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

Figure

Table A-64. Seasonal summary: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	1179.71	629.00	111.70	4167.30	1181.83	648.36	113.19	4177.76
Nov	844.33	336.00	108.80	2688.80	844.83	335.30	114.04	2693.78
Dec	581.08	229.00	65.30	1891.70	581.82	231.77	72.29	1893.75
Jan	342.05	209.00	44.80	811.80	339.39	198.22	44.65	783.14
Feb	742.08	312.00	86.80	1763.20	741.65	311.96	93.07	1767.16
Mar	579.23	396.00	70.00	1224.00	578.91	394.09	65.26	1226.50
Apr	450.39	271.00	75.90	1020.60	450.59	267.81	80.09	1015.12
May	612.75	441.00	77.40	1373.60	613.99	459.88	81.68	1370.60
Jun	1225.23	1254.00	309.00	2055.40	1227.60	1267.95	331.85	2053.54
Jul	1322.72	1266.50	243.00	2674.00	1324.67	1251.95	249.15	2674.45
Aug	1280.87	1028.00	149.30	3173.40	1282.57	1015.95	155.69	3179.57
Sep	1192.52	799.50	190.60	2790.30	1193.48	789.98	195.95	2798.53

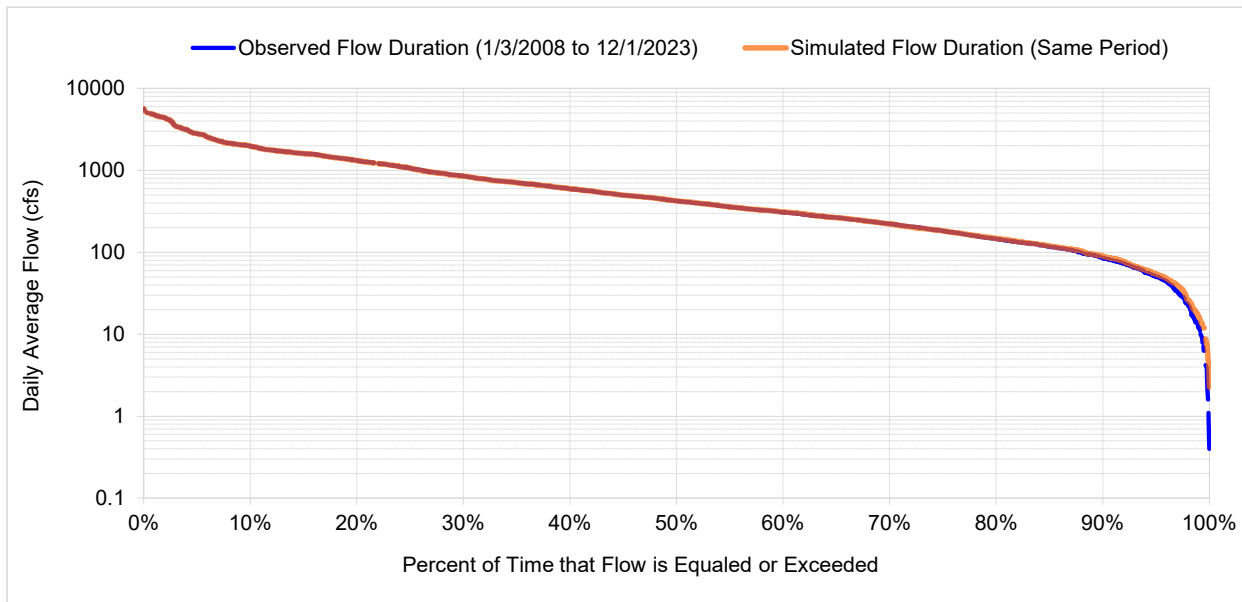


Figure A-137. Flow exceedance: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

