FINAL REPORT

DELIVERABLE 6.1.1

SOUTH MIAMI-DADE FLOOD PROTECTION LEVEL OF SERVICE FOR CURRENT CONDITIONS AND FUTURE SLR SCENARIOS FOR THE C-1, C-100, C-102 AND C-103 WATERSHEDS

CONTRACT 4600003994

Work Order 02

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May 27, 2022

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EXECUTIVE SUMMARY

The South Florida Water Management District (District) is conducting a system-wide review of its regional water management infrastructure to determine the flood protection level of service (FPLOS). The FPLOS describes the level of flood protection provided by the SFWMD water management facilities within south Miami-Dade C-1, C-100, C-102 and C-103 watersheds under both current and future conditions, where future conditions FPLOS considers future development and Sea Level Rise (SLR). The FPLOS performance metrics rely on the existing conditions and future conditions model outputs resulting from design short-term high intensity rainfall events. This information can be used by local governments, the SFWMD, and other state and federal agencies to identify areas where improvements or upgrades of water management facilities are required, the appropriate entity or entities responsible for making improvements, and funding and technical resources available in support of these efforts.

The surface water management watersheds in eastern Miami-Dade County, Florida, were first delineated in the 1950's by the US Army Corps of Engineers (USACE) in their General Design Memorandum (GDM) for the Central and Southern Florida Flood Control Project. Based on the hydrology of the watersheds within the County, the USACE designed and constructed a system of canals, levees, and control structures to provide flood protection for southern and central Florida. The primary drainage system in South Florida consists of the canals and associated features that are managed by the SFWMD and USACE. Secondary systems consist of canals and features that are managed by designated drainage districts or private entities, which may discharge to the coast or receiving lakes, or into the primary system. Tertiary systems consist of canals and features generally located on private lands that provide localized drainage and discharge into retention/detention areas or into secondary systems. The drainage basin (or watershed) of the canals includes the land that contributes surface water runoff to the canal or its tributaries. For the conditions of South Florida, the watershed delineation is defined by levees and roadways, and less frequently by natural ridges and high ground. Within each watershed, surface water inflows and outflows are managed by operating weirs, spillways, culverts, or pump stations. The study domain for South Miami-Dade County Flood Protection Level of Service (South Miami-Dade FPLOS) consists of four (4) main watersheds:

- C-100 watershed (including C-100 West and C-100 East sub watersheds)
- C-1 watershed (C-1 East and C-1 West sub watersheds)
- C-102 watershed (C-102 East and C-102 West sub watersheds)
- C-103 watershed (BD-C103 West, BD-C103 Central, BD-C103 East, Homestead Air Force Base (HARB), North Canal (NO-Canal) and Florida City (Fla-City) watersheds)

The control structures in the above watersheds regulate the flow of water in the primary canals which were designed to discharge excess water from the watersheds during flooding and to maintain minimum water levels in the canals during drought periods. Some interior structures are usually closed to prevent water from passing from one watershed to another but can be opened to supply water from one watershed or canal to another, as necessary. The coastal structures have the additional function of preventing saltwater from a tidal or storm surge from entering canals discharging to tidewater. Since the initial design, new surface water management infrastructure has been constructed and the existing infrastructure is continuously modified to meet the changing needs of South Florida.

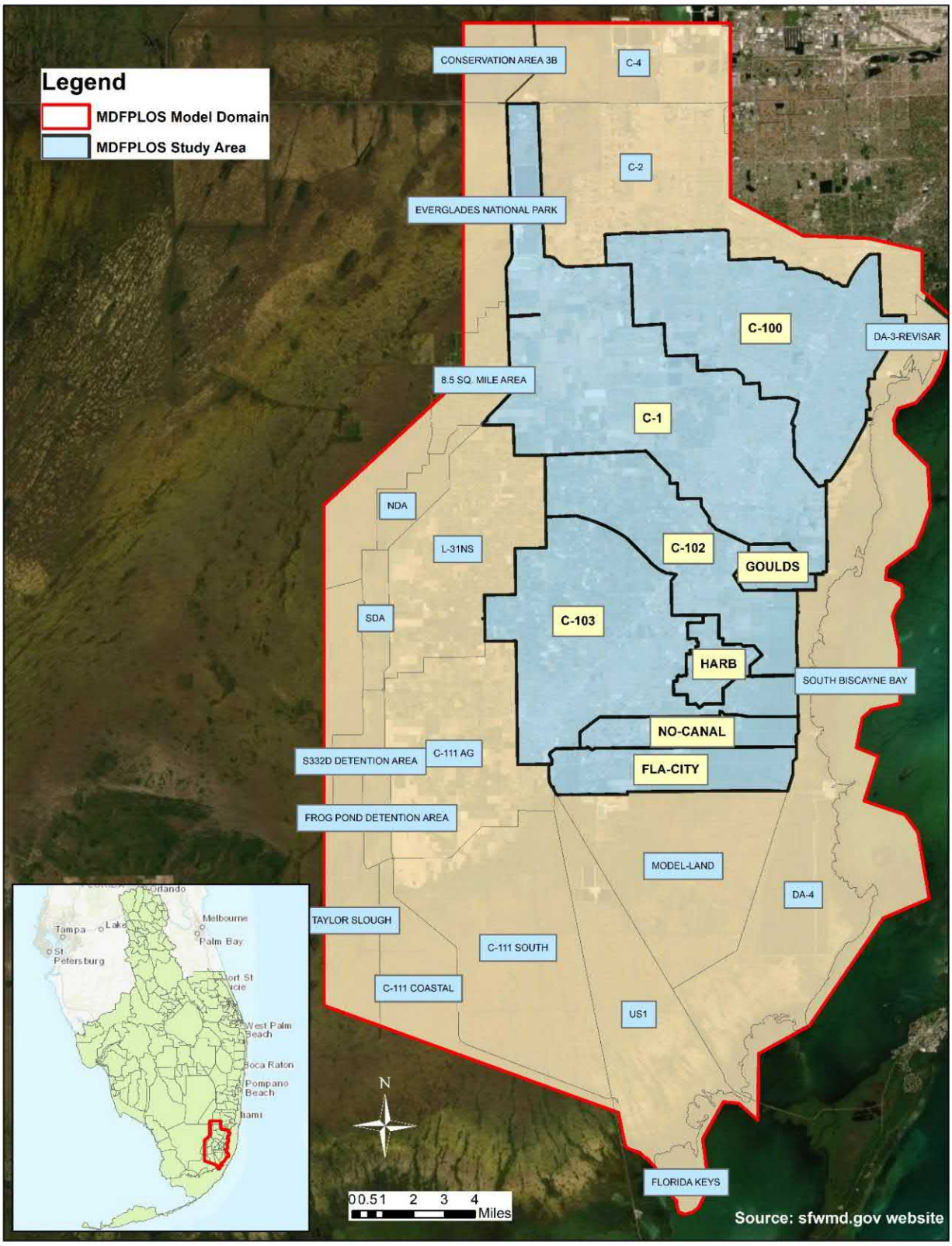

Figure 1. South Miami-Dade FPLOS Project domain

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The South Miami Dade Level of Service model (SMD FPLOS) has been developed and calibrated to simulate the main components of the full range of hydrology - transitioning from natural areas on the west to the urban and agricultural areas to Biscayne Bay on the east. The model encompasses an area of approximately 550 square miles; bounded by L-31N canal on the west, C-4 watershed to the north, C-111 canal to the south and Biscayne Bay to the east. It simulates all major water budget components that are relevant to South Florida, which include evaporation, transpiration, overland and groundwater flows, levee seepage, and canal flows. The model includes all major canals, and many secondary and tertiary canals.

Spatial Data: The model domain was developed in the UTM-17N coordinate system using a 100 m grid resolution. Spatial files represent the distributed properties of the model domain. The topography was derived from the Digital Elevation Model (DEM) containing georeferenced digital representation of the ground surface elevations providing the vertical position above NAVD 88 in feet with horizontal resolution of a 5-foot grid cell. Bathymetry from NOAA was merged with the DEM for model areas which are below the Mean Sea Level and are not included in the 2015 or 2018 LiDAR datasets. Land Use and Land Cover have been obtained from SFWMD's statewide Land Cover and Land Use (2012-2019) and was compared to NOAA's Coastal Change Analysis Program (C-CAP) Regional Land Cover Database from 2016. Soil Survey Geographic Database (SSURGO) was used to define soil properties within model domain for the Unsaturated Zone. SFWMD Lower East Coast sub-regional model (LECsR) was the basis for the hydro stratigraphy and saturated zone properties of the Surficial Aquifer System of Miami-Dade County.

Monitoring Data: Within the study domain, SFWMD collects and maintains records of stage, flow, gate operations, rainfall, and evapotranspiration. Data are accessible through a Web accessible database, known as DBHYDRO. The DBHYDRO data are subject to Quality Assurance and Quality Control (QA/QC) procedures and integrate data acquired from NOAA, USGS, NPS, and other agencies. Data from DBHYDRO were downloaded, reviewed, and converted to model input files (1D and 2D timeseries) for model boundary conditions and for model calibration and validation targets.

Infrastructure Data:

SFWMD operates and maintains all primary control structures and water level gages within the project domain. SFWMD maintains records of gate operations, headwater elevations, tailwater elevations, and flow at each structure for various time intervals. These data are part of the South Miami-Dade Flood Protection Level of Service (SMD FPLOS) model and geodatabase. Additional infrastructure data included the secondary and tertiary conveyance system operated and maintained by Miami-Dade County.

Storm Events:

A review of the storm events between 1999 and 2019 was conducted and two of the most recent events were selected for calibration and validation: the primary calibration event is Hurricane Irma which occurred on September 9-11, 2017 and an additional storm event which occurred on December 4-6, 2015 was selected for validation. The storm events were selected based rainfall distribution across the domain, volume, peak intensity, peak stages within primary canals, peak discharges to Biscayne Bay, peak storm surge backflow.

Model Parameters:

The Model Domain covers approximately 550 square miles with subdomains: OL – Two-dimensional Overland Flow, UZ – One dimensional flow in unsaturated zone, SZ – Three-dimensional flow in saturated zone and OC – Open Channel and Hydraulics (canals, control structures, culverts, bridges and pumps). The model domain is discretized into two model versions with cell sizes 50 m and 100 m.

- 328 ft x 328 ft (100 m X 100 m), 626 rows x 332 columns, 5 layers (SAS)
- 164 ft x 164 ft (50 m x 50 m), 1252 rows x 664 columns, 5 layers (SAS)
- The 1 D model is discretized to 422 branches, with 2,265 h-points (stage calculations) and 1843 Q-points (discharge calculations)

Each of the solvers (UZ, SZ, OL) uses adaptive timesteps allowing the user to set a maximum timestep which in this model are:

- The Overland (OL): Maximum allowed timestep of 15 minutes
- Unsaturated Zone (UZ): Maximum allowed timestep of 15 minutes
- Saturated Zone (SZ): Maximum allowed timestep of 15 minutes
- 1D Open Channel (OC): Uses fixed 5-seconds timesteps.
- Model output is recorded at 1 hour for OL, UZ and SZ and every 5 min for OC
- 2-month period of simulation for calibration and validation (approximately 1 month before and after the peak event)

Model Calibration:

Initial sensitivity analysis was conducted to determine the model sensitivity to input parameters. Model calibration was performed by varying the parameters within the common range established from previous similar models for Miami-Dade County and South Florida. Based on available observed data, a set of primary and secondary calibration and validation targets were defined and evaluated using multiple statistical parameters, including Bias, Mean Absolute Error, Root Mean Square Error, Standard Deviation, Nash-Sutcliffe Efficiency, peak differences, and peak timing. The model is calibrated using peak stages and peak flows for Hurricane Irma (September 2017) and validated for the storm event in December 2015. The overall calibration and validation statistics for the calibration and validation targets exceeding (meeting) the calibration criteria are summarized in Table 1.

Table 1 Calibration Results for Targets within Project Watersheds

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
All Stages (GW and SW)	Total	150	150	150	150	150	150	150	150
	Exceed	126	117	89	77	87	126	94	108
	% Exceed	84%	78%	59%	51%	58%	84%	63%	72%
	Average	0.10	0.41	0.48	0.90	0.29	0.73	0.41	0.39

For the entire model the average Bias is 0.10 ft, MAE is 0.41, RMSE is 0.48, COR is 0.90, STD is 0.29, PE is 0.73, and NS is 0.41 with Peak Differences average of 0.39.

Validation statistics for all stations within the project domain are summarized below.

A summary of all surface and groundwater stages within the model domain exceeding the validation criteria is provided in Table 2.

Table 2 Validation Results for Targets within Project Watersheds

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
All Stages (GW and SW)	Total	162	162	162	162	162	162	162	162
	Exceed	115	105	127	135	137	124	62	113
	% Exceed	71%	65%	78%	83%	85%	77%	38%	70%
	Average	0.39	0.45	0.51	0.87	0.27	0.40	0.66	0.53

For the entire model the average Bias is 0.34 ft, MAE is 0.45, RMSE is 0.51, COR is 0.87, STD is 0.27, PE is 0.40, and NS is 0.66 with Peak Differences average of 0.53.

The calibration of the SMD FPLOS was successful in meeting calibration-stage criteria at most of the groundwater and surface water stage, and surface water flow locations.

The surface/groundwater integrated model includes the latest regional static data sets for topography, land use and hydrogeology. Time-varying datasets included rainfall, ET, and tidal stages, structure operations, groundwater withdrawals and others. The MIKE 1D network represents the primary canals, with Water Control District (WCD) canals representing the secondary canal system in south Miami-Dade. The simulation time step was a maximum of 15 minutes for OL, UZ and SZ subdomains and fixed 5 seconds for MIKE 1D OC subdomain, allowing the model to represent water control structures operations closer to SFWMD operations during storm events. The land use, groundwater withdrawals and other datasets were based on most recent data since the calibration period is chronologically close to the existing conditions; no major changes were completed to the land use, infrastructure, or operations of the system in the two elapsed years between the period of calibration and validation.

Simulations of Design Events

The numerical model was applied to analyze a set of design events including 5-yr, 10-yr, 25-yr and 100-year storm event with a duration of 72 hours. The existing conditions model was based on the calibrated and validated SMD FPLOS model, and datasets modified for application setup. The tailwater timeseries for each return interval for the coastal structures (S22, S123, S21, S21A, S20F, S20G, S20, S197) were provided by SFWMD, and were developed for Hurricane Irma from 2017 and scaled to represent 5-yr, 10-yr, 25-yr and 100-year design storm conditions. All observed structure operations in the model were replaced with rule-based operations, using the latest information provided in the SFWMD's Water Control Operations Atlas of South Miami-Dade County (last updated 2021). The rainfall dataset for application follows the spatial 3-day design storm rainfall distribution by SFWMD; rainfall depths were obtained from NOAA's Rainfall Atlas ASCII grid data. Sensitivity analysis showed that the stages were at the highest value when the two peaks were aligned with each other, which was assumed to be the most conservative approach and was subsequently used for all design event simulations. The land use, groundwater withdrawals and other datasets were not modified for current conditions since the calibration

period is chronologically close to the existing conditions; no major changes were completed to the land use, infrastructure, or operations of the system in the two elapsed years between the period of calibration and period of simulation of the existing conditions. For future conditions, land use and topography were modified to reflect changes in land use and compliance with Miami-Dade County's County Flood Criteria which provides the minimum elevations of parcels for future development. Additionally, stormwater storage nodes were included to account for the development of vacant land within the model domain. Furthermore for future conditions, the drainage infrastructure was extended by adding planned secondary canals within the project domain.

Performance Metrics Analysis

The results from simulating the 5-yr, 10-yr, 25-yr and 100-year storm events were analyzed using a set of six (6) Performance Metrics (PMs), which were applied to evaluate the flood protection LOS of each of the watersheds C-1, C-100, C-102 and C-103.

- PM1: The peak stage in the canals was applied in PM1 which uses the Maximum Stage in the Primary Canals to determine the LOS required not to overtop the canal banks. he largest of the design storms that stayed within the MIKE 1D canal banks per the modeling established the FPLOS of the primary conveyance system.
- PM2: The peak discharge capacity of the12-hr average discharges was determined for PM2, Maximum Daily Discharge Capacity through the Primary Canals. This computed 12-hr peak discharges was compared with the design discharges at each structure and the SFWMD Environmental Resource Permit (ERP) Allowable Discharges.
- PM3: In addition, the computed discharges at each tidal structure were compared to the structure capacity as defined by the original static design conditions as outlined in PM3 Structure Performance.
- PM4: The peak discharge capacity of the coastal structures was then compared for a range of design storms as required by PM4 - Peak Storm Runoff, which determines the maximum conveyance capacity. Modeled scenarios considered the combined effect of design storm events and storm surge, averaged over the tidal cycle for coastal structures. PM4 shows the maximum conveyance given specific tidal boundary conditions and design storm events.
- PM5: The frequency of flooding was evaluated under PM5 and provides the overall ability of the water management infrastructure to prevent flooding. This PM evaluated the overland flooding depths for 72-hr duration of 5-, 10-, 25- and 100-year recurrence intervals and determined the flood duration metrics.
- PM6: The duration of flooding was determined in PM6 which determines the time required for surface water stages to recede to non-flood levels. PM6 quantifies the flooding duration in SMD FPLOS watersheds.

Watershed C-1 FPLOS:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of watershed C-1, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation and low hydraulic gradient. Canal banks are consistently below the 25-yr peak water elevation for current conditions, and in multiple locations are below 10-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S148 and S148) showed limited capacity to increase peak and cumulative flows for increasing SLR. The peak flow for both structures decreased for increasing SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater. Structure S148 shows limitation with respect to peak discharges from design events. Mitigation will require increasing flow capacity of canals C-1W and structure S148, which will potentially trigger requirements for higher flow capacity in downstream coastal structure S21. The peak discharges of structures S148 and S149 increase for design events from 5-yr to 10-yr, followed by smaller increase after the 25-year event to the 100-year event, which also confirms that the peak discharges a limited for design events with greater than 25-yr return frequency. The peak discharges decrease with respect to increasing SLR which is caused by reducing the head gradient within canals discharging to Biscayne Bay.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S21 does not have limitations based on the peak and cumulative flows which showed consistent increase of discharges for increasing the return period of the design events and for increased SLR. The SPF discharge of 4,300 cfs is defined for 0.8 ft head differential at tailwater elevation of 0.45 ft NAVD however structure S21 is under different hydraulic conditions in comparison to the original design. Additionally, the outflows considerably increase for tailwater elevations greater than the design levels. This indicates that Structure S21 will not reduce its performance for increasing SLR, however, the structure capacity for instantaneous peak discharge may become deficient if improvements of the design capacity of C-1W canal and structure S148 are required.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event.

Localized Flood Risks: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 15%, 32%, 63% and 93% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event are 51%.

The overall LOS ranking of the C-11 Watershed is listed below:

- For C-1 the LOS rating for current conditions is 5-yr
- The overall rating of watershed C-1 is 5-yr FPLOS for SLR = +0 and +1.0 ft. For SLR = +2.0 and +3.0 ft, the LOS is less than 5-yr.

Watershed C-100 FPLOS:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of watershed C-100, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S118, S119 and S120) showed limited capacity based on the cumulative and peak flow results for increasing SLR. The peak flow for both structures considerably decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S123 has limited discharge capacity based on the peak and cumulative flows, which showed consistent decrease of discharges for increasing the return period of the design events and for increased SLR. Therefore, the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than + 2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event.

Localized Flood Potential: The flood maps (PM5 and PM6) showed that a 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The overall FPLOS rating of watersheds was determined as follows:

- For C-100 the LOS rating for current conditions is 5-yr
- The overall rating of C-100 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft.

Watershed C-102 FPLOS:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of watershed C-102, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S165 and S195) showed limited capacity based on the cumulative and peak flow results for increasing SLR. The peak flow for both structures considerably decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S21A has limited discharge capacity based on the peak and cumulative flows which showed consistent decrease of discharges for increasing the return period of the design events and for increased SLR. Therefore, the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than +2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event.

Localized Flood Potential: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The overall FPLOS rating of watersheds was determined as follows:

- For C-102 the LOS rating for current conditions is 10-yr
- The overall rating of C-102 is assigned 10-yr for SLR = +0 ft, 5-yr for SLR = +1 and +2 ft, and less than 5-yr for SLR = +3 ft.

Watershed C-103 FPLOS:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the flat topography of watershed C-103, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S166, S167, S20G, S179) showed limited capacity to increase flow for higher SLR. The peak flow for both structures were nearly constant or decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater

Coastal Structure Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event. Therefore, the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than +2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the canal profiles of the secondary drainage system show that the water elevations of the 5-yr event can overtop many locations along the canal and the LOS of 5-yr cannot be assigned mainly because the canal banks are not consistently high and can be overtopped

Localized Flood Potential: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The overall FPLOS rating of watersheds was determined as follows:

- For C-103 the LOS rating for current conditions is 5-yr
- The C-103 Watershed has been assigned a 5-Year FPLOS rating for SLR = +0 and +1.0 ft and less than 5-Year for SLR = +2.0 and +3.0 ft.

The Frequency of Flooding was determined under PM5 and provided the overall ability of the water management infrastructure to prevent flooding. This PM evaluated the overland flooding depths for 72-hr duration of 5-, 10-, 25- and 100-Year recurrence intervals and SLR = 0, +1, +2 and +3, to determine the flood extent and depth metrics.

Table 382 and Table 383 represent the fraction of flooded urban and Agricultural areas with depth greater than 1 ft, for the 25-Yr storm event. Based on results, best urban flood protection is provided for watersheds C-1 and C-100. Watershed C-102 and C-103 have the greatest extent of flooding. The thresholds of 1.0 ft for urban areas and 0.5 ft for agricultural areas were recommended by SFWMD's reviewers as critical values for these areas.

Table 3 Fraction of Flooded Urban Areas of C-1 Watershed with Depth > 1.0 ft

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	**5%**	**5%**	**6%**	**8%**
C-100	**5%**	**5%**	**6%**	**9%**
C-102	**13%**	**14%**	**17%**	**19%**
C-103	**8%**	**9%**	**11%**	**14%**

The best agricultural flood protection is provided for watersheds C-100. Watersheds C-103 and C-103 have higher fraction of flooded agricultural areas. Watershed C-1 has the greatest extent of flooding.

Table 4 Fraction of Flooded Agricultural Areas with Depth > 0.5 ft

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	**16%**	**16%**	17%	18%
C-100	**1%**	**1%**	1%	1%
C-102	**8%**	**8%**	9%	10%
C-103	**7%**	**7%**	8%	8%

The duration of flooding in PM6 was determined by the time required for surface water stages to recede to non-flood levels. PM6 quantified the flooding duration in SMD FPLOS watersheds.

Table 384 and Table 385 provide the fraction of areas with flooding greater than 24 hours for urban and agricultural areas. For urban areas C-102 has largest fraction of areas with flood

duration greater than 24 hours (lowest flood protection), while watershed C-1 and C-100 have lower fraction of flood duration greater than 24 hours.

Table 5 Fraction of Urban Area Flooded with Duration > 24 hr

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	10%	10%	11%	14%
C-100	12%	18%	21%	28%
C-102	25%	26%	29%	31%
C-103	16%	17%	20%	24%

For agricultural areas show that C-1 has largest fraction of areas with flood duration greater than 24 hours (lowest flood protection), while watershed C-1 and C-100 have lower fraction of flood duration greater than 24 hours (best flood protection).

Table 6 Fraction of Agricultural Areas Flooded with Duration > 24 hr

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	22%	22%	23%	25%
C-100	1%	2%	2%	3%
C-102	11%	11%	11%	12%
C-103	8%	9%	10%	11%

FPLOS for Current Conditions:

The current conditions are based on SLR +0 ft and current hydrologic and drainage infrastructure conditions (current land use, topography, drainage infrastructure, structure operations). For the overall rating of the watersheds weight was placed on PM1, PM5 and PM6.

The overall FPLOS rating of watersheds was determined as follows:

- For C-1 the LOS rating for current conditions is 5-yr
- For C-100 the LOS rating for current conditions is 5-yr
- For C-102 the LOS rating for current conditions is 10-yr
- For C-103 the LOS rating for current conditions is 5-yr

The low FPLOS rating is triggered by canal overtopping for the specified events, the flood extent and depth, and flood duration. It is important to take into consideration that the storm surge can affect the LOS capacity of the primary canals particularly during high tailwater elevation and high storm surge events.

FPLOS for Future Conditions:

The current conditions are based on SLR +0, +1, +2 and +3 ft and future hydrologic and drainage infrastructure conditions (future land use, topography, drainage infrastructure, structure operations). For the overall rating of the watersheds weight was placed on PM1, PM5 and PM6.

- The overall rating of watershed C-1 is 5-yr FPLOS for SLR = +0 and +1.0 ft. For SLR = +2.0 and +3.0 ft, the LOS is less than 5-yr.
- The overall rating of C-100 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft.
- The overall rating of C-102 is assigned 10-yr for SLR = +0 ft, 5-yr for SLR = +1 and +2 ft, and less than 5-yr for SLR = +3 ft.
- The C-103 Watershed has been assigned a 5-Year FPLOS rating for SLR = +0 and +1.0 ft and less than 5-Year for SLR = +2.0 and +3.0 ft.

Recommendations:

The results from the FPLOS analysis established multiple deficiencies of the drainage infrastructure for current and future conditions and the following recommendations are provided to extend this study with additional investigations which will focus on development of specific flood mitigation projects:

- Analyze the effect of elevating the top of the levees at the eastern model boundaries for all SLR conditions, determine potential storm surge conditions which can overtop these levees and cause potential flooding of inland areas through overland and through canals. Determine potential impacts resulting from mitigation strategies which include upgrades bank canal bank elevations
- Analyze the operation of coastal structures for all SLR conditions in terms of timing and gates opening and closing criteria to determine most optimal management which will maximize runoff discharges and minimize storm surge influx through open structures
- Analyze potential impacts of future projects which consider installation of structures across the levees at the eastern watershed boundaries and determine the needs for gates, and determine gate's most optimal operations to reduce potential backflow through the watershed boundaries
- Provide analysis in coordination with Miami-Dade County (to account for the effect of planned stormwater infrastructure projects) of required localized infrastructure within each watershed to decrease timing and depth of flooding for problematic areas which were identified in this work.
- Provide analysis of SLR impacts on watershed hydrology resulting from elevated water levels in Primary Canals, including groundwater level rise, changes of water content and storage in unsaturated and saturated zones, changes of evapotranspiration rates and patterns, impacts to sensitive wetlands and agricultural areas, determine the most optimal levels in Primary Canals which provide the required FPLOS protection while preserving watershed hydrology
- Address concerns of land developers related to loss of storage if canal operating levels are increased correspondingly to SLR.

Provide analysis of forward pumping at the coastal structures, including pump flow rates, pump location, operational criteria, and effectiveness of forward pumping to resolve potential impacts from future SLR conditions, such as elevated canal water levels.

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1 INTRODUCTION

The South Florida Water Management District (District) is conducting a system-wide review of its regional water management infrastructure to determine the flood protection level of service (FPLOS). The FPLOS describes the level of flood protection provided by the SFWMD water management facilities within south Miami-Dade C-1, C-100, C-102 and C-103 watersheds under both current and future conditions, where future conditions FPLOS considers future development and Sea Level Rise (SLR). The FPLOS performance metrics rely on the existing conditions and future conditions model outputs resulting from short-term high intensity rainfall design events. This information can be used by the SFWMD, local governments, and other state and federal agencies to identify areas where improvements or upgrades of water management facilities are required, to determine the appropriate entity or entities responsible for making improvements, and to access the required funding and technical resources available in support of these efforts.

The surface water management watersheds in eastern Miami-Dade County, Florida, were first delineated in the 1950's by the US Army Corps of Engineers (USACE) in their General Design Memorandum (GDM) for the Central and Southern Florida Flood Control Project. Based on the hydrology of the watersheds within the County, the USACE designed and constructed a system of canals, levees, and control structures to provide flood protection for southern and central Florida. The primary drainage system in South Florida consists of the canals and associated water control features that are managed by the SFWMD and USACE. Secondary systems consist of canals and features that are managed by designated drainage districts or private entities, which may discharge to the coast or receiving lakes, or into the primary system. Tertiary systems consist of canals and features generally located on private lands that provide localized drainage and discharge into retention/detention areas or into secondary systems. The drainage basin (or watershed) of the canals includes the land that contributes surface water runoff to the canal or its tributaries. For the conditions of South Florida, the watershed delineation is defined by levees and roadways, and less frequently by natural ridges and high ground. Within each watershed, surface water inflows and outflows are managed by operating weirs, spillways, culverts, or pump stations. The study domain for South Miami-Dade County Flood Protection Level of Service (South Miami-Dade FPLOS) consists of four (4) main watersheds:

- C-1 watershed (C-1 East and C-1 West sub watersheds)
- C-100 watershed (including C-100 East and C-100 West sub watersheds)
- C-102 watershed (C-102 East and C-102 West sub watersheds)
- C-103 watershed (BD-C103 East, BD-C103 Central, BD-C103 West, Homestead Air Force Base (HARB), North Canal (NO-Canal) and Florida City (Fla-City) watersheds)

The control structures in the above watersheds regulate the flow of water in the primary canals which were designed to discharge excess water from the watersheds during flooding and to maintain minimum water levels in the canals during drought periods. Some interior structures are usually closed to prevent water from passing from one watershed to another but can be opened to supply water from one watershed or canal to another, as necessary. The coastal structures have the additional function of preventing saltwater from a tidal or storm surge from entering canals discharging to tidewater. Since the initial design, new surface water management infrastructure has been constructed and the existing infrastructure is continuously modified to meet the changing needs of South Florida.

The project domain for this FPLOS investigation is shown on Figure 2 and includes four (4) watersheds, C-1, C-100, C-102 and C-103. Watershed C-1 is adjacent to watersheds C-2 and C-4 to the north, and Watershed C-103 is adjacent to watershed C-111 to the south. To the west, watersheds C-1, C-100, C-102 and C-103 are bordered by Canals L-31N and C-111, which separate the Everglades National Park from the urban areas of Miami-Dade County. The model domain includes all hydrologic areas that directly impact watersheds C-1, C-100, C-102 and C-103.

Figure 2 shows the project domain with the four (4) watersheds that are the focus of this study, and the surrounding watersheds that are hydrologically and/or hydraulically connected to them. Additional description of each of the four (4) study watersheds with the significant hydrology and hydraulics (H&H) features within each, is provided below. For each watershed, the description includes the adjacent watersheds that impact the H&H and are critical for determining the model domain and understanding the flow and boundary conditions.

Urban and agricultural areas substantially altered by anthropogenic activities are situated between the natural areas – the Everglades (Everglades National Park and water-conservation areas) to the west and Biscayne Bay and the Atlantic Ocean to the East. An extensive and highly managed surface water system (canals, control structures, detention basins) is constructed in the urban and the agricultural areas. The primary functions of the canals within the project domain are to provide flood protection and water supply. Secondary uses include land drainage for agriculture and urban or residential development, and regulation of groundwater table elevations to prevent saltwater intrusion. Many of the canals are used to supply water for irrigation and to recharge local wellfields. The South Miami-Dade FPLOS project domain is underlain by the shallow, unconfined to semiconfined, highly permeable Biscayne aquifer, which is the primary municipal water supply for Miami-Dade County. The surface water system in South Miami-Dade FPLOS project domain is hydraulically connected to the groundwater system and affects groundwater resources, presenting a series of unique modeling challenges:

The configuration of relatively flat topography intersected with drainage canals managed by SFWMD control structures (Primary Conveyance System) and secondary drainage system maintained and operated by Miami-Dade County requires a model that is capable of simulating canal bank overflows, exchange between the canals and the groundwater, and detailed simulations of water control structures such as spillways, overflow gates, and pumps with variable timesteps.

Groundwater baseflow exchanging with canals from the Everglades to Biscayne Bay comprises a significant portion of the surface water flows in the South Miami-Dade FPLOS project domain. A major fraction of this flow is generated west of the modeled watersheds i.e., west of canals L31N and C-111. These lateral flows from long flow pathways need to be represented in the modeling. Local groundwater usage (including well withdrawals for irrigation and potable use) may affect the groundwater elevations. Additionally, the karst stratigraphy of the Surficial Aquifer in Miami-Dade County can vary greatly in aquifer parameters, boundary conditions, and also provides a representation of the Surficial Aquifer System of South Miami-Dade FPLOS project domain within Miami-Dade County.

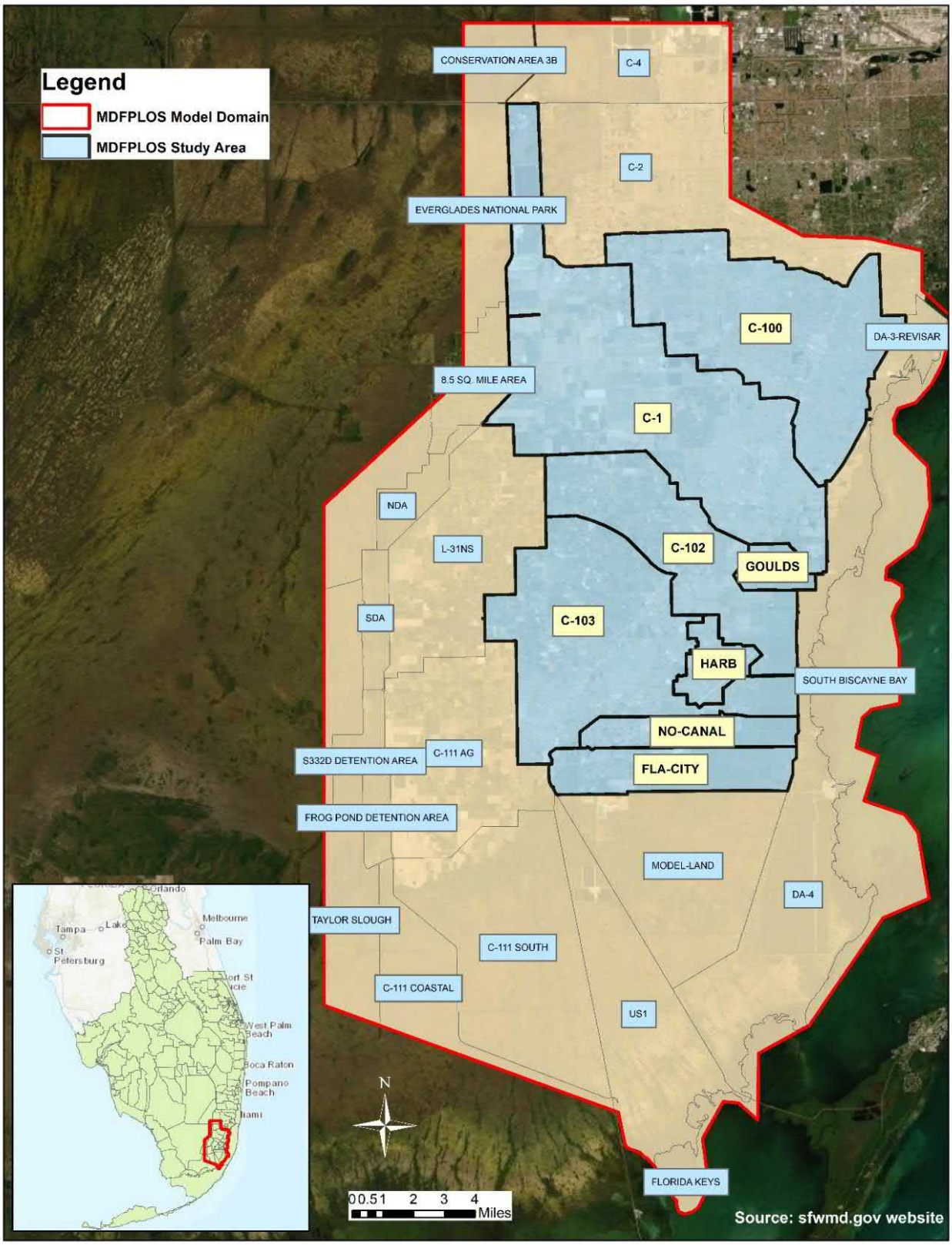


Figure 2. South Miami-Dade FPLOS Project domain

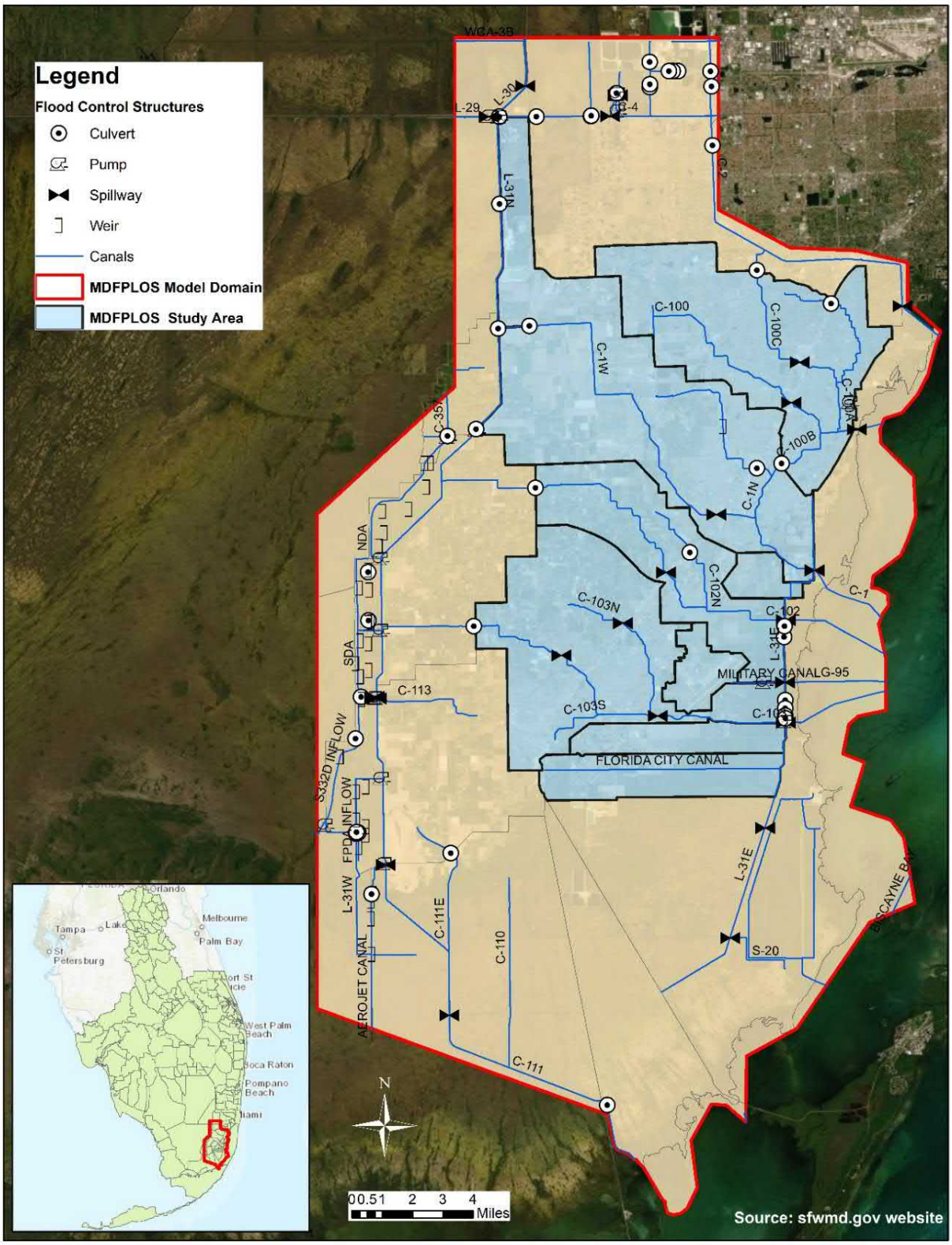


Figure 3. South Miami-Dade Project Domain Including Primary Canals, Structures, and Watershed Boundaries

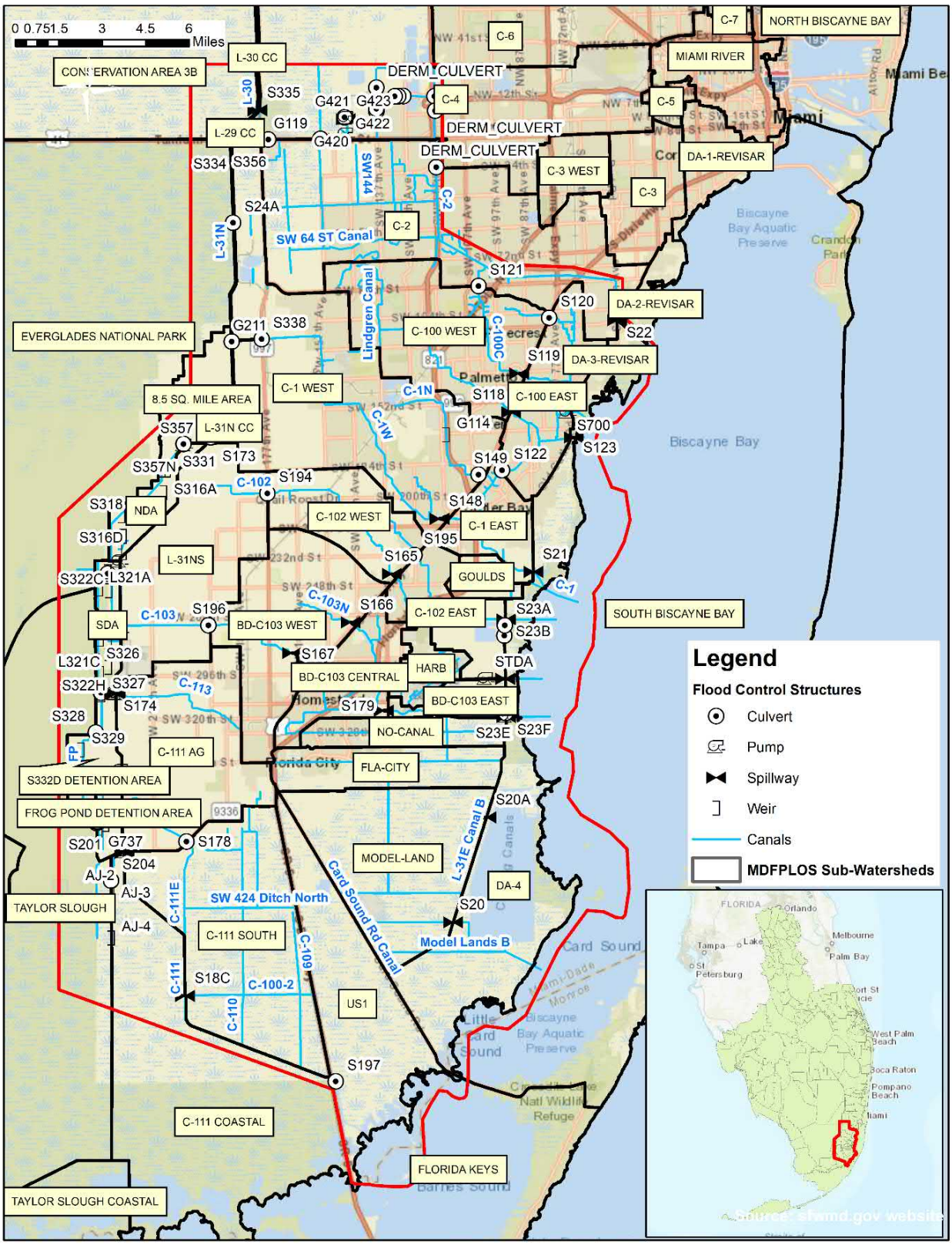


Figure 4. Watersheds and Structures within Model Domain

Miami-Dade County's soil layers within the project domain can significantly vary in terms of storage and infiltration rates. In addition, some of the watersheds have large areas of exfiltration trenches. The numerical model should account for the variability of the unsaturated zone and subsurface drainage directed to the canal system.

The groundwater flow system in the project domain within Miami Dade County is comprised of a shallow Surficial Aquifer System (SAS) that includes the Biscayne Aquifer and the Gray Limestone Aquifer; and the underlying confined Floridan Aquifer System (FAS). The SAS and FAS are separated by alternating beds of sand, silt, and clay that form the confining unit separating the two. A typical hydrogeologic section through South Florida showing the lithostratigraphic units of the SAS, taken from Hughes and White, 2016 is presented in Figure 5.

The Biscayne Aquifer does not directly correlate with lithostratigraphic boundaries as shown in Figure 5, but it includes several geologic units extending from land surface down to the base of connecting, highly permeable beds within the Tamiami Formation (Fish, 1988). The extent of the Biscayne Aquifer is from the southern part of Palm Beach County to the southern part of Monroe County and south Miami-Dade County; it underlies the entire South Miami-Dade FPLOS project domain. Geologic units of the Biscayne Aquifer have been shown to extend beneath Biscayne Bay and the Atlantic Ocean, although the offshore extent of these units has not been fully delineated.

The Biscayne Aquifer is approximately 20 ft thick at the west boundary of the South Miami-Dade FPLOS project domain to thicker than 100 ft at the east boundary. In an opposite trend, the gray limestone aquifer is approximately 75 ft at the west end of the South Miami-Dade FPLOS project domain to less than 20 ft in the east. Within the South Miami-Dade FPLOS project domain, the Biscayne Aquifer is the primary source of groundwater for consumptive water use and groundwater discharging to Biscayne Bay (Langevin, 2001) with transmissivities exceeding 1,500,000 ft^2/day based on aquifer pumping tests conducted by USACE (ref, Fish and Stewart, 1991). The Biscayne Aquifer is a designated sole source of drinking water (Federal Register Notice, 1979).

Miami-Dade County, including South Miami-Dade FPLOS project domain, experiences groundwater baseflow from west to east (from the Everglades Conservation Areas to Biscayne Bay). Generally, stages are maintained in the conservation areas to the west using a series of levees. However, since the underlying Biscayne Aquifer is highly transmissive, there are large baseflows associated with the gradient between these stages and the Bay. Since the C-1, C-100, C102 and C-103 and tributary canals are cut into the highly transmissive Biscayne Aquifer, the baseflows contribute significantly to the canal flow. SMD FPLOS model will include the Surficial Aquifer System including the upper soil or peat layer and the Biscayne Aquifer.

A substantial fraction of the land use in the South Miami-Dade FPLOS project domain is urban and represented by directly connected impervious areas (DCIA), which are drained into the primary and secondary canal system. The model should be capable of simulating distributed imperviousness within the model domain and exchange between drainage infrastructure and canal system.

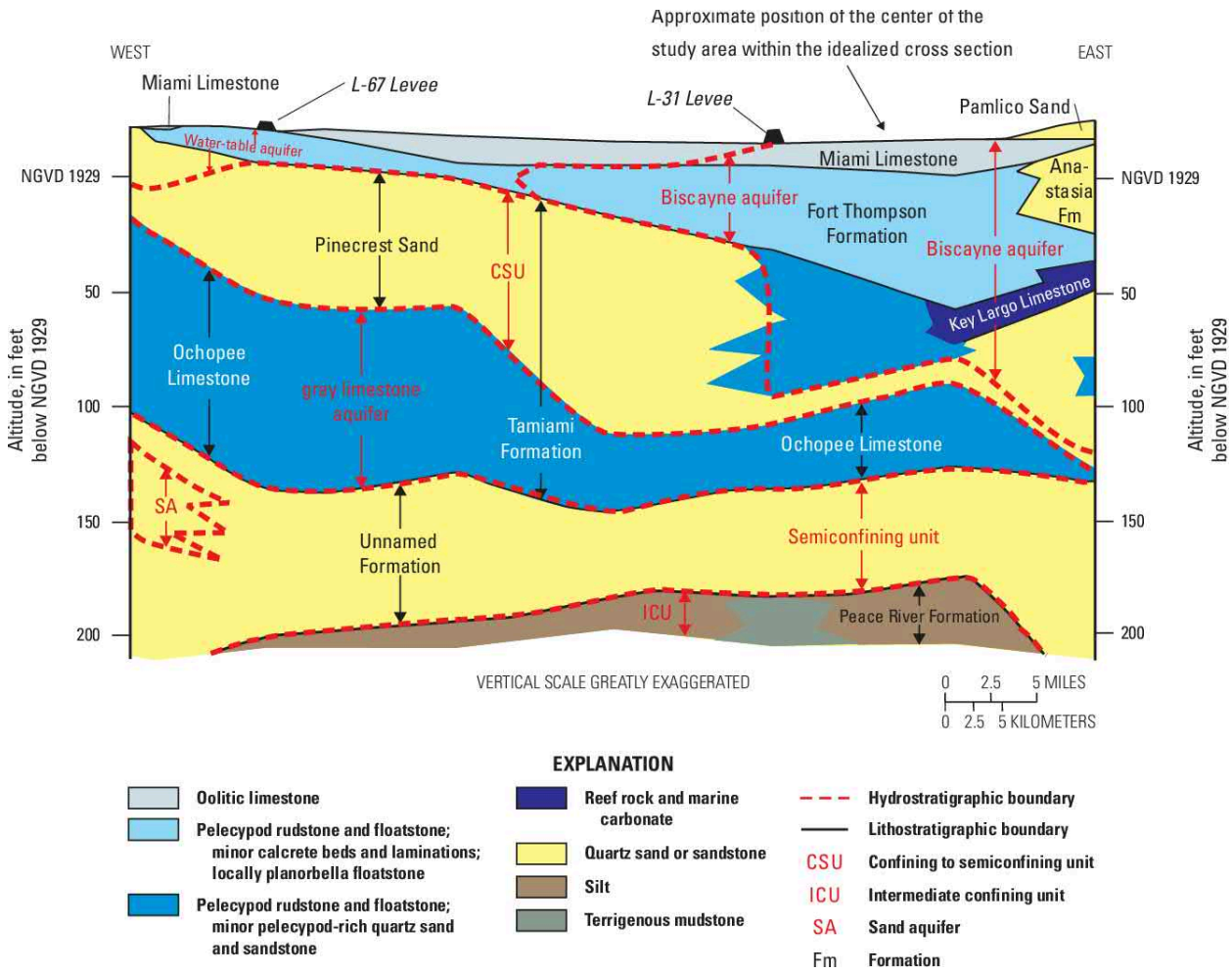


Figure 5. Generalized Hydrogeologic Section across Miami-Dade County (Wacker, Michael A. et al. "Geologic and hydrogeologic frameworks of the Biscayne aquifer in central Miami-Dade County, Florida." (2014).

This report documents the relevant information from the previous deliverables including model calibration and validation, and makes references to the previous deliverables when required, but the main focus is the design storm model set-up and parameterization for the SMD FPLOS model with the existing infrastructure for the C-1, C-100, C-102 and C-103 watersheds under current sea level conditions. Previous tasks completed as part of this study included model selection, technical design report, data summary, model conceptualization, model calibration, and model validation.

The South Florida Water Management District (District) is conducting a system-wide review of its regional water management infrastructure to determine the flood protection level of service (FPLOS). The FPLOS describes the level of flood protection provided by the SFWMD water management facilities within south Miami-Dade C-1, C-100, C-102 and C-103 watersheds under both current and future conditions, where future conditions FPLOS considers future development and Sea Level Rise (SLR). The FPLOS performance metrics rely on the existing conditions and future conditions model outputs resulting from short-term high intensity rainfall design events. This information can be used by the SFWMD, local governments, and other state and federal

agencies to identify areas where improvements or upgrades of water management facilities are required, to determine the appropriate entity or entities responsible for making improvements, and to access the required funding and technical resources available in support of these efforts.

This report provides analysis of the design storm model set-up and parameterization for SMD FPLOS model within the existing infrastructure for the C-1, C-100, C-102 and C-103 watersheds under current and future sea level conditions. Previous tasks completed as part of this study included model selection, technical design report, data summary, model conceptualization, model calibration, and model validation.

The FPLOS analysis is based on results from numerical simulations of watershed hydrology using an Integrated Surface and Groundwater Hydrologic Model which is referred to herein and after as SMD LOS Model. The model is used to develop analysis of both current and future hydrologic conditions. The future conditions include future development, modifications of the stormwater conveyance system and Sea Level Rise (SLR).

The calibrated SMD FPLOS MIKE SHE / MIKE 1D model was used to develop design storm simulations. This section of the report provides information about the changes to the calibration model setup that were implemented to simulate the synthetic design storm events for future conditions with and without SLR. These changes included rainfall, structure operations, topography, land use, introducing detention storage to represent stormwater management ponds, tailwater boundary conditions at the coastal structures, and initial conditions.

The implementation of SLR alternatives resulted in 16 simulations (4 design events and 4 SLR scenarios). A Performance Metric (PM) analysis has been developed for:

- C-1 watershed (C-1 East and C-1 West sub watersheds)
- C-100 watershed (including C-100 East and C-100 West sub watersheds)
- C-102 watershed (C-102 East and C-102 West sub watersheds)
- C-103 watershed (BD-C103 East, BD-C103 Central, BD-C103 West, Homestead Air Force Base (HARB), North Canal (NO-Canal) and Florida City (Fla-City) watersheds

Watershed C-1 is adjacent to watersheds C-2 and C-4 to the north, and Watershed C-103 is adjacent to Watershed C-111 to the south. To the west, watersheds C-1, C-100, C-102 and C-103 are bordered by Canals L-31N and C-111, which separate the Everglades National Park from the urban areas of Miami-Dade County. The model domain includes all hydrologic areas that are adjacent and can impact the hydrology of watersheds C-1, C-100, C-102 and C-103.

This document provides a summary of proposed preliminary mitigation projects based the analysis of current and future hydrologic conditions of existing infrastructure within Miami-Dade's C-1, C-100, C-102 and C-103 watersheds. The focus of this summary is to introduce a series of infrastructure upgrades to ensure that the performance of the primary conveyance infrastructure is preserved and improved for future hydrologic conditions with consideration of potential sea level rise. Additional local infrastructure improvements are proposed which can be further developed in collaboration with Miami-Dade County. The intent of this document is to highlight potential drainage challenges for rising sea levels and to suggest possible improvements of the hydraulics and operation of the primary conveyance system to ensure Flood Protection Level of Service for future conditions.

The FPLOS analysis is based on results from numerical simulations of watershed hydrology using an Integrated Surface and Groundwater Hydrologic Model which is referred to herein and after as SMD LOS Model. The calibrated SMD LOS MIKE SHE / MIKE 1D model was used to develop design storm simulations which provided an analysis of both current and future hydrologic conditions. The design storm events model included simulations of 5-yr, 10-yr, 25-yr and 100-yr rainfall events, and changes to structure operations, topography and land use. It introduced detention storage to represent stormwater management ponds, tailwater boundary conditions at the coastal structures with storm surge, and initial conditions reflecting Sea Level Rise (SLR) and included:

- New canals and canal extensions were added to the MIKE 1D network.
- Miami-Dade County's current and future land use plans were compared to provide changes to the relevant input files in the MIKE SHE model.
- Tidal boundary conditions for SLR of +1, +2, and +3 feet were developed based on data provided by SFWMD, converted to .dfs0 format and implemented in the model.
- Future Land Use was applied to vacant parcels within the model domain, and an increase of density was provided for projected changes in low urban development density areas.
- Future topography was developed from the most recent Miami-Dade County Flood Criteria which applies for new development and substantial property upgrades with costs of upgrades greater than 50% of property value.
- Future storage was developed to account for an increase in density to ensure that the post development stormwater runoff for the 25-yr 3-day storm event is retained on site.

The implementation of SLR alternatives resulted in 16 simulations (4 design events and 4 SLR scenarios) and summarized on Deliverable 5.2 Analysis of Future Hydrologic Conditions. A Performance Metrics of six indicators was applied to the design event simulations to analyze the hydrologic and hydraulic performance of the stormwater management infrastructure and to develop strategies for infrastructure upgrades and mitigation of flooding within the watersheds C-1, C-100, C-102 and C-103 watersheds in Miami-Dade County. Project and Modeling objectives

The objective of the South Miami-Dade FPLOS project is the development of a calibrated model capable of simulating historical extreme events and demonstrating that the model can successfully be used to predict stages and discharges within the project domain and can provide information about flood extent and duration. The predictive capability of the model was applied to determine six South Miami-Dade FPLOS performance metrics briefly described below:

- PM1: Maximum stage in primary canals
- PM2: Maximum daily discharge through the primary canals
- PM3: Tidal structure flow performance – effects of sea level rise
- PM4: Peak storm runoff – maximum conveyance capacity of the watershed
- PM5: Frequency of flooding – stage-based LOS for sub-watersheds
- PM6: Duration of flooding – effects of sea level rise

The South Miami-Dade FPLOS performance metrics collectively assess the flood protection level of service under current and future sea level rise conditions.

- PM1 and PM 2 were used to evaluate the stages and capacity of the canal reaches and require accurate analysis of flow dynamics within the canals when operating at conditions of peak stages and peak discharges.

- PM3 and PM4 were used to evaluate conditions at the downstream structure (applicable only to tidal structures) and required a thorough analysis of the outflow boundary conditions.
- PM5 and PM6 were used to evaluate the impacts of flooding and required the model to accurately describe the topography and the interaction of the overbank spills and inflows in the canals.

Therefore, an integrated surface and subsurface model was required with the capability to analyze the exchange between the main model subdomains: Overland Flow, Open Channel Flow, Unsaturated and Saturated zones.

1.1 Model Conceptualization

The conceptualization of the four watersheds in the project domain are described in this section. The surrounding watersheds that are connected hydraulically and hydrologically are also described, focusing on their impact on the project domain, objectives, and the performance metrics. The conceptualization of the four (4) South Miami-Dade FPLOS watersheds will be refined and detailed throughout the model calibration and validation phases. Figure 4 shows the model domain with major structures. Detailed explanation of conceptualization is provided below for each watershed in the project domain.

1.1.1 C-1 Watershed

Watershed C-1, shown in Figure 5, has four primary canals: C-1, C-1W, C-1N, and the L-31N borrow canal. These canals provide drainage and flood protection for the C-1 watershed, supply water to the C-1 and the C-100 watersheds for irrigation and maintain a groundwater table elevation near the lower reach of C-1 adequate to prevent saltwater intrusion to local groundwater.

C-1 and C-1W make up the main canal of this watershed (thereafter, designated C-1/C-1W). The C-1W Canal is upstream of structure S148, and the C-1 canal is downstream of structure S148. The C-1N Canal and the L-31N Borrow Canal are tributaries to the C-1/C-1W. The C-1/C-1W begins in the east borrow canal of L-31N. Flow in the canal is to the southeast with discharge via SFWMD Structure S21 to Biscayne Bay southwest of Black Point. C-1N begins at the intersection of Lingren Road and Coral Reef Drive. Flow in the canal is to the south to the confluence of the canal with C-1/C-1W just east of the West Dade Expressway. The L-31N borrow canal is aligned along the west boundary of the watershed. This canal is part of the South Dade Conveyance System (SDCS). When operating to supply water to watersheds in south Dade County, flow in the canal is to the south. During a storm event, flow in the L-31N borrow canal is to C-1/C-1W.

There is one other primary canal associated with the C-1 watershed; C-100B connects C-1N to C-100. C-100B joins C-1N one-half mile downstream of the Florida EastCoast Railway. The canal starts in the watershed at S122, with normal flows in the canal north through the structure to the C-100 watershed. Structure S122 is closed during wet weather events, so there is no lateral inter-watershed flows during the storms.

There are ten project control structures within the C-1 watershed. Five of these (S21, S148, S338, S149, and S122) are directly related to the operation of C-1/C-1W and C-1N. The other five structures (S173, S331, S334, S335, S336, and G-211) along with the L-31N borrow canal are part of the SDCS which supplies water to watersheds in South Dade County.

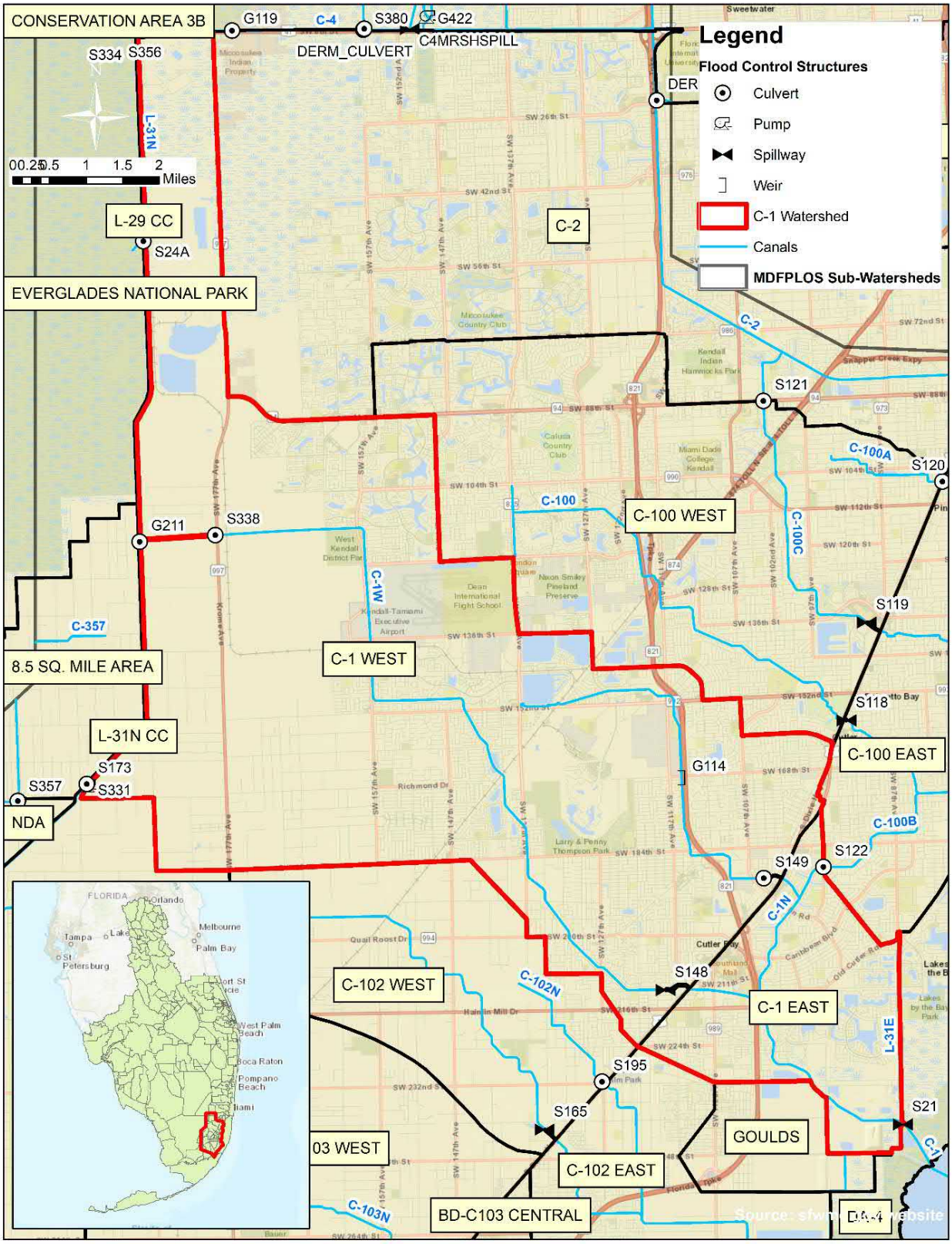


Figure 6. C-1 Watershed

Kimley»Horn

The MIKE 1D model provides the 1D representation of C-1, C-1W and C-1N canals and the L-31N borrow canal. Additional secondary canals have been included. Groundwater links are used to provide exchange of water between the canals and the SZ and OL subdomains. The exchange is based on 'Aquifer Only' or conductance for the initial calibration procedures. Additional adjustments can be expected during calibration and overbank spilling modeled using the weir formulation which allows flow to exchange in both directions (river to floodplain). All available cross section data were used to define the canal profile and cross-sectional area.

The structures in the western part of the watershed have two basic types of operation: for stormwater drainage and for water supply. During a storm event, S173, S335, and S336 are closed to prevent downstream flooding in the C-1, C-2 and C-4 canals. Structures S336 and S338 can be opened to provide drainage to the east for the L-31N borrow canal if there is capacity on the downstream portions of the canals. When water is being supplied to south Dade County, S335, S336, and S173 or S331 are in operation, and S338 is closed except as needed to supply water to the C-1 watershed.

The calibration model uses sluice and underflow gates as appropriate with parameter data provided by SFWMD. For all structures, the breakpoint gate opening data are available along with headwater, tailwater and discharge, which will allow detailed comparison of the performance of each structure.

S21 is a 3-gate spillway located in C-1 one mile west of Black Point. It controls stages in the lower reaches of C-1/C-1W and C-1N, and it controls discharges to tidewater. A headwater stage is maintained by S21 adequate to prevent saltwater intrusion to local groundwater. The structure is modeled as MIKE 1D underflow gate individually controlled.

S148 is a 2-gate spillway located in C-1W at the Florida East Coast Railway crossing. It controls stages in the upper reach of C1/C-1W and it regulates discharges to the lower reach of C-1/C-1W, it is implemented as an underflow gate structure with individually controlled gates.

S338 is a double-barreled gated culvert located in C-1W at Krome Avenue. It controls inflows to C-1/C-1W from the L-31N borrow canal, and it helps to maintain the optimum stage in the borrow canal. The structure is modeled as MIKE 1D underflow gate individually controlled.

S149 is a double-barreled gated culvert located in C-1N at the Florida East Coast Railway crossing. It controls stages in the upper reach of C-1N, and it regulates discharges to C-1. The structure is modeled as MIKE 1D underflow gated culvert individually controlled. Two circular closed cross sections with diameter 7' and two links with length of 62.35 ft are used to represent the double-barreled culvert structures with underflow gates.

S122 is a single-barreled gated culvert located in C-100B one-tenth mile south of the east end of Peters Road. There are no specific operational guidelines for this structure. In general, it is closed to prevent flood flows in the C-1 watershed from entering the C-100 watershed, and it is opened as necessary to supply water from C-1 to the C-100 watershed for irrigation and to maintain the optimum stage in the lower reaches of canals in the C-100 watershed. The structure is modeled as MIKE 1D underflow gated culvert.

S173 is a single-barreled gated culvert located in the L-31N borrow canal at the divide between the C-1 and C-111 watersheds. It is adjacent to pumping station S331 just north of Richmond

Drive. It is closed during storm events to prevent flood flows from passing from one watershed to the other. It is also closed when the pumps at S331 are in operation. The structure is modeled as MIKE 1D underflow gated culvert.

S331 is a pumping station in the L-31N borrow canal at the divide between the C-1 and C-111 watersheds. It is adjacent to S173 just north of Richmond Drive. The pumping station is a component of the SDCS. Its function in conjunction with S173 is to supply water to South Dade County watersheds and to Everglades National Park. It also controls the stage in the L-31N borrow canal and protects the residential area west of L-31N from flooding. Water is supplied to the south whenever the headwater stage at any downstream structure is more than 1.5 feet below optimum.

S336 is a triple-barreled gated culvert located in C-4 just west of Krome Avenue at the divide between the C-1 and C-4 watersheds. This structure is ordinarily closed. It is opened to supply water from the L-31N borrow canal to C-4, and to C-2 and C-3, when the stage in C-4 at 5-25B or in C-2 at 5-22 falls below 2.8 ft NGVD and no water is available in the area between the Dade-Broward Levee and Krome Avenue. It can also be used for flood control provided there is capacity in the lower C4 canal. The structure is modeled as MIKE 1D underflow gated culvert with individually controlled gates.

S334 is a gated spillway located in the L-29 borrow canal at the west end of C-4. It is used to supply water to the SDCS from WCA 3A (via S333 and the L-29 borrow canal). Water is discharged to the south by way of the L-3I N borrow canal. The structure is modeled as MIKE 1D underflow gate with individually operated gates.

S335 is a gated spillway in the L-30 borrow canal north of C-4. It controls the stage held in the L-30 borrow canal, and it regulates discharges to the L-31N borrow canal and the SDCS. The structure is modeled as MIKE 1D underflow gate with individually operated gates.

G-211 is a six-barreled corrugated metal culvert, located south of the point where L-31N Canal joins C-1W Canal controlled by six manually operated sluice gates on the upstream end of the structure. The structure has been added as 6 gated culverts with individually operated gates.

The portion of the C-1 watershed north of Howard Drive is in an area which is characterized with limited drainage therefore this area has been subject to limitations on development. Boundary outfalls for this watershed include:

- Boundary at the north end of canal L-31N
- Boundary outfall of canal C-1 in the Biscayne Bay

The C-2 and C-4 Watersheds are located to the north of the C-1 Watershed. The proposed model domain includes sections of C-2 and C-4 watersheds which are relevant to the drainage system. Canal C-2 provides drainage and flood protection for the C-2 watershed, supplies water to the C-2 and the C-100 watersheds for irrigation and maintains a groundwater table elevation near the lower reach of C-2 adequate to prevent saltwater intrusion into local groundwater.

S22 is a gated spillway located in C-2 on the east side of Red Road. The structure controls water surface elevations in C-2, and it controls discharges to tidewater. A headwater stage is

maintained by S22 adequate to prevent saltwater intrusion into local groundwater. The structure is modeled as MIKE 1D underflow gate.

S121 is a gated culvert in C-100C at the State Road 94 crossing. There are no specific operational guidelines for this structure. In general, it is closed to prevent flood water in the C-2 watershed from flowing into the C-100 watershed, and it is opened to supply water from C-2 to the C-100 watershed for irrigation and to maintain the optimum stage in the lower reaches of canals in the C-100 watershed. The structure is modeled as MIKE 1D underflow gated culvert.

The western portion of the C-2 watershed is in an area which is characterized by limited drainage potential. During flooding, the portion of the C-2 watershed in this area contribute only a small amount of runoff to C-2.

The C-2 canal is designed to pass 100 percent of the Standard Project Flood (SPF); however, a number of watershed modifications have occurred after the original design, including enlargement of the C-2 cross sections upstream of S22 to Sunset Drive and from Sunset Drive to U. S. Highway 41 to increase capacity and to provide fill for the Homestead Extension of the Turnpike. Furthermore, after the initial development, the C-2 watershed has experienced considerable urban development with an increase in the impervious surface. The enlargement of the canal has reduced the stage that will occur in the canal for a given discharge, however, this increase of the conveyance increases the amount of runoff that can be accommodated in the canal from the watershed. The increase in impervious area due to urban development has increased the runoff from the watershed. In addition to watershed runoff, there is also seepage into the canals from groundwater.

The primary boundary outfall is represented with the tailwater gage data at the S22 Structure. For design storm simulations, the boundary condition will be set at the tidal location in Biscayne Bay.

The C-1 watershed also has a common boundary with the C-4 watershed, which has two primary canals: C-4 and the L-30 borrow canal. The canals provide flood protection and drainage for the C-4 watershed; supplies water to the C-2, C-3, C-4, and C-5 watersheds; and maintains a groundwater table elevation near the lower reach of C-4 adequate to prevent intrusion of saltwater into local groundwater.

- C-2, the Snapper Creek Canal, makes an open channel connection with C-4 at S.W. 117th Avenue. Normal flow is from C-4 to C-2; however, flow may reverse from C-2 to C-4 at the peak of storm events.
- C-3, the Coral Gables Canal, makes an open channel connection to C-4 just east of the Palmetto Expressway. Flow is normally from C-4 to C-3, however, during the dry season a stage below 3.0 ft NGVD in C-4 at S25B can cause flow from C-3 to C-4.
- C-5 branches from C-4 at Blue Lagoon east of Coral Gables. It connects downstream to C-4. Normal flow is from C-5 to C-4.

The area in the C-4 watershed between Krome Avenue and the Dade-Broward Levee drains to C-4 by an open channel between S336 and G-119. The Dade-Broward Levee borrow canal can also channelize seepage from the Pennsuco wetlands into the C-4 canal thorough a connection east of G-119. When drainage from the rest of the watershed and from the C-2 and C-3 watersheds is adequate to supply the water needs of the three watersheds, S336 and G-119 are

typically closed during storm events, however, S381 is used to provide a small amount of flow for the operation of the G421 and G422 pumps in the C4 Emergency Detention Basin. The stored water within the area between Krome Avenue and the Dade-Broward Levee can then be released to C-4 through G-119 as needed, to meet water demands in the C-2, C-3 and C-4 watersheds.

There are three structures controlling flow in C-4: S380, S336 and G-119, and are included in the MIKE 1D model.

- **S336** is a gated culvert located in C-4 just west of Krome Avenue. This structure is ordinarily closed. It is opened to supply water from the L-31N borrow canal to C-4, and to C-2 and C-3, when the stage in C-4 at S25B or in C-2 at S22 falls below 2.8 ft NGVD and no water is available in the area between the Dade-Broward Levee and Krome Avenue. The structure is modeled as MIKE 1D underflow gate, and is typically closed during flood events
- **G-119** is a gated culvert located in C-4 just east of Krome Avenue. This structure is operated in the same manner as S336 except that it may be opened when S336 is closed to release water from the area between Krome Avenue and the Dade-Broward Levee. The structure is modeled as MIKE 1D underflow gate, and is typically closed during flood events
- **S380** is a structure comprised by five-barreled gated culverts with a diameter of 6 feet, individually controlled, discharging from western C-4 canal into C-4 canal for flood control and water supply. Structure typically remains open during the wet season

There are three other control structures in the watershed: S32A, S337, and S335, which are part of the SDCS, however only S335 is included to provide the boundary conditions of canal L-30.

- **S335** is a gated spillway in the L-30 borrow canal north of C-4. It controls the stage held in the L-30 borrow canal, and it regulates discharges to the L-31N borrow canal and to the SDCS. The structure is modeled as MIKE 1D underflow gate.

The C-4 canal was designed to pass 100 percent of the Standard Project Flood from the area east of S.W. 87th Avenue. The portion of the C-4 watershed west of S.W. 87th Avenue is poorly drained. A stage of 5.5 ft NGVD (4.0 ft NAVD 88) at monitoring station TW5 indicates a potential for flooding in Sweetwater east of S.W. 117th Avenue. Currently, back pumping of runoff from these areas is provided by the C4 Emergency Detention Basin which has a pumping facility (G420 and G422 pumps) adequate to handle two inches of runoff per day from the combined 59 square miles of these poorly drained areas of the C-2 and C-4 watersheds. Only a portion of the C-4 basin is modeled, this portion includes canal C-4 west of structure S336 to surface water monitoring station TW5. The C-4 and C-6 canals are connected by the Florida East Coast Railway borrow canal that flows to the south along the west side of the Miami International Airport. It is possible to pass up to 100 cfs south from C-6 to C-4, however this feature is not in the initial implementation of South Miami-Dade FPLOS MIKE 1D model.

1.1.2 C-100 Watershed

The C-100 Watershed, also known as the Cutler Watershed, is in eastern Miami-Dade County. The C-100 Watershed is adjacent to the C-2 Watershed to the north and for approximately one mile to the west along SW 157th Avenue between Sunset Drive and Kendall Drive. The C-100

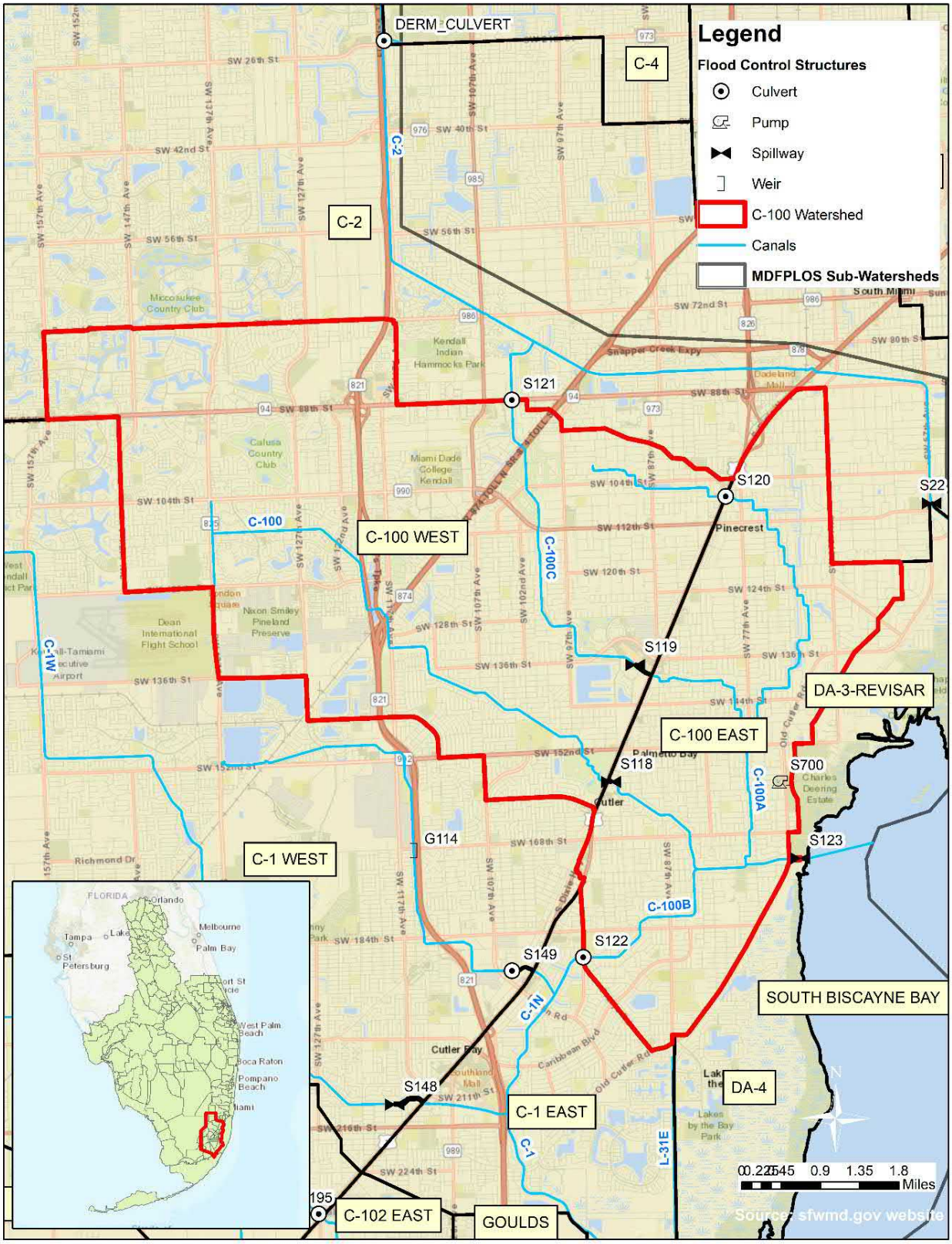


Figure 7. C-100 Watershed

Watershed is adjacent to the C-1 Watershed to the west, south of Kendall Drive, and to the south. The C-100, C-100A, C-100B, and C-100C canals provide drainage and flood protection for the C-100 Watershed, supply water to the watershed for irrigation; and maintains a groundwater table elevation near the lower reach of the C-100 adequate to prevent saltwater intrusion to local groundwater. Figure 6 shows the C-100 watershed and the adjacent connected watersheds.

The MIKE 1D model provides a 1D-dimensional representation of C-100, C-100A, C-100B, C-100C and all secondary canals and structures. The C-100A, C-100B, and C-100C Canals are tributaries to the C-100 Canal. The C-100B Canal connects the C-1 Watershed to the C-100 Watershed at Structure S122, one-tenth of a mile south of Peters Road. Normal flows in the C-100B is to the northeast to the canal's confluence with the C-100 Canal, one-quarter of a mile west of Biscayne Bay. The C-100C Canal connects the C-100 Watershed to the C-2 Watershed at Structure S121, at State Road 94. Normal flows in the C-100C Canal are to the southeast to the canal's confluence with the C-100A Canal, one-quarter mile north of Coral Reef Drive. Water is supplied to the C-100 Watershed during periods of low natural flow from the C-1 Watershed by way of the S122 Structure and the C-100B canal and from the C-2 Watershed by way of the S121 Structure and the C-100C Canal. The SFWMD control structures located within or on the boundary of the C-100 Watershed include:

S118 Structure is a single gated spillway located in the C-100 Watershed, just east of U.S. Highway 1. This structure is a reinforced concrete, gated spillway, controlled by a cable operated, vertical lift gate. The structure is located on the C-100 Canal about 200 feet east of U.S. Highway 1. Operation of the gate is automatically controlled so that the gate hydraulic operating system opens or closes the gate in accordance with the operational criteria. This structure maintains optimum upstream water control stages for the C-100 Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D single gated spillway.

S119 Structure is a single gated spillway located on the C-100C Canal, just west of U.S. Highway 1. This structure is a reinforced concrete, gated spillway, controlled by a stem operated, vertical lift gate. Operation of the gate is automatically controlled so that the gate hydraulic operating system opens or closes the gate in accordance with the operational criteria. The structure is located on the C-100C Canal about 1000 feet west of U.S. Highway 1. This structure maintains optimum upstream water control stages the C-100C Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D single gated spillway.

S120 Structure is a single barreled box culvert structure, which controls inflows to the C-100A Canal from local drainage systems. This structure is a single-barreled reinforced concrete box culvert located on the C-100A Canal at U.S. Highway 1. Control is provided by a manually operated sluice gate mounted on a reinforced concrete head structure. This structure maintains optimum upstream water control stages on the C-100A Canal, it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gated culvert which is defined by 2 closed cross sections with dimensions 9'x9'.

S122 is a double-barreled, reinforced concrete pipe culvert, with discharge controlled by two cable operated, vertical lift gates in the C-100B, one-tenth of a mile south of the east end of Peters Road. There are no specific operational guidelines for this structure. In general, it is closed to prevent flows in the C-1 Watershed from entering the C-100 Watershed, though it is opened as necessary to supply water from the C-1 to the C-100 for irrigation and to maintain optimum stage in the lower reaches of the canals in the watershed. The structure is modeled as a set of two MIKE 1D underflow gated culverts individually controlled. Two closed circular cross sections at a distance of 60.05' are used to represent the culvert.

S123 Structure is a 2-gate spillway located in the C-100 Canal at Biscayne Bay, three-quarters of a mile south of Richmond Drive. It controls the stage in the lower reaches of the C-100, C-100A, C-100B, and C-100C Canals and regulates discharges to tidewater. A headwater stage is maintained by the S123 Structure at an adequate level to prevent saltwater intrusion to local groundwater. The structure is modeled as MIKE 1D underflow gate individually controlled.

For calibration, all structures use observed gate elevation timeseries data. The computed flow, headwater and tailwater are used as calibration targets if observed data are available. The interior structures S118, S119 and S120 are typically fully open, following general SFWMD practice for severe storm events. For design storm simulations, they will be modeled as fully open structures.

The tributary area of the C-100 Canal and the tributary C-100A, C-100B, and C-100C Canals through the outfall structure is approximately 40.3 square miles. The extended area, approximately 5.7 square miles, of the C-100 Watershed discharges directly to Biscayne Bay and does not pass through the SFWMD structures. For design storm simulations, the boundary S121 and S122 structures will be modeled as fully closed.

In addition to the structures described above, the C-100 Watershed has one pump station, S700 Pump Station, located east of the C-100 A Canal, at the east end of a tributary spur canal adjacent to SW 159th Terrace, between SW 77th Avenue and SW 158th Terrace. This structure is primarily used for rehydration of the coastal wetland and therefore was not included in this study.

1.1.3 C-102 Watershed

The C-102 Watershed, including the Goulds Drainage Area Canal is in southeastern Miami-Dade County between Cutler Bay and Homestead. As shown in Figure 7, the watershed boundaries are the C-1 Watershed on the north, the C-103 Watershed on the south, the Everglades (including L-31N Canal) on the west, and Biscayne Bay on the east. There are two major canals in the C-102 Watershed: C-102, C-102N. Goulds Cana is maintained by DERM and provides drainage and flood protection for the C-102 watershed, supplies water to the watershed for irrigation; and maintains a groundwater table elevation adequate to prevent saltwater intrusion to local groundwater.

The C-102 Canal begins in the L-31N Borrow Canal, one and one-half miles south of Richmond Drive (approximately even with SW 192nd Street). Flow in the canal is to the southeast with discharge via the SFWMD S21A Structure to Biscayne Bay, north of Fender Point (near the intersection of Moody Drive and SW 97th Avenue).

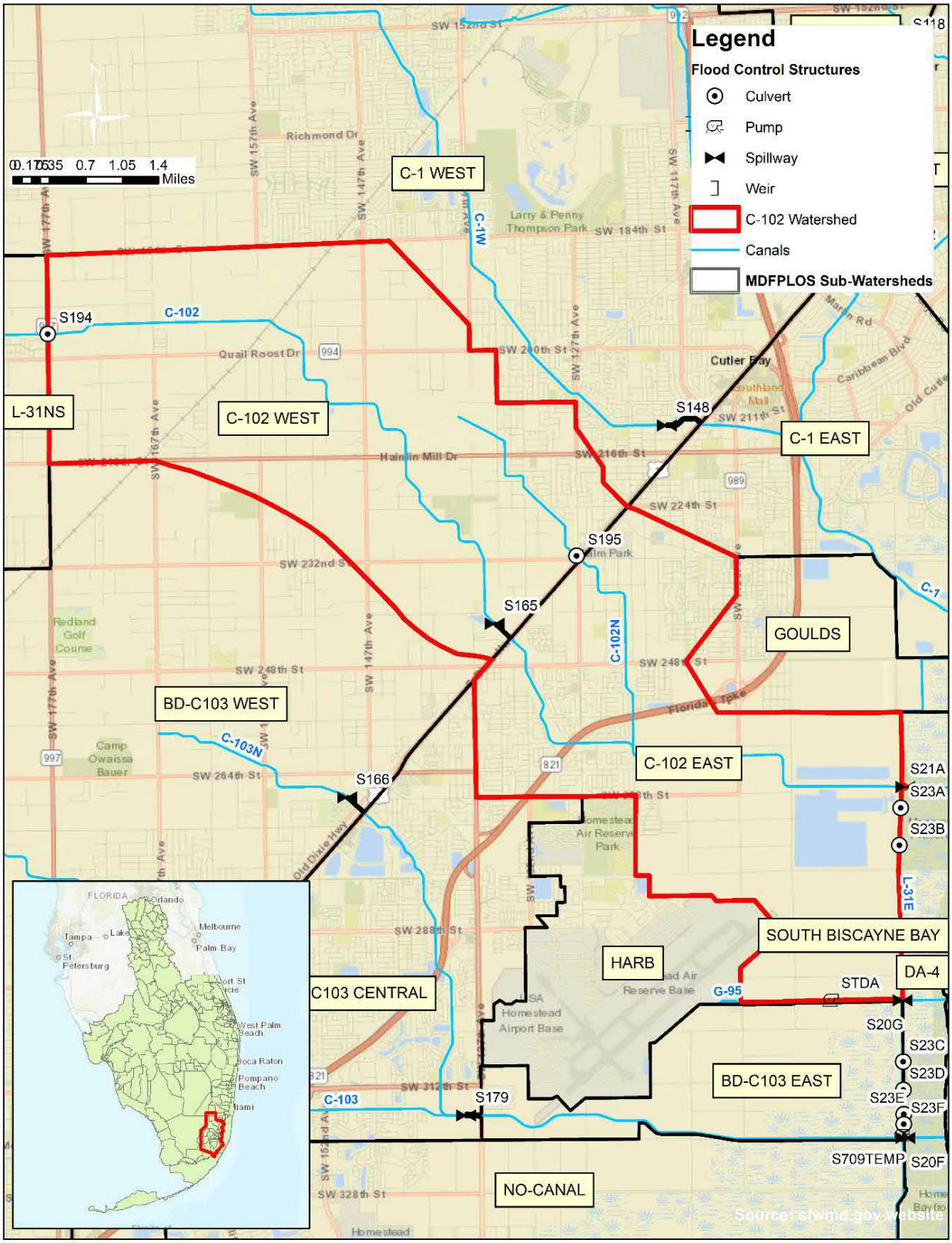


Figure 8. C-102 Watershed

The C-102N Canal is tributary to the C-102 Canal. The C-102N Canal begins at SFWMD Structure S195, northwest of the intersection of U.S. Highway 1 and Silver Palm Drive. Flow in the canal is south to the canal's confluence with the C-102 Canal just south of the Florida Turnpike crossing of the C-102N Canal and east of the Florida Turnpike crossing of the C-102 Canal. The MIKE 1D model simulates C-102, C-102N, and the Goulds Canals.

During severe flooding events, the S194 structure (located at Krome Avenue on the C-102 Canal) is closed, effectively removing 11.8 acres from the contributing area of the watershed. Sub-watersheds west of Krome Avenue are routed west to the L-31N Borrow Canal when the structure is closed. Therefore, the sub-watersheds west of Krome Avenue are under the influence of the C-111 Canal.

The SFWMD control structures located within or on the boundary of the C-102 Watershed include:

S21A Structure is a reinforced concrete, gated spillway, with discharge controlled by two cable operated, vertical lift gates. Operation of the gates is automatically controlled so that the gate hydraulic operating system opens or closes the gates in accordance with the seasonal operational criteria. The structure is located near the mouth of the C-102 Canal at its junction with the L-31E Canal, about one mile from the shore of Biscayne Bay. This structure maintains optimum upstream water control stages in the C-102 Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels and prevents saltwater intrusion during periods of high tides. The structure is modeled as MIKE 1D underflow gate.

S165 Structure is a reinforced concrete, gated spillway, controlled by a stem operated, vertical lift gate. Operation of the gate is automatically controlled so that the gate operating system opens or closes the gate in accordance with seasonal operational criteria. The structure is located on the C-102 Canal about 1100 feet west of U.S. Highway 1. This structure maintains optimum upstream water control stages the C-102 Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gate.

S195 Structure is a reinforced concrete box intake structure in front of a single-barreled, corrugated metal pipe arch located in the C-102N Canal at Old Dixie Highway. Control is affected by a manually operated sluice gate mounted on the reinforced concrete head structure. This structure maintains optimum upstream water control stages the C-102N Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gated box culvert. The culvert is implemented using rectangular cross section at the beginning and end of the link representing the culvert.

S194 Structure is a gated culvert located on the C-102 Canal, just west of Krome Avenue, on the divide between the C-111 and C-102 Watersheds. The structure is normally open to supply water to the C-102 watershed from the L-31N Borrow Canal, but during flood events, the structure is closed, and the flood water is directed to the L-31 N Canal and eventually to the C-111 Watershed. The structure is modeled as MIKE 1D underflow gated culverts.

For design storm simulations, the interior S165 and S195 structures will be fully open and the S194 Structure will be fully closed, according to the general SFWMD practice. The C-102 Watershed outfalls through the S21A Structure, a gated salinity control structure, located approximately one mile west of Biscayne Bay.This structure will be operated in “Low Range” for the design storm events in SMD FPLOS model, that is the general operation under severe weather conditions.

One weir, owned by DERM has been implemented in this model between the L-31E Canal and the C-102 Canal, just south of S21A. This weir passes water from the L-31E south of the C-102 Canal when stages reach 1.0 ft NAVD.

The C-102 Watershed has extensive exfiltration systems, primarily consisting of slab covered trenches, French drains, and gravity wells (vertical french drains). Generalizations have been made on the effectiveness of each system, based on length of trench and/or number of wells and in the South Miami-Dade FPLOS MIKE model, the exfiltration trenches have been implemented as subsurface drainage to the saturated zone.

1.1.4 C-103 Watershed

The C-103 Watershed, shown in Figure 9, is in southeast Miami-Dade County. There are three primary canals in the C-103 Watershed: C-103, C-103S, and C-103N which provide drainage and flood protection for the C-103 Watershed, supply water to the watershed for irrigation, and maintain a groundwater table elevation adequate to prevent intrusion of saltwater into the groundwater system.

Water is supplied to the C-103 Watershed from the South Dade Conveyance System (SDCS) during periods of low natural flow. C-103 begins in the L-31N borrow canal one mile west of Loveland Road between Bauer Drive and Fillmore Drive. Flow in the canal is to the southeast with discharge via S20F to Biscayne Bay north of Convoy Point. C-103S and C-103N are tributaries to C-103. C-103S begins at North Canal Drive, one-half mile east of Krome Avenue. Flow in the canal is to the east to the canal's confluence with C-103 one- quarter mile south of Campbell Drive. C-103N begins at Tennessee Road south of Plummer Drive. Flow in the canal is to the southeast to the canal’s confluence with C-103 one-half mile southwest of the intersection of Campbell Drive and Tallahassee Road. During normal operation, the 4.5 square mile area adjacent to C-103 west of Richard Road drains to the east via C-103 to Biscayne Bay. During flood conditions S196 is closed, and this area drains to the west to the L-31N borrow canal and the C-111 Watershed. Representations of C-103, C-103S, and C-103N canals are in the MIKE 1D model.

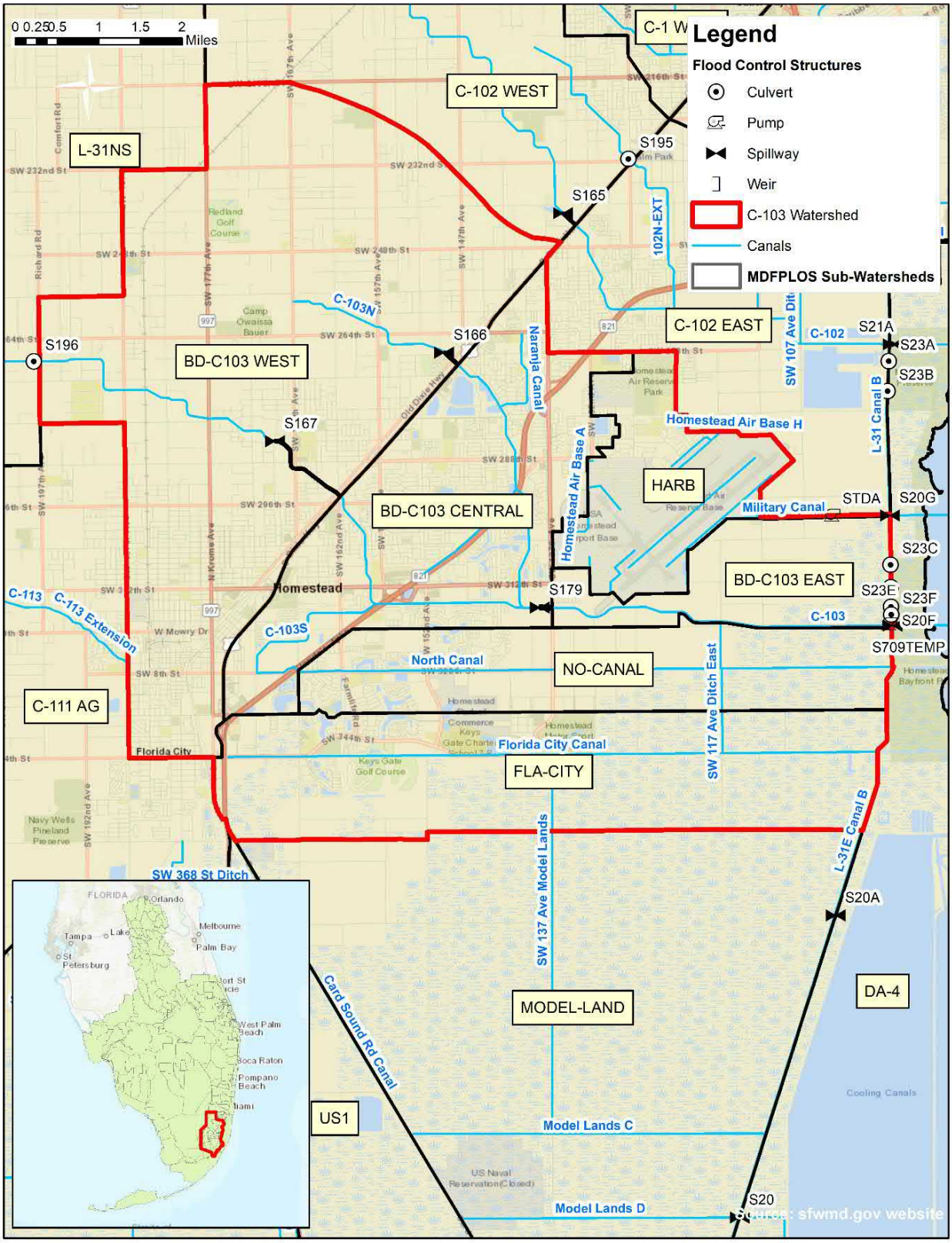


Figure 9. C-103 Watershed

There are five control structures in the C-103 watershed: S20F, S179, S167, S166, and S194.

- **S20F** is a gated spillway located in C-103 one mile west of Biscayne Bay. It controls stages in the lower reach of C-103, and it regulates discharges to tidewater. A headwater stage is maintained by S20F adequate to prevent saltwater intrusion into local groundwater. The structure is modeled as MIKE 1D underflow gate.
- **S179** is a gated spillway located in C-103 just west of Tallahassee Road. The structure controls the stage in the middle reach of C-103 and in the lower reaches of C-103S and C-103N, and it regulates discharges to the lower reach of C-103. The structure is modeled as MIKE 1D underflow gate.
- **S167** is a gated spillway located in C-103 just west of Tennessee Road. It controls stages in the upper reach of C-103, and it controls discharges to middle reach of C-103 The structure is modeled as MIKE 1D underflow gate.
- **S166** is a gated spillway located in C-103N just west of U.S. Highway 1. It controls stages in the upper reach of C-103N, and it controls discharges to the middle reach of C-103. The structure is modeled as MIKE 1D underflow gate.
- **S196** is a gated culvert located in C-103 just west of Richard Road on the divide between the C-111 and C-103 Watersheds. The structure is normally open to supply water to the C-103 Watershed from the L-31N borrow canal. During flooding the gates at S196 are closed to prevent water from passing between watersheds. The structure is modeled as MIKE 1D underflow gated culvert. The culvert is represented using two circular cross sections with diameter of 7 feet at beginning and end of the link.

The C-103 Watershed originally included North Canal, Florida City Canal, Model Land and Homestead Airforce Base Watersheds. The area occupied by the Homestead Air Force Base, and the area south of the C-103 Watershed, east of Old Dixie Highway and Card Sound Road, and west and north of L-31E is drained by five existing Dade County canals:

- The Military Canal which drains the 4.7 square miles of the Homestead Air Force Base
- The North Canal which drains 7.8 square miles
- The Florida City Canal which drains 12.5 square miles
- The North Model Land Canal
- The South Model Land Canal, which together with the North Model Land Canal, drains 28.1 square miles

Drainage from Homestead Air Force Base is pumped into Military Canal just west of Allapattah Drive. The canal then flows due east discharging into Biscayne Bay via S20G. The North Canal and Florida City canals drain to C-103 via the west borrow of L-31E. This adds approximately 26 square miles to the watershed served by S20F. North Canal parallels North Canal Drive beginning at the south end of C-103S and ending in the west borrow canal of L-31E. The Florida City Canal is one mile south of and parallel to North Canal. It flows from U. S. Highway 1 East to the east, to the west borrow of L-31E. The land within the Model Land watershed drains to the west borrow canal of L-31E. Water in the west borrow canal of L-31E is passed through L-31E by way of S20. The water is routed to the south around the cooling canals for the Florida Power and Light Turkey Point Power Plant and is discharged to Biscayne Bay.

All the operational control structures (S20G, S20F, and S20) in these watersheds provide water surface elevation control upstream of their locations in the canals in which they occur. Structure S20F is in C-103; however, since the Florida City Canal and the North Canal are connected by

open channel connections with the L-31E borrow canal which, in turn, joins C-103 by an open channel connection upstream of S20F, the structure effectively controls water surface elevations in the Florida City and North Canals.

For calibration, the model is set up to use multiple stage gages within the watershed; however, the only flow estimate is at the outfall structure at the downstream end of the watershed, the structures in the west section of the model are closed during the storm event. The boundary connections with the C-103 watershed can be considered minor and are not expected to impact peak stages. The calibration version also uses the tailwater of S20F Structure as the boundary condition. SFWMD provided the tailwater boundary conditions at the tidal structures for the design storms.

The model includes Watersheds L-31NS, BD-C103 WEST, BD-C103-CENTRAL and BD-C103-EAST. South of these watersheds the model domain covers C-111 AG, C-111 SOUTH which are south of BD-C103 WEST and L-31NS. The model domain additionally covers the watersheds south of BD-C103 CENTRAL and BD-C-103 EAST which includes NO-CANAL, FLA-CITY MODEL-LAND and US1 according to the AHED designation. To the east the model domain extends to cover DA-4. There are five operational project canals in the C-103 watersheds and south of C-103 the C-111, C-111E, C-113, L-31N, and L-31E. These canals provide drainage and flood protection for the C-111 watershed, supply water to the C-111, C-102, and C-103 watersheds and to Everglades National Park (i.e., to Taylor Slough and the panhandle of the park); and, maintain a groundwater table elevation in the lower reach of the C-111 adequate to prevent saltwater intrusion to local groundwater. Additionally, the model domain includes the North Detention Area (NDA), South Detention Area (SDA), S332 Detention Area, and the Frog Pond Detention Area which cause significant seepage from the Everglades National Park into Canal C-111.

Water is supplied to the C-111 Canal through the L-31N Borrow Canal. The L31W Borrow Canal is used to help make water deliveries to Taylor Slough in Everglades National Park by way of several SFWMD structures and pump stations. Water is discharged to the panhandle of the park by way of a series of gaps in the south berm of the C-111 Canal between the S18C and S197 Structures.

The L-31N Canal separates the easterly and westerly drainage in south Miami-Dade County. The L31N Canal Levee prevents overflow from ENP into the primarily agricultural development in the south Miami-Dade area. The levee borrow canal conveys runoff from the area between the levee drainage divide and the south Miami-Dade area southward into the C-111 Canal and the L-31W Canal. The levee is located immediately north of the SFWMD S332D Structure and extends northward to the junction with Levee 29 (L-29) and Canal 4 (C-4). In the C-111 Watershed model, this canal extends from the S332D Structure north to the S331 Structure near S.W. 188th Street and picks up pump station flows from S331 and inflows from both the C-102 and C-103 Canals in the design storm simulations. It is important to note the L-31W Canal at one time extended from a junction with L-31N to the ENP boundary and then flowed southward for about 8 miles. The canal originally prevented flooding from ENP into the agricultural and industrial areas to the east. However, portions of L-31 West were filled under the C-111 Federal Project, and stormwater detention area stages are now controlled by SFWMD Pump Stations S332D, S200, and S199. The portions that remain aid in the flow around the detention areas.

The C-111 Canal begins downstream of the SFWMD S332D and S176 structures (approximately even with S.W. 304th Street, one mile north of Mowery Drive and immediately north of the confluence with the C-113 Canal) and continues southward to approximately 1.1 miles south of S177 where C-111 turns southeast to the intersection of C-111E, approximately 2.7 miles. The C-111 then continues due south 3.0 miles; then southeast to the S197 Structure, approximately 5.5 miles. The canal continues south of S197 discharging into Manatee Bay. Stages within the reach of this canal, which lie upstream of S177 and upstream of S18C, may be incrementally increased to reduce return seepage to the C-111 Canal, contributing to a net increase in flows to Eastern Florida Bay via Taylor Slough. During severe flooding events, the S194 structure (located at Krome Avenue on the C-102 Canal) is closed, effectively removing 11.8 square miles from the C-102 Watershed. Also, during severe flooding events, the S196 structure (located at Krome Avenue on the C-103 Canal) is closed, effectively removing 10.9 square miles from the C-103 Watershed. Sub-watersheds west of Krome Avenue are routed west to the L-31N Borrow Canal when the structures are closed. Therefore, the sub-watersheds west of Krome Avenue are under the influence of the C-111 Canal.

The C-111E Canal is in the Loveland Slough area. The C-111E Canal begins at S.R. 27, 0.4 miles west of Country Club Road and carries discharges from the SFWMD S178 Structure to the confluence with the C-111 Canal. C-111E was designed to remove the 40 percent SPF runoff and reduce the depth and duration of floods exceeding design conditions. Stages within the C-111E canal, which are also dependent on S18C operations, may be incrementally increased as a result of incremental increase in S18C open and/or close triggers. Like the C-111 Canal, these increased stages should help reduce return seepage to the C-111E Canal, contributing to a net increase in flows to Eastern Florida Bay via Taylor Slough.

The C-113 Canal begins at Richard Road, one-quarter of a mile north of Mowery Drive and flows west to the C-111 Canal, immediately downstream (south) of the S176 Structure.

The L-31E Canal is in lower Miami-Dade County, extending from the Florida City Canal, generally southwesterly for a distance of 8.8 miles to Old Dixie Highway and contains the SFWMD S20 and S20A Structures, however, no DBHYDRO records were available for S20A, indicating that most likely S20A was not operable at that time The purpose of this levee is to provide a salinity barrier that would furnish flood and surface salinity protection for the lands west of the levee from inundation by tide-associated flooding. Stages within the reach of this canal, which lies between S20 and S20A, may be incrementally increased in order to increase hydroperiods within the Model Lands, and to reduce overall seepage losses from the west.

SFWMD operates multiple control structures and water level gages within Miami-Dade County. The SFWMD pump stations and control structures located within or on the boundary of the C-111 Watershed are described below:

S176 is a reinforced concrete, gated spillway, with discharge controlled by a vertical lift gate. S176 is located on C-111 approximately 5 miles west of Homestead. It is used to maintain a desirable water control stage upstream in the L-31N borrow canal. It passes the design flood (40 percent of the SPF, 630 cfs) without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. During low-flow periods, S176 can pass sufficient flow to maintain stages downstream. The structure is modeled as MIKE 1D underflow gate.

S177 is a reinforced concrete, gated spillway, with discharge controlled by a vertical lift gate. The structure is located on C-111 just downstream from State Road 27 and maintains optimum water levels upstream in the C-111 Canal. It passes the design flood (40 percent of the SPF, 1400 cfs) without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gate.

S178 is a single-barreled, reinforced concrete box culvert located at the north end of Canal 111E (C-111E) at State Road 27. S178 maintains optimum water control stages upstream in C-111E, passes the design flood (40 percent of the SPF, 510 cfs) without exceeding upstream flood design stages, and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gated culvert. The culvert is represented as a rectangular cross section at the beginning and end of the link representing the culvert.

S18C is a reinforced concrete, gated spillway, with discharge controlled by two vertical life gates located on C-111 approximately 6.5 miles upstream from S197. S18C maintains a desirable freshwater head against salt-water intrusion through C-111 north of the structure, passes flood flows up to 40 percent SPF (2,100 cfs) without exceeding design stages upstream, and acts as a control point for water deliveries to the Eastern Panhandle of ENP. The structure is modeled as MIKE 1D underflow gate.

S197 is a four-barreled 10-foot by 10-foot rectangular box culvert, located near the mouth of C-111 approximately 3 miles from the shore of Manatee Bay and 750 feet east of US1. This structure maintains optimum upstream water control stages in C-111 and prevents saltwater intrusion during high tides. Most of the time S197 diverts discharge from S18C overland to the panhandle of ENP and releases water only during major floods according to established guidelines. The design discharge rate is 40 percent of the SPF (2,400 cfs). The structure is modeled as MIKE 1D underflow gate. The structure is represented by four MIKE 1D links with the length equal to the culvert length. Each culvert link is represented as a rectangular cross section at the beginning and end of the link with dimensions width = 10’ and height = 11’

S20 is a reinforced concrete, gated spillway with discharge controlled by a vertical lift gate. The structure is located on L-31E about 3 miles from the shore of Biscayne Bay. This structure maintains optimum water control stages in the upstream agricultural area; it passes the design flood (40 percent of the SPF, 450 cfs) without exceeding upstream flood design stage, and restricts downstream flood stages and discharge velocities to non-damaging levels. It prevents saltwater intrusion during high tides. The structure is modeled as MIKE 1D underflow gate.

Pump Station 331 (S331) is located on the L-31N near S.W. 168th Street, north of the C-102 Watershed. The primary purpose for the pump station is to control water levels in the L-31N Borrow Canal and supply water to the C-111 Canal. Under the flood control operating guidelines, the S331 PS is controlled by upstream stages in the watershed north of the station, and downstream stages in the L-31N and C-111 Canals, at S331 (Tailwater) and at S176, respectively. If the stage is below approximately 4 ft NAVD at the S176 Structure, the pump may be on, provided other operational criteria are met. For the purposes of modeling the C-111 Canal under extreme flow conditions, the model expects the other criteria to be met. Though the design discharge rate is 1,160 cfs, the observed rates in DBYDRO for recent years indicate the flows have never been above 800 cfs; therefore 800 cfs has been implemented in the model. The pump

station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

Pump Station 332B (S332B) is located on the L-31N near S.W. 232nd Street. The primary purpose for the pump station is to pump water from the canal between the C-102 and C-103 confluences into the North Detention Area. S-332B has a total capacity of 575 cfs of which 250 cfs are pumped to the NDA and 325 cfs to the SDA. The pump station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

Pump Station 332C (S332C) is located on the L-31N near S.W. 266th Street, immediately south of the confluence with the C-103 Canal. The primary purpose for the pump station is to pump water from the canal south of the C-103 confluence into the South Detention Area. Pump station S332C has a total capacity of 575 cfs. There are four 125 cfs units plus one 75 cfs unit. The pump station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

Pump Station 332D (S332D) is located at the junction of the L-31N and the L-31W borrow canals. The primary purpose for the pump station is to pump water from the canal upstream of S176 into the S332DN detention area. The pump station contains four diesel driven pumps with 125 cfs capacity each and one electric motor pump with 75 cfs capacity. Under current operation guidance (IOP), maximum pumping of 575 cfs may occur from July 16 to November 31; 325 cfs from December 1 to January 31; and 165 cfs from February 1 to July 15. The pump station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

Pump Station 200 (S200) is located on the C-111 Canal near S.W. 344th Street, between the S176 and S177 Structures. This pump station pumps water from the C-111 Canal between these structures to a newly developed trapezoidal discharge channel. The channel runs west, then south for approximately 3.5 miles, with discharge locations to three detention areas (Frog Pond North, Central and South). The pump station has a capacity of 300 cfs (4 units of 75 cfs each). The pump station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

Pump Station 199 (S199) is located on the C-111 Canal near S.W. 392nd Street, just north of the S177 Structure. This pump station pumps water from the C-111 Canal north of the S177 to a newly developed trapezoidal discharge channel and into the Aerojet Canal which delivers the water to the lower Taylor Slough in the Park The pump station has a capacity of 300 cfs (4 units of 75 cfs each). The pump station is modeled as discharge structure for calibration events with boundary conditions defined by the discharge timeseries.

For design storm simulations, all the above C-103 SFWMD structures will be managed according to operational protocols for wet conditions. For tidal structures the gate trigger elevations will be set at “Low Range” settings and for interior structures the model will use “Normal” wet season trigger settings. The pump stations will use a set of criteria that will be developed in collaboration with SFWMD. The operation is typically based on headwater stage and defines pump discharge during design storms. The pump stations are needed to define the water balance components in the L-31N and C-111 canals.

For calibration, the primary outfall is a node representing the tailwater gage at the S197 Structure. For design storm simulations, the boundary conditions will use data provided by SFWMD.

Table 7. SFWMD Storm and Regular Structure Operations

STATION	TARGET UPSTREAM STAGE (ft NAVD88)	DESIGN FLOW, CFS	Regular Stage Open (ft NAVD88)	Regular Stage Close (ft NAVD88)	Storm Stage Open (ft NAVD88)	Storm Stage Close (ft NAVD88)
S176	3.45	630	3.45	3.2	3.45	3.05
S177	2.65	1400	2.65	2.05	2.65	2.05
S178	2.95	510	2.95	-	2.95	-
S18C	1.05 (dry) 0.75 (wet)	2100	1.05	0.75	0.7	0.45
S197	-	2400	-	-	-	-
S20	0.35 (dry) 0.05 (wet)	450	0.85	0.25	-0.15	-0.55

The operation of the S197 Structure is dependent on upstream structures S18C and S177 and are represented as such.

For normal wet seasonal operation Table 8 lists the trigger values for opening and closing of the gates upstream S197.

Table 8. Trigger values for normal wet seasonal operation of structures upstream S197 (units converted to NAVD 88 from the original NGVD29)

Structure	Open Trigger Elevation	Close Trigger Elevation
	(ft NAVD88)	(ft NAVD88)
S176	3.45	3.2
S177	2.65	2.05
S178	3.45	2.95
S18C	1.05	0.75
S197	Based on S18C and S177 stages	Based on S18C and S177 stages

1.2 Numerical Model Selection

Initial screening of the numerical models consisted of analyzing the hydrology and hydraulics of the area to be modeled and the project objectives. The numerical model selection criteria included:

- Functionality: This assessment was a model's computational ability to quantify the hydrologic and hydraulic variables that significantly influence the six (6) performance metrices for the South Miami-Dade FPLOS project.

- Technical Defensibility: This criterion was used for the justification to choose a model based on its reliable application in South Florida and its compatibility with the long-term modeling strategy of the SFWMD.
- Cost-Effectiveness: This considered software implementation costs, time to develop and maintain software, computational time, technical support, and pre and post processing tools.
- SFWMD in-house skills: This criterion considered if there are existing in-house skills at SFWMD which reduces ramp-up time and increases success of effective use of the model in future.

The modeling tool selection criteria were considered to assess the models that could appropriately simulate the performance metrices and differentiate between model runs with mitigation measures being tested in future phases of the work. The selected modeling tool MIKE SHE and MIKE 1D, was approved by SFWMD.

2 FLOOD PROTECTION LEVEL OF SERVICE DEFINITIONS FOR SOUTH MIAMI-DADE

The SFWMD's primary canals are designed to hold water at stages estimated to occur during the Standard Project Flood (SPF), which is generated by the Standard Project Storm (SPS), defined as the 100-Year storm increased by 25%, according to the USACE's General Design Memoranda (GDM) for the Dade Conveyance System. The capacity of a canal and its structures may be given as a percentage of the SPF (e.g., 40 percent SPF typical rating). The storm that would generate this amount of runoff is given by its frequency (e.g., 1-10 years) for antecedent weather conditions that are assumed to generate runoff from the storm. The amount of runoff to be expected per unit area for design storms at various recurrence intervals, antecedent conditions, and land use are available in the USACE General Design Memoranda for the Dade Conveyance System. The runoff calculated to occur for a given storm frequency, antecedent conditions, and land use is the design discharge. The flood protection level of service requires all primary canals to operate per the USACE GDM, with an effective canal and control structure capacity based on passing the rated design flood, typically established as a percent of the SPF, with four distinct goals:

1. Maintain upstream flood design stage.
2. Restrict downstream flood stages and canal flow velocities to avoid excessive erosional impacts.
3. Convey sufficient discharge during low-flow periods to maintain minimum downstream stages.
4. Prevent overtopping of control structures by wave action during a storm including tidal effects in coastal structures.

The secondary drainage system consists of canals and features that are managed by designated drainage districts or private entities, which may discharge to the coast or receiving lakes, or into the primary system. Such secondary systems operate under permits issued by the SFWMD. The tertiary drainage system consists of canals and features generally located on private lands that provide localized drainage and discharge into retention/detention areas or into secondary systems.

The District LOS program relies on six (6) formal Performance Metrics (PMs) to evaluate the flood protection provided by the primary SFWMD infrastructure. An earlier section of this report defined these metrics briefly and their purpose. This section describes the methodology, analysis of the model results and the results of the analysis.

PM1 - Maximum Stage in Primary Canals: The key indicator used for this PM was instantaneous maximum peak stage. To evaluate and present this PM under current conditions within the four (4) project domain watersheds, instantaneous maximum peak stage profiles were prepared for all primary canals, and some secondary canals for each of the design storm events. Canal bank elevations shown in the profile figures are based on the MIKE-1D cross section data. The canal banks were additionally reviewed using LiDAR data. Significant features like major roadways and primary canal junctions were examined to determine the potential for canal bank overflow and bridge overtopping. In the model, bridges with sufficient clearance (the upstream and downstream canal banks were lower than the lowest elevation of the bridge overhead structure) were modeled as open cross-sections.

PM2 - Maximum Daily Discharge Capacity through the Primary Canals: The key indicator for this PM was determined based on the area weighted drainage capacity of each upstream watershed at the structures. This PM was assessed by computing the area weighted drainage capacity of structures as a function of the upstream watershed and the design rainfall recurrence interval. The discharge capacity of the primary canals is a function of the upstream and downstream stages, and the canal conveyance upstream, of the salinity control structures. The conveyance capacity of the canal upstream of the salinity control structure for each design event was reflected in the peak discharge, and the head loss through the structure, as a function of upstream and downstream stage hydrographs. Figure 10 shows the contributing areas for the structures in the project domain. The areas were delineated using topography; SFWMD watersheds, sub watersheds and water control catchments are too coarse for this analysis.

The SFWMD Environmental Resource Permit (ERP) publishes allowable discharge numbers. This is a regulatory number and represents the maximum value a development can discharge into the canal. The 10-Year event discharges for C-100, C-100A, C-100B, C-100C are computed using EQ1.

$$Q = \left(\frac{104}{\sqrt{A}} + 43\right) A \qquad \text{EQ. 1}$$

The 10-Year event for watershed C-102 is computed using EQ2.

$$Q = \left(\frac{119}{\sqrt{A}} + 25\right) A \qquad \text{EQ. 2}$$

The 10-Year event for watersheds C-103N and C-103S is computed using EQ. 3.

$$Q = \left(\frac{107}{\sqrt{A}} + 39\right) A \qquad \text{EQ. 3}$$

The 10-Year event for watershed C-1 is computed using EQ.4.

$$Q = \left(\frac{112}{\sqrt{A}} + 31\right) A \qquad \text{EQ. 4}$$

Where A is in square mile (sq-mi), and Q is in cubic feet per second (cfs)

The allowable runoff discharges for each basin are determined using EQ 1, 2, 3 and 4, using the area obtained from the AHED database and are listed in Table 9:

Table 9. Allowable Discharges and Return Frequency for each Watershed

Watershed	Area (acre)	Area (mi^2)	Allowable Discharge (cfs)	Allowable Discharge (CSM)	Design Frequency(yr)
C-1	37,839.11	59.12	2,694	45.57	10
C-100	25,068.83	39.17	2,335	59.62	10
C-102	15,035.38	23.49	1,164	49.55	10
C-103	39,871.71	62.30	3,274	52.56	10

Note: CSM is cubic feet per second per square mile.

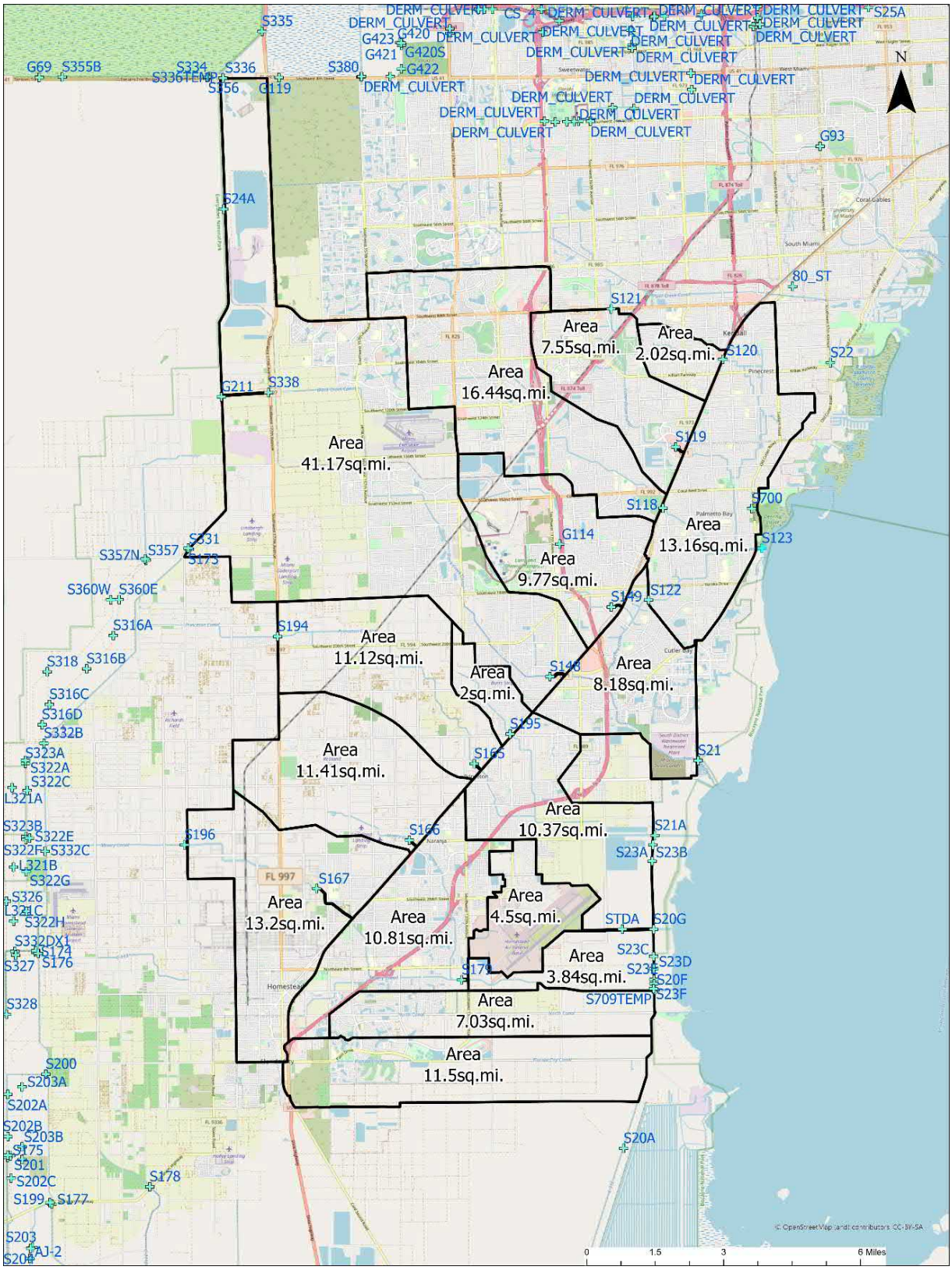


Figure 10 Contributing Areas for Structures within the Project domain

A summary of the drainage areas for each structure is provided in Table 10 below:

Table 10 Summary of Watersheds, Drainage Area and Outfall Structures

Outfall Structure	AHED Watershed	Model Basin	Drainage Area (mi^2)	Total Drainage Area (mi^2)
S179	BD-C103 CENTRAL	C-103	10.81	35.42
S20F	BD-C103 EAST	C-103	3.84	39.27
S167	BD-C103 WEST	C-103	13.20	13.20
S166	BD-C103 WEST	C-103	11.41	11.41
S21	C-1 EAST	C-1	8.18	59.12
S148	C-1 WEST	C-1	41.17	41.17
S149	C-1 WEST	C-1	9.77	9.77
S123	C-100 EAST	C-100	13.16	39.17
S118	C-100 WEST	C-100	16.44	16.44
S120	C-100 WEST	C-100	2.02	2.02
S119	C-100 WEST	C-100	7.55	7.55
S21A	C-102 EAST	C-102	10.37	23.49
S165	C-102 WEST	C-102	11.12	11.12
S195	C-102 WEST	C-102	2.00	2.00
S20G	HARB	C-103	4.50	4.50
Watershed Outfall	FLA-CITY	C-103	11.50	11.50
Watershed Outfall	NO-CANAL	C-103	7.03	7.03

PM3 – Structure Performance: This metric was included by SFWMD to show the effective capacity of the South Miami Dade tidal structures. It is the static design conditions which were assumed in the original structure's design, but the evaluation included comparison of structure flows over a range of design storm and storm surge events. The focus for this PM assessment is the peak instantaneous discharge capacity of structures as a function of the design rainfall recurrence interval.

This PM was analyzed using:

- Stages and flows at structures at the time of peak flow
- Stages and flows at structures at the time of peak headwater stage
- Stages and flows at structures at the time of peak tailwater stage

The SFWMD primary conveyance system is designed to hold water at stages estimated to occur during the Standard Project Flood (SPF), which amounts to the runoff generated by the Standard Project Storm (SPS), defined as the 100-Year storm increased by 25%. The capacity of a canal and its structures may be given as a percentage of the SPF (e.g., 40 percent SPF typical rating). The storm that would generate this amount of runoff is given by its frequency (e.g., 1-10 years) for antecedent weather conditions that are assumed to generate runoff from the storm.

The amount of runoff to be expected per unit area for design storms at various recurrence intervals, antecedent conditions, and land use can be found in the USACE General Design Memorandums for the Dade Conveyance System. The runoff calculated to occur for a given set of storm frequency, antecedent conditions, and land use is the design discharge.

The secondary drainage system consists of canals and features that are managed by designated drainage Districts or private entities, which may discharge to the coast or receiving lakes, or into the primary system. Such secondary systems operate under permits issued by the water management district. The tertiary drainage system consists of canals and features generally located on private lands that provide localized drainage and discharge into retention/detention areas or into secondary systems.

PM4 - Peak Storm Runoff: The key indicator used is peak storm runoff at the coastal structures, which reflects the watershed characteristics and the capacity of the watershed to drain. Included in analysis under this PM is also the cumulative drainage capacity of structures as a function of Design Rainfall Recurrence interval. The cumulative drainage capacity evaluates the maximum conveyance capacity of a watershed through the South Miami Dade tidal structures for the range of simulated design storms. The performance of each coastal structure was evaluated, and assessment was made for the maximum conveyance for each design storm and a specific tidal boundary condition. The model results have been tabulated and discussed for each design event. Comparisons are made with future conditions model results to complete the assessment.

PM5 - Frequency of Flooding: This is determined using stage-based FPLOS for sub watersheds. The key indicator used for this PM was the inundation depth of overland water. MIKE model gridded, temporal outputs included water elevations, inundation overland water depths and other data. These were used in evaluation for every storm event, and maximum flood inundation maps were produced and converted to GIS format for presentation of results. To determine the flood extent for a given design event, inundation maps were developed which illustrated the flood depth within each of the project domain watersheds. The inundation maps were developed using 5 ft topography. Flood inundation maps for each of the design events are presented, and a summary of watershed and flooded areas in square miles and percent flooded area are tabulated. For each design event, tables were also produced with incremental inundation depths. This analysis is summarized in tables and maps for the entire project domain, and additionally for urban, agricultural and wetland areas. In Phase II inundation stages/depths will be used to compute actual damages for a more comprehensive PM5.

PM6 - Duration of Flooding: This PM quantifies the duration of flooding at specific locations for each watershed. The key indicator was temporal component of flood, i.e., temporal length of flooding. In subsequent Phase II studies, the inundation stages/depths will be used to compute actual damages for additional and more comprehensive analysis of this PM.

A threshold depth of 0.25 feet was used to calculate the length of time the overland flood depth was exceeded, which is also the standard used for other LOS studies. MIKE gridded series output includes 2-D overland flow component in x and y directions. Using this output, the length of time of the flood elevation was mapped over the entire SMD FPLOS project domain for each design event using the following approach for each design event (5-, 10-, 25- and 100-Year):

- For the duration of the simulation period computed as 816 hours (9/1/2017-10/5/2017) the 2D flood depth timeseries (with 0.1 hour timesteps) was analyzed to determine the number of hours and the total area for which the flood depth is greater than 0.25 ft.
- Each timestep subtracts the initial areas which are flooded (assuming this includes the canals, lakes, and wetland areas) and determines the flooded area.

- The duration of flooding was evaluated for each model cell and a raster was created to provide visual representation of the flood duration characteristics of each watershed within the project domain.

For each design event, tables were generated to show the duration of flooding. This analysis is summarized in tables and maps for the entire project domain, and additionally for urban, agricultural and wetland areas. The results of all the PMs are presented by each of the watersheds: C-1, C-100, C-102 and C-103. For every project domain watershed, information is included on inflows and outflows, design parameters from South Miami-Dade Atlas and then the LOS rating of the watershed for the specific PM.

3 MODEL DEVELOPMENT

3.1 Model Components and Simulation Specification

The model was developed using DHI's MIKE modeling framework known as MIKE ZERO. MIKE ZERO provides access to available DHI models and contains software facilities which include:

- Data editing;
- Visualization tools;
- Presentation facilities;
- Miscellaneous simulations, analytical and model management tools; and
- Matlab libraries which allow the use of scripting for automation of data processing.

The model was created using MIKE 1D (hydrodynamic software for channel flow, pipe and infrastructure that can be represented as one-dimensional) and MIKE SHE (simulating all components of the hydrologic cycle, including evapotranspiration, overland runoff, infiltration and vertical flow in the unsaturated zone, and saturated groundwater flow). The main aspect of the MIKE modeling framework is the ability to include the interactions between all hydrologic and hydrodynamic processes.

This numerical model application includes the four main hydrologic subdomains: Overland Flow (OL), Flow in Vadose Zone (UZ), Flow in Saturated Zone (SZ) and Flow in Open Channels and other water conveyance structures that can be represented as one-dimensional flow (OC).

MIKE SHE/MIKE 1D has several options and numerical methods to effectively simulate the hydrologic processes. Below are highlights of the possible hydrologic processes and numerical approaches; with the ones used in SMD FPLOS model italicized.

1. Climate (Precipitation and Evapotranspiration)
2. Rivers and Lakes (OC) (MIKE 1D)
3. Overland Flow (OL) Processes
    - *Finite Difference Method*
    - Simplified Overland Flow Routing Method
4. Unsaturated Flow (UZ) Processes
    - *1D Simplified Gravity Flow Equation*
    - Two-Layer Water Balance Method
    - 1D Richards Equation Solution
5. Saturated Flow (SZ) Processes
    - Linear Reservoir Method
    - *3D Finite Difference Method*

The SMD FPLOS MIKE SHE/MIKE 1D integrated model utilizes all major modules. The overland flow module is solved using the 2D finite difference diffusive wave approximation of the St. Venant equations, because that is considered reasonable for this region and model scale. The unsaturated zone module is solved with the 1D simplified gravity flow method. The saturated zone is solved with the 3D finite difference Darcy flow equation. Each of these processes are discussed in further detail within the appropriate sections of this report.

Each of the subdomains uses a different numerical solver which requires solver specific setup and timestep:

- OC: MIKE 1D uses a constant 5-second time step and outputs results every 5 minutes.
- OL: Overland module is critical for flooding assessment to capture watershed runoff processes and accurately simulate exchanges between the OL and OC modules; a maximum overland time step of 15 minutes was set. The OL module used an Explicit solver which is recommended for overbank spilling. The solver used a maximum Courant Number for adaptive time step of 0.8, which is the default. The threshold water depth for overland flow was set at 0.01 ft. The threshold gradient (water elevation slope) for applying low-gradient flow reduction was set at 1e-4. Furthermore, the solver used the weir formula for overbank spilling. OL results are stored every hour.
- UZ: Maximum allowed time step of the UZ was set to 15 minutes, and the maximum infiltration depth per time step was set to 4 inches. The UZ numerical software solver for SMD FPLOS model uses the Gravity Flow option. For the UZ-SZ coupling the maximum profile water balance error was set at 0.005 ft, which is the default parameter. The gravity flow has faster numerical performance than Richard's Equation, and is considered reasonable for this analysis. UZ, ET, and Precipitation results are stored every hour.
- SZ: Saturated Zone was set to use maximum allowed timestep of 15 minutes. The SZ flow numerical solver uses the Transient Preconditioned Conjugate Gradient as the default solver with maximum of 50 iterations, maximum head change per iteration of 0.01 ft and Maximum residual error of 0.0164 ft/d. Sink deactivation of drying cells and saturated thickness threshold was assumed for cells that have less than 0.2 ft water levels, which is the model default. Additional settings were applied including Gradual Drain-activation, Horizontal Conductance was averaged between iteration, and No-underrelaxation. The maximum exchange from river during one-time step was assumed as maximum fraction of H-point (in MIKE 1D) volume of 0.9. SZ results are stored every hour in SMD FPLOS model.

While the maximum timestep is established by the user, smaller variable steps can be used by each of the solvers (OL, UZ, SZ), which use adaptive timesteps. Periods of heavy rainfall, as during the storm event, can lead to numerical instabilities if the time step is too long, so the model reduces the timestep in increments of 10% of the maximum specified timestep when the precipitation depth exceeds 100 mm, the infiltration amount exceeds 100 mm, or the input precipitation rate exceeds 0.5 mm/hr, which are the time step control default values.

The simulation period for the Calibration Event (Hurricane Irma) is 8/15/2017 through 10/15/2017 and the simulation period for the Validation Event (December 2015 event) is 11/1/2015 through 12/31/2015.

3.2 Model Domain and Grid

The SMD FPLOS model domain covers an area of approximately 550 square miles, bounded by the detention areas west of L-31N canal, to the Biscayne Bay on the east, C-4 watershed on the north to C-111 canal on the south. The model includes approximately 423 miles of canals and ditches within its domain.

Model Discretization: 328 ft x 328 ft (100 m X 100 m), 626 rows, 332 columns, 5 layers (SAS)

3.3 Model Version and Execution Time

The model runs with MIKE SHE/ MIKE 1D Model version v2019, Update 1. In general, model versions are backward and forward compatible within a reasonable time frame (a few years).

The model is set up to use a project file (.mzp file extension). At the top level of the project folder there are three directories:

- **MODELS** is model directory file, which contains a set of directories for each specific model, it is also used for storing model development steps.
- **Results** folder stores all simulation output files. Typically, the result files from each simulation are approximately 50 to 100 GB depending on the input options (e.g. multicell overland resolution).
- **INPUTFILES** stores all input data sets and is subdivided into multiple subfolders, as shown:

The folders BC-*** store the boundary conditions for all simulations and the corresponding observed data files. Data were downloaded for eight (8) storm events and were converted to DHI's dfs0 and dfs2 formats. Data for the final Calibration and Validation simulations are provided. AERIALS and DOMAIN store the corresponding input files, ET and RAINFALL are within the corresponding directories. Additionally, separate directories are available for SZ (spatial files for the saturated zone), MANNING (spatial files for the Manning's roughness factor), TOPOGRAPHY, VEGETATION, LANDUSE and INITIAL store the corresponding spatial files. The GIS directory contains the spatial files which are used for the in-model display. The 2-month calibration model runs for approximately 15 hours using eight (8) processors with total iterations and average iteration timesteps listed in Table 11, below.

Table 11. Typical Iterations and Average Timesteps for Simulating the Calibration and Validation Storm Events

Numeric Sub-domain	Calibration Storm	Validation Storm
No. of UZ time steps	5900	5802
Average real-time simulated per time step	0.248 hours	0.248 hours
No. of OL time steps	2082777	2075133
Average real-time simulated per time step	.0007 hours (2.53 secs)	.00069 hours (2.50 secs)
No. of SZ time steps	5900	5802
Average real-time simulated per time step	0.248 hours	0.248 hours

Table 12. Typical distribution of simulation time of subdomains for the Calibration and Validation events

	Calibration Event		Validation Event	
Numerical Sub-domain	**Elapsed Seconds**	**% of Total**	**Elapsed Seconds**	**% of Total**
Initialization phase	8.9		9.5	
Simulation phase:				
SZ	17154.3	31.64	12783.4	29.88
UZ + ET	3962.4	7.31	4201.7	9.82
Overland	13663.3	25.2	10597.1	24.77

River	16834.0	31.05	13077.2	30.57
Met. input	113.3	0.21	89.6	0.21
Veg. input	31.3	0.06	21.5	0.05
Grid series output	620.7	1.14	499.0	1.17
Detailed TS output	354.3	0.65	308.0	0.72
Admin	1358.8	2.51	1111.3	2.60
Other	124.8	0.23	87.5	0.20

The fraction of simulation time for each subdomain is listed in Table 12 for both the Calibration simulation (Hurricane Irma, August – September 2017) and the Validation simulation (November - December 2015). The table shows that majority of the simulation time was spent on OL and SZ sub-domain computations. The one-dimensional river model used approx. 31% of the total simulation time for both runs.

3.4 Topography and Bathymetry

Topography dataset is important for the flooding assessment in the MIKE SHE/ MIKE 1D model. It is used for overland flow routing, overland flow/river exchanges and map inundation extents. In addition, the saturated zone hydro stratigraphy is relative to the topography. The topography dataset has a single, averaged surface elevation value for each grid cell of the model domain. Based on review of the topography data, approximately 100 m grid cell size is considered the optimal dimension.

The land surface elevation data are collected from three main sources listed below and arranged by priority of overlapping data, one (1) being the highest and three (3) being the lowest priority as numbered below.

1. LiDAR topographical surveys for Miami-Dade County topographic elevation, based on raster 5-ft DEM, 2015. This is a raster dataset, representing a 5-ft digital elevation model (DEM) of bare earth for the majority of Miami-Dade County. The accuracy of this set is estimated at +/- 0.23 ft.
2. LiDAR topographical surveys for Miami-Dade County topographic elevation, based on raster 5-ft DEM, 2018. This is a raster dataset, representing a 5-ft digital elevation model (DEM) of bare earth for the majority of Miami-Dade County. Considering that this set is the latest, it was used as priority. The accuracy of this set was not available but was assumed to have a greater accuracy than the 2015 LiDAR.
3. A bathymetry set from NOAA, known as Continuously Updated Digital Elevation Model (CUDEM) - Ninth Arc-Second Resolution Bathymetric-Topographic Tiles were used for all areas for which the SFWMD provided topography was below 0.0 ft NAVD 88.

SFWMD Geospatial Services merged the first two (2) sources, and KH-GIT team merged the bathymetry data with the SFWMD dataset to have coverage for coastal areas with elevations lower than 0.0 ft NAVD 88. Figure 11 shows this merged topography dataset.

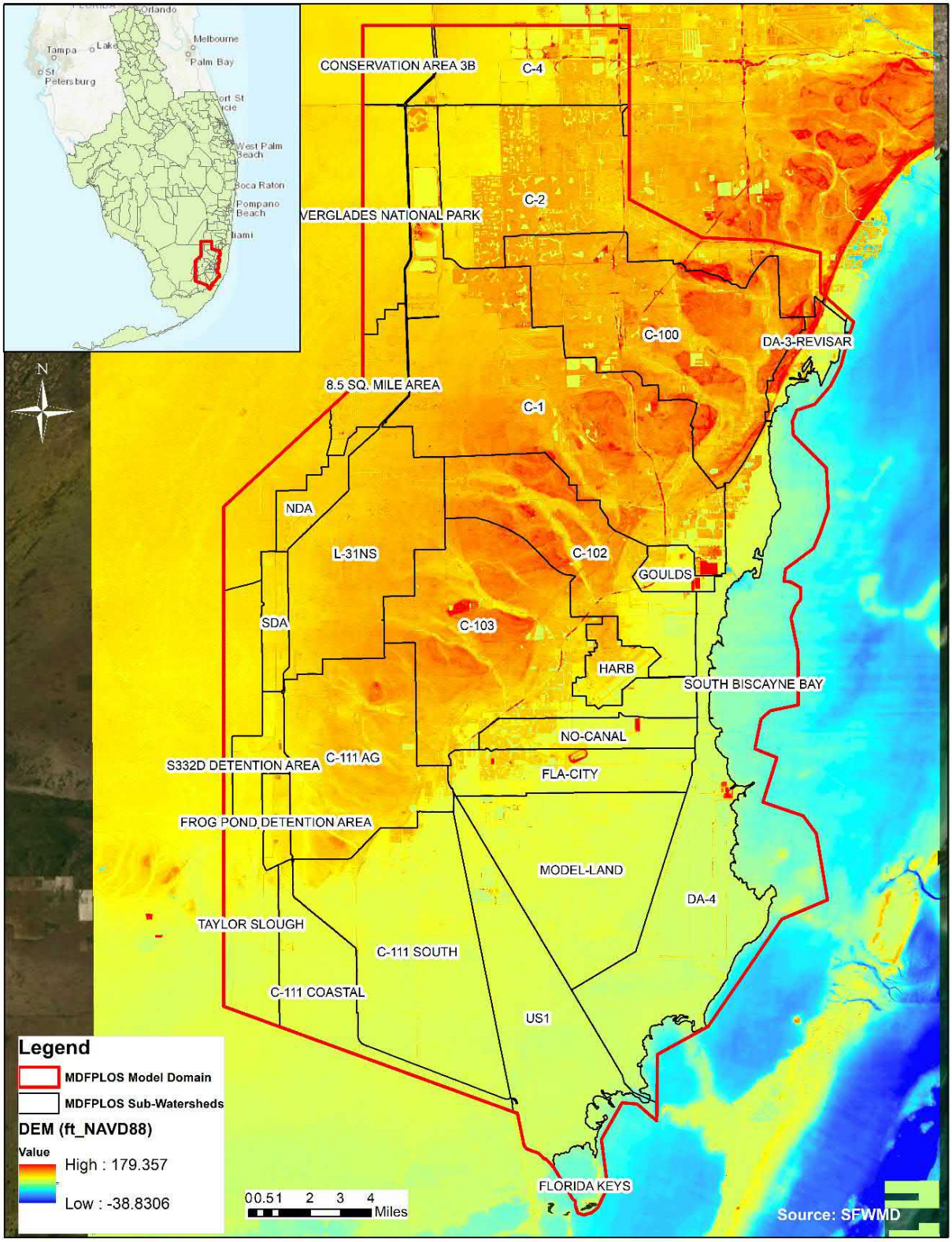


Figure 11. SMD FPLOS Merged Topography dataset: SFWMD 5-feet Topography (LiDAR 2015 and LiDAR 2018) and Bathymetry from NOAA

The DEM represents a 5-foot bare-earth surface and does not include vegetative and building features. Estimates of water edges at the time of data collection, were performed using orthophotography. The LiDAR data horizontal accuracy follows the National Standard for Spatial Data Accuracy (NSSDA) RMSE estimation of elevation data in support of 2-ft contour mapping products as it is referenced in the FEMA Guidelines and Standards for Flood Risk Analysis and Mapping. Horizontal accuracy was tested to meet or exceed a 3.8-foot horizontal accuracy (2.2-ft RMSE) at 95% confidence level using RMSE(r) x 1.7308 as defined by the Federal Geographic Data Committee's (FGDC) Geospatial Positioning Accuracy Standards, Part 3: NSSDA. The Fundamental Vertical Accuracy is shown to meet or exceed a 0.60-ft fundamental vertical accuracy in open well-defined terrain at 95% confidence level using RMSE(z) x 1.9600 as set forth in the FGDC Geospatial Positioning Accuracy Standards, Part 3: NSSDA.

The final model topography, with 100 m x 100 m grid size, is shown in Figure 12.

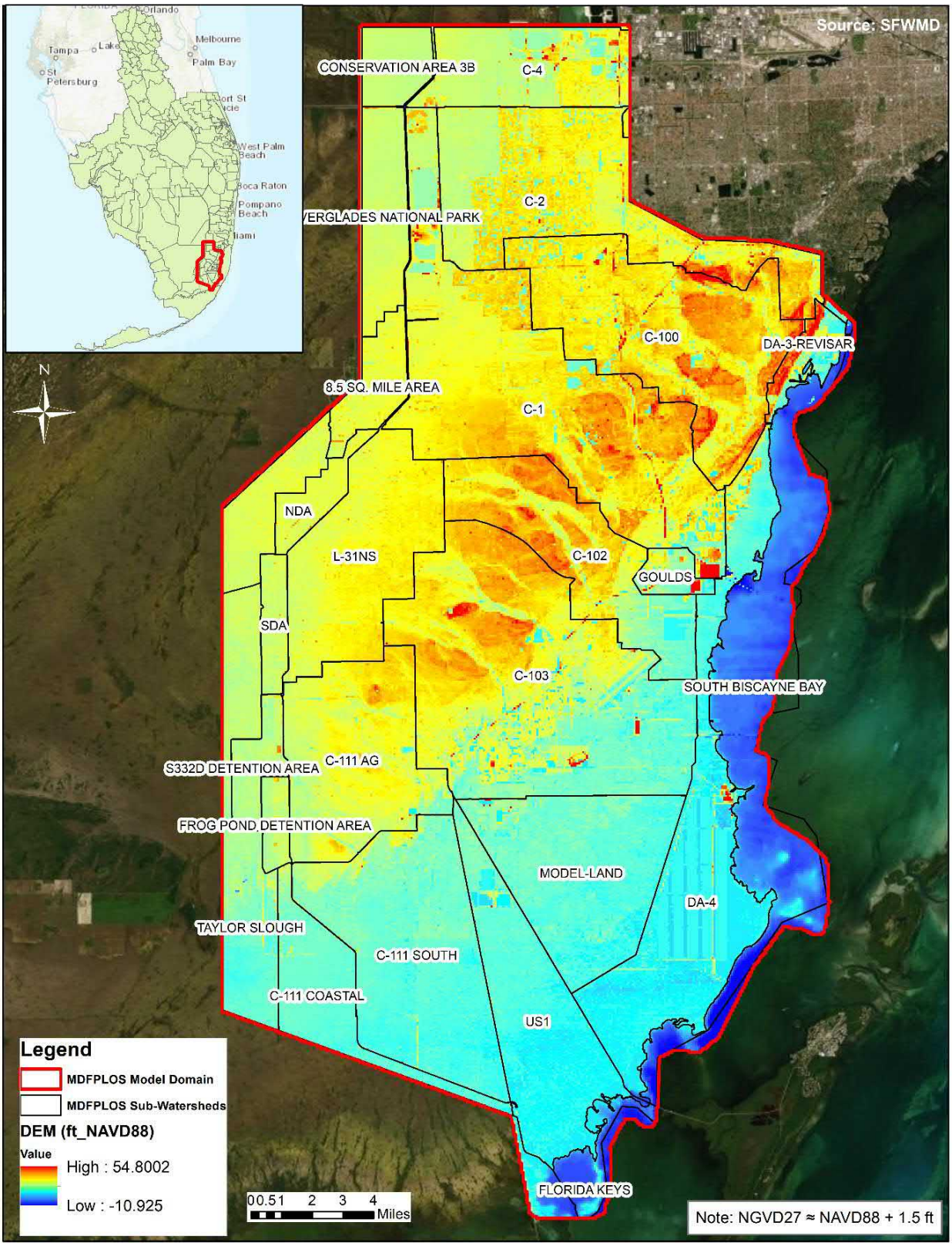


Figure 12. SMD FPLOS Model Topography (100 m x 100 m resolution)

3.5 Rainfall

Rainfall is the primary hydrological driver of the model. MIKE SHE has the ability to distribute precipitation spatially and temporally in various ways, depending on data availability. The spatial distribution of rainfall can be uniform of the entire domain, station based (i.e., distributed using Thiessen polygons), or fully distributed (i.e., NEXRAD data).

The two sources of data for this project are Station data (rain gage) and NEXRAD, both from SFWMD:

5. NEXRAD data is QA/QC ed by SFWMD; it was converted to dfs2 format with the same cell size of 2 km x 2km (2,000 m, 6,562 ft) as the NEXRAD data, for the model domain.
6. Gage data has been QA/QC ed by SFWMD. For this project, they were reviewed for outliers (negative values, values considerably greater than adjacent stations, or values greater than 25 inch/day), then interpolated using natural neighbor method over the model domain and converted to dfs2 format for the same cell size as the NEXRAD data.

A fully distributed, temporally varying 15-minute gage-based datasets were used in the SMD FPLOS model for the calibration and validation simulations. Previous investigations have demonstrated that NEXRAD underestimates rainfall peaks and volumes (ref 14). NEXRAD measures precipitation in the atmosphere, which is fundamentally different from rain gage sampling and numerous factors cause differences between the two methodologies, and therefore difference between the two datasets. Investigation by Skinner et al. (ref. 14) reported that the average difference in South Florida between NEXRAD and gage data is close to 7% and the NEXRAD can vary up to +/- 40% in comparison to station data. Additionally, it was reported that for precipitation values less than 0.10 inches, NEXRAD provides rainfall records less frequently than the gages. For values in the range of 0.10 - 1.0 inches, NEXRAD provides rainfall records more frequently than gage records, and for the range of 1.0 - 5.0 inches, NEXRAD provides rainfall records less frequently. Radar to gage (R/G) ratios of 0.95 were reported for stations within South Florida. Skinner et al. (ref. 14) recommended that the ratio of NEXRAD to Observed Gages can be represented as $NEXRAD = 0.9\ Observed^{0:9}$ based on analysis of rainfall records within South Florida.Skinner et al. (ref. 14) discussions and comparisons were made with daily data. For South Miami-Dade FPLOS project, comparisons were made between NEXRAD and gage datasets at 15-minute time intervals. These comparisons were done for 18 stations in the model domain, and performance statistics were generated for 18 stations for the following time periods shown in Table 13.

Table 13. Time Periods of comparison of NEXRAD and Gage data in model domain

No.	Time Period	Year	Remarks
1	09/01/2000 00:00 - 10/31/2000 23:45	2000	Not available for NEXRAD
2	08/01/2005 00:00 - 09/30/2005 23:45	2005	
3	06/01/2008 00:00 - 07/31/2008 23:45	2008	
4	10/01/2011 00:00 - 11/30/2011 23:45	2011	
5	08/01/2012 00:00 - 09/30/2012 23:45	2012	
6	11/01/2015 00:00 - 12/31/2015 23:45	2015	
7	08/15/2017 00:00 - 10/15/2017 23:45	2017	

For each 2-month time period, statistics used for comparison were:

- Mean
- Sum
- Max
- Standard Deviation
- % Average Difference
- *RMSE* (Root Mean Square Error). Root mean square of the observed minus computed
- R^2 (Correlation Coefficient)
- *MAE* (Mean Absolute Error). Sum of the absolute difference of observed minus calculated divided by the total number of samples.
- *NS* (Nash-Sutcliffe Efficiency). Compares the residual squared to the measured variance

A summary of selected rain gages compared to NEXRAD data is shown in Table 14. This table shows a comparison of gage and NEXRAD datasets for the calibration and validation periods for 3 of the 18 stations.

Table 14. Comparison of NEXRAD and gage datasets for calibration and validation storm events

Parameter	2017 S18C-R	2017 S20F-R	2017 S123	2015 S18C-R	2015 S20F-R	2015 S123
Mean Obs (inch)	0.034	0.039	0.038	0.042	0.040	0.044
Sum Obs (inch)	16.650	18.855	18.405	20.705	19.935	22.000
Max Obs (inch)	2.335	5.560	1.840	2.260	2.075	1.995
Std Obs (inch)	0.195	0.294	0.178	0.180	0.153	0.169
Mean NEXRAD (inch)	0.032	0.039	0.034	0.039	0.043	0.042
Sum NEXRAD (inch)	15.860	18.830	16.690	19.240	21.540	20.590
Max NEXRAD (inch)	2.110	4.380	1.830	2.580	2.050	1.810
Std NEXRAD (inch)	0.191	0.267	0.168	0.176	0.176	0.161
% Average Diff (inch)	5.900	0.000	10.500	7.100	7.000	4.500
Pairwise Comparison of Gage and NEXRAD timeseries						
RMSE	0.113	0.249	0.138	0.038	0.053	0.041
R2	0.684	0.369	0.464	0.957	0.917	0.942
MAE (inch)	0.023	0.036	0.028	0.009	0.013	0.012
NS	0.646	0.127	0.323	0.954	0.908	0.935

The analysis at 15-minute time steps shows the same trends as published literature, like Skinner et al. (ref. 14); for the events chosen for calibration and validation, the NEXRAD and gage data are very close; in general, NEXRAD underestimates the peaks (except for Hurricane Wilma in 2005). For the selected calibration and validation periods, NEXRAD underestimates the peaks. Therefore, the rainfall input used for the calibration and validation simulations is the observed gage data, gridded using the NEXRAD grid cell size.

The recommendation for design events is to use the point precipitation estimates obtained from NOAA Atlas 14, Volume 9, Version 2. The spatial distribution of rainfall used in the calibration model dataset, and temporal SFWMD distribution which can be found in Section 4 of this report.

3.6 Evapotranspiration

PET is the maximum possible evapotranspiration rate that can occur from a continuously saturated surface under ambient meteorological conditions. The reference evapotranspiration (RET) is the rate of evapotranspiration from a reference vegetation type (i.e., wet marsh) surface, computed without any shortage of water.

SMD FPLOS model uses potential evapotranspiration as the input dataset. The MIKE SHE's ET model is based on empirically derived equations developed by Kristensen and Jensen (ref 32 and 41). The model calculates the daily actual evapotranspiration based on the potential evapotranspiration. PET is multiplied by an appropriate crop coefficient (Kc), developed to a standardized estimation of crop water use and representing variations in stomatal control by the plants and the aerodynamic resistance.

The DHI ET model reduces the PET according to vegetation density, water content in the root zone, and the rainfall distribution. DHI's ET model yields information on soil water content and runoff from the root zone. The empirical equations in the model were based on actual measurements and were verified by comparing measured and calculated evapotranspiration from barley, fodder sugar beets, and grass over a four-year period with error between measured and calculated values within 10 %.

Continuous and high spatial resolution of ET data are not attainable from ground-based observation networks; therefore, available remote sensing methodologies were investigated. Two sources of data were available: USGS evapotranspiration spatial data based on remote sensing and SFWMD measured ET station data.

The primary factor driving ET is the solar radiation, along with vegetation and availability of soil moisture, a remote sensing radiation-based methodology has been utilized by Mecikalski et al. (ref 28) using data from the Geostationary Operational Environmental Satellites (GOES). Potential and reference evapotranspiration were computed based on albedo, solar radiation, and meteorological data obtained from weather stations. For the USGS dataset, albedo at grid points were determined from the Moderate Resolution Imaging Spectrometer (MODIS) satellite, solar radiation data were obtained from Geostationary Operational Environmental Satellites (GOES), meteorological data was interpolated to grid points using a radial basis function. High-Resolution GOES Insolation–Evapotranspiration Data Set has been developed by USGS using satellite-based (data received at resolution of 0.5 to 1-km) estimates of insolation (incoming solar radiation).

Reference evapotranspiration (RET) and potential evapotranspiration (PET) are computed for the State of Florida at 2-km resolution for the period from June 1, 1995, to December 31, 2017. Figure 13 shows the coverage of this dataset. PET estimates are based on the Priestley-Taylor equation (Priestley and Taylor in ref 30) that estimates evaporation from a wet surface under conditions of minimum advection. The RET estimates are based on Penman-Monteith, following Allen et al. (ref 3).

Figure 13. Map of the USGS measured ET datapoints in SMD FPLOS model domain

The Remote sensing data have been calibrated by comparing 57 ground pyranometer stations (based on methodology of Otkin et al. 2005, (ref 58). To bias-correct and adjust the data for parameters that the model does not account for, satellite driven calibration of insolation estimates to ground based pyranometer measurements and clear sky radiation models was performed. Additional validation is performed to ensure that the model performs well under varying atmospheric conditions: clear v. cloudy sky; dry versus moist atmosphere. The overall estimate of the accuracy RMSE (Root Mean Square Error) was reportedly 9 %, additional details can be found in R. Mecikalski et al (ref 28).

Data sets with measured ET are provided in Table 15, which shows the ET station data in and around the SMD FPLOS model domain and the periods of availability. S331W is the only station with data in South Miami-Dade FPLOS calibration and validation period, and within the model domain.

Table 15. ET Station Data Availability in and around SMD FPLOS model domain

Dbkey	Station	Data Type	Freq	Stat	Recorder	Agency	Start Date	End Date	X Coord	Y Coord	Basin
OH515	3AS3WX	EVAPOTRANS POTENTIAL, MM millimetres	DA	SUM	PREF	WMD	4/5/2000	4/30/2020	733034	551868.6	CA3A
US348	3AS3WX	EVAPOTR POTN COMPUTED, IN inches	BK	INST	CR10	WMD	3/5/2007	5/23/2020	733034	551868.6	CA3A
US347	3AS3WX	EVAPOTR POTN COMPUTED, IN inches	DA	SUM	CR10	WMD	3/5/2007	5/22/2020	733034	551868.6	CA3A
07190	HIALEAH_E	EVAP PAN, MEASURED, IN	MO	SUM	APAN	NOAA	1/1/1941	12/31/1947	891064	543668.2	C6
06368	HIALEAH_E	EVAP PAN, MEASURED, IN	DA	SUM	APAN	NOAA	7/1/1948	11/30/1998	891064	543668.2	C6
06358	HOMES.ES_E	EVAP PAN, MEASURED, IN	DA	SUM	APAN	NOAA	2/2/1956	9/30/1987	821143	427448.8	C103W
OH513	JBTS	EVAPOTR POTN COMPUTED, IN inches	DA	SUM	PREF	WMD	5/23/1991	2/29/2016	808213	324129.7	C111_CO
UT752	JBTS	EVAPOTR POTN COMPUTED, IN inches	DA	SUM	CR10	WMD	12/8/2006	2/29/2016	808213	324129.7	C111_CO
63715	NP-FMB	EVAP PAN, MEASURED, IN	DA	MEAN	????	ENP	1/1/2000	12/5/2011	714010	518774.8	ENP
OH514	S331W	EVAPOTRANS POTENTIAL, MM millimetres	DA	SUM	PREF	WMD	7/21/1994	4/30/2020	817765	464392.9	C1 WEST
TA787	S331W	EVAPOTR POTN COMPUTED, IN inches	DA	SUM	CR10	WMD	8/4/2005	5/22/2020	817765	464392.9	C1 WEST
06333	SHRIMP F_E	EVAP PAN, MEASURED, IN	MO	SUM	APAN	WMD	1/1/1977	5/31/1977	857115	414777.1	C103E
01099	SITE4_E	EVAP PAN, MEASURED, IN	DA	SUM	????	USGS	5/1/1977	6/16/1978	880292	488386	C2
01100	SITE4_E	EVAP PAN, MEASURED, IN	DA	SUM	????	USGS	10/1/1977	6/16/1978	880292	488386	C2
06367	TAMITR40_E	EVAP PAN, MEASURED, IN	DA	SUM	APAN	NOAA	3/1/1941	11/30/1998	713832	518639	ENP

Note: Highlighted in yellow if within MDFPLOS calibration and validation time period; green if within model domain

The average seasonal PET values reported by SFWMD and USGS data for the three spatial locations are shown in Table 16.

Table 16. Average Monthly PET values from SFWMD and USGS datasets

MONTH	3AS3WX	JBTS	S331W	USGS PET	USGS REF (RET)
JAN	2.82	2.93	2.85	2.13	2.75
FEB	3.43	3.64	3.57	2.93	3.31
MAR	4.15	4.37	4.34	4.1	4.25
APR	4.72	4.94	4.9	5.09	5
MAY	4.69	4.91	4.96	5.54	5.2
JUN	4.1	4.23	4.52	5.22	4.67
JUL	4.08	4.46	4.53	5.45	4.82
AUG	3.98	4.19	4.26	5.15	4.61
SEP	3.58	3.68	3.58	4.42	4.07
OCT	3.35	3.46	3.5	3.63	3.76
NOV	3.07	3.06	3.11	2.59	3.12
DEC	2.63	2.76	2.73	1.98	2.56
AVE	**3.72**	**3.89**	**3.9**	**4.02**	**4.01**

Overall, the USGS daily average values over the entire period (1999-2017) are larger than the reported SFWMD PET data. USGS PIXEL 26010 in proximity to station JBTS has average of 3.98 mm/day which is comparable to observed at station JBTS, 3.89 mm/day. USGS PIXEL 42588 in proximity of 3AS3WX shows average of 3.98 mm/day, which is 7% larger than the average of 3AS3WX of 3.72 mm/day. USGS PIXEL 36440 in proximity to S331W shows average of 3.94 mm/day, which is comparable to the observed average of 3.90 mm/day observed at station S331W.

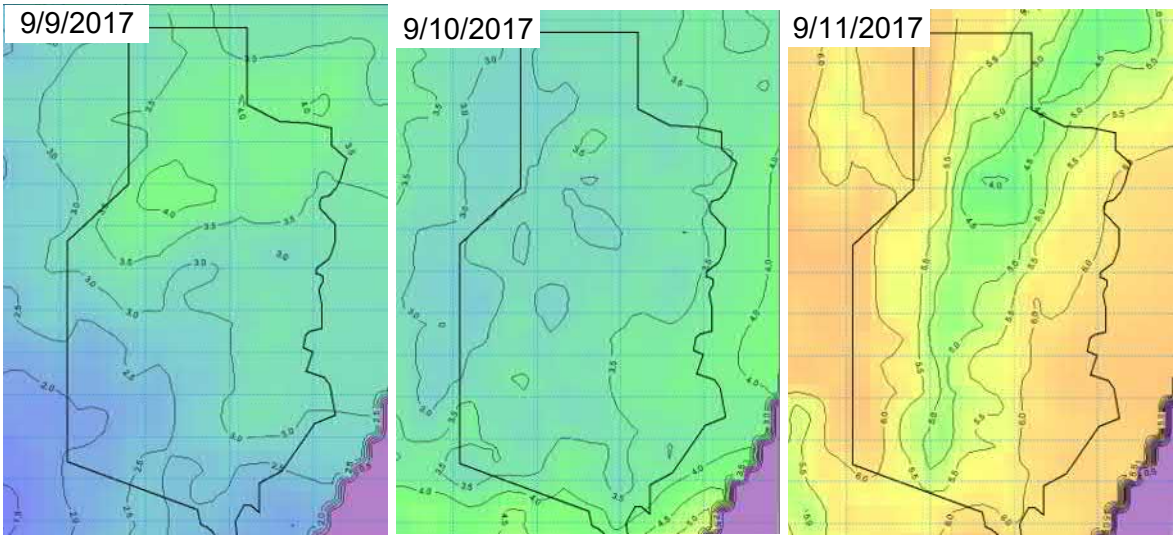


Figure 14 Spatial variability of PET during storm Irma (USGS dataset)

Considering that continuous and spatially distributed PET data are not readily available at the SFWMD DBHYDRO site, the choice was to develop the interpolation based on the USGS dataset. The USGS data are distributed over a 2,000-meter grid. The data for all four project domain

watersheds included 1,251 PIXELS (with a name specified as a 4 to 5-digit number labeled as PIXEL) each with 6,940 time series data values.

The USGS PET data were selected over the observed SFWMD data because ground ET data published by SFWMD is very limited, and only a few stations were available with accessible data for the period of 1999-2018. For design storm event simulations in future phases of this project, this dataset will be used with an adjustment if needed, to correspond with the antecedent conditions.

3.7 Land Use

The land use component of MIKE SHE/ MIKE 1D defines parameters associated with land use classifications that affect hydraulic and hydrologic processes. Florida Land Use and Cover Classification (FLUCCS) was obtained from SFWMD and is shown in Table 17 and Figure 15. Level 2 of the FLUCCS codes were used to derive overland runoff and vegetation parameters. The same set of parameters were used for the calibration and validation events assuming that only minor land use changes occurred between the calibration and validation events.

Table 17. SFWMD Land Use Land Cover Codes

MIKE SHE Code	Model Land Use Type	SFWMD LULC Code
1	Citrus	2210, 2230, 2240, 2410
2	Pasture	2110, 2120, 2610, 8320, 2510, 8200
5	Truck Crops	2140, 2150, 2160
6	Golf Course	1820, 2420
7	Bare Ground	1620, 1630, 7400, 7430, 8350
8	Mesic, Xeric, Hydric Flatwood	3100, 3200, 3220, 3300, 4110, 4410, 6250
9	Mesic, Xeric Hammock	4200, 4220, 4270, 4300, 4340, 4370
13	Hydric Hammock	4240, 6110, 6111, 6172, 6180
14	Wet Prairie	6430
16	Marsh	6410, 6420
17	Cypress	6210, 6215, 6216
18	Swamp Forest	6170, 6191, 6300
19	Mangrove	6120
20	Water	1660, 5110, 5120, 5300, 5410, 5420, 5430, 5710, 6500, 6510, 8340, 8360
22	Sawgrass	6411
23	Emergent Marsh	6440
41	Urban Low Density	1110, 1180, 1190, 1480, 1830, 1840, 1850, 1860, 1920, 2410, 2430, 2500, 2540, 8115, 8300, 8310
42	Urban Medium Density	1210, 1220, 1290
43	Urban High Density	1300, 1310, 1320, 1330, 1340, 1350, 1390, 1460, 1500, 1560, 1700, 1710, 1730, 1760, 8100, 8113, 8120, 8140, 8330
44	Commercial	1400, 1411, 1423, 1490

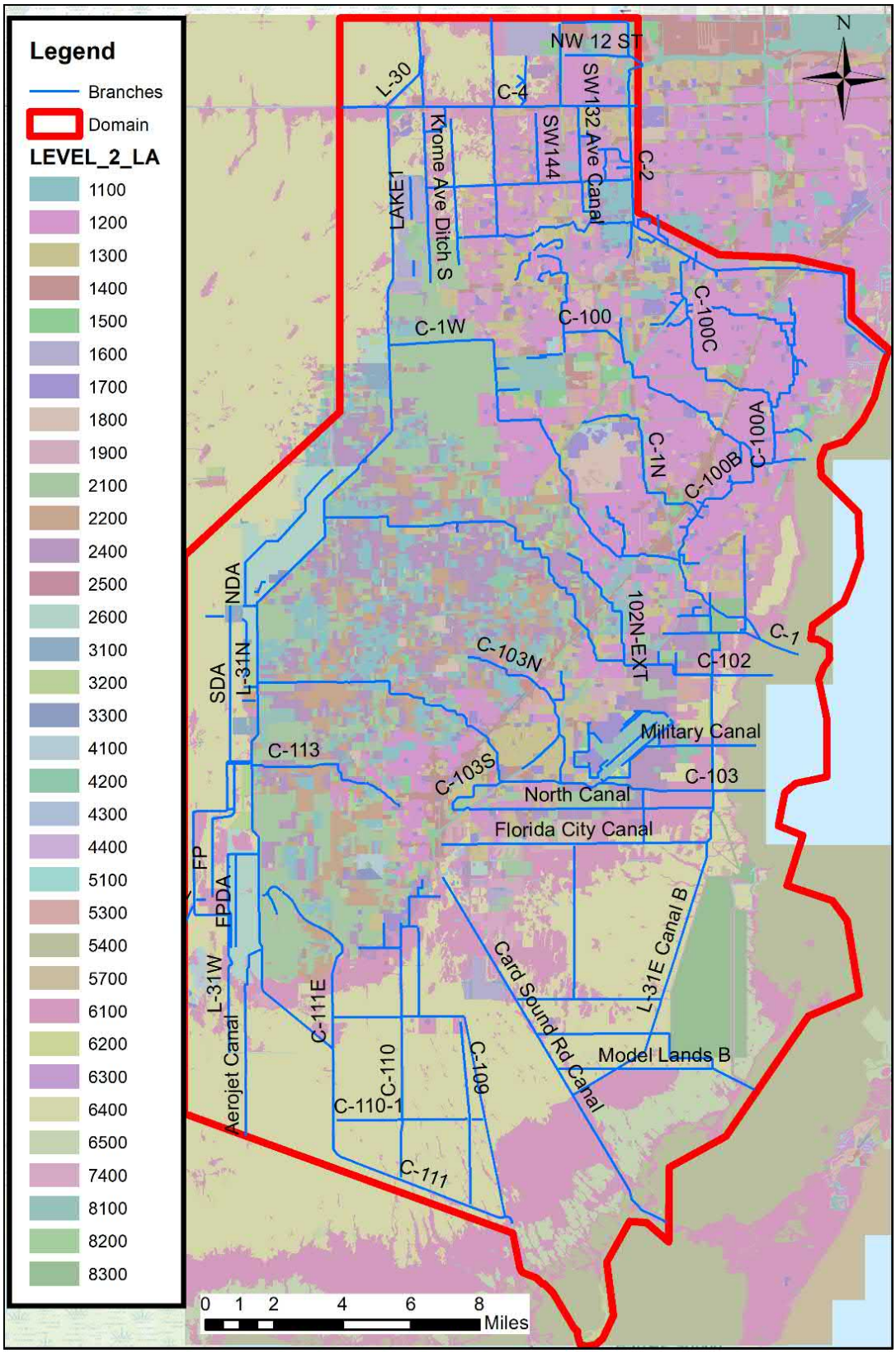


Figure 15. SFWMD Land Use and Land Cover Codes, Level 2

The ET parameters for spatial and temporal datasets are based on land use classifications; the ET parameters include the Leaf Area Index (LAI), the Root Depth (RD), and the crop coefficient (K_c). The LAI is one of the primary variables used by MIKE SHE in calculation of ET fluxes; RD determines the vertical distribution of ET in the soil profile. K_c is used to scale specified PET rates to individual vegetation types and growth stages.

FLUCCS codes were aggregated into 20 categories based on similarity of land-use, as shown Figure 16. Agricultural lands are included in the Citrus, Pasture, and Truck Crops categories. Urban landscapes are included in the Urban Low Density, Urban Medium Density, Urban High Density, and Commercial categories. The MIKE SHE land use codes for each category are shown on the map in Figure 16. The total area of each South Miami-Dade FPLOS land use classification is summarized in Table 18. Aside from water, the largest coverage is Medium Density Urban areas covering 13.1% of the total model domain, followed by Sawgrass (12.2%) and Marsh (8.6%). Monthly values of land use based LAI, RD, and K_c parameter values are provided in Table 19, Table 20 and Table 21 respectively. The parameters were based on the KBMOS model (40).

Table 18. Land Use, MIKE SHE Code, Description and Area in SMD FPLOS Model Domain

MIKE SHE Code	MIKE SHE Description	Cell Count	Area (ac)	% of Total Area
1	Citrus	10305	25,464	7.3
2	Pasture	1987	4,910	1.4
5	Truck Crops	11388	28,140	8.1
6	Golf Course	525	1,297	0.4
7	Bare Ground	1436	3,548	1
8	Mesic, Xeric, Hydric (M.X.H.) Flatwood	7013	17,330	5
9	Mesic, Xeric Hammock	1180	2,916	0.8
13	Hydric Hammock	6911	17,077	4.9
14	Wet Prairie	3564	8,807	2.5
16	Marsh	12092	29,880	8.6
17	Cypress	43	106	0.03
18	Swamp Forest	2774	6,855	2
19	Mangrove	5663	13,994	4
20	Water	18638	46,056	13.2
22	Sawgrass	17159	42,401	12.2
23	Emergent Marsh	7	17	0.005
41	Urban Low Density	10581	26,146	7.5
42	Urban Medium Density	18421	45,519	13.1
43	Urban High Density	8723	21,555	6.2
44	Commercial	2559	6,323	1.8
	Total	**140969**	**348341**	**100%**

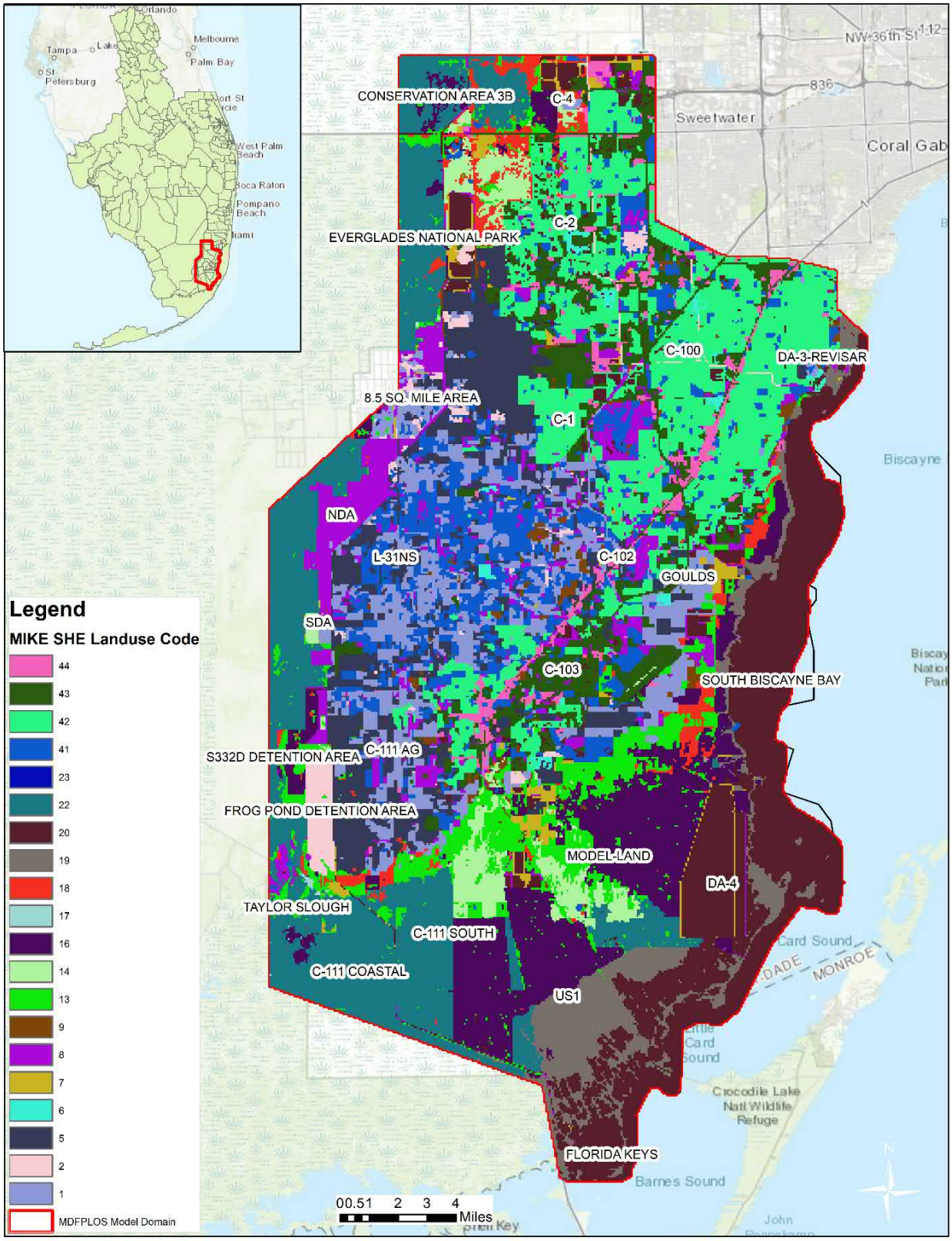


Figure 16. MIKE SHE Land Use Codes

Table 19. Leaf Area Index (LAI) Values for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	3.38	3.75	4.12	4.5	4.5	4.5	4.5	4.5	4.5	3.75	3.38	3.38
2	Pasture	3.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	3.5
5	Truck Crops	3.75	4.5	3	3.75	4.5	3	3	3	3	3	3	3
6	Golf Course	2	2.5	3	3	3	3	3	3	3	3	3	2
7	Bare Ground	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
8	Mesic, Xeric, Hydric Flatwood	1.5	2.25	3	3	3	3	3	3	3	2.5	1.5	1.5
9	Mesic, Xeric Hammock	2.5	3.25	4	4	4	4	4	4	4	4	3.25	2.5
13	Hydric Hammock	2.5	3.25	4	4	4	4	4	4	4	4	3.25	2.5
14	Wet Prairie	1.5	2.25	3	3	3	3	3	3	3	3	2.25	1.5
16	Marsh	2	3	4	4	4	4	4	4	4	2	2	2
17	Cypress	2	4	4	4	4	4	4	4	4	2	2	2
18	Swamp Forest	4.5	3.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4.5	3.5
19	Mangrove	3	3	3	3	3.5	4	4	4	3.5	3.5	3	3
20	Water	0	0	0	0	0	0	0	0	0	0	0	0
22	Sawgrass	3	3.5	4	4	4	4	4	4	4	4	3.5	3
23	Emergent Marsh	3	3.5	4	4	4	4	4	4	4	4	3.5	3
41	Urban Low Density	0.9	1.25	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.9
42	Urban Medium Density	0.8	1.13	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.8
43	Urban High Density	0.7	0.98	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.98	0.7

Table 20. Root Depths (RD), in inches, for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2
2	Pasture	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
5	Truck Crops*	17.7	29.5	6.0	17.7	29.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
6	Golf Course	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
7	Bare Ground	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
8	Mesic, Xeric, Hydric Flatwood	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
9	Mesic, Xeric Hammock	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
13	Hydric Hammock	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
14	Wet Prairie	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
16	Marsh	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
17	Cypress	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
18	Swamp Forest	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
19	Mangrove	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8
20	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Sawgrass	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
23	Emergent Marsh	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
41	Urban Low Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
42	Urban Medium Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
43	Urban High Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9

* Truck crops are the only vegetation type that show a seasonal variation in root depth

Table 21. Crop Coefficients (Kc) for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	0.686	0.686	0.735	0.823	0.907	0.990	1.029	1.029	1.029	1.029	0.907	0.735
2	Pasture	0.670	0.724	0.859	0.975	0.999	1.013	1.013	0.980	0.919	0.876	0.754	0.646
5	Truck Crops	0.711	0.862	1.029	1.063	0.960	0.877	0.916	0.965	0.970	0.960	0.907	0.764
6	Golf Course	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
7	Bare Ground	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
8	Mesic, Xeric, Hydric Flatwood	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
9	Mesic, Xeric Hammock	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
13	Hydric Hammock	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
14	Wet Prairie	0.782	0.784	0.816	0.855	0.872	0.872	0.892	0.897	0.875	0.835	0.789	0.782
16	Marsh	0.773	0.775	0.797	0.804	0.809	0.811	0.821	0.826	0.805	0.777	0.767	0.777
17	Cypress	0.817	0.826	0.843	0.919	1.000	1.012	1.032	1.044	0.925	0.802	0.786	0.800
18	Swamp Forest	0.701	0.706	0.735	0.764	0.818	0.887	0.941	0.960	0.946	0.892	0.794	0.725
19	Mangrove	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	Water	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
22	Sawgrass	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
23	Emergent Marsh	0.800	0.600	0.600	0.600	0.800	1.000	1.000	1.000	1.000	1.000	1.000	1.000
41	Urban Low Density	0.544	0.533	0.554	0.568	0.578	0.612	0.686	0.724	0.714	0.664	0.595	0.570
42	Urban Medium Density	0.467	0.456	0.471	0.483	0.493	0.516	0.561	0.591	0.593	0.558	0.507	0.488
43	Urban High Density	0.389	0.379	0.389	0.398	0.409	0.420	0.436	0.458	0.472	0.453	0.420	0.406

3.8 Rivers and Lakes (Hydraulic Network – OC)

MIKE 1D is a dynamic, 1-Dimensional modelling package for modelling river channel networks, lakes and reservoirs. The MIKE software uses a hydrodynamic engine and provides a broad selection of hydraulic structures, allowing definition of complex control strategies.

3.8.1 Stormwater Network, Infrastructure and Management

MIKE 1D OC module in SMD FPLOS model represents channels (canals, streams, ditches, etc.), bridges, culverts, pipes, weirs, orifices, pumps, gated structures, and groundwater coupling. The channels are typically represented as 1D hydrodynamic features, which are also coupled with the 2D features (overland flow, subsurface flow) to allow exchange between all model subdomains, i.e., Saturated Zone (SZ), Overland Flow (OL), Open Channel Flow (OC), and Flow in Unsaturated Zone (UZ).

3.8.2 Channels

The major canals and corresponding tributaries modeled are shown in Section 3.89 on Figure 22. Each canal reach is represented in the hydraulic model by cross section data from Miami-Dade Regulatory and Economic Resources Department (RER) Water Management Division surveys completed in 2005-2015. The limits of the reach are generally located at canal intersections, culverts, bridges, or where the geometry of the canal varies significantly. Canal reach lengths were measured from the shape files. Natural channel shapes are defined by cross sections which are station/elevation pairs measured normal to the direction of flow. Stationing is from left to right as the observer is looking downstream. Natural channels or canals were segmented so the cross section for the segment is representative of the entire segment. The flow area between the banks uses the main channel Manning's roughness value. The areas outside of the banks use a left bank and right bank Manning's roughness value for these overbank floodplain areas. Generally, the embankment roughness values are higher than the main channel, as embankments typically have vegetation, either maintained or natural. In some cases, such as when the floodplain includes a paved area, the Manning's roughness value on the embankment is lower than the channel value. Lakes and water bodies are implemented as MIKE 1D channels.

Canal dimensions, such as the length and cross-sectional width and depth are used in MIKE 1D, to define the canal geometry. This information was based on the Miami-Dade County Stormwater Atlas, and the SFWMD AHED database. In addition, channel roughness (Manning's M) is defined in the model via global values or at individual cross-sections. This coefficient was used as a calibration parameter for the model. Various sources were used to evaluate the range of appropriate roughness values, that have been used for canals within the SMD FPLOS model domain, from other published modeling efforts.

3.8.3 Canal Cross Sections

Elevation data of the channel cross sections are entered as an array of x-coordinate positions in feet and elevations at each coordinate entry in feet. Cross section data sources are shown in Figure 17; cross-sections from Miami-Dade As-Built info and DEM are shown in light blue, cross sections provided from Miami-Dade County are shown in yellow, and cross sections from SFWMD are shown in pink.

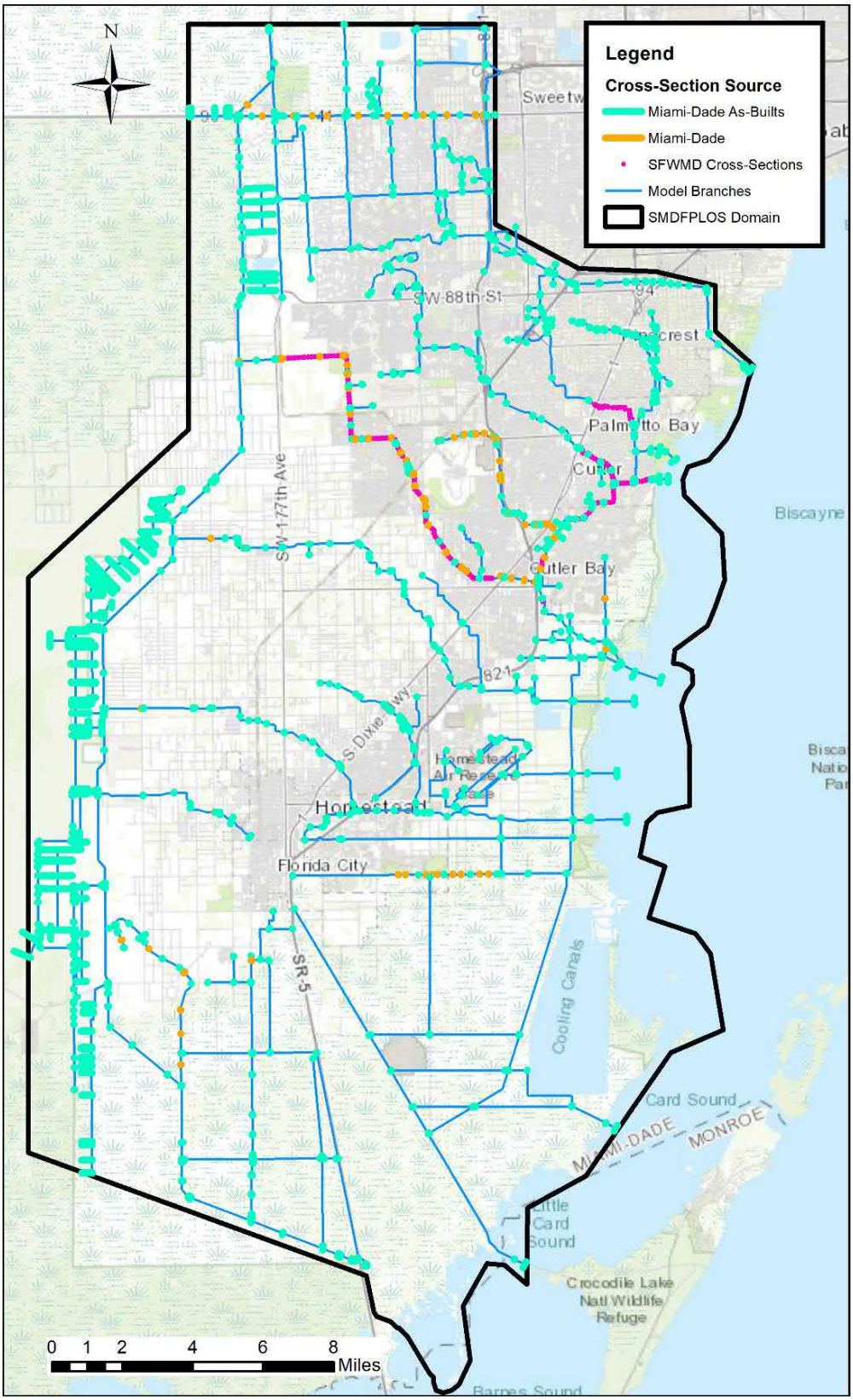


Figure 17. MIKE 1D Cross Section data sources

The cross-sections require user-specified markers to establish the edges of the canal to be used in computations and the low flow and high flow regions within the channel. Left and right low flow bank markers establish the x-coordinate positions which are assigned as the edge of the bank, or toe-of-slope for the bank. Figure 18 shows a sample cross-section from the MIKE 1D model, where the black line indicates the cross-section dimensions, the red vertical lines indicate the edges of the separate flow zones, and the horizontal blue lines indicate the variable Manning's M values applied to the flow zones.

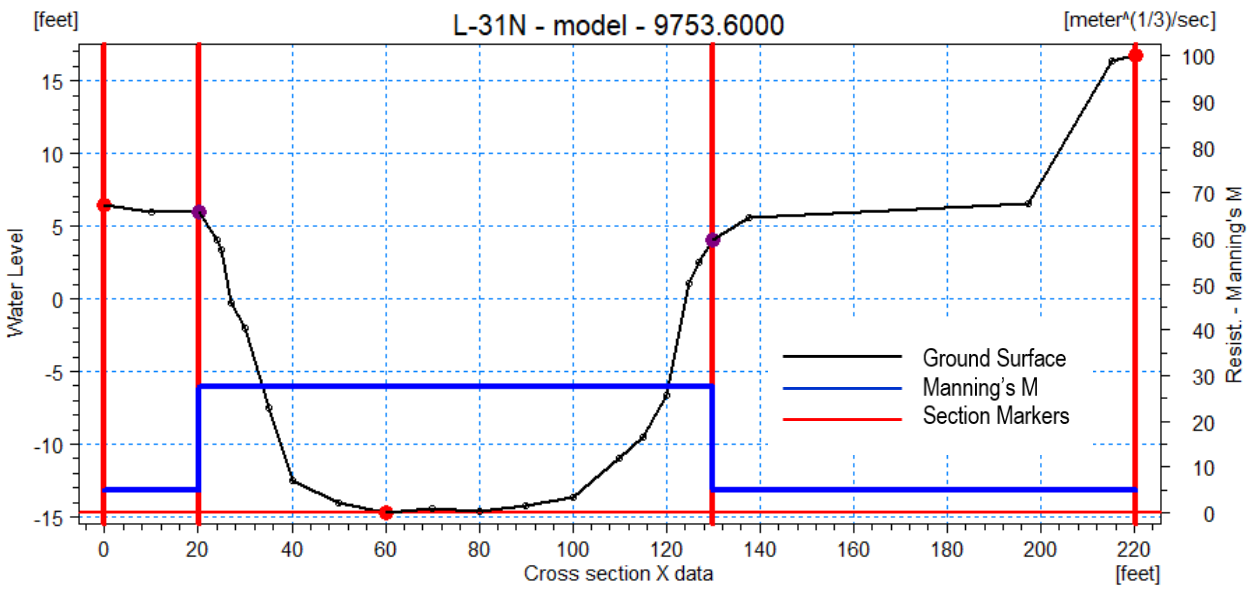


Figure 18. Sample Model Cross-Section with Markers

During calibration the Manning's M values were used as shown in Table 22 below. Manning's M values between 30 and 33 are considered typical for most unlined dredged canals. Higher M values are smoother, typically lined canals, and lower M values are for more natural channels or canals with vegetation growth, debris, and/or siltation.

Table 22. List of Manning's M values (and correlated Manning's n values) used in the Model for MIKE 1D channels and banks

Manning's M	Manning's n
1	1.000
2	0.500
5	0.200
10	0.100
20	0.050
22	0.045
25	0.040
30	0.033
40	0.025
50	0.020
100	0.010

The low and high flow zones can then be assigned distinct Manning's roughness coefficients for the area on each embankment and within the channel. Maps of the final calibrated cross-section roughness values (Manning's) for the low flow, or main channel, and the embankments are shown in Figure 19.

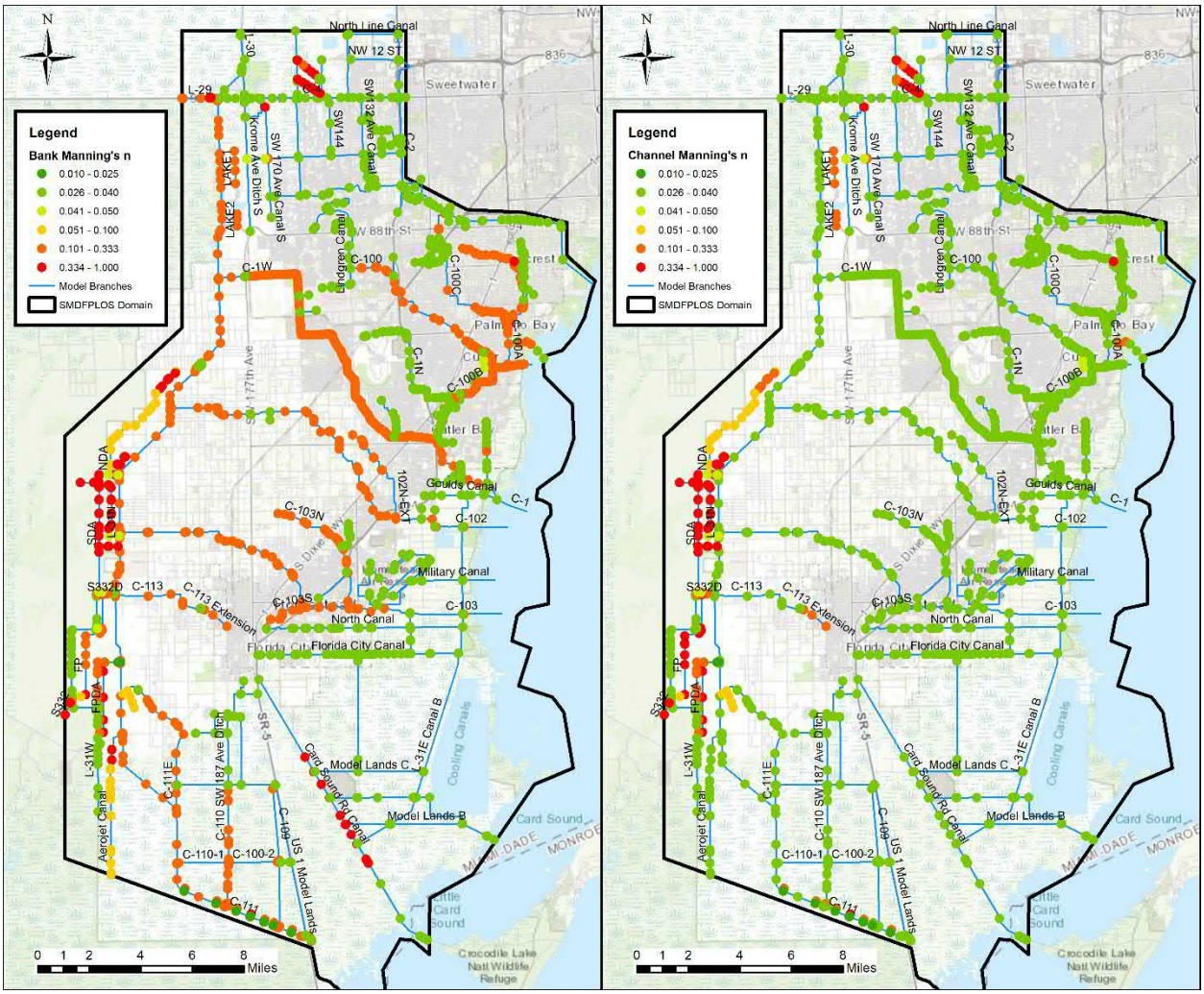


Figure 19. Cross-Section Manning's n Values for the Banks (left) and Channel (right)

3.8.4 Coupling

The coupling between MIKE 1D and MIKE SHE is made via river links, which are located on the edges that separate adjacent grid cells. The entire river system was included in the MIKE 1D model; but MIKE SHE will only exchange water at specified coupling reaches. Figure 21 shows linkage of MIKE 1D and MIKE SHE. The exchange type is either full or reduced; if the exchange is full, the aquifer hydraulic conductivity governs the exchanges. With the reduced option, the conductivity of the riverbed material governs exchanges. These options were evaluated during the calibration phase. The initial construction of SMD FPLOS model was full exchange, with aquifer hydraulic conductivity governing the exchange. In this option, weir equations govern the MIKE SHE to MIKE 1D exchange.

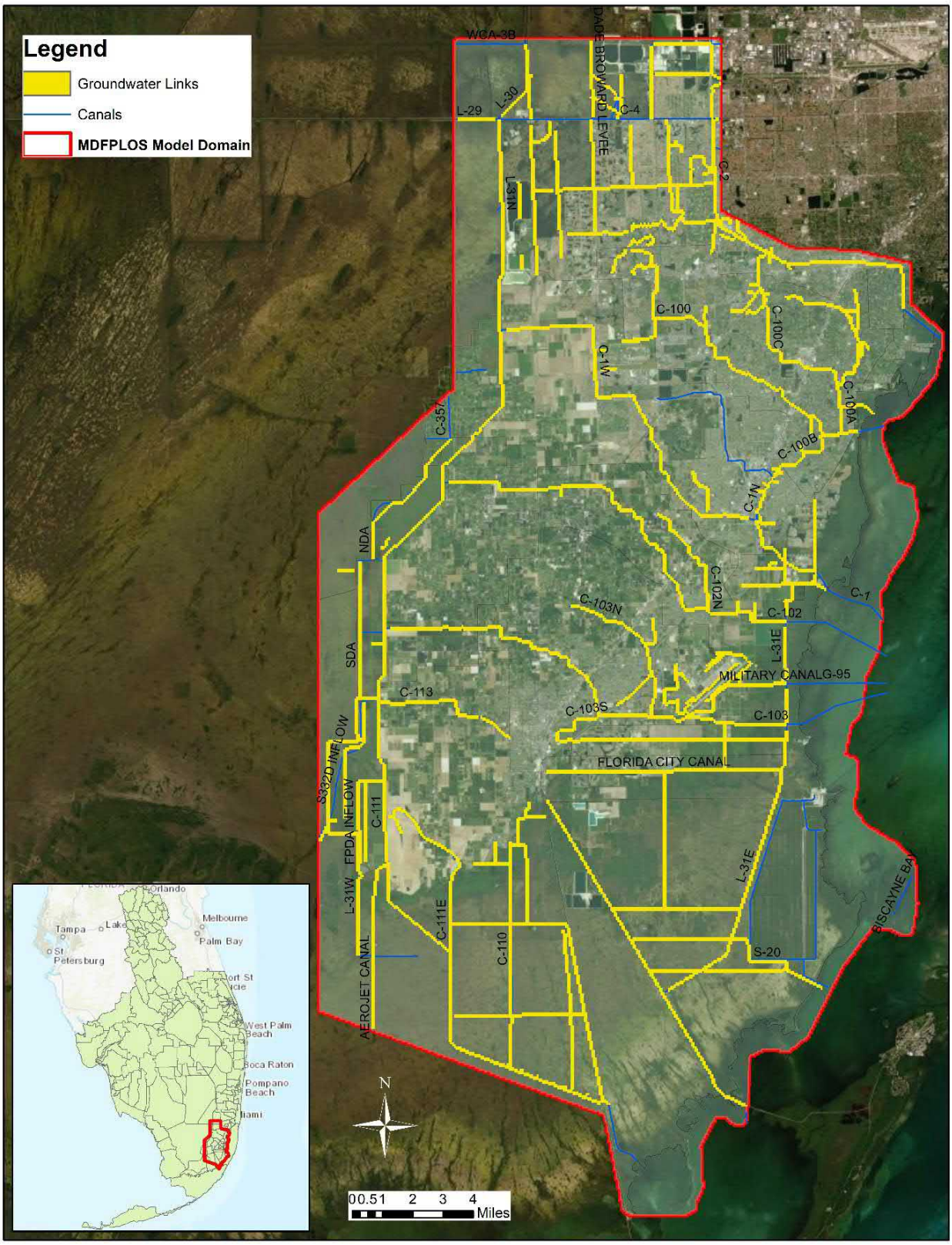


Figure 20. MIKE 1D to Groundwater Coupling Links in SMD FPLOS model

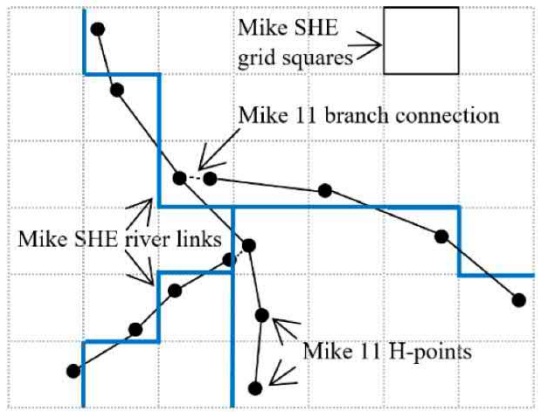


Figure 21. Coupling between MIKE SHE and MIKE 11

In the SMD FPLOS model, there are a total of 7,356 river links defined. A map of the groundwater links, as defined by the M1D network, is shown in Figure 20. The MIKE 1D to groundwater links are shown in yellow, while the branches that do not have coupling are shown in blue.

3.8.5 Bridges

In general, the bridges were modeled as a short section of channel with no structure, if the lower chord of the bridge deck is above the likely peak flood level in the canal. Thus, the flow under the bridge cannot become pressurized. However, if the bridge deck is low enough to impede flow, the "User Defined" option is used, and the bridge is defined as a culvert, where a table of cross-sectional area, wetted perimeter, and surface width per increment of depth is applied to the link. At the elevation of the lower chord of the bridge deck, the wetted perimeter significantly increases, and the surface width drops to zero.

3.8.6 Culverts

The comprehensive culvert inventory available from RER Water Management Division was used to enter the culvert data into the model. Culvert inventory included length, material, diameter, invert elevations and headwall information for all culverts within the watershed. Most culverts were assigned an entrance loss of 0.5, though depending on the headwall, entrance loss may range from 0.5 to 1.0 (ref **49**). For culverts exiting to moving water (i.e. a canal reach) an exit loss of 0.5 was provided to the link. For culverts exiting to still water, an exit loss of 1.0 was provided to the link. In SMD FPLOS model, there are 28 weirs and 138 culverts. Culverts were represented as structures, or as changes in cross-sections.

3.8.7 Weirs

Weirs specified in the model typically represent fixed overflow weirs associated with structures but sometimes were used to represent the crown of a roadway when modeling a culvert under a road that may experience overtopping. A list of weirs used in the model is provided in Table 23.

Table 23. Weirs in South Miami-Dade FPLOS MIKE 1D and their chainages and dimensions

River	Chain. (ft)	ID	Type	Valve
NDA	6250	W-S360E	Broad Crested Weir	None
NDA	6250	W-S360W	Broad Crested Weir	None
S332BN-OVERFLOW	10	W-S332BN-E	Broad Crested Weir	None
SDAC	65.6168	W-S332B-PC	Broad Crested Weir	None
SDAC	9383.202	W-S332C-PC	Broad Crested Weir	None
FP	10	W-S332D-HHCtoC1	Broad Crested Weir	None
FP	7260	W-S332D-C1toC2	Broad Crested Weir	None
FP	12700	W-S332D-C2toC3	Broad Crested Weir	None
FPDA-C1	50	W-S202-A	Broad Crested Weir	None
FPDA-C2	50	W-S202-B	Broad Crested Weir	None
FPDA-C3	50	W-S202-C	Broad Crested Weir	None
Aerojet Canal	6525	W-AJ-CONC	Broad Crested Weir	None
SDA	2570	W-S332B-LEVEE-S	Broad Crested Weir	No Flow
SDA	10641.58	W-S332C-LEVEE-N	Broad Crested Weir	No Flow
SDA	15875	W-S332C-LEVEE-S	Broad Crested Weir	No Flow
S332C-OVERFLOW	50	W-S332C-E	Broad Crested Weir	None
NDA	22450	W-S332BN-LEVEE-N	Broad Crested Weir	No Flow
S332BW-OVERFLOW	65.6168	W-S332BW-W	Broad Crested Weir	None
C-110	17250.93	C110-W-17250	Broad Crested Weir	None
C-110	4450	C110-W-4450	Broad Crested Weir	None
C-110	21521.76	C110-W-21500	Broad Crested Weir	None
C-110	25825.04	C110-W-25825	Broad Crested Weir	None
C-110	30054.83	C110-W-30054	Broad Crested Weir	None
C-110	34303.01	C110-W-34303	Broad Crested Weir	None
C-110	35100	C110-W-35100	Broad Crested Weir	None
S332BN-OVERFLOW	2750	S332BN-OL-W	Broad Crested Weir	None
S332BW-OVERFLOW	2830	S332BW-OL-W	Broad Crested Weir	None
S332C-OVERFLOW	2040	S332C-OL-W	Broad Crested Weir	None

3.8.8 Structures

The discharge, under and overflow gates, and sluice gate structures used in the model are listed in Table 24, Table 25, and Table 26, respectively. This list includes pumps modeled as discharge structures with specified flows for historical events, downloaded from DBHYDRO as breakpoint data. Underflow, overflow, and sluice gates are modeled with recorded gate operations. For design events, these structures will be modeled using wet season operation rules specified in the structure book.

In MIKE 1D, the sluice formula uses parameters for the four flow regimes: controlled submerged, uncontrolled submerged, controlled free, and uncontrolled free flow (ref 49). These parameters have been established by the SFWMD for each individual structure using flow rate studies. The

model uses up-to-date parameters from recent flow rate studies provided by the SFWMD (ref. 9, 71, 8, 62, 10, 22, 69) and the SFWMD's Atlas of Flow Equations (ref. 69). Structures without flow rate studies were assigned generalized spillway parameters from the 2009 Ansar and Chen study (ref. 5).

Table 24. SMD FPLOS MIKE 1D structures modeled as discharge (using DBHYDRO data of discharge rate versus time) and their chainages and dimensions

Network Branch	Chainage	Structure	MIKE 1D definition
G-420	140	G-420-P	Discharge
C-4 Impoundment Ditch S	190	G-420S-P	Discharge
G-422	130	G-422-P	Discharge
G-423	120	G-423-G	Discharge
G119-G1	10	G119-G1	Discharge[A]
G119-G2	10	G119-G2	Discharge[A]
Aerojet Canal	125	S199-P	Discharge
FPDA-INLET	40	S200-P	Discharge
L-31N	56500	S331P	Discharge
S332BN	60	S332BN	Discharge
S332BW	65	S332BS	Discharge
S332C	65	S332C	Discharge
S332D	40	S332D	Discharge
S356	180	S356	Discharge
Bigman Canal	2070	S700-P	Discharge
L-31N-S331s	250	S331S	Discharge
[A] – Data not available for the design events after year 2014			

Table 25. Underflow and Overflow structures in SMD FPLOS MIKE 1D, their chainages and dimensions

Network Branch	Chainage	Structure	Type	No. of Gates	Gate Width (ft)	Sill Level (ft NAVD88)
C-1N	15050	G114	Overflow	1	39.75	1.95
C-4	6820	G119-OVERTOP	Overflow	1	100	9.55
G211-G1	10	G211-G1	Underflow	1	6	-4.062
G211-G2	10	G211-G2	Underflow	1	6	-4.062
G211-G3	10	G211-G3	Underflow	1	6	-4.062
G211-G4	10	G211-G4	Underflow	1	6	-4.062
G211-G5	10	G211-G5	Underflow	1	6	-4.062
G211-G6	10	G211-G6	Underflow	1	6	-4.062
L-31N	37100	G211-OVERTOP	Overflow	1	100	6
G737	25	G737	Underflow	1	4.5	-2.578

Network Branch	Chainage	Structure	Type	No. of Gates	Gate Width (ft)	Sill Level (ft NAVD88)
C-100A	9455	S120	Underflow	1	6	-4.545
C-100C	4400	S121	Underflow	1	8	-6.055
C-100C	4400	S121-OVERTOP	Overflow	1	100	6
S122-G1	10	S122-G1	Underflow	1	6	-4.532
S122-G2	10	S122-G2	Underflow	1	6	-4.532
C-100B	2920	S122-OVERTOP	Overflow	1	100	9.55
S149-G1	10	S149-G1	Underflow	1	7	-4.532
S149-G2	10	S149-G2	Underflow	1	7	-4.532
C-1N	27500	S149-OVERTOP	Overflow	1	100	9
L-31N-S173	380	S173-G	Underflow	1	6	-4.062
C-111	60660	S18C-G1	Underflow	1	22.8	-8.562
C-111	60660	S18C-G2	Underflow	1	22.8	-8.562
S194-G1	10	S194-G1	Underflow	1	7	-4.549
S194-G2	10	S194-G2	Underflow	1	7	-4.549
C-102	17750	S194-OVERTOP	Overflow	1	100	11
C-102N	10430	S195	Underflow	1	6	-3.326
C-103	16040	S196-G	Underflow	2	7	-4.539
S197-G1	10	S197-G1	Underflow	1	11	-13.565
S197-G2	10	S197-G2	Underflow	1	11	-13.565
S197-G3	10	S197-G3	Underflow	1	11	-13.565
S197-G4	10	S197-G4	Underflow	1	11	-13.565
C-111	95300	S197-OVERTOP	Overflow	1	100	3.5
S336-G1	10	S336-G1	Underflow	1	4.5	-3.358
S336-G2	10	S336-G2	Underflow	1	4.5	-3.35
S336-G3	10	S336-G3	Underflow	1	4.5	-3.358
C-4	300	S336-OVERTOP	Overflow	1	100	8
S338-G1	10	S338-G1	Underflow	1	7	-6.055
S338-G2	10	S338-G2	Underflow	1	7	-6.055
C-1W	5400	S338-OVERTOP	Overflow	1	100	6.5
L-31W	37650	S175	Underflow	3	7	-6.578
S332DX1	80	S332DX1	Underflow	4	5	-1.555
S328	400	S328-TO-UPDATE	Underflow	8	5	-1.555

Table 26. Sluice Gate structures in SMD FPLOS MIKE 1D, their chainages and dimensions

Network Branch	Chainage	ID	No. of Gates	Gate Width (ft)	Sill Level (ft NAVD88)	Parameter Source
C-4 Impoundment Ditch N	120	G-421-S	1	15	4.432	(ref. **5**)
C-100	33710	S118	1	20.8	-6.539	(ref. 9)
C-100C	25600	S119	1	12.8	-3.942	(ref.9)
C-100	48350	S123-G1	1	25	-8.826	(ref. 5)
C-100	48350	S123-G2	1	25	-8.826	(ref. 5)
C-1W	63270	S148-G1	1	20	-8.529	(ref. 8)

C-1W	63270	S148-G2	1	20	-8.529	(ref. 8)
C-102	52300	S165	1	12.8	-2.026	(ref. 5)
C-103N	10830	S166	1	12.8	-3.519	(ref. 69)
C-103	34560	S167	1	12.8	-2.016	(ref. 5)
C-111	20	S176	1	20.8	-2.552	(ref. 62)
C-111	29450	S177	1	22.8	-8.681	(ref. 10)
C-111E	11215	S178-G1	1	8	-4.555	(ref. 69)
C-111E	11215	S178-G2	1	8	-4.555	(ref. 69)
C-103	58650	S179-G1	1	25.8	-9.026	(ref. 5)
C-103	58650	S179-G2	1	25.8	-9.026	(ref. 5)
Cooling Canal	50	S20	1	16.75	-8.932	(ref. 5)
C-103	81660	S20F-G2	1	25	-10.529	(ref. 5)
C-103	81660	S20G-G2	1	25	-10.529	(ref. 5)
C103	81660	S20F-G3	1	25	-10.529	(ref. 5)
Military Canal	10290	S20G	1	25.8	-9.829	(ref. 5)
C-1	15850	S21-G1	1	27.8	-8.026	(ref. 5)
C-1	15850	S21-G2	1	27.8	-8.026	(ref. 5)
C-1	15850	S21-G3	1	27.8	-8.026	(ref. 5)
C-102	79200	S21A-G1	1	20.8	-9.326	(ref. 22)
C-102	79200	S21A-G2	1	20.8	-9.326	(ref. 22)
C-2	59880	S22-G1	1	17.7	-12.542	(ref. 69)
C-2	59880	S22-G2	1	17.7	-12.542	(ref. 69)
L-29	5830	S334	1	29	-8.68	(ref. 5)
L-30	7945	S335	1	20	-5.95	(ref. 9)

3.8.9 Canal Boundaries

Time series files (dfs0) were used for initial and boundary conditions of stages and flows. These were created from QA/QC-ed historical, measured data from DBHYDRO. The stages and flows from DBHYDRO were downloaded as breakpoint data.

Table 27 provides a list of the boundary conditions that were applied to the model during the calibration/validation phase. The boundary source is also identified for the design storm simulations and sea level rise scenarios. The Aerojet Canal boundary condition is listed as closed during calibration and validation as the channelized area ends into Taylor Slough. The water will then overflow the canal and discharge as overland flow.

A detailed map of the location of all 1D river boundaries is provided in Figure 22. This indicates the closed boundaries in purple and the open boundaries (as listed in Table 27) as lighter colors: yellow if flow is specified, blue if a Q/h relationship is defined, and green if a water level boundary is specified.

Table 27. Sources of time series used for MIKE 1D Boundary Conditions: Calibration, Design Events and Sea Level Rise Conditions

BOUNDARY	Calibration/Validation	Design Events	Sea Level Rise
BC-L-30	S335-HW	SFWMD	SFWMD
BC-L-29	S334-TW	SFWMD	SFWMD
BC-West Broward Levee Ditch	CLOSED	SFWMD	SFWMD
BC-C-4	T5W	Miami-Dade SWMP 2020	Miami-Dade SWMP 2020
BC-C-102	S22-TW	SFWMD	SFWMD
BC-Bigman Canal	S123-TW	SFWMD	SFWMD
BC-C-100	S123-TW	SFWMD	SFWMD
BC-C-1	S21-TW	SFWMD	SFWMD
BC-C-102	S21A-TW	SFWMD	SFWMD
BC-Military Canal	S20G-TW	SFWMD	SFWMD
BC-C-103	S20F-TW	SFWMD	SFWMD
BC-Card Sound Rd Canal	S197-TW	SFWMD	SFWMD
BC-C-111	S197-TW	SFWMD	SFWMD
BC-Aerojet Canal	CLOSED	SFWMD	SFWMD
BC-S332	FREE OUTFALL	SFWMD	SFWMD

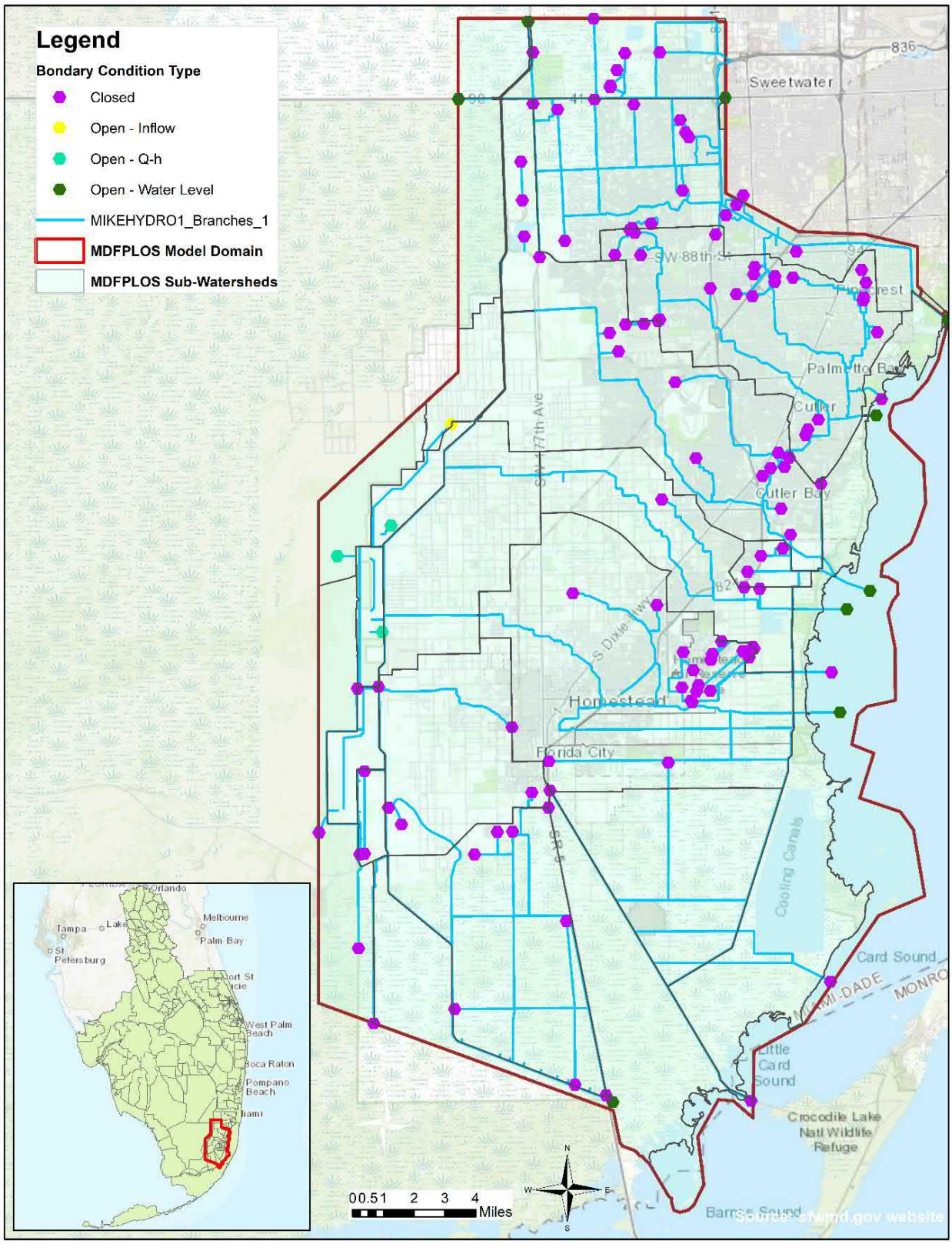


Figure 22. MIKE 1D Canals with Boundary Types

3.9 Overland Flow Zone (OL)

The OL module of the SMD FPLOS model uses a grid cell based finite difference method, discretized based on the topography. The finite difference OL is a two-dimensional finite difference diffusive wave approximation of the St. Venant's equations. The topography of the model is shown in Section 3.4 on Figure 12 and has a 100 m resolution.

A sensitivity analysis was performed to test multi-cell overland flow method and found no impact on model calibration and performance. Overland heads from the smaller grid cells are distributed to the larger grid cells, producing almost the same results as the model configuration the larger grid size. Therefore, the 100 m resolution was used throughout the model.

3.9.1 Overland Parameters

The parameters associated with OL module are spatially distributed and a function of model grid size and hydrologic conditions under which sheet-flow begins to occur in the watershed. The SMD FPLOS model uses an initial water depth, Manning's M, and detention storage, which are each described in detail in the following sections.

3.9.2 Manning's M

Manning's M values are the inverse of Manning's n values and are equivalent to the Strickler roughness coefficient. Manning's M values capture the friction effects due to vegetation and bedding impact the velocity of overland flow; and therefore, have an impact on the performance measures of South Miami-Dade FPLOS. The initial spatial distribution of these values is based on land use, and constant over the entire flow regime. The Manning's M values and their associated land use, as established in the model, are shown in Table 28. A map of the Manning's M values is shown in Figure 23.

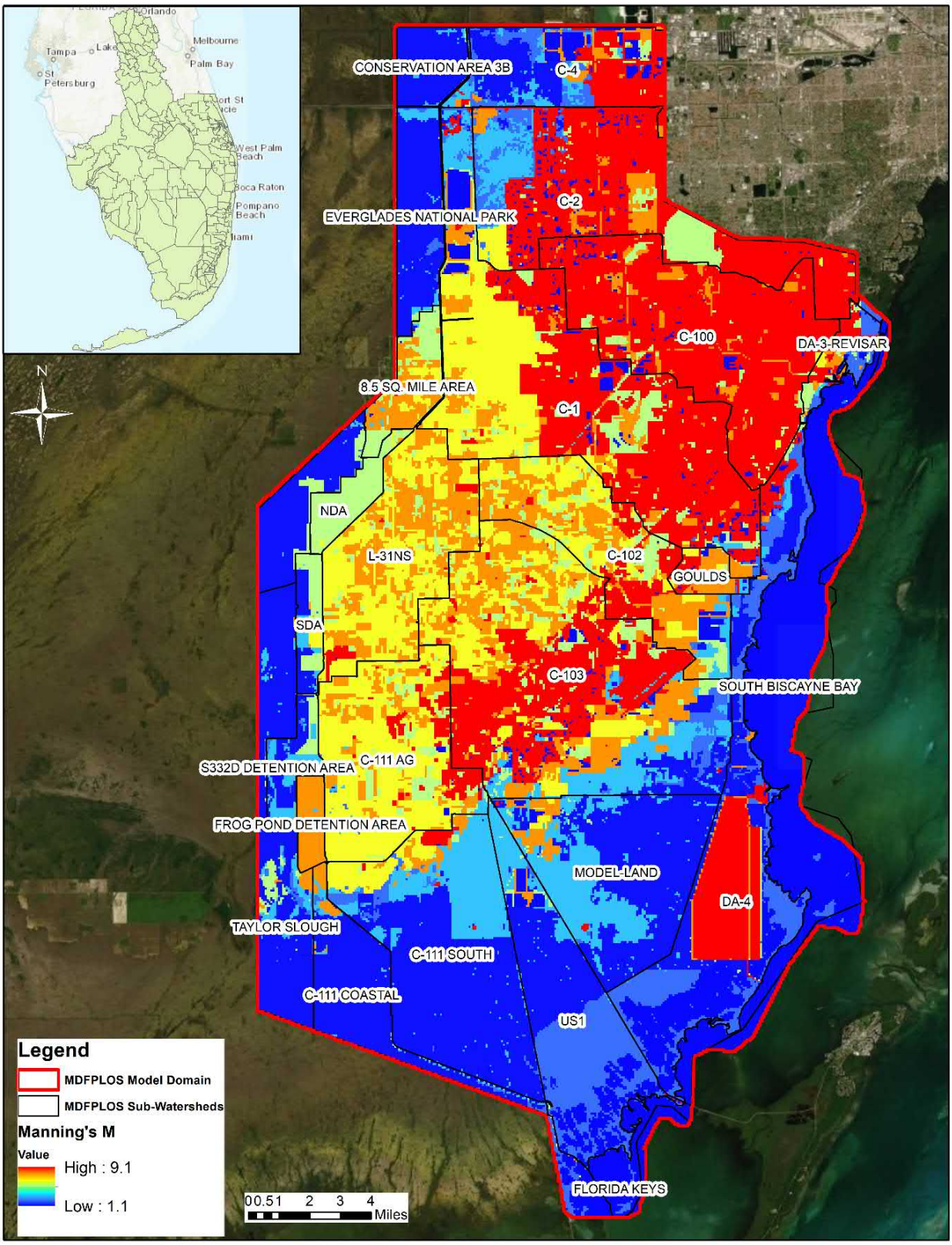


Figure 23. Overland Manning's M values in SMD FPLOS model

3.9.3 Detention Storage

This is defined as the storage depths that must be exceeded in a model grid cell before overland flow can occur. This is an important part of a flood model water budget, and accounts for water detained in micro-topographic features which cannot be accounted for within the topographic resolution and grid cell size. Water in detention storage is unavailable for overland flow but is available for ET and infiltration to the UZ. A map of the detention storage used in the model is shown in Figure 24. As with Manning's M, the values for detention storage are based on land use. The values of detention storage depths used in the model are shown in Table 28.

Table 28. Initial Manning's M and Detention Storage for Each Model Land use Code

MIKE SHE Code	MIKE SHE Description	Manning's M (m1/3/s)	Manning's n	Detention Storage Depth (in)
1	Citrus	5.88	0.170	0.25
2	Pasture	7.14	0.140	0.15
5	Truck Crops	5.88	0.170	0.25
6	Golf Course	7.14	0.140	0.15
7	Bare Ground	7.14	0.140	0.15
8	Mesic, Xeric, Hydric Flatwood	5	0.200	0.3
9	Mesic, Xeric Hammock	5	0.200	0.3
13	Hydric Hammock	3.3	0.303	0.3
14	Wet Prairie	3.3	0.303	0.15
16	Marsh	1.6	0.625	0.15
17	Cypress	2.5	0.400	0.4
18	Swamp Forest	2.5	0.400	0.4
19	Mangrove	2.5	0.400	0.4
20	Water	16.6	0.060	0
22	Sawgrass	1.6	0.625	0.25
23	Emergent Marsh	1.6	0.625	0.15
41	Urban Low Density	7.14	0.140	0.1
42	Urban Medium Density	8.3	0.120	0.1
43	Urban High Density	9.1	0.110	0.1
44	Commercial	9.1	0.110	0.1

3.9.4 Overland Ponded Drainage

South Miami-Dade has exfiltration trenches that are an important component of the secondary drainage systems. Flooding occurs only when the capacities of these systems are exceeded. For an accurate assessment of flood protection level of service, it is critical to include these in the model. Figure 25 shows the density of these exfiltration trenches in Miami Dade and their representation in the model as grid codes. The grid code number is assigned to a unique drain area. Appendix H details the procedure used to convert the data on exfiltration trenches from Miami-Dade County to the SMD FPLOS model.

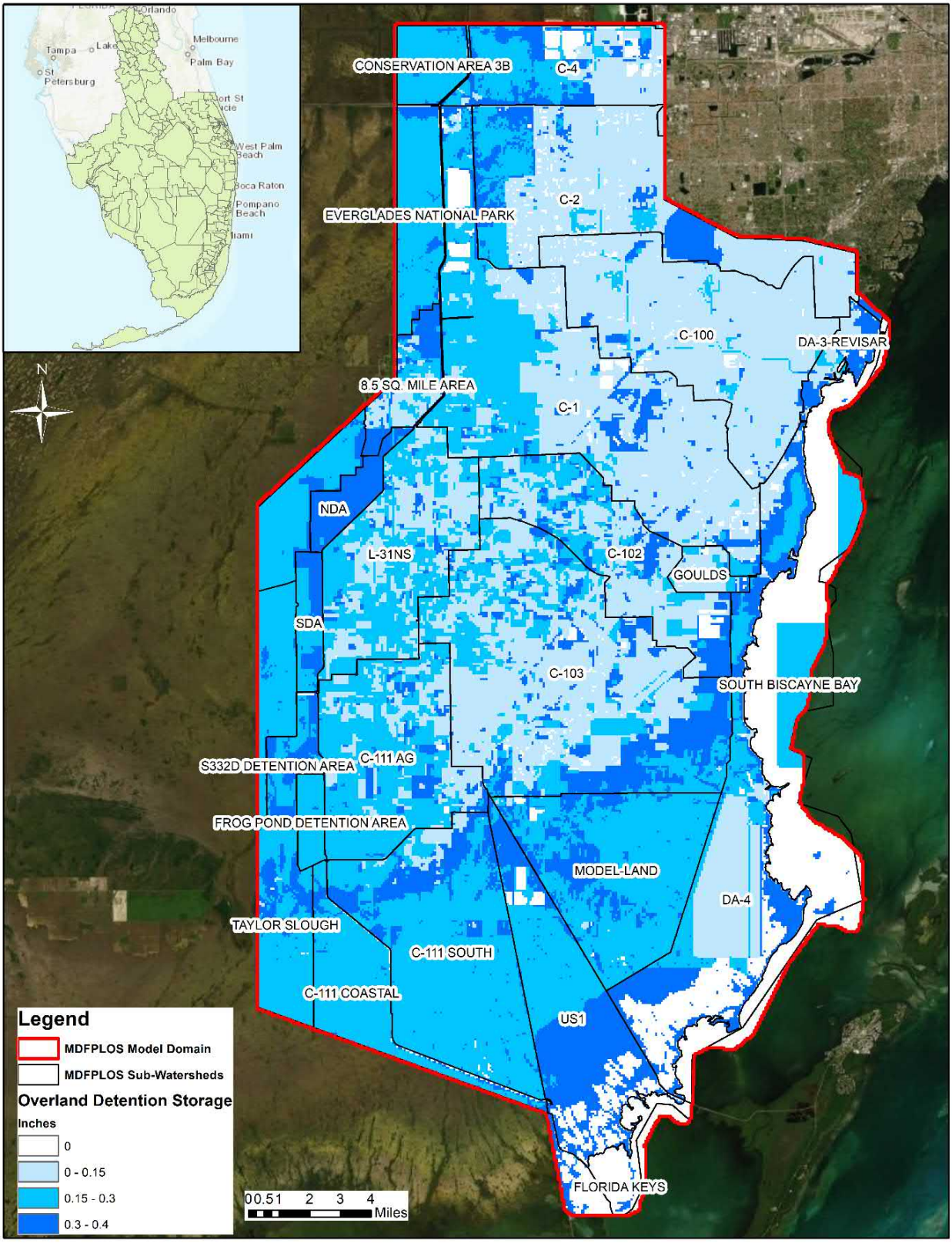


Figure 24. Overland Detention Storage (inches)

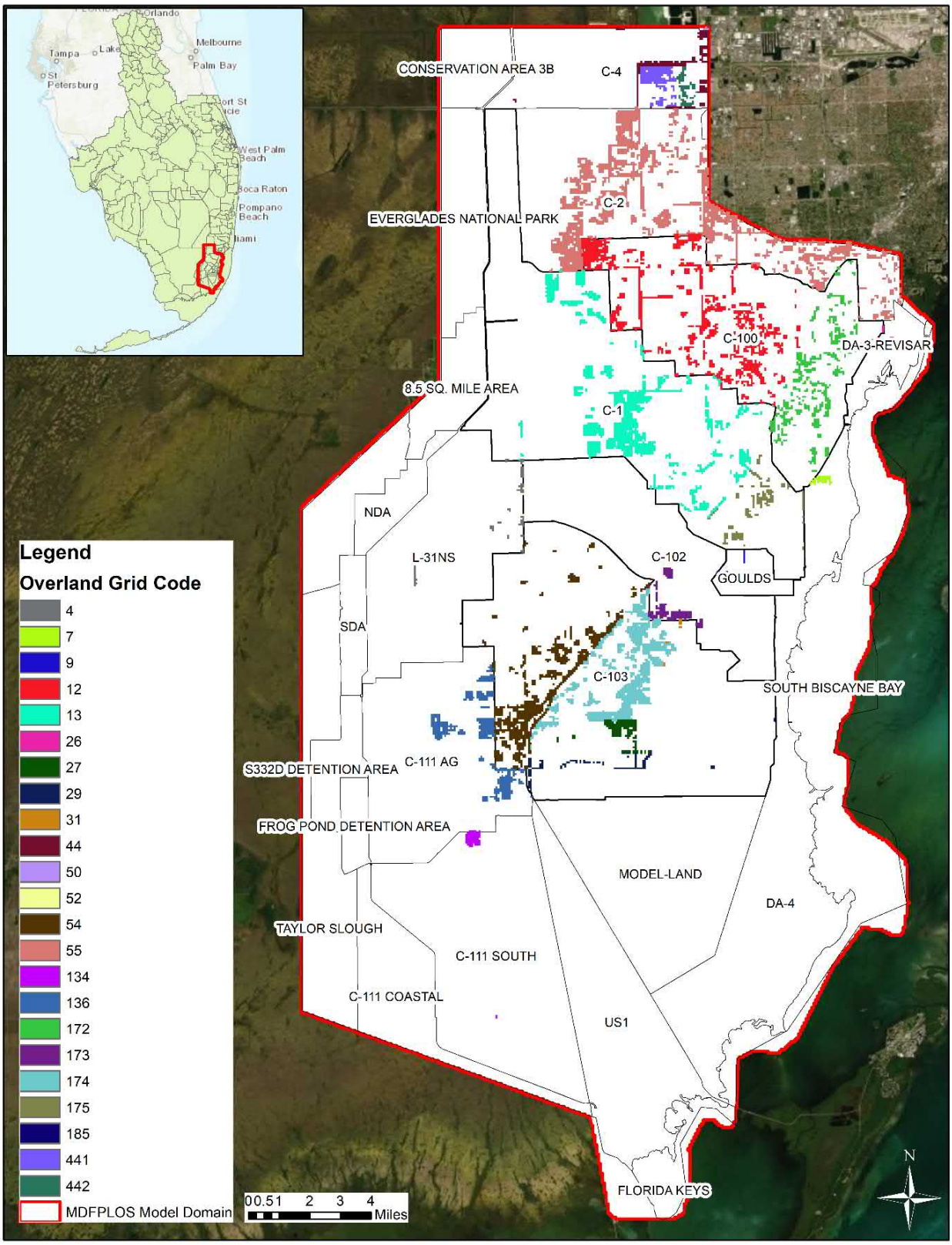


Figure 25. Overland Drainage Grid Codes for Representing Exfiltration Trenches

3.9.5 Initial OL Water Depth

Considering that the simulations with the MIKE SHE model are short term, (i.e., 2 months or less), it is important to provide best estimate for the initial boundary conditions. Initial conditions were developed by spatial interpolation of the observed surface and groundwater elevations at the beginning of the simulation. The initial water depth represents conditions at the start of the calibration period (8/15/2017) and for the start of the validation period (11/1/2015), as shown in Figure 26. These initial conditions will be modified for the design storms.

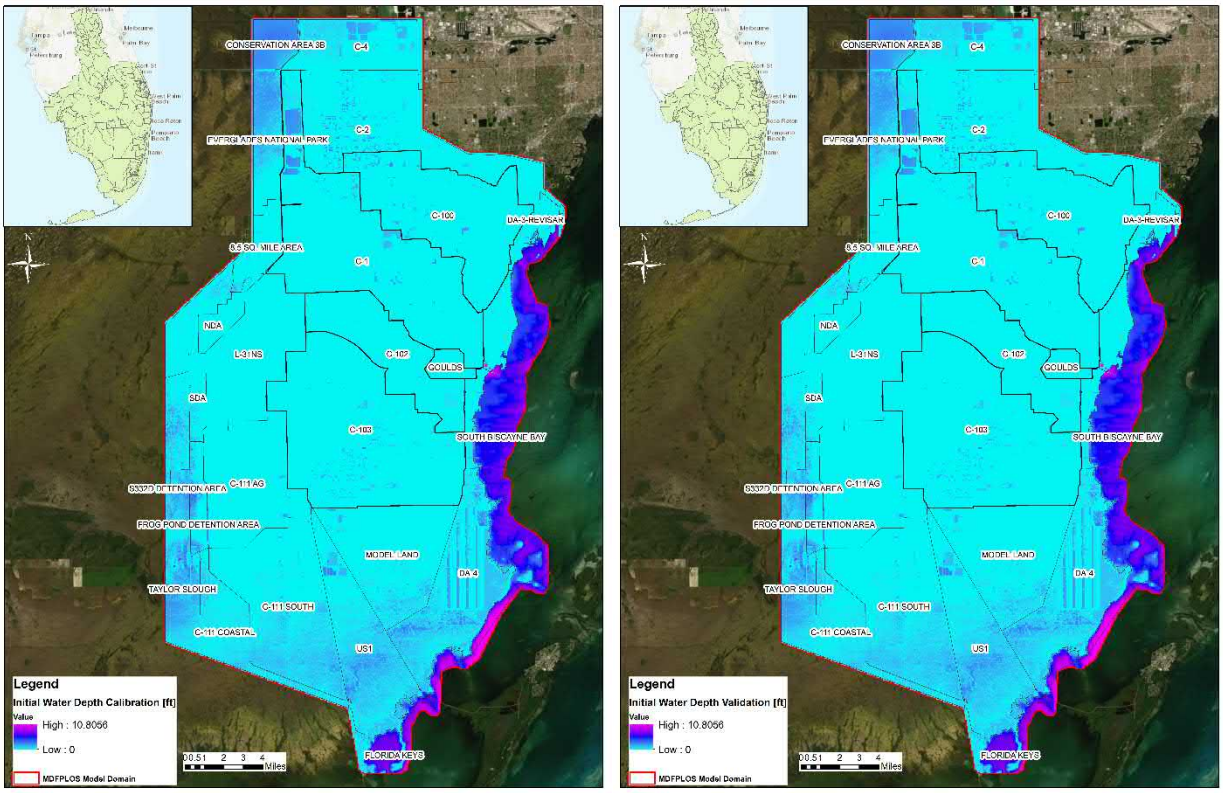


Figure 26. Initial Water Depth for 8/15/2017 (Calibration Event) and 11/1/2015 (Validation Event)

3.9.6 OL Boundary Conditions

For overland boundary conditions, gridded timeseries are at 15-minute intervals and cell resolution of 400x400 m. It is necessary to use overland boundary timeseries to accurately represent the 2D flow at the interface between coastal and inland flow. The gridded timeseries were obtained by spatial interpolation of single timeseries in Biscayne Bay or tail water at structures,.

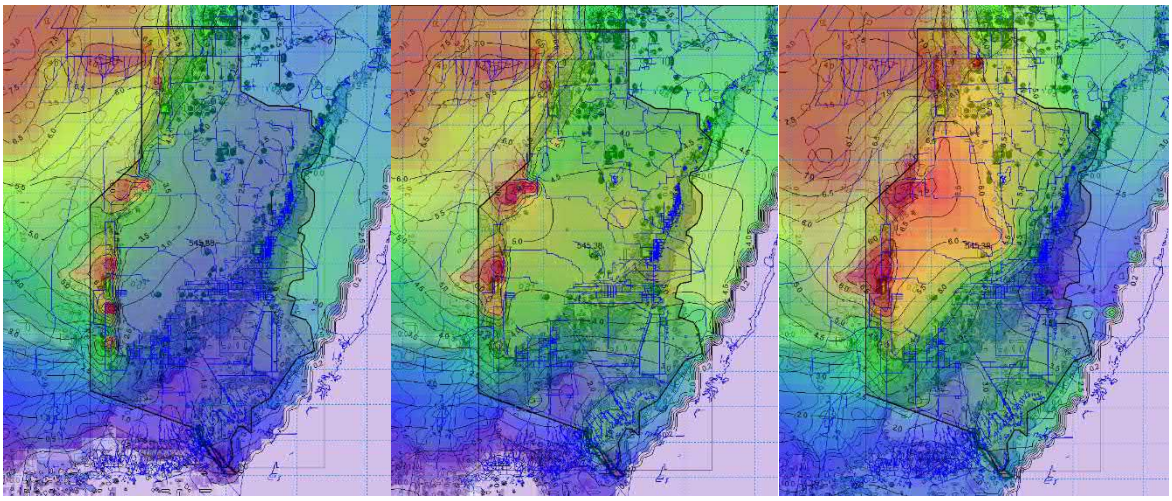


Figure 27. Illustration of Overland Boundary Conditions

These images show the progression of the overland elevation for 3 consecutive days during Hurricane Irma (September 9-11, 2017).

3.10 Unsaturated Flow Zone (UZ)

Unsaturated flow refers to the process whereby soil moisture is replenished by rainfall and removed by evapotranspiration and subsequently interacts with the saturated zone. The downward infiltration is primarily one-dimensional vertical flow and was sufficiently accurate for this model application to calculate the infiltration from surface water to the saturated zone. MIKE SHE/ MIKE 1D has three (3) ways to represent the unsaturated zone:

- Full Richard's equation which is the most accurate but computationally intensive; for this method, the soils are defined in detail in input.
- Gravity flow method assumes a uniform vertical gradient and ignores the capillary forces. This method works well when the unsaturated zone dynamics respond mostly to the actual precipitation and evapotranspiration.
- Simple two-layer approach, which divides the unsaturated zone into a layer above the root zone and a zone below. This method is most effective when the recharge is mostly affected by evapotranspiration.

SMD FPLOS model uses the gravity flow method for the calibration and validation models. Each soil type is defined spatially with a 2-dimensional grid file (dfs2). For each soil type, relationships of moisture content to conductivity and retention are defined by curves; an example is shown in Figure 28. For initial model calibration, no hysteresis was applied for the drying and wetting processes in the saturated zone; this was revisited during the calibration and validation process to reevaluate. Gravity flow method was adequate for SMD FPLOS model unsaturated zone representation; and so was not modified.

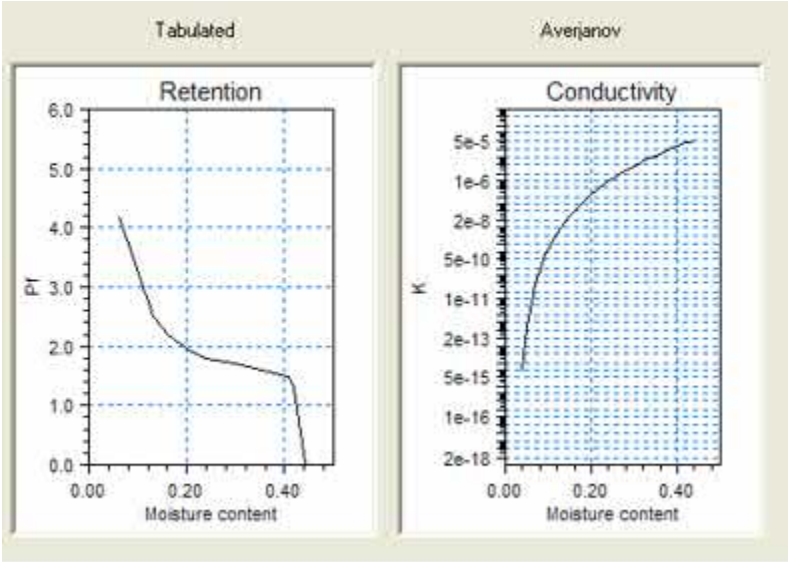


Figure 28. Relationships of moisture content to conductivity and retention in the UZ module of MIKE SHE

Table 29. Soils Types and Primary Soil Parameters

Soil Names	Grid Code	Saturated Water Content	Residual Water Content	Saturated Conductivity [ft/d]
Biscayne gravelly marl, drained	631,567	0.20	0.10	41.58
Lauderhill muck, frequently ponded, 0 to 1 percent slopes	631,568	0.20	0.01	87.70
Pennsuco marl, drained	631,569	0.20	0.01	27.20
Pennsuco marl	631,570	0.20	0.01	32.89
Perrine marl, drained	631,571	0.20	0.01	27.27
Krome very gravelly loam	631,572	0.20	0.01	34.80
Udorthents-Water complex	631,573	0.20	0.01	65.00
Udorthents, limestone substratum-Urban land complex	631,574	0.20	0.01	82.75
Udorthents, marl substratum-Urban land complex	631,575	0.20	0.01	38.28
Perrine marl	631,576	0.20	0.01	32.44
Biscayne marl	631,577	0.20	0.10	37.09
Dania muck, frequently ponded, 0 to 1 percent slopes	631,578	0.20	0.01	83.80
Urban land, 0 to 2 percent slopes	631,579	0.10	0.01	89.99
Biscayne marl, drained	631,580	0.20	0.15	37.44
Tamiami muck, depressional	631,582	0.20	0.01	70.77
Cardsound silty clay loam-Rock outcrop complex	631,583	0.20	0.01	58.41
Opalocka sand-Rock outcrop complex	631,585	0.20	0.01	124.63
Chekika very gravelly loam	631,586	0.20	0.01	43.00
Matecumbe muck	631,587	0.20	0.01	82.34
Biscayne marl-Rock outcrop complex	631,588	0.20	0.10	62.15
Perrine marl, tidal	631,589	0.20	0.01	20.47
Demory sandy clay loam-Rock outcrop complex	631,590	0.20	0.01	40.70

Pahokee muck, depressional	631,592	0.20	0.01	90.88
Pennsuco marl, tidal	631,593	0.20	0.01	24.54
Terra Ceia muck, tidal	631,594	0.20	0.01	87.99
Hallandale fine sand, 0 to 2 percent slopes	631,596	0.20	0.01	71.72
Rock outcrop-Vizcaya-Biscayne complex	631,599	0.20	0.01	61.38
Udorthents, limestone substratum, 0 to 5 percent slopes	631,603	0.20	0.01	90.37
Water	750,490	0.20	0.01	0.00

Figure 29 provides a map of the soil types, by grid code, acquired from SSURGO that are present throughout the model domain. Table 29 summarizes the soil type by grid code and provides the saturated soil moisture content, residual soil moisture content, and saturated hydraulic conductivity applied to each soil type in the model.

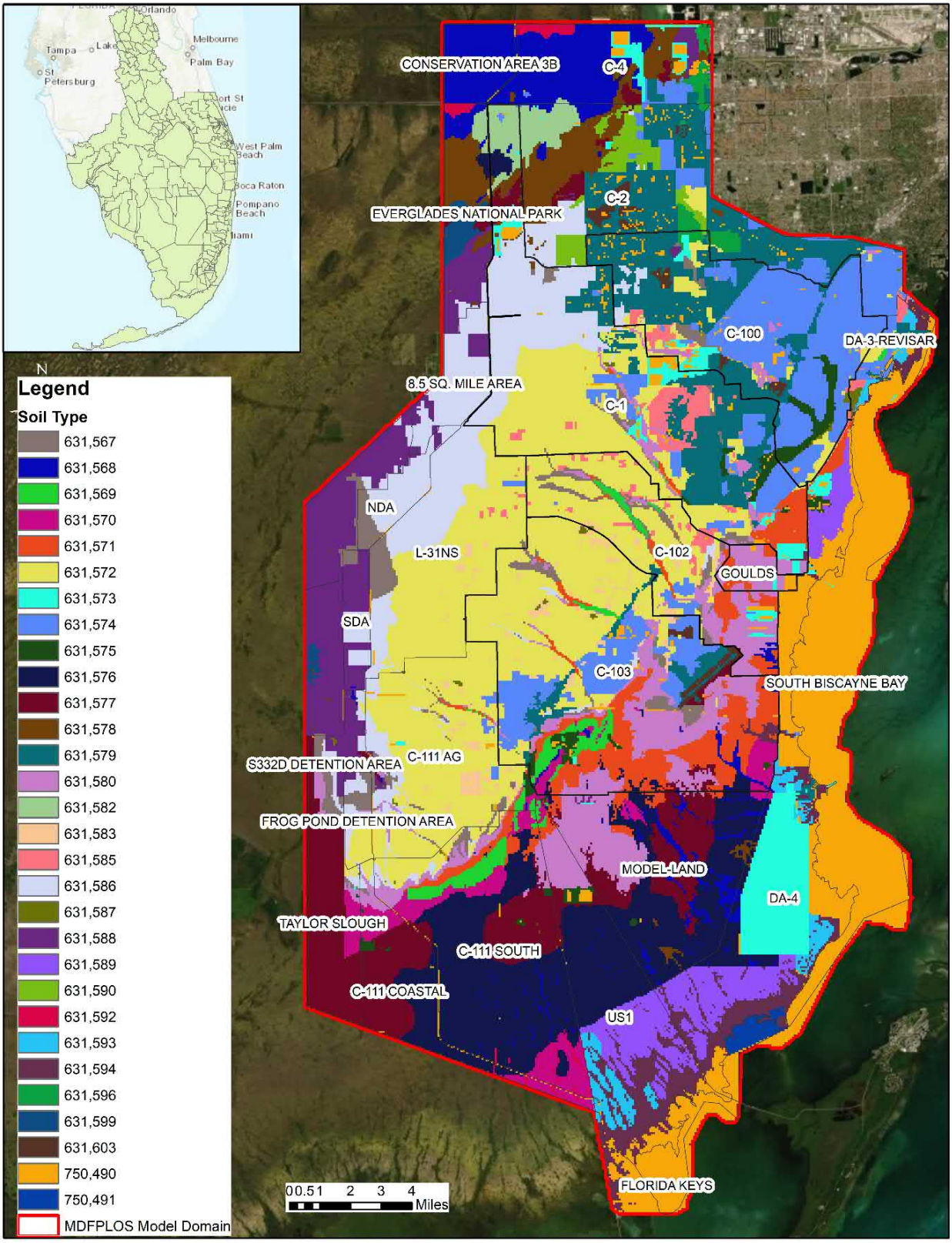


Figure 29. Spatial Soil Distribution in SMD FPLOS model

3.11 Saturated Zone

As outlined in the Introduction section, the saturated zone flow system in south Miami-Dade County is composed of a shallow Surficial Aquifer System (SAS), which includes the Biscayne Aquifer and Gray Limestone Aquifer, and the underlying, confined Floridan Aquifer System (FAS). The SAS and FAS are separated by alternating beds of sand, silt, and clay that collectively minimize the movement of groundwater between the them. SMD FPLOS model only includes the SAS.

3.11.1 Hydrostratigraphy

The highly transmissive Biscayne Aquifer does not correlate with lithostratigraphic boundaries (Figure 30) but includes several geologic units. Several publications on the geology of the Biscayne Aquifer, including Fish, 1988, document Biscayne Aquifer extending from land surface to the base of contiguous, highly permeable beds of the Tamiami Formation. The Biscayne Aquifer underlies the whole project domain and includes the Pamlico Sand, Miami Limestone, Anastasia Formation, Key Largo Limestone, and Fort Thompson Formation, as well as the Pinecrest Sand Member of the Tamiami Formation (Fish and Stewart,1991). Geologic units which compose the Biscayne Aquifer extend beneath Biscayne Bay and the Atlantic Ocean, but the offshore lateral extent of these units has not been fully delineated (Reese and Cunningham, 2000).

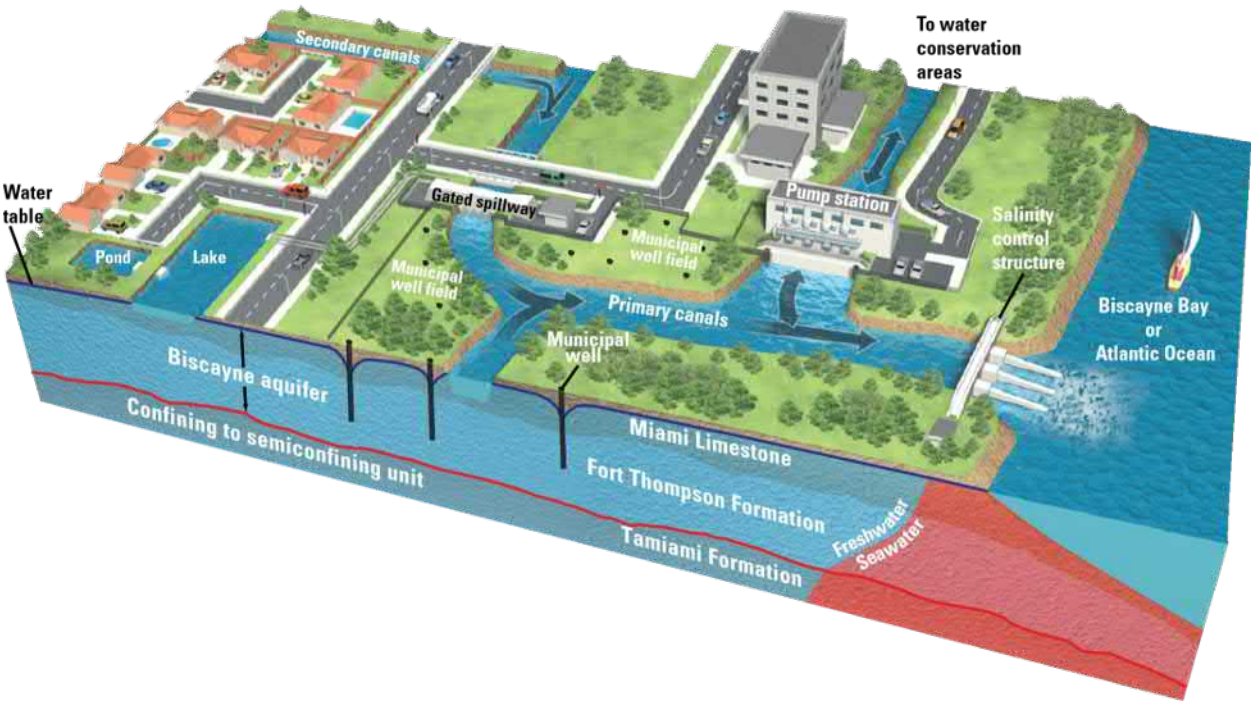


Figure 30. Conceptual block diagram showing the components of the surface-water features and management in Miami-Dade County (modified from South Florida Water Management District, 2010).

Perkins (1977) identified and defined five Quaternary marine sequences Q1-Q5 of the highly transmissive Pleistocene-age limestones of the Biscayne aquifer. The Q1-Q5 that the Biscayne

Aquifer was divided into, have been correlated to previously identified high-frequency sequence stratigraphic depositional cycles (ref. 15). Vertical lithofacies successions record the principal water depth during cycles of relative sea level rise and fall (ref. 33). The porosity and permeability of the Biscayne Aquifer in south Miami-Dade, including the SMD FPLOS project domain, are typically linked to the vertical arrangement of lithofacies within each succession of the high-frequency cycle (ref. 15). A conceptual hydrogeologic column developed and kriged by SFWMD (ref. 21), corresponding to the quaternary marine sequences, was provided for this project; this was adapted from Cunningham and others, 2006. The five Quaternary marine sequences make the five (5) SZ layers of SMD FPLOS model. Figure 5 shows the hydrogeologic layering conceptualization.

3.11.2 Aquifer Properties

Transmissivity values for the Biscayne Aquifer derived from aquifer performance tests (APTs) vary widely throughout South Miami-Dade FPLOS project domain. Results of APTs conducted by SFWMD near Turkey Point and tests at the NWWF reported by Renken and others in (ref 63) yielded transmissivity estimates as high as 1.6×10^6 to 3.07×10^6 ft^2/d. Horizontal hydraulic conductivity data were interpolated to a 1000 ft x 1000 ft model mesh, encompassing the SMD FPLOS model domain using ordinary kriging, were provided by SFWMD. The values of horizontal hydraulic conductivity for Layer 1 ranges from 1,500 – 18,000 ft/d; layers 2 and 3 range from 5,000 – 70,000 ft/d; Layer 4 ranges from 80 to 1,000 ft/d and Layer 5 ranges from 250 – 4,000 ft/d. Vertical hydraulic conductivity data for the Biscayne Aquifer are limited. Sukop and others, 2013 noted that the ratio of vertical to horizontal hydraulic conductivity of flow zone samples, as determined by the Lattice Boltzman method, ranged from 0.5 to 1.3 (ref. 76). This indicates that within flow zones, there is not much difference between horizontal and vertical hydraulic conductivity values. In addition, Cunningham and others, 2009 document presence of cross-cutting vertical solution features connecting Biscayne Aquifer flow zones (ref. 15) making these preferential flow paths. The Biscayne aquifer generally acts as an unconfined aquifer in response to rainfall, evapotranspiration, withdrawals and other hydrologic and hydraulic stresses. In unconfined aquifers, the specific yield is equivalent to the storage coefficient, which controls saturated zone storage changes. Specific yield estimates for the Biscayne aquifer range from 0.20 to 0.25 and have been obtained by comparison of water table rise during large rainfall events and calibrated models (ref.46 43). Merritt (1996) reported 0.23 as the average value of specific yield based on 30 years of historical rainfall records (ref. 46). SMD FPLOS model uses a constant value equal of 0.2 for specific yield.

3.11.3 Water Supply and Use

The Biscayne aquifer is the primary source of water in South Miami-Dade FPLOS project domain (ref. 44). Water use types in the project domain include domestic, commercial, industrial, agricultural, and municipal water use.Municipal groundwater use data for the years 1996 through 2016 were provided by Miami Dade Water and Sewer Department (MDWASD), which included the SFWMD data. This dataset included all municipal Biscayne Aquifer wells permitted in the project domain. The withdrawal quantities from MDWASD well fields were relatively consistent and ranged from 300 MGD to 425 MGD (500 – 650 ft^3/s) for the years included in the dataset. Average groundwater withdrawal at production well fields ranged from 0.01 MGD to 84 MGD, as shown in Figure 31. The SMD FPLOS model uses daily timesteps of well withdrawals which are based on average values of groundwater withdrawals.

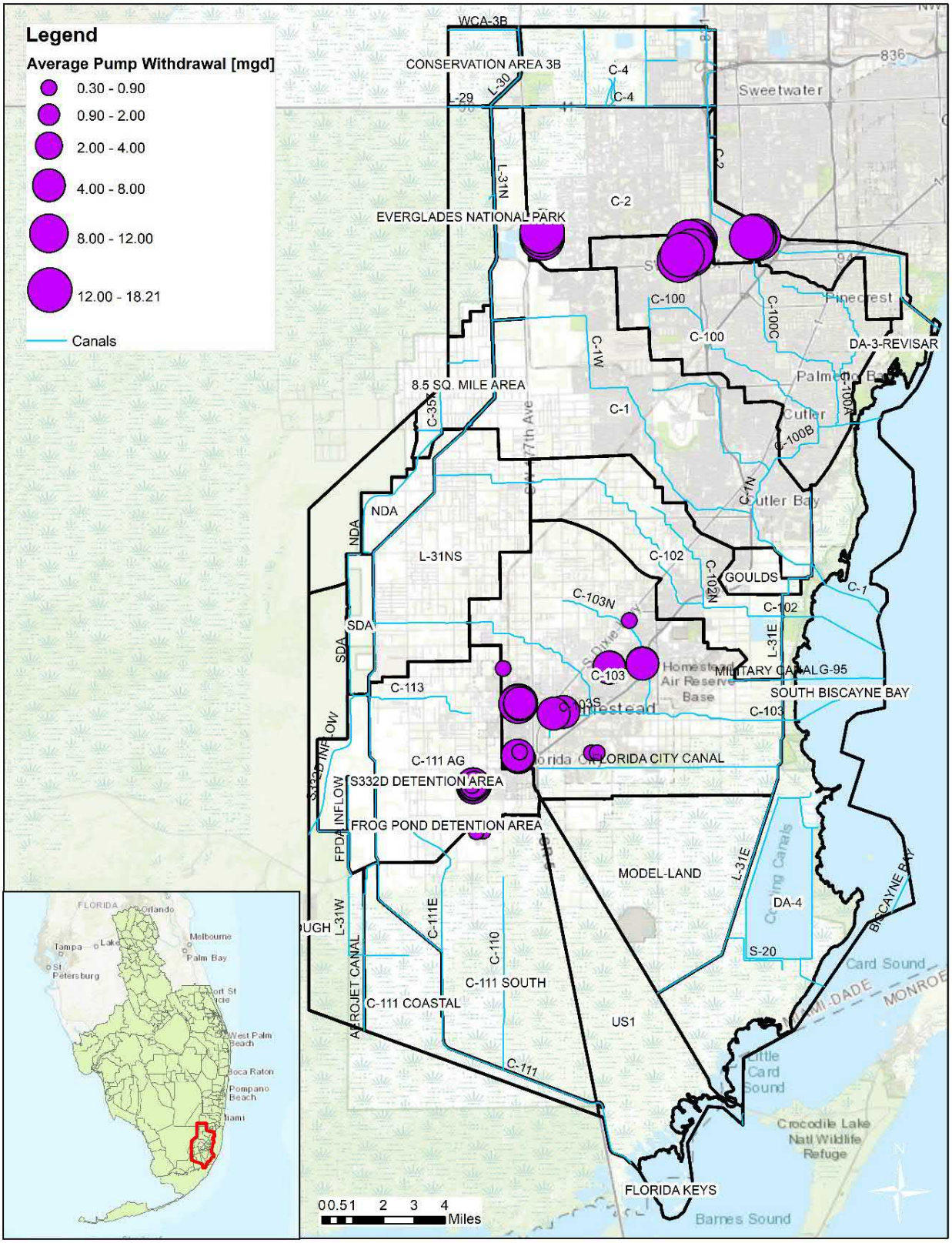


Figure 31. Groundwater Pumping Wells with Average Monthly Pumping (MGD)

All other types of water use, including agricultural and recreational land uses were negligible for storm event simulations, according to estimates.

3.11.4 Groundwater Recharge

Net groundwater recharge to the saturated zone is typically defined as the difference between the sum of rainfall and infiltration into the Biscayne Aquifer, and the sum of interception, overland storage and runoff, evapotranspiration, and water retained in the unsaturated zone. Hughes and White, 2016 estimated that, annual net groundwater recharge in their project domain which encompasses South Miami-Dade FPLOS project domain, computed for the period of 1996 through 2010, ranged from 4.02 in. to 34.16 in (323.40 ft^3/s to 2,748.09 ft^3/s). Monthly net groundwater recharge in their project domain ranged from –3.06 to 14.86 inches (–2,951.39 to 14,349.02 ft^3/s), according to their estimates. As a percentage of rainfall, their estimate of average annual net groundwater recharge ranged from 11.06 to 50.12 percent of rainfall. These estimates were calculated using daily NEXRAD rainfall, land use data, census-based septic return estimates, daily satellite-based reference evapotranspiration rates, and estimates of water use. These numbers were used as soft calibration targets in SMD FPLOS model.

3.11.5 Interaction of Groundwater and Surface Water

Groundwater in the Biscayne Aquifer is hydraulically connected to the surface water system because of the high transmissivity of the aquifer; and so are closely coupled. In general, canals in South Miami-Dade FPLOS project domain act as a source to Biscayne Aquifer in the dry season and as a sink in the wet seasons. Actual volumes or rates of exchange between the two are difficult to quantify and are not completely understood, but the groundwater is a significant component of the water budget. Simulated values of seepage (flow from Biscayne Aquifer to the canal) and leakage (flow from the canals to Biscayne Aquifer) from this peer reviewed model and documentation ranged from 230 cfs to 702 cfs. This was a soft calibration target for SMD FPLOS modeling.

3.11.6 SZ Initial Conditions

Considering that the simulations with the MIKE SHE model are short term, (i.e. 2 months or less), it is important to provide best estimate for the initial boundary conditions. Initial conditions were developed by spatial interpolation of the observed surface and groundwater elevations at the beginning of the simulation. For overland boundary conditions, gridded timeseries are at 15-minute intervals and cell resolution of 1-mile x 1-mile. It is necessary to use overland boundary timeseries to accurately represent the 2D flow at the interface between coastal and inland flow. The gridded timeseries were obtained by spatial interpolation of single timeseries in Biscayne Bay or tail water at structures, which are a good representation of stages in Biscayne Bay.

3.11.7 SZ Boundary Conditions

The saturated zone module of MIKE SHE (SZ) module supports the three types of boundary conditions:

1. Type 1: Dirichlet's conditions, where the hydraulic head is prescribed on the boundary; as constant or time series

2. Type 2: Neumann's conditions, where the gradient of the hydraulic head as flux across the boundary is prescribed
3. Type 3: Fourier's conditions, where the head dependent flux is prescribed on the boundary.

The SMD FPLOS model uses a Type 1 time-varying head boundary based on measured groundwater data. Measured daily groundwater stage data were interpolated using the weighted averaged method to generate the gridded time-series (2,000 m resolution). Figure 32 shows three consecutive days of groundwater elevations during Hurricane Irma (September 9, 10, and 11, 2017). Elevations along the interior model boundary use this interpolated data as a time-varying head boundary. Coastal boundary data is interpolated at an hourly timestep from tidal data.

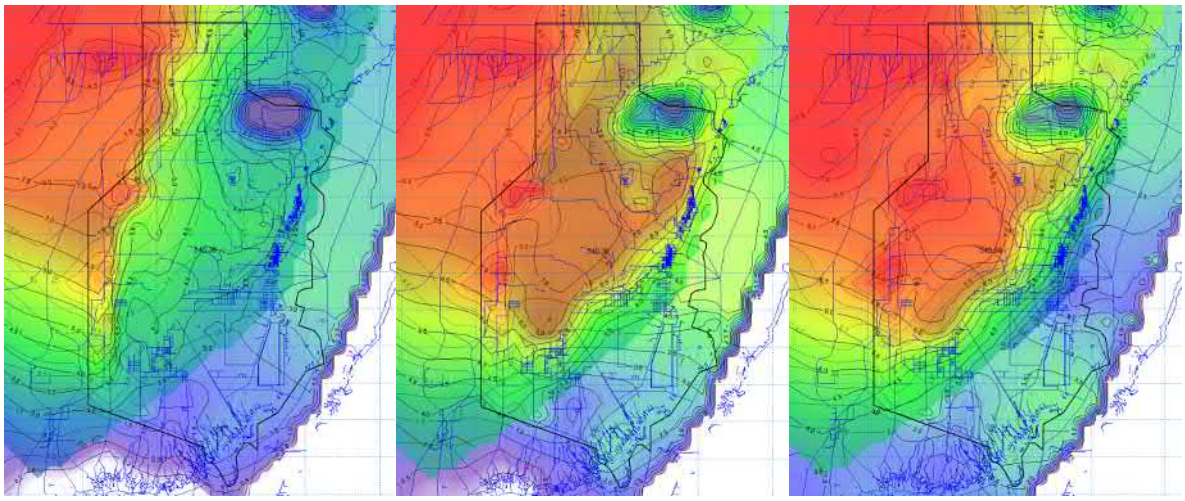


Figure 32. Groundwater elevations used as boundary condition shown for 3 consecutive days during Hurricane Irma (September 9, 10, and 11, 2017).

3.12 Additional Model Development Datasets

The following data were downloaded and reviewed during the development of the MIKE SHE / MIKE 1D model and utilized for implementing water management infrastructure within the model domain. Only components which have significant impact on the water resources within the domain were implemented:

- Environmental Resource Permits
- Above ground Impoundments surrounded by a dike
- Water Use Permitting Facilities
- Water Use Permits for Diversion/Impoundments
- Consumptive Use Permits
    - Water Use Public Water Supply
    - Water Use Dewatering
    - All other Water Use
- Miami Dade County's geodatabase of stormwater infrastructure

Table 30 provides a summary of the datasets considered and the sources which were converted to DHI format.

Table 30. South Miami-Dade FPLOS data, sources and status

Data type	Model Input Data	Source	Quality	Status	Any gap filling methods
Time-Series	Flow rate, Canal Stages, Gates Levels	DBHYDRO (SFWMD)	SFWMD best available data	More than 400 timeseries downloaded per event, two months period	None used, breakpoint data
1D Timeseries	Flow rate, Canal Stages, Gates Levels	DBHYDRO (SFWMD)		All timeseries converted to MIKE 1D files; .dfs0 format	
Spatial Data:					
2D Timeseries	2D data timeseries			Surface water data interpolated to .dfs2 file format to be used for external boundaries: Overland and Subsurface boundary	Interpolated
Rainfall data	Rainfall	NEXRAD (SFWMD)	QA/QC ed by OneRain in DBHYDRO	Obtained and discretized to 15-minute spatial timeseries data	No gap filling done by KH-GIT
		Gage Data (SFWMD)	QA/QC ed by SFWMD in DBHYDRO	Preliminary QA/QC; interpolated using natural neighbor method	
Evapo-transpiration	PET	USGS		Obtained daily PET data from USGS, converted to .dfs2 for input daily timestep	Converted to daily; gap filled with interpolation when needed
Topography	Topography	SFWMD Combined LiDAR 2018, LiDAR 2015 (5 ft) NOAA Bathymetry (30 M)	Best available SFWMD dataset	Topography converted to .dfs2 files for use as Multicell, subsurface resolution 100 or 200 meters, overland and flooding at 10 or 20 m resolution.	Spatially, bathymetry data combined with SFWMD LiDAR dataset
Land Use		SFWMD's FLUCCS codes	Best available	Data converted to .dfs2 files and MIKE SHE database developed; dataset enhanced with C-CAP	
Soil data	Unsaturated Zone	SSURGO Data - US Department of Agriculture (USDA)	Best source for soils data	Data converted to .dfs2 files and MIKE SHE database developed	No gaps

4 CALIBRATION RESULTS

The calibration model covers a two-month simulation period, Aug 15, 2017, to Oct 15, 2017, and included Hurricane Irma which occurred in the period 9/9/2017-9/11/2017. The calibration of the model was based on a total of 197 monitoring sites, with 89 surface water, 83 groundwater and 26 flow monitoring stations within the model domain. Within the project watersheds (C-1, C-100, C-102 and C-103) there were correspondingly 10, 25, and 11 surface water, groundwater, and flow monitoring stations.

Calibration statistics are provided for each watershed, surface water, groundwater, and discharges for monitoring stations within the project watersheds and for the entire domain.

4.1.1.1 Watershed C-1 Calibration Results

The observed and computed timeseries for the groundwater timeseries within Watershed C-1 are provided in Figure 33 through Figure 41.

The computed calibration results show an acceptable match with observed values for wells G-3561, G-3899, G-3967, G-3968 and G-3968, however, the computed peak of G-3889 is considerably higher than observed, and the computed Bias of -0.76 ft shows that the computed levels in this well are high overall (Figure 34).

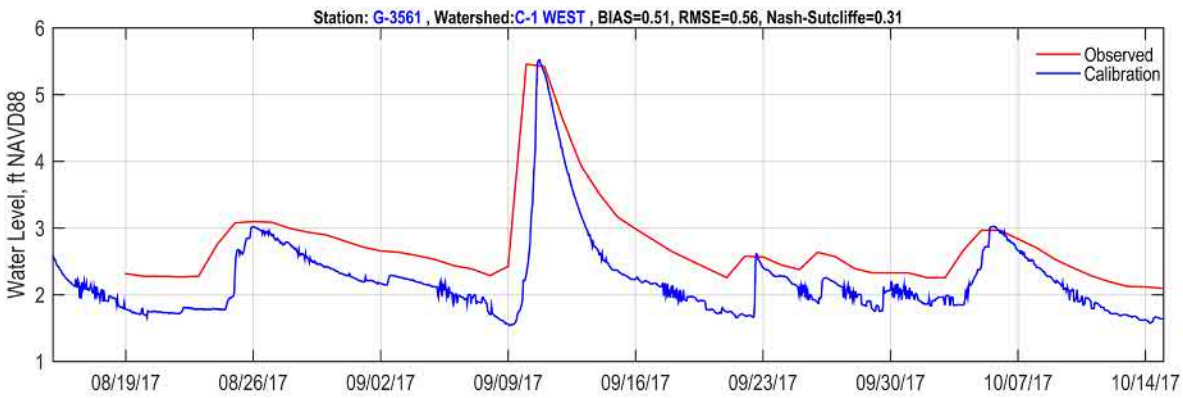


Figure 33 Watershed C-1 Calibration Timeseries for Groundwater Well G-3561

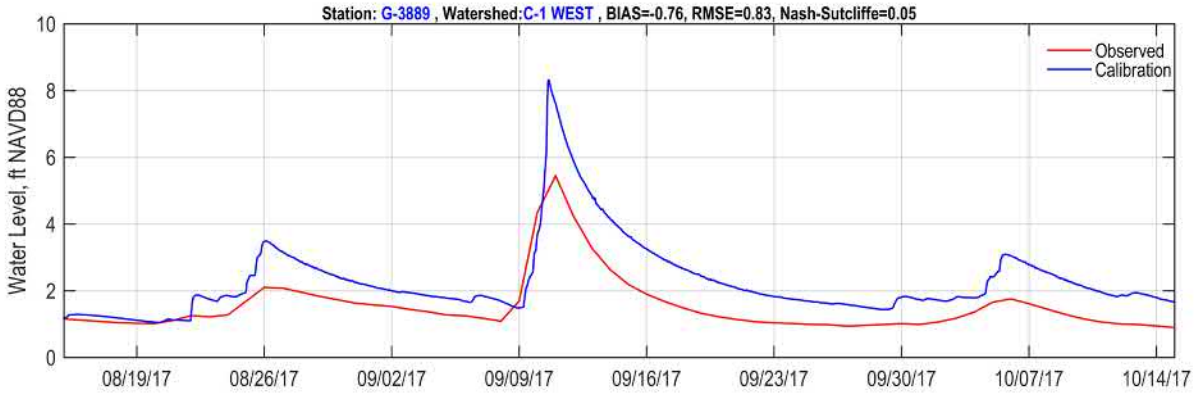


Figure 34 Watershed C-1 Calibration Timeseries for Groundwater Well G-3889

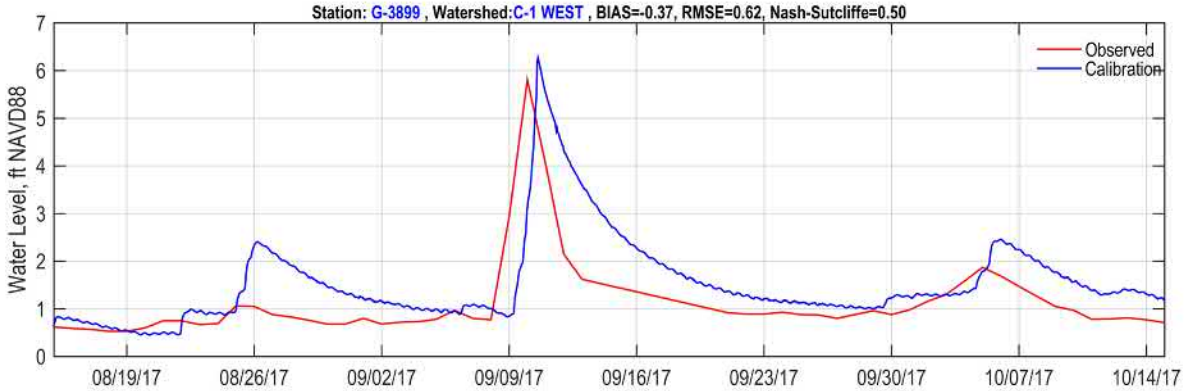


Figure 35 Watershed C-1 Calibration Timeseries for Groundwater Well G-3899

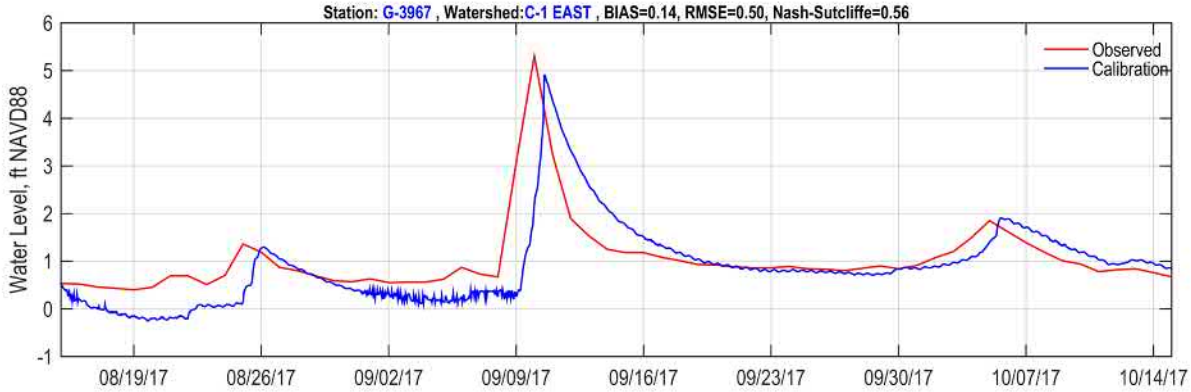


Figure 36 Watershed C-1 Calibration Timeseries for Groundwater Well G-3967

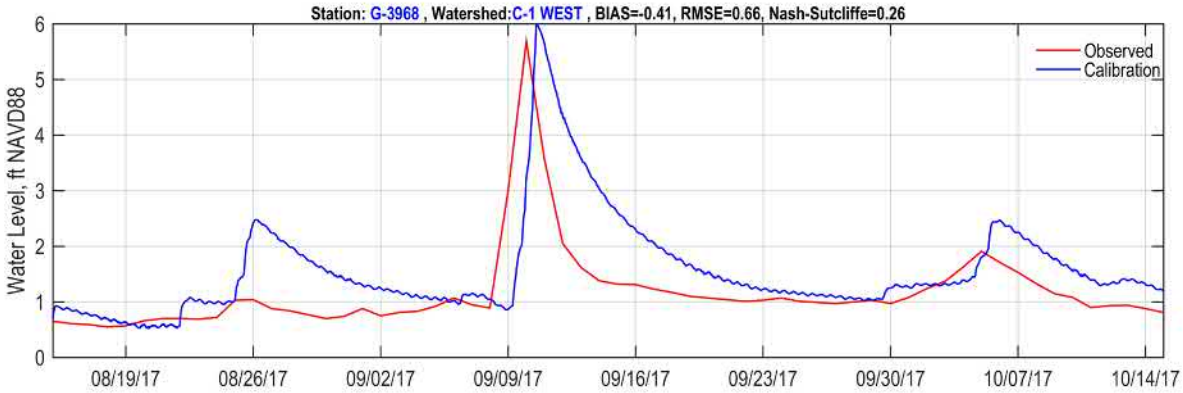


Figure 37 Watershed C-1 Calibration Timeseries for Groundwater Well G-3968

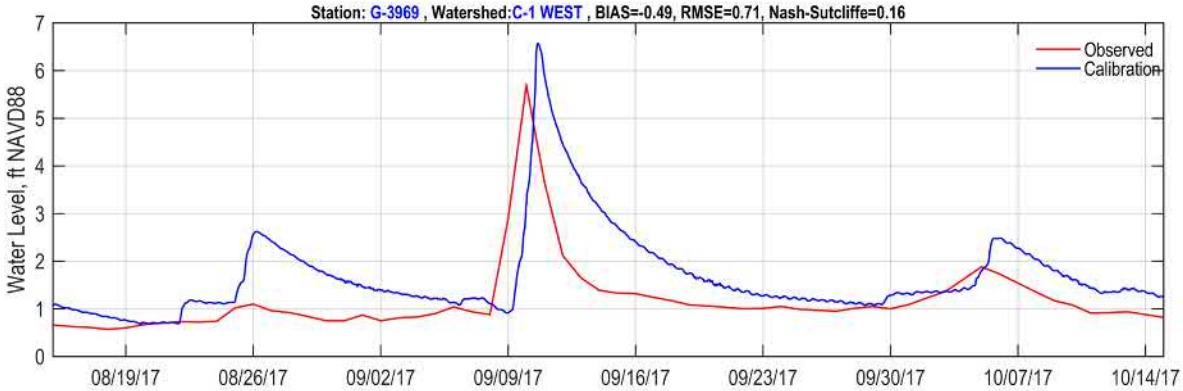


Figure 38 Watershed C-1 Calibration Timeseries for Groundwater Well G-3969

The peaks of G-3967, G-3968 and G-3969 are relatively well represented, for the peak and the overall bias for the simulation period.

Figure 39 Watershed C-1 Calibration Timeseries for Groundwater Well G-855

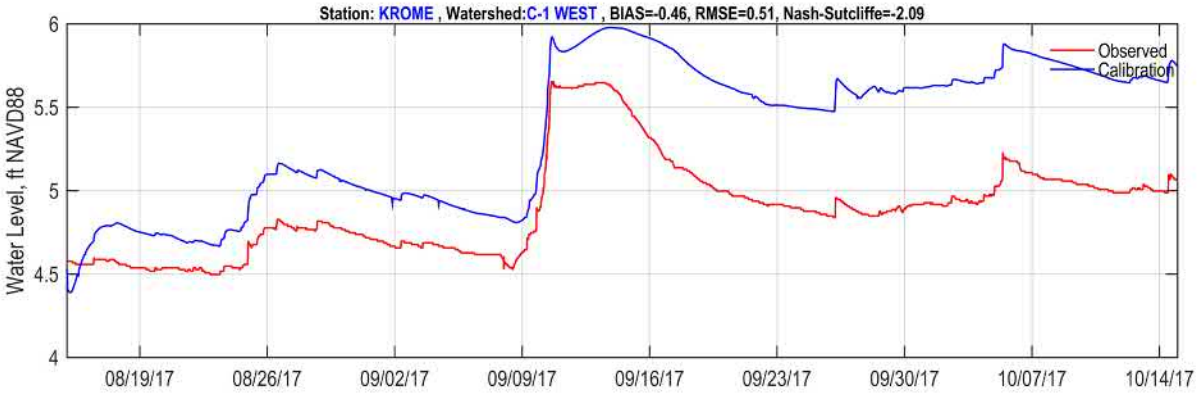


Figure 40 Watershed C-1 Calibration Timeseries for Groundwater Well KROME

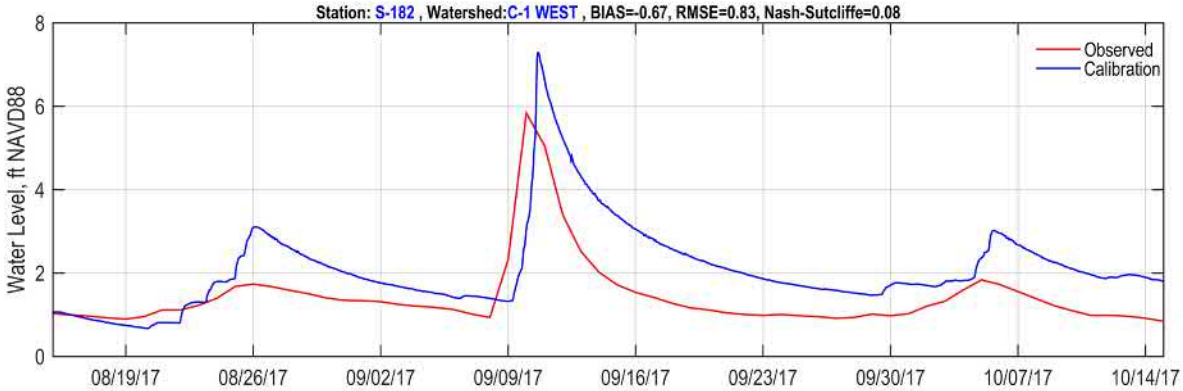


Figure 41 Watershed C-1 Calibration Timeseries for Groundwater Well S-182

The observed and computed timeseries for the surface water timeseries within Watershed C-1 which include the headwater and tailwater of structures S148, S149 and S21 are provided in Figure 42 through Figure 46. The timeseries show acceptable overall Bias within the calibration criterion of 0.5 ft, and relatively good match of computed and observed peak stages.

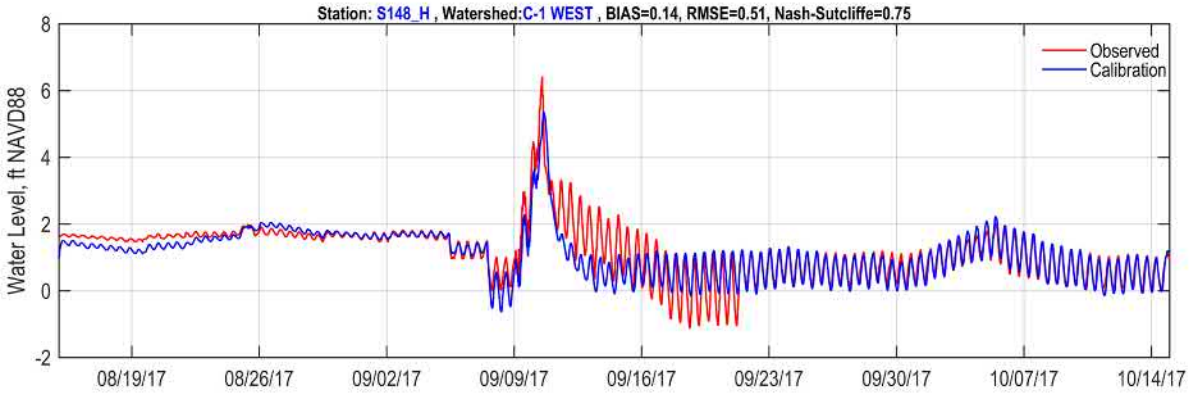


Figure 42 Watershed C-1 Calibration Timeseries of Structure S148 Headwater

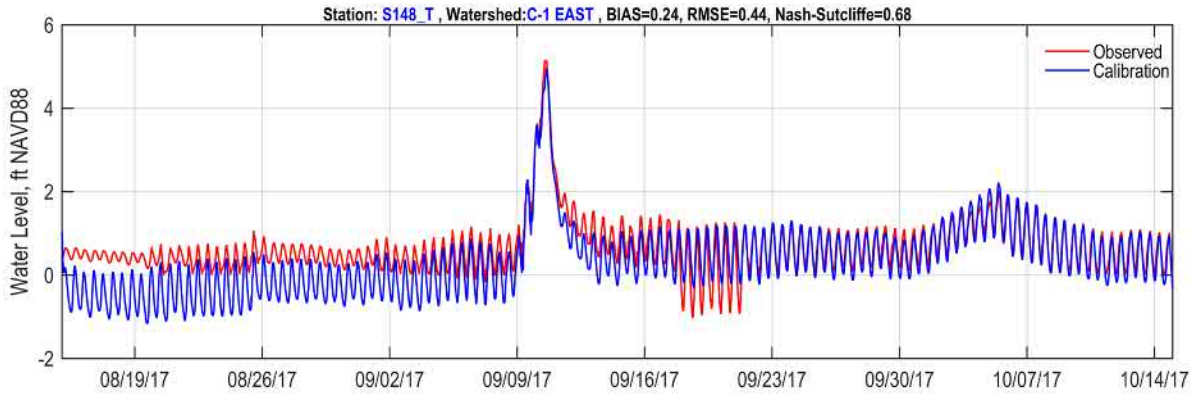


Figure 43 Watershed C-1 Calibration Timeseries of Structure S148 Tailwater

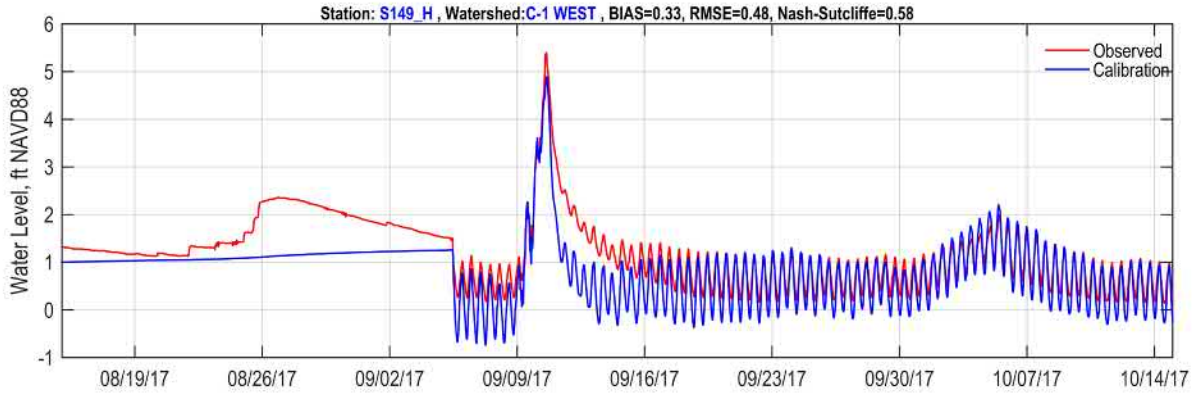


Figure 44 Watershed C-1 Calibration Timeseries of Structure S149 Headwater

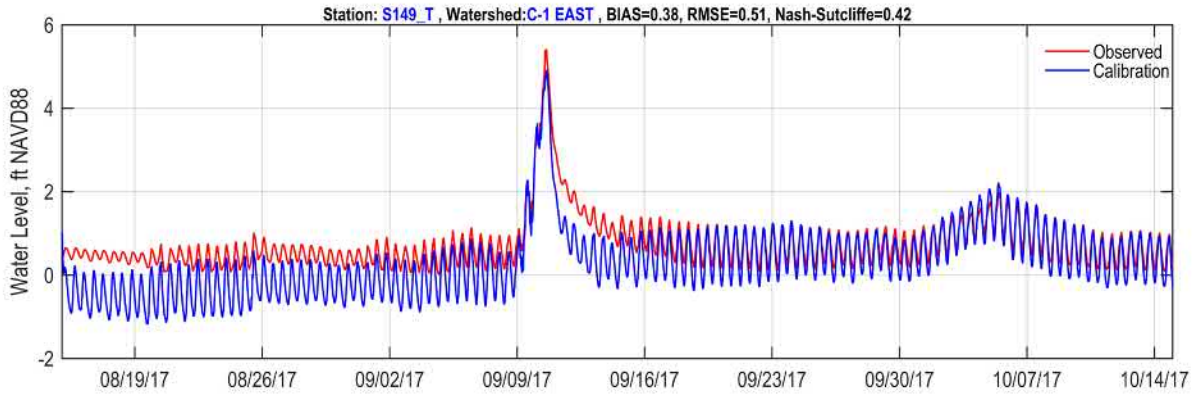


Figure 45 Watershed C-1 Calibration Timeseries of Structure S149 Tailwater

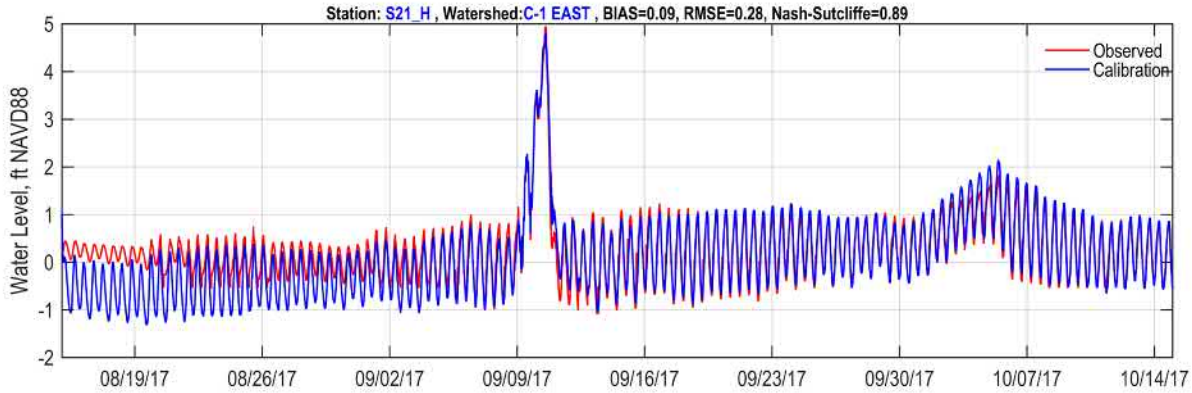


Figure 46 Watershed C-1 Calibration Timeseries Structure S21 Headwater

The observed and computed discharge timeseries for structures within Watershed C-1 are provided in Figure 47 through Figure 52.

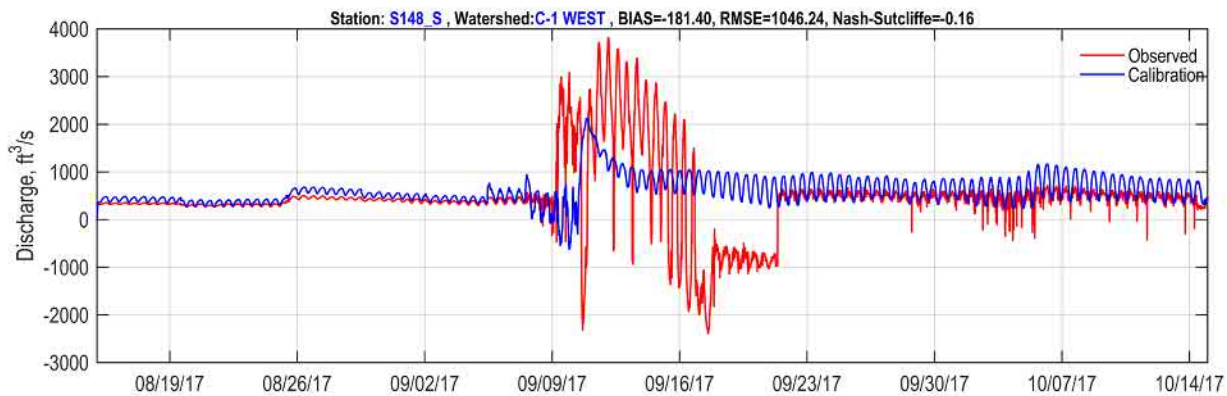


Figure 47 Watershed C-1 Calibration Timeseries of Structure S148 Discharge

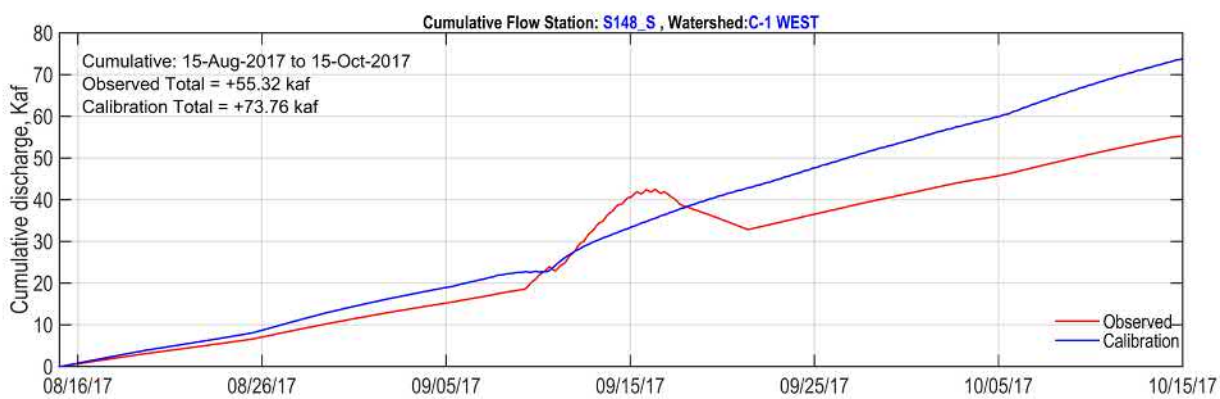


Figure 48 Watershed C-1 Cumulative Discharge at Structure S148

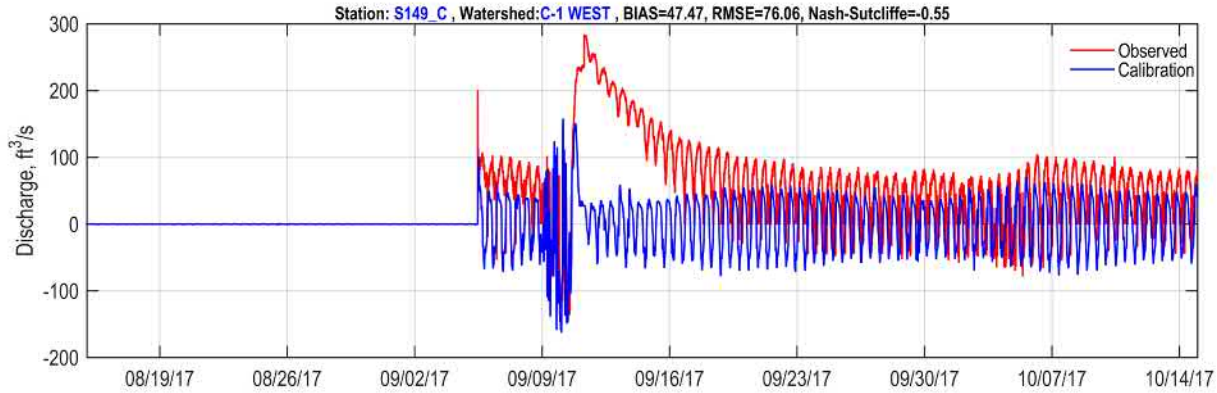


Figure 49 Watershed C-1 Calibration Timeseries Structure S149 Discharge

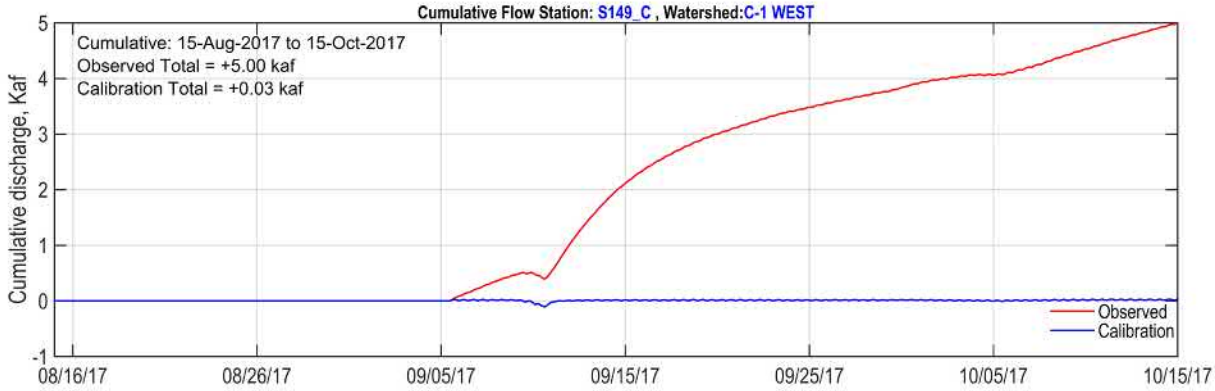


Figure 50 Watershed C-1 Cumulative Discharge at Structure S149

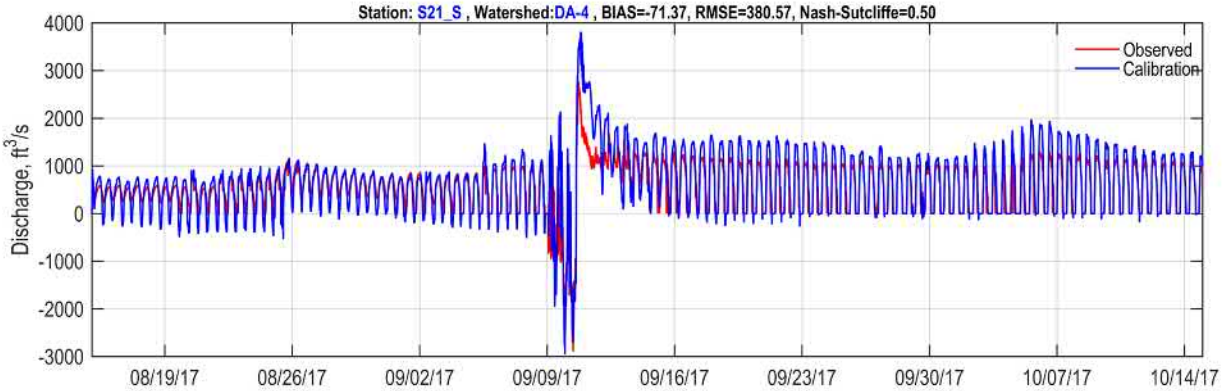


Figure 51 Watershed C-1 Calibration Timeseries Structure S21 Discharge

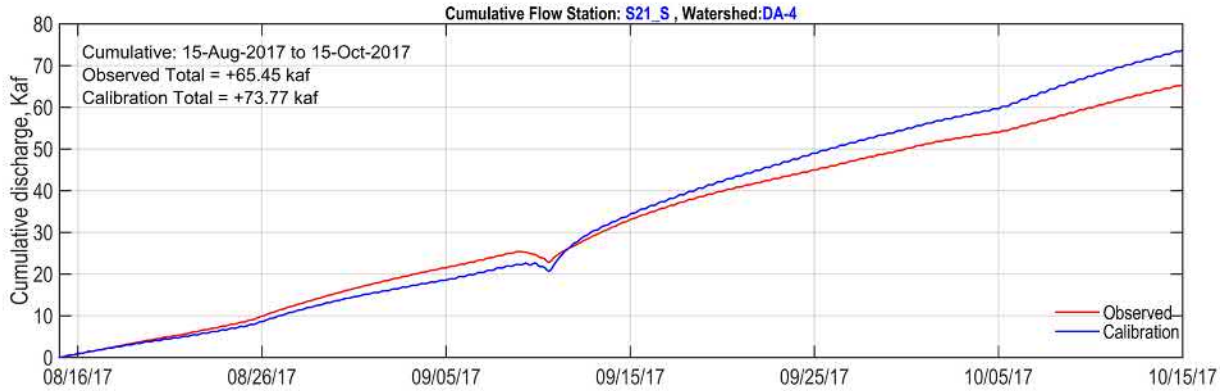


Figure 52 Watershed C-1 Cumulative Discharge at Structure S21

Although, the computed stages show a relatively good match with observed values, the computed discharge of the inland structures had a lower performance, which was attributed to the high sensitivity of flow with respect to head differential across the structures.

The coastal structure has acceptable performance in terms of peak discharge and cumulative flow (Figure 51 and Figure 52).

4.1.1.2 Watershed C-100 Calibration Results

The observed and computed timeseries for the groundwater timeseries within atershed C-100 are provided in Figure 53 through Figure 56. Three of the wells within this watershed (G 553, G 580A, G 860) show acceptable performance in terms of Bias and Peak stages, however, well G-3897 had a higher computed peak stage (difference of 1.90 ft.), while Bias of 0.03 ft. is better represented.

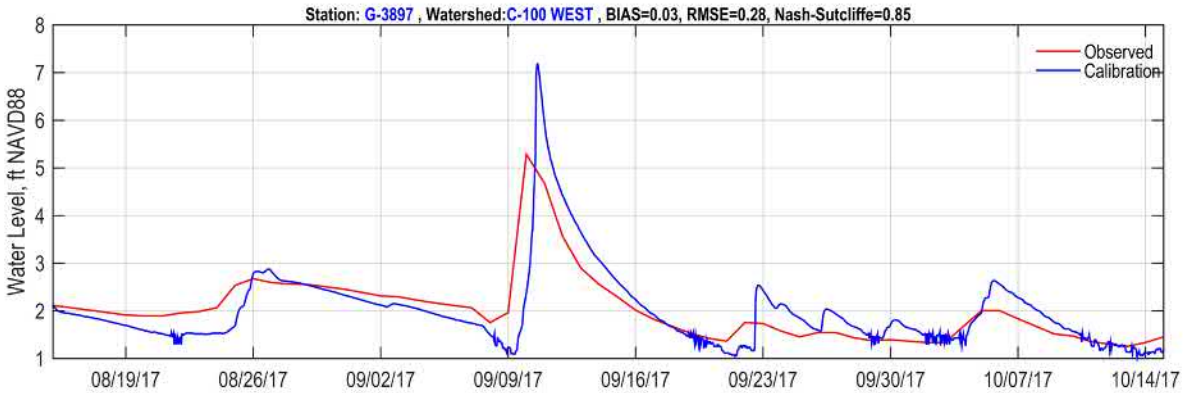


Figure 53 Watershed C-100 Calibration Timeseries for Groundwater Well G-3897

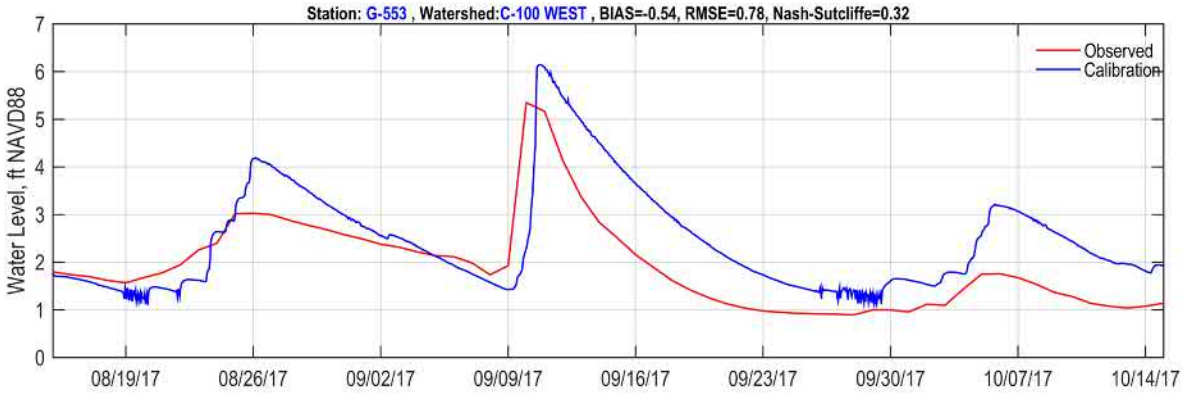


Figure 54 Watershed C-100 Calibration Timeseries for Groundwater Well G-553

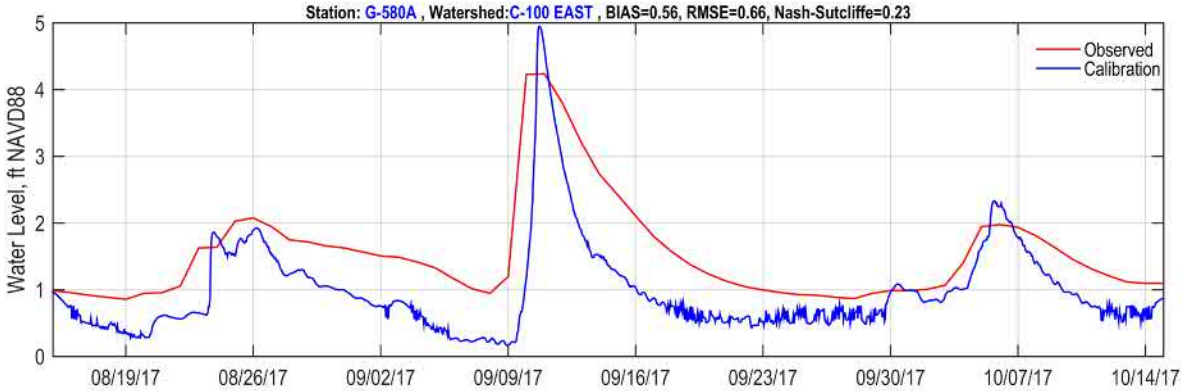


Figure 55 Watershed C-100 Calibration Timeseries for Groundwater Well G-580A

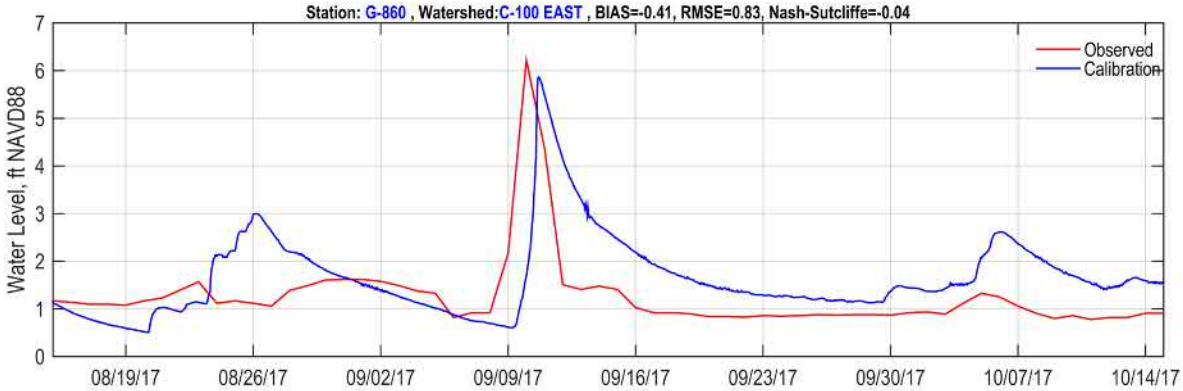


Figure 56 Watershed C-100 Calibration Timeseries for Groundwater Well G-860

The observed and computed timeseries for the surface water timeseries within Watershed C-100 are provided in Figure 57 through Figure 61. The headwater and tailwater timeseries at structures S118, S119 and S123 showed an acceptable response with respect to all statistic parameters.

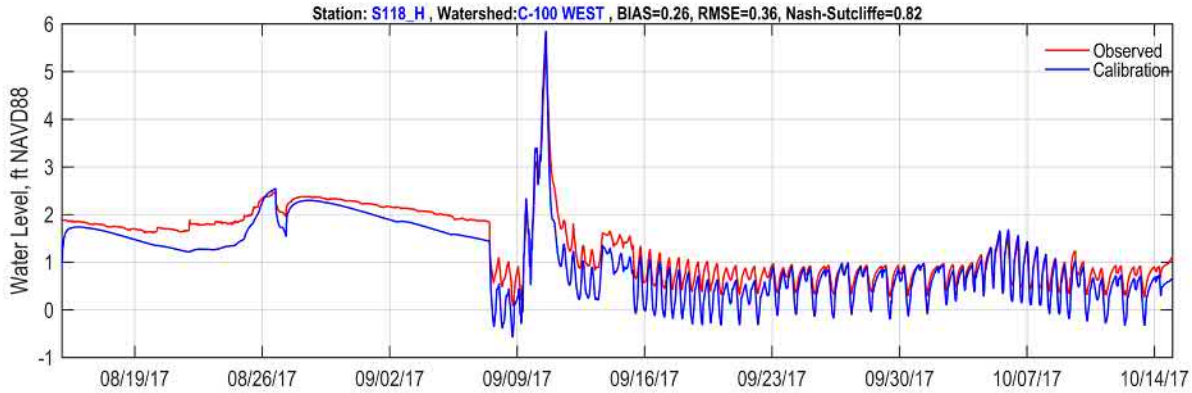


Figure 57 Watershed C-100 Calibration Timeseries of Structure S118 Headwater

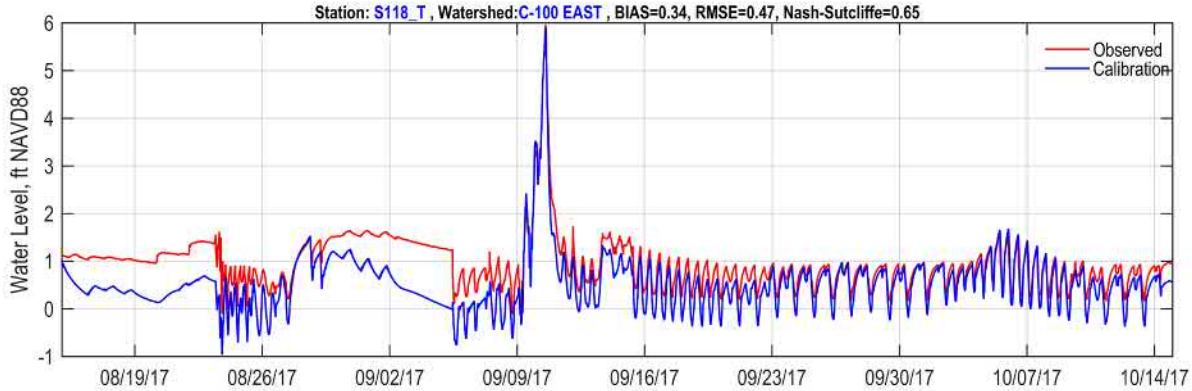


Figure 58 Watershed C-100 Calibration Timeseries of Structure S118 Tailwater

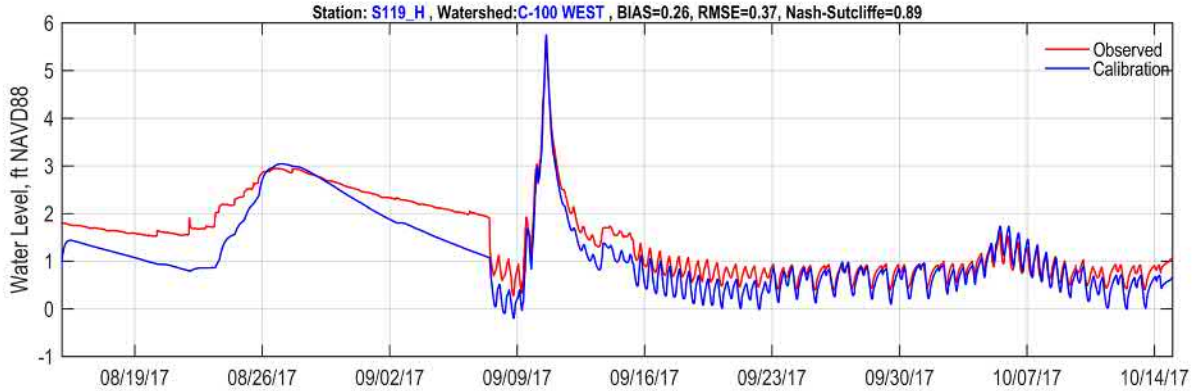


Figure 59 Watershed C-100 Calibration Timeseries of Structure S119 Headwater

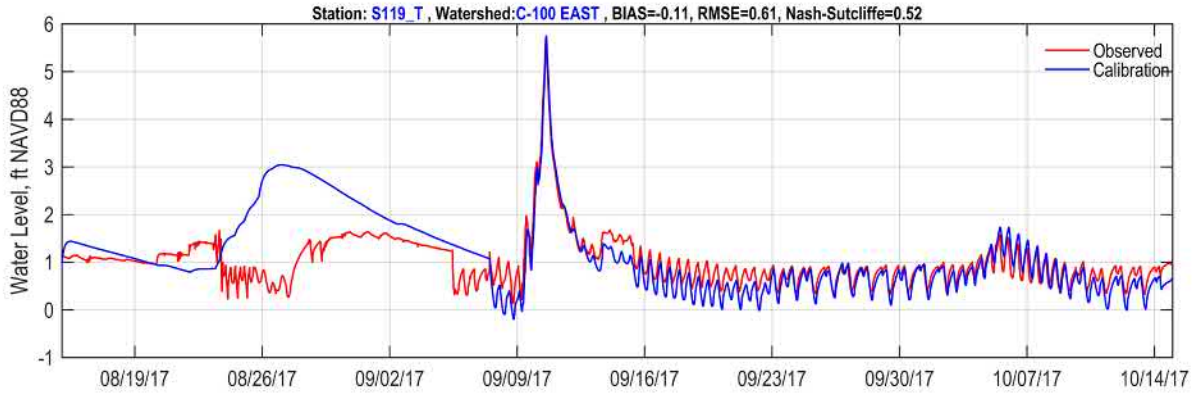


Figure 60 Watershed C-100 Calibration Timeseries of Structure S119 Tailwater

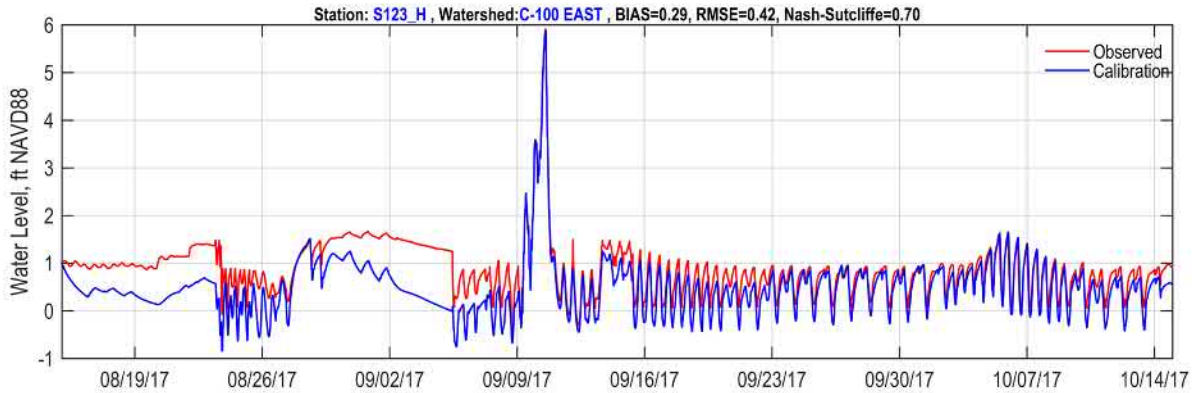


Figure 61 Watershed C-100 Calibration Timeseries of Structure S123 Headwater

The observed and computed discharge timeseries for structures within Watershed C-1 are provided in Figure 62 through Figure 67. The discharges in structure S118 had an acceptable peak response (Figure 62), while the computed cumulative discharges underestimate discharges reported in DBHYDRO.

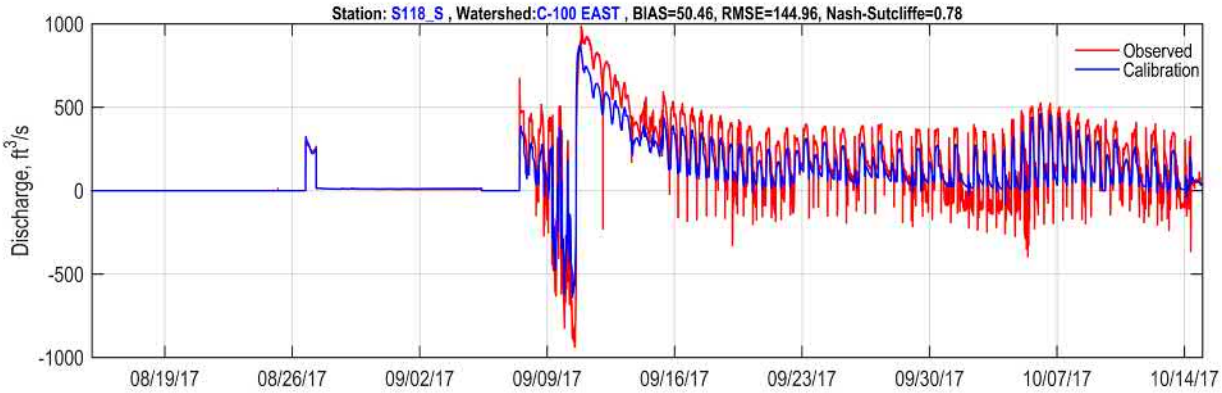


Figure 62 Watershed C-100 Calibration Timeseries of Structure S118 Discharge

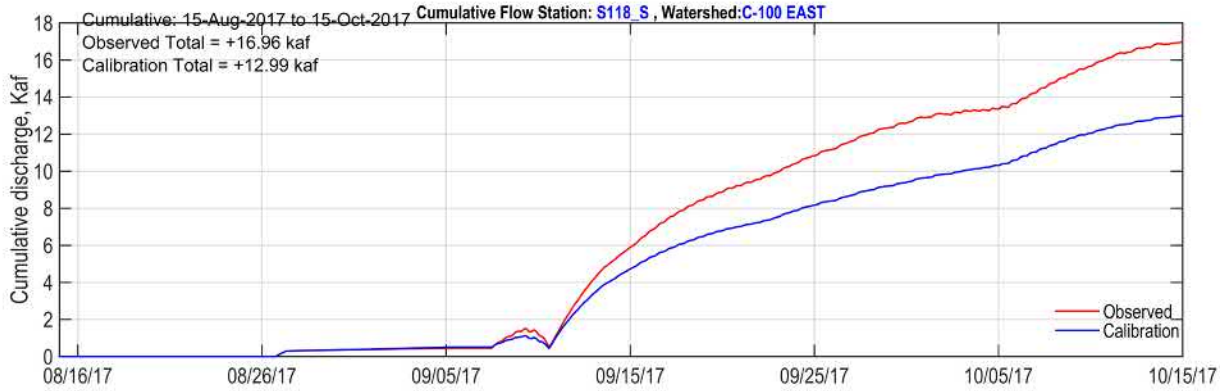


Figure 63 Watershed C-100 Cumulative Discharge at Structure S118

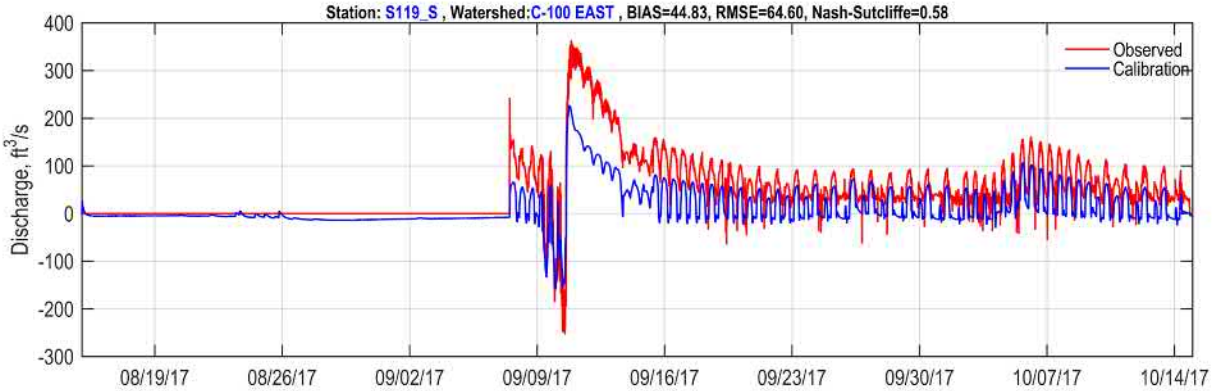


Figure 64 Watershed C-100 Calibration Timeseries of Structure S119 Discharge

The peak and the cumulative discharges at structure S119 were underestimated and the discrepancies were attributed to peak stage differentials for which discharges have high sensitivity.

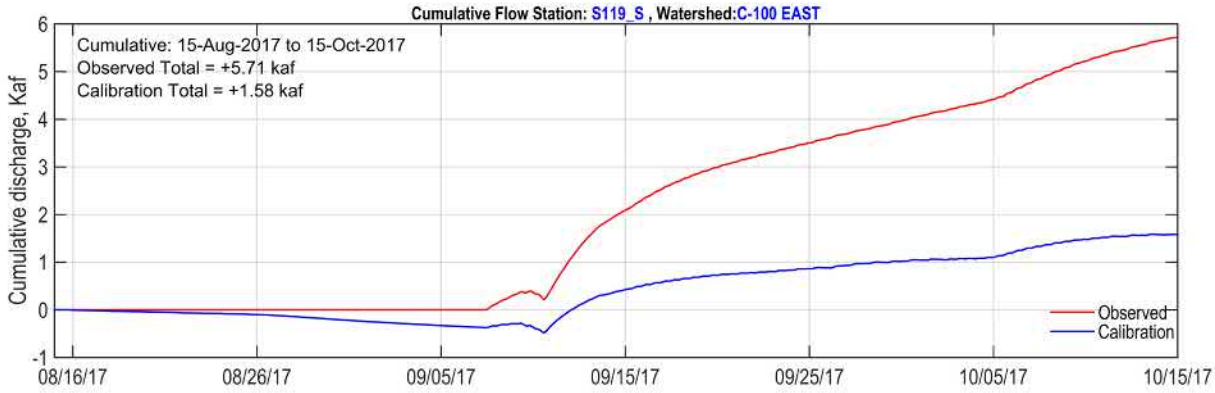


Figure 65 Watershed C-100 Cumulative Discharge at Structure S119

Figure 66 Watershed C-100 Calibration Timeseries of Structure S123 Discharge

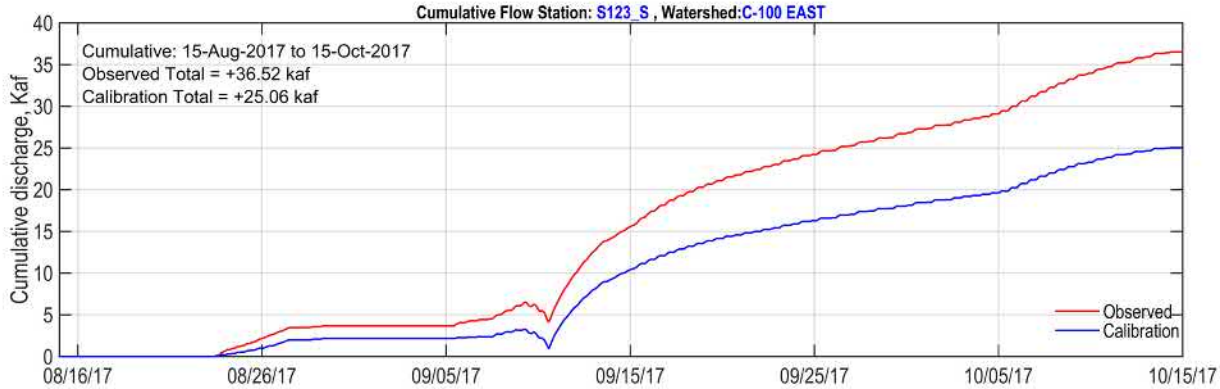


Figure 67 Watershed C-100 Cumulative Discharge at Structure S123

The peak stages at coastal structure S123 are well represented and the performance of structure S21 was assumed acceptable even though the cumulative values deviated more significantly for the entire 2 -month period (Figure 67).

4.1.1.3 Watershed C-102 Calibration Results

The observed and computed timeseries for the groundwater timeseries within Watershed C-102 are provided in Figure 68 through Figure 71.

The response of the groundwater wells within this watershed was considered acceptable in terms of statistic parameters for all four wells.

Figure 68 Watershed C-102 Calibration Timeseries for Groundwater Well BBCMW4G1

Figure 69 Watershed C-102 Calibration Timeseries for Groundwater Well BBCMW4G2

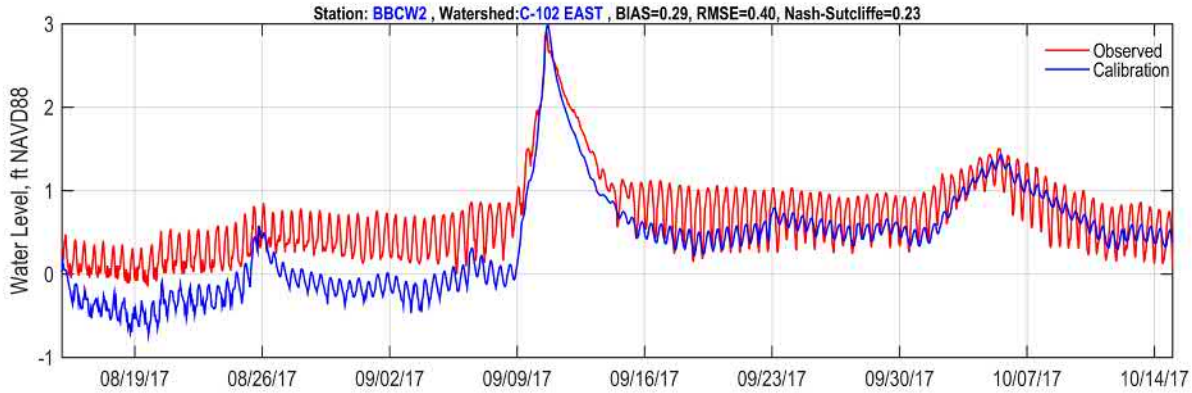


Figure 70 Watershed C-102 Calibration Timeseries for Groundwater Well BBCW2

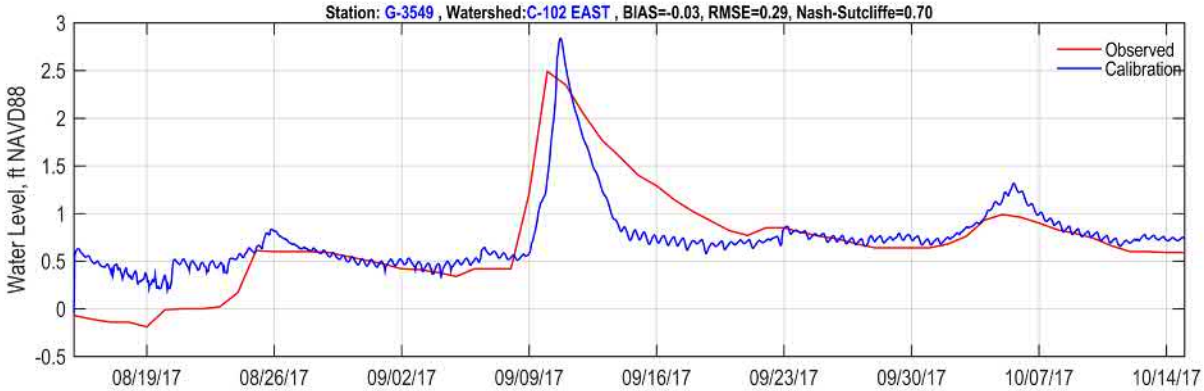


Figure 71 Watershed C-102 Calibration Timeseries for Groundwater Well G-3549

The observed and computed timeseries for the surface water timeseries within Watershed C-102 are provided in Figure 72 through Figure 74. The surface water stages show acceptable representation of the peak stages, however, the computed hydrographs show greater tidal amplitude than the observed data.

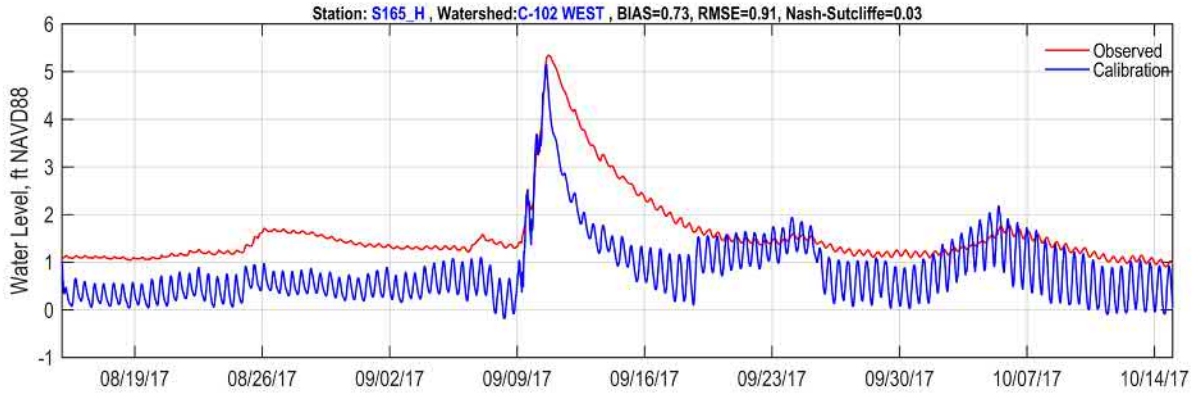


Figure 72 Watershed C-102 Calibration Timeseries of Structure S165 Headwater

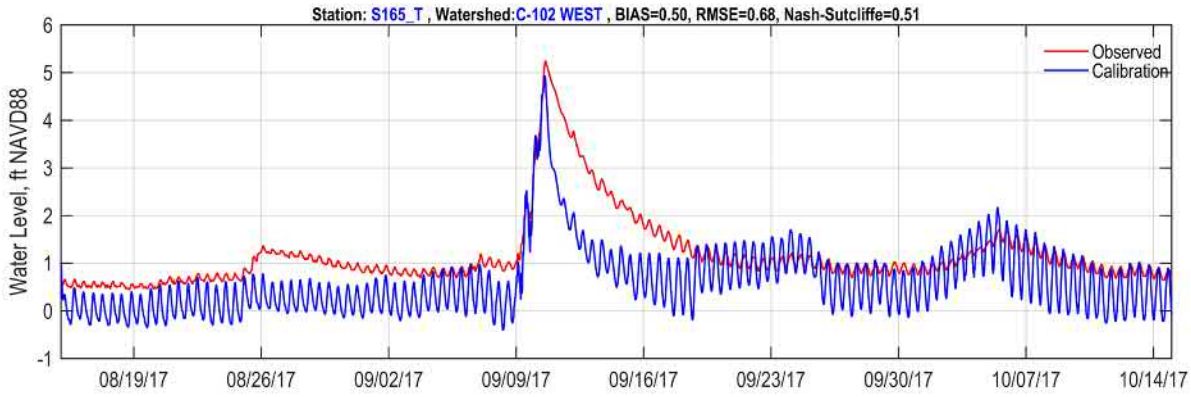


Figure 73 Watershed C-102 Calibration Timeseries of Structure S165 Tailwater

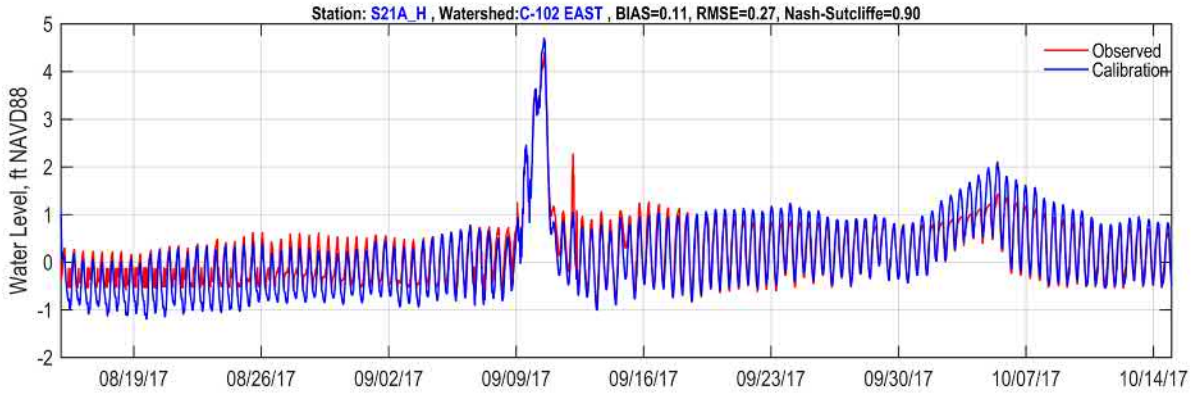


Figure 74 Watershed C-102 Calibration Timeseries of Structure S21A Headwater

The observed and computed discharge timeseries for structures within Watershed C-102 are provided in Figure 75 through Figure 78.

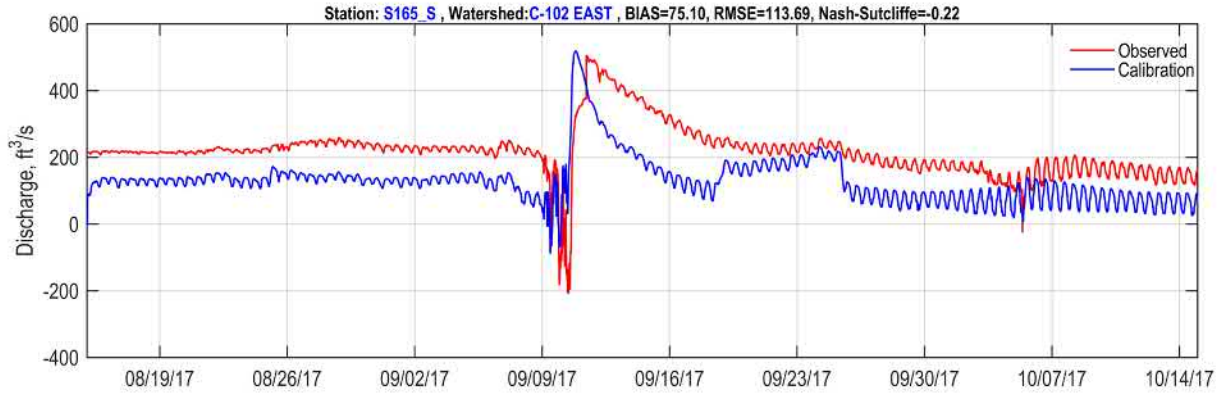


Figure 75 Watershed C-102 Calibration Timeseries of Structure S165 Discharge

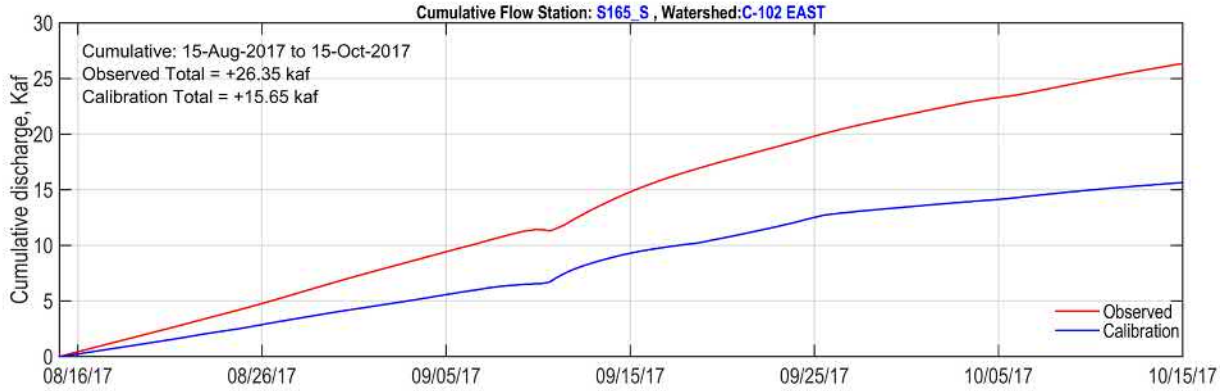


Figure 76 Watershed C-102 Cumulative Discharge at Structure S165

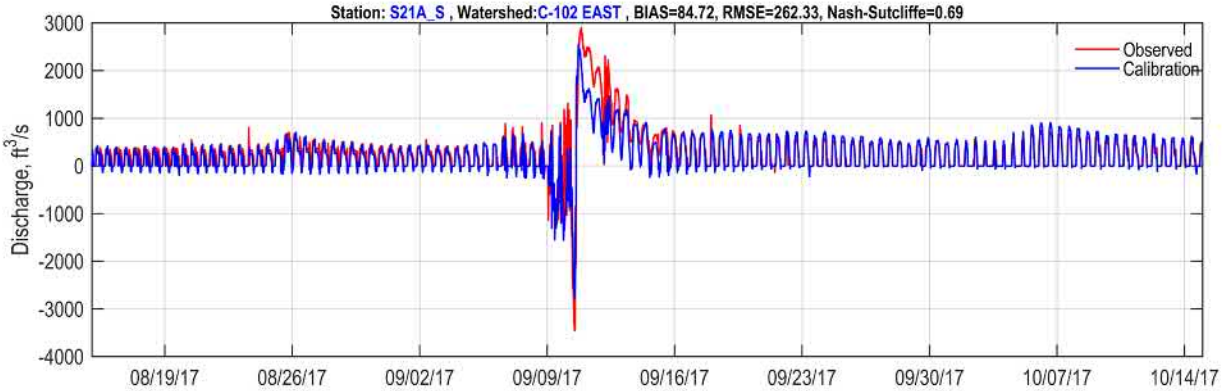


Figure 77 Watershed C-102 Calibration Timeseries of Structure S21A Discharge

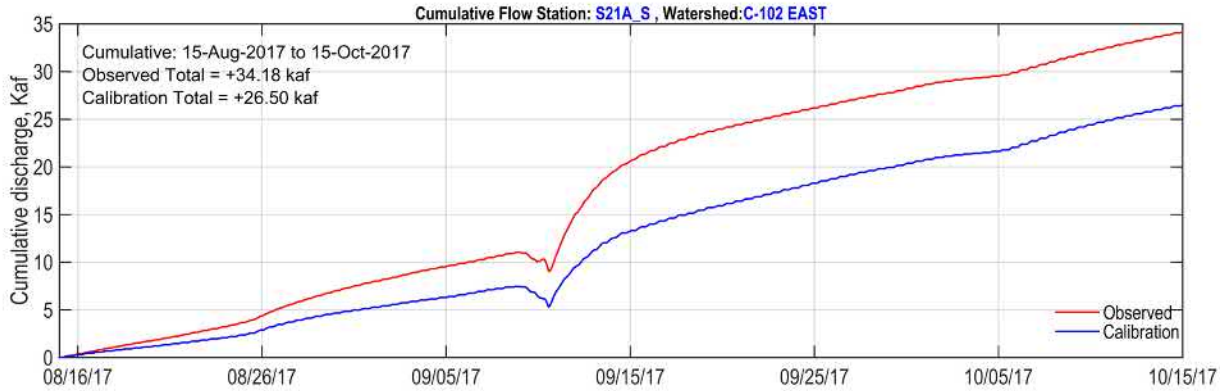


Figure 78 Watershed C-102 Cumulative Discharge at Structure S21A

Computed discharge rates and cumulative flows show similar patterns to observed data with deviations which were attributed to high sensitivity of discharges to head differential across the structures even though the discrepancies between computed and observed stages could be small, the discharges discrepancies tend to be amplified.

4.1.1.4 Watershed C-103 Calibration Results

The observed and computed timeseries for the groundwater timeseries within Watershed C-103 are provided in Figure 79 through Figure 86:

There are eight groundwater stations within the C-103 Watershed. Based on the comparison of data provided in the following figures and the statistical summary, the response of the model is representative of the groundwater stages. Most of the groundwater stages within the C-103 Watershed showed Bias and Peaks within the calibration criterion. Higher discrepancies, with respect to peak values, were observed for wells G-1183 and G-1486. For most of the watershed, the observed values had positive Bias and Peaks and the observed peak stages were greater than the computed.

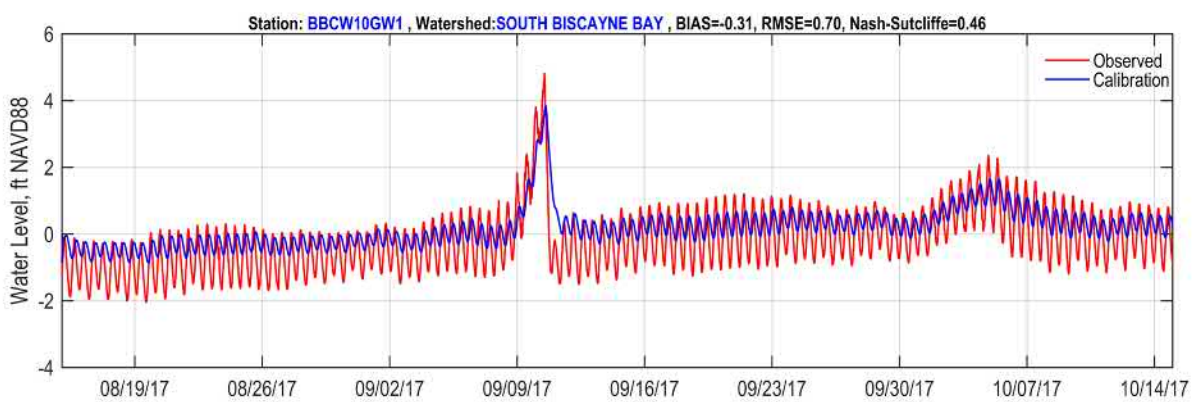


Figure 79 Watershed C-103 Calibration Timeseries for Groundwater Well BBCW10GW1

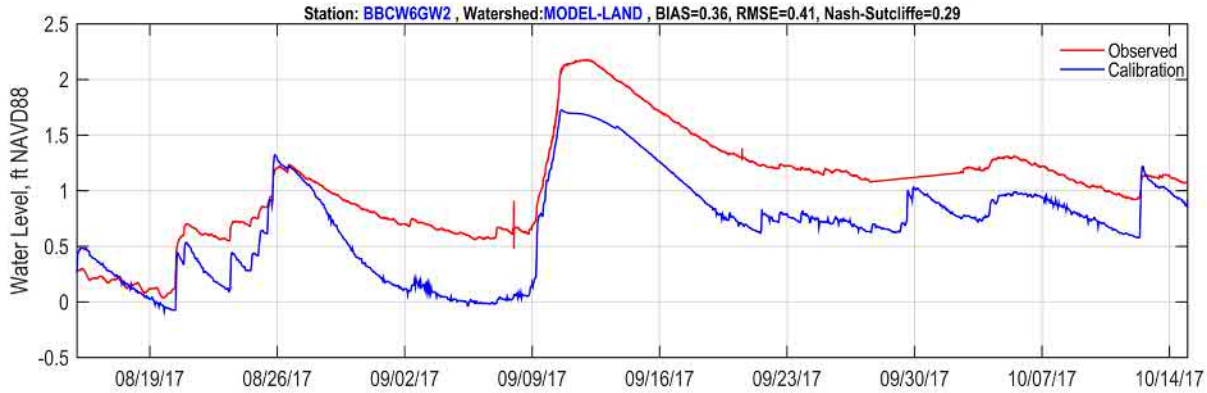


Figure 80 Watershed C-103 Calibration Timeseries for Groundwater Well BBCW10GW2

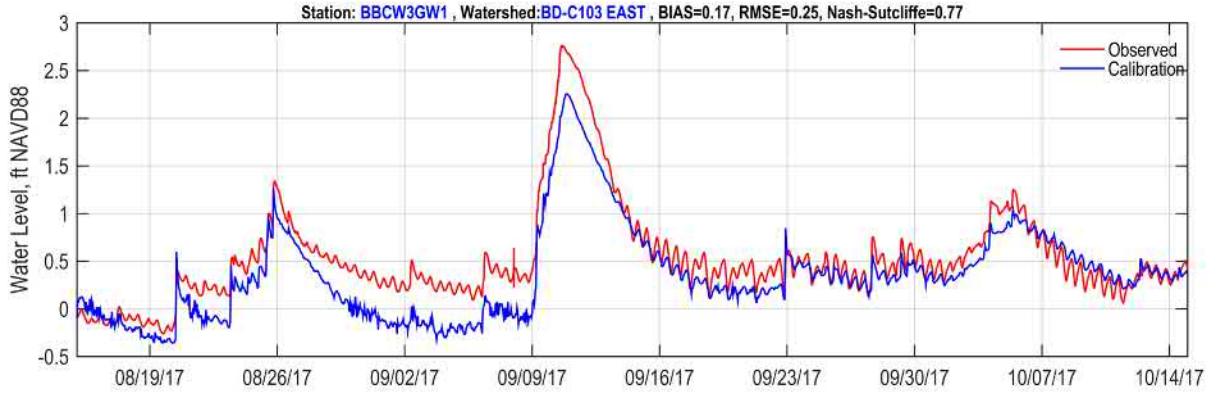


Figure 81 Watershed C-103 Calibration Timeseries for Groundwater Well BBCW3GW1

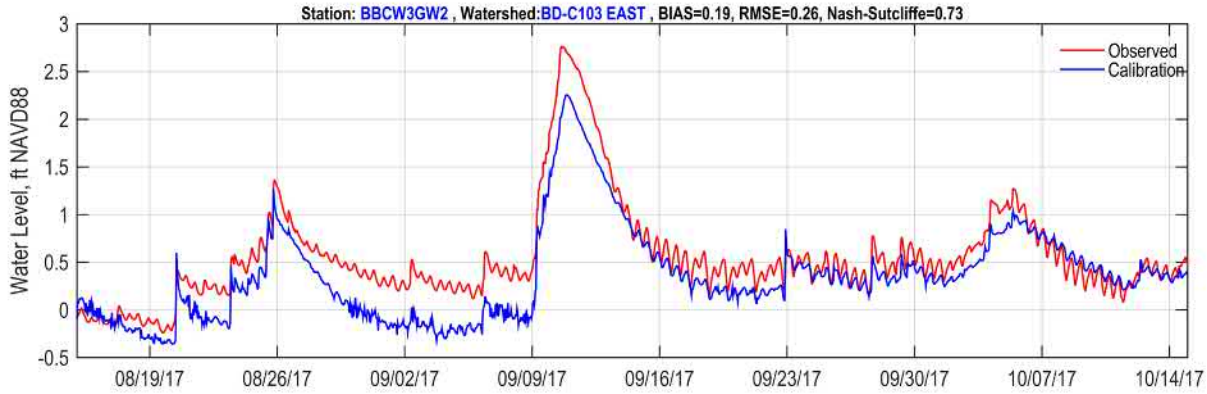


Figure 82 Watershed C-103 Calibration Timeseries for Groundwater Well BBCW3GW2

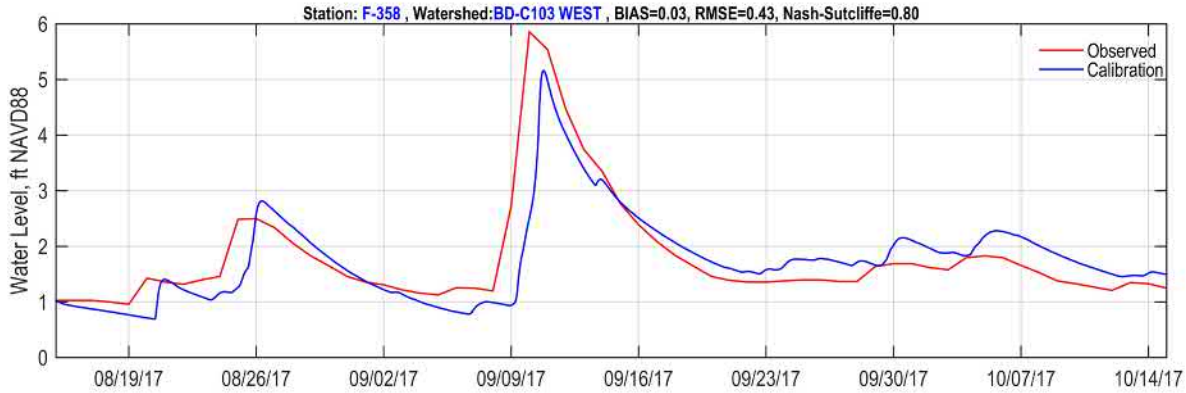


Figure 83 Watershed C-103 Calibration Timeseries for Groundwater Well F-358

Figure 84 Watershed C-103 Calibration Timeseries for Groundwater Well G-1183

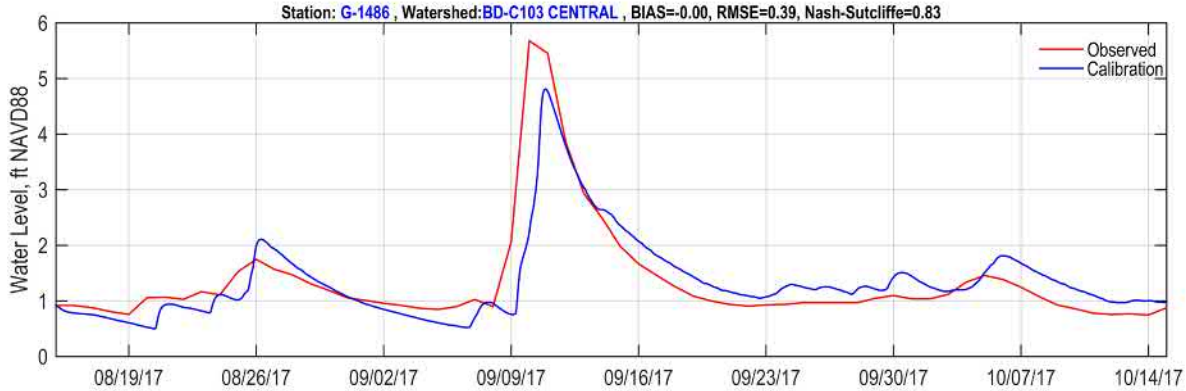


Figure 85 Watershed C-103 Calibration Timeseries for Groundwater Well G-1486

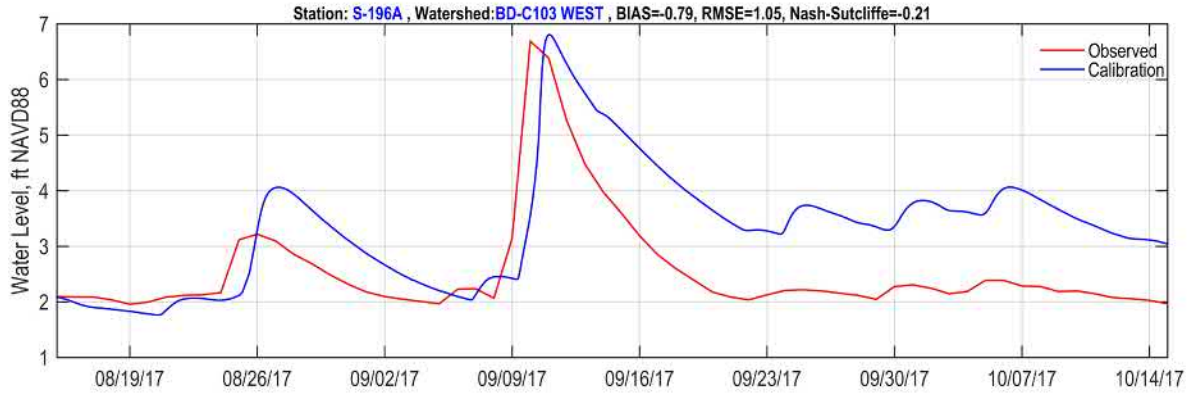


Figure 86 Watershed C-103 Calibration Timeseries for Groundwater Well S-196A

The observed and computed timeseries for the surface water timeseries within Watershed C-103 are provided in Figure 87 through Figure 94. The computed peak stages were acceptably close to observed peak stages, however, they were lower for all inland and coastal structures. For the inland structures, the computed hydrograph shows a recess after the peak which is faster than the observed data.

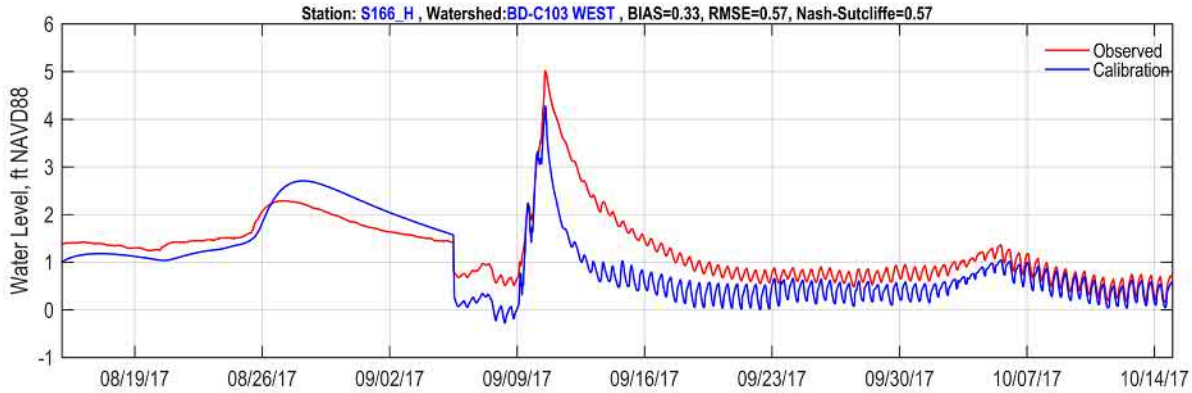


Figure 87 Watershed C-103 Calibration Timeseries of Structure S166 Headwater

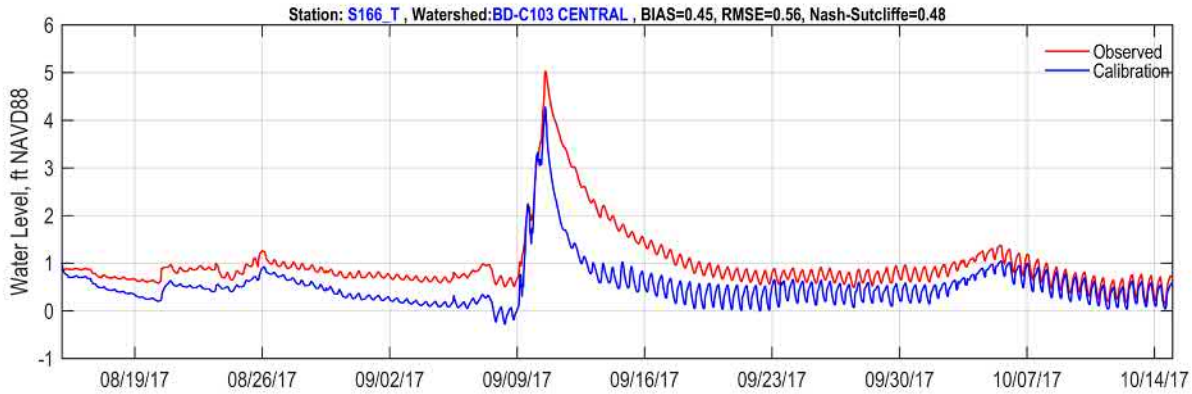


Figure 88 Watershed C-103 Calibration Timeseries of Structure S166 Tailwater

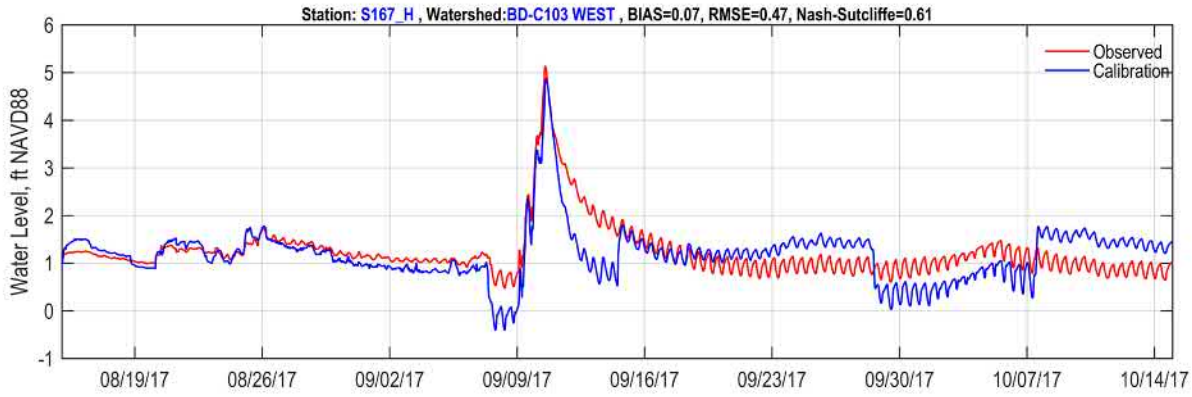


Figure 89 Watershed C-103 Calibration Timeseries of Structure S167 Headwater

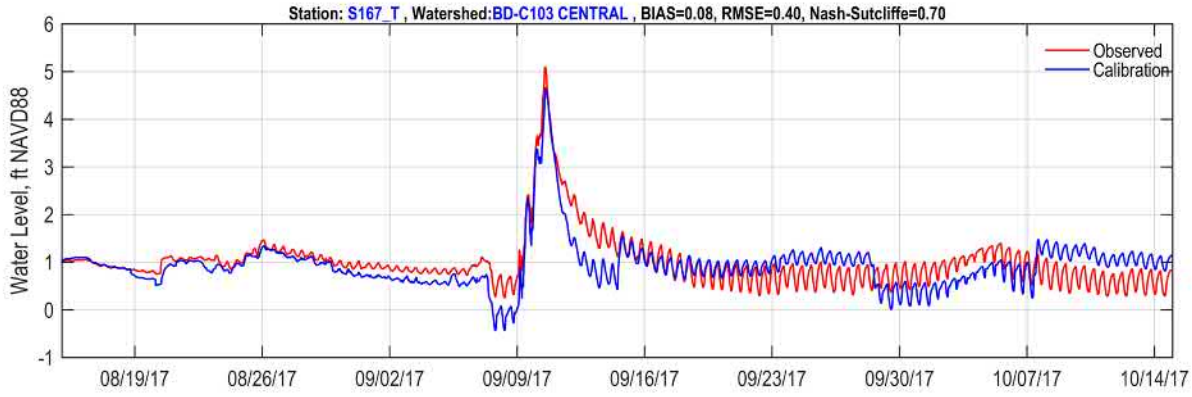


Figure 90 Watershed C-103 Calibration Timeseries of Structure S167 Tailwater

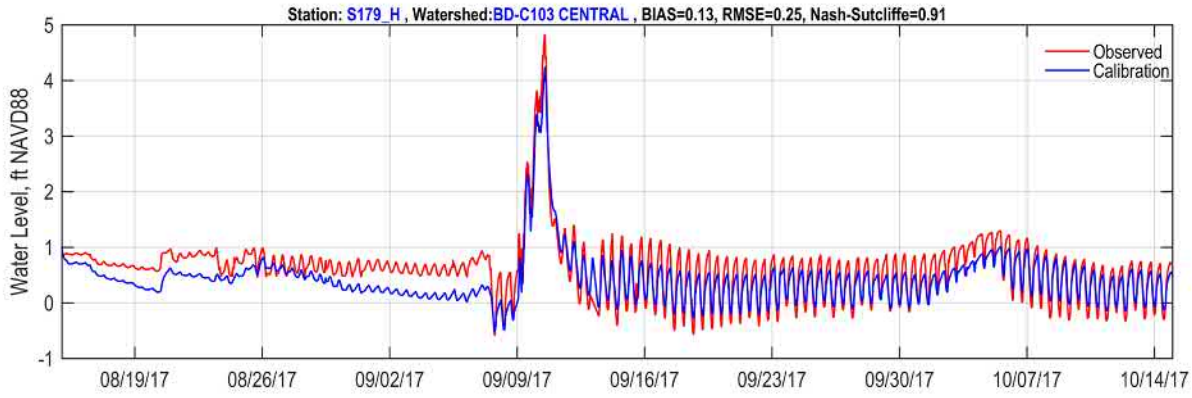


Figure 91 Watershed C-103 Calibration Timeseries of Structure S179 Headwater

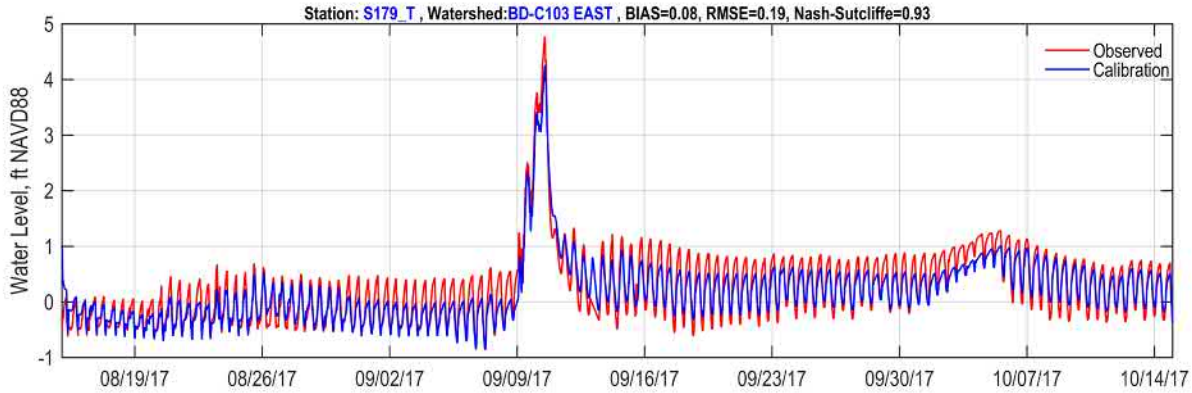


Figure 92 Watershed C-103 Calibration Timeseries of Structure S179 Tailwater

The stages, at the headwater of structures S20F and S20G, show an acceptable close response with a BIAS of 0.10 and 0.11 ft. and are a good match of the peak values.

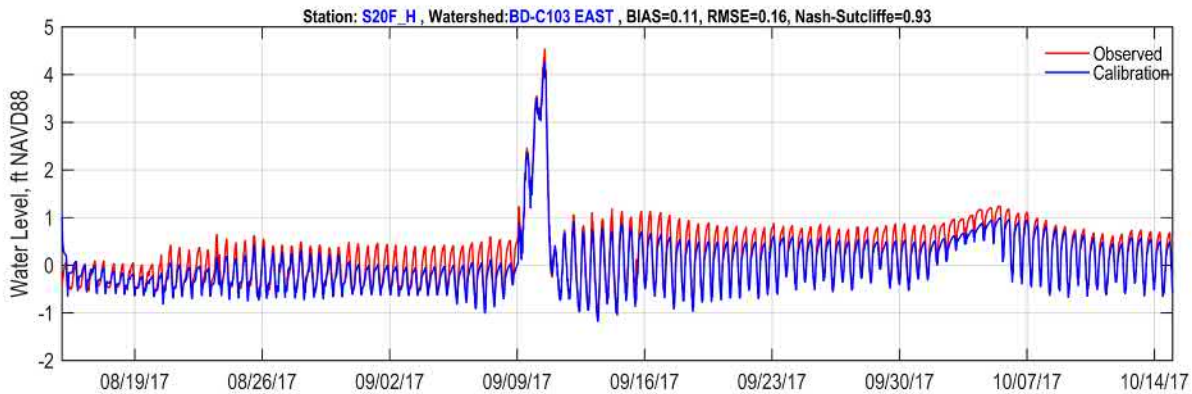


Figure 93 Watershed C-103 Calibration Timeseries of Structure S20F Headwater

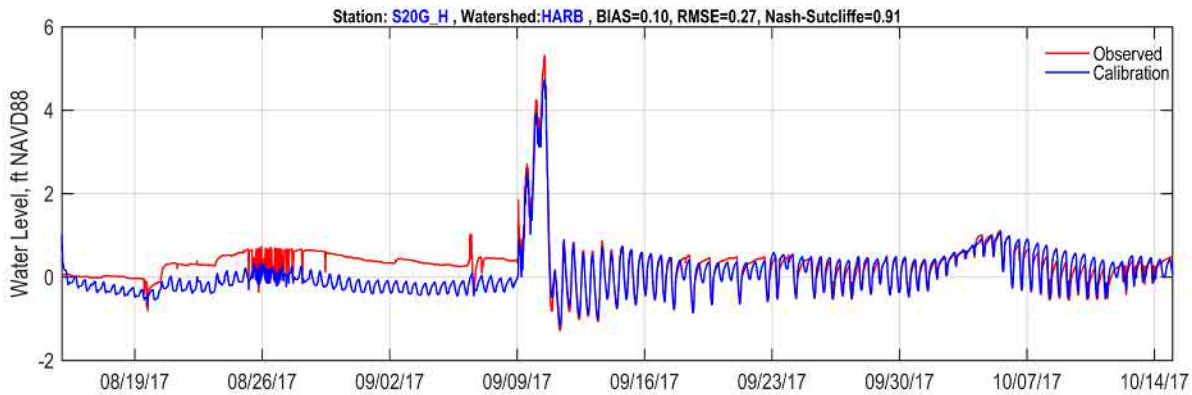


Figure 94 Watershed C-103 Calibration Timeseries of Structure S20G Headwater

The observed and computed discharge timeseries for structures within Watershed C-103 are provided in Figure 95 through Figure 104.

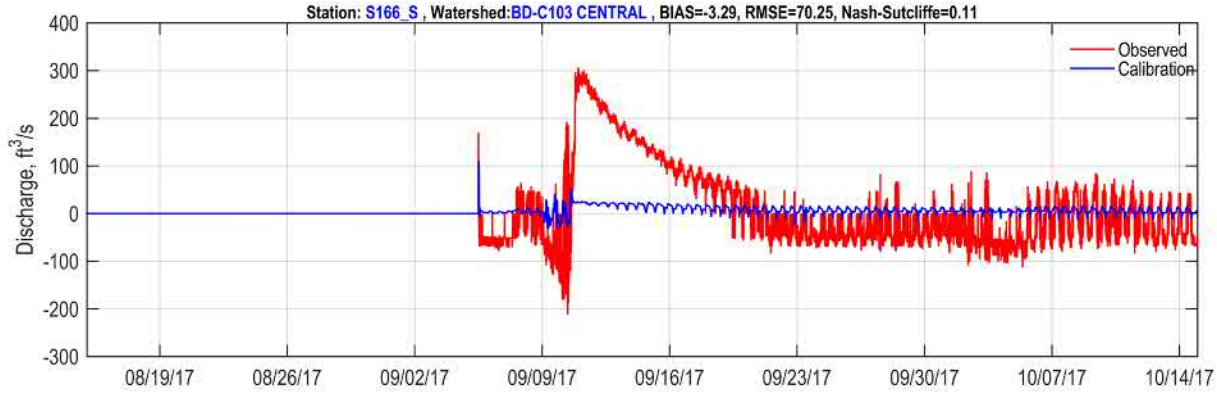


Figure 95 Watershed C-103 Calibration Timeseries of Structure S166

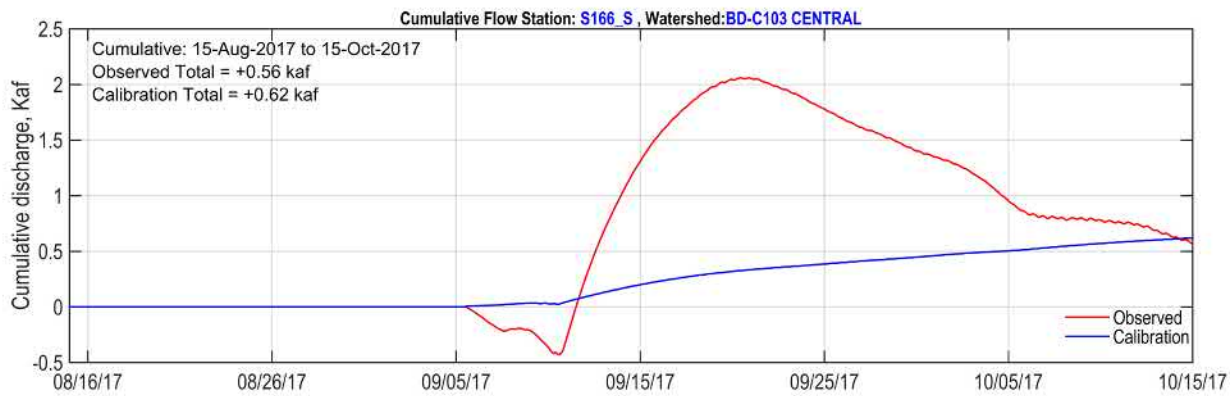


Figure 96 Watershed C-103 Cumulative Discharge at Structure S166

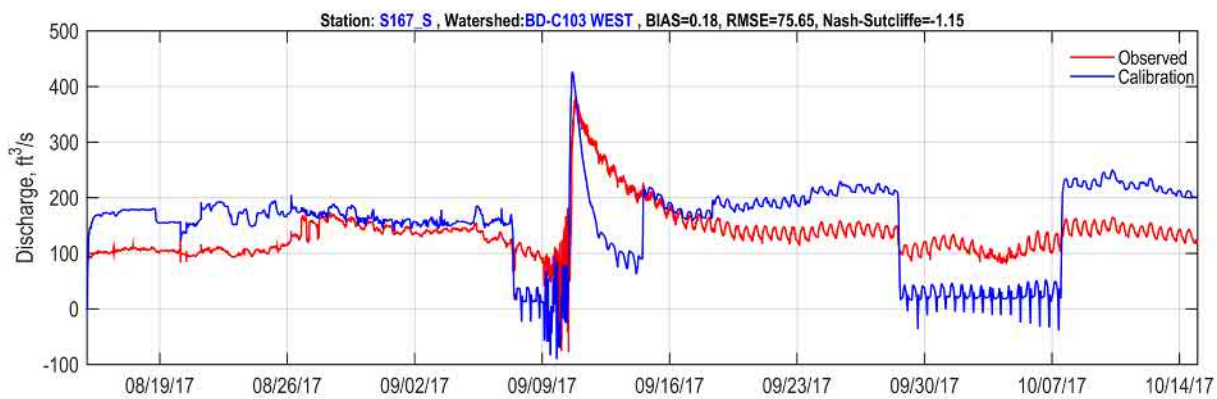


Figure 97 Watershed C-103 Calibration Timeseries of Structure S167 Discharge

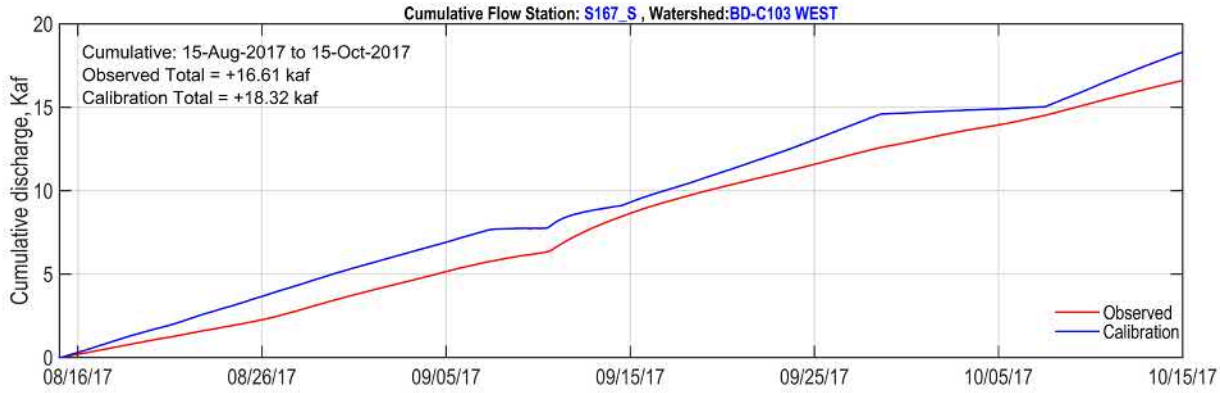


Figure 98 Watershed C-103 Cumulative Discharge at Structure S167

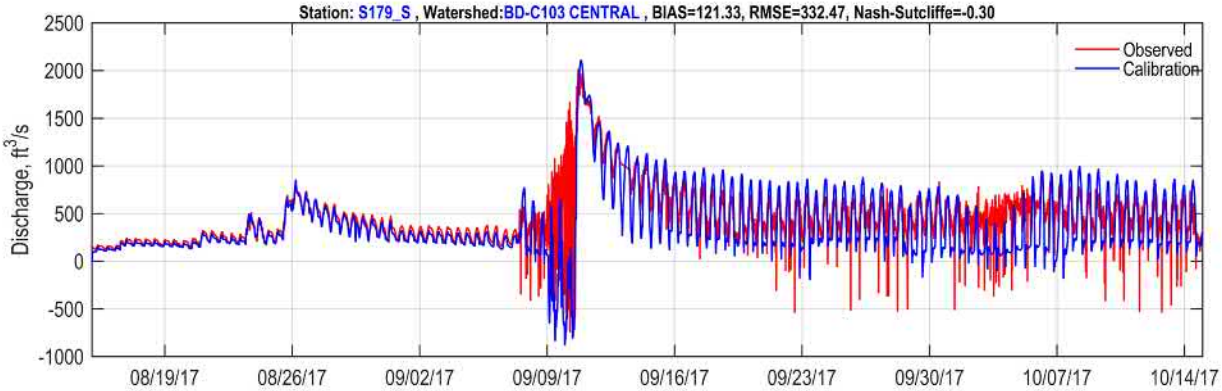


Figure 99 Watershed C-103 Calibration Timeseries of Structure S179 Discharge

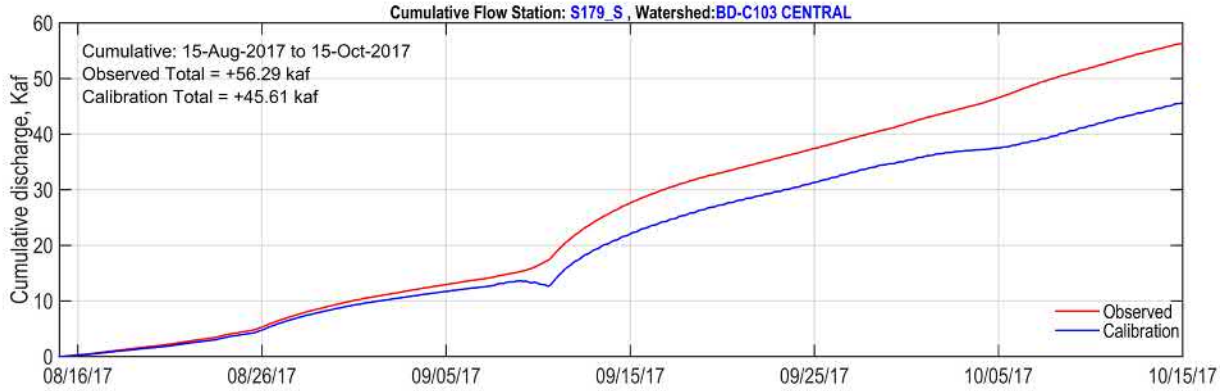


Figure 100 Watershed C-103 Cumulative Discharge at Structure S179

Figure 101 Watershed C-103 Calibration Timeseries of Structure S20F Discharge

The calibration cumulative timeseries of structure S20F shows a good match between observed and computed.

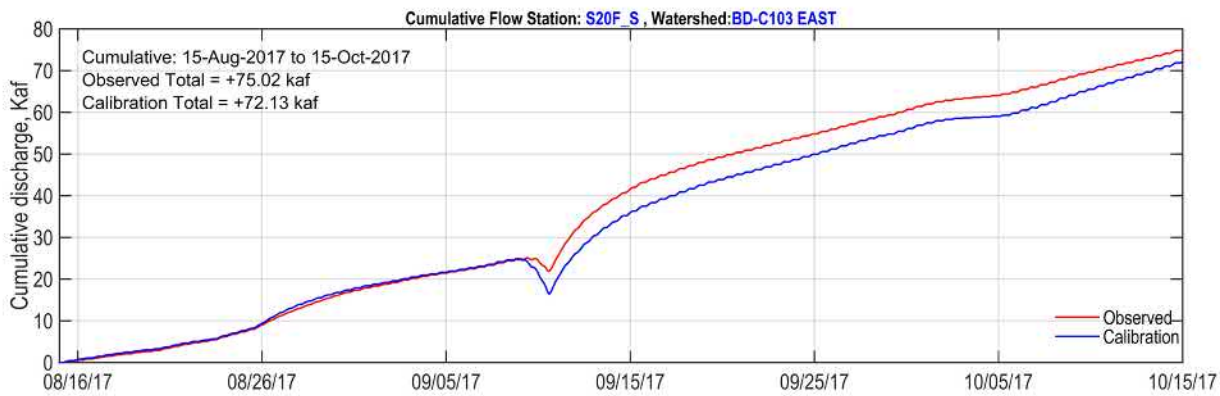


Figure 102 Watershed C-103 Cumulative Discharge at Structure S20F

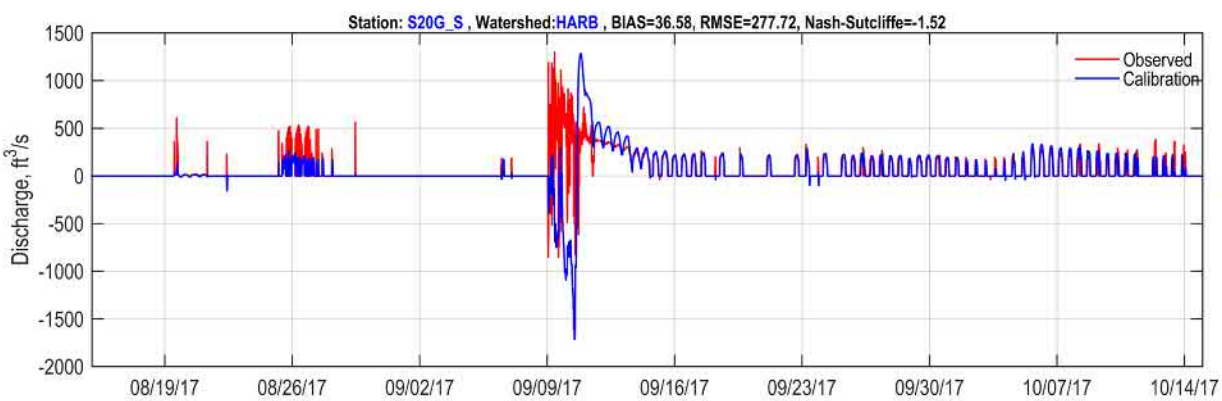


Figure 103 Watershed C-103 Calibration Timeseries of Structure S20G Discharge

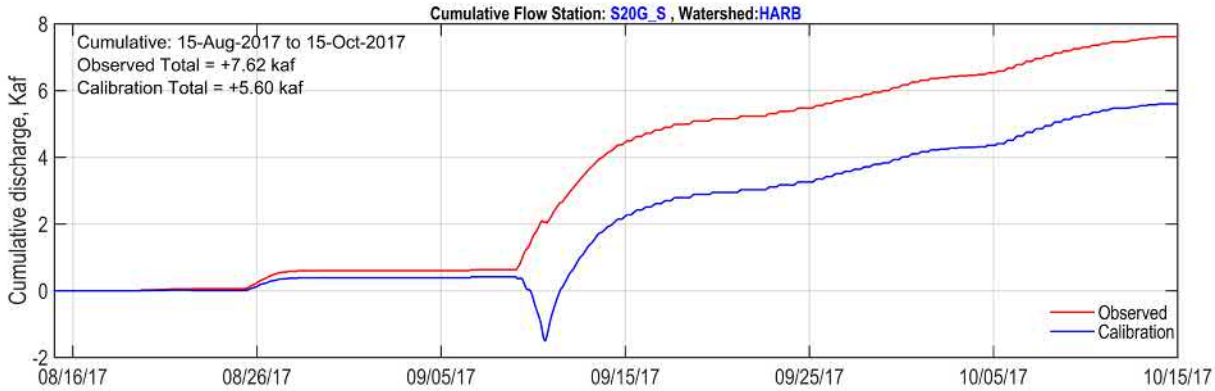


Figure 104 Watershed C-103 Cumulative Discharge at Structure S20G

4.1.1.5 Summary of Calibration Statistics

Calibration statistics are provided for Bias, Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Correlation (COR), Standard Deviation (STD), Bias, Percent Explained Variance (PE), Nash-Sutcliffe Efficiency (NS), Peak Differences (Peak Diff), for surface and groundwater observation stations within the project watersheds (C-1, C-100, C-102 and C-103) and within the entire model domain.

4.1.1.5.1 Calibration Statistics of Surface Water Stations

Within the project watersheds, there are 20 surface water monitoring stations, which include canal stages upstream and downstream of the control structures (Table 31). The table lists the calibration statistics observation stations within the four project watersheds.

The calibration statistics of the surface water stations outside of the four project watersheds are listed in Table 32.

Table 31. Calibration Statistics of Surface Water Stations within Project Watersheds

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
S148_H	C-1	11464	0.14	0.33	0.51	0.88	0.49	0.77	0.75	1.05
S148_T		11788	0.24	0.34	0.44	0.91	0.36	0.78	0.68	0.19
S149_H		10394	0.33	0.36	0.48	0.89	0.34	0.79	0.58	0.51
S149_T		11806	0.38	0.40	0.51	0.91	0.35	0.74	0.42	0.50
S21_H		16847	0.09	0.20	0.28	0.96	0.27	0.90	0.89	0.15
S118_H	C-100	7122	0.26	0.30	0.36	0.97	0.25	0.92	0.82	0.19
S118_T		8713	0.34	0.37	0.47	0.93	0.33	0.83	0.65	0.08
S119_H		6169	0.26	0.29	0.37	0.97	0.26	0.94	0.89	0.02
S119_T		8440	-0.11	0.39	0.61	0.81	0.61	0.53	0.52	0.04
S123_H		9737	0.29	0.32	0.42	0.94	0.31	0.84	0.70	0.03
S165_H	C-102	4098	0.73	0.76	0.91	0.83	0.54	0.65	0.03	0.19
S165_T		3216	0.50	0.55	0.68	0.89	0.47	0.77	0.51	0.32
S21A_H		16996	0.11	0.20	0.27	0.97	0.24	0.91	0.90	0.29
S166_H	C-103	7516	0.33	0.44	0.57	0.85	0.47	0.71	0.57	0.75
S166_T		7694	0.45	0.45	0.56	0.91	0.33	0.81	0.48	0.75
S167_H		5629	0.07	0.39	0.47	0.80	0.46	0.62	0.61	0.25
S167_T		7196	0.08	0.33	0.40	0.85	0.39	0.72	0.70	0.44
S179_H		10467	0.13	0.20	0.25	0.97	0.21	0.94	0.91	0.59
S179_T		14209	0.08	0.15	0.19	0.97	0.17	0.94	0.93	0.52
S20F_H		22770	0.11	0.13	0.16	0.98	0.12	0.97	0.93	0.28

Table 32. Calibration Statistics of Surface Water Stations Outside Project Watersheds C-1, C100, C-102 and C-103

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
3BS1-PZ1	CONSERVATION AREA 3B	6297	0.18	0.18	0.19	1.00	0.05	0.99	0.80	0.13
3BS1-PZ2	CONSERVATION AREA 3B	6137	0.14	0.15	0.15	0.99	0.05	0.98	0.86	0.10
3BS1-PZ3	CONSERVATION AREA 3B	6282	0.04	0.05	0.08	0.99	0.07	0.97	0.97	0.01
3BS1-PZ4	CONSERVATION AREA 3B	6108	0.14	0.14	0.16	0.99	0.08	0.97	0.87	0.03
3BS1W1	CONSERVATION AREA 3B	1441	0.29	0.29	0.30	0.99	0.06	0.98	0.55	0.21
3B-SE	CONSERVATION AREA 3B	1441	0.43	0.43	0.45	0.99	0.12	0.93	0.06	0.34
BBCW10	SOUTH BISCAYNE BAY	6249	-0.33	0.60	0.71	0.70	0.63	0.49	0.35	0.93
C2GSW1	C-2	5605	0.19	0.24	0.28	0.97	0.20	0.92	0.85	0.17
C2SW1	C-2	7216	0.02	0.13	0.16	0.97	0.16	0.93	0.93	0.32
C2SW2	C-2	12451	0.09	0.16	0.19	0.97	0.17	0.93	0.91	0.03
C4EDBSW	C-4	6248	0.24	0.37	0.45	0.92	0.38	0.81	0.73	0.26
CT50R	C-111 COASTAL	1441	-0.16	0.16	0.17	0.98	0.05	0.96	0.58	0.13
CV5NR	C-111 SOUTH	1441	-0.05	0.12	0.14	0.84	0.14	0.70	0.66	0.07
EVER4	C-111 COASTAL	1441	-0.27	0.29	0.29	0.96	0.10	0.91	0.16	0.21
EVER8	C-111 SOUTH	1441	-0.04	0.11	0.15	0.92	0.14	0.81	0.80	0.46
L31NN	EVERGLADES NATIONAL PARK	1441	0.35	0.35	0.36	0.99	0.07	0.97	0.02	0.26
L31W	S332D DETENTION AREA	1441	0.08	0.08	0.10	1.00	0.05	0.98	0.90	0.01
NESRS3	EVERGLADES NATIONAL PARK	1441	0.19	0.19	0.20	0.99	0.05	0.98	0.69	0.15
NESRS3_B	EVERGLADES NATIONAL PARK	5796	0.20	0.20	0.21	0.99	0.05	0.98	0.67	0.16
NTS1	TAYLOR SLOUGH	1441	0.10	0.10	0.11	0.99	0.04	0.99	0.89	0.13
NTS18	SDA	1441	0.21	0.38	0.43	0.97	0.37	0.81	0.74	0.84
G211_H	L-29 CC	3595	-1.32	1.32	1.37	0.79	0.35	0.37	-8.68	1.11
G211_T	L-31N CC	8313	-0.80	0.87	1.01	0.81	0.61	0.57	-0.17	0.10
G422_T	C-4	4082	0.26	0.53	0.67	0.90	0.62	0.71	0.66	0.05
L31NW03GW2	C-111 AG	60	-0.61	0.69	0.77	0.86	0.48	0.72	0.27	0.46
L31NW03GW3	C-111 AG	60	-0.62	0.70	0.78	0.86	0.48	0.72	0.25	0.44
L31NW06GW	L-31NS	61	-0.84	0.84	1.03	0.70	0.60	0.09	-1.74	0.06
NP-31W	TAYLOR SLOUGH	61	-0.03	0.05	0.06	1.00	0.05	0.97	0.96	0.11
NP-NESS20	EVERGLADES NATIONAL PARK	61	0.33	0.33	0.34	0.98	0.08	0.95	0.07	0.21

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
NP-NTS1	TAYLOR SLOUGH	61	0.04	0.05	0.05	0.99	0.03	0.99	0.98	0.05
NP-RG3	EVERGLADES NATIONAL PARK	61	-0.17	0.26	0.29	0.99	0.24	0.89	0.83	0.25
NP-RG4	SDA	1384	-0.15	0.21	0.25	0.99	0.20	0.94	0.90	0.08
NP-ROB	C-111 AG	61	-0.41	0.56	0.61	0.91	0.45	0.78	0.59	0.52
S123_T	SOUTH BISCAYNE BAY	22970	0.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00
S176_H	L-31NS	5453	-0.64	0.69	0.85	0.58	0.56	0.12	-1.01	0.33
S176_T	C-111 AG	5458	-0.48	0.56	0.68	0.68	0.47	0.46	-0.11	1.04
S177_H	C-111 AG	4047	0.11	0.26	0.34	0.81	0.32	0.64	0.60	1.41
S177_T	C-111 SOUTH	10193	-0.26	0.36	0.41	0.92	0.31	0.80	0.65	1.45
S178_H	C-111 AG	6767	-0.16	0.19	0.21	0.97	0.14	0.91	0.79	0.16
S178_T	C-111 SOUTH	6934	-0.11	0.20	0.25	0.96	0.23	0.81	0.77	1.20
S18C_H	C-111 SOUTH	6141	-0.01	0.16	0.23	0.98	0.23	0.85	0.85	0.92
S18C_T	C-111 COASTAL	7306	-0.13	0.20	0.23	0.96	0.19	0.86	0.79	0.96
S197_H	C-111 COASTAL	7549	-0.12	0.14	0.16	0.96	0.11	0.93	0.84	0.56
S197_T	US1	11925	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.00
S199_H	C-111 AG	5858	-0.57	0.62	0.71	0.70	0.43	0.49	-0.42	0.86
S199_T	C-111 COASTAL	5616	0.16	0.47	0.76	0.81	0.75	0.23	0.19	0.65
S20_H	MODEL-LAND	3488	0.53	0.54	0.60	0.85	0.27	0.71	-0.39	1.14
S20_T	DA-4	4160	0.47	0.50	0.68	0.87	0.50	0.72	0.47	2.50
S200_H	C-111 AG	5728	-0.65	0.71	0.79	0.73	0.45	0.54	-0.42	0.91
S200_T	FROG POND DETENTION AREA	6006	0.86	0.88	0.93	0.92	0.36	0.85	0.00	1.11
S20F_T	DA-4	29963	0.00	0.01	0.01	1.00	0.01	1.00	1.00	0.01
S20G_H	HARB	10325	0.10	0.18	0.27	0.96	0.25	0.93	0.91	0.59
S20G_T	DA-4	22529	0.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00
S21_T	DA-4	19233	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.00
S21A_T	DA-4	25750	0.00	0.01	0.01	1.00	0.01	1.00	1.00	0.00
S22_H	C-2	15928	0.01	0.10	0.16	0.98	0.16	0.95	0.95	0.08
S22_T	DA-3-REVISAR	27998	0.00	0.01	0.02	1.00	0.02	1.00	1.00	0.00
S331_H	L-31N CC	9880	-0.80	0.93	1.07	0.75	0.71	0.27	-0.64	0.26

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
S331_T	L-31NS	8994	-0.68	0.71	0.85	0.77	0.52	-0.29	-2.46	0.50
S332B_H	L-31NS	6138	-1.31	1.32	1.54	0.37	0.81	-1.75	-8.97	0.00
S332C_H	L-31NS	6067	-0.63	0.67	0.84	0.55	0.55	-0.25	-1.90	0.39
S332D_H	L-31NS	5780	-0.68	0.70	0.88	0.55	0.56	-0.02	-1.51	0.25
S334_H	EVERGLADES NATIONAL PARK	5656	0.00	0.03	0.06	0.99	0.06	0.97	0.97	0.08
S334_T	L-29 CC	5437	-0.96	0.96	1.04	0.55	0.41	0.01	-5.48	0.25
S335_H	L-30 CC	5411	0.00	0.01	0.01	1.00	0.01	1.00	1.00	0.00
S335_T	L-29 CC	5786	-0.95	0.95	1.03	0.54	0.40	-0.11	-6.35	0.17
S380_H	C-2	3595	0.35	0.43	0.53	0.83	0.40	0.15	-0.48	0.34
S380_T	C-4	3671	0.27	0.38	0.46	0.78	0.37	-0.01	-0.54	0.27
T5W	C-4	3690	-0.02	0.02	0.02	1.00	0.02	1.00	1.00	0.02

A summary of the calibration results for the surface water monitoring stations is provided in **Error! Not a valid bookmark self-reference.**. The table lists the results for each watershed, and for the entire domain.

Table 33. Summary of Calibration Results of Surface Water Stations

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
C1	Total	5	5	5	5	5	5	5	5
	Exceed	5	5	5	5	5	5	4	2
	% Exceed	100%	100%	100%	100%	100%	100%	80%	40%
	Average	0.24	0.32	0.44	0.91	0.36	0.79	0.66	0.48
C-100	Total	5	5	5	5	5	5	5	5
	Exceed	5	5	5	5	4	5	5	5
	% Exceed	100%	100%	100%	100%	80%	100%	100%	100%
	Average	0.25	0.33	0.45	0.92	0.35	0.81	0.72	0.07
C-102	Total	3	3	3	3	3	3	3	3
	Exceed	2	1	2	3	2	3	2	3
	% Exceed	67%	33%	67%	100%	67%	100%	67%	100%
	Average	0.44	0.50	0.62	0.89	0.42	0.78	0.48	0.27
C-103	Total	7	7	7	7	7	7	7	7
	Exceed	7	7	7	7	7	7	6	3
	% Exceed	100%	100%	100%	100%	100%	100%	86%	43%
	Average	0.18	0.30	0.37	0.91	0.31	0.81	0.73	0.51
Project Watersheds	Total	20	20	20	20	20	20	20	20
	Exceed	19	18	19	20	18	20	17	13
	% Exceed	95%	90%	95%	100%	90%	100%	85%	65%
	Average	0.25	0.34	0.45	0.91	0.35	0.80	0.67	0.36
Entire Model	Total	89	89	89	89	89	89	89	89
	Exceed	71	66	72	74	75	73	59	63
	% Exceed	80%	74%	81%	83%	84%	82%	66%	71%
	Average	0.30	0.36	0.43	0.89	0.28	0.71	0.70	0.38

The calibration results show that 80% of the stations exceed the Bias criterion of 0.50 ft. with an average within 0.30 ft, 83% of the stations exceed the COR criterion, and 82% and 66% exceed the PE and NS criteria. The peak difference of observed minus computed is exceeded for 71% of the stations with an overall average of 0.38 ft.

The peak timing of the surface water stations is provided in Table 34 and includes the computed and observed peak values and differences.

Table 34. Peak Timing of Surface Water Stations within Project Watersheds

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max Obs ft	Max Comp ft	Diff ft
S148_T	C-1	9/10/17 12:24	9/10/17 14:30	2:06	5.14	4.95	0.19
S149_H		9/10/17 14:12	9/10/17 14:40	0:28	5.41	4.90	0.51
S149_T		9/10/17 14:24	9/10/17 14:40	0:16	5.42	4.91	0.50
S21_H		9/10/17 13:08	9/10/17 13:55	0:47	4.95	4.80	0.15
S118_H		9/10/17 13:56	9/10/17 14:00	0:04	5.66	5.85	0.19
S118_T	C-100	9/10/17 13:24	9/10/17 13:50	0:26	5.97	5.89	0.08
S119_H		9/10/17 14:01	9/10/17 14:25	0:24	5.74	5.75	0.02
S119_T		9/10/17 13:52	9/10/17 14:25	0:33	5.72	5.75	0.04
S123_H		9/10/17 13:31	9/10/17 13:15	0:16	5.92	5.89	0.03
S165_H		9/10/17 17:41	9/10/17 14:30	3:11	5.34	5.16	0.19
S165_T	C-102	9/10/17 14:45	9/10/17 13:30	1:15	5.25	4.93	0.32
S21A_H		9/10/17 13:14	9/10/17 12:55	0:19	4.41	4.71	0.29
S166_H		9/10/17 13:02	9/10/17 13:15	0:13	5.03	4.28	0.75
S166_T	C-103	9/10/17 13:02	9/10/17 13:15	0:13	5.03	4.28	0.75
S167_H		9/10/17 12:53	9/10/17 14:40	1:47	5.13	4.88	0.25
S167_T		9/10/17 13:01	9/10/17 13:20	0:19	5.10	4.66	0.44
S179_H		9/10/17 12:40	9/10/17 12:50	0:10	4.83	4.24	0.59
S179_T		9/10/17 12:21	9/10/17 12:50	0:29	4.77	4.25	0.52
S20F_H		9/10/17 12:33	9/10/17 12:20	0:13	4.55	4.27	0.28

Most of the peaks (80%) are within the range of 0.5 hours and 20% of the peak differences are greater than the criterion of 0.5 hours.

4.1.1.5.2 Calibration Statistics of Groundwater Stations

Within the project watersheds, there are 25 groundwater monitoring stations (Table 35). The table lists the calibration statistics of stations within the four project watersheds.

Table 35. Calibration Statistics of Groundwater Stations within Project Watersheds

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
G-3561	C-1	58	0.51	0.51	0.56	0.95	0.23	0.89	0.31	0.07
G-3889		59	-0.76	0.76	0.83	0.97	0.36	0.83	0.05	2.89
G-3899		54	-0.37	0.47	0.62	0.85	0.50	0.68	0.50	0.46
G-3967		61	0.14	0.34	0.50	0.81	0.49	0.59	0.56	0.40
G-3968		61	-0.41	0.49	0.66	0.81	0.53	0.54	0.26	0.31
G-3969		61	-0.49	0.55	0.71	0.82	0.51	0.56	0.16	0.88
G-855		61	0.53	0.53	0.57	0.95	0.19	0.91	0.17	0.32
KROME		5915	-0.46	0.46	0.51	0.89	0.21	0.46	-2.09	0.26
S-182		61	-0.67	0.74	0.83	0.87	0.49	0.68	0.08	1.45
G-3897	C-100	61	0.03	0.24	0.28	0.93	0.28	0.85	0.85	1.90
G-553		61	-0.54	0.67	0.78	0.84	0.57	0.65	0.32	0.80
G-580A		61	0.56	0.57	0.66	0.88	0.36	0.78	0.23	0.72
G-860		61	-0.41	0.67	0.83	0.60	0.73	0.22	-0.04	0.35
BBCMW4G1	C-102	6073	0.07	0.19	0.24	0.91	0.23	0.73	0.70	0.47
BBCMW4G2		6137	0.23	0.27	0.32	0.92	0.23	0.75	0.50	0.29
BBCW2		11540	0.29	0.34	0.40	0.88	0.28	0.63	0.23	0.08
G-3549		61	-0.03	0.21	0.29	0.87	0.29	0.71	0.70	0.35
BBCW10GW1	C-103	20980	-0.31	0.58	0.70	0.75	0.63	0.56	0.46	1.00
BBCW10GW2		6250	-0.36	0.63	0.75	0.67	0.66	0.45	0.28	0.83
BBCW3GW1		7602	0.17	0.20	0.25	0.94	0.19	0.88	0.77	0.52
BBCW3GW2		7527	0.19	0.22	0.26	0.93	0.18	0.87	0.73	0.52
F-358		61	0.03	0.32	0.43	0.90	0.44	0.80	0.80	0.70
G-1183		61	0.23	0.25	0.41	0.92	0.35	0.81	0.72	1.04
G-1486		61	0.00	0.27	0.39	0.92	0.39	0.83	0.83	0.87
S-196A		61	-0.79	0.92	1.05	0.76	0.70	0.47	-0.21	0.12

The calibration statistics of the groundwater stations outside of the four project watersheds are listed in Table 36.

Table 36. Calibration Statistics of Groundwater Stations Outside Project Watersheds C-1, C100, C-102 and C-103

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
3BS1-GW1	CONSERVATION AREA 3B	6294	0.16	0.16	0.16	1.00	0.04	0.99	0.84	0.12
3BS1-GW2	CONSERVATION AREA 3B	6136	0.18	0.18	0.19	0.99	0.06	0.98	0.79	0.13
3BS1-GW3	CONSERVATION AREA 3B	6286	0.01	0.04	0.06	0.99	0.06	0.98	0.98	0.03
3BS1-GW4	CONSERVATION AREA 3B	6104	0.04	0.05	0.07	0.99	0.06	0.98	0.97	0.02
BBCW6GW2	MODEL-LAND	5705	0.36	0.37	0.41	0.92	0.19	0.85	0.29	0.46
C111AE	C-111 SOUTH	6237	-0.29	0.33	0.35	0.88	0.20	0.77	0.31	0.38
C111AK5	C-111 SOUTH	5760	-0.36	0.44	0.48	0.91	0.32	0.78	0.49	0.56
C111AK6	C-111 SOUTH	5760	-0.35	0.37	0.40	0.91	0.19	0.81	0.12	0.32
C111AW	C-111 SOUTH	6397	-0.29	0.33	0.35	0.92	0.19	0.80	0.34	0.51
C111VC1	C-111 AG	5759	-0.38	0.52	0.56	0.85	0.40	0.67	0.37	0.56
C111VC2	C-111 AG	5760	-0.37	0.50	0.54	0.86	0.40	0.68	0.41	0.45
C111W11	C-111 AG	5760	-0.40	0.54	0.59	0.90	0.43	0.75	0.54	0.72
C111W12	C-111 AG	5761	-0.19	0.33	0.38	0.92	0.33	0.81	0.74	0.40
C111W14	C-111 AG	5759	-0.35	0.43	0.49	0.89	0.34	0.77	0.53	1.79
C111W17	C-111 SOUTH	5760	-0.31	0.36	0.39	0.88	0.24	0.77	0.40	0.55
C2GSW1_GW1	C-2	5594	-0.73	0.76	0.81	0.97	0.36	0.91	0.55	0.30
G-1487	EVERGLADES NATIONAL PARK	61	0.06	0.15	0.21	0.93	0.20	0.81	0.79	0.01
G-3336	C-111 COASTAL	61	-0.15	0.17	0.18	0.93	0.11	0.87	0.64	0.21
G-3338	C-111 SOUTH	6112	-0.10	0.15	0.17	0.96	0.13	0.85	0.75	0.62
G-3339	C-111 SOUTH	6112	-0.06	0.10	0.13	0.96	0.12	0.87	0.83	0.65
G-3437	EVERGLADES NATIONAL PARK	1441	0.37	0.38	0.43	0.97	0.21	0.88	0.52	0.07
G-3553	C-2	61	0.86	0.86	0.89	0.92	0.25	0.73	-2.49	0.30
G-3557	L-29 CC	61	-0.32	0.33	0.39	0.92	0.23	0.70	0.08	0.29
G-3558	C-2	61	-0.39	0.40	0.42	0.93	0.17	0.85	0.02	0.15
G-3560	C-2	58	0.41	0.41	0.46	0.96	0.22	0.83	0.24	0.00
G-3565	C-2	61	0.63	0.63	0.66	0.94	0.21	0.89	-0.09	0.53

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
G-3572	C-2	61	0.18	0.19	0.30	0.95	0.24	0.88	0.81	0.50
G-3574	EVERGLADES NATIONAL PARK	1441	-0.53	0.53	0.57	0.91	0.19	0.50	-3.33	0.35
G-3575	EVERGLADES NATIONAL PARK	1441	0.22	0.23	0.30	0.99	0.20	0.57	0.05	0.17
G-3576	EVERGLADES NATIONAL PARK	1441	0.08	0.08	0.09	1.00	0.03	0.99	0.93	0.08
G-3577	EVERGLADES NATIONAL PARK	1441	0.33	0.33	0.35	0.98	0.12	0.89	0.04	0.16
G-3578	EVERGLADES NATIONAL PARK	1441	0.15	0.15	0.15	0.99	0.04	0.99	0.80	0.08
G-3620	C-111 SOUTH	61	-0.17	0.24	0.27	0.87	0.21	0.74	0.57	0.39
G-3621	C-111 SOUTH	61	0.03	0.12	0.19	0.88	0.19	0.75	0.75	0.61
G-3676	C-4	1441	0.23	0.23	0.28	0.97	0.15	0.85	0.49	0.15
G-3881	C-2	61	-1.12	1.13	1.23	0.90	0.51	0.76	-0.41	1.33
G-3898	C-2	61	0.73	0.73	0.77	0.92	0.25	0.72	-1.67	0.25
G-3900	FLA-CITY	61	0.45	0.45	0.50	0.93	0.22	0.85	0.22	0.61
G-3901	C-111 AG	61	0.15	0.32	0.52	0.88	0.50	0.63	0.60	1.08
G-3903	C-2	61	0.64	0.64	0.68	0.95	0.23	0.91	0.17	0.50
G-3913	C-2	61	-0.96	0.98	1.09	0.90	0.51	0.76	-0.08	1.15
G-3918	C-2	61	1.57	1.57	1.64	0.84	0.45	0.71	-2.96	0.58
G-3927	C-2	61	0.92	0.92	0.94	0.96	0.20	0.93	-0.64	0.54
G-596	8.5 SQ. MILE AREA	1441	-0.97	0.97	1.12	0.77	0.55	0.59	-0.71	0.22
G-613	C-111 AG	61	-0.23	0.35	0.43	0.81	0.36	0.65	0.50	0.72
G-864	C-111 AG	60	0.07	0.43	0.70	0.88	0.70	0.64	0.64	1.44
G-864A	C-111 AG	61	0.00	0.40	0.61	0.89	0.61	0.70	0.70	1.22
HUMBLE	L-31NS	6468	-0.87	0.89	1.04	0.76	0.56	0.42	-0.97	0.22
L31NSGW1	EVERGLADES NATIONAL PARK	6098	-0.39	0.39	0.45	0.94	0.22	0.49	-1.07	0.28
L31NSGW2	EVERGLADES NATIONAL PARK	6091	-0.23	0.28	0.34	0.91	0.25	0.30	-0.29	0.05
L31NSGW3	EVERGLADES NATIONAL PARK	6096	-0.07	0.22	0.24	0.95	0.23	0.42	0.37	0.03
L31NSGW4	EVERGLADES NATIONAL PARK	6093	0.06	0.17	0.20	0.98	0.19	0.61	0.58	0.05
L31NW02GW1	L-31NS	5723	-0.96	1.01	1.16	0.71	0.64	0.41	-0.92	0.39
L31NW02GW2	L-31NS	5726	-0.98	1.03	1.16	0.73	0.63	0.44	-0.94	0.36
L31NW02GW3	L-31NS	5718	-0.96	1.01	1.15	0.72	0.64	0.42	-0.90	0.39

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
L31NW03GW1	C-111 AG	5702	-0.56	0.70	0.78	0.87	0.54	0.73	0.44	1.06
R-158	TAYLOR SLOUGH	61	0.04	0.17	0.24	0.92	0.23	0.78	0.78	0.51
RUTZKE	TAYLOR SLOUGH	61	0.25	0.28	0.41	0.91	0.33	0.82	0.72	0.15

A summary of the calibration results for the ground water monitoring stations is provided in Table 37. The table lists the results for each watershed, and for the entire domain.

Table 37. Summary of Calibration Results of Groundwater Stations

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
C1	Total	9	9	9	9	9	9	9	9
	Exceed	5	4	7	9	7	8	2	6
	% Exceed	56%	44%	78%	100%	78%	89%	22%	67%
	Average	0.48	0.54	0.64	0.88	0.39	0.68	0.26	0.78
C-100	Total	4	4	4	4	4	4	4	4
	Exceed	2	1	2	3	2	3	1	1
	% Exceed	50%	25%	50%	75%	50%	75%	25%	25%
	Average	0.39	0.54	0.64	0.82	0.48	0.62	0.47	0.94
C-102	Total	4	4	4	4	4	4	4	4
	Exceed	4	4	4	4	4	4	2	4
	% Exceed	100%	100%	100%	100%	100%	100%	50%	100%
	Average	0.16	0.25	0.31	0.90	0.26	0.70	0.53	0.30
C-103	Total	8	8	8	8	8	8	8	8
	Exceed	7	5	7	5	5	6	5	1
	% Exceed	88%	63%	88%	63%	63%	75%	63%	13%
	Average	0.26	0.42	0.53	0.85	0.44	0.71	0.65	0.70
Project Watersheds	Total	25	25	25	25	25	25	25	25
	Exceed	18	14	20	21	18	21	10	12
	% Exceed	72%	56%	80%	84%	72%	84%	40%	48%
	Average	0.34	0.46	0.55	0.86	0.40	0.68	0.46	0.70
Entire Model	Total	83	83	83	83	83	83	83	83
	Exceed	60	54	65	74	66	72	35	47
	% Exceed	72%	65%	78%	89%	80%	87%	42%	57%
	Average	0.38	0.46	0.53	0.90	0.32	0.73	0.51	0.52

The calibration results show that 72% of the stations exceed the Bias criterion of 0.50 ft with an average within 0.38 ft, 89% of the stations exceed the COR criterion, and 88% and 42% exceed the PE and NS criteria. The peak difference of observed minus computed is exceeded for 57% of the stations with an overall average of 0.52 ft.

The peak timing of the groundwater stations is provided in Table 38 and includes the computed and observed peak values and differences.

Table 38. Peak Timing Difference for Groundwater Wells within Project Watersheds

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max obs (cfs)	Max comp (cfs)	Diff (cfs)
G-3889	C-1	9/11/17 0:00	9/10/17 15:00	9:00	5.45	8.34	2.89
G-3899		9/10/17 0:00	9/10/17 14:00	14:00	5.81	6.27	0.46
G-3967		9/10/17 0:00	9/10/17 14:00	14:00	5.31	4.91	0.40
G-3968		9/10/17 0:00	9/10/17 14:00	14:00	5.69	6.00	0.31
G-3969		9/10/17 0:00	9/10/17 15:00	15:00	5.69	6.57	0.88
G-855		9/10/17 0:00	9/10/17 19:00	19:00	6.03	5.70	0.32
KROME		9/10/17 14:30	9/10/17 16:00	1:30	5.66	5.92	0.26
S-182		9/10/17 0:00	9/10/17 16:00	16:00	5.84	7.29	1.45
G-3897		9/10/17 0:00	9/10/17 14:00	14:00	5.29	7.18	1.90
G-553	C-100	9/10/17 0:00	9/10/17 19:00	19:00	5.35	6.15	0.80
G-580A		9/11/17 0:00	9/10/17 17:00	7:00	4.24	4.96	0.72
G-860		9/10/17 0:00	9/10/17 16:00	16:00	6.22	5.87	0.35
BBCMW4G1		9/10/17 16:00	9/10/17 18:00	2:00	2.30	2.77	0.47
BBCMW4G2	C-102	9/10/17 15:15	9/10/17 18:00	2:45	2.48	2.77	0.29
BBCW2		9/10/17 13:49	9/10/17 16:00	2:11	2.91	2.99	0.08
G-3549		9/10/17 0:00	9/10/17 17:00	17:00	2.49	2.84	0.35
BBCW10GW1		9/10/17 12:04	9/10/17 13:00	0:56	4.83	3.83	1.00
BBCW10GW2	C-103	9/10/17 12:00	9/10/17 13:00	1:00	4.66	3.83	0.83
BBCW3GW1		9/10/17 15:00	9/10/17 22:00	7:00	2.77	2.25	0.52
BBCW3GW2		9/10/17 15:00	9/10/17 22:00	7:00	2.77	2.25	0.52
F-358		9/10/17 0:00	9/10/17 19:00	19:00	5.86	5.16	0.70
G-1183		9/10/17 0:00	9/10/17 14:00	14:00	4.38	3.34	1.04
G-1486		9/10/17 0:00	9/10/17 21:00	21:00	5.68	4.81	0.87
S-196A		9/10/17 0:00	9/11/17 1:00	1:00	6.69	6.81	0.12

Most of the groundwater stations only have daily data values, which results in greater differences in timing, however, all peaks are within the 24-hour differences.

4.1.1.5.3 Calibration Statistics of Structure Discharges

Within the model domain, there are 26 control structures, which are in the primary canals (Table 39). The table lists the calibration statistics of discharges of all structures.

Table 39. Calibration Statistics of Structure Discharges

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS
S148_S	C-1	21978	-181	658	1046	0.00	1030	-0.13	0.05
S149_C	C-1	17050	47	52	76	0.38	59	0.05	0.81
S118_S	C-100	12610	50	110	145	0.92	136	0.81	0.78
S119_S	C-100	11494	45	50	65	0.93	47	0.78	0.82
S123_S	C-100	35345	152	182	293	0.91	250	0.82	0.31
S165_S	C-102	6630	75	102	114	0.59	85	0.31	0.73
S21A_S	C-102	56602	85	161	262	0.85	248	0.73	0.11
S166_S	C-103	9331	-3	47	70	0.51	70	0.11	-1.15
S167_S	C-103	9966	0	67	76	0.51	76	-1.15	-0.13
S179_S	C-103	22345	121	185	332	0.59	310	-0.13	0.63
S20F_S	C-103	60825	58	293	432	0.88	428	0.63	0.88
G211_C	L-31N CC	13464	-17	57	120	0.94	119	0.88	-0.64
S176_S	C-111 AG	7989	-204	208	257	0.29	155	-0.64	0.60
S177_S	C-111 SOUTH	11715	-136	156	242	0.80	201	0.60	-2.20
S178_S	C-111 SOUTH	7813	-8	15	28	0.56	27	-2.20	0.50
S18C_S	C-111 COASTAL	8519	-174	367	522	0.76	492	0.50	0.91
S197_C	US1	13384	60	227	294	0.96	288	0.91	0.96
S199_P	C-111 COASTAL	48774	1	2	10	0.98	10	0.96	0.70
S20_S	MODEL-LAND	4724	-32	117	218	0.89	216	0.70	0.95
S200_P	FPDA	51882	1	2	10	0.98	10	0.95	-1.47
S20G_S	HARB	32092	37	97	278	0.09	275	-1.47	0.51
S21_S	DA-4	50048	-71	259	381	0.87	374	0.51	0.82
S22_S	DA-3-REVISAR	53833	7	90	147	0.92	147	0.82	0.86
S331_P	L-31NS	24815	-6	66	123	0.93	123	0.86	0.65
S335_S	L-29 CC	8714	106	109	150	0.94	105	0.65	-2.90
S380_C	C-2	5149	-193	199	240	-0.23	143	-2.90	0.00

The summary of calibration results show that the averages of absolute Bias was 15%, the MAE is 21%, RMSE is 29%, STD is 23% and Peak Discharge Difference is 31% with some of the inland structures (S166, and S149) experiencing greater deviation between observed and computed. All coastal structures (S21, S21A, S123, S20F and S20G) had acceptable performance in terms of the selected calibration criteria.

The peak timing of structure discharges is provided in Table 40 and includes the computed and observed peak values and differences.

Table 40. Calibration Timing of Structure Discharge Peaks

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max obs cfs	Max comp cfs	Diff cfs	Diff %
S148_S	C-1	9/11/17 13:51	9/10/17 21:45	16:06	3724	2129	1595	43%
S149_C	C-1	9/11/17 7:28	9/10/17 3:30	3:58	284	158	125	44%
S118_S	C-100	9/10/17 20:49	9/10/17 19:10	1:39	991	874	117	12%
S119_S	C-100	9/10/17 20:51	9/10/17 18:35	2:16	363	227	136	37%
S123_S	C-100	9/10/17 15:47	9/10/17 15:50	23:57	3097	3022	74	2%
S165_S	C-102	9/11/17 10:28	9/10/17 20:10	14:18	507	519	12	2%
S21A_S	C-102	9/10/17 21:03	9/10/17 17:20	3:43	2919	2561	357	12%
S166_S	C-103	9/10/17 23:45	9/10/17 15:05	8:40	307	50	257	84%
S167_S	C-103	9/10/17 19:46	9/10/17 15:40	4:06	379	427	47	13%
S179_S	C-103	9/10/17 16:45	9/10/17 20:45	20:00	2018	2112	94	5%
S20F_S	C-103	9/10/17 19:05	9/10/17 19:40	23:25	4798	5480	682	14%
G211_C	L-31N CC	9/8/17 2:12	9/8/17 2:10	0:02	886	713	173	20%
S176_S	C-111 AG	9/11/17 9:22	9/11/17 9:25	23:57	649	926	276	43%
S177_S	C-111 SOUTH	9/11/17 16:35	9/11/17 3:30	13:05	1593	1534	59	4%
S178_S	C-111 SOUTH	9/10/17 18:52	9/10/17 12:20	6:32	138	283	145	105%
S18C_S	C-111 COASTAL	9/11/17 1:55	9/11/17 10:10	15:45	2497	1615	882	35%
S197_C	US1	9/11/17 23:12	9/11/17 23:30	23:42	2977	2295	682	23%
S199_P	C-111 COASTAL	9/9/17 7:37	9/9/17 7:40	23:57	228	226	2	1%
S20_S	MODEL-LAND	9/11/17 12:46	9/11/17 21:25	15:21	479	430	48	10%
S200_P	FPDA	9/9/17 7:37	9/9/17 7:45	23:52	227	225	2	1%
S20G_S	HARB	9/9/17 9:57	9/10/17 20:20	13:37	1309	1288	21	2%
S21_S	DA-4	9/10/17 17:18	9/10/17 20:40	20:38	2769	3816	1047	38%
S22_S	DA-3-REVISAR	9/11/17 7:44	9/11/17 7:45	23:59	1691	1994	303	18%
S331_P	L-31NS	9/8/17 1:10	9/8/17 4:55	20:15	1211	1200	11	1%
S335_S	L-29 CC	9/8/17 11:00	9/8/17 11:00	0:00	68	53	15	22%
S380_C	C-2	9/11/17 11:07	9/12/17 0:00	11:07	203	620	417	206%

The timing of computed and observed discharge peaks is within 4 hours for most of the structures, with larger differences for structures S165, S166 within the project watersheds. All coastal structures except S20G had peak differences within 4 hours.

The overall calibration and validation statistics for the calibration and validation targets exceeding (meeting) the calibration criteria are summarized in Table 41.

Table 41 Calibration Results for Targets within Project Watersheds

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
All Stages (GW and SW)	Total	150	150	150	150	150	150	150	150
	Exceed	126	117	89	77	87	126	94	108
	% Exceed	84%	78%	59%	51%	58%	84%	63%	72%
	Average	0.10	0.41	0.48	0.90	0.29	0.73	0.41	0.39

For the entire model the average Bias is 0.10 ft, MAE is 0.41, RMSE is 0.48, COR is 0.90, STD is 0.29, PE is 0.73, and NS is 0.41 with Peak Differences average of 0.39.

4.1.1.5.4 Cumulative Flows at Coastal Structures for Calibration

Table 42 lists the cumulative flows and percent errors at each coastal structure in the project domain. While head differential at the structures between the observed and simulated is around 0.2 ft, the flows are over 20% different.

Storm surge at these structures during Hurricane Irma were very high, making the tailwater higher than headwater resulting in higher inaccuracies of cumulative flow calculations. As in the calibration and validation flow statistics, the largest errors in cumulative volumes are associated with the inland structures which have relatively smaller flows. Structures S123, S21 and S20F have relatively good performance, with cumulative volumes percent errors of -30.89 percent, 21.24 percent and -19.82 percent respectively.