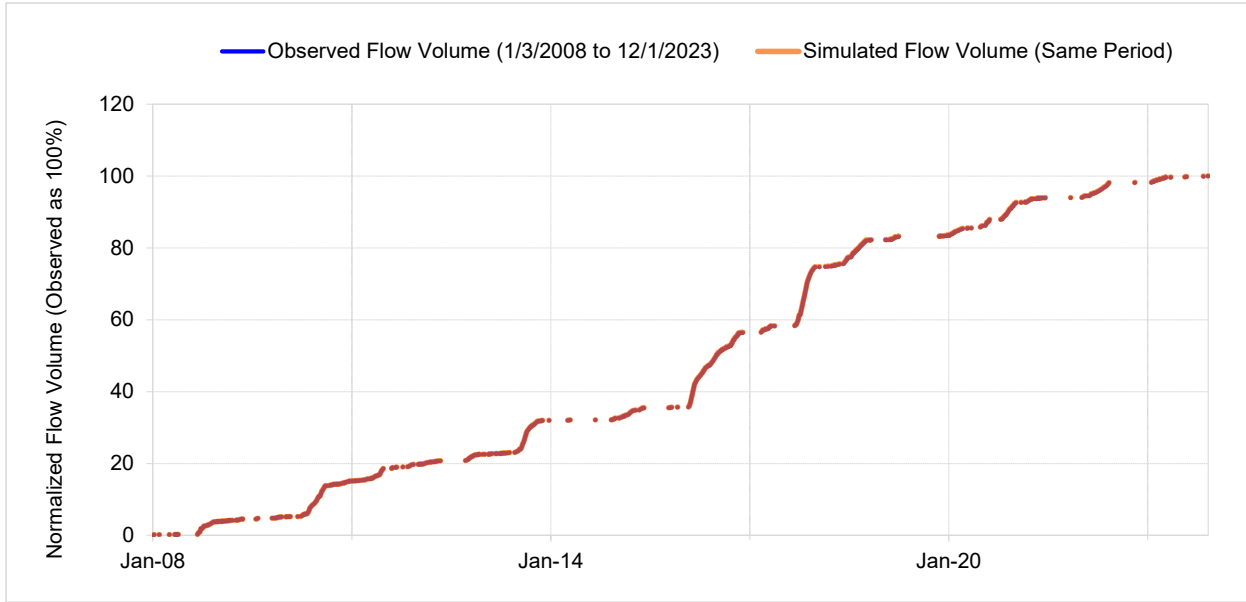


Figure A-138. Flow accumulation: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

Table A-65. Summary statistics: Model vs. S308\_S\_2 St. Lucie (2008/01/03 - 2023/12/01)

**S308\_S\_2 St. Lucie (ID - S308\_S\_2)**

Drainage Area (sq-mi): 1

Analysis Period: 1/3/2008 to 12/1/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	4691.81	4695.05	0.07	10
Total lowest 50% flows	569.79	575.48	1.00	10
Total highest 10% flows	1834.50	1834.46	0.00	15
Summer flow volume (months 7-9)	1273.32	1274.83	0.12	30
Fall flow volume (months 10-12)	1352.07	1353.74	0.12	30
Winter flow volume (months 1-3)	992.95	991.38	-0.16	30
Spring flow volume (months 4-6)	1073.47	1075.10	0.15	30
Total storm volume	1077.81	1042.16	-3.31	20
Summer storm volume (7-9)	318.66	311.27	-2.32	50
Baseflow	3614.00	3652.89	1.08	20
Nash-Sutcliffe Coefficient of Efficiency, E			1.000	0.7
Baseline adjusted coefficient (Garrick), E'			0.985	0.5
Monthly NSE			1.000	0.8