Table 42. Cumulative Calibration Flows at Coastal Structures

Structure	Observed (kAF)	Simulated (kAF)	Percentage Difference
S123	17.45	12.06	-31%
S21	22.13	26.83	21%
S21A	16	10.72	-33%
S20F	31.03	24.88	-20%
S20G	4.39	2.27	-48%

4.1.2 Watershed Storage

The role of storage utilization within all subdomains, SZ, OL, UZ, and OC is critical for runoff generation, timing and magnitude of flows during flood events. Below are the watershed storage plots that show which subdomain storage is dominant before, during and after a storm event. The

plots also show the range of storage that is utilized from different subdomains, the order in which the subdomains drain, after a storm event and the relative rate of watershed draining after the storm. The figures represent storage utilized assuming an initial value of 0.

In all project watersheds (C-1, C-100, C-102 and C-103), the SZ subdomain storage is the most dominant, and between 1" and 6" of storage was utilized during Hurricane Irma.

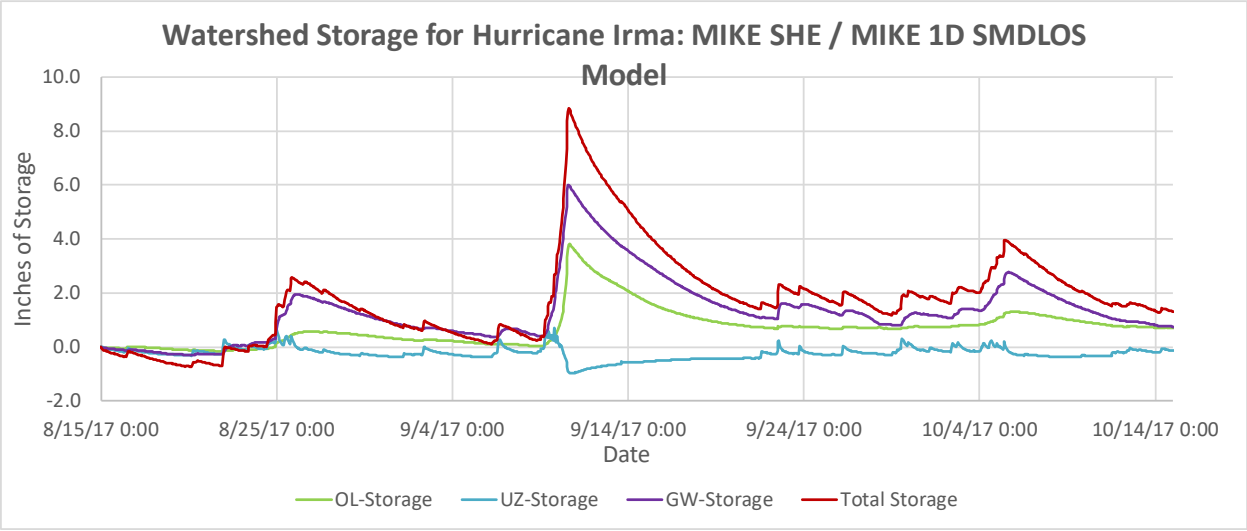


Figure 105. Watershed Storage Utilization for C-1 Watershed

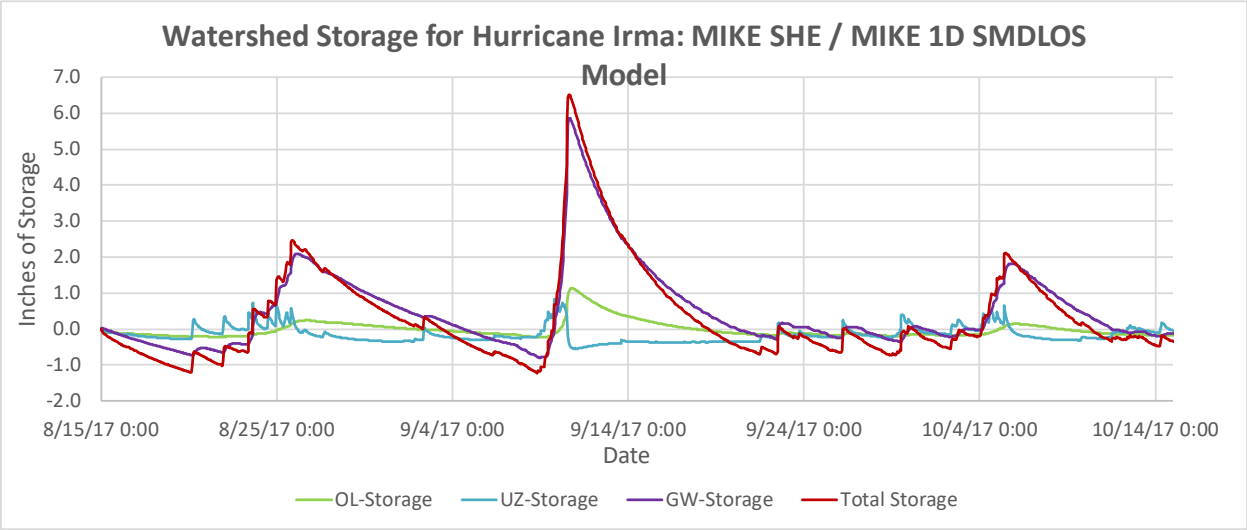


Figure 106. Watershed Storage Utilization for C-100 Watershed

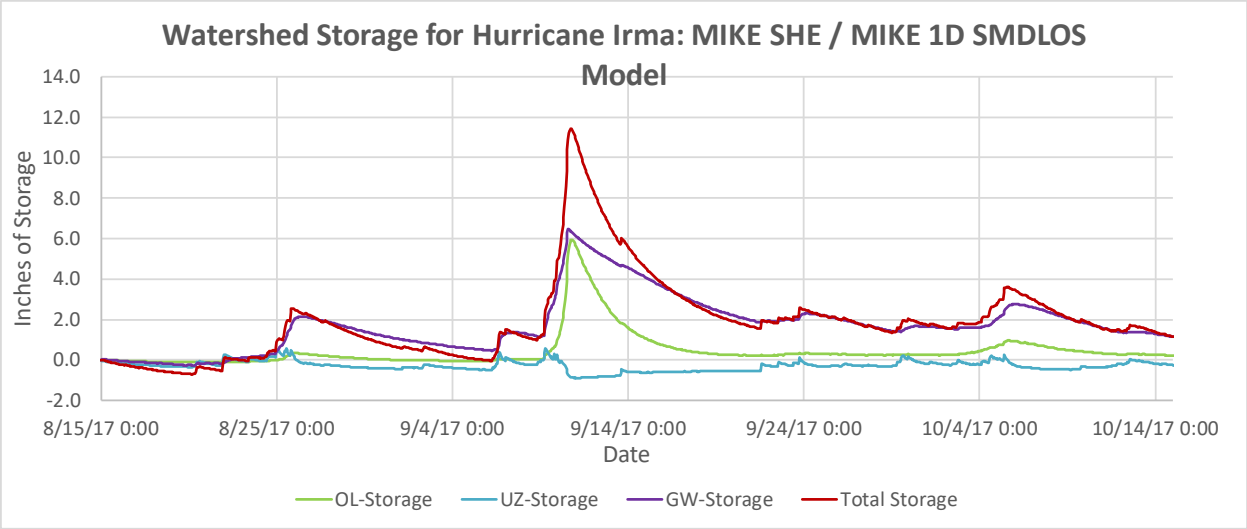


Figure 107. Watershed Storage Utilization for C-102 Watershed

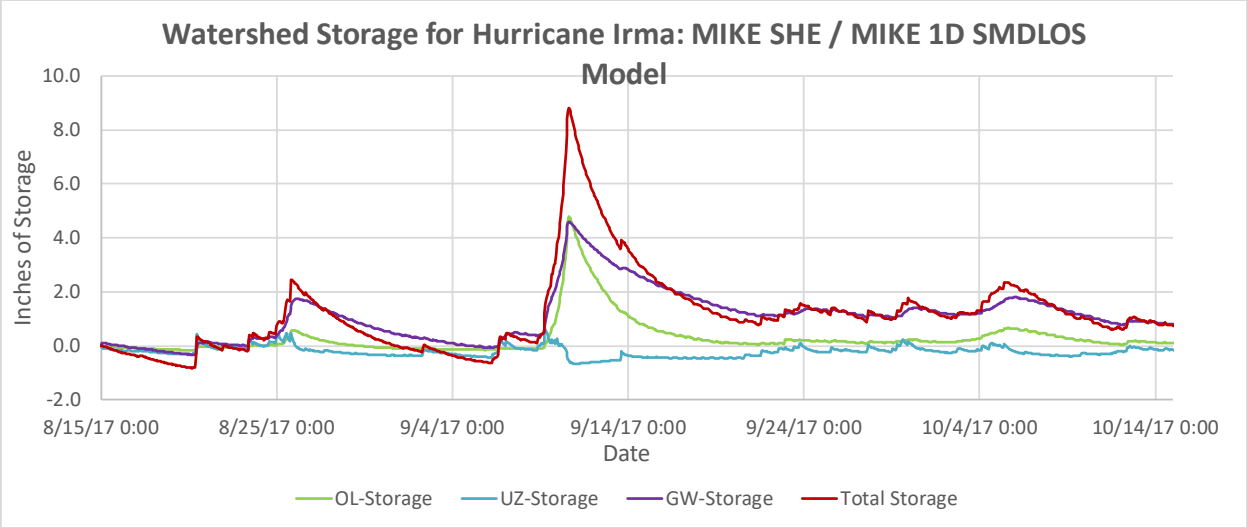


Figure 108. Watershed Storage Utilization for C-103 Watershed

4.1.3 Watershed Calibration Boundary Flows

A boundary flows analysis provides an understanding of the flows across the watershed boundaries within the project domain. Figure 109 shows the transects for which OL and SZ fluxes were computed and provided in the Water Budget Section.

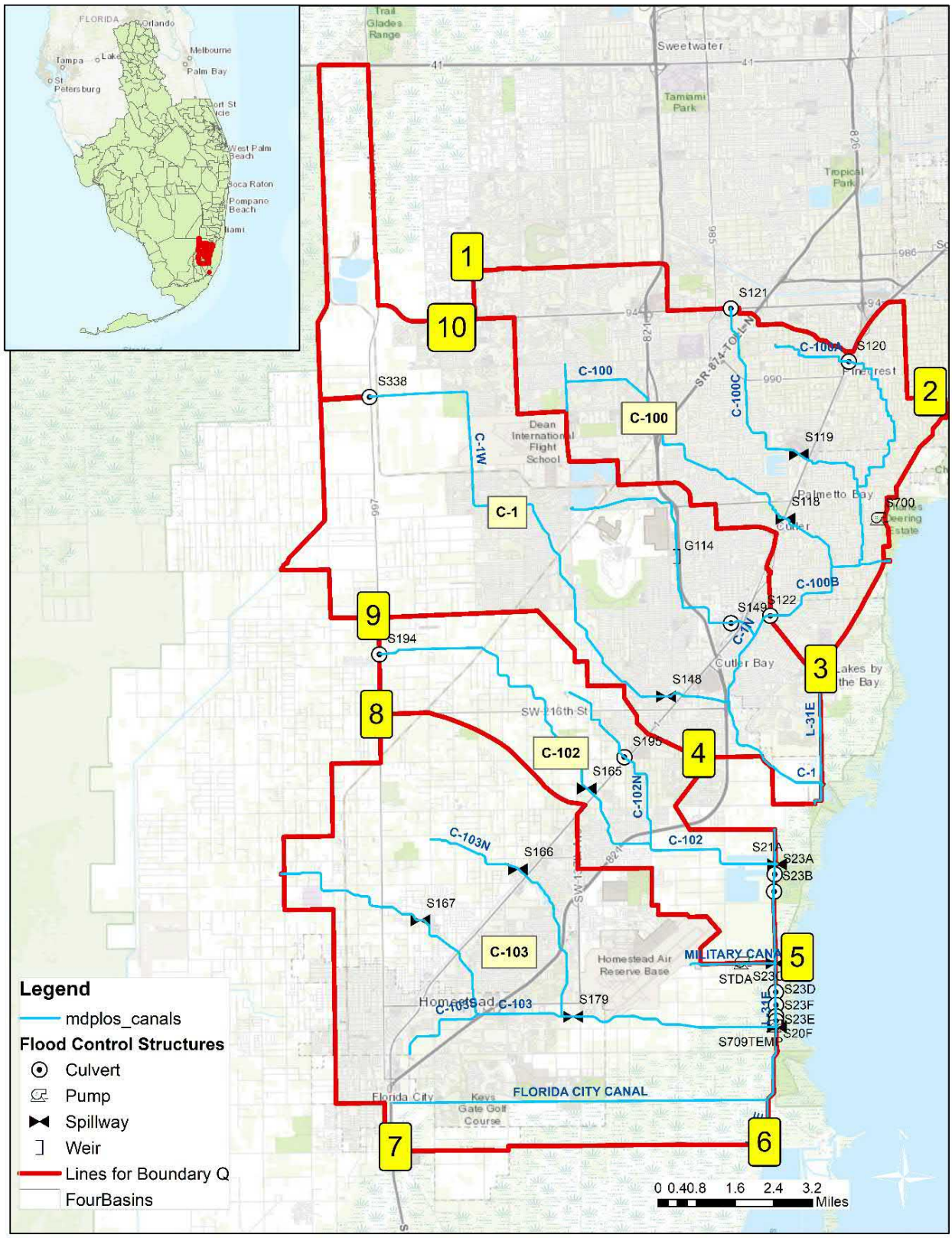


Figure 109. Vertices Indicating Boundary Flow Calculation Sections

The analysis shows that for the duration of the storm event (8/15/2017 to 10/15/2017), three (3) of the project domain watersheds (C-100, C-1 and C-103) are net sinks for groundwater, and C-102, the smallest of the four (4) watersheds, is a source. The boundary flows across the project domain watersheds are generally between 5.5 and 6 kaf, except the boundary flow from C-102 watershed to C-103 watershed is more than 9 kaf.

Ideally, the lateral boundary outflows from the upstream watershed should be the same as the lateral boundary inflows in the downstream watershed. Although this was true for most of the period of simulation, it was not always the case in this analysis. For groundwater, there is a match of the upstream outflows and downstream inflows except at the boundary between C-1 and C-102 watersheds; a closer examination shows the slight gain of groundwater budget at the northern watershed boundary is where it borders the Goulds watershed, which is not included in this analysis. For analysis for overland flows, examination of time series data of overland water shows that mismatch of the upstream watersheds with downstream watersheds at the boundaries was during times of high storm surge and high rainfall when the gain to the OL subdomain is from interaction with the OC subdomain that is not part of this boundary flows analysis.

4.2 Validation Results

The validation model covers a two-month simulation period, Nov 1, 2015, to Dec 31, 2015 with an extreme rainfall event which occurred in 12/3/2015-12/5/2015.The validation of the model includes a total of 188 monitoring sites, with 85 surface water, 77 groundwater and 26 flow monitoring stations within the model domain. Within the project watersheds (C-1, C-100, C-102 and C-103) there were correspondingly 10, 25, and 11 surface water, groundwater, and flow monitoring stations. Validation statistics are provided for each watershed, surface water, groundwater, and discharges for monitoring stations within the project watersheds and for the entire domain.

4.2.1.1 Watershed C-1 Validation Results

The observed and computed timeseries for the groundwater timeseries within watershed C-1 are provided in Figure 110 through Figure 118. The computed validation results show an acceptable match with observed values for wells G-3561, G-3967, and G-855. Computed peaks of the remaining 6 wells are consistently higher than observed with higher bias and peak differences.

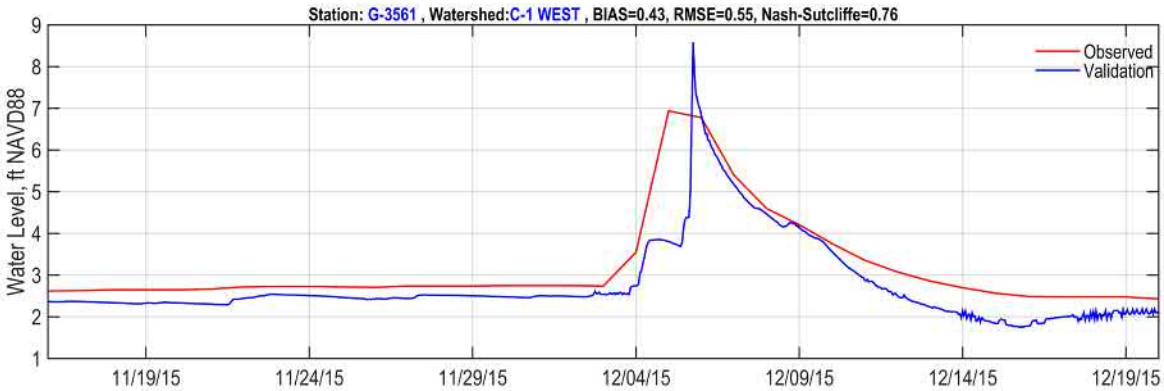


Figure 110 Watershed C-1 Validation Timeseries for Groundwater Well G-3561

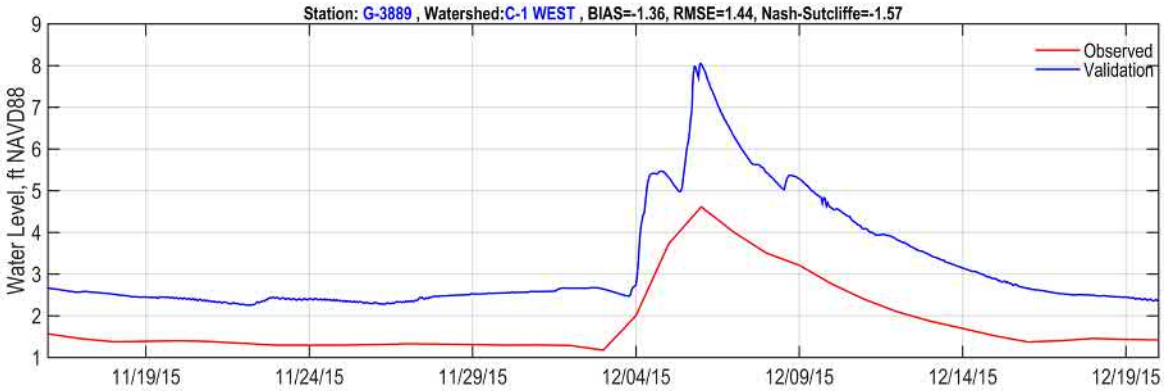


Figure 111 Watershed C-1 Validation Timeseries for Groundwater Well G-3889

Figure 112 Watershed C-1 Validation Timeseries for Groundwater Well G-3899

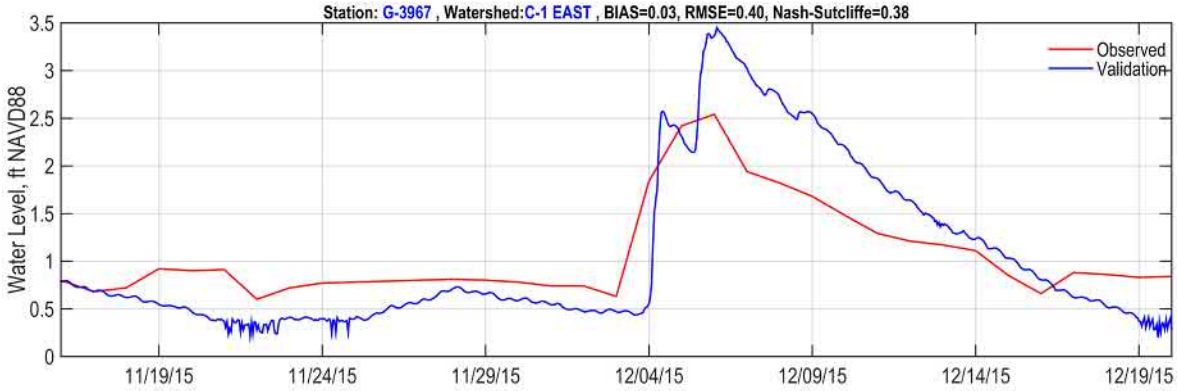


Figure 113 Watershed C-1 Validation Timeseries for Groundwater Well G-3967

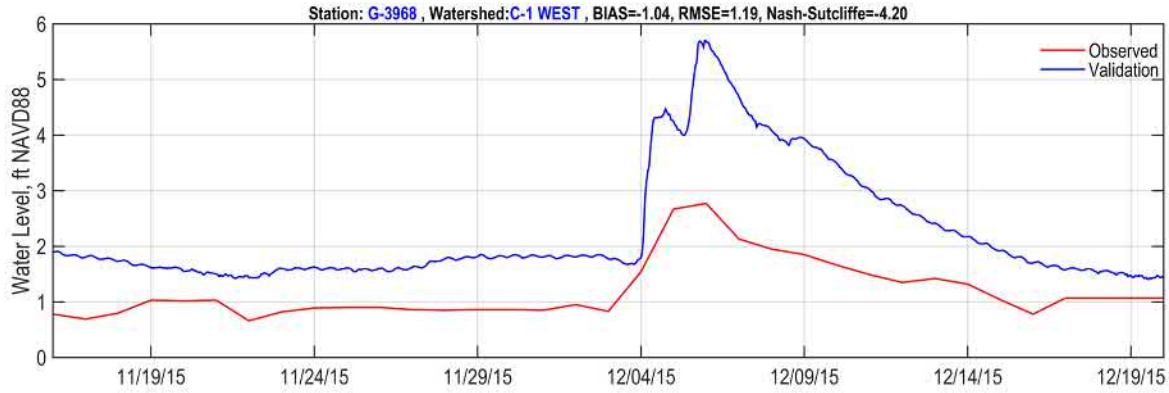


Figure 114 Watershed C-1 Validation Timeseries for Groundwater Well G-3968

Figure 115 Watershed C-1 Validation Timeseries for Groundwater Well G-3969

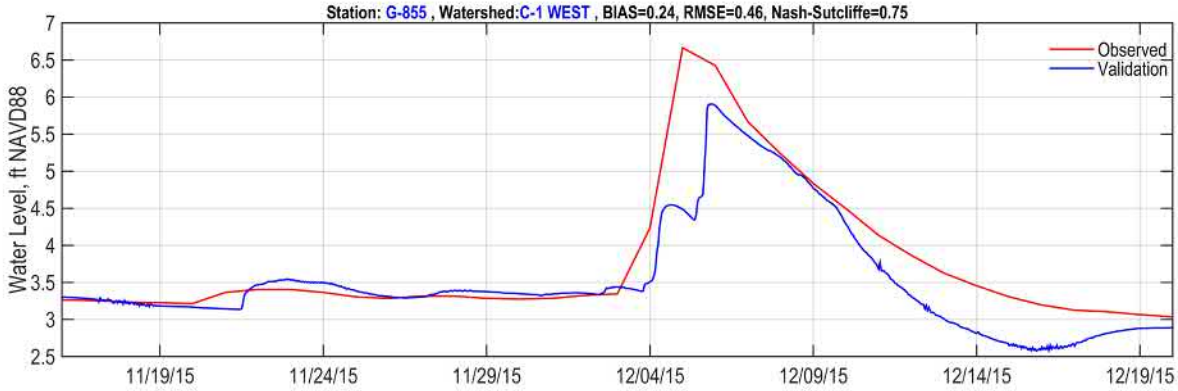


Figure 116 Watershed C-1 Validation Timeseries for Groundwater Well G-855

The observed and computed timeseries for the surface water timeseries within Watershed C-1 are provided in Figure 119 through Figure 123. The figures show that the validation stages follow

the pattern, however, the peak stages of S148_H and S149_H deviate from observed peaks which also affects the discharge timeseries.

Figure 117 Watershed C-1 Validation Timeseries for Groundwater Well KROME

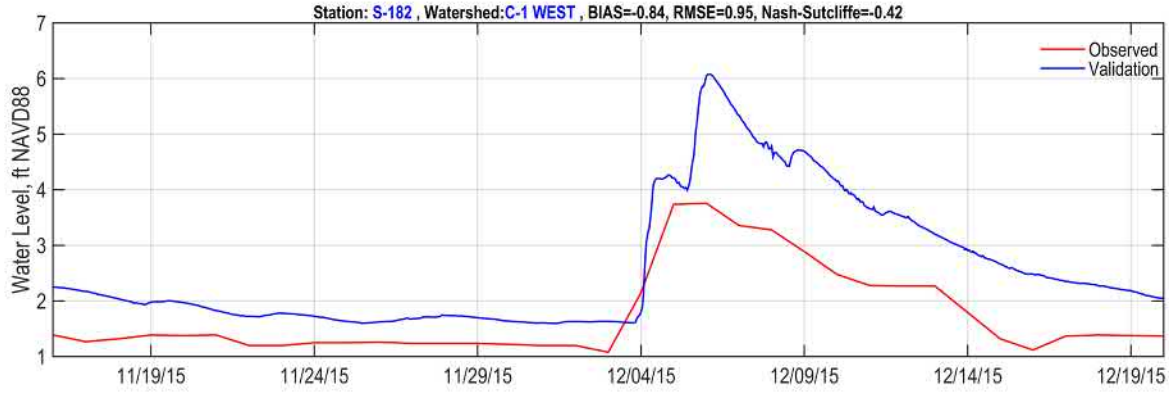


Figure 118 Watershed C-1 Validation Timeseries for Groundwater Well S-182

Figure 119 Watershed C-1 Validation Timeseries of Structure S148 Headwater

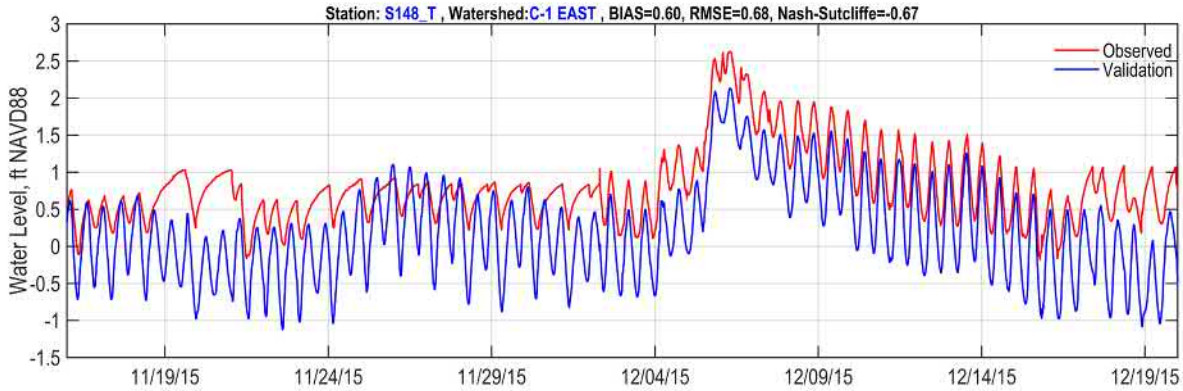


Figure 120 Watershed C-1 Validation Timeseries of Structure S148 Tailwater

Figure 121 Watershed C-1 Validation Timeseries of Structure S149 Headwater

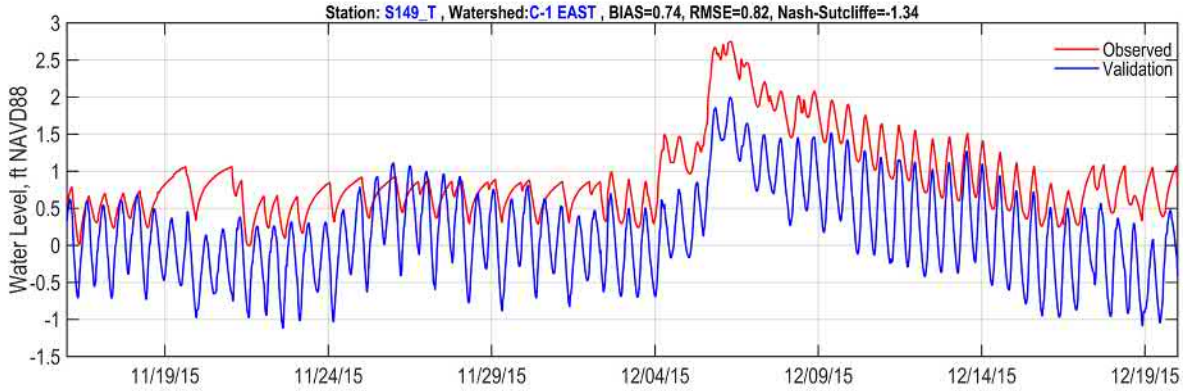


Figure 122 Watershed C-1 Validation Timeseries of Structure S149 Tailwater

The observed and computed discharge timeseries for structures within Watershed C-1 are provided in Figure 124 through Figure 127.

The discharge is overestimated in Structure S148 and the peak discharge is similar to the calibration discharge (approximately 2,000 cfs) primarily caused by the headwater stage peak.

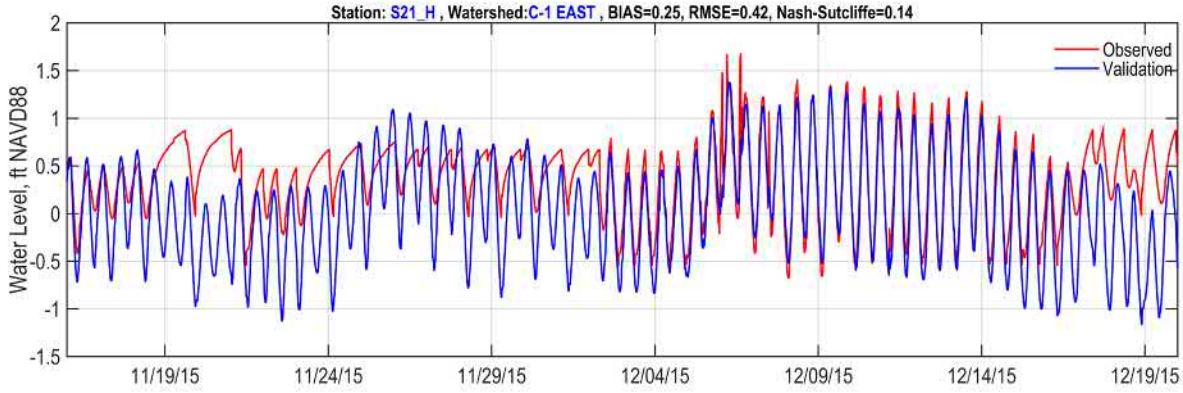


Figure 123 Watershed C-1 Validation Timeseries of Structure S21 Headwater

Figure 124 Watershed C-1 Validation Timeseries of Structure S148 Discharge

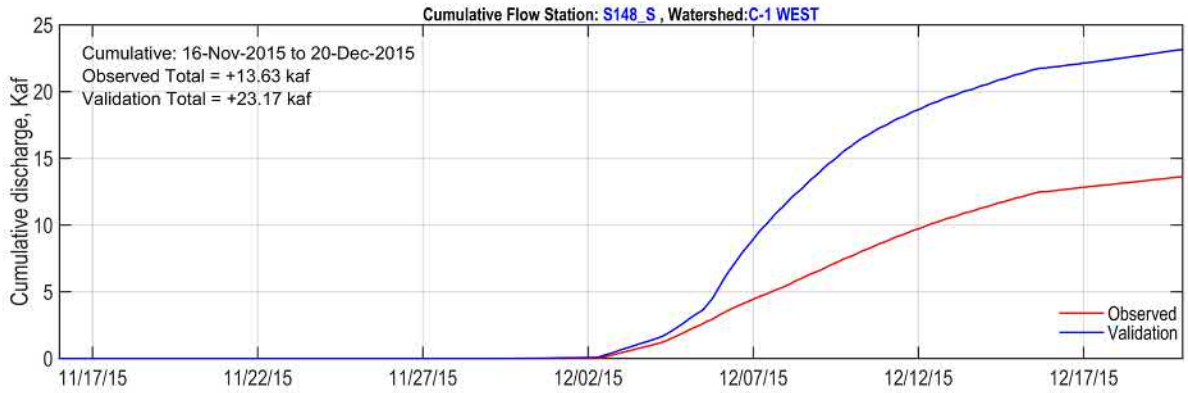


Figure 125 Watershed C-1 Cumulative Discharge at Structure S148

The validation discharge rates, and cumulative flows are well represented for the coastal structure, Figure 126 and Figure 127.

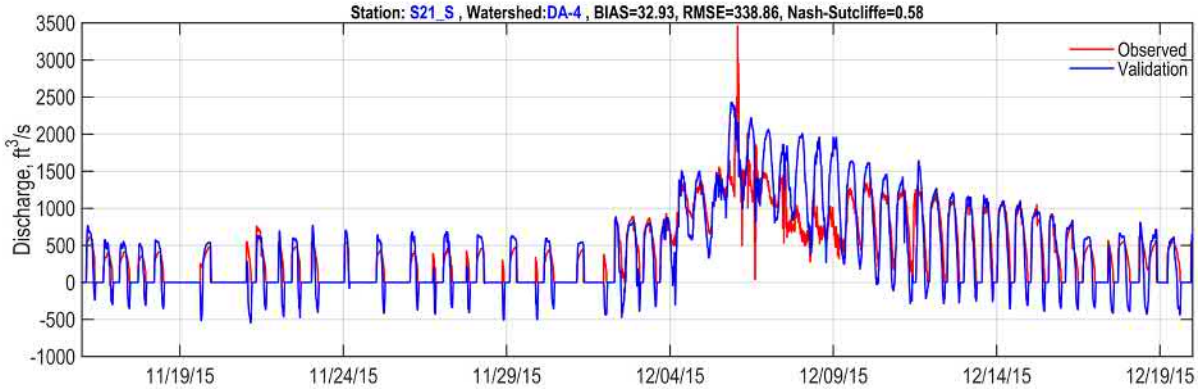


Figure 126 Watershed C-1 Validation Timeseries of Structure S21 Discharge

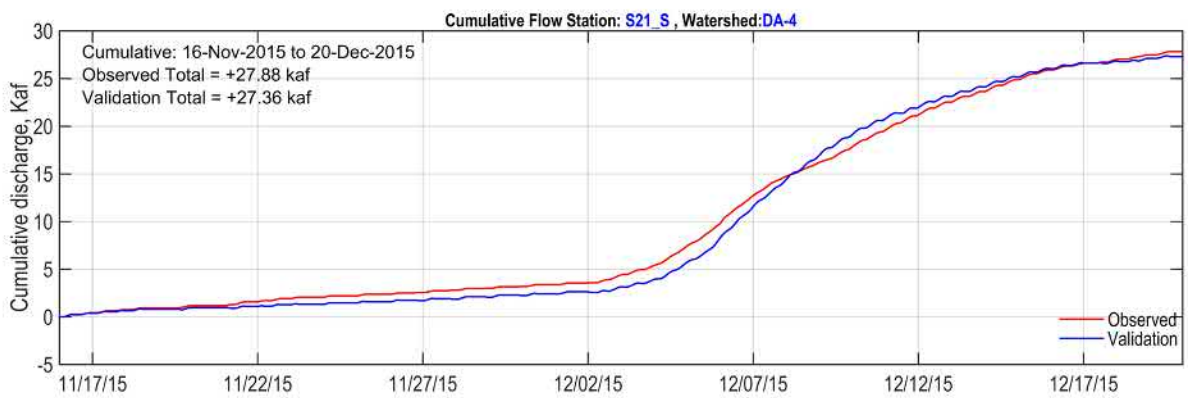


Figure 127 Watershed C-1 Cumulative Discharge at Structure S21

4.2.1.2 Watershed C-100 Validation Results

The observed and computed timeseries for the groundwater timeseries within watershed C-100 are provided in Figure 128 through Figure 131.

Except for well G-553 and G-860 (Figure 129 and Figure 131), the validation groundwater stages have acceptable representation based the computed Bias (within 0.5 ft and head differentials). G-553 has acceptable Bias, however the peak difference between observed and computed is greater than the calibration criteria of 0.5 ft.

Figure 128 Watershed C-100 Validation Timeseries for Groundwater Well G-3897

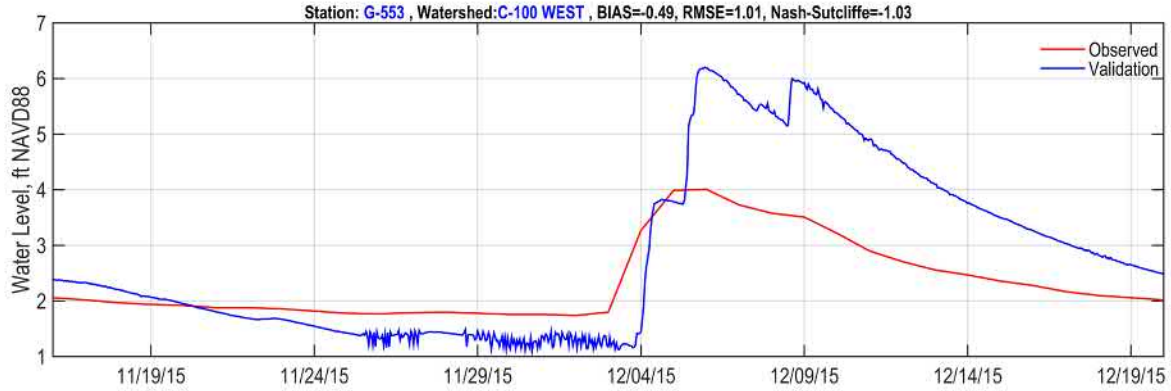


Figure 129 Watershed C-100 Validation Timeseries for Groundwater Well G-553

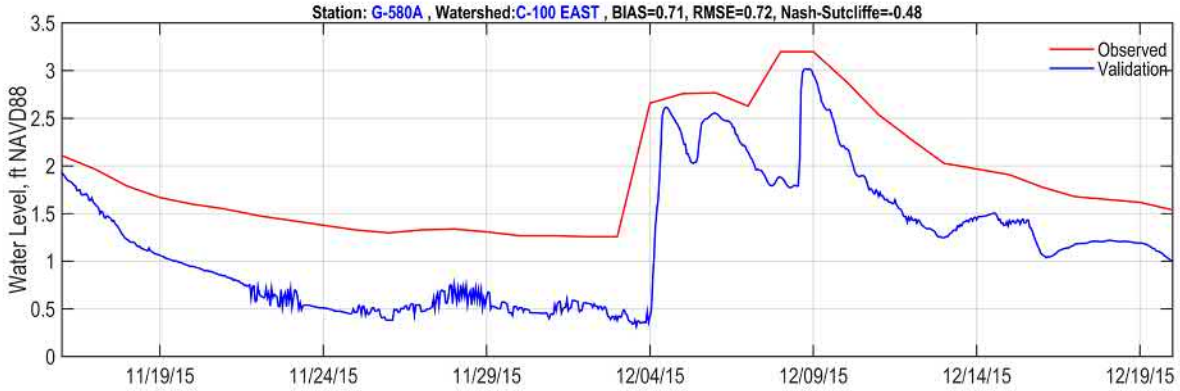


Figure 130 Watershed C-100 Validation Timeseries for Groundwater Well G-580A

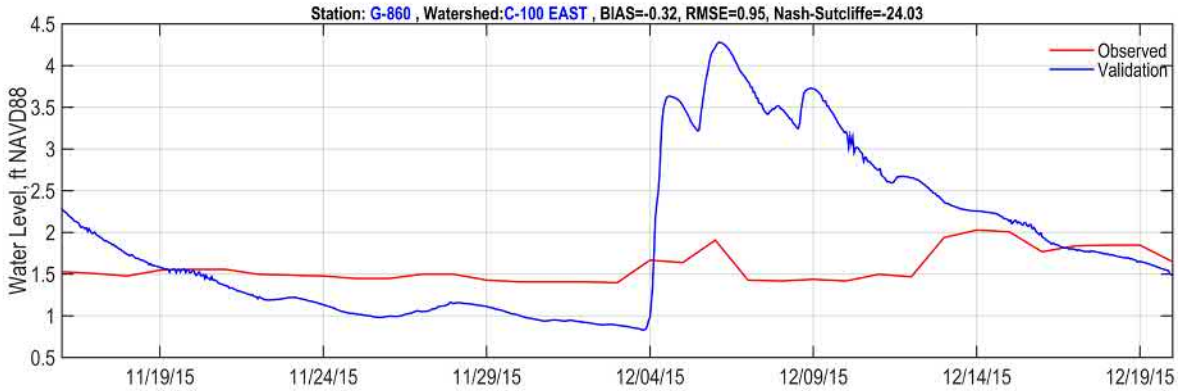


Figure 131 Watershed C-100 Validation Timeseries for Groundwater Well G-860

The observed and computed timeseries for the surface water timeseries within Watershed C-100 are provided in Figure 132 through Figure 136.

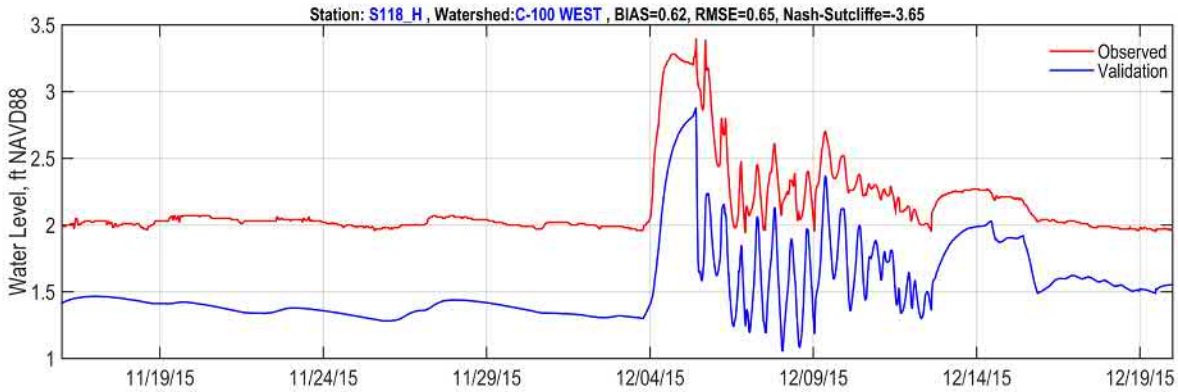


Figure 132 Watershed C-100 Validation Timeseries of Structure S118 Headwater

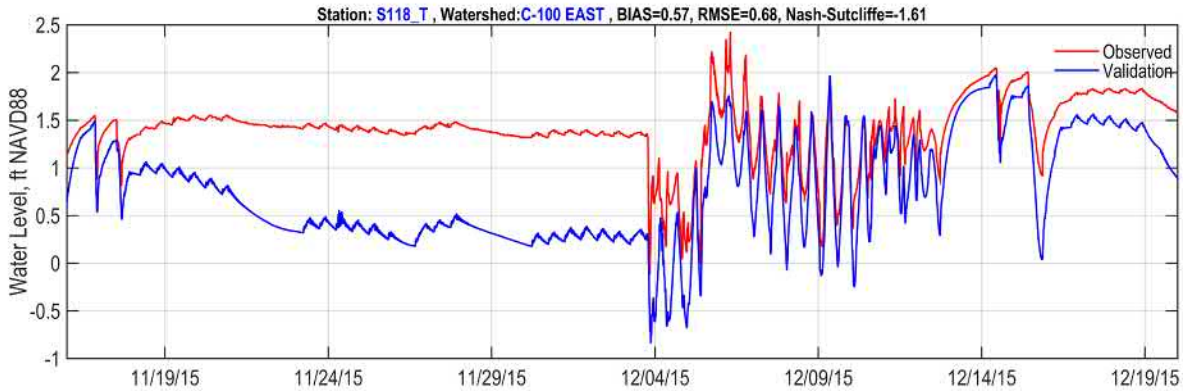


Figure 133 Watershed C-100 Validation Timeseries of Tailwater of Structure S118

Figure 134 Watershed C-100 Validation Timeseries of Structure S119 Headwater

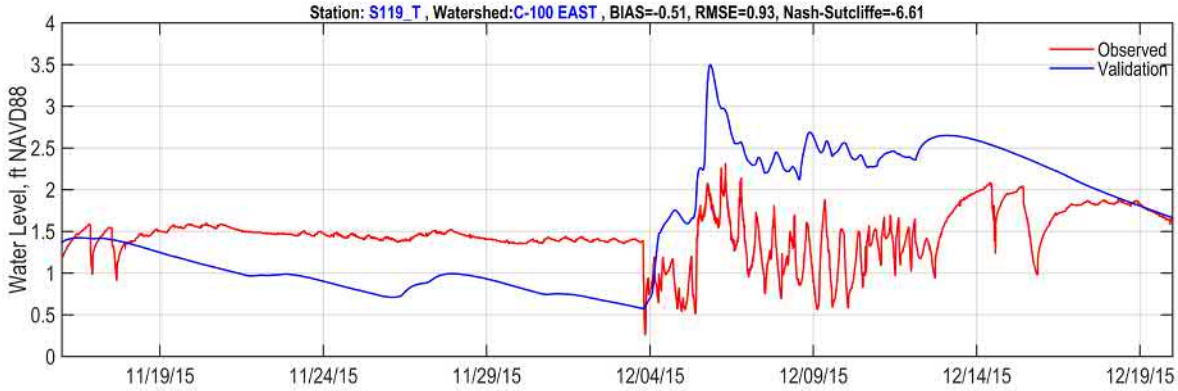


Figure 135 Watershed C-100 Validation Timeseries of Tailwater of Structure S119

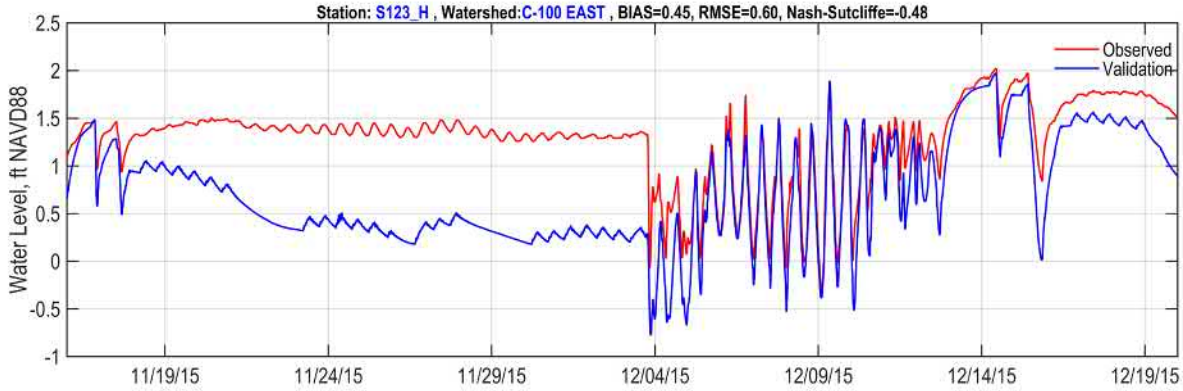


Figure 136 Watershed C-100 Validation Timeseries of Structure S123 Headwater

The observed and computed discharge timeseries for structures within Watershed C-1 are provided in Figure 137 through Figure 142. Inland structure S118 shows a good match of

computed and observed discharge rates and cumulative flow, while inland Structure S119 has a lower computed discharge peak and cumulative values (Figure 137 and Figure 138).

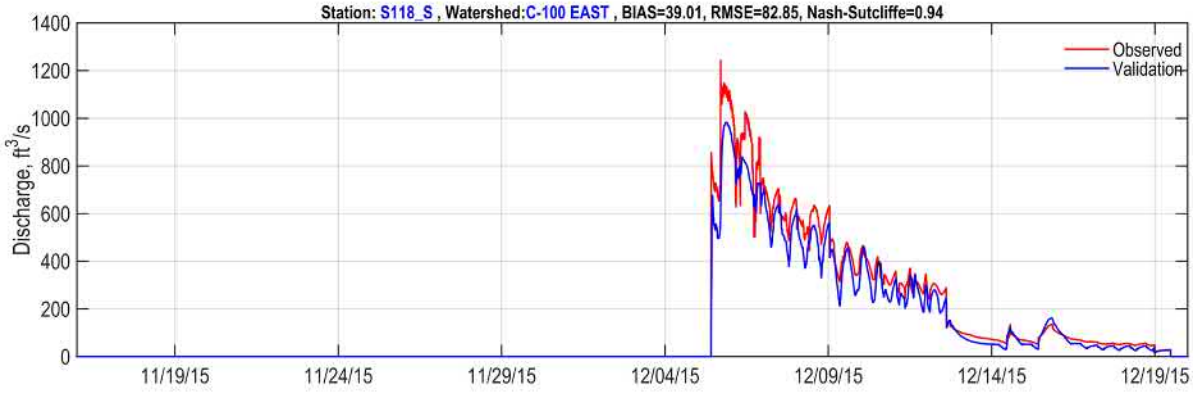


Figure 137 Watershed C-100 Validation Timeseries of Structure S118 Discharge

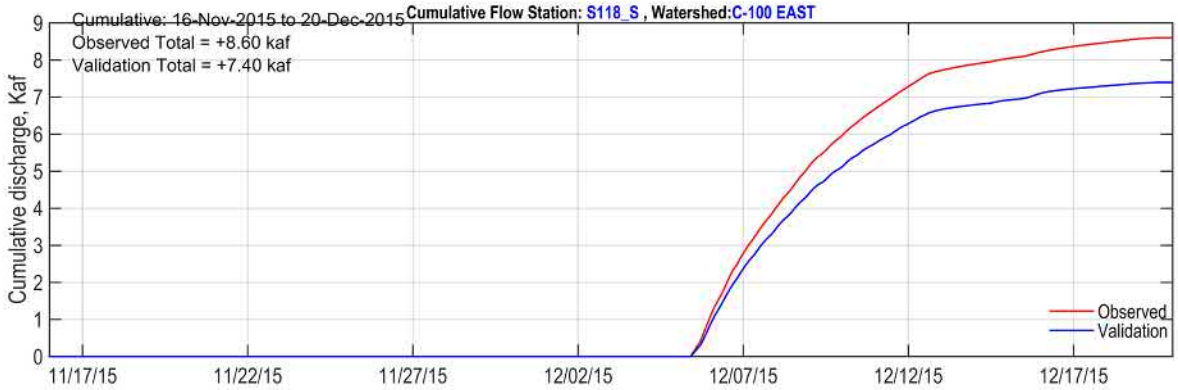


Figure 138 Watershed C-100 Cumulative Discharge at Structure S118

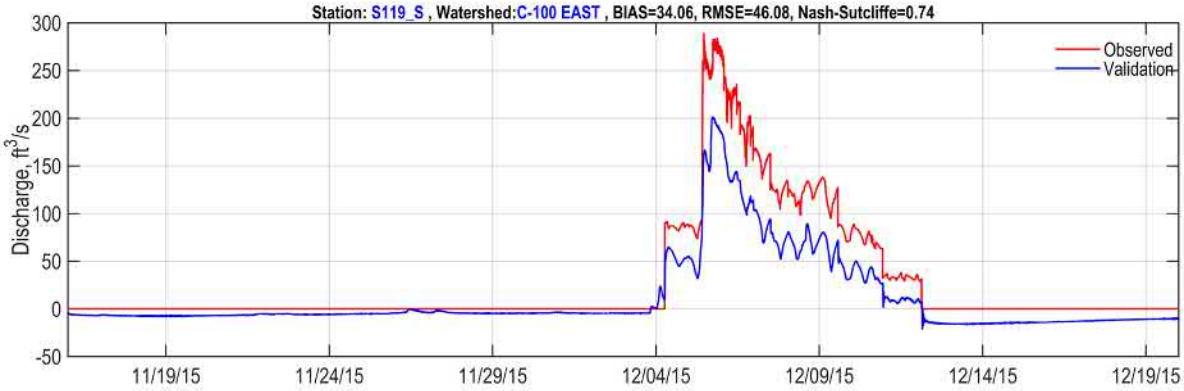


Figure 139 Watershed C-100 Validation Timeseries of Structure S119 Discharge

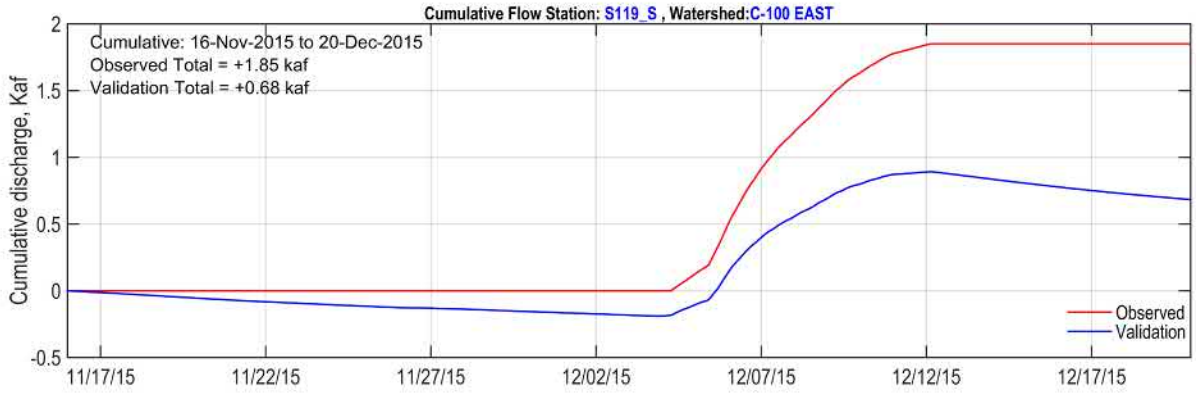


Figure 140 Watershed C-100 Cumulative Discharge at Structure S119

The time of the discharge rate and cumulative flows at the coastal structure show a good match between computed and observed values.

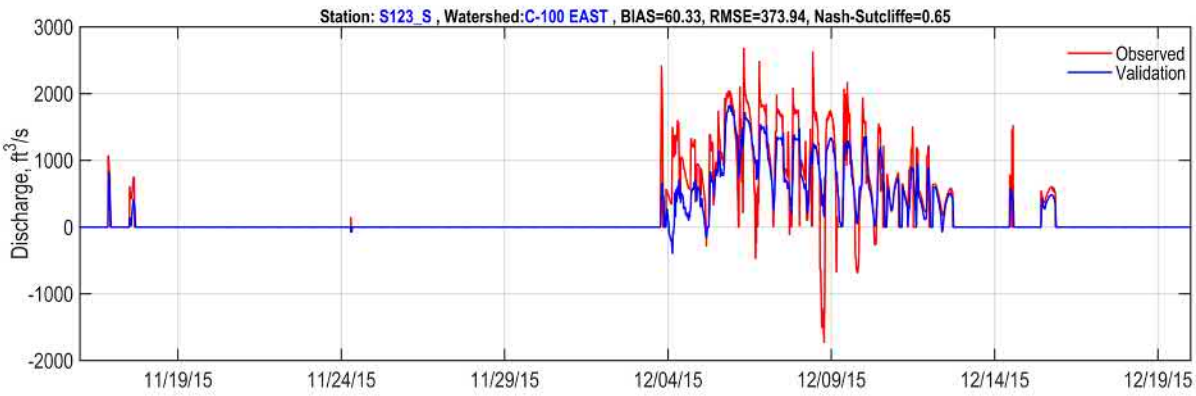


Figure 141 Watershed C-100 Validation Timeseries of Structure S123 Discharge

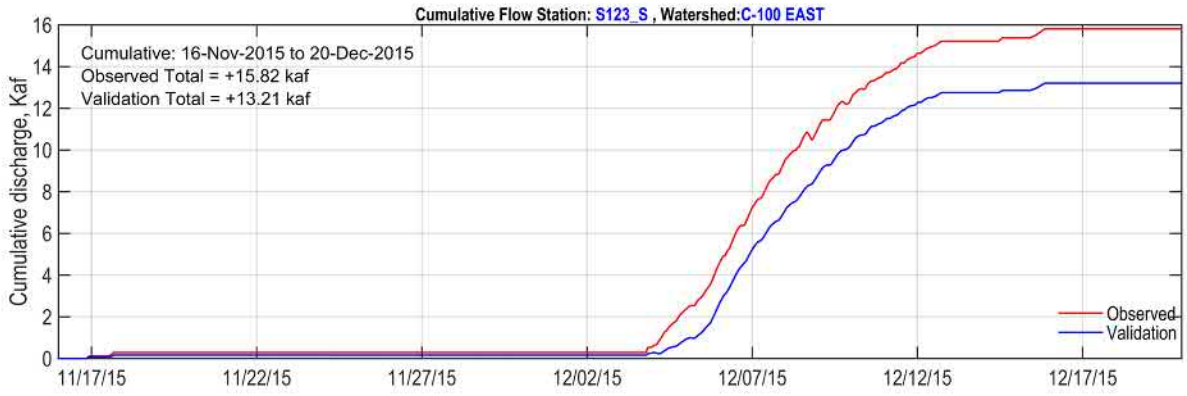


Figure 142 Watershed C-100 Cumulative Discharge at Structure S123

4.2.1.3 Watershed C-102 Validation Results

The observed and computed timeseries for the groundwater timeseries within Watershed C-102 are provided in Figure 143 through Figure 145:

Figure 143 Watershed C-102 Validation Timeseries for Groundwater Well BBCMW4G1

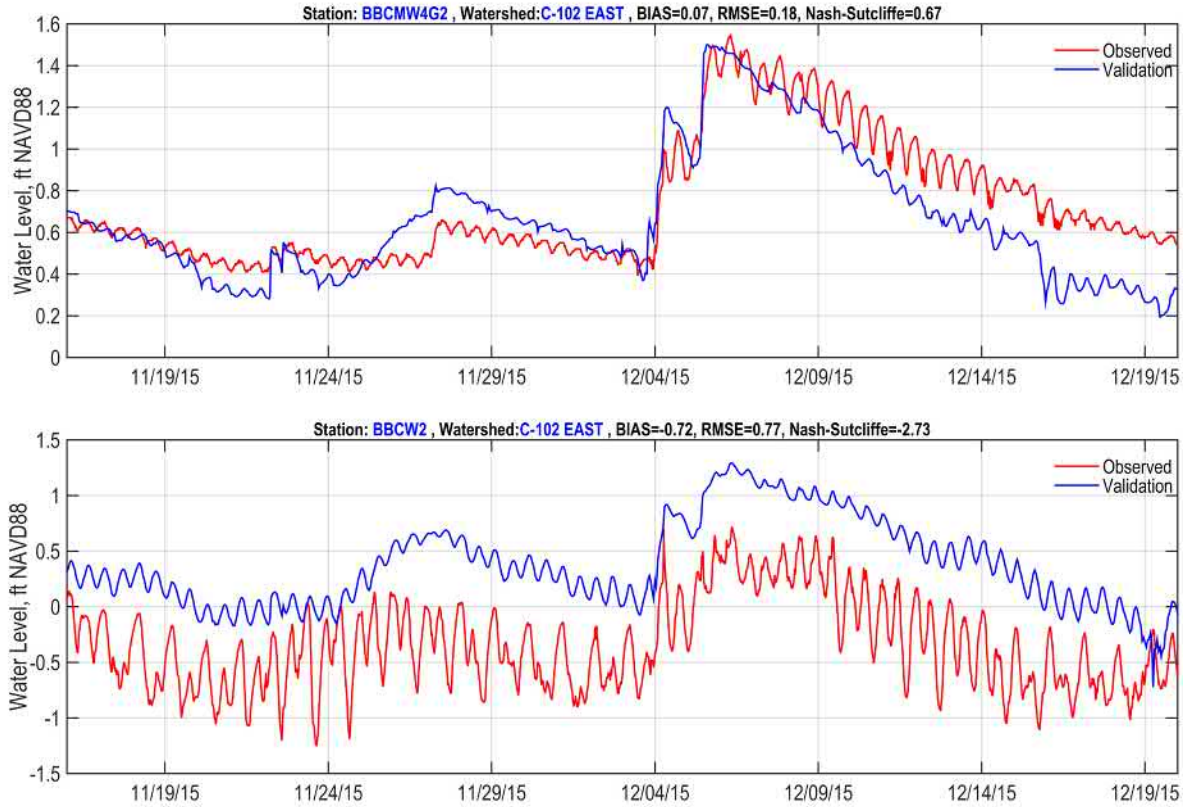


Figure 144 Watershed C-102 Validation Timeseries for Groundwater Well BBCMW4G2 and BBCW2

The observed and computed timeseries for the surface water timeseries within Watershed C-102 are provided in Figure 146 through Figure 147. The results show that stages are relatively well represented for most surface water stations, however underestimated at Structure S165 and with a pattern which differs from the observed (Figure 146).

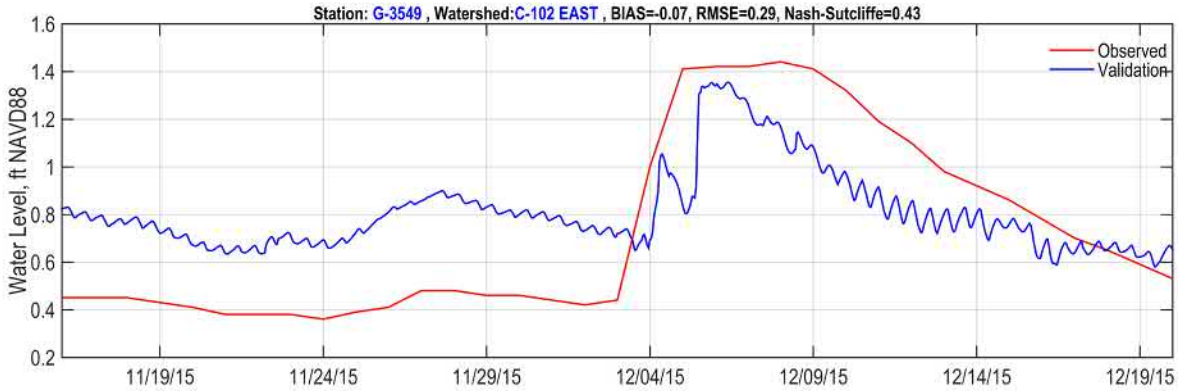


Figure 145 Watershed C-102 Validation Timeseries for Groundwater Well G-3549

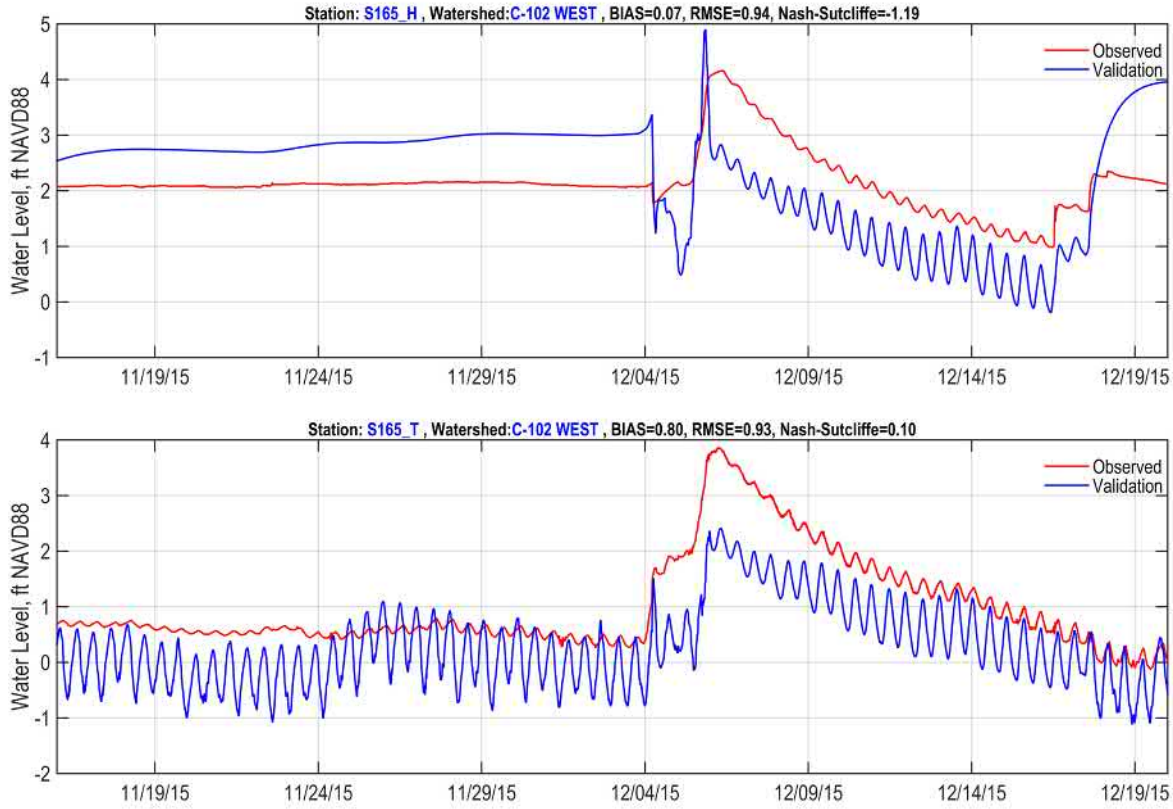


Figure 146 Watershed C-102 Validation Timeseries of Structure S165 Headwater and Tailwater

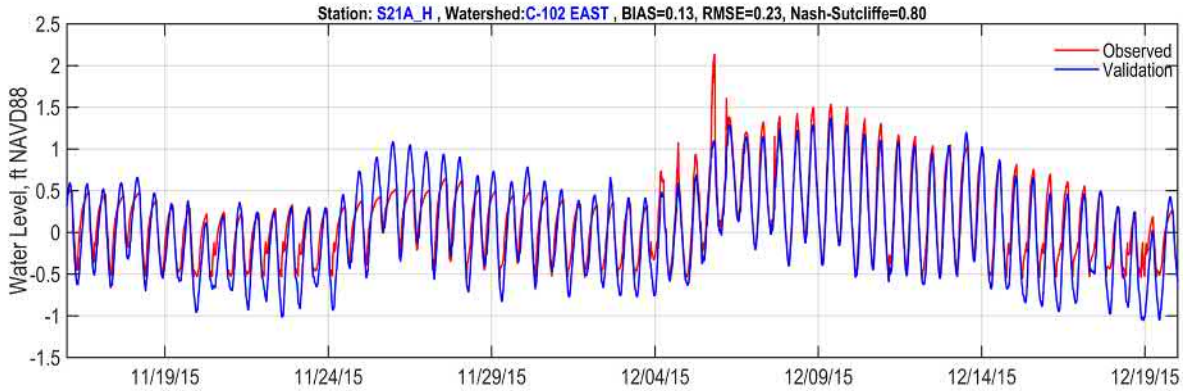


Figure 147 Watershed C-102 Validation Timeseries of Structure S21A Headwater

The observed and computed discharge timeseries for structures within Watershed C-102 are provided in Figure 148 through Figure 151.

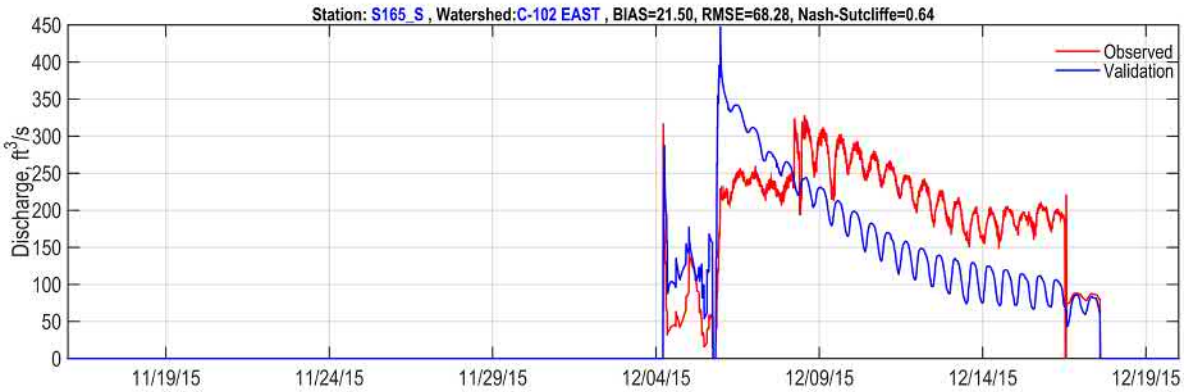


Figure 148 Watershed C-102 Validation Timeseries of Structure S165 Discharge

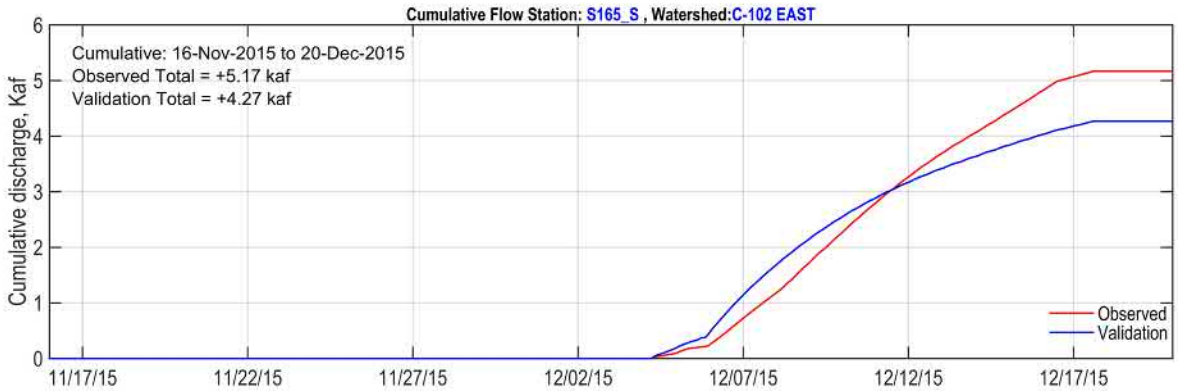


Figure 149 Watershed C-102 Cumulative Discharge at Structure S165

The results for coastal structure S21A shows a good representation of the discharge rate and overall underestimates the cumulative flow at the structure (Figure 150 and Figure 151).

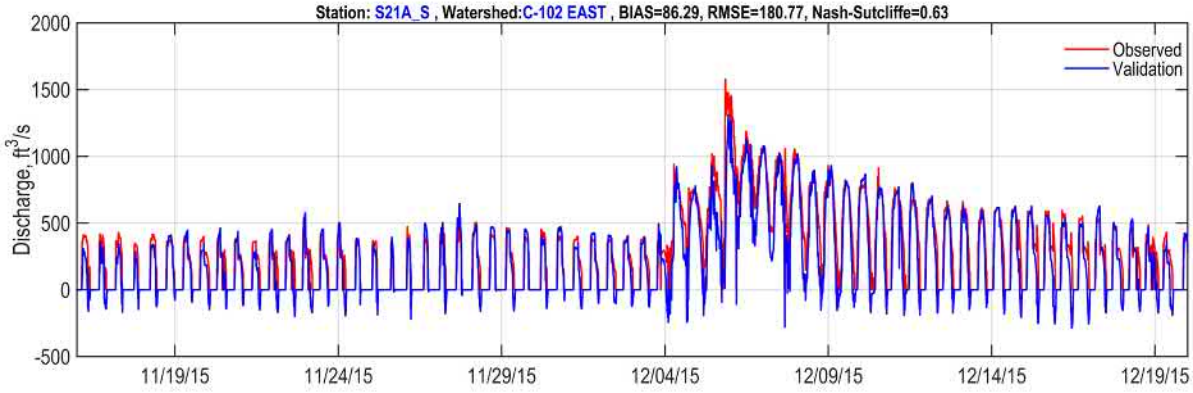


Figure 150 Watershed C-102 Validation Timeseries of Structure S21A Discharge

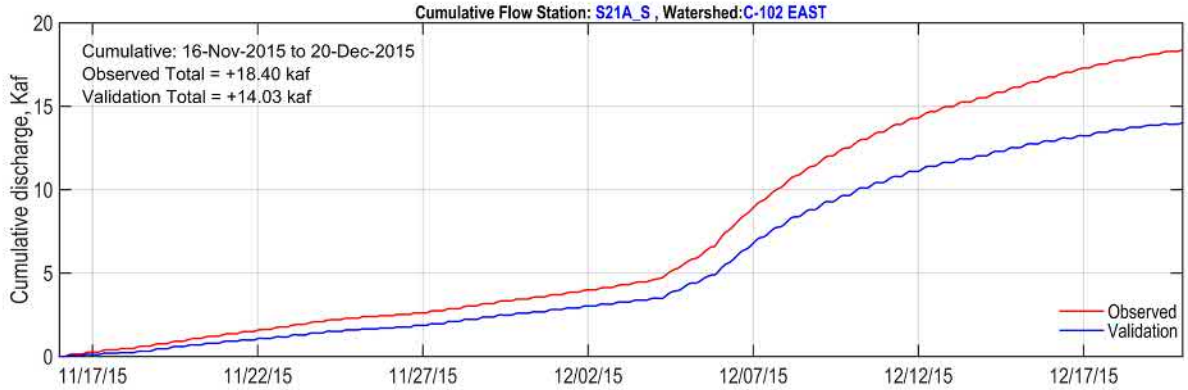


Figure 151 Watershed C-102 Cumulative Discharge at Structure S21A

4.2.1.4 Watershed C-103 Validation Results

The observed and computed timeseries for the groundwater timeseries within Watershed C-103 are provided in Figure 152 through Figure 159. The computed groundwater stages show good match in comparison to observed stages which in terms of Bias and Peak Differences.

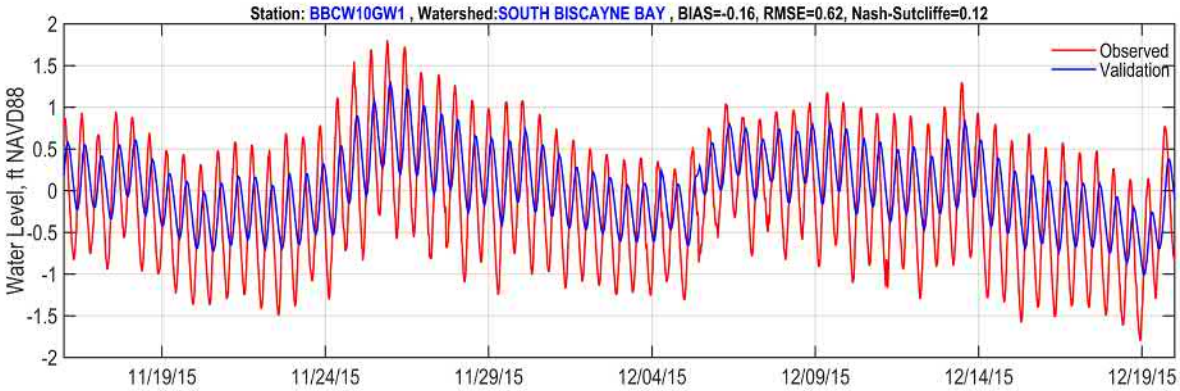


Figure 152 Watershed C-103 Validation Timeseries for Groundwater Well BBCW10GW1

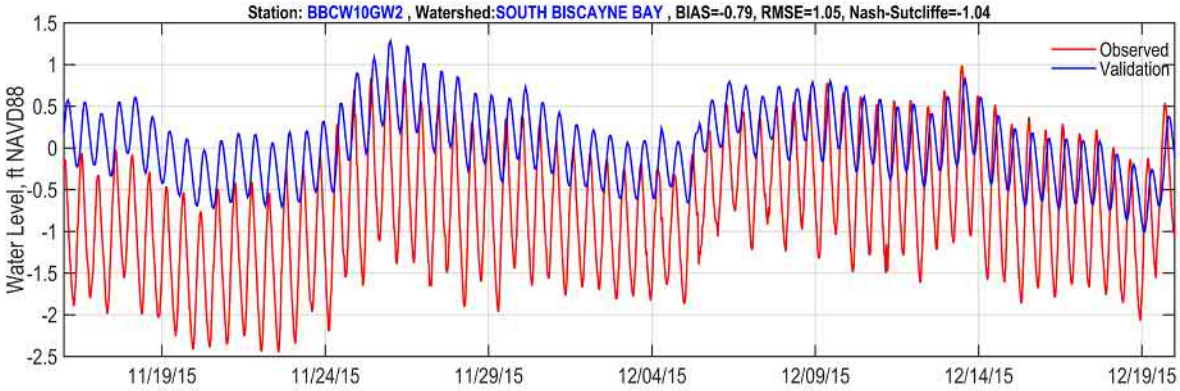


Figure 153 Watershed C-103 Validation Timeseries for Groundwater Well BBCW10GW2

Figure 154 Watershed C-103 Validation Timeseries for Groundwater Well BBCW3GW1

Figure 155 Watershed C-103 Validation Timeseries for Groundwater Well BBCW3GW2

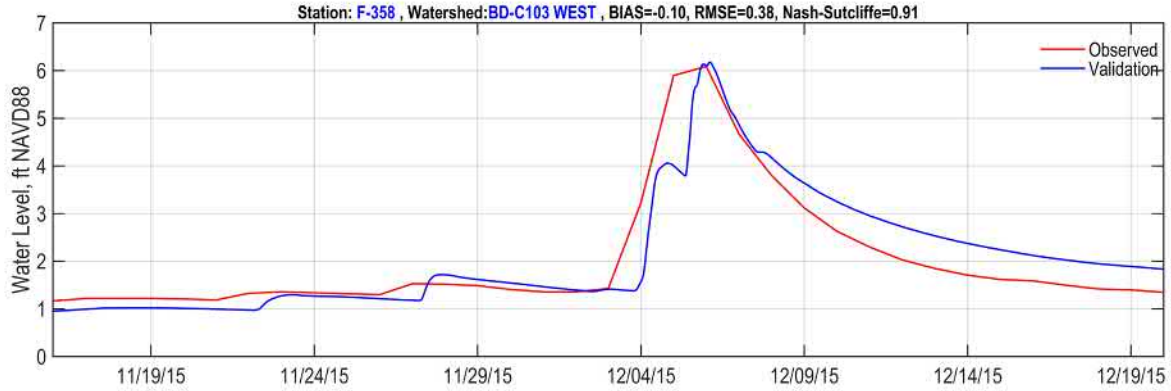


Figure 156 Watershed C-103 Validation Timeseries for Groundwater Well F-358

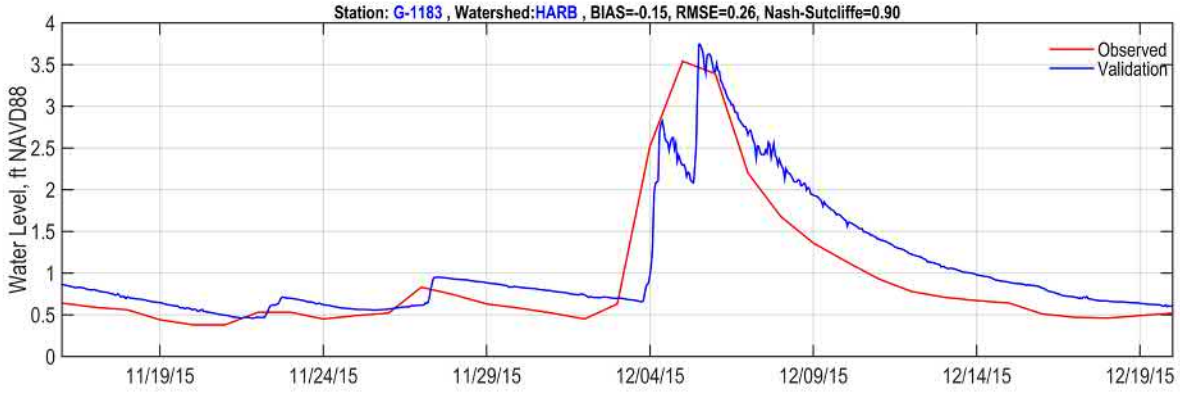


Figure 157 Watershed C-103 Validation Timeseries for Groundwater Well G-1183

The observed and computed timeseries for the surface water timeseries within Watershed C-103 are provided in Figure 160 through Figure 167. With the exception of the headwater and tailwater

at Structure S167 (Figure 162 and Figure 163), the stages of the remaining surface water stations show acceptable performance based on the statistic results.

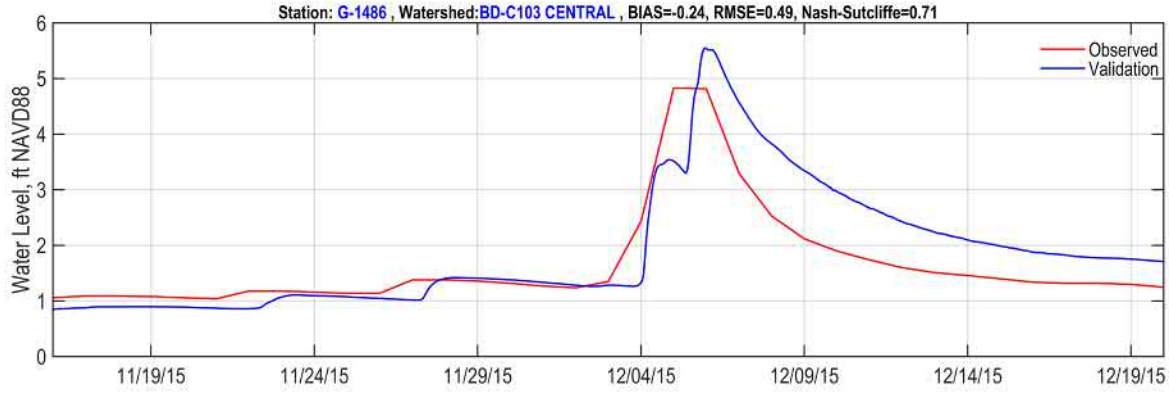


Figure 158 Watershed C-103 Validation Timeseries for Groundwater Well G-1486

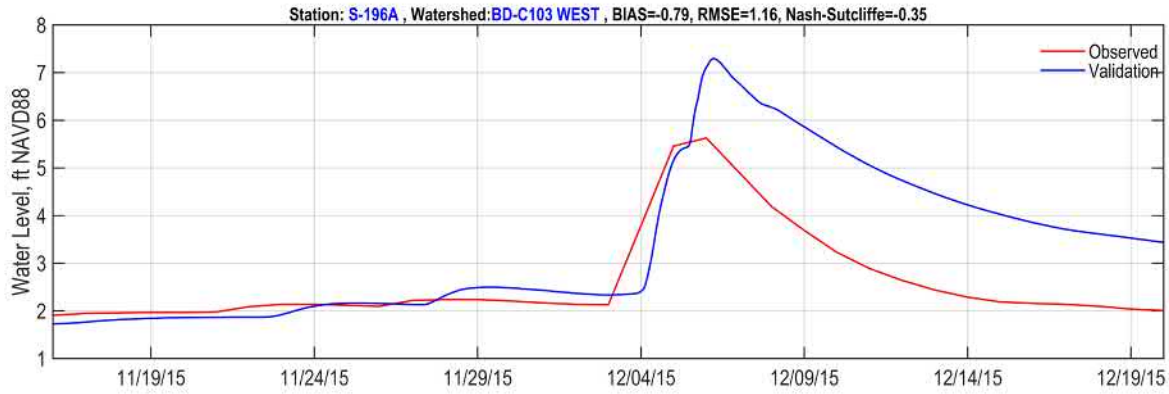


Figure 159 Watershed C-103 Validation Timeseries for Groundwater Well S-196A

Figure 160 Watershed C-103 Validation Timeseries of Structure S166 Headwater

Figure 161 Watershed C-103 Validation Timeseries of Structure S166 Tailwater

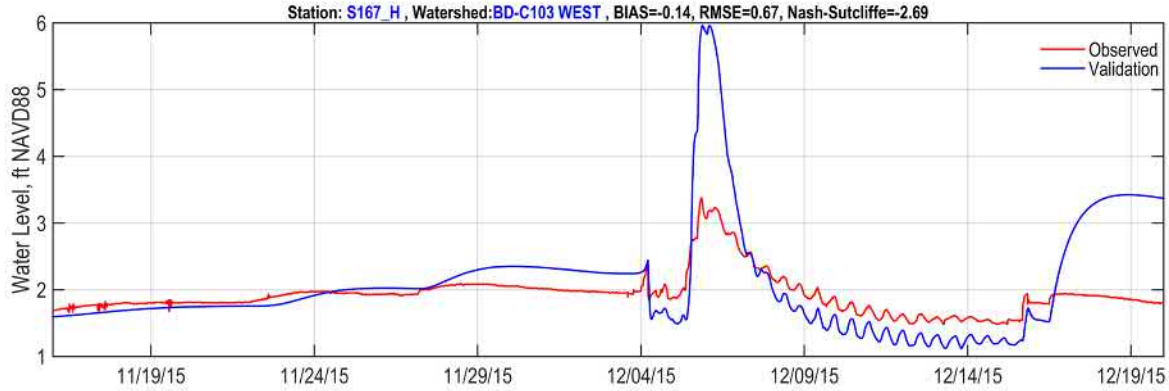


Figure 162 Watershed C-103 Validation Timeseries of Structure S167 Headwater

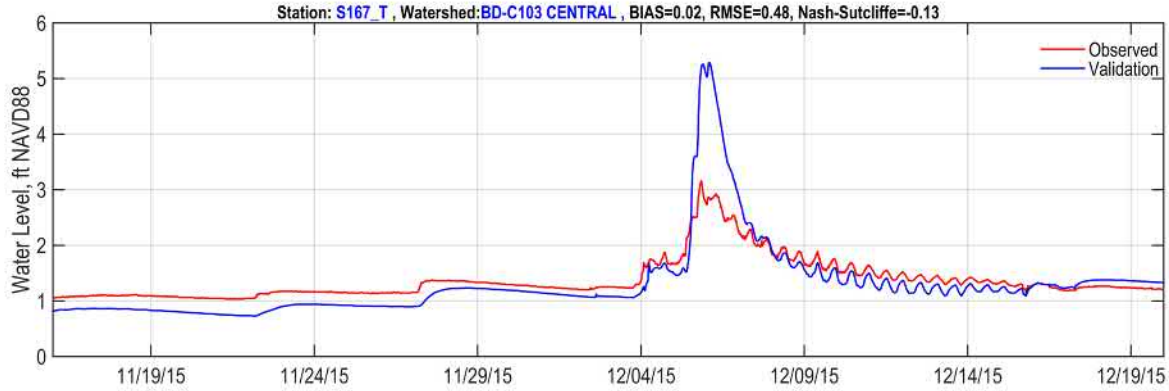


Figure 163 Watershed C-103 Validation Timeseries of Structure S167 Tailwater

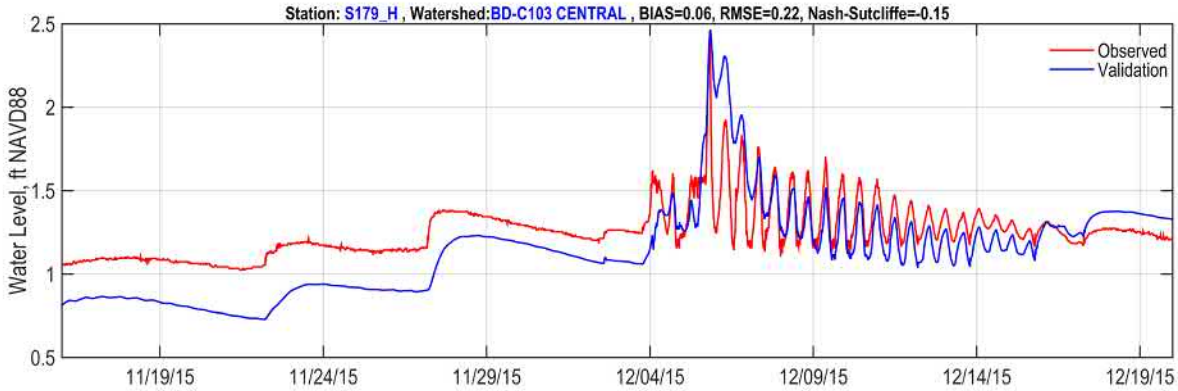


Figure 164 Watershed C-103 Validation Timeseries of Structure S179 Headwater

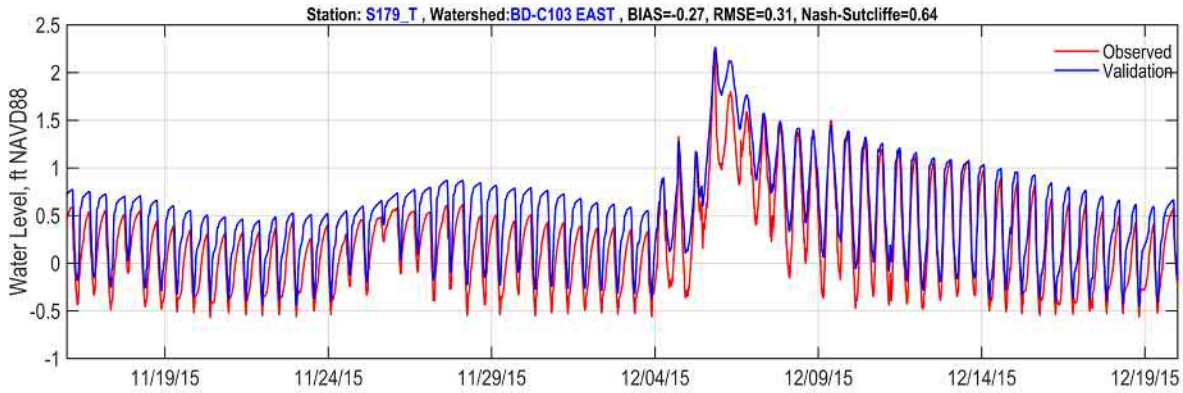


Figure 165 Watershed C-103 Validation Timeseries of Structure S179 Tailwater

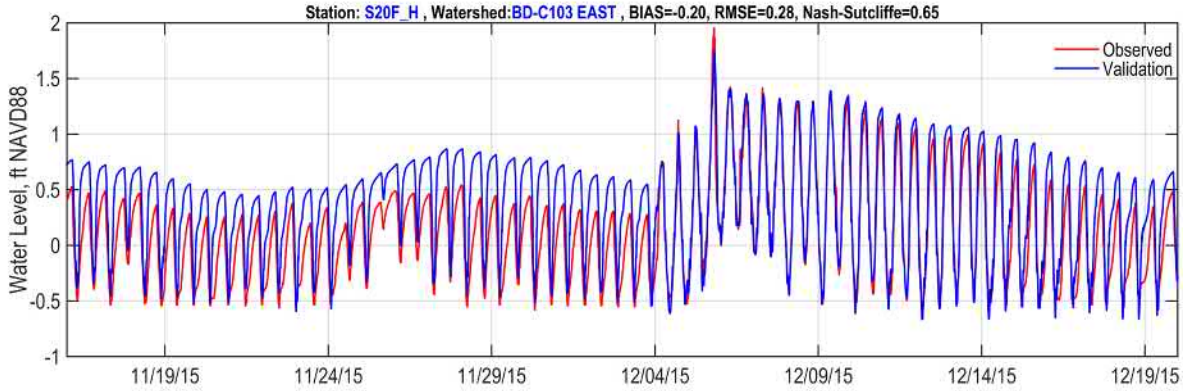


Figure 166 Watershed C-103 Validation Timeseries of Structure S20F Headwater

The observed and computed discharge timeseries for structures within Watershed C-103 are provided in Figure 168 through Figure 177. The discharge rates and cumulative flow of structure

S166 are considerably lower than observed (Figure 168 and Figure 170) even though computed headwater and tailwater stages have acceptable match.

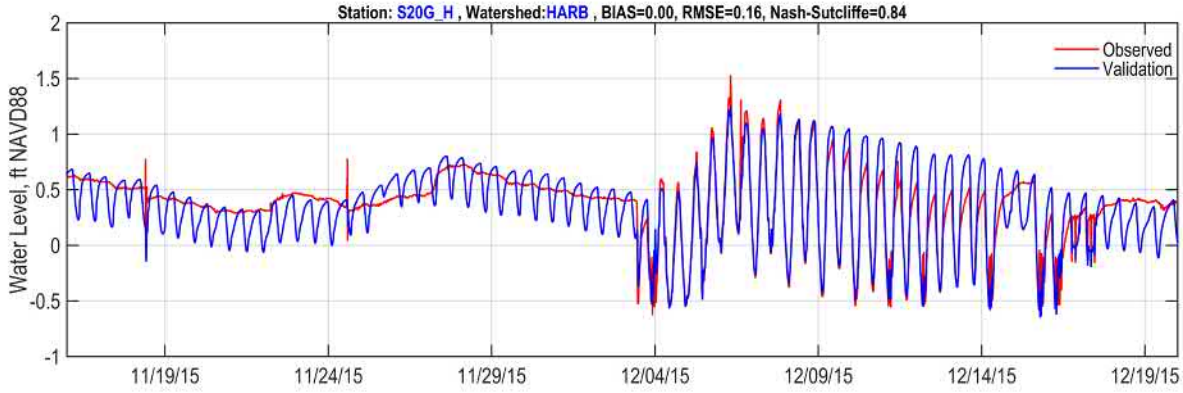


Figure 167 Watershed C-103 Validation Timeseries of Structure S20G Headwater

Figure 168 Watershed C-103 Validation Timeseries of Structure S166 Discharge

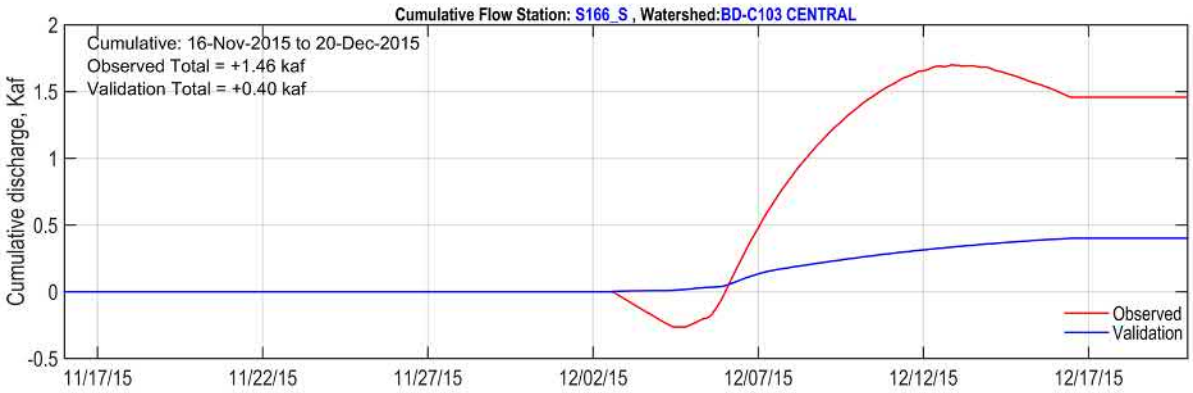


Figure 169 Watershed C-103 Cumulative Discharge at Structure S166

Figure 170 Watershed C-103 Validation Timeseries of Structure S167 Discharge

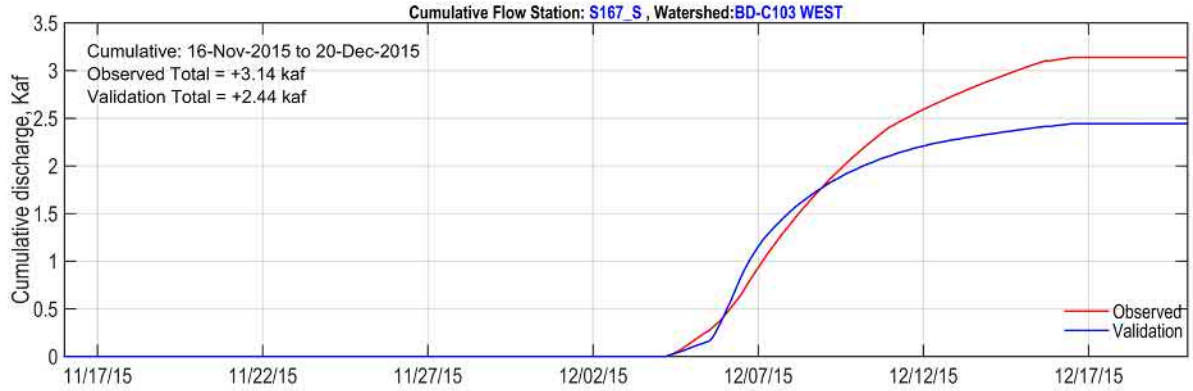


Figure 171 Watershed C-103 Cumulative Discharge at Structure S167

The computed validation discharge rates and cumulative flows of Structure S179 shows a good match with observed data (Figure 172 and Figure 173):

Figure 172 Watershed C-103 Validation Timeseries of Structure S179 Discharge

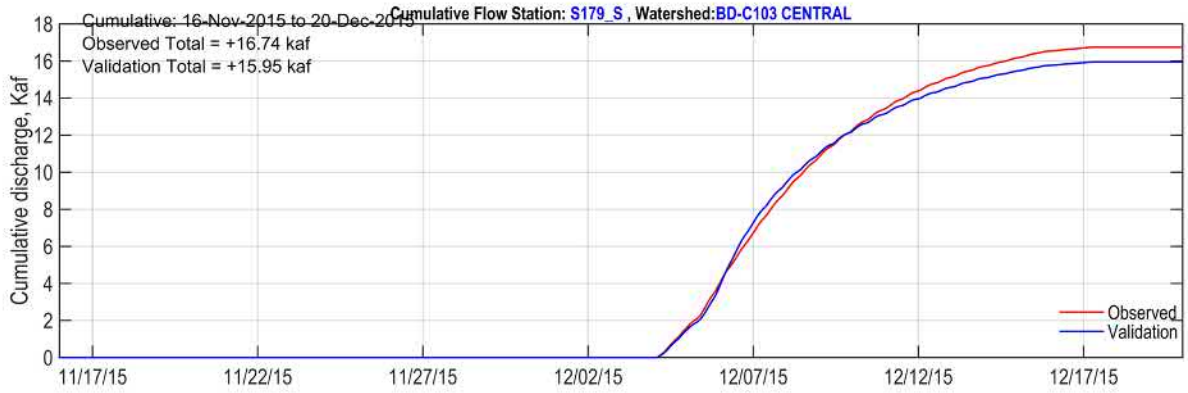


Figure 173 Watershed C-103 Cumulative Discharge at Structure S179

The computed validation discharge rates of structure S20F show a good match with observed data (Figure 174), however, the cumulative flows are overestimated (Figure 175).

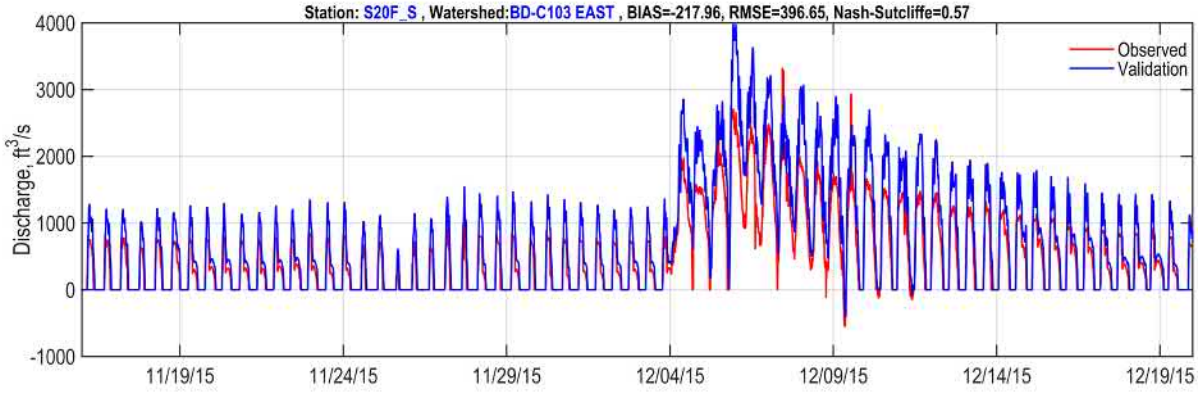


Figure 174 Watershed C-103 Validation Timeseries of Structure S20F Discharge

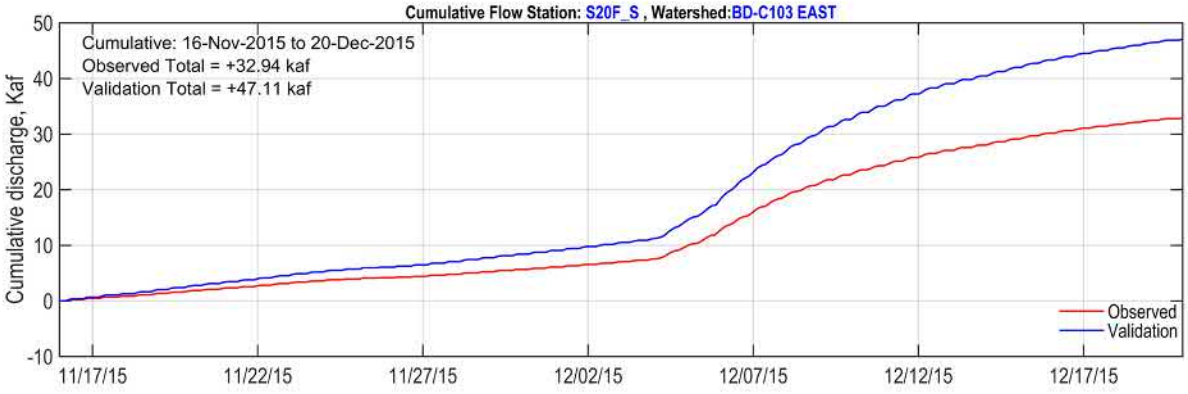


Figure 175 Watershed C-103 Cumulative Discharge at Structure S20F

The computed validation discharge rates of Structure S20G also show a good match with observed data (Figure 176), and additionally, the cumulative flows have acceptable match within 20% (Figure 177).

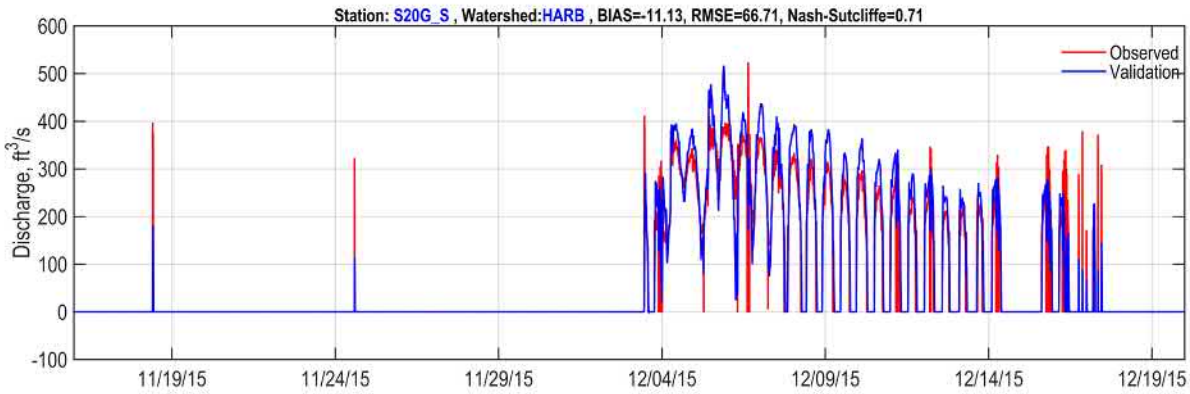


Figure 176 Watershed C-103 Validation Timeseries of Structure S20G Discharge

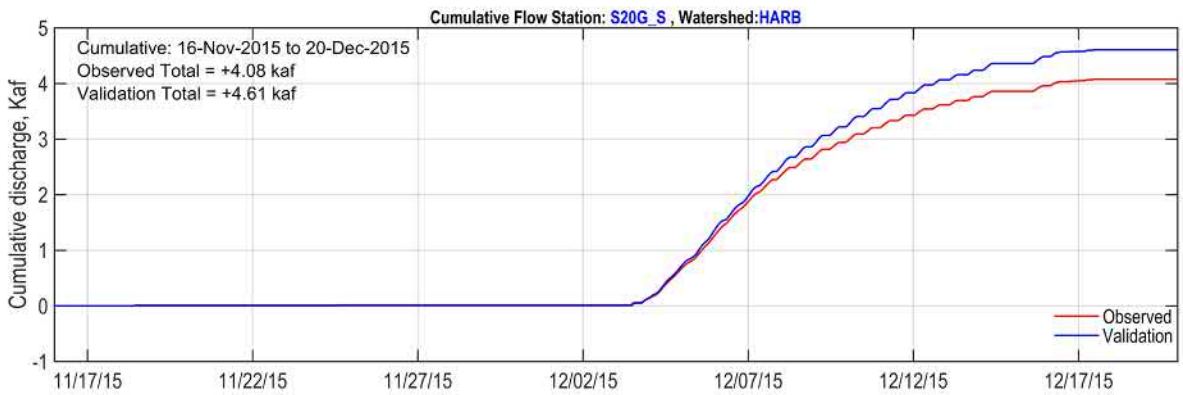


Figure 177 Watershed C-103 Cumulative Discharge at Structure S20G

4.2.1.5 Summary of Validation Statistics

Validation statistics are provided for Bias, Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Correlation (COR), Standard Deviation (STD), Bias, Percent Explained Variance (PE), Nash-Sutcliffe Efficiency (NS), Peak Differences (Peak Diff), for surface and groundwater observation stations within the project watersheds (C-1, C-100, C-102 and C-103) and within the entire model domain.

4.2.1.5.1 Validation Statistics of Surface Water Stations within Project Watersheds

Within the project watersheds, there are 21 surface water monitoring stations, which include canal stages upstream and downstream of the control structures (Table 43). The table lists the calibration statistics observation stations within the four project watersheds.

Table 43. Validation Statistics of Surface Water Stations within Project Watersheds

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
S148_H	C-1	2790	-0.18	0.29	0.39	0.92	0.34	0.48	0.33	1.28
S148_T		4767	0.59	0.60	0.67	0.87	0.31	0.64	-0.64	0.49
S149_H		4614	0.69	0.69	0.81	0.69	0.42	0.20	-2.00	0.99
S149_T		4614	0.73	0.73	0.81	0.80	0.37	0.53	-1.29	0.75
S21_H		6817	0.24	0.28	0.42	0.78	0.34	0.44	0.15	0.30
S118_H	C-100	3136	0.62	0.62	0.64	0.85	0.17	0.68	-3.69	0.52
S118_T		4793	0.56	0.57	0.67	0.76	0.37	0.21	-1.61	0.67
S119_H		2948	0.54	0.59	0.71	0.86	0.46	-0.24	-1.91	0.40
S119_T		4835	-0.50	0.81	0.92	0.25	0.77	-4.31	-6.57	1.18
S123_H		4953	0.44	0.46	0.60	0.72	0.40	0.34	-0.48	0.36
S165_H	C-102	2220	0.06	0.87	0.93	0.51	0.93	-1.19	-1.20	0.74
S165_T		3960	0.79	0.81	0.92	0.88	0.47	0.76	0.10	1.46
S21A_H		7838	0.13	0.16	0.22	0.94	0.18	0.86	0.80	0.85
S166_H	C-103	3439	-0.05	0.20	0.35	0.71	0.34	-0.36	-0.38	0.23
S166_T		3439	0.09	0.15	0.17	0.95	0.14	0.83	0.75	0.15
S167_H		2265	-0.13	0.39	0.66	0.84	0.65	-2.49	-2.63	2.58
S167_T		2247	0.02	0.28	0.48	0.94	0.48	-0.11	-0.12	2.12
S179_H		2726	0.06	0.18	0.22	0.82	0.21	-0.06	-0.14	0.05
S179_T		8373	-0.27	0.27	0.31	0.96	0.14	0.92	0.64	0.05
S20F_H		7377	-0.20	0.23	0.28	0.91	0.20	0.82	0.64	0.20

The validation statistics of the surface water stations outside of the four project watersheds are listed in Table 44.

Table 44. Validation Statistics of Surface Water Stations Outside Project Watersheds C-1, C100, C-102 and C-103

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
3BS1-PZ1	CONSERVATION AREA 3B	3394	0.10	0.10	0.11	1.00	0.03	0.99	0.81	0.11
3BS1-PZ2	CONSERVATION AREA 3B	3352	0.09	0.09	0.09	1.00	0.03	0.98	0.86	0.10
3BS1-PZ3	CONSERVATION AREA 3B	3396	0.03	0.06	0.07	0.99	0.07	0.94	0.93	0.06
3BS1-PZ4	CONSERVATION AREA 3B	3387	0.02	0.05	0.06	0.99	0.06	0.95	0.94	0.20
3BS1W1	CONSERVATION AREA 3B	817	0.18	0.18	0.18	1.00	0.04	0.97	0.51	0.20
3B-SE	CONSERVATION AREA 3B	817	0.27	0.27	0.27	1.00	0.07	0.95	0.07	0.31
BBCW10	SOUTH BISCAYNE BAY	3264	-0.10	0.55	0.61	0.53	0.60	0.27	0.25	0.35
C2GSW1	C-2	5868	0.30	0.30	0.33	0.95	0.14	0.90	0.40	0.34
C2SW1	C-2	3354	0.14	0.15	0.18	0.97	0.11	0.93	0.82	0.14
C2SW2	C-2	5944	0.13	0.14	0.17	0.97	0.11	0.92	0.81	0.49
CT50R	C-111 COASTAL	817	-0.24	0.24	0.24	0.99	0.03	0.98	-0.56	0.21
CV5NR	C-111 SOUTH	817	-0.11	0.15	0.17	0.93	0.13	0.78	0.62	0.12
EVER4	C-111 COASTAL	817	-0.38	0.38	0.38	0.98	0.05	0.96	-1.11	0.29
EVER8	C-111 SOUTH	817	-0.42	0.42	0.43	0.99	0.08	0.95	-0.71	0.43
L31NN	EVERGLADES NATIONAL PARK	817	0.27	0.27	0.27	0.97	0.05	0.77	-5.80	0.21
L31W	S332D DETENTION AREA	817	0.14	0.14	0.15	1.00	0.05	0.99	0.94	0.18
NESRS3	EVERGLADES NATIONAL PARK	817	0.18	0.18	0.18	0.98	0.04	0.91	-1.47	0.14
NESRS3_B	EVERGLADES NATIONAL PARK	3273	0.19	0.19	0.19	0.98	0.04	0.90	-1.65	0.15
NTS1	TAYLOR SLOUGH	817	0.10	0.11	0.12	1.00	0.06	0.99	0.96	0.11
NTS18	SDA	817	-0.26	0.37	0.44	0.99	0.36	0.90	0.85	0.24
G211_H	L-29 CC	1906	-1.80	1.80	1.95	-0.16	0.73	-0.21	-7.47	1.59
G211_T	L-31N CC	5858	-1.07	1.07	1.08	0.89	0.19	0.73	-7.61	0.74
G422_T	C-4	2280	0.39	0.61	0.80	0.91	0.70	0.63	0.52	0.33
NP-31W	TAYLOR SLOUGH	35	0.03	0.04	0.05	1.00	0.04	1.00	0.99	0.08
NP-NESS20	EVERGLADES NATIONAL PARK	35	0.30	0.30	0.31	0.97	0.04	0.90	-5.32	0.15
NP-NTS1	TAYLOR SLOUGH	35	0.04	0.06	0.06	1.00	0.05	0.99	0.99	0.07
NP-RG3	EVERGLADES NATIONAL PARK	35	-0.58	0.58	0.61	0.97	0.19	0.89	-0.11	0.58

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
NP-RG4	SDA	788	-0.12	0.22	0.29	0.96	0.27	0.90	0.88	0.15
NP-ROB	C-111 AG	35	-0.41	0.49	0.53	0.98	0.34	0.92	0.80	0.11
S123_T	SOUTH BISCAYNE BAY	12932	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.03
S176_H	L-31NS	4029	-0.61	0.62	0.96	-0.51	0.74	-3.07	-5.87	0.32
S176_T	C-111 AG	2369	-0.19	0.25	0.33	0.77	0.27	0.54	0.32	0.12
S177_H	C-111 AG	2300	0.55	0.63	0.73	0.08	0.48	-1.43	-4.66	0.21
S177_T	C-111 SOUTH	3071	-0.35	0.35	0.38	0.97	0.17	0.82	0.04	0.46
S178_H	C-111 AG	3401	-0.73	0.73	0.87	0.32	0.47	-1.66	-8.01	1.29
S178_T	C-111 SOUTH	3401	-0.20	0.20	0.21	0.98	0.06	0.96	0.46	0.08
S18C_H	C-111 SOUTH	3765	-0.17	0.17	0.18	0.97	0.06	0.94	0.48	0.04
S18C_T	C-111 COASTAL	3853	-0.27	0.27	0.28	0.98	0.05	0.95	-0.69	0.29
S197_H	C-111 COASTAL	5573	-0.24	0.24	0.25	0.95	0.05	0.90	-1.68	0.19
S197_T	US1	5564	0.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00
S199_H	C-111 AG	3141	-0.36	0.39	0.52	0.47	0.37	0.21	-0.52	0.39
S199_T	C-111 COASTAL	2815	0.68	1.14	1.64	0.89	1.49	-1.81	-2.40	0.41
S20_H	MODEL-LAND	1760	0.05	0.13	0.16	0.87	0.15	0.70	0.67	0.11
S20_T	DA-4	2397	-0.33	0.33	0.34	0.96	0.08	0.92	-0.59	0.38
S200_H	C-111 AG	4436	-0.52	0.52	0.59	0.67	0.27	0.44	-1.68	0.37
S200_T	FROG POND DETENTION AREA	2878	0.92	0.92	0.94	0.95	0.20	0.84	-2.29	0.87
S20F_T	DA-4	11849	0.00	0.01	0.01	1.00	0.01	1.00	1.00	0.00
S20G_H	HARB	4713	0.01	0.12	0.16	0.92	0.16	0.84	0.84	0.28
S20G_T	DA-4	12713	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.01
S21_T	DA-4	10776	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.00
S21A_T	DA-4	13130	0.00	0.01	0.01	1.00	0.01	1.00	1.00	0.00
S22_H	C-2	7830	0.08	0.11	0.14	0.97	0.11	0.94	0.90	0.60
S22_T	DA-3-REVISAR	16961	0.00	0.01	0.02	1.00	0.02	1.00	1.00	0.00
S331_H	L-31N CC	5549	-1.06	1.06	1.08	0.90	0.20	0.73	-6.84	0.76
S331_T	L-31NS	5160	-0.45	0.46	0.72	0.58	0.56	-0.58	-1.62	0.07
S332B_H	L-31NS	5740	-1.53	1.53	1.78	-0.27	0.90	-5.48	-24.15	0.92

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
S332C_H	L-31NS	3644	-0.61	0.61	0.95	-0.46	0.72	-3.53	-6.81	0.29
S332D_H	L-31NS	4065	-0.65	0.65	0.99	-0.53	0.75	-3.05	-6.13	0.34
S334_H	EVERGLADES NATIONAL PARK	1799	0.00	0.00	0.00	1.00	0.00	1.00	1.00	0.00
S334_T	L-29 CC	2468	-0.96	0.96	0.97	0.92	0.15	0.78	-8.73	0.53
S335_H	L-30 CC	1999	0.00	0.00	0.01	1.00	0.01	1.00	1.00	0.04
S335_T	L-29 CC	2893	-0.99	0.99	1.00	0.92	0.14	0.78	-10.72	0.57
S380_H	C-2	1906	-1.49	1.49	1.60	0.92	0.58	0.26	-4.74	0.67
S380_T	C-4	2098	0.33	0.35	0.41	0.95	0.23	0.63	-0.10	0.36
T5W	C-4	2101	-0.01	0.02	0.02	1.00	0.02	1.00	1.00	0.03

A summary of the calibration results for the surface water monitoring stations is provided in Table 45. The table lists the results for each watershed, and for the entire domain.

Table 45. Summary of Validation Results of Surface Water Stations

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
C1	Total	5	5	5	5	5	5	5	5
	Exceed	2	2	3	2	5	2	0	2
	% Exceed	40%	40%	60%	40%	100%	40%	0%	40%
	Average	0.49	0.52	0.62	0.81	0.36	0.46	0.24	0.76
C-100	Total	5	5	5	5	5	5	5	5
	Exceed	1	1	4	2	4	1	0	2
	% Exceed	20%	20%	80%	40%	80%	20%	0%	40%
	Average	0.53	0.61	0.71	0.69	0.43	0.34	-	0.63
C-102	Total	3	3	3	3	3	3	3	3
	Exceed	2	1	1	2	2	2	1	0
	% Exceed	67%	33%	33%	67%	67%	67%	33%	0%
	Average	0.33	0.61	0.69	0.77	0.53	0.14	0.45	1.01
C-103	Total	7	7	7	7	7	7	7	7
	Exceed	7	7	7	6	6	3	3	5
	% Exceed	100%	100%	100%	86%	86%	43%	43%	71%
	Average	0.12	0.24	0.35	0.88	0.31	-0.07	0.68	0.77
Project Watersheds	Total	20	20	20	20	20	20	20	20
	Exceed	12	11	15	12	17	8	4	9
	% Exceed	60%	55%	75%	60%	85%	40%	20%	45%
	Average	0.35	0.46	0.56	0.80	0.39	0.59	0.49	0.77
Entire Model	Total	85	85	85	85	85	85	85	85
	Exceed	61	58	66	65	72	60	33	63
	% Exceed	72%	68%	78%	76%	85%	71%	39%	74%
	Average	0.35	0.40	0.47	0.81	0.26	0.31	0.72	0.41

The validation results have relatively lower performance than the calibration results. More than 70% of the stations exceed the Bias criterion of 0.50 ft with an average within 0.30 ft, 78% of the stations exceed the COR criterion, and 71% and 38% exceed the PE and NS criteria. The peak difference of observed minus computed is exceed for 71% of the stations with overall average of 0.41 ft.

The peak timing of the surface water stations is provided in Table 46 and additional includes the computed and observed peak values and differences.

Table 46. Peak Timing of Surface Water Stations within Project Watersheds

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max Obs cfs	Max Comp ft	Diff ft
S148_T	C-1	12/6/15 6:51	12/6/15 7:05	0:14	2.63	2.14	0.49
S149_H		12/6/15 6:45	12/6/15 7:20	0:35	2.99	1.99	0.99
S149_T		12/6/15 6:45	12/6/15 7:10	0:25	2.75	1.99	0.75
S21_H		12/6/15 15:00	12/6/15 6:30	8:30	1.68	1.38	0.30
S118_H		12/5/15 9:56	12/5/15 9:45	0:11	3.40	2.88	0.52
S118_T	C-100	12/6/15 7:18	12/6/15 6:20	0:58	2.43	1.76	0.67
S119_H		12/5/15 10:03	12/5/15 20:10	10:07	3.10	3.50	0.40
S119_T		12/6/15 7:26	12/5/15 20:10	11:16	2.32	3.50	1.18
S123_H		12/6/15 18:38	12/6/15 6:10	12:28	1.74	1.38	0.36
S165_H		12/6/15 9:11	12/5/15 20:35	12:36	4.16	4.90	0.74
S165_T	C-102	12/6/15 6:11	12/6/15 7:50	1:39	3.86	2.41	1.46
S21A_H		12/5/15 19:45	12/6/15 6:20	10:35	2.14	1.30	0.85
S166_H		12/5/15 20:11	12/5/15 21:35	1:24	3.02	2.79	0.23
S166_T	C-103	12/5/15 20:15	12/5/15 21:35	1:20	2.94	2.79	0.15
S167_H		12/5/15 20:18	12/5/15 21:25	1:07	3.38	5.96	2.58
S167_T		12/5/15 20:14	12/6/15 2:10	5:56	3.16	5.29	2.12
S179_H		12/5/15 19:47	12/5/15 20:25	0:38	2.41	2.46	0.05
S179_T		12/5/15 19:48	12/5/15 20:15	0:27	2.21	2.26	0.05
S20F_H		12/5/15 19:32	12/5/15 19:35	0:03	1.96	1.76	0.20

Approximately 30% of the peaks are within the range of 0.5 hours, most are within 2 hours, and 20% of the peak differences are greater than 8 hours which is caused by the differences in computed peak stages, since the gates opening use historical values.

4.2.1.5.2 Validation Statistics of Groundwater Stations within Project Watersheds

Within the project watersheds, there are 25 groundwater monitoring stations (17). The table lists the validation statistics of stations within the four project watersheds.

Table 47. Validation Statistics of Groundwater Stations within Project Watersheds

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
G-3561	C-1	35	0.43	0.43	0.54	0.96	0.33	0.91	0.76	1.65
G-3889		35	-1.35	1.35	1.43	0.97	0.46	0.74	-1.60	3.44
G-3899		35	-0.99	0.99	1.12	0.97	0.54	0.10	-3.06	2.72
G-3967		35	0.03	0.33	0.39	0.96	0.39	0.39	0.38	0.91
G-3968		35	-1.05	1.05	1.19	0.95	0.57	-0.17	-4.23	2.94
G-3969		35	-1.24	1.24	1.34	0.96	0.51	0.19	-4.69	3.11
G-855		35	0.24	0.28	0.45	0.91	0.39	0.82	0.76	0.76
KROME		3288	-0.58	0.58	0.58	0.96	0.06	0.91	-7.99	0.72
S-182		34	-0.84	0.84	0.95	0.97	0.44	0.69	-0.44	2.32
G-3897	C-100	35	0.42	0.49	0.62	0.93	0.46	0.87	0.76	0.96
G-553		35	-0.48	0.77	1.00	0.95	0.89	-0.55	-1.02	2.20
G-580A		35	0.70	0.70	0.72	0.96	0.17	0.92	-0.48	0.15
G-860		35	-0.32	0.66	0.94	0.25	0.90	-21.26	-24.25	2.37
BBCMW4G1	C-102	3261	-0.15	0.18	0.22	0.86	0.16	0.71	0.46	0.16
BBCMW4G2		3263	0.07	0.14	0.17	0.86	0.16	0.72	0.67	0.05
BBCW2		6716	-0.72	0.72	0.76	0.77	0.26	0.55	-2.73	0.57
G-3549		35	-0.08	0.27	0.29	0.75	0.28	0.45	0.41	0.07
BBCW10GW1	C-103	11881	-0.16	0.54	0.62	0.47	0.60	0.17	0.12	0.25
BBCW10GW2		3261	-0.80	0.88	1.06	0.38	0.69	0.11	-1.09	0.24
BBCW3GW1		3473	-0.09	0.13	0.16	0.96	0.13	0.92	0.88	0.31
BBCW3GW2		3471	-0.10	0.14	0.16	0.96	0.13	0.92	0.87	0.28
F-358		35	-0.09	0.30	0.38	0.96	0.38	0.91	0.91	0.08
G-1486		35	-0.16	0.22	0.25	0.97	0.20	0.94	0.90	0.21
G-1487		35	-0.23	0.38	0.49	0.92	0.44	0.78	0.71	0.72
S-196A		35	-0.76	0.83	1.15	0.85	0.87	0.25	-0.33	1.66

The calibration statistics of the groundwater stations outside of the four project watersheds are listed in Table 48.

Table 48. Validation Statistics of Groundwater Wells Outside Project Watersheds C-1, C100, C-102 and C-103

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
3BS1-GW1	CONSERVATION AREA 3B	3397	0.07	0.07	0.08	1.00	0.03	0.99	0.90	0.08
3BS1-GW2	CONSERVATION AREA 3B	3411	0.10	0.10	0.11	1.00	0.03	0.98	0.81	0.12
3BS1-GW3	CONSERVATION AREA 3B	3403	-0.03	0.04	0.05	1.00	0.04	0.97	0.96	0.01
3BS1-GW4	CONSERVATION AREA 3B	3389	0.00	0.03	0.03	1.00	0.03	0.98	0.98	0.01
BBCW6GW2	MODEL-LAND	3344	-0.21	0.21	0.22	0.99	0.05	0.99	0.80	0.11
C111AE	C-111 SOUTH	3474	-0.54	0.54	0.56	0.93	0.17	0.87	-0.45	0.05
C111AK5	C-111 SOUTH	3264	-0.44	0.49	0.52	0.98	0.26	0.89	0.59	0.50
C111AK6	C-111 SOUTH	3265	-0.37	0.38	0.40	0.94	0.15	0.89	0.23	0.49
C111AW	C-111 SOUTH	3742	-0.40	0.40	0.43	0.92	0.16	0.85	-0.01	0.04
C111VC1	C-111 AG	3264	-0.23	0.40	0.43	0.96	0.36	0.78	0.68	0.38
C111VC2	C-111 AG	3265	-0.27	0.42	0.44	0.96	0.35	0.80	0.69	0.33
C111W12	C-111 AG	3263	-0.28	0.41	0.43	0.98	0.32	0.90	0.82	0.39
C111W14	C-111 AG	3262	-0.46	0.49	0.52	0.98	0.24	0.92	0.64	0.98
C111W17	C-111 SOUTH	3264	-0.47	0.48	0.51	0.94	0.20	0.88	0.22	0.28
C2GSW1_GW1	C-2	5864	-0.44	0.46	0.55	0.96	0.34	0.92	0.79	1.06
G-1183	HARB	35	-0.20	0.36	0.38	0.76	0.32	0.48	0.27	0.09
G-3336	C-111 COASTAL	35	-0.11	0.12	0.14	0.97	0.10	0.87	0.71	0.10
G-3338	C-111 SOUTH	3290	-0.29	0.29	0.29	0.98	0.05	0.96	-0.06	0.14
G-3339	C-111 SOUTH	3294	-0.27	0.27	0.27	0.98	0.06	0.96	-0.06	0.14
G-3437	EVERGLADES NATIONAL PARK	35	0.05	0.17	0.20	0.98	0.19	0.89	0.89	0.07
G-3553	C-2	35	0.92	0.92	0.93	0.96	0.18	0.92	-1.34	0.33
G-3557	L-29 CC	35	-0.49	0.50	0.55	0.82	0.27	0.57	-0.84	0.21
G-3558	C-2	35	-0.61	0.61	0.68	0.91	0.30	0.64	-0.84	0.38
G-3560	C-2	35	0.30	0.30	0.38	0.94	0.25	0.89	0.73	0.19
G-3565	C-2	35	0.67	0.67	0.69	0.98	0.17	0.94	0.08	0.34
G-3572	C-2	35	0.22	0.22	0.26	0.98	0.14	0.95	0.80	0.52

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
G-3574	EVERGLADES NATIONAL PARK	817	-0.57	0.57	0.57	0.96	0.05	0.92	-11.39	0.48
G-3575	EVERGLADES NATIONAL PARK	817	0.17	0.17	0.18	0.95	0.06	0.90	0.07	0.19
G-3576	EVERGLADES NATIONAL PARK	817	0.09	0.09	0.09	1.00	0.01	0.99	0.48	0.11
G-3577	EVERGLADES NATIONAL PARK	817	0.13	0.18	0.22	0.68	0.18	0.47	0.21	0.16
G-3578	EVERGLADES NATIONAL PARK	817	0.12	0.12	0.12	0.98	0.03	0.96	0.24	0.15
G-3620	C-111 SOUTH	35	-0.30	0.30	0.34	0.91	0.16	0.82	0.21	0.31
G-3621	C-111 SOUTH	31	-0.36	0.36	0.37	0.98	0.09	0.94	-0.13	0.41
G-3676	C-4	817	0.35	0.35	0.38	0.98	0.15	0.85	0.10	0.05
G-3881	C-2	35	-2.17	2.17	2.21	0.99	0.41	0.90	-2.01	2.40
G-3900	FLA-CITY	35	-0.02	0.06	0.10	0.99	0.10	0.98	0.98	0.33
G-3901	C-111 AG	35	-0.09	0.45	0.54	0.98	0.54	0.76	0.75	0.85
G-3903	C-2	35	0.73	0.74	0.77	0.98	0.24	0.92	0.17	0.84
G-3913	C-2	34	-1.94	1.94	1.98	0.99	0.41	0.90	-1.52	1.99
G-3918	C-2	35	0.94	0.94	0.99	0.99	0.32	0.92	0.20	0.62
G-3927	C-2	35	0.60	0.60	0.62	0.98	0.16	0.96	0.47	1.05
G-596	8.5 SQ. MILE AREA	817	-0.44	0.44	0.47	0.91	0.17	0.83	-0.27	0.23
G-613	C-111 AG	35	-0.49	0.51	0.53	0.95	0.23	0.89	0.37	0.36
G-864	C-111 AG	33	-0.11	0.59	0.72	0.98	0.72	0.80	0.80	0.70
G-864A	C-111 AG	35	-0.14	0.56	0.67	0.98	0.67	0.83	0.82	0.52
HUMBLE	L-31NS	3377	-0.80	0.80	1.02	0.71	0.64	0.29	-0.82	0.04
L31NSGW1	EVERGLADES NATIONAL PARK	3761	-0.62	0.62	0.63	0.96	0.08	0.88	-6.35	0.48
L31NSGW2	EVERGLADES NATIONAL PARK	3748	-0.53	0.53	0.54	0.97	0.05	0.93	-5.74	0.35
L31NSGW3	EVERGLADES NATIONAL PARK	3749	-0.47	0.47	0.47	0.97	0.05	0.93	-4.15	0.28
L31NSGW4	EVERGLADES NATIONAL PARK	3766	-0.16	0.16	0.17	0.93	0.06	0.87	0.13	0.08
R-158	TAYLOR SLOUGH	35	-0.36	0.36	0.36	1.00	0.08	0.99	0.72	0.41
RUTZKE	CONSERVATION AREA 3B	35	0.10	0.23	0.28	0.96	0.26	0.84	0.81	0.03

A summary of the validation results for the ground water monitoring stations is provided in Table 3719. The table lists the results for each watershed, and for the entire domain.

Table 49. Summary of Validation Results of Groundwater Stations

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
C1	Total	9	9	9	9	9	9	9	9
	Exceed	3	3	4	9	6	5	2	0
	% Exceed	33%	33%	44%	100%	67%	56%	22%	0%
	Average	0.75	0.79	0.89	0.96	0.42	0.50	0.63	2.06
C-100	Total	4	4	4	4	4	4	4	4
	Exceed	3	1	2	3	2	2	1	1
	% Exceed	75%	25%	50%	75%	50%	50%	25%	25%
	Average	0.48	0.66	0.83	0.77	0.61	-5.00	0.76	1.42
C-102	Total	4	4	4	4	4	4	4	4
	Exceed	3	3	3	2	4	3	1	3
	% Exceed	75%	75%	75%	50%	100%	75%	25%	75%
	Average	0.25	0.33	0.36	0.81	0.22	0.61	0.52	0.21
C-103	Total	8	8	8	8	8	8	8	8
	Exceed	6	5	6	5	5	4	4	6
	% Exceed	75%	63%	75%	63%	63%	50%	50%	75%
	Average	0.31	0.45	0.55	0.78	0.45	0.57	0.63	0.46
Project Watersheds	Total	25	25	25	25	25	25	25	25
	Exceed	15	12	15	20	17	15	9	10
	% Exceed	60%	48%	60%	80%	68%	60%	36%	40%
	Average	0.48	0.58	0.68	0.86	0.42	0.64	0.66	1.16
Entire Model	Total	77	77	77	77	77	77	77	77
	Exceed	54	47	61	69	65	64	30	50
	% Exceed	70%	61%	79%	90%	84%	83%	39%	65%
	Average	0.43	0.49	0.55	0.92	0.27	0.80	0.59	0.64

The validation results show that 70% of all groundwater stations exceed the Bias criterion of 0.50 ft with average within 0.49 ft, 90% of the stations exceed the COR criterion, and 83% and 39% exceed the PE and NS criteria. The peak difference of observed minus computed is exceed for 40% of the stations with overall average which is 1.15 ft and higher than the calibration results.

The peak timing of the groundwater stations is provided in Table 50 and additional includes the computed and observed peak values and differences.

Table 50. Peak Timing Difference for Groundwater Stations within Project Watersheds

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max obs ft	Max comp ft	Diff ft
G-3889	C-1	12/6/15 0:00	12/5/15 23:00	1:00	4.61	8.05	3.44
G-3899		12/6/15 0:00	12/5/15 23:00	1:00	2.85	5.58	2.72
G-3967		12/6/15 0:00	12/6/15 2:00	2:00	2.54	3.45	0.91
G-3968		12/6/15 0:00	12/5/15 23:00	1:00	2.77	5.71	2.94
G-3969		12/6/15 0:00	12/5/15 19:00	5:00	2.94	6.06	3.11
G-855		12/5/15 0:00	12/5/15 21:00	21:00	6.67	5.91	0.76
KROME		12/5/15 17:06	12/5/15 18:00	0:54	5.19	5.91	0.72
S-182		12/6/15 0:00	12/6/15 2:00	2:00	3.76	6.08	2.32
G-3897		12/5/15 0:00	12/5/15 18:00	18:00	6.83	7.79	0.96
G-553	C-100	12/6/15 0:00	12/5/15 23:00	1:00	4.01	6.21	2.20
G-580A		12/6/15 0:00	12/4/15 12:00	12:00	2.77	2.62	0.15
G-860		12/6/15 0:00	12/6/15 3:00	3:00	1.91	4.28	2.37
BBCMW4G1		12/6/15 7:30	12/5/15 14:00	17:30	1.34	1.50	0.16
BBCMW4G2	C-102	12/6/15 7:30	12/5/15 14:00	17:30	1.55	1.50	0.05
BBCW2		12/6/15 8:30	12/6/15 8:00	0:30	0.72	1.29	0.57
G-3549		12/6/15 0:00	12/6/15 9:00	9:00	1.42	1.35	0.07
BBCW10GW1		12/6/15 6:11	12/6/15 9:00	2:49	1.04	0.80	0.25
BBCW10GW2	C-103	12/6/15 6:15	12/6/15 9:00	2:45	0.55	0.80	0.24
BBCW3GW1		12/5/15 19:15	12/5/15 12:00	7:15	2.18	1.87	0.31
BBCW3GW2		12/5/15 19:30	12/5/15 12:00	7:30	2.15	1.87	0.28
F-358		12/6/15 0:00	12/6/15 3:00	3:00	6.09	6.17	0.08
G-1486		12/5/15 0:00	12/5/15 23:00	23:00	4.83	5.55	0.72
G-1487		12/5/15 0:00	12/6/15 11:00	11:00	5.93	5.84	0.09
S-196A		12/6/15 0:00	12/6/15 5:00	5:00	5.63	7.29	1.66

Most of the groundwater stations only have daily data values which results in greater differences in timing, however all peaks are within the 24 hours are within 24-hour differences.

4.2.1.5.3 Validation Statistics of Structure Discharges

Within the model domain, there are 26 control structures, which are in the primary canals (Table 51). The table lists the validation statistics of discharges of all structures.

Table 51. Validation Statistics of Structure Discharges

Name	Watershed	Obs	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS
S148_S	C-1 WEST	6516	-223	225	415	0.88	350	-1.16	-0.11
S149_C	C-1 WEST	4692	65	66	103	0.05	79	-0.11	0.95
S118_S	C-100 EAST	5605	38	44	82	0.98	73	0.95	0.88
S119_S	C-100 EAST	5556	34	34	46	0.99	31	0.88	0.66
S123_S	C-100 EAST	18386	60	187	371	0.81	366	0.66	0.68
S165_S	C-102 EAST	4733	21	49	68	0.83	64	0.68	0.72
S21A_S	C-102 EAST	23231	86	113	180	0.85	158	0.72	0.20
S166_S	BD-C103 CENTRAL	3461	19	38	69	0.77	67	0.20	0.62
S167_S	BD-C103 WEST	2919	11	33	55	0.85	54	0.62	0.95
S179_S	BD-C103 CENTRAL	10277	22	63	113	0.98	111	0.95	0.70
S20F_S	BD-C103 EAST	23874	-215	288	394	0.93	330	0.70	0.97
G211_C	L-31N CC	7941	-20	41	51	0.98	47	0.97	0.70
S176_S	C-111 AG	5052	-58	58	121	0.99	106	0.70	0.97
S177_S	C-111 SOUTH	4000	20	58	97	0.98	95	0.97	-27.57
S178_S	C-111 SOUTH	3411	-16	17	38	0.68	34	-27.57	0.93
S18C_S	C-111 COASTAL	4636	-36	105	140	0.97	135	0.93	0.97
S197_C	US1	5640	11	67	116	0.98	116	0.97	0.99
S199_P	C-111 COASTAL	3681	0	2	11	0.99	11	0.99	0.82
S20_S	MODEL-LAND	2526	25	25	40	0.96	32	0.82	0.99
S200_P	FPDA	5087	0	1	5	1.00	5	0.99	0.72
S20G_S	HARB	17126	-11	33	66	0.87	65	0.72	0.59
S21_S	DA-4	19231	33	215	336	0.86	334	0.59	0.84
S22_S	DA-3-REVISAR	31924	16	87	126	0.94	125	0.84	0.90
S331_P	L-31NS	12769	-16	63	117	0.95	116	0.90	0.53
S335_S	L-29 CC	3348	52	60	83	0.80	65	0.53	-40.52
S380_C	C-2	2389	-155	155	181	-0.56	94	-40.52	0.00

The summary of calibration results show that the averages of absolute Bias was 13%, the MAE is 18%, RMSE is 27%, STD is 21% and Peak Discharge Difference is 65% with some of the inland structures (S148, S178 and S380) experiencing greater deviation between observed and computed. The coastal structures (S21, S21A, S123, S20F and S20G) had discrepancies between computed and observed peaks corresponding to 20%, 17%, 32%, 44% and 1%.

The peak timing of structure discharges is provided in Table 52 and includes the computed and observed peak values and differences.

Table 52. Calibration Timing of Structure Discharge Peaks

Station	Watershed	T Max Obs	T Max Comp	Peak Time Diff (hrs)	Max obs cfs	Max comp cfs	Diff cfs	Diff %
S148_S	C-1	12/5/15 12:14	12/5/15 22:45	13:29	847	2192	1345	43%
S149_C	C-1	12/5/15 17:43	12/4/15 7:30	10:13	254	54	200	44%
S118_S	C-100	12/5/15 16:57	12/5/15 20:55	20:02	1246	985	261	12%
S119_S	C-100	12/5/15 11:13	12/5/15 18:25	16:48	290	201	88	37%
S123_S	C-100	12/6/15 7:48	12/5/15 21:40	10:08	2688	1827	861	2%
S165_S	C-102	12/4/15 5:26	12/5/15 23:20	6:06	317	448	131	2%
S21A_S	C-102	12/5/15 20:19	12/5/15 22:30	21:49	1582	1315	267	12%
S166_S	C-103	12/6/15 0:45	12/6/15 10:30	14:15	272	51	220	84%
S167_S	C-103	12/6/15 13:06	12/6/15 7:50	5:16	305	418	113	13%
S179_S	C-103	12/5/15 22:13	12/6/15 1:00	21:13	1807	2163	357	5%
S20F_S	C-103	12/5/15 21:00	12/5/15 22:30	22:30	2775	3993	1218	14%
G211_C	L-31N CC	12/5/15 17:50	12/5/15 17:35	0:15	680	539	141	20%
S176_S	C-111 AG	12/5/15 20:20	12/5/15 18:50	1:30	571	756	185	43%
S177_S	C-111 SOUTH	12/5/15 21:48	12/6/15 2:20	19:28	1465	1306	159	4%
S178_S	C-111 SOUTH	12/5/15 19:06	12/5/15 19:25	23:41	48	319	271	105%
S18C_S	C-111 COASTAL	12/6/15 3:13	12/6/15 2:45	0:28	2021	1738	282	35%
S197_C	US1	12/6/15 2:00	12/6/15 2:00	0:00	2025	1999	26	23%
S199_P	C-111 COASTAL	12/4/15 4:06	12/4/15 8:05	20:01	229	229	0	1%
S20_S	MODEL-LAND	12/6/15 5:10	12/6/15 1:30	3:40	163	131	32	10%
S200_P	FPDA	12/5/15 20:09	12/5/15 20:10	23:59	229	229	0	1%
S20G_S	HARB	12/6/15 15:23	12/5/15 21:25	17:58	524	517	7	2%
S21_S	DA-4	12/6/15 1:41	12/5/15 21:25	4:16	3467	2436	1031	38%
S22_S	DA-3-REVISAR	12/5/15 21:44	12/5/15 22:20	23:24	1392	1677	285	18%
S331_P	L-31NS	12/5/15 15:51	12/5/15 16:00	23:51	1199	1169	30	1%
S335_S	L-29 CC	12/3/15 11:06	12/3/15 17:50	17:16	112	45	67	22%
S380_C	C-2	12/5/15 16:51	12/6/15 18:10	22:41	87	392	305	206%

The timing of computed and observed discharge peaks is within 4 hours for most of the structures, with larger differences for structures S21A, S167 and S21.

A summary of all surface and groundwater stages within the model domain exceeding the validation criteria is provided in Table 53.

Table 53 Validation Results for Targets within Project Watersheds

Watershed	Summary	Bias (ft)	MAE (ft)	RMSE (ft)	COR	STD (ft)	PE	NS	Peak Diff (ft)
All Stages (GW and SW)	Total	162	162	162	162	162	162	162	162
	Exceed	115	105	127	134	137	124	63	113
	% Exceed	71%	65%	78%	83%	85%	77%	39%	70%
	Average	0.39	0.44	0.51	0.86	0.27	0.80	0.65	0.52

For the entire model the average Bias is 0.34 ft, MAE is 0.45, RMSE is 0.51, COR is 0.87, STD is 0.27, PE is 0.40, and NS is 0.66 with Peak Differences average of 0.53.

4.2.1.5.4 Cumulative Flows at Coastal Structures for Validation Event

Table 54 lists the cumulative flows and percent errors at each coastal structure in the project domain. While head differential at the structures between the observed and simulated is around 0.2 ft, the flows are over 20% different.

Table 54. Cumulative Calibration Flows at Coastal Structures

Structure	Observed (kAF)	Simulated (kAF)	Percent Difference
S123	14.92	12.96	-13%
S21	20.45	22.2	8%
S21A	12.07	9.5	-21%
S20F	22.39	31.57	41%
S20G	3.75	4.21	12%

Structures S123, S21 and S20G have relatively good performance, with cumulative volumes percent errors of -13 percent, 8 percent and 12 percent respectively, while higher deviations were observed for structures S1A and S20F.

4.3 Summary of Calibration and Validation Results

The assessment of the predictive ability of the model was based on exploratory data analysis and detailed comparison between observed and computed data and descriptive statistics common for H&H models for design events, including:

- Shape of the hydrographs
- Peak stages and bias

- Time differences between peaks
- Volume of water at coastal structures
- Instantaneous and cumulative discharges

The saturated zone subdomain of the model is represented by variable hydraulic conductivity in the horizontal and vertical directions. This distribution was obtained from published data from field tests and analysis of observed surface-water stage and groundwater level data; however, observation data are sparse in certain sections of the South Miami-Dade FPLOS project domain. As a result, the Biscayne Aquifer properties datasets used in the model may additionally be improved if additional data become available for the hydrogeologic properties of areas. Furthermore, nested groundwater monitoring wells are limited in the project domain; so vertical hydraulic conductivity data may not accurately reflect the vertical heterogeneity of the aquifer. The best available data and publications were utilized in this parametrization.

Canal seepage and leakage in the model are controlled by a calibrated leakance parameter. Canal seepage and leakance values are not field measured and have been parameterized by matching the observed groundwater data and simulated canal leakage and seepage to calculated net surface-water watershed discharge between water control structures. The accuracy of these values is uncertain because of several ungaged secondary drainage features and canals that contribute flow into the MIKE 1D network.

In the project domain watersheds, the groundwater and surface-water are closely coupled, and the SMD FPLOS model provides a good representation of both systems and demonstrates and simulates reasonably well their coupling. Stages and flows were used to calibrate the model, and some soft calibration targets were used; and even though hydraulic properties of the Biscayne Aquifer and the canal system and are not known at all locations, this model is designed to simulate physically based surface-water and groundwater processes, and the interaction between them.

The model will be used for analysis of design events in the conditions of sea level rise, which will reduce the hydraulic gradient from across the model domain from Everglades to the Coast. For current conditions, the gradient is approximately 4-5 feet for starting from canal L31N and ending at the coastline. For the conditions of SLR, this gradient will be reduced by half or more for potential SLR increase by +3 ft. Therefore, the primary selected storm event for calibration was Hurricane Irma; with high storm surge and additional wet antecedent conditions. Hurricane Irma additionally had high rainfall intensity and was relatively uniform over the model domain. The storm event selected for validation was December 4-6, 2015 event; with dry antecedent conditions, similarly high rainfall intensity and rapid system response to the rainfall. The management of the SFWMD system and structure operations were also different between the two events. Selection of events that were not exactly alike, and calibration of parameters to both, improves the robustness of the model and reduces uncertainty.

The performance of the model focused stages, flows and cumulative flows with the understanding that:

1. Canal stages are more critical for flood events to determine flooding depths and inundation extents
2. SFWMD system operational schedules were based on observed gate opening which in some cases may not correspond to the control rules which are based on stages

3. The observed data are stages, while flows are computed by rating curves based on head differential of tailwater and headwater which may introduce some inaccuracy for flow calculation particularly for negative flows and coastal structures under certain conditions with two-dimensional flow

Spatial distribution of stages passing the calibration criteria are shown in Figure 178 and Figure 179.

Based on the results from the calibration and validation events, it is concluded that the model adequately represents the project domain hydrology in terms of peak stages and discharges for surface water, peak groundwater stages and can be applied for simulation of design events with variable recurrence intervals. Considering that only some of the rainfall stations reported precipitation up to 25 year 72-hr recurrence, higher uncertainty may be expected for design events with recurrence of 100 years.

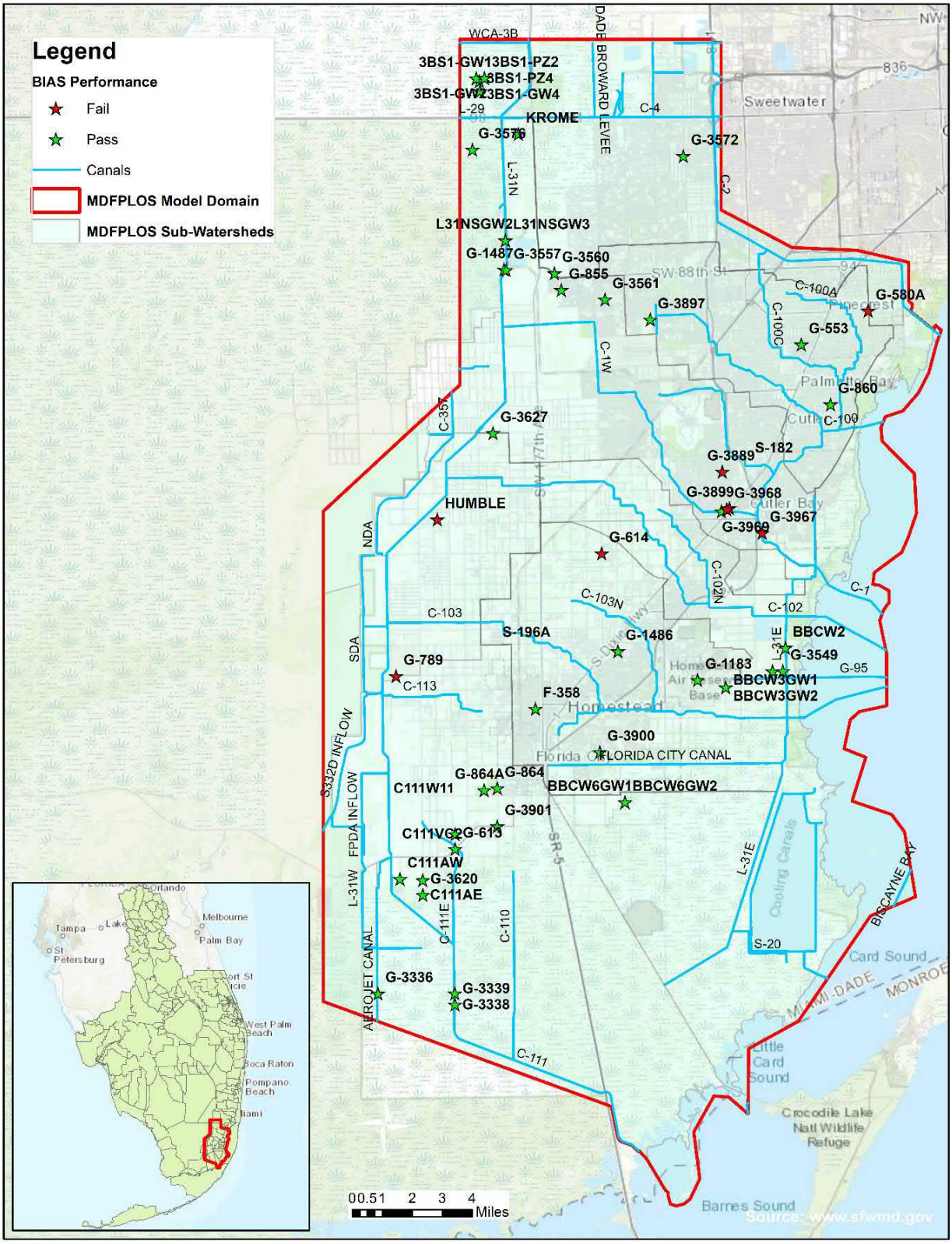


Figure 178. GW Stations with BIAS less than ±0.5 ft (green stars)

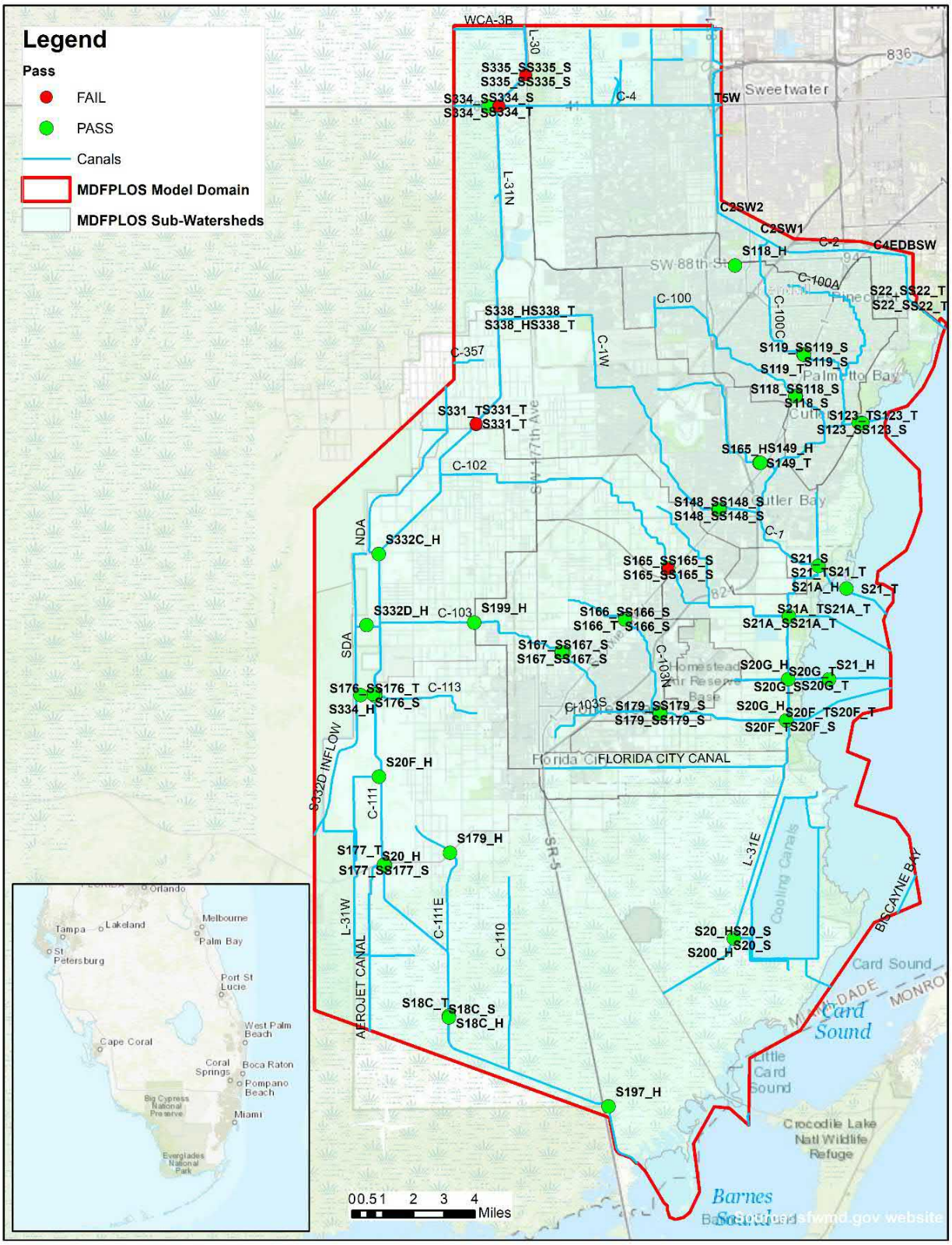


Figure 179. Surface Water Stations with BIAS less than ±0.5 ft (green circles)

5 FLOOD PROTECTION LEVEL OF SERVICE FOR EXISTING CONDITIONS

The District LOS program relies on six performance metrics (PMs) to evaluate the flood protection provided by the primary SFWMD infrastructure defined in Section 2 of this document. This section describes the model setup and analysis of model results for each of the performance metrics indicators for current conditions:

- PM1 - Maximum Stage in Primary Canals:
- PM2 - Maximum Daily Discharge Capacity through the Primary Canals:
- PM3 – Structure Performance:
- PM4 - Peak Storm Runoff:
- PM5 - Frequency of Flooding:
- PM6 - Duration of Flooding:

5.1 Model Set-Up for Existing Conditions

The calibrated SMD FPLOS MIKE SHE / MIKE 1D model was used as the basis for the current conditions model with design storms. This section focuses on the changes to the calibration model setup that were required to simulate the synthetic design storm events for current (2019) conditions. These changes included rainfall, structure operations, tailwater boundary conditions and initial conditions.

5.1.1 Period of Simulation

The length of simulation was modified for the existing conditions model. The calibration model was set up for 2-month simulation period. The existing conditions model is set up for 35 days to include a warm-up period, the 72-hr design storm event and 4 weeks to capture the storm event recession hydrographs completely. The period of simulation covers September 1st to October 5th based on preliminary model runs and discussion with the SFWMD FPLOS review team.

5.1.2 Rainfall Design Events

The rainfall volumes use the precipitation frequency estimates provided by NOAA Atlas 14, which were developed using historical records. NOAA's estimates were prepared by spatially interpolating point precipitation frequency estimates. The precipitation frequency estimates were calculated using regional statistics based on an annual maximum data series. More details about the processes used to create this grid can be found in the project quarterly reports posted at <http://www.nws.noaa.gov/ohd/hdsc/current-projects/project.html> or the NOAA Atlas 14 Documentation (ref 1). The original NOAA grid provides total precipitation in 1,000*inches using a grid of 0.00833333 decimal degrees (approximately 915 m). For the model, the grid is converted to inches and used to develop spatial grid timeseries using the same resolution as the original grid from NOAA.

Figure 180 through Figure 183 show the spatial distribution of the design storm volume of the 72-hr storm events. The information provided in Table 55 correlates to the spatial distribution shown in Figure 180 through Figure 183 and the rainfall statistics are shown in Table 56 through Table 59.

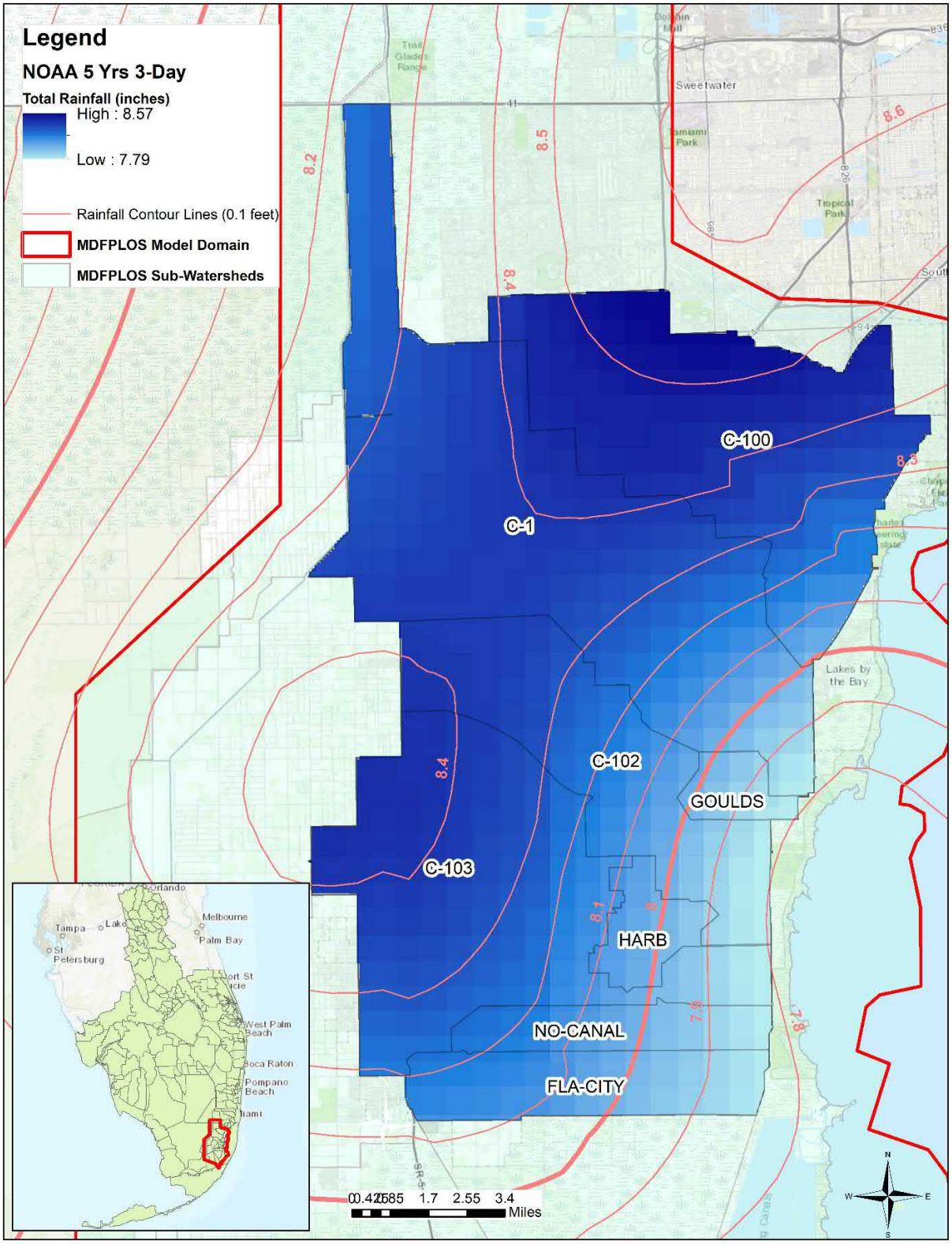


Figure 180. Spatial Distribution of Rainfall Depth for the 5-Year 72-Hour Design Event within Watersheds C-1, C-100, C102 and C-103

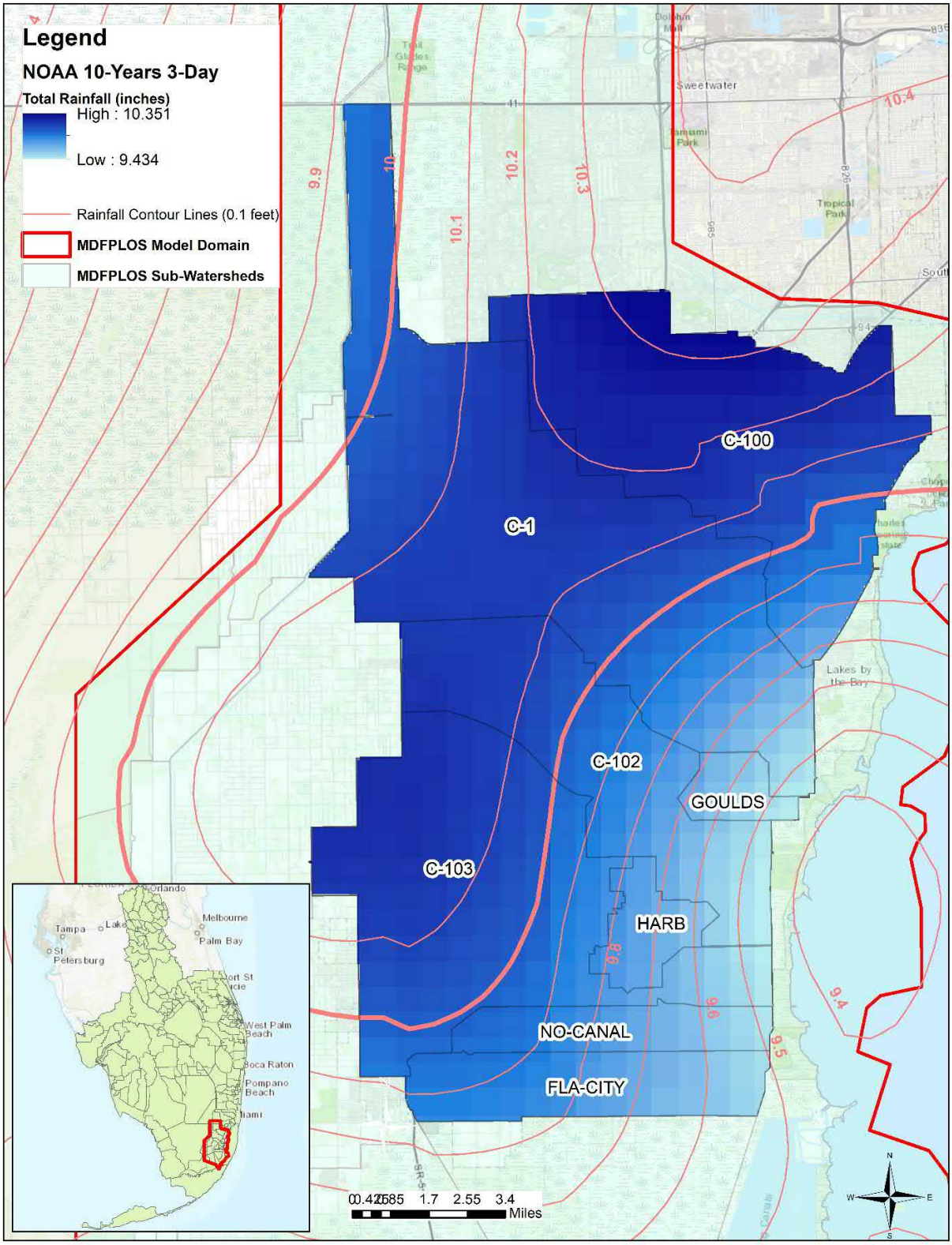


Figure 181. Spatial Distribution of Rainfall Depth for the 10-Year 72-Hour Design Event within Watersheds C-1, C-100, C102 and C-103

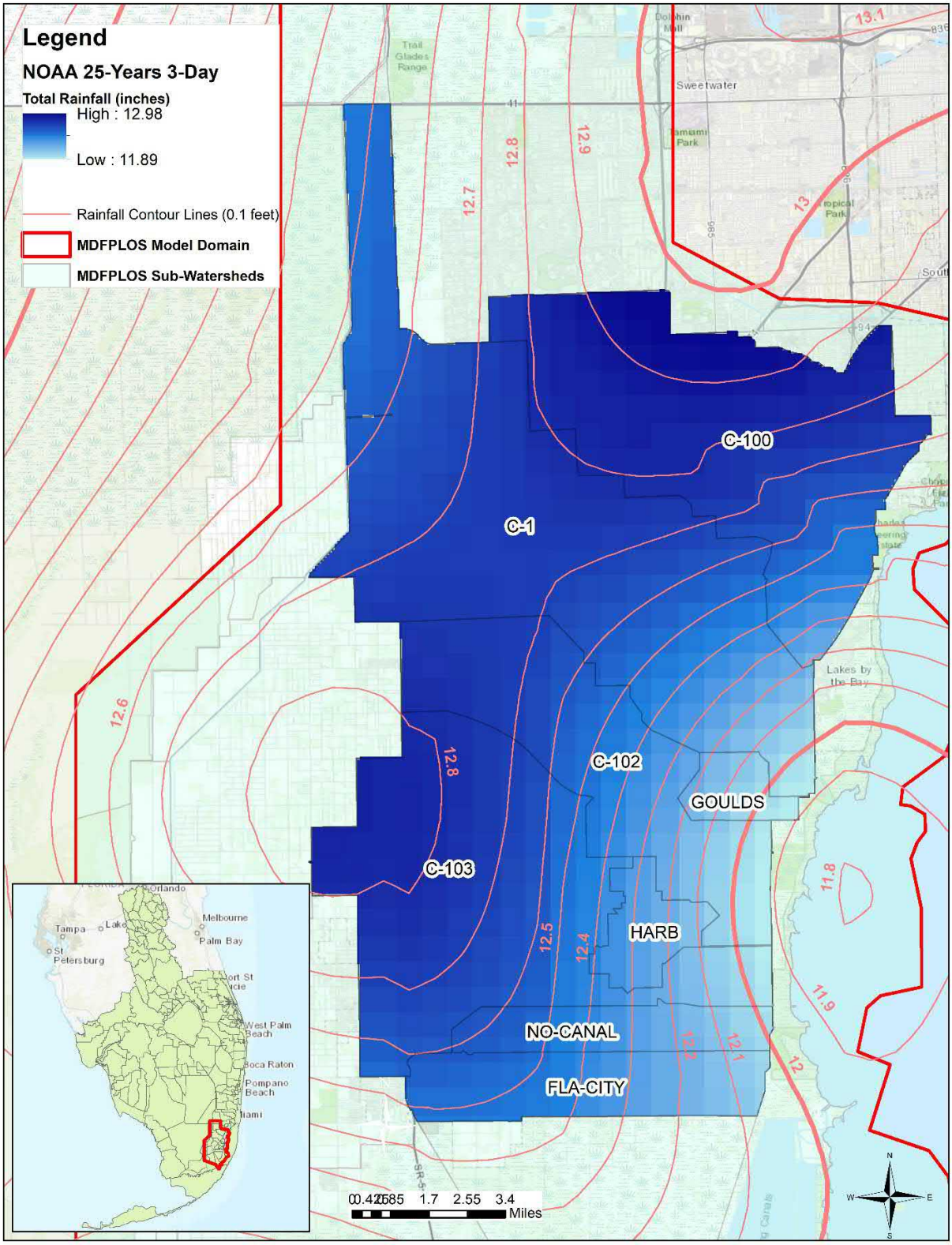


Figure 182. Spatial Distribution of Rainfall Depth for the 25-Year 72-Hour Design Event within Watersheds C-1, C-100, C102 and C-103

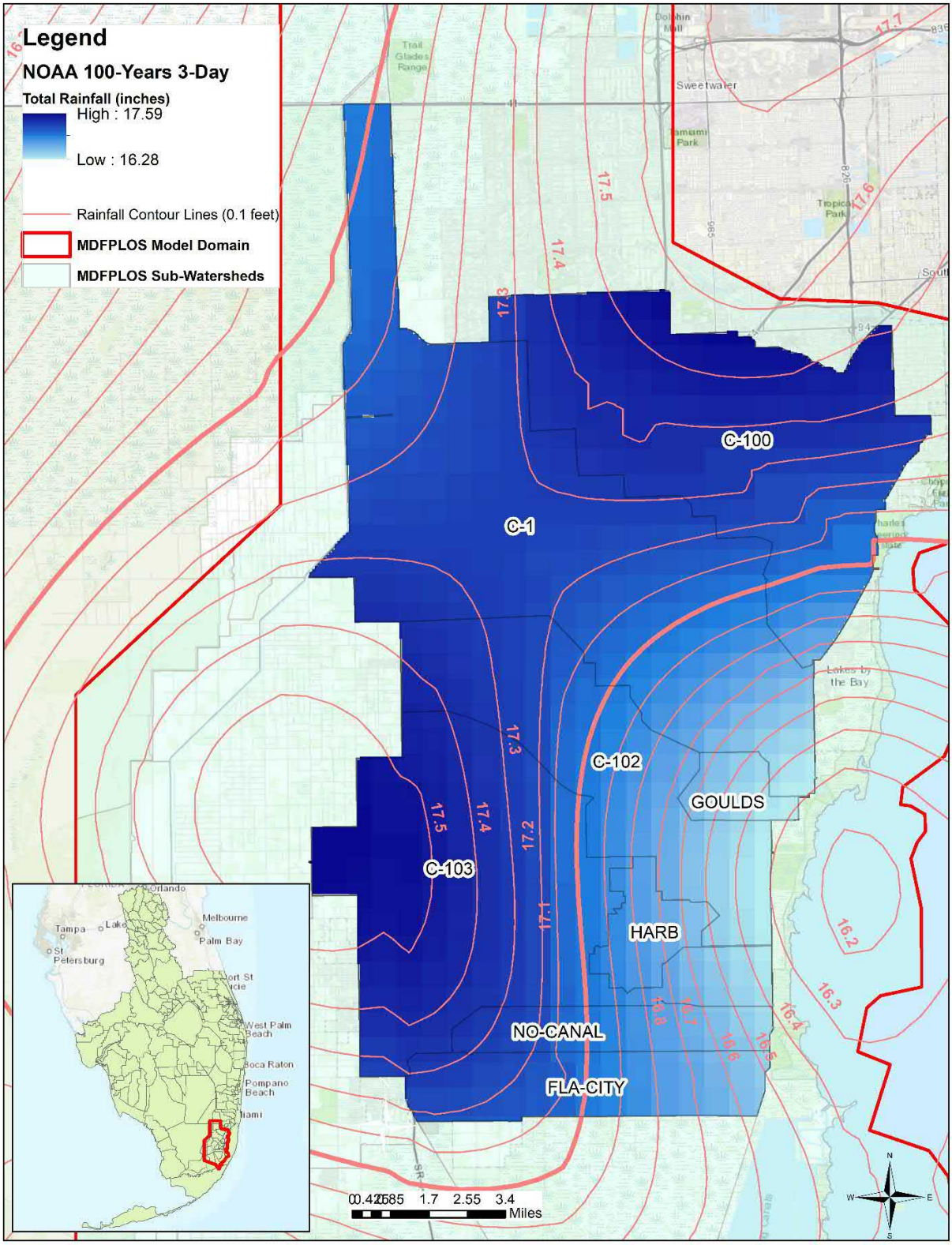


Figure 183. Spatial Distribution of Rainfall Depth for the 100-Year 72-Hour Design Event within Watersheds C-1, C-100, C102 and C-103

Flood events of a magnitude that are expected to be equaled or exceeded on average at least once during any 5-,10-, 25-, or the 100-year period (recurrence interval). These events, commonly termed the 5-,10-, 25-, or the 100-year, have a 10-, 4-, 2-, and 1% annual chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. An example of precipitation frequency estimates that was obtained from NOAA (ref 1) for a selected location within the C-1 watershed is shown in Table 55. The rainfall data in Table 24 was obtained from NOAA Atlas 14, Volume 9, Version 2 for Latitude: 25.5857° and Longitude: -80.4051° located in Watershed C-1. Highlighted are the design events which are included in this study.

Table 55. Point Precipitation Frequency (PF) Estimates with 90% Confidence Intervals

Recurrence (years)	24-hr Duration (inch)	3-day Duration (inch)
5	6.67(5.44-8.22)	8.52(7.01-10.4)
10	8.06(6.54-9.97)	10.2(8.31-12.4)
25	10.2(8.20-13.4)	12.6(10.2-16.3)
100	14.2(10.7-19.2)	17.1(13.0-22.7)

The spatial statistics of the total rainfall depth (maximum, minimum, mean, and standard deviation) are listed in Table 56, Table 57, Table 58 and Table 59. For example, Table 55 reports 8.52, 10.2, 12.6 and 17.1 inches of rainfall for the 5-yr, 10-yr, 25-yr and 100-yr events for a specific point within Watershed C-1. The averages for watershed C-1 reported in Table 56, Table 57, Table 58 and Table 59 closely match within the standard deviation values in Table 1. Based on the summaries shown in Table 2, 3, 4 and 5, the total minimum and maximum rainfall volumes for the 5-yr, 10-yr, 25-yr and 100-yr events are respectively 8.18 – 8.40 in, 9.59 – 10.15 in, 12.08 – 12.75 in and 16.48 – 17.32 in.

Table 56. Rainfall Statistics for the 5-yr 72-hr Design Event

Watershed	Maximum (in)	Mean (in)	Minimum (in)	Standard Deviation (in)
C-100	8.57	8.40	7.98	0.12
C-1	8.46	8.29	7.80	0.13
C-102	8.41	8.18	7.80	0.19
C-103	8.43	8.19	7.80	0.18

Table 57. Rainfall Statistics for the 10-yr 72-hr Design Event

Watershed	Maximum (in)	Mean (in)	Minimum (in)	Standard Deviation (in)
C-100	10.35	9.59	9.59	0.14
C-1	10.22	10.15	10.15	0.15
C-102	10.17	10.01	10.01	0.23
C-103	10.19	9.89	9.89	0.20

Table 58. Rainfall Statistics for the 25-yr 72-hr Design Event

Watershed	Maximum (in)	Mean (in)	Minimum (in)	Standard Deviation (in)
C-100	12.28	12.08	11.91	0.09
C-1	12.99	12.75	12.17	0.16
C-102	12.82	12.59	11.90	0.18
C-103	12.80	12.45	11.91	0.27

Table 59. Rainfall Statistics for the 100-yr 72-hr Design Event

Watershed	Maximum (in)	Mean (in)	Minimum (in)	Standard Deviation (in)
C-100	16.71	16.48	16.29	0.10
C-1	17.58	17.32	16.62	0.19
C-102	17.38	17.11	16.28	0.23
C-103	17.44	16.94	16.31	0.34

5.1.2.1 Rainfall Distribution

The SFWMD rainfall distributions were used to create rainfall hyetographs for the design storm events (ref 2).

Table 60. 72-hr Rainfall Distribution

Time (hours)	Cumulative Percentage of Peak One Day Rainfall	Cumulative 100% One Day Rainfall	Cumulative 100% 3 Day Rainfall
0	0.0%	0.0%	0.0%
24	14.6%	0.0%	10.7%
48	35.9%	0.0%	26.4%
58	57.2%	21.3%	42.1%
59	62.8%	26.9%	46.2%
59.5	67.8%	31.9%	49.9%
59.75	82.8%	46.9%	60.9%
60	101.5%	65.6%	74.7%
60.5	108.8%	72.9%	80.1%
61	112.6%	76.7%	82.9%
62	117.7%	81.8%	86.6%
72	135.9%	100.0%	100.0%

The cumulative percentage for the 72-hr rainfall distribution shown in Table 60 was interpolated to 5-minute intervals and is shown in Figure 184.

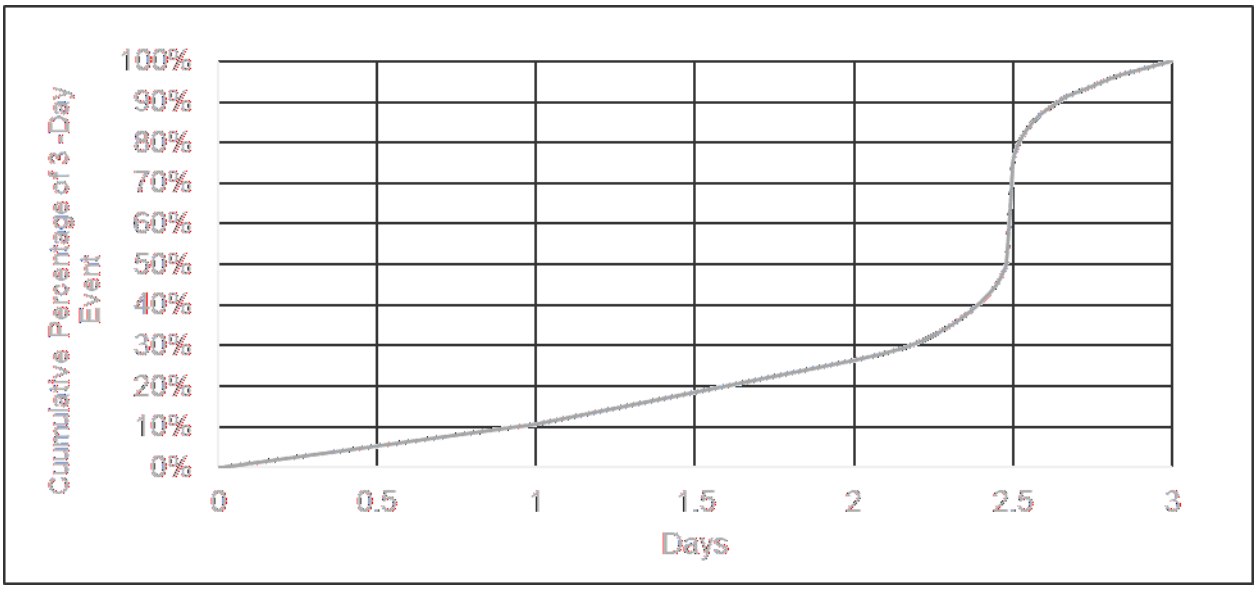


Figure 184. Cumulative Rainfall Distribution for 72-hour Rainfall Duration.

The distribution shown on Figure 185 was used to develop a rainfall hydrograph for each rainfall raster cell based on 5-minute intervals. The dates for the rainfall distributions were adjusted so that the peak rainfall intensity is aligned with the peak tailwater stage.

An example of the cumulative distribution rainfall (for rainfall volumes 10.5, 13, 14.8 and 17.6 inches, for the 10-, 25-, 50- and 100-year recurrence intervals) is shown in Figure 185.

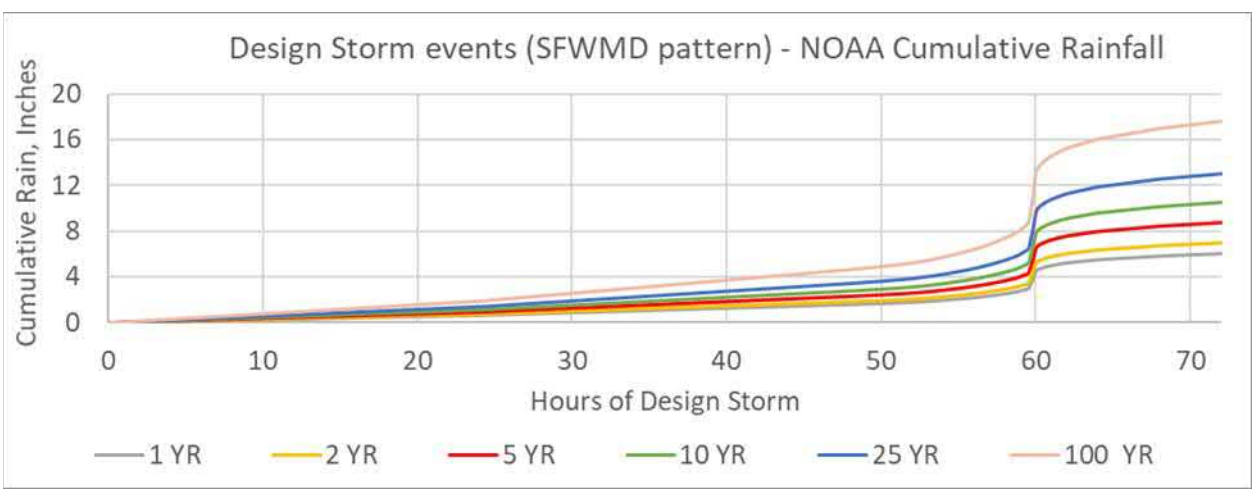


Figure 185. Cumulative Rainfall Distribution for 72-hour Rainfall Duration.

5.1.2.2 Rainfall Peak Timing

A sensitivity analysis was conducted during calibration of the SMD FPLOS model to test sensitivity of the model to various parameters. The sensitivity analysis with this task was performed to understand the watershed behavior in response to alignment of coastal tailwater peak and peak storm event intensity. This section presents the methodology, observations, results and conclusions of the sensitivity analysis.

To determine model sensitivity to the timing of peak tailwater stages and peak rainfall intensity, a series of simulations were developed by shifting the rainfall peak in one-hour increments - 6 hours backward and 6 hours forward from the tailwater peak stage. This analysis focused on the stages since they are critical for inundation depths and extent. The results showed that the headwater stages reach the maximum value when the coastal tailwater peak and the rainfall intensity peak are within a few hours from each other, which also results in discharge being at a minimum value. All results show that the rainfall peak affects the timing of the peak stages to a greater extent than the total rainfall amount.

Results from the sensitivity analysis of the timing between rainfall and peak tailwater stage at the coastal structures included:

- Coastal structures
    - Peak headwater stage – the greatest headwater peak stage occurred for rainfall peaks within an hour of the peak tailwater stage.
    - Cumulative discharge – the greatest cumulative discharge occurred for rainfall occurring 6 hours prior to the peak tailwater stage (caused by storm surge).
    - Peak discharge – the greatest peak discharge occurred for rainfall occurring 6 hours prior to the peak tailwater stage (caused by storm surge).
- Inland structures
    - Peak headwater stage – the greatest headwater peak stage occurred for rainfall peaks within an hour of the peak tailwater stage.
    - Cumulative discharge – the greatest cumulative discharge occurred for rainfall occurring 6 hours prior to the peak tailwater stage (caused by storm surge).
    - Peak discharge – the greatest peak discharge occurred for rainfall occurring 6 hours prior to the peak tailwater stage (caused by storm surge).

Based on the sensitivity analysis, it was observed that coincident peaks of rainfall intensity and peak tailwater stages have the highest impact on stages and would provide the most conservative case scenario for flooding depth and inundation extent. All further simulations to assess flood protection level of service with existing conditions used coincident timing of coastal tailwater peaks and rainfall intensity peaks.

5.1.3 Evapotranspiration

All available ET datasets were compared in the calibration phase of this project. The USGS Potential Evapotranspiration (PET) data were selected over the observed SFWMD data because ground ET data published by SFWMD was limited, and only a few stations were available with accessible data. Therefore, the same PET dataset that was used in the calibration model was used for the design storm event simulations. The DHI ET model in MIKE SHE reduces the PET according to vegetation density, water content in the root zone, and the rainfall distribution, all of

which are input datasets.The ET data for the design events can be assumed a steady state at the minimum wet seasonal average of 2.00 mm/day using the USGS timeseries which results in 3.85 mm/day average. For a conservative assumption 2.00 was used. A comparative run between the two alternative ET boundary conditions illustrates the difference in output for the two boundary conditions. The results are shown in Figure 186, Figure 187 and Figure 188.

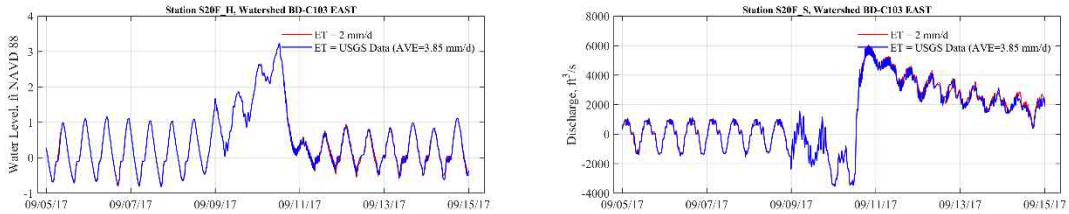


Figure 186 Structure S20F Headwater and Discharge Using Constant ET value of 2 mm/day and Time Variable Distributed Boundary with Average of 3.85 mm/day

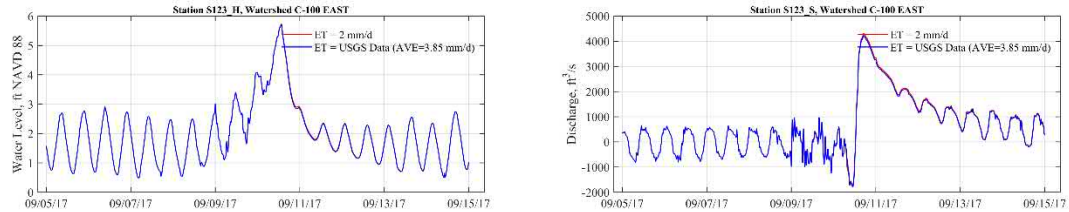


Figure 187 Structure S123 Headwater and Discharge Using Constant ET value of 2 mm/day and Time Variable Distributed Boundary with Average of 3.85 mm/day

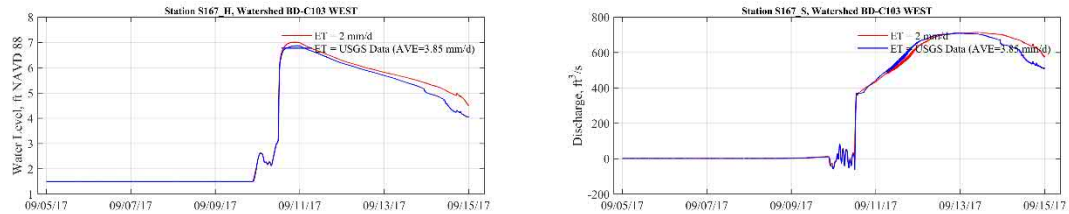


Figure 188 Structure S167 Headwater and Discharge Using Constant ET value of 2 mm/day and Time Variable Distributed Boundary with Average of 3.85 mm/day

The comparison shows that the inland structures are affected by the ET values and for SLR studies 2.00 mm/day will be used as the boundary condition based on the recommendations by the SFWMD.

5.1.4 Boundary Conditions

5.1.4.1 MIKE 1D Boundary Conditions

The tailwater timeseries for the coastal structures (S22, S20, S197, S123, S21, S21A, S20F and S20G) which include storm surge were provided by SFWMD for each of the return intervals (5-, 10-, 25- and 100-year design storm events).

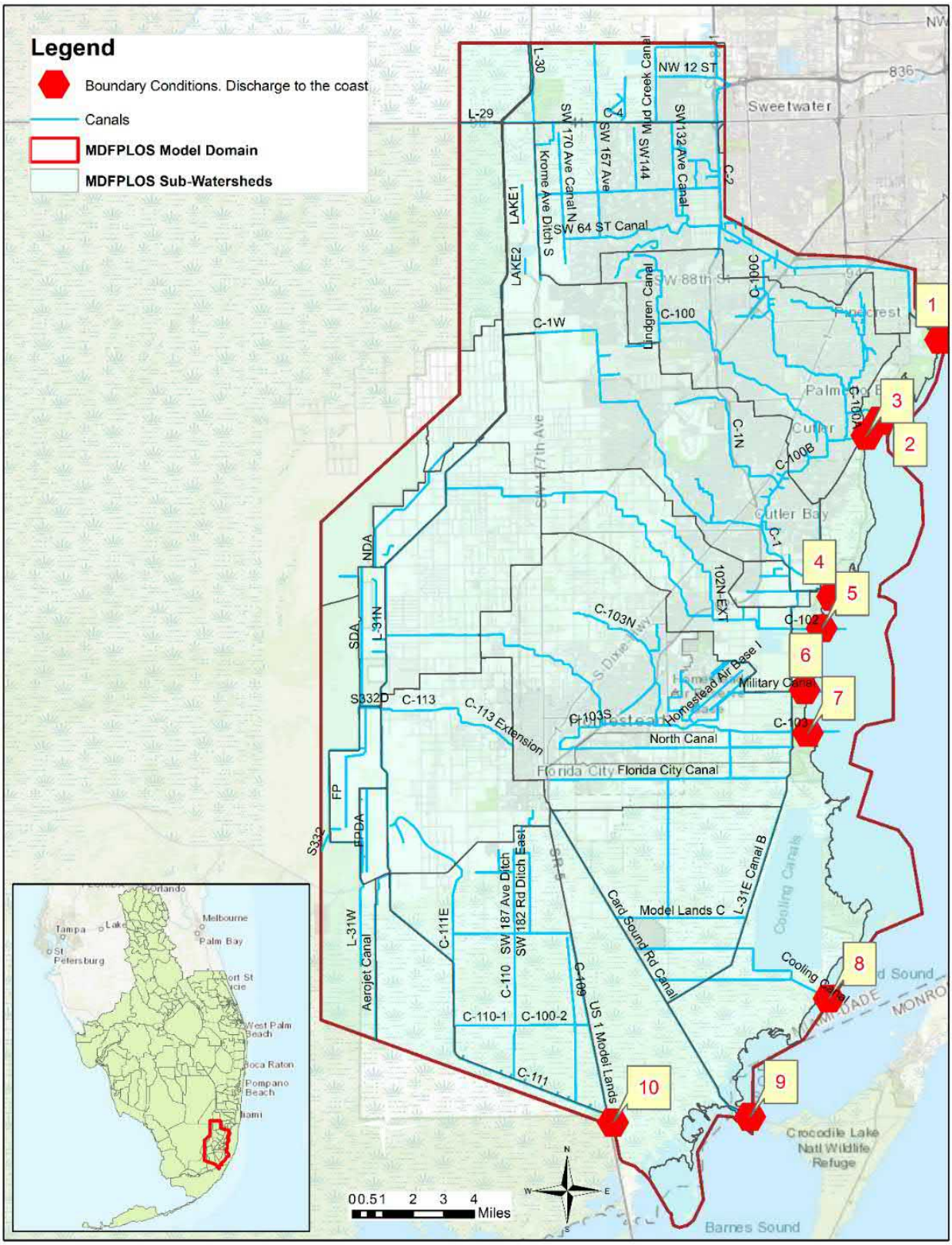


Figure 189. Boundary Conditions: Discharges to the Coast

All these datasets were incorporated in the model as tailwater boundary conditions for the corresponding canals: C-1, C-2, C-100, C-102, C-103 and C-111. Figure 189 shows the boundary conditions that discharge to the coast, and Table 61 provides the time series datasets used for MIKE-1D boundaries.

Table 61. List of MIKE 1D Boundary Conditions

Boundary	Canal	Outfall of Canal	MIKE 1D Boundary Conditions
1	C-2	Discharge to coast	S22-T
2	Bigman Canal	Discharge to Deering Estate	S700P*
3	C-100	Discharge to coast	S123-T
4	C-1	Discharge to coast	S21-T
5	Goulds Canal	Discharge to coast	S21-T
6	C-102	Discharge to coast	S21A-T
7	Military Canal	Discharge to coast	S20G-T
8	C-103	Discharge to coast	S20F-T
9	Cooling Canal	Discharge to coast	S20F-T
10	C-111	Discharge to coast	S197-T
*S700P is not operated during storm events			

The tidal boundary conditions with storm surge for the 5-yr, 10-yr, 25-yr and 100-yr were developed by SFWMD and are provided in Figure 190 through Figure 195.

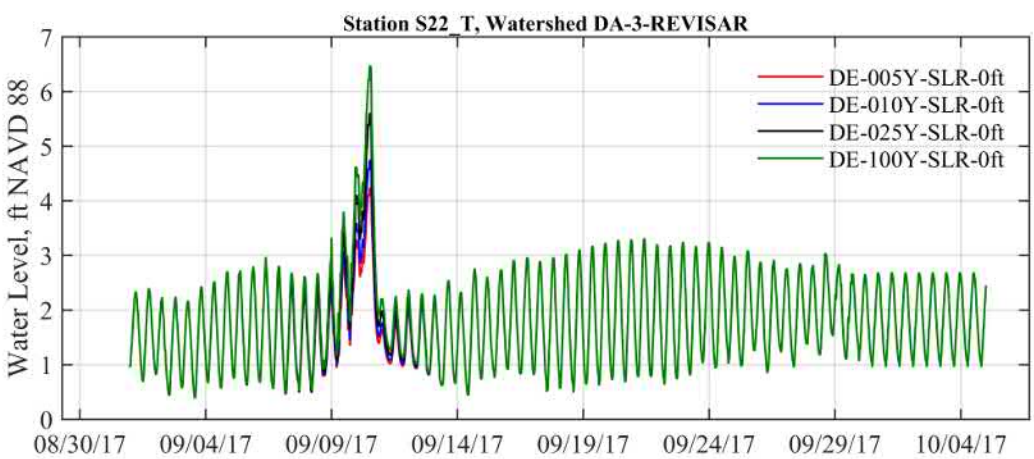


Figure 190. S22 Tailwater Boundary Timeseries for the Design Events

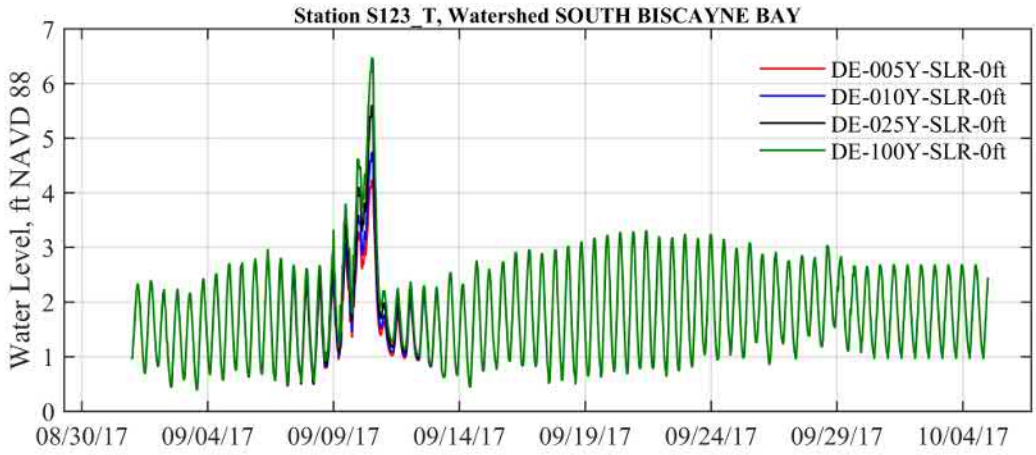


Figure 191. S123 Tailwater Boundary Timeseries for the Design Events

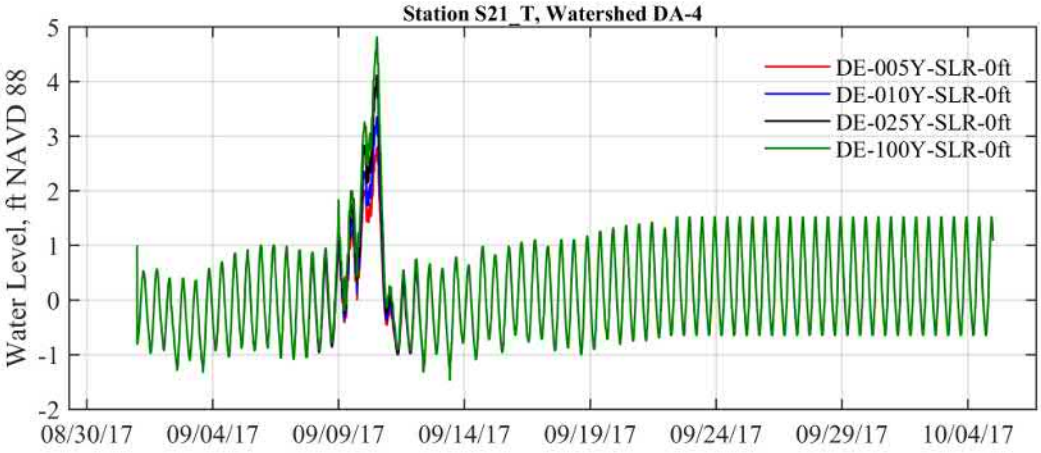


Figure 192. S21 Tailwater Boundary Timeseries for the Design Events

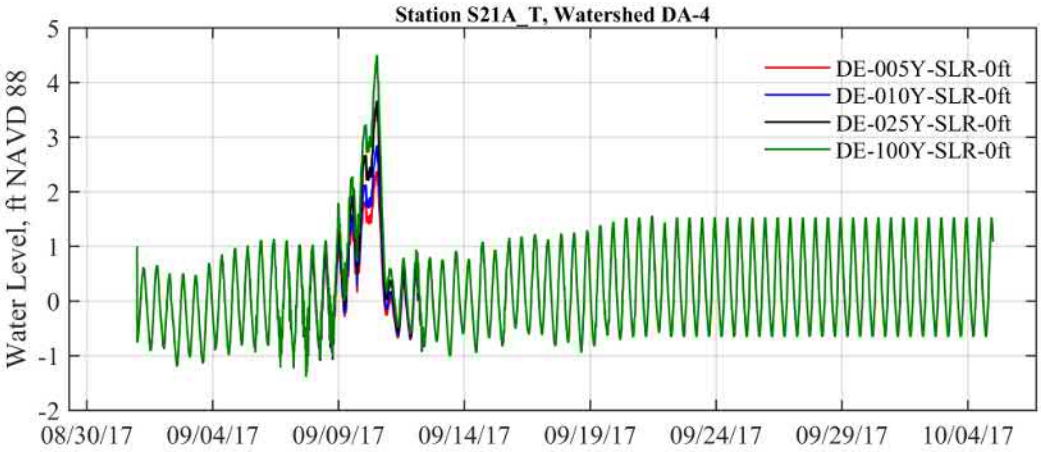


Figure 193. S21A Tailwater Boundary Timeseries for the Design Events

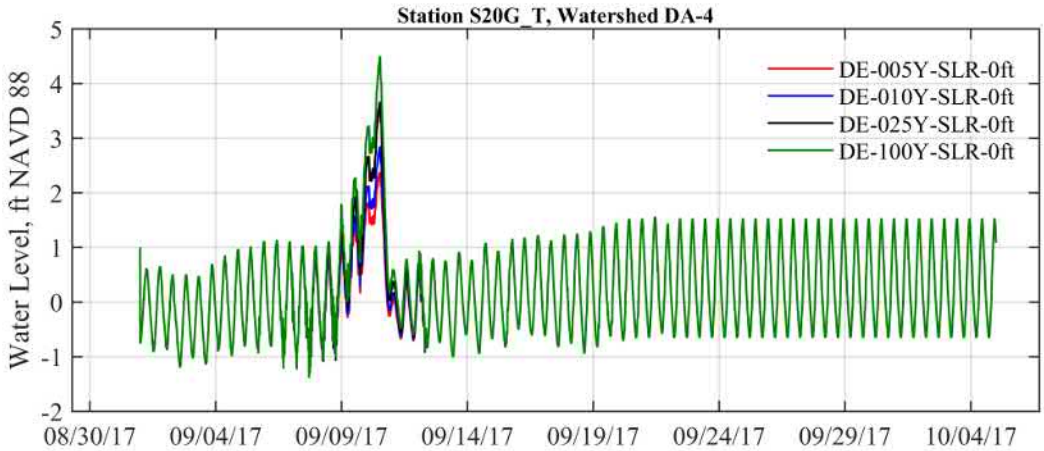


Figure 194. S20G Tailwater Boundary Timeseries for the Design Events (using S20F boundary conditions)

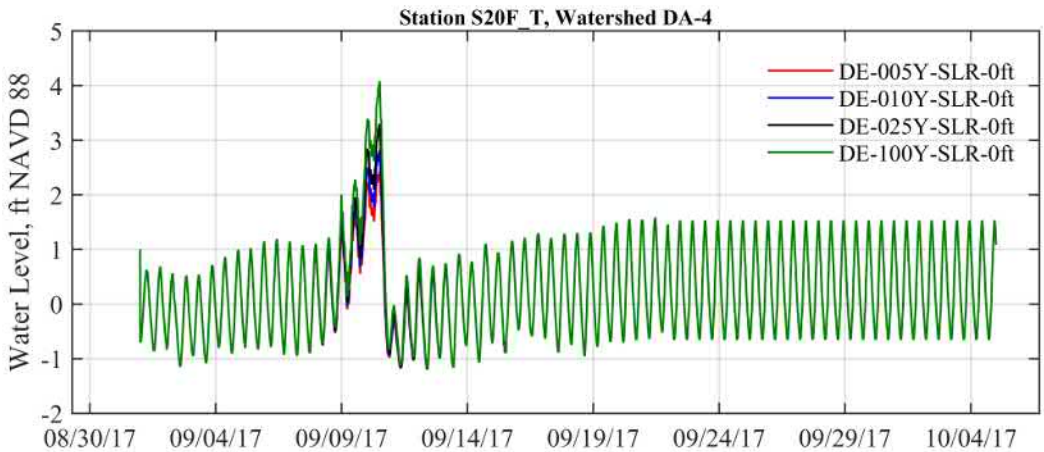


Figure 195. S20F TW for Existing Conditions Model Design Events

Figure 196 shows the boundary locations for the inland flows, and Table 62 provides the corresponding time series.

Table 62. MIKE 1D Inland Boundary Conditions and Corresponding Timeseries

Boundary	Canal	MIKE 1D Boundary Conditions
1	C-4	T5 Stage boundary condition
2	L-29	S334-H*; Headwater observed during Hurricane Irma
3	L-30	S335-H*; Headwater observed during Hurricane Irma
4	S332	Q-H (Discharge-Stage) relationship
5	Aerojet	Closed 1D boundary
*Timeseries during Hurricane Irma were used for all design events		

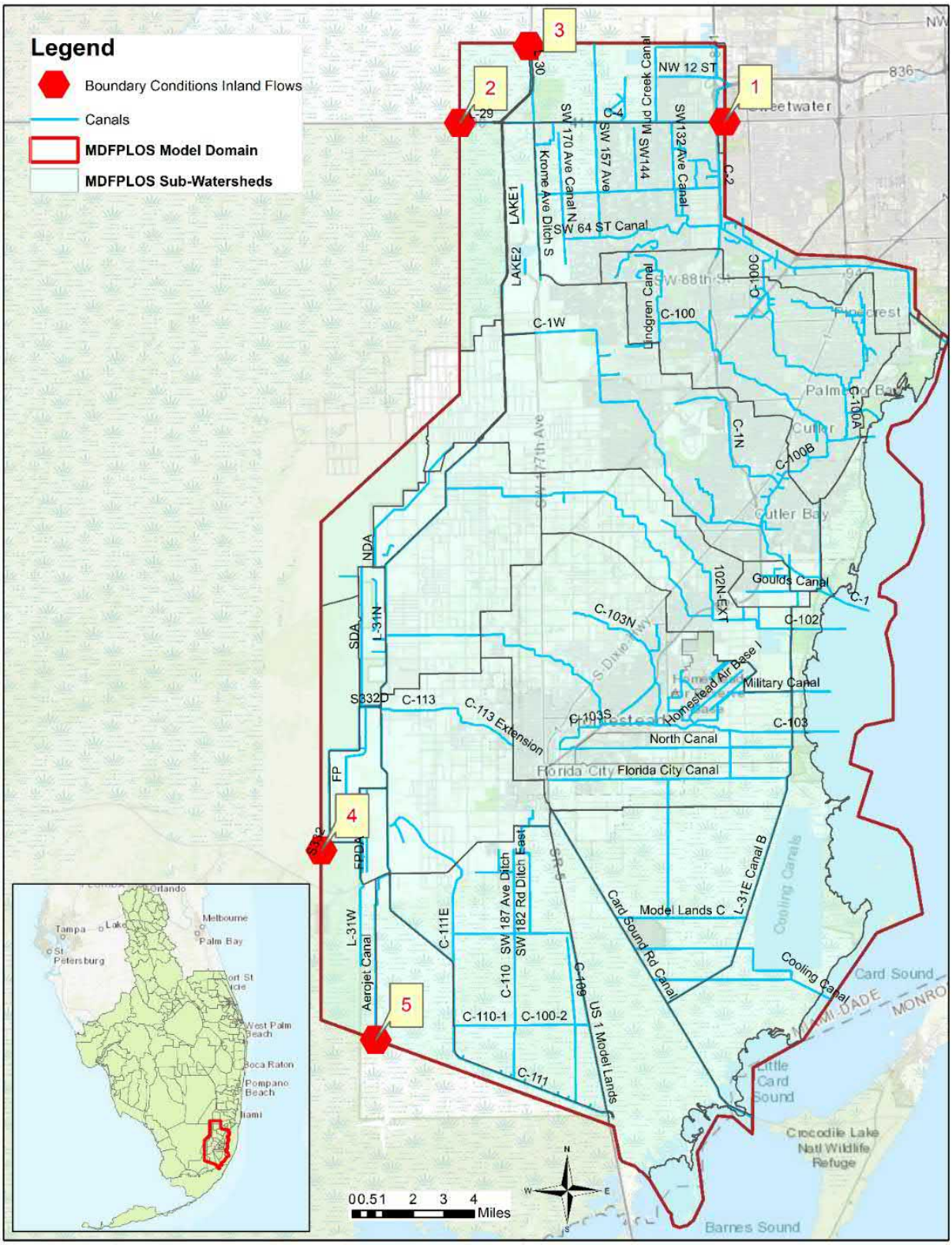


Figure 196. Boundary Conditions: Inland Flows

The control structures in the primary canals in Miami-Dade County are operated by SFWMD using stage criteria. The primary canals are used to discharge excess water from the watersheds during flooding and to maintain minimum water levels in the canals during drought periods. Some structures are usually closed to prevent water from passing from one watershed to another but can be opened to supply water from one watershed or canal to another as necessary. The coastal structures have the additional function of preventing saltwater from a tidal or storm surge from entering those canals discharging to tidewater.

The SMD FPLOS model was calibrated to the conditions of Hurricane Irma. The information in this section is for comparative purposes and for an understanding of how the calibrated model relates to the existing conditions model. The sea levels for the storms associated with Hurricane Irma as recorded in Virginia Key are shown in Figure 197. The records show that the highest recorded levels approached 3.84 ft NAVD 88 on September 10, 2017. Some of the tailwater stages at structures S22, S21, S21A, S123, S20F, S20G and S197 showed a similar pattern with stages up to 5.9 ft NAVD during the peak of Hurricane Irma, which caused significant backflow in the canals.

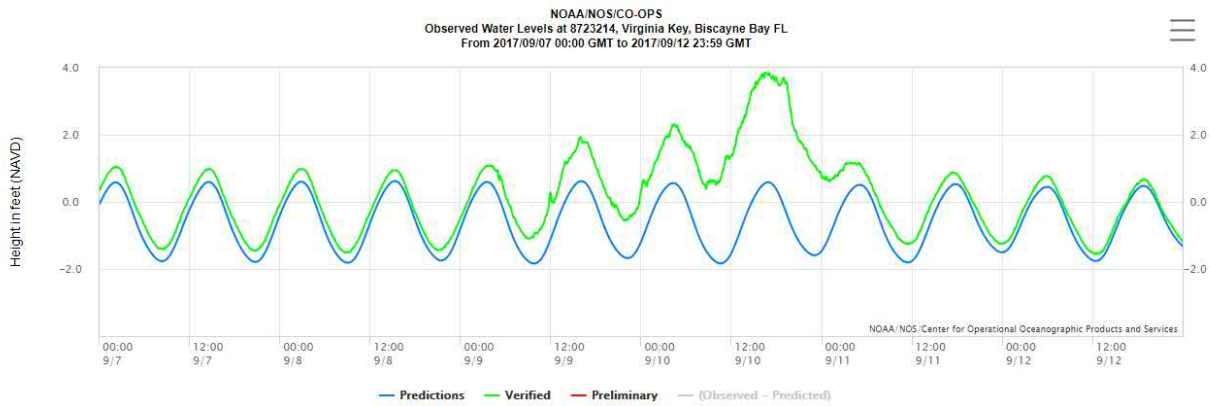


Figure 197. Recorded Sea Levels for Station 8723214, Virginia Key, Biscayne Bay FL in September 2017 (including Storm Surge Generated by Hurricane Irma).

Observed data of storm surge peaks in Miami-Dade County show variations of up to 2 feet from north to south, with the southern part of the county open directly to storm surge. Similar differences were observed during Hurricane Irma with a storm surge in the northern part of Miami-Dade County of approximately 3.5 feet, and 5.5 feet in the southern part of the county.

For reference, Figure 198 the mean sea level reported by NOAA is -0.89 ft NAVD 88 for the epoch ending in 2001 (https://bit.ly/3uqVlJI). For 2019, the 50% probability exceedance using 6-min interval tidal data downloaded from NOAA is -0.568 ft NAVD 88, which indicates a SLR of 0.322 ft increase since 2001. In addition to tidal increase, storm surge timeseries have been developed by SFWMD for design events of 2 to 100 years and were utilized for the model set up.

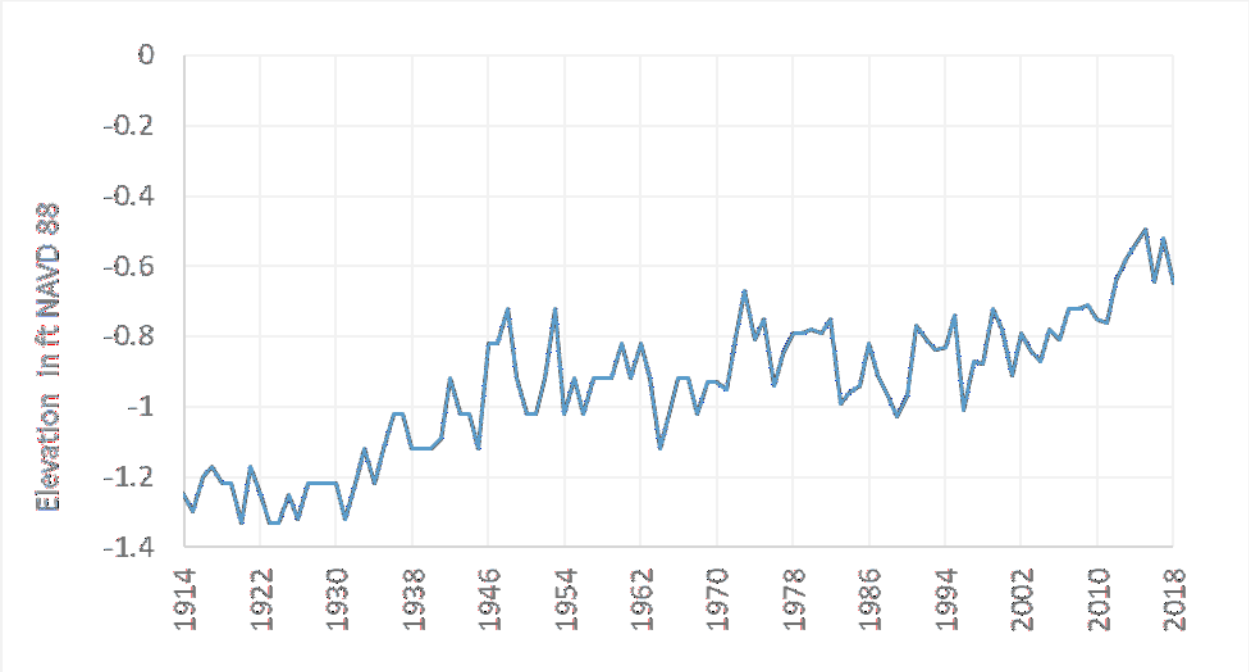


Figure 198. Observed Median of Sea Levels.

5.1.4.2 Groundwater and Overland 2D Boundary Conditions

For the coastal boundaries, 2D timeseries was developed for each design event (using the timeseries of the tailwater of S21, S21A, S20F, S20G and S123) using 15 min timestep; these were applied for OL and GW time dependent boundaries. The tidal boundary time series stages for the coastal structures were provided by SFWMD, with storm surge included.

For the inland section of the model domain the 2D groundwater timeseries which were developed for Irma were applied to the Overland and Saturated Zone as the best estimate.

The gridded timeseries were obtained by spatial interpolation of S22_T, S123_T, S21_T, S21A_T, S20G_T, S20F_T and S197_T. The dataset for the inland boundaries was based on the gridded dataset used for the calibration event in September 2017 as the best available data.

5.1.5 Initial Conditions

Initial water levels used were from Hurricane Irma for the western domain of the model, including Water Conservation Areas and Everglades National Park. The following structures were used for water levels in canals L-31N and C-111:

- Canal L30: S335
- Canal L29: S334
- Canal L31N: G211, S331, S331S, S173
- Canal C111: S176, S18C, S197, S332BN, S332BS, S332C, S332D, S199, S200

Initial Surface Water Stages: The existing conditions model used stages representative of Hurricane Irma across the model domain – for the area east of L-31N and C-111 and south of C-4. A 1-week warm-up period prior to the storm was used to establish equilibrium of groundwater, surface water and canal levels.

Initial Groundwater Levels: Daily Biscayne Aquifer data for Hurricane Irma were interpolated to a daily grid timeseries and used as initial conditions for the SMD FPLOS model. At the coast, the model was set up to use a 2D dataset from gridded tailwater conditions.

Sufficient initial simulation time was provided (10 days) to equilibrate the model initial water levels with the model boundary conditions, stages in the Everglades National Park, canal stages, surface water and groundwater levels within the model.

5.1.6 Structure Operations

All observed structure operations (using breakpoint gate level records) in the model were replaced with rule-based operations for flood protection; based on the information from District's Water Control Operations Atlas for south Miami-Dade, the original structure book, and meetings with Operations Bureau on 12/02/20. Guidance from SFWMD Operations Bureau was provided for structure operations and is summarized in Table 63.

The calibration model POS (2017) is close enough chronologically to existing conditions (2019) that no changes to the network or structure location and dimensions needed to be made. In other words, no major projects or structure operations happened during the time between the period of calibration and the period of simulation of existing conditions that necessitated modifications to the MIKE 1D network.

Table 63. Structure Operations in SMD FPLOS Model Set Up for the Existing Conditions (ref 45)

Structure	Canal	Control Point	Open ft NAVD 88	Close ft NAVD 88	Mike 1D Structure	Structure Function
S118	C-100	H upstream	4	3.5	Sluice, Formula	Optimum upstream water control stages in Canal 100
S119	C-100C	H upstream	4.6	4	Sluice, Formula	Optimum upstream water control stages in Canal 100C
S122	S122-G1	H upstream	closed	closed	Underflow	Divides the drainage areas of C-1 and C-100B
S123	C-100	H upstream	2.4	1.6	Sluice, Formula	Optimum water control stages upstream in Canals C-100, C-100A, and C-100B
S148	C-1W	H upstream	4	3	Sluice, Formula	Optimum upstream water control stage of 5.0 feet in Canal 1
S149	S149-G1	H upstream	open	Open	Underflow	Optimum upstream water control stages of 5.5 feet in Canal 1
S165	C-102	H upstream	3	2.5	Sluice, Formula	Optimum upstream water control stages in Canal 102
S166	C-103N	H upstream	Open	Open	Sluice, Formula	Optimum upstream water control stages in Canal 102
S167	C-103	H upstream	3	2.5	Sluice, Formula	Optimum upstream water control stages in Canal 103N

S194	S194-G1	H upstream	Closed	Closed	Underflow	Drainage divide structure and as a control for stages in C-102
S195	C-102N	H upstream	Open	Open	Underflow	Optimum upstream water control stages in Canal 102N
S196	C-103	H upstream	Closed	Closed	Underflow	Drainage divide structure and as a control for stages to the west
S20F	C-103	H upstream	1.4	1	Sluice, Formula	Optimum water control stages upstream in Canal 103
S20G	Military Canal	H upstream	1.4	1	Sluice, Formula	Optimum upstream water control stages in the Military Canal
S21	C-1	H upstream	2	1	Sluice, Formula	
S21A	C-102	H upstream	1.4	1	Sluice, Formula	
S338	S338-G1	H upstream	5.8	5.5	Underflow	Water supply

Additional information provided in the coordination meeting with SFMWD included items related to typical structure operations for expected storm events such as:

- During King Tides, SFWMD attempts to maximize discharging to tide.
- Typically, canals are lowered by SFWMD two (2) days prior to the storm. When a significant impact from tides is expected, canals are drawn down earlier than that.
- Under very dry conditions, SFWMD may wait until a day before to drawdown canals.
- In general, the SFWMD gates are opened when the head differential is 0.3 ft and closed when it is 0.1 ft
- In the case of Hurricane Irma, the tidal structures were completely open which caused significant backflow to occur.

An example of the rule-based gate operations is shown in Figure 199.

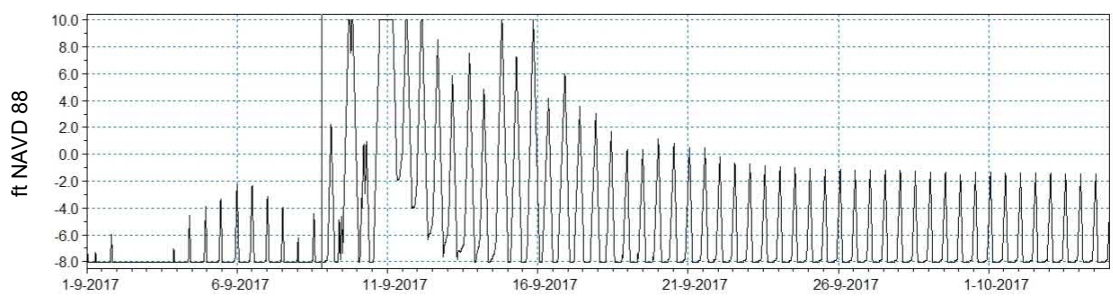


Figure 199. An example of S21 Gate Level (ft NAVD 88) for the 100-year Design Event

The MIKE 1D model uses gate levels as shown and not gate openings.

- Gate level at 10 ft for underflow structures indicates open, a gate level at sill level indicates fully closed structure.
- MIKE 1D requires gate levels and sill elevations for structure input.

- DBHYDRO provides gate openings, therefore the input files of the MIKE 1D set up for the gates were converted to gate levels by subtracting the sill level from the gate opening.
- MIKE 1D compares absolute gate levels (in this model in ft NAVD 88) with the sill levels (in ft NAVD 88) and determines the opening.
- For example, for underflow spillways, if gate level (which is an input dfs0 file) is at -10 ft NAVD 88 or lower, and the sill level is at -10 ft NAVD 88, the gate is open. If the gate level is at -8.0 ft NAVD 88, then the gate opening is 2.0 feet.

Boundary conditions used were from observed data from Hurricane Irma for the western domain of the model, including Water Conservation Areas and Everglades National Park. The following structures were used for water levels in canals L-31N and C-111:

- Canal L30: S335
- Canal L29: S334
- Canal L31N: G211, S331, S331S, S173
- Canal C111: S176, S18C, S197, S332BN, S332BS, S332C, S332D, S199, S200

5.1.7 Land Use

The land use parameters for current conditions are described in Section3.7 of this report.

5.1.8 Groundwater Withdrawals

Municipal groundwater use data for the years 1996 through 2016 were provided by Miami Dade Water and Sewer Department (MDWASD), which included the SFWMD data.

This dataset included all municipal Biscayne Aquifer wells permitted in the project domain. The withdrawal quantities from MDWASD well fields were relatively consistent and ranged from 300 MGD to 425 MGD (500 – 650 ft^3/s) for the years included in the dataset. Average groundwater withdrawal at production well fields ranged from 0.01 MGD to 84 MGD, illustrated in Figure 200. The SMD FPLOS model uses daily timesteps of well withdrawals which are based on average values of groundwater withdrawals from the Biscayne Aquifer for the calibration model; this was not modified for the existing conditions model. All other types of water use, including agricultural and recreational land uses were negligible for storm event simulations, according to estimates.

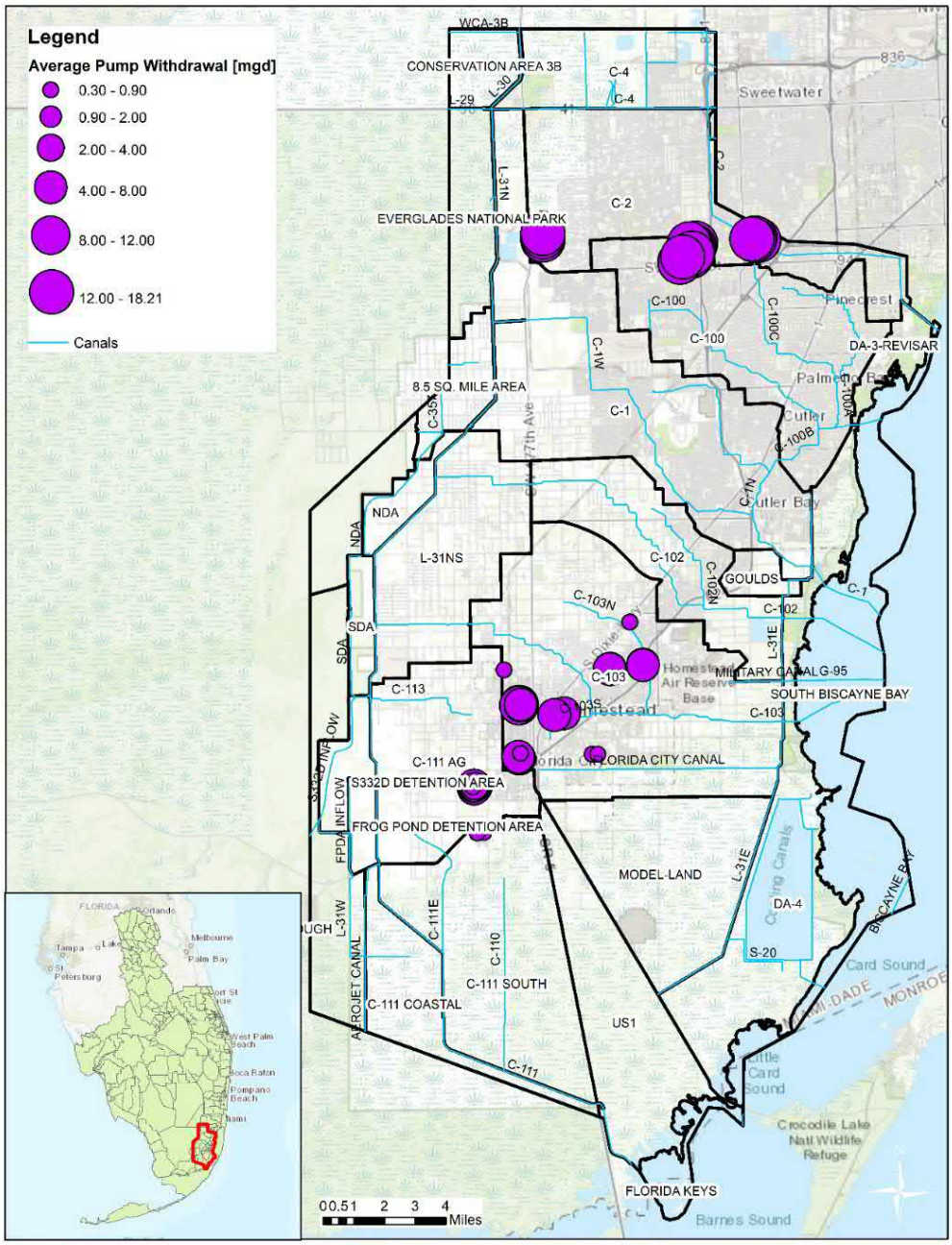


Figure 200. Groundwater Pumping Wells with Average Monthly Withdrawals (MGD)

5.2 C-1 Watershed Flood Protection Level of Service

There are ten SFWMD water control structures in the C-1 Watershed. Figure 201 shows the inflows and outflows in this watershed, and Table 64 contains the design parameters of these water control structures. Control structures S21, S222, S148, S149 and S338 are directly related to operation of the main canals C-1/C-1W and C-1N. The other control structures S173, S331, S334, S335, and S336 along with the L-31N borrow canal are part of the South Dade Conveyance System (SDCS).

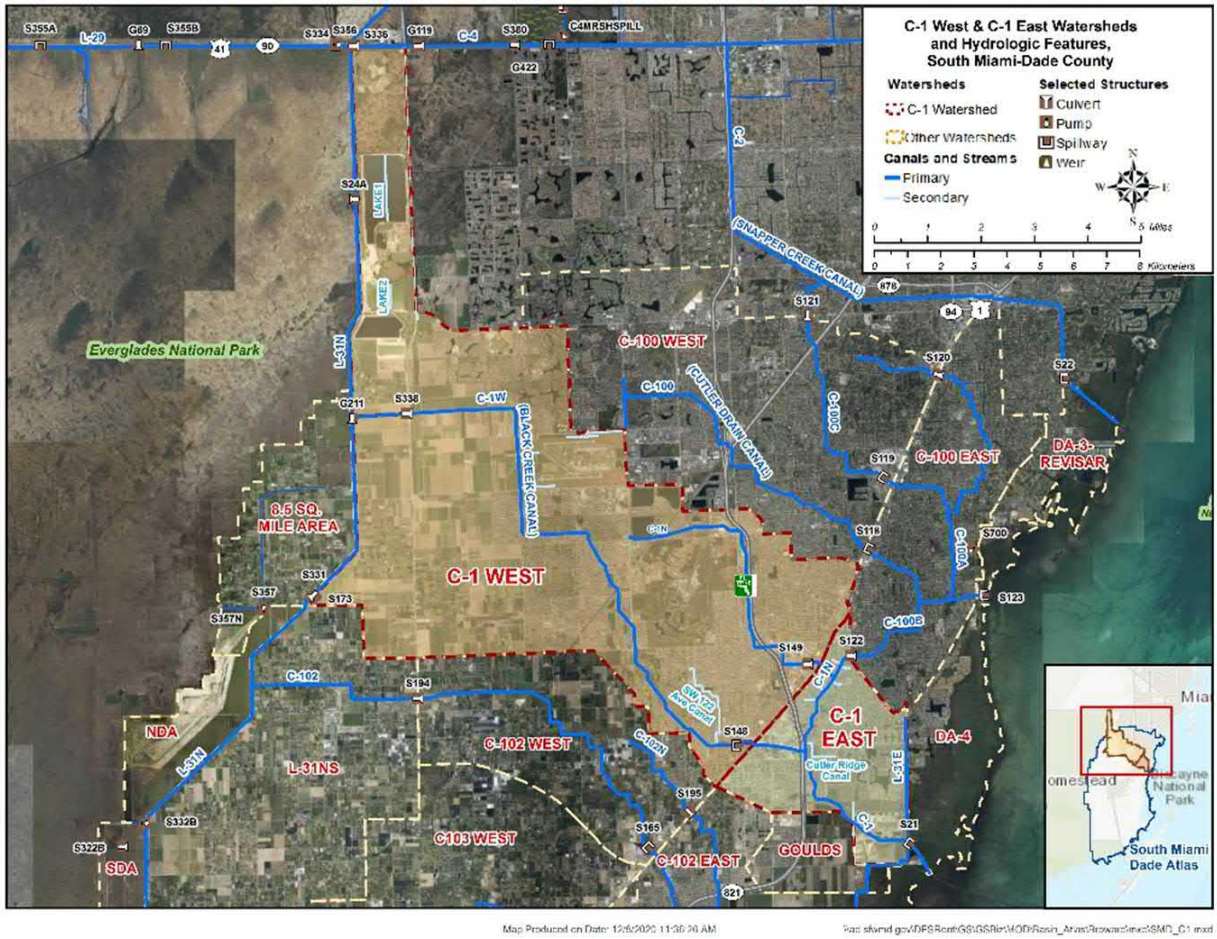


Figure 201. Drainage Network in C-1 Watershed (Source: SFWMD South Miami Dade Atlas)

Table 64. Design Parameters of Water Control Structures in the C-1 Watershed Primary Network

Structure	Design HW/TW Stage (ft NAVD88)	Optimum HW Stage (ft NAVD88)	Design Q (CFS)	Operations
S21	0.35 HW/ -0.15 TW	-0.05 (Wet Season) 0.35 (Dry Season)	2,560	High range: -0.05 to 0.85 ft NAVD88 Low range: -0.55 to 0.45 ft NAVD88 Manatee protection: minimum gate opening is 2.5 ft.
S122	0.95 HW/ 0.45 TW	N/A	200	Low Water Conditions in C-100B: Open structure Aggravated Flood in C-100CB: Close structure
S148	2.35 HW/ 2.15 TW	2.95	1500	Open: When HW Stage= 3.65 ft NAVD88 Close: When HW Stage= 2.15 ft NAVD88
S149	3.45 HW/ 2.25 TW	3.95	400	Open: When HW Stage= 4.65 ft NAVD88 Close: When HW Stage= 3.25 ft NAVD88
S173	3.45 HW/ 2.95 TW	N/A	100	S173 is used with syphon operations at S331 to pass water south

S331	1.45 HW/ 4.45 TW	N/A	1,161	February 14th to July 31st: Discharge when stage in L-31N canal is 2.95 – 3.45 ft NAVD88 August 1st to January 1st : Discharge when stage in L-31N canal is 2.75 – 3.05 ft NAVD88 January 1st to February 14th: Transition between the two operating ranges Flood releases: Discharge when S331 TW stage is below 4.45 ft NAVD88. Up to 200 cfs can be routed to S197 if S-18C HW is below 0.75 ft NAVD88
S334	3.45 HW/ 3.15 TW	N/A	1,230	Normal: operated with -335 when the L-31N canal stage is 1 ft below optimum or S25B or S22 HW stage falls below 0.45 ft NAVD88 Closed: When supplemental deliveries are not being made.
S335	3.45 HW/ 3.25 TW	N/A	525	Normal: operated with S334 when the L-31N canal stage is 1 ft below optimum or S25B or S22 HW stage falls below 0.45 ft NAVD88 HW stage maintained between 3.45 – 4.45 ft NAVD88 When supplemental deliveries are not being made, operated with S32A to maintain optimum stage of 4.45 ft NAVD88 in-L-30 canal
S336	3.15 HW/ 2.65 TW	N/A	145	Dry Season: supplemental deliveries when S25B or S22 HW stage falls below 0.45 ft NAVD88 Flood releases: When stage at gage T-5 is less than 1.45 ft NAVD88
S338	4.55 HW/ 4.35 TW	N/A	170	Open: When HW Stage= 4.25 ft NAVD88 Close: When HW Stage= 3.95 ft NAVD88

5.2.1 C-1: PM1 Maximum Stage in Primary Canals

For PM1, the LOS rating of canals in the C-1 watershed is shown in Table 65. The C-1 watershed canal system with water surface profiles and the canal right and left bank elevations and other canals that affect the hydrology of C-1 Canal are reflected in Figure 202 through Figure 205.

Table 65. LOS Rating of Canals in C-1 Watershed for PM1

Canal	LOS Rating
C-1W	Upstream of S338: 10-year LOS Downstream of S338 & upstream of SR-994: 10-year LOS Downstream of SR-994 and upstream of US-1: 10-year LOS Downstream of US-1: Less than 5-year LOS
C-1N – C-1 Canal	Upstream of G114 - 5-year LOS Downstream of G114 & SR-994: 10-year LOS Downstream SR-994 to Downstream US-1 Highway: Less than 5-year LOS

Considering that there is overtopping of the canal in chainage 6.5 - 7.0 miles, a conclusion can be made that the LOS of Canal C-1N is 5-yr.

The C-1W canal can be considered as 10-year LOS considering that only a short section downstream of the junction with US-1 has canal banks lower than the 10-year design flood profile.

Table 66 List of Landmarks and Design Water Elevations in C-1N

Landmark	Canal	Top Left Bank ft NAVD 88	Top Right Bank ft NAVD88	5-yr ft NAVD 88	10-yr ft NAVD 88	25-yr ft NAVD 88	100-yr ft NAVD 88
Structure G114	C-1N	14.0	11.3	3.78	4.89	6.12	7.35
SR-821 Crossing	C-1N	10.0	10.0	2.95	3.72	6.02	8.03
SR-994 Crossing	C-1N	7.6	7.5	2.93	3.68	5.65	7.44
Structure S149	C-1N	7.5	5.9	2.91	3.63	5.05	6.47
Structure G114	C-1N	10.1	10.1	2.91	3.62	4.96	6.31
US-1 Crossing	C-1N	5.7	6.1	2.90	3.61	4.99	6.37
C-1W Junction	C-1N	6.2	6.0	2.89	3.58	4.81	5.93

The overall rating of C-1 is 5-yr FPLOS.

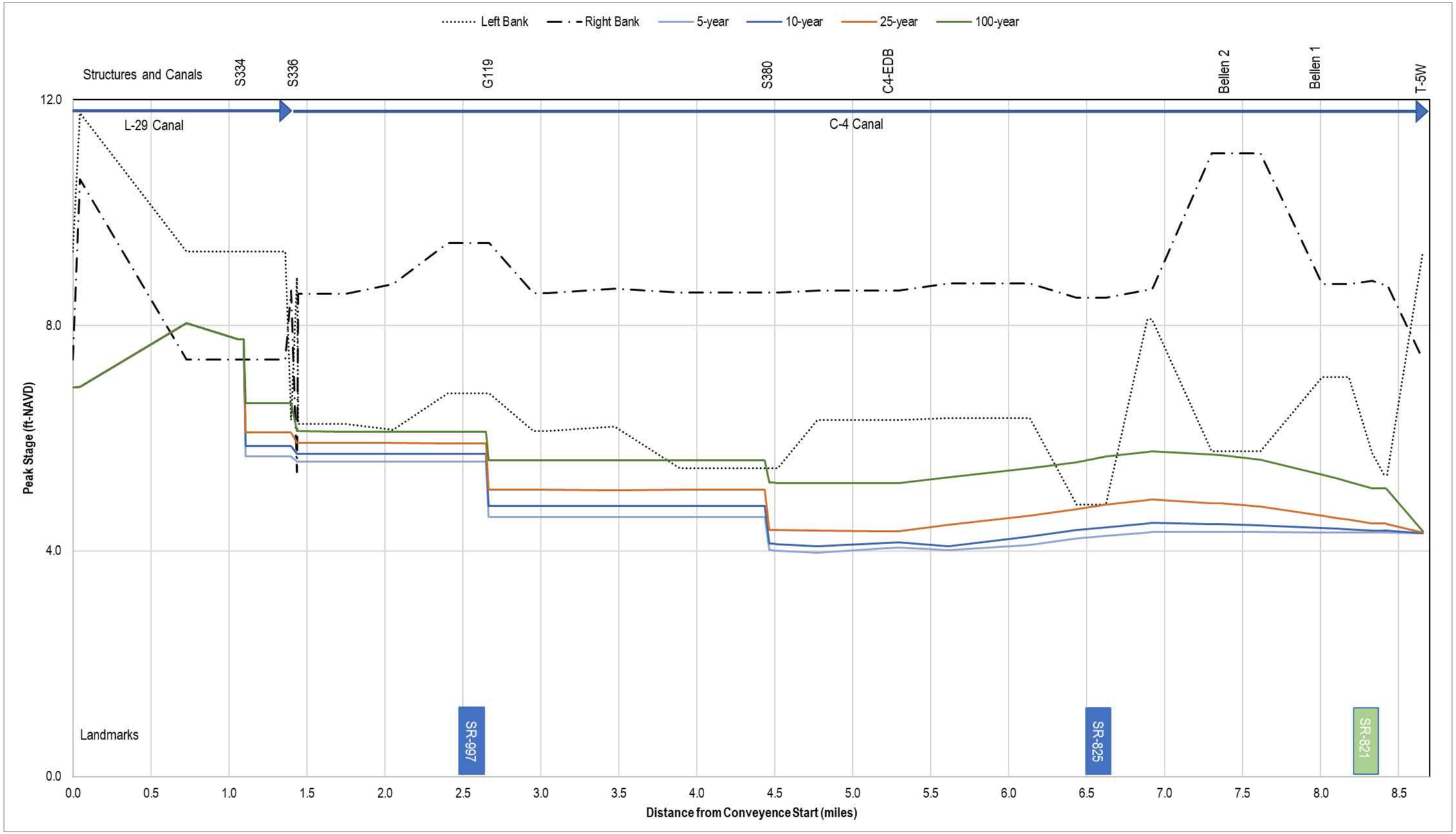


Figure 202. Profile of Peak Stages in Canals L-29 and C-4

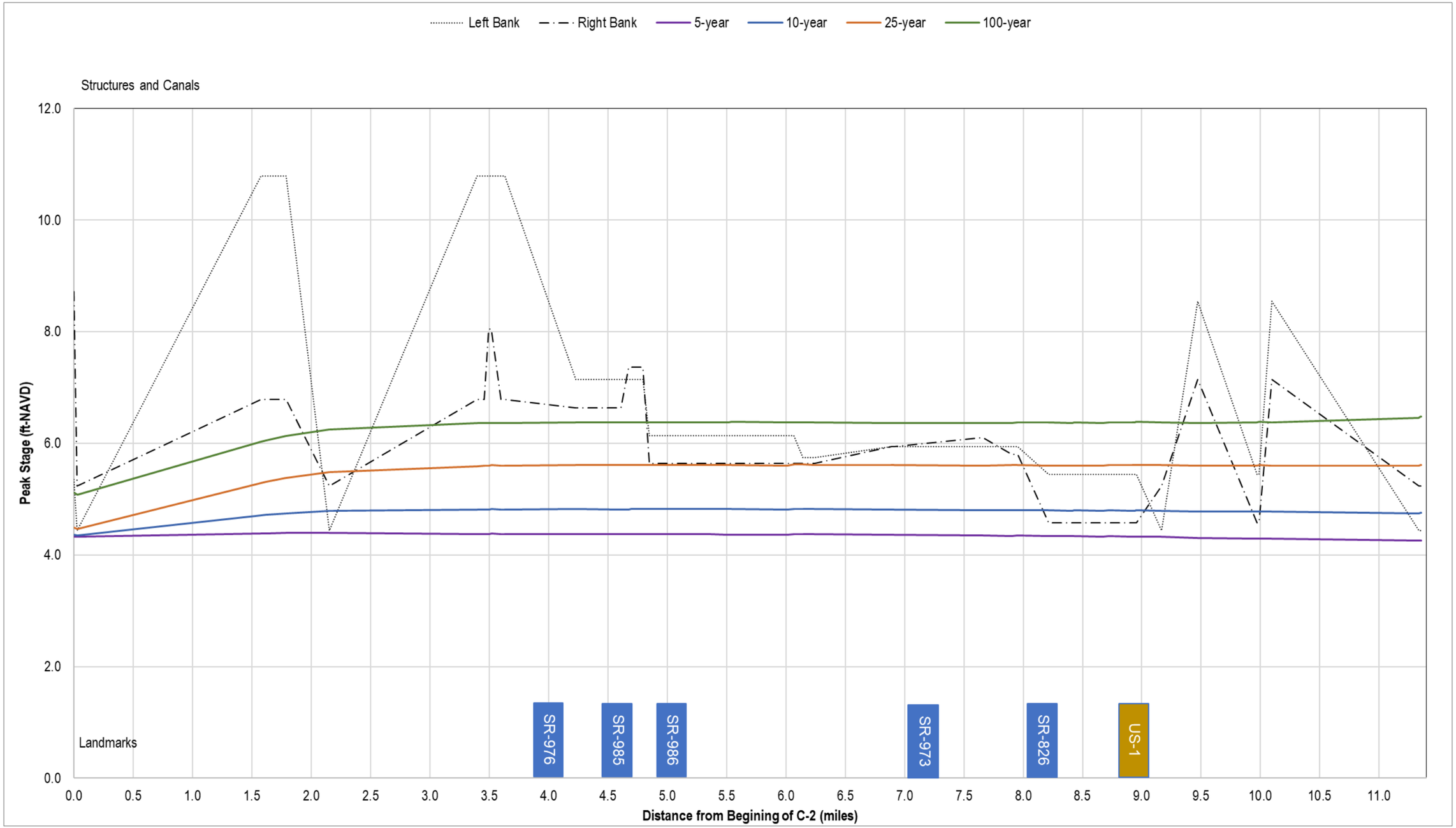


Figure 203. Profile of Peak Stages in Canal C-2

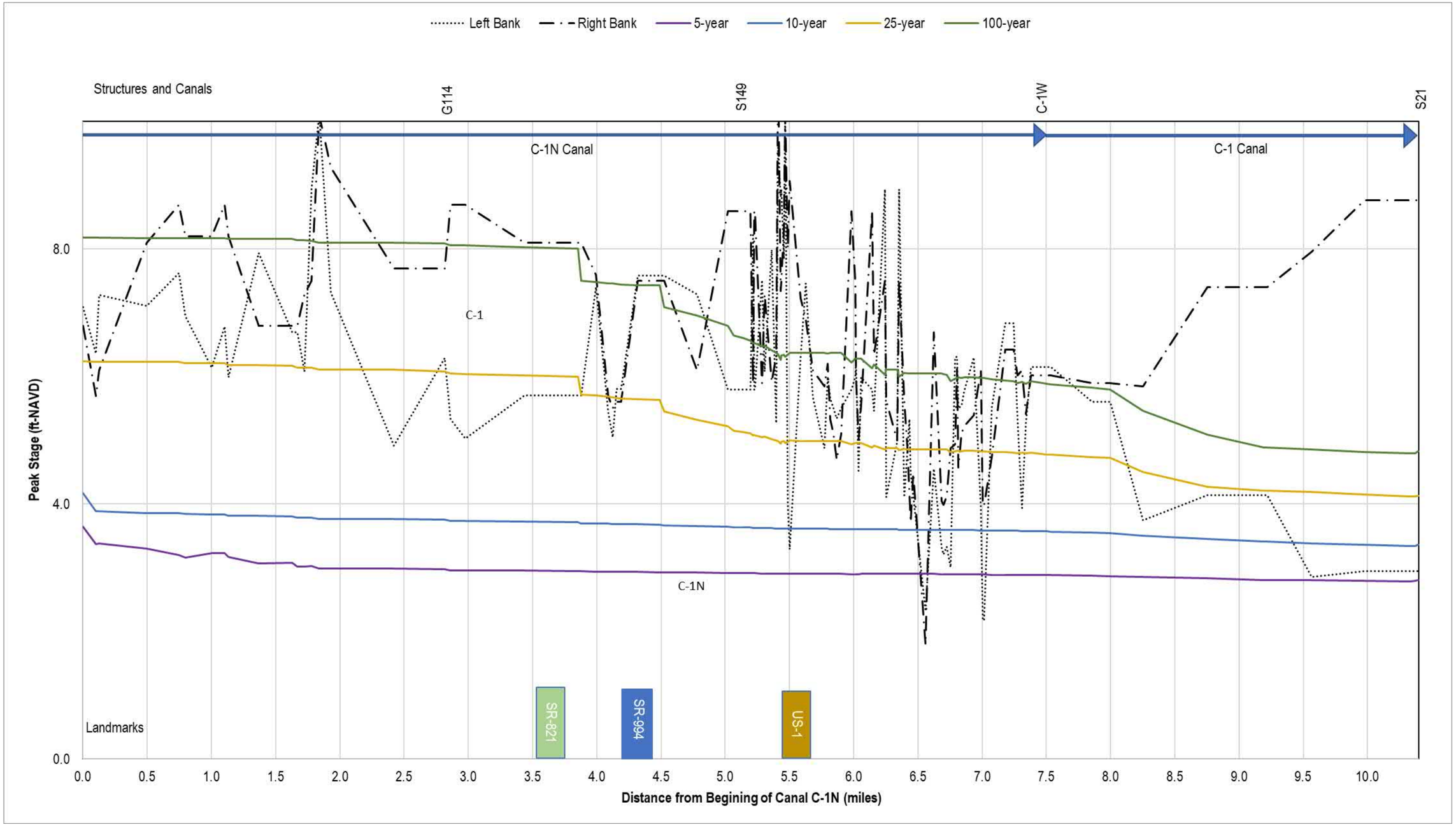


Figure 204. Profile of Peak Stages in Canals C-1N and C-1

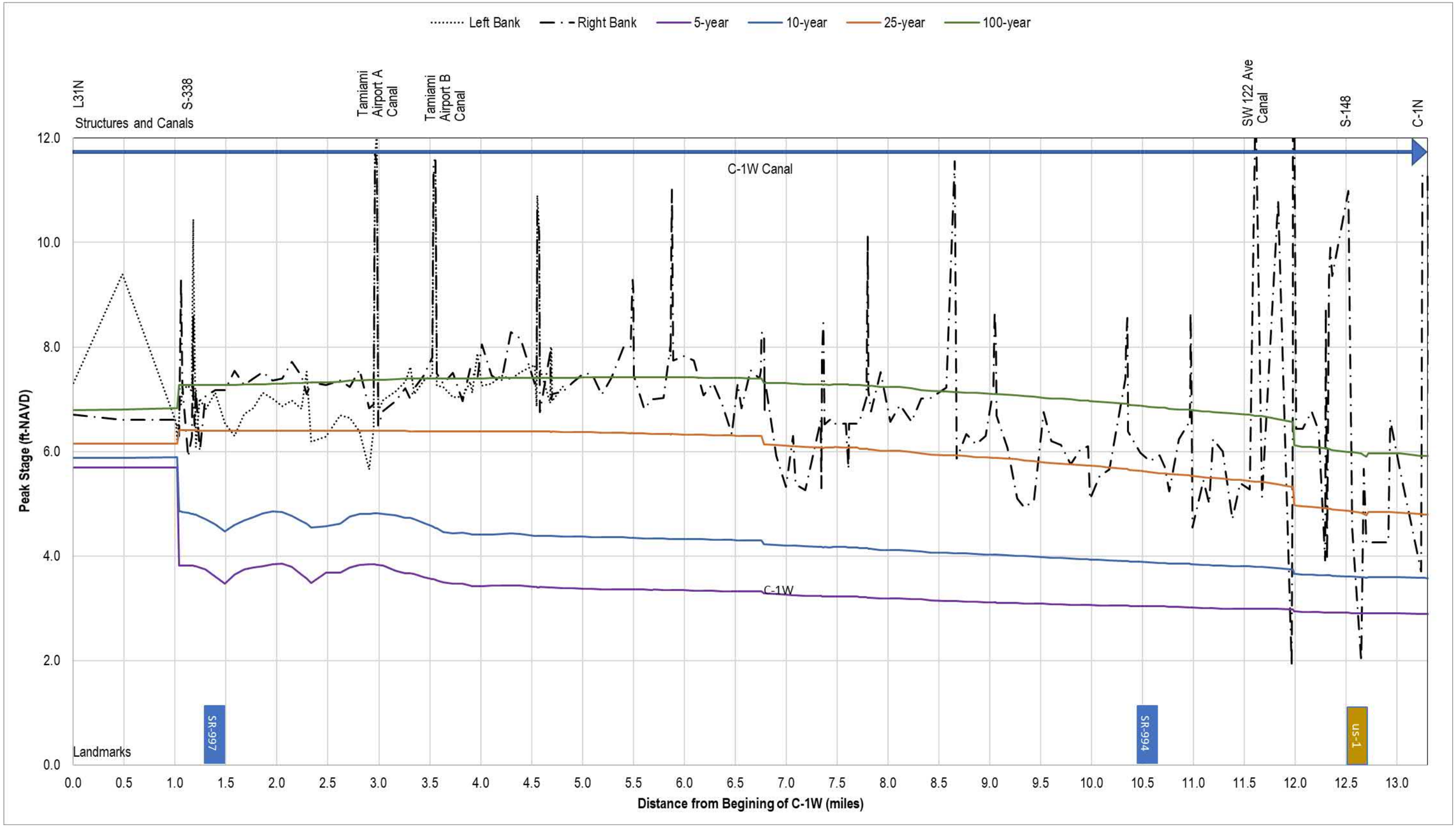


Figure 205. Profile of Peak Stages in Canal C-1W

The results of this analysis showed that most of the canals in C-1 Watershed can convey the 5-year event without overflowing. Multiple short sections of which canals were identified that overflow during the 10-year and 25-year flood events for a short period of time. For the 100-year event all C-1 watershed canals have cross sections which overflow the banks. The figures also show the peak stages at the major landmarks along the C-1 watershed canals for each of the design storms. C-1 W canal, which is the upstream portion of the C-1 canal system has better flood protection level of service than the remaining of the canal system. Overall, the C-1 Watershed canals provide 5-year LOS.

5.2.2 C-1: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 67 contains information on the discharges and the drainage areas in the C-1 Watershed. The maximum daily discharge capacity of the C-1 Watershed through S21 is a function of the drainage from the entire watershed. The discharge hydrographs in the figures below are area-weighted by upstream drainage areas for the 72-hour 5-year, 10-year, 25-year, and 100-year design storms. The peak 12-hour moving average discharge per square mile is shown in Figure 92. The inland structures S148 and S149 represent the inter-watershed movement and flow through the structures; the flows across the watersheds are shown in Figure 206 and Figure 207. Structure S-21 exceeds the allowable ERP discharge for the 10-yr event (highlighted).

Table 67. C-1 Watershed Drainage Discharge Capacity (cfs/sq. mi)

Structure	Watershed Model	AHED Name	Total Area (mi²)	5-yr	10-yr	25-yr	100-yr	Allowable 10-yr ERP
S148	C-1	C-1 WEST	41.17	30.24	43.71	60.91	75.93	45.57
S149	C-1	C-1 WEST	9.77	16.29	32.99	67.18	104.28	45.57
S21	C-1	C-1 EAST	59.12	36.25	51.71	76.38	106.16	45.57

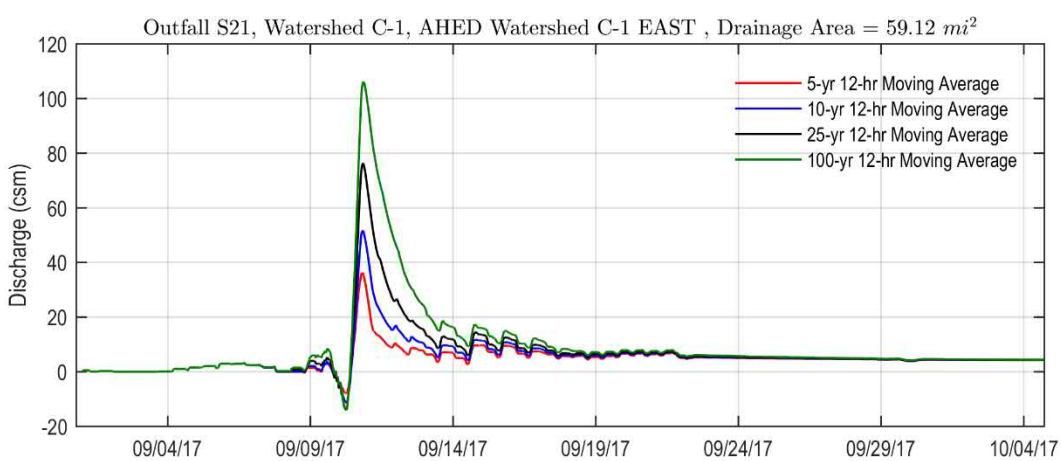


Figure 206. Drainage Discharge Capacity at Structure S21

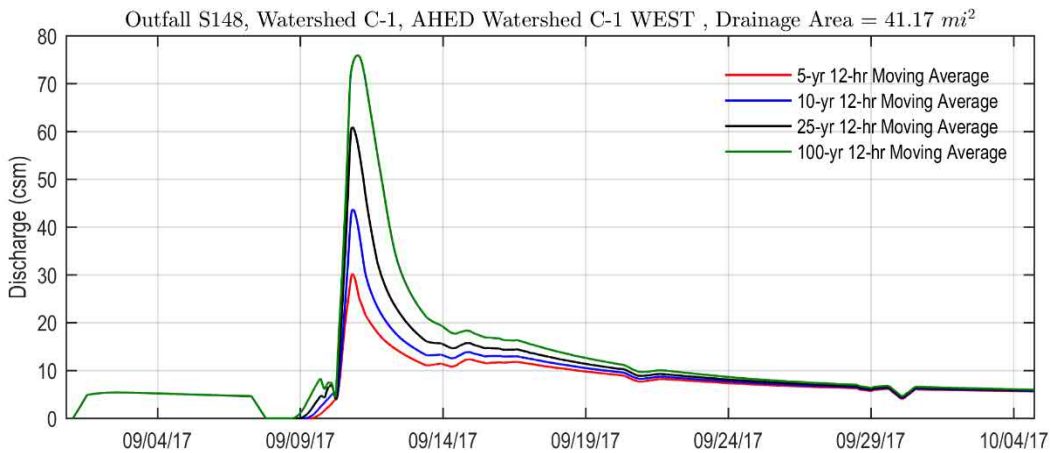


Figure 207. Drainage Discharge Capacity at Structure S148

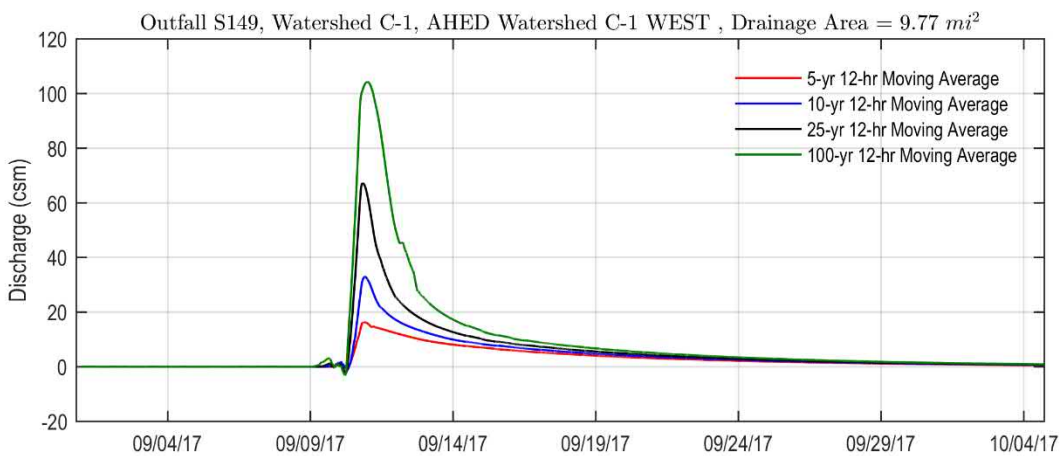


Figure 208. Drainage Discharge Capacity at Structure S149

For C-1 watershed, the discharge at coastal structure S21 exceeds the SFWMD ERP allowable discharge if instantaneous value or the 12-hr moving average is used for comparison.

5.2.3 C-1: PM3 Structure Performance

The design parameters of Structure S21 are listed in Table 68.

Table 68 Design parameters of Structure S21

Structure	S21
Design Discharge	2560 cfs for 40% SPF
SPF Discharge	4.300 cfs
Design Headwater Elevation	1.9 ft NGVD 29
Design Tailwater Elevation	1.4 ft NGVD 29
SPF Headwater Elevation	2.8 ft NGVD 29
SPF Tailwater Elevation	2.0 ft NGVD 29
Optimum Headwater	1.5 to 3.0 ft NGVD 29 (wet conditions) 1.9 ft NGVD 29 (dry conditions)
Optimum Tailwater	Tidal

Figure 209 shows instantaneous values for the 25-year and 100-year design storms, respectively.

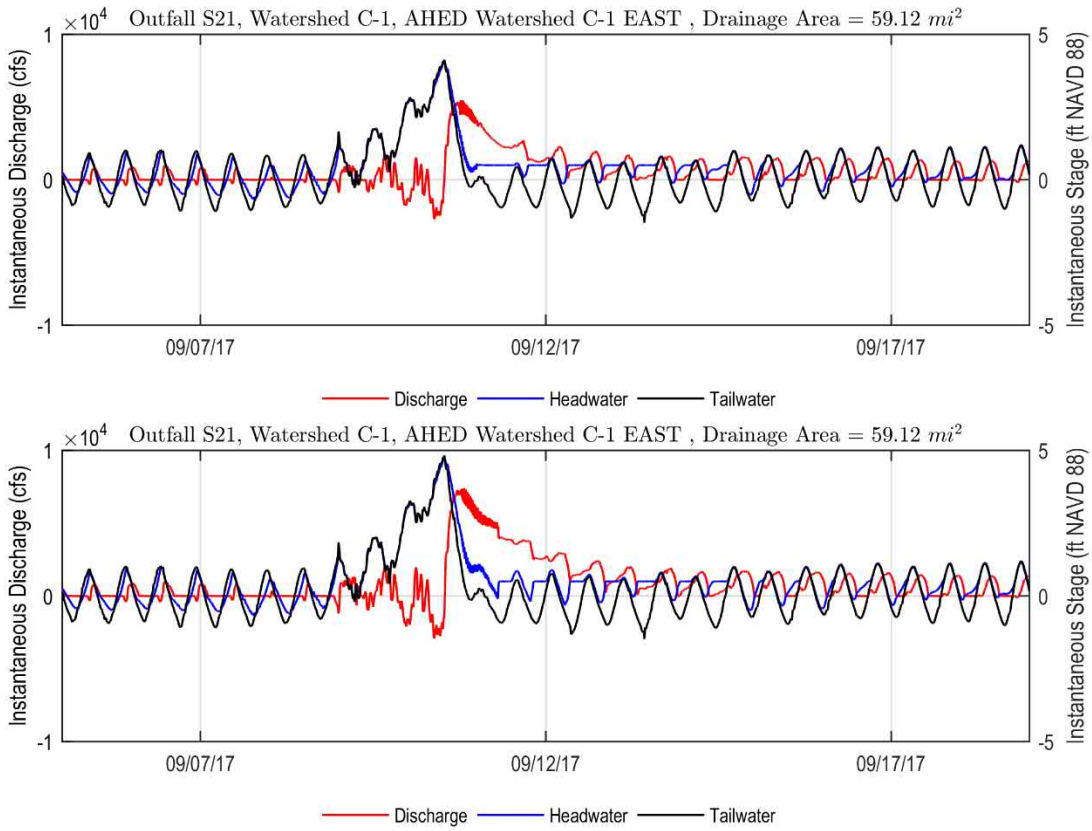


Figure 209 Structure S123 Instantaneous Conditions for 25-yr and 100-yr Design Events

Table 69. Summary of the Instantaneous Peak Conditions at S21

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 5:30 PM	9/10/17 5:15 PM	9/10/17 6:20 PM	9/10/17 7:25 PM
Headwater (ft)	1.05	1.53	1.66	1.73
Discharge (cfs)	3641.98	4483.22	5675.13	7307.71
Tailwater (ft)	0.75	1.10	0.96	0.53

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:45 PM	9/10/17 12:45 PM	9/10/17 12:45 PM	9/10/17 12:45 PM
Headwater (ft)	2.81	3.36	4.13	4.79
Discharge (cfs)	126.07	-171.74	24.59	-1422.62
Tailwater (ft)	2.81	3.37	4.13	4.83

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:45 PM	9/10/17 12:45 PM	9/10/17 12:45 PM	9/10/17 12:45 PM
Headwater (ft)	2.81	3.36	4.13	4.79
Discharge (cfs)	126.07	-171.74	24.59	-1422.62
Tailwater (ft)	2.81	3.37	4.13	4.83

Table 70. Summary of the Instantaneous Peak Conditions at S148

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 7:10 PM	9/10/17 8:30 PM	9/10/17 7:55 PM	9/11/17 12:35 AM
Headwater (ft)	2.11	2.79	4.57	5.78
Discharge (cfs)	1584.29	2018.91	2654.32	3256.49
Tailwater (ft)	1.82	2.38	4.03	5.10

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:15 PM	9/10/17 2:10 PM	9/10/17 2:40 PM	9/10/17 4:00 PM
Headwater (ft)	3.00	3.81	5.36	6.57
Discharge (cfs)	691.00	1449.17	2386.35	2879.96
Tailwater (ft)	2.96	3.64	4.99	6.11

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:15 PM	9/10/17 1:15 PM	9/10/17 2:30 PM	9/10/17 3:15 PM
Headwater (ft)	3.00	3.76	5.36	6.56
Discharge (cfs)	691.00	1055.38	2370.12	2828.30
Tailwater (ft)	2.96	3.68	4.99	6.11

Table 71. Summary of the Instantaneous Peak Conditions at S149

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 9:05 PM	9/11/17 4:45 AM	9/10/17 8:45 PM	9/11/17 12:00 AM
Headwater (ft)	1.44	1.62	4.37	5.92
Discharge (cfs)	217.13	501.00	720.33	1076.91
Tailwater (ft)	1.42	2.20	4.32	5.87

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:20 PM	9/10/17 1:25 PM	9/10/17 2:55 PM	9/10/17 4:20 PM
Headwater (ft)	2.93	3.66	5.12	6.55
Discharge (cfs)	17.21	53.82	555.59	919.06
Tailwater (ft)	2.93	3.65	5.09	6.51

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:15 PM	9/10/17 1:25 PM	9/10/17 2:55 PM	9/10/17 4:10 PM
Headwater (ft)	2.93	3.66	5.12	6.55
Discharge (cfs)	4.63	53.82	555.59	913.00
Tailwater (ft)	2.93	3.65	5.09	6.51

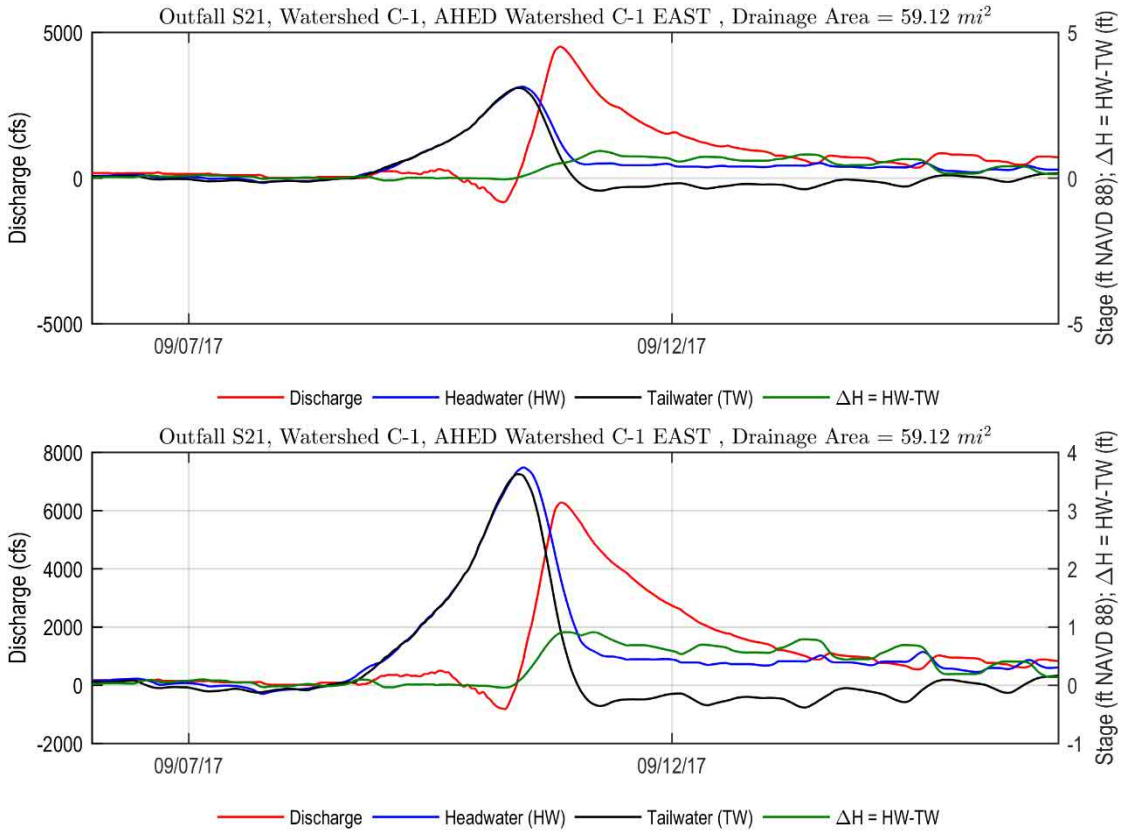


Figure 210. Tidally Averaged (12-hour) Discharge, Stage and Head Differential at S21 Structure - 25-yr and 100-yr Design Events

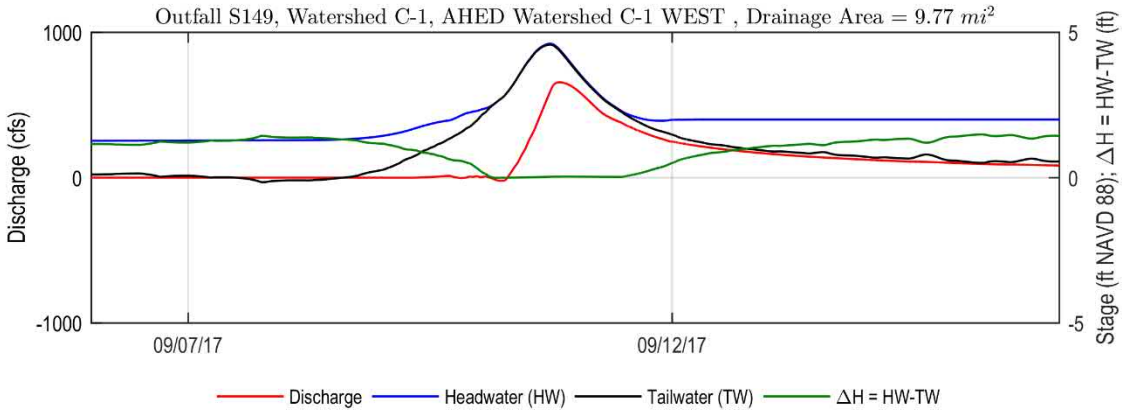


Figure 211. Discharge, Headwater, Tailwater and Head Differential at S149 for the 25-yr Design Event and 12-hr Moving Average

Table 72 Summary of the 12-hr Moving Average Conditions at Structures in C-1 Watershed

Structure	Watershed Model	AHED Name	Total Area (mi2)	Design Event	Peak Tailwater(ft NAVD 88)	Disdcharge (cfs)	Headwater (ft NAVD 88) at Peak TW	Head Differential (ft)
S148	C-1	C-1 WEST	41.170	5-yr	1.622	1245	2.483	0.861
				10-yr	2.491	1800	2.884	0.393
				25-yr	4.061	2508	4.542	0.481
				100-yr	5.115	3126	5.750	0.635
S149	C-1	C-1 WEST	9.770	5-yr	1.560	159	1.994	0.434
				10-yr	2.432	322	2.456	0.023
				25-yr	4.356	656	4.394	0.038
				100-yr	5.763	1019	5.817	0.054
S21	C-1	C-1 EAST	59.120	5-yr	0.354	2143	0.683	0.329
				10-yr	0.526	3057	0.906	0.380
				25-yr	0.760	4515	1.269	0.509
				100-yr	0.917	6276	1.821	0.904

5.2.4 C-1: PM4 Watershed Peak Storm Runoff

PM4 represents the discharge at tidal structure S21 from the 12-hour moving average of the design storm on the C-1 Canal. These discharge hydrographs, particularly the peak discharge, will be compared with the peak discharge under future sea level rise scenarios when executed.

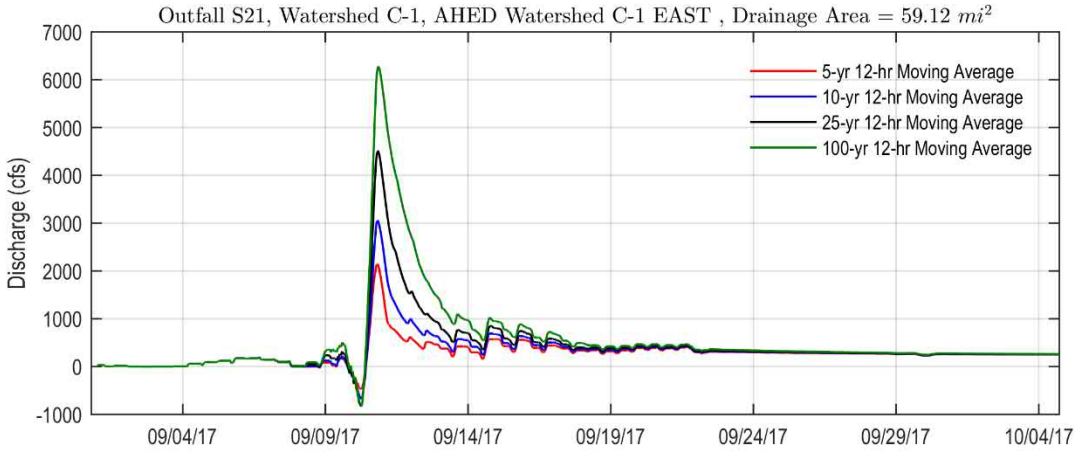


Figure 212. 12-hr Moving Average of Instantaneous Flows at S21 for the Design Events

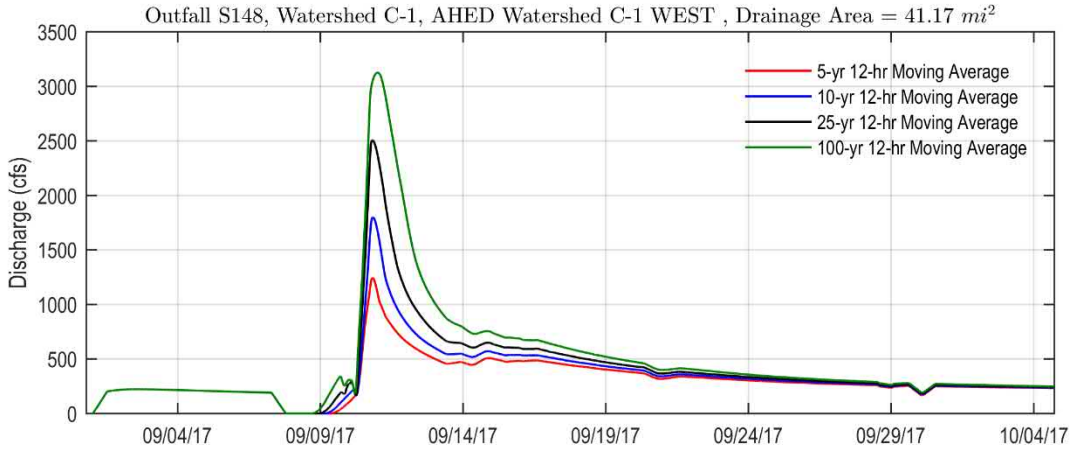


Figure 213. 12-hr Moving Average of Instantaneous Flows at S148 for the Design Events

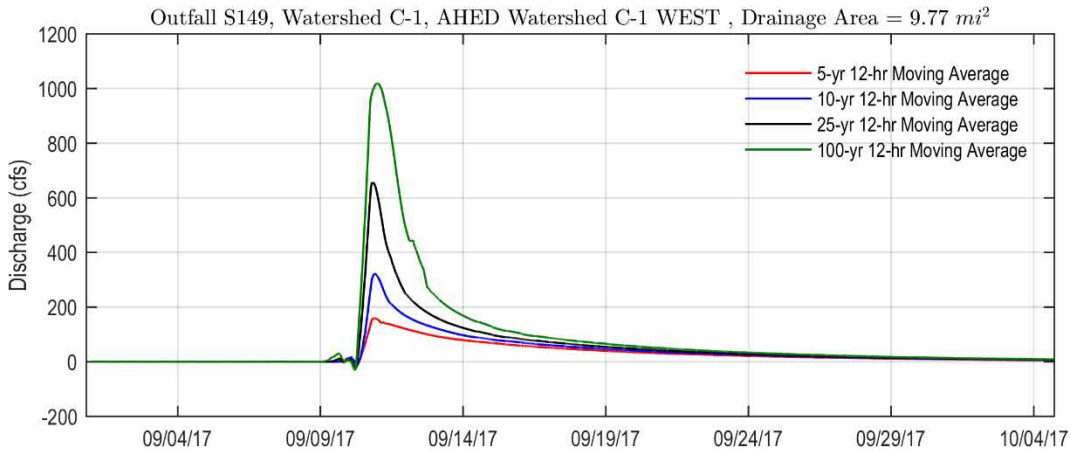


Figure 214. 12-hr Moving Average of Instantaneous Flows at S149 for the Design Events

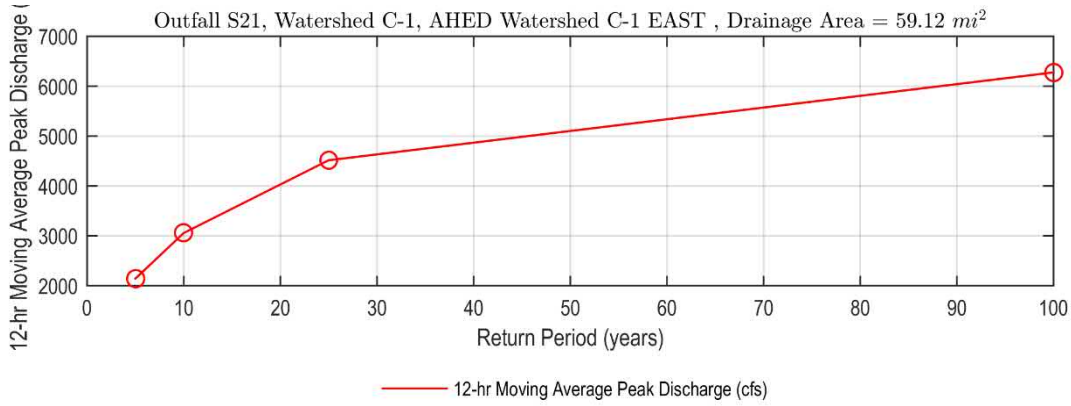


Figure 215 Structure S121 12-Hour Average Peak Discharge vs Return Period

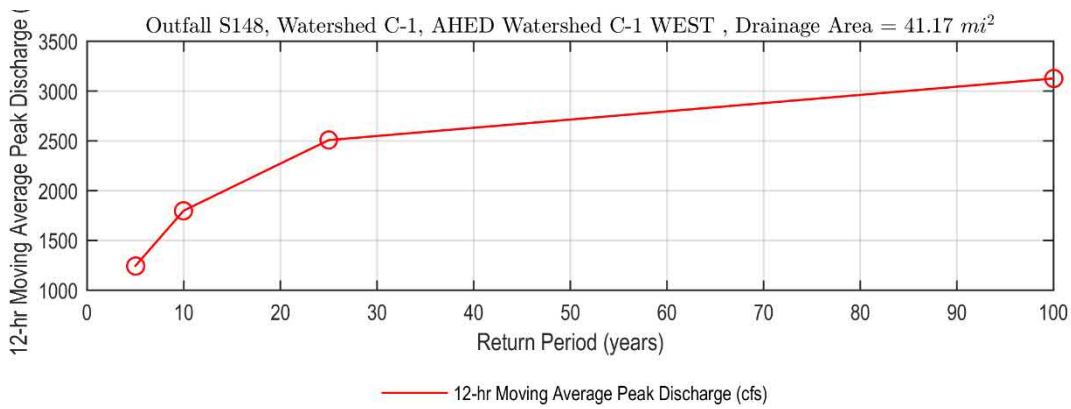


Figure 216 Structure S148 12-Hour Average Peak Discharge vs Return Period

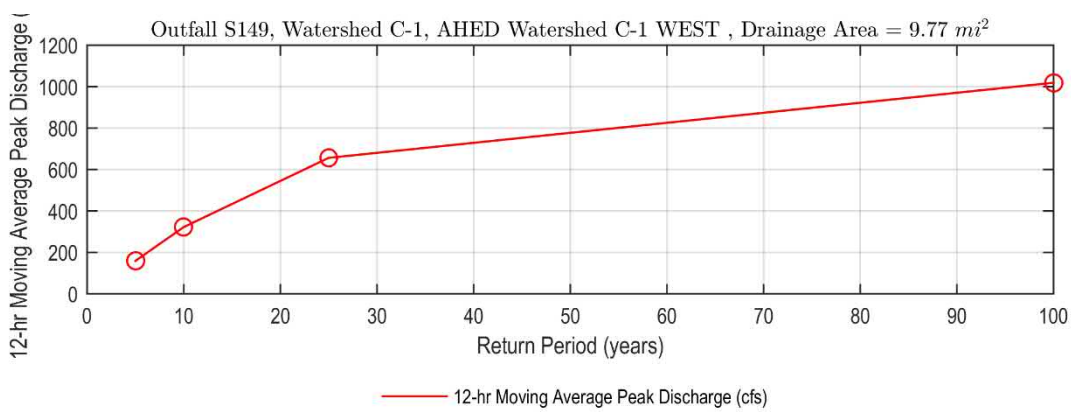


Figure 217 Structure S149 12-Hour Average Peak Discharge vs Return Period

The historic discharges were downloaded and compared with computed data using the USGS methodology for watershed discharges and Log Pearson III analysis for extreme events. First, the peak discharges through structure S21 were obtained for the period of record (1984-2020). Observed mean, maximum peak discharges and standard deviation for S21 are shown in Table 73.

Table 73 Observed Mean and Maximum Peak Discharges for S21 (DBKEY Key 65052)

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
1984	49.669	1284.045	170.78
1985	102.268	2068.692	252.86
1986	90.458	1933.979	236.85
1987	80.886	1740.494	221.88
1988	243.581	4517.305	431.22
1989	50.437	1641.401	192.12
1990	168.378	2272.767	307.99
1991	306.618	2399.986	499.2
1992	210.532	4258.538	470.12
1993	205.804	1972.494	330.44
1994	354.017	1944.761	407.41
1995	432.352	4301.877	416.8
1996	281.284	1880.118	377.95
1997	139.728	1520.785	340.9
1998	215.801	3647.401	369.26
1999	148.212	2093.473	380.39
2000	138.995	2107.267	270.23
2001	171.328	2749.789	299.92
2002	269.732	2308.868	323.7
2003	322.709	1810.999	331.35
2004	229.34	1661.035	318.36
2005	207.34	3346.929	380.63
2006	177.482	1608.159	288.8
2007	148.856	2229.734	291.93
2008	221.708	1680.728	313.58
2009	179.541	1321.465	268
2010	210.309	1446.976	270.03
2011	105.901	1889.357	223.7
2012	338.933	1680.932	370.36
2013	242.74	2211.506	319.57
2014	170.303	1753.997	252.56
2015	177.772	3466.969	331.02
2016	317.422	1322.975	275.87
2017	367.908	2769.088	414.14
2018	302.642	1555.018	355.03
2019	185.853	1770.052	274.63
2020	165.68	1543.677	309.57

The Log Pearson III probability distribution parameters were determined using the HEC-SPS software. Next, confidence intervals of 5% and 95% were used as criteria of fitting computed discharges as function of return frequencies as shown on Figure 218.

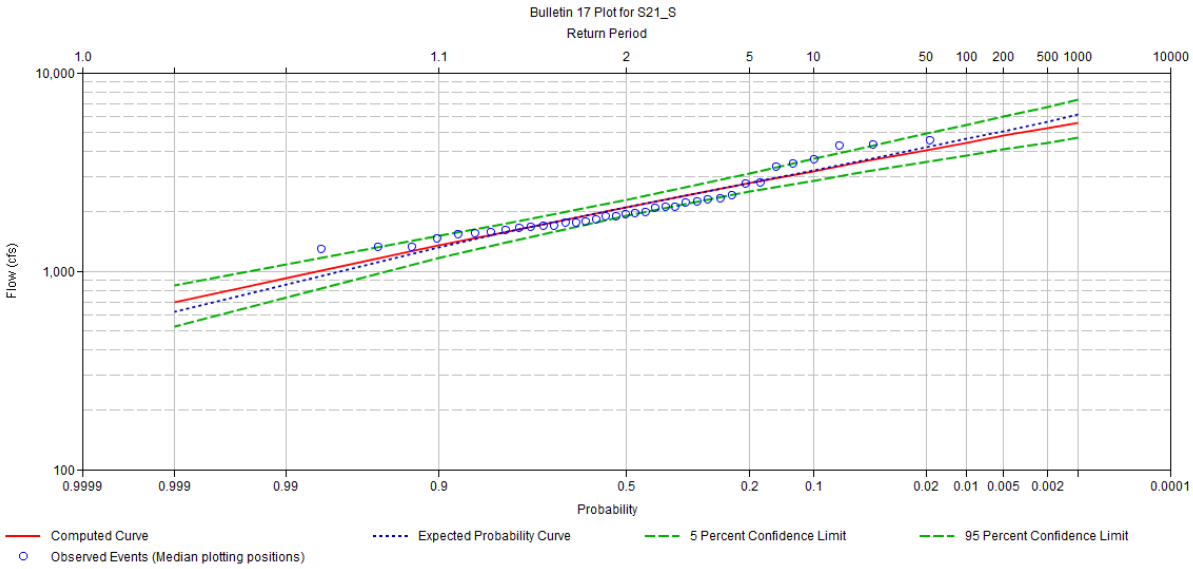


Figure 218 Log-Pearson III Analysis of Return Period for S21_S Discharges

The design criterion for the S21 Structure is 2,560 cfs, which is 40% of the Standard Project Flood (SPF). The Standard Project Flood is listed as 4,300 cfs in the SFWMD Structure Book. The discharge from the 100-year, 72-hour design event for current conditions is 7,308 cfs for instantaneous and 6,257 cfs for 12 hour moving average, which are greater than the SPF values, however, they are within the 95% confidence limits of the Log Pearson III probability distribution.

Similar to basin C-100, two main factors are attributed to the higher computed discharge values at the structures. Contribution from increased imperviousness caused by development since the original design and the second factor is a difference in the design assumptions. The original design uses a steady state boundary of 2.0 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.8 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (100-yr Outfall Timeseries provided by SFWMD and Steady State boundary originally used as design criteria).

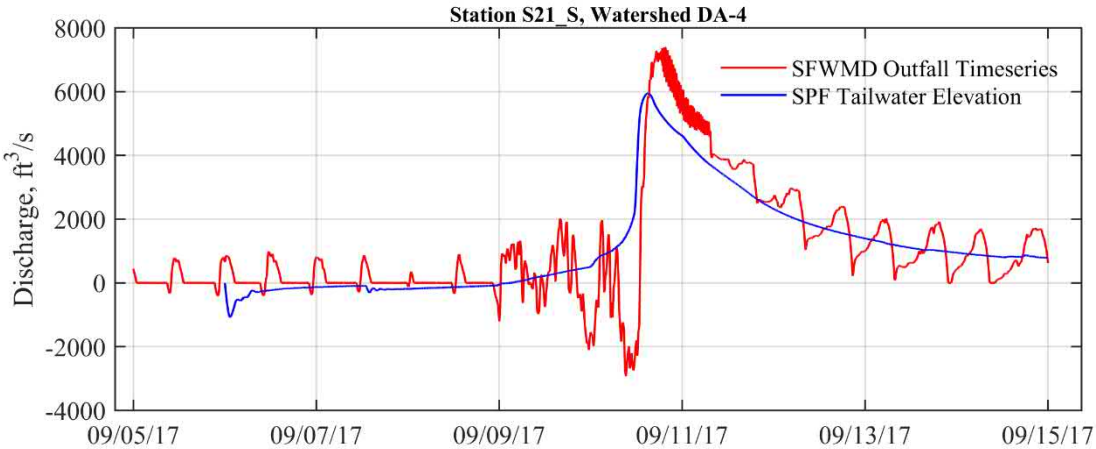


Figure 219 Comparison of Discharges at Structure S21 for SPF tail water and SFWMD Tailwater

5.2.5 C-1: PM5 Frequency of Flooding

Table 74 through Table 77 summarize the area of flooding shown in the C-1 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. Figures A-1 through A-3, A-9 through A-11, A-17 through A-20 and A25 through A-28 in Appendix A Flood Extent and Duration Maps for Current Conditions show the inundation depths for the watershed, agricultural, urban and wetland areas in C-1 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively. The total area of the C-1 watershed is 37,839.11 acres (based on GIS data). The values in the tables are based on discretization to 100 m raster which results in total watershed area 37,684 acres with 23,418 acres urban land, 10,892 acres agricultural land and 4,171 acres wetlands

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval.
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 74 Summary of the PM#5 Flood Inundation in Acres for the C-1 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	28854	25657	20962	13900
0.25 >= 0.50 ft	3400	4455	4621	4937
0.50 >= 0.75 ft	1626	2637	4352	3798
0.75 >= 1.00 ft	813	1374	2600	3954
1.00 >= 1.25 ft	311	600	1374	3637
1.25 >= 1.50 ft	163	279	647	2226
1.50 >= 1.75 ft	136	131	282	1240
1.75 >= 2.00 ft	94	128	156	677
2.00 >= 2.25 ft	101	128	99	272
2.25 >= 2.50 ft	472	109	111	180
>= 2.50 ft	1713	2184	2481	2861
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 75. Summary of the PM#5 Flood Inundation in Acres for the Urban Areas of the C-1 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	21088	19949	17218	11982
0.25 >= 0.50 ft	415	988	2192	3632
0.50 >= 0.75 ft	213	497	1075	2276
0.75 >= 1.00 ft	124	230	704	1505
1.00 >= 1.25 ft	94	116	331	983
1.25 >= 1.50 ft	84	91	183	633
1.50 >= 1.75 ft	54	69	96	339
1.75 >= 2.00 ft	32	86	59	217
2.00 >= 2.25 ft	35	42	40	119
2.25 >= 2.50 ft	326	37	52	114
>= 2.50 ft	954	1312	1468	1619
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 76. Summary of the PM#5 Flood Inundation in acres for the Agricultural Areas of the C-1 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	6640	4665	2866	1238
0.25 >= 0.50 ft	2723	3304	2330	1203
0.50 >= 0.75 ft	1030	1866	3089	1488
0.75 >= 1.00 ft	306	704	1623	2323
1.00 >= 1.25 ft	94	180	628	2461
1.25 >= 1.50 ft	35	91	193	1265
1.50 >= 1.75 ft	17	20	69	509
1.75 >= 2.00 ft	12	17	37	232
2.00 >= 2.25 ft	10	12	15	54
2.25 >= 2.50 ft	0	7	10	47
>= 2.50 ft	25	25	32	72
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 77. Summary of the PM#5 Flood Inundation in Acres for the Wetlands Areas of the C-1 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	1834	1663	1433	1018
0.25 >= 0.50 ft	282	217	188	217
0.50 >= 0.75 ft	390	282	217	131
0.75 >= 1.00 ft	381	442	274	178
1.00 >= 1.25 ft	148	309	418	240
1.25 >= 1.50 ft	49	104	282	339
1.50 >= 1.75 ft	64	49	121	405
1.75 >= 2.00 ft	64	37	64	222
2.00 >= 2.25 ft	62	74	47	106
2.25 >= 2.50 ft	138	69	54	35
>= 2.50 ft	759	924	1072	1280
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Figures A-1 through A-4, A-9 through A-11, A-17 through A-20 in Appendix A Flood Extent and Duration Maps for Current Conditions and Table 74 through Table 77 show the flood extend

in the entire watershed and the agricultural, urban and wetland areas of the C-100 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

Assessment:

Table 78. PM#5 Assessment for C-1 Watershed

Canal	LOS Rating
Areas draining to C-1W	Upstream of the junction with Tamiami Airport B Canal: 0.25 – 0.5 foot of flood depth in the watershed. Most areas in C-1W watershed have 0.5 – 1 foot flood depth for 25-year design event. 100-year storm causes approximately 1 – 1.75 feet flood depth. There is significant flooding in agricultural areas, mainly located in C-1 West, that is attributable to the elevated stages in C-1W Canal and possibly, secondary canals for the 25-year and 100-year design events. Urban areas, mainly located in C-1 East sub-watershed, show less significant flooding, with water depth in the range of 0.5 – 0.75 feet for the 100-year design storm. This is in agreement with PM#1 that indicates that upstream of SR 994 the canals provide at least 10-year LOS.
Areas draining to C-1N – C-1 Canal	Watershed areas upstream of G114, and around C-1N Canal have more than 2 feet of water depth for the 100-year design event. Areas downstream of SR-994 have approximately 0.25- 0.5 foot of water depth for the 25-year design event and around 1 foot water depth for the 100-year design event. For the 5-year and 10-year events, flooding in general is less than 0.5 foot deep.

Analysis shows that for C-1 Watershed, LOS rating is 10-year LOS.

5.2.6 C-1: PM6 Duration of Flooding

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S21_H (Figure 220) to return to target reference stage, which was defined based on the average prior to the storm event, Average S21_H (period of 9/1-9/8) = -0.01 ft NAVD 88.

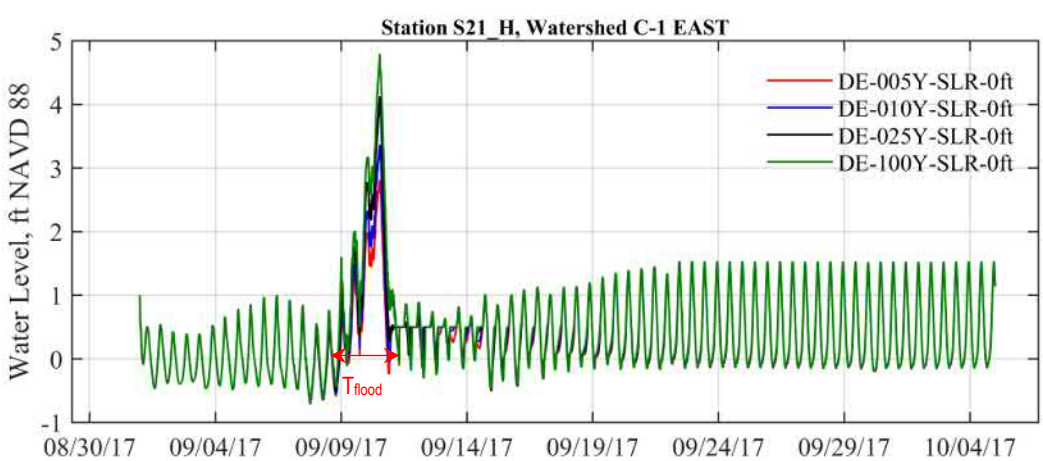


Figure 220 Flood Duration Period in Canal C-1

The flood duration for 5-yr, 10-yr, 25-yr and 100-yr are shown in the table below:

Table 79 Flood Duration at Headwater of Structure S21

Duration of Flooding (hr)	5-Year Time (hr)	10-Year Time (hr)	25-Year Time (hr)	100-Year Time (hr)
S21_H	16.08	17.17	18.75	31.33

Table 80 through Table 83 show the duration of time taken for the water levels in the C-1 Watershed canals to return to baseflow for the entire watershed, the urban, agricultural and wetland areas, respectively. SMD FPLOS model POS was long enough to ensure the recession part of the hydrograph was captured completely, so duration of flooding was estimated well.

Figures A-5 through A-8, A-13 through A-15, A-21 through A-24 and A29 through A-32 in Appendix A Flood Extent and Duration Maps for Current Conditions are flood depth maps corresponding to flood depths that show the flood duration in the entire watershed, the agricultural, urban areas of the C-1 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

Table 80. Summary of the PM#6 Flood Duration Area in Acres for the C-1 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	84	161	420	1226
1 - 4 hr	188	267	707	1218
4 - 8 hr	257	393	573	1127
8 - 12 hr	255	385	702	1134
12 - 24 hr	1090	1418	2197	3588
24 - 48 hr	1619	2429	2896	3998
48 - 96 hr	1695	2676	3954	4626
96 - 168 hr	788	1324	2063	3072
168 - 240 hr	272	346	484	899
240 - 360 hr	297	351	385	457
> 360 hr	2236	2276	2340	2439
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 81. Summary of the PM#6 Flood Duration for the Urban Areas of the C-1 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	10	72	289	1040
1 - 4 hr	64	168	556	1033
4 - 8 hr	72	193	423	867
8 - 12 hr	52	180	462	867
12 - 24 hr	220	507	1260	2513
24 - 48 hr	292	512	1035	2261
48 - 96 hr	180	358	586	1070
96 - 168 hr	106	116	193	336
168 - 240 hr	35	54	77	99
240 - 360 hr	30	37	32	57
> 360 hr	1270	1273	1287	1292
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 82. Summary of the PM#6 Flood Duration Area in Acres for the Agricultural Areas of the C-1 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	67	82	109	156
1 - 4 hr	101	101	153	173
4 - 8 hr	173	188	133	225
8 - 12 hr	195	188	222	259
12 - 24 hr	803	845	899	1016
24 - 48 hr	1223	1792	1695	1606
48 - 96 hr	1332	2157	3175	3277
96 - 168 hr	316	825	1537	2496
168 - 240 hr	7	12	62	393
240 - 360 hr	10	10	12	25
> 360 hr	25	27	27	30
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Table 83. Summary of the PM#6 Flood Duration Area in Acres for the Wetlands Areas of the C-1 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	10	12	30	49
1 - 4 hr	32	5	17	42
4 - 8 hr	17	17	30	44
8 - 12 hr	15	27	25	57
12 - 24 hr	77	77	54	156
24 - 48 hr	104	158	217	208
48 - 96 hr	178	163	213	339
96 - 168 hr	403	408	346	247
168 - 240 hr	227	284	366	442
240 - 360 hr	259	309	343	378
> 360 hr	1016	1048	1097	1191
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-1 covers 37,839 acres, or 59.124 square miles				

Figures A-5 through A-8, A-13 through A-18, A-21 through A-24 are flood duration maps corresponding to Table 80 through Table 83 and showing the flood duration in the entire watershed and the agricultural, urban and wetland areas of the C-1 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

5.2.7 LOS Rating of C-1 Watershed for Current Conditions

The C-1 Watershed has been assigned a 5-year FPLOS rating for the current hydrologic conditions. For this overall rating, weight was placed on PM1, as the primary canals in this watershed collectively are expected to contain the 5-year storm event within its MIKE 1D right and left banks as modeled.

5.3 C-100 Watershed Flood Protection Level of Service

There are seven primary water control structures in the C-100 watershed: S123, S118, S119, S120, S121, S122, and S700. Figure 222 shows the inflows and outflows in this watershed, and Table 84 contains the design parameters of these water control structures (ref 8).

Table 84 Structure Operating Parameters within C-100 Watershed

Structure	HW Stage, ft NAVD 88	TW Stage, ft NAVD88	Optimum HW Stage ft NAVD88	Design Q (CFS)	Operation
S123	0.45	-0.05	0.45 – 1.45	2,300	Normal: 0.45 – 1.45 ft NAVD88 Dry: 0.95 – 1.95 ft NAVD88 Low Range (flood or regulatory releases): -0.06 to 0.96 ft NAVD88
S118	2.05	1.55	2.15	860	Open: When HW Stage= 3.35 ft NAVD88 Close: When HW Stage= 1.95 ft NAVD88
S119	2.85	2.35	3.15	400	Open: When HW Stage= 3.85 ft NAVD88 Close: When HW Stage= 2.65 ft NAVD88
S120	3.25	2.75	3.45	150	Low Water Conditions: Close structure Flood: open structure to release excess water to maintain optimum upstream stage
S121	1.35	1.25	N/A	100	Low Water Conditions in C-100C: Open structure Aggravated Flood in C-100C: Close structure
S122	0.95	0.45	N/A	200	Low Water Conditions in C-100B: Open structure Aggravated Flood in C-100B: Close structure
S700	1.05	N/A	N/A	100	Operated primarily to supply water to BBCW project. Operations may be constrained by local water level, salinity control and water table conditions

Figure 222 provides the outline of watershed C-100 and associated structures and canals.

5.3.1 C-100: PM1 Maximum Stage in Primary Canal

The canal bank deficiency (canal bank lower than computed surface water profile) and the chainage is shown Figure 221. A conclusion is made that the LOS of Canal C-100 is 5-yr.

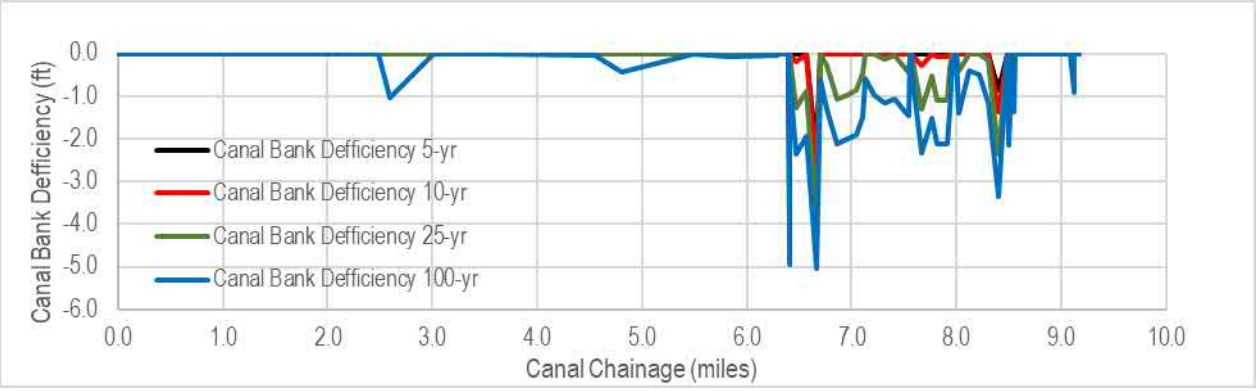


Figure 221 C-100 Canal Bank Deficiency (in negative ft) for Design Events

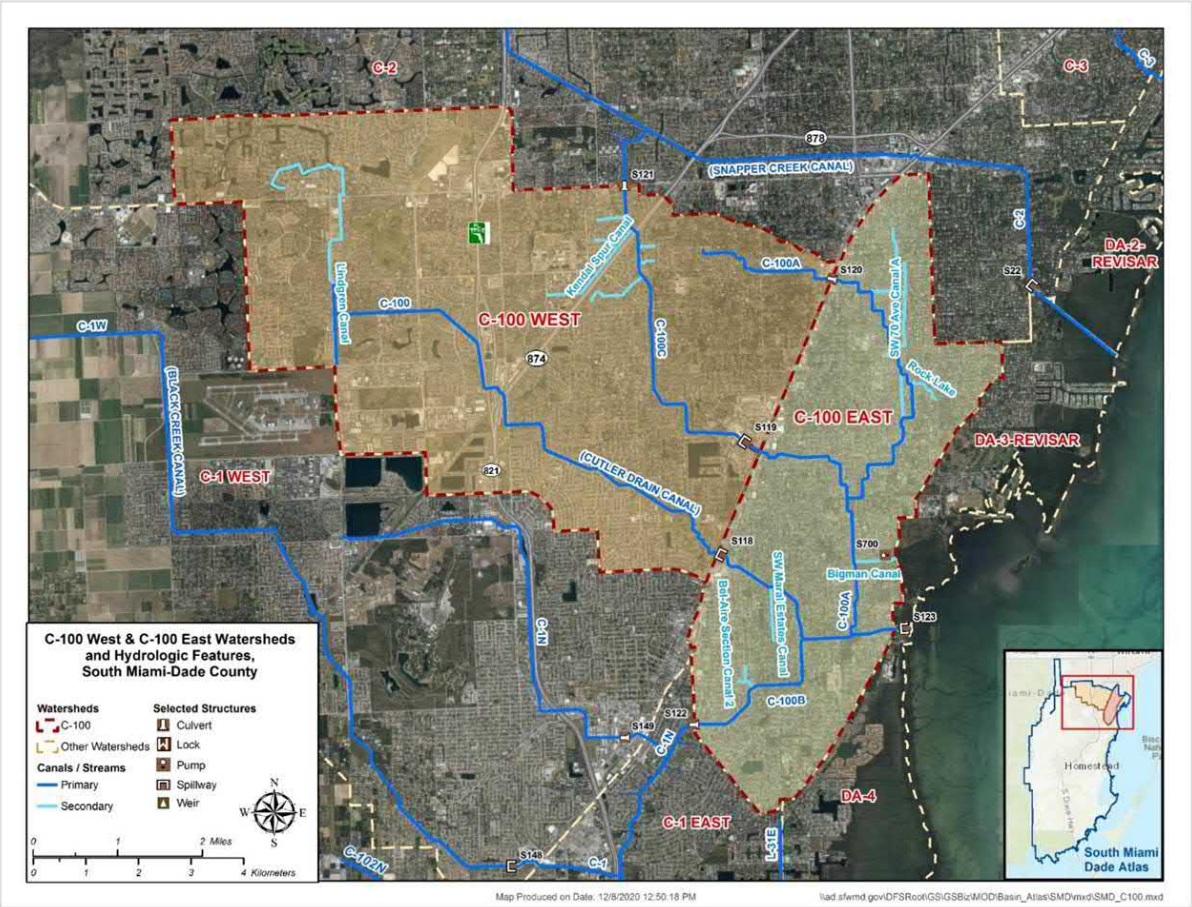


Figure 222. Drainage Network in C-100 Watershed (Source: SFWMD South Miami Dade C-100: PM1 Maximum Stage in Primary Canals

A list of landmarks within Watershed C-100 is provided in Table 85.

Table 85 List of Landmarks and Design Water Elevations in C-100, C-100A and C-100C.

Landmark	Canal	Top Left Bank ft NAVD 88	Top Right Bank ft NAVD88	5-yr ft NAVD 88	10-yr ft NAVD 88	25-yr ft NAVD 88	100-yr ft NAVD 88
SR-821 Crossing	C-100	14.0	11.3	3.78	4.89	6.12	7.35
SR-874 Crossing	C-100	10.0	10.0	3.76	4.87	6.11	7.34
SR-992 Crossing	C-100	12.0	12.0	3.74	4.79	6.01	7.14
US-1 Crossing	C-100	5.5	4.6	4.27	4.80	5.89	6.95
SR-973 Crossing	C-100A	10.5	7.8	3.50	3.51	3.93	7.71
Structure S120	C-100A	9.4	10.0	3.50	3.50	3.92	7.68
US-1 Crossing	C-100A	9.4	10.0	4.41	4.99	6.19	7.41
C-100C Crossing	C-100A	9.0	9.0	4.31	4.86	6.00	7.13
C-100 Crossing	C-100A	12.9	15.7	4.25	4.76	5.75	6.75
S121	S100-C	9.0	9.4	3.79	4.96	6.43	7.73
CR-94 Crossing	S100-C	9.0	9.4	3.79	4.96	6.43	7.73
SR-874 Crossing	S100-C	9.0	9.4	3.78	4.94	6.43	7.73
SR-990 Crossing	S100-C	9.0	9.4	3.76	4.91	6.42	7.73
S119	S100-C	7.9	8.5	3.67	4.78	6.30	7.66
US-1 Crossing	S-100C	11.2	11.5	4.32	4.87	6.13	7.33

Figure 223 through Figure 226 show the canal profiles for the C-100 watershed and includes the following canals:

- C-100
- C-100A
- C-100B
- C-100C

For PM1, the LOS rating of canals in C-100 watershed is shown in Table 86.

Table 86 LOS Rating of Canals in C-100 Watershed for PM1

Canal	LOS Rating
C-100	Upstream of S118: 25-year LOS
	Downstream of S118: Less than 5-year LOS
C-100A	25-year LOS
C-100B	Upstream of S122: 25-year LOS
	Downstream of S122: 5-year LOS
C-100C	Upstream of S119: 25-year LOS
	Downstream of S119: Less than 5-year LOS

The overall rating of C-100 is 5-yr FPLOS

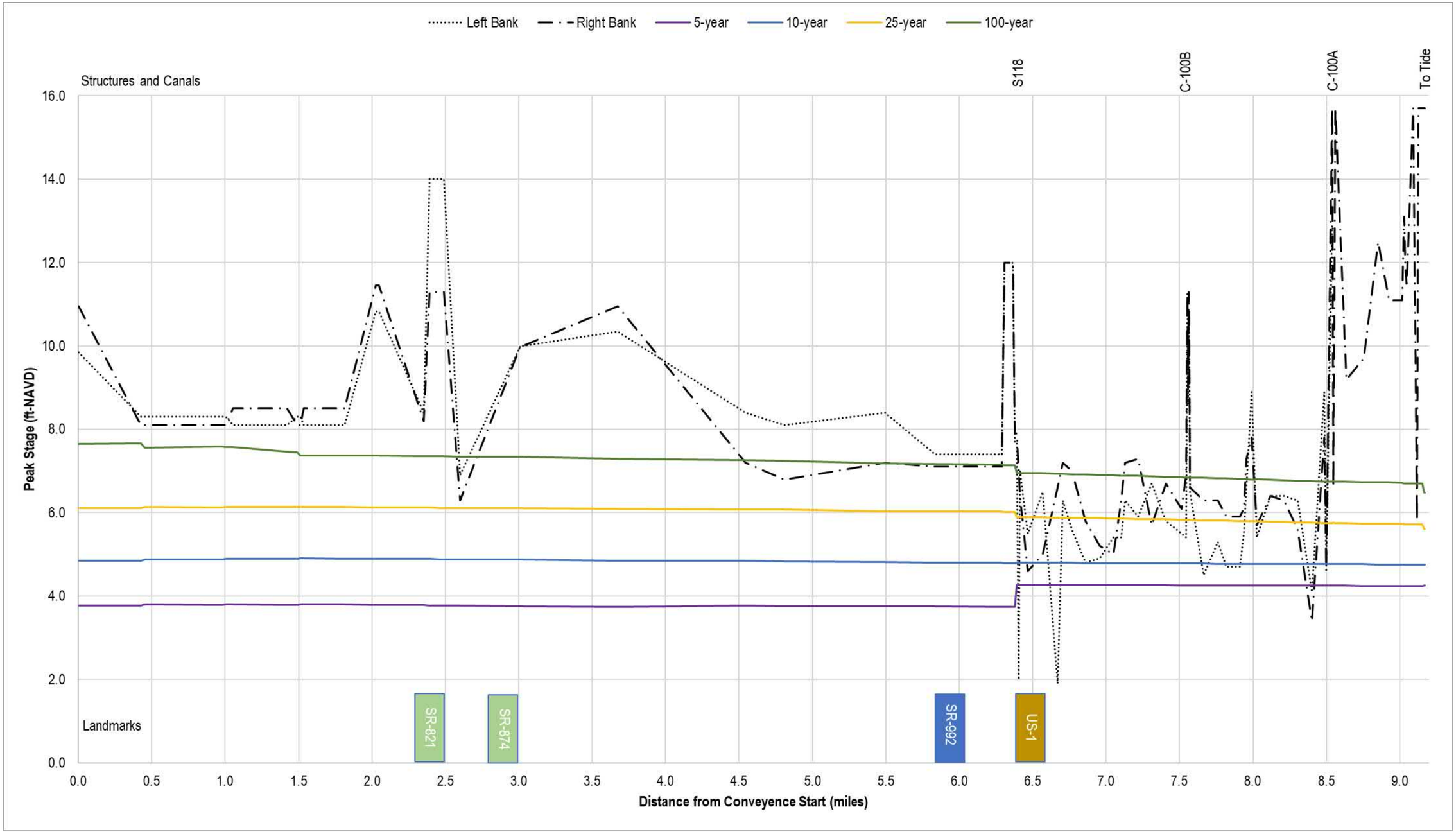


Figure 223. Profile of Peak Stages in Canal C-100

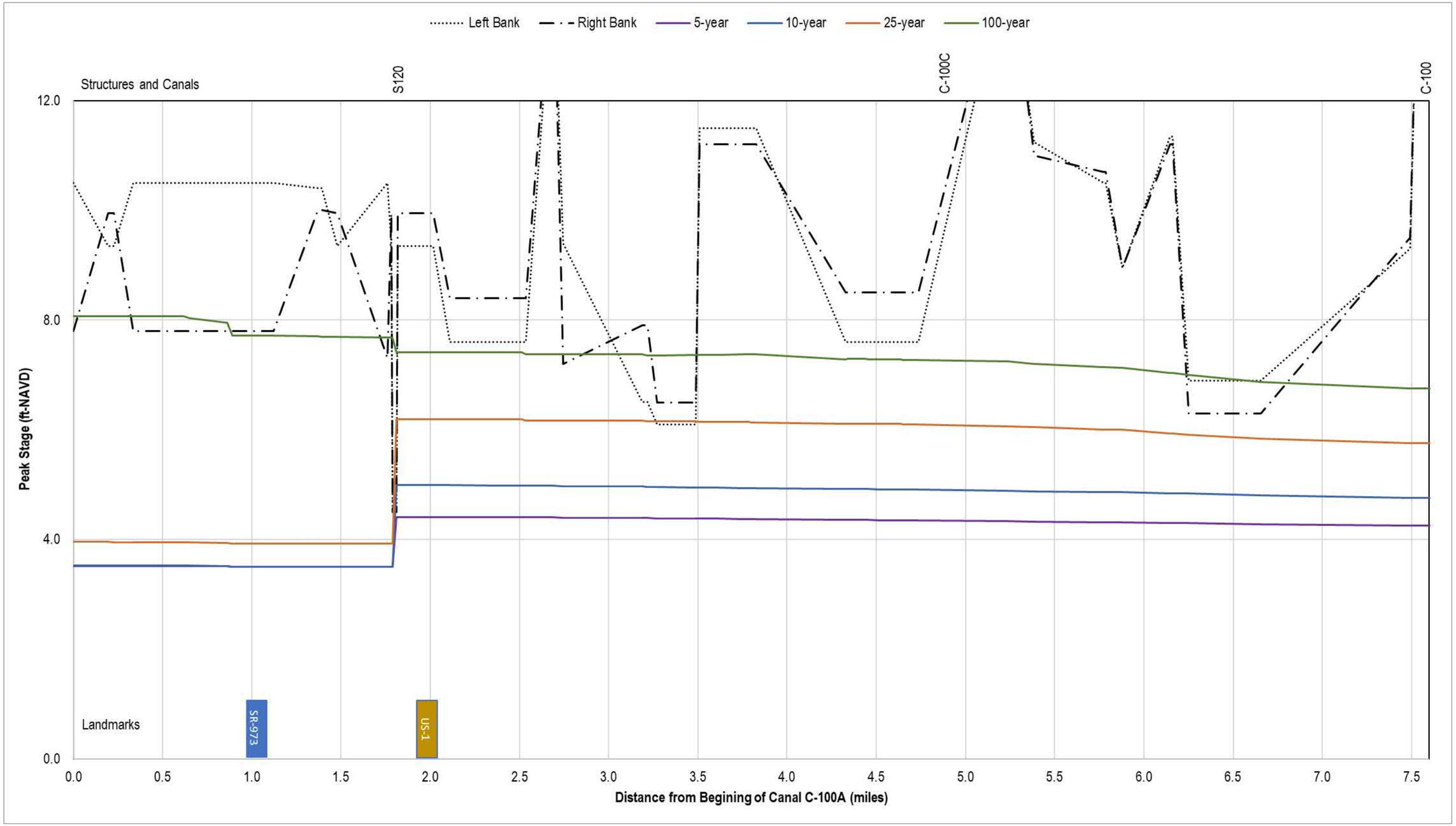


Figure 224. Profile of Peak Stages in Canal C-100A

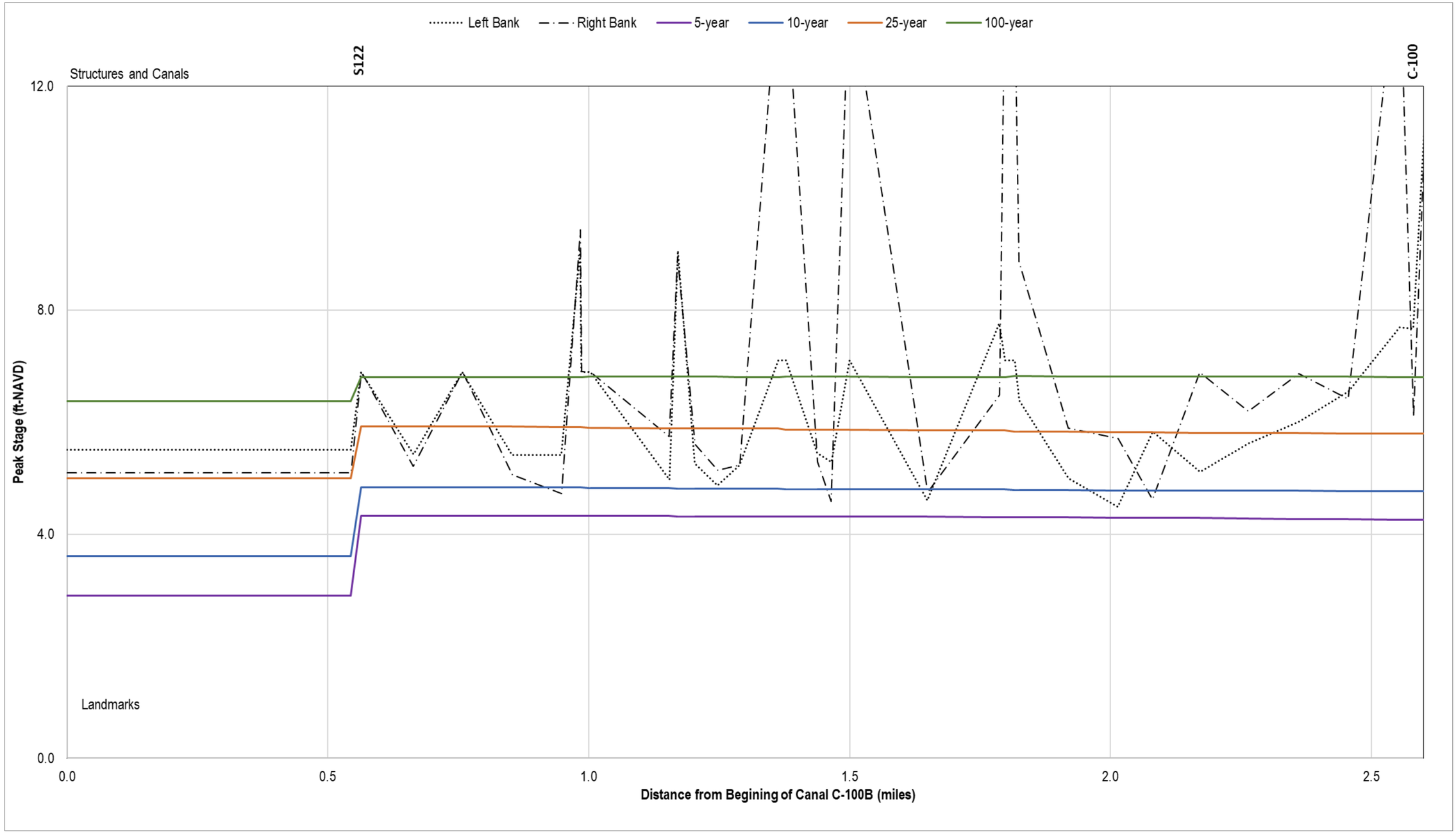


Figure 225. Profile of Peak Stages in Canal C-100B

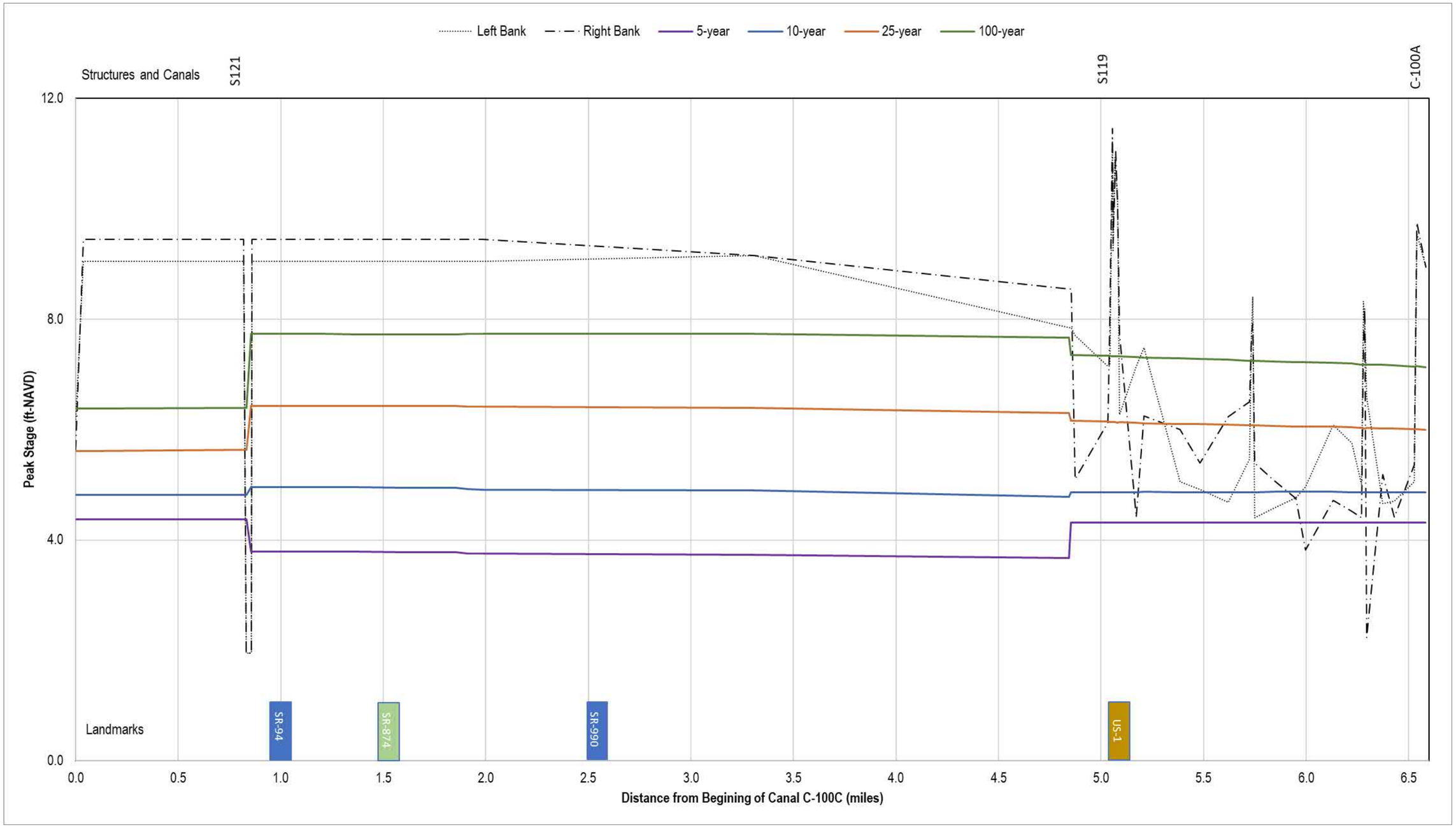


Figure 226. Profile of Peak Stages in Canal C-100C

5.3.2 C-100: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 87 contains information on the discharges and the drainage areas in the C-100 watershed. The maximum daily discharge capacity of the C-100 Watershed through S123 is a function of the drainage from the entire watershed. The discharge hydrographs in the figures below are area-weighted by upstream drainage areas for the 72-hour 5-year, 10-year, 25-year, and 100-year design storms. The peak 12-hour moving average discharge per square mile is shown in Figure 227. The inland structures S118, S119 and S120 represent the inter-watershed movement and flow through the structures.

Table 87. C-100 Watershed Drainage Discharge Capacity (cfs/sq. mi)

Structure	Watershed	AHED Name	Total Area (mi^2)	5-yr	10-yr	25-yr	100-yr	Allowable 10-yr ERP
S118	C-100	C-100 WEST	16.44	30.51	42.72	61.81	94.07	59.62
S119	C-100	C-100 WEST	7.55	16.42	24.43	32.26	35.93	59.62
S120	C-100	C-100 WEST	2.02	6.00	11.40	22.75	83.68	59.62
S123	C-100	C-100 EAST	39.17	40.49	59.16	93.36	138.03	59.62

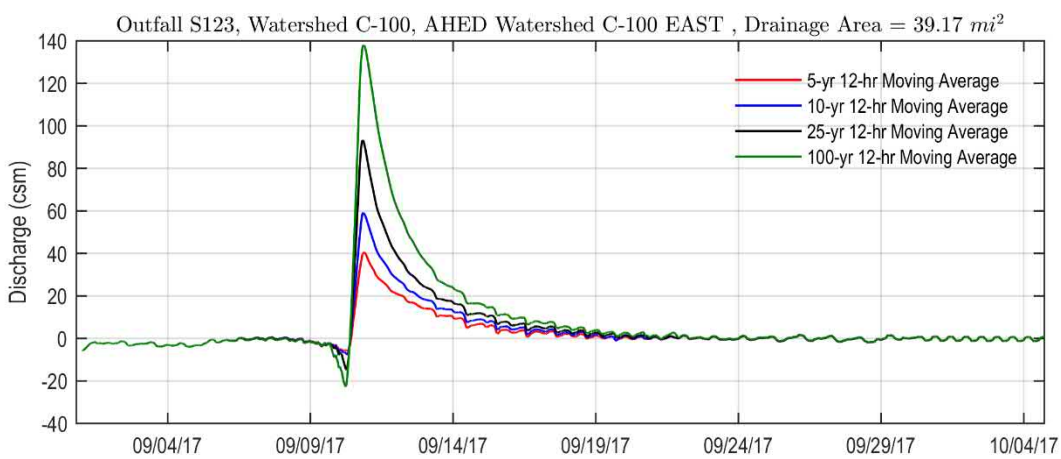


Figure 227. Drainage Discharge Capacity at Structure S123

The 10-year discharge using SFWMD's Allowable Discharge formulas are listed in Table 87. None of the 10-yr design events exceed the Allowable ERP Discharges.

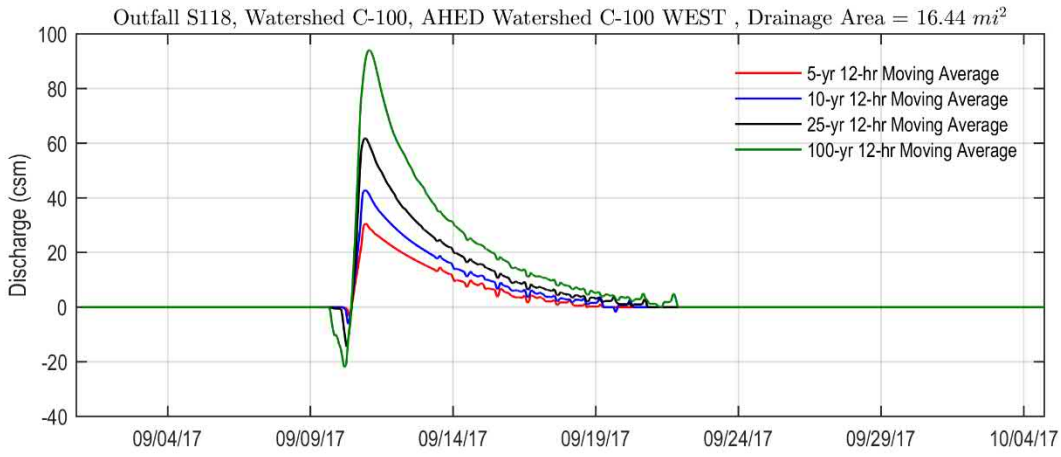


Figure 228. Drainage Discharge Capacity at Structure S118

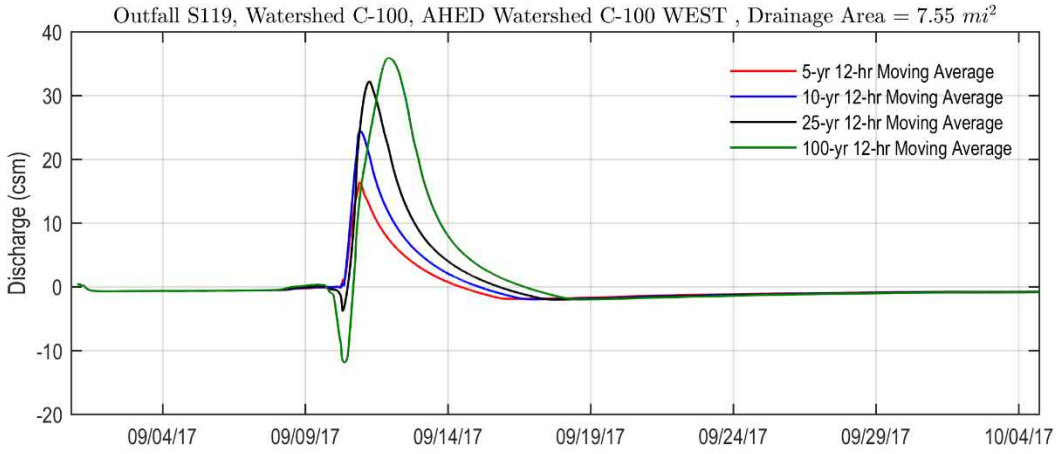


Figure 229. Drainage Discharge Capacity at Structure S119

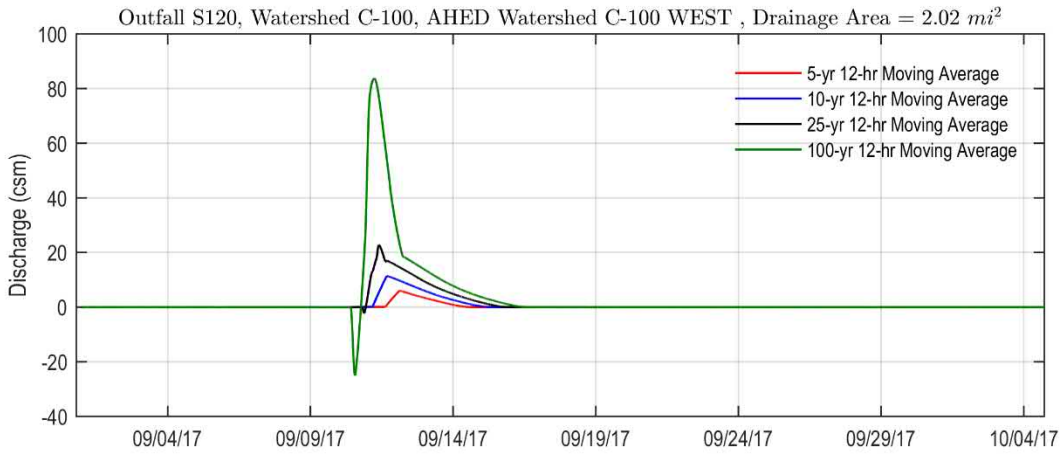


Figure 230. Drainage Discharge Capacity at Structure S120

5.3.3 C-100: PM3 Structure Performance

The design parameters of Structure S123 are listed in Table 88. Figure 231 shows instantaneous values for the 25-year and 100-year design storms, respectively.

Table 88 Design parameters of Structure S123

Structure	S123
Design Discharge	2300 cfs for 40% SPF
SPF Discharge	5000 cfs
Design Headwater Elevation	2.0 ft NGVD 29
Design Tailwater Elevation	1.5 ft NGVD 29
SPF Headwater Elevation	3.8 ft NGVD 29
SPF Tailwater Elevation	1.7 ft NGVD 29
Optimum Headwater	2.0 to 3.0
Optimum Tailwater	Tidal

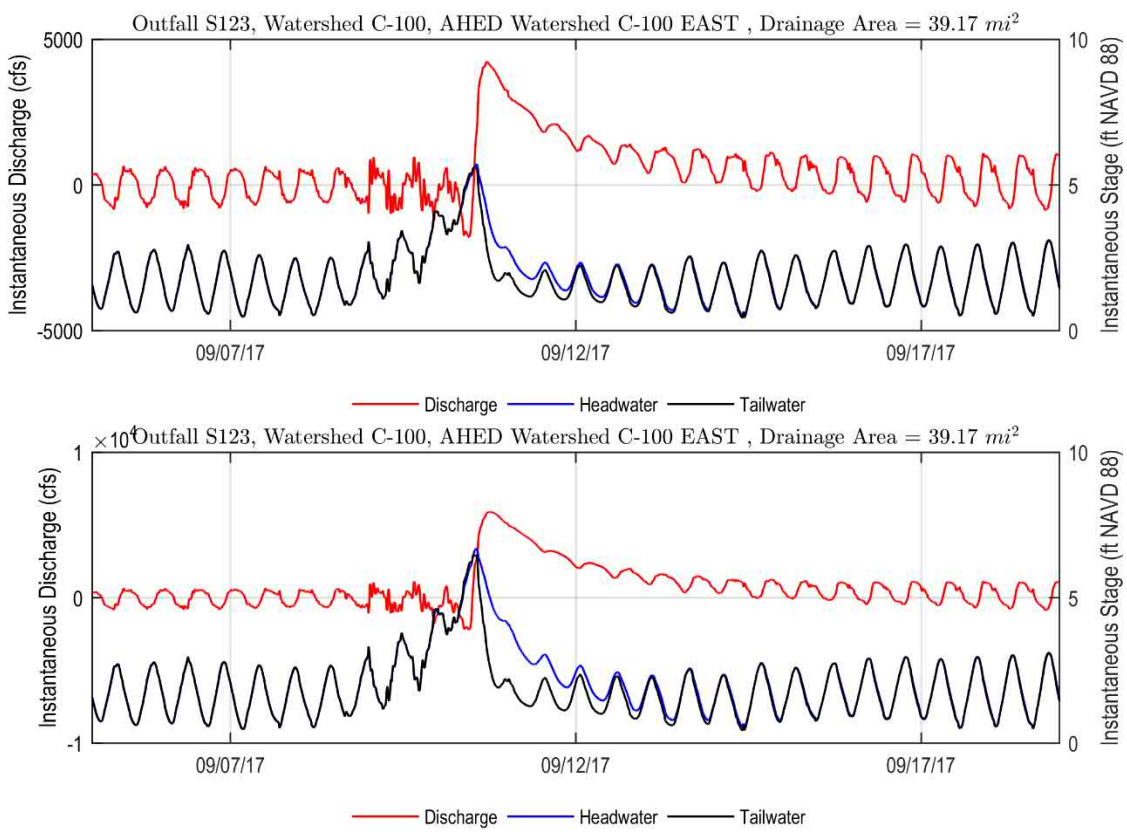


Figure 231 Structure S123 Instantaneous Conditions for 25-yr and 100-yr Design Events

Table 89 through Table 92 summarize the simulated data for structure S123, S118, S119 and S120 at the conditions of peak flows, peak headwater and peak tailwater stages.

Table 89. Summary of the Instantaneous Peak Conditions at S123

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 5:15 PM	9/10/17 5:15 PM	9/10/17 5:00 PM	9/10/17 6:00 PM
Headwater (ft)	2.43	2.89	4.10	5.00
Discharge (cfs)	1882.97	2571.95	4121.90	5829.85
Tailwater (ft)	2.16	2.37	2.89	2.70
Max Headwater	**5-yr**	**10-yr**	**25-yr**	**100-yr**
Time	9/10/17 1:15 PM	9/10/17 1:15 PM	9/10/17 1:30 PM	9/10/17 1:30 PM
Headwater (ft)	4.24	4.76	5.69	6.67
Discharge (cfs)	-225.69	56.01	1688.09	2477.17
Tailwater (ft)	4.25	4.75	5.58	6.43
Max Tailwater	**5-yr**	**10-yr**	**25-yr**	**100-yr**
Time	9/10/17 1:15 PM	9/10/17 1:15 PM	9/10/17 12:45 PM	9/10/17 12:45 PM
Headwater (ft)	4.24	4.76	5.62	6.57
Discharge (cfs)	-225.69	56.01	277.06	1618.66
Tailwater (ft)	4.25	4.75	5.61	6.48

Table 90. Summary of the Instantaneous Peak Conditions at S118

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 7:05 PM	9/10/17 8:15 PM	9/10/17 7:15 PM	9/11/17 12:35 AM
Headwater (ft)	2.36	2.81	4.44	6.32
Discharge (cfs)	595.17	765.43	1106.71	1731.27
Tailwater (ft)	2.20	2.55	4.02	5.31

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 2:10 PM	9/10/17 1:55 PM	9/10/17 1:50 PM	9/10/17 2:15 PM
Headwater (ft)	3.75	4.79	5.99	7.11
Discharge (cfs)	-320.40	-70.56	564.01	713.71
Tailwater (ft)	3.92	4.80	5.87	6.92

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:30 PM	9/10/17 1:50 PM	9/10/17 1:50 PM	9/10/17 2:05 PM
Headwater (ft)	2.44	4.79	5.99	7.11
Discharge (cfs)	-51.09	-121.86	564.01	696.67
Tailwater (ft)	4.27	4.80	5.87	6.92

Table 91. Summary of the Instantaneous Peak Conditions at S119

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 6:40 PM	9/10/17 8:30 PM	9/11/17 1:05 AM	9/11/17 8:15 AM
Headwater (ft)	3.38	4.22	5.54	6.84
Discharge (cfs)	159.87	197.85	255.11	318.68
Tailwater (ft)	3.38	4.22	5.54	6.84

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 3:25 PM	9/10/17 2:35 PM	9/10/17 2:50 PM	9/10/17 2:25 PM
Headwater (ft)	3.78	4.92	6.41	7.72
Discharge (cfs)	87.69	117.95	77.54	-26.88
Tailwater (ft)	3.78	4.92	6.41	7.72

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 3:25 PM	9/10/17 2:35 PM	9/10/17 2:50 PM	9/10/17 2:25 PM
Headwater (ft)	3.78	4.92	6.41	7.72
Discharge (cfs)	87.69	117.95	77.54	-26.88
Tailwater (ft)	3.78	4.92	6.41	7.72

Table 92. Summary of the Instantaneous Peak Conditions at S120

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/11/17 10:55 PM	9/11/17 12:20 PM	9/11/17 7:30 AM	9/11/17 5:40 AM
Headwater (ft)	3.50	3.50	3.50	6.86
Discharge (cfs)	14.67	24.92	66.44	183.85
Tailwater (ft)	1.56	2.27	3.42	6.22

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/13/17 11:40 PM	9/11/17 10:20 AM	9/11/17 3:25 AM	9/10/17 10:45 PM
Headwater (ft)	3.50	3.50	3.84	7.60
Discharge (cfs)	0.72	8.66	21.06	141.91
Tailwater (ft)	1.01	2.14	3.82	7.21

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:15 PM	9/10/17 1:15 PM	9/10/17 2:25 PM	9/10/17 3:05 PM
Headwater (ft)	1.05	1.23	1.70	3.11
Discharge (cfs)	0.01	0.03	0.04	0.05
Tailwater (ft)	4.40	4.95	6.11	7.35

A summary of headwater, tailwater, discharge and head differential across structures is presented in Figure 232.

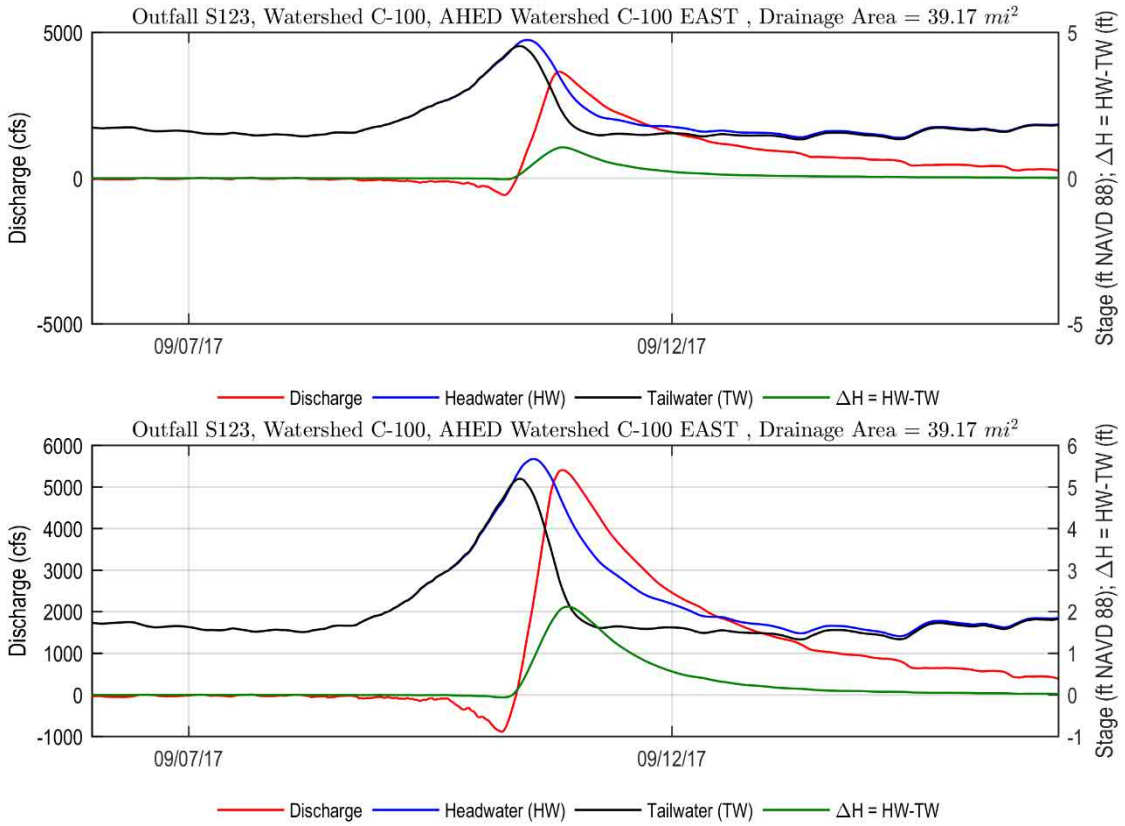


Figure 232. Tidally Averaged (12-hour) Discharge, Stage and Head Differential at S123 Structure - 25-yr and 100-yr Design Events

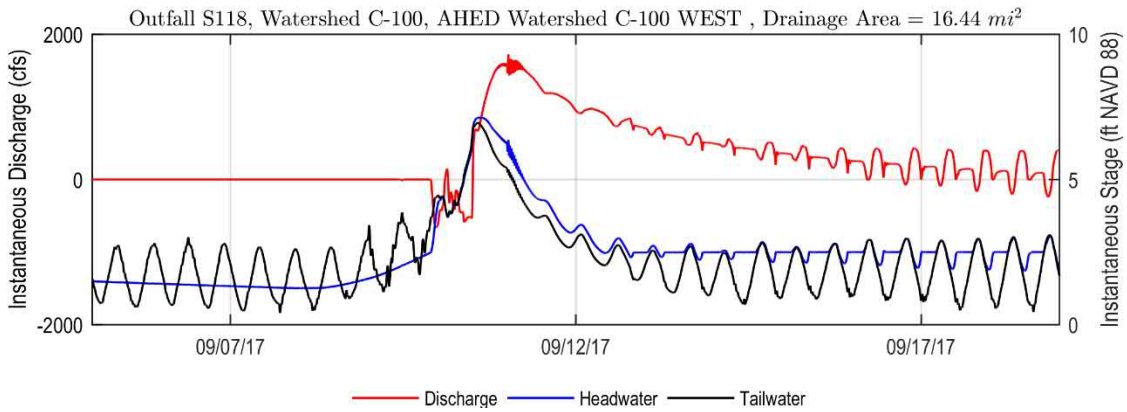


Figure 233. Instantaneous Discharge and Stage at S118 Structure -25-yr Design Event

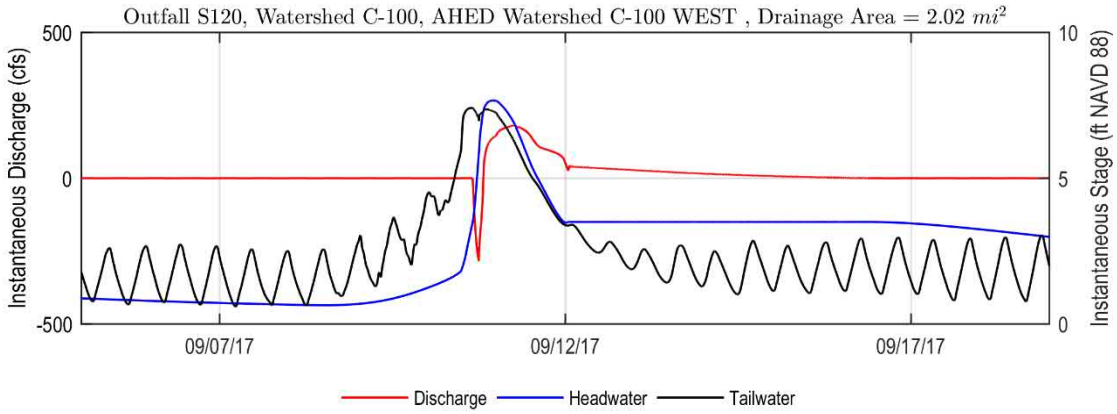


Figure 234. Instantaneous Discharge and Stage at S120 Structure - 25-yr Design Event

A summary of the 12-hour moving average results is provided in Table 93

Table 93 Summary of the 12-hr Moving Average Conditions at Structures in C-100 Watershed

Structure	Watershed Model	AHED Name	Total Area (mi²)	Design Event	Peak Tailwater (ft NAVD 88)	Discharge (cfs)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)
S118	C-100	C-100 WEST	16.440	5-yr	1.992	502	2.512	0.519
				10-yr	2.551	702	2.803	0.252
				25-yr	3.764	1016	4.139	0.376
				100-yr	5.001	1546	5.819	0.818
S119	C-100	C-100 WEST	7.550	5-yr	3.403	124	3.403	0.000
				10-yr	4.142	184	4.142	0.000
				25-yr	4.954	244	4.954	0.000
				100-yr	5.526	271	5.526	0.000
S120	C-100	C-100 WEST	2.020	5-yr	1.782	12	3.500	1.718
				10-yr	2.174	23	3.500	1.326
				25-yr	3.338	46	3.584	0.246
				100-yr	6.278	169	6.825	0.547
S123	C-100	C-100 EAST	39.170	5-yr	1.749	1586	1.959	0.210
				10-yr	2.103	2317	2.547	0.445
				25-yr	2.453	3657	3.503	1.050
				100-yr	2.551	5407	4.635	2.084

5.3.4 C-100: PM4 Watershed Peak Storm Runoff

Figure 235 represents the discharge at tidal structure S123 from the 12-hour moving average of the design storm on the C-100 Canal.

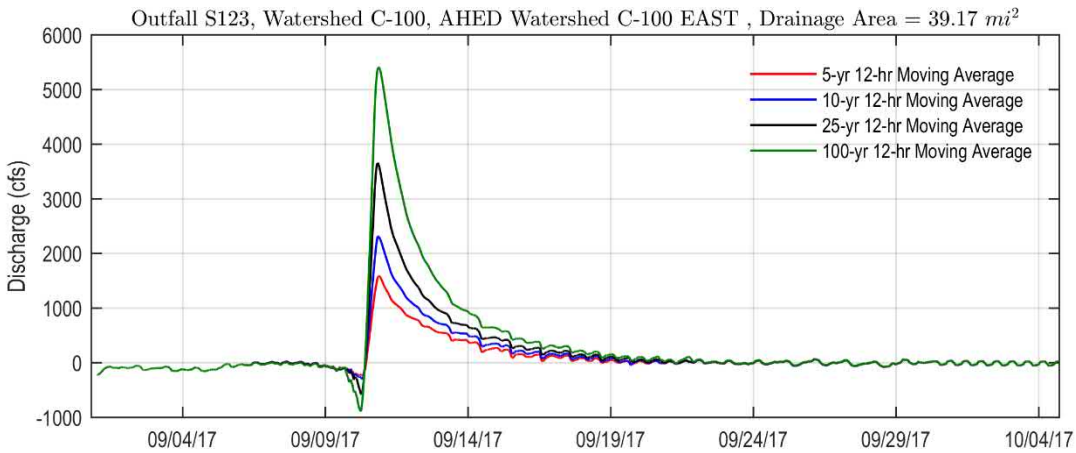


Figure 235. 12-hr Moving Average of Instantaneous Flows at S123 for the Design Events

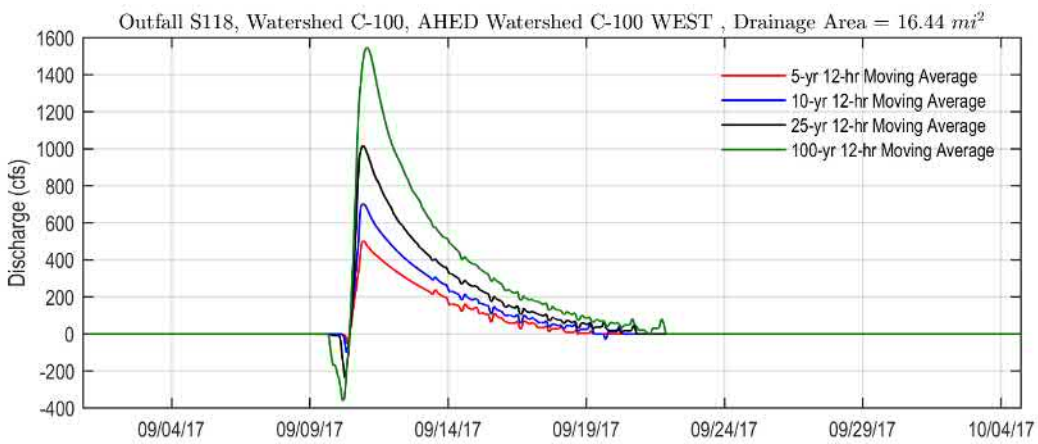


Figure 236. 12-hr Moving Average of Instantaneous Flows at S118 for the Design Events

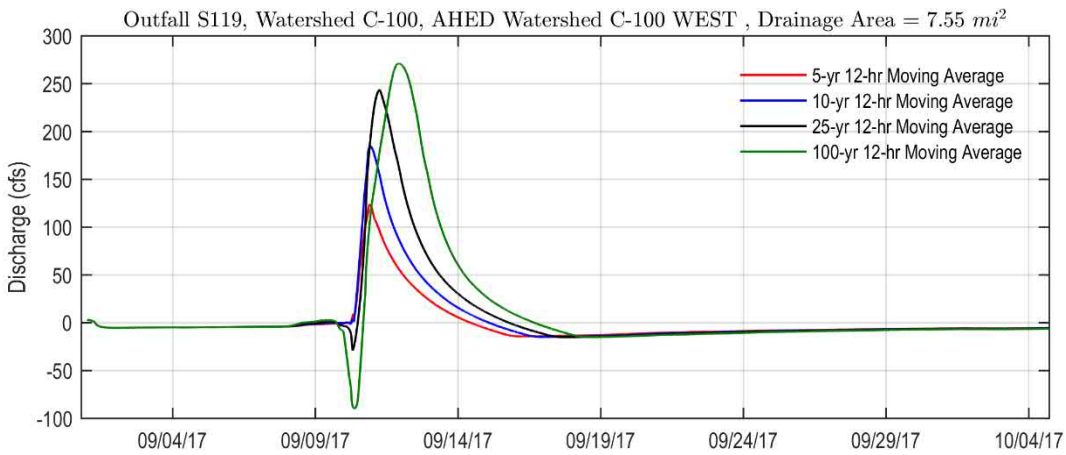


Figure 237. 12-hr Moving Average of Instantaneous Flows at S119 for the Design Events

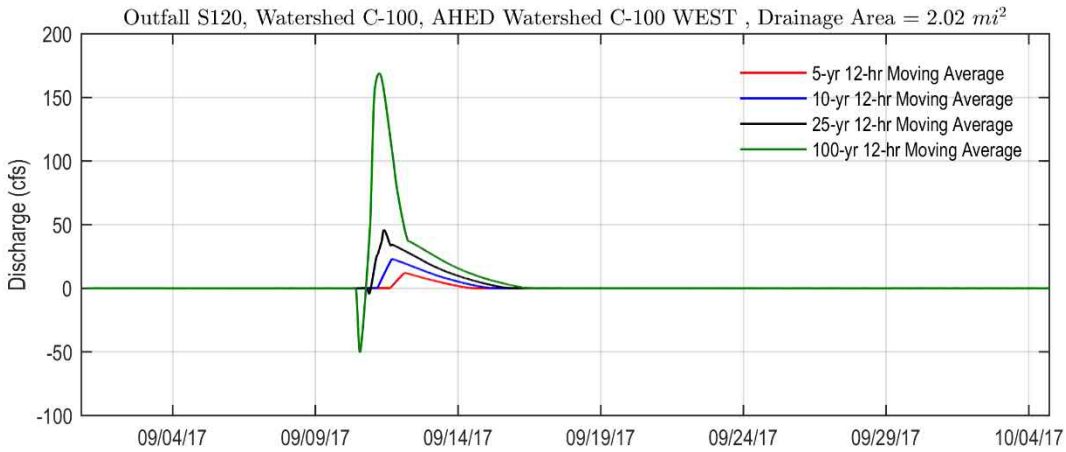


Figure 238. 12-hr Moving Average of Instantaneous Flows at S120 for the Design Events

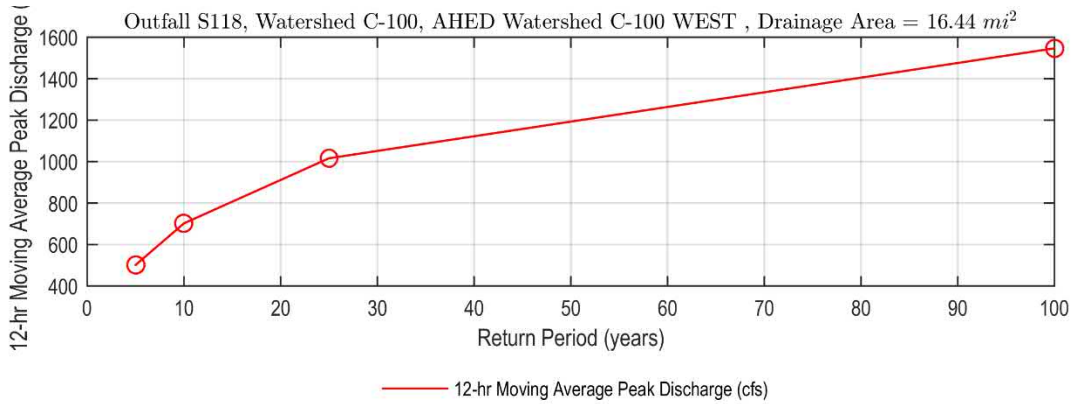


Figure 239 Structure S118 12-Hour Average Peak Discharge vs Return Period

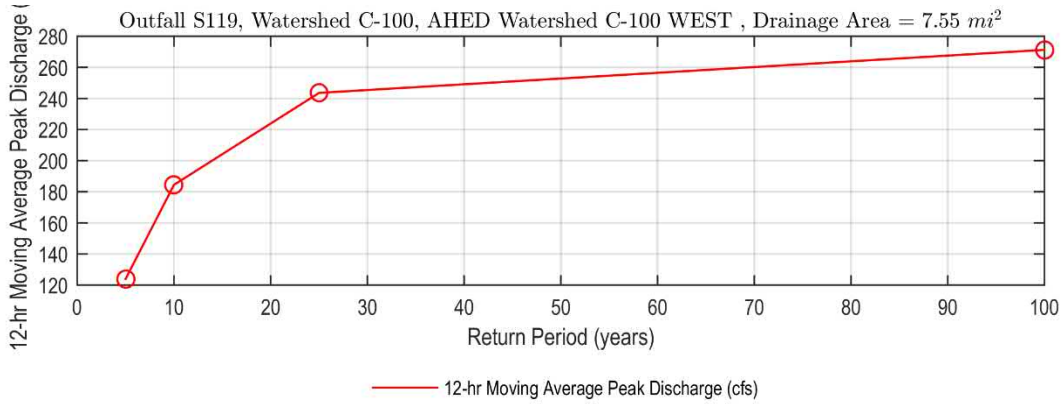


Figure 240 Structure S119 12-Hour Average Peak Discharge vs Return Period

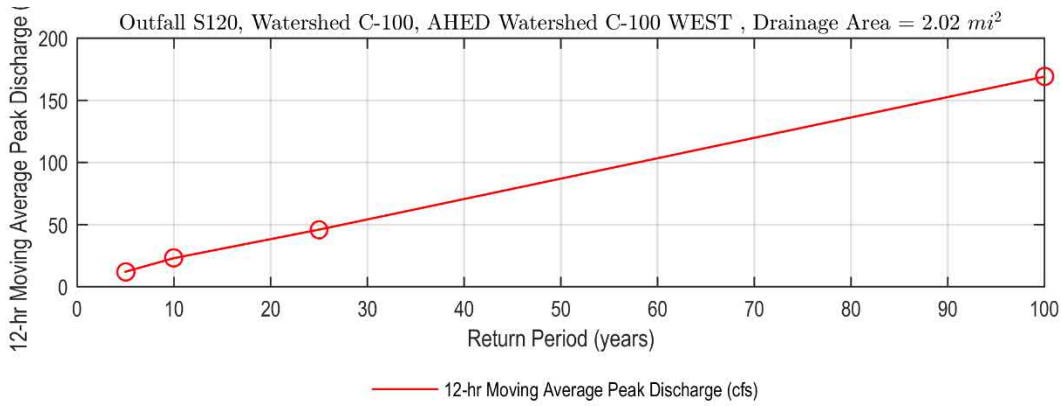


Figure 241 Structure S120 12-Hour Average Peak Discharge vs Return Period

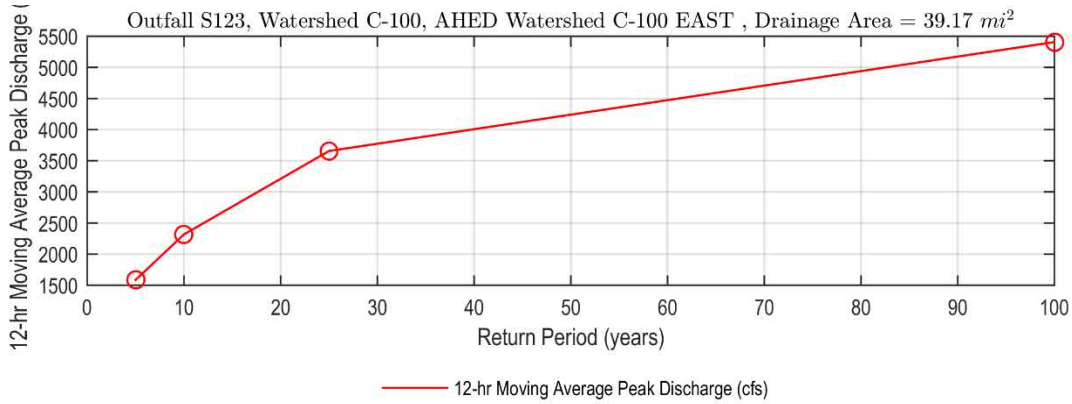


Figure 242 Structure S123 12-Hour Average Peak Discharge vs Return Period

The historic discharges were compared with design event discharges. Table 94 provides the peak discharges through the S123 structure as reported in the SFWMD DBHYDRO database for Station S123_S (DBKEY 64824).

Table 94 Observed Maximum Peak Discharges for S123 Structure

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
1980	12.48	1,038.53	76.68
1981	130.685	4,122.45	456.15
1982	278.571	3,627.25	675.41
1983	68.668	1,583.82	203.46
1984	5.588	688.829	54.66
1981	130.685	4,122.45	456.15
1982	278.571	3,627.25	675.41
1983	68.668	1,583.82	203.46
1984	5.588	688.829	54.66
1985	8.562	791.906	53.96
1986	16.675	1,365.97	80.93
1987	15.705	1,656.21	76
1988	33.635	3,565.99	176.04
1989	1.578	4,046.67	47.22
2000	62.416	2,839.34	276.12
2001	59.351	3,081.65	217.63
2002	57.413	1,733.21	187.56
2003	48.254	3,302.82	195.36
2004	35.927	2,063.50	145.59
2005	97.22	3,856.97	311.12
2006	30.381	2,573.13	169.74
2007	73.517	2,630.58	272.51
2008	59.333	2,275.13	204.92
2009	17.756	1,801.91	99.53
2010	36.981	3,680.92	172.26
2011	40.286	2,427.98	175.58
2012	75.173	2,121.23	231.34
2013	37.336	2,618.59	170.94
2014	0.934	936.949	18.84
2015	136.363	3,254.35	401.02
2016	41.751	3,313.06	207.85
2017	105.104	3,096.72	347.64
2018	30.488	2,249.46	151.04
2019	52.843	3,084.45	229.3
2020	47.793	2,734.10	196.94

The design criterion for the S123 Structure is 2,300 cfs, which is 40% of the Standard Project Flood (SPF). The Standard Project Flood is listed as 5000 cfs in the SFWMD Structure Book. The peak 100-year flow rate through the structure in the model is 5,908 cfs for instantaneous discharge

and 5,407 cfs for 12-hour moving average, which is higher than the SPF value, however it is within the 95% confidence limits of the Log Pearson III Extreme Value probability distribution.

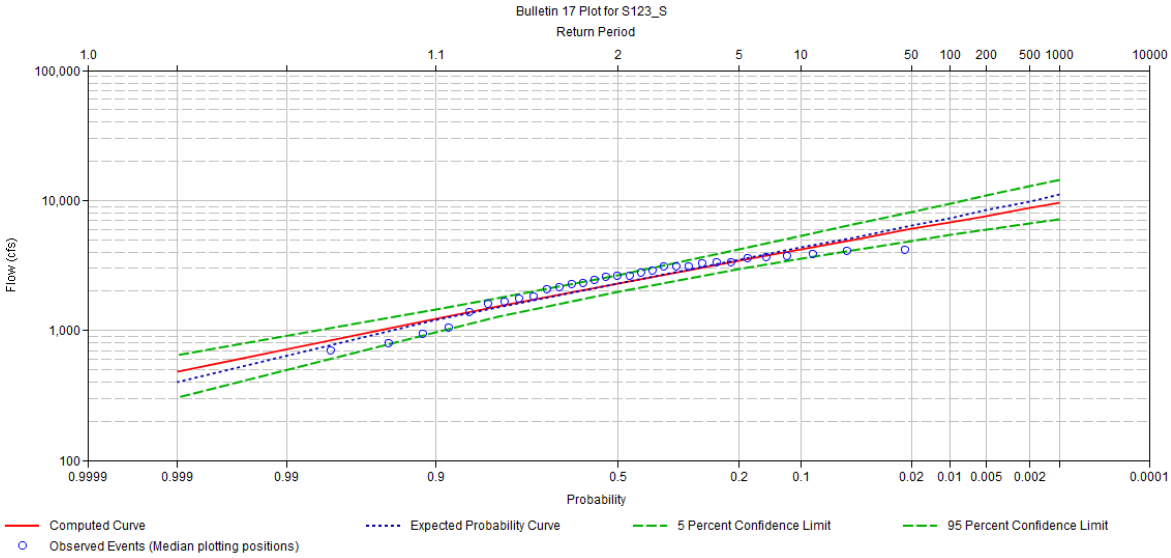


Figure 243 Log-Pearson III Analysis of Return Period Structure S123 Discharges

Two main factors are attributed to the higher computed discharge values at the structures. Contribution from increased imperviousness caused by development since the original design. The second factor is a difference in the design assumptions. The original design uses a steady state boundary of 1.7 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 6.5 ft NAVD followed by a very fast recess. For comparison, a simulation is provided for the two cases (100-yr Outfall Timeseries provided by SFWMD and Steady State boundary originally used as design criteria)

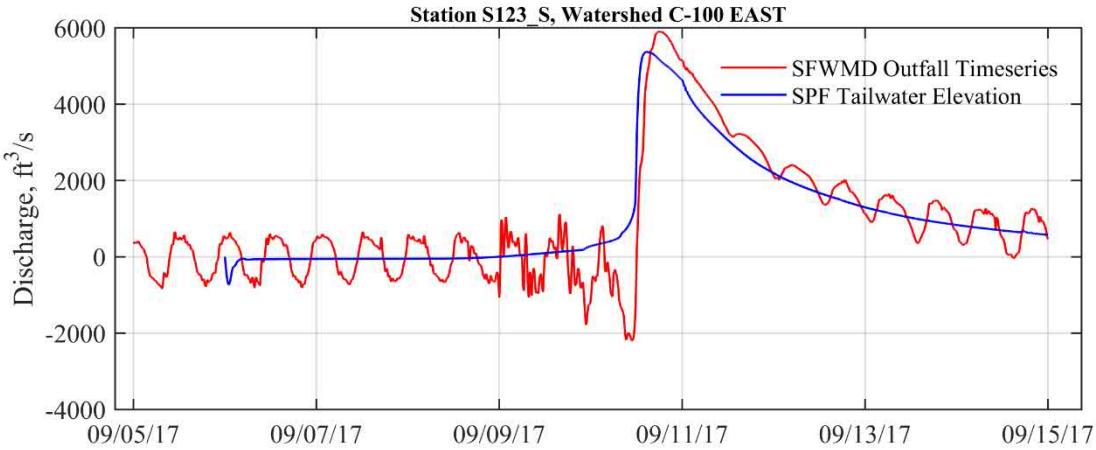


Figure 244 Comparison of Discharges at Structure S123 for SPF tail water and SFWMD Tailwater

5.3.5 C-100: PM5 Frequency of Flooding

Table 95 through Table 98 summarize the area of flooding shown in the C-100 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. Figures A-25 through A-28, A-33 through A-38, A-41 through A-44 in Appendix A Flood Extent and Duration Maps for Current Conditions show inundation depths for the entire watershed, urban, agricultural areas in the C-100 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively. The total area of the C-100 watershed is 25,068.83 acres (based on GIS data). The values in the tables are based on discretization to 100 m raster which results in total watershed area 24,809 acres with 23,616 acres urban land, 124 acres agricultural land and 1,703 acres wetlands.

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval.
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 95. Summary of the PM#5 Flood Inundation Area in Acres for the C-100 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	23554	22561	19749	13341
0.25 >= 0.50 ft	235	729	1834	3726
0.50 >= 0.75 ft	84	346	1023	2177
0.75 >= 1.00 ft	86	158	578	1557
1.00 >= 1.25 ft	44	104	319	1117
1.25 >= 1.50 ft	32	86	203	714
1.50 >= 1.75 ft	22	40	116	519
1.75 >= 2.00 ft	25	30	86	311
2.00 >= 2.25 ft	22	17	44	173
2.25 >= 2.50 ft	17	20	37	116
>= 2.50 ft	1320	1352	1453	1691
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 96. Summary of the PM#5 Flood Inundation in Acres for the Urban Areas of C-100 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	22926	21992	19321	13104
0.25 >= 0.50 ft	230	680	1740	3605
0.50 >= 0.75 ft	74	319	986	2098
0.75 >= 1.00 ft	69	143	531	1485
1.00 >= 1.25 ft	42	91	301	1087
1.25 >= 1.50 ft	17	74	195	682
1.50 >= 1.75 ft	15	27	89	492
1.75 >= 2.00 ft	15	20	84	294
2.00 >= 2.25 ft	15	10	37	156
2.25 >= 2.50 ft	17	15	27	111
>= 2.50 ft	195	245	304	502
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 97. Summary of the PM#5 Flood Inundation in Acres for the Agricultural Areas of the C-100 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	124	109	86	62
0.25 >= 0.50 ft	0	7	10	12
0.50 >= 0.75 ft	0	7	7	10
0.75 >= 1.00 ft	0	0	12	2
1.00 >= 1.25 ft	0	0	7	10
1.25 >= 1.50 ft	0	0	0	7
1.50 >= 1.75 ft	0	0	0	7
1.75 >= 2.00 ft	0	0	0	10
2.00 >= 2.25 ft	0	0	0	2
2.25 >= 2.50 ft	0	0	0	0
>= 2.50 ft	0	0	0	0
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 98. Summary of the PM#5 Flood Inundation in Acres for the Wetland Areas of the C-100 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	1075	954	709	418
0.25 >= 0.50 ft	32	89	158	141
0.50 >= 0.75 ft	12	35	79	116
0.75 >= 1.00 ft	37	20	59	119
1.00 >= 1.25 ft	10	22	27	69
1.25 >= 1.50 ft	15	20	32	72
1.50 >= 1.75 ft	15	22	40	57
1.75 >= 2.00 ft	10	20	12	30
2.00 >= 2.25 ft	10	12	7	30
2.25 >= 2.50 ft	2	5	12	25
>= 2.50 ft	484	504	566	628
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Figures A-25 through A-28, A-33 through A-38, A-41 through A-44 in Appendix A Flood Extent and Duration Maps for Current Conditions are flood depth maps corresponding to Table 95 through Table 98 and show the flood extent in the entire watershed and the agricultural, urban and wetland areas of the C-100 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

Canal	LOS Rating
Areas draining to C-100	A comparison of land surface topography elevations and the peak stage in the C-100 canal for 25-year and 100-year design storm revealed that a significant portion of the flooded area, mostly urban, is higher than the predicted peak stage for both design storms. Flood depth oscillated in the range of 0.25-1 feet, where the maximum values are found next to the canal.
Areas draining to C-100A	The areas most upstream portion of the canal show <0.75 feet of flooding for 100-year design storm. C-100A canal from PM1 has 25-year LOS. Therefore, the flooding in the watershed can be attributed to deficiencies of the secondary and tertiary canals; or other reasons. At junction of canals C-100A and SW 70 Ave Canal A, flooding inundation depth is high - greater than 2.25 feet.
Areas draining to C-100B	Urban areas that contribute to C-100B show flooding of 1.5+ feet for 25 and 100-year design storms, especially in zones north to the canal C-100B. For 5-year and 10-year design storms, the flooding is less than 20 acres (approximately).
Areas draining to C-100C	Flood inundation areas are in the northern section of the canal, with inundation depth higher than 2.25 feet in areas next to the canal. The urban area in between SW 128th and SW 136th St. has considerable amount of flooding for 100-year design storms. This area shows minimal flooding impact for the 5, 10, and 25-year design events.

At the watershed level, C-100 Watershed has a 25-year level of service which would indicate that flooding at the watershed level is not significant for smaller modeled design storms.

5.3.6 C-100: PM6 Duration of Flooding

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S123_H (Figure 245) to return to target reference stage, which was defined based on the average prior to the storm event, Average S123_H (period of 9/1-9/8) = 1.54 ft NAVD 88.

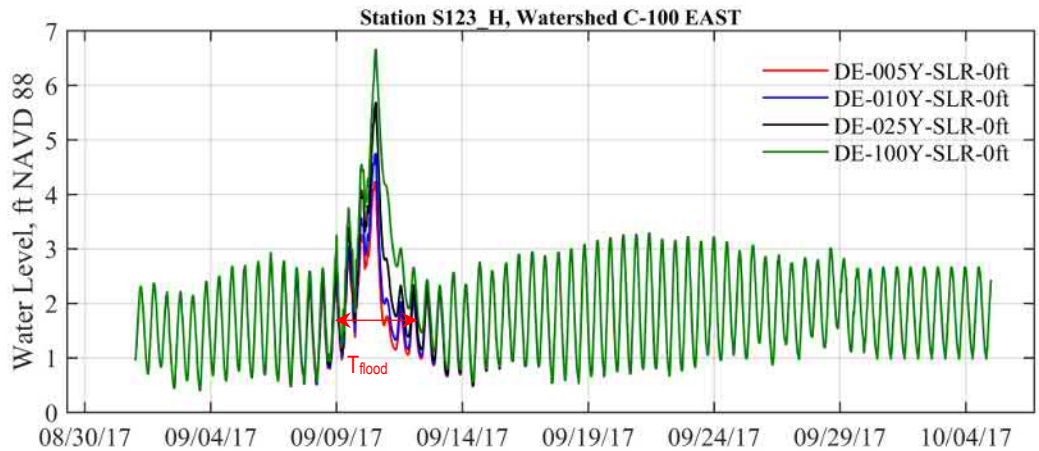


Figure 245 Flood Duration Period in Canal C-100

The flood duration for 5-yr, 10-yr, 25-yr and 100-yr are shown in the table below:

Table 99 Flood Duration at Headwater of Structure S123

Duration of Flooding (hr)	5-Year Time (hr)	10-Year Time (hr)	25-Year Time (hr)	100-Year Time (hr)
S123_H	16.08	17.17	18.75	31.33

Table 99 shows the duration of time taken for the water levels in the C-100 Watershed canals to return to baseflow for the entire watershed, and then for the urban, agricultural and wetland areas, respectively. SMD FPLOS model POS was long enough to ensure the recession part of the hydrograph was captured completely, so duration of flooding was estimated well.

Table 100 through Table 103 provide a summary of the flood duration for each time interval.

- The first row (0.1 >= 1 hr) and the following rows up to and including (240 >= 360 hr) of the summary tables represent areas for which the flood duration is within the specified interval.
- The last row (>=360 hr) are the areas flooded with flood duration greater than 360 hr.
- The severity of flooding in terms of duration is determined based on the flooded areas reported at each successive row.
- The severity of flooding is proportional to the increase of time interval.

Table 100. Summary of PM#6 Flood Duration Flood Inundation Area in Acres for C-100

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	5	54	245	1043
1 - 4 hr	30	141	450	1018
4 - 8 hr	59	200	467	924
8 - 12 hr	32	168	400	731
12 - 24 hr	141	457	1327	2483
24 - 48 hr	151	279	998	3146
48 - 96 hr	86	205	390	1238
96 - 168 hr	35	54	84	156
168 - 240 hr	25	25	22	42
240 - 360 hr	37	25	27	37
> 360 hr	623	640	647	647
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 101. Summary of PM#6 Flood Duration Area in Acres for the Urban Areas of C-100

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	2	49	242	1025
1 - 4 hr	30	131	430	991
4 - 8 hr	59	188	452	912
8 - 12 hr	32	156	385	724
12 - 24 hr	131	423	1226	2392
24 - 48 hr	131	252	937	2987
48 - 96 hr	64	173	346	1119
96 - 168 hr	15	22	44	119
168 - 240 hr	15	17	15	15
240 - 360 hr	20	20	17	27
> 360 hr	190	193	198	198
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 102. Summary of PM#6 Flood Duration Area in Acres for the Agricultural Areas of C-100

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	0	2	0	0
1 - 4 hr	0	2	2	5
4 - 8 hr	0	2	5	7
8 - 12 hr	0	2	2	2
12 - 24 hr	0	5	20	10
24 - 48 hr	0	0	7	15
48 - 96 hr	0	0	0	22
96 - 168 hr	0	0	0	0
168 - 240 hr	0	0	0	0
240 - 360 hr	0	0	0	0
> 360 hr	0	0	0	0
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Table 103. Summary of PM#6 Flood Duration Area in Acres for the Wetlands Areas of C-100

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	2	12	10	17
1 - 4 hr	0	12	40	15
4 - 8 hr	12	15	32	32
8 - 12 hr	2	27	37	20
12 - 24 hr	32	54	146	178
24 - 48 hr	32	44	109	304
48 - 96 hr	32	52	72	138
96 - 168 hr	25	40	49	59
168 - 240 hr	10	10	10	32
240 - 360 hr	15	7	10	10
> 360 hr	465	474	479	479
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-100 covers 25,069 acres, or 39.170 square miles				

Figures A-29 through A-32, A-37 through A-42, A-45 through A-48 in Appendix A Flood Extent and Duration Maps for Current Conditions are flood duration maps corresponding to Table 100 through Table 103 and showing the flood duration in the entire watershed and the agricultural, urban and wetland areas of the C-100 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

5.3.7 LOS Rating of C-100 Watershed for Current Conditions

The C-100 Watershed has been assigned a 5-year FPLOS rating for the current hydrologic conditions. For this overall rating, weight was placed on PM1, as the primary canals in this watershed collectively are expected to contain the 5-year storm event within its MIKE 1D right and left banks as modeled.

5.4 C-102 Watershed Flood Protection Level of Service

There are four SFWMD water control structures in the C-102 Watershed: S21A, S165, S194 and S195. Figure 246 shows the inflows and outflows in this watershed, and Table 104 lists the design parameters of these water control structures.

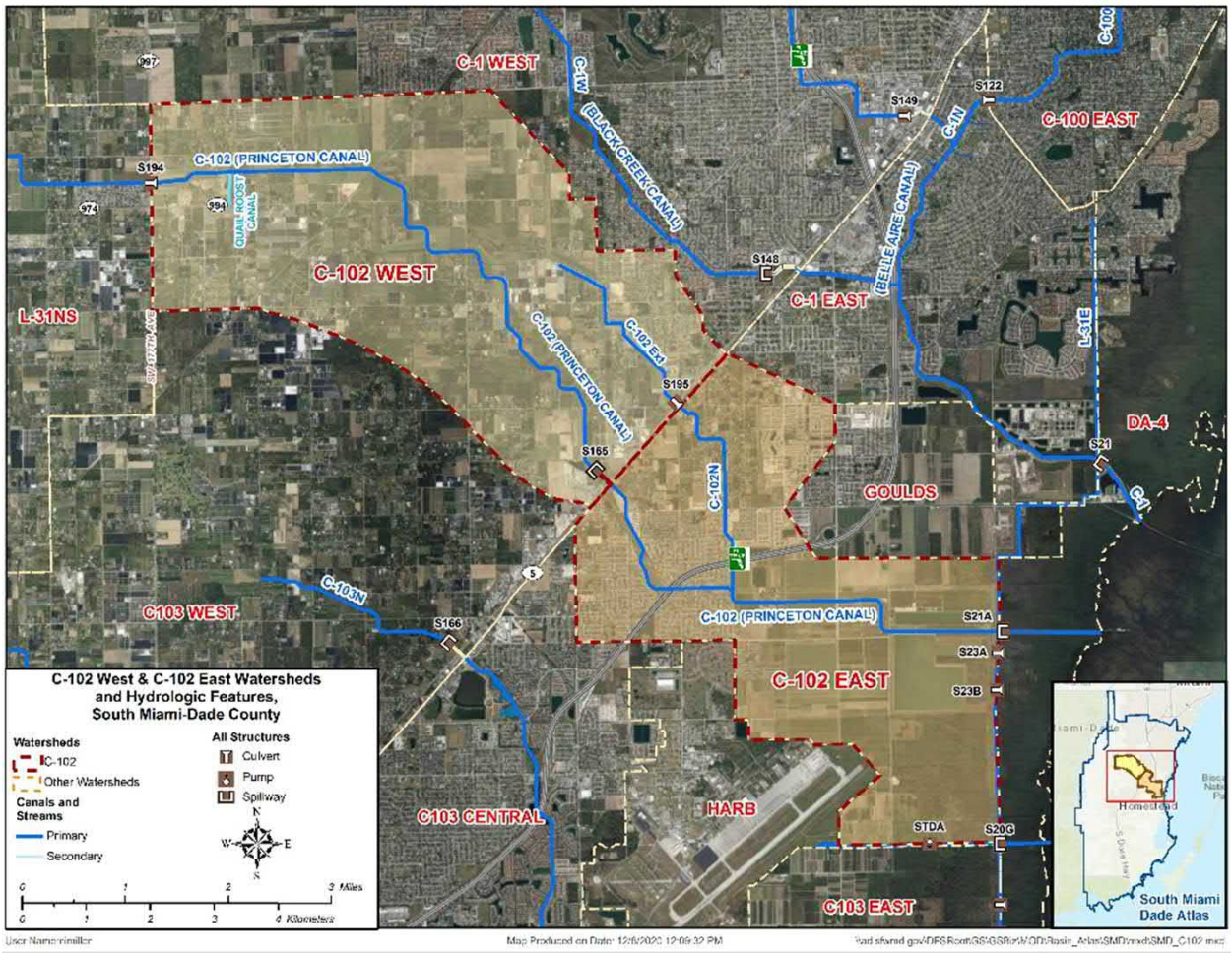


Figure 246. Drainage Network in C-102 Watershed (Source: SFWMD South Miami Dade Atlas)

Watershed C-102 has 5 water control structures including S194, S195, S21A, S165, S23-A and S23-B.

- Structure S194: This structure can provide supplemental water transfer to Eastern Dade County from Water Conservation Area 3. The structure can also be operated to alleviate flood conditions to the west when flood conditions will not be created to the south and east in the C-102 basin. Structure S194 is closed for the storm event. Canal C-102 is connected to canal L-31N at chainage 20794.5 ft, therefore the flow direction is defined by canal stages at L-31N and drainage discharge in the reach between S194 headwater and the connection to L-31N.

- Structure S195: This structure maintains optimum upstream water control stages in Canal 102N; it passes the design flood (40% of the Standard Project Flood) without exceeding the upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels.
- Structure S21A: This structure is operated to maintain an optimum headwater elevation which varies seasonally from a low during the dry season of 1.4 to a maximum during the flood season of 2.2 feet (NGVD 29), when sufficient water is available to maintain this level. This structure maintains optimum water control stages upstream in Canal 102; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and discharge velocities to non-damaging levels; and it prevents saline intrusion during periods of high flood tides.
- Structure S165 This structure maintains optimum upstream water control stages the C-102 Canal; it passes the design flood (40 percent of the Standard Project Flood) without exceeding upstream flood design stage and restricts downstream flood stages and channel velocities to non-damaging levels. The structure is modeled as MIKE 1D underflow gate.
- Structures S23A and S23B are culverts on Levee L-31E, no information is available for culvert operation.

Table 104. Design Parameters of Water Control Structures in the C-102 Watershed Primary Network (Source: SFWMD South Miami Dade Atlas)

<table>
<tr><th>Structure</th><th>Design HW/TW Stage (ft NAVD88)</th><th>Optimum HW Stage (ft NAVD88)</th><th>Design Q (CFS)</th><th>Operations</th></tr>
<tr><td>S21A</td><td>0.55 HW/
0.05 TW</td><td>0.45 (Wet Season)
-0.35 (Dry Season)</td><td>1,330</td><td>Maintain seasonal optimum HW elevation
<u>High range</u> (April 30th to October 15th):0.25 – 0.65 ft NAVD88
Low range (October 15th to April 30th): -0.55 - -0.15 ft NAVD88</td></tr>
<tr><td>S23 A & B</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>S165</td><td>4.05 HW/
3.05 TW</td><td>3.95</td><td>450</td><td>• When HW rises to 4.35 ft NAVD88, gate opens.
• When HW is 3.95 ft NAVD88, gate is stationary.
• When HW falls to 3.55 ft NAVD88, the gate closes.
When the TW rises within 0.2 ft of HW, the gate closes to prevent backflow.</td></tr>
<tr><td>S194</td><td>2.35 HW/
2.15 TW</td><td>N/A</td><td>190</td><td>The ERTP operation criteria (16 April 2012) is listed below.
<table>
<tr><th>No WCA-3A Regulatory Releases to SDCS or Shark Slough.</th><th>WCA-3A Regulatory Releases to SDCS</th></tr>
<tr><td>Open 3.95 ft NAVD88</td><td>Open 3.35 ft NAVD88</td></tr>
<tr><td>Close 3.25 ft NAVD88</td><td>Close 2.95 ft NAVD88</td></tr>
</table></td></tr>
<tr><td>S195</td><td>4.05 HW/
3.25 TW</td><td>3.95</td><td>180</td><td>Maintain a headwater elevation of 3.95 ft NAVD88</td></tr>
</table>

5.4.1 C-102: PM1 Maximum Stage in Primary Canals

For PM1, the LOS rating of canals in C-102 watershed is shown in Table 105. Figure 247 through Figure 248 shows the canal water surface profiles of C-102 system of canals.

Table 105. LOS Rating of Canals in C-102 Watershed for PM1

Canal	LOS Rating
C-102	Upstream of S194: 5-year LOS Downstream of S194 & upstream of S165/ SR-5: 10-year LOS Downstream of SR-5: 25-year LOS
C-102N	Upstream of US-1: 100-year LOS Downstream of US-1: 100-year LOS (Except for small section near S195

Table 106 List of Landmarks and Design Water Elevations in C-102, C-102N.

Landmark	Canal	Top Left Bank ft NAVD 88	Top Right Bank ft NAVD88	5-yr ft NAVD 88	10-yr ft NAVD 88	25-yr ft NAVD 88	100-yr ft NAVD 88
Structure S194	C-102	7.1	10.0	3.10	3.83	6.29	7.99
SR-997 Crossing	C-102	7.1	10.0	3.10	3.83	6.29	7.99
Structure S-165	C-102	17.3	19.0	2.49	2.99	3.92	5.12
SR-5 Crossing	C-102	13.3	13.3	2.46	2.95	3.82	4.81
C-102N Junction	C-102	17.9	15.8	2.46	2.94	3.80	4.75
Structure S195	C-102N	7.8	7.7	2.48	2.97	3.82	6.91
US-1 Crossing	C-102N	6.4	6.8	2.47	2.96	3.81	4.94
SR-821 Crossing	C-102N	6.4	6.8	2.45	2.93	3.78	4.72

The overall rating of C-102 is 10-yr FPLOS.

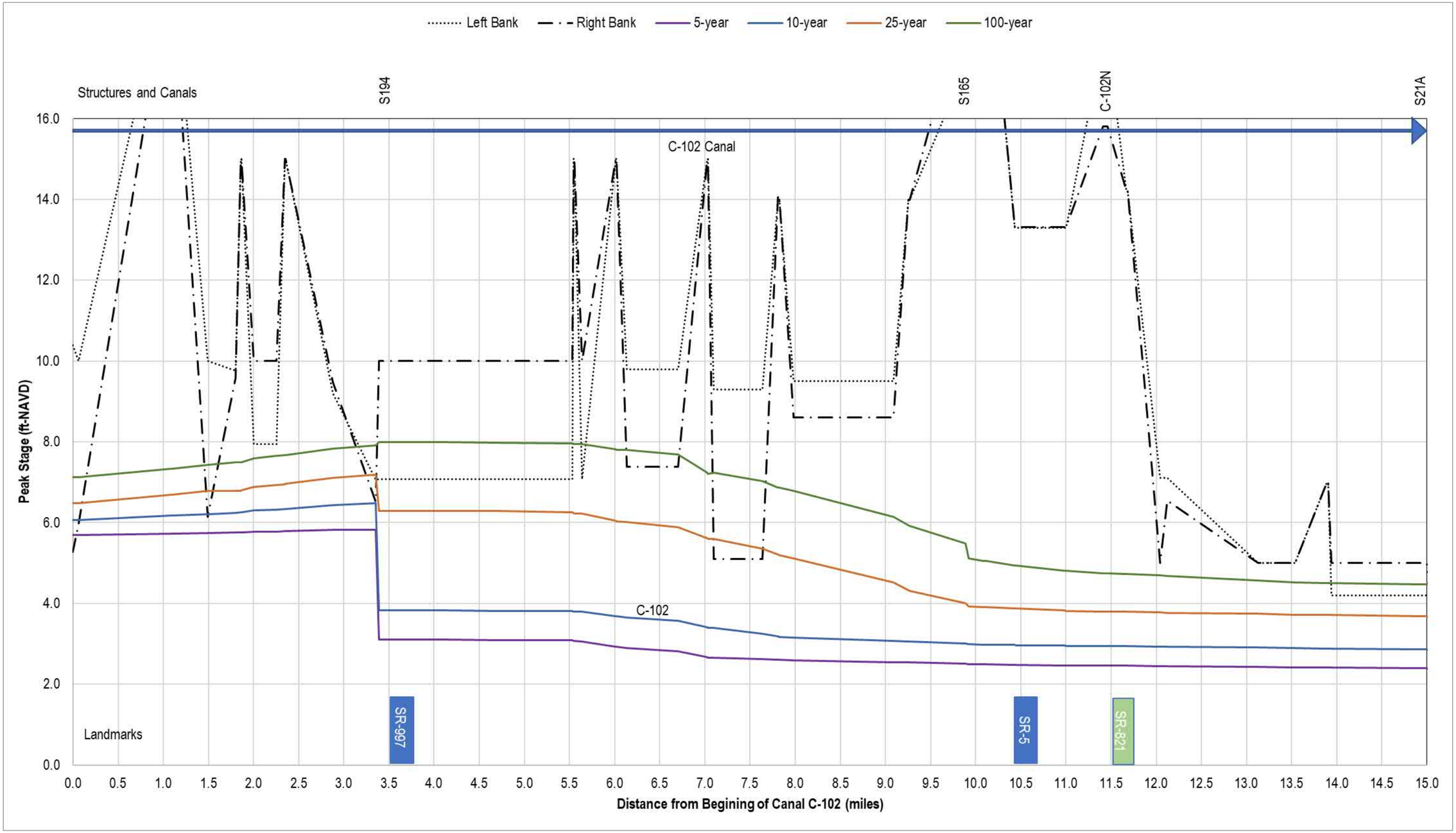


Figure 247. Profile of Peak Stages in Canal C-102

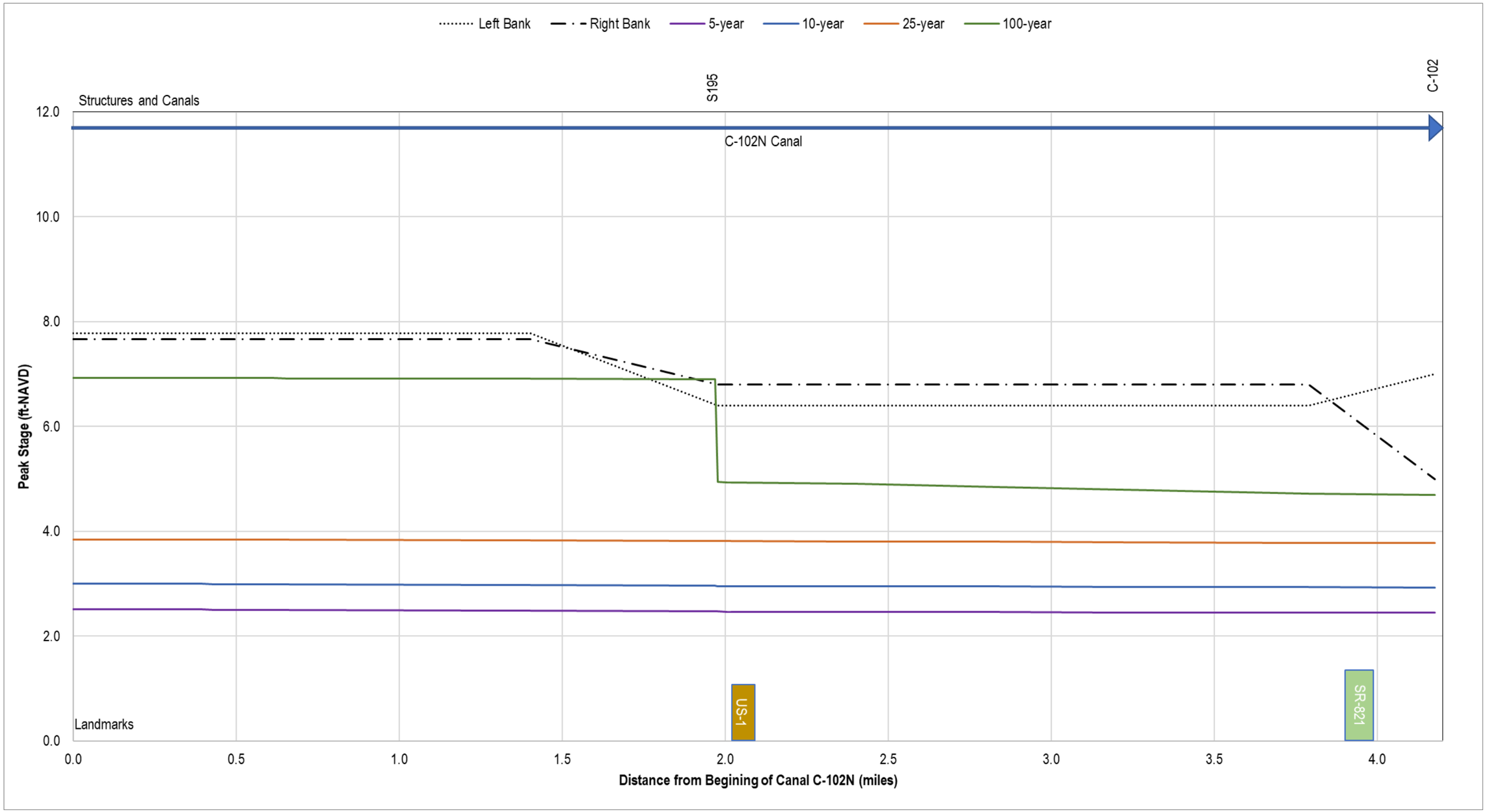


Figure 248. Profile of Peak Stages in Canal C-102N

The results of this analysis showed that the majority of the C-102 system of canals can convey the 25-year event without overflowing; some sections can convey up to the 100-year event. However, there are a few sections of which canals were identified that overflow during the 10-year flood event for a short period of time. Almost at the headwaters of the C-102 Canal, water overflowed during a 5-year event. The LOS was revised to refer to 5-yr, one of the initial considerations was that the canal is overtopped outside of the urban boundary (where agricultural and natural areas are the majority of the canals).

5.4.2 C-102: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 107 contains information on the discharges and the drainage areas in the C-102 Watershed. The maximum daily discharge capacity of the C-102 Watershed through S21A is a function of the drainage from the entire watershed. The discharge hydrographs in the figures below are area-weighted by upstream drainage areas for the 72-hour 5-year, 10-year, 25-year, and 100-year design storms. The peak 12-hour moving average discharge per square mile is shown in Figure 249. The inland structures S165 and S195 represent the inter-watershed movement and flow through the structures; the flows across the watersheds are shown in Figure 249 and Figure 250. The Allowable ERP Discharges are exceeded for structure S21A.

Table 107. C-102 Watershed Drainage Discharge Capacity (cfs/sq. mi)

Structure	Watershed Model	AHED Name	Total Area (mi²)	5-yr	10-yr	25-yr	100-yr	Allowable 10-yr ERP
S165	C-102	C-102 WEST	11.12	16.34	23.52	44.11	64.26	49.55
S195	C-102	C-102 WEST	2	18.61	20.57	28.13	96.78	49.55
S21A	C-102	C-102 EAST	23.49	49.91	59.31	76.08	105.51	49.55

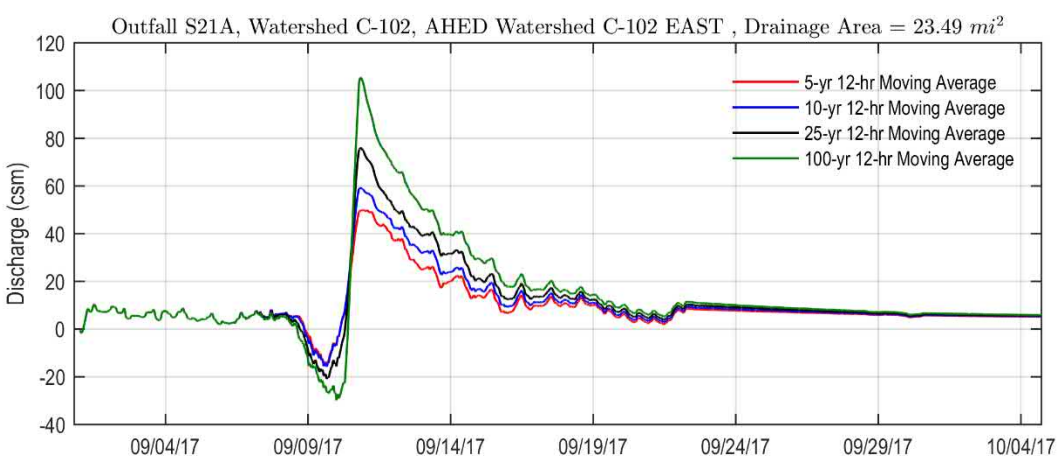


Figure 249. Drainage Discharge Capacity at Structure S21A

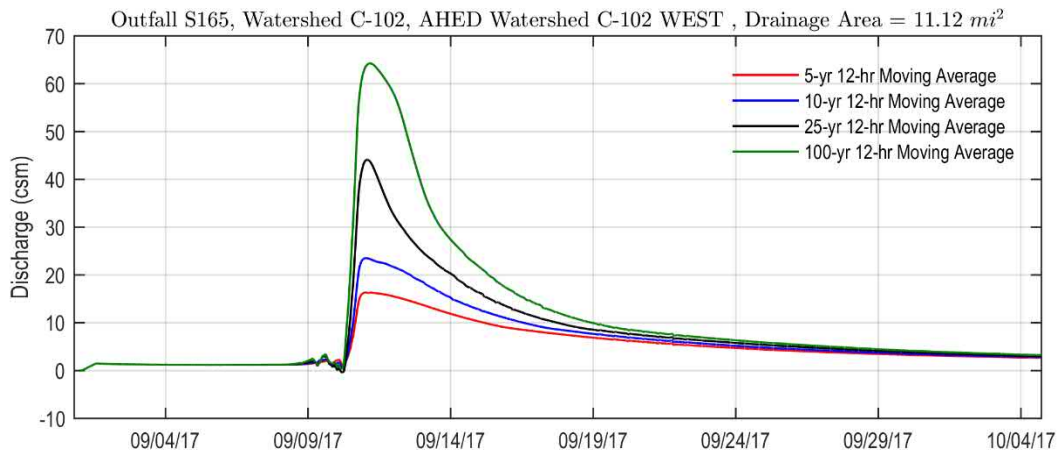


Figure 250. Area Weighted Discharge Capacity of S165 Structure

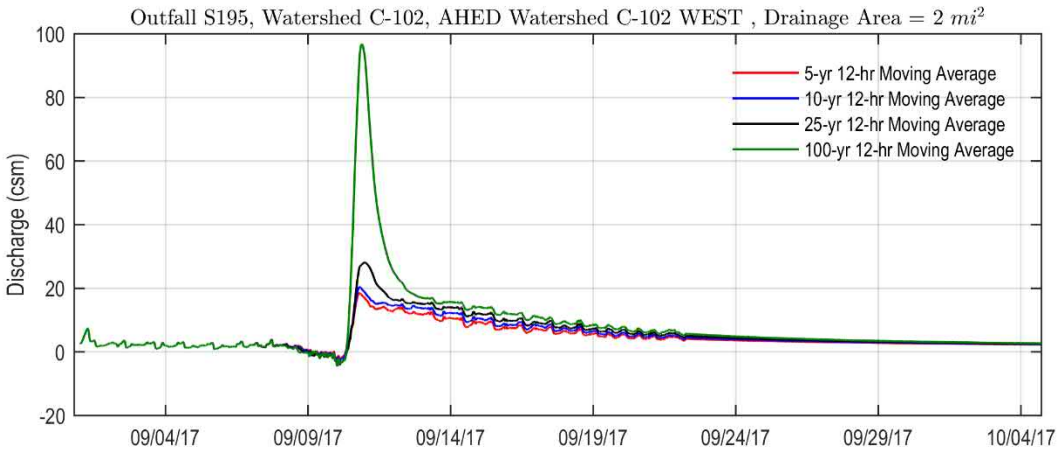


Figure 251. Drainage Discharge Capacity at Structure S195

5.4.3 C-102: PM3 Structure Performance

The design parameters of Structure S21A are listed in Table 108.

Table 108 Design parameters of Structure S21

Structure	S123
Design Discharge	1330 cfs for 40% SPF
SPF Discharge	2500 cfs
Design Headwater Elevation	2.1 ft NGVD 29
Design Tailwater Elevation	1.6 ft NGVD 29
SPF Headwater Elevation	3.0 ft NGVD 29
SPF Tailwater Elevation	2.0 ft NGVD 29
Optimum Headwater	2.0 to 1.2
Optimum Tailwater	Tidal

Figure 252 shows instantaneous values for the 25-year and 100-year design storms, respectively.

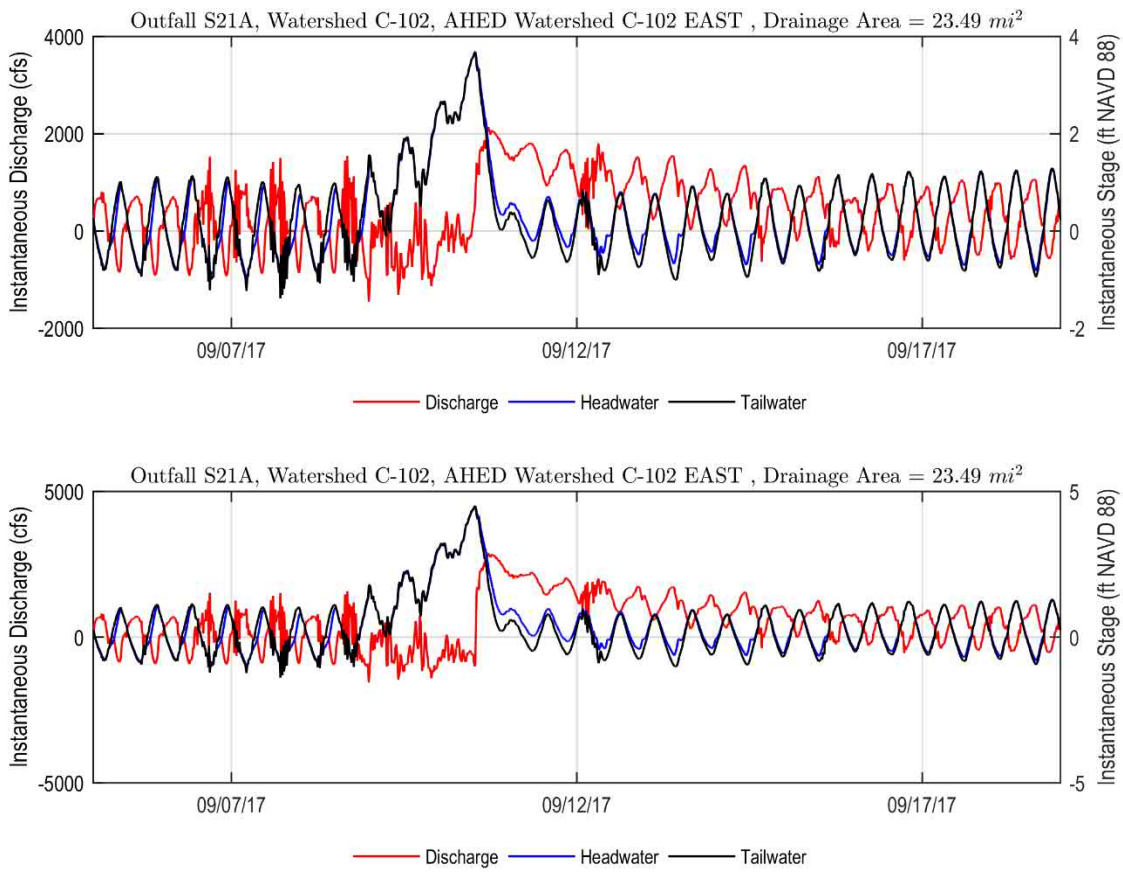


Figure 252 Structure S21A Instantaneous Conditions for 25-yr and 100-yr Design Events

Table 109. Summary of the Instantaneous Peak Conditions at S21A

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 5:15 PM	9/10/17 5:15 PM	9/10/17 5:15 PM	9/10/17 5:15 PM
Headwater (ft)	1.02	1.30	1.79	2.39
Discharge (cfs)	1736.08	1933.79	2276.49	2868.20
Tailwater (ft)	0.77	1.01	1.41	1.83

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:30 PM	9/10/17 12:35 PM	9/10/17 12:45 PM	9/10/17 12:45 PM
Headwater (ft)	2.41	2.88	3.69	4.48
Discharge (cfs)	670.21	731.71	741.57	-652.94
Tailwater (ft)	2.38	2.85	3.66	4.50

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:30 PM	9/10/17 12:30 PM	9/10/17 12:30 PM	9/10/17 12:30 PM
Headwater (ft)	2.41	2.88	3.69	4.47
Discharge (cfs)	670.21	670.29	541.33	-904.96
Tailwater (ft)	2.38	2.85	3.67	4.50

Table 110. Summary of the Instantaneous Peak Conditions at S165

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 9:35 PM	9/10/17 10:00 PM	9/11/17 12:30 AM	9/11/17 2:15 AM
Headwater (ft)	1.23	1.90	3.78	5.29
Discharge (cfs)	195.49	270.37	511.18	719.09
Tailwater (ft)	0.91	1.47	3.07	4.41

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:00 PM	9/10/17 1:00 PM	9/10/17 1:15 PM	9/10/17 2:35 PM
Headwater (ft)	2.52	3.02	4.02	5.49
Discharge (cfs)	53.51	76.48	215.00	502.32
Tailwater (ft)	2.50	3.00	3.93	5.12

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:00 PM	9/10/17 1:00 PM	9/10/17 1:05 PM	9/10/17 2:25 PM
Headwater (ft)	2.52	3.02	4.01	5.48
Discharge (cfs)	53.51	76.48	193.43	490.51
Tailwater (ft)	2.50	3.00	3.93	5.13

Table 111. Summary of the Instantaneous Peak Conditions at S195

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/1/17 1:25 AM	9/1/17 1:25 AM	9/1/17 1:25 AM	9/10/17 8:05 PM
Headwater (ft)	0.40	0.40	0.40	6.30
Discharge (cfs)	93.66	93.66	93.66	263.26
Tailwater (ft)	0.27	0.27	0.27	3.89

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:05 PM	9/10/17 1:05 PM	9/10/17 1:10 PM	9/10/17 5:45 PM
Headwater (ft)	2.49	2.97	3.82	6.89
Discharge (cfs)	7.88	8.01	13.87	187.05
Tailwater (ft)	2.47	2.96	3.79	4.15

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:00 PM	9/10/17 1:00 PM	9/10/17 1:00 PM	9/10/17 1:30 PM
Headwater (ft)	2.48	2.97	3.81	5.07
Discharge (cfs)	4.73	3.54	-2.46	41.79
Tailwater (ft)	2.48	2.96	3.81	4.94

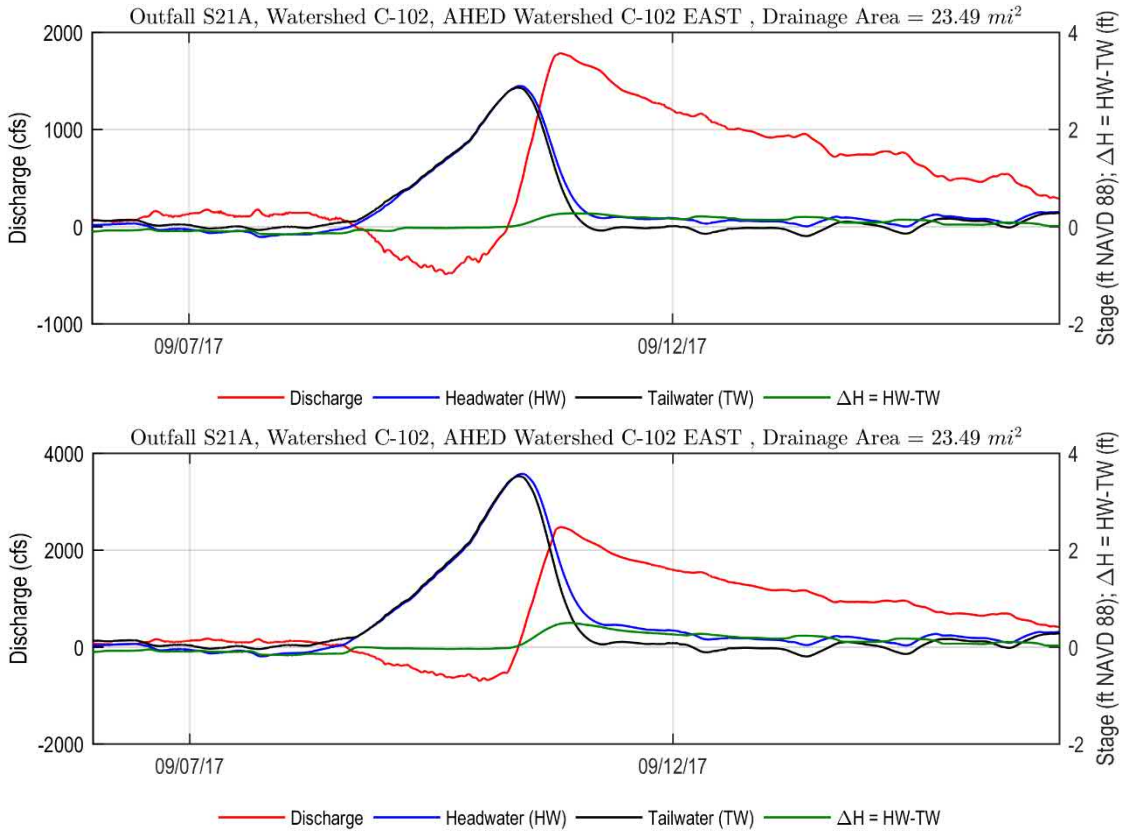


Figure 253. Tidally Averaged (12-hour) Discharge, Stage and Head Differential at S21A Structure - 25-yr and 100-yr Design Events

Table 112 Summary of the 12-hr Moving Average Conditions at Structures in C-102 Watershed

Structure	Watershed Model	AHED Name	Total Area (mi2)	Design Event	Peak Tailwater(ft NAVD 88)	Disdcharge (cfs)	Headwater (ft NAVD 88) at Peak TW	Head Differential (ft)
S165	C-102	C-102 WEST	11.120	5-yr	0.863	182	1.463	0.600
				10-yr	1.457	262	1.864	0.407
				25-yr	2.943	491	3.629	0.686
				100-yr	4.308	715	5.201	0.893
S195	C-102	C-102 WEST	2.000	5-yr	0.942	37	1.077	0.136
				10-yr	1.300	41	1.464	0.164
				25-yr	1.548	56	1.824	0.277
				100-yr	3.605	194	5.742	2.137
S21A	C-102	C-102 EAST	23.490	5-yr	0.043	1172	0.172	0.129
				10-yr	0.588	1393	0.755	0.167
				25-yr	0.889	1787	1.155	0.266
				100-yr	1.192	2478	1.677	0.485

5.4.4 C-102: PM4 Watershed Peak Storm Runoff

PM4 represents discharge at tidal structure S21A from the 12-hour moving average of the design storm on the C-102 Canal. These discharge hydrographs, particularly the peak discharge, will be compared with the peak discharge under future sea level rise scenarios when executed.

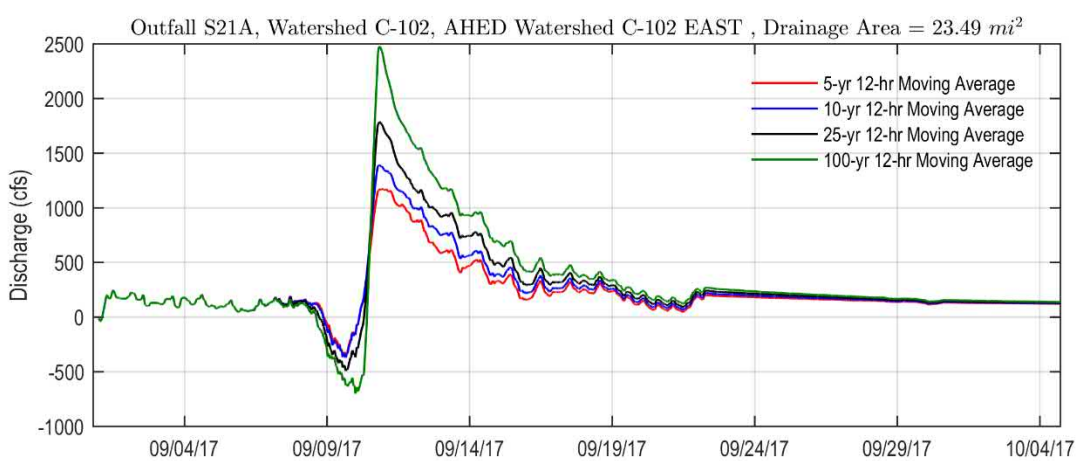


Figure 254. 12-hr Moving Average of Instantaneous Flows at S21A for all Design Events

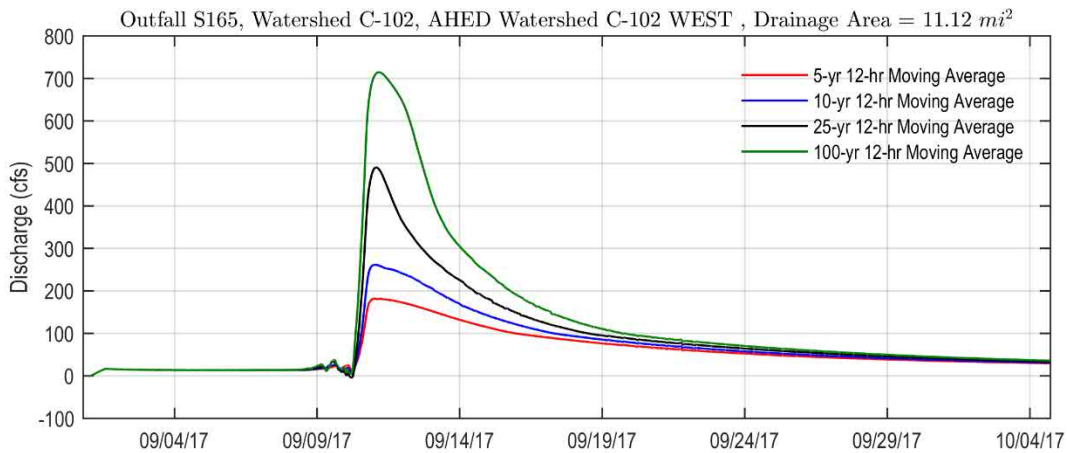


Figure 255. 12-hr Moving Average of Instantaneous Flows at S165 for all Design Events

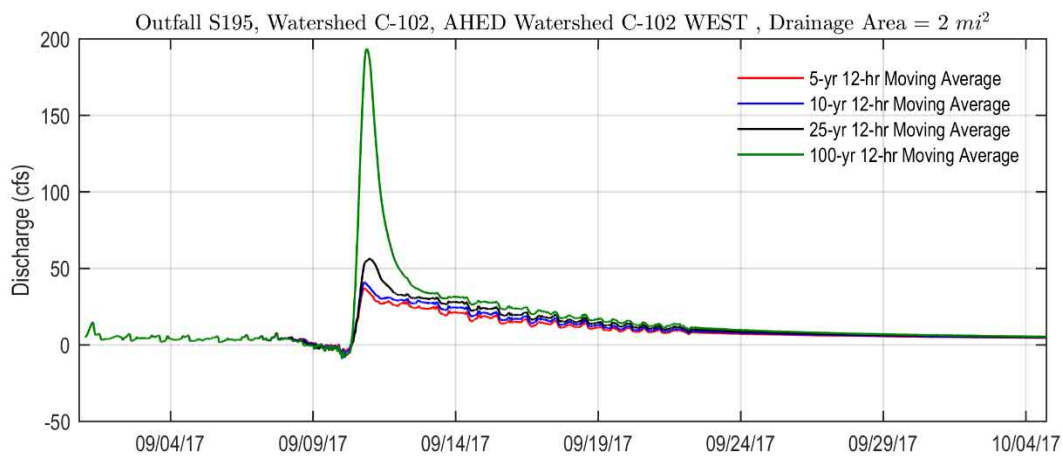


Figure 256. 12-hr Moving Average of Instantaneous Flows at S195 for all Design Events

The historic discharges were downloaded and compared with computed data using the USGS methodology for watershed discharges and Log Pearson III analysis for extreme events. First, the peak discharges through structure S21A were determined for the period of record. Table 113 provides the peak discharges through the S21A Structure as reported in the SFWMD DBHYDRO database for S21A-S (DBKEY 65050). The flows were significantly higher in the 1970's and early 1980's indicating a significantly different flow regime. The data has been truncated to include data after 1984.

Table 113 Observed maximum peak discharges for S21A_S Structure (DBKEY 65050)

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
1974	63.354	2,875.59	167.86
1975	29.078	1,488.12	78.4
1976	77.993	1,581.08	123.25
1977	114.66	1,958.35	172.76

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
1978	84.703	1,701.78	127.32
1979	500.273	3,334.62	550.23
1980	153.575	3,892.26	212.15
1981	116.812	3,203.16	293.55
1982	186.556	3,533.83	299.42
1983	254.435	3,544.05	434.62
1984	115.366	2,164.65	157.12
1985	91.81	1,636.16	158.23
1986	140.418	1,560.59	207.39
1987	119.227	1,689.26	176.59
1988	148.112	1,897.34	252.14
1989	65.747	1,397.42	158.61
1990	10.174	3,321.80	107.71
1991	90.444	2,625.52	289.28
1992	47.284	2,561.66	250.21
1993	40.285	1,919.08	173.46
1994	68.408	2,358.15	307.11
1995	26.649	5,494.03	396.07
1996	99.601	1,713.63	297.55
1997	57.702	2,674.48	248.14
1998	26.577	2,042.85	304.87
1999	91.043	3,436.60	296
1990	91.855	1,191.93	176.37
1991	159.289	1,492.42	227.83
1992	152.809	2,069.70	270.08
1993	146.145	1,574.61	188.66
1994	164.919	1,758.33	226.91
1995	169.802	1,586.78	235.14
1996	131.451	1,057.18	180.69
1997	125.014	2,037.66	218.07
1998	119.016	1,279.13	190.76
1999	161.436	2,856.52	262.13
2000	157.099	2,371.63	270.89
2001	156.614	2,936.29	239.68
2002	184.001	1,667.87	255.27
2003	167.13	1,588.69	220.98
2004	138.111	1,553.24	208.58
2005	203.133	3,008.11	318.68
2006	108.719	1,297.81	161.54
2007	111.178	1,381.72	178.37

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
2008	99.697	1,562.14	177.94
2009	97.073	997.434	157.75
2010	121.578	1,099.40	172.77
2011	97.117	1,420.21	163.65
2012	132.424	1,120.35	175.66
2013	161.047	1,172.84	184.8
2014	139.239	1,665.51	165.77
2015	146.483	1,582.25	197.92
2016	205.036	1,212.60	200.59
2017	185.855	2,918.72	273.81
2018	151.747	1,285.86	171.19
2019	170.885	1,122.73	190.47
2020	195.499	1,293.31	232.41

The Log Pearson III probability distribution parameters were determined using the HEC-SPS software. Confidence intervals of 5% and 95% were used as criteria of fitting computed discharges as function of return frequencies.

The design criterion for the S21A Structure is 1330 cfs, which is 40% of the Standard Project Flood. The Standard Project Flood is listed as 2,500 cfs in the SFWMD Structure Book. The peak 100-year flow rate through the open structure in the model is 2,868 cfs for instantaneous discharge and 2,477 cfs for 121-hour moving average.

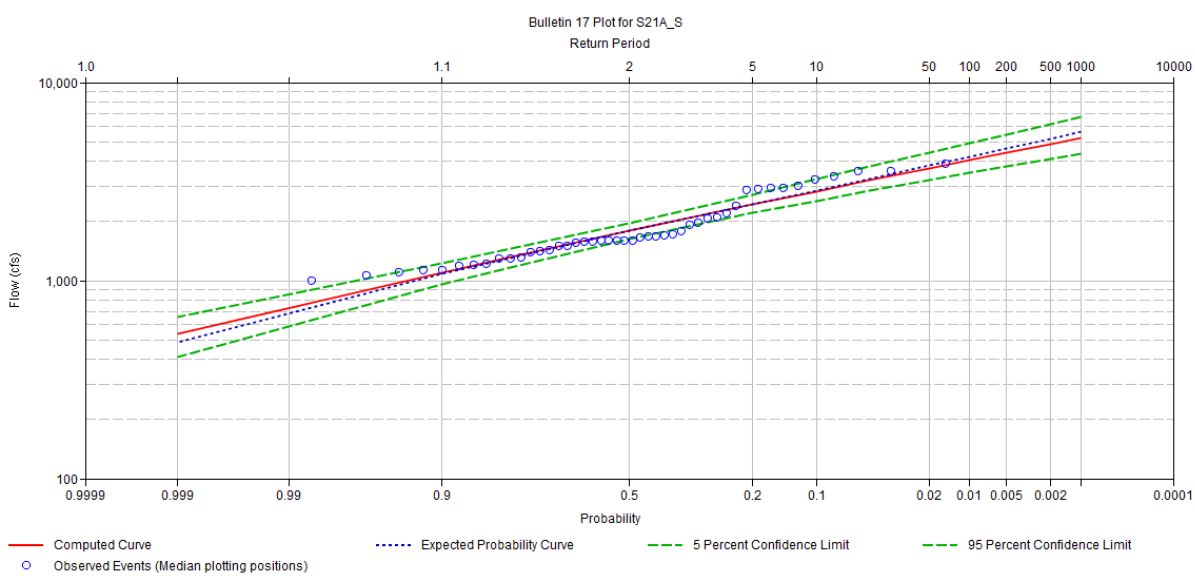


Figure 257 Log-Pearson III Analysis of Return Period Structure S21A_S Discharges

The main factors for the higher computed discharge values at the structures is attributed to the difference in the boundary conditions used to derive the structure capacity and the boundary outfall conditions used in the model. The original design uses a steady state boundary of 2.0 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.6 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (100-yr Outfall Timeseries provided by SFWMD and Steady State boundary originally used as design criteria).

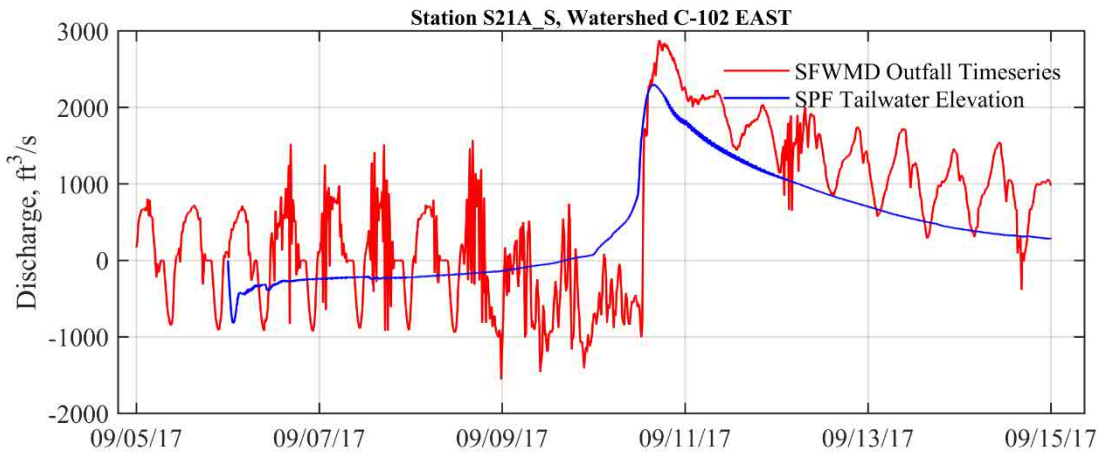


Figure 258 Comparison of Discharges at Structure S21A for SPF tail water and SFWMD Tailwater

5.4.5 C-102: PM5 Frequency of Flooding

Table 114 through Table 117 summarize the area of flooding shown in the C-102 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. Figures A-49 through A-52, A-57 through A-61, A-65 through A-69 in Appendix A Flood Extent and Duration Maps for Current Conditions show the inundation depths for the watershed, agricultural, urban and wetland areas in the C-102 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively. The total area of the C-102 watershed is 15,035.38 acres (based on GIS data). The values in the tables are based on discretization to 100 m raster which results in total watershed area 14,925 acres with 4,764 acres urban land, 8,303 acres agricultural and 2,177 acres wetlands.

The information in Table 114 through Table 117 includes the following information:

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval.
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 114. Summary of the PM#5 Flood Inundation Area in Acres for the C-102 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	11300	10262	8787	6044
0.25 >= 0.50 ft	934	803	941	1544
0.50 >= 0.75 ft	865	862	806	1035
0.75 >= 1.00 ft	596	843	754	850
1.00 >= 1.25 ft	398	704	808	709
1.25 >= 1.50 ft	205	447	773	689
1.50 >= 1.75 ft	101	269	598	642
1.75 >= 2.00 ft	161	151	415	726
2.00 >= 2.25 ft	272	64	272	754
2.25 >= 2.50 ft	5	376	136	509
>= 2.50 ft	89	143	635	1421
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 115. Summary of the PM#5 Flood Inundation in Acres for the Urban Areas of the C-102 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	4312	4072	3590	2562
0.25 >= 0.50 ft	106	133	272	625
0.50 >= 0.75 ft	94	114	193	373
0.75 >= 1.00 ft	54	114	143	267
1.00 >= 1.25 ft	54	74	101	200
1.25 >= 1.50 ft	32	84	114	126
1.50 >= 1.75 ft	15	40	79	106
1.75 >= 2.00 ft	22	22	77	86
2.00 >= 2.25 ft	32	20	52	109
2.25 >= 2.50 ft	2	44	25	49
>= 2.50 ft	40	47	119	259
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 116. Summary of the PM#5 Flood Inundation in Acres for the Agricultural Areas of the C-102 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	6368	5624	4742	3163
0.25 >= 0.50 ft	652	608	596	828
0.50 >= 0.75 ft	529	628	563	613
0.75 >= 1.00 ft	351	519	551	539
1.00 >= 1.25 ft	200	403	596	489
1.25 >= 1.50 ft	106	222	460	504
1.50 >= 1.75 ft	67	138	292	492
1.75 >= 2.00 ft	7	99	195	504
2.00 >= 2.25 ft	2	30	131	413
2.25 >= 2.50 ft	2	10	72	257
>= 2.50 ft	17	22	106	502
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 117. Summary of the PM#5 Flood Inundation in Acres for the Wetland Areas of the C-102 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	833	709	591	432
0.25 >= 0.50 ft	183	99	59	64
0.50 >= 0.75 ft	267	143	64	64
0.75 >= 1.00 ft	200	242	96	49
1.00 >= 1.25 ft	148	237	136	42
1.25 >= 1.50 ft	82	156	227	77
1.50 >= 1.75 ft	30	96	235	86
1.75 >= 2.00 ft	124	49	161	151
2.00 >= 2.25 ft	257	20	109	252
2.25 >= 2.50 ft	5	339	30	208
>= 2.50 ft	49	86	469	751
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Figures A-49 through A-52, A-57 through A-61, A-65 through A-69 in Appendix A, are flood depth maps corresponding to Table 114 through Table 117 and showing the flood extent in the entire watershed and the agricultural, urban and wetland areas of the C-102 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

For PM5, the C-102 Watershed is assigned a LOS rating of 5-year (Table 118), due to the flooding in the agricultural areas in the C-102 Watershed that flood for a 10-year event.

Table 118. PM#5 Assessment for C-102 Watershed

Canal	LOS Rating
Areas draining to C-102	Most areas upstream of SR-821 (Florida Turnpike) and around C-102 canal area have 2.25+ feet of water for 100-year design event, and 1 – 2.25 feet for 25-year design event. Areas between SW 216th Street and SR-821 have flooding depth >2.25 feet for 25-year event. Areas between S194 and S165 structures are experiencing a significant amount of flooding, for 25-year and 100-year design storms and, this can be due to lack of conveyance in the primary canal C-102 – this is evidenced by C-102 canal overflowing (PM1). For 10-year events, these areas have no flooding. Agriculture areas located in C-102 East sub-watershed are mostly low-lying areas which experience considerable amount of flooding for 10-year, 25-year and 100-year events. For the 5-year design event, flooding depth is less than 0.5 feet. Urban areas across the sub-watershed have less impact from peak stages, relative to the agricultural areas.
Areas draining to C-102N	Areas upstream of US-1 have 2-2.5 feet of flood depth around C-102N for 100-year design storm and less than 0.75 feet for 25-year design event. For 10-year and 5-year events, the flooding depth is less than 0.5 feet.

5.4.6 C-102: PM6 Duration of Flooding

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S21A_H (Figure 259) to return to target reference stage, which was defined based on the average prior to the storm event, Average S21A _H (period of 9/1-9/8) = -0.10 ft NAVD 88.

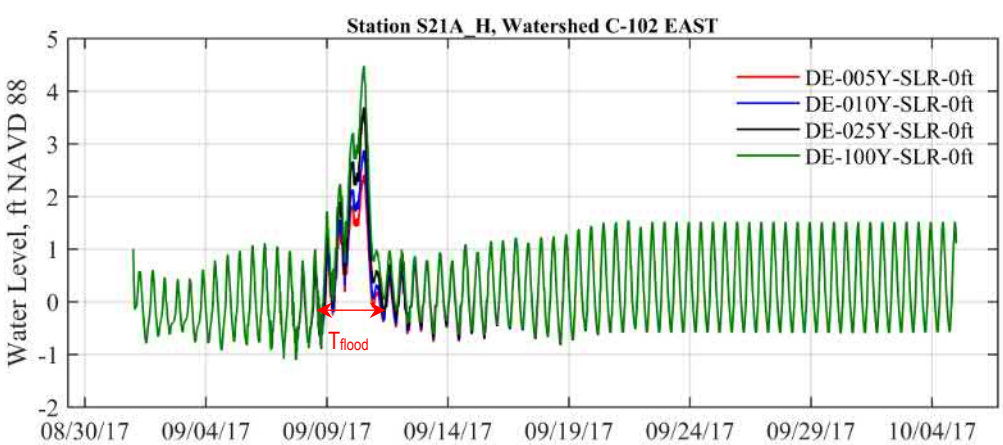


Figure 259 Flood Duration Period in Canal C-102

The flood duration for 5-yr, 10-yr, 25-yr and 100-yr are shown in the table below:

Table 119 Flood Duration at Headwater of Structure S21A

Duration of Flooding (hr)	5-Year Time (hr)	10-Year Time (hr)	25-Year Time (hr)	100-Year Time (hr)
S21A_H	13.83	15.92	29.33	43.08

Table 120 through Table 123 provide a summary of the areas in the C-102 Watershed with flood depths greater than 0.25 ft for the specified duration interval for the entire C-102 watershed, agricultural, urban and wetland areas of the C-102 watershed.

Table 120. Summary of the PM#6 Flood Duration Area in Acres for the C-102 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	10	20	77	279
1 - 4 hr	30	42	131	484
4 - 8 hr	59	72	151	368
8 - 12 hr	86	84	185	284
12 - 24 hr	363	351	445	1011
24 - 48 hr	815	838	872	1198
48 - 96 hr	1018	1490	1764	1621
96 - 168 hr	593	971	1421	1999
168 - 240 hr	91	220	457	845
240 - 360 hr	32	44	84	222
> 360 hr	521	531	551	568
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 121. Summary of the PM#6 Flood Duration Area in Acres for the Urban Areas of the C-102 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	2	7	30	114
1 - 4 hr	2	12	62	180
4 - 8 hr	17	32	64	171
8 - 12 hr	15	22	52	138
12 - 24 hr	69	77	171	390
24 - 48 hr	96	148	222	418
48 - 96 hr	91	190	287	351
96 - 168 hr	47	77	136	247
168 - 240 hr	15	20	40	67
240 - 360 hr	7	17	12	22
> 360 hr	89	89	99	104
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 122. Summary of the PM#6 Flood Duration Area in Acres for the Agricultural Areas of the C-102 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	7	12	40	153
1 - 4 hr	22	25	52	264
4 - 8 hr	37	35	84	175
8 - 12 hr	40	52	111	136
12 - 24 hr	247	247	259	571
24 - 48 hr	519	566	571	719
48 - 96 hr	645	969	1156	1102
96 - 168 hr	348	610	944	1334
168 - 240 hr	42	131	284	546
240 - 360 hr	12	15	37	114
> 360 hr	12	17	22	25
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Table 123. Summary of the PM#6 Flood Duration Area in Acres for the Wetlands Areas of the C-102 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	0	2	7	7
1 - 4 hr	5	0	2	15
4 - 8 hr	7	7	7	25
8 - 12 hr	27	10	22	10
12 - 24 hr	67	57	17	42
24 - 48 hr	227	146	101	91
48 - 96 hr	294	403	393	242
96 - 168 hr	217	292	383	497
168 - 240 hr	44	86	156	247
240 - 360 hr	15	20	42	99
> 360 hr	440	445	455	469
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-102 covers 15,035 acres, or 23.493 square miles				

Figures A-53 through A-56, A-57 through A-61, A-65 through A-69 in Appendix A, Flood Extent and Duration Maps for Current Conditions, are flood duration maps corresponding to Table 120 through Table 123 and show the flood duration in the entire watershed and the agricultural, urban and wetland areas of the C-102 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events.

5.4.7 LOS Rating of C-102 Watershed for Current Conditions

The C-102 Watershed has been assigned a 10-year FPLOS rating for the current hydrologic conditions. For this overall rating, weight was placed on PM1, as the primary canals in this watershed collectively are expected to contain the 10-year storm event within its MIKE 1D right and left banks as modeled. However, the 10-year capacity of the canals may be exceeded if the tailwater elevations are high, particularly during extreme tailwater surge events such as Hurricane Irma.

5.5 C-103 Watershed Flood Protection Level of Service

There are eleven SFWMD water control structures in the C-103 Watershed: S20F, S20G, S23C, S23D, S23E, S23F, S166, S167, S179, S196, and S709. Figure 260 shows the primary canals in this watershed, and Table 124 contains the design parameters of these water control structures.

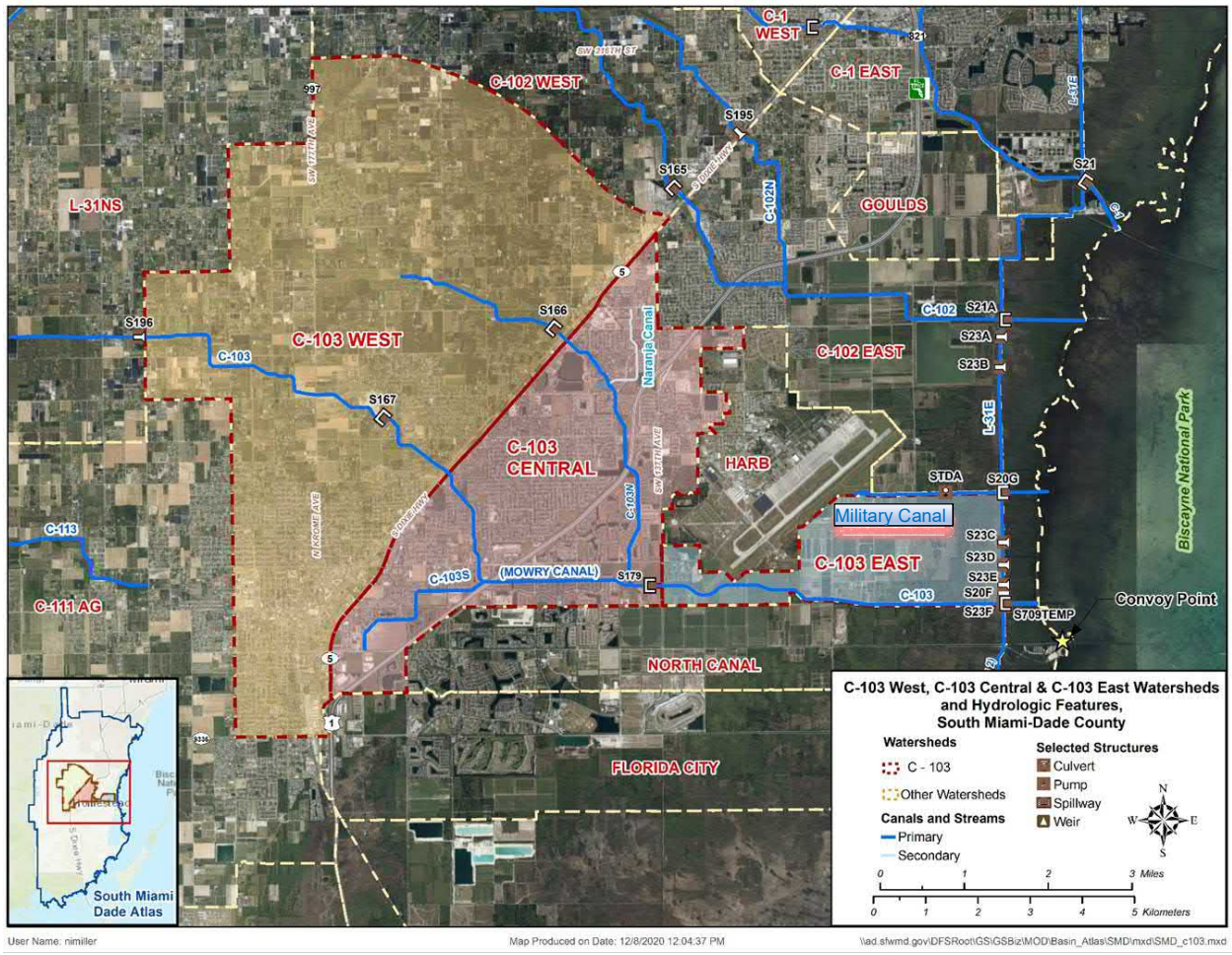


Figure 260. Drainage Network in C-103 Watershed (Source: SFWMD South Miami Dade Atlas)

Table 124. Design Parameters of Water Control Structures in the C-103 Watershed Primary Network (Source: SFWMD South Miami Dade Atlas)

Structure	Design HW/TW Stage (ft NAVD88)	Optimum HW Stage (ft NAVD88)	Design Q (cfs)	Operations
S20F	0.35 HW/ -0.15 TW	0.45 (Wet Season) -0.35 (Dry Season)	2,900	Maintain an optimum headwater elevation which varies seasonally field conditions: • High range (April 30th to October 15th): 0.25 – 0.65 ft NAVD88 • Low range(October 15th to April 30th): -0.55 - -0.15 ft NAVD88

S20G	0.35 HW/ -0.15 TW	0.45 (Wet Season) -0.35 (Dry Season)	1,700	Maintain an optimum headwater elevation which varies seasonally field conditions • High range (April 30th to October 15th): 0.65 to 0.65 ft NAVD88 • Intermediate range (April 30th to October 15th): 0.65 to 0.65 ft NAVD88 • Low range(October 15th to April 30th): -0.55 to -0.15 ft NAVD88
S23 C, D, E, F	N/A	N/A	N/A	Not operated
S166	3.65 HW/ 3.05 TW	3.55	420	• Gates open when HW rises to 4.15 ft NAVD88, • Gates stationary when HW elevation rises or falls to 3.55 ft NAVD88, • Gates close when HW falls to 3.35 ft NAVD88
S167	4.05 HW/ 3.25 TW	3.95	330	• Gates open when HW rises to 3.95 ft NAVD88, the gate begins to open. • Gates stationary when HW rises or falls to 3.95 ft NAVD88, • Gate closes when HW falls to 3.55 ft NAVD88
S179	2.25 HW/ 1.65 TW	1.95 (Wet Season) 0.95 to 1.95 (Dry Season based on rainfall)	1,920	• Optimum is 1.95 ft NAVD88 Low Setting (Growing season: October 15 to the end of April) – • Gates open when HW rises to 1.55 ft NAVD88; • Gates stationary when HW rises or falls to 1.35 ft NAVD88; and • Gates close when HW falls to 1.15 ft NAVD88 High setting (non-growing season): • Gates open when HW rises to 2.35 ft NAVD88; • Gates stationary when HW rises or falls to 1.95 ft NAVD88; • Gates close when HW falls to 1.55 ft NAVD88.
S196	4.95 HW/ 3.95 TW	3.95 (to the West)	200	• No WCA regulatory releases: gates open at 3.95 ft NAVD88 and close at 3.25 ft NAVD88 • WCA regulatory releases: gates open at 3.35 ft NAVD88 and close at 2.95 ft NAVD88
S709 temp				Not operated during storm events

5.5.1 C-103: PM1 Maximum Stage in Primary Canals

For PM1, the LOS rating of canals in the C-103 Watershed is shown in Table 94; and the canal profiles are in Figure 261 through Figure 268.

Table 125. LOS Rating of Canals in C-103 Watershed for PM1

Canal	LOS Rating
C-103	Upstream of S196: Less than 5-year LOS Downstream of S196 & Upstream of SR-997: 10-year LOS Downstream of SR-997 & Upstream of US-1: 5-year LOS Downstream of US-1: 25-year LOS
C-103S	5-year LOS
C-103N	25-year LOS

Table 126 List of Landmarks and Design Water Elevations in C-103

Landmark	Canal	Top Left Bank ft NAVD 88	Top Right Bank ft NAVD88	5-yr ft NAVD 88	10-yr ft NAVD 88	25-yr ft NAVD 88	100-yr ft NAVD 88
Structure S196	C-103	6.3	6.7	3.69	6.13	7.19	7.32
SR-997	C-103	6.3	6.7	3.48	5.77	6.97	7.85
Structure S167	C-103	5.0	6.0	3.42	5.67	6.87	7.79
US-1 Crossing	C-103	5.0	6.0	2.91	4.69	6.07	7.06
Structure S179	C-103	5.0	6.0	2.57	3.19	3.95	5.17
SSR-821 Crossing	C-103	5.1	4.8	2.57	3.16	3.88	4.93
C-103N Crossing	C-103	4.9	5.0	2.50	3.07	3.77	4.69
Structure S20F	C-103	6.1	5.6	2.42	2.81	3.30	4.08

The overall rating of C-103 is 5-yr FPLOS.

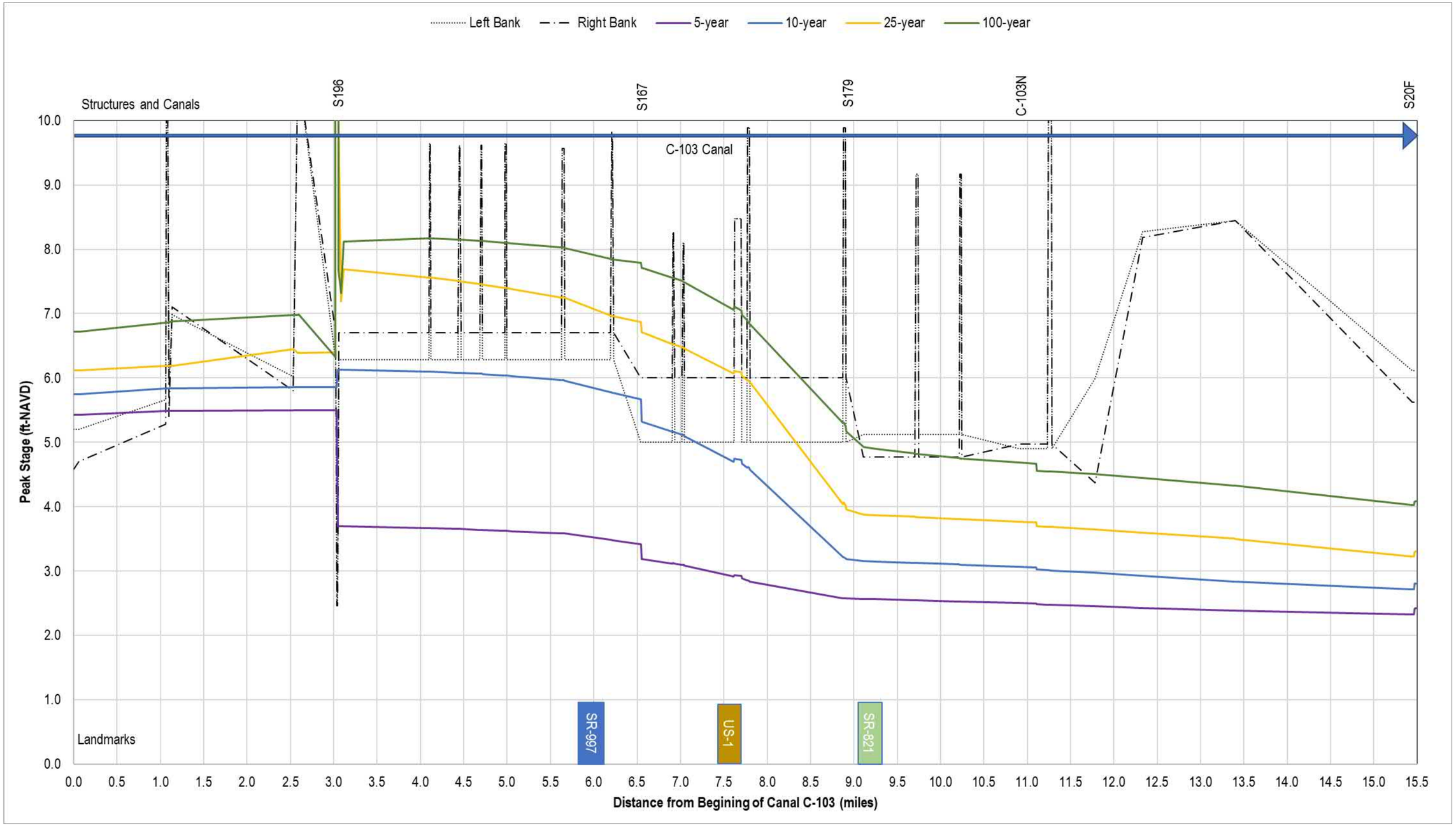


Figure 261. Profile of Peak Stages in Canal C-103

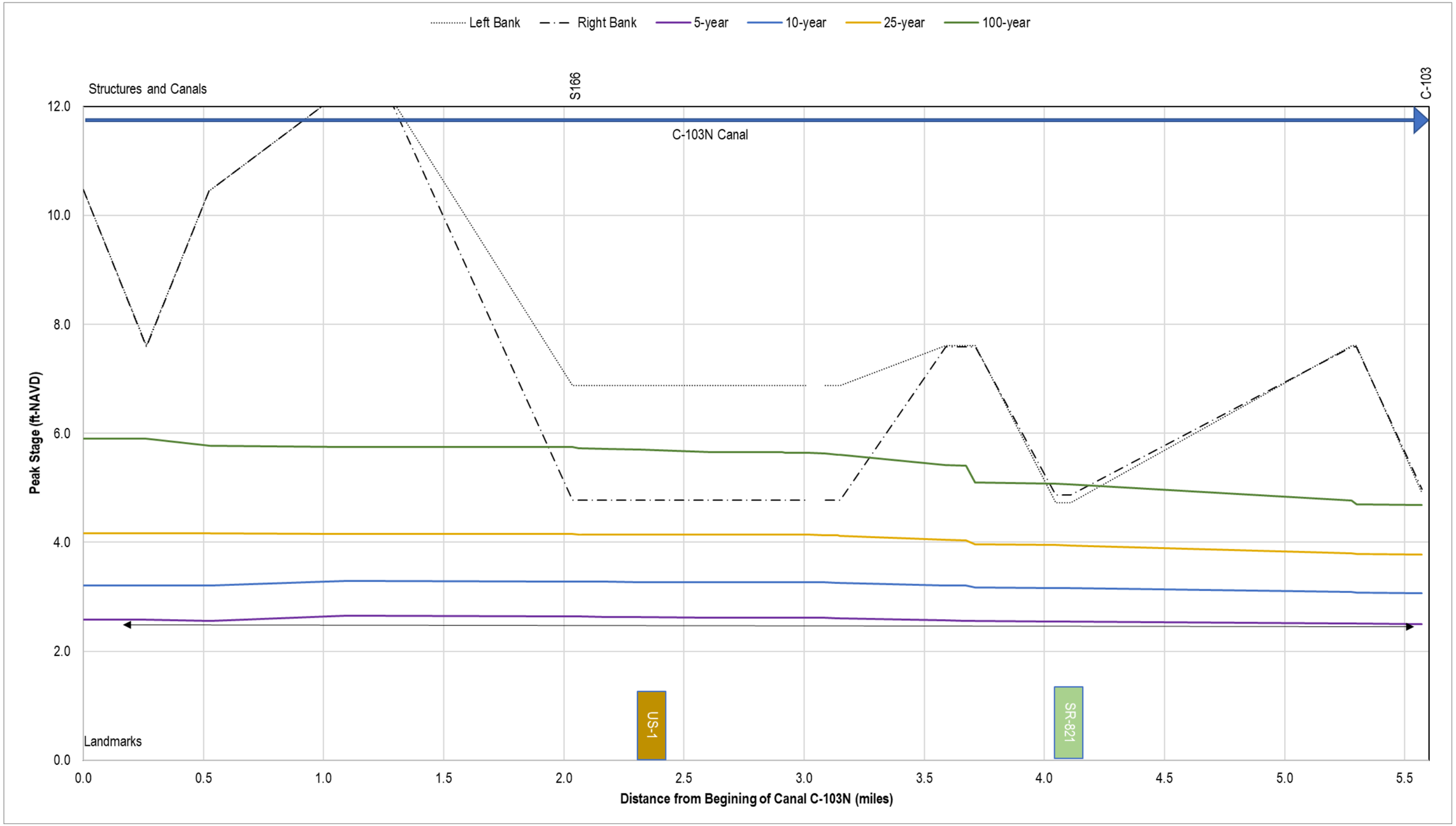


Figure 262. Profile of Peak Stages in Canal C-103N

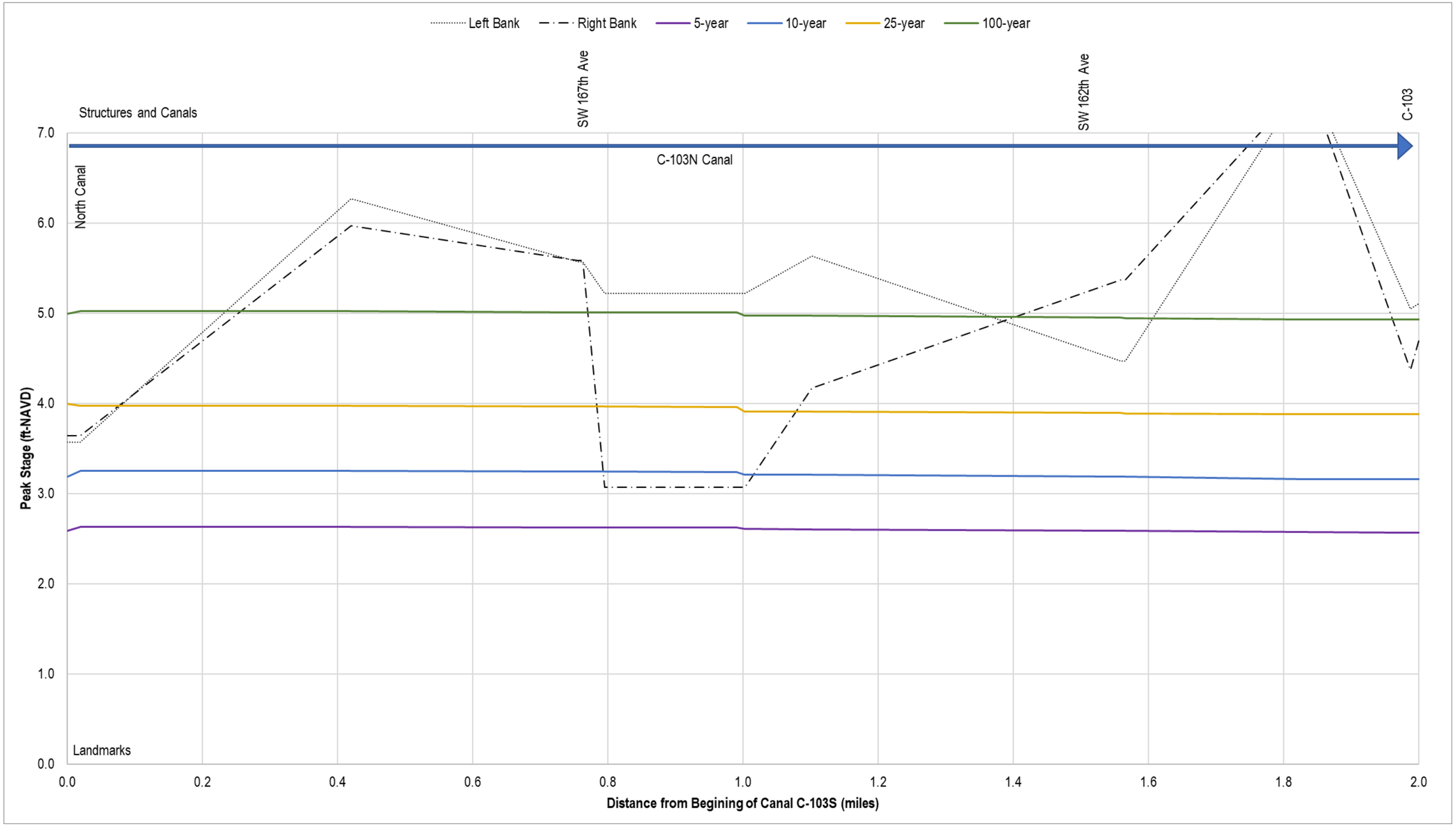


Figure 263. Profile of Peak Stages in Canal C-103S

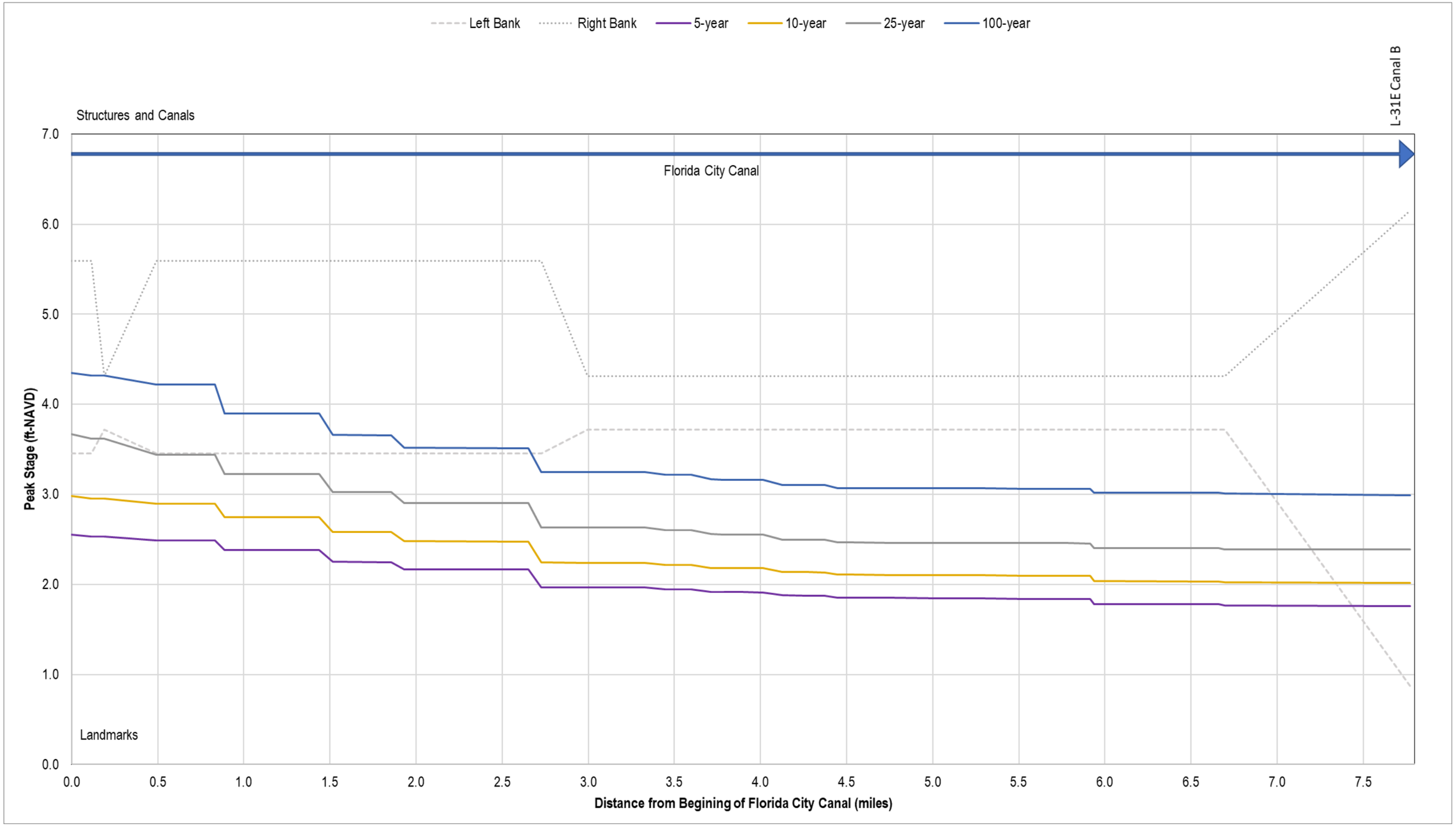


Figure 264. Profile of Peak Stages in Florida City Canal

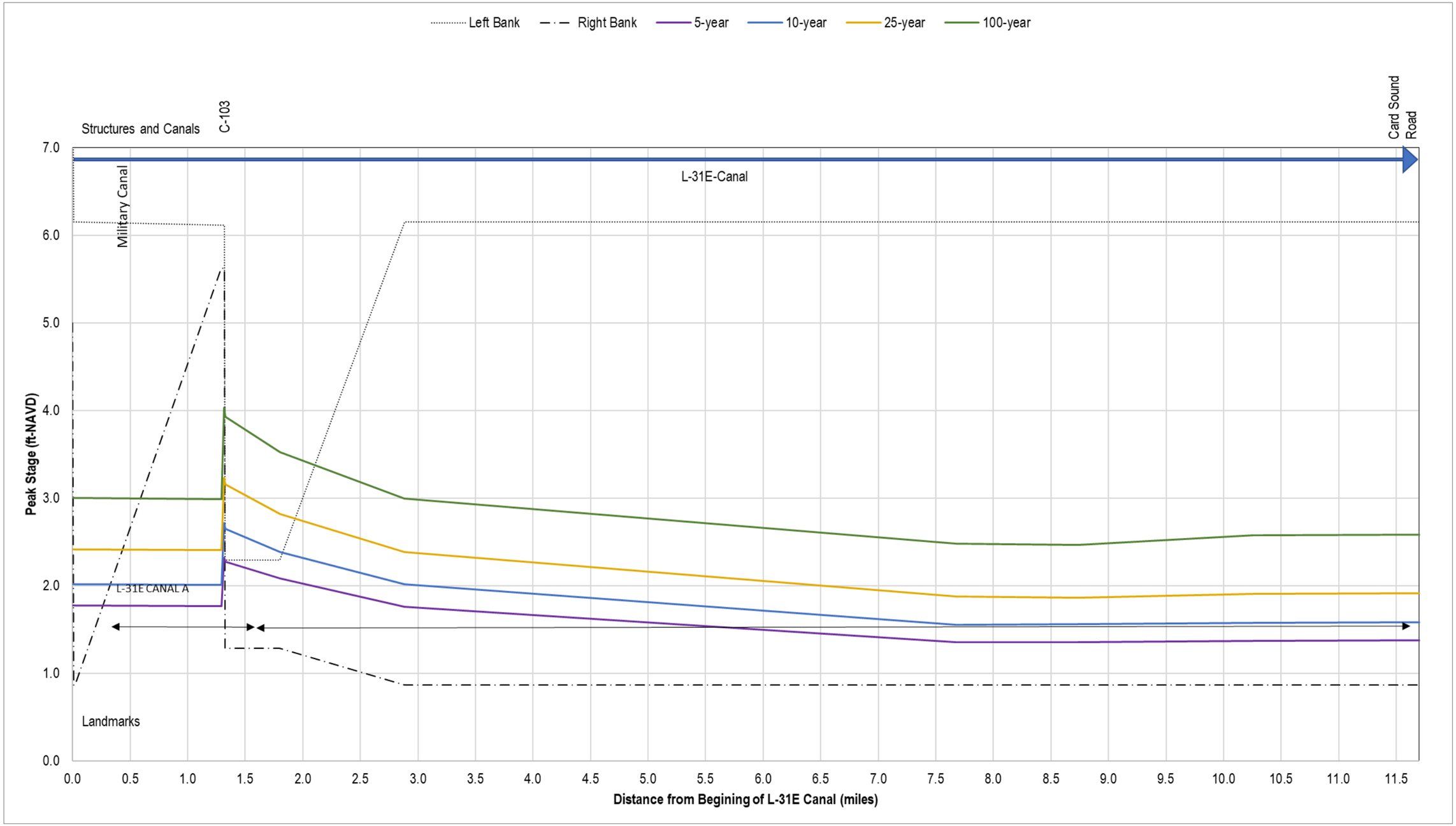


Figure 265. Profile of Peak Stages in Canal L-31E

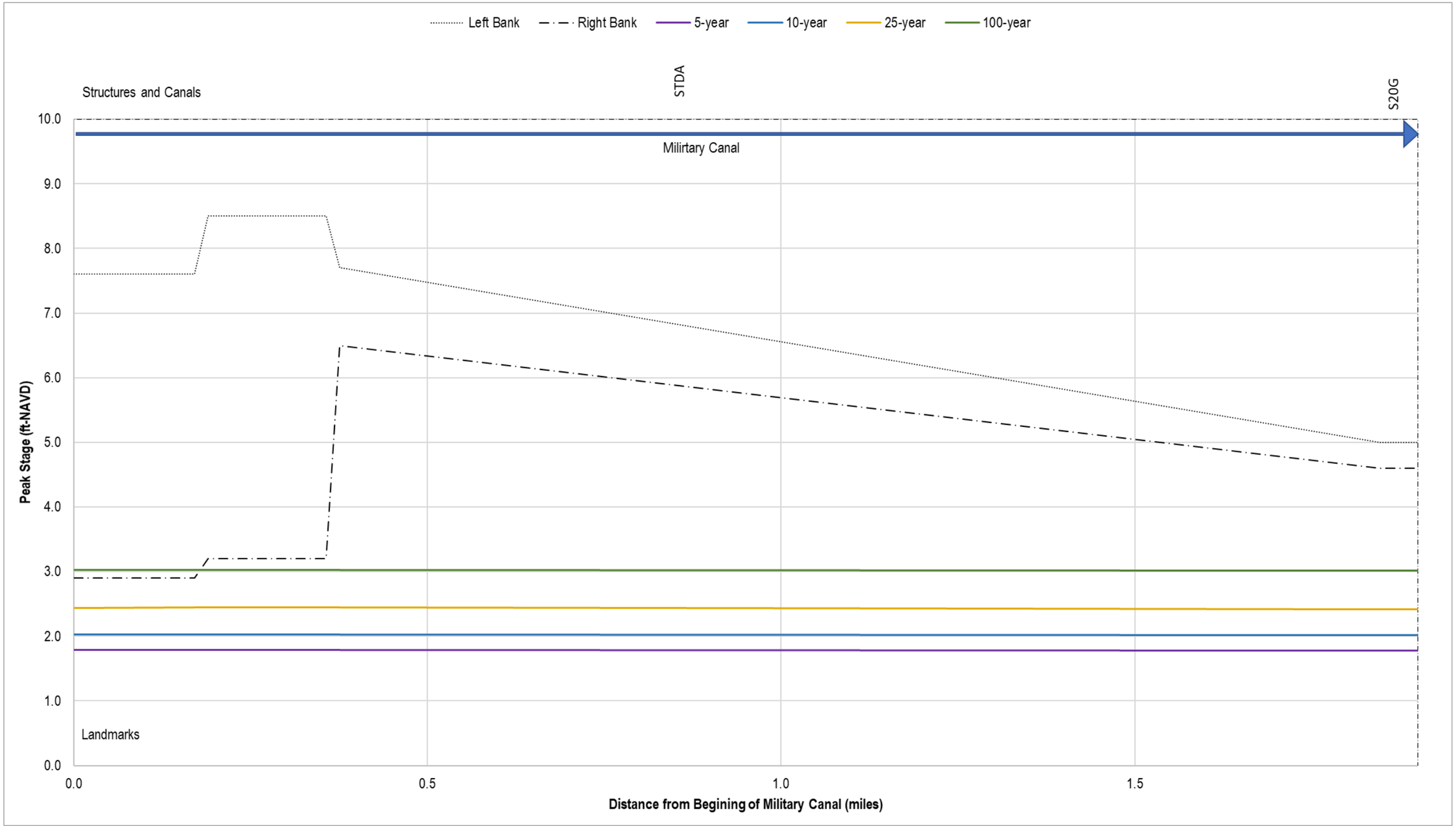


Figure 266. Profile of Peak Stages in Military Canal

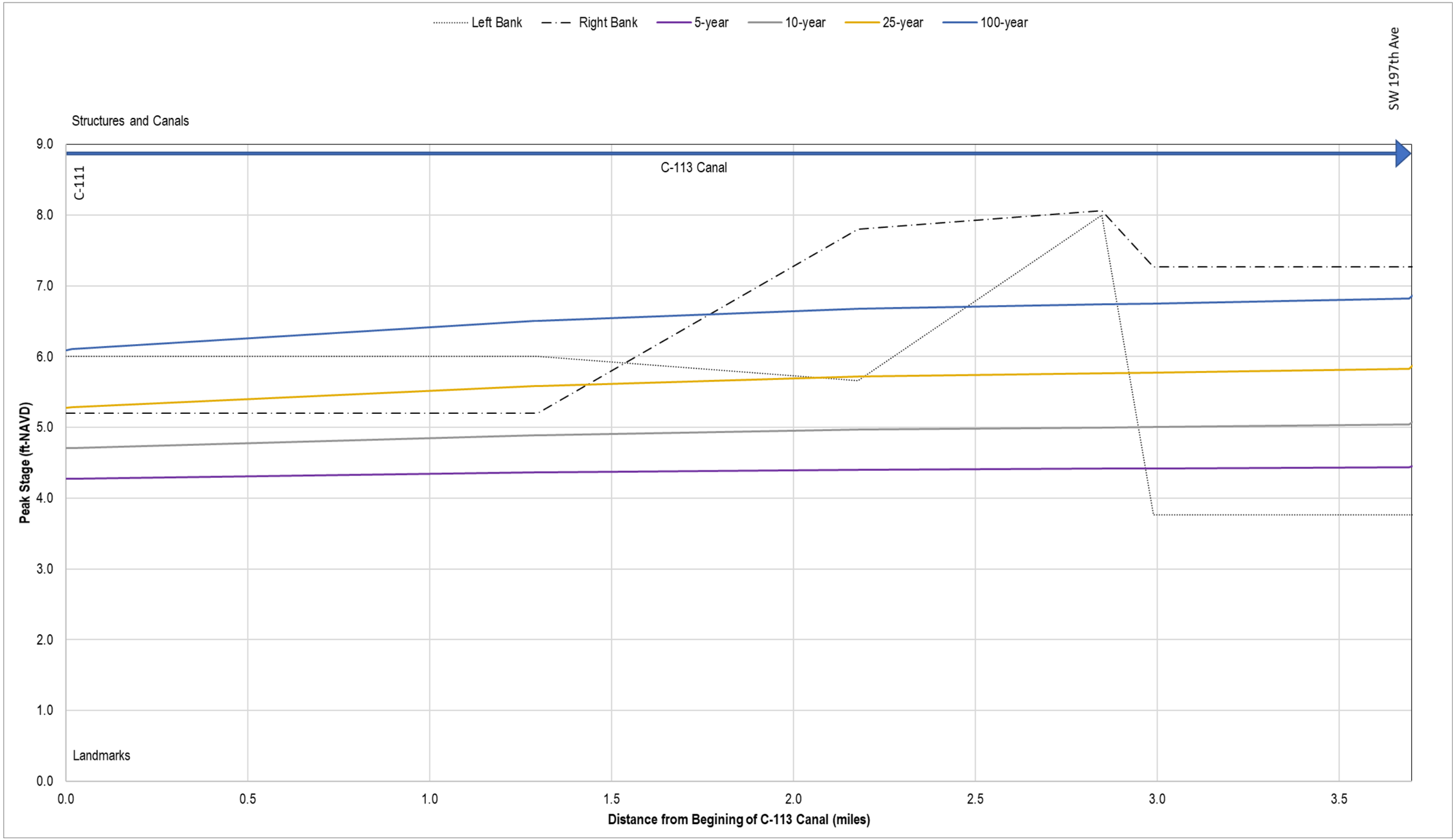


Figure 267. Profile of Peak Stages in Canal C-113

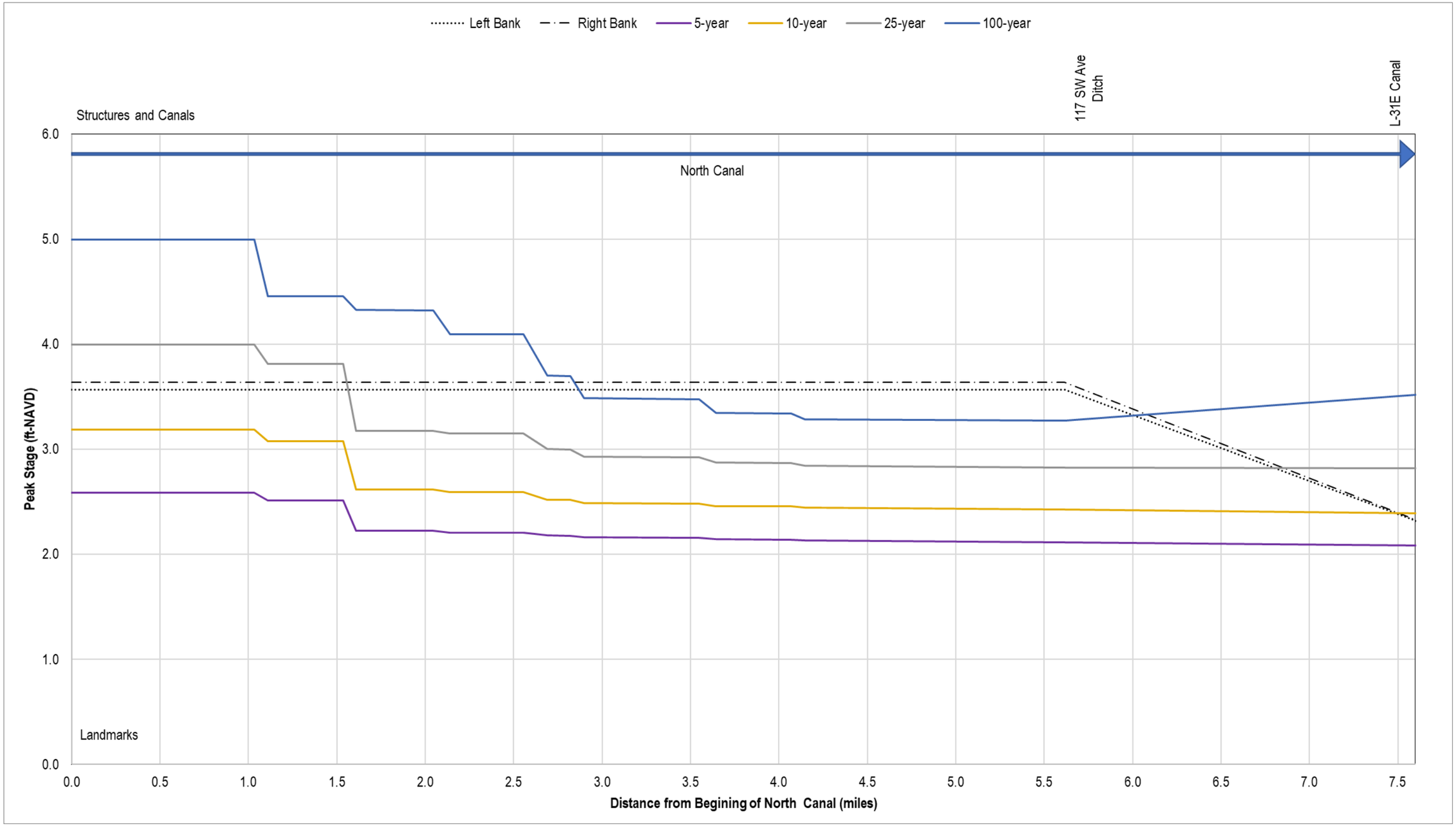


Figure 268. Profile of Peak Stages in North Canal

The results of this analysis showed that most sections of all canals in the C-103 Watershed can convey the 25-year event without overflowing. Multiple sections of which canals were identified that do not overflow even during the 100-year flood event. However, the canal system upstream of S196 overflowed during the 5-year event for periods of time and the total length of canal that overflowed during the 5-year event is about 1 mile. Therefore, Watershed C-103 is assigned a LOS-rating of 5-year LOS for PM1.

5.5.2 C-103: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 127 contains information on the discharges and the drainage areas in the C-103 Watershed. The maximum daily discharge capacity of the C-103 Watershed through S20F and S20G is a function of the drainage from the entire watershed; S20G does not have significant discharges. The discharge hydrographs in the figures below are area-weighted by upstream drainage areas for the 72-hour 5-year, 10-year, 25-year, and 100-year design storms. The peak 12-hour moving average discharge per square mile is shown in Figure 269 though Figure 280. The allowable ERP discharges are exceeded in structure S20F (highlighted).

Table 127. C-103 Watershed Drainage Discharge Capacity (cfs/sq. mi)

Structure	Watershed Model	AHED Name	Total Area (mi²)	5-yr	10-yr	25-yr	100-yr	Allowable 10-yr ERP
Florida City Canal Outfall	C-103	FLA-CITY	11.5	25.80	25.53	26.31	28.21	51.56
North Canal Outfall	C-103	NO-CANAL	7.03	59.80	66.51	72.53	82.39	51.56
S166	C-103	BD-C103 WEST	11.41	1.49	2.69	7.84	19.06	51.56
S167	C-103	BD-C103 WEST	13.2	20.36	37.94	53.60	53.94	51.56
S179	C-103	BD-C103 CENTRAL	35.42	47.07	61.68	76.13	91.53	51.56
S20F	C-103	BD-C103 EAST	39.27	88.05	109.13	130.37	162.01	51.56

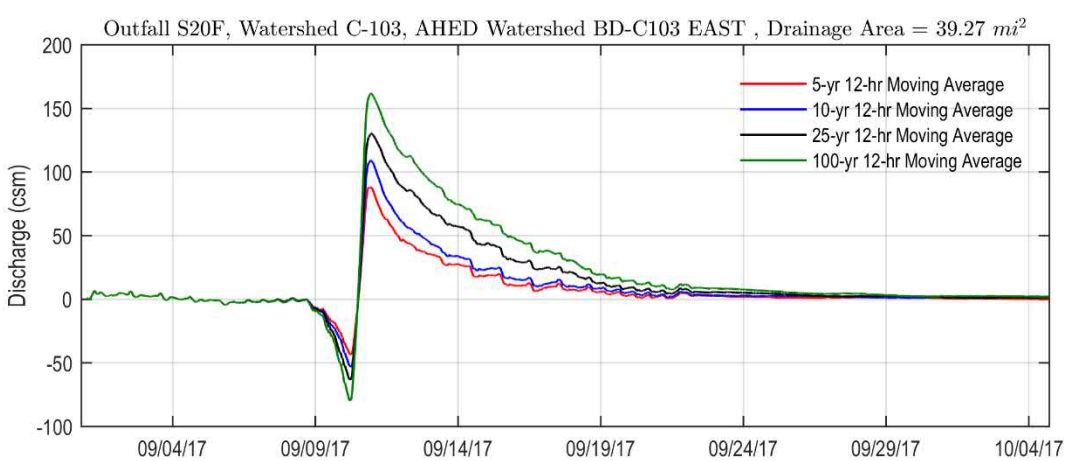


Figure 269. Drainage Discharge Capacity at Structure S20F

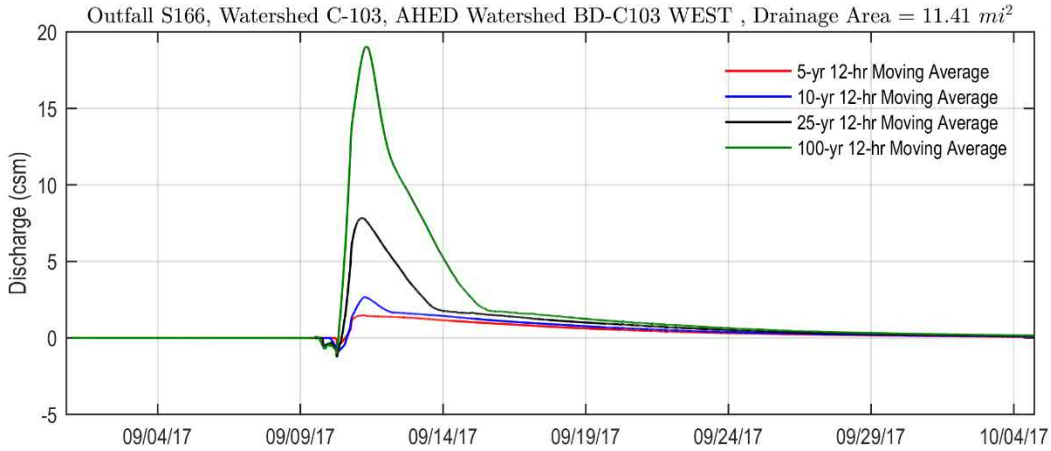


Figure 270. Drainage Discharge Capacity at Structure S166

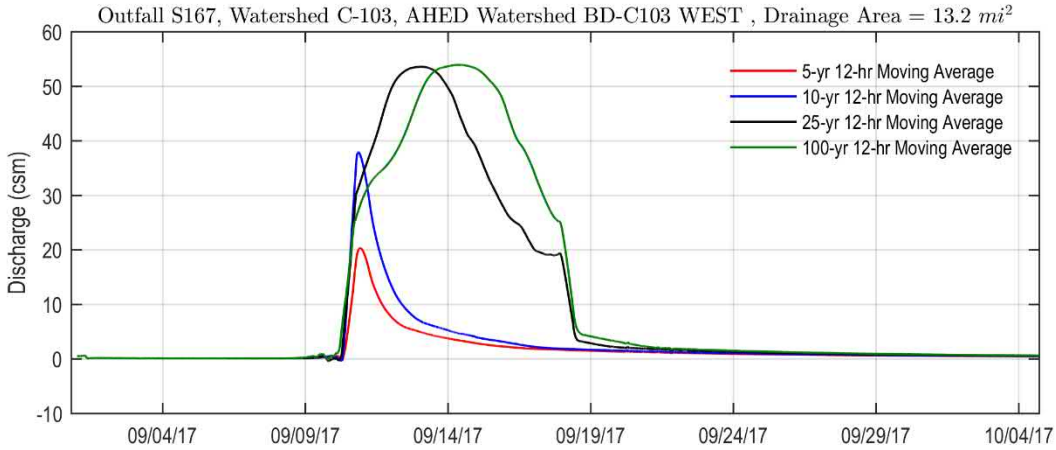


Figure 271. Drainage Discharge Capacity at Structure S167

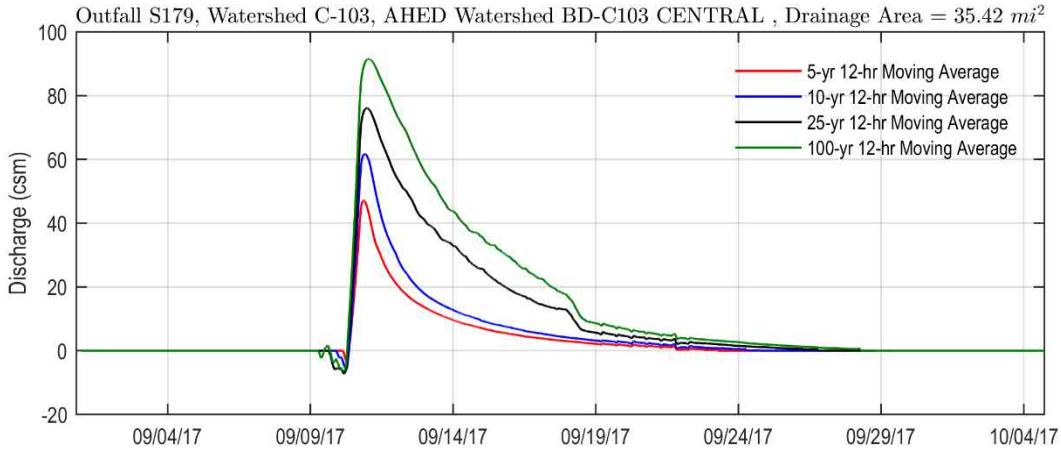


Figure 272. Drainage Discharge Capacity at Structure S179

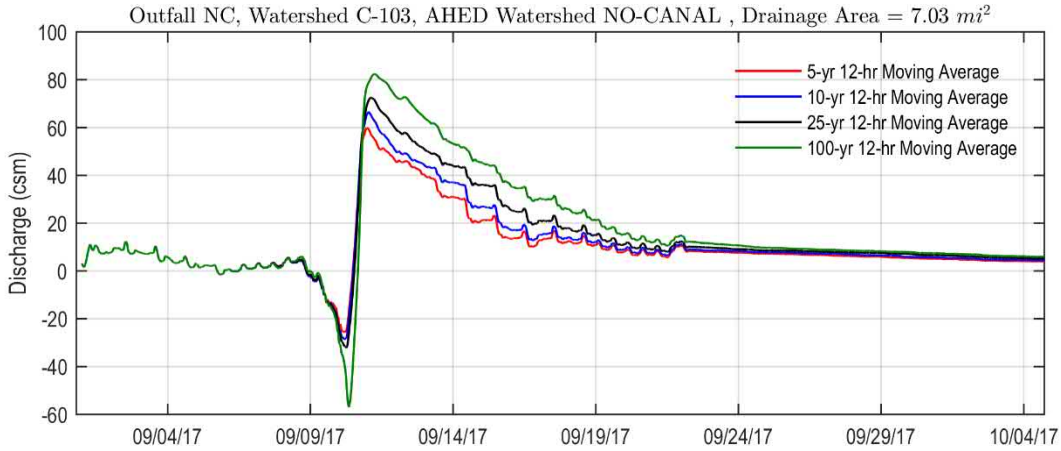


Figure 273. Drainage Discharge Capacity at Structure North Canal Outfall

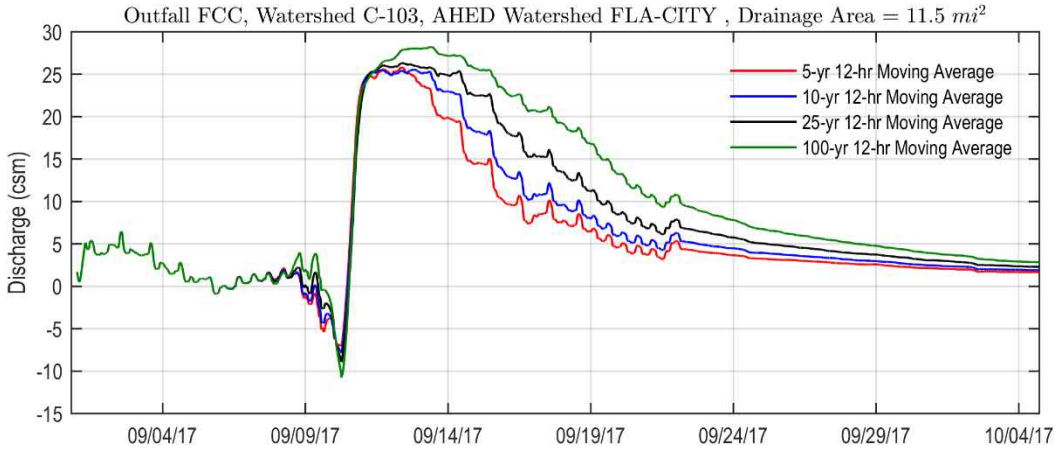


Figure 274. Drainage Discharge Capacity at Structure Florida City Canal Outfall

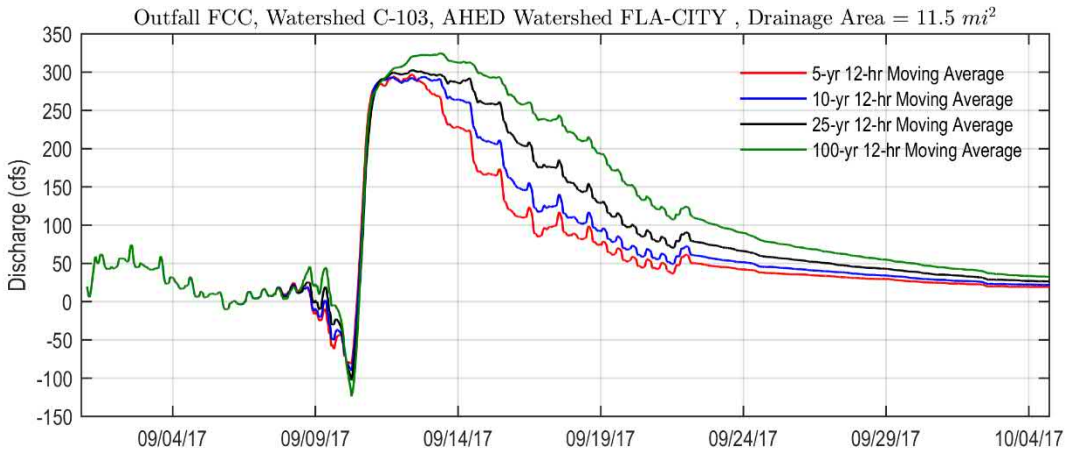


Figure 275 12-hr Moving Average Discharge Hydrograph at Florida City Canal Outfall

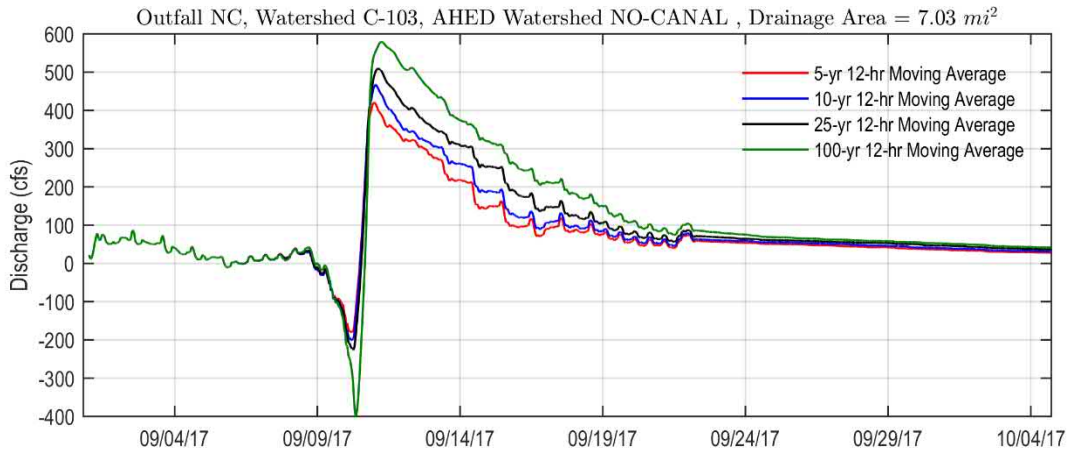


Figure 276 12-hr Moving Average Discharge Hydrograph at North Canal Outfall

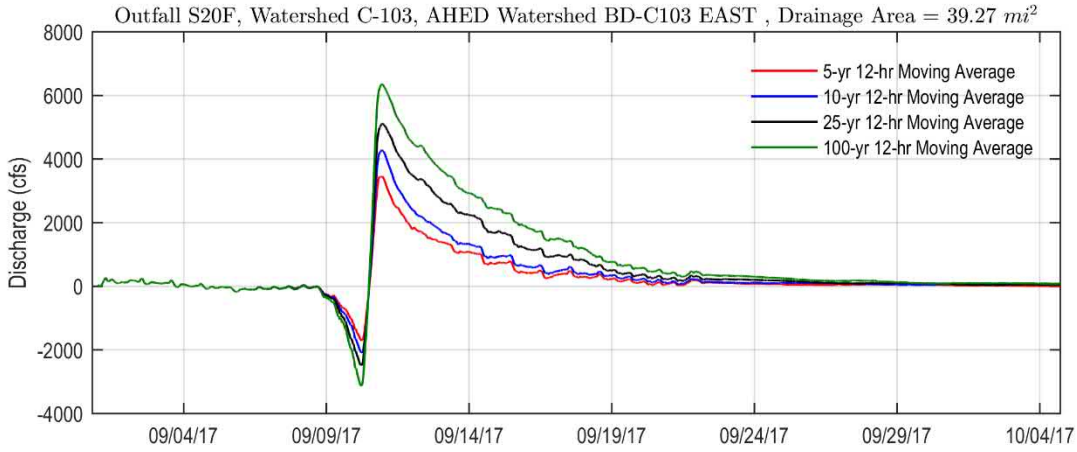


Figure 277 12-hr Moving Average Discharge Hydrograph at Structure S20F

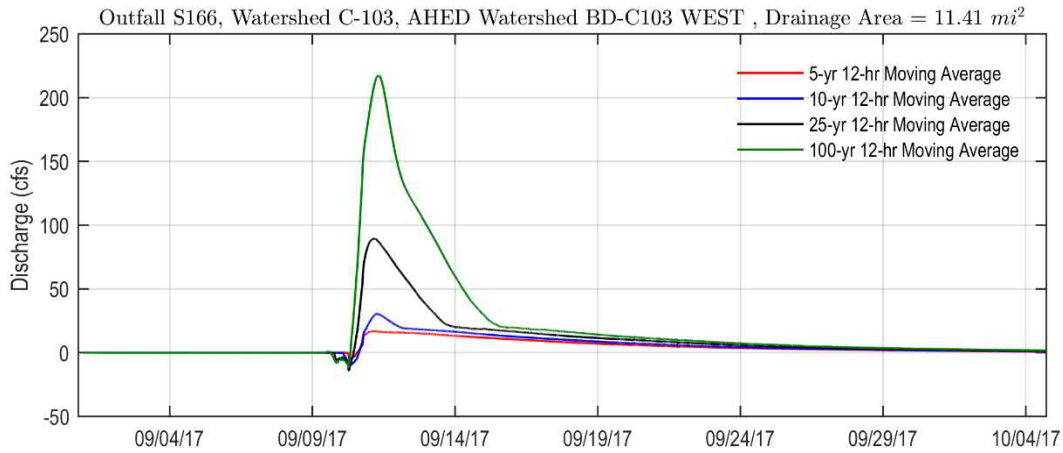


Figure 278 12-hr Moving Average Discharge Hydrograph at Structure S166

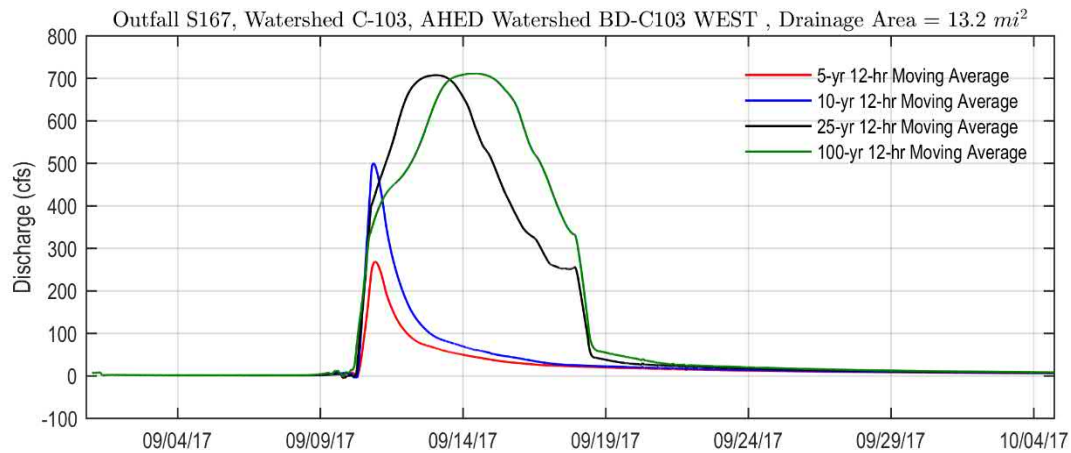


Figure 279 12-hr Moving Average Discharge Hydrograph at Structure S167

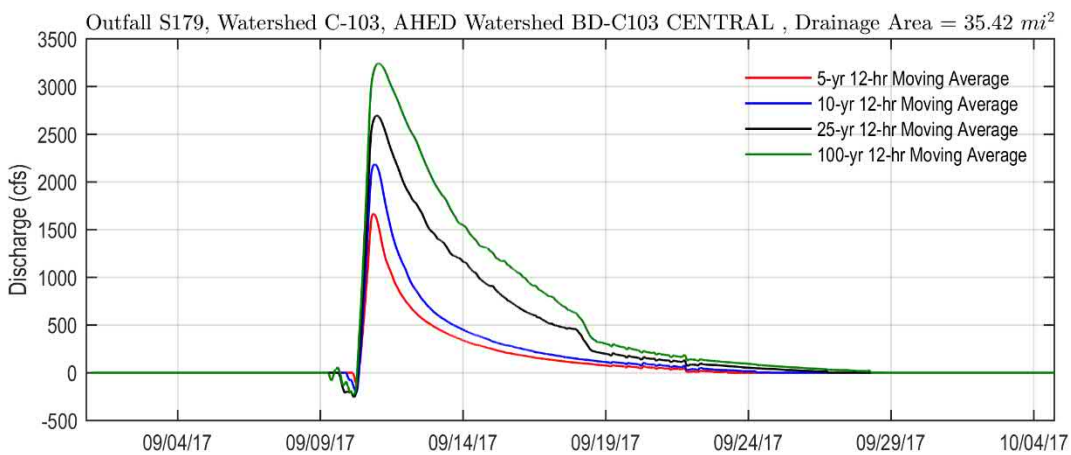


Figure 280 12-hr Moving Average Discharge Hydrograph at Structure S179

5.5.3 C-103: PM3 Structure Performance

The design parameters of Structure S20F are listed in Table 128.

Table 128 Design parameters of Structure S123

Structure	S20F
Design Discharge	2900 cfs for 40% SPF
SPF Discharge	4900 cfs
Design Headwater Elevation	1.9 ft NGVD 29
Design Tailwater Elevation	1.4 ft NGVD 29
SPF Headwater Elevation	3.0 ft NGVD 29
SPF Tailwater Elevation	2.5 ft NGVD 29
Optimum Headwater	2.0 feet NGVD29 and 1.2 feet NGVD29
Optimum Tailwater	Tidal

Figure 281 shows instantaneous values for the 25-year and 100-year design storms, respectively.

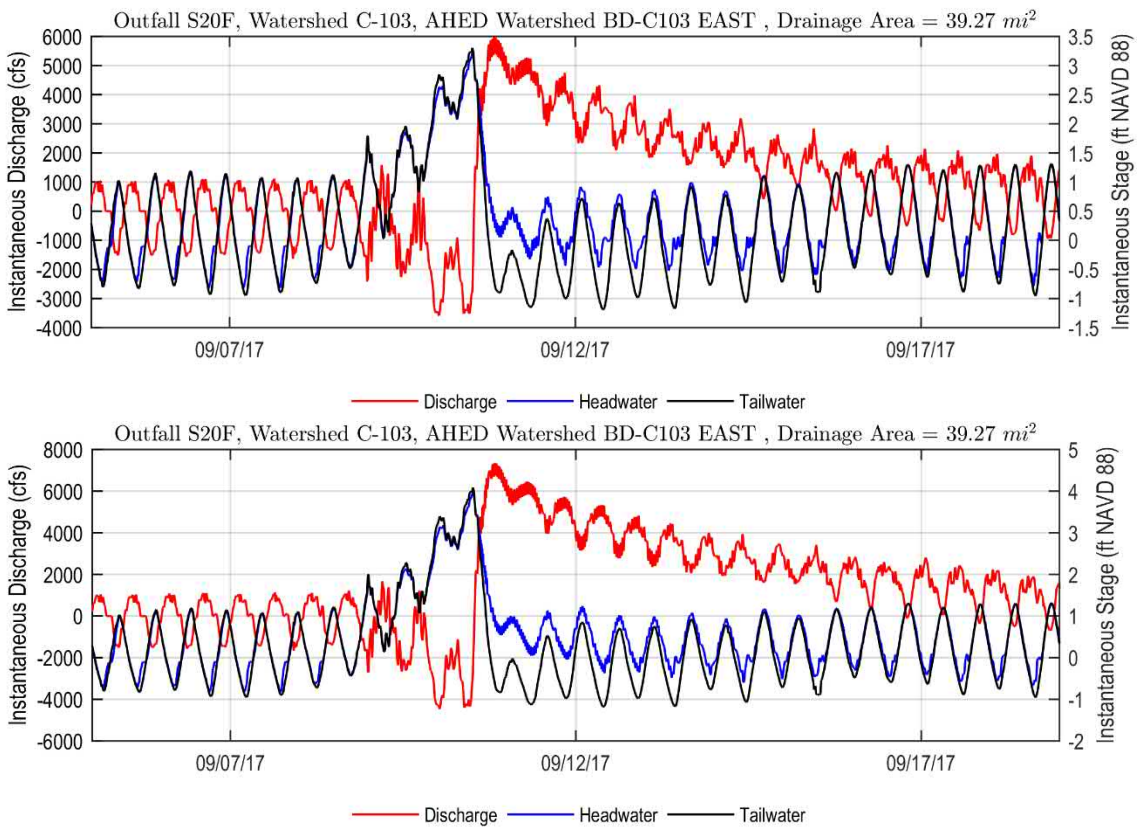


Figure 281 Structure S20F Instantaneous Conditions for 25-yr and 100-yr Design vents

Table 129 through Table 135 summarize the simulated data at conditions of peak flows, peak headwater and peak tailwater stages for all structures and outfalls within the C-103 Watershed.

Table 129. Summary of the Instantaneous Peak Conditions at S20F

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 8:05 PM	9/10/17 8:00 PM	9/10/17 8:15 PM	9/10/17 8:10 PM
Headwater (ft)	-0.07	0.17	0.39	0.85
Discharge (cfs)	4768.69	5362.13	6081.82	7174.42
Tailwater (ft)	-0.87	-0.81	-0.82	-0.72

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:15 PM	9/10/17 12:15 PM	9/10/17 12:15 PM	9/10/17 12:20 PM
Headwater (ft)	2.39	2.78	3.26	4.02
Discharge (cfs)	-1452.83	-1710.04	-2301.38	-2497.06
Tailwater (ft)	2.42	2.81	3.30	4.06

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:15 PM	9/10/17 12:15 PM	9/10/17 12:15 PM	9/10/17 12:15 PM
Headwater (ft)	2.39	2.78	3.26	4.02
Discharge (cfs)	-1452.83	-1710.04	-2301.38	-2948.70
Tailwater (ft)	2.42	2.81	3.30	4.08

Table 130. Summary of the Instantaneous Peak Conditions at S20G

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/6/17 4:20 PM	9/6/17 4:20 PM	9/10/17 3:25 PM	9/10/17 3:45 PM
Headwater (ft)	-0.30	-0.30	2.57	2.96
Discharge (cfs)	1.01	1.01	2.96	34.92
Tailwater (ft)	-0.59	-0.59	2.44	2.84

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 3:10 PM	9/10/17 3:35 PM	9/10/17 2:15 PM	9/10/17 2:00 PM
Headwater (ft)	2.19	2.34	2.58	2.99
Discharge (cfs)	0.06	0.13	-36.27	-168.97
Tailwater (ft)	1.60	1.79	3.03	4.02

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:30 PM	9/10/17 12:30 PM	9/10/17 12:30 PM	9/10/17 12:30 PM
Headwater (ft)	2.06	2.22	2.48	2.87
Discharge (cfs)	-0.04	-20.35	-114.37	-253.57
Tailwater (ft)	2.38	2.85	3.67	4.50

Table 131. Summary of the Instantaneous Peak Conditions at S166

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/11/17 2:25 AM	9/11/17 2:25 AM	9/11/17 1:55 AM	9/11/17 6:55 AM
Headwater (ft)	1.96	2.63	3.90	5.42
Discharge (cfs)	34.58	56.45	112.43	236.96
Tailwater (ft)	1.95	2.62	3.88	5.37

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:30 PM	9/10/17 1:15 PM	9/10/17 4:45 PM	9/10/17 8:30 PM
Headwater (ft)	2.66	3.30	4.13	5.73
Discharge (cfs)	12.43	-0.28	56.94	162.61
Tailwater (ft)	2.65	3.30	4.12	5.70

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 1:25 PM	9/10/17 1:15 PM	9/10/17 1:00 PM	9/10/17 8:30 PM
Headwater (ft)	2.66	3.30	4.12	5.73
Discharge (cfs)	-16.09	-0.28	-9.26	162.61
Tailwater (ft)	2.67	3.30	4.12	5.70

Table 132. Summary of the Instantaneous Peak Conditions at S167

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/11/17 12:15 AM	9/11/17 12:20 AM	9/12/17 9:00 PM	9/13/17 11:30 PM
Headwater (ft)	3.34	5.40	5.65	5.74
Discharge (cfs)	304.35	528.15	707.45	712.13
Tailwater (ft)	3.07	4.97	4.90	5.01

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 8:25 PM	9/10/17 6:35 PM	9/10/17 9:30 PM	9/10/17 5:45 PM
Headwater (ft)	3.46	5.69	6.88	7.78
Discharge (cfs)	294.44	512.73	424.11	336.26
Tailwater (ft)	3.22	5.33	6.72	7.71

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 5:45 PM	9/10/17 6:15 PM	9/10/17 8:40 PM	9/10/17 5:25 PM
Headwater (ft)	3.42	5.68	6.88	7.78
Discharge (cfs)	264.08	511.31	418.86	332.09
Tailwater (ft)	3.23	5.33	6.73	7.71

Table 133. Summary of the Instantaneous Peak Conditions at S179

Max Q	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 8:40 PM	9/10/17 8:40 PM	9/10/17 9:55 PM	9/10/17 10:05 PM
Headwater (ft)	1.58	2.32	3.12	4.31
Discharge (cfs)	1896.63	2339.19	2815.04	3342.23
Tailwater (ft)	1.37	2.02	2.69	3.55

Max Headwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:50 PM	9/10/17 12:50 PM	9/10/17 12:40 PM	9/10/17 12:30 PM
Headwater (ft)	2.52	3.08	3.76	4.65
Discharge (cfs)	-17.40	716.21	988.35	1362.58
Tailwater (ft)	2.52	3.05	3.71	4.55

Max Tailwater	5-yr	10-yr	25-yr	100-yr
Time	9/10/17 12:50 PM	9/10/17 12:45 PM	9/10/17 12:35 PM	9/10/17 12:30 PM
Headwater (ft)	2.52	3.08	3.75	4.65
Discharge (cfs)	-17.40	561.59	870.32	1362.58
Tailwater (ft)	2.52	3.06	3.72	4.55

Table 134. Summary of the Instantaneous Peak Conditions at North Canal Outfall

Max Q	10-yr	25-yr	100-yr
Time	9/11/17 6:25 AM	9/11/17 8:35 AM	9/11/17 8:50 AM
Headwater (ft)	0.94	1.16	1.74
Discharge (cfs)	520.06	565.47	644.34
Tailwater (ft)	0.66	0.85	1.42

Max Headwater	10-yr	25-yr	100-yr
Time	9/10/17 12:40 PM	9/10/17 12:40 PM	9/10/17 2:25 PM
Headwater (ft)	2.42	2.82	3.27
Discharge (cfs)	-55.54	-195.15	-313.35
Tailwater (ft)	2.39	2.82	3.23

Max Tailwater	10-yr	25-yr	100-yr
Time	9/10/17 12:45 PM	9/10/17 12:40 PM	9/10/17 12:40 PM
Headwater (ft)	2.42	2.82	3.13
Discharge (cfs)	-32.78	-195.15	-945.42
Tailwater (ft)	2.39	2.82	3.52

Table 135. Summary of the Instantaneous Peak Conditions at Florida City Canal Outfall

Max Q	10-yr	25-yr	100-yr
Time	9/12/17 7:50 PM	9/14/17 9:45 AM	9/13/17 9:50 AM
Headwater (ft)	0.72	0.64	1.27
Discharge (cfs)	349.61	358.01	360.80
Tailwater (ft)	0.63	0.55	1.20

Max Headwater	10-yr	25-yr	100-yr
Time	9/10/17 2:20 PM	9/10/17 2:30 PM	9/10/17 2:35 PM
Headwater (ft)	2.02	2.39	3.01
Discharge (cfs)	67.76	54.76	87.22
Tailwater (ft)	2.01	2.38	2.99

Max Tailwater	10-yr	25-yr	100-yr
Time	9/10/17 2:15 PM	9/10/17 2:20 PM	9/10/17 2:25 PM
Headwater (ft)	2.02	2.39	3.01
Discharge (cfs)	64.31	46.01	72.40
Tailwater (ft)	2.02	2.38	2.99

The instantaneous discharges are provided in Figure 282 through Figure 287.

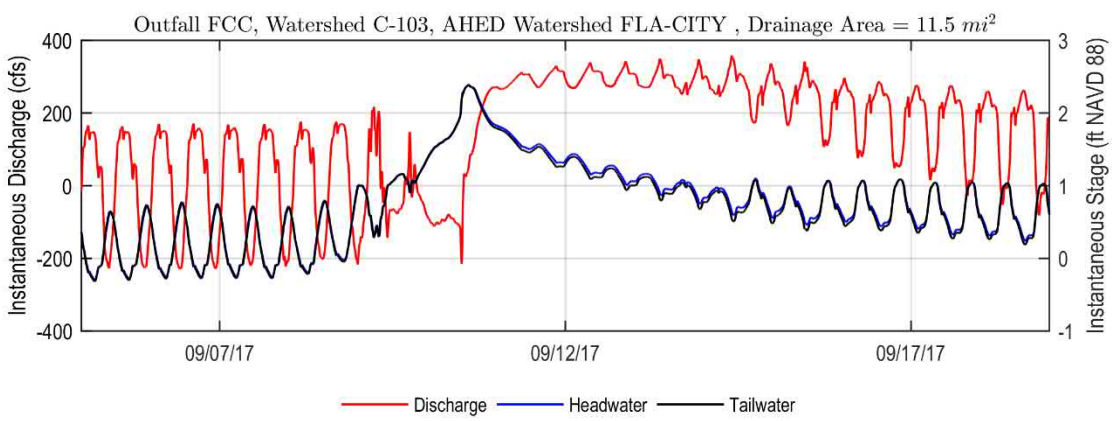


Figure 282 Instantaneous Discharge and stages at the Florida City Canal Outfall

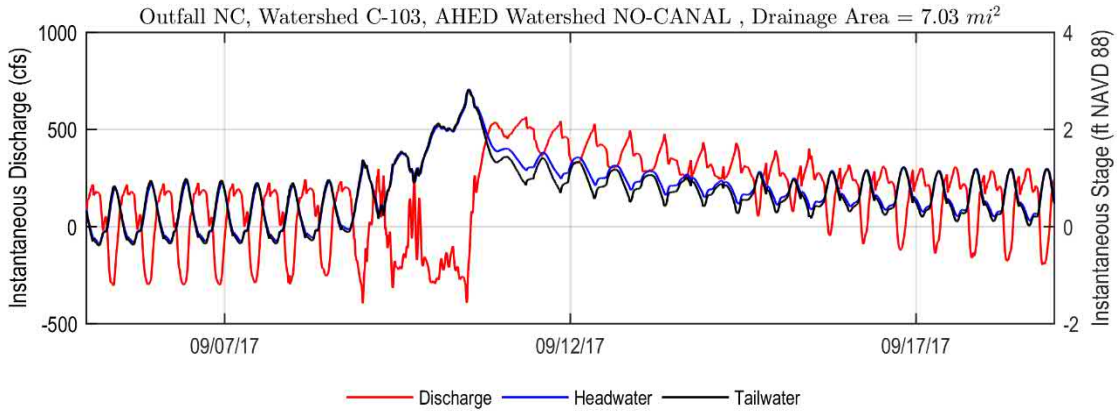


Figure 283 Instantaneous Discharge and stages at the North Canal Outfall

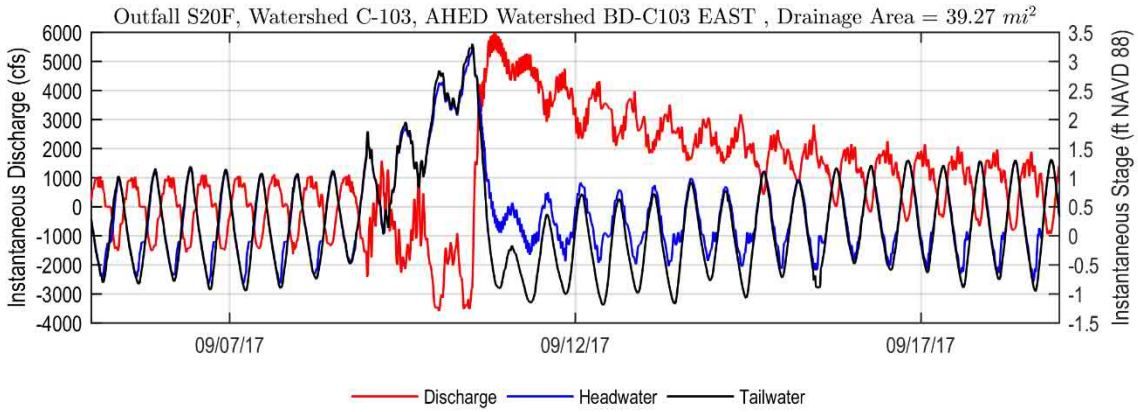


Figure 284 Instantaneous Discharge and stages at the S20F Outfall

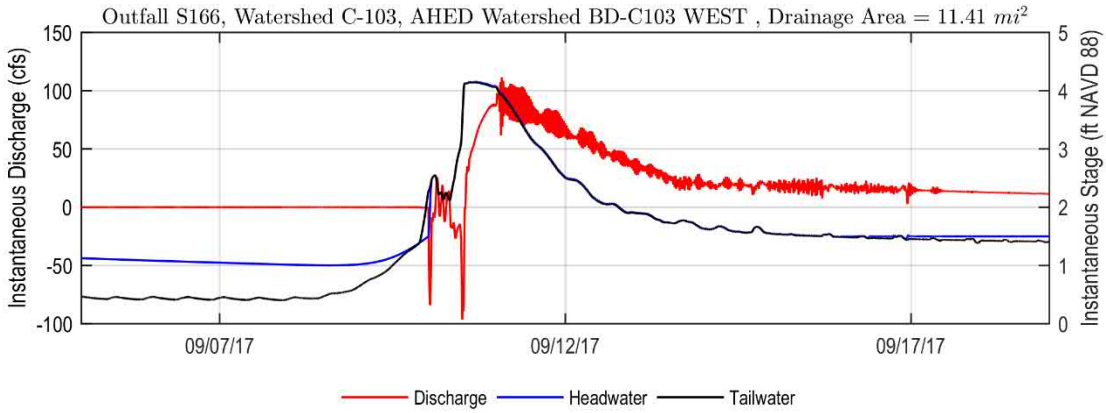


Figure 285 Instantaneous Discharge and stages at the S166 Outfall

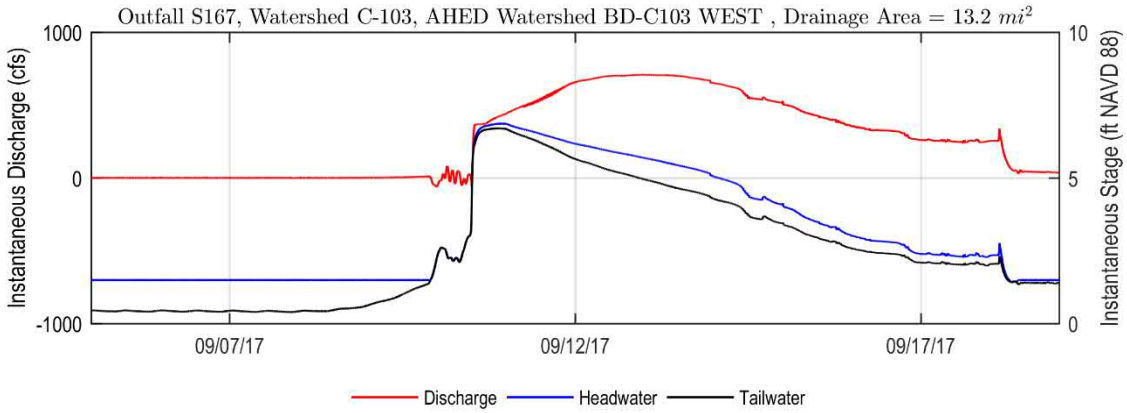


Figure 286 Instantaneous Discharge and stages at the S167 Outfall

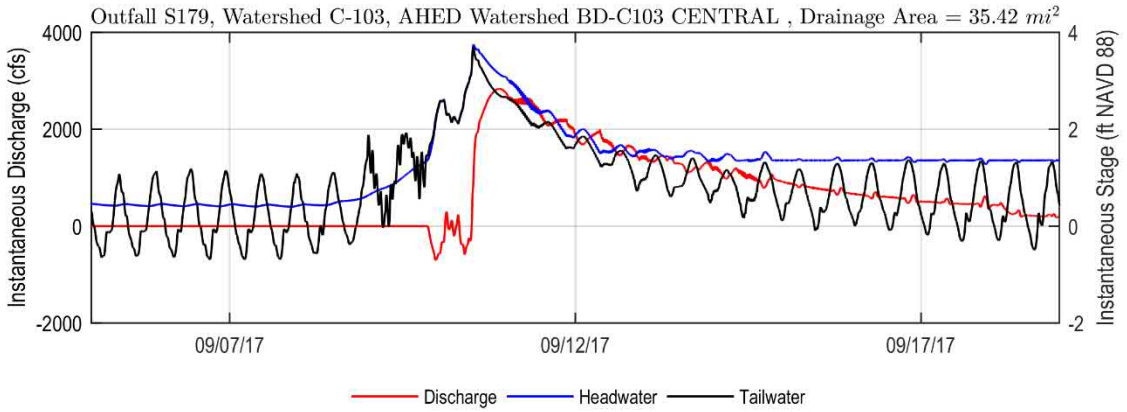


Figure 287 Instantaneous Discharge and stages at S179 Outfall

The tidally averaged 12-hr design storm discharge, stages and head differential are provided in Figure 288.

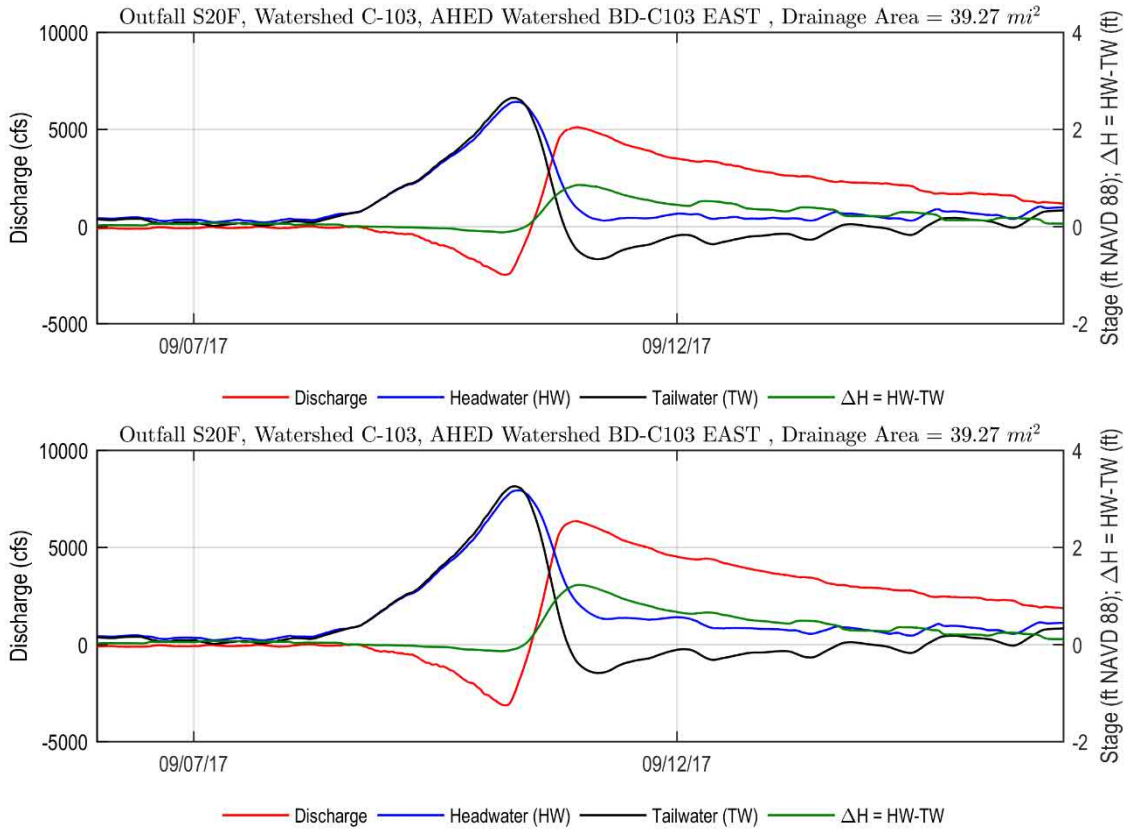


Figure 288. Tidally Averaged (12-hour) Discharge, Stage and Head Differential at S20FStructure - 25-yr and 100-yr Design Events

Table 136 Summary of the 12-hr Moving Average Conditions at Structures in C-103 Watershed

Structure	Watershed Model	AHED Name	Total Area (mi2)	Event	Peak Tailwater(ft NAVD 88)	Disdcharge (cfs)	Peak HW (ft NAVD 88) at Peak TW	Head Differential (ft)
Florida City Canal Outfall	**C-103**	**FLA-CITY**	**11.50**	**5-yr**	**0.642**	**297**	**0.706**	**0.064**
				10-yr	0.798	294	0.856	0.059
				25-yr	1.194	303	1.247	0.053
				100-yr	1.319	324	1.376	0.057
North Canal Outfall	**C-103**	**NO-CANAL**	**7.03**	**5-yr**	**0.821**	**420**	**1.001**	**0.180**
				10-yr	0.970	468	1.178	0.208
				25-yr	1.253	510	1.476	0.223
				100-yr	1.715	579	1.977	0.263
S166	**C-103**	**BD-C103 WEST**	**11.41**	**5-yr**	**1.859**	**17**	**1.864**	**0.005**
				10-yr	2.384	31	2.392	0.008
				25-yr	3.799	89	3.818	0.019
				100-yr	5.335	217	5.378	0.043
S167	**C-103**	**BD-C103 WEST**	**13.20**	**5-yr**	**2.996**	**269**	**3.209**	**0.214**
				10-yr	5.113	501	5.476	0.364
				25-yr	4.914	708	5.659	0.744
				100-yr	4.980	712	5.718	0.739
S179	**C-103**	**BD-C103 CENTRAL**	**35.42**	**5-yr**	**1.410**	**1667**	**1.685**	**0.275**
				10-yr	1.974	2185	2.233	0.259
				25-yr	2.667	2696	3.062	0.395
				100-yr	3.520	3242	4.223	0.703
S20F	**C-103**	**BD-C103 EAST**	**39.27**	**5-yr**	**-0.584**	**3458**	**-0.065**	**0.519**
				10-yr	-0.498	4286	0.123	0.620
				25-yr	-0.502	5120	0.359	0.861
				100-yr	-0.286	6362	0.932	1.219

5.5.4 C-103: PM4 Watershed Peak Storm Runoff

PM4 represents discharge at tidal structures S20F and S20G from the 12-hour moving average of the design storm on the C-103 Canal. Figure 289 through Figure 294 represent Florida City Canal, North Canal, S20F, S166 and S167. These discharge hydrographs, particularly the peak discharge, will be compared with the peak discharge under future sea level rise scenarios when executed.

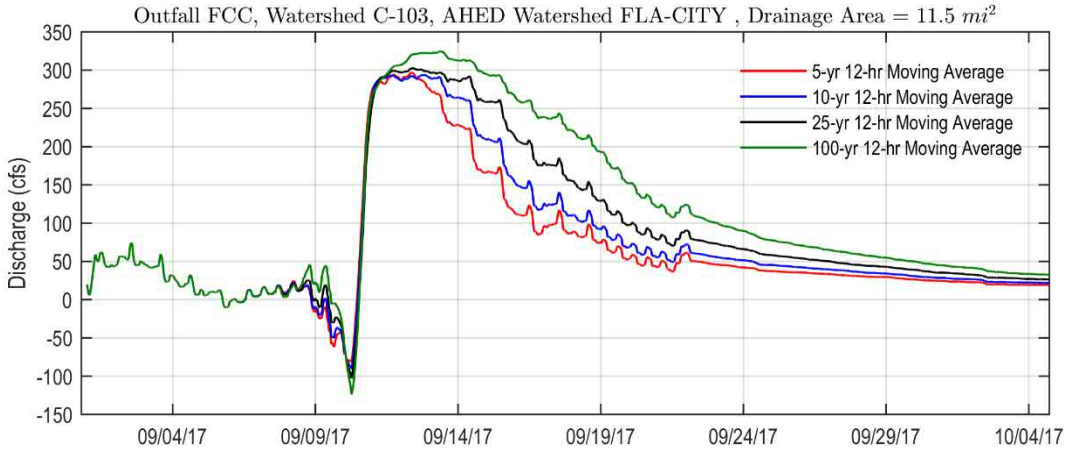


Figure 289 Discharge Hydrograph at Florida City Canal Outfall

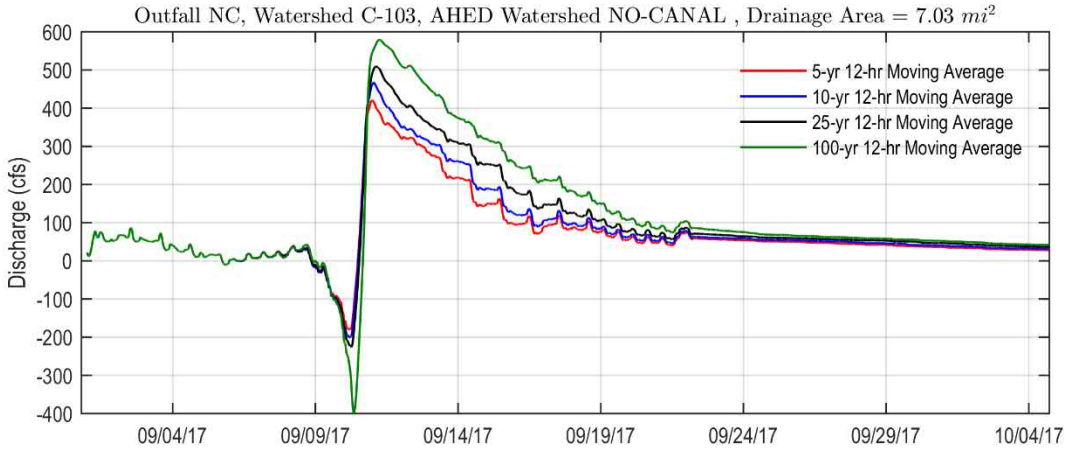


Figure 290 Discharge Hydrograph at North Canal Outfall

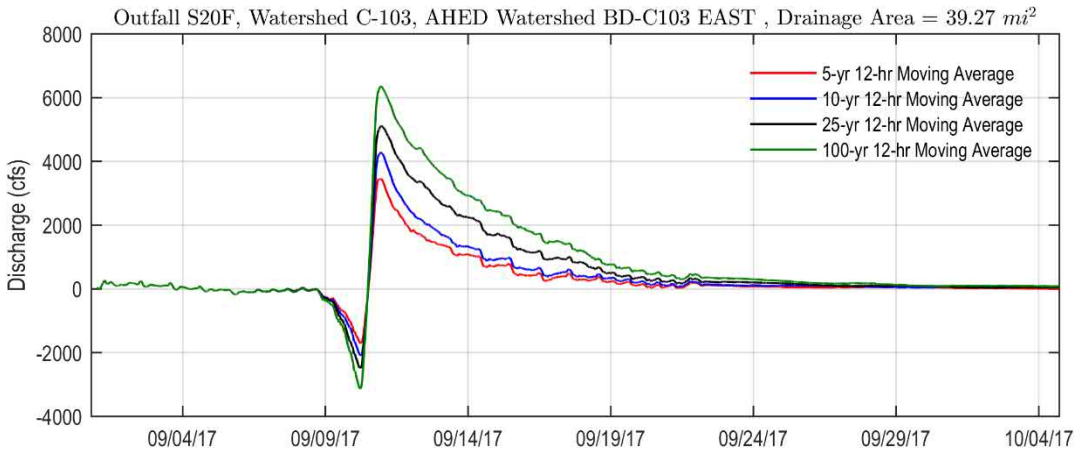


Figure 291 Discharge Hydrograph Structure S20F

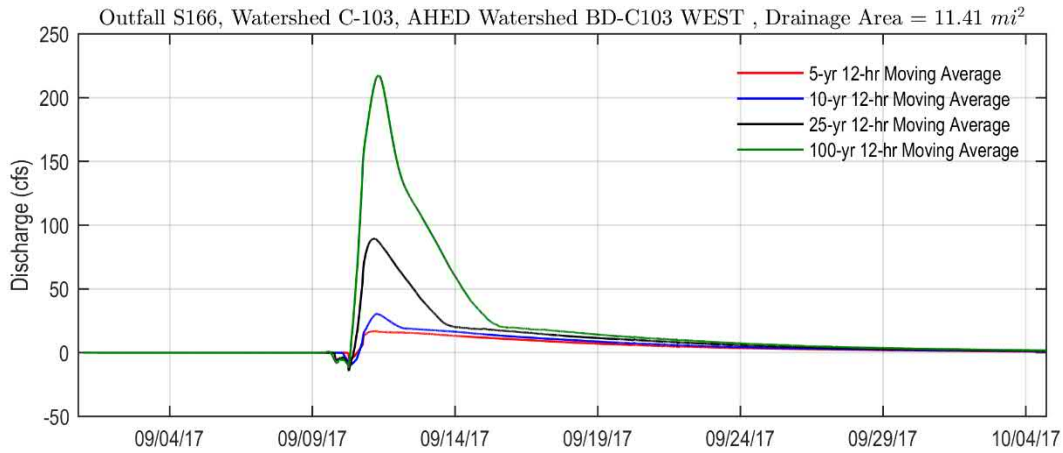


Figure 292 Discharge Hydrograph at Structure S166

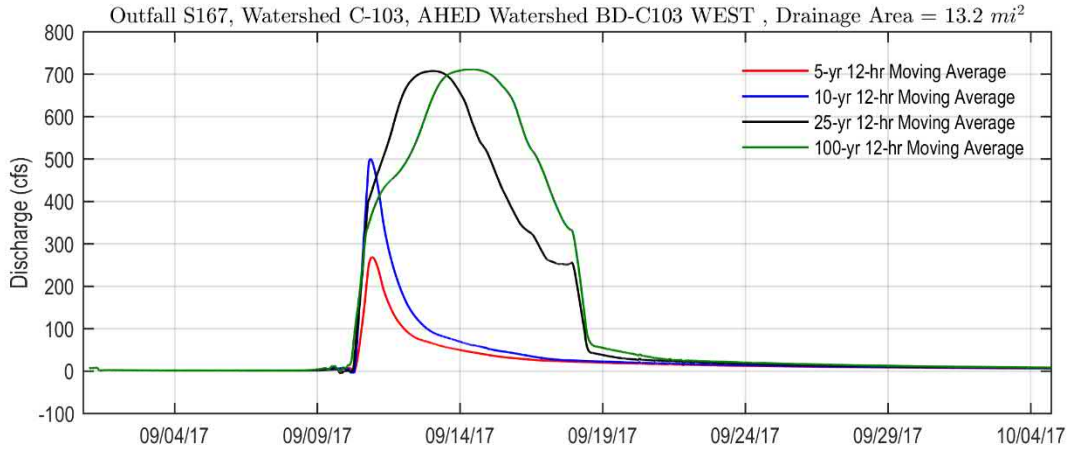


Figure 293 Discharge Hydrograph at Structure S167

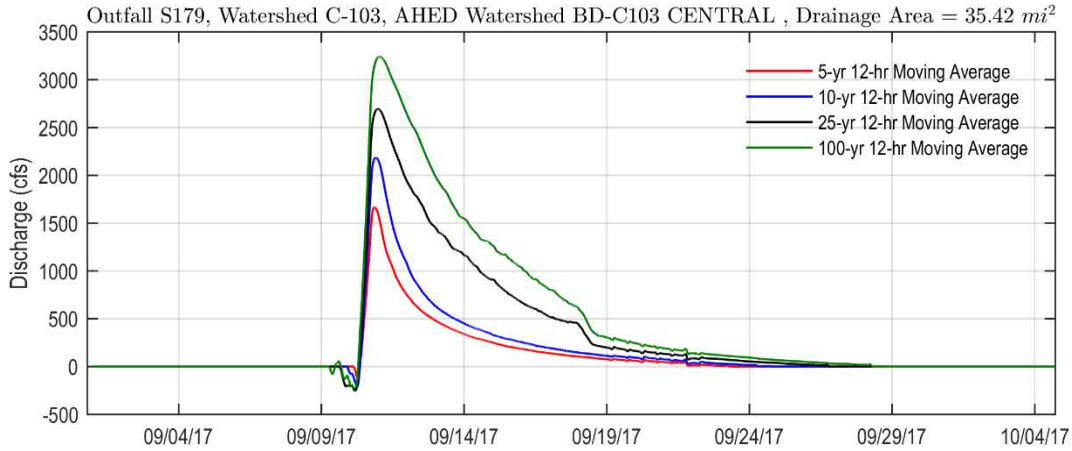


Figure 294 Discharge Hydrograph at Structure S179

Plots of discharge vs. return period is provided in Figure 295 through Figure 300.

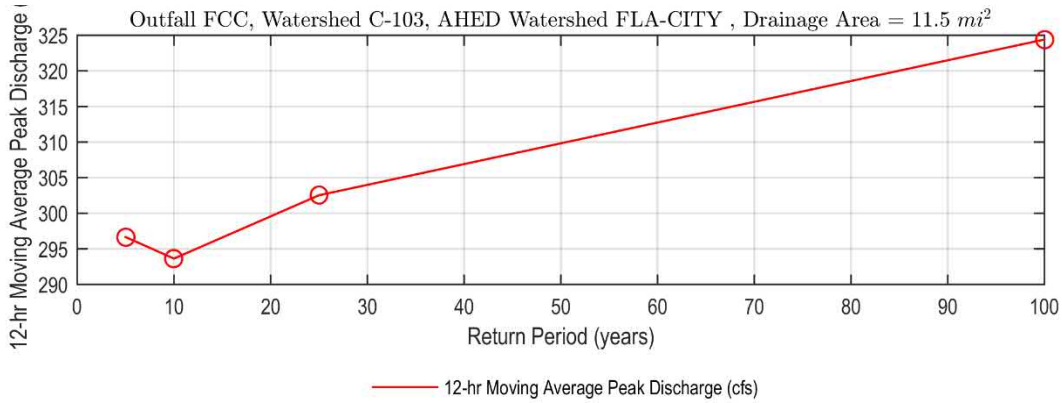


Figure 295 Florida City Canal Outfall Peak Discharge for Return Period

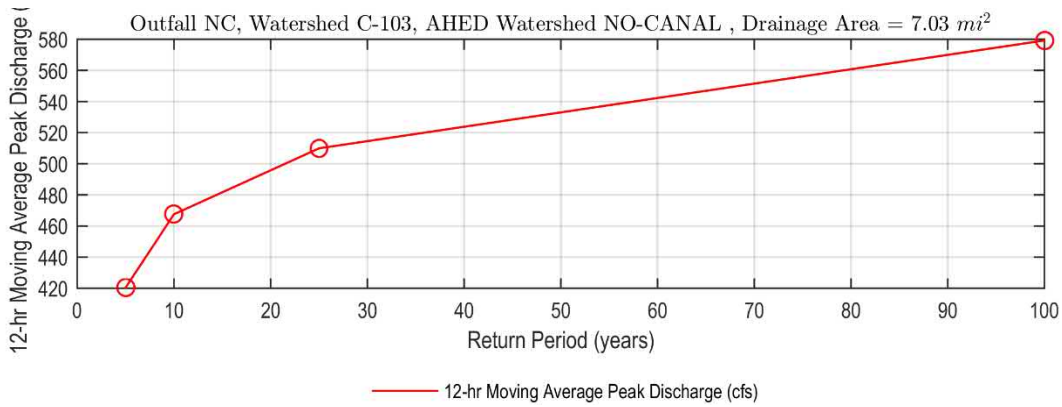


Figure 296 North Canal Outfall Peak Discharge for Return Period

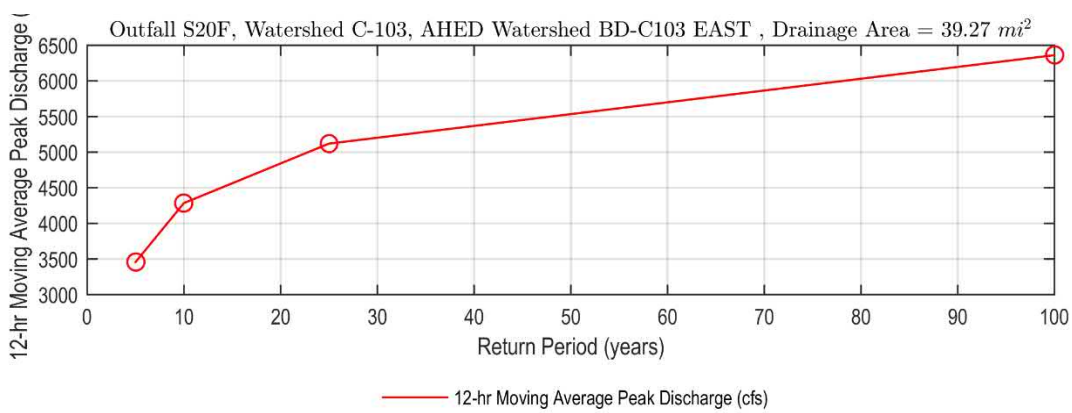


Figure 297 Structure S20F Peak Discharge for Return Period

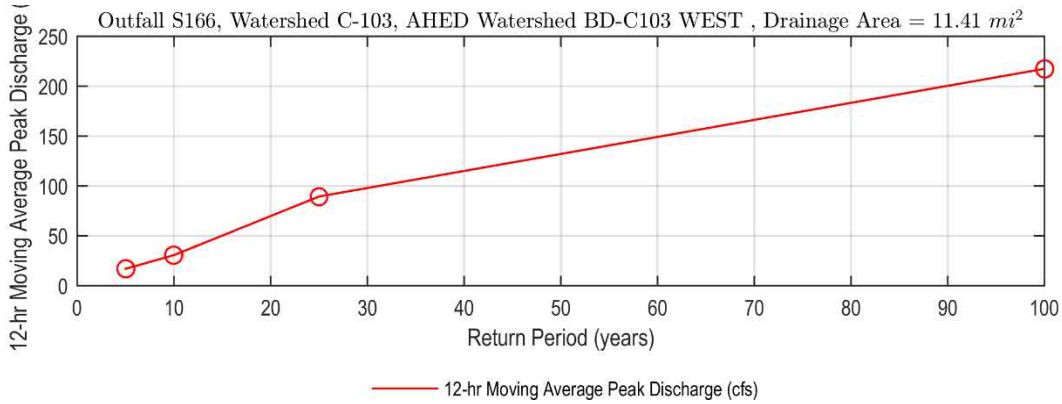


Figure 298 Structure S166 Peak Discharge for Return Period

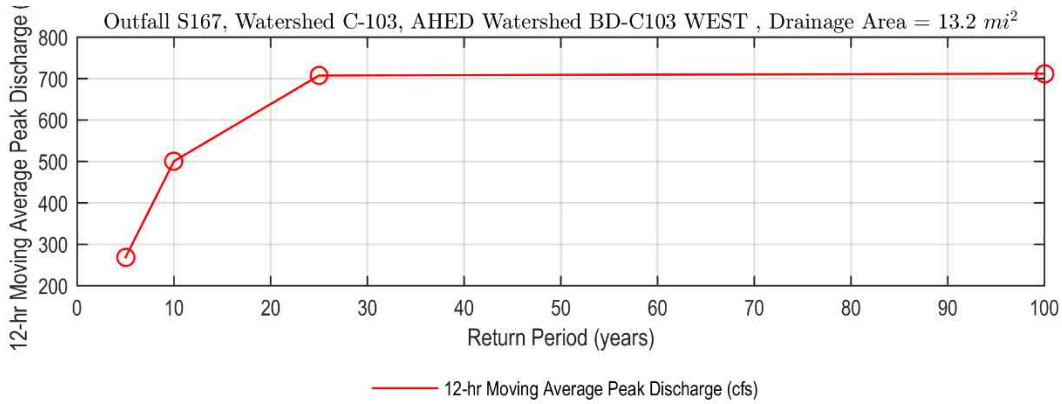


Figure 299 Structure S167 Peak Discharge for Return Period

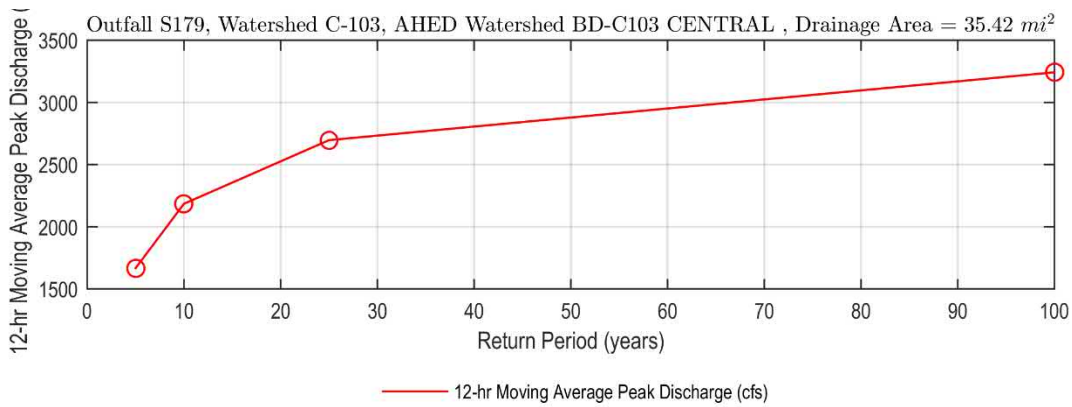


Figure 300 Structure S179 Peak Discharge for Return Period

Validation of the computed design events was determined using the USGS methodology for watershed discharges and Log Pearson III analysis for extreme events. First, the peak discharges through structure S20F were determined for the period of record. Table 137 lists the observed instantaneous discharges (mean and maximum) on an annual basis:

Table 137. DBHYDRO Observed Min and Max Peak Discharges for S20F (DBKEY 65046)

Year	Mean (cfs)	Maximum (cfs)	Std. Dev. (cfs)
1986	175.515	2,367.15	300.95
1987	181.135	2,354.52	310.79
1988	229.174	2,443.01	373.36
1989	48.327	1,069.66	153.83
1990	247.812	1,848.88	309.95
1991	251.976	1,955.87	357.48
1992	219.527	5,671.66	395.98
1993	253.68	2,448.71	341.94
1994	317.577	2,887.25	404.38
1995	400.168	3,015.61	480.13
1996	294.721	2,102.75	388.2
1997	234.543	3,158.71	416.51
1998	240.906	2,032.82	348.03
1999	271.938	3,679.70	441.22
2000	246.381	3,459.83	408.62
2001	240.788	3,640.71	372.09
2002	291.306	2,031.31	414.72
2003	298.76	3,256.26	381.26
2004	190.053	3,168.77	331.25
2005	313.835	3,786.10	469.74
2006	164.618	2,241.13	265.44
2007	204.066	3,259.05	320.18
2008	210.249	3,026.09	339
2009	298.729	2,922.60	437.03
2010	244.213	2,565.59	341.85
2011	205.983	2,886.54	328.07
2012	288.15	2,296.61	344.56
2013	296.557	2,127.88	333
2014	246.704	2,224.94	310.27
2015	248.318	3,323.50	388.4
2016	320.539	2,150.71	321.3
2017	415.917	4,798.16	484.59
2018	345.203	2,994.60	391.61
2019	317.997	1,909.25	368.61
2020	284.9	2,127.76	400.33

The Log Pearson III probability distribution parameters were determined using the HEC-SPS software. Confidence intervals of 5% and 95% were used as criteria of fitting computed discharges as function of return frequencies.

The structure flows for all SLR scenarios were within the 95% confidence limits of the Log-Pearson III analysis for the 100-year event as shown on Figure 301.

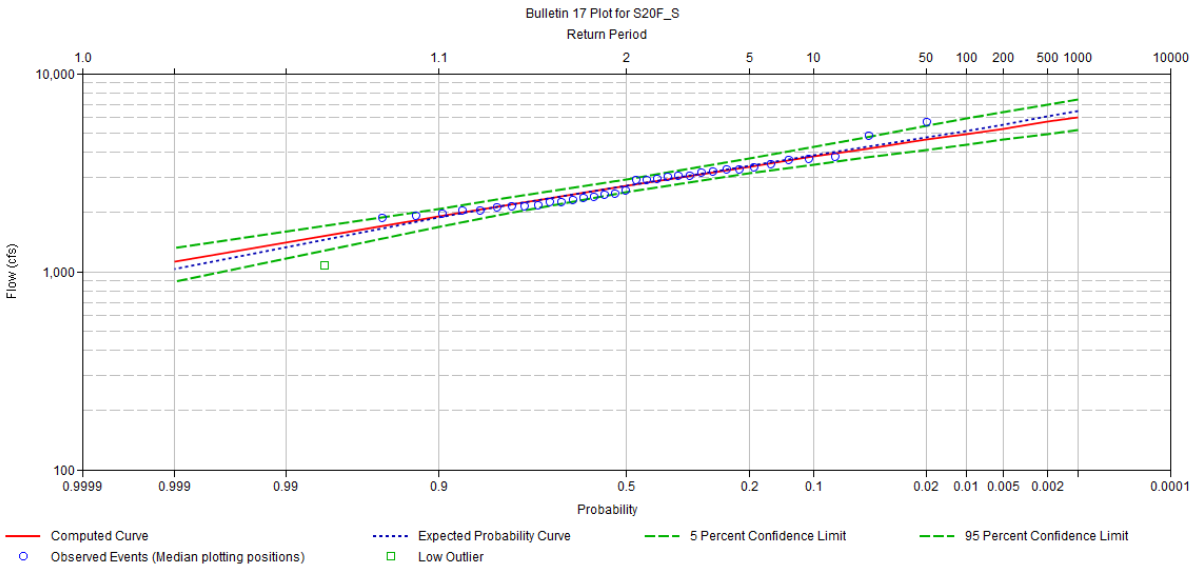


Figure 301. Log-Pearson III Analysis of Return Period for Discharges in Structure S20F_S

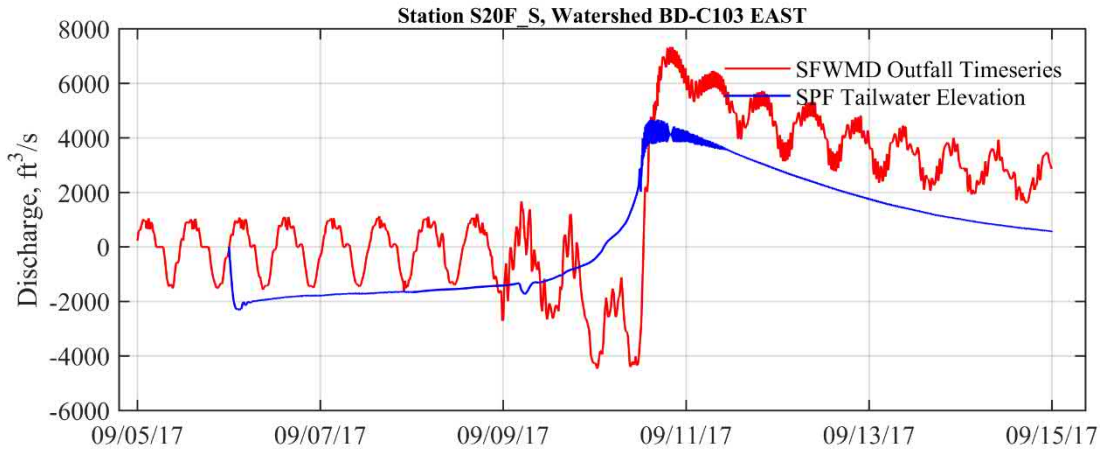


Figure 302 Comparison of Discharges at Structure S20F for SPF tail water and SFWMD Tailwater

The rating of structure S20F_S for SPF is 4,900 cfs. The instantaneous discharge from the 100-year, 72-hour design event is 7,174 cfs, and for the 12-hour moving average, 6,362 cfs, and is at the highest range of the 95% confidence limits.

The main factors for the higher computed discharge values at the structures is attributed to the difference in the boundary conditions used to derive the structure capacity and the boundary outfall conditions used in the model. The original design uses a steady state boundary of 2.5 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.0 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (100-yr Outfall Timeseries provided by SFWMD and Steady State boundary originally used as design criteria).

5.5.5 C-103: PM5 Frequency of Flooding

Table 138 through Table 140 summarize the area of flooding shown in the C-103 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. Figures A-77 through A-81, A-85 through A-88, A-92 through A-96 in Appendix A, Flood Extent and Duration Maps for Current Conditions, show the inundation depths for the watershed, agricultural, urban and wetland areas in the C-103 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively. The total area of the C-100 watershed is 39,871.71 acres (based on GIS data). The values in the tables are based on discretization to 100 m raster which results in total watershed area 39,821 acres with 18,894 acres urban land, 12,150 acres agricultural and 9,420 acres wetlands.

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval.
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 138 Summary of the PM#5 Flood Inundation Area in acres for the C-103 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	28639	26366	22207	14574
0.25 >= 0.50 ft	2261	2231	2844	4609
0.50 >= 0.75 ft	2221	2197	2199	2965
0.75 >= 1.00 ft	2081	2244	2177	2377
1.00 >= 1.25 ft	1572	2016	2244	1982
1.25 >= 1.50 ft	917	1532	2219	2125
1.50 >= 1.75 ft	556	966	1715	2041
1.75 >= 2.00 ft	309	591	1263	2068
2.00 >= 2.25 ft	183	358	838	1826
2.25 >= 2.50 ft	133	205	474	1589
>= 2.50 ft	949	1114	1641	3665
Note: Rows provide the inundation areas in acres for each flood depth interval, Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 139. Summary of the PM#5 Flood Inundation in Acres for the Urban Areas of the C-103 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	17455	16689	14856	10549
0.25 >= 0.50 ft	284	605	1305	2802
0.50 >= 0.75 ft	217	334	704	1562
0.75 >= 1.00 ft	166	235	445	1050
1.00 >= 1.25 ft	138	180	309	672
1.25 >= 1.50 ft	91	146	225	489
1.50 >= 1.75 ft	89	111	171	294
1.75 >= 2.00 ft	64	106	146	252
2.00 >= 2.25 ft	35	64	146	203
2.25 >= 2.50 ft	25	52	96	195
>= 2.50 ft	329	371	492	825
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 140. Summary of the PM#5 Flood Inundation in Acres for the Agricultural Areas of the C-103 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	8846	8004	6321	3445
0.25 >= 0.50 ft	808	739	1095	1623
0.50 >= 0.75 ft	739	746	783	1142
0.75 >= 1.00 ft	704	813	652	946
1.00 >= 1.25 ft	425	670	815	689
1.25 >= 1.50 ft	247	487	912	630
1.50 >= 1.75 ft	146	240	558	709
1.75 >= 2.00 ft	89	138	356	843
2.00 >= 2.25 ft	54	126	220	751
2.25 >= 2.50 ft	25	67	119	521
>= 2.50 ft	67	121	319	850
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 141. Summary of the PM#5 Flood Inundation in Acres for the Wetland Areas of the C-103 Watershed

Water Depth (ft)	5-Year	10-Year	25-Year	100-Year
0 < 0.25 ft	2918	2147	1478	937
0.25 >= 0.50 ft	1166	890	477	230
0.50 >= 0.75 ft	1240	1129	707	282
0.75 >= 1.00 ft	1211	1191	1075	430
1.00 >= 1.25 ft	1003	1169	1147	633
1.25 >= 1.50 ft	581	902	1072	993
1.50 >= 1.75 ft	324	635	974	1030
1.75 >= 2.00 ft	163	358	766	986
2.00 >= 2.25 ft	84	173	504	870
2.25 >= 2.50 ft	94	89	277	870
>= 2.50 ft	635	736	944	2160
Note: Rows provide the inundation areas in acres for each flood depth interval				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Figures A-77 through A-81, A-85 through A-88, A-92 through A-96 in Appendix A Flood Extent and Duration Maps for Current Conditions are flood depth maps showing the flood depth in the entire watershed and the agricultural, urban and wetland areas of the C-103 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

For PM5, C-103 Watershed is assigned LOS rating of 5-year (Table 142), mainly because of the flooding in the agricultural areas.

Table 142. PM#5 Assessment for C-103 Watershed

Canal	LOS Rating
Areas draining to C-103	Areas east of S179 to the coast are mostly wetlands and have a flood inundation depth between 0.5 – 1.25 feet for 25-year design event and above 2.25 feet for 100-year design event. But PM1 results show that C-103 primary canal system east of S179 can convey up to 100-year design storm. This shows the inundation is due to the wetlands holding water. Urban areas on C-103 Central watershed are being affected with flooding of less than 0.75 feet of depth for 100-year design storm. For 25-year design storm, the flooding depth is less than 0.5 feet.
Areas draining to C-103S	Areas east of the C-103S canal are flooded with 0.25 – 1 feet water depth for 25-year design storm, and above 2.25 feet for 100-year LOS. For 10-year and 5-year design storms, the flooding depths are minimal (< 0.25 feet), in general.
Areas draining to C-103N	Areas upstream US-1 Highway has inundation areas with 0.5 – 2.25 feet flood depth for 25-year design event and above 2.25 feet flood depth for 100-year design event. The results of PM#5 indicate that 100-year design storm would result in significant flooding (> 2.25 feet) for

	the area upstream S-166, in agricultural areas without adequate drainage canals. For 10-year event, these areas have approximately 1 feet of water and for 5-year design storm, the flooding depth is 0.75 – 1.25 feet. Urban areas that drain to this canal have inundation depths that are similar for all design storms, generally between 0.25 feet and 0.5 feet. Urban areas provide higher LOS than the agricultural areas.

5.5.6 C-103: PM6 Duration of Flooding

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S20F_H to return to target reference stage, which was defined based on the average prior to the storm event, Average S20F _H (period of 9/1-9/8) = -0.08 ft NAVD 88.

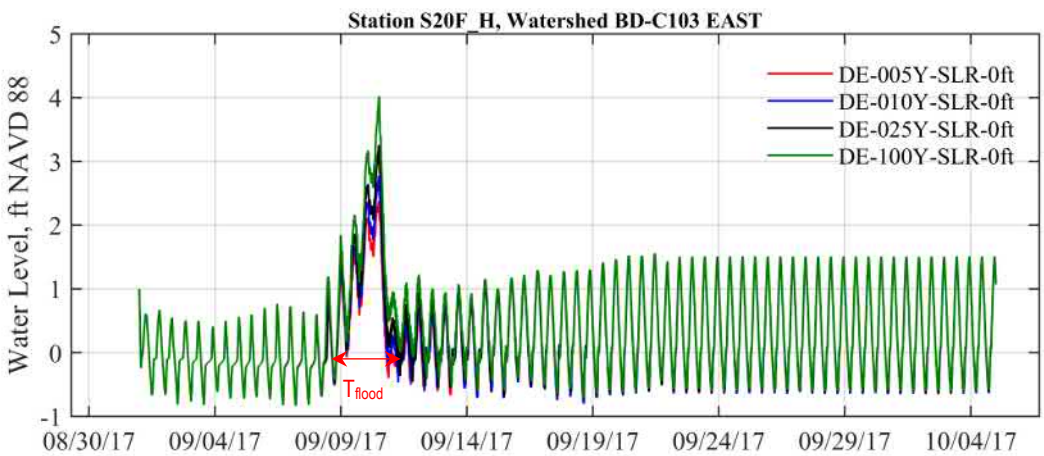


Figure 303 Flood Duration Period

The flood duration for 5-yr, 10-yr, 25-yr and 100-yr are shown in Table 143.

Table 143 Flood Duration at Headwater of Structure S20F

Duration of Flooding (hr)	5-Year Time (hr)	10-Year Time (hr)	25-Year Time (hr)	100-Year Time (hr)
S20F_H	7.50	8.50	21.67	40.75

Table 144 through Table 116 provide a summary of the areas in C-103 Watershed with flood depths greater than 0.25 ft for the specified duration interval for the entire C-103 watershed and the urban areas of the C-103 watershed.

Table 144. Summary of the PM#6 Flood Duration Area in Acres for the C-103 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	52	151	329	1119
1 - 4 hr	153	272	484	1201
4 - 8 hr	195	259	469	1001
8 - 12 hr	279	272	390	778
12 - 24 hr	949	1030	1577	2263
24 - 48 hr	1779	1903	2081	3254
48 - 96 hr	3247	3442	3487	3739
96 - 168 hr	1925	2859	3897	4245
168 - 240 hr	568	1077	1863	3217
240 - 360 hr	190	334	914	2051
> 360 hr	1747	1856	2123	2377
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 145. Summary of the PM#6 Flood Duration Area in Acres for the Urban Areas of the C-103 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	20	94	262	833
1 - 4 hr	67	148	326	768
4 - 8 hr	44	148	262	630
8 - 12 hr	69	109	180	512
12 - 24 hr	136	324	806	1401
24 - 48 hr	161	284	684	1762
48 - 96 hr	252	297	435	1038
96 - 168 hr	183	203	287	455
168 - 240 hr	82	158	198	257
240 - 360 hr	35	32	141	255
> 360 hr	390	408	457	435
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 146. Summary of the PM#6 Flood Duration Area in Acres for the Agricultural Areas of the C-103 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	17	49	57	269
1 - 4 hr	40	91	126	390
4 - 8 hr	47	67	156	311
8 - 12 hr	94	82	148	232
12 - 24 hr	371	331	581	736
24 - 48 hr	563	670	786	1245
48 - 96 hr	1075	1164	1315	1700
96 - 168 hr	665	986	1384	1633
168 - 240 hr	183	395	640	1191
240 - 360 hr	40	84	371	707
> 360 hr	210	227	267	289
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Table 147. Summary of the PM#6 Flood Duration for the Wetlands Areas of the C-103 Watershed

Duration of Flooding (hr)	5-Year	10-Year	25-Year	100-Year
0.1 - 1 hr	7	10	17	30
1 - 4 hr	49	32	32	47
4 - 8 hr	104	47	52	52
8 - 12 hr	126	77	59	35
12 - 24 hr	437	381	203	166
24 - 48 hr	1038	949	650	274
48 - 96 hr	1955	1994	1717	1050
96 - 168 hr	1090	1680	2234	2160
168 - 240 hr	311	546	1038	1782
240 - 360 hr	124	217	423	1114
> 360 hr	1260	1339	1517	1774
Notes: Rows provide the inundation areas in acres for each time interval				
Areas with flood duration less than 0.1 hour are not listed				
Watershed C-103 covers 39,872 acres, or 62.300 square miles				

Figures A-77 through A-81, A-85 through A-88, A-92 through A-96 in Appendix A Flood Extent and Duration Maps for Current Conditions are flood duration maps corresponding to Table 144 through Table 147 and showing the flood duration in the entire watershed and the agricultural, urban and wetland areas of the C-103 Watershed, for the 5-year, 10-year, 25-year, and 100-year 72-hour design storm events, respectively.

5.5.7 LOS Rating of C-103 Watershed for Current Conditions

The C-103 Watershed has been assigned a 5-year FPLOS rating for the current hydrologic conditions. For this overall rating, weight was placed on PM1, as the primary canals in this watershed collectively are expected to contain the 5-year storm event within its MIKE 1D right and left banks as modeled.

6 FLOOD PROTECTION LEVEL OF SERVICE FOR FUTURE CONDITIONS

The District LOS program relies on six performance metrics (PMs) to evaluate the flood protection provided by the primary SFWMD infrastructure defined in *Section 2 Flood Protection Level of Service Definitions for South Miami-Dade*. This section describes the model setup and analysis of model results for each of the performance metrics indicators for current conditions:

- **PM1 - Maximum Stage in Primary Canals:**
- **PM2 - Maximum Daily Discharge Capacity through the Primary Canals:**
- **PM3 - Structure Performance:**
- **PM4 - Peak Storm Runoff:**
- **PM5 - Frequency of Flooding:**
- **PM6 - Duration of Flooding:**

6.1 Model Setup for Future Conditions

The future conditions model was developed by modifying the existing conditions model which was presented in *Section 5 Flood Protection Level of Service for Existing Conditions* of this document. The modifications to the existing conditions model reflect changes in future structure operations, tailwater boundary conditions, future land use and development, future topography, and initial conditions. This section provides a summary of the model revisions and updates applied to the existing conditions model.

6.1.1 Period of Simulation

For the future conditions model, the length of simulation for the existing conditions model was modified.. The calibration model was set up for a 2-month simulation period. The future conditions model is set up for 35 days and includes a 10-day warm-up period prior to the beginning of the stormwater event, 3-day design storm event, and 4 weeks to capture the recession hydrograph. The period of simulation covers September 1st to October 5th based on preliminary model runs and discussion with the SFWMD review team.

6.1.2 Topography

The topography of Miami-Dade County which was used for development of the model topography is shown in Figure 304. To determine the required changes to apply for the future topography the following approach was applied: Parcels with properties older than 1970 (50 years) and vacant parcels were used to determine spatial extent of future changes in topography:

- Parcels with acreage of less than 1 acre were excluded considering one model cell is less than 2.47 acres and will not reflect changes in the model topography.
- The future topography considered two regulatory products: i) FEMA's Base Flood Elevation (Figure 305) which requires the first finish floor of a building structure to be above the 100-Year flood level and ii) Miami-Dade County Flood Criteria (CFC) which requires future minimum elevations of parcels and crown of the roads (for new or substantial upgrade which is greater than 50% of the property value) to be above the CFC.
- The CFC directly relates to the parcel elevation and the topography; therefore, the future topography was developed based on Miami-Dade County's CFC (Figure 306).

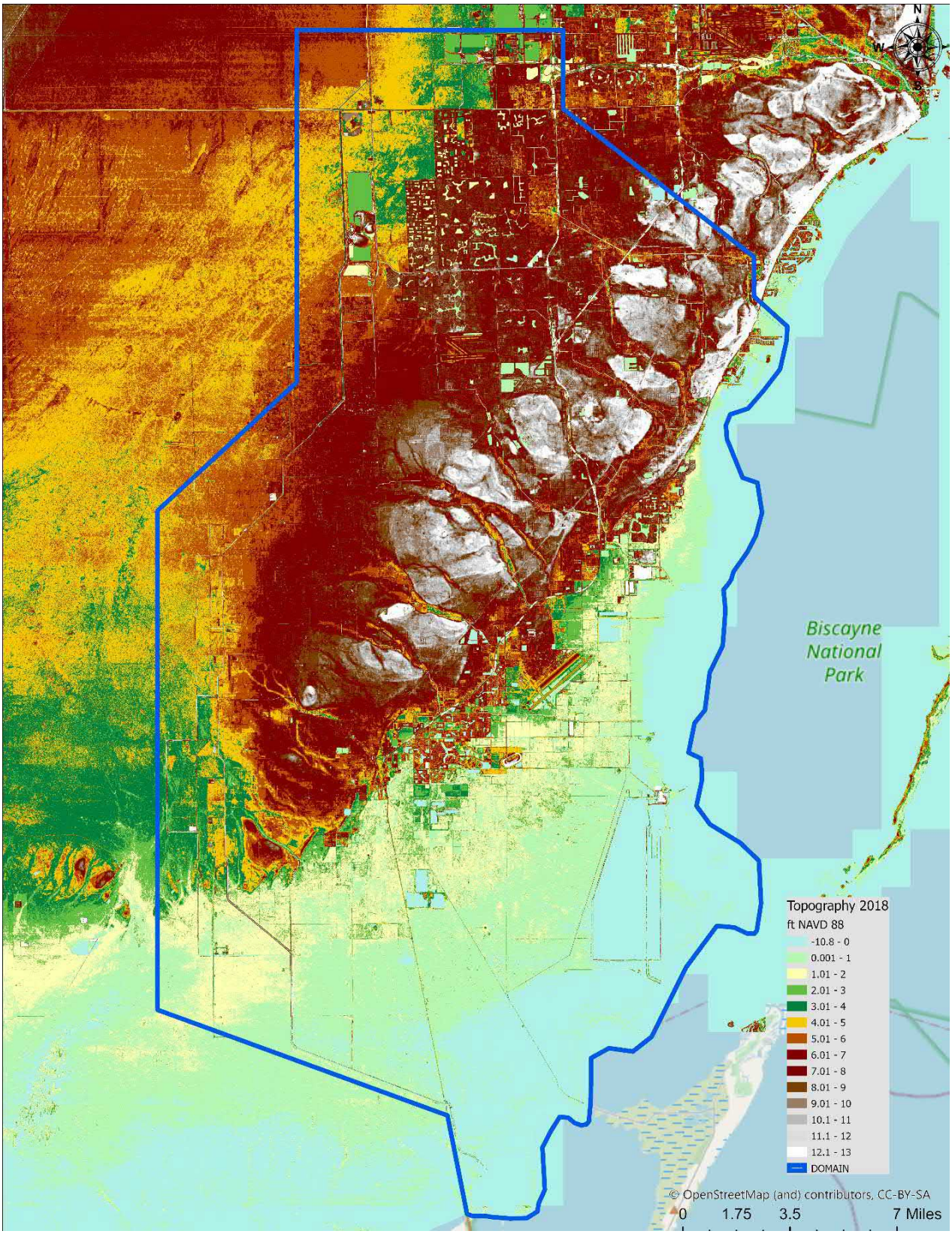


Figure 304 Miami Dade County Topography

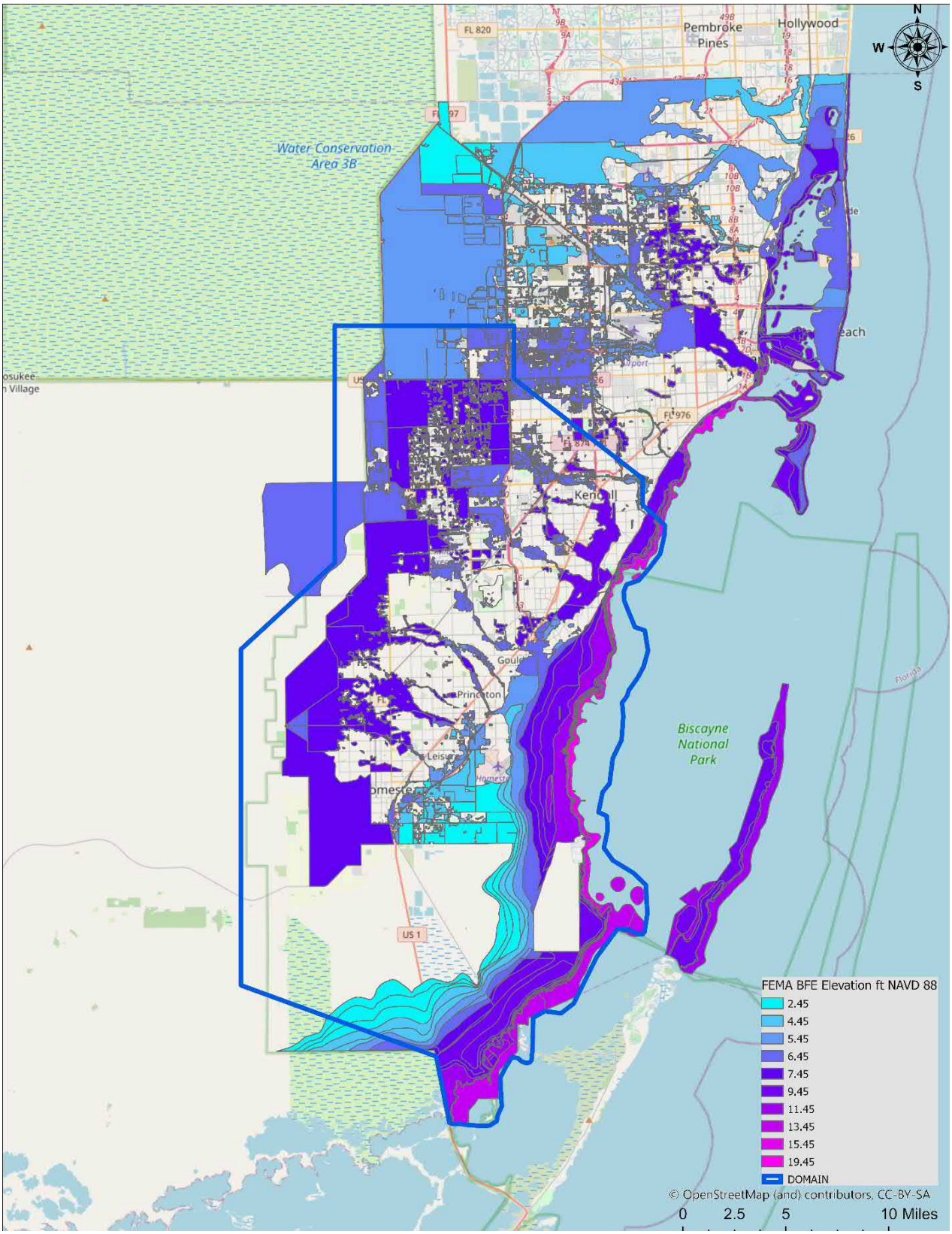


Figure 305 FEMA BFE for Miami Dade County

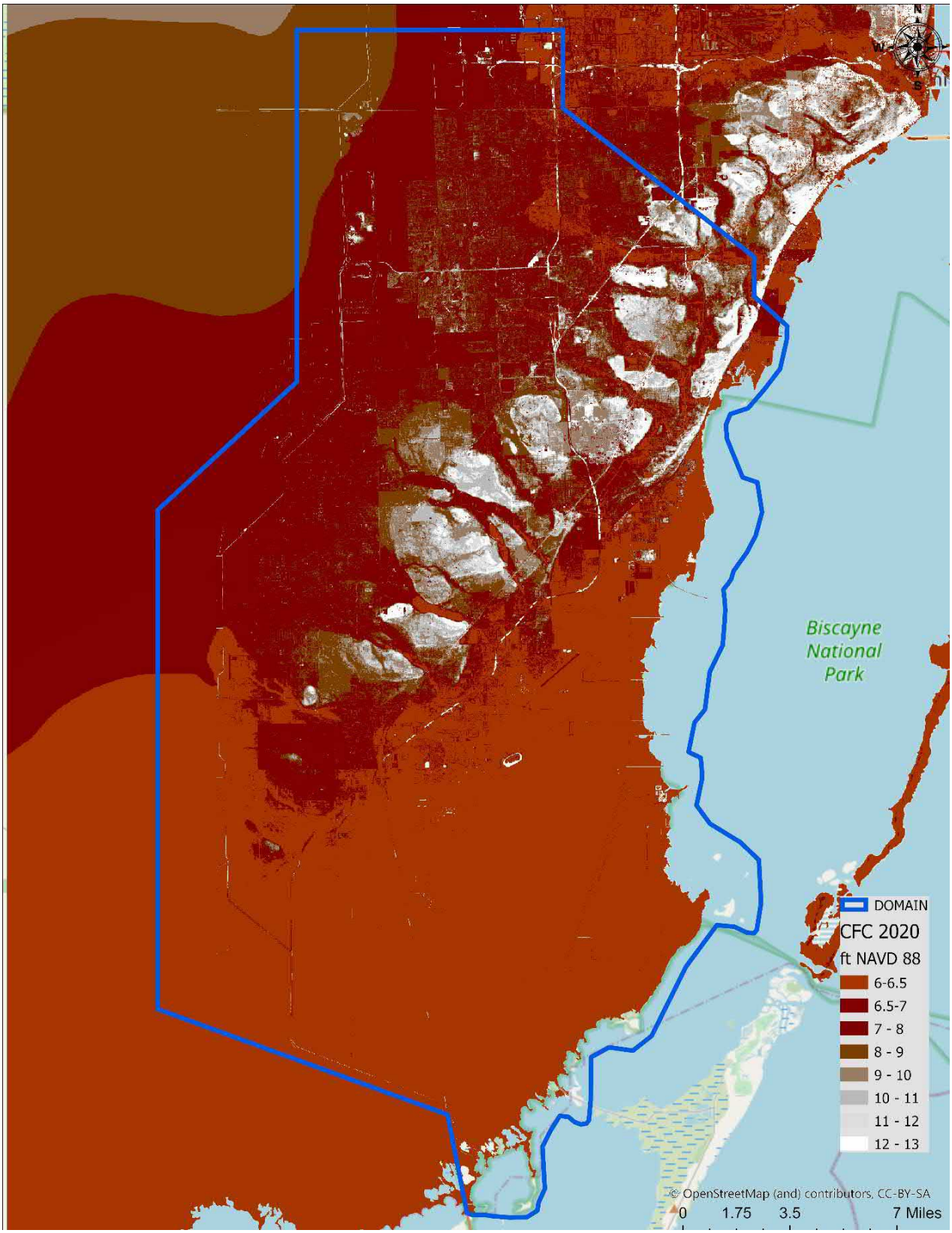


Figure 306 Miami Dade County Flood Criteria

- The vacant parcels and the parcels older than 50 years within the Urban Development Boundary were combined into a single layer and the elevations of the CFC were extracted and combined with the latest DEM assuming that at the extent of vacant parcels and parcels with properties older than 50 years, the CFC elevations apply.
- A total of 1,448 vacant parcels larger than 1 acre were selected for sensitivity testing of future topography changes (Figure 307). A total of 2,346 cells have changed value (Figure 309) with an average change in elevation of 2.27 feet (total volume of topography change is 13,153.79 ac-feet).
- A total of 178 vacant parcels larger than 10 acres were selected for sensitivity testing of future topography changes (Figure 308). A total of 1,258 cells have changed value (Figure 310) with average elevations of 2.56 feet (total volume is 7,954 ac-feet).

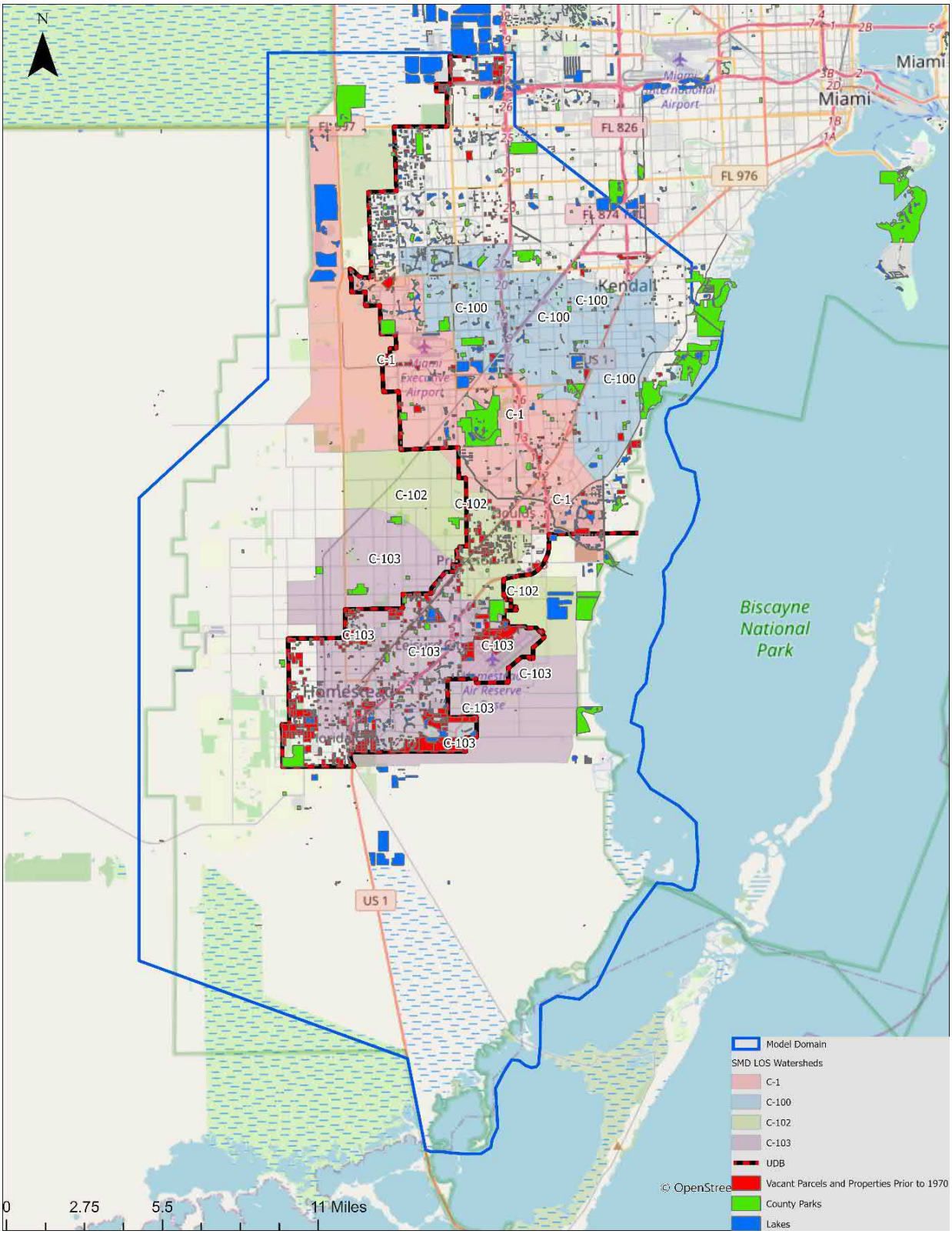


Figure 307 Vacant Parcels and Parcels with Properties Developed Prior to Year 1970 Larger than 1 Acre within the Urban Development Boundary

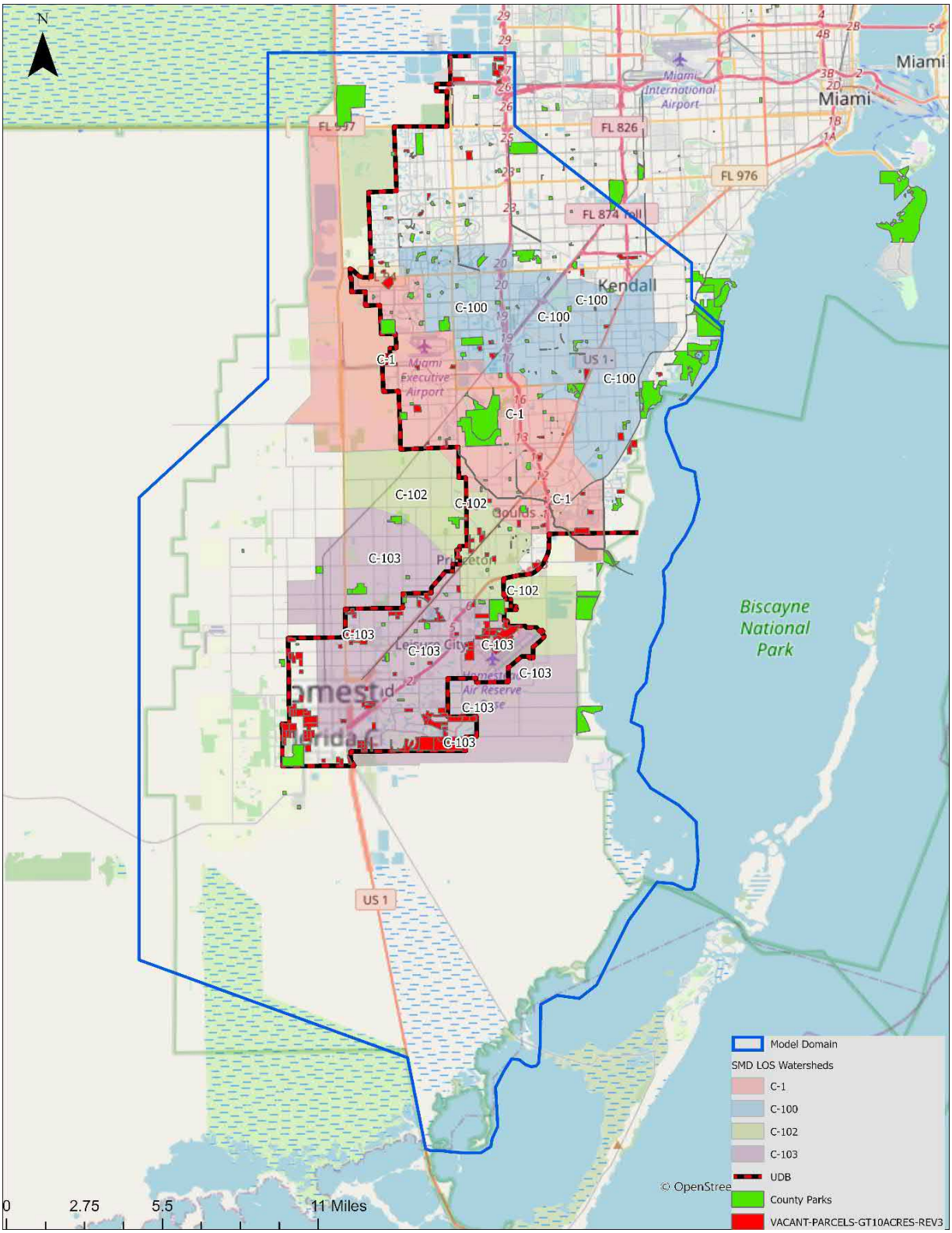


Figure 308 Vacant Parcels and Parcels with Properties Developed Prior to Year 1970 Larger than 10 Acre within the Urban Development Boundary

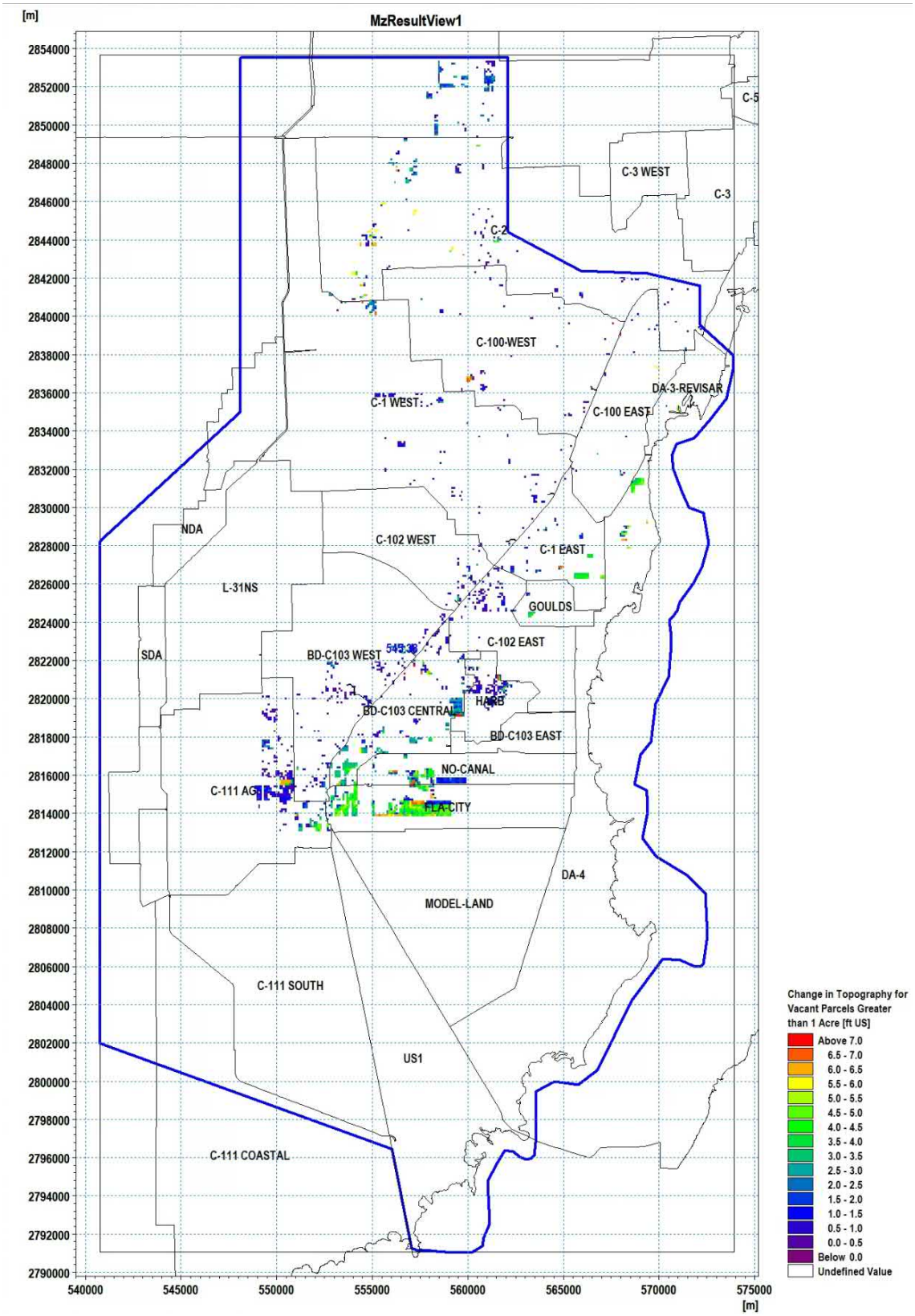


Figure 309 Changes to Future Topography for Acreage Greater than One Acre

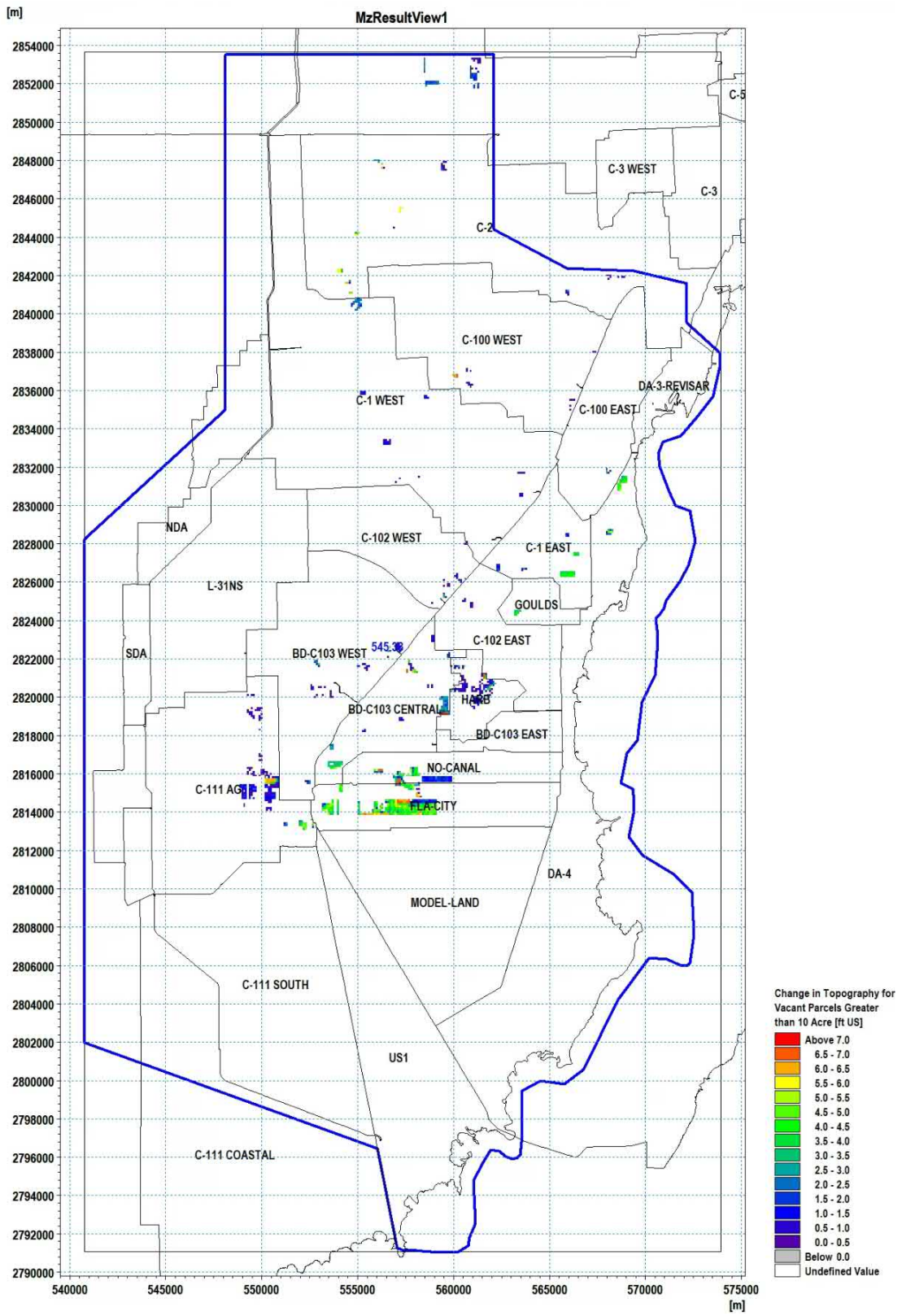


Figure 310 Changes to Future Topography for Acreage Greater than Ten Acres

6.1.3 Land Use

The land use component of MIKE SHE/ MIKE 1D defines parameters associated with land use classifications that affect hydraulic and hydrologic processes. The Florida Land Use and Cover Classification (FLUCCS) was obtained from SFWMD (Figure 311). Level 2 of the FLUCCS codes were used to derive overland runoff and vegetation parameters. The same set of parameters were used for the calibration and validation events, and for simulations of the current and future design events.

FLUCCS codes were aggregated into 20 categories based on similarity of land-use, as shown in Table 148. Agricultural lands are included in the Citrus, Pasture, and Truck Crops categories. Urban landscapes are included in the Urban Low Density, Urban Medium Density, Urban High Density, and Commercial categories. The MIKE SHE land use codes for each category are shown on the map in Figure 312.

Table 148. SFWMD Land Use Land Cover Codes

MIKE SHE Code	Model Land Use Type	SFWMD LULC Code
1	Citrus	2210, 2230, 2240, 2410
2	Pasture	2110, 2120, 2610, 8320, 2510, 8200
5	Truck Crops	2140, 2150, 2160
6	Golf Course	1820, 2420
7	Bare Ground	1620, 1630, 7400, 7430, 8350
8	Mesic, Xeric, Hydric Flatwood	3100, 3200, 3220, 3300, 4110, 4410, 6250
9	Mesic, Xeric Hammock	4200, 4220, 4270, 4300, 4340, 4370
13	Hydric Hammock	4240, 6110, 6111, 6172, 6180
14	Wet Prairie	6430
16	Marsh	6410, 6420
17	Cypress	6210, 6215, 6216
18	Swamp Forest	6170, 6191, 6300
19	Mangrove	6120
20	Water	1660, 5110, 5120, 5300, 5410, 5420, 5430, 5710, 6500, 6510, 8340, 8360
22	Sawgrass	6411
23	Emergent Marsh	6440
41	Urban Low Density	1110, 1180, 1190, 1480, 1830, 1840, 1850, 1860, 1920, 2410, 2430, 2500, 2540, 8115, 8300, 8310
42	Urban Medium Density	1210, 1220, 1290
43	Urban High Density	1300, 1310, 1320, 1330, 1340, 1350, 1390, 1460, 1500, 1560, 1700, 1710, 1730, 1760, 8100, 8113, 8120, 8140, 8330
44	Commercial	1400, 1411, 1423, 1490

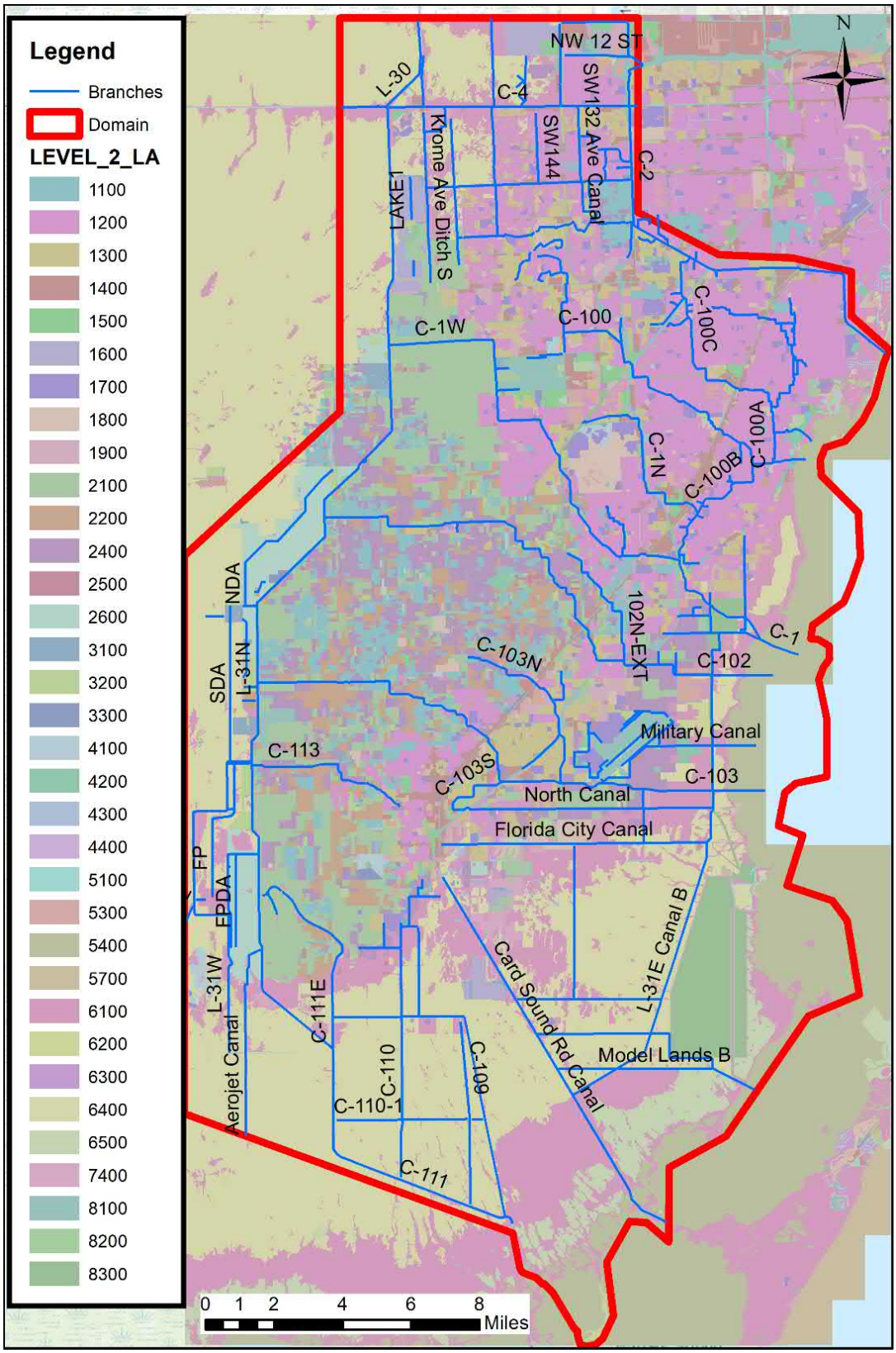


Figure 311. SFWMD Land Use and Land Cover Codes, Level 2

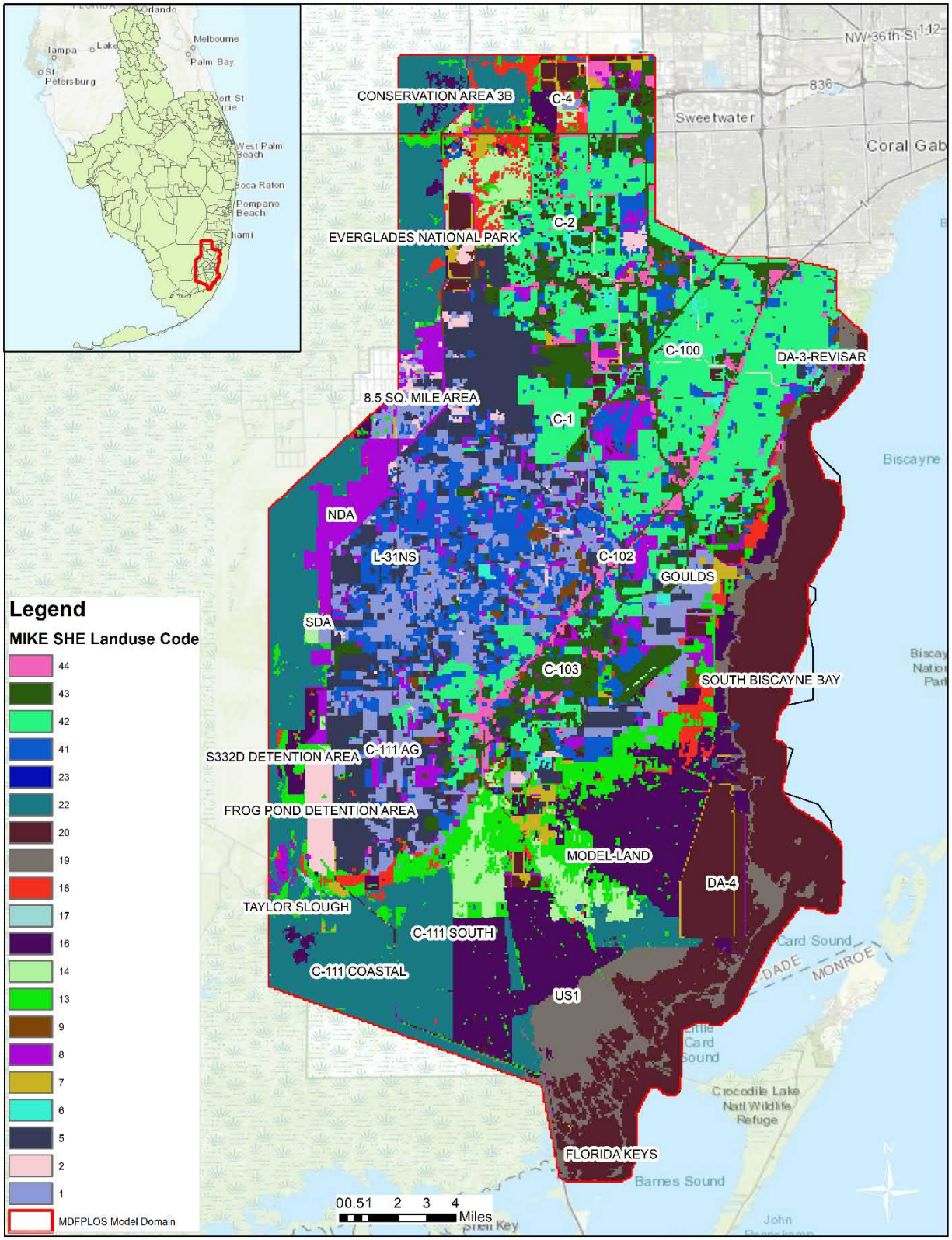


Figure 312. MIKE SHE Current Land Use Codes

The total area of each South Miami-Dade FPLOS land use classification is summarized in Table 149. Aside from water, the largest coverage is Medium Density Urban areas covering 13.1% of the total model domain, followed by Sawgrass (12.2%) and Marsh (8.6%).

Table 149. Land Use, MIKE SHE Code, Description and Area in SMD FPLOS Model Domain

MIKE SHE Code	MIKE SHE Description	Cell Count	Area (ac)	% of Total Area
1	Citrus	10305	25,464	7.3
2	Pasture	1987	4,910	1.4
5	Truck Crops	11388	28,140	8.1
6	Golf Course	525	1,297	0.4
7	Bare Ground	1436	3,548	1
8	Mesic, Xeric, Hydric (M.X.H.) Flatwood	7013	17,330	5
9	Mesic, Xeric Hammock	1180	2,916	0.8
13	Hydric Hammock	6911	17,077	4.9
14	Wet Prairie	3564	8,807	2.5
16	Marsh	12092	29,880	8.6
17	Cypress	43	106	0.03
18	Swamp Forest	2774	6,855	2
19	Mangrove	5663	13,994	4
20	Water	18638	46,056	13.2
22	Sawgrass	17159	42,401	12.2
23	Emergent Marsh	7	17	0.005
41	Urban Low Density	10581	26,146	7.5
42	Urban Medium Density	18421	45,519	13.1
43	Urban High Density	8723	21,555	6.2
44	Commercial	2559	6,323	1.8
	Total	**140969**	**348341**	**100%**

The Future Land Use model input dataset was developed using the land cover classification developed by SFWMD. The grid file discretization was based on Level 2 of the Florida Land Use, Cover and Forms Classification System (FLUCCS) codes. The OL runoff and vegetation parameters were also based on the Land Cover Classification. The Future Land Use data (2030) were obtained from Miami Dade County and is shown in Figure 313.

The Future Land Use data from Miami-Dade County provides generalized Land Use and is considerably coarser than the Current Land Use discretization from SFWMD. Minor changes of imperviousness, and more specifically, directly connected impervious areas, are reflected in the Future Land Use files. To determine changes in Future Land Use and to develop a model input dataset, the following conditions were taken into consideration:

- The Urban Development Boundary (UDB) limits urban development within this boundary, all changes of the overland flow parameters were applied within the UDB, while areas outside the UDB were left unchanged.
- Within the Urban Development Boundary only the vacant parcels were assumed to change Future Land Use Classification.
- From a flood control perspective, a more conservative conversion from current to future land use is considered by changing overland flow parameters in the direction of increasing runoff (development density increases, overland Manning's factors with reduced flow resistance, increased imperviousness) assuming:
    - Conversion of Open/Vacant to Low Density Land Use classification
    - Conversion of Low Density to Medium Density Land Use classification
    - Conversion of Medium Density to High Density Land Use classification
    - Conversion of Agricultural to Low Density Land Use classification
- The current Land Use classification of the vacant parcels was extracted, and the Land Use was modified to reflect the Future Land Use Layer from Miami-Dade County, as outlined further in this section.
- Vacant parcels in the Agriculture, Urban and Built-Up Land Uses were modified to reflect increased urbanization.
- In addition, the overland flow parameters were modified in order to reflect the projected increase of runoff due to higher development density and future population growth.
- Initially a total of 7,693 vacant parcels with a surface area of 6,775 acres were assumed to result in Land Use changes. Parcels with surface area of less than 1 acre were excluded and this resulted in a total of 1,448 parcels.
- For the sensitivity analysis, a second Land Use input dataset was developed which excluded parcels smaller than 10 acres. The objective was to determine the model response for the two land use scenarios considering the long-term implementation of land use changes.
- Future Land Use Projections (Highlighted are Future Land Use Changes) are listed in Table 150.

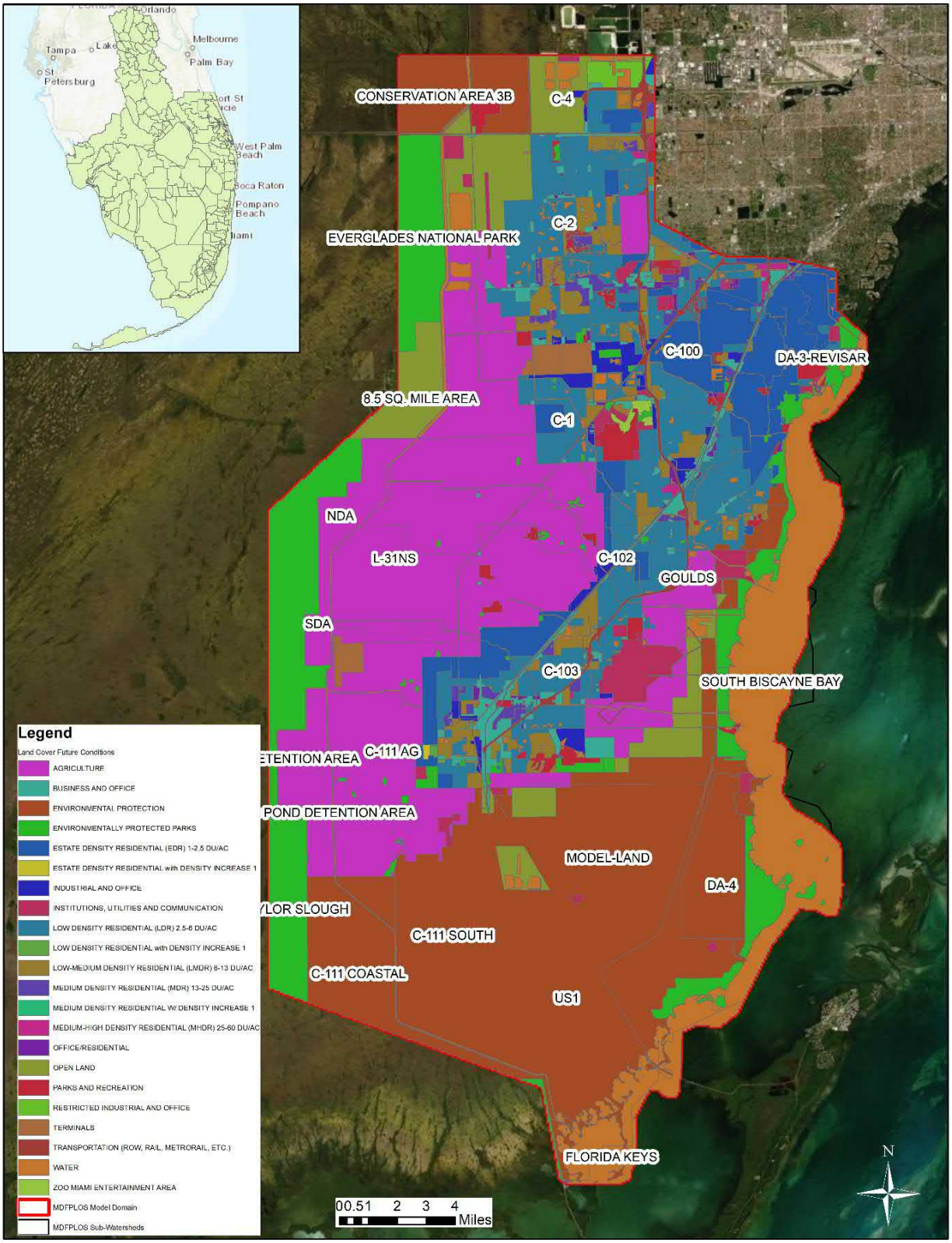


Figure 313. Miami-Dade County Future Land Use (2030)

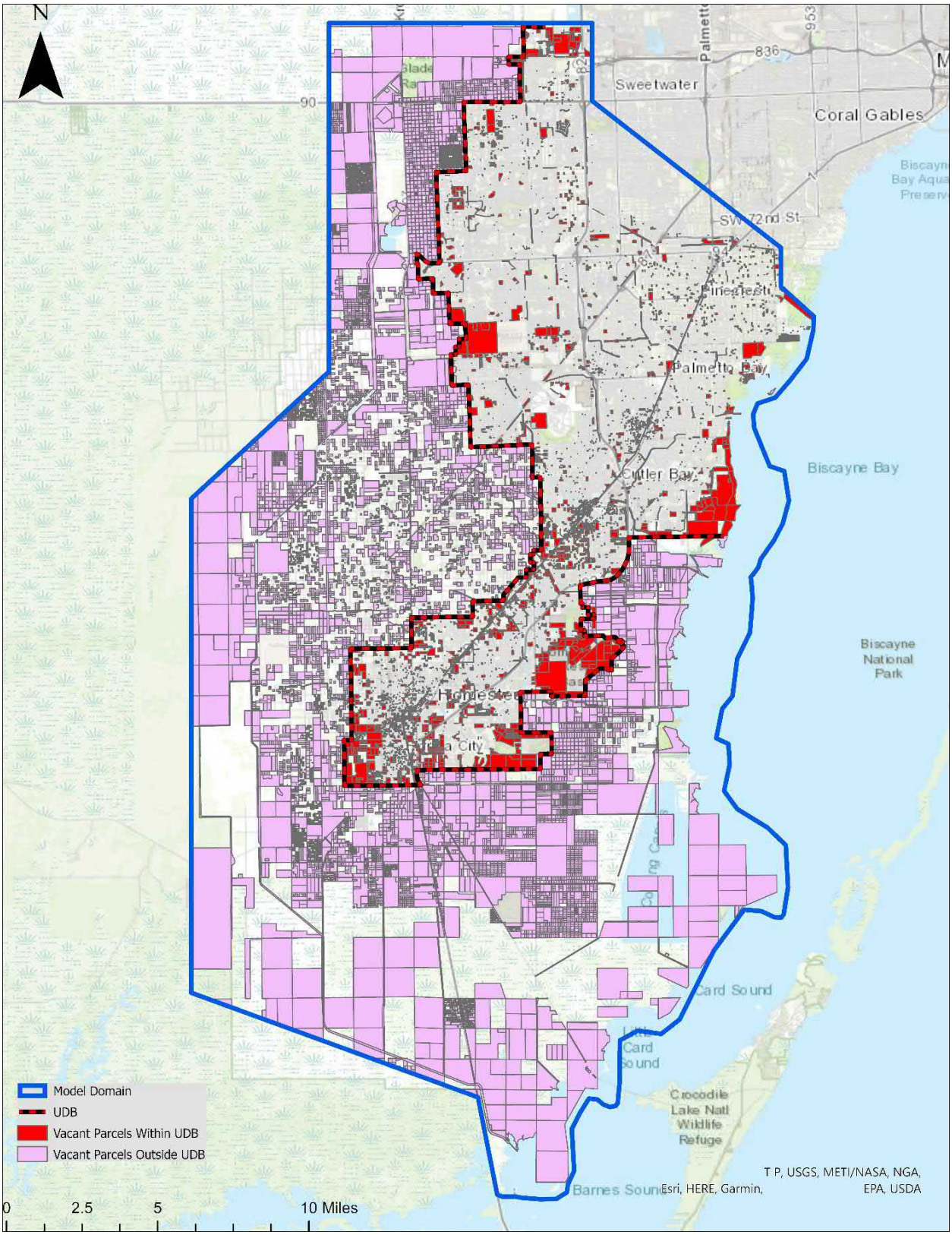


Figure 314. Vacant Parcels within Miami-Dade County's Urban Development Boundary

Table 150 Future Land Use Projections (Highlighted are Future Land Use Changes)

Category	Acreage	Count Vacant Parcels	Future Land Use
Agriculture	1887	4567	
Cropland and Pastureland	1259	3069	Residential, Low Density
Nurseries and Vineyards	297	824	Residential, Low Density
Other Open Lands - Rural	48	81	Residential, Low Density
Tree Crops	283	593	Residential, Low Density
Barren Land	101	434	
Disturbed Land	101	434	
Transportation, Communication & Utilities	249	1534	
Transportation	107	1117	
Utilities	142	417	
Upland Forests	222	1034	
Upland Coniferous Forests	26	457	
Upland Hardwood Forests	174	404	
Upland Mixed Forests	21	130	
Tree Plantations	1	42	
Upland Nonforested	200	453	
Herbaceous (Dry Prairie)	92	62	
Mixed Rangeland	23	98	
Upland Shrub and Brushland	85	292	
Urban And Built Up	7042	6559	
Commercial and Services	1005	800	
Extractive	5	250	
Industrial	145	125	
Institutional	178	1274	
Open Land	1020	1467	Residential, Low Density
Recreational	78	618	
Residential, High Density	743	366	
Residential, Low Density	1028	541	Residential, Medium Density
Residential, Medium Density	2840	1118	Residential, High Density
Water	88	738	
Bays and Estuaries	2	0	
Reservoirs	49	497	
Streams and Waterways	37	240	
Wetlands	364	2760	
Vegetated Non-Forested Wetlands	47	1256	
Wetland Hardwood Forests	317	1504	
Grand Total	**10153**	**18079**	

The areas which were modified in terms of MIKE SHE Land Use Code, Manning's M, and Detention Storage are summarized in Figure 315. The modifications of the MIKE SHE Land Use Code within the Urban Development Boundary is provided in Table 151.

Table 151 MIKE SHE Current and Future Land Use Code

Category	Current MIKE SHE Land Use Code	Future MIKE SHE Land Use Code
Agriculture		
Cropland and Pastureland	5	41
Nurseries and Vineyards	41	42
Other Open Lands - Rural	2	41
Tree Crops	1	41
Urban And Built Up		
Open Land	41	42
Residential, Low Density	41	42
Residential, Medium Density	42	43

Figure 316 and Figure 317 show the changes of land use within the model domain for the two sensitivity analysis scenarios, one- and ten-acre threshold of vacant parcel size for which land use change applies (as provided in Table 151).

Figure 318 and Figure 319 show the model land use input files for the two sensitivity analysis scenarios, one- and ten-acre threshold of vacant parcel size for which land use change applies (as provided in Table 151).

The two sets of maps were used to develop a sensitivity analysis to determine the model response to modified topography and land use assuming thresholds of one and ten acres for vacant properties.

To represent the additional storage requirements by Miami-Dade County, additional MIKE 1D branches representing ponds, were added to provide the required storage for a 25-yr/3-day event. Each area with modified land use will use provide approximately 10% of the newly developed land for detention storage.

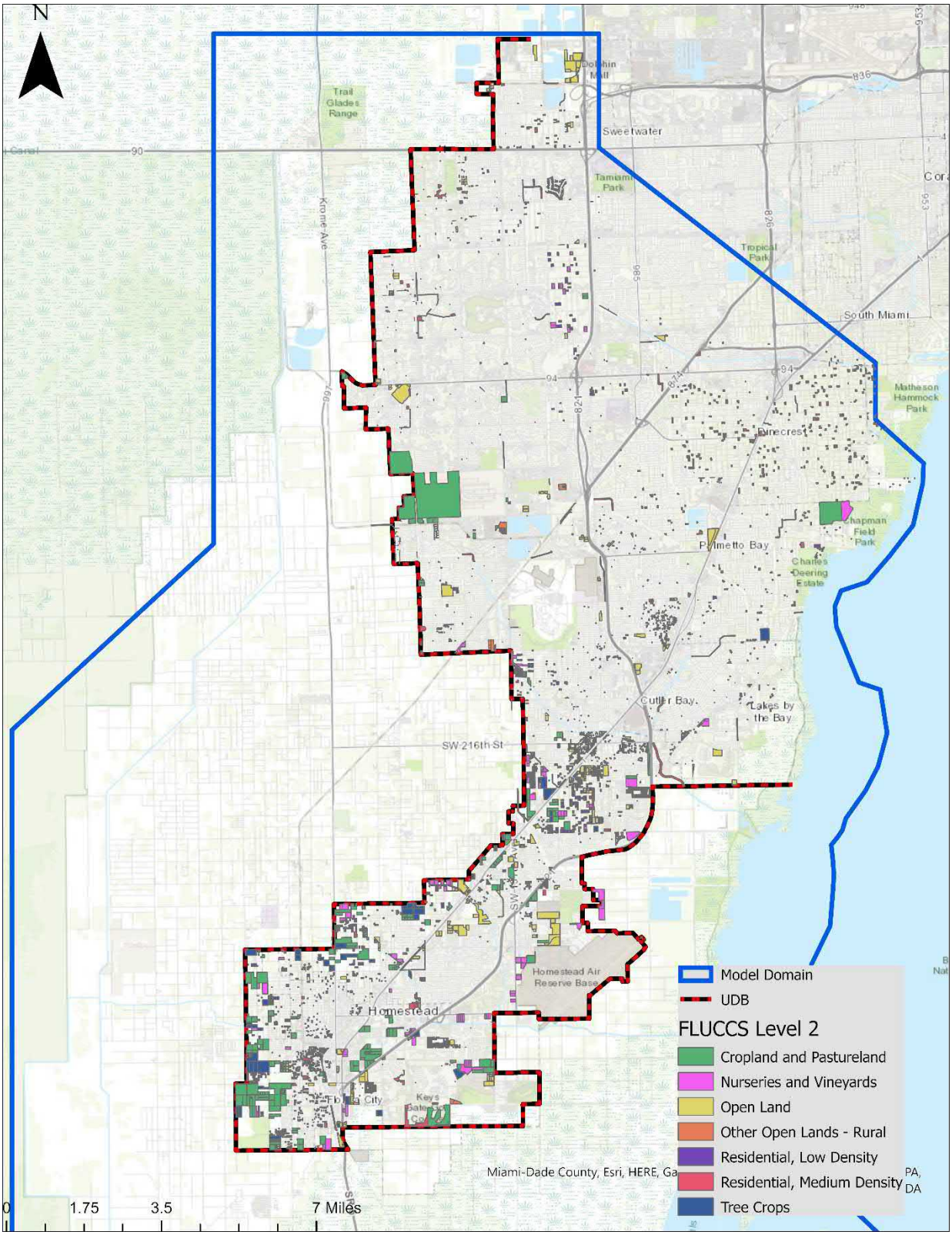


Figure 315. Future Land Use Changes within Urban Development Boundary

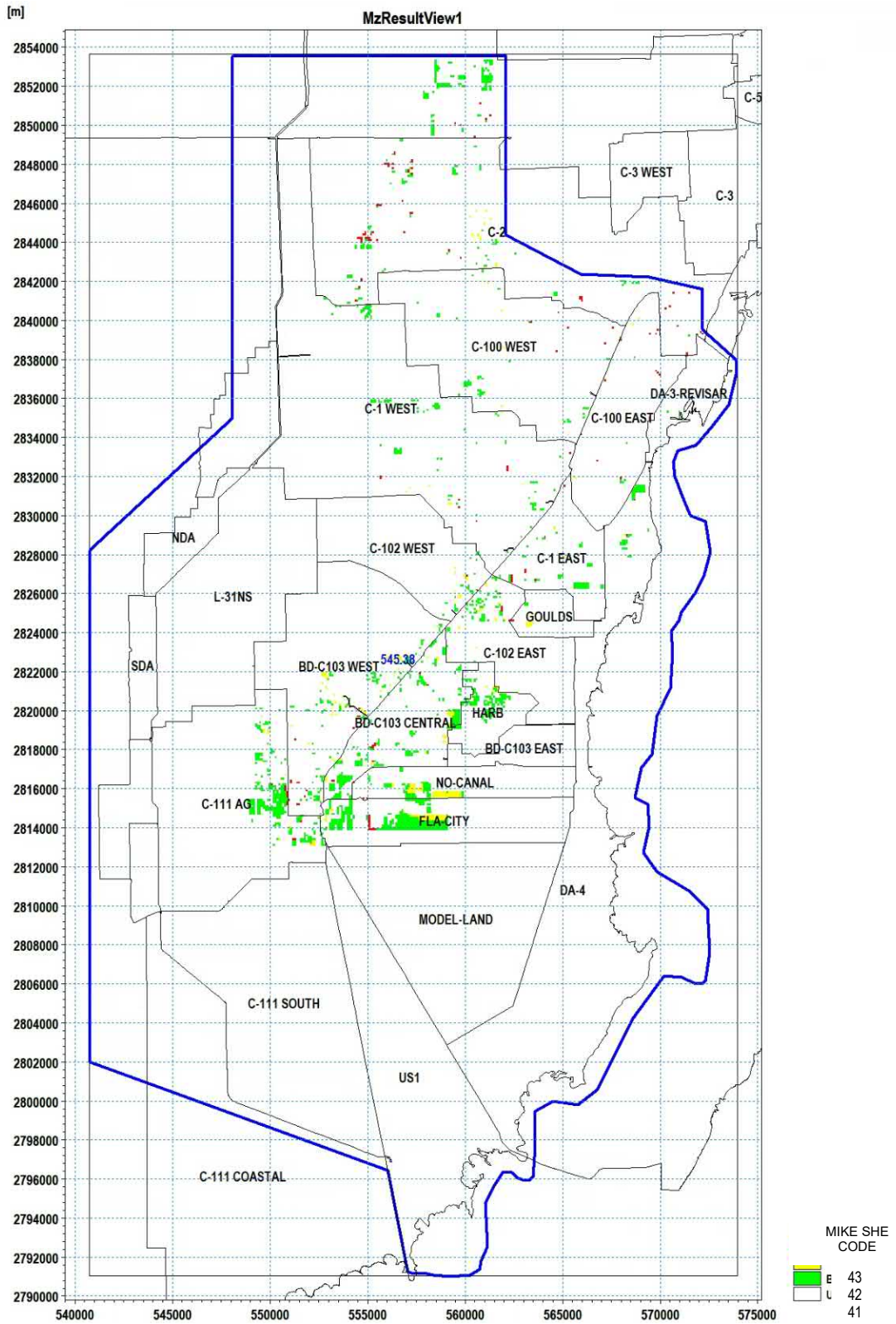


Figure 316. Future Land Use Changes within Urban Development Boundary for Vacant Properties Greater than One Acre (Codes Listed in Table 1519)

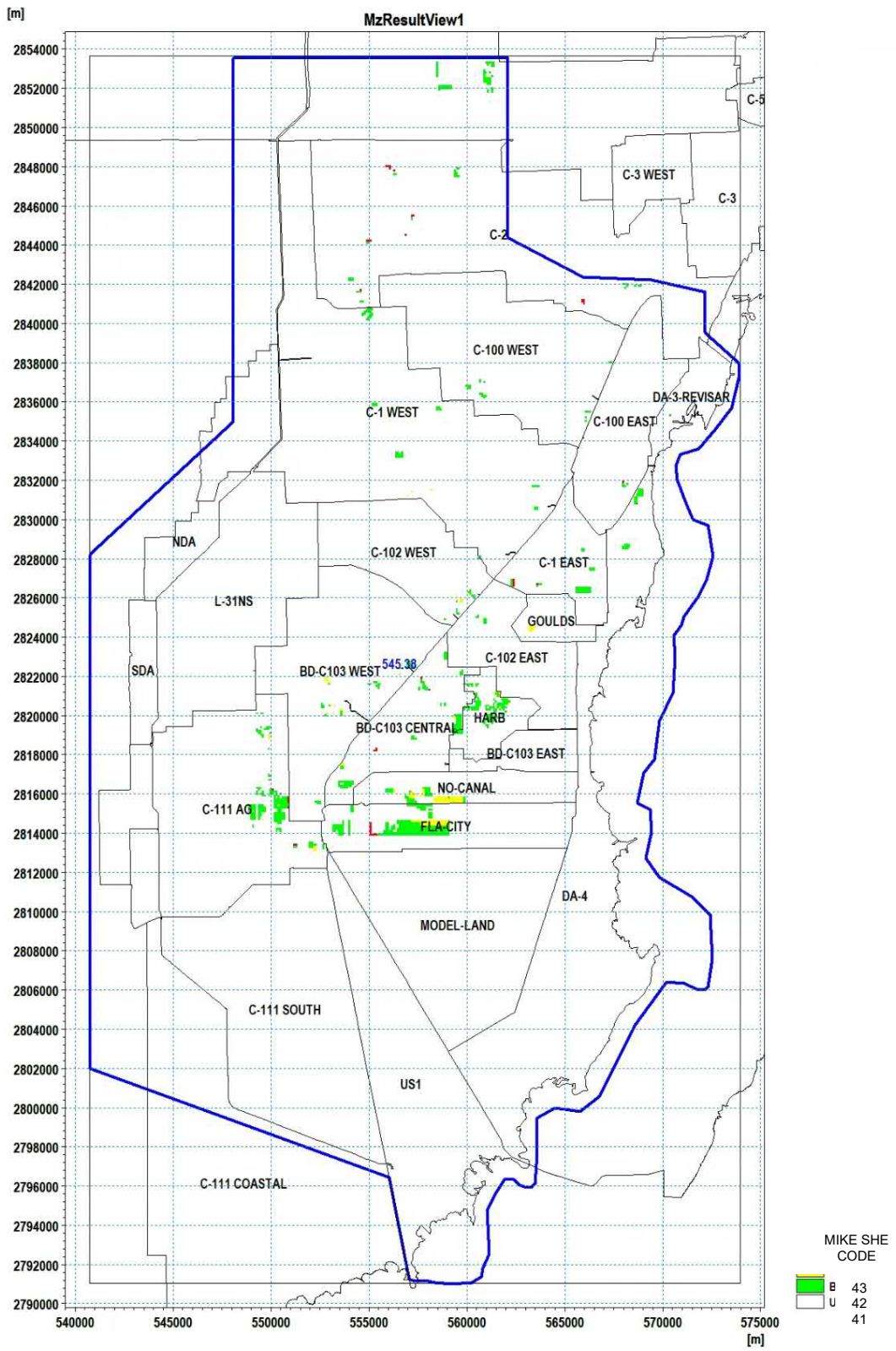


Figure 317. Future Land Use Changes within Urban Development Boundary for Vacant Properties Greater than Ten Acres (Codes Listed in Table 151)

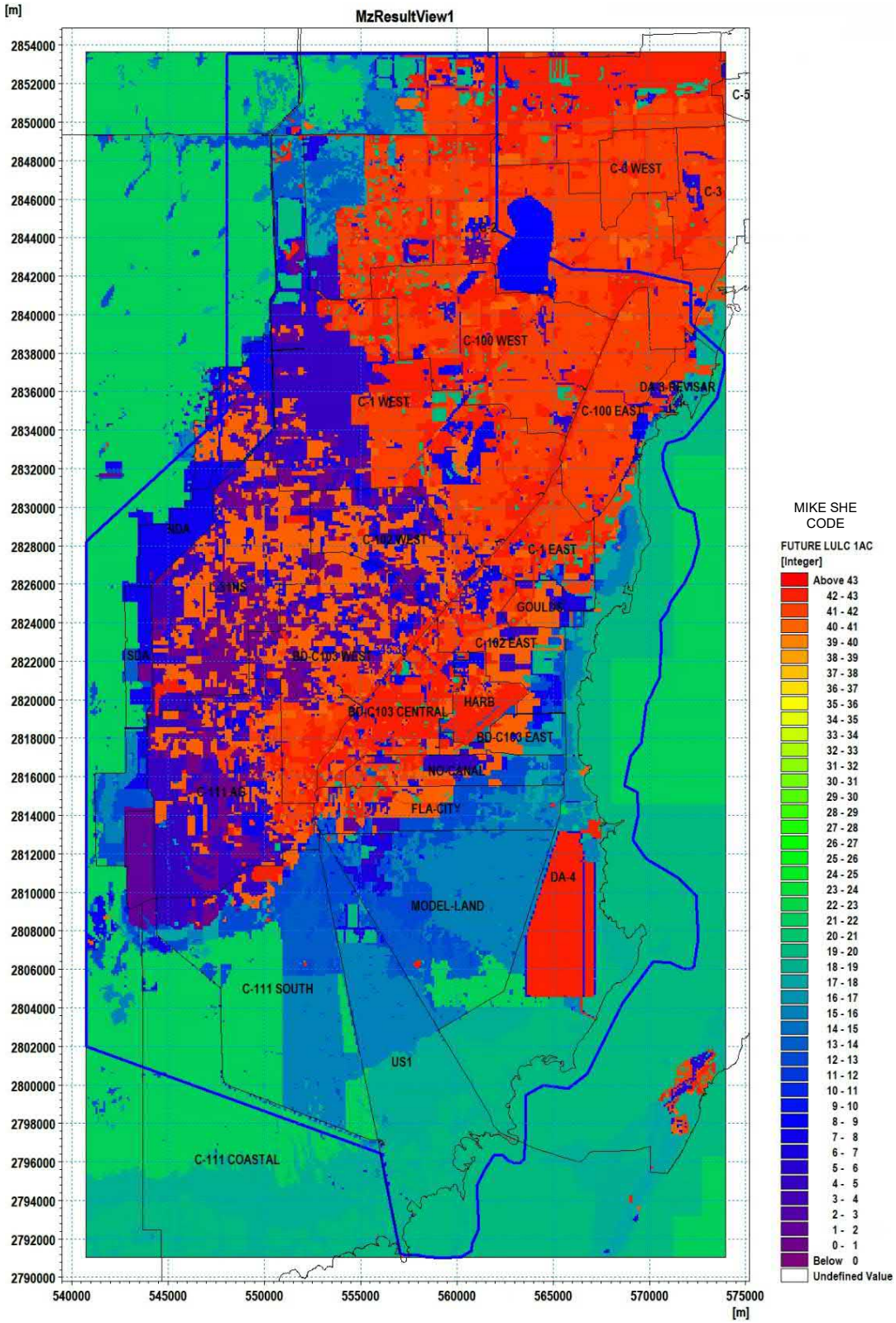


Figure 318. Future Land Use MIKE SHE Code Map Modified for Vacant Properties Greater than One Acre

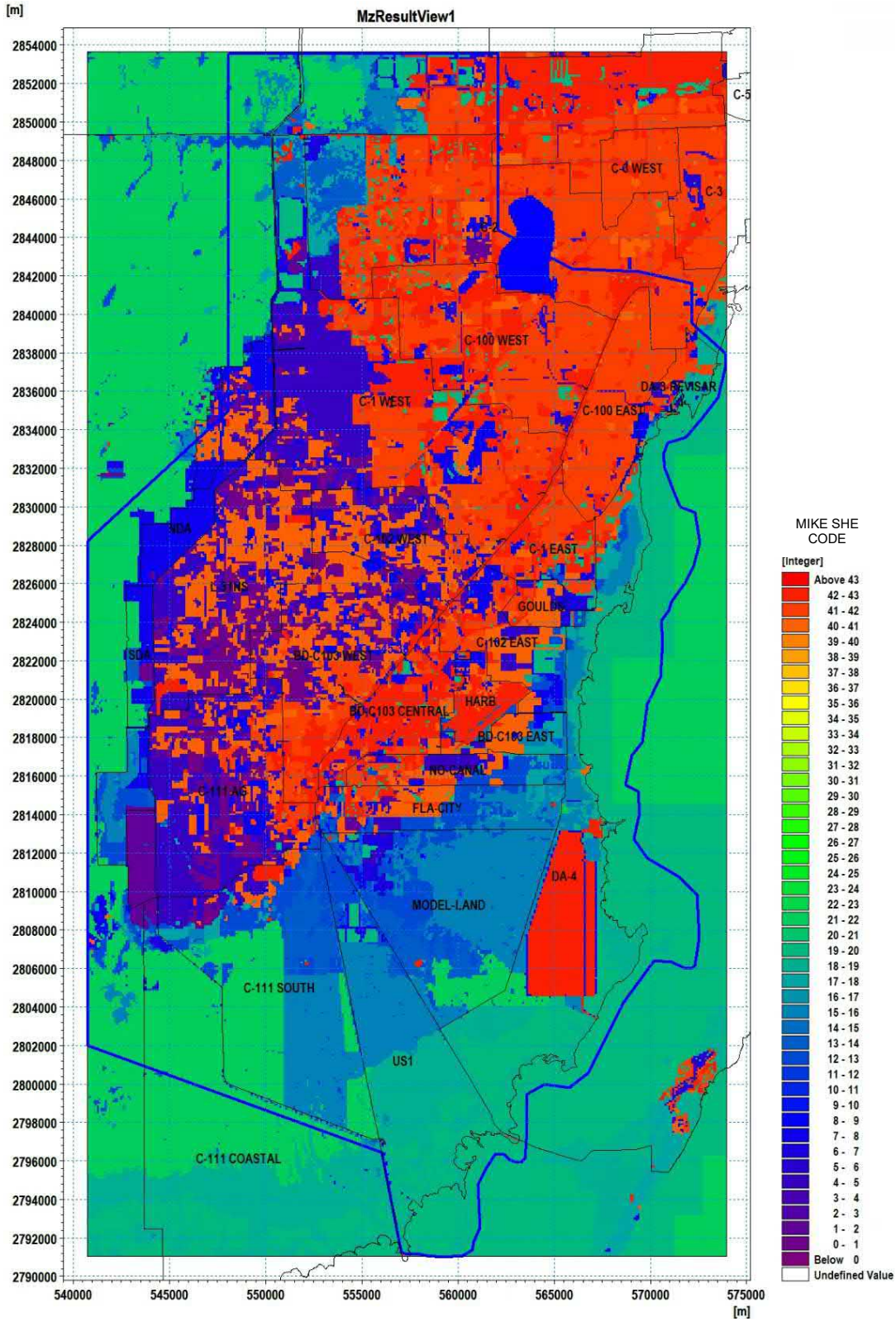


Figure 319. Future Land Use MIKE SHE Code Map Modified for Vacant Properties Greater than Ten Acres

The modifications of the MIKE SHE Manning's M within the Urban Development Boundary is provided in Table 152:

Table 152 Changes of MIKE SHE Manning's M

Current Land Use Category	Current MIKE SHE Overland Manning's M	Future Land Use Category	Future MIKE SHE Overland Manning's M
Agriculture			
Cropland and Pastureland	6	Residential, Low Density	7
Nurseries and Vineyards	7.1	Residential, Low Density	8.5
Other Open Lands - Rural	7	Residential, Low Density	7
Tree Crops	3	Residential, Low Density	7
Urban And Built Up			
Open Land	7	Residential, Low Density	8.5
Residential, Low Density	7	Residential, Medium Density	8.5
Residential, Medium Density	8.5	Residential, High Density	9.5

Development of vacant parcels will increase the impervious areas and will require additional storage volume to preserve the post development runoff to predevelopment conditions.

The modifications of the MIKE SHE Detention Storage within the Urban Development Boundary is provided in Table 153.

Table 153 MIKE SHE Current and Future Detention Storage

Category	Current MIKE SHE Detention Storage (in)	Future MIKE SHE Detention Storage (in)
Agriculture		
Cropland and Pastureland	0.20	0.15
Nurseries and Vineyards	0.20	0.15
Other Open Lands - Rural	0.15	0.10
Tree Crops	0.15	0.10
Urban And Built Up		
Open Land	0.1	0.05
Residential, Low Density	0.15	0.1
Residential, Medium Density	0.1	0.05

The Evapotranspiration (ET) parameters for spatial and temporal datasets are based on land use classifications; the ET parameters include the Leaf Area Index (LAI), the Root Depth (RD), and the crop coefficient (K_c). The LAI is one of the primary variables used by MIKE SHE in the

calculation of ET fluxes; RD determines the vertical distribution of ET in the soil profile. K_c is used to scale specified Potential Evapotranspiration (PET) rates to individual vegetation types and growth stages.

Monthly values of land use based Leaf Area Index, Crop Coefficient and Root Depth parameters for each land use are listed in provided in Table 154, Table 155 and Table 156 respectively. The parameters were based on the KBMOS model (ref 40).

Table 154. Leaf Area Index (LAI) Values for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	3.38	3.75	4.12	4.5	4.5	4.5	4.5	4.5	4.5	3.75	3.38	3.38
2	Pasture	3.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	3.5
5	Truck Crops	3.75	4.5	3	3.75	4.5	3	3	3	3	3	3	3
6	Golf Course	2	2.5	3	3	3	3	3	3	3	3	3	2
7	Bare Ground	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
8	Mesic, Xeric, Hydric Flatwood	1.5	2.25	3	3	3	3	3	3	3	2.5	1.5	1.5
9	Mesic, Xeric Hammock	2.5	3.25	4	4	4	4	4	4	4	4	3.25	2.5
13	Hydric Hammock	2.5	3.25	4	4	4	4	4	4	4	4	3.25	2.5
14	Wet Prairie	1.5	2.25	3	3	3	3	3	3	3	3	2.25	1.5
16	Marsh	2	3	4	4	4	4	4	4	4	2	2	2
17	Cypress	2	4	4	4	4	4	4	4	4	2	2	2
18	Swamp Forest	4.5	3.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	4.5	3.5
19	Mangrove	3	3	3	3	3.5	4	4	4	3.5	3.5	3	3
20	Water	0	0	0	0	0	0	0	0	0	0	0	0
22	Sawgrass	3	3.5	4	4	4	4	4	4	4	4	3.5	3
23	Emergent Marsh	3	3.5	4	4	4	4	4	4	4	4	3.5	3
41	Urban Low Density	0.9	1.25	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	0.9
42	Urban Medium Density	0.8	1.13	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.8
43	Urban High Density	0.7	0.98	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	0.98	0.7

Table 155. Root Depths (RD), in inches, for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2
2	Pasture	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
5	Truck Crops*	17.7	29.5	6.0	17.7	29.5	6.0	6.0	6.0	6.0	6.0	6.0	6.0
6	Golf Course	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
7	Bare Ground	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
8	Mesic, Xeric, Hydric Flatwood	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
9	Mesic, Xeric Hammock	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
13	Hydric Hammock	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0
14	Wet Prairie	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
16	Marsh	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
17	Cypress	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
18	Swamp Forest	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
19	Mangrove	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8	71.8
20	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	Sawgrass	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
23	Emergent Marsh	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
41	Urban Low Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
42	Urban Medium Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9
43	Urban High Density	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9

* Truck crops are the only vegetation type that show a seasonal variation in root depth

Table 156. Crop Coefficients (Kc) for each Vegetation Type

Mike She Code	Model Land Use Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Citrus	0.686	0.686	0.735	0.823	0.907	0.990	1.029	1.029	1.029	1.029	0.907	0.735
2	Pasture	0.670	0.724	0.859	0.975	0.999	1.013	1.013	0.980	0.919	0.876	0.754	0.646
5	Truck Crops	0.711	0.862	1.029	1.063	0.960	0.877	0.916	0.965	0.970	0.960	0.907	0.764
6	Golf Course	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
7	Bare Ground	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850	0.850
8	Mesic, Xeric, Hydric Flatwood	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
9	Mesic, Xeric Hammock	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
13	Hydric Hammock	0.671	0.676	0.701	0.715	0.730	0.745	0.760	0.764	0.755	0.730	0.706	0.691
14	Wet Prairie	0.782	0.784	0.816	0.855	0.872	0.872	0.892	0.897	0.875	0.835	0.789	0.782
16	Marsh	0.773	0.775	0.797	0.804	0.809	0.811	0.821	0.826	0.805	0.777	0.767	0.777
17	Cypress	0.817	0.826	0.843	0.919	1.000	1.012	1.032	1.044	0.925	0.802	0.786	0.800
18	Swamp Forest	0.701	0.706	0.735	0.764	0.818	0.887	0.941	0.960	0.946	0.892	0.794	0.725
19	Mangrove	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
20	Water	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980	0.980
22	Sawgrass	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
23	Emergent Marsh	0.800	0.600	0.600	0.600	0.800	1.000	1.000	1.000	1.000	1.000	1.000	1.000
41	Urban Low Density	0.544	0.533	0.554	0.568	0.578	0.612	0.686	0.724	0.714	0.664	0.595	0.570
42	Urban Medium Density	0.467	0.456	0.471	0.483	0.493	0.516	0.561	0.591	0.593	0.558	0.507	0.488
43	Urban High Density	0.389	0.379	0.389	0.398	0.409	0.420	0.436	0.458	0.472	0.453	0.420	0.406

6.1.4 Infrastructure and Mike 1D updates

Based on information from Miami-Dade County, some of the secondary and tertiary canals within the model domain will be extended and/or new canals will be constructed as shown in Figure 320.

The new planned canals (Table 157) and proposed extensions were added to the MIKE 1D network model for future condition simulations. Some of the canals are also present in the MIKE 1D network for current conditions as network links, however, these links use cross sections defined by the topography and were obtained by the Digital Elevation Model (DEM) as existing land depressions. For the future condition simulations, these cross sections were replaced with a trapezoidal canal to represent the new canals and extensions. The cross sections of the canal are with minimum bottom width of 10 ft, depth of 15 ft below the average May water table assuming side slopes of 1H:1V according to Miami-Dade County's Public Works Manual Part 2.

Table 157 Planned Canals Included in the Future Conditions Model

Item	NAME	SFWMD NAME	MAINTBY	Length
1	C111 EXT NORTH		MIAMI-DADE COUNTY	10300
2	C111 EXT NORTH		MIAMI-DADE COUNTY	3734
3	C111 EXT NORTH		MIAMI-DADE COUNTY	3782
4	SW 204 ST		INSPECTED RECO REMOVAL	3708
5	SW 169 AVE		PRIVATE AG SLOUGH	7268
6	C-113 EXTENSION		MIAMI-DADE COUNTY	9894
7	C-100 SPUR EXTENSION (BIGMAN)	C-100 SPUR	DEERING SPILLWAY	531
8	CUTLER WETLANDS C-1 FLOWWAY		SFWMD	9374
9	SW 170 AVE CANAL		MIAMI-DADE COUNTY	22618
10	SW 157 AVE		MIAMI-DADE COUNTY	11844
11	SW 157 AVE		MIAMI-DADE COUNTY	5179
12	SW 63 ST CANAL		MIAMI-DADE COUNTY	919
13	C-1 EXT @ SW 150 ST	C-1 EXT	MIAMI-DADE COUNTY	11027

To account for future development of vacant lands, additional storage, OL and SZ drainage, were provided.

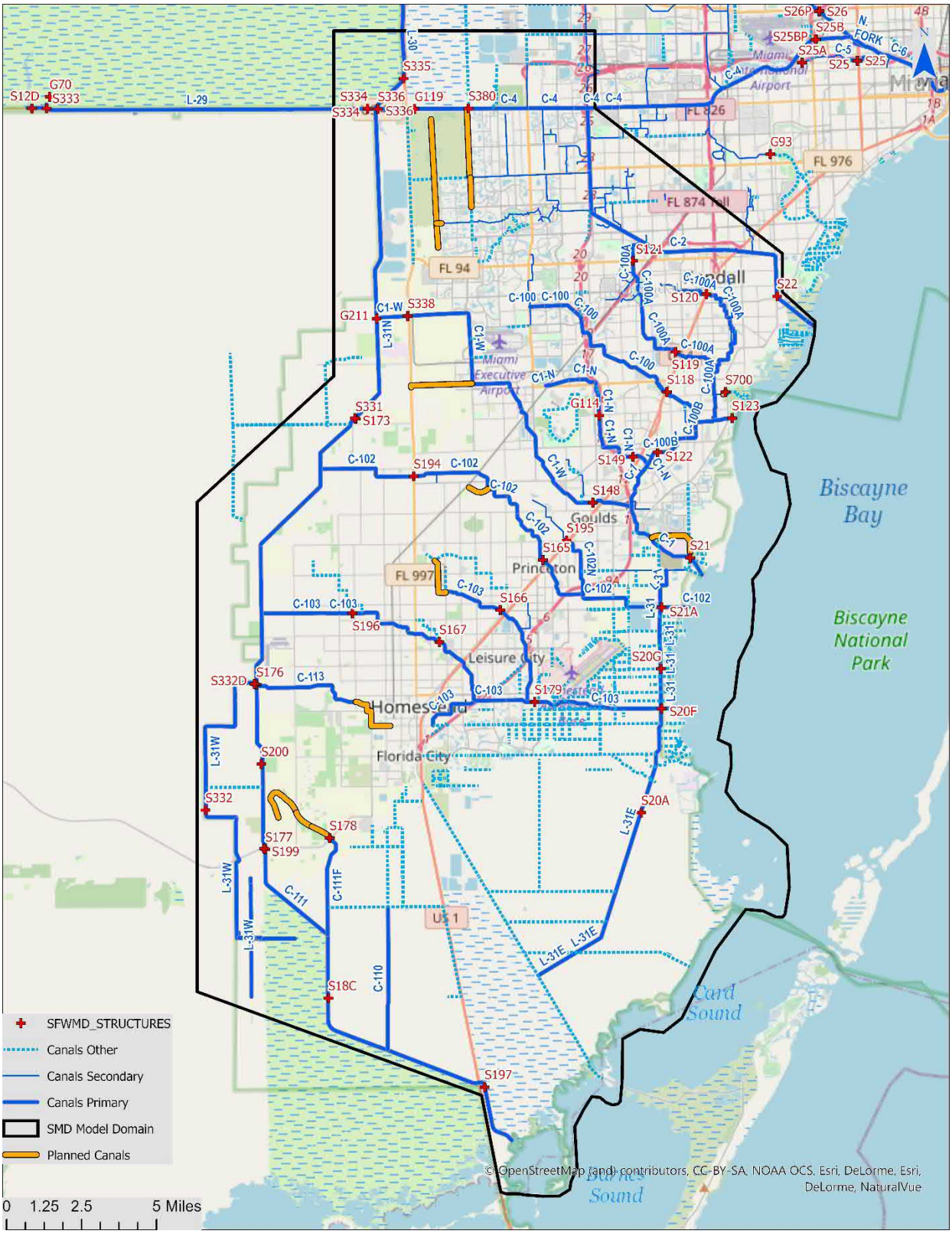


Figure 320 Planned new canals and extension of existing canals.

6.1.4.1 Additional Retention Storage

To account for increased future density of low-density areas and conversion from open land to a low-density development, additional stormwater infrastructure will be required to comply with Miami-Dade County's Municipal Code. The stormwater infrastructure will include a system of interconnected and distributed stormwater storage infrastructure (lakes, dry ponds, and smaller green infrastructure components), and conventional stormwater conveyance components to ensure adequate management of the potential increase of the stormwater runoff. For most of the County, the stormwater system will need to introduce enough storage to attenuate the post-development peak discharge rate to pre-development rates and to provide a conveyance system for a 25-Year, 3-day peak discharge rate. Future storage was added as MIKE 1D branches as side structures. The storage was determined assuming that for post development conditions appropriate storage will be required to not to exceed the predevelopment conditions for the 25-Year 3-day storm event.

The future storage as estimated from land use, soil properties using the runoff curve number (CN) which is an empirical parameter used in hydrology for predicting direct runoff or infiltration from rainfall excess.[1]. The curve number method was developed by the USDA Natural Resources Conservation Service, from an empirical analysis of runoff from small catchments and hillslope plots monitored by the USDA. It is commonly used to determine the approximate amount of direct runoff from a rainfall event in a particular area. The runoff curve number is based on the area's hydrologic soil group, land use, treatment, and hydrologic condition. References, such as from USDA [1] provide the runoff curve numbers for characteristic land cover descriptions and a hydrologic soil group. The runoff equation which was applied to estimate the storage need is provided in equation (5.1):

$$Q = \begin{cases} 0 & \text{for } P \leq I_a \\ \frac{(P-I_a)^2}{P-I_a+S} & \text{for } P > I_a \end{cases} \tag{5.1}$$

Where, Q is runoff (in), P is rainfall (in), S is the potential maximum soil moisture retention after runoff begins (in), a is the initial abstraction (in), or the amount of water before runoff, such as infiltration, or rainfall interception by vegetation; typically assumed a=0.2S, although for urban 0.05S has been used as well for urbanized watersheds where the CN is updated to reflect developed conditions, and compacted soil after development. The runoff curve number, CN is related to storage as shown in equation (5.2):

$$S = \frac{1000}{CN} - 10 \tag{5.2}$$

The CN is a dimensionless number (range 0 to 100) depending on the hydrologic soil group, cover type, treatment, hydrological condition, and antecedent moisture conditions. Typical values of CN are between 60 and 90 for most encountered conditions and ranging up to 98 for impervious surfaces. The CN is applied only for the pervious area and the input for impervious area is restricted to the directly connected area. An area weighted composite number is typically used by CN for the pervious area and 98 for the impervious area. The remaining area within a AHED watershed is a combination of the actual pervious area and the non-directly connected impervious

area (NDCIA). Since there should be no infiltration under the NDCIA surface, a correction is applied to estimate a composite number for just the pervious surface.

For a large portion of Miami-Dade County, the NRCS provides a classification of "U" for urban land. As a result of urbanization, the underlying soil may be disturbed or covered by a new layer. In this case, the Type D (poorly draining) classification is substituted for the Type U as the dominant soil classification. Additionally, soil types with dual classifications (e.g., Type B/D) generally represent areas where there is a lens of poorly drained soils lying above a section of better draining soils. Typically, the lower (Type-D) classification is used in the model, unless the soil is disturbed, such as a field of row crops where it is likely the upper lens has been penetrated.

Soil classification is based on Hydrologic Soil Groups (HSG). Typical soil classifications are Types A (>10 in/hr infiltration rate), B (7-10 in/hr), C (5-7 in/hr) and D (less than 5 in/hr). For fully developed urban areas (vegetation established), the CN values were obtained from Urban Hydrology for Small Watersheds TR-55 and summarized in Table 158:

Table 158 CN Values for Land Use and Hydrologic Soil Group

Land Use	Hydrologic Soil Group			
	A	B	C	D
Urban Areas				
Open Space Poor Condition (grass cover < 50%)	68	79	86	89
Open Space Fair Condition (grass cover 50 to 75%)	49	69	79	84
Open Space Good Condition (grass cover > 75%)	39	61	74	80
Developing Urban Areas				
Newly graded areas (pervious only, no vegetation)	77	86	91	94

The hydrologic soil group (HSG) listed for each map unit were used to derive the Curve Number (CN).

- **Group A** is sand, loamy sand or sandy loam types of soils characterized by low runoff potential and high infiltration rates even when thoroughly wetted.
- **Group B** is silt loam or loam with a moderate infiltration rate when thoroughly wetted and consists mainly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
- **Group C** soils are sandy clay loam with low infiltration rates when thoroughly wetted and consist mainly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
- **Group D** soils are clay loam, silty clay loam, sandy clay, silty clay or clay characterized by the highest runoff potential and very low infiltration rates.

For model development, an Open Space Poor Condition (grass cover 50% to 75%) was used for assigning the CN values.

Three categories can be used to provide the impact of the preexisting soil conditions, ARC I (dry soils), ARC II (typical conditions) and ARC III (saturated soil after heavy rainfall). The CN was

developed using ARC II (typical conditions), and therefore no adjustments to CN values were performed based on antecedent moisture conditions. The soil layer HSG types were joined to the corresponding CN values from Table 158, then spatially joined to the AHED Watershed Delineation to determine the weighted average CN value for each AHED watershed. Additionally, Land Use data were used to adjust the CN for NDCIA using the following formula:

$$CN_{NDCIA} = \frac{98*NDCIA+CN*PERV}{\text{PERV+NDCIA}} \tag{5.3}$$

The NRCS method assumes that infiltration follows an exponential decay curve with time. Storage capacity of the soil, S (i.e., the potential maximum retention after runoff begins) is a dimensionless variable calculated from the curve number by:

$$S = \frac{1000}{\text{CN}} - 10 \tag{5.4}$$

Watershed imperviousness for the current and future land use was obtained from Miami-Dade County's Planning Department with typical Total Impervious Areas (TIA) and DCIA values per land use as provided in Table 159. The typical TIA – Total Impervious Area, DCIA – Directly Connected Impervious Areas, NDCIA – Non-Directly Connected Impervious Areas, PERV – Pervious Areas for generalized land use categories for current and future conditions are listed in Table 159 and Table 160. The land-use layers were overlain with the AHED Watershed Delineation to determine area-weighted DCIA values for each AHED watershed.

Table 159 Imperviousness Parameters for Generalized Land Use for Current Conditions

Generalized Category	TIA (%)	DCIA (%)	NDCIA (%)	PERV (%)
Agriculture	0.01	0	0.01	99.99
Airports	27	4	23	73
Biscayne National Park	0.01	0	0.01	99.99
Cultural/Entertainment	78.42	53	25.42	21.58
Everglades National Park	0.01	0	0.01	99.99
Golf Courses/Municipal Parks	3	0	3	97
Government/Institutional	56.1	26	30.1	43.9
Hospitals/Medical	59.72	26	33.72	40.28
Hotels/Motels	61.53	30	31.53	38.47
Industrial Intensive	82.6	53	29.6	17.4
Junk Yards/Equipment Storage	74.71	45	29.71	25.29
Light Industrial	74.55	45	29.55	25.45
Mixed Use Commercial	75.5	45	30.5	24.5
Mobile Homes	74.93	45	29.93	25.07
Multi-Family Residential	70.5	38	32.5	29.5
Office Building with Parking	74.55	45	29.55	25.45
Parking Lots	79.73	53	26.73	20.27
Religious Facilities	64.62	30	34.62	35.38
Retail Commercial	82.6	53	29.6	17.4
Single Family Residence - Low Density	64.62	30	34.62	35.38
Single Family Residence - Other	69.63	38	31.63	30.37
Transportation	82.6	53	29.6	17.4
Utilities	27	4	23	73
Vacant Land	0.01	0	0.01	99.99
Water	100	100	0	0

Table 160 Imperviousness Parameters for Generalized Land Uses for Future Conditions

Generalized Category	TIA (%)	DCIA (%)	NDCIA (%)	PERV (%)
Agriculture	0.01	0	0.01	99.99
Business and Office	75.5	45	30.5	69.5
Environmental Protection	0.01	0	0.01	99.99
Environmentally Protected Parks	0.01	0	0.01	99.99
Estate Density Residential (EDR) 1-2.5 DU/Ac	64.62	30	34.62	65.38
ESTATE DENSITY RESIDENTIAL With DENSITY INCREASE 1	69.63	38	31.63	68.37
High Density Residential (HDR) 60-125 DU/Ac	70.5	38	32.5	67.5
Industrial and Office	74.55	45	29.55	70.45
Institutions, Utilities and Communication	56.1	26	30.1	69.9
Low Density Residential (LDR) 2.5-6 DU/Ac	64.62	30	34.62	65.38
Low Density Residential with Density Increase 1	69.63	38	31.63	68.37
Low Medium Density Residential W/ Density Increase 1	70.5	38	32.5	67.5
Low-Medium Density Residential (LMDR) 6-13 DU/Ac	70.5	38	32.5	67.5
Medium Density Residential (MDR) 13-25 DU/Ac	70.5	38	32.5	67.5
Medium Density Residential W/Density Increase 1	75.5	45	30.5	69.5
Medium-High Density Residential (MHDR) 25-60 Du/Ac	75.5	45	30.5	69.5
Office/Residential	75.5	45	30.5	69.5
Open Land	0.01	0	0.01	99.99
Parks and Recreation	0.01	0	0.01	99.99
Restricted Industrial and Office	74.55	45	29.55	70.45
Terminals	79.73	53	26.73	73.27
Transportation (Row, Rail, Metrorail, Etc.)	82.6	53	29.6	70.4
Water	100	100	0	100
Zoo Miami Entertainment Area	3	0	3	97

The land use change was clustered into 10 areas (Figure 321) for which storage requirements were determined for corresponding storage nodes. The total storage in ac-ft required to keep post development runoff to predevelopment conditions was estimated from the storage capacity of the soil using equation 2 and are listed in Table 161. Based on estimated storage and assumed stage operation between 8.0 ft NAVD and 3.0 ft NAVD (reflecting October high groundwater), the storage areas (required input in Mike 1D) were determined for each cluster of vacant properties.

Table 161 Computed Storage to Attenuate Post Development Runoff

Storage Node Code	Total Acre	Total Acre-Feet Required (ac-ft)	Average Depth to Groundwater (ft)	Storage Area (ac)
601	279	61.72	3	20.57
602	298	65.92	3	21.97
603	146	32.30	3	10.77
604	265	58.62	3	19.54
605	80	17.70	3	5.90
606	60	13.27	3	4.42
607	49	10.84	3	3.61
608	22	4.87	3	1.62
609	24	5.31	3	1.77
610	28	6.19	3	2.06

The implementation of storage nodes is based on the following changes:

- An artificial short MIKE 1D branch was added to the network
- A side structure with a storage node was implemented (this node has no physical footprint)
- A stage storage relation was developed based on storage area and elevations listed in Table 161.
- The MIKE 1D branch is connected to the nearest canal through an overflow gate which can open and close between average groundwater elevations and assumed 8.0 ft NAVD to reflect weir operation
- OL and SZ drainage codes were developed for each of the vacant properties greater than 10 acre (based on discussion with SFWMD)
- The drainage codes were directed to discharge seepage into the corresponding artificial MIKE 1D branch.
- Prior to the storm, the overflow gate is maintained at the average October high groundwater elevation
- At the time of the storm (a day before the storm) the overflow gate closes to 8 ft and seepage from the areas with corresponding OL and SZ codes is directed into the storage node.
- This allows additional storage for the large areas which were clustered into the corresponding storage nodes.
- For the areas which are much smaller and dispersed, the detention storage was increased to 2.5” which is approximate difference between pre- and post-development runoff.
- The additional storage areas and the corresponding SZ drain codes are depicted in Figure 321.

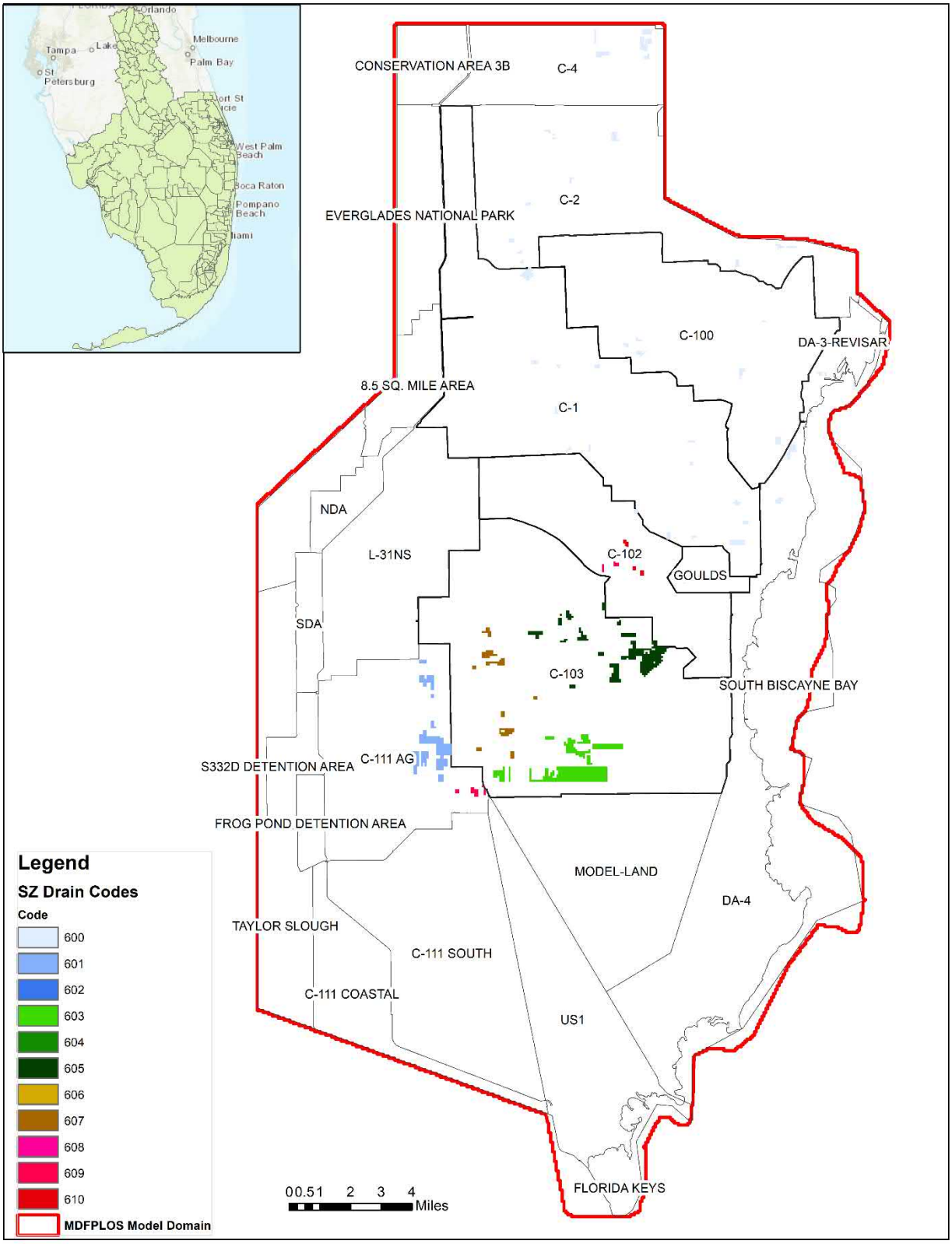


Figure 321 Additional Storage Area provided for OL and SZ drainage Areas.

6.1.4.2 OL Drainage

Overland Drainage codes were developed along with 10 storage nodes which were implemented in MIKE 1D. The total volume was calculated from estimate of post development run runoff using the methodology provided above.

The OL drainage codes were directed to an artificial Mike 1D branch which discharges in the storage node.

6.1.4.3 SZ Drainage

SZ Drainage codes were developed along with 10 storage nodes which were implemented in MIKE 1D. The total volume was calculated from the estimate of post development run runoff using the methodology provided above.

The SZ drainage codes were directed to an artificial Mike 1D branch which discharges in the storage node.

6.1.5 Boundary Conditions for Future Hydrologic Conditions

6.1.5.1 Rainfall Design Events and Distribution

In the calibration models gridded NEXRAD rainfall records were provided by SFWMD. For the design storm simulations, this gridded rainfall data was replaced by rainfall that follows the spatial 3-day design storm rainfall distribution by SFWMD. Rainfall depths were obtained from NOAA's Rainfall Atlas 14 ASCII Grid data. NOAA developed design rainfall depths based on historical records prepared by spatially interpolating point precipitation frequency estimates. The precipitation frequency estimates were calculated using regional statistics based on an annual maximum data series. More details about the processes used to create this grid can be found in the project quarterly reports posted at <http://www.nws.noaa.gov/ohd/hdsc/current-projects/project.html> or the NOAA Atlas 14 Documentation (ref 1). For more details about the processes used to create this grid, please see the project quarterly reports posted at https://bit.ly/3sI5fG6 or the NOAA Atlas 14 Documentation (ref 55). The original NOAA grid provides total precipitation in 1,000*inches using a grid of 0.00833333 decimal degrees (approximately 915 m). For the model, the grid is converted to inches and used to develop spatial grid timeseries using the same resolution as the original grid from NOAA.

No changes were applied to future rainfall volume estimates. The original NOAA's statistical analysis (ref 55) did not discern an increasing trend in precipitation frequency over the available 70-Year rainfall datasets for South Florida. The Fourth National Climate Assessment report estimated that the projected changes in seasonal and total annual precipitation for our region of South Florida would be minimal and less than 5% however, future rainfall design events (ref 20) will be taken into consideration. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 5-, 10-, 25-, or the 100-Year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events have a 20-, 10-, 4-, and 1% annual chance, respectively, of being equaled or exceeded during any year.

Figure 322 through Figure 325 show the 100-yr, 25-yr, 10-yr and 5-yr rainfall distribution (inches) within the project domain.

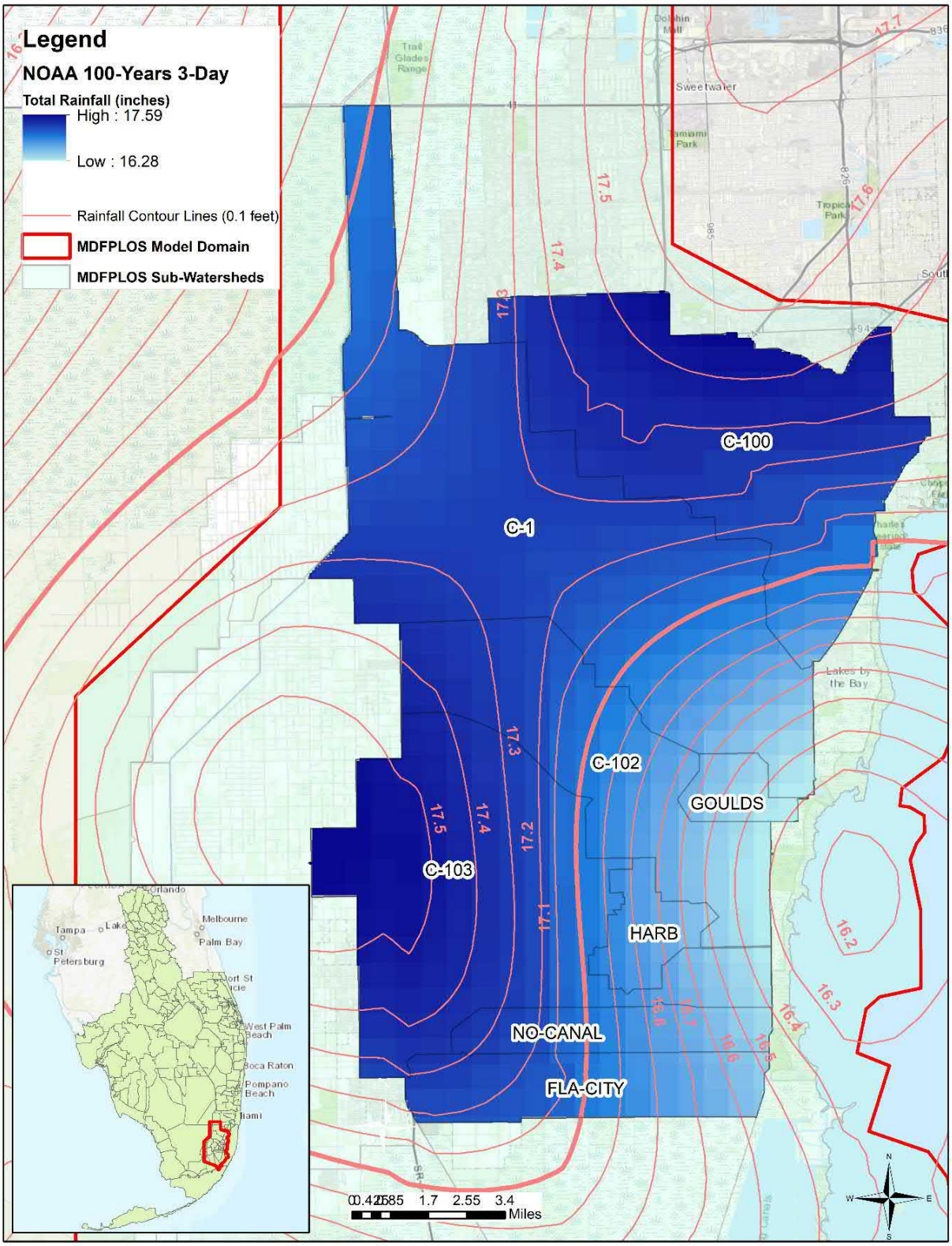


Figure 322 Precipitation Distribution for 100-Year 3-day Design Event Obtained from NOAA Atlas 14

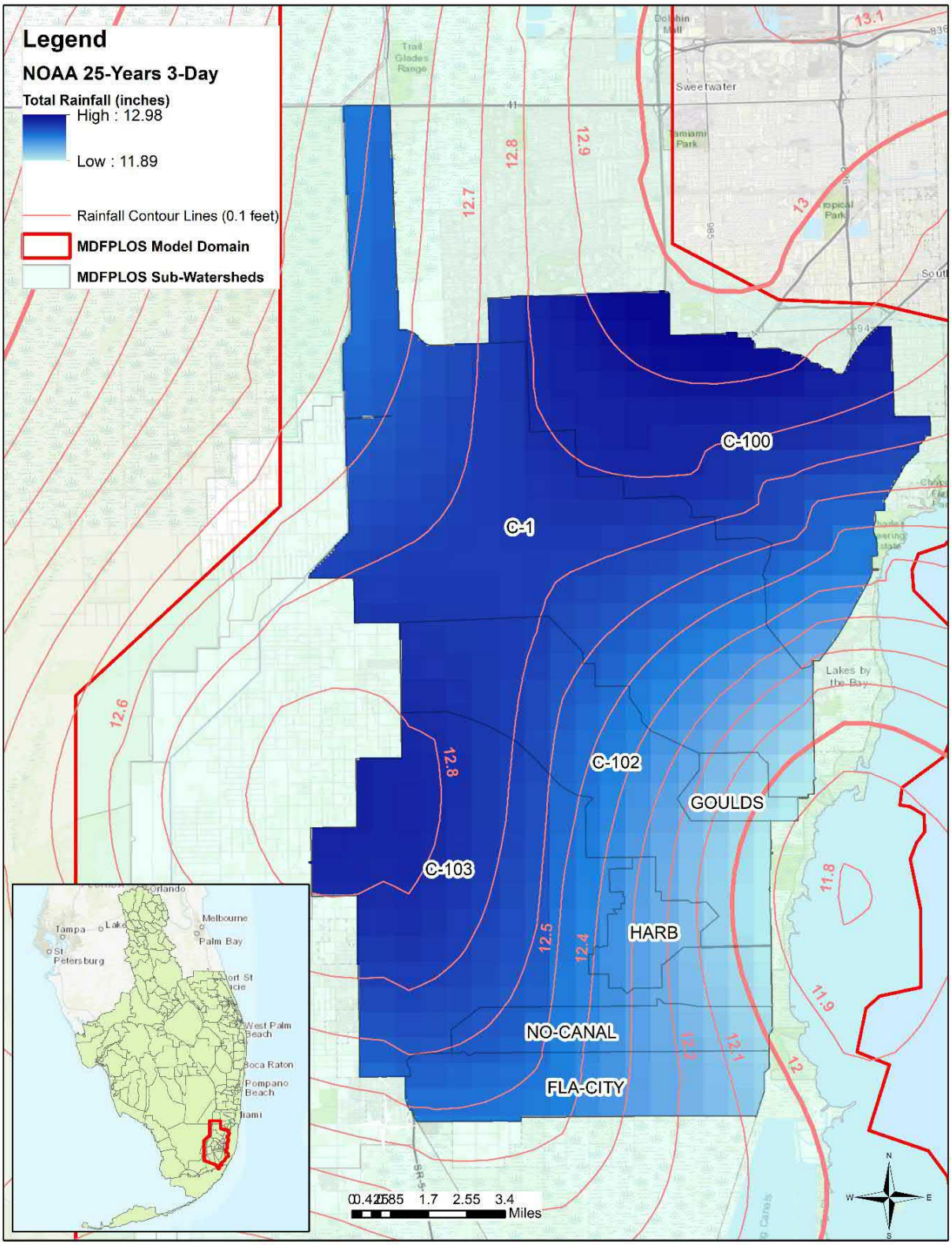


Figure 323 Precipitation Distribution for 25-Year 3-day Design Event Obtained from NOAA Atlas 14

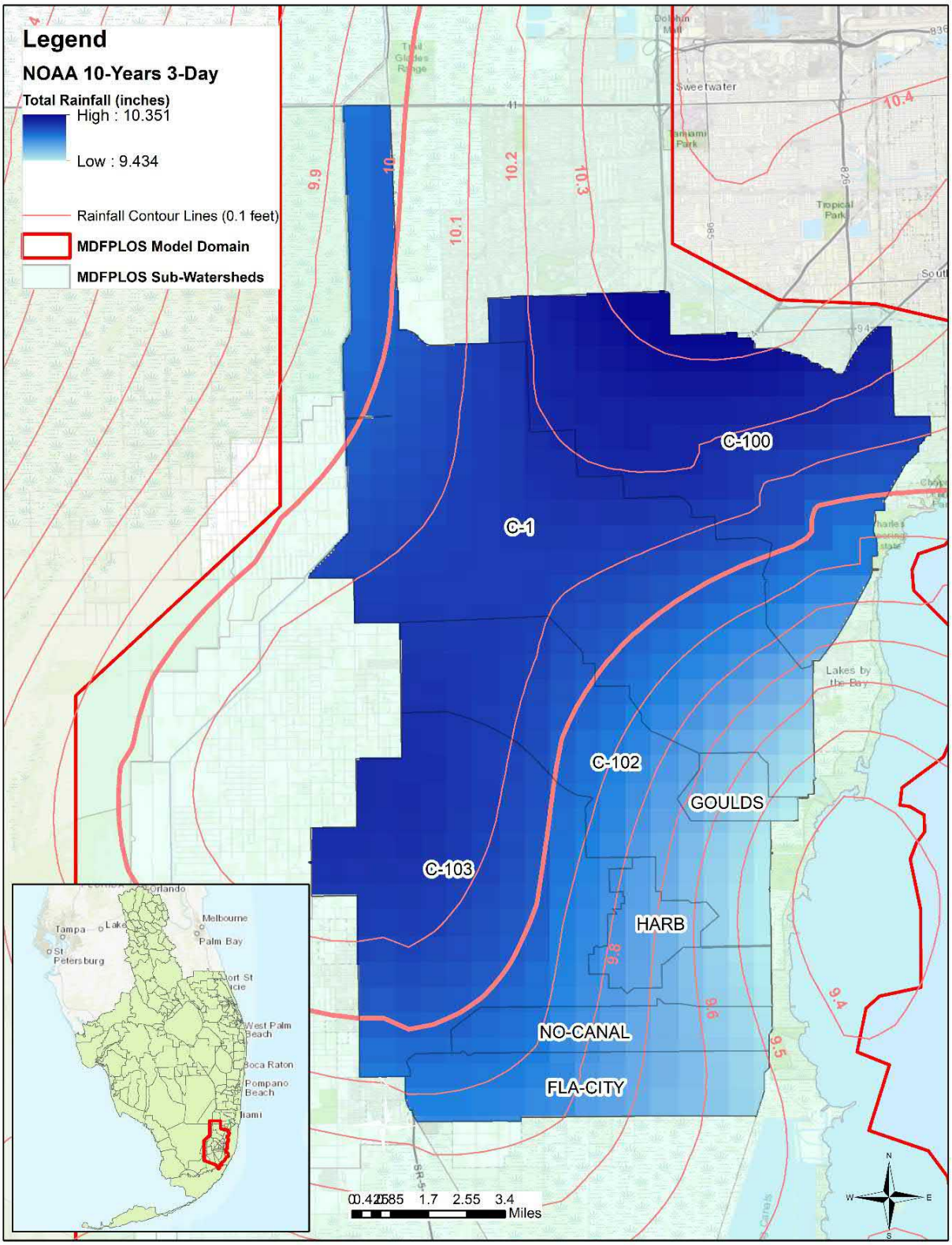


Figure 324 Precipitation Distribution for 10-Year 3-day Design Event Obtained from NOAA Atlas 14

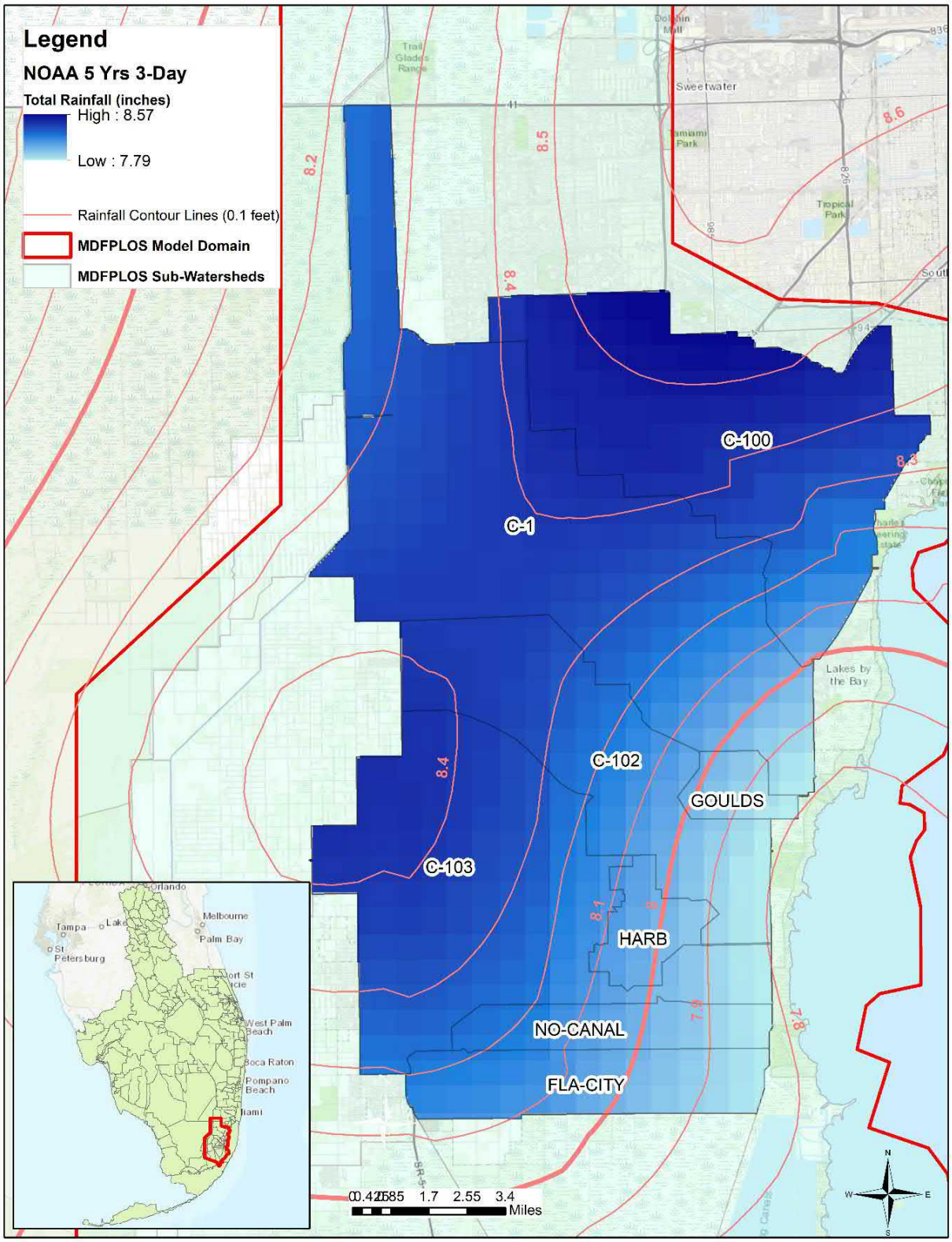


Figure 325 Precipitation Distribution for 5-Year 3-day Design Event Obtained from NOAA Atlas 14

Table 162 provides a list of descriptive statistics parameters and is computed for each watershed using the Precipitation Distribution for 100-Year, 25-Year, 10-Year, and 5-Year, 3-day Design Events Obtained from NOAA (ref 55).

Table 162 Rainfall Statistics for Each Watershed (using Precipitation Distribution Rainfall Data Obtained from NOAA, ref 55)

Design Event Watershed	Maximum, inch	Mean, inch	Minimum, inch	Standard Deviation,
5-Year 72-Hr				
C-100	8.57	8.40	7.98	0.12
C-1	8.46	8.29	7.80	0.13
C-102	8.41	8.18	7.80	0.19
C-103	8.43	8.19	7.80	0.18
10-Year 72-Hr				
C-100	10.35	9.59	9.59	0.14
C-1	10.22	10.15	10.15	0.15
C-102	10.17	10.01	10.01	0.23
C-103	10.19	9.89	9.89	0.20
25-Year 72-Hr				
C-100	12.28	12.08	11.91	0.09
C-1	12.99	12.75	12.17	0.16
C-102	12.82	12.59	11.90	0.18
C-103	12.80	12.45	11.91	0.27
100-Year 72-Hr				
C-100	16.71	16.48	16.29	0.10
C-1	17.58	17.32	16.62	0.19
C-102	17.38	17.11	16.28	0.23
C-103	17.44	16.94	16.31	0.34

For illustration of the point precipitation frequency for Latitude: 25.5857° and Longitude: -80.4051° the values listed in Table 163 were obtained from NOAA Atlas 14, Volume 9, Version 2. The SFWMD rainfall distributions are used to create rainfall hyetographs for the design storm events. The estimates obtained from NOAA (ref 55) for a selected location within C-1 watershed are shown in Table 163.

Table 163. Point Precipitation Frequency (PF) Estimates with 90% Confidence Intervals and Supplementary Information NOAA Atlas 14, Volume 9, Version 2

Recurrence (years)	24-hr Duration (inch)	3-day Duration (inch)
1	4.45(3.65-5.47)	5.80(4.79-7.05)
2	5.22(4.27-6.42)	6.76(5.58-8.23)
5	6.67(5.44-8.22)	8.52(7.01-10.4)
10	8.06(6.54-9.97)	10.2(8.31-12.4)
25	10.2(8.20-13.4)	12.6(10.2-16.3)
50	12.1(9.46-16.0)	14.8(11.6-19.2)
100	14.2(10.7-19.2)	17.1(13.0-22.7)
200	16.5(12.0-22.8)	19.6(14.4-26.7)
500	19.8(13.9-28.1)	23.2(16.4-32.5)
1000	22.6(15.4-32.2)	26.1(18.0-36.8)

The methodology for development of the rainfall curves included multiplication of the rainfall hydrograph by the value of each rainfall raster cell. The value of each rainfall cell of the raster provided by NOAA represents the total cumulative rainfall for the 3-day storm event. Therefore, for each timestep (which is based on a 5-minute interval), the intensity of the rainfall hydrograph was multiplied by the value of the raster cell (which represents the total cumulative rainfall for the entire event.

Figure 326 shows the total cumulative rainfall for the 3-day, 5-, 10-, 25- and 100-Year recurrence interval events. Additional information is required for the temporal distribution to develop a gridded spatial timeseries. For this project the SFWMD rainfall distribution curve with 5-minute intervals was used. The rainfall volume data obtained from NOAA is applied as a multiplier to the unit hydrograph of SFWMD's rainfall distribution curves as the input boundary condition for simulating design events.

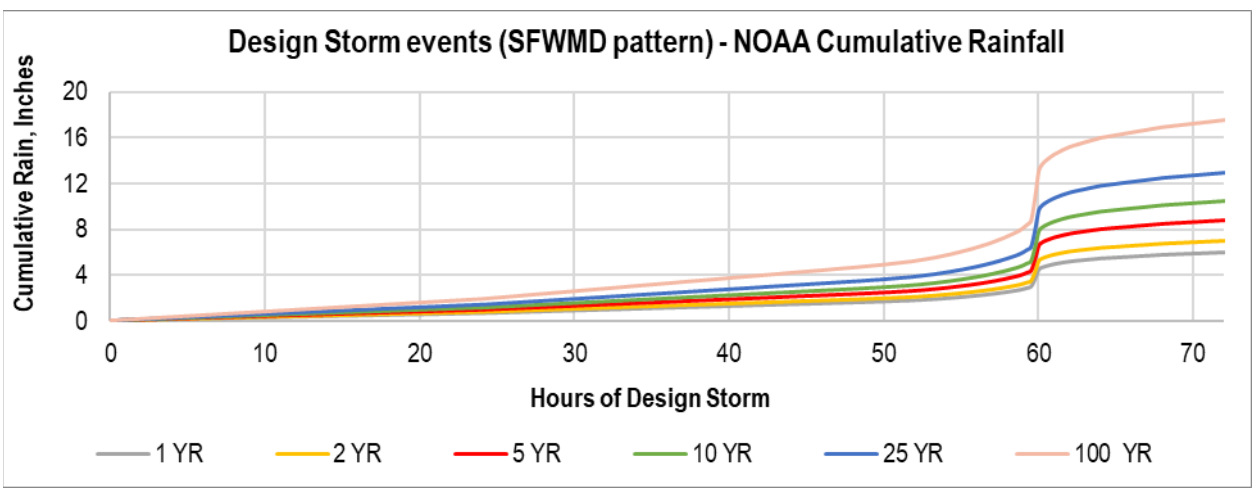


Figure 326. Cumulative Rainfall Distribution for 72-hour Rainfall Duration.

The SFWMD rainfall distributions provided in ERP Vol IV (ref 19) were used to create rainfall hyetographs for the design storm events (ref 2).

Table 164. 72-hr Rainfall Distribution

Time (hours)	Cumulative Percentage of Peak One Day Rainfall	Cumulative 100% One Day Rainfall	Cumulative 100% 3 Day Rainfall
0	0.0%	0.0%	0.0%
24	14.6%	0.0%	10.7%
48	35.9%	0.0%	26.4%
58	57.2%	21.3%	42.1%
59	62.8%	26.9%	46.2%
59.5	67.8%	31.9%	49.9%
59.75	82.8%	46.9%	60.9%
60	101.5%	65.6%	74.7%
60.5	108.8%	72.9%	80.1%
61	112.6%	76.7%	82.9%
62	117.7%	81.8%	86.6%
72	135.9%	100.0%	100.0%

The cumulative percentage for the 72-hr rainfall distribution shown in Table 60 was interpolated to 5-minute intervals and is shown in Figure 327.

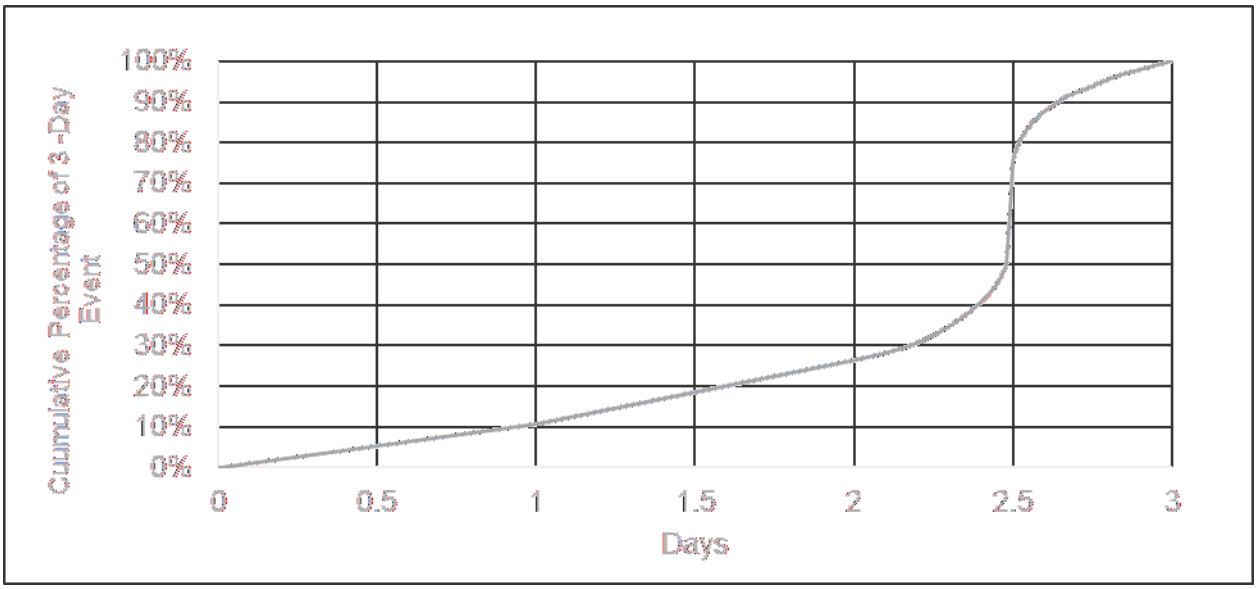


Figure 327. Cumulative Rainfall Distribution for 72-hour Rainfall Duration.

The distribution shown on Figure 327 was used to develop a rainfall hydrograph for each rainfall raster cell based on 5-minute intervals.

Based on the sensitivity analysis of the timing of rainfall peak and storm surge peak at the coastal tailwater boundaries, the most conservative case scenario for flooding depth and inundation extent was when both peaks coincide. All further simulations to assess flood protection level of service with existing conditions used coincident timing of coastal tailwater peaks and rainfall intensity peaks.

6.1.5.2 Evapotranspiration

All available ET datasets were compared in the calibration phase of this project. The USGS Potential Evapotranspiration (PET) data were selected over the observed SFWMD data because ground ET data published by SFWMD was limited, and only a few stations were available with accessible data. Therefore, the same PET dataset that was used in the calibration model was used for the design storm event simulations. The DHI ET model in MIKE SHE reduces the PET according to vegetation density, water content in the root zone, and the rainfall distribution, all of which are input datasets. The ET data for the design events can be assumed a steady state at the minimum wet seasonal average of 2.00 mm/day using the USGS timeseries which results in 3.85 mm/day average. Based on the recommendations by SFWMD, ET of 2.00 mm/day was used as a conservative estimate reflecting average minimum evapotranspiration rates.

6.1.5.3 Groundwater Withdrawals

Municipal groundwater use data for the period of 1996 through 2016 were provided by Miami Dade Water and Sewer Department (MDWASD). Figure 328 shows the location of the wells and Figure 329 represents the location of wellfields and magnitude of withdrawals. This dataset includes all municipal Biscayne Aquifer wells which are permitted in the model domain. All other types of water use, including agricultural and recreational land uses were negligible for storm event simulations. Average groundwater withdrawal at production well fields range from 0.01 MGD to 84 MGD, as shown in Figure 329.

The SMD LOS model uses daily timesteps of future well withdrawals which are based on average values of groundwater withdrawals for current conditions with 10% increase for future conditions and total of 300.75 MGD withdrawals.

Table 165 Increase of Public Water Supply from Groundwater Withdrawals (all data in MGD)

Watershed	MGD Current	MGD Future	% Increase
C-100	129.31	151.96	17.5%
C-103	36.67	36.67	0%
C-111	16.30	16.30	0%
C-2	91.39	95.82	5%
Total (MGD)	**273.67**	**300.75**	10%

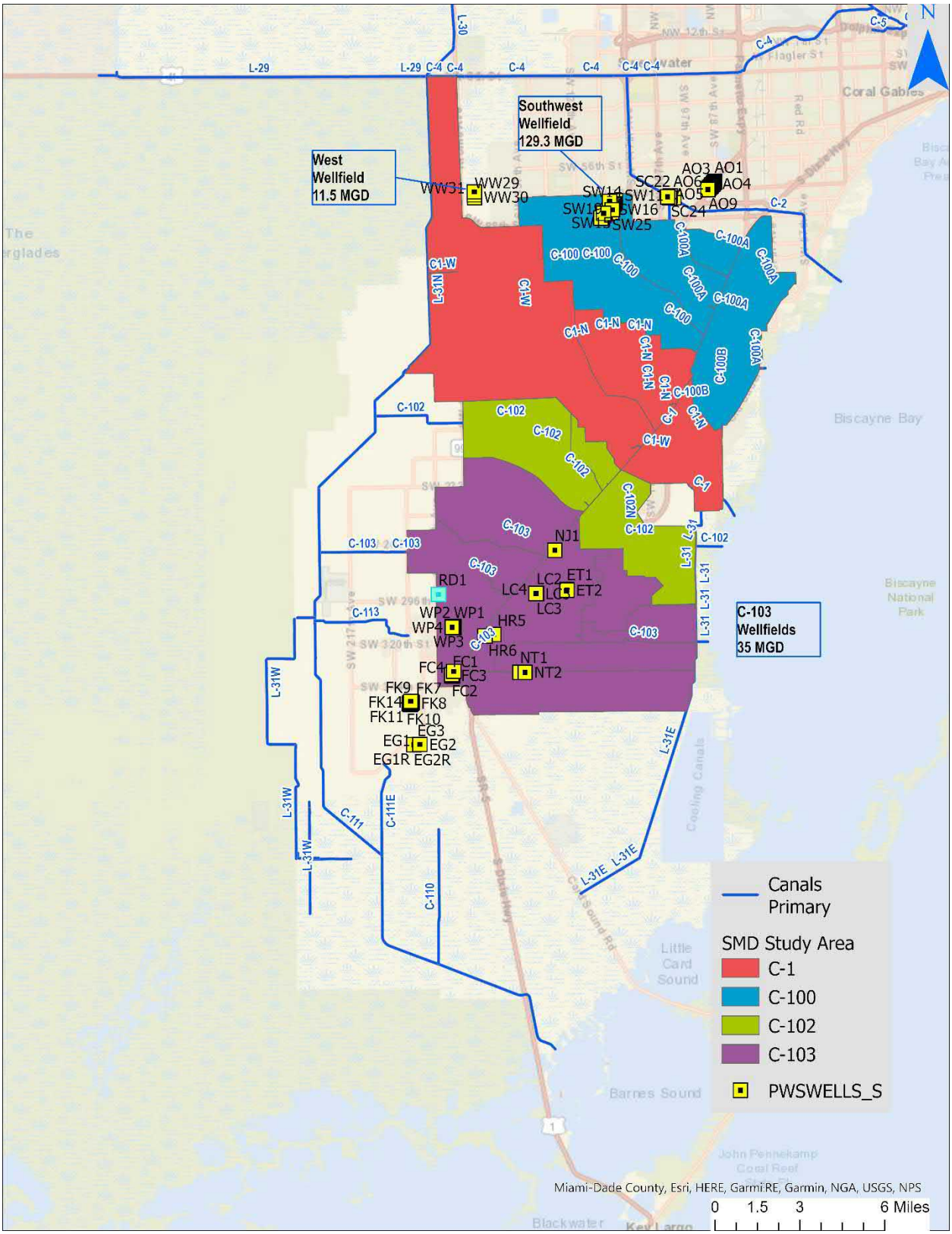


Figure 328. Groundwater Pumping Wells Implemented in Model

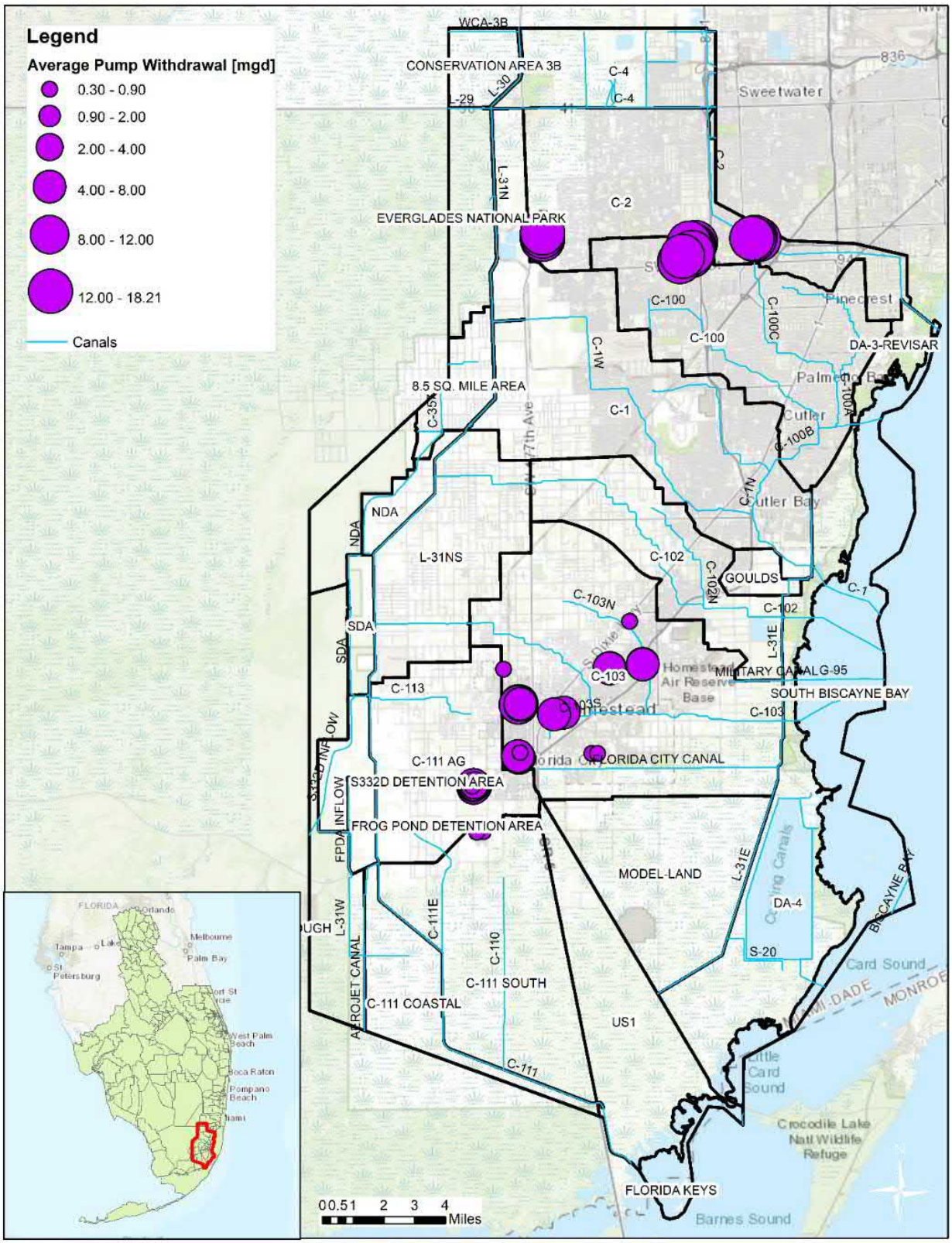


Figure 329. Groundwater Pumping Wells with Average Monthly Withdrawals (MGD)

6.1.5.4 Tidal MIKE 1D Boundary Conditions

The tailwater timeseries for the coastal structures (S22, S123, S21, S21A, S20F, S20G, S20 and S197) which include SLR of 0, 1, 2 and 3 ft and storm surge were provided by SFWMD for each of the return intervals (5-, 10-, 25- and 100-Year design storm events). The outfall of the Goulds Canal, which is an open channel discharging in the Biscayne Bay uses the tidal series of the adjacent structure S21. All these datasets were incorporated in the model as tailwater boundary conditions for the corresponding canals: C-1, C-2, C-100, C-102, C-103 and C-111. Table 166 lists the time series datasets used for MIKE-1D boundaries at coastal structures and outfalls.

Table 166. List of MIKE 1D Boundary Conditions at Coastal Structures and Outfalls

No.	Canal	MIKE 1D Boundary Conditions
1	C-2	S22-T - Tailwater provided by SFWMD
2	Bigman Canal	S700P* - *Not operated during Storms
3	C-100	S123-T - Tailwater provided by SFWMD
4	C-1	S21-T - Tailwater provided by SFWMD
5	Goulds Canal	S21-T - Tailwater provided by SFWMD
6	C-102	S21A-T - Tailwater provided by SFWMD
7	Military Canal	S20G-T - Tailwater provided by SFWMD
8	C-103	S20F-T - Tailwater provided by SFWMD
9	Cooling Canal	S20-T - Tailwater provided by SFWMD
10	C-111	S197-T - Tailwater provided by SFWMD
11	L-31E	S20-T - Tailwater provided by SFWMD

The tidal boundary conditions with storm surge for the 5-yr, 10-yr, 25-yr and 100-yr for all coastal structures of the South Miami Dade (SMD) project were developed by SFWMD. Figure 330 through Figure 339 show the boundary conditions for the five coastal structures within the SMD project (S21A, S20F, S21, S20G and S123).

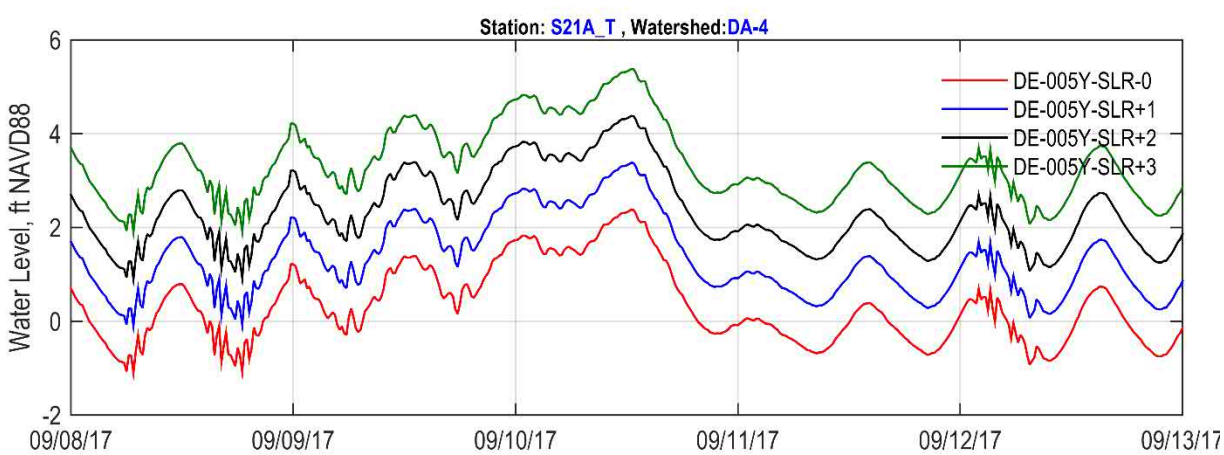


Figure 330. S21A Tailwater Boundary Timeseries for the 5-Year Event and SLR = 0, +1, +2 and +3 ft

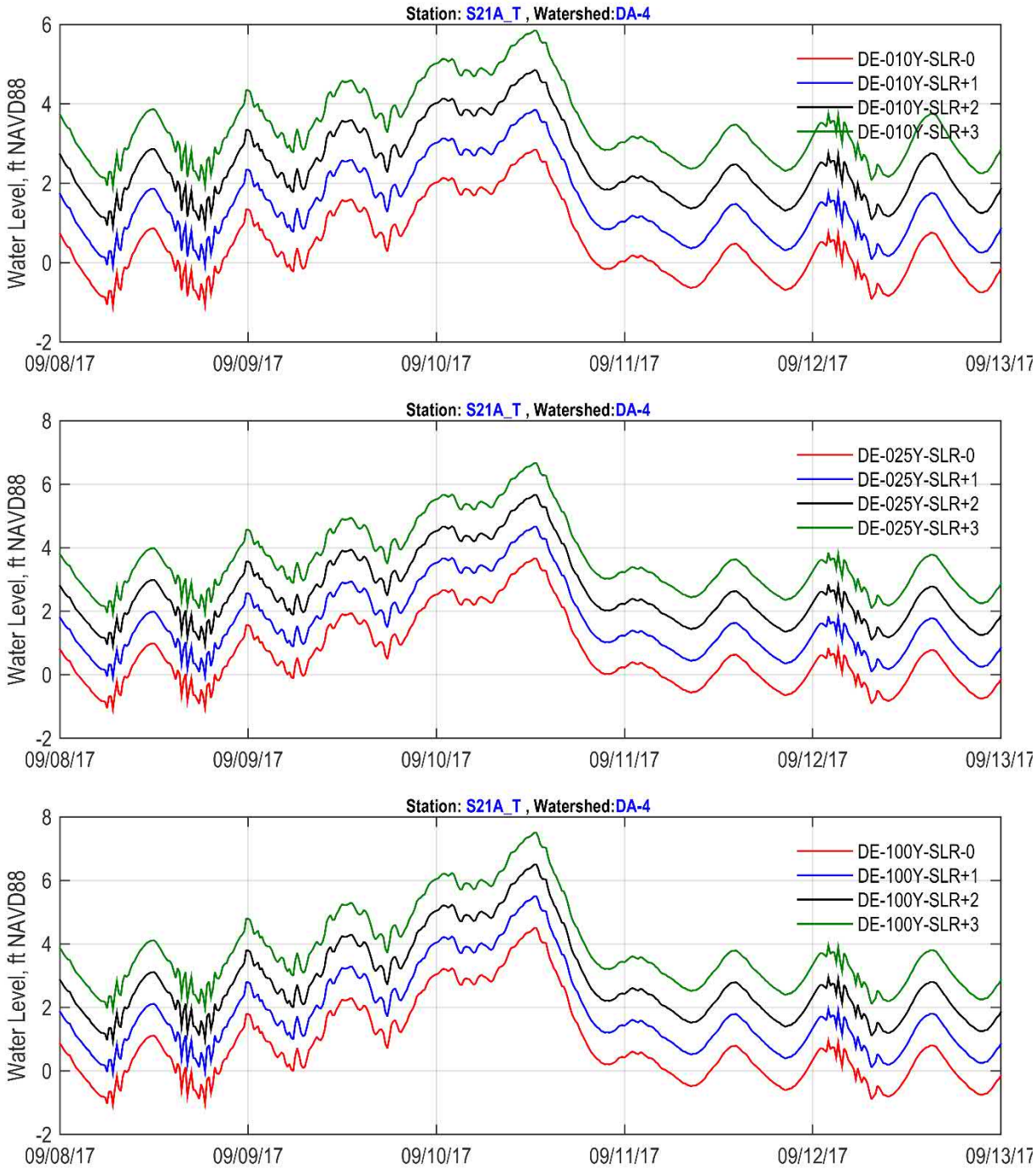


Figure 331. S21A Tailwater Boundary Timeseries for the 10-, 25- and 100-Year Events and SLR = 0, +1, +2 and +3 ft

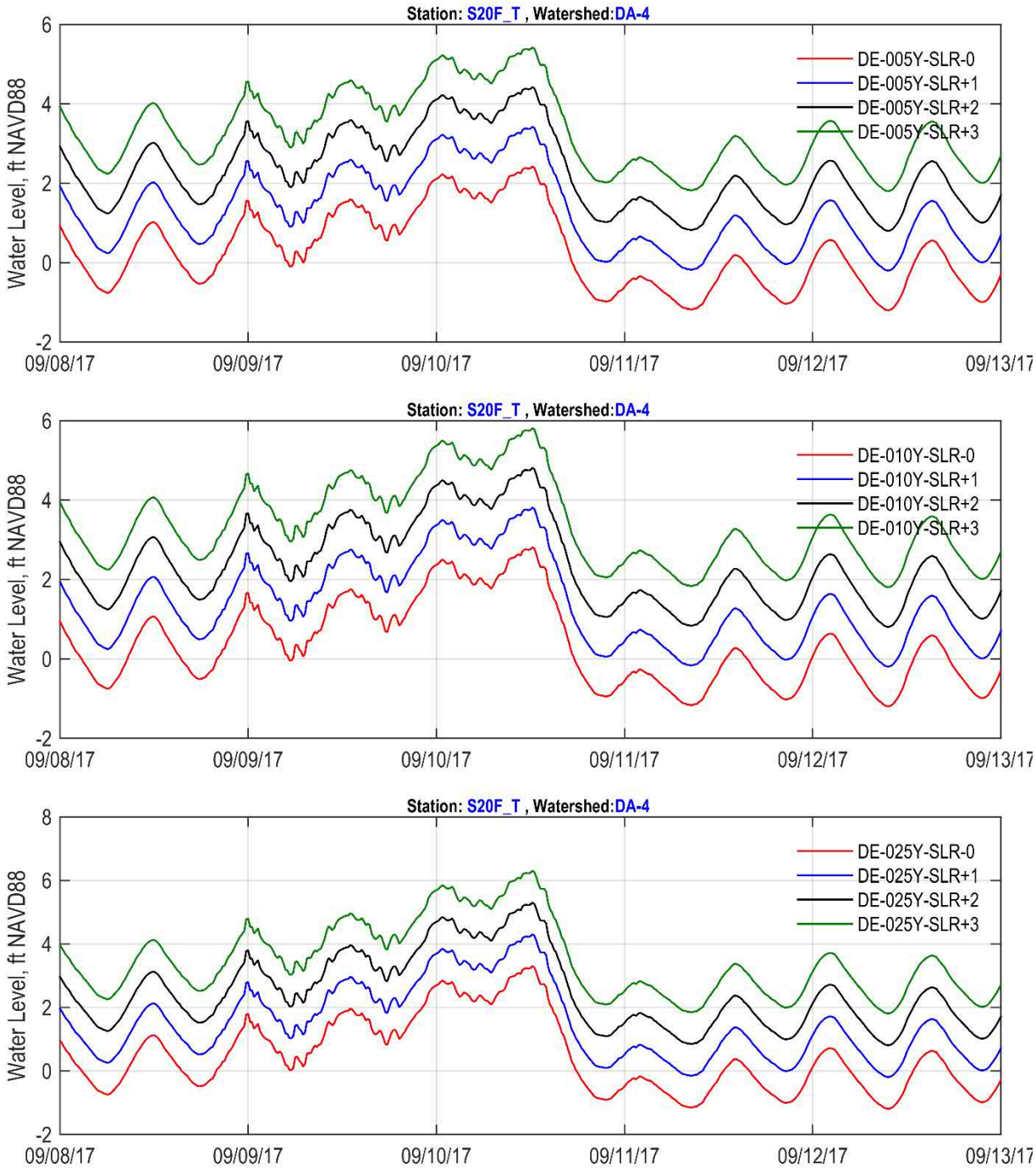


Figure 332. S20F Tailwater Boundary Timeseries for the 5-, 10- and 25-Year Events and SLR = 0, +1, +2 and +3 ft

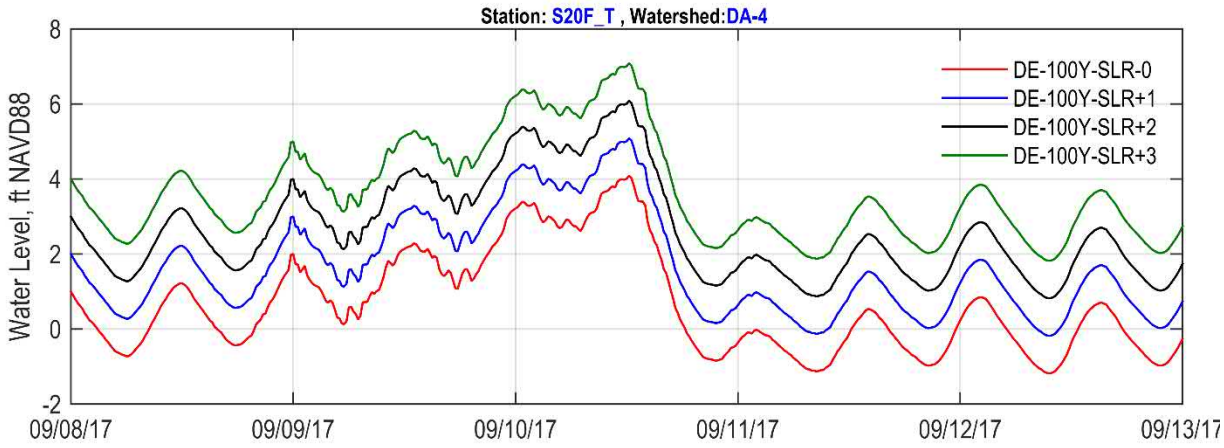


Figure 333. S20F Tailwater Boundary Timeseries for the 100-Year Event and SLR = 0, +1, +2 and +3 ft

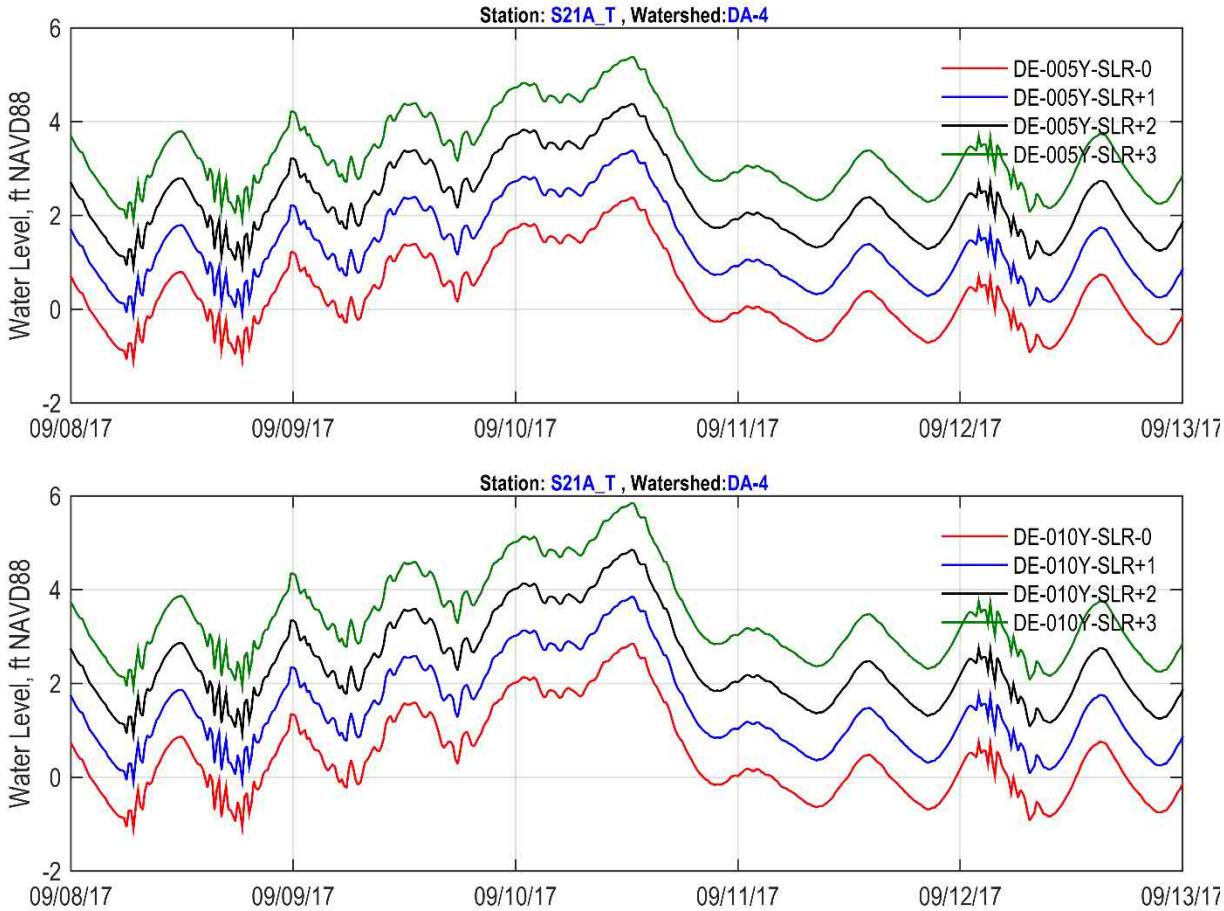


Figure 334. S21A Tailwater Boundary Timeseries for the 5- and 10-Year Events and SLR = 0, +1, +2 and +3 ft

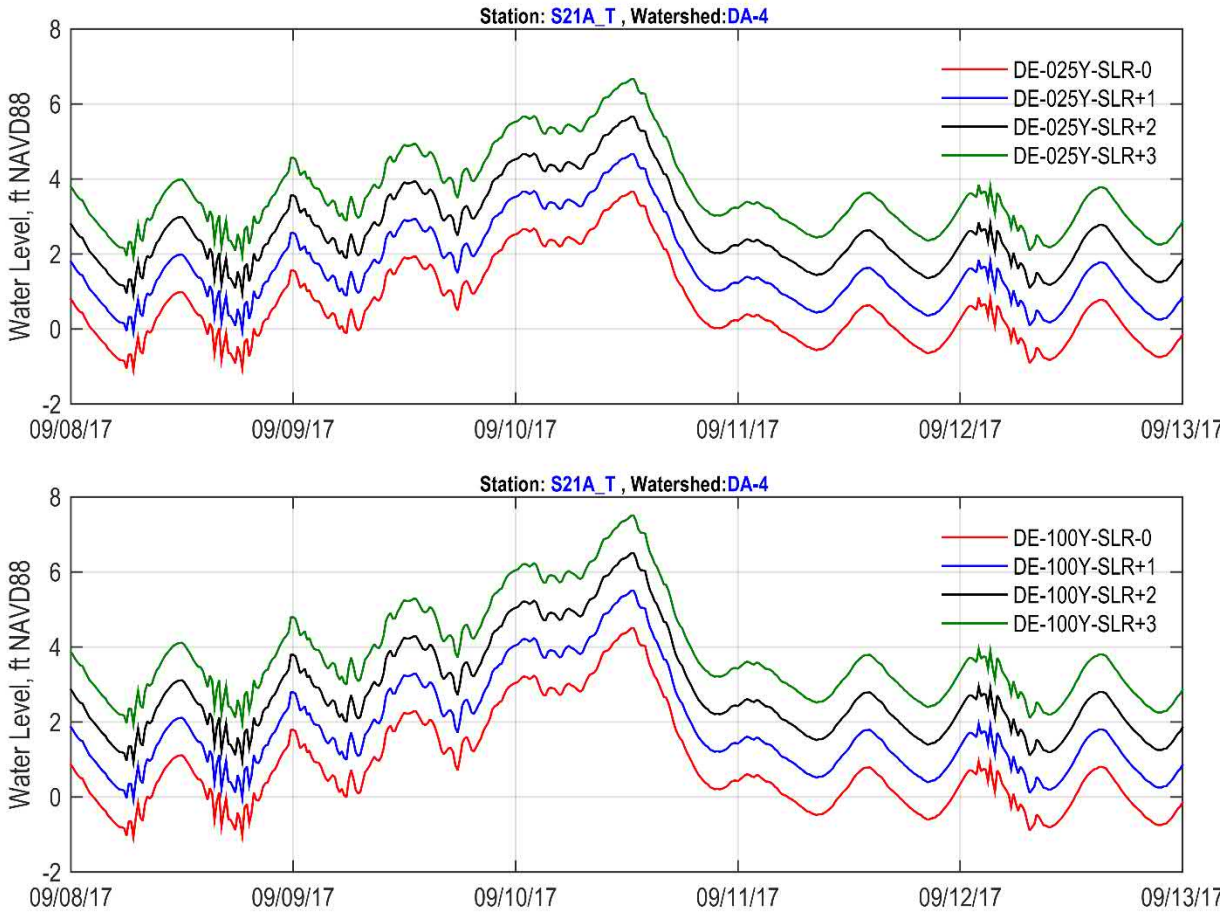


Figure 335. S21A Tailwater Boundary Timeseries for the 25- and 100-Year Events and SLR = 0, +1, +2 and +3 ft

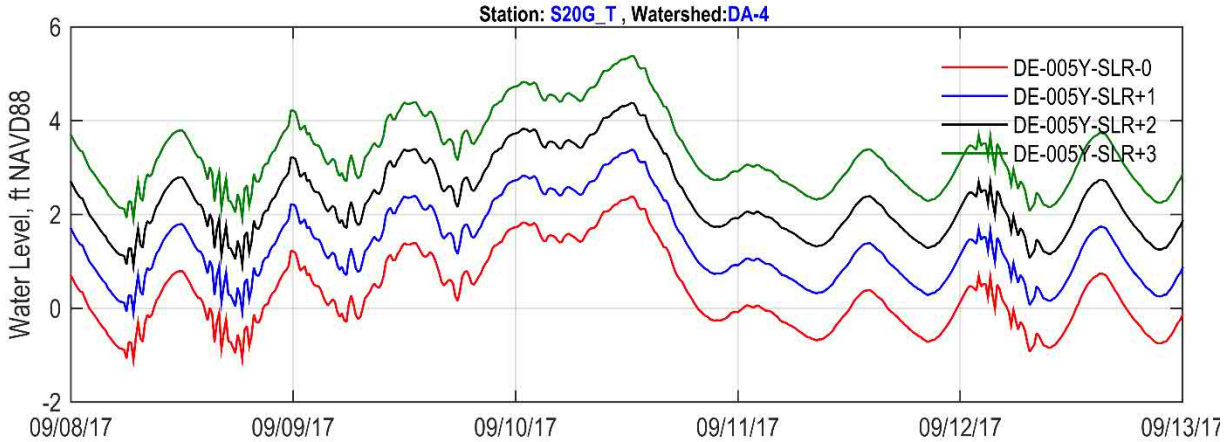


Figure 336. S20G Tailwater Boundary Timeseries for the 5-Year Event and SLR = 0, +1, +2 and +3 ft

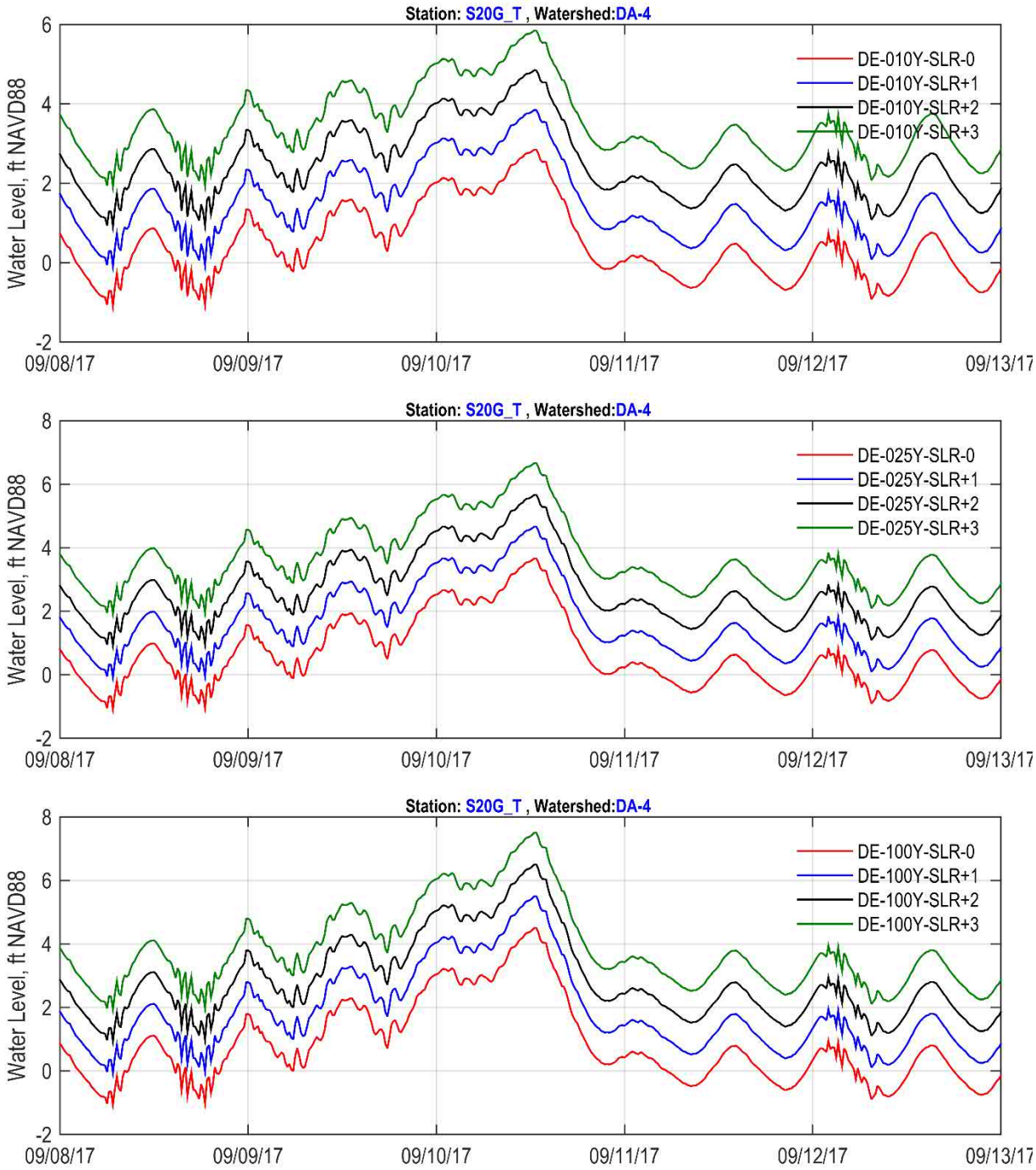


Figure 337. S20G Tailwater Boundary Timeseries for the 10-, 25- and 100year Event and SLR = 0, +1, +2 and +3 ft

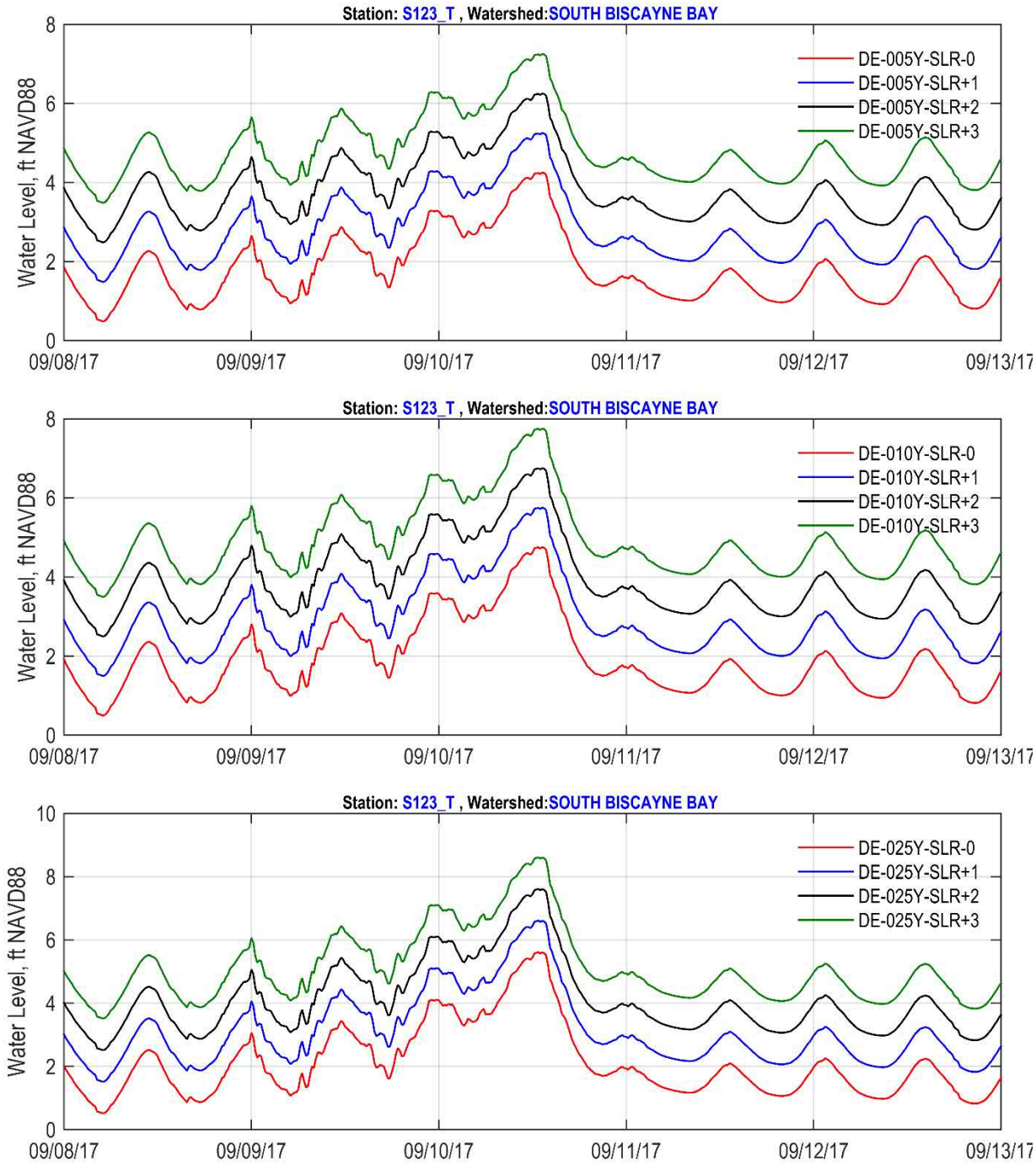


Figure 338. S123 Tailwater Boundary Timeseries for the 5-yr, 10-yr and 25-yr Event and SLR = 0, +1, +2 and +3 ft

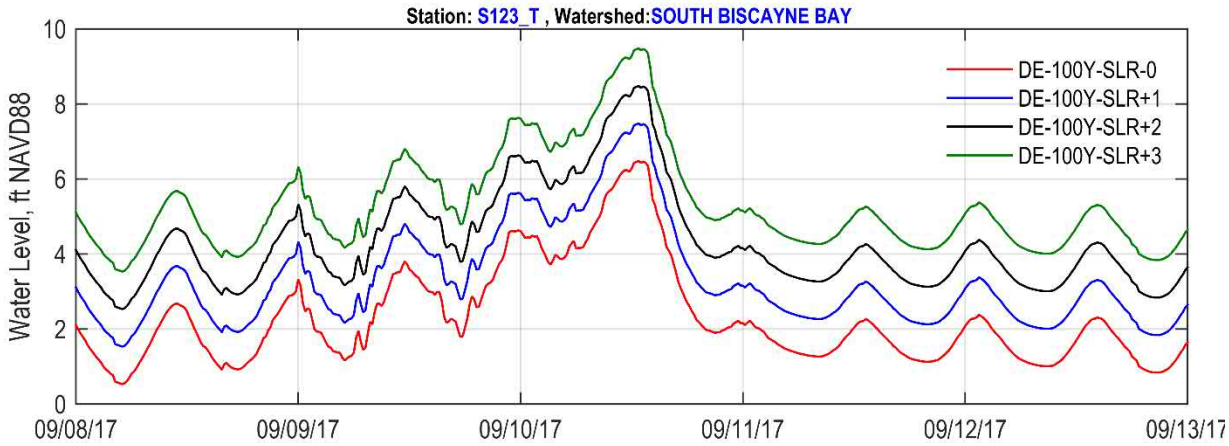


Figure 339. S123 Tailwater Boundary Timeseries for the 100year Event and SLR = 0, +1, +2 and +3 ft

6.1.5.5 Inland Mike 1D Boundary Conditions

The inland boundary conditions were developed using headwater of the nearest MIKE 1D structures. The following structures were used for water levels in Canals L-31N and C-111, Table 167.

- Canal L30: S335
- Canal L29: S334
- Canal L31N: G211, S331, S331S, S173
- Canal C111: S176, S18C, S197, S332BN, S332BS, S332C, S332D, S199, S200

Table 167. Inland MIKE 1D Boundary Conditions

No.	Canal	MIKE 1D Boundary Conditions
1	C-4	T5 Stage boundary condition
2	L-29	S334-H*; Headwater observed during Hurricane Irma
3	L-30	S335-H*; Headwater observed during Hurricane Irma
4	S332	Q-H (Discharge-Stage) relationship
5	Aerojet	Closed 1D boundary (Zero Discharge)
Note: * Observed data from Hurricane Irma was used		

6.1.5.6 Mike 1D Structure Operations

The control structures in Miami-Dade County regulate the flow of water in the primary canals using stage criteria. The primary canals are used to discharge excess water from the watersheds during flooding and to maintain minimum water levels in the canals during drought periods. Some structures are usually closed to prevent water from passing from one watershed to another but can also be opened to supply water between watersheds during periods of water demand. These coastal structures, which discharge to tide, have the additional function of preventing saltwater intrusion into these primary canals during a tidal or storm surge event.

All observed structure operations (using breakpoint gate level records) in the calibrated and validated model were replaced with rule-based operations for flood protection. Based on the descriptions in the District's *Water Control Operations Atlas for South Miami-Dade,* structure book and meetings with the SFWMD's Operations Bureau on 12/02/20, the operations were implemented in the MIKE 1D SMD FPLOS model. Guidance from SFWMD Operations Bureau was prioritized for defining the operations and is summarized in Table 168. The structures operation was coordinated with SFWMD's Operations Bureau 12/02/20 (ref 45).

Table 168. Structure Operations in SMD FPLOS model set up for the existing conditions

Structure	Canal	NGVD 29 to NAVD 88	Gate Open (ft NAVD 88)	Gate Close (ft NAVD 88)	Structure Type	Purpose of Operation
S118	C-100	-1.539	4	3.5	Sluice Formula	Optimum upstream water control stages in Canal 100
S119	C-100C	-1.542	4.6	4	Sluice Formula	Optimum upstream water control stages in Canal 100C
S122	S122-G1	-1.532	Closed	Closed	Underflow	Divides the drainage areas of C-1 and C-100B
S123	C-100	-1.532	2.4	1.6	Sluice Formula	Maintains optimum water control stages upstream in Canals C-100, C-100A, and C-100B
S148	C-1W	-1.529	4	3	Sluice Formula	Optimum upstream water control stage of 5.0 feet in Canal 1
S149	S149-G1	-1.532	Open	Open	Underflow	Optimum upstream water control stages of 5.5 feet in Canal 1
S165	C-102	-1.519	3	2.5	Sluice Formula	Optimum upstream water control stages in Canal 102
S166	C-103N	-1.519	Open	Open	Sluice Formula	Optimum upstream water control stages in Canal 102
S167	C-103	-1.516	3	2.5	Sluice Formula	Optimum upstream water control stages in Canal 103N
S194	S194	-1.549	Closed	Closed	Underflow	Drainage divide structure and as a control for stages in C-102
S195	C-102N	-1.526	Open	Open	Underflow	Optimum upstream water control stages in Canal 102N
S196	C-103	-1.539	Closed	Closed	Underflow	Drainage divide structure and as a control for stages to the west
S20F	C-103	-1.529	1.4	1	Sluice Formula	Maintains optimum water control stages upstream in Canal 103
S20G	Military Canal	-1.529	1.4	1	Sluice Formula	Optimum upstream water control stages in the Military Canal
S20	Cooling Canal	-1.532	1.4	1.0	Sluice, Formula	Flood Control
S21	C-1	-1.526	2	1	Sluice Formula	Maintains optimum water control stages upstream in C-1
S21A	C-102	-1.526	1.4	1	Sluice Formula	Maintains optimum water control stages upstream in C-102
S338	S338	-1.555	5.8	5.5	Underflow	Water supply
S18C	C-111	-1.553	1.038	0.45	Sluice Formula	Optimum upstream water control stages in S177
S197	C-111	-1.553	-0.162	-0.962	Sluice Formula	Optimum upstream water control stages in S18C

The structures listed in Table 169 implement the salinity control operations as per SFWMD's Water Control Operation Atlas Part 2 (Ref 55):

Table 169 List of Structures with Salinity Control Operations

Structure	Canal	NGVD 29 to NAVD 88	Gate Open (ft NAVD 88)	Gate Close (ft NAVD 88)	Salinity Control Gate Close	Max Allowable Discharge (cfs)
S18C	C-111	-1.562		0.45		
S20	L-31E	-1.532	HW – TW > 0.1		HW – TW < =0.1	
S20F	C-103	-1.529	HW – TW > 0.1		HW – TW < =0.1	
S20G	Military Canal	-1.529	HW – TW > 0.1		HW – TW < =0.1	
S21	C-1	-1.526	HW – TW > 0.1		HW – TW < =0.1	
S21A	C-102	-1.526	HW – TW > 0.1		HW – TW < =0.1	
S121	C-100C	-1.555				Max 100 cfs
S122	C-100B	-1.532				Max 200 cfs
S123	C-100	-1.532	HW – TW > 0.1		HW – TW < =0.1	
S177	C-100	-1.581	HW – TW > 0.1		HW – TW < =0.1	

Additional considerations provided by SFWMD are listed below, however not included in the model.

- During King Tide events, SFWMD attempts to maximize discharging to Biscayne Bay prior to the expected event.
- Typically, canals are lowered by SFWMD 2 days prior to major storm events such as Hurricane Irma, 2017
- When a significant impact from high tides is expected, canals are drawn down even earlier than two days prior to event.
- Under very dry conditions, SFWMD may wait until a day before to drawdown canals due to water supply demands.
- In general, the SFWMD gates are opened when the head differential is 0.3 feet and closed when it is 0.1 feet

An example of the headwater, tailwater and discharges and the corresponding gate operations is shown in Figure 340.

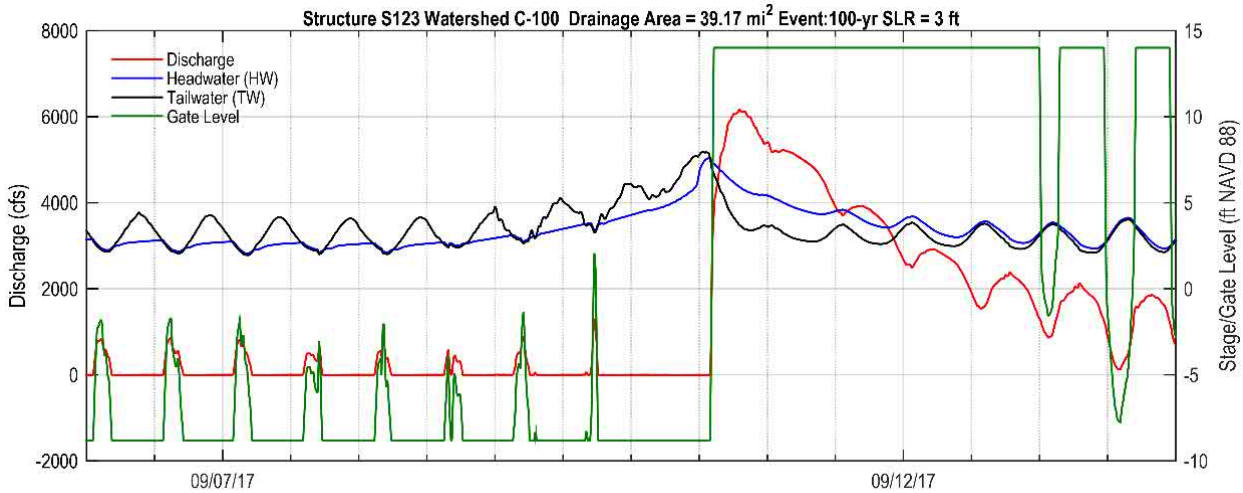


Figure 340. An example of S123 Gate Level (ft NAVD 88) for the 25-Year Design Event with 0 SLR

The MIKE 1D model uses gate levels as described below.

- Gate level at 10 ft for underflow structures indicates open, a gate level at sill level indicates fully closed structure.
- MIKE 1D requires gate levels and sill elevations for structure input.
- DBHYDRO provides gate openings, therefore the input files of the MIKE 1D set up for the gates were converted to gate levels by subtracting the sill level from the gate opening.
- MIKE 1D compares absolute gate levels (in this model in ft NAVD 88) with the sill levels (in ft NAVD 88) and determines the opening.
- For example, for underflow spillways, if the gate level (which is an input dfs0 file) is at -10 ft NAVD 88 or lower, and the sill level is at -10 ft NAVD 88, the gate is open. If the gate level is at -8.0 ft NAVD 88, then the gate opening is 2.0 feet.

Boundary conditions used were from observed data from Hurricane Irma for the western domain of the model, including Water Conservation Areas and Everglades National Park. The following structures were used for water levels in canals L-31N and C-111:

- Canal L30: S335
- Canal L29: S334
- Canal L31N: G211, S331, S331S, S173
- Canal C111: S176, S18C, S197, S332BN, S332BS, S332C, S332D, S199, S200

6.1.5.7 MIKE SHE Boundary Conditions

The MIKE SHE boundary conditions were developed using distributed timeseries:

- For the coastal boundaries, a 2D timeseries were developed for each design event (using the tailwater timeseries of S21, S21A, S20F, S20G, S20, S197 and S123). The 2D

timeseries were applied at OL and GW boundary cells. The tidal boundary time series stages for the coastal structures which were provided by SFWMD include storm surge.

- For the inland section of the model domain a 2D groundwater timeseries were developed using observed data from DBHYDRO.

Figure 341 shows the spatial extent how the overland and inland based boundaries were applied

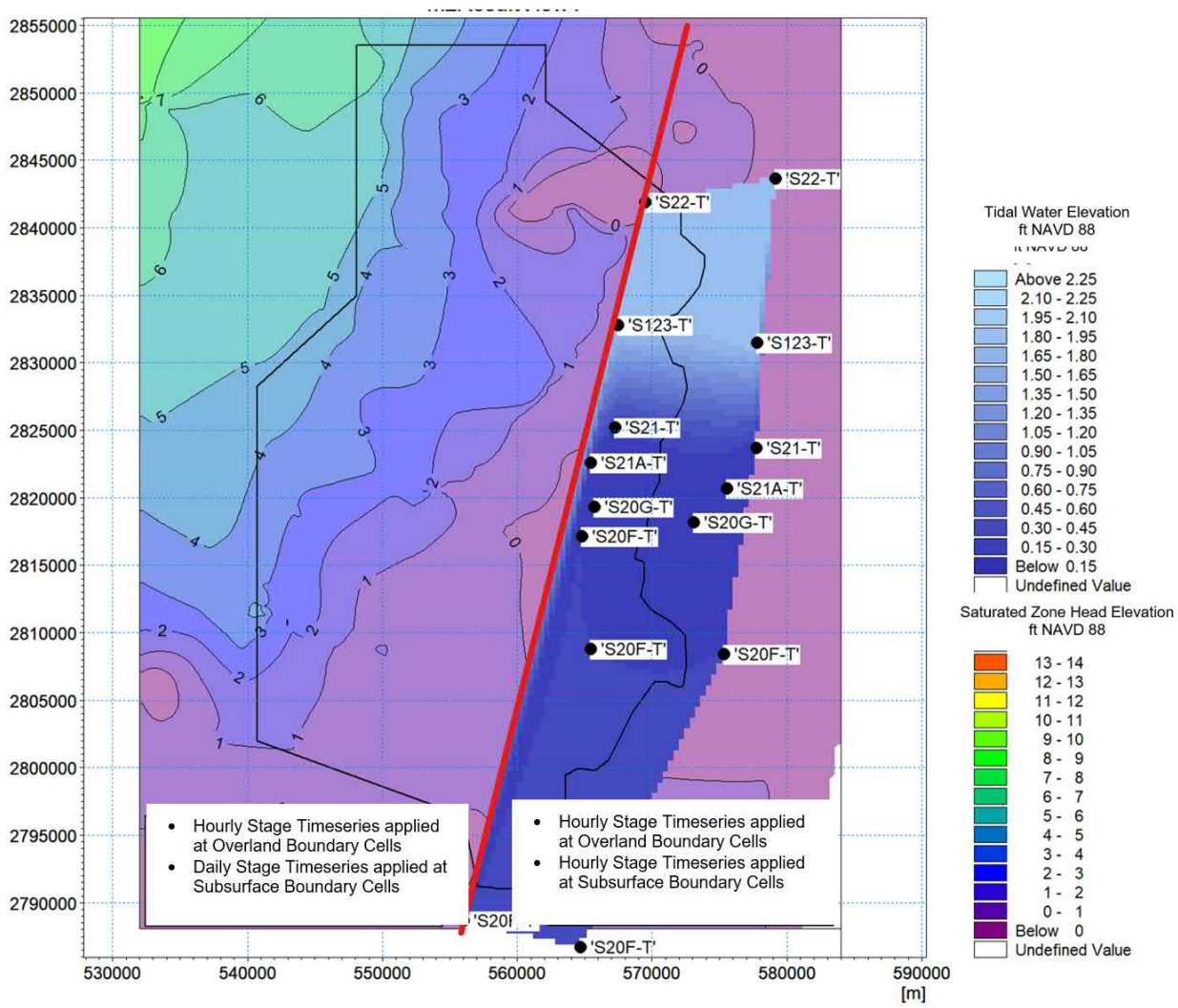


Figure 341. Development of the 2D for the Coastal Overland and Saturated Zone Boundary.

6.1.6 Initial Conditions

Initial water levels used were from Hurricane Irma for the western domain of the model. The SMD FPLOS model requires initial conditions for groundwater elevations, overland surface water elevations and Mike 1D water elevations. A summary is provided in the sections below.

6.1.6.1 Initial Canal Stages

The canal network was updated to use initial stages corresponding to the SLR conditions, i.e., by adding +1, +2 and +3 ft NAVD 88 to the initial conditions used for the current conditions model.

6.1.6.2 Initial Overland Depth

The initial water depth conditions were developed using the following approach.

1. DBHYDRO was used to download available surface water and groundwater timeseries within the model domain which include canal stages, tailwater and groundwater stages.
2. The tailwater stages provided by SFWMD for each combination of SLR and design events were applied at the location of the structure.
3. For the period 2015-2020 the average October surface water elevations were obtained from the available data and interpolated to provide water levels within the model domain.
4. The data were interpolated to provide coverage of the spatial extent of the coastal boundary and a 2D surface representing the water elevation at the initial time step was developed
5. The Overland Depth was determined by subtracting the topography (bathymetry) raster from the water levels and negative values were set to 0.0 which is a MIKE SHE input file requirement (overland flow depth cannot be negative).

The future conditions model uses a 2D groundwater timeseries with a timestep of 1 hour, which was also used for the calibration model; these timeseries were applied to the inland boundaries of the model.

Surface (overland) water levels were downloaded and interpolated to an hourly grid timeseries. The average October Overland Water Elevation were computed using the last 5 years and are used as the initial conditions for the overland.

The initial overland water depth for SLR +0, +1, +2 and +3 are provided in Figure 342 through Figure 345. (+0 refers to SLR of 0 ft and future conditions of infrastructure, topography, and land use)

Figure 346, Figure 347 and Figure 348 illustrate the difference between initial overland water levels for future and current conditions of SLR which includes+1, +2 and +3 feet.

- Four sets of initial overland depth conditions for each of the SLR conditions (+0, +1, +2 and +3 ft SLR) applied at each overland cell at the beginning of simulation.
- The initial overland conditions were developed assuming October average of last 5 years and using the initial stage in the tidal structure timeseries provided by SFWMD.

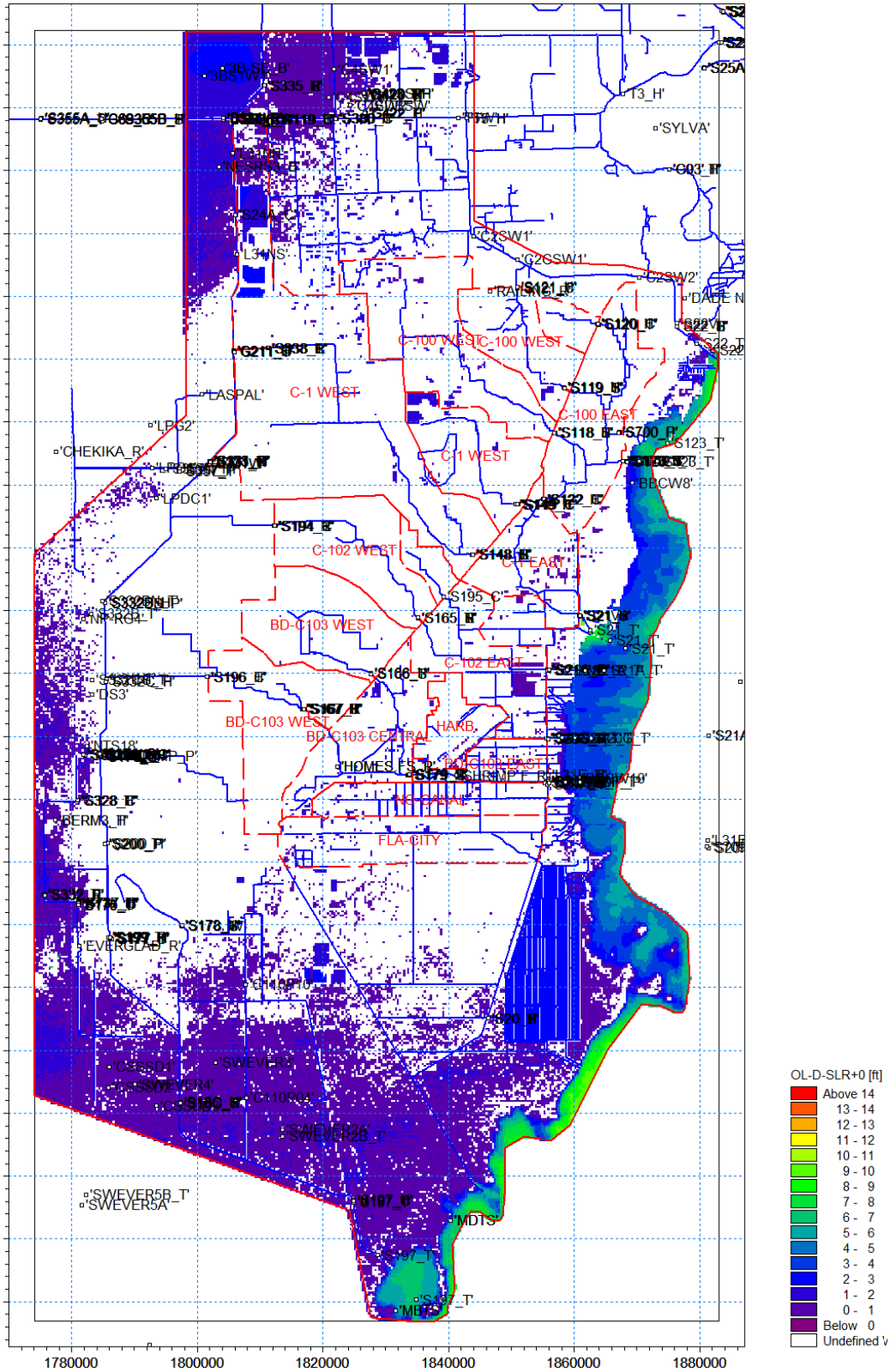


Figure 342. Initial Water Depth for SLR +0

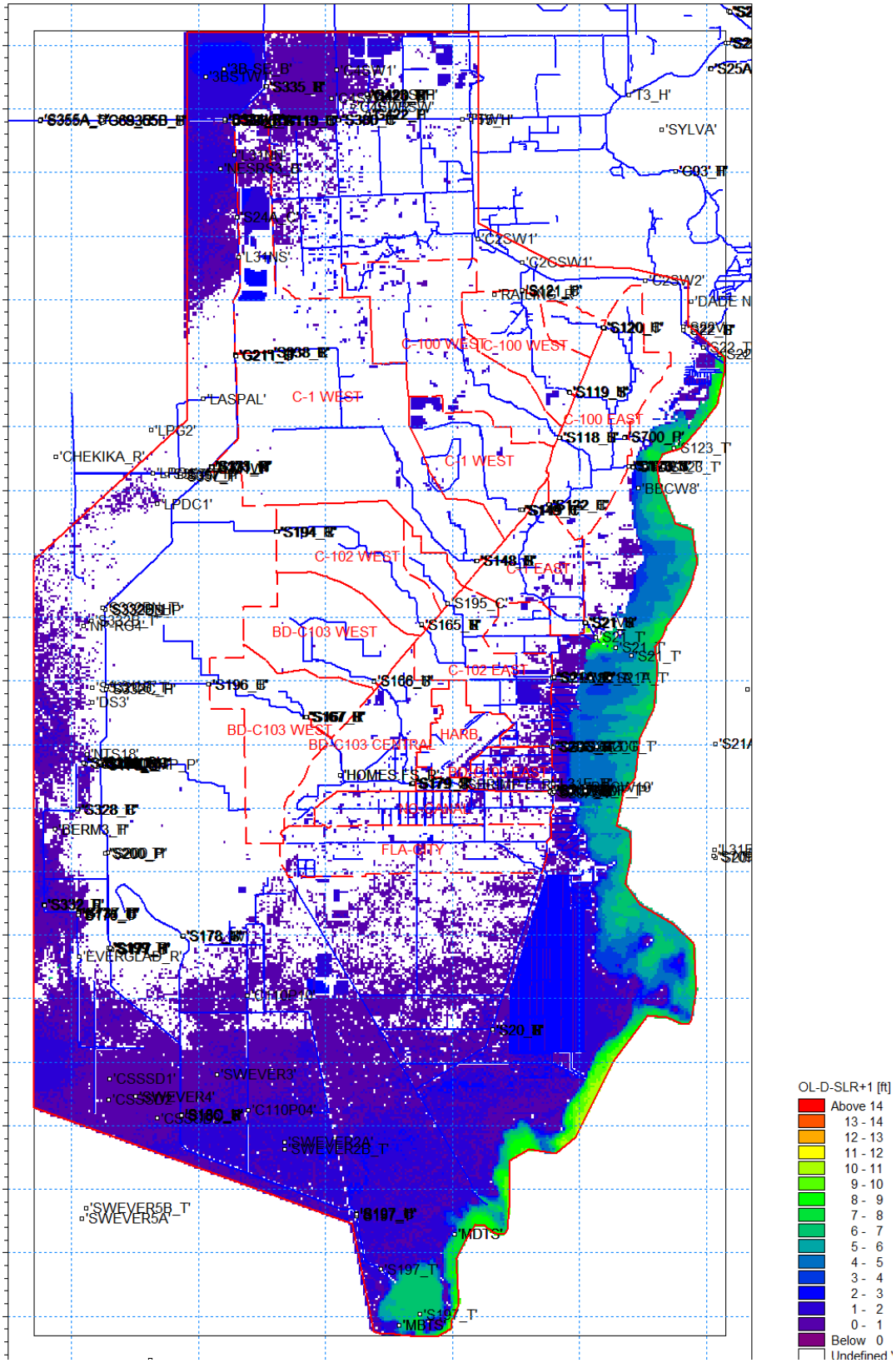


Figure 343. Initial Water Depth for SLR +1

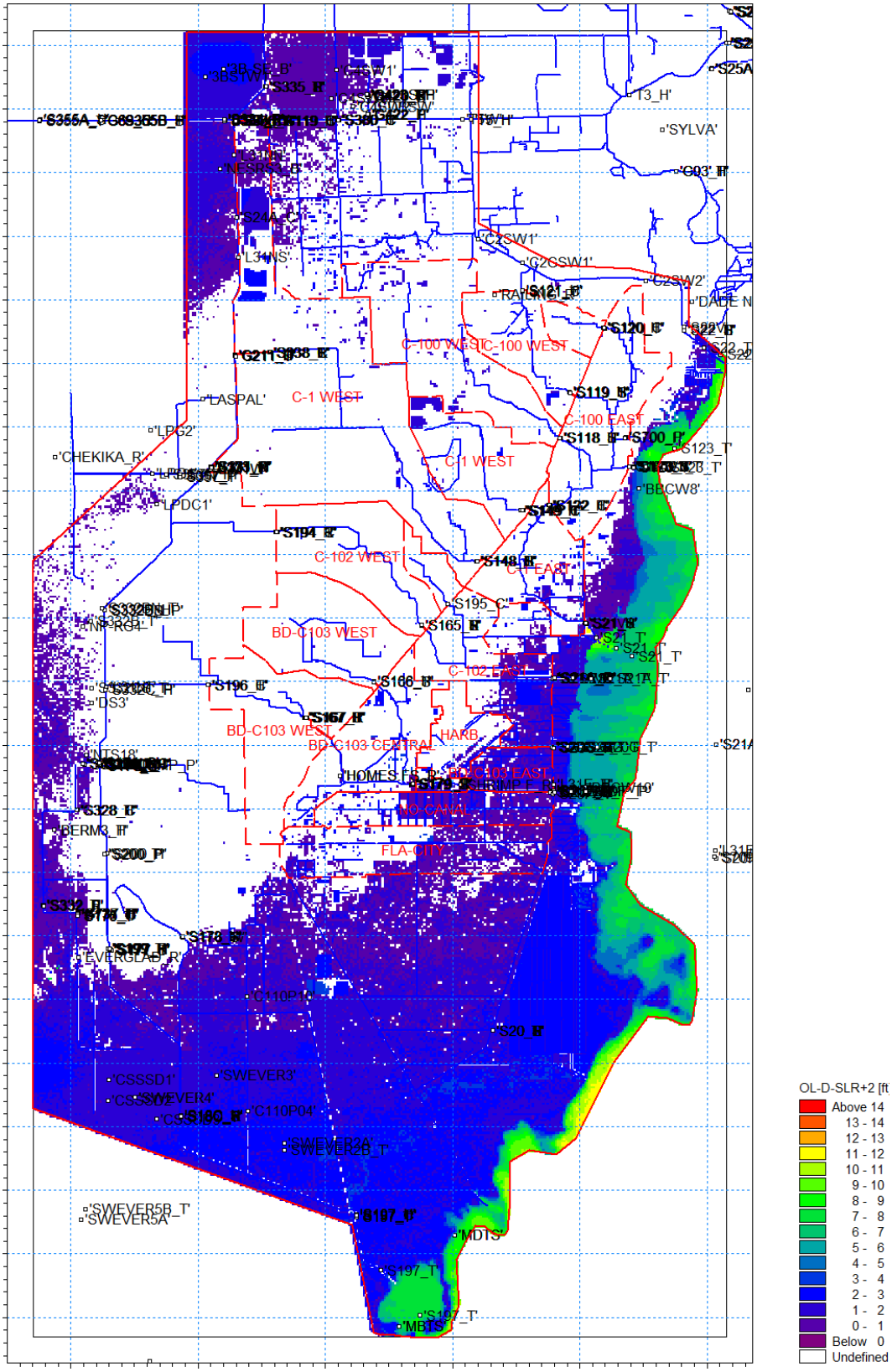


Figure 344. Initial Water Depth for SLR +2

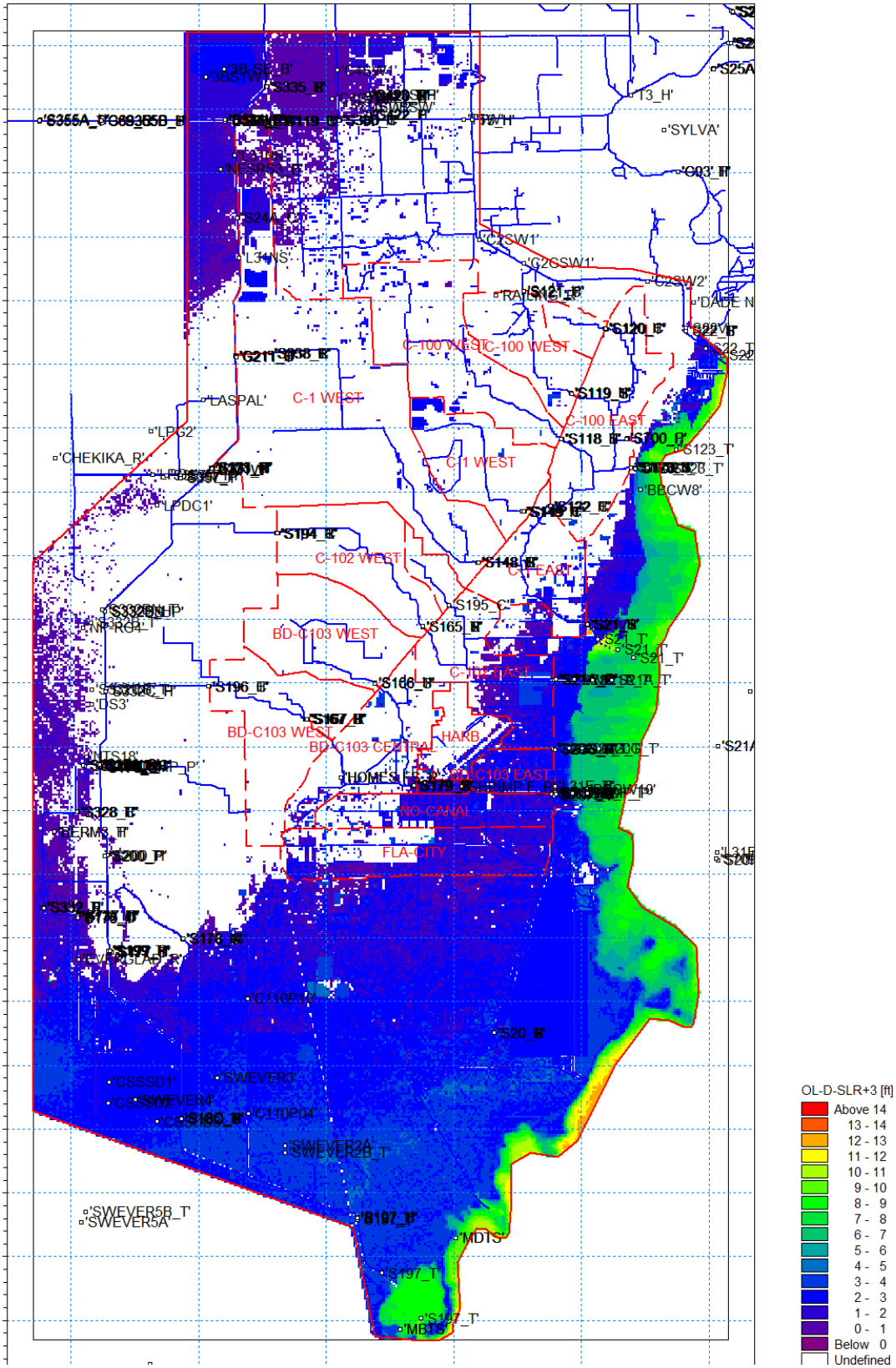


Figure 345. Initial Water Depth for SLR +3

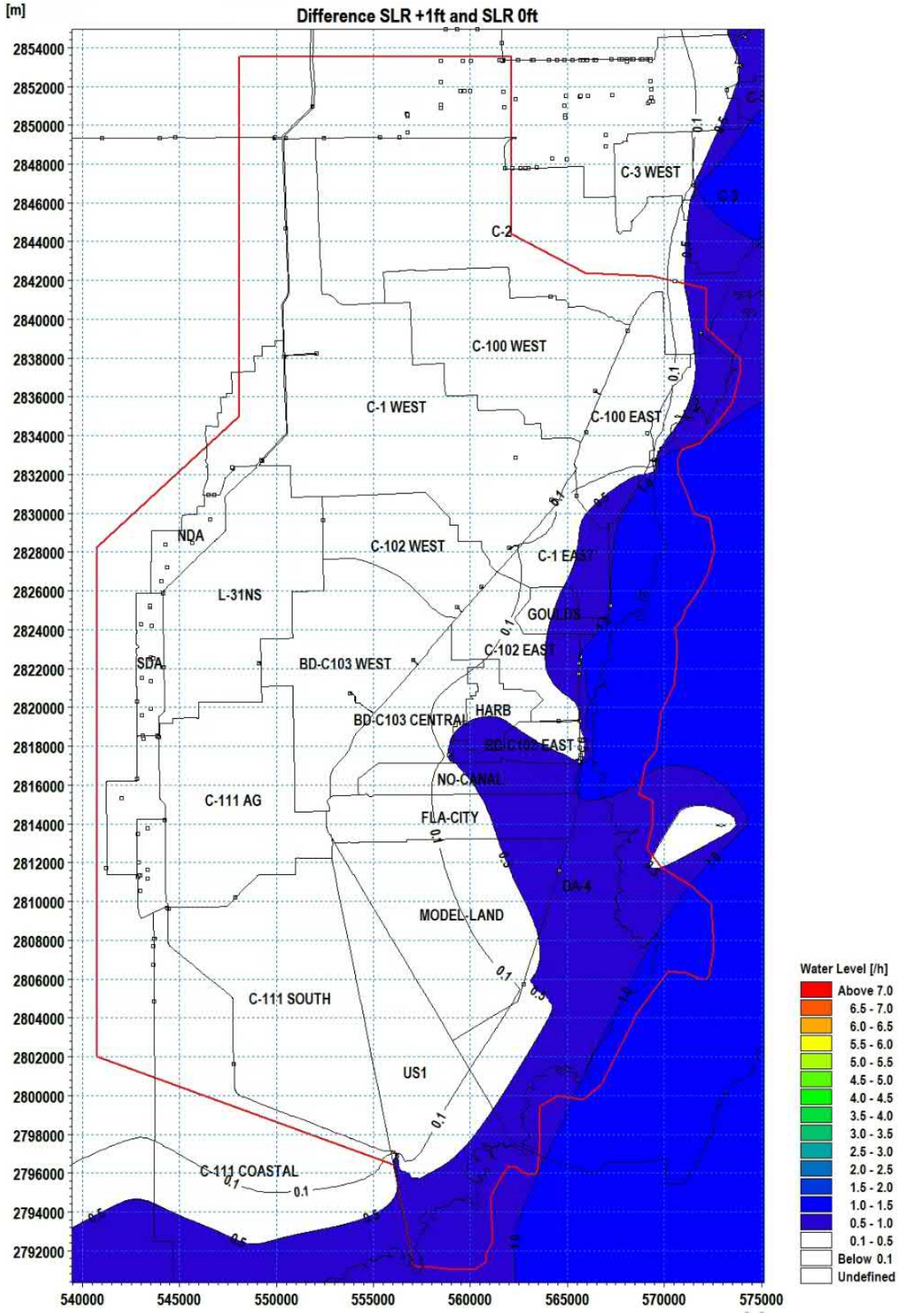


Figure 346. Difference between Initial Water Levels in Saturated Zone for +1 ft SLR and Initial Water Level for Current Conditions

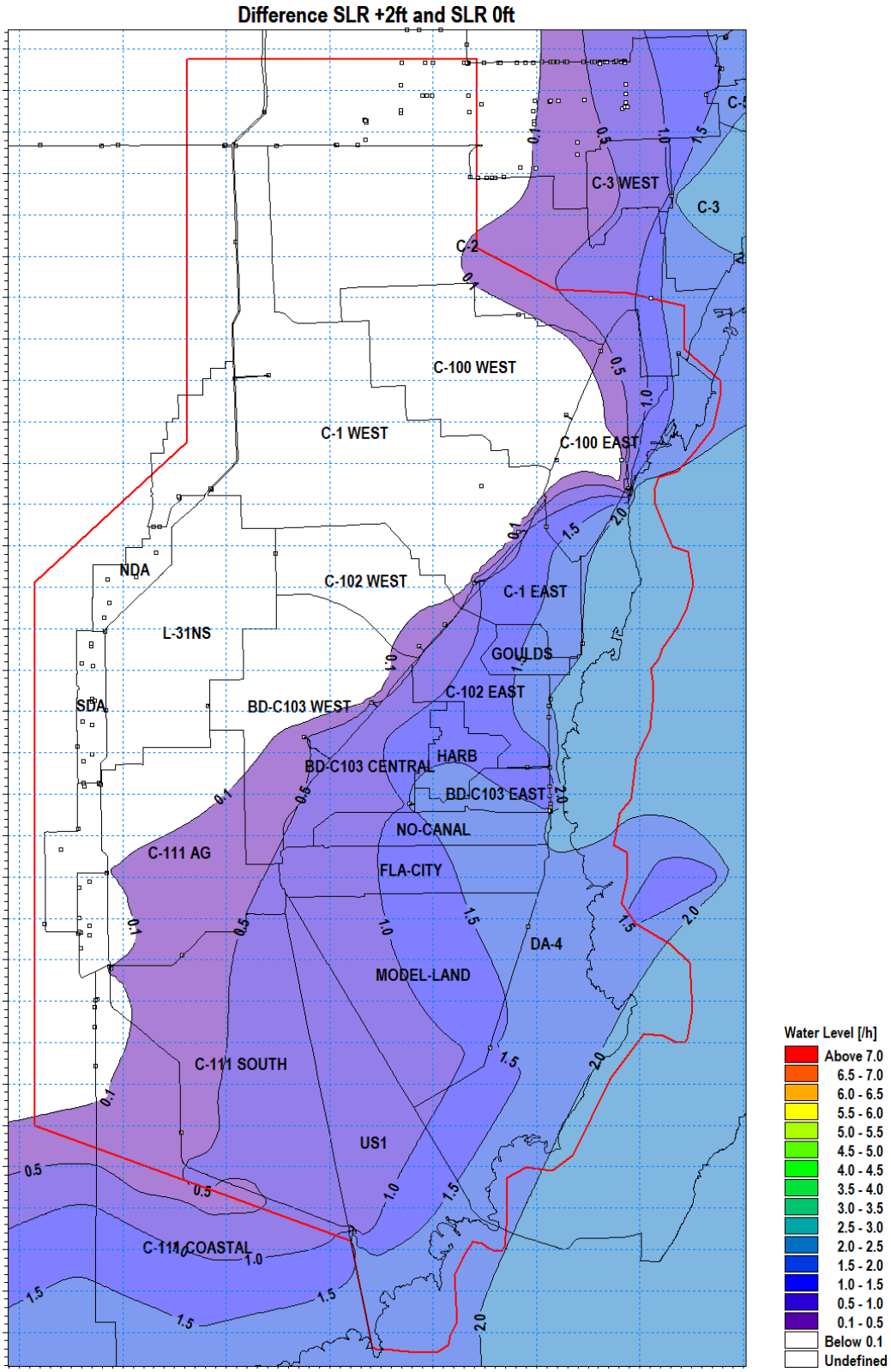


Figure 347. Difference between Initial Water Levels in Saturated Zone for +2 ft SLR and Initial Water Level for Current Conditions

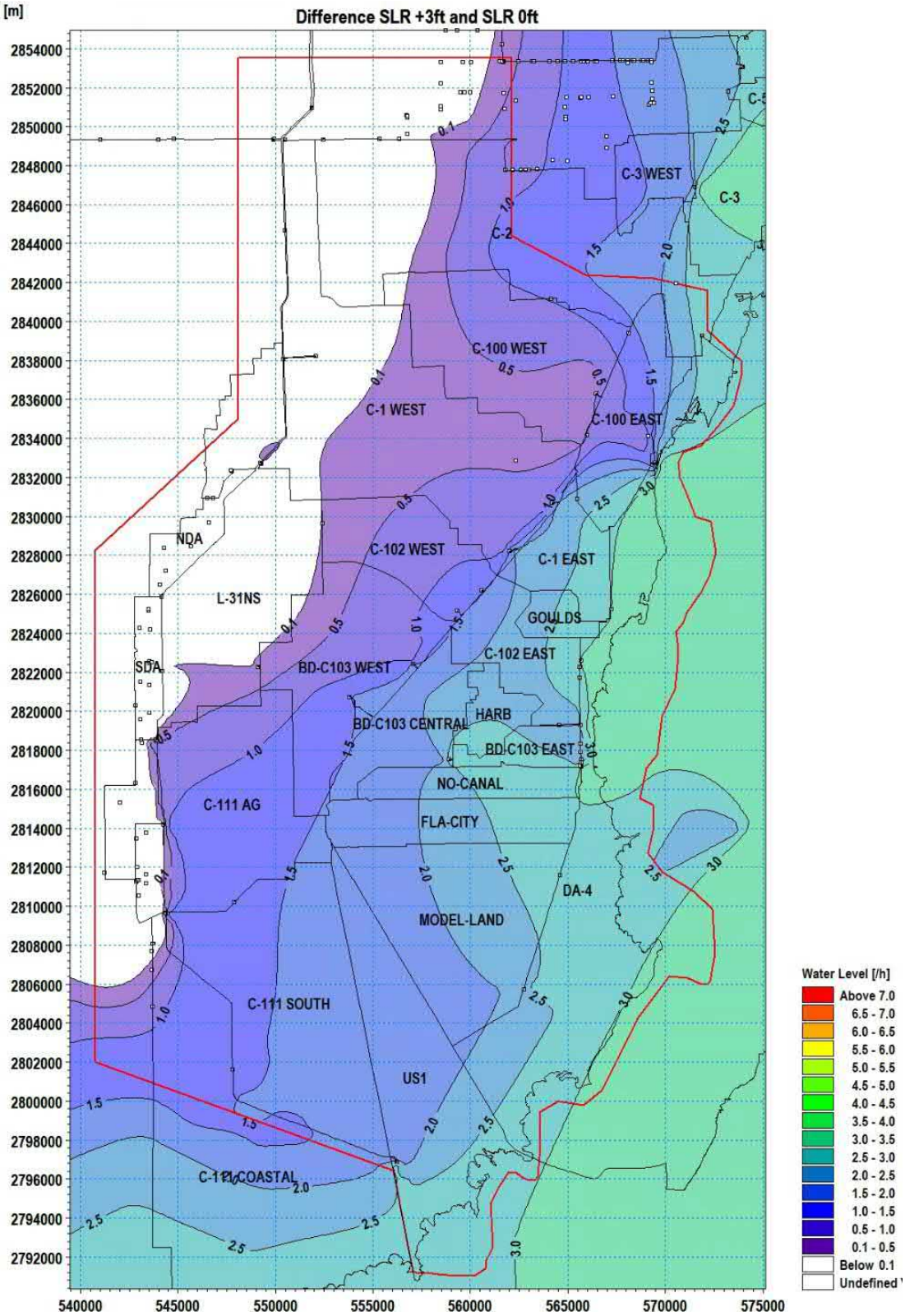


Figure 348. Difference between Initial Water Levels in Saturated Zone for +3 ft SLR and Initial Water Level for Current Conditions

A summary of the initially flooded overland cells for each SLR condition is shown in Table 170:

Table 170 Initially Flooded Overland Cells

SLR Condition	Flooded Cells	Average Depth	%Cells Flooded	Ac-ft Initial OL
SLR +0	47083	1.31	33%	38119
SLR +1	47084	1.99	33%	38121
SLR +2	63385	2.15	44%	69085
SLR +3	70194	2.72	49%	84725

6.1.6.3 Initial Groundwater Levels

Daily Biscayne Aquifer stage data for Hurricane Irma were downloaded and interpolated to an hourly grid timeseries.

The average October groundwater table was computed for the last 5 years and was used as the initial conditions for the Saturated Zone.

The subsurface model uses four sets of initial groundwater elevations for each of the SLR conditions (+0, +1, +2 and +3 ft SLR) applied at each SZ and each of the five layers at the beginning of simulation

Figure 349 through Figure 352 illustrate the initial groundwater levels for Current and Future conditions (SLR includes +1, +2 and +3 ft).

Figure 353, Figure 354 and Figure 355 illustrate the difference between initial water levels for future and current conditions of SLR which includes +1, +2 and +3 feet.

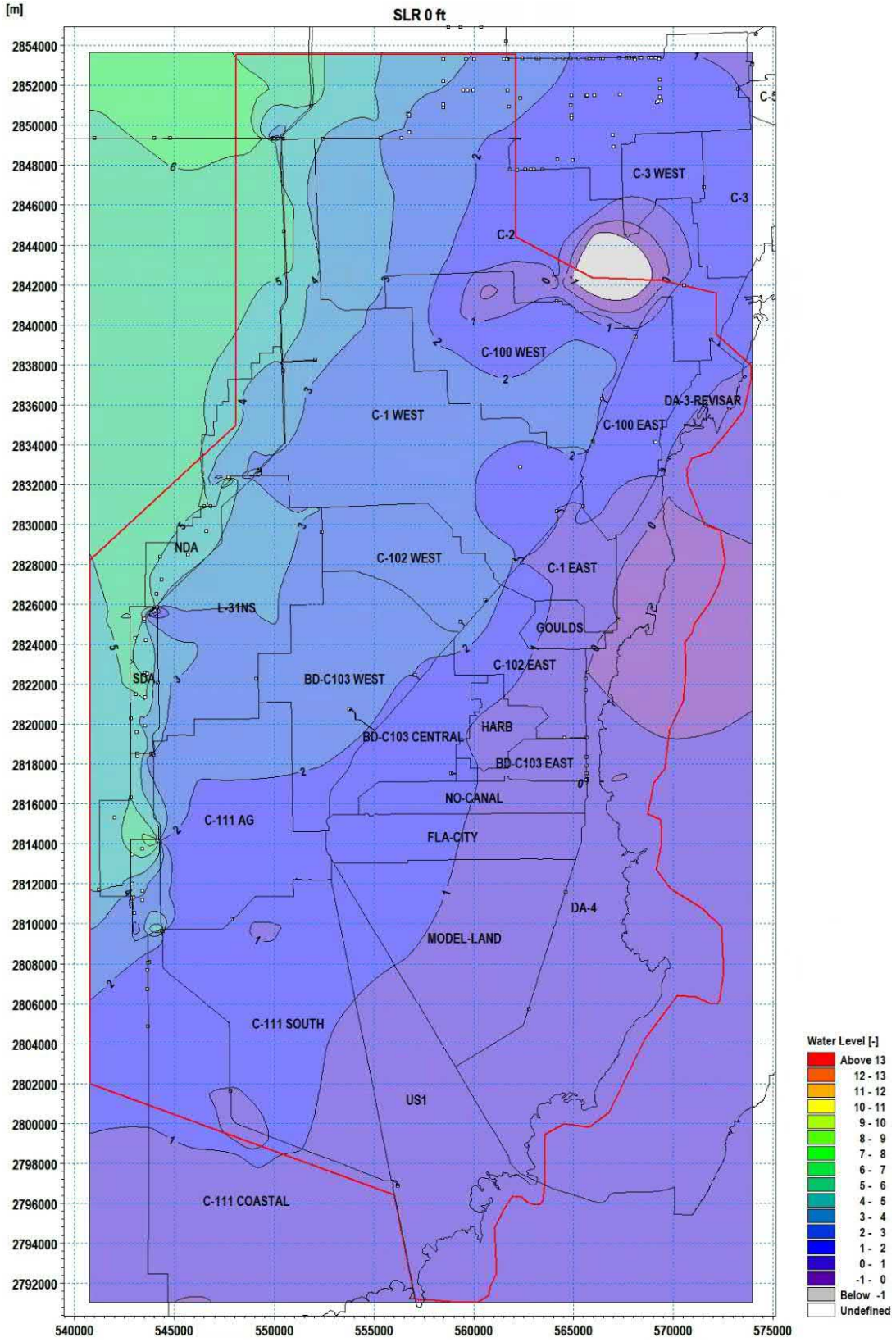


Figure 349. Initial Water Levels in Saturated Zone for +0 ft SLR

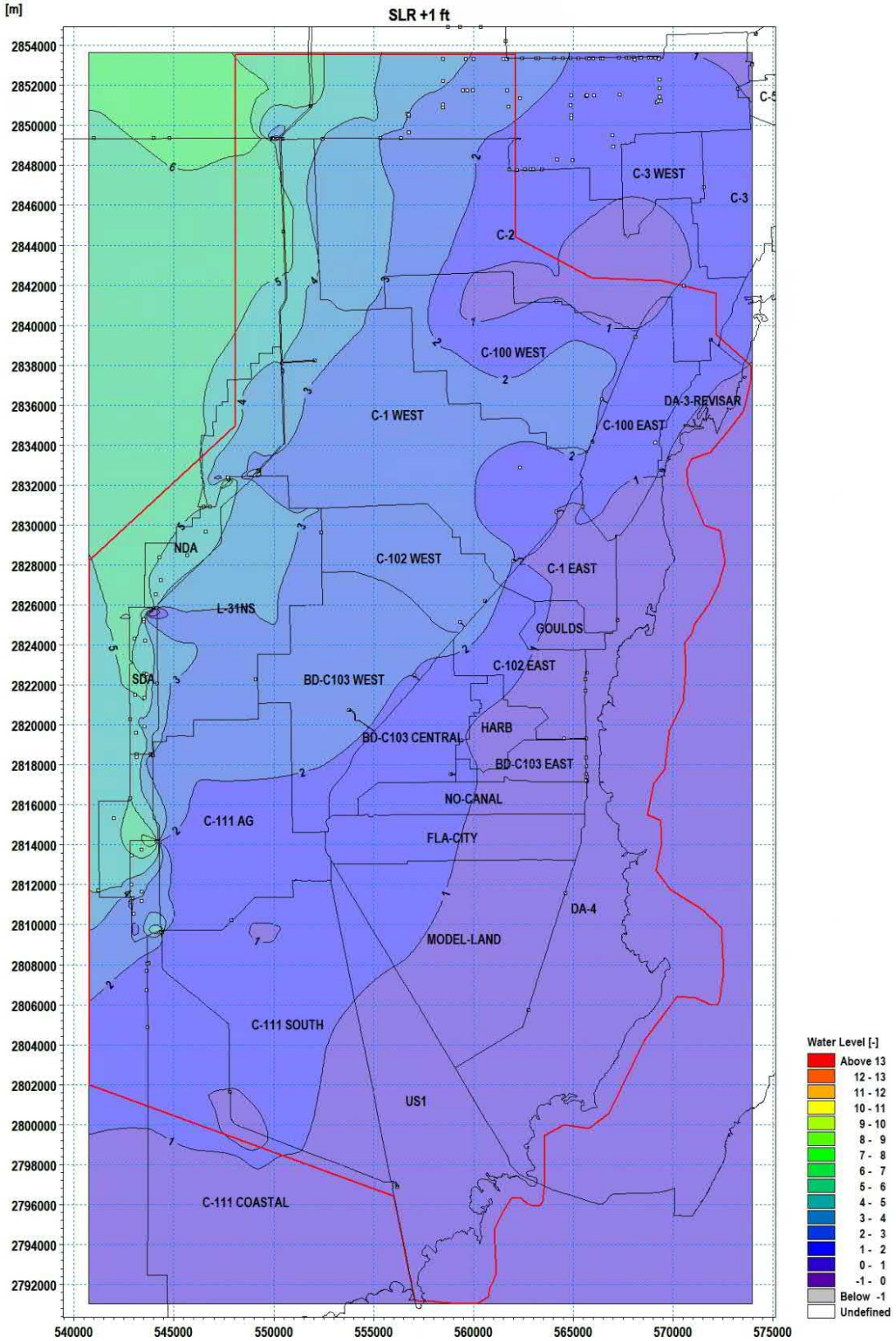


Figure 350. Initial Water Levels in Saturated Zone for +1 ft SLR

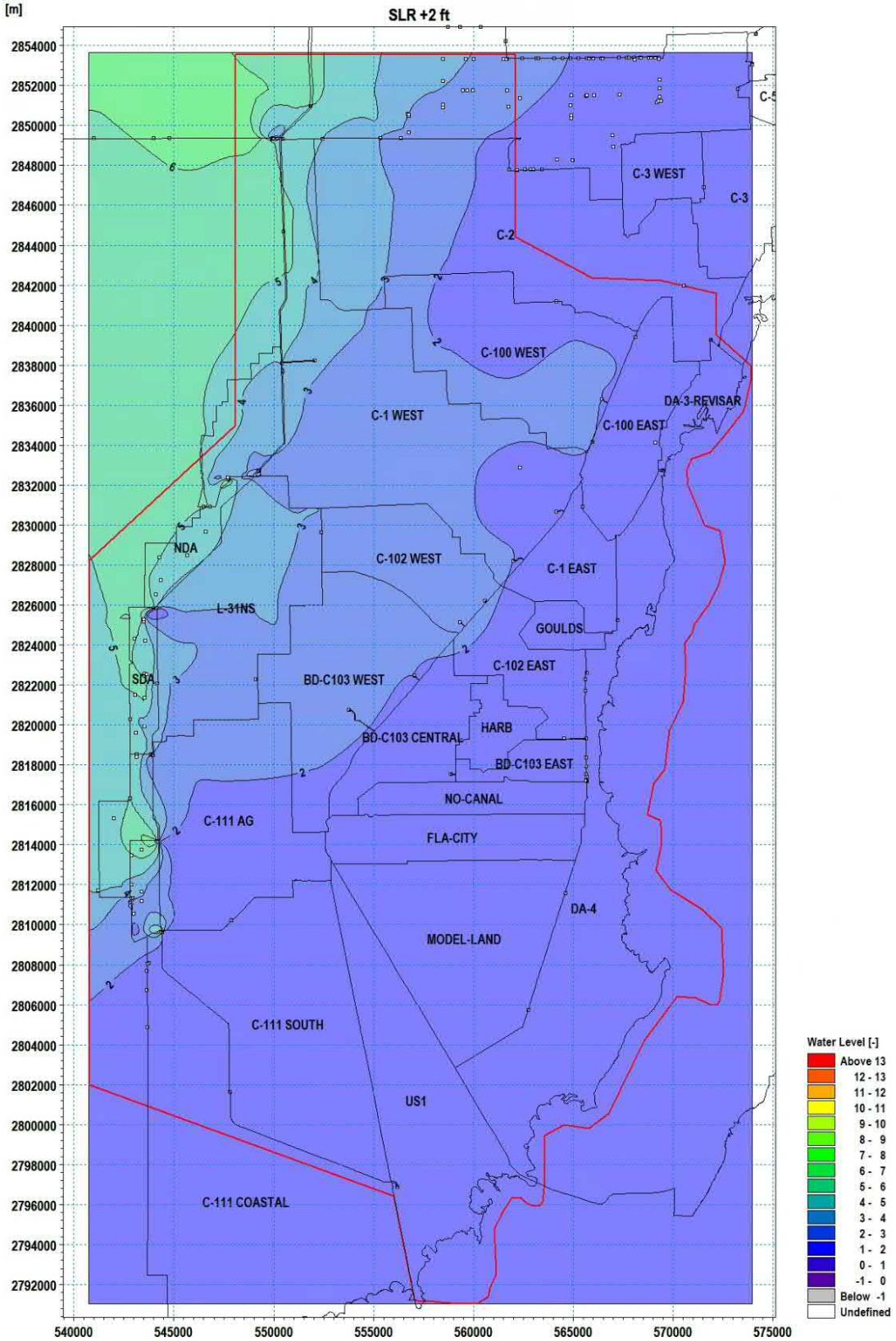


Figure 351. Initial Water Levels in Saturated Zone for +2 ft SLR

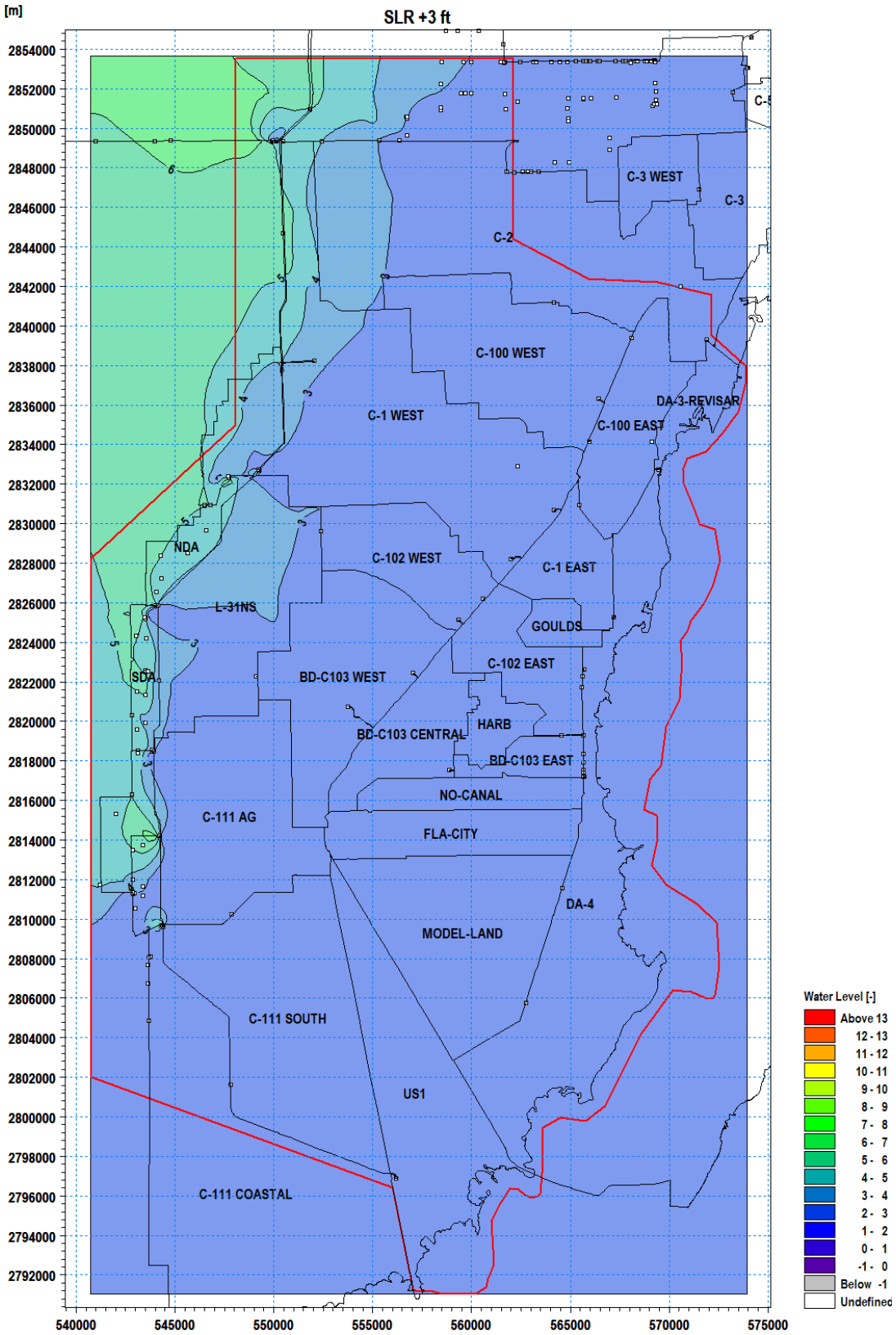


Figure 352. Initial Water Levels in Saturated Zone for +3 ft SLR

The initial groundwater levels within the wellfields at the northeaster section of the model (watershed C-100) were assumed to increase proportionally to SLR in Figure 353, Figure 354 and Figure 355

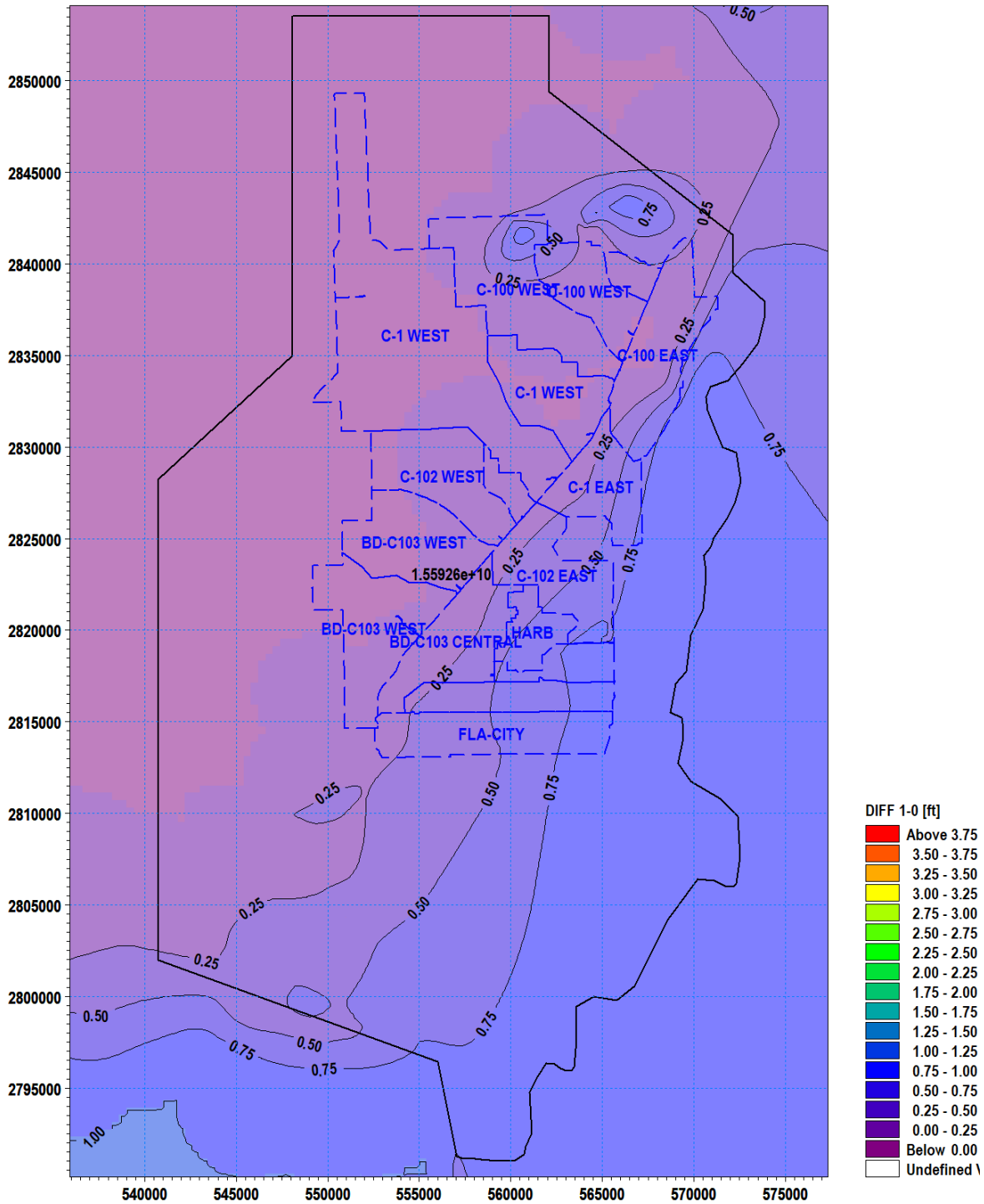


Figure 353. Difference between Initial Water Levels in Saturated Zone for +1 ft SLR and Initial Water Level for SLR +0 ft

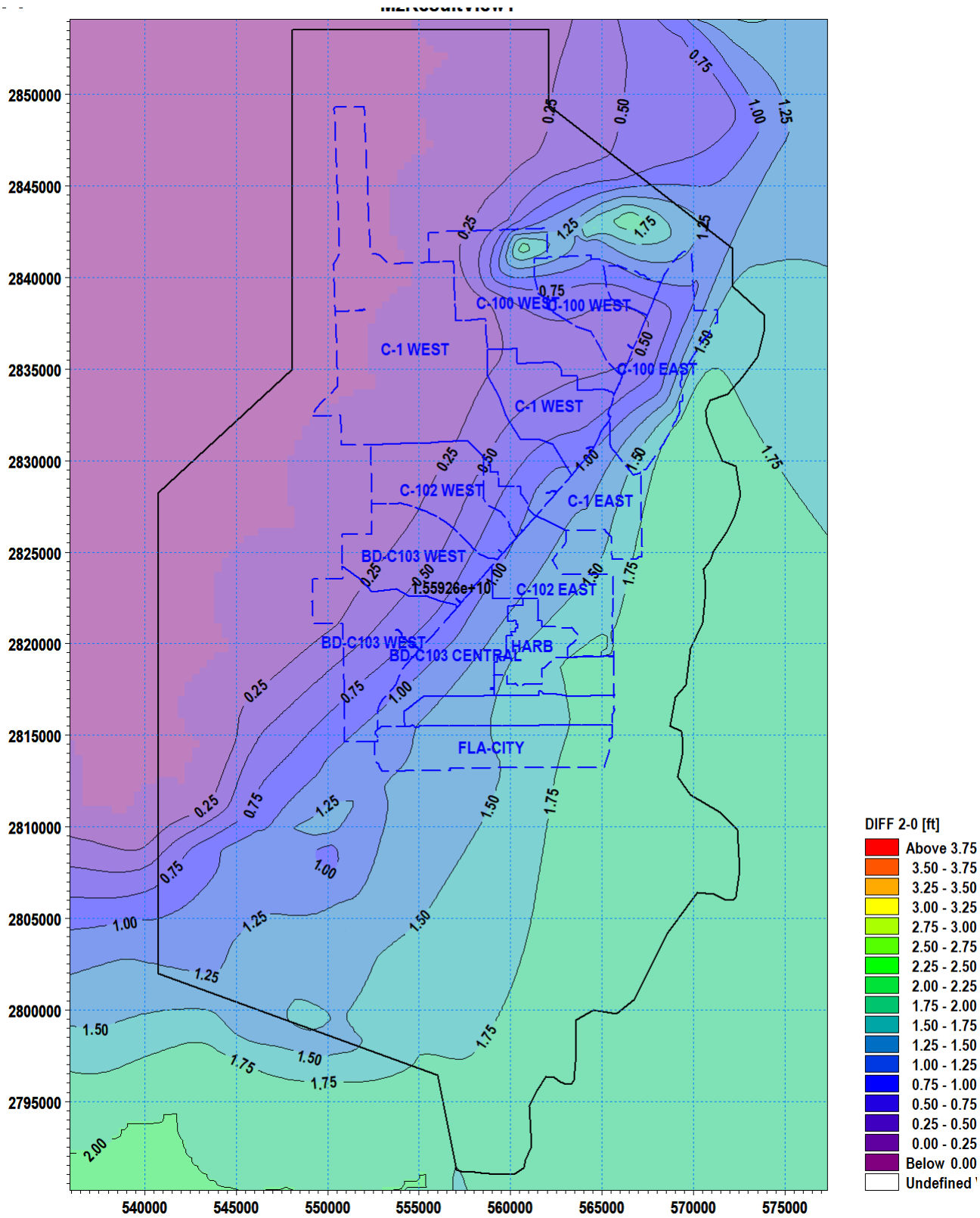


Figure 354 Difference between Initial Water Levels in Saturated Zone for +2 ft SLR and Initial Water Level for SLR +0 ft

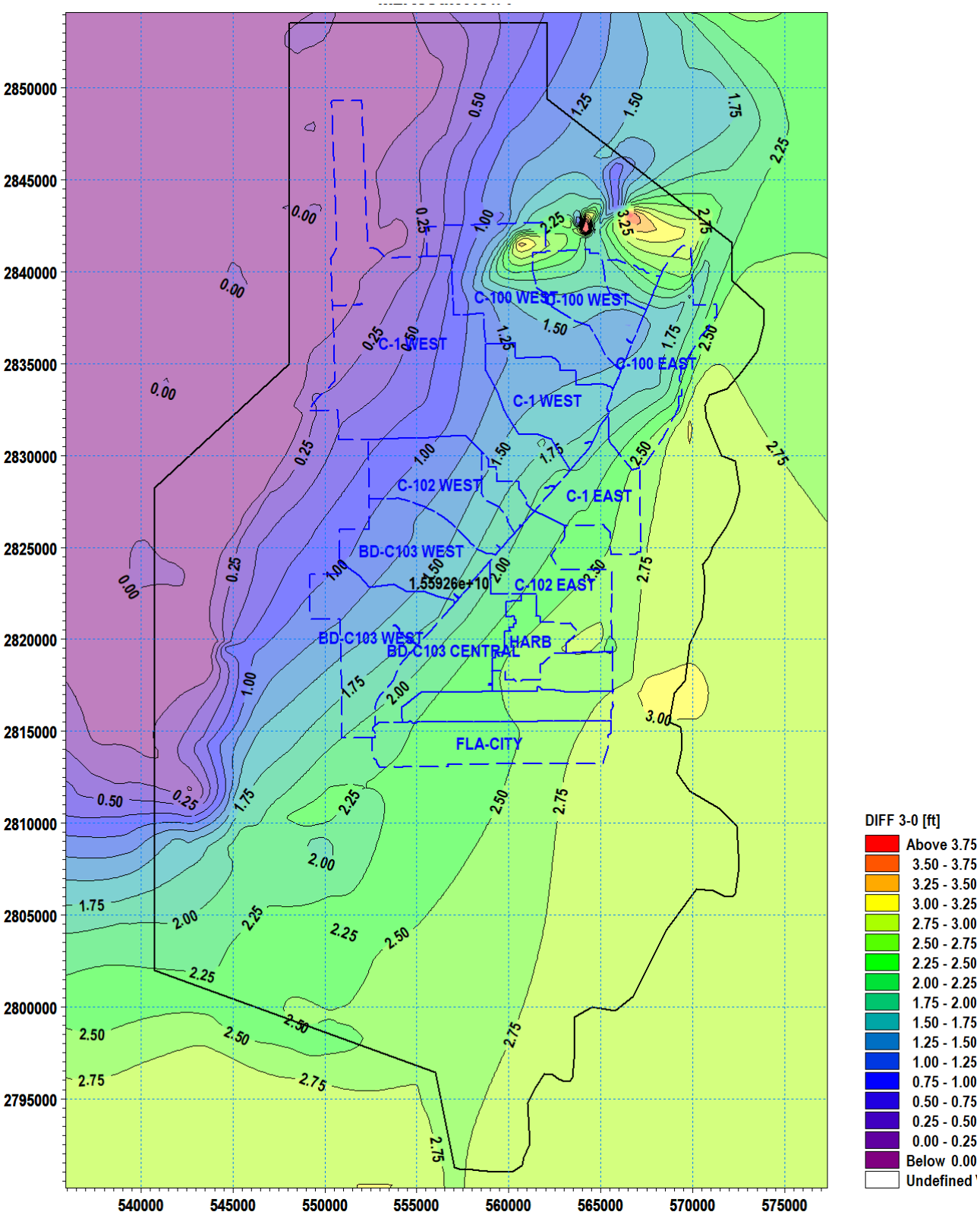


Figure 355 Difference between Initial Water Levels in Saturated Zone for +3 ft SLR and Initial Water Level for SLR +0 ft

The initial groundwater levels were compared with the final groundwater levels for the most extreme case of a 100-yr design event with 3 ft SLR. The difference is shown in Figure 356:

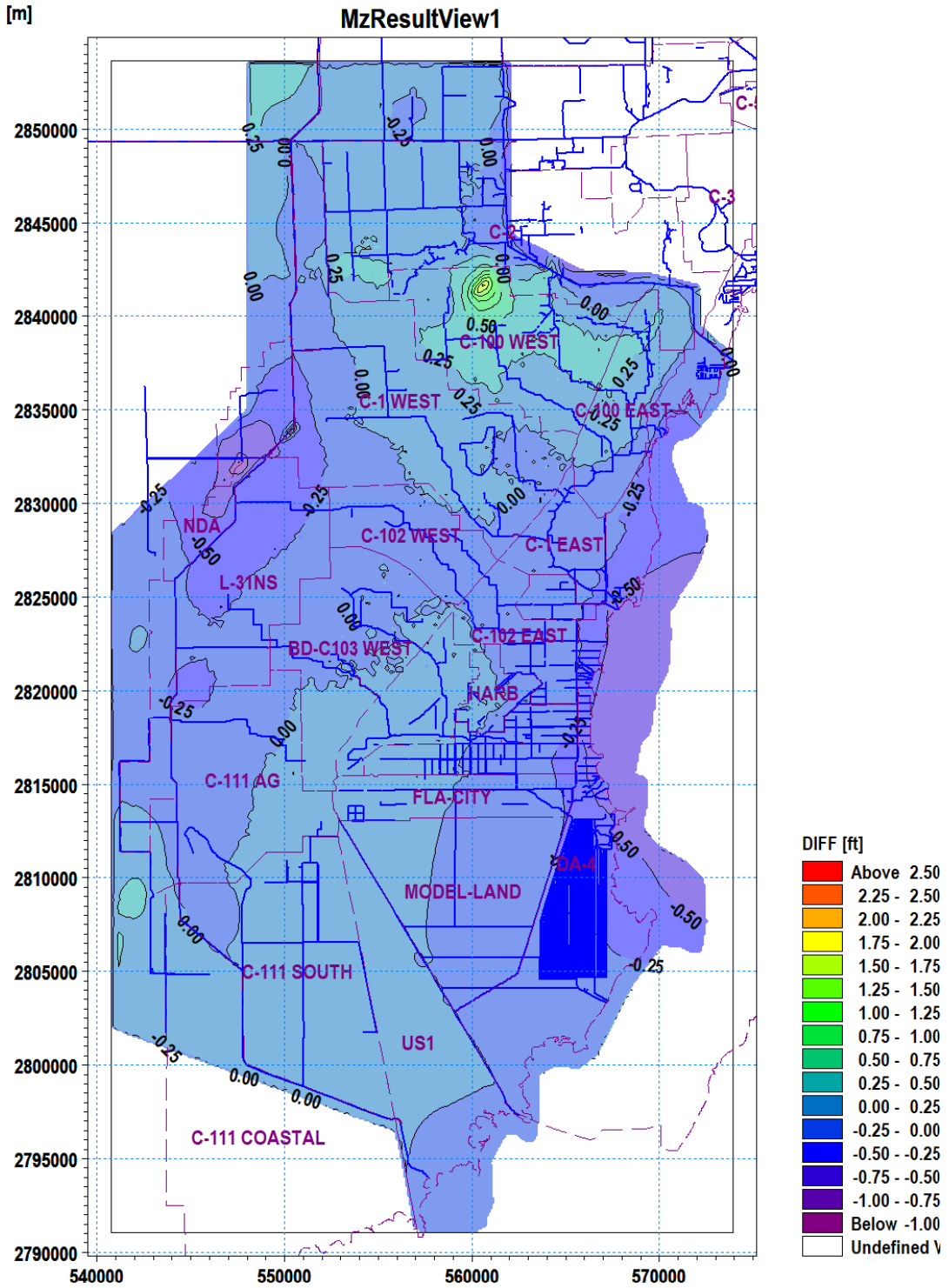


Figure 356 Difference between Initial and Final Elevation of the Phreatic Surface for the 100-yr design event with 3 ft SLR

The spatial map (Figure 356) shows that there is a redistribution of groundwater between the initial and final elevation of the phreatic surface. The average depth of the phreatic surface for the initial condition and the final condition of the entire model shows has a mean value at the beginning of simulations equal to -0.64 and a mean value at the end of simulation equal to -0.48 ft, or a difference indicating raising by 0.16 ft, which is adequate for the most extreme case of 100-yr rainfall and 3 ft SLR

An example hydrograph of groundwater elevation for 100-year, 3 ft SLR for cell X=218 and Y = 173 (watershed C-103) is shown in Figure 357. The hydrograph shows the third layer which represents the Biscayne Aquifer which is with highest transmissivity, therefore, representative for the major fraction of the groundwater flows.

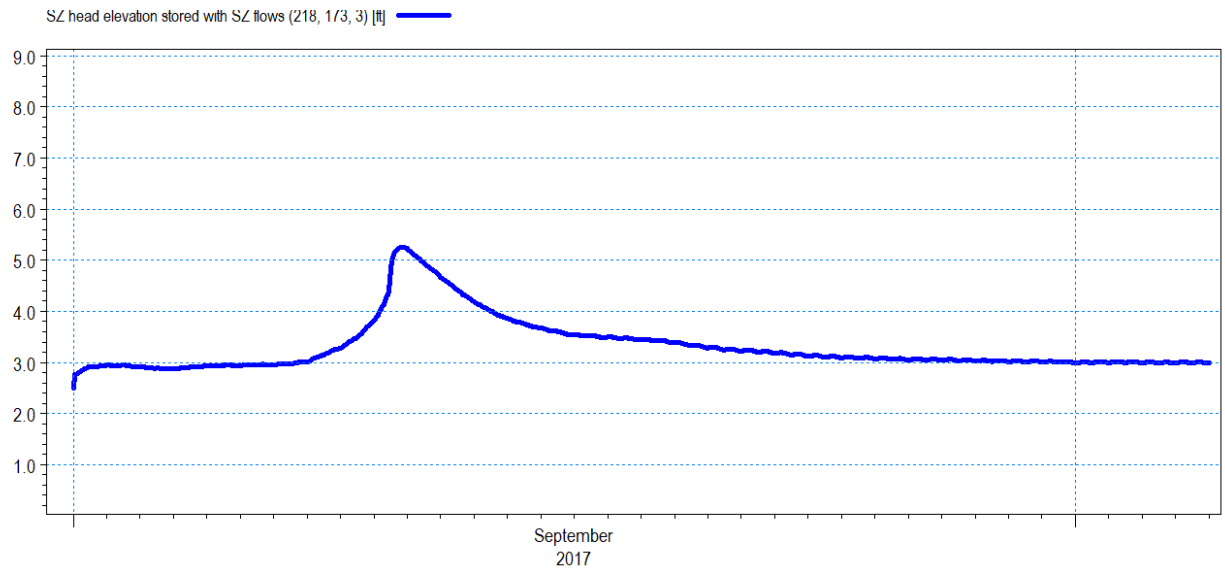


Figure 357 Groundwater Hydrograph for Cell X=218 and y = 173 (watershed C-103) for Layer 3 for a 100-yr Design Event and SLR 3.

6.2 C-1 Watershed Flood Protection Level of Service

Figure 201 shows the inflows and outflows in this watershed. There are ten SFWMD water control structures in the C-1 Watershed. Control structures S21, S122, S148, S149 and S338 control the stages of the Primary canals C-1/C-1W and C-1N. The other control structures S173, S331, S334, S335, and S336 along with the L-31N borrow canal are part of the South Dade Conveyance System (SDCS). The structures are operated as discussed in 6.1.5.6.

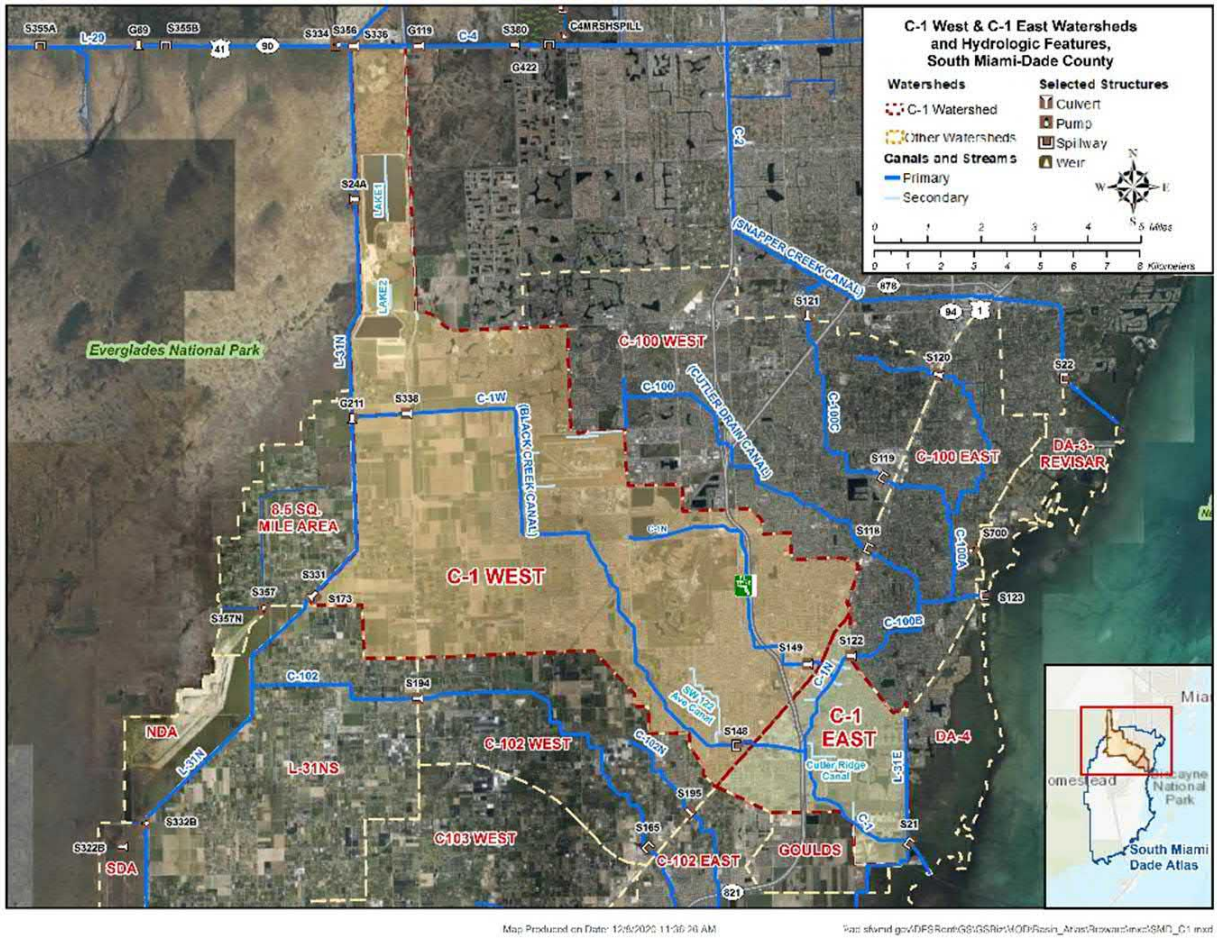


Figure 358. Drainage Network in C-1 Watershed (Source: SFWMD South Miami Dade Atlas)

6.2.1 Watershed C-1: Structure S21 Gate Operation

The gates of structure S21 are closed when the head differential (HW – TW) is less than 0.1 ft. Figure 359 and Figure 360 shows the gate levels, headwater, tailwater and discharge for SLR +1.0, +2.- and +3.0 ft for the 25-yr storm event. The gate operation shows similar patterns for all design events, and for SLR conditions, however shown here for illustration is the operation for the 25-yr event for SLR +1.0, +2.0, and +3.0 (Figure 359 and Figure 360). The gates open after the tidal peak recedes and the headwater becomes higher than the tailwater by 0.1 ft.

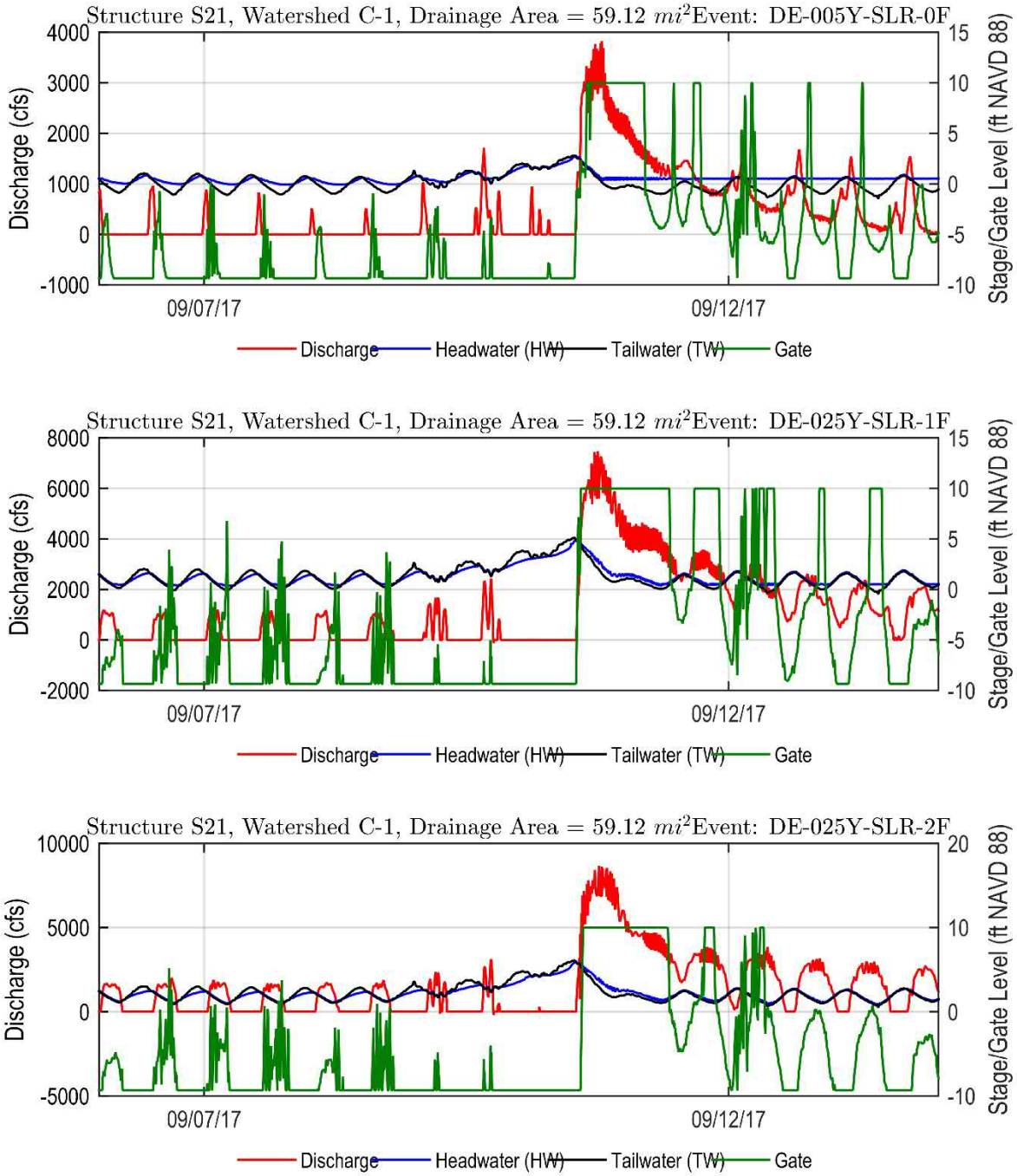


Figure 359. Gate Operation of Structure S-21 for 25-yr Event and SLR 0, 1 and 2

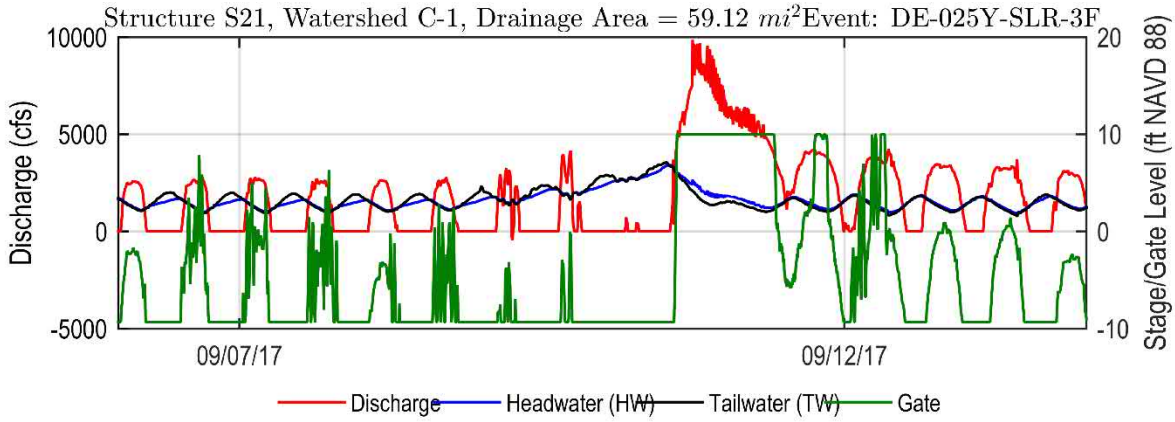


Figure 360. Gate Operation of Structure S-21 for 25-yr Event and SLR 3

6.2.2 C-1: PM1 Maximum Stage in Primary Canals

To evaluate this PM under future conditions within the C-1 Watershed, instantaneous peak stage profiles were prepared for the primary canals. Bank elevations on the profile figures are based on the Mike 1D cross-section data. The canal bank elevations were compared and verified with elevations from the latest LIDAR data (from 2018). Also shown in the figures are major roadway landmarks, control structures, and primary canal junctions.

A list of landmarks and peak stages within Watershed C-1 canals for SLR = +0.0 ft is provided in Table 171. Highlighted are water elevations which exceed one of the canal banks at the specified chainage.

A series of figures are provided to display the profiles for SLR 0, 1, 2 and 3. Each figure refers to a single design event.

- Figure 361 and Figure 362 show the canal profiles for the C-1 watershed and includes canals C-1, C-1W, C-1N for the 5-yr Design Event.
- Figure 363 and Figure 364 show the canal profiles for the 10-yr Design Event for the C-1 watershed including canals C-1, C-1W and C-1N
- Figure 365 and Figure 366 show the canal profiles for the 25-yr Design Event for the C-1 watershed and includes canals C-1 and C-1W, C-1N.
- Figure 367 and Figure 368 show the canal profiles for the 25-yr Design Event for the C-1 watershed and includes canals C-1, C-1W and C-1N.

Table 171 List of Landmarks and Design Water Elevations for Watershed C-1 canals (all elevations in ft NAVD 88)

Landmark	Canal	Mileage	Left Bank	Right Bank	5-yr SLR 0	5-yr SLR 1	5-yr SLR 2	5-yr SLR 3	10-yr SLR 0	10-yr SLR 1	10-yr SLR 2	10-yr SLR 3	25-yr SLR 0	25-yr SLR 1	25-yr SLR 2	25-yr SLR 3	100-yr SLR 0	100-yr SLR 1	100-yr SLR 2	100-yr SLR 3
S334 Crossing	L-29	1.100	9.311	7.402	5.745	5.809	5.991	6.511	5.750	5.973	6.157	6.651	6.159	6.233	6.408	6.814	6.633	6.678	6.786	7.046
Structure S338	C-1W	1.100	7.260	5.899	4.061	5.038	5.850	6.486	4.203	6.288	6.557	6.858	6.764	6.872	6.999	7.152	7.319	7.361	7.427	7.566
SR-997 Crossing	C-1W	1.350	6.539	7.169	4.030	5.034	5.852	6.485	4.175	6.288	6.556	6.858	6.760	6.869	7.000	7.154	7.322	7.366	7.433	7.573
Tamiami Airport Canal A Outfall	C-1W	1.400	7.129	7.178	4.042	5.035	5.853	6.485	4.185	6.288	6.555	6.858	6.762	6.870	7.000	7.152	7.320	7.363	7.429	7.568
Tamiami Airport Canal B Outfall	C-1W	3.100	6.539	7.169	4.030	5.034	5.852	6.485	4.175	6.288	6.556	6.858	6.760	6.869	7.000	7.154	7.322	7.366	7.433	7.573
SR-994 Crossing	C-1W	3.600	11.299	11.572	3.999	5.022	5.779	6.471	4.141	6.172	6.534	6.891	6.749	6.936	7.066	7.276	7.493	7.555	7.654	7.814
SW 122 Ave Canal	C-1W	10.500	6.270	5.971	3.327	4.638	5.487	6.356	3.589	5.501	6.233	6.835	5.988	6.432	6.879	7.300	7.015	7.249	7.511	7.829
Structure S148	C-1W	12.500	5.551	4.521	3.002	4.457	5.373	6.276	3.326	5.117	6.027	6.741	5.195	5.954	6.625	7.197	6.239	6.708	7.176	7.689
US-1 Crossing	C-1W	12.600	8.166	1.982	2.989	4.446	5.367	6.271	3.319	5.101	6.019	6.737	5.167	5.938	6.616	7.190	6.215	6.690	7.166	7.683
C-1N Crossing	C-1W	13.300	6.152	6.020	2.970	4.438	5.362	6.263	3.308	5.085	6.010	6.731	5.132	5.911	6.599	7.186	6.173	6.660	7.148	7.674
Structure G114	C-1N	2.900	5.331	8.701	3.121	4.545	5.528	6.547	3.451	5.768	6.523	7.181	6.775	7.133	7.491	7.947	8.334	8.430	8.569	8.794
SR-821 Crossing	C-1N	3.600	5.700	8.100	3.110	3.110	3.110	3.110	3.440	3.440	3.440	3.440	6.700	6.700	6.700	6.700	8.300	8.300	8.300	8.300
SR-994 Crossing	C-1N	4.300	7.500	7.500	3.100	3.100	3.100	3.100	3.400	3.400	3.400	3.400	6.300	6.300	6.300	6.300	7.700	7.700	7.700	7.700
Structure S149	C-1N	5.100	5.800	8.600	3.000	3.000	3.000	3.000	3.500	3.500	3.500	3.500	5.600	5.600	5.600	5.600	6.800	6.800	6.800	6.800
US-1 Crossing	C-1N	5.500	6.300	8.000	3.000	3.000	3.000	3.000	3.300	3.300	3.300	3.300	5.400	5.400	5.400	5.400	6.600	6.600	6.600	6.600
C-1W Junction	C-1N	7.500	6.130	6.000	3.000	3.000	3.000	3.000	3.300	3.300	3.300	3.300	5.100	5.100	5.100	5.100	6.130	6.130	6.130	6.130
Structure S21	C-1N	10.500	2.800	8.800	2.700	2.700	2.700	2.700	3.000	3.000	3.000	3.000	4.100	4.100	4.100	4.100	4.800	4.800	4.800	4.800

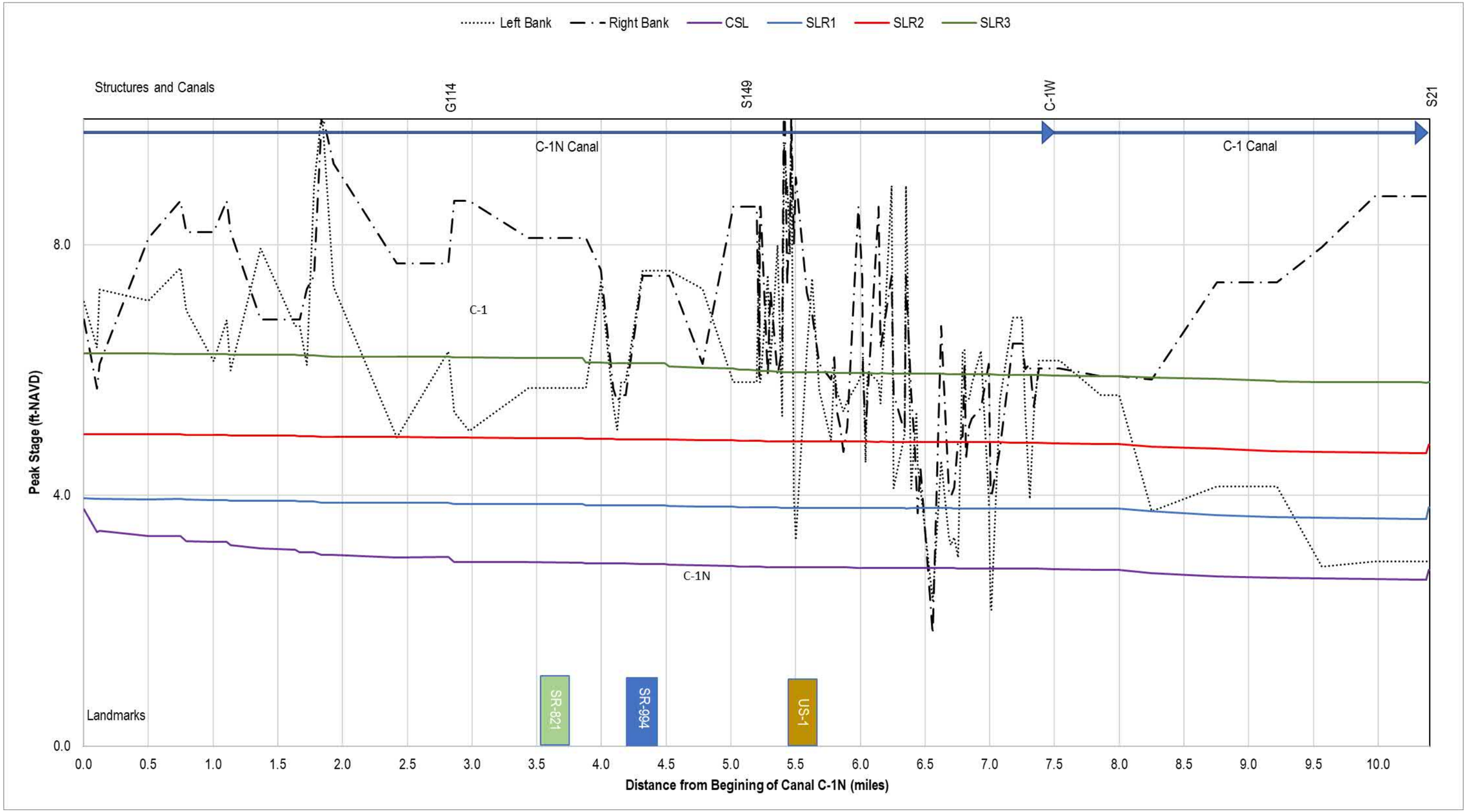


Figure 361 Profile of Peak Stages in Canals C-1N and C-1 for Future Land Use and Topography for 5-yr Design Storm

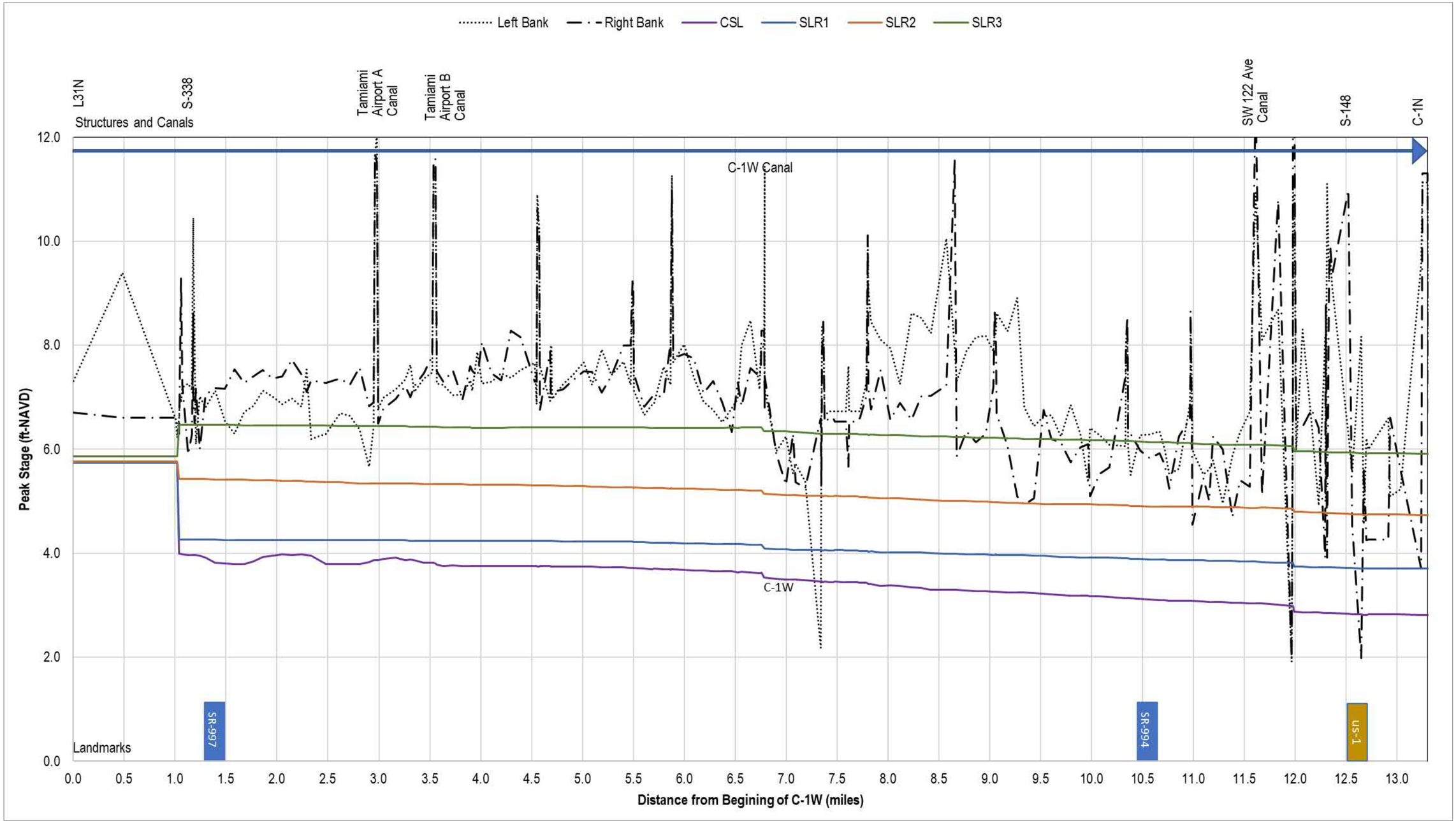


Figure 362 Profile of Peak Stages in Canal C-1W for Future Land Use and Topography for 5-yr Design Storm

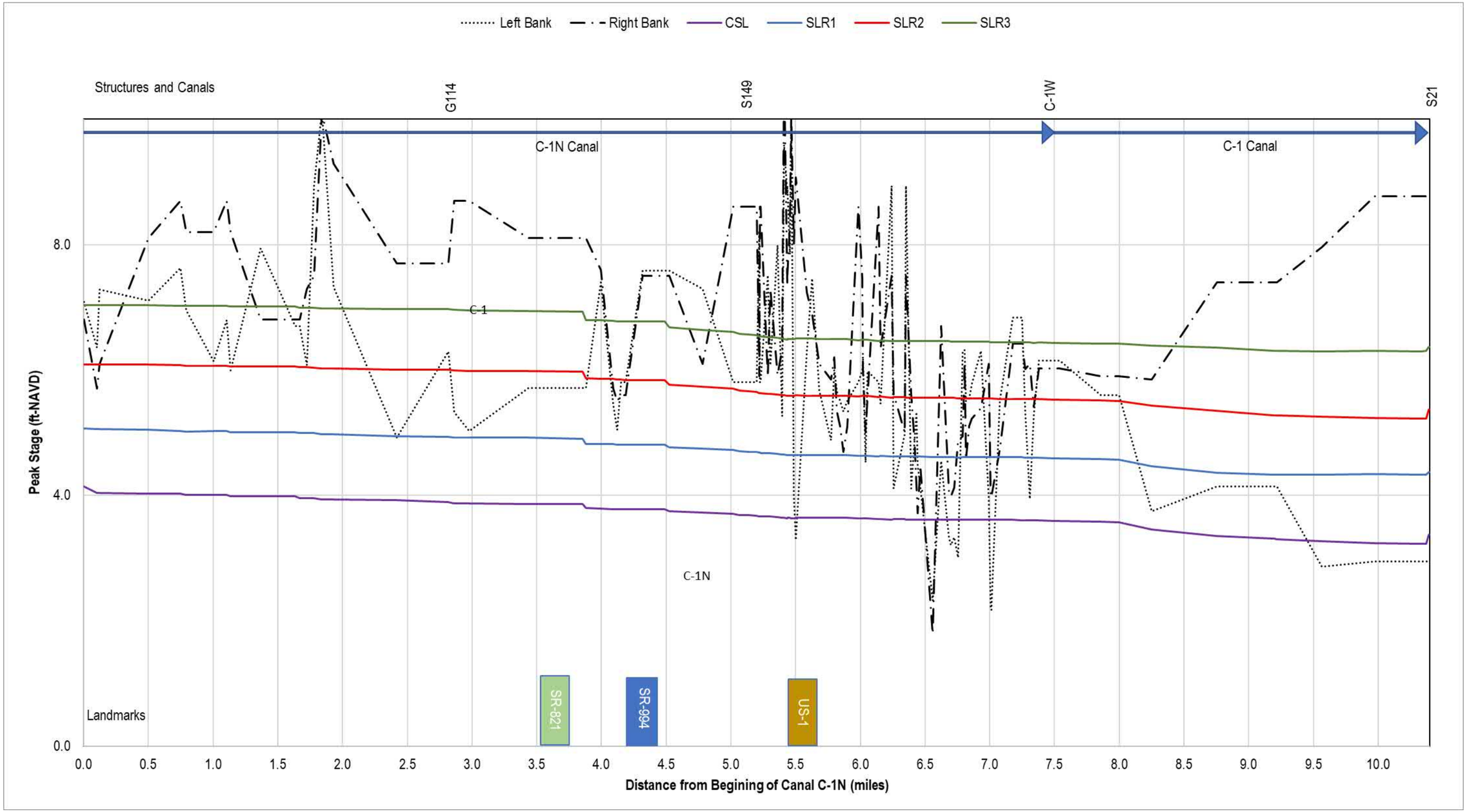


Figure 363 Profile of Peak Stages in Canals C-1N and C-1 for Future Land Use and Topography for 10-yr Design Storm

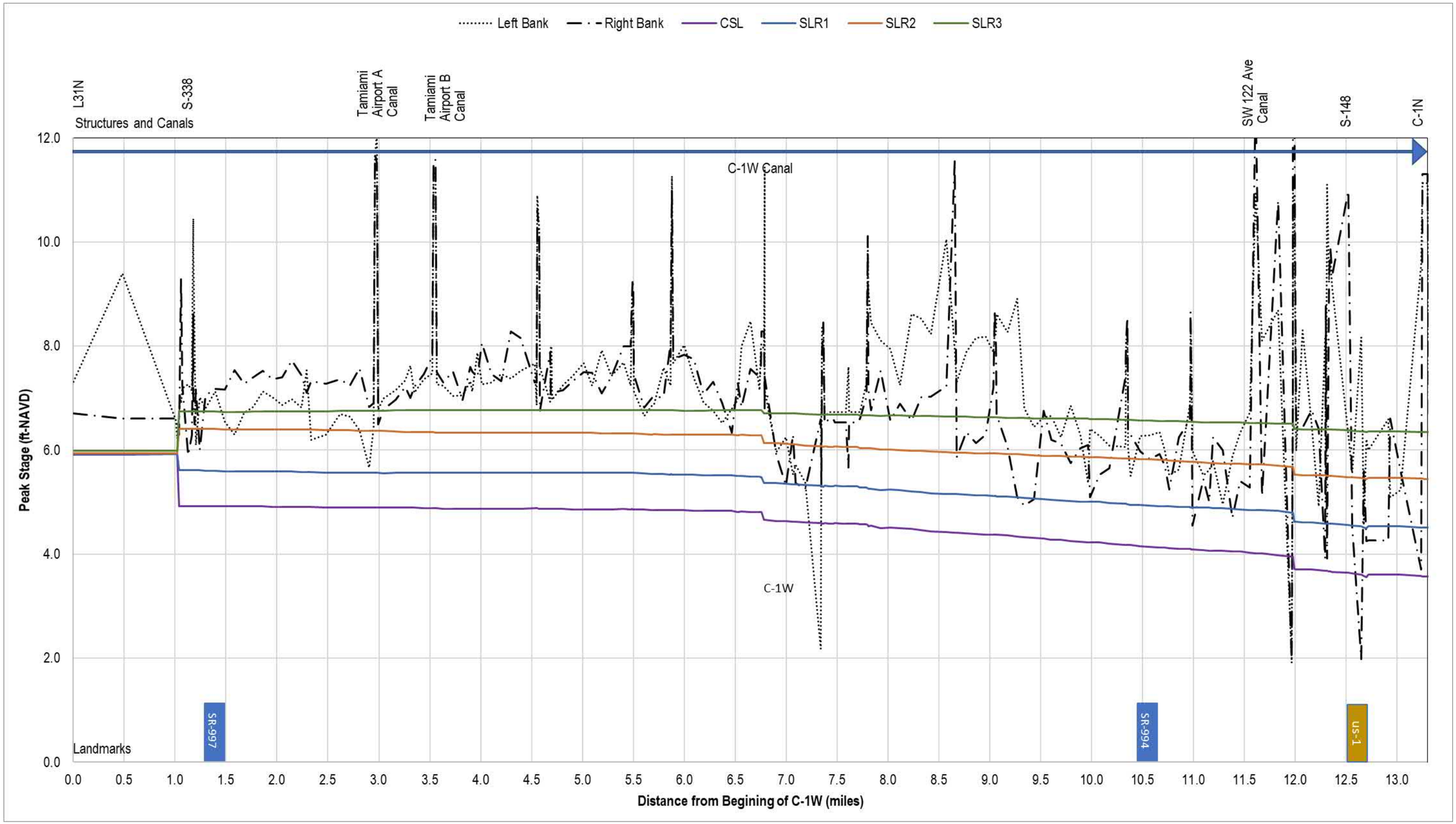


Figure 364 Profile of Peak Stages in Canal C-1W for Future Land Use and Topography for 10-yr Design Storm

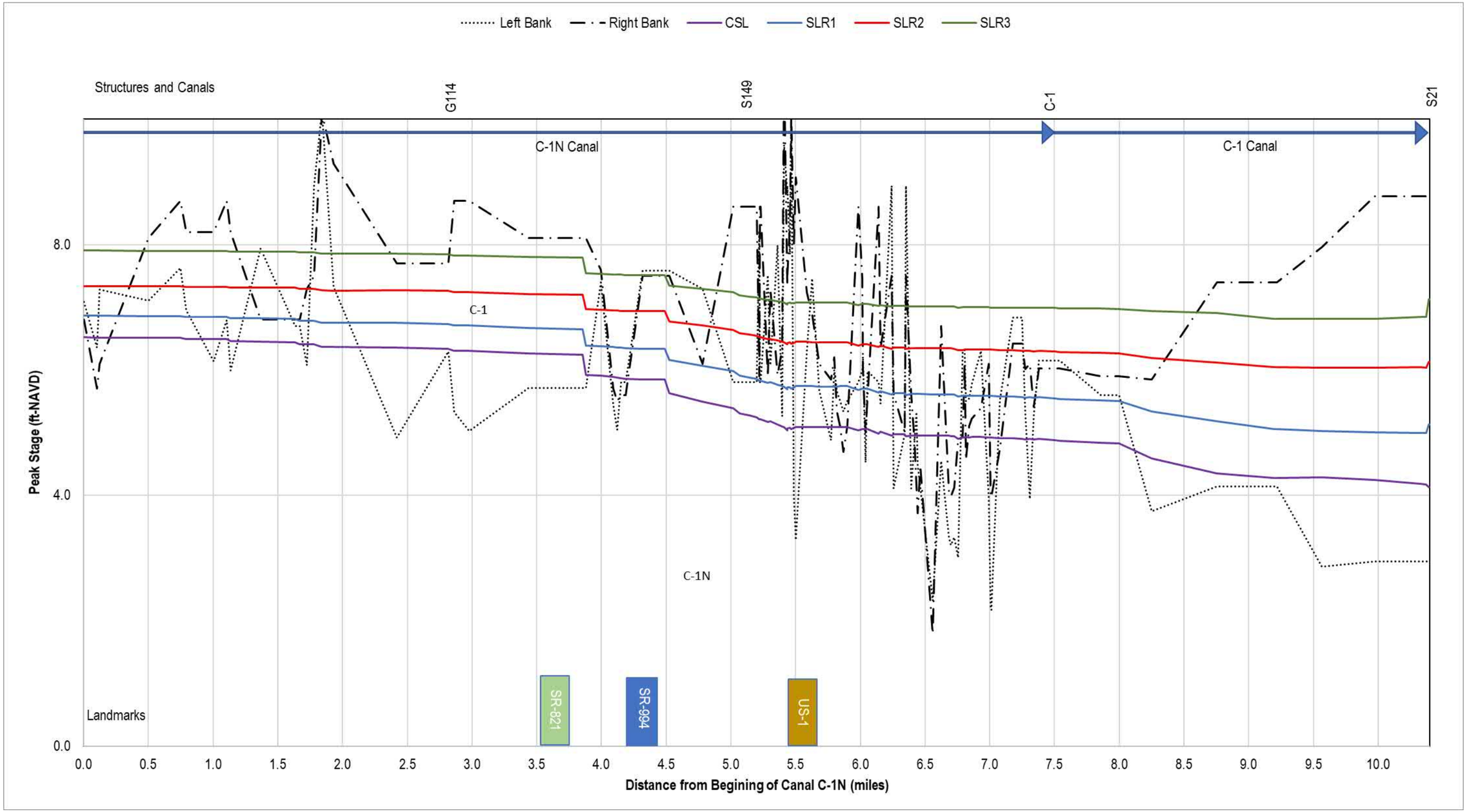


Figure 365 Profile of Peak Stages in Canals C-1N and C-1 for Future Land Use and Topography for 25-yr Design Storm

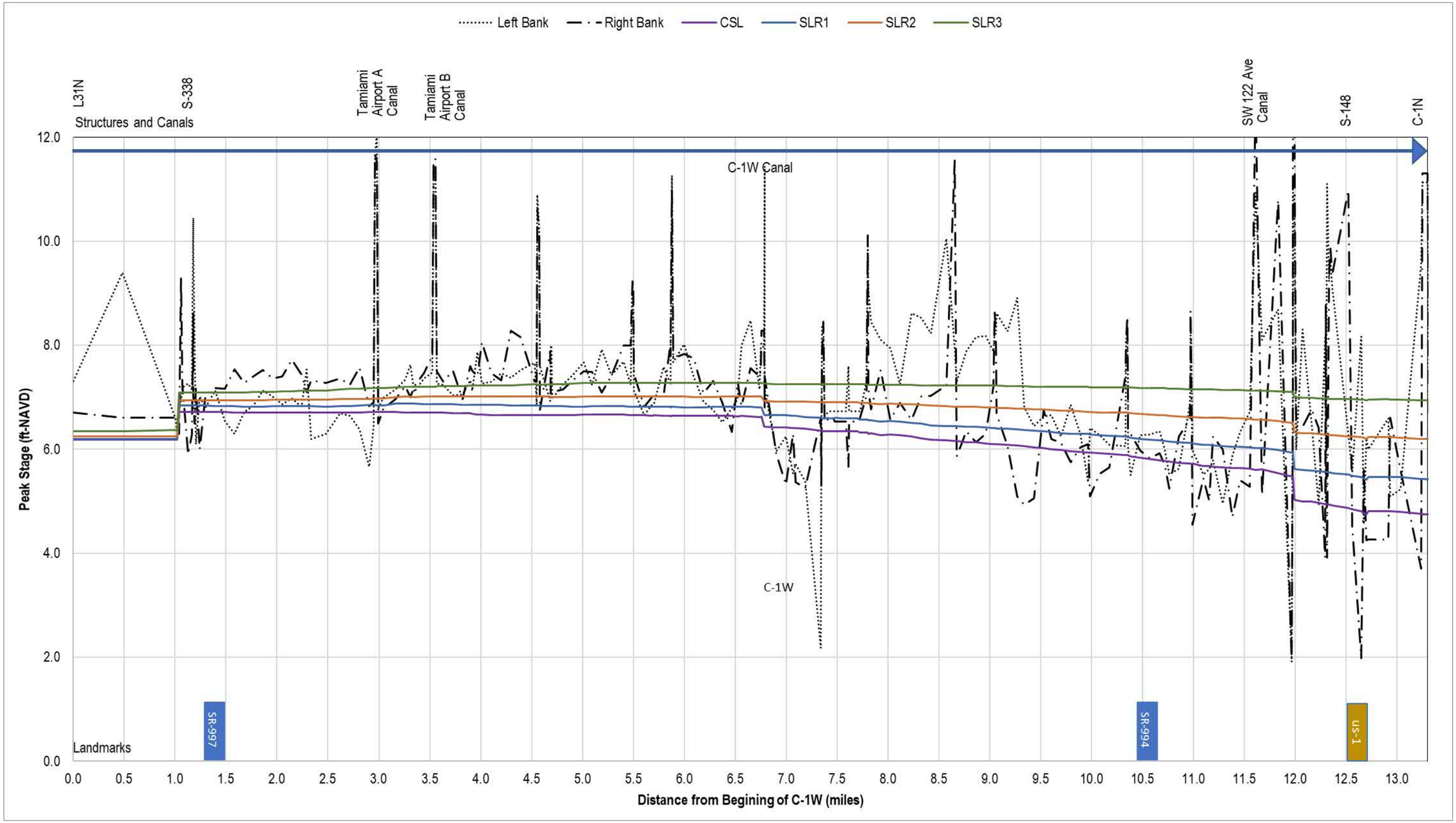


Figure 366 Profile of Peak Stages in Canal C-1W for Future Land Use and Topography for 25-yr Design Storm

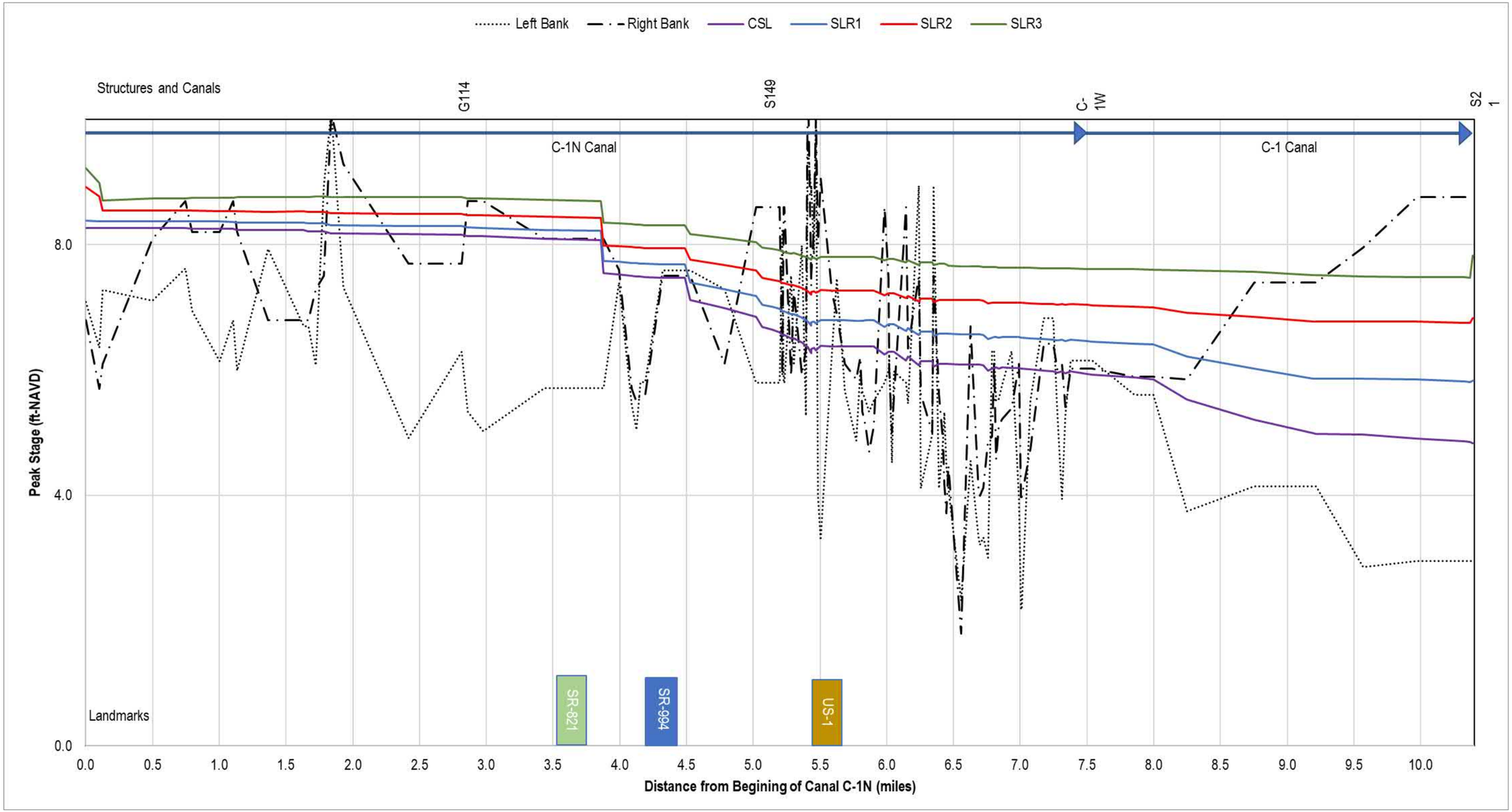


Figure 367 Profile of Peak Stages in Canals C-1N and C-1 for Future Land Use and Topography for 100-Yr Design Storm

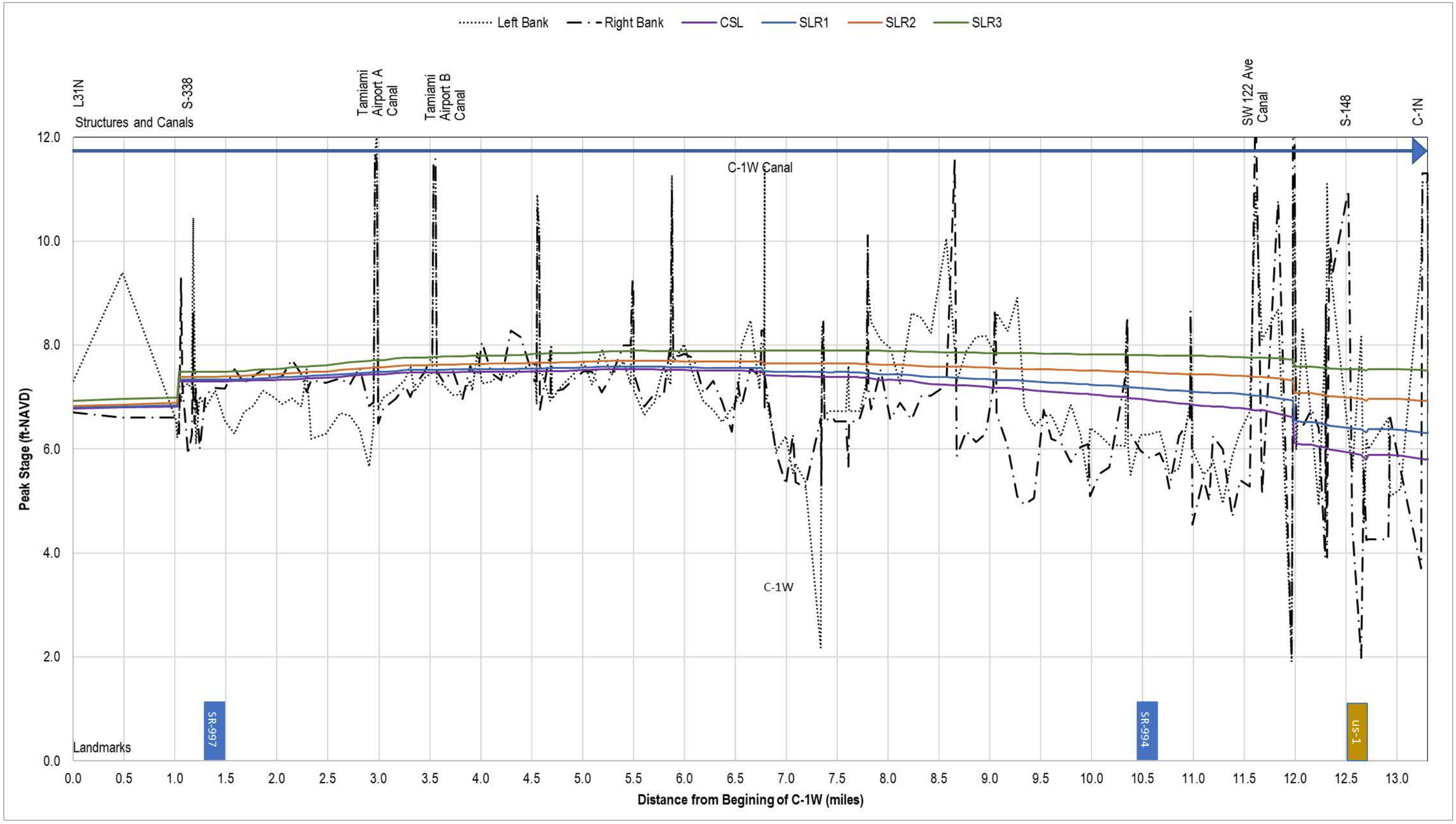


Figure 368 Profile of Peak Stages in Canal C-1W for Future Land Use and Topography for 100-Yr Design Storm

The C-1 Watershed canal system with water surface profiles and the canal right and left bank elevations and other canals that affect the hydrology of the C-1 are listed in Table 172.