**S308D.S: St. Lucie Canal below S308 at Port Mayaca FL Rd.**

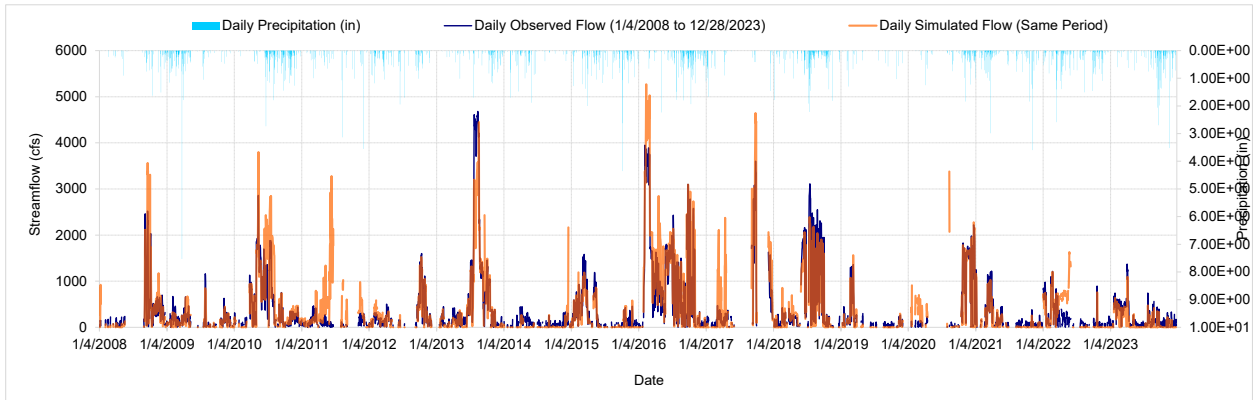


Figure A-139. Mean daily flow: Model vs. S308 DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

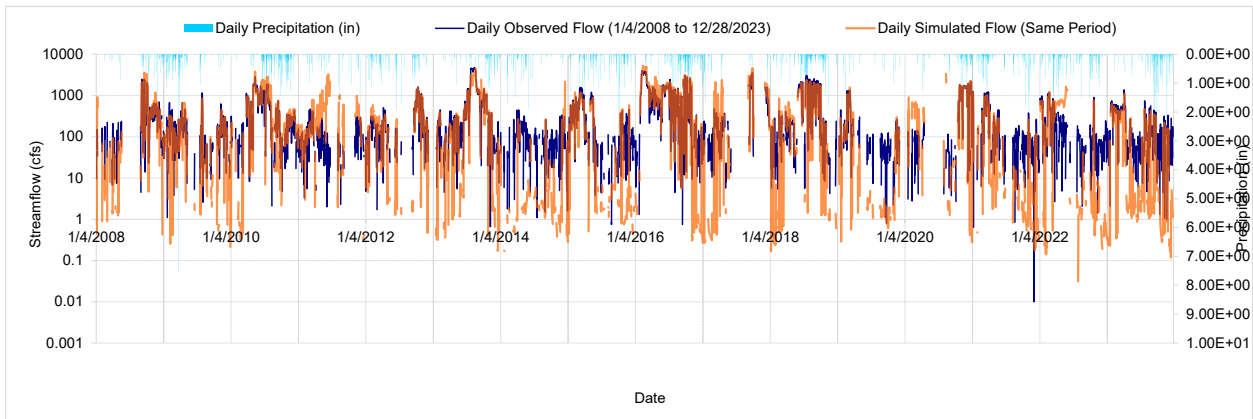


Figure A-140. Log Scale Mean daily flow: Model vs. S308 DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