Table 172. LOS Rating of Canals in C-1 Watershed for PM1

Canal	SLR = 0.0 ft	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C-1W	Upstream of S338: 10-Year LOS Downstream of S338 & upstream of SR-994: 10-Year LOS Downstream of SR-994 and upstream of US-1: 10-Year LOS Downstream of US-1: Less than 5-Year LOS	Upstream of S338: 10-Year LOS Downstream of S338 & upstream of SR-994: 10-Year LOS Downstream of SR-994 and upstream of US-1: 10-Year LOS Downstream of US-1: Less than 5-Year LOS	Upstream of S338: 5-Year LOS Downstream of S338 & upstream of SR-994: 5-Year LOS Downstream of SR-994 and upstream of US-1: 10-Year LOS Downstream of US-1: Less than 5-Year LOS	Upstream of S338: 5-Year LOS Downstream of S338 & upstream of SR-994: 5-Year LOS Downstream of SR-994 and upstream of US-1: 5Year LOS Downstream of US-1: Less than 5-Year LOS
C-1N – C-1 Canal	Upstream of G114 - 5-Year LOS Downstream of G114 & SR-994: 10-Year LOS Downstream SR-994 to Downstream US-1 Highway: Less than 5-Year LOS	Upstream of G114 - 5-Year LOS Downstream of G114 & SR-994: 5-Year LOS Downstream SR-994 to Downstream US-1 Highway: Less than 5-Year LOS	Upstream of G114 - 5-Year LOS Downstream of G114 & SR-994: 5-Year LOS Downstream SR-994 to Downstream US-1 Highway: Less than 5-Year LOS	Upstream of G114 - 5-Year LOS Downstream of G114 & SR-994: 5-Year LOS Downstream SR-994 to Downstream US-1 Highway: Less than 5-Year LOS

The simulation results of PM1 are summarized below:

- Multiple sections of canal were identified that overflow during the 10-year and 25-year flood events, therefore most of the canals have LOS between 5 and 10 years.
- For the 100-year event all C-1 Watershed canals have cross sections which overflow the banks in peak stages.
- The C-1W canal has a 10-Year LOS considering that only a short section downstream (outside of the Urban Development Boundary) of the junction with US-1 has canal banks lower than the 10-Year design flood profile for SLR = 0 and +1.0 ft, for SLR = +2 and +3 ft, the LOS is 5 years
- For all SLR scenarios C-1 and C-1N canals can convey a 5-year event without overbanking, however at 10-yr events overbanking occurs.

Based on the results it is concluded that the LOS for the primary canal is reduced from 10-yr to 5-yr LOS for SLR changes from 0 to 3, with most significant change of LOS occurring for SLR 2 and SLR 3.

6.2.3 C-1: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 173 provides information for the discharges and the drainage areas in the C-1 Watershed. The allowable discharge is defined as 45.57 csm for a 10-Yr design event. Highlighted are the exceedances for the 10-Yr design event. The peak drainage discharge of structures S21, significantly increase with increasing the SLR. One of the reasons for this increase is attributed to backflow through adjacent canals and overtopping low location of levees, and the tailwater boundary condition which cause the gate to close (as illustrated in Figure 360) resulting in accumulation of water volume upstream, followed by rapid release (defined by the shape of tailwater hydrograph). The pattern of continuous increase of the area averaged rates with respect to SLR may be a result of relatively higher natural watershed drainage capacity while decreasing discharge for higher tailwater may indicate relatively low natural drainage capacity. Based on the results it is presumed that increase SLR affects structure S21 and S149, however S148 has limitation of natural drainage. Additional reasons for higher discharges include higher urbanization and drainage improvements within the watershed which will increase the drainage capacity per square mile. The peak 12-hr moving average discharge per square mile are shown for each structure and SLR condition. The discharge hydrographs are area-weighted by upstream drainage areas for the 72-hour 5-Year, 10-Year, 25-Year, and 100-Year design storms. Table 173 provides a list of area waited discharges for all four design events and four SLR alternatives.

- Structure S21 exceeds the allowable ERP discharge for the 10-yr Event for all SLR scenarios.
- Structure S148 exceeds the allowable ERP discharge for the 10-yr Event for all SLR scenarios.
- Structure S149 exceeds the allowable ERP discharge for the 10-yr Event for all SLR 1, 2 and 3.

Table 173. C-1 Watershed Peak Drainage Discharge Capacity Based on 12-hr Moving Average (csm)

Structure	Watershed Model	AHED Name	Area (mi^2)	Inflow Structure	Design Event	Discharge SLR 0	Discharge SLR 1	Discharge SLR 2	Discharge SLR 3
S21	C-1	C-1 EAST	8.18	S148, S149, S122	5-Yr	44.45	56.38	68.24	92.75
					10-Yr	60.56	70.49	86.81	108.84
					25-Yr	84.05	92.78	111.46	122.28
					100-Yr	111.71	124.17	137.32	143.05
S148	C-1	C-1 WEST	41.17	S338	5-Yr	47.42	45.48	46.75	51.23
					10-Yr	62.05	58.68	59.95	62.66
					25-Yr	78.68	75.10	73.87	73.66
					100-Yr	96.16	92.56	89.22	83.96
S149	C-1	C-1 WEST	9.77	-	5-Yr	25.55	26.62	80.75	109.07
					10-Yr	30.10	49.11	79.89	106.17
					25-Yr	34.29	55.67	79.31	103.20
					100-Yr	45.84	63.67	80.67	100.27
The allowable discharge is defined as 45.57 csm									

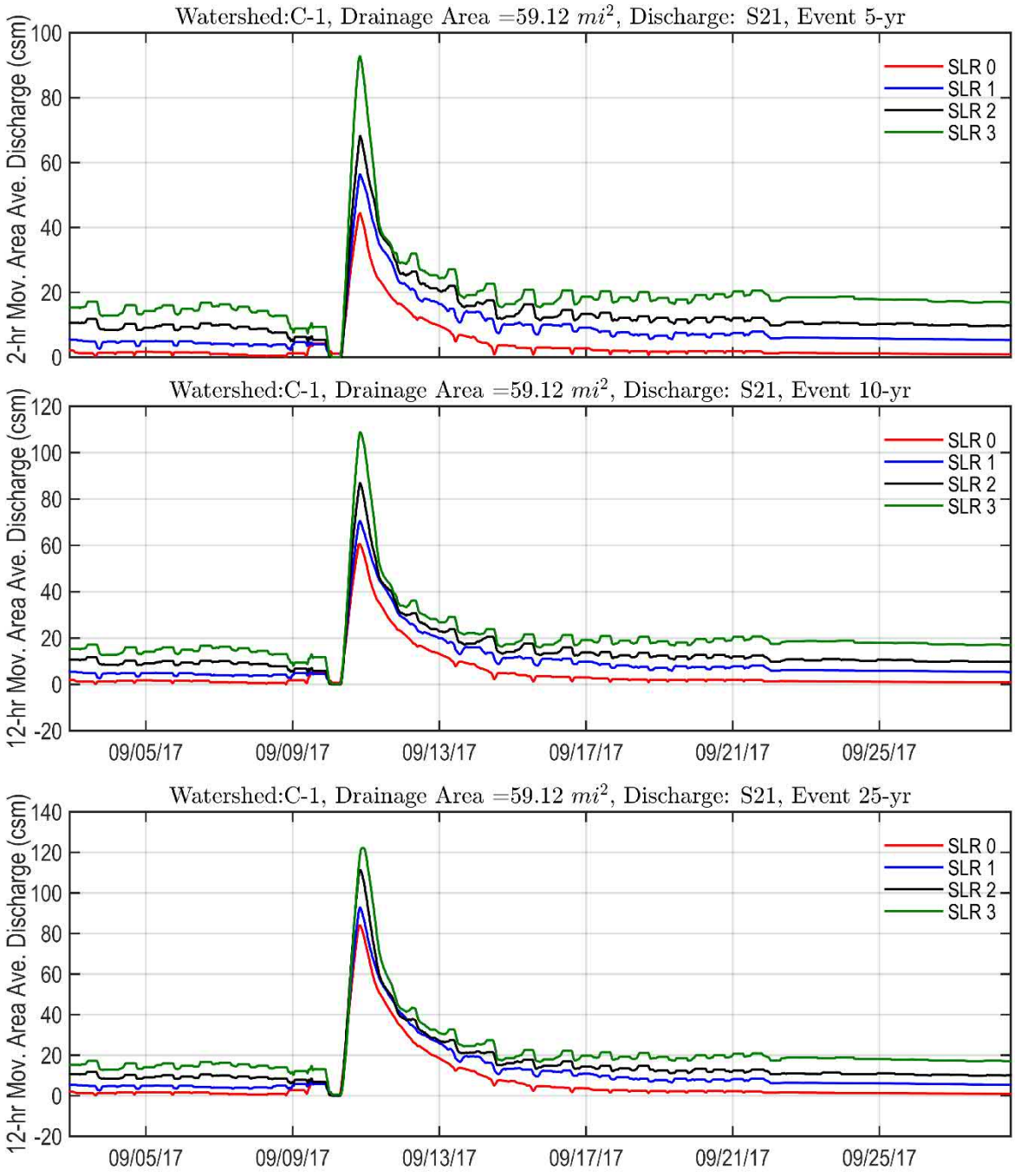


Figure 369. Drainage Discharge Capacity at Structures S21 for 5-yr, 10-yr and 25-yr Storm Event

Figure 369 and Figure 370 show the discharge hydrograph (csm) of structures S21 for 5-Yr, 10-yr and 25-yr storm event, and provide information about the gradual increase of the discharge peak values.

Figure 370 shows the discharge hydrograph (csm) of structures S21 for 100-Yr storm events and provides visual information about the gradual increase of the discharge peak values.

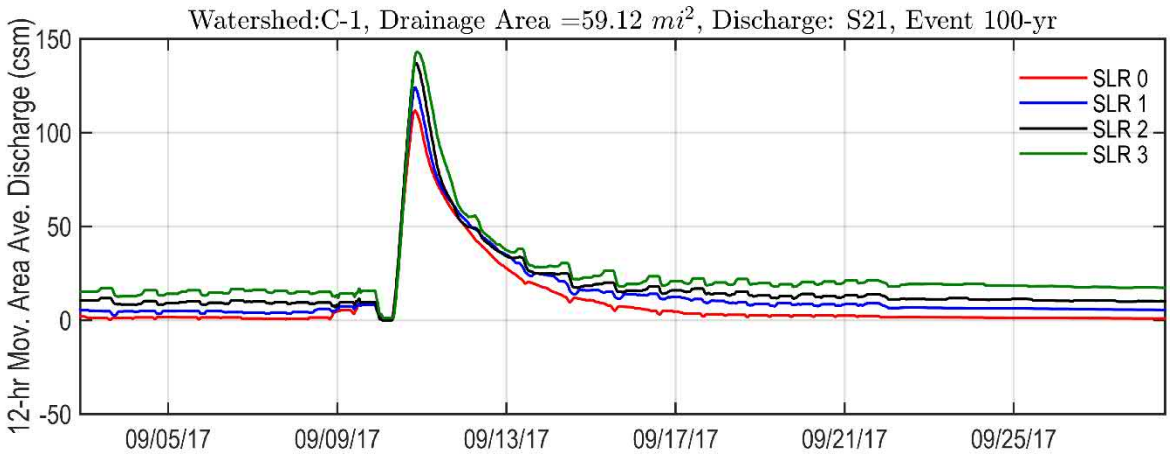


Figure 370. Drainage Discharge Capacity at Structures S21, S148 and S149 for 25-Yr Storm Event

Based on the results from analysis of peak discharges, structure S148 has drainage limitations at increasing SLR and considering that the contributing drainage area to structure S148 is greater than 70% of the total drainage area of the C-1 watershed, it is concluded that canal C-1W and the areas upstream structure S148 impact the drainage capacity of the entire C-1 watershed. Additionally, the drainage capacity of structure S21 and the upstream canal C-1 will require improvements to accommodate increased inflows from canal C-1W. Furthermore, backflow issues from Biscayne Bay through overland and canals will require levee upgrades and installation of control facilities at Goulds Canal and the future Cutler Wetlands C-1 Flow Way.

6.2.4 C-1: PM3 S21 Structure Performance

This metric shows the effective capacity of the tidal structures and provides information about the peak instantaneous discharge capacity as a function of the design rainfall recurrence interval and SLR conditions. The design parameters of Structure S21 are listed in Table 174.

Table 174 Design parameters of Structure S21

Structure	S21
Design Discharge	2,560 cfs for 40% SPF
SPF Discharge	4,300 cfs
Design Headwater Elevation	1.9 ft NGVD 29
Design Tailwater Elevation	1.4 ft NGVD 29
SPF Headwater Elevation	2.8 ft NGVD 29
SPF Tailwater Elevation	2.0 ft NGVD 29
Overtopping	8.0 ft NGVD 29

For this PM, the data were analyzed for:

- Stages and flows at structures at the time of peak flow
- Stages and flows at structures at the time of peak headwater stage
- Stages and flows at structures at the time of peak tailwater stage for overtopping

The results were tabulated for all simulations and include 4 design events and 4 SLR conditions.

6.2.4.1 PM3: Structure S21

Figure 371 and Figure 372 illustrate the instantaneous headwater, tailwater and discharge for selected design events (25-Year), for SLR 1, 2 and 3.

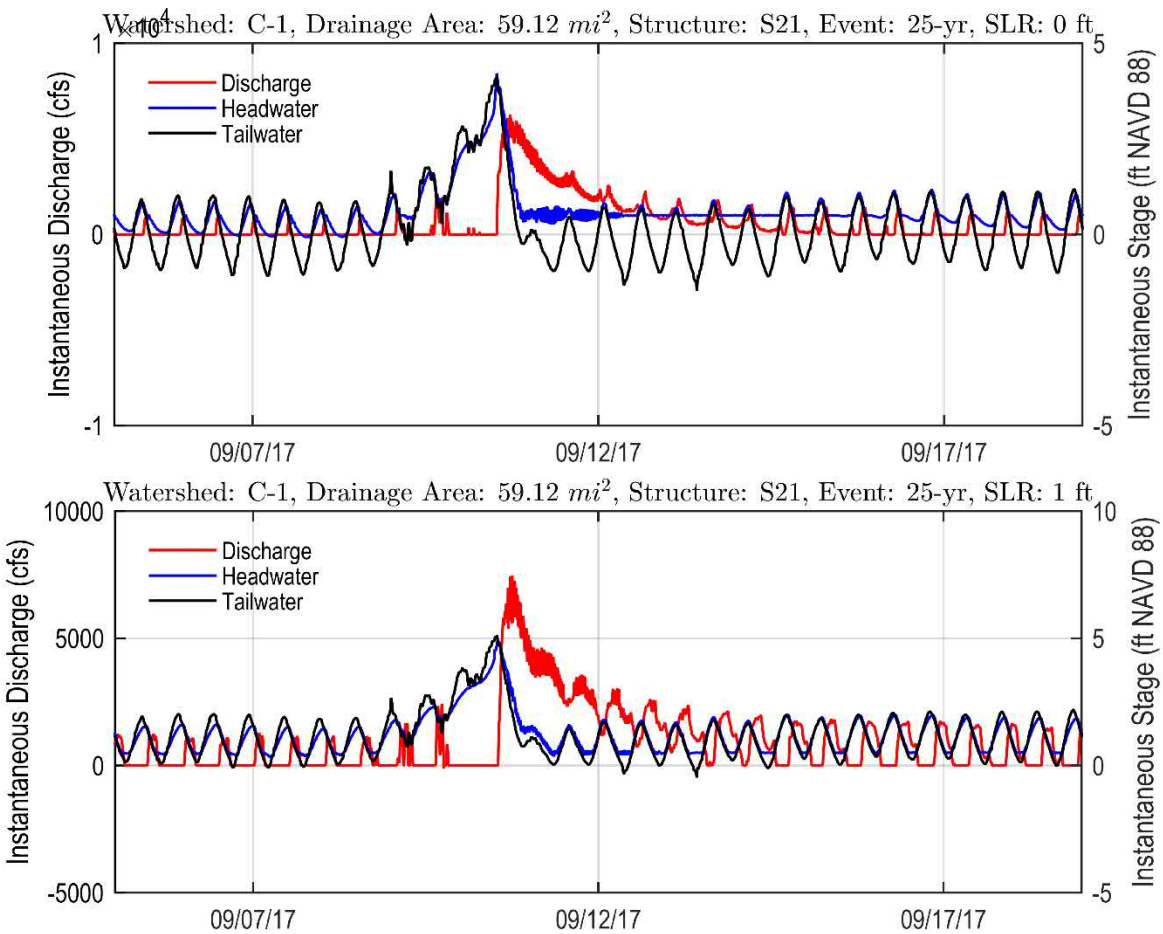


Figure 371 Structure S21 Instantaneous Conditions for 25-yr Design Event for SLR = 0 and 1 ft

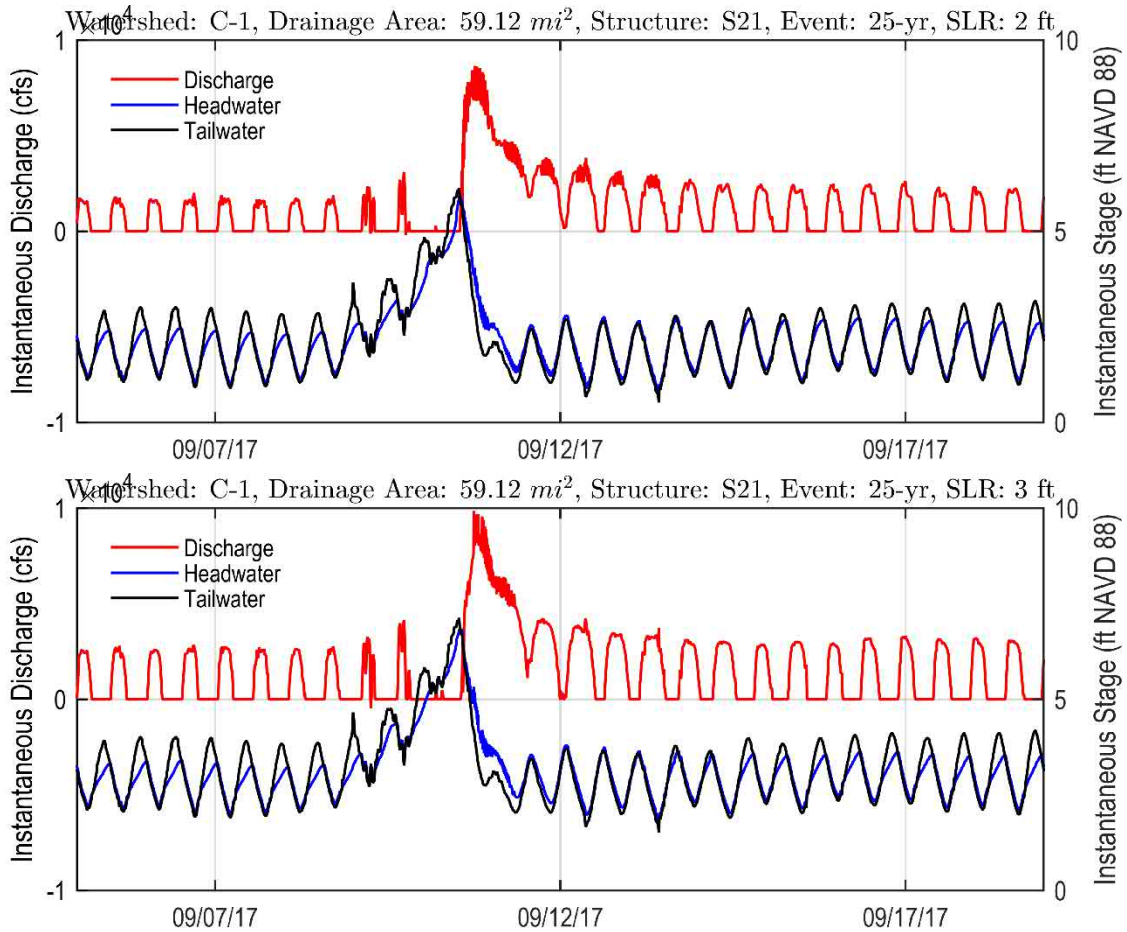


Figure 372 Structure S21 Instantaneous Conditions for 25-yr Design Event for SLR = 2 and 3 ft

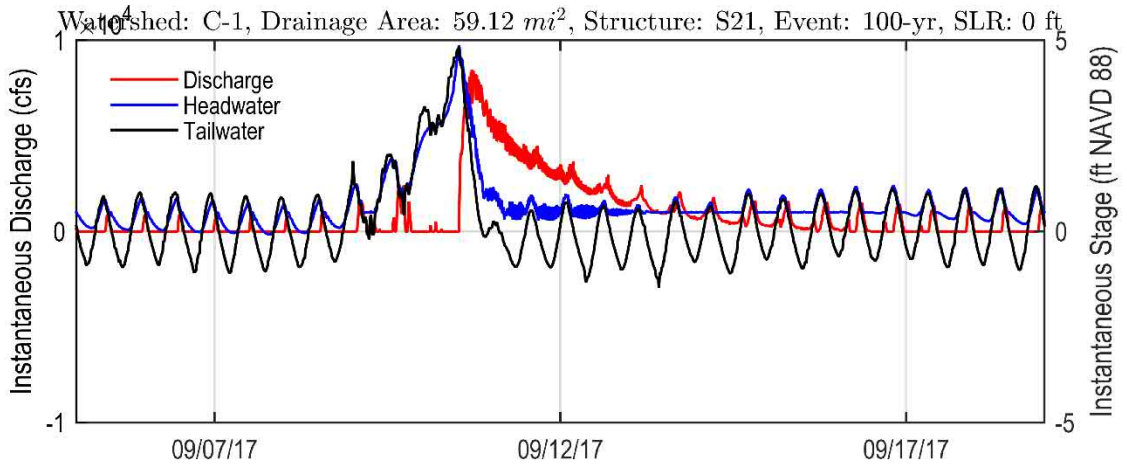


Figure 373 Structure S21 Instantaneous Conditions for 100-yr Design Event for SLR = 0 ft

Figure 373 and Figure 374 illustrates the instantaneous headwater, tailwater and discharge for the 100-Yr event for SLR = +1, +2 and +3.

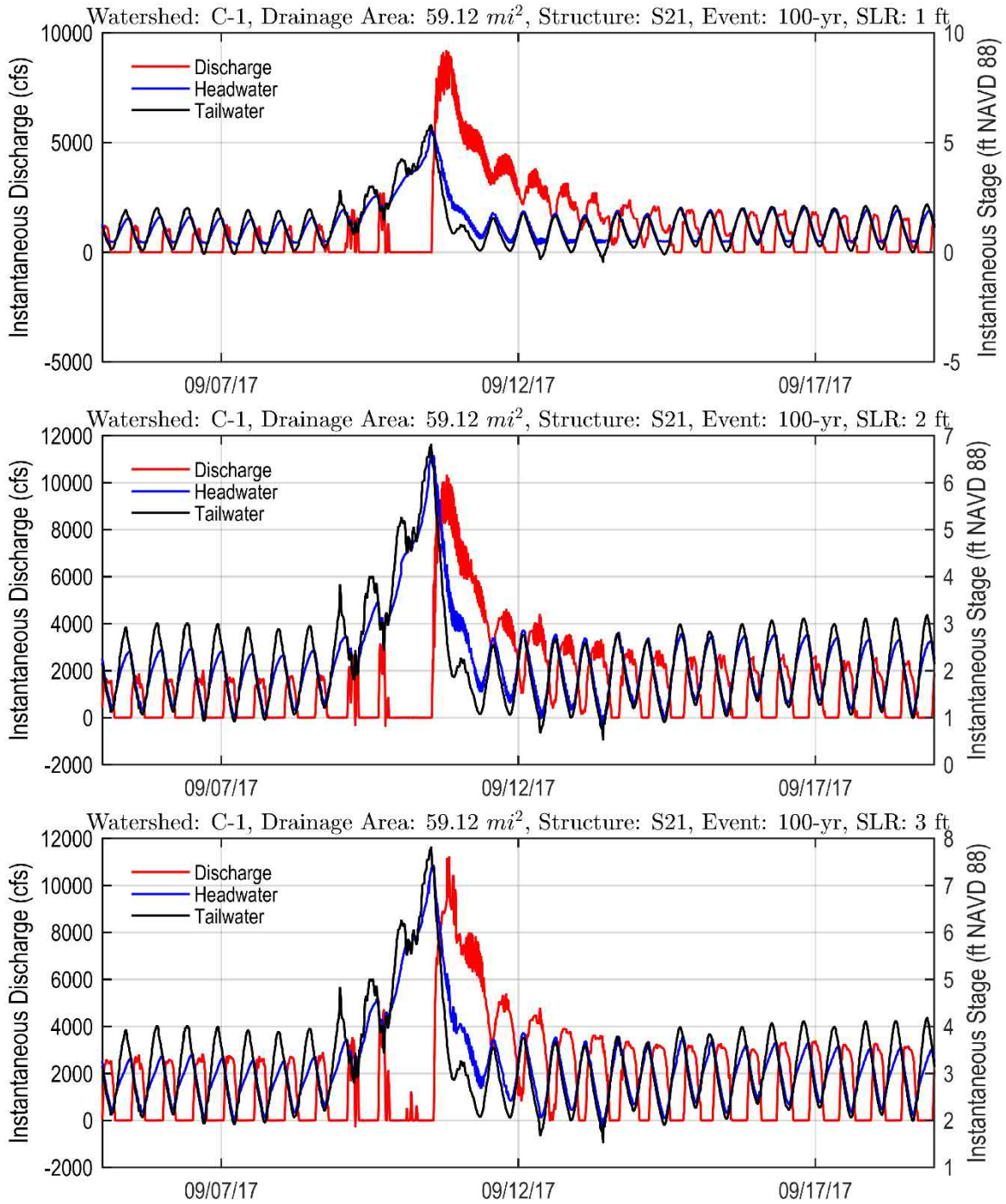


Figure 374 Structure S21 Instantaneous Conditions for 100-yr Design Event for SLR = 1, 2 and 3 ft

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 175. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3 ft. The instantaneous peak discharges listed in Table 175 are considerably higher and exceed the SPF discharge of 4,300 cfs for all SLR scenarios.

Table 175 Structure S21 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-1	S21	59.120	SLR = +0 ft	3830	4235	5587	7357
			SLR = +1 ft	4711	5374	7117	8497
			SLR = +2 ft	6257	7467	8658	9859
			SLR = +3 ft	8461	9222	10351	11227

Table 176 provides a list of the instantaneous conditions at structure S21 at peak tailwater.

Table 176 Structure S21 Summary of Instantaneous Conditions at Structure S21 at Peak Tailwater

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
5-yr	SLR 0	2.38	234.38	2.48	0.10
	SLR 1	2.85	352.91	2.95	0.10
	SLR 2	3.67	425.08	3.77	0.10
	SLR 3	4.50	-0.37	4.42	-0.08
10-yr	SLR 0	3.38	-0.17	3.31	-0.07
	SLR 1	3.85	-0.21	3.88	0.03
	SLR 2	4.67	-0.31	4.40	-0.26
	SLR 3	5.50	-0.45	5.01	-0.49
25-yr	SLR 0	4.38	-0.18	4.32	-0.06
	SLR 1	4.85	-0.24	4.61	-0.24
	SLR 2	5.67	-0.36	5.16	-0.50
	SLR 3	6.50	-0.45	5.53	-0.97
100-yr	SLR 0	5.38	-0.23	5.15	-0.23
	SLR 1	5.85	-0.28	5.39	-0.45
	SLR 2	6.67	-0.36	5.94	-0.73
	SLR 3	7.50	-0.45	6.67	-0.84

The head differential provided in Table 176 is less or equal to the gate closing criteria, therefore the discharges are nearly zero for almost all events and SLR conditions except the 5-yr event for SLR 0, 1 and 2.

Table 177 provides the structure conditions at peak discharge.

Table 177 Structure S21 Summary of Instantaneous Conditions at Structure S21 at Peak Discharge

Design Event	Scenario	Peak Discharge cfs	TW at Peak Discharge ft NAVD	HW at Peak Discharge ft NAVD	Head Differential at Peak Discharge ft NAVD
5-yr	SLR 0	3830	0.16	0.54	0.38
	SLR 1	4711	0.38	0.94	0.56
	SLR 2	6257	1.36	2.15	0.78
	SLR 3	8461	1.77	3.02	1.25
10-yr	SLR 0	4235	0.38	1.50	1.12
	SLR 1	5374	2.60	3.05	0.45
	SLR 2	7467	2.10	3.05	0.95
	SLR 3	9222	1.83	3.28	1.45
25-yr	SLR 0	5587	2.72	3.21	0.48
	SLR 1	7117	2.33	3.15	0.82
	SLR 2	8658	2.96	4.04	1.08
	SLR 3	10351	2.72	4.27	1.55
100-yr	SLR 0	7357	2.94	3.73	0.79
	SLR 1	8497	3.11	4.13	1.02
	SLR 2	9859	4.18	5.33	1.15
	SLR 3	11227	3.25	4.89	1.64

PM3: The SPF discharge of 4,300 cfs is defined for 0.8 ft head differential at tailwater elevation of 0.45 ft NAVD. Table 177 shows that the structure S21 is under different hydraulic conditions with respect to tailwater elevation. Additionally, the outflows considerably increase for tailwater elevations greater than the design levels. This indicates that Structure S21 will not reduce its performance for increasing SLR, however, the structure capacity may become deficient if improvements of the design capacity of C-1W canal and structure S148 are required.

The 12-hr moving average timeseries for SLR 0, 1, 2 and 3 for the 25-yr and 100-Yr design events are shown in Figure 375 and Figure 376.

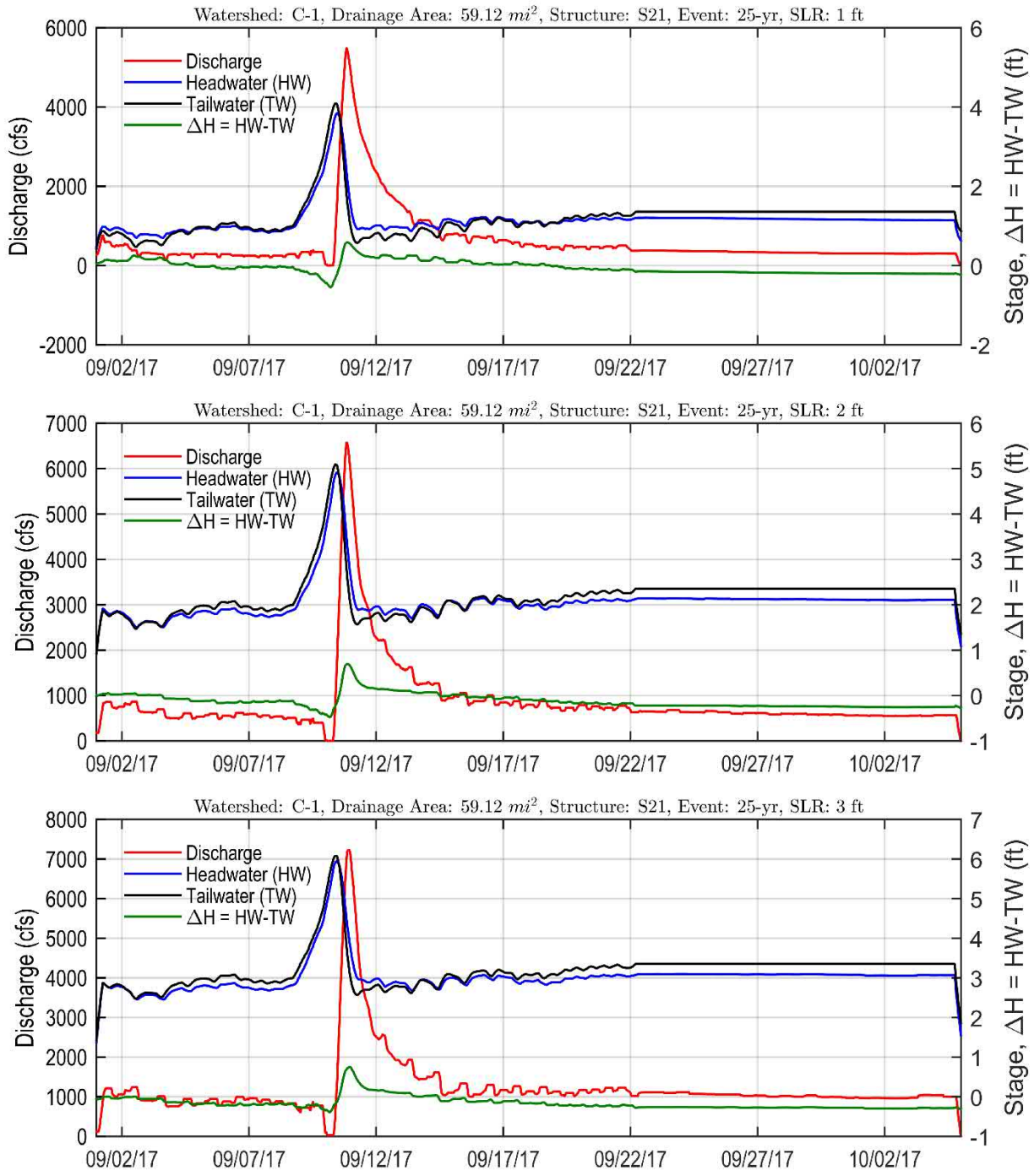


Figure 375 Structure S21: 12-hr Moving Averages of Discharge, Stage, and Head Difference for a 25-Year Design Event for SLR 1, 2 and 3

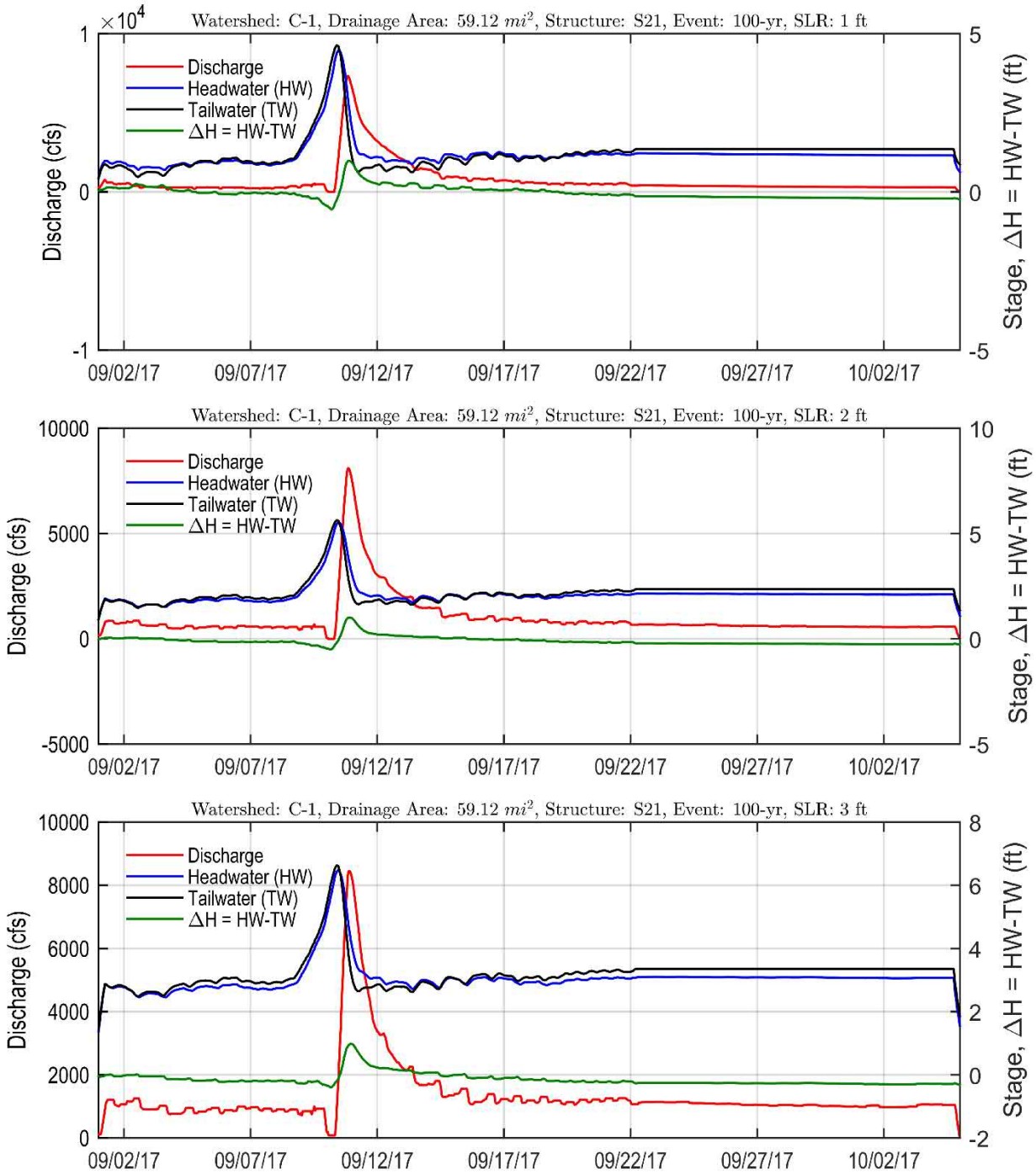


Figure 376 Structure S21: 12-hr Moving Averages of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3

A summary of 12-hr averaged peak discharges is provided in Table 178. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater and the head differentials are provided. The head differential gradually increases up to 1.7 ft with increasing the tailwater boundary conditions and increasing the return period. The table shows the HW, TW and Head Differential values at the time of peak discharge.

Table 178 Structure S21: 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-1	S21	59.12	5-yr	SLR = +0 ft	0.336	0.870	0.534	2628
			5-yr	SLR = +1 ft	1.336	1.564	0.228	3333
			5-yr	SLR = +2 ft	2.319	2.597	0.278	4034
			5-yr	SLR = +3 ft	3.354	3.787	0.433	5483
			10-yr	SLR = +0 ft	0.546	1.069	0.523	3580
			10-yr	SLR = +1 ft	1.546	1.892	0.346	4167
			10-yr	SLR = +2 ft	2.506	2.948	0.442	5132
			10-yr	SLR = +3 ft	3.449	4.032	0.584	6435
			25-yr	SLR = +0 ft	0.807	1.389	0.583	4969
			25-yr	SLR = +1 ft	1.783	2.360	0.577	5485
			25-yr	SLR = +2 ft	2.737	3.430	0.694	6590
			25-yr	SLR = +3 ft	3.269	4.016	0.747	7229
			100-yr	SLR = +0 ft	0.967	1.928	0.960	6605
			100-yr	SLR = +1 ft	1.967	2.939	0.972	7341
			100-yr	SLR = +2 ft	2.917	3.912	0.995	8118
			100-yr	SLR = +3 ft	3.638	4.591	0.953	8457

Peak TW and Peak HW are reported using 12-hr averaging
Head differential is computed by subtracting HW-TW at the time of 12-hr Peak Discharge
12-hr moving average is computed by taking the centered average over 288 timesteps (timestep is 5-min)

Figure 377 shows the cumulative discharges for the 5-yr, 10-yr, and 25-yr events. There is consistent increase of the cumulative discharge with respect to SLR increase which is valid for all design events.

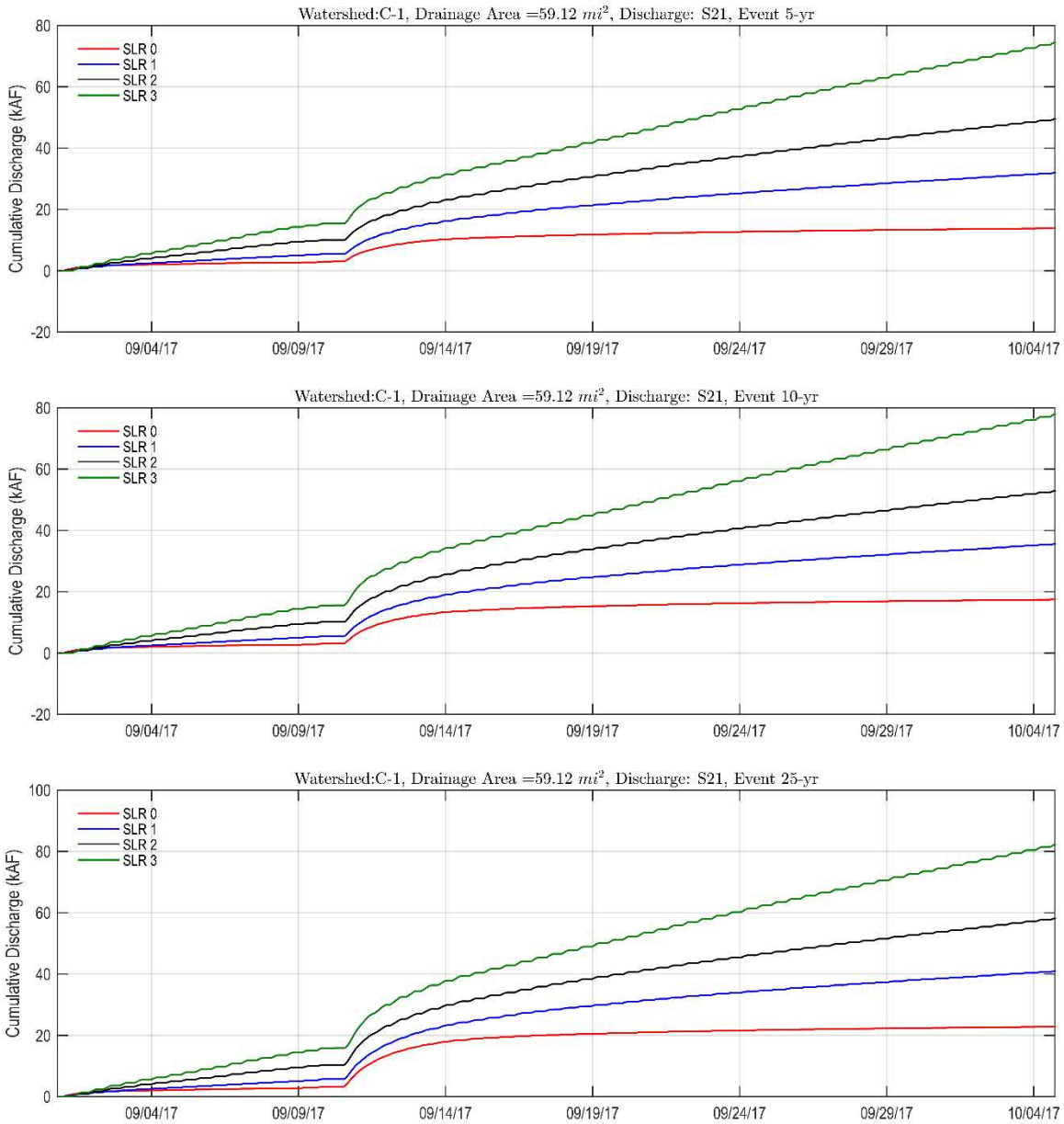


Figure 377. Cumulative Discharges of Structure S-21 for the 5-yr, 10-yr, and 25-yr Event and for SLR 0, 1, 2 and 3

Figure 378 shows the cumulative discharges for the 100-yr event. There is significant increase of the cumulative discharge with respect to SLR increase which is valid for all design events. The review of the gates show that the gate operation differs between the SLR scenarios and results in different cumulative timeseries primarily before and after the storm (Figure 360).

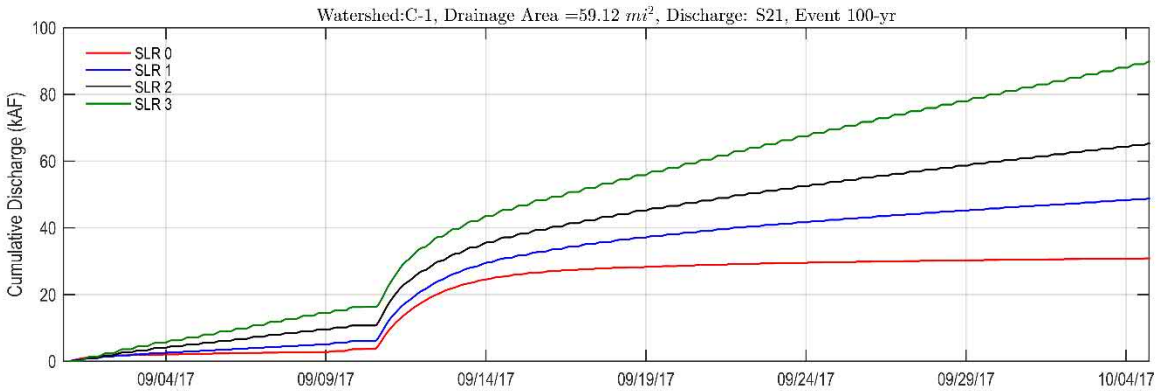


Figure 378. Cumulative Discharges of Structure S-21 for the 100-yr Event and for SLR 0, 1, 2 and 3

Additional information is provided below to discuss the reasons for the observed consistent increase of the cumulative discharges with respect to SLR increase. An outline of the watersheds which discharge in the C-1 Canal is shown in Figure 378 and include AHED watersheds C-1 East, Goulds and DA-4.

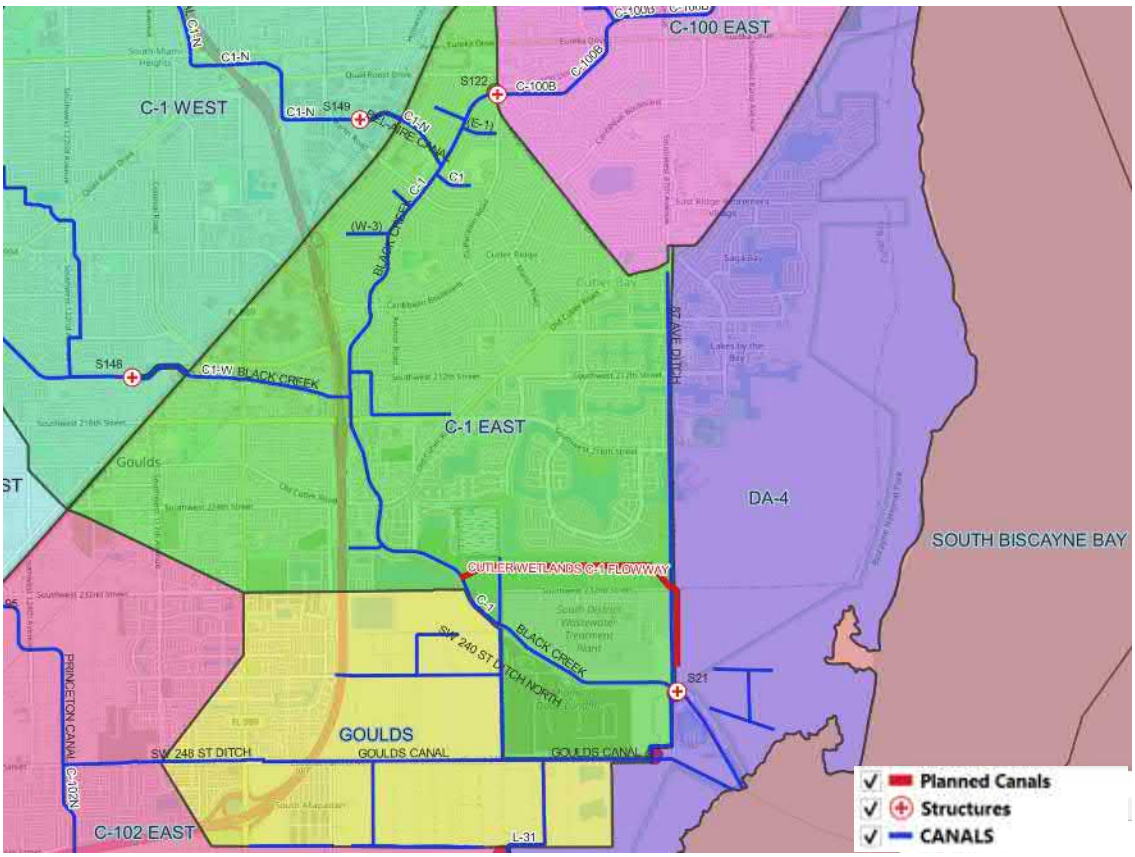


Figure 379. Outline of AHED Watersheds C-1 East, DA-4 and Goulds

To determine the magnitude of the inflows from Biscayne Bay, the inflows in the C-1 canal in Watershed C-1 were analyzed including structures S148, S149 and S122. Additionally, the inflows/outflows from the Goulds Canal and the planned Cutler Wetlands C-1 Flow Way were determined. The cumulative flows at structures S122, S148 and S149 which are upstream structure S21 were reviewed to determine the discharges with respect to SLR (the flow through structure S122 is nearly zero and not shown).

Figure 380 shows the cumulative discharges at structures S148 and S149 illustrate that the impacts of SLR on the discharges from these structures does not increase at structure S148 and has relatively minor increase for structure S149.

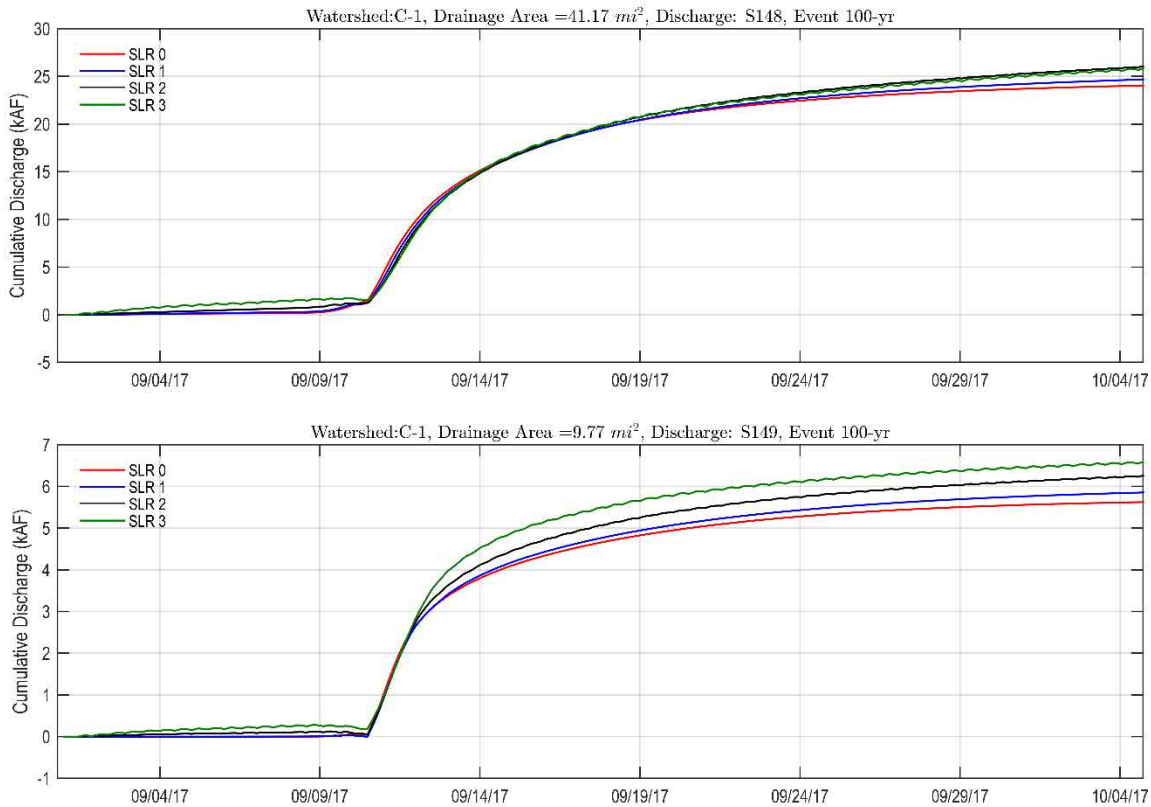


Figure 380. Cumulative Discharges of Structure S148 and S149 Upstream Structure S21 for the 100-yr Event and for SLR 0, 1, 2 and 3

The computed discharges each Mike 1D node of the C-1 Canal are shown in Figure 381. There is increase of discharges in chainages 2296, 4750 and 4751 m, which are the location of the C-1 Canal junction with:

- Planned Cutler Wetlands C-1 Flow Way at C-1 chainage 2296 m,
- Canals SW 97 Ave Ditch West B and SW 97 Ave Ditch West A at C-1 chainage 2925 m.
- Canals South Dade Landfill E Ditch and SW 87 Ave Canal at C-1 Chainage 4750 m
- Qa and Qb shown in Figure 382 are locations of inflows from Biscayne Bay caused by storm surge

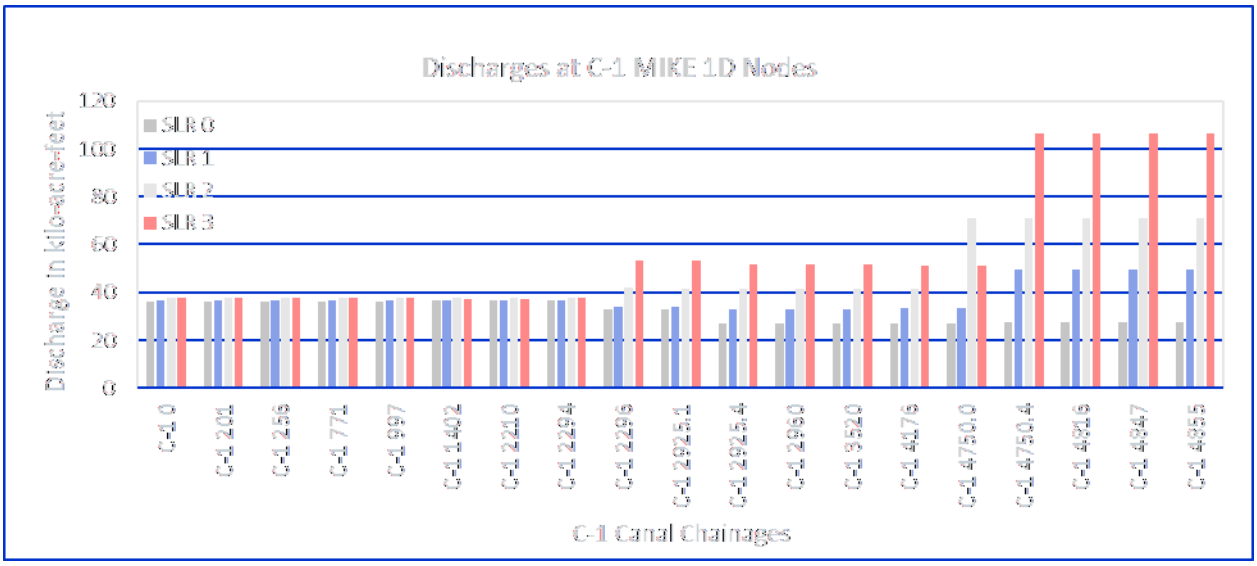


Figure 381. Computed Discharges in C-1 Canal at MIKE 1D nodes for a 100-year Event

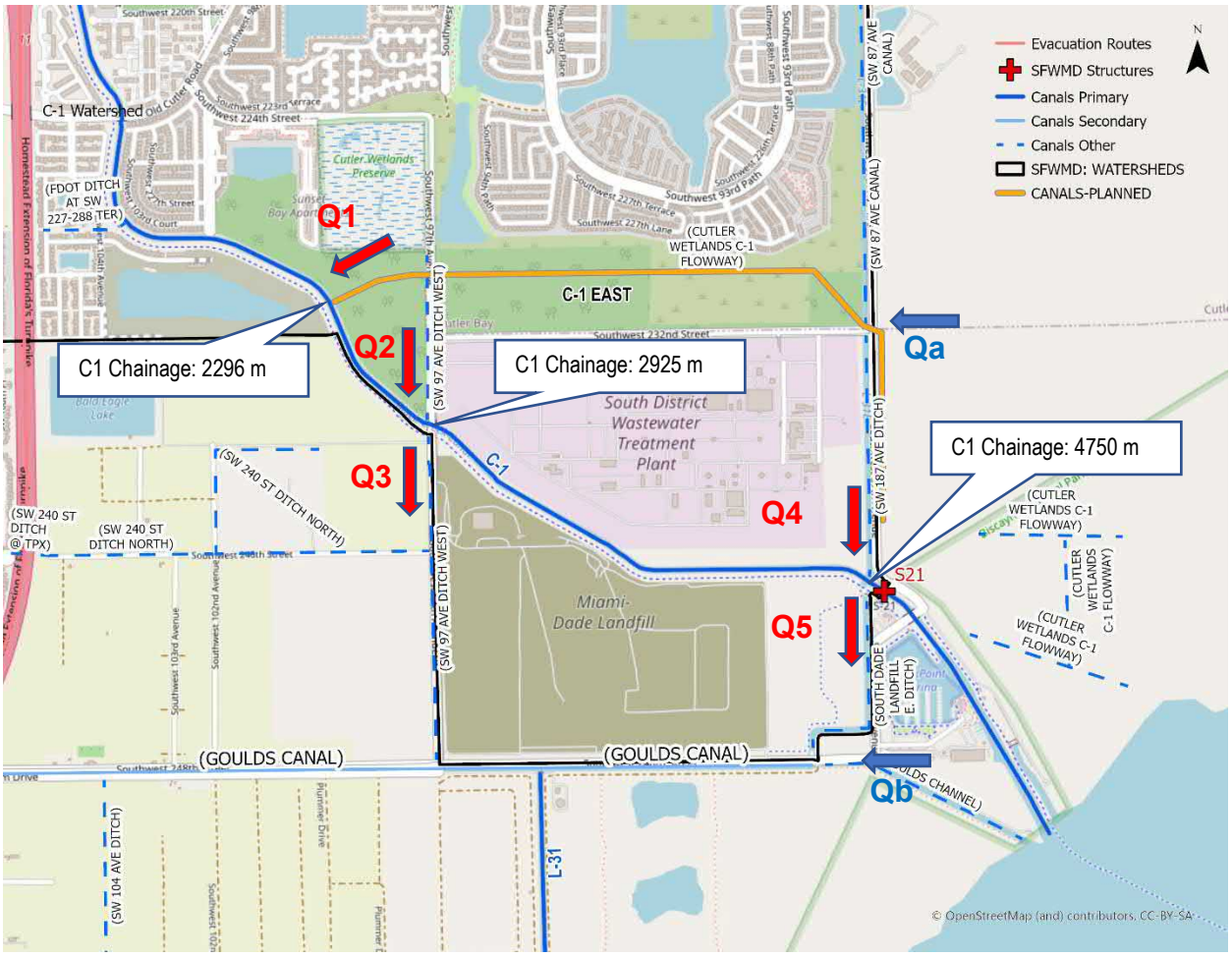


Figure 382. Outline of AHED Watersheds C-1 East, DA-4 and Goulds

The computed water budget of Canal C-1 is summarized in Table 179.

Table 179 Water Budget of Canal C-1 (in kilo acre-feet)

Canal C-1 Water Budget	SLR 0	SLR 1	SLR 2	SLR 3
C-1 Inflow, at chainage 0 and junction with C-1W canal	36.12	36.40	37.67	37.51
S21 Discharge	-27.58	-49.61	-70.95	-106.46
Q1 Cutler Wetlands C-1 Flow Way 0	-3.86	-2.68	4.28	15.87
Q5 - South Dade Landfill E Ditch 0	-7.46	5.05	12.45	18.83
Q4 - SW 87 Ave Canal 3864.87	7.94	11.54	17.49	36.72
Q2 - SW 97 Ave Ditch West A 0	-5.92	-1.44	-1.43	-3.20
Q3 - SW 97 Ave Ditch West B 516.884	0.14	0.19	0.36	0.81
OL Exchange	0.12	-0.04	0.02	0.02
SZ Exchange	0.52	0.46	0.37	0.28
Change in Storage	0.00	-0.04	-0.08	-0.13
Sum Inflows	44.19	48.12	55.52	75.04
Sum Outflows	-44.82	-48.68	-55.64	-74.96
Discrepancy	0.02	-0.17	0.73	0.25

The computed water budget shows that Canal C-1 receives inflow from Cutler Wetlands C-1 Flow Way, South Dade Landfill E Ditch and SW 87 Ave Canal. The inflow increases with increasing SLR.

The model for future conditions added the planned Cutler Wetlands C-1 Flow Way Project which is part of the Comprehensive Everglades Restoration Plan. The project contemplates the redistribution and improvement of freshwater flows to Biscayne Bay and Biscayne National Park by redirecting water from the C-1 Canal to the coastal wetlands along Biscayne Bay. The objective of this canal is to support restoration of wetland, estuarine, and marine habitats.

Additionally, the project considers a pump station on the C-1 Canal west of SW 97 Avenue, a lined conveyance channel, a spreader canal, box culverts, and the plugging of ditches within wetlands to discourage the unnatural channelization of the water delivered to the area by the spreader canal. The model implements the Flow way as a direct connection between the Wetlands in watershed DA-4 and the Flow Way, since no information was available for possible control structure which would limit backflow from the Biscayne Bay. This direct connection can result in significant inflow from Biscayne Bay for SLR in the conditions of storm surge.

Additionally, the topography of the areas delimited by AHED Watersheds C-1 East, DA-4 and Goulds is shown in Figure 383. The topography shows that most of the areas downstream of the junction of canals C1-W and C-1 Canal is lower than 2 ft NAVD 88.

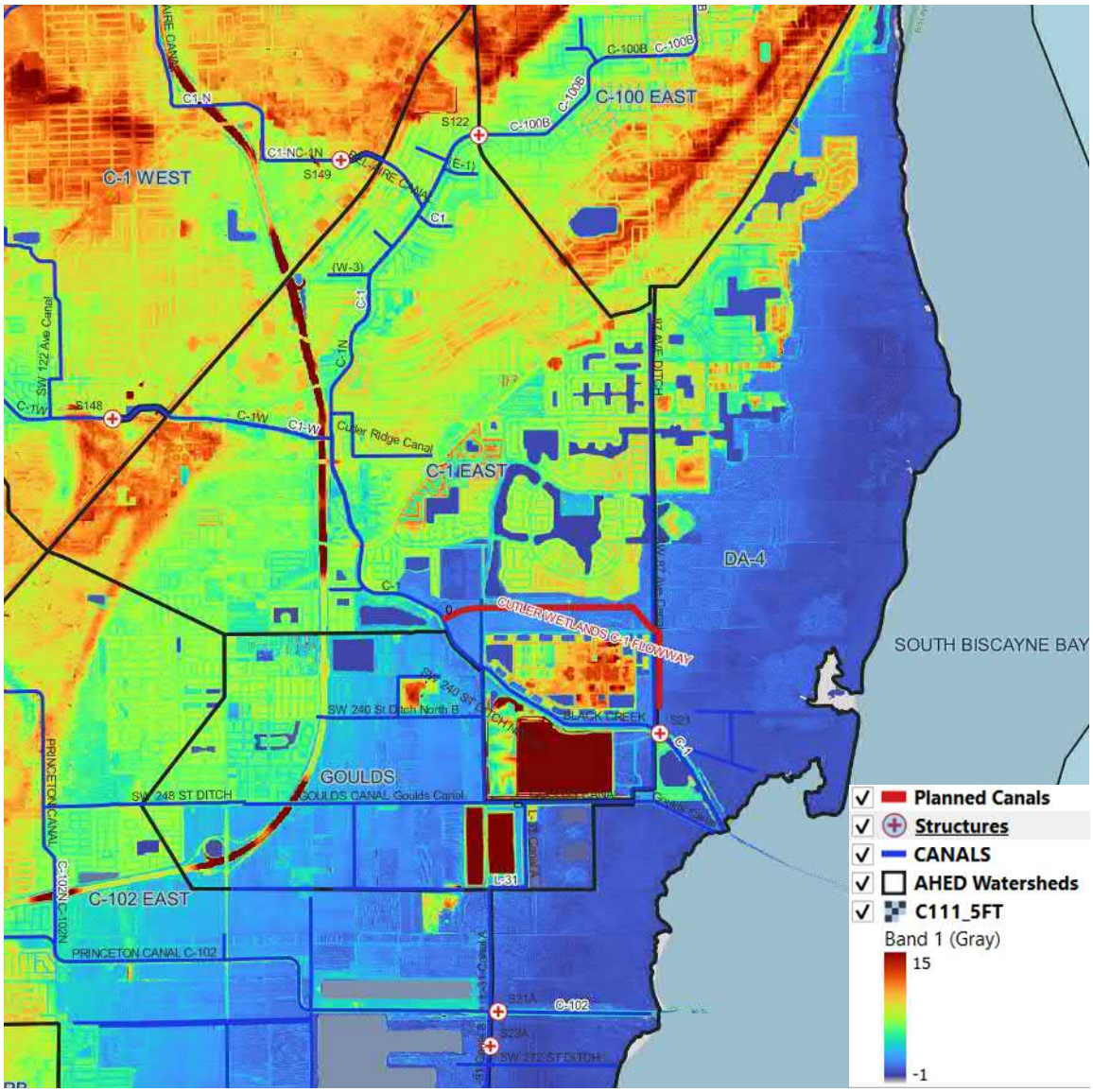


Figure 383. Topography within AHED Watersheds C-1 East, DA-4 and Goulds

In addition, the model implements the Goulds Canal using a closed boundary conditions at the end of the canal. The Goulds Canal crossing shown below can be overtopped for water levels greater than 5.74 ft NAVD 88 as shown in Figure 384.

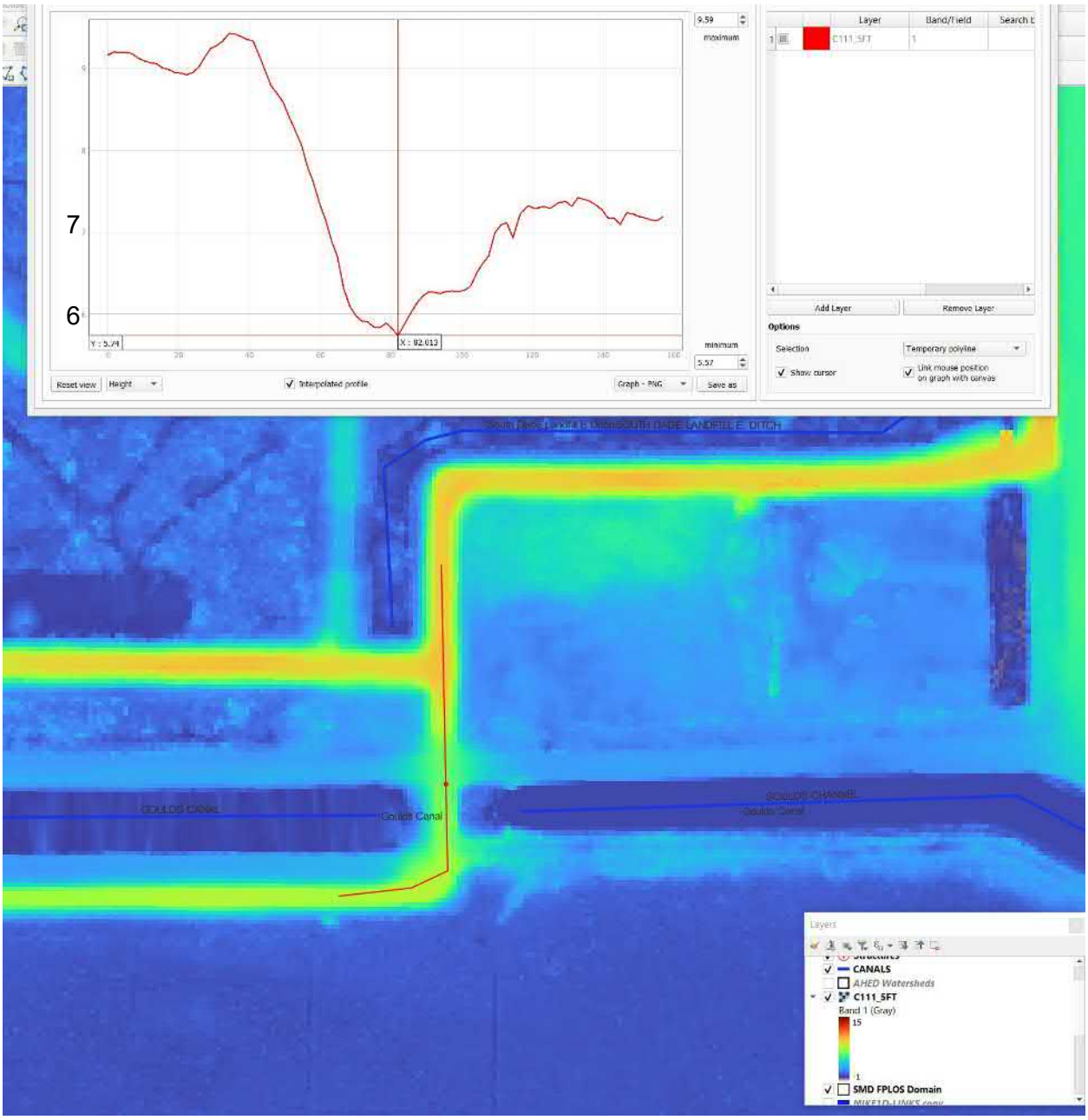


Figure 384. Topography of the Goulds Canal Crossing (elevation in NAVD)

Additionally, the top of the Levee L-31 between Goulds Canal and C-102 Canal can be overtopped in several locations in a case when the water levels are above 6 ft NAVD as shown in Figure 385.

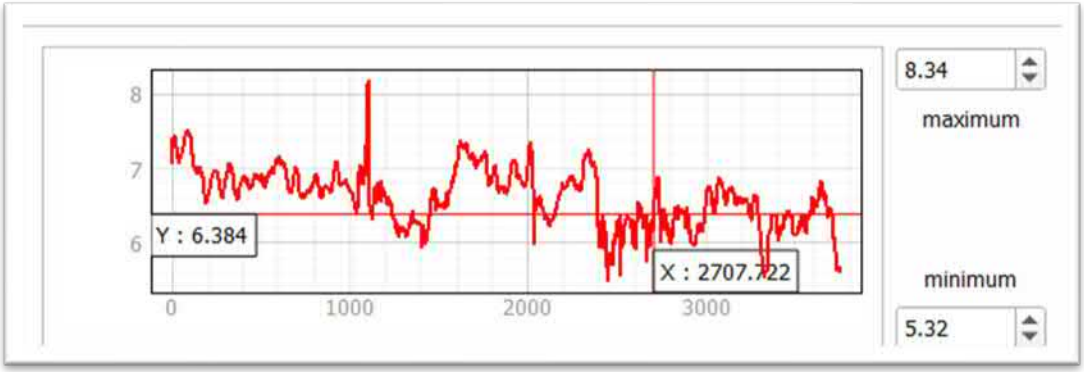


Figure 385 Top of Levee L-31E between Goulds and C-102 Canals

A summary of the cumulative flows entering Watershed C-1 through Q1 Cutler Wetlands C-1 Flow Way and Goulds Canal are shown in Figure 386.

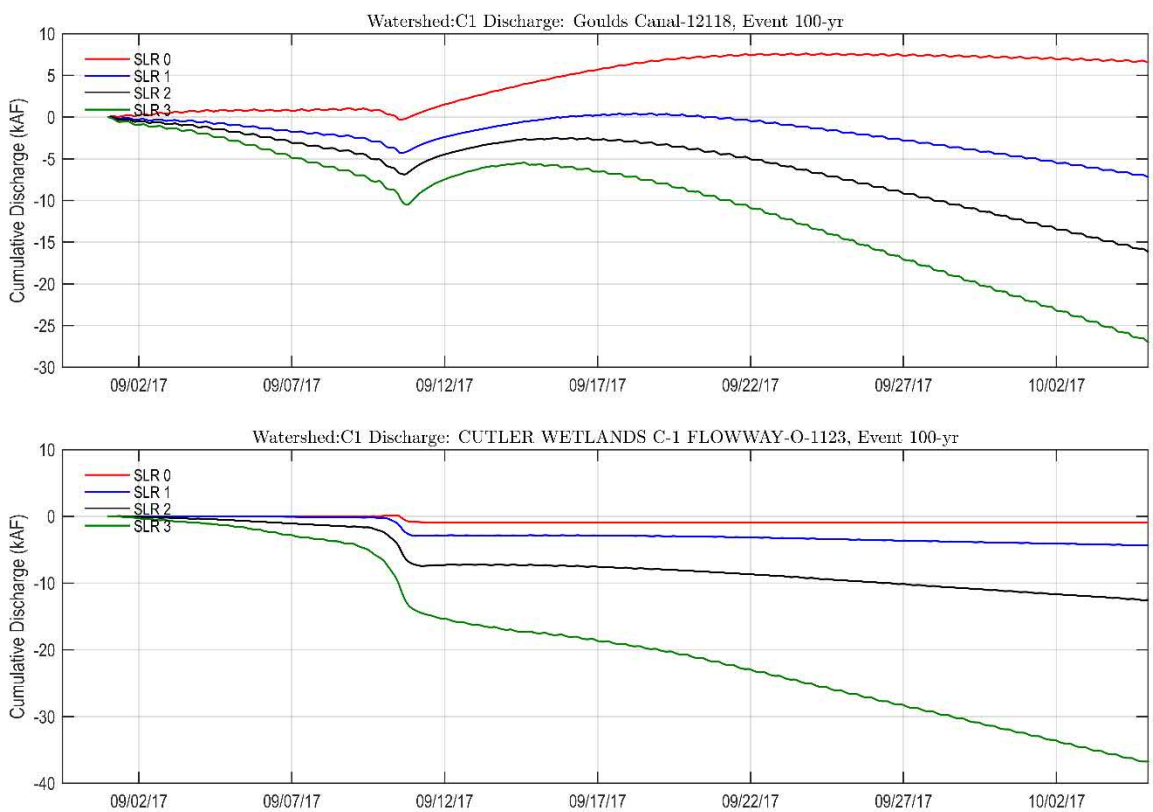


Figure 386 Cumulative Flows Entering Watershed C-1 through Cutler Wetlands Flow Way and Goulds Canal (depicted as Qa and Qb in Figure 382)

The above summary demonstrates that inflows from Biscayne Bay through Goulds Canal (item Qb in Figure 382) and the planned Cutler Wetlands C-1 Flow Way (item Qa in Figure 382) can impact the flows through structure S21 for SLR and storm surge conditions.

6.2.4.2 PM3: Structure S148

A summary of computed instantaneous peak discharges (in cfs) for structure S148 is provided in Table 180. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft. The design rate of this structure is 1,500 cfs at 40% of SPF for head differential of 0.2 ft and tailwater elevation at 2.5 ft NAVD.

Table 180 Structure S148 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-1	S148	41.170	SLR = +0 ft	1667	1757	1794	1891
			SLR = +1 ft	1757	1794	1891	2154
			SLR = +2 ft	1794	1891	2154	2166
			SLR = +3 ft	1891	2154	2166	2234

6.2.4.3 PM3: Structure S149

A summary of computed instantaneous peak discharges (in cfs) for structure S148 is provided in Table 181. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft. The design rate of this structure is 400 cfs at 40% of SPF for head differential of 1.2 ft and tailwater elevation at 3.5 ft NAVD.

Table 181 Structure S149 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-1	S148	41.170	SLR = +0 ft	206	534	790	1123
			SLR = +1 ft	262	532	815	1067
			SLR = +2 ft	328	578	835	1042
			SLR = +3 ft	518	703	839	1011

6.2.5 C-1: PM4 Watershed Peak Storm Runoff

PM4 represents the 12-hr moving average time series at tidal structure S21. The discharge hydrographs, particularly the peak discharge, are compared with the peak discharge for future sea level rise scenarios.

6.2.5.1 PM4: Structure S21

The 12-hr moving average timeseries were summarized for all SLR conditions and for the design events in Figure 387 and Figure 388.

For SLR = 0 (Figure 387), the discharge hydrograph shows that the maximum peaks have considerable separation in terms of total maximum. With increase of SLR, the peaks become with similar amplitude and more similar as shown in subsequent figures.

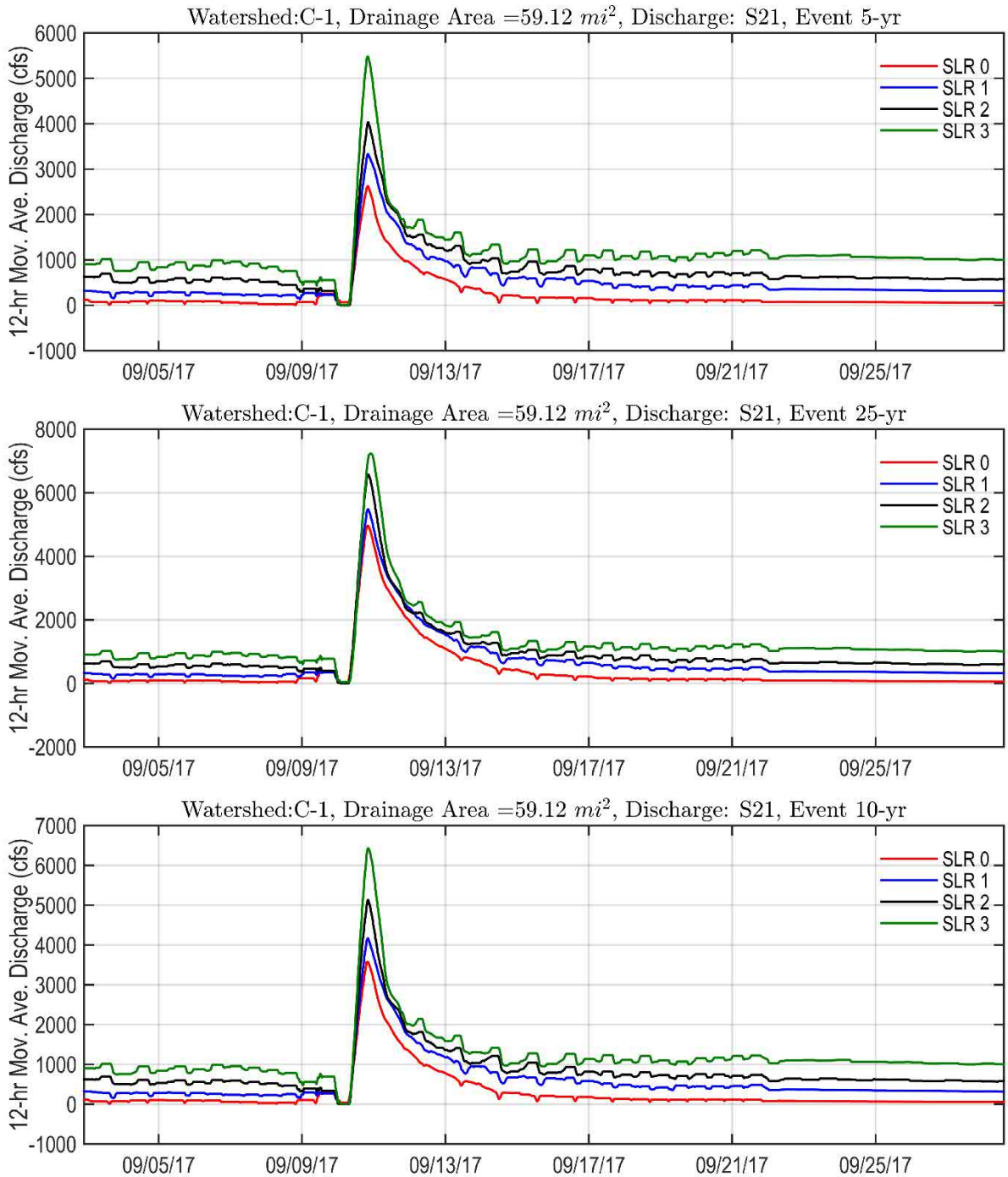


Figure 387. 12-hr Moving Average Flow Timeseries at S21 for 5-Yr, 10-Yr and 25-Yr Design Events

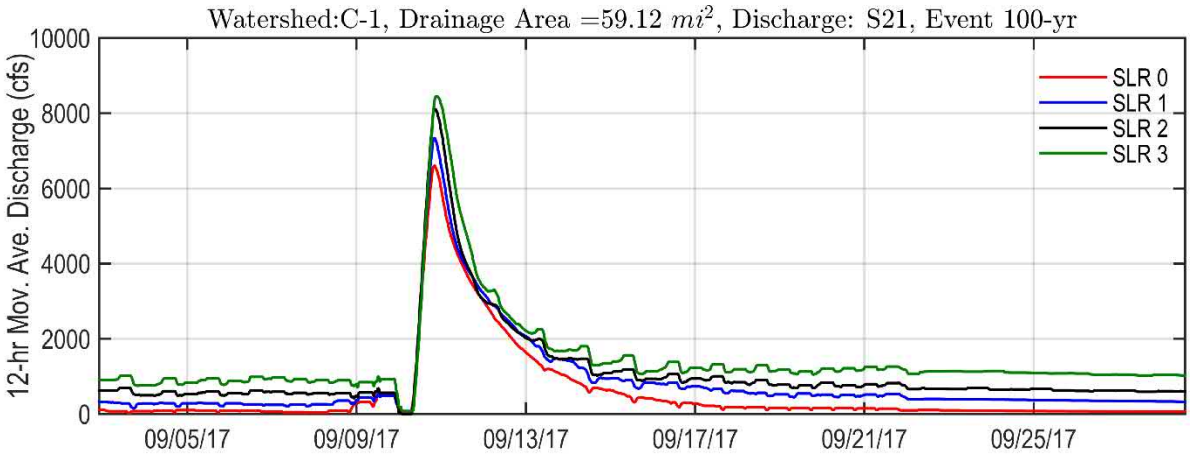


Figure 388. 12-hr Moving Average Flow Timeseries at S21 for the 100-Yr Design Event

Figure 389 provides a summary of the 12-hr moving average discharge peak values for structure S21.

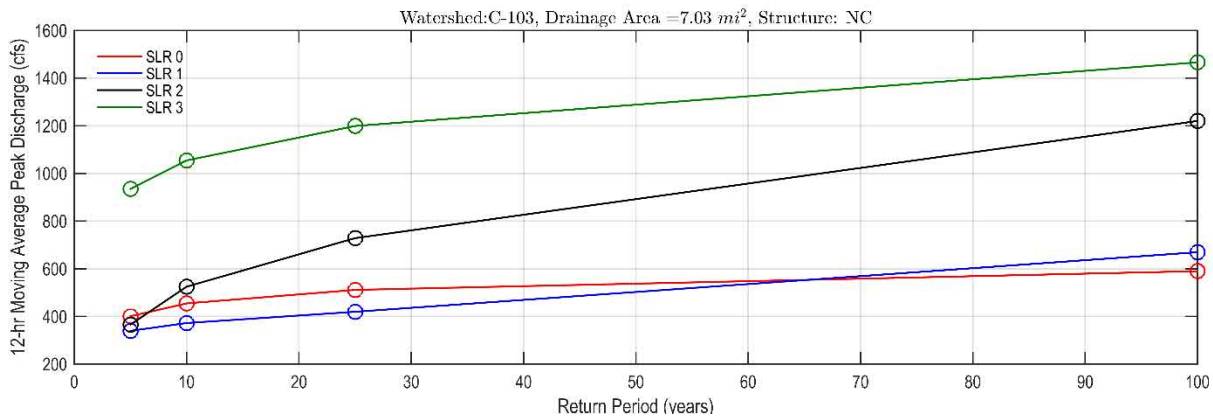


Figure 389 Structure S21 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The summary shows that discharges increase with for increasing SLR.

The calculated design flows at the structure are considerably higher than the design flow of 2,560 cfs and the 100% SPF discharge rated as 4,300 cfs.

The rating of structure S21_S for a 100-Year 40% SPF (also design discharge rate) is 2,560 cfs and for 100% SPF is 4,300 cfs. The discharge from the 100-Year, 72-hour design event for current conditions is 7,308 cfs for instantaneous and 6,257 cfs for moving average peak discharge, which are greater than the SPF values.

Two main factors are attributed to the higher computed discharge values at the structures. Contribution from increased imperviousness caused by development since the original design and the second factor is a difference in the design assumptions. The original design uses a steady

state boundary of 2.0 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.8 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (applying the 100-yr outfall timeseries provided by SFWMD or using the steady state boundary originally used as design criteria).

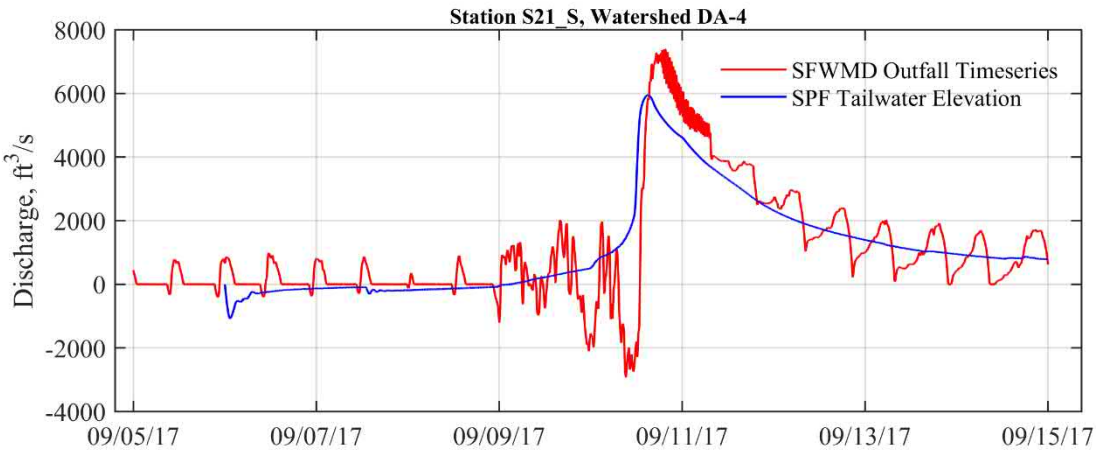


Figure 390 Comparison of Instantaneous Discharges at Structure S21 for the Design SPF Tailwater Elevation and SFWMD Tailwater Boundary Condition for 100-Yr Storm

6.2.5.2 PM4: Structure S148

A summary of the 12-hr peak discharges at structure S149 is shown in Figure 391 and includes all SLR conditions and design events.

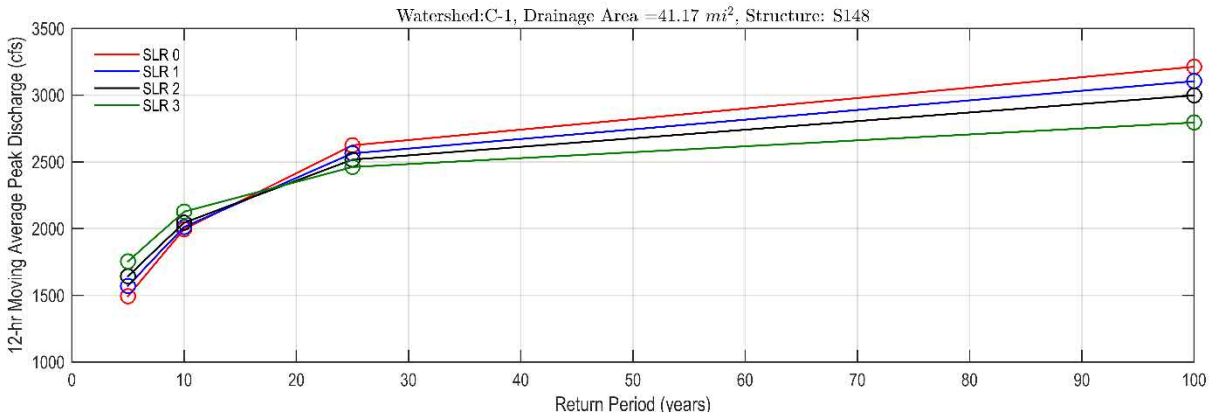


Figure 391 Structure S148 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The summary shows that peak discharges increase for design events from 5-yr to 10-yr, followed by smaller increase after the 25-year event to the 100-year event, which also confirms that the peak discharges a limited for design events with greater than 25-yr return frequency. The peak discharges decrease with respect to increasing SLR which is caused by reducing the head gradient within canals discharging to Biscayne Bay.

6.2.5.3 PM4: Structure S149

A summary of the 12-hr moving average peak discharges at structure S149 shown in Figure 392. The summary shows that discharges increase with for increasing SLR for design events 5- and 10-yr, are nearly steady for the 25-year event and reverse direction for the 100-year event.

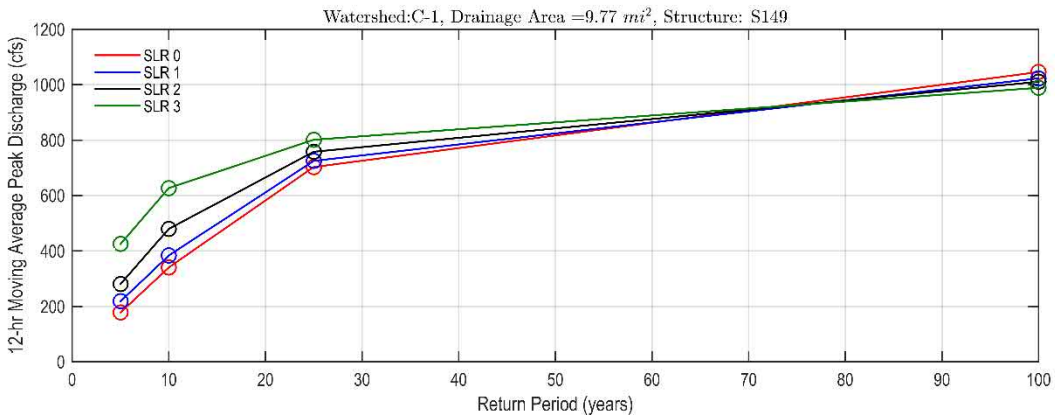


Figure 392 Structure S149 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The summary shows similar trend as S148. The peak discharges increase for design events from 5-yr to 10-yr, followed by smaller increase after the 25-year event to the 100-year event, which also confirms that the peak discharges a limited for design events with greater than 25-yr return frequency. The peak discharges decrease with respect to increasing SLR which is caused by reducing the head gradient within canals discharging to Biscayne Bay.

6.2.6 C-1: PM5 Flood Frequency

PM5 is determined using stage based FPLOS for the entire watershed. The model output files of water elevations and overland water depths were extracted and converted to grid files, which were then imported in ARC GIS Pro software and process to generate raster data to show flood extent and depth and flood extent and duration. The flood depth maps were developed using 5 ft topography, while the flood duration maps were developed using the original grid size (100m). In addition, flood tables were developed to list the acreage of preselected flood depth levels and the duration in hours for preselect flood duration times.

Table 182 through Table 185 summarize the area of flooding shown in the C-1 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. The maps provided in in Appendix A Flood Maps show the inundation depths for the watershed, agricultural, urban and wetland areas in C-1 Watershed, for the 5-Year, 10-Year, 25-Year, and 100-Year 72-hour design storm events, respectively.

The total area of the C-1 watershed is 37,861 acres (based on the raster data). The values in the tables are based on discretization to 100 m raster which results in total watershed area 37,861 acres with 20,846 acres urban land, 10,181 acres agricultural land and 6,835 acres wetlands. The tables provide the following information:

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.

The severity of flooding is determined based on the flooded areas reported at each successive row.

The corresponding flood extent and maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions**:**

- Figure B-1 through Figure B-16 provide flood extent maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-33 through Figure B-48 provide flood extent maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-65 through Figure B-80 provide flood extent maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Upstream of the junction with Tamiami Airport B Canal: 0.25 – 0.5 foot of flood depth in the watershed. Most areas in C-1W watershed have 0.5 – 1 foot flood depth for 25-Year design event. 100-Year storm causes approximately 1 – 1.75 feet flood depth. There is significant flooding in agricultural areas, mainly located in C-1 West, that is attributable to the elevated stages in C-1W Canal and possibly, secondary canals for the 25-Year and 100-Year design events. Urban areas, mainly located in C-1 East watershed, show less significant flooding, with water depth in the range of 0.5 – 0.75 feet for the 100-Year design storm. Watershed areas upstream of G114, and around C-1N Canal have more than 2 feet of water depth for the 100-Year design event. Areas downstream of SR-994 have approximately 0.25- 0.5 foot of water depth for the 25-Year design event and around 1 foot water depth for the 100-Year design event. For the 5-Year and 10-Year events, flooding in general is less than 0.5 foot deep.

Table 182 Summary of the PM5 Flood Inundation in Acres for the C-1 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	28751	27826	28004	27164	25064	25543	24214	24352	23188	20895	20707	19232	19296	18073	16151	13702	12812	12684	11737	10443
0.25 >= 0.50	3548	3884	3729	4102	4905	4470	4994	4880	5135	5169	4730	4950	4799	4903	4821	4922	5135	5157	4945	4715
0.50 >= 0.75	1737	1712	1663	1816	2352	2773	2921	2899	3240	4107	4379	4636	4564	4534	4448	3870	4043	4038	4077	3815
0.75 >= 1.00	850	1060	964	1060	1270	1421	1562	1485	1698	2123	2691	2891	2950	3321	3835	3922	3912	3867	3934	3766
1.00 >= 1.25	311	529	521	593	746	620	857	825	949	1310	1495	1643	1604	1908	2370	3754	3539	3492	3613	3741
1.25 >= 1.50	166	245	208	220	395	297	423	413	479	734	635	979	1040	1139	1497	2305	2461	2501	2780	3052
1.50 >= 1.75	143	158	116	96	178	146	232	183	245	324	284	440	437	605	902	1295	1413	1455	1606	2130
1.75 >= 2.00	101	89	96	67	94	133	146	84	89	180	168	220	220	287	432	714	949	956	1117	1379
2.00 >= 2.25	109	106	136	89	96	121	109	101	64	119	126	138	109	141	242	272	415	445	578	862
2.25 >= 2.50	620	119	168	89	79	126	106	101	89	111	136	136	84	104	141	175	190	225	284	479
>= 2.50	1525	2133	2256	2565	2681	2212	2298	2538	2686	2790	2511	2597	2758	2847	3022	2931	2992	3042	3190	3479
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 covers 37,861 acres																				

Table 183. Summary of the PM5 Flood Inundation in Acres for the Urban Areas of the C-1 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	19168	18726	18834	18343	17110	17994	17114	17201	16465	14977	15259	14404	14396	13467	11997	10430	9946	9803	9000	7949
0.25 >= 0.50	554	798	722	961	1493	1090	1567	1500	1772	2135	2229	2414	2394	2634	2758	3417	3457	3477	3351	3222
0.50 >= 0.75	259	343	334	420	699	549	719	741	897	1292	1179	1448	1446	1572	1885	2155	2249	2268	2350	2249
0.75 >= 1.00	133	163	131	222	378	287	403	358	487	719	692	813	813	996	1273	1542	1616	1604	1848	1885
1.00 >= 1.25	47	77	69	99	178	121	193	175	230	425	390	502	482	645	813	1016	1058	1092	1218	1485
1.25 >= 1.50	47	54	42	57	111	86	86	91	124	225	188	277	309	341	551	682	736	739	899	1040
1.50 >= 1.75	52	40	47	32	69	42	64	47	104	126	101	126	119	183	299	321	432	462	519	793
1.75 >= 2.00	37	37	32	30	64	37	37	35	37	96	69	84	96	111	198	240	277	269	358	549
2.00 >= 2.25	32	47	40	32	57	37	27	35	32	62	54	49	49	86	133	114	151	163	220	329
2.25 >= 2.50	77	47	35	35	25	42	44	35	42	67	37	59	40	62	84	106	79	104	116	220
>= 2.50	440	514	561	615	662	561	591	628	657	722	647	670	702	749	855	823	845	865	966	1124
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 urban areas cover 20,846 acres																				

Table 184. Summary of the PM5 Flood Inundation in acres for the Agricultural Areas of the C-1 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	5933	5644	5703	5441	4747	4127	3899	3956	3642	3062	2466	2150	2179	2036	1769	1075	981	991	946	860
0.25 >= 0.50	2681	2807	2773	2908	3146	3094	3141	3096	3052	2664	2150	2115	2021	1858	1680	1055	1095	1105	1060	956
0.50 >= 0.75	1038	1075	1063	1129	1408	1900	1930	1908	2118	2565	2911	2879	2829	2637	2219	1384	1451	1428	1359	1208
0.75 >= 1.00	316	415	400	442	529	692	786	791	877	1119	1646	1796	1880	2073	2278	2053	1972	1940	1762	1577
1.00 >= 1.25	99	111	121	131	171	185	232	232	267	447	645	771	764	932	1270	2434	2189	2145	2100	1962
1.25 >= 1.50	40	49	44	49	69	84	82	86	99	156	185	262	284	361	521	1226	1408	1455	1611	1777
1.50 >= 1.75	17	17	15	17	40	27	37	40	47	62	79	84	96	133	240	549	598	613	714	1016
1.75 >= 2.00	10	10	7	5	10	15	17	12	17	32	30	47	44	62	57	237	277	282	358	423
2.00 >= 2.25	10	7	12	12	12	10	7	5	5	12	10	17	20	27	52	57	82	89	111	185
2.25 >= 2.50	0	7	5	5	7	10	7	10	12	17	15	5	2	2	22	40	49	52	59	69
>= 2.50	37	37	37	40	42	37	42	44	44	44	44	54	59	59	72	72	79	82	99	148
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 agricultural areas cover 10,181 acres																				

Table 185. Summary of the PM5 Flood Inundation in Acres for the Wetlands Areas of the C-1 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	3650	3457	3467	3380	3207	3422	3200	3195	3081	2857	2983	2679	2721	2570	2385	2197	1885	1890	1792	1633
0.25 >= 0.50	314	279	235	232	267	287	287	284	311	371	351	420	383	410	383	450	583	576	534	536
0.50 >= 0.75	440	294	267	267	245	324	272	250	225	250	289	309	289	326	343	331	343	341	368	358
0.75 >= 1.00	400	482	432	395	363	442	373	336	334	284	353	282	257	252	284	326	324	324	324	304
1.00 >= 1.25	166	341	331	363	398	314	432	418	452	437	460	371	358	331	287	304	292	255	294	294
1.25 >= 1.50	79	141	121	114	215	126	255	235	257	353	262	440	447	437	425	398	316	306	269	235
1.50 >= 1.75	74	101	54	47	69	77	131	96	94	136	104	230	222	289	363	425	383	381	373	321
1.75 >= 2.00	54	42	57	32	20	82	91	37	35	52	69	89	79	114	178	237	395	405	400	408
2.00 >= 2.25	67	52	84	44	27	74	74	62	27	44	62	72	40	27	57	101	183	193	247	348
2.25 >= 2.50	544	64	128	49	47	74	54	57	35	27	84	72	42	40	35	30	62	69	109	190
>= 2.50	1048	1581	1658	1910	1977	1614	1665	1866	1984	2024	1819	1873	1997	2039	2095	2036	2068	2095	2125	2207
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 wetlands cover 6,835 acres																				

Table 186 and Table 187 show the fraction of flooded urban and agricultural areas. The results indicate that the flood extent is relatively constant for the urban areas for SLR 0, 1, 2 and 3 and it is expected that the drainage system will have similar performance for future SLR conditions. The agricultural areas show similar trend with relatively small changes with increase of SLR.

Table 186 Fraction of Flooded Urban Area of C-1 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	38%	38%	36%	32%
>=0.25	17%	17%	19%	23%
>=0.5	11%	11%	13%	16%
>=0.75	7%	7%	8%	11%
>=1.00	5%	5%	6%	8%
>=1.25	3%	3%	4%	6%
>=1.50	3%	3%	3%	4%
>=1.75	2%	2%	3%	3%
>=2.00	2%	2%	2%	3%
>=2.25	2%	2%	2%	2%
>=2.50	2%	2%	2%	2%

Table 187 Fraction of Flooded Agricultural Area of C-1 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	21%	21%	20%	17%
>=0.25	21%	21%	22%	22%
>=0.5	16%	16%	17%	18%
>=0.75	8%	8%	10%	12%
>=1.00	3%	3%	4%	6%
>=1.25	1%	1%	2%	3%
>=1.50	1%	1%	1%	1%
>=1.75	0%	0%	0%	1%
>=2.00	0%	0%	0%	0%
>=2.25	0%	0%	0%	0%
>=2.50	0%	0%	0%	0%

The flooding identified in PM5 is a combination of two factors:

- Bank overtopping from PM1 may cause flooding in the vicinity of the canal. The flooding from the canals is relatively limited in extent, however, overtopping of secondary and other canals maintained by Miami-Dade County may cause flooding to propagate further inland. In addition, high stages in primary canals can cause backflow in culverts and other structures with outfall in the primary canals.
- Local drainage deficiencies may result in ponding which can be seen at locations with lower topography, for example the figure below shows that in vicinity of the eastern section of canal C-1W, there are areas are next to the canals with flooding that can be attributed

to overtopping. The western section of the C-1W canal shown on the image demonstrates that local flooding and separation from the canal (Figure 393).

Figure 393 Illustration of Flooding in the Vicinity of a Section of Canal C-1W

6.2.7 C-1: PM6 Flood Duration

Flood duration analysis was developed for the primary canals upstream the coastal structures and for the entire watershed domain, grouped in Agricultural, Urban and Total watershed Flood Duration maps. For all design events and SLR conditions, tables were generated to show the duration of flooding. This analysis is summarized in tables and maps for the entire project domain, and additionally for urban, agricultural and wetland areas.

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S21_H (Figure 394) to return to target reference stage, which was defined as 3 ft NAVD.

6.2.7.1 Flood Duration in Canal C-1

To determine the duration of flooding in the canals, the following approach was applied as illustrated in Figure 394 using the 100-yr design event:

- The reference elevation was selected as 3 ft NAVD to exceed the average tidal for the highest event.
- The last time when this elevation was exceeded for the last 24-hr without returning below the criteria was marked as the time of flood start
- The first time when the water elevation went below the reference level for the last 24-hr was assumed to be the end of the flood
- The time difference was calculated and assigned as flood duration for canal flooding
- An example is shown Figure 394 for structure S21 for the 100-yr design event and for SLR 3
- Data for all events and SLR conditions were summarized and provided in Table 188

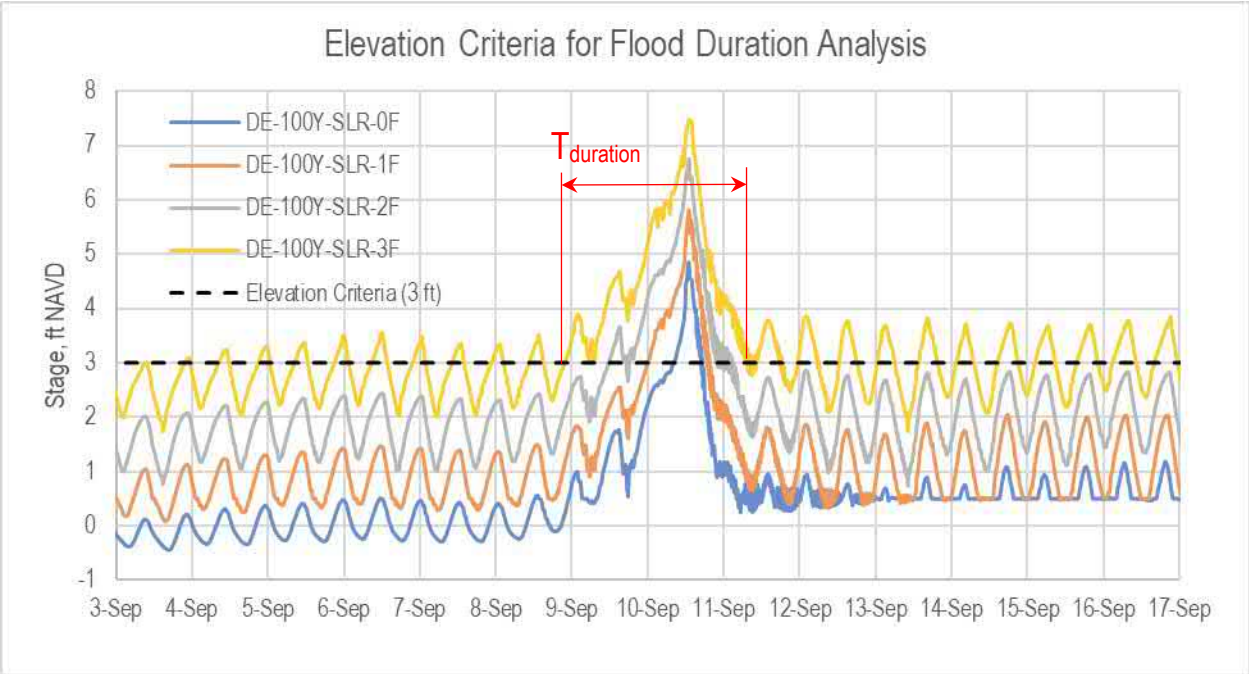


Figure 394 Calculation of Flood Duration Period in Canal C-1 for 100-yr Event and SLR +0, +1, +2 and +3 ft

Table 188 shows the duration of time taken for the water levels in the C-1 Watershed canals to return to baseflow. The flood duration for 5-yr, 10-yr, 25-yr and 100-yr and SLR = 0, +1.0, +2, and +3.0 ft are shown in Table 188.

Table 188 Hours of Canal Flood Duration at Headwater of Structure S21

Design Event	SLR 0	SLR 1	SLR 2	SLR 3
5-yr	0:10	6:15	18:35	38:10
10-yr	4:50	8:55	20:50	44:35
25-yr	6:15	15:35	23:55	55:15
100-yr	9:15	19:05	34:25	58:00

6.2.7.2 Flood Duration in Watershed C-1

Table 189 through Table 192 show the flood duration in entire watershed, the agricultural, urban and wetland areas of the C-1 Watershed, for the 5-Year, 10-Year, 25-Year, and 100-Year 72-hour design storm events, respectively for SLR = 0. SMD FPLOS model POS was long enough to ensure the recession part of the hydrograph was captured completely, so duration of flooding was estimated well.

The first row (0.1 >= 1 hr) and the following rows up to and including (240 >= 360 hr) of the summary tables represent areas for which the flood duration is within the specified interval.

- The last row (>=360 hr) are the areas flooded with flood duration greater than 360 hr.
- The severity of flooding in terms of duration is determined based on the flooded areas reported at each successive row.
- The severity of flooding is proportional to the increase of time interval.

The corresponding flood duration maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions**:**

- Figure B-17 through Figure B-32 provide flood duration maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-49 through Figure B-64 provide flood duration maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-80 through Figure B-96 provide flood duration maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Table 189 Summary of the PM6 Flood Duration Area in Acres for the C-1 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	30	203	195	220	287	74	279	289	294	299	242	526	509	487	497	704	853	899	853	820
1 >= 4	136	215	178	217	262	277	346	324	403	504	558	699	588	652	793	1132	1324	1226	1223	1159
4 >= 8	203	262	230	336	462	329	410	408	487	638	598	709	729	783	830	1008	1161	1164	1139	1129
8 >= 12	262	343	334	415	526	432	512	469	677	771	610	736	754	825	1001	1043	988	1065	1033	1055
12 >= 24	946	1245	1154	1248	1742	1421	1982	1915	2031	2548	2182	2691	2681	2815	3170	3464	3524	3524	3867	4006
24 >= 48	1307	1470	1396	1497	1940	2318	2592	2498	2659	3215	3064	3677	3625	3771	3966	4035	4500	4463	4636	4952
48 >= 96	1374	1144	1203	1228	1468	2140	1866	1890	2011	2466	3514	3299	3252	3551	4057	4856	4838	4858	5016	5281
96 >= 168	670	418	405	445	558	1077	687	724	778	865	1710	1129	1223	1270	1520	2434	2006	2088	2268	2642
168 >= 240	336	205	183	180	208	385	205	195	188	294	507	287	309	341	403	835	568	586	573	662
240 >= 360	213	289	284	215	195	289	297	269	232	220	339	319	292	250	272	477	304	289	309	383
>= 360	2204	2785	2879	3195	3408	2229	2842	2950	3252	3462	2271	2923	3017	3314	3509	2335	3032	3131	3390	3595
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 covers 38,861 acres																				

Table 190. Summary of the PM6 Flood Duration Area in Acres of the C-1 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	12	111	109	114	183	35	203	185	220	230	178	368	368	353	390	544	652	702	672	647
1 >= 4	59	91	62	96	143	131	188	171	235	341	425	484	430	469	578	877	969	887	882	811
4 >= 8	62	116	86	138	279	153	193	242	282	437	381	502	509	571	608	670	729	741	709	694
8 >= 12	62	111	104	180	272	183	208	183	348	497	351	413	474	544	704	724	675	751	739	788
12 >= 24	255	358	346	420	781	437	736	719	838	1238	1129	1307	1327	1562	2053	2241	2352	2370	2721	2918
24 >= 48	240	267	242	316	524	546	620	578	741	1077	993	1206	1191	1438	1742	1989	2147	2244	2612	3146
48 >= 96	168	151	161	185	215	279	242	259	269	385	544	487	484	586	830	1095	1033	1038	1189	1547
96 >= 168	72	91	69	77	94	121	121	99	116	119	188	143	156	168	168	269	227	264	282	304
168 >= 240	49	44	37	35	52	35	47	40	32	47	42	64	49	47	69	91	89	64	69	86
240 >= 360	30	44	49	27	30	44	52	47	37	47	49	57	52	44	52	54	59	52	52	62
>= 360	457	499	512	576	625	462	502	524	578	630	474	512	534	583	638	482	531	551	591	652
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 urban areas cover 20,846 acres																				

Table 191. Summary of the PM6 Flood Duration Area in Acres for the Agricultural Areas of the C-1 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	15	74	72	91	96	32	54	82	59	40	52	109	89	89	84	101	124	119	106	111
1 >= 4	62	96	99	91	82	124	114	119	131	119	89	133	101	109	138	168	183	190	188	185
4 >= 8	119	116	124	175	151	153	180	141	161	128	161	148	153	148	148	255	299	287	274	309
8 >= 12	173	195	198	210	220	220	269	252	287	220	213	250	217	203	195	230	200	193	173	161
12 >= 24	605	771	746	756	870	867	1090	1050	1080	1154	892	1166	1137	1050	865	922	865	848	823	731
24 >= 48	919	1035	1006	1097	1297	1601	1735	1767	1752	1942	1811	2135	2137	2051	1967	1641	1913	1846	1656	1418
48 >= 96	971	828	853	924	1161	1589	1416	1423	1636	1962	2716	2518	2560	2773	2953	3373	3363	3420	3450	3324
96 >= 168	227	205	183	210	306	556	378	390	445	605	1077	781	811	929	1226	1779	1564	1591	1816	2175
168 >= 240	12	35	32	42	67	12	54	47	54	114	44	111	114	133	185	294	277	284	316	447
240 >= 360	7	10	10	10	12	12	20	17	20	32	12	37	30	42	62	20	64	62	79	133
>= 360	35	44	47	47	57	35	44	47	49	57	37	47	49	49	59	37	49	52	54	67
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 agricultural areas cover 10,181 acres																				

Table 192. Summary of the PM6 Flood Duration Area in Acres for the Wetlands Areas of the C-1 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	2	17	15	15	7	7	22	22	15	30	12	49	52	44	22	59	77	79	74	62
1 >= 4	15	27	17	30	37	22	44	35	37	44	44	82	57	74	77	86	173	148	153	163
4 >= 8	22	30	20	22	32	22	37	25	44	72	57	59	67	64	74	84	133	136	156	126
8 >= 12	27	37	32	25	35	30	35	35	42	54	47	74	62	79	101	89	114	121	121	106
12 >= 24	86	116	62	72	91	116	156	146	114	156	161	217	217	203	252	301	306	306	324	356
24 >= 48	148	168	148	84	119	171	237	153	166	195	259	336	297	282	257	405	440	373	368	388
48 >= 96	235	166	190	119	91	272	208	208	106	119	255	294	208	193	274	388	442	400	378	410
96 >= 168	371	121	153	158	158	400	188	235	217	141	445	205	257	173	126	385	215	232	171	163
168 >= 240	274	126	114	104	89	339	104	109	101	133	420	111	146	161	148	450	203	237	188	128
240 >= 360	175	235	225	178	153	232	225	205	175	141	277	225	210	163	158	403	180	175	178	188
>= 360	1712	2241	2320	2572	2726	1732	2296	2380	2624	2775	1759	2365	2434	2681	2812	1816	2451	2528	2745	2876
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-1 wetlands cover 6,835 acres																				

Table 193 and Table 194 show the fraction of flooded urban and agricultural areas for the flood duration ranges listed in the tables.

Table 193 Fraction of Flooded Urban Areas and Duration of C-1 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	15%	15%	17%	21%
> 1	14%	14%	16%	20%
> 4	12%	13%	15%	18%
> 8	11%	11%	13%	17%
> 12	10%	10%	12%	15%
> 24	7%	7%	8%	9%
> 48	3%	3%	4%	5%
> 96	2%	2%	2%	2%
> 168	2%	2%	2%	2%
> 240	2%	2%	2%	2%
> 360	1%	1%	2%	2%

Table 194 Fraction of Flooded Agricultural Areas and Duration of C-1 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	20%	20%	20%	21%
> 1	19%	19%	20%	21%
> 4	19%	19%	19%	20%
> 8	19%	19%	19%	20%
> 12	18%	18%	19%	19%
> 24	15%	15%	16%	17%
> 48	9%	9%	10%	12%
> 96	3%	3%	3%	4%
> 168	1%	1%	1%	1%
> 240	0%	0%	0%	0%
> 360	0%	0%	0%	0%

The results indicate gradual increase of flood duration for urban and agricultural areas for SLR 0, 1, 2 and 3 and it is assumed that the drainage system will have similar performance for future SLR conditions with no significant loss of drainage capacity over the entire watershed.

6.2.8 LOS Rating of C-1 Watershed

The flood protection LOS of the C-1 Watershed was evaluated for current and future hydrologic conditions, land use, topography, and canal infrastructure. Six performance measures were applied to four sea level rise scenarios, four design events to determine the performance of the

drainage infrastructure and potential needs for improvement. The overall conclusions of the analysis are summarized below:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of Watershed C-1, the main limitation of conveyance capacity of the Primary Canals is the overtopping of canal bank elevations and low hydraulic gradient. Canal banks are consistently below the 25-yr peak water elevation for current conditions, and in multiple locations are below 10-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S148 and S148) showed limited capacity to maximum peak and cumulative flows for increasing SLR. The peak flow for both structures decreased for increasing SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater. Structure S148 shows limitation with respect to overtopping of canal bank elevations during design events. Mitigation will require increasing flow capacity of canals C-1W and structure S148, which will potentially trigger requirements for higher flow capacity in downstream coastal structure S21. The peak discharges of structures S148 and S149 increase for design events from 5-yr to 10-yr, followed by smaller increase after the 25-year event to the 100-year event, which also confirms that the peak discharges a limited for design events with greater than 25-yr return frequency. The peak discharges decrease with respect to increasing SLR which is caused by reducing the head gradient within canals discharging to Biscayne Bay.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S21 does not have limitations based on the peak and cumulative flows which showed consistent increase of discharges for increasing the return period of the design events and for increased SLR. The SPF discharge of 4,300 cfs is defined for 0.8 ft head differential at tailwater elevation of 0.45 ft NAVD however structure S21 is under different hydraulic conditions in comparison to original design. Additionally, the outflows considerably increase for tailwater elevations greater than the design levels. This indicates that Structure S21 will not reduce its performance for increasing SLR, however, the structure capacity for instantaneous peak discharge may become deficient if improvements of the design capacity of C-1W canal and structure S148 are required.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event.

Localized Flood Risks: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 15%, 32%, 63% and 93% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event are 51%.

The C-1 Watershed is assigned a 10-Year FPLOS rating for the current hydrologic conditions and for SLR 1. For overall rating, weight was placed on PM1, PM5 and PM6, as the primary canals in this watershed collectively are expected to contain the 5-yr and 10-yr storm events. The overall

rating of watershed C-1 is: PM 1: 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5-yr for SLR = +2.0 and +3.0 ft.

6.3 C-100 Watershed Flood Protection Level of Service

There are seven primary water control structures in the C-100 watershed: S123, S118, S119, S120, S121, S122, and S700. Figure 395 shows the drainage network in this watershed and associated structures and canals. The structures are operated as discussed in 6.1.5.6.

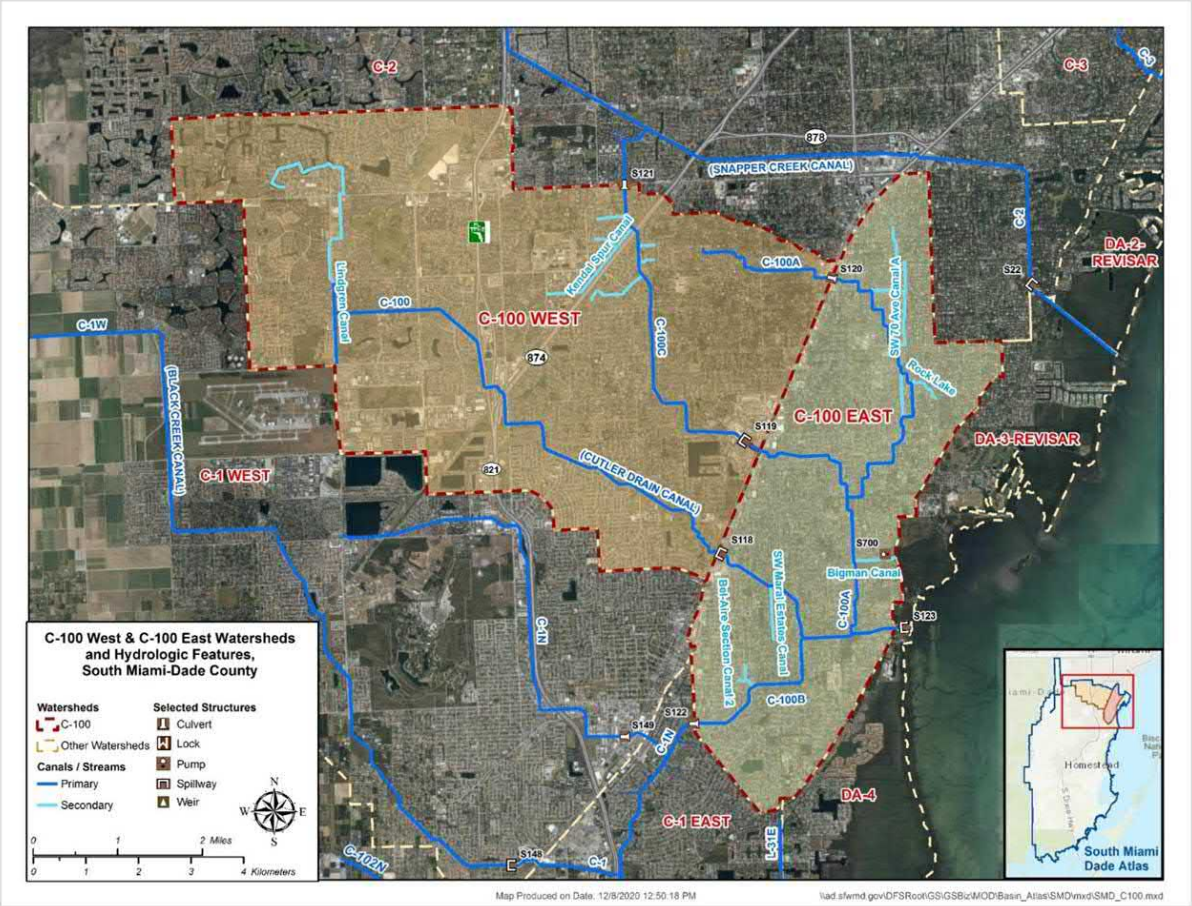


Figure 395. Drainage Network in C-100 Watershed (Source: SFWMD South Miami Dade C-100: PM1 Maximum Stage in Primary Canals

6.3.1 Watershed C-100: Structure S123 Gate Operation

The gates of structure S123 are closed when the head differential HW – TW is less than 0.1 ft. The gate operation and the corresponding tailwater, stages and operations are shown for SLR +1, +2 +3 for the 25-yr event (Figure 396 and Figure 397. The gate operation patterns are similar for all design events.

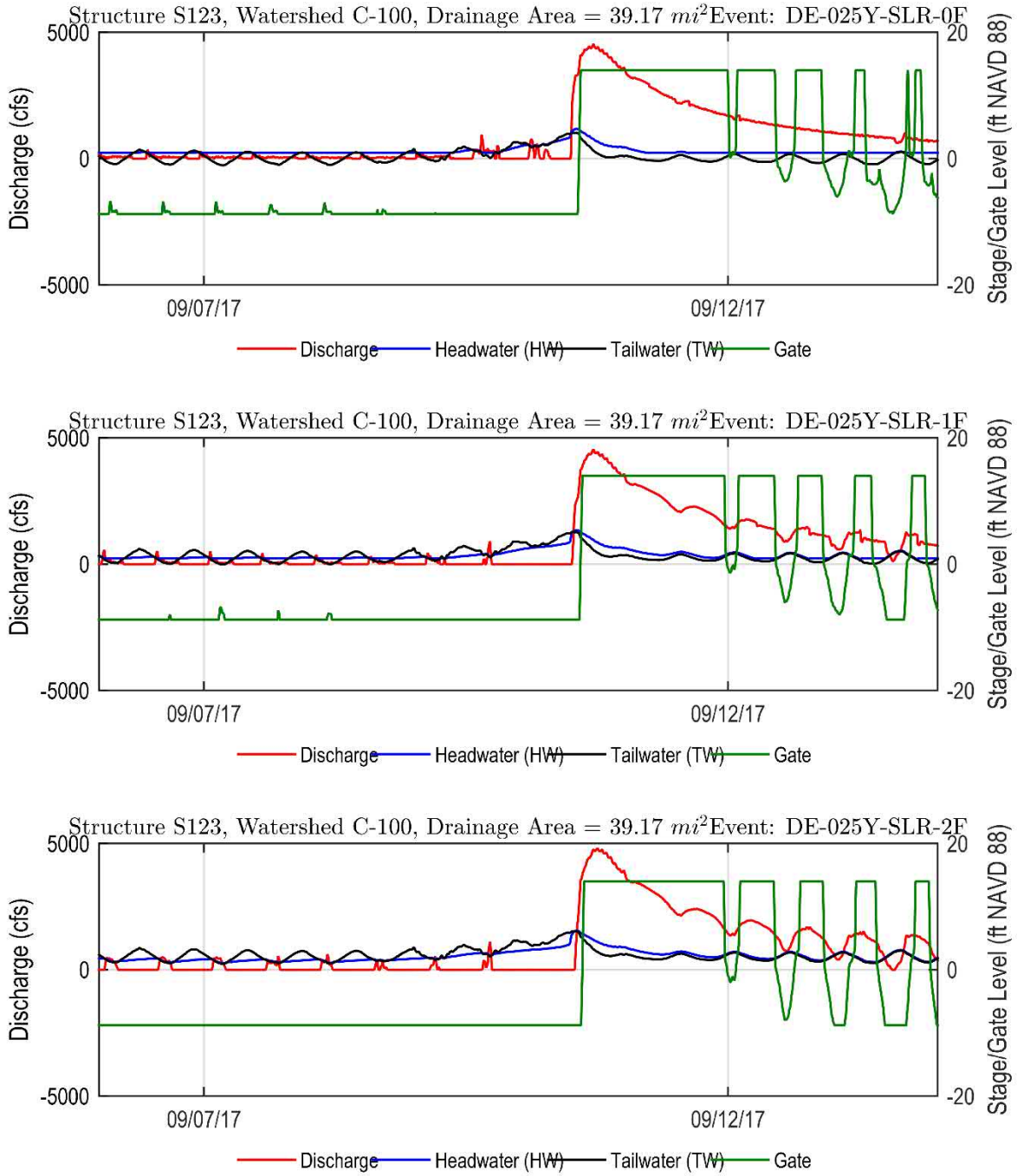


Figure 396. Gate Operation of Structure S123 for 25-yr Event and SLR 0, 1 and 2

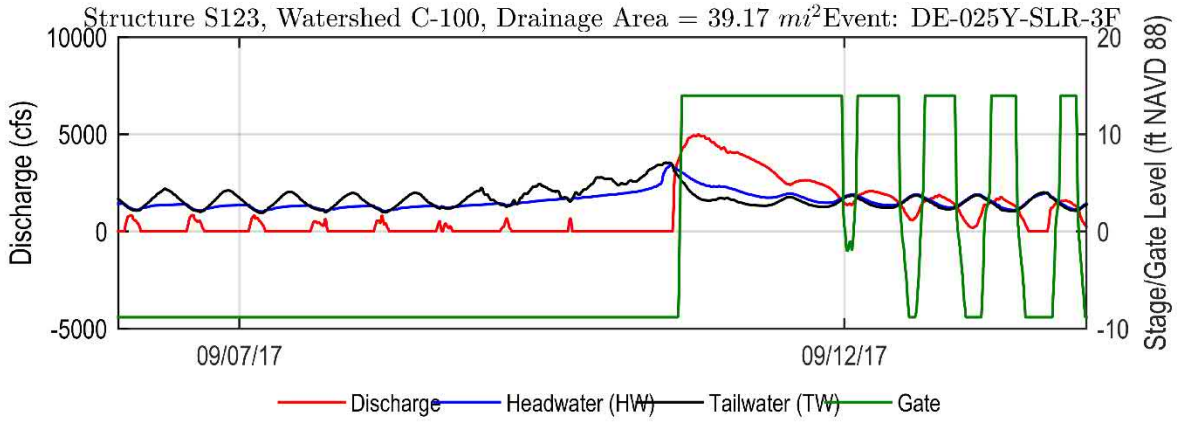


Figure 397. Gate Operation of Structure S123 for 25-yr Event and SLR 3

6.3.2 C-100: PM1 Maximum Stage in Primary Canal

To evaluate this PM under future conditions within the C-100 Watershed, instantaneous peak stage profiles were prepared for the primary canals. Bank elevations on the profile figures are based on the MIKE 1D cross-section data. The canal bank elevations were verified with elevations from the latest LIDAR data (from 2018). Also shown in the figures are major roadway landmarks, control structures, and primary canal junctions

A list of landmarks within Watershed C-100 and peak stages for future conditions at SLR = +0.0 ft is provided in Table 195. Highlighted are water elevations which exceed one of the canal banks at specified chainage.

Table 195 List of Landmarks and Design Water Elevations for Watershed C-100 canals (all elevations in ft NAVD 88)

Landmark	Canal	Mileage	Left Bank	Right Bank	5-yr SLR 0	5-yr SLR 1	5-yr SLR 2	5-yr SLR 3	10-yr SLR 0	10-yr SLR 1	10-yr SLR 2	10-yr SLR 3	25-yr SLR 0	25-yr SLR 1	25-yr SLR 2	25-yr SLR 3	100-yr SLR 0	100-yr SLR 1	100-yr SLR 2	100-yr SLR 3
SR-821 Crossing	C-100	2.400	13.999	11.299	3.977	4.976	6.279	7.154	4.193	5.909	6.784	7.389	6.537	6.870	7.415	7.662	7.633	7.749	7.946	8.218
SR-874 Crossing	C-100	3.000	10.000	10.000	3.964	4.971	6.273	7.154	4.180	5.908	6.782	7.388	6.545	6.888	7.368	7.649	7.589	7.746	7.948	8.229
SR-992 Crossing	C-100	6.000	7.402	7.100	5.830	7.426	9.458	10.739	6.189	8.796	10.173	11.052	9.595	10.257	10.886	11.455	11.138	11.557	11.886	12.378
Structure S118	C-100	6.400	7.001	6.401	3.855	4.928	6.323	7.239	4.111	5.846	6.785	7.483	6.211	6.752	7.284	7.783	7.178	7.561	7.973	8.477
US-1 Crossing	C-100	6.500	5.499	4.600	3.853	4.927	6.322	7.240	4.111	5.846	6.785	7.485	6.209	6.753	7.285	8.121	7.176	7.560	8.268	8.808
C-100B Crossing	C-100	7.500	5.449	6.499	5.727	7.357	9.453	10.872	6.133	8.748	10.144	11.247	9.215	10.095	10.926	11.994	10.621	11.220	12.005	13.023
C-100A Crossing	C-100	8.500	8.961	10.079	3.787	4.878	6.301	7.372	4.049	5.822	6.769	7.646	6.086	6.705	7.346	8.374	7.018	7.441	7.952	9.059
To Tide Outfall	C-100	9.100	11.434	12.399	3.766	4.852	6.284	7.389	4.032	5.812	6.760	7.680	6.051	6.691	7.353	8.245	6.991	7.430	7.942	8.806
SR-973 Crossing	C-100A	1.100	10.499	7.799	3.505	3.508	4.291	6.668	3.506	3.837	5.665	7.360	4.301	5.954	7.157	8.167	7.770	8.153	8.503	8.950
Structure S120	C-100A	1.800	7.640	7.241	3.711	4.118	5.141	6.941	3.788	4.710	6.166	7.389	5.125	6.327	7.262	8.079	7.614	7.997	8.362	8.831
US-1 Crossing	C-100A	2.000	9.350	9.951	4.025	5.043	6.421	7.352	4.219	6.029	6.924	7.436	6.372	6.896	7.448	7.987	7.437	7.811	8.193	8.695
C-100C Crossing	C-100A	4.900	11.099	11.701	3.944	5.014	6.370	7.366	4.140	5.963	6.881	7.595	6.308	6.845	7.422	8.006	7.337	7.615	7.981	8.558
C-100 Crossing	C-100A	7.600	19.902	20.000	3.787	4.878	6.303	7.383	4.049	5.822	6.771	7.660	6.086	6.704	7.352	8.305	7.018	7.441	7.952	8.932
Structure S122	C-100B	0.600	6.900	6.900	3.854	4.938	6.120	6.721	4.095	5.878	6.463	7.005	6.146	6.526	6.914	7.423	6.876	7.152	7.512	8.054
C-100 Crossing	C-100B	2.600	9.624	11.568	3.806	4.890	6.288	7.258	4.071	5.830	6.749	7.506	6.120	6.714	7.277	7.972	7.050	7.453	7.955	8.666
Structure S121	C-100C	0.800	5.497	5.697	4.468	6.007	7.137	8.285	4.823	6.290	7.245	8.344	5.834	6.673	7.395	8.446	6.574	7.072	7.646	8.579
SR-94 Crossing	C-100C	1.000	7.273	7.573	4.264	5.145	6.405	7.397	4.410	6.172	6.931	7.684	6.725	7.108	7.590	8.140	8.083	8.235	8.416	8.565
SR-874 Crossing	C-100C	1.600	9.049	9.449	4.259	5.142	6.403	7.398	4.405	6.165	6.931	7.684	6.713	7.101	7.583	8.138	8.075	8.227	8.415	8.562
SR-990 Crossing	C-100C	2.600	9.100	9.400	4.160	4.160	4.160	4.160	4.600	4.600	4.600	4.600	6.720	6.720	6.720	6.720	8.120	8.120	8.120	8.120
Structure S-119	C-100C	5.000	7.200	6.100	4.000	4.000	4.000	4.000	4.170	4.170	4.170	4.170	6.400	6.400	6.400	6.400	7.500	7.500	7.500	7.500
US-1 Crossing	C-100C	5.100	6.400	6.400	4.000	4.000	4.000	4.000	4.170	4.170	4.170	4.170	6.400	6.400	6.400	6.400	7.500	7.500	7.500	7.500
C-100A Crossing	C-100C	6.500	7.305	7.554	3.906	4.987	6.353	7.385	4.110	5.919	6.861	7.662	6.265	6.812	7.426	8.112	7.280	7.589	7.741	9.037

- Figure 398 through Figure 401 show the corresponding canal profiles for 5-yr design storm.
- Figure 402 through Figure 405 show the corresponding canal profiles for 10-yr design storm
- Figure 406 through Figure 409 show the corresponding canal profiles for 25-yr design storm.
- Figure 410 through Figure 413 show the corresponding canal profiles for 100-yr design storm

The canal profiles within Watershed C-100 include canals C-100, C-100A, C-100B and C-100C. Datasets were developed for each SLR condition and include the four design events per plot.

The plots show that in overall the LOS is becoming reduced with the increase of the SLR conditions even though the salinity control structures are closed.

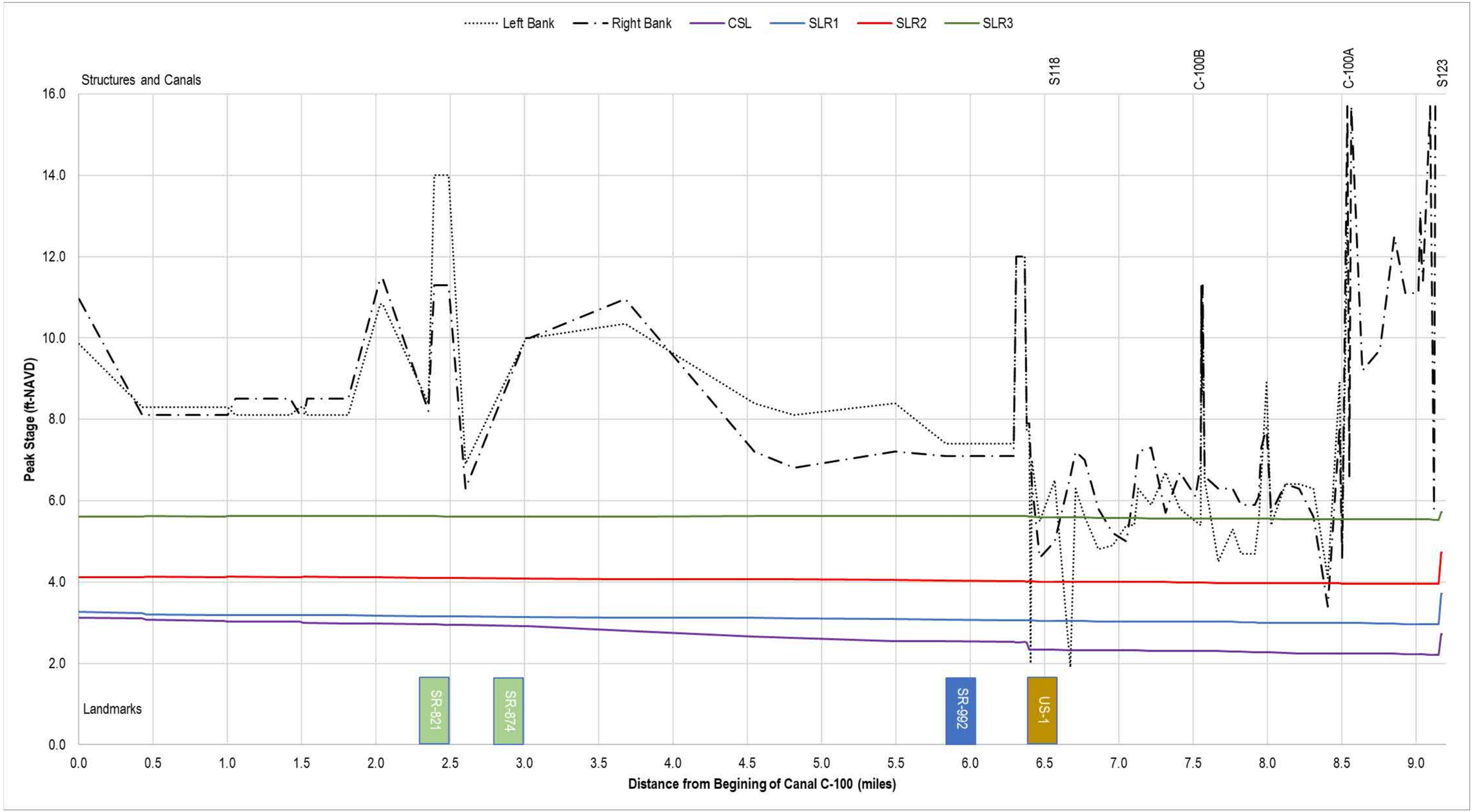


Figure 398 Profile of Peak Stages in Canal C-100 for Future Land Use and Topography for 5-yr Design Storm

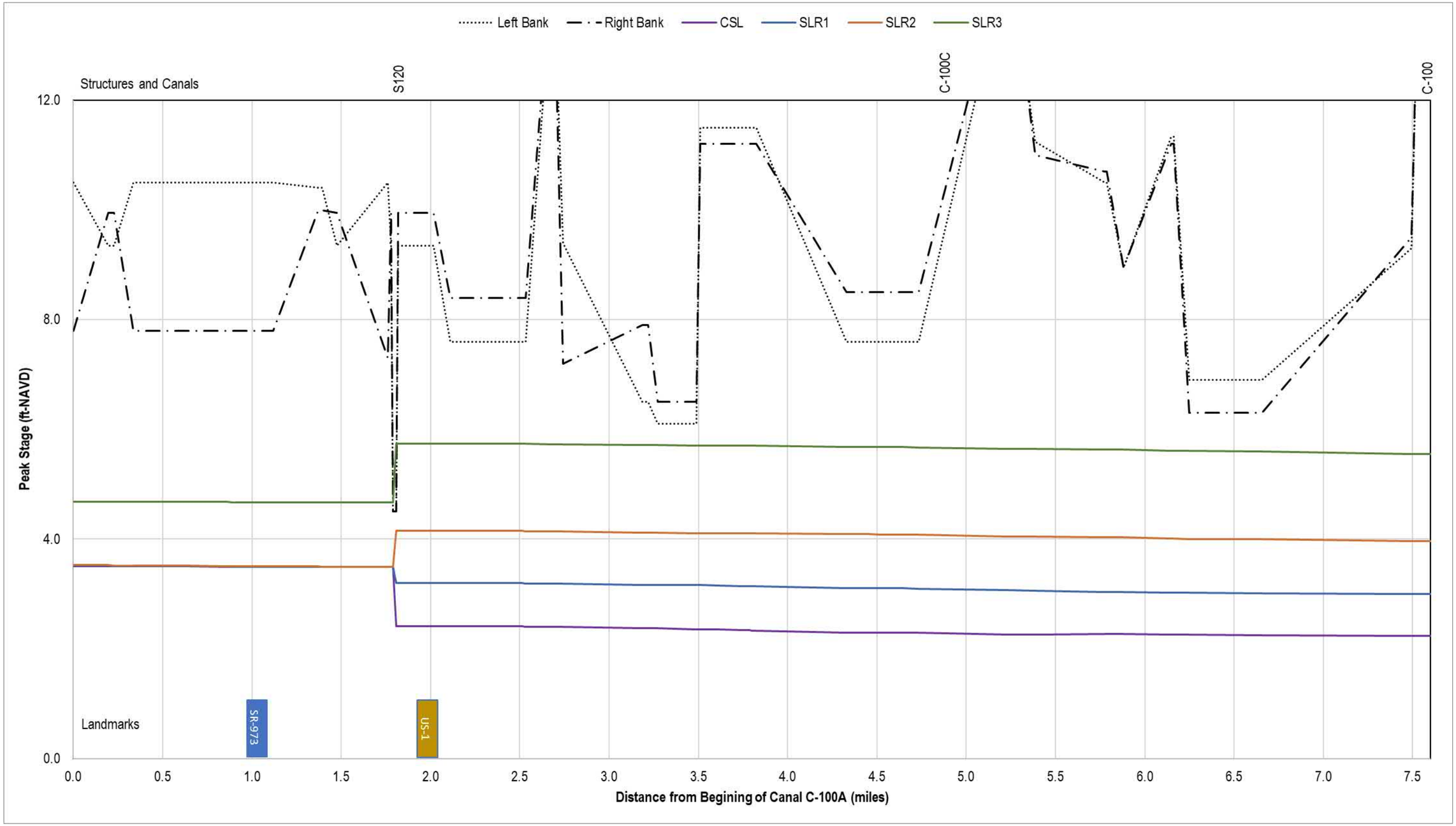


Figure 399 Profile of Peak Stages in Canal C-100A for Future Land Use and Topography for 5-yr Design Storm

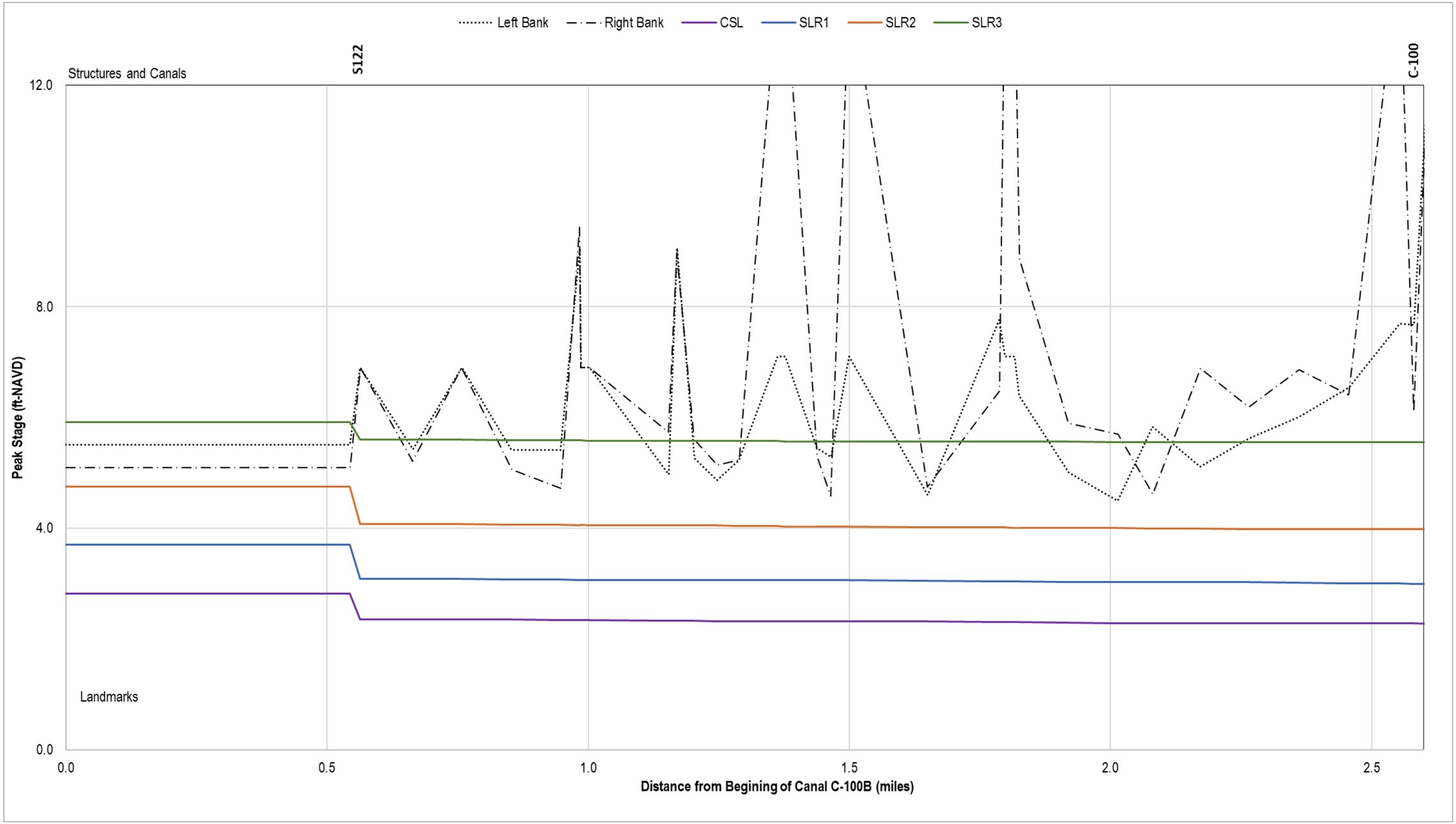


Figure 400 Profile of Peak Stages in Canal C-100B for Future Land Use and Topography for 5-yr Design Storm

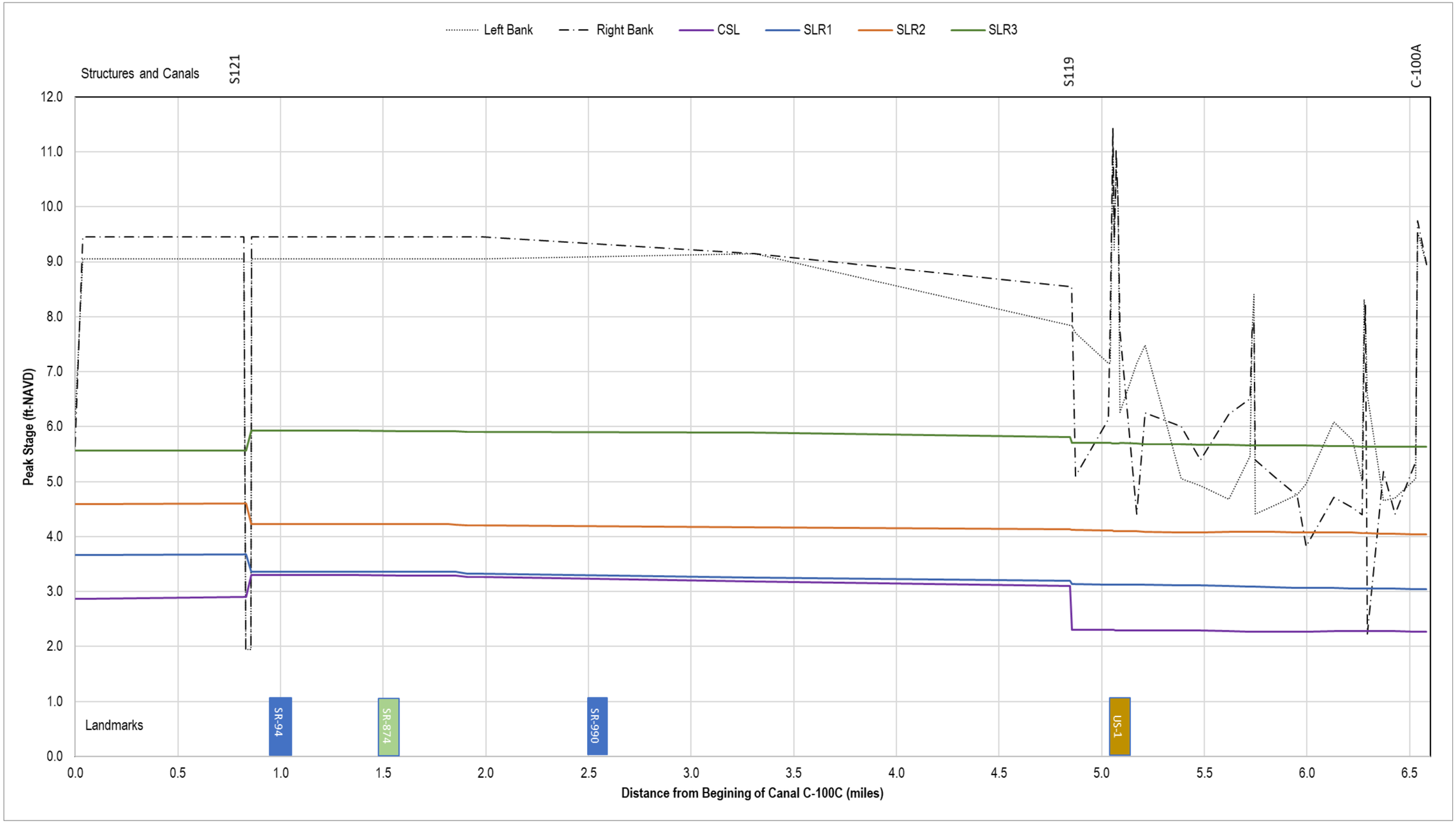


Figure 401 Profile of Peak Stages in Canal C-100C for Future Land Use and Topography for 5-yr Design Storm

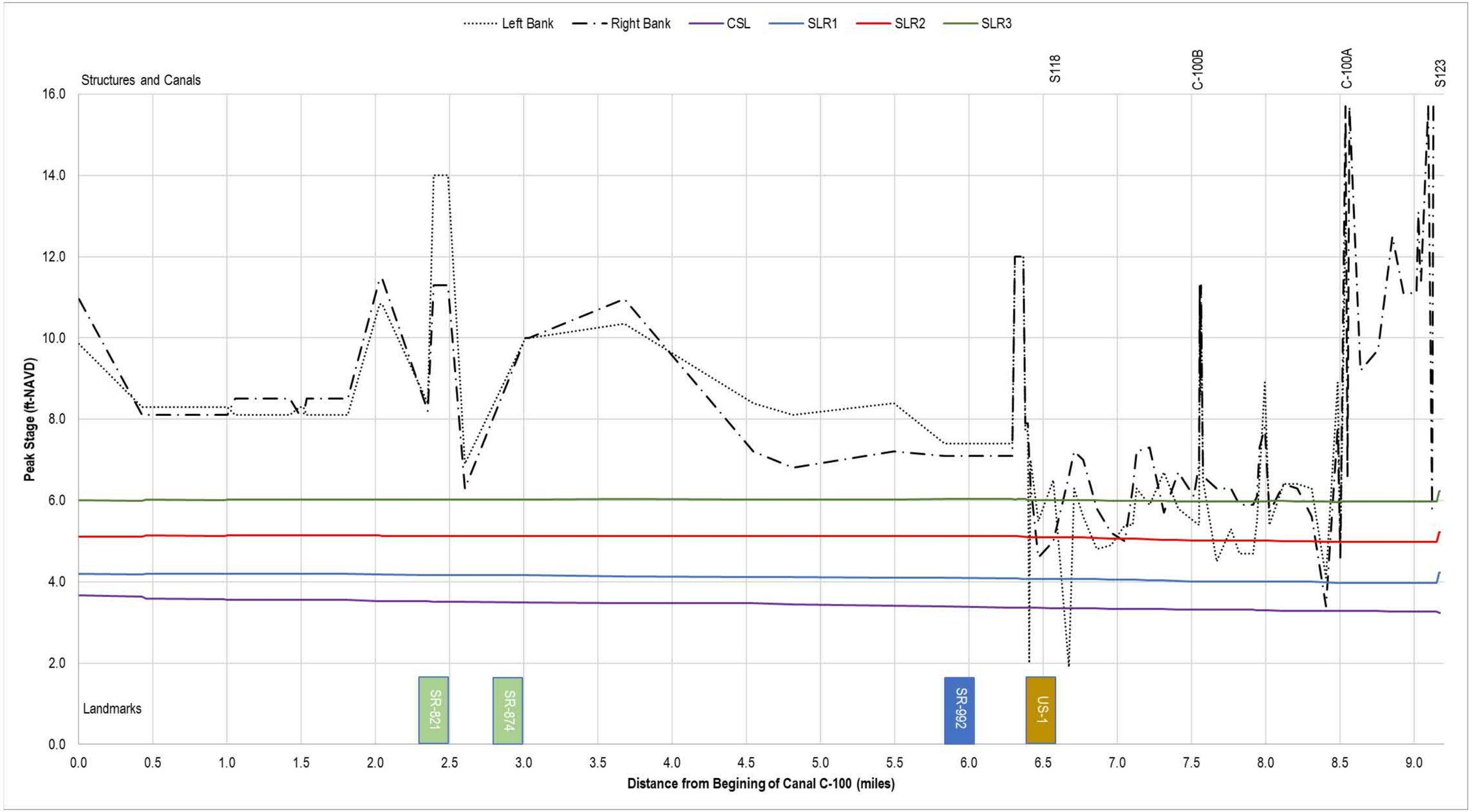


Figure 402 Profile of Peak Stages in Canal C-100 for Future Land Use and Topography for 10-yr Design Storm

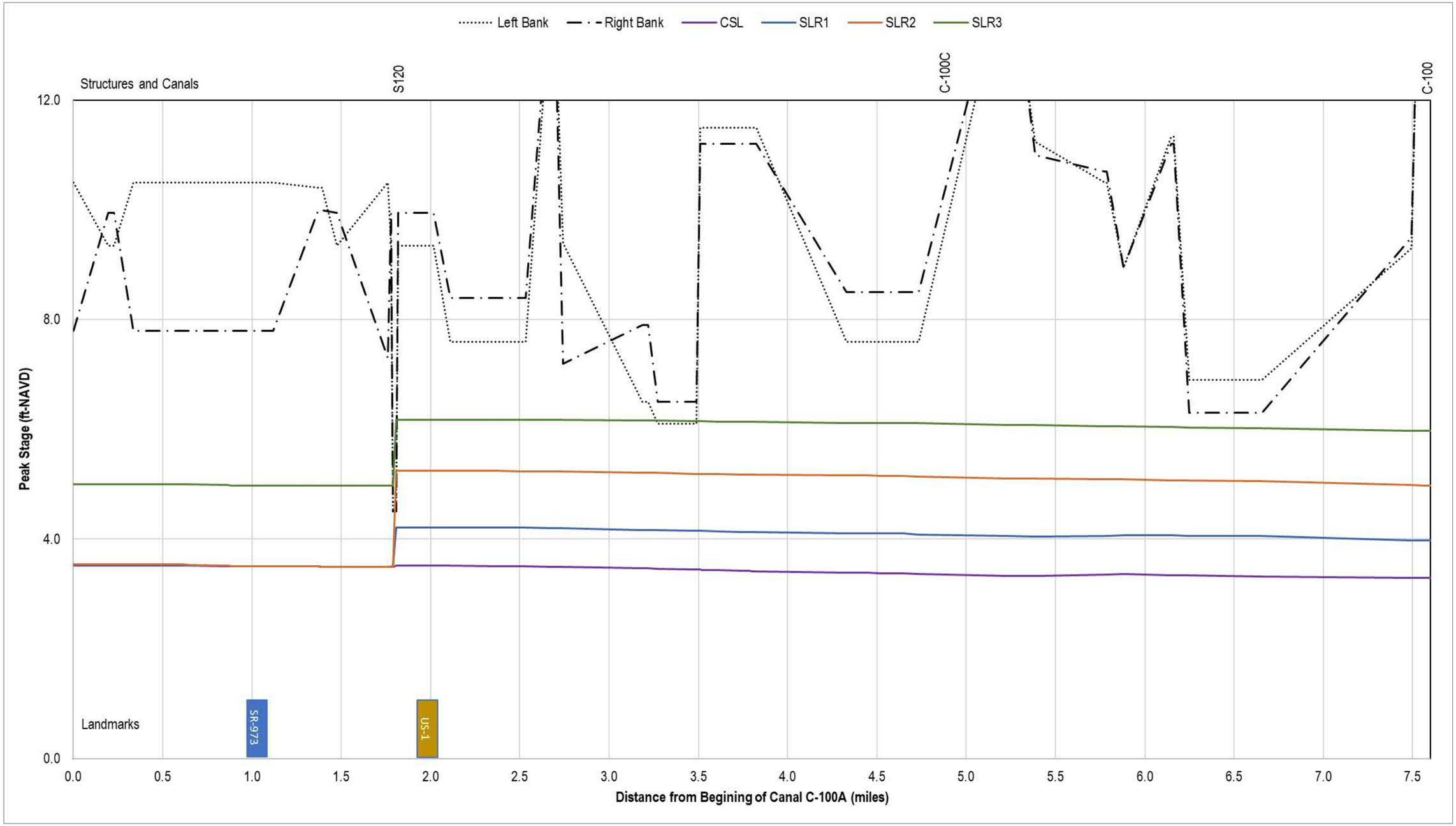


Figure 403 Profile of Peak Stages in Canal C-100A for Future Land Use and Topography for 25-yr Design Storm

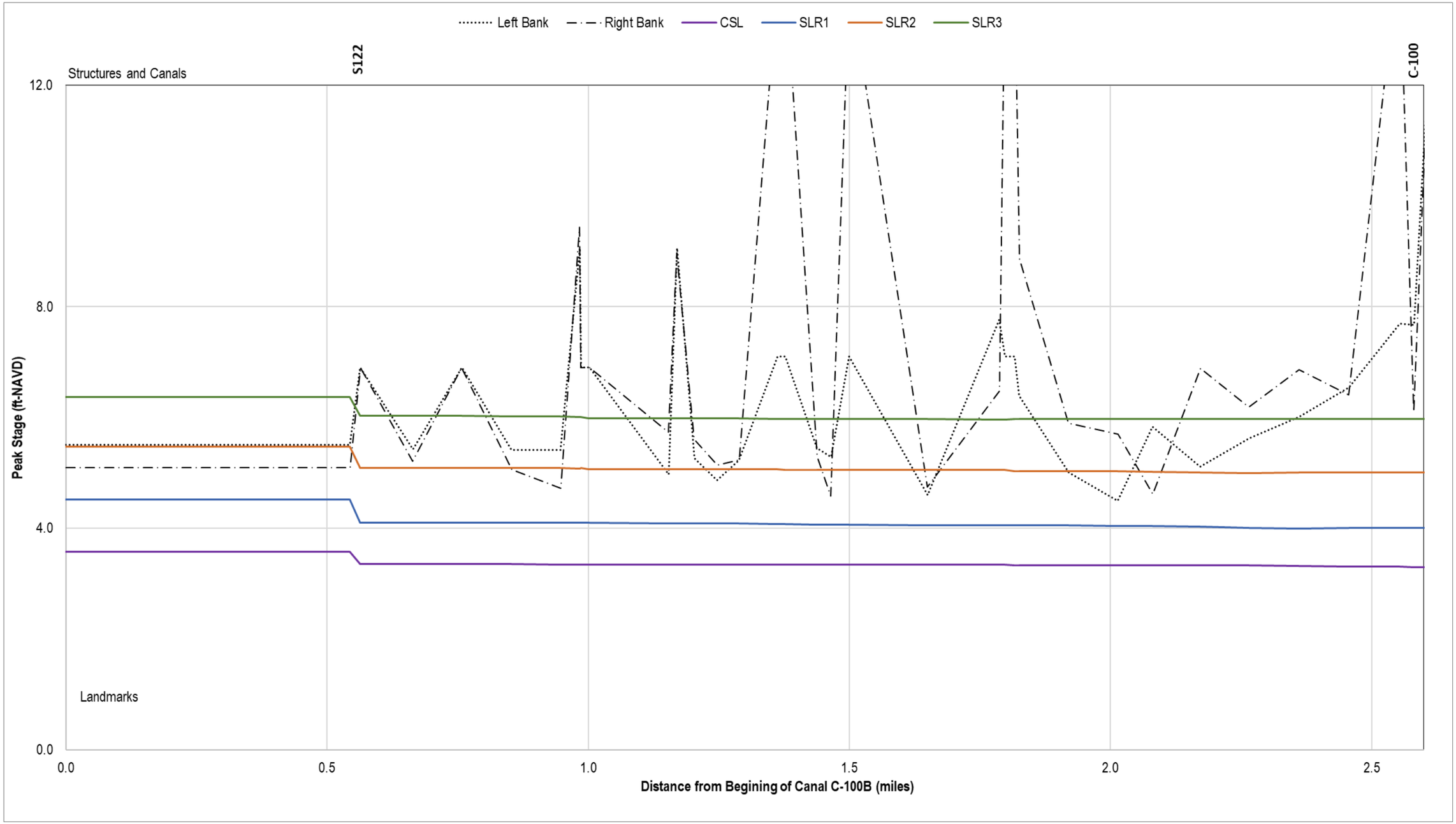


Figure 404 Profile of Peak Stages in Canal C-100B for Future Land Use and Topography for 25-yr Design Storm

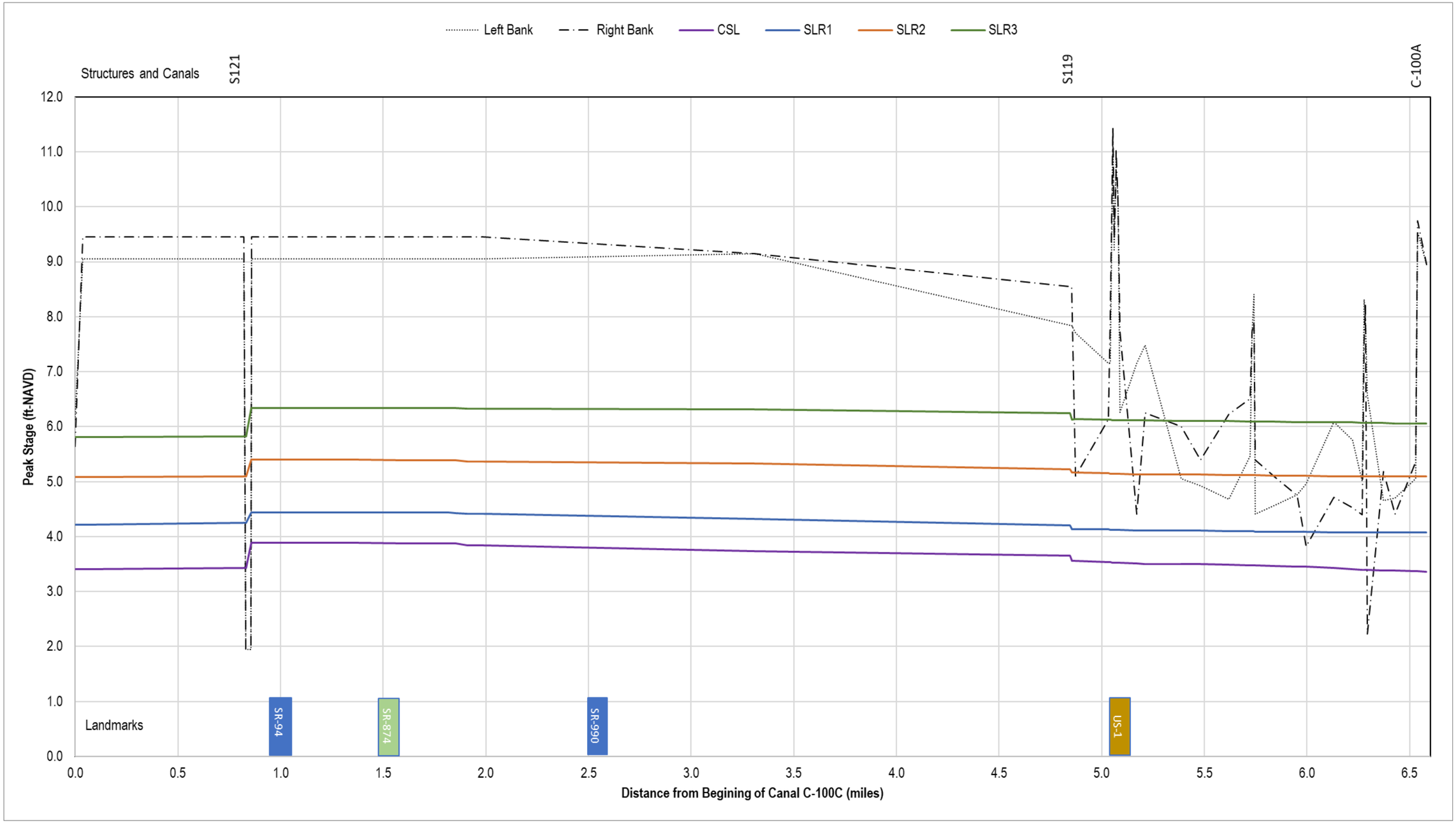


Figure 405 Profile of Peak Stages in Canal C-100C for Future Land Use and Topography for 10-yr Design Storm

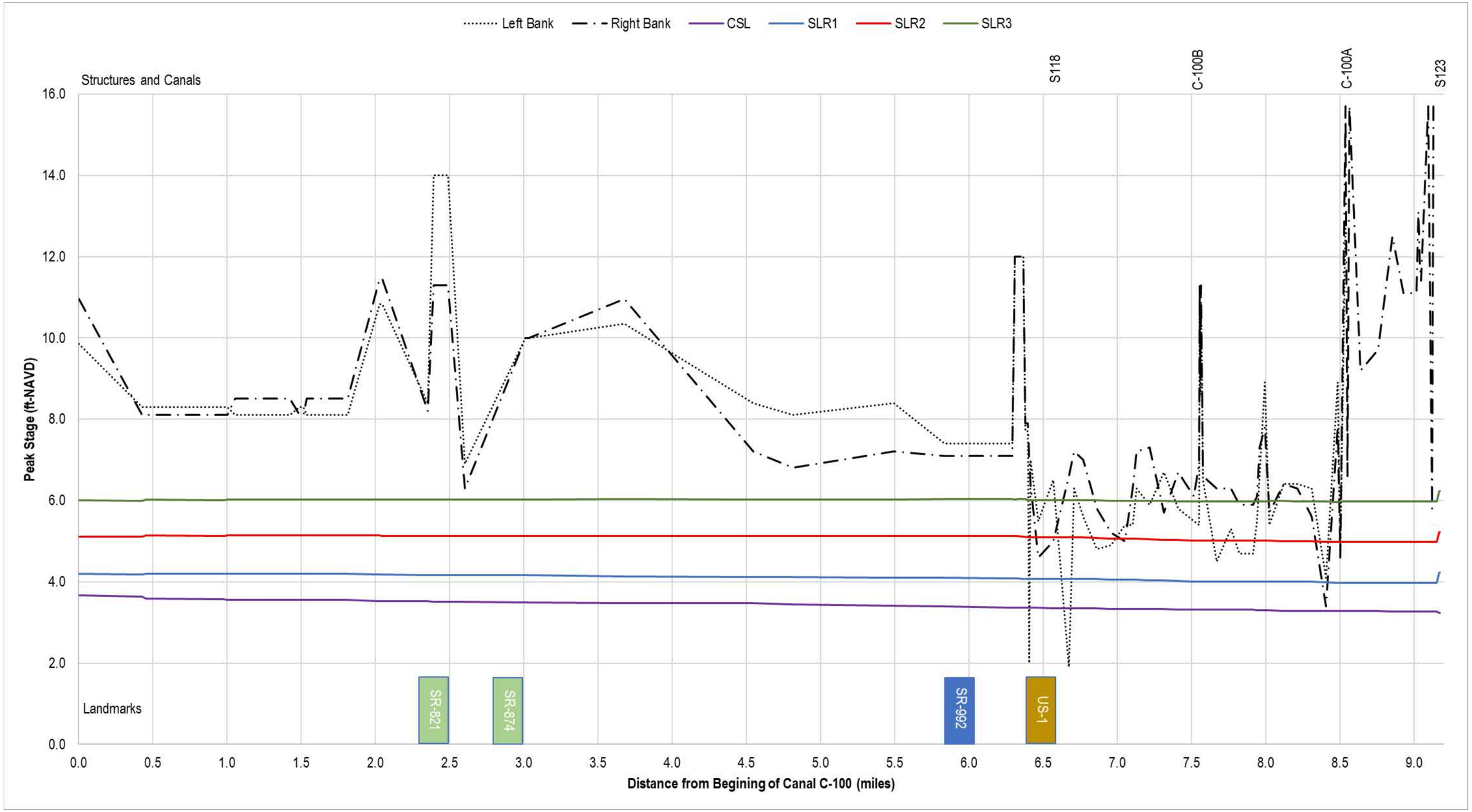


Figure 406 Profile of Peak Stages in Canal C-100 for Future Land Use and Topography for 25-yr Design Storm

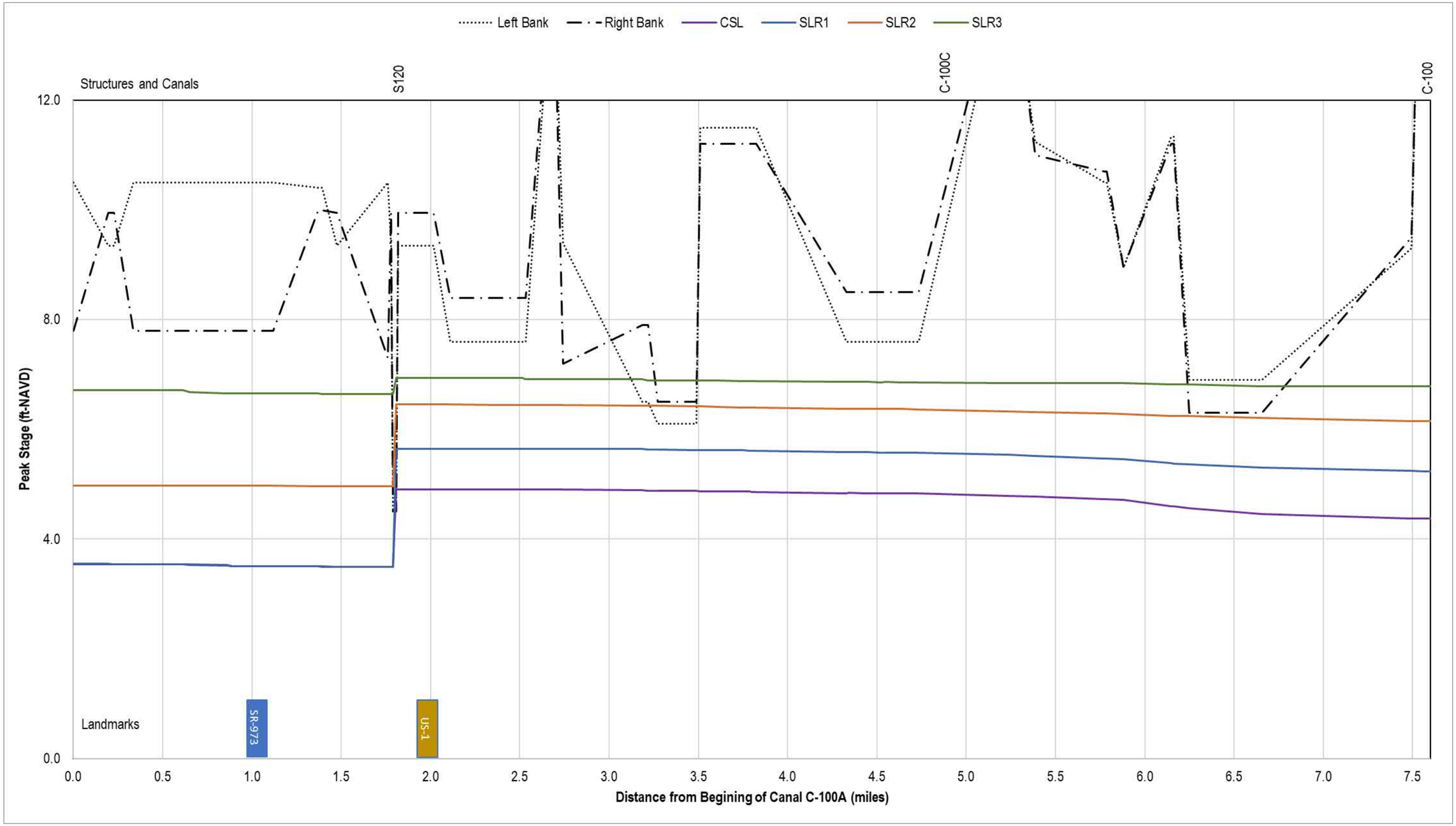


Figure 407 Profile of Peak Stages in Canal C-100A for Future Land Use and Topography for 25-yr Design Storm

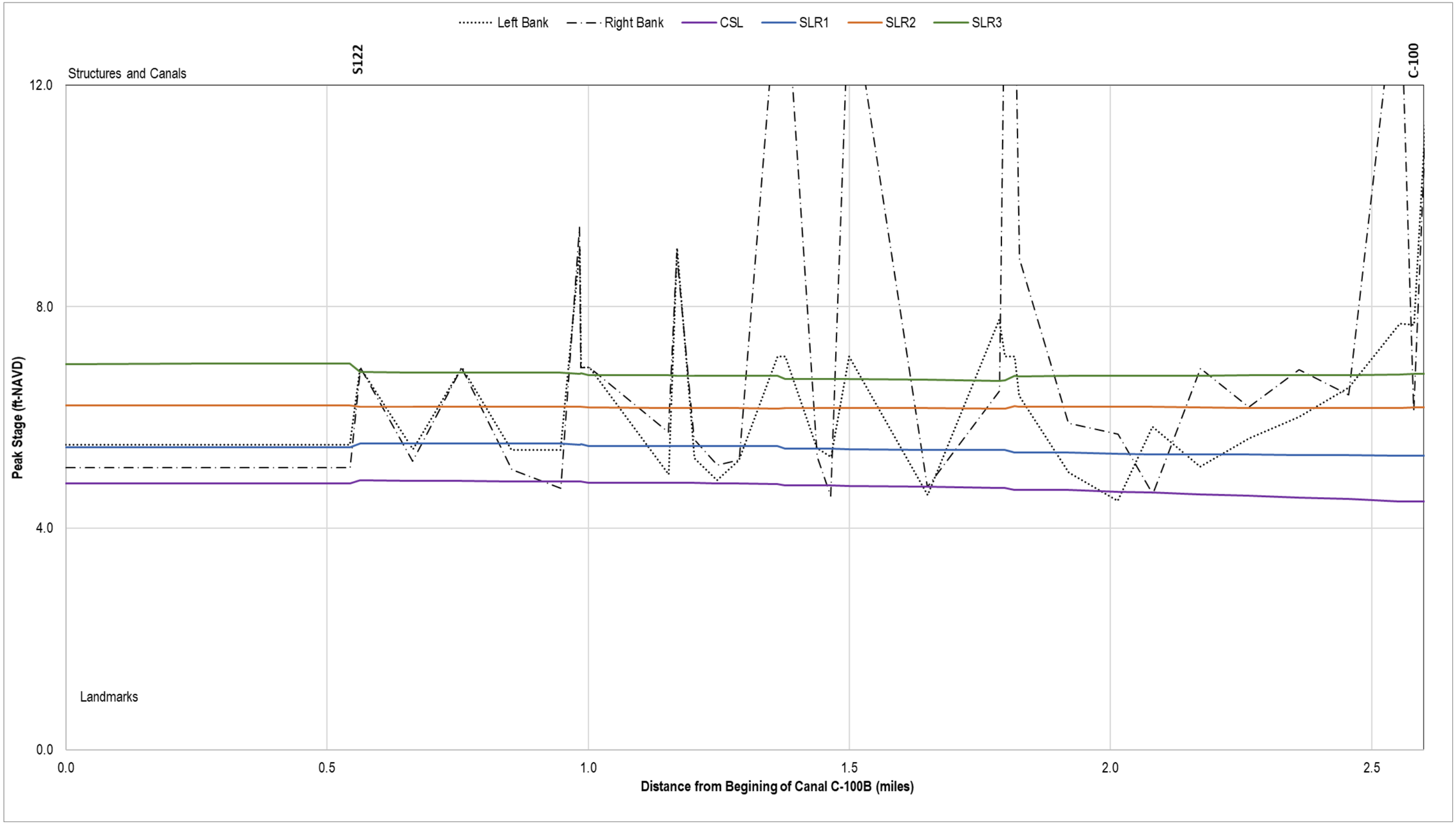


Figure 408 Profile of Peak Stages in Canal C-100B for Future Land Use and Topography for 25-yr Design Storm

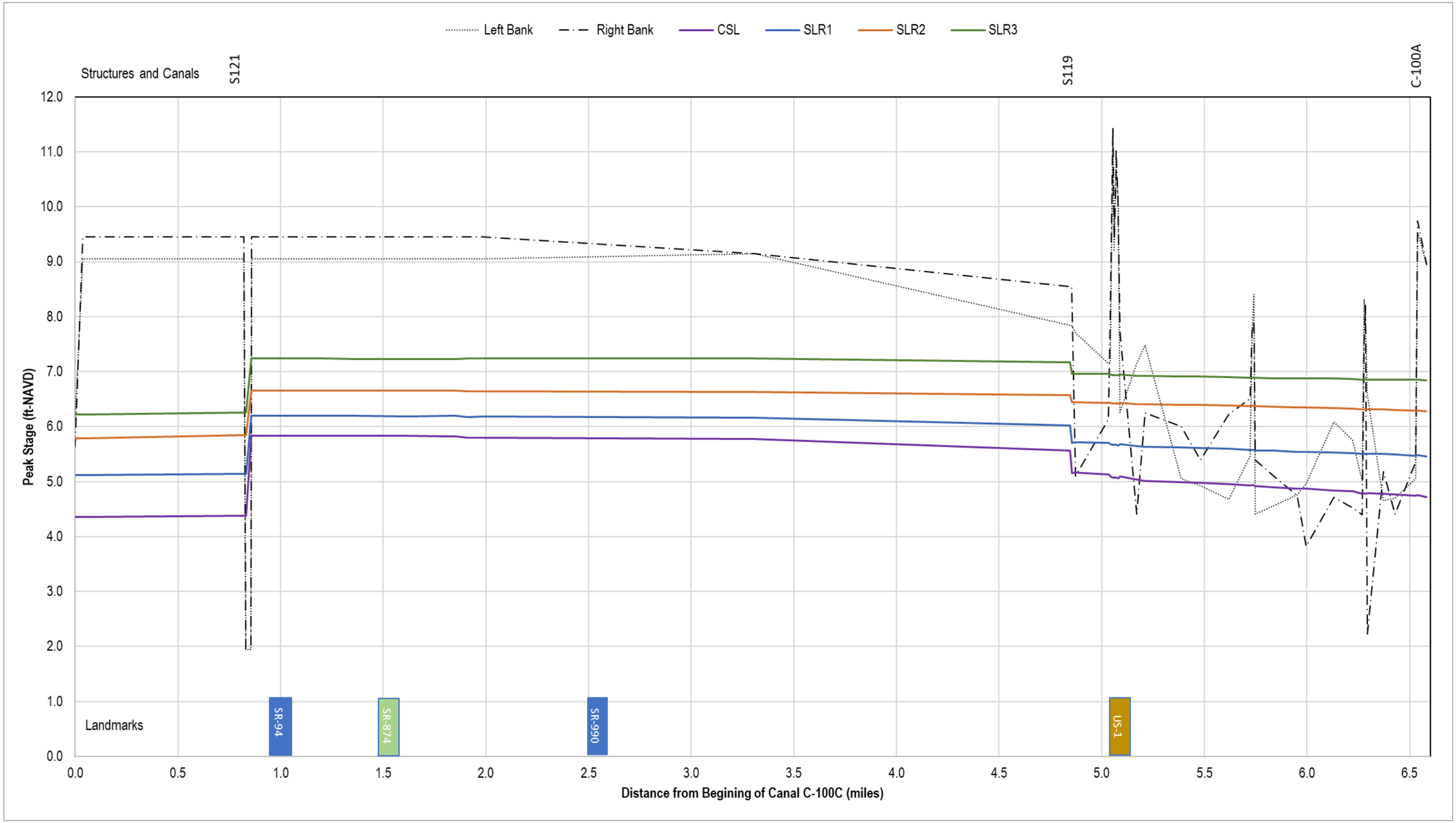


Figure 409 Profile of Peak Stages in Canal C-100C for Future Land Use and Topography for 25-yr Design Storm

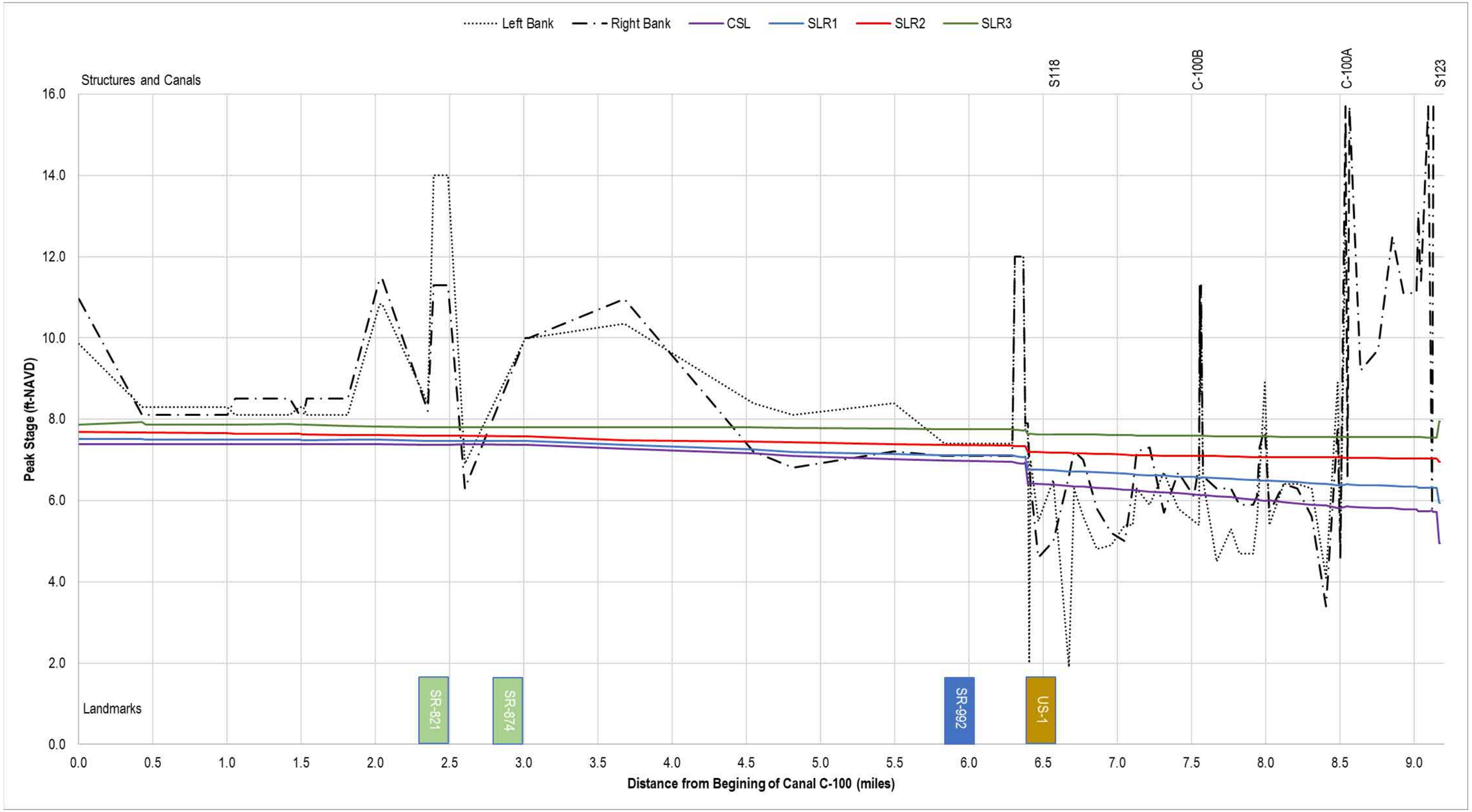


Figure 410 Profile of Peak Stages in Canal C-100 for Future Land Use and Topography for 100-Yr Design Storm

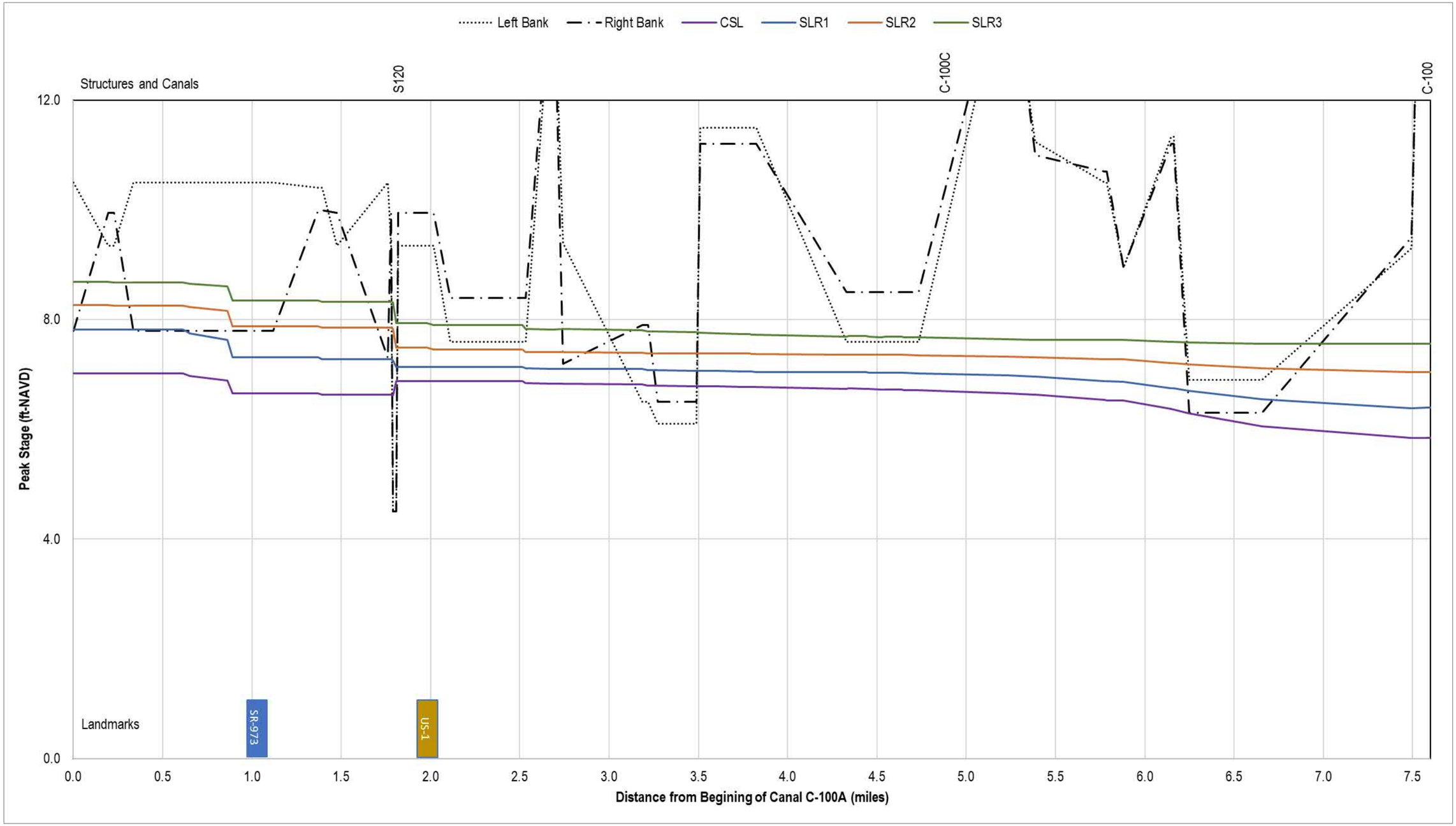


Figure 411 Profile of Peak Stages in Canal C-100A for Future Land Use and Topography for 100-Yr Design Storm

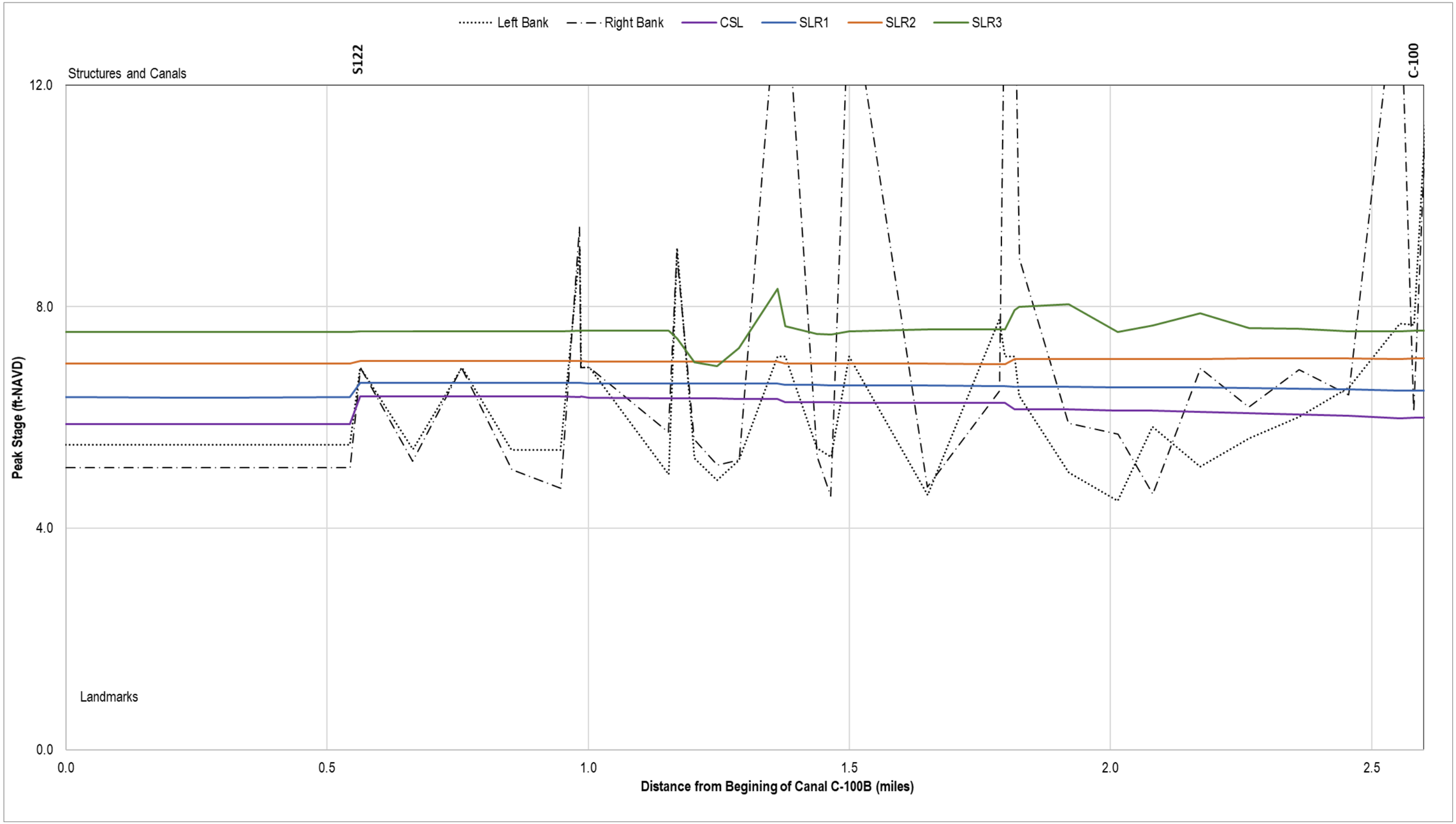


Figure 412 Profile of Peak Stages in Canal C-100B for Future Land Use and Topography for 100-Yr Design Storm

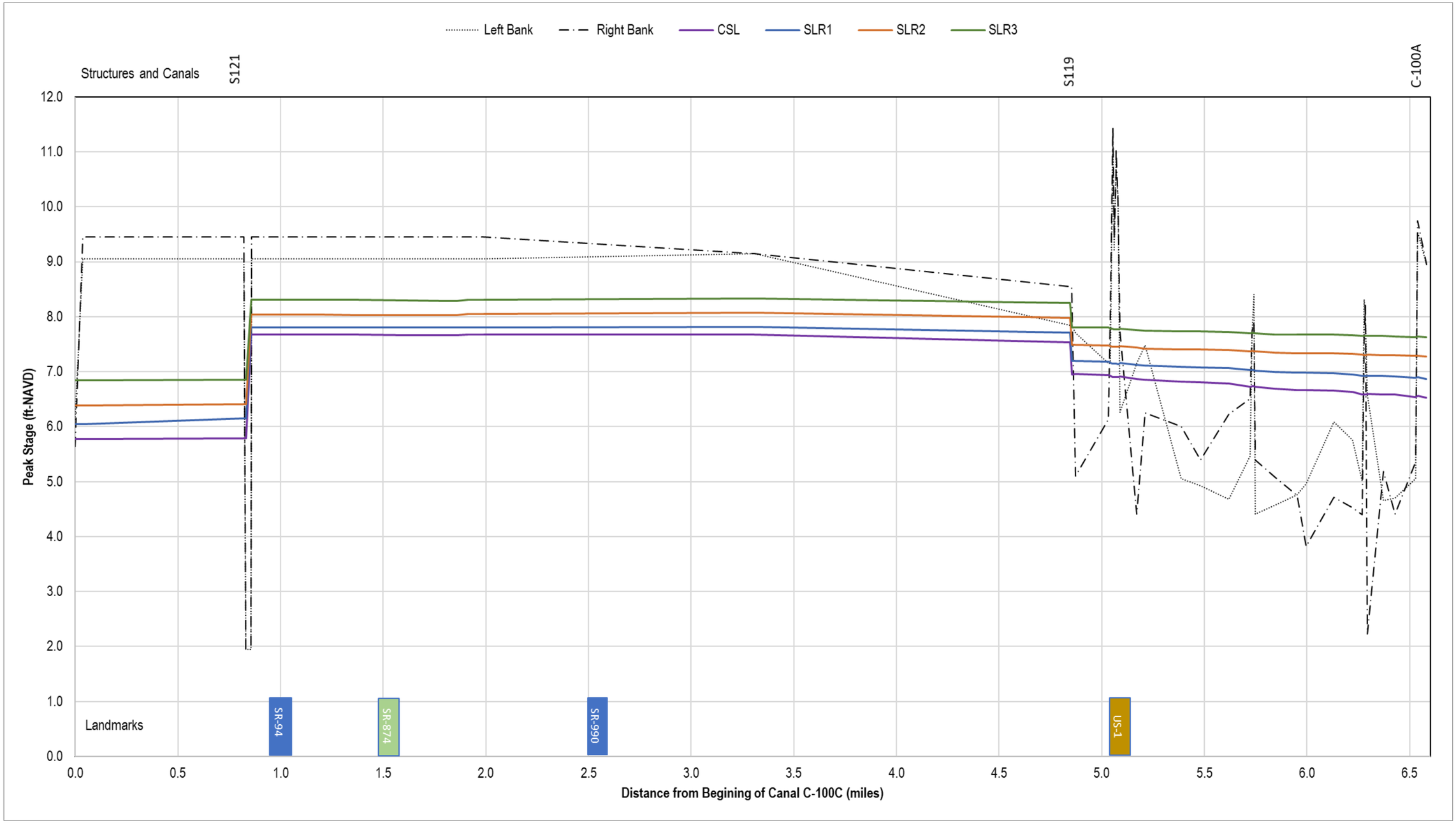


Figure 413 Profile of Peak Stages in Canal C-100C for Future Land Use and Topography for 100-Yr Design Storm

For PM1, the LOS rating of canals in C-100 Watershed is shown in Table 196.

Table 196 LOS Rating of Canals in C-100 Watershed for PM1

Canal	SLR = 0	SLR = + 1.0 ft	SLR = + 2.0 ft	L SLR = + 3.0 ft t
C-100	Upstream of S118: 25-Year LOS	Upstream of S118: 25-Year LOS	Upstream of S118: 10-Year LOS	Upstream of S118: 5-Year LOS
	Downstream of S118: Less than 5-Year LOS	Downstream of S118: Less than 5-Year LOS	Downstream of S118: Less than 5-Year LOS	Downstream of S118: Less than 5-Year LOS
C-100A	25-Year LOS	25-Year LOS	10-Year LOS	10-Year LOS
C-100B	Upstream of S122: 25-Year LOS	Upstream of S122: 10-Year LOS	Upstream of S122: 10-Year LOS	Upstream of S122: 10-Year LOS
	Downstream of S122: 5-Year LOS	Downstream of S122: 5-Year LOS	Downstream of S122: 5-Year LOS	Downstream of S122: Less than 5-Year LOS
C-100C	Upstream of S119: 25-Year LOS	Upstream of S119: 25-Year LOS	Upstream of S119: 10-Year LOS	Upstream of S119: 5-Year LOS
	Downstream of S119: Less than 5-Year LOS	Downstream of S119: Less than 5-Year LOS	Downstream of S119: Less than 5-Year LOS	Downstream of S119: Less than 5-Year LOS

The overall rating of canal C-100 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft. Multiple flooded sections along the canals can be observed for design storms greater than 5-yr.

6.3.3 C-100: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 197 provides information on the discharges and the drainage areas in the C-100 Watershed. The 10-Year discharge using SFWMD's Allowable Discharge is 59.62 csm. Highlighted are the exceedances for the 10-Yr design event.

- The discharges from the 10-yr design events exceed the Allowable ERP Discharges for all SLR scenarios for structure S123 and show increase by approximately 10% for SLR 0 to SLR 3 for Design Events 5-Yr, 10-Yr and 25-Yr and are relatively constant for the the 100-Yr Design Event
- The discharges from the 10-yr design events at structure S118 are within the SFWMD's value for Allowable Discharge and show decrease with increasing SLR for design events 25-Yr and 100-Yr and stay relatively constant for 5-Yr and 10-Yr.
- The discharges from the 10-yr design events at structure S119 and S120 are below SFWMD's Allowable Discharge doe all SLR scenarios, and show decrease with increasing SLR
- Based on the results it is presumed that the shape of the recession hydrography does not significantly impact the discharges in watershed C-100.

Table 197. C-100 Watershed Peak Drainage Discharge Capacity Based on 12-hr Moving Average (csm)

Structure	Watershed Model	AHED Name	Area (mi^2)	Inflow Structure	Design Event	SLR 0	SLR 1	SLR 2	SLR 3
S123	C-100	C-100 EAST	13.16	S118, S119, S120, S122	5-Yr	50.97	50.19	55.89	64.80
					10-Yr	71.56	69.02	76.28	86.81
					25-Yr	101.94	100.48	107.49	114.71
					100-Yr	144.54	141.80	143.09	143.23
S118	C-100	C-100 WEST	16.44	-	5-Yr	45.17	42.28	45.27	47.89
					10-Yr	60.70	55.14	56.28	60.98
					25-Yr	82.05	76.14	78.22	79.70
					100-Yr	108.63	103.48	99.21	93.00
S119	C-100	C-100 WEST	7.55	-	5-Yr	22.55	21.43	23.72	24.11
					10-Yr	29.14	28.08	28.59	28.44
					25-Yr	36.23	34.74	33.24	31.26
					100-Yr	39.63	38.32	36.85	34.10
S120	C-100	C-100 WEST	2.02	-	5-Yr	7.92	8.14	11.70	25.62
					10-Yr	13.02	13.10	21.31	34.30
					25-Yr	26.29	29.52	42.72	59.72
					100-Yr	87.00	82.75	84.10	82.53
The allowable discharge is defined as 59.62 csm									

The discharge hydrographs in Figure 414, Figure 415 and Figure 416 are area-weighted by upstream drainage areas for the 72-hour 5-Year, 10-Year, 25-Year, and 100-Year design storms. The inland structures S118, S119 and S120 represent the inter-watershed movement and flow through the structures.

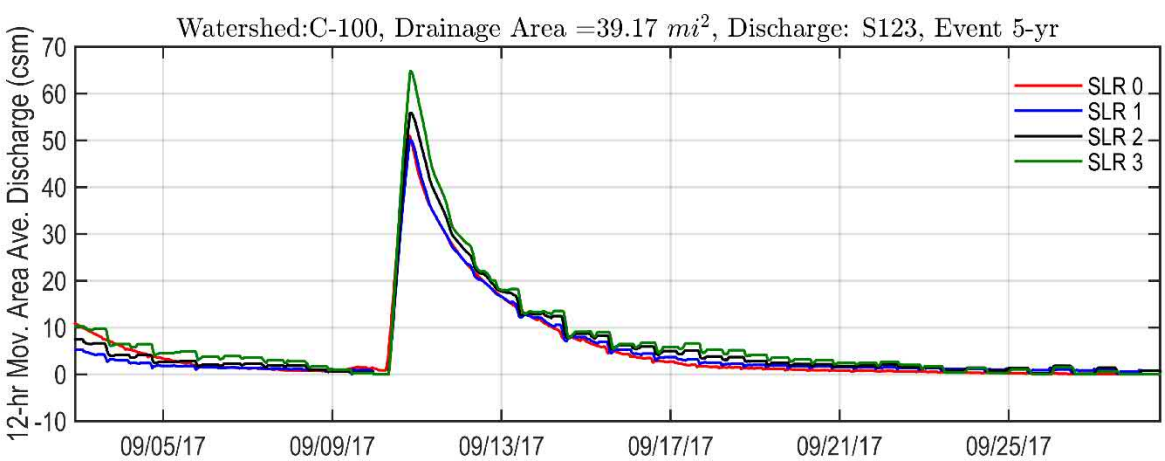


Figure 414. Drainage Discharge Capacity at Structures S123 for 5-yr Storm Event

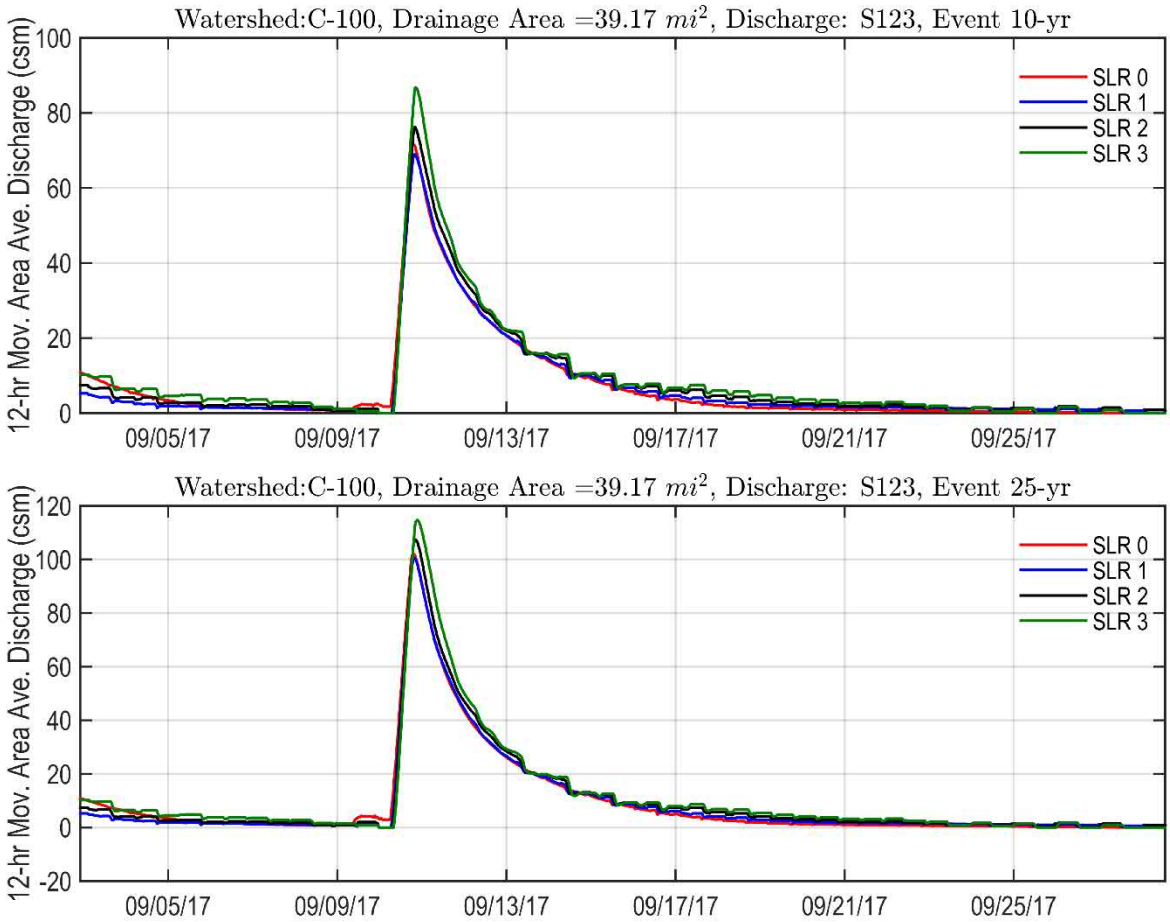


Figure 415. Drainage Discharge Capacity at Structures S123 for 10-yr and 25-yr Storm Events

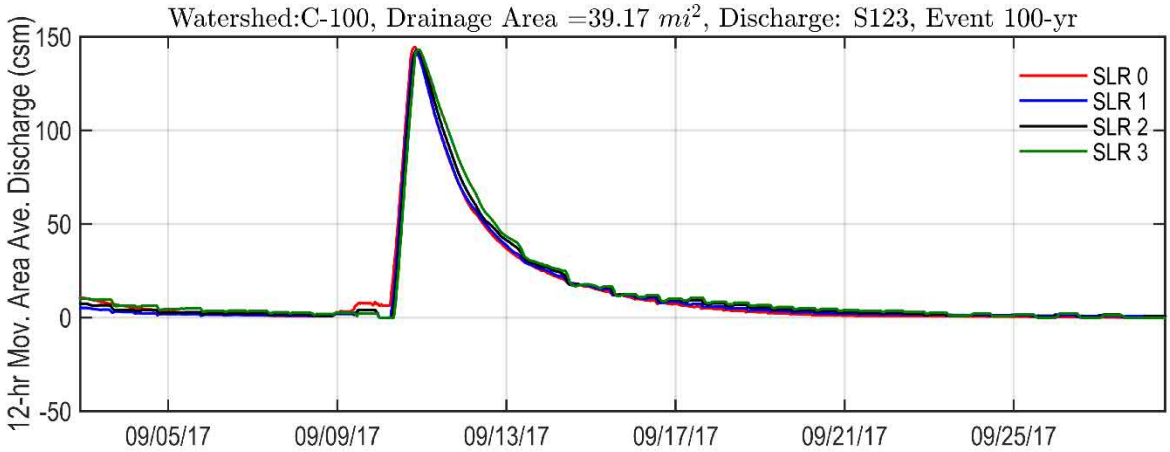


Figure 416. Drainage Discharge Capacity at Structures S123 for 100-yr Storm Event

Structure S123 shows small increase of the peak discharge for higher SLR caused by the pattern of the tailwater hydrograph and potential backflow during storm surge.

For the 10-yr scenario, the peak discharges in structure S123 are greater than Allowable ERP Allowable Discharge (59.62 CSM). For structures S118, S119 and S120, the peak discharges are considerably smaller than the Allowable ERP Allowable Discharge. A review of the Flood Extent maps shows that in many locations along canals C-100, C-100A and C-100B, overbanking can be observed at events greater than the 5-yr event.

6.3.4 C-100: PM3 S123 Structure Performance

This metric shows the effective capacity of the tidal structures and provides information about the peak instantaneous discharge capacity as a function of the design rainfall recurrence interval and SLR conditions. The design parameters of Structure S123 are listed in Table 198.

Table 198 Design parameters of Structure S123

Structure	S123
Design Discharge	2300 cfs for 40% SPF
SPF Discharge	5000 cfs
Design Headwater Elevation	2.0 ft NGVD 29
Design Tailwater Elevation	1.5 ft NGVD 29
SPF Headwater Elevation	3.8 ft NGVD 29
SPF Tailwater Elevation	1.7 ft NGVD 29
Overtopping	10.0 ft NGVD 29

For this PM, the data were analyzed for:

- Stages and flows at structures at the time of peak flow
- Stages and flows at structures at the time of peak headwater stage
- Stages and flows at structures at the time of peak tailwater stage for overtopping

The results were tabulated for all simulations and include 4 design events and 4 SLR conditions.

Summaries of the simulated data for structure S123, S118, S119 and S120 at the conditions of peak flows, peak headwater and peak tailwater stages are provided below.

6.3.4.1 PM3: Structure S123

Figure 417 and Figure 418 depict the typical response of structure flows and stages for a 12-hr moving average timeseries of headwater, tailwater, head differential and discharge for the 25-yr and 100-yr design events.

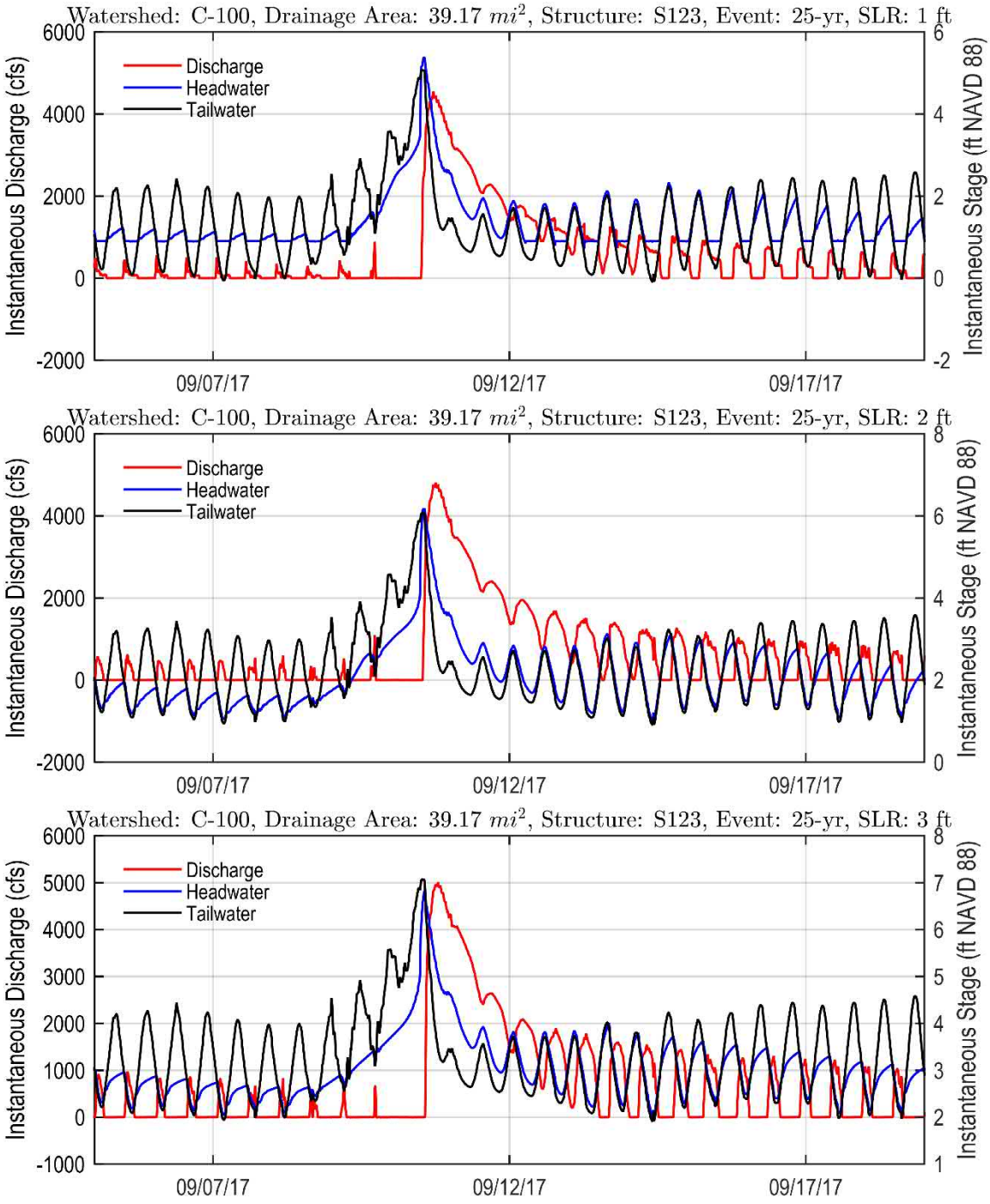


Figure 417 Structure S123 Instantaneous Conditions for the 25-yr Design Events for SLR 1, 2 and 3 ft

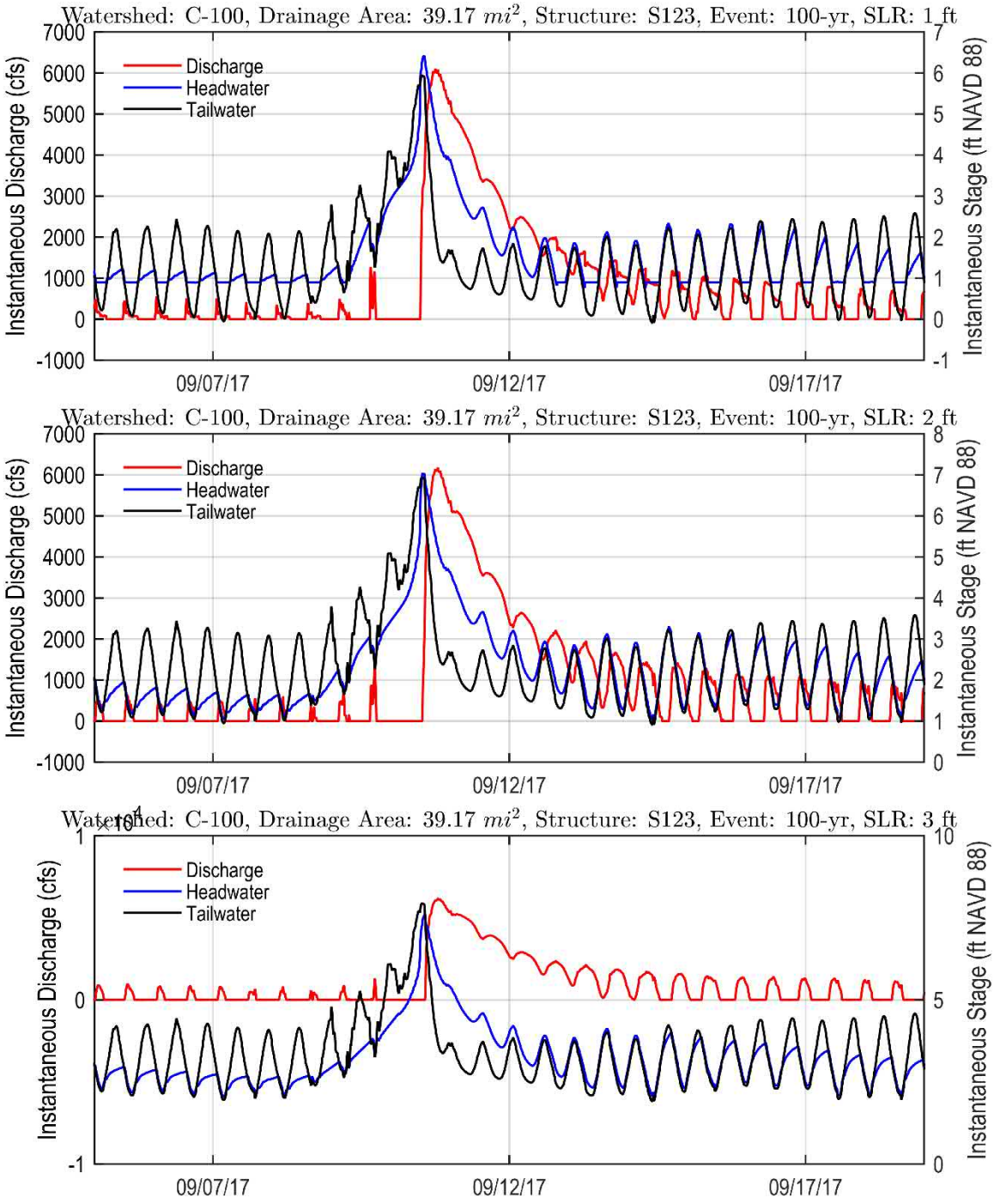


Figure 418 Structure S123 Instantaneous Conditions for 100-yr Design Events for SLR 1, 2 and 3 ft

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 199. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 199 Structure S123 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-100	S123	39.170	SLR = +0 ft	2394	2414	4698	6174
			SLR = +1 ft	2732	4034	5169	6339
			SLR = +2 ft	3753	4569	5434	6236
			SLR = +3 ft	4641	5146	5743	6047

Table 200 provides a list of the instantaneous conditions at structure S123 at peak tailwater. The head differential for some of the simulations is less or equal to the gate closing criteria, therefore some of the discharges are nearly zero.

Table 200 Structure S123 Summary Instantaneous Conditions at Peak Tailwater

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
5-yr	SLR 0	2.72	1280.05	2.83	0.10
	SLR 1	3.23	2174.91	3.53	0.31
	SLR 2	4.08	2903.73	4.57	0.49
	SLR 3	4.95	4098.20	5.83	0.87
10-yr	SLR 0	3.72	-0.20	3.51	-0.22
	SLR 1	4.23	1556.62	4.35	0.12
	SLR 2	5.08	1611.32	5.19	0.11
	SLR 3	5.95	2947.19	6.33	0.37
25-yr	SLR 0	4.72	-0.21	4.42	-0.30
	SLR 1	5.23	428.03	5.33	0.10
	SLR 2	6.08	-0.11	6.03	-0.05
	SLR 3	6.95	44.46	7.05	0.10
100-yr	SLR 0	5.72	-0.21	5.32	-0.41
	SLR 1	6.23	-0.22	6.01	-0.22
	SLR 2	7.08	-0.11	6.51	-0.57
	SLR 3	7.95	-0.15	7.34	-0.61

Table 201 provides the structure conditions at peak discharge.

Table 201 Structure S123 Summary of Instantaneous Conditions at Peak Discharge

Design Event	Scenario	Peak Discharge cfs	TW at Peak Discharge ft NAVD	HW at Peak Discharge ft NAVD	Head Differential at Peak Discharge ft NAVD
5-yr	SLR 0	2398	0.63	1.27	0.64
	SLR 1	3171	0.89	1.93	1.04
	SLR 2	4528	1.26	3.11	1.84
	SLR 3	6190	1.14	4.20	3.07
10-yr	SLR 0	2325	0.89	2.15	1.26
	SLR 1	4547	1.89	2.71	0.82
	SLR 2	4547	2.26	3.86	1.60
	SLR 3	6098	2.14	4.79	2.65
25-yr	SLR 0	2550	2.67	3.15	0.48
	SLR 1	3470	2.89	3.76	0.87
	SLR 2	4807	2.83	4.45	1.62
	SLR 3	6178	2.70	5.23	2.53
100-yr	SLR 0	3031	3.67	4.24	0.58
	SLR 1	3990	3.52	4.56	1.03
	SLR 2	5009	3.45	5.05	1.60
	SLR 3	6165	3.72	5.94	2.22

Figure 419 and Figure 420 show the average discharge, tailwater, headwater and head differential for the 12-hr moving average timeseries for the 25-yr design event.

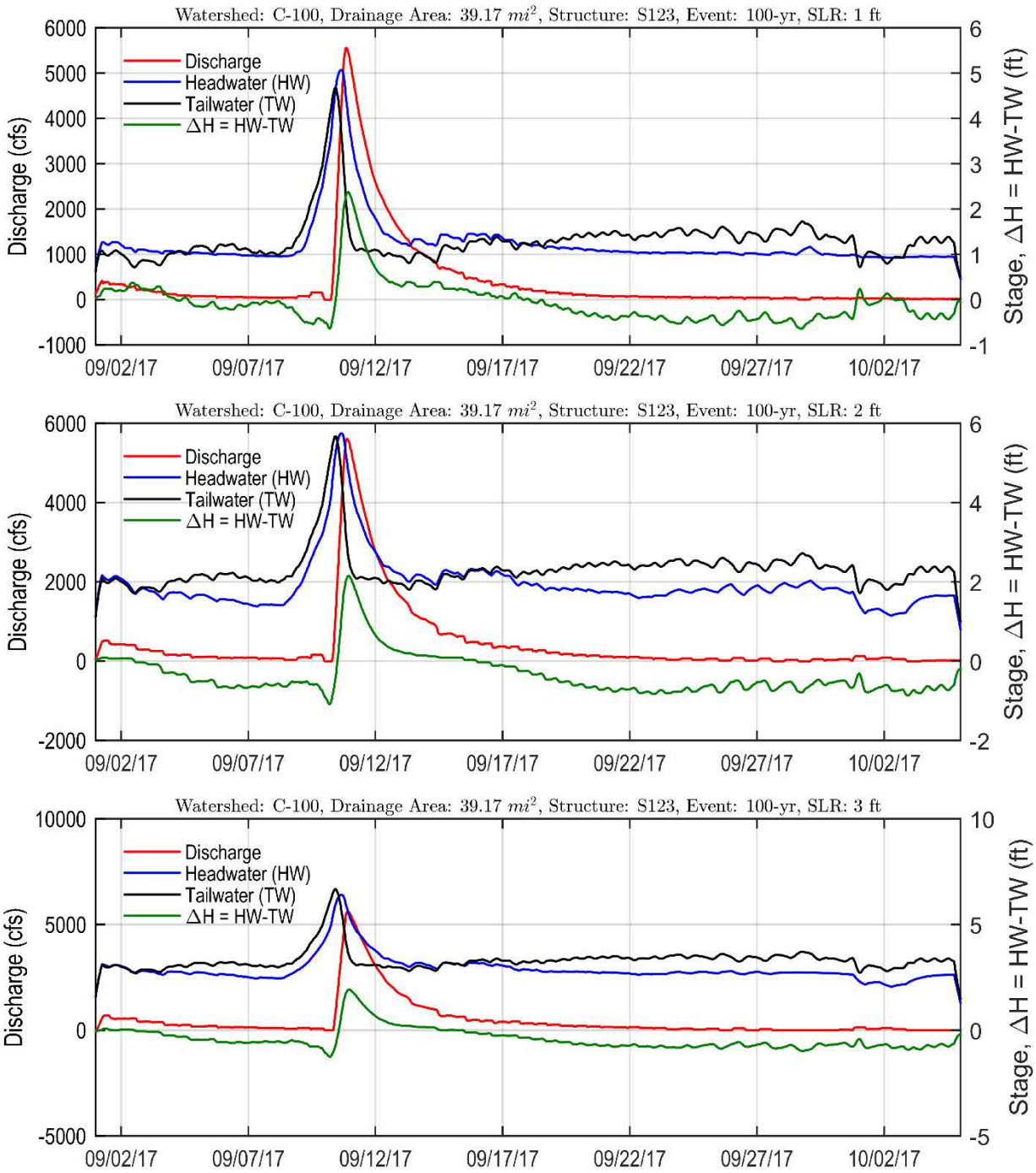


Figure 419 Structure S123: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 25-Year Design Event for SLR 1, 2 and 3 ft

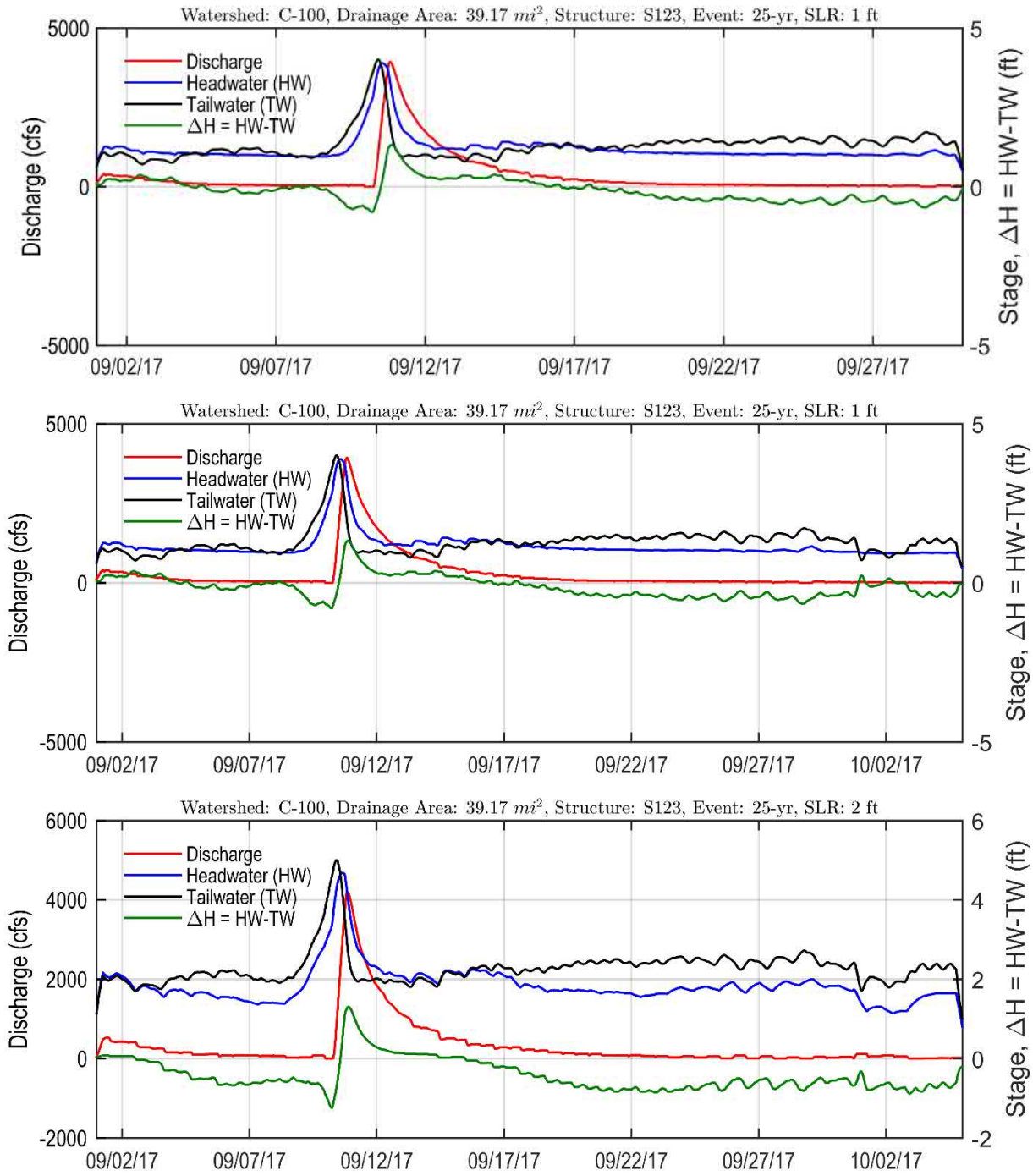


Figure 420 Structure S123: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3 ft

A summary of 12-hr averaged peak discharges is provided in Table 202. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak tailwater, headwater and the head differentials are provided. The head differential gradually increases up to 2.3 ft (maximum for SLR = 0), with increasing the tailwater boundary conditions and increasing the return period. The table shows the HW, TW and dH values at peak discharge.

Table 202 Structure S123 12-hr Moving Average Peak Discharge vs Return Period and SLR Changes

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-100	S123	39.17	5-yr	SLR = +0 ft	0.462	1.209	0.746	1996
			5-yr	SLR = +1 ft	1.395	1.759	0.364	1966
			5-yr	SLR = +2 ft	2.335	2.710	0.375	2189
			5-yr	SLR = +3 ft	3.320	3.747	0.427	2538
			10-yr	SLR = +0 ft	0.824	1.679	0.855	2803
			10-yr	SLR = +1 ft	1.613	2.286	0.673	2704
			10-yr	SLR = +2 ft	2.595	3.279	0.685	2988
			10-yr	SLR = +3 ft	3.508	4.272	0.764	3400
			25-yr	SLR = +0 ft	1.207	2.738	1.531	3993
			25-yr	SLR = +1 ft	1.951	3.259	1.308	3936
			25-yr	SLR = +2 ft	2.883	4.166	1.283	4210
			25-yr	SLR = +3 ft	3.577	4.869	1.293	4493
			100-yr	SLR = +0 ft	1.273	3.934	2.661	5662
			100-yr	SLR = +1 ft	2.095	4.411	2.316	5554
			100-yr	SLR = +2 ft	2.873	4.989	2.116	5605
			100-yr	SLR = +3 ft	3.725	5.618	1.894	5610

Peak TW and Peak HW are reported using 12-hr averaging
Head differential is computed by subtracting HW-TW at the time of 12-hr Peak Discharge
12-hr moving average is computed by taking the centered average over 288 timesteps (timestep is 5-min)

Figure 421 and Figure 422 show the cumulative discharges for the 5-yr, 10-yr and 25-yr and 100-yr. The cumulative timeseries are relatively constant with slight increase for SLR 3.

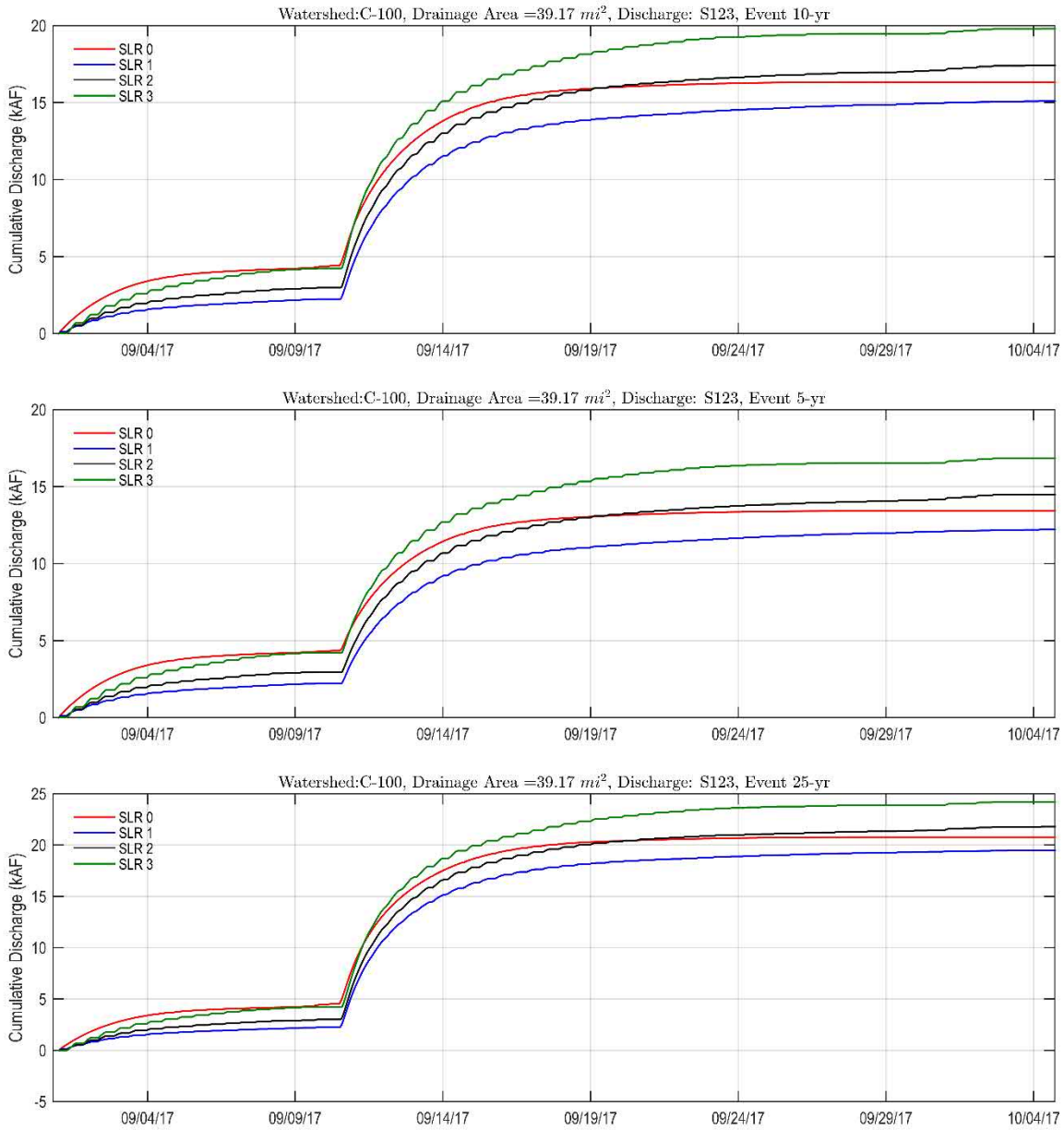


Figure 421 Cumulative Flow through S123 for 5-yr, 10-Yr and 25-Yr

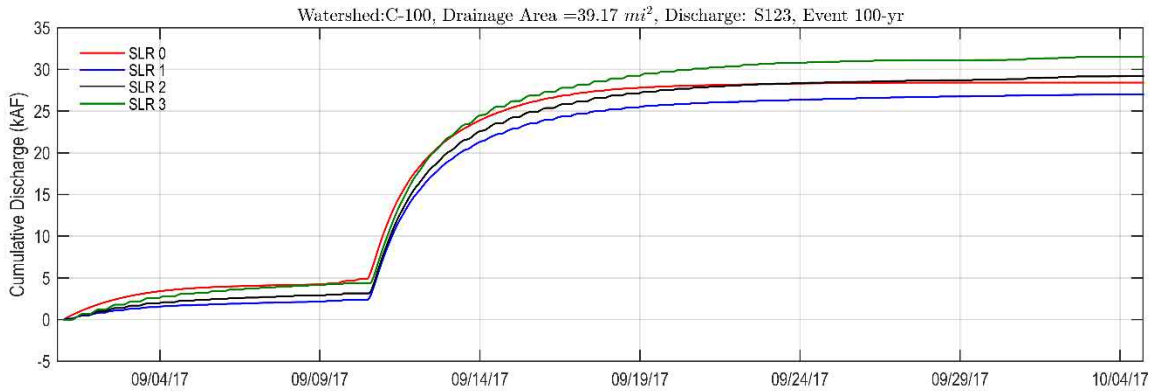


Figure 422 Cumulative Flow through S123 for the 100-Yr Event

The corresponding cumulative discharge for the S123 for the 100-Year event shows increase of the cumulative discharges for SLR increase which is attributed to backflow during storm surge. The upstream structures S118 and S119 show minimum change of cumulative discharges.

6.3.4.2 PM3: Structure S118

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 203. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft. The table illustrates gradual increase of the peak discharge for increasing SLR.

Table 203 Structure S118 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-100	S118	16.440	SLR = +0 ft	738	740	1342	1731
			SLR = +1 ft	718	941	1321	1657
			SLR = +2 ft	823	1057	1339	1502
			SLR = +3 ft	915	1124	1269	1429

6.3.4.3 PM3: Structure S119

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 204. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft which gradually increase with increasing SLR except for the 100-yr event.

Table 204 Structure S123 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-100	S119	7.550	SLR = +0 ft	181	181	267	294
			SLR = +1 ft	183	222	258	284
			SLR = +2 ft	194	225	244	262
			SLR = +3 ft	200	211	216	240

6.3.4.4 PM3: Structure S120

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 205. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 205 Structure S120 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
S120	S120	2.020	SLR = +0 ft	12	18	75	82
			SLR = +1 ft	23	28	81	85
			SLR = +2 ft	54	69	86	126
			SLR = +3 ft	152	157	158	158

6.3.5 C-100: PM4 Watershed Peak Storm Runoff

PM4 represents the discharge at tidal structure S123 from the 12-hr moving average of design storms on the C-100 Canal. The discharge hydrographs, particularly the peak discharge, are compared with the peak discharge under future sea level rise scenarios.

Figure 423 and Figure 424 show the 12-hr moving average discharge timeseries for each design event (5-Yr, 10-Yr, 25-Yr and 100-Yr).

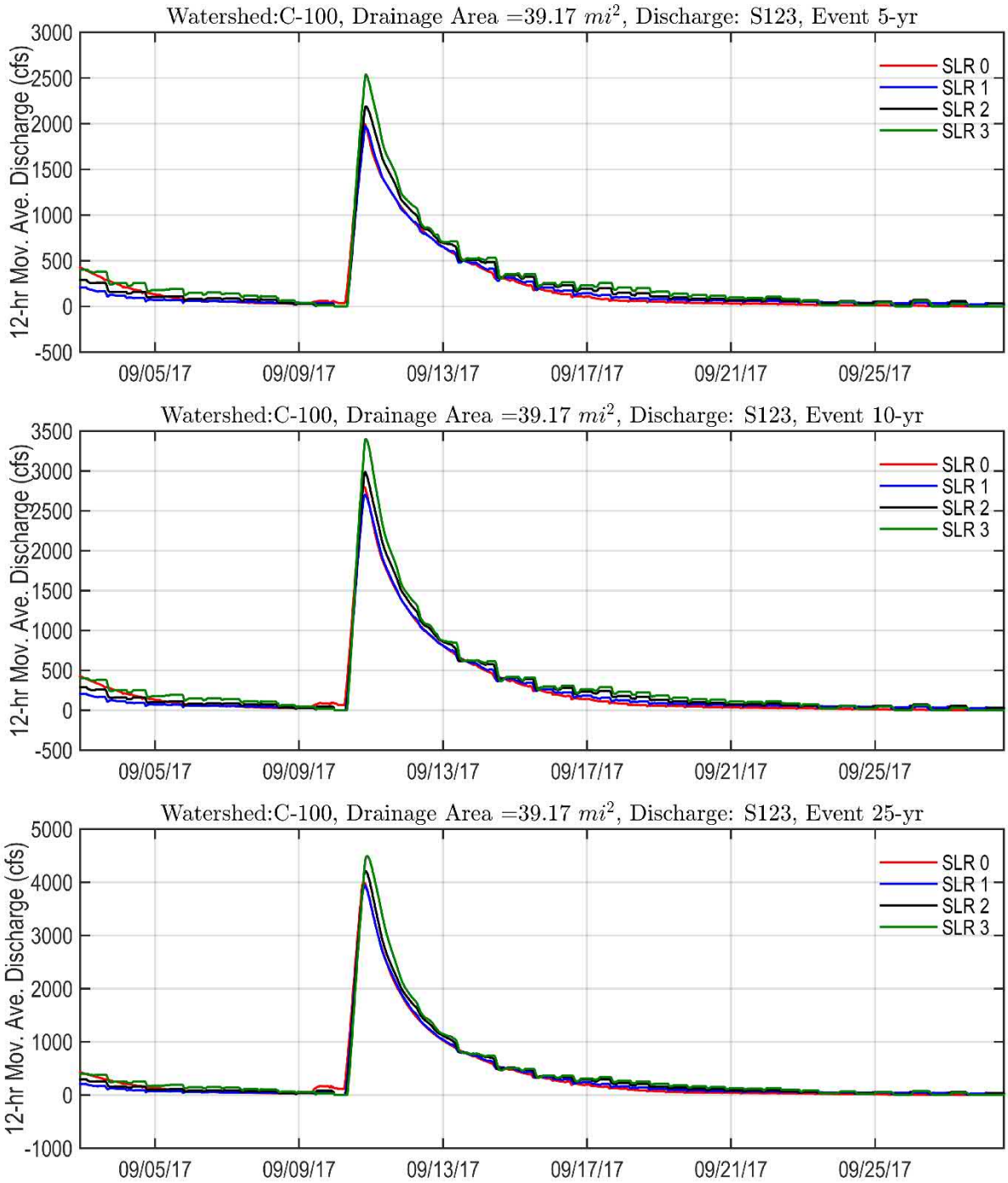


Figure 423. 12-hr Moving Average Flow Timeseries at S123 for the 5-Yr, 10-Yr and 25-Yr Design Events

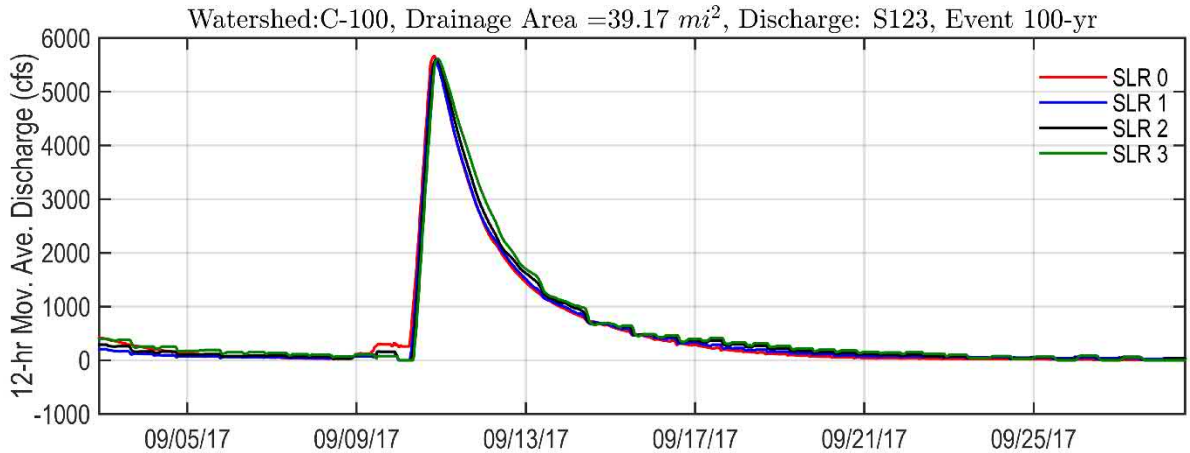


Figure 424. 12-hr Moving Average Flow Timeseries at S123 for 100-Yr Design Events

6.3.5.1 PM4: Structure S123

Figure 425 shows a summary of the 12-hr moving average peak discharges for structure S123:

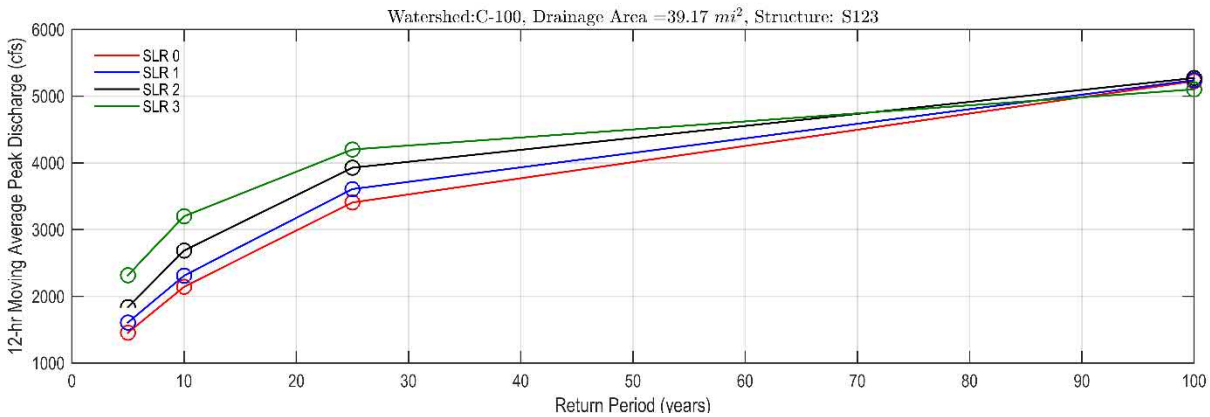


Figure 425 Structure S123 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The design criterion for the S123 Structure is 2,300 cfs, which is 40% of the Standard Project Flood (SPF). The Standard Project Flood is listed as 5000 cfs in the SFWMD Structure Book. The peak 100-Year flow rate through the structure in the model is 5,908 cfs for instantaneous discharge and 5,407 cfs for 12-hr moving average peak discharge, which is higher than the SPF value.

Two main factors are attributed to the higher computed discharge values at the structures. Contribution from increased imperviousness caused by development since the original design. The second factor is a difference in the design assumptions. The original design uses a steady state boundary of 1.7 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 6.5 ft NAVD followed by a very fast recess. For comparison, a

simulation is provided for the two cases (applying the 100-yr Outfall Timeseries provided by SFWMD or using the steady state boundary originally used as design criteria)

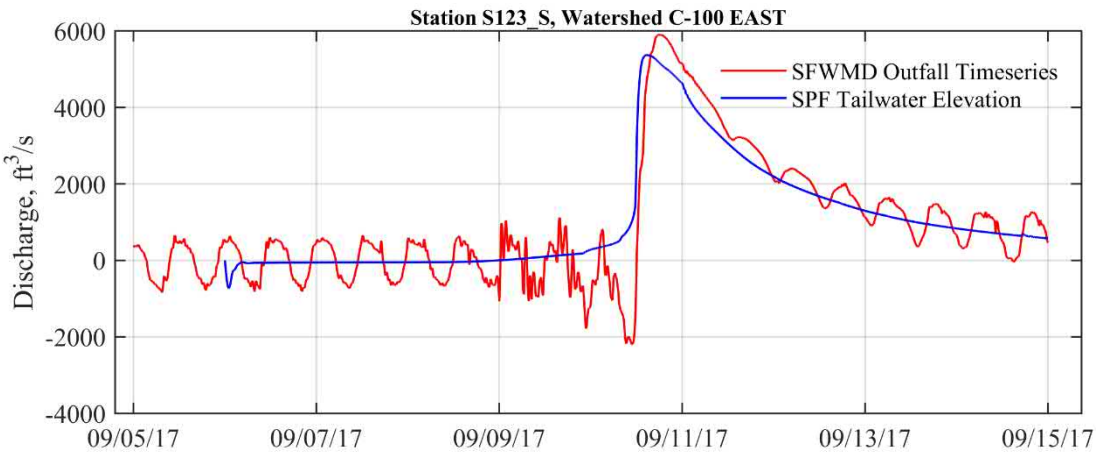


Figure 426 Comparison of Discharges at Structure S123 for the Design SPF Tailwater Elevation and SFWMD Tailwater Boundary Condition for 100-Yr Storm

6.3.5.2 PM4: Structure S118

Figure 427 shows a summary of the 12-hr moving average peak discharges for structure S118:

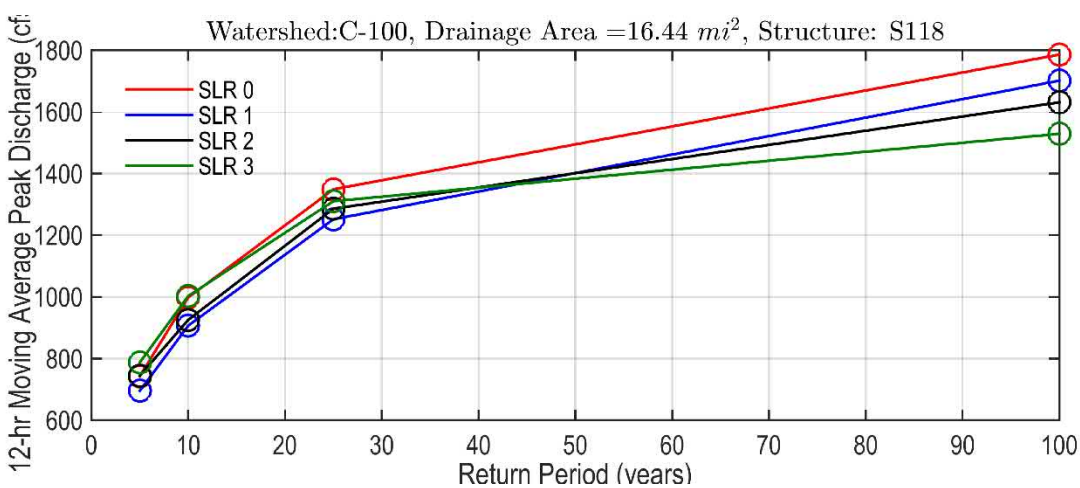


Figure 427 Structure S118 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

For SLR 0, 1,2 the peak discharges at structure S118 are almost equivalent and are lower for SLR 2 and 3 which is the expected discharge pattern. This also indicates no backflow in the watershed caused by storm surge.

6.3.5.3 PM4: Structure S119

Figure 428 shows a summary of the 12-hr moving average peak discharges for structure S119:

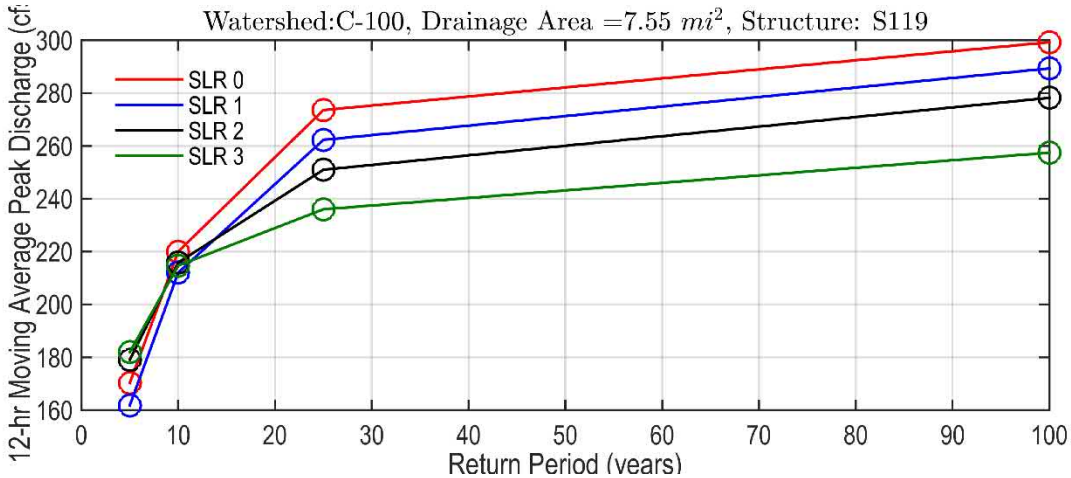


Figure 428 Structure S119 12-hr Moving Average Peak Discharge for Return Period for SLR 0, 1, 2, 3

Similar to structure S118, for SLR 0, 1,2 the peak discharges at structure S119 are almost equivalent and are lower for SLR 2 and 3 which is the expected discharge pattern. This also indicates no backflow in the watershed caused by storm surge.

6.3.5.4 PM4: Structure S120

Figure 429 shows a summary of the 12-hr moving average peak discharges for structure S120

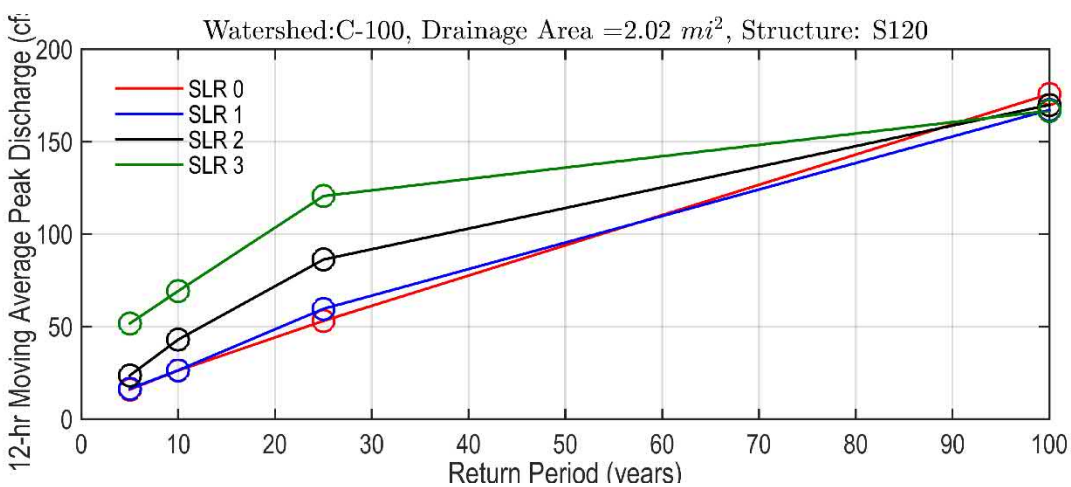


Figure 429 Structure S120 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2, 3

Structure S120 shows initial higher peak discharges for SLR 2 and 3 and for return periods 5-yr,10-yr and 25-yr, however for SLR 3 the peak discharges for design events are equivalent which indicates potential influence from other watersheds.

6.3.6 C-100: PM5 Flood Frequency

PM5 is determined using stage based FPLOS for the entire watershed. The mode output files of water elevations and overland water depths were extracted and converted to grid files, which were then imported in ARC GIS Pro software and process to generate rasters to show flood extent and depth and flood extent and duration. The flood depth maps were developed using 5 ft topography, while the flood duration maps were developed using the original grid size (100m). In addition, flood tables were developed to list the acreage of preselected flood depth levels and the duration in hours for preselect flood duration times. The values in the tables are based on discretization to 100 m raster which results in total watershed area 24,809 acres with 23,616 acres urban land, 124 acres agricultural land and 1,703 acres wetlands.

Table 206 through Table 209 summarize the area of flooding shown in the C-100 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas. Based on total area of the C-100 Watershed of 25,052 acres (based on raster cells) the tables are interpreted as follows:

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 206 Summary of the PM5 Flood Inundation in Acres for the C-100 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	24098	23468	23561	23124	22304	23317	22264	22380	21644	20448	20962	19692	19628	18521	17072	15034	13998	13766	12647	11401
0.25 >= 0.50	91	460	378	593	897	509	1021	937	1233	1589	1586	2019	2011	2340	2570	3563	3655	3625	3776	3736
0.50 >= 0.75	74	151	158	255	479	213	462	432	623	922	803	1117	1142	1315	1623	1982	2175	2184	2296	2338
0.75 >= 1.00	40	114	96	133	235	114	250	247	326	479	388	600	608	833	1067	1362	1488	1581	1703	1918
1.00 >= 1.25	25	86	82	74	148	91	126	119	175	353	222	348	353	467	684	919	1090	1092	1310	1448
1.25 >= 1.50	25	27	30	84	86	35	86	91	116	161	101	200	210	314	452	561	677	722	820	1035
1.50 >= 1.75	15	25	17	25	86	32	57	54	86	106	104	133	126	161	247	306	474	482	573	697
1.75 >= 2.00	25	22	32	25	22	20	30	27	42	96	59	62	74	111	198	185	267	292	400	524
2.00 >= 2.25	15	17	10	20	20	22	20	27	22	72	22	54	67	72	99	124	126	171	252	366
2.25 >= 2.50	32	40	30	20	37	15	25	22	35	27	30	25	30	79	111	72	114	119	151	250
>= 2.50	613	642	657	699	736	684	712	714	749	798	773	801	803	840	927	944	988	1018	1124	1339
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 covers 25,052 acres																				

Table 207. Summary of the PM5 Flood Inundation in Acres for the Urban Areas of the C-100 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	22222	21651	21743	21352	20643	21528	20631	20730	20065	19007	19425	18343	18288	17253	15909	13984	13042	12835	11777	10635
0.25 >= 0.50	84	413	324	539	801	457	882	811	1107	1423	1453	1819	1809	2142	2367	3333	3435	3395	3546	3519
0.50 >= 0.75	59	133	146	208	420	195	400	373	539	808	704	974	1001	1156	1460	1824	2004	2014	2123	2155
0.75 >= 1.00	32	109	96	124	205	91	217	220	284	420	343	531	536	744	959	1213	1322	1411	1520	1717
1.00 >= 1.25	25	77	69	69	121	82	109	99	151	314	190	297	299	405	605	815	964	976	1203	1307
1.25 >= 1.50	17	15	22	74	72	22	77	82	86	141	91	178	180	279	388	492	608	640	729	954
1.50 >= 1.75	12	25	15	17	82	27	49	47	82	84	89	104	111	141	222	269	415	420	507	620
1.75 >= 2.00	20	17	27	20	17	17	27	25	37	82	42	49	52	84	180	158	230	262	346	457
2.00 >= 2.25	15	17	10	20	15	22	15	20	15	54	22	37	52	59	79	109	106	141	222	321
2.25 >= 2.50	30	37	22	20	30	12	22	22	30	25	20	20	17	67	94	57	94	104	131	222
>= 2.50	314	336	356	388	425	376	400	403	435	472	450	479	484	499	566	576	610	633	726	922
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 urban areas cover 22,830 acres																				

Table 208. Summary of the PM5 Flood Inundation in acres for the Agricultural Areas of the C-100 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	766	739	741	724	660	741	652	665	625	539	600	497	489	450	393	348	301	284	259	217
0.25 >= 0.50	2	22	25	22	47	15	69	67	57	74	67	96	104	84	91	94	77	94	94	84
0.50 >= 0.75	7	5	2	15	30	5	20	12	42	67	47	72	69	89	67	67	84	79	57	62
0.75 >= 1.00	2	2	0	5	12	7	15	12	17	32	17	44	40	44	72	69	64	67	82	86
1.00 >= 1.25	0	2	7	2	15	5	10	10	10	20	20	22	27	35	44	72	86	74	67	67
1.25 >= 1.50	2	10	2	5	5	2	5	5	17	12	7	10	12	25	40	42	42	54	59	54
1.50 >= 1.75	2	0	2	5	5	5	5	5	0	12	7	12	12	10	15	22	35	35	42	52
1.75 >= 2.00	5	0	0	2	0	0	0	0	5	12	10	10	10	20	12	17	30	22	40	42
2.00 >= 2.25	0	0	0	0	5	0	2	5	2	5	0	7	5	7	17	12	12	22	20	32
2.25 >= 2.50	0	2	7	0	2	2	2	0	2	0	0	5	7	7	12	10	17	10	17	20
>= 2.50	35	40	35	42	42	40	42	42	44	49	47	47	47	52	59	69	74	82	86	106
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 agricultural areas cover 823 acres																				

Table 209. Summary of the PM5 Flood Inundation in Acres for the Wetlands Areas of the C-100 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	1110	1077	1077	1048	1001	1048	981	986	954	902	937	853	850	818	771	702	655	647	610	549
0.25 >= 0.50	5	25	30	32	49	37	69	59	69	91	67	104	99	114	111	136	143	136	136	133
0.50 >= 0.75	7	12	10	32	30	12	42	47	42	47	52	72	72	69	96	91	86	91	116	121
0.75 >= 1.00	5	2	0	5	17	15	17	15	25	27	27	25	32	44	37	79	101	104	101	114
1.00 >= 1.25	0	7	5	2	12	5	7	10	15	20	12	30	27	27	35	32	40	42	40	74
1.25 >= 1.50	5	2	5	5	10	10	5	5	12	7	2	12	17	10	25	27	27	27	32	27
1.50 >= 1.75	0	0	0	2	0	0	2	2	5	10	7	17	2	10	10	15	25	27	25	25
1.75 >= 2.00	0	5	5	2	5	2	2	2	0	2	7	2	12	7	5	10	7	7	15	25
2.00 >= 2.25	0	0	0	0	0	0	2	2	5	12	0	10	10	5	2	2	7	7	10	12
2.25 >= 2.50	2	0	0	0	5	0	0	0	2	2	10	0	5	5	5	5	2	5	2	7
>= 2.50	264	267	267	269	269	269	269	269	269	277	277	274	272	289	301	299	304	304	311	311
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 wetlands cover 1,399 acres																				

The corresponding flood extent and maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions**:**

- Figure B-97 through Figure B-112 provide flood extent maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-129 through Figure B-144 provide flood extent maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-161 through Figure B-176 provide flood extent maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

A comparison of land surface topography elevations and the peak stage in the C-100 Canal for 25-Year and 100-Year design storm revealed that a significant portion of the flooded area, mostly urban, is higher than the predicted peak stage for both design storms. Flood depth oscillated in the range of 0.25-1 feet, where the maximum values are found next to the canal.

The areas most upstream portion of the canal show <0.75 feet of flooding for 100-Year design storm. C-100A canal from PM1 has 25-Year LOS. Therefore, the flooding in the watershed can be attributed to deficiencies of the secondary and tertiary canals. At junction of canals C-100A and SW 70 Ave Canal A, flooding inundation depth is greater than 2.25 feet.

Urban areas that contribute to C-100B show flooding of 1.5+ feet for 25 and 100-Year design storms, especially in zones north to the canal C-100B. For 5-Year and 10-Year design storms, the flooding is less than 20 acres (approximately).

Flood inundation areas are in the northern section of the canal, with inundation depth higher than 2.25 feet in areas next to the canal. The urban area in between SW 128th and SW 136th St. has considerable amount of flooding for 100-Year design storms. This area shows minimal flooding impact for the 5, 10, and 25-Year design events.

At the watershed level, C-100 Watershed has a 25-Year level of service which would indicate that flooding at the watershed level is not significant for smaller modeled design storms. The flooding identified in PM5 is a combination of two factors:

- Bank overtopping from PM1 may cause flooding in the vicinity of the canal. The flooding from the canals is relatively limited in extent, however, overtopping of secondary and other canals maintained by Miami-Dade County may cause flooding to propagate further inland. In addition, high stages in primary canals can cause backflow in culverts and other structures with outfall in the primary canals.
- Local drainage deficiencies may result in ponding which can be seen at locations with lower topography, for example the figure below shows that in vicinity of the eastern section of canal C-1W, there are areas are next to the canals with flooding that can be attributed to overtopping. The western section of the C-1W canal shown on the image demonstrates that local flooding and separation from the canal.

Table 210 and Table 211 show the fraction of flooded urban and agricultural areas for the flood depth ranges listed in the tables. The results indicate gradual increase of flood extent for urban and agricultural areas for SLR 0, 1, 2 and 3 and it is expected that the drainage system will have similar performance for future SLR conditions with no significant loss of drainage capacity over the entire watershed.

Table 210 Fraction of Flooded Urban Area of C-100 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	73%	73%	69%	64%
>=0.25	18%	18%	22%	28%
>=0.5	11%	11%	14%	18%
>=0.75	7%	7%	9%	12%
>=1.00	5%	5%	6%	9%
>=1.25	3%	4%	5%	6%
>=1.50	3%	3%	3%	5%
>=1.75	2%	2%	3%	4%
>=2.00	2%	2%	2%	3%
>=2.25	2%	2%	2%	3%
>=2.50	2%	2%	2%	2%

Table 211 Fraction of Flooded Agricultural Area of C-100 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	2%	2%	2%	2%
>=0.25	1%	1%	1%	2%
>=0.5	1%	1%	1%	1%
>=0.75	1%	1%	1%	1%
>=1.00	0%	0%	1%	1%
>=1.25	0%	0%	0%	1%
>=1.50	0%	0%	0%	0%
>=1.75	0%	0%	0%	0%
>=2.00	0%	0%	0%	0%
>=2.25	0%	0%	0%	0%
>=2.50	0%	0%	0%	0%

6.3.7 C-100: PM6 Flood Duration

For each design event and SLR conditions, tables were generated to show the duration of flooding. This analysis is summarized in tables and maps for the entire project domain, and additionally for urban, agricultural and wetland areas. The values in the tables are based on discretization to 100 m raster which results in total watershed area 24,809 acres with 23,616 acres urban land, 124 acres agricultural land and 1,703 acres wetlands.

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S123 to return to target reference stage, which was defined as 3 ft.

6.3.7.1 Flood Duration in Canal C-100

Table 212 shows the duration of time taken for the water levels in the C-100 Watershed canals to return to baseflow. The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S123 to return to target reference stage, which was defined as 3.0 ft. The flood duration for 5-yr, 10-yr, 25-yr and 100-yr and SLR = 0, +1.0, +2, and +3.0 ft are shown in the table below:

Table 212 Hours of Canal Flood Duration at Headwater of Structure S123

Design Event	SLR 0	SLR 1	SLR 2	SLR 3
5-yr	2:50	5:55	69:00	> 2 weeks
10-yr	4:45	8:50	74:25	> 2 weeks
25-yr	7:55	18:55	80:35	> 2 weeks
100-yr	22:20	41:55	> 2 weeks	> 2 weeks

6.3.7.2 Flood Duration in Watershed C-100

Table 213 through Table 214 provide a summary of the flood duration for each time interval.

- The first row (0.1 >= 1 hr) and the following rows up to and including (240 >= 360 hr) of the summary tables represent areas for which the flood duration is within the specified interval.
- The last row (>=360 hr) are the areas flooded with flood duration greater than 360 hr.
- The severity of flooding in terms of duration is determined based on the flooded areas reported at each successive row.
- The severity of flooding is proportional to the increase of time interval.
- The tables provide a summary of the areas in the C-102 Watershed with flood depths greater than 0.25 ft for the specified duration interval for the entire C-102 watershed, agricultural, urban and wetland areas of the C-102 watershed, respectively.

Table 213 Summary of the PM6 Flood Duration Area in Acres for the C-100 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	0	111	111	96	124	20	143	136	136	213	96	336	287	304	385	469	680	707	724	712
1 >= 4	2	91	42	84	153	79	148	148	227	363	237	351	381	452	519	788	914	830	983	1001
4 >= 8	12	79	44	99	180	69	168	136	208	334	319	373	413	566	618	741	813	833	798	885
8 >= 12	7	59	35	128	195	104	198	171	225	319	262	306	316	467	509	677	672	739	744	803
12 >= 24	69	126	126	215	447	175	474	487	672	939	914	1198	1211	1408	1841	2150	2355	2338	2486	2483
24 >= 48	84	190	208	217	331	227	334	339	479	697	583	885	912	1156	1643	2199	2429	2617	3007	3408
48 >= 96	57	106	91	143	188	136	183	183	222	309	279	316	334	452	623	729	882	976	1292	1895
96 >= 168	42	47	35	35	64	42	57	40	42	82	62	82	59	64	96	104	111	106	133	240
168 >= 240	47	27	22	17	25	52	15	25	20	35	42	20	25	22	35	49	37	32	27	49
240 >= 360	62	64	44	27	15	59	62	40	22	17	67	54	44	27	22	54	52	47	27	25
>= 360	531	578	598	652	694	549	598	610	660	694	561	605	608	660	702	581	613	615	667	707
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 covers 25,052 acres																				

Table 214. Summary of the PM6 Flood Duration Area in Acres of the C-100 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	0	5	5	7	5	0	5	7	7	2	2	20	10	5	7	5	5	15	15	10
1 >= 4	0	5	0	0	17	0	10	7	12	15	12	20	17	7	10	12	10	7	15	27
4 >= 8	2	2	5	2	7	0	10	10	15	20	7	25	35	15	17	20	5	10	20	12
8 >= 12	0	2	0	5	7	2	12	12	10	15	5	15	12	30	10	25	20	15	10	12
12 >= 24	5	10	7	22	30	12	25	20	47	47	44	57	52	69	74	84	94	82	84	49
24 >= 48	7	5	7	7	27	10	30	30	40	82	62	104	106	116	136	153	166	171	171	183
48 >= 96	0	10	7	7	7	7	12	12	12	20	20	22	22	44	77	109	124	141	173	217
96 >= 168	5	0	5	2	5	2	2	2	2	5	2	2	2	2	10	2	12	7	12	20
168 >= 240	2	2	0	5	2	5	2	2	2	2	5	2	2	2	0	5	0	5	2	2
240 >= 360	5	5	2	0	2	0	5	2	2	2	0	2	2	2	5	2	5	0	2	2
>= 360	30	35	35	37	40	35	35	35	37	40	35	37	35	37	40	35	37	37	37	42
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 urban areas cover 22,830 acres																				

Table 215. Summary of the PM6 Flood Duration Area in Acres for the Agricultural Areas of the C-100 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	0	5	5	7	5	0	5	7	7	2	2	20	10	5	7	5	5	15	15	10
1 >= 4	0	5	0	0	17	0	10	7	12	15	12	20	17	7	10	12	10	7	15	27
4 >= 8	2	2	5	2	7	0	10	10	15	20	7	25	35	15	17	20	5	10	20	12
8 >= 12	0	2	0	5	7	2	12	12	10	15	5	15	12	30	10	25	20	15	10	12
12 >= 24	5	10	7	22	30	12	25	20	47	47	44	57	52	69	74	84	94	82	84	49
24 >= 48	7	5	7	7	27	10	30	30	40	82	62	104	106	116	136	153	166	171	171	183
48 >= 96	0	10	7	7	7	7	12	12	12	20	20	22	22	44	77	109	124	141	173	217
96 >= 168	5	0	5	2	5	2	2	2	2	5	2	2	2	2	10	2	12	7	12	20
168 >= 240	2	2	0	5	2	5	2	2	2	2	5	2	2	2	0	5	0	5	2	2
240 >= 360	5	5	2	0	2	0	5	2	2	2	0	2	2	2	5	2	5	0	2	2
>= 360	30	35	35	37	40	35	35	35	37	40	35	37	35	37	40	35	37	37	37	42
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 agricultural areas cover 823 acres																				

Table 216. Summary of the PM6 Flood Duration Area in Acres for the Wetlands Areas of the C-100 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	0	2	7	0	0	0	10	5	0	10	0	2	2	5	12	10	25	30	27	7
1 >= 4	0	5	5	12	2	0	7	12	7	7	5	2	10	7	7	10	25	20	37	42
4 >= 8	0	7	0	5	5	2	12	12	10	7	20	25	15	7	17	25	12	25	20	42
8 >= 12	0	7	0	7	15	12	10	10	20	27	17	12	15	22	22	20	12	15	15	25
12 >= 24	10	15	7	17	42	12	62	54	49	59	64	82	82	91	91	94	96	94	104	79
24 >= 48	10	7	12	17	25	27	17	25	40	52	40	82	86	94	106	171	175	171	158	163
48 >= 96	0	10	5	10	10	7	10	7	15	27	25	27	25	35	52	47	72	86	109	131
96 >= 168	0	0	0	0	10	0	2	0	2	7	2	2	2	2	10	5	7	5	10	32
168 >= 240	10	7	2	0	0	2	0	0	0	2	0	0	0	0	2	0	0	0	0	5
240 >= 360	17	15	17	7	0	20	22	17	0	0	20	17	17	0	0	12	17	12	0	0
>= 360	242	247	250	262	269	247	247	252	269	269	250	252	252	269	269	257	252	257	269	269
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-100 wetlands cover 1,399 acres																				

The corresponding flood duration maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions:

- Figure B-113 through Figure B-128 provide flood duration maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-145 through Figure B-160 provide flood duration maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-177 through Figure B-192 provide flood duration maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Table 217 and Table 218 show the fraction of flooded urban and agricultural areas for the flood duration ranges listed in the tables. The results indicate gradual increase of flood duration for urban and areas for SLR 0, 1, 2 and 3 and it is expected that the drainage system will require improvements to preserve the LOS for future SLR conditions. For agricultural areas, the LOS will be maintained for SLR 0, 1, 2 and 3.

Table 217 Fraction of Flooded Urban Areas and Duration of C-100 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	15%	15%	19%	24%
> 1	14%	14%	18%	23%
> 4	12%	13%	16%	21%
> 8	11%	11%	14%	18%
> 12	10%	10%	12%	16%
> 24	6%	6%	7%	10%
> 48	3%	3%	3%	4%
> 96	2%	2%	2%	2%
> 168	1%	1%	2%	2%
> 240	1%	1%	2%	2%
> 360	1%	1%	1%	2%

Table 218 Fraction of Flooded Agricultural Areas and Duration of C-100 Watershed d

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	1%	1%	1%	2%
> 1	1%	1%	1%	2%
> 4	1%	1%	1%	1%
> 8	1%	1%	1%	1%
> 12	1%	1%	1%	1%
> 24	1%	1%	1%	1%
> 48	0%	0%	0%	1%
> 96	0%	0%	0%	0%
> 168	0%	0%	0%	0%
> 240	0%	0%	0%	0%
> 360	0%	0%	0%	0%

The results indicate gradual increase of flood duration for urban and agricultural areas for SLR 0, 1, 2 and slight increase for SLR 2 and 3 and it is assumed that the drainage system will have similar performance for future SLR conditions with no significant loss of drainage capacity over the entire watershed for SLR 0 and 1 and will have lower performance for SLR 2 and 3.

6.3.8 LOS Rating of C-100 Watershed

The flood protection LOS of the C-100 Watershed was evaluated for current and future hydrologic conditions, land use, topography, and canal infrastructure. Three sea level rise scenarios and five performance measures were applied to determine the performance of the drainage infrastructure and potential needs for improvement. The overall conclusions of the analysis are summarized below in five additional components:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of Watershed C-100, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S118, S119 and S120) showed limited capacity based on the cumulative and peak flow results for increasing SLR. The peak flow for both structures considerably decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S123 has limited discharge capacity based on the peak and cumulative flows, considering that there is a consistent decrease of discharges for increased SLR. Based on the results it was concluded that the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than + 2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop canal banks at many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that overtopping is present for return period greater than 5-yr event.

Localized Flood Potential: The flood maps (PM5 and PM6) showed that a 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The overall rating of Watershed C-100 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft. For this overall rating, weight was placed on PM1, PM5 and PM6 as the primary canals in this watershed collectively are expected to contain the 5-Year storm event within its canal banks as modeled.

6.4 C-102 Watershed Flood Protection Level of Service

There are four SFWMD water control structures in the C-102 Watershed: S21A, S165, S194 and S195.Figure 430 shows the inflows and outflows in this watershed. The structures are operated as discussed in 6.1.5.6.

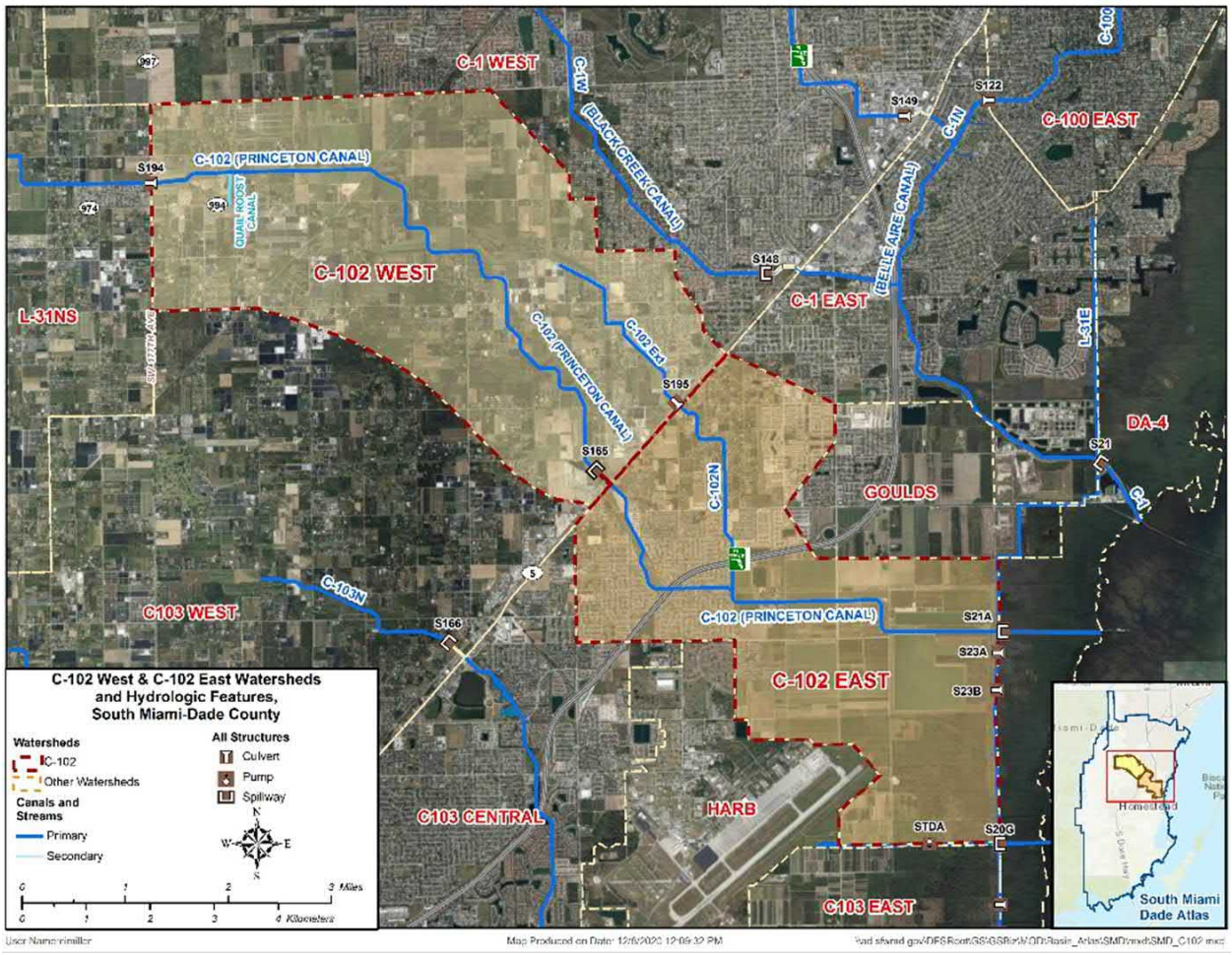


Figure 430. Drainage Network in C-102 Watershed (Source: SFWMD South Miami Dade Atlas)

6.4.1 C-102 Watershed: Structure S21A Gate Operation

The gates of structure S123 are closed when the head differential HW – TW is less than 0.1 ft. The gate operation and the corresponding tailwater, stages and operations are shown for SLR +1, +2 +3 for the 25-yr event. The gate operation of structure S21A for SLR 1, 2 and 3 are shown in Figure 431 and Figure 432.

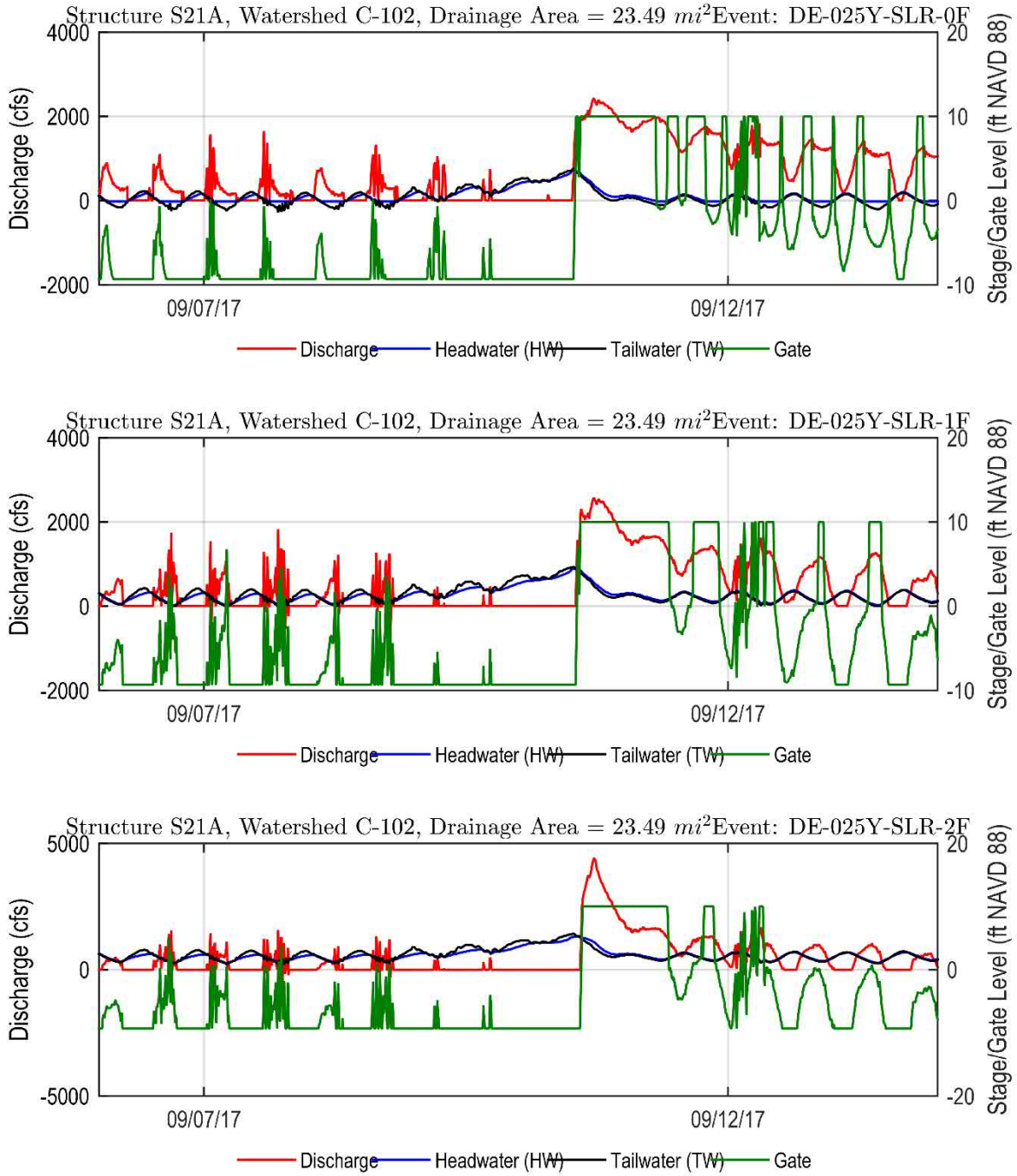


Figure 431. Gate Operation of Structure S123 for 25-yr Event and SLR 0, 1 and 2

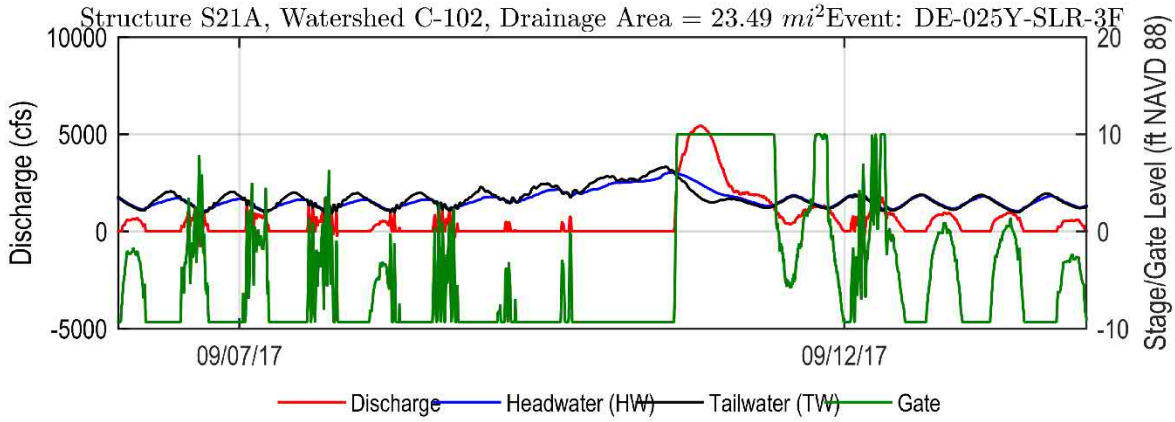


Figure 432. Gate Operation of Structure S123 for 25-yr Event and SLR 3

The gate operation patterns are similar for increasing the tailwater boundary conditions. The corresponding cumulative discharge for the S21 for the 25-Year event shows considerable increase of the cumulative discharges for gradual increase of SLR as a result of the increased upstream hold up of water. The upstream structures S148 and S149 show minimum change of cumulative discharges.

6.4.2 C-102: PM1 Maximum Stage in Primary Canals

To evaluate this PM under future conditions within the C-102 Watershed, instantaneous peak stage profiles were prepared for the primary canals. Bank elevations on the profile figures are based on the MIKE 1D cross-section data. The canal bank elevations were verified with elevations from the latest LIDAR data (from 2018). Also shown in the figures are major roadway landmarks, control structures, and primary canal junctions. A list of landmarks within Watershed C-102 and C-102N and peak stages for future conditions at SLR = 0, 1, 2 and 3 is provided in Table 219. Highlighted are water elevations which exceed one of the canal banks at specified chainage.

The canal profiles are provided in the following figures:

- Figure 433 and Figure 434 show the canal profiles for the C-102 watershed and includes canals C-102 and C-102N for the 5-yr Design Storm
- Figure 435 and Figure 436 show the canal profiles for the C-102 watershed and includes canals C-102 and C-102N for 10-yr Design Storm
- Figure 437 and Figure 438 show the canal profiles for the C-102 watershed and includes canals C-102 and C-102N for 25-yr Design Storm
- Figure 439 and Figure 440 show the canal profiles for the C-102 watershed and includes canals C-102 and C-102N for 100-yr Design Storm

Table 219 List of Landmarks and Design Water Elevations for Watershed C-102 canals (all elevations in ft NAVD 88)

Landmark	Canal	Mileage	Left Bank	Right Bank	5-yr SLR 0	5-yr SLR 1	5-yr SLR 2	5-yr SLR 3	10-yr SLR 0	10-yr SLR 1	10-yr SLR 2	10-yr SLR 3	25-yr SLR 0	25-yr SLR 1	25-yr SLR 2	25-yr SLR 3	100-yr SLR 0	100-yr SLR 1	100-yr SLR 2	100-yr SLR 3
Structure S194	C-102	7.023	15.000	15.000	3.070	3.872	5.031	5.689	3.320	4.905	5.562	6.308	6.166	6.392	6.695	7.181	7.502	7.604	7.811	8.002
SR-997 Crossing	C-102	7.097	9.301	5.098	3.051	3.868	5.032	5.689	3.311	4.910	5.560	6.306	6.155	6.384	6.691	7.181	7.505	7.608	7.815	8.006
Structure S-165	C-102	9.886	17.300	18.999	2.702	3.728	4.920	5.593	3.097	4.553	5.351	6.056	4.656	5.355	5.948	6.687	6.280	6.623	7.055	7.423
SR-5 Crossing	C-102	10.446	13.301	13.310	2.675	3.696	4.899	5.565	3.065	4.515	5.317	6.037	4.552	5.261	5.687	6.572	5.896	6.181	6.636	7.165
C-102N Junction	C-102	11.457	17.900	15.801	2.646	3.668	4.870	5.548	3.032	4.462	5.273	6.021	4.403	5.153	5.557	6.517	5.619	5.897	6.335	7.052
SR-821 Crossing	C-102	11.670	14.190	14.219	2.641	3.655	4.851	5.545	3.025	4.437	5.255	6.018	4.369	5.111	5.532	6.509	5.559	5.845	6.268	7.033
Structure S21A	C-102	15.009	4.199	4.783	2.380	3.380	4.380	5.380	2.848	3.848	4.848	5.848	3.665	4.665	5.665	6.665	4.502	5.502	6.502	7.502
Structure S195	C-102N	1.900	6.750	7.026	2.683	3.648	4.838	5.547	3.068	4.434	5.240	6.075	4.382	5.063	5.666	6.717	6.267	6.612	6.859	7.409
US-1 Crossing	C-102N	2.100	6.400	6.800	2.700	2.700	2.700	2.700	3.100	3.100	3.100	3.100	4.400	4.400	4.400	4.400	6.000	6.000	6.000	6.000
SR-821 Crossing	C-102N	3.900	7.000	6.000	2.600	2.600	2.600	2.600	3.000	3.000	3.000	3.000	4.300	4.300	4.300	4.300	5.500	5.500	5.500	5.500
Structure C-102	C-102N	4.300	7.000	5.000	2.600	2.600	2.600	2.600	3.000	3.000	3.000	3.000	4.300	4.300	4.300	4.300	5.500	5.500	5.500	5.500

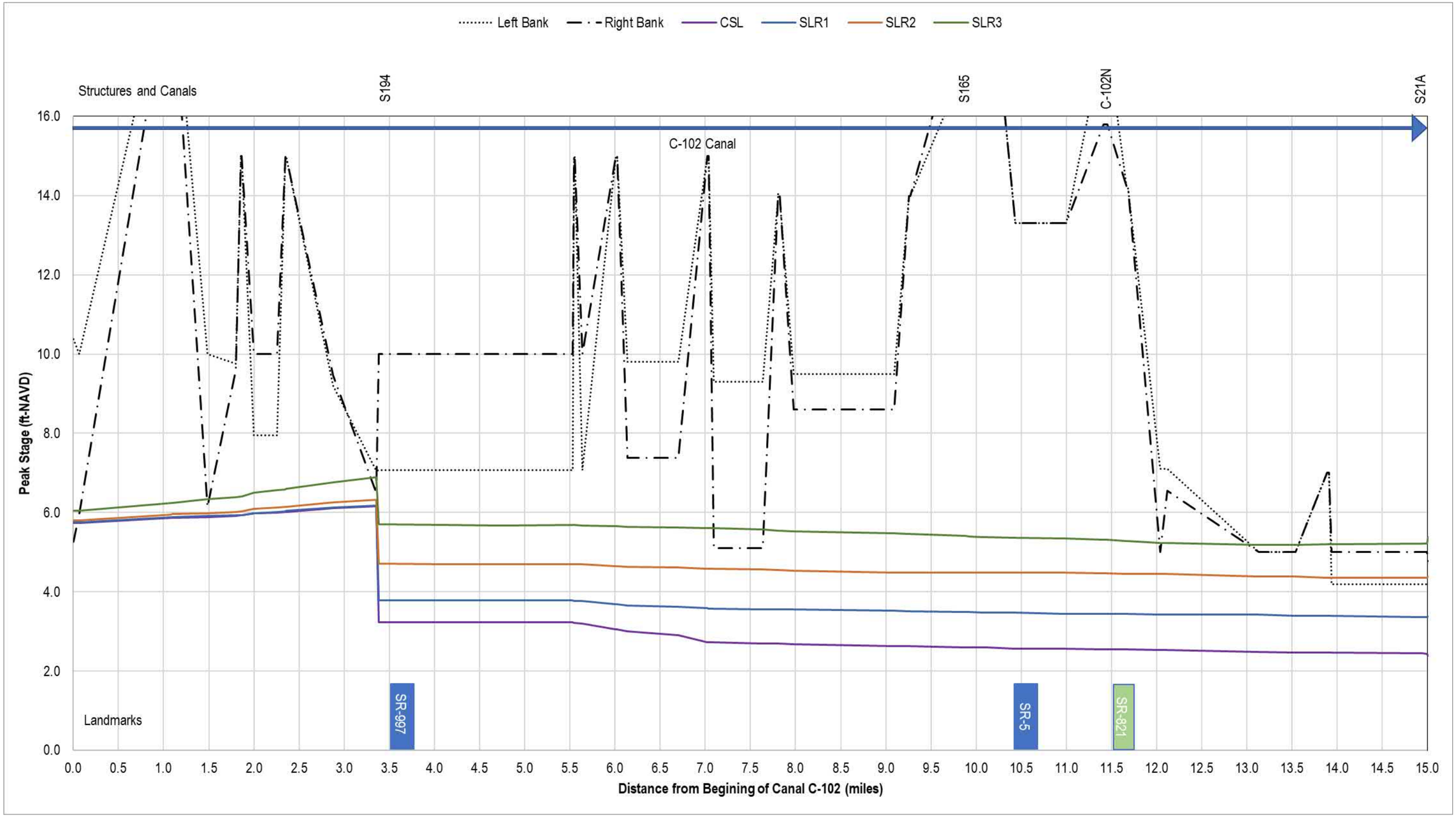


Figure 433 Profile of Peak Stages in Canal C-102 for Future Land Use and Topography for 5-yr Design Storm

Kimley»Horn

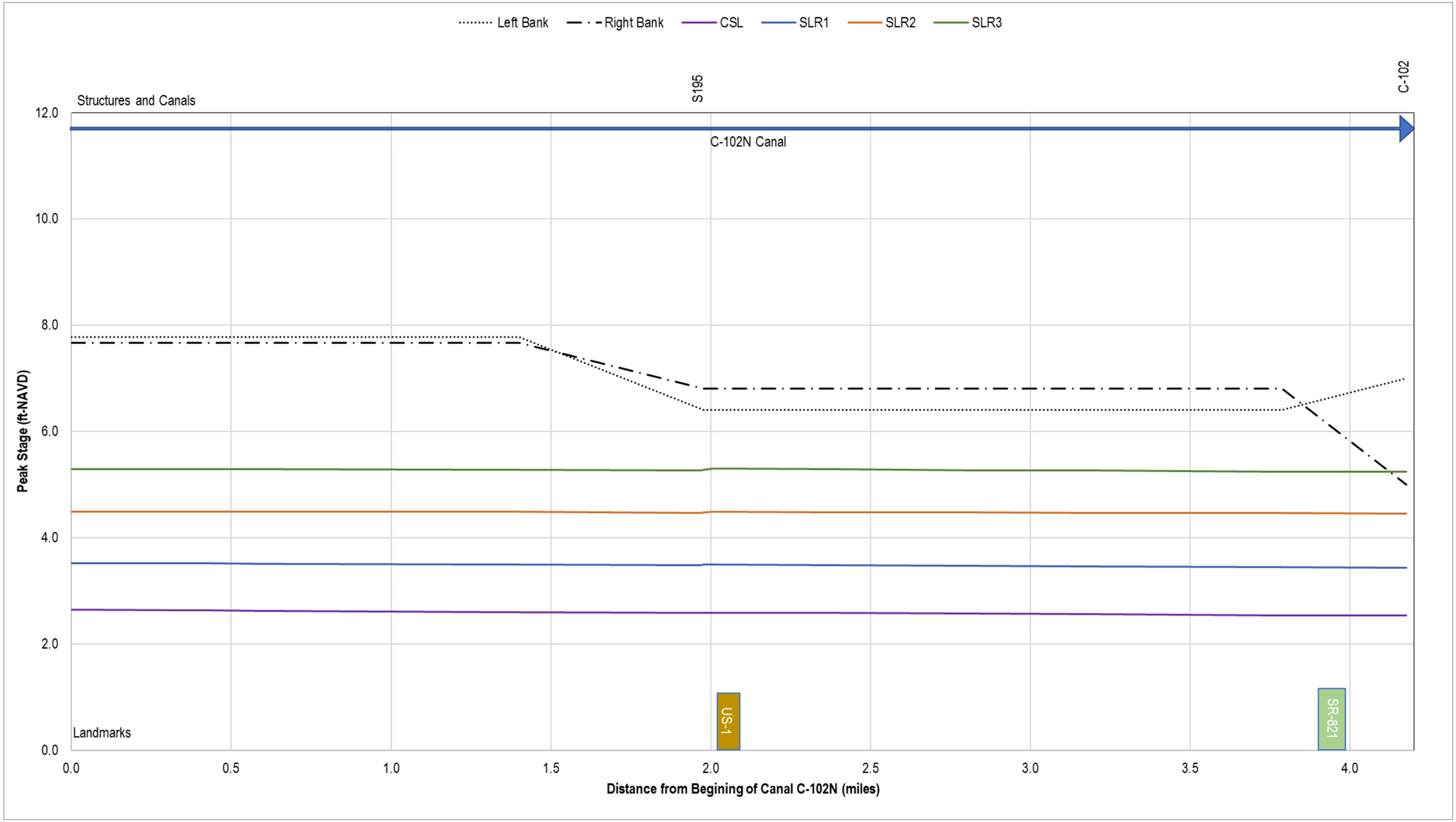


Figure 434 Profile of Peak Stages in Canal C-102N for Future Land Use and Topography for 5-yr Design Storm

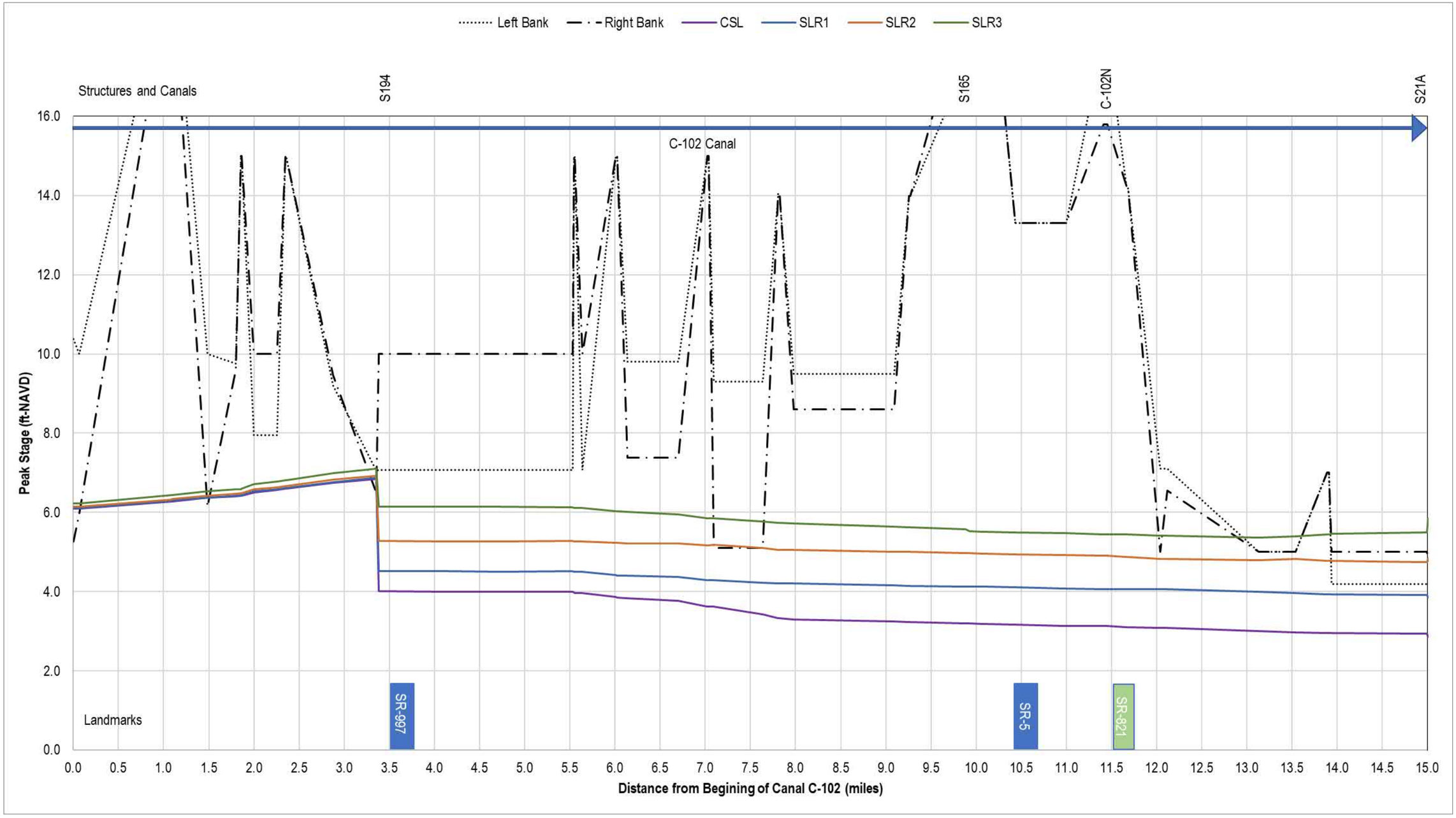


Figure 435 Profile of Peak Stages in Canal C-102 for Future Land Use and Topography for 10-yr Design Storm

Kimley»Horn

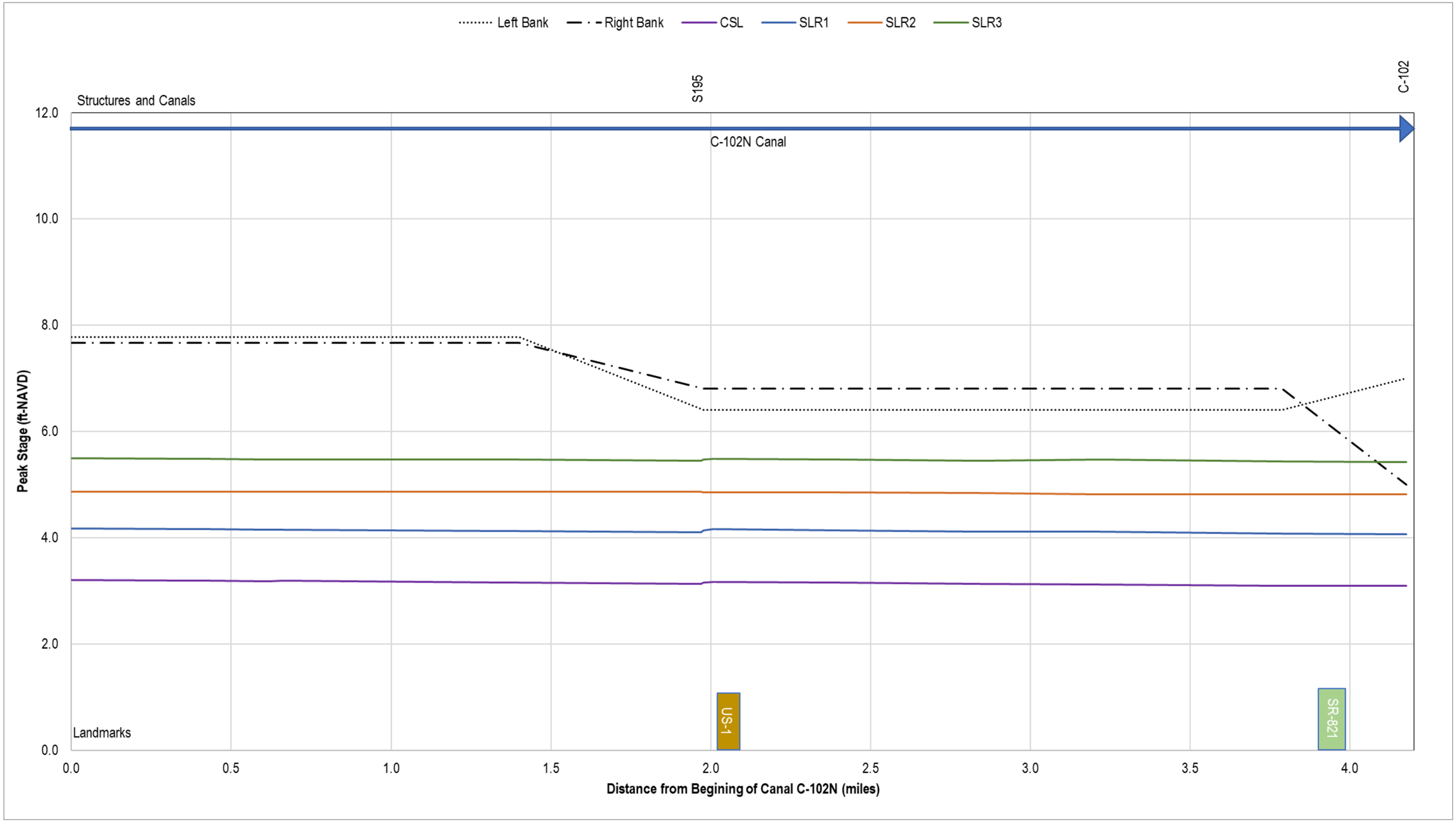


Figure 436 Profile of Peak Stages in Canal C-102N for Future Land Use and Topography for 10-yr Design Storm

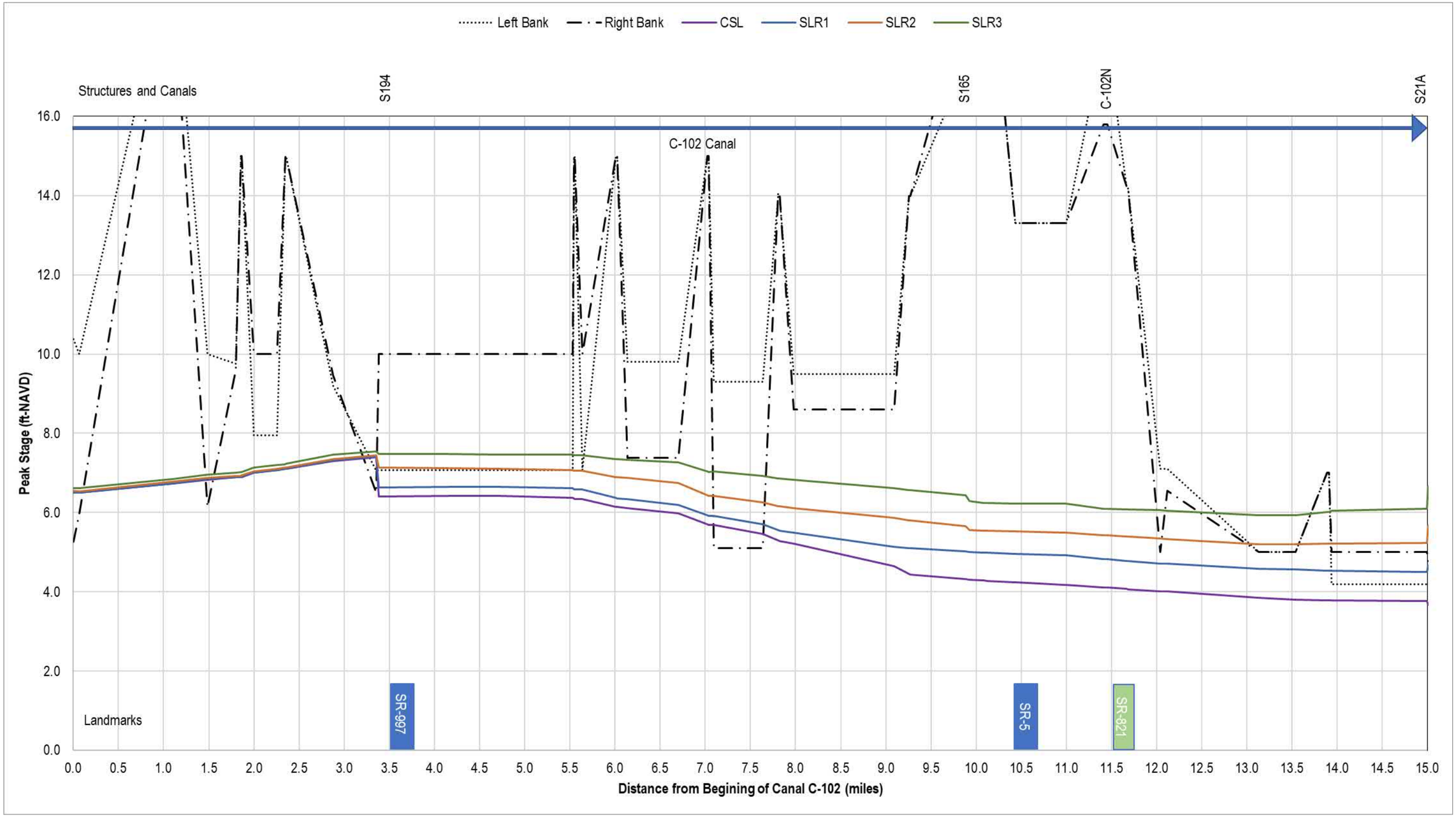


Figure 437 Profile of Peak Stages in Canal C-102 for Future Land Use and Topography for 25-yr Design Storm

Kimley»Horn

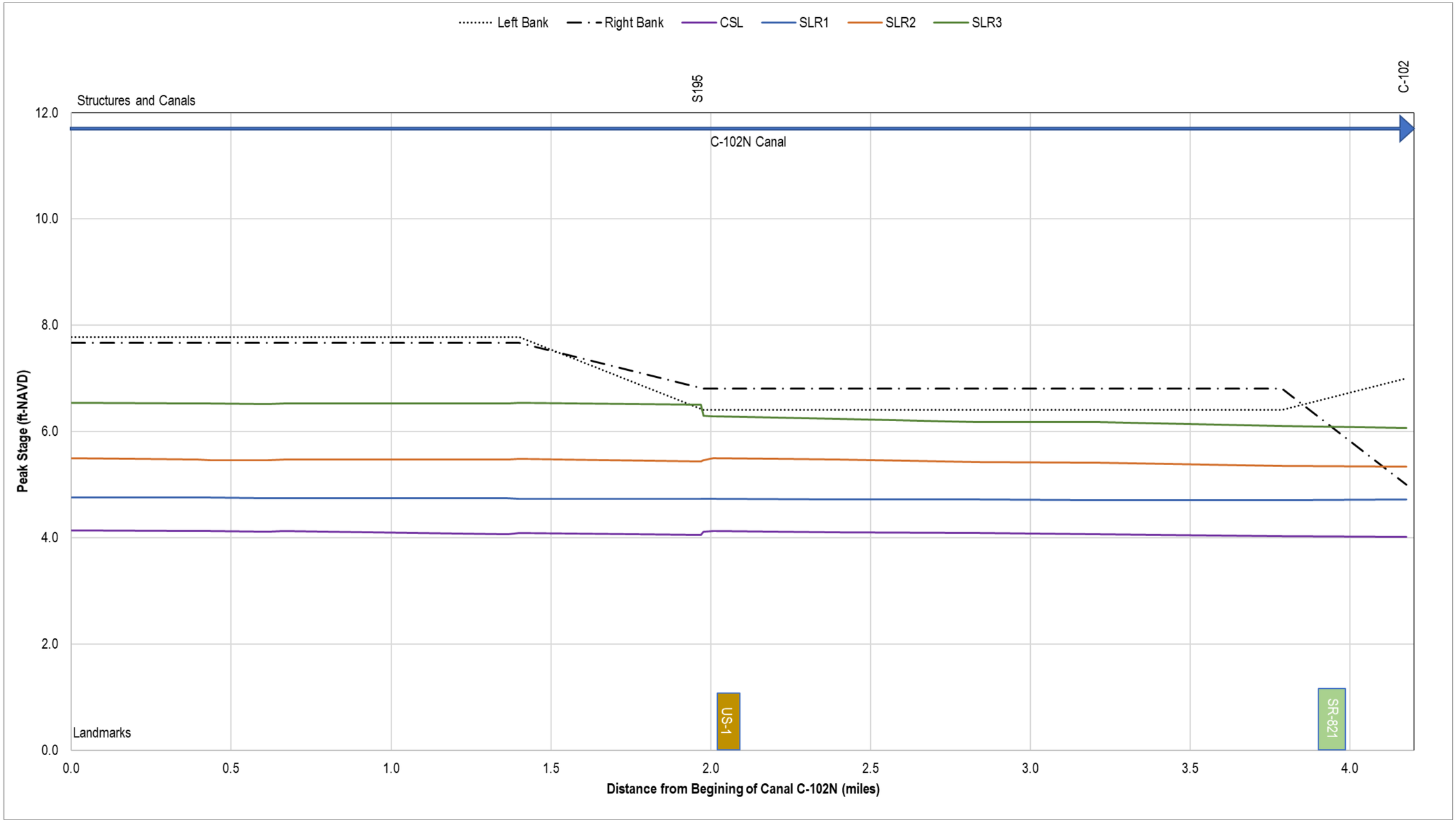


Figure 438 Profile of Peak Stages in Canal C-102N for Future Land Use and Topography for 25-yr Design Storm

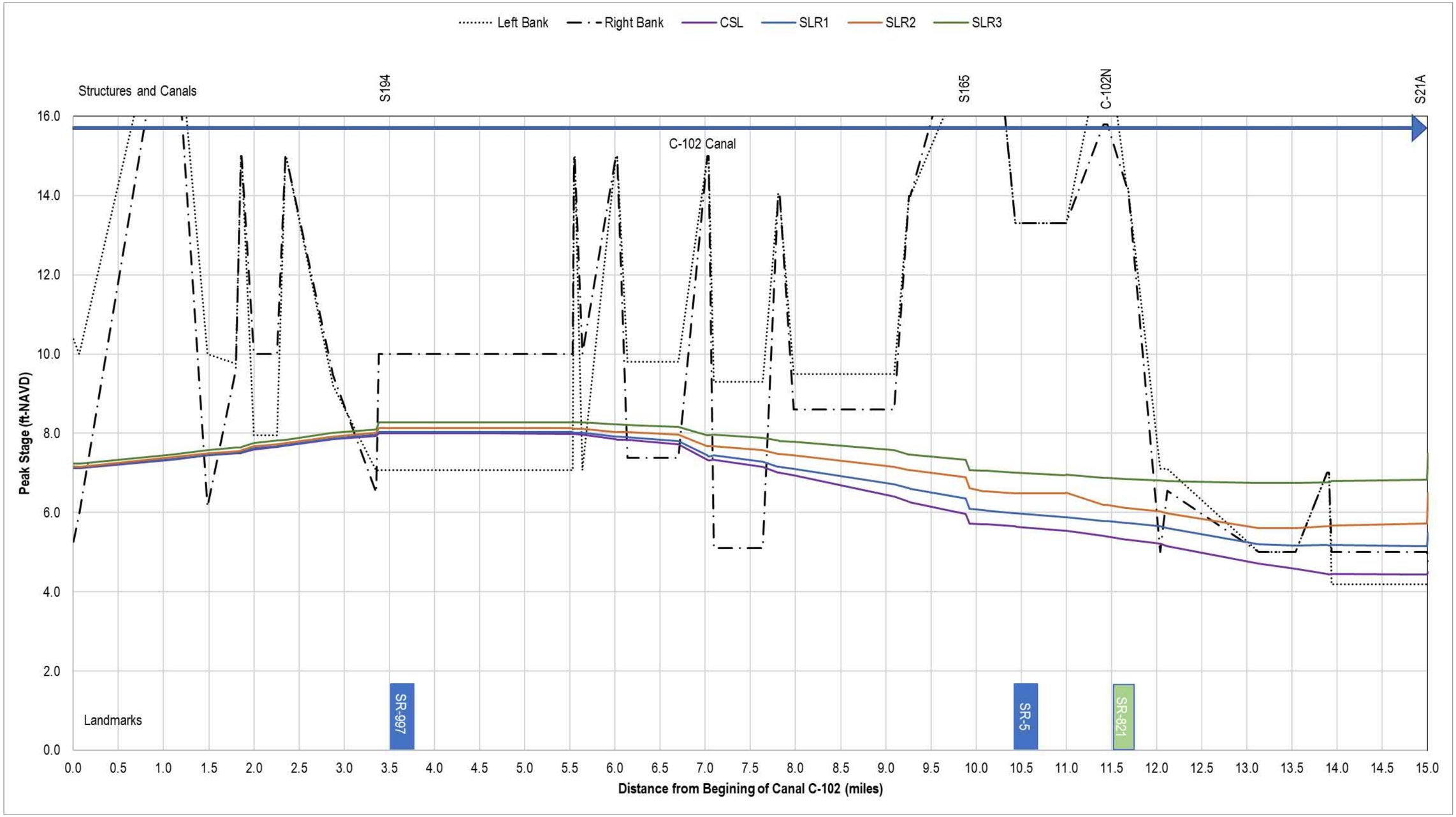


Figure 439 Profile of Peak Stages in Canal C-102 for Future Land Use and Topography for 100-Yr Design Storm

Kimley»Horn

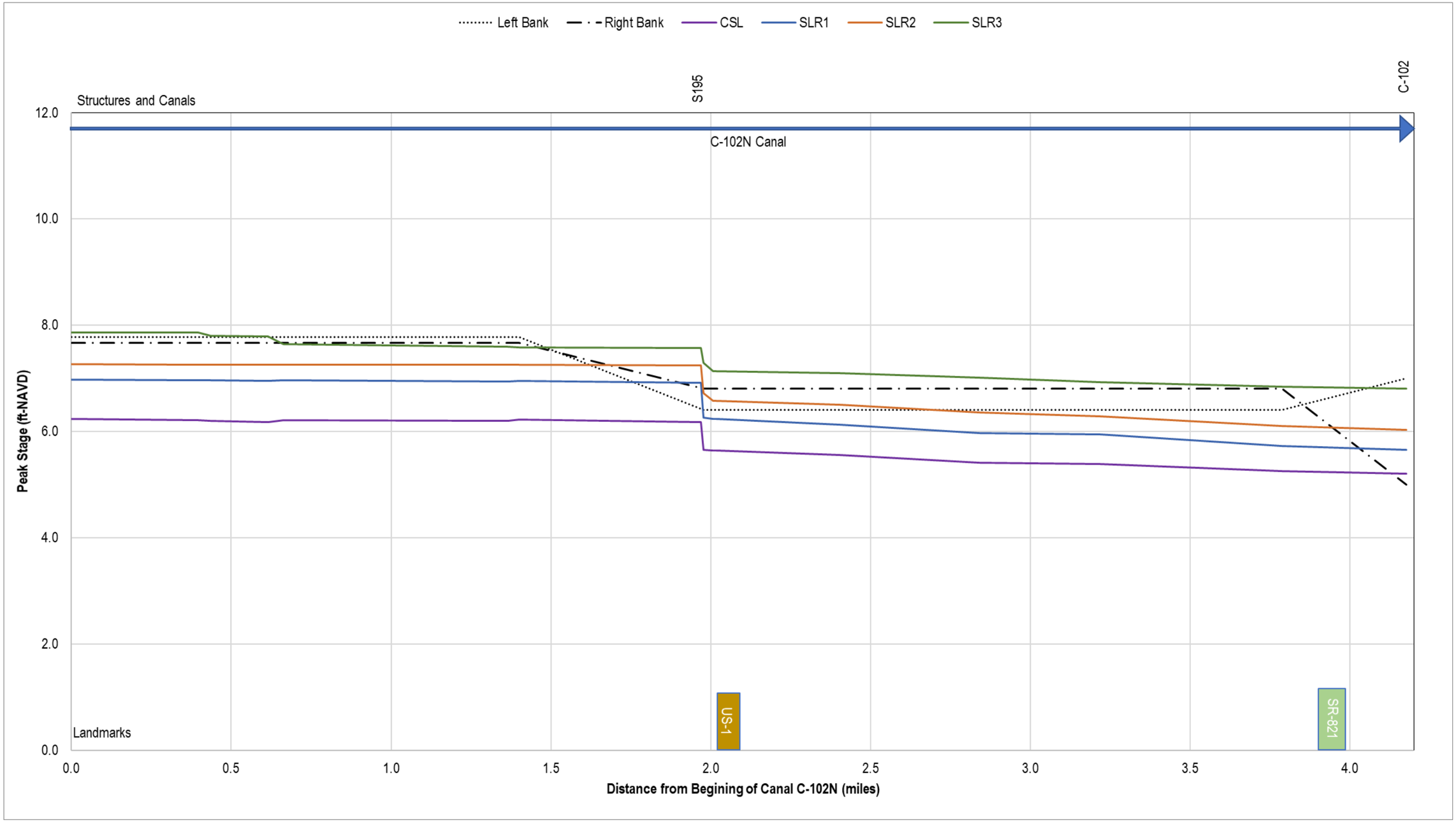


Figure 440 Profile of Peak Stages in Canal C-102N for Future Land Use and Topography for 100-Yr Design Storm

Kimley»Horn

The results of this analysis showed that the majority of the C-102 system of canals can convey the 25-Year event without overflowing; some sections can convey up to the 100-Year event. However, there are a few sections of which canals were identified that overflow during the 10-Year flood event for a short period of time. Almost at the headwaters of the C-102 Canal, water overflowed during a 5-Year event. The LOS was revised to refer to 5-yr, one of the initial considerations was that the canal is overtopped outside of the urban boundary (where agricultural and natural areas are the majority of the canals).

For PM1, the LOS rating of canals in the C-102 Watershed is shown in Table 220.

Table 220. LOS Rating of Canals in C-102 Watershed for PM1

Canal	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft2
C-102	Upstream of S194: 5-Year LOS	Upstream of S194: 5-Year LOS	Upstream of S194: less than 5-Year LOS	Upstream of S194: less than 5-Year LOS
	Downstream of S194 & upstream of S165/ SR-5: 10-Year LOS	Downstream of S194 & upstream of S165/ SR-5: 10-Year LOS	Downstream of S194 & upstream of S165/ SR-5: 5-Year LOS	Downstream of S194 & upstream of S165/ SR-5: 5-Year LOS
	Downstream of SR-5: 25-Year LOS	Downstream of SR-5: 10-Year LOS	Downstream of SR-5: 10-Year LOS	Downstream of SR-5: 150-Year LOS
C-102N	Upstream of US-1: 100-Year LOS	Upstream of US-1: 100-Year LOS	Upstream of US-1: 25-Year LOS	Upstream of US-1: 25-Year LOS
	Downstream of US-1: 100-Year LOS	Downstream of US-1: 100-Year LOS	Downstream of US-1: 25-Year LOS	Downstream of US-1: 25-Year LOS
	(Except for small section near S195	(Except for small section near S195	(Except for small section near S195	(Except for small section near S195

The overall rating of C-102 is 10-yr FPLOS for SLR = 0 and +1.0 ft and 5 years for SLR = +2.0 and +3.0 ft

6.4.3 C-102: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 221 provide information of the discharges and the drainage areas in the C-102 Watershed based on 12-hr moving averages discharge timeseries per square mile. For comparison the allowable discharge is defined as 49.95 csm for a 10-Yr design event. Highlighted are the exceedances for the 10-Yr design event.

Table 221 shows that with the exception of structure S195, for S21 A and S165, the peak drainages increase with increasing the SLR. The main reason for discharge increase for increasing SLR is attributed to the tailwater boundary condition which cause the gate to close resulting in accumulation of water volume upstream, followed by rapid gate opening and release. This pattern may be a result of relatively higher natural watershed drainage capacity while

decreasing discharge for higher tailwater may indicate relatively low natural drainage capacity. Furthermore, if the shape of the recession hydrograph curve is in larger head and tailwater differentials and correspondingly higher discharge rates may develop. Based on the results it is presumed that the shape of the recession hydrograph impacts the discharges in S195, however may significantly impact the discharge in S21A and S165.

Table 221. C-102 Watershed Peak Drainage Discharge Capacity (csm) Based on 12-hr Moving Average

Structure	Watershed Model	AHED Name	Area (mi^2)	Inflow Structure	Design Event	SLR 0	SLR 1	SLR 2	SLR 3
S21A	C-102	C-102 EAST	10.3674	S165,S195	5-Yr	59.78	53.92	59.32	97.08
					10-Yr	70.58	68.63	80.63	124.27
					25-Yr	88.25	89.80	119.88	172.64
					100-Yr	119.97	130.06	171.75	221.31
S165	C-102	C-102 WEST	11.1236	S194	5-Yr	24.17	22.90	24.76	29.65
					10-Yr	35.73	32.94	36.34	41.93
					25-Yr	54.96	52.57	53.44	53.53
					100-Yr	65.90	64.01	61.26	58.33
S195	C-102	C-102 WEST	2.00176	-	5-Yr	20.04	19.11	17.59	17.38
					10-Yr	21.80	21.12	21.84	31.98
					25-Yr	48.25	44.50	55.73	65.79
					100-Yr	157.57	140.05	157.38	171.42
The allowable discharge is defined as 49.95 csm									

Figure 441 and Figure 442 provide the weighted discharge timeseries for structure S21A for the 5-Yr, 10-Yr, 25-Yr and 100-Yr design events:

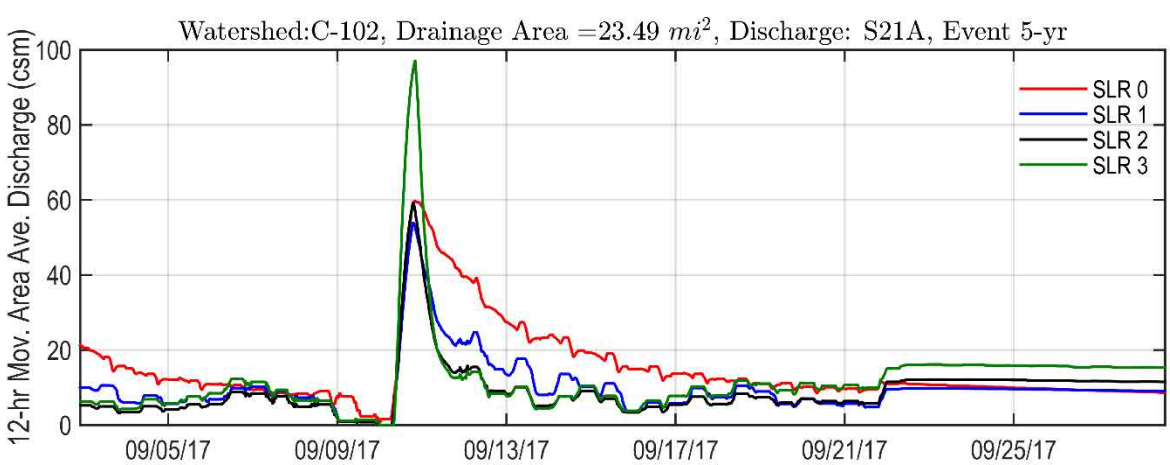


Figure 441. Area Weighted Discharge Capacity of S21A for the 5-Yr Design Event

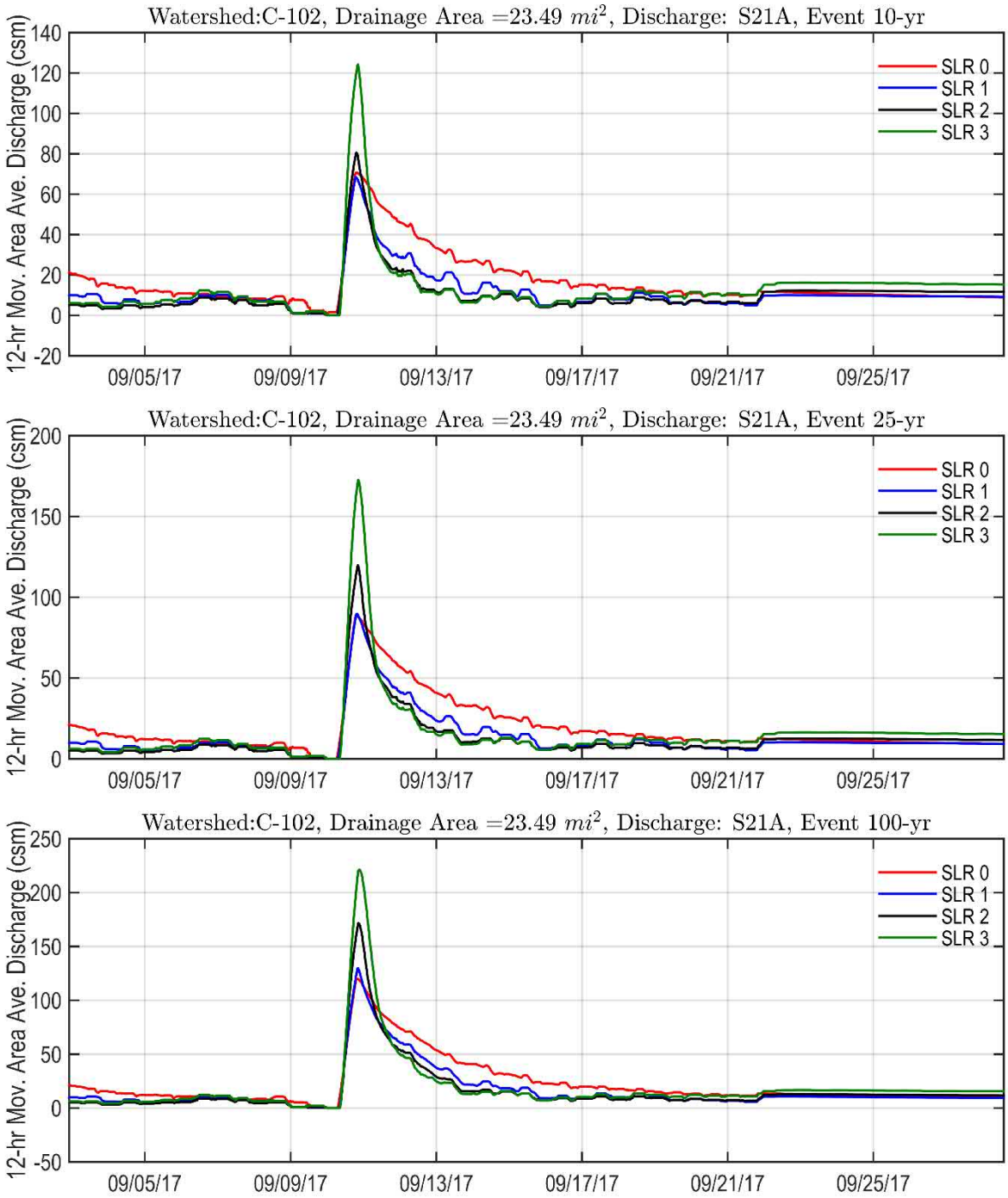


Figure 442. Area Weighted Discharge Capacity of S21A for the 10-Yr, 25-Yr and 100-Yr Design Events

6.4.4 C-102: PM3 S21A Structure Performance

This metric shows the effective capacity of the tidal structures and provides information about the peak instantaneous discharge capacity as a function of the design rainfall recurrence interval and SLR conditions. For this PM, the data were analyzed for:

- Stages and flows at structures at the time of peak flow
- Stages and flows at structures at the time of peak headwater stage
- Stages and flows at structures at the time of peak tailwater stage

The results were tabulated for all simulations and include 4 design events and 4 SLR conditions.

The design parameters of Structure S21A are listed in Table 222.

Table 222 Design parameters of Structure S21A

Structure	S123
Design Discharge	1330 cfs for 40% SPF
SPF Discharge	2500 cfs
Design Headwater Elevation	2.1 ft NGVD 29
Design Tailwater Elevation	1.6 ft NGVD 29
SPF Headwater Elevation	3.0 ft NGVD 29
SPF Tailwater Elevation	2.0 ft NGVD 29
Overtopping	7.0 ft NGVD 29

6.4.4.1 PM3: Structure S21A

Figure 443 and Figure 444 show instantaneous values for the 25-Year and 100-Year design storms for the SLR 1, 2 and 3 scenarios.

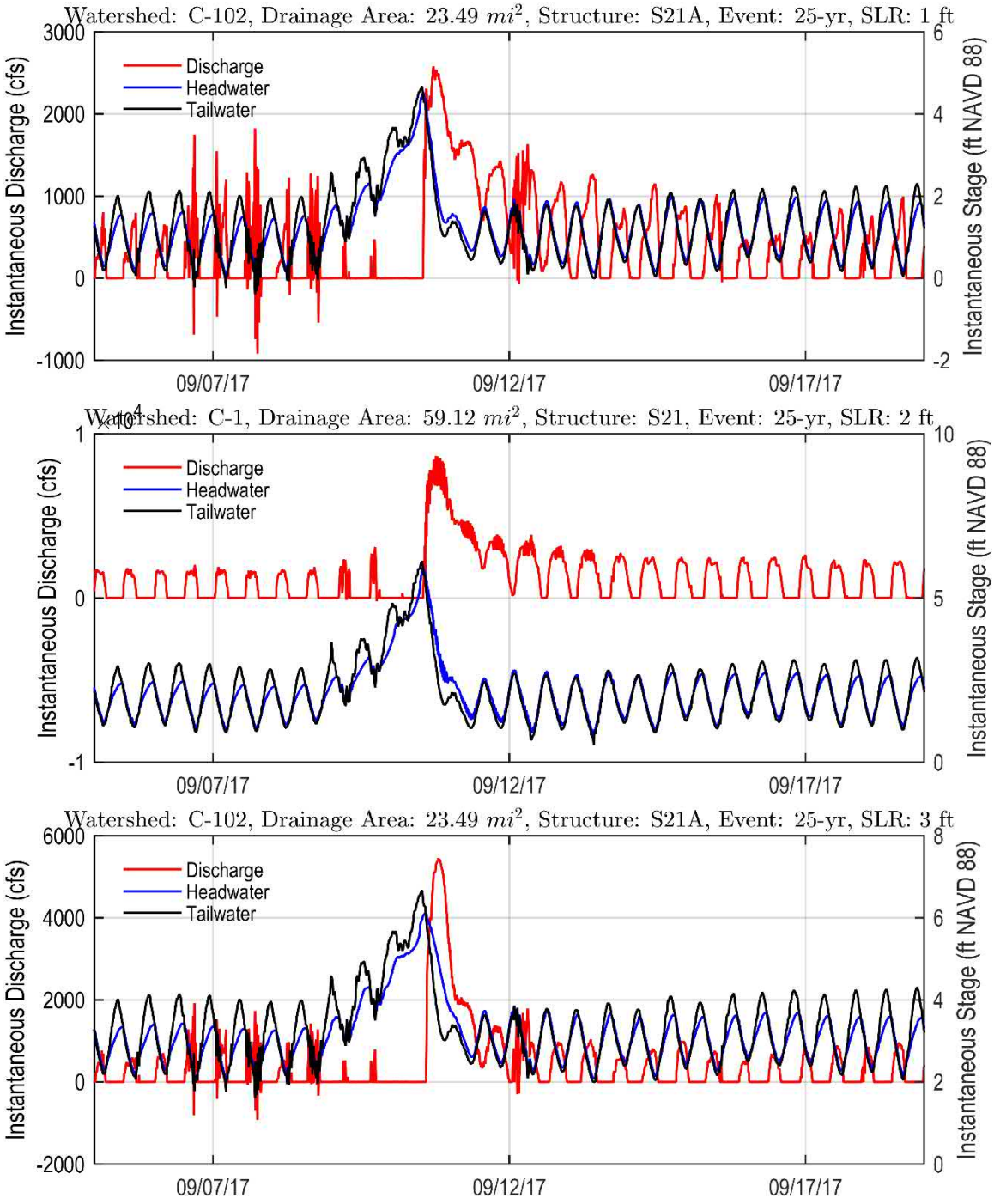


Figure 443 Structure S21A Instantaneous Conditions for 25-yr Design Events for SLR = 1, 2 and 3

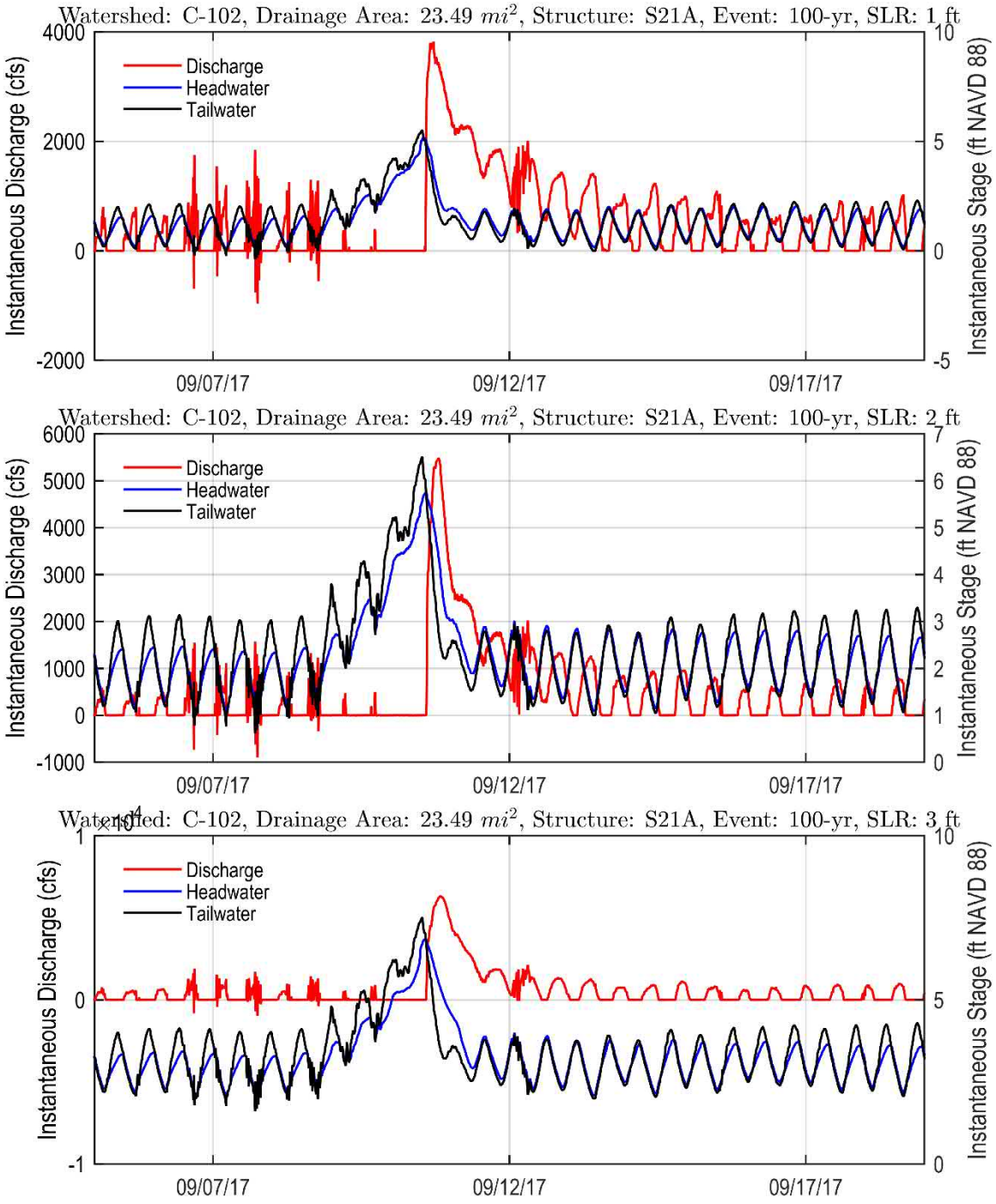


Figure 444 Structure S21A Instantaneous Conditions for 25-yr Design Events for SLR 1, 2 and 3

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 223. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 223 Structure S21A Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-102	S21A	23.490	SLR = +0 ft	1624	1765	2547	3449
			SLR = +1 ft	2331	2844	3081	4997
			SLR = +2 ft	4072	4983	5449	6053
			SLR = +3 ft	5648	6069	6338	6675

Table 224 provides a list of the instantaneous conditions at structure S21A at peak tailwater. The head differential is less or equal to the gate closing criteria, therefore the discharges are nearly zero for almost all events and SLR conditions except the 5-yr event for SLR 0, 1 and 2.

Table 224 Structure S21A Summary of Instantaneous Conditions at Peak Tailwater

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
5-yr	SLR 0	2.38	234.38	2.48	0.10
	SLR 1	2.85	352.91	2.95	0.10
	SLR 2	3.67	425.08	3.77	0.10
	SLR 3	4.50	-0.37	4.42	-0.08
10-yr	SLR 0	3.38	-0.17	3.31	-0.07
	SLR 1	3.85	-0.21	3.88	0.03
	SLR 2	4.67	-0.31	4.40	-0.26
	SLR 3	5.50	-0.45	5.01	-0.49
25-yr	SLR 0	4.38	-0.18	4.32	-0.06
	SLR 1	4.85	-0.24	4.61	-0.24
	SLR 2	5.67	-0.36	5.16	-0.50
	SLR 3	6.50	-0.45	5.53	-0.97
100-yr	SLR 0	5.38	-0.23	5.15	-0.23
	SLR 1	5.85	-0.28	5.39	-0.45
	SLR 2	6.67	-0.36	5.94	-0.73
	SLR 3	7.50	-0.45	6.67	-0.84

Table 225 provides the structure conditions at peak discharge.

Table 225 Structure S21A Summary Instantaneous Conditions at Peak Discharge

Design Event	Scenario	Peak Discharge cfs	TW at Peak Discharge ft NAVD	HW at Peak Discharge ft NAVD	Head Differential at Peak Discharge ft
5-yr	SLR 0	2902	-0.75	0.18	0.93
	SLR 1	2902	-0.75	0.18	0.93
	SLR 2	2902	-0.75	0.18	0.93
	SLR 3	3271	1.78	2.51	0.73
10-yr	SLR 0	1798	-0.75	-0.05	0.71
	SLR 1	2052	2.01	2.28	0.28
	SLR 2	2577	2.41	2.82	0.41
	SLR 3	3821	2.83	3.66	0.83
25-yr	SLR 0	1934	2.77	2.98	0.21
	SLR 1	2515	3.99	4.28	0.30
	SLR 2	4401	3.33	4.33	1.01
	SLR 3	5478	2.82	4.41	1.60
100-yr	SLR 0	3818	3.71	4.44	0.73
	SLR 1	4376	3.54	4.51	0.96
	SLR 2	5435	3.48	4.92	1.45
	SLR 3	6303	3.44	5.32	1.88

Figure 445 and Figure 446 provide a summary of discharge, headwater, tailwater and head differential for the 25-Yr and 100-Yr design events and SLR 1, 2, and 3 scenarios.

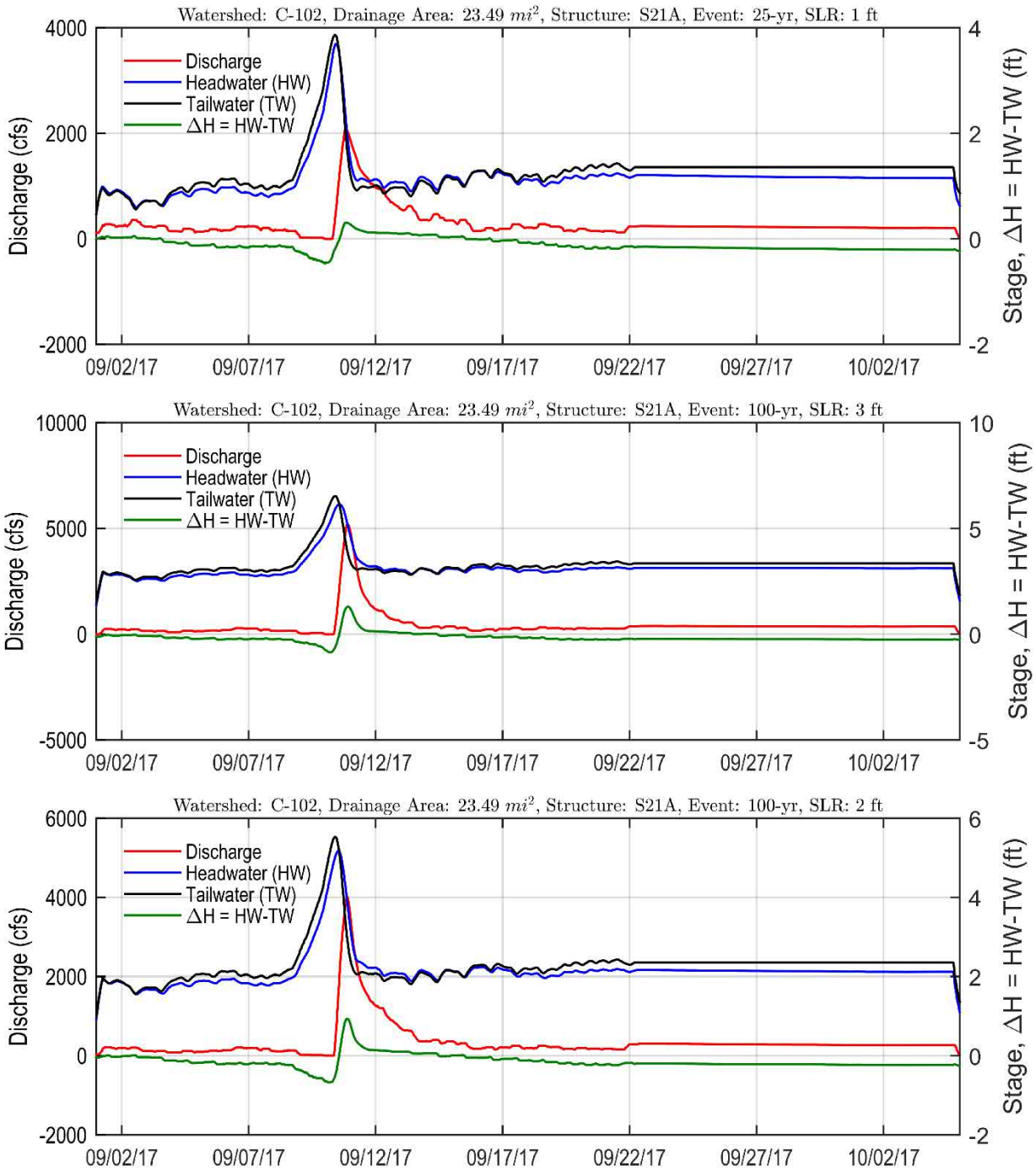


Figure 445 Structure S21A: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 25-Year Design Event for SLR 1, 2 and 3

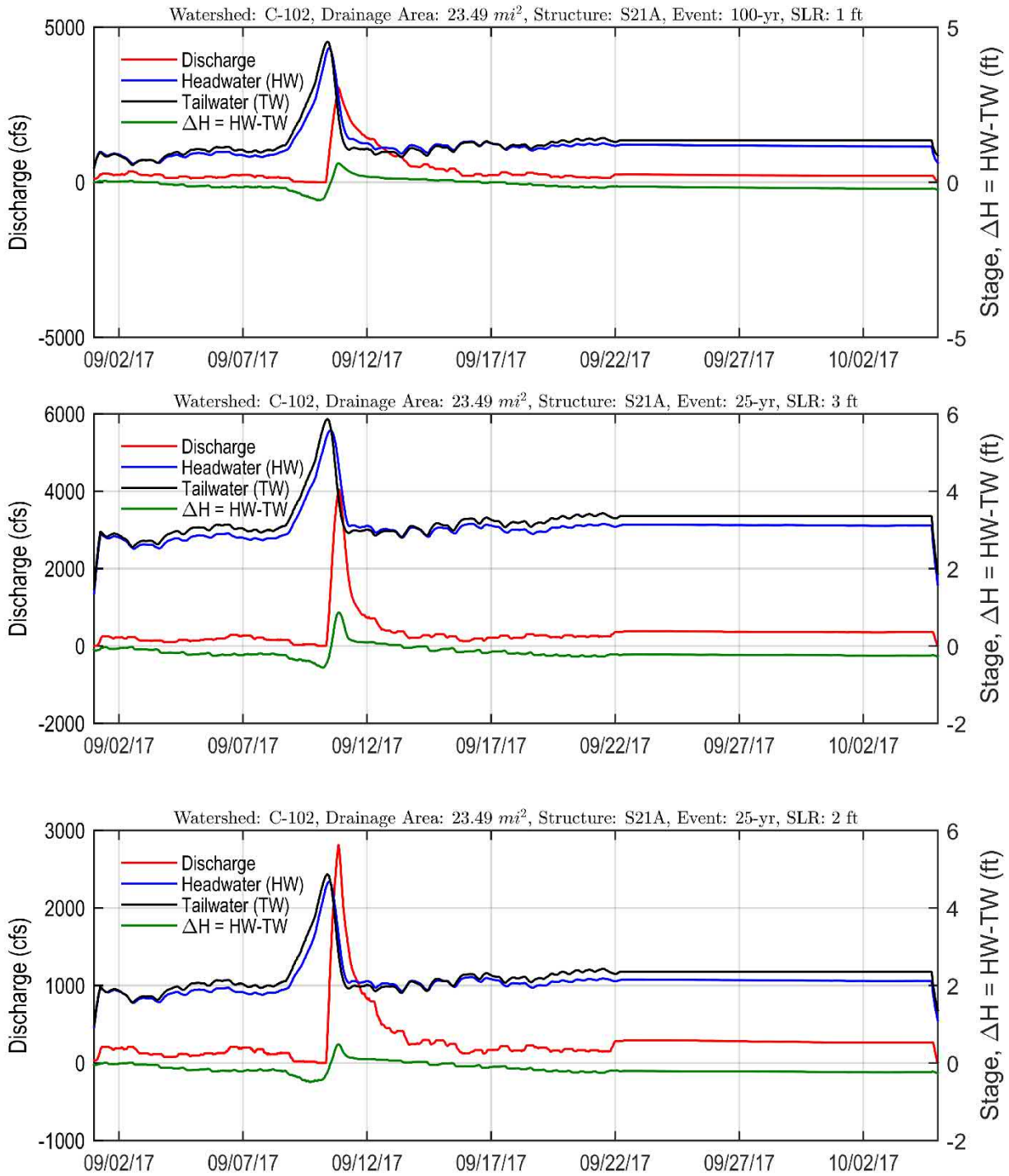


Figure 446 Structure S21A: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3

A summary of 12-hr averaged peak discharges is provided in Table 226. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater and the head differentials are provided. The head differential gradually increases up to 1.7 ft with increasing the tailwater boundary conditions and increasing the return period. The table shows the HW, TW and Head Differential values at peak discharge.

Table 226 Structure S21A 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-102	S21A	23.490	5-yr	SLR = +0 ft	0.404	0.582	0.178	1404
			5-yr	SLR = +1 ft	1.564	1.693	0.130	1267
			5-yr	SLR = +2 ft	2.549	2.687	0.138	1393
			5-yr	SLR = +3 ft	3.390	3.718	0.328	2280
			10-yr	SLR = +0 ft	0.588	0.829	0.241	1658
			10-yr	SLR = +1 ft	1.789	1.972	0.183	1612
			10-yr	SLR = +2 ft	2.721	2.941	0.220	1894
			10-yr	SLR = +3 ft	3.526	4.013	0.486	2919
			25-yr	SLR = +0 ft	0.909	1.267	0.358	2073
			25-yr	SLR = +1 ft	1.909	2.215	0.306	2109
			25-yr	SLR = +2 ft	2.816	3.298	0.482	2816
			25-yr	SLR = +3 ft	3.781	4.644	0.863	4055
			100-yr	SLR = +0 ft	1.215	1.835	0.620	2818
			100-yr	SLR = +1 ft	2.149	2.757	0.608	3055
			100-yr	SLR = +2 ft	3.045	3.977	0.932	4034
			100-yr	SLR = +3 ft	3.910	5.203	1.293	5199

Peak TW and Peak HW are reported using 12-hr averaging
Head differential is computed by subtracting HW-TW at the time of 12-hr Peak Discharge
12-hr moving average is computed by taking the centered average over 288 timesteps (timestep is 5-min)

The cumulative timeseries for structure S21A for the 5-yr, 10-yr, 25-yr and 100-yr design events are provided in Figure 447 and Figure 448.

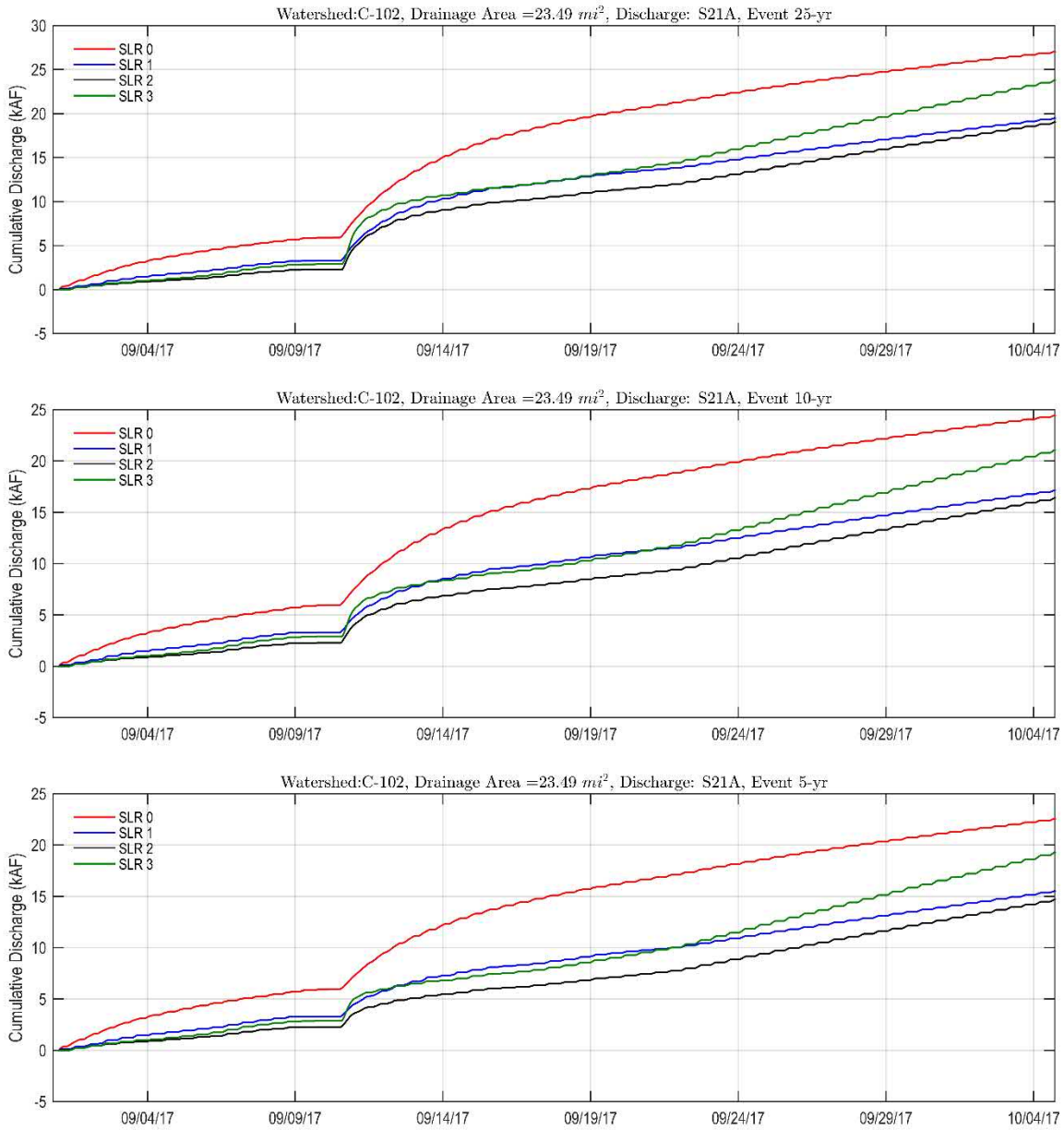


Figure 447. Cumulative Discharges of Structure S21A for 5-yr, 10-yr and 25-yr Events

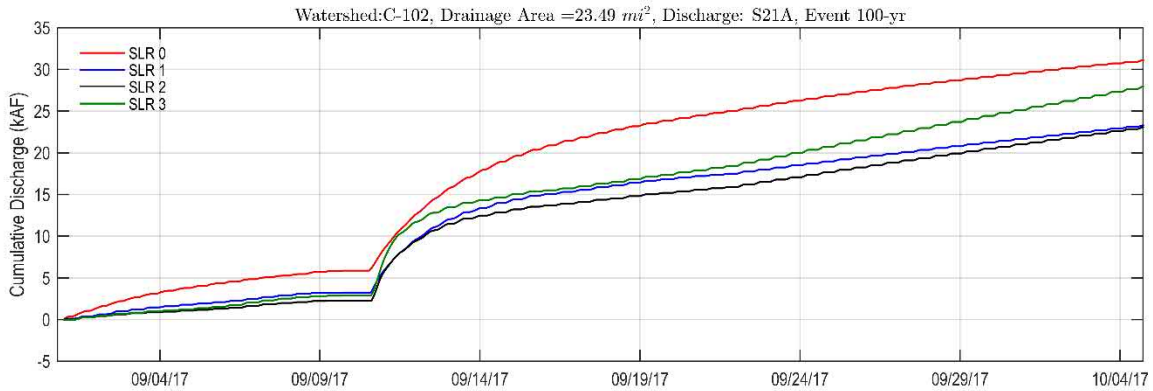


Figure 448. Cumulative Discharges of Structure S21A for 100-yr and 25-yr Event

6.4.4.2 PM3: Structure S165

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 227. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 227 Structure S165 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi2)	SLR	5-yr	10-yr	25-yr	100-yr
S21A	23.490	SLR = +0 ft	1624	1765	2547	3449	S21A
		SLR = +1 ft	2331	2844	3081	4997	
		SLR = +2 ft	4072	4983	5449	6053	
		SLR = +3 ft	5648	6069	6338	6675	

6.4.4.3 PM3: Structure S195

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 228. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 228 Structure S195 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-102	**S195**	2.000	SLR = +0 ft	92	92	92	354
			SLR = +1 ft	55	63	103	330
			SLR = +2 ft	59	70	137	356
			SLR = +3 ft	63	83	145	340

6.4.5 C-102: PM4 Watershed Peak Storm Runoff

PM4 represents discharge at tidal structure S21A from the 12-hr moving average discharge of the design storm on the C-102 Canal. These discharge hydrographs, particularly the peak discharge, will be compared with the peak discharge under future sea level rise scenarios when executed.

6.4.5.1 PM4: Structure S21A

The 12-hr Moving Average Flow Timeseries at S21A for Design Events and SLR = 0, 1, 2 and 3 are provided in Figure 449 for the 5-Yr, 10-Yr and 25-Yr design events and in Figure 450 for the 100-Yr design event.

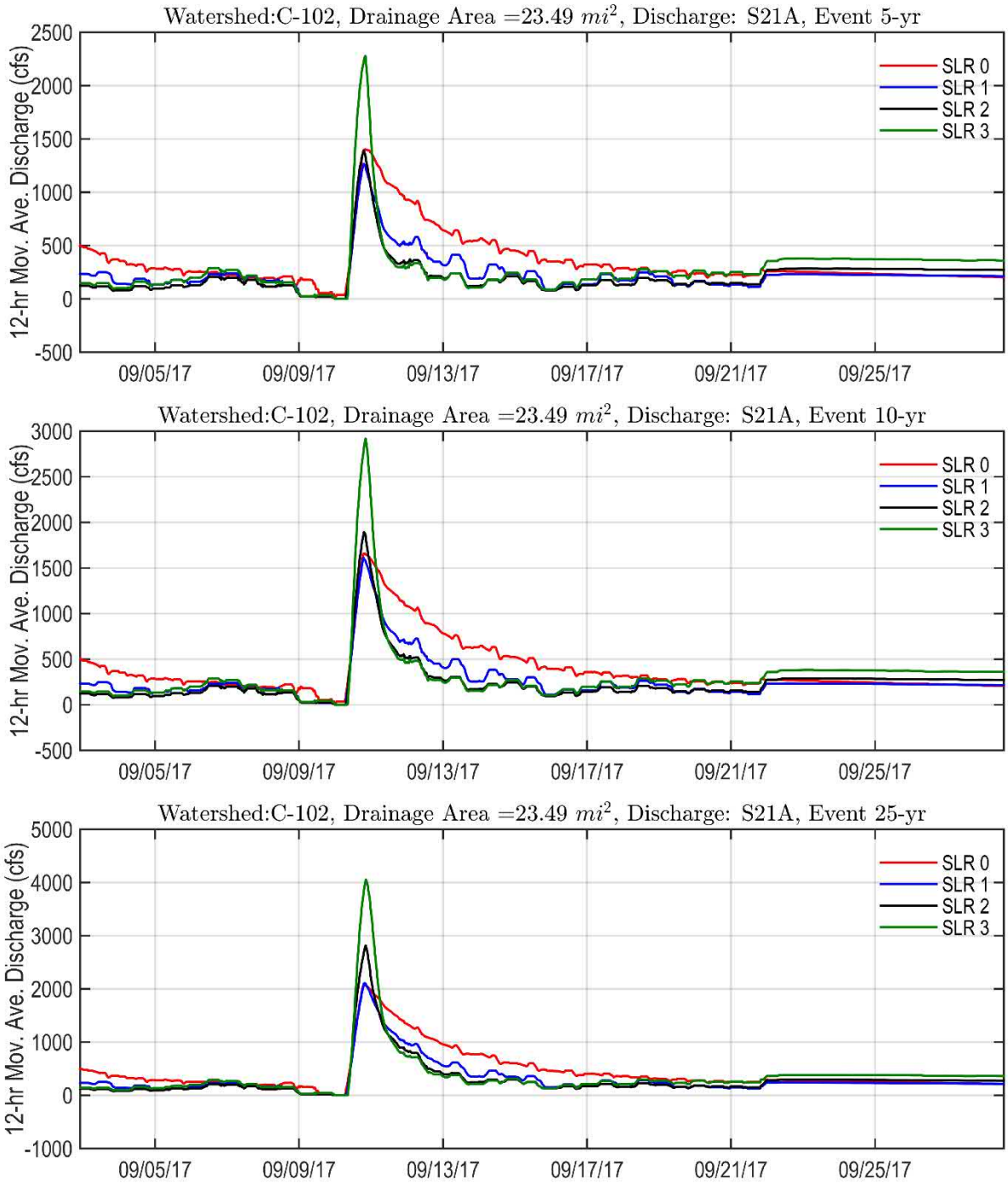


Figure 449. 12-hr Moving Average Flow Timeseries at S21A for SLR = 0, 1, 2 and 3 for the 5-yr, 10-yr and 25-yr Design Events

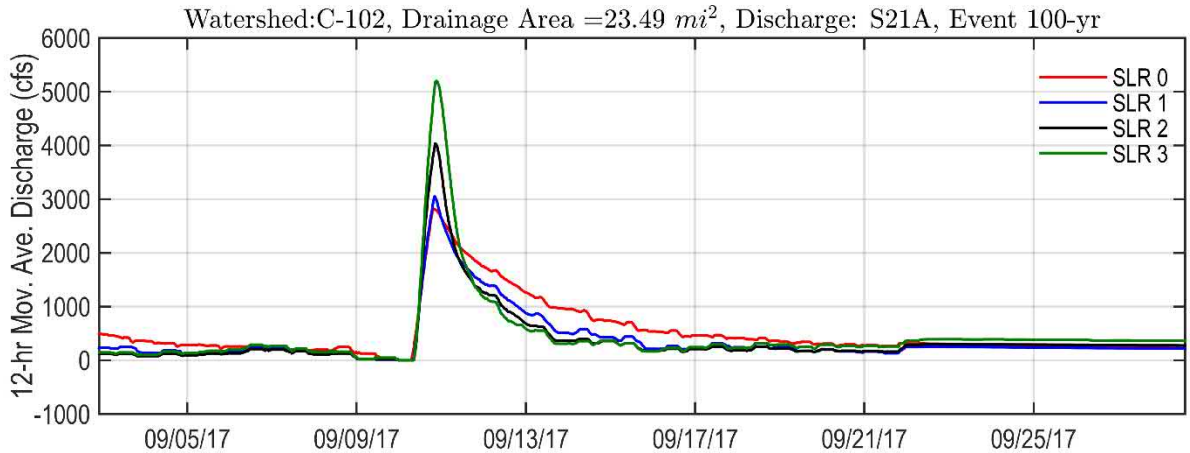


Figure 450. 12-hr Moving Average Flow Timeseries at S21A for for SLR = 0, 1, 2 and 3 and the 100-yr Design Event

The peak 12-hr moving average peak discharges are provided in Figure 451.

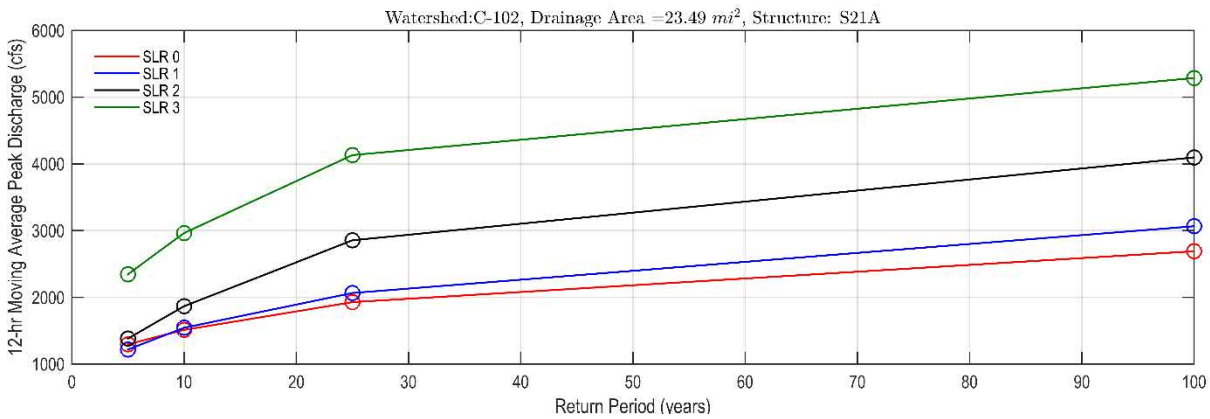


Figure 451 Structure S21A 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The design criterion for the S21A Structure is 1330 cfs, which is 40% of the Standard Project Flood, (2,500 cfs) provided in the SFWMD Structure Book. The peak 100-Year flow rate through the open structure in the model is 2,868 cfs for instantaneous discharge and 2,477 cfs for 121-hour moving average.

The main factors for the higher computed discharge values at the structures is attributed to the difference in the boundary conditions used to derive the structure capacity and the boundary outfall conditions used in the model. The original design uses a steady state boundary of 2.0 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.6 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (applying the 100-yr Outfall Timeseries provided by SFWMD or using the steady state boundary originally used as design criteria).

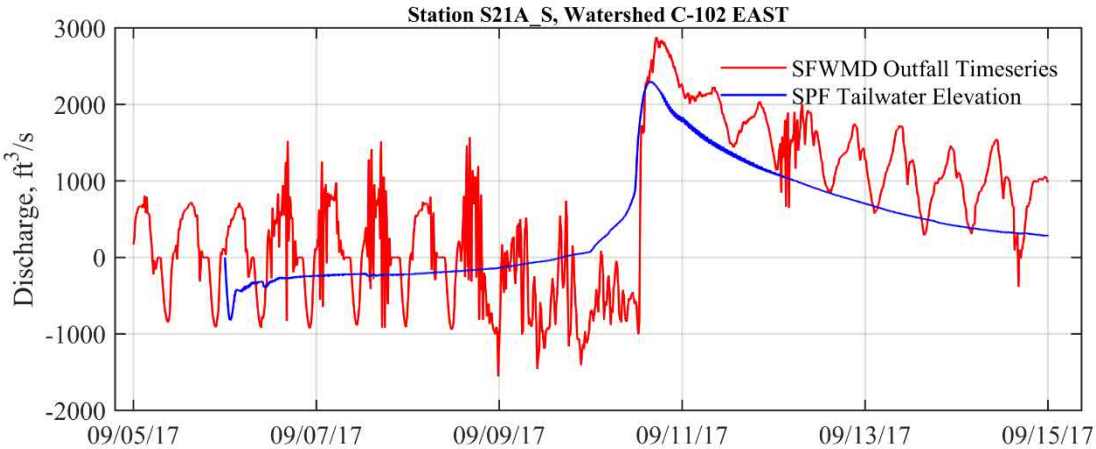


Figure 452 Comparison of Discharges at Structure S21A for the Design SPF Tailwater Elevation and SFWMD Tailwater Boundary Condition for 100-Yr Storm

6.4.5.2 PM4: Structure S165

The 12-hr moving average peak discharges are provided in Figure 453 for structure S165:

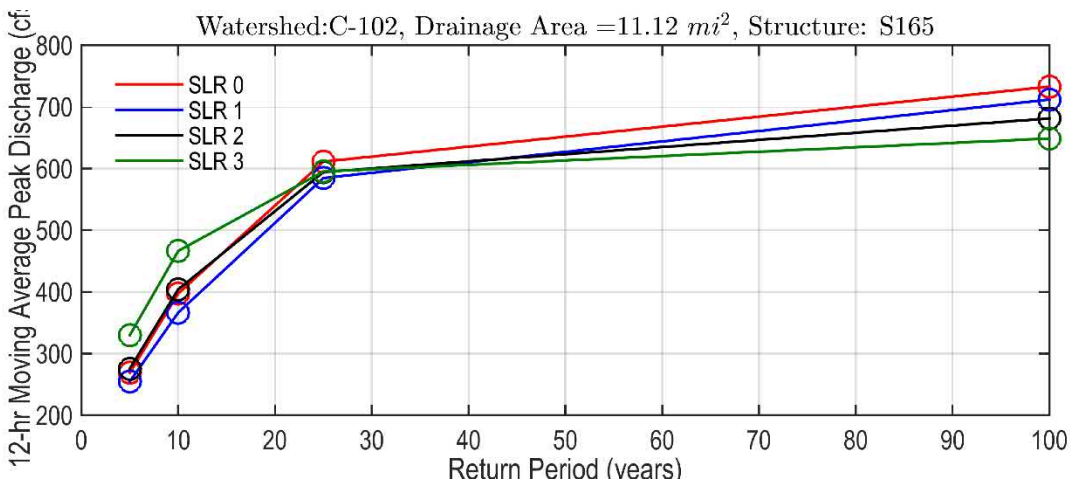


Figure 453 Structure S165 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.4.5.3 PM4: Structure S195

The 12-hr moving average peak discharges are provided in Figure 454 for structure S195:

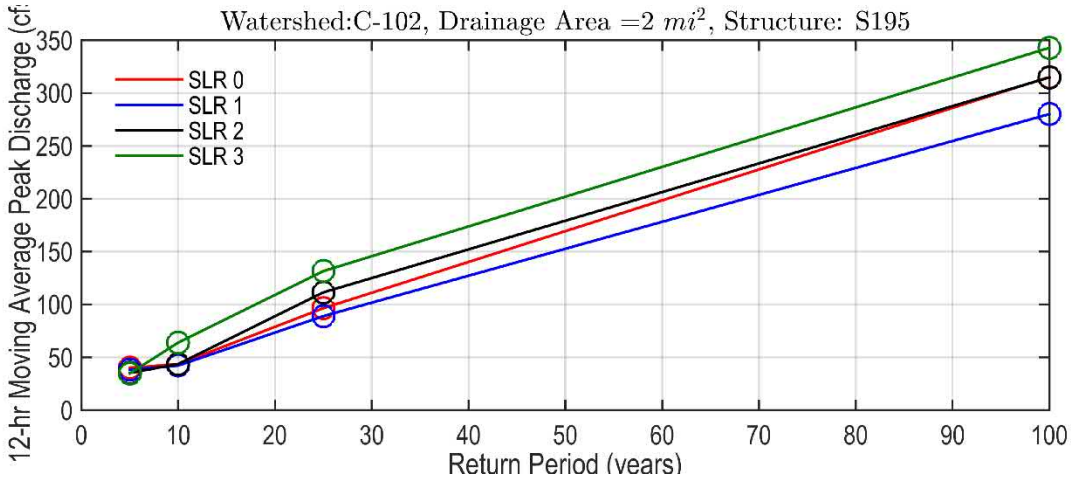


Figure 454 Structure S195 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.4.6 C-102: PM5 Flood Frequency

The area of flooding was summarized for the C-102 Watershed in a series of maps shown in Appendix A Flood Maps, which show the inundation depths for the watershed, agricultural, urban and wetland areas in the C-102 Watershed, for the 5-Year, 10-Year, 25-Year, and 100-Year 72-hour design storm events, respectively. The total area of the C-102 watershed is 15,035.38 acres (based on GIS data). The values in the tables are based on discretization to 5 ft raster which results in total watershed area 14,925 acres with 4,764 acres urban land, 8,303 acres agricultural and 2,177 acres wetlands.

The information in Table 229 through Table 230 includes the following information:

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

For PM5, C-102 watershed is assigned a LOS rating of 5-Year, due to the flooding in the agricultural areas in C-102 Watershed that floods for 10-Year event.

Most areas upstream of SR-821 (Florida Turnpike) and around C-102 canal area have 2.25+ feet of water for 100-Year design event, and 1 – 2.25 feet for 25-Year design event. Areas between SW 216th Street and SR-821 have flooding depth >2.25 feet for 25-Year event. Areas between S194 and S165 structures are experiencing a significant amount of flooding, for 25-Year and 100-Year design storms and, this can be due to lack of conveyance in the primary canal C-102 – this

is evidenced by C-102 canal overflowing (PM1). For 10-Year events, these areas have no flooding.

Agriculture areas located in C-102 East watershed are mostly low-lying areas which experience considerable amount of flooding for 10-Year, 25-Year and 100-Year events. For the 5-Year design event, flooding depth is less than 0.5 feet. Urban areas across the AHED watershed have less impact from peak stages, relative to the agricultural areas.

Areas upstream of US-1 have 2-2.5 feet of flood depth around C-102N for 100-Year design storm and less than 0.75 feet for 25-Year design event. For 10-Year and 5-Year events, the flooding depth is less than 0.5 feet.

The corresponding flood extent and maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions**:**

- Figure B-193 through Figure B-208 provide flood extent maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-225 through Figure B-240 provide flood extent maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-257 through Figure B-272 provide flood extent maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Table 229. Summary of the PM5 Flood Inundation in Acres for the C-102 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	11261	10512	10292	9731	9054	10245	9346	9316	8755	8043	8654	7655	7636	7196	6533	5931	5034	5090	4680	4233
0.25 >= 0.50	929	988	739	628	660	791	1087	820	835	937	1043	1399	1305	1270	1285	1559	1925	1843	1922	1853
0.50 >= 0.75	855	1008	667	489	465	855	956	697	610	539	808	946	759	712	778	1092	1218	1114	1092	1132
0.75 >= 1.00	692	788	665	465	398	843	971	697	512	509	776	833	647	578	613	850	917	796	798	756
1.00 >= 1.25	395	546	618	465	363	754	813	645	460	403	843	922	707	529	455	722	798	702	591	593
1.25 >= 1.50	252	346	578	395	289	499	571	556	465	341	746	895	583	465	415	714	759	588	526	578
1.50 >= 1.75	128	178	437	373	269	287	319	578	373	284	647	677	541	413	381	672	675	534	390	390
1.75 >= 2.00	91	128	301	358	287	173	235	512	326	252	423	477	544	378	284	734	781	571	440	390
2.00 >= 2.25	356	423	173	462	269	79	133	341	356	245	289	299	578	385	245	736	803	477	353	366
2.25 >= 2.50	5	35	59	408	262	366	353	240	368	235	163	175	479	314	250	539	578	504	331	292
>= 2.50	99	111	534	1290	2748	173	279	662	2004	3277	672	786	1285	2824	3825	1515	1577	2844	3939	4480
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 covers 15,064 acres																				

Table 230. Summary of the PM5 Flood Inundation in Acres for the Urban Areas of the C-102 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	6032	5592	5510	5162	4710	5454	4922	4908	4569	4117	4492	4008	3971	3712	3299	3037	2740	2728	2456	2229
0.25 >= 0.50	494	516	410	403	410	435	620	499	516	526	630	778	731	687	687	857	979	944	988	892
0.50 >= 0.75	393	492	410	299	292	450	526	418	383	321	474	519	442	415	445	623	657	596	558	563
0.75 >= 1.00	324	400	390	297	259	460	494	415	329	353	457	467	400	346	348	469	479	423	425	390
1.00 >= 1.25	168	247	294	240	232	353	390	361	274	245	467	551	442	351	259	430	437	410	324	341
1.25 >= 1.50	99	151	255	222	185	188	257	299	255	213	371	425	343	289	272	413	437	339	321	329
1.50 >= 1.75	72	89	161	203	158	119	136	269	208	173	269	294	282	259	255	383	343	279	200	240
1.75 >= 2.00	22	52	84	193	171	79	109	175	185	161	158	195	269	208	178	420	437	366	297	222
2.00 >= 2.25	25	59	62	227	136	37	52	106	193	171	119	114	257	213	128	316	381	306	247	255
2.25 >= 2.50	2	22	27	163	141	35	44	89	190	133	64	84	175	166	171	185	222	272	203	180
>= 2.50	57	67	84	279	993	79	136	148	586	1275	185	252	373	1043	1646	554	573	1025	1668	2046
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 urban areas cover 7,687 acres																				

Table 231. Summary of the PM5 Flood Inundation in acres for the Agricultural Areas of the C-102 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	5933	5644	5703	5441	4747	4127	3899	3956	3642	3062	2466	2150	2179	2036	1769	1075	981	991	946	860
0.25 >= 0.50	2681	2807	2773	2908	3146	3094	3141	3096	3052	2664	2150	2115	2021	1858	1680	1055	1095	1105	1060	956
0.50 >= 0.75	1038	1075	1063	1129	1408	1900	1930	1908	2118	2565	2911	2879	2829	2637	2219	1384	1451	1428	1359	1208
0.75 >= 1.00	316	415	400	442	529	692	786	791	877	1119	1646	1796	1880	2073	2278	2053	1972	1940	1762	1577
1.00 >= 1.25	99	111	121	131	171	185	232	232	267	447	645	771	764	932	1270	2434	2189	2145	2100	1962
1.25 >= 1.50	40	49	44	49	69	84	82	86	99	156	185	262	284	361	521	1226	1408	1455	1611	1777
1.50 >= 1.75	17	17	15	17	40	27	37	40	47	62	79	84	96	133	240	549	598	613	714	1016
1.75 >= 2.00	10	10	7	5	10	15	17	12	17	32	30	47	44	62	57	237	277	282	358	423
2.00 >= 2.25	10	7	12	12	12	10	7	5	5	12	10	17	20	27	52	57	82	89	111	185
2.25 >= 2.50	0	7	5	5	7	10	7	10	12	17	15	5	2	2	22	40	49	52	59	69
>= 2.50	37	37	37	40	42	37	42	44	44	44	44	54	59	59	72	72	79	82	99	148
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 agricultural areas cover 3,823 acres																				

Table 232. Summary of the PM5 Flood Inundation in Acres for the Wetlands Areas of the C-102 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	3650	3457	3467	3380	3207	3422	3200	3195	3081	2857	2983	2679	2721	2570	2385	2197	1885	1890	1792	1633
0.25 >= 0.50	314	279	235	232	267	287	287	284	311	371	351	420	383	410	383	450	583	576	534	536
0.50 >= 0.75	440	294	267	267	245	324	272	250	225	250	289	309	289	326	343	331	343	341	368	358
0.75 >= 1.00	400	482	432	395	363	442	373	336	334	284	353	282	257	252	284	326	324	324	324	304
1.00 >= 1.25	166	341	331	363	398	314	432	418	452	437	460	371	358	331	287	304	292	255	294	294
1.25 >= 1.50	79	141	121	114	215	126	255	235	257	353	262	440	447	437	425	398	316	306	269	235
1.50 >= 1.75	74	101	54	47	69	77	131	96	94	136	104	230	222	289	363	425	383	381	373	321
1.75 >= 2.00	54	42	57	32	20	82	91	37	35	52	69	89	79	114	178	237	395	405	400	408
2.00 >= 2.25	67	52	84	44	27	74	74	62	27	44	62	72	40	27	57	101	183	193	247	348
2.25 >= 2.50	544	64	128	49	47	74	54	57	35	27	84	72	42	40	35	30	62	69	109	190
>= 2.50	1048	1581	1658	1910	1977	1614	1665	1866	1984	2024	1819	1873	1997	2039	2095	2036	2068	2095	2125	2207
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 wetlands cover 3,553 acres																				

Table 233 and Table 234 show the fraction of flooded urban and agricultural areas for the flood depth ranges listed in the tables. The results indicate gradual increase of flood depth for urban and agricultural areas for SLR 0, 1, 2 and 3 and it is expected that the drainage system will have similar performance for future SLR conditions with no significant loss of drainage capacity over the entire watershed.

Table 233 Fraction of Flooded Urban Area of C-102 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	27%	26%	25%	22%
>=0.25	24%	25%	26%	29%
>=0.5	19%	20%	22%	25%
>=0.75	16%	17%	19%	22%
>=1.00	13%	14%	17%	19%
>=1.25	9%	11%	14%	18%
>=1.50	6%	9%	13%	16%
>=1.75	4%	7%	11%	14%
>=2.00	3%	5%	9%	13%
>=2.25	2%	4%	8%	12%
>=2.50	2%	2%	7%	11%

Table 234 Fraction of Flooded Agricultural Area of C-102 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	15%	15%	14%	13%
>=0.25	11%	11%	11%	12%
>=0.5	8%	8%	9%	10%
>=0.75	6%	7%	8%	9%
>=1.00	5%	6%	7%	8%
>=1.25	4%	5%	6%	7%
>=1.50	2%	4%	5%	6%
>=1.75	2%	2%	4%	5%
>=2.00	1%	1%	3%	5%
>=2.25	1%	1%	2%	4%
>=2.50	0%	0%	2%	4%

6.4.7 C-102: PM6 Flood Duration

For each design event and SLR conditions, tables were generated to show the duration of flooding for the C-102 Watershed, and additionally for urban, agricultural and wetland areas.

6.4.7.1 Flood Duration in Canal C-102

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S21A to return to target reference stage which was defined as 3.0 ft.

Table 235 shows the duration of time taken for the water levels in the C-102 Watershed canals to return to baseflow. The flood duration for 5-yr, 10-yr, 25-yr and 100-yr and SLR = 0, +1.0 , +2, and +3.0 ft are shown in the table below:

Table 235 Hours of Canal Flood Duration at Headwater of Structure S21A

Design Event	SLR 0	SLR 1	SLR 2	SLR 3
5-yr	0:10	5:55	18:00	46:55
10-yr	0:10	8:30	20:05	54:05
25-yr	6:00	15:05	23:15	56:20
100-yr	8:45	18:40	37:50	70:20

6.4.7.2 Flood Duration in Watershed C-102

For SLR = 0, Table 236 through Table 239 provide a summary of the areas in the C-102 Watershed with flood depths greater than 0.25 ft for the specified duration interval for the entire C-102 watershed, agricultural, urban and wetland areas of the C-102 Watershed, respectively. For

The corresponding flood duration maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions**:**

- Figure B-209 through Figure B-224 provide flood duration maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-241 through Figure B-256 provide flood duration maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-273 through Figure B-288 provide flood duration maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Table 236. Summary of the PM6 Flood Duration Area in Acres for the C-102 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	7	59	44	52	40	2	86	57	94	148	54	185	171	151	151	153	329	306	326	294
1 >= 4	30	74	49	52	47	42	96	74	94	119	111	267	237	306	304	469	566	507	541	556
4 >= 8	59	79	47	49	82	86	138	101	89	148	146	264	210	267	341	336	442	440	427	405
8 >= 12	99	89	54	49	69	79	114	109	89	158	146	188	171	163	242	287	348	311	373	371
12 >= 24	435	423	292	250	240	400	457	351	339	363	482	625	588	593	768	979	1053	1025	1072	1297
24 >= 48	830	909	689	514	467	1013	998	734	603	583	1013	1018	828	801	731	1231	1307	1201	1154	1166
48 >= 96	1028	976	1194	833	717	1483	1453	1436	1018	828	1918	1821	1411	1072	890	1955	1774	1423	1154	1006
96 >= 168	423	798	707	591	507	806	974	993	761	610	1250	1221	1404	976	818	1927	1754	1690	1218	961
168 >= 240	57	195	264	183	163	124	301	339	289	245	299	519	512	403	331	598	726	751	534	405
240 >= 360	22	128	69	64	91	35	163	138	84	104	57	213	230	136	119	114	336	343	232	217
>= 360	509	529	1100	2488	3333	514	546	1119	2508	3356	516	568	1147	2535	3380	534	600	1203	2562	3403
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 covers 15,064 acres																				

Table 237. Summary of the PM6 Flood Duration Area in Acres of the C-102 Watershed for SLR = CC, 0, +1, +2 and +3 ft

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	5	49	30	37	30	2	57	37	47	96	40	94	104	74	74	101	161	153	173	163
1 >= 4	15	35	25	17	37	27	67	37	57	72	72	163	124	183	161	272	274	230	262	225
4 >= 8	35	37	25	37	42	37	69	82	57	99	79	133	111	141	200	166	200	215	175	158
8 >= 12	49	40	40	30	44	59	49	47	49	79	82	104	94	86	121	158	183	166	205	178
12 >= 24	203	198	171	151	148	200	232	217	213	227	301	329	321	304	440	514	549	539	598	778
24 >= 48	371	413	346	306	334	474	521	427	385	390	571	578	526	549	435	724	714	657	630	647
48 >= 96	521	472	613	489	415	734	640	719	593	516	885	843	771	640	586	1043	939	845	739	665
96 >= 168	190	435	376	348	314	405	556	524	452	383	680	642	709	581	519	966	830	899	739	591
168 >= 240	35	106	178	111	101	69	153	213	171	143	141	282	294	225	200	289	398	388	294	237
240 >= 360	12	74	30	37	67	17	91	84	49	72	35	121	146	96	74	67	168	222	153	148
>= 360	64	79	200	820	1290	67	89	205	838	1310	67	96	217	845	1327	77	124	237	860	1339
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 urban areas cover 7,687 acres																				

Table 238. Summary of the PM6 Flood Duration Area in Acres for the Agricultural Areas of the C-102 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	2	7	15	2	5	0	20	17	22	27	7	57	40	49	57	32	86	82	96	77
1 >= 4	5	27	10	22	10	15	22	27	27	30	17	54	49	62	72	111	175	156	166	205
4 >= 8	7	17	12	12	20	22	37	12	20	27	47	91	67	69	77	94	148	136	148	141
8 >= 12	17	22	15	17	15	12	49	37	25	42	35	47	47	47	91	72	99	82	91	116
12 >= 24	99	101	67	54	57	114	121	72	77	89	116	185	161	178	190	304	329	321	319	341
24 >= 48	171	200	188	143	64	259	190	193	126	89	240	237	193	138	171	314	378	346	336	343
48 >= 96	158	222	294	269	237	264	361	413	329	235	452	413	376	311	203	450	403	358	259	200
96 >= 168	91	166	190	227	166	168	205	242	272	193	225	289	383	329	240	395	435	474	383	282
168 >= 240	5	32	22	52	52	20	49	54	99	86	69	94	121	161	119	141	146	188	222	148
240 >= 360	5	10	5	15	20	7	22	7	17	25	7	27	10	25	32	10	47	37	59	57
>= 360	2	10	15	183	469	2	10	17	185	472	2	10	17	195	479	7	10	17	200	487
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 agricultural areas cover 3,823 acres																				

Table 239. Summary of the PM6 Flood Duration Area in Acres for the Wetlands Areas of the C-102 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	0	2	0	12	5	0	10	2	25	25	7	35	27	27	12	20	82	72	57	54
1 >= 4	10	12	15	12	0	0	7	10	10	17	22	49	64	62	7	86	116	121	114	126
4 >= 8	17	25	10	0	20	27	32	7	12	22	20	40	32	57	17	77	94	89	104	106
8 >= 12	32	27	0	2	10	7	15	25	15	37	30	37	30	30	22	57	67	64	77	77
12 >= 24	133	124	54	44	35	86	104	62	49	47	64	111	106	111	91	161	175	166	156	178
24 >= 48	289	297	156	64	69	279	287	114	91	104	203	203	109	114	106	193	215	198	188	175
48 >= 96	348	282	287	74	64	484	452	304	96	77	581	566	264	121	52	462	432	220	156	141
96 >= 168	141	198	141	15	27	232	213	227	37	35	346	289	311	67	10	566	489	316	96	89
168 >= 240	17	57	64	20	10	35	99	72	20	15	89	143	96	17	2	168	183	175	17	20
240 >= 360	5	44	35	12	5	10	49	47	17	7	15	64	74	15	0	37	121	84	20	12
>= 360	442	440	885	1485	1574	445	447	897	1485	1574	447	462	912	1495	269	450	467	949	1502	1577
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-102 wetlands cover 3,553 acres																				

Table 240 and Table 241 show the fraction of flooded urban and agricultural areas for the flood duration ranges listed in the tables. The results indicate gradual increase of flood duration for urban areas for SLR 0, 1, 2 and 3 and it is assumed that the drainage system will require improvements to preserve the LOS for future SLR conditions. For agricultural areas, the LOS will be maintained for SLR 0, 1, 2 and 3.

Table 240 Fraction of Flooded Urban Areas and Duration of C-102 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	22%	23%	25%	27%
> 1	22%	22%	24%	27%
> 4	21%	21%	23%	26%
> 8	20%	20%	22%	25%
> 12	19%	20%	22%	24%
> 24	17%	18%	19%	21%
> 48	13%	14%	16%	18%
> 96	8%	9%	12%	14%
> 168	3%	4%	8%	11%
> 240	1%	2%	6%	9%
> 360	1%	1%	6%	9%

Table 241 Fraction of Flooded Agricultural Areas and Duration of C-102 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	10%	10%	10%	11%
> 1	10%	9%	10%	11%
> 4	9%	9%	10%	11%
> 8	9%	9%	9%	10%
> 12	8%	8%	9%	10%
> 24	7%	7%	8%	8%
> 48	6%	6%	7%	7%
> 96	3%	4%	5%	6%
> 168	1%	1%	3%	4%
> 240	0%	0%	1%	3%
> 360	0%	0%	1%	3%

6.4.8 LOS Rating of C-102 Watershed

The flood protection LOS of the C-102 Watershed was evaluated for current and future hydrologic conditions, land use, topography, and canal infrastructure. The overall conclusions of the analysis are summarized below:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the consistently flat topography of Watershed C-102, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S165 and S195) showed limited capacity based on the cumulative and peak flow results for increasing SLR. The peak flow for both structures considerably decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater.

Coastal Structure Performance: PM2, PM3 and PM4 showed that structure S21A has limited discharge capacity based on the peak and cumulative flows which showed consistent decrease of discharges for increasing the return period of the design events and for increased SLR. Therefore, the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than +2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event.

Localized Flood Potential: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The C-102 Watershed is assigned a 10-Year FPLOS rating for the current hydrologic conditions. For the future conditions C-102 is assigned 5-yr for SLR = +1 and +2 ft, and less than 5-yr for SLR = +3 ft. For this overall rating, weight was placed on PM1 and PM2, as the primary canals in this watershed collectively are expected to contain the 10-Year storm event within its canal banks as modeled.

6.5 C-103 Watershed Flood Protection Level of Service

There are eleven SFWMD water control structures in the C-103 Watershed: S20F, S20G, S23C, S23D, S23E, S23F, S166, S167, S179, S196, and S709. Figure 455 shows the drainage network in this watershed. The structures are operated as discussed in 6.1.5.6.

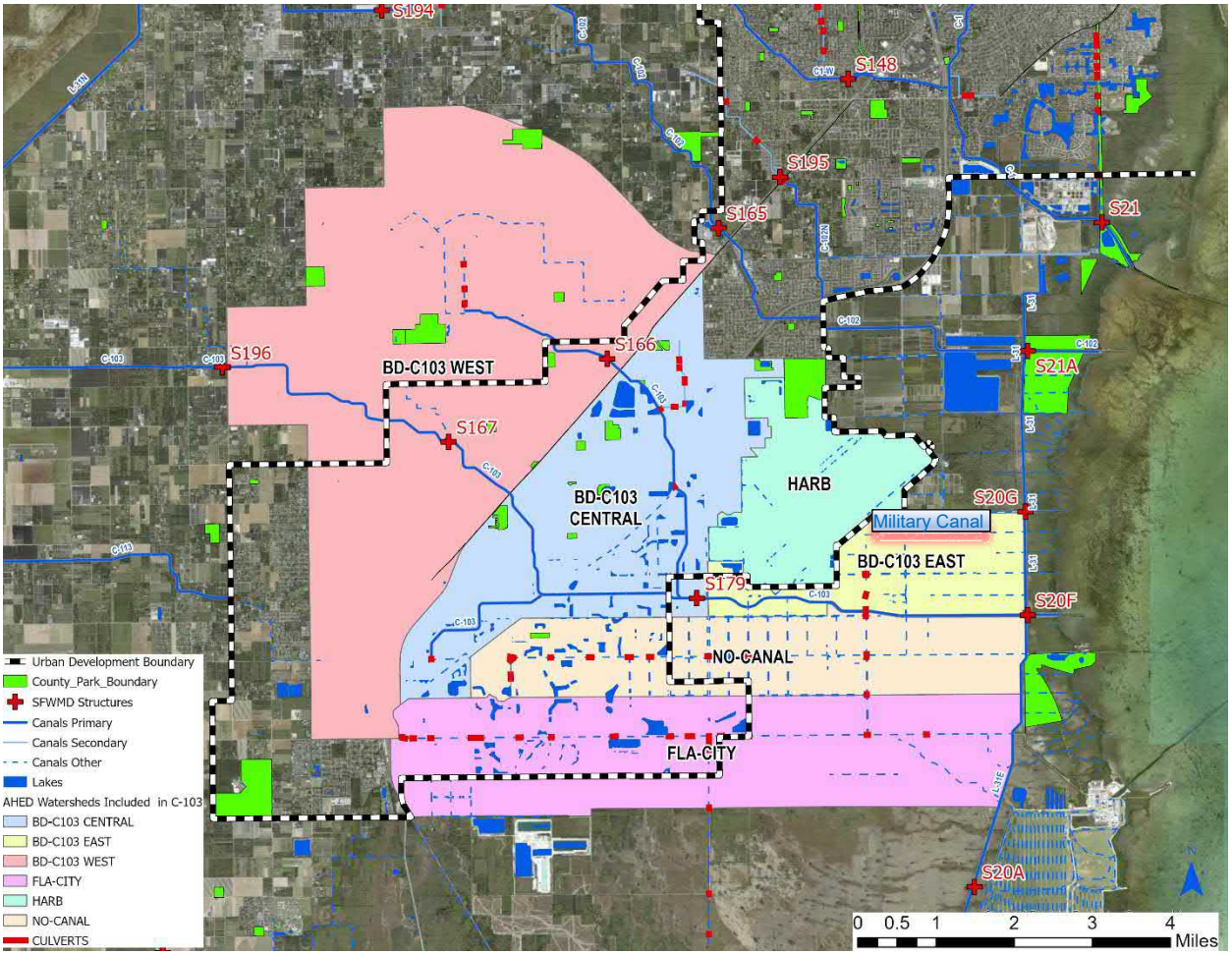


Figure 455. Drainage Network in C-103 Watershed (Source: SFWMD South Miami Dade Atlas)

6.5.1 Watershed C-103: Structures S20F and S20G Gate Operation

The gates of structure S20F are closed when the head differential HW – TW is less than 0.1 ft. The gate operation and the corresponding tailwater, stages and operations are shown for SLR +1, +2 +3 for the 25-yr event. The gate operation patterns are similar for all design events. The gate operation of structure S20F and S20G for SLR 1, 2 and 3 is shown in Figure 456 and Figure 457.

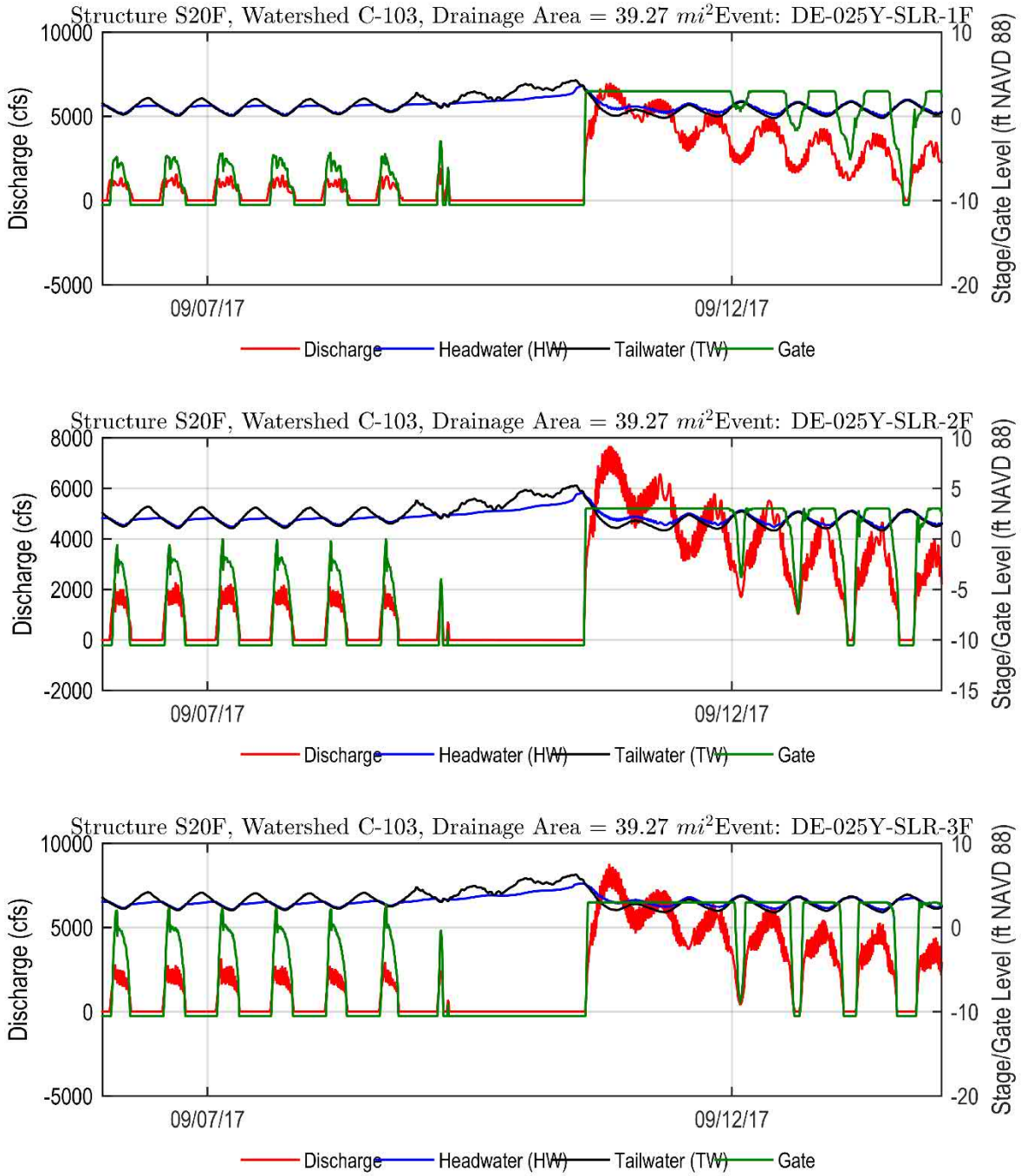


Figure 456. Gate Operation of Structure S20F for 25-year event and for SLR 1, 2 and 3

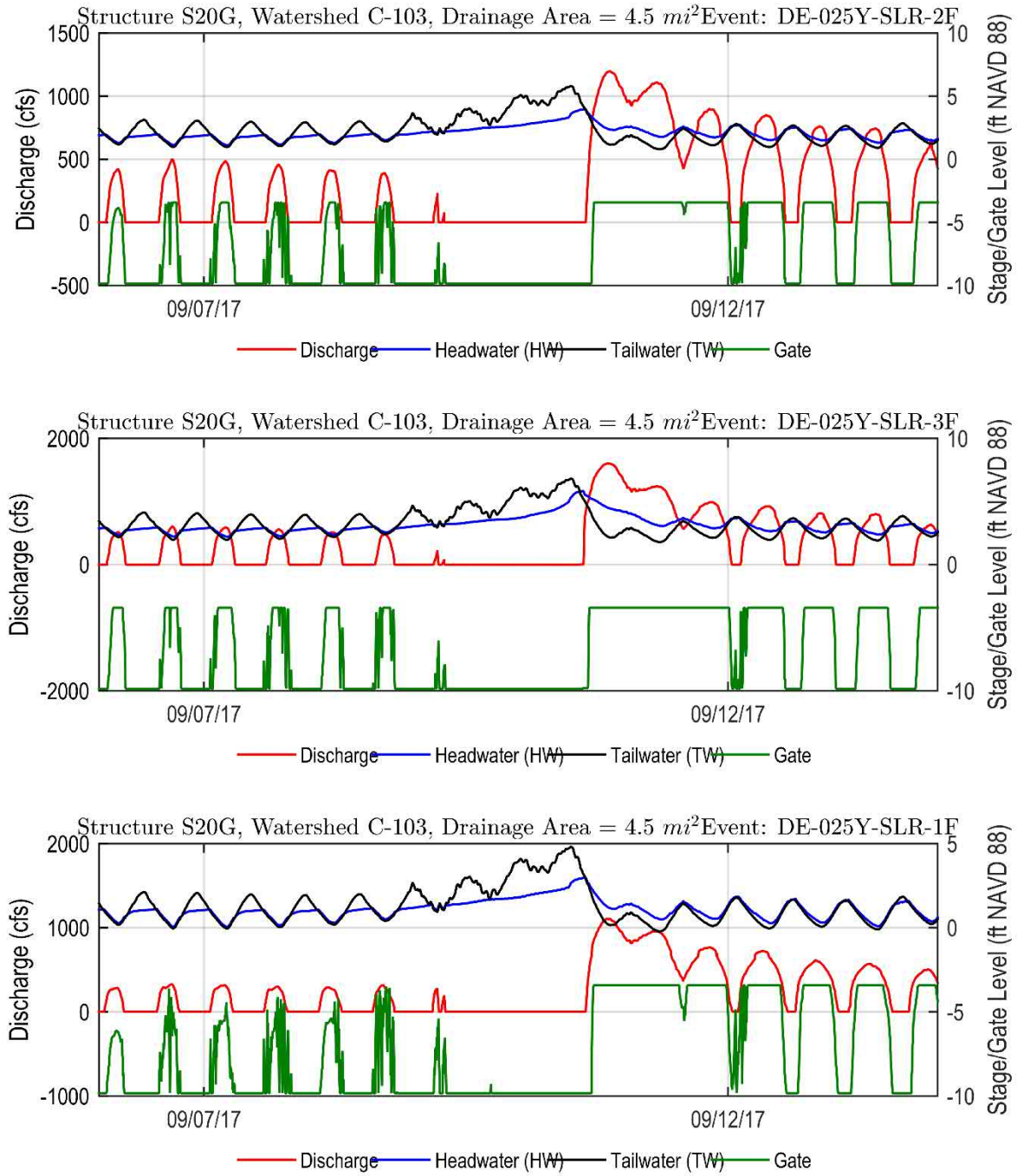


Figure 457. Gate Operation of Structure S20F for 100-year event and for SLR 1, 2 and 3

The cumulative discharge slight increase with SLR increase which indicates that the upstream section of Canal C-103 receives inflow from adjacent canals during storm surge.