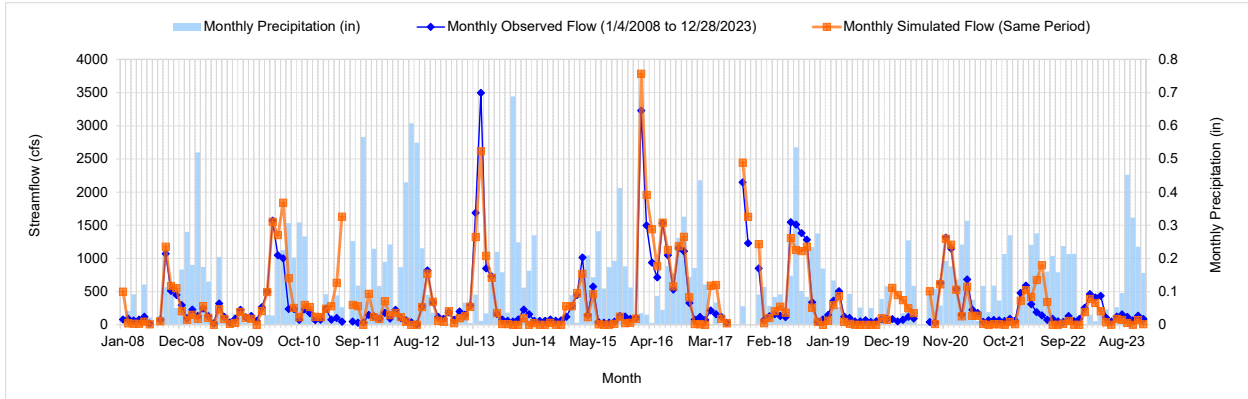


Figure A-141. Mean monthly flow: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

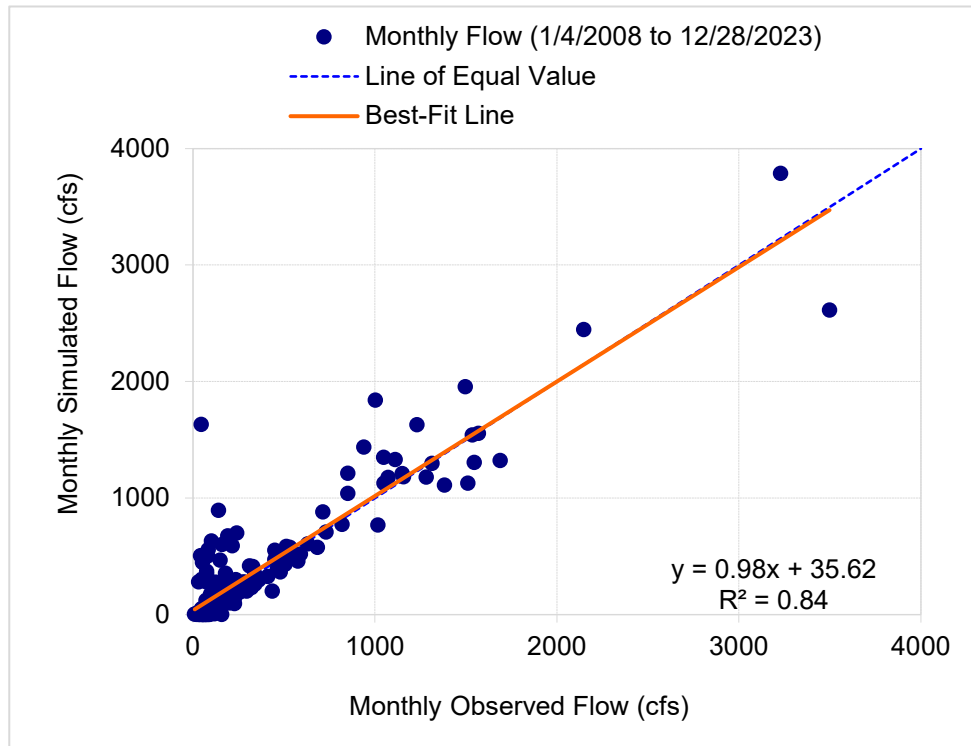


Figure A-142. Monthly flow regression and temporal variation: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