6.5.2 C-103: PM1 Maximum Stage in Primary Canals

To evaluate this PM under future conditions within the C-103 Watershed, instantaneous peak stage profiles were prepared for the primary canals. Bank elevations on the profile figures are based on the MIKE 1D cross-section data. The canal bank elevations were verified with elevations from the latest LIDAR data (from 2018). Also shown in the figures are major roadway landmarks, control structures, and primary canal junctions.

A list of landmarks within Watershed C-103 and peak stages for future conditions at SLR = +0.0 ft is provided in Table 243. Highlighted are water elevations which exceed one of the canal banks at specified chainage.

The results of this analysis showed that most sections of all canals in C-103 Watershed can convey the 5-Year event without overflowing. Multiple sections of which canals were identified that do not overflow even during the 100-Year flood event. The canal system upstream of S196 overflowed during the 5-Year event for periods of time and the total length of canal that overflowed during the 5-Year event is about 1 mile, however this section is outside the Urban Development Boundary. Therefore, C-103 is assigned a LOS-rating of 5-Year LOS for PM1.

Table 242. LOS Rating of Canals in C-103 Watershed for PM1

Canal	SLR = 0	SLR = +1.0 ft	SLR = +3.0 ft	SLR = +2.0 ft
C-103	Upstream of S196: Less than 5-Year LOS Downstream of S196 & Upstream of SR-997: 10-Year LOS Downstream of SR-997 & Upstream of US-1: 5-Year LOS Downstream of US-1: 25-Year LOS	Upstream of S196: Less than 5-Year LOS Downstream of S196 & Upstream of SR-997: 10-Year LOS Downstream of SR-997 & Upstream of US-1: 5-Year LOS Downstream of US-1: 25-Year LOS	Upstream of S196: Less than 5-Year LOS Downstream of S196 & Upstream of SR-997: Less than 5-Year LOS Downstream of SR-997 & Upstream of US-1: 5-Year LOS Downstream of US-1: 10-Year LOS	Upstream of S196: Less than Less than 5-Year LOS Downstream of S196 & Upstream of SR-997: Less than 5-Year LOS Downstream of SR-997 & Upstream of US-1: Less than 5-Year LOS Downstream of US-1: 5-Year LOS
C-103S	5-Year LOS	5-Year LOS	Less than 5-Year LOS	Less than 5-Year LOS
C-103N	25-Year LOS	25-Year LOS	5-Year LOS	5-Year LOS

The overall rating of C-103 canal is 5-yr FPLOS for SLR = 0 and +1.0 ft and 5 years for SLR = +2.0 and +3.0 ft.

Table 243 List of Landmarks and Design Water Elevations for Watershed C-103 canals (all elevations in ft NAVD 88)

Landmark	Canal	Mileage	Left Bank	Right Bank	5-yr SLR 0	5-yr SLR 1	5-yr SLR 2	5-yr SLR 3	10-yr SLR 0	10-yr SLR 1	10-yr SLR 2	10-yr SLR 3	25-yr SLR 0	25-yr SLR 1	25-yr SLR 2	25-yr SLR 3	100-yr SLR 0	100-yr SLR 1	100-yr SLR 2	100-yr SLR 3
Structure S196	C-103	3.000	3.734	3.874	5.360	5.580	5.905	6.121	5.379	6.310	6.410	6.549	6.848	6.879	6.923	7.008	7.562	7.576	7.611	7.674
SR-997 Crossing	C-103	6.000	8.005	8.221	4.399	5.002	5.789	6.342	4.415	6.407	6.633	6.860	7.066	7.116	7.221	7.378	7.841	7.872	7.930	8.015
Structure S167	C-103	6.600	5.000	6.001	3.823	4.499	5.393	6.090	3.862	5.980	6.319	6.610	6.747	6.820	6.973	7.172	7.660	7.708	7.790	7.887
US-1 Crossing	C-103	7.600	5.000	6.001	3.357	4.097	5.053	5.767	3.409	5.406	5.854	6.206	6.152	6.256	6.475	6.738	7.117	7.186	7.324	7.467
Structure S179	C-103	9.000	6.670	6.886	2.518	3.539	4.601	5.167	2.591	4.071	4.888	5.376	4.155	4.744	5.243	5.741	5.293	5.539	5.745	6.231
SR-821 Crossing	C-103	9.200	5.121	4.770	2.469	3.519	4.588	5.143	2.547	4.012	4.845	5.318	4.013	4.636	5.132	5.649	5.046	5.321	5.544	6.127
C-103N	C-103	11.000	4.902	4.970	2.349	3.483	4.553	5.096	2.435	3.893	4.778	5.267	3.737	4.448	4.963	5.563	4.626	4.960	5.194	6.007
Structure S20F	C-103	15.500	6.119	5.620	2.295	3.388	4.438	5.395	2.590	3.739	4.764	5.716	3.159	4.179	5.156	6.122	3.913	4.852	5.774	6.773
Structure S166	C-103N	2.000	6.880	4.770	2.858	3.742	4.747	5.241	2.913	4.283	5.042	5.649	4.727	5.205	5.739	6.214	6.406	6.576	6.798	7.075
US-1 Crossing	C-103N	2.400	6.900	4.800	2.700	2.700	2.700	2.700	3.100	3.100	3.100	3.100	4.400	4.400	4.400	4.400	6.000	6.000	6.000	6.000
SR-821 Crossing	C-103N	4.100	4.731	4.869	2.658	3.602	4.635	5.131	2.721	4.055	4.898	5.368	4.159	4.727	5.216	5.739	5.265	5.545	5.773	6.216
Structure C-102	C-103N	5.600	4.902	4.970	2.383	3.498	4.561	5.103	2.473	3.940	4.790	5.276	3.857	4.530	5.020	5.581	4.793	5.099	5.297	6.028
SW 167th Ave Crossing	C-103S	0.800	5.454	4.744	2.637	3.564	4.579	5.137	2.689	4.069	4.869	5.331	4.181	4.700	5.161	5.668	5.143	5.383	5.626	6.146
SW 162nd Ave Crossing	C-103S	1.600	4.469	5.371	2.524	3.530	4.577	5.140	2.592	4.024	4.857	5.323	4.055	4.653	5.140	5.657	5.083	5.340	5.573	6.138
C-103 Crossing	C-103S	2.000	5.085	4.570	2.472	3.521	4.587	5.144	2.550	4.015	4.847	5.320	4.020	4.641	5.137	5.653	5.058	5.331	5.554	6.134
L-31E Canal Crossing	Florida City Canal	7.800	0.869	6.152	1.951	3.061	4.081	5.192	2.041	3.191	4.205	5.348	2.509	3.399	4.371	5.601	3.034	3.787	4.668	6.020
Military Canal Crossing	L-31E Canal A	0.500	6.100	2.600	1.800	1.800	1.800	1.800	1.900	1.900	1.900	1.900	2.400	2.400	2.400	2.400	2.900	2.900	2.900	2.900
C-103 Crossing	L-31E Canal A	1.300	5.162	4.537	1.966	3.228	4.349	5.352	2.076	3.468	4.542	5.554	2.733	3.775	4.754	5.825	3.397	4.204	5.075	6.218
Card Sound Rd Crossing	L-31E Canal A	11.700	6.152	0.869	2.815	3.519	4.308	4.906	2.850	3.585	4.344	5.019	3.133	3.696	4.424	5.136	3.421	3.907	4.652	5.361
Pump Station STDA	Military Canal	0.800	6.900	5.900	1.800	1.800	1.800	1.800	1.900	1.900	1.900	1.900	2.400	2.400	2.400	2.400	2.900	2.900	2.900	2.900
Structure S20G	Military Canal	1.900	5.000	4.600	1.758	2.853	4.012	5.366	1.889	3.040	4.350	5.390	2.366	3.315	4.848	5.539	2.957	3.729	5.339	5.687
C-111 Crossing	C-113	0.100	6.000	5.200	1.800	1.800	1.800	1.800	1.900	1.900	1.900	1.900	2.400	2.400	2.400	2.400	2.900	2.900	2.900	2.900
SW 197th Ave Crossing	C-113	3.700	3.760	7.270	4.910	5.130	5.392	5.693	4.915	5.673	5.872	6.071	6.252	6.312	6.415	6.549	7.006	7.027	7.077	7.147
117 SW Ave Crossing	Florida City Canal	5.600	3.720	4.311	2.259	2.998	3.733	4.638	2.299	3.193	3.825	4.790	3.034	3.534	4.059	5.049	3.805	4.038	4.551	5.507
L-31E Crossing	Florida City Canal	7.600	3.720	4.311	2.203	2.981	3.733	4.641	2.250	3.169	3.824	4.779	2.915	3.457	4.058	5.025	3.663	3.918	4.550	5.457

Figure 458 through Figure 465 show the canal profiles for the C-103 Watershed and includes canals C-103, C-103N, C-103S and Florida City Canal, L-31E Levell, Military Canal, C-113 for the 5-yr Design Storm.

Figure 466 through Figure 473 show the canal profiles for the C-103 Watershed and includes Canals C-103, C-103N, C-103S and Florida City Canal, L-31E Levell, Military Canal, C-113 for the 10-yr Design Storm.

Figure 474 through Figure 481 show the canal profiles for the C-103 Watershed and includes Canals C-103, C-103N, C-103S and Florida City Canal, L-31E Levell, Military Canal, C-113 for the 25-yr Design Storm.

Figure 482 through Figure 489 show the canal profiles for the C-103 Watershed and includes Canals C-103, C-103N, C-103S and Florida City Canal, L-31E Levell, Military Canal, C-113 for SLR + 3.0 ft.

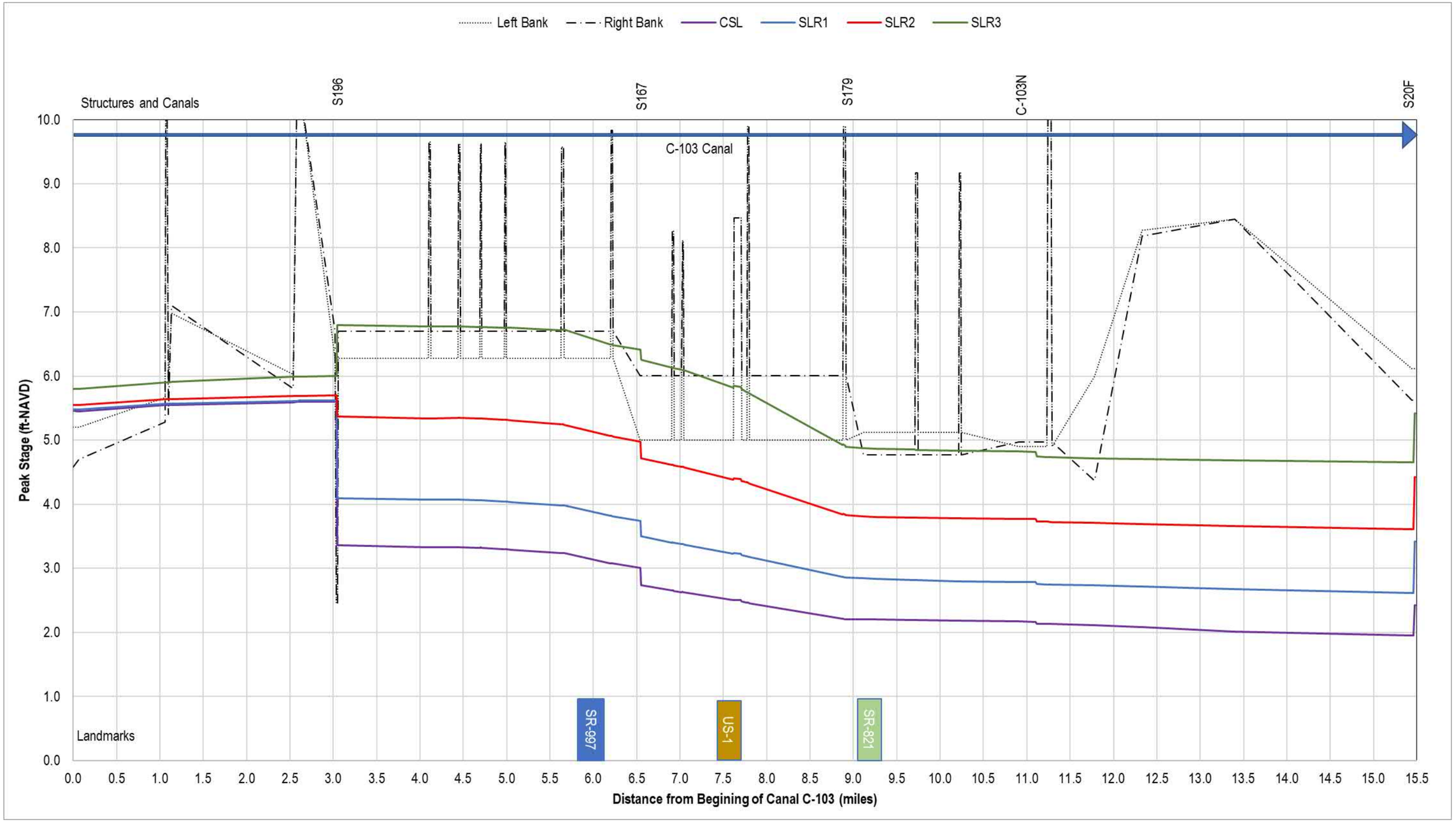


Figure 458 Profile of Peak Stages in Canal C-103 for Future Land Use and Topography for 5-yr Design Storm

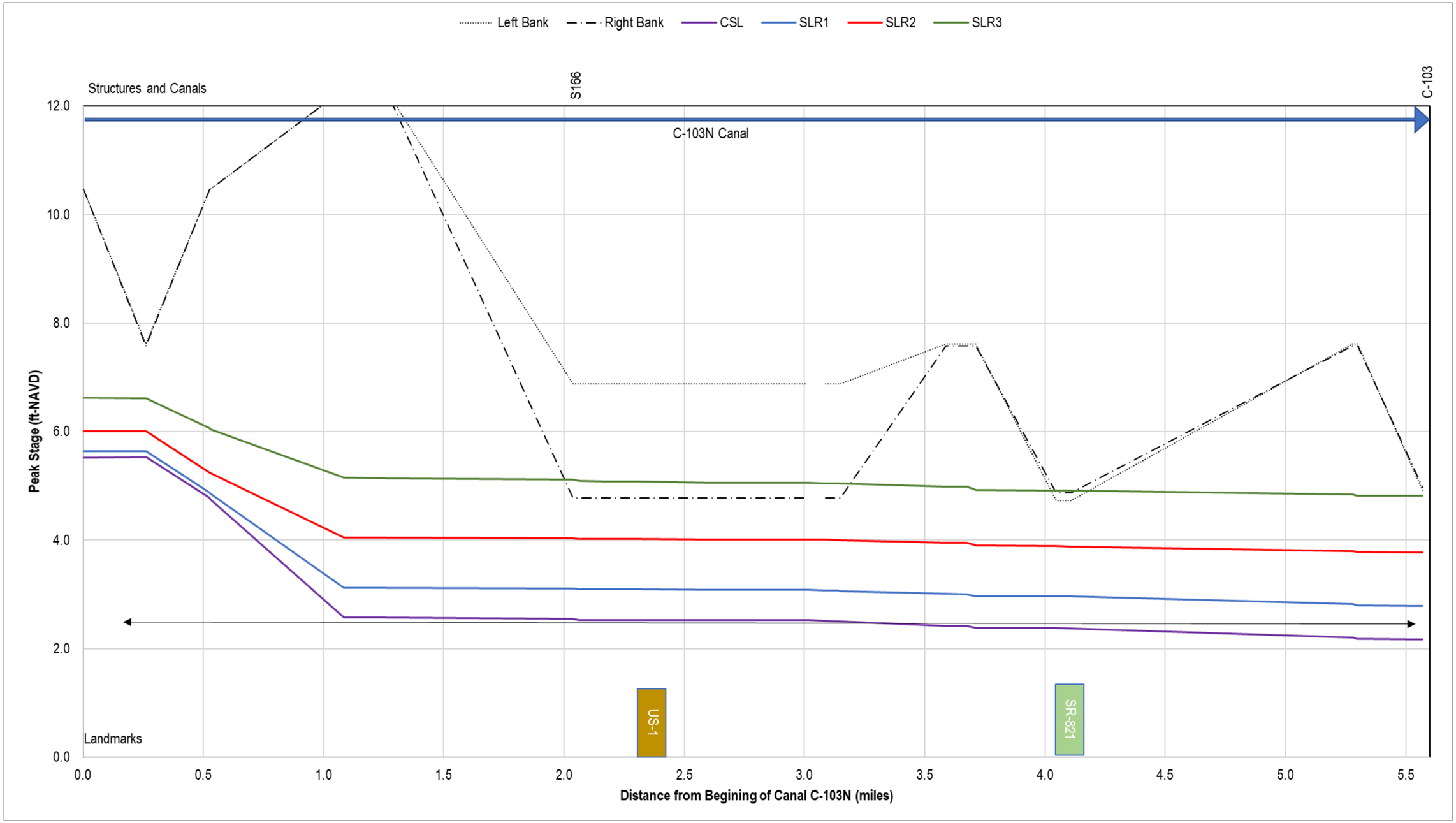


Figure 459 Profile of Peak Stages in Canal C-103N for Future Land Use and Topography for 5-yr Design Storm

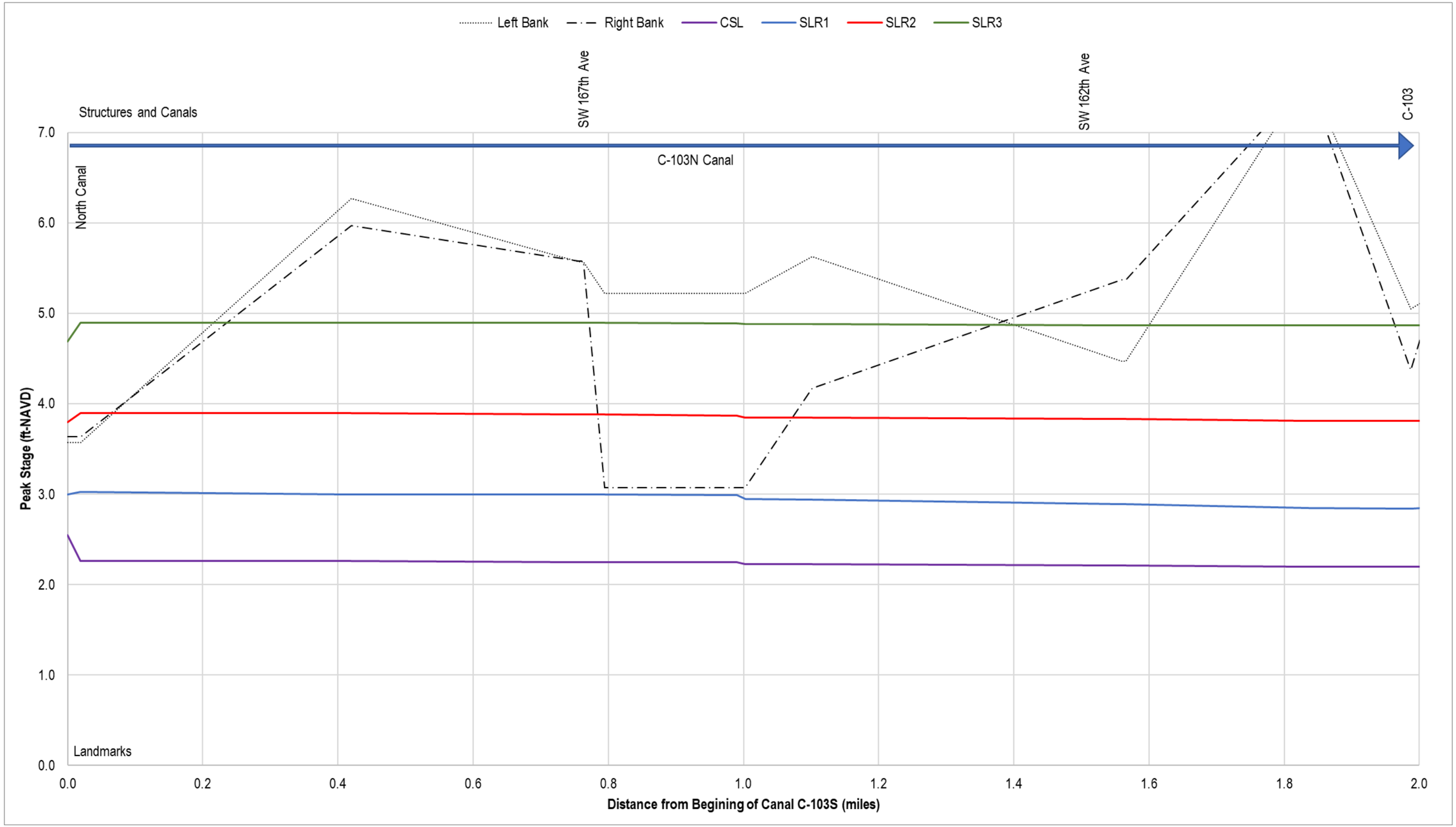


Figure 460 Profile of Peak Stages in Canal C-103S for Future Land Use and Topography for 5-yr Design Storm

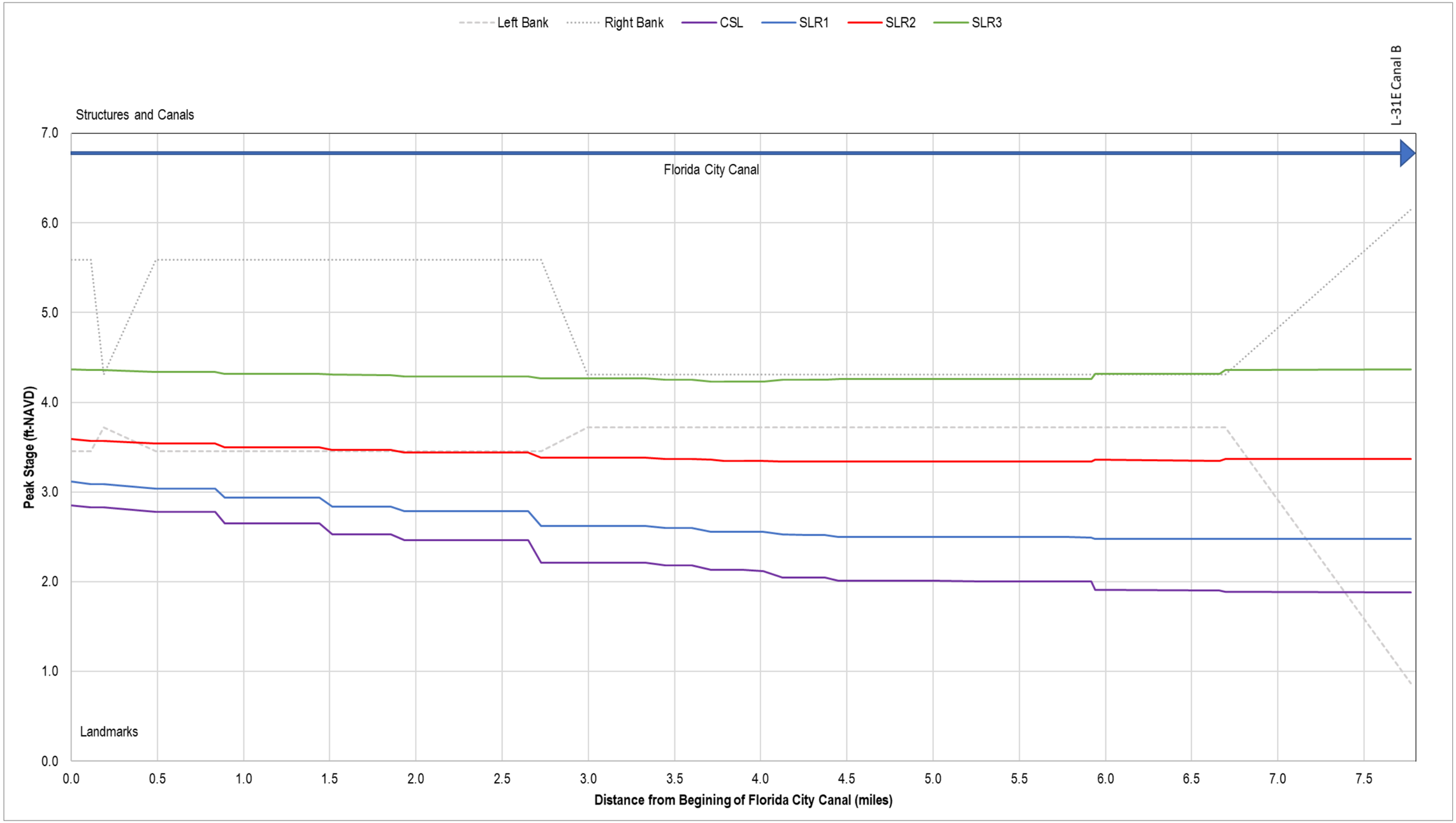


Figure 461 Profile of Peak Stages in Florida City Canal for Future Land Use and Topography for 5-yr Design Storm

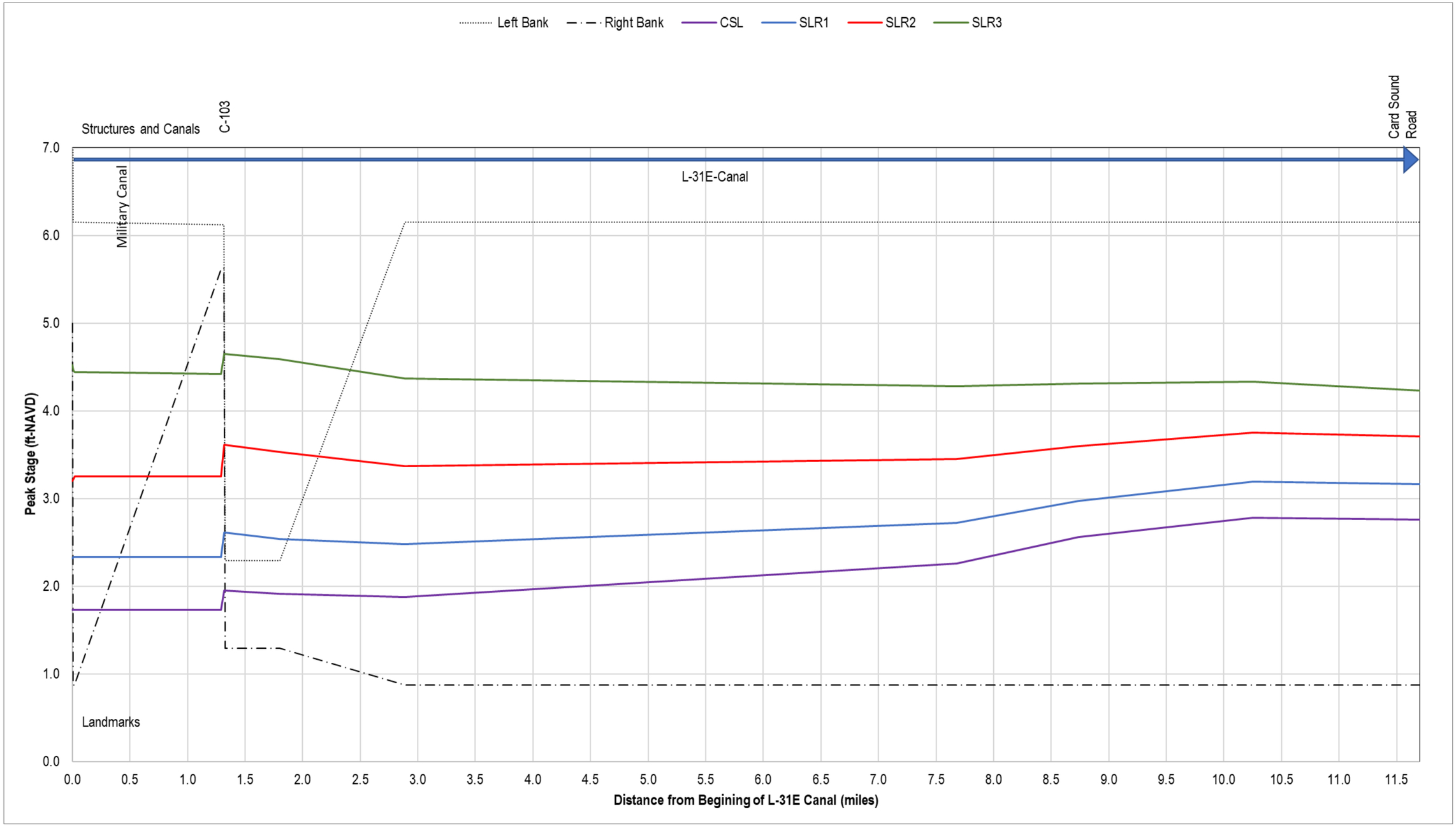


Figure 462 Profile of Peak Stages in Canal L-31E for Future Land Use and Topography for 5-yr Design Storm

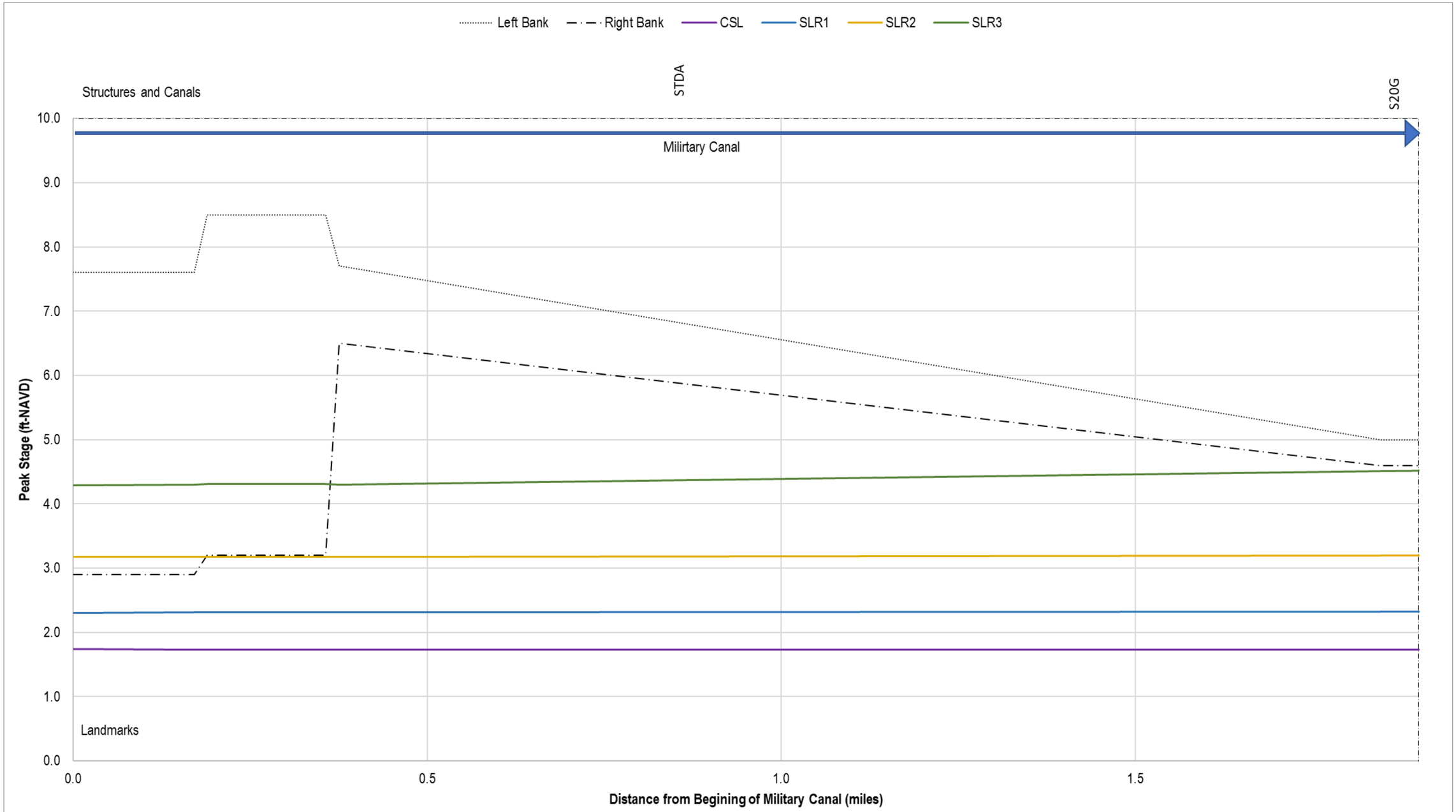


Figure 463 Profile of Peak Stages in Military Canal for Future Land Use and Topography for 5-yr Design Storm

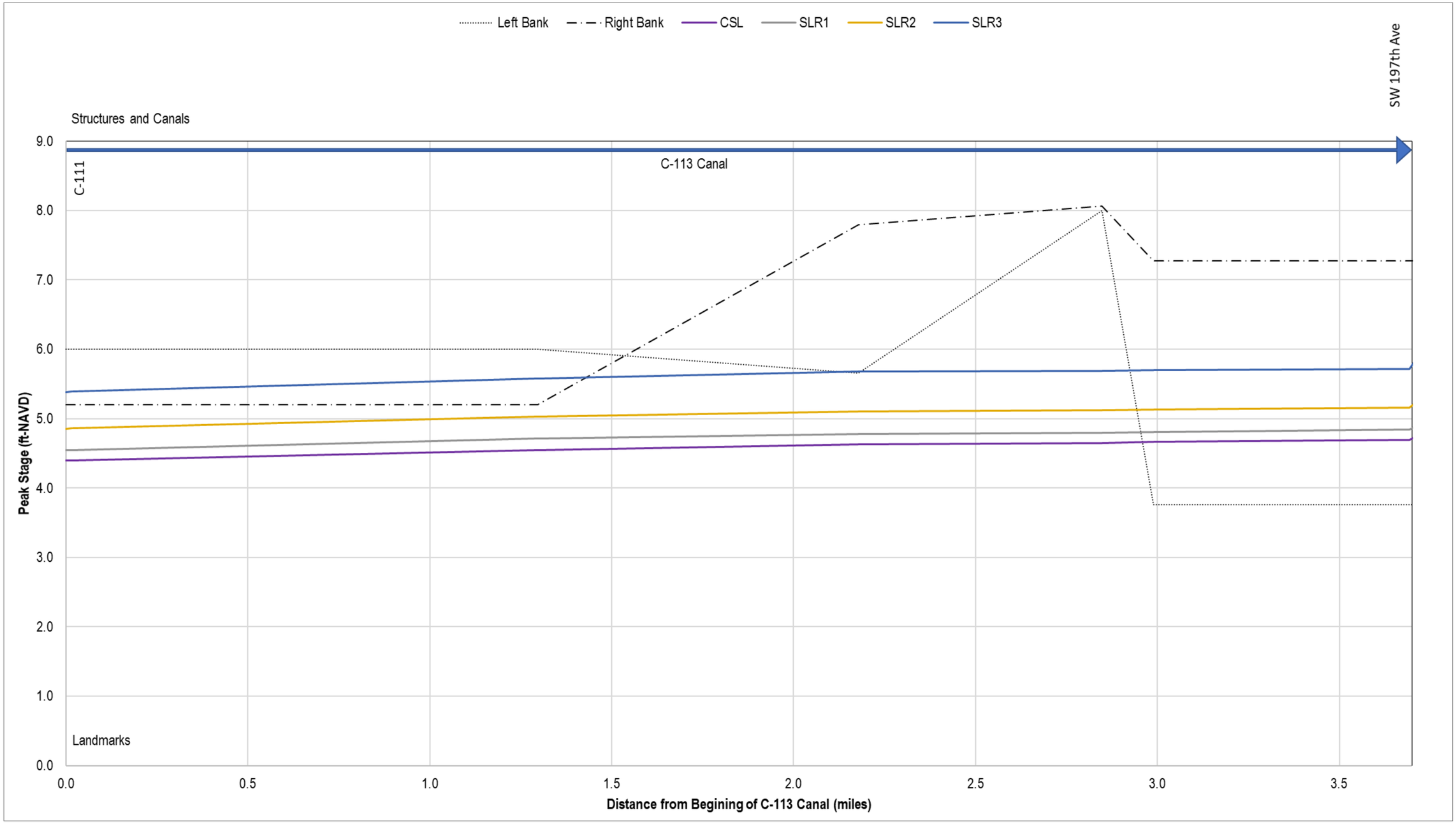


Figure 464 Profile of Peak Stages in Canal C-113 for Future Land Use and Topography for 5-yr Design Storm

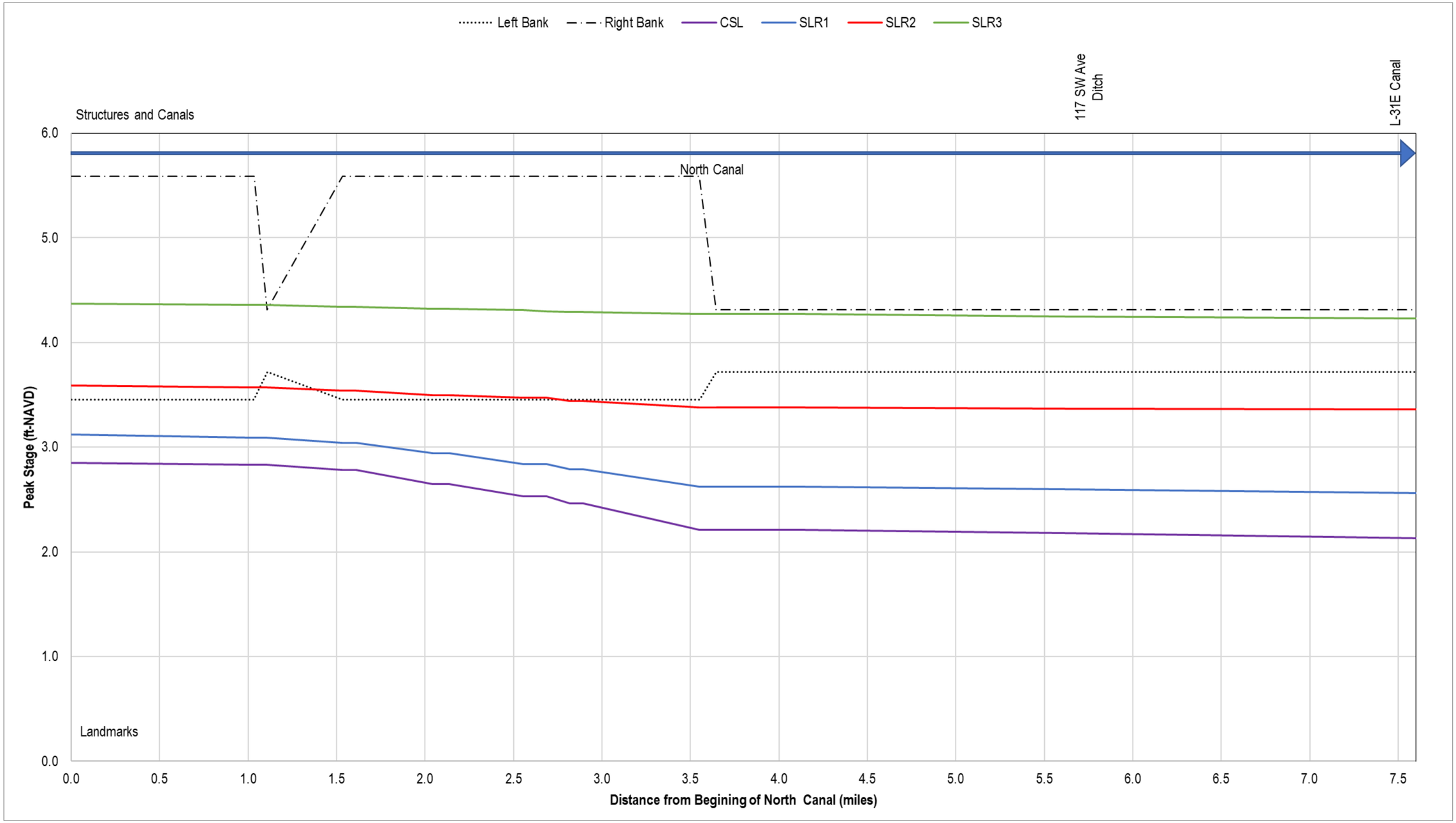


Figure 465 Profile of Peak Stages in North Canal for Future Land Use and Topography for 5-yr Design Storm

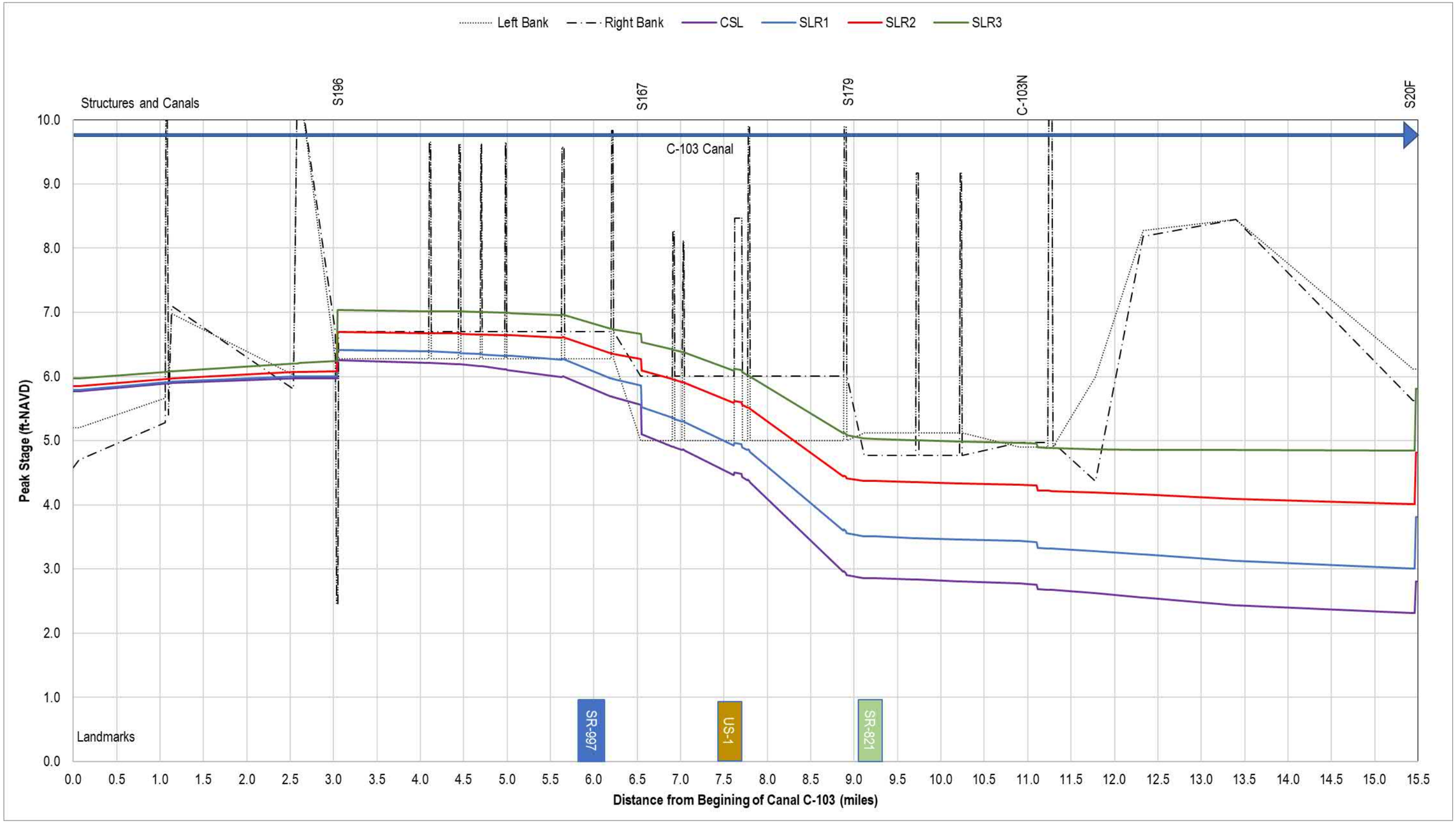


Figure 466 Profile of Peak Stages in Canal C-103 for Future Land Use and Topography for 10-yr Design Storm

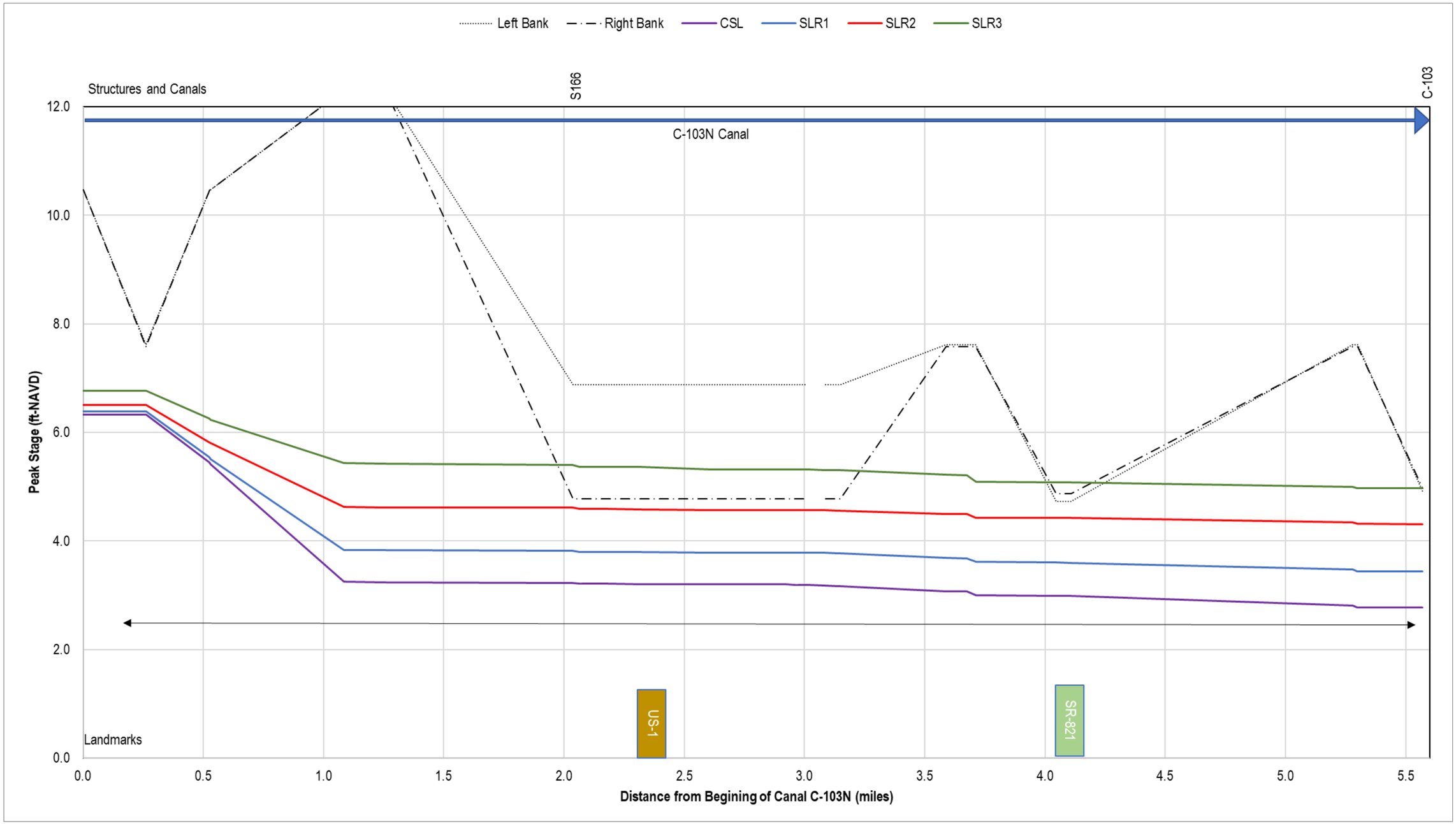


Figure 467 Profile of Peak Stages in Canal C-103N for Future Land Use and Topography for 10-yr Design Storm

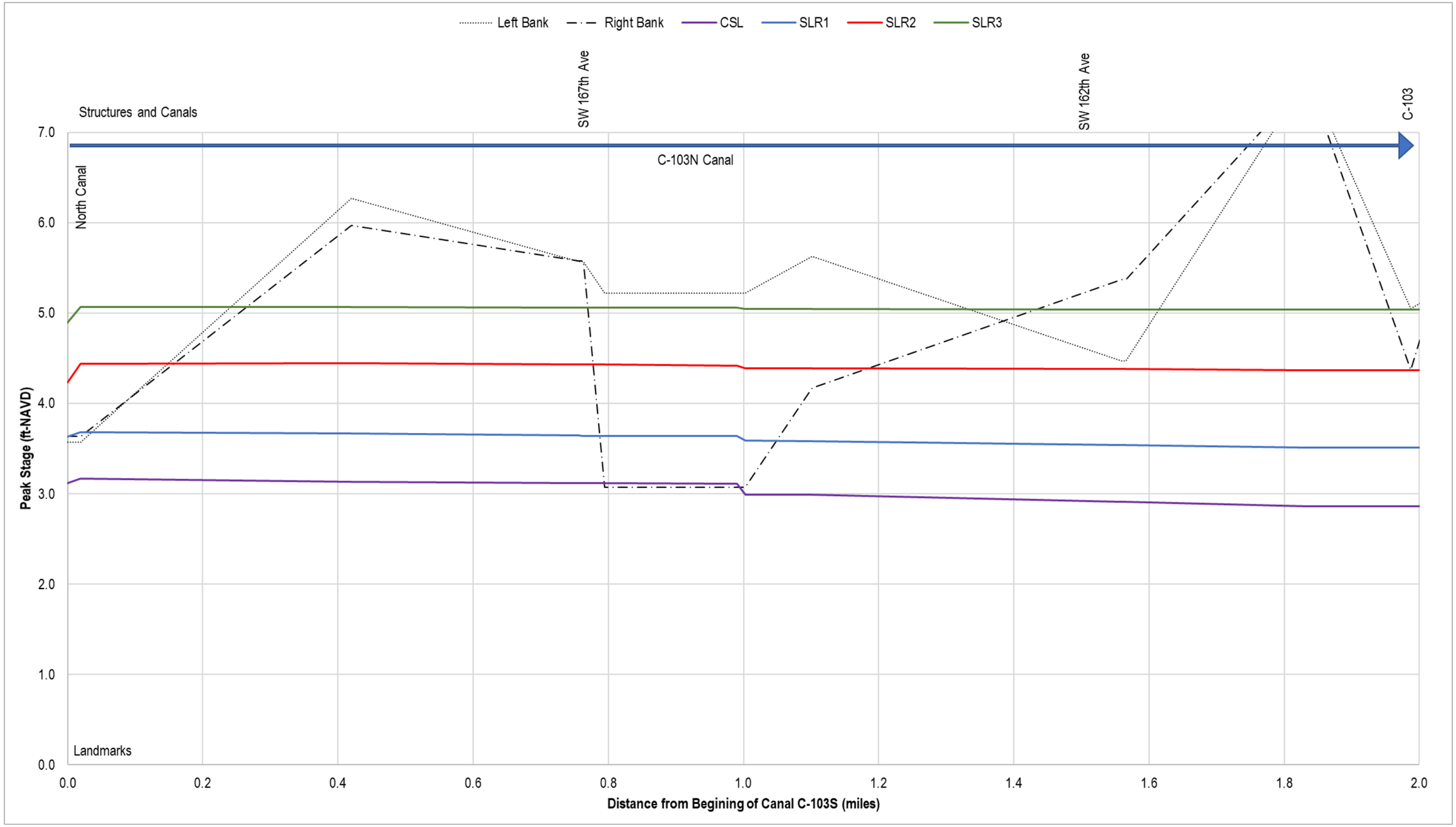


Figure 468 Profile of Peak Stages in Canal C-103N for Future Land Use and Topography for 10-yr Design Storm

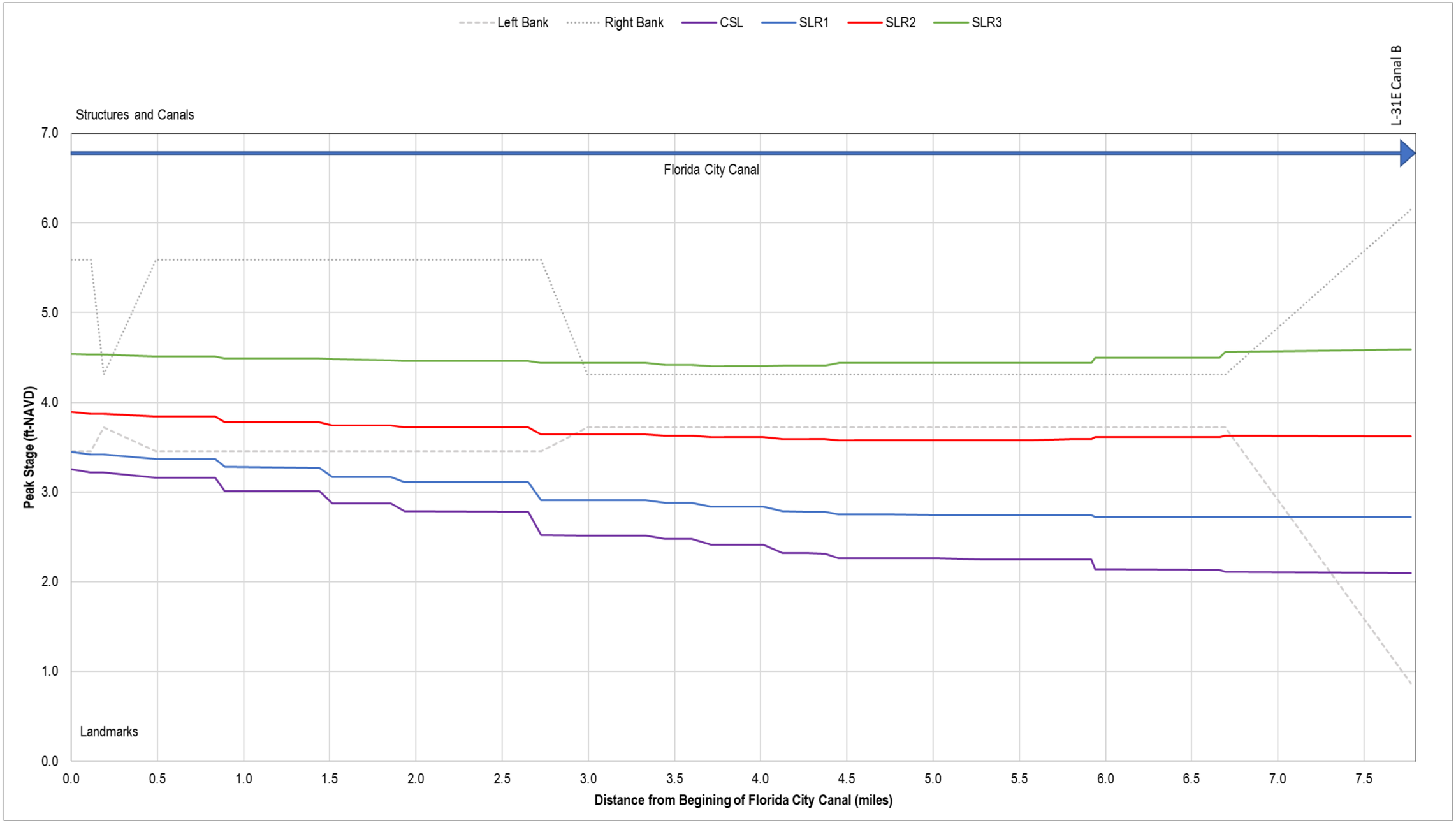


Figure 469 Profile of Peak Stages in Florida City Canal for Future Land Use and Topography for 10-yr Design Storm

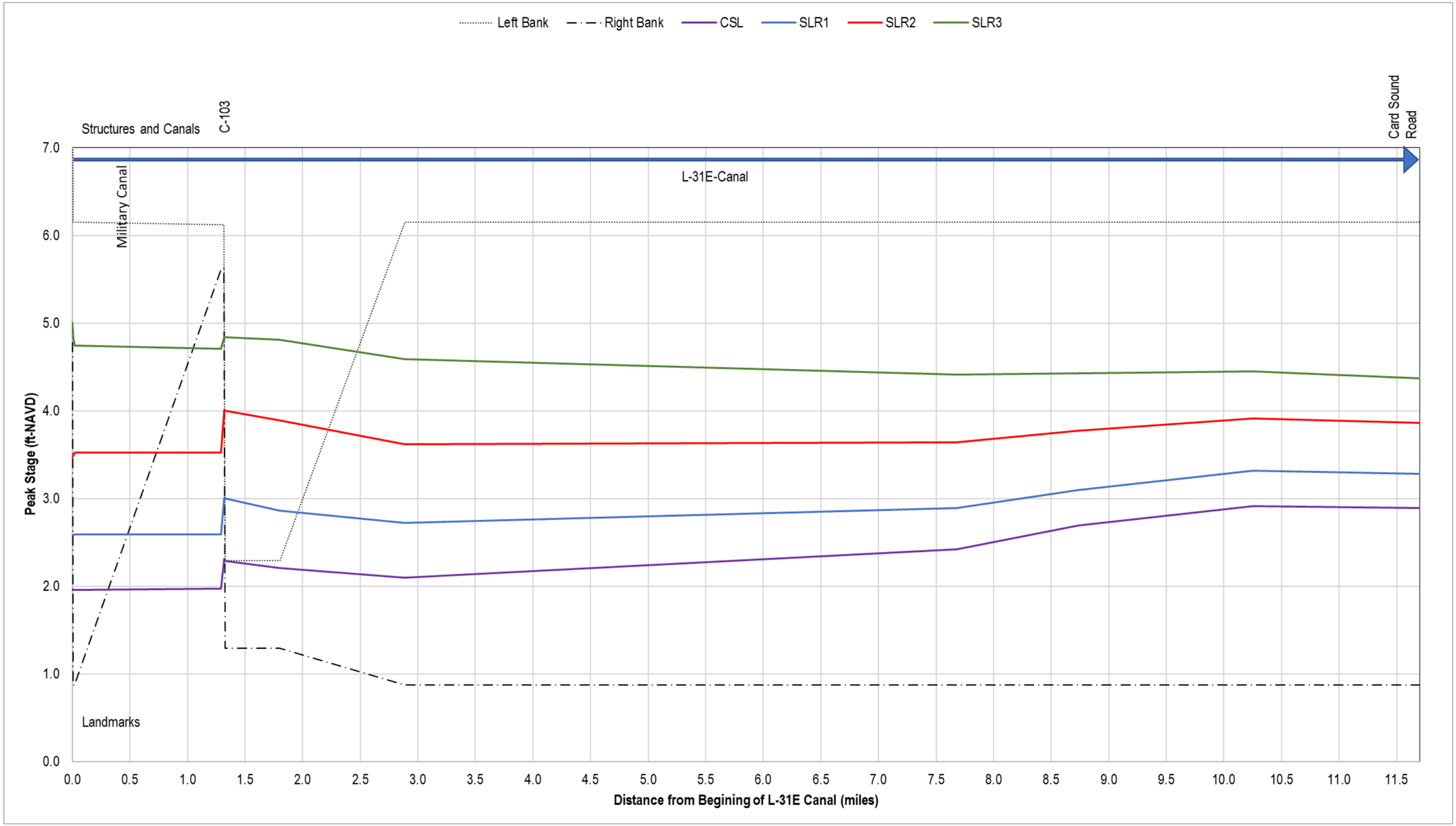


Figure 470 Profile of Peak Stages in Canal L-31E for Future Land Use and Topography for 10-yr Design Storm

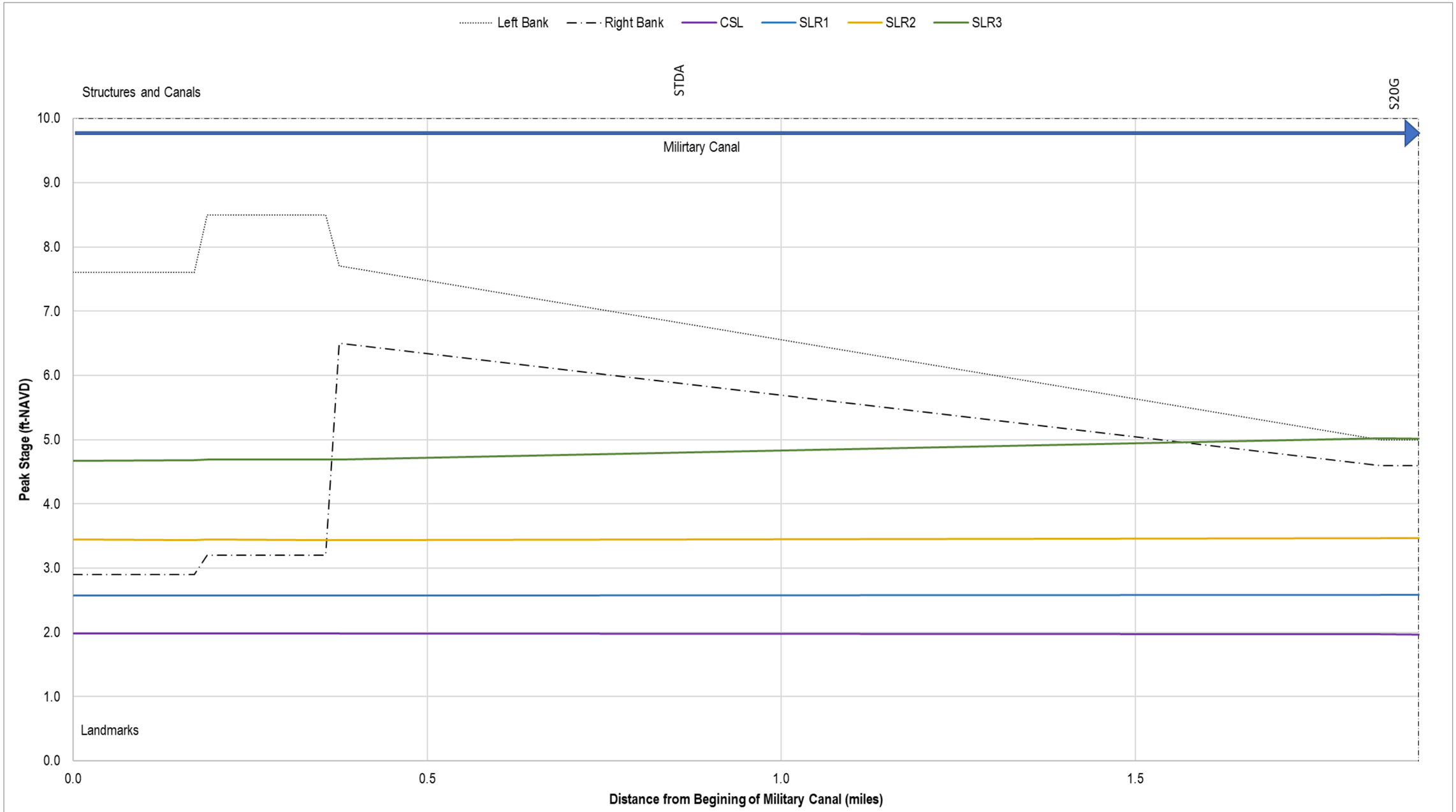


Figure 471 Profile of Peak Stages in Military Canal for Future Land Use and Topography for 10-yr Design Storm

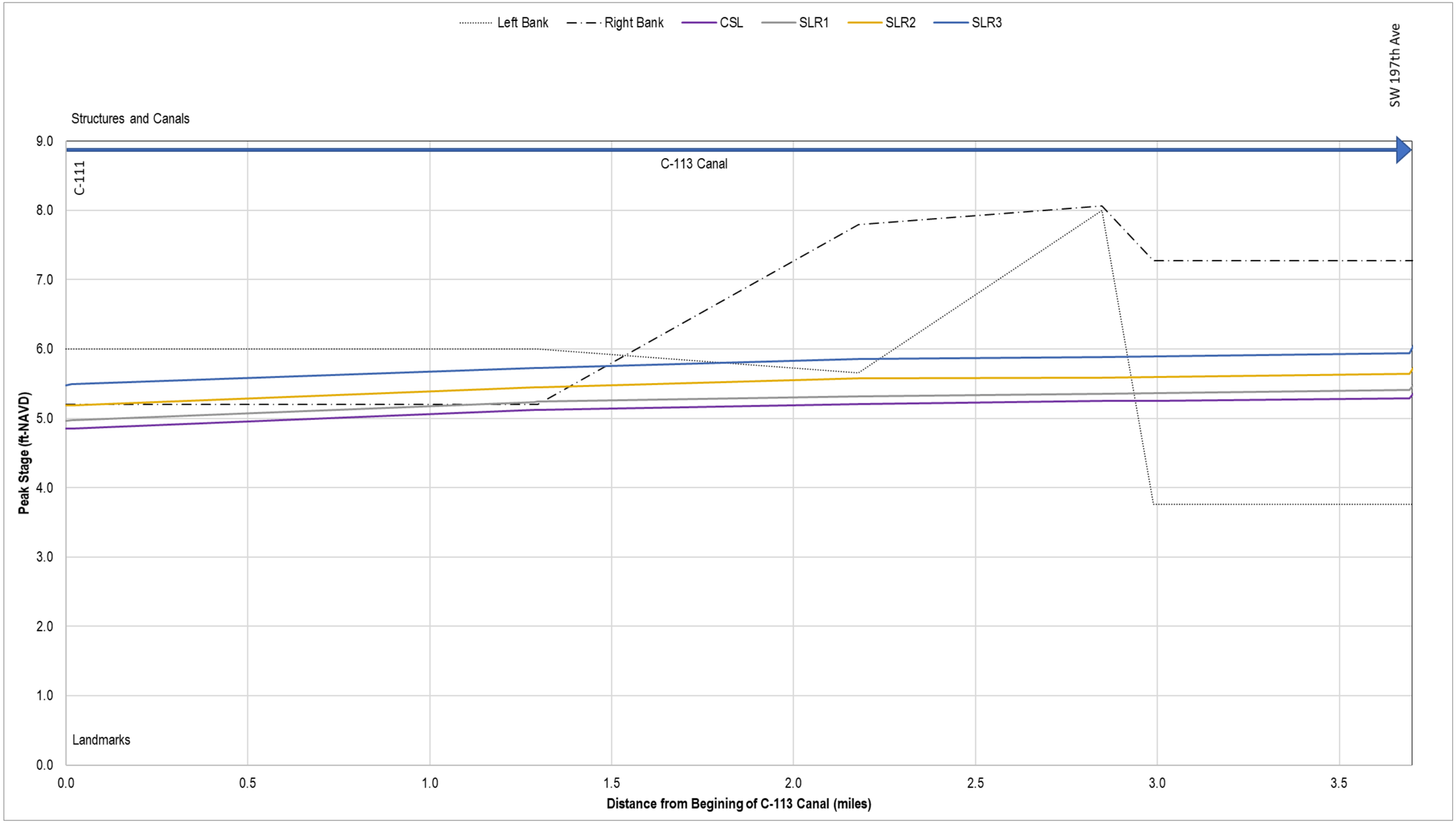


Figure 472 Profile of Peak Stages in Canal C-113 for Future Land Use and Topography for 10-yr Design Storm

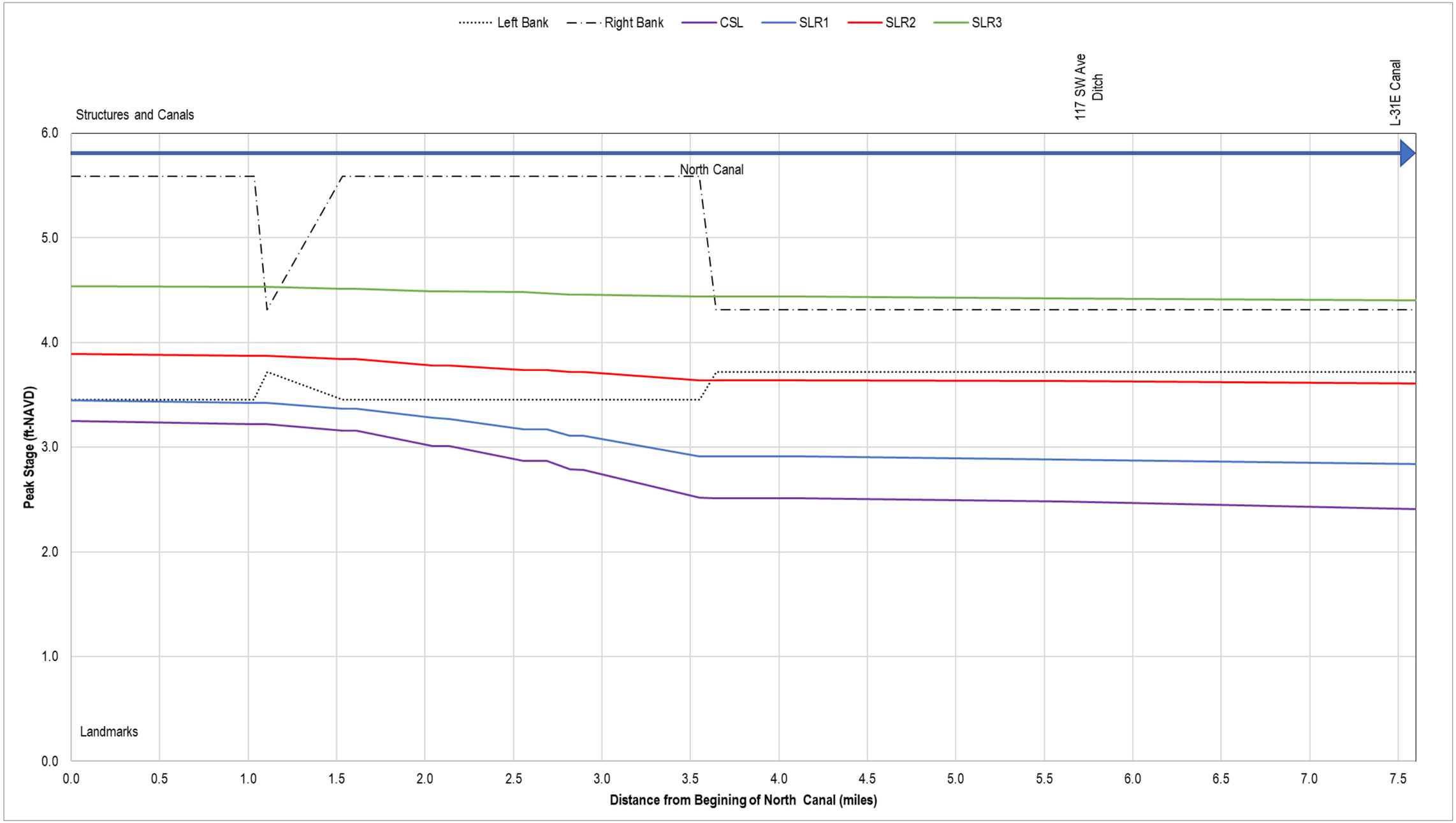


Figure 473 Profile of Peak Stages in North Canal for Future Land Use and Topography for 10-yr Design Storm

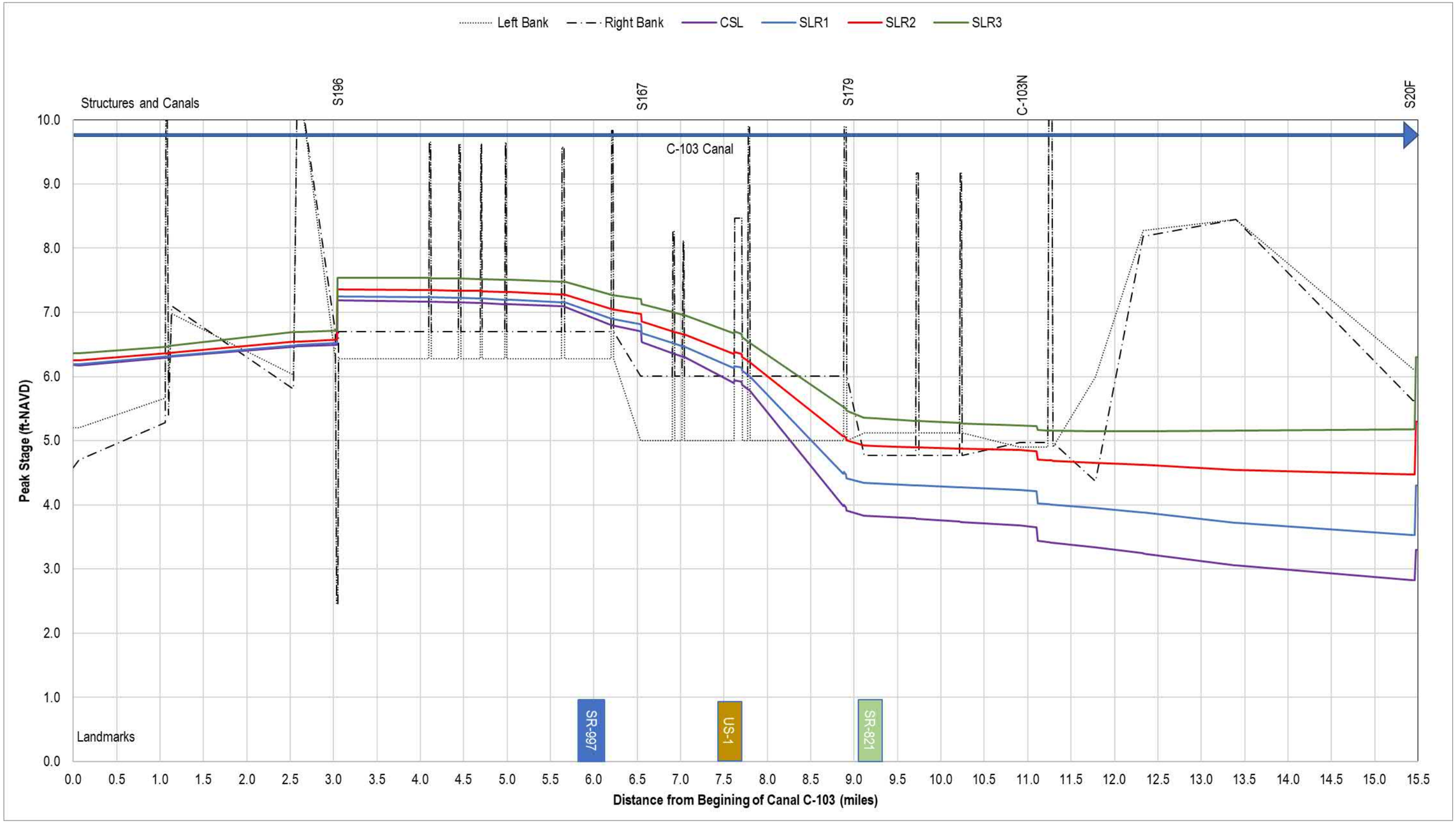


Figure 474 Profile of Peak Stages in Canal C-103 for Future Land Use and Topography for 25-yr Design Storm

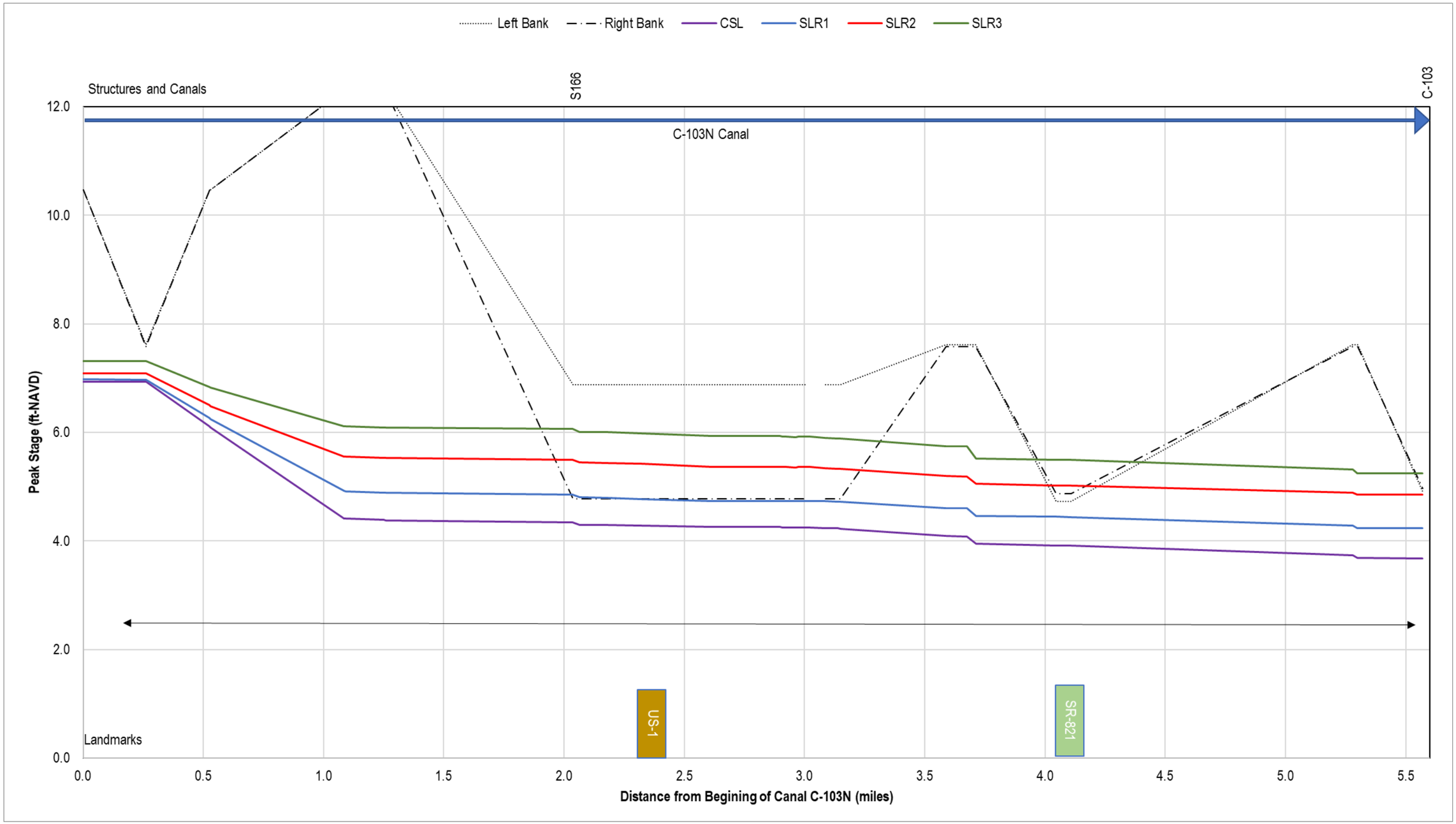


Figure 475 Profile of Peak Stages in Canal C-103N for Future Land Use and Topography for 25-yr Design Storm

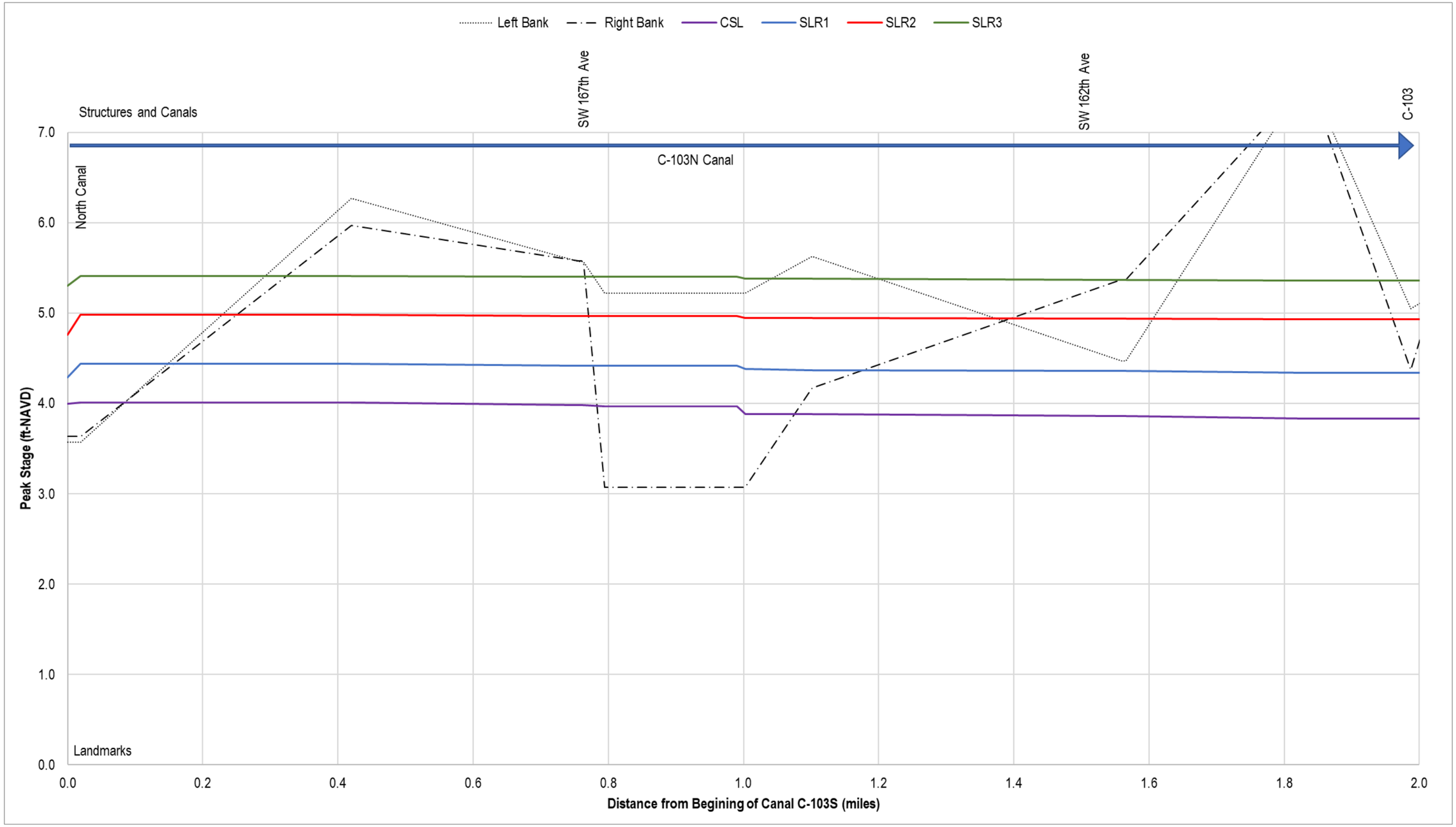


Figure 476 Profile of Peak Stages in Canal C-103S for Future Land Use and Topography for 25-yr Design Storm

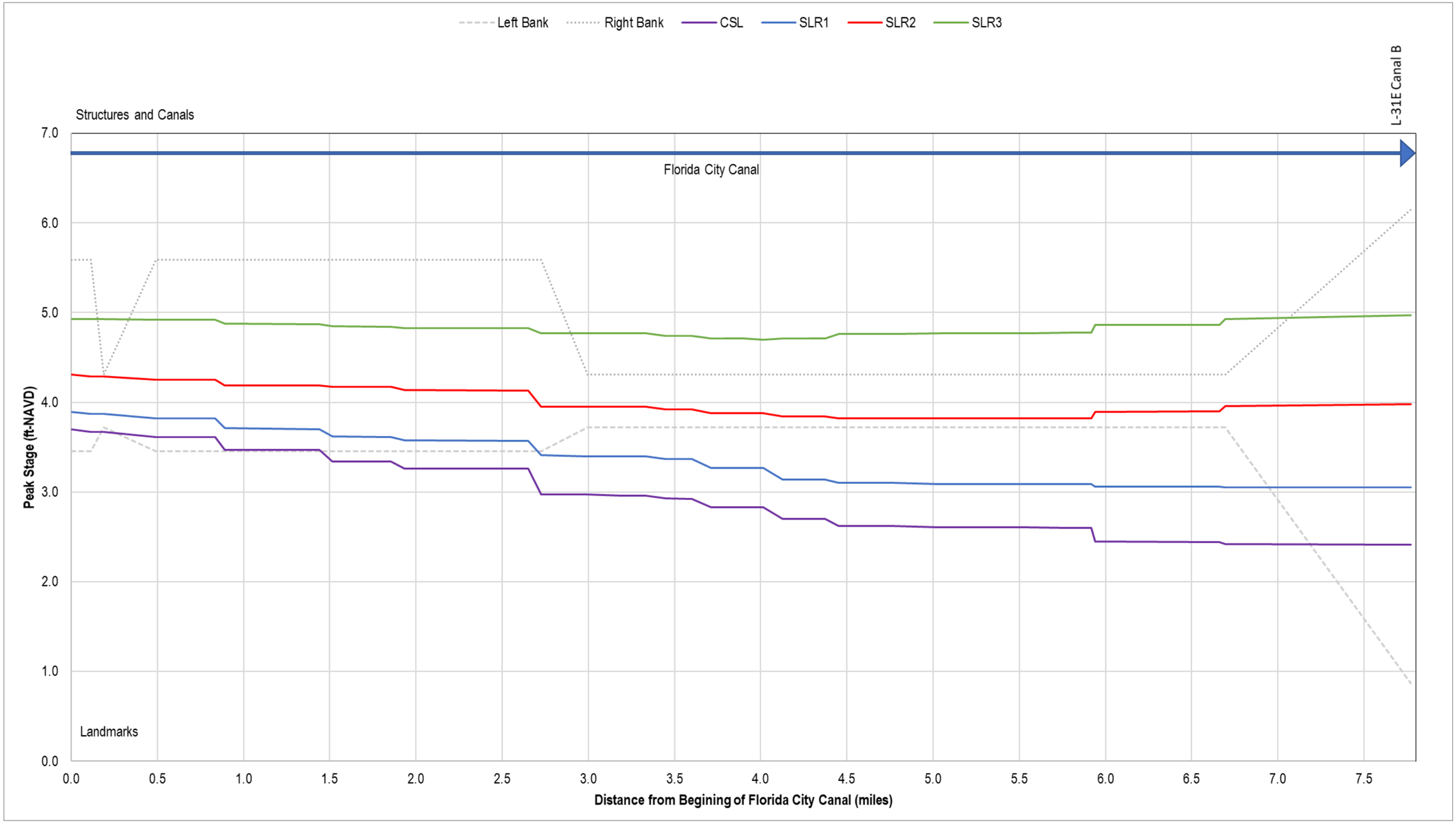


Figure 477 Profile of Peak Stages in Florida City Canal for Future Land Use and Topography for 25-yr Design Storm

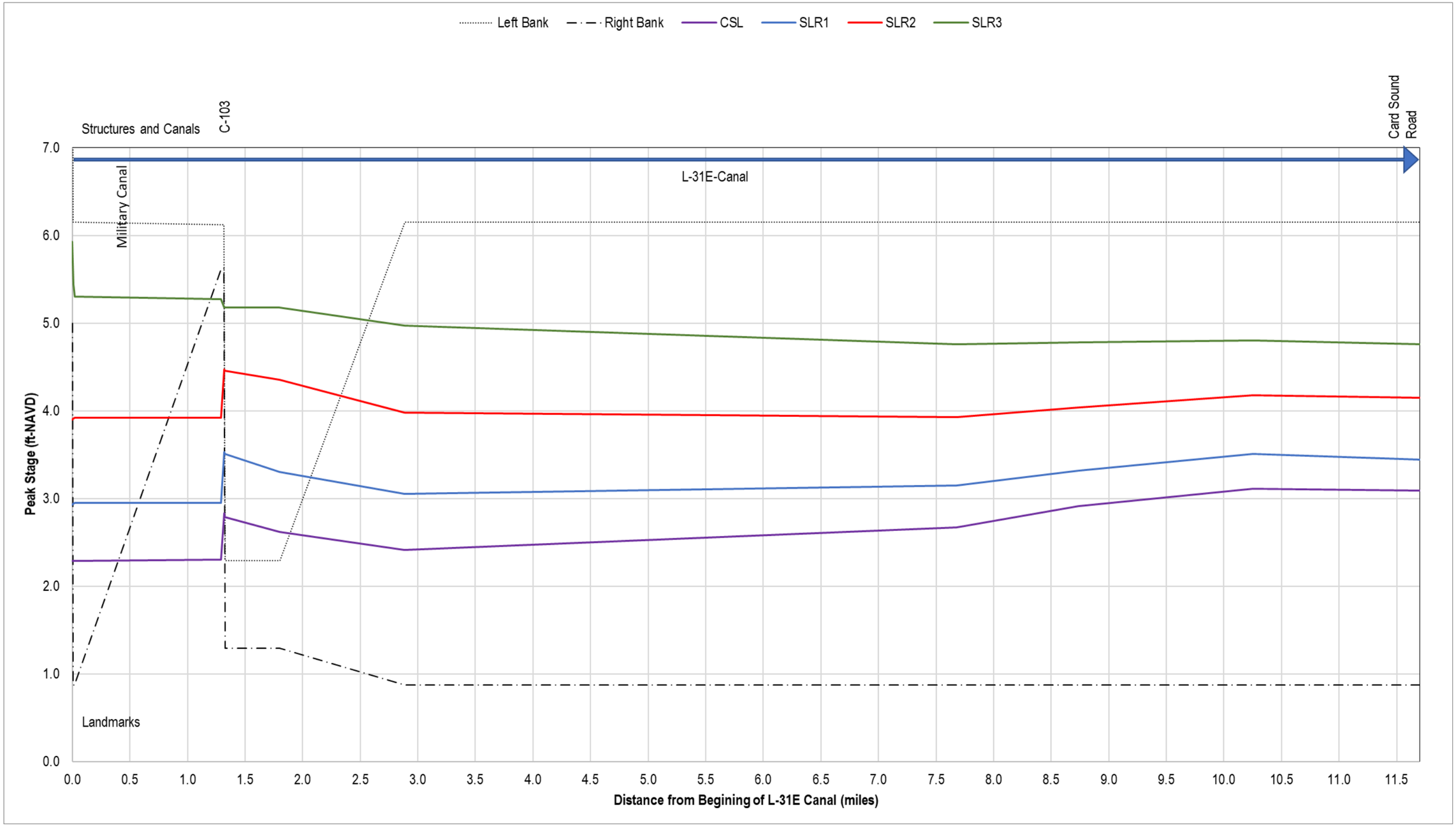


Figure 478 Profile of Peak Stages in Canal L-31E for Future Land Use and Topography for 25-yr Design Storm

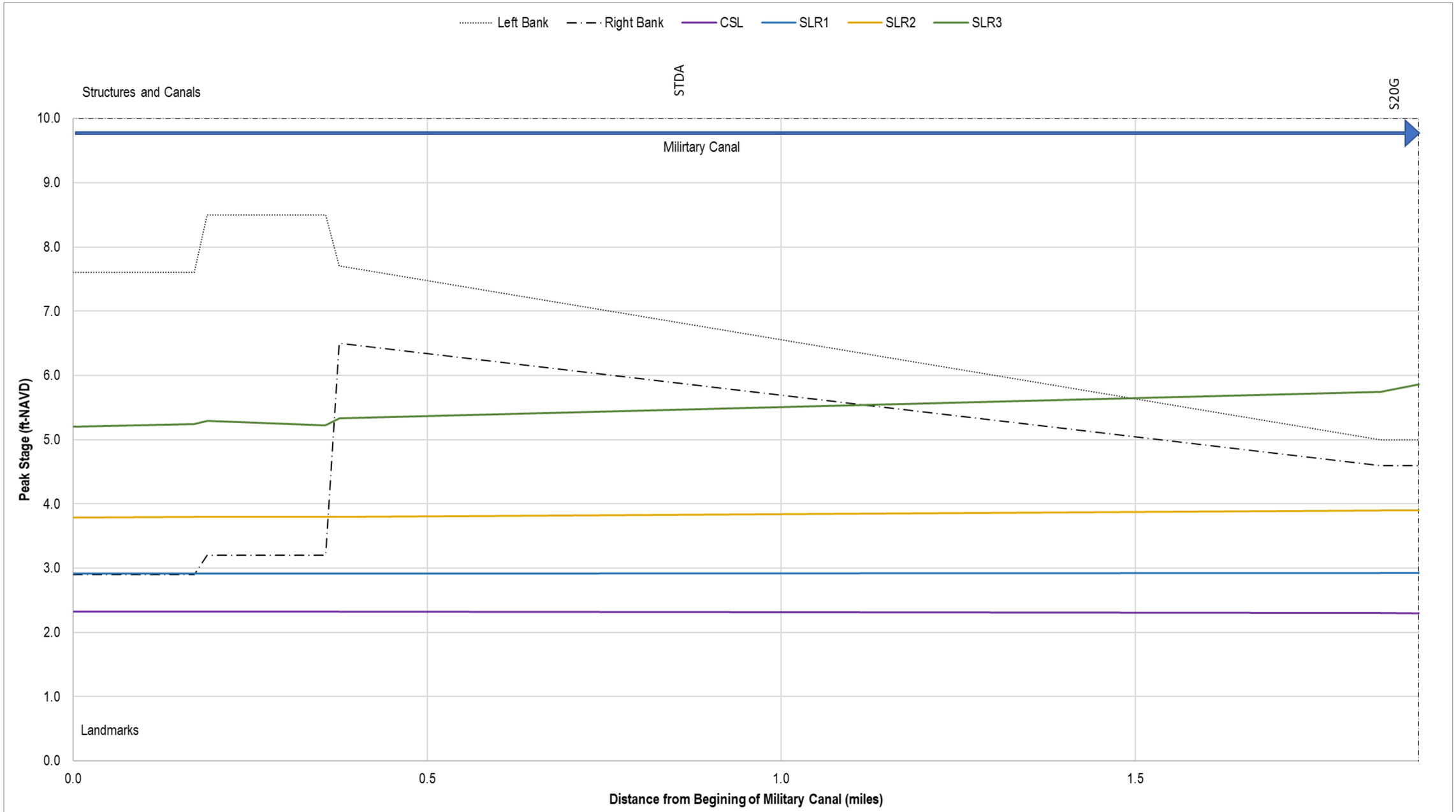


Figure 479. Profile of Peak Stages in Military Canal for Future Land Use and Topography for 25-yr Design Storm

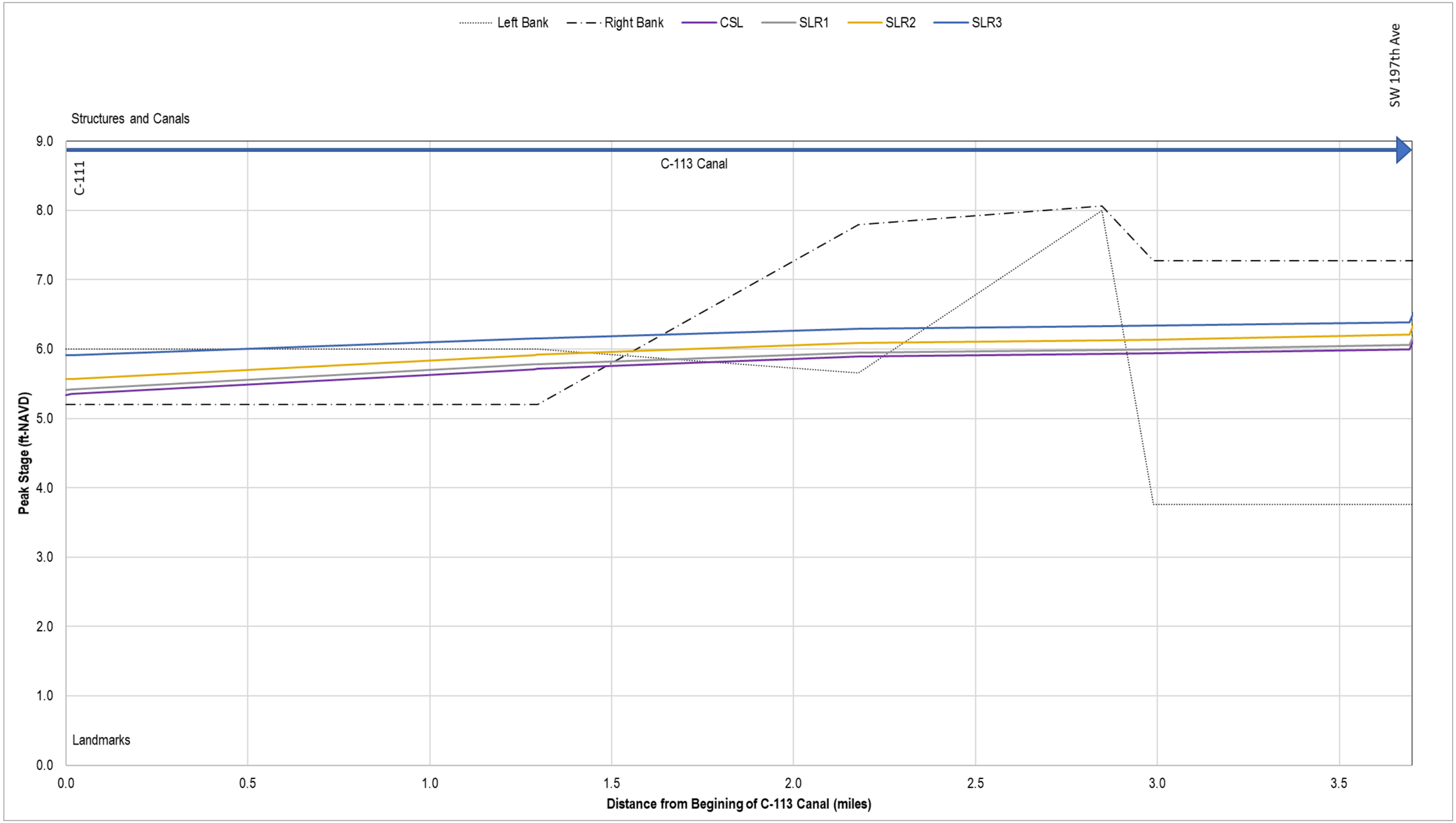


Figure 480. Profile of Peak Stages in Canal C-113 for Future Land Use and Topography for 25-yr Design Storm

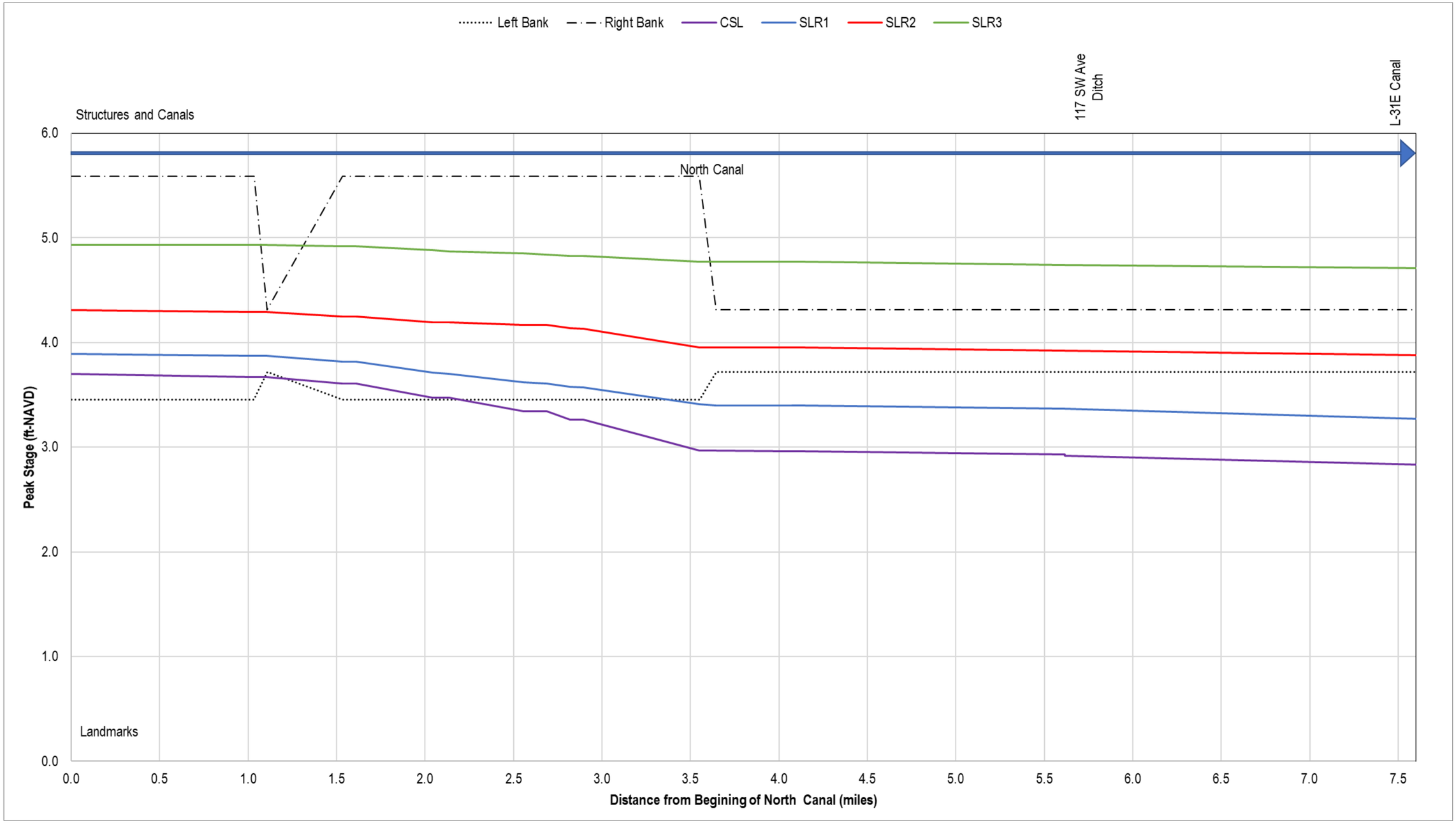


Figure 481. Profile of Peak Stages in North Canal for Future Land Use and Topography for 25-yr Design Storm

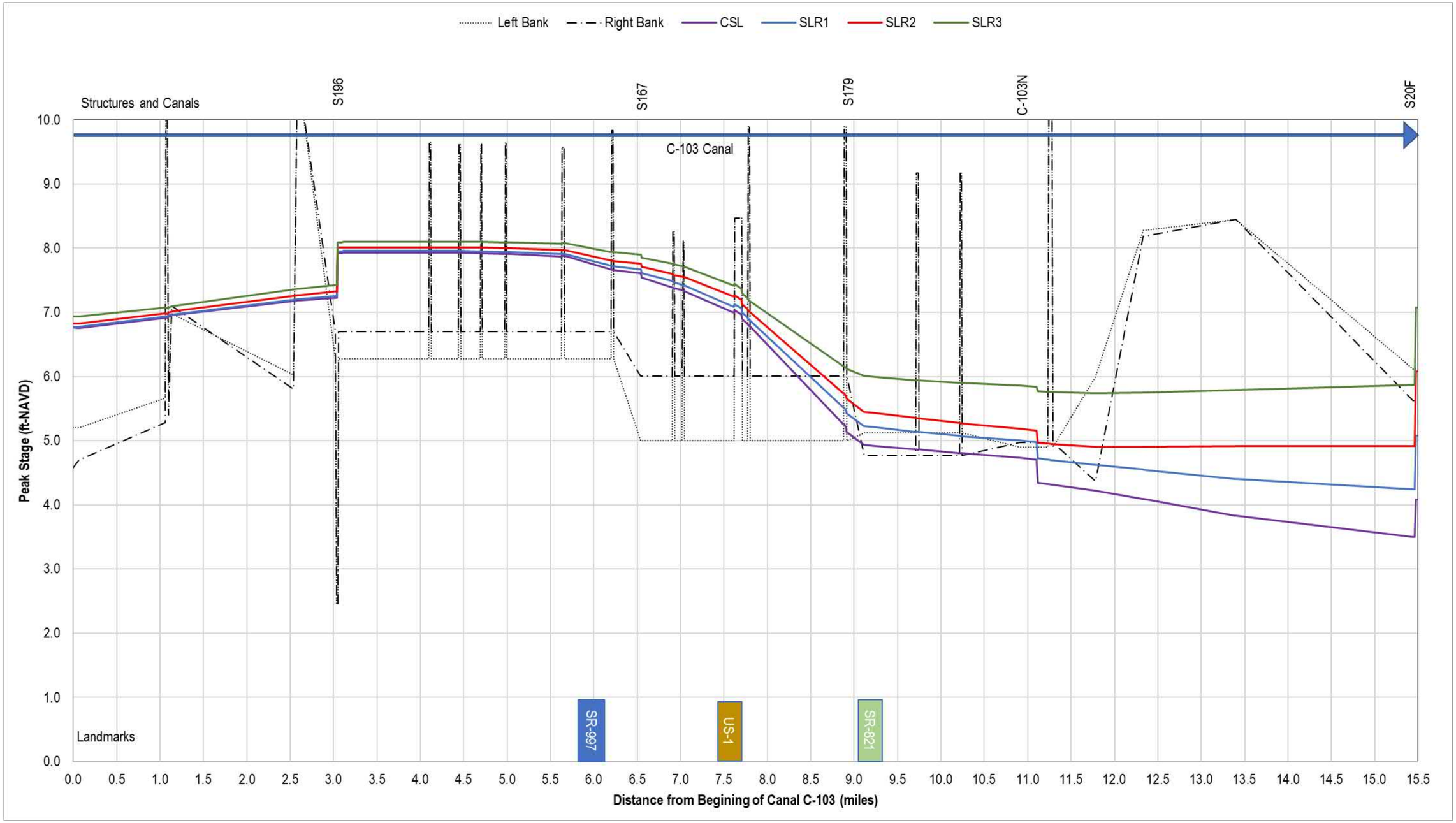


Figure 482. Profile of Peak Stages in Canal C-103 for Future Land Use and Topography for 100-Yr Design Storm

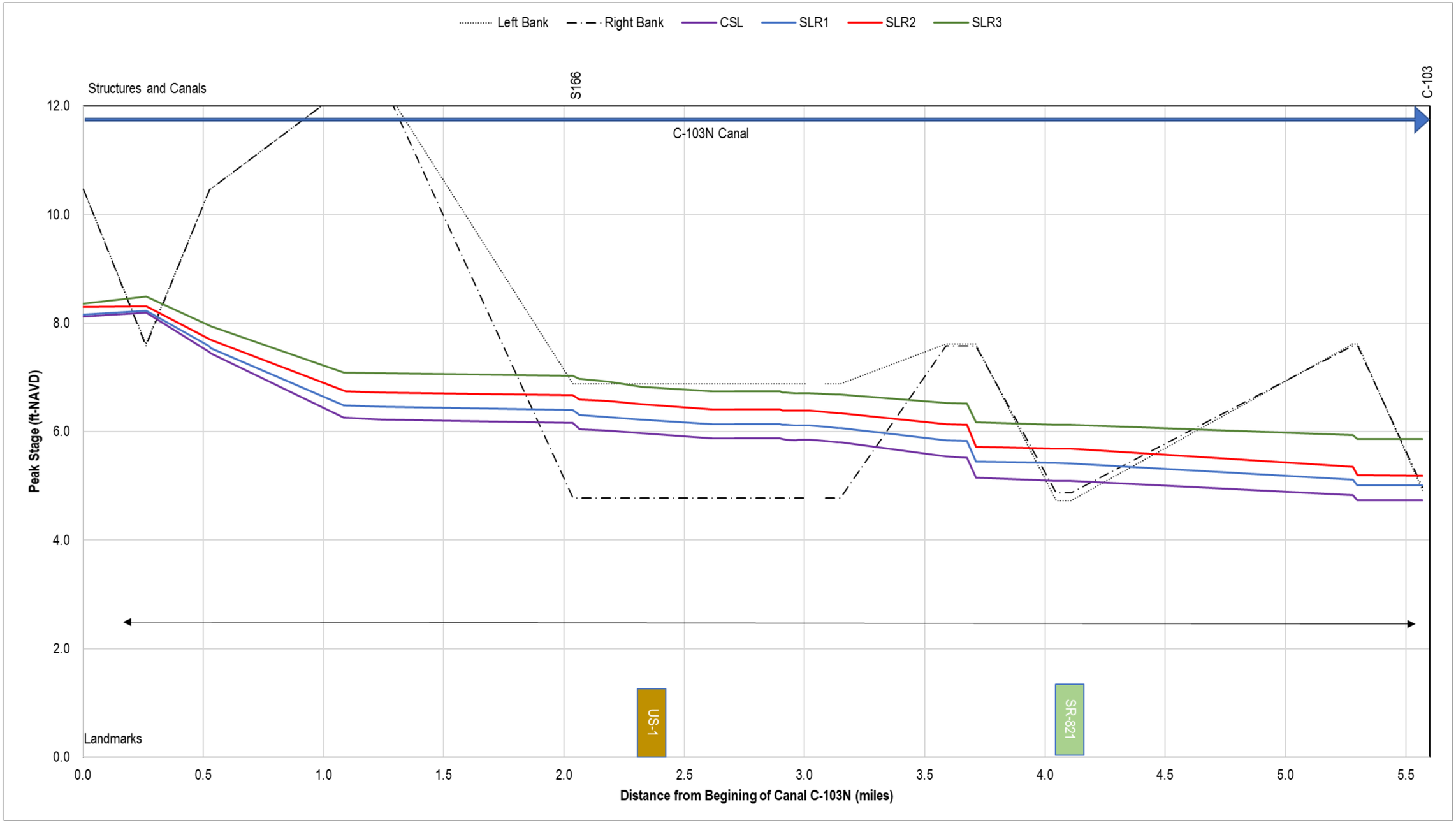


Figure 483. Profile of Peak Stages in Canal C-103N for Future Land Use and Topography for 100-Yr Design Storm

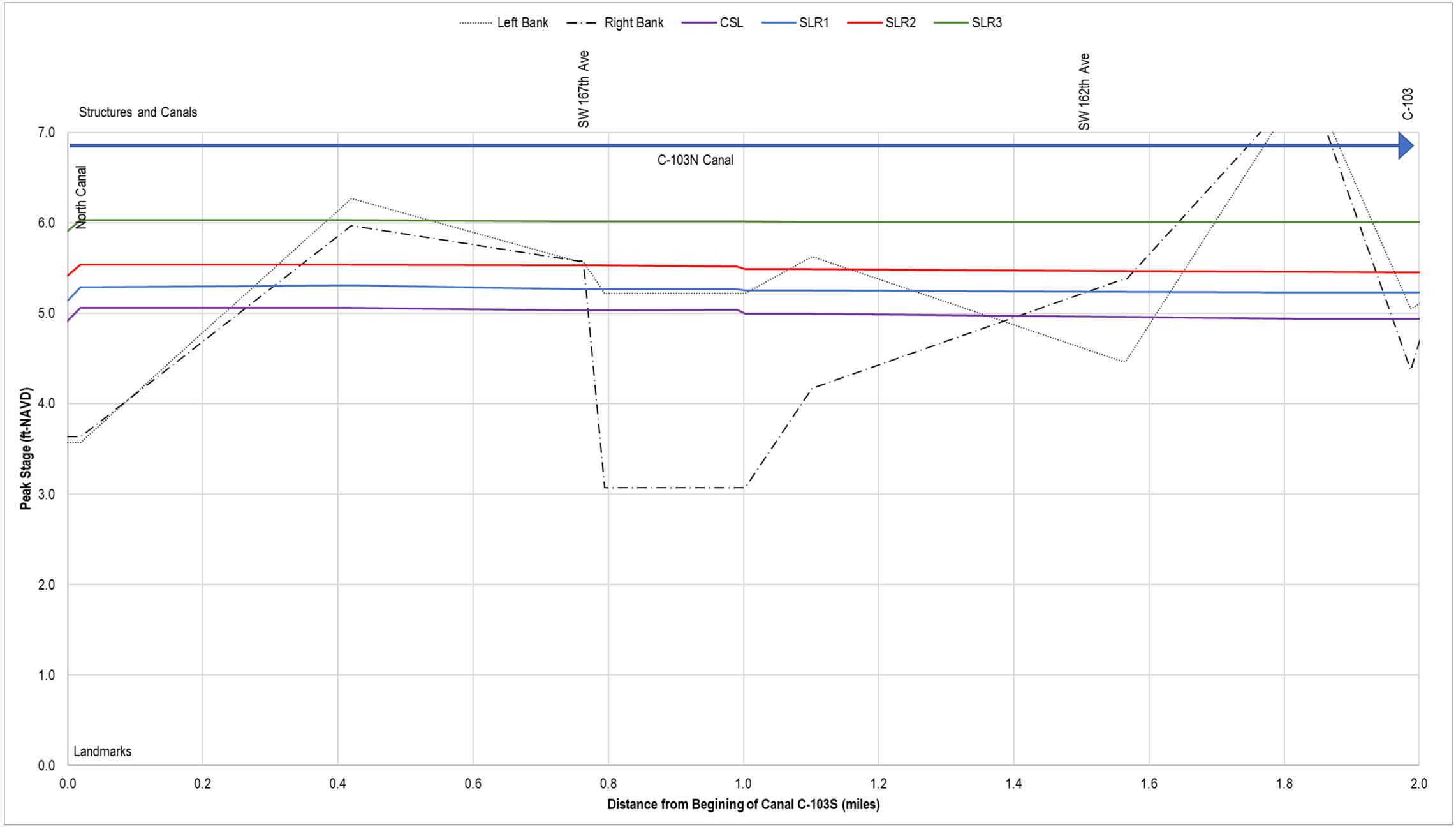


Figure 484. Profile of Peak Stages in Canal C-103S for Future Land Use and Topography for 100-Yr Design Storm

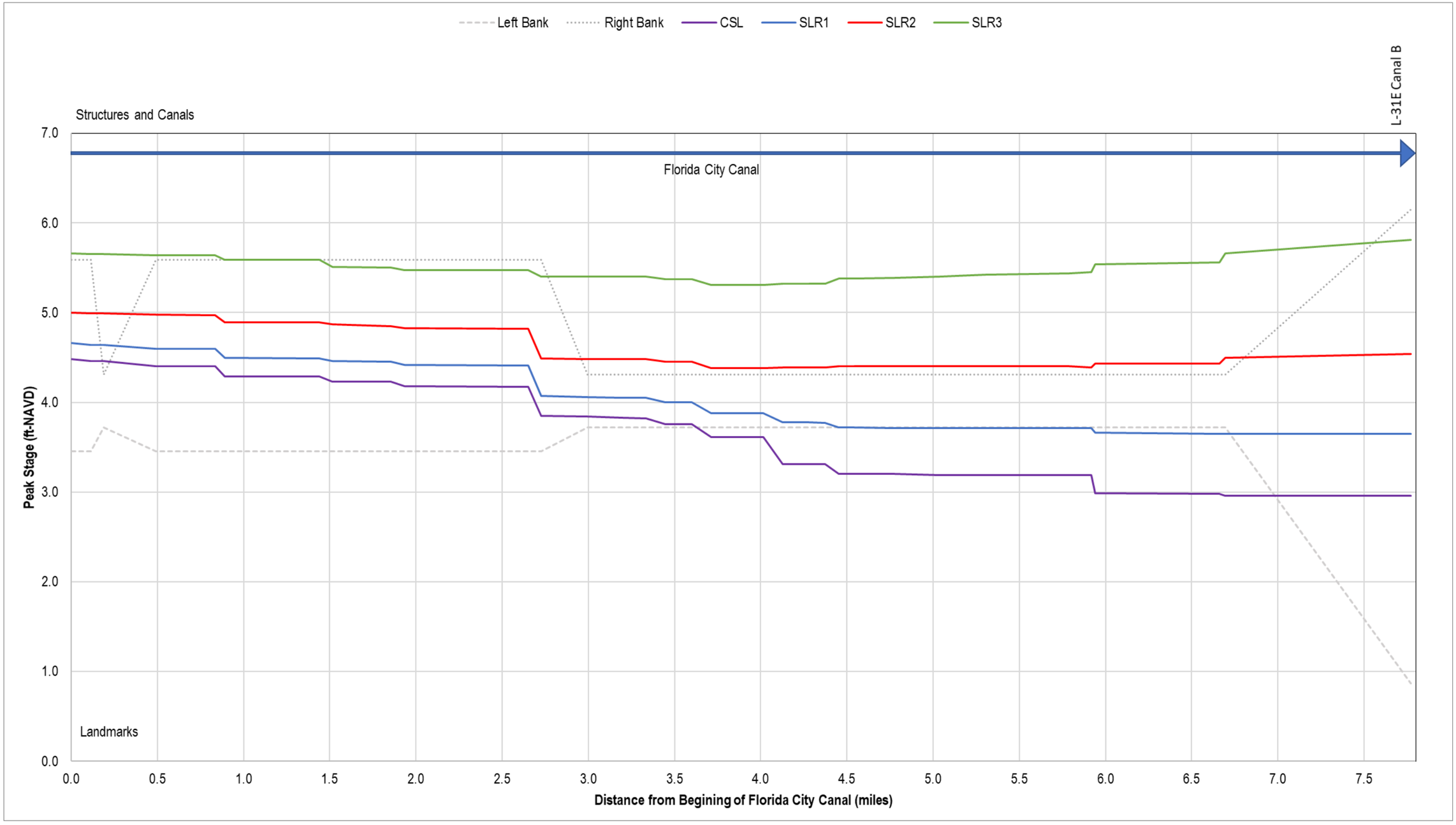


Figure 485. Profile of Peak Stages in Florida City Canal for Future Land Use and Topography for 100-Yr Design Storm

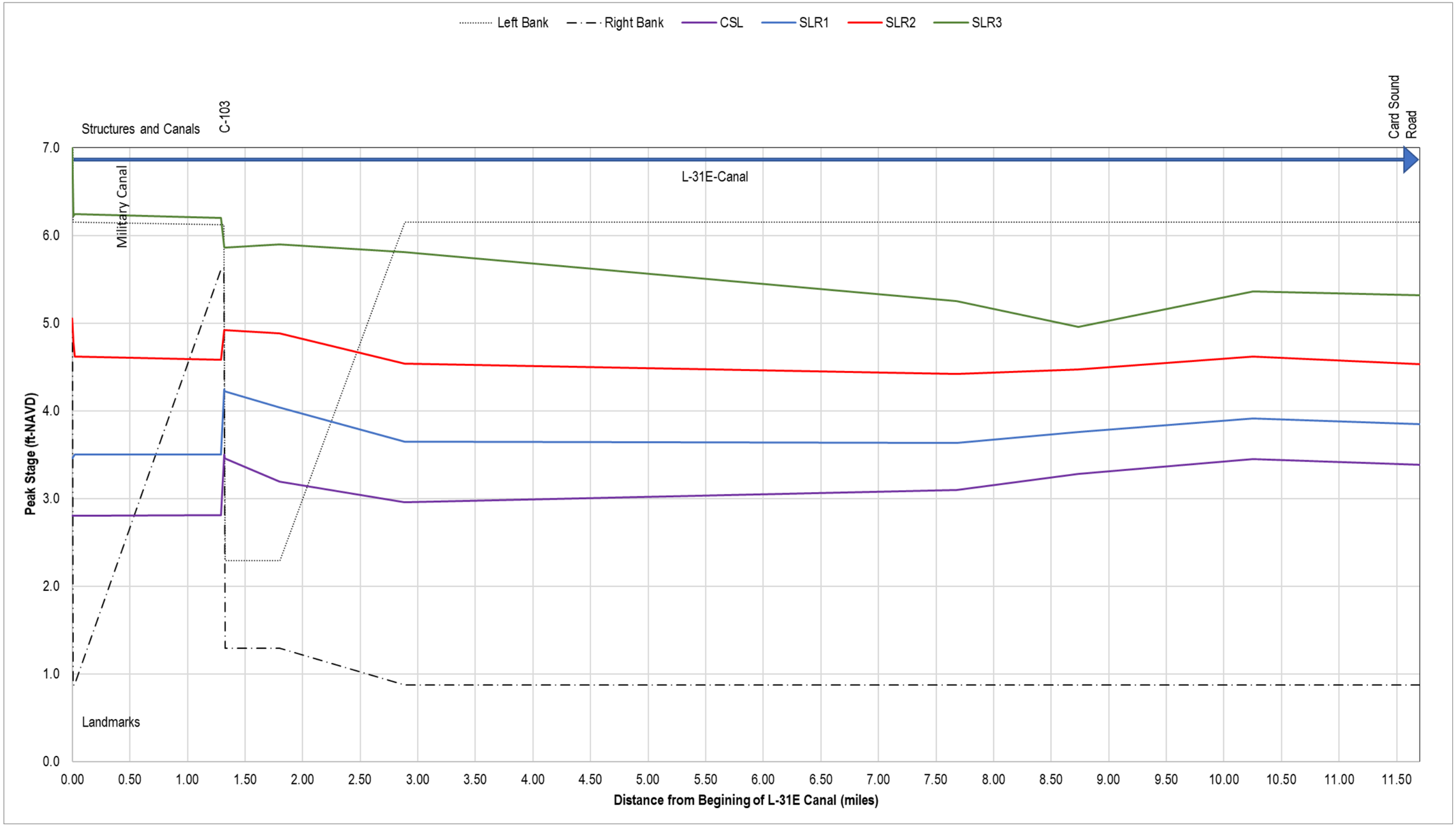


Figure 486. Profile of Peak Stages in Canal L-31E for Future Land Use and Topography for 100-Yr Design Storm

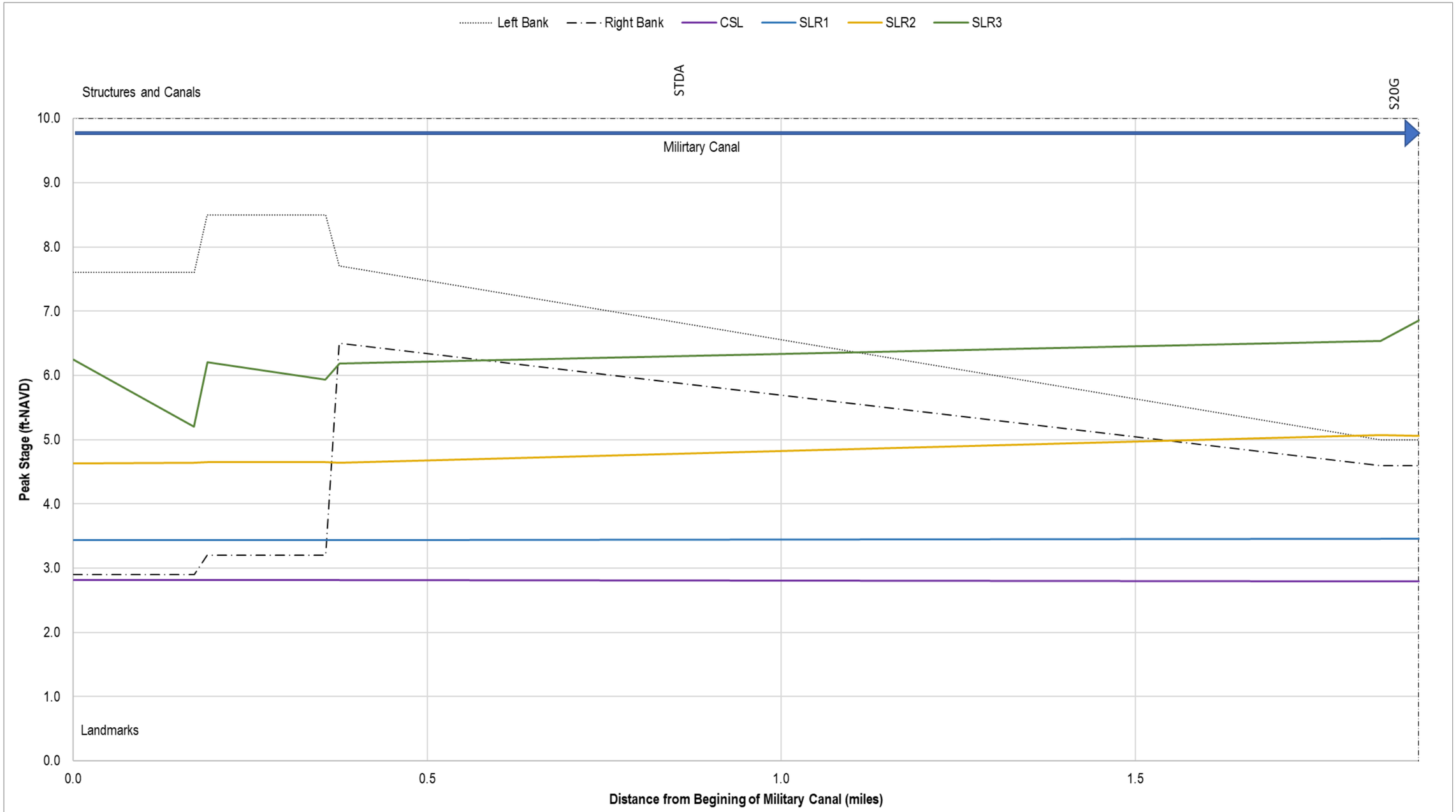


Figure 487. Profile of Peak Stages in Military Canal for Future Land Use and Topography for 100-Yr Design Storm

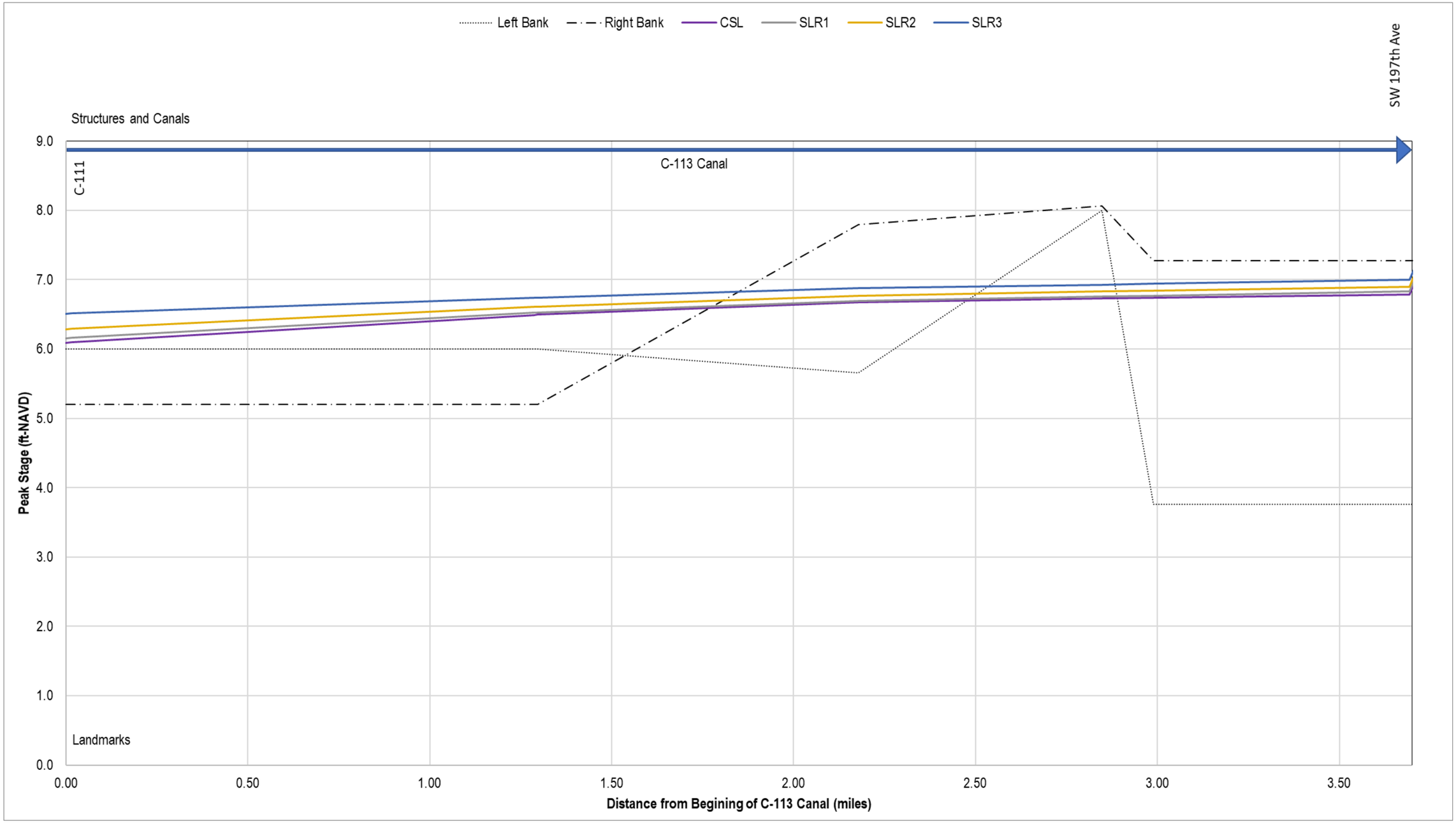


Figure 488. Profile of Peak Stages in Canal C-113 for Future Land Use and Topography for 100-Yr Design Storm

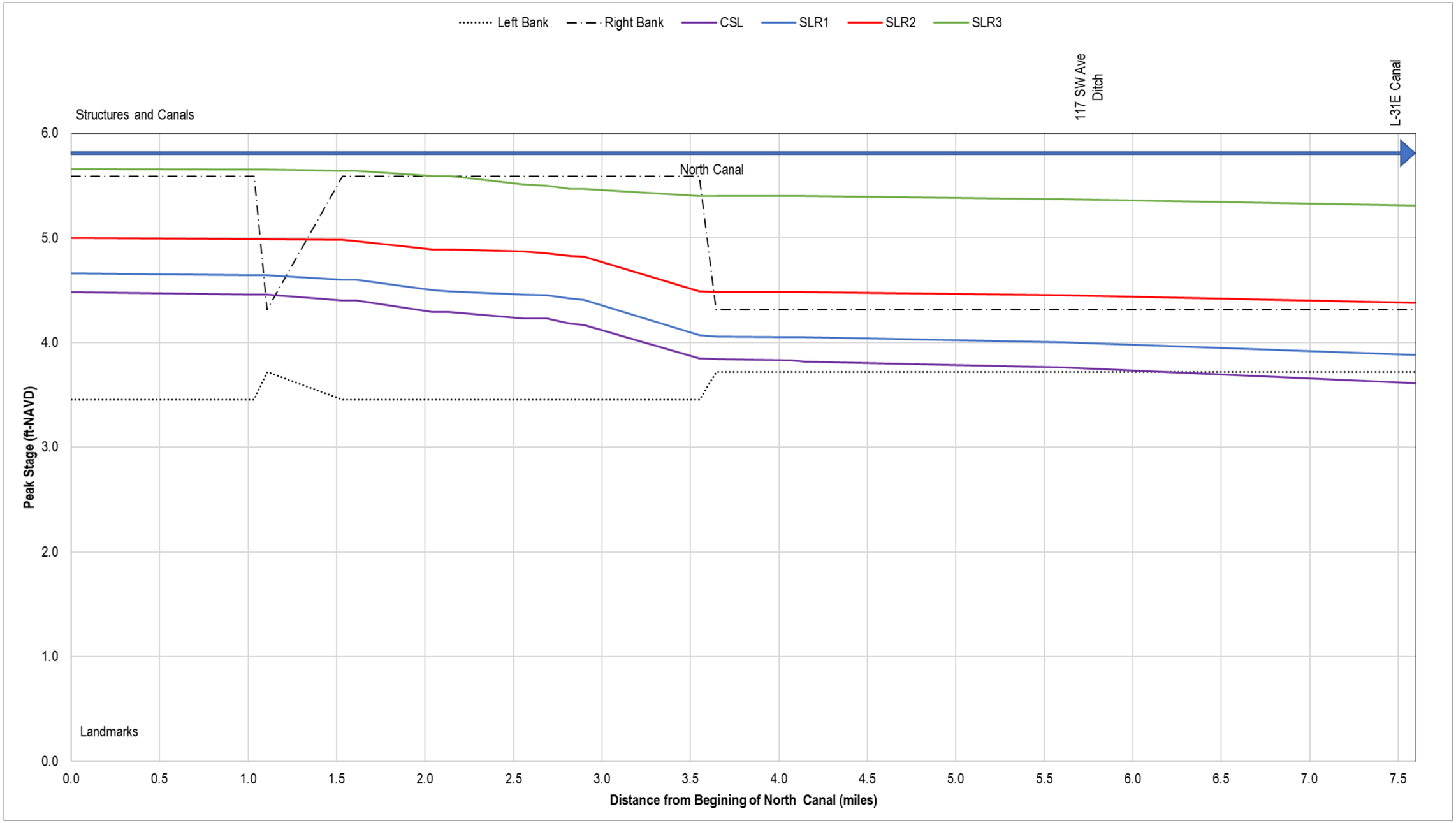


Figure 489. Profile of Peak Stages in North Canal for Future Land Use and Topography for 100-Yr Design Storm

6.5.3 C-103: PM2 Watershed Maximum Daily Discharge Capacity through the Primary Canals

Table 244 contains information on the discharges and the drainage areas in the C-103 Watershed and provides a summary of the 12-hr moving average peak discharges per square mile computed at each structure. For comparison the allowable discharge is defined as 52.56 csm for a 10-Yr design event. Highlighted are the exceedances for the 10-Yr design event.

For Structures S20F, S20G and the outfall of North Canal, the peak drainage discharge increases with increasing the SLR for structures S20F, and the outfall at North Canal. The main reason for this increase is attributed to the tailwater boundary condition which cause accumulation of water volume upstream, followed by rapid release. This pattern may be a result of relatively higher natural watershed drainage capacity while decreasing discharge for higher tailwater may indicate relatively lower natural drainage capacity. Furthermore, if the shape of the recession hydrograph curve is in larger head and tailwater differentials and correspondingly higher discharge rates may develop.

Table 244. C-103 Watershed Drainage Discharge Capacity Based on 12-hr Moving Average (csm)

Structure	Watershed Model	AHED Name	Area (mi^2)	Inflow Structure	Design Event	SLR 0	SLR 1	SLR 2	SLR 3
S20F	C-103	BD-C103 EAST	3.84	S179	5-Yr	107.59	108.95	120.49	132.55
					10-Yr	123.79	127.73	135.40	147.56
					25-Yr	143.66	147.12	155.28	169.43
					100-Yr	175.40	176.20	187.32	203.35
S20G	C-103	HARB	4.50	-	5-Yr	123.42	157.37	187.76	212.59
					10-Yr	150.82	181.31	207.85	250.34
					25-Yr	192.60	212.70	236.50	307.45
					100-Yr	244.61	254.63	305.65	350.09
S166	C-103	BD-C103 WEST	11.41	-	5-Yr	13.81	13.10	15.24	17.70
					10-Yr	19.21	18.33	19.66	21.96
					25-Yr	25.96	24.70	25.83	26.79
					100-Yr	38.58	37.21	37.18	39.08
S167	C-103	BD-C103 WEST	13.20	S196	5-Yr	41.00	36.33	36.65	33.99
					10-Yr	43.12	40.80	38.90	35.90
					25-Yr	45.96	43.72	40.80	36.82
					100-Yr	46.26	43.93	40.88	36.07
S179	C-103	BD-C103 CENTRAL	10.81	S165, S166	5-Yr	59.08	55.89	57.60	59.66
					10-Yr	70.02	66.90	66.66	67.07
					25-Yr	81.43	77.84	76.75	73.45
					100-Yr	95.65	91.97	86.57	72.88
FCC	C-103	FLA-CITY	11.50	-	5-Yr	25.44	16.22	14.80	15.38
					10-Yr	25.44	17.80	15.59	18.87
					25-Yr	25.44	19.53	17.05	26.45
					100-Yr	25.44	22.23	23.32	45.90
NC	C-103	NO-CANAL	7.03	-	5-Yr	61.23	50.70	59.33	140.85
					10-Yr	67.57	55.17	80.88	156.07
					25-Yr	75.47	62.08	123.72	175.96
					100-Yr	85.07	101.10	178.69	212.54
The allowable discharge is defined as 52.56 csm									

Figure 490 through Figure 493 provide the 12-hr moving average discharge for the 5-yr, 10-yr, 25-yr and 100-yr design events.

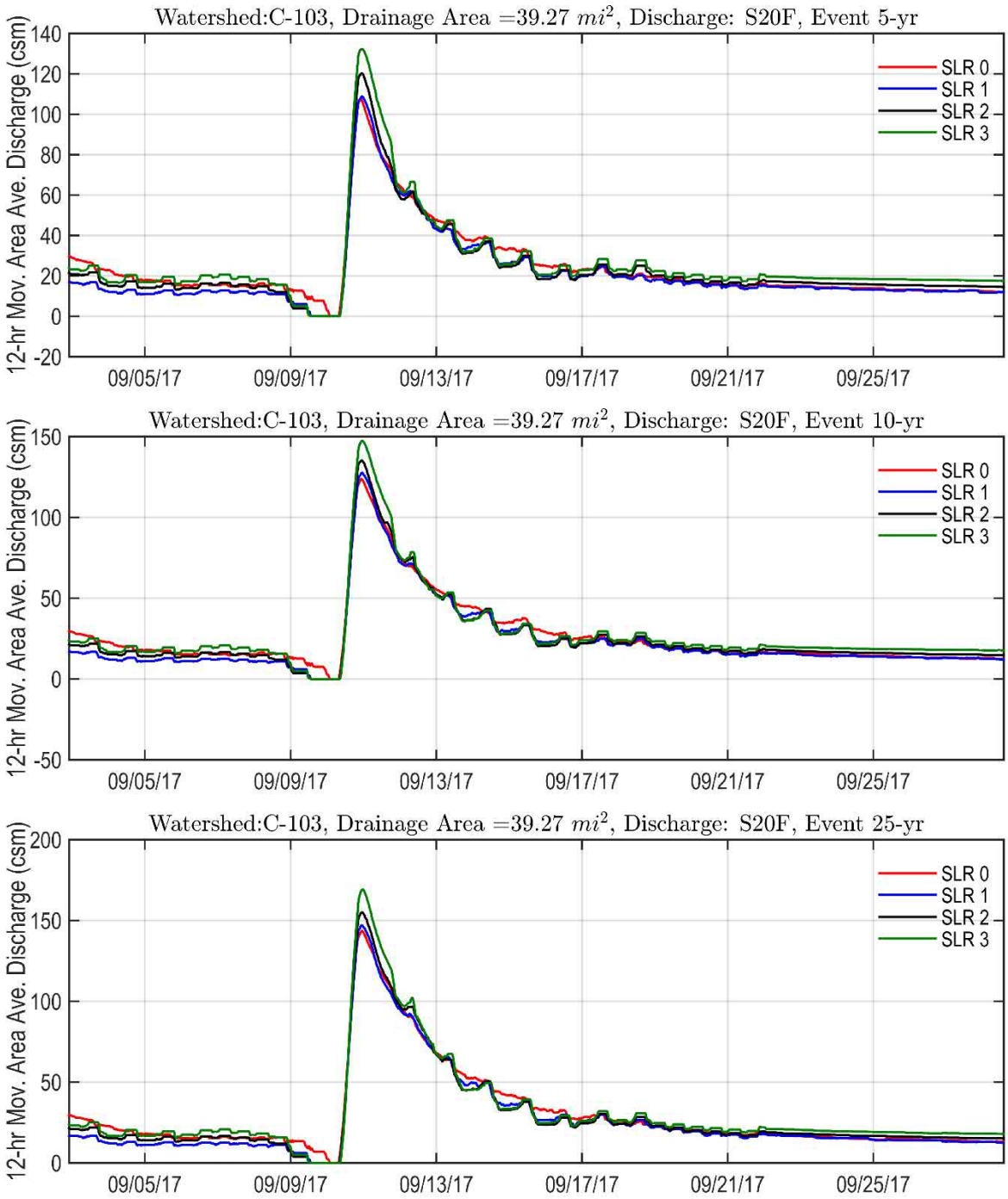


Figure 490. Drainage Discharge Capacity at Structure S20F for 5-Yr, 10-Yr and 25-Yr Design Events

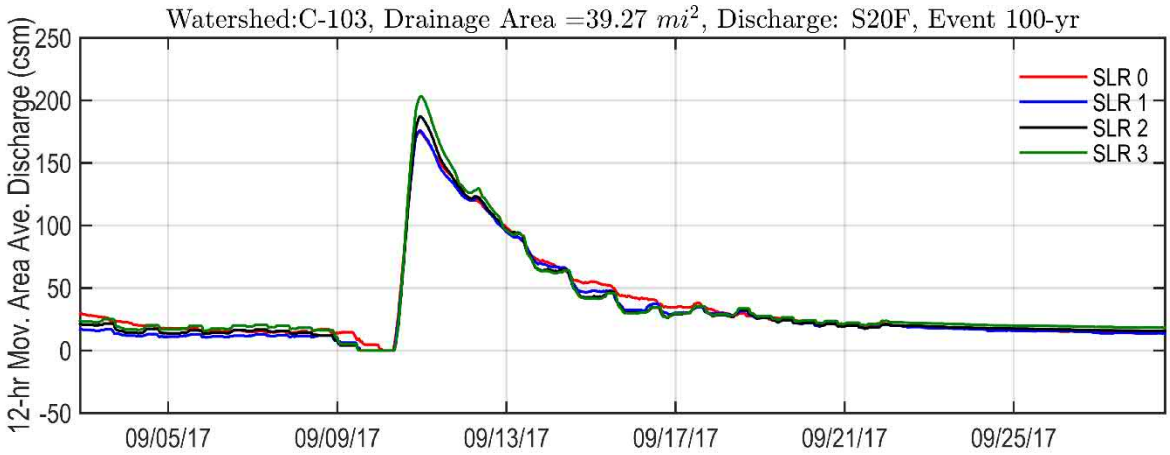


Figure 491. Drainage Discharge Capacity at Structure S20F for 100-Yr Design Event

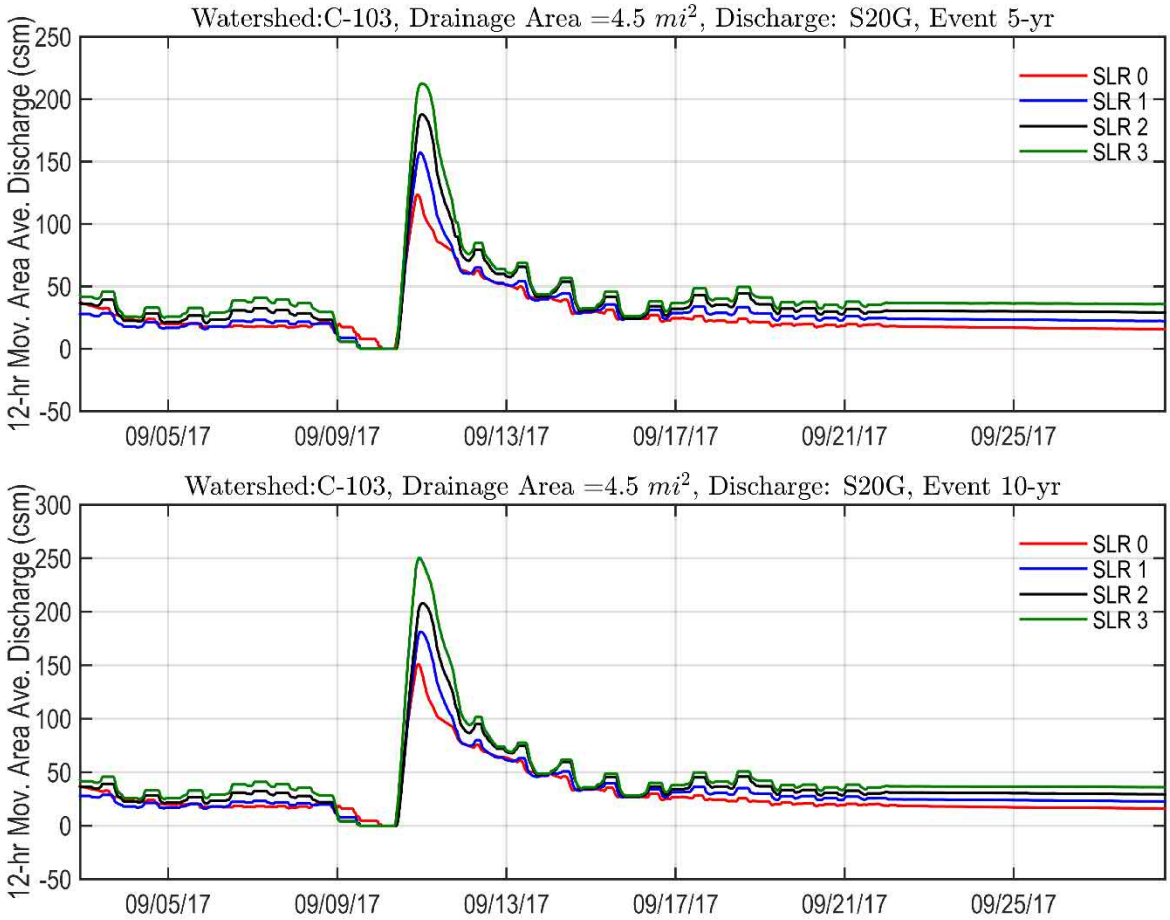


Figure 492. Drainage Discharge Capacity at Structure S20G for 5-Yr and 10-Yr Design Events

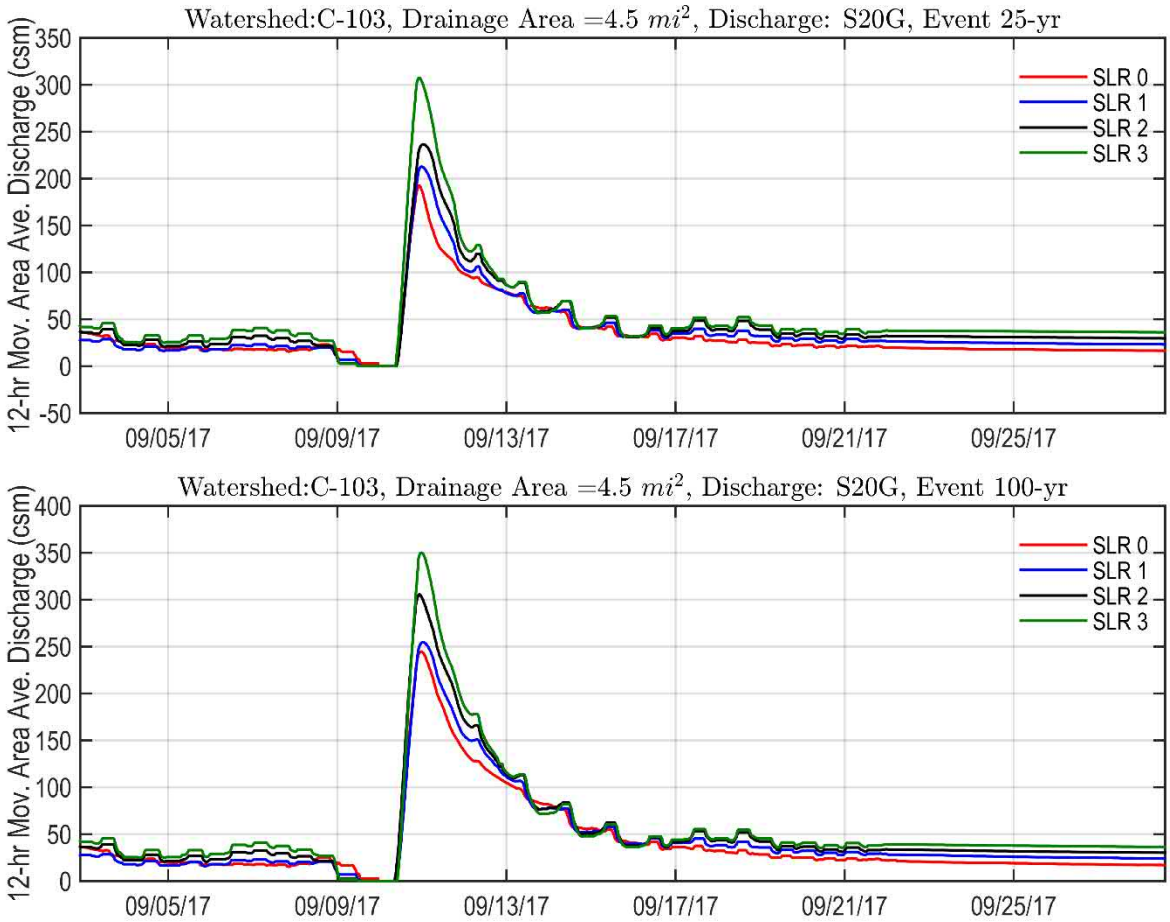


Figure 493. Drainage Discharge Capacity at Structure S20G for 5-Yr and 25-Yr Design Events

The increase of the peak drainage capacity with increase of SLR is attributed to the storm surge boundary conditions which cause gates to be closed during the peak rainfall event and on potential backflow from the storm surge event.

6.5.4 C-103: PM3 Structure Performance

This metric shows the effective capacity of the tidal structures and provides information about the peak instantaneous discharge capacity as a function of the design rainfall recurrence interval and SLR conditions. The design parameters of Structure S20F are listed in Table 245.

Table 245 Design parameters of Structure S20F

Structure	S20F	S20G
Design Discharge	2900 cfs for 40% SPF	900 cfs for 40% SPF
SPF Discharge	4900 cfs	1700 cfs
Design Headwater Elevation	1.9 ft NGVD 29	2.0 ft NGVD 29
Design Tailwater Elevation	1.4 ft NGVD 29	1.5 ft NGVD 29
SPF Headwater Elevation	3.0 ft NGVD 29	3.0 ft NGVD 29
SPF Tailwater Elevation	2.5 ft NGVD 29	2.5 ft NGVD 29
Overtopping	7.0 ft NGVD 29	7.0 ft NGVD 29

For this PM, the data were analyzed for:

- Stages and flows at structures at the time of peak flow
- Stages and flows at structures at the time of peak headwater stage
- Stages and flows at structures at the time of peak tailwater stage

The results were tabulated for all simulations and include 4 design events and 4 SLR conditions.

6.5.4.1 PM3: Structure S20F

This section provides a summary of simulated data at conditions of peak flows, peak headwater and peak tailwater stages for structures and outfalls within the C-103 Watershed.

Figure 494 and Figure 496 show instantaneous values for the 25-Year and 100-Year design storms, respectively.

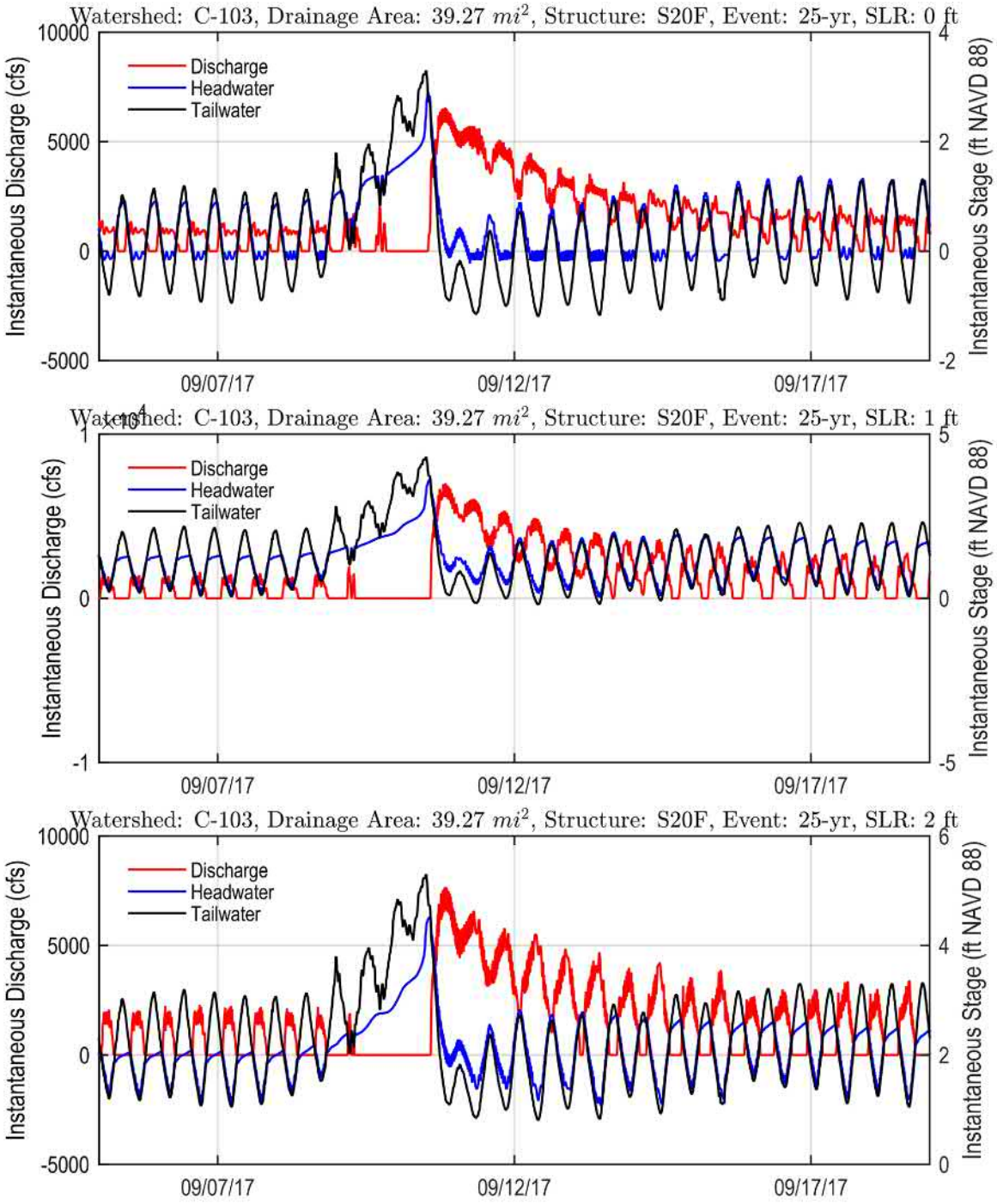


Figure 494 Structure S20F Instantaneous Conditions for 25-yr Design Event for SLR 0, 1 and 2 ft

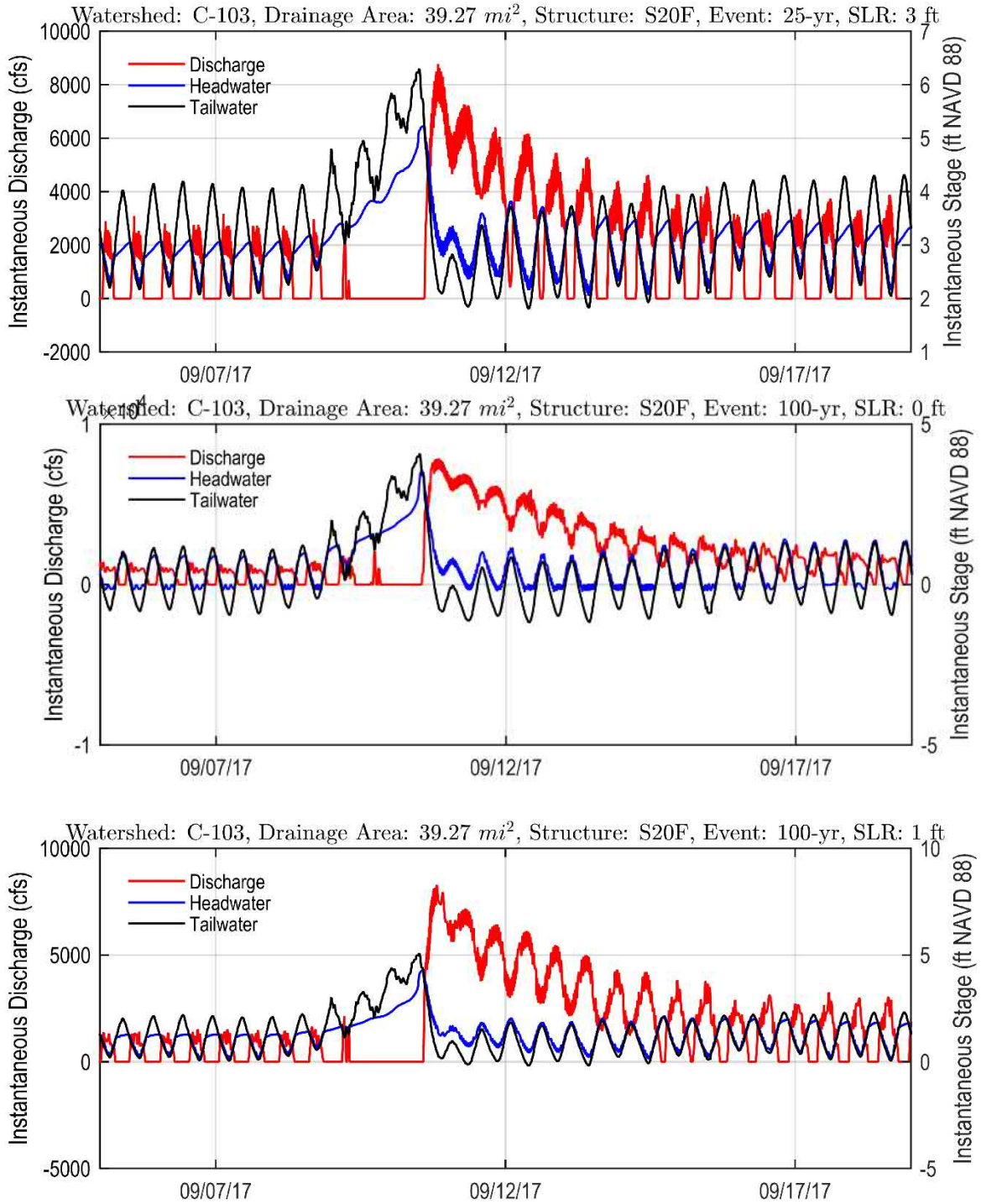


Figure 495 Structure S20F Instantaneous Conditions for 25-yr Design Events SLR 3 ft and 100-yr Event for SLR 0 and 1 ft

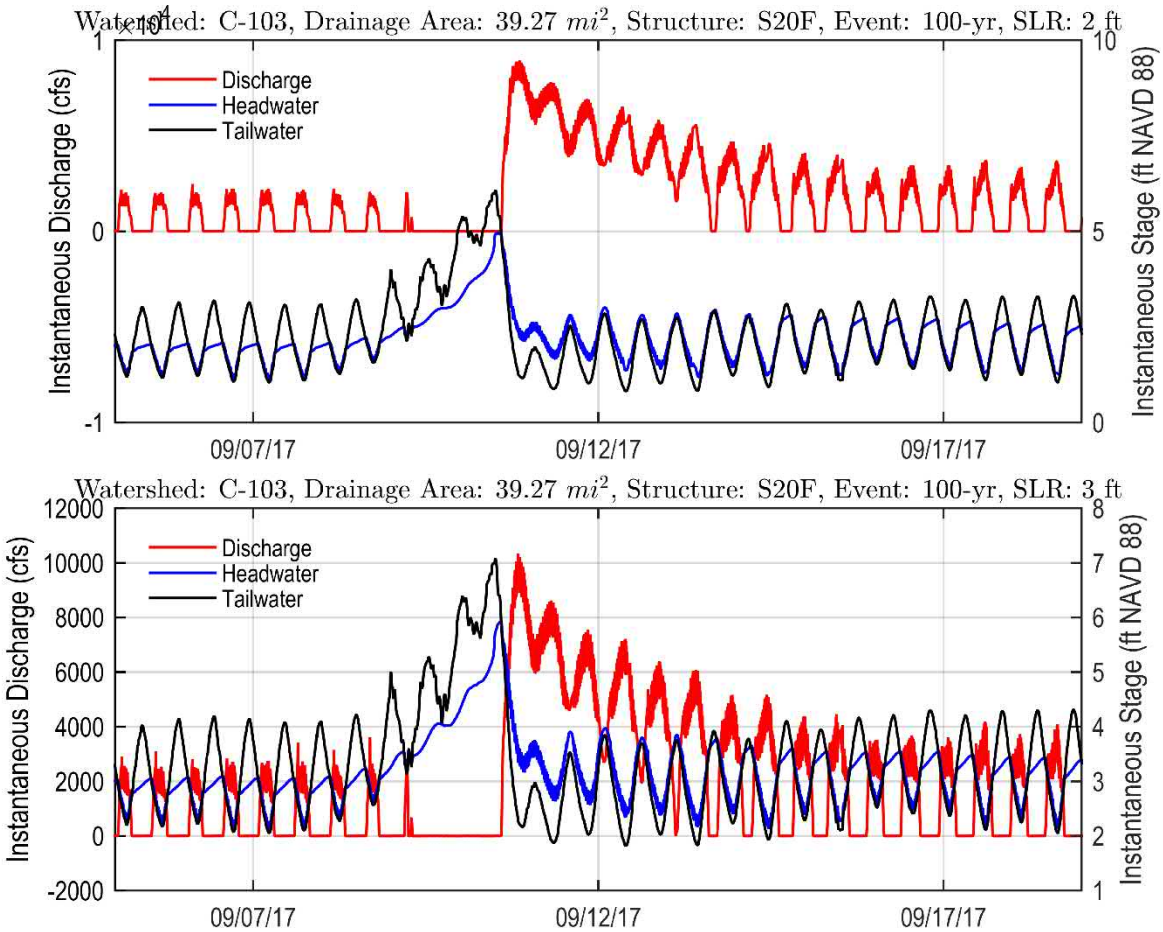


Figure 496 Structure S20F Instantaneous Conditions for 100-yr Design Events for SLR 2 and 3 ft

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 246. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 246 Structure S20F Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi²)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	S20F	39.270	SLR = +0 ft	4955	5076	6446	7882
			SLR = +1 ft	6397	6894	7601	8394
			SLR = +2 ft	7409	7746	8457	9181
			SLR = +3 ft	8785	9249	9855	10715

Table 247 provides a list of the instantaneous conditions at structure S21A at peak tailwater. The head differential is less or equal to the gate closing criteria, therefore the discharges are nearly zero for all events and SLR conditions.

Table 247 Structure S20F Summary Instantaneous Conditions at Peak Tailwater

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
5-yr	SLR 0	2.42	-0.36	1.84	-0.58
	SLR 1	2.81	-0.43	2.06	-0.75
	SLR 2	3.30	-0.50	2.48	-0.82
	SLR 3	4.08	-0.63	3.26	-0.83
10-yr	SLR 0	3.42	-0.37	2.40	-1.03
	SLR 1	3.81	-0.44	2.70	-1.12
	SLR 2	4.30	-0.52	3.18	-1.12
	SLR 3	5.08	-0.65	4.02	-1.06
25-yr	SLR 0	4.42	-0.39	3.41	-1.01
	SLR 1	4.81	-0.45	3.76	-1.06
	SLR 2	5.30	-0.53	4.28	-1.03
	SLR 3	6.08	-0.78	4.93	-1.15
100-yr	SLR 0	5.42	-0.40	4.49	-0.93
	SLR 1	5.81	-0.52	4.78	-1.04
	SLR 2	6.30	-0.72	5.13	-1.17
	SLR 3	7.08	-0.88	5.73	-1.36

Table 248 provides a summary of the instantaneous conditions at structure S20F at peak discharge.

Table 248 Structure S20F Summary of Instantaneous Conditions at Peak Discharge

Design Event	Scenario	Peak Discharge cfs	TW at Peak Discharge ft NAVD	HW at Peak Discharge ft NAVD	Head Differential at Peak Discharge ft
5-yr	SLR 0	5087	-0.59	0.00	0.59
	SLR 1	5715	-0.85	-0.09	0.76
	SLR 2	6557	-0.75	0.22	0.97
	SLR 3	7854	-0.57	0.74	1.31
10-yr	SLR 0	5403	-0.85	0.65	1.50
	SLR 1	6044	0.12	0.85	0.73
	SLR 2	6971	0.18	1.10	0.92
	SLR 3	8279	0.48	1.70	1.22
25-yr	SLR 0	6239	1.15	1.79	0.64
	SLR 1	6876	1.17	1.94	0.77
	SLR 2	7681	1.17	2.13	0.96
	SLR 3	8952	1.21	2.48	1.26
100-yr	SLR 0	7048	2.09	2.79	0.70
	SLR 1	7724	2.12	2.95	0.83
	SLR 2	8775	2.25	3.28	1.04
	SLR 3	10344	2.28	3.68	1.40

Figure 497 and Figure 498 provide 12-hr Moving Average of Structure S20F Discharge, Stage, and Head Difference for the 25-yr and 100-Year Design Event for SLR 1, 2 and 3.

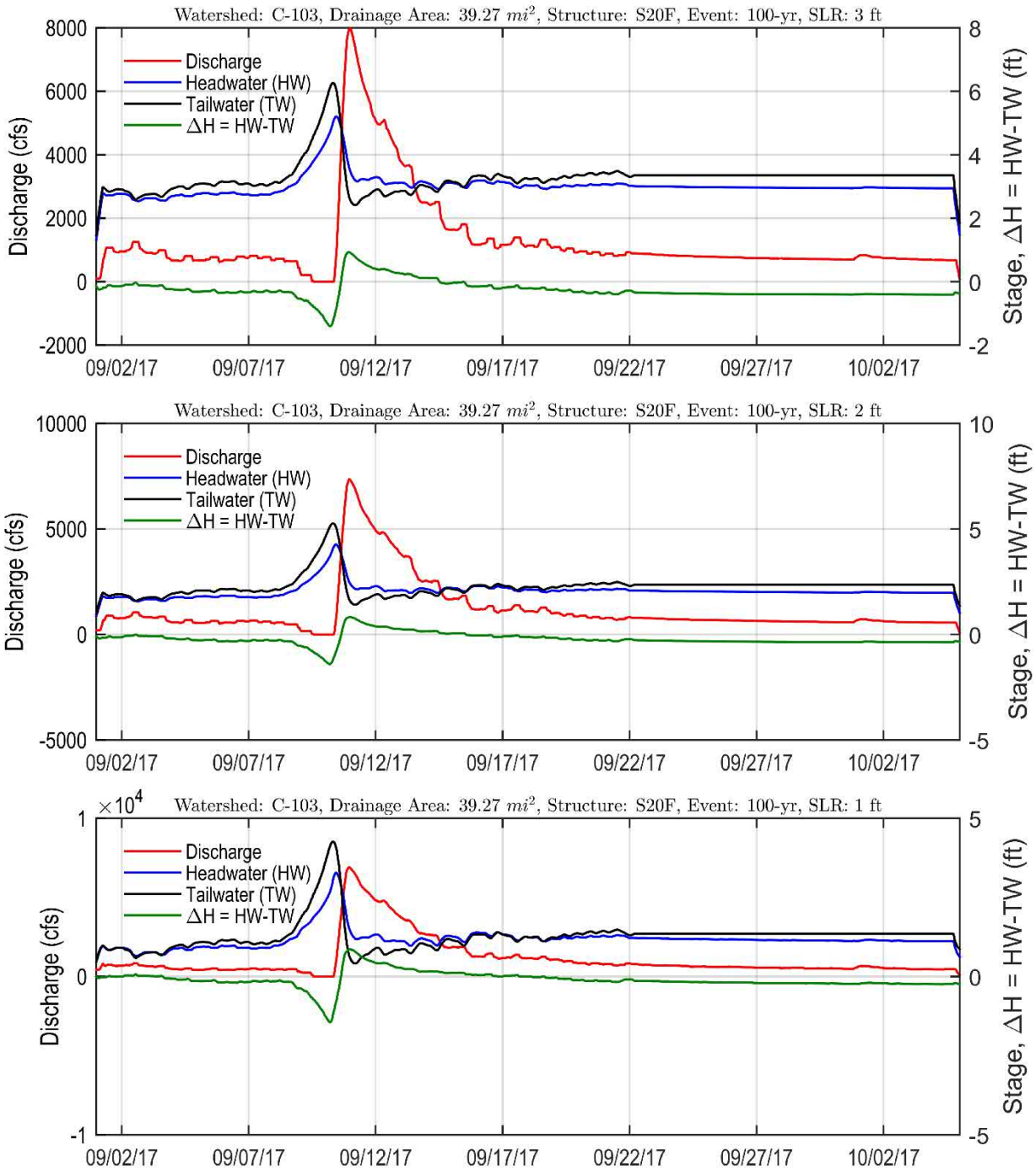


Figure 497 Structure S20F: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3

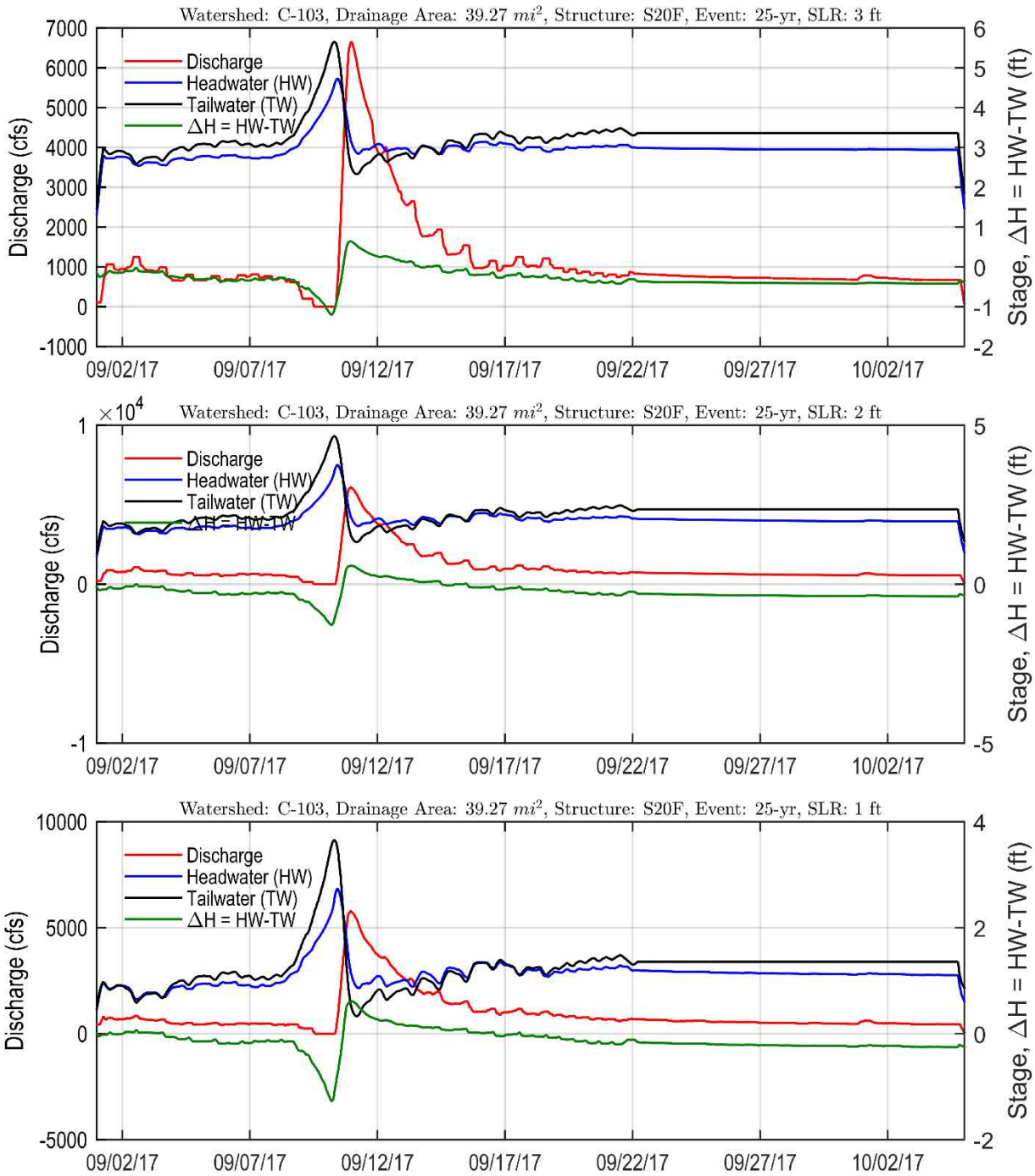


Figure 498 Structure S20F: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3

A summary of 12-hr averaged peak discharges is provided in Table 249. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater

and the head differentials are provided. The head differential gradually increases up to 1.02 ft with increasing the tailwater boundary conditions and increasing the return period. The table shows the HW, TW and Head Differential values at peak discharge.

Table 249 Structure S20F 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-103	S20F	39.270	5-yr	SLR = +0 ft	-0.502	0.035	0.537	4225
			5-yr	SLR = +1 ft	0.416	0.758	0.343	4279
			5-yr	SLR = +2 ft	1.402	1.762	0.360	4732
			5-yr	SLR = +3 ft	2.390	2.773	0.384	5205
			10-yr	SLR = +0 ft	-0.480	0.092	0.572	4861
			10-yr	SLR = +1 ft	0.478	0.943	0.465	5016
			10-yr	SLR = +2 ft	1.470	1.920	0.450	5317
			10-yr	SLR = +3 ft	2.456	2.935	0.479	5795
			25-yr	SLR = +0 ft	-0.460	0.246	0.706	5641
			25-yr	SLR = +1 ft	0.525	1.142	0.618	5777
			25-yr	SLR = +2 ft	1.532	2.116	0.584	6098
			25-yr	SLR = +3 ft	2.518	3.153	0.635	6654
			100-yr	SLR = +0 ft	-0.319	0.683	1.002	6888
			100-yr	SLR = +1 ft	0.662	1.525	0.863	6919
			100-yr	SLR = +2 ft	1.644	2.471	0.827	7356
			100-yr	SLR = +3 ft	2.613	3.534	0.921	7986

The cumulative flow in structure S20F is provided in Figure 499 and Figure 500.

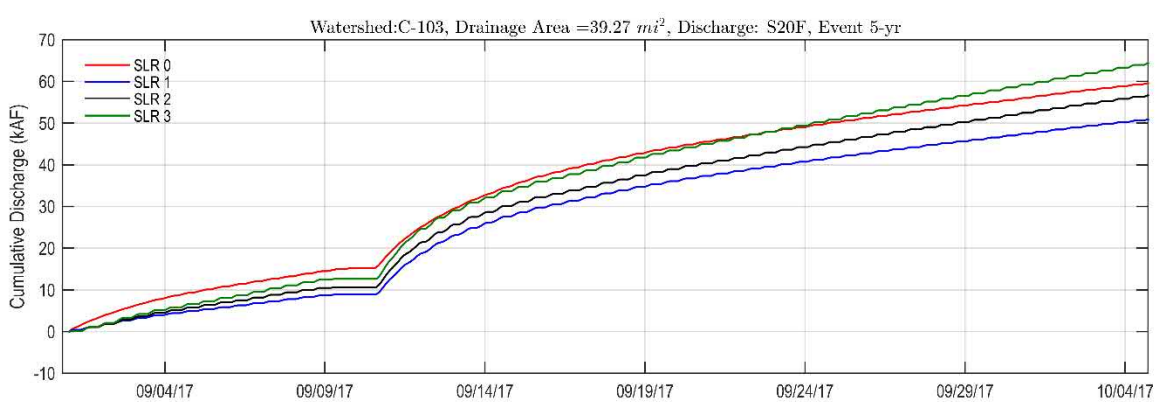


Figure 499 Cumulative Flow through S20F for 5-Yr Events

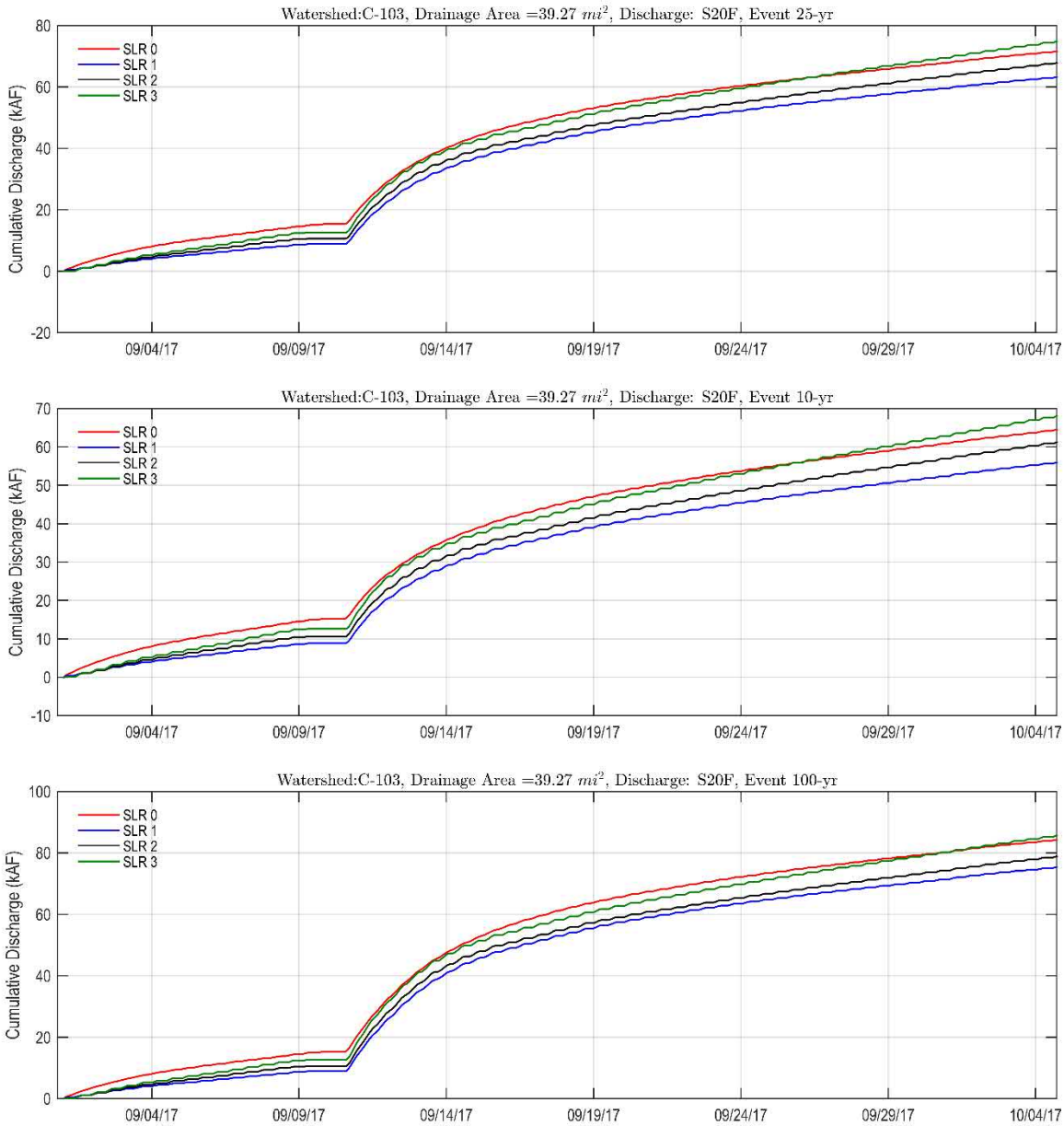


Figure 500 Cumulative Flow through S20F for 10-Yr, 25-Yr and 100-Yr Events

Figure 499 and Figure 500 show that there is an overall decrease of the cumulative flow with increasing SLR which is expected based on the reduced average hydraulic gradient in the C-103 for increasing tailwater.

6.5.4.2 PM3: Structure S20G

This metric shows the effective capacity of the tidal structures and provides information about the peak instantaneous discharge capacity as a function of the design rainfall recurrence interval and SLR conditions. The design parameters of Structure S20G are provided Table 250:

Table 250 Design parameters of Structure S20G

Structure	S20G
Design Discharge	900 cfs for 40% SPF
SPF Discharge	1700 cfs

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 251. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 251 Structure S20G Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	S20G	4.500	SLR = +0 ft	644	684	825	1019
			SLR = +1 ft	882	935	1002	1106
			SLR = +2 ft	1022	1058	1150	1473
			SLR = +3 ft	1396	1457	1531	1628

Table 252 provides a list of the instantaneous conditions at structure S20G at peak tailwater. The head differential is less or equal to the gate closing criteria, therefore the discharges are nearly zero for almost all events and SLR conditions except the 5-yr event for SLR 0, 1 and 2.

Table 252 Structure S20G Summary of Instantaneous Conditions at Peak Tailwater

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
5-yr	SLR 0	2.59	-0.05	1.58	-1.00
	SLR 1	3.16	-0.06	1.78	-1.37
	SLR 2	3.81	-0.07	2.06	-1.74
	SLR 3	4.55	-0.10	2.50	-2.04
10-yr	SLR 0	3.59	-0.05	2.13	-1.45
	SLR 1	4.16	-0.06	2.35	-1.81
	SLR 2	4.81	-0.09	2.65	-2.15
	SLR 3	5.55	-0.11	3.11	-2.43
25-yr	SLR 0	4.59	-0.05	3.04	-1.55
	SLR 1	5.16	-0.07	3.26	-1.90

Design Event	Scenario	Peak TW (ft)	Discharge at Peak TW(cfs)	Headwater at Peak TW (ft)	Head Differential at Peak TW (ft)
	SLR 2	5.81	-0.09	3.58	-2.22
	SLR 3	6.55	-0.11	4.56	-1.99
100-yr	SLR 0	5.59	-0.06	4.22	-1.37
	SLR 1	6.16	-0.08	4.67	-1.48
	SLR 2	6.81	-0.09	5.31	-1.50
	SLR 3	7.55	-0.11	6.44	-1.11

Table 253 provides a list of the instantaneous conditions at structure S20G at peak discharge.

Table 253 Structure S20G Summary Instantaneous Conditions at Peak Discharge

Design Event	Scenario	Peak Discharge cfs	TW at Peak Discharge ft NAVD	HW at Peak Discharge ft NAVD	Head Differential at Peak Discharge ft
100-yr	SLR 0	821	-0.71	-0.07	0.65
	SLR 1	883	-0.62	0.01	0.62
	SLR 2	1030	-0.75	0.13	0.88
	SLR 3	1243	-0.65	0.69	1.33
10-yr	SLR 0	873	-0.62	0.74	1.36
	SLR 1	968	0.19	0.95	0.76
	SLR 2	1106	0.25	1.27	1.02
	SLR 3	1275	0.21	1.60	1.40
25-yr	SLR 0	996	1.07	1.87	0.80
	SLR 1	1076	1.12	2.07	0.95
	SLR 2	1198	1.15	2.36	1.21
	SLR 3	1634	1.32	3.73	2.41
100-yr	SLR 0	1104	2.07	3.08	1.00
	SLR 1	1349	2.30	3.87	1.57
	SLR 2	1604	2.23	4.53	2.30
	SLR 3	1802	2.28	5.26	2.98

Figure 501 and Figure 502 provide the 12-hr Moving Average of Discharge, Stage, and Head Difference for the 25-yr and 100-yr Design Events for SLR 1, 2 and 3

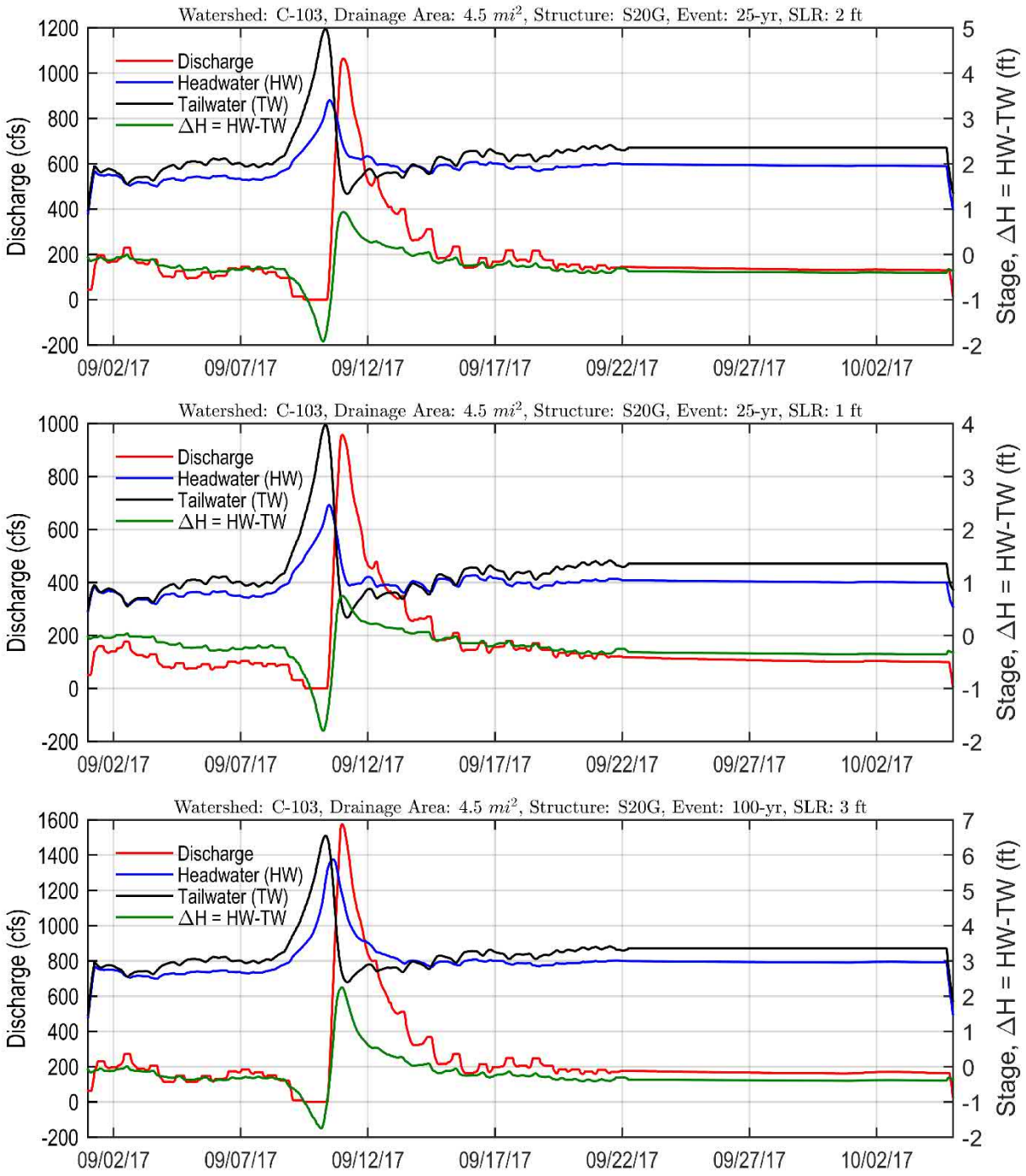


Figure 501 Structure S20G: 12-hr Moving Average of Discharge, Stage, and Head Difference for the 25-Year Design Event for SLR 1, 2 and 3

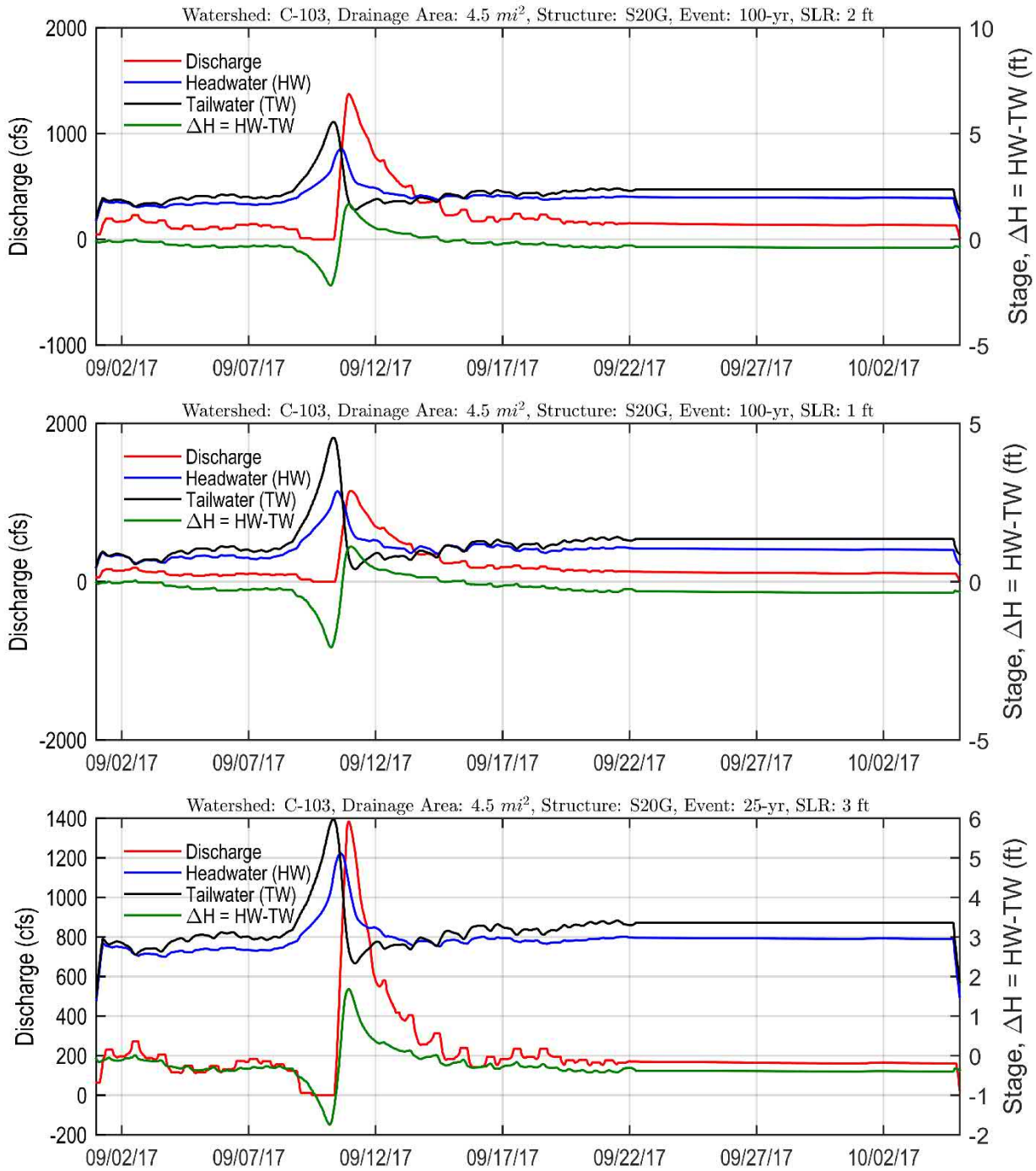


Figure 502 Structure S20G: 12-hr Moving Average of Discharge, Stage, and Head Difference for a 100-Year Design Event for SLR 1, 2 and 3

A summary of 12-hr averaged peak discharges is provided in Table 254. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater and the head differentials are provided. The head differential gradually increases up to 1.7 ft with

increasing the tailwater boundary conditions and increasing the return period. The table shows the HW, TW and Head Differential values at peak discharge.

Table 254 Structure S20G 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-103	S20G	39.270	5-yr	SLR = +0 ft	-0.378	0.092	0.471	555
			5-yr	SLR = +1 ft	0.457	0.849	0.393	708
			5-yr	SLR = +2 ft	1.373	1.941	0.568	845
			5-yr	SLR = +3 ft	2.373	3.114	0.741	957
			10-yr	SLR = +0 ft	-0.351	0.123	0.474	679
			10-yr	SLR = +1 ft	0.502	1.030	0.528	816
			10-yr	SLR = +2 ft	1.398	2.104	0.706	935
			10-yr	SLR = +3 ft	2.572	3.643	1.071	1127
			25-yr	SLR = +0 ft	-0.311	0.301	0.612	867
			25-yr	SLR = +1 ft	0.528	1.276	0.748	957
			25-yr	SLR = +2 ft	1.450	2.386	0.936	1064
			25-yr	SLR = +3 ft	2.666	4.351	1.685	1384
			100-yr	SLR = +0 ft	-0.338	0.685	1.024	1101
			100-yr	SLR = +1 ft	0.540	1.648	1.107	1146
			100-yr	SLR = +2 ft	1.760	3.430	1.670	1375
			100-yr	SLR = +3 ft	2.625	4.873	2.248	1575

The cumulative discharges at structure S20G are provided in Figure 503 and Figure 504.

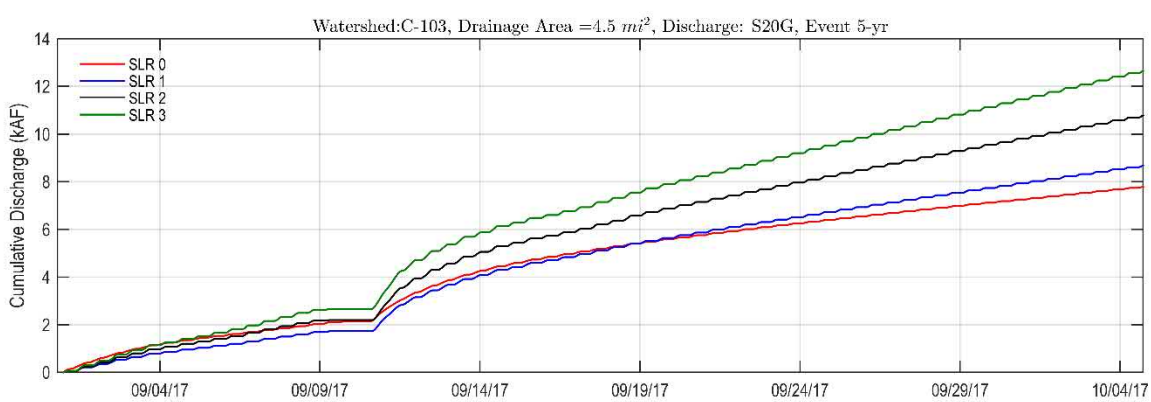


Figure 503 Cumulative Flow through S20G for 5-Yr Event

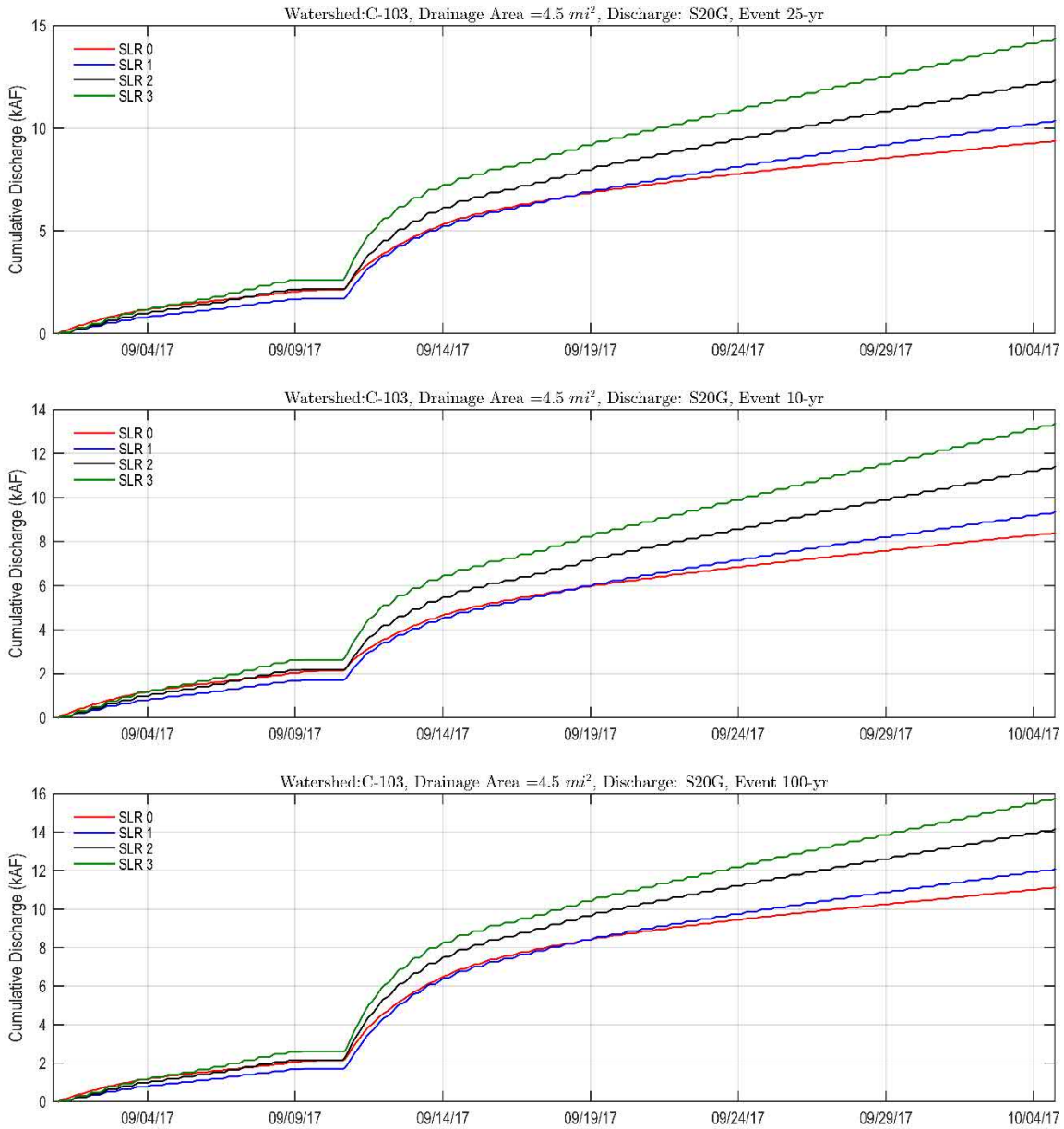


Figure 504 Cumulative Flow through S20G for 10-Yr, 25-Yr and 100-Yr Events

Figure 503 and Figure 504 show that the cumulative flow increases with the increase of SLR, which indicates that there is a backflow which is most likely caused by levee overtopping during storm surge.

6.5.4.3 PM3: Structure S166

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 255. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 255 Structure S166 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	S166	11.410	SLR = +0 ft	133	133	280	438
			SLR = +1 ft	138	200	290	431
			SLR = +2 ft	190	214	291	435
			SLR = +3 ft	199	231	286	442

A summary of 12-hr averaged peak discharges is provided in Table 256. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater and the head differentials are provided. The head differential gradually increases up to 1.7 ft with increasing the tailwater boundary conditions and increasing the return period.

Table 256 Structure S166 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-103	S166	11.410	5-yr	SLR = +0 ft	2.007	2.048	0.041	131
			5-yr	SLR = +1 ft	2.407	2.445	0.038	135
			5-yr	SLR = +2 ft	3.484	3.519	0.035	154
			5-yr	SLR = +3 ft	4.705	4.737	0.032	175
			10-yr	SLR = +0 ft	2.025	2.066	0.041	131
			10-yr	SLR = +1 ft	3.441	3.499	0.058	195
			10-yr	SLR = +2 ft	4.328	4.379	0.051	207
			10-yr	SLR = +3 ft	5.246	5.292	0.046	222
			25-yr	SLR = +0 ft	4.275	4.363	0.087	265
			25-yr	SLR = +1 ft	4.798	4.876	0.078	268
			25-yr	SLR = +2 ft	5.343	5.414	0.071	275
			25-yr	SLR = +3 ft	5.783	5.847	0.064	276
			100-yr	SLR = +0 ft	5.716	5.874	0.158	418
			100-yr	SLR = +1 ft	5.946	6.092	0.146	413
			100-yr	SLR = +2 ft	6.238	6.370	0.132	407
			100-yr	SLR = +3 ft	6.812	6.925	0.112	402

6.5.4.4 PM3: Structure S167

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 257. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 257 Structure S167 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi^2)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	S167	13.200	SLR = +0 ft	425	423	615	623
			SLR = +1 ft	446	546	583	594
			SLR = +2 ft	471	508	540	547
			SLR = +3 ft	413	451	474	482

A summary of 12-hr averaged peak discharges is provided in Table 258. The table lists the peaks for all design events and for SLR 0, 1, 2 and 3ft. Additionally the peak headwater, peak tailwater and the head differentials are provided. The head differential gradually increases up to 1.7 ft with increasing the tailwater boundary conditions and increasing the return period.

Table 258 Structure S167 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Total Area (mi^2)	Design Event	SLR	Peak TW (ft NAVD 88)	HW (ft NAVD 88) at Peak TW	Head Differential (ft)	Discharge (cfs)
C-103	S167	13.200	5-yr	SLR = +0 ft	3.471	3.800	0.329	365
			5-yr	SLR = +1 ft	4.139	4.433	0.294	387
			5-yr	SLR = +2 ft	5.115	5.371	0.256	419
			5-yr	SLR = +3 ft	5.674	5.858	0.184	389
			10-yr	SLR = +0 ft	3.509	3.835	0.325	366
			10-yr	SLR = +1 ft	5.403	5.760	0.357	515
			10-yr	SLR = +2 ft	5.529	5.830	0.301	482
			10-yr	SLR = +3 ft	5.839	6.055	0.216	430
			25-yr	SLR = +0 ft	5.343	5.814	0.471	589
			25-yr	SLR = +1 ft	5.420	5.842	0.421	563
			25-yr	SLR = +2 ft	5.574	5.920	0.346	521
			25-yr	SLR = +3 ft	5.832	6.079	0.247	459
			100-yr	SLR = +0 ft	5.339	5.836	0.497	606
			100-yr	SLR = +1 ft	5.417	5.857	0.439	575
			100-yr	SLR = +2 ft	5.567	5.929	0.361	533
			100-yr	SLR = +3 ft	5.837	6.093	0.256	468

Peak TW and Peak HW are reported using 12-hr averaging. Head differential is computed by subtracting HW-TW at the time of 12-hr Peak Discharge. 12-hr moving average is computed by taking the centered average over 288 timesteps (timestep is 5-min)

6.5.4.5 PM3: Structure S179

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 259. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 259 Structure S179 Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi²)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	S179	35.420	SLR = +0 ft	2151	2156	2950	3453
			SLR = +1 ft	2165	2512	2872	3356
			SLR = +2 ft	2195	2492	2824	3120
			SLR = +3 ft	2157	2545	2736	2766

6.5.4.6 PM3: Structure North Canal Outfall

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 260. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 260 North Canal Outfall Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi²)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	North Canal	7.030	SLR = +0 ft	573	573	573	659
			SLR = +1 ft	542	542	581	830
			SLR = +2 ft	710	895	1103	1326
			SLR = +3 ft	1207	1252	1377	1597

6.5.4.7 PM3: Florida City Canal Outfall

A summary of computed instantaneous peak discharges (in cfs) is provided in Table 261. The table lists the instantaneous peaks for all design events and for SLR 0, 1, 2 and 3ft.

Table 261 Florida City Canal Outfall (FCC) Instantaneous Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

Watershed Model	Structure	Area (mi²)	SLR	5-yr	10-yr	25-yr	100-yr
C-103	**FCC**	11.500	**SLR = +0 ft**	436	**436**	436	436
			SLR = +1 ft	431	**431**	431	431
			SLR = +2 ft	355	**355**	355	355
			SLR = +3 ft	256	**317**	450	638

6.5.5 C-103: PM4 Watershed Peak Storm Runoff

PM4 represents peak discharge at tidal structures S20F and S20G from the 12-hr moving average of the design storms on the C-1 Canal.

6.5.5.1 PM4: Structure S20F

The 12-hr moving average peak discharges for structure S20F are provided in Figure 505 and Figure 506 for the 5-yr, 10-yr, 25-yr and 100-yr design events:

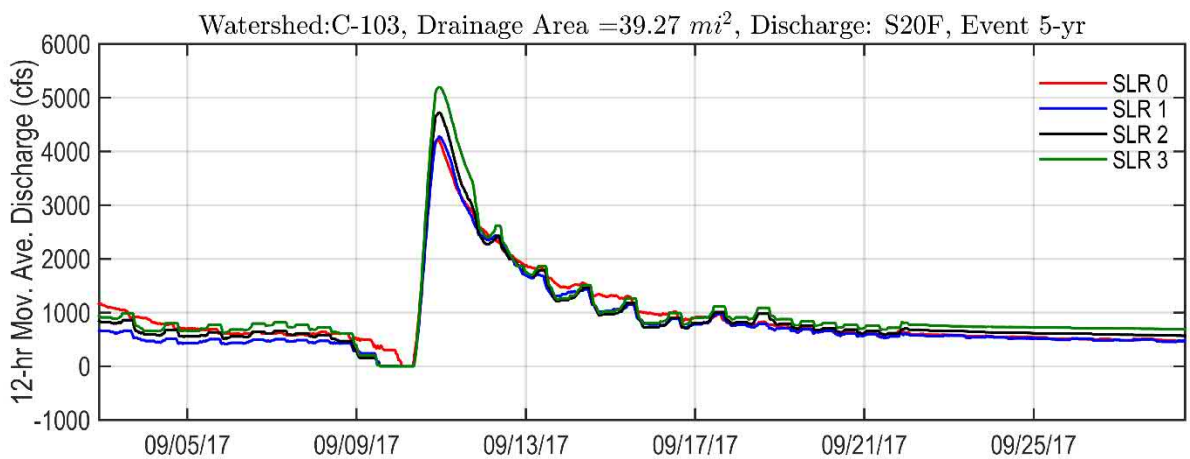


Figure 505. 12-hr Moving Average Flow Timeseries at S20F for the 5-yr Design Event

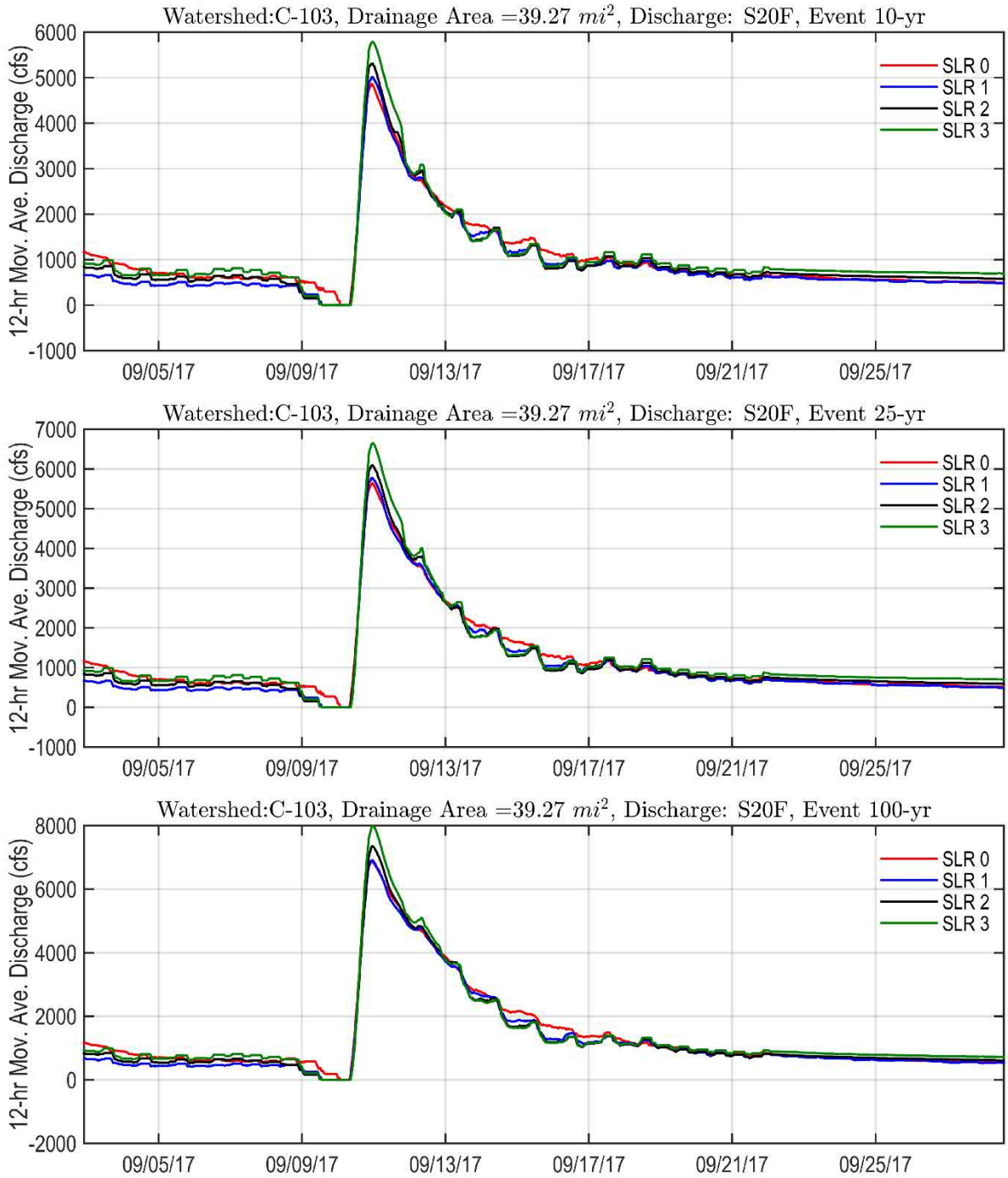


Figure 506. 12-hr Moving Average Flow Timeseries at S20F 10-yr, 25-yr and 100-yr Design Events

Figure 507 provides the peak discharge at structure S20F for SLR 0, 1, 2 and 3 and includes all design events (5-yr, 10-yr, 25-yr and 100-yr) return periods.

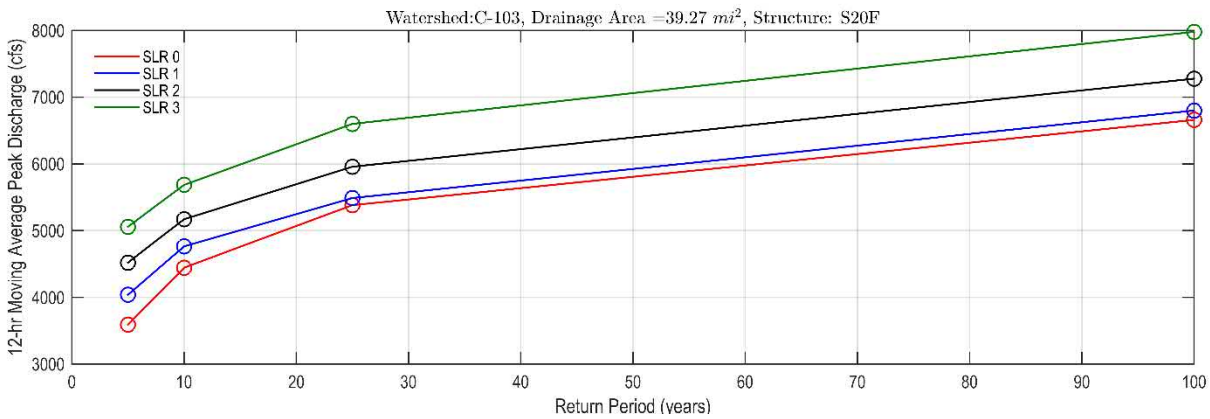


Figure 507 Structure S20F 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

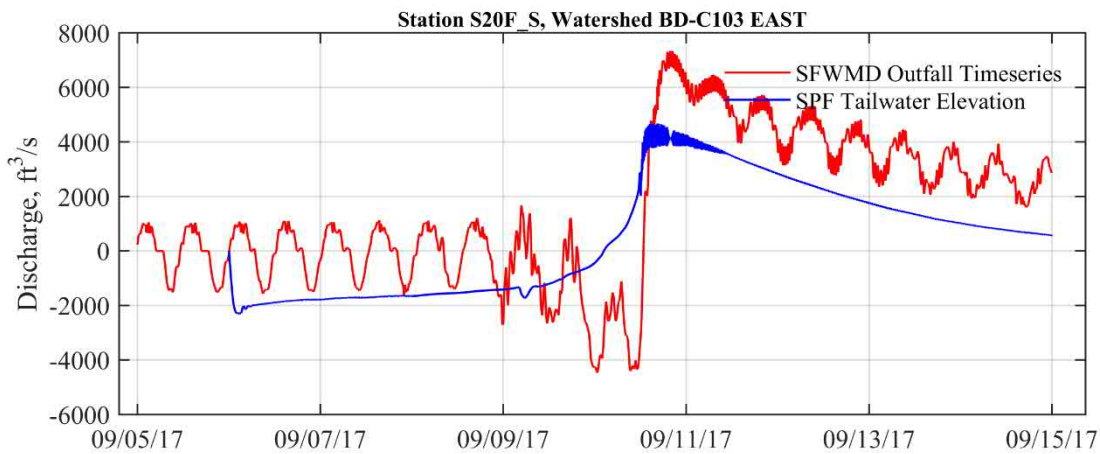


Figure 508 Comparison of Discharges at Structure S21A for the Design SPF Tailwater Elevation and SFWMD Tailwater Boundary Condition for 100-Yr Storm

The rating of structure S20F_S for SPF is 4,900 cfs. The instantaneous discharge from the 100-Year, 72-hour design event is 7,174 cfs, and for the 12-hr moving average, 6,362 cfs, and is at the highest range of the 95% confidence limits.

The main factors for the higher computed discharge values at the structures is attributed to the difference in the boundary conditions used to derive the structure capacity and the boundary outfall conditions used in the model. The original design uses a steady state boundary of 2.5 ft NGVD 29, while the current simulations use a tailwater which is time variable and reaches more than 4.0 ft NAVD followed by very fast recess. For comparison, a simulation is provided for the two cases (applying the 100-yr Outfall Timeseries provided by SFWMD or using the steady state boundary originally used as design criteria).

6.5.5.2 PM4: Structure S20G

The 12-hour moving average discharge hydrographs for the 5-yr, 10-yr and 25-yr events are shown in Figure 509 and Figure 510.

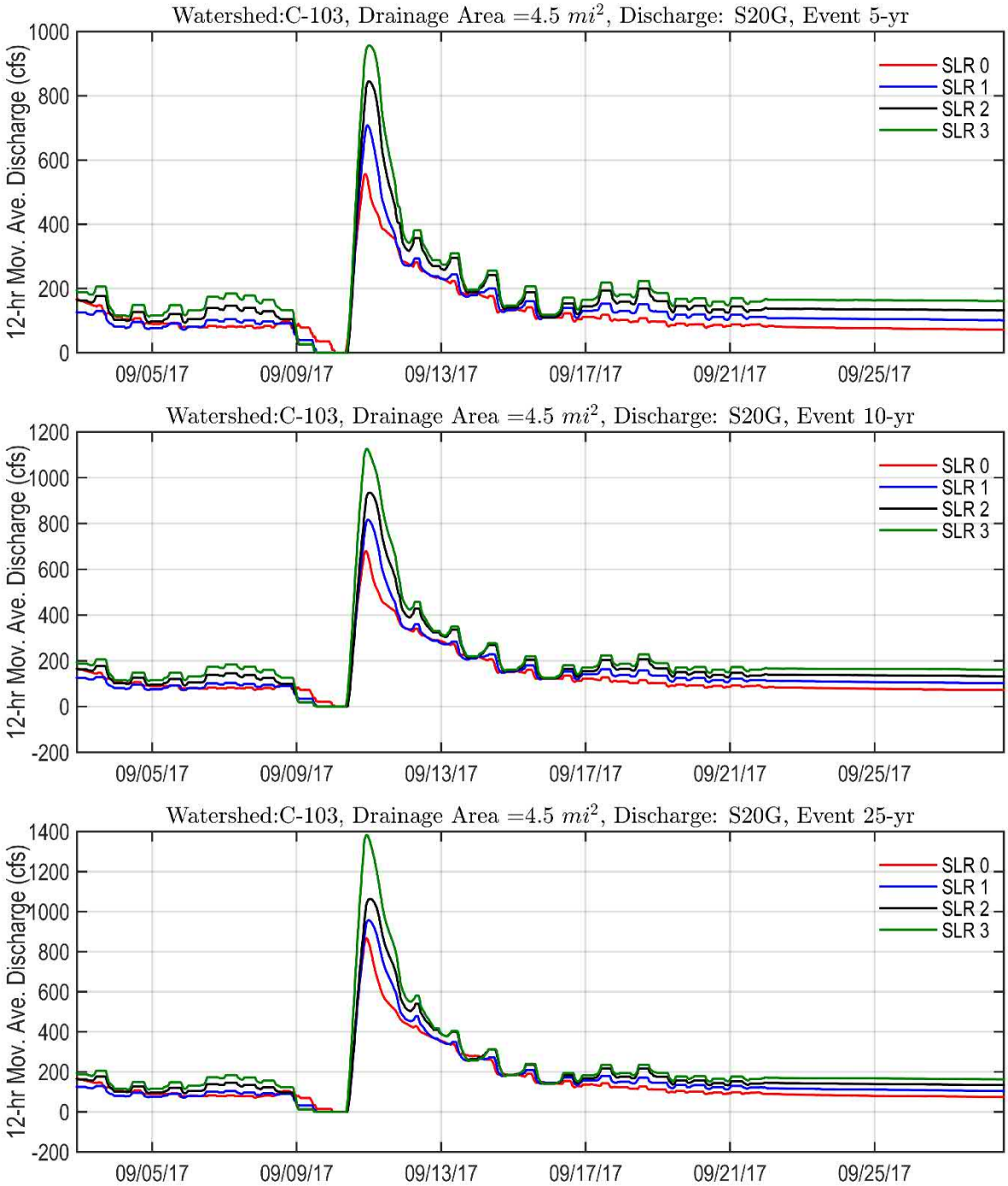


Figure 509. 12-hr Moving Average Flow Timeseries at S20G for Design Events and SLR = +1.0 ft

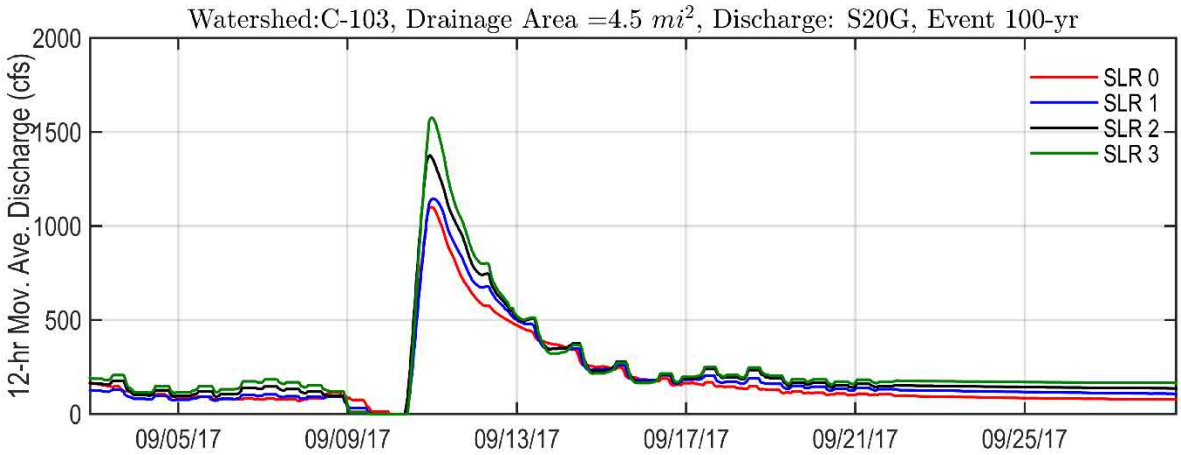


Figure 510. 12-hr Moving Average Flow Timeseries at S20G for Design Events and SLR = 0

The 12-hr moving average peak discharges of structure S20G are provided in Figure 511. The figure illustrates that increased 12-hr moving average peak discharges are expected for increasing SLR, which is attributed to potential backflow in the adjacent uncontrolled canals, or levee overtopping during storm surge.

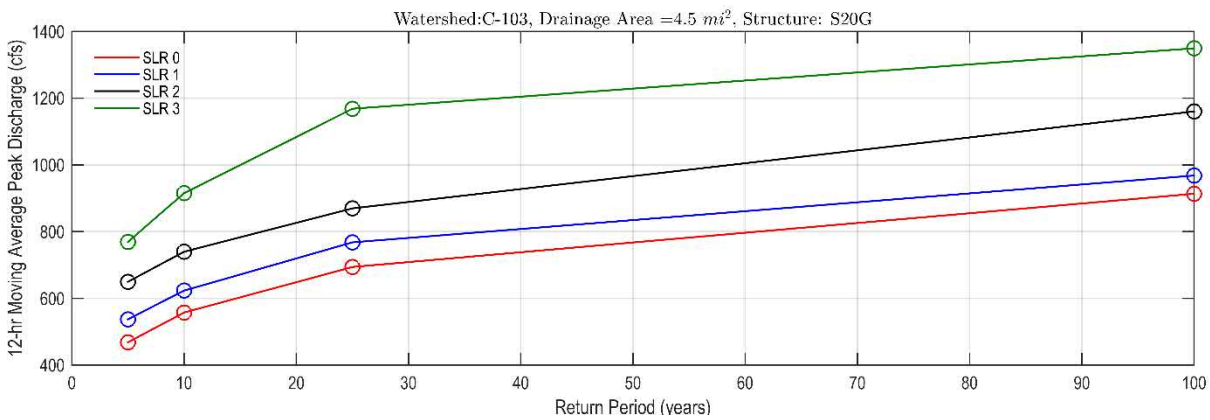


Figure 511 Structure S20G 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.5.5.3 PM4: Structure S166:

The 12-hr moving average peak discharges are provided in Figure 512 for structure S166:

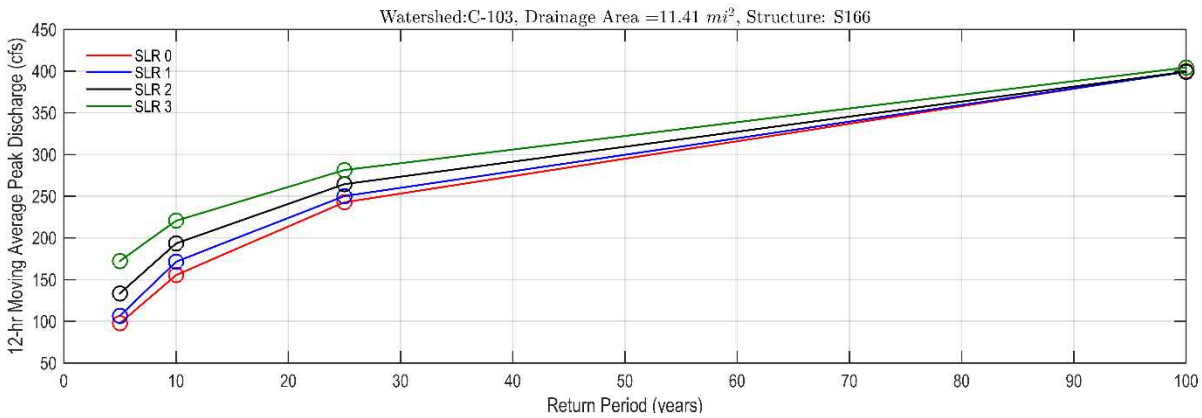


Figure 512 Structure S166 12-hr Average Peak Discharge vs Return for SLR 0, 1, 2 and 3

6.5.5.4 PM4: Structure S167

The 12-hr moving average peak discharges in structure S167 are provided in Figure 513:

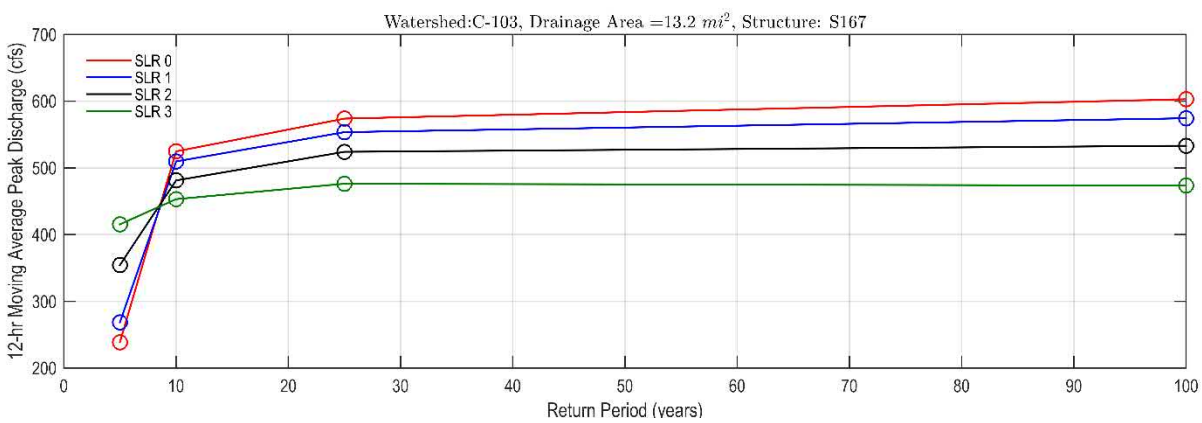


Figure 513 Structure S167 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.5.5.5 PM4: Structure S179

The 12-hr moving average peak discharges in structure S179 are provided in Figure 514:

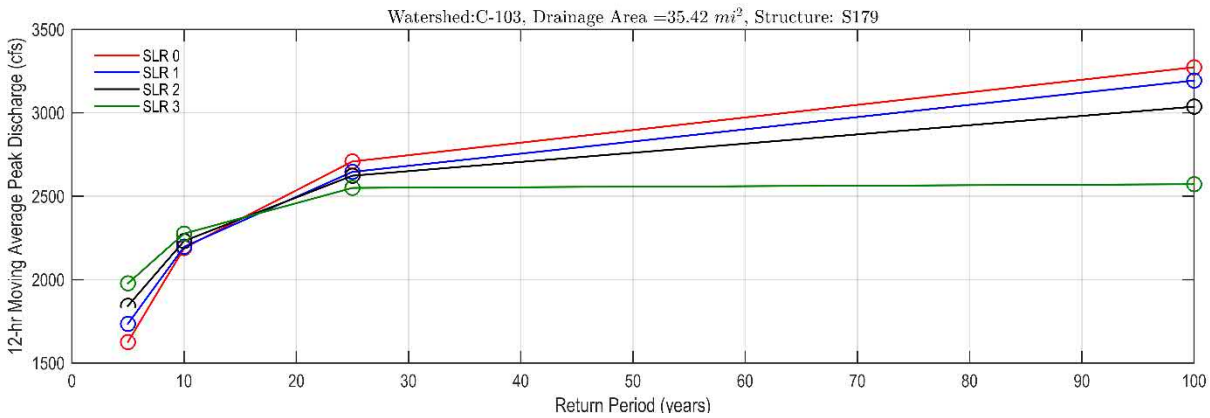


Figure 514 Structure S179 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.5.5.6 PM4: Florida City Canal Outfall

The 12-hr moving average peak discharges in the Florida City Canal outfall are provided in Figure 515.

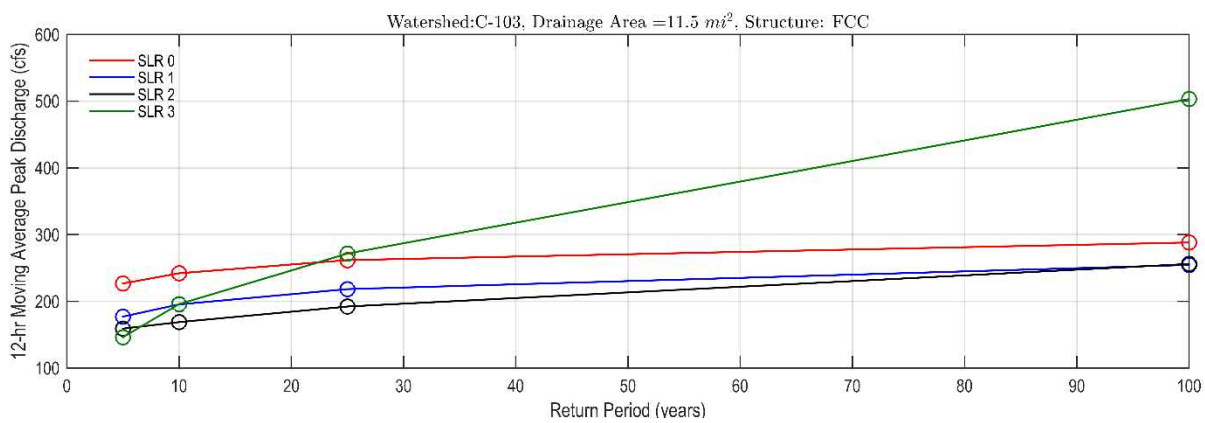


Figure 515 Outfall of Florida City Canal 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

The data shows that for the 100-yr event, and for SLR 3, there is a significant increase in the discharge which as shown in Figure 515. The reason for this increase is attributed to the backflow during storm surge which is more than doubled for SLR 3 as shown in Figure 516.

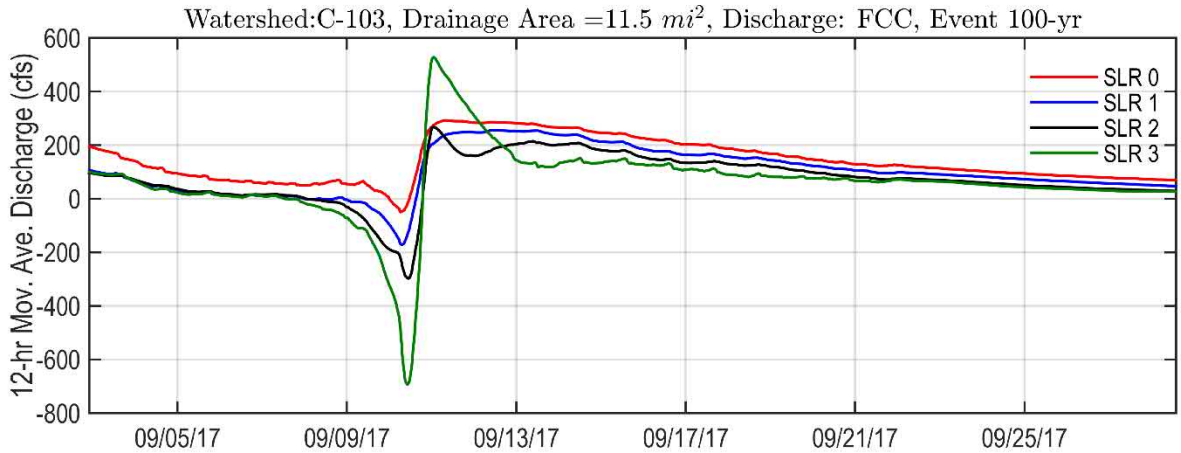


Figure 516 Outfall of Florida City Canal 12-hr Moving Average Peak Discharge Timeseries for the 100-yr Event.

6.5.5.7 PM4: North Canal Outfall

The 12-hr moving average peak discharges are provided in Figure 517 for the North Canal Outfall:

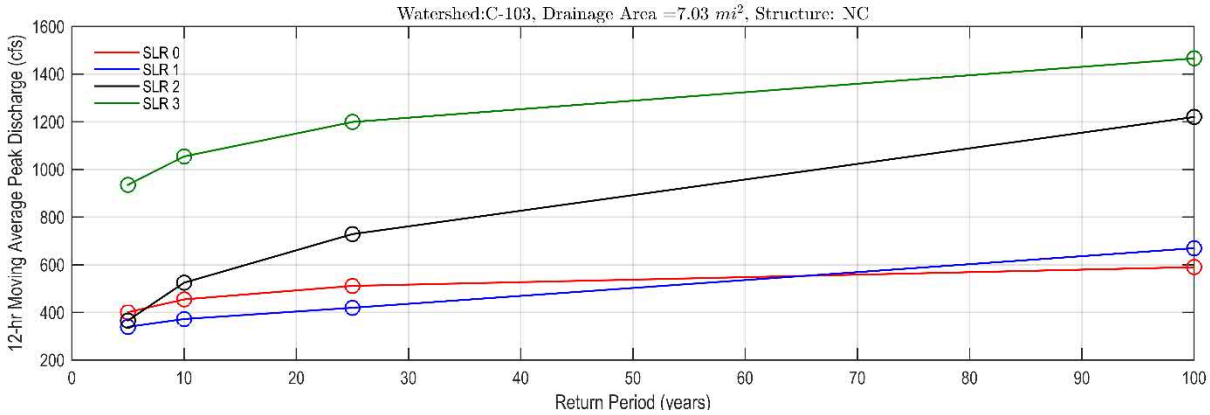


Figure 517 Structure S123 12-hr Moving Average Peak Discharge vs Return Period for SLR 0, 1, 2 and 3

6.5.6 C-103: PM5 Flood Frequency

The frequency of flooding was analyzed by developing flood maps and flood depth tables which show the extent of the flood depth at preselected intervals uniform for all LOS study. The flood depths for the watershed, agricultural, urban and wetland areas in the C-103 Watershed are provided for the 5-Year, 10-Year, 25-Year, and 100-Year 72-hour design storm events and for SLR = 0, +1.0, +2.0, and +3.0 ft. The total area of the C-103 Watershed is 39,871.71 acres (based on GIS data).

The values in the tables are based on discretization to 100 m raster which results in total watershed area 39,821 acres with 18,894 acres urban land, 12,150 acres agricultural and 9,420 acres wetlands.

- The first row of the summary tables represents areas for which the flooding is less than 0.25 ft (essentially these areas are not considered to be flooded).
- The second (0.25 >= 0.50 ft) and the following rows (including 2.25 >= 2.50ft) represent the areas flooded within this flood depth interval
- The last row (>= 2.50 ft) are the areas flooded with depth greater than 2.50 ft.
- The severity of flooding is determined based on the flooded areas reported at each successive row.

Table 262 through Table 265 summarize the area of flooding shown in the C-103 Watershed for the entire watershed, and focused on urban, agricultural and wetland areas.

Table 262. Summary of the PM5 Flood Inundation in Acres of the Entire C-103 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	28541	27557	26806	25170	23203	26099	25081	24622	22963	20702	21923	20861	20648	19104	16680	14495	14414	14191	13079	10628
0.25 >= 0.50	2234	2478	1703	1539	1606	2305	2733	2197	2162	2513	3052	3568	3146	3296	3756	4505	4695	4497	4458	4465
0.50 >= 0.75	2189	2281	1628	1013	1072	2165	2273	1572	1386	1500	2219	2580	2236	1984	2197	3099	3222	3116	3059	3217
0.75 >= 1.00	2098	2219	1740	895	862	2207	2293	1606	1003	998	2157	2214	1530	1495	1495	2385	2449	2236	2133	2451
1.00 >= 1.25	1537	1784	1900	949	764	2024	2133	1772	897	806	2184	2212	1502	1030	1008	1994	2036	1767	1544	1772
1.25 >= 1.50	996	1154	1621	1110	603	1512	1829	1905	964	811	2123	2219	1717	865	855	2044	2016	1327	1297	1248
1.50 >= 1.75	652	687	1320	1416	536	1063	1060	1532	1198	625	1772	1843	1858	857	724	2009	2068	1245	934	857
1.75 >= 2.00	376	430	1003	1480	630	697	689	1374	1453	581	1265	1433	1774	1030	707	2024	2130	1621	768	771
2.00 >= 2.25	217	257	657	1347	712	432	445	1033	1443	642	914	833	1451	1339	642	1893	1861	1750	803	650
2.25 >= 2.50	131	188	378	1245	845	262	230	645	1337	699	549	526	1159	1468	605	1564	1537	1735	890	680
>= 2.50	966	902	1181	3773	9103	1171	1171	1680	5130	10060	1779	1648	2916	7468	11268	3926	3509	6452	10971	13198
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 covers 39,937 acres																				

Table 263. Summary of the PM5 Flood Inundation in Acres of the Urban Areas of the C-103 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	18812	18899	18778	17918	16593	17616	17599	17507	16489	14895	15036	15002	14898	13892	12158	10240	11006	10801	10003	7996
0.25 >= 0.50	786	919	744	870	1072	1001	1324	1161	1406	1707	1848	2135	2026	2204	2565	2970	2968	2869	2824	2889
0.50 >= 0.75	697	647	529	504	682	811	801	739	744	998	1149	1327	1292	1310	1463	1927	1935	1984	2061	2177
0.75 >= 1.00	593	578	507	427	494	731	694	516	514	645	820	862	751	892	1040	1485	1364	1342	1418	1678
1.00 >= 1.25	432	376	457	326	371	603	549	536	435	469	773	729	573	549	660	1030	1102	1124	1048	1310
1.25 >= 1.50	292	259	423	351	289	455	423	492	371	376	714	623	534	420	534	843	786	667	766	862
1.50 >= 1.75	240	205	309	356	262	289	240	410	371	319	581	479	519	366	420	744	682	499	514	600
1.75 >= 2.00	141	148	168	353	252	242	205	324	358	274	378	321	546	376	294	741	647	534	410	509
2.00 >= 2.25	86	101	161	358	274	175	156	188	346	269	269	225	356	366	319	640	499	474	339	361
2.25 >= 2.50	57	74	89	339	217	124	82	131	363	267	178	168	235	361	269	487	361	504	348	398
>= 2.50	524	452	497	857	2152	613	588	655	1263	2439	912	788	929	1925	2938	1552	1310	1861	2928	3880
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 urban areas cover 22,660 acres																				

Table 264. Summary of the PM5 Flood Inundation in Acres of the Agricultural Areas of the C-100 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	5644	5110	5085	4754	4394	5157	4473	4492	4166	3783	4198	3435	3526	3235	2849	2404	1843	1900	1764	1586
0.25 >= 0.50	413	615	549	526	395	465	773	724	596	633	717	961	828	823	909	1095	1191	1166	1169	1132
0.50 >= 0.75	385	460	385	361	289	378	489	398	499	348	432	687	667	526	549	796	892	823	741	746
0.75 >= 1.00	306	410	351	247	252	393	435	326	314	259	358	423	366	469	336	482	724	684	521	576
1.00 >= 1.25	158	215	339	237	309	292	381	378	222	257	398	390	306	329	240	383	415	415	371	329
1.25 >= 1.50	57	109	180	208	213	185	247	368	235	319	395	435	353	222	217	321	390	314	418	287
1.50 >= 1.75	32	47	69	247	109	79	94	173	252	210	252	297	383	203	217	334	329	210	294	178
1.75 >= 2.00	10	22	27	235	133	37	57	84	267	131	124	185	319	227	309	381	381	277	190	185
2.00 >= 2.25	22	17	22	128	133	15	35	35	227	124	72	84	138	259	217	356	314	361	203	188
2.25 >= 2.50	7	22	10	49	131	12	15	15	153	133	37	52	59	252	133	237	257	395	217	193
>= 2.50	62	69	79	104	739	84	99	104	166	899	114	148	151	551	1119	309	361	551	1208	1698
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 agricultural areas cover 7,097 acres																				

Table 265. Summary of the PM5 Flood Inundation in Acres of the Wetlands Areas of the C-103 Watershed

Water Depth (ft)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0 < 0.25	4085	3548	2943	2498	2217	3326	3010	2622	2308	2024	2689	2424	2224	1977	1673	1851	1564	1490	1312	1045
0.25 >= 0.50	1035	944	410	143	138	840	635	311	161	173	487	472	292	269	282	440	536	462	465	445
0.50 >= 0.75	1107	1174	714	148	101	976	983	435	143	153	638	566	277	148	185	376	395	309	257	294
0.75 >= 1.00	1198	1231	882	220	116	1082	1164	764	175	94	979	929	413	133	119	418	361	210	193	198
1.00 >= 1.25	946	1194	1105	385	84	1129	1203	857	240	79	1013	1092	623	153	109	581	519	227	126	133
1.25 >= 1.50	647	786	1018	551	101	872	1159	1045	358	116	1013	1161	830	222	104	880	840	346	114	99
1.50 >= 1.75	381	435	941	813	166	694	726	949	576	96	939	1067	956	289	86	932	1058	536	126	79
1.75 >= 2.00	225	259	808	892	245	418	427	966	828	175	764	927	909	427	104	902	1102	811	168	77
2.00 >= 2.25	109	138	474	860	304	242	255	811	870	250	573	524	956	714	106	897	1048	914	262	101
2.25 >= 2.50	67	91	279	857	497	126	133	499	820	299	334	306	865	855	203	840	919	835	324	89
>= 2.50	381	381	605	2812	6212	474	484	922	3702	6721	754	712	1836	4992	7211	2066	1838	4040	6835	7621
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 wetlands cover 10,181 acres																				

The corresponding flood extent and maps are provided in **Appendix A Flood Extent and Flood Duration Maps:**

- Figure A-289 through Figure A-304 provide flood extent maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure A-321 through Figure A-336 provide flood extent maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure A-353 through Figure A-368 provide flood extent maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

For PM5, the C-103 Watershed has flooding in the agricultural areas. Areas east of S179 to the coast are mostly wetlands and have a flood inundation depth between 0.5 – 1.25 feet for 25-Year design event and above 2.25 feet for 100-Year design event. But PM1 results show that C-103 primary canal system east of S179 can convey up to 100-Year design storm. This shows the inundation is due to the wetlands holding water. Urban areas on C-103 Central watershed is being affected with flooding of less than 0.75 feet of depth for 100-Year design storm. For 25-Year design storm, the flooding depth is less than 0.5 feet.

Areas east of the C-103S canal are flooded with 0.25 – 1 feet water depth for 25-Year design storm, and above 2.25 feet for 100-Year LOS. For 10-Year and 5-Year design storms, the flooding depths are minimal (< 0.25 feet), in general.

Areas upstream US-1 Highway has inundation areas with 0.5 – 2.25 feet flood depth for 25-Year design event and above 2.25 feet flood depth for 100-Year design event. The results of PM5 indicate that 100-Year design storm would result in significant flooding (> 2.25 feet) for the area upstream S-166, in agricultural areas without adequate drainage canals. For 10-Year event, these areas have approximately 1 feet of water and for 5-Year design storm, the flooding depth is 0.75 – 1.25 feet.

Urban areas that drain to this canal have inundation depths that are similar for all design storms, generally between 0.25 feet and 0.5 feet.

Table 266 and Table 267 show the fraction of flooded urban and agricultural areas for the flood depth ranges listed in the tables. The results indicate gradual increase of flood depth for urban areas for SLR 0, 1, 2 and 3 and it is expected that the drainage system will require improvements to preserve the LOS for future SLR conditions. For agricultural areas, the LOS will be relatively constant for SLR 0, 1, 2 and 3.

Table 266 Fraction of Flooded Urban Area of C-103 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	38%	37%	35%	30%
>=0.25	19%	19%	22%	26%
>=0.5	14%	14%	16%	20%
>=0.75	11%	11%	13%	16%
>=1.00	8%	9%	11%	14%
>=1.25	7%	8%	10%	12%
>=1.50	5%	6%	8%	11%
>=1.75	4%	5%	8%	10%
>=2.00	3%	4%	7%	9%
>=2.25	2%	3%	6%	8%
>=2.50	2%	2%	5%	7%

Table 267 Fraction of Flooded Agricultural Area of C-103 Watershed

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0 - 0.25	9%	9%	8%	7%
>=0.25	9%	9%	10%	11%
>=0.5	7%	7%	8%	8%
>=0.75	5%	5%	6%	7%
>=1.00	4%	4%	5%	6%
>=1.25	3%	4%	4%	6%
>=1.50	2%	3%	4%	5%
>=1.75	1%	2%	3%	4%
>=2.00	1%	1%	3%	4%
>=2.25	1%	1%	2%	3%
>=2.50	0%	0%	1%	3%

6.5.7 C-103: PM6 Flood Duration

For each design event and SLR conditions, tables were generated to show the duration of flooding. This analysis is summarized in tables and maps for the entire project domain, and additionally for urban, agricultural and wetland areas.

6.5.7.1 Flood Duration in Canal C-103

The duration of flooding in primary canals was estimated as the amount of time it takes for the headwater level of S20F to return to target reference stage, which was defined as 3.0 ft.

Table 268 and Table 269 show the duration of time taken for the water levels in the C-103 Watershed canals at structures S20F and S20Gto return to baseflow which was assumed the average for the timeseries plus 1 ft. The flood duration for 5-yr, 10-yr, 25-yr and 100-yr and SLR = 0, +1.0, +2, and +3.0 ft are shown in the tables below:

Table 268 Hours of Canal Flood Duration at Headwater of Structure S20F

Design Event	SLR 0	SLR 1	SLR 2	SLR 3
5-yr	0:10	0:10	6:25	43:00
10-yr	0:10	0:10	10:25	44:20
25-yr	0:10	5:10	15:35	46:30
100-yr	5:10	6:55	19:40	66:20

Table 269 Hours of Canal Flood Duration at Headwater of Structure S20G

Design Event	SLR 0	SLR 1	SLR 2	SLR 3
5-yr	0:10	0:10	5:05	51:55
10-yr	0:10	0:10	6:40	64:50
25-yr	0:10	0:10	12:10	78:30
100-yr	0:10	5:45	26:50	82:50

6.5.7.2 Flood Duration in Watershed C-103

Table 270 through Table 273 provide a summary of the areas in C-103 Watershed with flood depths greater than 0.25 ft for the specified duration interval for the entire C-103 watershed and the urban areas of the C-103 watershed.

- The first row (0.1 >= 1 hr) and the following rows up to and including (240 >= 360 hr) of the summary tables represent areas for which the flood duration is within the specified interval.
- The last row (>=360 hr) are the areas flooded with flood duration greater than 360 hr.
- The severity of flooding in terms of duration is determined based on the flooded areas reported at each successive row.
- The severity of flooding is proportional to the increase of time interval.

Table 270 Summary of the PM6 Flood Duration Area in Acres of the Entire C-103 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	35	373	230	185	188	84	314	282	284	341	247	460	492	460	489	645	803	734	722	640
1 >= 4	126	405	166	163	217	215	368	259	269	316	403	647	502	603	702	1149	1236	1174	1206	1117
4 >= 8	282	259	173	217	240	237	378	274	316	356	415	531	554	544	603	924	1018	946	969	1050
8 >= 12	294	262	175	213	272	306	460	321	336	376	437	504	405	457	531	749	739	712	739	986
12 >= 24	929	961	751	692	855	1285	1297	1097	1181	1347	1809	1908	1685	1668	1814	2350	2488	2417	2370	2604
24 >= 48	1955	1542	1112	825	971	2031	1710	1282	1169	1500	2382	2481	2207	2197	2441	3581	3600	3311	3314	3640
48 >= 96	3158	2256	1527	1008	909	3640	2644	1735	1213	1228	3684	2869	2058	1609	1947	3949	3551	3027	2958	3398
96 >= 168	1727	1925	1446	853	665	2518	2310	1680	1095	766	3731	2884	1767	1297	969	4500	3262	2212	1480	1483
168 >= 240	472	820	778	383	240	880	1102	979	504	361	1470	1451	1364	771	504	2646	2155	1589	1045	647
240 >= 360	188	726	692	316	282	299	862	880	371	297	613	1161	1006	415	321	1426	1591	1359	608	435
>= 360	1520	2434	5550	9432	11320	1594	2627	5735	9491	11372	1695	2884	6069	9615	11461	1935	3361	6536	9788	11582
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 covers 39,937 acres																				

Table 271. Summary of the PM6 Flood Duration Area in Acres of the C-103 Watershed Urban Areas

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	20	247	153	121	133	52	235	198	215	247	210	316	358	334	348	484	492	484	445	385
1 >= 4	67	255	82	116	168	153	222	171	198	222	297	432	336	425	442	751	801	704	739	689
4 >= 8	89	111	84	148	163	114	190	178	198	237	267	316	358	363	415	647	608	598	586	640
8 >= 12	119	94	77	153	188	163	222	193	210	264	259	299	255	311	378	516	487	499	509	712
12 >= 24	353	361	351	378	598	541	677	603	808	941	1087	1105	1060	1117	1213	1609	1661	1641	1643	1826
24 >= 48	630	494	420	450	588	734	625	573	665	979	1114	1287	1273	1473	1779	2229	2273	2249	2338	2602
48 >= 96	890	655	561	467	536	1110	793	665	605	734	1206	971	840	882	1203	1784	1641	1678	1866	2409
96 >= 168	507	497	462	351	334	731	610	544	430	403	1117	801	633	563	549	1399	981	803	746	872
168 >= 240	175	200	166	148	121	282	264	255	203	180	425	311	395	299	240	773	514	482	388	341
240 >= 360	49	158	138	79	136	99	220	163	99	146	200	297	183	121	156	395	356	316	222	205
>= 360	670	642	1154	2049	2733	689	655	1194	2066	2755	712	697	1265	2103	2800	773	803	1352	2147	2859
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 urban areas cover 22,660 acres																				

Table 272. Summary of the PM6 Flood Duration Area in Acres of the Agricultural Areas of the C-103 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	5	86	62	47	35	20	52	64	47	67	22	104	96	79	94	106	213	190	200	183
1 >= 4	22	91	69	32	35	25	101	67	52	67	74	141	104	136	195	292	301	314	331	311
4 >= 8	49	54	47	44	57	40	119	57	89	74	94	143	128	138	133	198	299	277	287	299
8 >= 12	57	57	40	40	59	49	136	99	91	82	109	131	119	114	114	148	168	148	151	178
12 >= 24	146	235	173	200	198	237	326	326	289	311	405	551	467	413	413	502	581	554	541	541
24 >= 48	331	366	329	252	259	343	432	366	321	393	504	652	650	554	516	907	907	806	736	764
48 >= 96	400	432	351	358	255	544	571	484	398	311	610	697	615	465	516	892	1016	813	751	729
96 >= 168	203	321	294	336	232	272	385	358	479	250	489	519	427	519	292	717	719	768	482	383
168 >= 240	44	62	124	86	79	138	111	133	143	126	222	208	237	289	183	334	343	343	469	210
240 >= 360	17	27	67	49	94	25	35	114	72	106	35	59	138	86	111	133	131	178	161	163
>= 360	67	94	245	729	1253	69	104	264	731	1270	74	114	297	756	1297	84	128	361	791	1334
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 agricultural areas cover 7,097 acres																				

Table 273. Summary of the PM6 Flood Duration Area in Acres of the Wetlands Areas of the C-103 Watershed

Duration of Flooding (hr)	SLR-C 5-Yr	SLR-0 5-Yr	SLR-1 5-Yr	SLR-2 5-Yr	SLR-3 5-Yr	SLR-C 10-Yr	SLR-0 10-Yr	SLR-1 10-Yr	SLR-2 10-Yr	SLR-3 10-Yr	SLR-C 25-Yr	SLR-0 25-Yr	SLR-1 25-Yr	SLR-2 25-Yr	SLR-3 25-Yr	SLR-C 100-Yr	SLR-0 100-Yr	SLR-1 100-Yr	SLR-2 100-Yr	SLR-3 100-Yr2
0.1 >= 1	10	40	15	17	20	12	27	20	22	27	15	40	37	47	47	54	99	59	77	72
1 >= 4	37	59	15	15	15	37	44	22	20	27	32	74	62	42	64	106	133	156	136	116
4 >= 8	143	94	42	25	20	84	69	40	30	44	54	72	67	42	54	79	111	72	96	111
8 >= 12	119	111	59	20	25	94	101	30	35	30	69	74	32	32	40	84	84	64	79	96
12 >= 24	430	366	227	114	59	507	294	168	84	94	316	252	158	138	188	240	247	222	185	237
24 >= 48	993	682	363	124	124	954	652	343	183	128	764	541	284	171	146	445	420	257	240	274
48 >= 96	1868	1169	615	183	119	1987	1280	586	210	183	1868	1201	603	262	227	1273	895	536	341	259
96 >= 168	1018	1107	689	166	99	1515	1315	778	185	114	2125	1564	707	215	128	2385	1562	640	252	227
168 >= 240	252	558	489	148	40	460	726	591	158	54	823	932	731	183	82	1539	1297	764	188	96
240 >= 360	121	541	487	188	52	175	608	603	200	44	378	806	684	208	54	897	1105	865	225	67
>= 360	783	1698	4151	6655	7334	835	1868	4277	6694	7346	909	2073	4507	6756	7364	1077	2429	4823	6850	7388
Note: Rows provide the inundation areas in acres for each flood depth interval																				
Watershed C-103 wetlands cover 10,181 acres																				

The corresponding flood duration maps are provided in Appendix B Flood Extent and Duration Maps for Future Conditions:

- Figure B-305 through Figure B-320 provide flood duration maps for the entire watershed for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-337 through Figure B-352 provide flood duration maps for the agricultural areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr
- Figure B-369 through Figure B-384 provide flood duration maps for the urban areas for SLR 0, 1, 2 and 3 and 5-Yr, 10-Yr, 25-Yr, 100-Yr

Table 274 and Table 275 show the fraction of flooded urban and agricultural areas for the flood duration ranges listed in the tables. The results indicate gradual increase of flood duration for urban areas for SLR 0, 1, 2 and 3 and it is assumed that the drainage system will require improvements to preserve the LOS for future SLR conditions. For agricultural areas, the LOS will be maintained for SLR 0, 1, 2 and 3.

Table 274 Fraction of Flooded Urban Areas and Duration of C-103 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	22%	23%	25%	27%
> 1	22%	22%	24%	27%
> 4	21%	21%	23%	26%
> 8	20%	20%	22%	25%
> 12	19%	20%	22%	24%
> 24	17%	18%	19%	21%
> 48	13%	14%	16%	18%
> 96	8%	9%	12%	14%
> 168	3%	4%	8%	11%
> 240	1%	2%	6%	9%
> 360	1%	1%	6%	9%

Table 275 Fraction of Flooded Agricultural Areas and Duration of C-103 Watershed

Flood Duration (hr)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
0.1 - 1	10%	10%	10%	11%
> 1	10%	9%	10%	11%
> 4	9%	9%	10%	11%
> 8	9%	9%	9%	10%
> 12	8%	8%	9%	10%
> 24	7%	7%	8%	8%
> 48	6%	6%	7%	7%
> 96	3%	4%	5%	6%
> 168	1%	1%	3%	4%
> 240	0%	0%	1%	3%
> 360	0%	0%	1%	3%

6.5.8 LOS Rating of C-103 Watershed

The flood protection LOS of the C-102 Watershed was evaluated for current and future hydrologic conditions, land use, topography, and canal infrastructure. The overall conclusions of the analysis are summarized below:

Conveyance Capacity of Primary Canals: Considering the results from PM1 and the flat topography of Watershed C-103, the main limitation of conveyance capacity of the Primary Canals is the canal bank elevation. Canal banks are consistently below the 10-yr peak water elevation for current conditions, and in multiple locations are below 5-yr elevation for current conditions and below 5-yr for future conditions. Therefore, for current conditions rating of 5-yr was assigned for the watershed for the current conditions and SLR = +1.0 ft, and less than 5-yrs for future conditions for SLR = +2.0 and +3.0 ft.

Performance of Inland Structures: Based on results from PM2, PM3 and PM4 the inland structures (S166, S167, S20G, S179) showed limited capacity to increase flow for higher SLR. The peak flow for both structures were nearly constant or decreased at higher SLR. Both structures exceed the 10-yr ERP values for SLR = +1.0 ft and greater

Coastal Structure Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the 5-yr event can overtop many locations along the secondary and other canals, and the LOS of 5-yr or lower is assigned for most canals considering that the canal banks are consistently overtopped for greater than 5-yr event. Therefore, the existing gravity-drained tidal structures will be unable to provide acceptable levels of flood protection for SLR greater than +2 ft.

Secondary and Local Drainage System Performance: The PM1, PM2, PM3 and PM4 analysis showed that the water elevations of the canal profiles of the secondary drainage system show that the water elevations of the 5-yr event can overtop many locations along the canal and the LOS of 5-yr cannot be assigned mainly because the canal banks are not consistently high and can be overtopped

Localized Flood Potential: The flood maps (PM5 and PM6) showed that even 5-yr storm can result in localized flooding which doubles its extent for each higher return period, for 5-yr event the urban flooded areas (with depth greater than 0.25 ft) are respectively 6%, 7%, 43% and 81% for the 5-yr, 10-yr, 25-yr and 100-yr events for SLR = 0. For SLR = +3.0 ft the flooded areas for the 5-yr event area 51%.

The overall rating of Watershed C-103 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft

6.6 Water Budget Summaries

This Section provides water balance summaries for the Calibration and Validation models, and for Design Events for current and future SLR conditions (5-yr/72-hr, 10-yr/72-hr, 25-yr/72-hr, 100-yr/72-hr) and SLR = 0, +1.0 +2.0 and +3.0 ft. All calculations were based on an hourly based timeseries and were summarized in a set of tables. All files which include balance tables, model and GIS files are provided as a part of this Section.

The water balance analysis includes overall summary of the water balances which were obtained from the DHI's Water Balance Tool and is summarized for all four subdomains: OL – Two-dimensional Overland Flow, UZ – One dimensional flow in the Unsaturated Zone, SZ – Three-dimensional flow in Saturated Zone and OC – Open Channel and hydraulics (canals, control structures, culverts, bridges, and pumps). However, the water balance tool does not provide analysis of flow across transect lines. Furthermore, the tool only includes the water flux which is exchanged with the canals and do not provide an integrated analysis of Mike-SHE and MIKE 1D water budgets and does not include Inflows/Outflows across MIKE 1D boundaries and change of storage in the canals. Therefore, the water balance tool was combined with additional analysis of canal flow and change of storage (by using the Mike 1D results). Additionally, the transect flows across the model and between each of the watersheds were calculated for overland, saturated zone and canal flows crossing the boundaries using the results from the overland and saturated zone flow simulations.

The general water balance which is used in this analysis is based on the equation:

$$Error = Inflows + Outflows - Change\ in\ Storage \qquad (eq.\ 1)$$

The inflows are defined as positive if the water flux is defined to enter the model domain (Inflows), and negative when the water flux is defined as leaving the water domain (Outflows). The pumping rates are based on information from Application 140627-12 (2012-06-13) for Water Use Permit 13-00017-W SFWMD (ref. 6).

The project domain for South Miami-Dade County Flood Protection Level of Service (South Miami-Dade FPLOS), consists of four watersheds (Figure 518):

- C-1 watershed (C-1 East and C-1 West sub watersheds)
- C-100 watershed (including C-100 West and C-100 East sub watersheds)
- C-102 watershed (C-102 East and C-102 West sub watersheds)
- C-103 watershed (BD-C103 West, BD-C103 Central, BD-C103 East, Homestead Air Force Base (HARB), North Canal (NO-Canal) and Florida City (Fla-City) watersheds)

Watershed C-1 is adjacent to Watersheds C-2 and C-4 to the north, and Watershed C-103 is adjacent to Watershed C-111 to the south. To the west, Watersheds C-1, C-100, C-102 and C-103 are bordered by Canals L-31N and C-111, which separate the Everglades National Park from the urban areas of Miami-Dade County. The model domain includes all hydrologic areas that impact watersheds C-1, C-100, C-102 and C-103. The design events include 5-yr/72-hr, 10-yr/72-hr, 25-yr/72-hr, 100-yr/72-hr and cover the period 9/1/2017-10/5/2017.

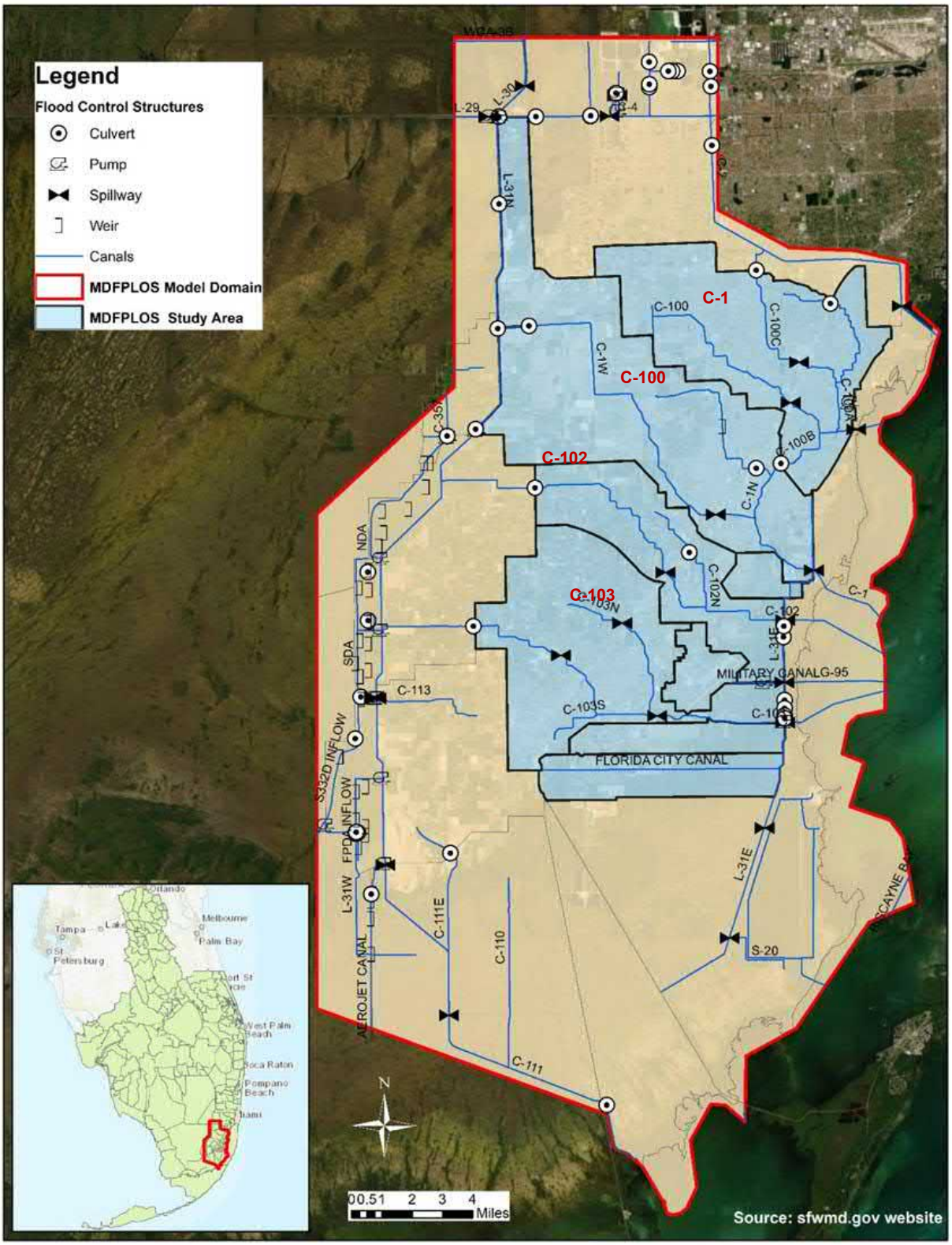


Figure 518 Model Domain and Project Domain Covering Watersheds C-1, C-100, C-102 and C-103

6.6.1 Overall Water Balance

The model domain and an outline of the project domains are provided in Figure 518. The water balance over the MIKE SHE domain in inches is summarized for all simulation events. MIKE 1D items treated as boundary flows and include Base flow from/to River, OL to River, and SZ Drain to/from River.

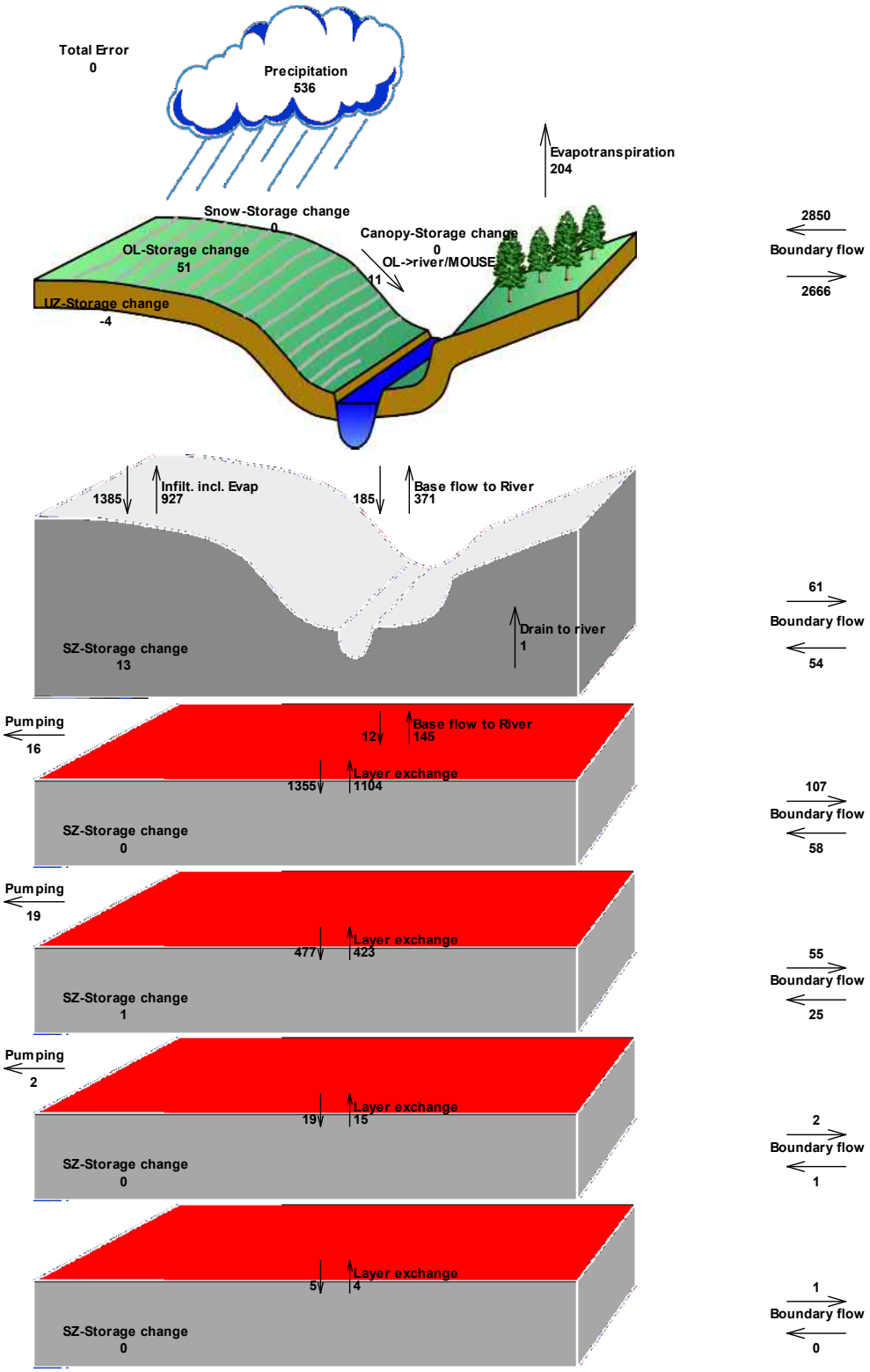
DHI's Water Balance Tool (an example for the 100-yr event is shown in Figure 519) provides a diagram showing the main water budget items. The exchange of OL and River is reported as OL->river/MOUSE (MOUSE is an Urban Drainage Tool).

The total Inflows, outflows and storage change are classified in Table 276. Highlighted are MIKE SHE and MIKE 1D couplings.

Table 276 Summary of Inflow, Outflow and Storage Items in the Water Balance Tool

Inflows	Outflows	Storage
Precipitation	Evapotranspiration	Canopy-Storage change
OL-Boundary Inflow	OL-Boundary Outflow	OL-Storage change
Irrigation	SZ-Boundary Outflow	SZ-Storage change
SZ-Boundary Inflow	Pumping	
Base flow from River	OL to river	
	SZ Drain to river	
	SZ Drain to ext river	
	Base flow to River	

Additionally, the flows across the transects shown in Figure 520 were determined for all simulations.



Accumulated waterbalance from 8/15/2017 to 10/15/2017. Data type : Storage depth [millimeter].
Flow Result File : Z:\2021-SFWMD-SMD\2021-06-01-SMD\Result\CAL_2017_130.she - Result Files\CAL_2017_130
Title : Text :

Figure 519 Model Water Budget Reported by DHI's Water Balance Tool

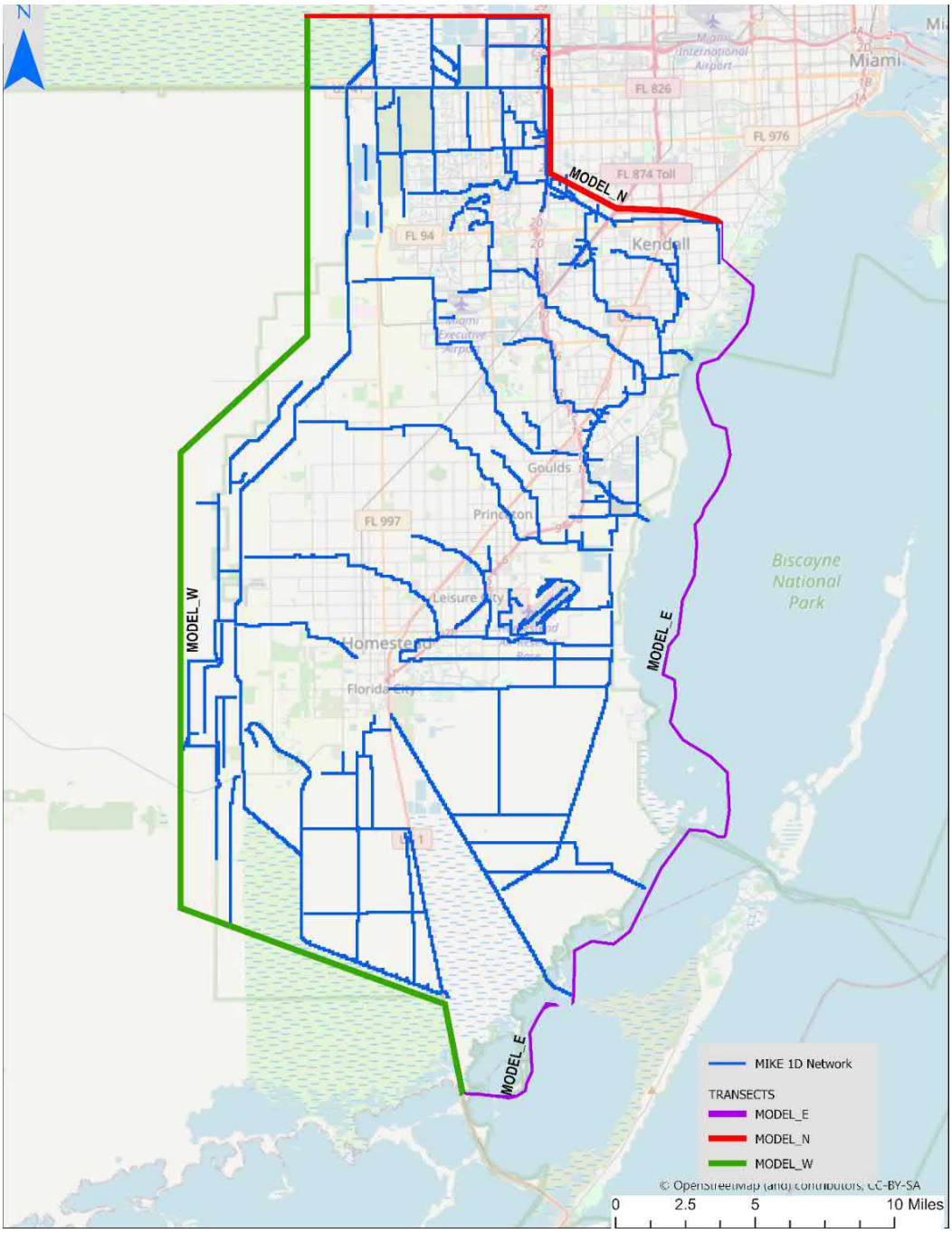


Figure 520 Locations of transect flows (defined as MODEL_E, MODEL_N and MODEL_W)

The Mike 1D boundaries of the entire model which are included the calculations and are listed in Table 277. The summary does not include the discharges from the model which are accounted in water balance calculations within each watershed (watershed balance summaries are provided for each project Watershed C-1, C-100, C-102, C-103).

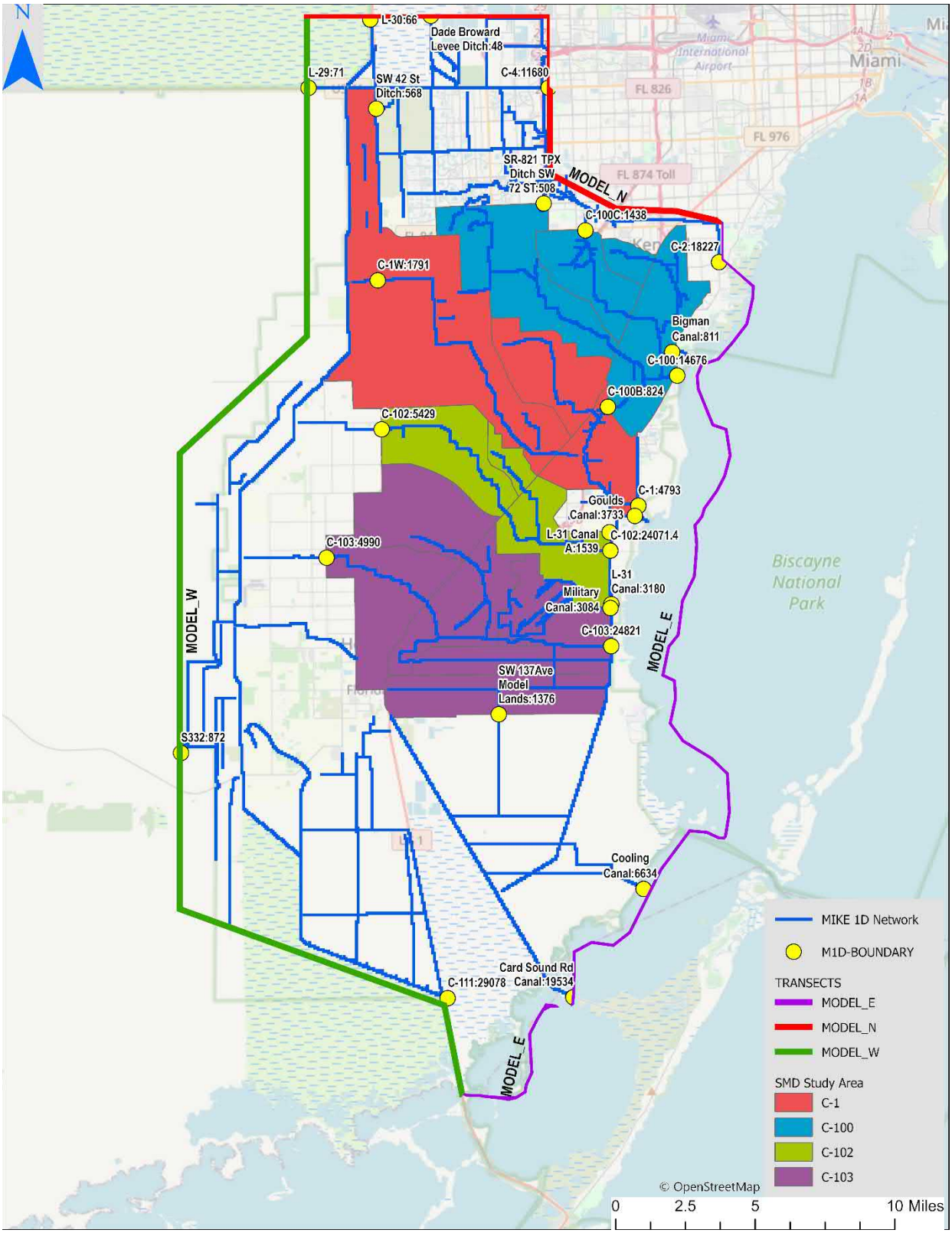


Figure 521 Location of Mike 1D Canals Crossing Watershed Boundaries

Table 277 List of Mike 1D Boundaries

Canal	Chainage	Q_Direction (chainage Increasing)
L-30	66	INFLOW
L-29	71	INFLOW
Bigman Canal	811	OUTFLOW
C-2	18227	OUTFLOW
Cooling Canal	6634	OUTFLOW
Card Sound Rd Canal	19534	OUTFLOW
C-111	29078	OUTFLOW
S332	872	OUTFLOW
C-4	11680	OUTFLOW
Dade Broward Levee Ditch	48	INFLOW
C-102	5429	OUTFLOW
C-103	4990	OUTFLOW
SW 42 St Ditch	568	INFLOW
C-1W	1791	OUTFLOW

A global model summary (inflow, outflow and storage change) is provided for all design events and for SLR 0, 1, 2 and 3 in tables Table 278 through Table 281). The summary shows that increase in SLR results in considerable increase of all three main categories of the water balance: Inflows, Outflows and Storage, mainly because the model is sensitive to the overland boundary flow at the coastal areas.

Table 278 Global Model Summary, MODEL Area = 349956 acres, 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	2492.771	2938.535	3347.531	3957.039
Outflows (kAF)	-2468.136	-2890.828	-3289.748	-3889.556
Storage Change (kAF)	-22.610	-45.676	-55.791	-65.092
Difference (kAF):	**2.025**	**2.031**	**1.992**	**2.390**

Table 279 Global Model Summary, MODEL Area = 349956 acres, 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	2551.395	2971.264	3379.430	3972.470
Outflows (kAF)	-2524.686	-2922.045	-3320.433	-3905.116
Storage Change (kAF)	-24.601	-47.106	-56.887	-64.875
Difference (kAF)	**2.108**	**2.113**	**2.110**	**2.480**

Table 280 Global Model Summary, MODEL Area = 349956 acres, 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	2646.568	3445.954	3419.345	4006.837
Outflows (kAF)	-2617.057	-3408.249	-3359.963	-3938.644
Storage Change (kAF)	-27.283	-37.664	-57.172	-65.541
Difference (kAF)	**2.228**	**0.041**	**2.211**	**2.652**

Table 281 Global Model Summary, MODEL Area = 349956 acres, 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	2806.334	3616.531	3505.319	4087.012
Outflows (kAF)	-2772.074	-3576.403	-3443.499	-4017.139
Storage Change (kAF)	-31.611	-40.089	-59.344	-67.028
Difference (kAF)	**2.649**	**0.039**	**2.475**	**2.845**

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in Table 282 through Table 286 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 282 Summary of all Inflows, Outflows and Storage Change for the Entire Model (all data in kAF), 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	236.584	236.584	236.584	236.584
Evapotranspiration	-103.805	-107.280	-110.899	-115.050
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1655.589	2125.259	2527.692	3108.096
OL-Boundary Outflow	-3234.611	-3406.864	-3490.348	-3212.301
OL-Storage change	-57.832	-72.369	-70.757	-64.743
OL to river	1209.072	1005.782	693.637	-174.214
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	399.426	368.344	353.938	349.823
SZ-Boundary Outflow	-58.898	-112.071	-121.143	-143.198
SZ-Storage change	26.667	17.380	4.569	-11.926
Pumping	-26.425	-26.425	-26.425	-26.425
SZ Drain to river	-15.386	-19.928	-30.523	-51.542
SZ Drain to ext river	0.000	0.000	0.000	0.000
Base flow to River	-238.082	-224.041	-204.047	-166.825
Base flow from River	201.171	208.347	229.317	262.535
Difference:	**2.025**	**2.031**	**1.992**	**2.390**
Difference	**0.1%**	**0.1%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 283 Summary of all Inflows, Outflows and Storage Change for the Entire Model (all data in kAF), 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	286.469	286.469	286.469	286.469
Evapotranspiration	-105.000	-108.290	-111.763	-115.445
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1668.866	2110.236	2511.093	3084.302
OL-Boundary Outflow	-3264.463	-3429.833	-3525.226	-3240.552
OL-Storage change	-59.178	-73.325	-71.407	-64.497
OL to river	1194.465	997.543	698.327	-165.557
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	396.426	366.407	352.362	349.037
SZ-Boundary Outflow	-62.327	-104.631	-113.033	-134.767
SZ-Storage change	26.143	17.033	4.220	-11.967
Pumping	-26.425	-26.425	-26.425	-26.425
SZ Drain to river	-17.321	-22.031	-32.889	-53.656
SZ Drain to ext river	0.000	0.000	0.000	0.000
Base flow to River	-243.614	-228.378	-209.424	-168.714
Base flow from River	199.634	208.151	229.506	252.662
Difference:	**2.108**	**2.113**	**2.110**	**2.480**
Difference	**0.1%**	**0.1%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 284 Summary of all Inflows, Outflows and Storage Change for the Entire Model (all data in kAF), 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	361.451	361.451	361.451	361.451
Evapotranspiration	-106.552	-104.081	-112.806	-116.288
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1692.361	2441.737	2481.635	3045.040
OL-Boundary Outflow	-3310.858	-2908.560	-3565.976	-3283.769
OL-Storage change	-61.078	-40.379	-71.281	-64.783
OL to river	1166.770	-44.333	690.890	-164.864
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	391.759	500.475	350.164	347.414
SZ-Boundary Outflow	-67.741	-102.342	-98.664	-119.931
SZ-Storage change	25.548	-7.954	3.929	-12.258
Pumping	-26.425	-23.600	-26.425	-26.425
SZ Drain to river	-20.289	-0.514	-36.266	-57.228
SZ Drain to ext river	0.000	0.000	0.000	0.000
Base flow to River	-251.960	-224.819	-210.715	-170.140
Base flow from River	200.997	142.291	226.095	252.933
Difference:	**2.228**	**0.041**	**2.211**	**2.652**
Difference	**0.1%**	**0.0%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 285 Summary of all Inflows, Outflows and Storage Change for the Entire Model (all data in kAF), 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	494.467	494.467	494.467	494.467
Evapotranspiration	-108.604	-106.267	-114.277	-117.603
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1723.356	2482.966	2435.028	2984.007
OL-Boundary Outflow	-3387.647	-3005.735	-3648.835	-3367.317
OL-Storage change	-64.256	-43.056	-72.686	-65.699
OL to river	1114.566	-81.787	680.154	-171.933
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	384.304	490.884	347.116	345.414
SZ-Boundary Outflow	-77.554	-115.204	-77.335	-97.798
SZ-Storage change	24.554	-7.356	3.296	-12.629
Pumping	-26.425	-26.425	-26.425	-26.425
SZ Drain to river	-25.661	-0.648	-42.041	-63.695
SZ Drain to ext river	0.000	0.000	0.000	0.000
Base flow to River	-260.748	-240.336	-214.740	-172.368
Base flow from River	204.206	148.214	228.708	263.124
Difference:	**2.649**	**0.039**	**2.475**	**2.845**
Difference	**0.1%**	**0.0%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

The summary shows that the Difference is within 2% except for the calibration period, which also showed larger differences also in comparing transect flows.

A summary of OL transect flows for each event and for change of SLR is provided in Table 286 through Table 289 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 286 Summary of Transect OL Flows for the Entire Model (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-OL	-1080.195	-841.200	-543.028	192.844
MODEL_N-OL	-101.535	-84.268	-57.988	-27.440
MODEL_W-OL	-270.903	-268.748	-310.246	-261.938
Transect OL Flows	**-1452.632**	**-1194.215**	**-911.262**	**-96.534**

Table 287 Summary of Transect OL Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-OL	-1077.685	-860.113	-572.587	170.213
MODEL_N-OL	-101.372	-86.022	-60.687	-31.837
MODEL_W-OL	-270.789	-281.507	-319.166	-281.063
Transect OL Flows	**-1449.846**	**-1227.643**	**-952.440**	**-142.686**

Table 288 Summary of Transect OL Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-OL	-1095.495	9.160	-606.149	132.878
MODEL_N-OL	-103.719	-123.766	-66.069	-41.450
MODEL_W-OL	-288.683	-330.565	-342.215	-307.425
Transect OL Flows	**-1487.897**	**-445.171**	**-1014.433**	**-215.997**

Table 289 Summary of Transect OL Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-OL	-1110.200	-18.515	-663.677	75.808
MODEL_N-OL	-106.926	-124.940	-77.984	-60.678
MODEL_W-OL	-313.215	-349.400	-388.583	-361.546
Transect OL Flows	**-1530.340**	**-492.855**	**-1130.244**	**-346.416**

A summary of SZ transect flows for each event and for change of SLR is provided in Table 290 through Table 293 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 290 Summary of Transect SZ Flows for the Entire Model (kAF), 5-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SZ1	-1.035	-7.263	-6.992	-6.818
MODEL_E-SZ2	-2.969	-20.224	-19.456	-19.234
MODEL_E-SZ3	-1.603	-9.546	-9.119	-8.839
MODEL_E-SZ4	-0.035	-0.191	-0.182	-0.179
MODEL_E-SZ5	-0.005	-0.047	-0.045	-0.045
MODEL_N-SZ1	20.381	13.383	5.166	-1.414
MODEL_N-SZ2	52.312	32.409	12.182	-4.924
MODEL_N-SZ3	22.455	16.094	9.495	3.515
MODEL_N-SZ4	0.220	-0.254	-0.675	-0.982
MODEL_N-SZ5	0.273	0.248	0.219	0.178
MODEL_W-SZ1	14.232	12.896	14.292	14.862
MODEL_W-SZ2	144.437	138.679	143.829	145.174
MODEL_W-SZ3	89.382	85.705	89.096	90.466
MODEL_W-SZ4	0.689	0.677	0.677	0.634
MODEL_W-SZ5	0.757	0.747	0.891	0.907
Sum:	339.490	263.313	239.378	213.302

Table 291 Summary of Transect SZ Flows for the Entire Model (kAF), 10-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SZ1	-1.026	-6.067	-5.794	-5.613
MODEL_E-SZ2	-2.933	-16.737	-15.951	-15.688
MODEL_E-SZ3	-1.588	-8.060	-7.631	-7.339
MODEL_E-SZ4	-0.035	-0.159	-0.149	-0.146
MODEL_E-SZ5	-0.005	-0.040	-0.038	-0.038
MODEL_N-SZ1	20.245	13.168	4.982	-1.559
MODEL_N-SZ2	51.911	31.430	11.367	-5.570
MODEL_N-SZ3	22.327	15.749	9.205	3.285
MODEL_N-SZ4	0.209	-0.292	-0.706	-1.006
MODEL_N-SZ5	0.272	0.247	0.218	0.177
MODEL_W-SZ1	14.197	12.938	14.435	15.043
MODEL_W-SZ2	144.307	138.317	143.857	145.615
MODEL_W-SZ3	89.294	85.429	89.050	90.691
MODEL_W-SZ4	0.689	0.673	0.675	0.633
MODEL_W-SZ5	0.754	0.742	0.900	0.921
Sum:	338.619	267.339	244.420	219.406

Table 292 Summary of Transect SZ Flows for the Entire Model kAF), 25-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SZ1	-1.037	-0.559	-3.580	-3.392
MODEL_E-SZ2	-3.035	-2.005	-9.536	-9.234
MODEL_E-SZ3	-1.605	-0.879	-4.802	-4.501
MODEL_E-SZ4	-0.036	-0.009	-0.089	-0.086
MODEL_E-SZ5	-0.006	-0.022	-0.025	-0.024
MODEL_N-SZ1	19.514	22.125	4.685	-1.798
MODEL_N-SZ2	49.044	53.505	10.066	-6.612
MODEL_N-SZ3	21.334	23.718	8.744	2.913
MODEL_N-SZ4	0.111	0.011	-0.754	-1.045
MODEL_N-SZ5	0.267	0.288	0.215	0.174
MODEL_W-SZ1	13.045	16.088	14.631	15.290
MODEL_W-SZ2	138.592	172.705	143.858	145.908
MODEL_W-SZ3	85.767	107.747	88.965	90.784
MODEL_W-SZ4	0.662	0.795	0.671	0.630
MODEL_W-SZ5	0.591	1.027	0.912	0.940
Sum:	323.209	394.536	253.961	229.948

Table 293 Summary of Transect SZ Flows for the Entire Model (kAF), 100-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SZ1	-1.038	-0.604	-0.255	-0.058
MODEL_E-SZ2	-3.092	-2.182	-0.184	0.166
MODEL_E-SZ3	-1.605	-0.951	-0.360	-0.046
MODEL_E-SZ4	-0.036	-0.011	-0.001	0.003
MODEL_E-SZ5	-0.006	-0.023	-0.001	0.000
MODEL_N-SZ1	18.676	21.337	4.210	-2.157
MODEL_N-SZ2	45.903	50.581	8.024	-8.153
MODEL_N-SZ3	20.236	22.673	8.006	2.349
MODEL_N-SZ4	0.007	-0.080	-0.830	-1.102
MODEL_N-SZ5	0.261	0.282	0.211	0.171
MODEL_W-SZ1	11.795	14.358	15.042	15.783
MODEL_W-SZ2	132.278	164.188	143.973	146.521
MODEL_W-SZ3	81.849	102.577	88.862	90.987
MODEL_W-SZ4	0.635	0.760	0.665	0.626
MODEL_W-SZ5	0.431	0.855	0.940	0.978
Sum:	306.293	373.761	268.301	246.068

A summary of Mike 1D flows in the transect for each event and for change of SLR is provided in Table 294 through Table 297 for SLR = 0, +1.0, +2.0, +3.0 f.

Table 294 Summary of Transect Mike 1D Flows for the Entire Model (all data in kAF), 5-yr/3-day

Transect OL Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
MODEL_E-SUM-OC-FLOW	335.934	277.900	195.519	-138.229
MODEL_N-SUM-OC-FLOW	-17.600	5.999	26.467	33.743
MODEL_W-SUM-OC-FLOW	-0.195	-0.500	-0.697	-0.698
Transect OL Flows	**318.140**	**283.399**	**221.288**	**-105.184**

Table 295 Summary of Transect Mike 1D Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
MODEL_E-SUM-OC-FLOW	335.049	272.444	183.227	-142.293
MODEL_N-SUM-OC-FLOW	-17.057	3.033	24.357	32.389
MODEL_W-SUM-OC-FLOW	-0.203	-0.507	-0.697	-0.694
Transect OL Flows	**317.789**	**274.971**	**206.888**	**-110.598**

Table 296 Summary of Transect Mike 1D Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SUM-OC-FLOW	312.735	-112.181	177.477	-145.053
MODEL_N-SUM-OC-FLOW	-25.727	-9.035	21.556	32.150
MODEL_W-SUM-OC-FLOW	-0.231	0.042	-0.702	-0.689
Transect OL Flows	**286.777**	**-121.173**	**198.331**	**-113.592**

Table 297 Summary of Transect Mike 1D Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
MODEL_E-SUM-OC-FLOW	291.795	-135.908	171.236	-145.526
MODEL_N-SUM-OC-FLOW	-34.696	-20.441	16.739	32.336
MODEL_W-SUM-OC-FLOW	-0.252	-0.002	-0.692	-0.668
Transect OL Flows	**256.847**	**-156.351**	**187.282**	**-113.858**

6.6.2 Watershed C-1

The water balance over the C-1 Watershed in inches is summarized for all simulation events. MIKE 1D items treated as boundary flows and include Base flow from/to River, OL to River, and SZ Drain to/from River. The exchange of OL and River is reported as OL->river/MOUSE (MOUSE is an Urban Drainage Tool).

The Mike 1D boundaries within Watershed C-1 are listed in shown in Table 298.

Table 298 List of Mike 1D Boundaries of Watershed C-1

Canal	Chainage	Q_Direction (chainage Increasing)
SW 42 St Ditch	568	OUTFLOW
C-1W	1791	INFLOW
C-100B	824	OUTFLOW
C-1	4793	OUTFLOW
Goulds Canal	3733	OUTFLOW
SW 42 St Ditch	568	OUTFLOW

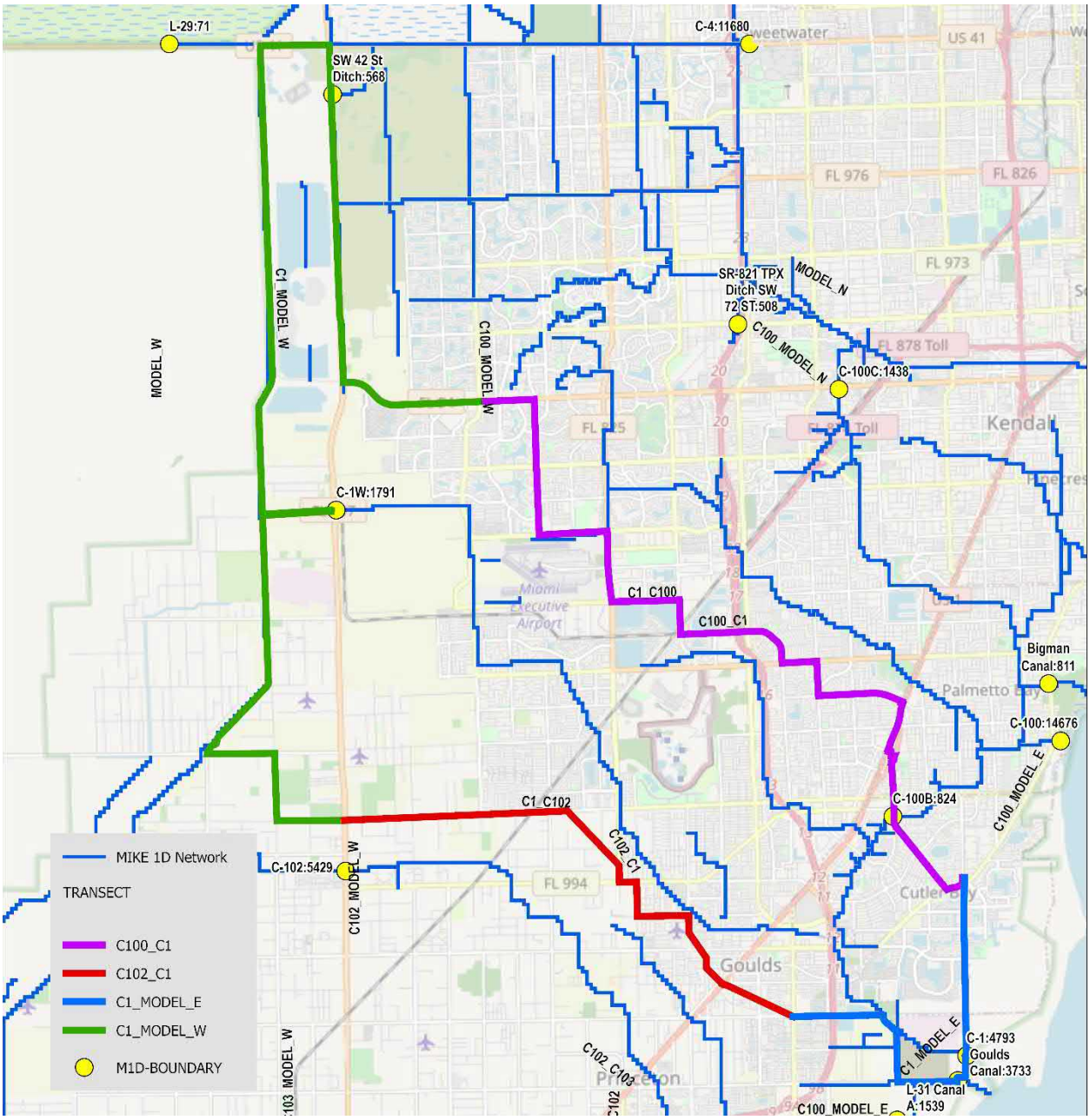


Figure 522 Locations of Transect Flows in Watershed C-1 and Location of Mike 1D Canals Crossing Watershed Boundaries

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in in the section below.

A global C-1 Watershed summary (inflow, outflow and storage change) is provided in

Table 299 through Table 302 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 299 Global C-1 Watershed Summary, C1 Area = 37251 acres, 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	49.655	50.390	50.301	49.641
Outflows (kAF)	-65.164	-61.094	-60.984	-60.799
Storage Change (kAF)	15.551	10.738	10.745	11.226
Difference (kAF)	**0.042**	**0.059**	**0.070**	**0.067**
Inflow Rainfall is 25.727 kAF Negative values of outflows refer to water leaving control volume				

Table 300 Global C-1 Watershed Summary, C1 Area = 37251 acres, 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	55.056	55.558	55.662	54.767
Outflows (kAF)	-70.405	-66.120	-66.236	-65.790
Storage Change (kAF)	15.424	10.612	10.633	11.124
Difference (kAF)	**0.075**	**0.050**	**0.059**	**0.101**
Inflow Rainfall is 31.089 kAF Negative values of outflows refer to water leaving control volume				

Table 301 Global C-1 Watershed Summary, C1 Area = 37251 acres, 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	62.768	63.450	63.825	62.153
Outflows (kAF)	-77.949	-73.829	-74.229	-73.034
Storage Change (kAF)	15.258	10.463	10.512	10.986
Difference (kAF)	**0.076**	**0.085**	**0.108**	**0.105**
Inflow Rainfall is 39.076 kAF Negative values of outflows refer to water leaving control volume				

Table 302 Global C-1 Watershed Summary, C1 Area = 37251 acres, 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	76.887	77.431	77.318	76.418
Outflows (kAF)	-91.770	-87.522	-87.442	-87.032
Storage Change (kAF)	15.042	10.255	10.319	10.812
Difference (kAF)	**0.159**	**0.164**	**0.195**	**0.198**
Inflow Rainfall is 53.107 kAF Negative values of outflows refer to water leaving control volume				

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in Table 303 through Table 306 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 303 Summary of all Inflows, Outflows and Storage Change for the C-1 Watershed (all data in kAF), 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	25.727	25.727	25.727	25.727
Evapotranspiration	-5.585	-5.664	-5.788	-6.083
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	2.001	2.026	2.043	2.204
OL-Boundary Outflow	-1.240	-1.493	-1.779	-1.855
OL-Storage change	0.503	-0.074	-0.659	-1.636
OL to river	-6.633	-7.594	-10.640	-10.893
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	21.623	21.931	22.414	18.483
SZ-Boundary Outflow	-23.141	-20.645	-17.338	-13.686
SZ-Storage change	3.554	2.654	1.518	-1.629
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-1.923	-2.053	-2.290	-3.250
SZ Drain to ext river	-0.002	-0.004	-0.006	-0.010
Base flow to River	-17.983	-18.494	-17.255	-14.028
Base flow from River	1.524	2.073	2.354	4.708
Difference:	**0.066**	**0.059**	**0.070**	**0.089**
Difference	**0.1%**	**0.1%**	**0.1%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				
Negative values of outflows refer to water leaving control volume (C-1 watershed)				

Table 304 Summary of all Inflows, Outflows and Storage Change for the C-1 Watershed (all data in kAF), 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	31.089	31.089	31.089	31.089
Evapotranspiration	-5.757	-5.839	-5.967	-6.264
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	2.105	2.123	2.066	2.363
OL-Boundary Outflow	-1.776	-2.068	-2.357	-2.729
OL-Storage change	0.470	-0.106	-0.701	-1.655
OL to river	-9.110	-10.172	-13.355	-13.607
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	21.391	21.870	21.549	18.378
SZ-Boundary Outflow	-23.504	-21.245	-17.249	-14.434
SZ-Storage change	3.482	2.602	1.440	-1.672
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-2.205	-2.350	-2.615	-3.643
SZ Drain to ext river	-0.006	-0.008	-0.010	-0.014
Base flow to River	-19.271	-19.564	-17.904	-14.392
Base flow from River	1.532	2.087	2.345	4.651
Difference:	**0.066**	**0.067**	**0.090**	**0.093**
Difference	**0.1%**	**0.1%**	**0.2%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				
Negative values of outflows refer to water leaving control volume (C-1 watershed)				

Table 305 Summary of all Inflows, Outflows and Storage Change for the C-1 Watershed (all data in kAF), 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	39.076	39.076	39.076	39.076
Evapotranspiration	-5.972	-5.939	-6.181	-6.473
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	2.221	1.912	2.199	2.814
OL-Boundary Outflow	-2.933	-3.113	-3.666	-4.587
OL-Storage change	0.430	0.434	-0.734	-1.689
OL to river	-13.476	-14.283	-17.922	-18.019
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	21.105	11.856	21.424	18.322
SZ-Boundary Outflow	-23.887	-17.703	-18.024	-15.333
SZ-Storage change	3.415	-1.390	1.372	-1.741
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-2.579	-0.081	-3.072	-4.183
SZ Drain to ext river	-0.011	0.000	-0.015	-0.019
Base flow to River	-20.465	-14.557	-18.416	-14.636
Base flow from River	1.558	2.304	2.318	4.580
Difference:	**0.066**	**-0.030**	**0.100**	**0.143**
Difference	**0.1%**	**-0.1%**	**0.2%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 306 Summary of all Inflows, Outflows and Storage Change for the C-1 Watershed (all data in kAF), 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	53.107	53.107	53.107	53.107
Evapotranspiration	-6.239	-6.031	-6.442	-6.732
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	2.661	2.353	2.874	4.154
OL-Boundary Outflow	-5.721	-5.816	-7.083	-9.068
OL-Storage change	0.368	0.482	-0.783	-1.735
OL to river	-22.523	-22.671	-26.673	-25.987
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	21.063	12.577	20.989	18.617
SZ-Boundary Outflow	-24.462	-17.448	-18.516	-16.992
SZ-Storage change	3.283	-0.965	1.272	-1.802
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-3.228	-0.101	-3.814	-5.034
SZ Drain to ext river	-0.018	0.000	-0.022	-0.027
Base flow to River	-21.271	-19.665	-18.748	-14.702
Base flow from River	1.540	2.724	2.257	4.369
Difference:	**0.153**	**-0.028**	**0.161**	**0.159**
Difference	**0.2%**	**0.0%**	**0.2%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				

The summary shows that the Difference is within 2% except for the calibration period, which also showed larger differences also in comparing transect flows.

A summary of OL transect flows for each event and for change of SLR is provided in Table 307 through Table 310 for SLR = 0, +1.0, +2.0, +3.0 ft.:

Table 307 Summary of Transect OL Flows for the C-1 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	0.000	0.000	-0.004	0.033
C102_MODEL_E-OL	0.780	0.609	0.411	0.430
C1_C102-OL	-0.011	-0.070	-0.138	-0.110
Transect OL Flows	**0.762**	**0.533**	**0.261**	**0.342**

Table 308 Summary of Transect OL Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.015	-0.019	-0.019	0.073
C102_MODEL_E-OL	0.404	0.193	-0.054	-0.180
C1_C102-OL	-0.032	-0.096	-0.199	-0.246
Transect OL Flows	**0.328**	**0.050**	**-0.297**	**-0.375**

Table 309 Summary of Transect OL Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.068	-0.051	0.007	0.170
C102_MODEL_E-OL	-0.487	-1.008	-1.117	-1.407
C1_C102-OL	-0.109	-0.105	-0.324	-0.517
Transect OL Flows	**-0.717**	**-1.207**	**-1.474**	**-1.782**

Table 310 Summary of Transect OL Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.051	-0.028	0.150	0.340
C102_MODEL_E-OL	-2.779	-3.456	-3.643	-4.045
C1_C102-OL	-0.206	-0.183	-0.716	-1.220
Transect OL Flows	**-3.067**	**-3.678**	**-4.212**	**-4.914**

A summary of SZ transect flows for each event and for change of SLR is provided in Table 311 through Table 314 for SLR = 0, +1.0, +2.0, +3.0 ft.:

Table 311 Summary of Transect SZ Flows for the C-1 Watershed (kAF), 5-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SZ1	-0.050	-0.022	0.057	0.103
C100_C1-SZ2	-0.614	-0.299	0.476	0.835
C100_C1-SZ3	-0.336	-0.191	0.198	0.380
C100_C1-SZ4	-0.060	-0.041	0.014	0.041
C100_C1-SZ5	-0.002	-0.001	0.001	0.002
C1_MODEL_W-SZ1	-0.012	0.042	0.125	0.145
C1_MODEL_W-SZ2	-0.554	0.031	0.755	0.895
C1_MODEL_W-SZ3	0.104	0.415	0.793	0.726
C1_MODEL_W-SZ4	-0.052	-0.025	0.007	0.022
C1_MODEL_W-SZ5	0.020	0.023	0.026	0.020
C1_MODEL_E-SZ1	-0.074	0.072	0.204	0.079
C1_MODEL_E-SZ2	-0.449	0.358	0.884	0.301
C1_MODEL_E-SZ3	-0.122	0.100	0.249	0.086
C1_MODEL_E-SZ4	-0.003	0.002	0.005	0.002
C1_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	0.042	0.051	0.080	0.076
C1_C102-SZ2	0.493	0.580	0.873	0.785
C1_C102-SZ3	0.162	0.198	0.331	0.304
C1_C102-SZ4	0.005	0.005	0.008	0.007
C1_C102-SZ5	0.000	0.000	0.000	0.000
Sum:	**-1.501**	**1.296**	**5.087**	**4.808**

Table 312 Summary of Transect SZ Flows for the C-1 Watershed (kAF), 10-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SZ1	-0.056	-0.027	0.052	0.095
C100_C1-SZ2	-0.651	-0.338	0.427	0.769
C100_C1-SZ3	-0.343	-0.198	0.186	0.359
C100_C1-SZ4	-0.061	-0.042	0.013	0.038
C100_C1-SZ5	-0.002	-0.001	0.001	0.002
C1_MODEL_W-SZ1	-0.059	-0.001	0.071	0.106
C1_MODEL_W-SZ2	-0.942	-0.350	0.374	0.525
C1_MODEL_W-SZ3	-0.176	0.138	0.518	0.458
C1_MODEL_W-SZ4	-0.059	-0.033	-0.001	0.014

C1_MODEL_W-SZ5	0.015	0.018	0.021	0.015
C1_MODEL_E-SZ1	-0.085	0.050	0.174	0.042
C1_MODEL_E-SZ2	-0.524	0.229	0.726	0.124
C1_MODEL_E-SZ3	-0.140	0.068	0.207	0.038
C1_MODEL_E-SZ4	-0.003	0.001	0.004	0.001
C1_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	0.065	0.074	0.100	0.093
C1_C102-SZ2	0.680	0.766	1.032	0.914
C1_C102-SZ3	0.240	0.275	0.396	0.356
C1_C102-SZ4	0.006	0.007	0.009	0.008
C1_C102-SZ5	0.000	0.000	0.000	0.000
Sum:	**-2.095**	**0.636**	**4.312**	**3.957**

Table 313 Summary of Transect SZ Flows for the C-1 Watershed (all data in kAF), 25-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C100_C1-SZ1	-0.050	-0.022	0.057	0.103
C100_C1-SZ2	-0.614	-0.299	0.476	0.835
C100_C1-SZ3	-0.336	-0.191	0.198	0.380
C100_C1-SZ4	-0.060	-0.041	0.014	0.041
C100_C1-SZ5	-0.002	-0.001	0.001	0.002
C1_MODEL_W-SZ1	-0.012	0.042	0.125	0.145
C1_MODEL_W-SZ2	-0.554	0.031	0.755	0.895
C1_MODEL_W-SZ3	0.104	0.415	0.793	0.726
C1_MODEL_W-SZ4	-0.052	-0.025	0.007	0.022
C1_MODEL_W-SZ5	0.020	0.023	0.026	0.020
C1_MODEL_E-SZ1	-0.074	0.072	0.204	0.079
C1_MODEL_E-SZ2	-0.449	0.358	0.884	0.301
C1_MODEL_E-SZ3	-0.122	0.100	0.249	0.086
C1_MODEL_E-SZ4	-0.003	0.002	0.005	0.002
C1_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	0.042	0.051	0.080	0.076
C1_C102-SZ2	0.493	0.580	0.873	0.785
C1_C102-SZ3	0.162	0.198	0.331	0.304
C1_C102-SZ4	0.005	0.005	0.008	0.007
C1_C102-SZ5	0.000	0.000	0.000	0.000
Sum:	**-1.501**	**1.296**	**5.087**	**4.808**

Table 314 Summary of Transect SZ Flows for the C-1 Watershed (all data in kAF), 100-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SZ1	-0.061	-0.055	0.045	0.088
C100_C1-SZ2	-0.683	-0.611	0.371	0.708
C100_C1-SZ3	-0.345	-0.336	0.172	0.341
C100_C1-SZ4	-0.061	-0.060	0.011	0.036
C100_C1-SZ5	-0.001	-0.002	0.001	0.002
C1_MODEL_W-SZ1	-0.113	-0.374	0.025	0.062
C1_MODEL_W-SZ2	-1.374	-2.470	-0.080	0.117
C1_MODEL_W-SZ3	-0.489	-1.435	0.193	0.177
C1_MODEL_W-SZ4	-0.068	-0.075	-0.011	0.004
C1_MODEL_W-SZ5	0.009	-0.002	0.015	0.009
C1_MODEL_E-SZ1	-0.105	-0.129	0.141	-0.007
C1_MODEL_E-SZ2	-0.638	-0.709	0.543	-0.112
C1_MODEL_E-SZ3	-0.170	-0.195	0.160	-0.027
C1_MODEL_E-SZ4	-0.004	-0.004	0.003	-0.001
C1_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	0.093	0.046	0.125	0.113
C1_C102-SZ2	0.906	0.458	1.217	1.066
C1_C102-SZ3	0.332	0.121	0.472	0.419
C1_C102-SZ4	0.008	0.004	0.011	0.009
C1_C102-SZ5	0.000	0.000	0.000	0.000
Sum:	**-2.763**	**-5.829**	**3.413**	**3.004**

A summary of Mike 1D flows in the transect for each event and for change of SLR is provided in Table 315 through Table 318 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 315 Summary of Transect Mike 1D Flows for the C-1 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.003	0.001	0.000	-0.009
C1_MODEL_W-SUM-OC-FLOW	1.281	1.175	0.802	1.360
C1_MODEL_E-SUM-OC-FLOW	-18.718	-27.917	-36.981	-53.550
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-17.107**	**-19.448**	**-18.702**	**-14.262**

Table 316 Summary of Transect Mike 1D Flows for the C-1 Watershed (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.004	0.002	-0.001	-0.021
C1_MODEL_W-SUM-OC-FLOW	1.118	1.027	1.045	1.338
C1_MODEL_E-SUM-OC-FLOW	-22.735	-31.314	-40.131	-56.843
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-17.475**	**-30.285**	**-39.087**	**-55.526**

Table 317 Summary of Transect Mike 1D Flows for the C-1 Watershed (all data in kAF), 25-yr/3-day

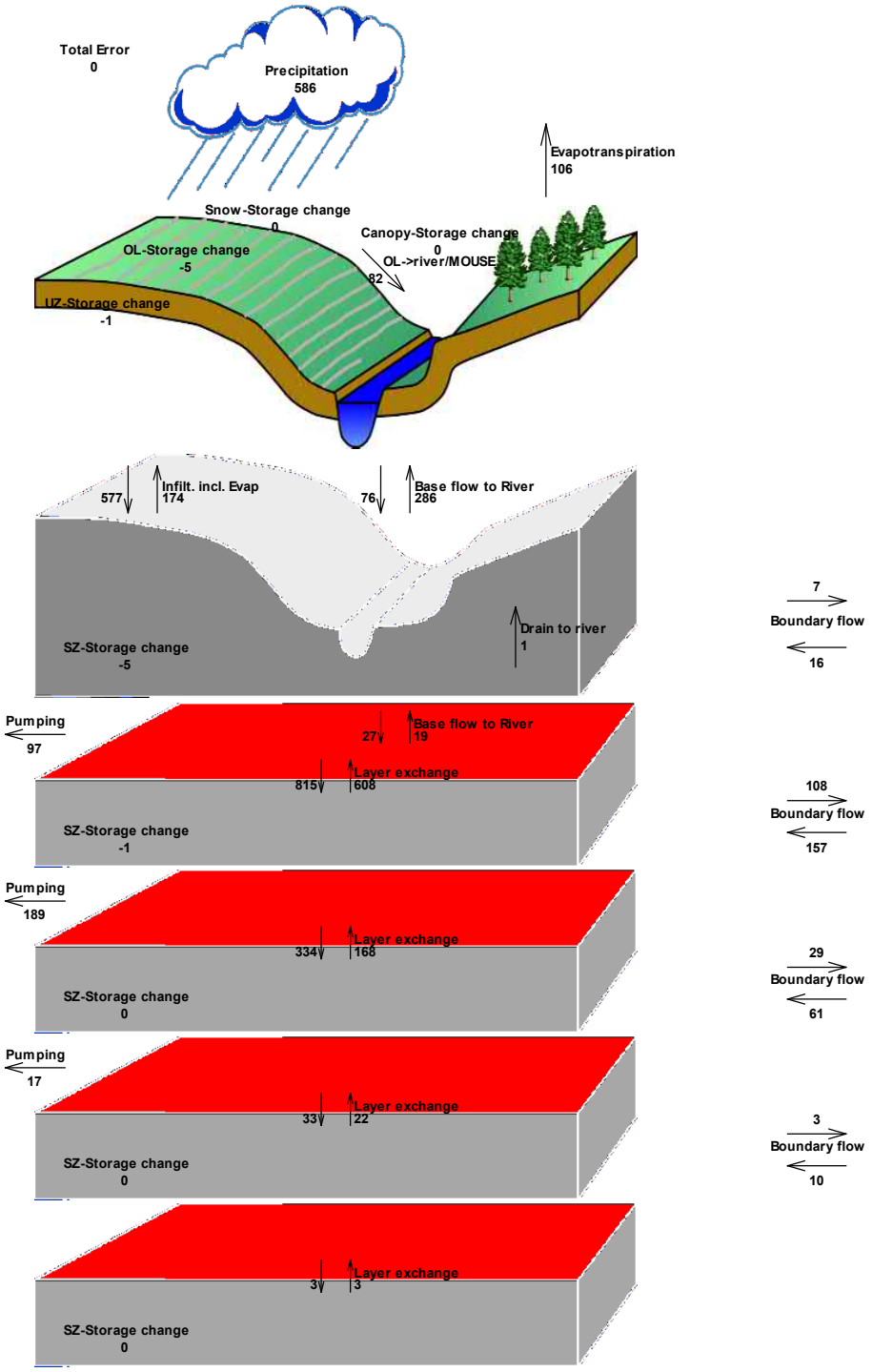
Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.006	0.001	-0.008	-0.070
C1_MODEL_W-SUM-OC-FLOW	0.939	11.625	1.004	0.851
C1_MODEL_E-SUM-OC-FLOW	-28.833	-35.317	-44.621	-61.924
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-27.888**	**-23.691**	**-43.624**	**-61.143**

Table 318 Summary of Transect Mike 1D Flows for the C-1 Watershed (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	-0.002	-0.005	-0.063	-0.106
C1_MODEL_W-SUM-OC-FLOW	0.509	11.425	0.733	-2.265
C1_MODEL_E-SUM-OC-FLOW	-37.739	-45.068	-51.058	-68.870
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-37.231**	**-33.648**	**-50.388**	**-71.240**

6.6.3 Watershed C-100

The water balance over the C-100 Watershed in inches is summarized for all simulation events. MIKE 1D items treated as boundary flows and include Base flow from/to River, OL to River, and SZ Drain to/from River. The exchange of OL and River is reported as OL->river/MOUSE (MOUSE is a Urban Drainage Tool).



Accumulated waterbalance from 8/15/2017 to 10/15/2017. Data type : Storage depth [millimeter].
Flow Result File : Z:\2021-SFWMD-SMD\2021-06-01-SMD\Result\CAL_2017_130.she - Result Files\CAL_2017_130
Title : Text :

Figure 523 C-100 Watershed Water Budget Reported by DHI's Water Balance Tool

The Mike 1D boundaries within Watershed C-100 are listed in Table 319.

Table 319 Location of Mike 1D Boundaries within Watershed C-100

Canal	Chainage	Q_Direction (chainage Increasing)
C-100	14676	OUTFLOW
SR-821 TPX Ditch SW 72 ST	508	OUTFLOW

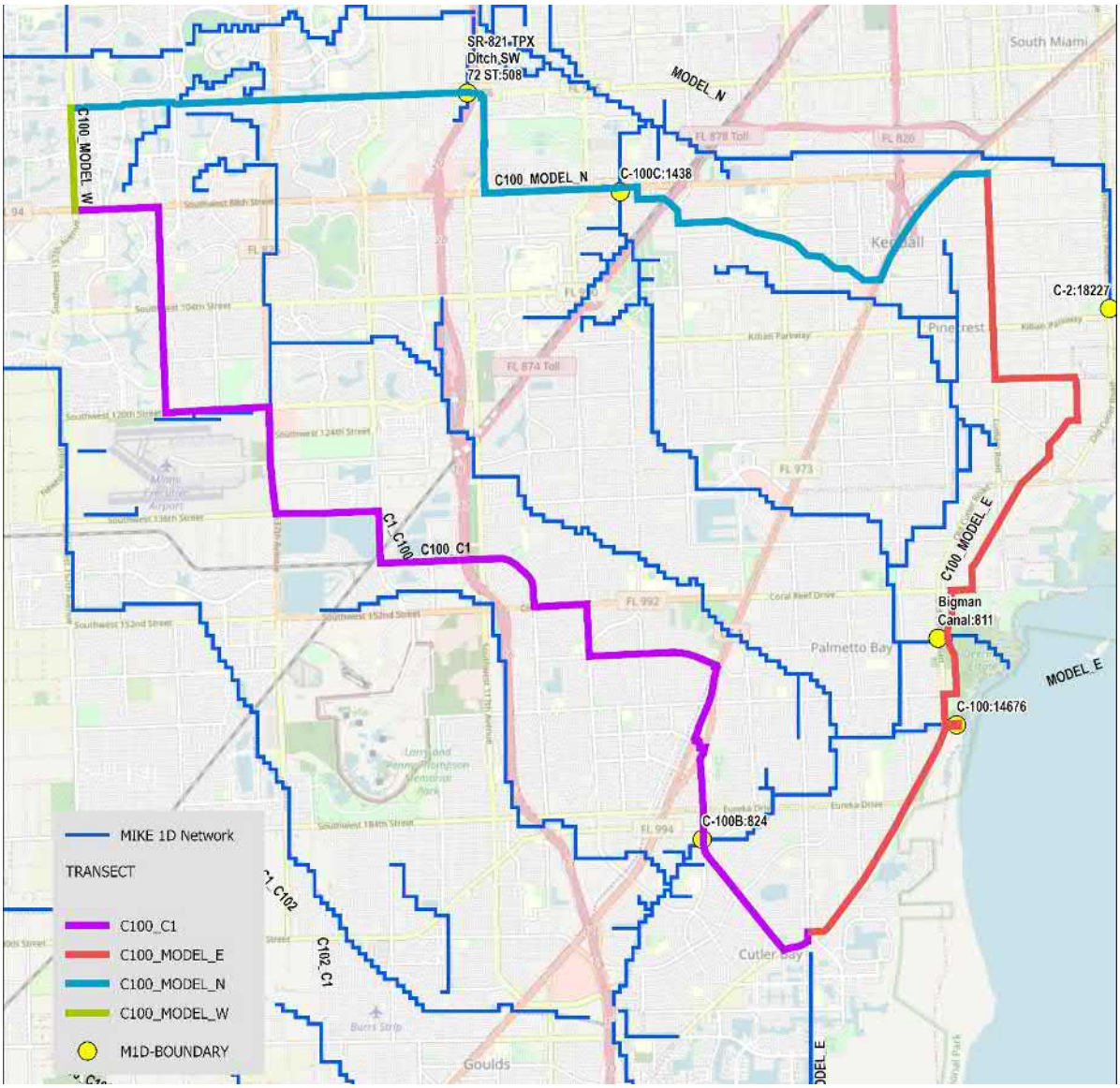


Figure 524 Locations of Transect Flows in Watershed C-100 and Location of Mike 1D Canals Crossing Watershed Boundaries

A global C-100 Watershed summary (inflow, outflow and storage change) is provided in Table 320 through Table 323.

Table 320 Global C-100 Watershed Summary, 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	35.184	36.200	38.022	43.737
Outflows (kAF)	-41.817	-40.870	-39.918	-42.276
Storage Change (kAF)	6.607	4.671	1.907	-1.427
Difference (kAF)	**-0.027**	**0.001**	**0.012**	**0.034**
Inflow Rainfall is 17.042 kAF Negative values of outflows refer to water leaving control volume				

Table 321 Global C-100 Watershed Summary, 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	38.912	39.955	41.974	47.705
Outflows (kAF)	-45.422	-44.521	-43.771	-46.189
Storage Change (kAF)	6.495	4.577	1.832	-1.458
Difference (kAF)	**-0.015**	**0.012**	**0.035**	**0.058**
Inflow Rainfall is 20.599 kAF Negative values of outflows refer to water leaving control volume				

Table 322 Global C-100 Watershed Summary, 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	44.707	42.935	47.618	52.827
Outflows (kAF)	-51.073	-43.975	-49.299	-51.233
Storage Change (kAF)	6.372	1.037	1.742	-1.505
Difference (kAF)	**0.006**	**-0.004**	**0.061**	**0.089**
Inflow Rainfall is 25.886 kAF Negative values of outflows refer to water leaving control volume				

Table 323 Global C-100 Watershed Summary, 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	54.442	54.148	57.147	62.024
Outflows (kAF)	-60.551	-55.447	-58.642	-60.325
Storage Change (kAF)	6.193	1.284	1.606	-1.555
Difference (kAF)	**0.084**	**-0.015**	**0.111**	**0.144**
Inflow Rainfall is 35.150 kAF Negative values of outflows refer to water leaving control volume				

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in Table 324 through Table 327 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 324 Summary of all Inflows, Outflows and Storage Change for the C-100 Watershed (all data in kAF), 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	17.042	17.042	17.042	17.042
Evapotranspiration	-2.157	-2.204	-2.295	-2.483
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.001	0.006	0.052	0.322
OL-Boundary Outflow	-0.003	-0.004	-0.015	-0.183
OL-Storage change	0.218	-0.045	-0.453	-0.775
OL to river	-3.260	-3.689	-3.956	-5.301
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	11.733	12.639	12.839	13.324
SZ-Boundary Outflow	-8.987	-7.927	-7.657	-8.762
SZ-Storage change	5.672	3.886	1.358	-1.966
Pumping	-15.859	-15.859	-15.859	-15.859
SZ Drain to river	-1.629	-1.965	-2.759	-4.732
SZ Drain to ext river	-0.016	-0.019	-0.027	-0.046
Base flow to River	-9.907	-9.204	-7.350	-4.912
Base flow from River	6.408	6.513	8.090	13.049
Difference:	**-0.027**	**0.001**	**0.012**	**0.034**
Difference	**-0.1%**	**0.0%**	**0.0%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 325 Summary of all Inflows, Outflows and Storage Change for the C-100 Watershed (all data in kAF), 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	20.599	20.599	20.599	20.599
Evapotranspiration	-2.226	-2.278	-2.381	-2.589
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.019	0.033	0.102	0.394
OL-Boundary Outflow	-0.012	-0.020	-0.063	-0.340
OL-Storage change	0.199	-0.065	-0.471	-0.785
OL to river	-4.828	-5.555	-6.167	-7.542
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	11.823	12.720	12.996	13.628
SZ-Boundary Outflow	-9.518	-8.507	-8.352	-9.535
SZ-Storage change	5.587	3.823	1.304	-1.994
Pumping	-15.859	-15.859	-15.859	-15.859
SZ Drain to river	-1.932	-2.301	-3.159	-5.201
SZ Drain to ext river	-0.028	-0.033	-0.041	-0.062
Base flow to River	-11.019	-9.969	-7.751	-5.061
Base flow from River	6.471	6.603	8.277	13.083
Difference:	**-0.015**	**0.012**	**0.035**	**0.058**
Difference	**0.0%**	**0.0%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 326 Summary of all Inflows, Outflows and Storage Change for the C-100 Watershed (all data in kAF), 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	25.886	25.886	25.886	25.886
Evapotranspiration	-2.323	-2.291	-2.488	-2.689
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.106	0.100	0.218	0.548
OL-Boundary Outflow	-0.070	-0.066	-0.274	-0.724
OL-Storage change	0.177	0.187	-0.494	-0.798
OL to river	-8.153	-8.368	-9.781	-11.018
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	12.079	9.533	13.110	13.374
SZ-Boundary Outflow	-10.363	-8.807	-9.207	-9.939
SZ-Storage change	5.487	0.051	1.230	-2.014
Pumping	-15.859	-13.495	-15.859	-15.859
SZ Drain to river	-2.381	-0.065	-3.751	-5.870
SZ Drain to ext river	-0.045	-0.001	-0.061	-0.085
Base flow to River	-11.877	-10.883	-7.877	-5.050
Base flow from River	6.636	7.417	8.404	13.019
Difference:	**0.006**	**-0.004**	**0.061**	**0.089**
Difference	**0.0%**	**0.0%**	**0.1%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 327 Summary of all Inflows, Outflows and Storage Change for the C-100 Watershed (all data in kAF), 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	35.150	35.150	35.150	35.150
Evapotranspiration	-2.460	-2.414	-2.641	-2.853
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.333	0.354	0.507	0.866
OL-Boundary Outflow	-0.485	-0.507	-1.026	-1.744
OL-Storage change	0.145	0.225	-0.522	-0.810
OL to river	-14.840	-15.695	-16.123	-16.749
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	12.237	10.613	12.983	13.312
SZ-Boundary Outflow	-11.588	-9.810	-10.271	-10.978
SZ-Storage change	5.344	0.285	1.121	-2.044
Pumping	-15.859	-15.859	-15.859	-15.859
SZ Drain to river	-3.194	-0.091	-4.766	-7.007
SZ Drain to ext river	-0.073	-0.001	-0.092	-0.120
Base flow to River	-12.052	-11.070	-7.864	-5.015
Base flow from River	6.722	8.030	8.508	12.696
Difference:	**0.084**	**-0.015**	**0.111**	**0.144**
Difference	**0.2%**	**0.0%**	**0.2%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				

The summary shows that the Difference is within 2% except for the calibration period, which also showed larger differences also in comparing transect flows.

A summary of OL transect flows for each event and for change of SLR is provided in Table 328 through Table 331:

Table 328 Summary of Transect OL Flows for the C-100 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-OL	0.000	0.000	0.004	-0.033
C1_MODEL_W-OL	-0.002	0.003	0.038	0.145
C1_MODEL_E-OL	0.000	0.000	-0.005	0.026
Transect OL Flows	**-0.002**	**0.002**	**0.036**	**0.138**

Table 329 Summary of Transect OL Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-OL	0.000	0.019	0.019	-0.073
C1_MODEL_W-OL	-0.002	0.003	0.045	0.150
C1_MODEL_E-OL	0.000	-0.010	-0.025	-0.024
Transect OL Flows	**-0.002**	**0.013**	**0.039**	**0.053**

Table 330 Summary of Transect OL Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-OL	0.068	0.051	-0.007	-0.170
C1_MODEL_W-OL	0.004	0.008	0.057	0.145
C1_MODEL_E-OL	-0.036	-0.024	-0.108	-0.153
Transect OL Flows	**0.036**	**0.034**	**-0.057**	**-0.179**

Table 331 Summary of Transect OL Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-OL	0.051	0.028	-0.150	-0.340
C1_MODEL_W-OL	0.028	0.045	0.068	0.116
C1_MODEL_E-OL	-0.230	-0.248	-0.436	-0.656
Transect OL Flows	**-0.152**	**-0.178**	**-0.521**	**-0.883**

A summary of SZ transect flows for each event and for change of SLR is provided in Table 332 through Table 335

Table 332 Summary of Transect SZ Flows for the C-100 Watershed (all data in kAF), 5-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SZ1	0.050	0.022	-0.057	-0.103
C100_C1-SZ2	0.614	0.299	-0.476	-0.835
C100_C1-SZ3	0.336	0.191	-0.198	-0.380
C100_C1-SZ4	0.060	0.041	-0.014	-0.041
C100_C1-SZ5	0.002	0.001	-0.001	-0.002
C1_MODEL_W-SZ1	-0.014	0.034	0.083	0.104
C1_MODEL_W-SZ2	-0.037	0.559	1.138	1.327
C1_MODEL_W-SZ3	0.004	0.094	0.186	0.216
C1_MODEL_W-SZ4	0.003	0.006	0.009	0.009
C1_MODEL_W-SZ5	0.000	0.000	0.000	0.000
C1_MODEL_E-SZ1	0.241	0.371	0.472	0.493
C1_MODEL_E-SZ2	0.901	1.854	2.526	2.397
C1_MODEL_E-SZ3	0.685	1.093	1.352	1.296
C1_MODEL_E-SZ4	0.159	0.224	0.264	0.251
C1_MODEL_E-SZ5	0.005	0.008	0.009	0.009
C1_C102-SZ1	-0.013	-0.004	-0.007	-0.013
C1_C102-SZ2	-0.119	-0.029	-0.056	-0.104
C1_C102-SZ3	-0.063	-0.015	-0.030	-0.056
C1_C102-SZ4	-0.006	-0.002	-0.003	-0.006
C1_C102-SZ5	-0.001	0.000	0.000	-0.001
Sum:	**2.806**	**4.747**	**5.194**	**4.562**

Table 333 Summary of Transect SZ Flows for the C-100 Watershed (all data in kAF), 10-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SZ1	0.050	0.027	-0.052	-0.095
C100_C1-SZ2	0.612	0.338	-0.427	-0.769
C100_C1-SZ3	0.335	0.198	-0.186	-0.359
C100_C1-SZ4	0.060	0.042	-0.013	-0.038
C100_C1-SZ5	0.002	0.001	-0.001	-0.002
C1_MODEL_W-SZ1	-0.012	0.016	0.064	0.087
C1_MODEL_W-SZ2	-0.013	0.362	0.940	1.154
C1_MODEL_W-SZ3	0.008	0.061	0.152	0.187

C1_MODEL_W-SZ4	0.003	0.004	0.007	0.008
C1_MODEL_W-SZ5	0.000	0.000	0.000	0.000
C1_MODEL_E-SZ1	0.243	0.357	0.451	0.469
C1_MODEL_E-SZ2	0.915	1.676	2.312	2.188
C1_MODEL_E-SZ3	0.691	1.027	1.272	1.216
C1_MODEL_E-SZ4	0.160	0.213	0.251	0.238
C1_MODEL_E-SZ5	0.005	0.007	0.009	0.008
C1_C102-SZ1	-0.013	-0.006	-0.009	-0.015
C1_C102-SZ2	-0.118	-0.047	-0.071	-0.116
C1_C102-SZ3	-0.063	-0.025	-0.038	-0.062
C1_C102-SZ4	-0.006	-0.003	-0.004	-0.007
C1_C102-SZ5	-0.001	0.000	0.000	-0.001
Sum:	**2.859**	**4.248**	**4.658**	**4.093**

Table 334 Summary of Transect SZ Flows for the C-100 Watershed (all data in kAF), 25-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C100_C1-SZ1	0.061	0.055	-0.045	-0.088
C100_C1-SZ2	0.683	0.611	-0.371	-0.708
C100_C1-SZ3	0.345	0.336	-0.172	-0.341
C100_C1-SZ4	0.061	0.060	-0.011	-0.036
C100_C1-SZ5	0.001	0.002	-0.001	-0.002
C1_MODEL_W-SZ1	-0.049	-0.088	0.040	0.064
C1_MODEL_W-SZ2	-0.425	-0.981	0.676	0.913
C1_MODEL_W-SZ3	-0.063	-0.157	0.108	0.146
C1_MODEL_W-SZ4	0.001	-0.004	0.006	0.007
C1_MODEL_W-SZ5	0.000	0.000	0.000	0.000
C1_MODEL_E-SZ1	0.213	0.215	0.420	0.435
C1_MODEL_E-SZ2	0.527	0.359	2.025	1.932
C1_MODEL_E-SZ3	0.550	0.485	1.162	1.115
C1_MODEL_E-SZ4	0.137	0.119	0.233	0.222
C1_MODEL_E-SZ5	0.005	0.004	0.008	0.008
C1_C102-SZ1	-0.019	-0.017	-0.012	-0.018
C1_C102-SZ2	-0.160	-0.143	-0.092	-0.133
C1_C102-SZ3	-0.085	-0.076	-0.049	-0.072
C1_C102-SZ4	-0.009	-0.008	-0.005	-0.007

C1_C102-SZ5	-0.001	-0.001	0.000	-0.001
Sum:	**1.775**	**0.774**	**3.917**	**3.436**

Table 335 Summary of Transect SZ Flows for the C-100 Watershed (all data in kAF), 100-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C100_C1-SZ1	0.066	0.060	-0.041	-0.080
C100_C1-SZ2	0.691	0.635	-0.342	-0.653
C100_C1-SZ3	0.334	0.330	-0.170	-0.323
C100_C1-SZ4	0.060	0.060	-0.010	-0.033
C100_C1-SZ5	0.001	0.001	-0.002	-0.002
C1_MODEL_W-SZ1	-0.080	-0.118	0.004	0.030
C1_MODEL_W-SZ2	-0.758	-1.291	0.295	0.571
C1_MODEL_W-SZ3	-0.120	-0.211	0.043	0.088
C1_MODEL_W-SZ4	-0.002	-0.006	0.003	0.005
C1_MODEL_W-SZ5	0.000	0.000	0.000	0.000
C1_MODEL_E-SZ1	0.170	0.163	0.365	0.374
C1_MODEL_E-SZ2	0.155	-0.060	1.589	1.488
C1_MODEL_E-SZ3	0.407	0.321	0.993	0.941
C1_MODEL_E-SZ4	0.114	0.093	0.206	0.194
C1_MODEL_E-SZ5	0.004	0.003	0.007	0.007
C1_C102-SZ1	-0.024	-0.026	-0.018	-0.023
C1_C102-SZ2	-0.196	-0.200	-0.126	-0.161
C1_C102-SZ3	-0.104	-0.107	-0.067	-0.086
C1_C102-SZ4	-0.011	-0.011	-0.007	-0.009
C1_C102-SZ5	-0.001	-0.001	-0.001	-0.001
Sum:	**0.705**	**-0.364**	**2.722**	**2.330**

A summary of Mike 1D flows in the transect for each event and for change of SLR is provided in

Table 336 through Table 339 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 336 Summary of Transect Mike 1D Flows for the C-100 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.003	0.001	0.000	-0.009
C1_MODEL_W-SUM-OC-FLOW	-10.476	-10.531	-8.367	-4.603
C1_MODEL_E-SUM-OC-FLOW	-6.634	-8.918	-10.335	-9.650
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-17.107**	**-19.448**	**-18.702**	**-14.262**

Table 337 Summary of Transect Mike 1D Flows for the C-100 Watershed (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.003	0.002	-0.001	-0.021
C1_MODEL_W-SUM-OC-FLOW	-10.522	-13.317	-11.090	-7.293
C1_MODEL_E-SUM-OC-FLOW	-6.709	-9.329	-10.647	-9.743
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-17.228**	**-22.643**	**-21.738**	**-17.057**

Table 338 Summary of Transect Mike 1D Flows for the C-100 Watershed (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	0.006	0.001	-0.008	-0.070
C1_MODEL_W-SUM-OC-FLOW	-17.630	-13.483	-15.133	-11.167
C1_MODEL_E-SUM-OC-FLOW	-8.067	-2.099	-11.101	-9.725
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-25.691**	**-15.580**	**-26.241**	**-20.962**

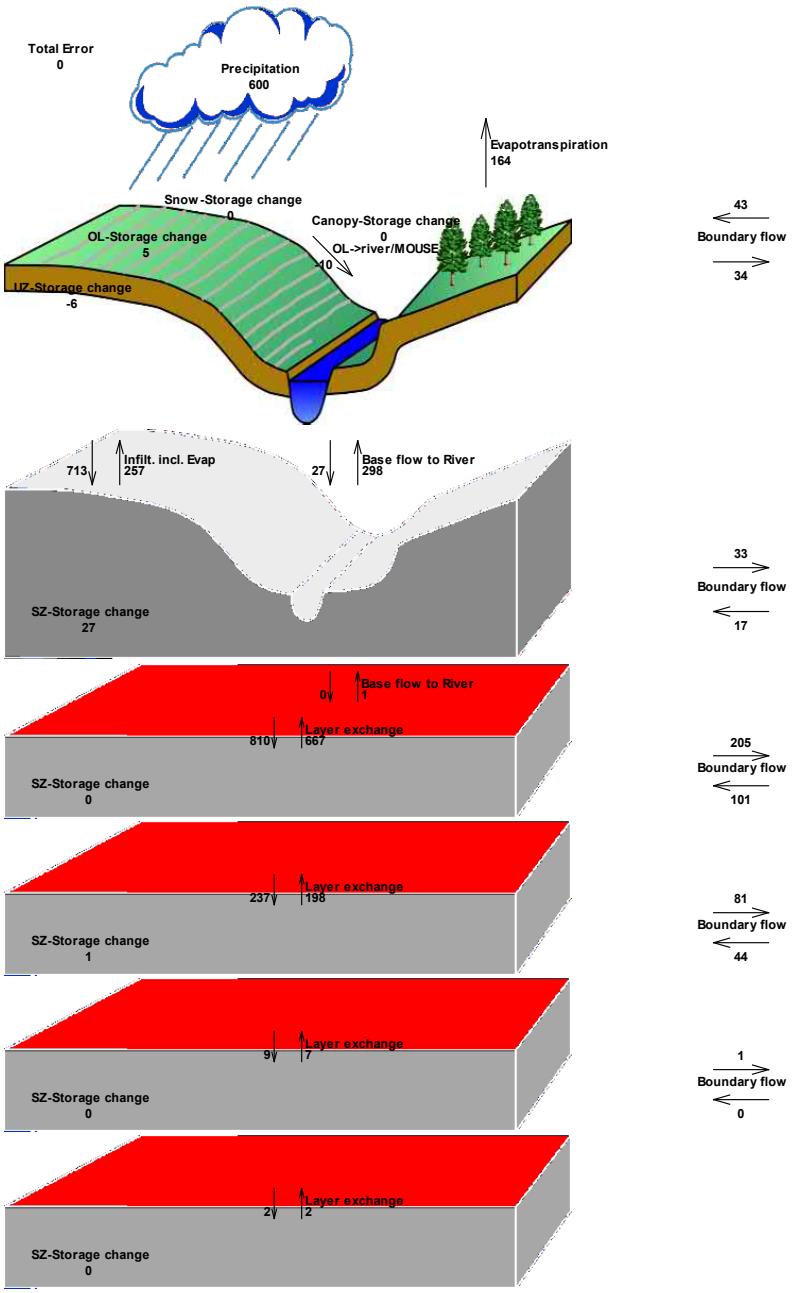
Table 339 Summary of Transect Mike 1D Flows for the C-100 Watershed (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C100_C1-SUM-OC-FLOW	-0.002	-0.005	-0.063	-0.106
C1_MODEL_W-SUM-OC-FLOW	-24.998	-20.863	-21.871	-17.714

C1_MODEL_E-SUM-OC-FLOW	-9.664	-3.807	-12.039	-10.140
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
Sum:	**-34.663**	**-24.675**	**-33.974**	**-27.960**

6.6.4 Watershed C-102

The water balance over the C-102 Watershed in inches is summarized for all simulation events. MIKE 1D items treated as boundary flows and include Base flow from/to River, OL to River, and SZ Drain to/from River. The exchange of OL and River is reported as OL->river/MOUSE (MOUSE is a Urban Drainage Tool).



Accumulated waterbalance from 8/15/2017 to 10/15/2017. Data type : Storage depth [millimeter].
Flow Result File : Z:\2021-SFWMD-SMD\2021-06-01-SMD\Result\CAL_2017_130.she - Result Files\CAL_2017_130
Title : Text :

Figure 525 C-102 Watershed Water Budget Reported by DHI's Water Balance Tool

The Mike 1D boundaries within Watershed C-102 are listed in Table 340.

Table 340 Location of Mike 1D Boundaries of Watershed C-102

Canal	Chainage	Q_Direction (chainage Increasing)
L-31 Canal A	1539	INFLOW

L-31 Canal B	3180	OUTFLOW
C-100C	1438	INFLOW
C-102	5429	INFLOW
C-102	24071.4	OUTFLOW

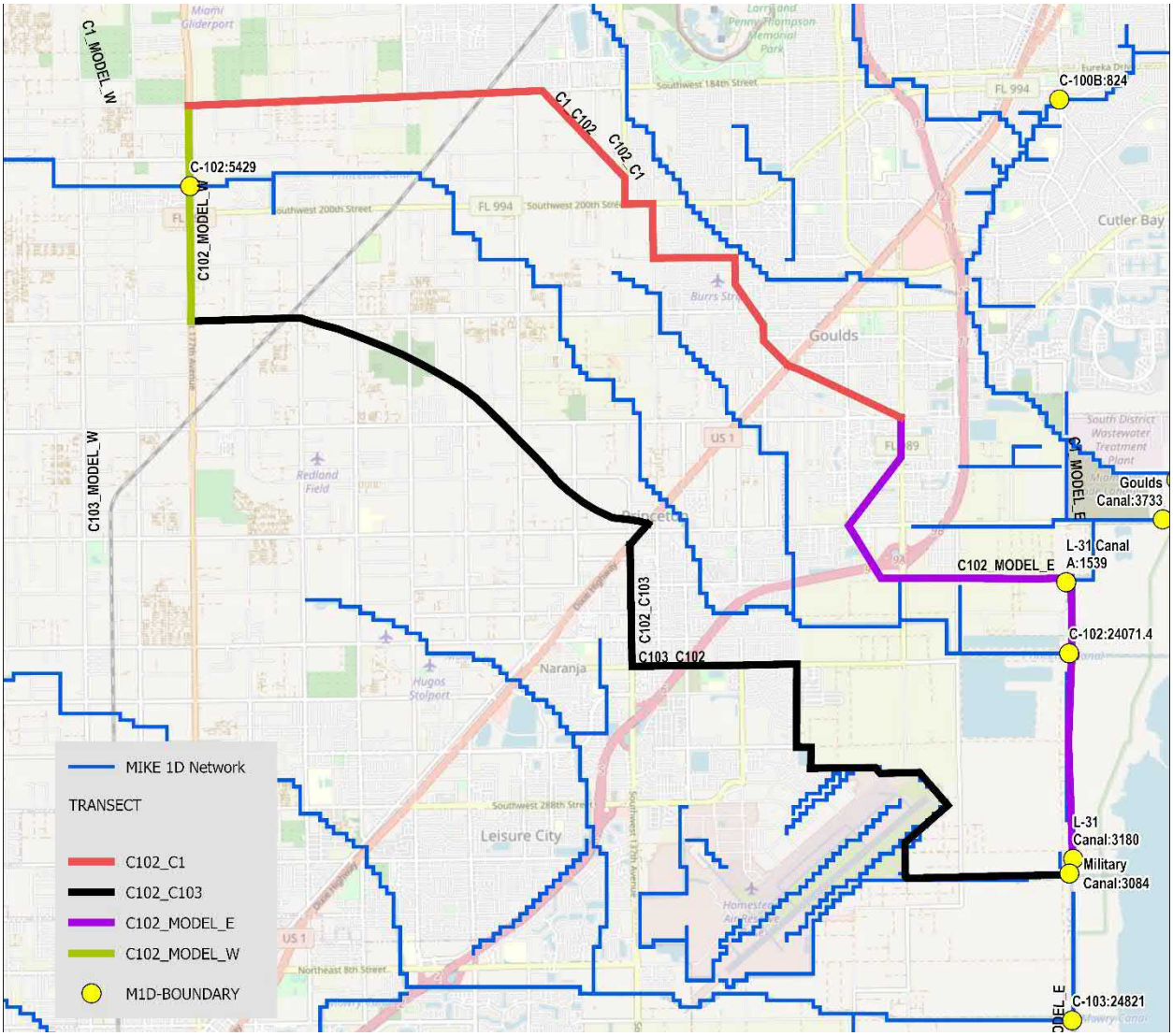


Figure 526 Locations of Transect Flows in Watershed C-102 and Location of Mike 1D Canals Crossing Watershed Boundaries

A global C-102 Watershed summary (inflow, outflow and storage change) is provided in Table 341 through Table 344 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 341 Global C-102 Watershed Summary, 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	16.821	20.477	26.499	38.843

Outflows (kAF)	-19.529	-22.385	-27.282	-38.219
Storage Change (kAF)	2.731	1.942	0.819	-0.579
Difference (kAF)	**0.023**	**0.034**	**0.035**	**0.045**
Inflow Rainfall is 10.096 kAF Negative values of outflows refer to water leaving control volume				

Table 342 Global C-102 Watershed Summary, 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	16.975	23.082	29.322	42.188
Outflows (kAF)	-19.680	-24.918	-30.031	-41.516
Storage Change (kAF)	2.731	1.872	0.752	-0.616
Difference (kAF)	**0.027**	**0.037**	**0.043**	**0.056**
Inflow Rainfall is 12.212 kAF Negative values of outflows refer to water leaving control volume				

Table 343 Global C-102 Watershed Summary, 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	23.579	23.597	33.710	47.285
Outflows (kAF)	-26.110	-23.622	-34.326	-46.533
Storage Change (kAF)	2.574	0.027	0.676	-0.691
Difference (kAF)	**0.044**	**0.002**	**0.061**	**0.062**
Inflow Rainfall is 15.367 kAF Negative values of outflows refer to water leaving control volume				

Table 344 Global C-102 Watershed Summary, 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	31.186	30.671	41.540	55.762
Outflows (kAF)	-33.575	-30.730	-42.042	-54.880
Storage Change (kAF)	2.464	0.059	0.578	-0.795
Difference (kAF)	**0.074**	**0.000**	**0.075**	**0.087**
Inflow Rainfall is 20.912 kAF Negative values of outflows refer to water leaving control volume				

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in Table 345 through Table 348 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 345 Summary of all Inflows, Outflows and Storage Change for the C-102 Watershed (all data in kAF), 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft

Precipitation	10.096	10.096	10.096	10.096
Evapotranspiration	-2.825	-2.909	-3.214	-3.432
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.552	3.141	9.416	21.789
OL-Boundary Outflow	-0.441	-1.984	-6.694	-17.472
OL-Storage change	3.672	-0.399	-0.821	-1.169
OL to river	-0.224	-1.817	-2.320	-3.442
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	6.111	6.490	5.990	5.501
SZ-Boundary Outflow	-9.502	-7.657	-8.323	-8.288
SZ-Storage change	1.975	1.522	0.769	-0.345
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-0.208	-0.182	-0.285	-0.528
SZ Drain to ext river	-0.009	-0.007	-0.007	-0.009
Base flow to River	-10.457	-7.829	-6.440	-5.048
Base flow from River	0.519	0.751	0.998	1.457
Difference:	**0.030**	**0.034**	**0.035**	**0.045**
Difference	**0.20%**	**0.2%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 346 Summary of all Inflows, Outflows and Storage Change for the C-102 Watershed (all data in kAF), 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	12.212	12.212	12.212	12.212
Evapotranspiration	-2.659	-2.983	-3.272	-3.482
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	0.492	3.581	10.014	22.980
OL-Boundary Outflow	-0.358	-2.547	-7.595	-19.234
OL-Storage change	-0.037	-0.406	-0.828	-1.172
OL to river	0.127	-2.613	-3.294	-4.333
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	5.798	6.504	6.068	5.537
SZ-Boundary Outflow	-7.973	-8.260	-8.775	-8.664
SZ-Storage change	1.978	1.475	0.727	-0.363
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-0.142	-0.238	-0.345	-0.589
SZ Drain to ext river	-0.007	-0.008	-0.009	-0.010
Base flow to River	-8.669	-8.269	-6.742	-5.204
Base flow from River	0.589	0.785	1.027	1.459
Difference:	**0.027**	**0.037**	**0.043**	**0.056**
Difference	**0.2%**	**0.2%**	**0.1%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 347 Summary of all Inflows, Outflows and Storage Change for the C-102 Watershed (all data in kAF), 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	15.367	15.367	15.367	15.367

Evapotranspiration	-2.828	-2.773	-3.339	-3.542
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1.414	1.547	11.118	24.539
OL-Boundary Outflow	-1.294	-1.496	-9.423	-22.625
OL-Storage change	-0.048	-0.264	-0.839	-1.191
OL to river	-2.507	-1.584	-4.782	-5.095
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	6.168	5.565	6.179	5.896
SZ-Boundary Outflow	-9.514	-8.261	-9.421	-9.380
SZ-Storage change	1.873	-0.553	0.682	-0.407
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-0.268	0.000	-0.426	-0.671
SZ Drain to ext river	-0.010	0.000	-0.011	-0.012
Base flow to River	-9.689	-9.509	-6.923	-5.208
Base flow from River	0.629	1.118	1.046	1.483
Difference:	**0.044**	**0.002**	**0.061**	**0.062**
Difference	**0.2%**	**0.0%**	**0.2%**	**0.1%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 348 Summary of all Inflows, Outflows and Storage Change for the C-102 Watershed (all data in kAF), 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	20.912	20.912	20.912	20.912
Evapotranspiration	-2.943	-2.895	-3.420	-3.610
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	2.986	3.152	13.163	26.937
OL-Boundary Outflow	-3.617	-3.953	-12.666	-25.966
OL-Storage change	-0.059	-0.266	-0.858	-1.230
OL to river	-5.816	-4.680	-8.394	-9.719
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	6.594	5.479	6.406	6.393
SZ-Boundary Outflow	-10.665	-9.423	-10.020	-9.554
SZ-Storage change	1.794	-0.499	0.622	-0.452
Pumping	0.000	0.000	0.000	0.000
SZ Drain to river	-0.376	0.000	-0.538	-0.781
SZ Drain to ext river	-0.013	0.000	-0.014	-0.015
Base flow to River	-10.146	-9.779	-6.990	-5.234
Base flow from River	0.693	1.128	1.059	1.520
Difference:	**0.074**	**0.000**	**0.075**	**0.087**
Difference	**0.2%**	**0.0%**	**0.2%**	**0.2%**
**Design Events Cover 9/1/2017-10/05/2017				

The summary shows that the Difference is within 2% except for the calibration period, which also showed larger differences also in comparing transect flows.

A summary of OL transect flows for each event and for change of SLR is provided in Table 349 through Table 352 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 349 Summary of Transect OL Flows for the C-102 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	0.005	-0.229	-0.817	-1.219
C102_MODEL_E-OL	0.048	1.382	3.535	5.566
C1_C102-OL	0.007	0.007	0.008	0.011
Transect OL Flows	**0.058**	**1.159**	**2.725**	**4.354**

Table 350 Summary of Transect OL Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.005	-0.244	-0.798	-1.402
C102_MODEL_E-OL	0.133	1.267	3.220	5.200
C1_C102-OL	0.006	0.027	0.025	0.022
Transect OL Flows	**0.134**	**1.034**	**2.420**	**3.778**

Table 351 Summary of Transect OL Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.026	-0.011	-0.804	-2.567
C102_MODEL_E-OL	0.190	0.100	2.562	4.642
C1_C102-OL	0.054	0.042	0.040	0.028
Transect OL Flows	**0.106**	**0.040**	**1.683**	**1.934**

Table 352 Summary of Transect OL Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	0.012	-0.054	-0.611	-2.046
C102_MODEL_E-OL	-0.155	-0.273	1.743	3.840
C1_C102-OL	0.031	0.011	0.002	-0.011
Transect OL Flows	**-0.646**	**-0.802**	**0.489**	**1.002**

A summary of SZ transect flows for each event and for change of SLR is provided in Table 353 through Table 356 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 353 Summary of Transect SZ Flows for the C-102 Watershed (all data in kAF), 5-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SZ1	-0.092	-0.140	-0.236	-0.236

C102_C103-SZ2	-0.471	-0.731	-1.052	-1.061
C102_C103-SZ3	-0.177	-0.279	-0.420	-0.432
C102_C103-SZ4	-0.002	-0.002	-0.003	-0.004
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.199	0.048	0.044	-0.011
C102_MODEL_E-SZ2	-0.927	0.023	0.048	-0.103
C102_MODEL_E-SZ3	-0.340	0.021	0.027	-0.032
C102_MODEL_E-SZ4	-0.005	0.000	0.000	0.000
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.042	-0.051	-0.080	-0.076
C1_C102-SZ2	-0.493	-0.580	-0.873	-0.785
C1_C102-SZ3	-0.162	-0.198	-0.331	-0.304
C1_C102-SZ4	-0.005	-0.005	-0.008	-0.007
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.065	0.062	0.046	0.020
C102_MODEL_W-SZ2	0.439	0.422	0.315	0.149
C102_MODEL_W-SZ3	0.258	0.248	0.185	0.087
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.001
C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-2.149**	**-1.158**	**-2.334**	**-2.794**

Table 354 Summary of Transect SZ Flows for the C-102 Watershed (all data in kAF), 10-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C102_C103-SZ1	-0.095	-0.130	-0.213	-0.222
C102_C103-SZ2	-0.483	-0.682	-0.940	-0.983
C102_C103-SZ3	-0.183	-0.259	-0.376	-0.400
C102_C103-SZ4	-0.002	-0.002	-0.003	-0.003
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.196	0.008	0.013	-0.037
C102_MODEL_E-SZ2	-0.916	-0.128	-0.067	-0.196
C102_MODEL_E-SZ3	-0.336	-0.034	-0.015	-0.066
C102_MODEL_E-SZ4	-0.005	0.000	0.000	-0.001
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.042	-0.074	-0.100	-0.093
C1_C102-SZ2	-0.494	-0.766	-1.032	-0.914

C1_C102-SZ3	-0.163	-0.275	-0.396	-0.356
C1_C102-SZ4	-0.005	-0.007	-0.009	-0.008
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.064	0.048	0.033	0.007
C102_MODEL_W-SZ2	0.437	0.345	0.246	0.082
C102_MODEL_W-SZ3	0.256	0.203	0.145	0.049
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.001
C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-2.159**	**-1.752**	**-2.713**	**-3.139**

Table 355 Summary of Transect SZ Flows for the C-102 Watershed (all data in kAF), 25-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C102_C103-SZ1	-0.079	-0.072	-0.196	-0.203
C102_C103-SZ2	-0.387	-0.374	-0.848	-0.874
C102_C103-SZ3	-0.143	-0.133	-0.339	-0.357
C102_C103-SZ4	-0.001	-0.001	-0.003	-0.003
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.269	-0.303	-0.038	-0.074
C102_MODEL_E-SZ2	-1.198	-1.278	-0.252	-0.330
C102_MODEL_E-SZ3	-0.438	-0.473	-0.085	-0.117
C102_MODEL_E-SZ4	-0.006	-0.006	-0.001	-0.001
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.093	-0.046	-0.125	-0.113
C1_C102-SZ2	-0.906	-0.458	-1.217	-1.066
C1_C102-SZ3	-0.332	-0.121	-0.472	-0.419
C1_C102-SZ4	-0.008	-0.004	-0.011	-0.009
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.039	0.046	0.023	-0.001
C102_MODEL_W-SZ2	0.301	0.340	0.193	0.039
C102_MODEL_W-SZ3	0.178	0.200	0.115	0.025
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.000
C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-3.339**	**-2.680**	**-3.254**	**-3.501**

Table 356 Summary of Transect SZ Flows for the C-102 Watershed (all data in kAF), 100-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SZ1	-0.065	-0.074	-0.147	-0.088
C102_C103-SZ2	-0.292	-0.361	-0.612	-0.350
C102_C103-SZ3	-0.106	-0.126	-0.243	-0.147
C102_C103-SZ4	-0.001	-0.001	-0.002	-0.002
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.333	-0.373	-0.099	-0.112
C102_MODEL_E-SZ2	-1.435	-1.531	-0.477	-0.473
C102_MODEL_E-SZ3	-0.526	-0.566	-0.169	-0.170
C102_MODEL_E-SZ4	-0.007	-0.008	-0.002	-0.002
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.129	-0.082	-0.153	-0.136
C1_C102-SZ2	-1.177	-0.745	-1.431	-1.232
C1_C102-SZ3	-0.444	-0.240	-0.561	-0.489
C1_C102-SZ4	-0.010	-0.007	-0.012	-0.011
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.034	0.041	0.018	-0.004
C102_MODEL_W-SZ2	0.266	0.305	0.164	0.021
C102_MODEL_W-SZ3	0.159	0.181	0.100	0.015
C102_MODEL_W-SZ4	0.001	0.001	0.001	0.000
C102_MODEL_W-SZ5	0.000	0.001	0.000	0.000
Sum:	**-4.066**	**-3.584**	**-3.627**	**-3.180**

A summary of Mike 1D flows in the transect for each event and for change of SLR is provided in Table 357 through Table 360 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 357 Summary of Transect Mike 1D Flows for the C-102 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-27.866	-24.371	-31.788	-42.403
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.283	0.283	0.263	0.242
Sum:	**-27.582**	**-24.088**	**-31.525**	**-42.160**

Table 358 Summary of Transect Mike 1D Flows for the C-102 Watershed (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-28.125	-26.378	-32.931	-42.575
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.283	0.348	0.327	0.308
Sum:	**-27.842**	**-26.029**	**-32.603**	**-42.267**

Table 359 Summary of Transect Mike 1D Flows for the C-102 Watershed (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-33.258	-26.213	-34.134	-43.199
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.477	0.415	0.461	0.423
Sum:	**-32.780**	**-25.798**	**-33.673**	**-42.776**

Table 360 Summary of Transect Mike 1D Flows for the C-102 Watershed (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-38.240	-29.513	-36.712	-44.846
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.512	0.475	0.400	0.271
Sum:	**-37.728**	**-29.038**	**-36.311**	**-44.575**

6.6.5 Watershed C-103

The water balance over the C-103 Watershed in inches is summarized for all simulation events. MIKE 1D items treated as boundary flows and include Base flow from/to River, OL to River, and SZ Drain to/from River. The exchange of OL and River is reported as OL->river/MOUSE (MOUSE is a Urban Drainage Tool).

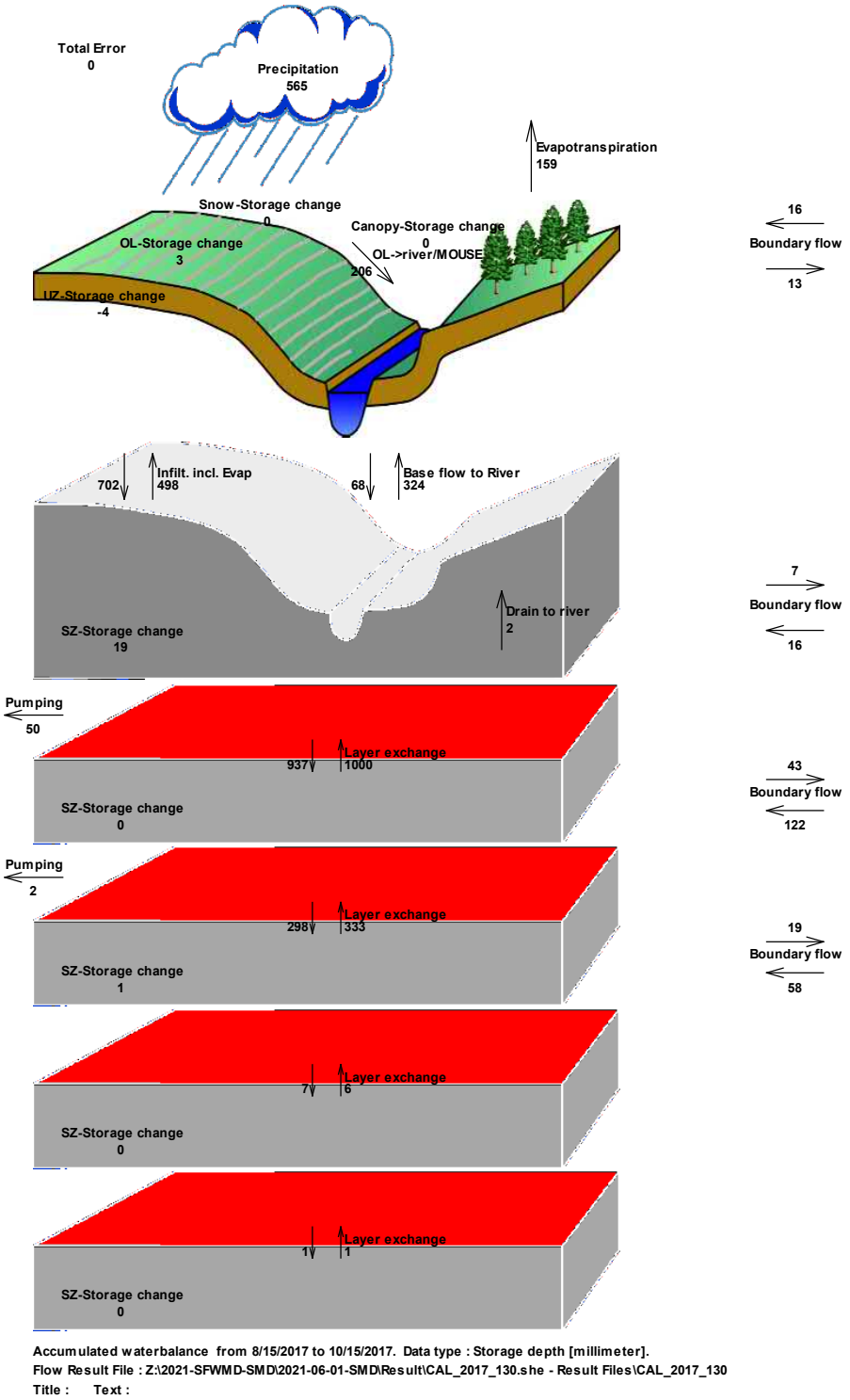


Figure 527 C-103 Watershed Water Budget Reported by DHI's Water Balance Tool

The Mike 1D boundaries within Watershed C-103 are listed in Table 361.

Table 361 Location of Mike 1D Boundaries

Canal	Chainage	Q_Direction (chainage Increasing)
C-103	4990	INFLOW
SW 137Ave Model Lands	1376	OUTFLOW
Military Canal	3084	OUTFLOW
C-103	24821	OUTFLOW

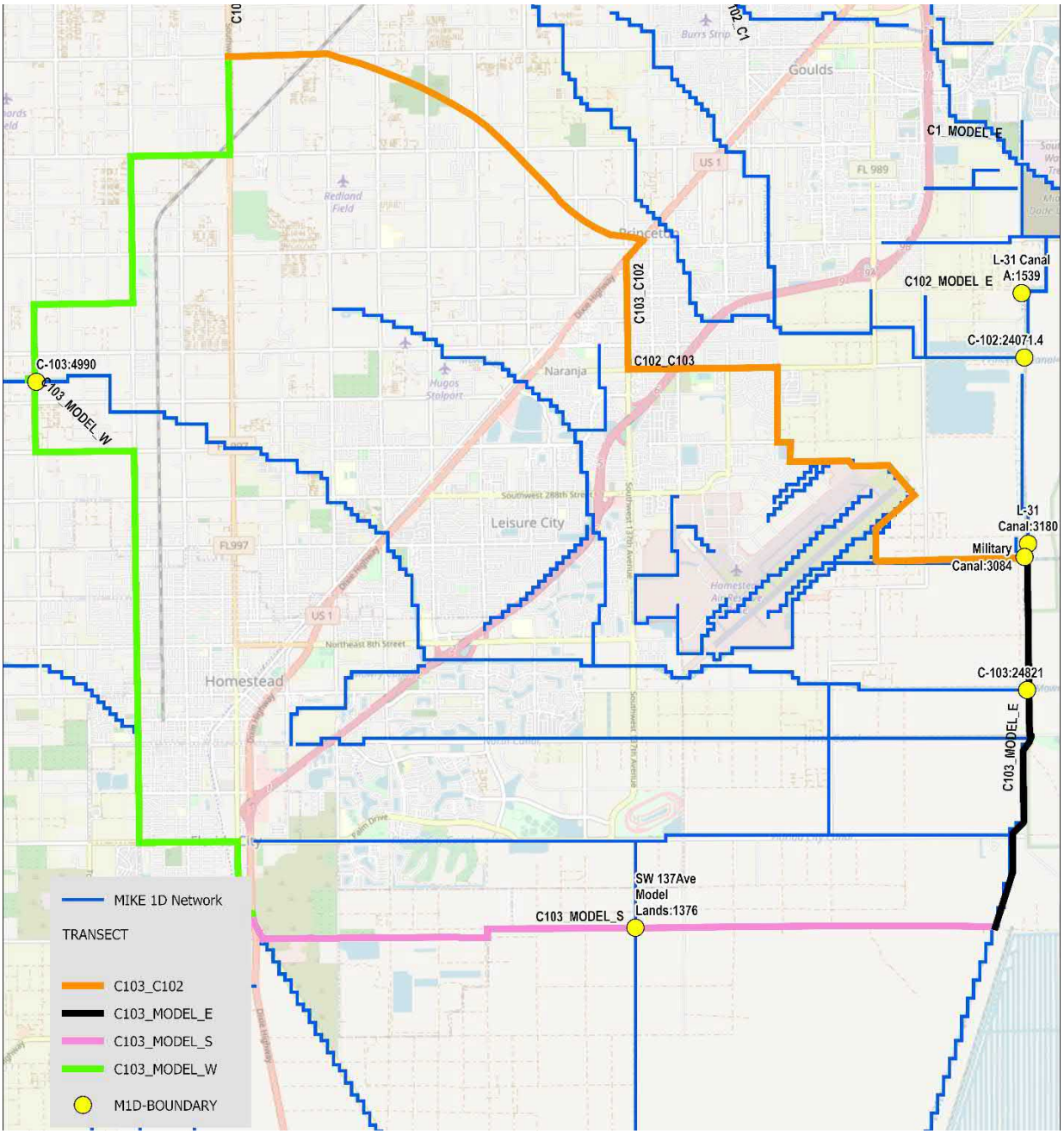


Figure 528 Locations of Transect Flows in Watershed C-103 and Location of Mike 1D Canals Crossing Watershed Boundaries

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in the section below. A global C-103 Watershed summary (inflow, outflow and storage change) is provided in Table 362 through Table 365 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 362 Global C-103 Watershed Summary, 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	16.821	20.477	26.499	38.843
Outflows (kAF)	-19.529	-22.385	-27.282	-38.219
Storage Change (kAF)	2.731	1.942	0.819	-0.579
Difference (kAF)	**0.023**	**0.034**	**0.035**	**0.045**
Inflow Rainfall is 27.059 kAF Negative values of outflows refer to water leaving control volume				

Table 363 Global C-103 Watershed Summary, 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	16.975	23.082	29.322	42.188
Outflows (kAF)	-19.680	-24.918	-30.031	-41.516
Storage Change (kAF)	2.731	1.872	0.752	-0.616
Difference (kAF)	**0.027**	**0.037**	**0.043**	**0.056**
Inflow Rainfall is 32.770 kAF Negative values of outflows refer to water leaving control volume				

Table 364 Global C-103 Watershed Summary, 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	23.579	23.597	33.710	47.285
Outflows (kAF)	-26.110	-23.622	-34.326	-46.533
Storage Change (kAF)	2.574	0.027	0.676	-0.691
Difference (kAF)	**0.044**	**0.002**	**0.061**	**0.062**
Inflow Rainfall is 41.367 kAF Negative values of outflows refer to water leaving control volume				

Table 365 Global C-103 Watershed Summary, 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Inflows (kAF)	31.186	30.671	41.540	55.762
Outflows (kAF)	-33.575	-30.730	-42.042	-54.880
Storage Change (kAF)	2.464	0.059	0.578	-0.795
Difference (kAF)	**0.074**	**0.000**	**0.075**	**0.087**
Inflow Rainfall is 56.640 kAF Negative values of outflows refer to water leaving control volume				

A summary of all model inflows and outflows including Mike 1D flows and storage change is shown in Table 366 through Table 369

Table 366 Summary of all Inflows, Outflows and Storage Change for the C-103 Watershed (all data in kAF), 5-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	27.059	27.059	27.059	27.059
Evapotranspiration	-7.855	-8.615	-9.105	-9.681
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	1.534	4.679	13.901	22.608
OL-Boundary Outflow	-0.983	-3.292	-8.340	-13.291
OL-Storage change	8.877	7.085	6.521	7.031
OL to river	-12.963	-11.330	-18.090	-20.455
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	13.355	14.631	14.656	13.446
SZ-Boundary Outflow	-8.769	-8.121	-6.456	-5.984
SZ-Storage change	5.948	-1.379	-0.514	0.352
Pumping	-3.827	-3.827	-3.827	-3.827
SZ Drain to river	-6.366	-7.535	-12.675	-21.025
SZ Drain to ext river	-0.006	-0.005	-0.008	-0.020
Base flow to River	-24.300	-18.148	-14.086	-10.439
Base flow from River	6.892	6.410	8.885	12.433
Difference:	**0.057**	**0.064**	**0.081**	**0.108**
Difference	**0.10%**	**0.10%**	**0.10%**	**0.10%**
**Design Events Cover 9/1/2017-10/05/2017				

Table 367 Summary of all Inflows, Outflows and Storage Change for the C-103 Watershed (all data in kAF), 10-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	32.770	32.770	32.770	32.770
Evapotranspiration	-9.798	-9.798	-9.798	-9.798
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	23.307	23.307	23.307	23.307
OL-Boundary Outflow	-14.797	-14.797	-14.797	-14.797
OL-Storage change	6.996	6.996	6.996	6.996
OL to river	-23.722	-23.722	-23.722	-23.722
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	13.439	13.439	13.439	13.439
SZ-Boundary Outflow	-6.294	-6.294	-6.294	-6.294
SZ-Storage change	0.306	0.306	0.306	0.306
Pumping	-3.827	-3.827	-3.827	-3.827
SZ Drain to river	-21.873	-21.873	-21.873	-21.873
SZ Drain to ext river	-0.023	-0.023	-0.023	-0.023
Base flow to River	-10.460	-10.460	-10.460	-10.460
Base flow from River	12.227	12.227	12.227	12.227
Difference:	**0.134**	**0.134**	**0.134**	**0.134**
Difference	**0.20%**	**0.20%**	**0.20%**	**0.20%**

**Design Events Cover 9/1/2017-10/05/2017

Table 368 Summary of all Inflows, Outflows and Storage Change for the C-103 Watershed (all data in kAF), 25-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	41.367	41.367	41.367	41.367
Evapotranspiration	-8.254	-8.945	-9.405	-9.926
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	3.229	6.621	15.719	25.182
OL-Boundary Outflow	-2.669	-5.759	-11.278	-17.572
OL-Storage change	8.753	6.909	6.434	6.926
OL to river	-20.513	-19.284	-25.928	-28.189
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	13.965	15.099	14.735	13.333
SZ-Boundary Outflow	-10.358	-9.653	-7.859	-6.926
SZ-Storage change	5.710	-1.568	-0.612	0.235
Pumping	-3.827	-3.827	-3.827	-3.827
SZ Drain to river	-8.127	-9.492	-14.794	-23.286
SZ Drain to ext river	-0.010	-0.009	-0.014	-0.027
Base flow to River	-27.377	-20.251	-15.179	-10.764
Base flow from River	6.822	6.527	8.694	11.805
Difference:	**0.121**	**0.136**	**0.143**	**0.178**
Difference	**0.20%**	**0.20%**	**0.20%**	**0.20%**

**Design Events Cover 9/1/2017-10/05/2017

Table 369 Summary of all Inflows, Outflows and Storage Change for the C-103 Watershed (all data in kAF), 100-yr/3-day

Category	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
Precipitation	56.640	56.640	56.640	56.640
Evapotranspiration	-8.543	-9.206	-9.630	-10.158
Canopy-Storage change	0.000	0.000	0.000	0.000
OL-Boundary Inflow	5.190	8.678	17.927	35.584
OL-Boundary Outflow	-5.702	-9.354	-15.614	-27.770
OL-Storage change	8.629	6.742	6.242	6.786
OL to river	-29.054	-27.087	-33.887	-38.129
Irrigation	0.000	0.000	0.000	0.000
SZ-Boundary Inflow	14.390	15.222	14.762	13.499
SZ-Boundary Outflow	-11.750	-10.862	-8.874	-7.923
SZ-Storage change	5.508	-1.712	-0.772	0.126
Pumping	-3.827	-3.827	-3.827	-3.827
SZ Drain to river	-10.133	-11.659	-17.012	-25.773
SZ Drain to ext river	-0.014	-0.015	-0.020	-0.037
Base flow to River	-29.582	-22.301	-16.153	-11.815
Base flow from River	7.131	6.681	8.511	11.380
Difference:	**0.255**	**0.287**	**0.349**	**0.391**
Difference	**0.30%**	**0.30%**	**0.40%**	**0.30%**

**Design Events Cover 9/1/2017-10/05/2017

The summary shows that the Difference is within 2% except for the calibration period, which also showed larger differences also in comparing transect flows.

A summary of OL transect flows for each event and for change of SLR is provided in Table 370 through Table 373 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 370 Summary of Transect OL Flows for the C-103 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	0.005	-0.229	-0.817	-1.219
C102_MODEL_E-OL	0.048	1.382	3.535	5.566
C1_C102-OL	0.007	0.007	0.008	0.011
Transect OL Flows	**0.058**	**1.159**	**2.725**	**4.354**

Table 371 Summary of Transect OL Flows (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.005	-0.244	-0.798	-1.402
C102_MODEL_E-OL	0.133	1.267	3.220	5.200
C1_C102-OL	0.006	0.027	0.025	0.022
Transect OL Flows	**0.134**	**1.034**	**2.420**	**3.778**

Table 372 Summary of Transect OL Flows (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	-0.026	-0.011	-0.804	-2.567
C102_MODEL_E-OL	0.190	0.100	2.562	4.642
C1_C102-OL	0.054	0.042	0.040	0.028
Transect OL Flows	**0.106**	**0.040**	**1.683**	**1.934**

Table 373 Summary of Transect OL Flows (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-OL	0.012	-0.054	-0.611	-2.046
C102_MODEL_E-OL	-0.155	-0.273	1.743	3.840
C1_C102-OL	0.031	0.011	0.002	-0.011
Transect OL Flows	**-0.646**	**-0.802**	**0.489**	**1.002**

A summary of SZ transect flows for each event and for change of SLR is provided in Table 374 through Table 377 for SLR = 0, +1.0, +2.0, +3.0 ft.

Table 374 Summary of Transect SZ Flows for the C-103 Watershed (all data in kAF), 5-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SZ1	-0.092	-0.140	-0.236	-0.236
C102_C103-SZ2	-0.471	-0.731	-1.052	-1.061
C102_C103-SZ3	-0.177	-0.279	-0.420	-0.432
C102_C103-SZ4	-0.002	-0.002	-0.003	-0.004
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.199	0.048	0.044	-0.011
C102_MODEL_E-SZ2	-0.927	0.023	0.048	-0.103
C102_MODEL_E-SZ3	-0.340	0.021	0.027	-0.032
C102_MODEL_E-SZ4	-0.005	0.000	0.000	0.000
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.042	-0.051	-0.080	-0.076
C1_C102-SZ2	-0.493	-0.580	-0.873	-0.785
C1_C102-SZ3	-0.162	-0.198	-0.331	-0.304
C1_C102-SZ4	-0.005	-0.005	-0.008	-0.007
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.065	0.062	0.046	0.020
C102_MODEL_W-SZ2	0.439	0.422	0.315	0.149
C102_MODEL_W-SZ3	0.258	0.248	0.185	0.087
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.001
C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-2.149**	**-1.158**	**-2.334**	**-2.794**

Table 375 Summary of Transect SZ Flows for the C-103 Watershed (all data in kAF), 10-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SZ1	-0.095	-0.130	-0.213	-0.222
C102_C103-SZ2	-0.483	-0.682	-0.940	-0.983
C102_C103-SZ3	-0.183	-0.259	-0.376	-0.400
C102_C103-SZ4	-0.002	-0.002	-0.003	-0.003
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.196	0.008	0.013	-0.037
C102_MODEL_E-SZ2	-0.916	-0.128	-0.067	-0.196
C102_MODEL_E-SZ3	-0.336	-0.034	-0.015	-0.066

C102_MODEL_E-SZ4	-0.005	0.000	0.000	-0.001
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.042	-0.074	-0.100	-0.093
C1_C102-SZ2	-0.494	-0.766	-1.032	-0.914
C1_C102-SZ3	-0.163	-0.275	-0.396	-0.356
C1_C102-SZ4	-0.005	-0.007	-0.009	-0.008
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.064	0.048	0.033	0.007
C102_MODEL_W-SZ2	0.437	0.345	0.246	0.082
C102_MODEL_W-SZ3	0.256	0.203	0.145	0.049
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.001
C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-2.159**	**-1.752**	**-2.713**	**-3.139**

Table 376 Summary of Transect SZ Flows for the C-103 Watershed (all data in kAF), 25-yr/3-day

Transect SZ Flows	**SLR = 0**	**SLR = +1.0 ft**	**SLR = +2.0 ft**	**SLR = +3.0 ft**
C102_C103-SZ1	-0.079	-0.072	-0.196	-0.203
C102_C103-SZ2	-0.387	-0.374	-0.848	-0.874
C102_C103-SZ3	-0.143	-0.133	-0.339	-0.357
C102_C103-SZ4	-0.001	-0.001	-0.003	-0.003
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.269	-0.303	-0.038	-0.074
C102_MODEL_E-SZ2	-1.198	-1.278	-0.252	-0.330
C102_MODEL_E-SZ3	-0.438	-0.473	-0.085	-0.117
C102_MODEL_E-SZ4	-0.006	-0.006	-0.001	-0.001
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.093	-0.046	-0.125	-0.113
C1_C102-SZ2	-0.906	-0.458	-1.217	-1.066
C1_C102-SZ3	-0.332	-0.121	-0.472	-0.419
C1_C102-SZ4	-0.008	-0.004	-0.011	-0.009
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.039	0.046	0.023	-0.001
C102_MODEL_W-SZ2	0.301	0.340	0.193	0.039
C102_MODEL_W-SZ3	0.178	0.200	0.115	0.025
C102_MODEL_W-SZ4	0.002	0.002	0.001	0.000

C102_MODEL_W-SZ5	0.001	0.001	0.000	0.000
Sum:	**-3.339**	**-2.680**	**-3.254**	**-3.501**

Table 377 Summary of Transect SZ Flows for the C-103 Watershed (all data in kAF), 100-yr/3-day

Transect SZ Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SZ1	-0.065	-0.074	-0.147	-0.088
C102_C103-SZ2	-0.292	-0.361	-0.612	-0.350
C102_C103-SZ3	-0.106	-0.126	-0.243	-0.147
C102_C103-SZ4	-0.001	-0.001	-0.002	-0.002
C102_C103-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_E-SZ1	-0.333	-0.373	-0.099	-0.112
C102_MODEL_E-SZ2	-1.435	-1.531	-0.477	-0.473
C102_MODEL_E-SZ3	-0.526	-0.566	-0.169	-0.170
C102_MODEL_E-SZ4	-0.007	-0.008	-0.002	-0.002
C102_MODEL_E-SZ5	0.000	0.000	0.000	0.000
C1_C102-SZ1	-0.129	-0.082	-0.153	-0.136
C1_C102-SZ2	-1.177	-0.745	-1.431	-1.232
C1_C102-SZ3	-0.444	-0.240	-0.561	-0.489
C1_C102-SZ4	-0.010	-0.007	-0.012	-0.011
C1_C102-SZ5	0.000	0.000	0.000	0.000
C102_MODEL_W-SZ1	0.034	0.041	0.018	-0.004
C102_MODEL_W-SZ2	0.266	0.305	0.164	0.021
C102_MODEL_W-SZ3	0.159	0.181	0.100	0.015
C102_MODEL_W-SZ4	0.001	0.001	0.001	0.000
C102_MODEL_W-SZ5	0.000	0.001	0.000	0.000
Sum:	**-4.066**	**-3.584**	**-3.627**	**-3.180**

A summary of Mike 1D flows in the transect for each event and for change of SLR is provided in Table 378 through Table 381:

Table 378 Summary of Transect Mike 1D Flows for the C-103 Watershed (all data in kAF), 5-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000

C102_MODEL_E-SUM-OC-FLOW	-27.866	-24.371	-31.788	-42.403
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.283	0.283	0.263	0.242
Sum:	**-27.582**	**-24.088**	**-31.525**	**-42.160**

Table 379 Summary of Transect Mike 1D Flows for the C-103 Watershed (all data in kAF), 10-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-28.125	-26.378	-32.931	-42.575
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.283	0.348	0.327	0.308
Sum:	**-27.842**	**-26.029**	**-32.603**	**-42.267**

Table 380 Summary of Transect Mike 1D Flows for the C-103 Watershed (all data in kAF), 25-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-33.258	-26.213	-34.134	-43.199
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.477	0.415	0.461	0.423
Sum:	**-32.780**	**-25.798**	**-33.673**	**-42.776**

Table 381 Summary of Transect Mike 1D Flows for the C-103 Watershed (all data in kAF), 100-yr/3-day

Transect OL Flows	SLR = 0	SLR = +1.0 ft	SLR = +2.0 ft	SLR = +3.0 ft
C102_C103-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_E-SUM-OC-FLOW	-38.240	-29.513	-36.712	-44.846
C1_C102-SUM-OC-FLOW	0.000	0.000	0.000	0.000
C102_MODEL_W-SUM-OC-FLOW	0.512	0.475	0.400	0.271
Sum:	**-37.728**	**-29.038**	**-36.311**	**-44.575**

The water balance analysis includes overall summary of the water balances which were obtained from the DHI's Water Balance Tool. The summary from the tool had very small water balance closure error (within a fraction of percent). Additionally, the transect flows across the model and

between each of the watersheds were calculated for overland, saturated zone and canal flows crossing the boundaries. All calculations were based on an hourly based timeseries and were summarized in a set of tables in inches and kilo-acre-feet (kaf). A set of files which includes balance tables, model and GIS files is provided with this Memorandum.

For most of the water balance summaries, the differences were less than 2.5 % and larger differences indicate that some of the minor flows were not included.

A summary of all transects calculations (for overland and each of the five saturated zone layers) are provided in the data submitted to SFWMD.

All calculations were based on an hourly based timeseries and were summarized in a set of tables in inches and kilo-acre-feet (kaf). A set of files which includes balance tables, model and GIS files is provided with this Section.

7 SUMMARY AND RECOMMENDATIONS

This project developed a calibrated numerical model which was applied to investigate the response of four watersheds in South Miami-Dade County to a set four design storm events (5-yr, 10-yr, 25-yr and 100-yr) for current and future hydrology of the watersheds and SLR scenarios which included +0, +1, +2 and +3 ft. This section provides a summary of the project results and recommendations for additional investigations.

Model Development and Calibration

The surface/groundwater integrated model includes the latest regional hydrologic data sets for topography, land use and hydrogeology. Time-varying datasets included rainfall, ET, and tidal stages, structure operations, groundwater withdrawals and others. The MIKE 1D network represents the primary canals managed by SFWMD and secondary canal system in south Miami-Dade managed by Miami-Dade County. The simulation time step was a maximum of 15 minutes for OL, UZ and SZ subdomains and fixed 5 seconds for MIKE 1D OC subdomain, allowing the model to represent water control structures operations closer to SFWMD operations during storm events. The land use, groundwater withdrawals and other datasets were based on most recent data since the calibration period is chronologically close to the existing conditions; no major changes were completed to the land use, infrastructure, or operations of the system in the two elapsed years between the period of calibration and validation.

For model calibration, observed data were used for gate operations at the structures. Model calibration consisted of matching historic stage data at groundwater stage sites, canal stage sites, and canal flow sites. The calibration model covered 8/15/17 to 10/15/17. Calibration error metrics, including ME, MAE, bias and RMSE, as well model performance at the peak at each observation site were determined to evaluate model performance of canal and groundwater stages. The calibration criteria for groundwater and canal water levels was of ±0.5 ft stage ME, MAE, bias and RMSE. Flow calibration criteria included 20% difference between observed and simulated values, but it is recognized that flows have errors in both flow measurements and computed flows.

Simulations of Design Events

The numerical model was applied to analyze a set of design events including 5-yr, 10-yr, 25-yr and 100-year storm event with a duration of 72 hours. The existing conditions model was based on the calibrated and validated SMD FPLOS model, with boundary datasets modified for application setup and structure operations based on recent operational criteria. The tailwater timeseries for each return interval for the coastal structures (S123, S21, S21A, S20F, S20G, S20, S22 and S197) were provided by SFWMD, and were scaled to represent 5-yr, 10-yr, 25-yr and 100-year design storm conditions. The tailwater conditions for S123, S21, S21A, S20F, S20G were developed for Hurricane Irma from 2017. The tailwater conditions for S22, S20, S197 were developed based on Hurricane Irene from 1999. All observed structure operations in the model were replaced with rule-based operations, using the latest information provided in the SFWMD's Water Control Operations Atlas of South Miami-Dade County (last updated 2021). The rainfall dataset for application follows the spatial 3-day design storm rainfall distribution by SFWMD; rainfall depths were obtained from NOAA's Rainfall Atlas ASCII grid data. Sensitivity analysis showed that the stages were at the highest value when the two peaks were aligned with each other, which was assumed to be the most conservative approach and was subsequently used for

all design event simulations. The land use, groundwater withdrawals and other datasets were not modified for current conditions since the calibration period is chronologically close to the existing conditions; no major changes were completed to the land use, infrastructure, or operations of the system in the two elapsed years between the period of calibration and period of simulation of the existing conditions. For future conditions, land use and topography were modified to reflect changes in land use and compliance with Miami-Dade County's County Flood Criteria which provides the minimum elevations of parcels for future development. Additionally, stormwater storage nodes were included to account for the development of vacant land within the model domain. Furthermore, for future conditions, the drainage infrastructure was extended by adding planned secondary canals within the project domain.

Performance Metrics Analysis

The results from simulating the 5-yr, 10-yr, 25-yr and 100-year storm events were analyzed using a set of six (6) Performance Metrics (PMs), which were applied to evaluate the flood protection LOS of watersheds C-1, C-100, C-102 and C-103.

- PM1: The peak stage in the canals was applied in PM1 which uses the Maximum Stage in the Primary Canals to determine the LOS required not to overtop the canal banks. he largest of the design storms that stayed within the MIKE 1D canal banks per the modeling established the FPLOS of the primary conveyance system.
- PM2: The peak discharge capacity of the12-hr average discharges was determined for PM2, Maximum Daily Discharge Capacity through the Primary Canals. This computed 12-hr peak discharges was compared with the design discharges at each structure and the SFWMD Environmental Resource Permit (ERP) Allowable Discharges.
- PM3: In addition, the computed discharges at each tidal structure were compared to the structure capacity as defined by the original static design conditions as outlined in PM3 Structure Performance.
- PM4: The peak discharge capacity of the coastal structures was then compared for a range of design storms as required by PM4 - Peak Storm Runoff, which determines the maximum conveyance capacity. Modeled scenarios considered the combined effect of design storm events and storm surge, averaged over the tidal cycle for coastal structures. PM4 shows the maximum conveyance given specific tidal boundary conditions and design storm events.
- PM5: The frequency of flooding was evaluated under PM5 and provides the overall ability of the water management infrastructure to prevent flooding. This PM evaluated the overland flooding depths for 72-hr duration of 5-, 10-, 25- and 100-year recurrence intervals and determined the flood duration metrics.
- PM6: The duration of flooding was determined in PM6 which determines the time required for surface water stages to recede to non-flood levels. PM6 quantifies the flooding duration in SMD FPLOS watersheds.

The peak stage in the canals was applied in PM1 which uses the Maximum Stage in the Primary Canals to determine the LOS not to overtop the canal banks. The largest of the design storms that stayed within the MIKE 1D canal banks per the modeling established the FPLOS of the primary conveyance system. The peak discharge of the 12-hr average discharges was determined for PM2, Maximum Daily Discharge Capacity, through the Primary Canals/ This computed 12-hr peak discharge was compared with the design discharges at each structure and the SFWMD Environmental Resource Permit (ERP) Allowable Discharges.

For all structures, the computed discharges at each tidal structure were compared to the structure capacity as defined by the original static design conditions in PM3 Structure Performance. The peak discharge capacity of the coastal structures was compared for a range of design storms. in PM4 - Peak Storm Runoff, which determined the maximum conveyance capacity. Modeled scenarios considered the combined effect of design storm events and storm surge – all averaged over the tidal cycle for coastal structures. PM4 showed the maximum conveyance given specific tidal boundary conditions and design storm event.

The Frequency of Flooding was determined under PM5 and provided the overall ability of the water management infrastructure to prevent flooding. This PM evaluated the overland flooding depths for 72-hr duration of 5-, 10-, 25- and 100-Year recurrence intervals and SLR = 0, +1, +2 and +3, to determine the flood extent and depth metrics.

Table 382 and Table 383 represent the fraction of flooded urban and Agricultural areas with depth greater than 1 ft, for the 25-Yr storm event. Based on results, best urban flood protection is provided for watersheds C-1 and C-100. Watershed C-102 and C-103 have the greatest extent of flooding. The thresholds of 1.0 ft for urban areas and 0.5 ft for agricultural areas were recommended by SFWMD's reviewers as critical values for these areas.

Table 382 Fraction of Flooded Urban Areas of C-1 Watershed with Depth > 1.0 ft

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	**5%**	**5%**	**6%**	**8%**
C-100	**5%**	**5%**	**6%**	**9%**
C-102	**13%**	**14%**	**17%**	**19%**
C-103	**8%**	**9%**	**11%**	**14%**

The best agricultural flood protection is provided for watersheds C-100. Watersheds C-103 and C-103 have higher fraction of flooded agricultural areas. Watershed C-1 has the greatest extent of flooding.

Table 383 Fraction of Flooded Agricultural Areas with Depth > 0.5 ft

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	**16%**	**16%**	17%	18%
C-100	**1%**	**1%**	1%	1%
C-102	**8%**	**8%**	9%	10%
C-103	**7%**	**7%**	8%	8%

The duration of flooding in PM6 was determined by the time required for surface water stages to recede to non-flood levels. PM6 quantified the flooding duration in SMD FPLOS watersheds.

Table 384 and Table 385 provide the fraction of areas with flooding greater than 24 hours for urban and agricultural areas. For urban areas C-102 has largest fraction of areas with flood duration greater than 24 hours (lowest flood protection), while watershed C-1 and C-100 have lower fraction of flood duration greater than 24 hours.

Table 384 Fraction of Urban Area Flooded with Duration > 24 hr

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	10%	10%	11%	14%
C-100	12%	18%	21%	28%
C-102	25%	26%	29%	31%
C-103	16%	17%	20%	24%

For agricultural areas show that C-1 has largest fraction of areas with flood duration greater than 24 hours (lowest flood protection), while watershed C-1 and C-100 have lower fraction of flood duration greater than 24 hours (best flood protection).

Table 385 Fraction of Agricultural Areas Flooded with Duration > 24 hr

Water Depth (ft)	25-Yr/SLR-0	25-Yr/SLR-1	25-Yr/SLR-2	25-Yr/SLR-3
C-1	22%	22%	23%	25%
C-100	1%	2%	2%	3%
C-102	11%	11%	11%	12%
C-103	8%	9%	10%	11%

FPLOS for Current Conditions:

The current conditions are based on SLR +0 ft and current hydrologic and drainage infrastructure conditions (current land use, topography, drainage infrastructure, structure operations). For the overall rating of the watersheds weight was placed on PM1, PM5 and PM6.

The overall FPLOS rating of watersheds was determined as follows:

- For C-1 the LOS rating for current conditions is 5-yr
- For C-100 the LOS rating for current conditions is 5-yr
- For C-102 the LOS rating for current conditions is 10-yr
- For C-103 the LOS rating for current conditions is 5-yr

The low FPLOS rating is triggered by canal overtopping for the specified events, the flood extent and depth, and flood duration. It is important to take into consideration that the storm surge can affect the LOS capacity of the primary canals particularly during high tailwater elevation and high storm surge events.

FPLOS for Future Conditions:

The current conditions are based on SLR +0, +1, +2 and +3 ft and future hydrologic and drainage infrastructure conditions (future land use, topography, drainage infrastructure, structure operations). For the overall rating of the watersheds weight was placed on PM1, PM5 and PM6.

- The overall rating of watershed C-1 is 5-yr FPLOS for SLR = +0 and +1.0 ft. For SLR = +2.0 and +3.0 ft, the LOS is less than 5-yr.
- The overall rating of C-100 is 5-yr FPLOS for SLR = 0 and +1.0 ft and less than 5 for SLR = +2.0 and +3.0 ft.
- The overall rating of C-102 is assigned 10-yr for SLR = +0 ft, 5-yr for SLR = +1 and +2 ft, and less than 5-yr for SLR = +3 ft.
- The C-103 Watershed has been assigned a 5-Year FPLOS rating for SLR = +0 and +1.0 ft and less than 5-Year for SLR = +2.0 and +3.0 ft.

Recommendations:

The results from the FPLOS analysis established multiple deficiencies of the drainage infrastructure for current and future conditions and the following recommendations are provided to extend this study with additional investigations which will focus on development of specific flood mitigation projects:

- Analyze the effect of elevating the top of the levees at the eastern model boundaries for all SLR conditions, determine potential storm surge conditions which can overtop these levees and cause potential flooding of inland areas through overland and through canals. Determine potential impacts resulting from mitigation strategies which include upgrades bank canal bank elevations
- Analyze the operation of coastal structures for all SLR conditions in terms of timing and gates opening and closing criteria to determine most optimal management which will maximize runoff discharges and minimize storm surge influx through open structures
- Analyze potential impacts of future projects which consider installation of structures across the levees at the eastern watershed boundaries and determine the needs for gates, and determine gate's most optimal operations to reduce potential backflow through the watershed boundaries
- Provide analysis in coordination with Miami-Dade County (to account for the effect of planned stormwater infrastructure projects) of required localized infrastructure within each watershed to decrease timing and depth of flooding for problematic areas which were identified in this work.
- Provide analysis of SLR impacts on watershed hydrology resulting from elevated water levels in Primary Canals, including groundwater level rise, changes of water content and storage in unsaturated and saturated zones, changes of evapotranspiration rates and patterns, impacts to sensitive wetlands and agricultural areas, determine the most optimal levels in Primary Canals which provide the required FPLOS protection while preserving watershed hydrology
- Address concerns of land developers related to loss of storage if canal operating levels are increased correspondingly to SLR.

Provide analysis of forward pumping at the coastal structures, including pump flow rates, pump location, operational criteria, and effectiveness of forward pumping to resolve potential impacts from future SLR conditions, such as elevated canal water levels.

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9 APPENDIX FLOOD MAPS FOR PM5 AND PM6

APPENDIX

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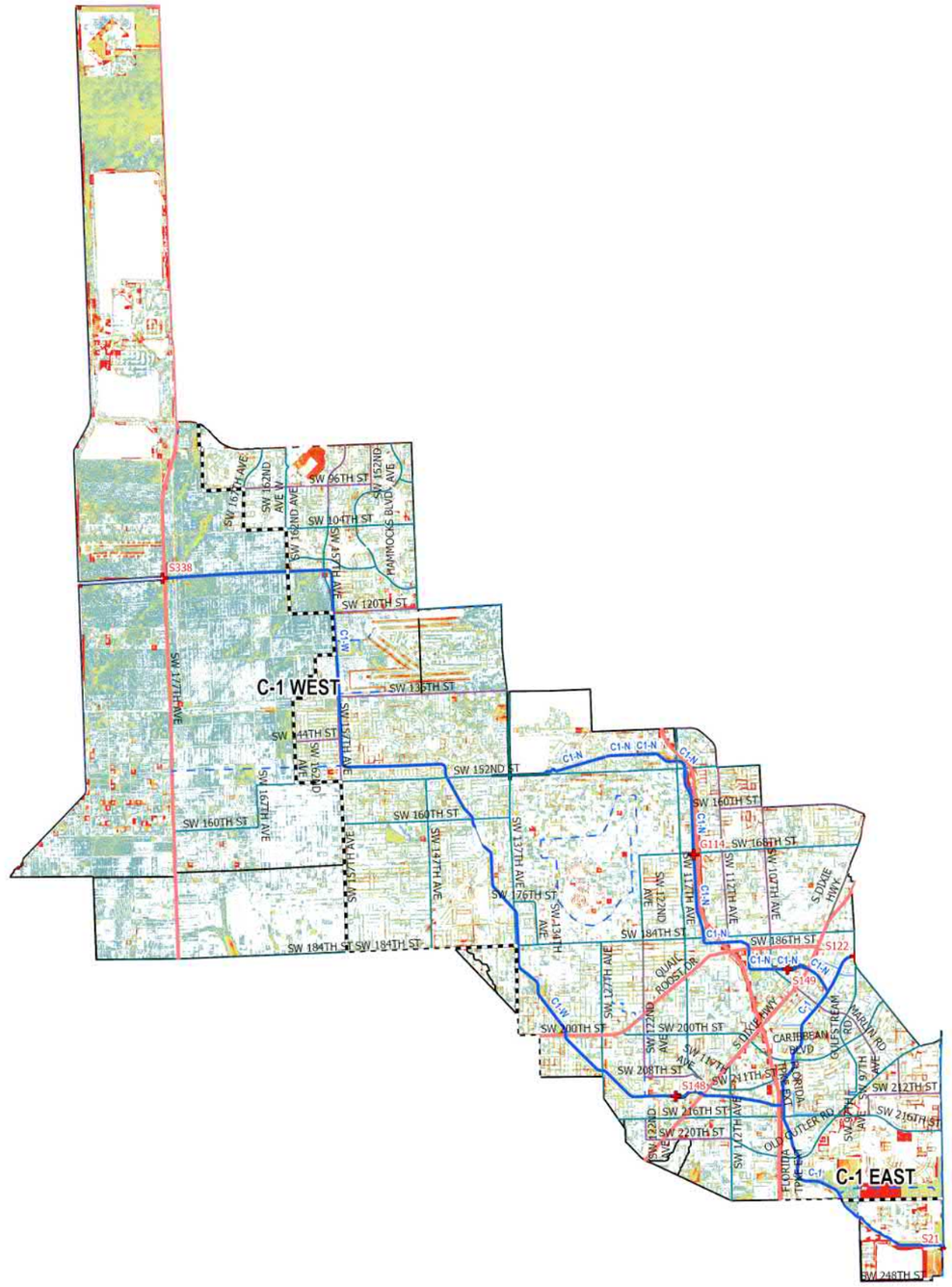
WATERSHED C-1: Flood Extent for Entire Watershed

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-1. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 0

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C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

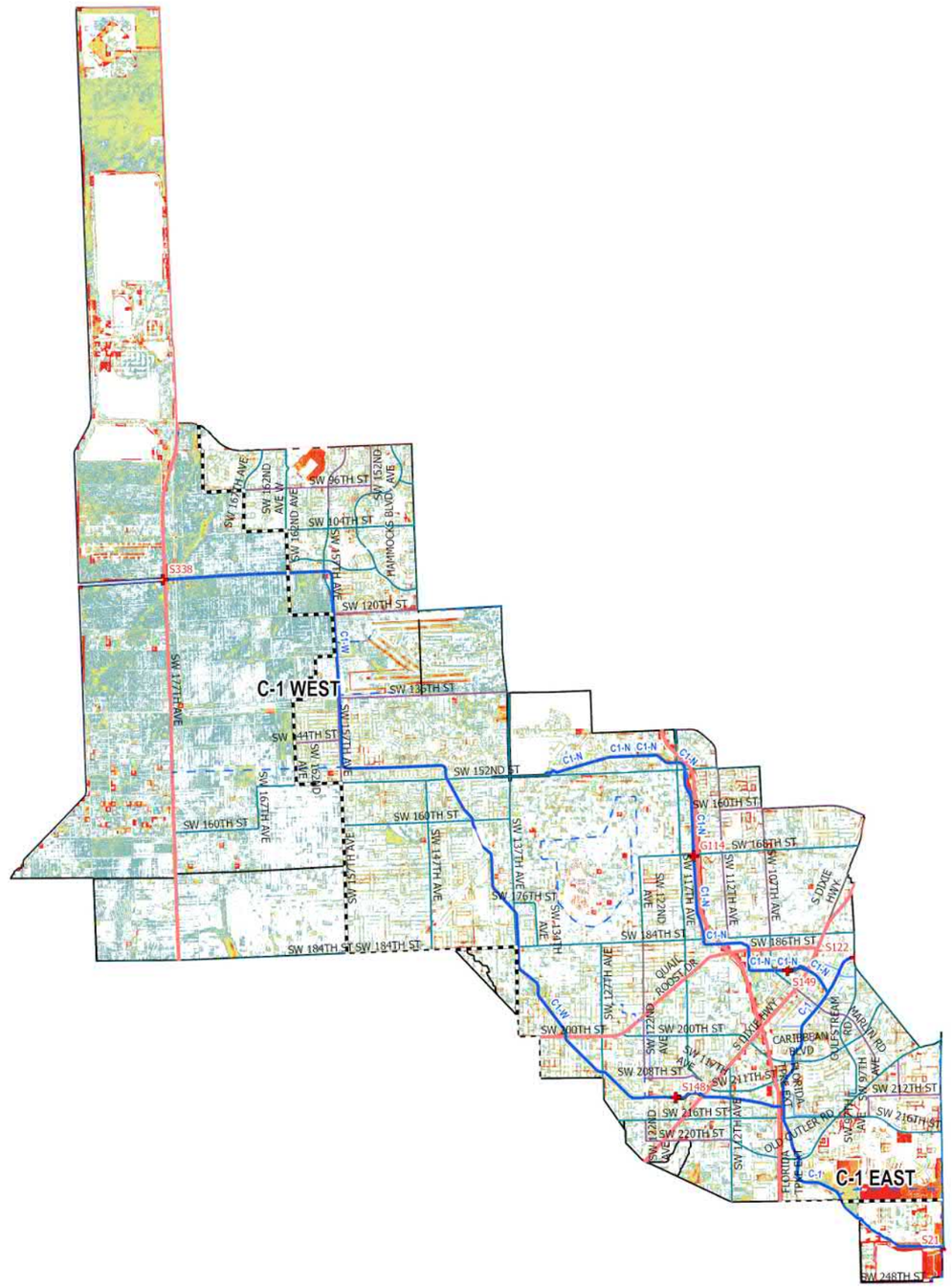
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft



0 0.5 1 2 3 4 Miles

Figure A-2. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

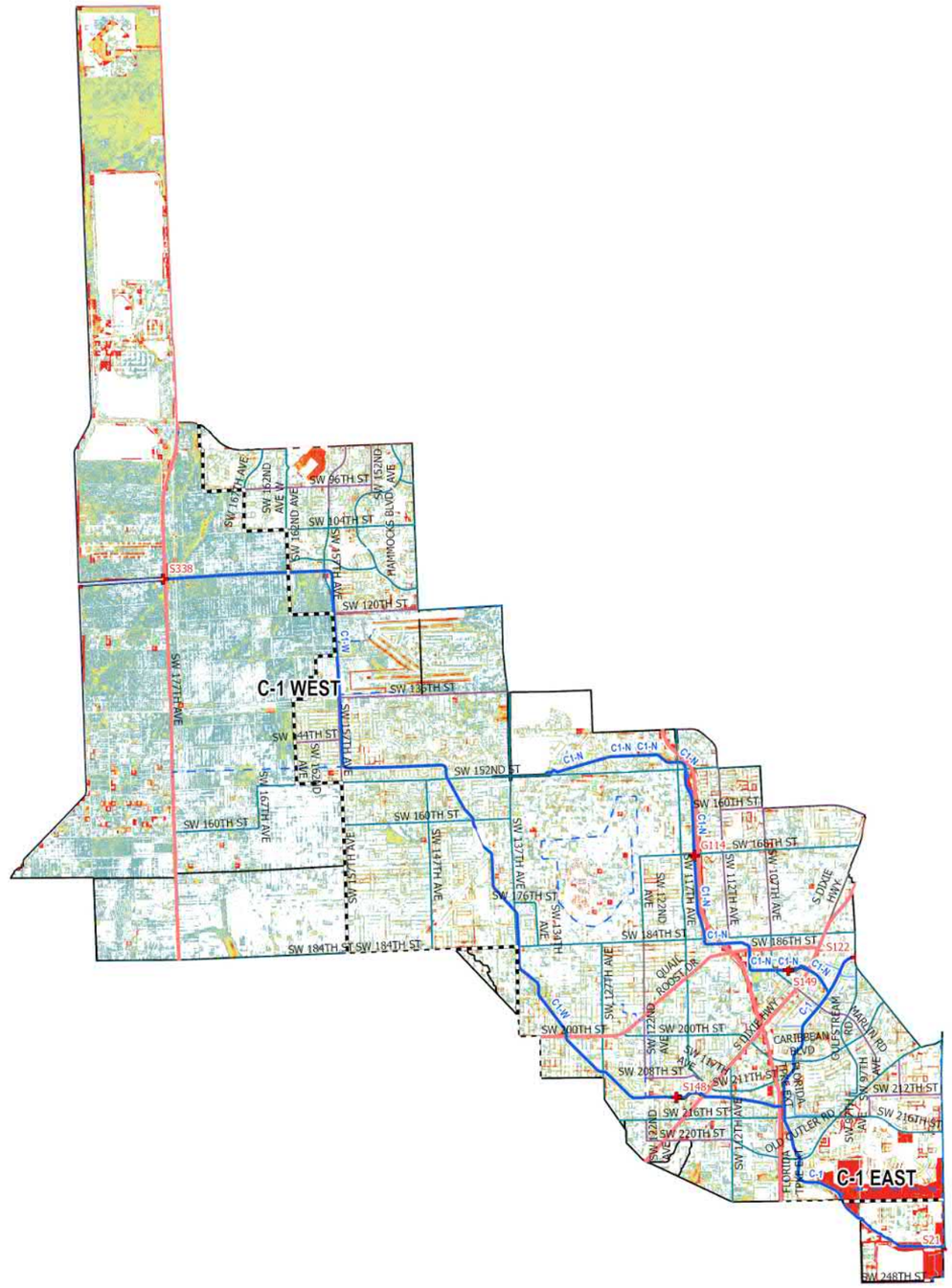


Figure A-3. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 2

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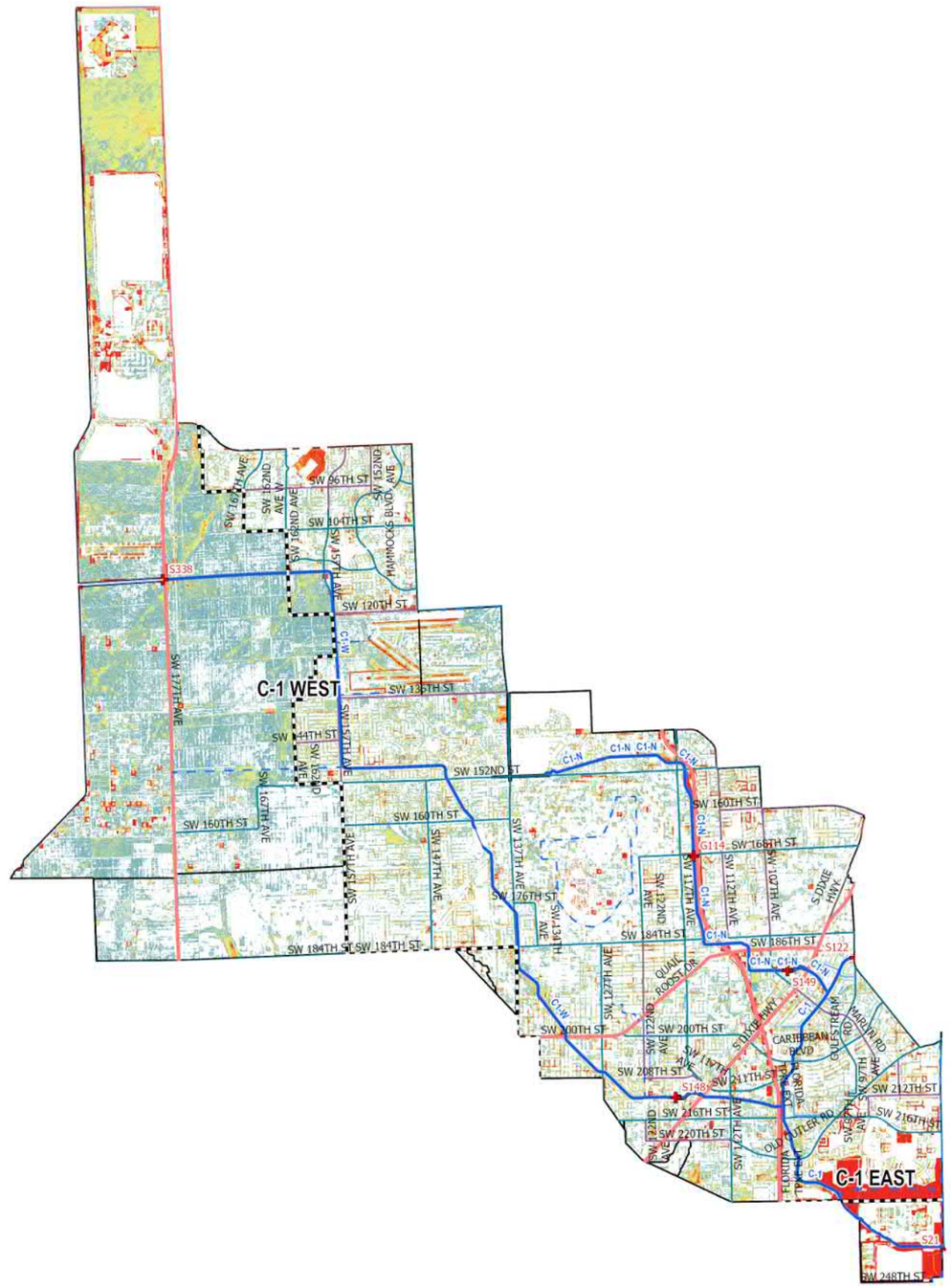
C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

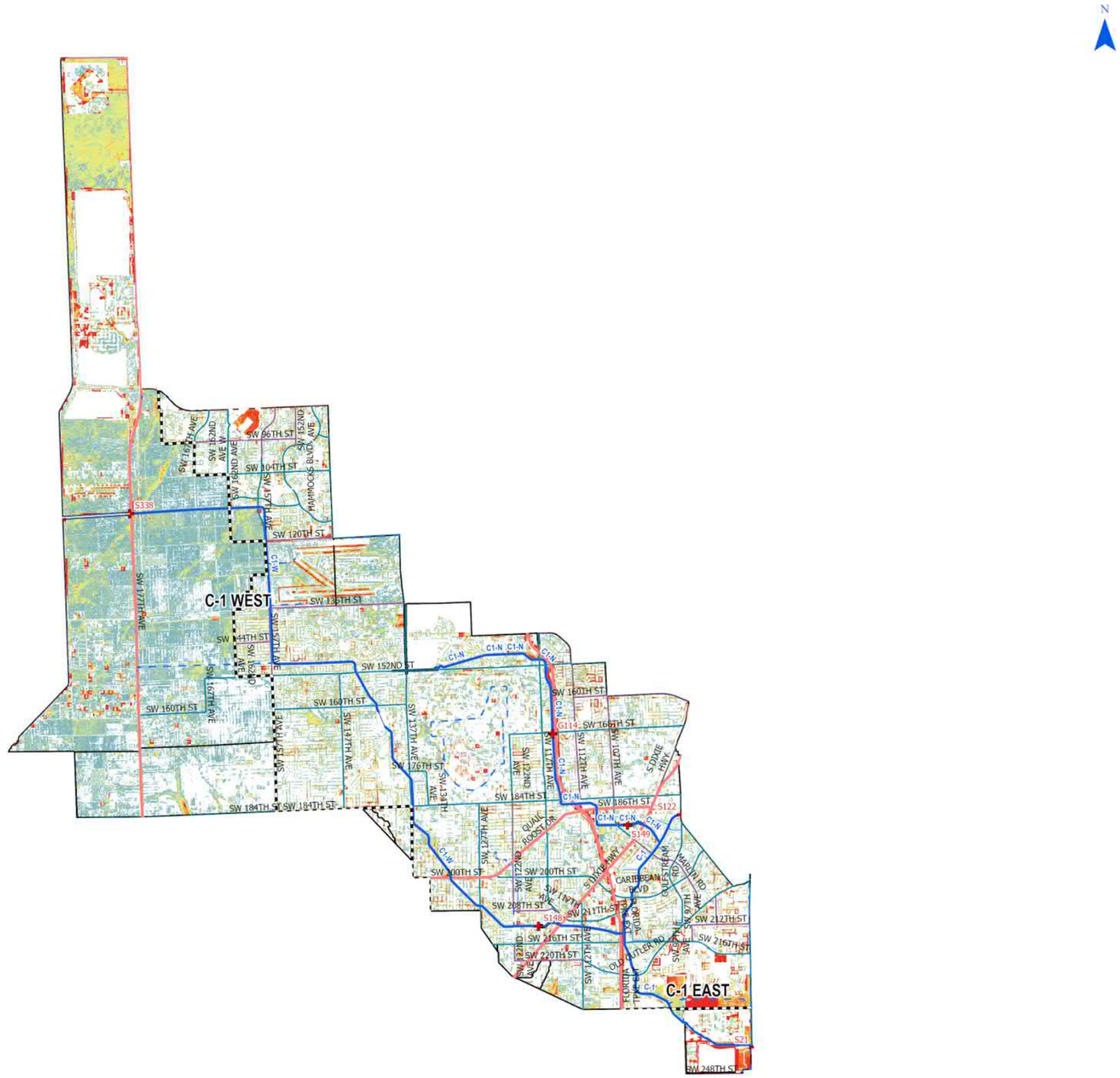
N

0 0.5 1 2 3 4 Miles

Figure A-4. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

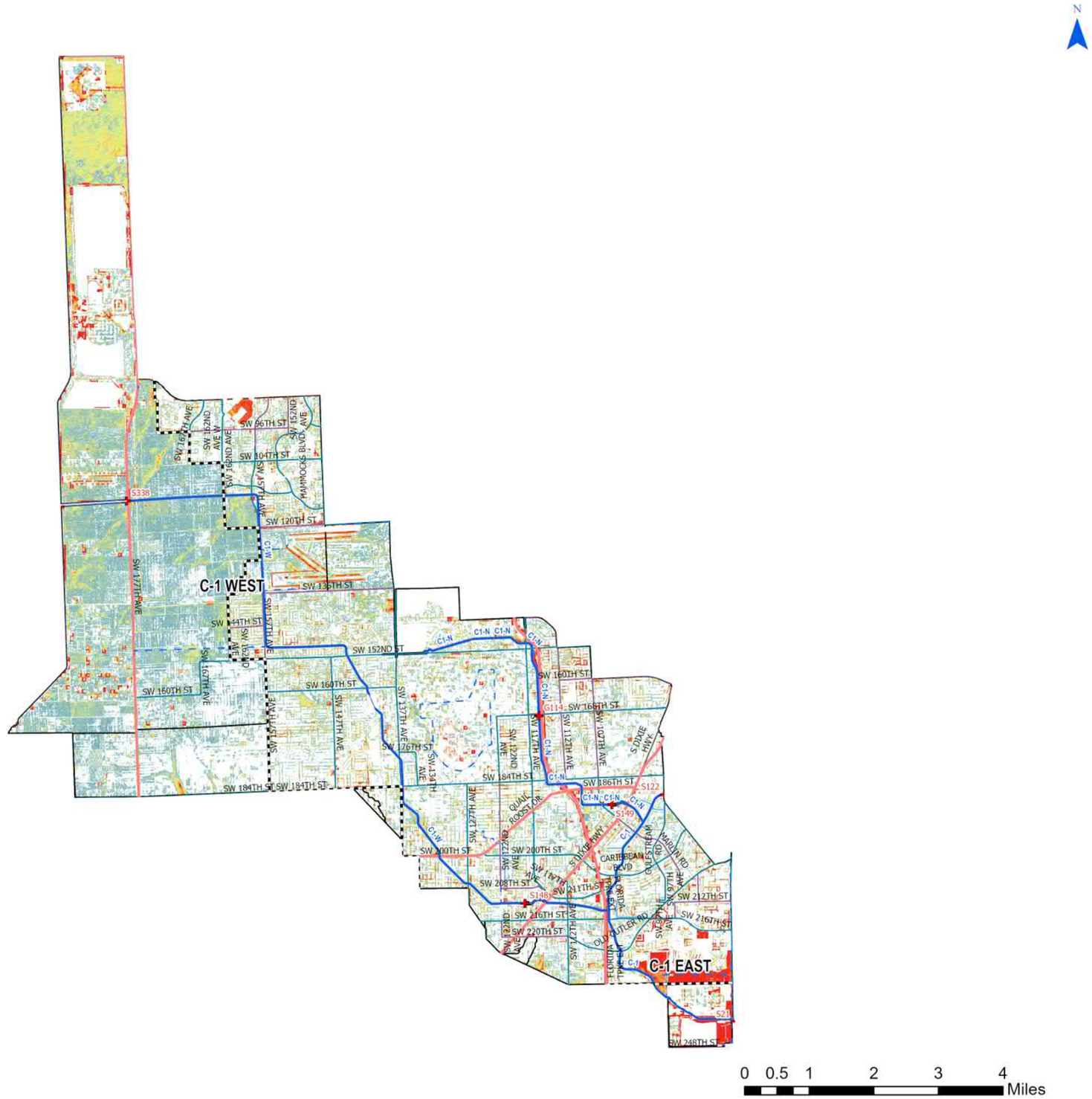
10-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-5. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 0

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

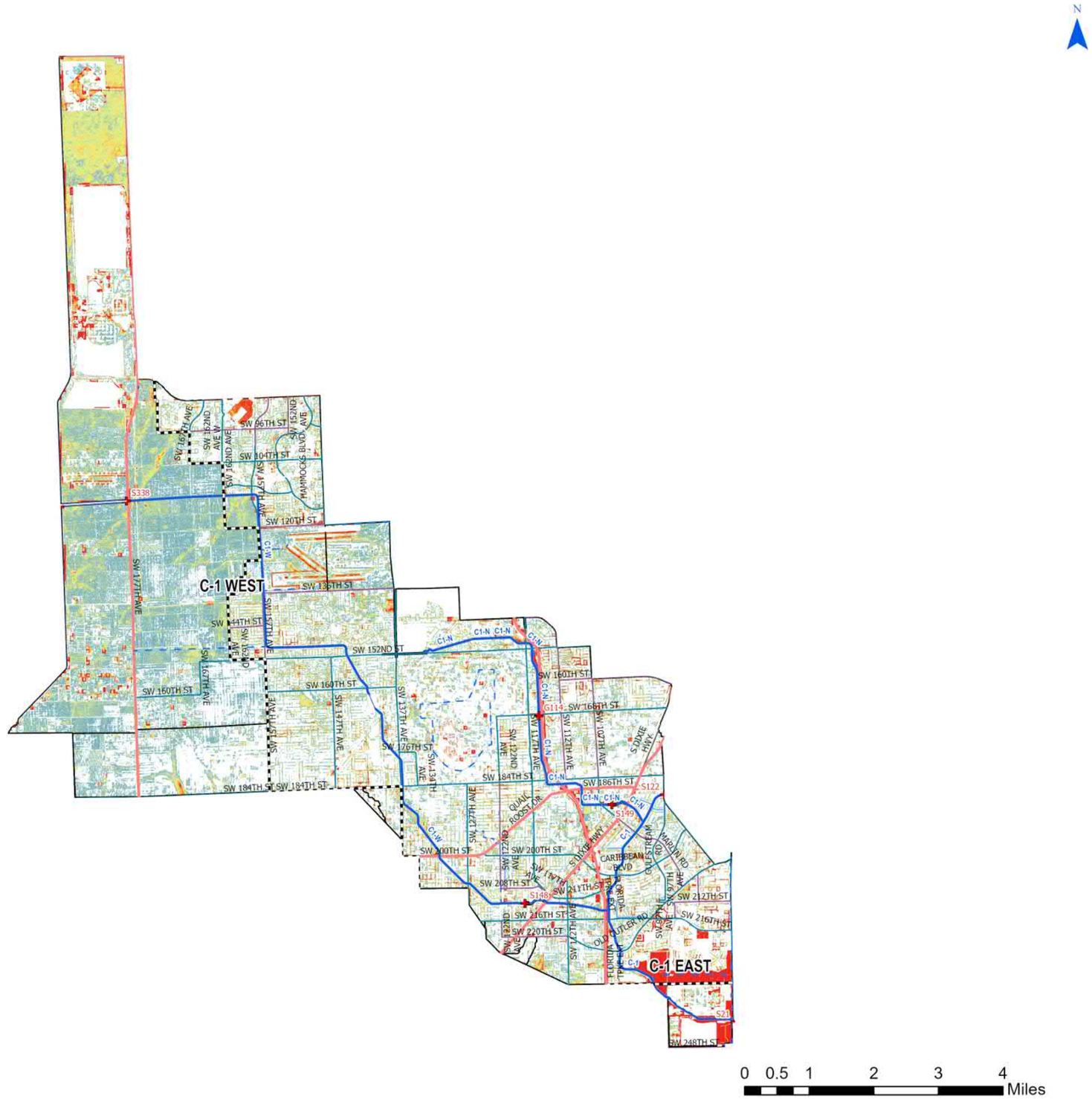
10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-6. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 1

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

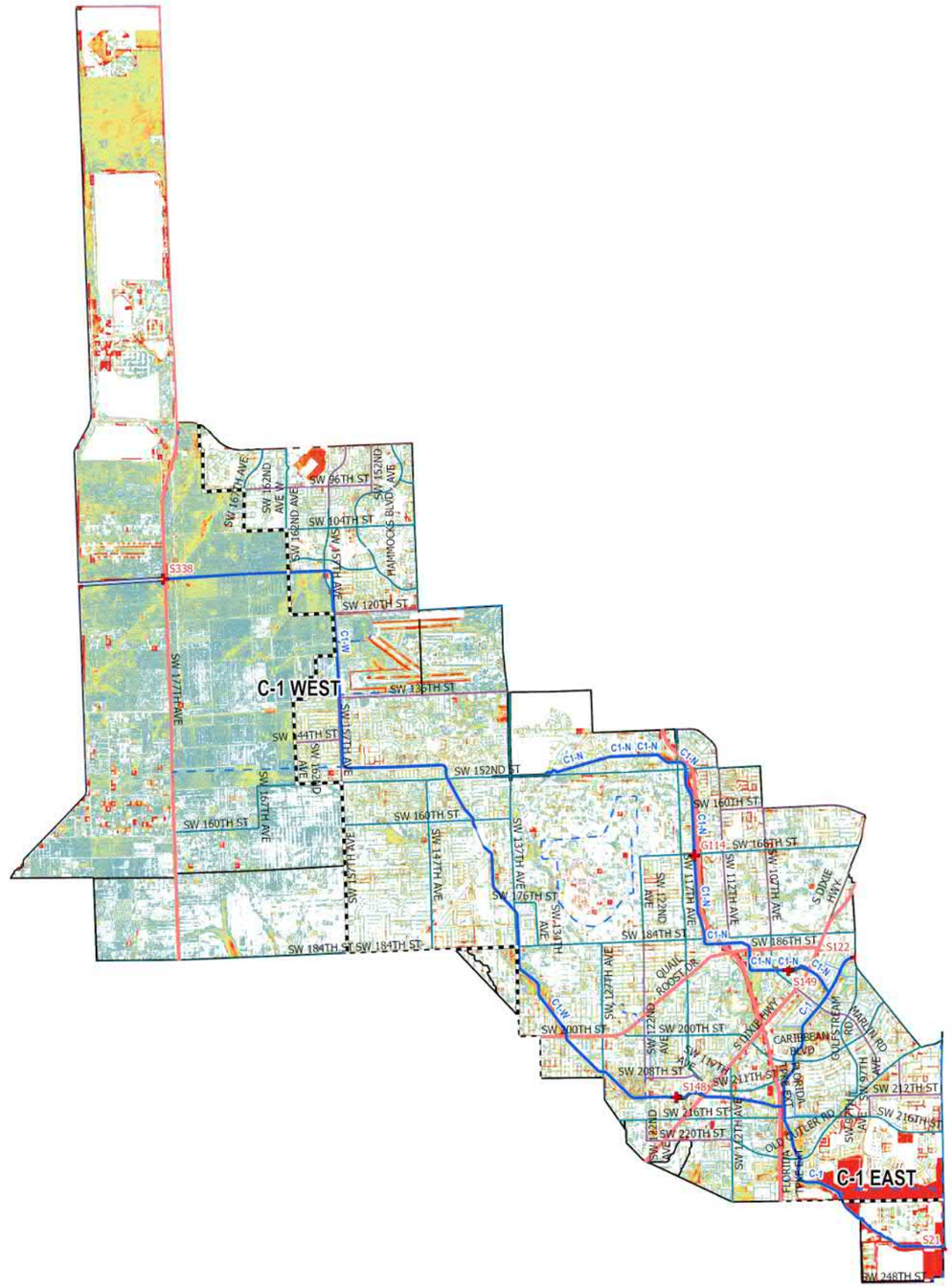
10-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-7. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 2

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

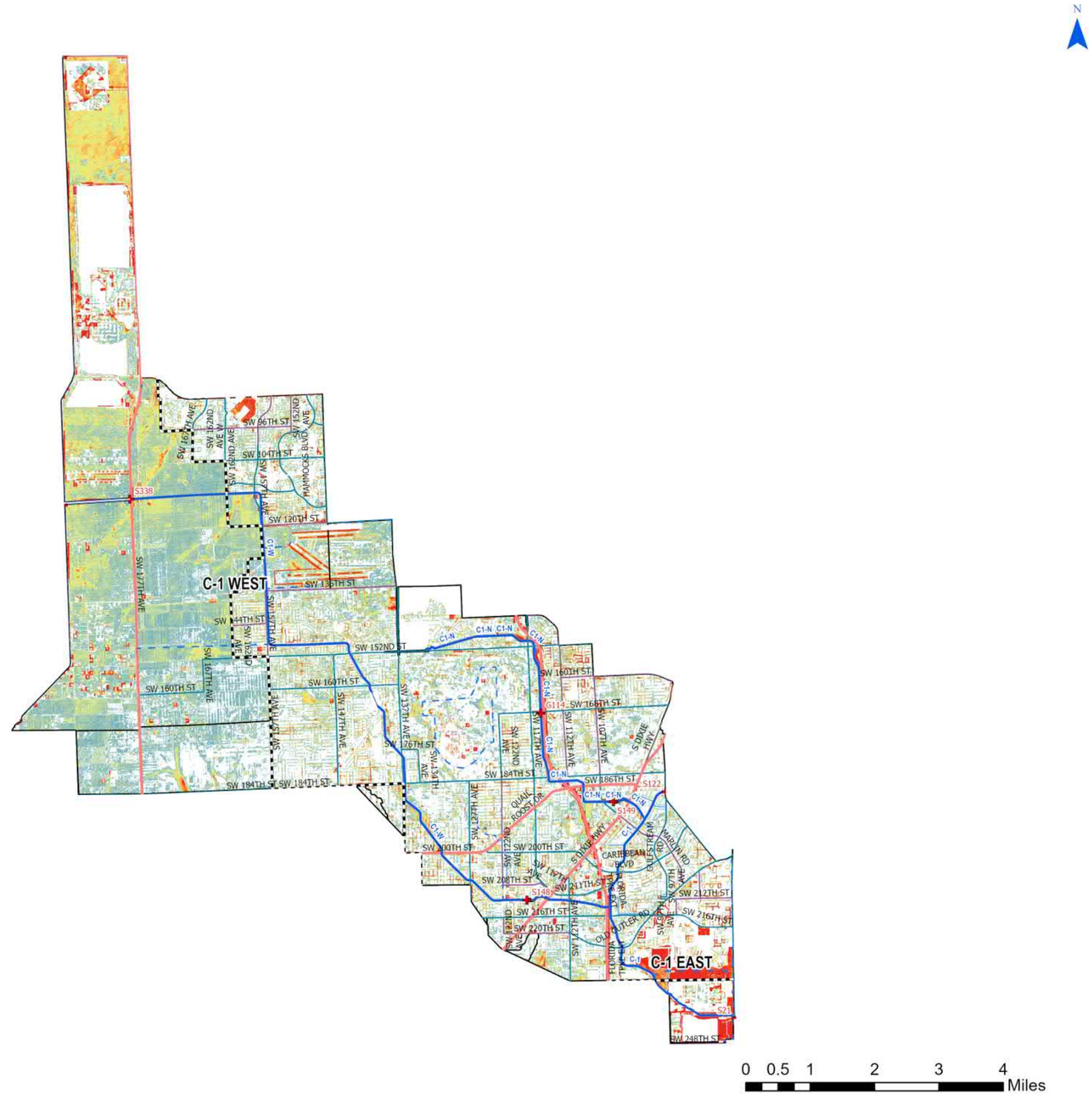
N

0 0.5 1 2 3 4 Miles

Figure A-8. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 3

Kimley»Horn

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

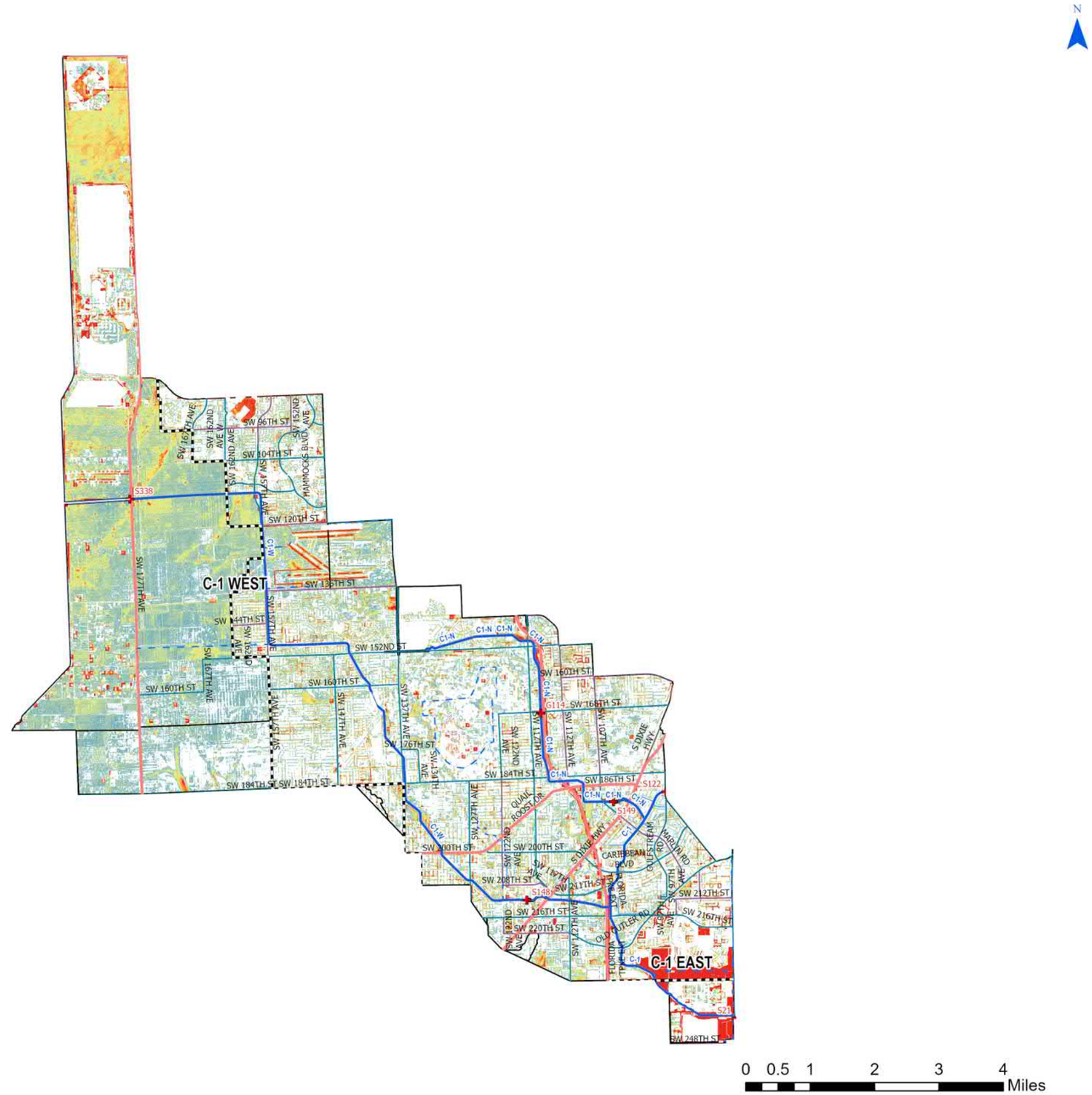
25-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-9. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 0

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

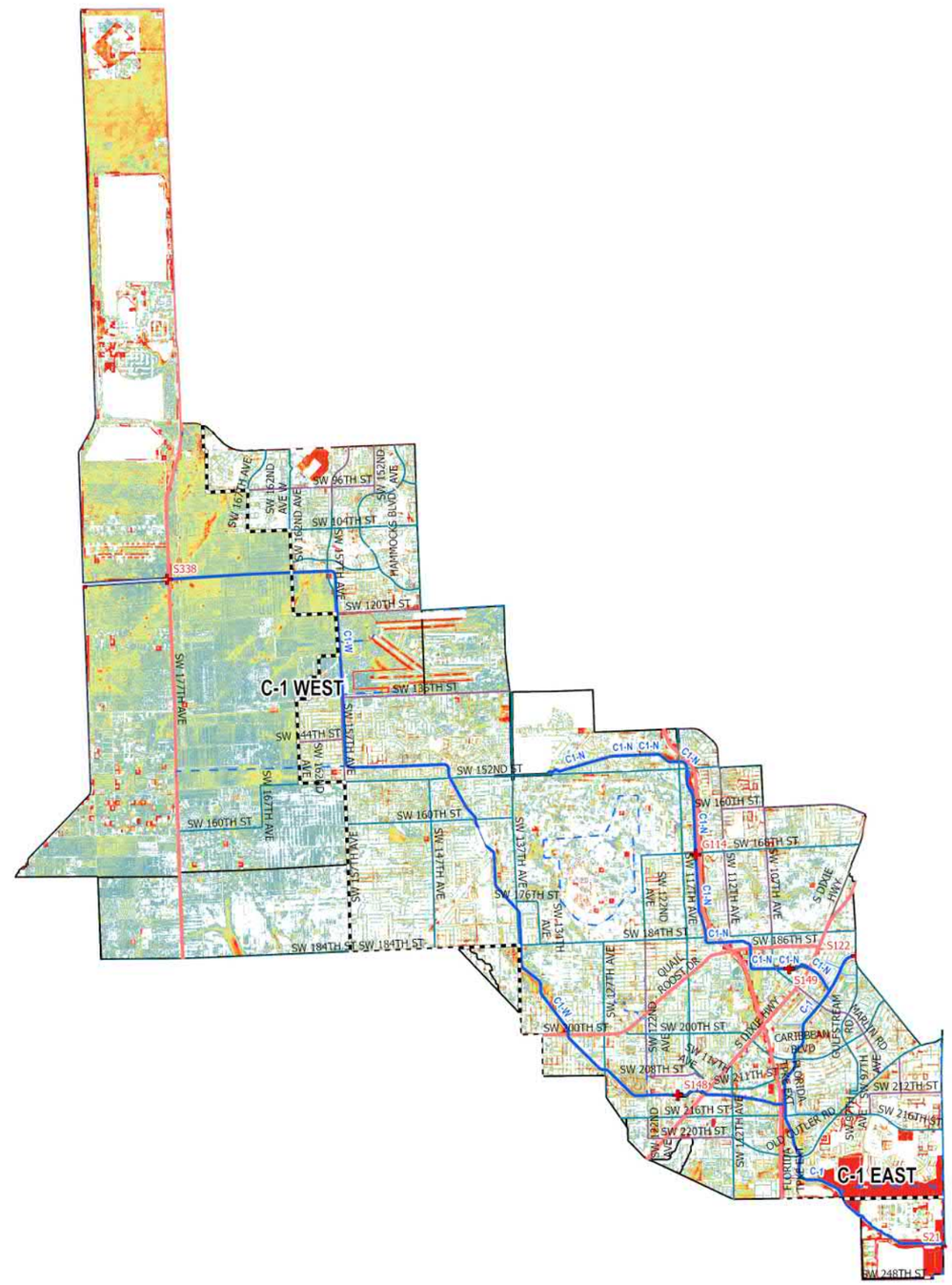
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-10. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

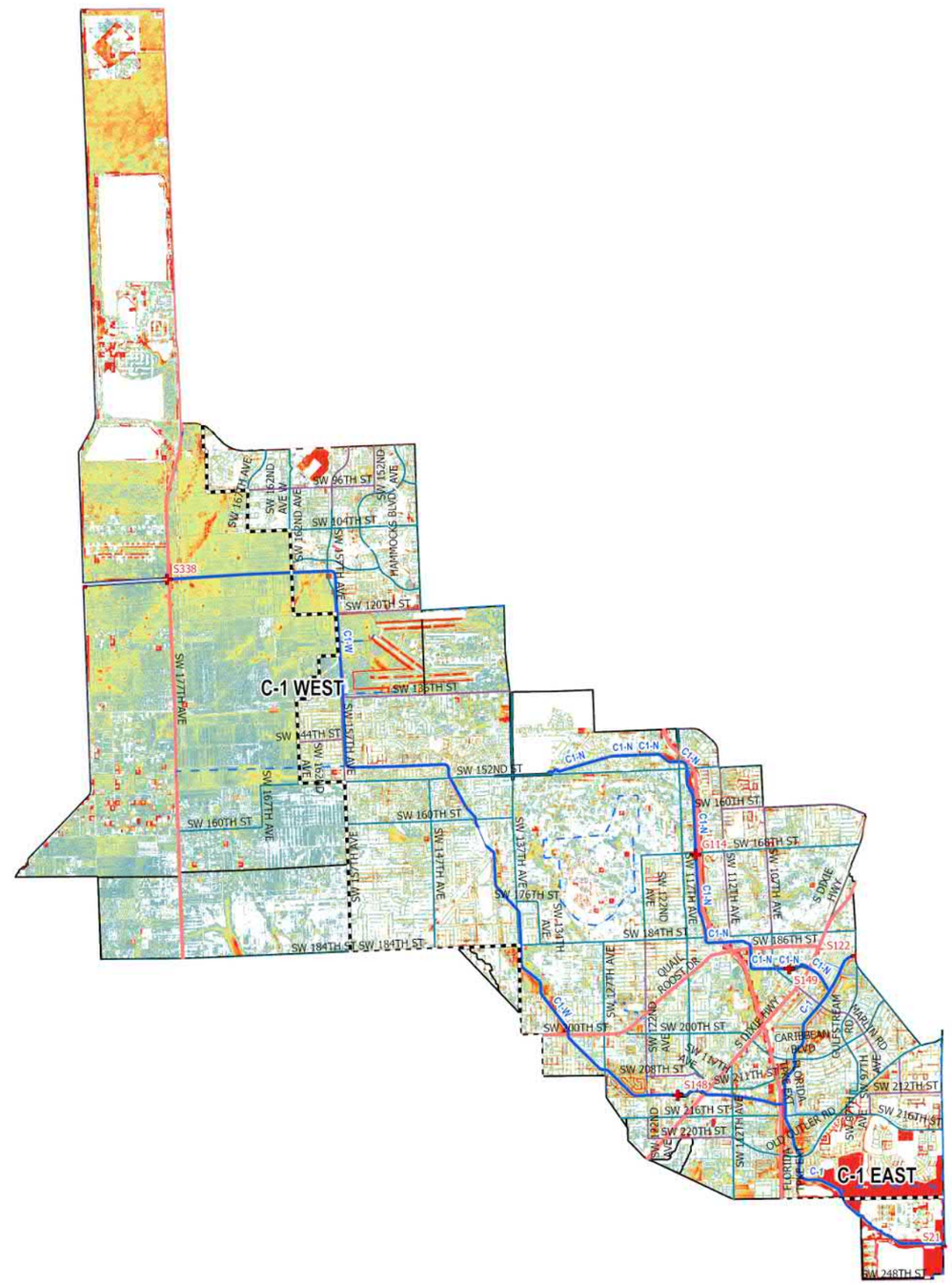
N

0 0.5 1 2 3 4 Miles

Figure A-11. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

N

0 0.5 1 2 3 4 Miles

Figure A-12. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

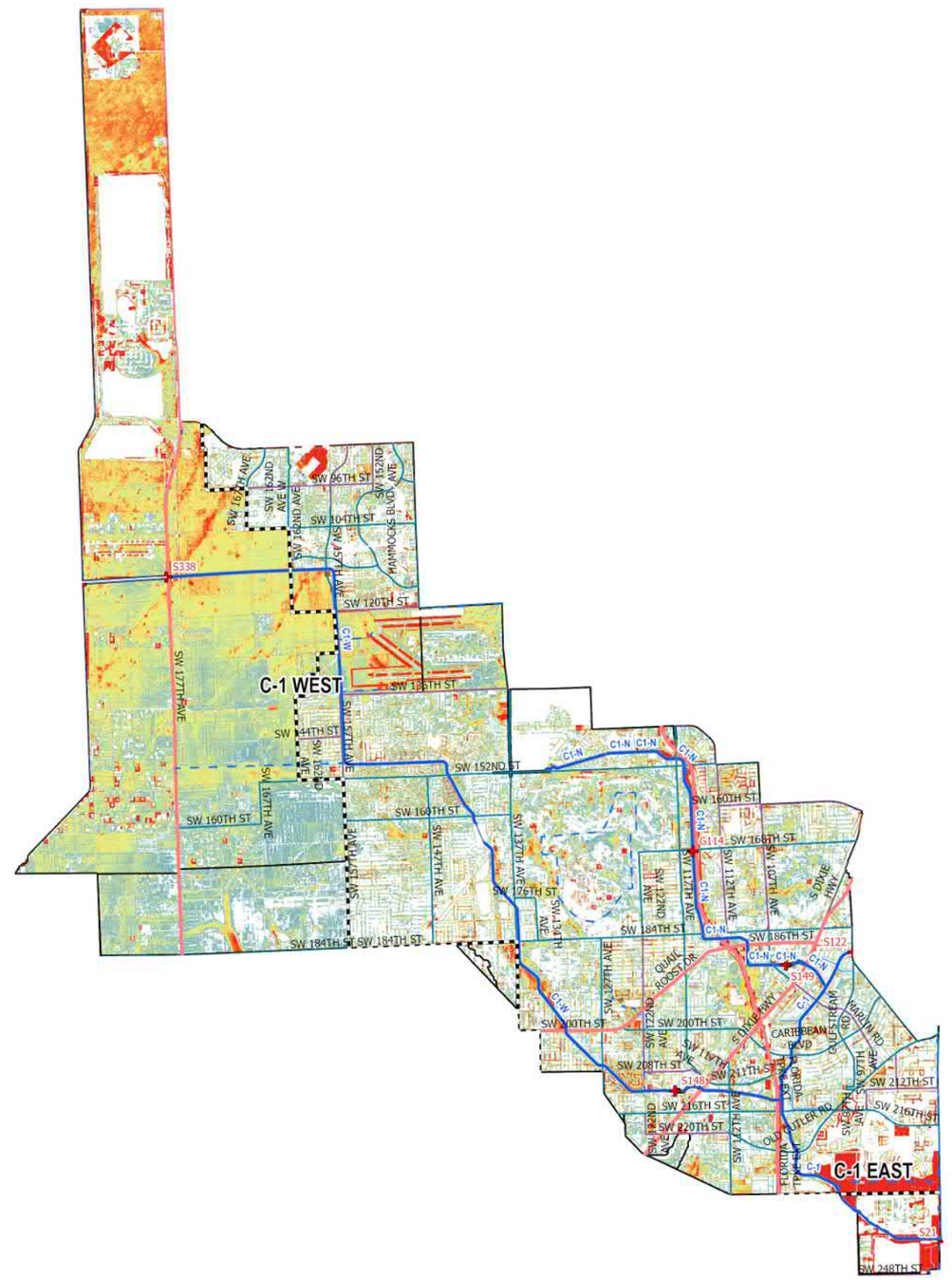
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft



0 0.5 1 2 3 4 Miles

Figure A-13. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

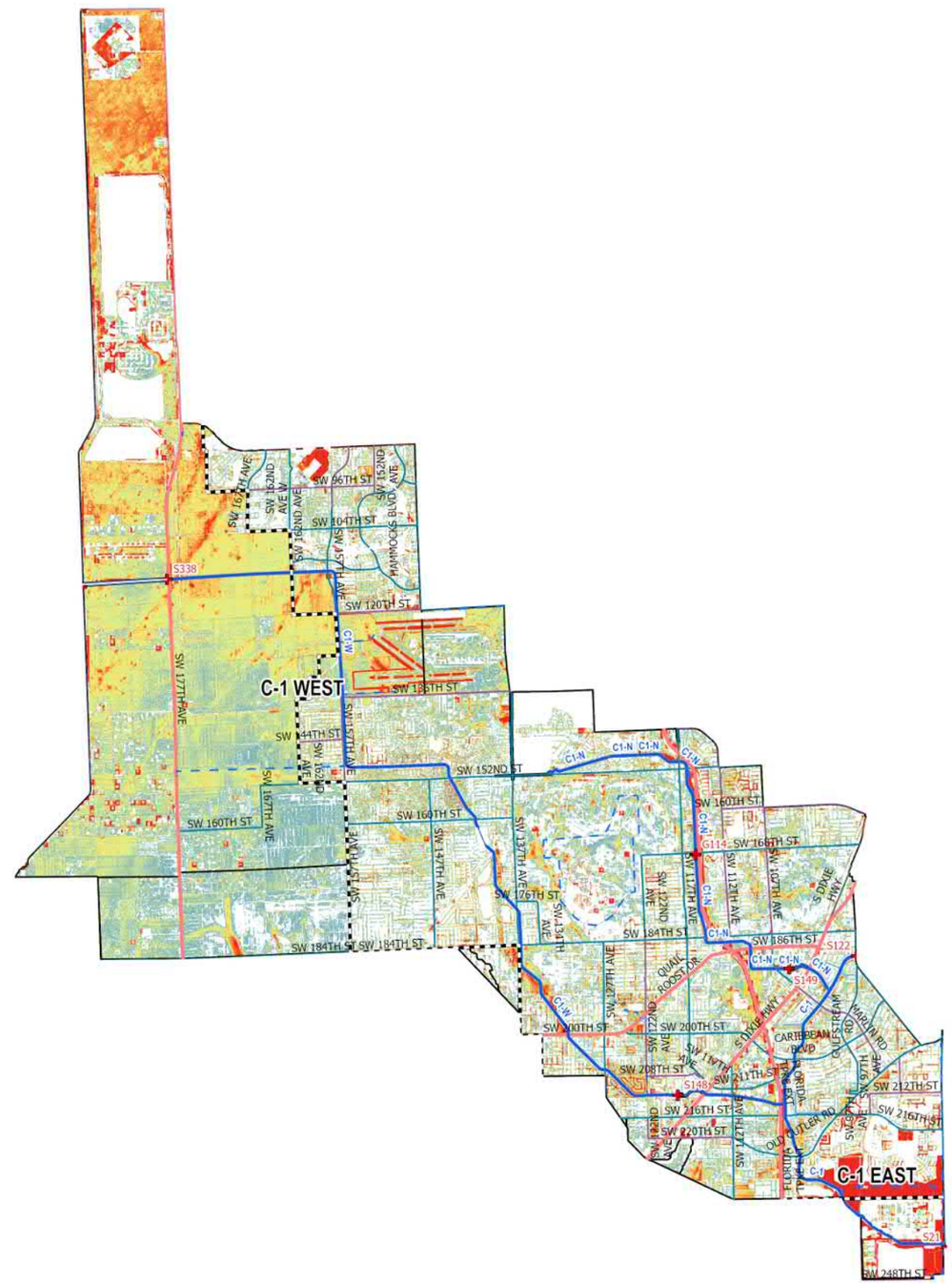
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

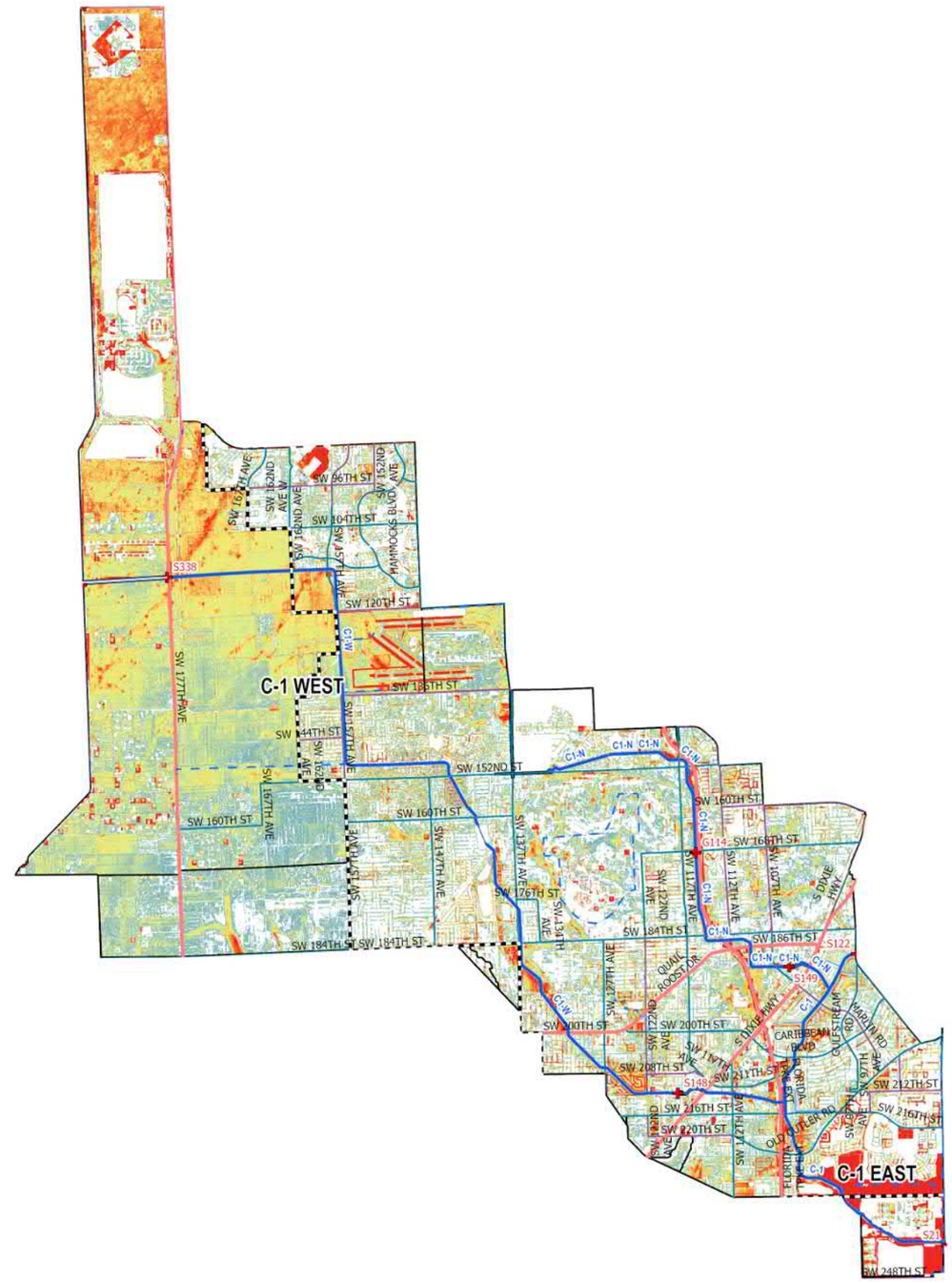


0 0.5 1 2 3 4 Miles

Figure A-14. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 1

Kimley»Horn

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

N

0 0.5 1 2 3 4 Miles

Figure A-15. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

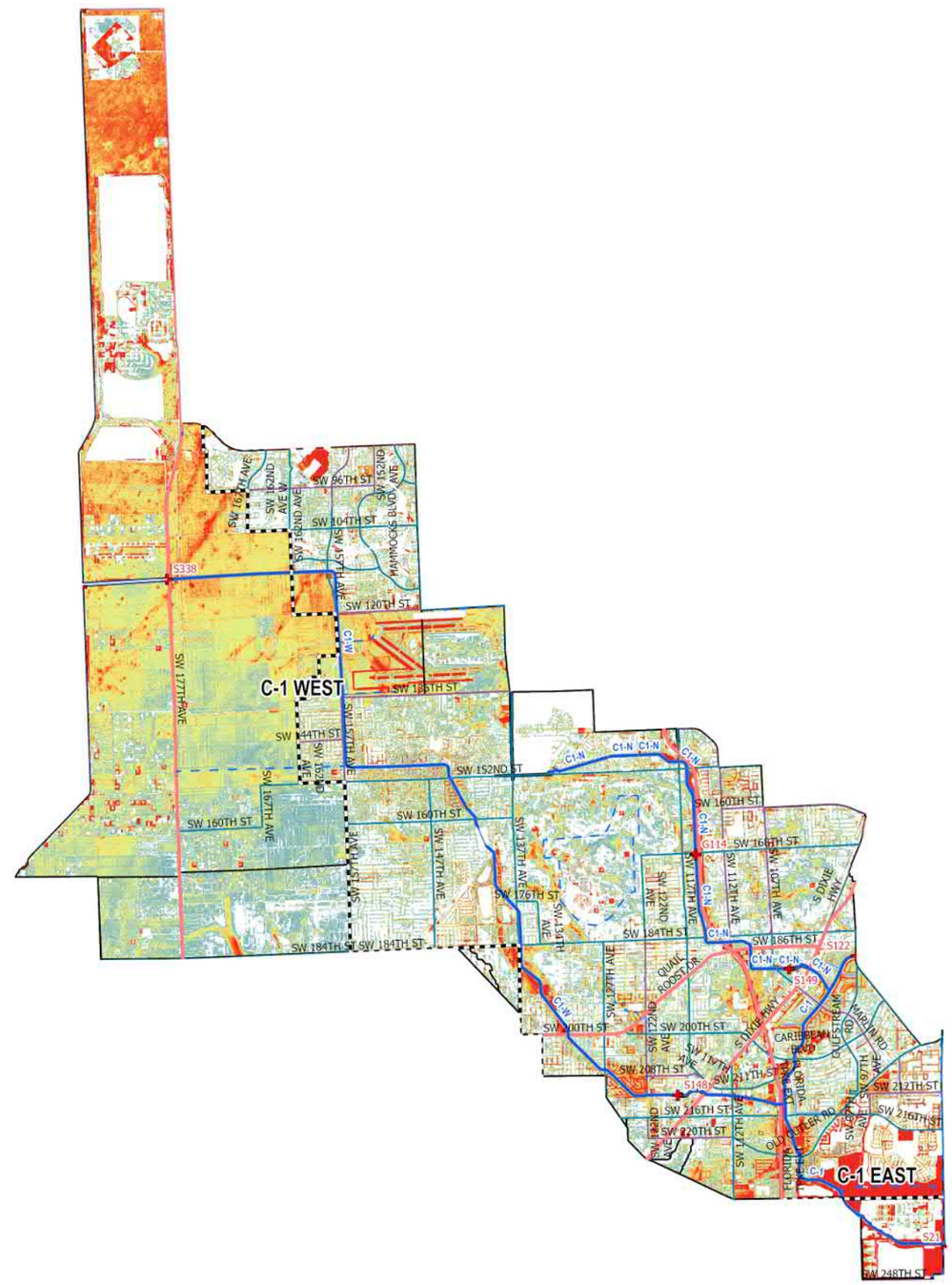
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

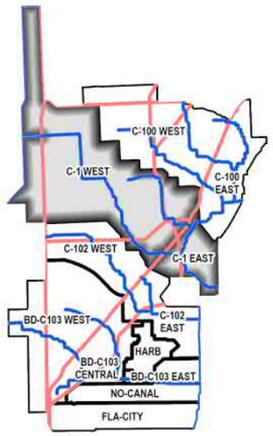


0 0.5 1 2 3 4 Miles

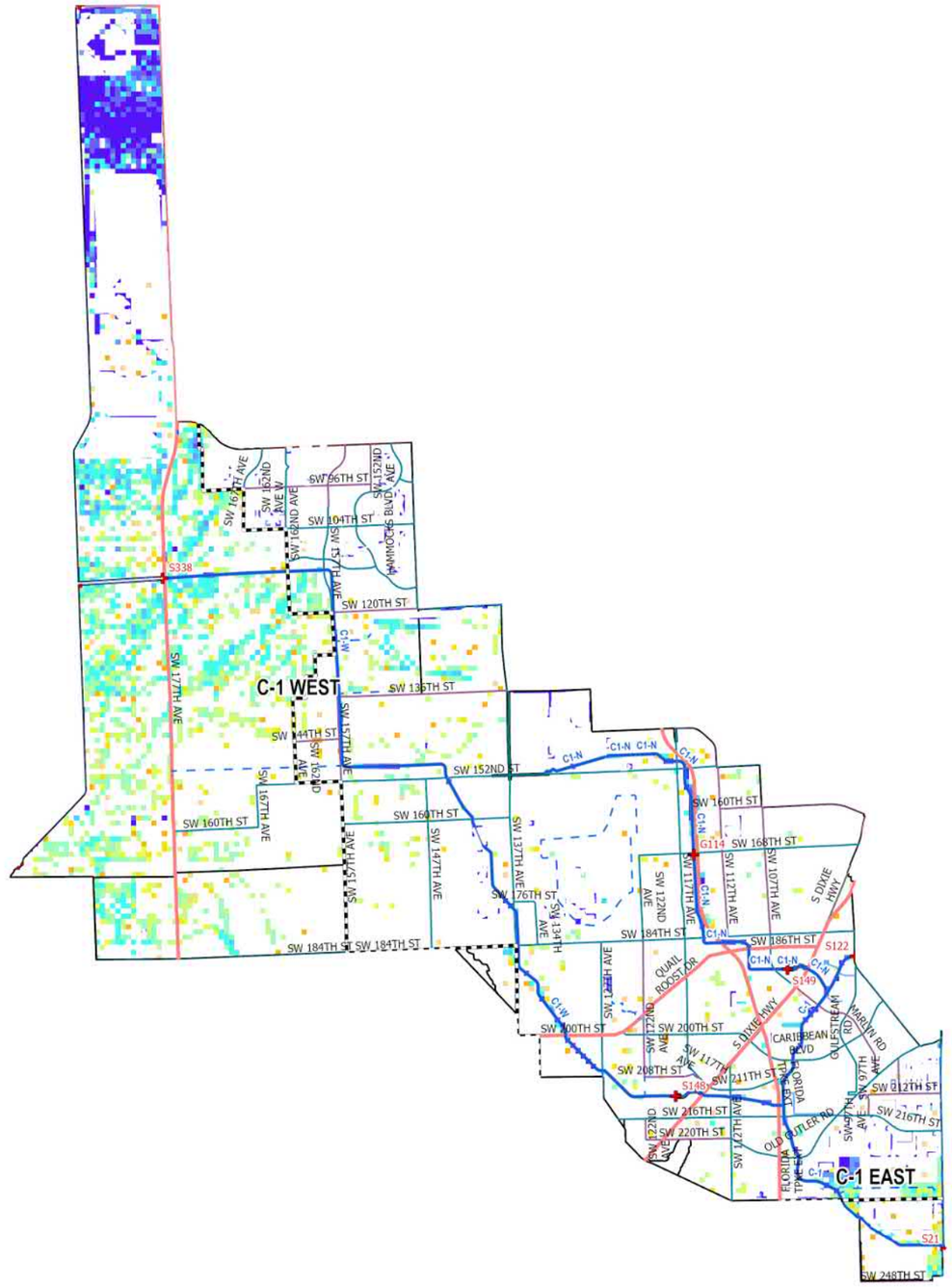
Figure A-16. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 3

Kimley»Horn

WATERSHED C-1: Flood Duration for Entire Watershed



C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

N

0 0.5 1 2 3 4 Miles

Figure A-17. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

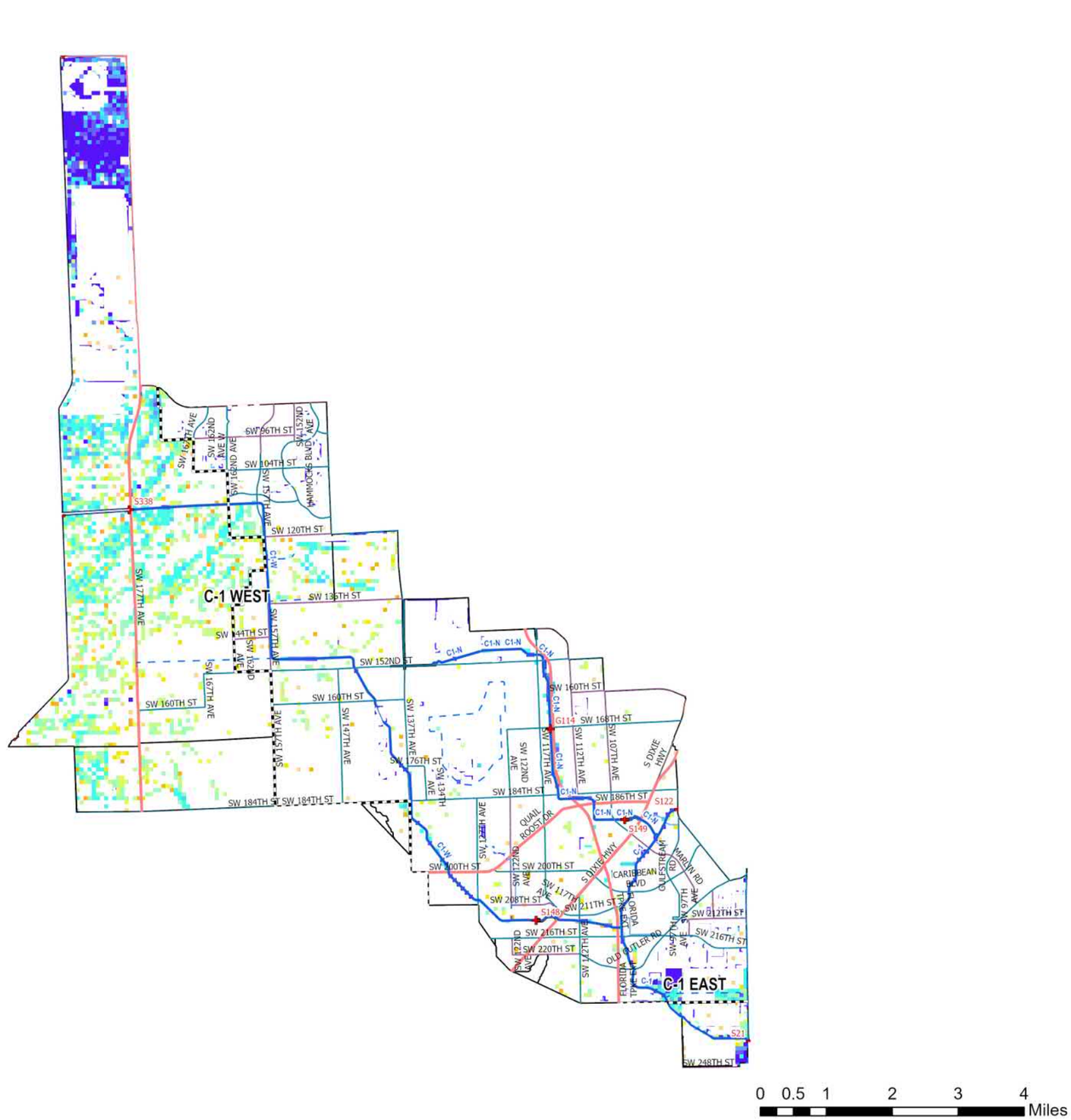
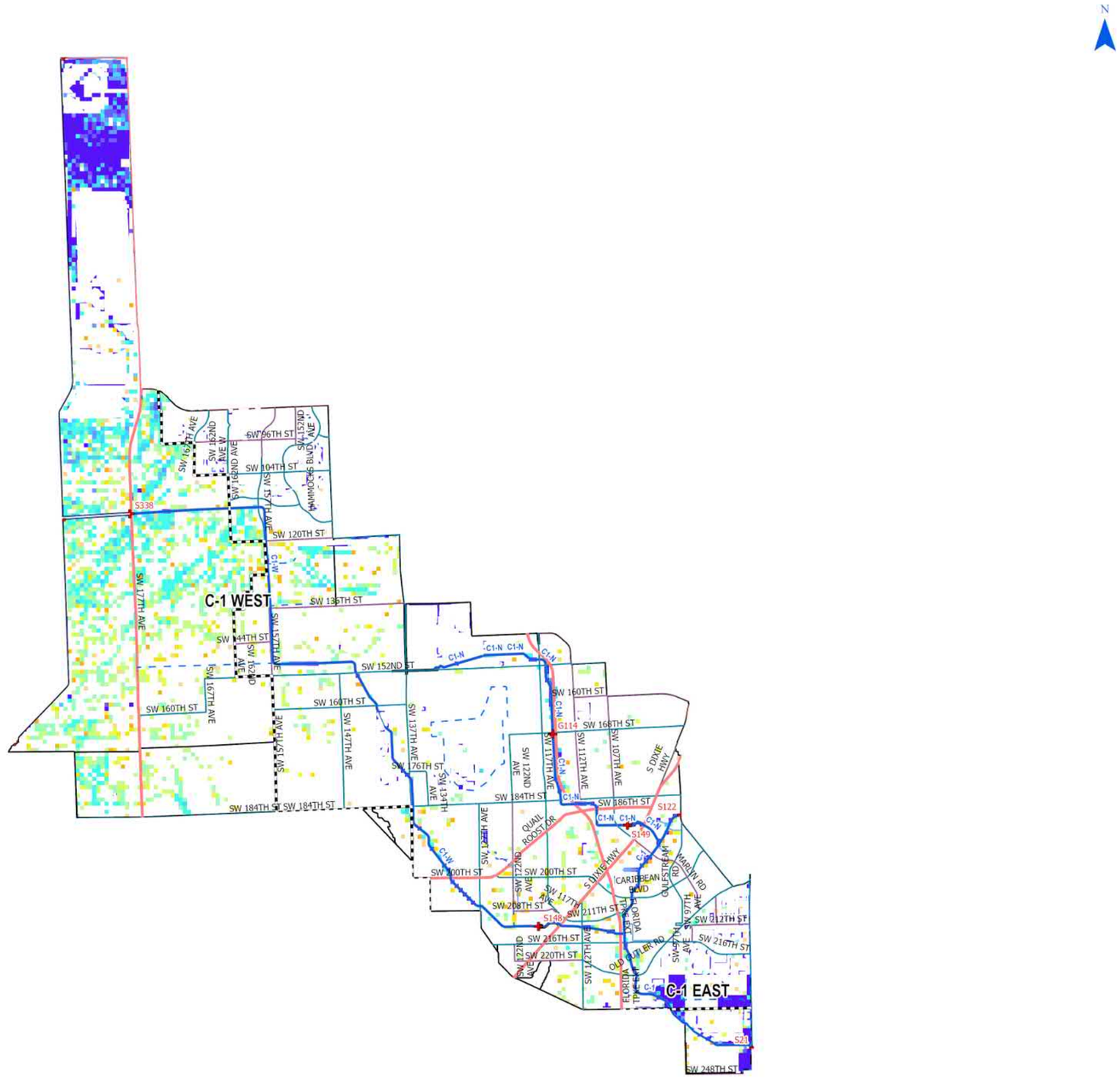


Figure A-18. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

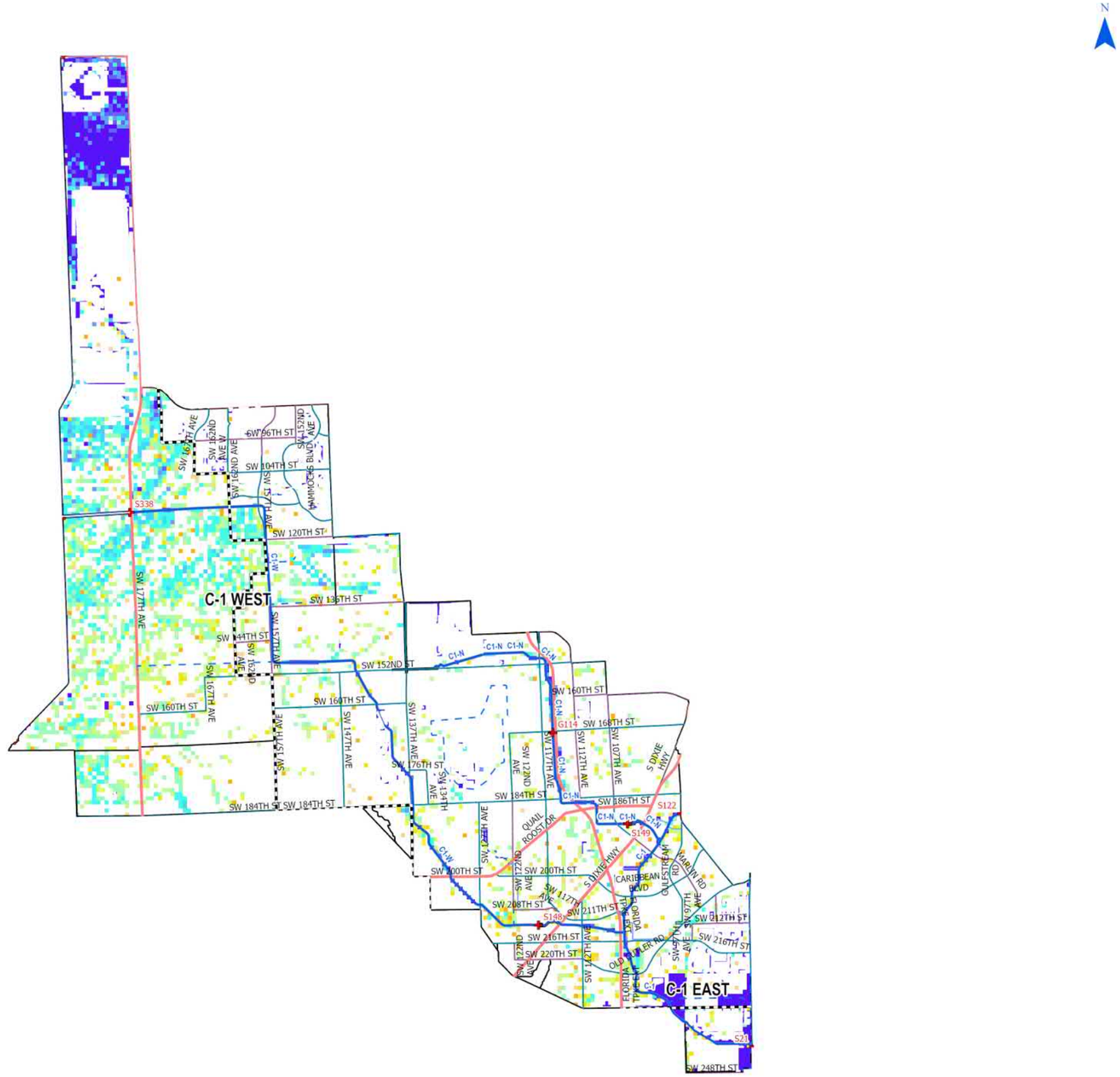
5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-19. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 2

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

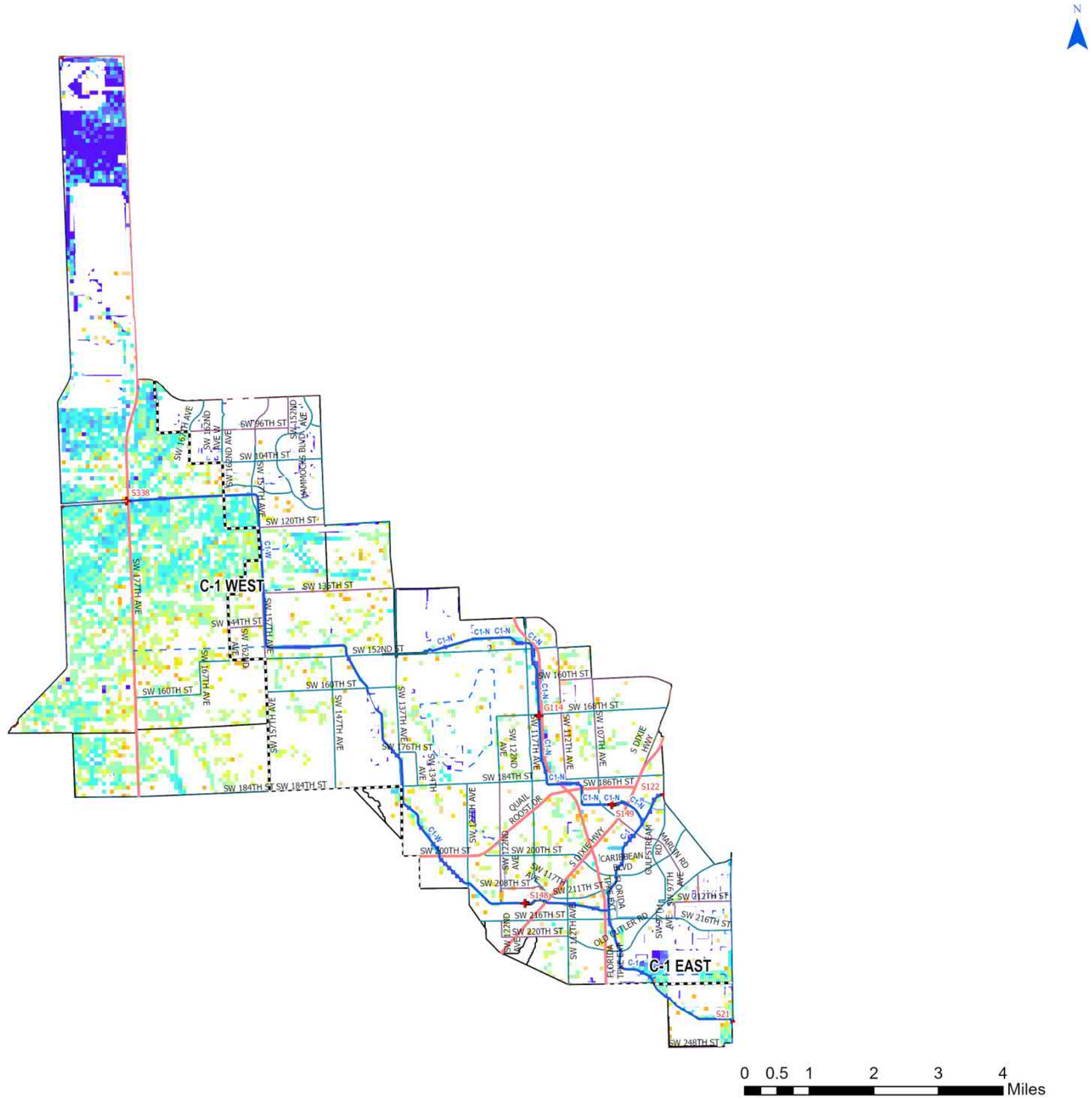
5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-20. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 3

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

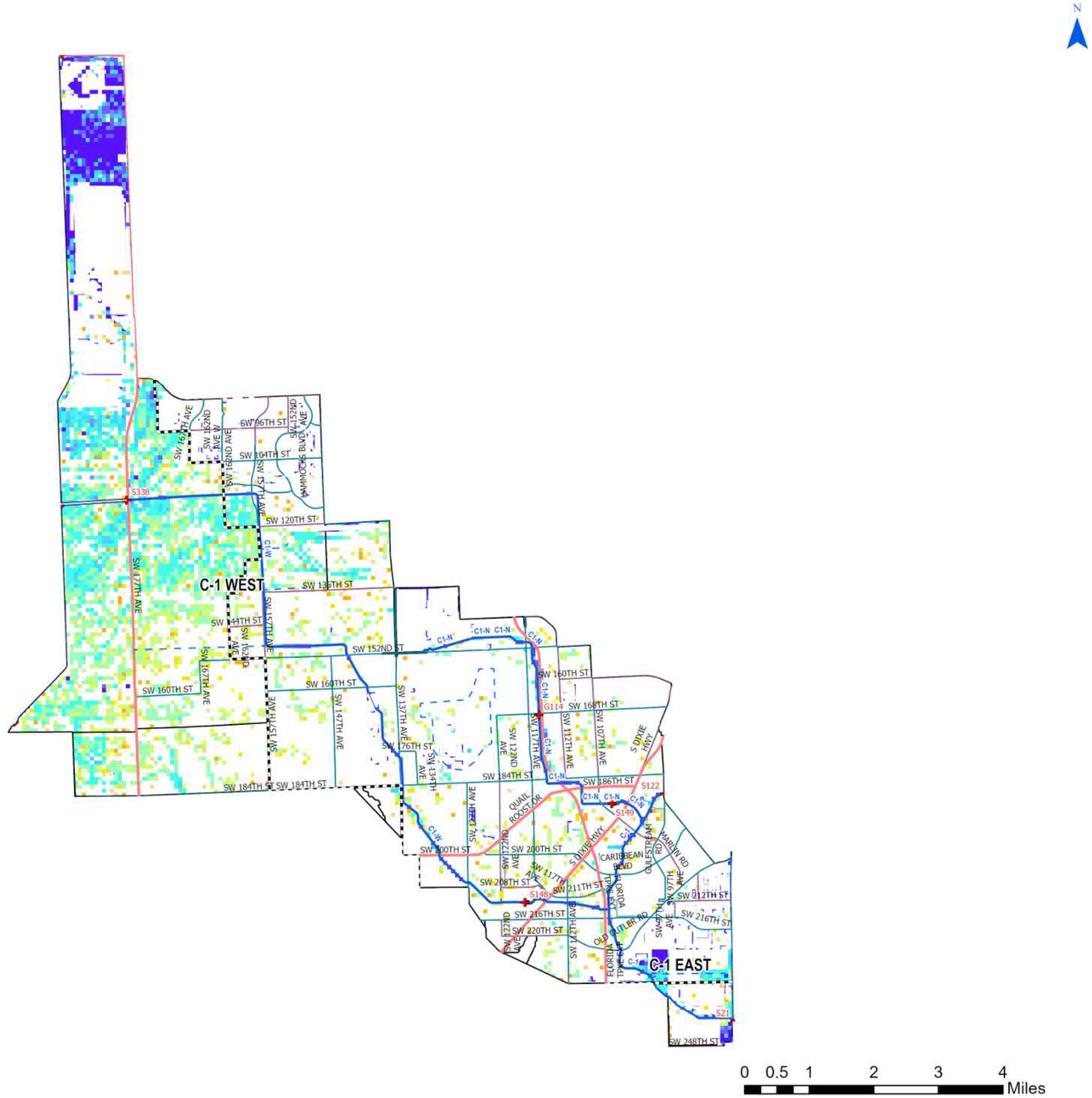
10-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-21. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 0

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

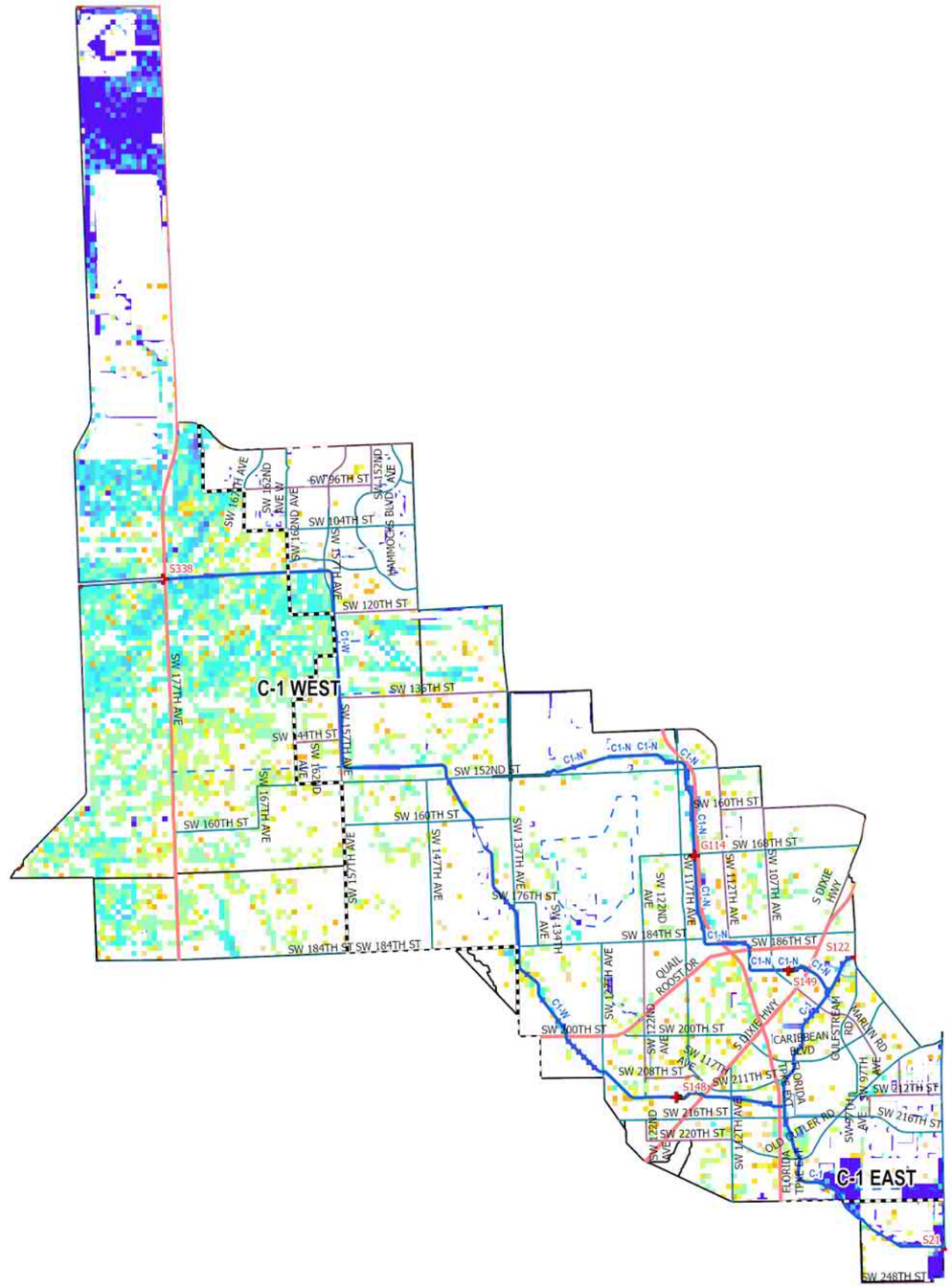
10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-22. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 1

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-23. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 2

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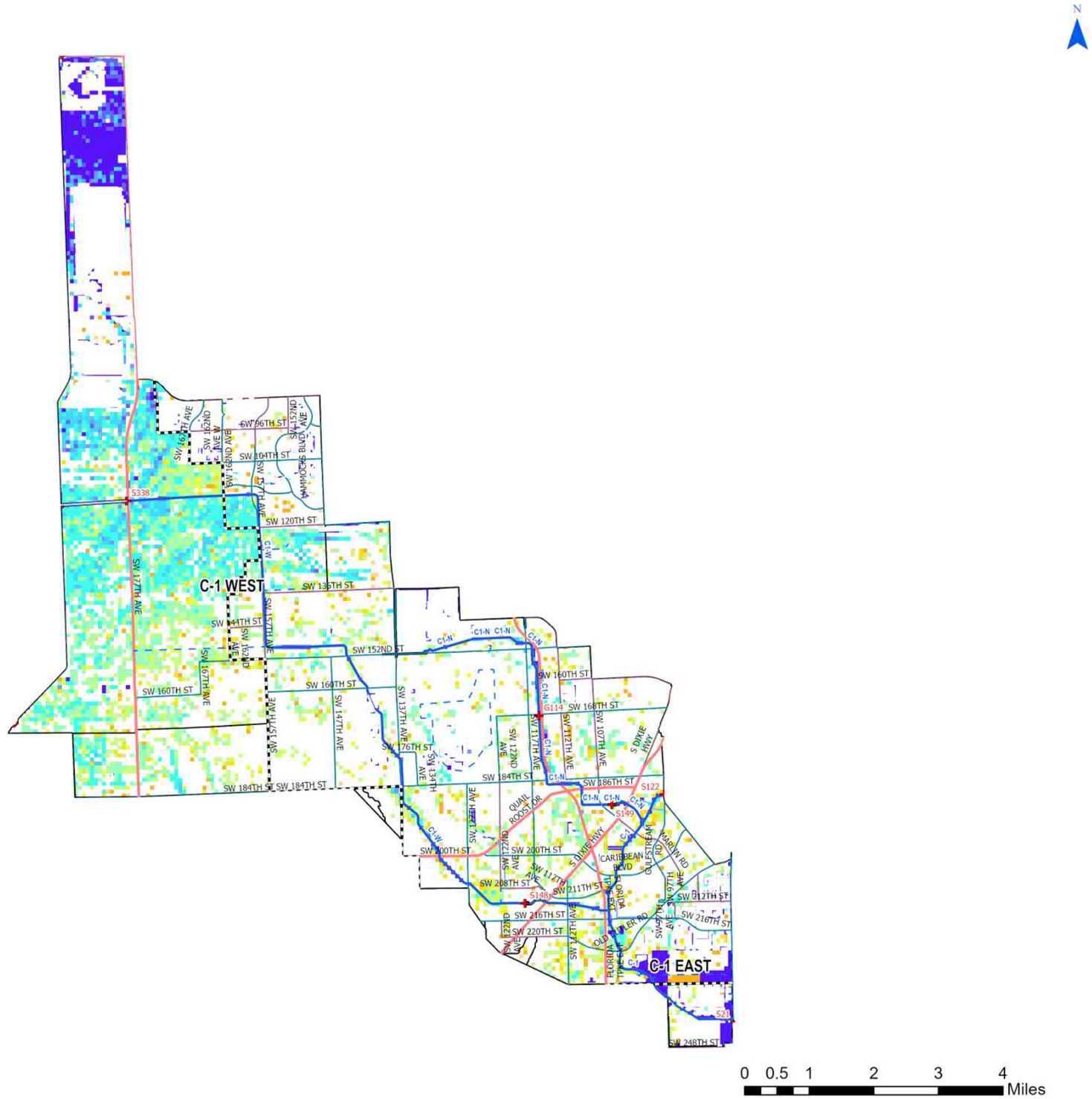
C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

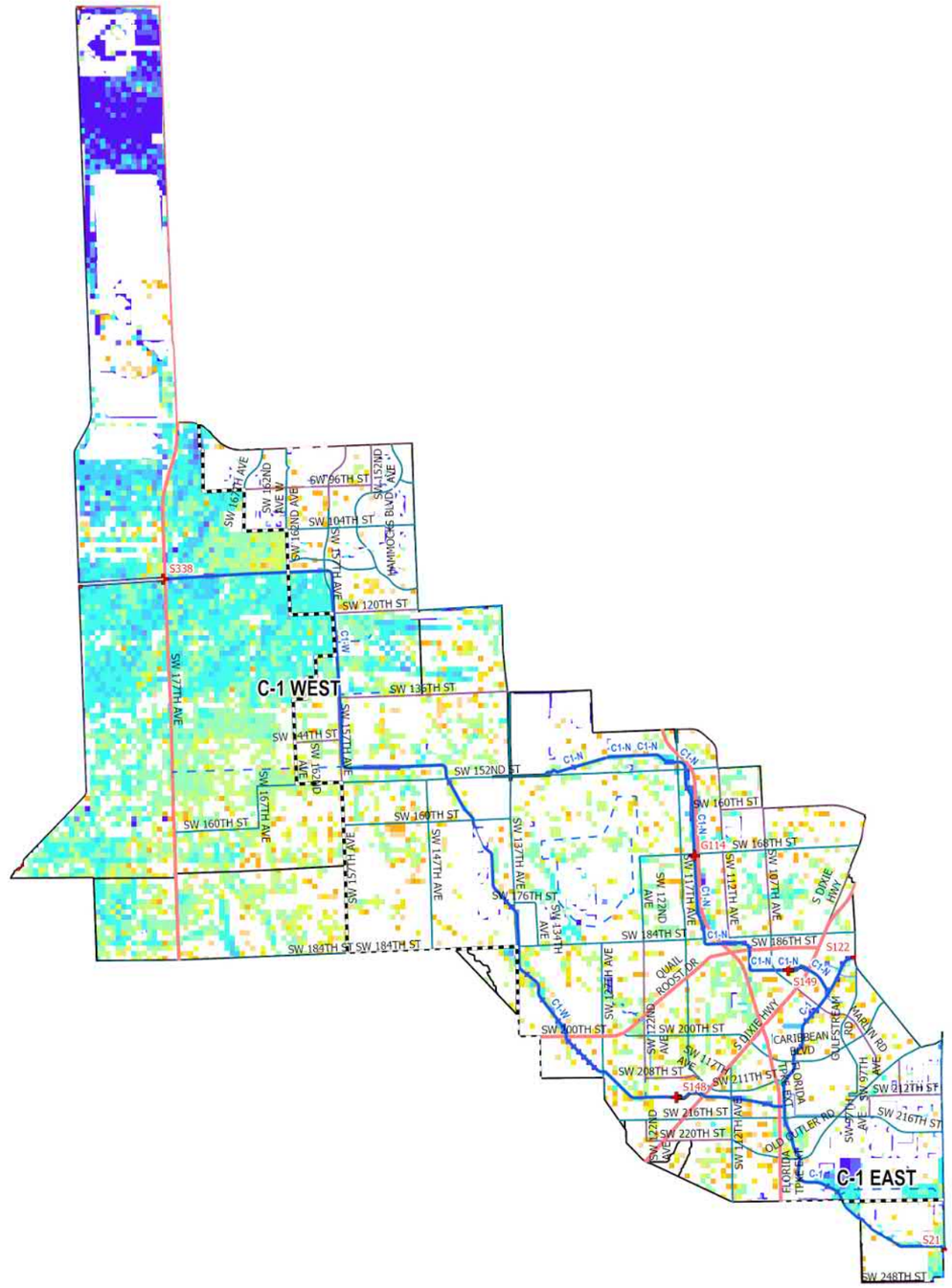
10-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-24. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 3

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-25. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 0

Kimley»Horn

C-1 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

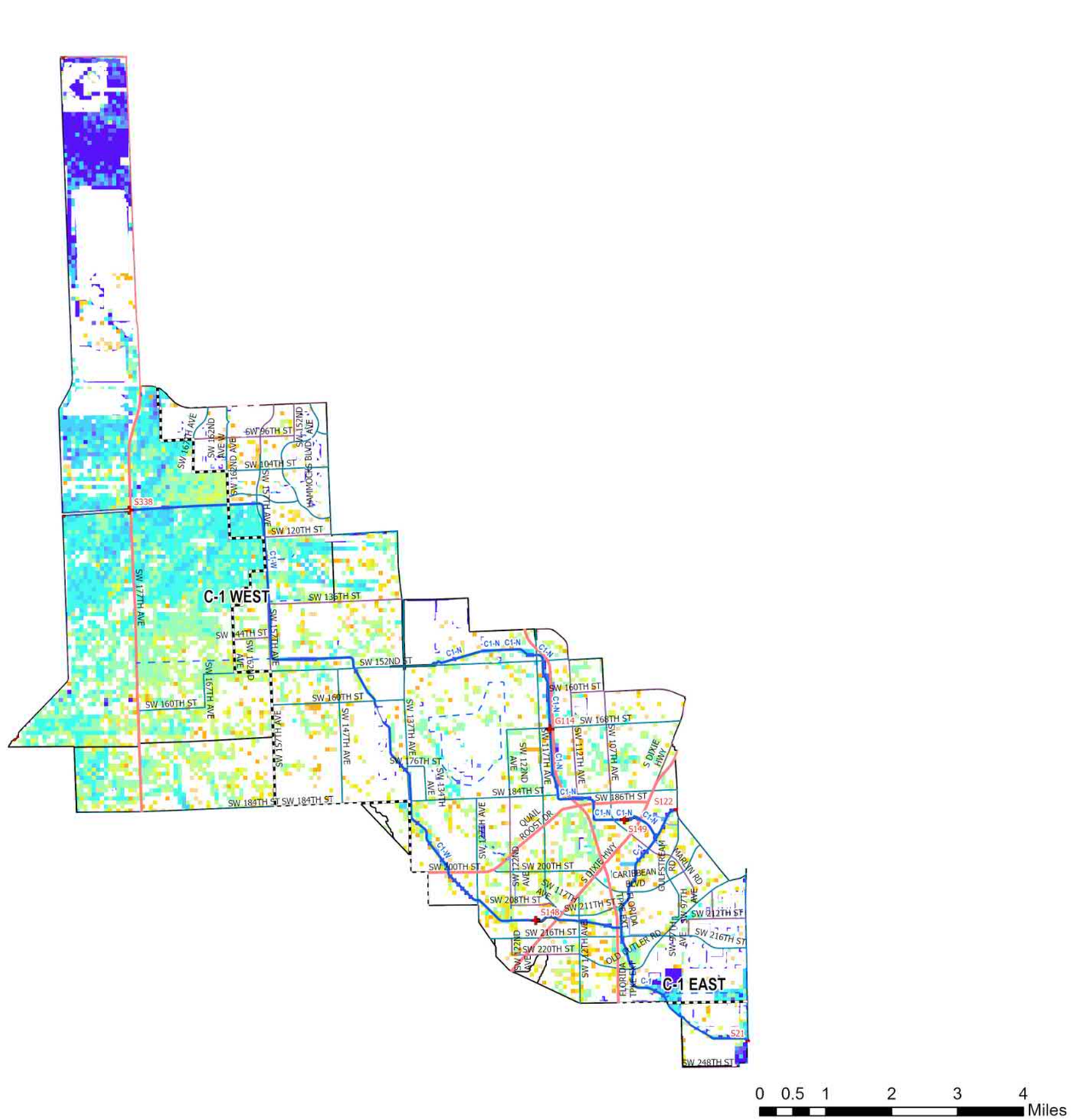
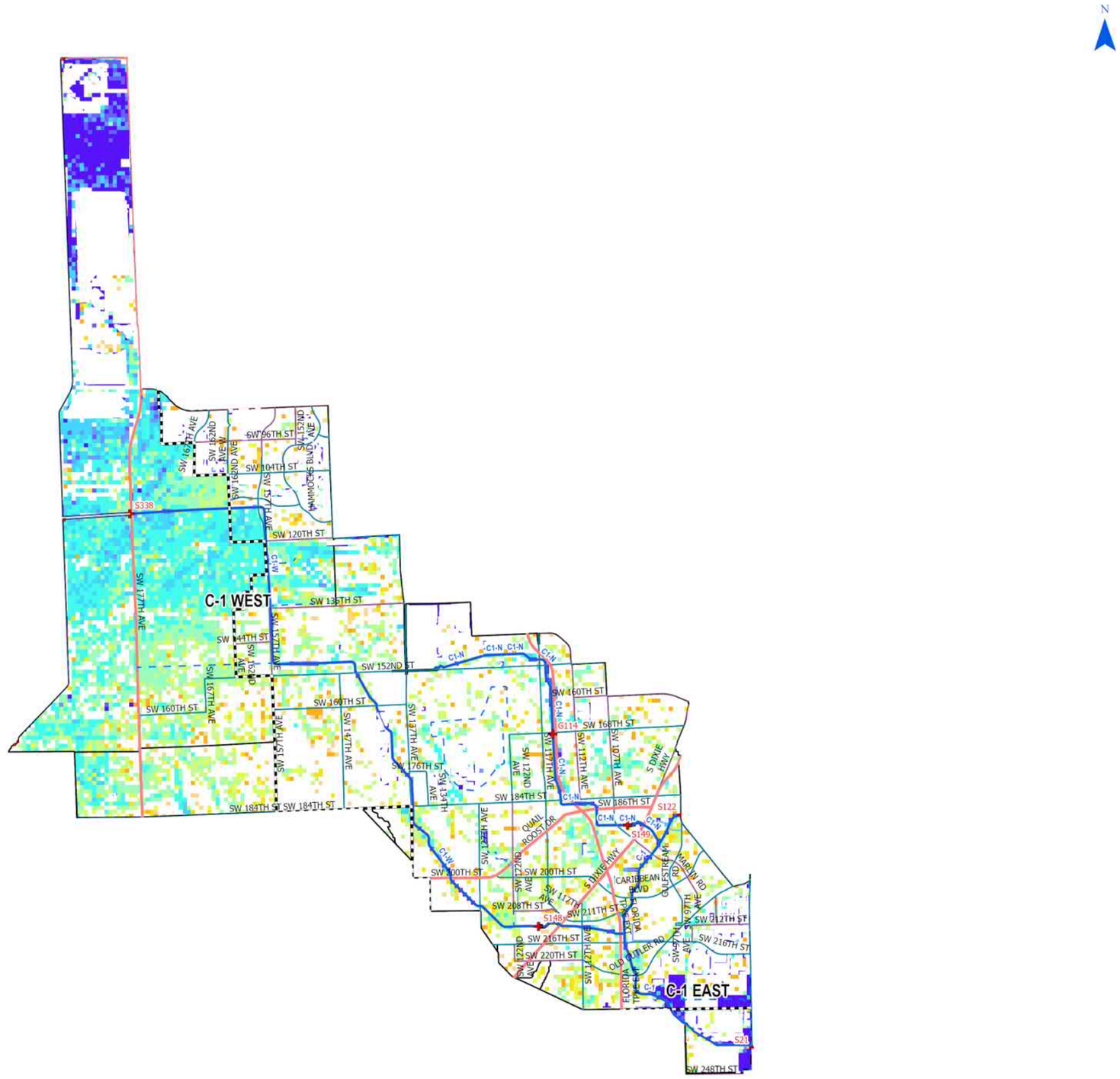


Figure A-26. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

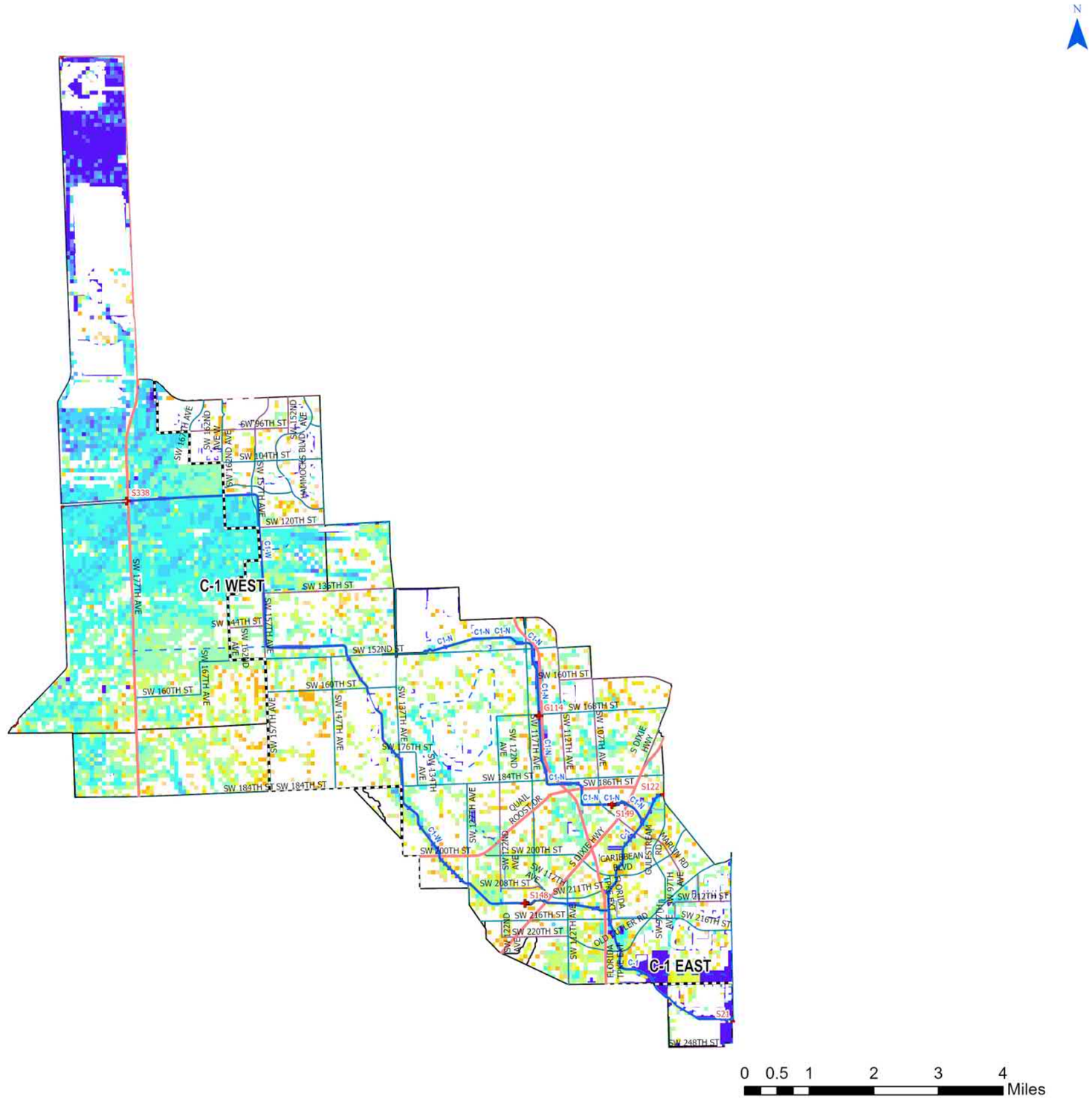
25-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-27. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 2

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

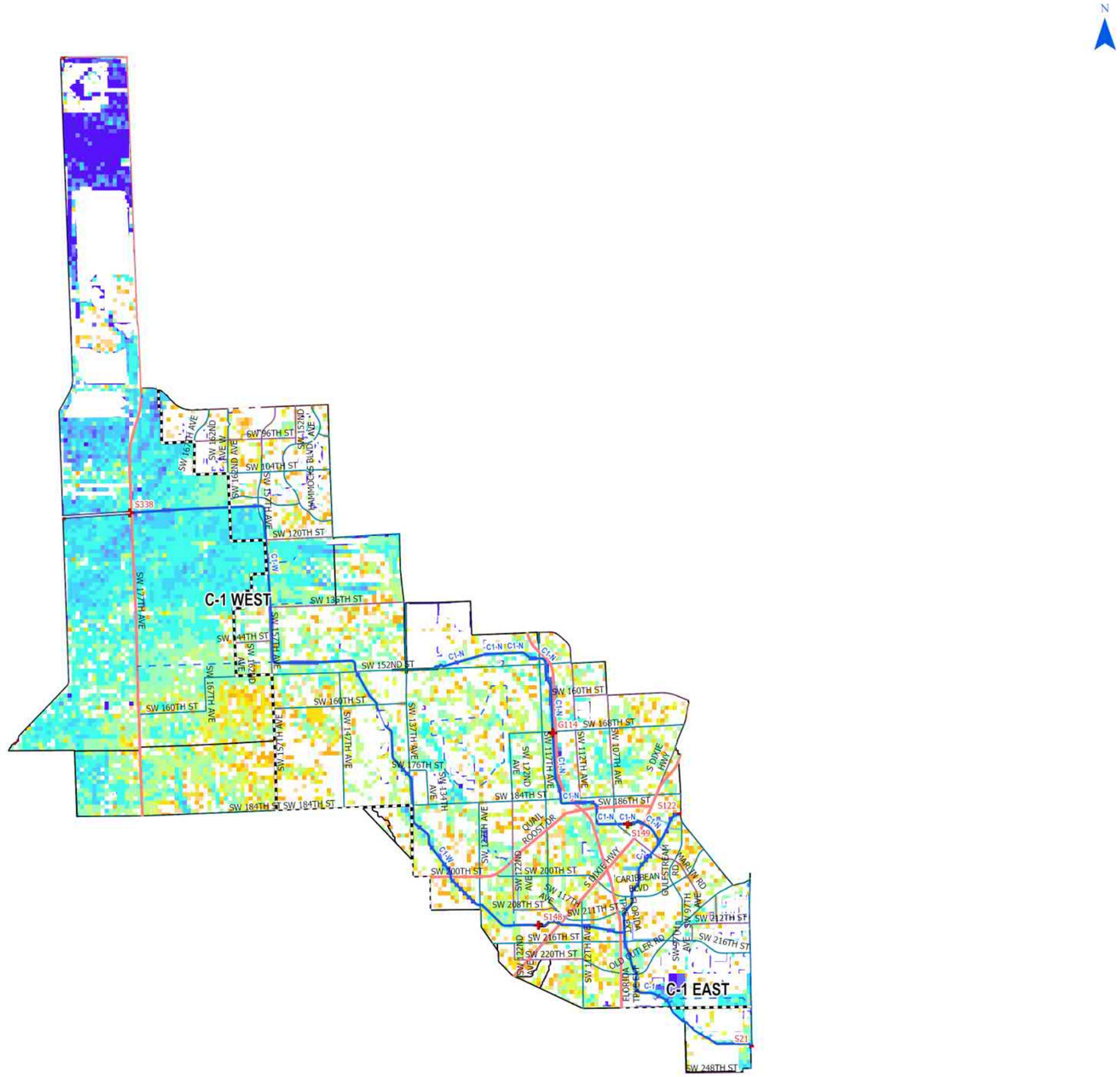
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-28. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 3

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-29. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 0

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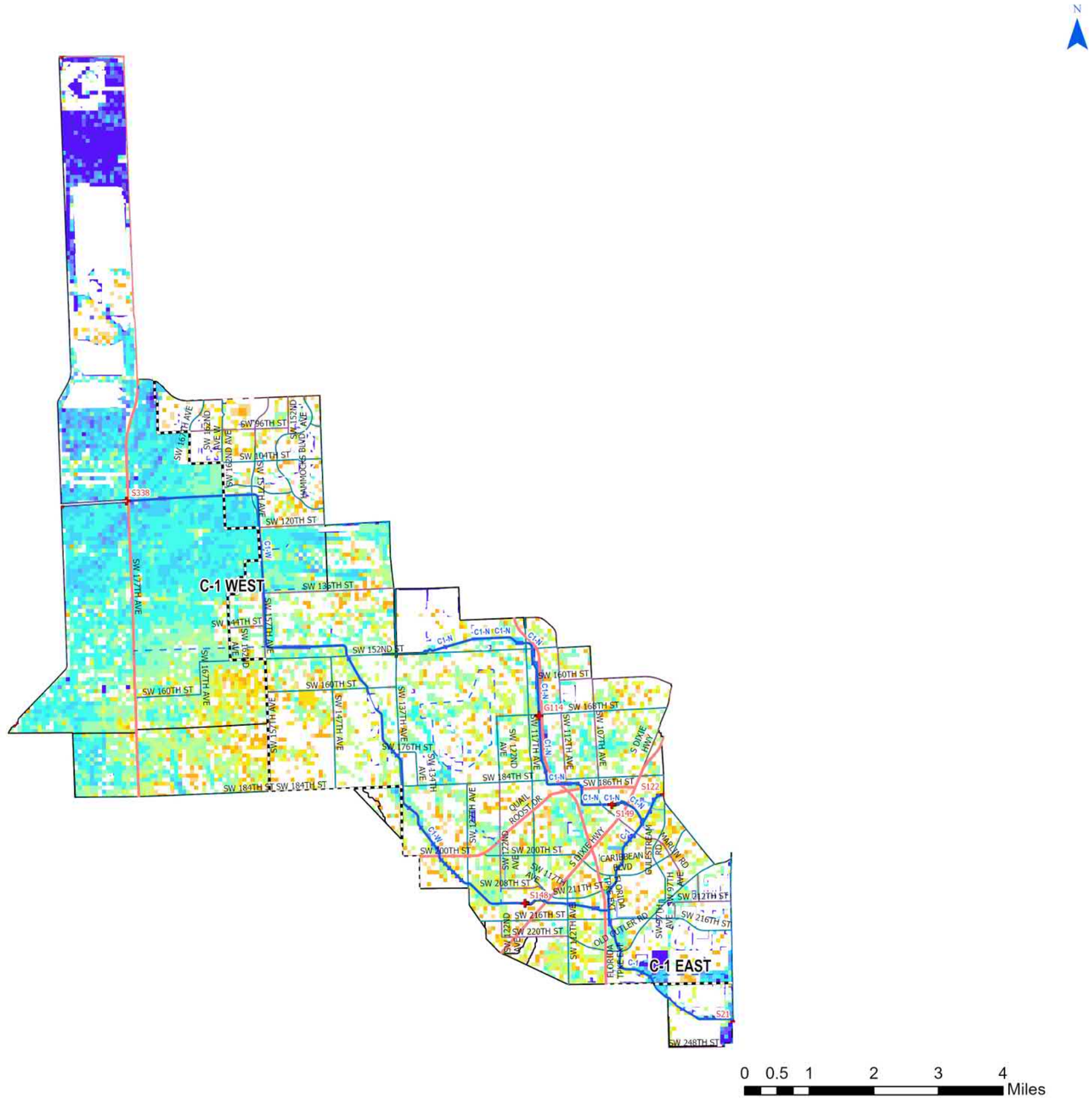
C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

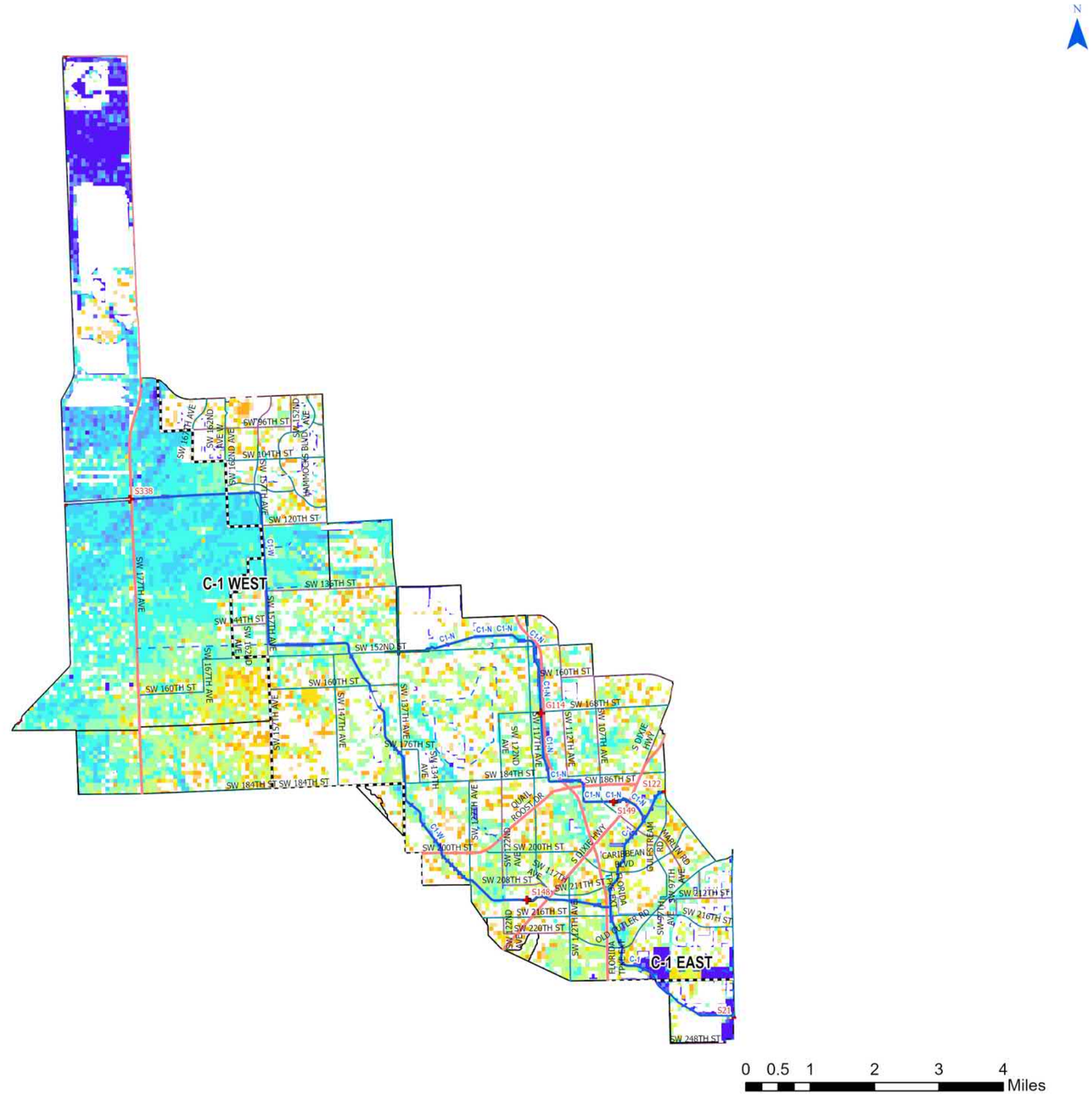
100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-30. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 1

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

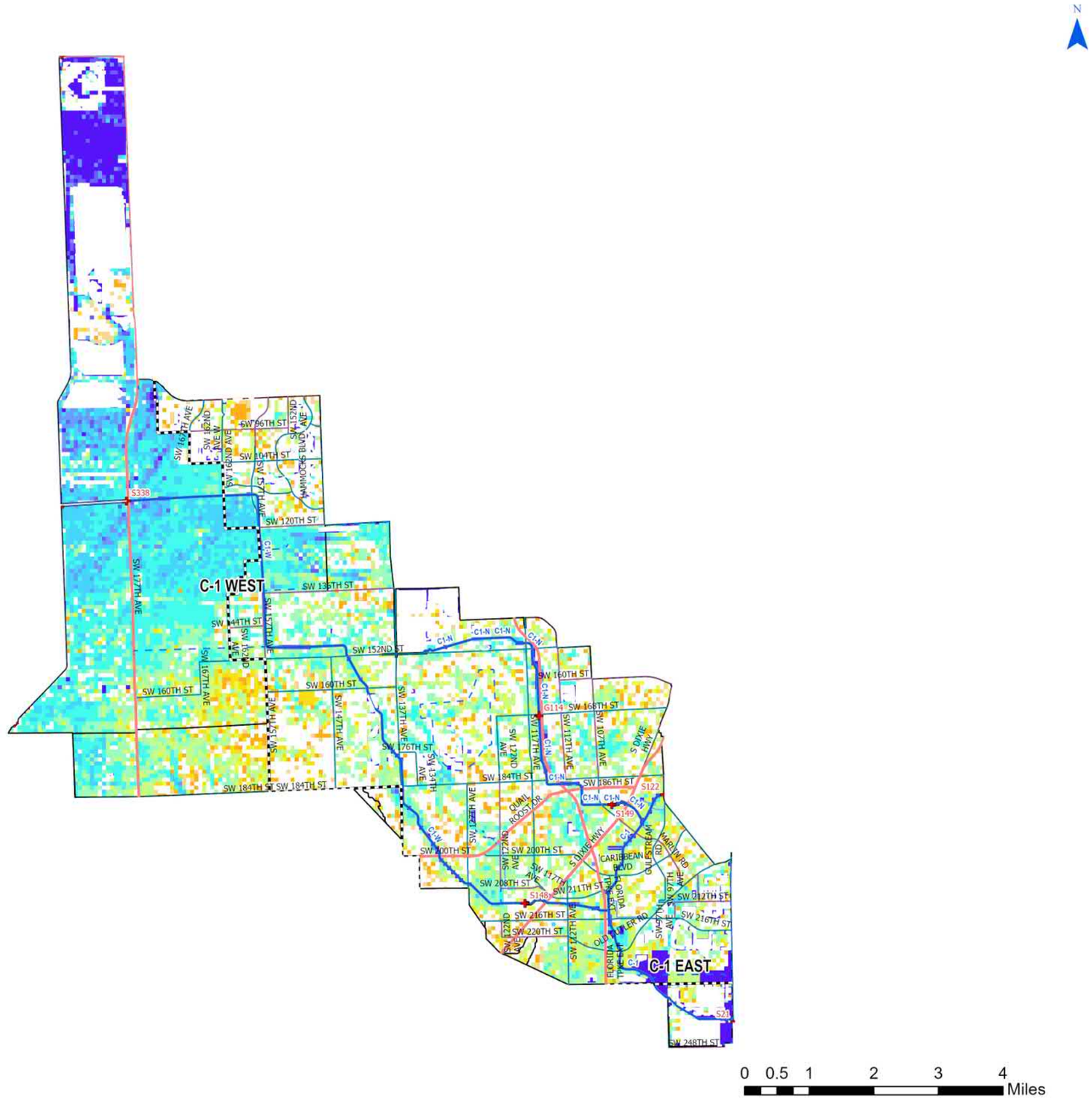
100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-31. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 2

C-1 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-32. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 3

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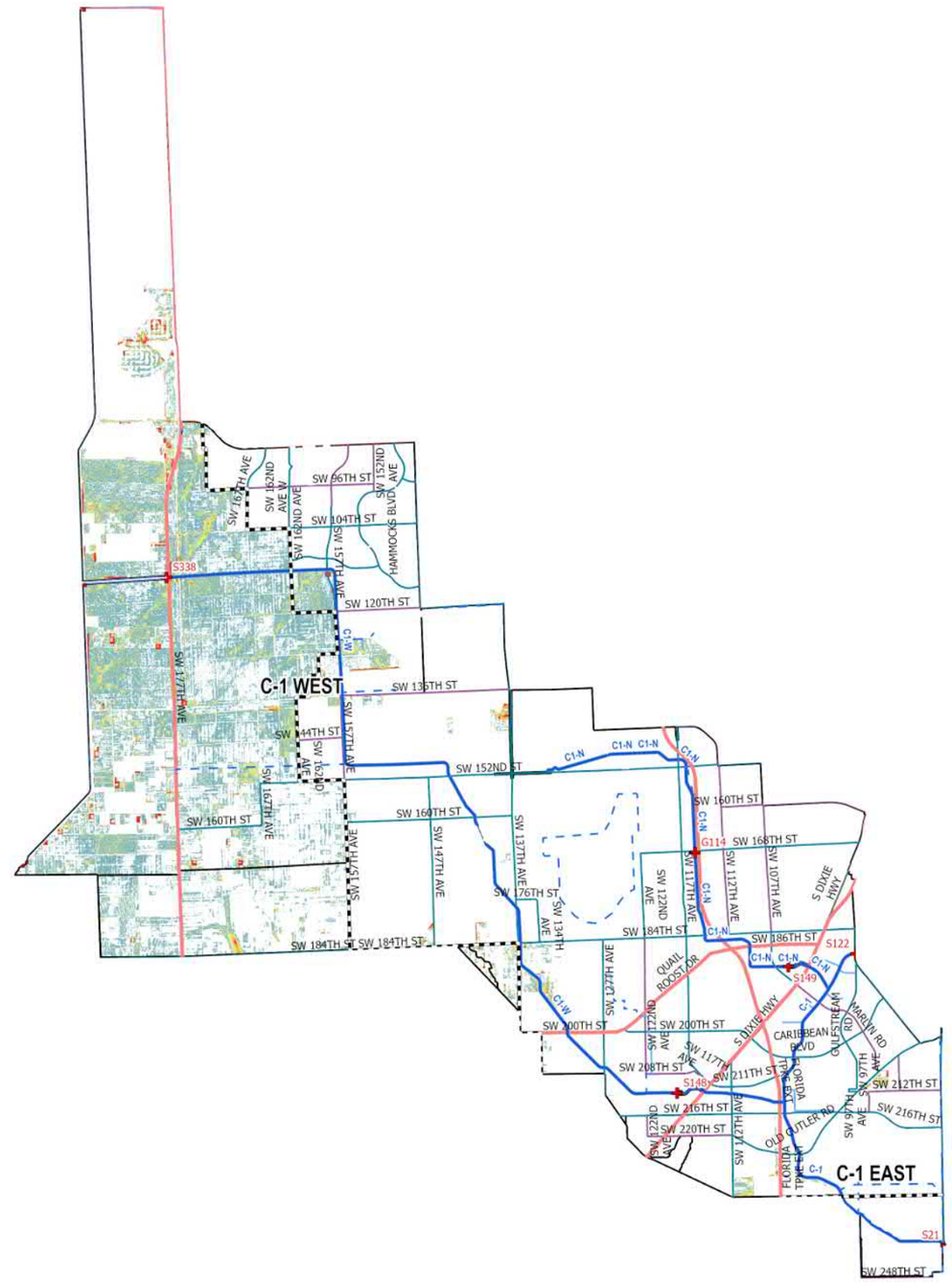
WATERSHED C-1: Flood Extent In Agricultural Areas

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-33. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

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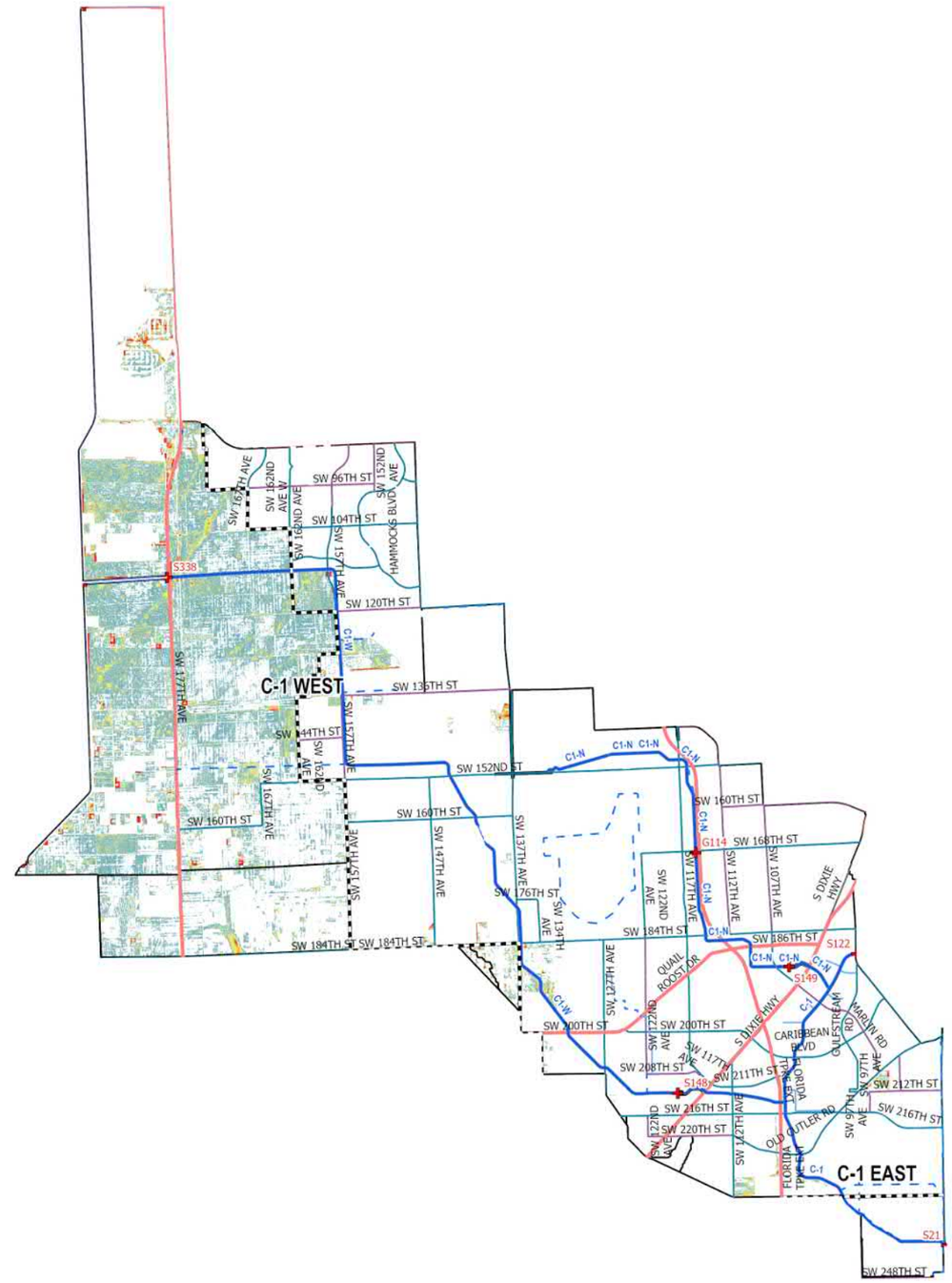
C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

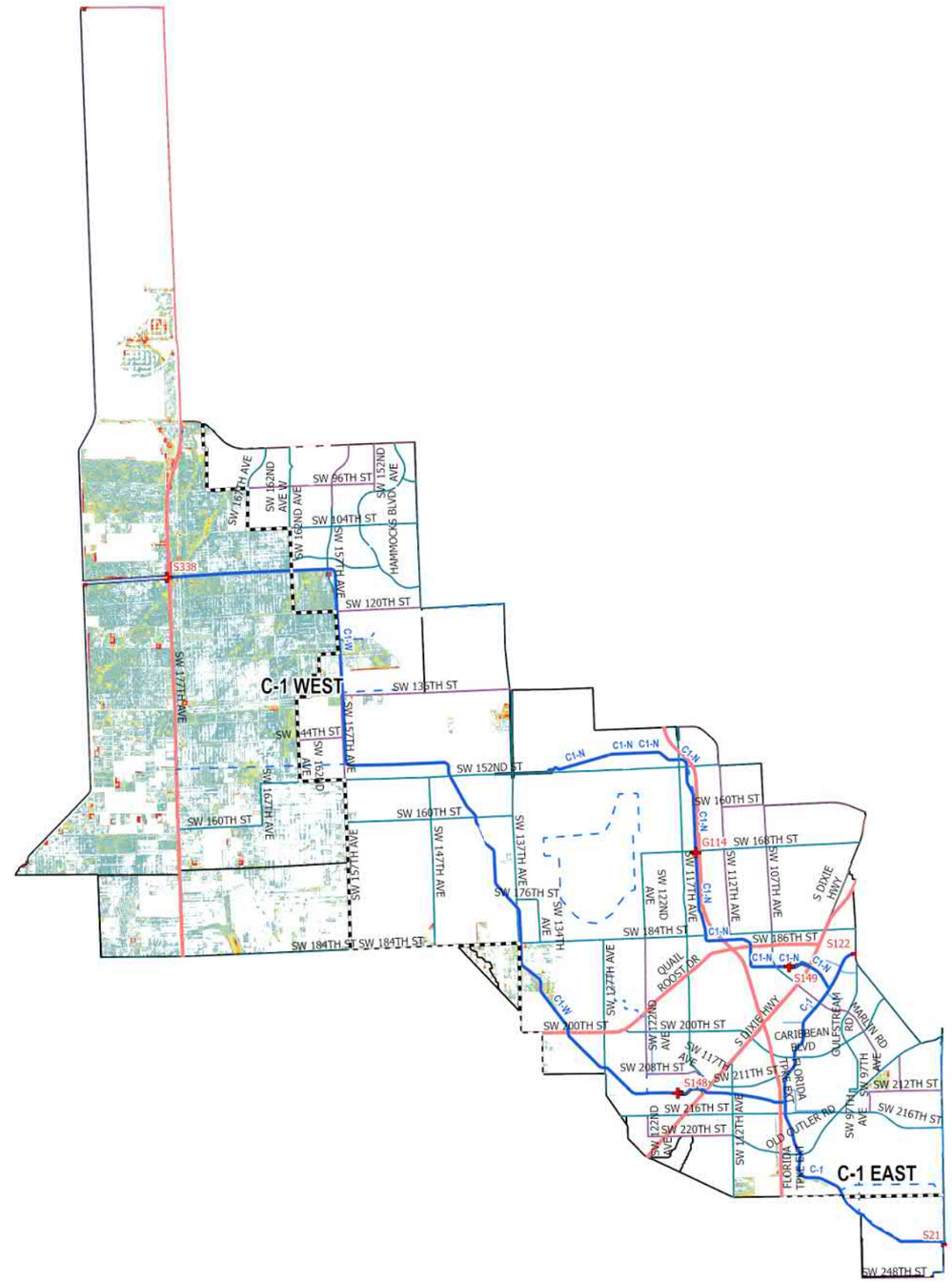
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-34. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-35. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

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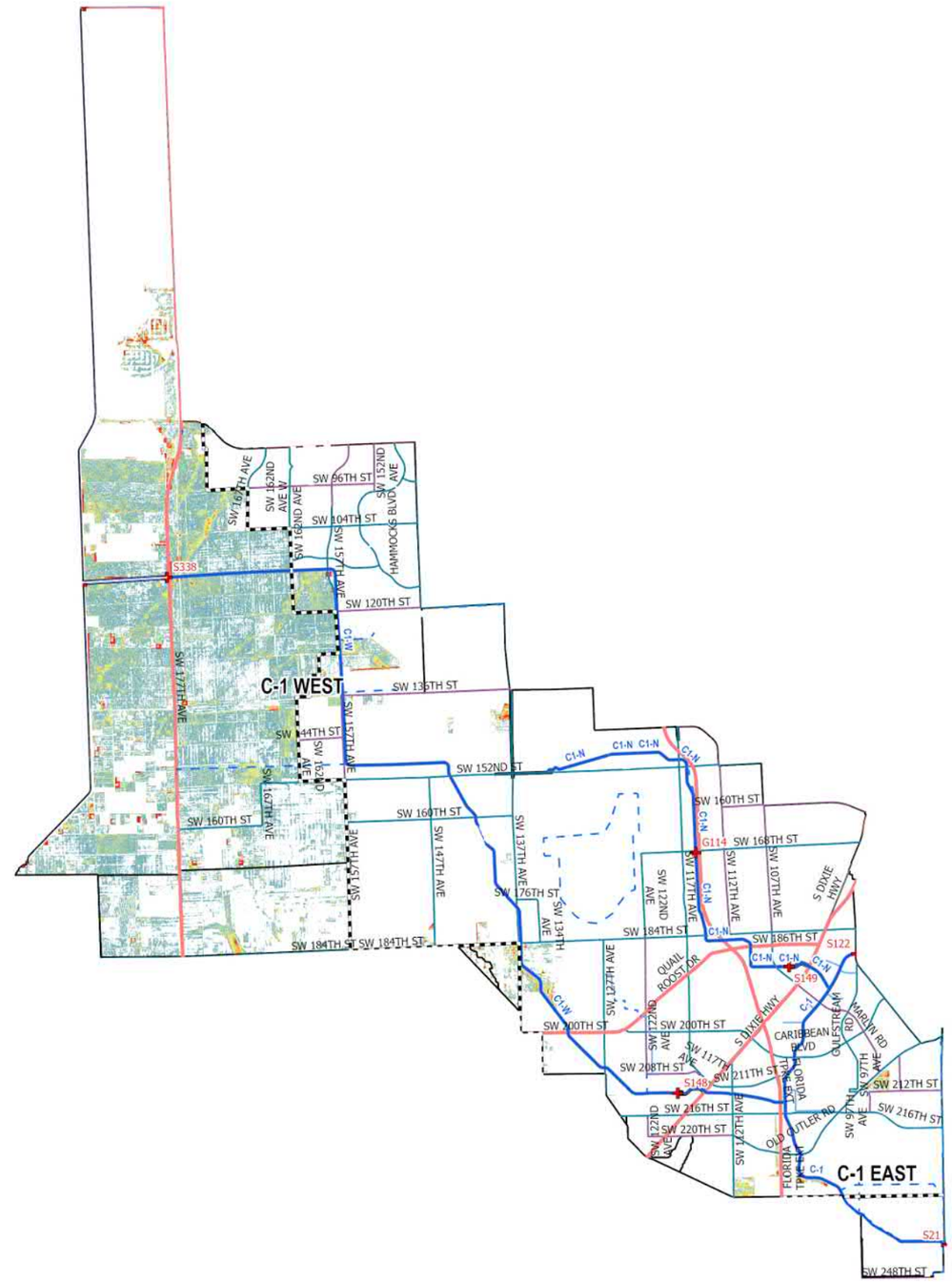
C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

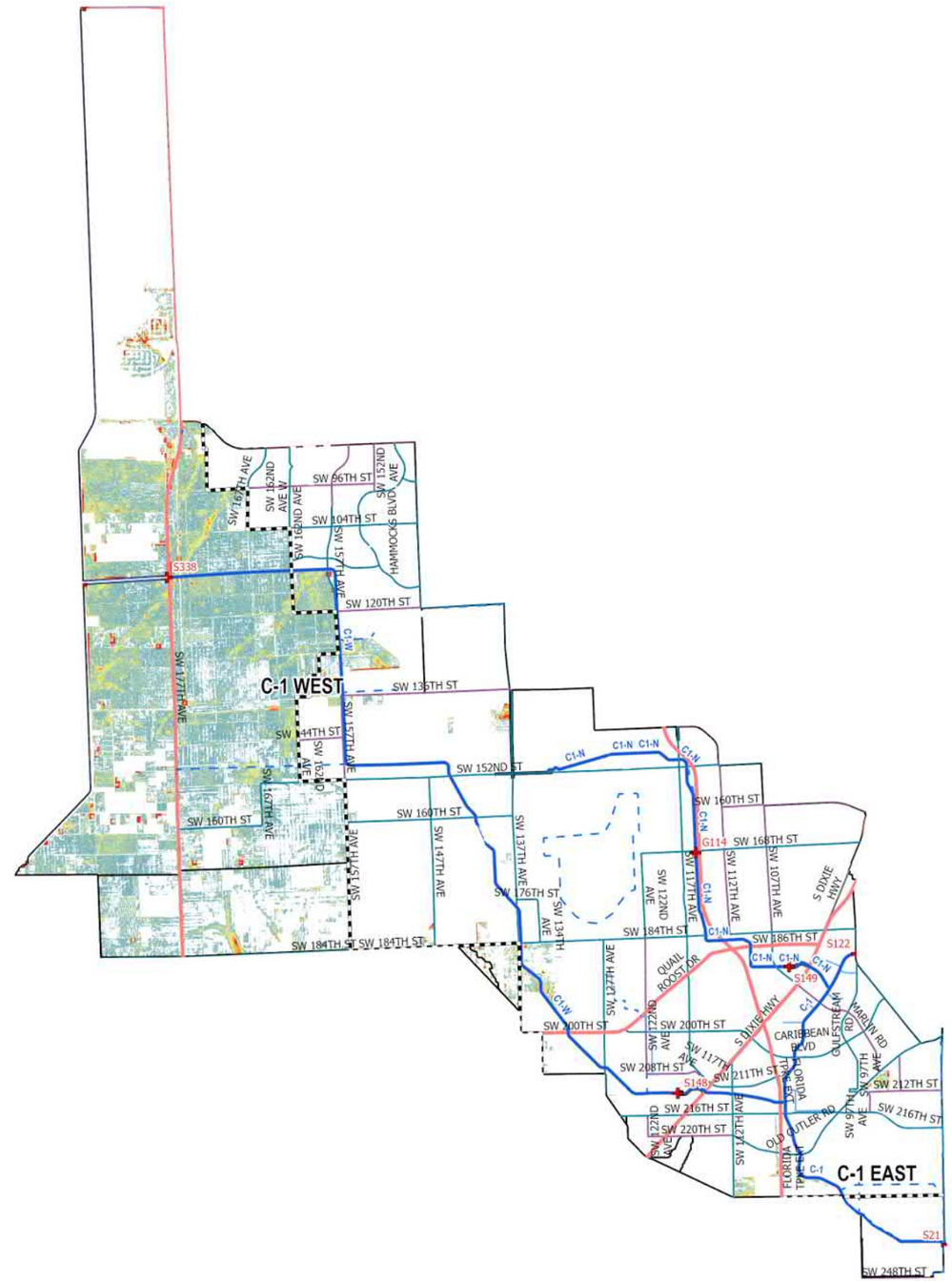
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-36. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

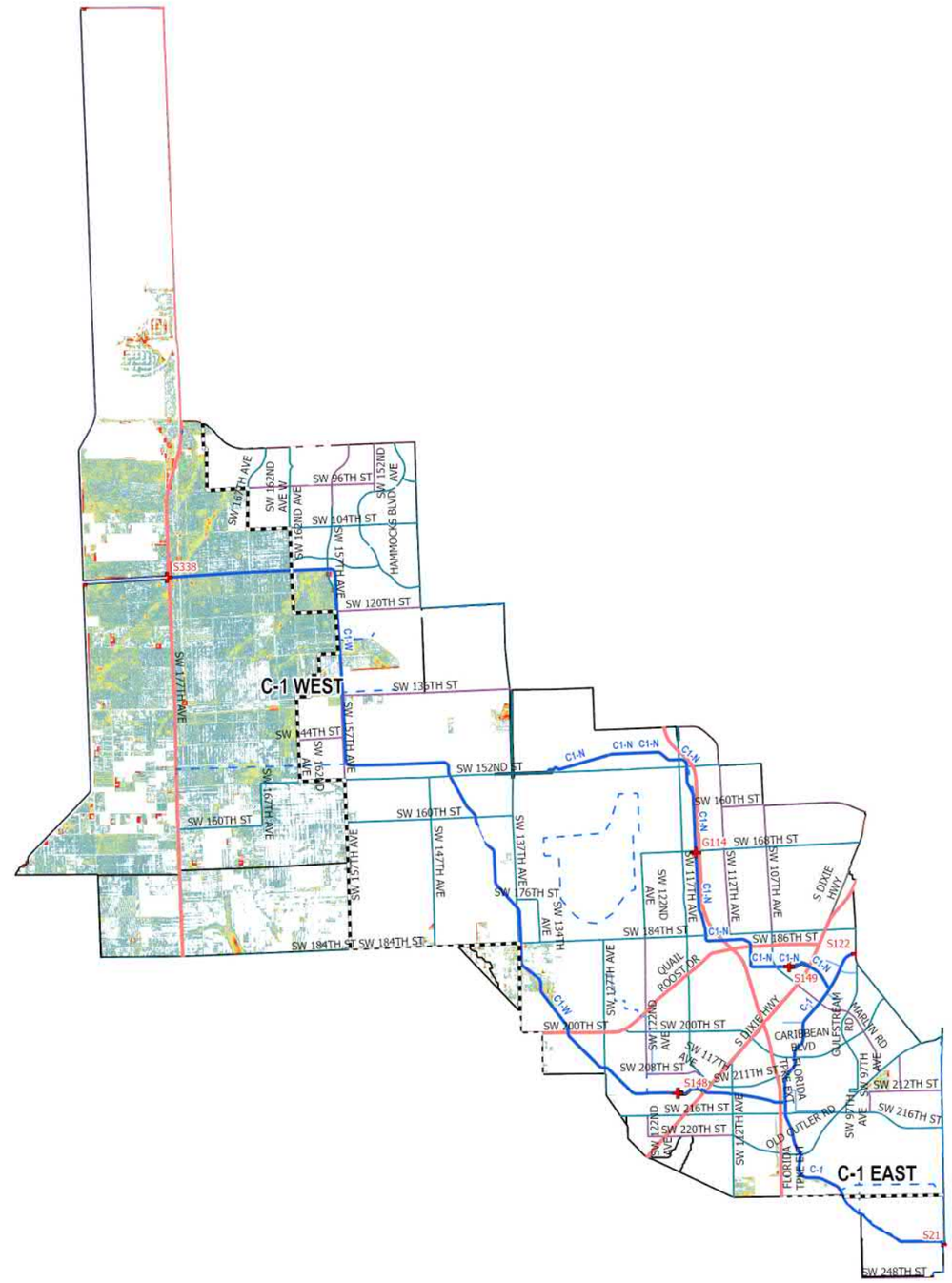
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-37. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas

C-1 Watershed



C-1 Agricultural Areas

N

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-38. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

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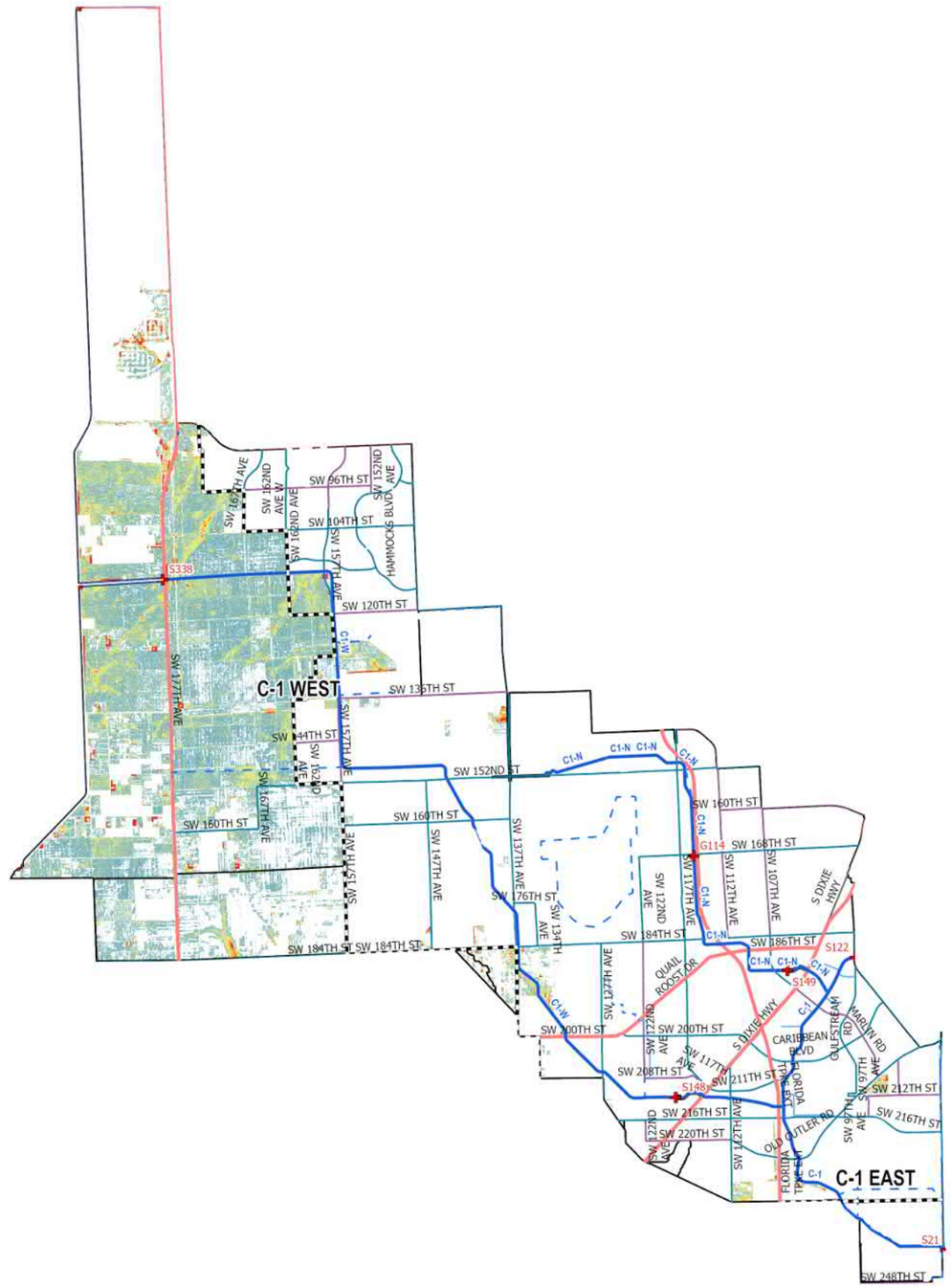
C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

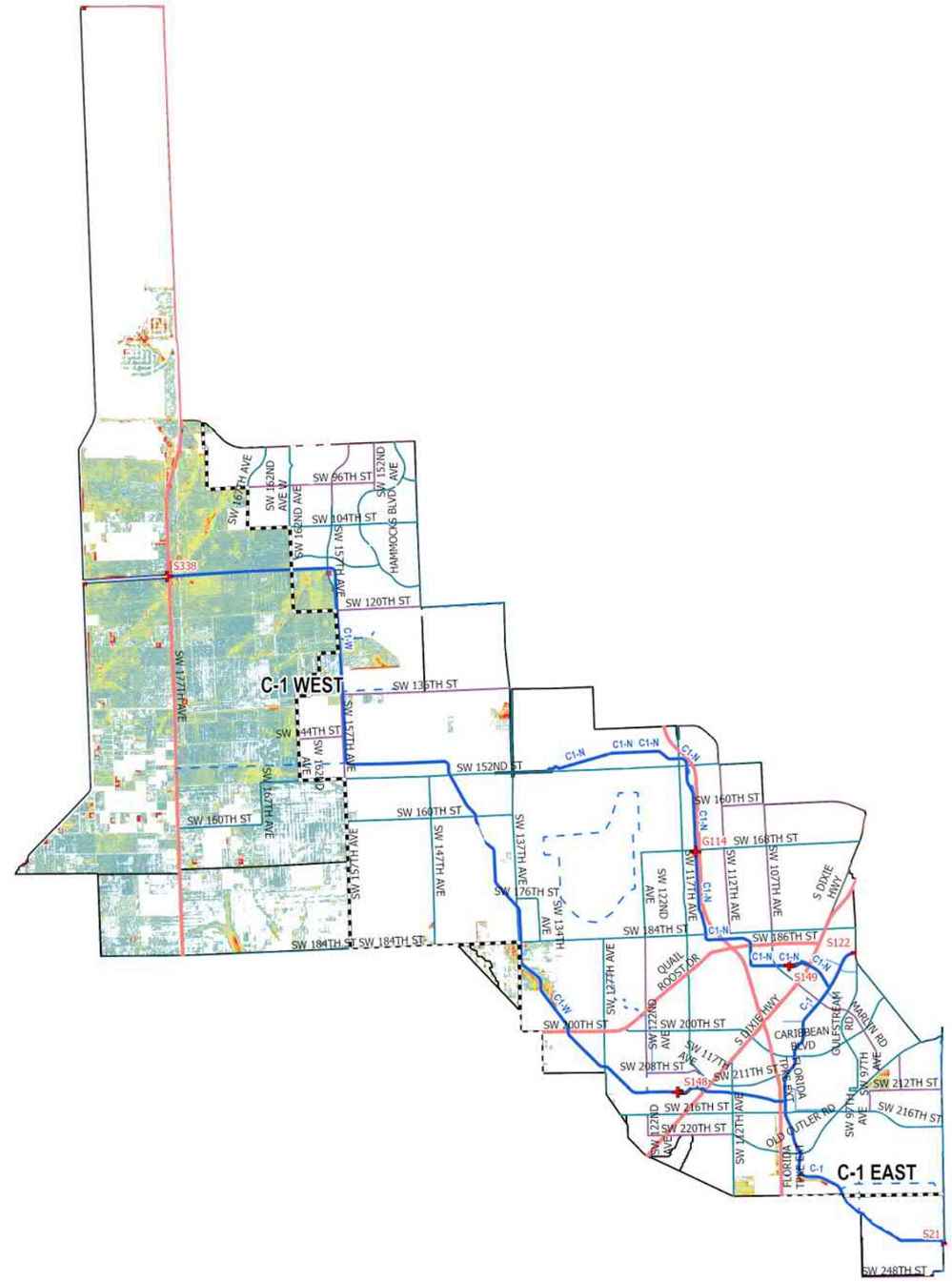
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-39. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

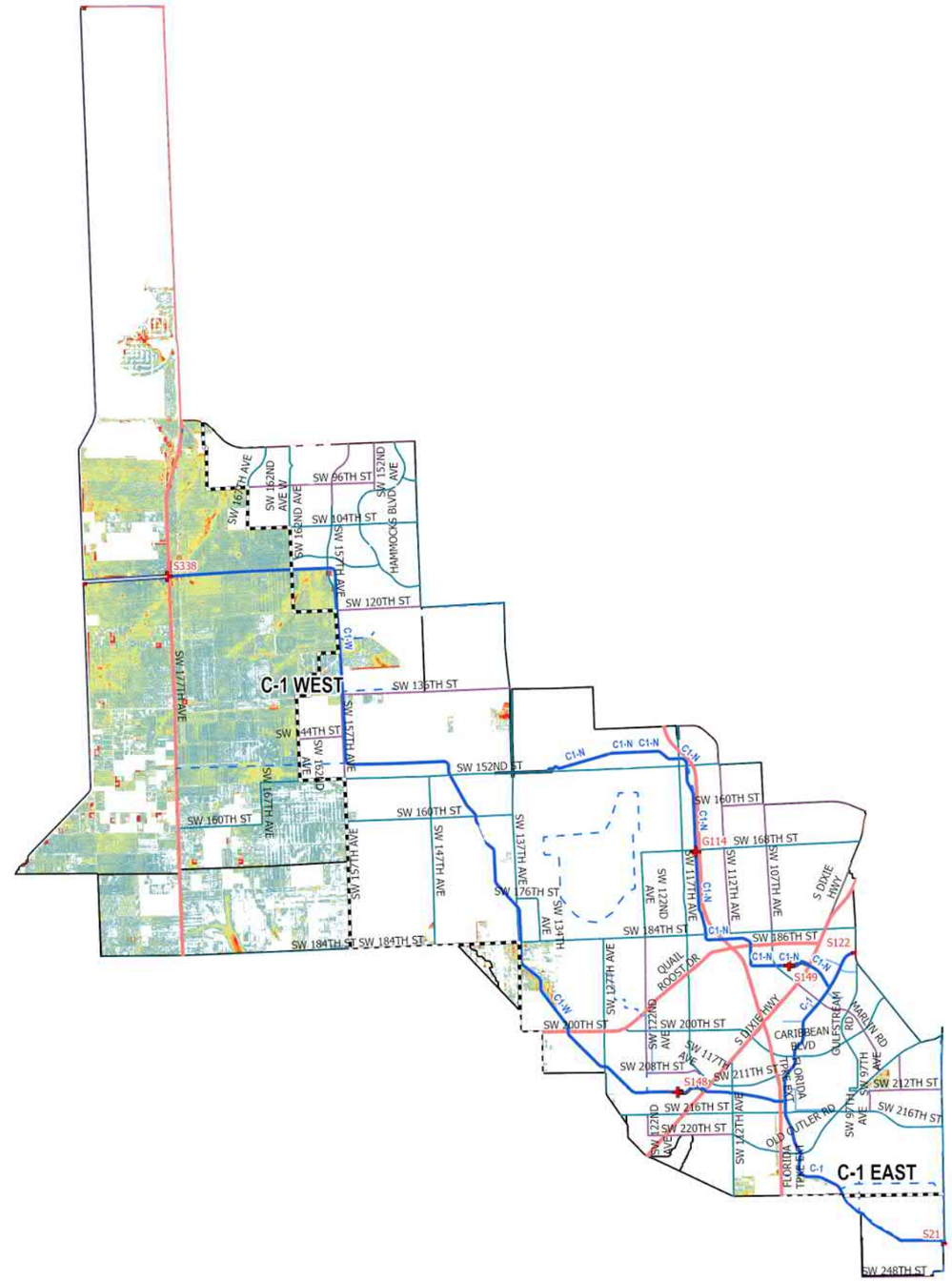
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-40. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-41. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas

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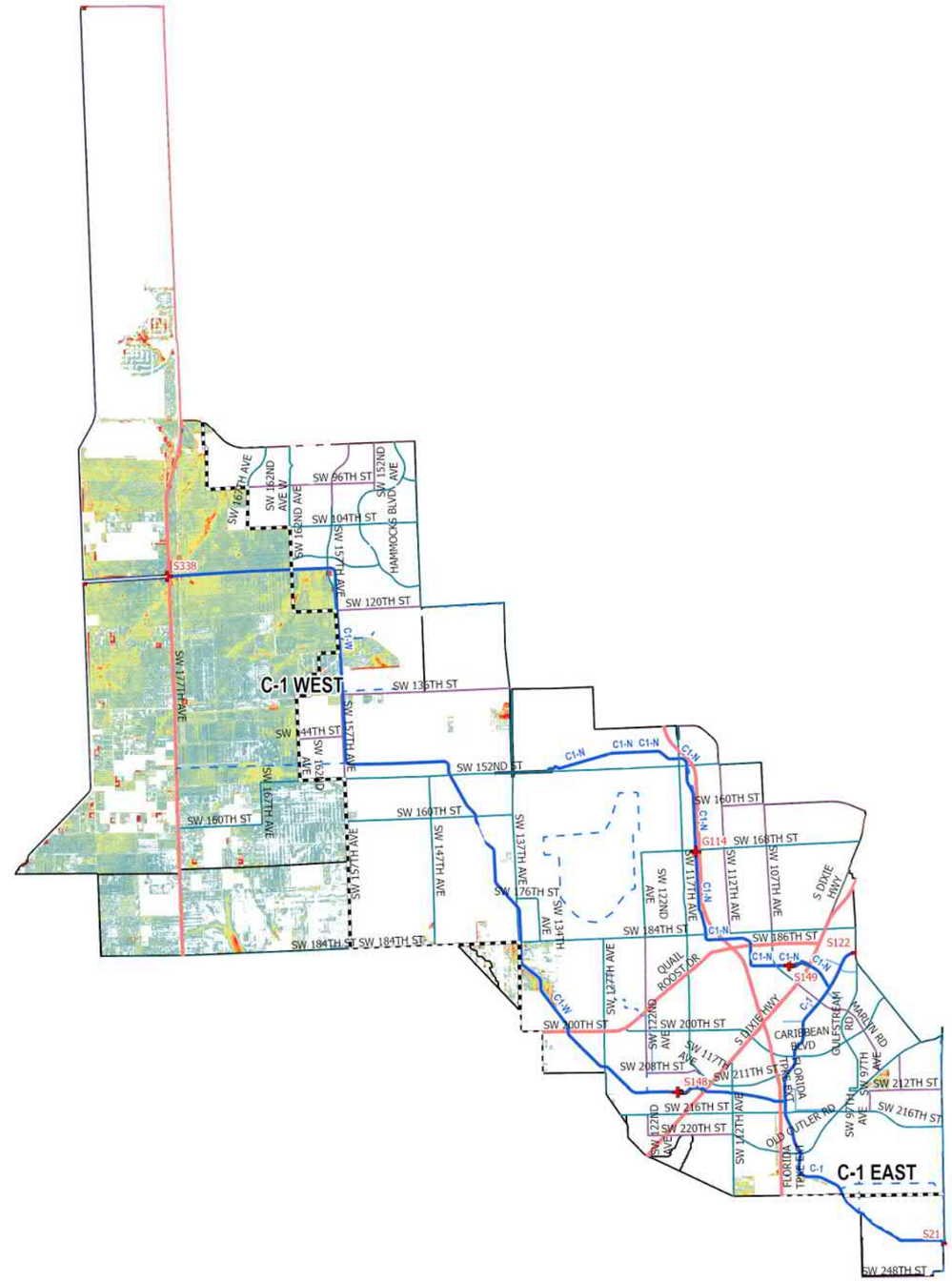
C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

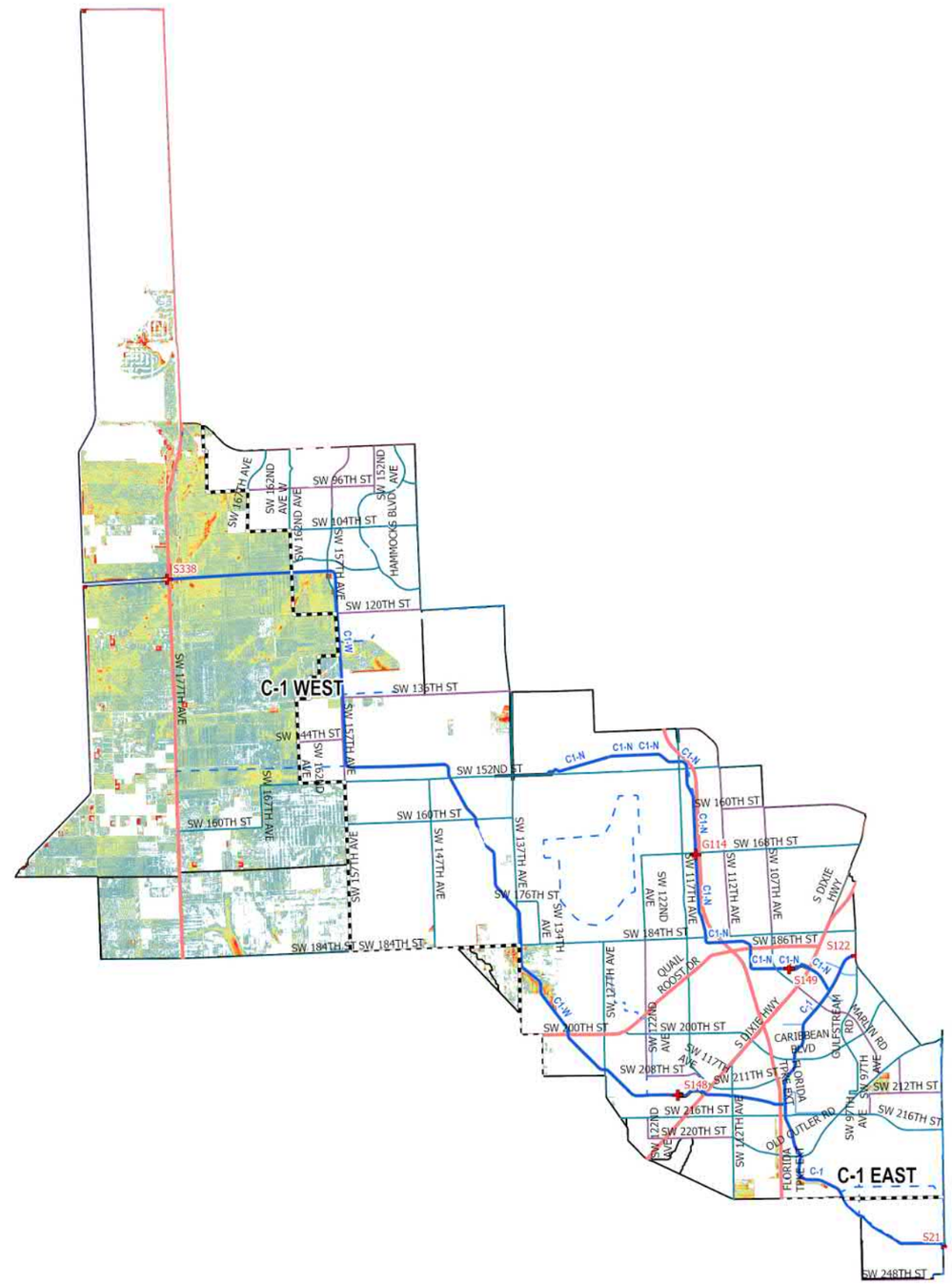
Flood Depth (ft)

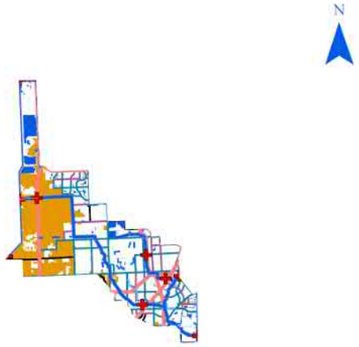
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-42. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-43. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas

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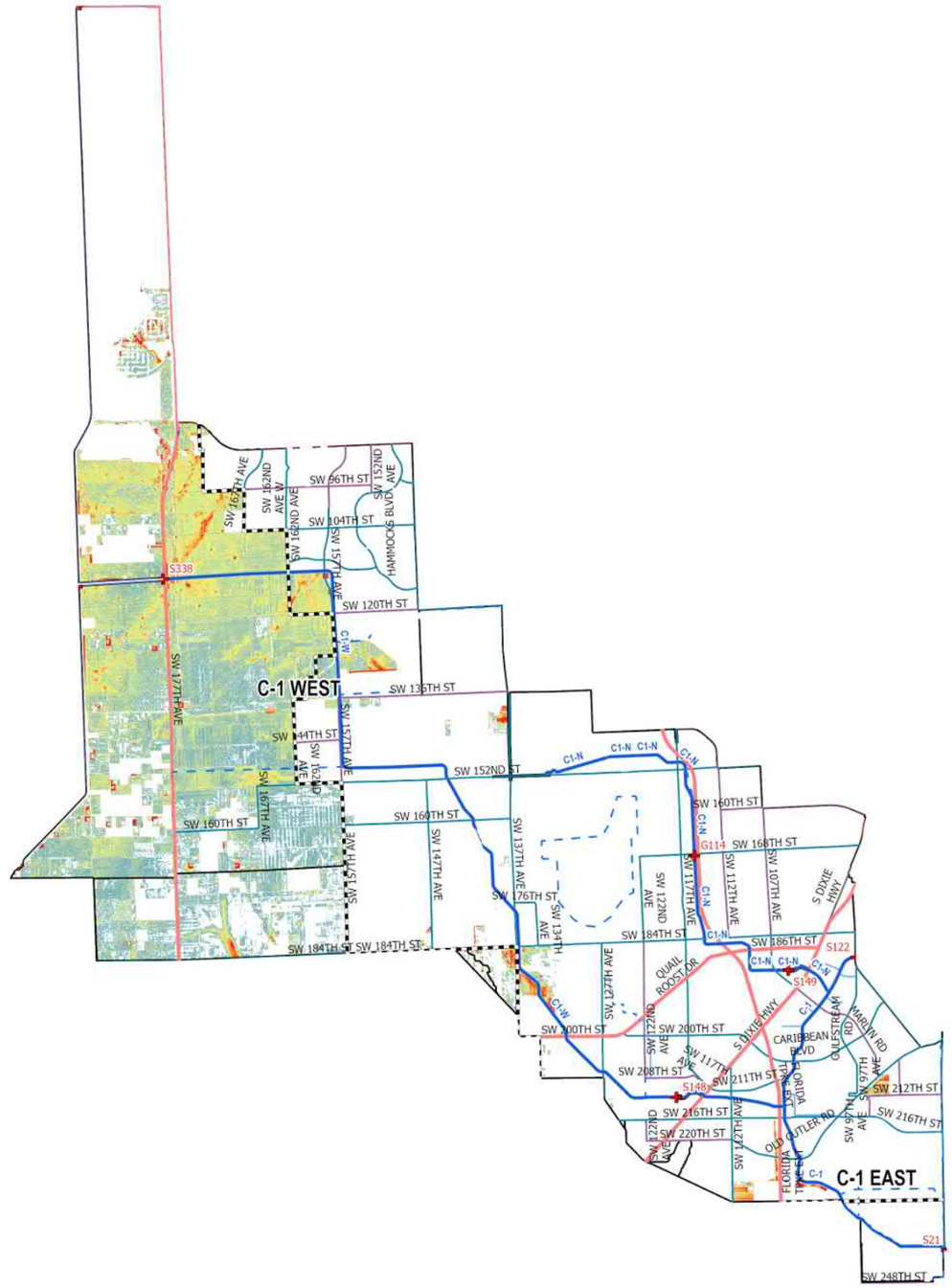
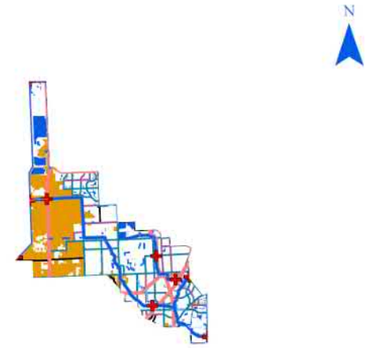
C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

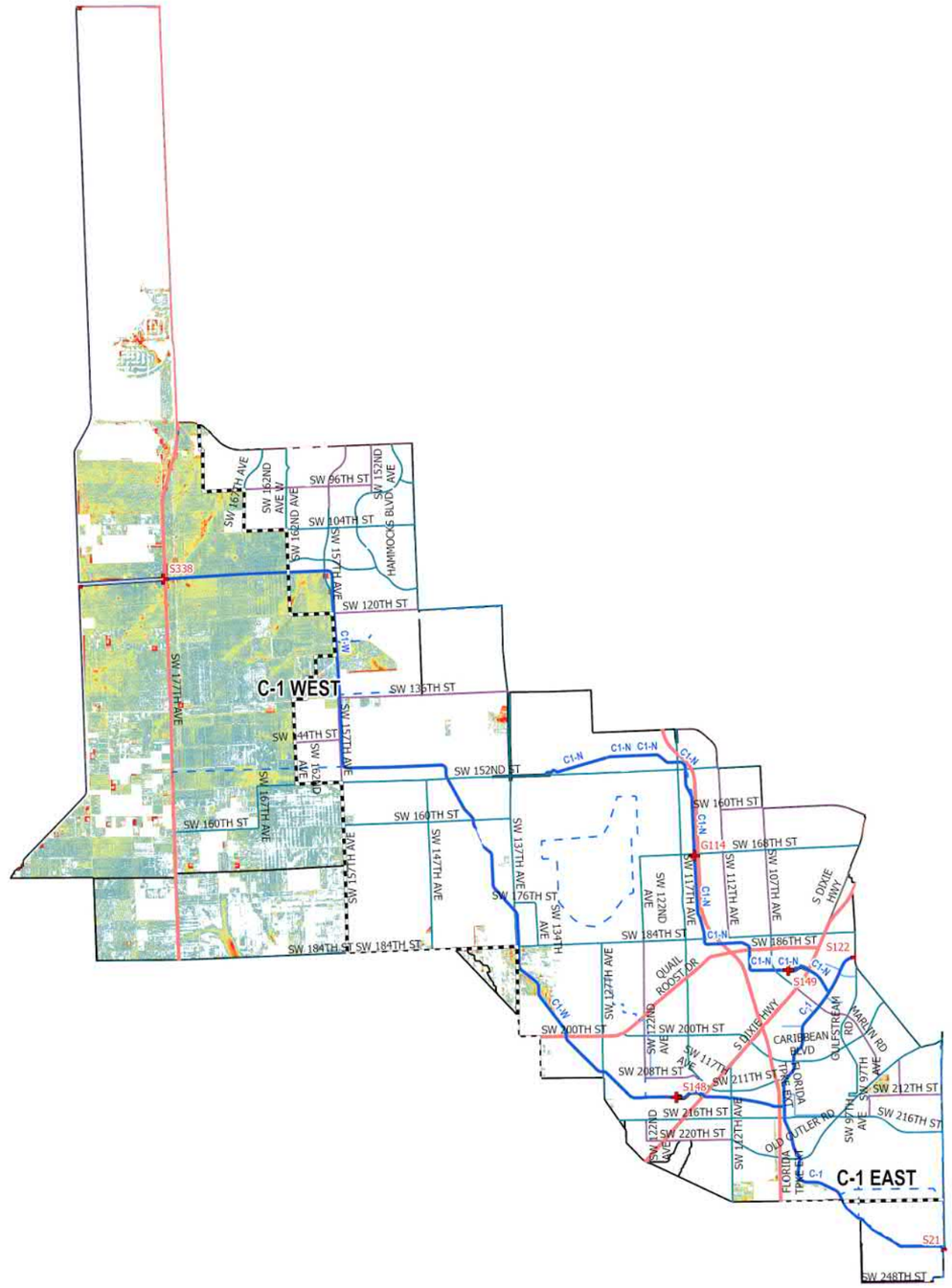
0 0.5 1 2 3 4 Miles

Figure A-44. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Depth (ft)

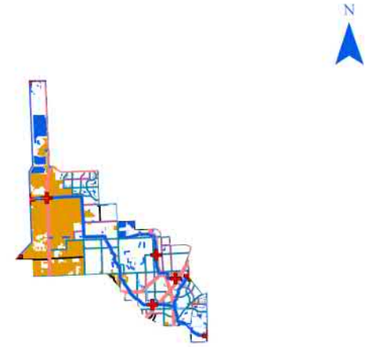
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

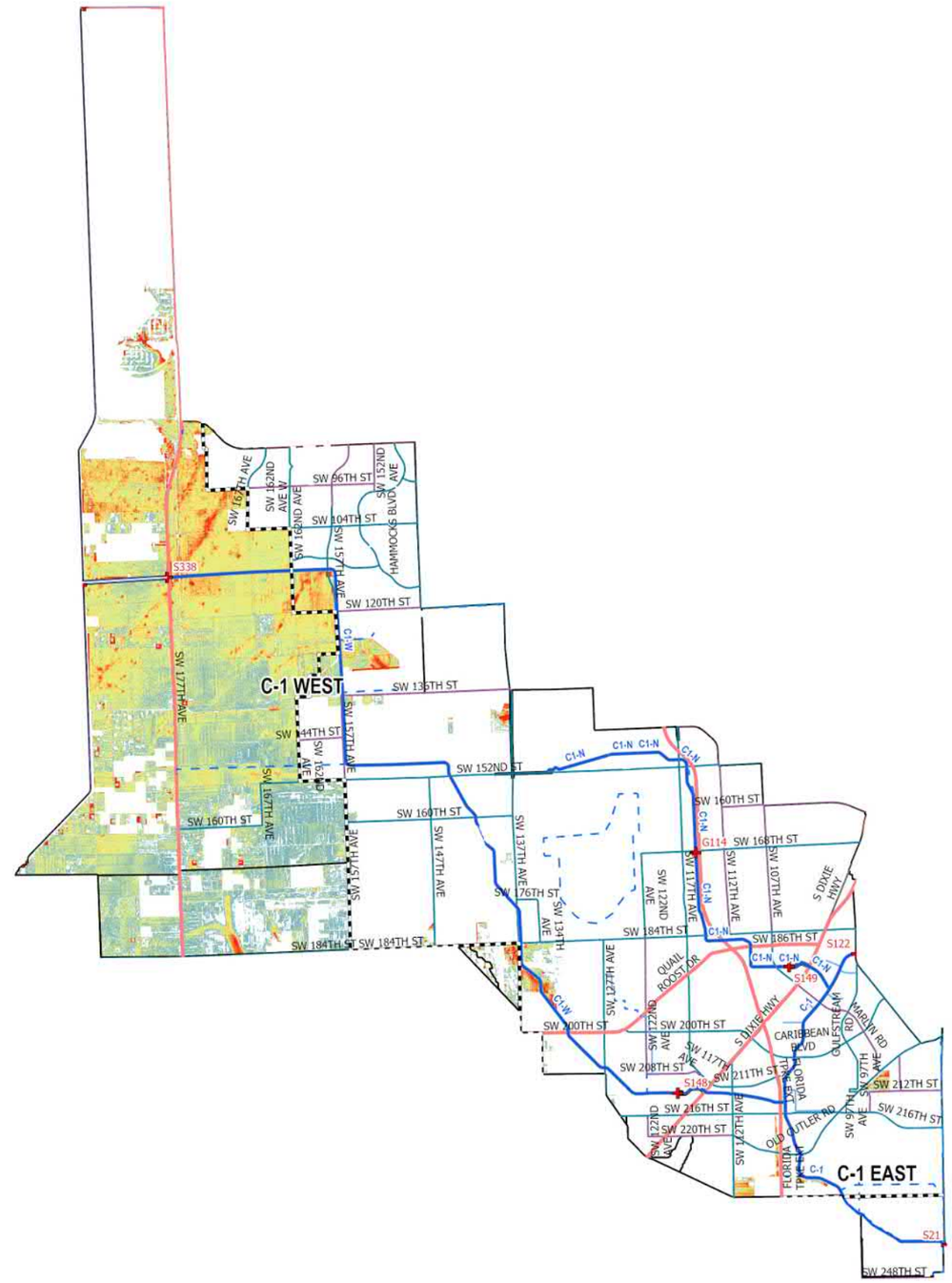
Figure A-45. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas



N

0 0.5 1 2 3 4 Miles

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

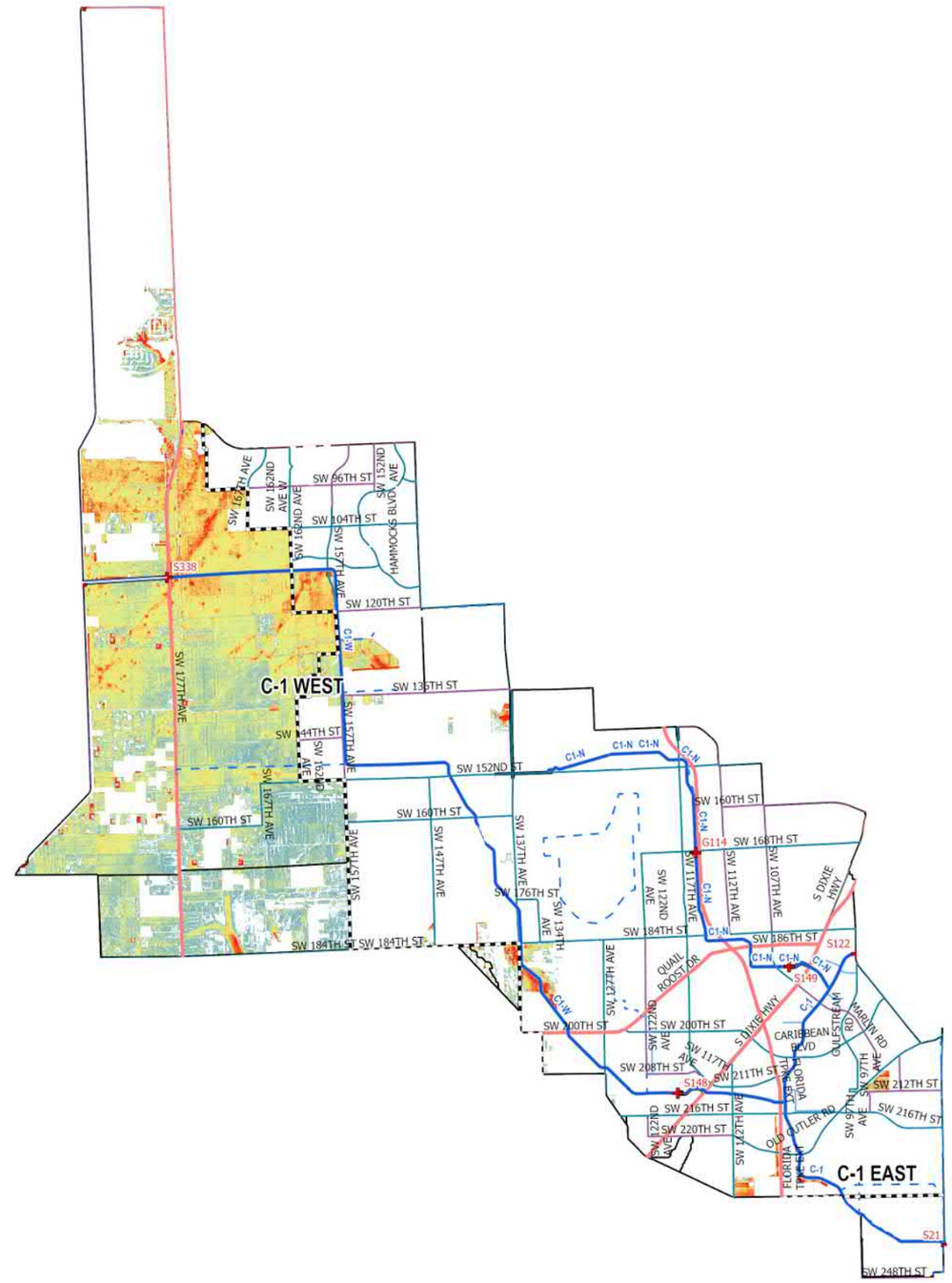
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-46. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

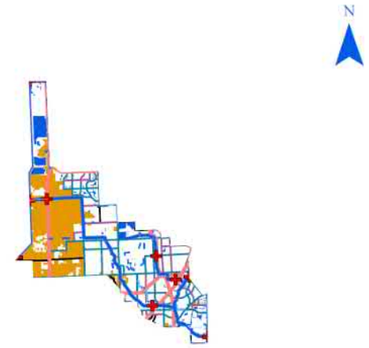
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

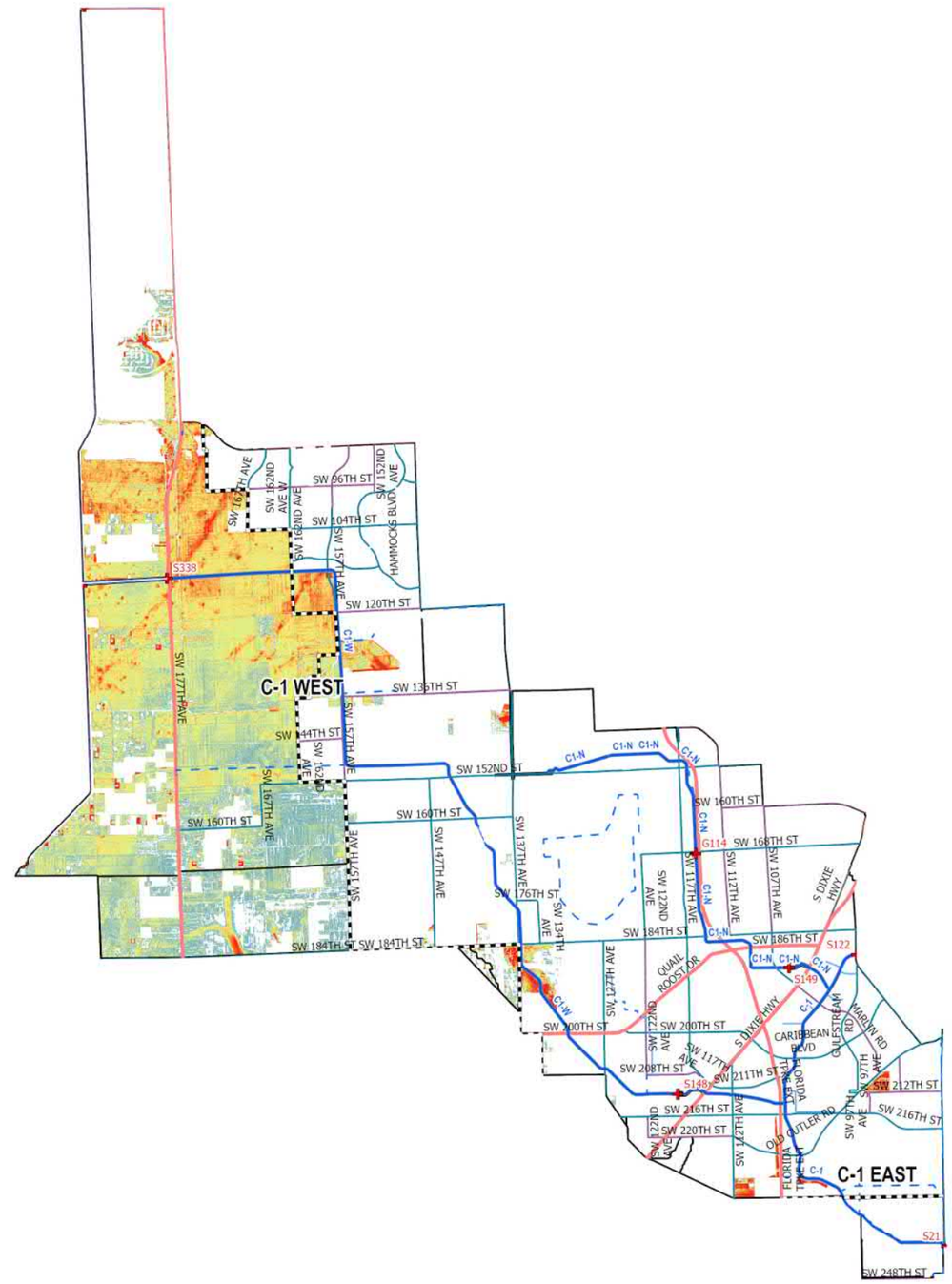
Figure A-47. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas



N

0 0.5 1 2 3 4 Miles

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

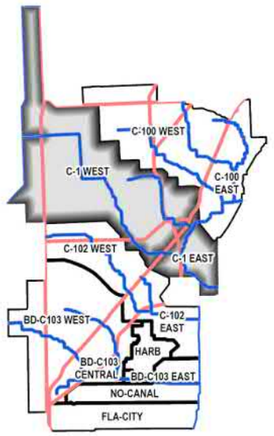
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

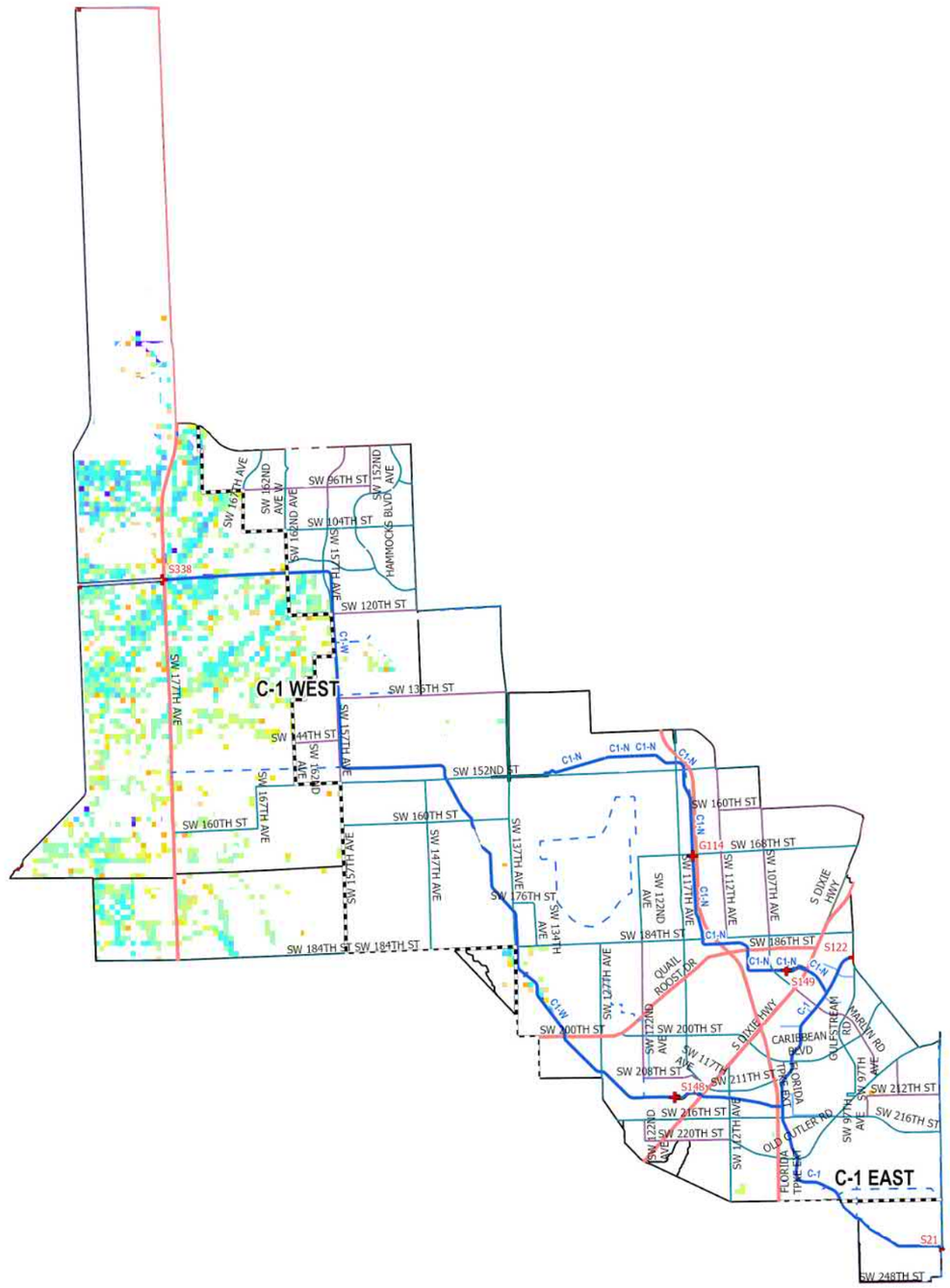
Figure A-48. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

WATERSHED C-1: Flood Duration in Agricultural Areas



C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Duration (hr)

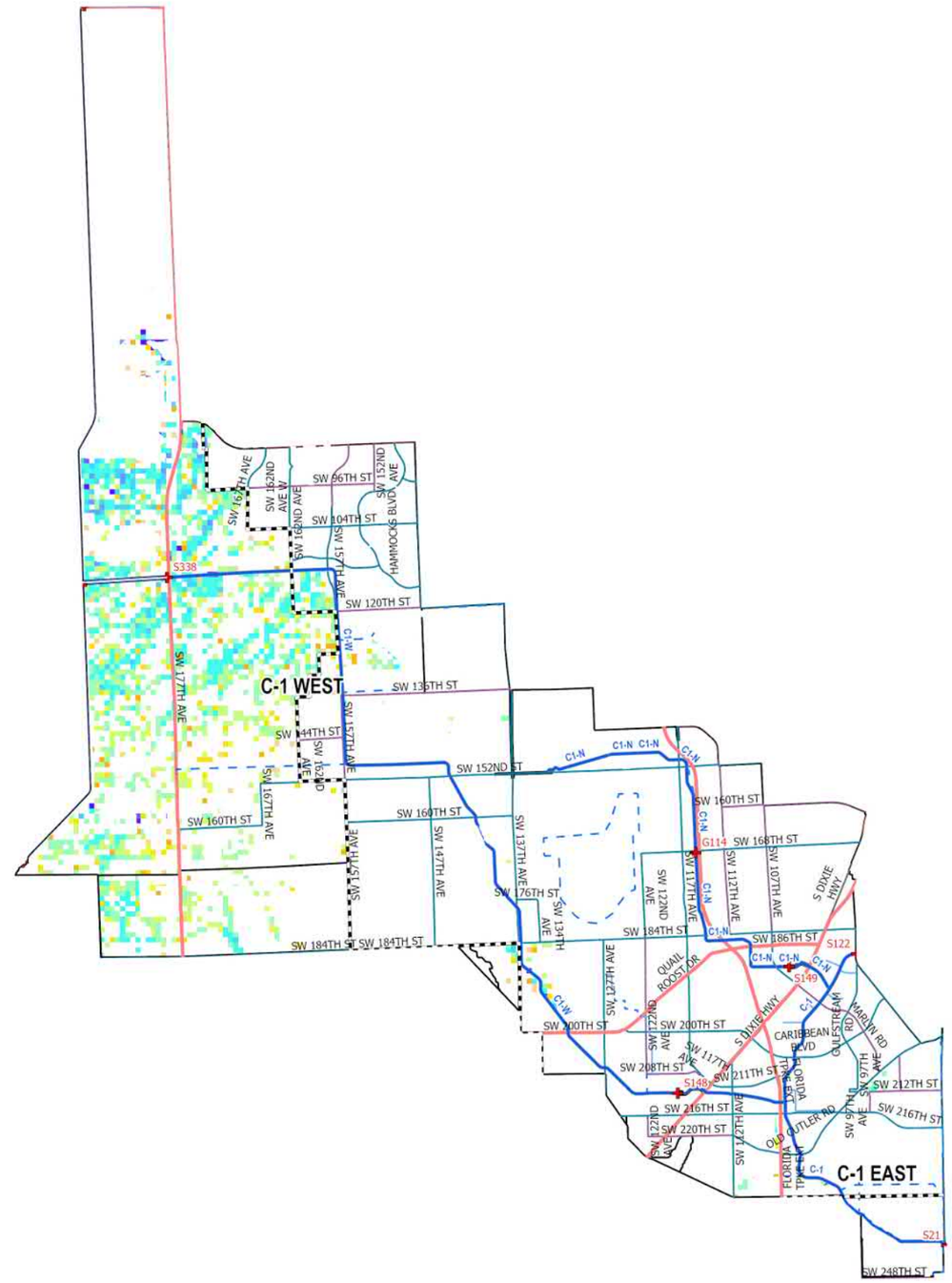
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-49. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

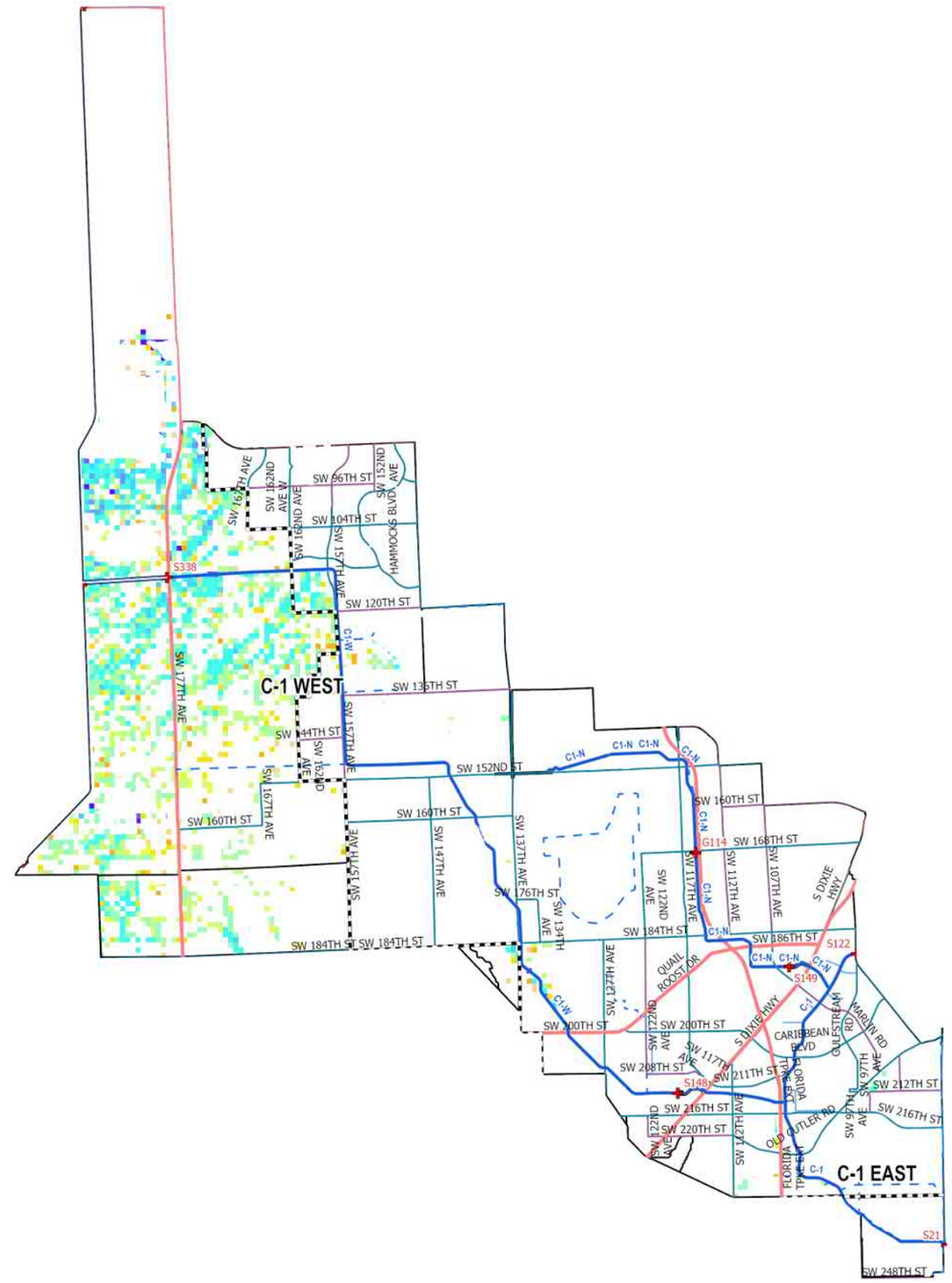
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-50. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

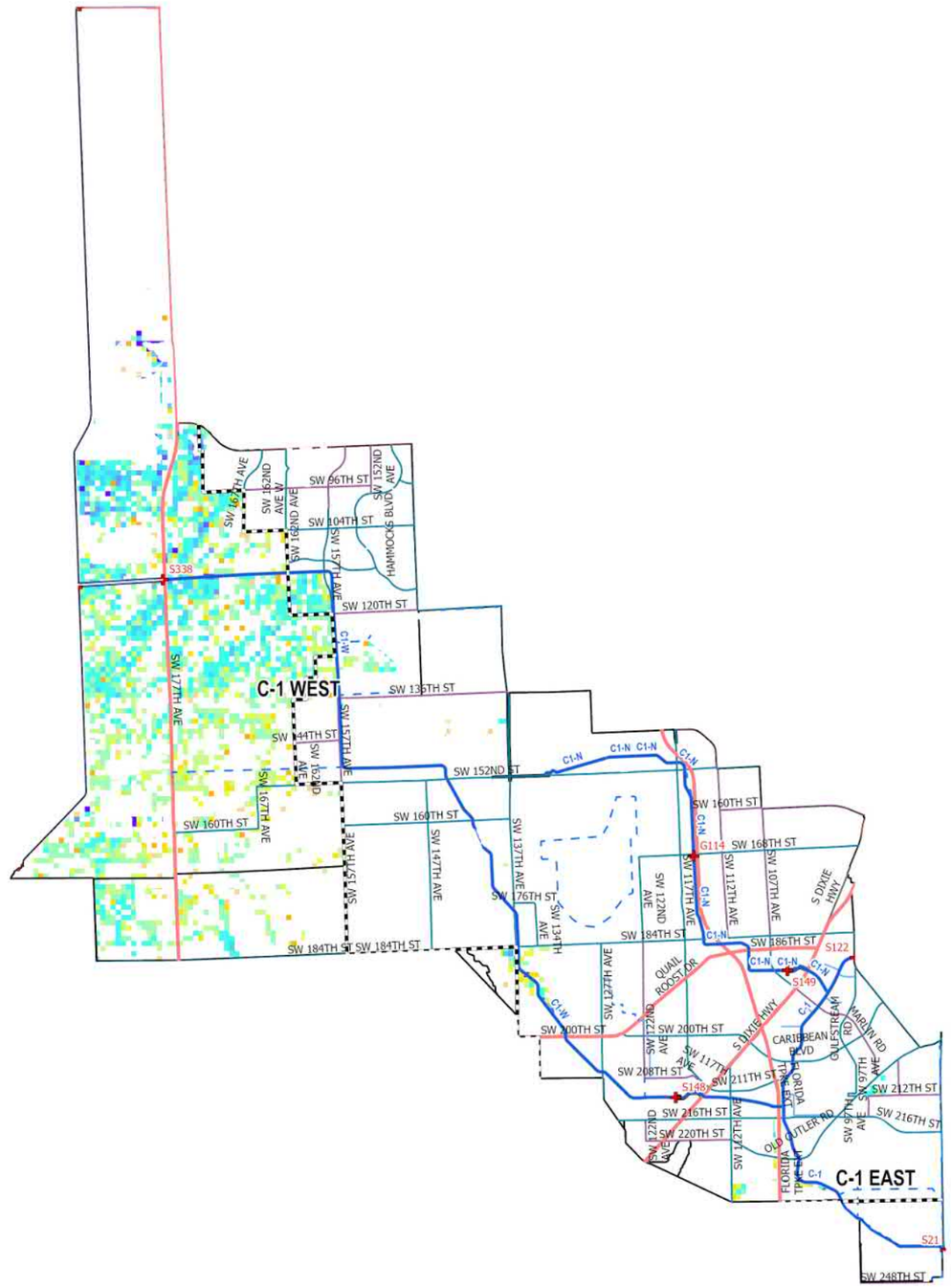
0 0.5 1 2 3 4 Miles

Figure A-51. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn

C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

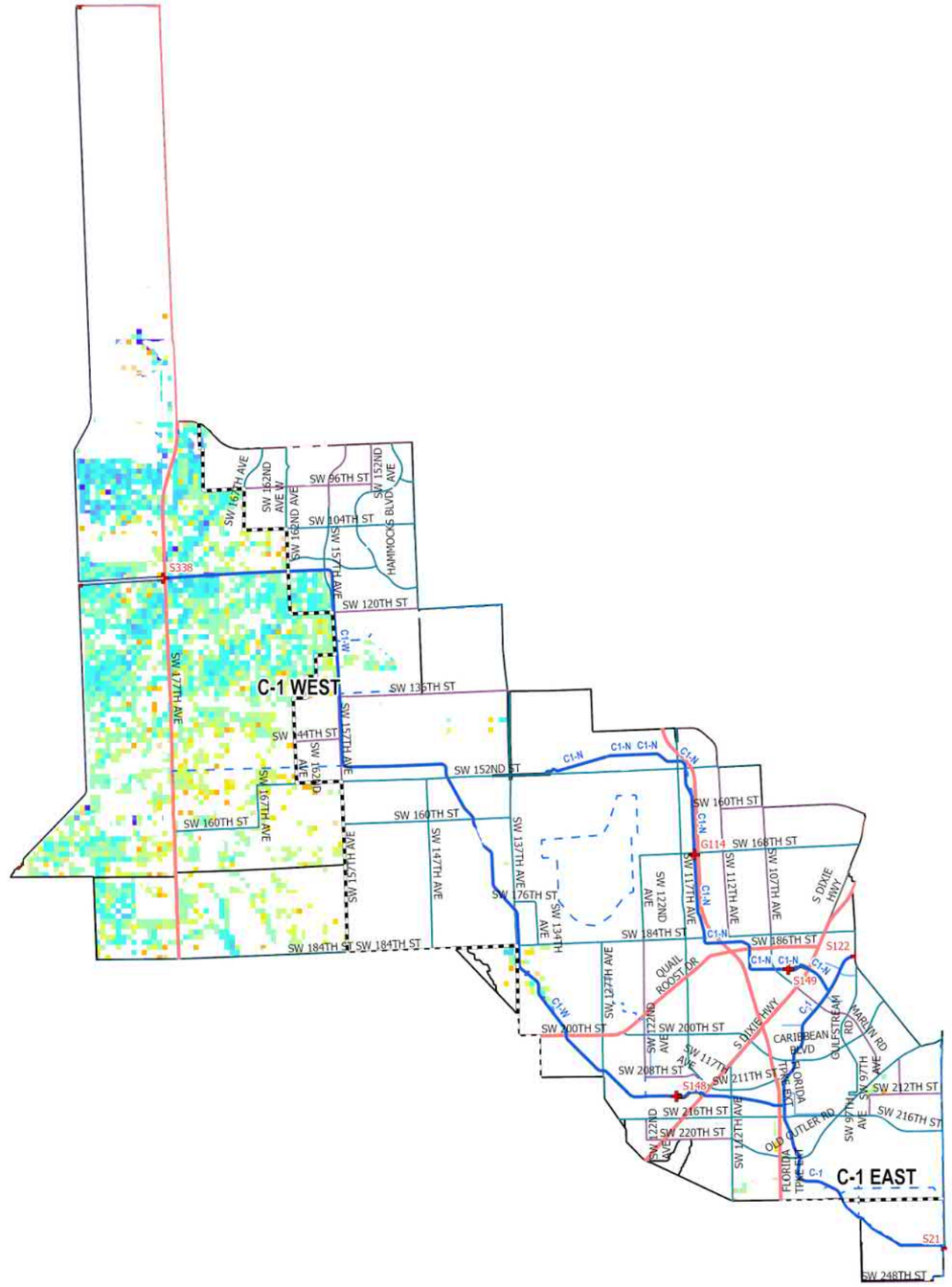
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

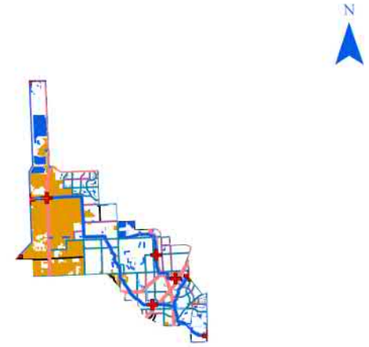
0 0.5 1 2 3 4 Miles

Figure A-52. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

Flood Duration (hr)

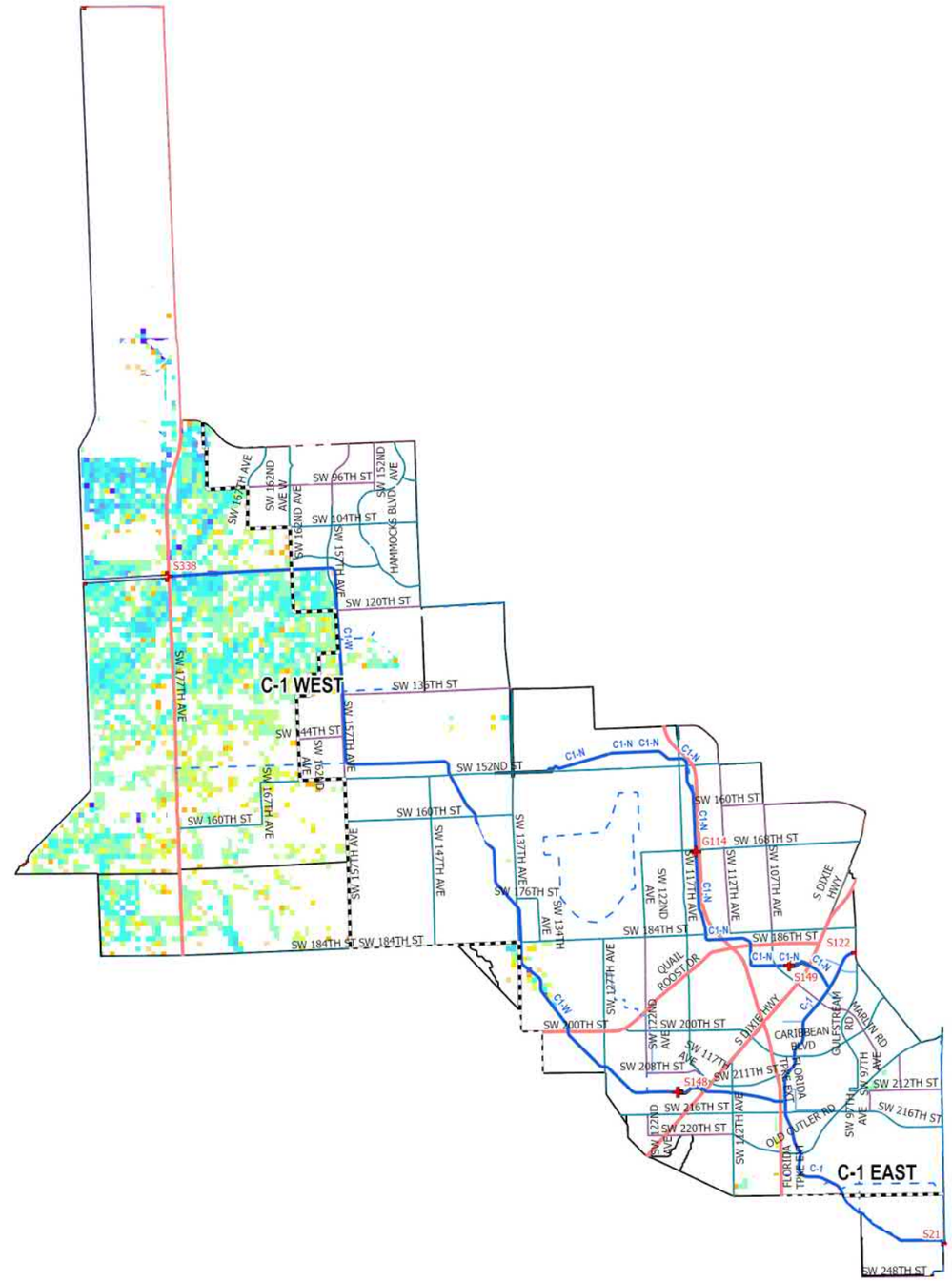
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-53. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

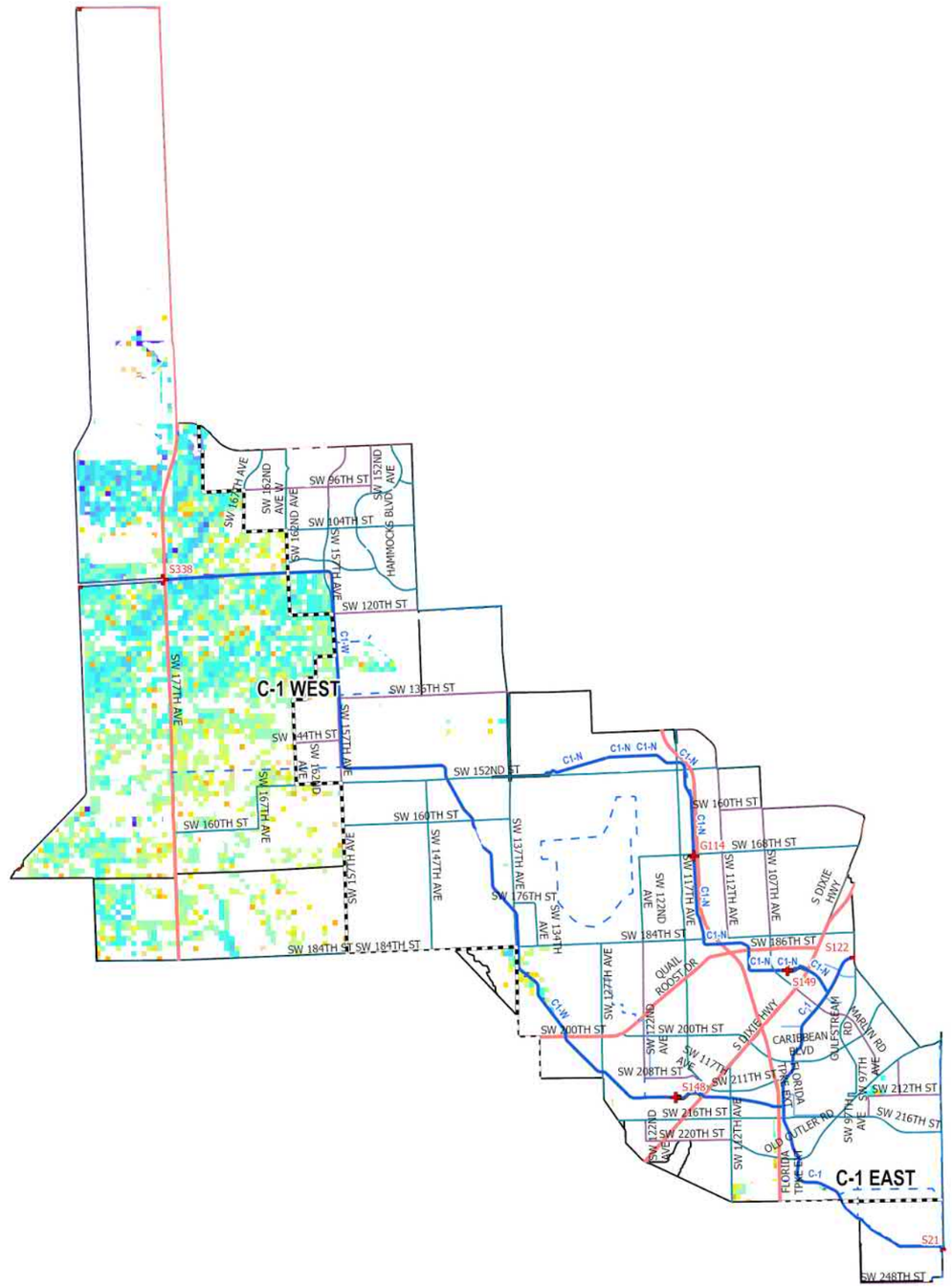
0 0.5 1 2 3 4 Miles

Figure A-54. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed

C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

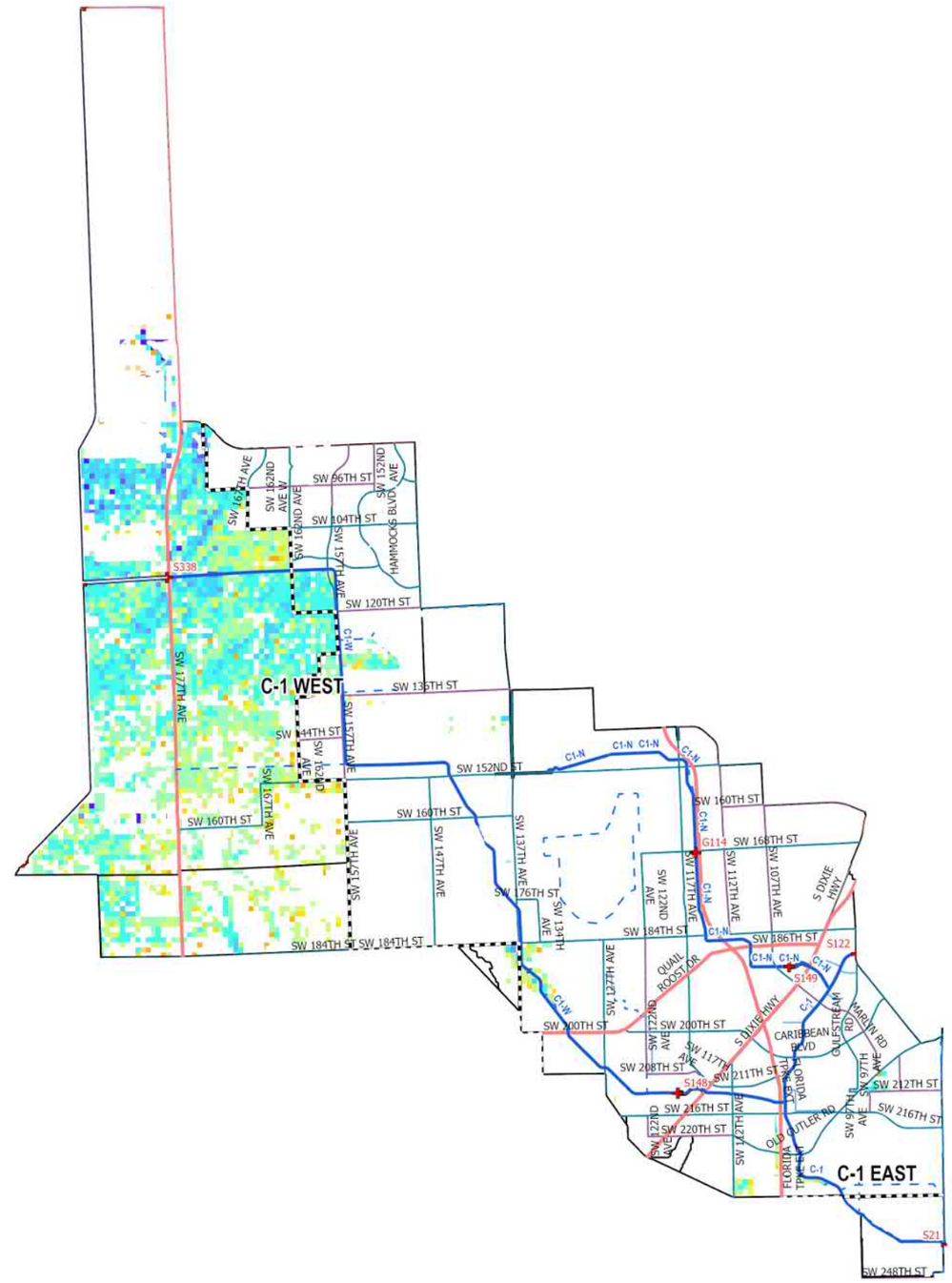
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-55. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

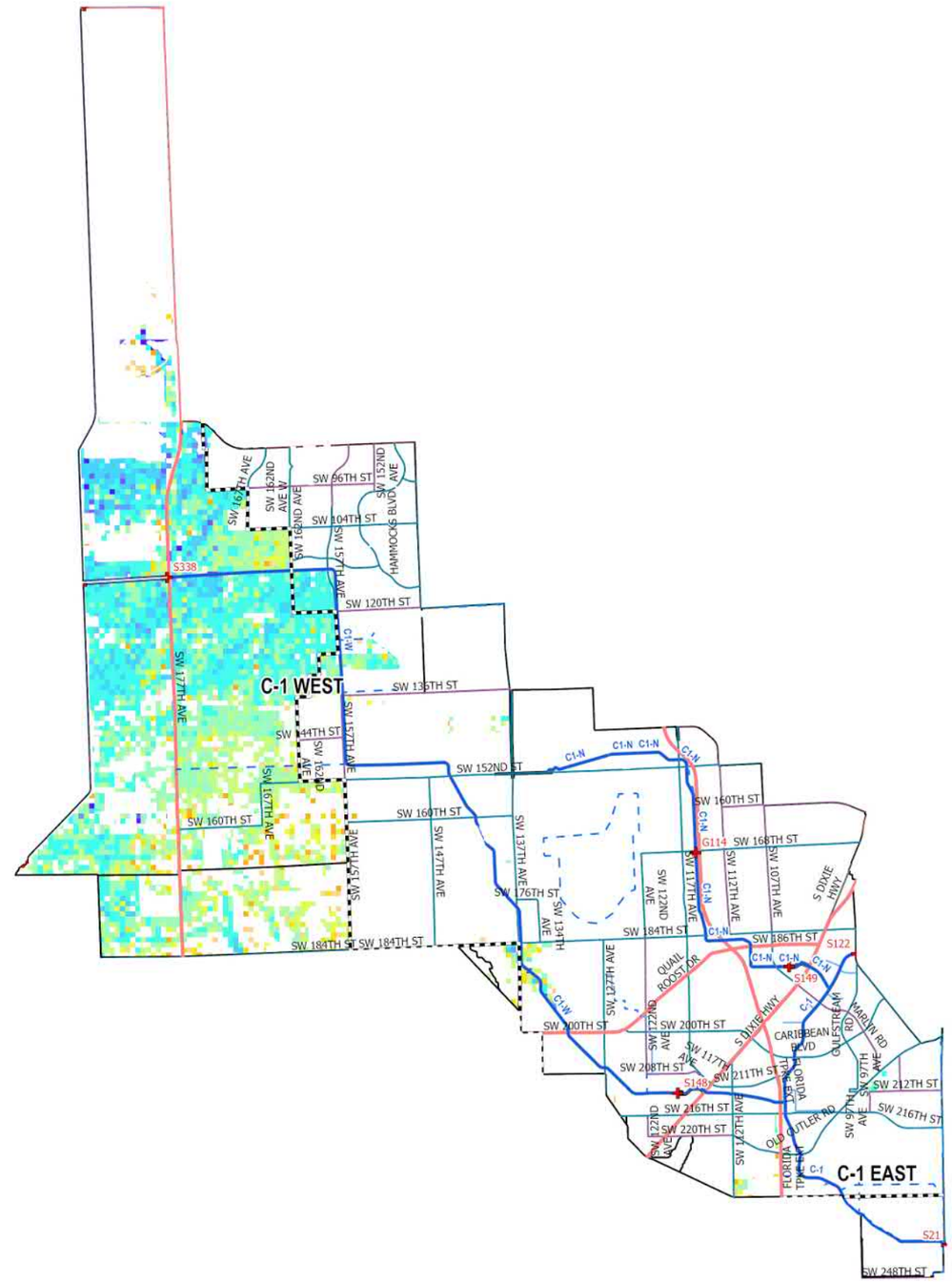
Flood Duration (hr)

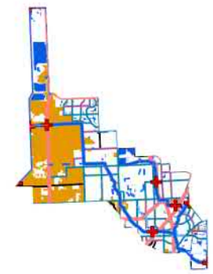
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-56. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

Flood Duration (hr)

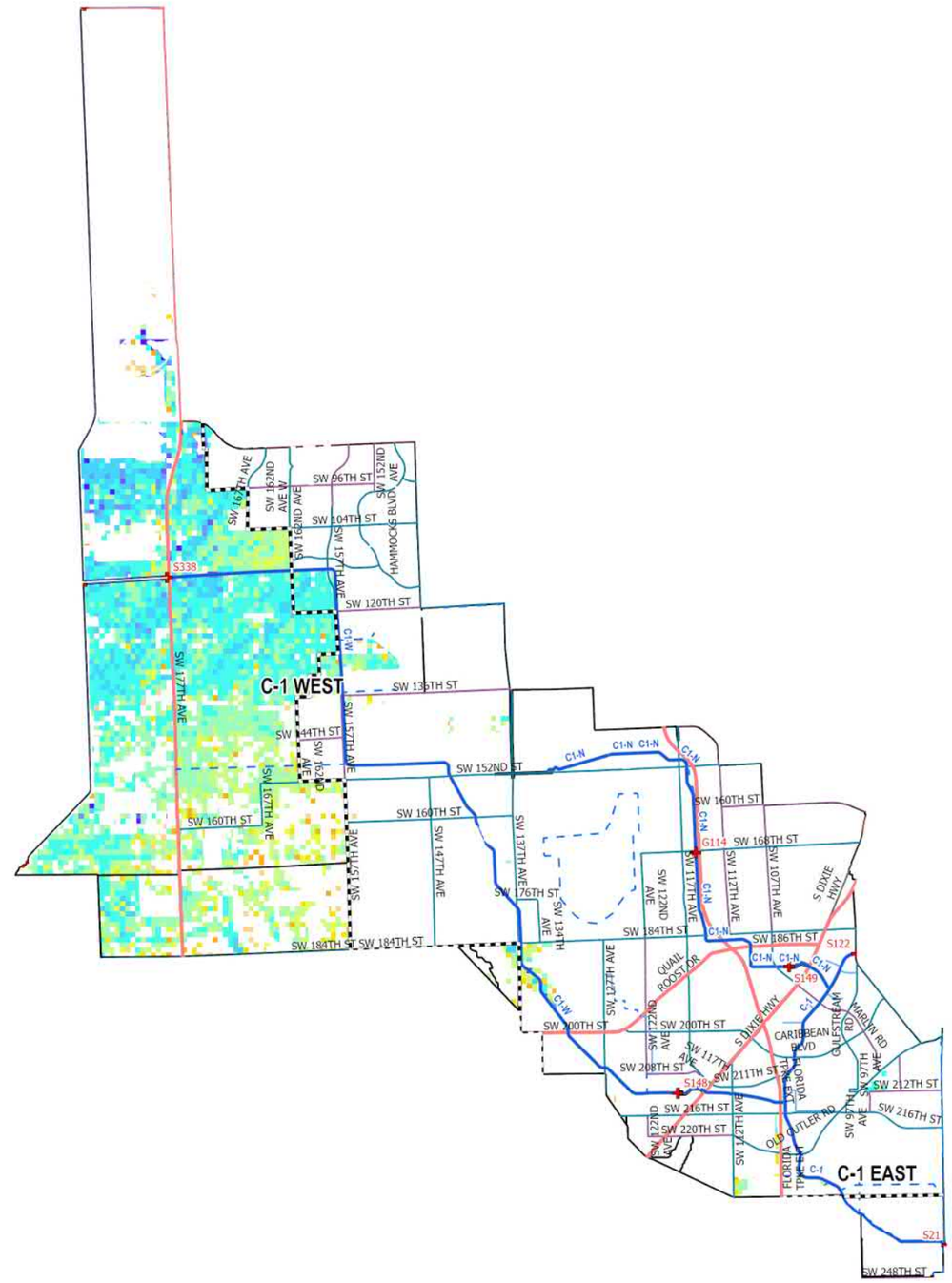
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

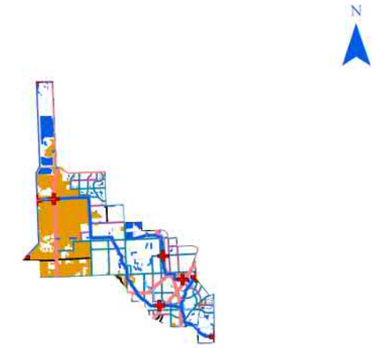
0 0.5 1 2 3 4 Miles

Figure A-57. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

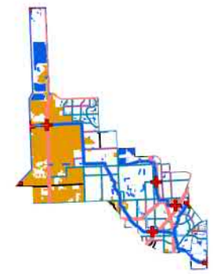
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

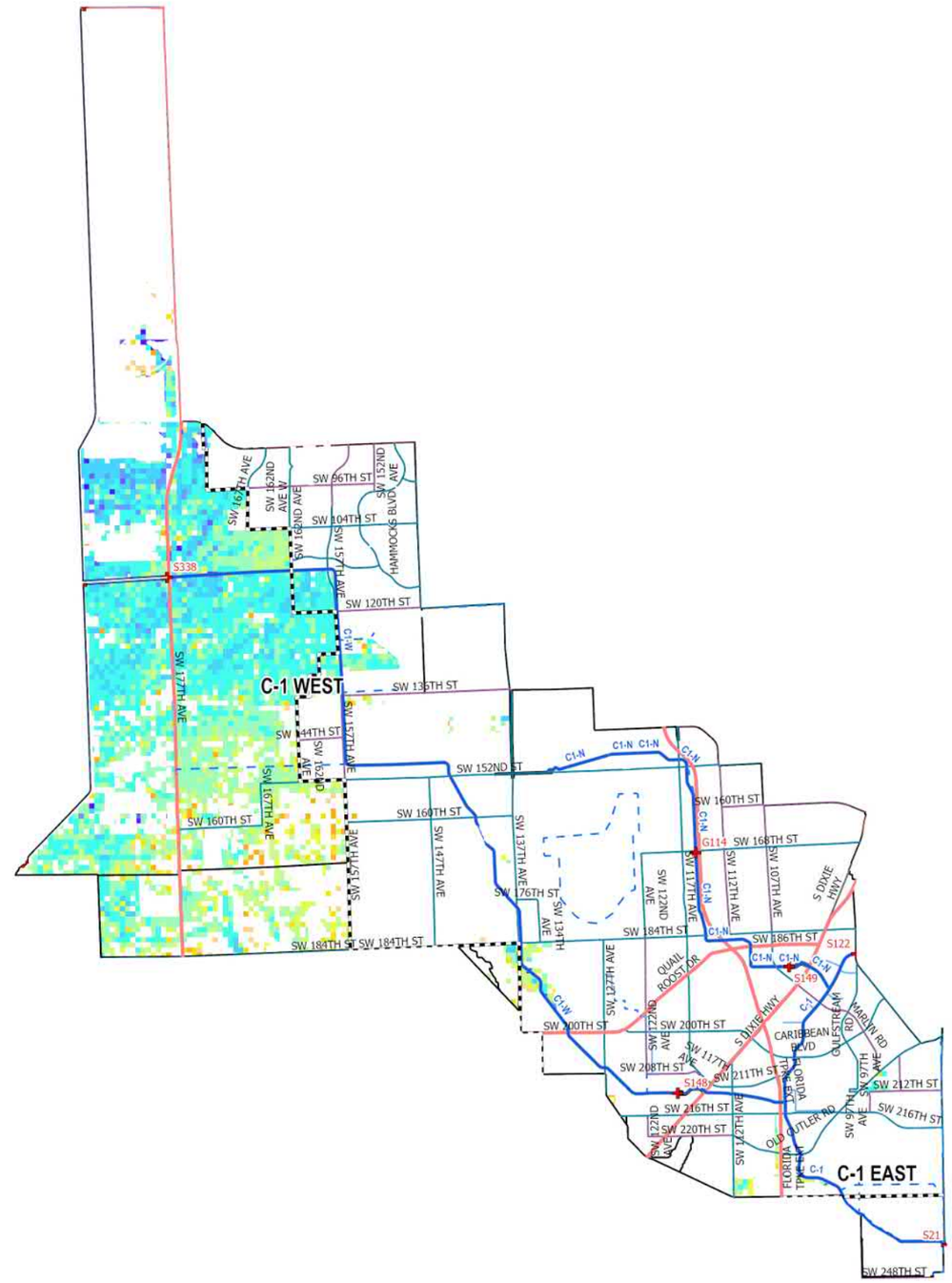
Figure A-58. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

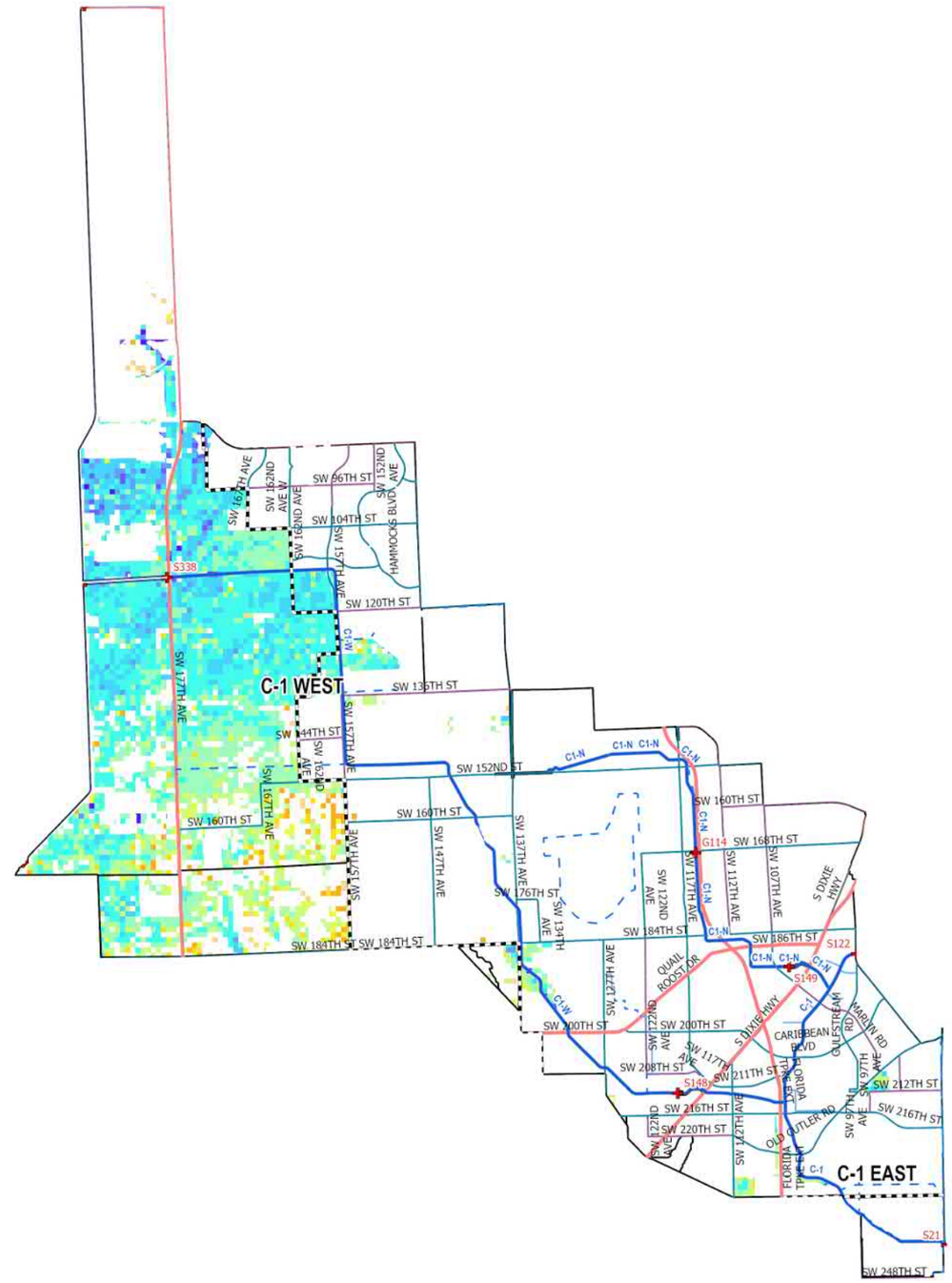
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-59. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn

C-1 Watershed



C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

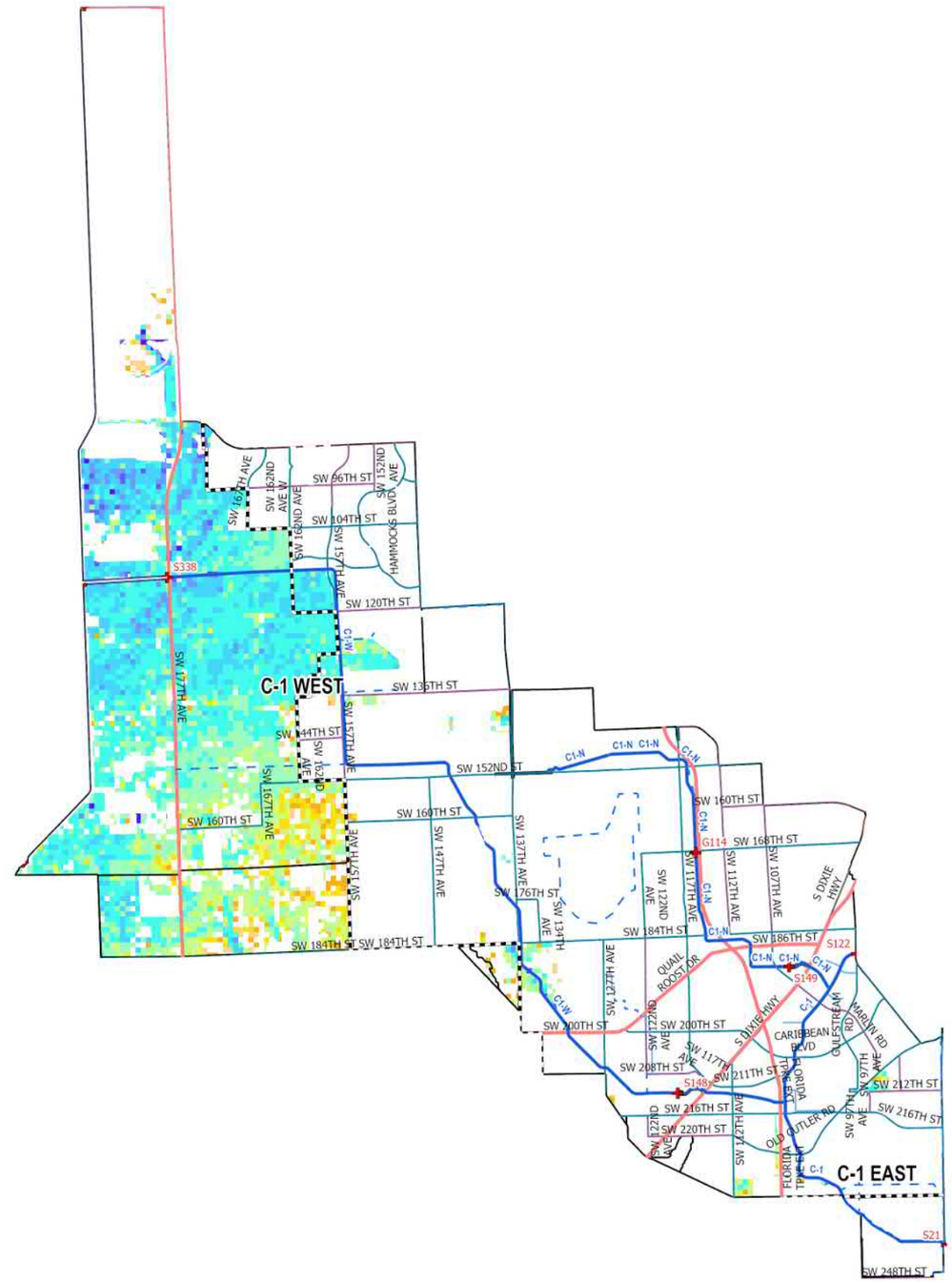
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

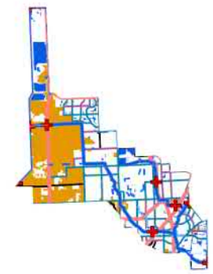
0 0.5 1 2 3 4 Miles

Figure A-60. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Duration (hr)

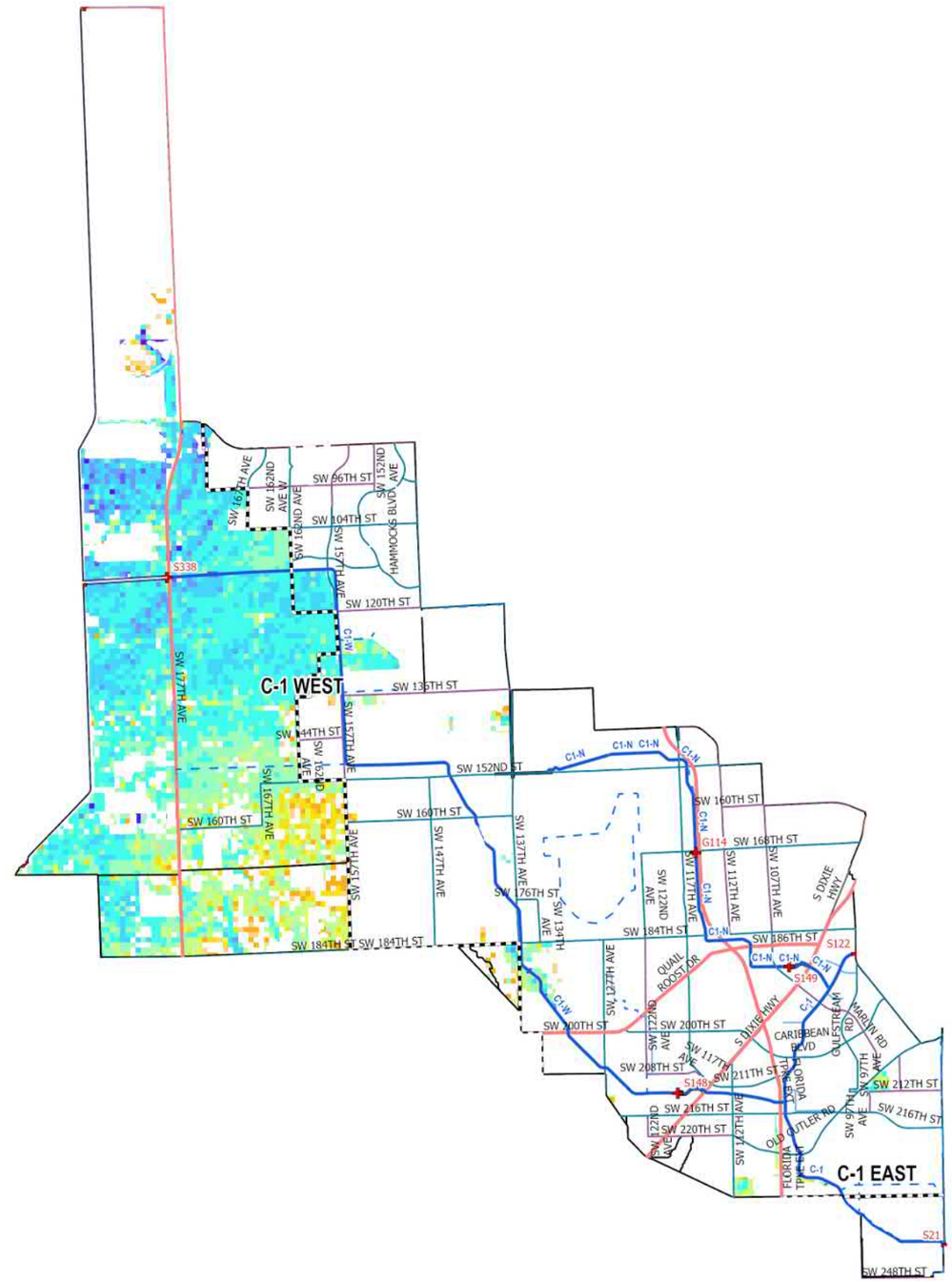
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

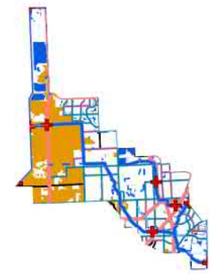
0 0.5 1 2 3 4 Miles

Figure A-61. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

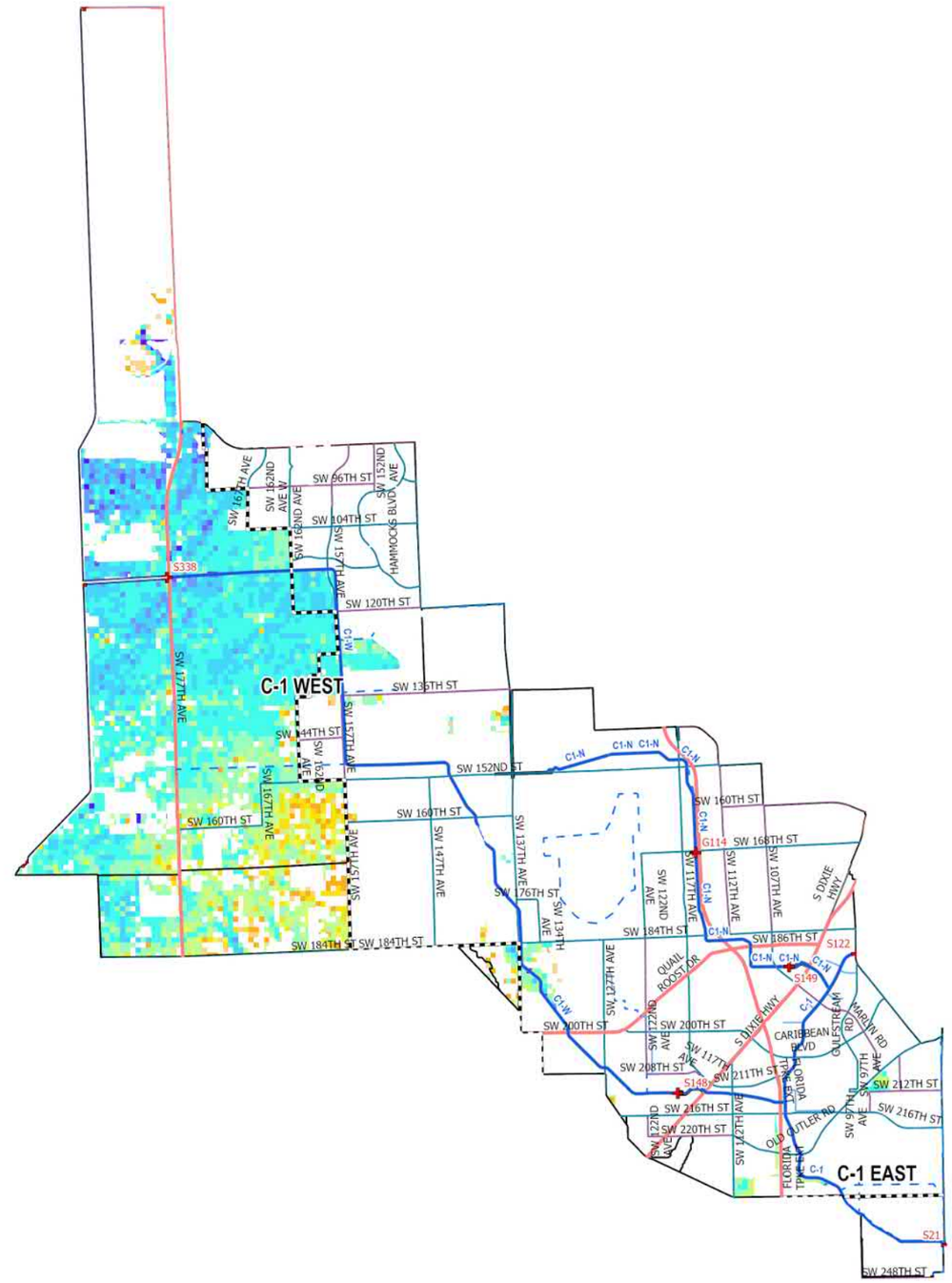
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

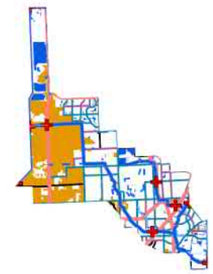
0 0.5 1 2 3 4 Miles

Figure A-62. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

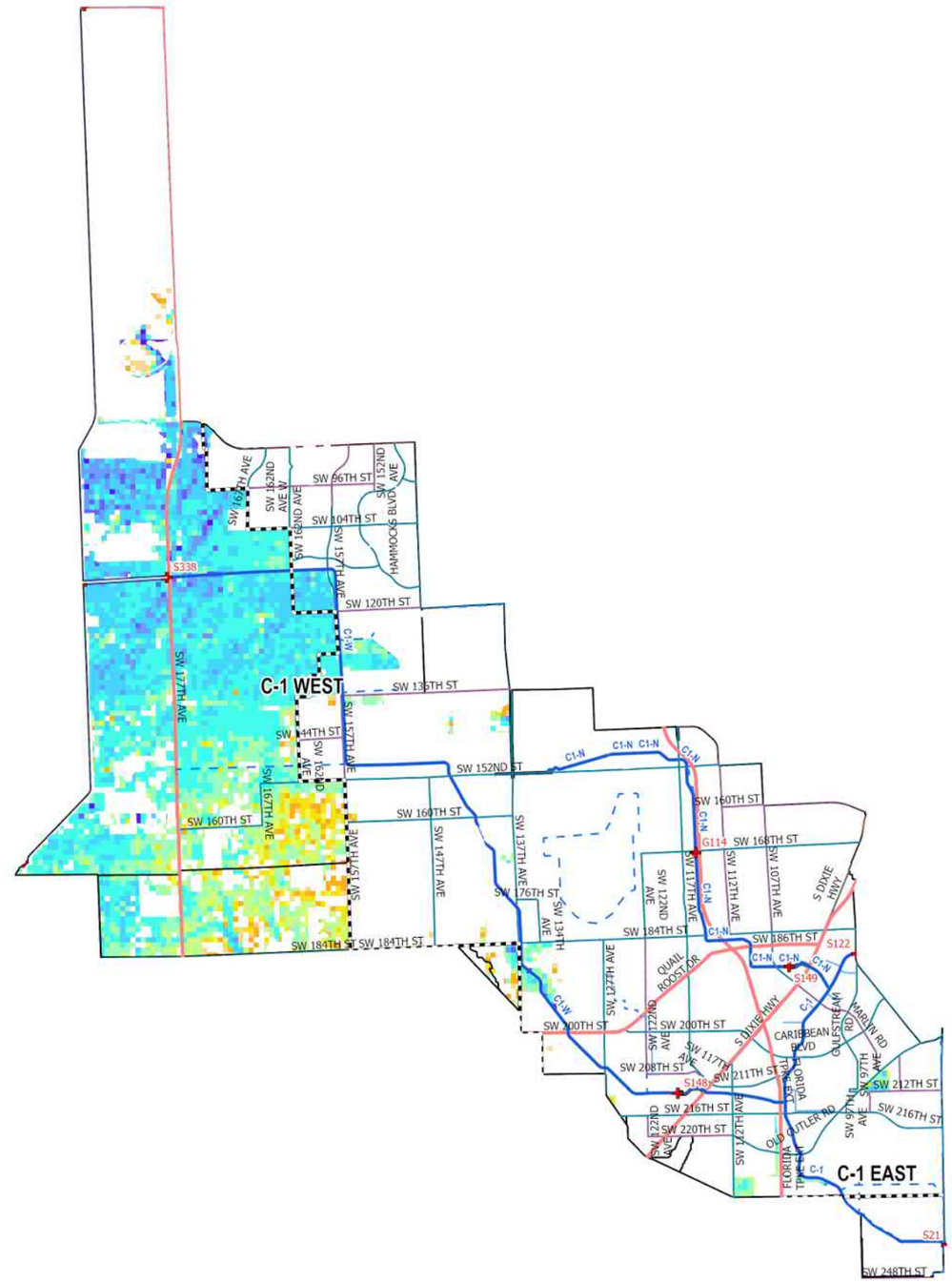
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

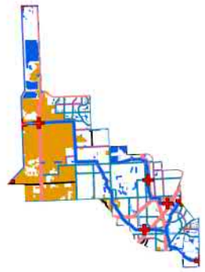
0 0.5 1 2 3 4 Miles

Figure A-63. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn

C-1 Watershed





C-1 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

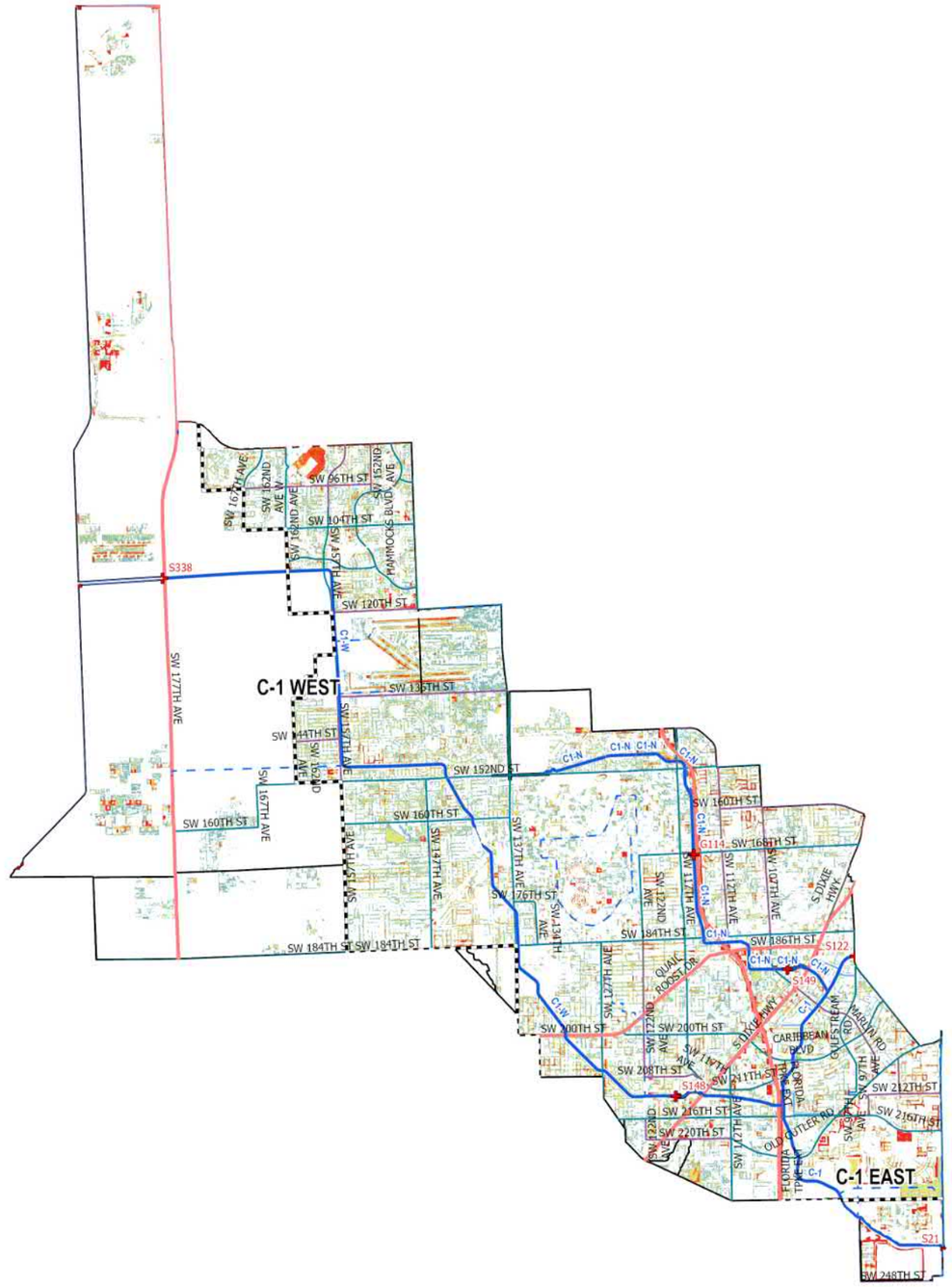
0 0.5 1 2 3 4 Miles

Figure A-64. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

WATERSHED C-1: Flood Extent In Urban Areas

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

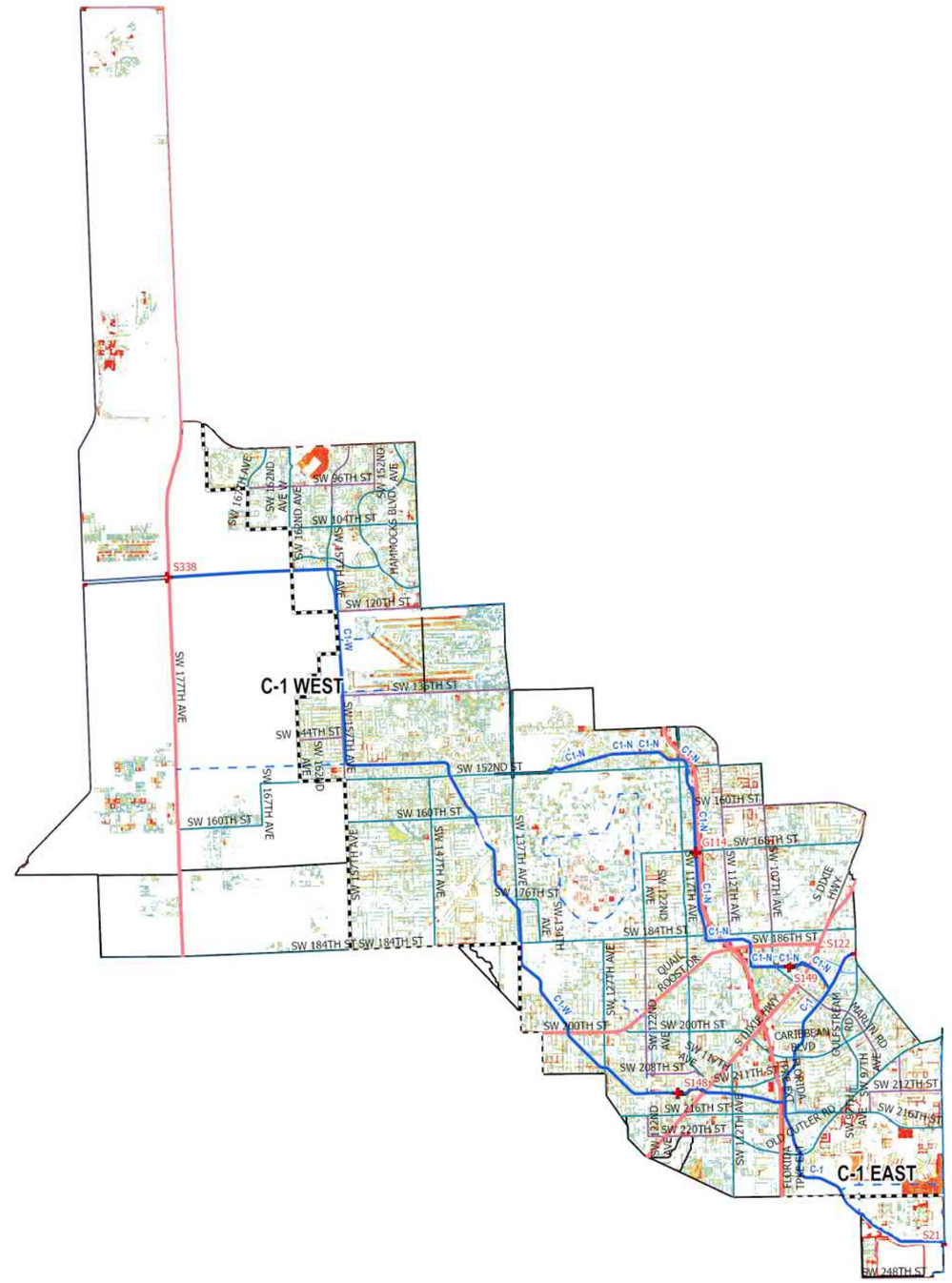
0 0.5 1 2 3 4 Miles

Figure A-65. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



UDB
Evacuation Routes
SFWMD Structures
Canals Primary
Canals Secondary
Canals Other
SFWMD: WATERSHEDS

Major Roads

Road Class
- Class 1
- Class 2
- Class 3
- Class 4

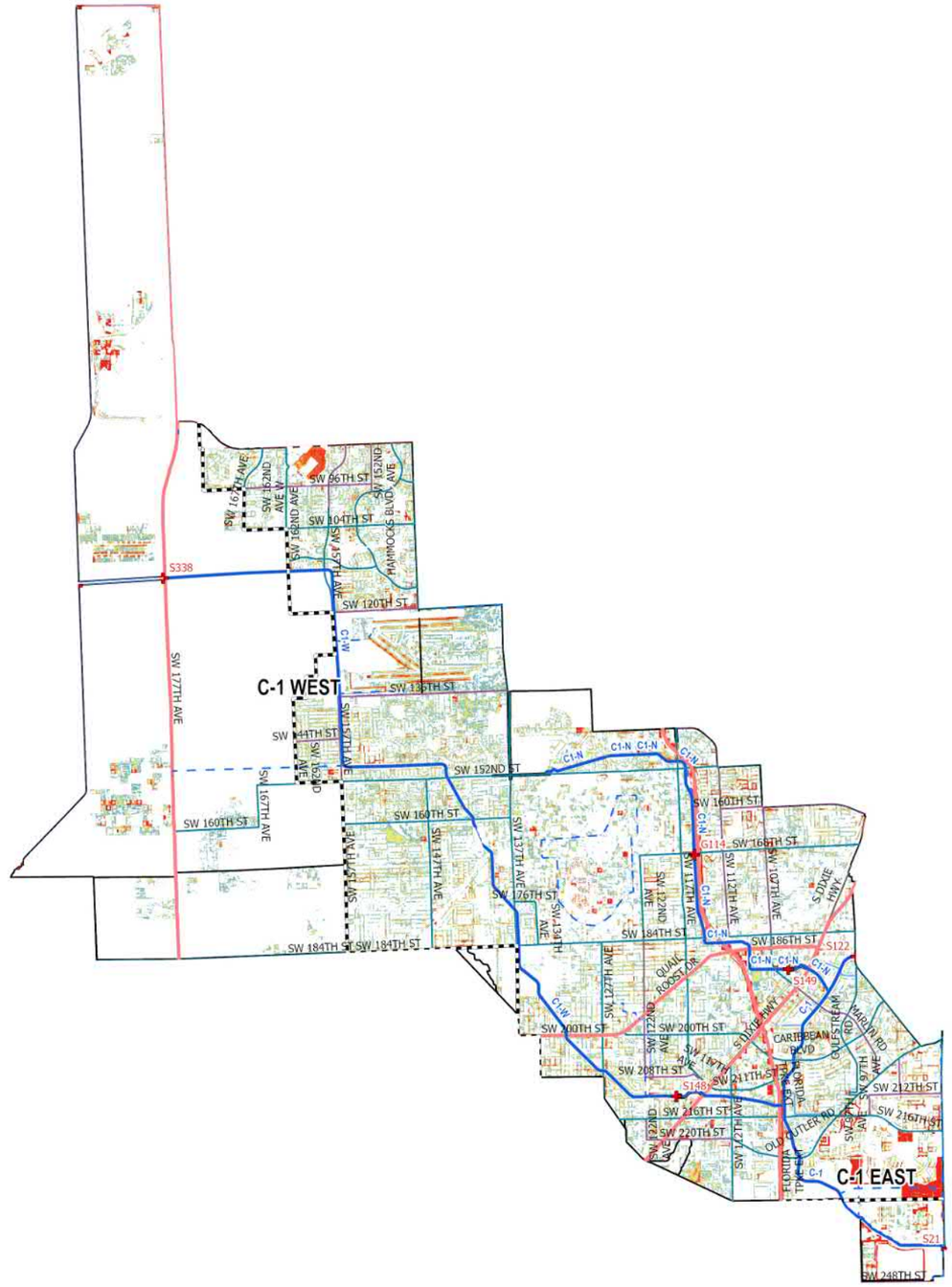
5-Yr/72-Hr SLR = +1.0

Flood Depth (ft)
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-66. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

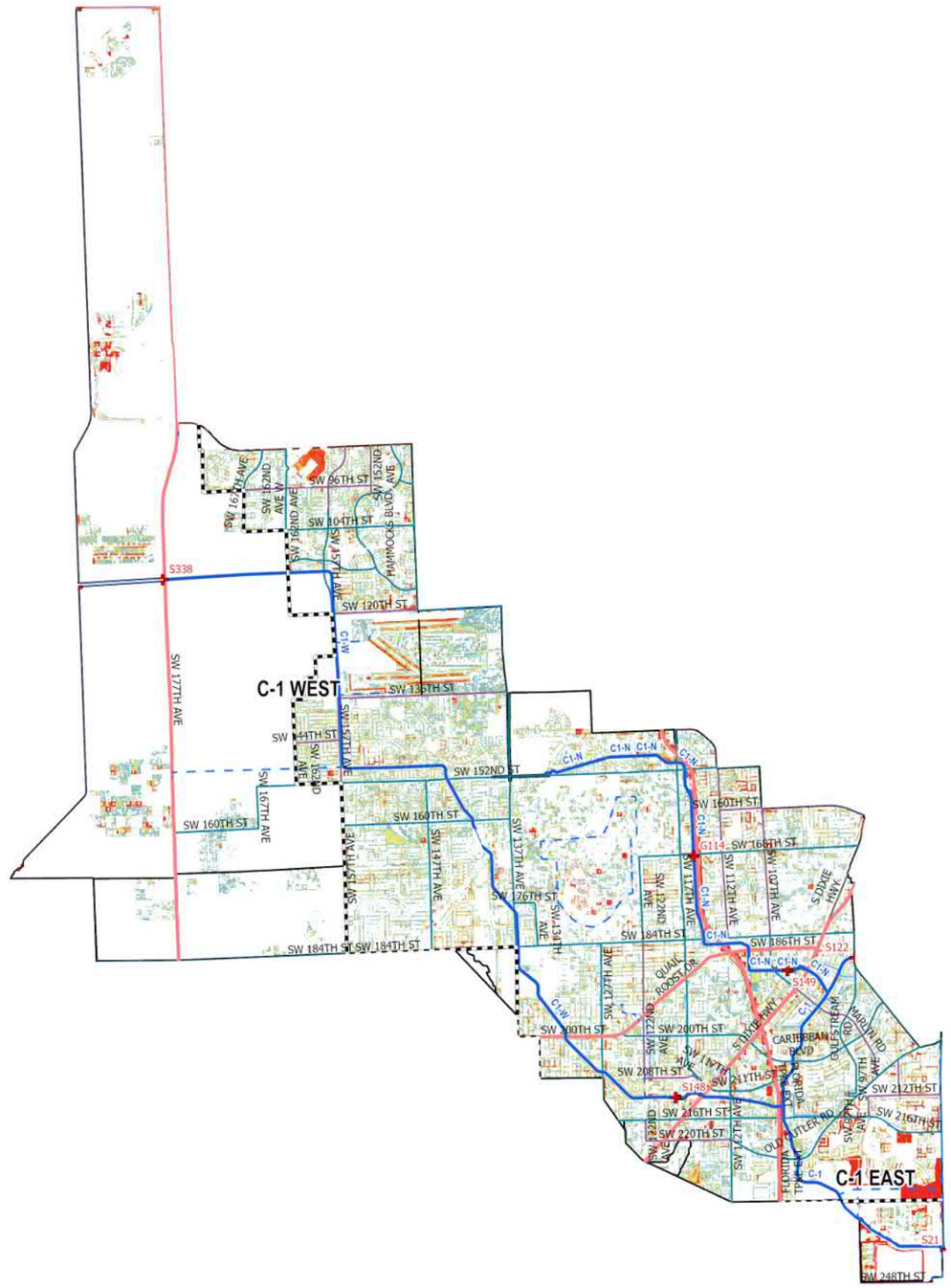
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-67. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

N

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

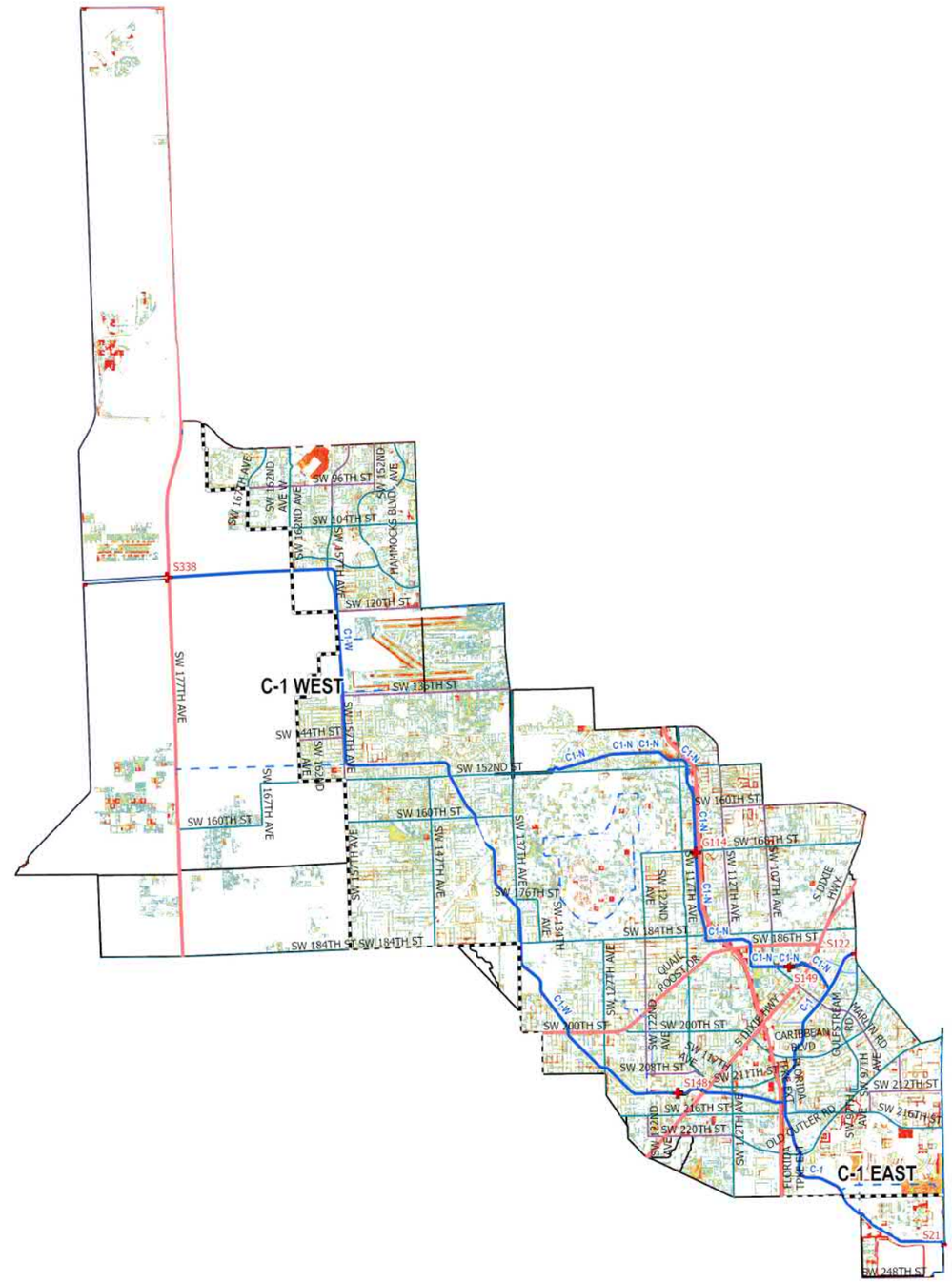
0 0.5 1 2 3 4 Miles

Figure A-68. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

Flood Depth (ft)

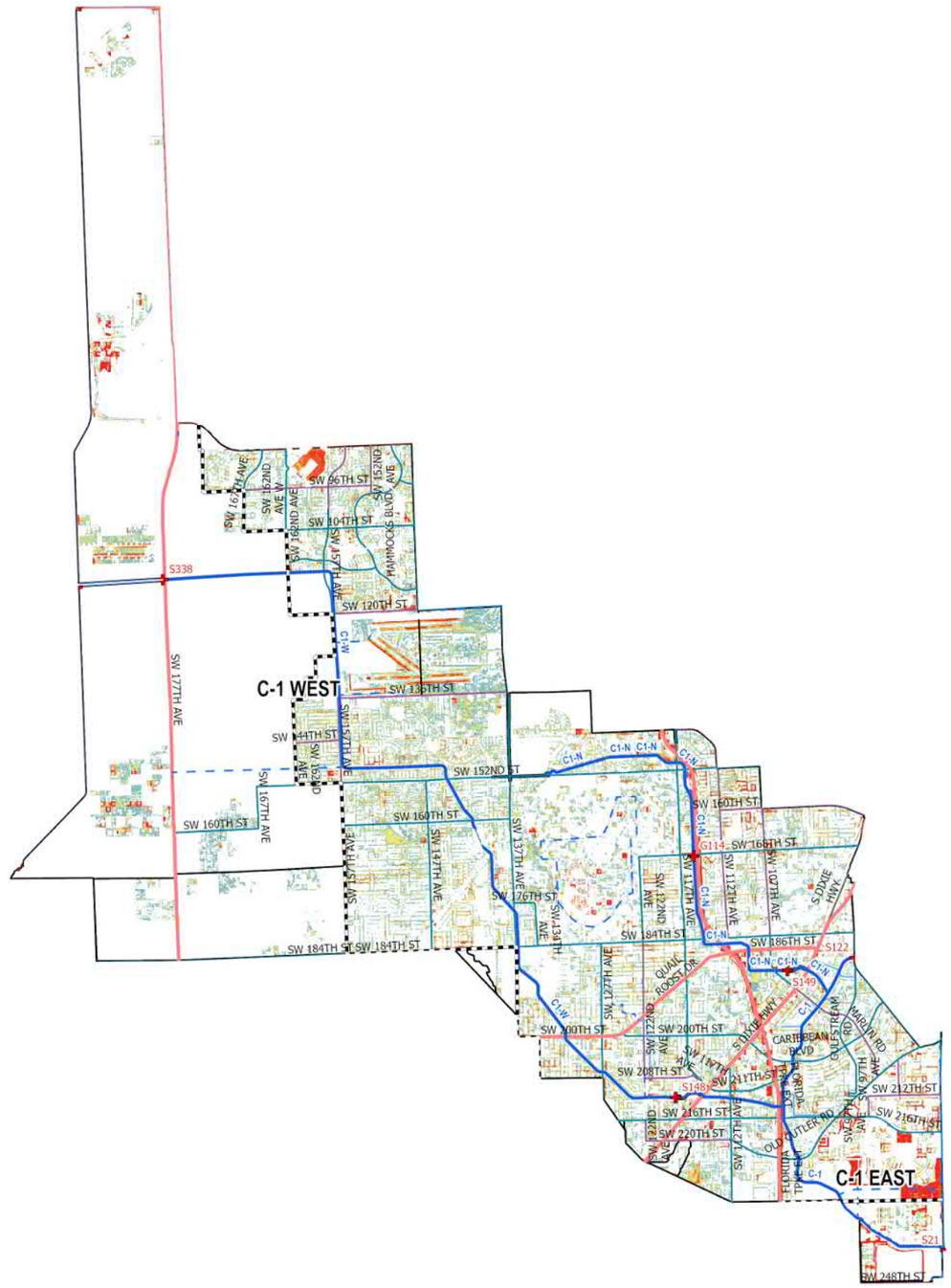
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-69. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

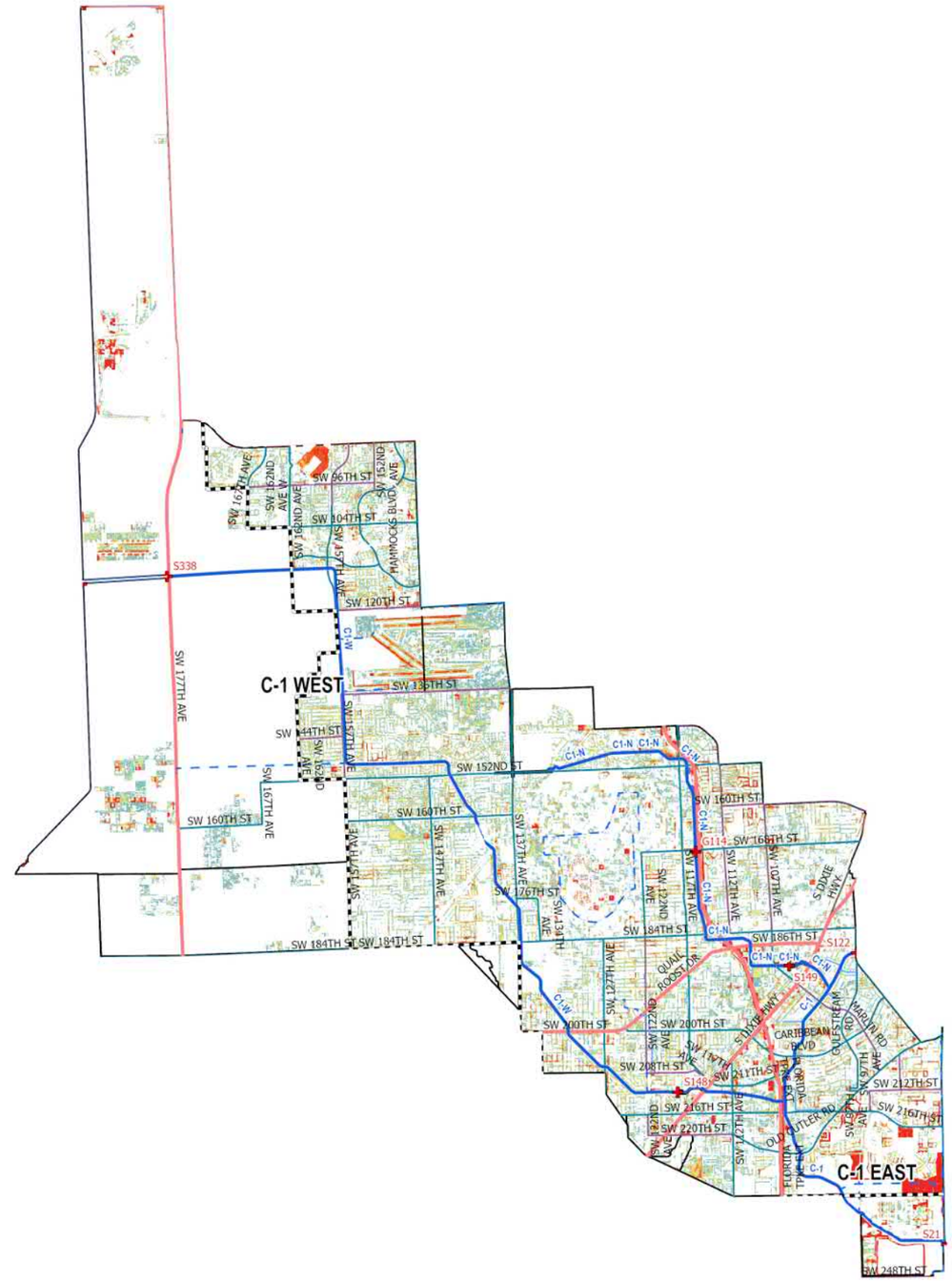
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-70. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

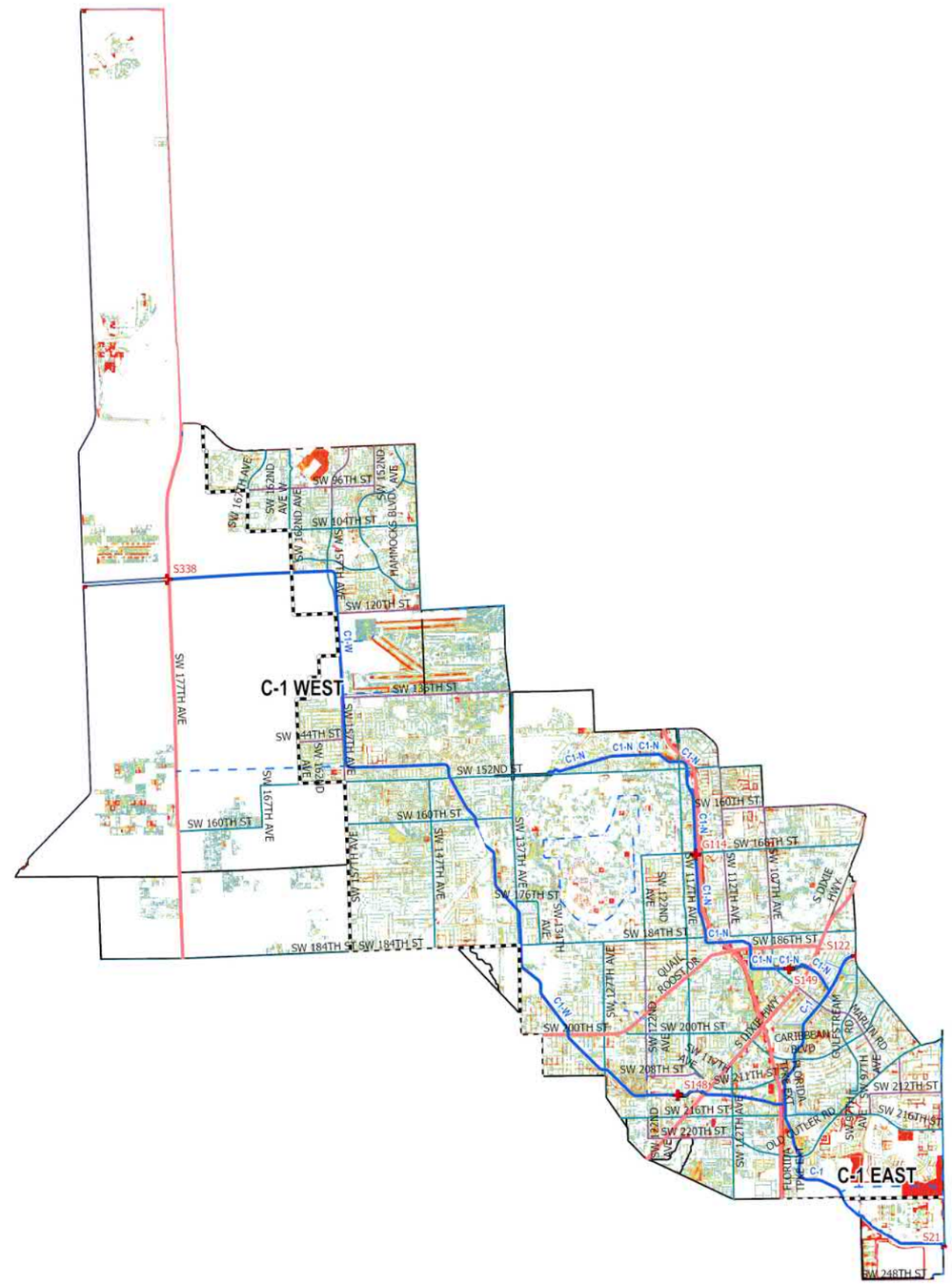
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-71. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

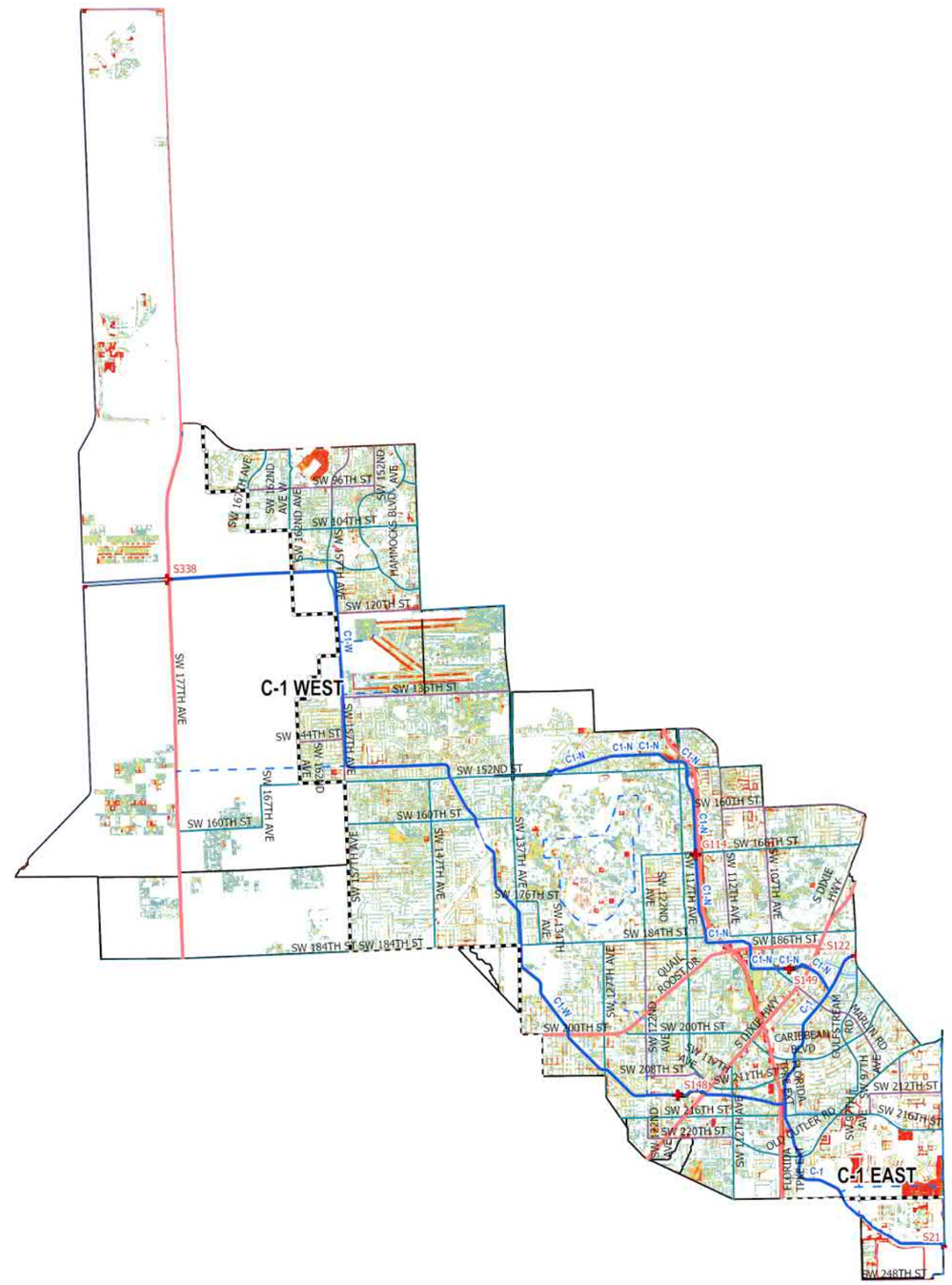
0 0.5 1 2 3 4 Miles

Figure A-72. Watershed C-1 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



N

UDB
Evacuation Routes
SFWMD Structures
Canals Primary
Canals Secondary
Canals Other
SFWMD: WATERSHEDS

Major Roads

Road Class
Class 1
Class 2
Class 3
Class 4

25-Yr/72-Hr SLR = 0

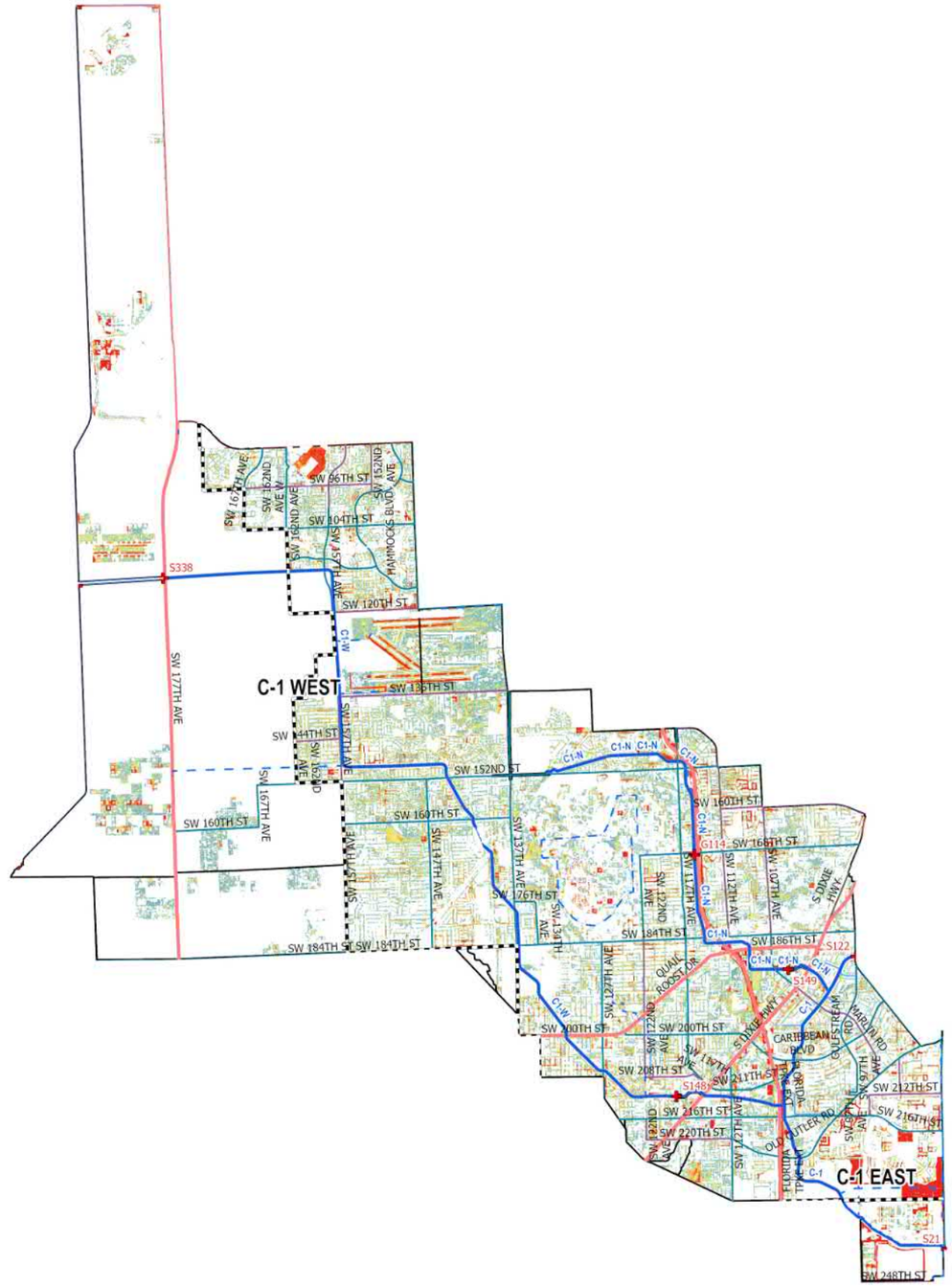
Flood Depth (ft)
< 0.25 ft
0.25 – 0.50 ft
0.50 – 0.75 ft
0.75 – 1.00 ft
1.00 – 1.25 ft
1.25 – 1.50 ft
1.50 – 1.75 ft
1.75 – 2.00 ft
2.00 – 2.25 ft
2.25 – 2.50 ft
> 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-73. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

N

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

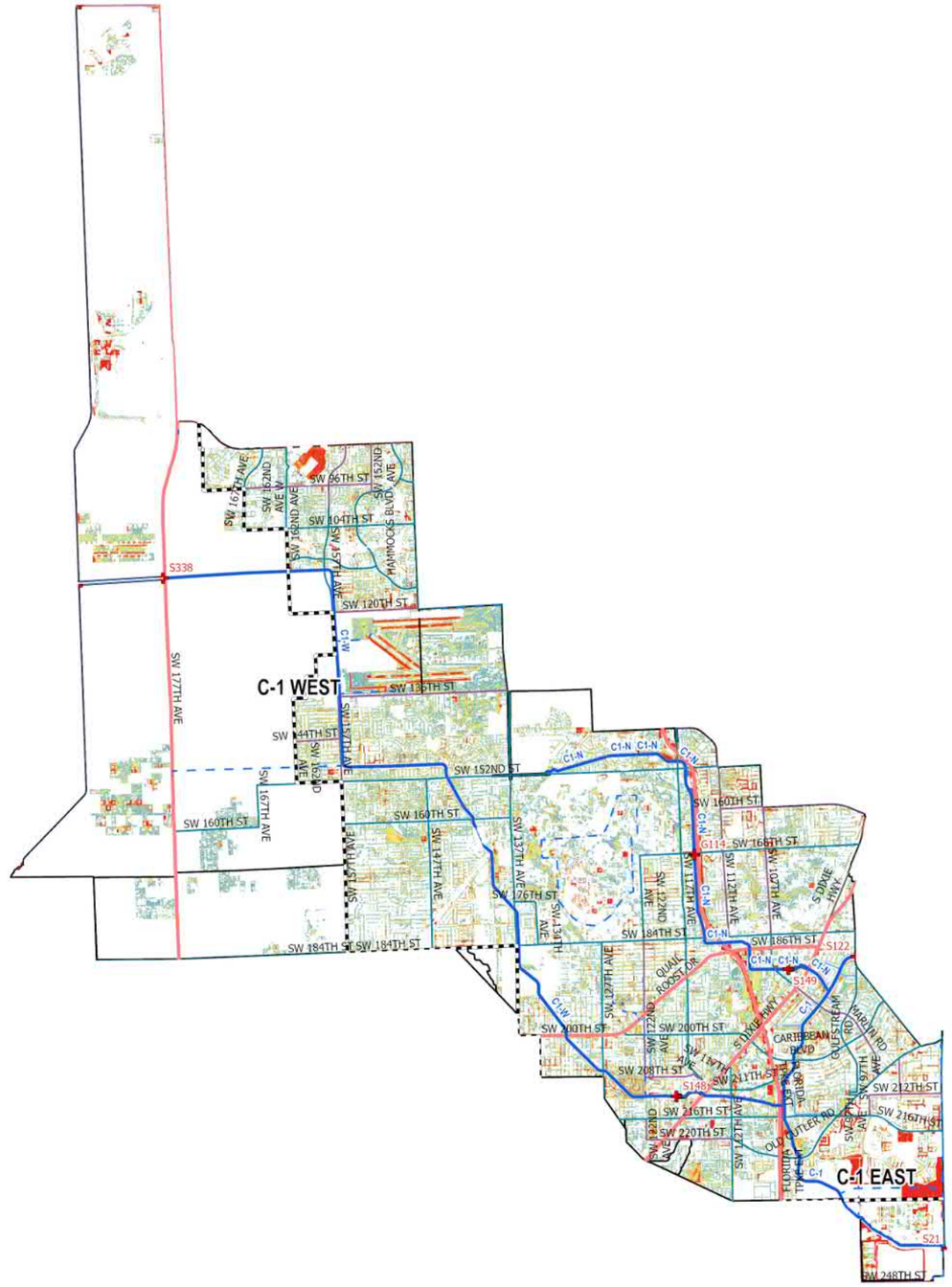
0 0.5 1 2 3 4 Miles

Figure A-74. Watershed C-1 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

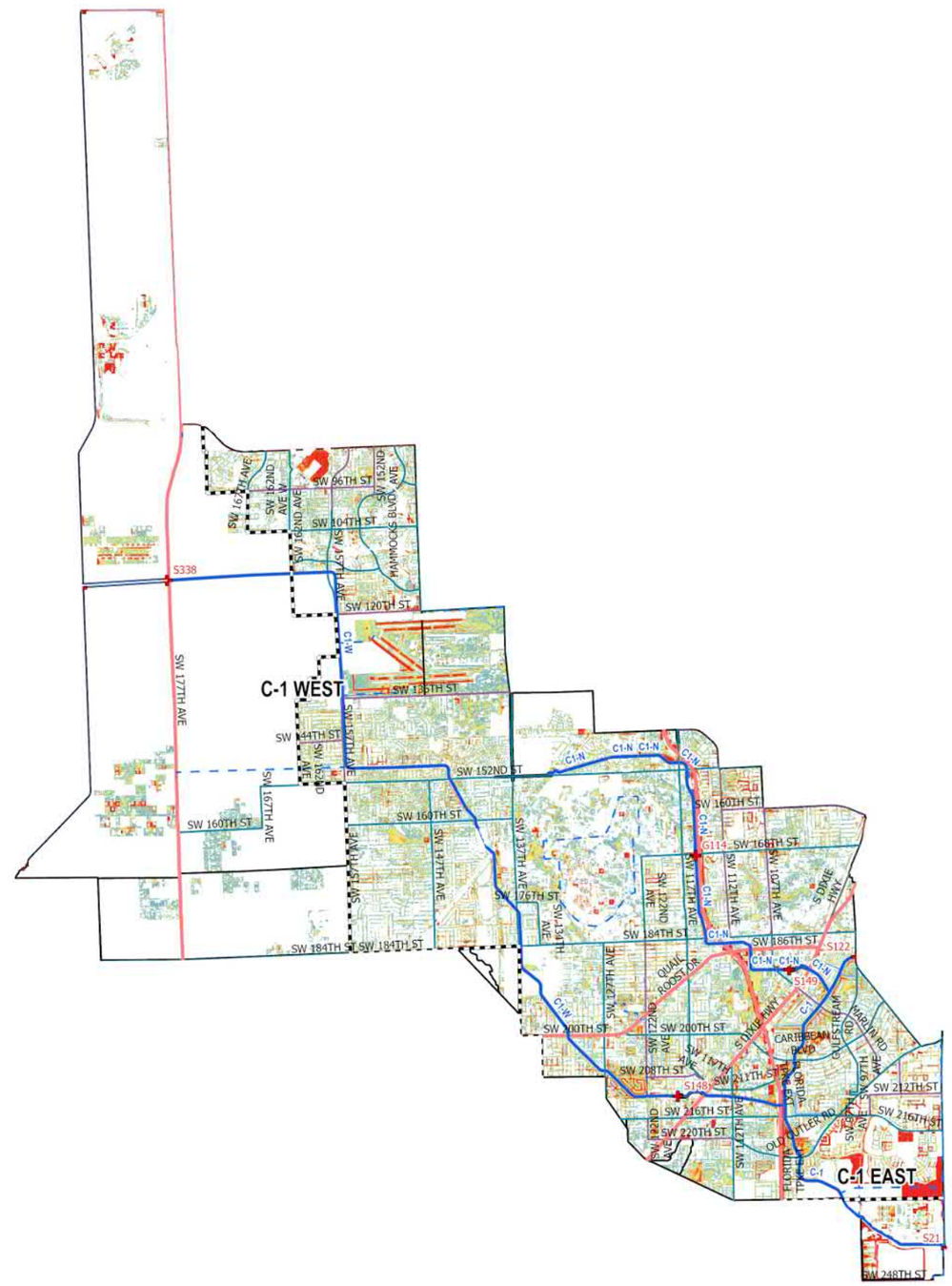
0 0.5 1 2 3 4 Miles

Figure A-75. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

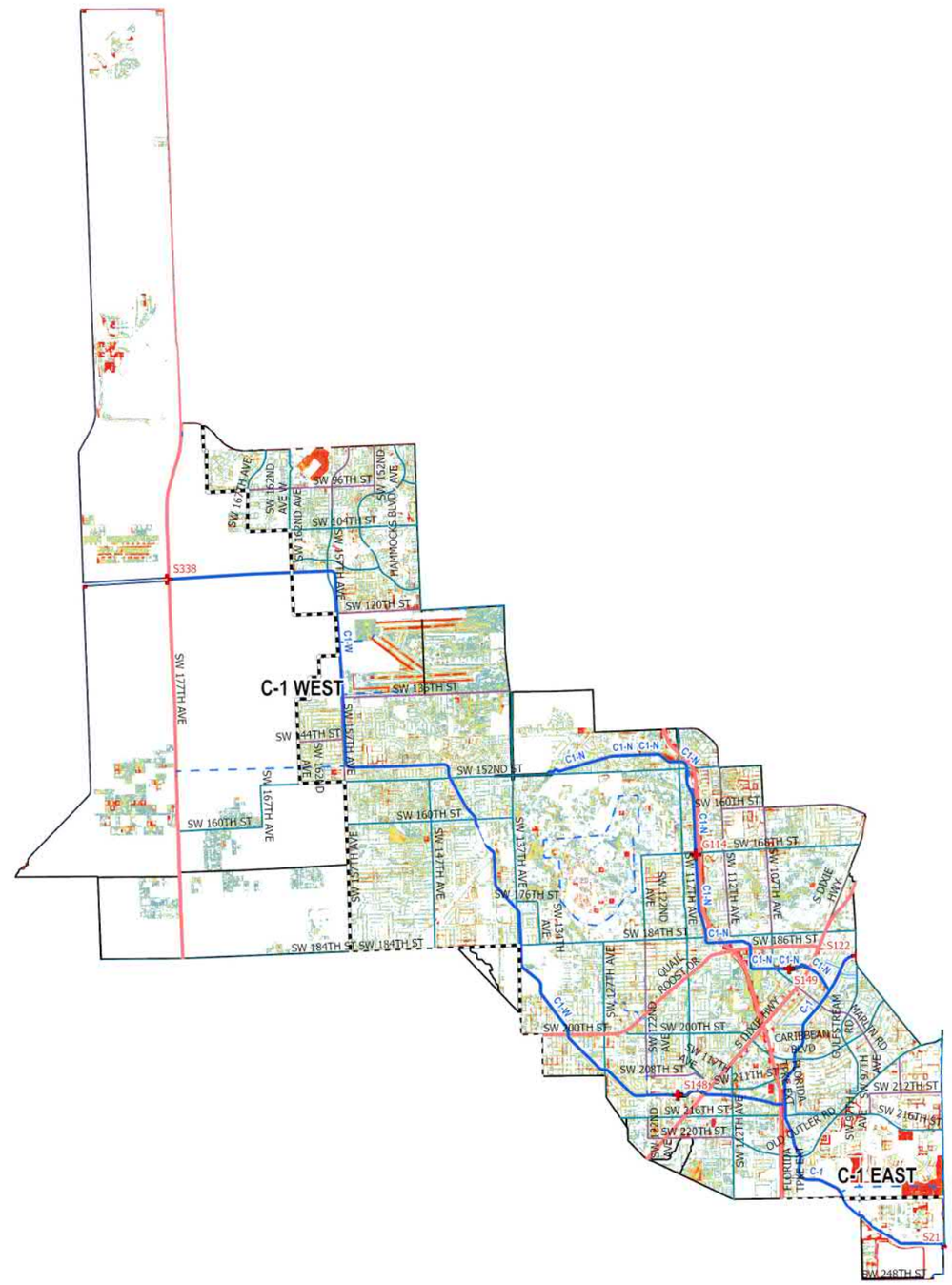
0 0.5 1 2 3 4 Miles

Figure A-76. Watershed C-1 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

N

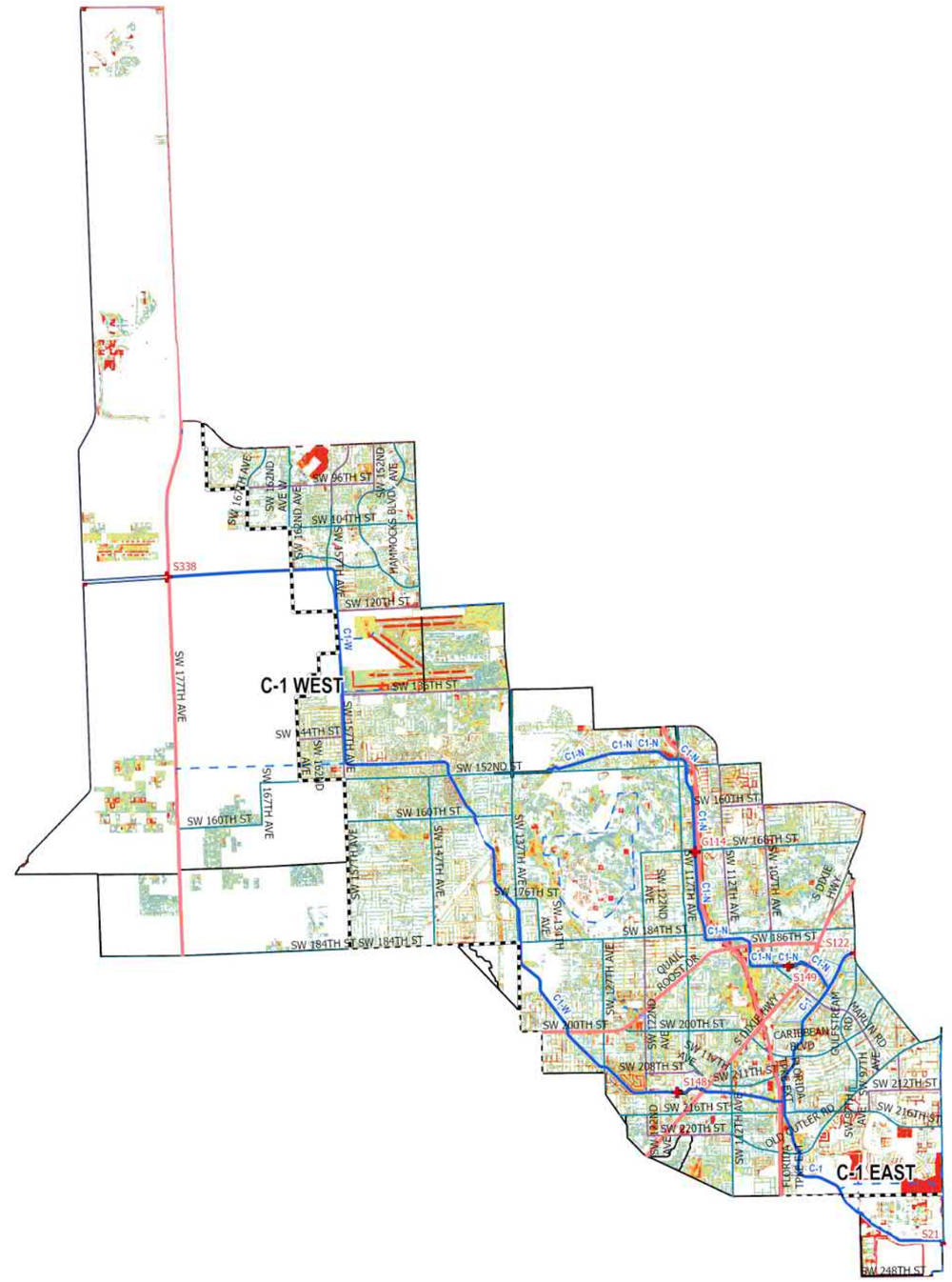
0 0.5 1 2 3 4 Miles

Figure A-77. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

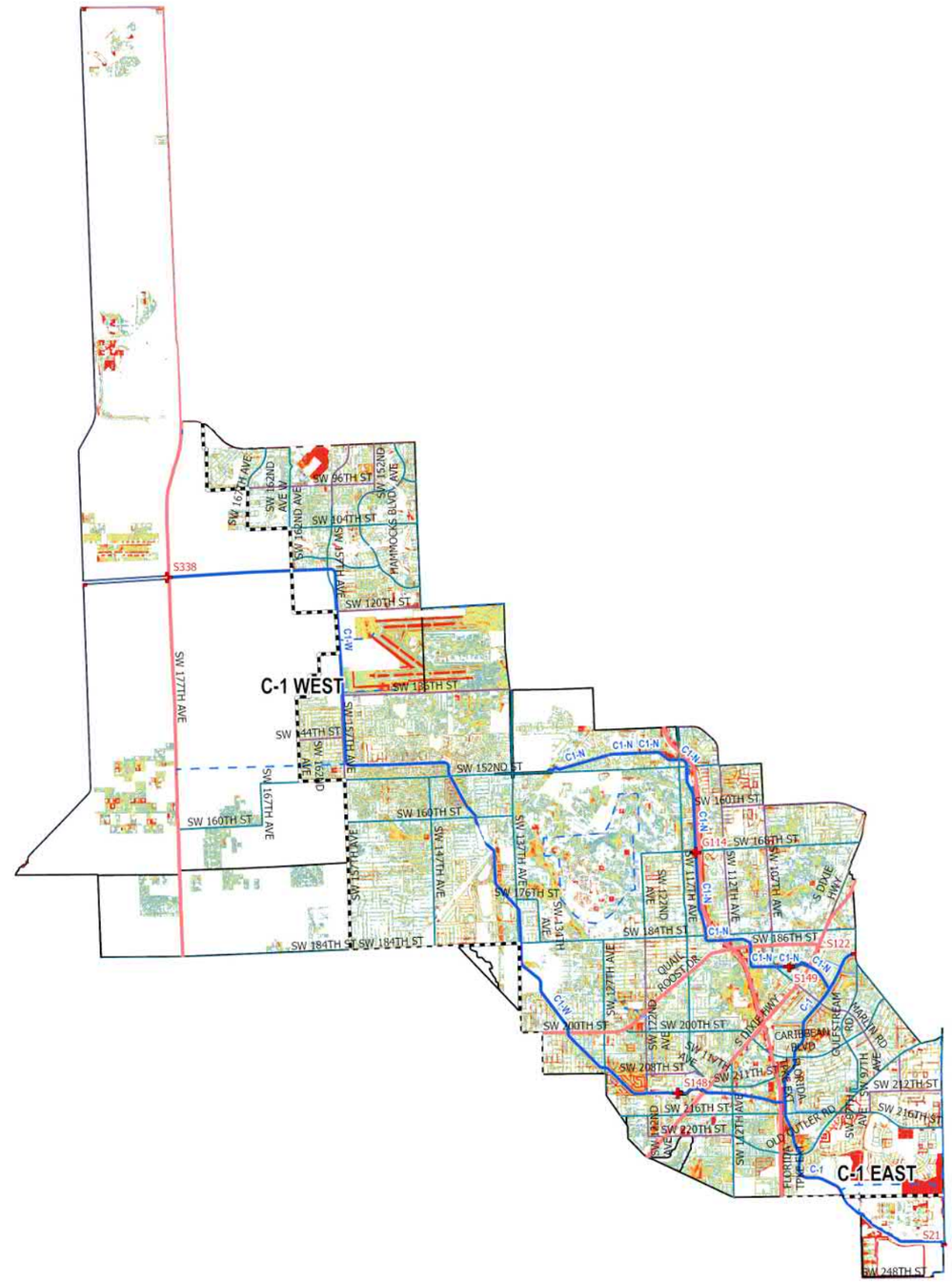
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-78. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

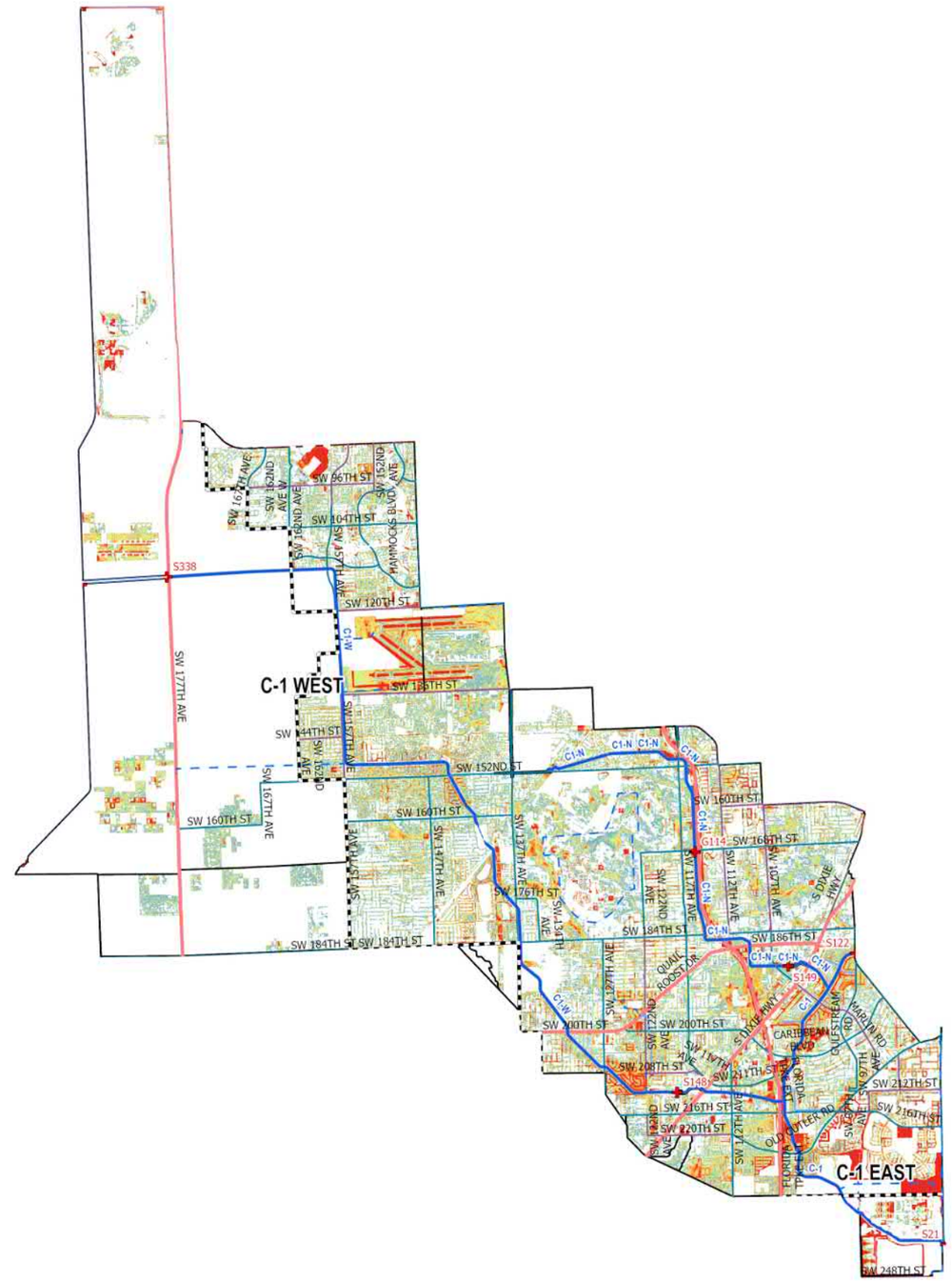
0 0.5 1 2 3 4 Miles

Figure A-79. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



N

UDB
Evacuation Routes
SFWMD Structures
Canals Primary
Canals Secondary
Canals Other
SFWMD: WATERSHEDS

Major Roads

Road Class
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

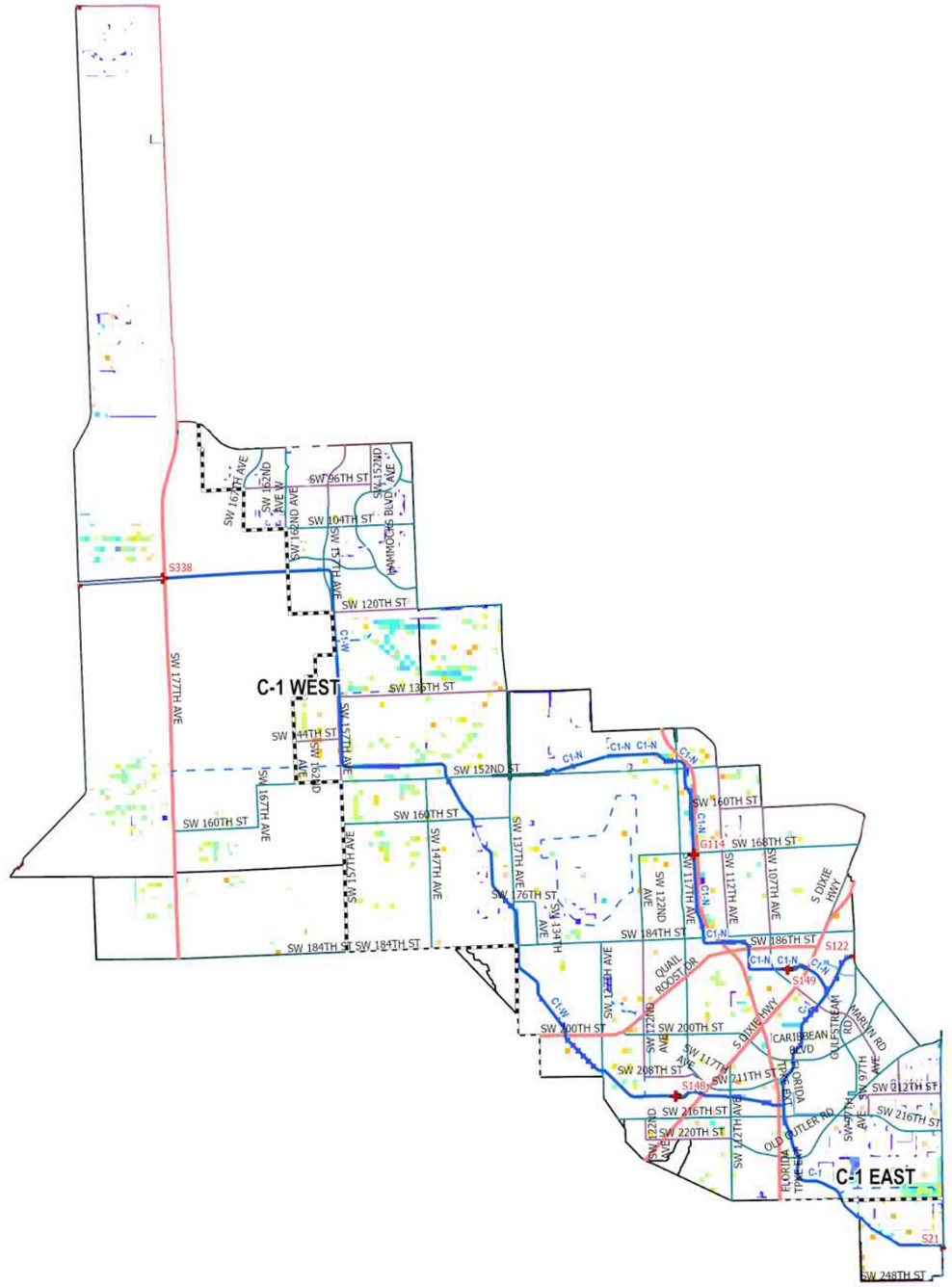
0 0.5 1 2 3 4 Miles

Figure A-80. Watershed C-1 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

WATERSHED C-1: Flood Duration in Urban Areas

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

Flood Duration (hr)

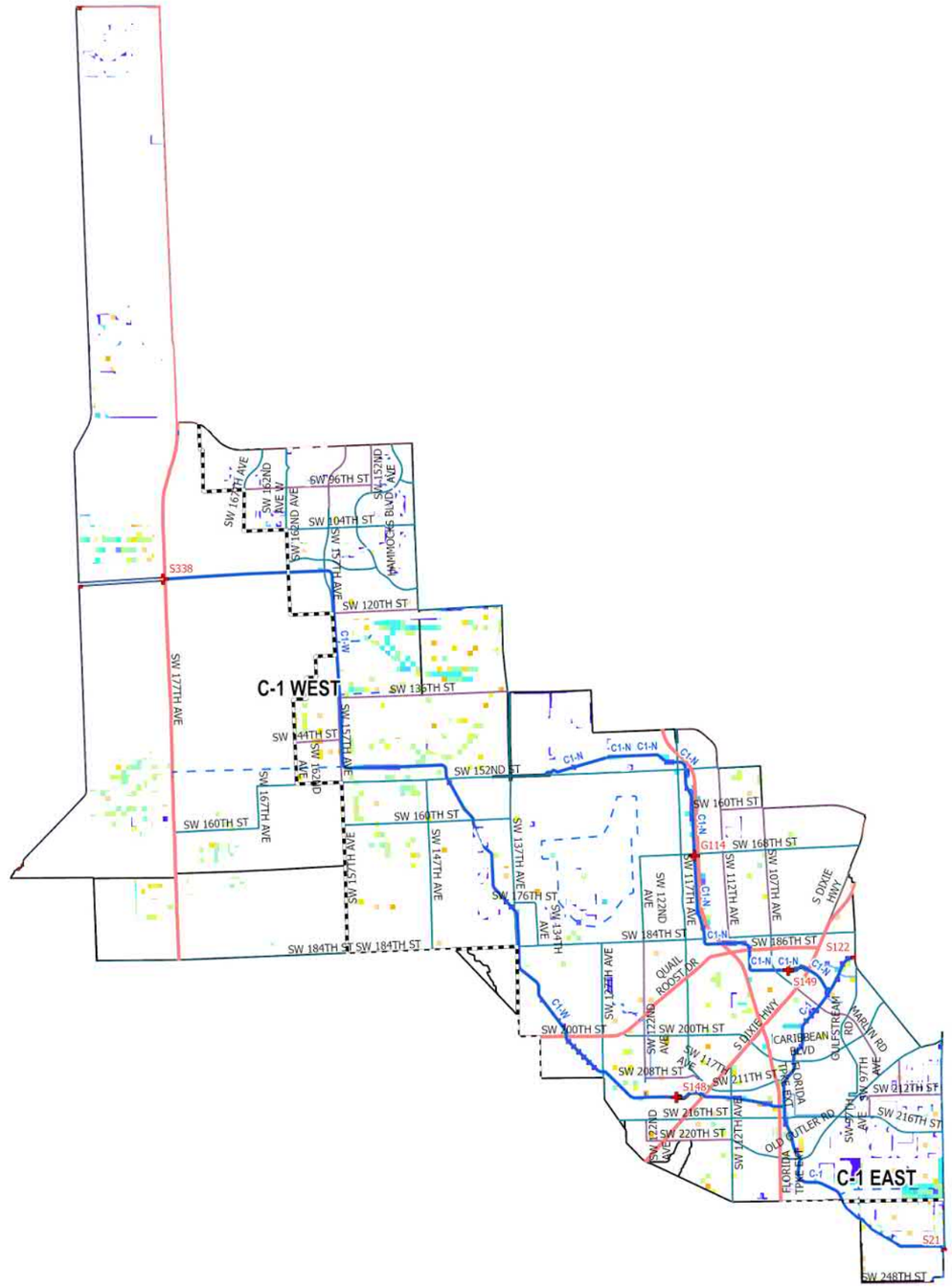
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-81. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

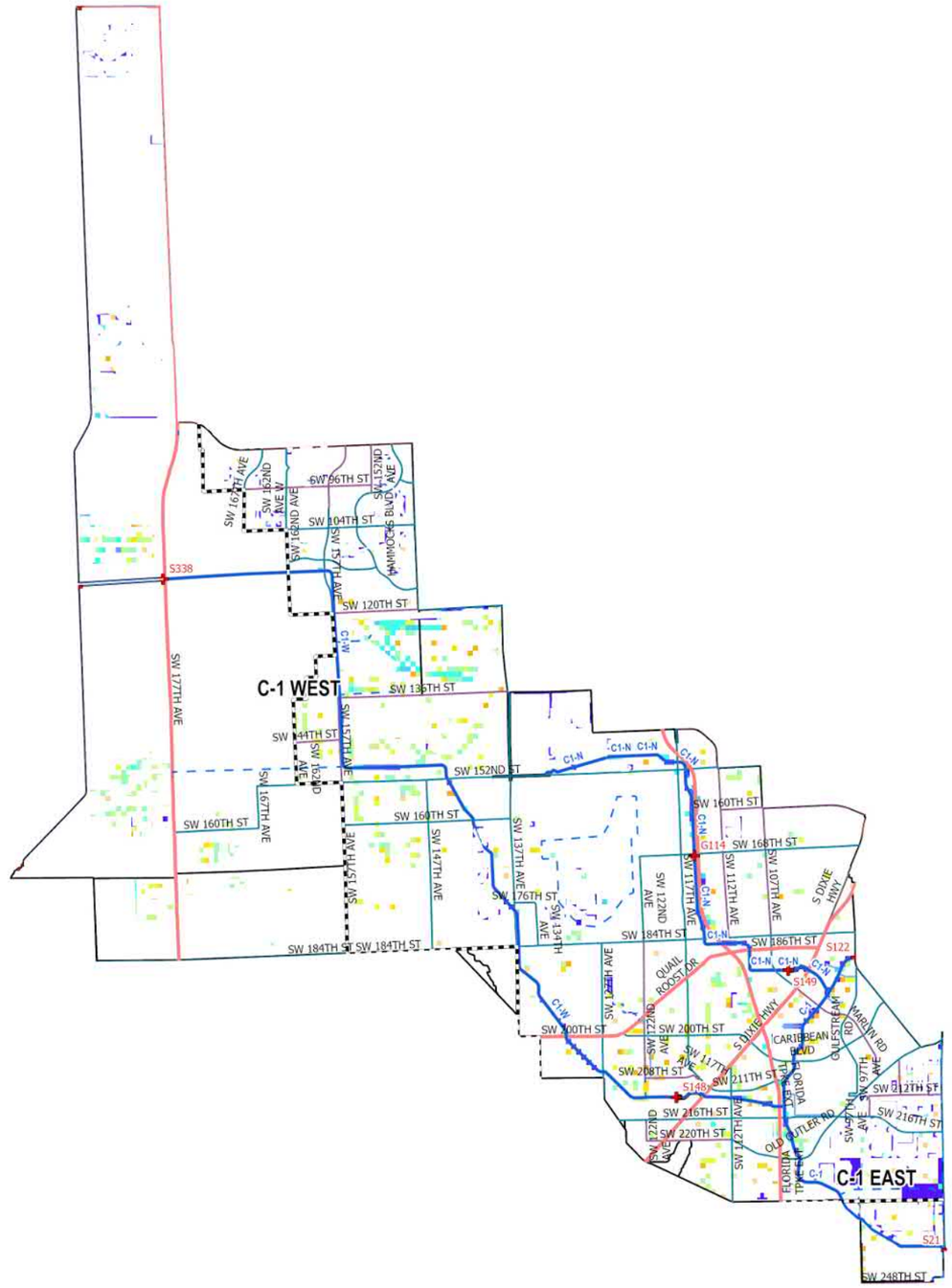
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-82. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

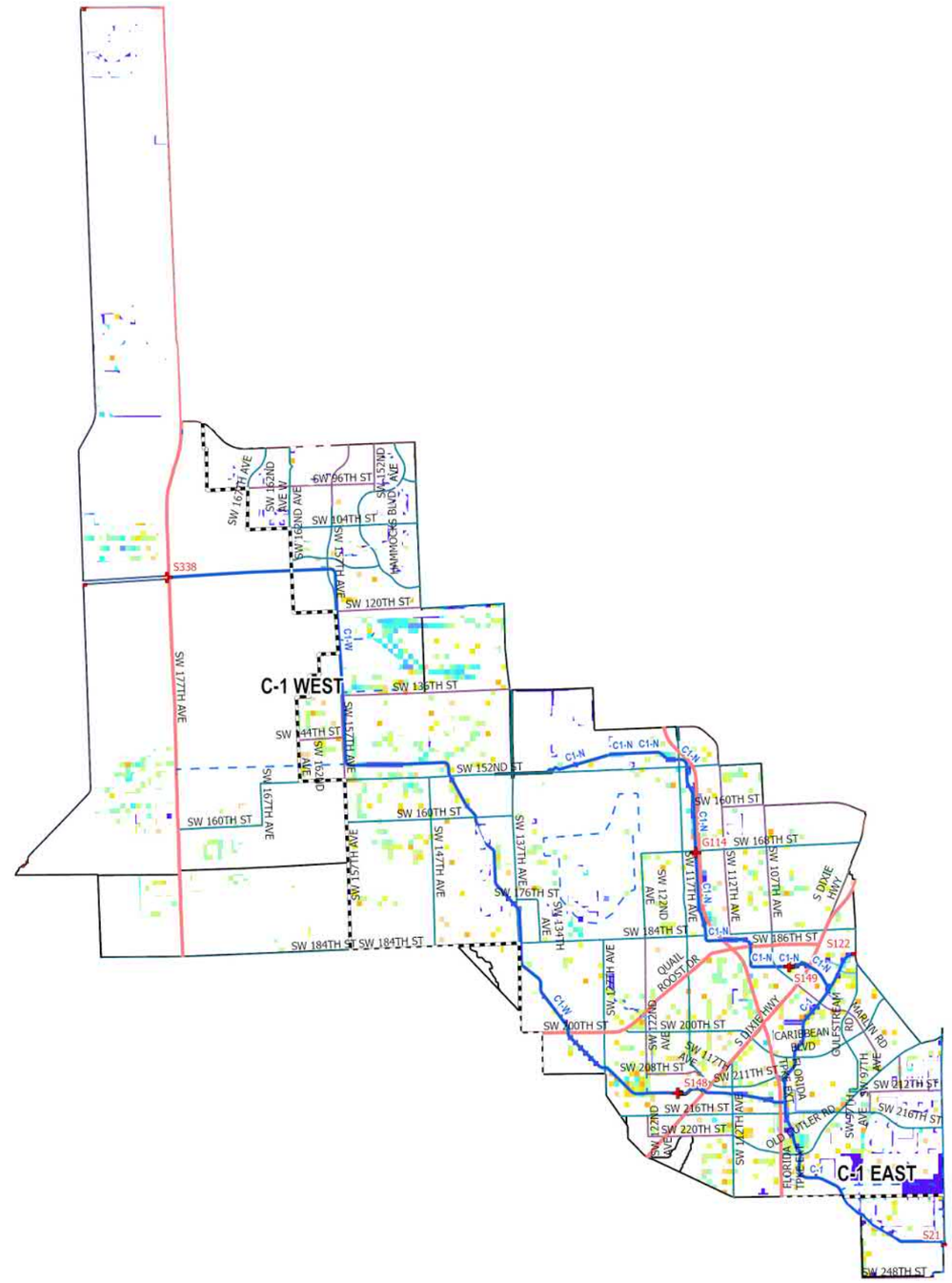
0 0.5 1 2 3 4 Miles

Figure A-83. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-84. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed

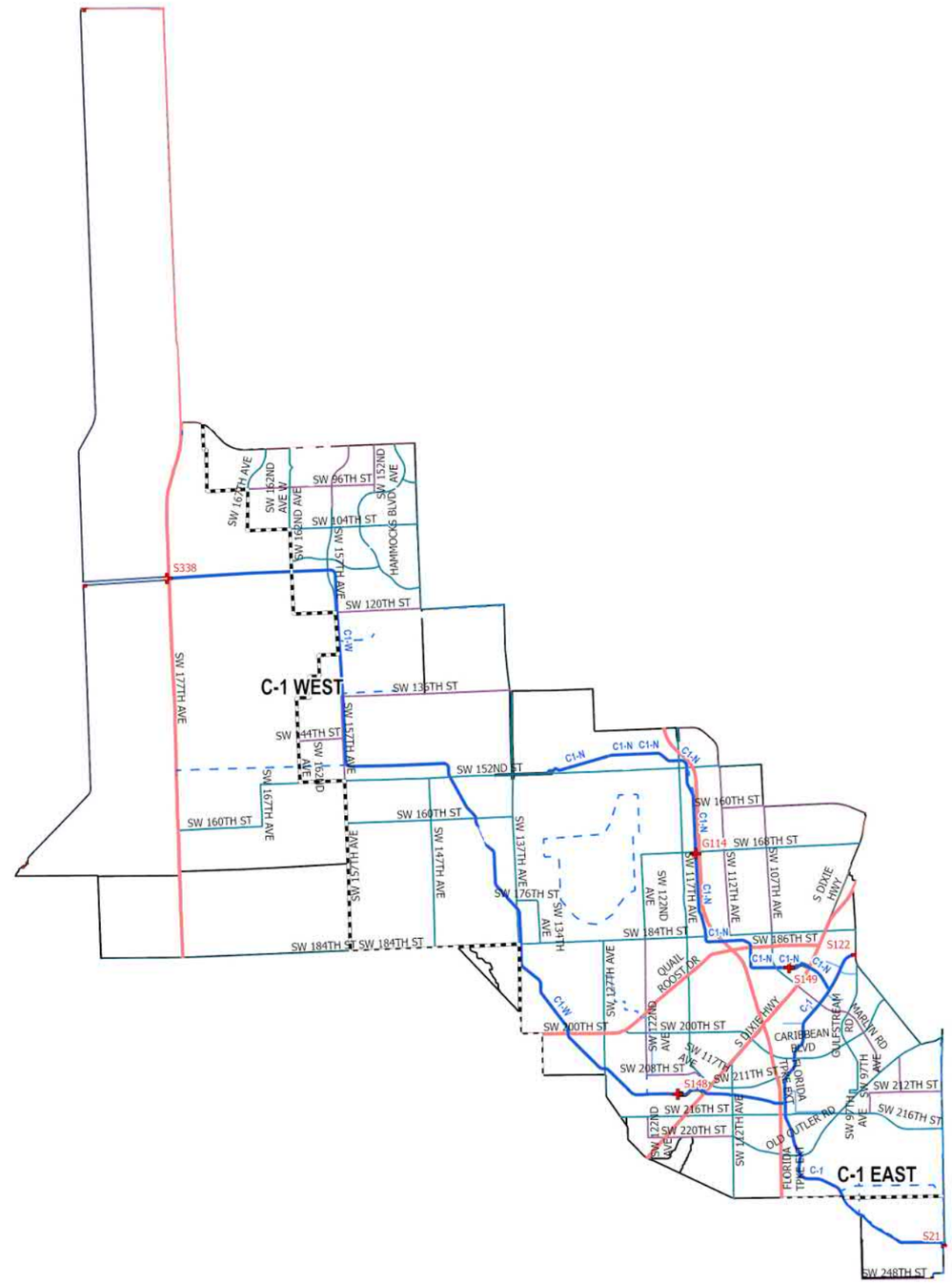
C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

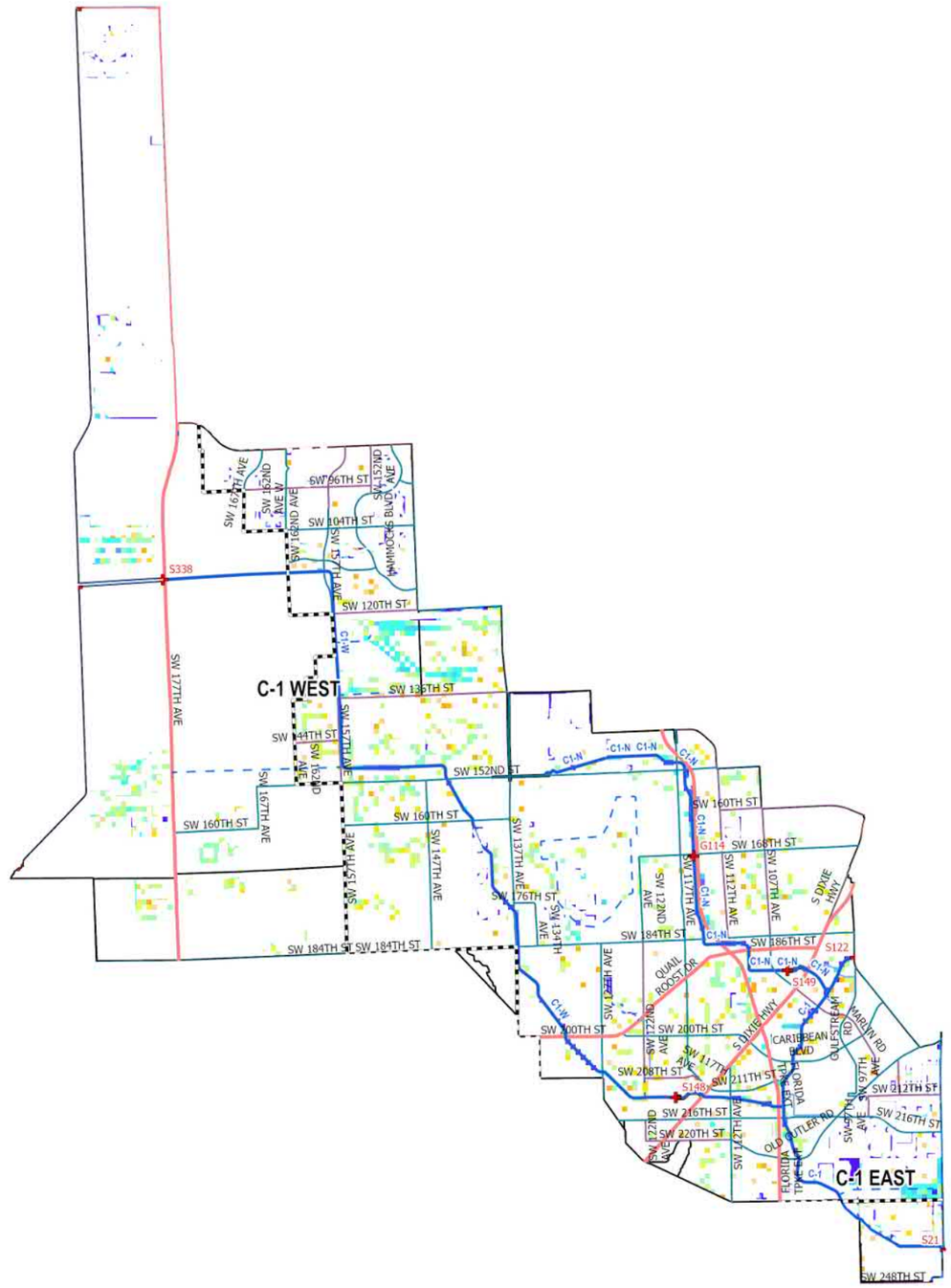


0 0.5 1 2 3 4 Miles

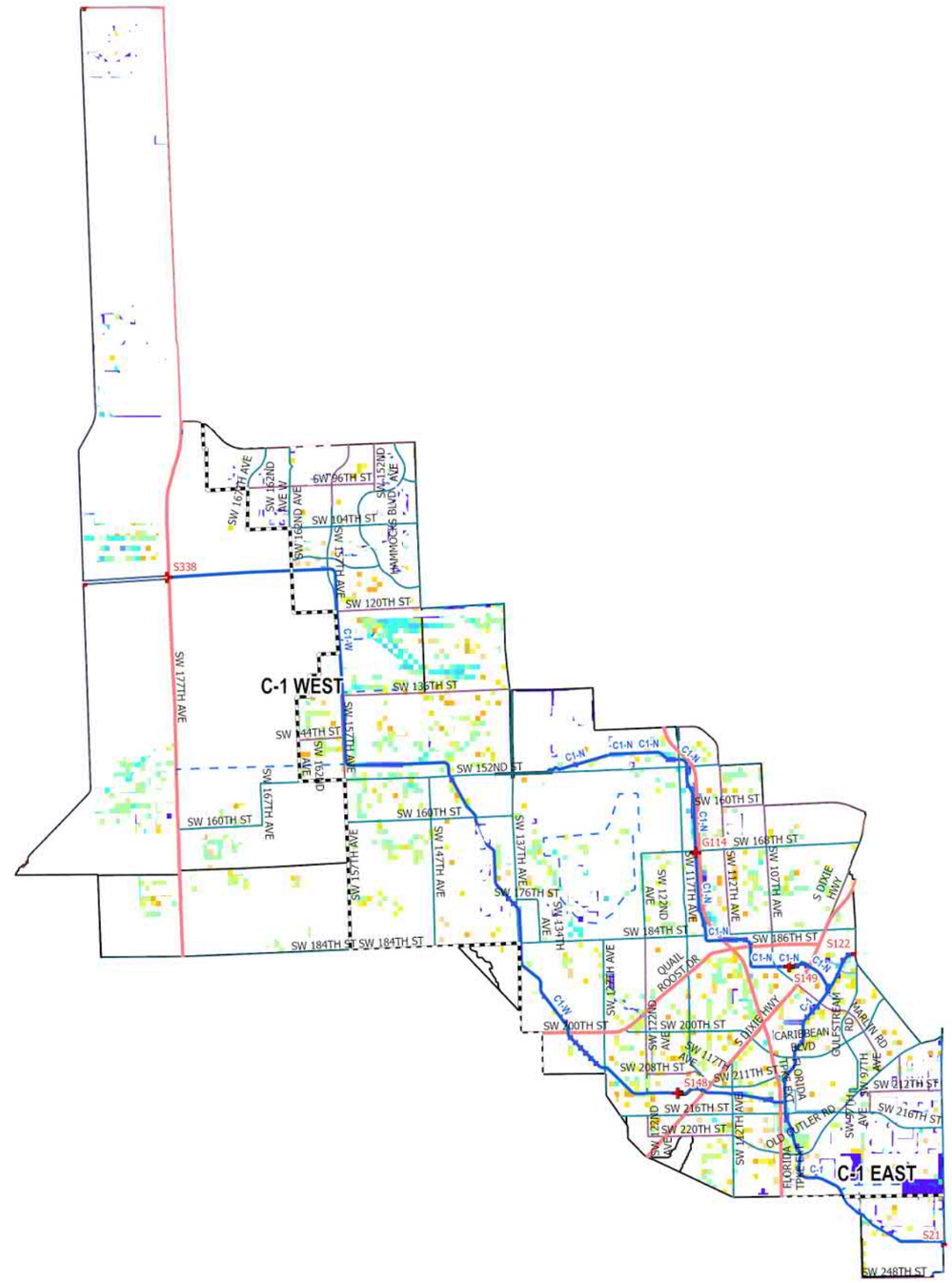
Figure A-85. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Watershed



C-1 Urban Areas

N

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

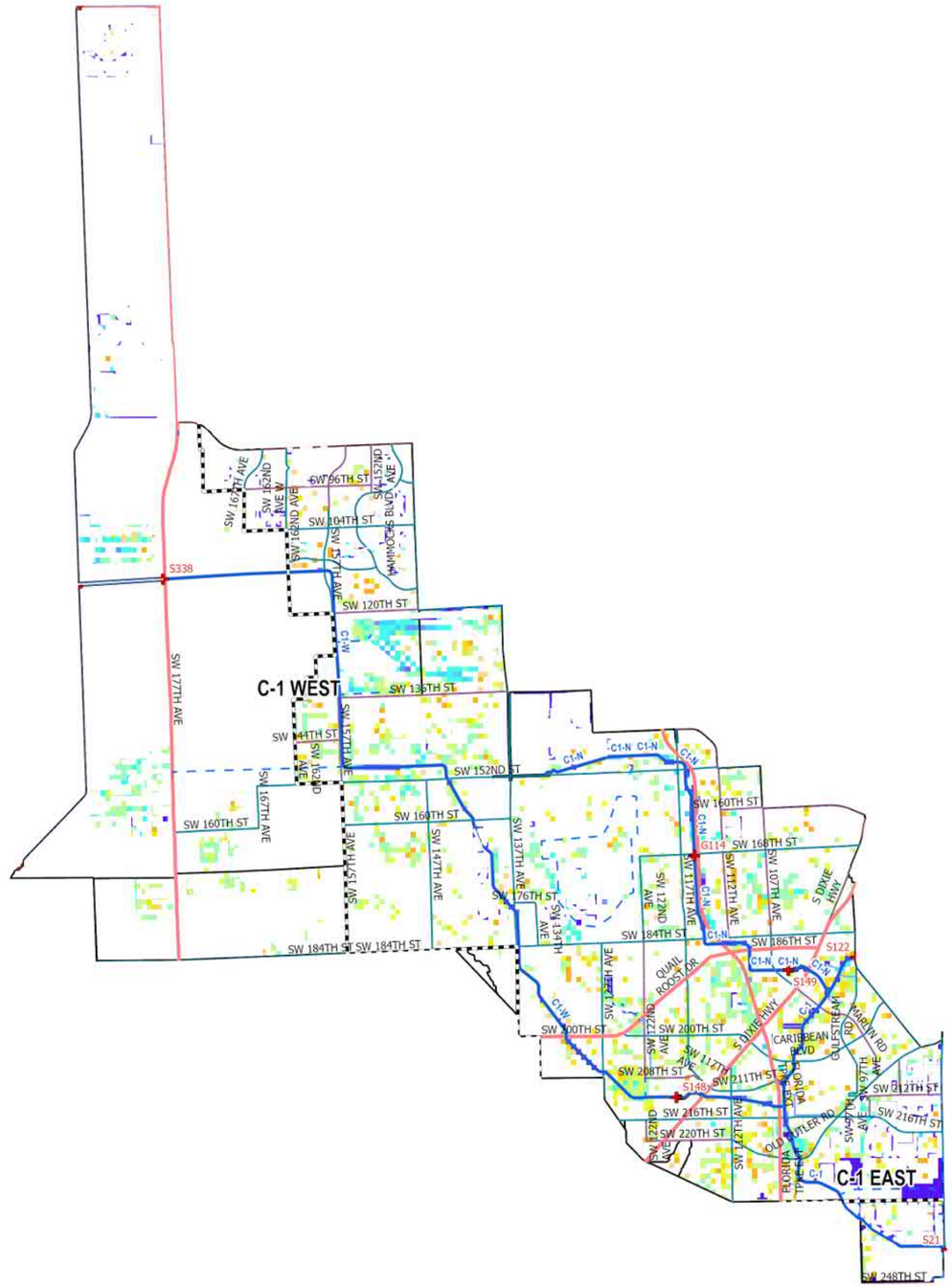
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-87. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

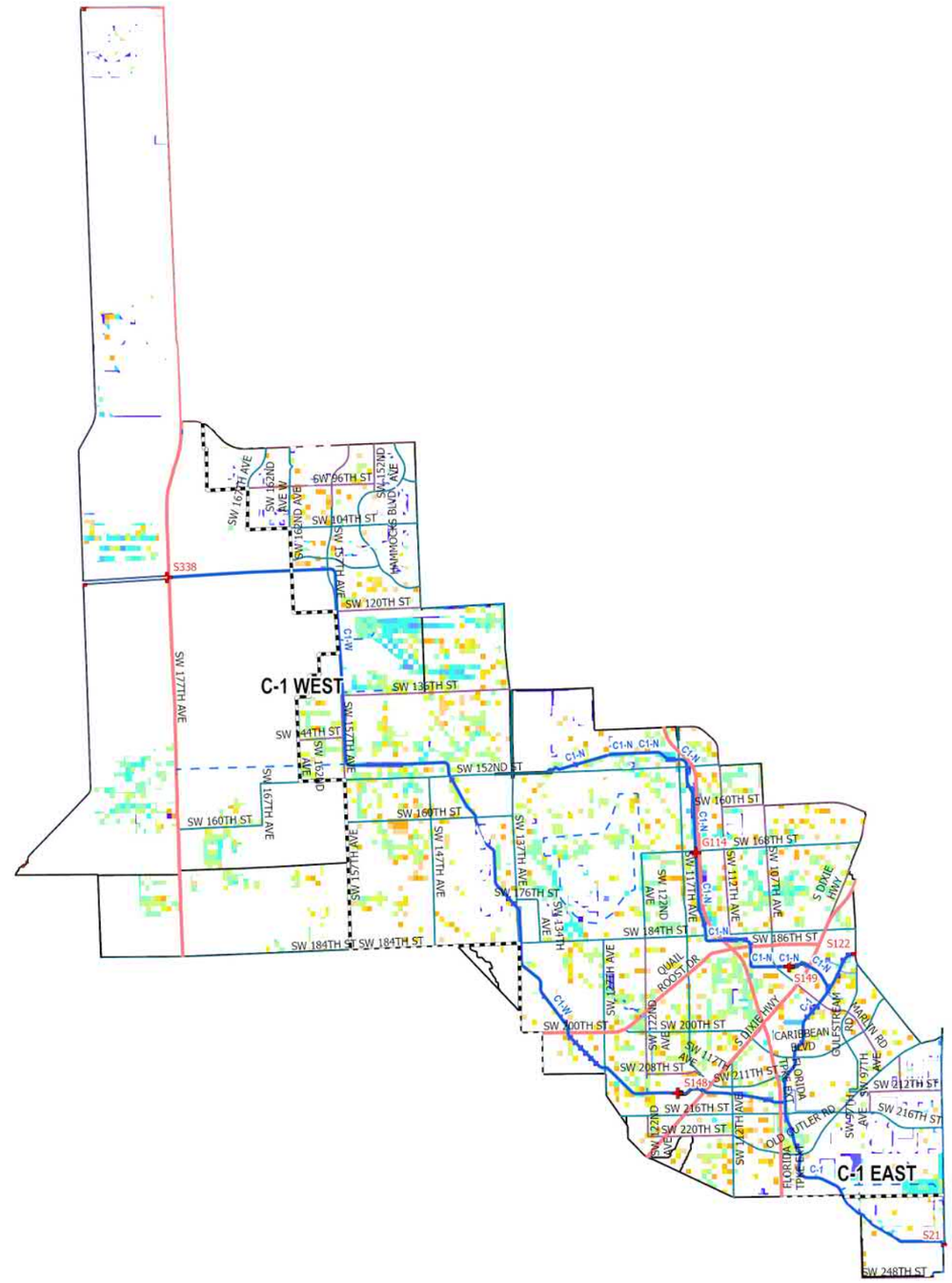
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-88. Watershed C-1 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

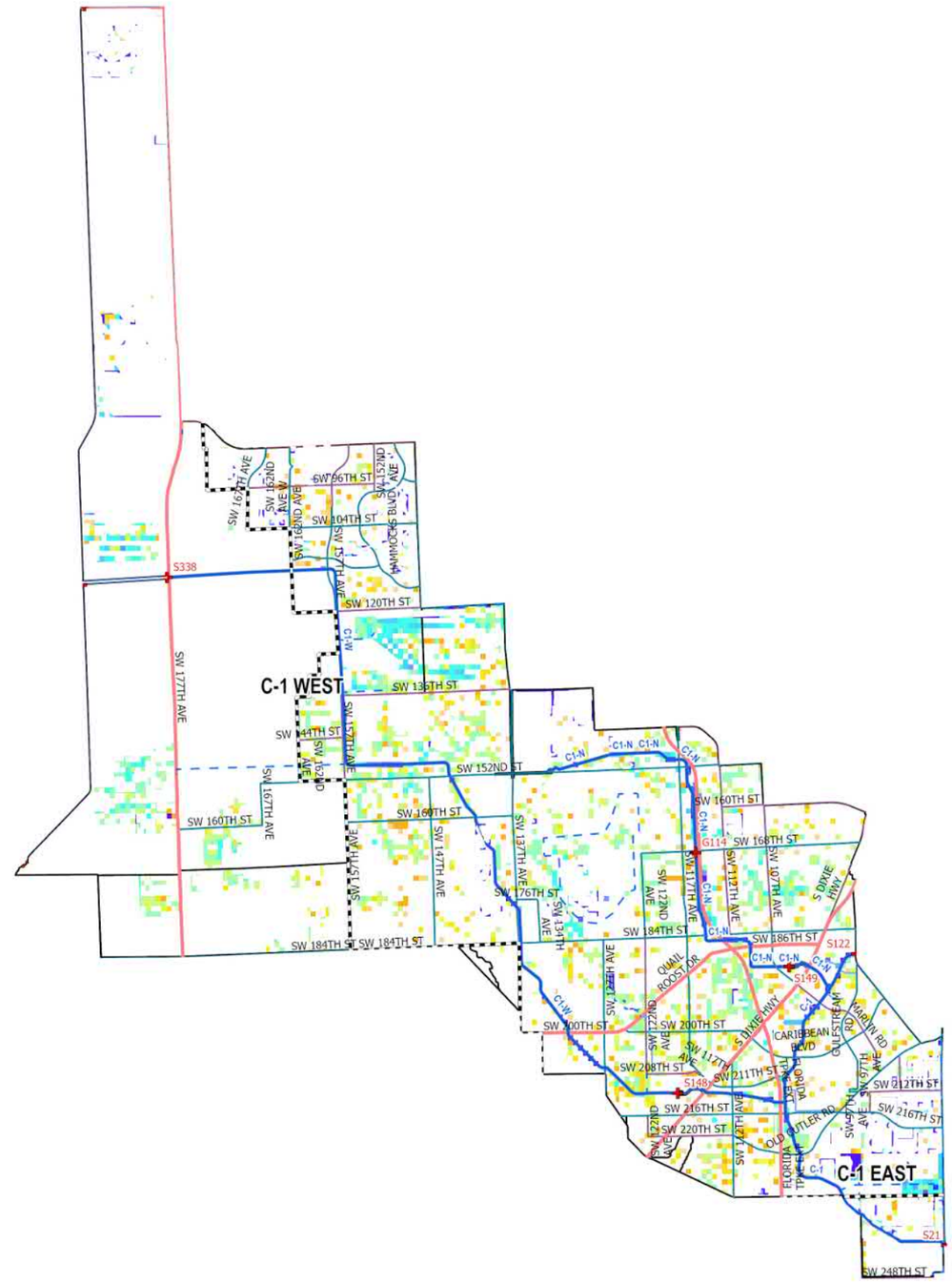
0 0.5 1 2 3 4 Miles

Figure A-89. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

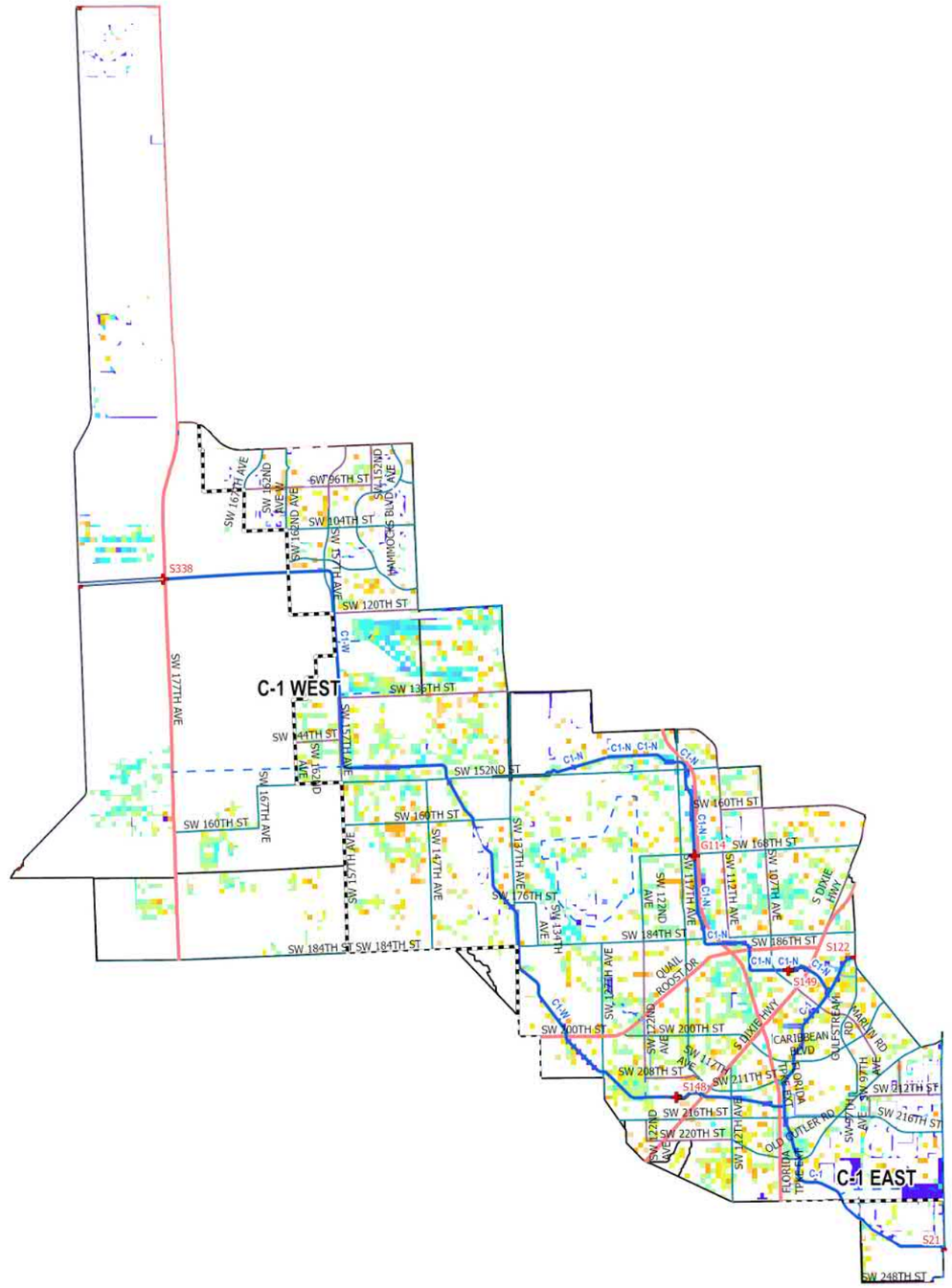
0 0.5 1 2 3 4 Miles

Figure A-90. Watershed C-1 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

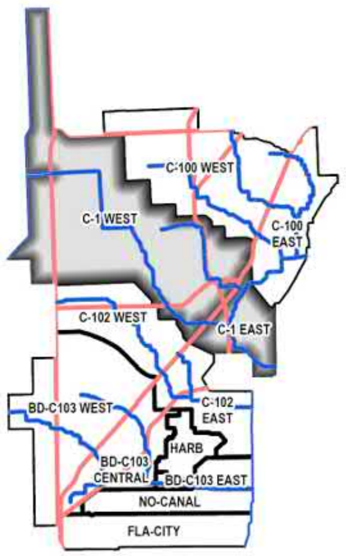
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

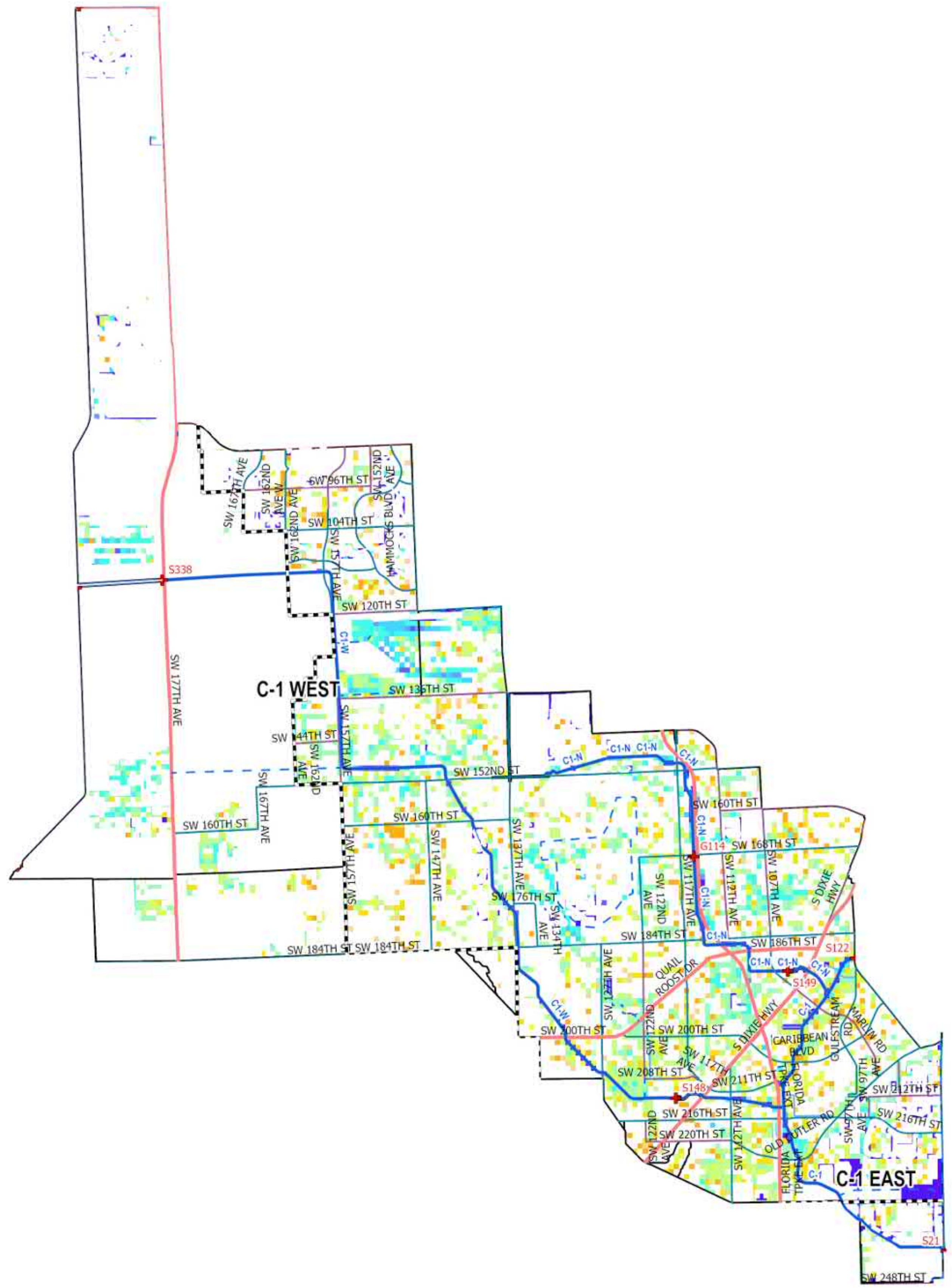
0 0.5 1 2 3 4 Miles

Figure A-91. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

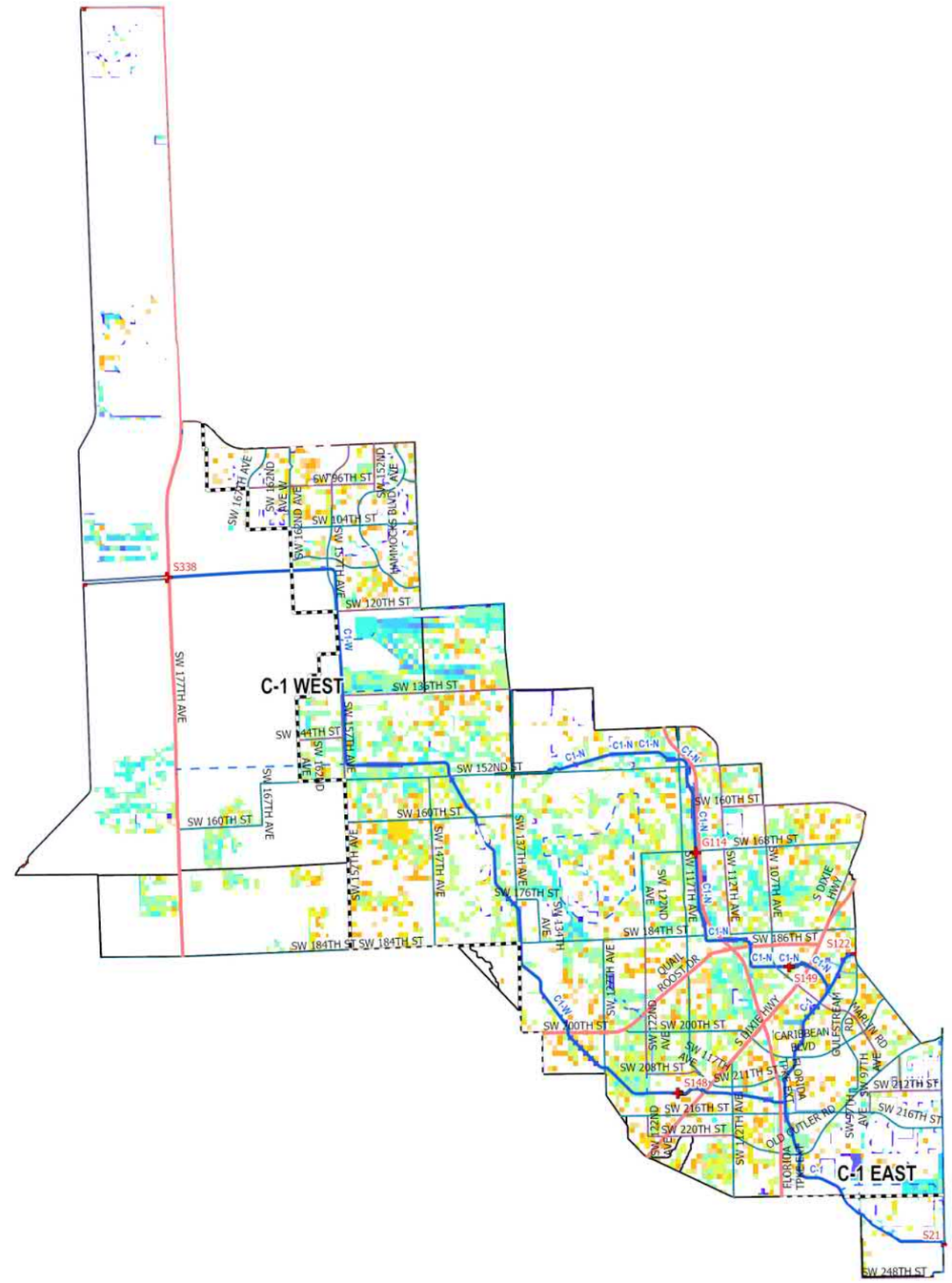
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-92. Watershed C-1 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Duration (hr)

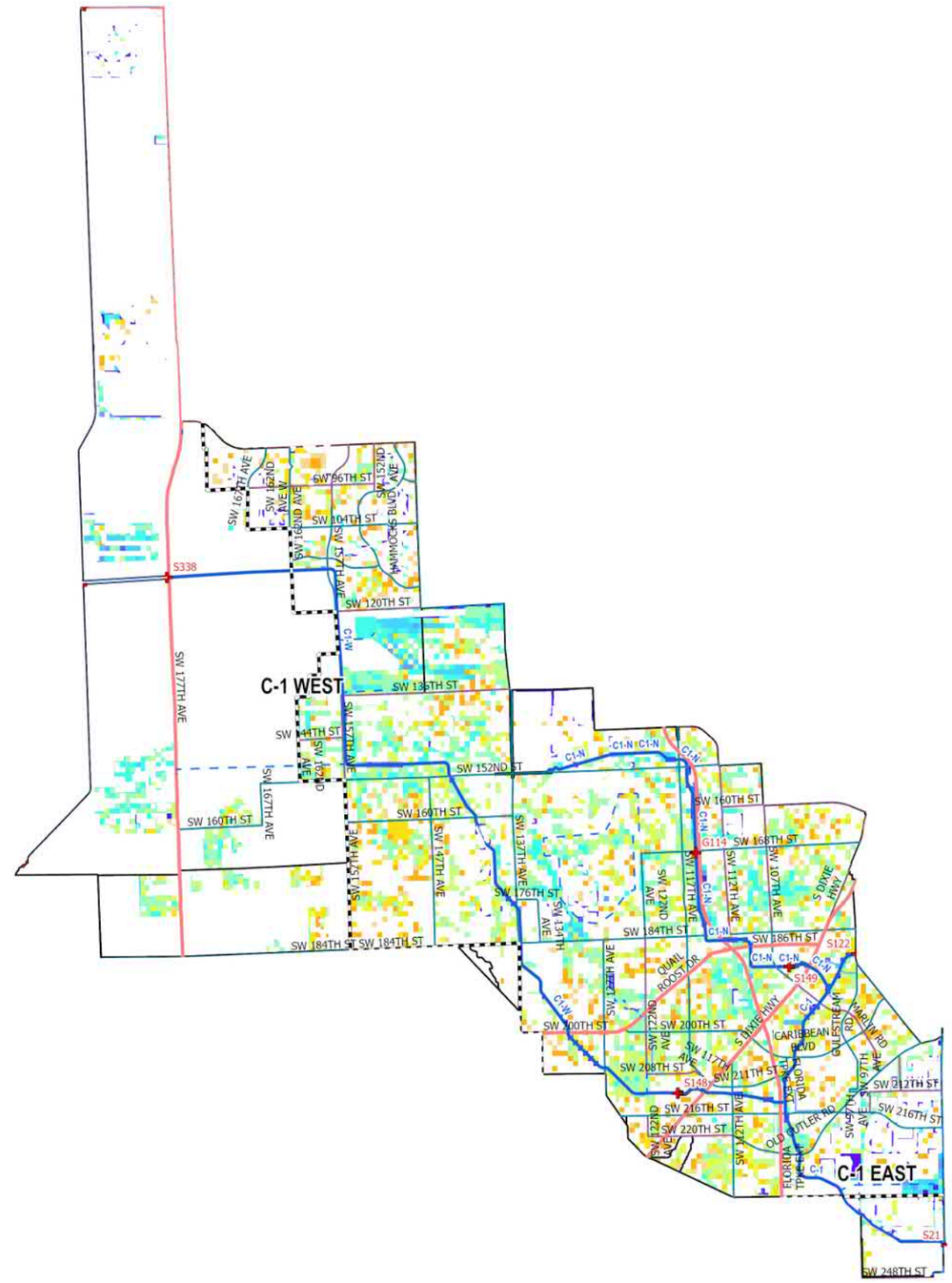
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-93. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

C-1 Watershed



C-1 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

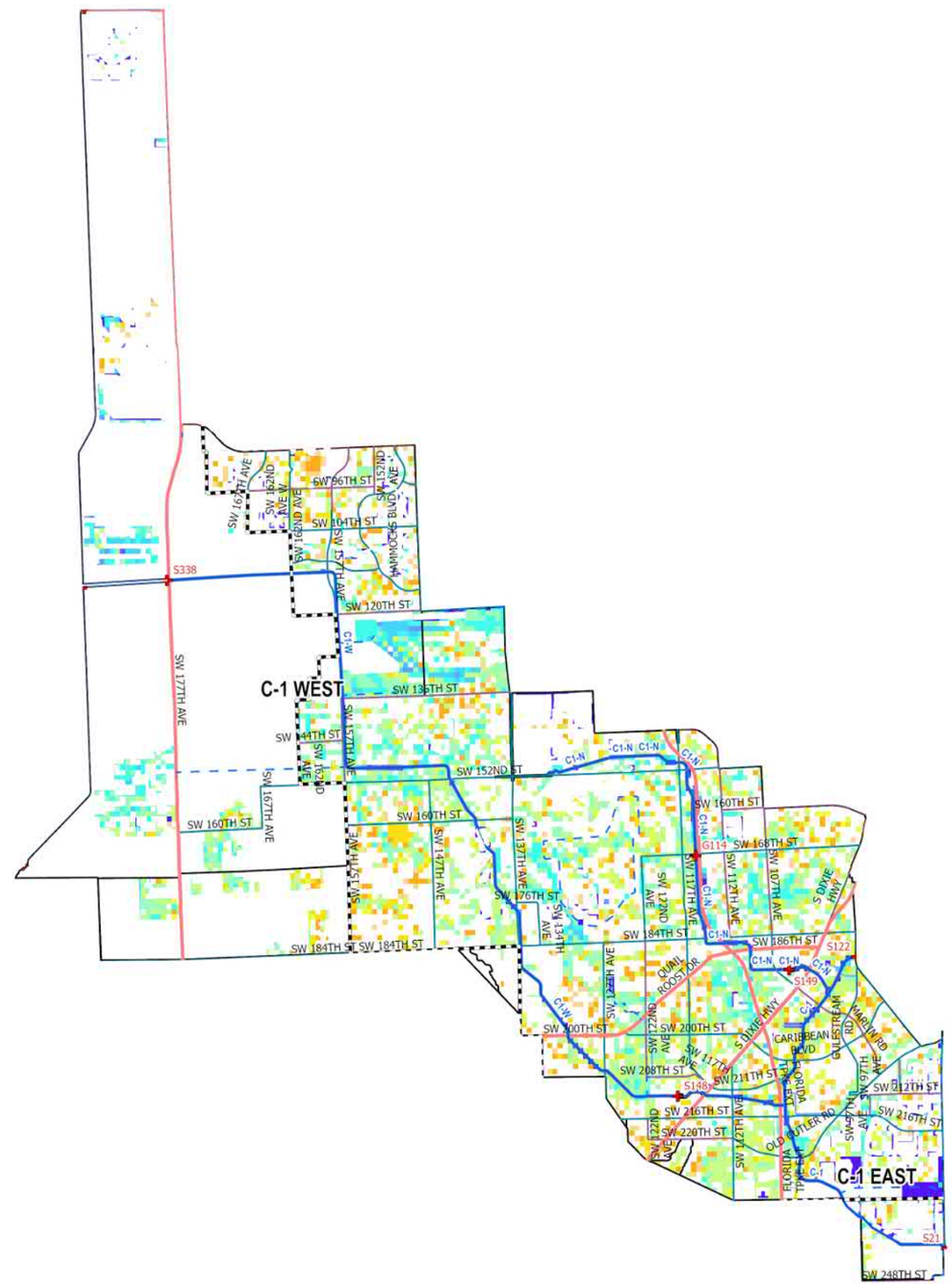
0 0.5 1 2 3 4 Miles

Figure A-94. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

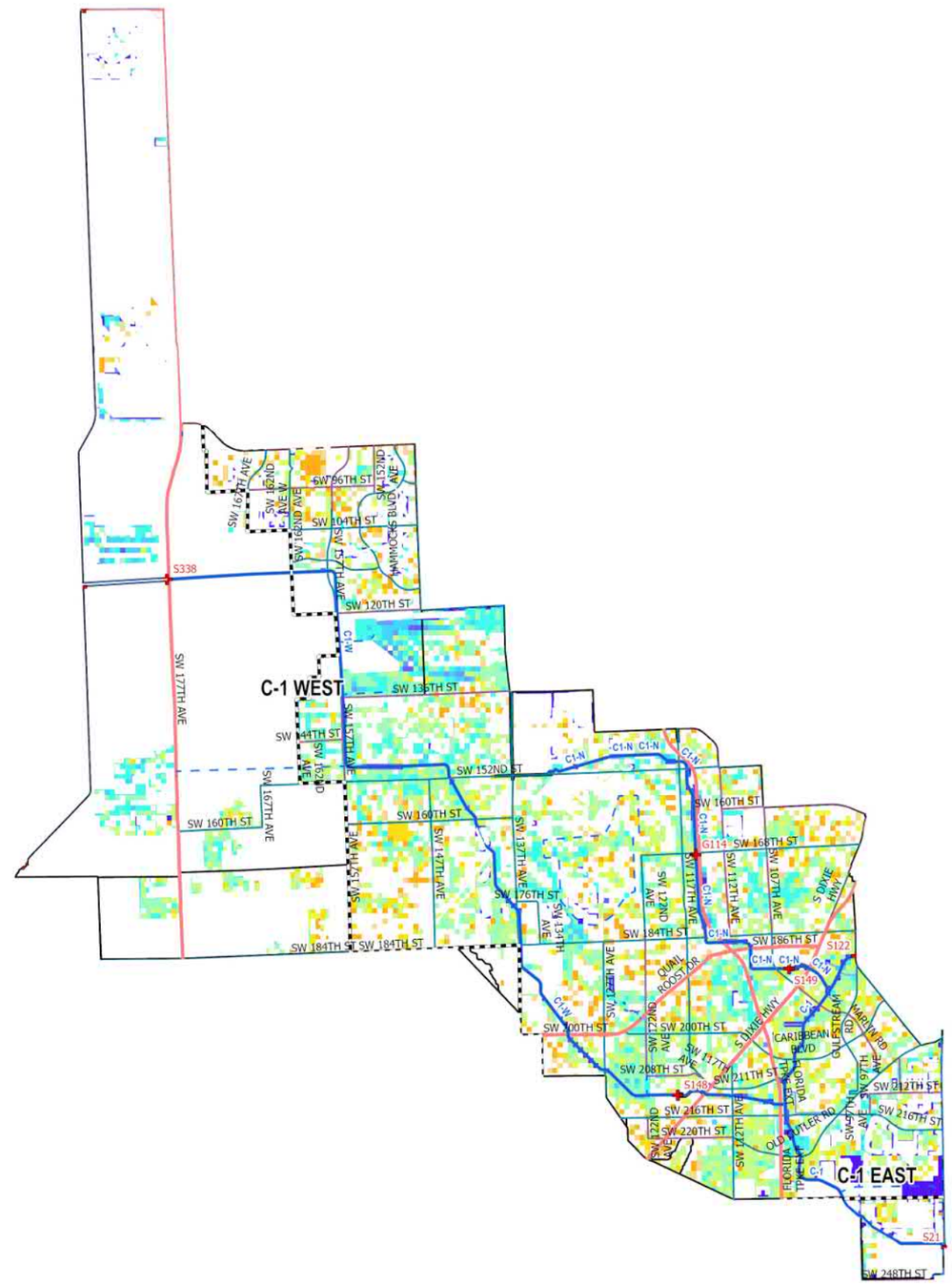
0 0.5 1 2 3 4 Miles

Figure A-95. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn

C-1 Watershed

C-1 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

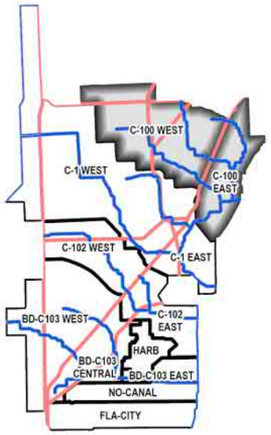
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-96. Watershed C-1 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

WATERSHED C-100: Flood Extent for Entire Watershed



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

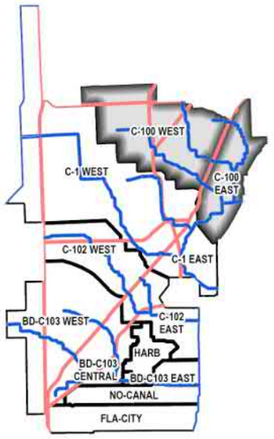
5-Yr/72-Hr SLR = 0

Flood Depth (ft)

- 0 < 0.25 ft
- 0.25 >= 0.50 ft
- 0.50 >= 0.75 ft
- 0.75 >= 1.00 ft
- 1.00 >= 1.25 ft
- 1.25 >= 1.50 ft
- 1.50 >= 1.75 ft
- 1.75 >= 2.00 ft
- 2.00 >= 2.25 ft
- 2.25 >= 2.50 ft
- >= 2.50 ft

Figure A-97. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

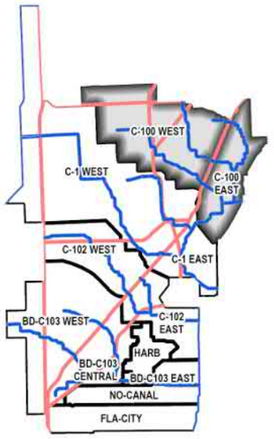
5-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-98. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-99. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 2

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

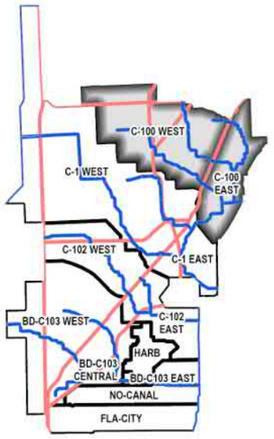
5-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-100. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-101. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 0

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-102. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 1

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-103. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-104. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 3

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-105. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 0

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-106. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-107. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-108. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

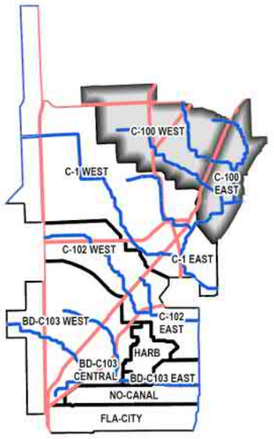
100-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-109. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

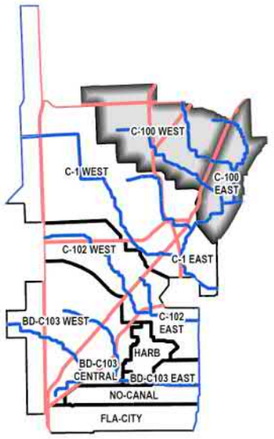
100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-110. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 1

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

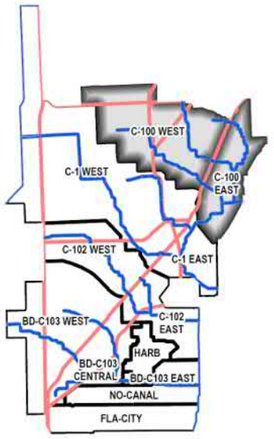
100-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-111. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-112. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 3

Kimley»Horn

WATERSHED C-100: Flood Duration for Entire Watershed

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

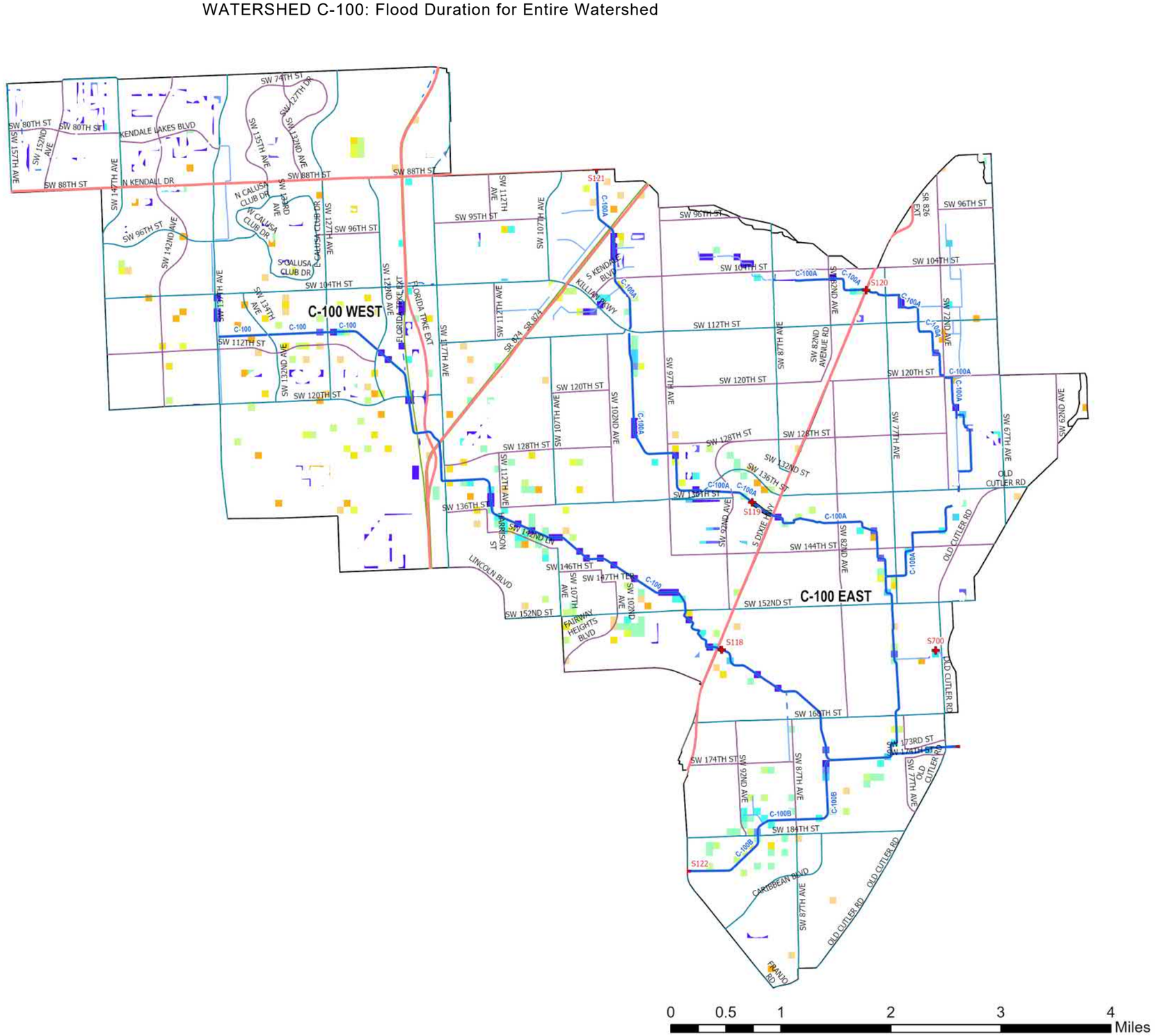
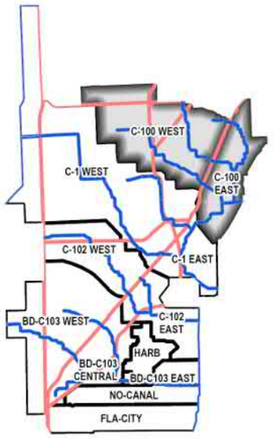


Figure A-113. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

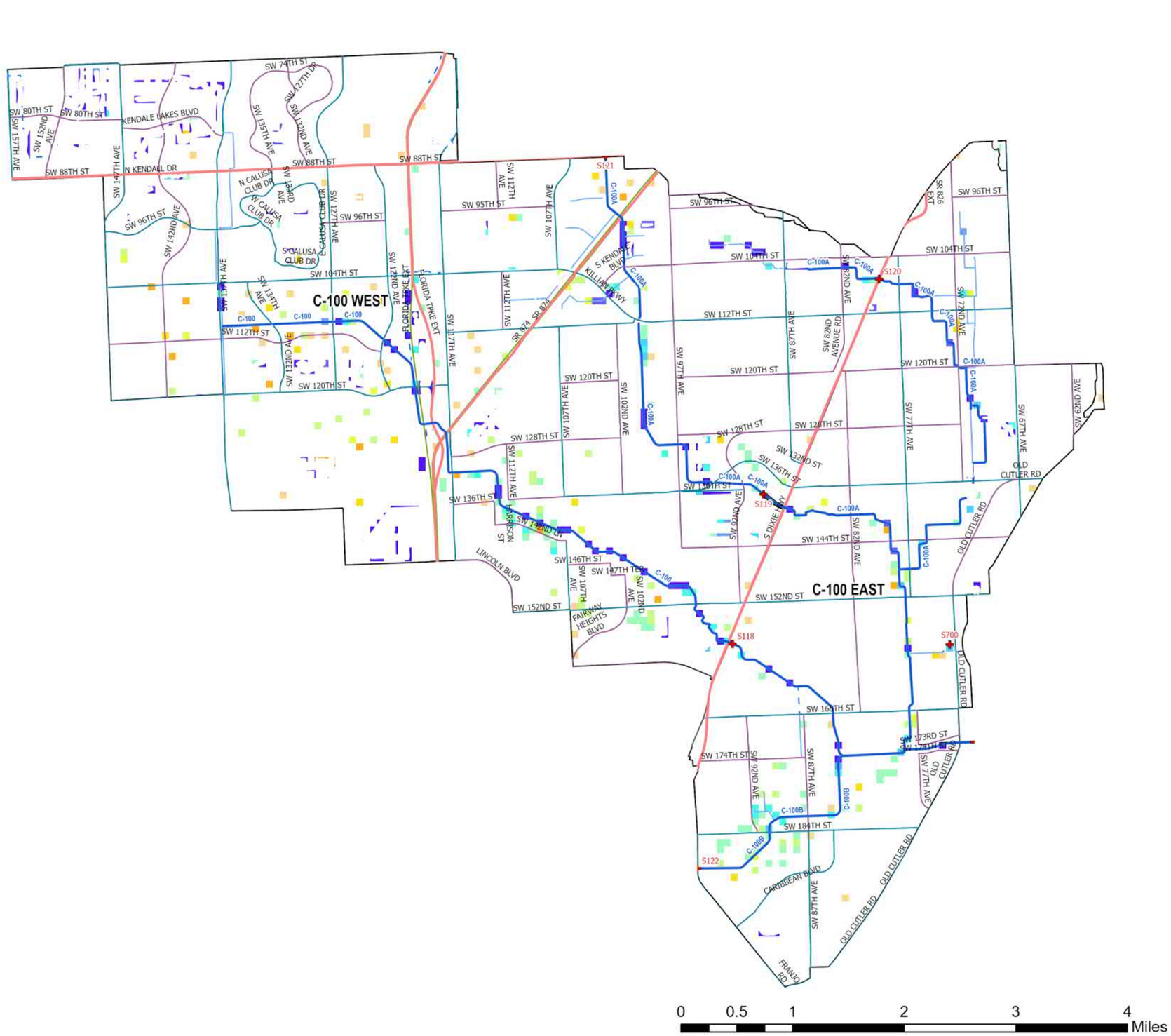
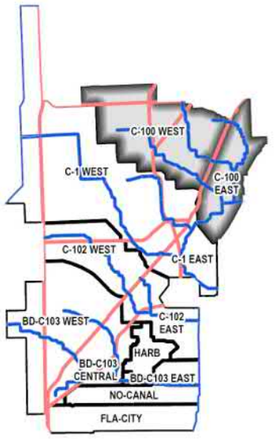


Figure A-114. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1



C-100 Location within Project Area

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

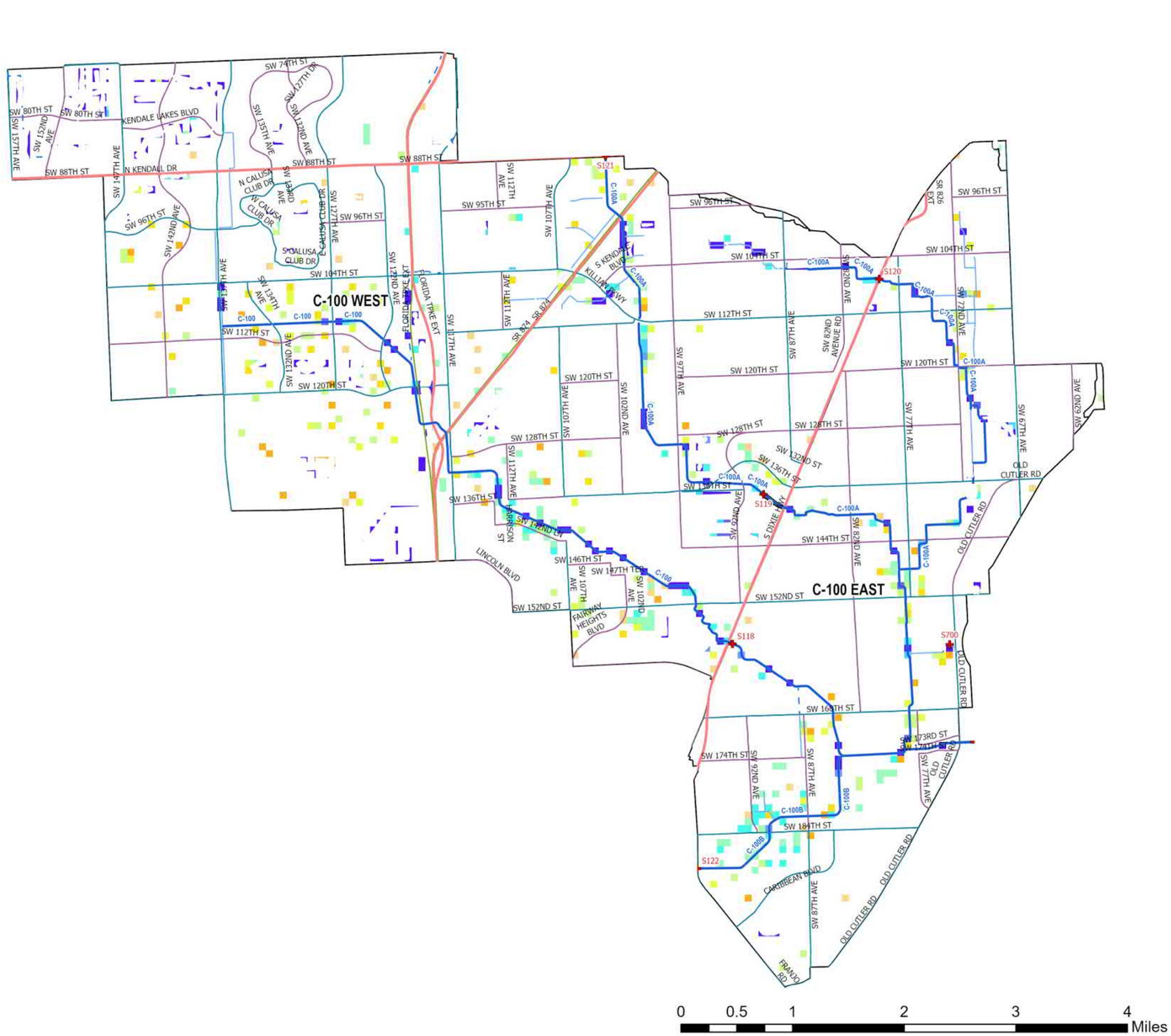
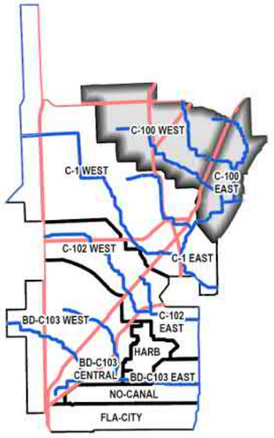
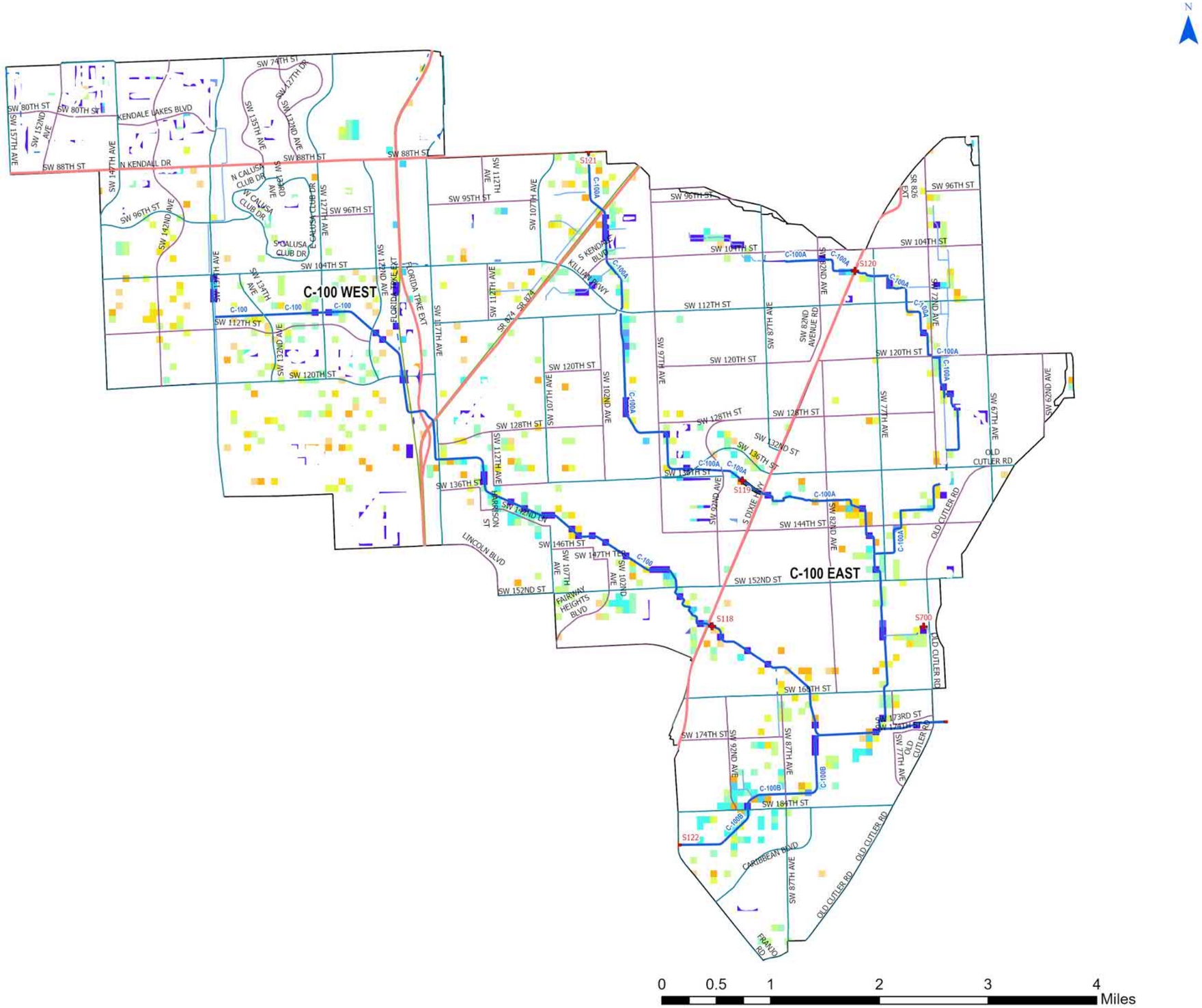


Figure A-115. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 2

Kimley»Horn



C-100 Location within Project Area



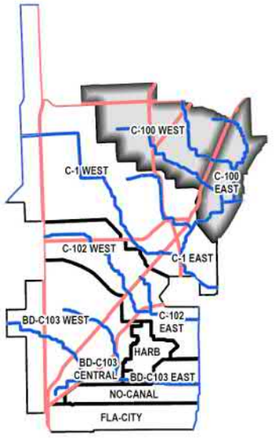
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +3.0

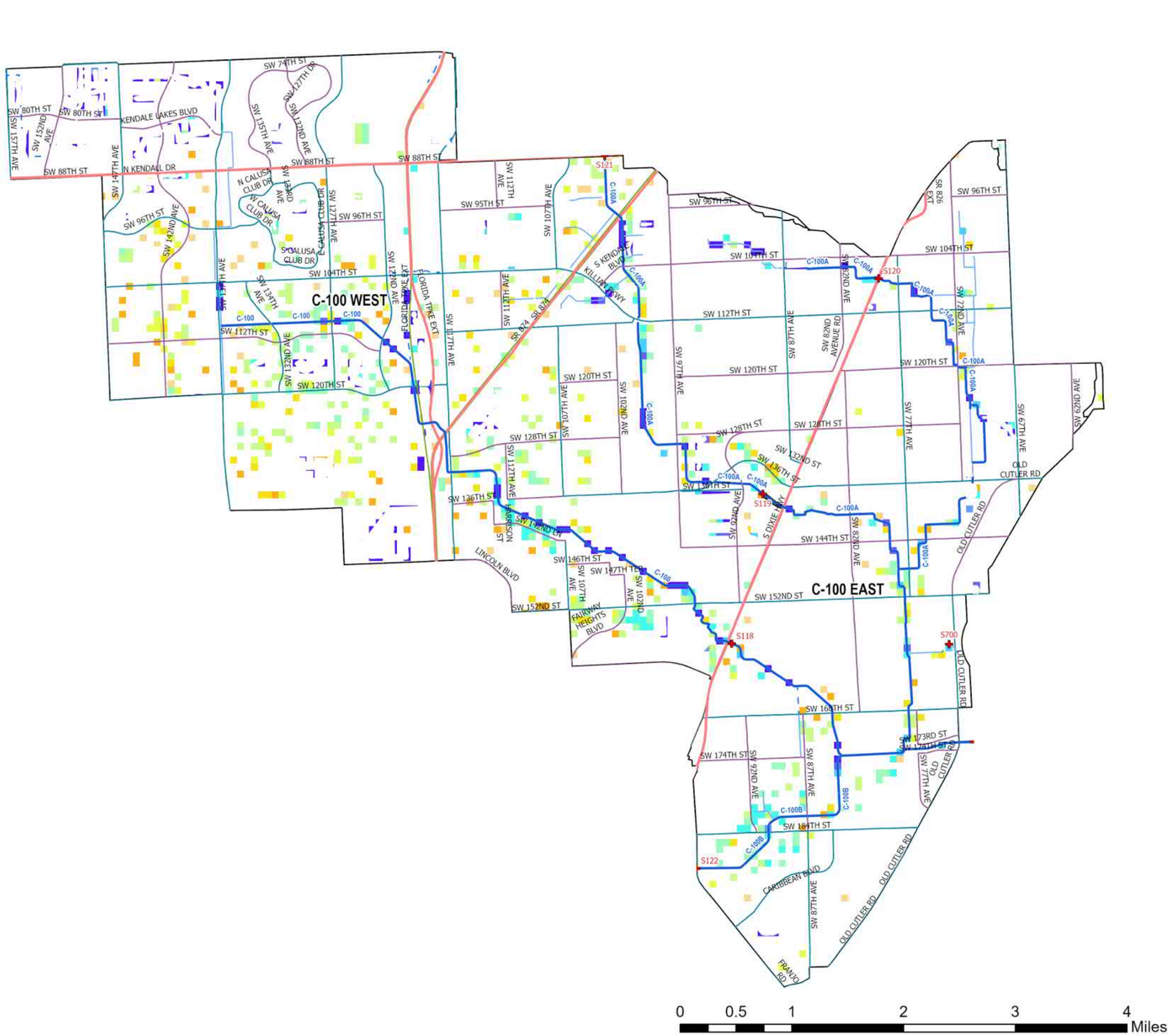
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-116. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 3



C-100 Location within Project Area



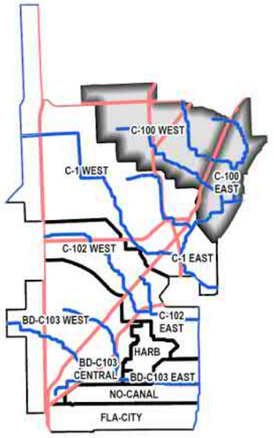
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-117. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 0



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

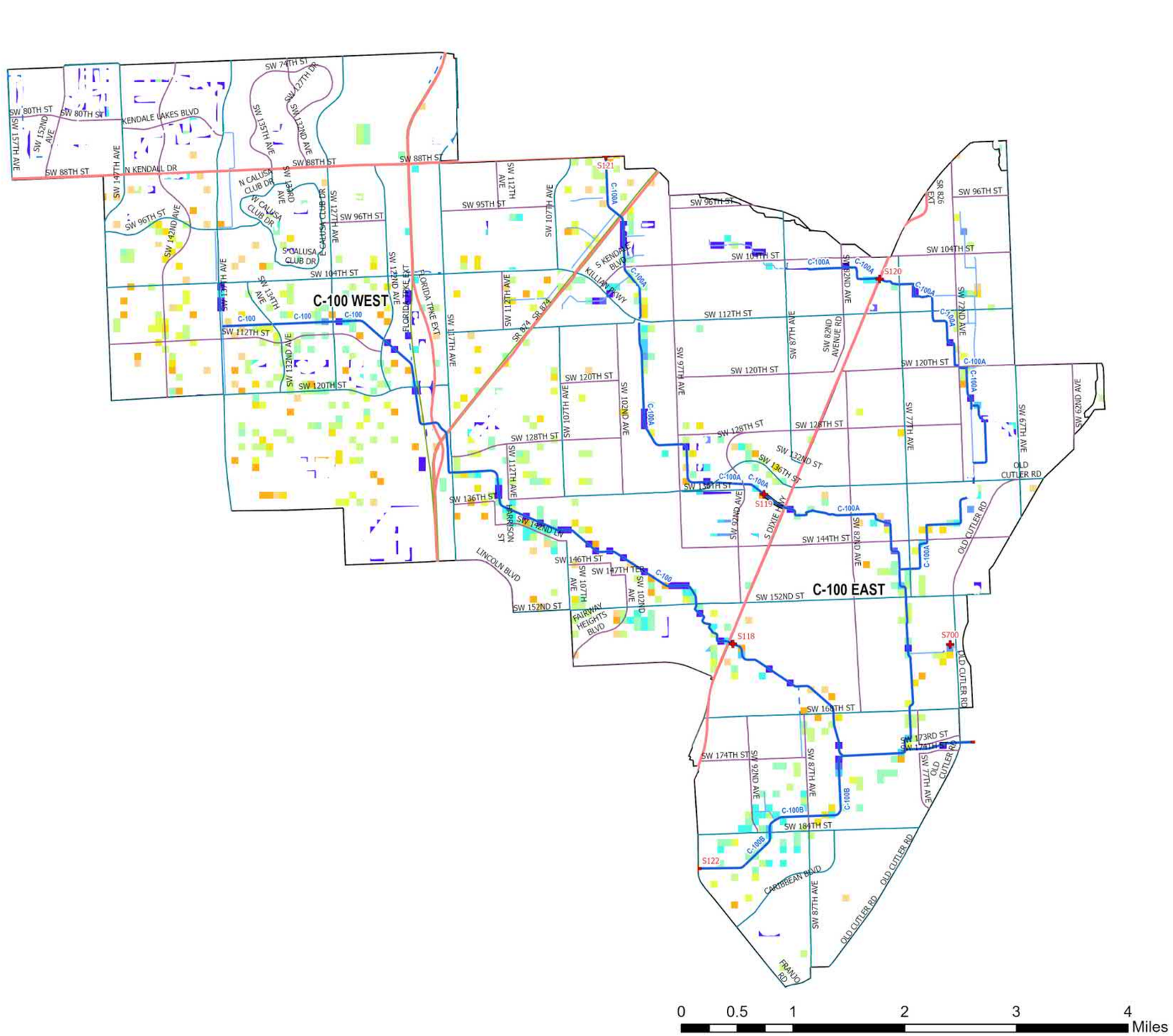
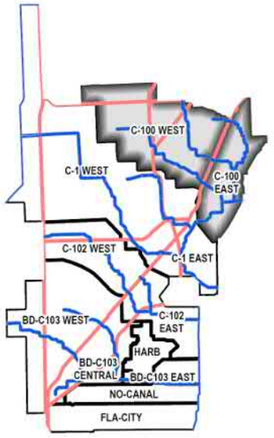


Figure A-118. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 1



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

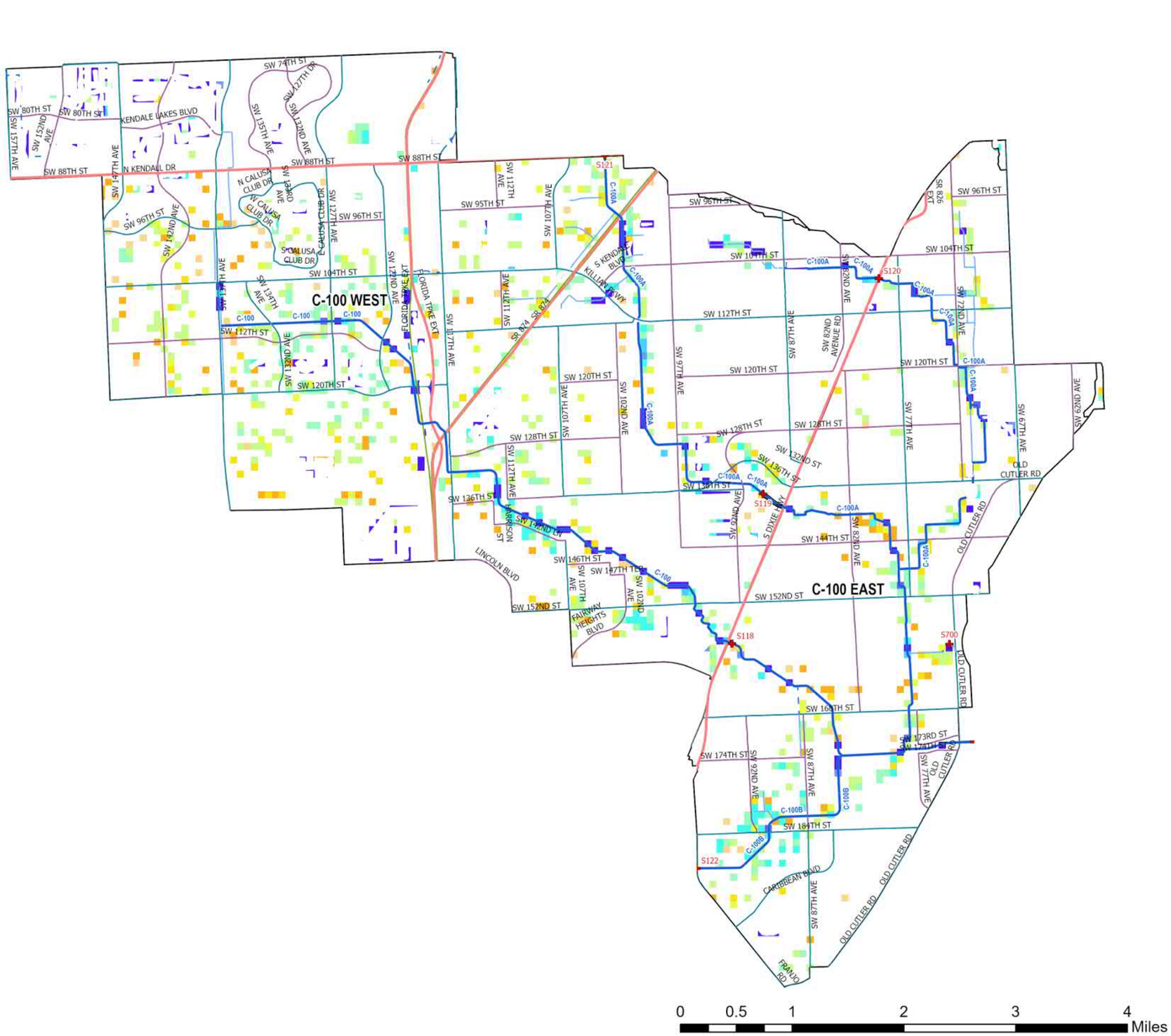
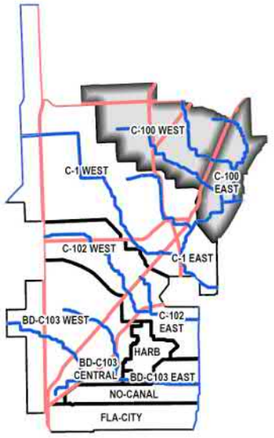


Figure A-119. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

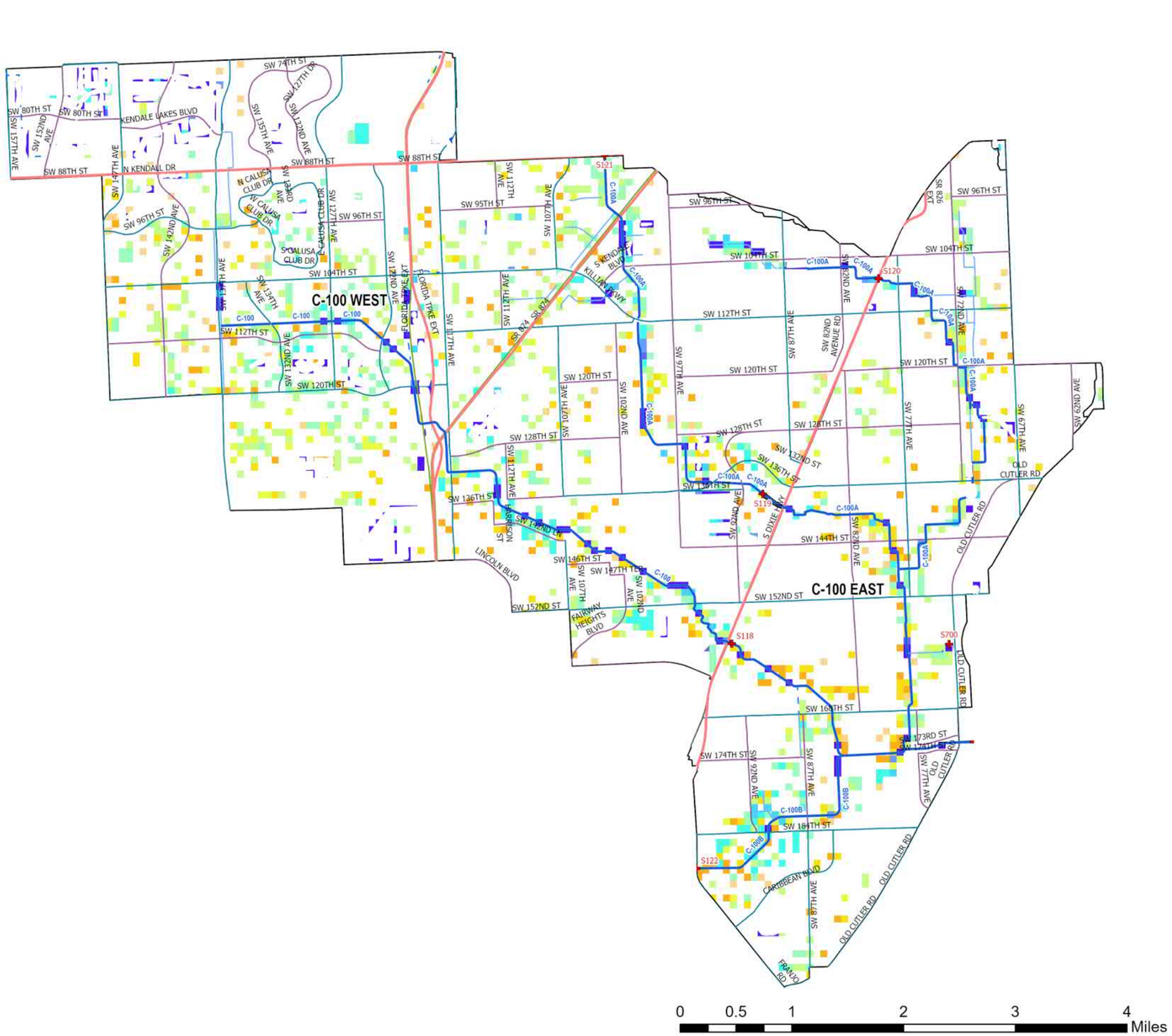
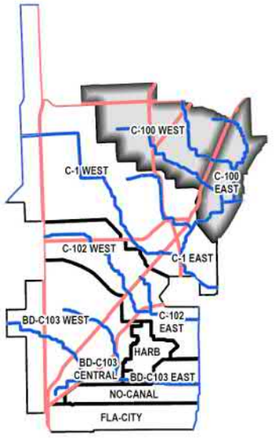
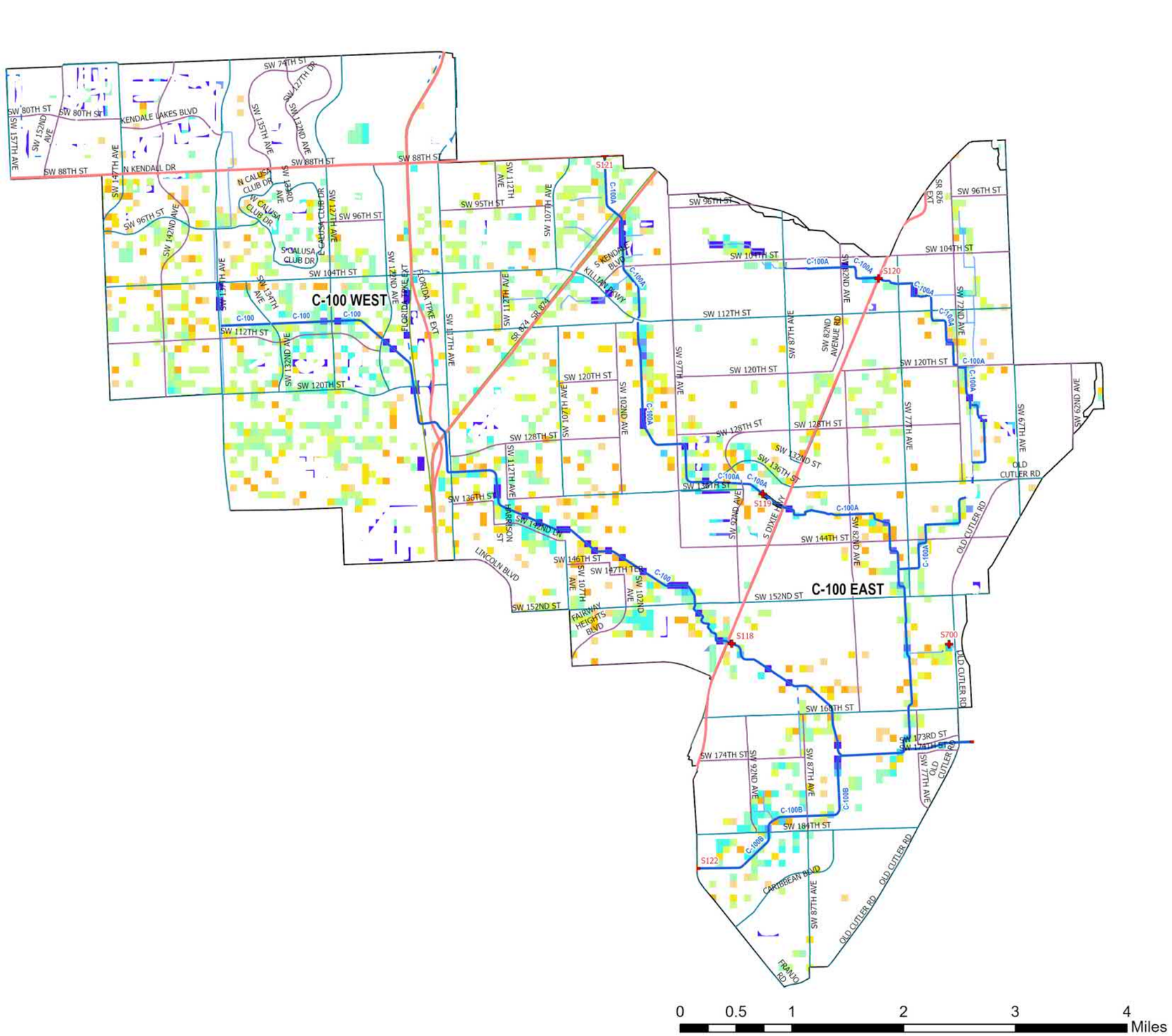


Figure A-120. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 3

Kimley»Horn



C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

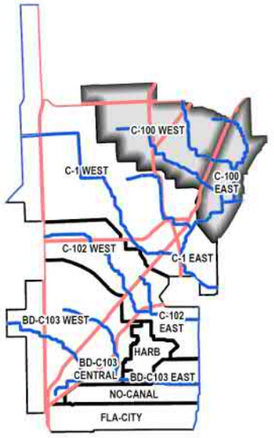
25-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-121. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 0

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

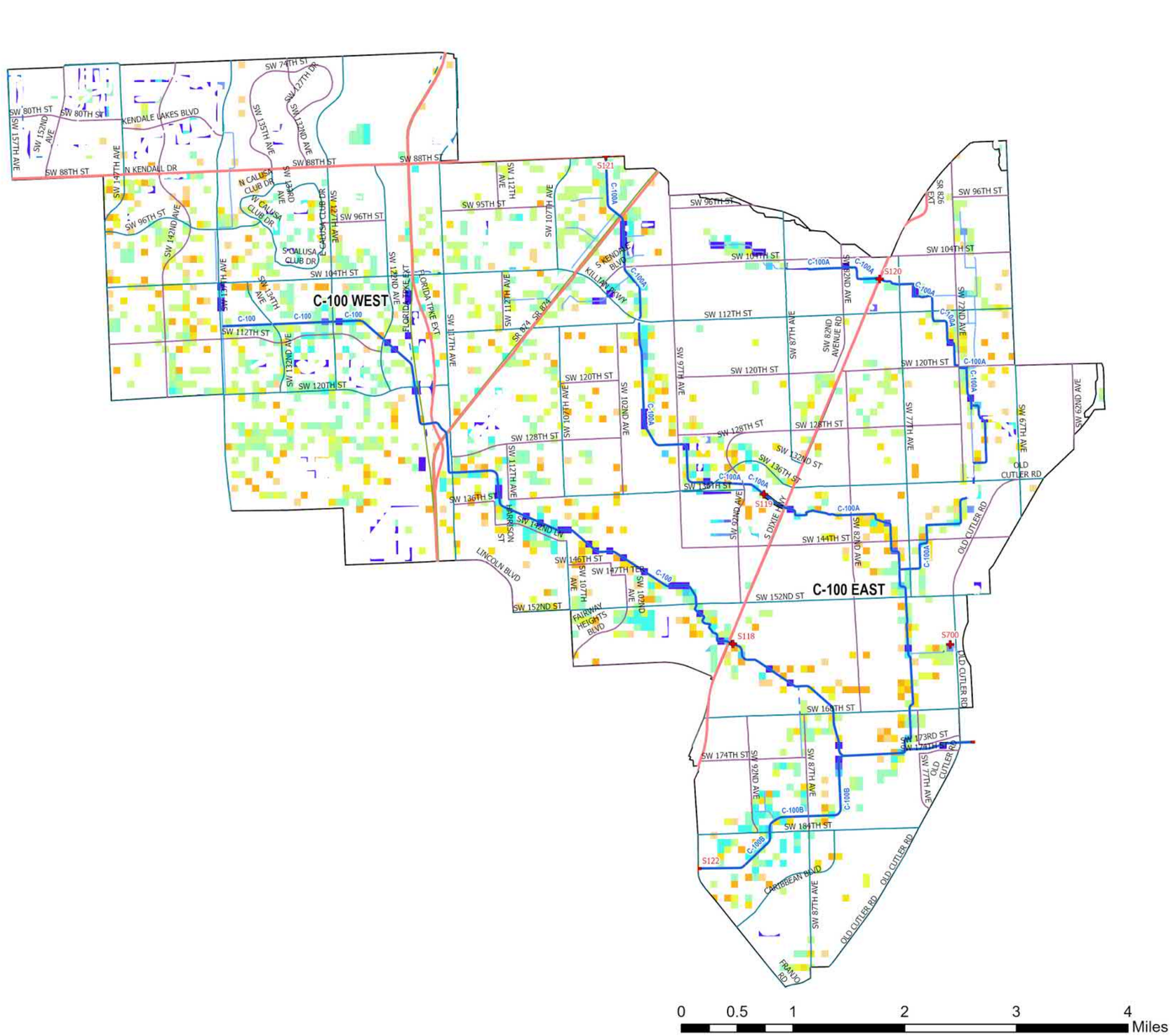
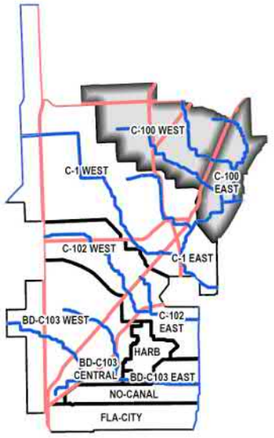


Figure A-122. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

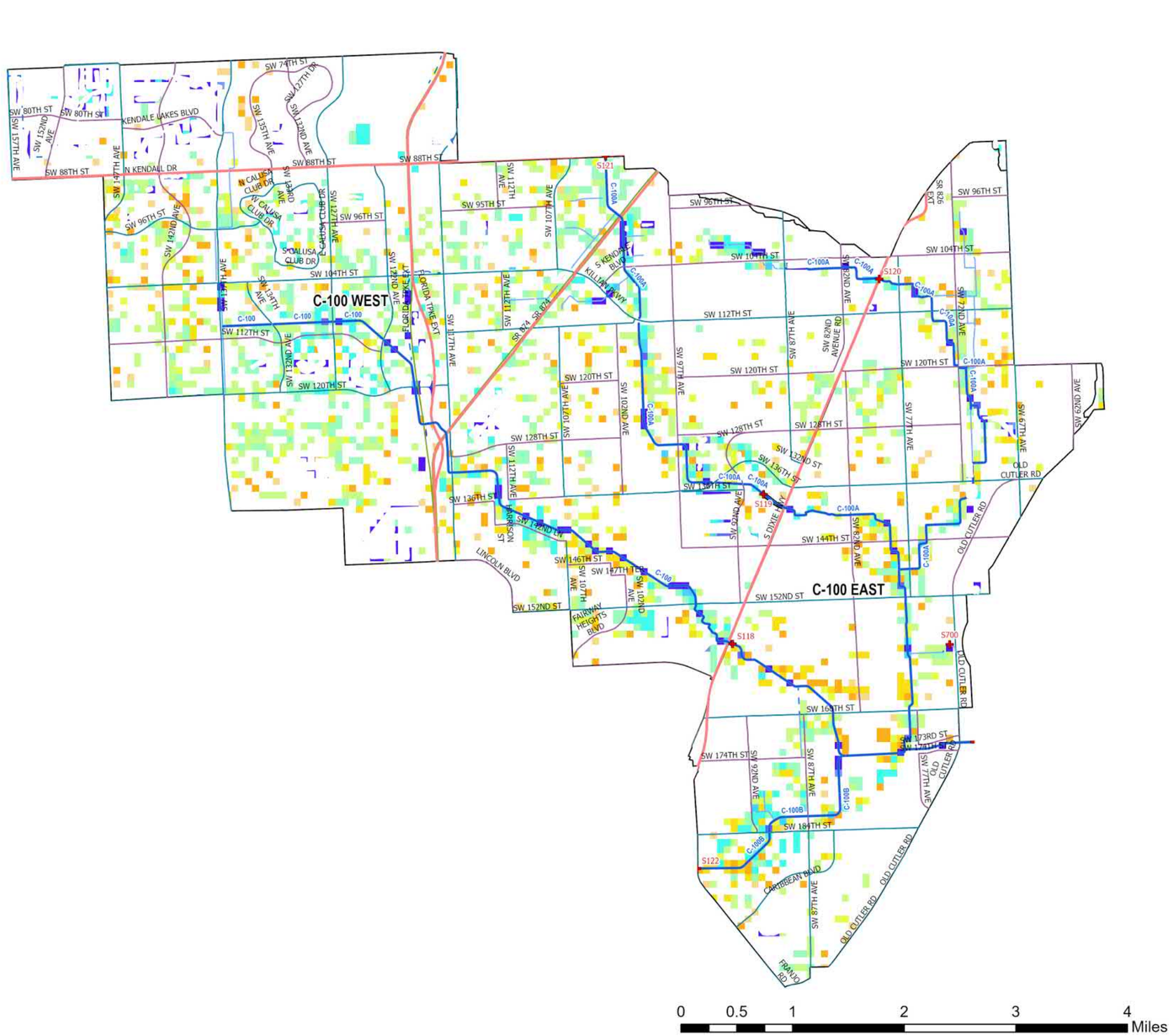
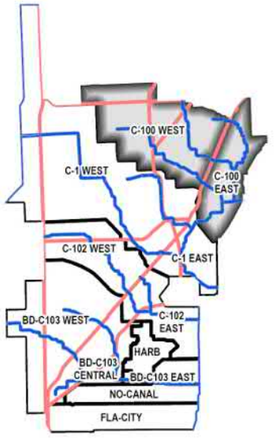
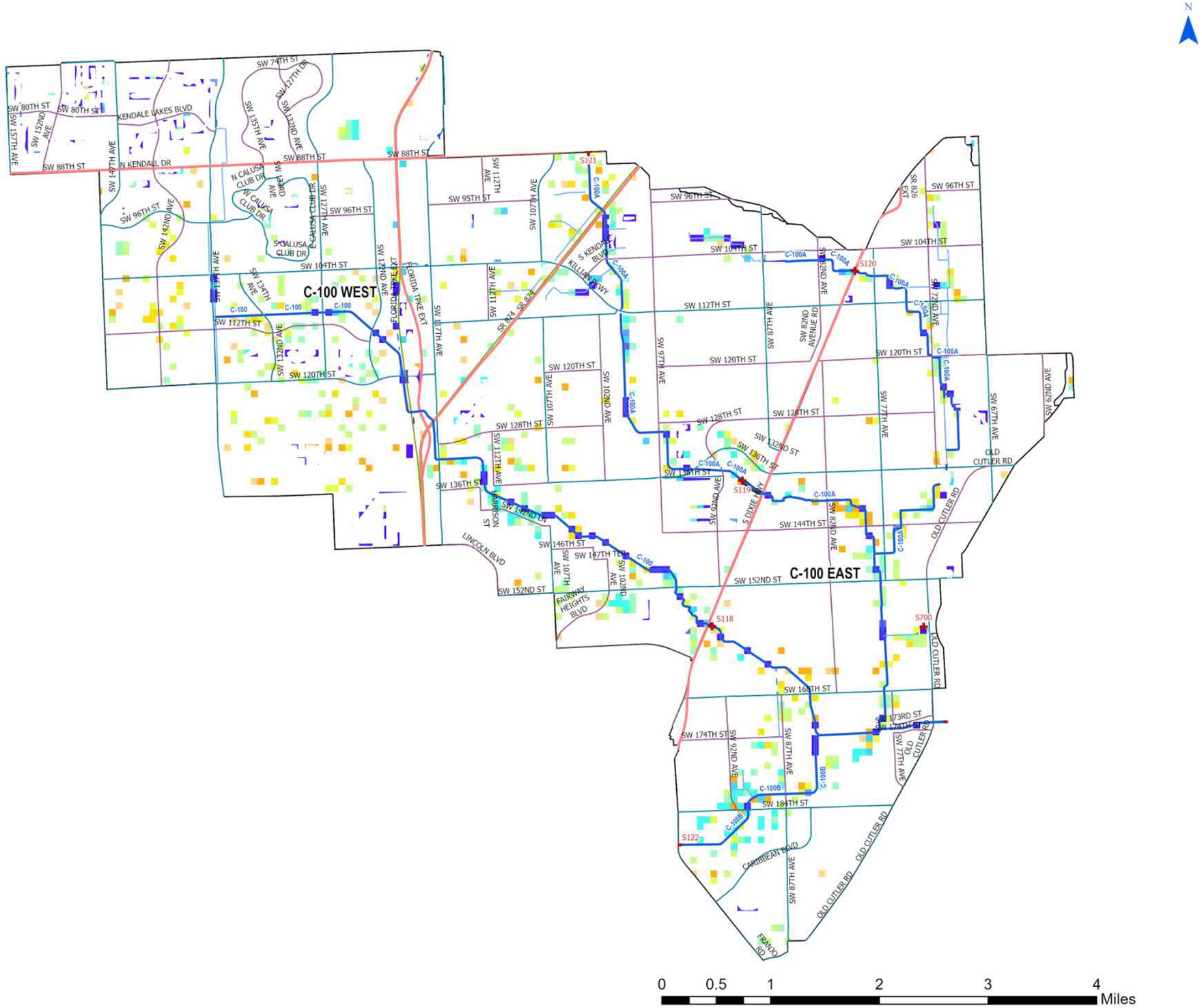


Figure A-123. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn



C-100 Location within Project Area



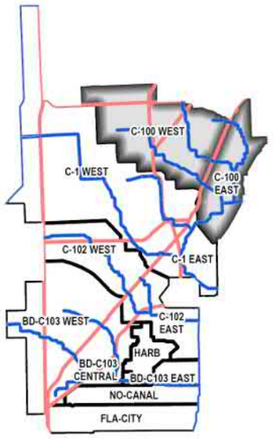
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-124. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 3



C-100 Location within Project Area

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

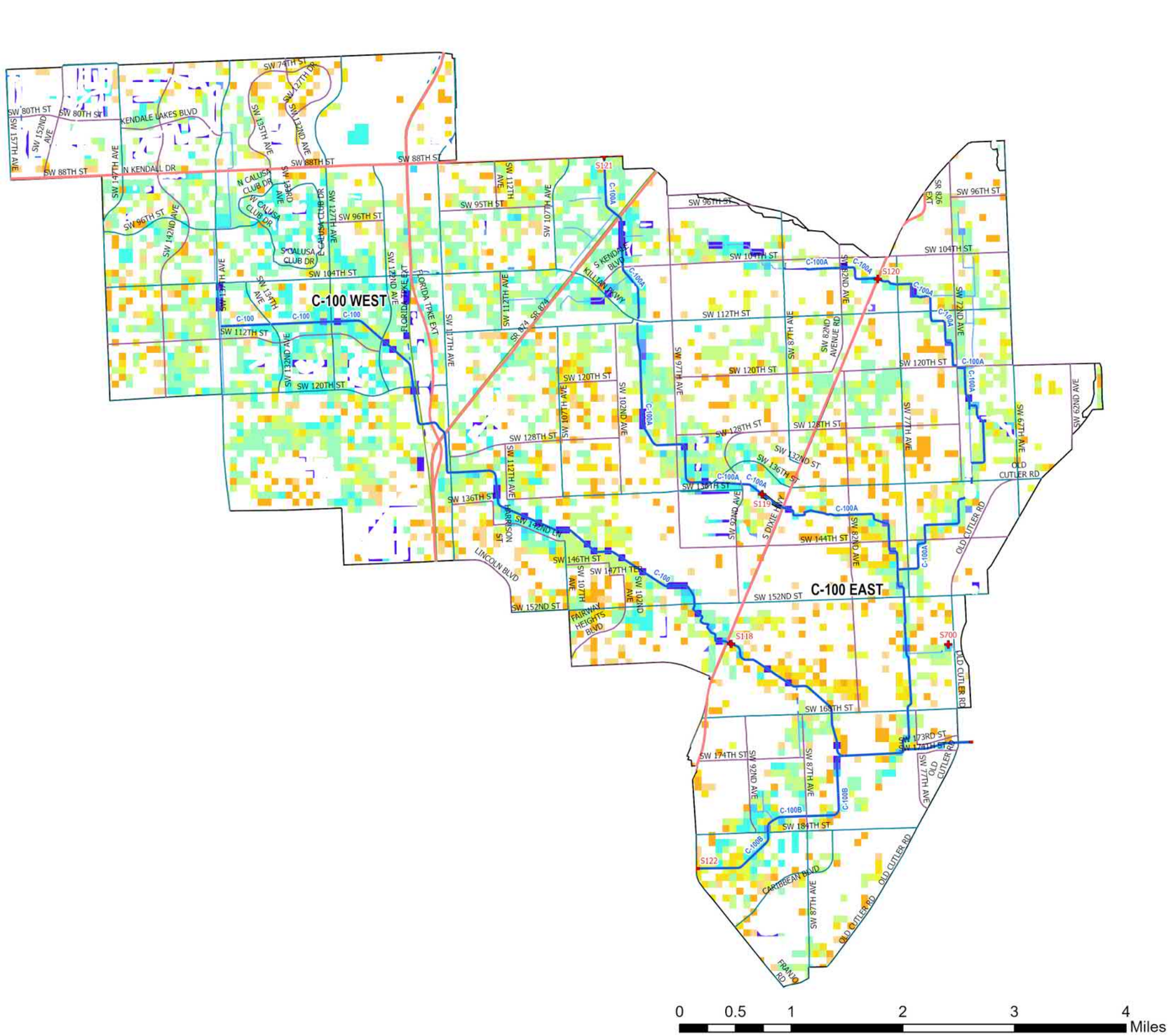
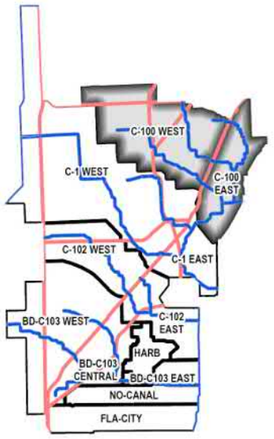


Figure A-125. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

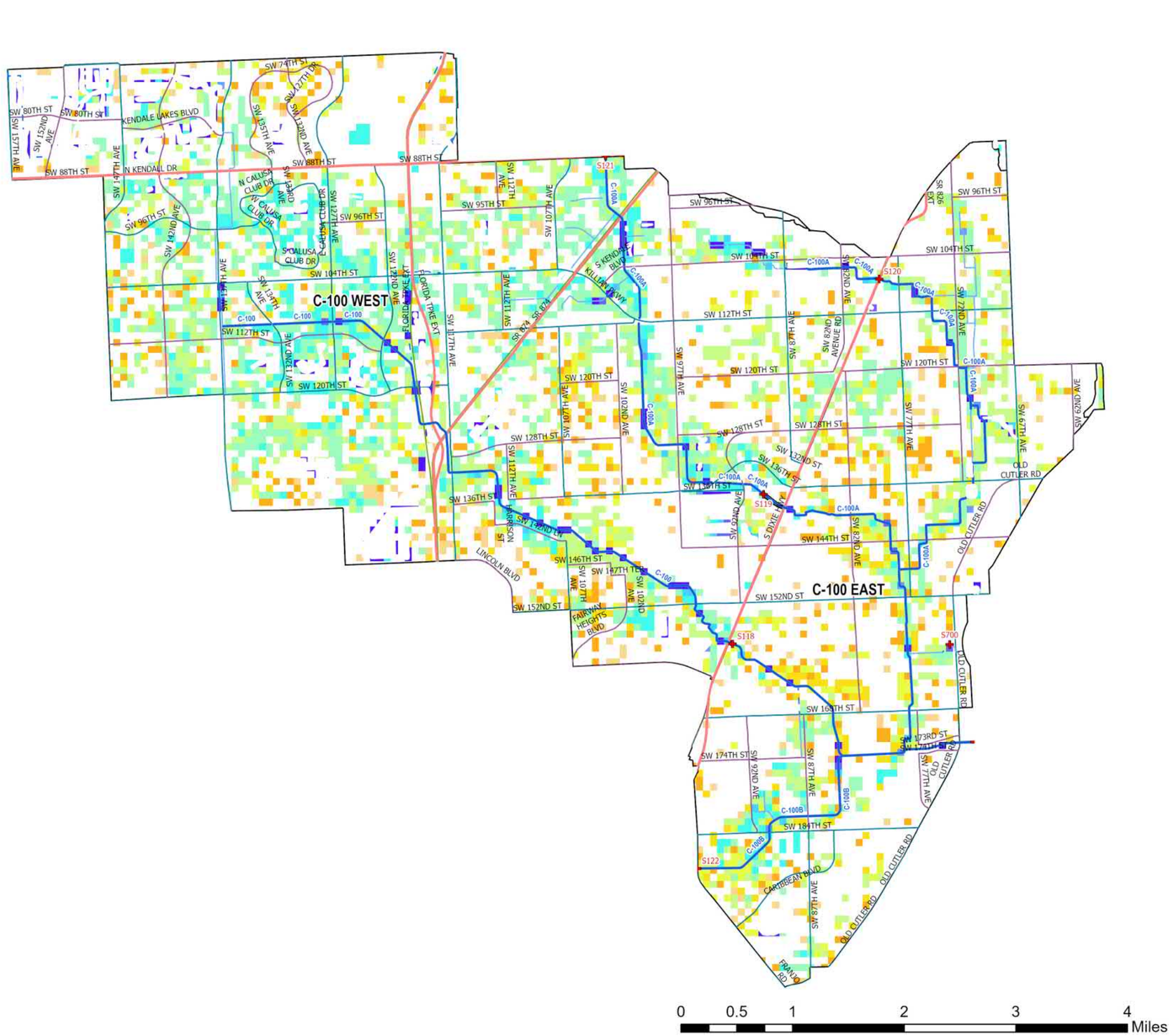
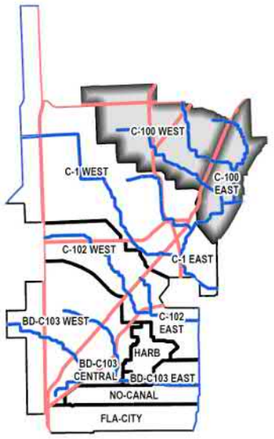