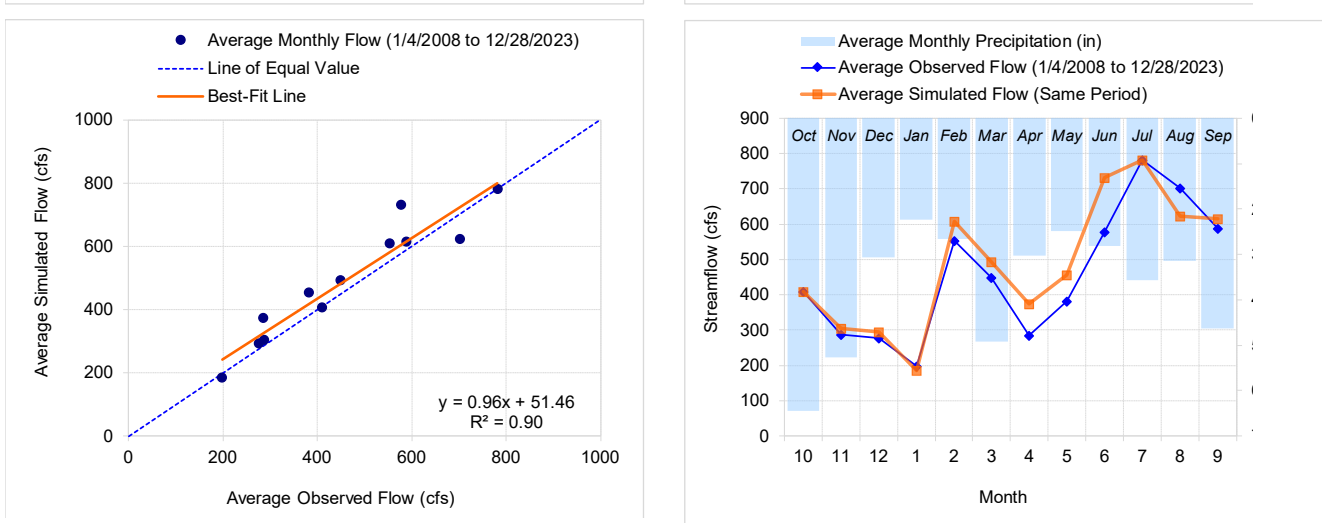


Figure A-143. Seasonal regression and temporal aggregate: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

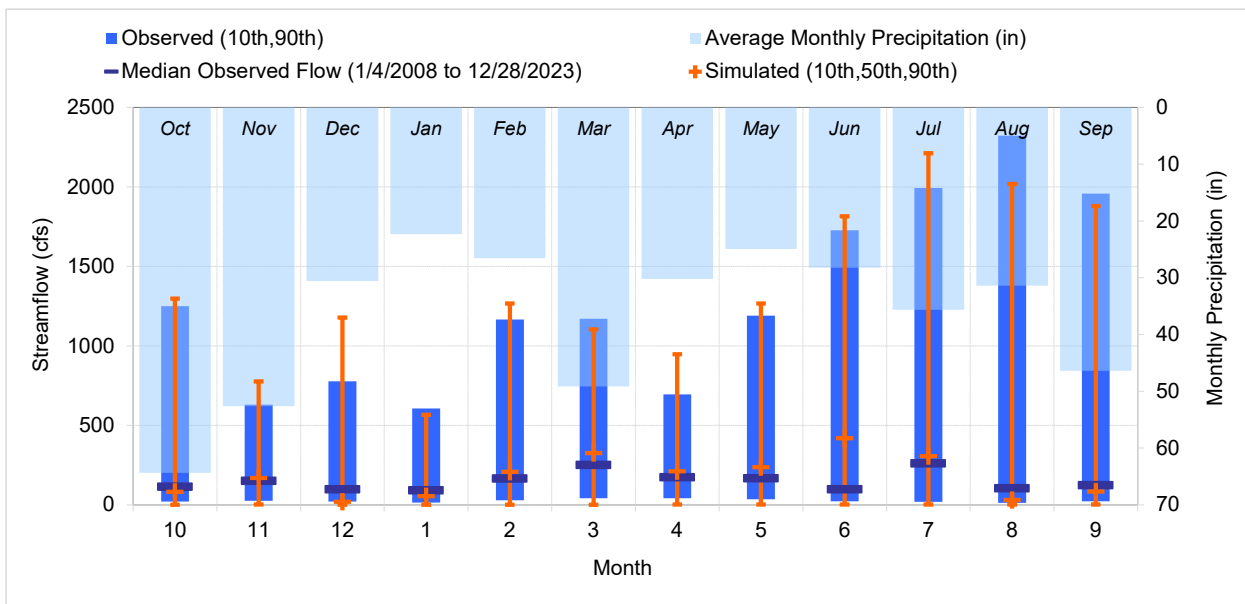


Figure A-144. Seasonal medians and ranges: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

Table A-66. Seasonal summary: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

Month	OBSERVED FLOW (cfs)				MODELED FLOW (cfs)			
	Mean	Median	Lower	Upper	Mean	Median	Lower	Upper
Oct	409.68	116.00	20.70	1250.00	408.27	82.76	0.75	1297.40
Nov	287.55	152.50	24.63	630.10	304.33	168.71	0.86	776.07
Dec	276.82	98.60	20.76	776.20	293.68	19.87	0.32	1177.80
Jan	198.66	93.30	13.79	605.10	186.13	55.32	0.28	566.98
Feb	554.10	167.00	27.86	1165.00	608.95	208.37	0.58	1266.66
Mar	448.90	253.00	40.70	1170.00	492.53	326.18	0.74	1104.12
Apr	286.07	175.00	40.92	694.80	375.16	210.69	2.24	947.28
May	382.85	168.00	35.20	1190.00	455.67	236.40	1.90	1266.60
Jun	578.08	98.50	21.00	1727.00	731.04	419.79	2.18	1815.37
Jul	782.03	262.00	18.59	1993.00	782.34	306.22	1.65	2212.34
Aug	702.16	106.00	12.11	2322.00	622.37	31.31	1.76	2017.87
Sep	589.27	125.50	21.76	1958.00	615.35	83.55	1.77	1879.25

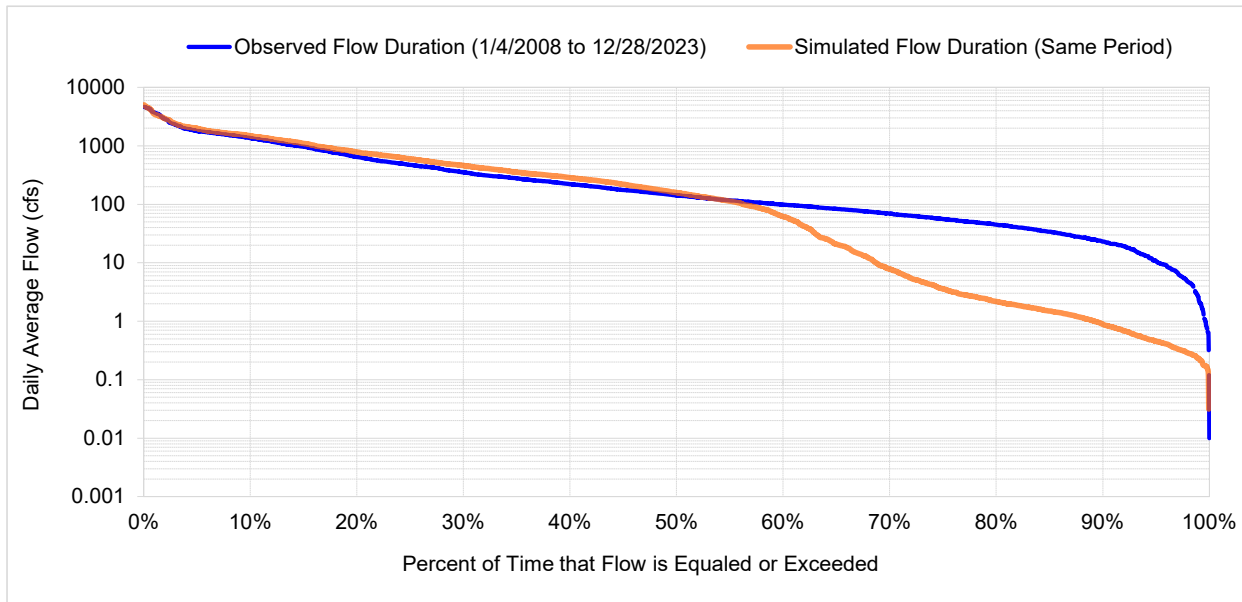


Figure A-145. Flow exceedance: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