Figure A-126. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 1

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

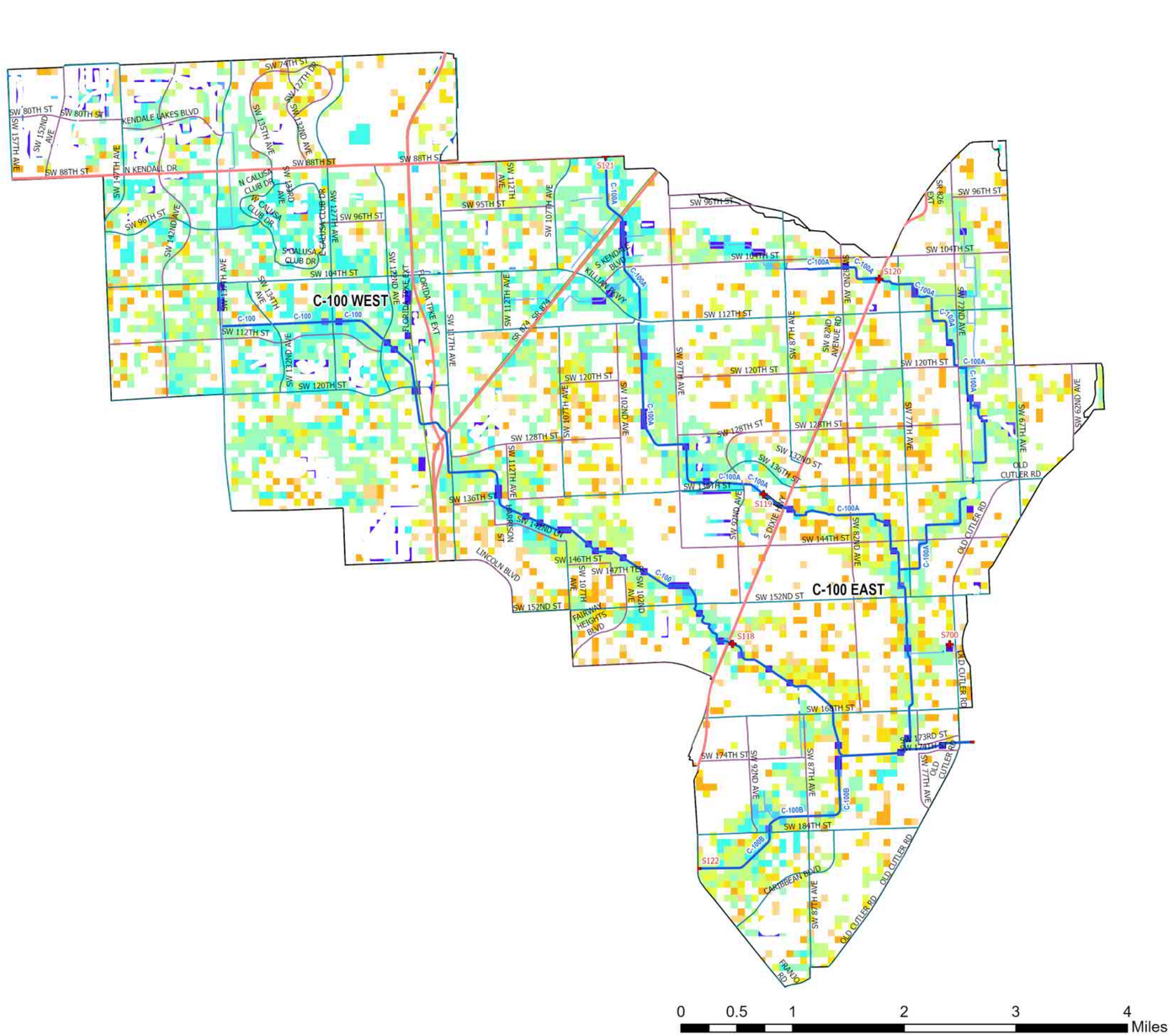
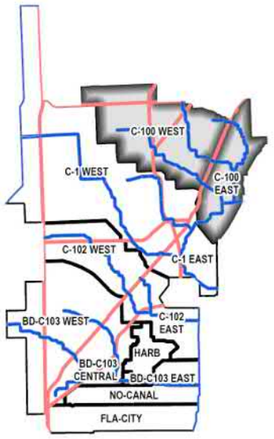


Figure A-127. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn



C-100 Location within Project Area

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

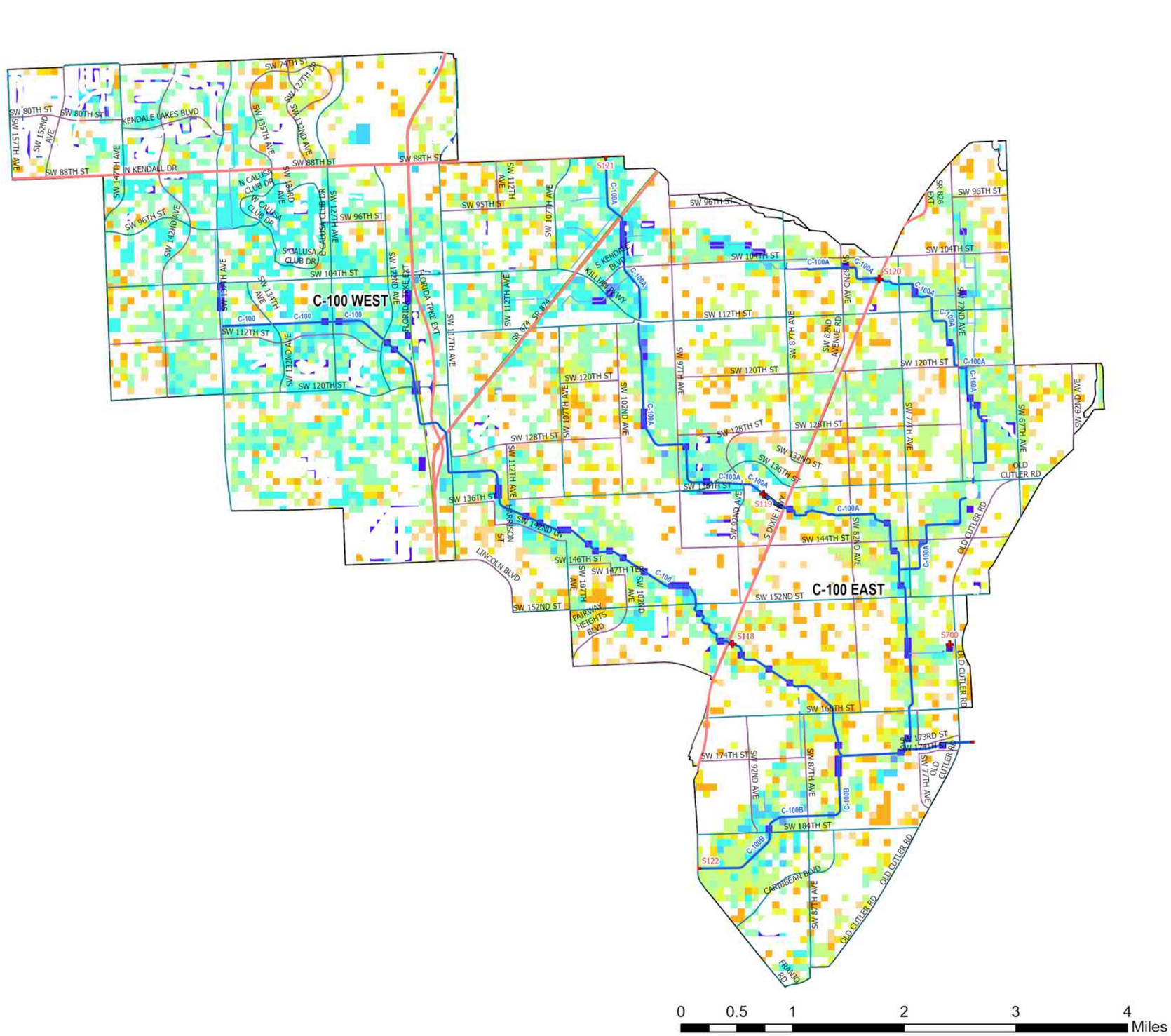
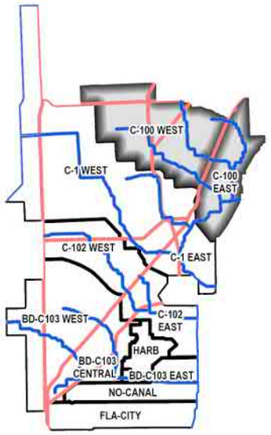
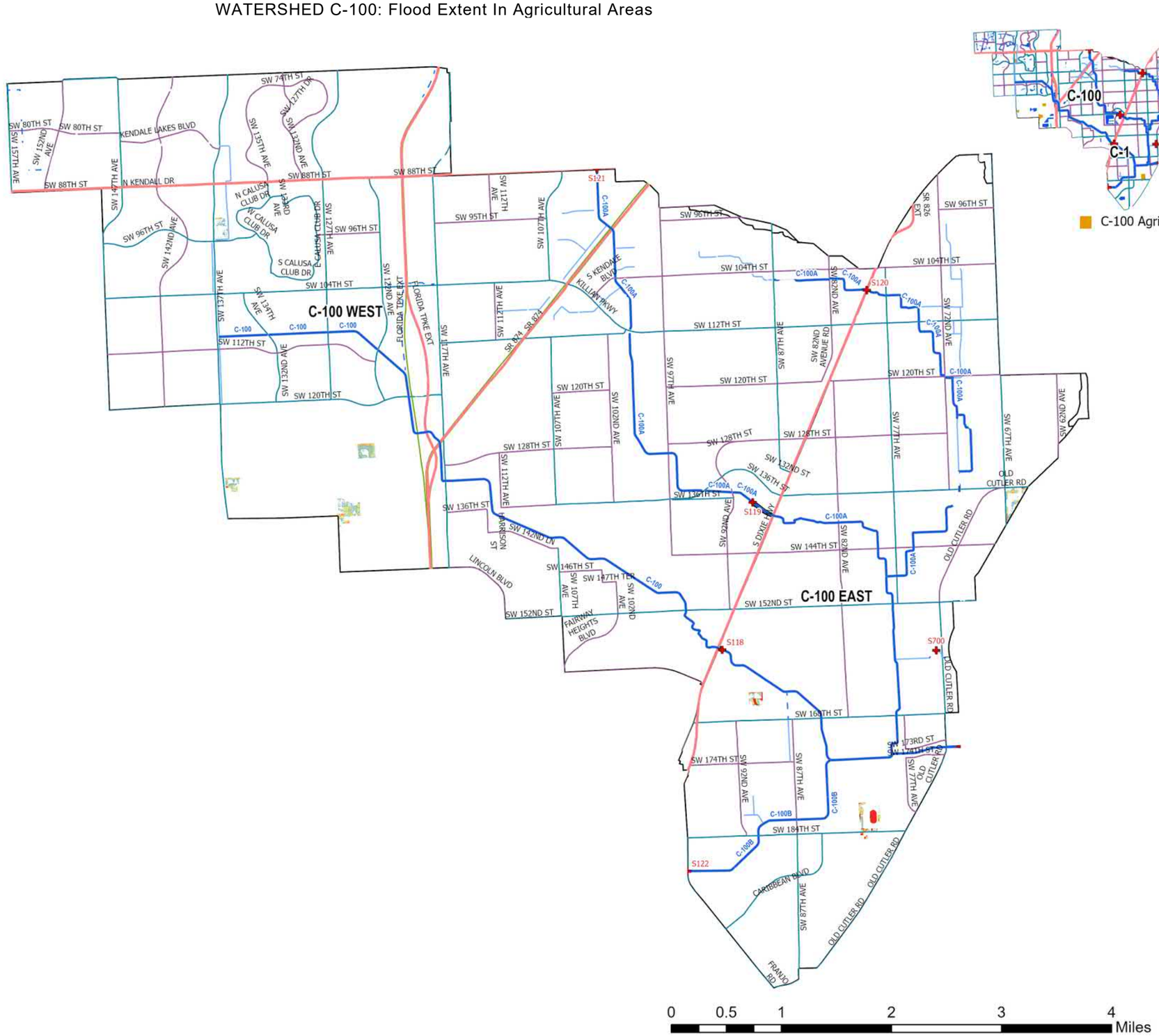


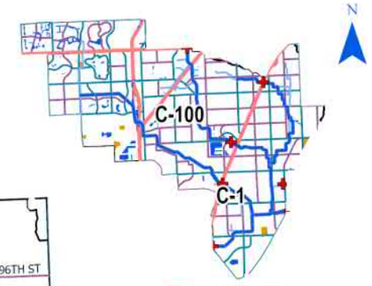
Figure A-128. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 3

WATERSHED C-100: Flood Extent In Agricultural Areas



C-100 Location within Project Area





- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

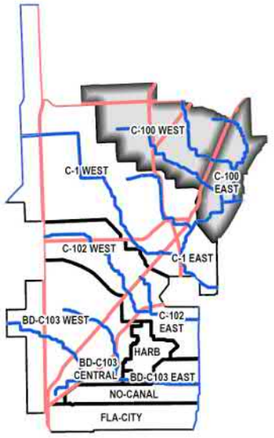
5-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-129. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

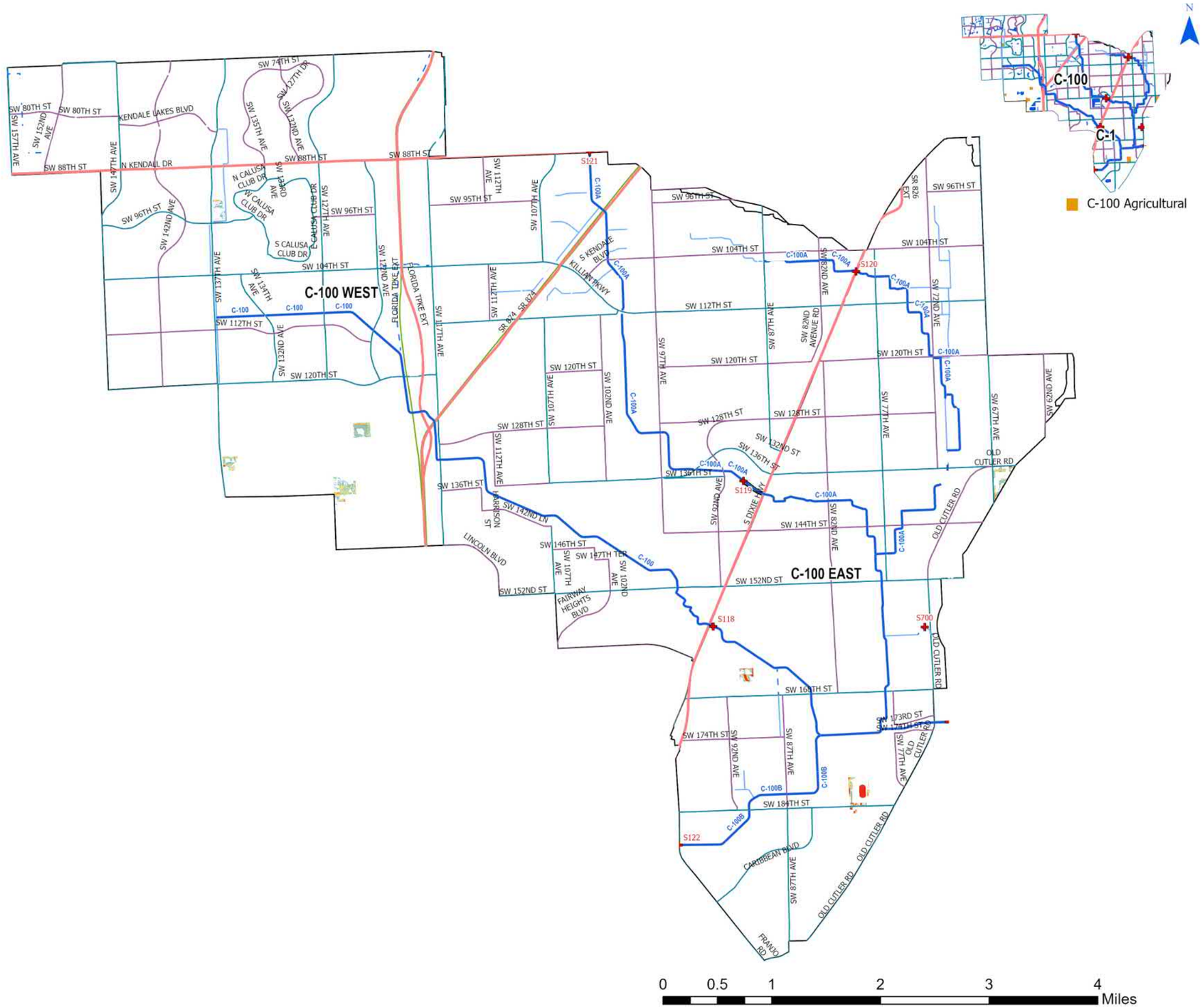
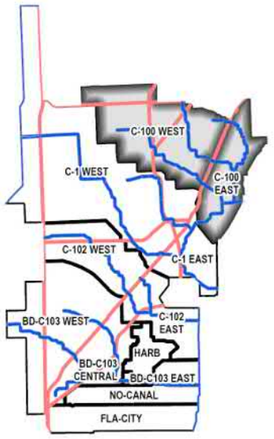


Figure A-130. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

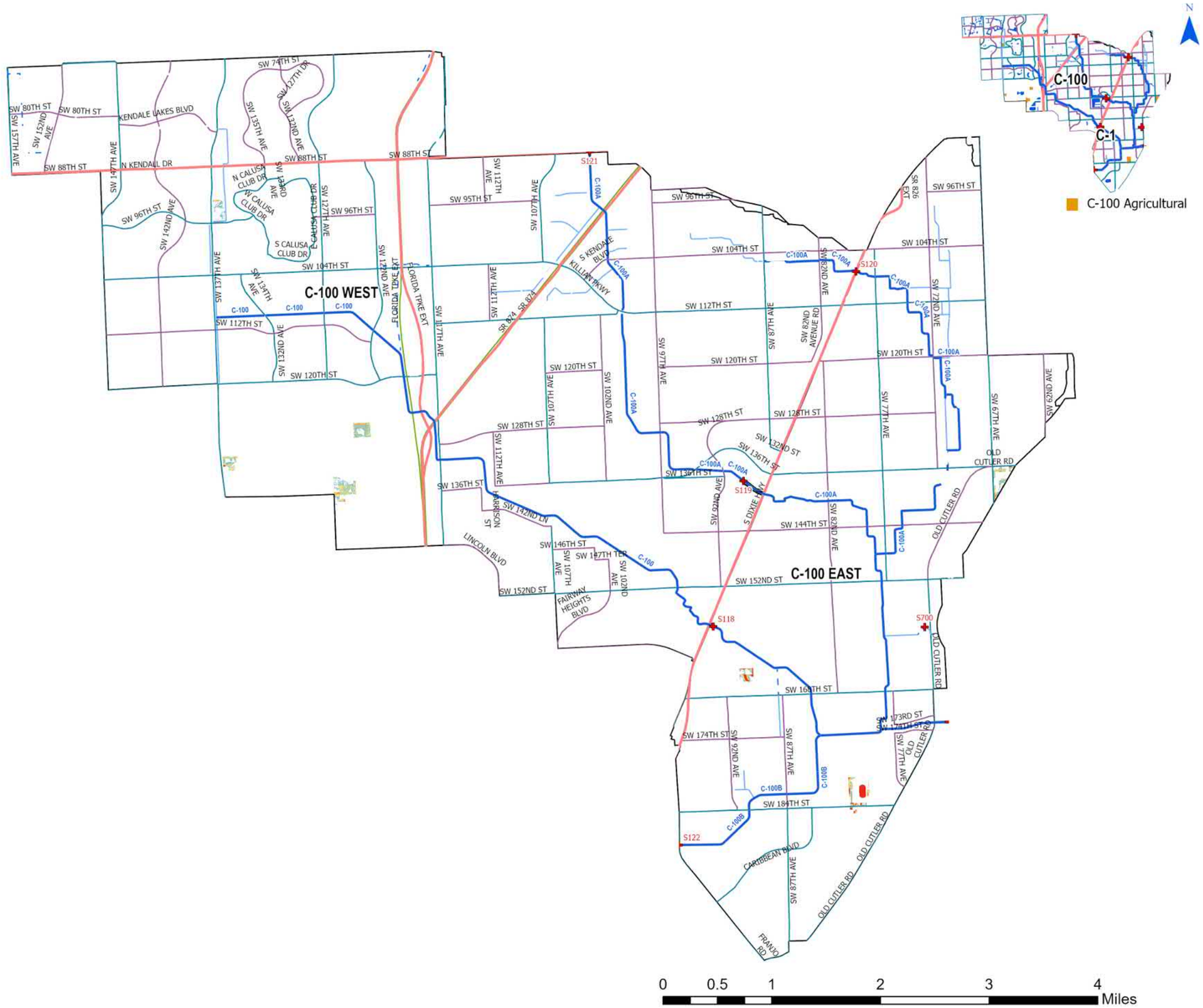
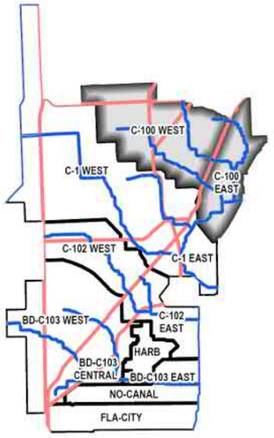


Figure A-131. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

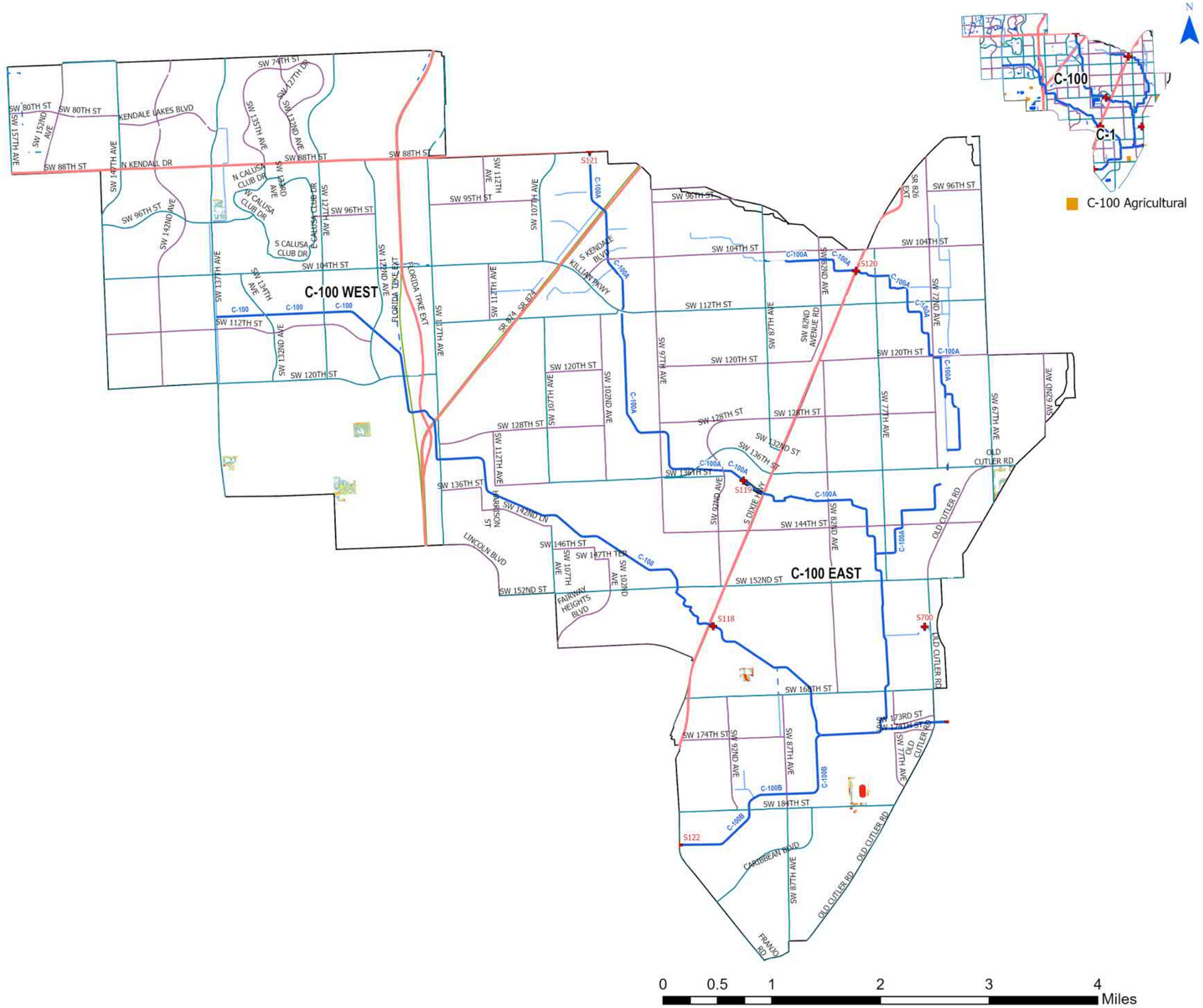
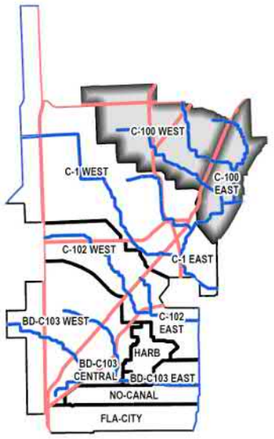


Figure A-132. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas



C-100 Location within Project Area

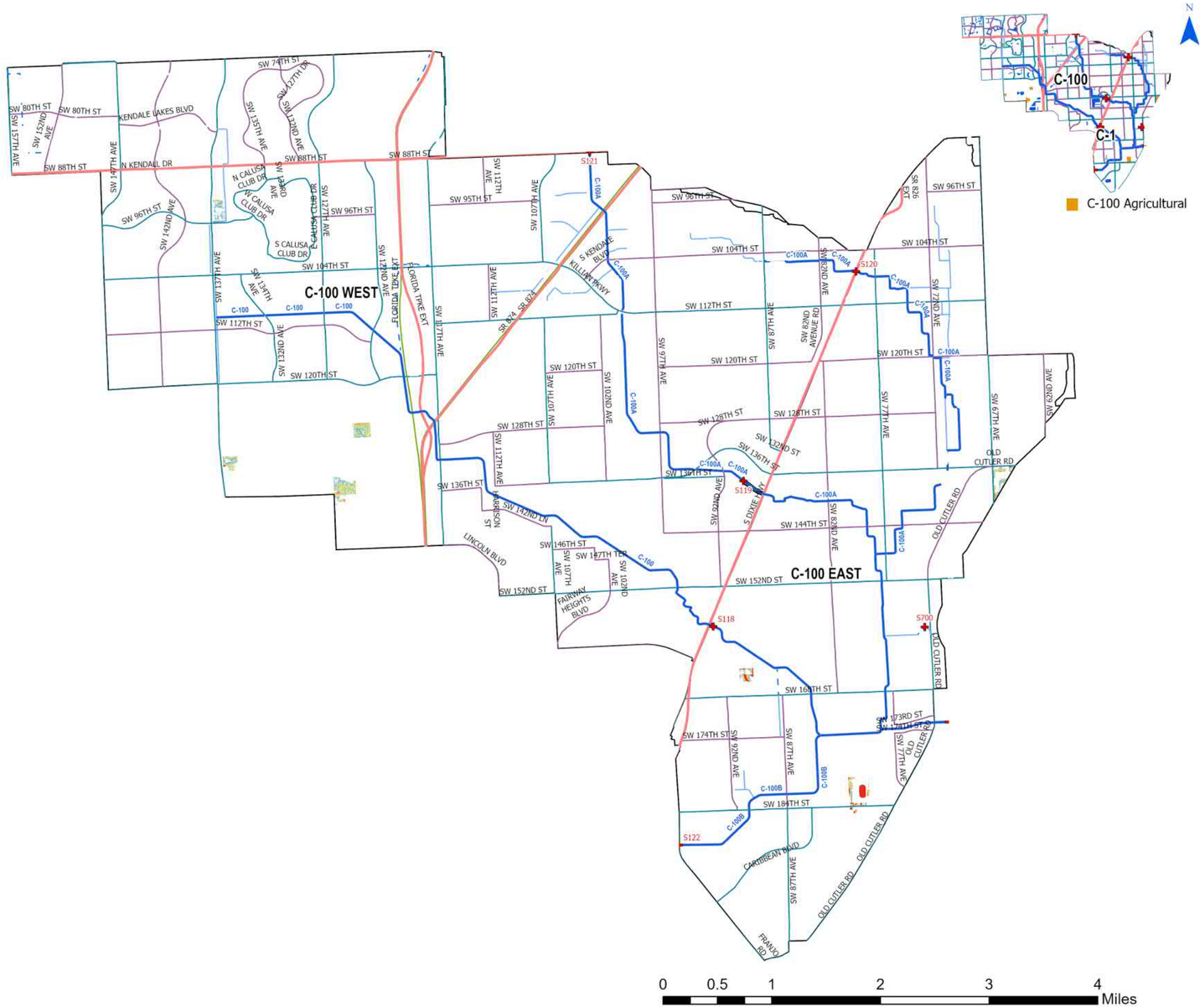


Figure A-133. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn

C-100 Location within Project Area

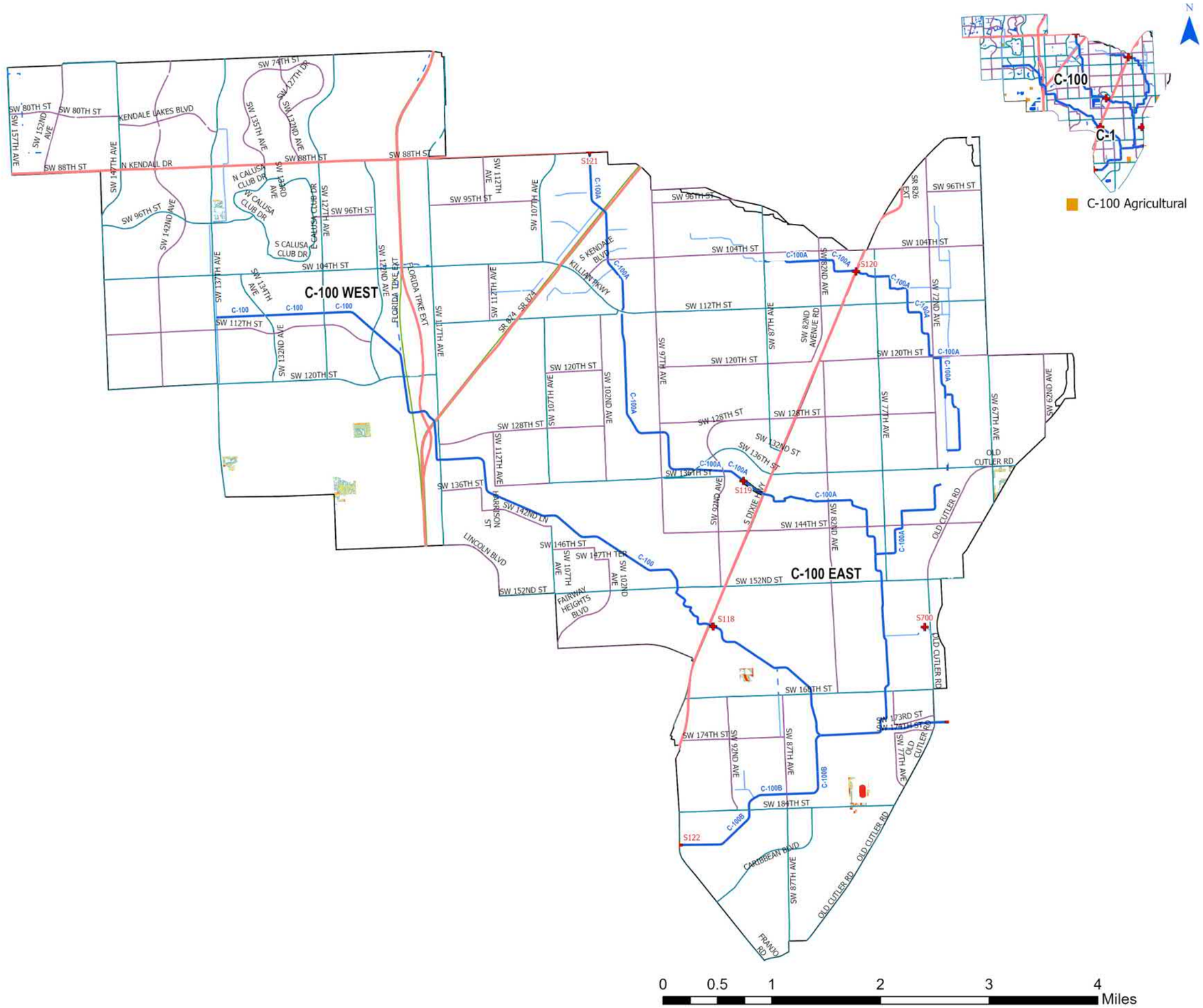


Figure A-134. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn

C-100 Location within Project Area

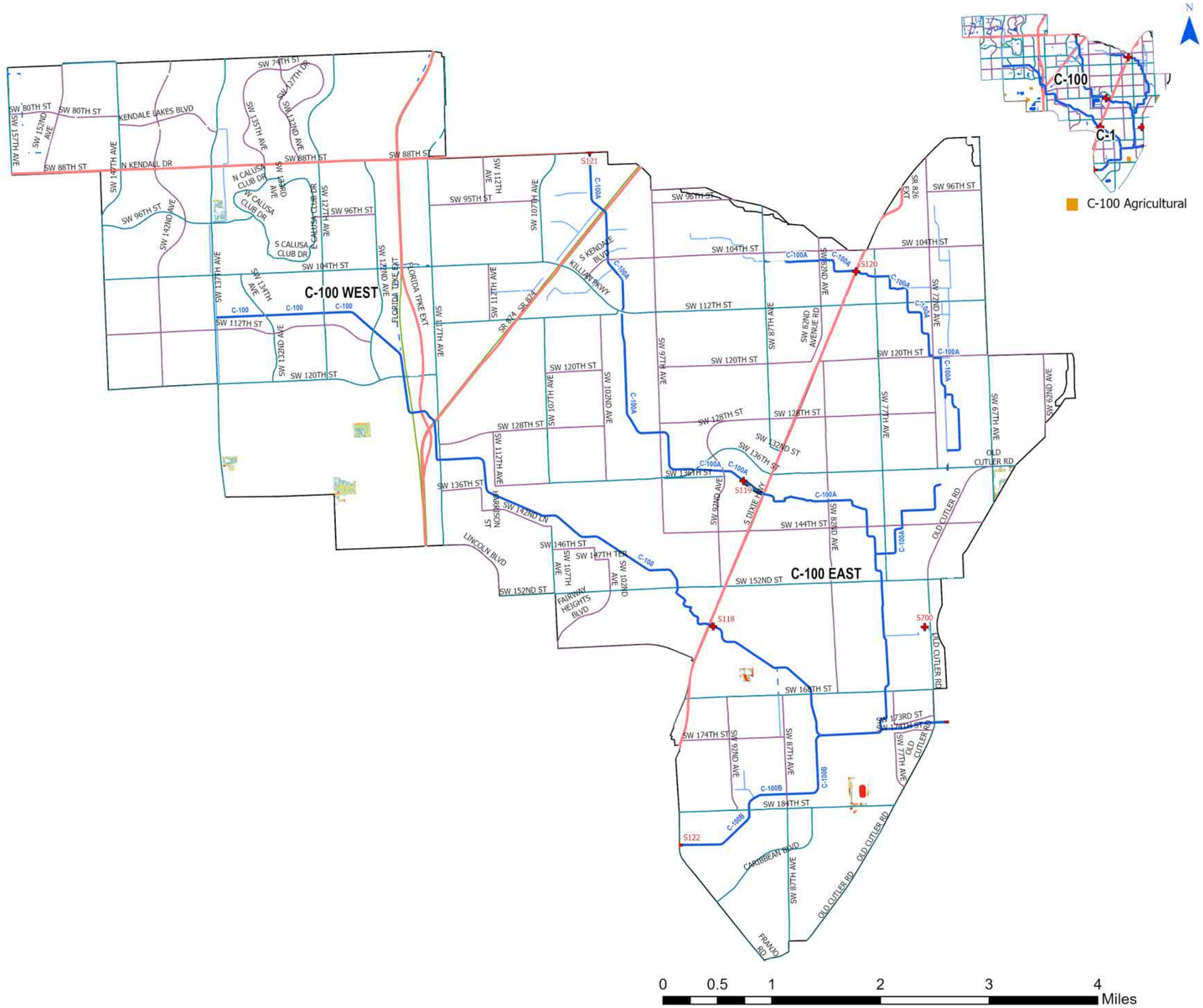
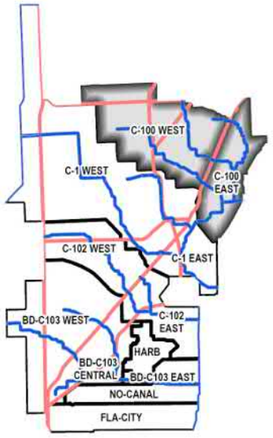


Figure A-135. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

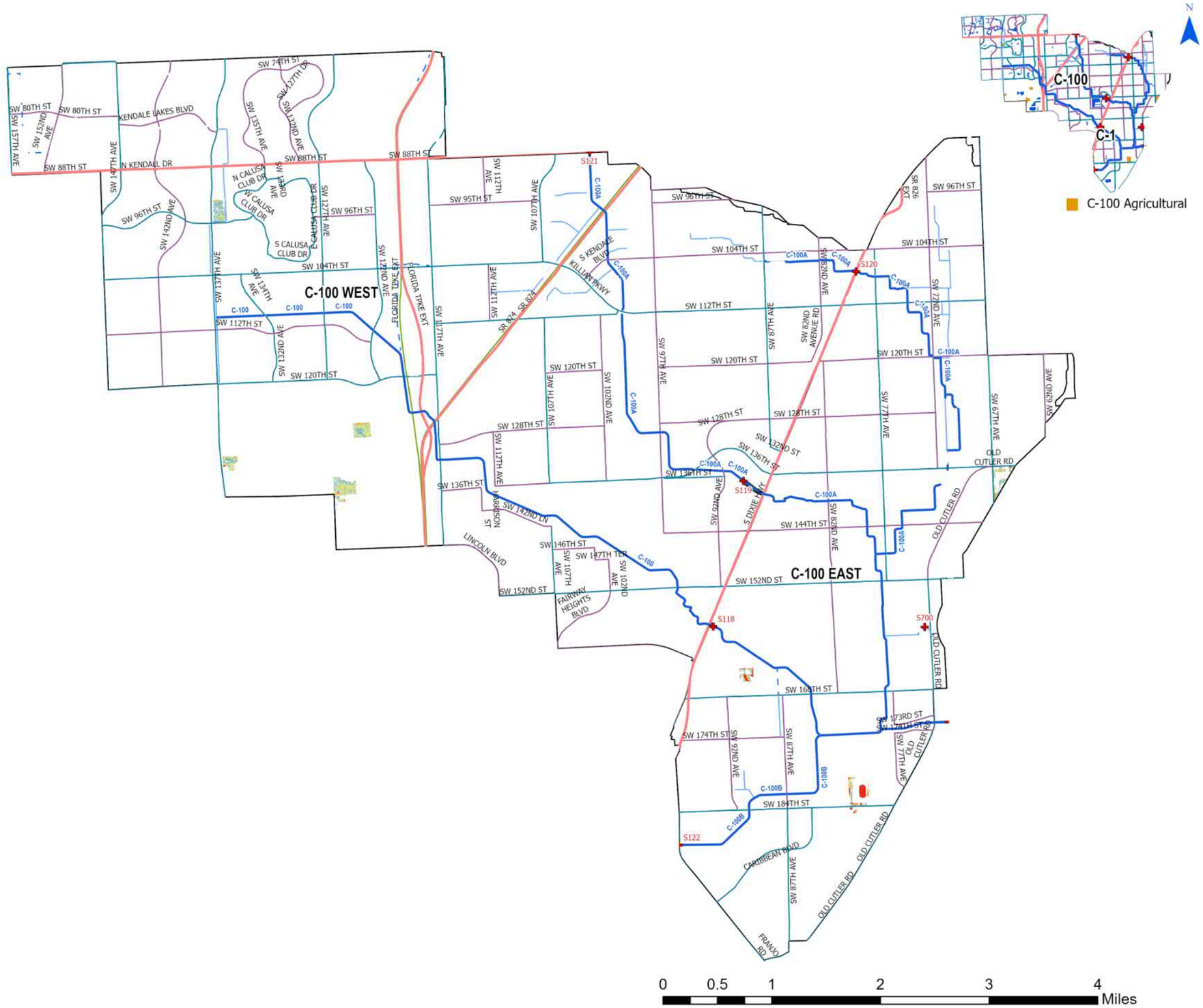
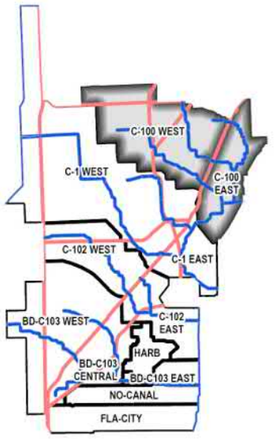


Figure A-136. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

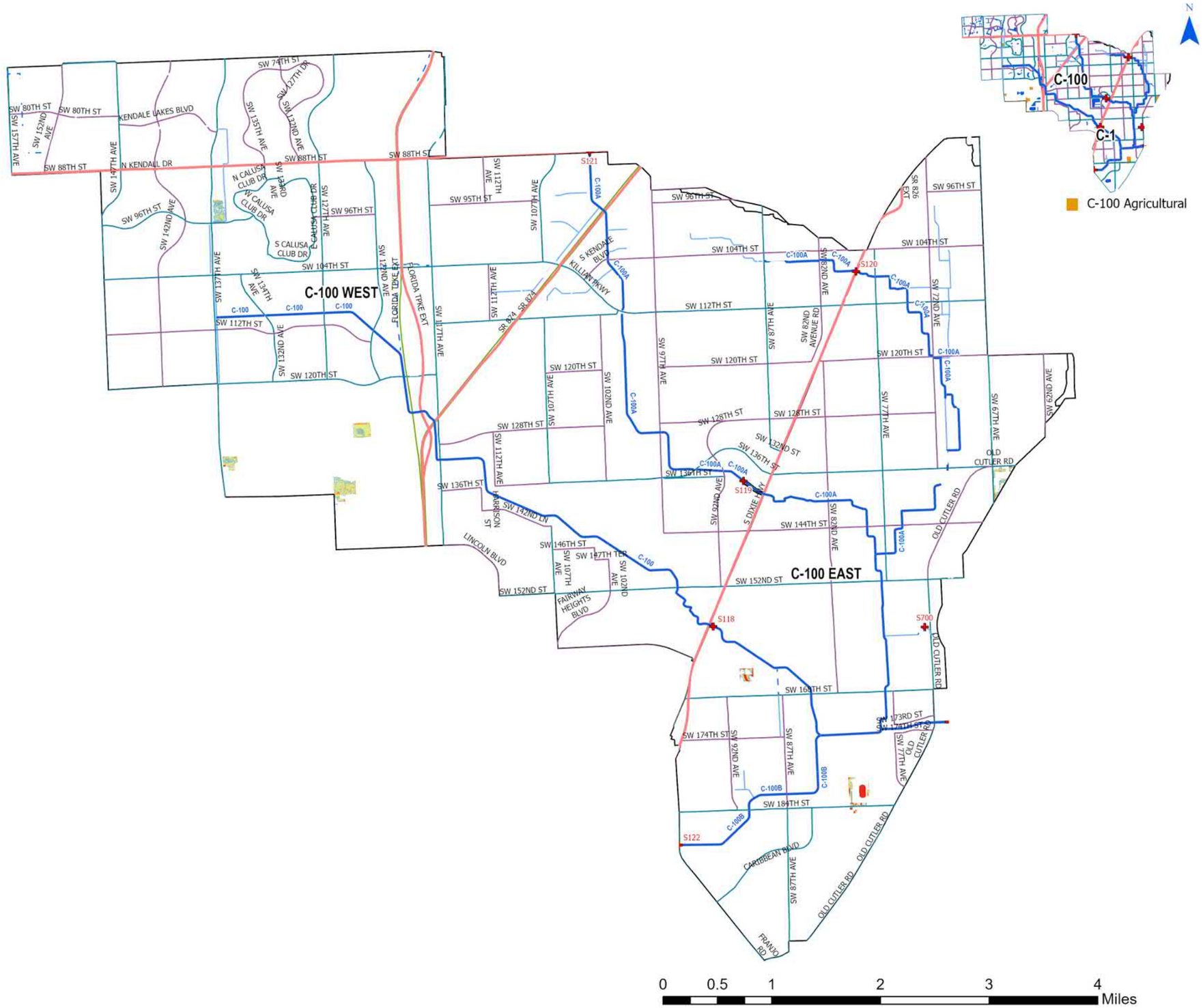
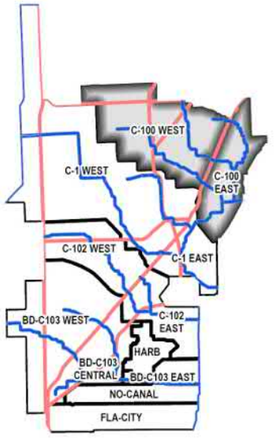


Figure A-137. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas



C-100 Location within Project Area

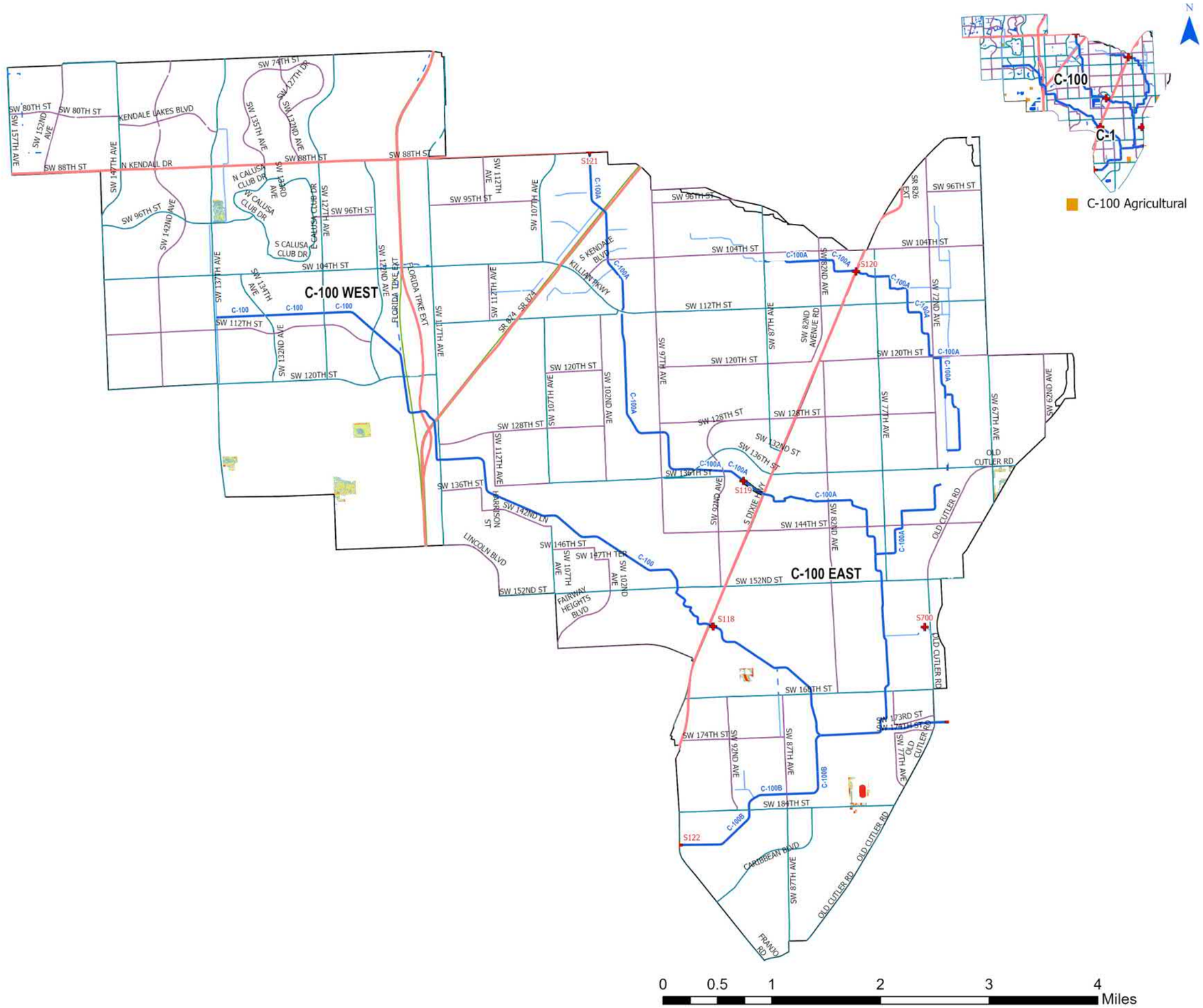


Figure A-138. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

C-100 Location within Project Area

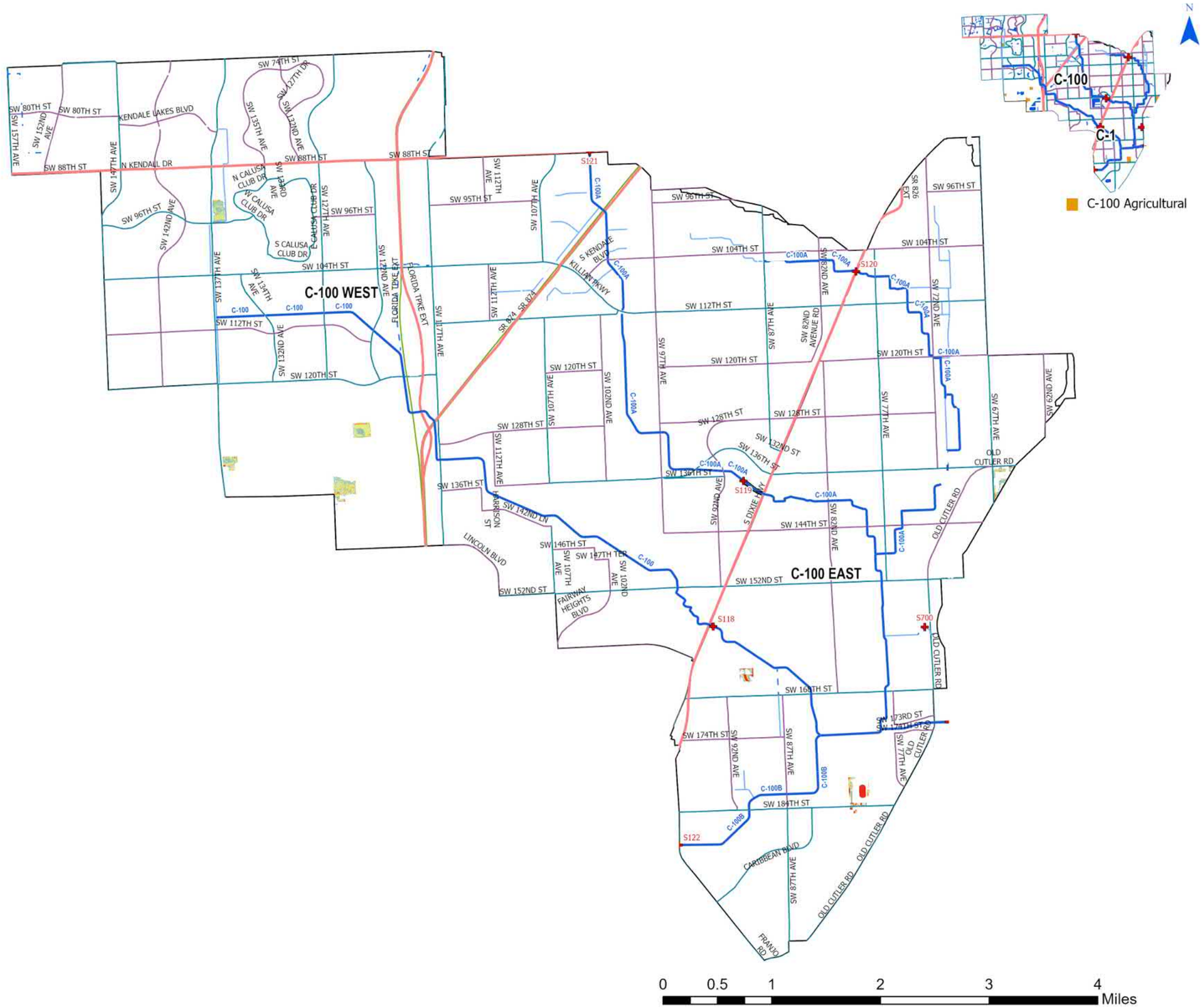


Figure A-139. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas

C-100 Location within Project Area

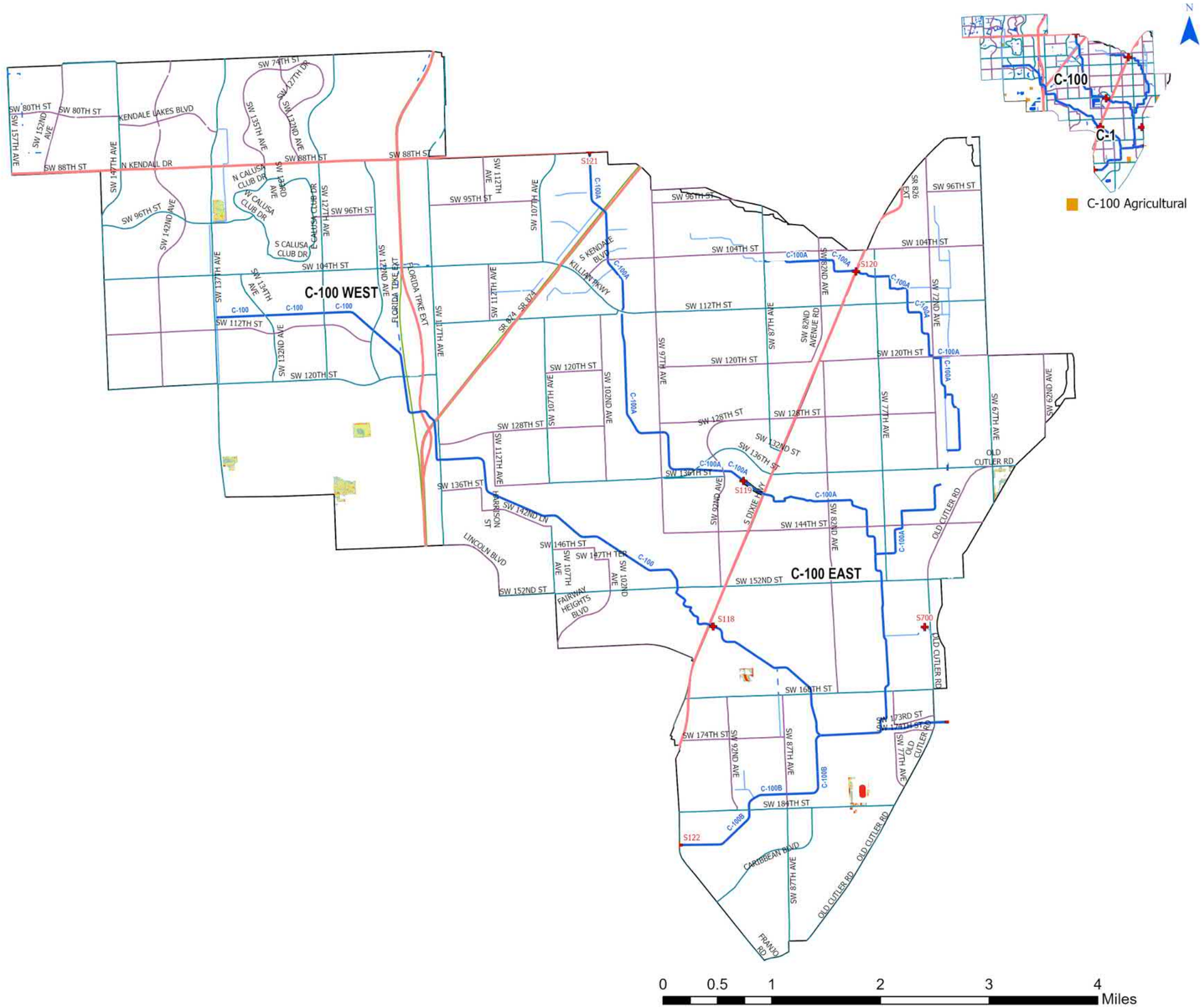
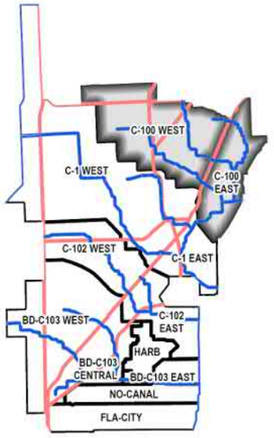


Figure A-140. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas



C-100 Location within Project Area

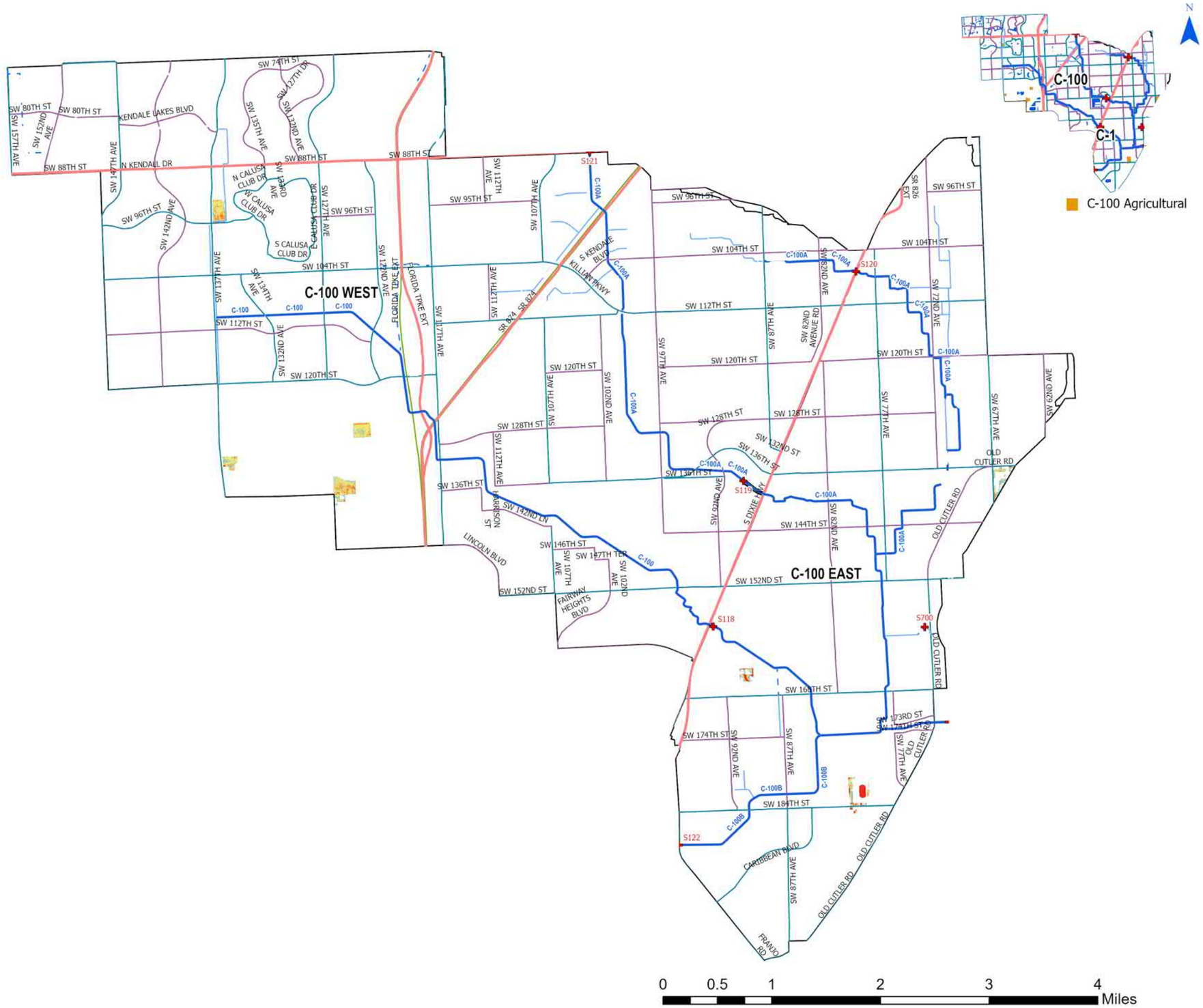
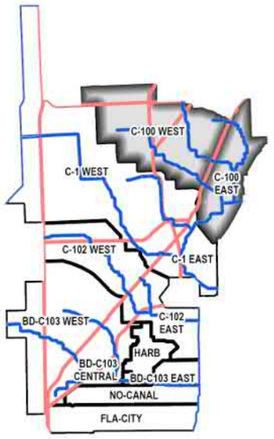


Figure A-141. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas



C-100 Location within Project Area

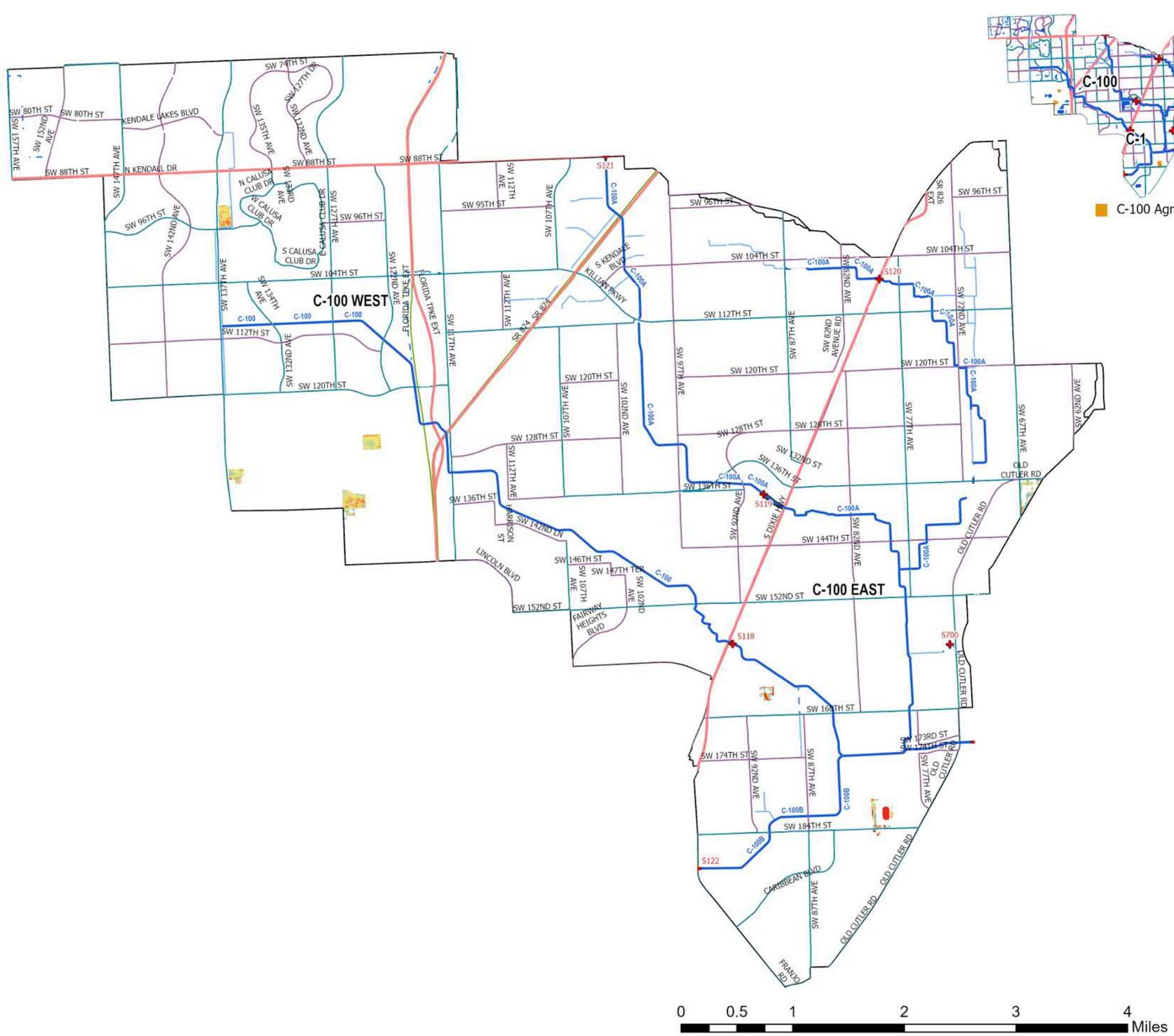
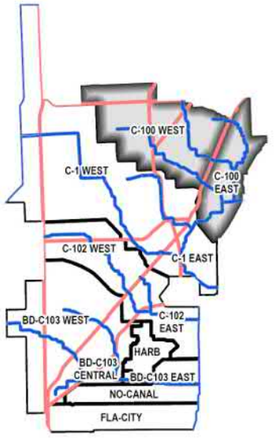


Figure A-142. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

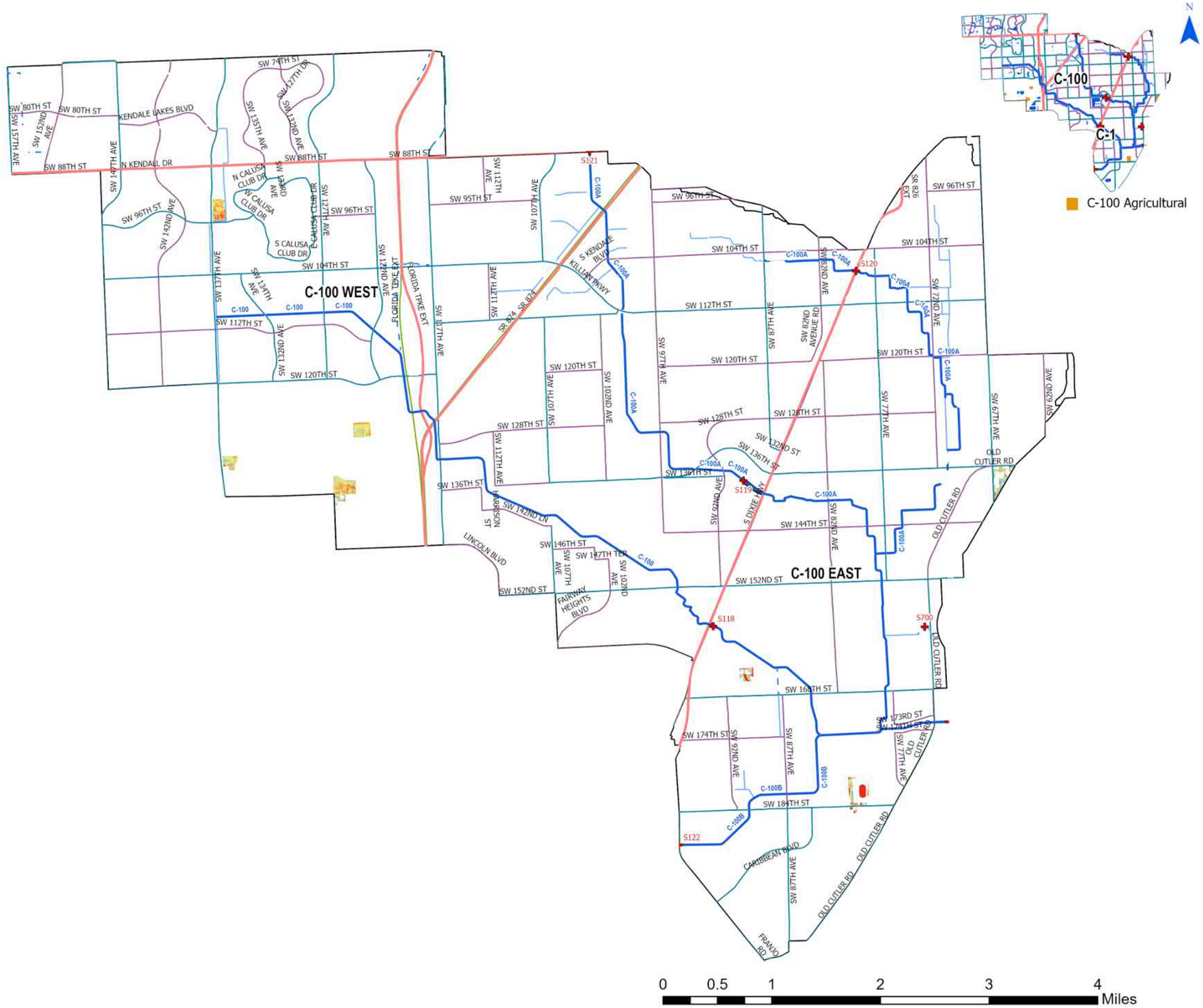
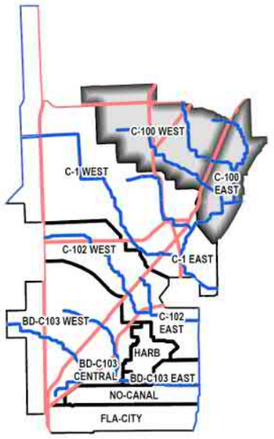


Figure A-143. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas



C-100 Location within Project Area

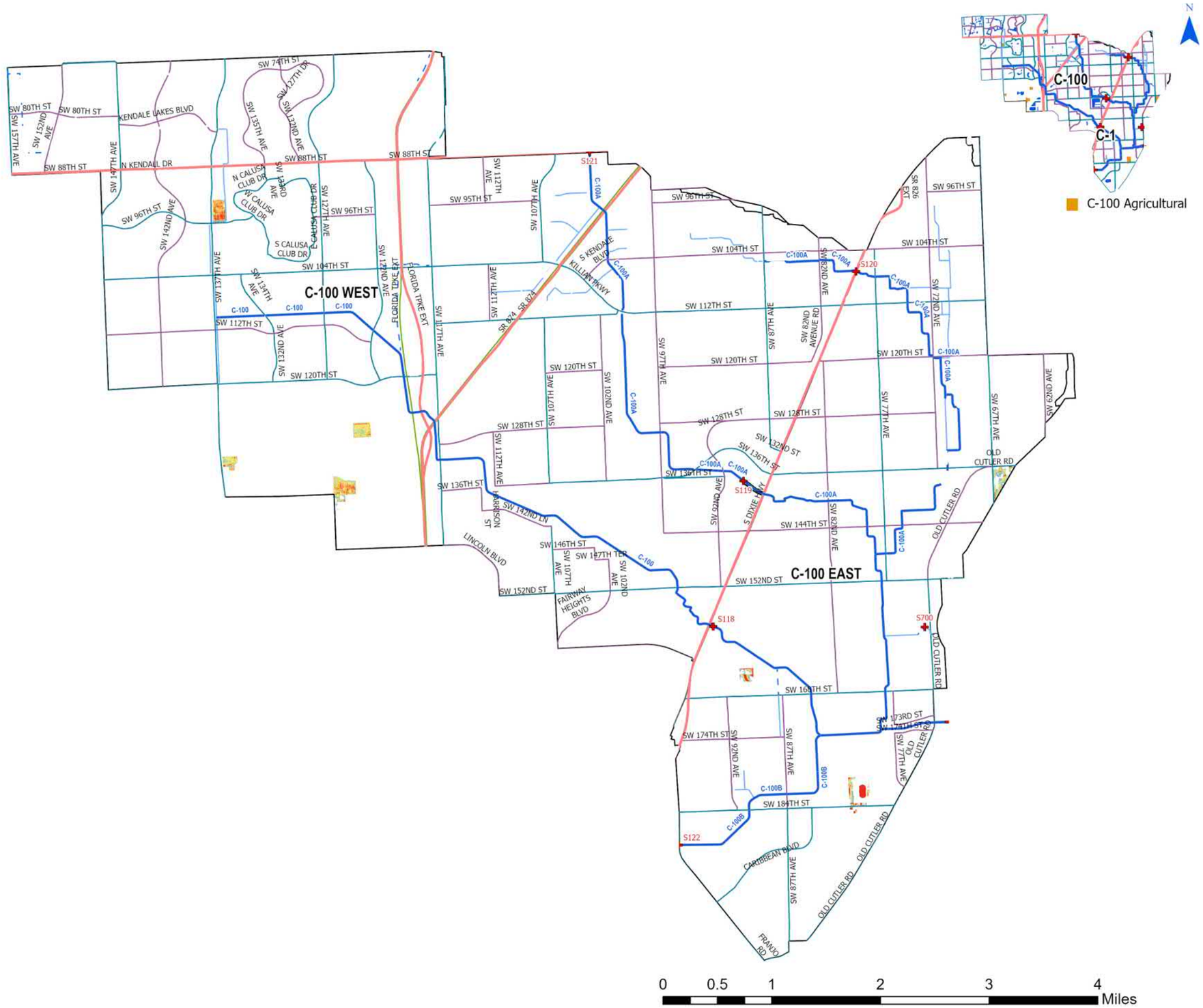


Figure A-144. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

WATERSHED C-100: Flood Duration in Agricultural Areas

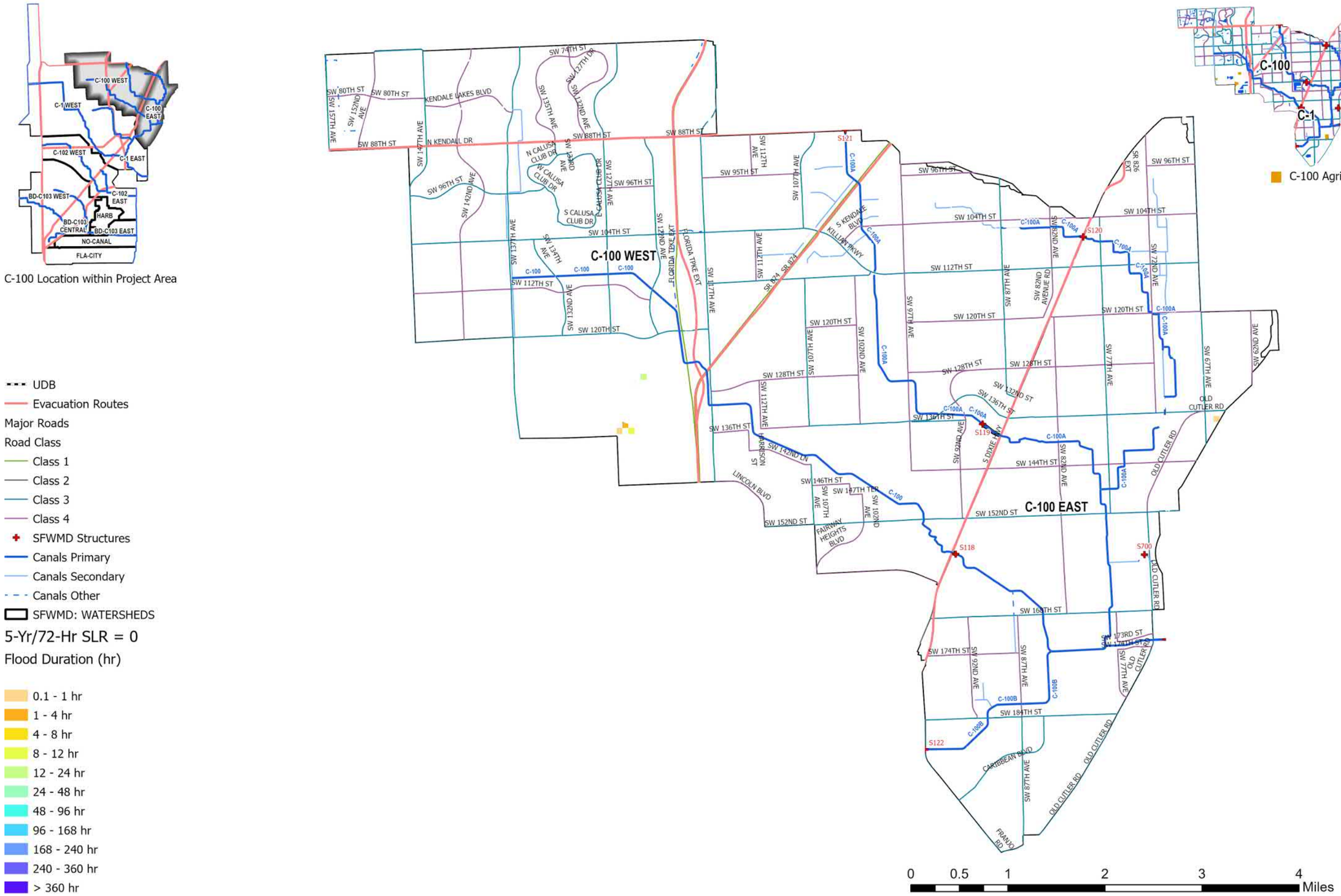
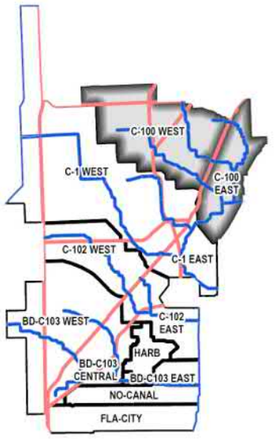


Figure A-145. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

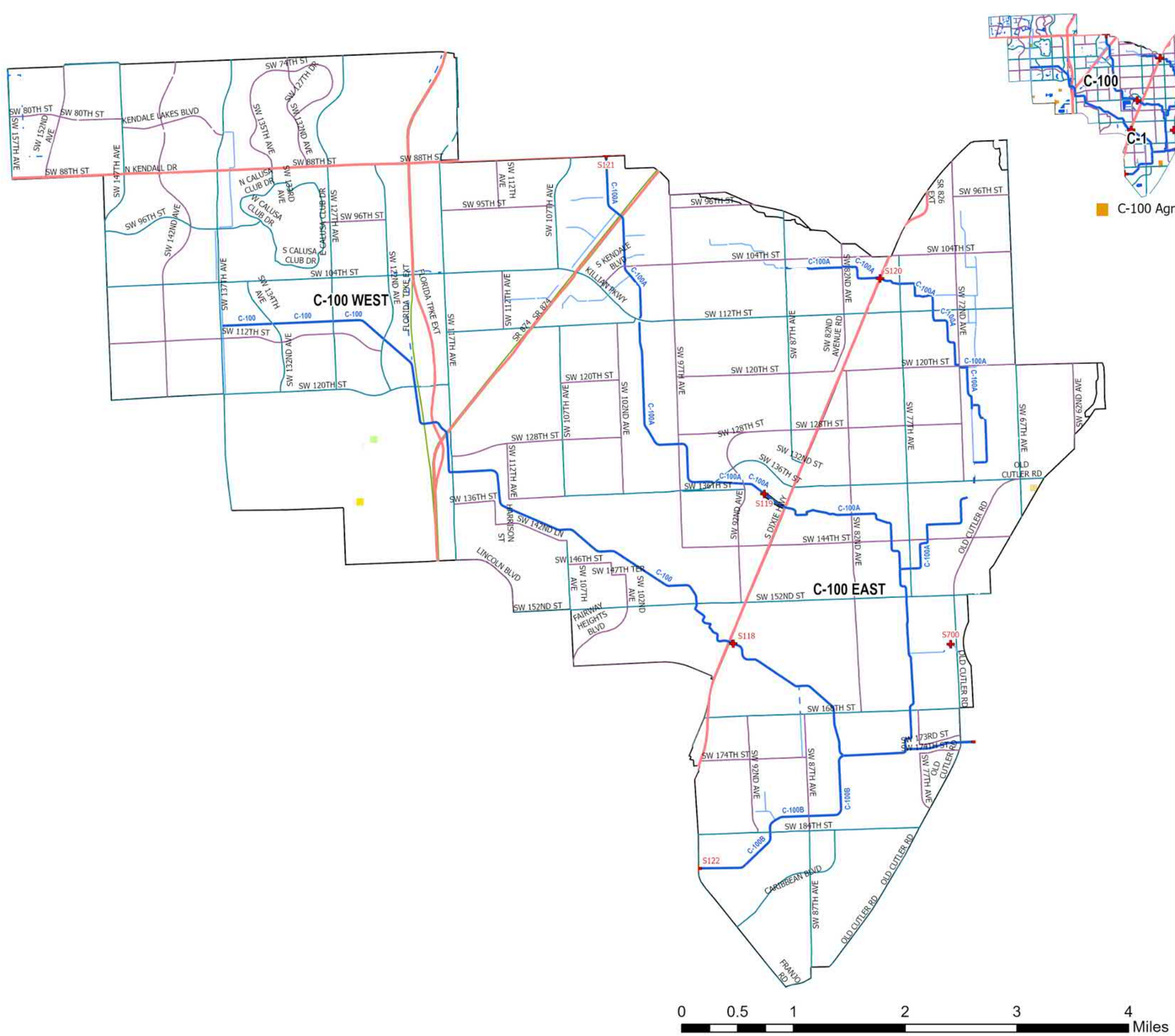
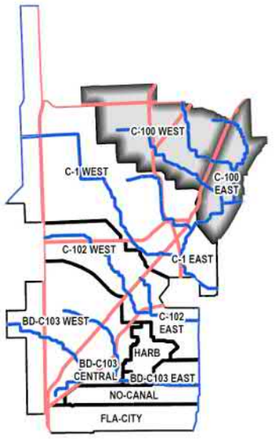
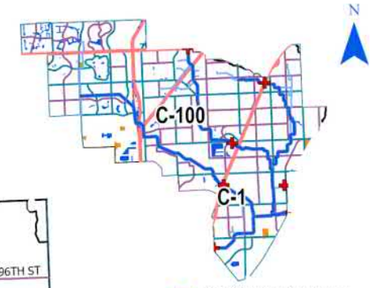


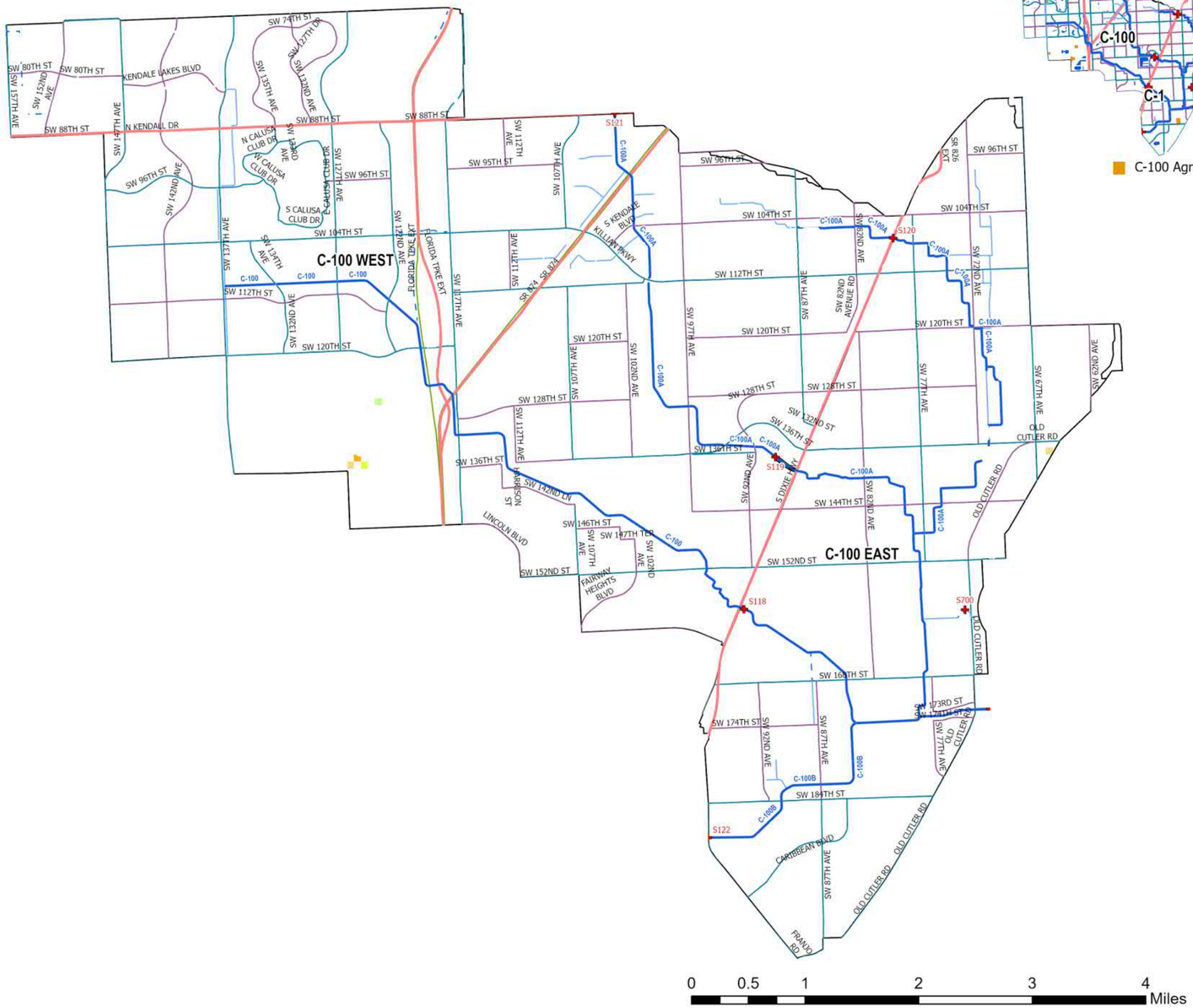
Figure A-146. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-100 Location within Project Area



C-100 Agricultural



- UDB
- Evacuation Routes

Major Roads

Road Class

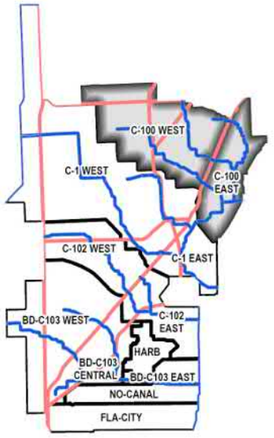
- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +2.0

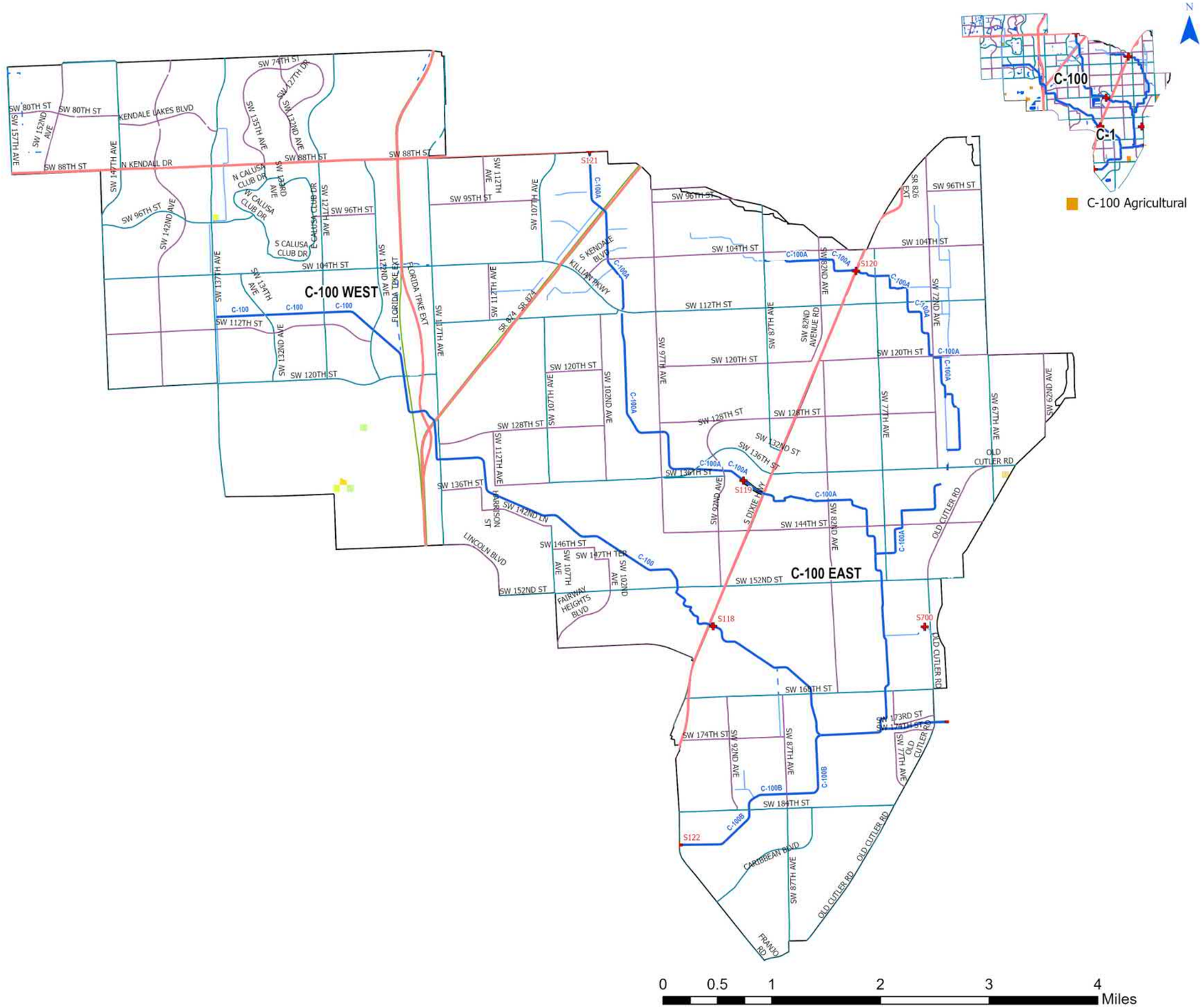
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-147. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas



C-100 Location within Project Area



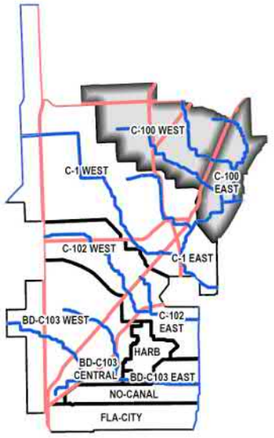
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +3.0

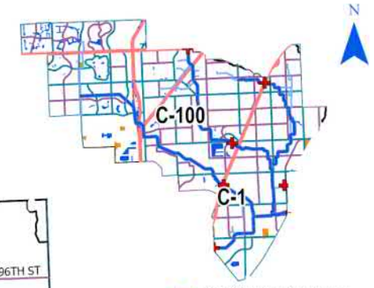
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-148. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas



C-100 Location within Project Area



C-100 Agricultural

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

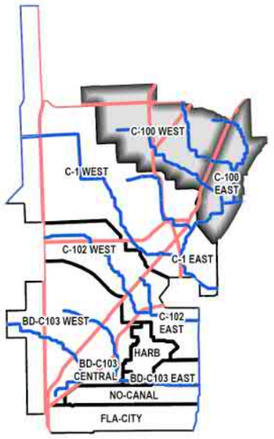
10-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-149. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas



C-100 Location within Project Area

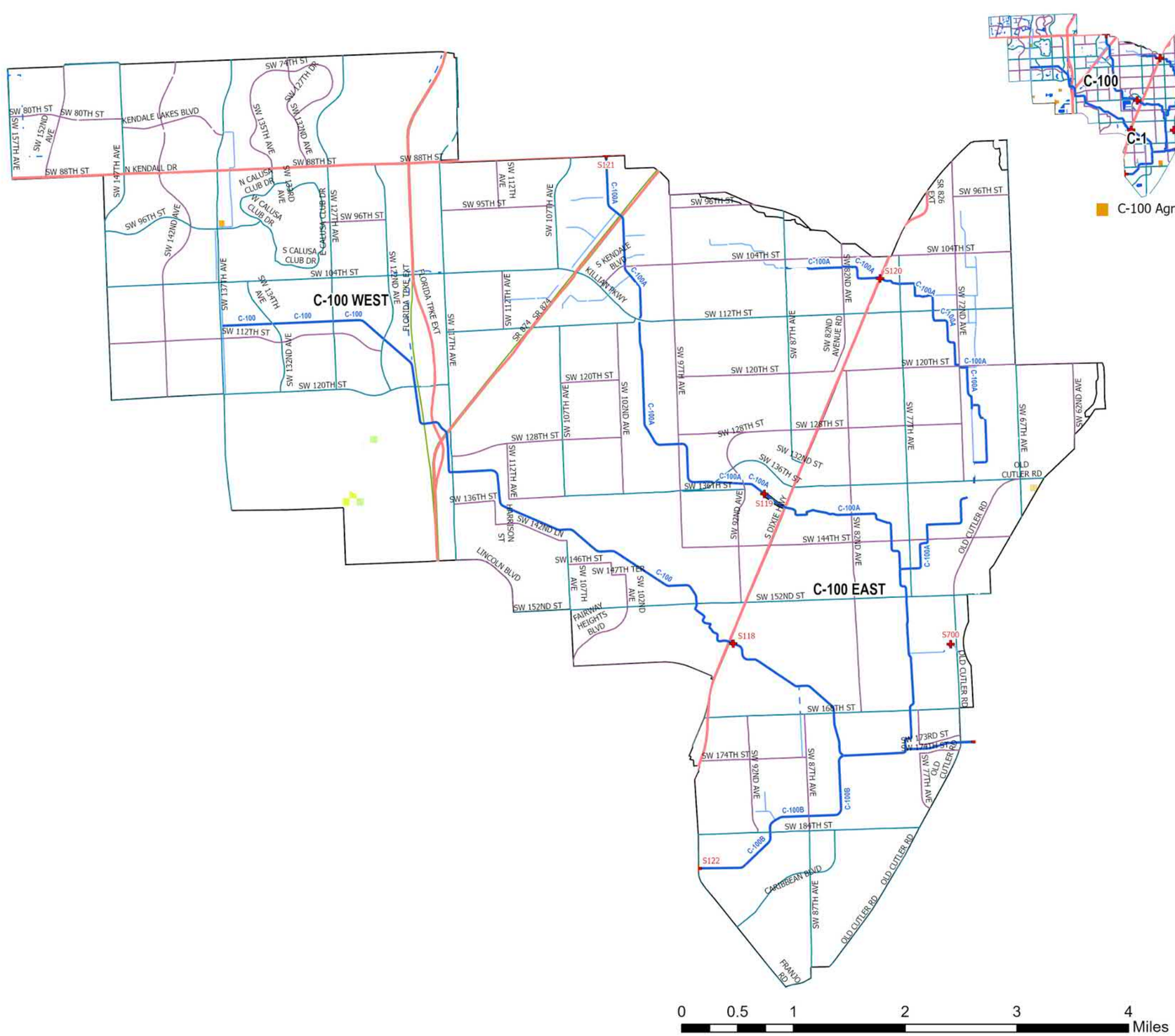
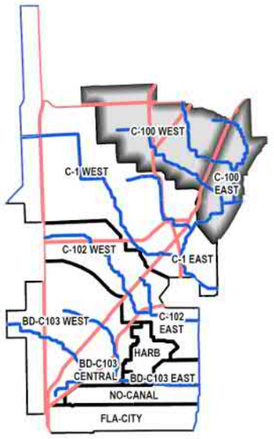
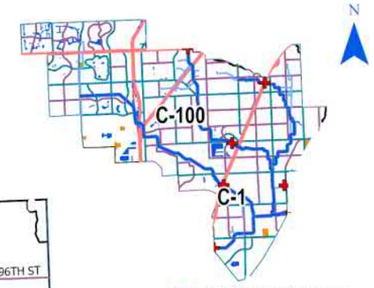


Figure A-150. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas



C-100 Location within Project Area



C-100 Agricultural

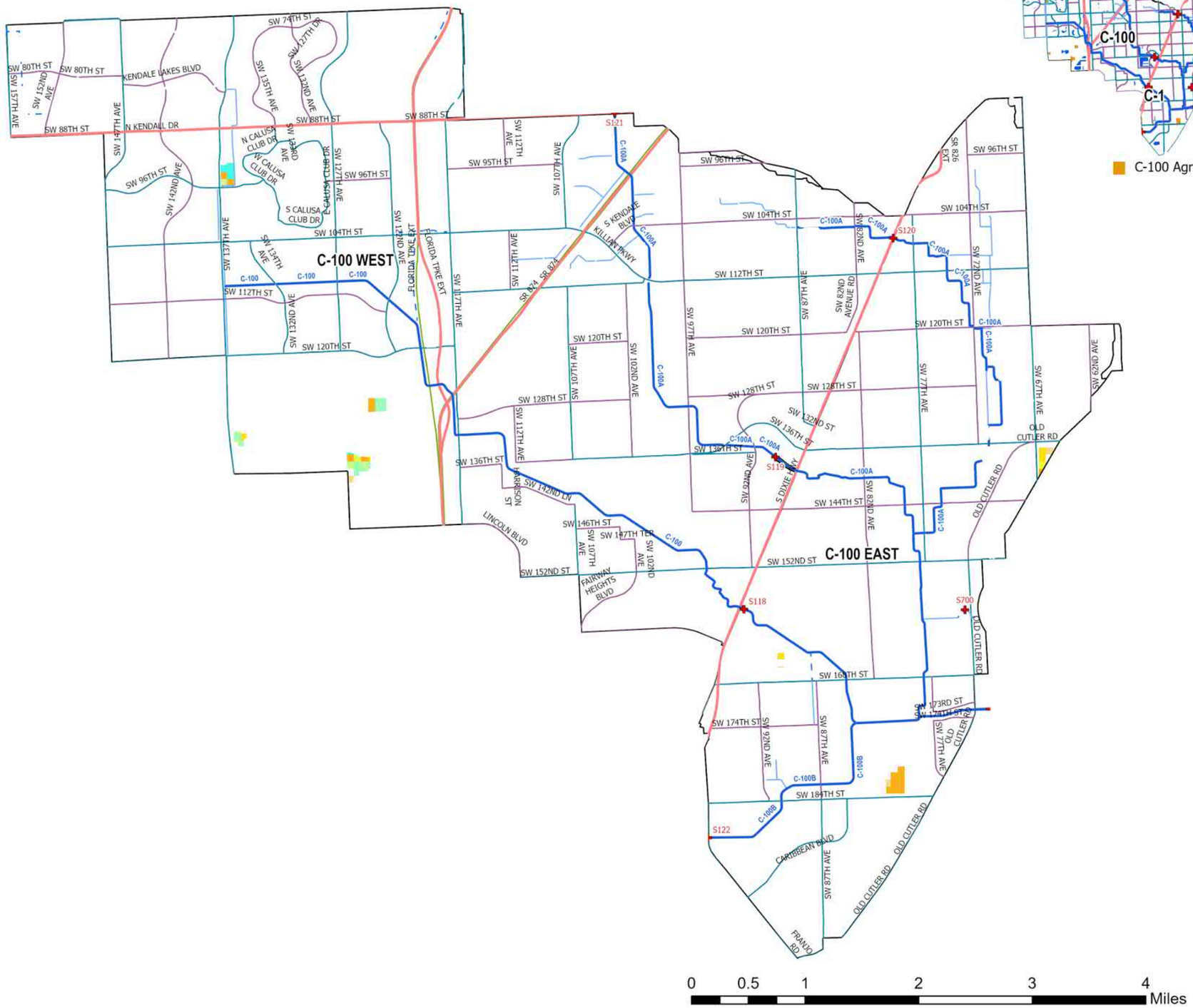
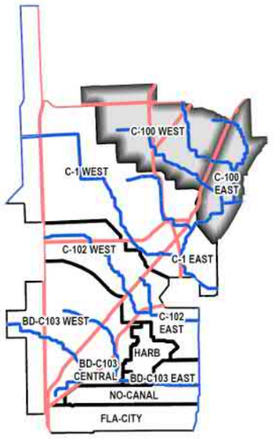


Figure A-151. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

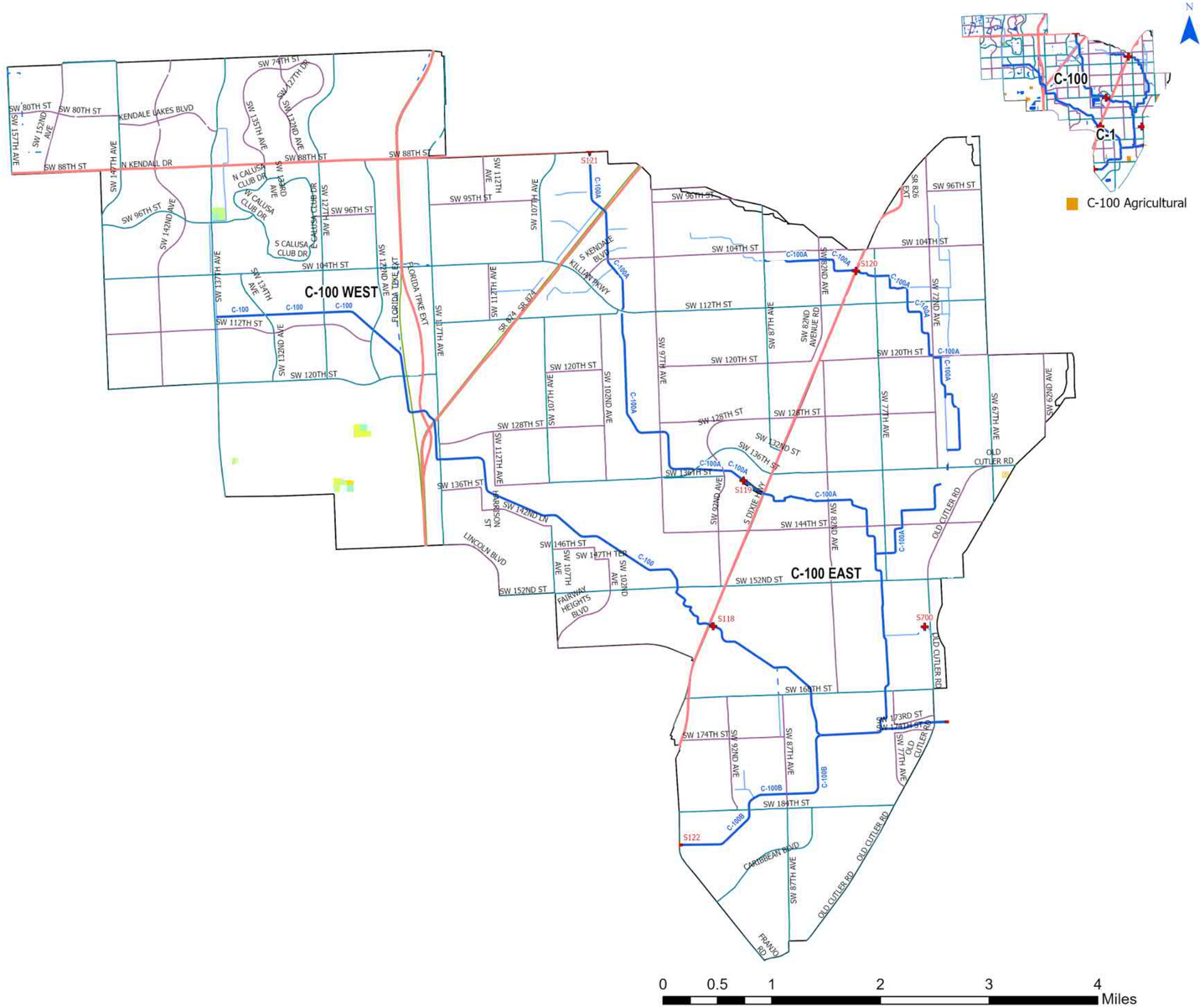
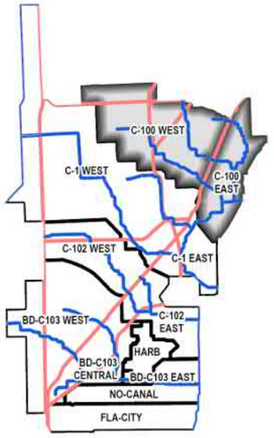
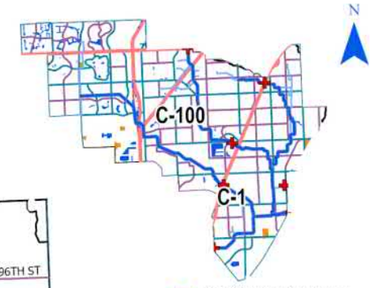
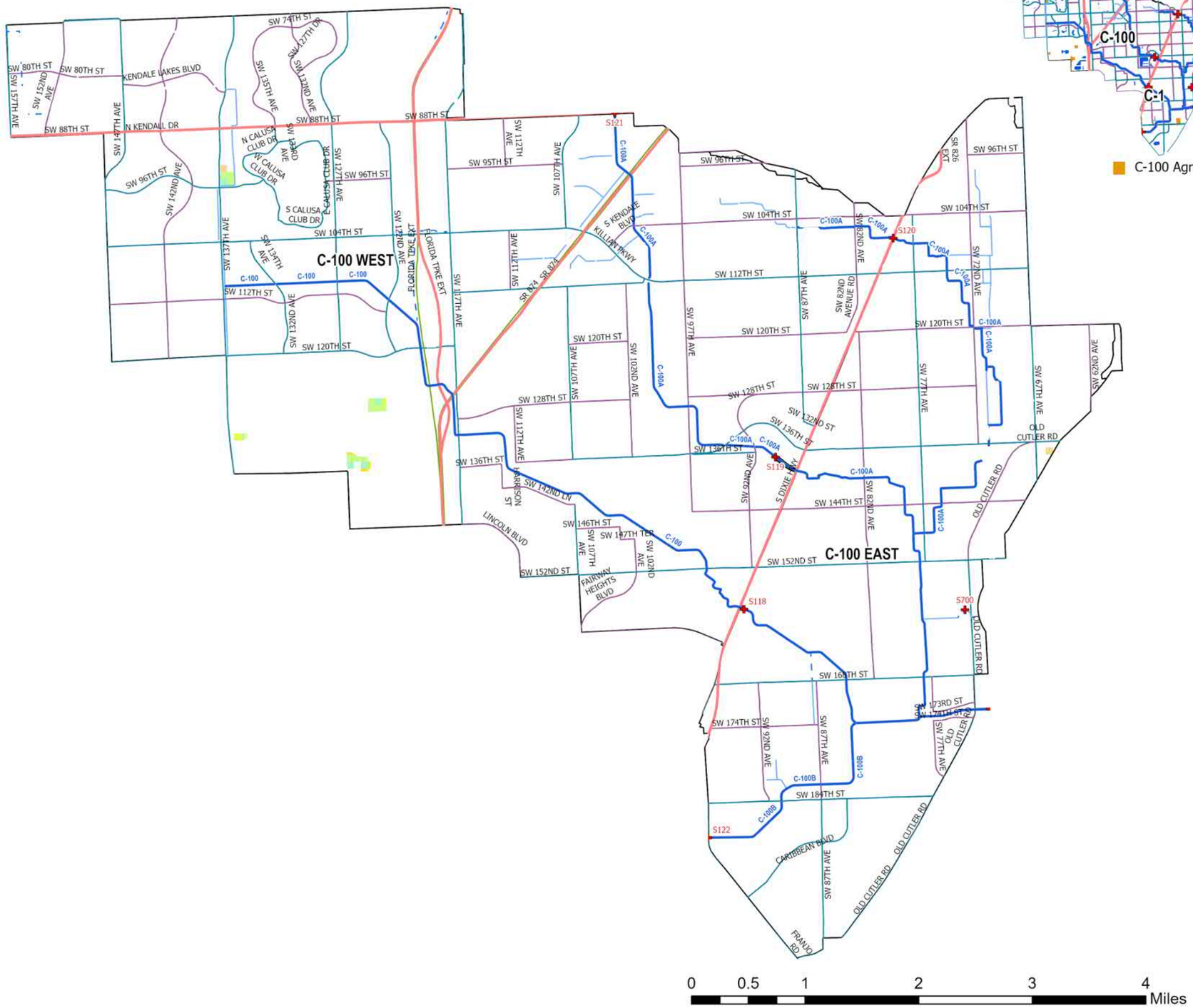


Figure A-152. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas



C-100 Location within Project Area





- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

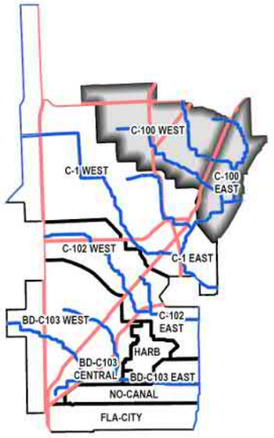
25-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-153. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area

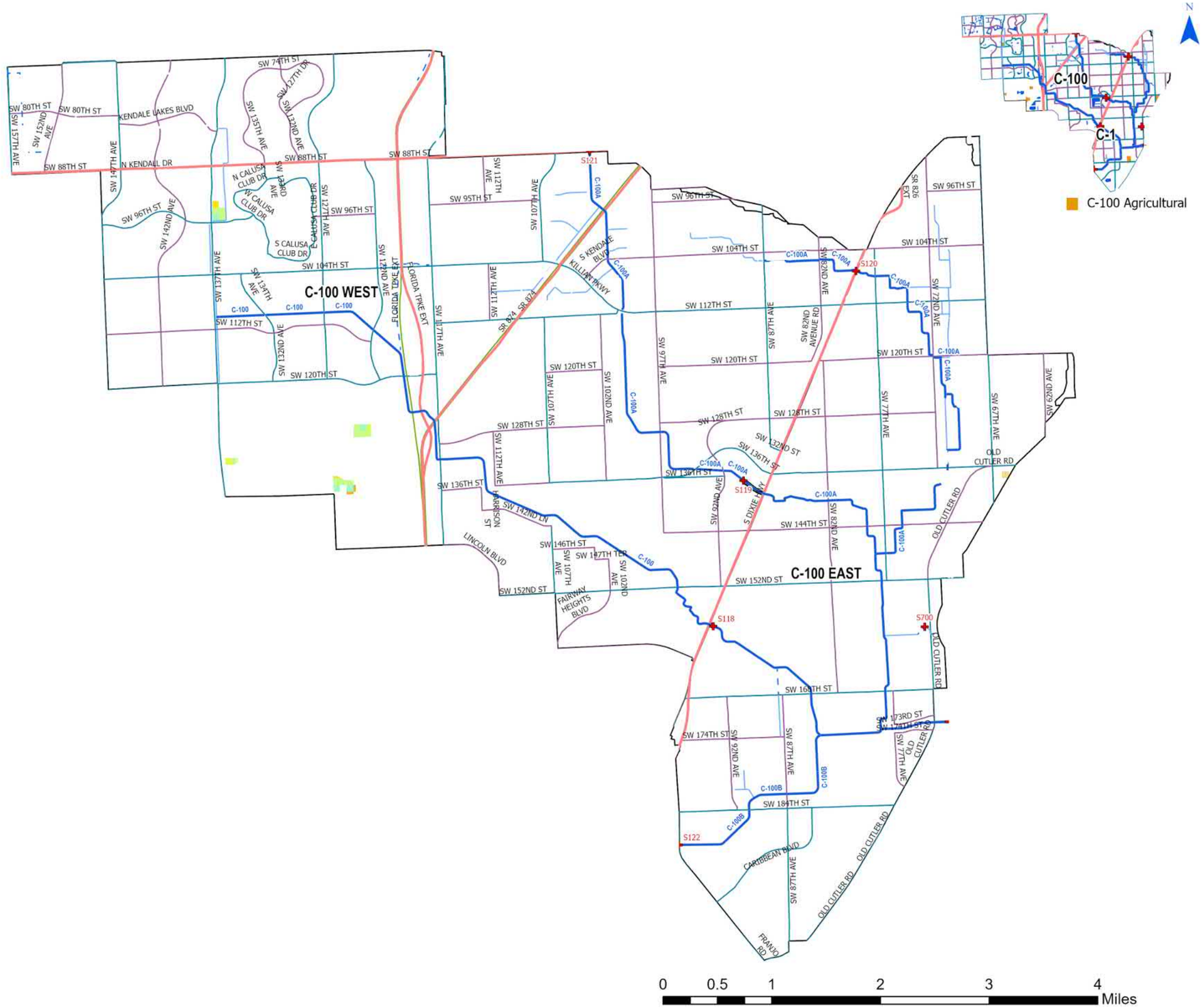
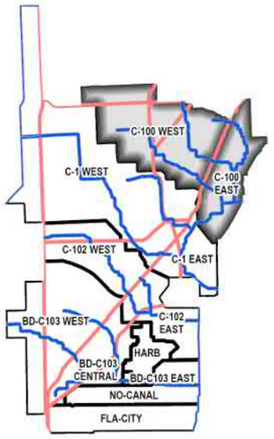
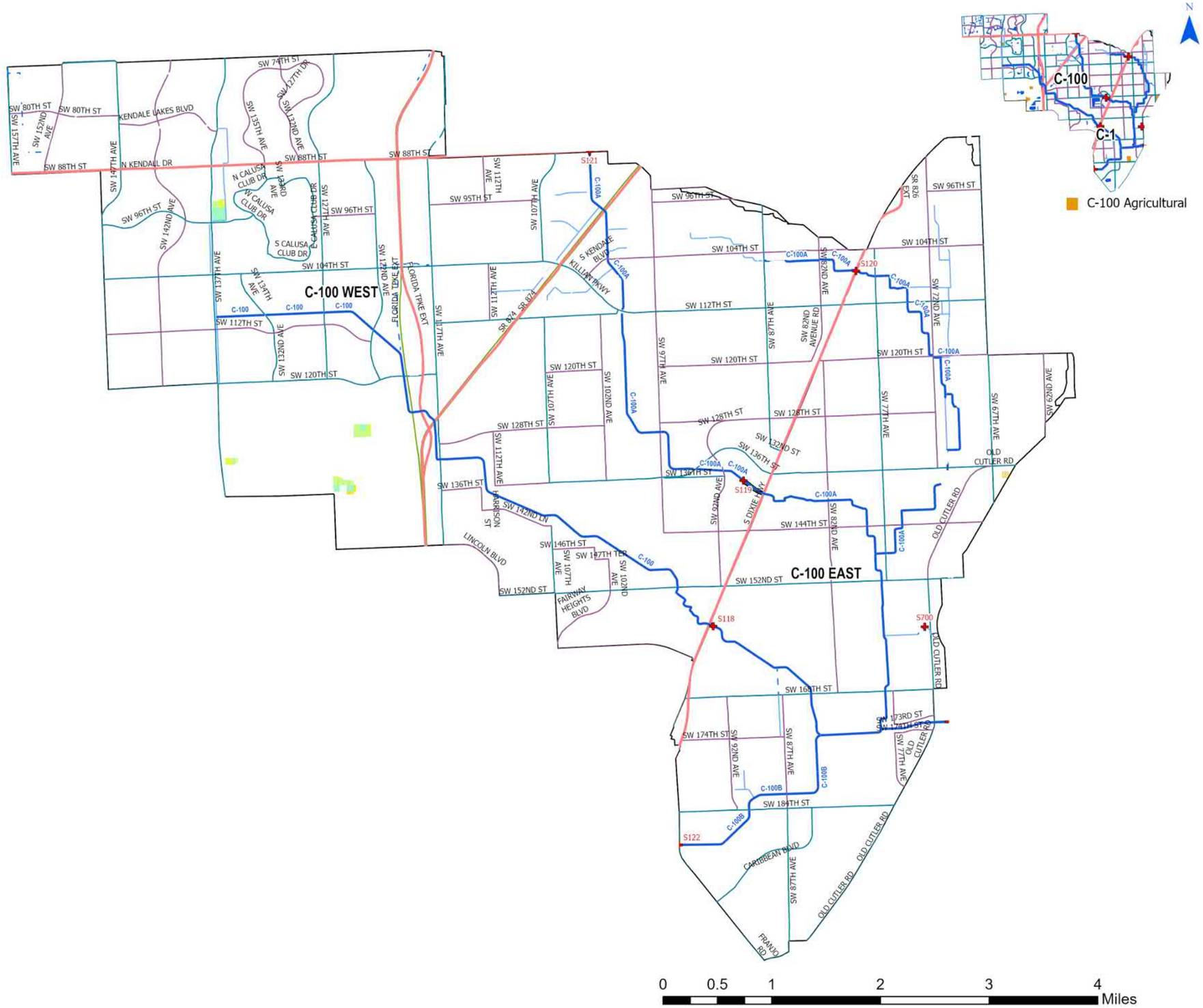


Figure A-154. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-100 Location within Project Area



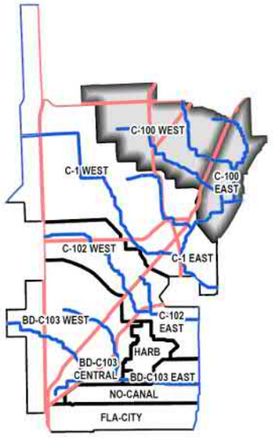
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +2.0

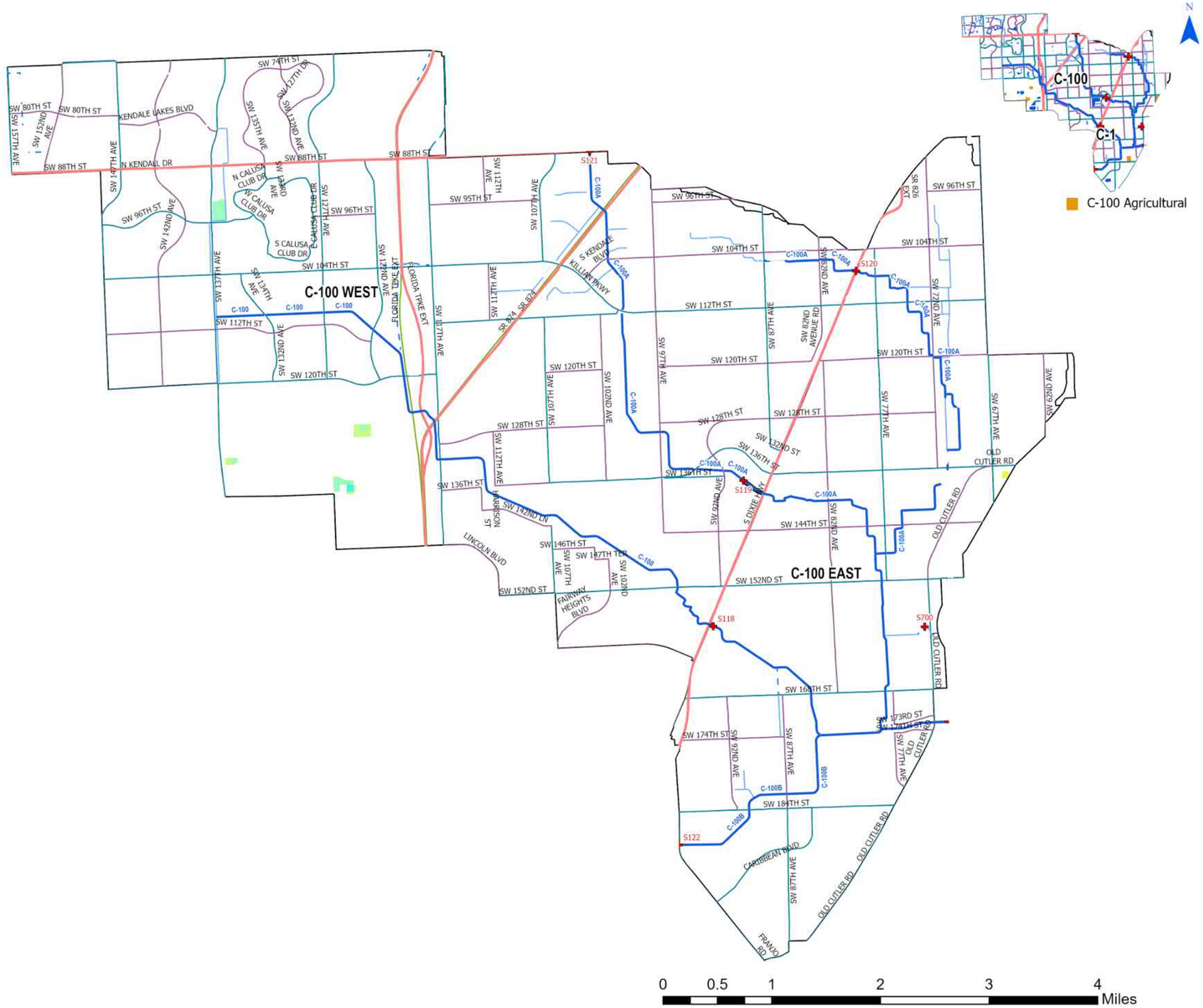
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-155. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas



C-100 Location within Project Area



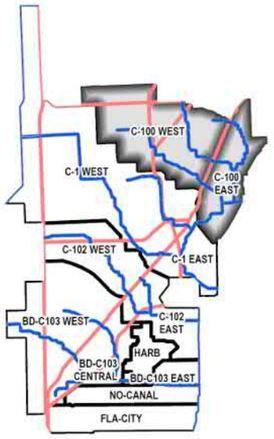
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-156. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas



C-100 Location within Project Area

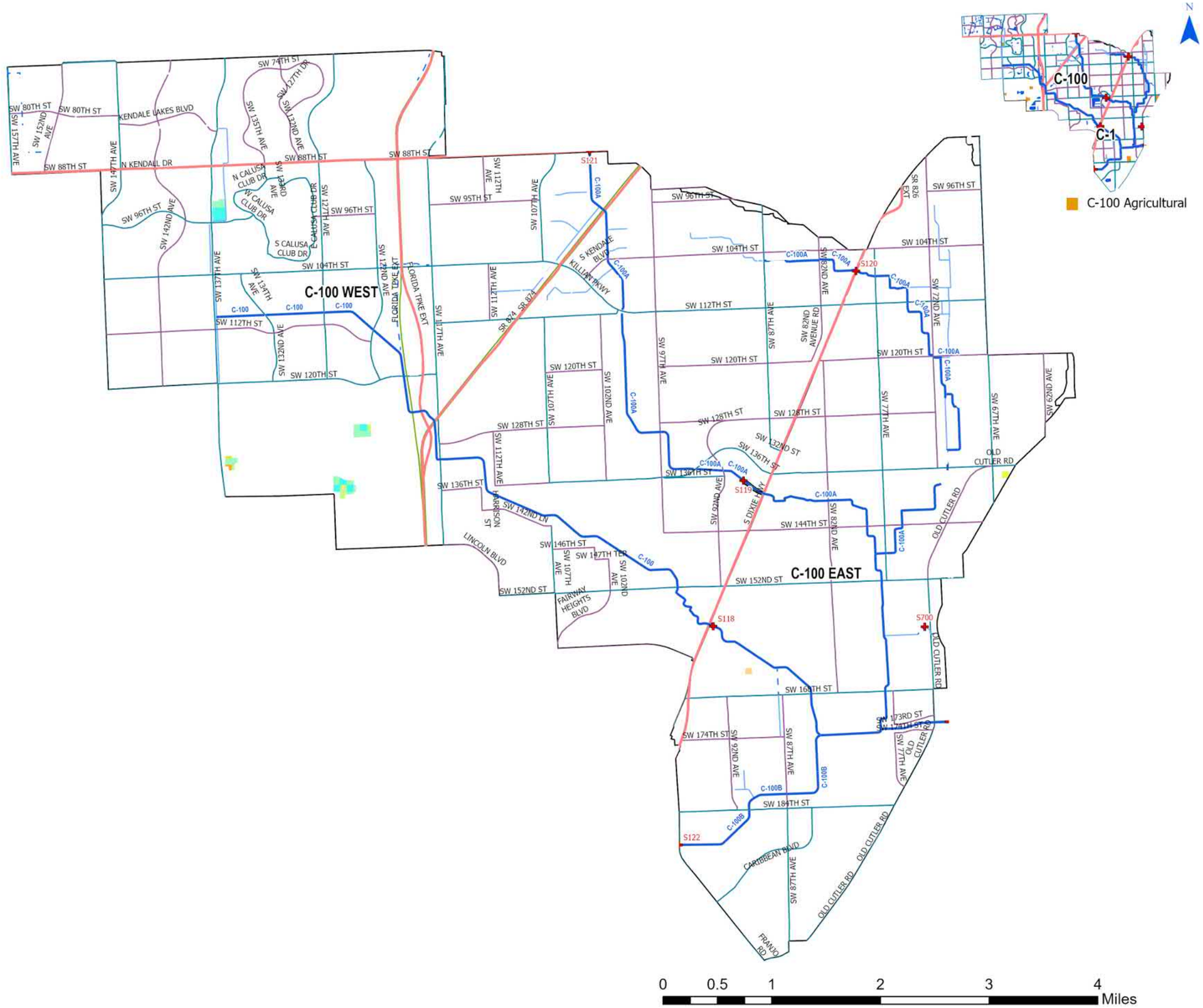
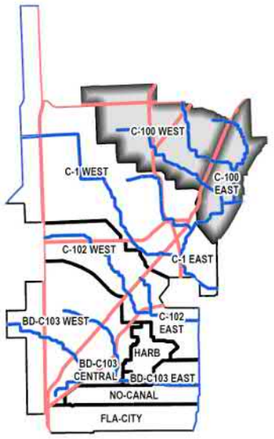
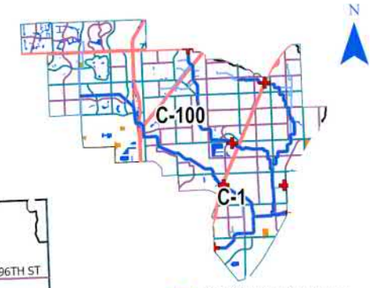


Figure A-157. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-100 Location within Project Area



C-100 Agricultural

- UDB
- Evacuation Routes

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

100-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

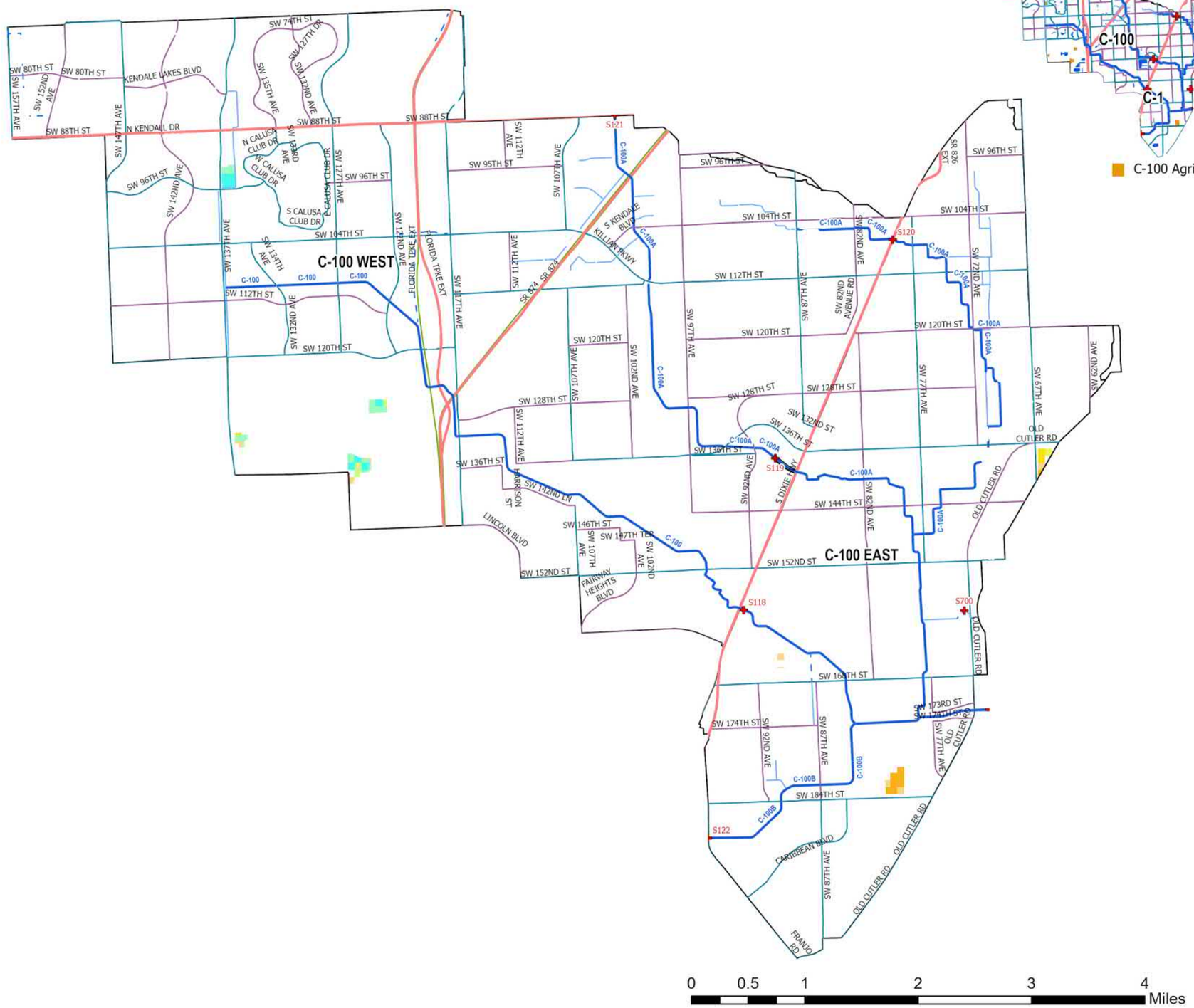
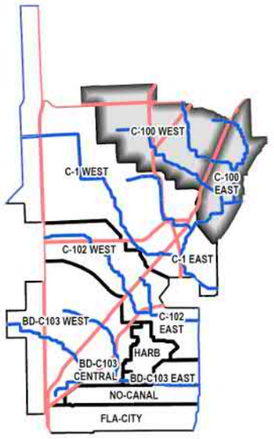


Figure A-158. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas



C-100 Location within Project Area

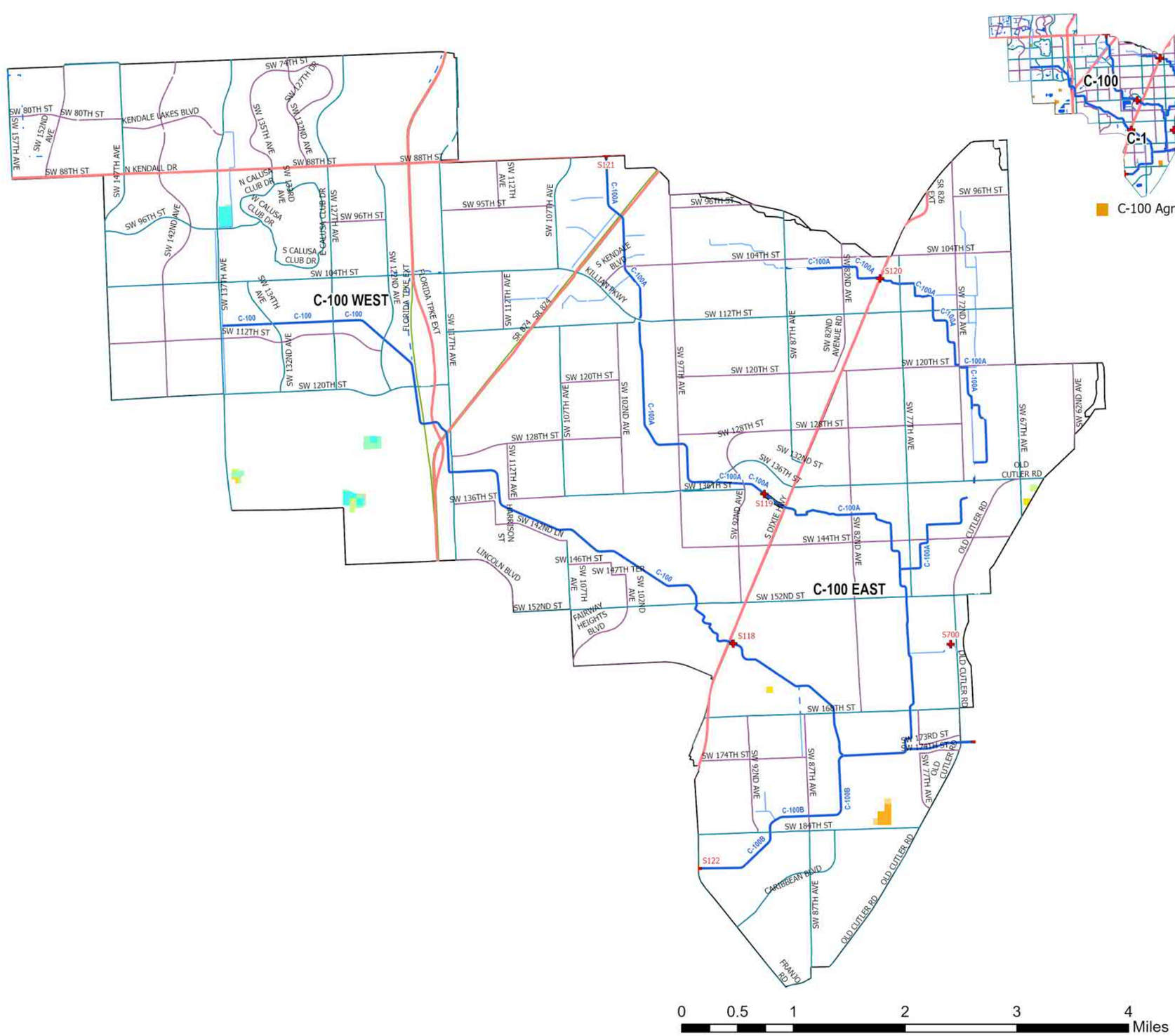
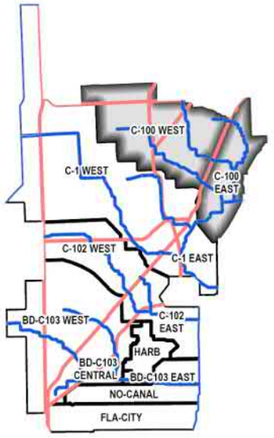
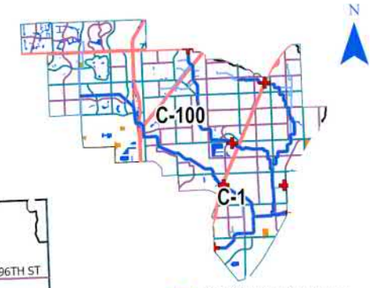


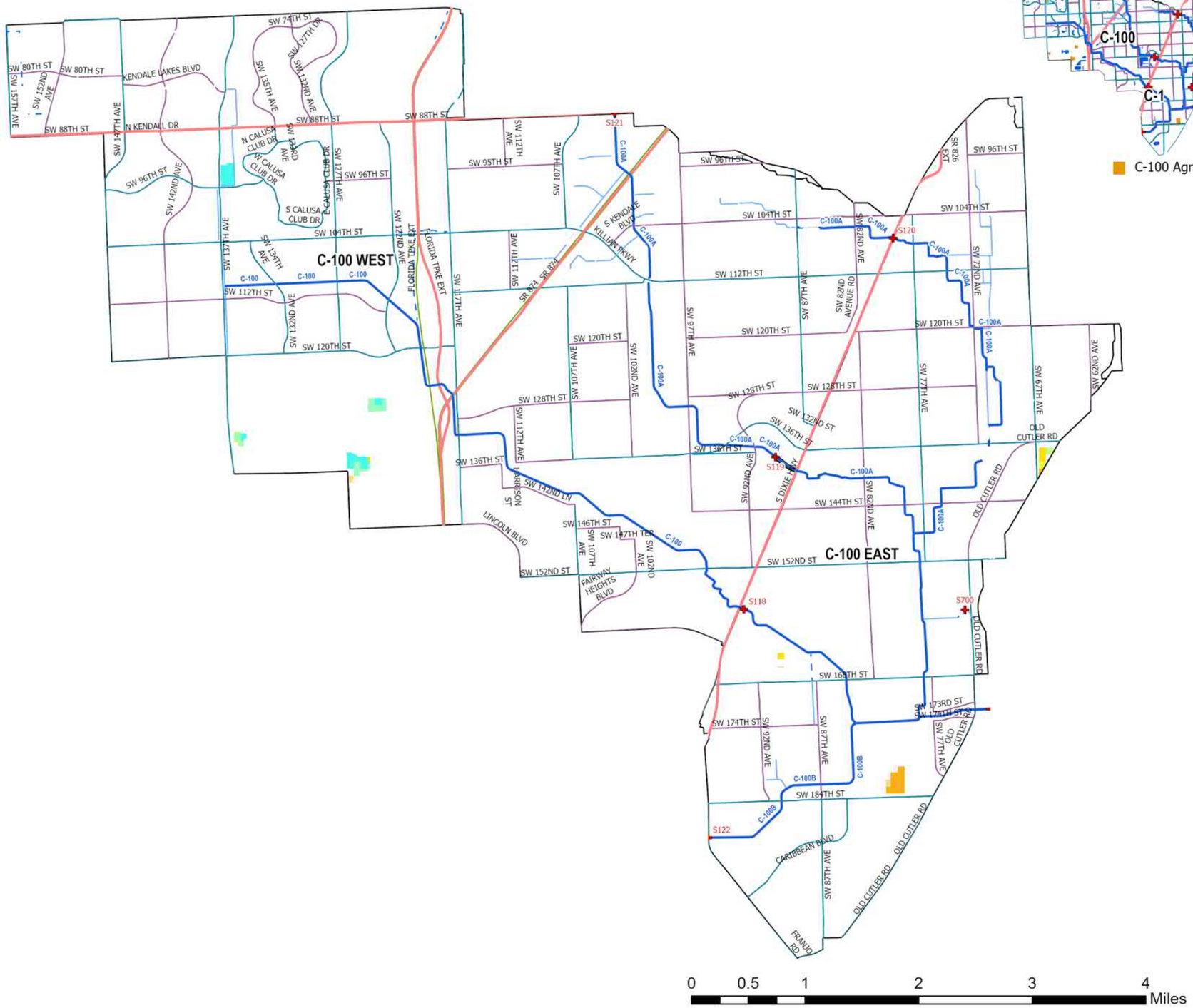
Figure A-159. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas



C-100 Location within Project Area



C-100 Agricultural



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +3.0

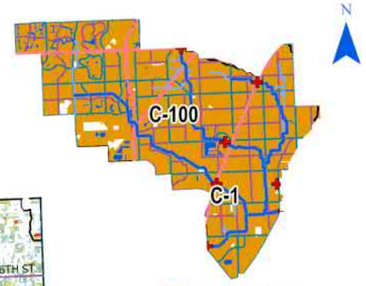
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-160. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

WATERSHED C-100: Flood Extent In Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

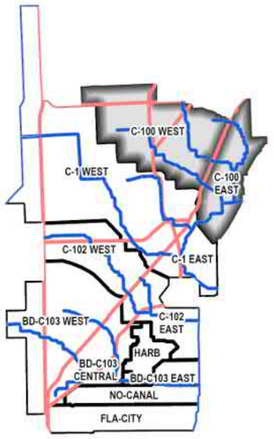
5-Yr/72-Hr SLR = 0

Flood Depth (ft)

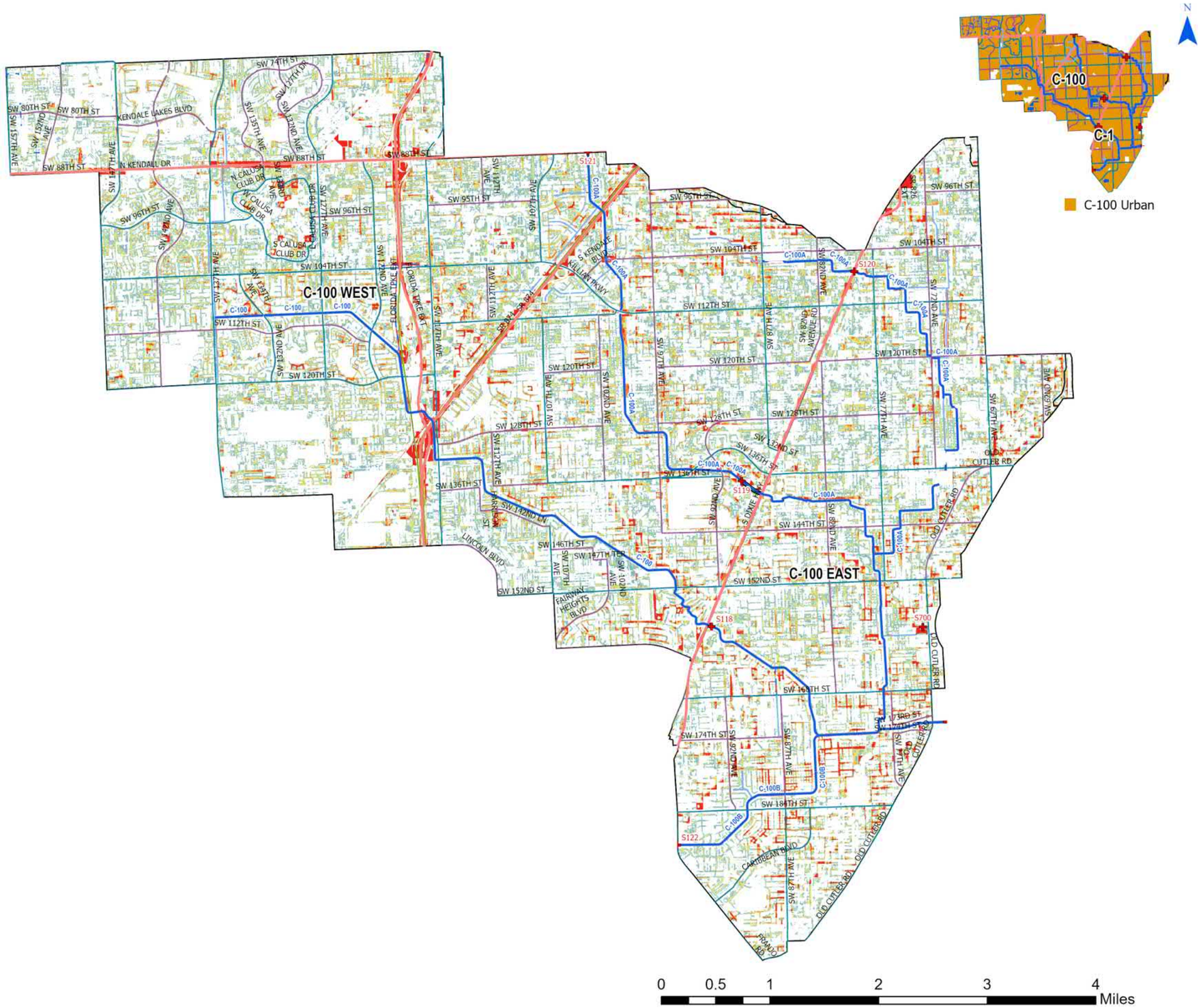
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-161. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-100 Location within Project Area



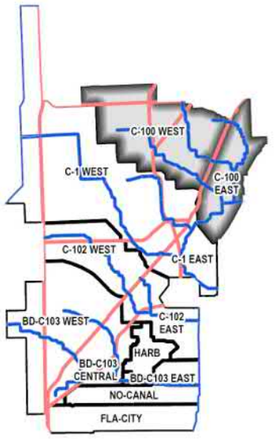
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +1.0

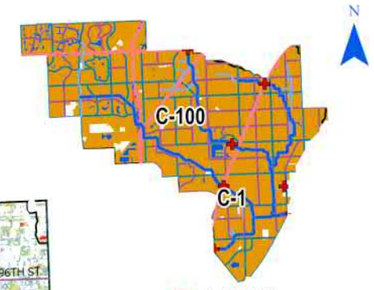
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-162. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area



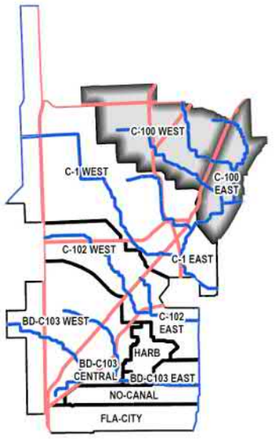
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +2.0

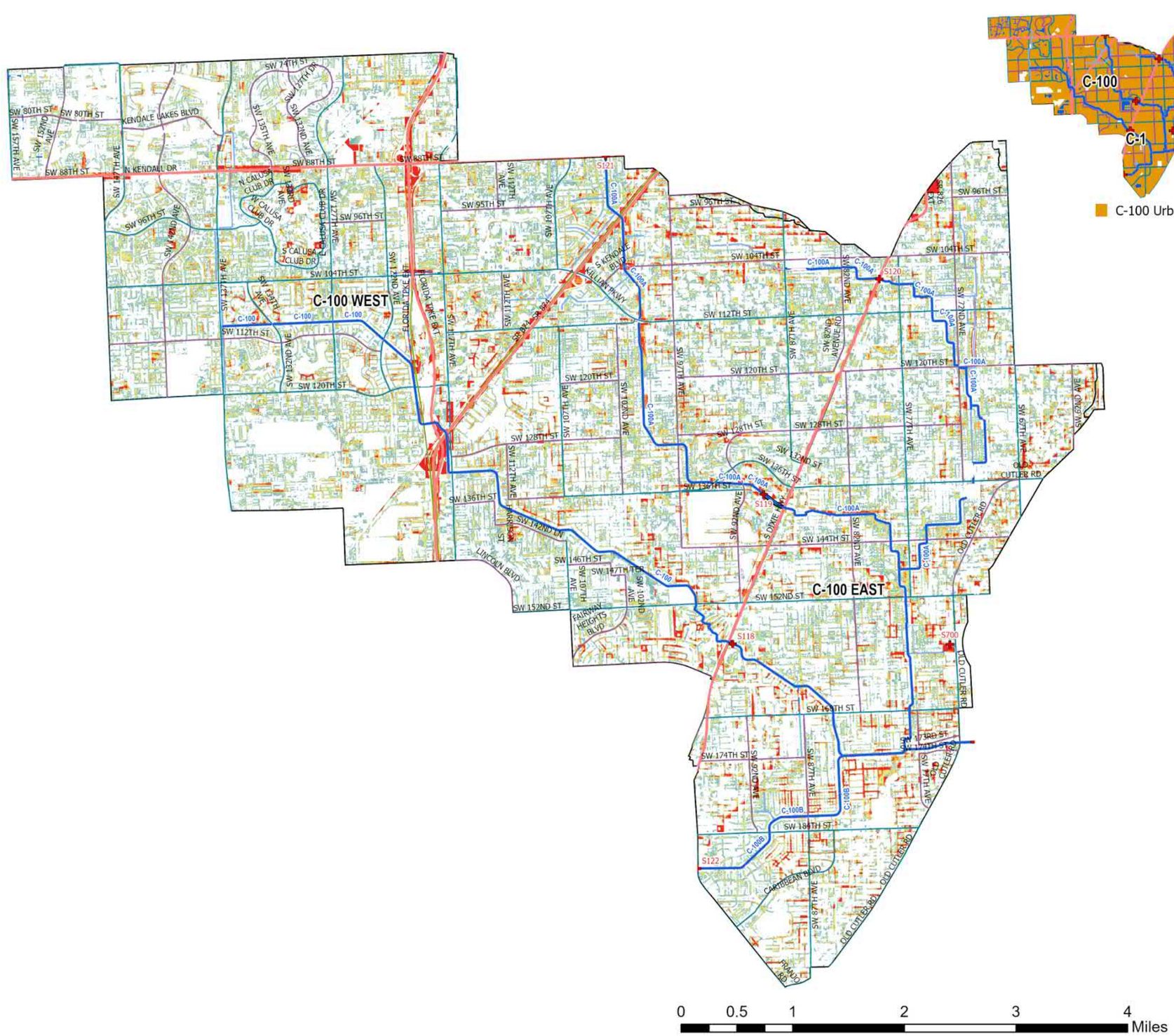
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-163. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas



C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

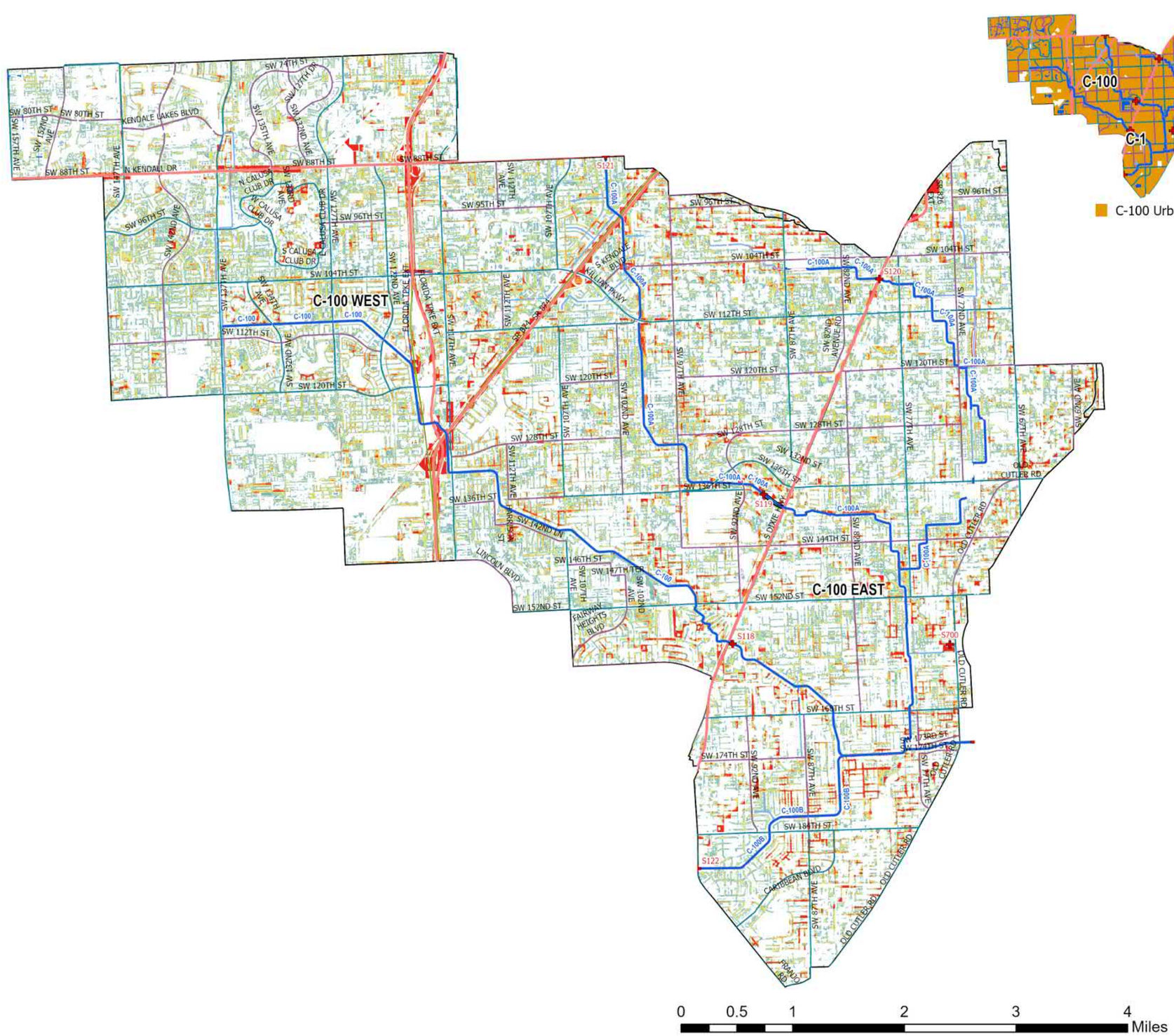
5-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-164. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

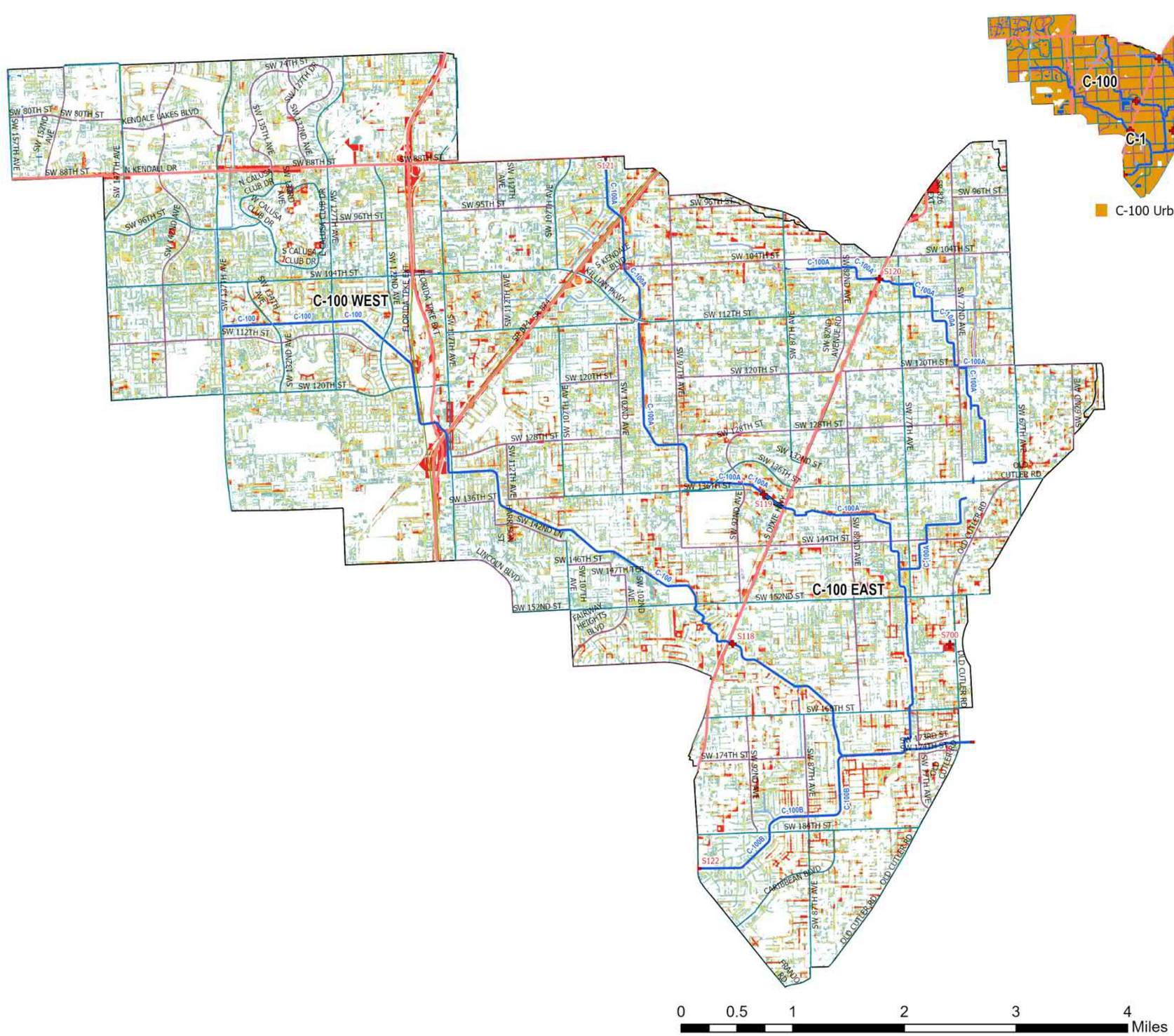
10-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-165. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

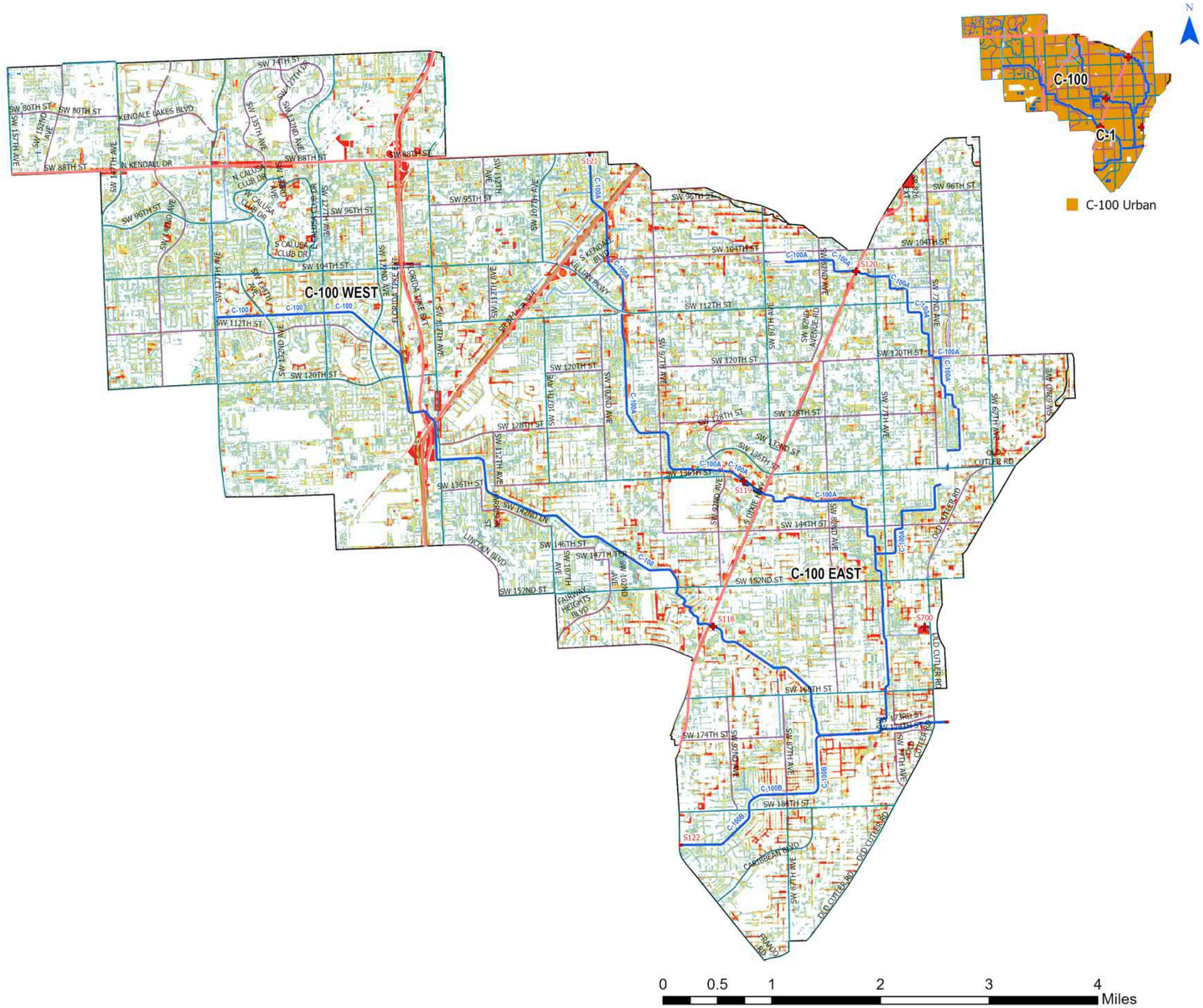
10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-166. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

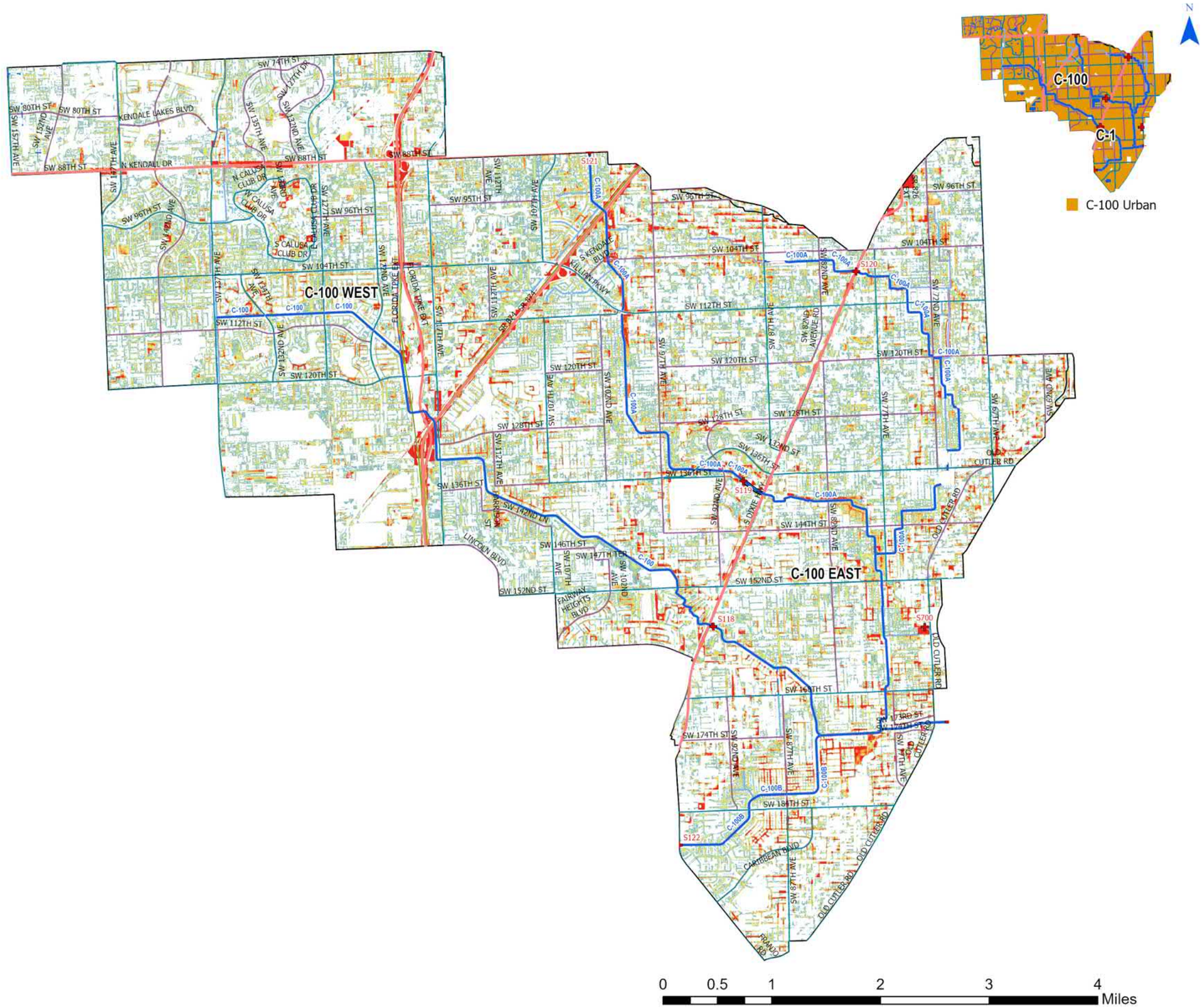
10-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-167. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

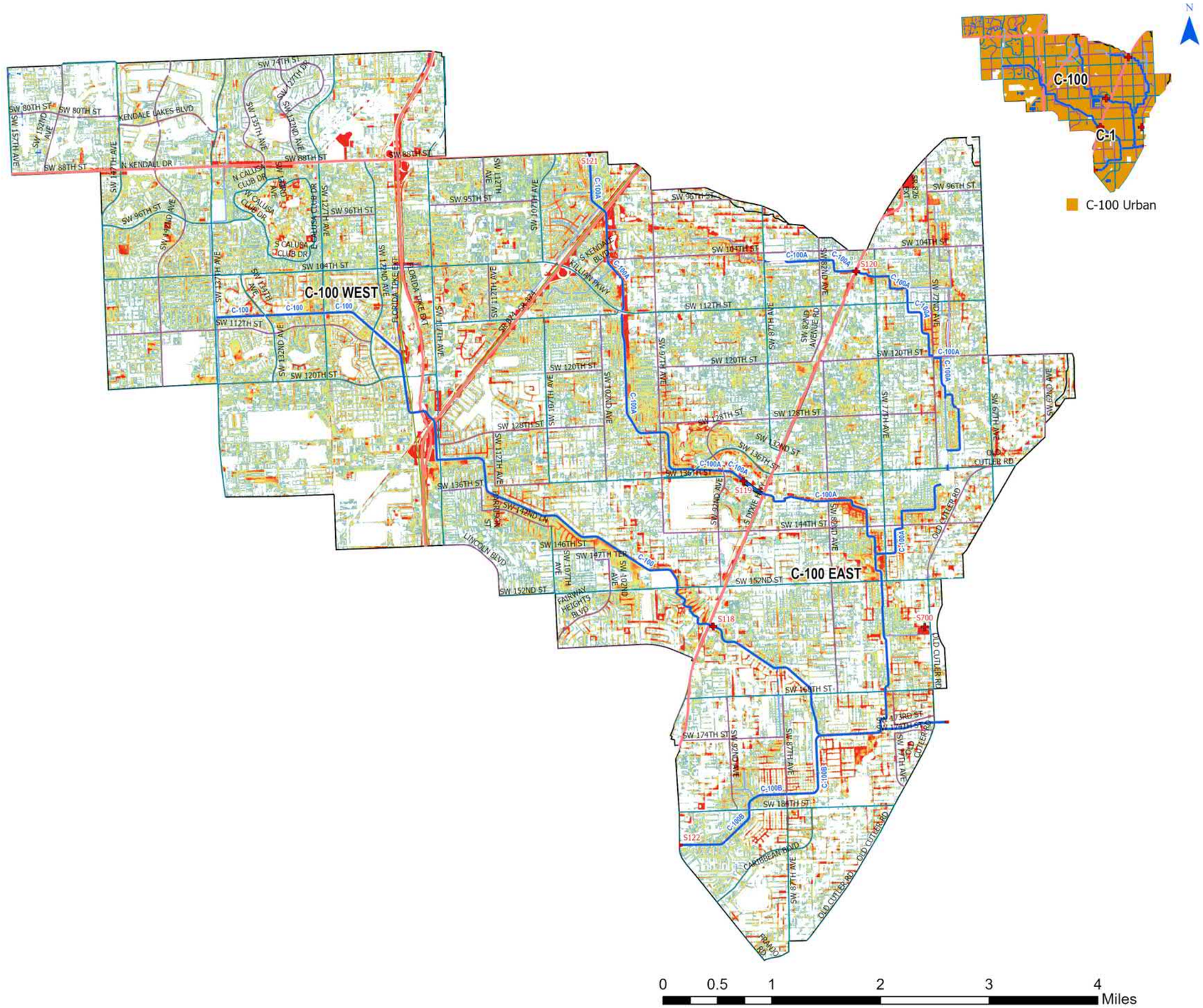
10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-168. Watershed C-100 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-169. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

C-100 Location within Project Area

- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

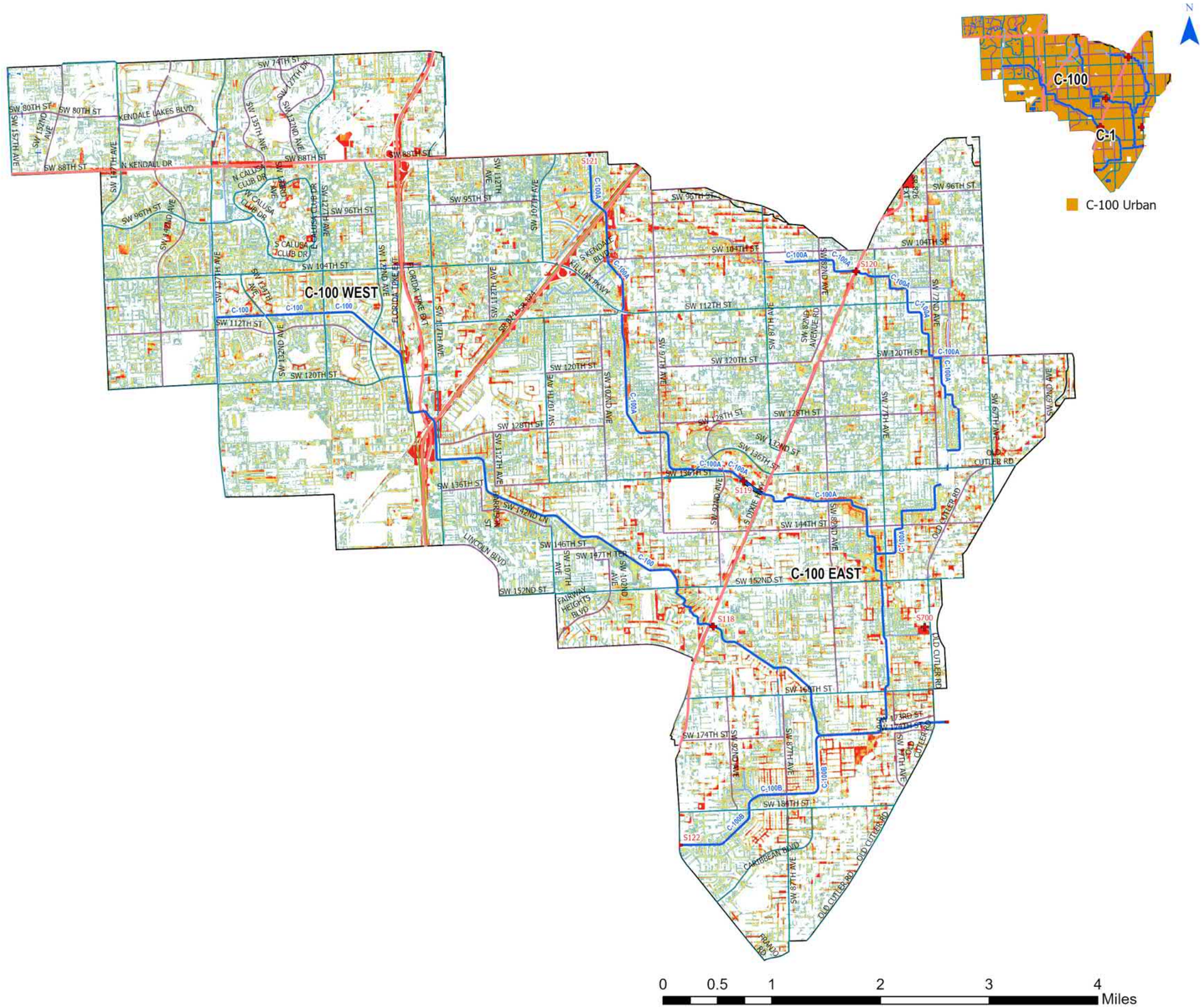
25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-170. Watershed C-100 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

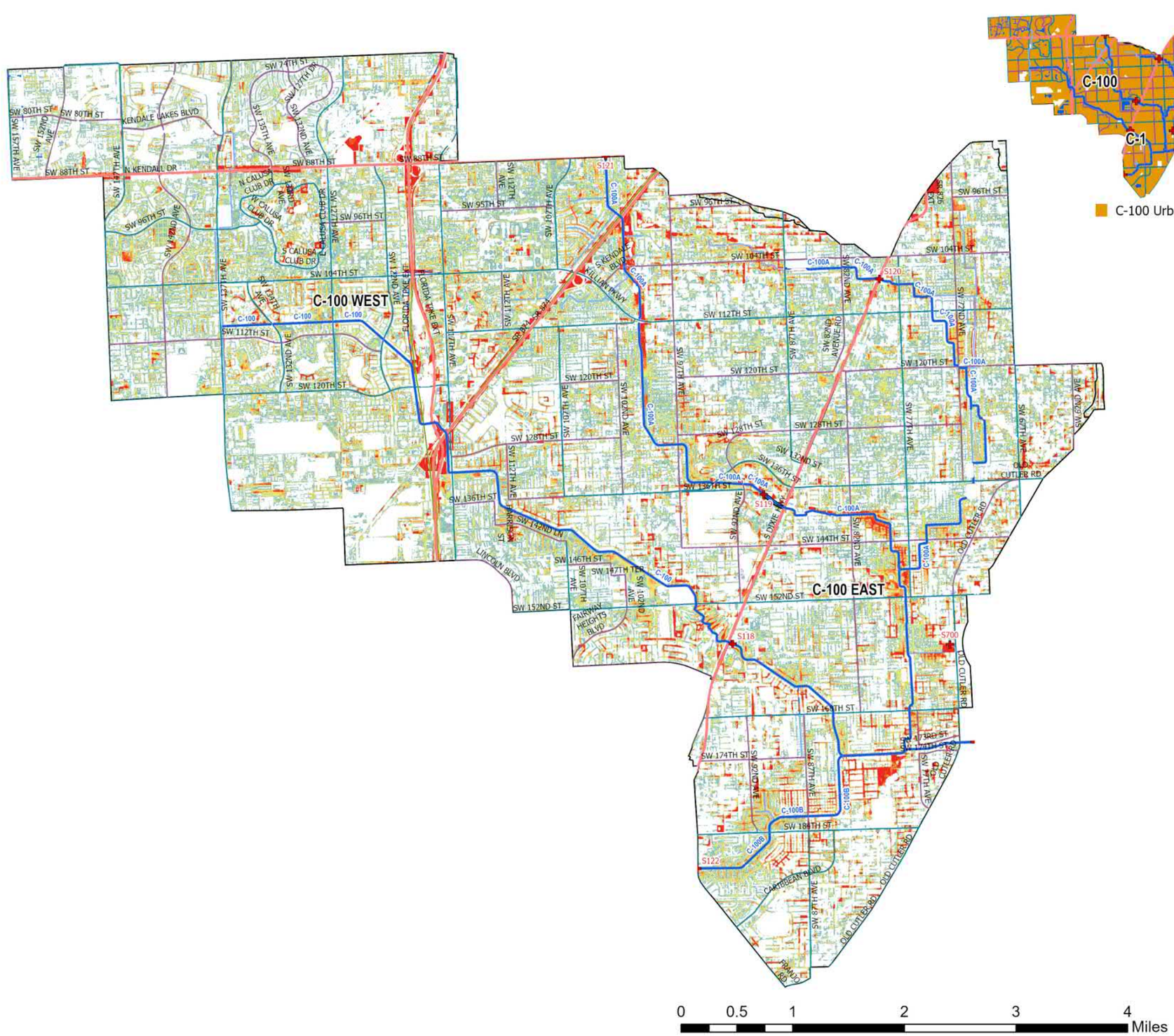
25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-171. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas

C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

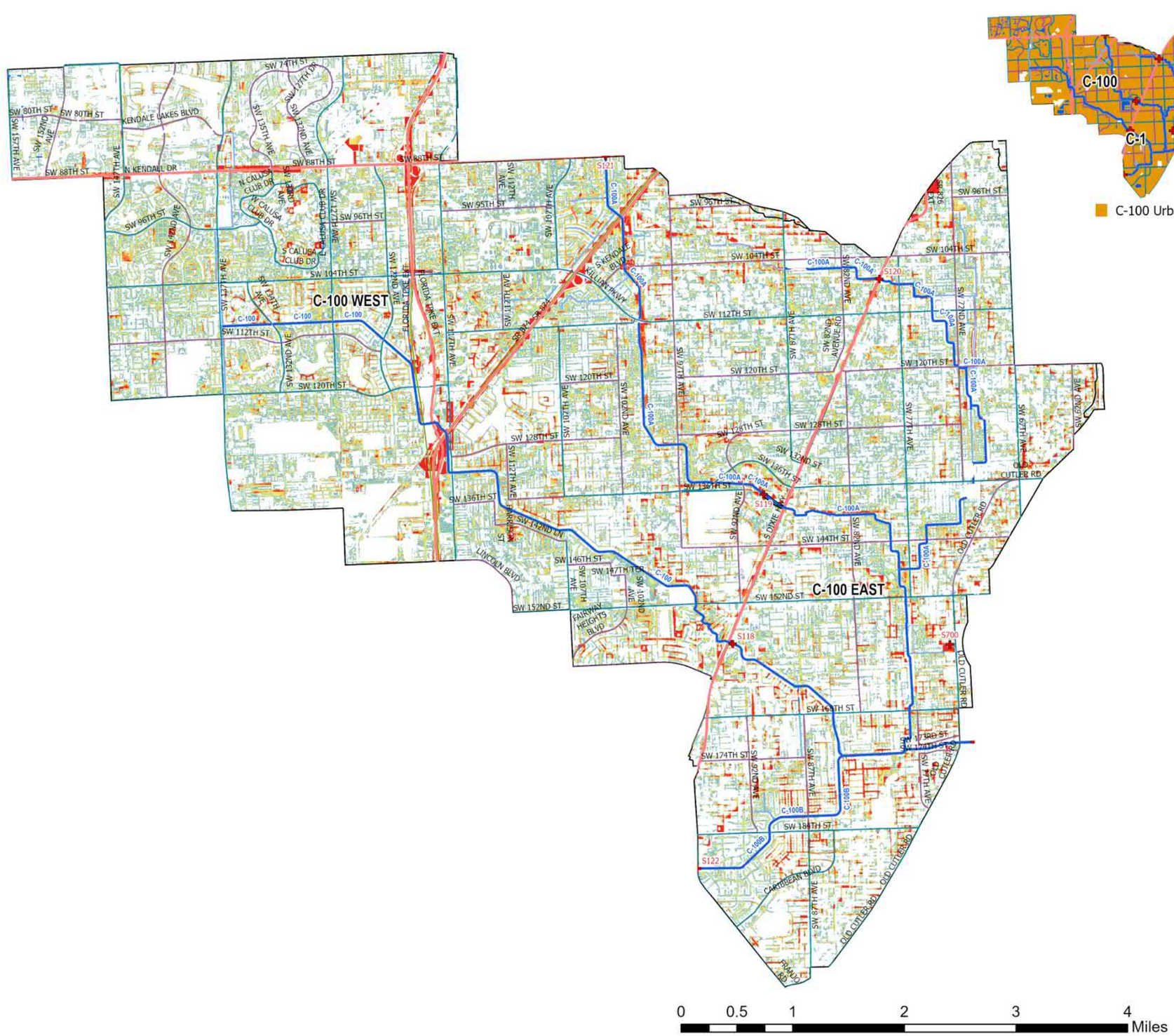
25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-172. Watershed C-100 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas

C-100 Location within Project Area



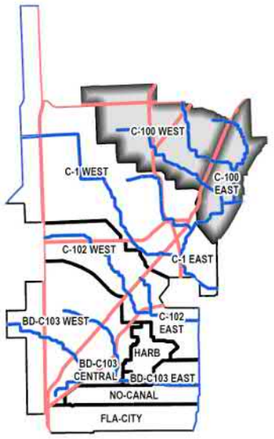
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = 0

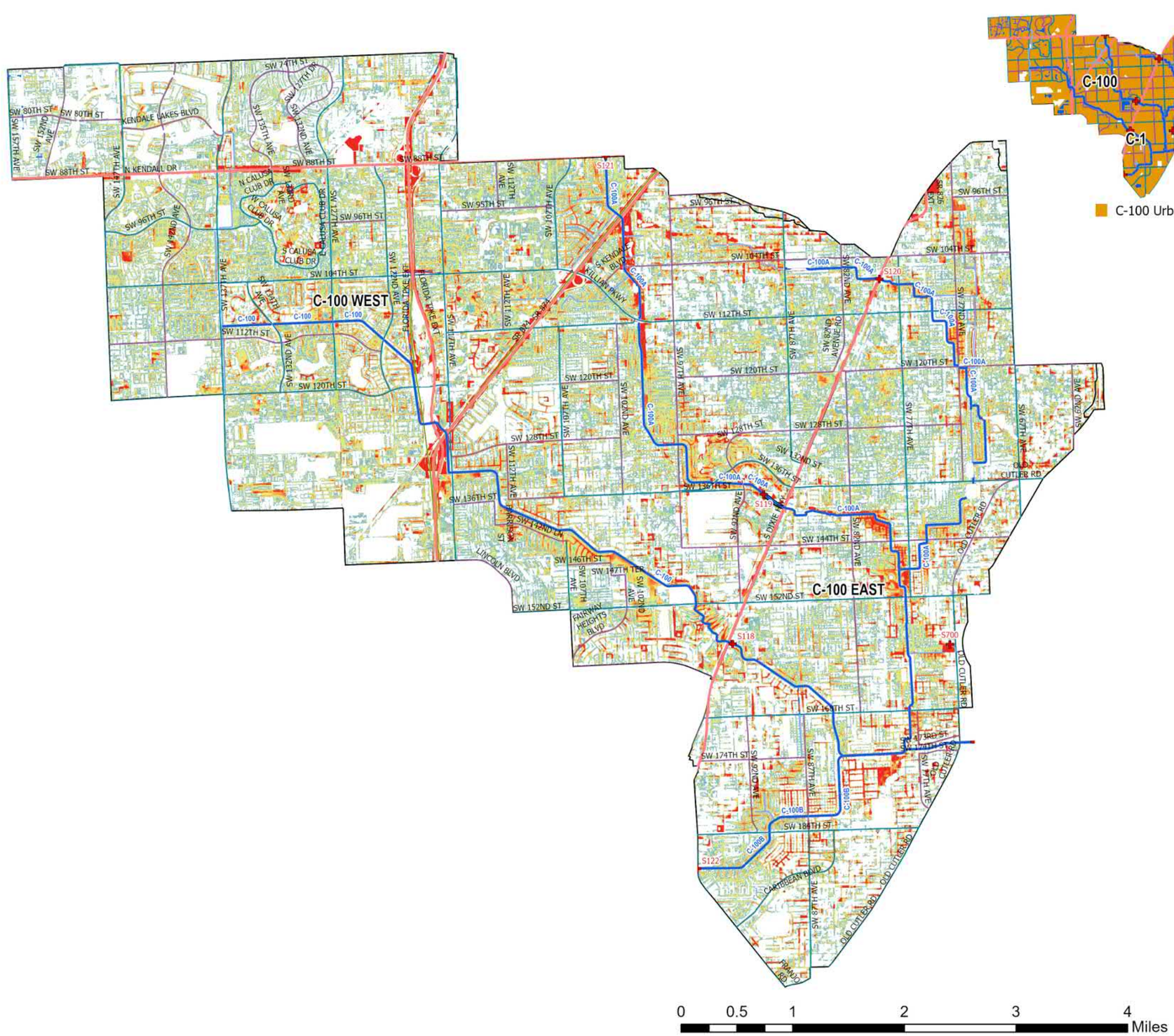
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-173. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas



C-100 Location within Project Area



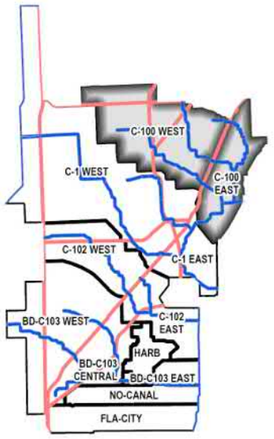
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +1.0

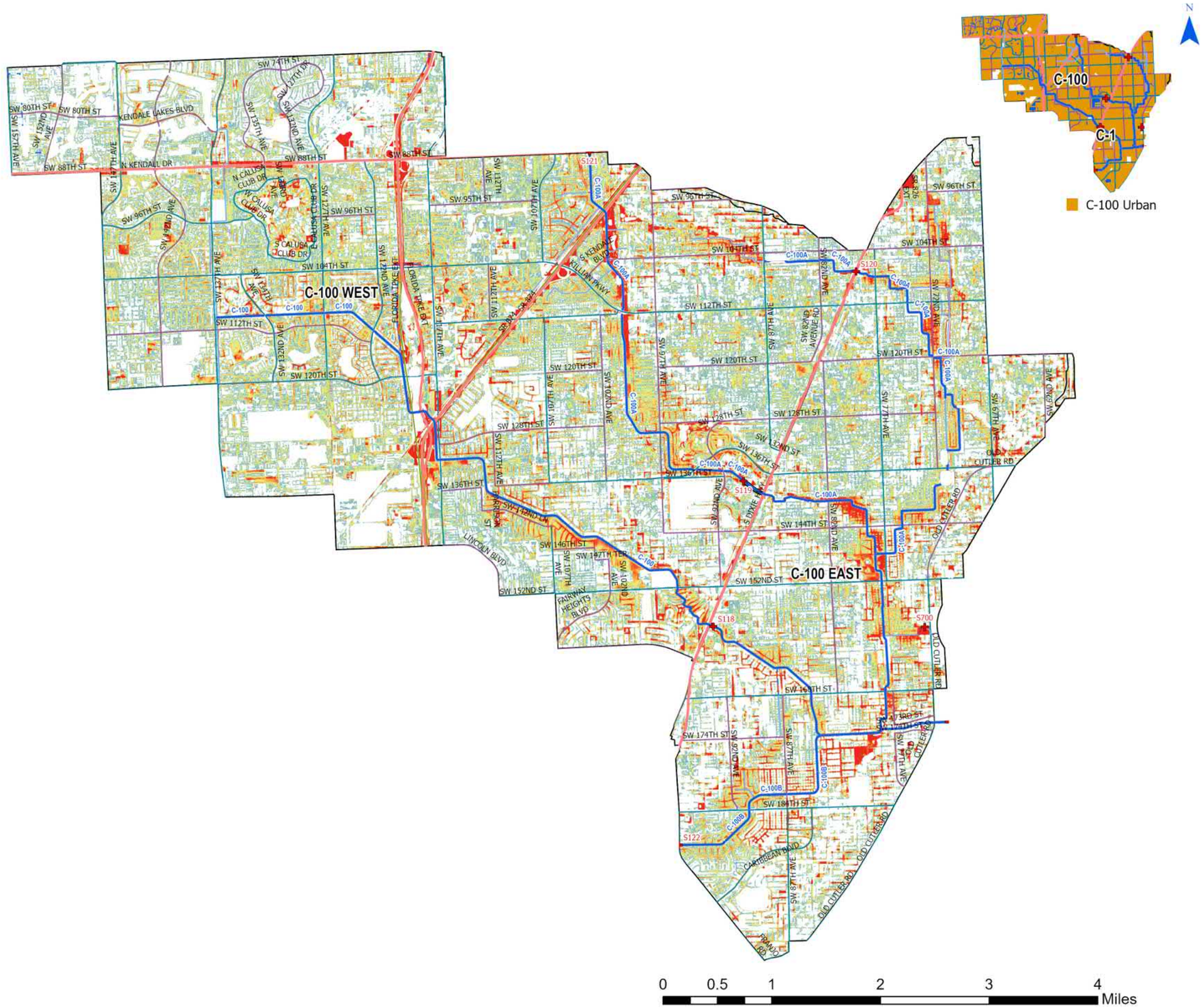
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-174. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area



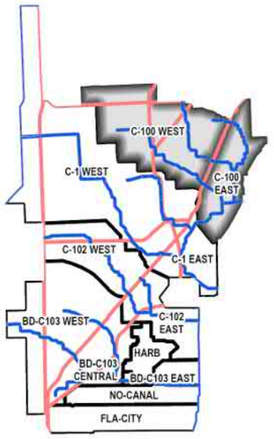
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +2.0

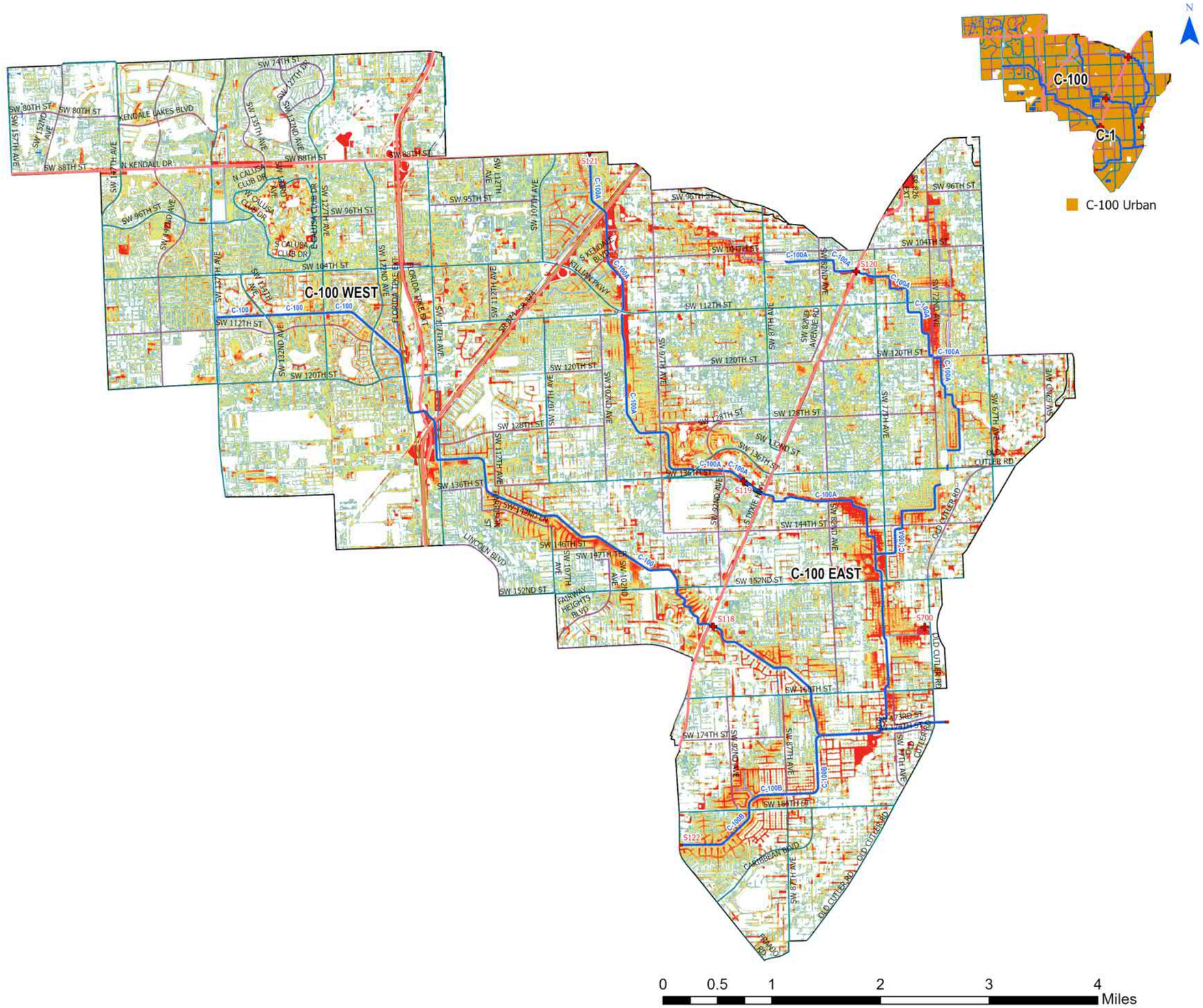
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-175. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas



C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

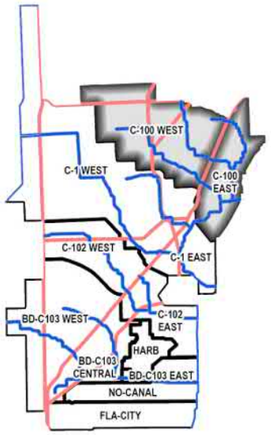
100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

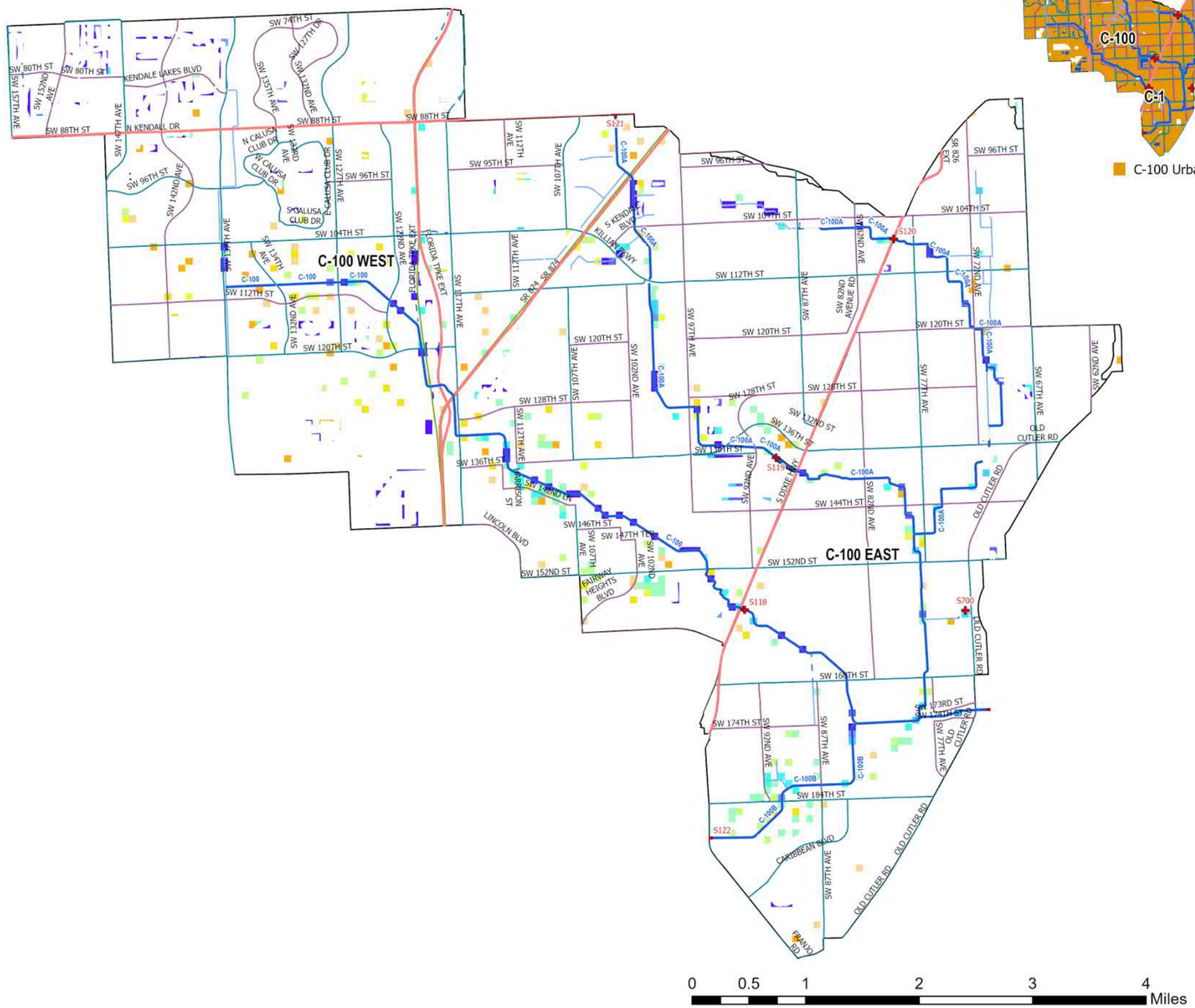
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

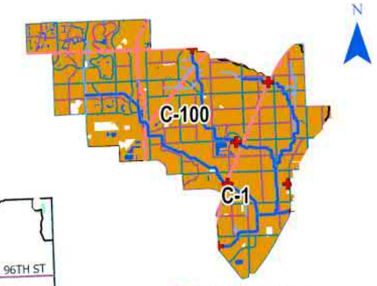
Figure A-176. Watershed C-100 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

WATERSHED C-100: Flood Duration in Urban Areas



C-100 Location within Project Area





- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = 0

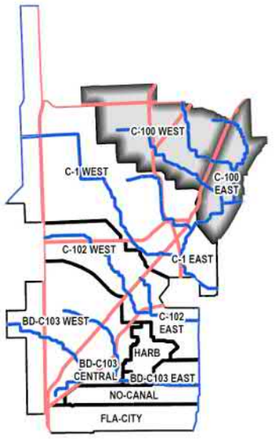
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

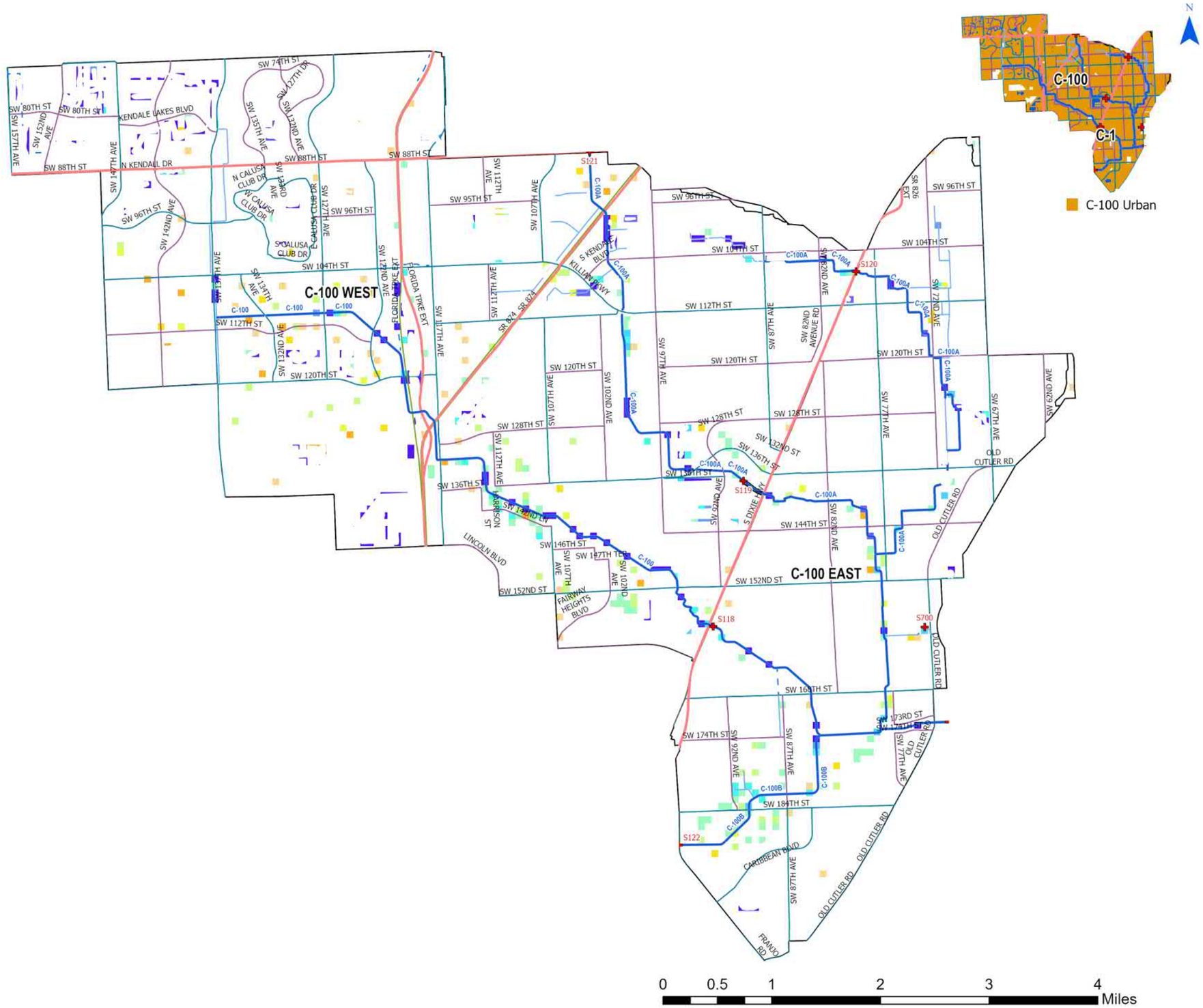
0 0.5 1 2 3 4 Miles

Figure A-177. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-100 Location within Project Area



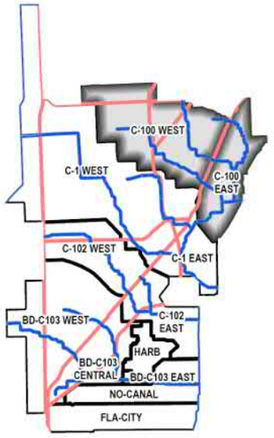
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-178. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area

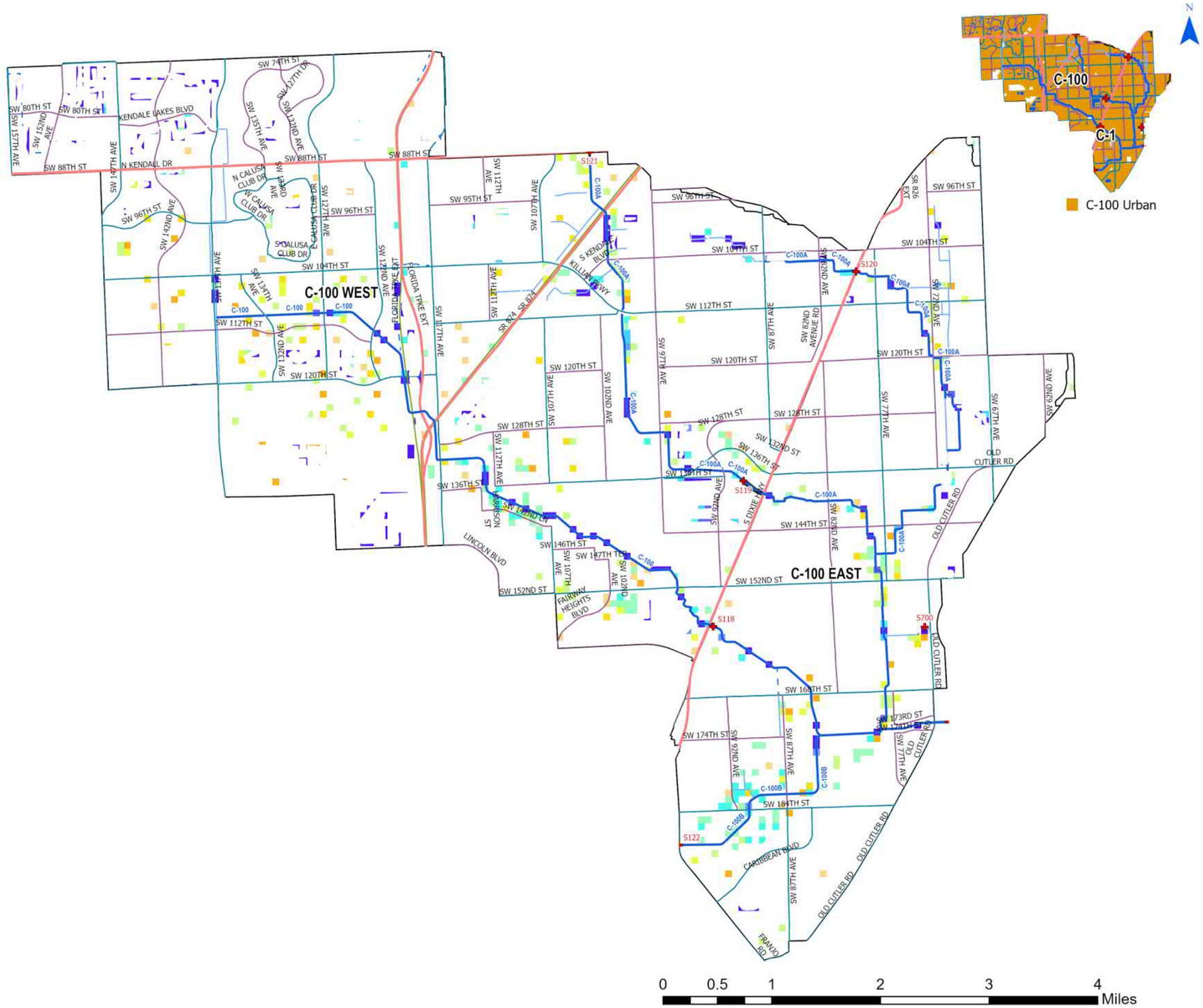
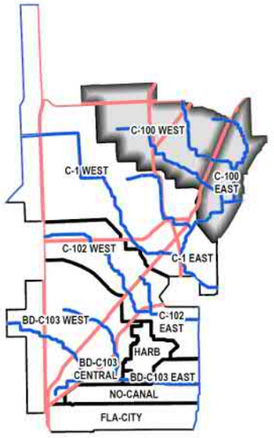


Figure A-179. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas



C-100 Location within Project Area

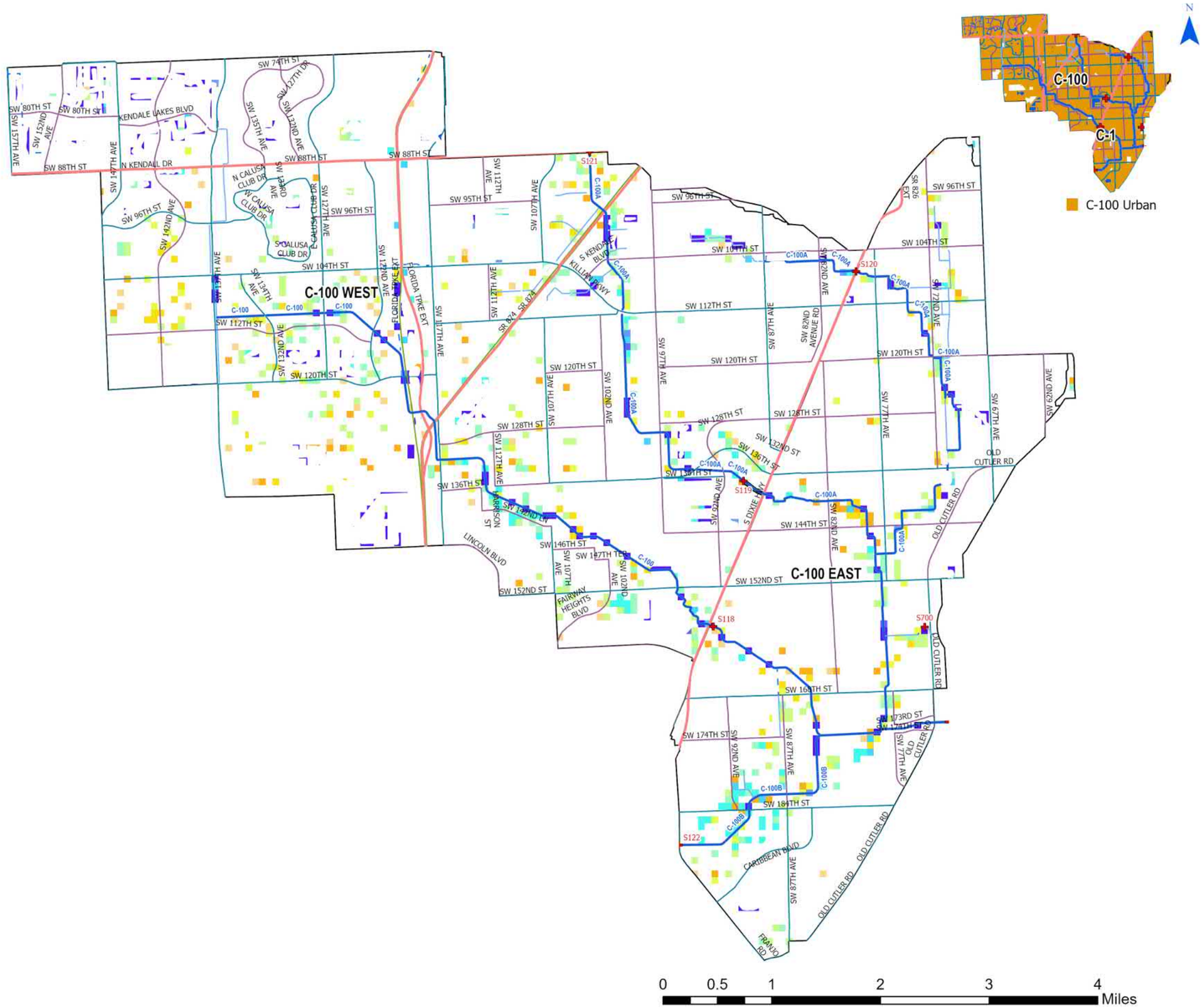
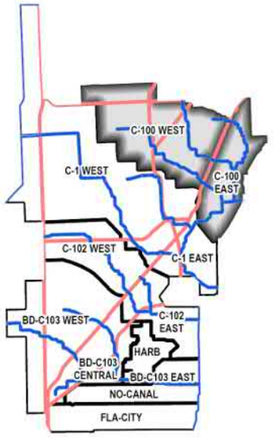


Figure A-180. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas



C-100 Location within Project Area

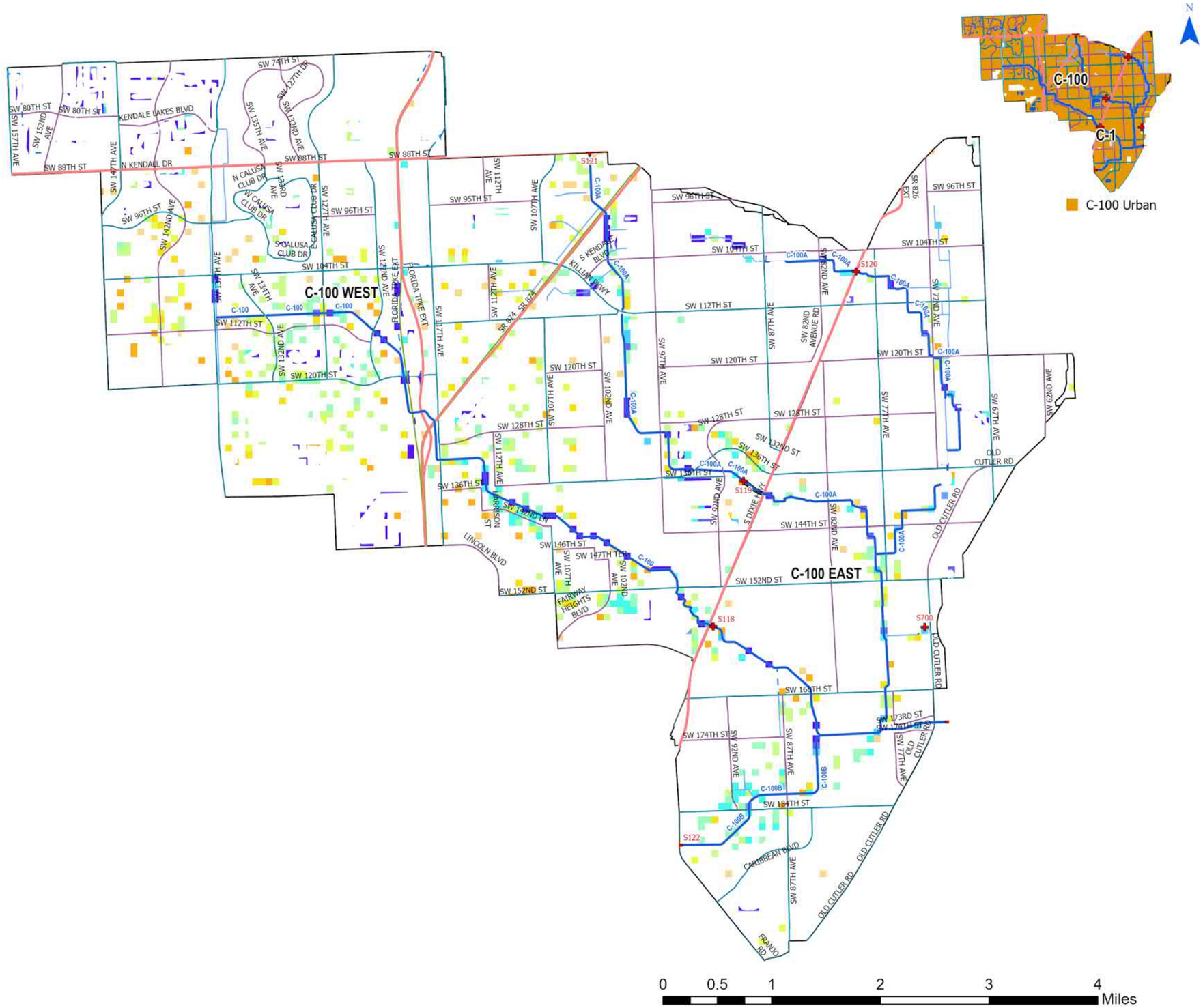
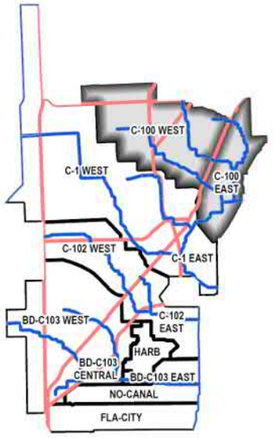
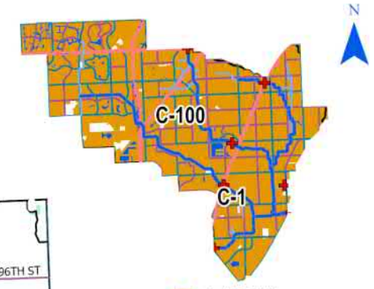
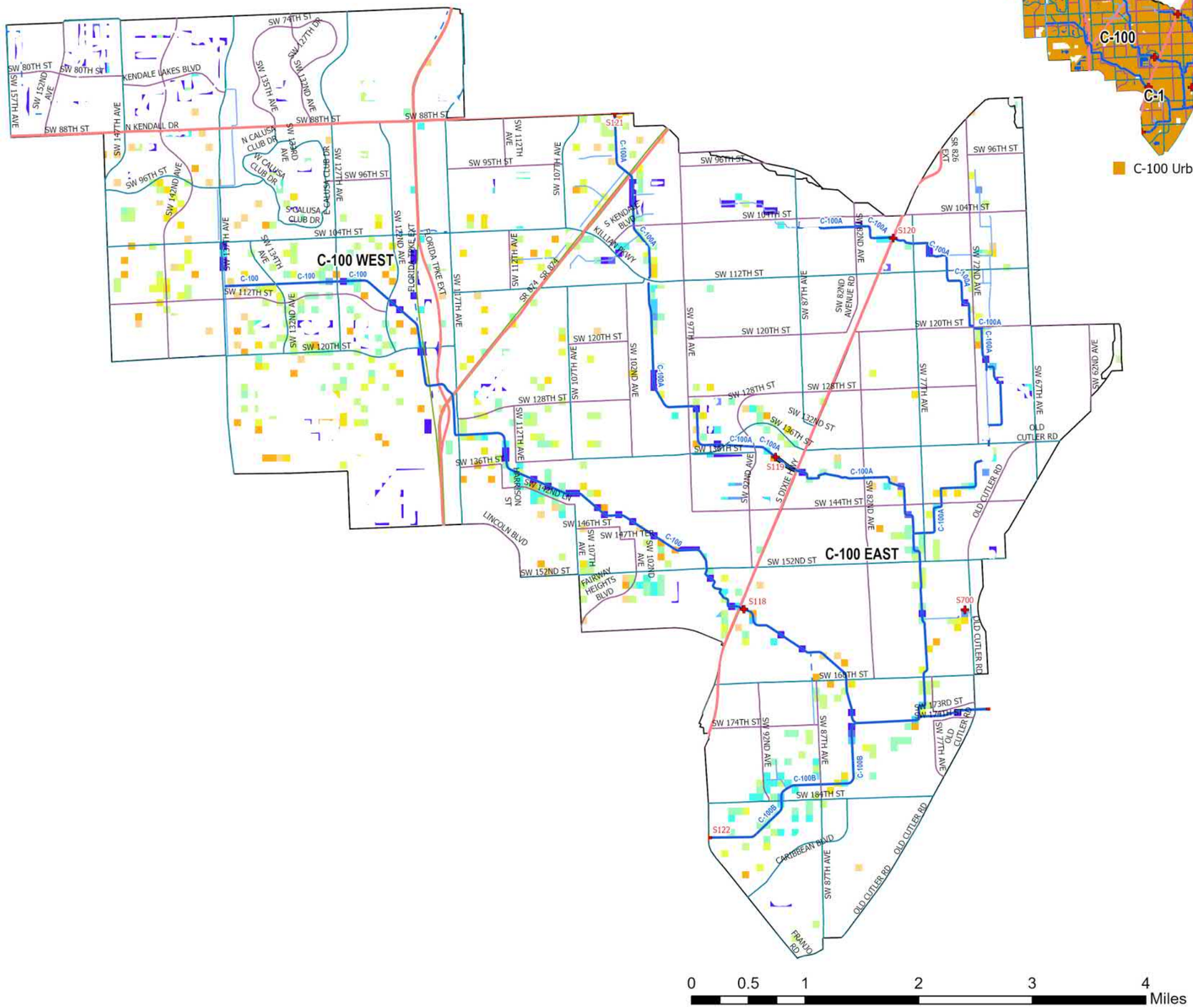


Figure A-181. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas



C-100 Location within Project Area





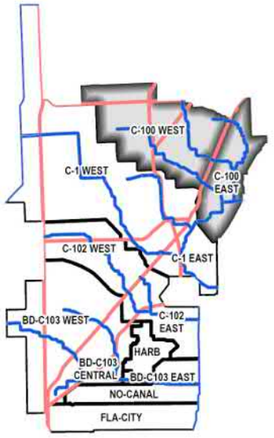
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-182. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area

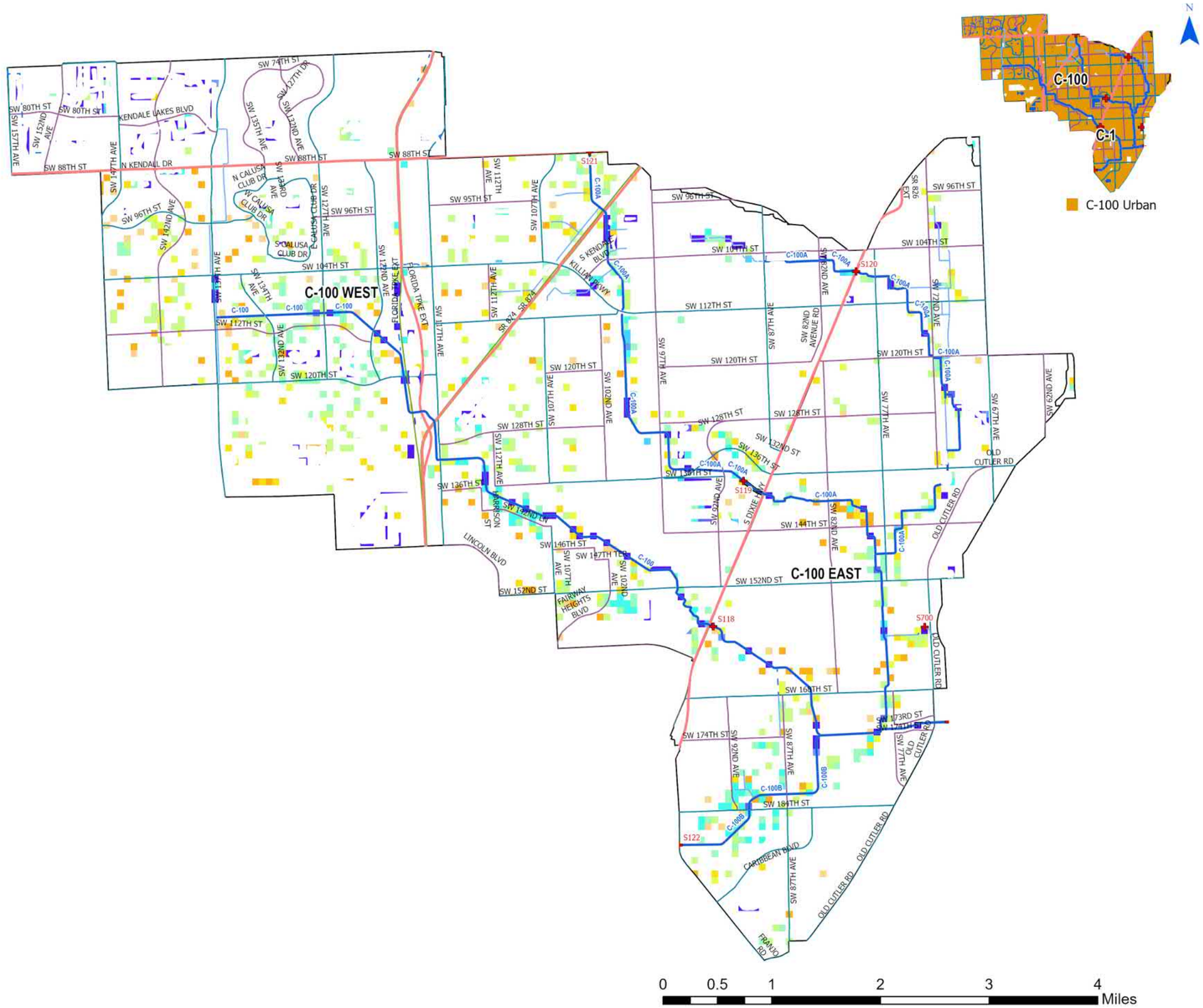


Figure A-183. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

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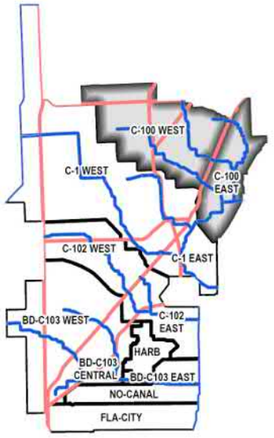


C-100 Location within Project Area

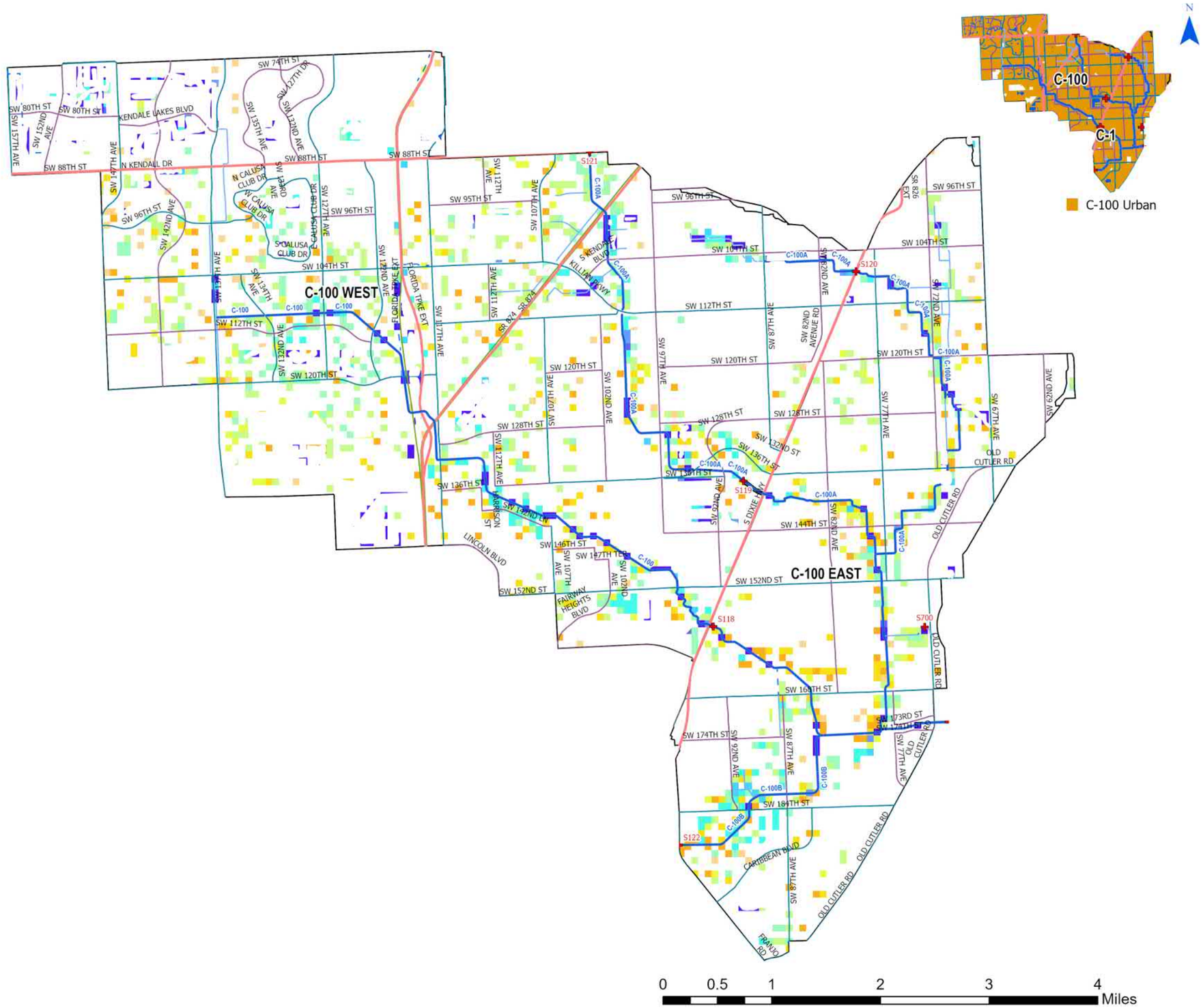
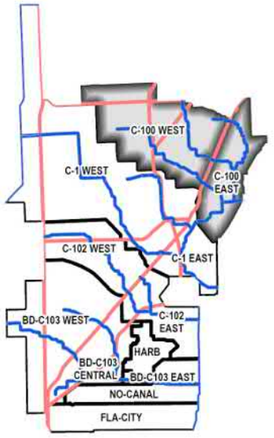


Figure A-184. Watershed C-100 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas



C-100 Location within Project Area

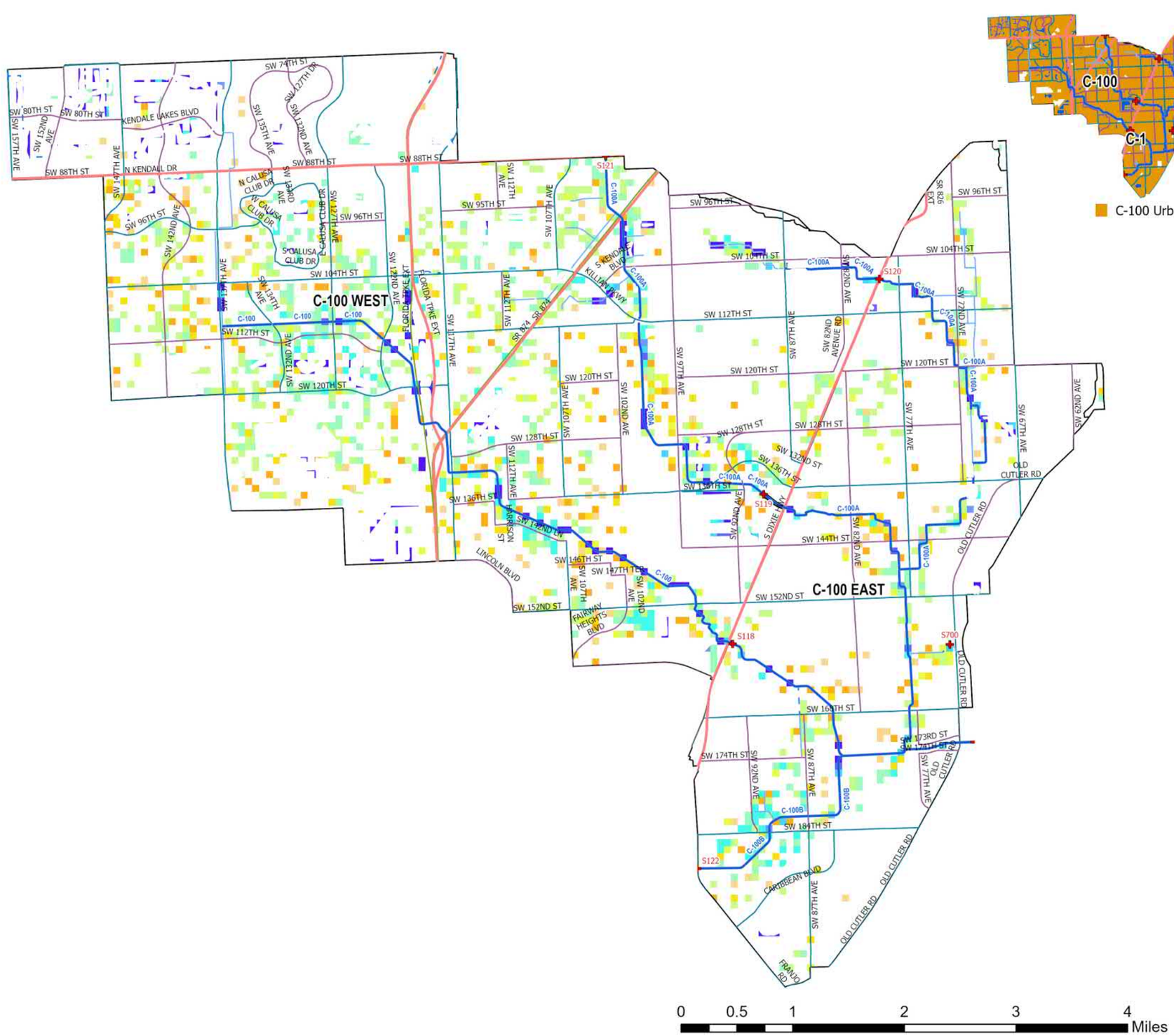
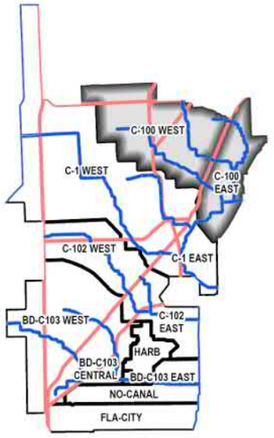
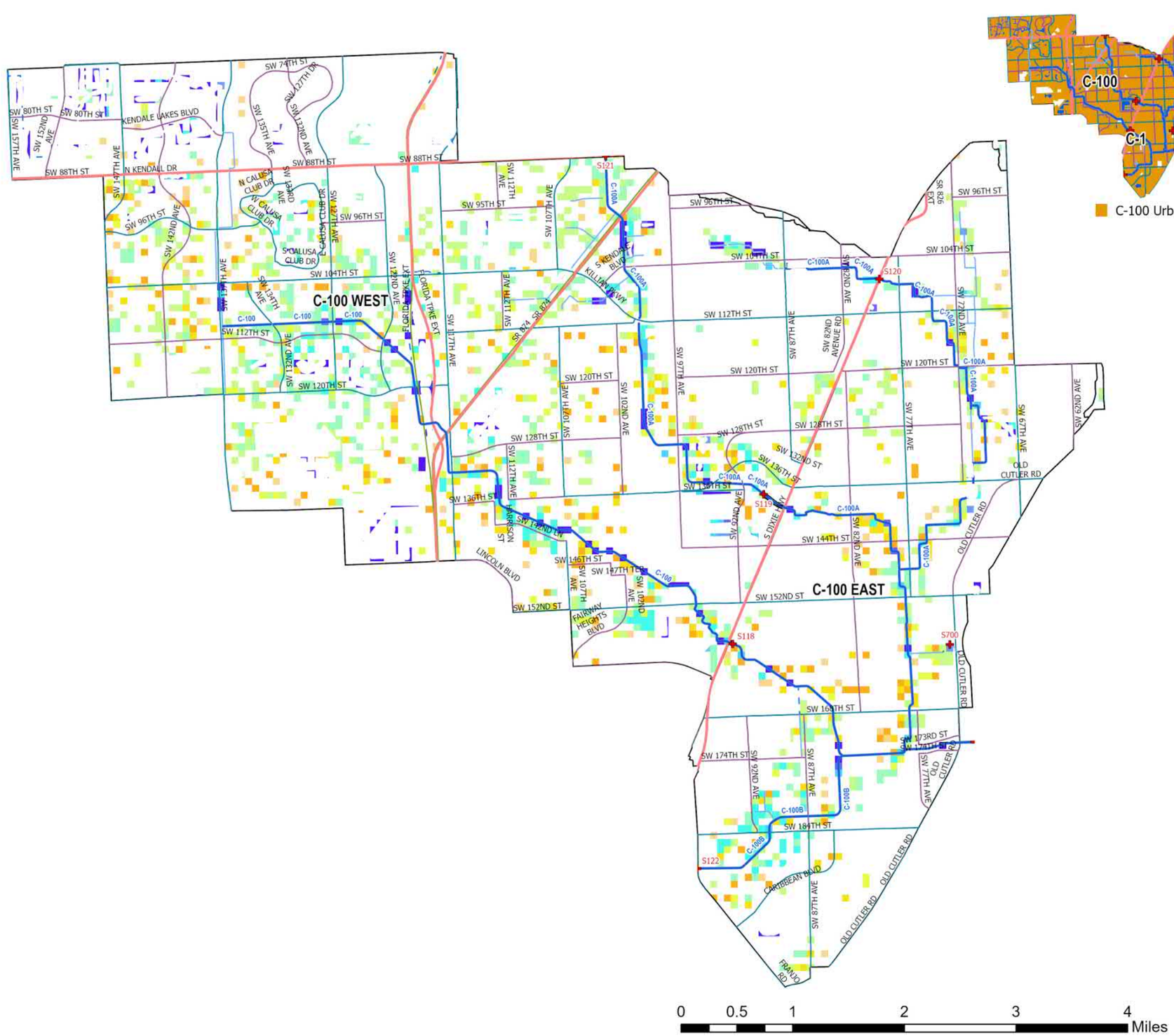


Figure A-185. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas



C-100 Location within Project Area



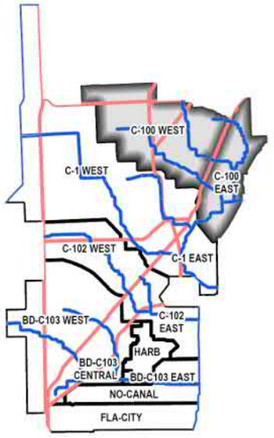
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +1.0

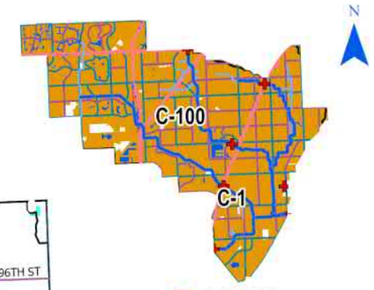
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

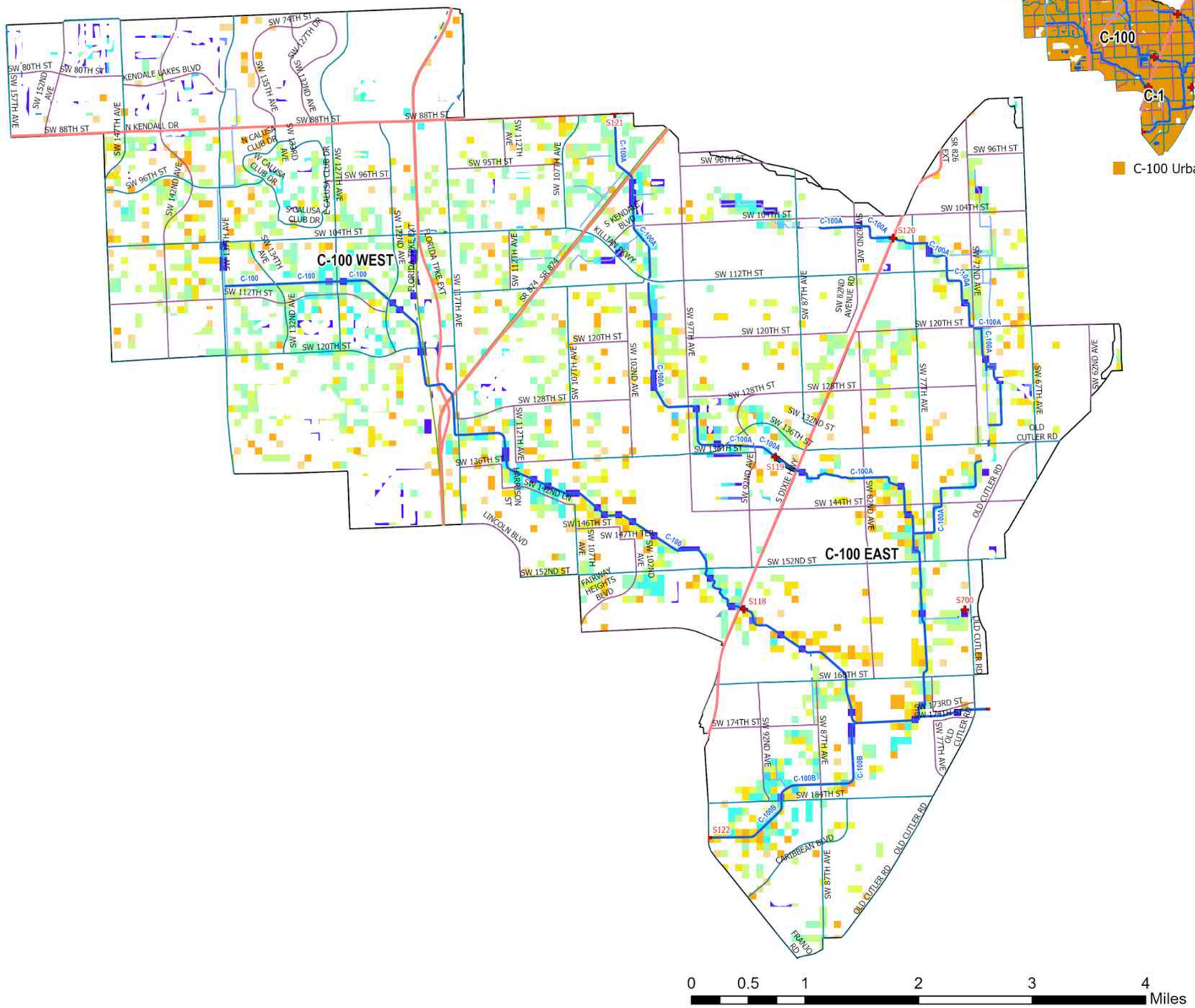
Figure A-186. Watershed C-100 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area



C-100 Urban



- UDB
- Evacuation Routes

Major Roads

Road Class

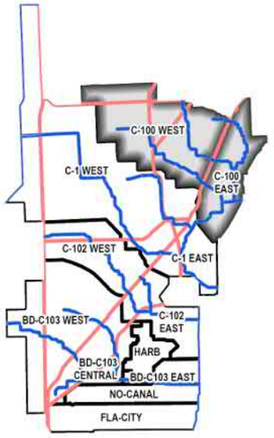
- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

25-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-187. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas



C-100 Location within Project Area

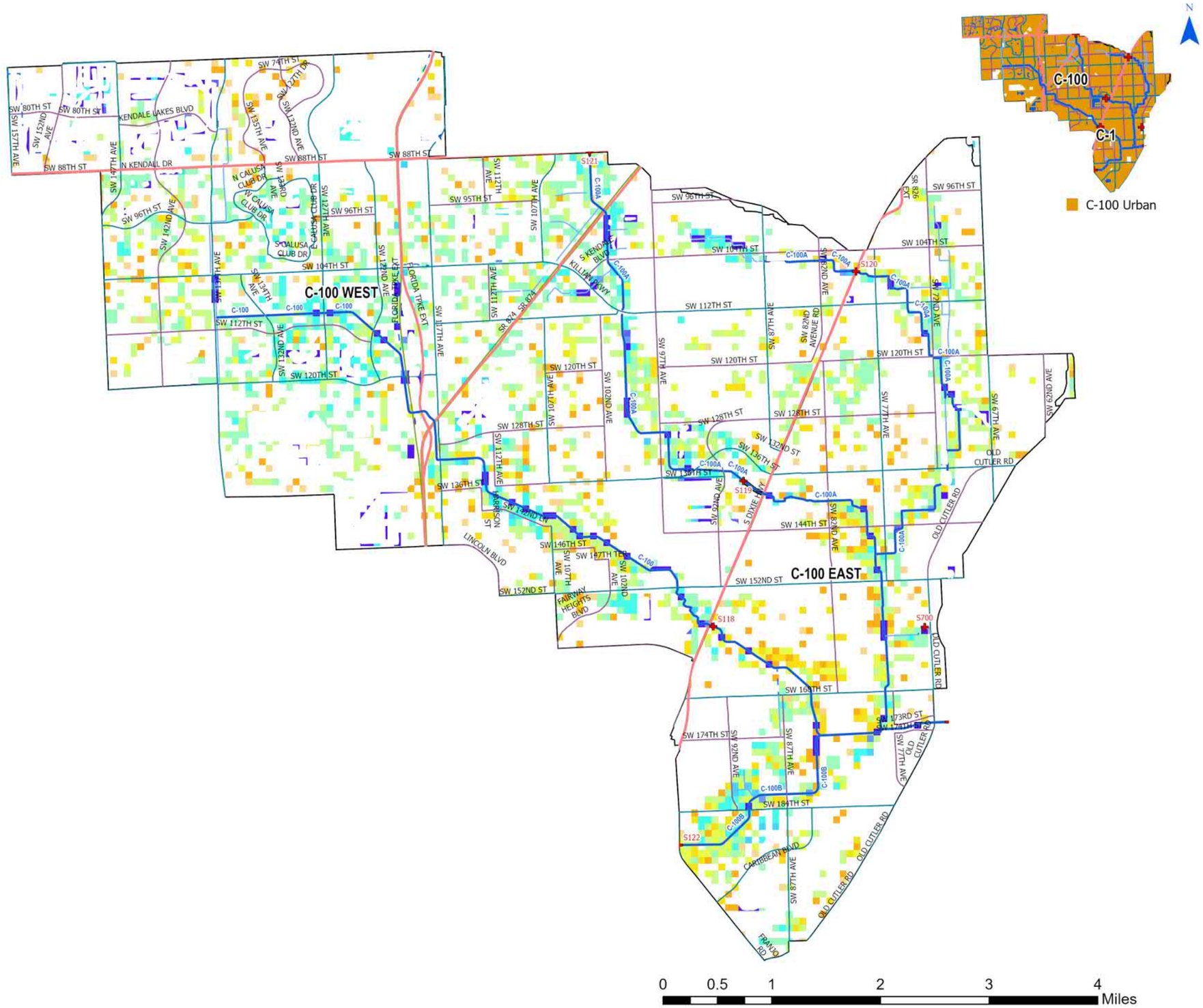
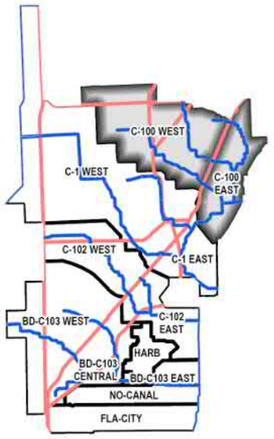
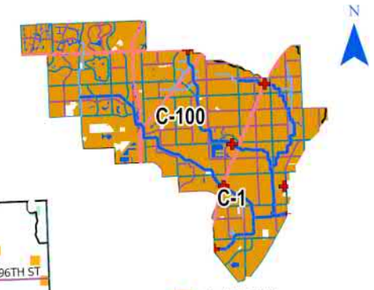
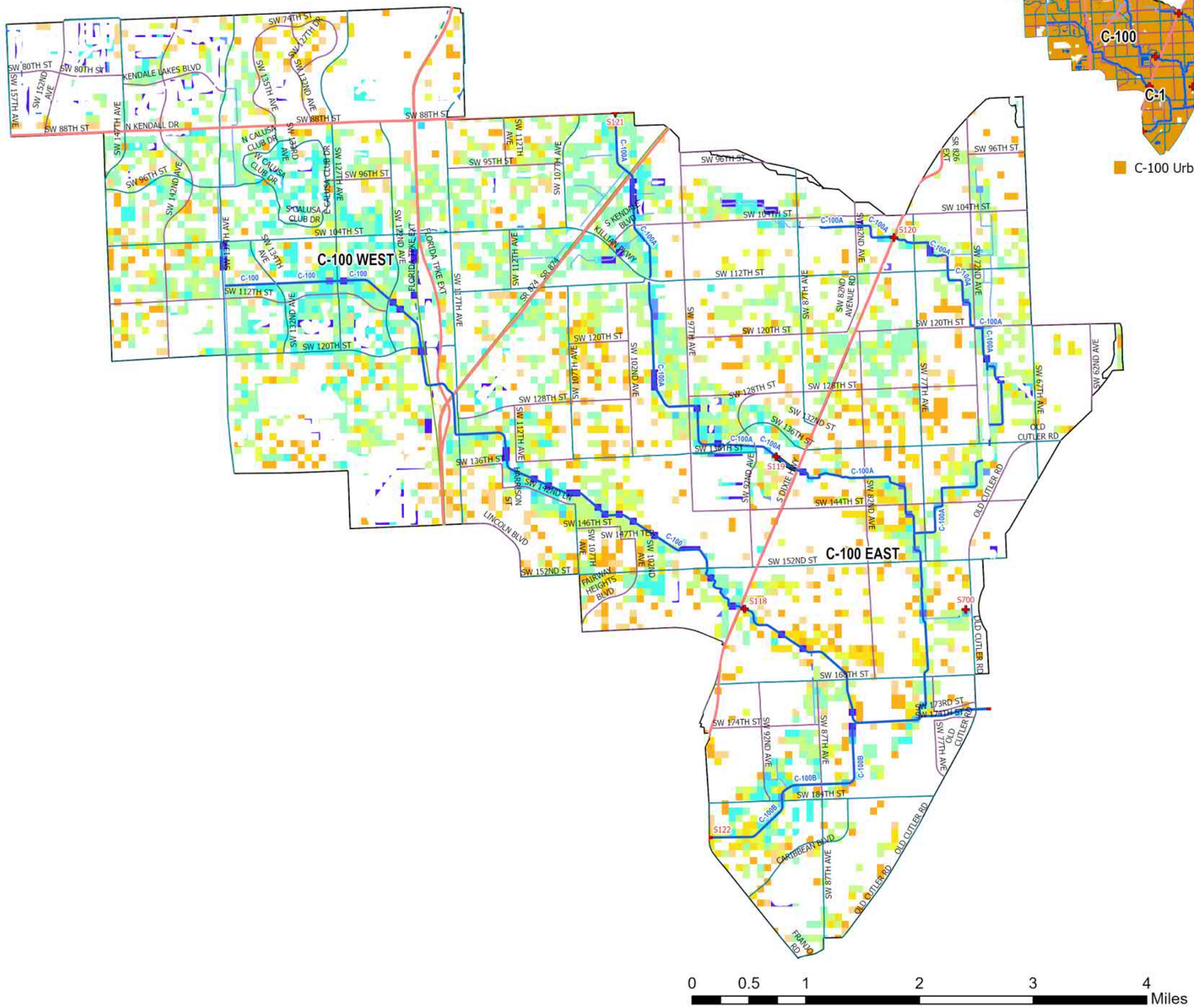


Figure A-188. Watershed C-100 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas



C-100 Location within Project Area





- UDB
- Evacuation Routes

Major Roads

Road Class

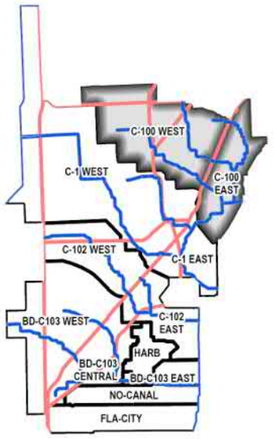
- Class 1
- Class 2
- Class 3
- Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-189. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas



C-100 Location within Project Area

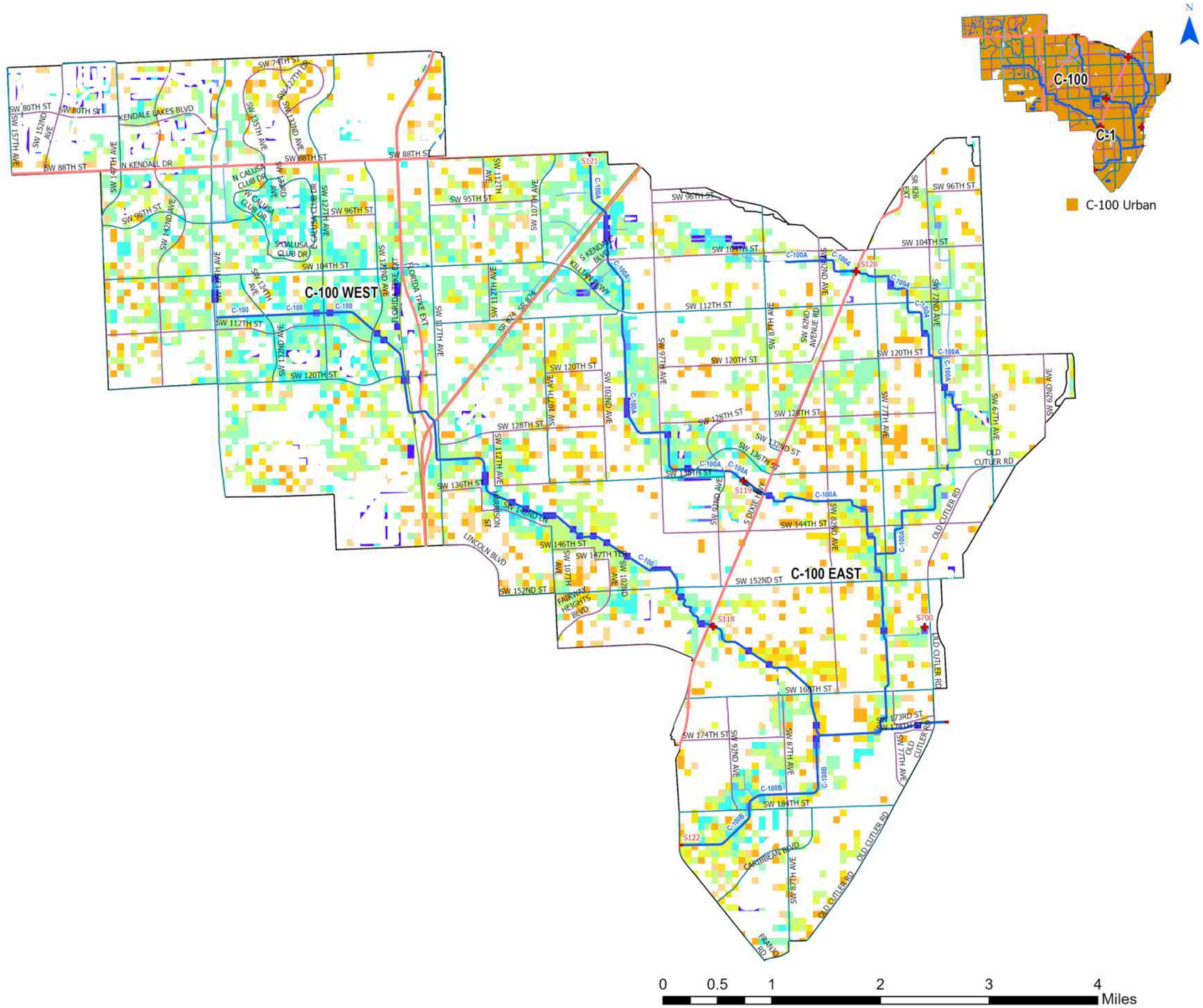
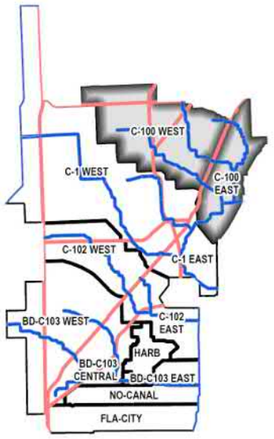
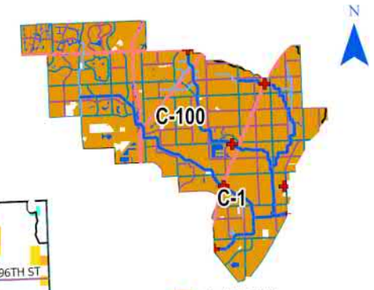
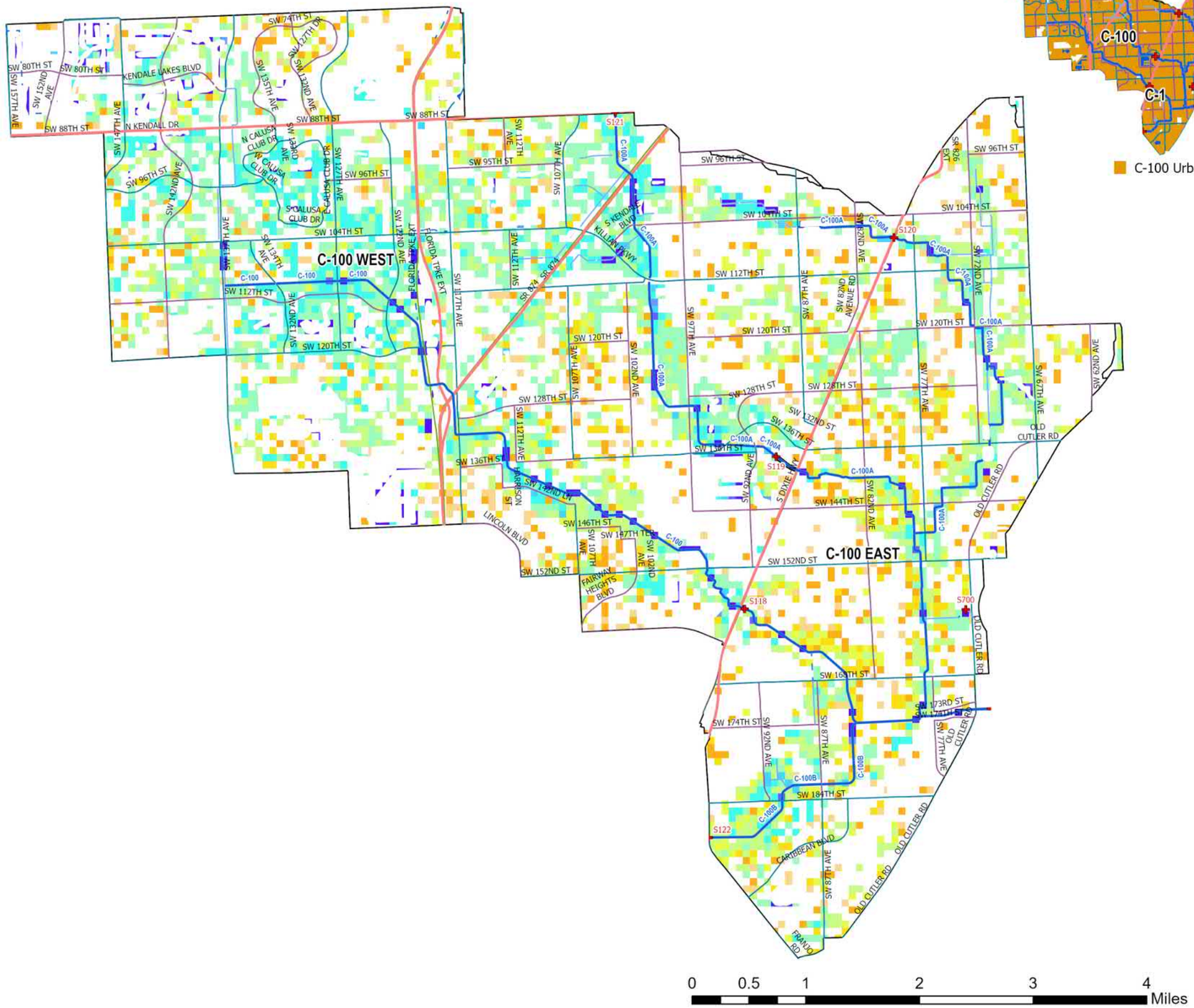


Figure A-190. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas



C-100 Location within Project Area





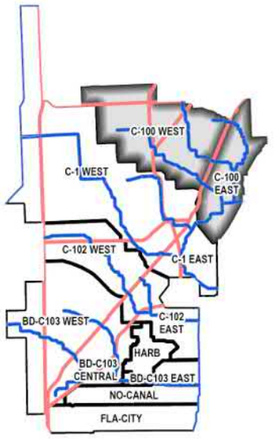
- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

100-Yr/72-Hr SLR = +2.0

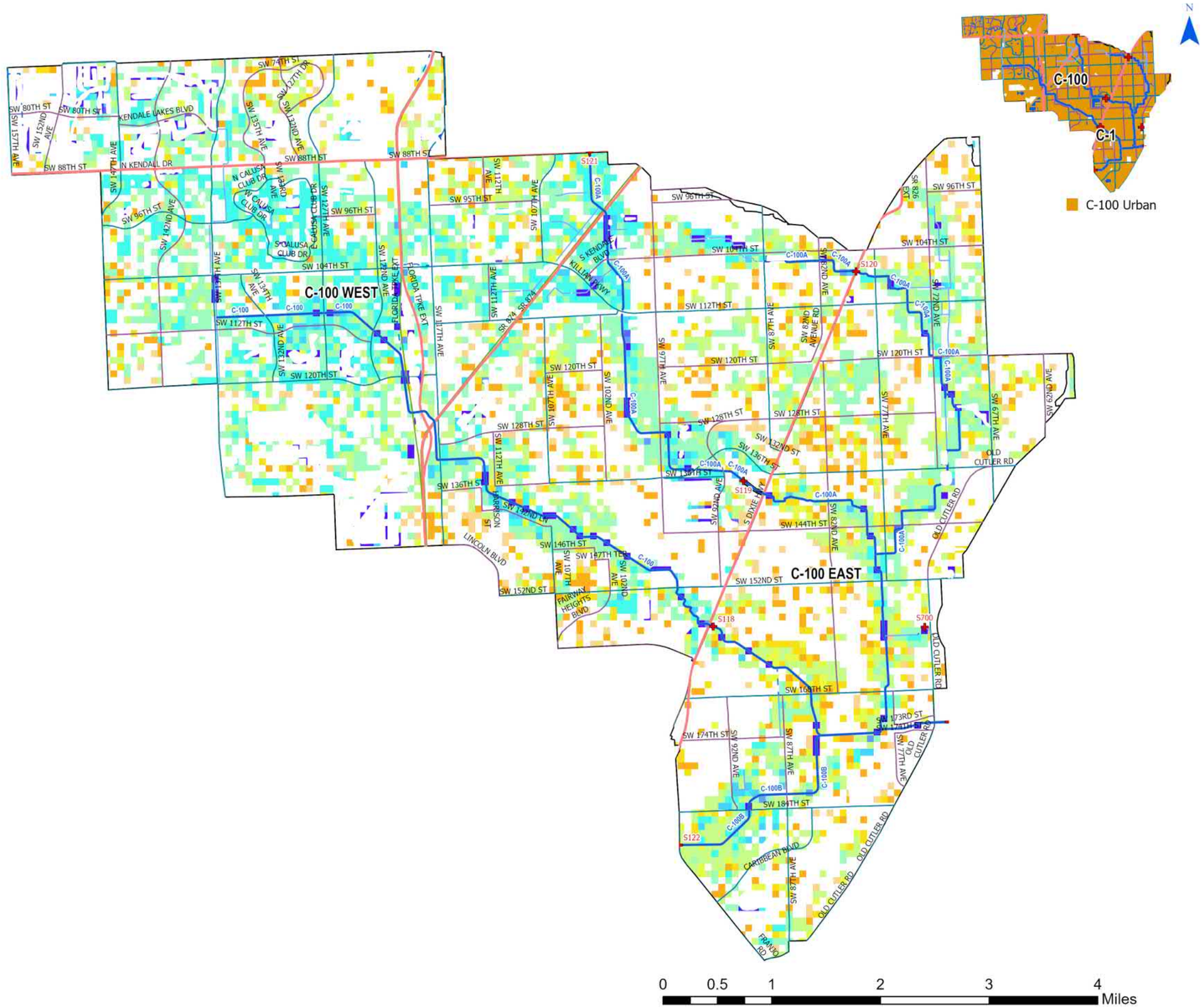
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-191. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas



C-100 Location within Project Area



- UDB
- Evacuation Routes
- Major Roads
- Road Class
  - Class 1
  - Class 2
  - Class 3
  - Class 4
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

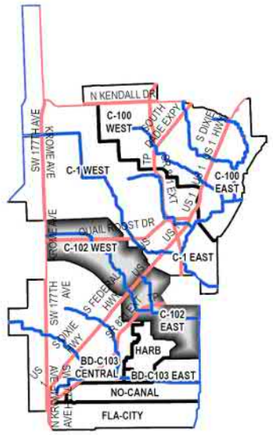
100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

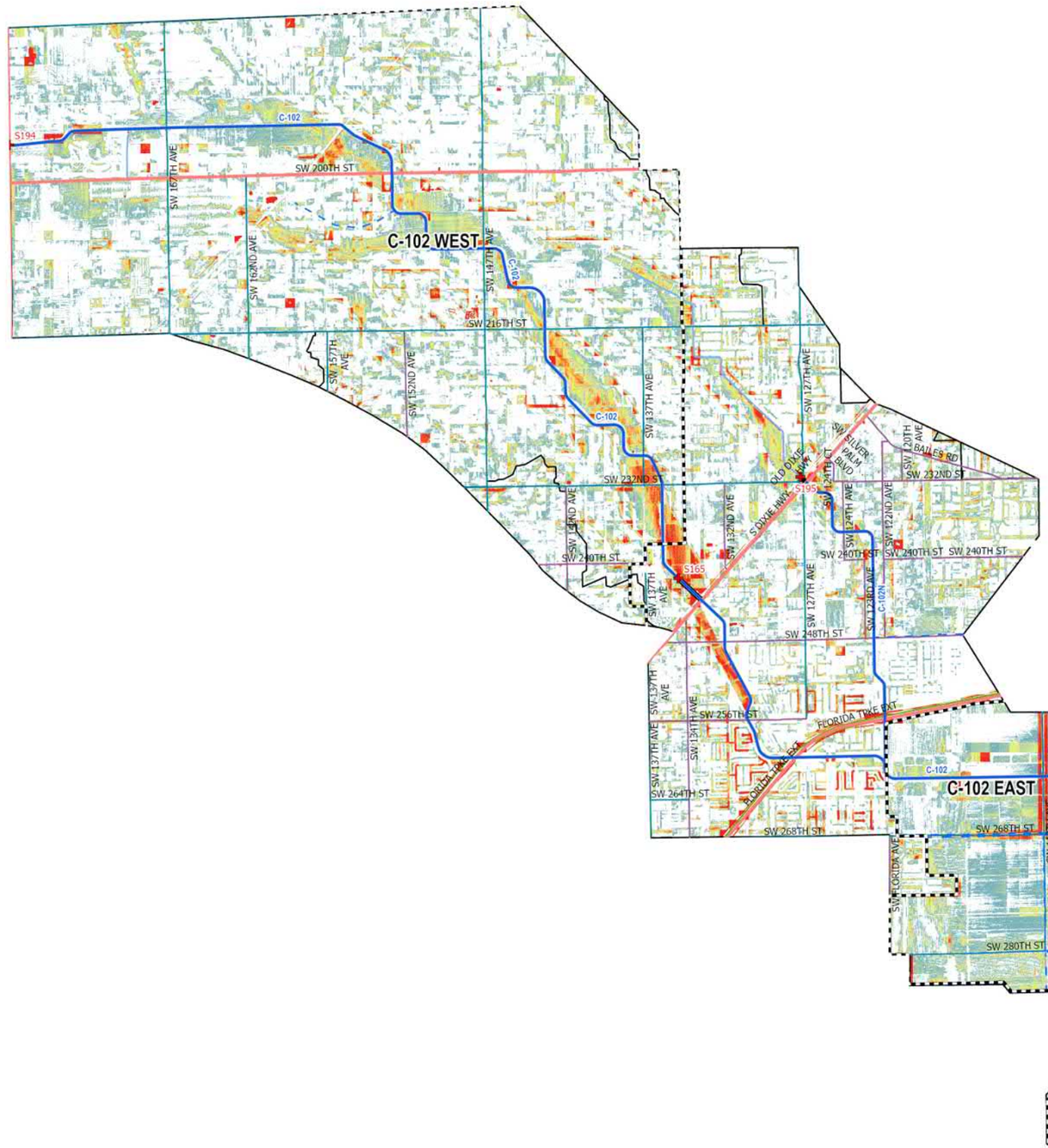
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-192. Watershed C-100 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

WATERSHED C-102: Flood Extent for Entire Watershed



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

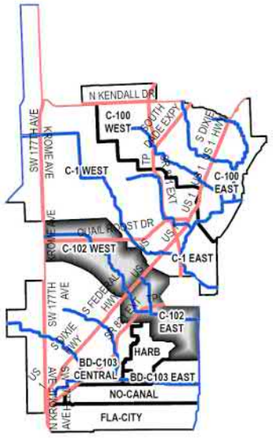
Flood Depth (ft)

- 0 < 0.25 ft
- 0.25 >= 0.50 ft
- 0.50 >= 0.75 ft
- 0.75 >= 1.00 ft
- 1.00 >= 1.25 ft
- 1.25 >= 1.50 ft
- 1.50 >= 1.75 ft
- 1.75 >= 2.00 ft
- 2.00 >= 2.25 ft
- 2.25 >= 2.50 ft
- >= 2.50 ft

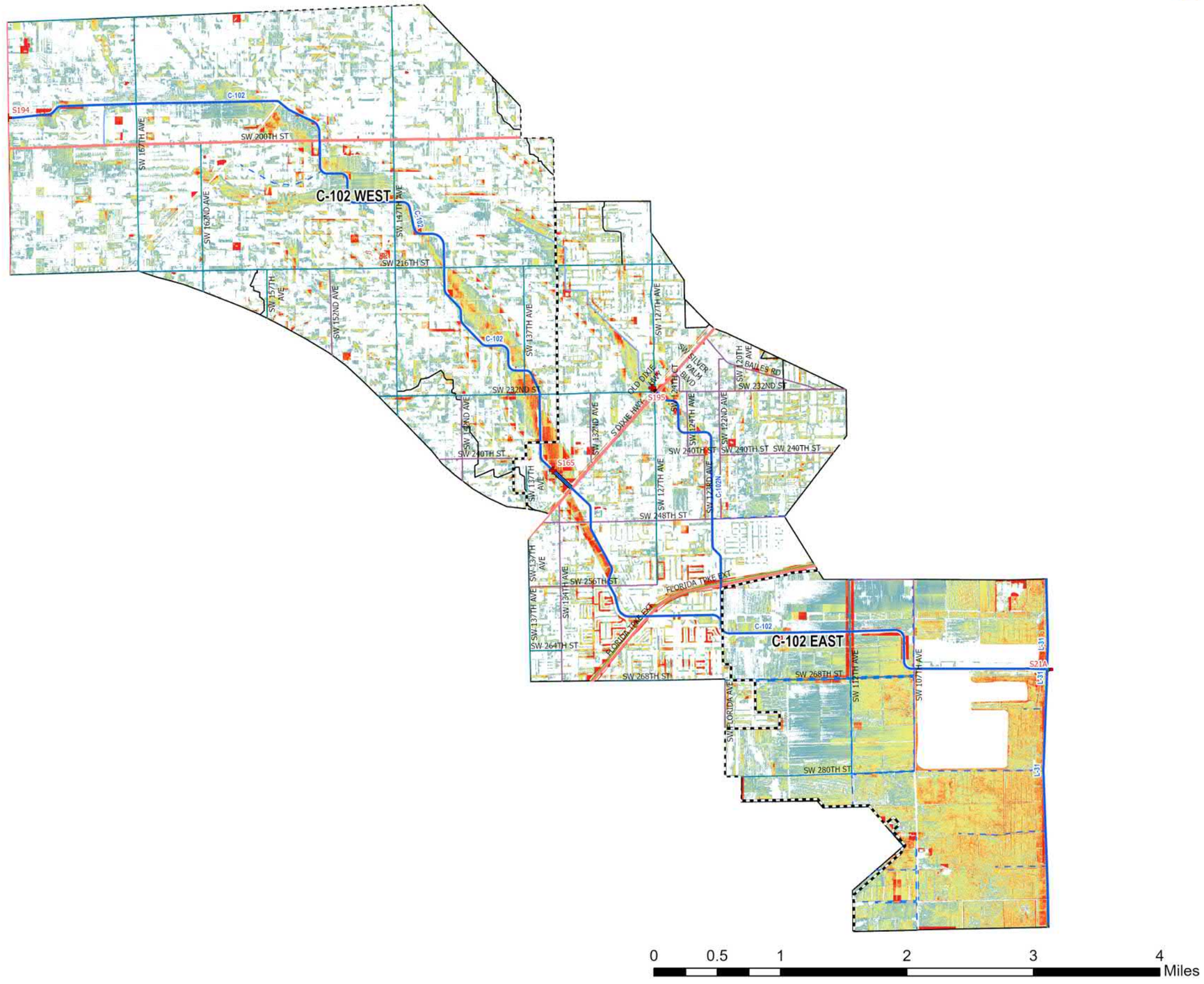
0 0.5 1 2 3 4 Miles

Figure A-193. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

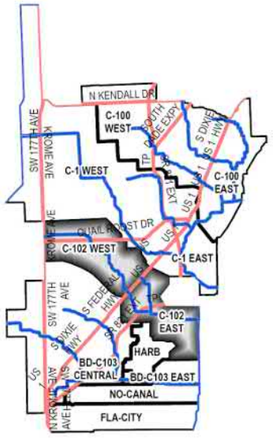
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

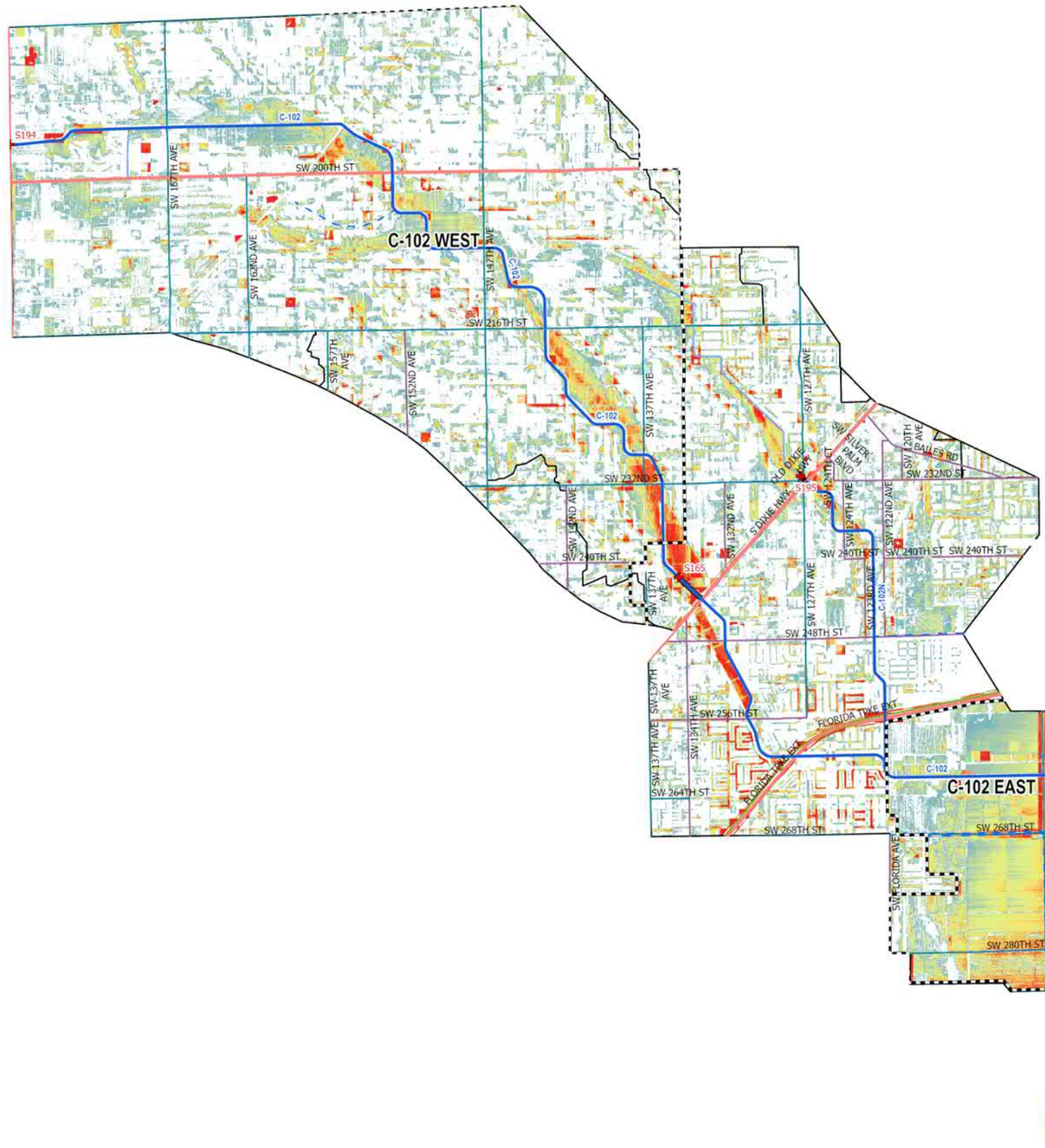
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-194. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

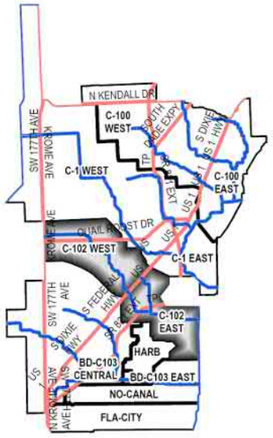
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

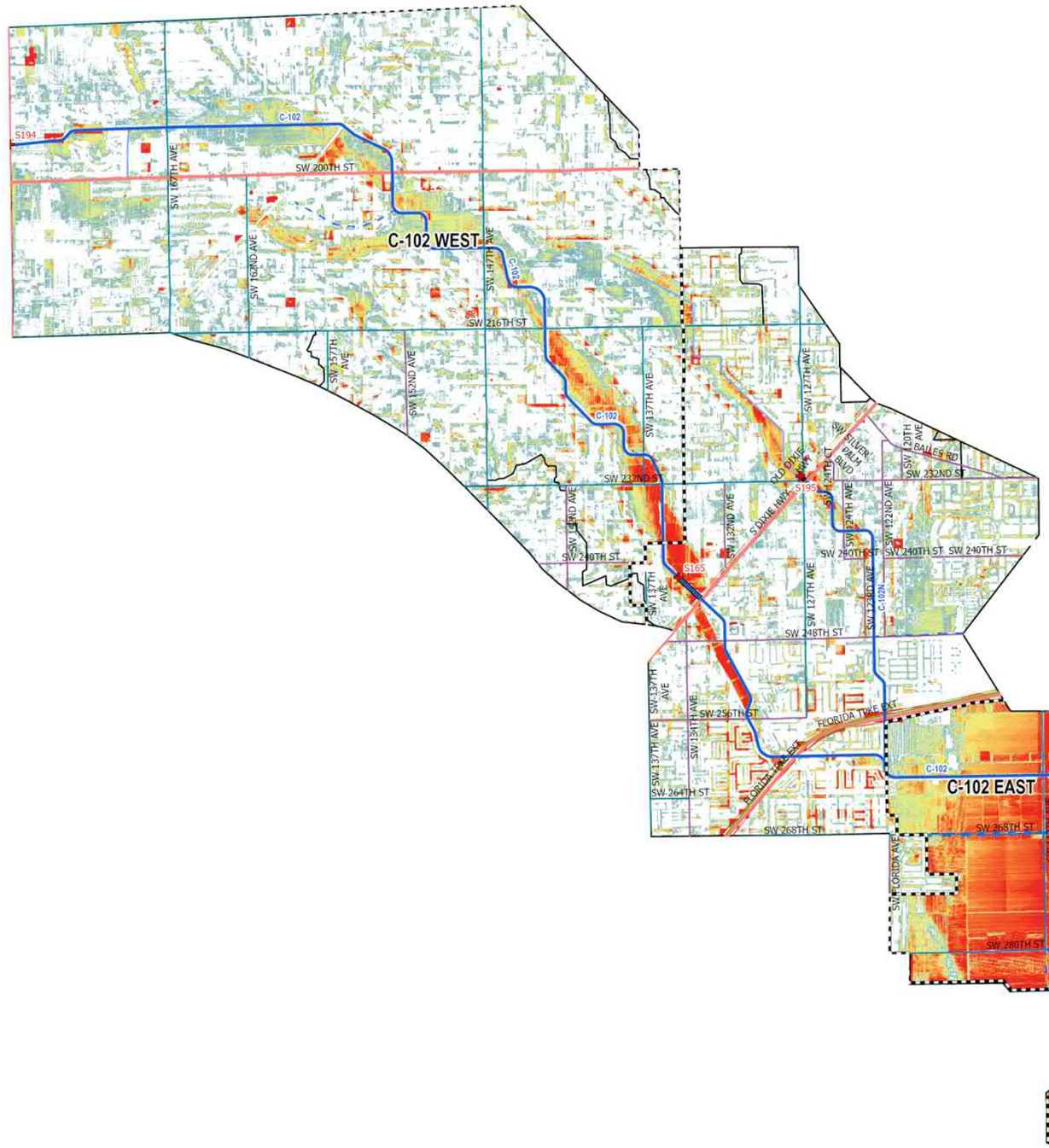
0 0.5 1 2 3 4 Miles

Figure A-195. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 2

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

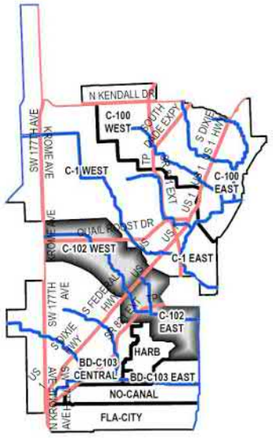
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

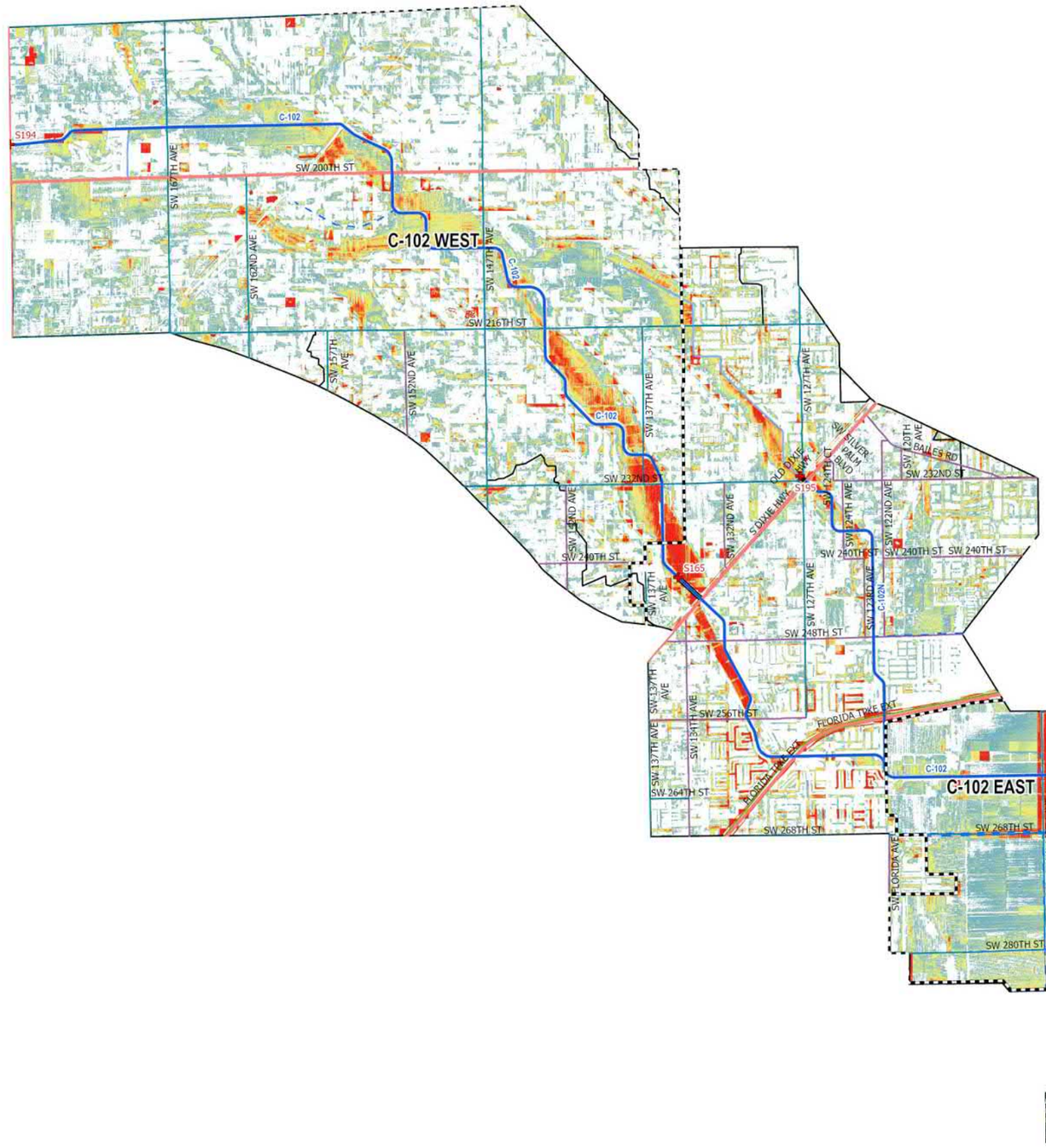
0 0.5 1 2 3 4 Miles

Figure A-196. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

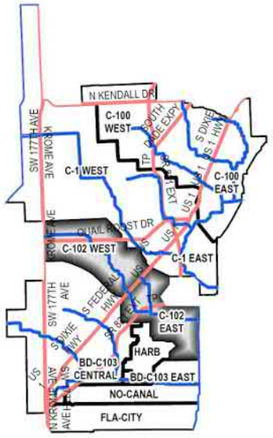
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

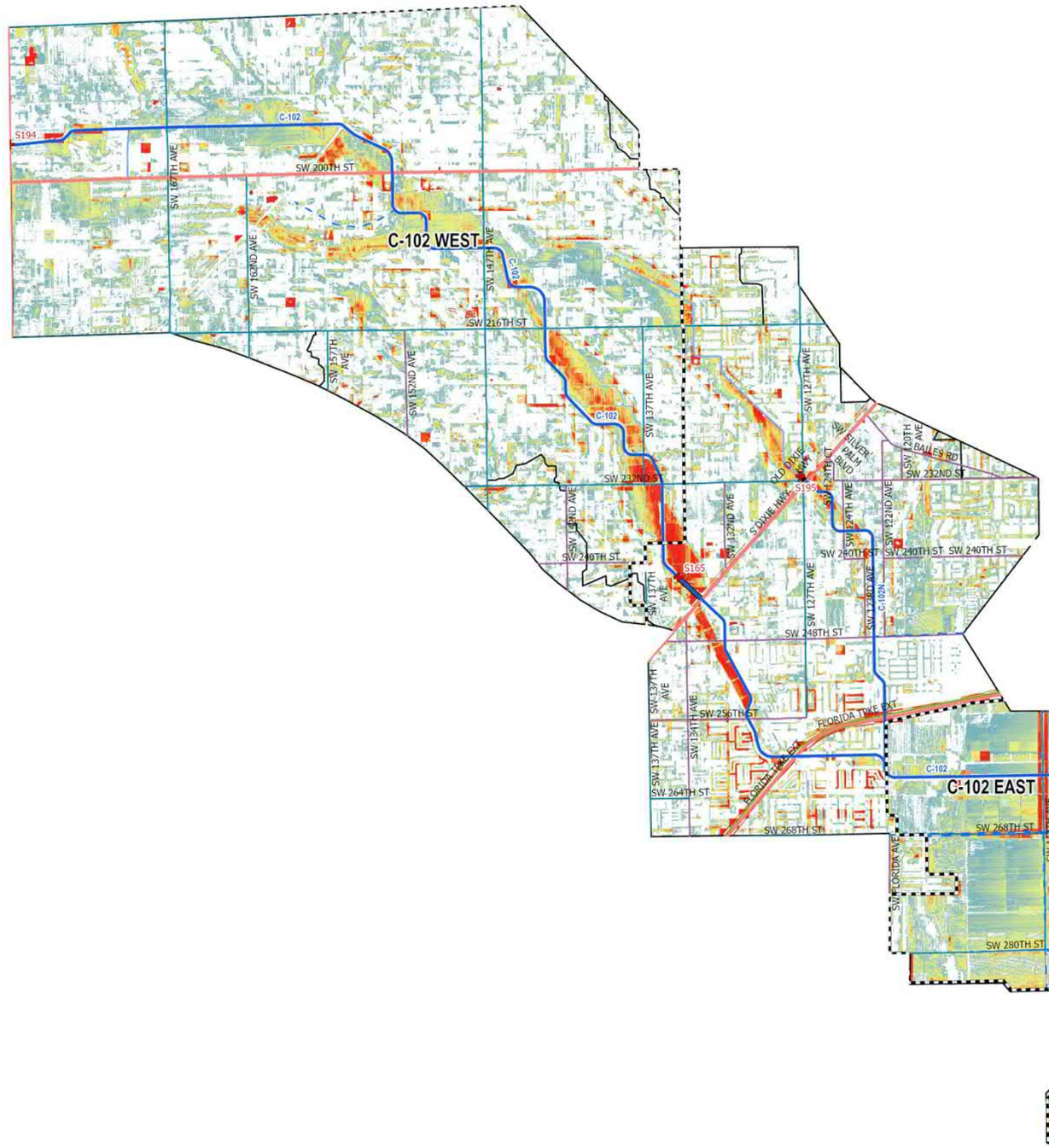
0 0.5 1 2 3 4 Miles

Figure A-197. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

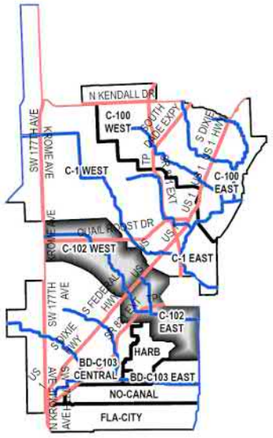
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

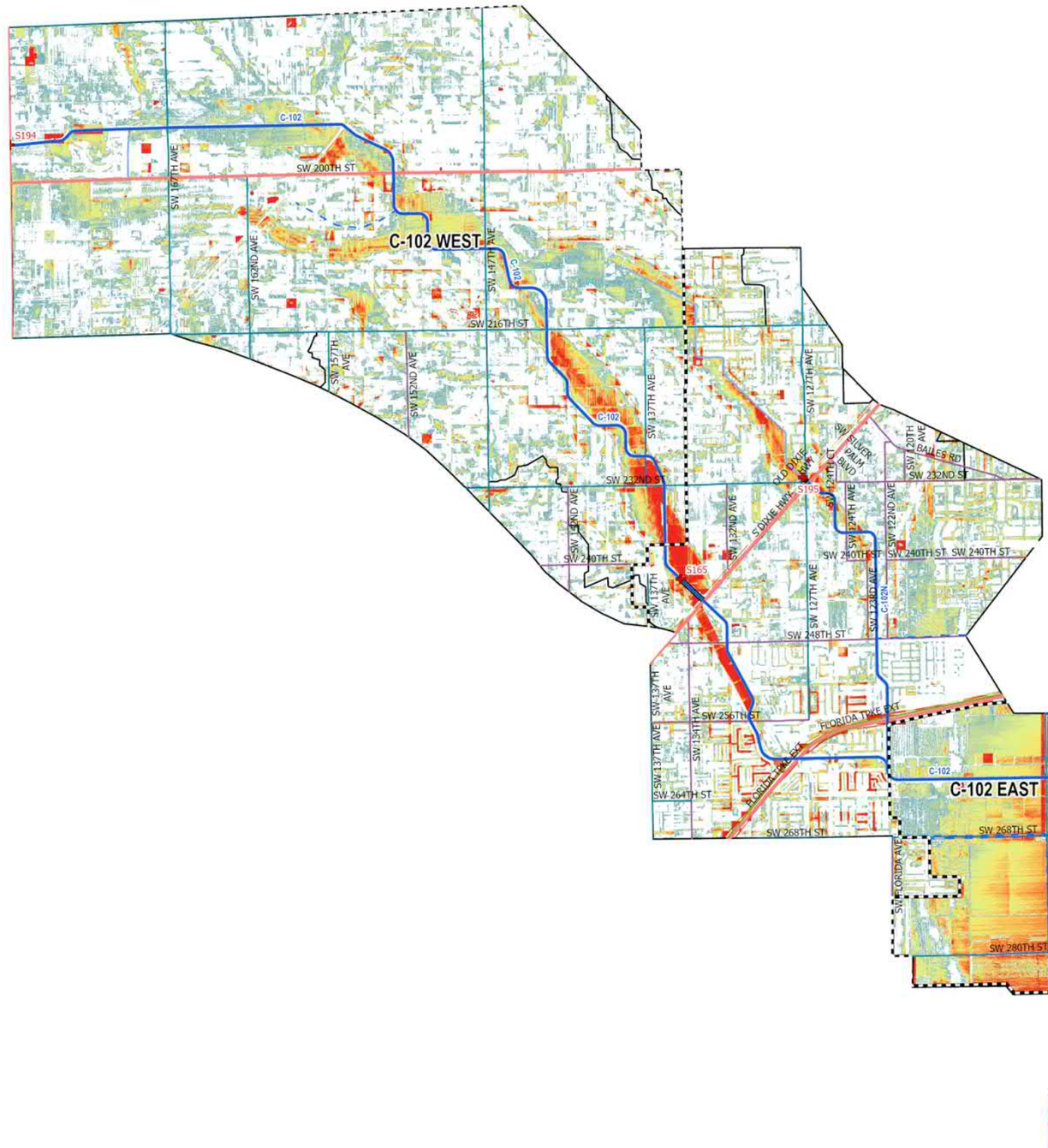
0 0.5 1 2 3 4 Miles

Figure A-198. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 1

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

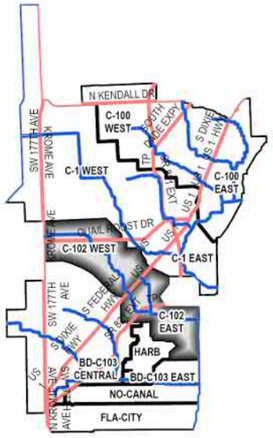
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

N

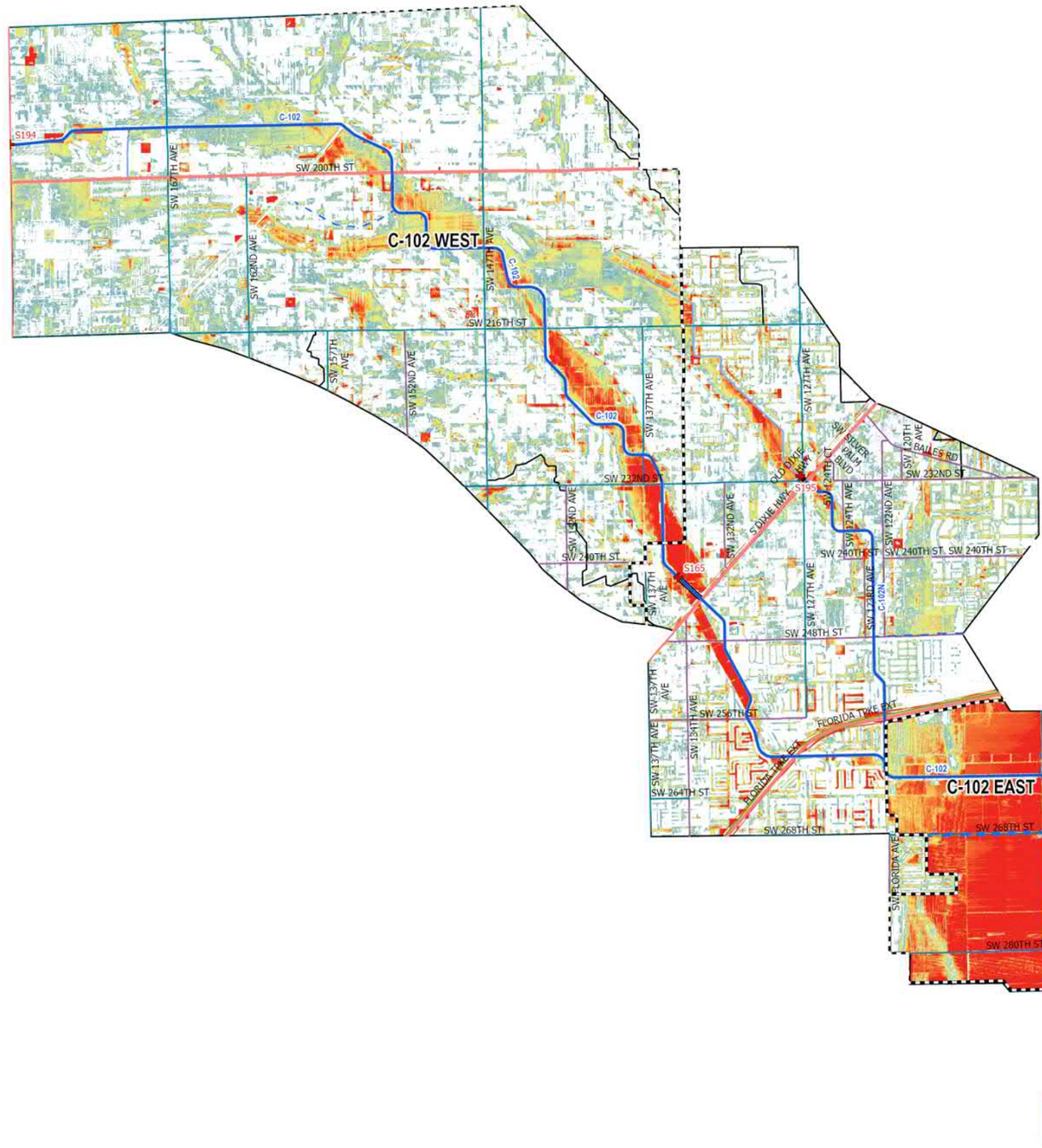
0 0.5 1 2 3 4 Miles

Figure A-199. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

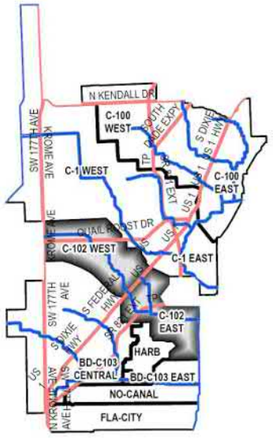
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

N

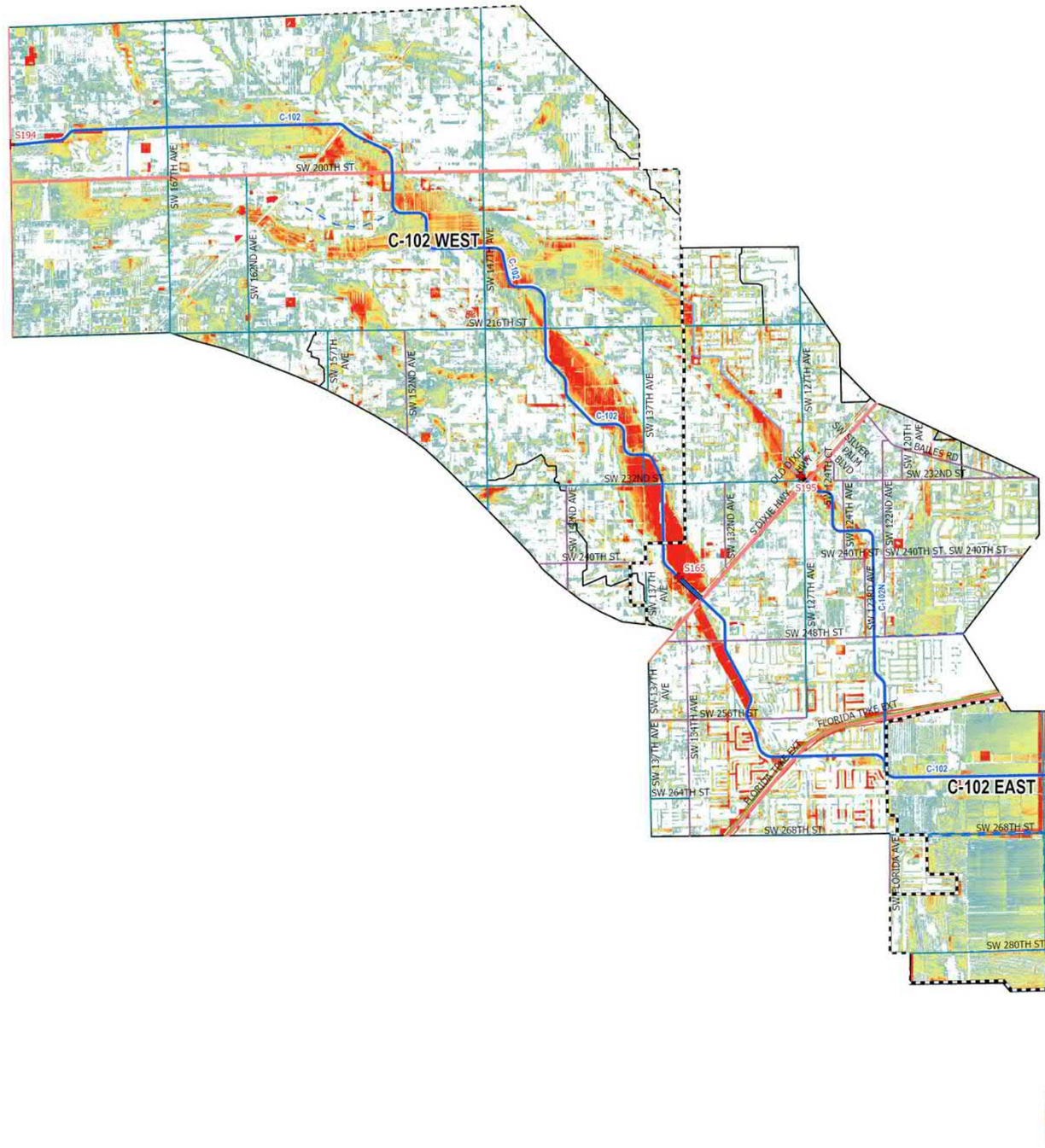
0 0.5 1 2 3 4 Miles

Figure A-200. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 3

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-201. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 0

Kimley»Horn

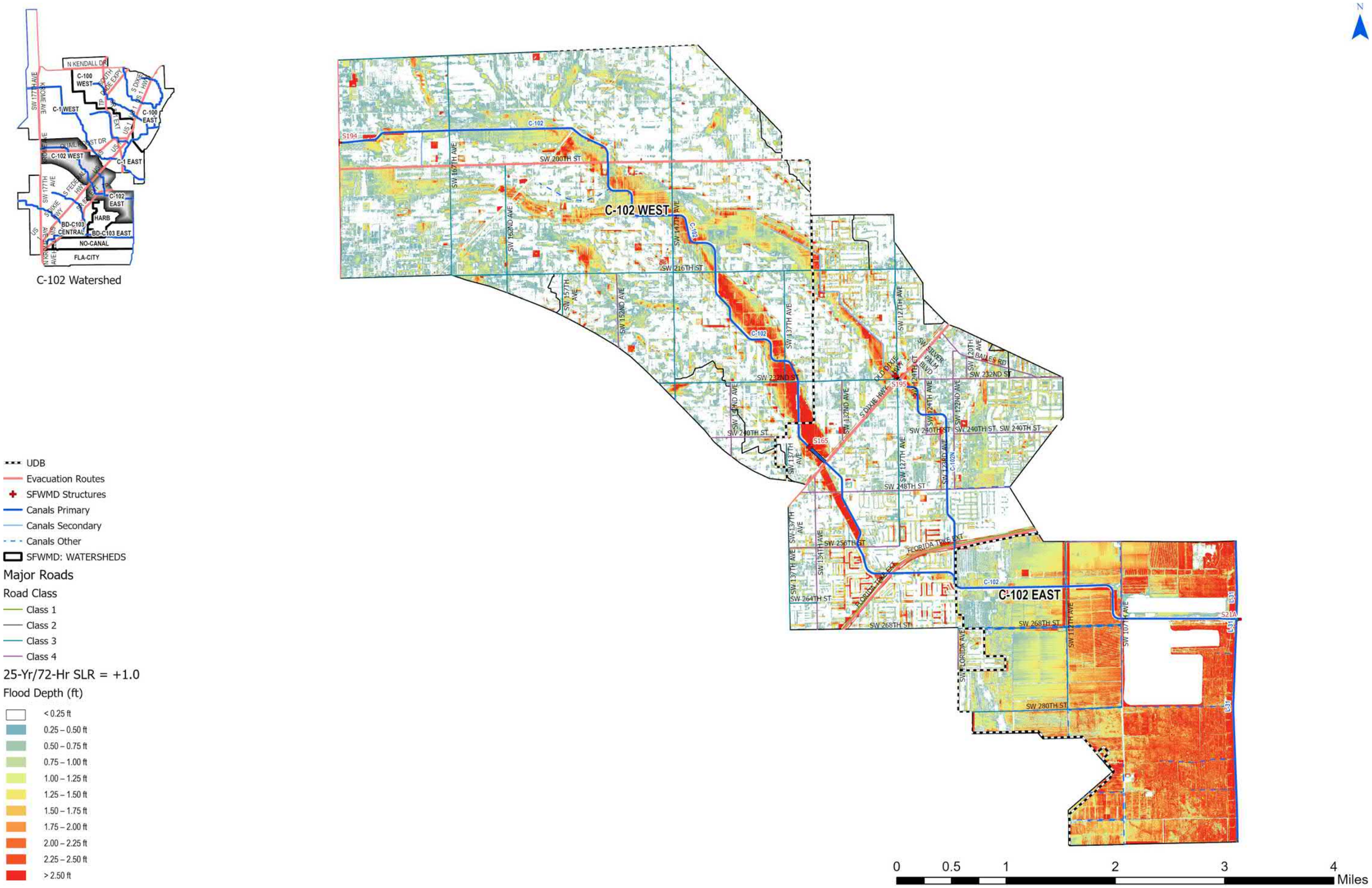
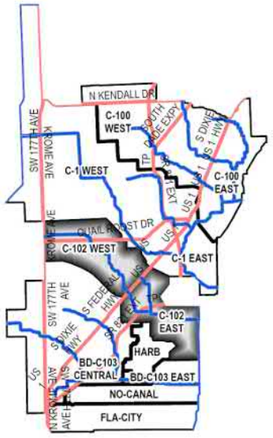
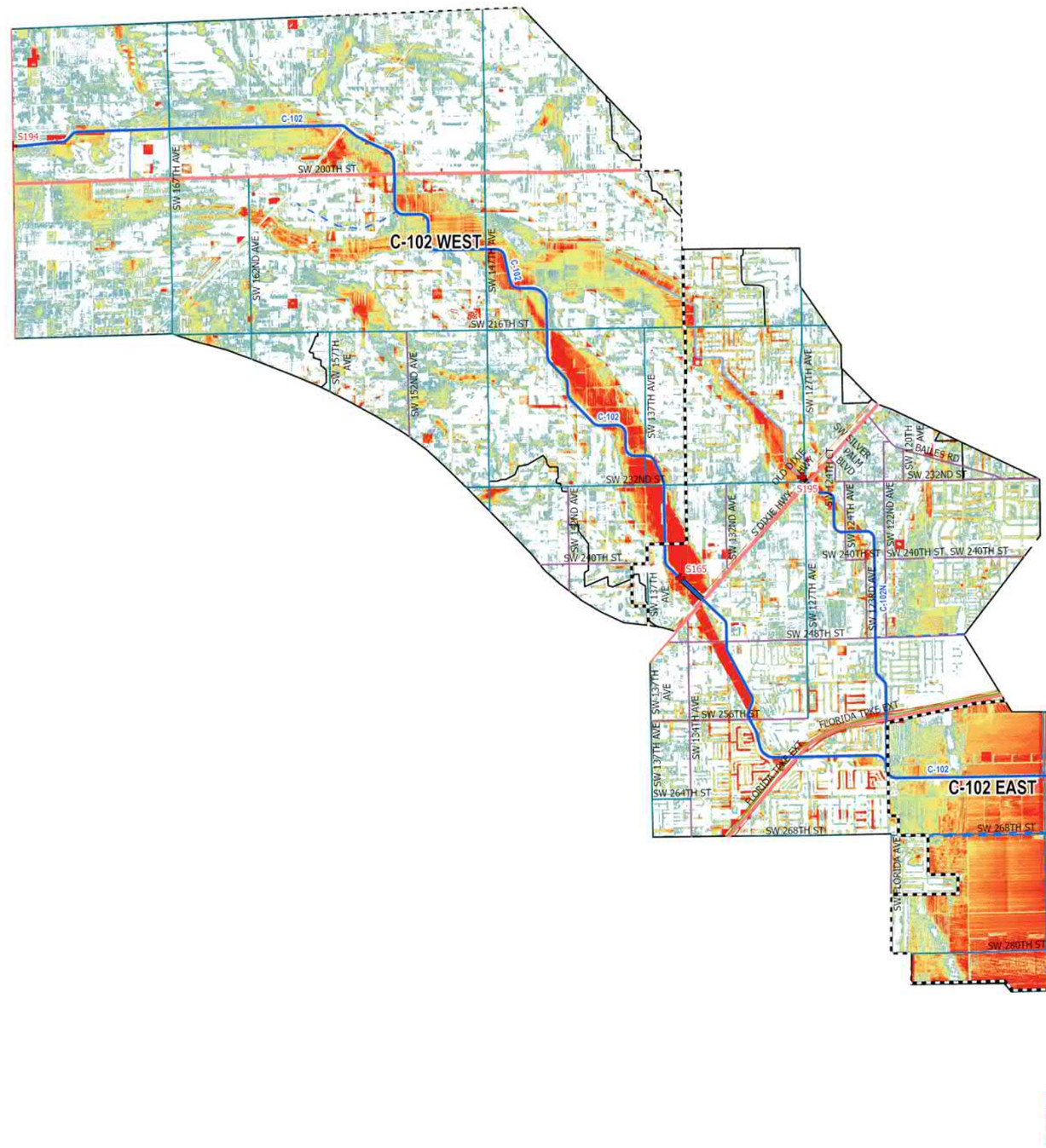


Figure A-202. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

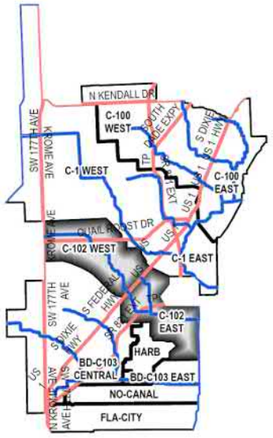
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

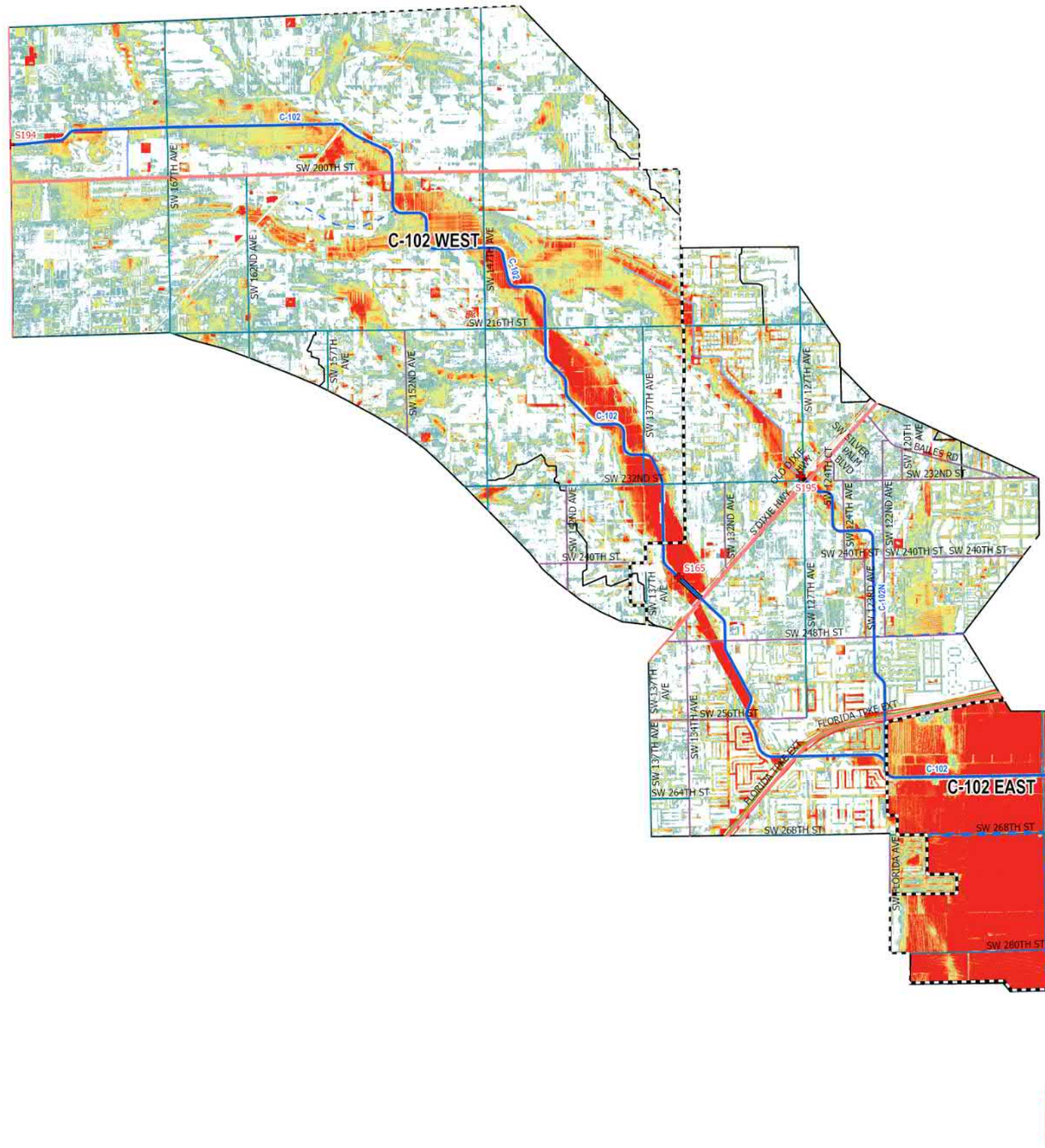
0 0.5 1 2 3 4 Miles

Figure A-203. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

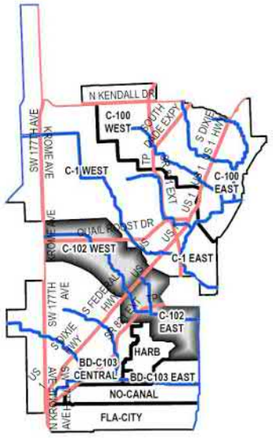
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

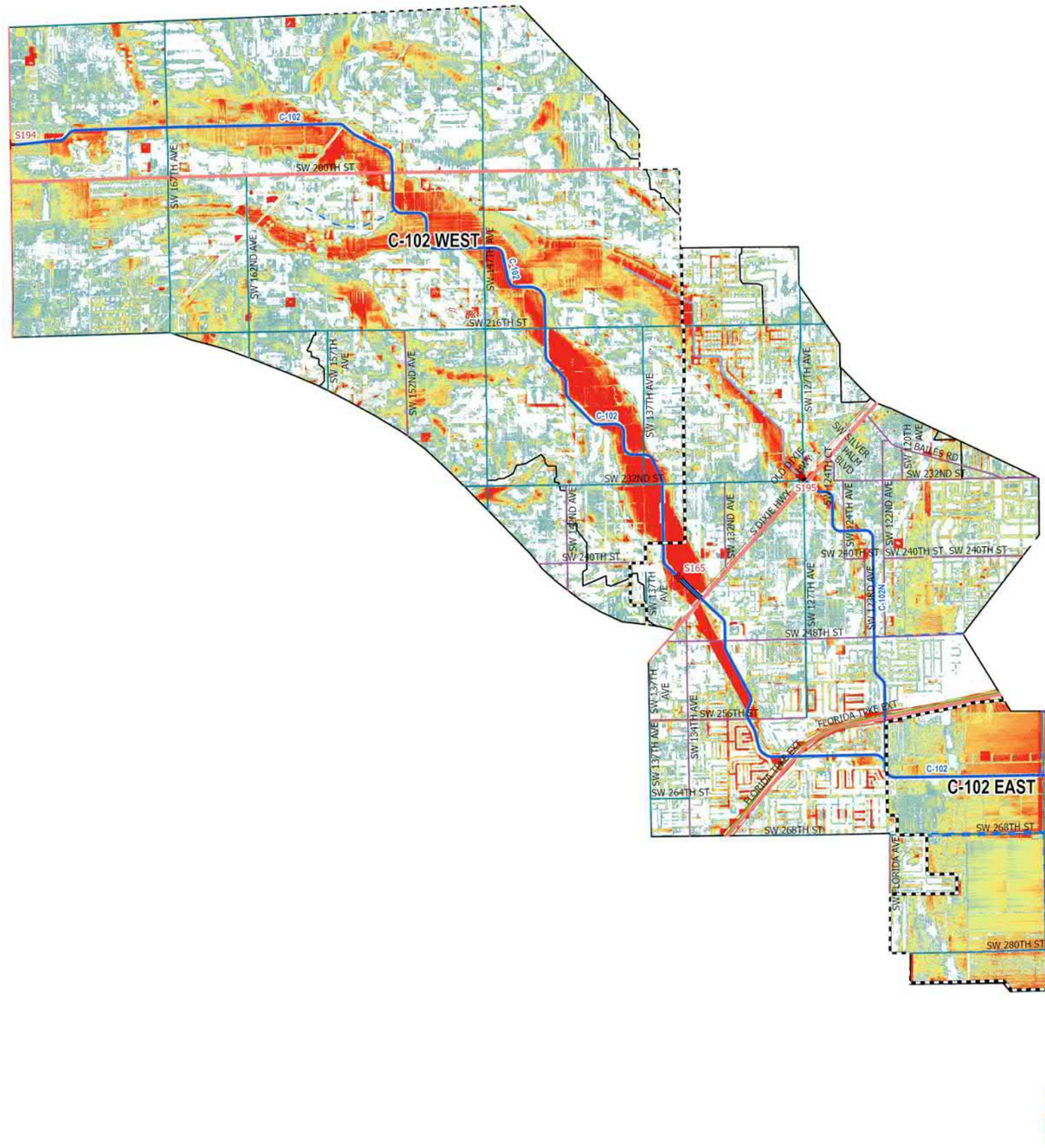
0 0.5 1 2 3 4 Miles

Figure A-204. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

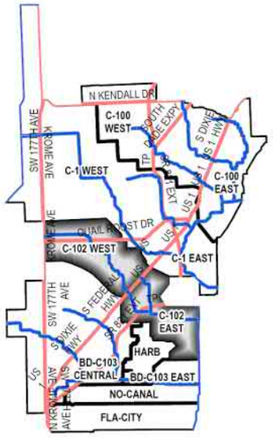
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

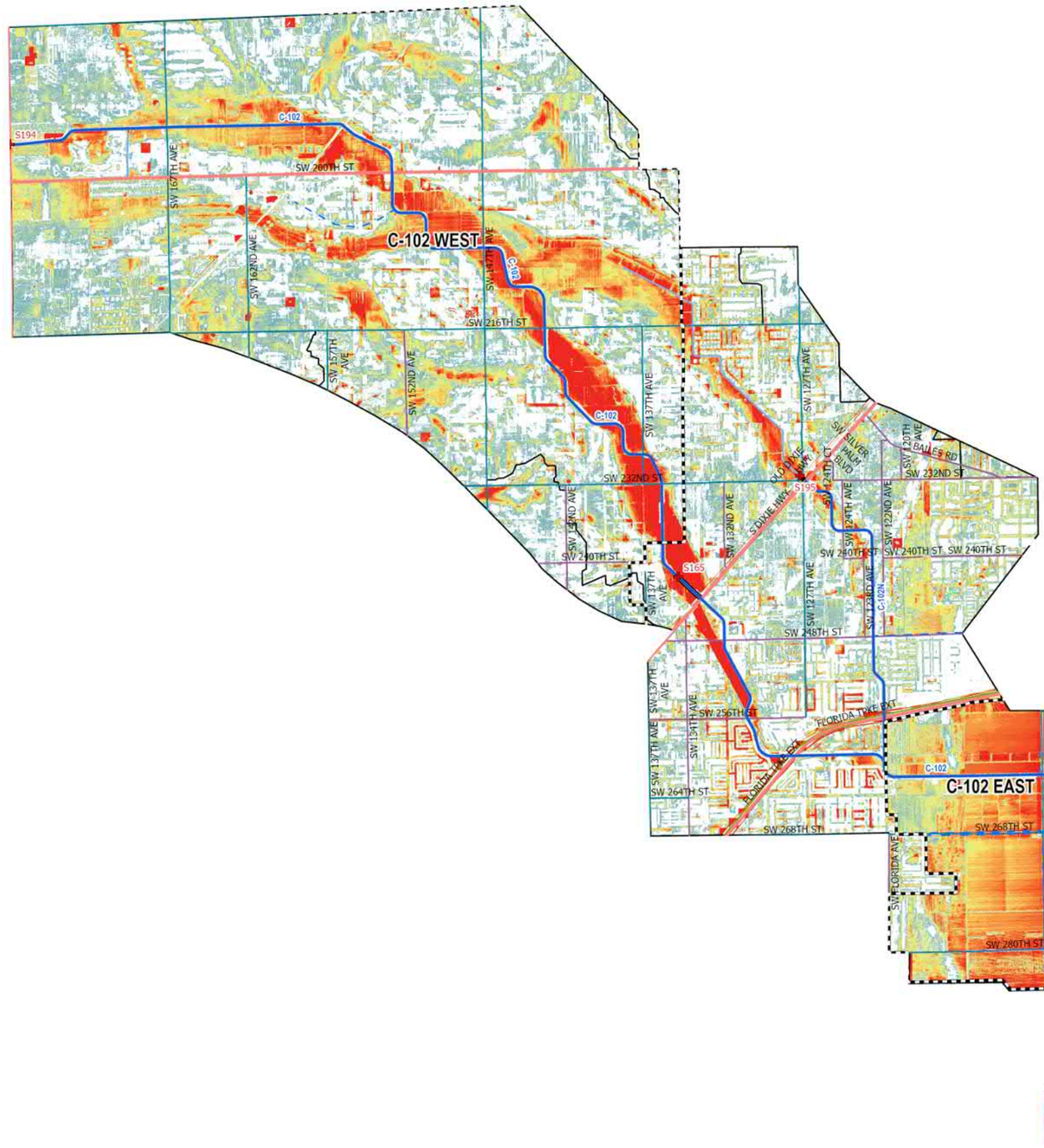
0 0.5 1 2 3 4 Miles

Figure A-205. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

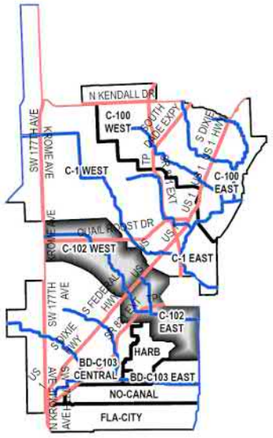
100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

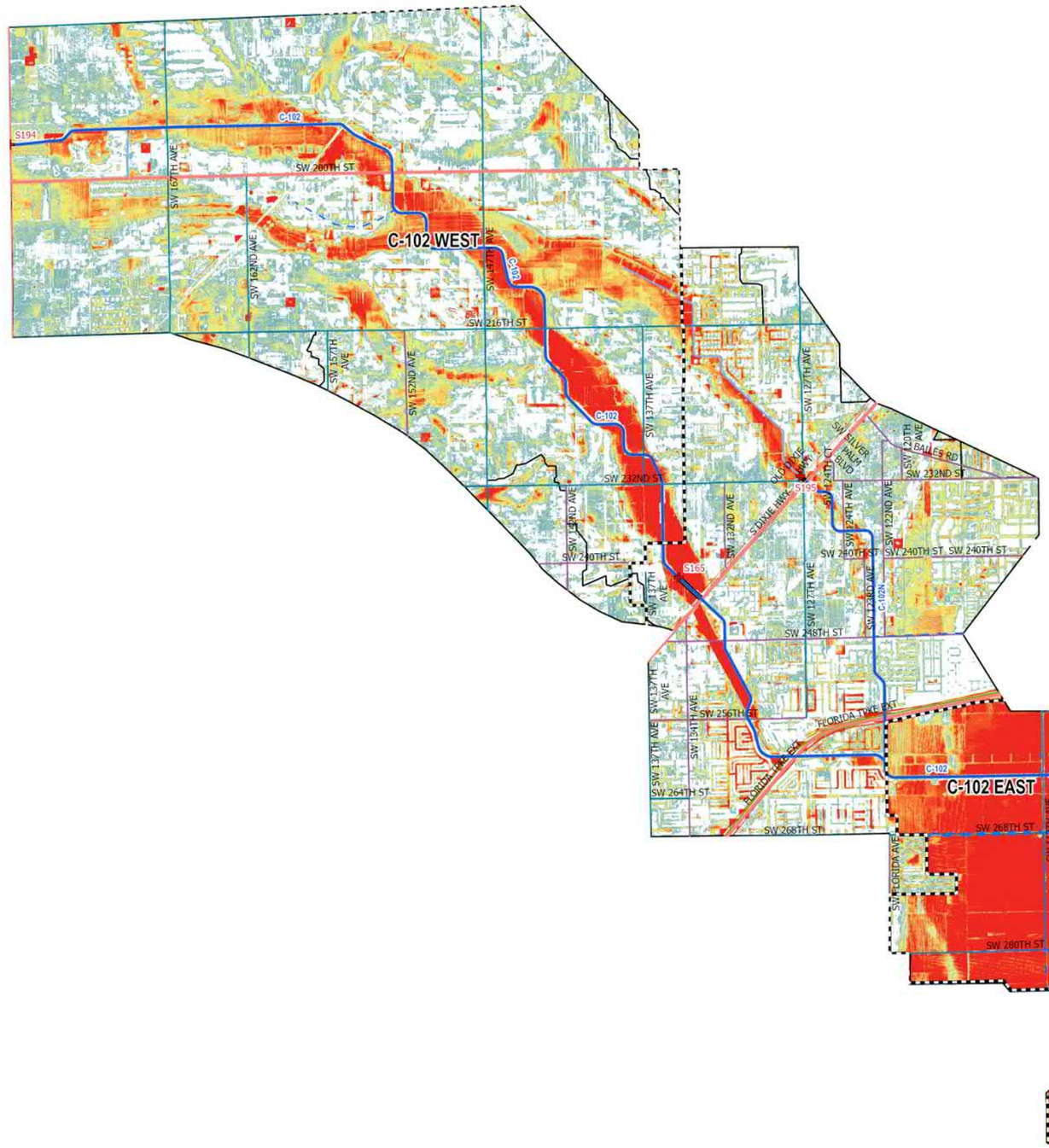
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-206. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

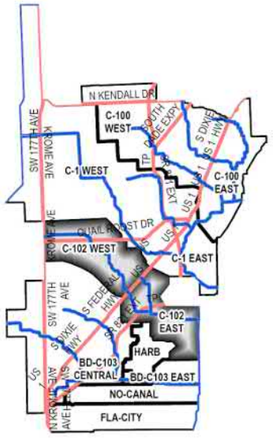
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

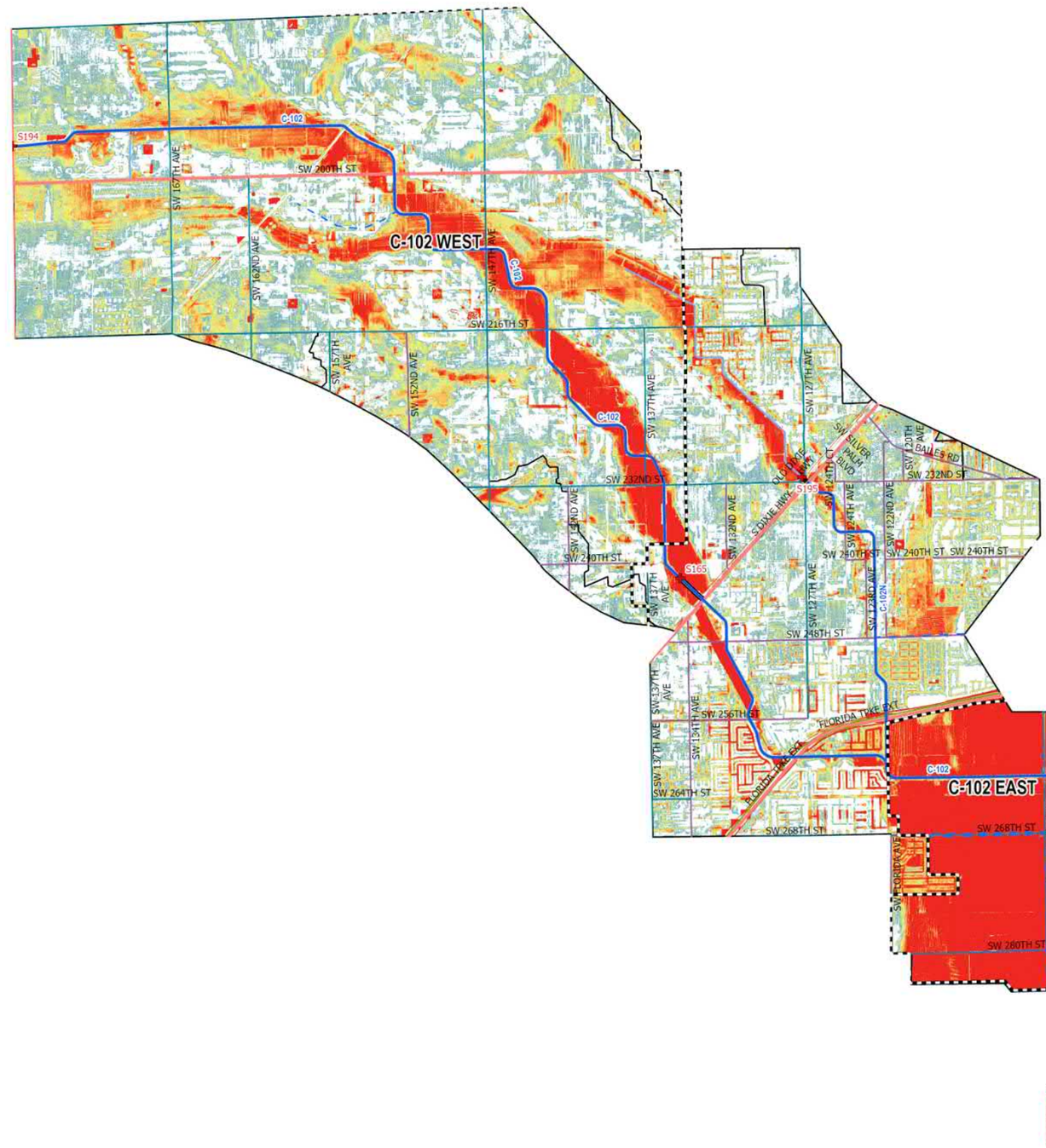
0 0.5 1 2 3 4 Miles

Figure A-207. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

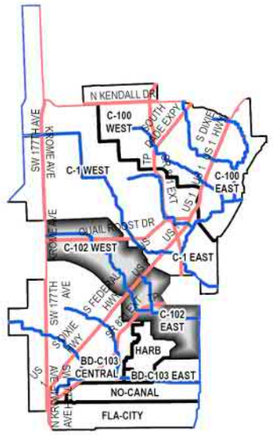
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

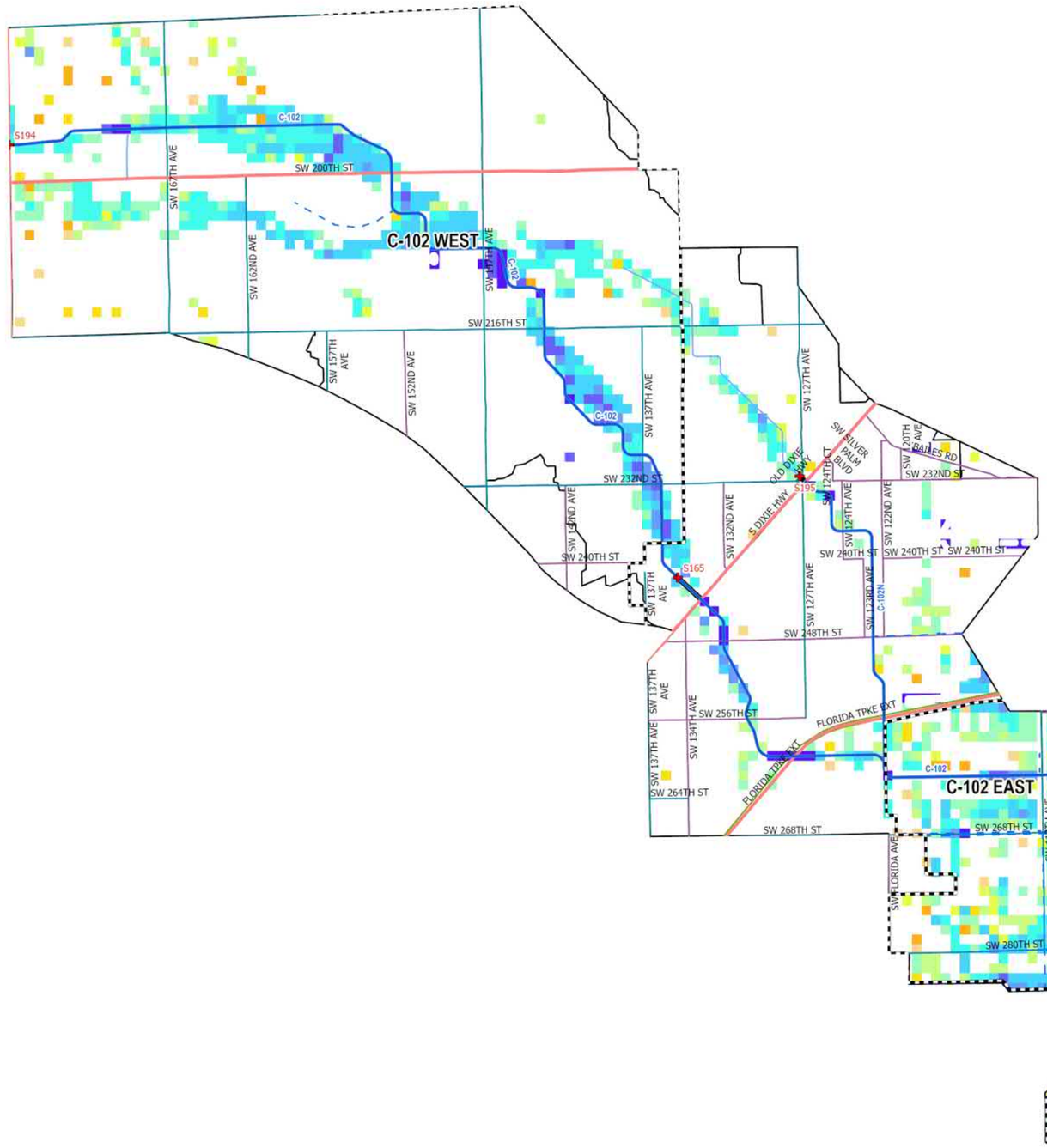
Figure A-208. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 3

Kimley»Horn

WATERSHED C-102: Flood Duration for Entire Watershed



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

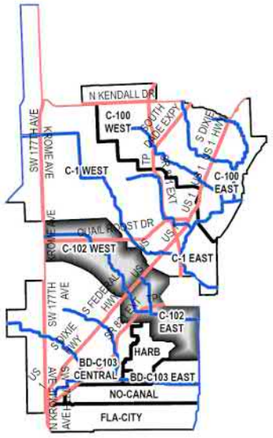
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

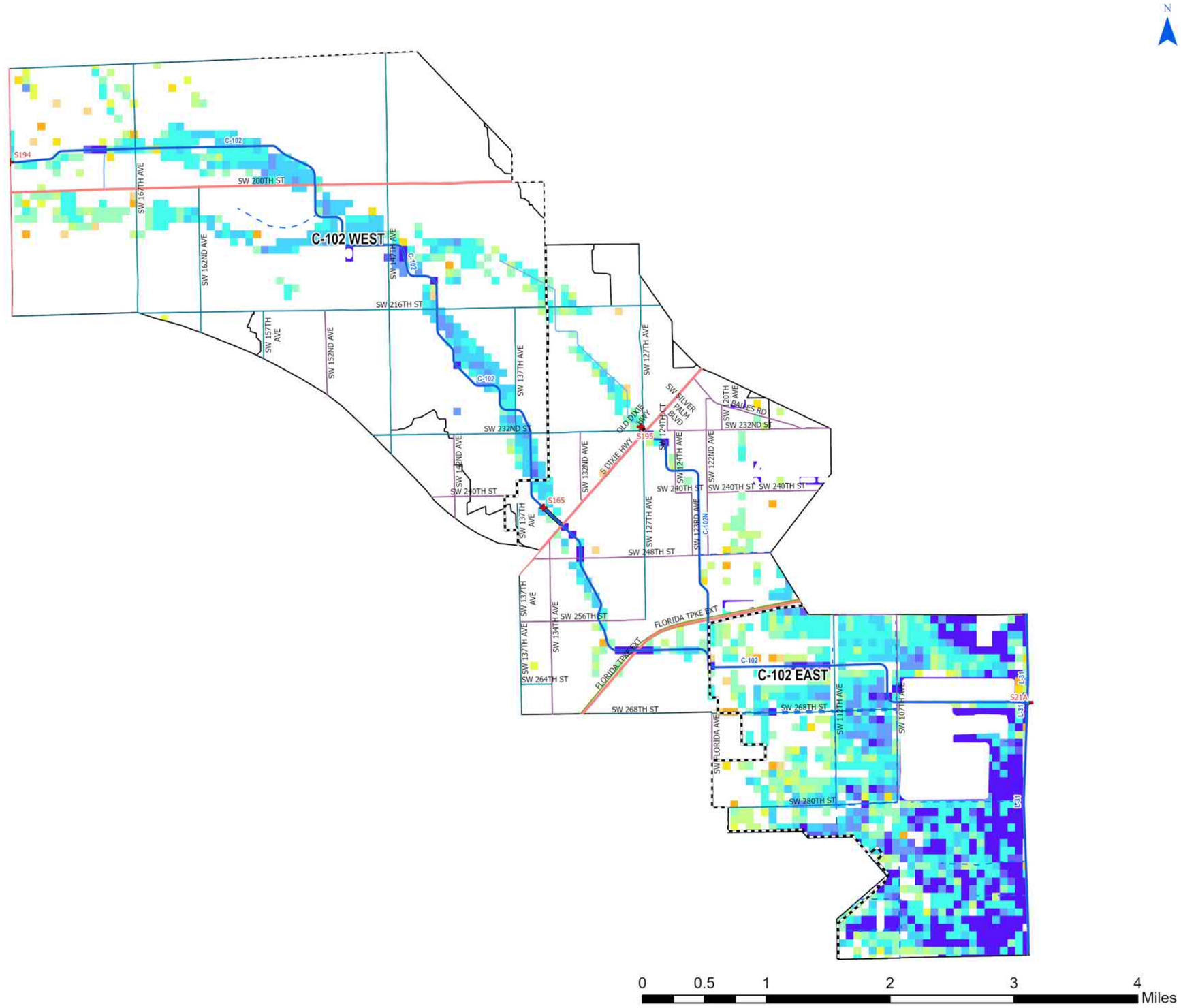
0 0.5 1 2 3 4 Miles

Figure A-209. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

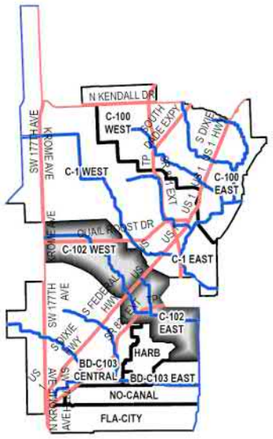
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

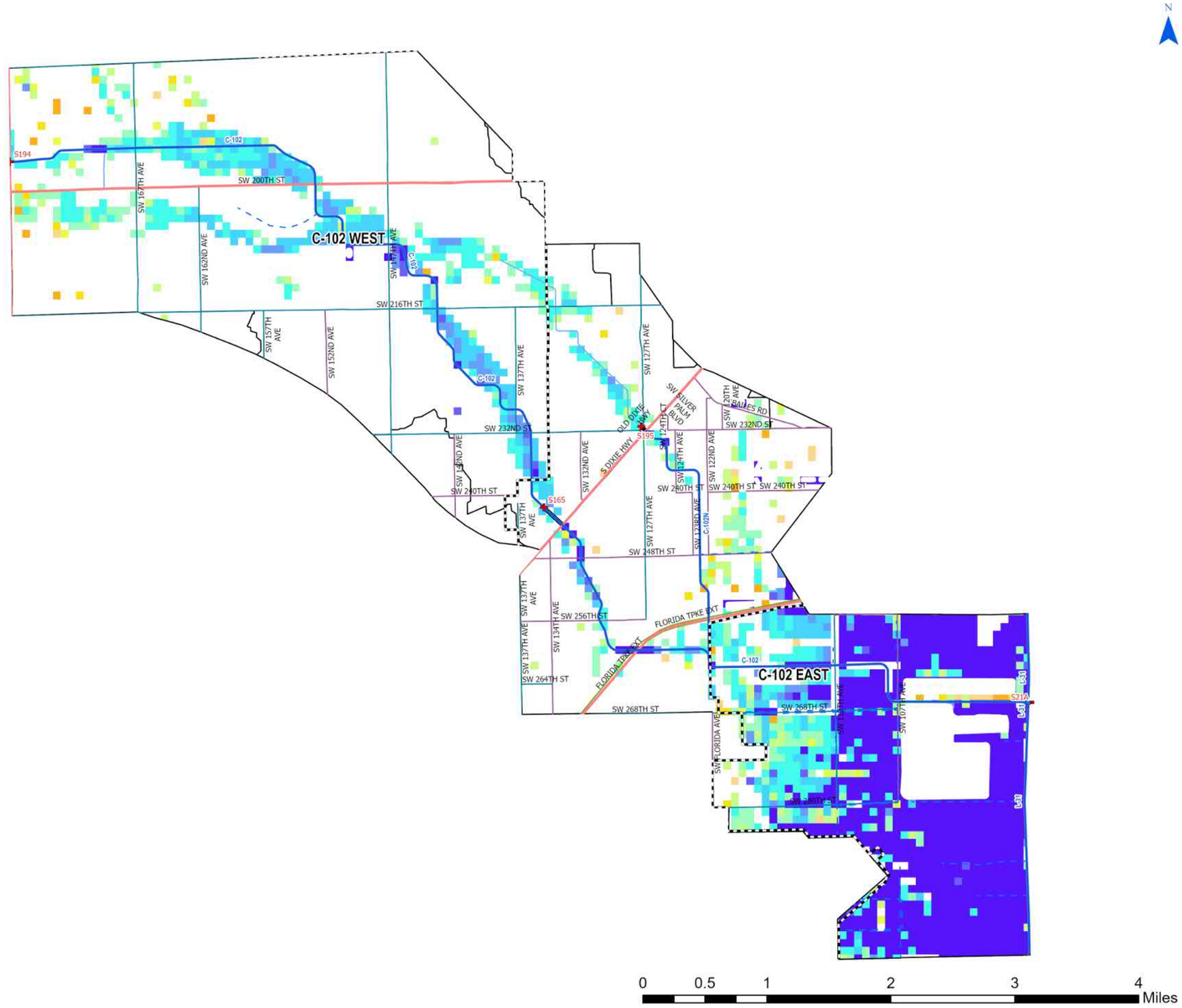
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-210. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

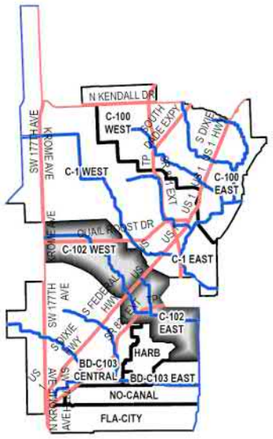
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

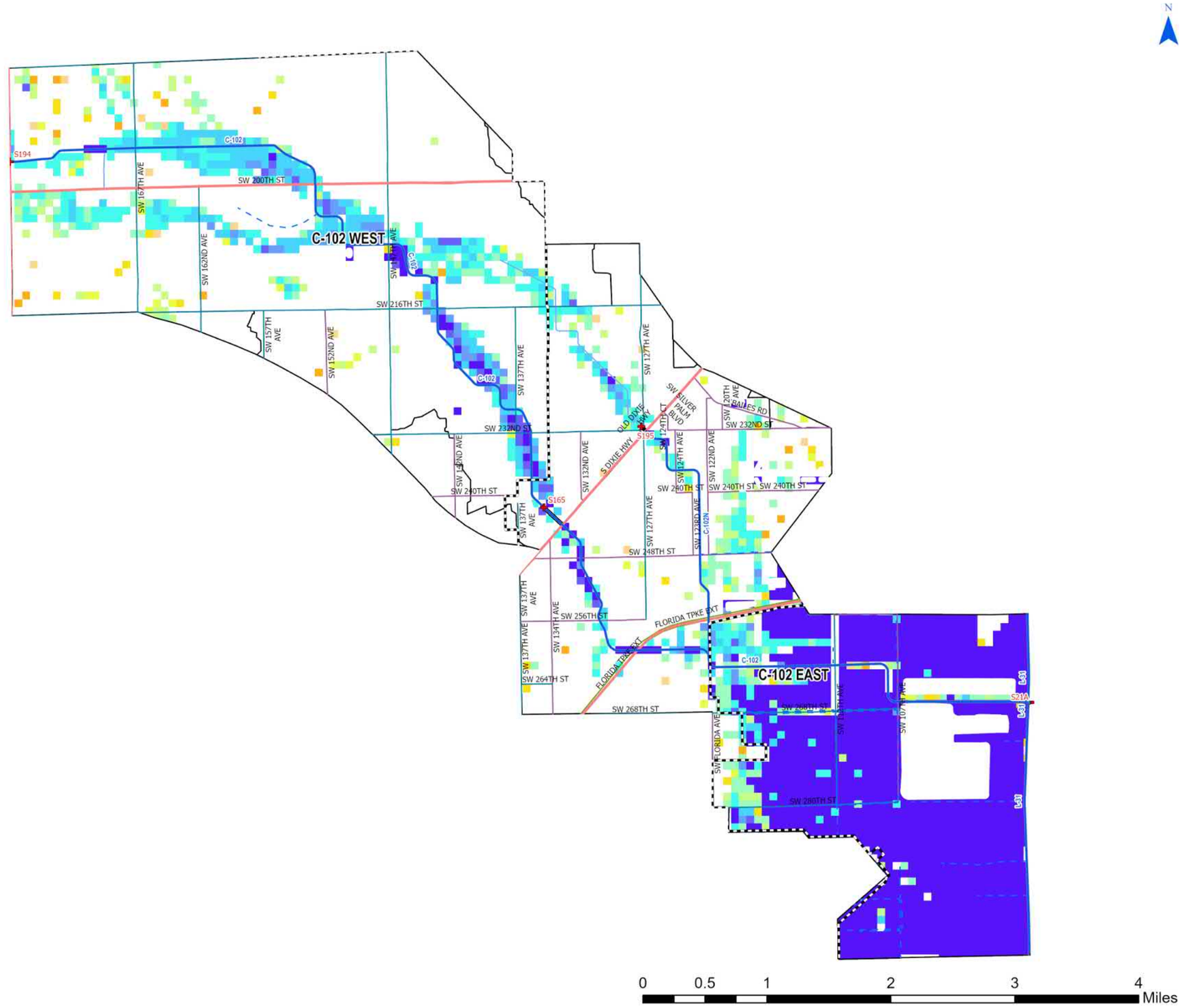
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-211. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 2



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

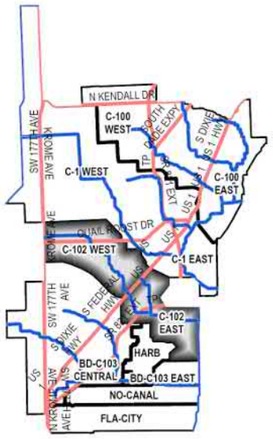
5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

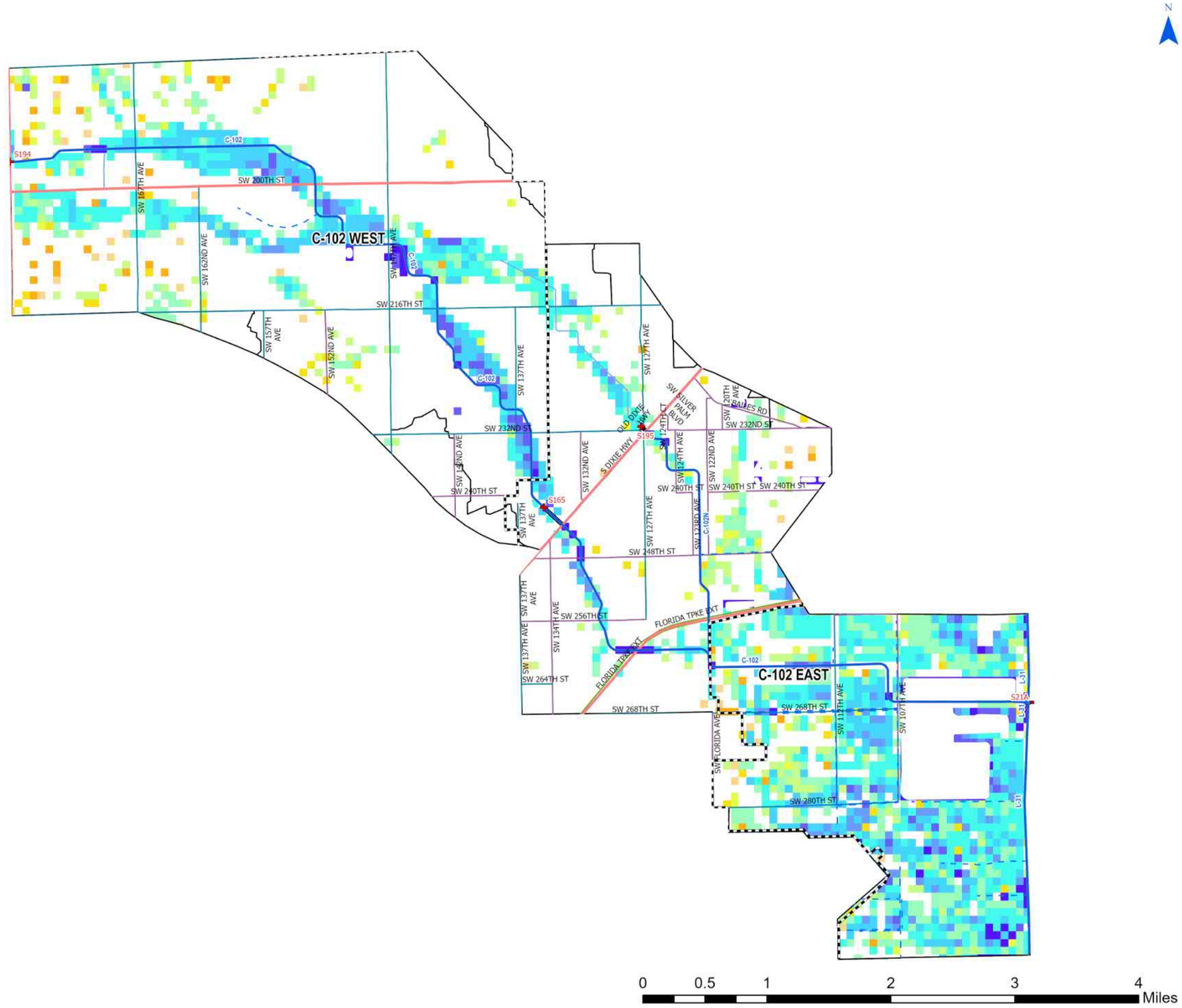
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-212. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

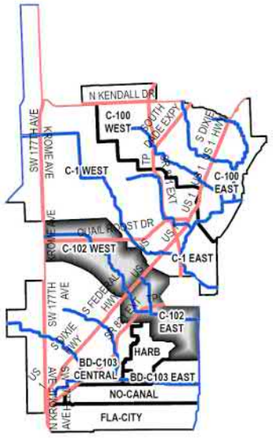
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

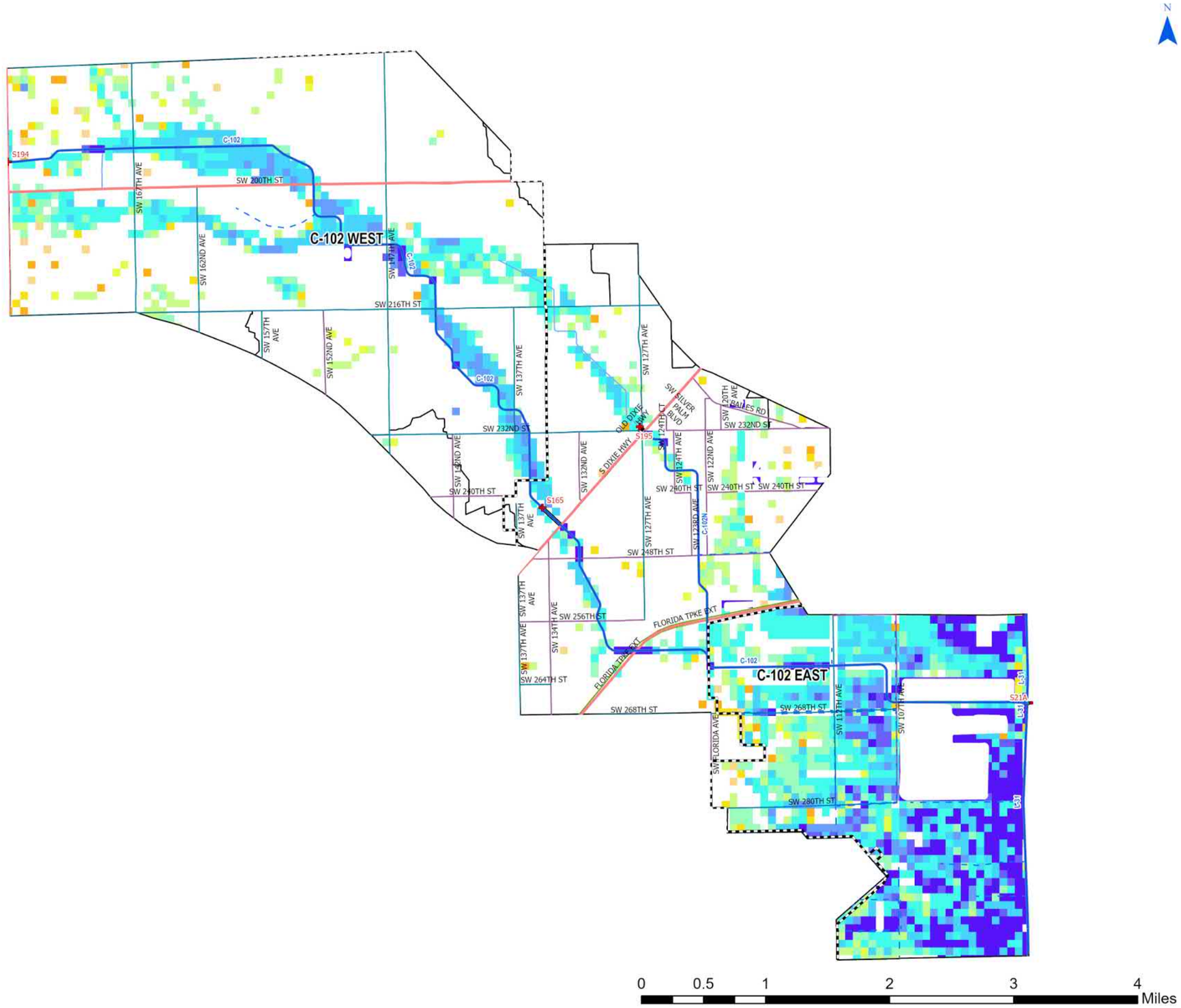
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-213. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 0



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

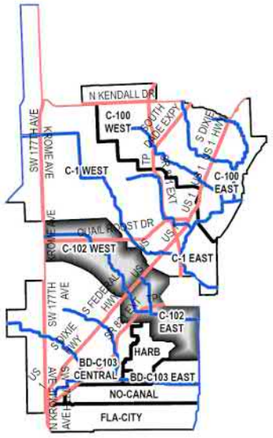
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

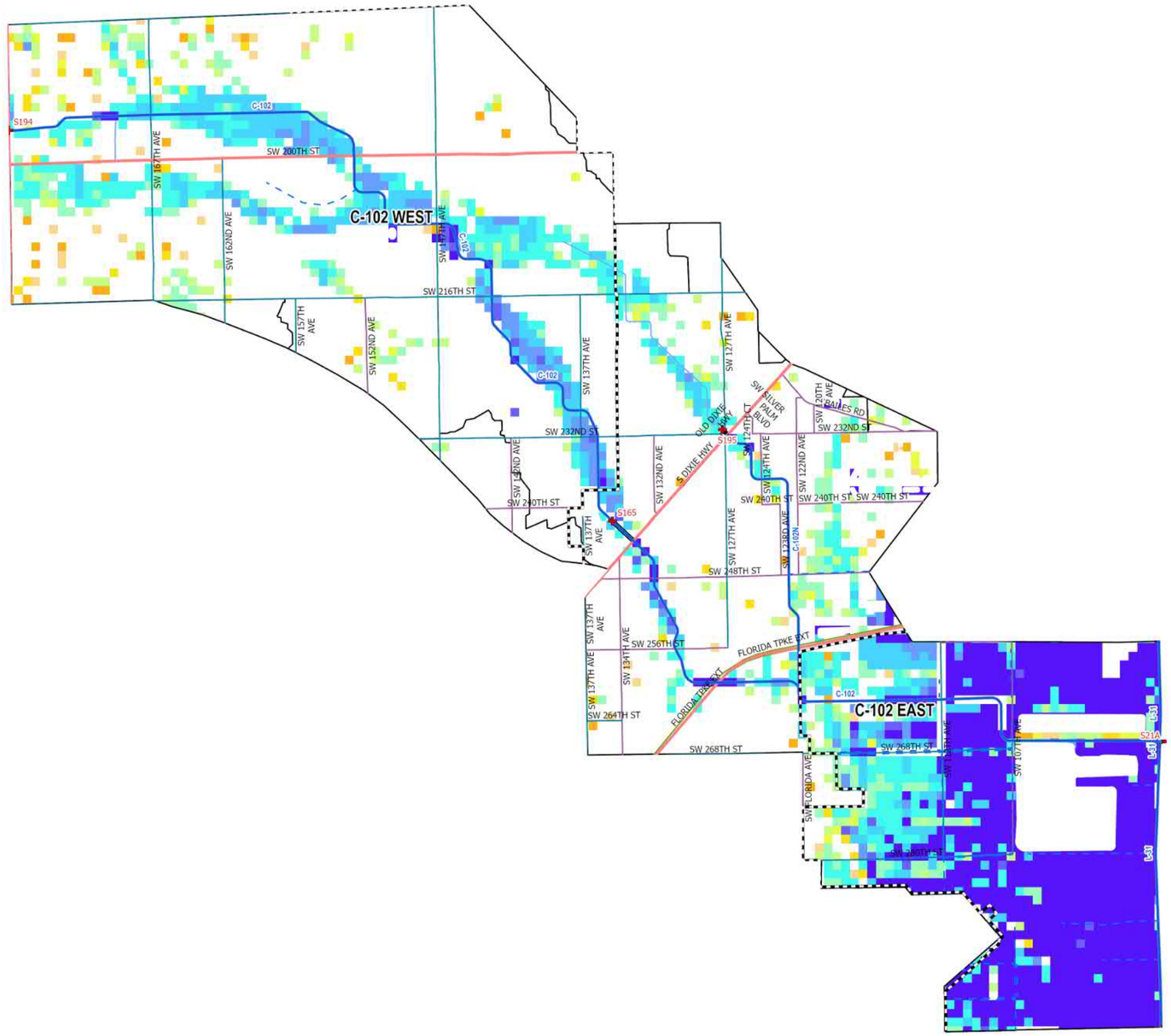
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-214. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-215. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn

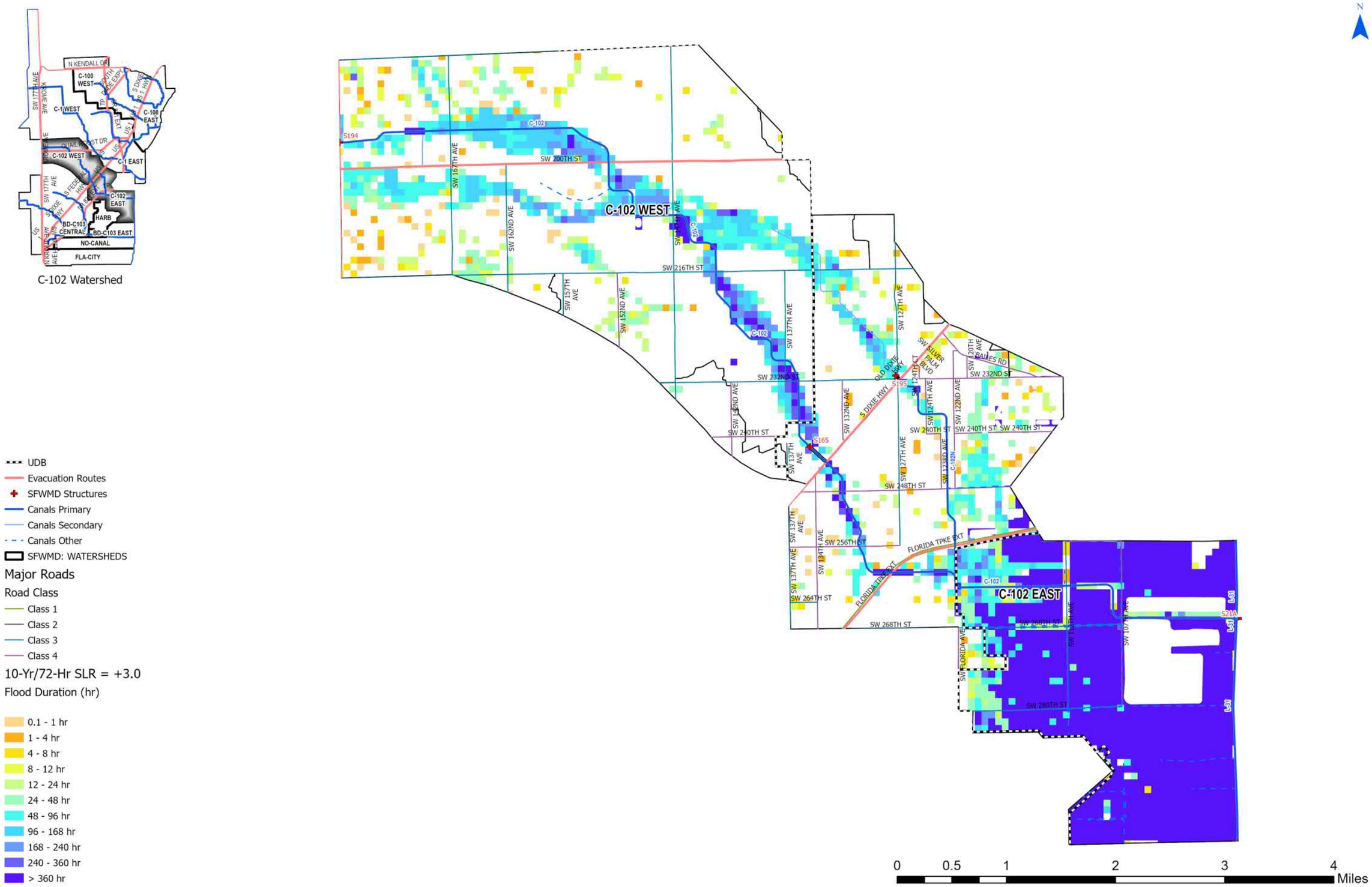
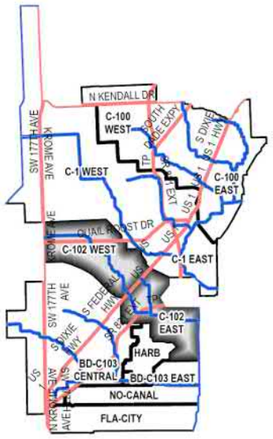
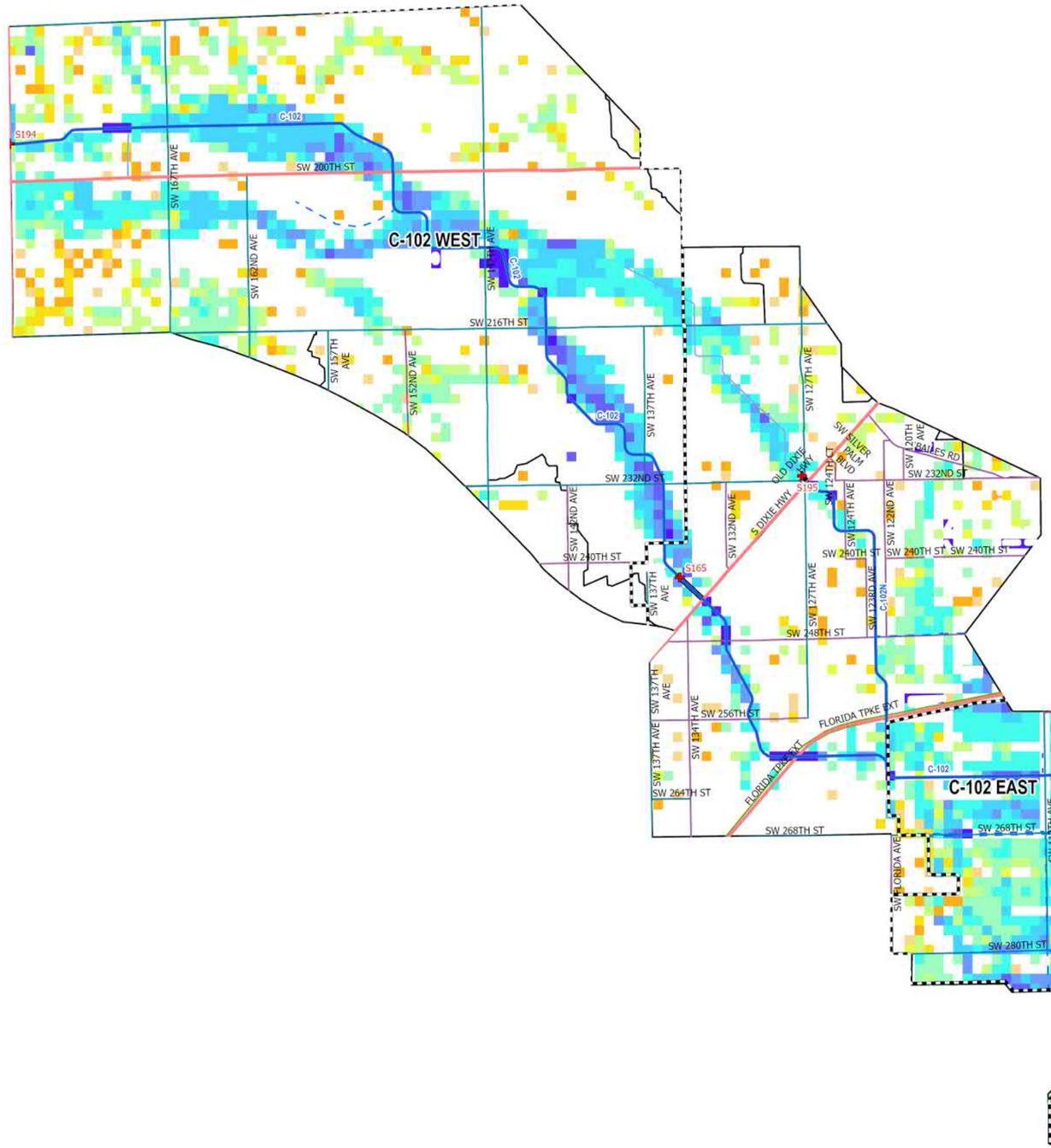


Figure A-216. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 3



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

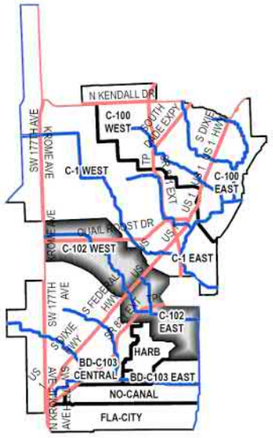
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

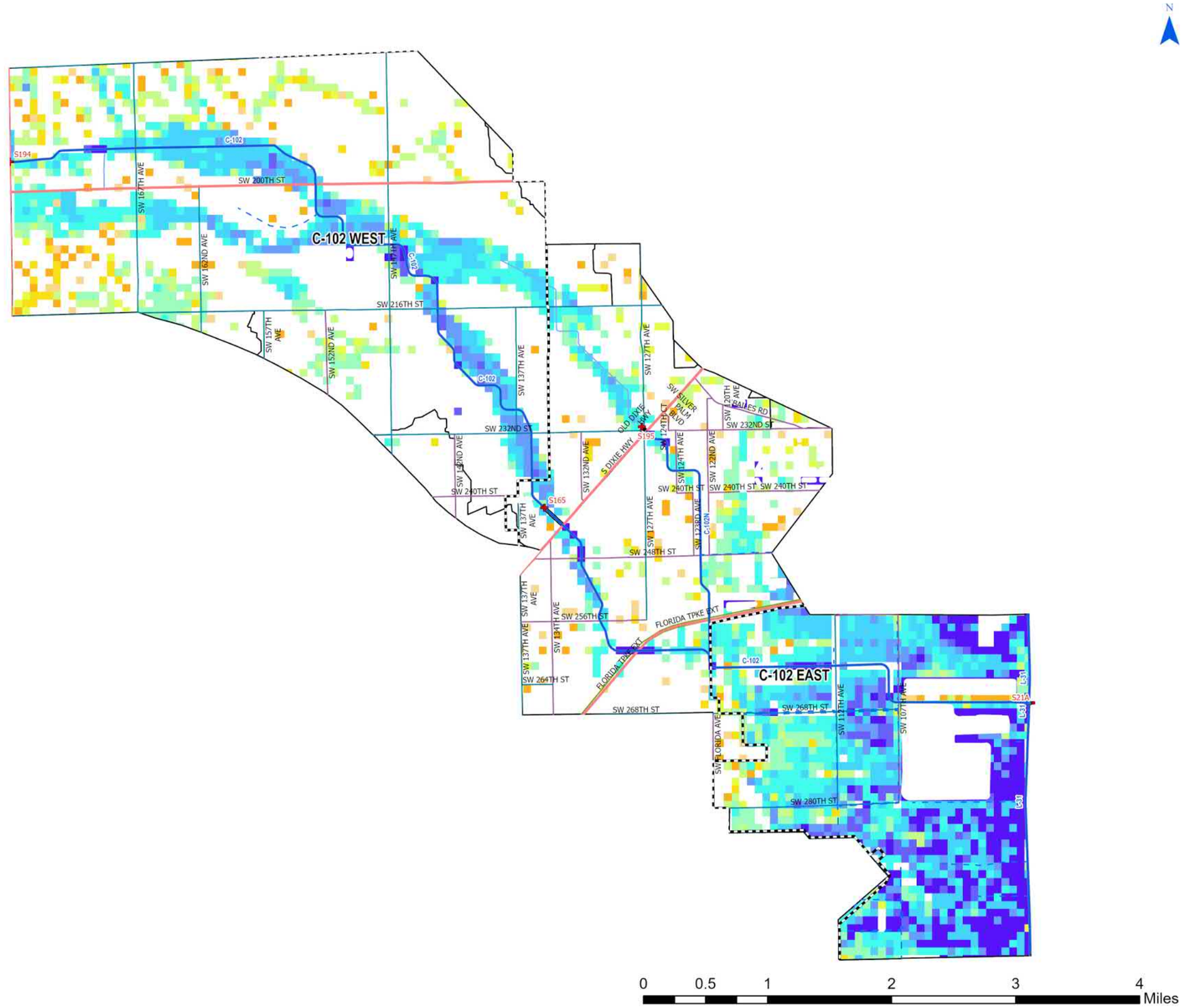
0 0.5 1 2 3 4 Miles

Figure A-217. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

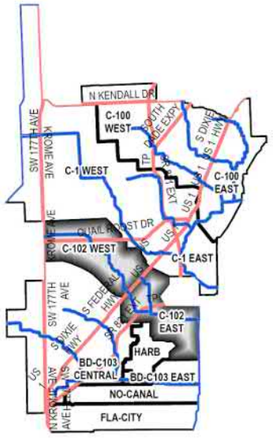
25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

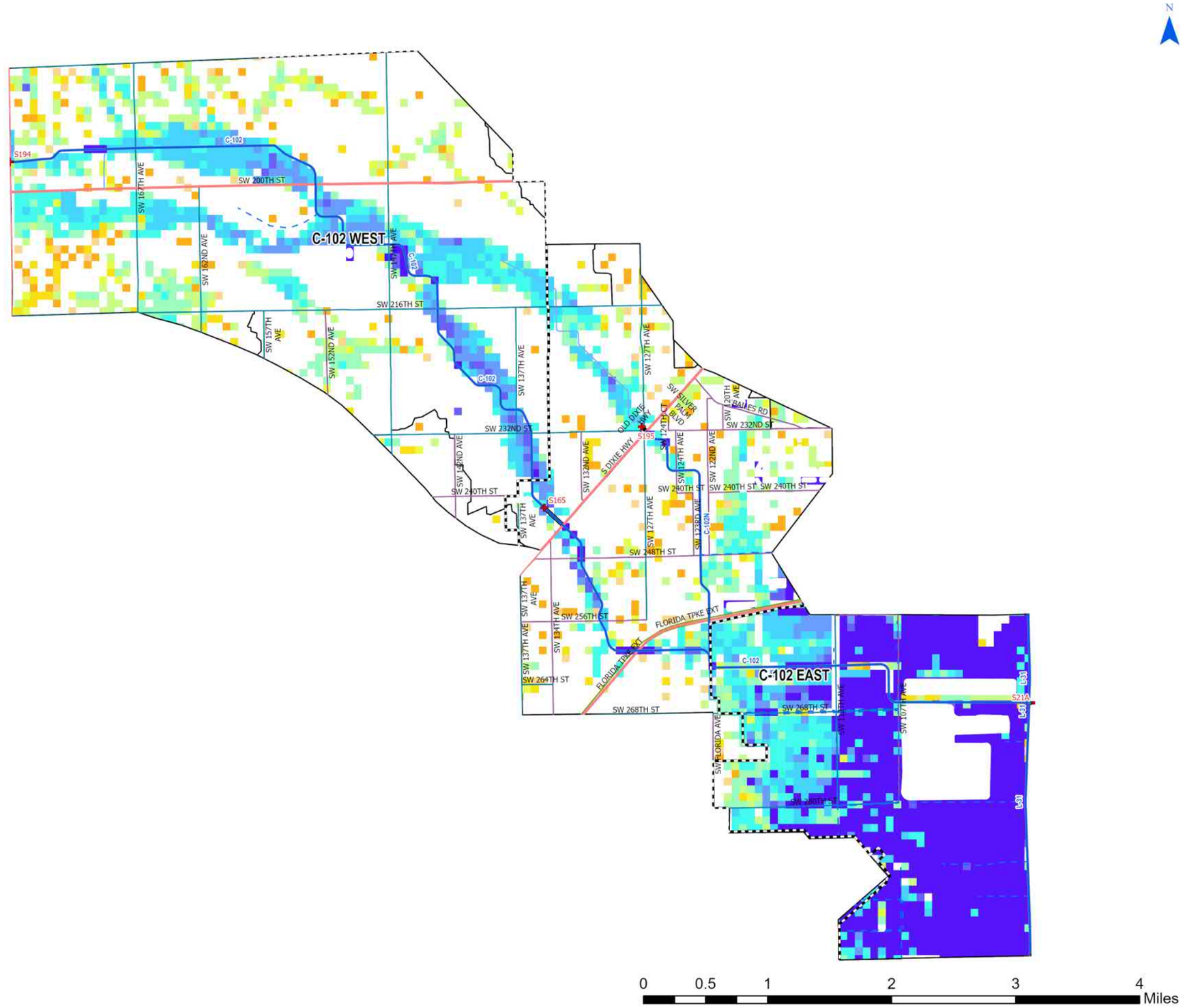
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-218. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

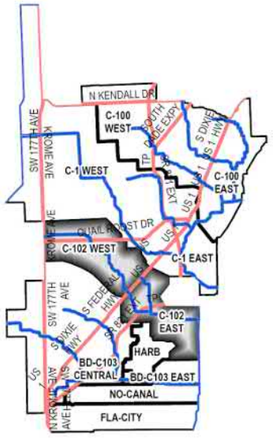
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

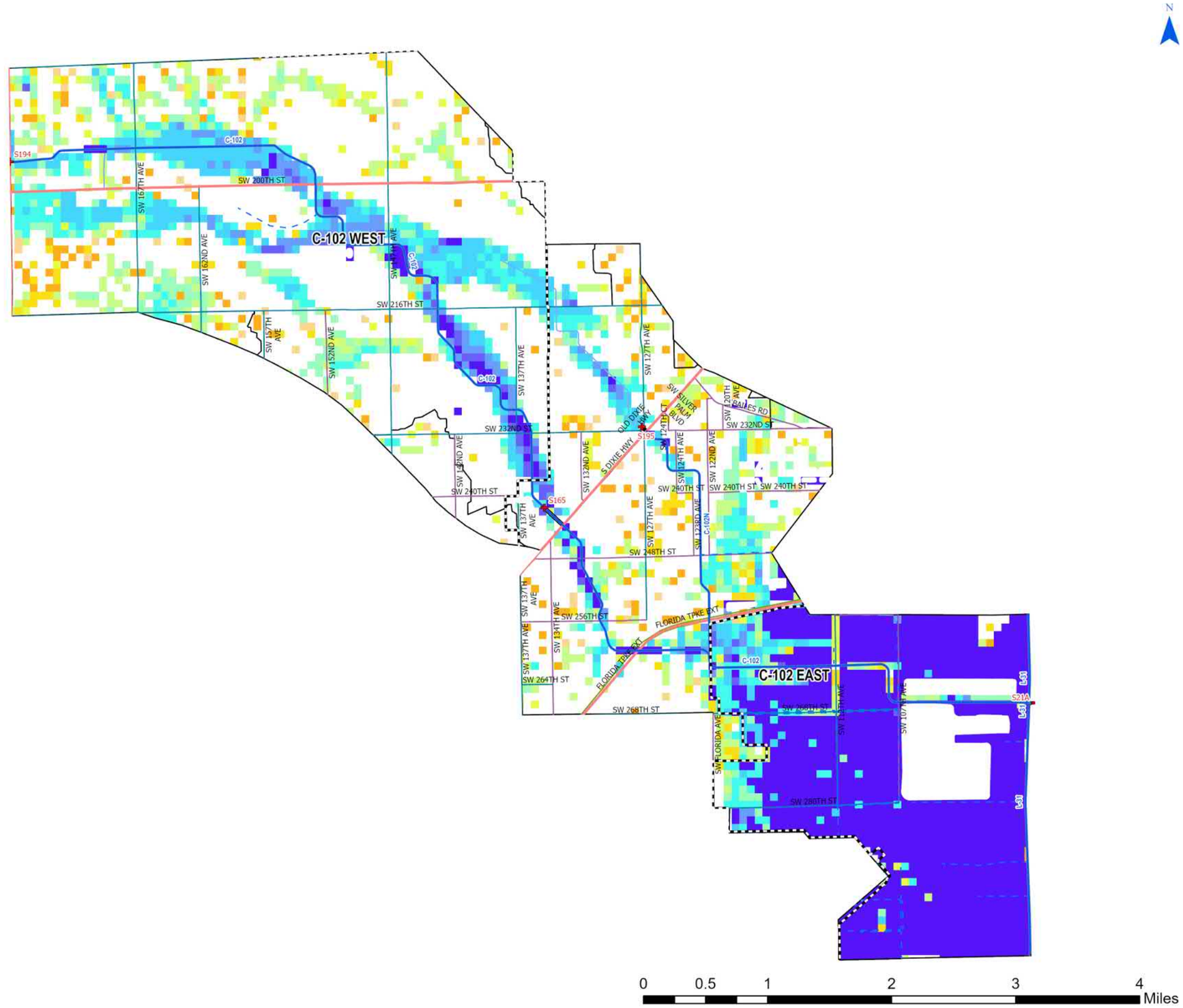
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-219. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 2



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

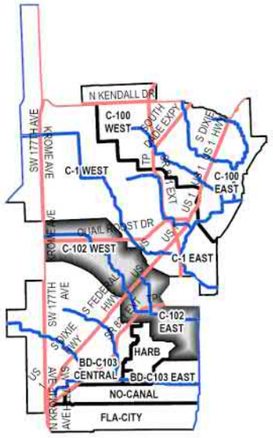
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

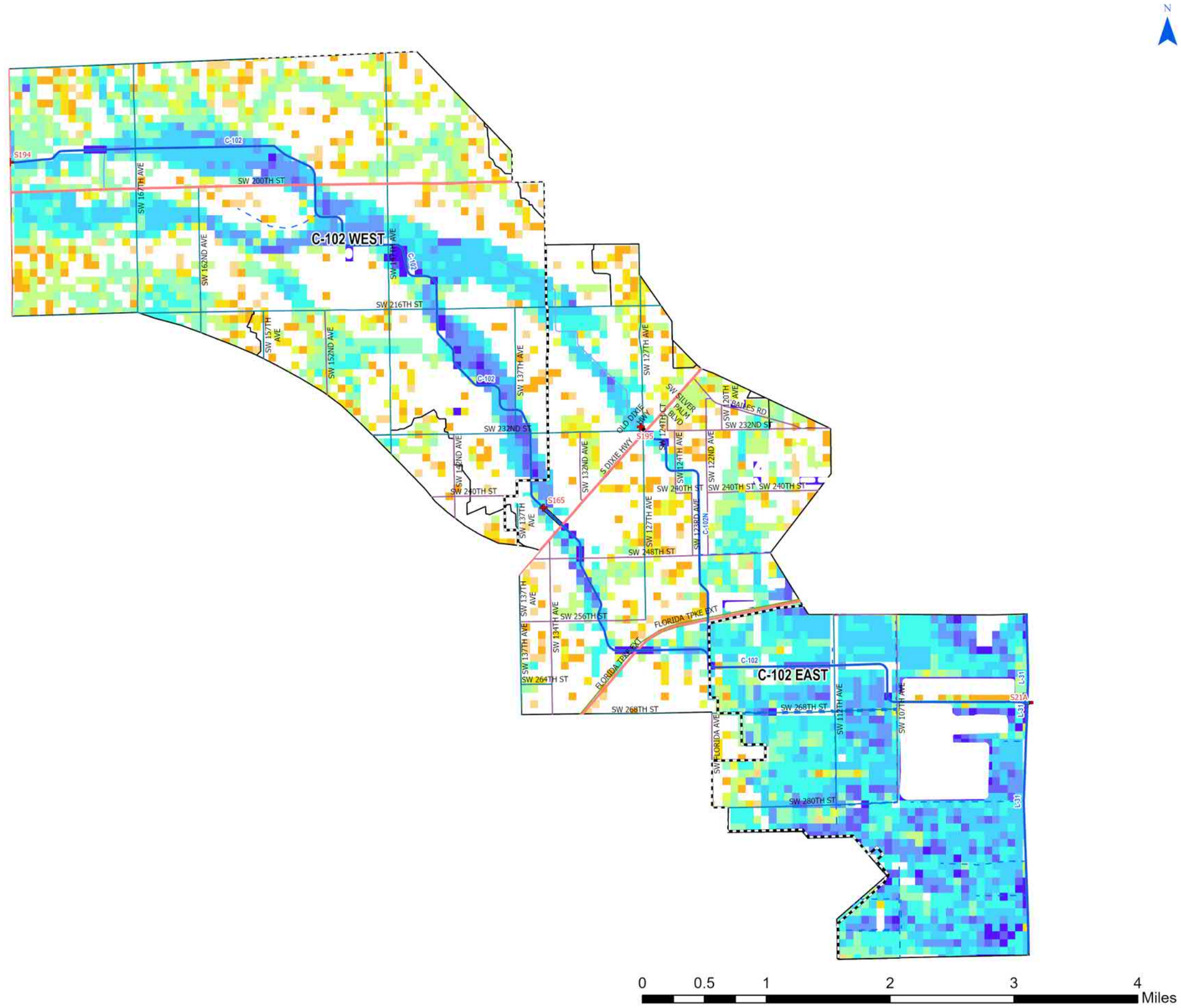
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-220. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

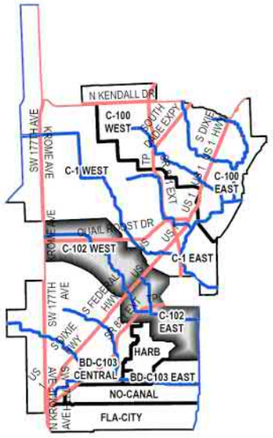
100-Yr/72-Hr SLR = 0

Flood Duration (hr)

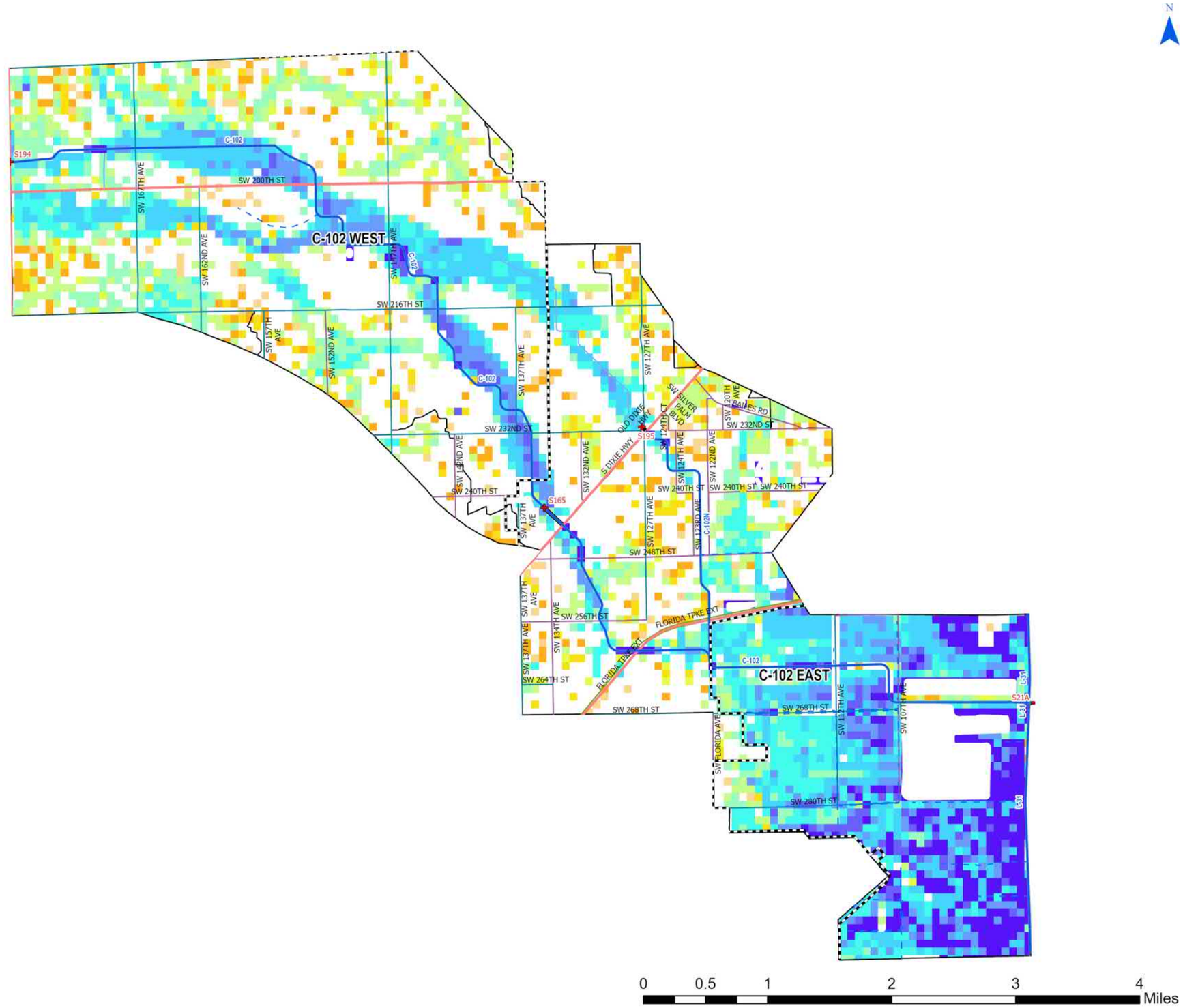
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-221. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

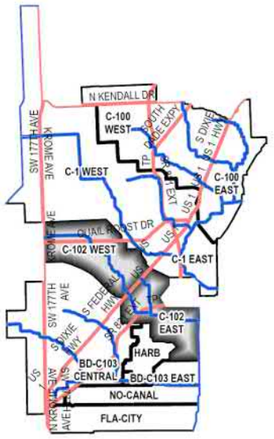
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

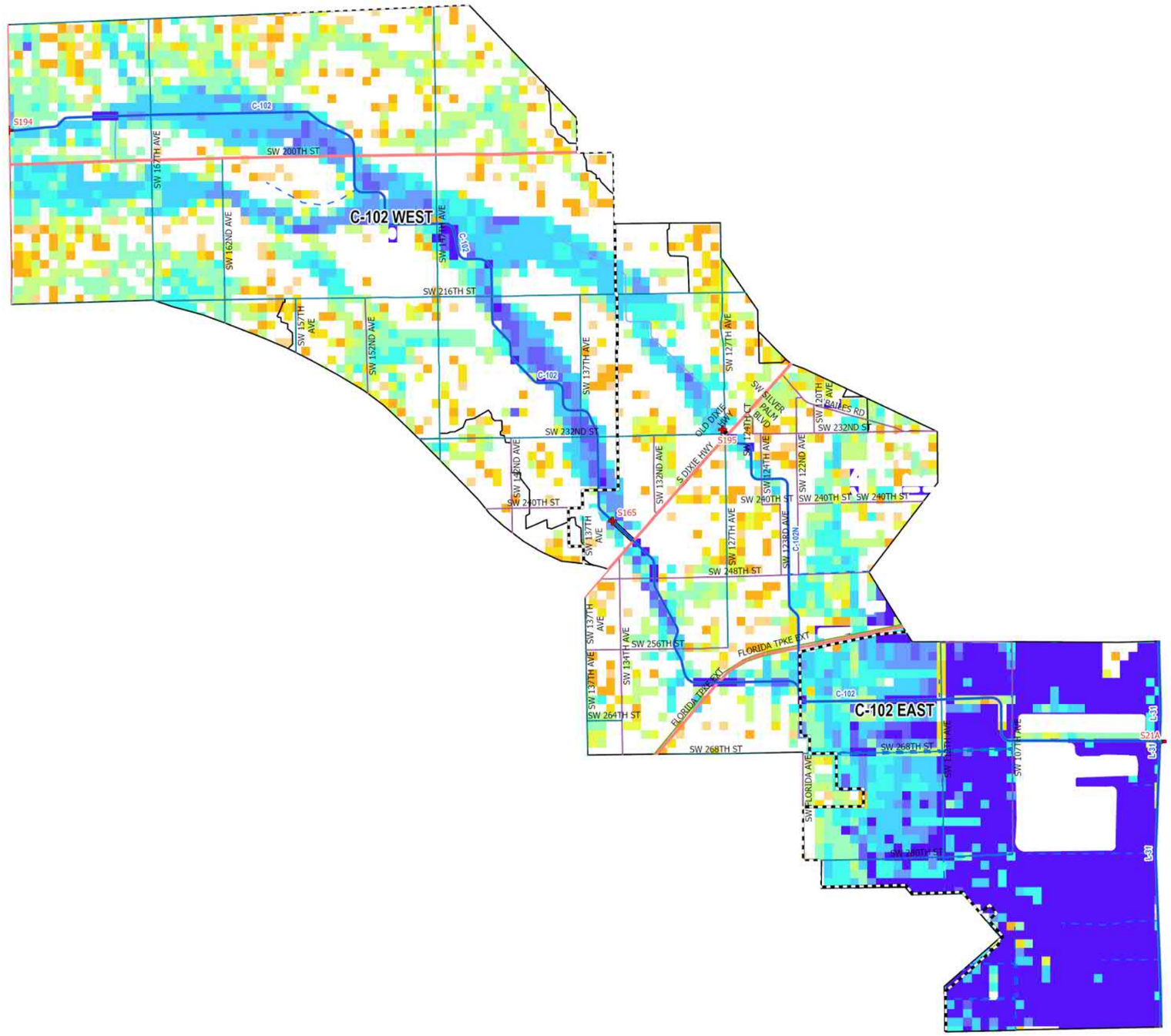
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-222. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 1



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

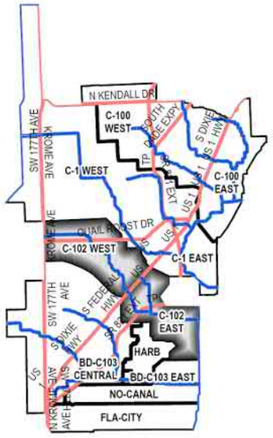
100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

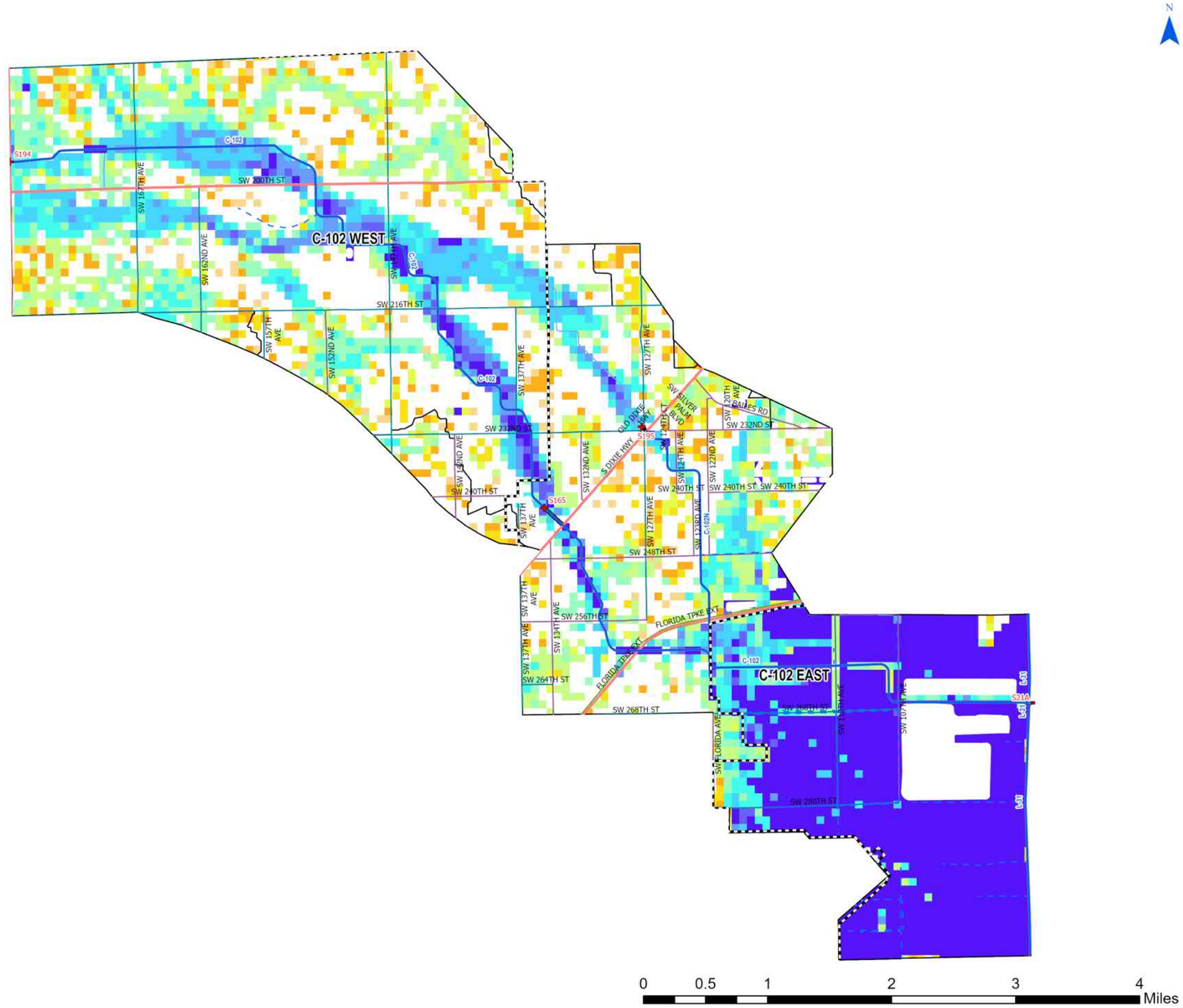
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-223. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 2



C-102 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

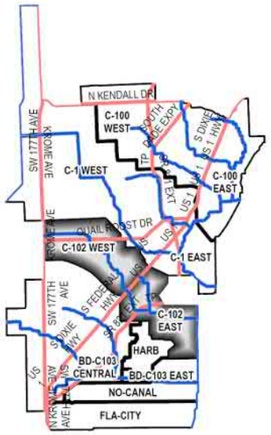
100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

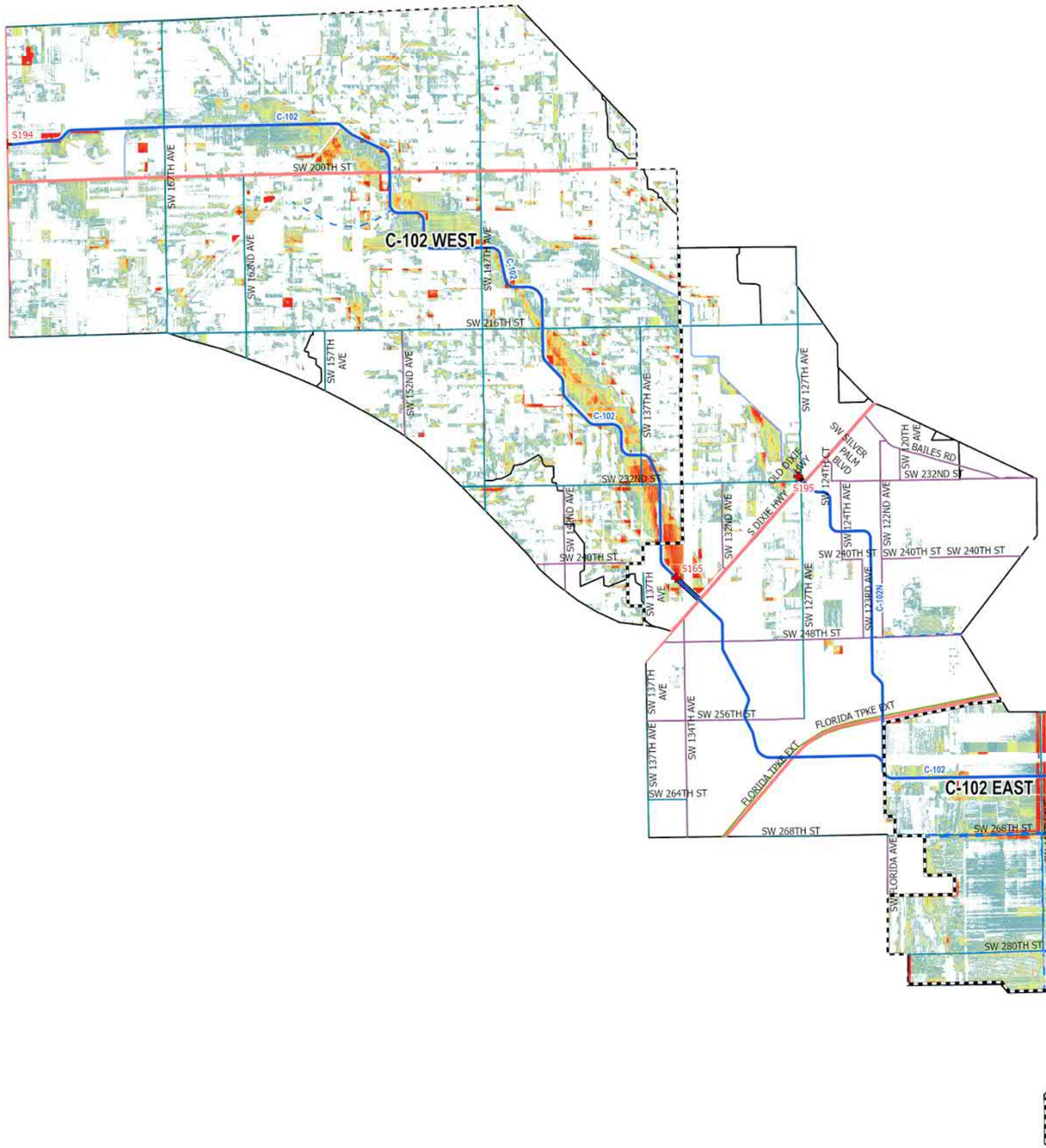
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-224. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 3

WATERSHED C-102: Flood Extent In Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

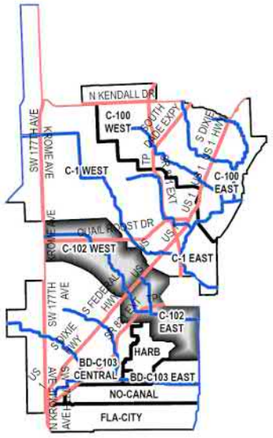
Flood Depth (ft)

- 0 < 0.25 ft
- 0.25 >= 0.50 ft
- 0.50 >= 0.75 ft
- 0.75 >= 1.00 ft
- 1.00 >= 1.25 ft
- 1.25 >= 1.50 ft
- 1.50 >= 1.75 ft
- 1.75 >= 2.00 ft
- 2.00 >= 2.25 ft
- 2.25 >= 2.50 ft
- >= 2.50 ft

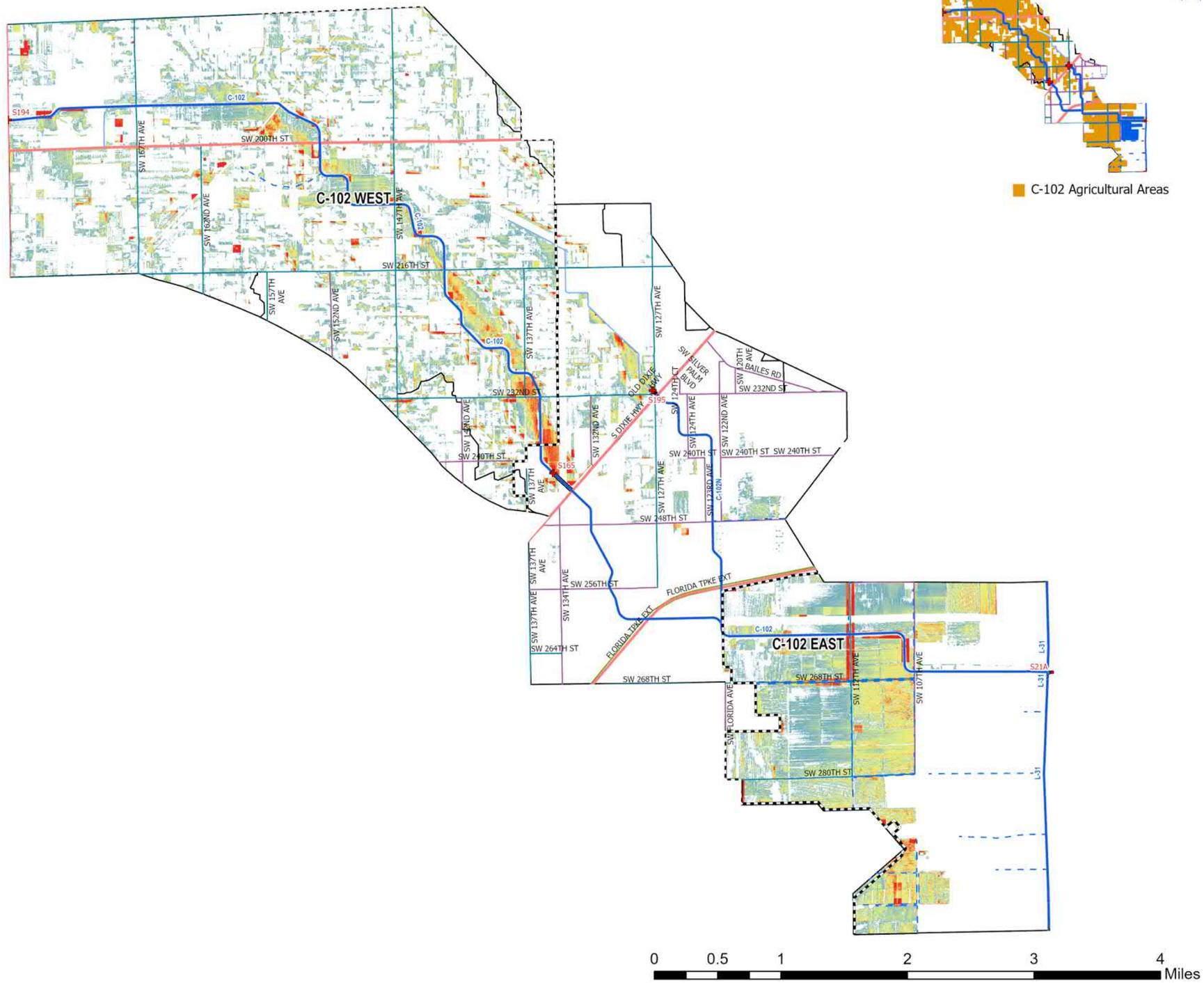
0 0.5 1 2 3 4 Miles

Figure A-225. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

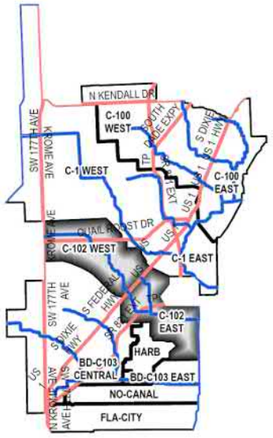
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

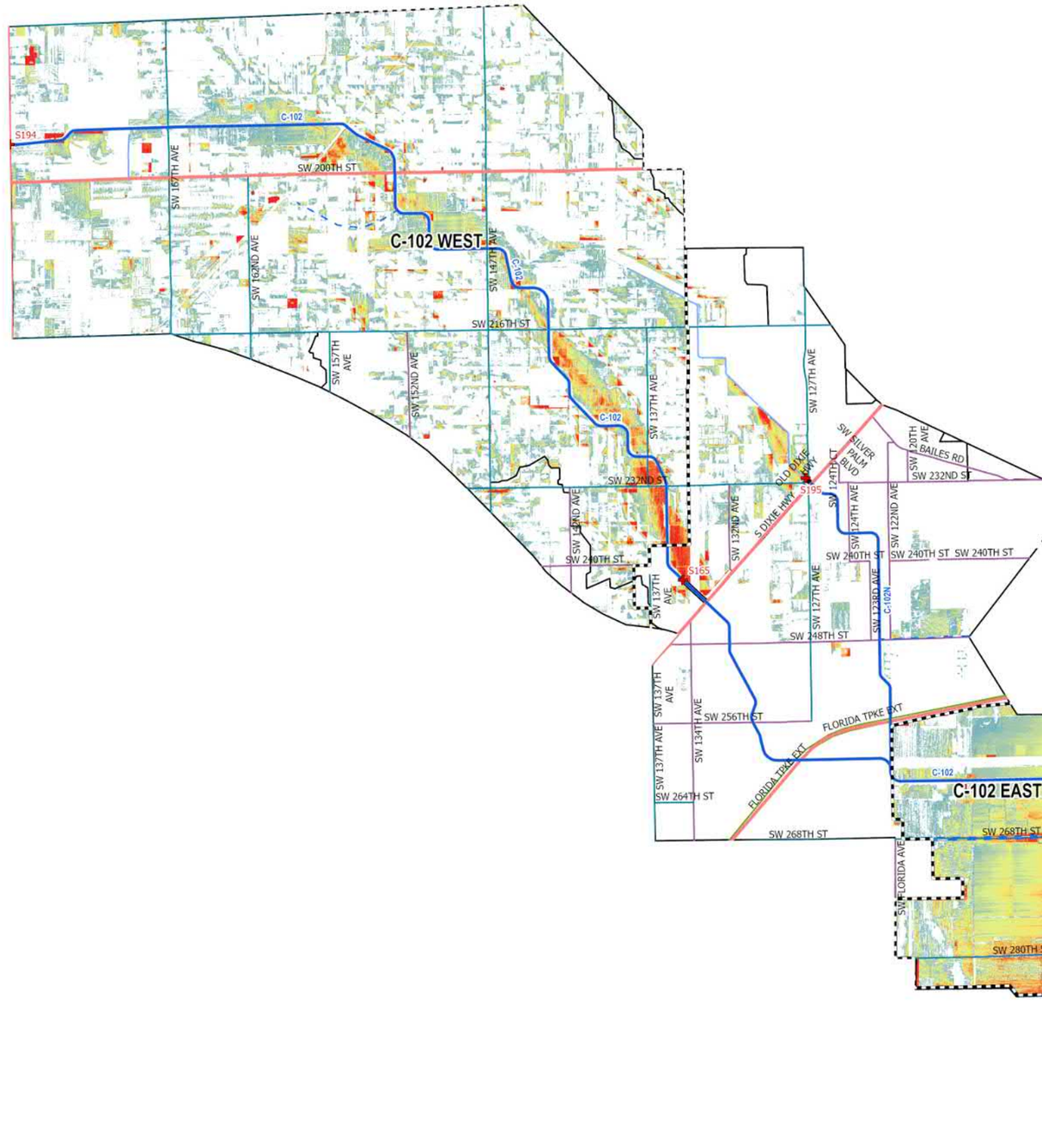
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-226. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

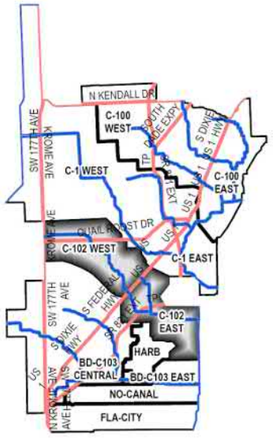
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

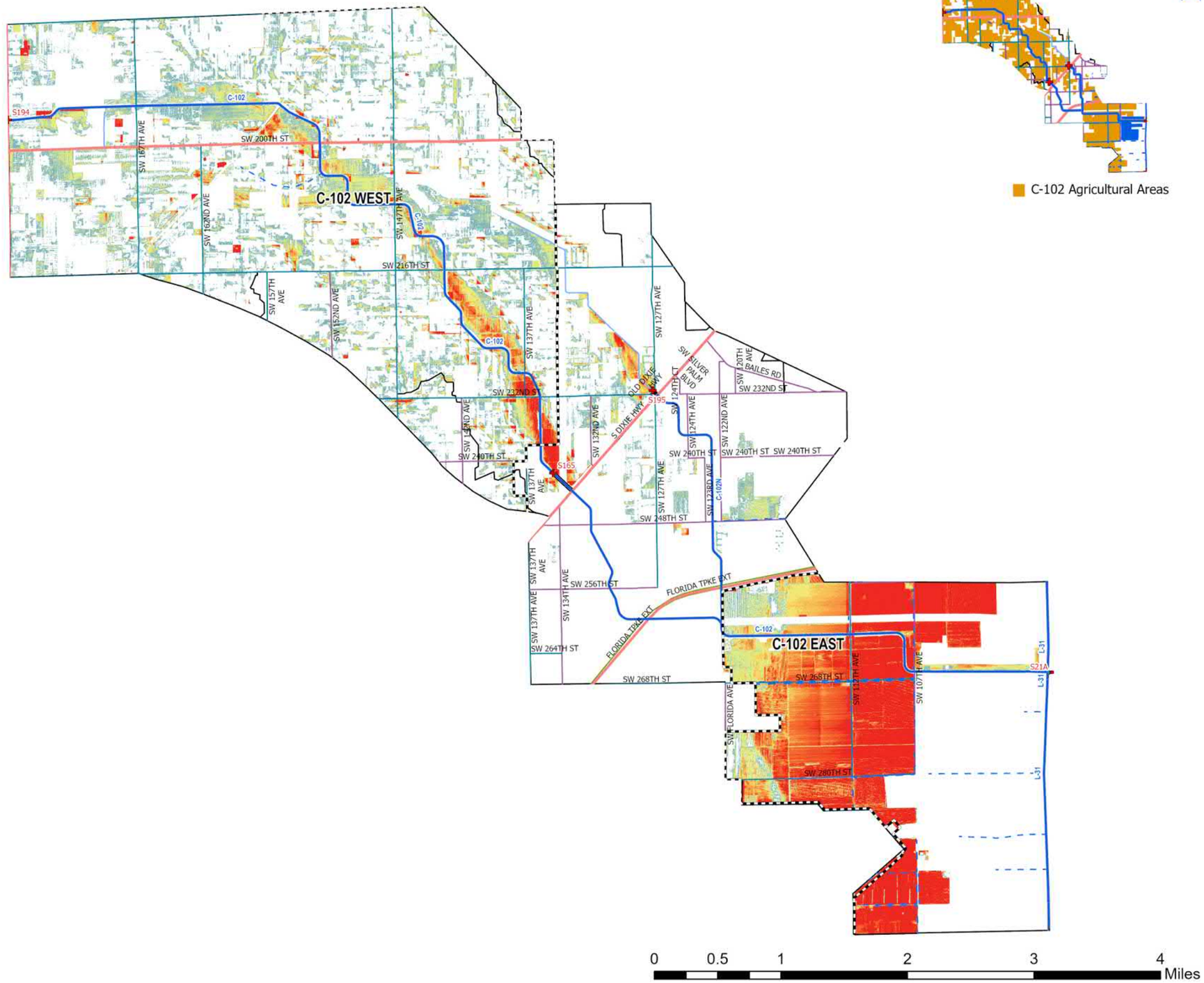
0 0.5 1 2 3 4 Miles

Figure A-227. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

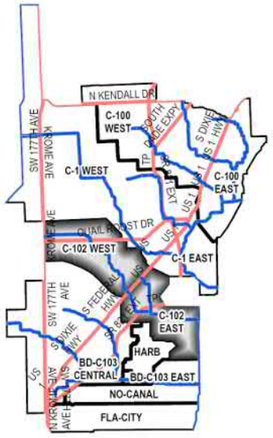
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