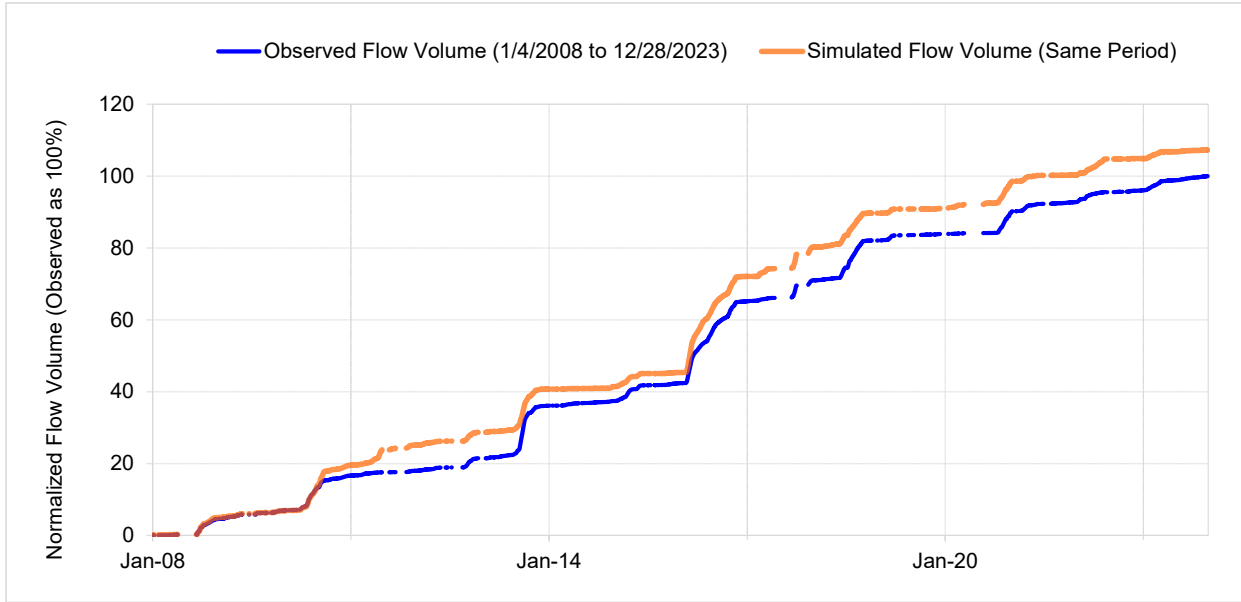


Figure A-146. Flow accumulation: Model vs. S308DS. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

Table A-67. Summary statistics: Model vs. St Lucie Canal Below S308 At Port Mayaca FL (2008/01/04 – 2023/12/28)

**St Lucie Canal Below S308 at Port Mayaca FL (ID - S308.DS)**

Drainage Area (sq-mi): 10

Analysis Period: 1/4/2008 to 12/28/2023

<b>Constituent</b>	<b>Observed (in/yr)</b>	<b>Simulated (in/yr)</b>	<b>Error (Sim-Obs)</b>	<b>Recommended</b>
Total flow	363.34	389.74	7.27	10
Total lowest 50% flows	24.99	11.82	-52.70	10
Total highest 10% flows	181.09	189.18	4.47	15
Summer flow volume (months 7-9)	121.63	118.68	-2.43	30
Fall flow volume (months 10-12)	76.25	78.74	3.27	30
Winter flow volume (months 1-3)	85.30	91.85	7.68	>> 30
Spring flow volume (months 4-6)	80.15	100.48	25.36	30
Total storm volume	100.54	104.36	3.80	20
Summer storm volume (7-9)	32.64	32.48	-0.49	50
Baseflow	262.80	285.38	8.59	20
Nash-Sutcliffe Coefficient of Efficiency, E			0.765	0.7
Baseline adjusted coefficient (Garrick), E'			0.635	0.5
Monthly NSE			0.876	0.8