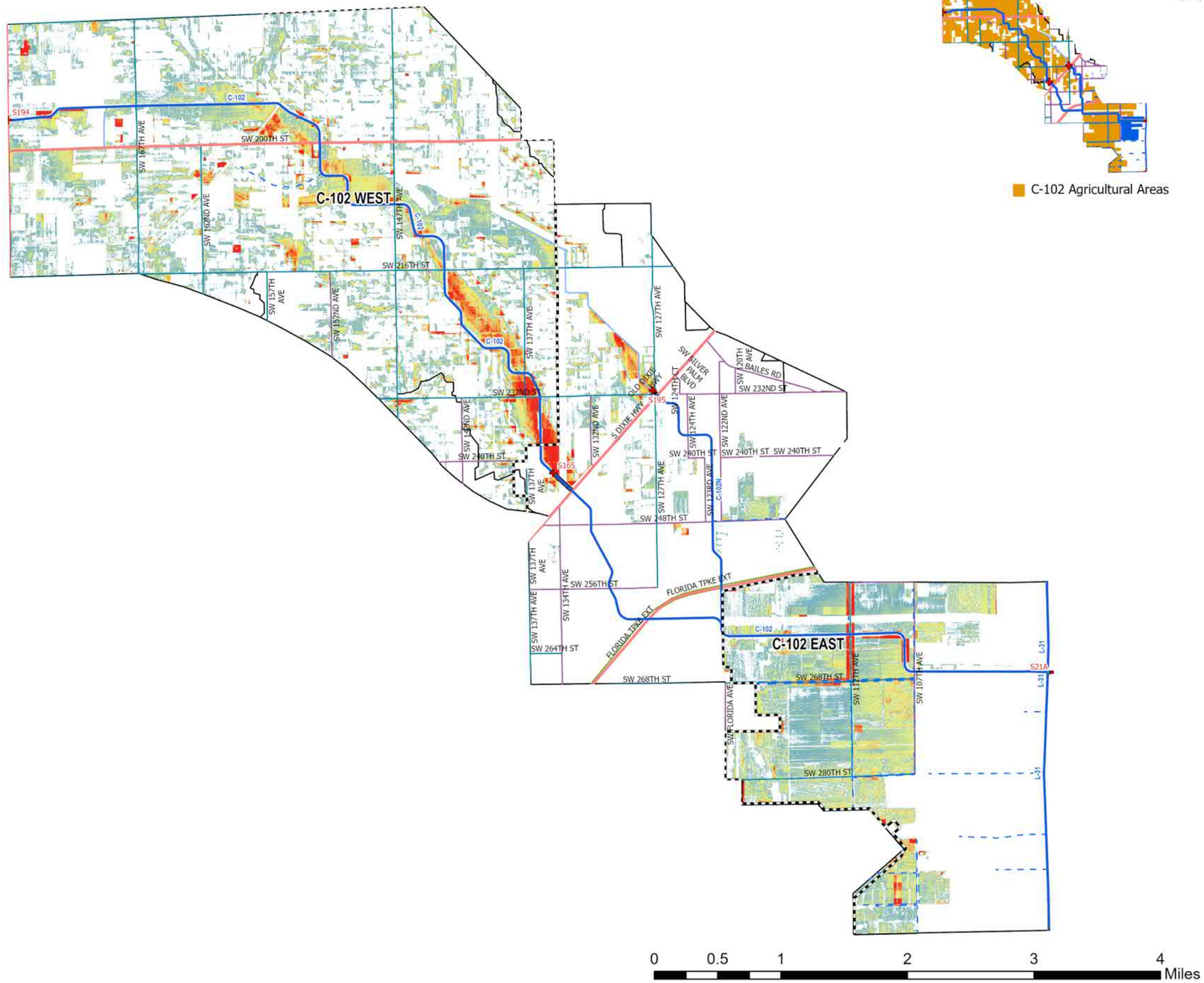
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-228. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

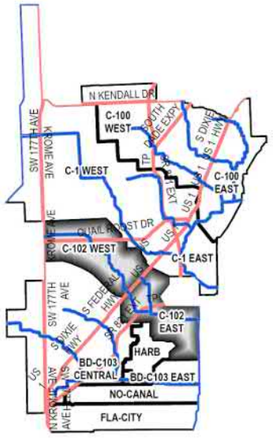
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

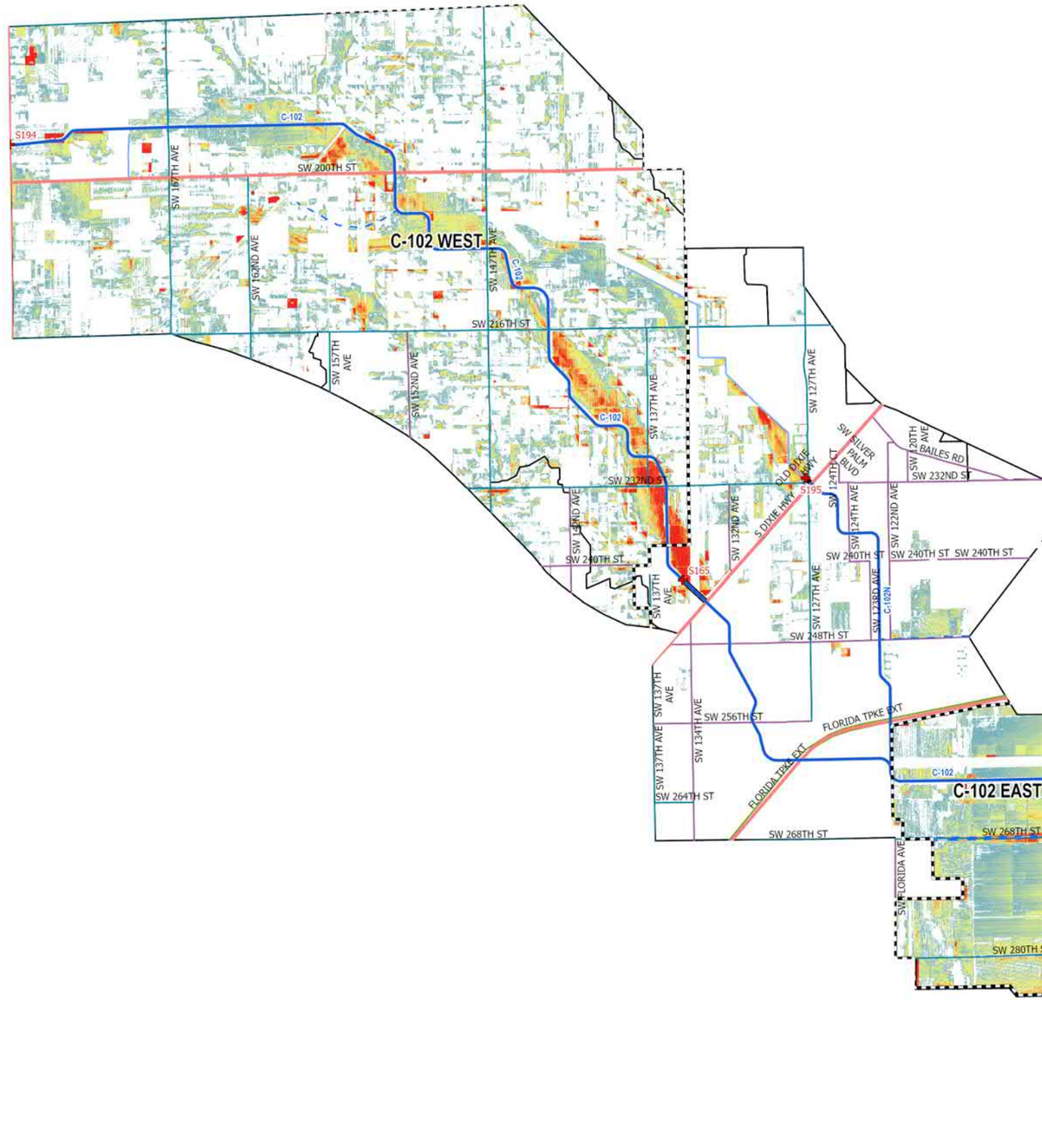
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-229. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

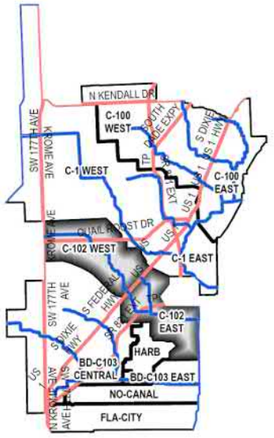
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

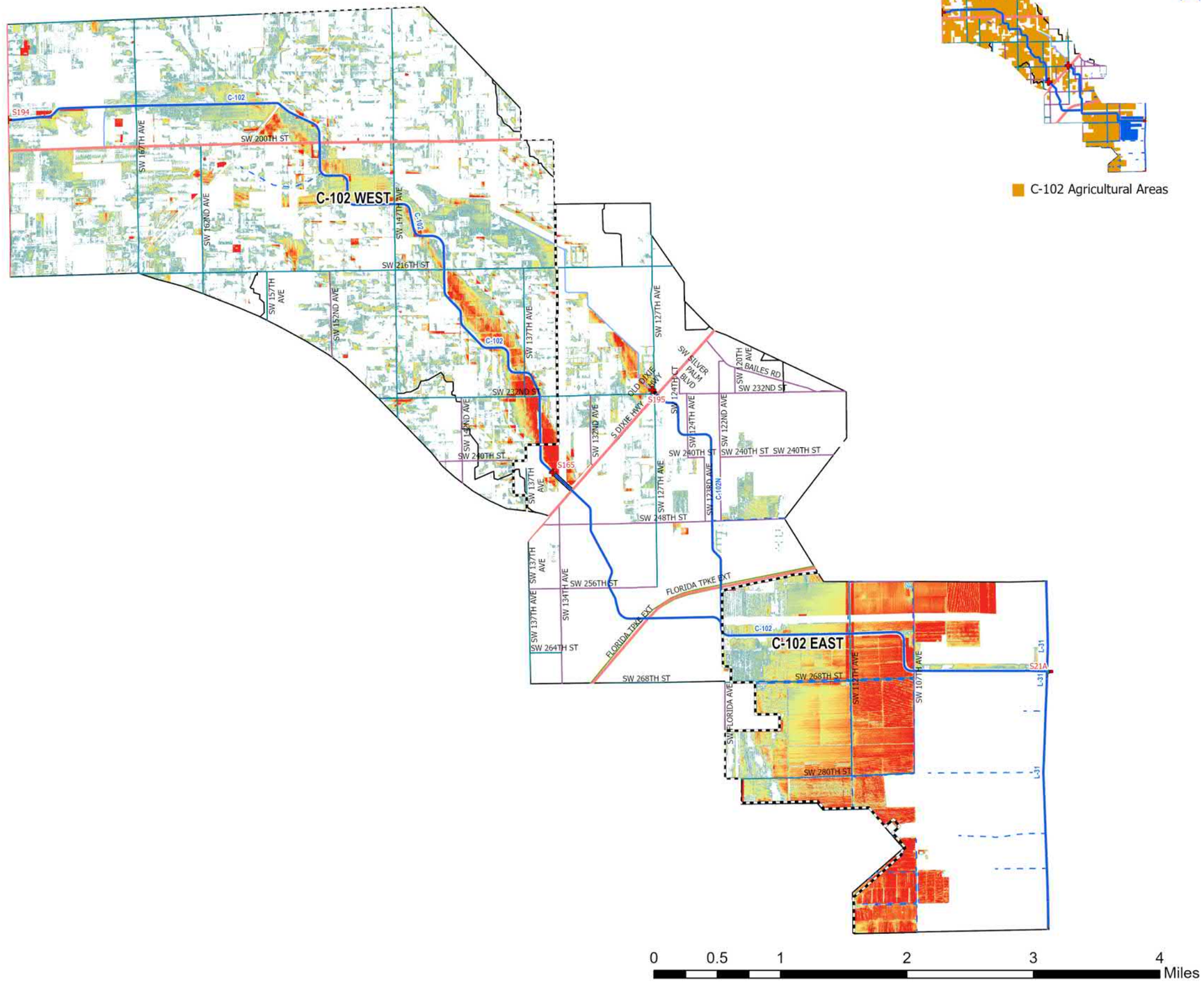
0 0.5 1 2 3 4 Miles

Figure A-230. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

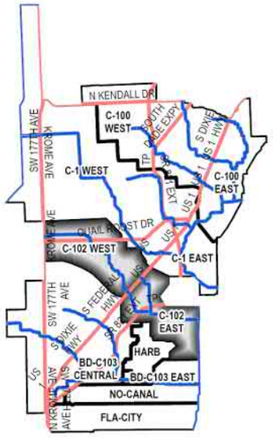
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

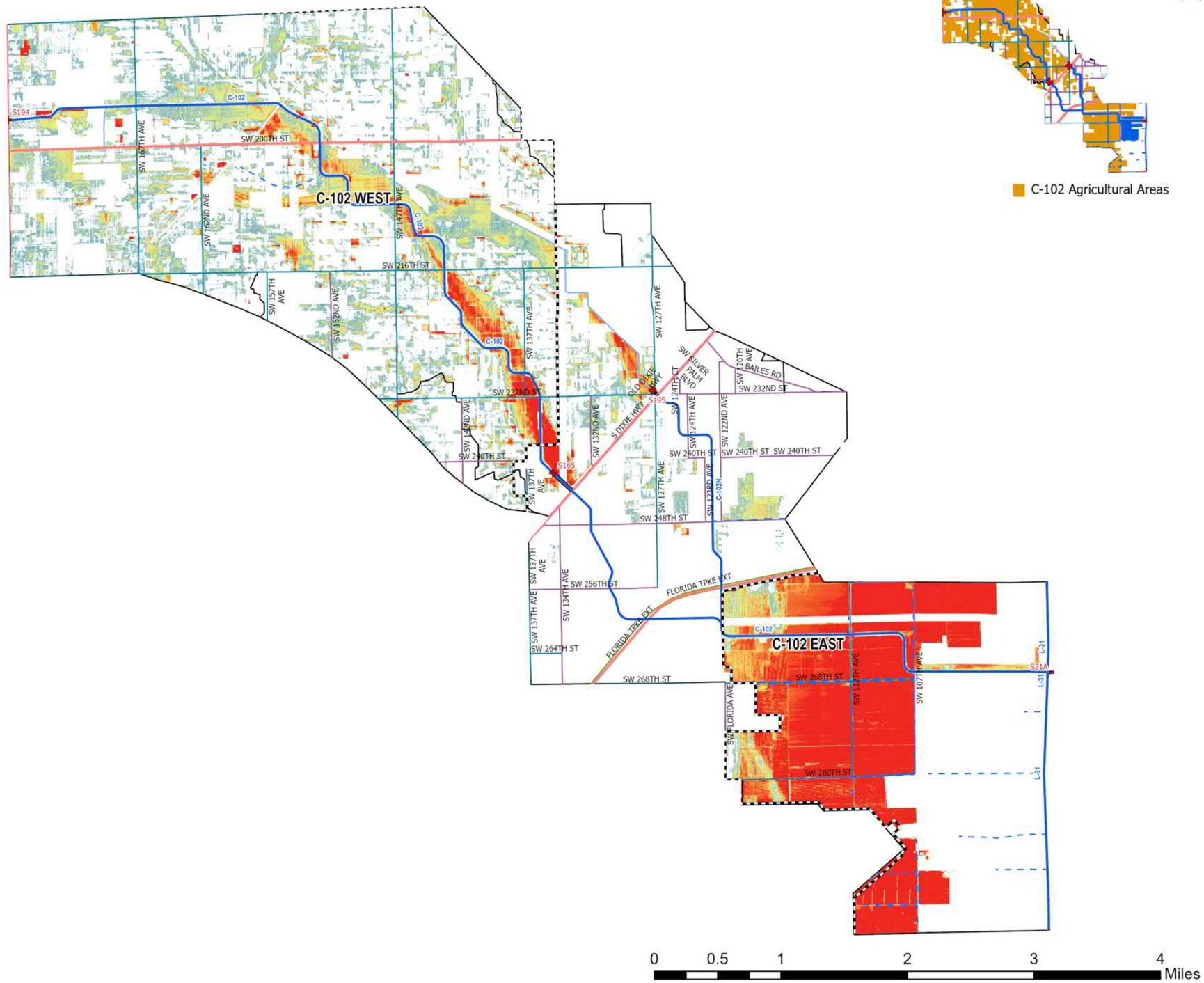
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-231. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

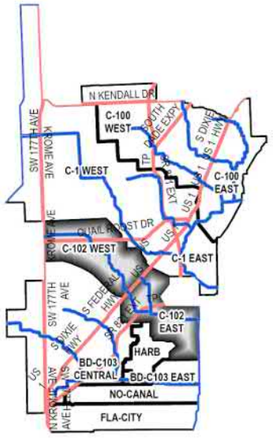
10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

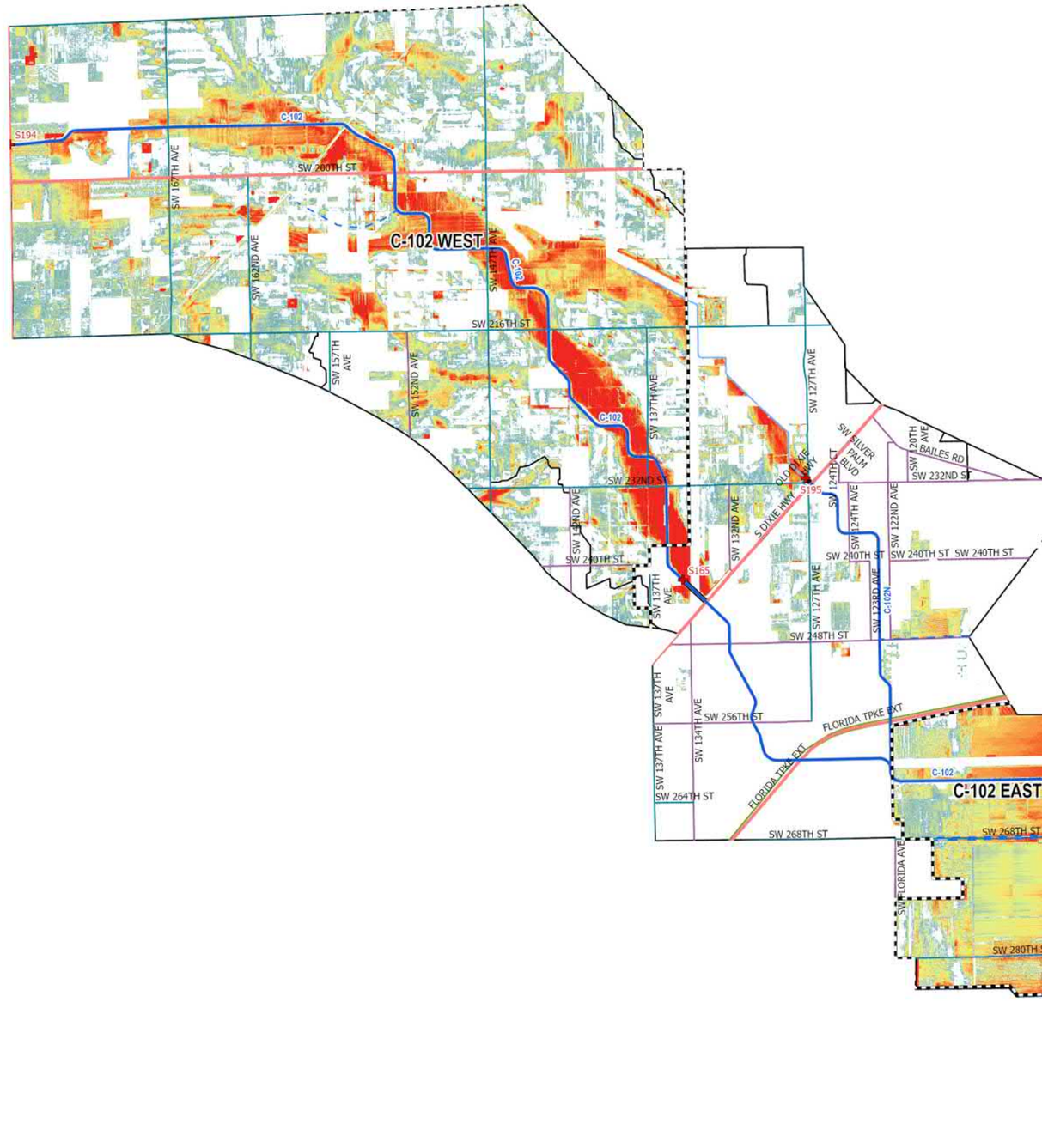
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-232. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

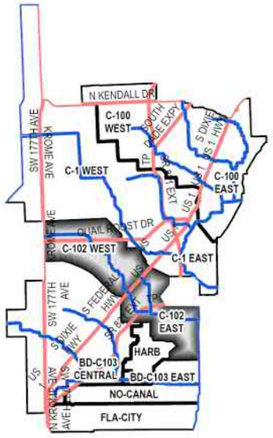
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

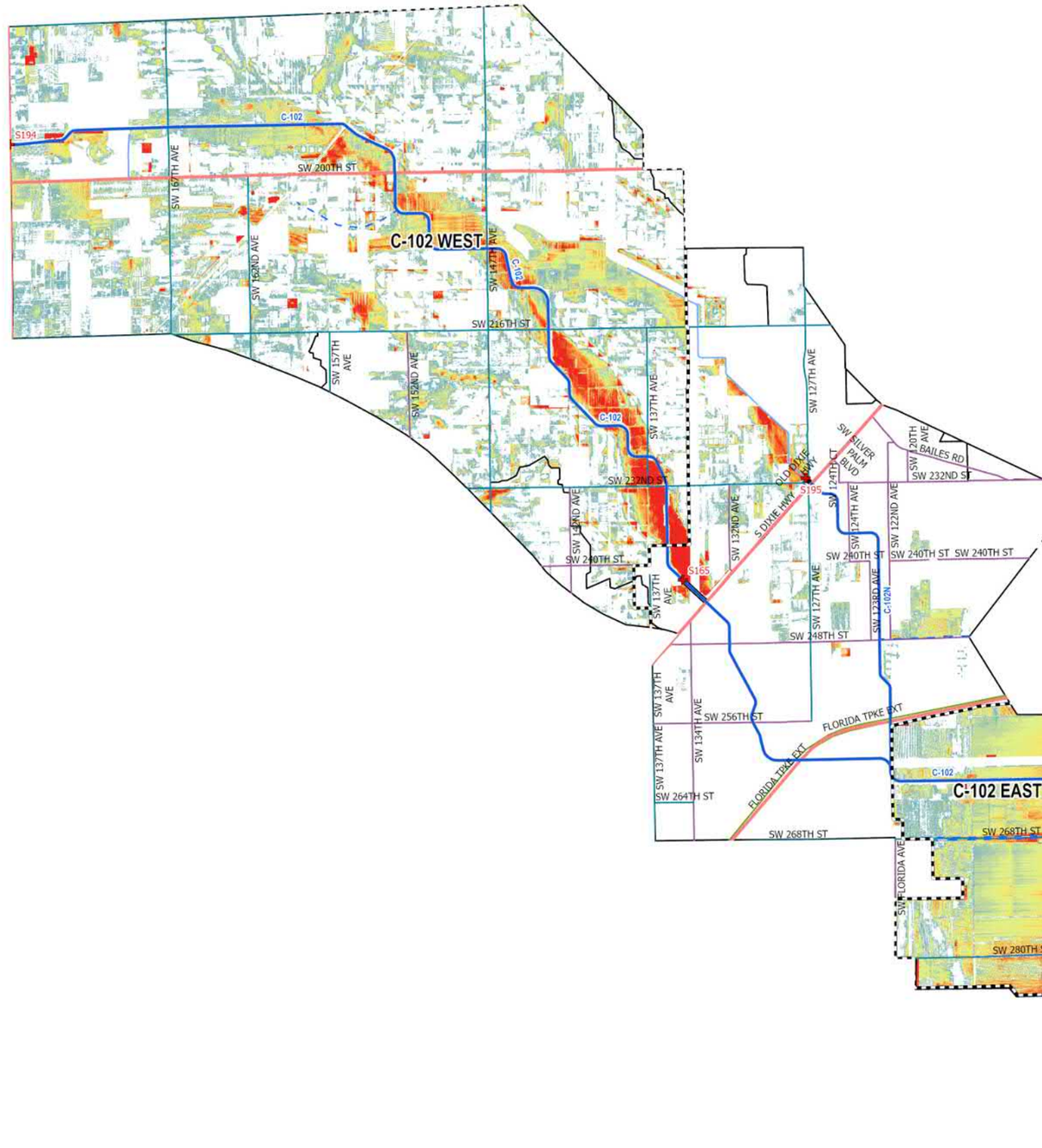
0 0.5 1 2 3 4 Miles

Figure A-233. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

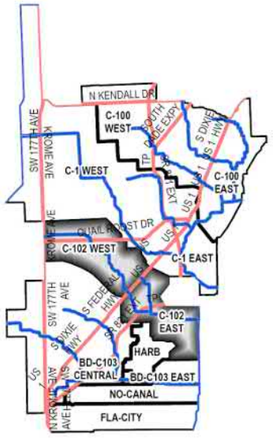
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

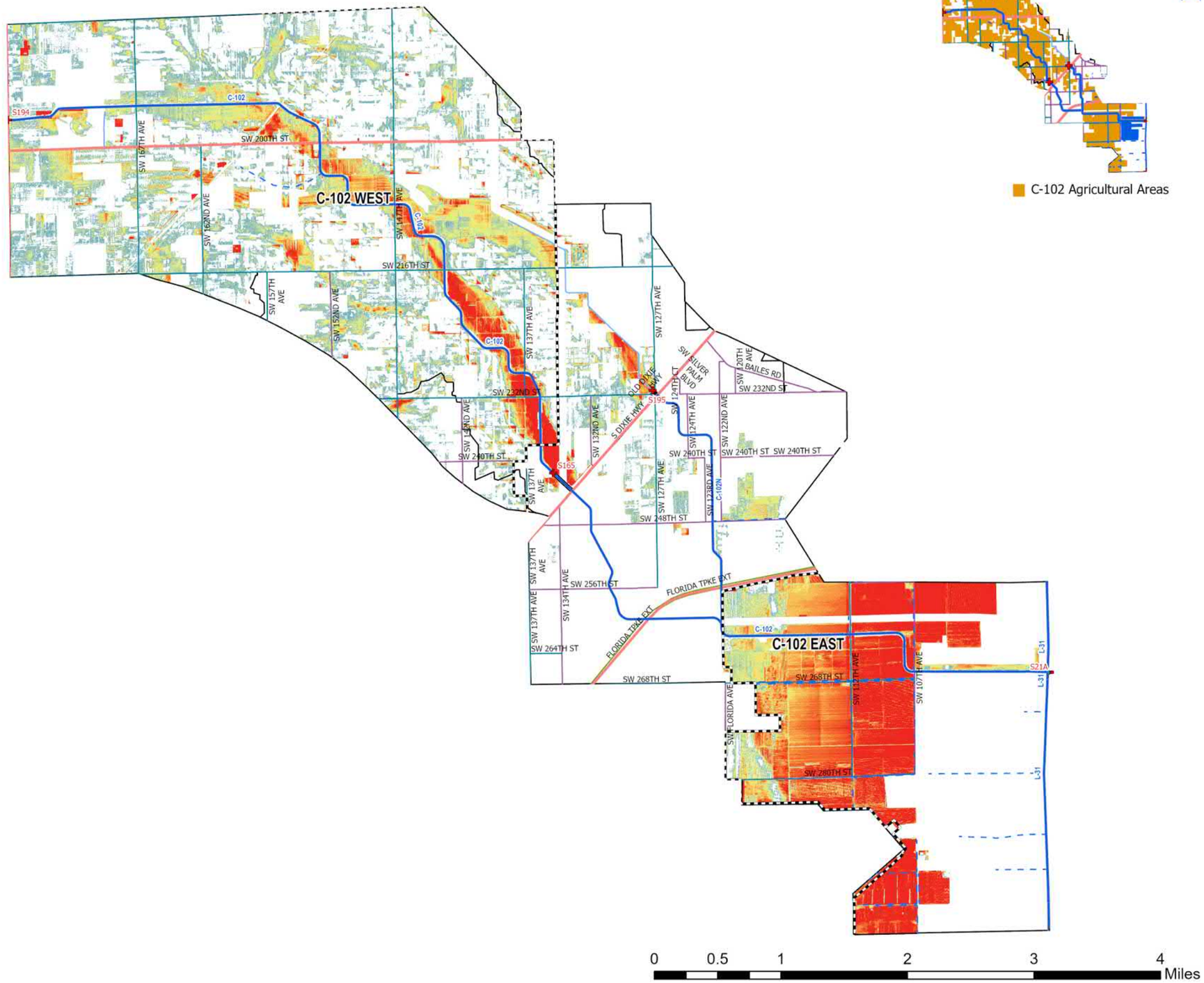
0 0.5 1 2 3 4 Miles

Figure A-234. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

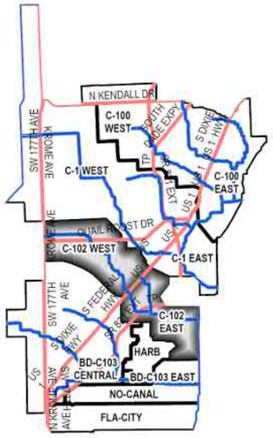
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

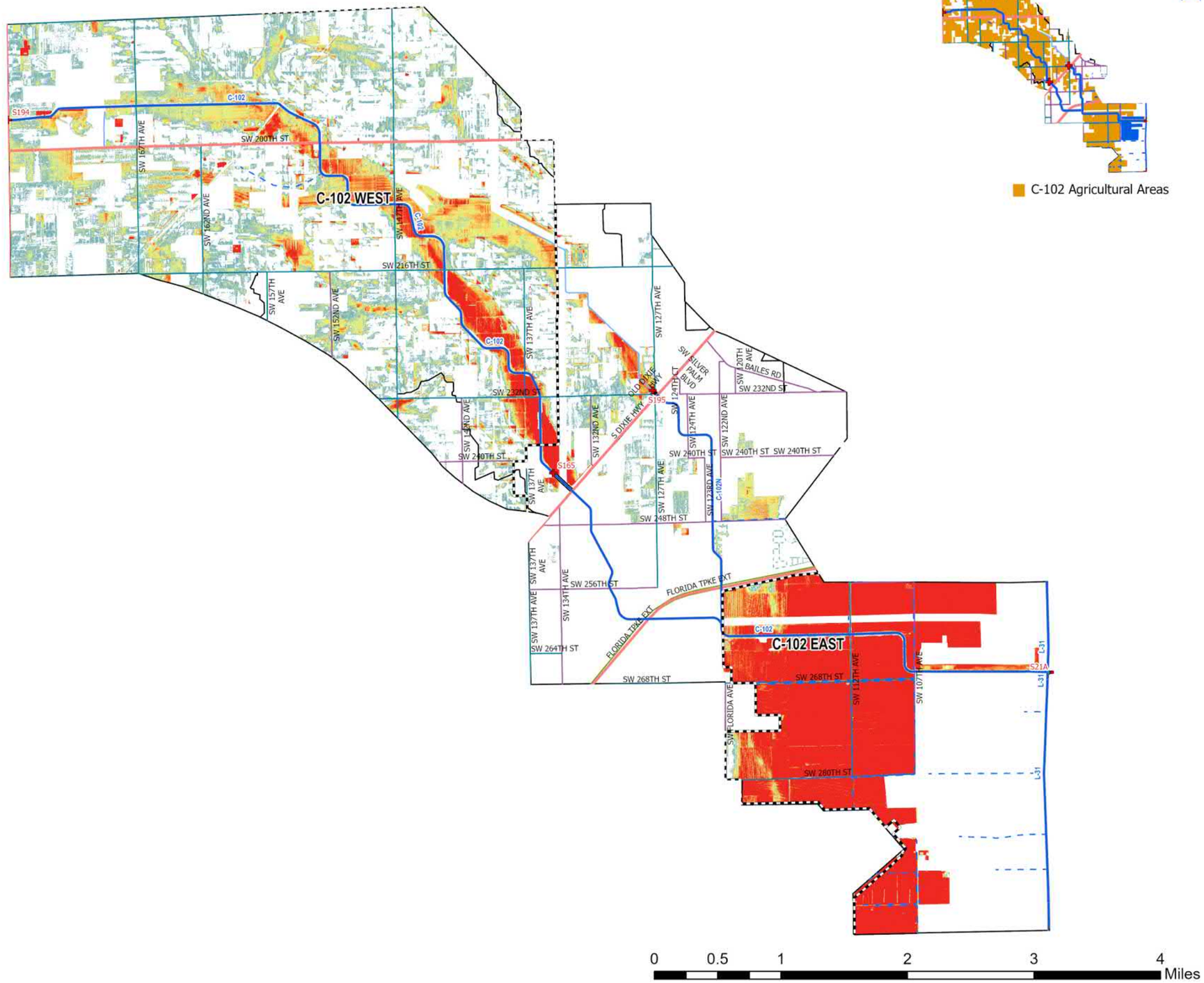
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-235. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

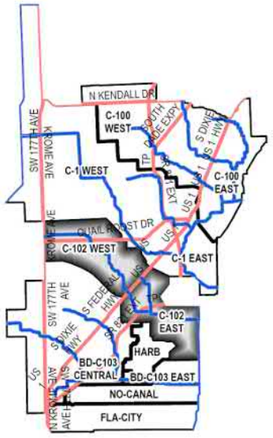
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

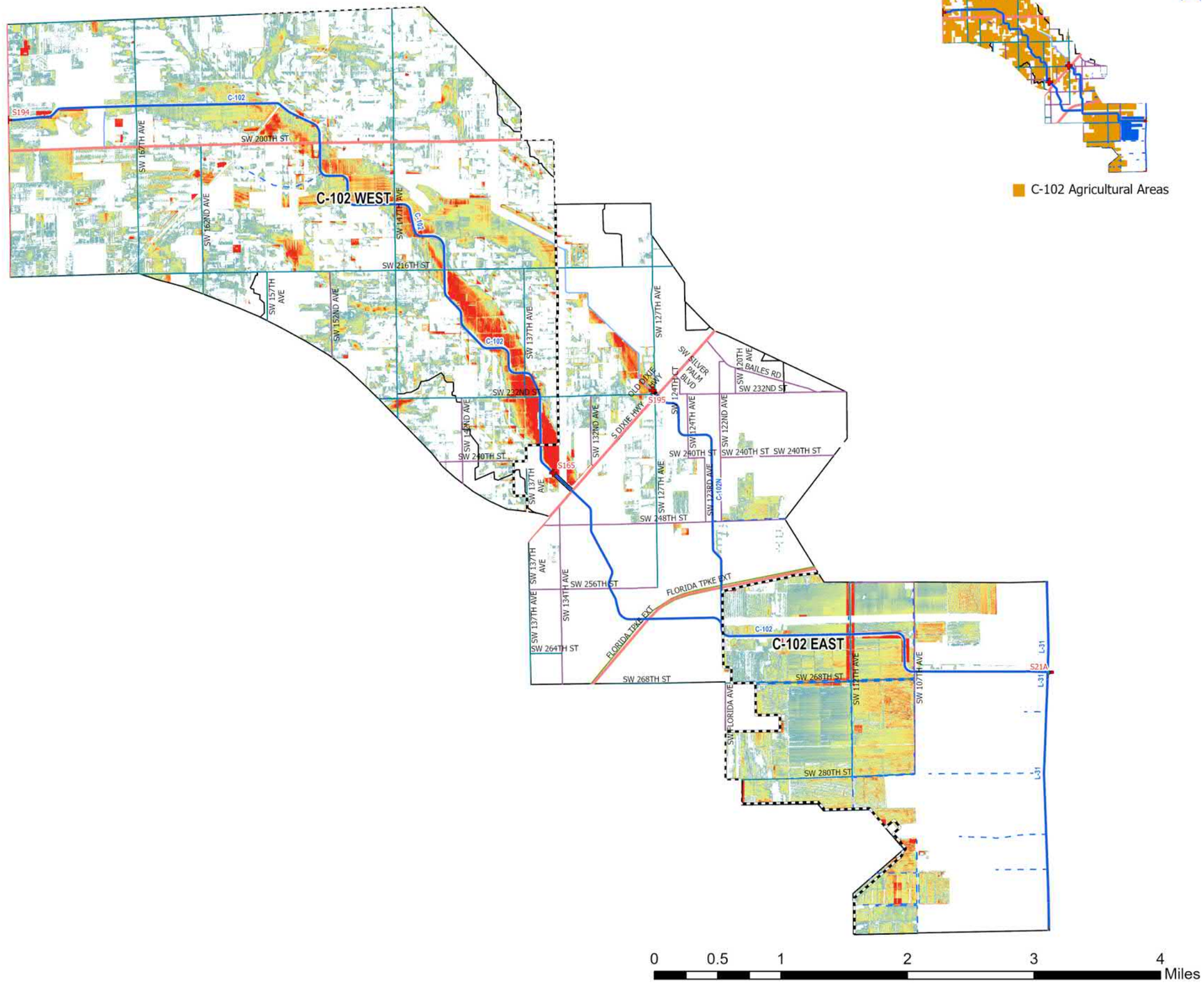
0 0.5 1 2 3 4 Miles

Figure A-236. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

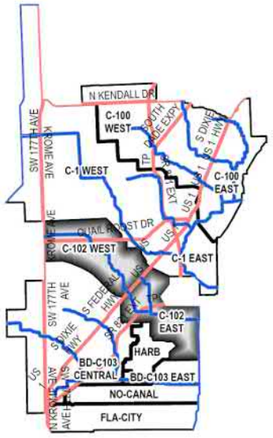
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

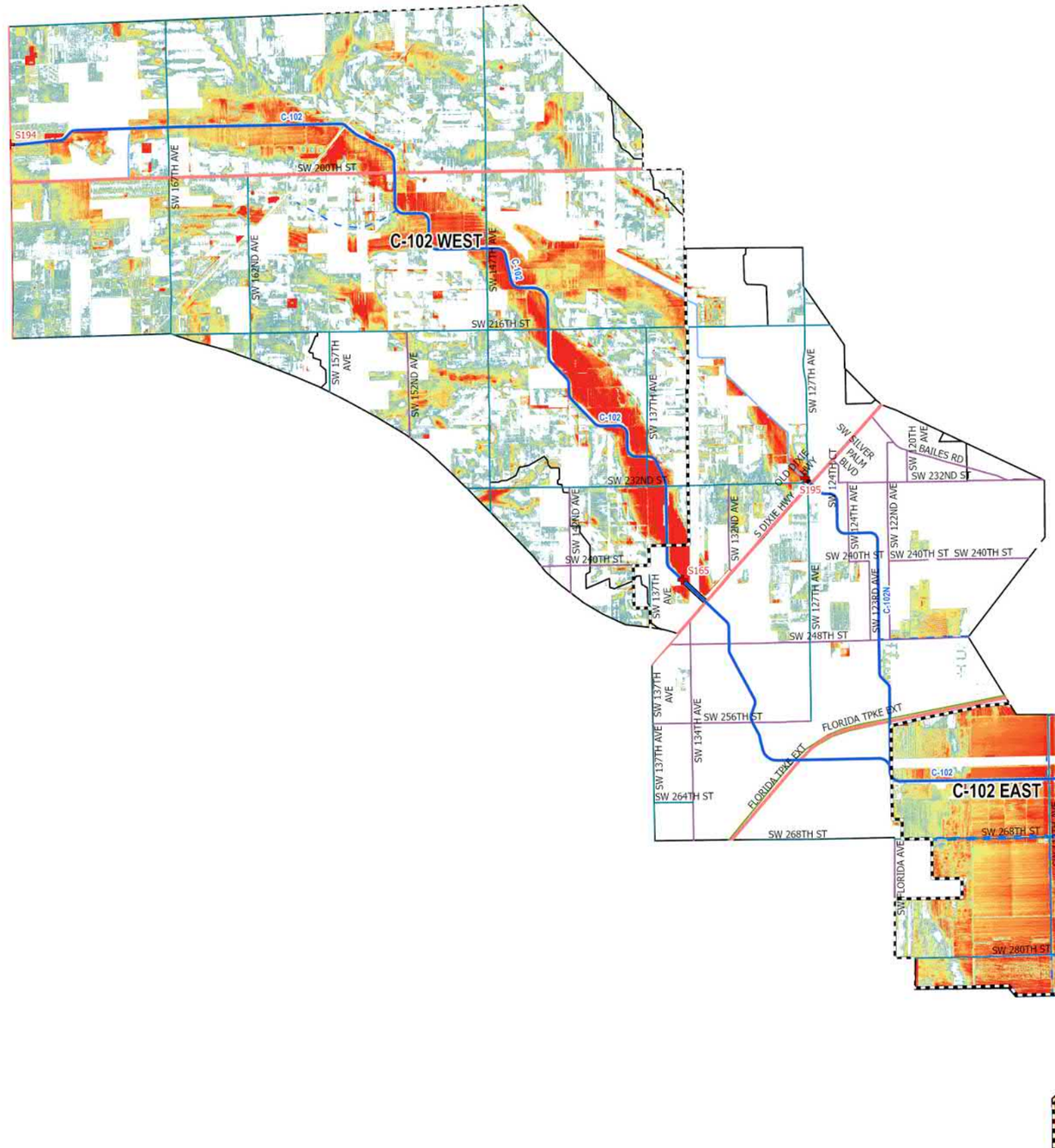
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-237. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

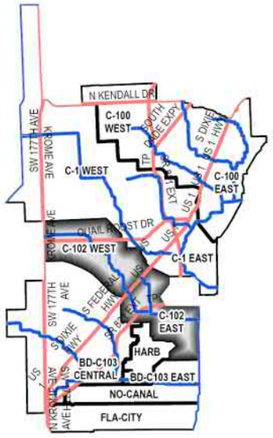
100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

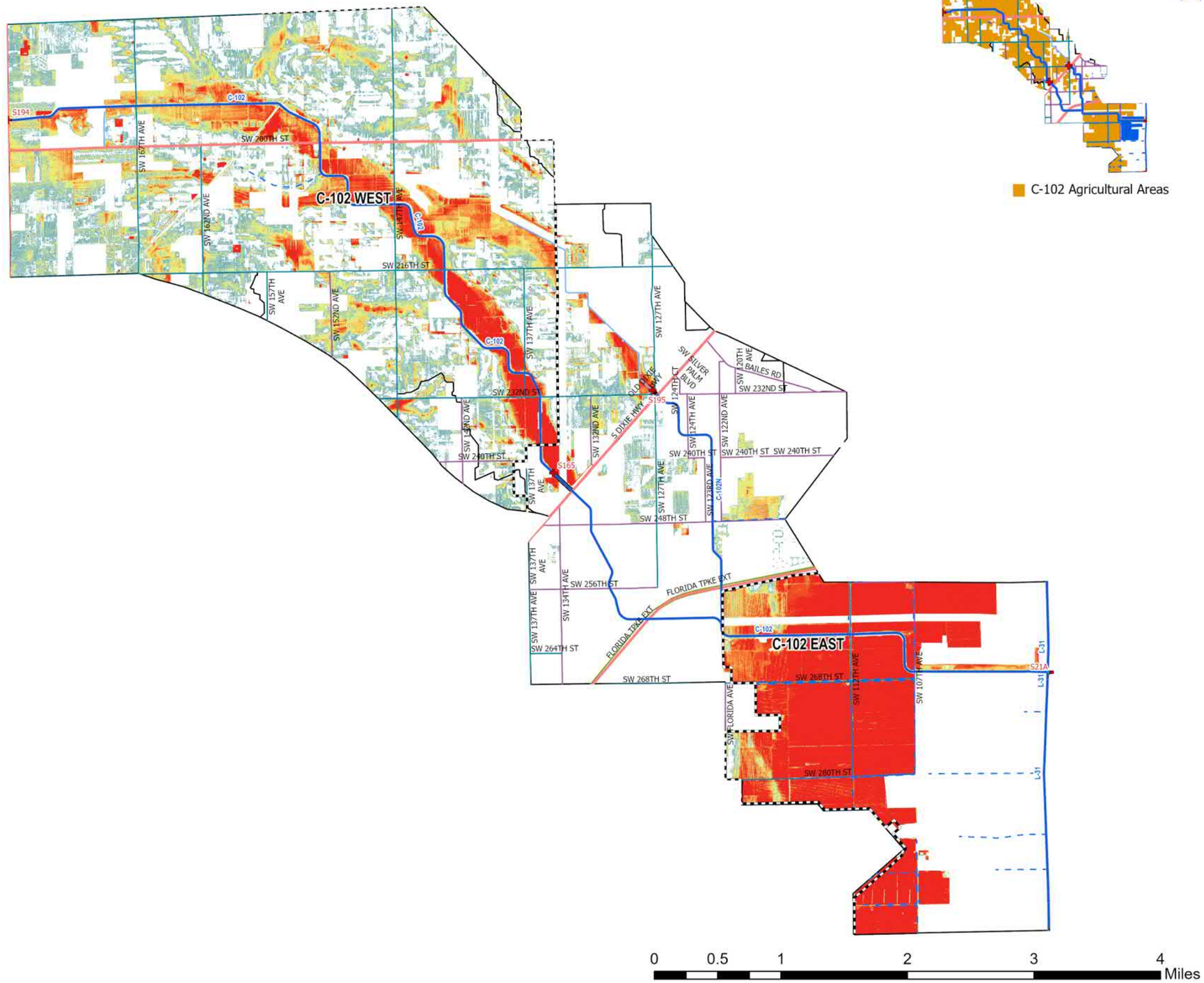
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-238. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

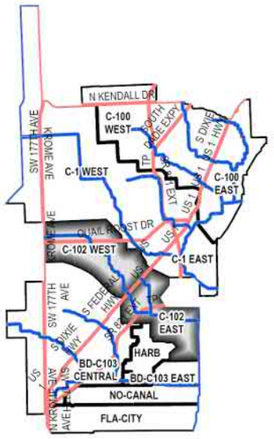
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

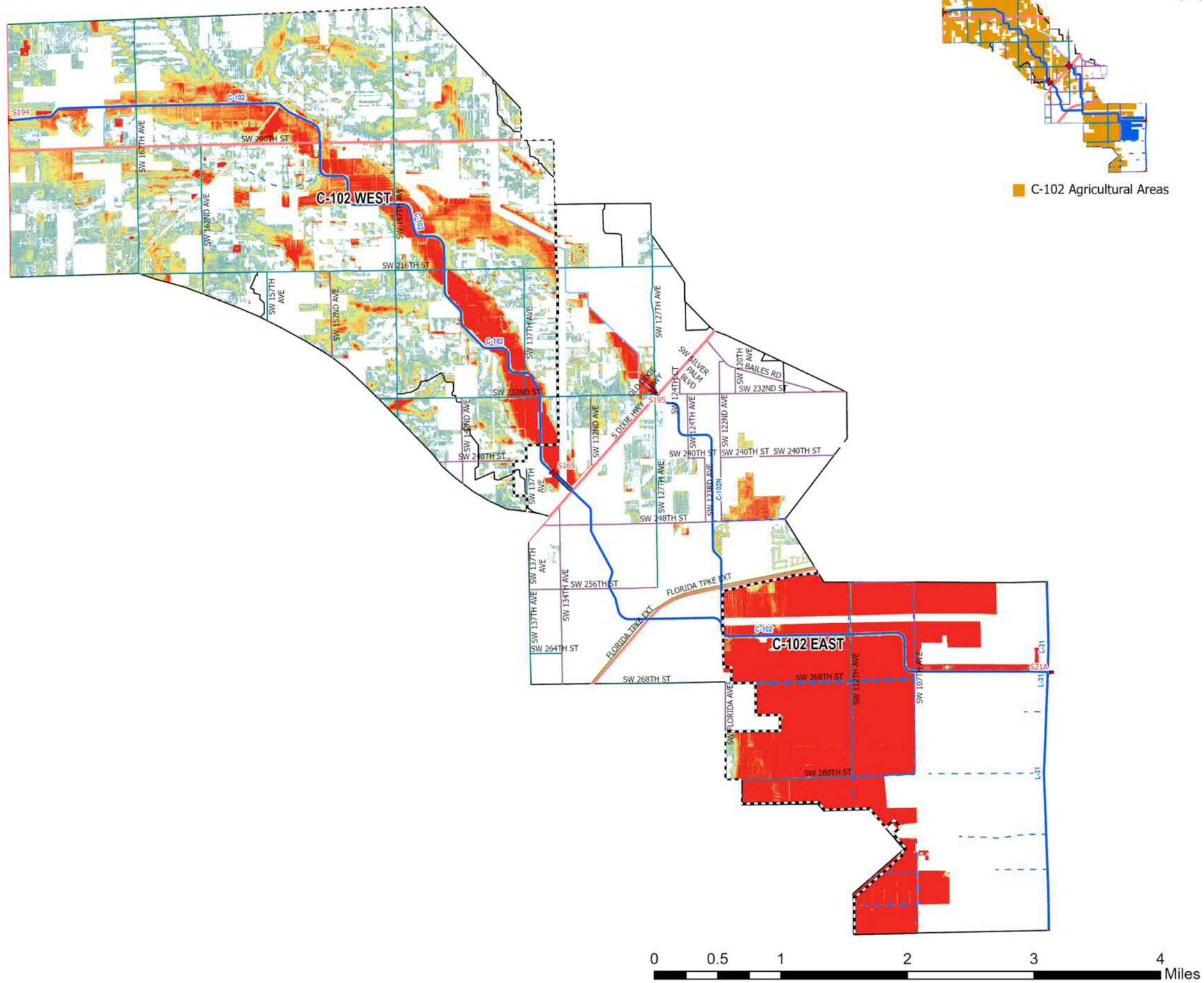
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-239. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

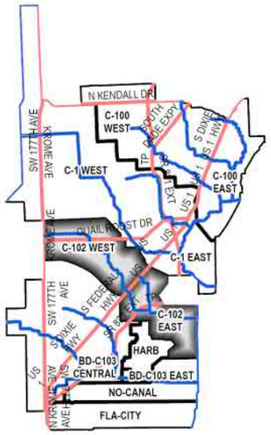
100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

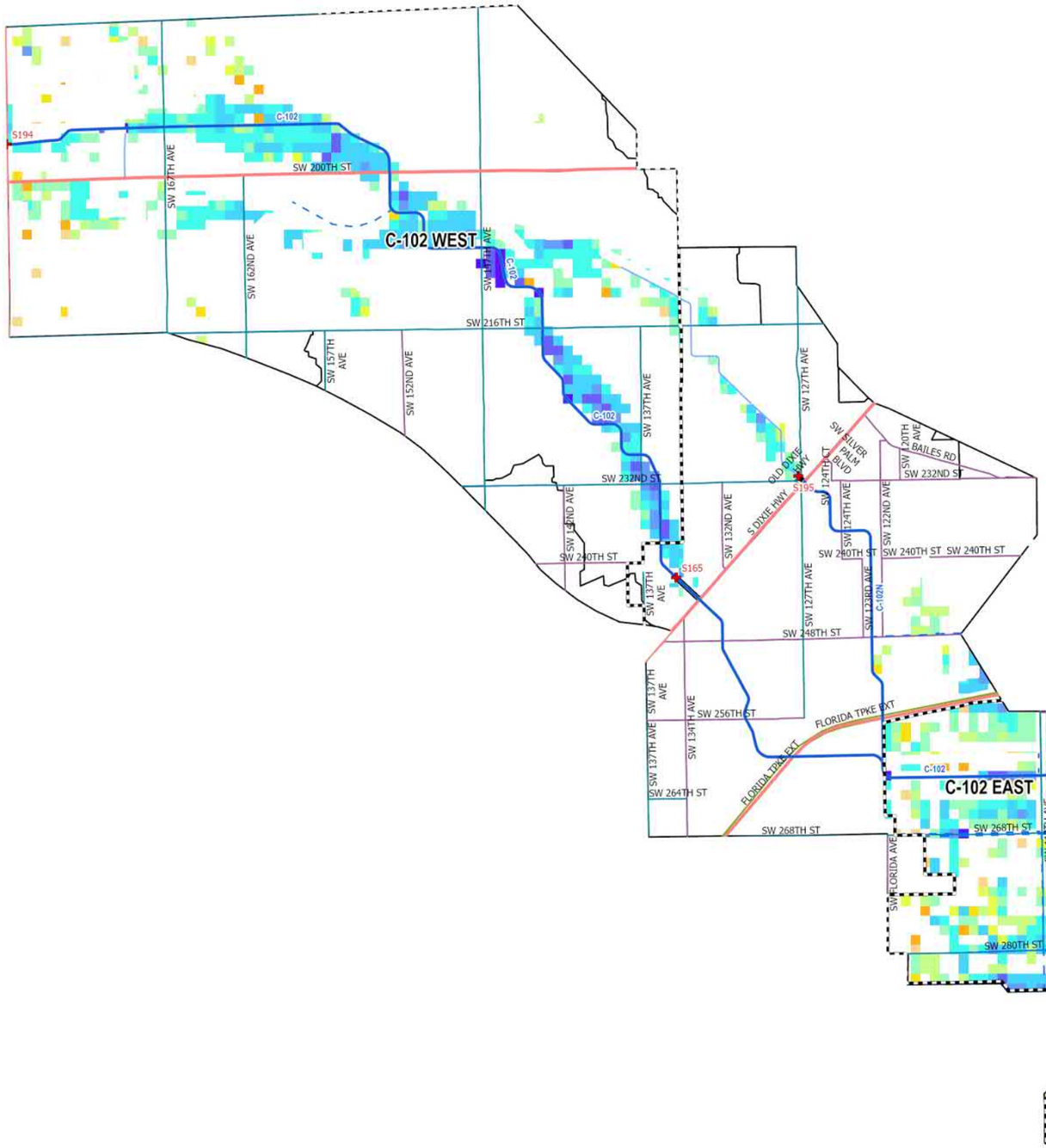
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-240. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

WATERSHED C-102: Flood Duration in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

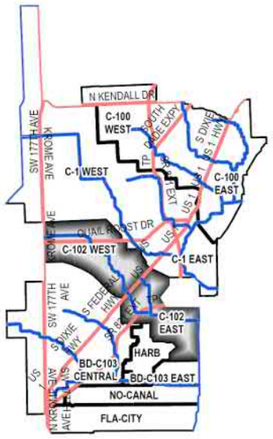
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

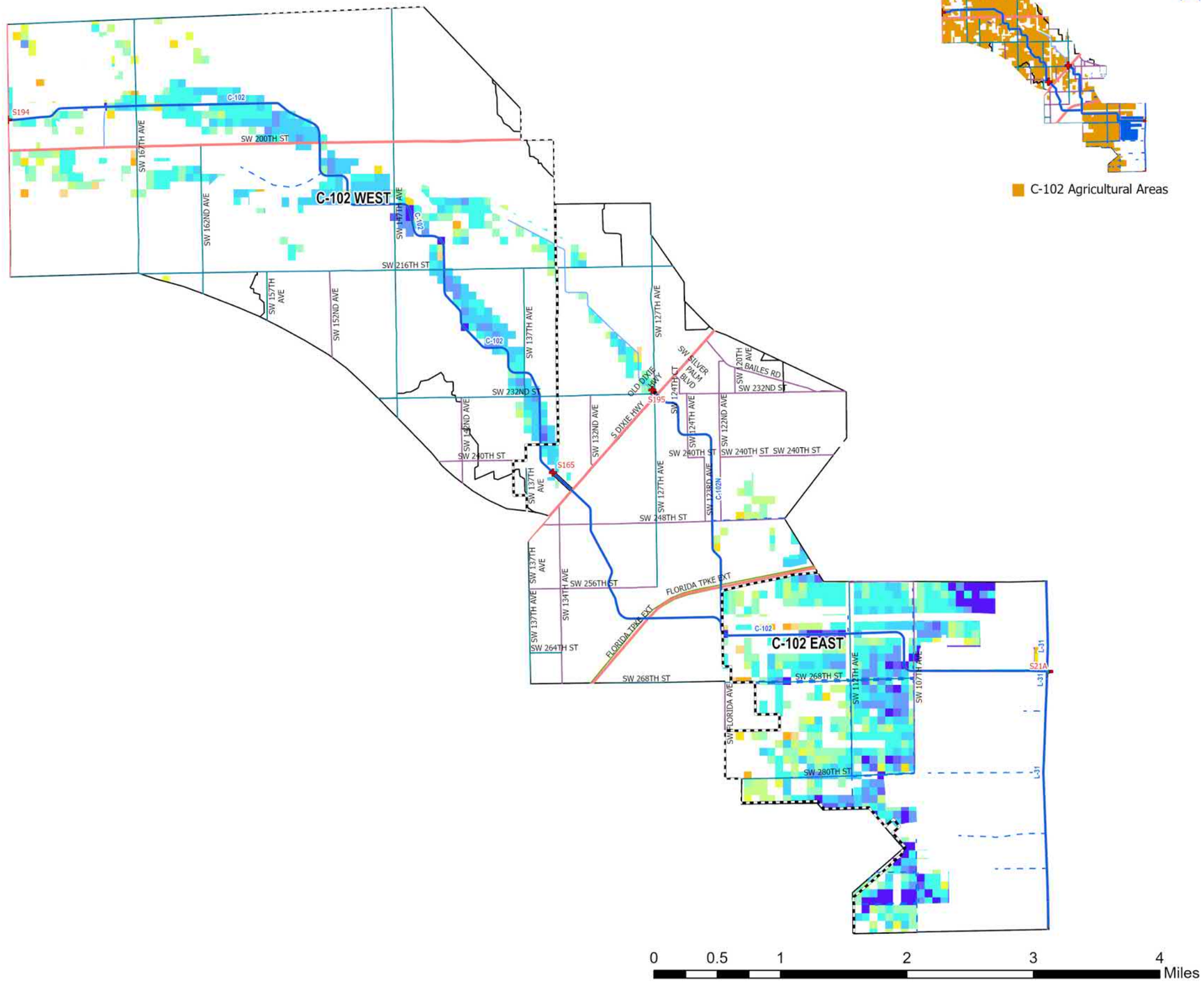
0 0.5 1 2 3 4 Miles

Figure A-241. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

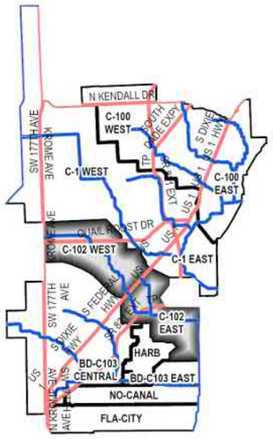
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

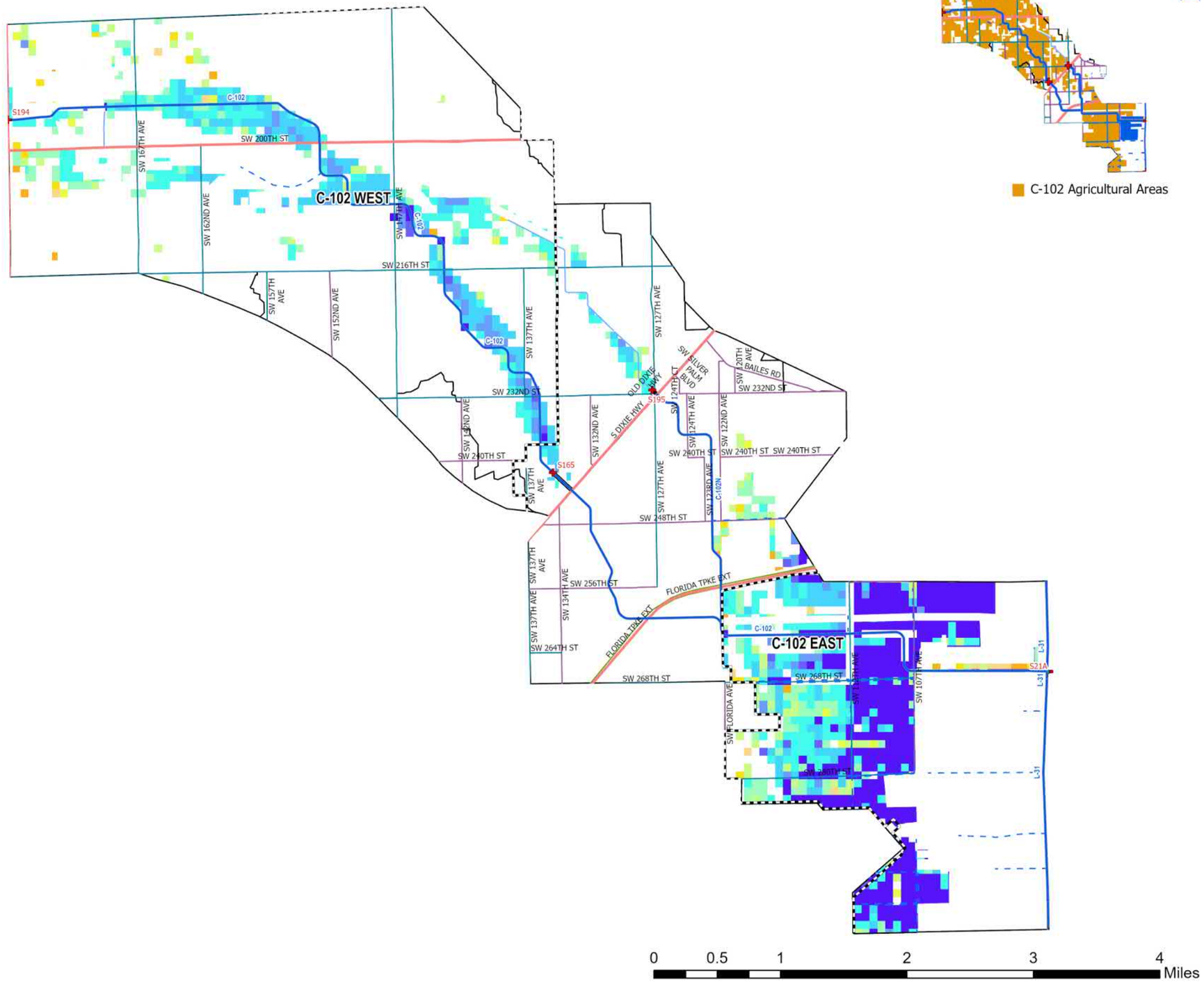
0 0.5 1 2 3 4 Miles

Figure A-242. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

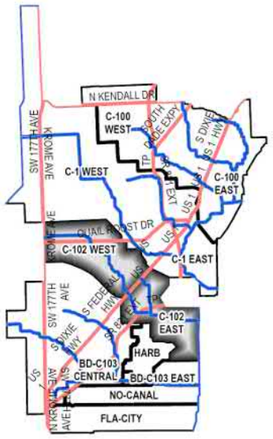
5-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

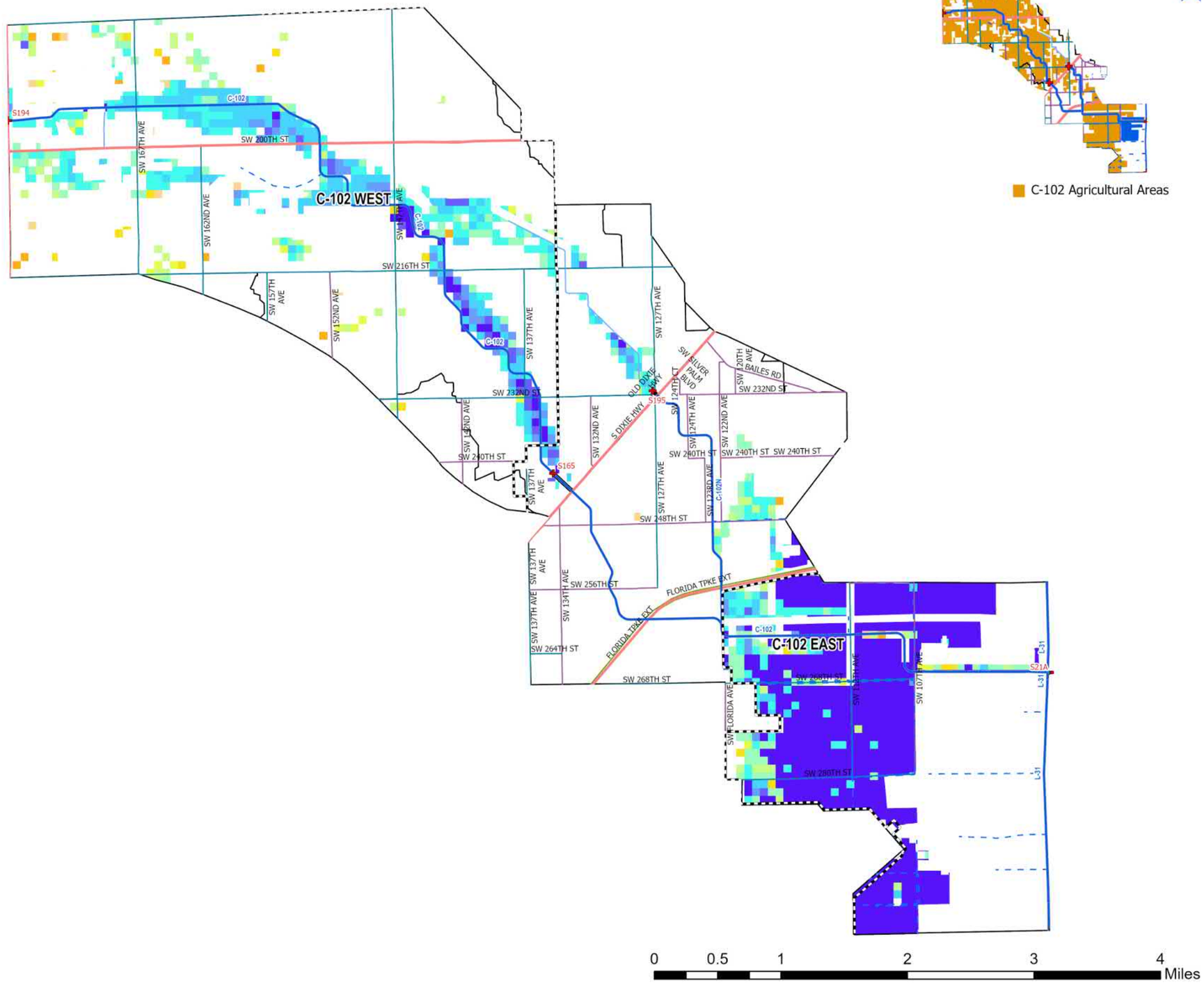
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-243. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

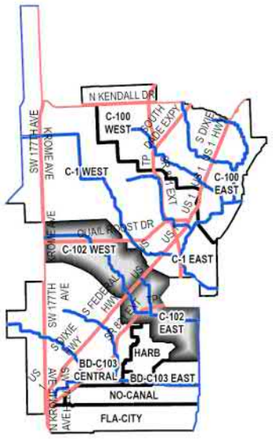
5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

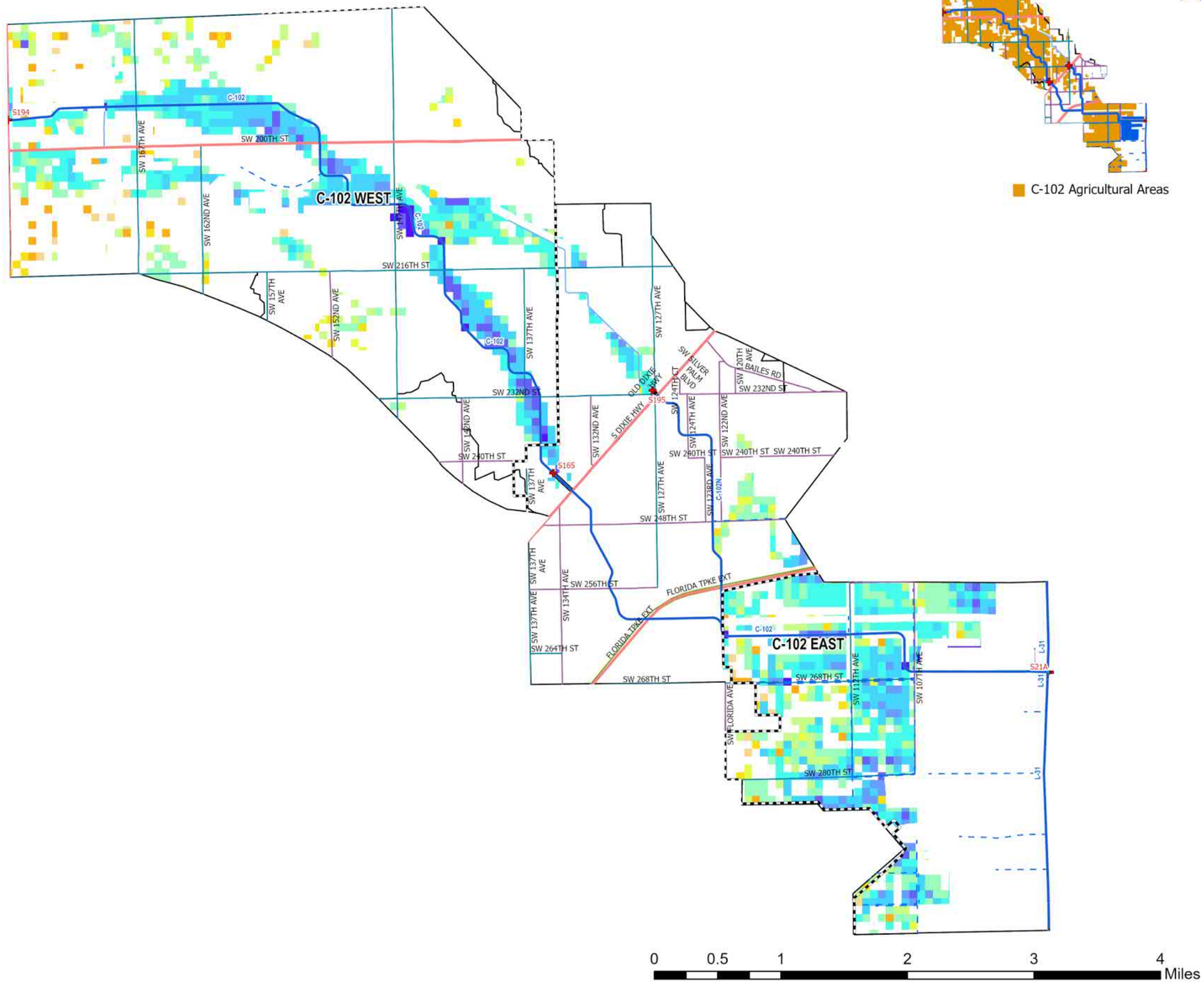
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-244. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

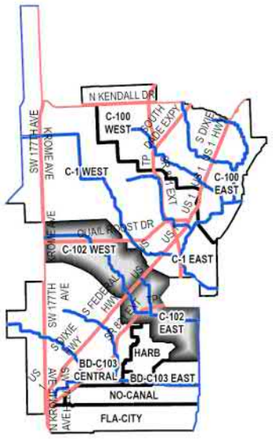
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

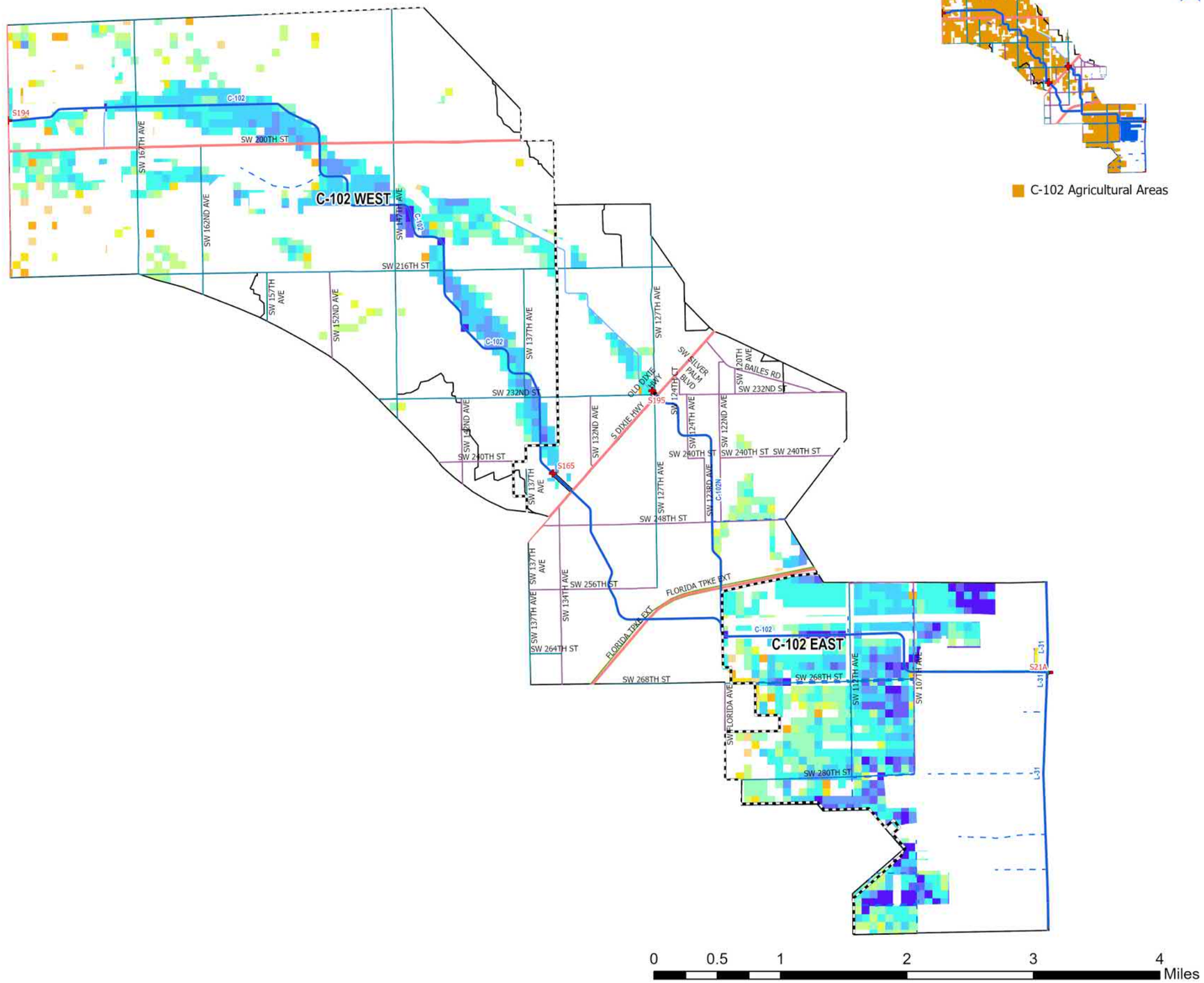
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-245. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

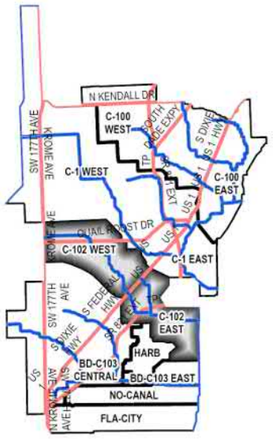
10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

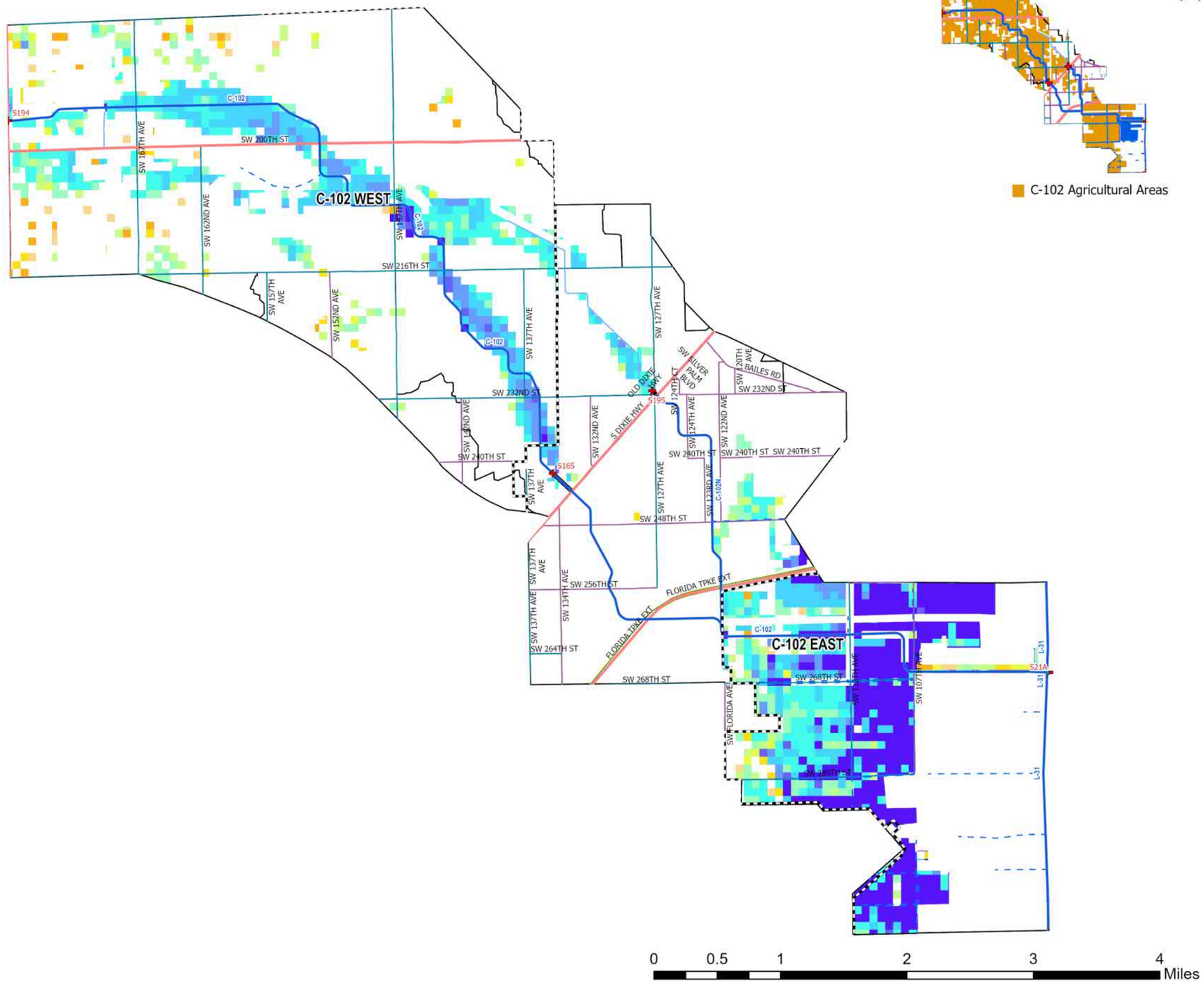
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-246. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

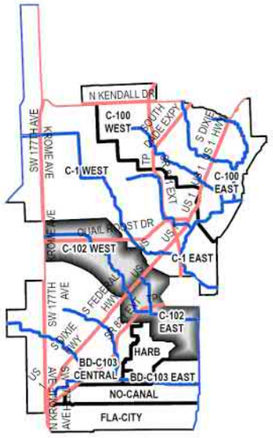
10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

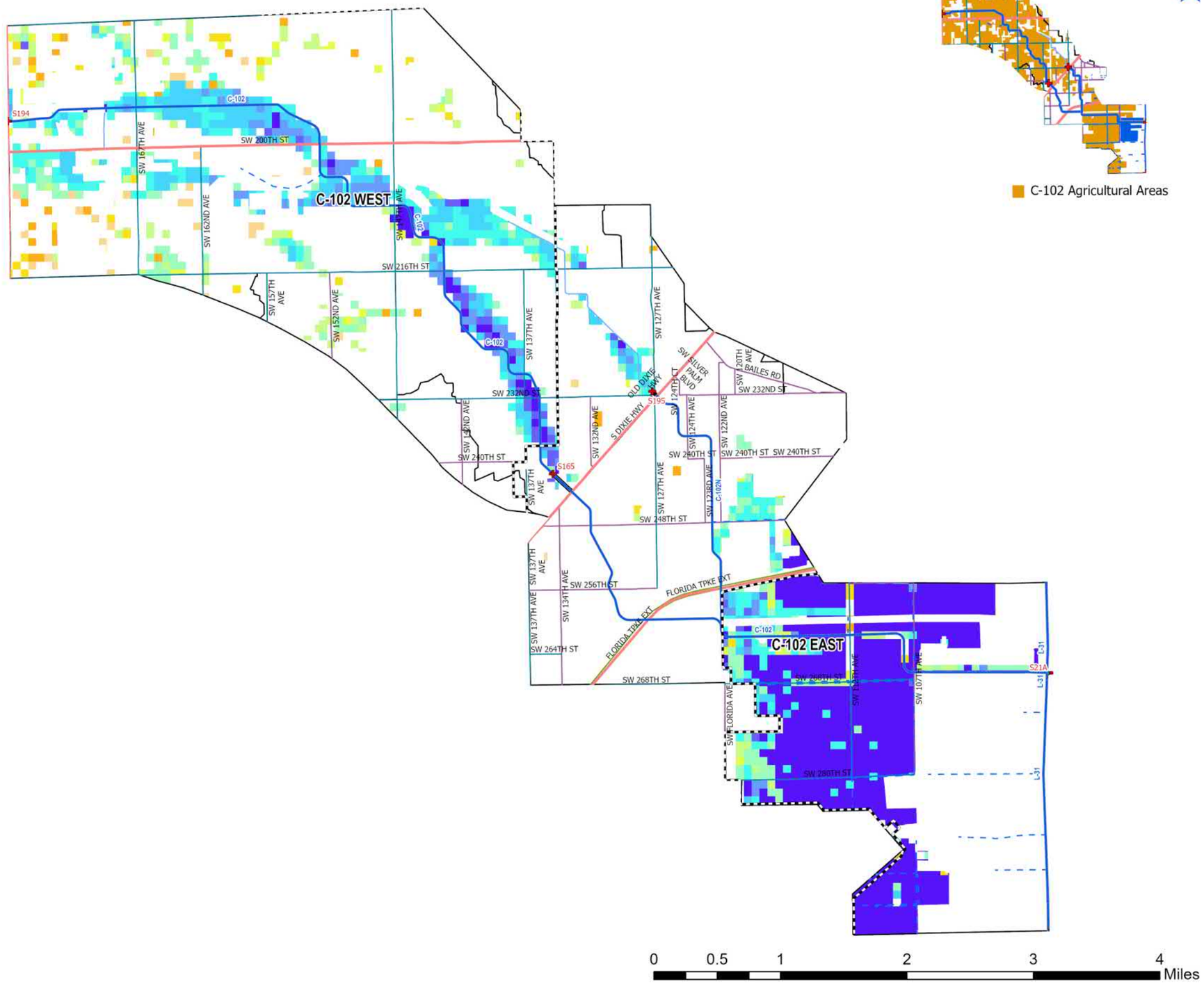
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-247. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

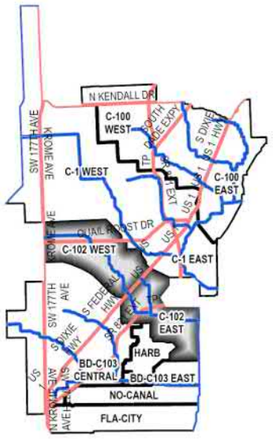
10-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

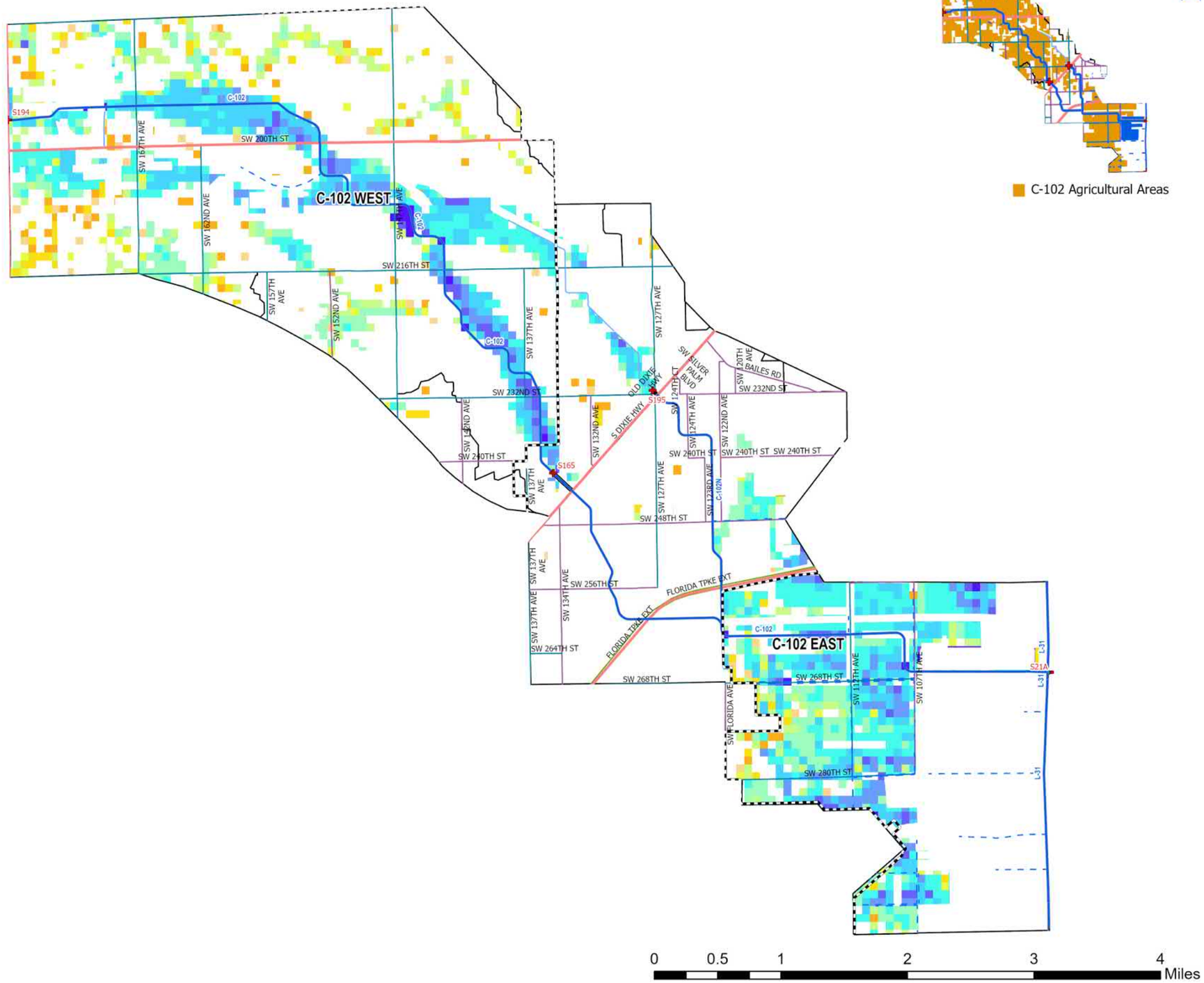
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-248. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

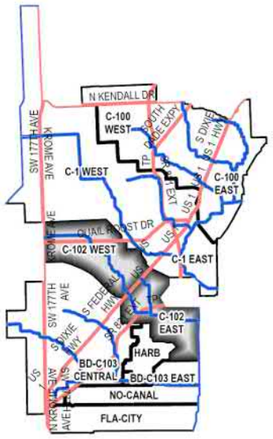
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

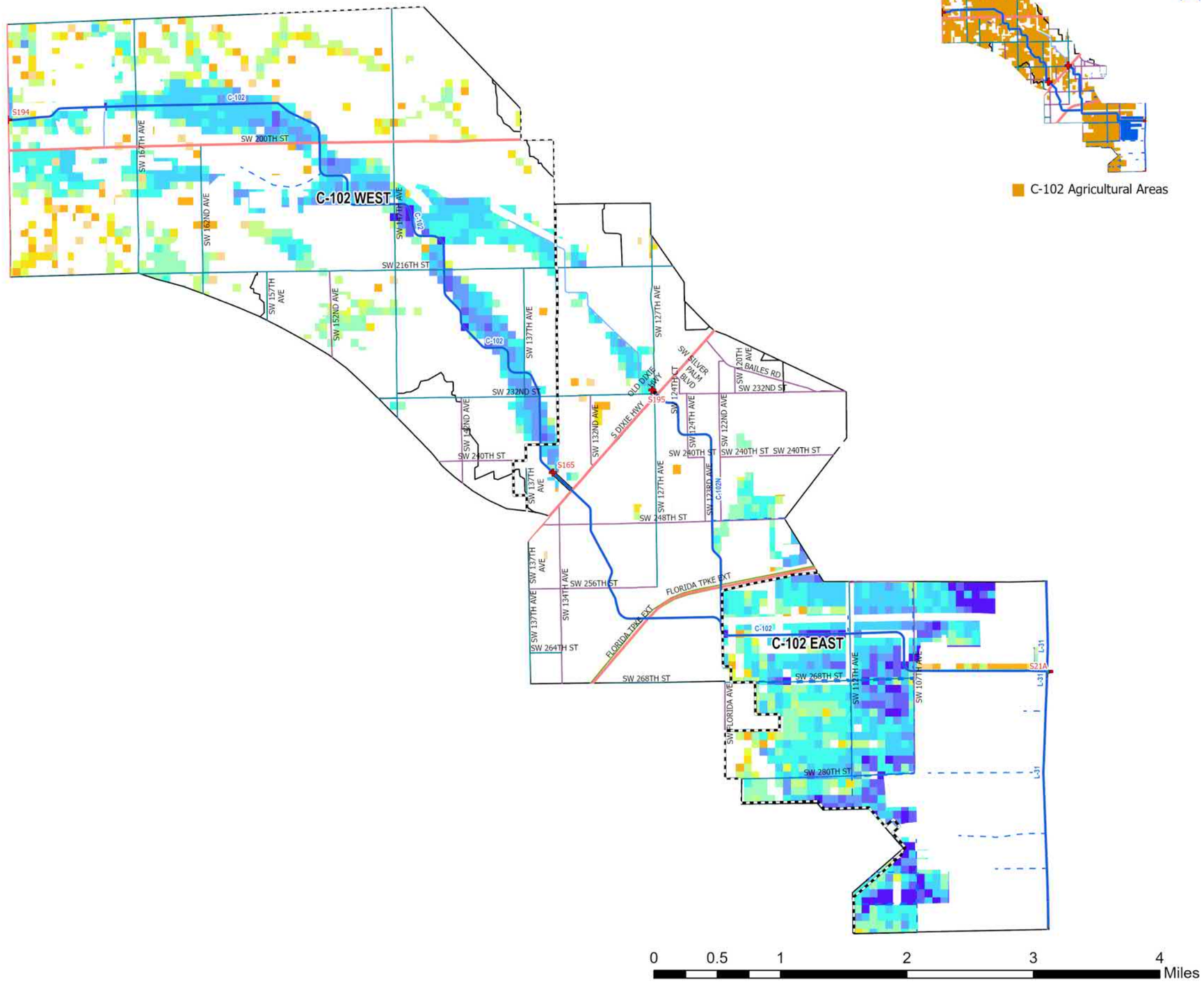
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-249. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

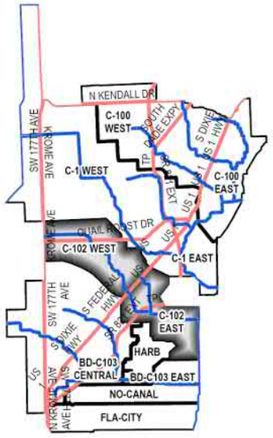
25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

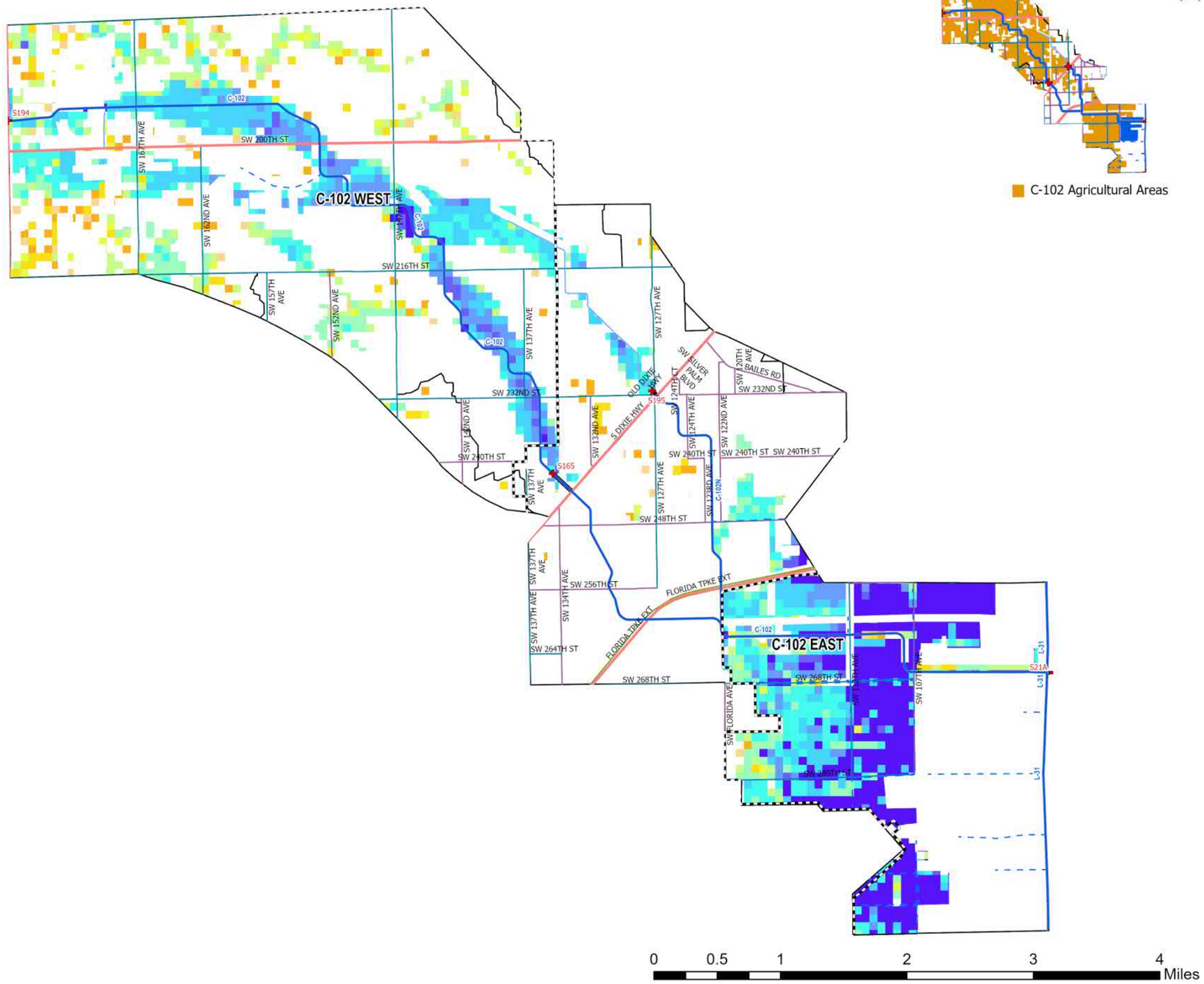
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-250. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

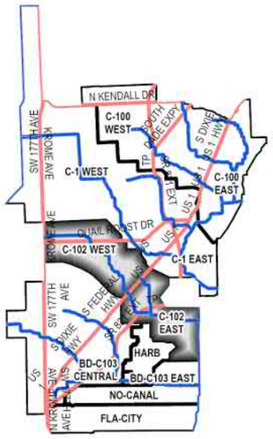
25-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

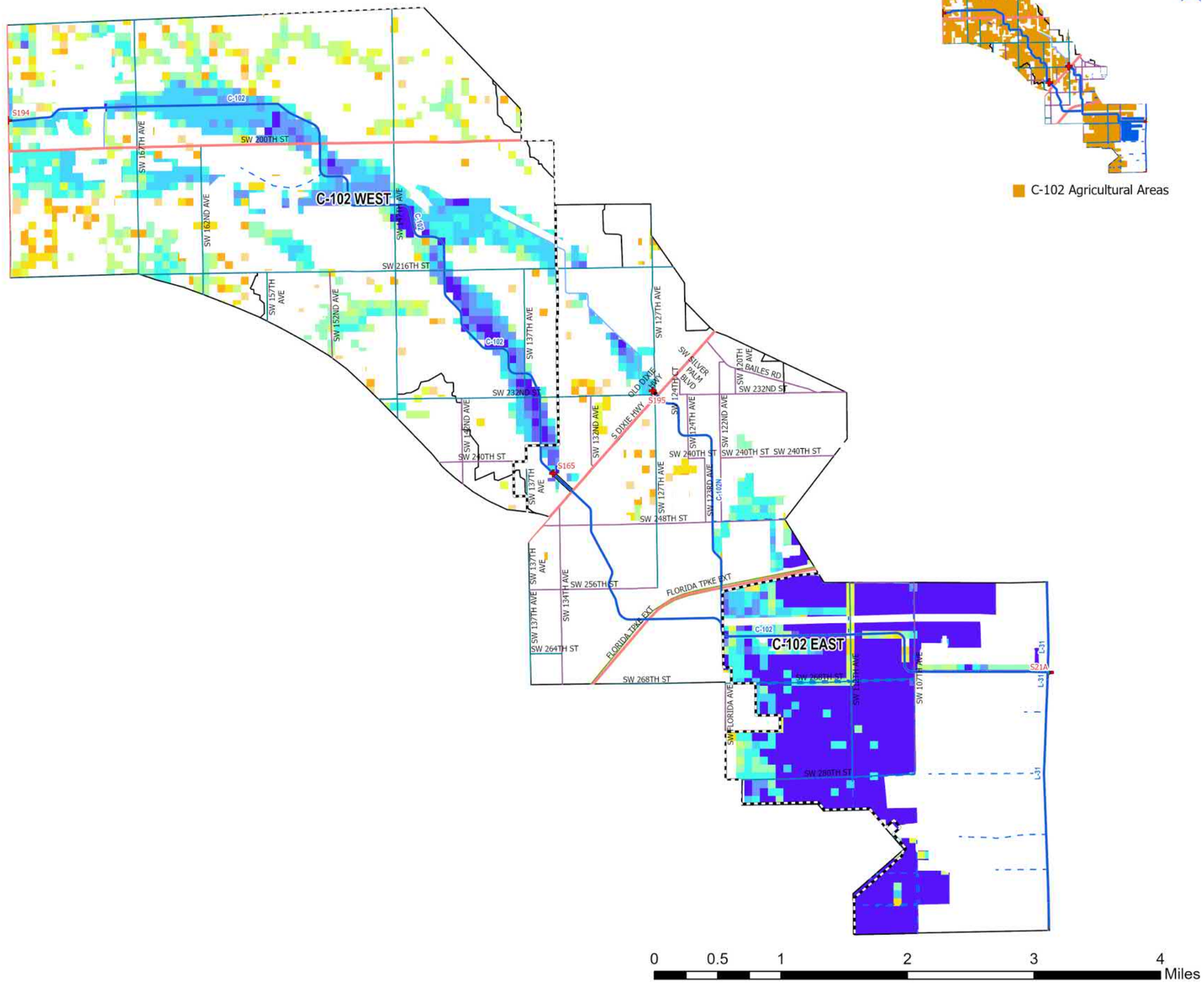
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-251. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

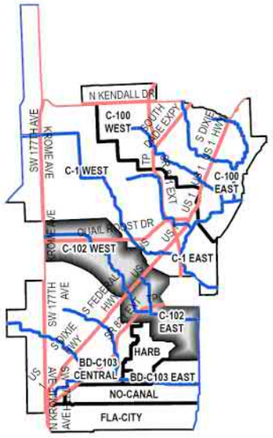
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

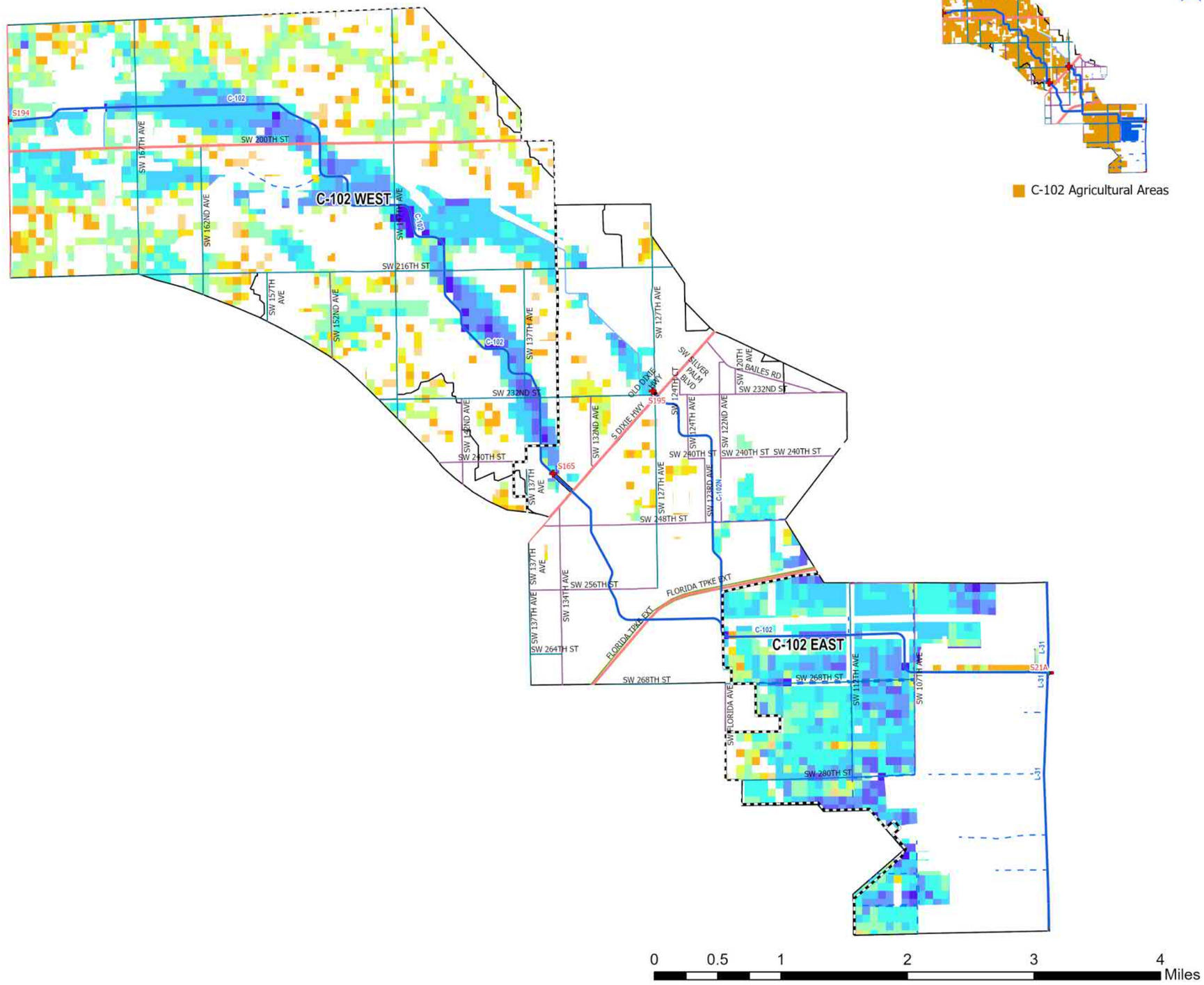
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-252. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

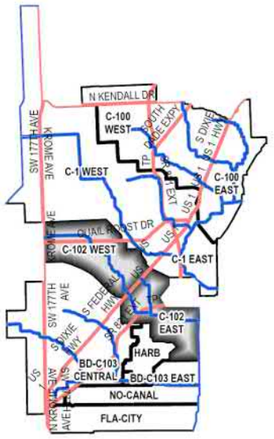
100-Yr/72-Hr SLR = 0

Flood Duration (hr)

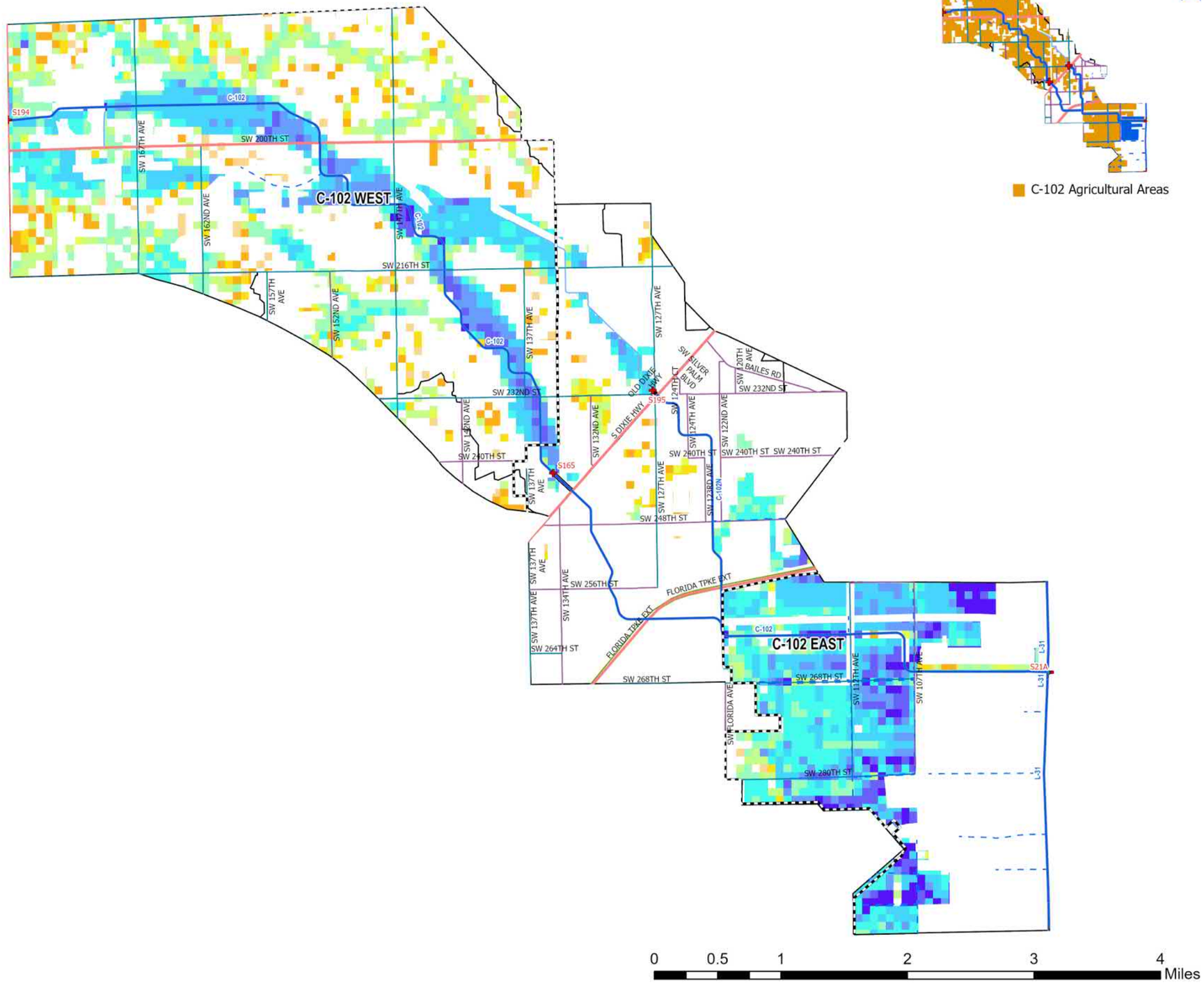
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-253. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

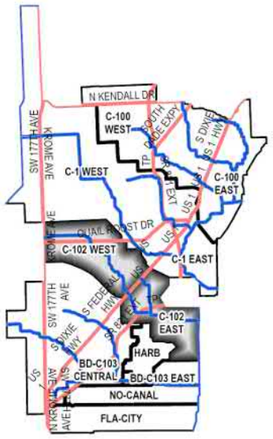
100-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

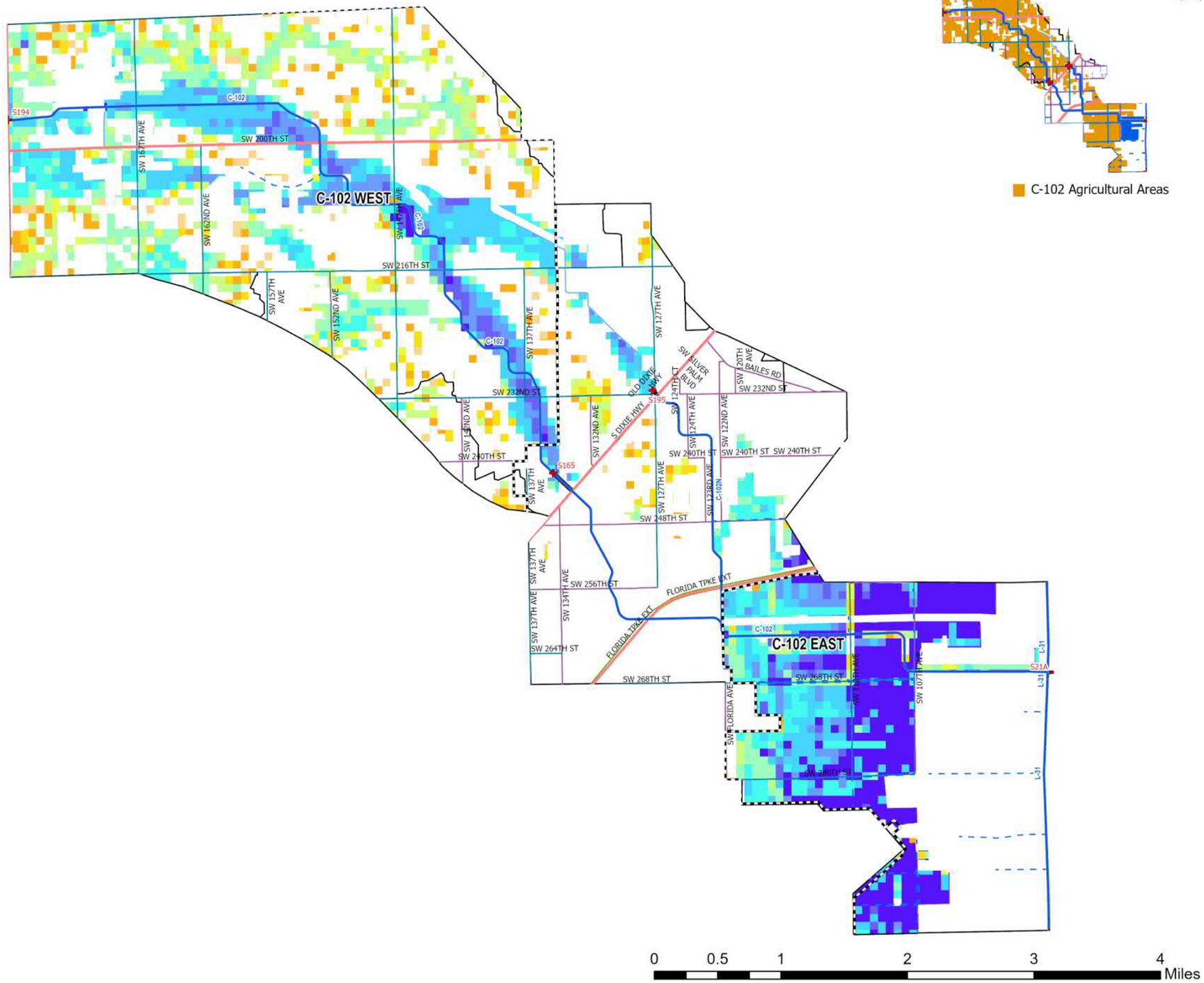
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-254. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

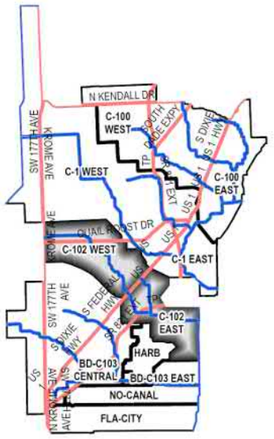
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

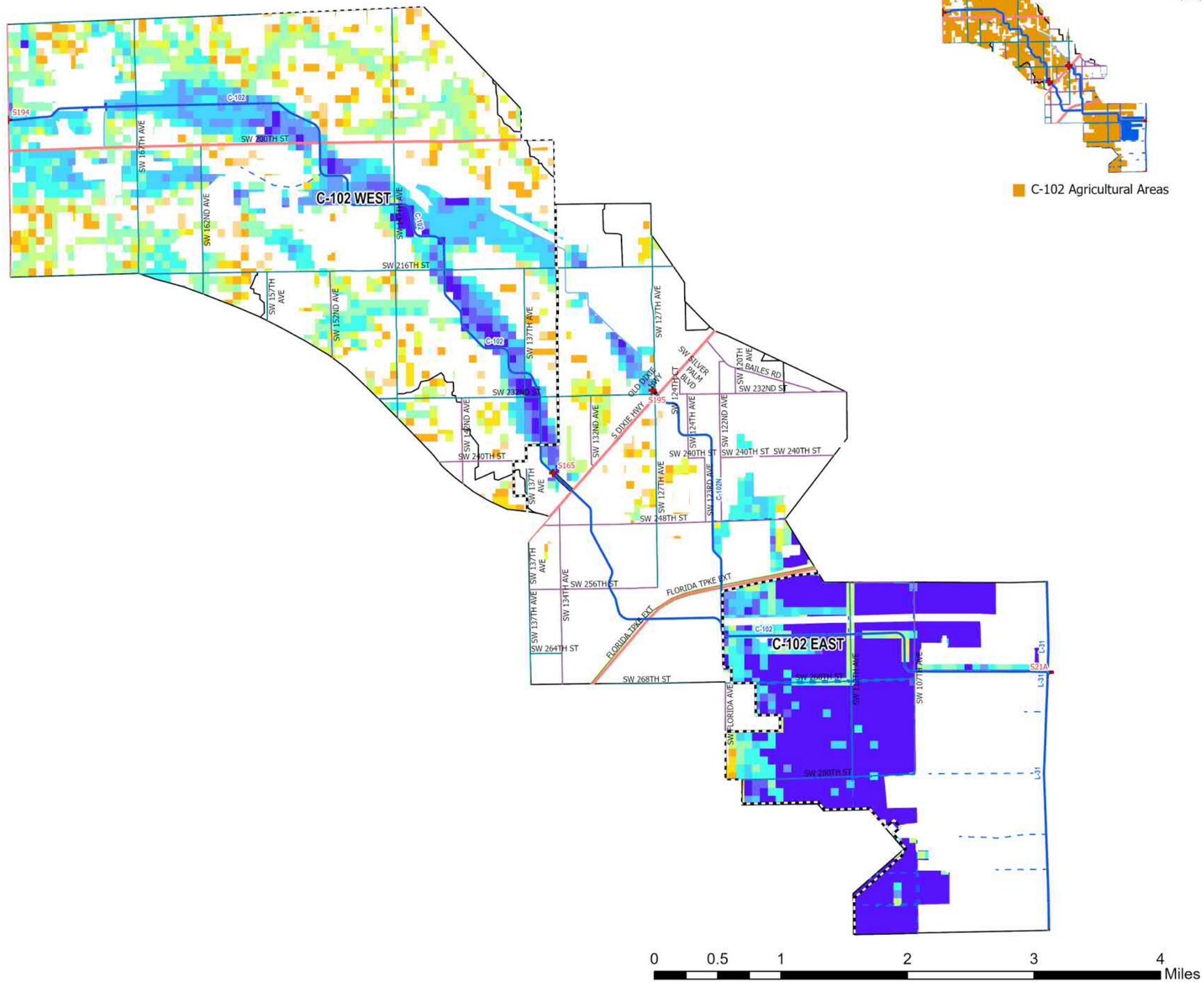
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-255. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas



C-102 Watershed



C-102 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

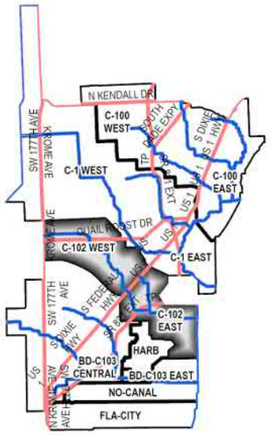
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

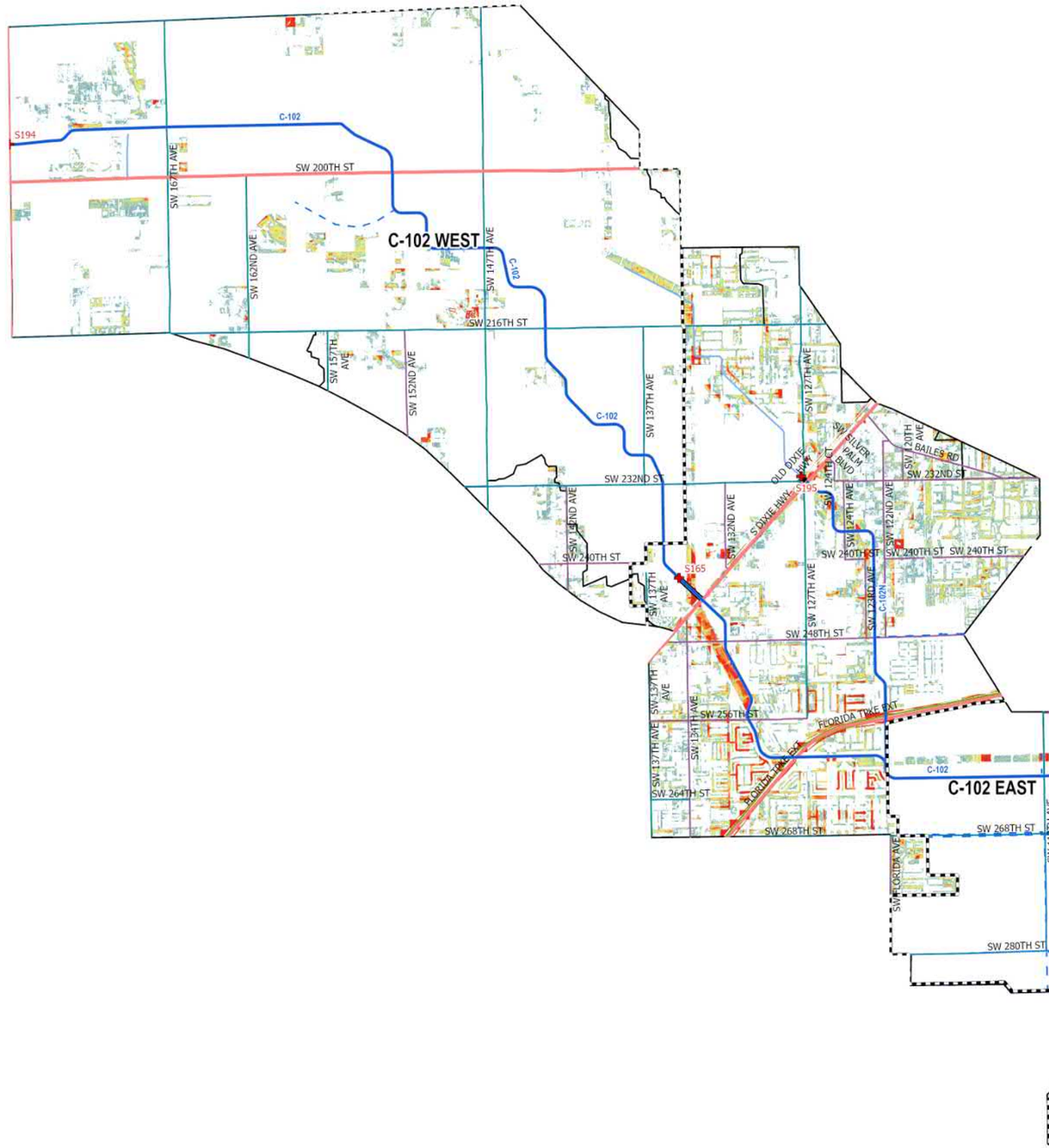
Figure A-256. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

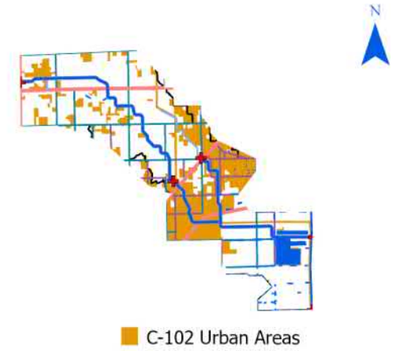
Kimley»Horn

WATERSHED C-102: Flood Extent In Urban Areas



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

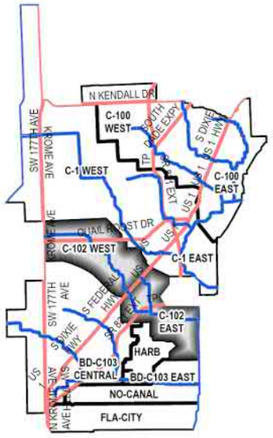
Flood Depth (ft)

- 0 < 0.25 ft
- 0.25 >= 0.50 ft
- 0.50 >= 0.75 ft
- 0.75 >= 1.00 ft
- 1.00 >= 1.25 ft
- 1.25 >= 1.50 ft
- 1.50 >= 1.75 ft
- 1.75 >= 2.00 ft
- 2.00 >= 2.25 ft
- 2.25 >= 2.50 ft
- >= 2.50 ft

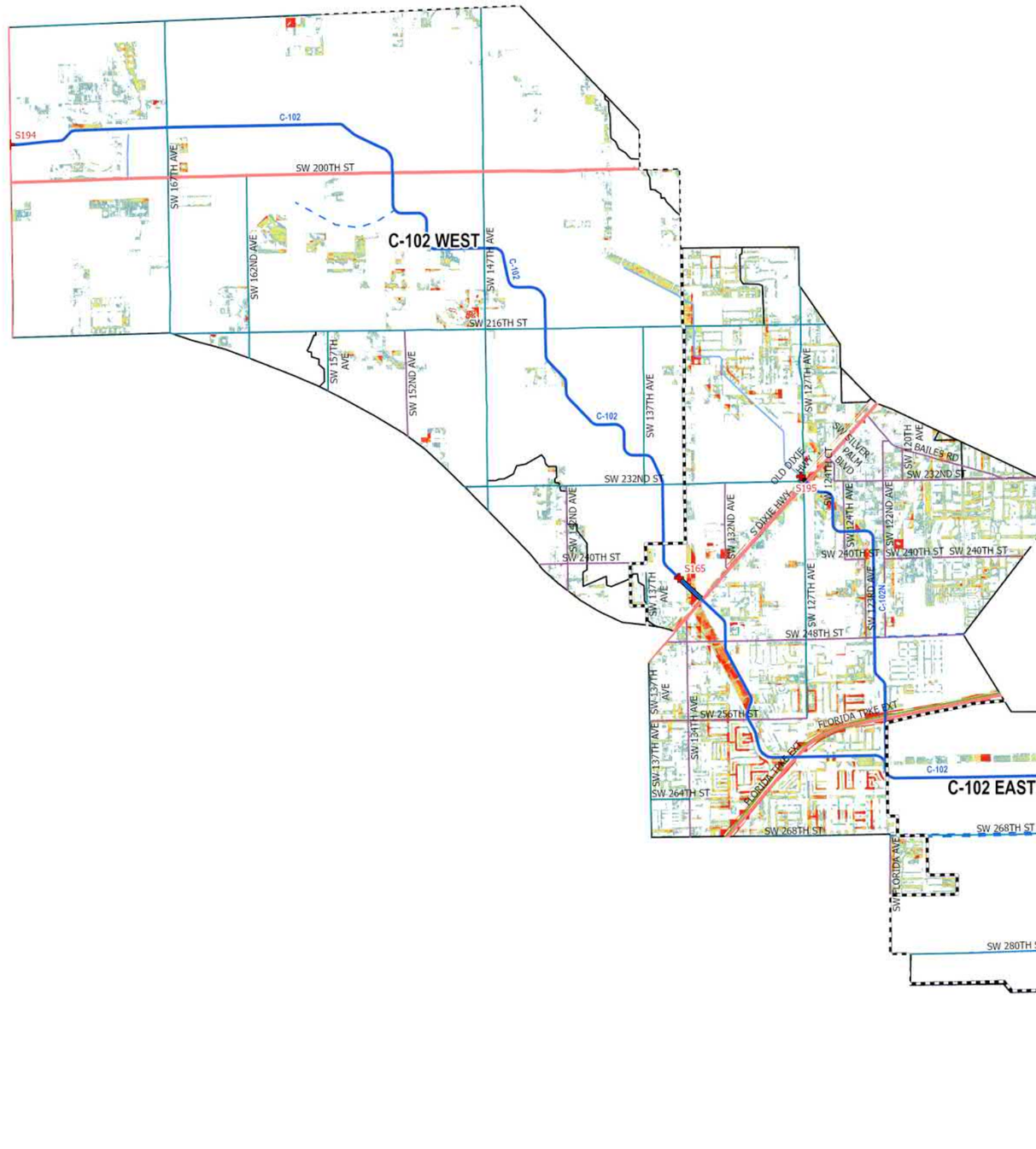
0 0.5 1 2 3 4 Miles

Figure A-257. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

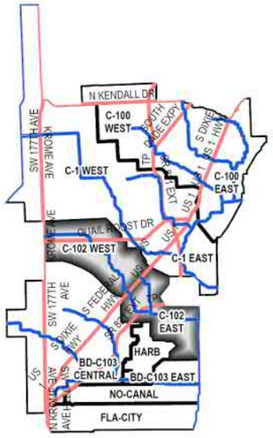
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

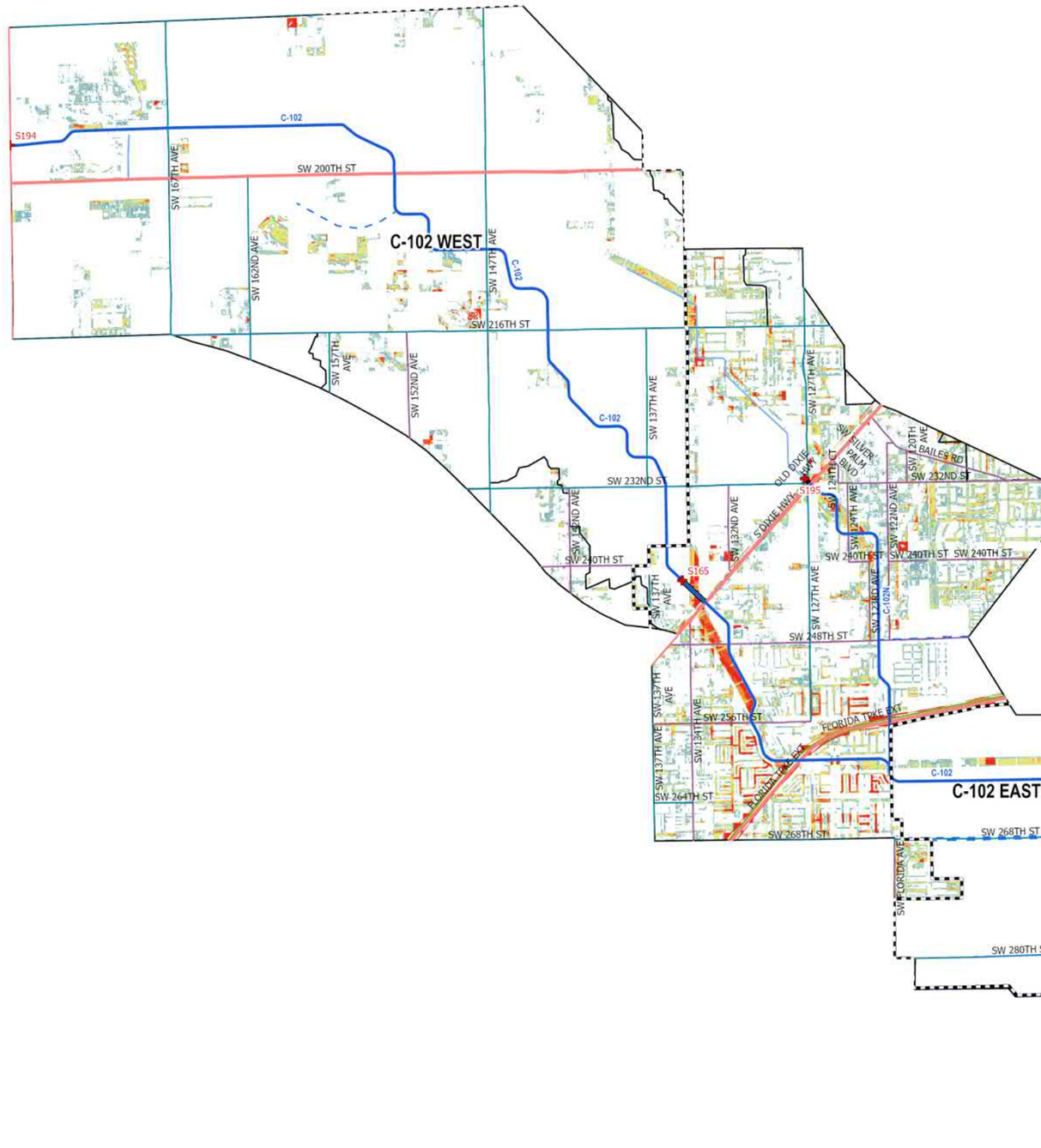
0 0.5 1 2 3 4 Miles

Figure A-258. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

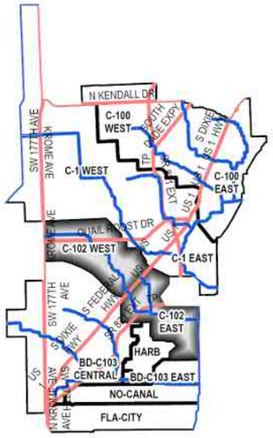
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

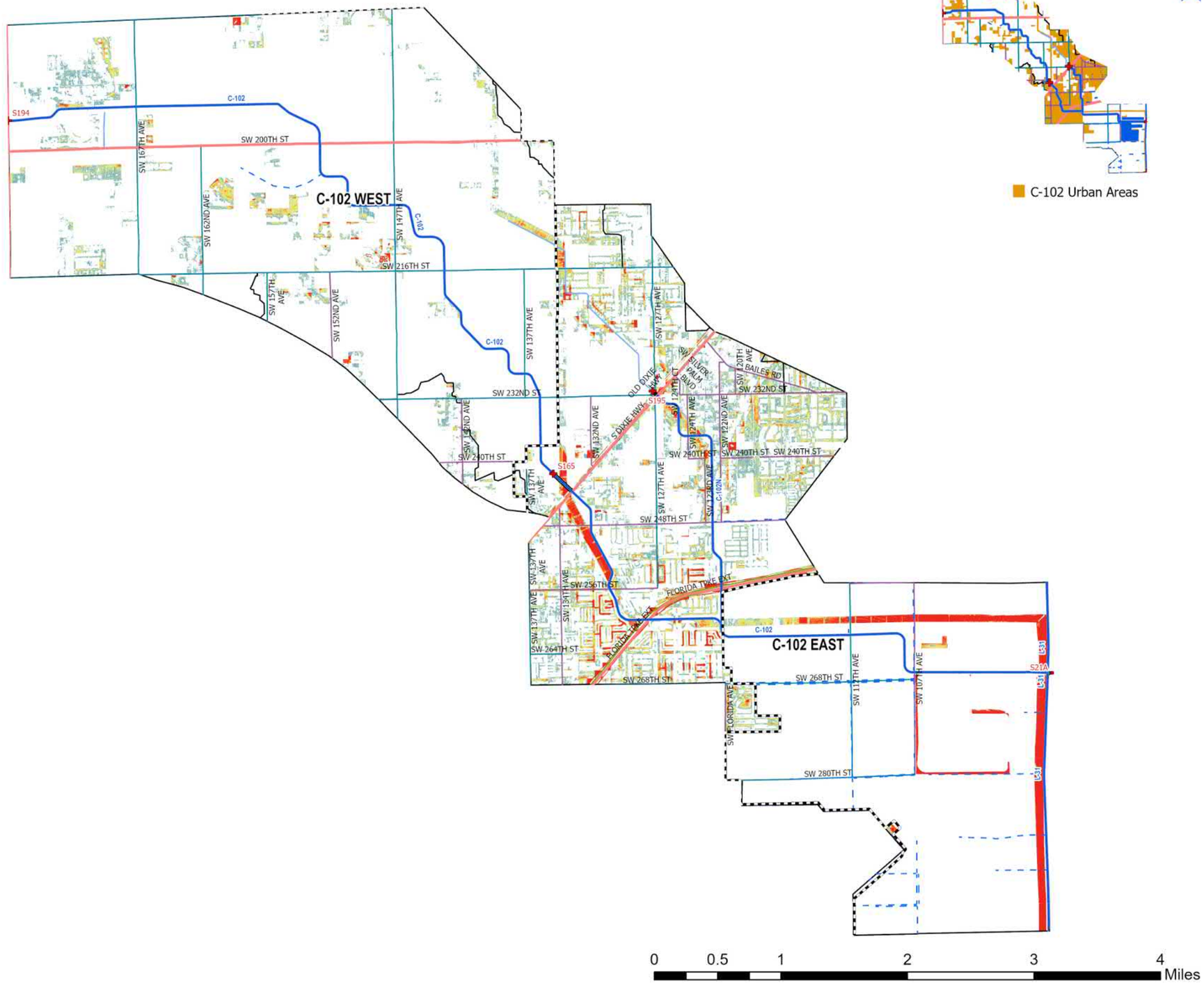
0 0.5 1 2 3 4 Miles

Figure A-259. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

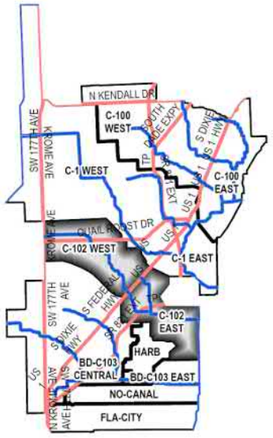
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

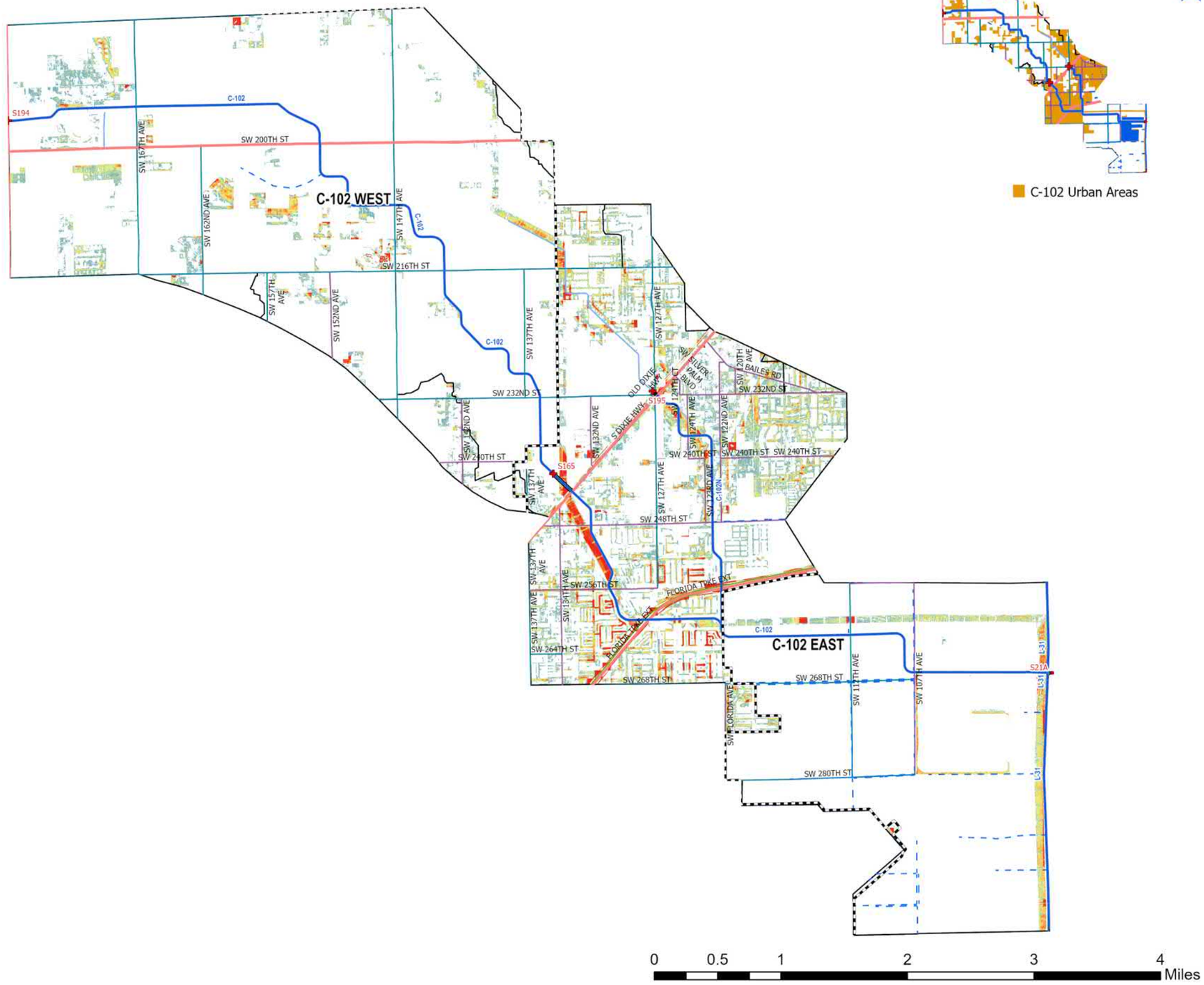
Flood Depth (ft)

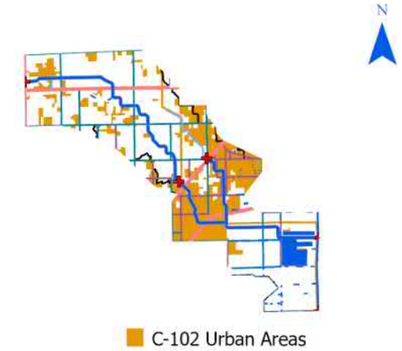
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-260. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

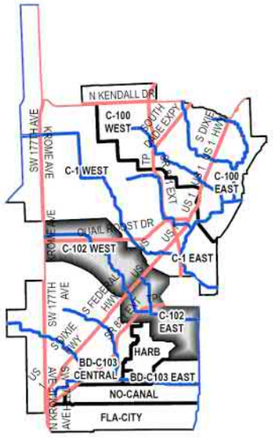
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

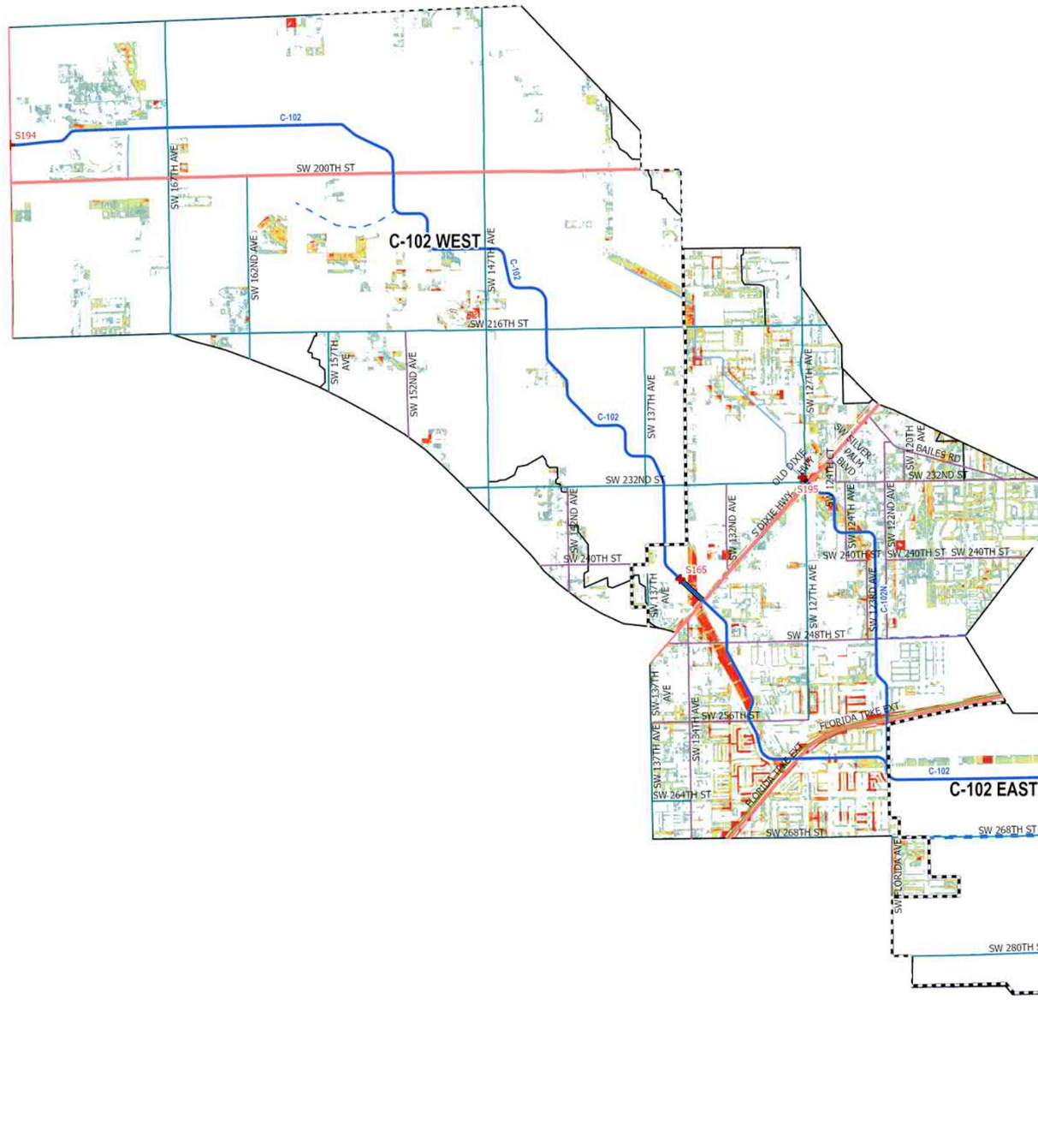
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-261. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

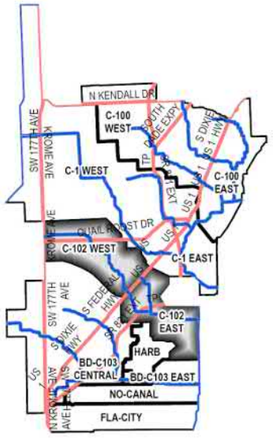
10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

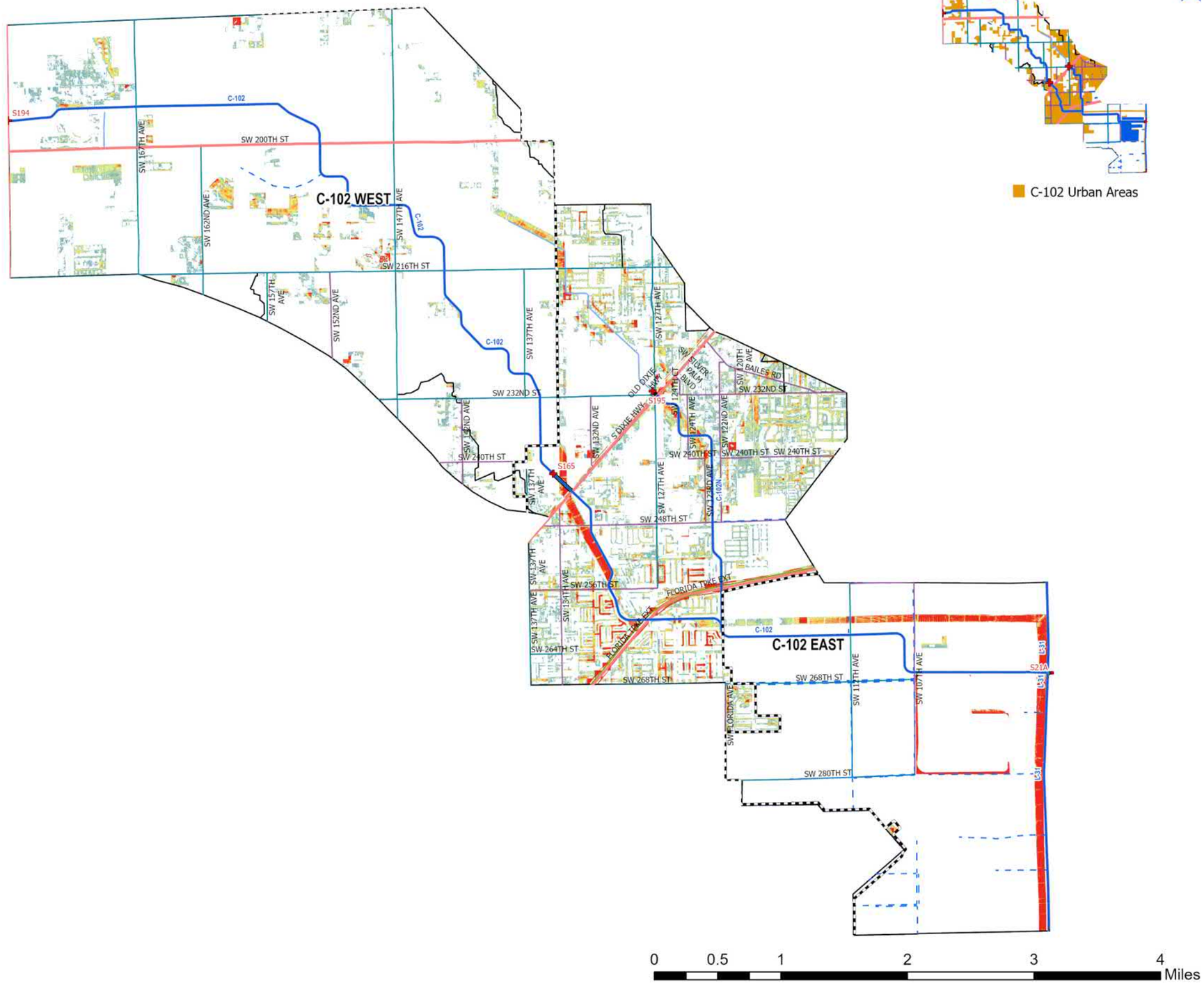
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-262. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

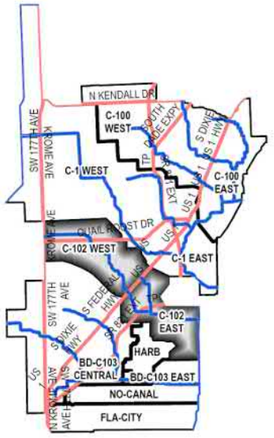
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

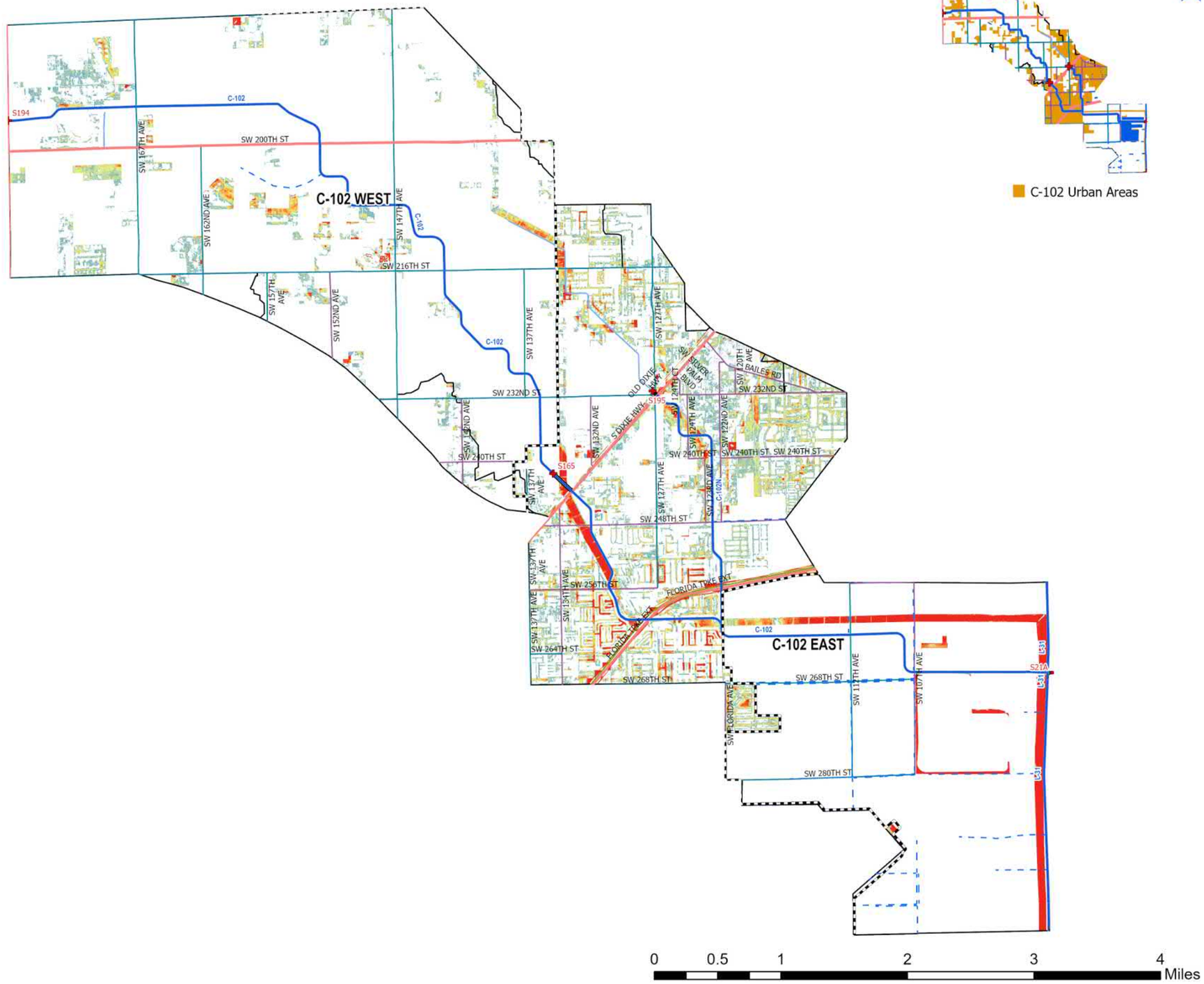
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-263. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-264. Watershed C-102 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

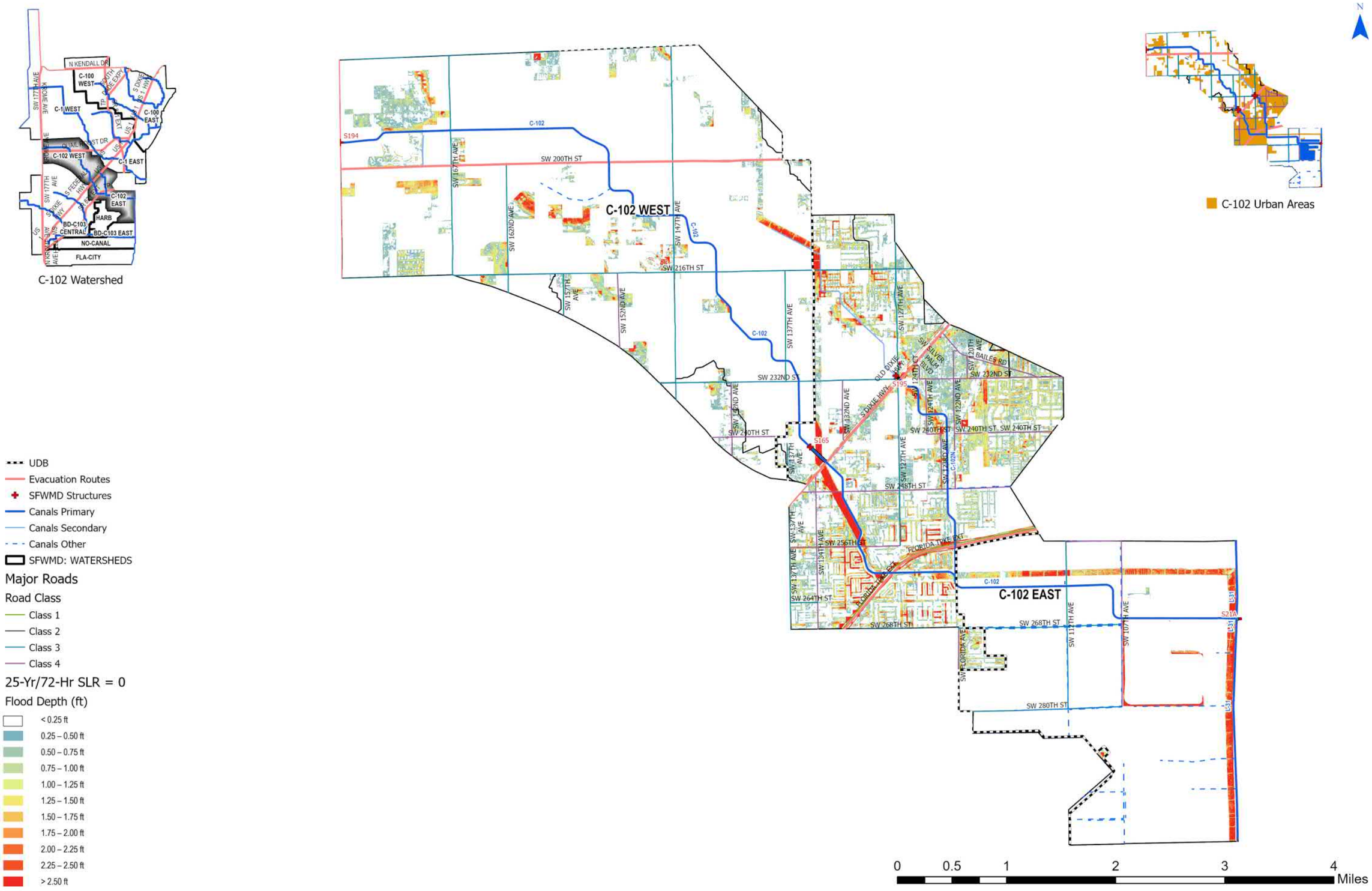
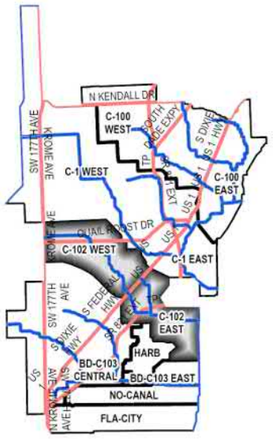
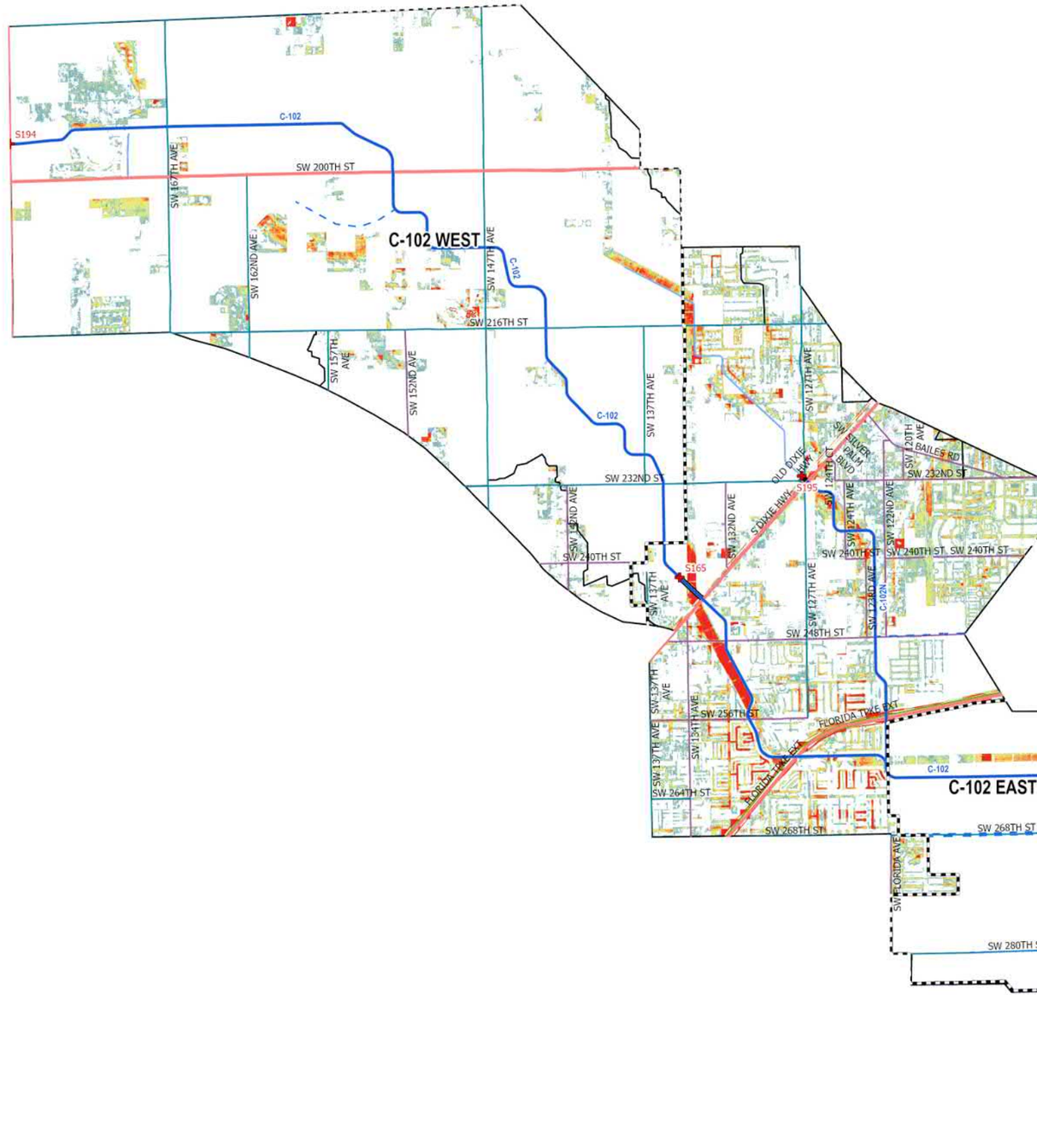


Figure A-265. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

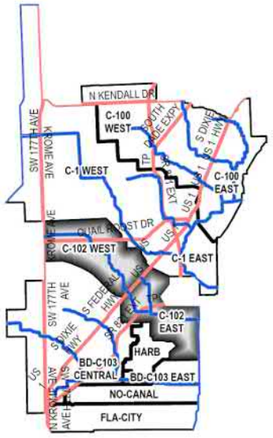
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

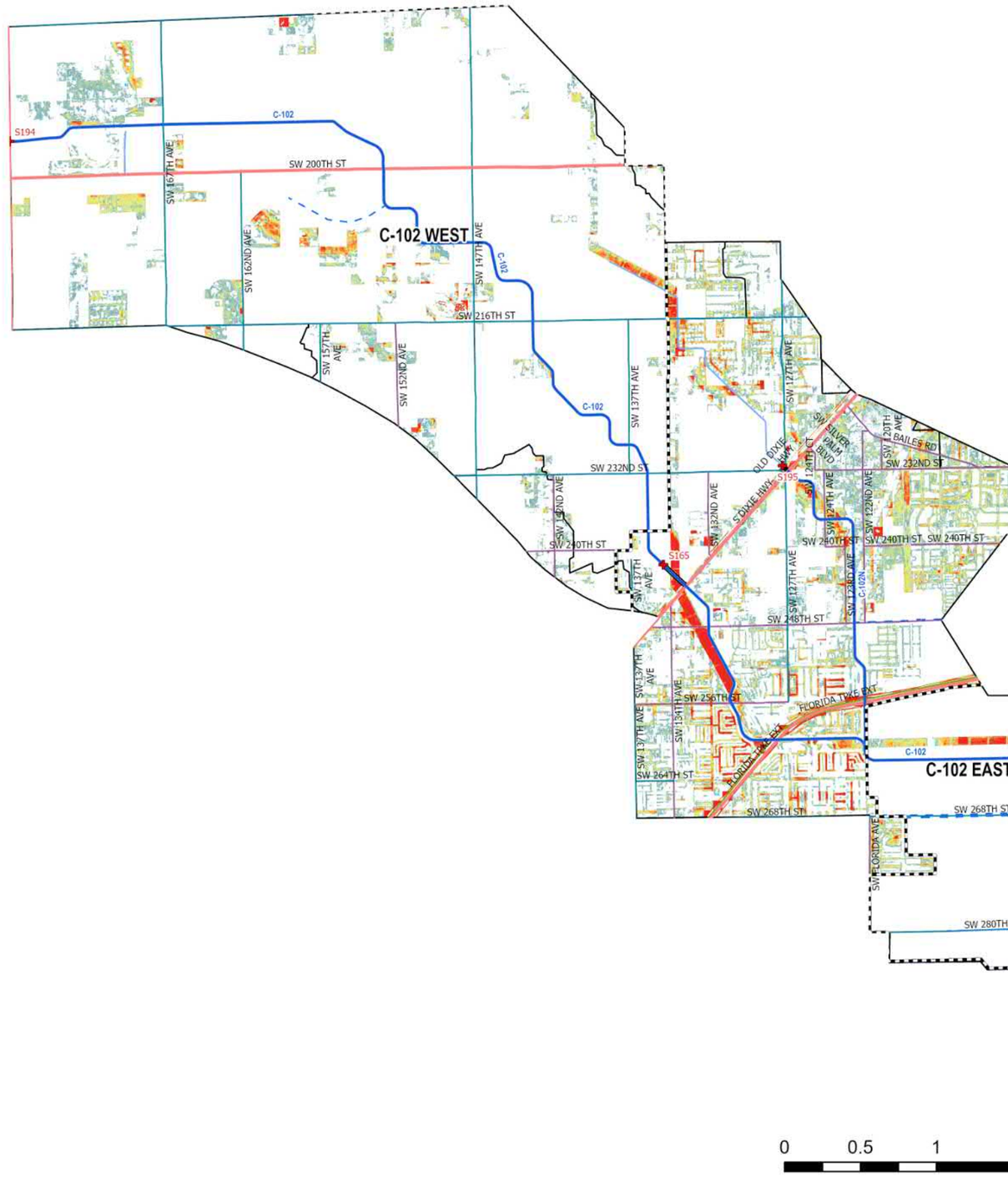
0 0.5 1 2 3 4 Miles

Figure A-266. Watershed C-102 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

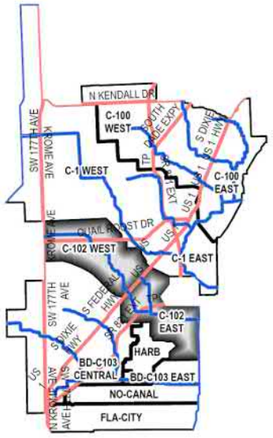
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

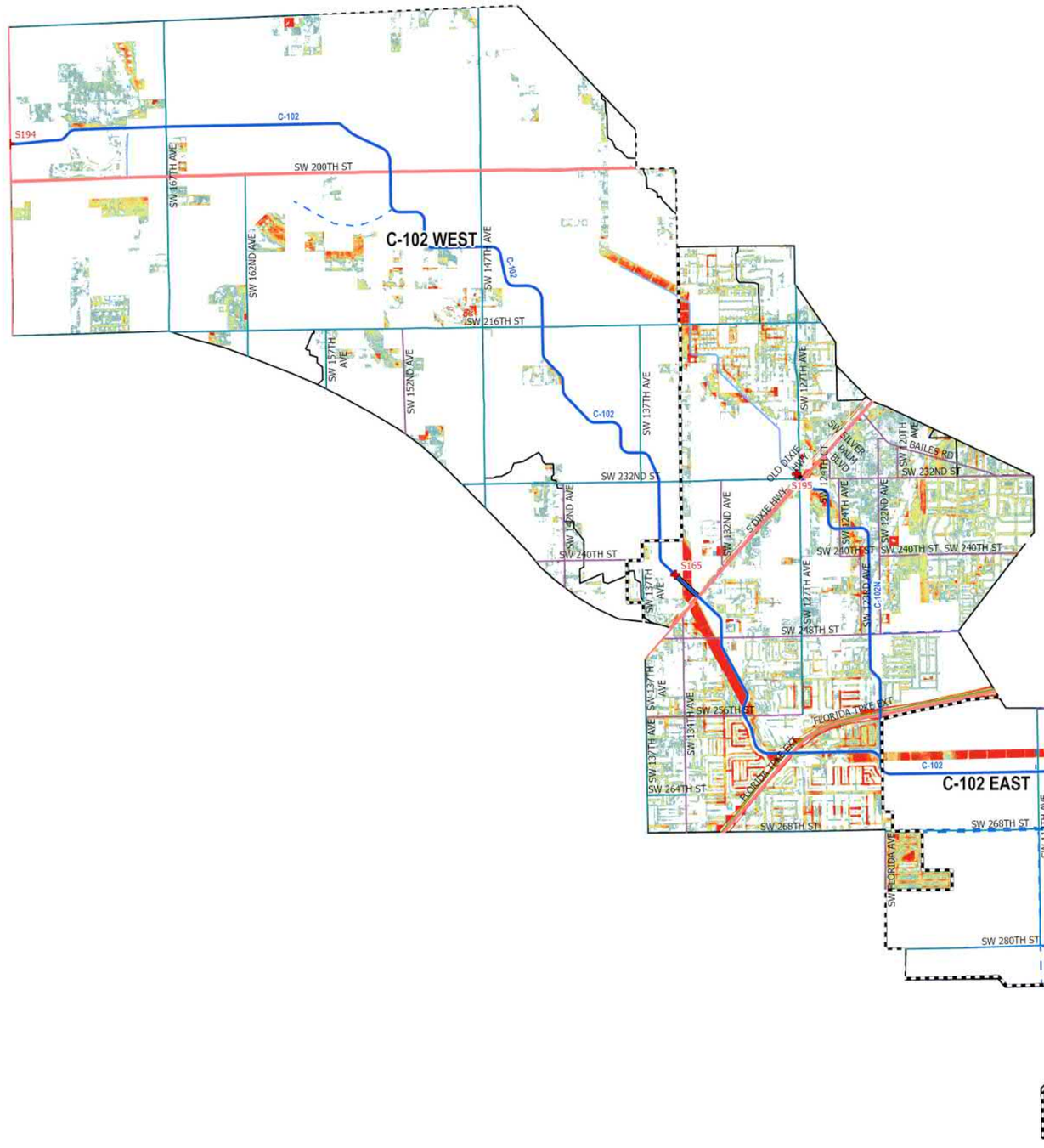
0 0.5 1 2 3 4 Miles

Figure A-267. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

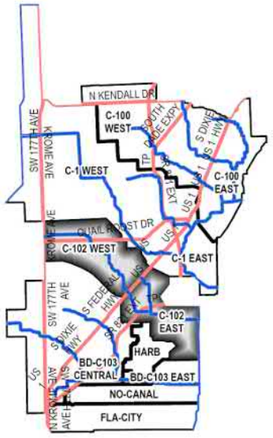
25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

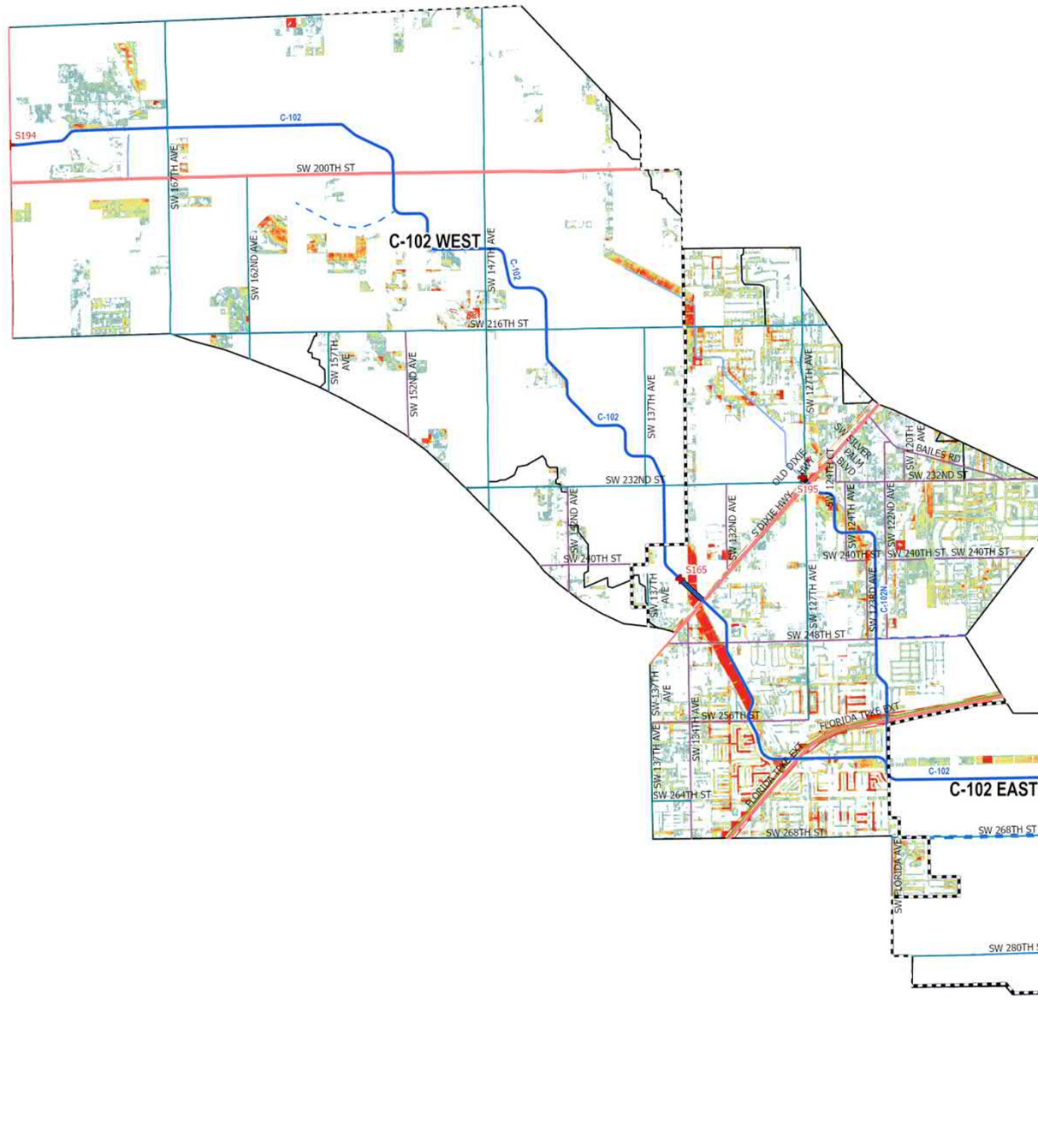
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

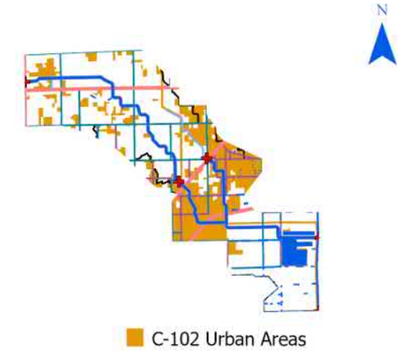
0 0.5 1 2 3 4 Miles

Figure A-268. Watershed C-102 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-269. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn

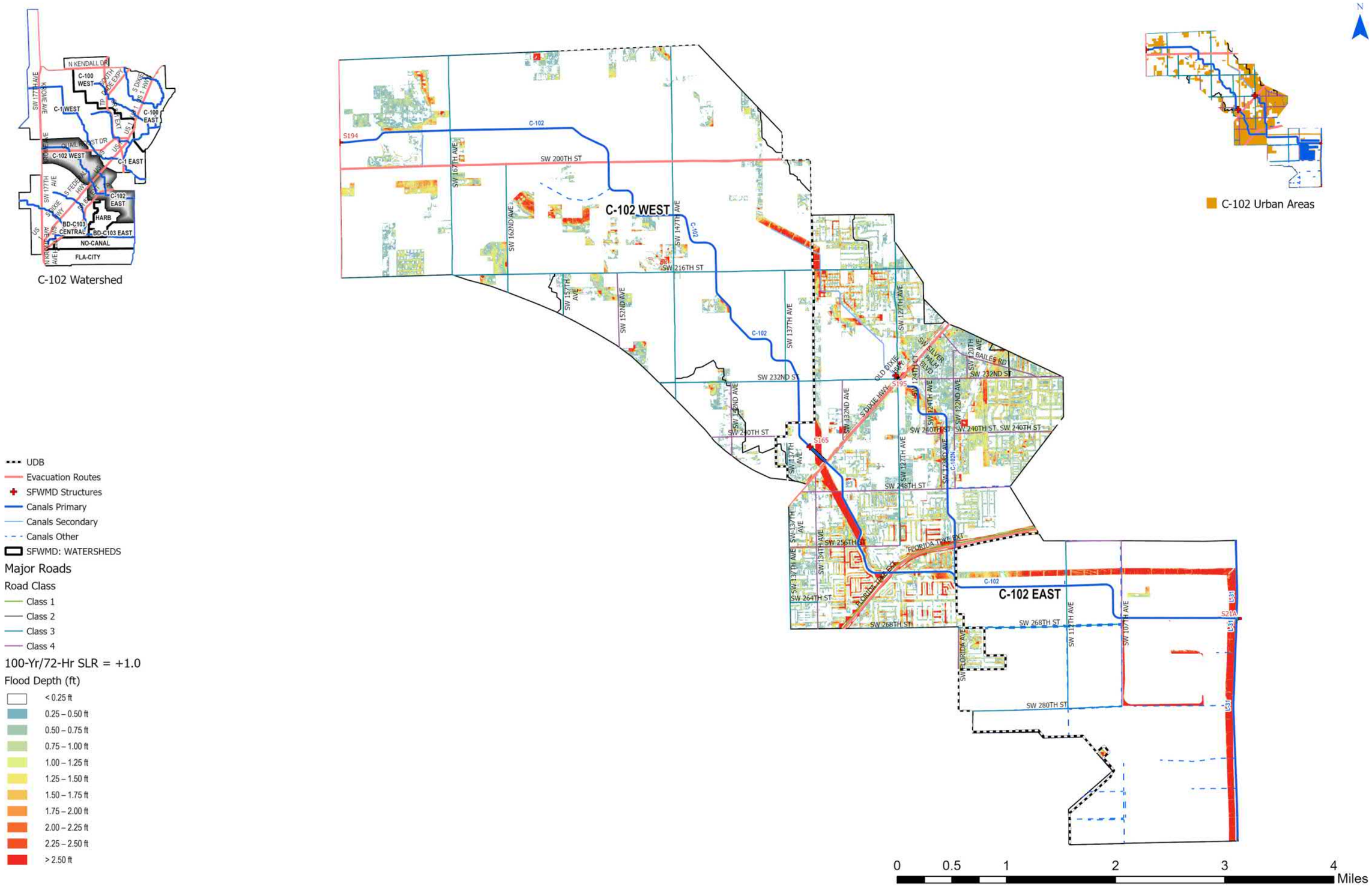
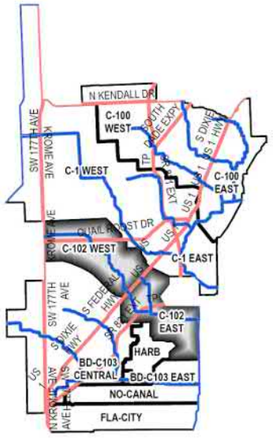
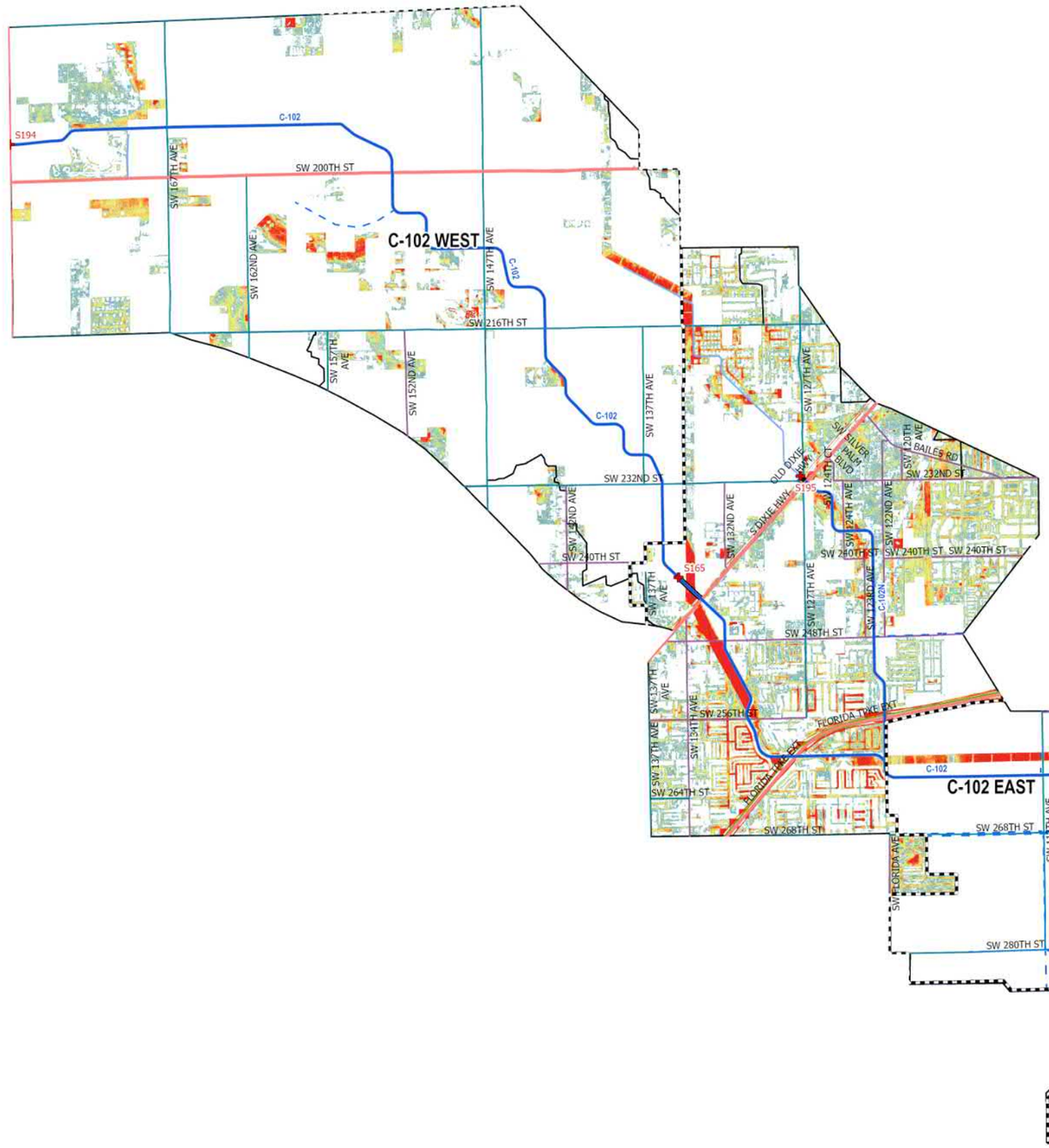


Figure A-270. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

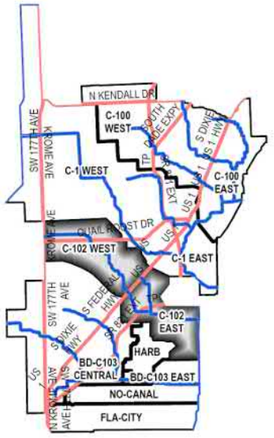
100-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

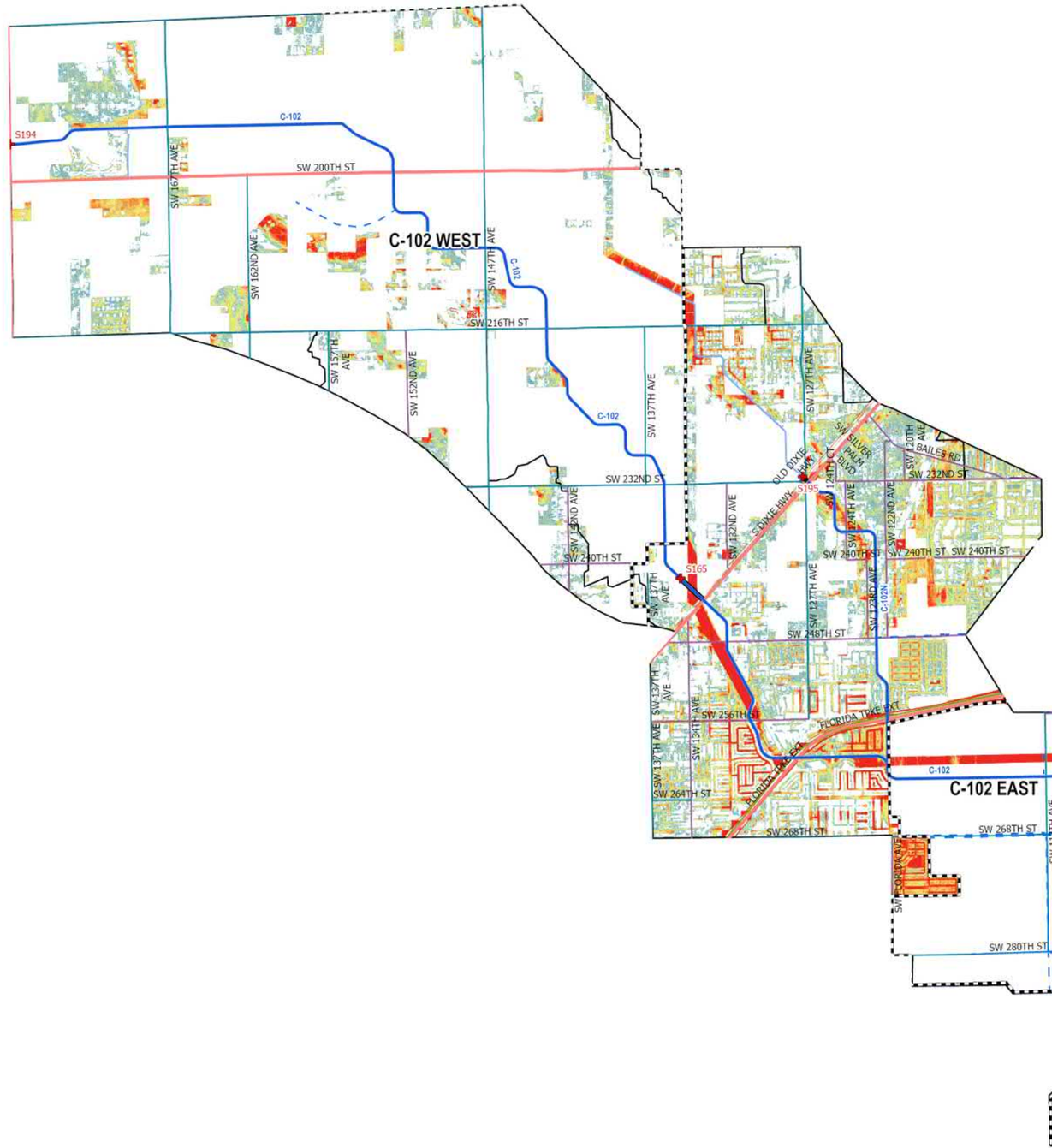
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-271. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

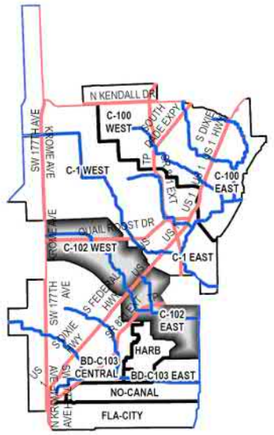
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

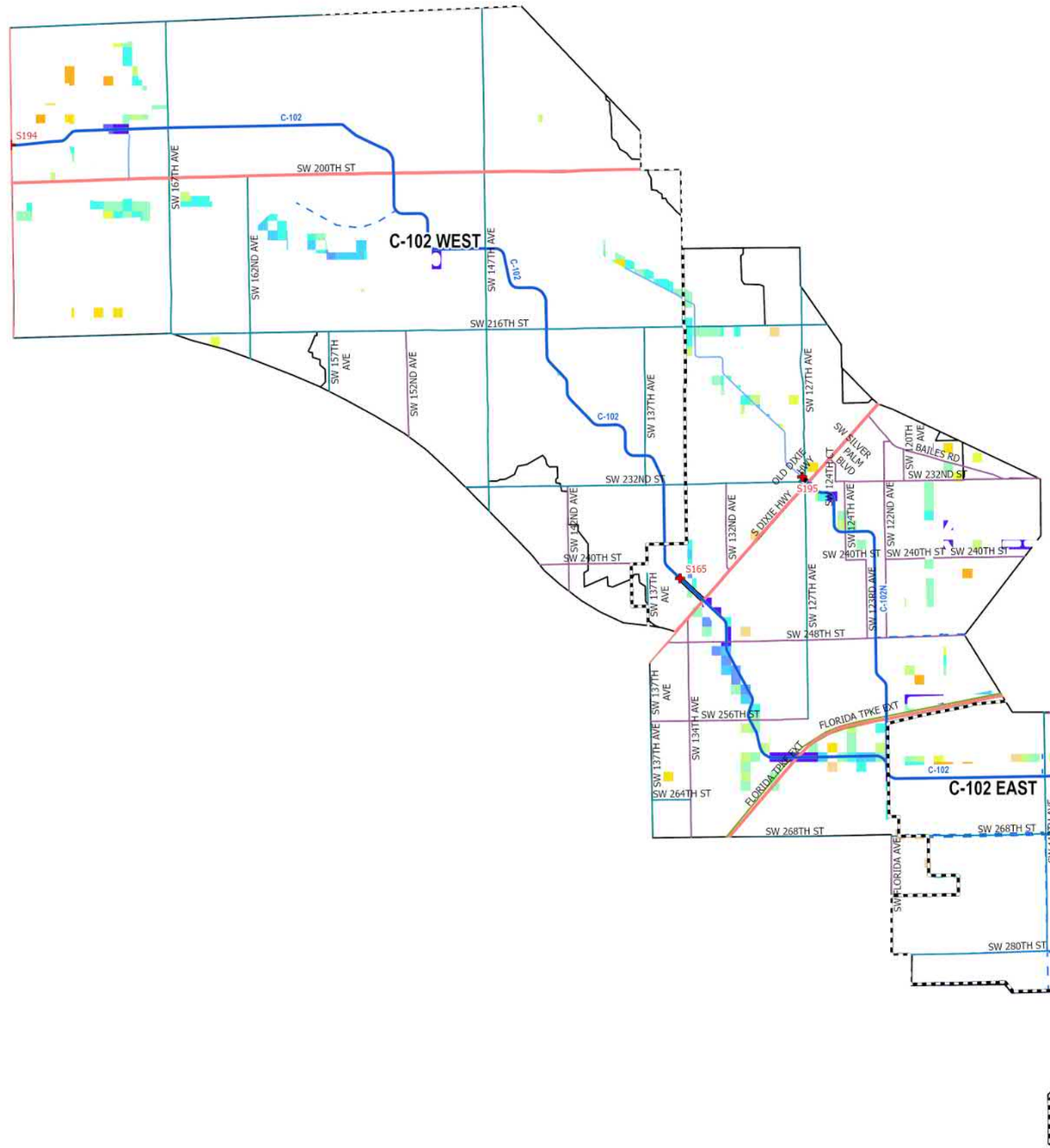
Figure A-272. Watershed C-102 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

WATERSHED C-102: Flood Duration in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

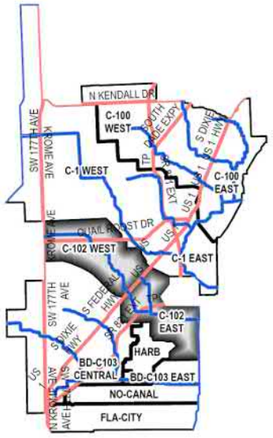
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

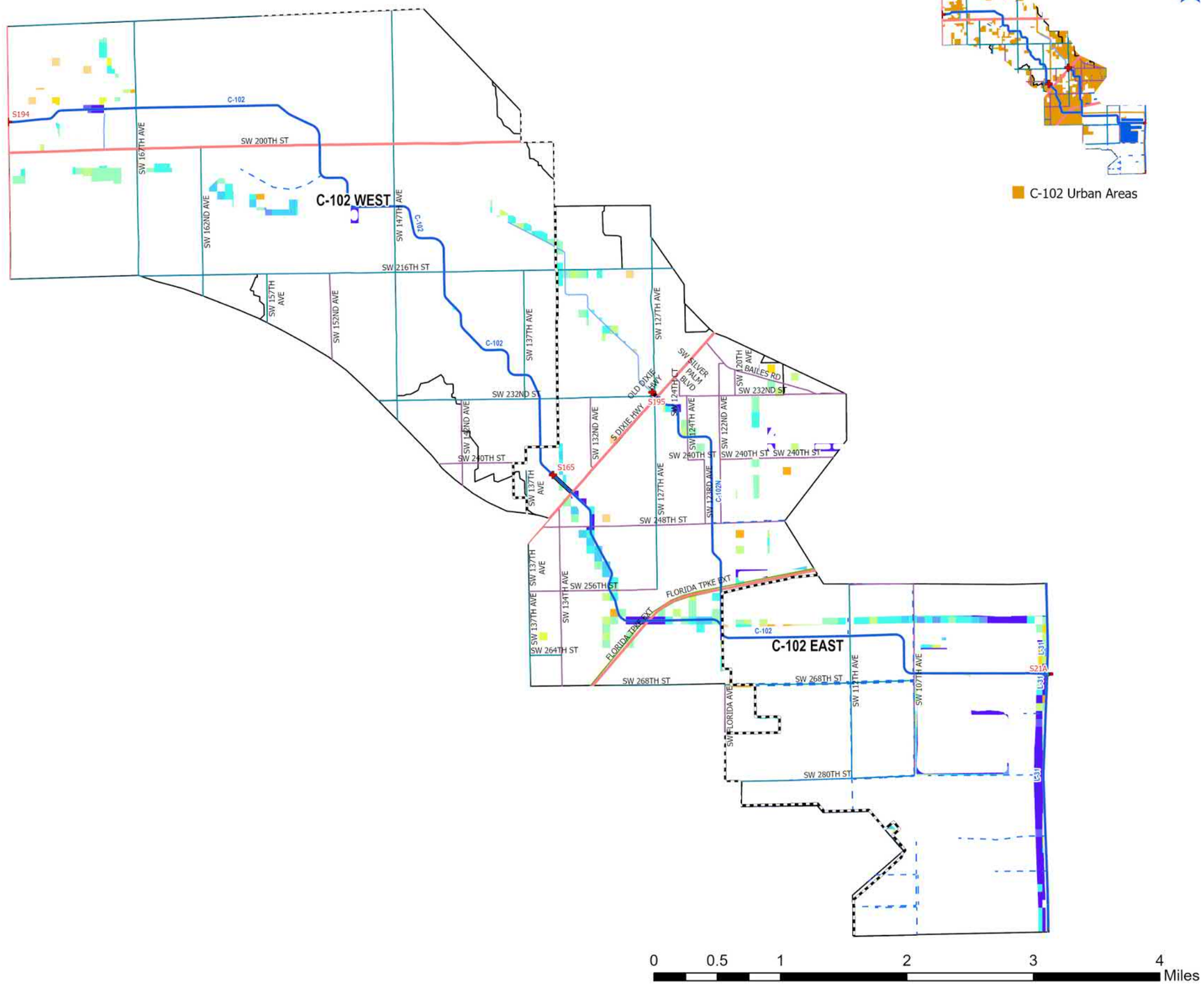
0 0.5 1 2 3 4 Miles

Figure A-273. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

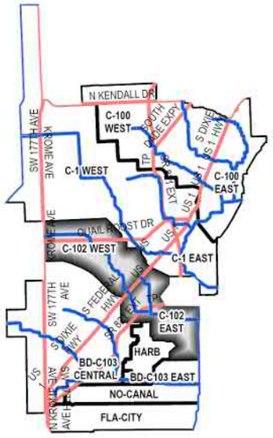
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

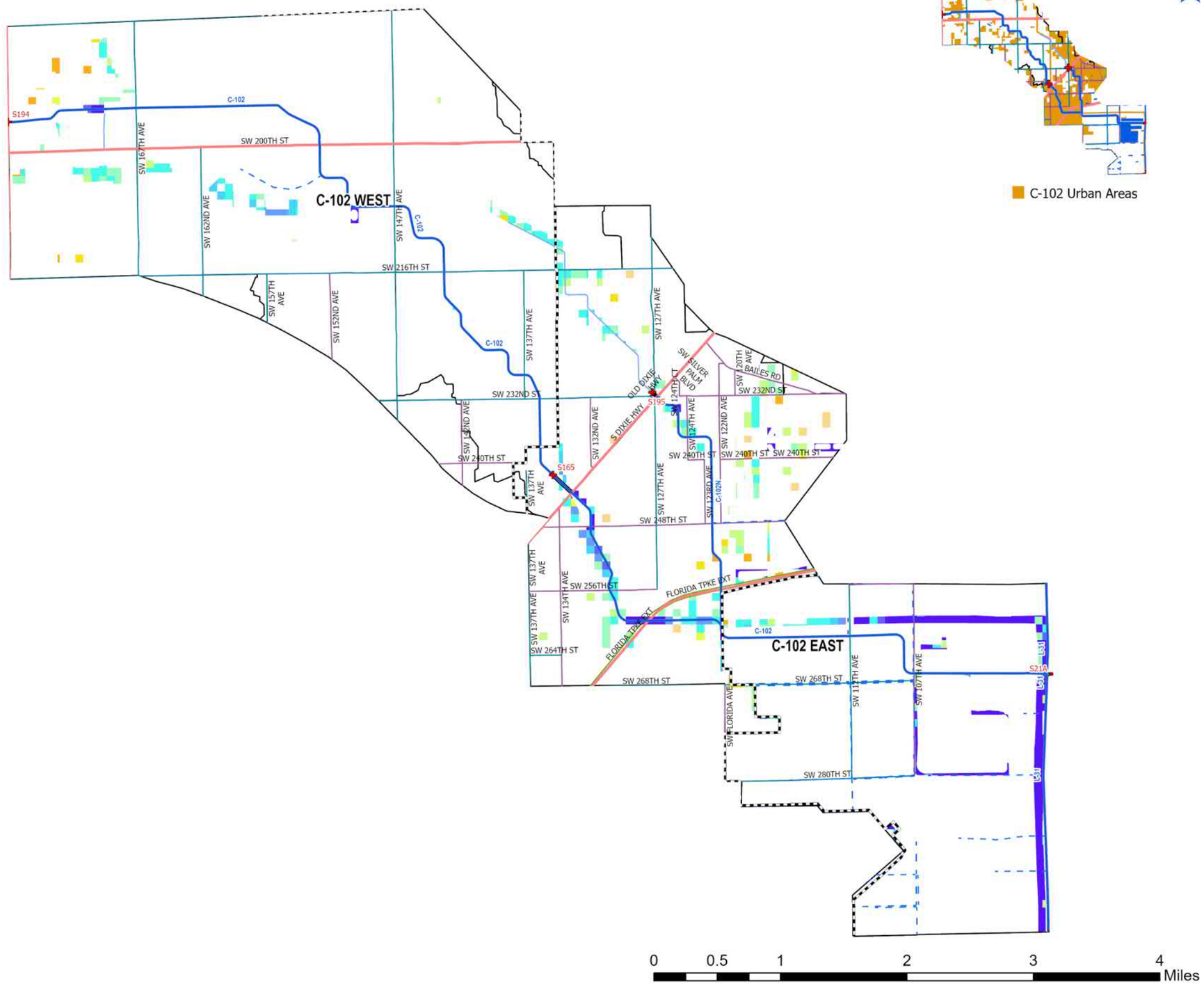
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-274. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

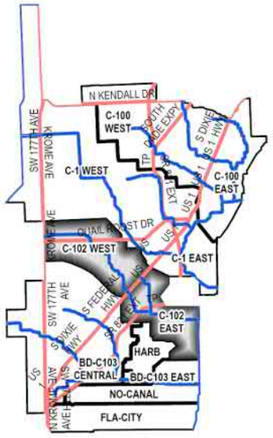
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

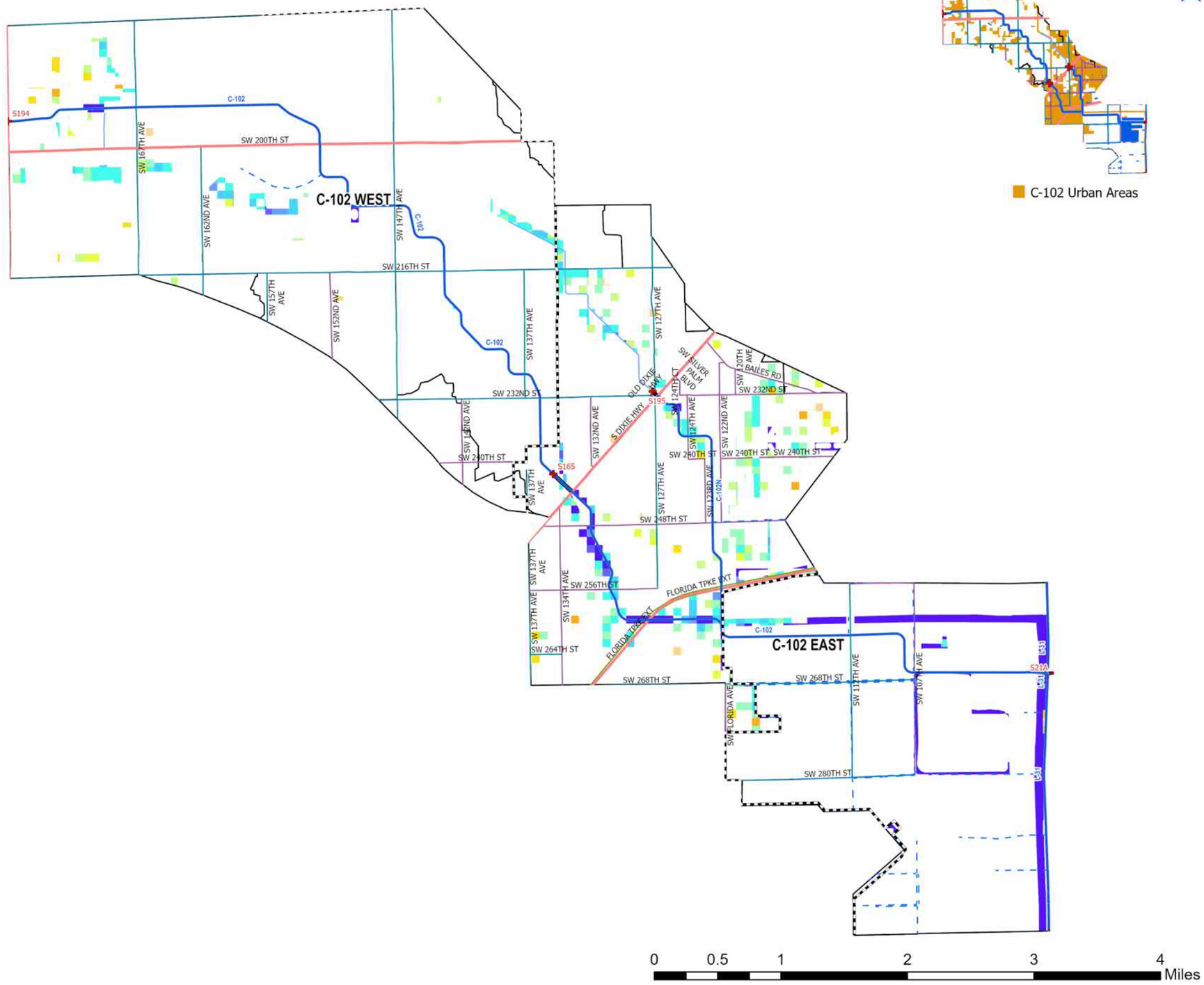
0 0.5 1 2 3 4 Miles

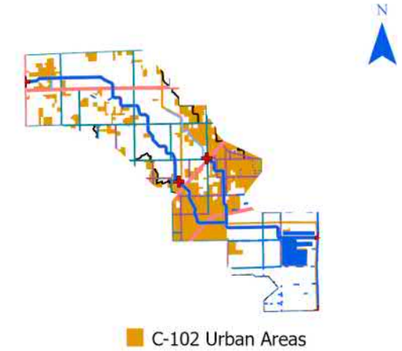
Figure A-275. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

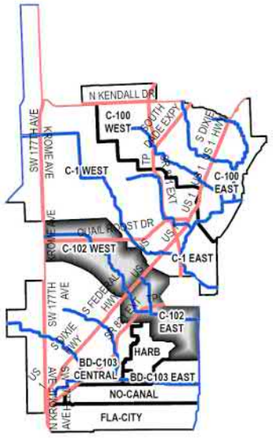
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

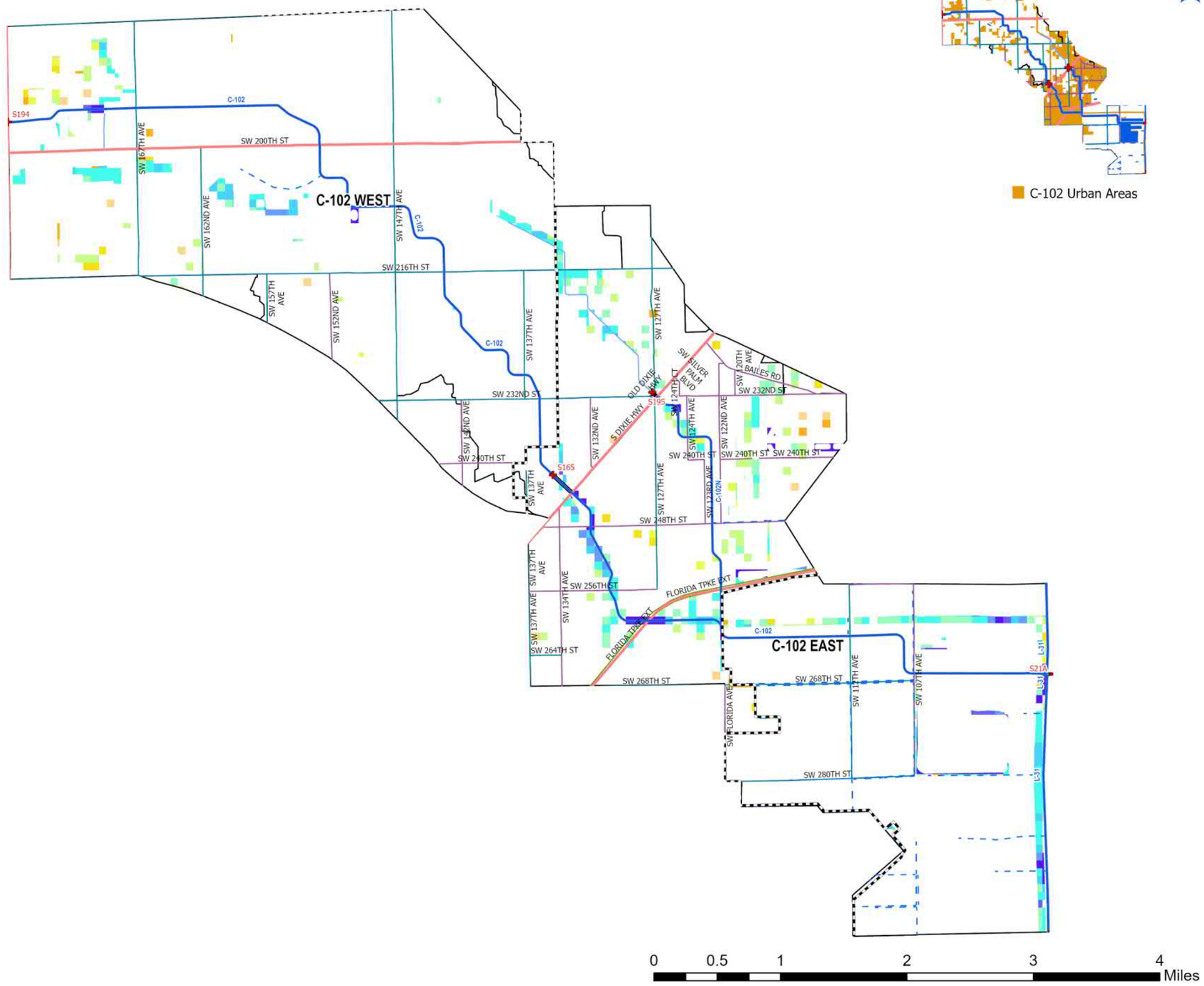
0 0.5 1 2 3 4 Miles

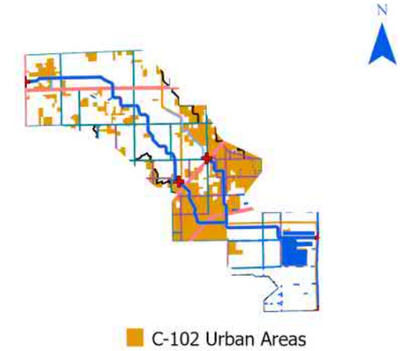
Figure A-276. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-102 Watershed





C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

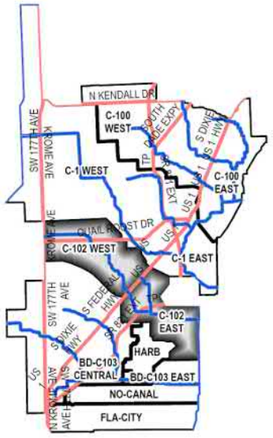
10-Yr/72-Hr SLR = 0

Flood Duration (hr)

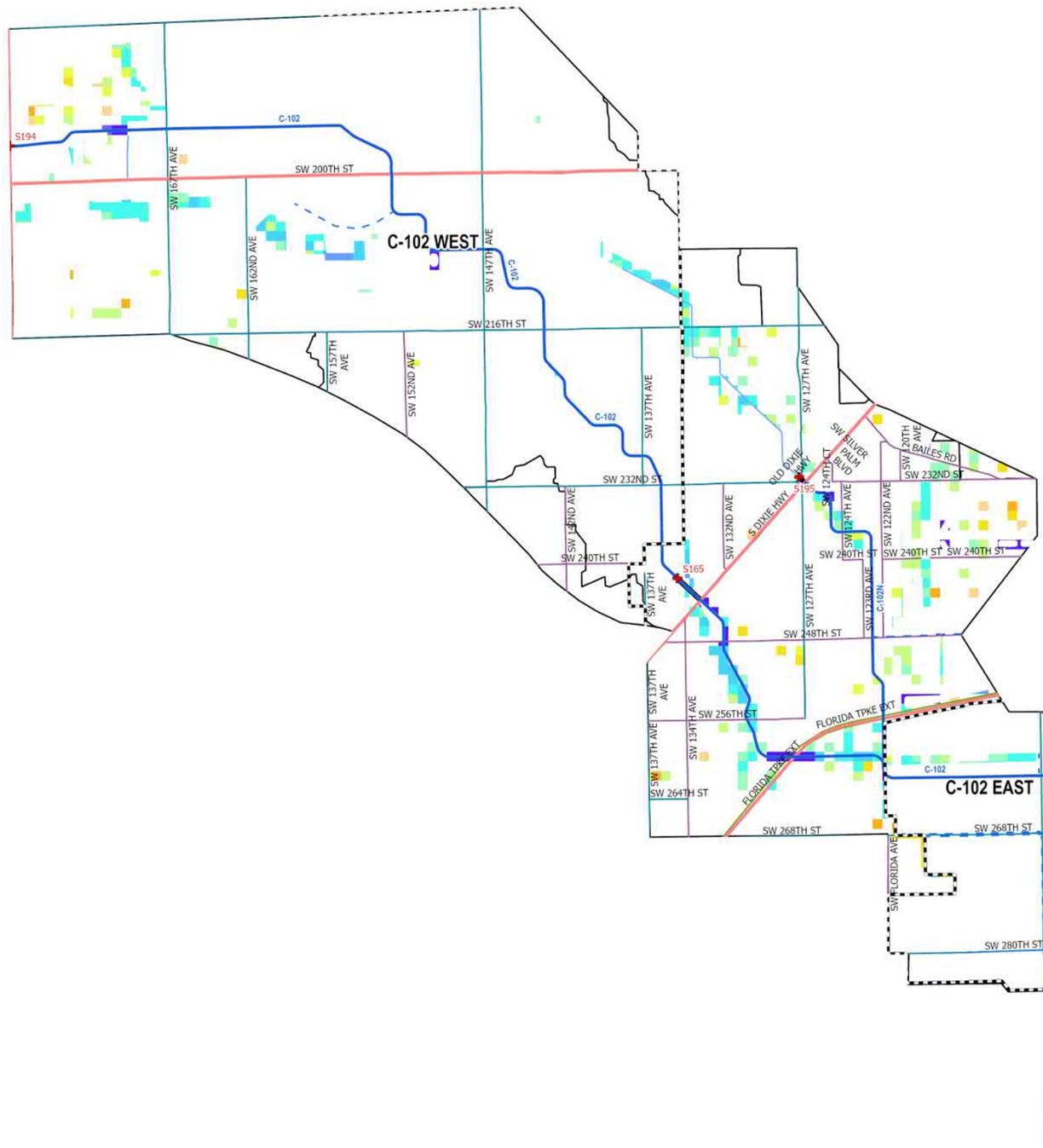
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-277. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

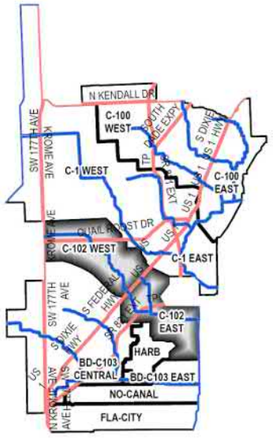
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

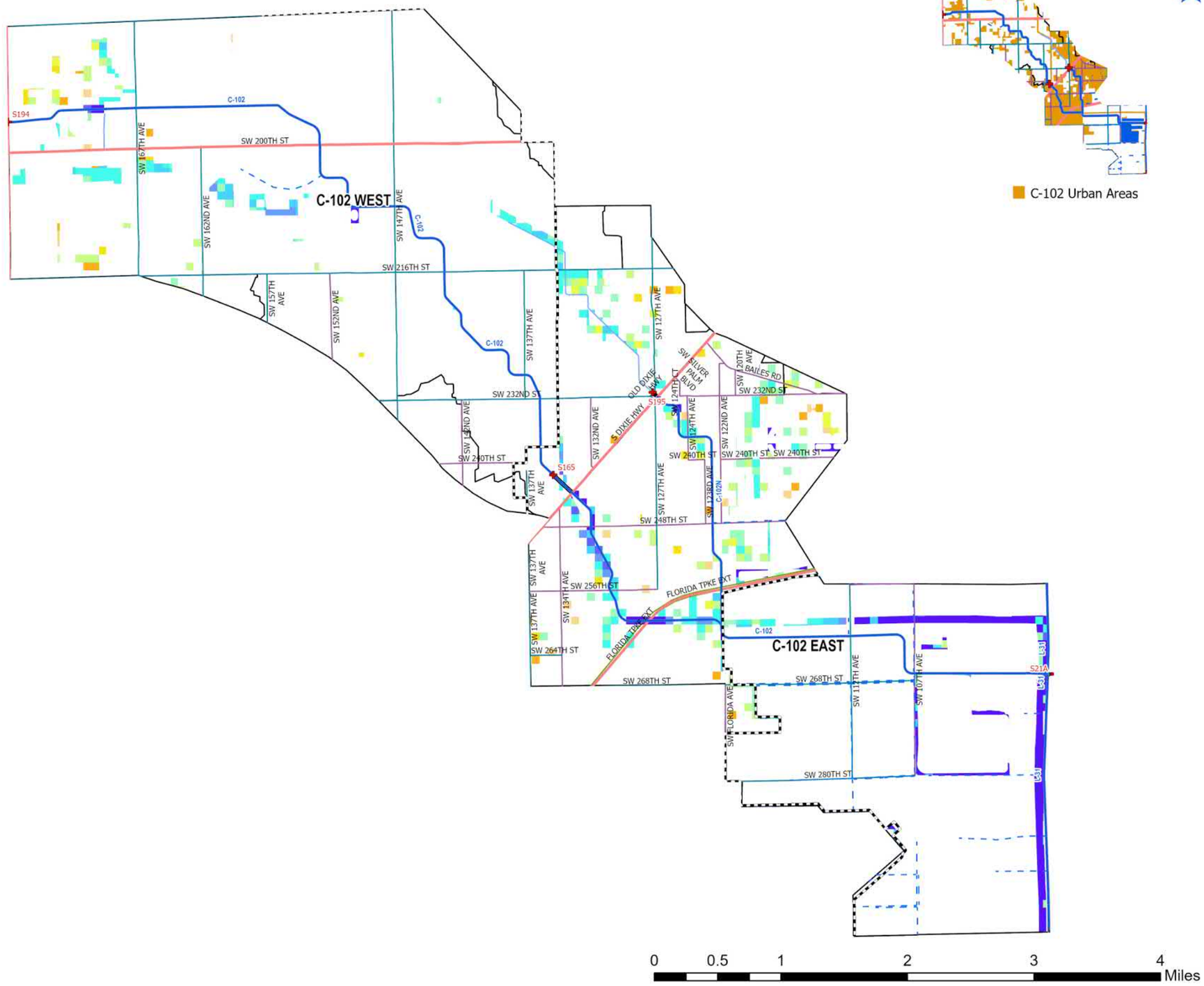
0 0.5 1 2 3 4 Miles

Figure A-278. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

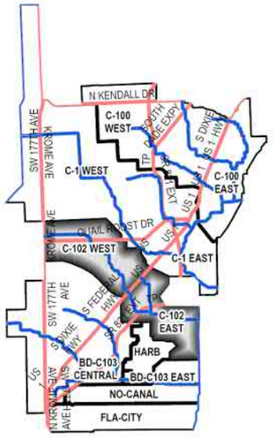
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

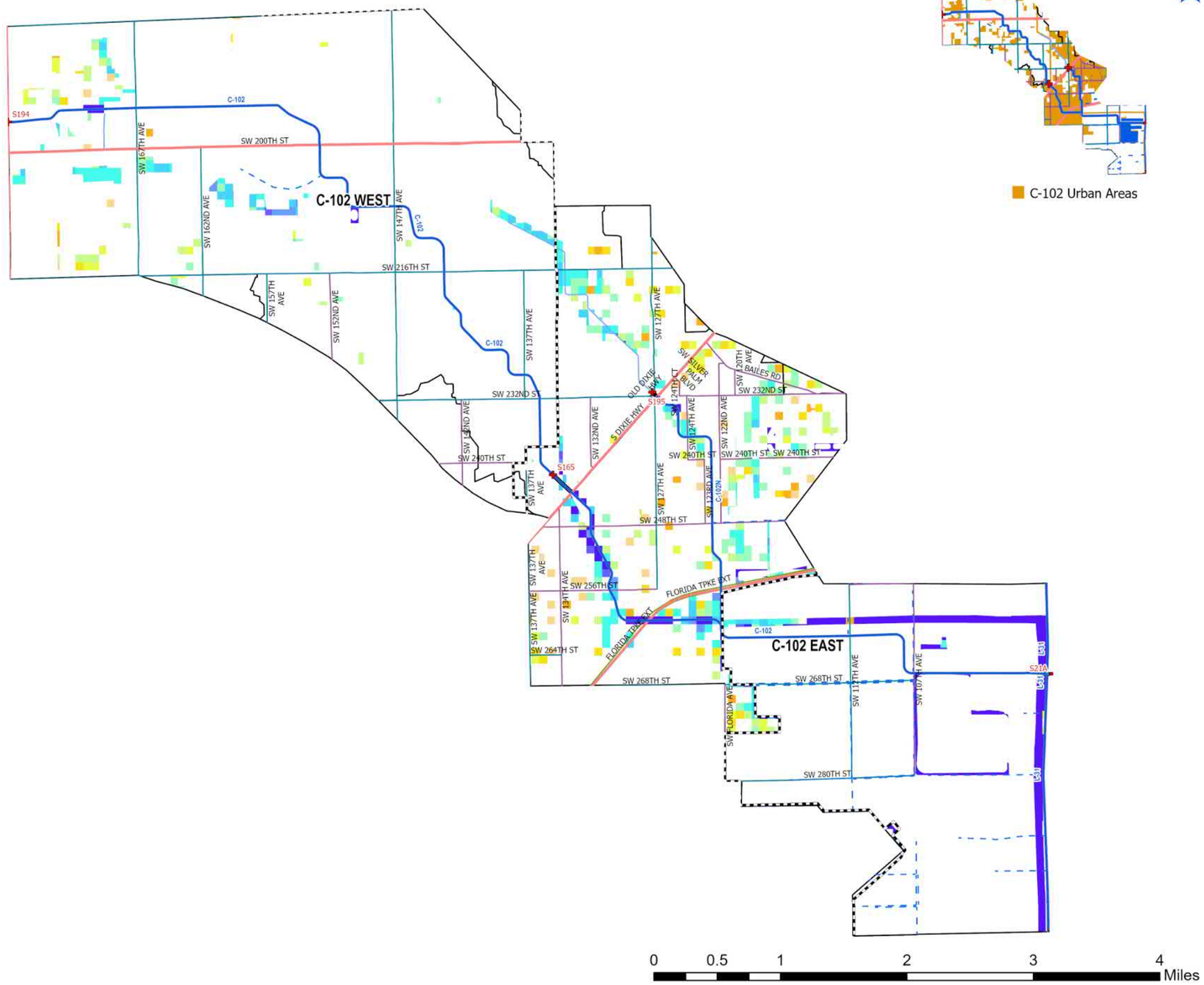
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-279. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-280. Watershed C-102 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

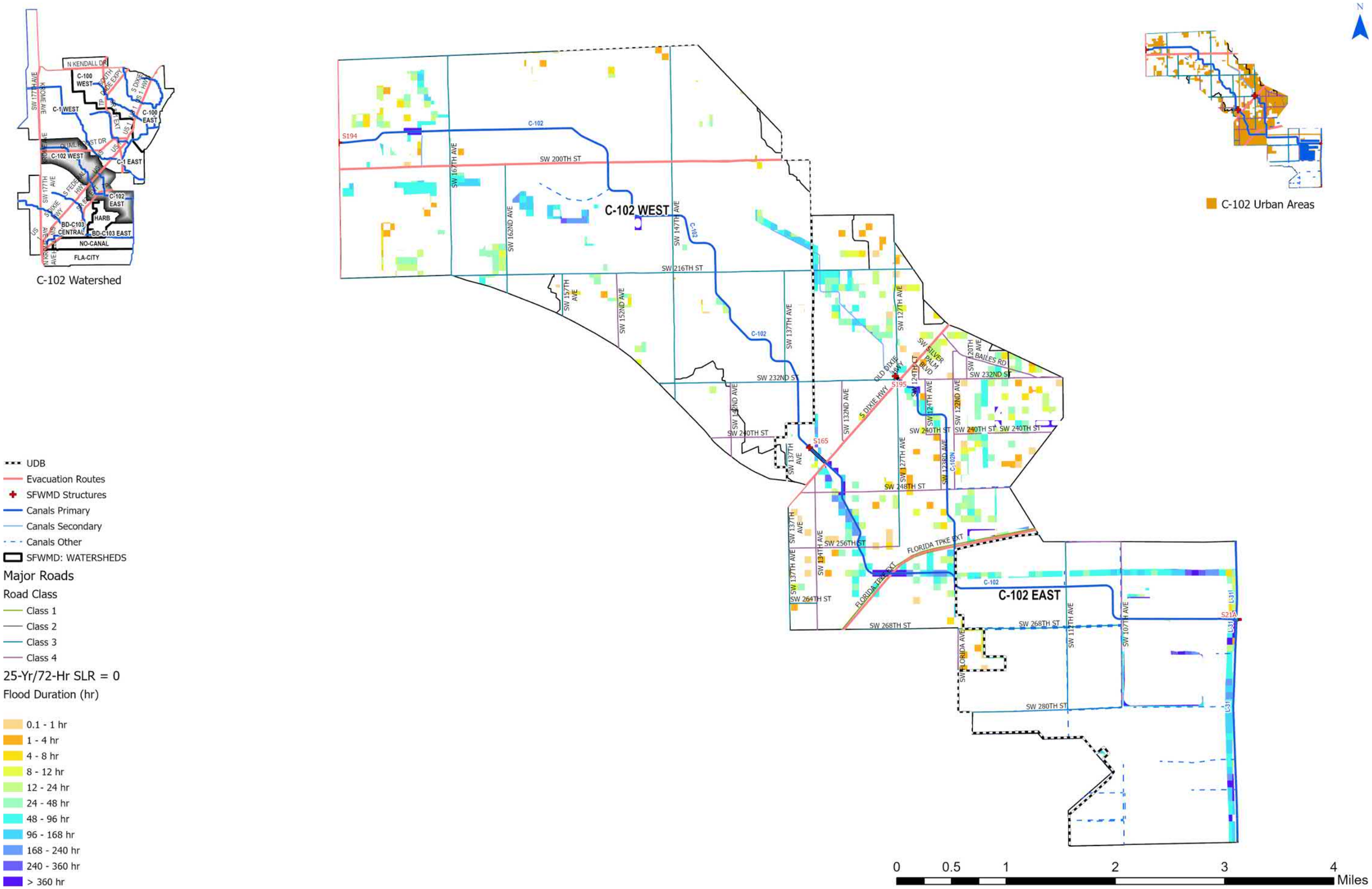
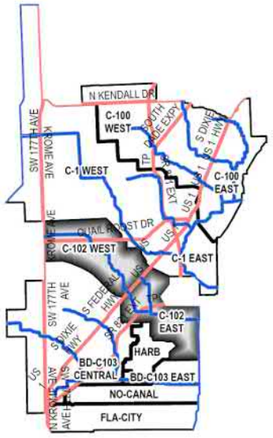
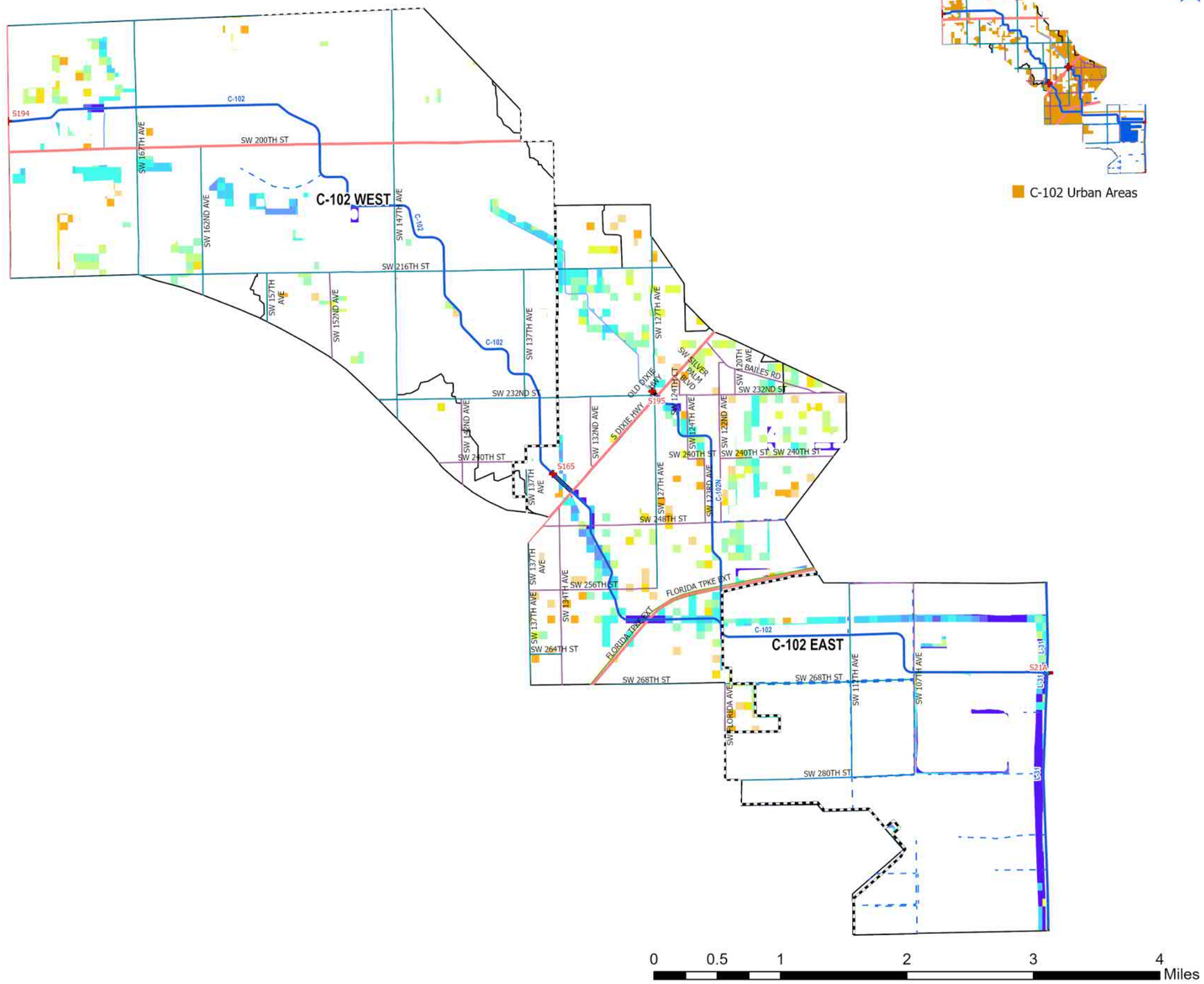


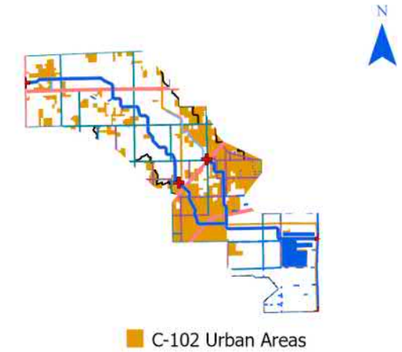
Figure A-281. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

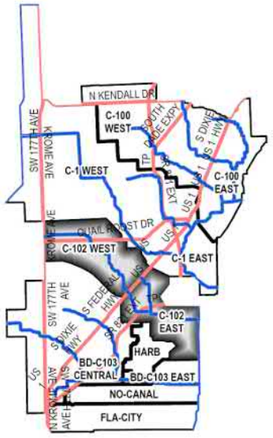
25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

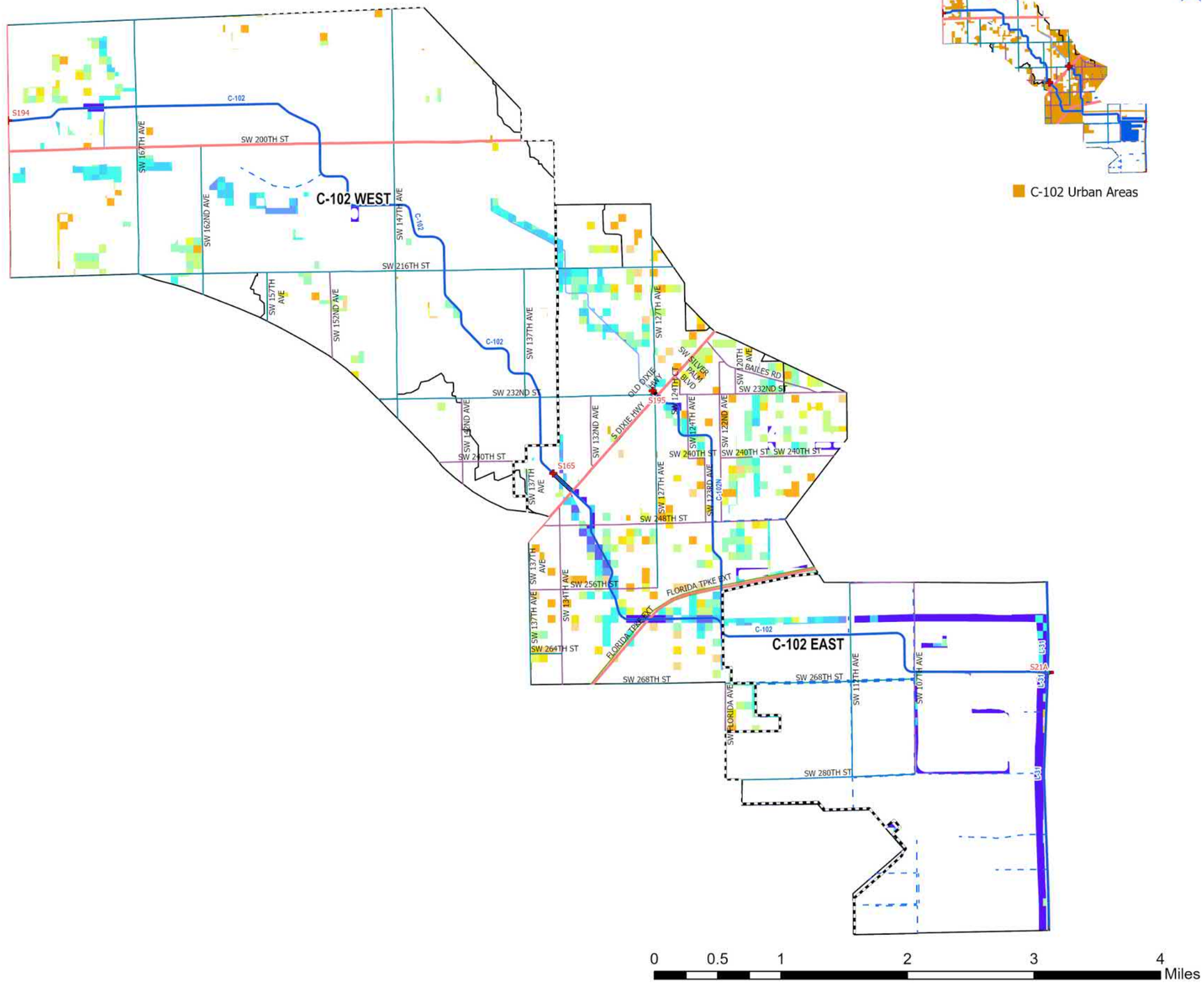
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-282. Watershed C-102 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

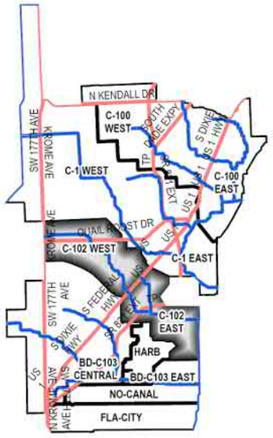
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

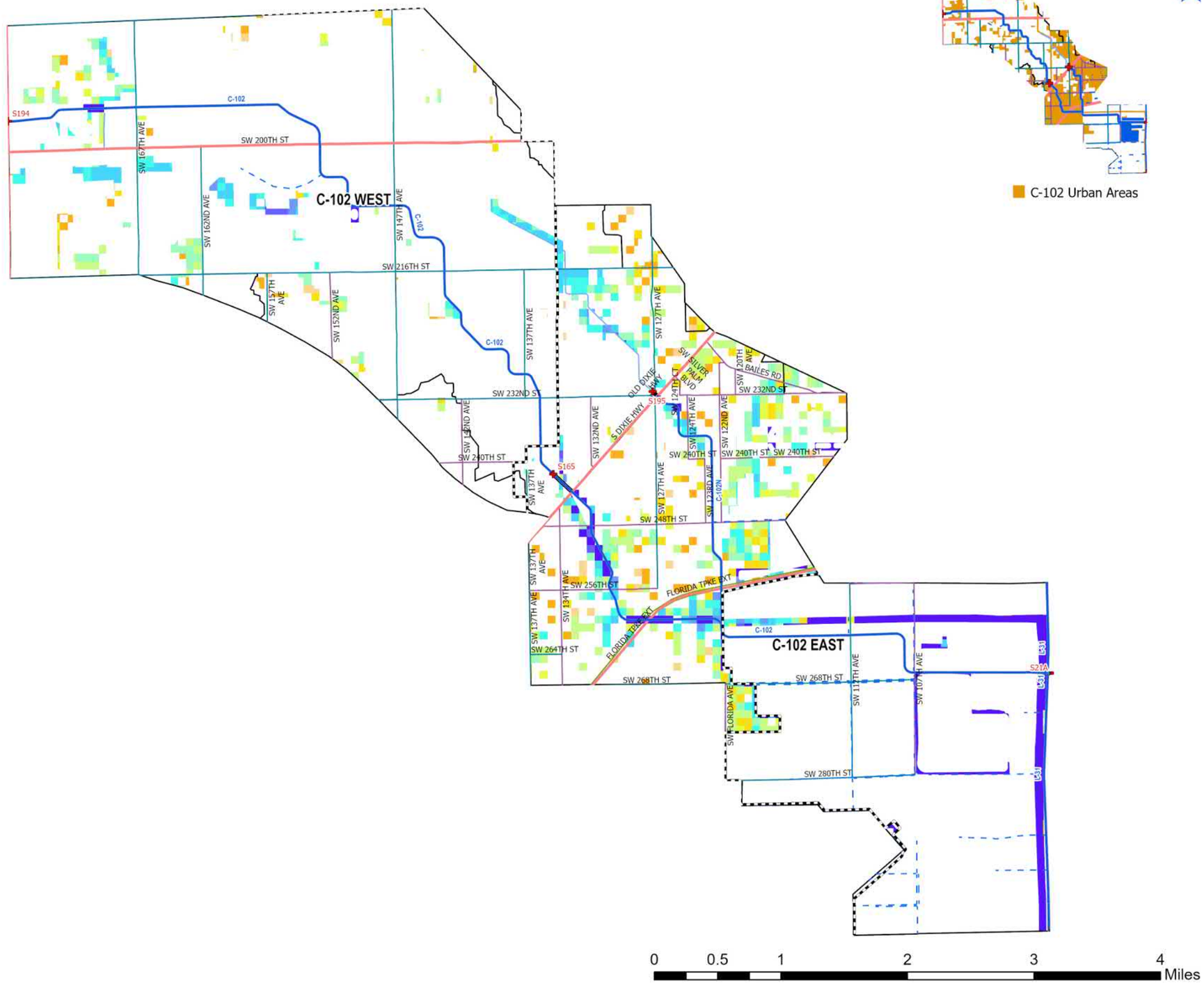
Flood Duration (hr)

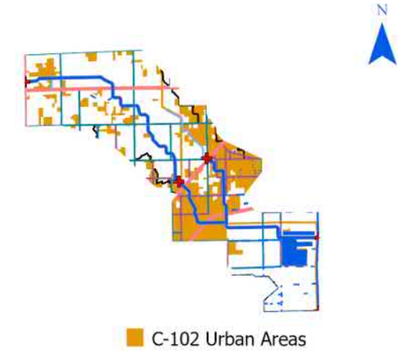
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-283. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

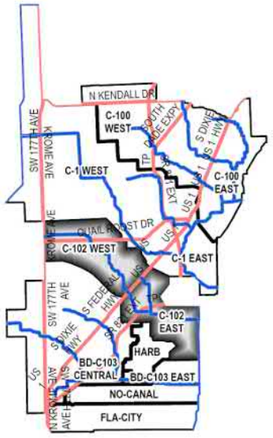
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

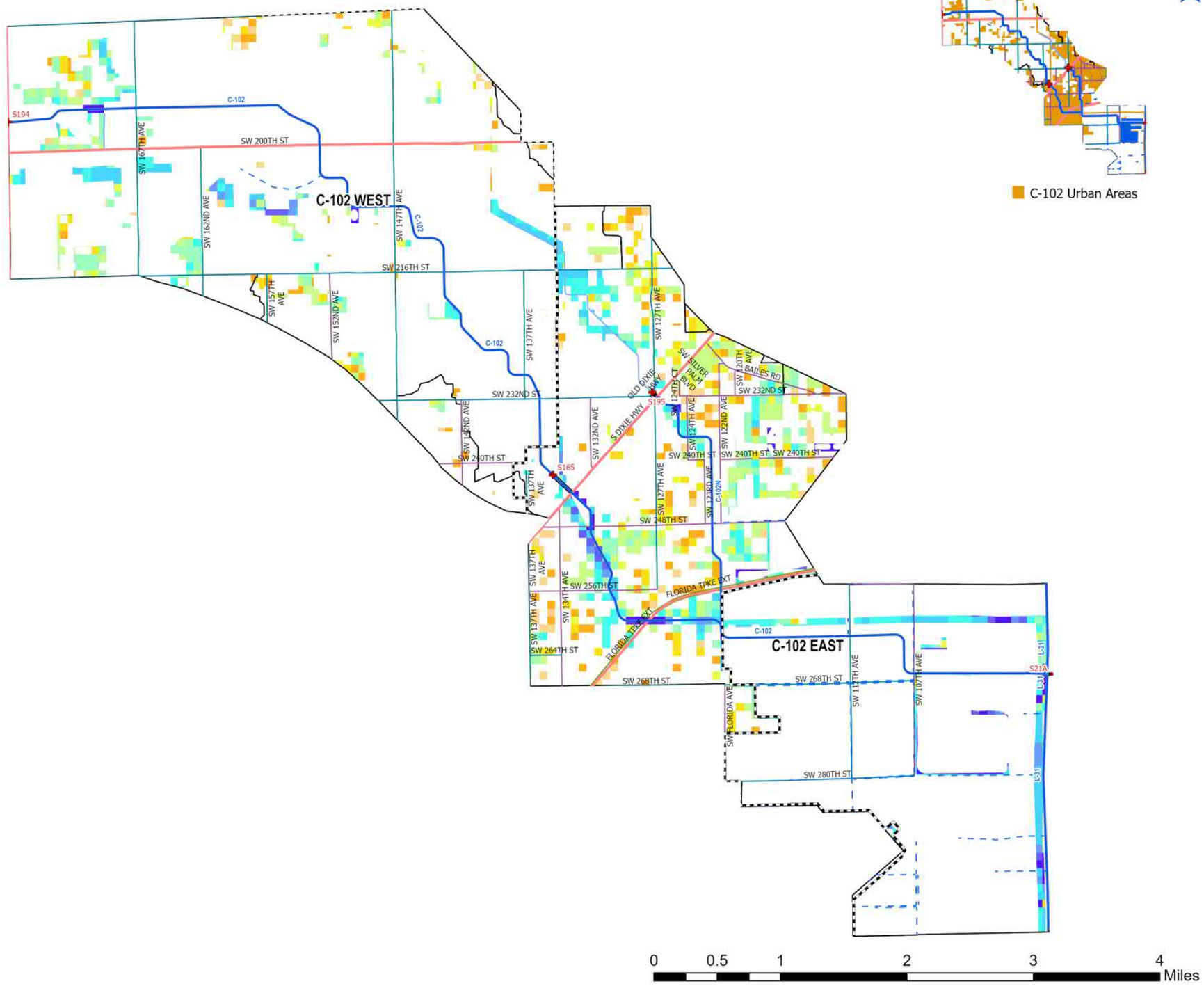
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

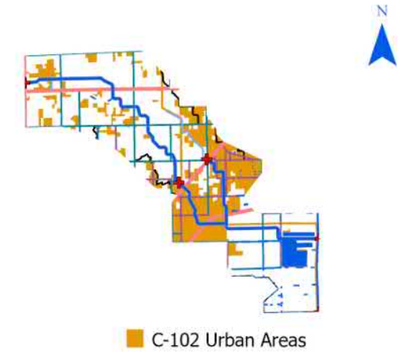
Figure A-284. Watershed C-102 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-102 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

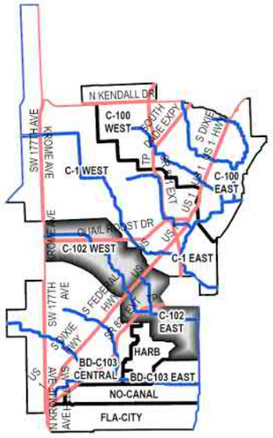
100-Yr/72-Hr SLR = 0

Flood Duration (hr)

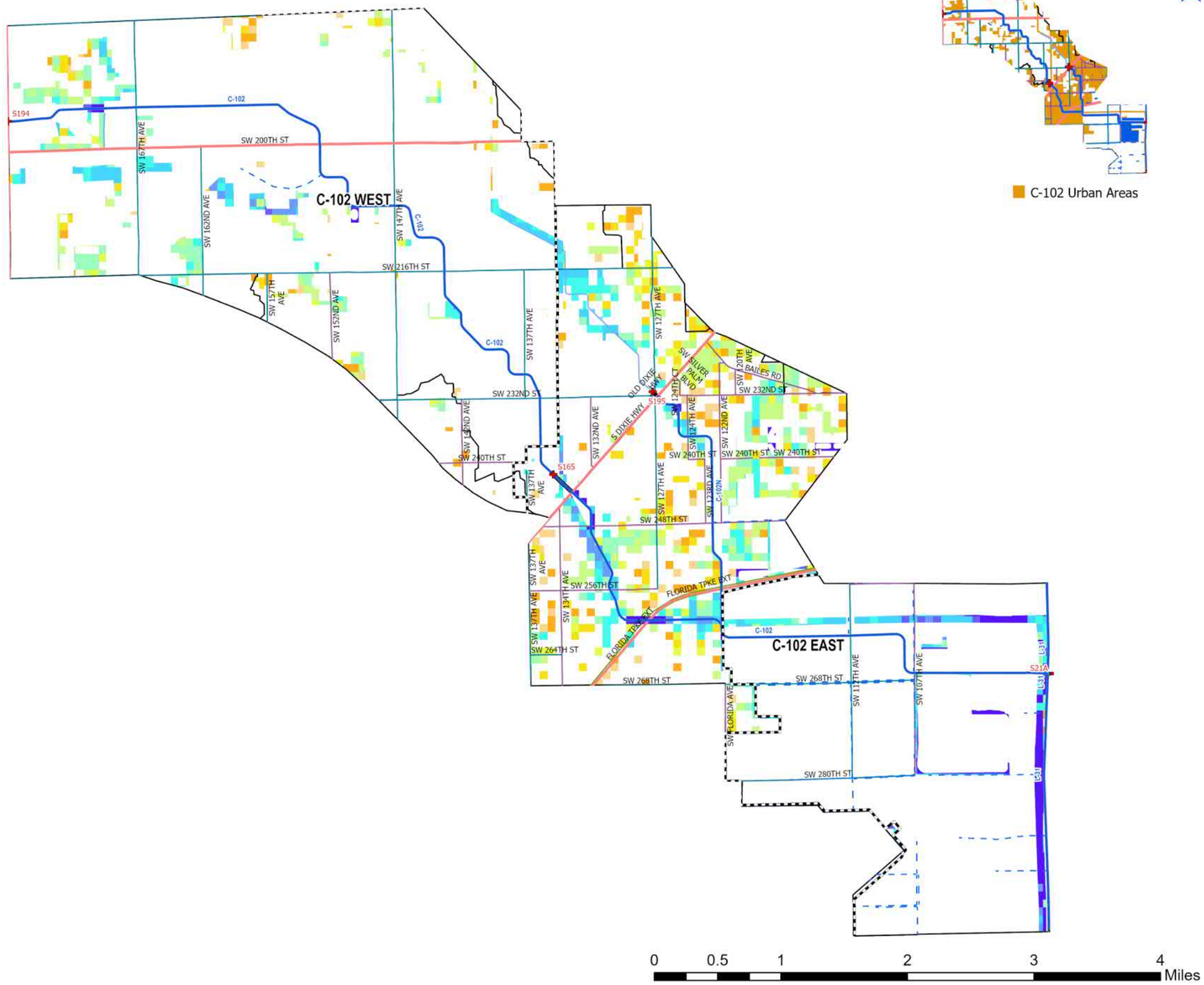
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-285. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

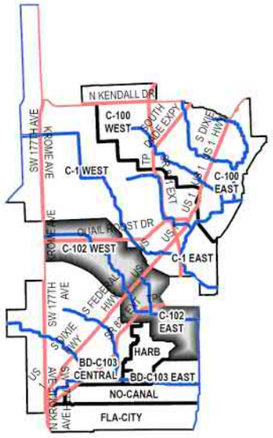
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

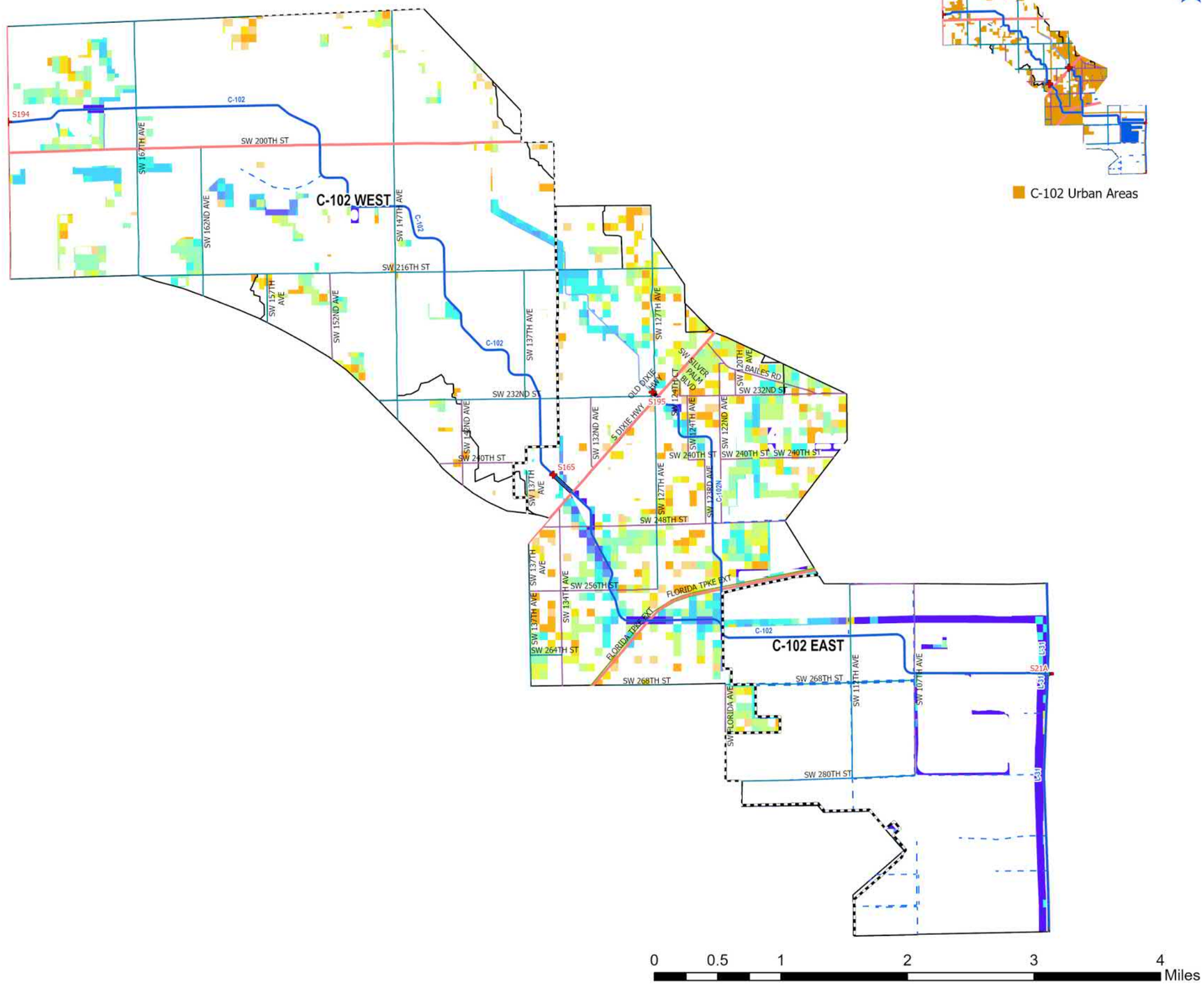
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-286. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

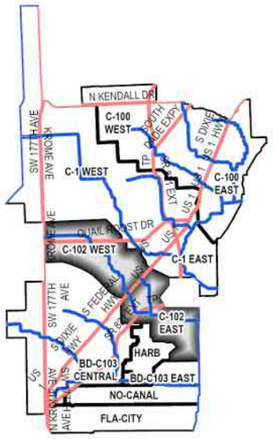
100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

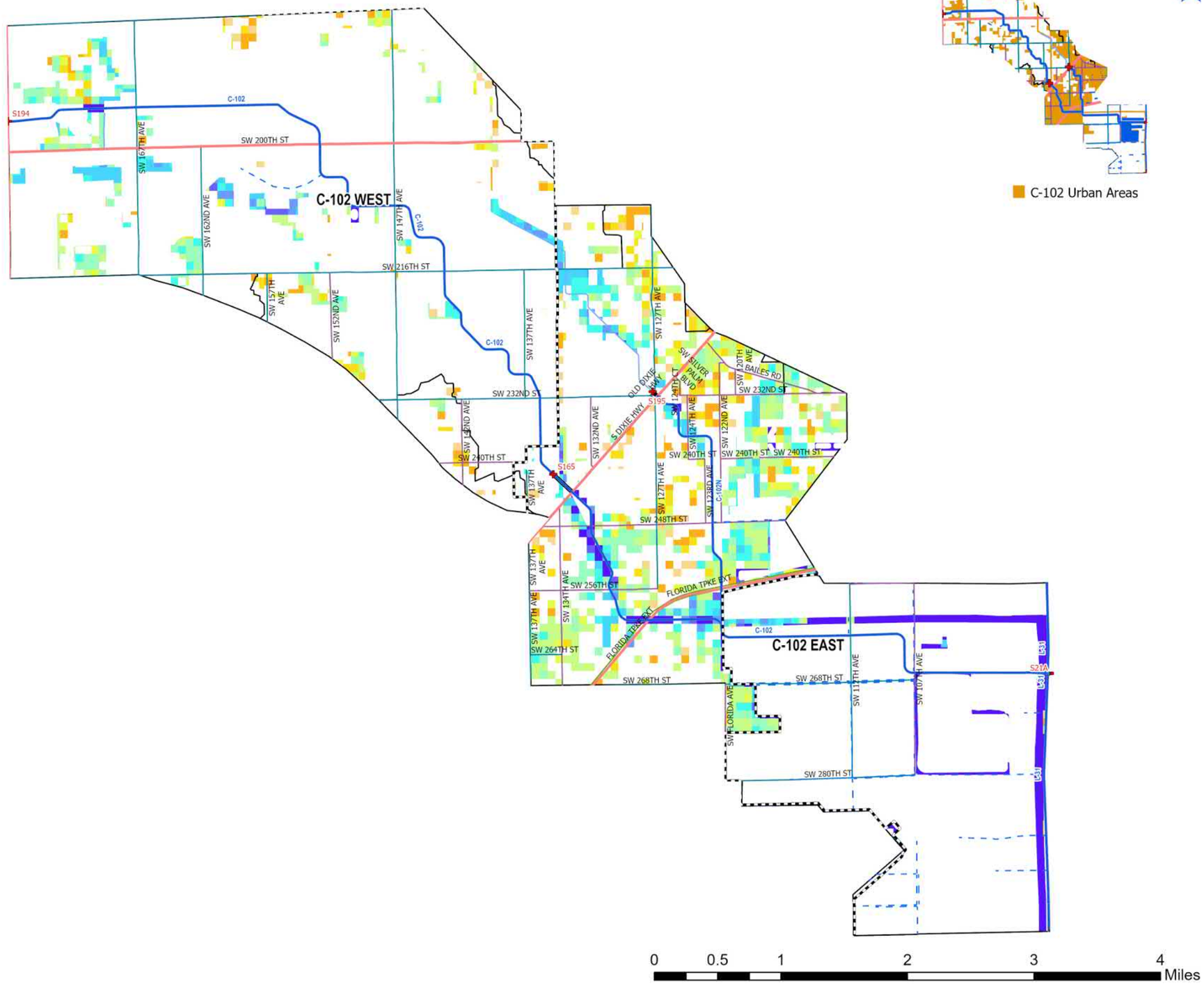
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-287. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-102 Watershed



C-102 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

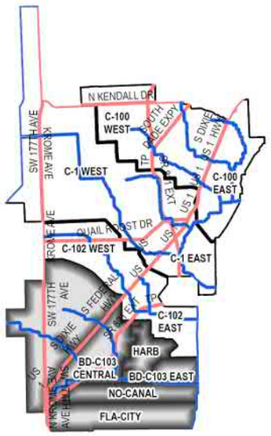
100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

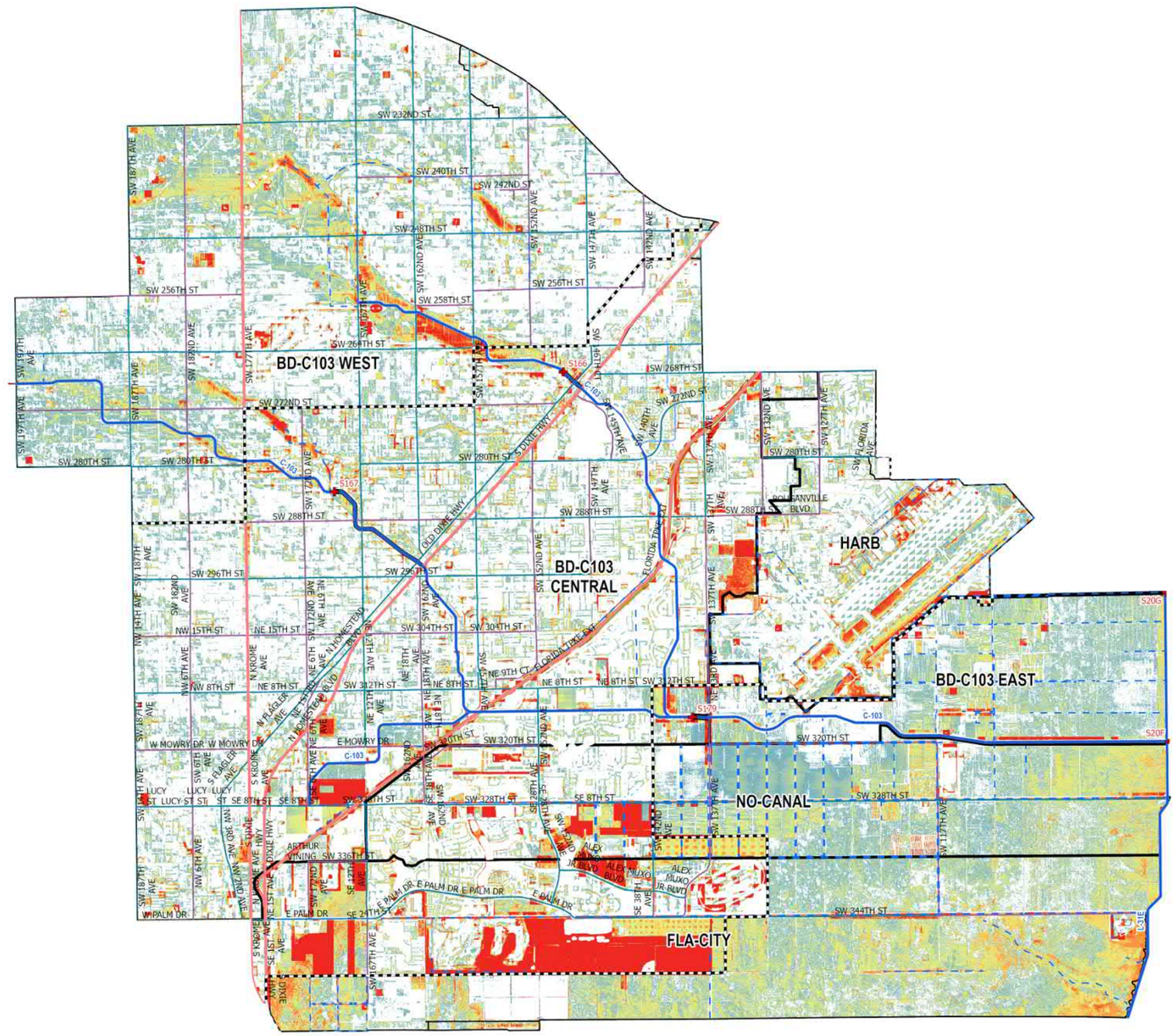
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-288. Watershed C-102 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

WATERSHED C-103: Flood Extent for Entire Watershed



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = 0

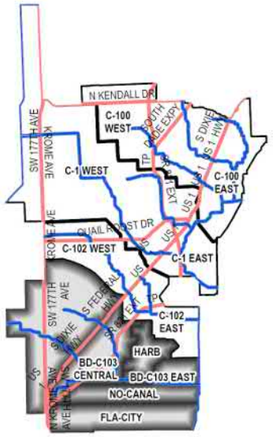
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-289. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 0

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

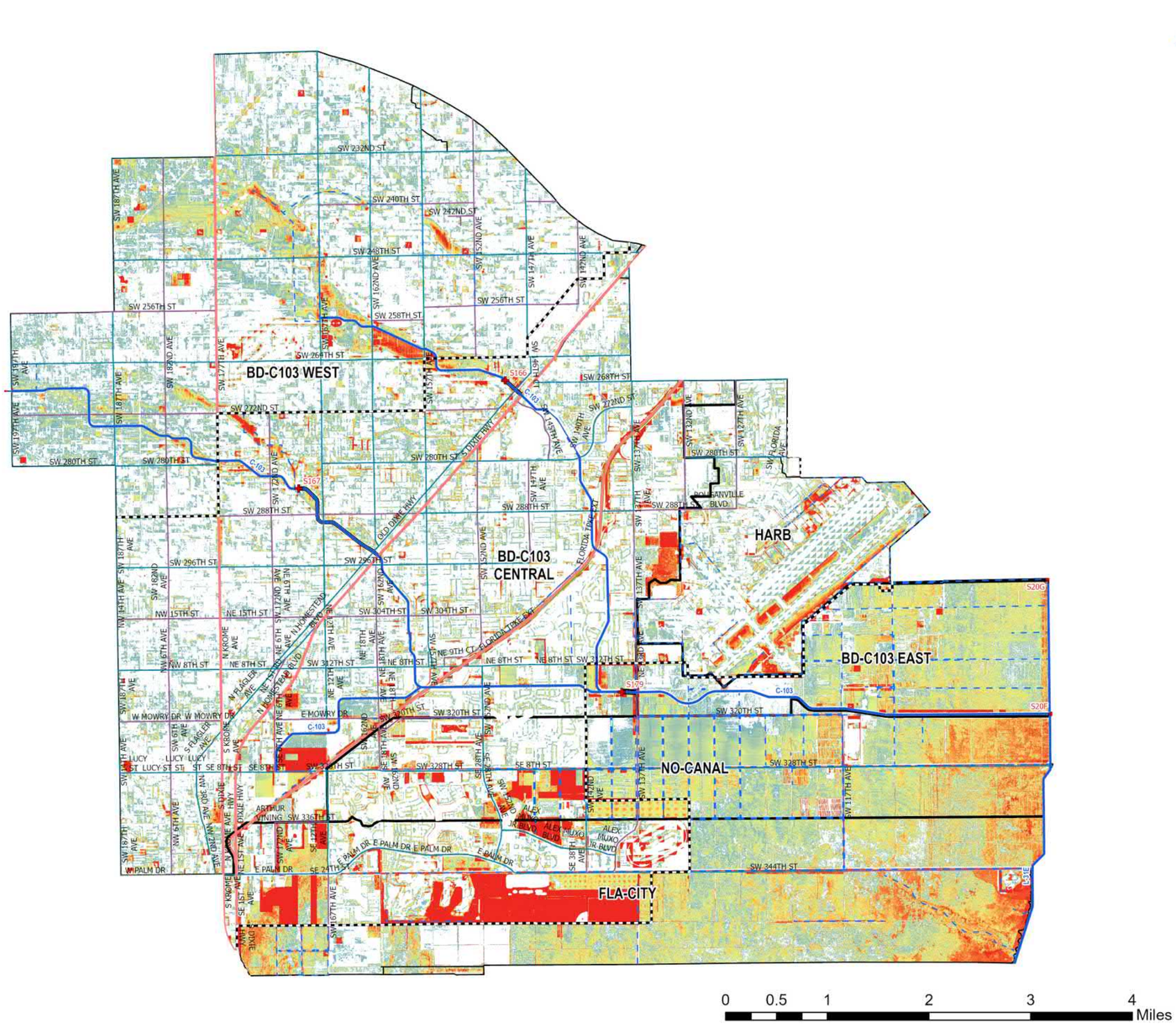
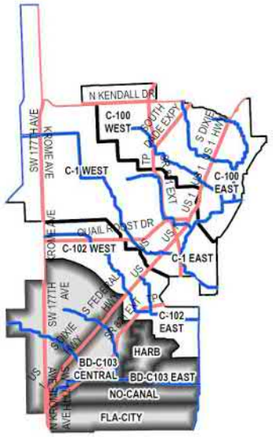


Figure A-290. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

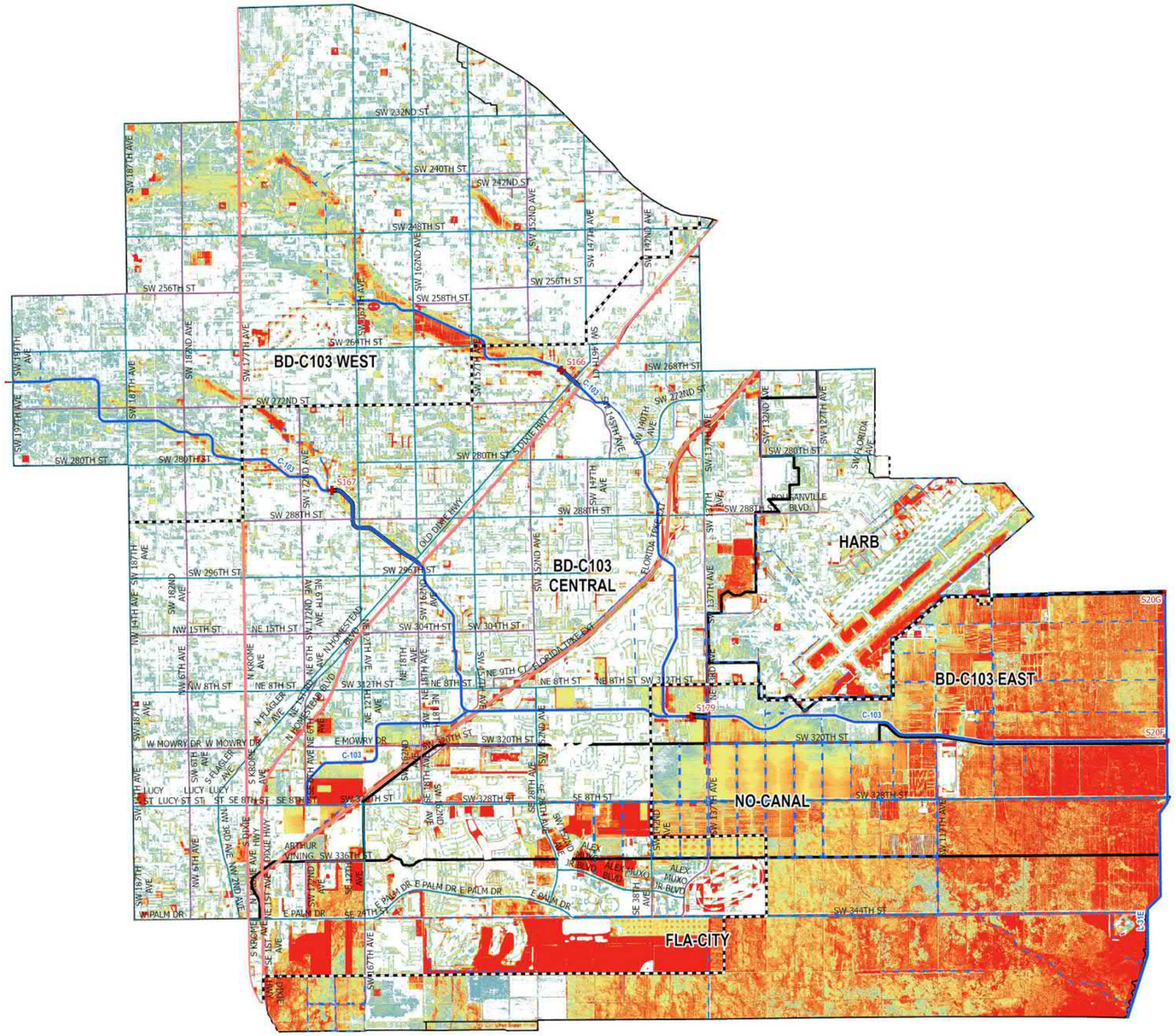
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

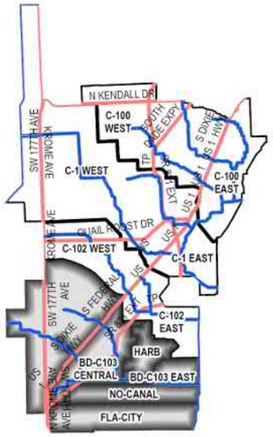
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft



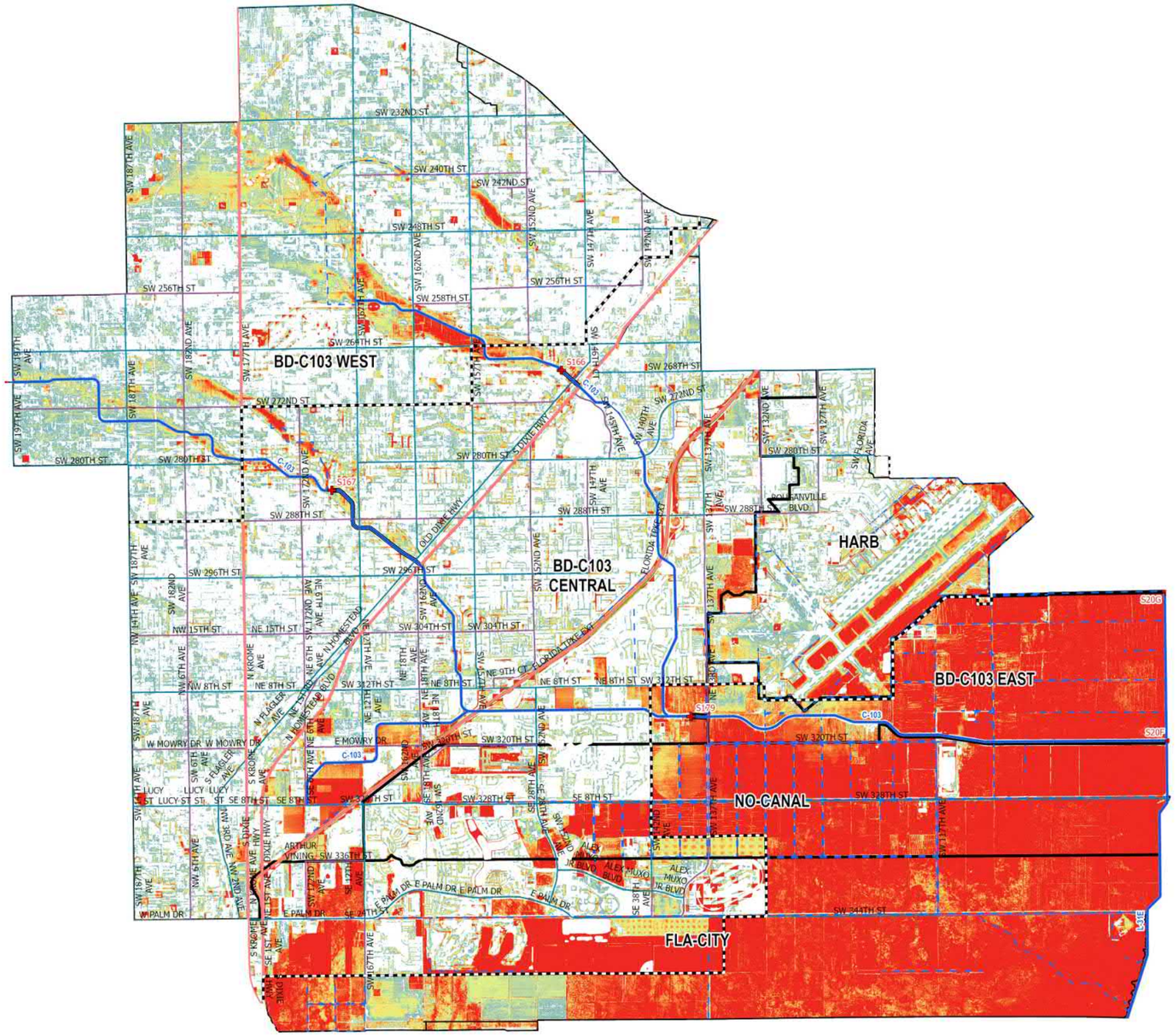
0 0.5 1 2 3 4 Miles

Figure A-291. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

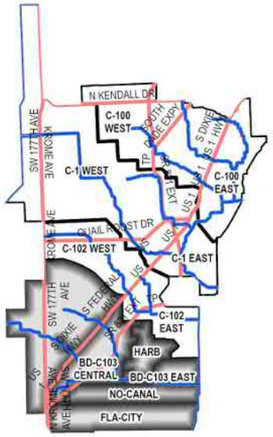
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-292. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

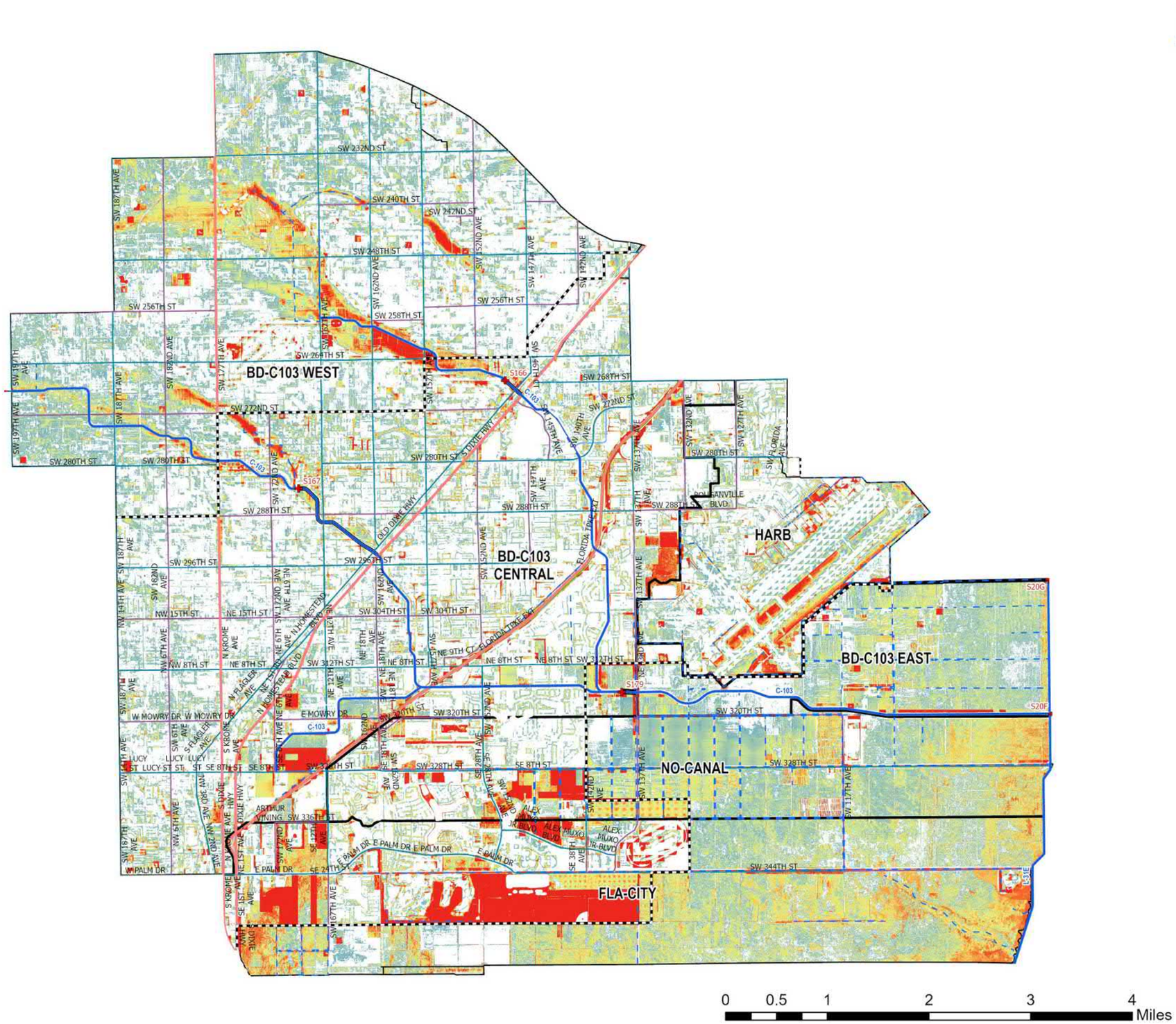
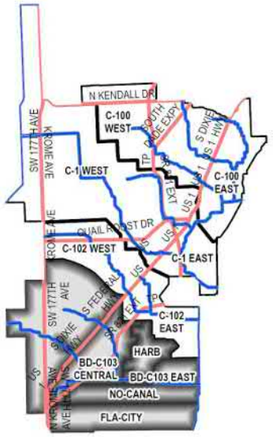
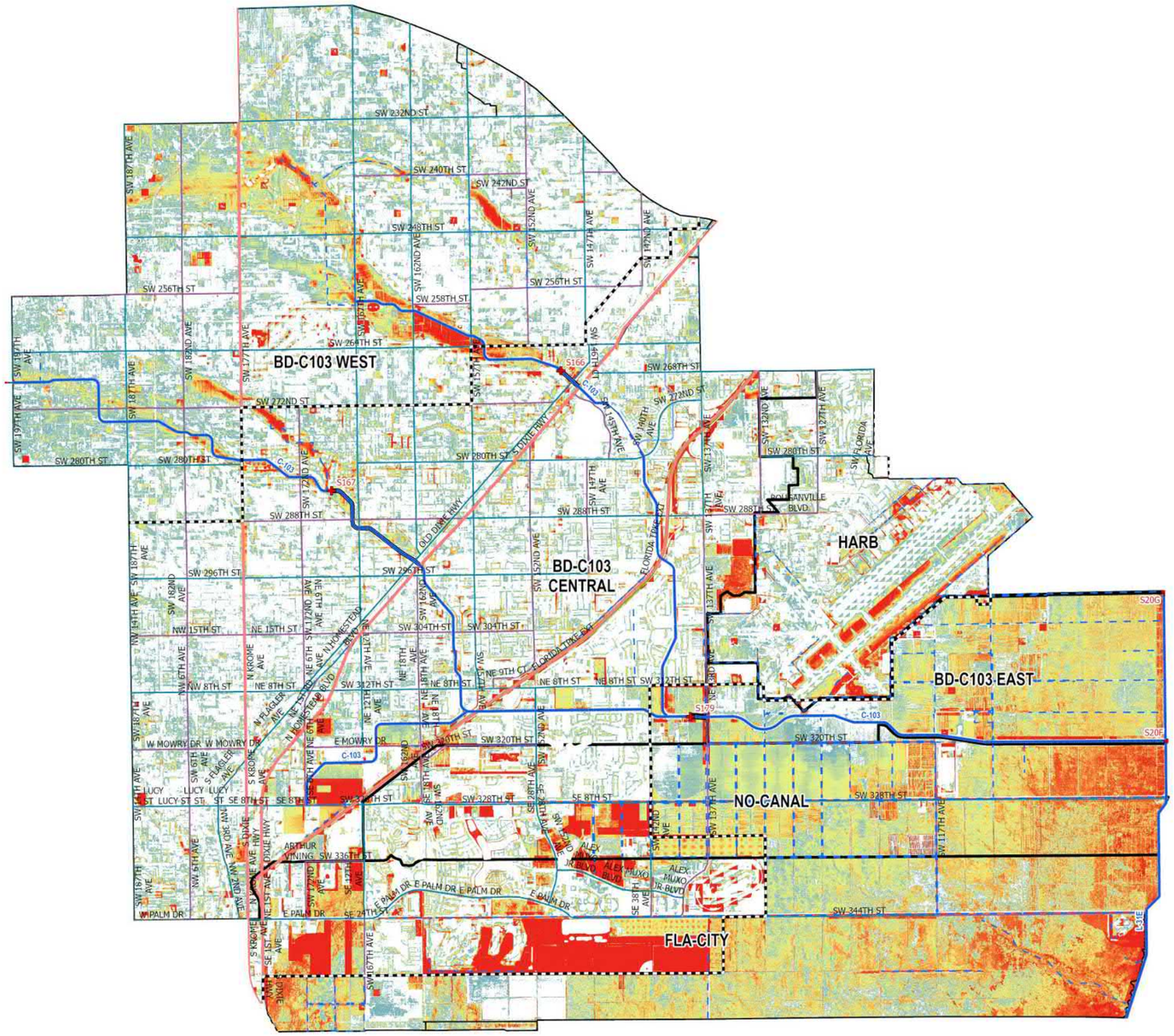


Figure A-293. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 0

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

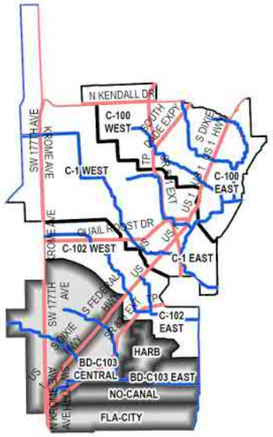
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

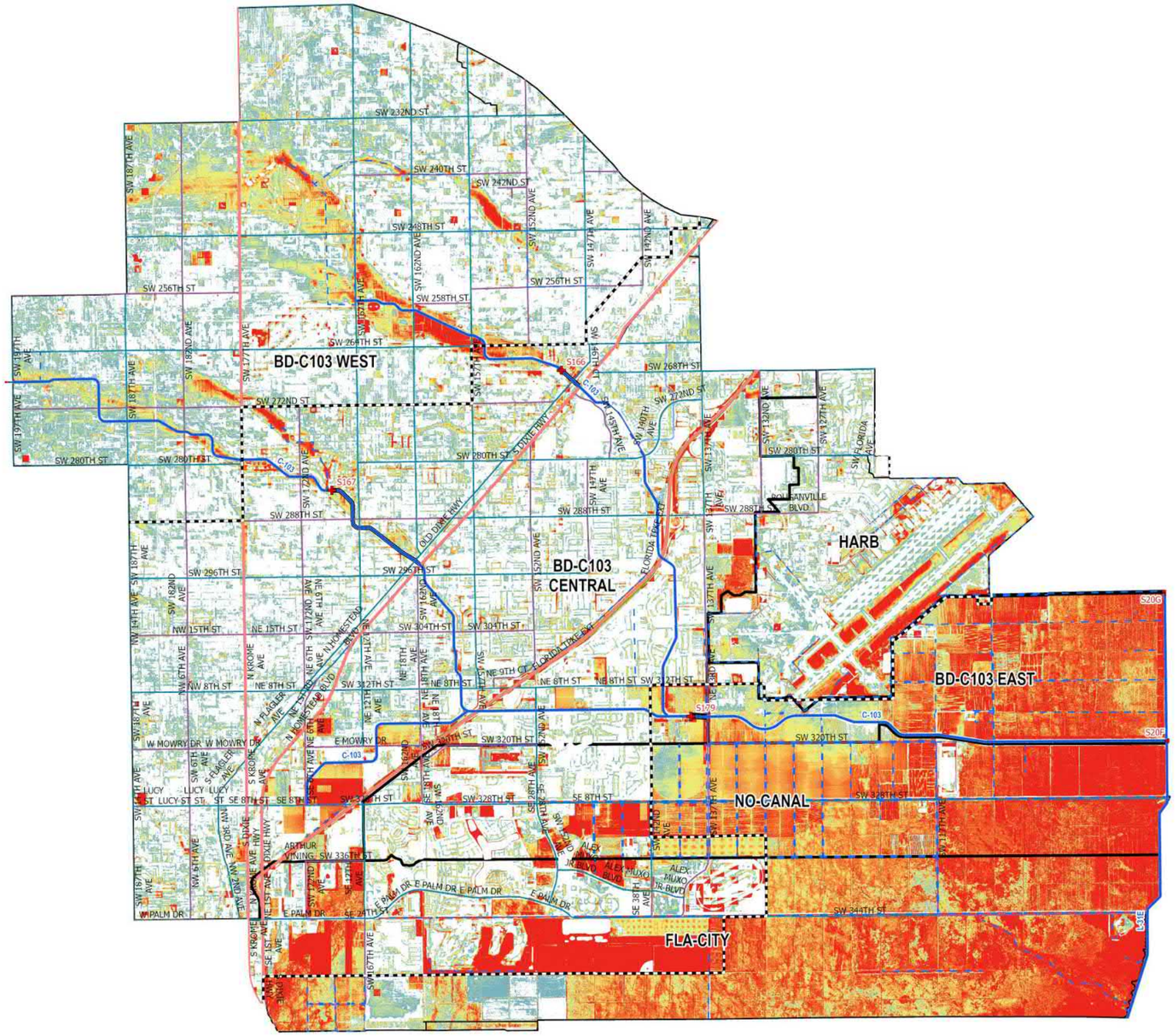
0 0.5 1 2 3 4 Miles

Figure A-294. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 1

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

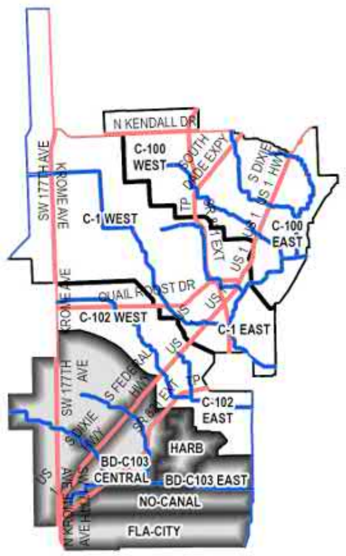
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-295. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

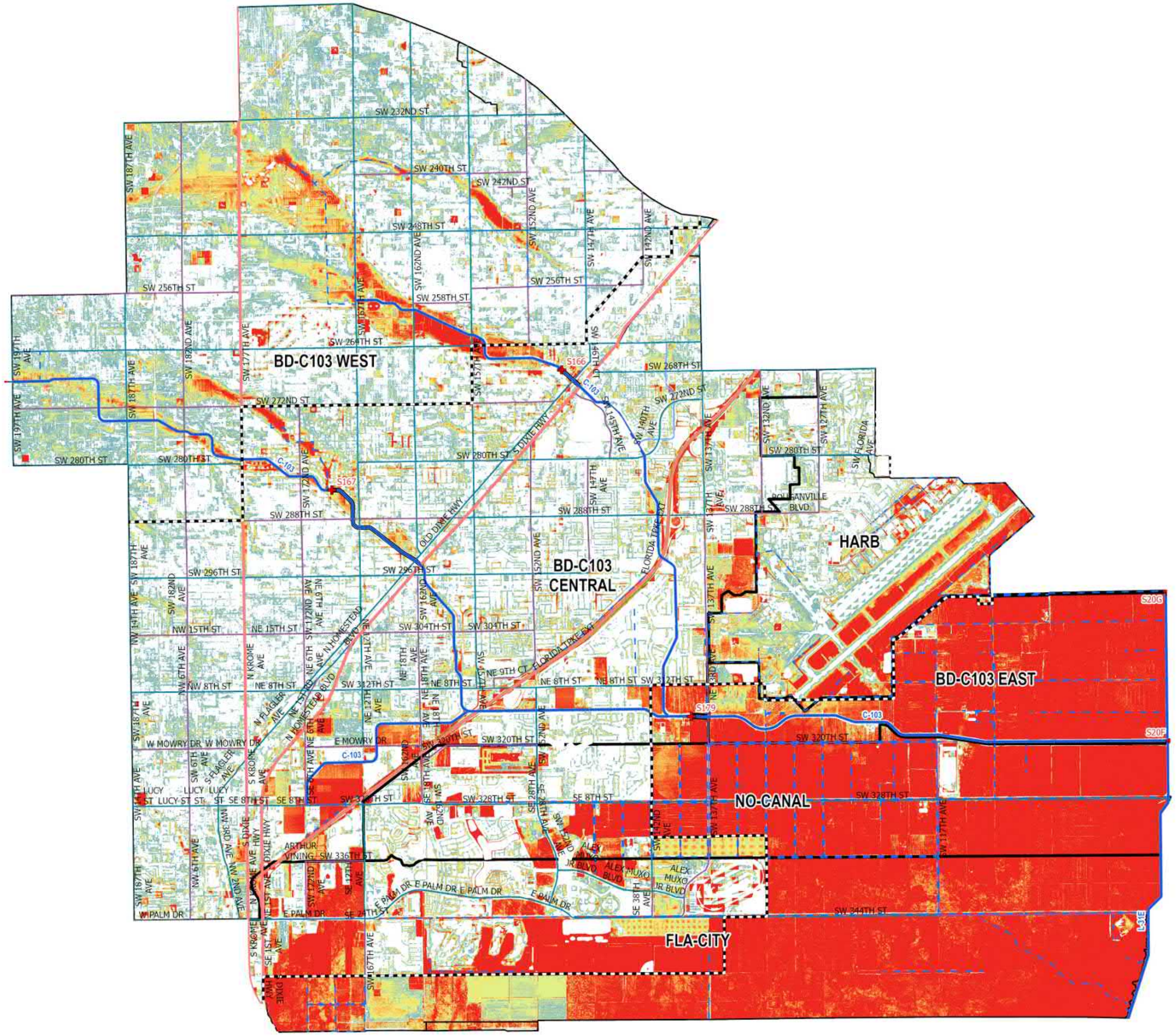
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

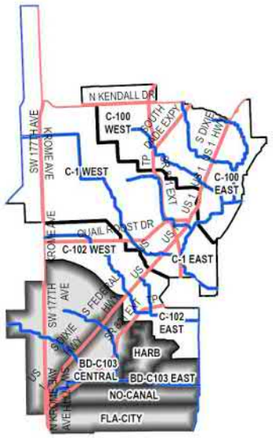
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

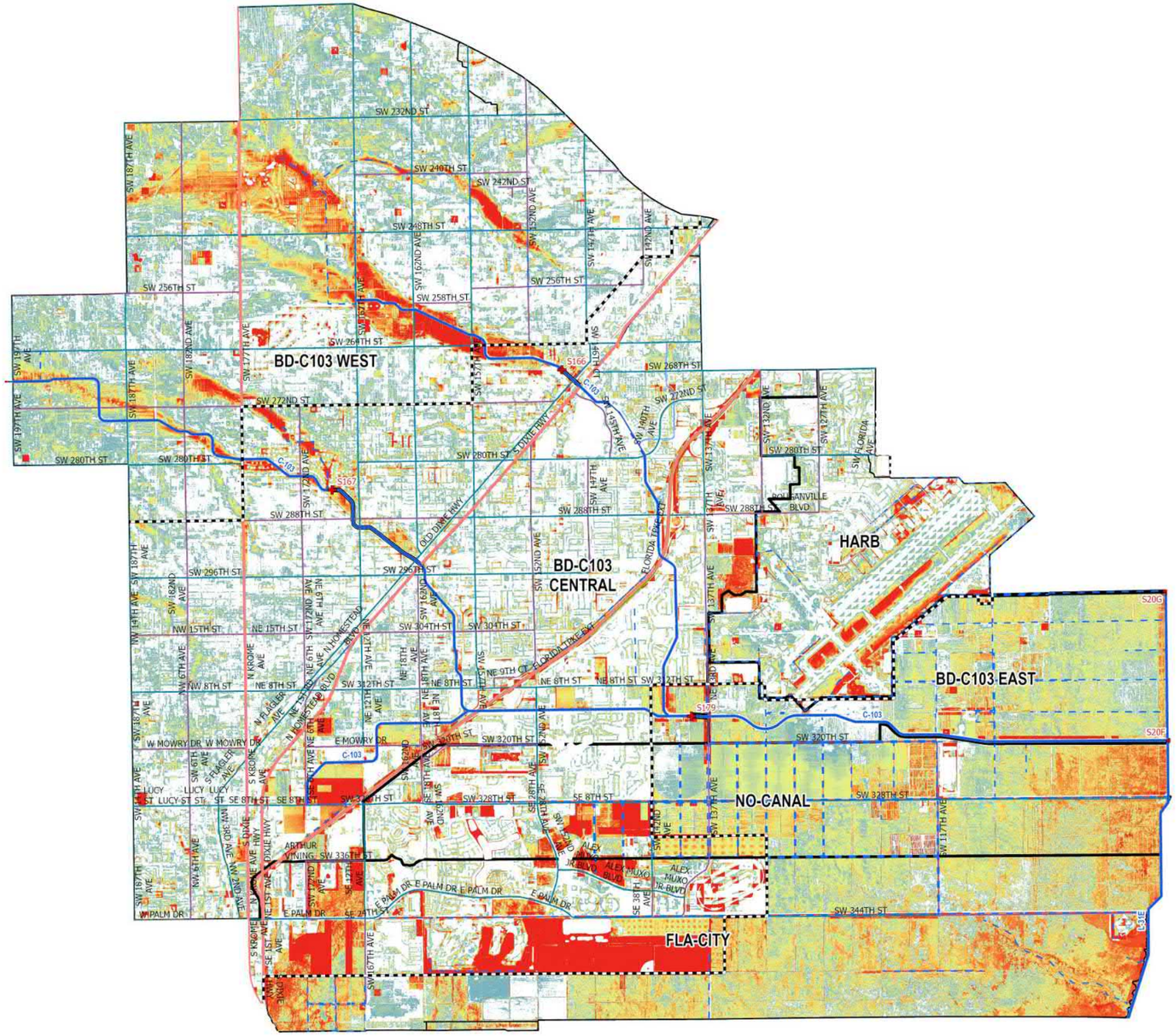


0 0.5 1 2 3 4 Miles

Figure A-296. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 3



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

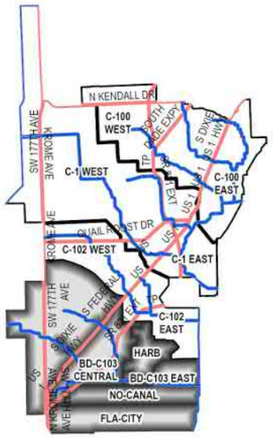
25-Yr/72-Hr SLR = 0

Flood Depth (ft)

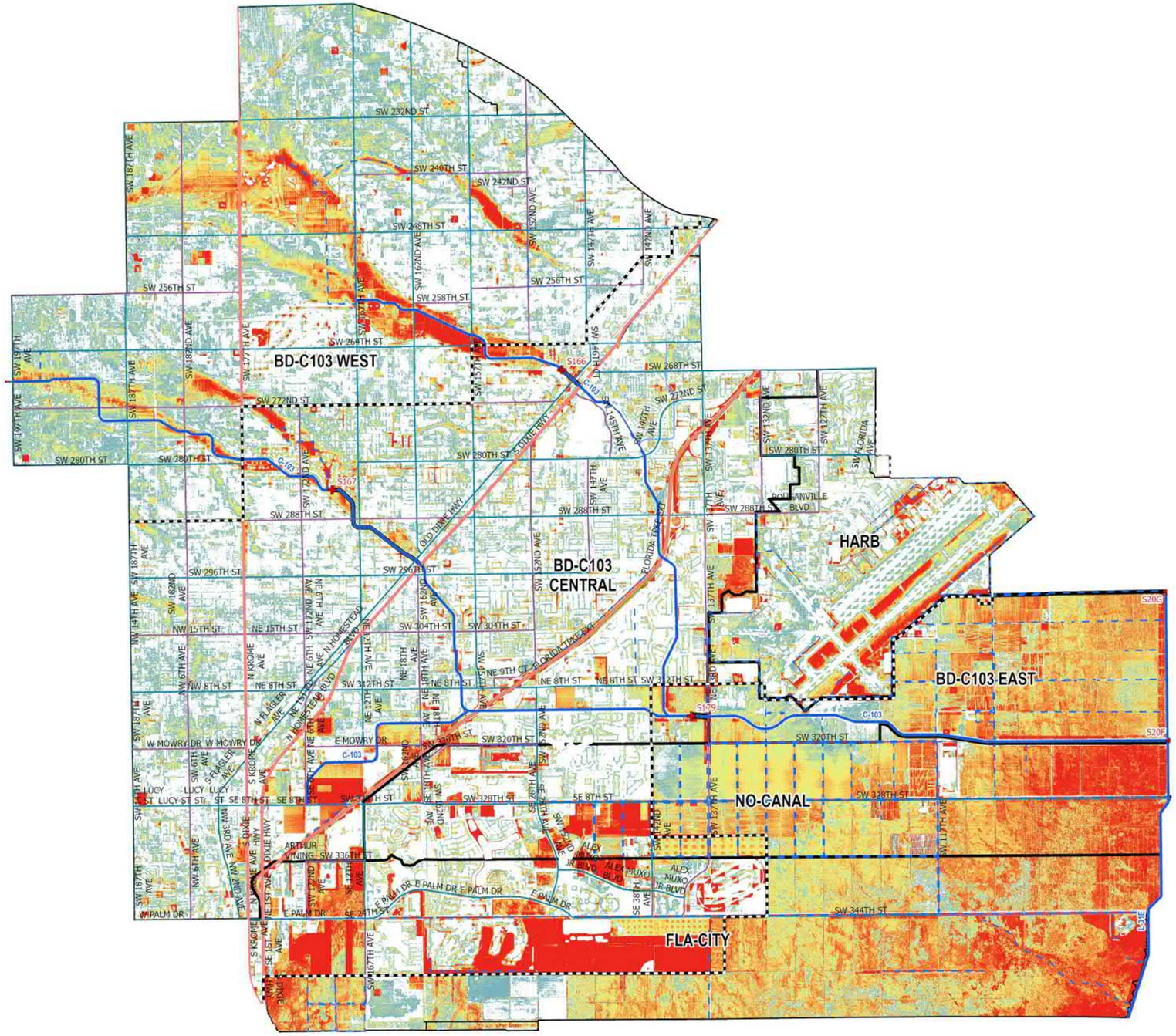
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-297. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 0



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

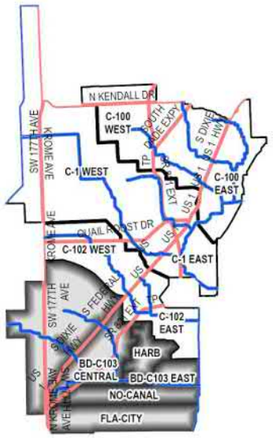
25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

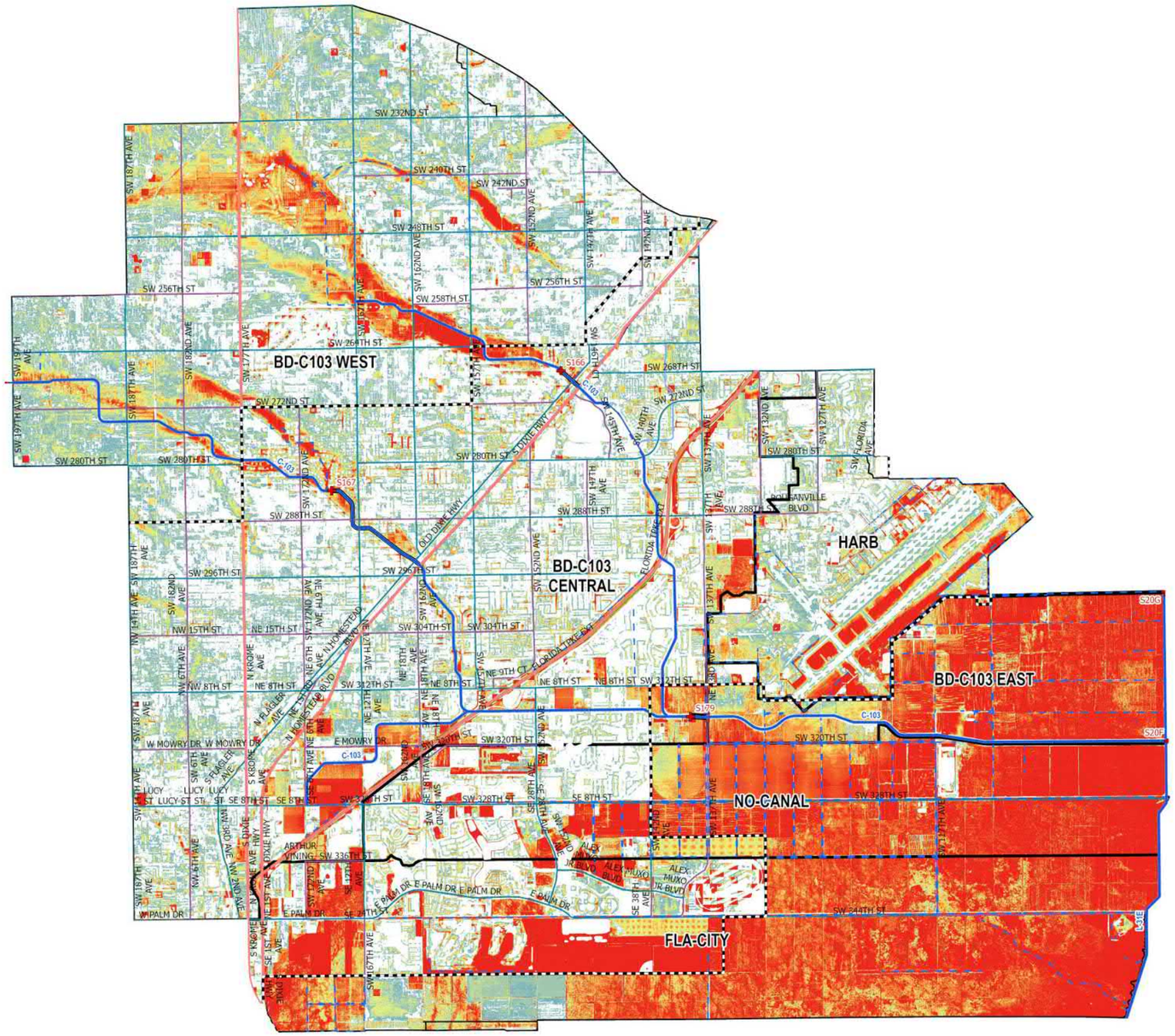
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-298. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

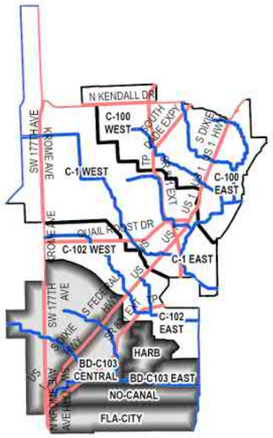
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

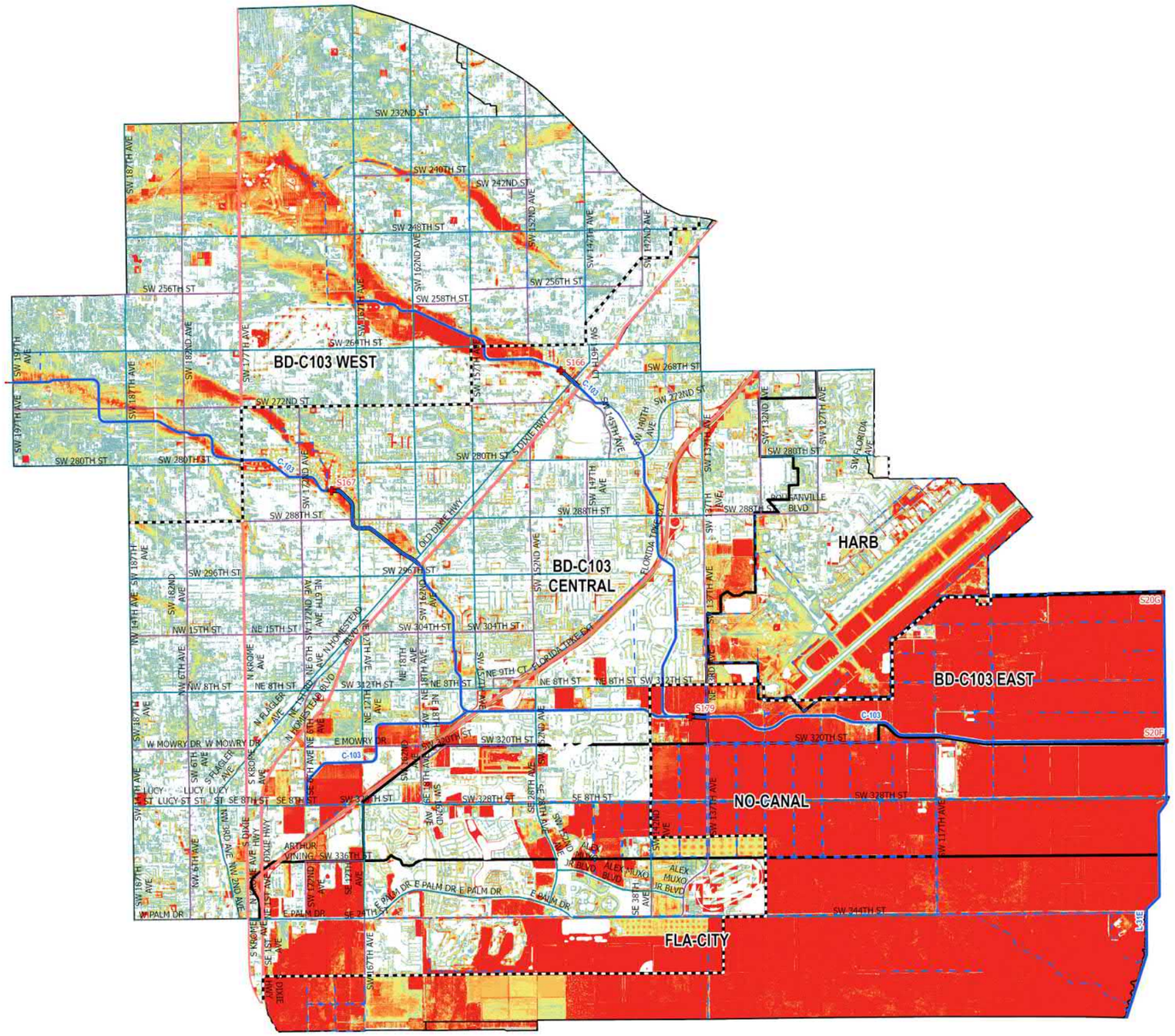
0 0.5 1 2 3 4 Miles

Figure A-299. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

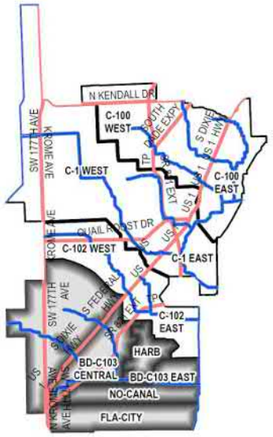
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

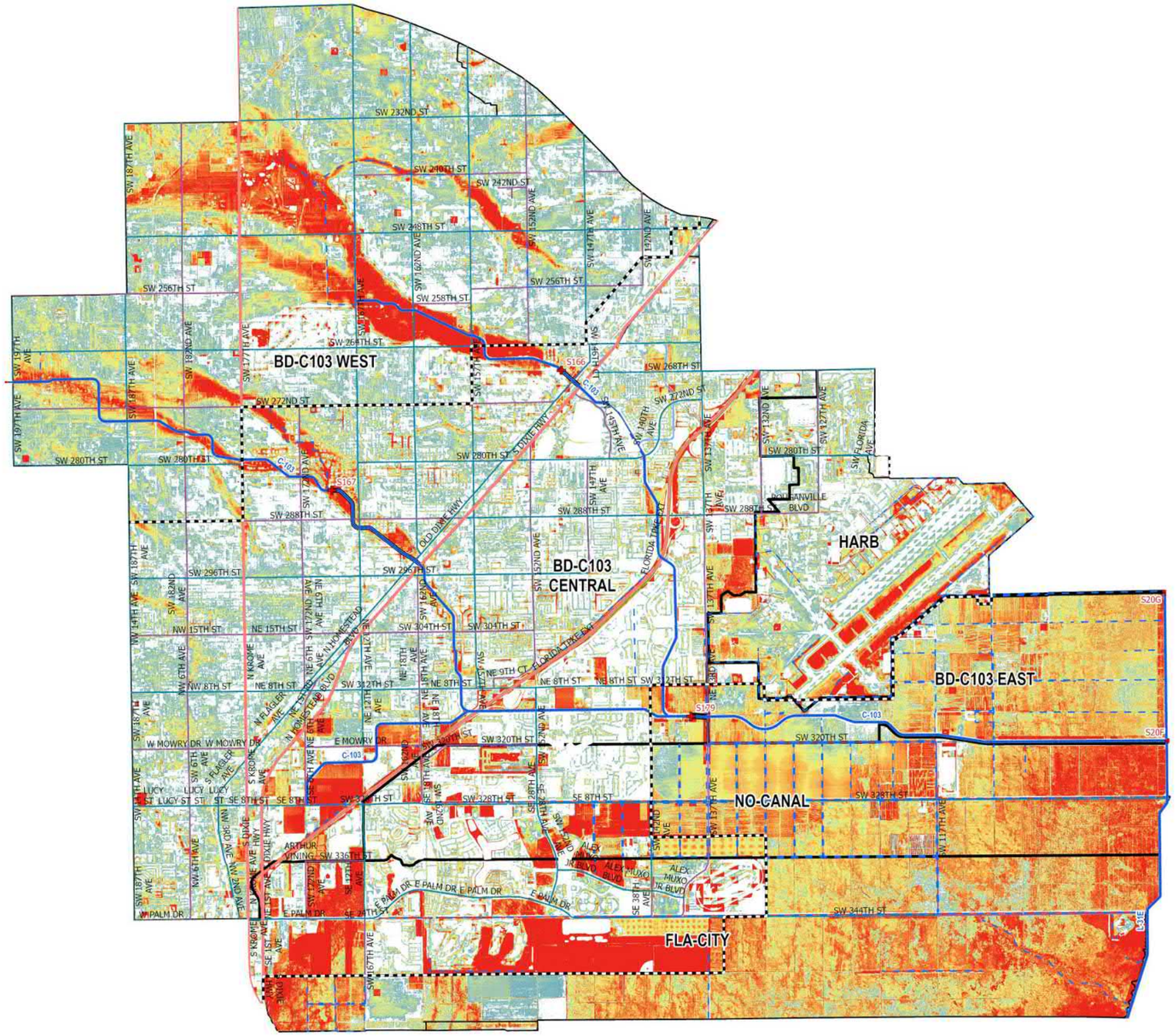
0 0.5 1 2 3 4 Miles

Figure A-300. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

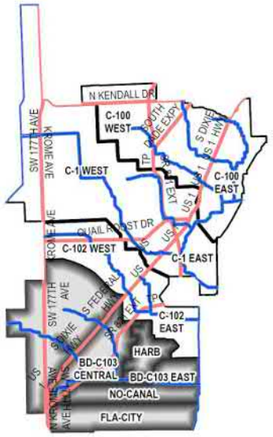
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-301. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

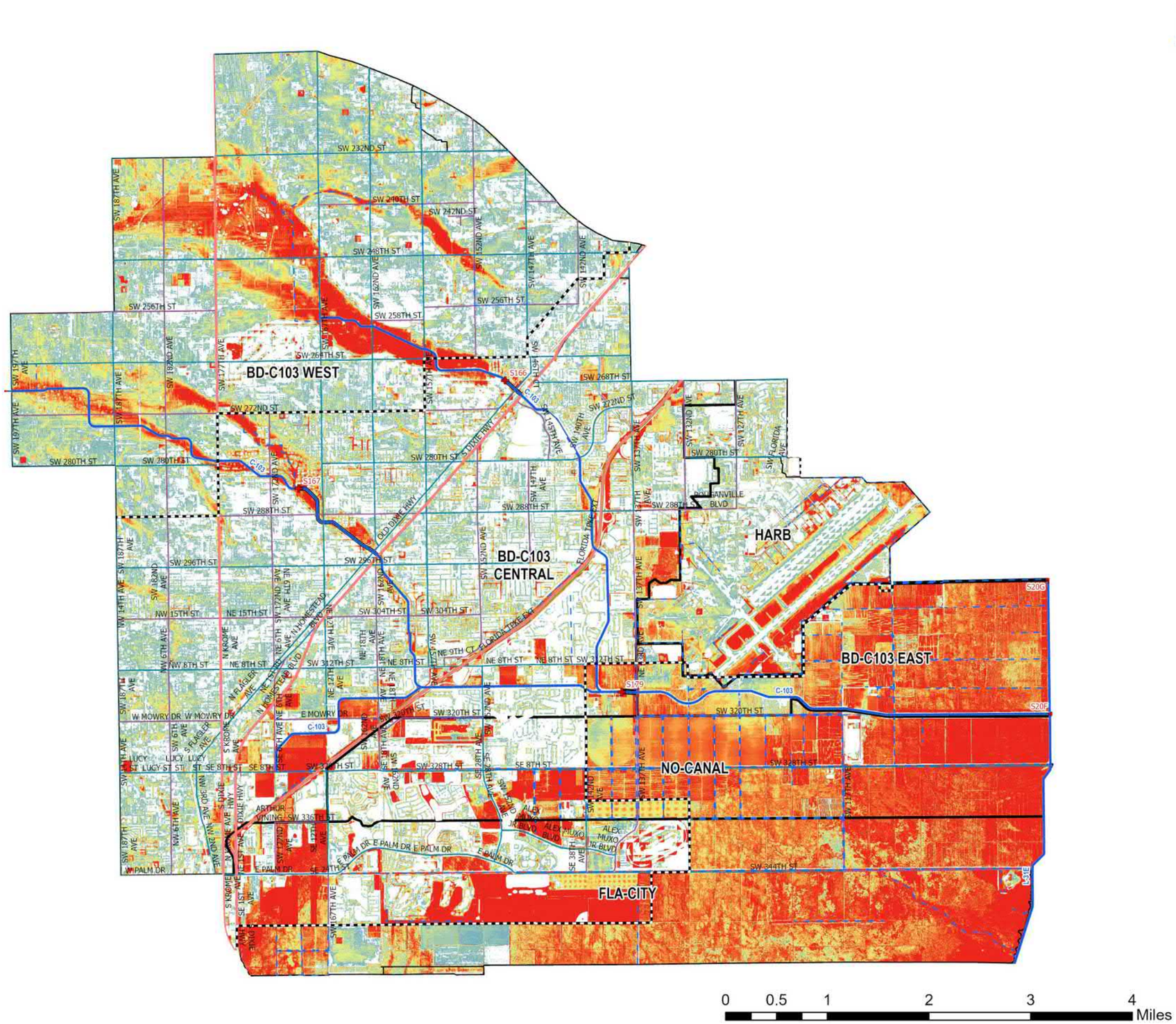
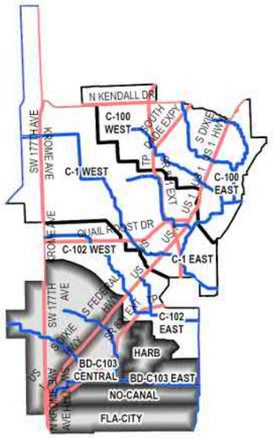
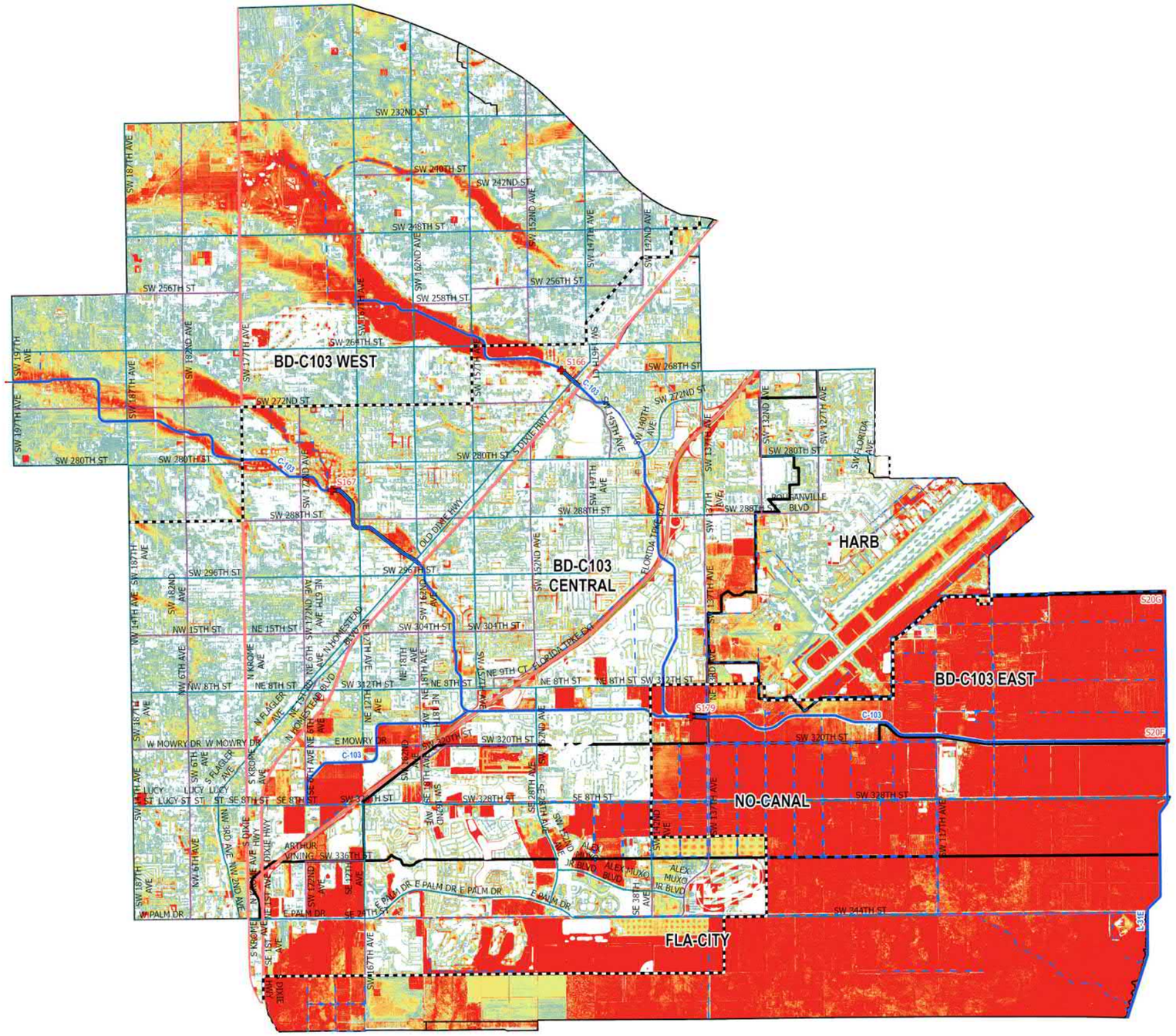


Figure A-302. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 1

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

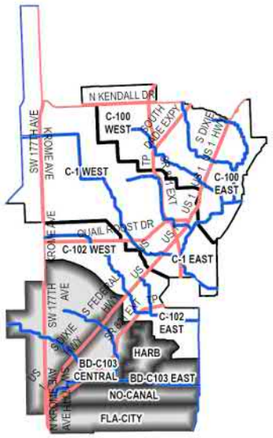
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

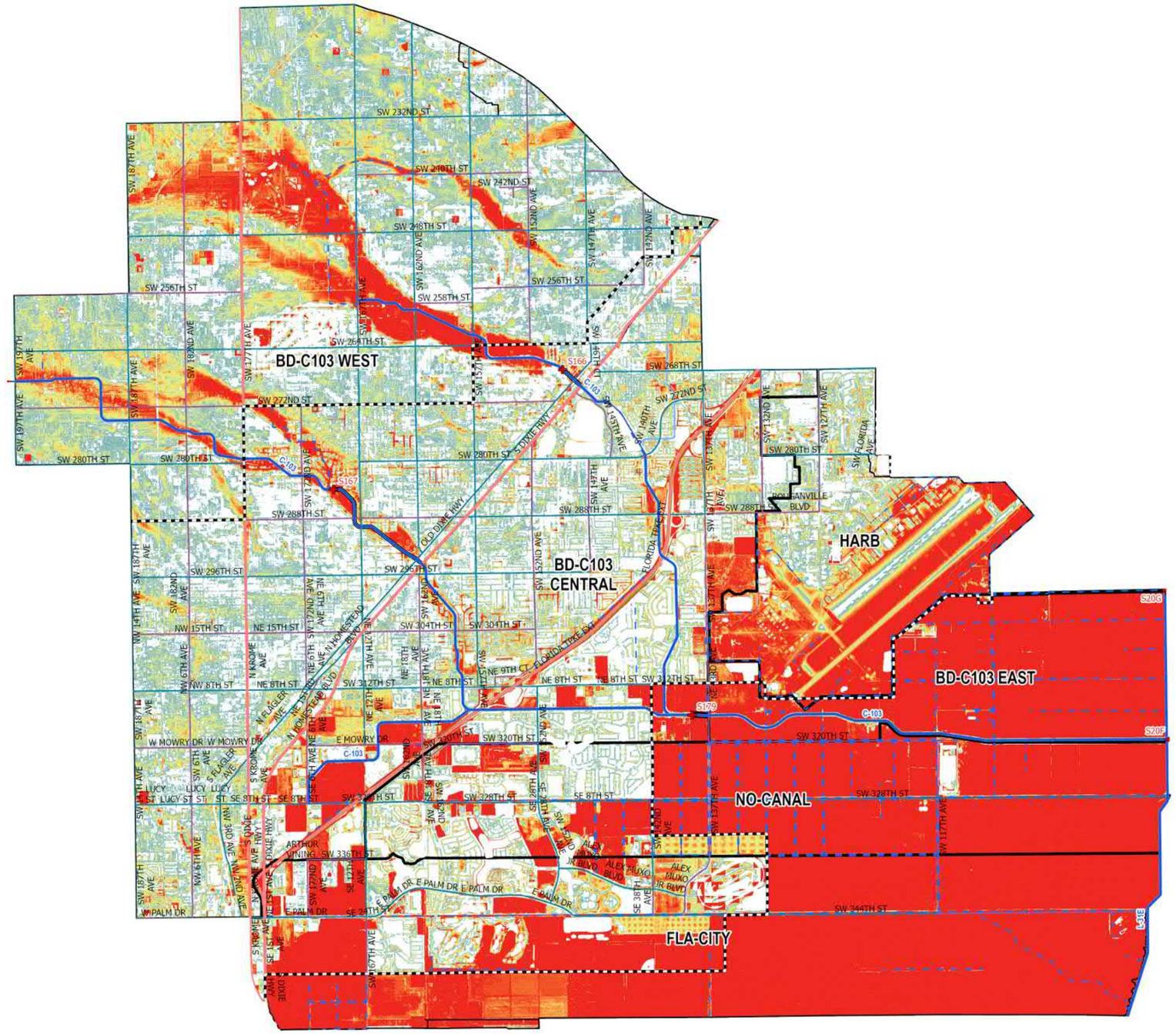
0 0.5 1 2 3 4 Miles

Figure A-303. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

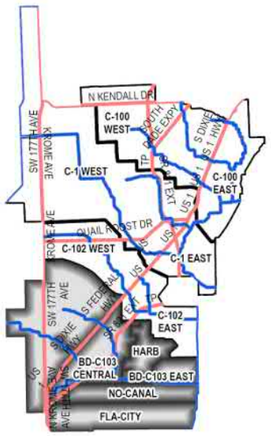
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

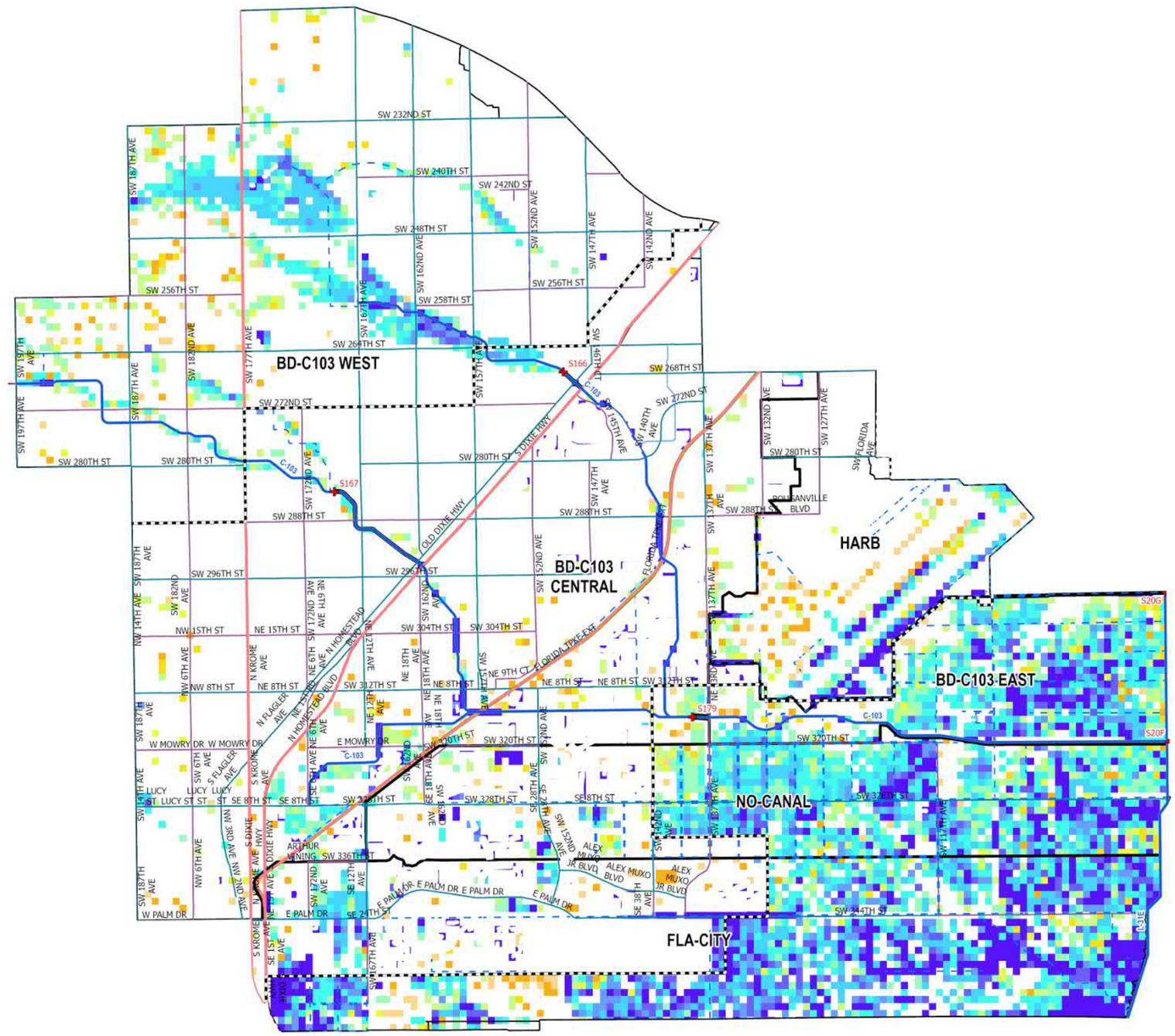
Figure A-304. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 3

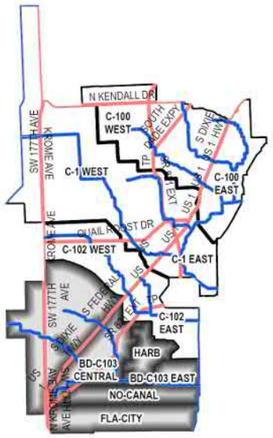
Kimley»Horn

WATERSHED C-103: Flood Duration for Entire Watershed

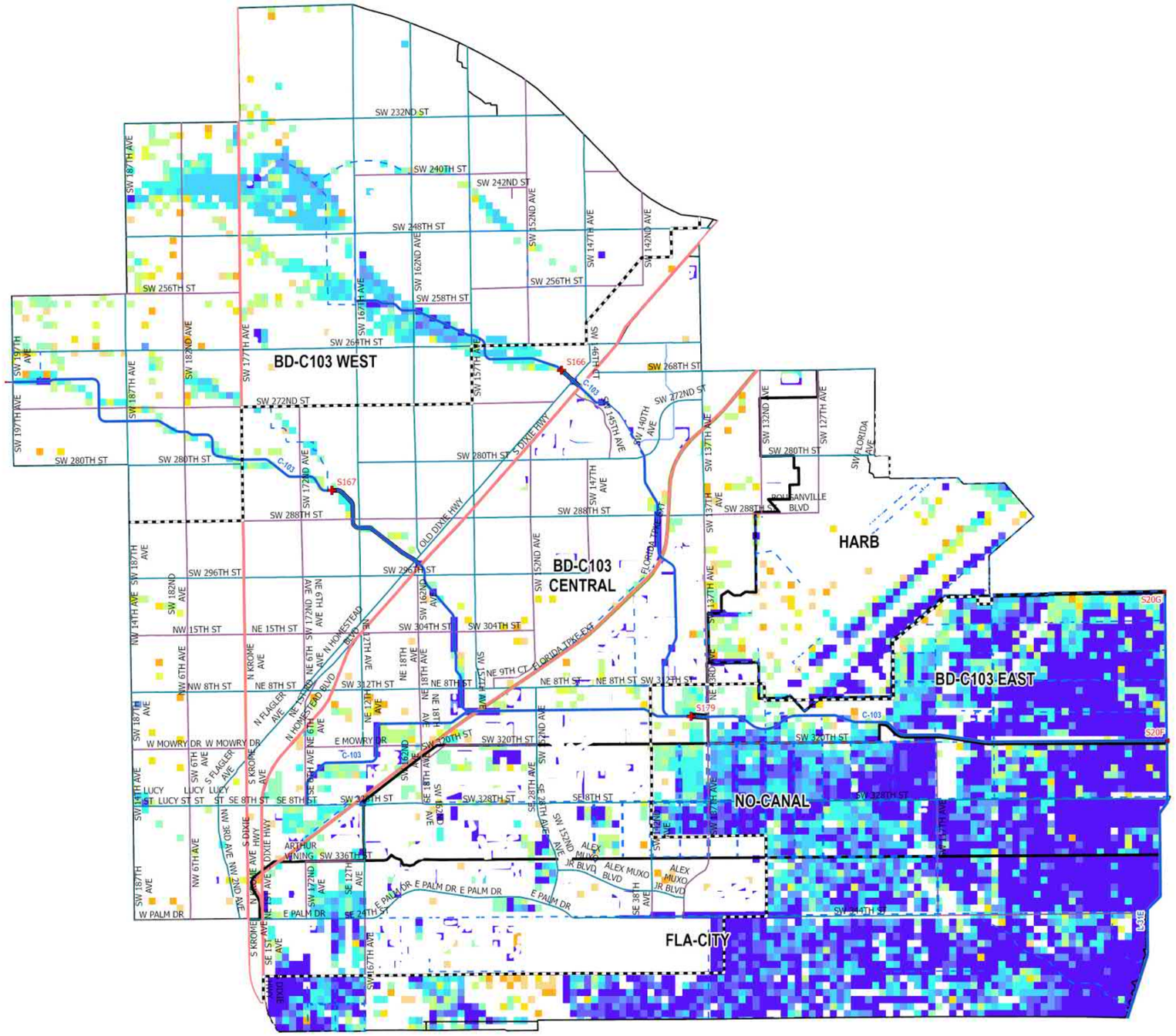


C-103 Watershed


BD-C103 WEST
BD-C103 CENTRAL
HARB
BD-C103 EAST
NO-CANAL
FLA-CITY
S166
S167
S179
S20G
S20F
S31E
C-103
SW 232ND ST
SW 240TH ST
SW 242ND ST
SW 248TH ST
SW 256TH ST
SW 258TH ST
SW 264TH ST
SW 268TH ST
SW 272ND ST
SW 280TH ST
SW 288TH ST
SW 296TH ST
SW 304TH ST
SW 312TH ST
SW 320TH ST
SW 328TH ST
SW 336TH ST
SW 344TH ST
S DIXIE HWY
OLD DIXIE HWY
FLORIDA TPKE EXT
ROBERTS AVE
SW 137TH AVE
SW 127TH AVE
SW 132ND AVE
SW 147TH AVE
SW 152ND AVE
SW 162ND AVE
SW 167TH AVE
SW 177TH AVE
SW 182ND AVE
SW 187TH AVE
SW 197TH AVE
SW 172ND AVE
SW 142ND AVE
SW 145TH AVE
SW 140TH AVE
SW FLORIDA AVE
N HOMESTEAD BLVD
N FLAGLER AVE
N KROME AVE
S KROME AVE
W MOWRY DR
E MOWRY DR
W PALM DR
E PALM DR
ARTHUR VINING
ALEX MUXO JR BLVD
NW 14TH AVE
NW 15TH ST
NE 15TH ST
NW 8TH ST
NE 8TH ST
SW 187TH AVE
NW 6TH AVE
SW 182ND AVE
SE 8TH ST
SE 24TH ST
SE 38TH AVE
SE 28TH AVE
SE 12TH AVE
SE 1ST AVE
NE 9TH CT
NE 18TH AVE
NE 12TH AVE
NE 6TH AVE
NE 67TH AVE
SW 172ND AVE
SW 162ND AVE
SW 152ND AVE
SW 147TH AVE
SW 137TH AVE
SW 127TH AVE
SW 117TH AVE
SW 167TH AVE
SW 152ND AVE
SW 142ND AVE
SW 137TH AVE
SW 132ND AVE
SW 127TH AVE
SW FLORIDA AVE
ROUSANVILLE BLVD
N KENDALL DR
SW 177TH AVE
KROME AVE
S DIXIE HWY
S FEDERAL HWY
QUAIL ROOST DR
SW 177TH AVE
SW 187TH AVE
SW 197TH AVE
SW 137TH AVE
SW 127TH AVE
SW 117TH AVE
SW 167TH AVE
SW 152ND AVE
SW 142ND AVE
SW 137TH AVE
SW 132ND AVE
SW 127TH AVE
SW FLORIDA AVE
SW 137TH AVE
SW 147TH AVE
SW 152ND AVE
SW 162ND AVE
SW 167TH AVE
SW 177TH AVE
SW 182ND AVE
SW 187TH AVE
SW 197TH AVE
SW 172ND AVE
SW 142ND AVE
SW 145TH AVE
SW 140TH AVE
SW 137TH



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

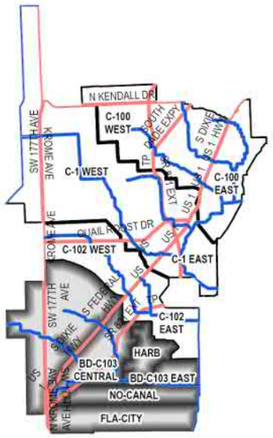
5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

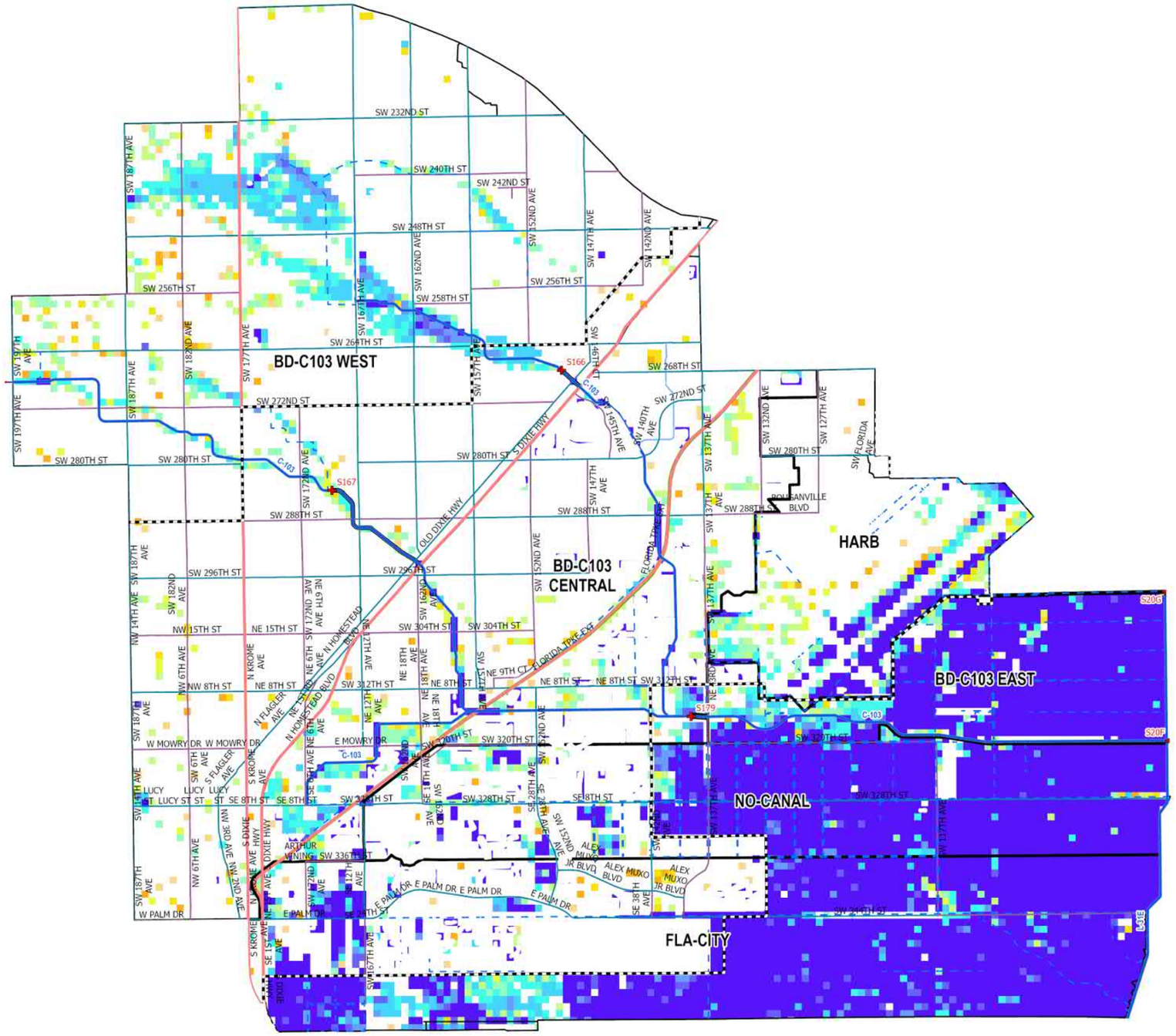
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-306. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 1

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

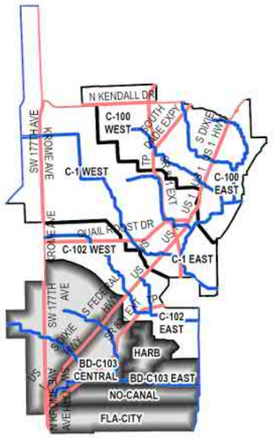
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

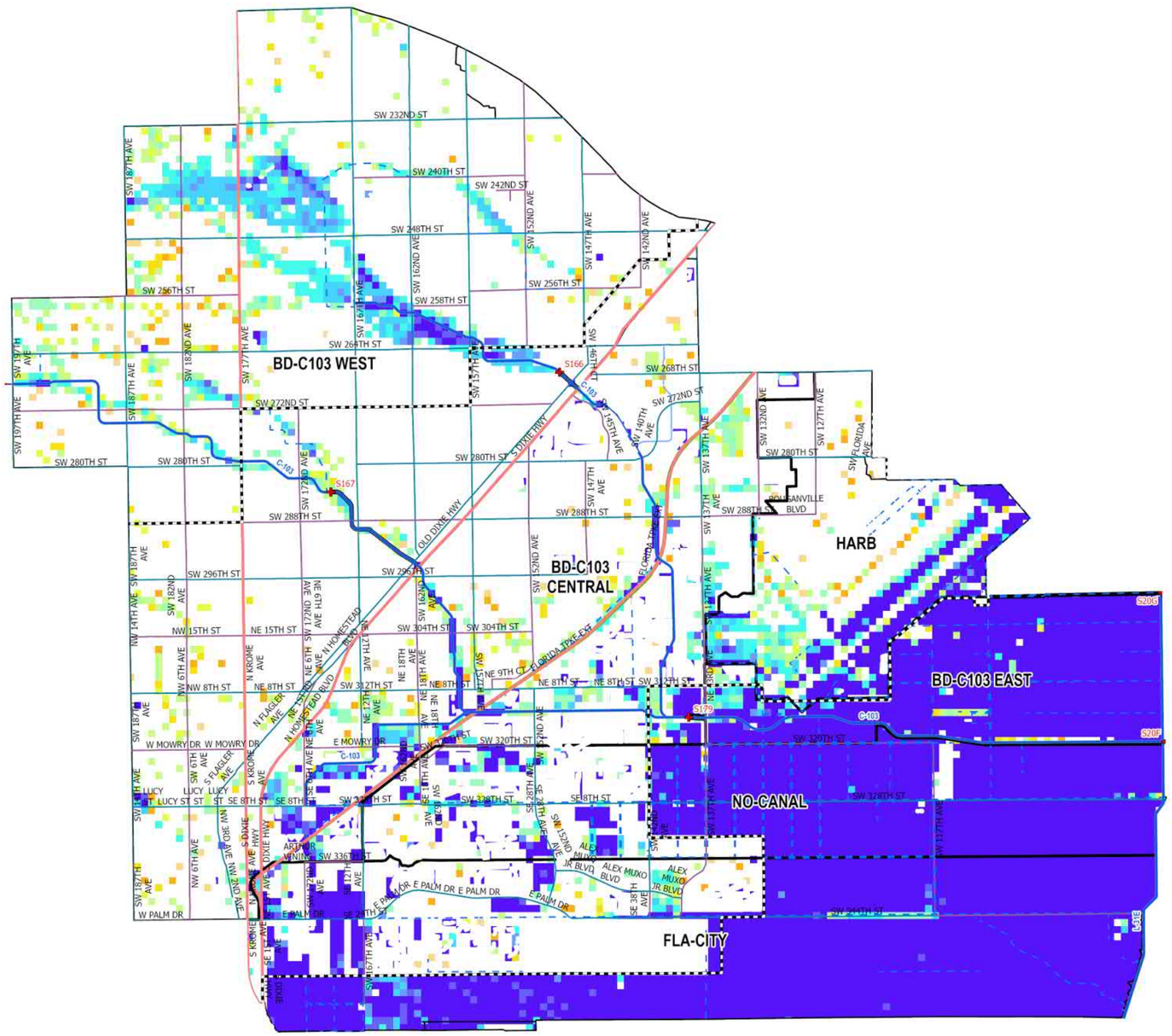
0 0.5 1 2 3 4 Miles

Figure A-307. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

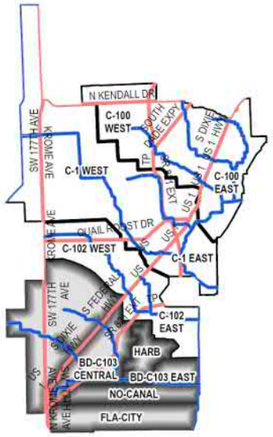
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-308. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 3

Kimley»Horn



C-103 Watershed

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

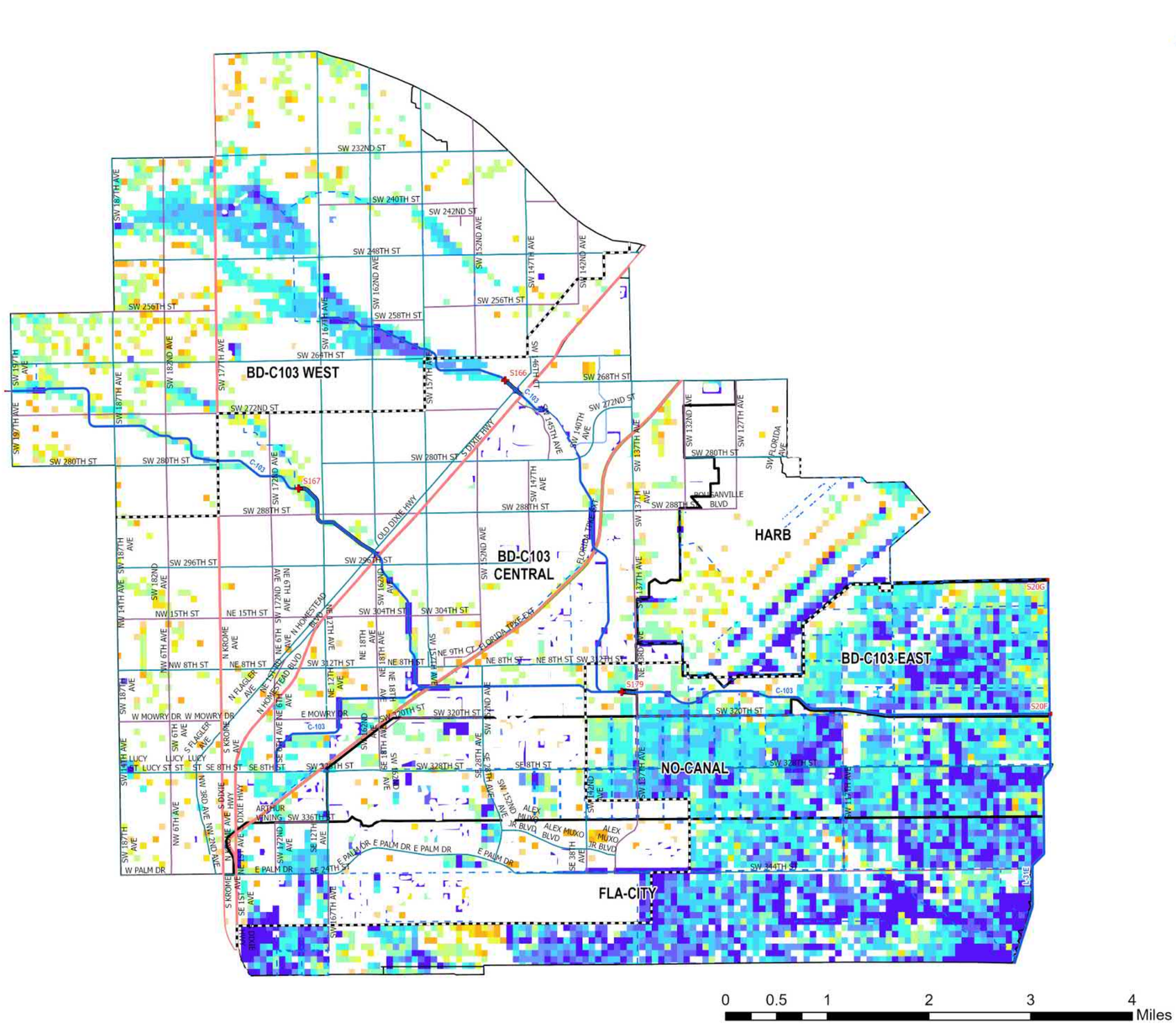
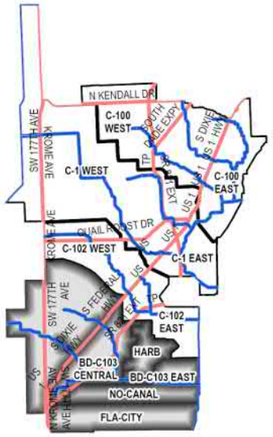
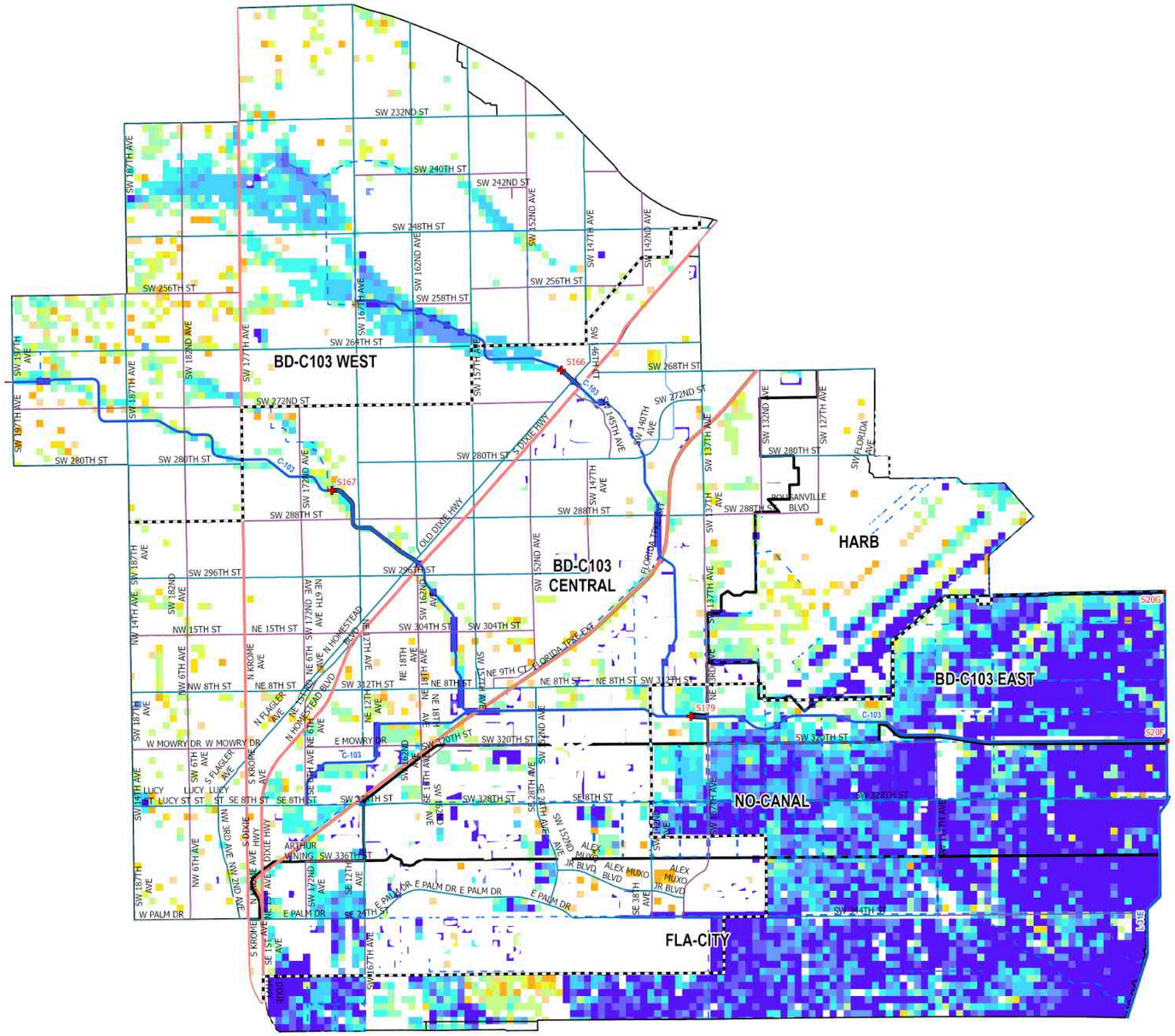


Figure A-309. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 0

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-310. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 1

Kimley»Horn

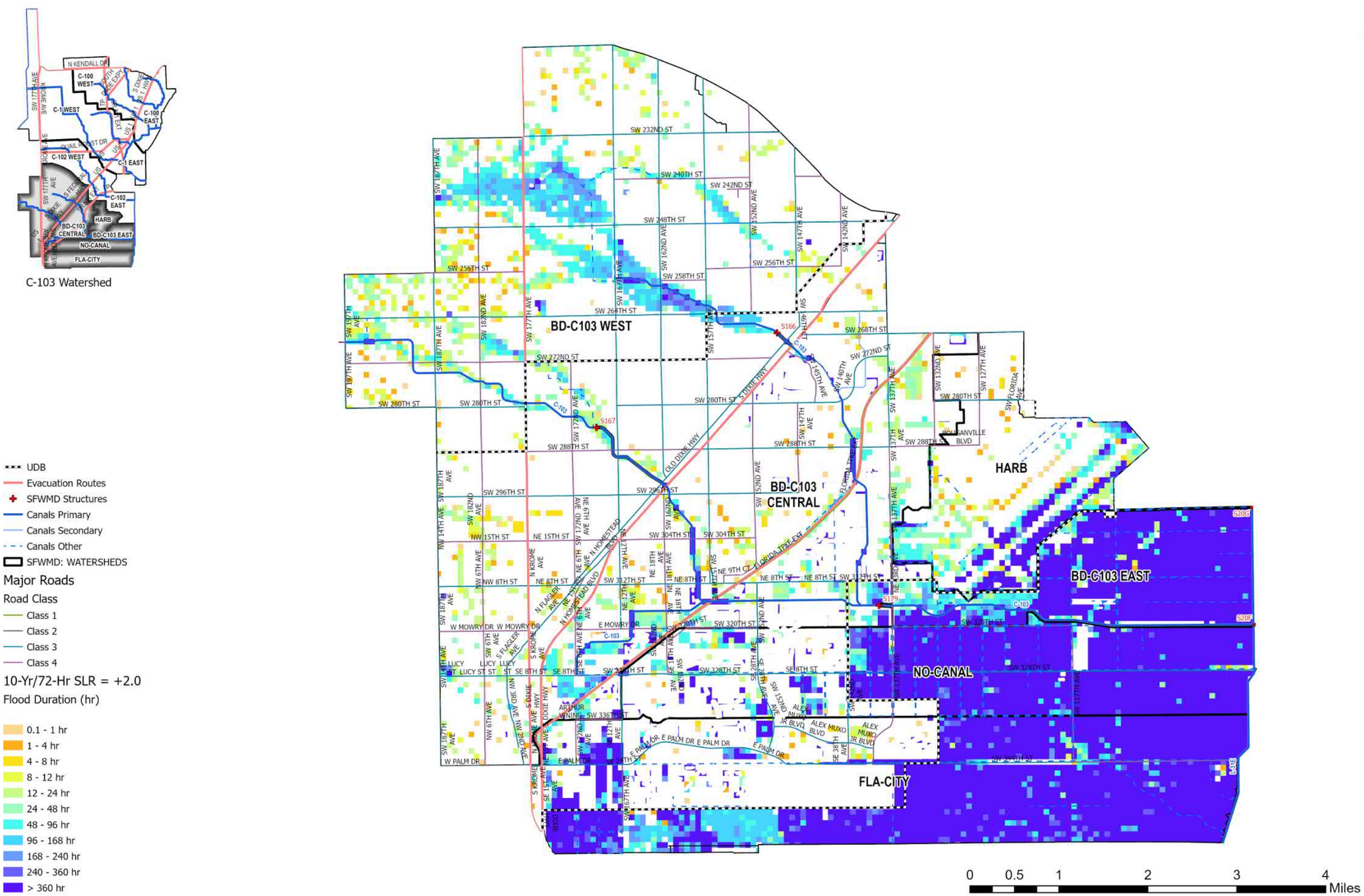
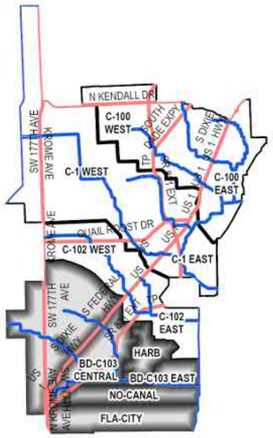
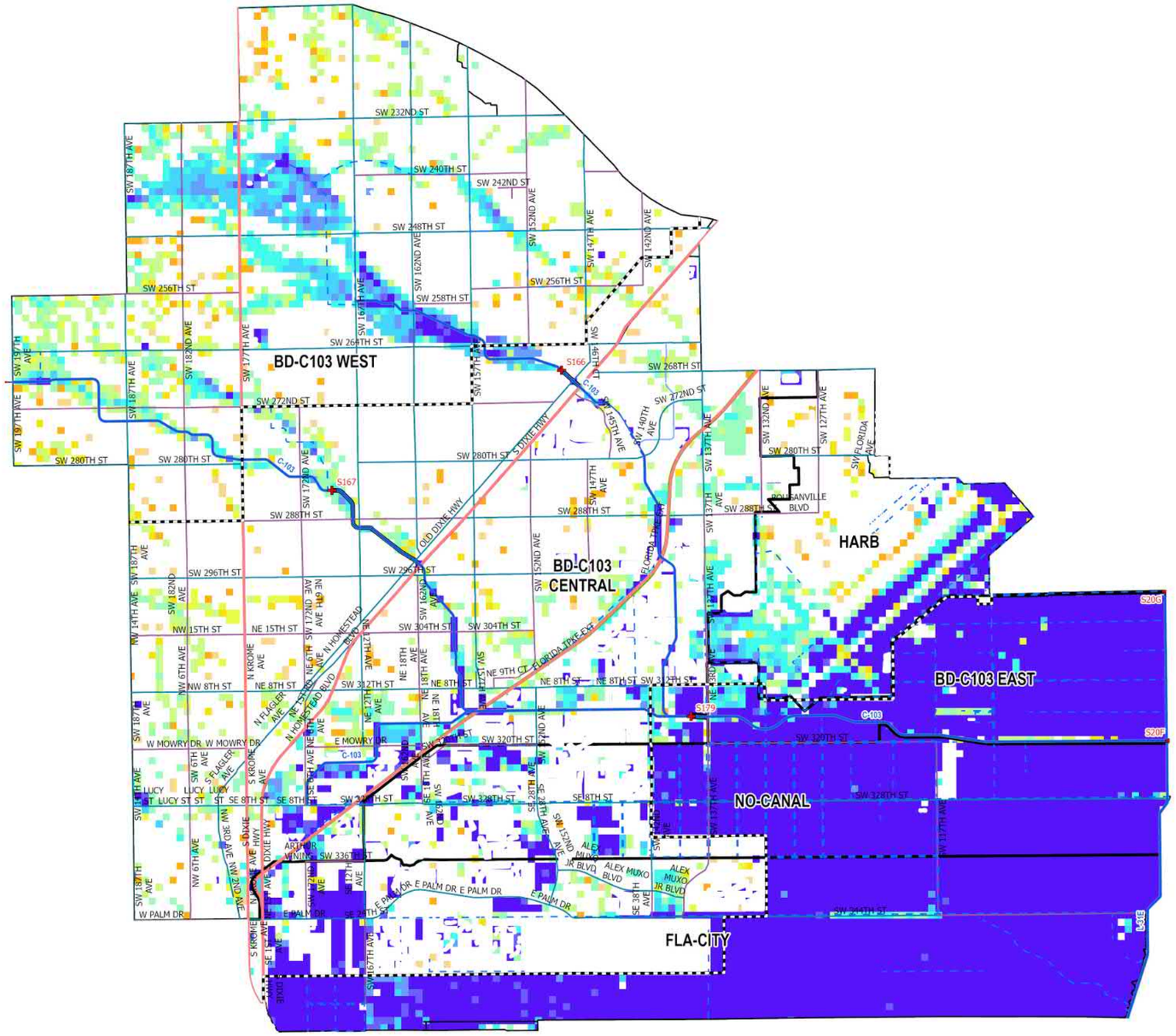


Figure A-311. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

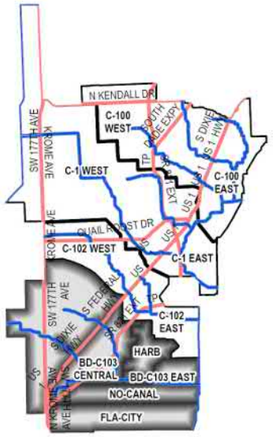
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

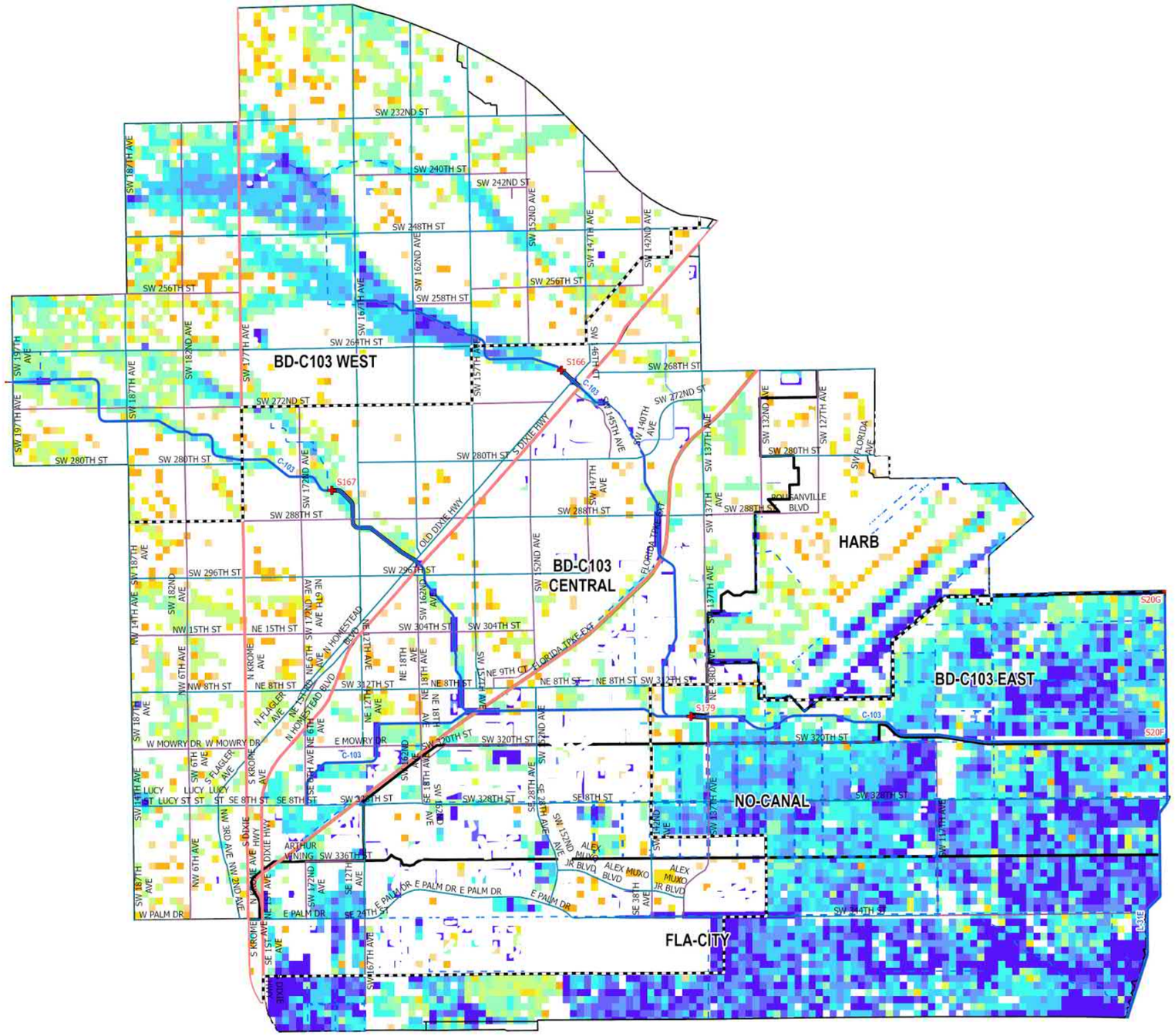
0 0.5 1 2 3 4 Miles

Figure A-312. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 3

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

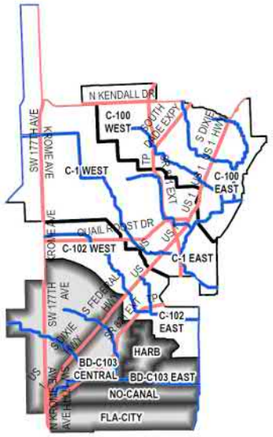
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

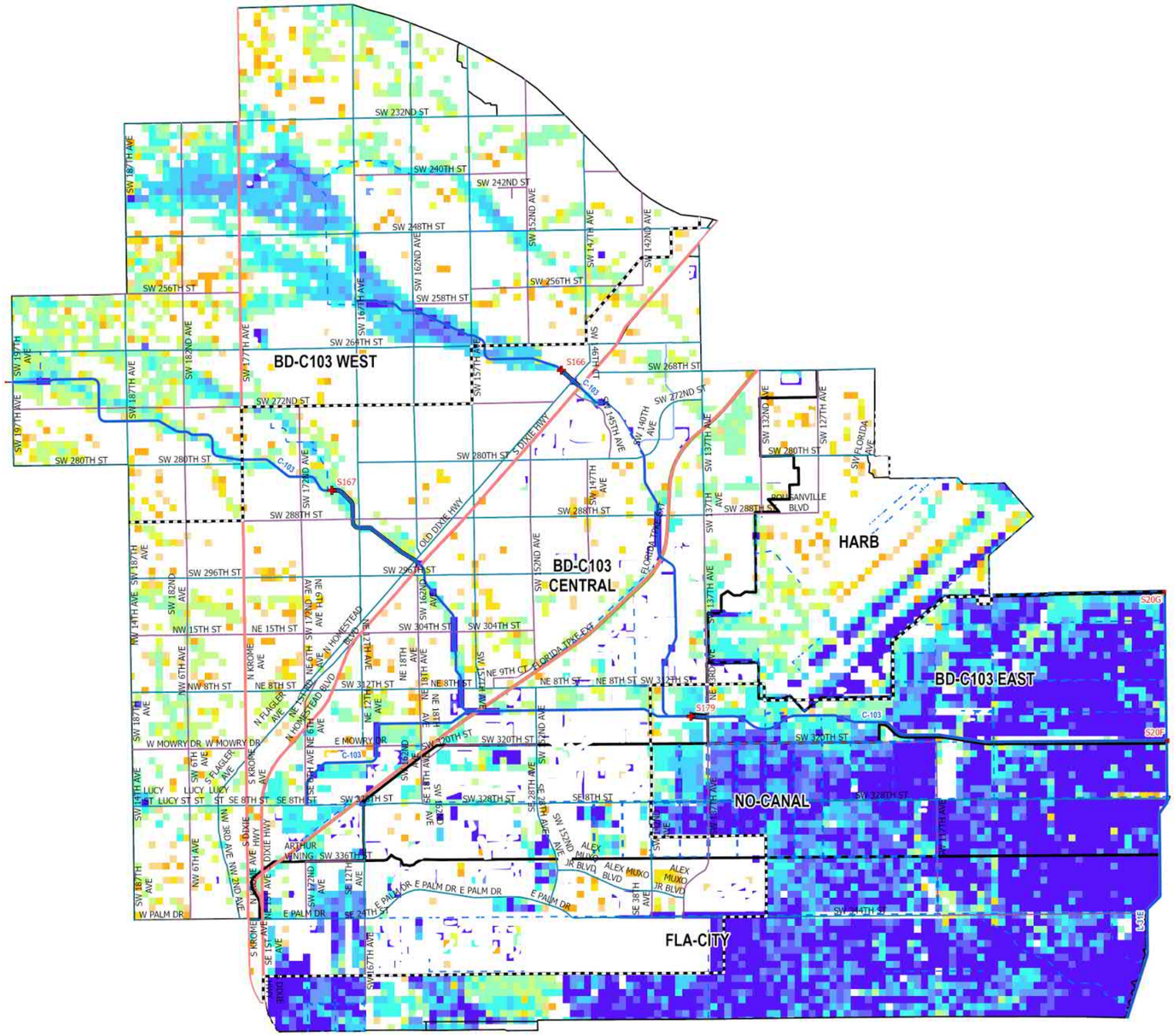
0 0.5 1 2 3 4 Miles

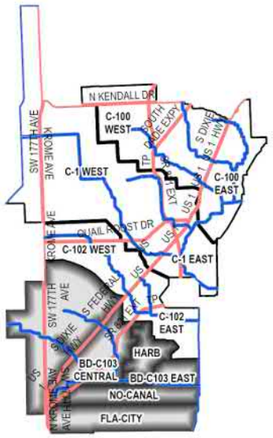
Figure A-313. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 0

Kimley»Horn

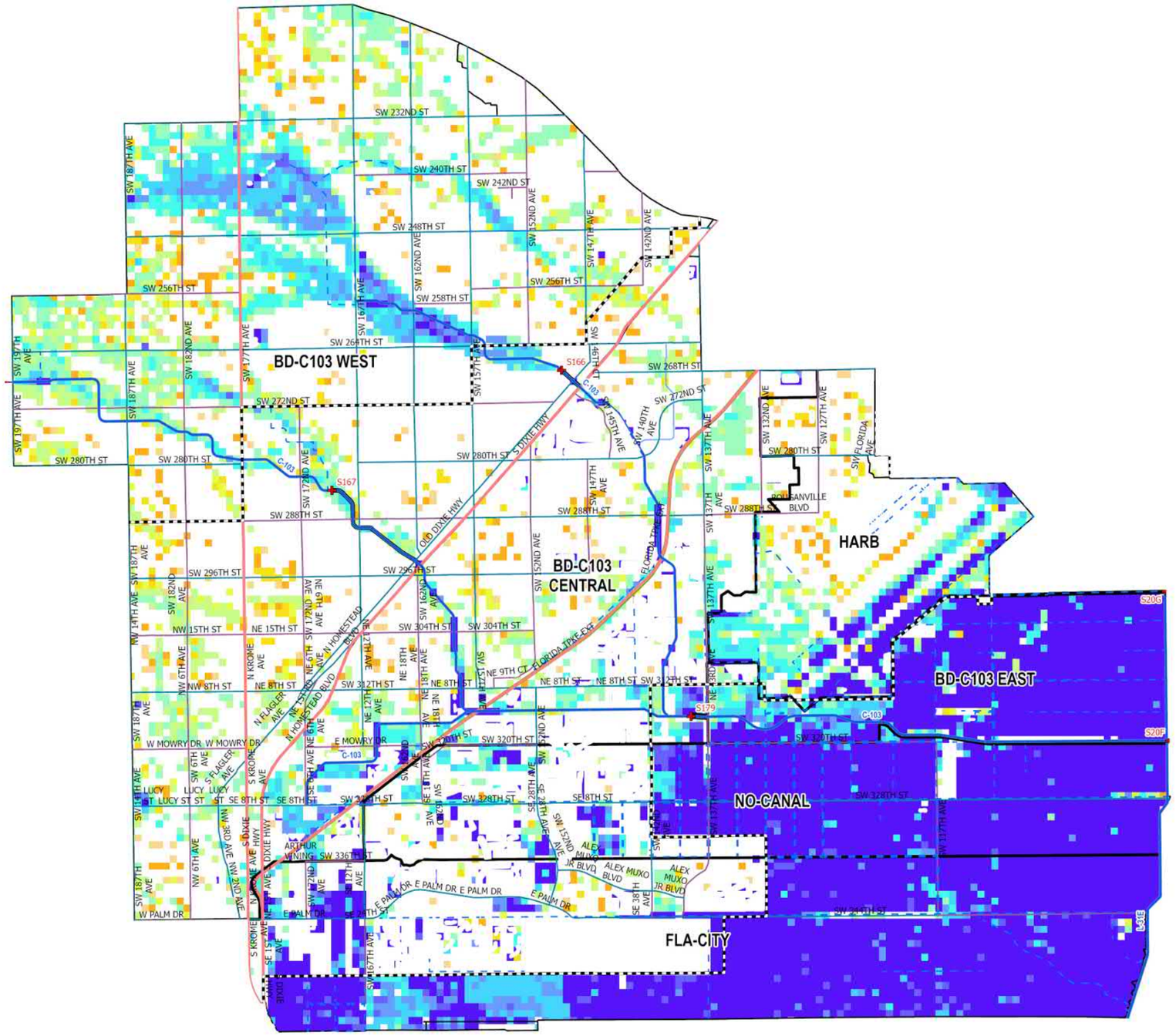


C-103 Watershed


BD-C103 WEST
BD-C103 CENTRAL
HARB
BD-C103 EAST
NO-CANAL
FLA-CITY
S166
S167
S179
S20G
S20F
C-103
SW 280TH ST
SW 288TH ST
SW 272ND ST
SW 268TH ST
SW 256TH ST
SW 258TH ST
SW 248TH ST
SW 242ND ST
SW 240TH ST
SW 232ND ST
SW 296TH ST
SW 304TH ST
SW 320TH ST
SW 328TH ST
SW 336TH ST
SW 187TH AVE
SW 177TH AVE
SW 167TH AVE
SW 157TH AVE
SW 147TH AVE
SW 137TH AVE
SW 127TH AVE
SW 152ND AVE
SW 142ND AVE
SW 132ND AVE
SW 162ND AVE
SW 182ND AVE
SW 197TH AVE
SW 172ND AVE
SW 140TH AVE
SW 145TH AVE
S DIXIE HWY
OLD DIXIE HWY
FLORIDA TPKE EXT
BOUGANVILLE BLVD
SW FLORIDA AVE
N HOMESTEAD BLVD
N FLAGLER AVE
S FLAGLER AVE
N KROME AVE
S KROME AVE
W MOWRY DR
E MOWRY DR
W PALM DR
E PALM DR
ALEX MUXO JR BLVD
ARTHUR WINING
NW 15TH ST
NE 15TH ST
NW 8TH ST
NE 8TH ST
NE 9TH CT
SE 8TH ST
LUCY ST
NW 3RD AVE
NW 2ND AVE
NW 6TH AVE
NW 14TH AVE
SE 24TH ST
SE 12TH AVE
SE 15TH AVE
SE 38TH AVE
SE 328TH AVE
SE 152ND AVE
SE 167TH AVE
SE 187TH AVE
SE 137TH AVE
SE 127TH AVE
SE 117TH AVE
SE 107TH AVE
SE 147TH AVE
SE 157TH AVE
SE 177TH AVE
SE 197TH AVE
SE 217TH AVE
SE 227TH AVE
SE 237TH AVE
SE 247TH AVE
SE 257TH AVE
SE 267TH AVE
SE 277TH AVE
SE 287TH AVE
SE 297TH AVE
SE 307TH AVE
SE 317TH AVE
SE 327TH AVE
SE 337TH AVE
SE



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

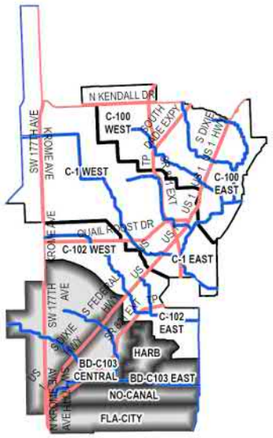
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

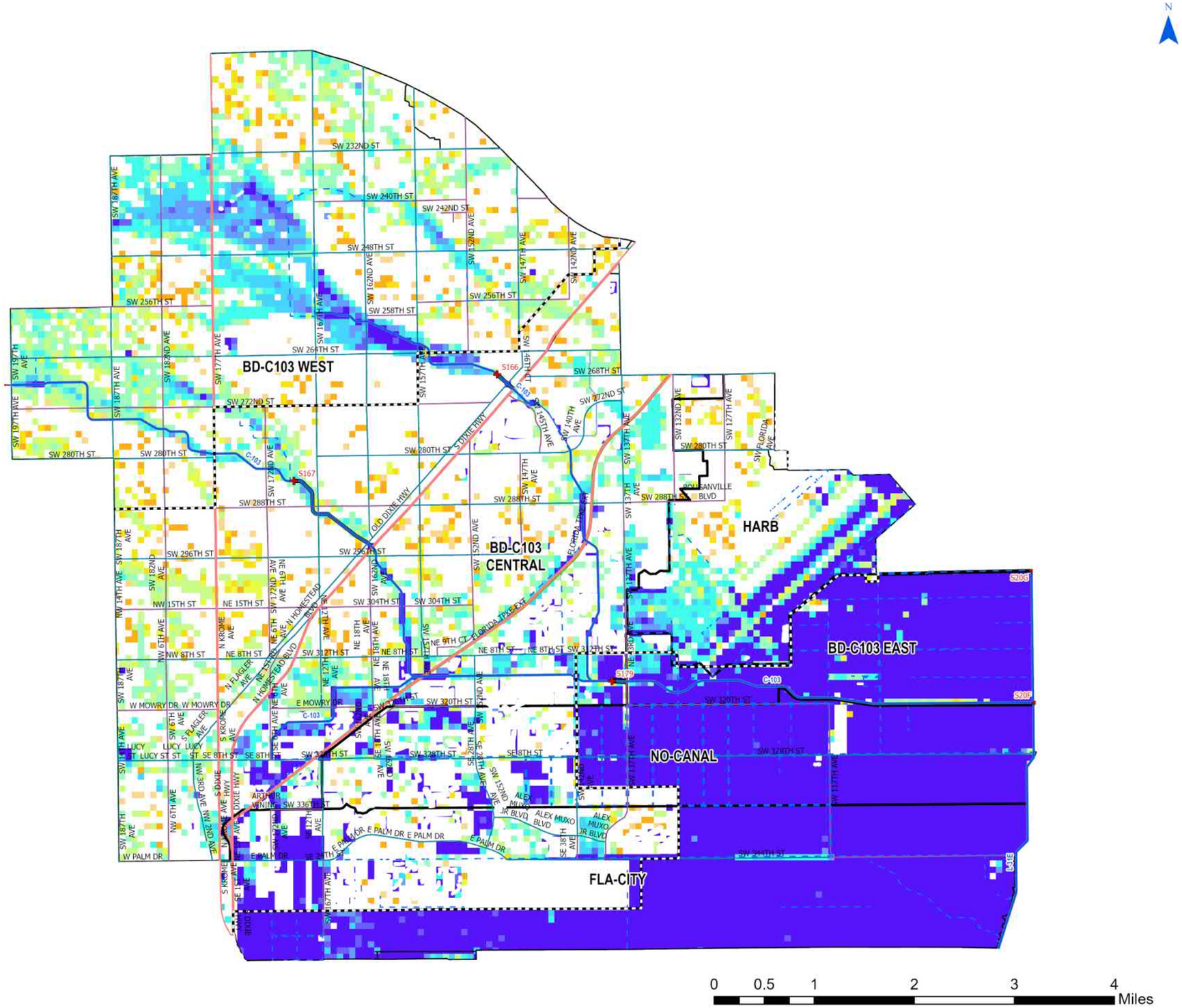
0 0.5 1 2 3 4 Miles

Figure A-315. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

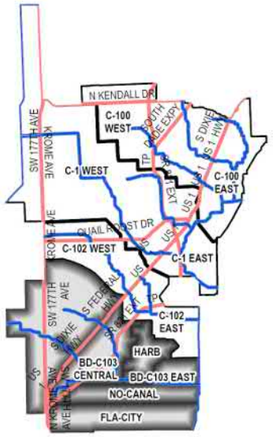
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

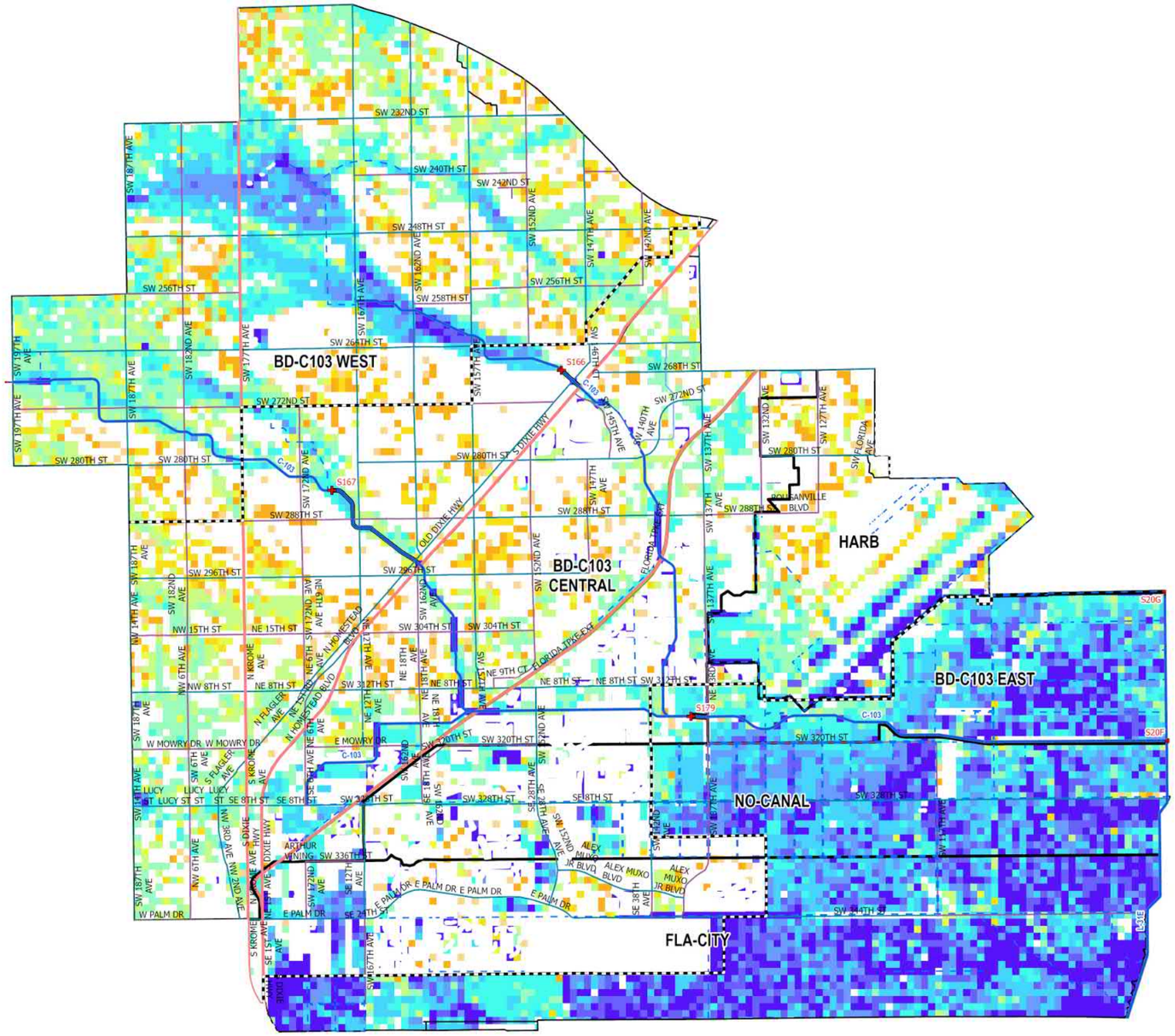
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-316. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 3

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

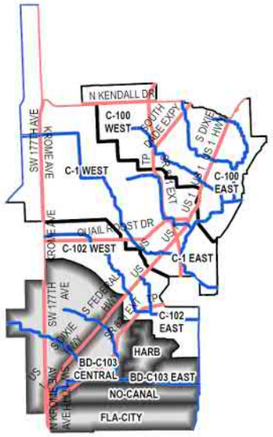
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

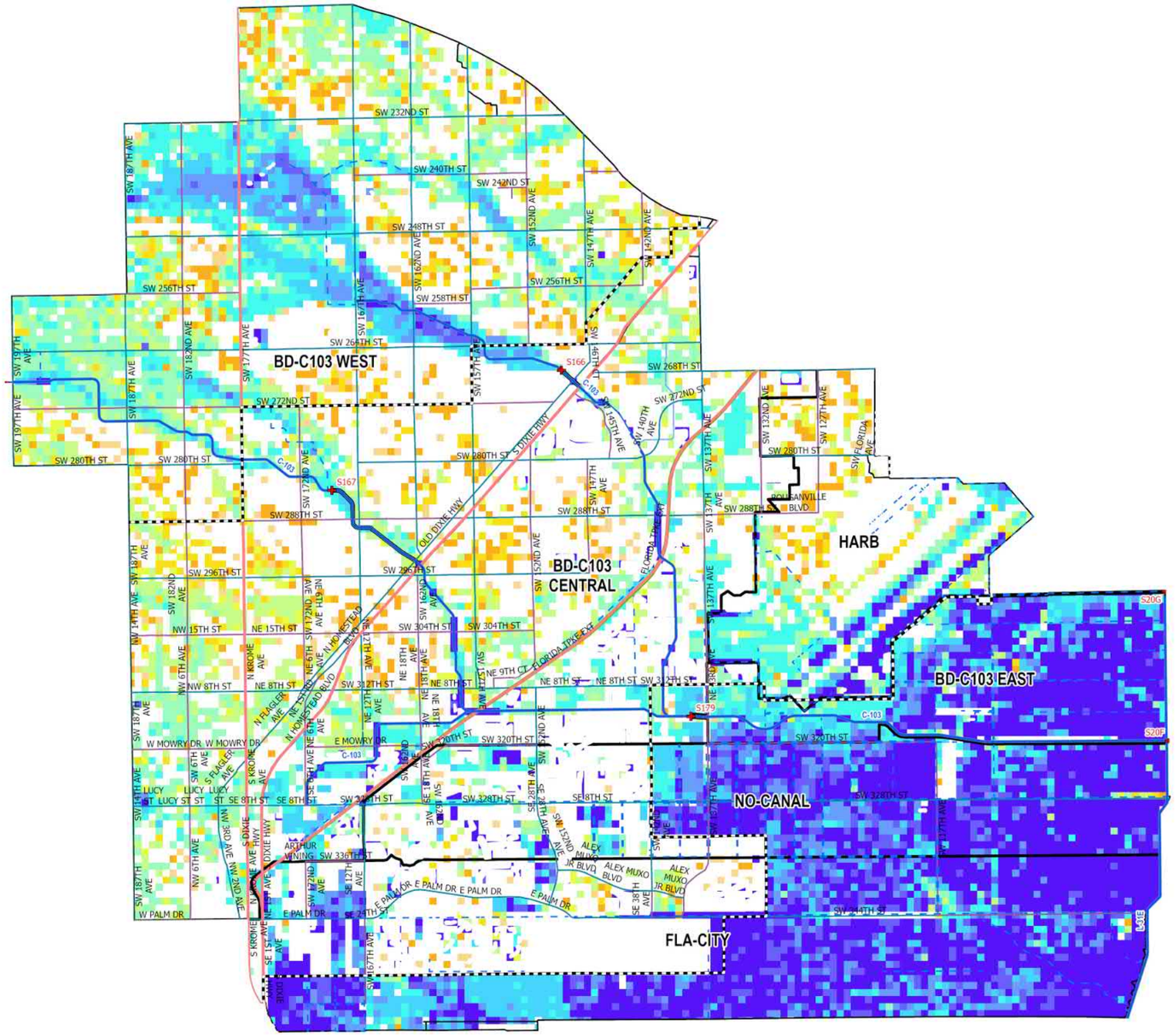
0 0.5 1 2 3 4 Miles

Figure A-317. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 0

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

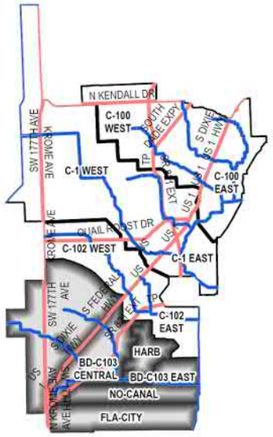
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

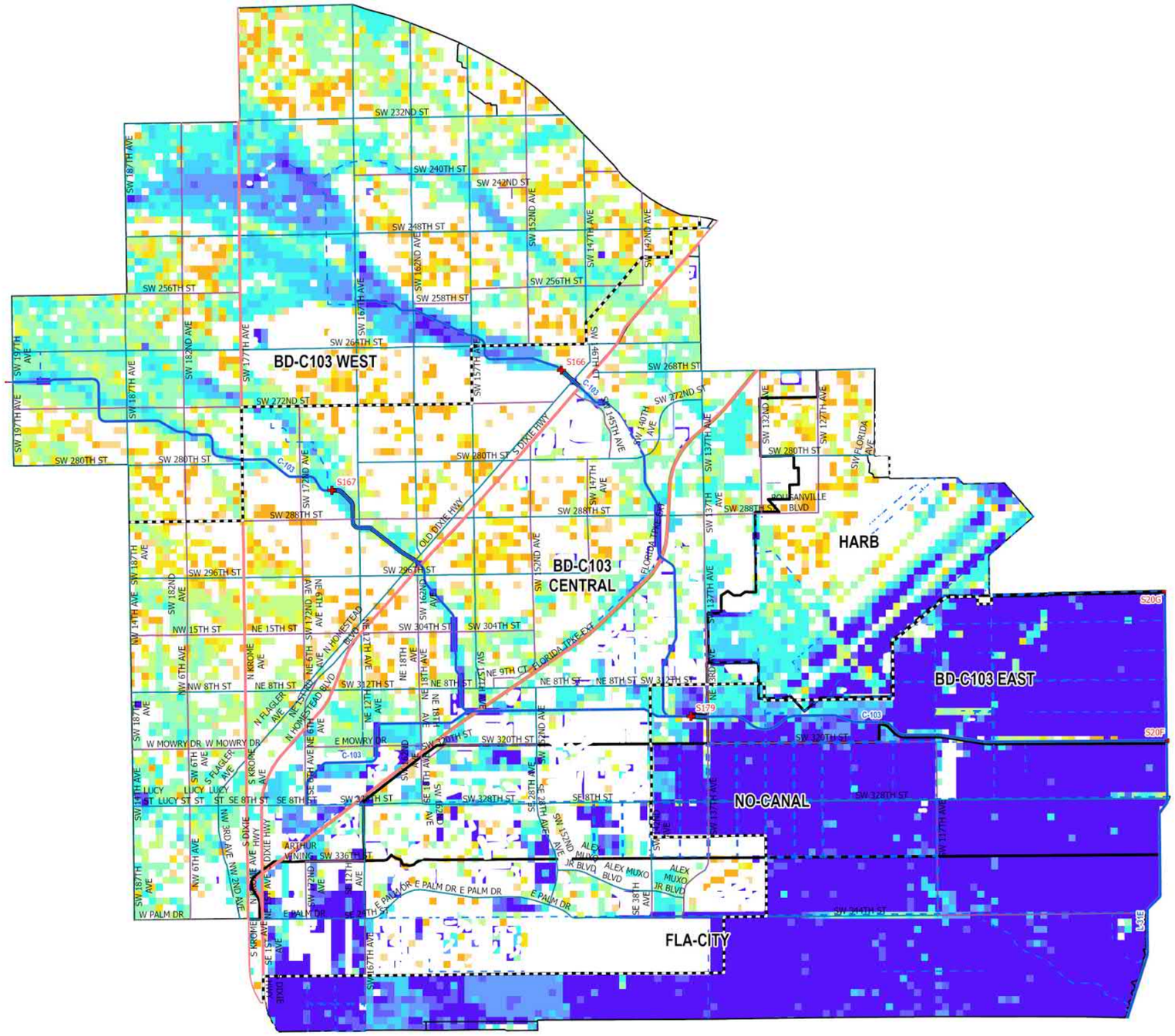
0 0.5 1 2 3 4 Miles

Figure A-318. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 1

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

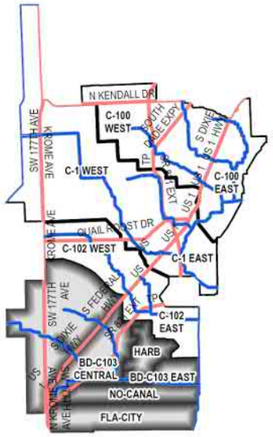
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

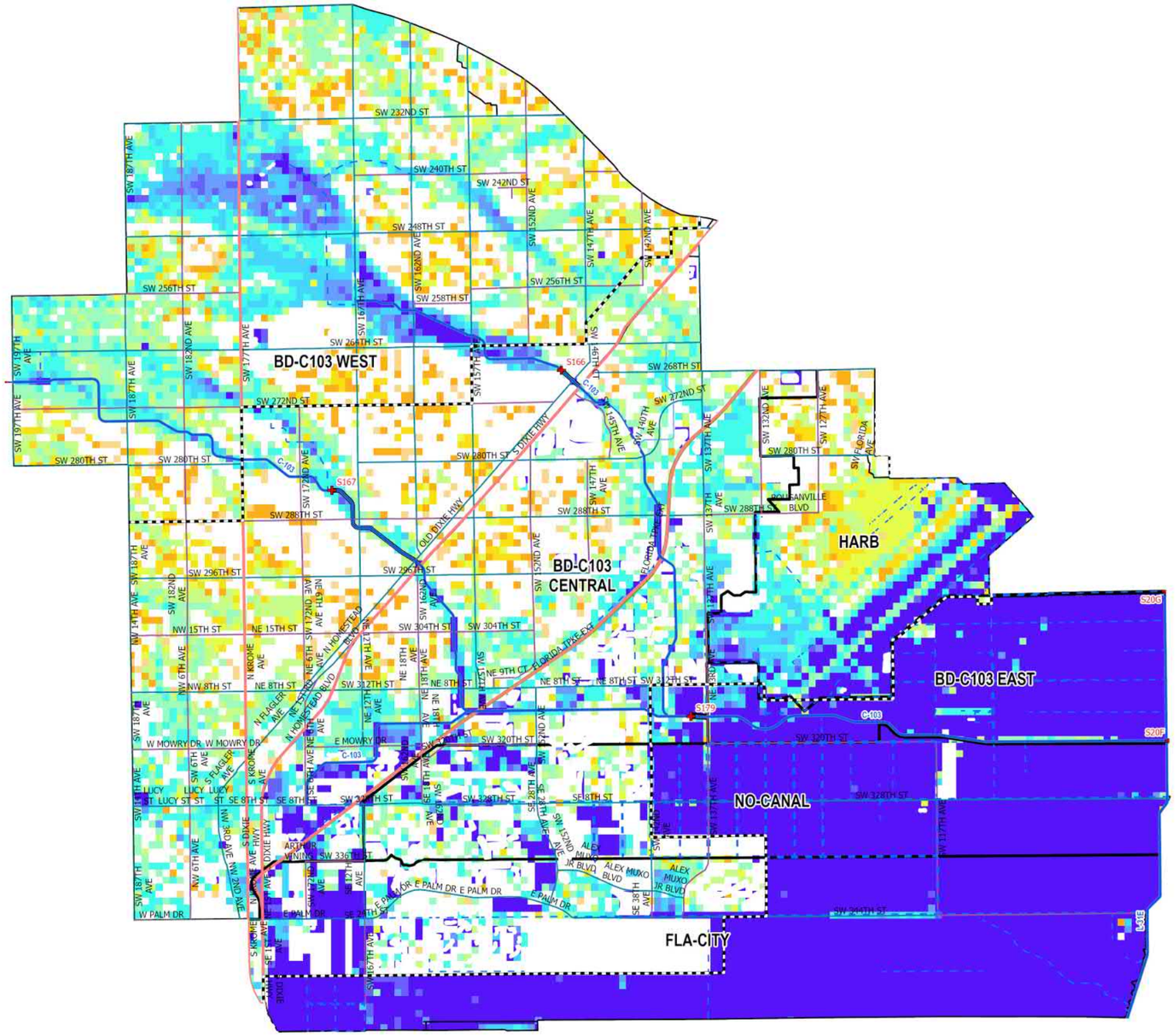
0 0.5 1 2 3 4 Miles

Figure A-319. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 2

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

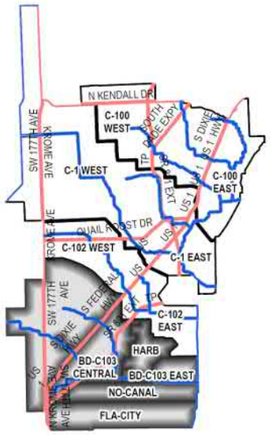
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

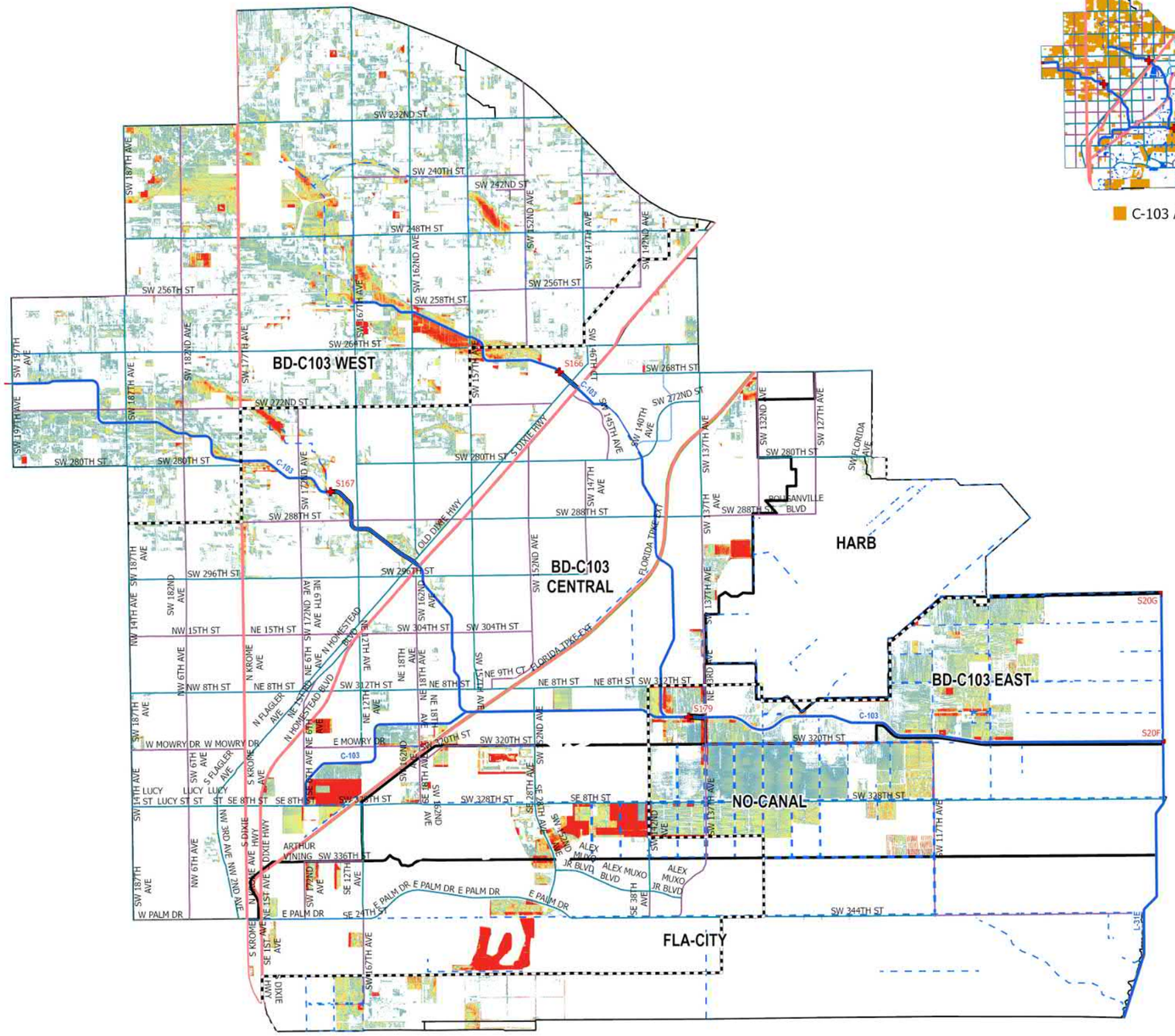
Figure A-320. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 3

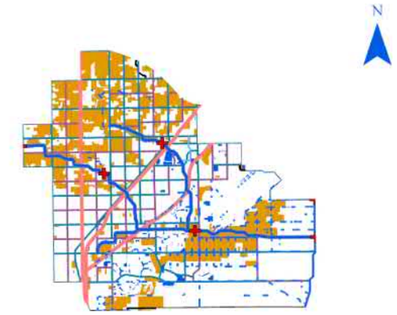
Kimley»Horn

WATERSHED C-103: Flood Extent In Agricultural Areas



C-103 Watershed





- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

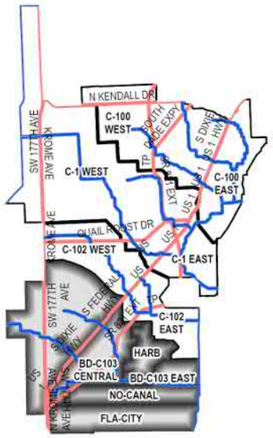
5-Yr/72-Hr SLR = 0

Flood Depth (ft)

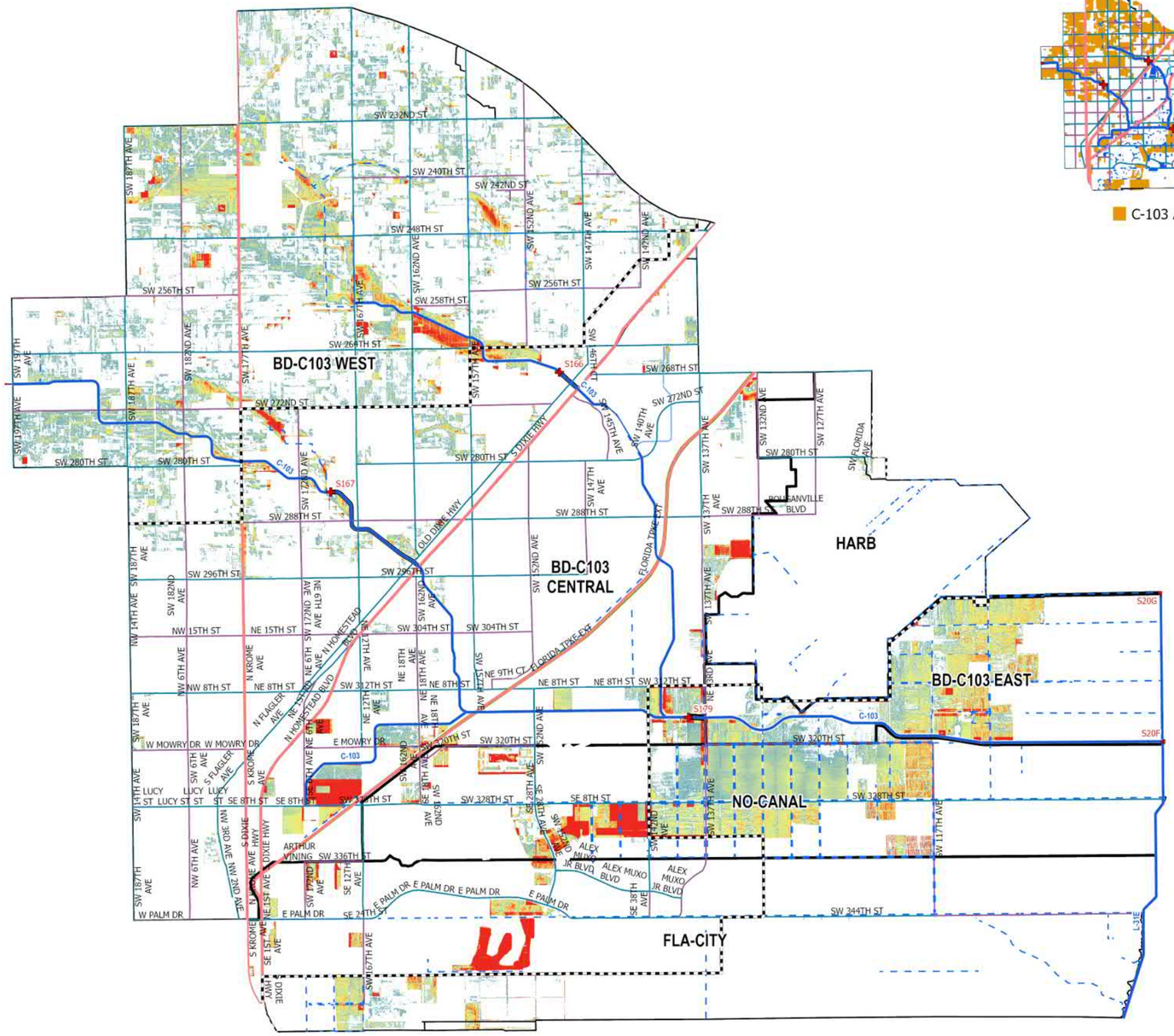
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-321. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

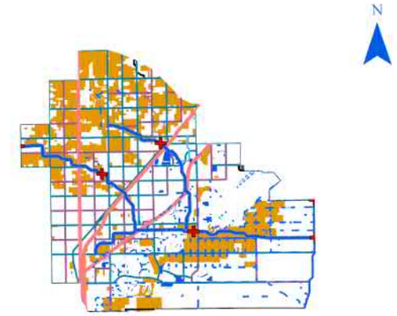
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

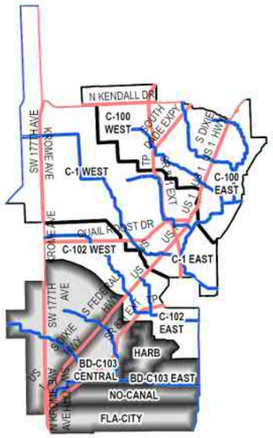
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

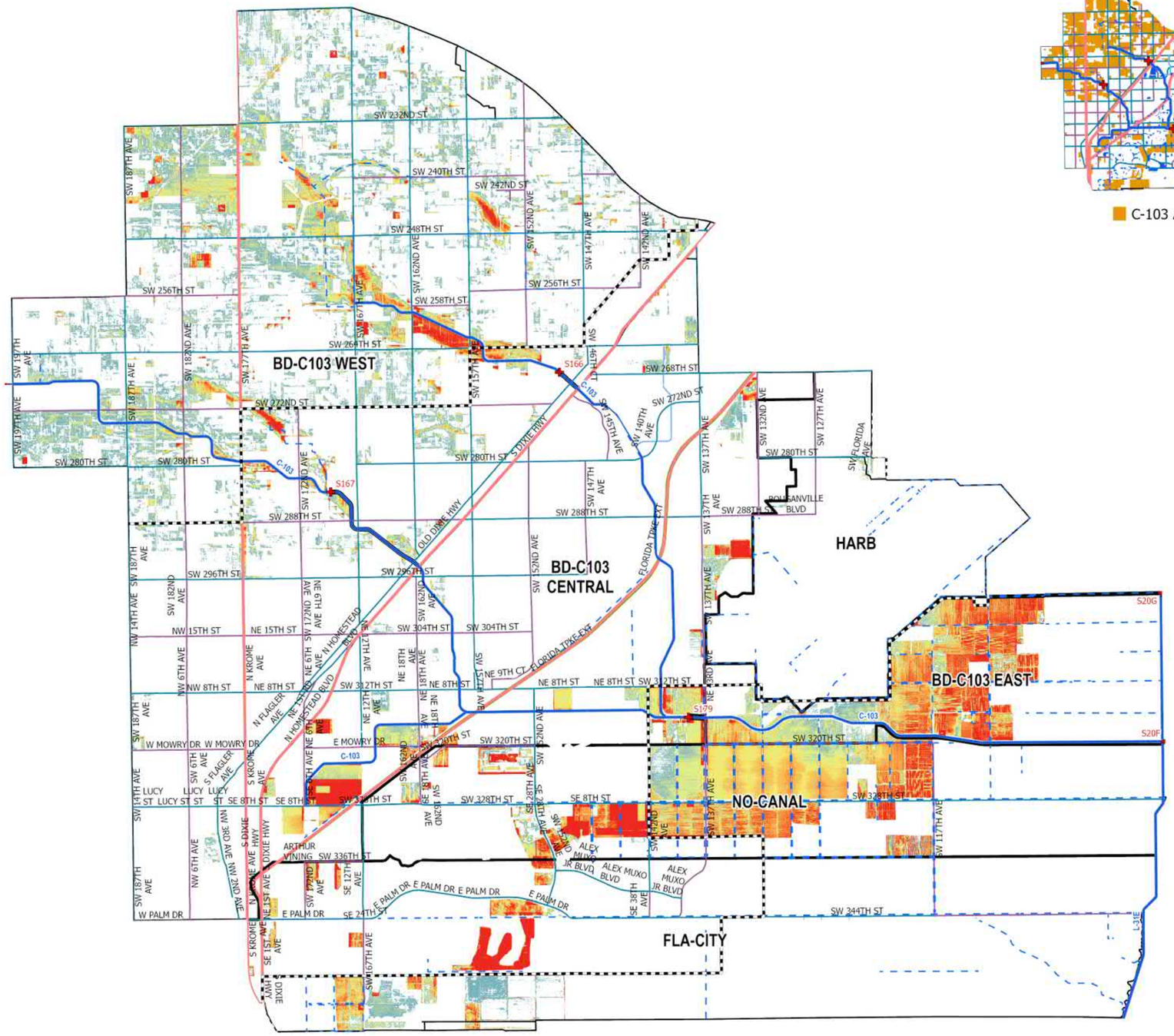


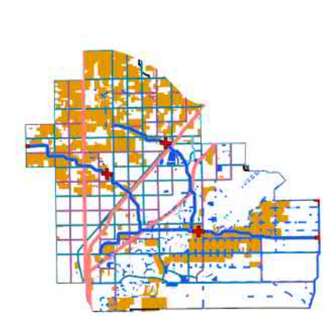
C-103 Agricultural Areas

Figure A-322. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

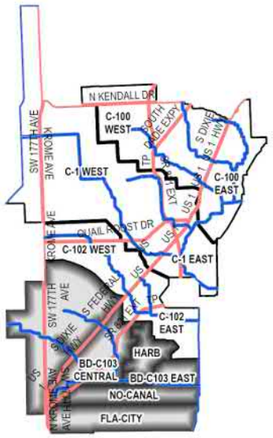
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

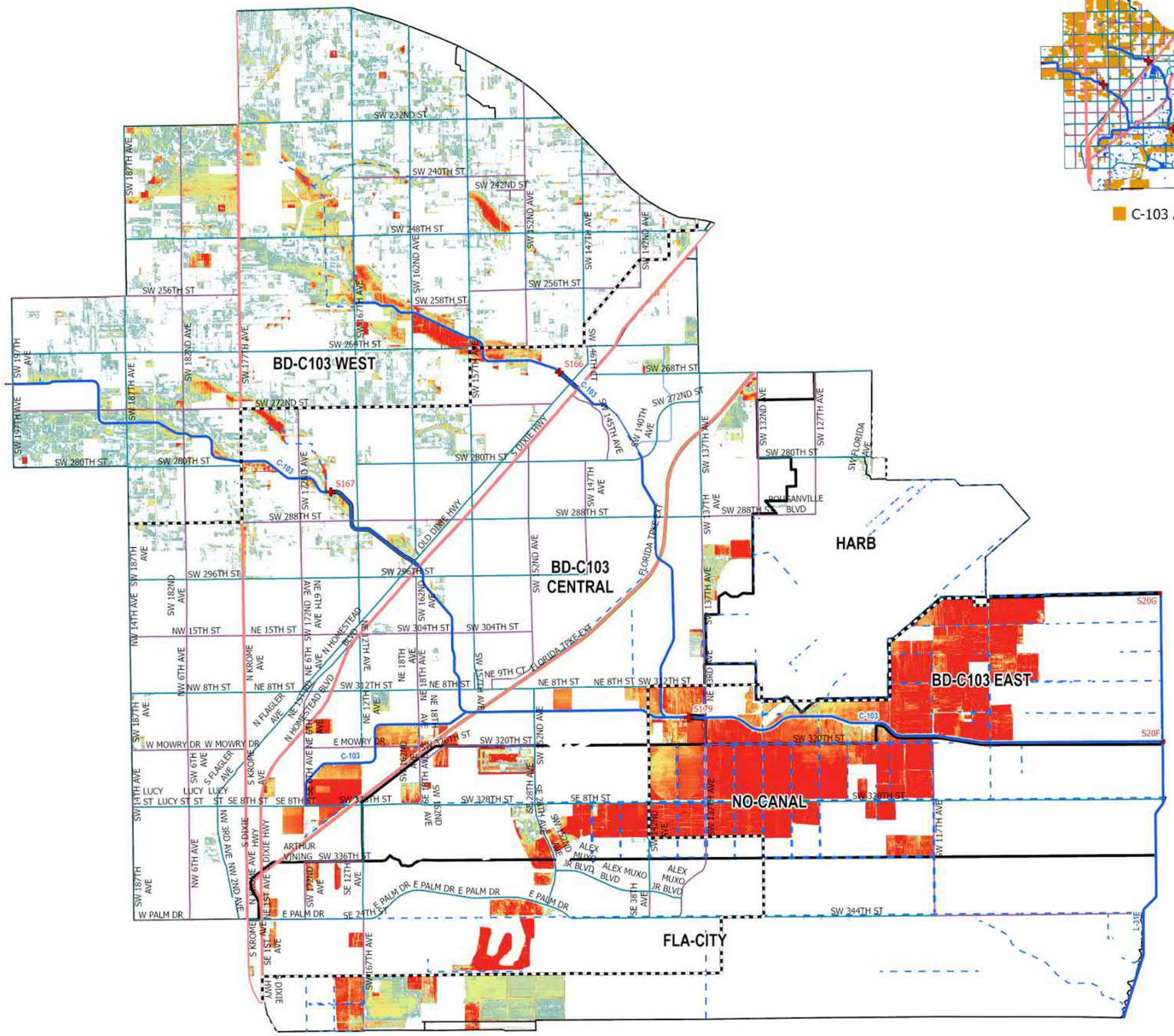
0 0.5 1 2 3 4 Miles

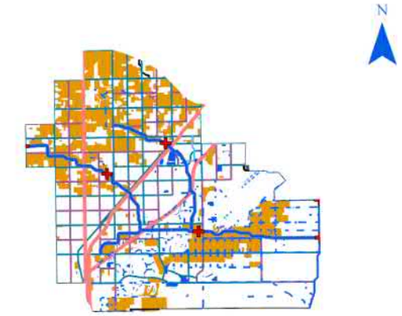
Figure A-323. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

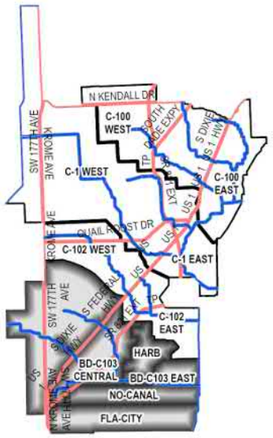
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

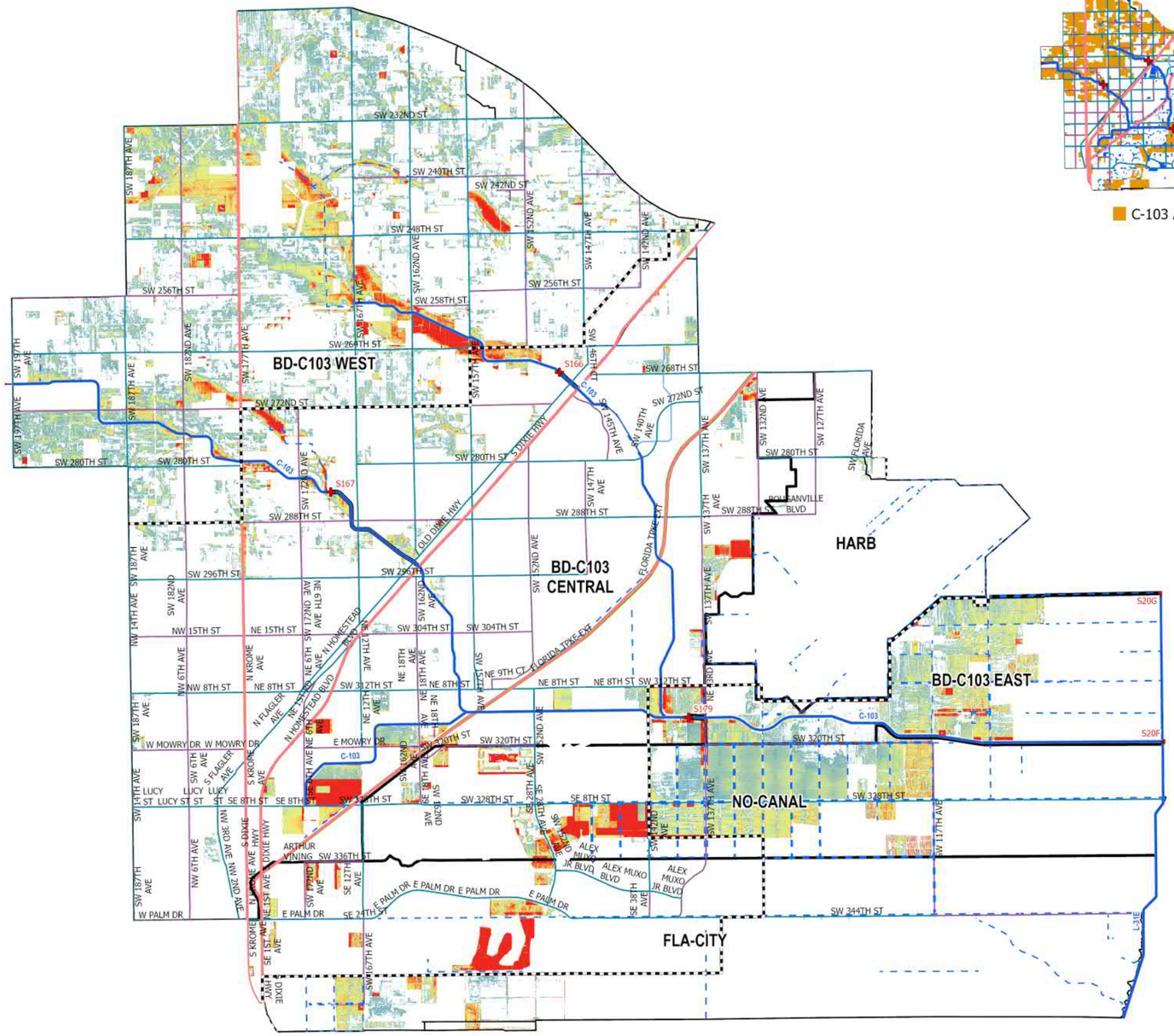
0 0.5 1 2 3 4 Miles

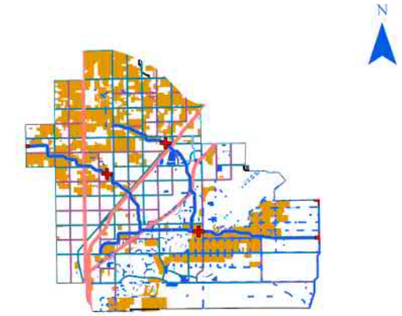
Figure A-324. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

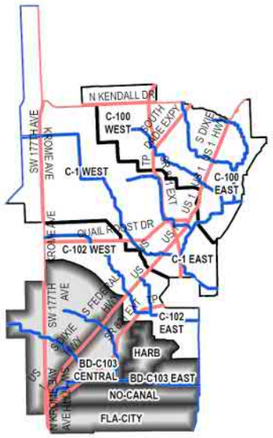
- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

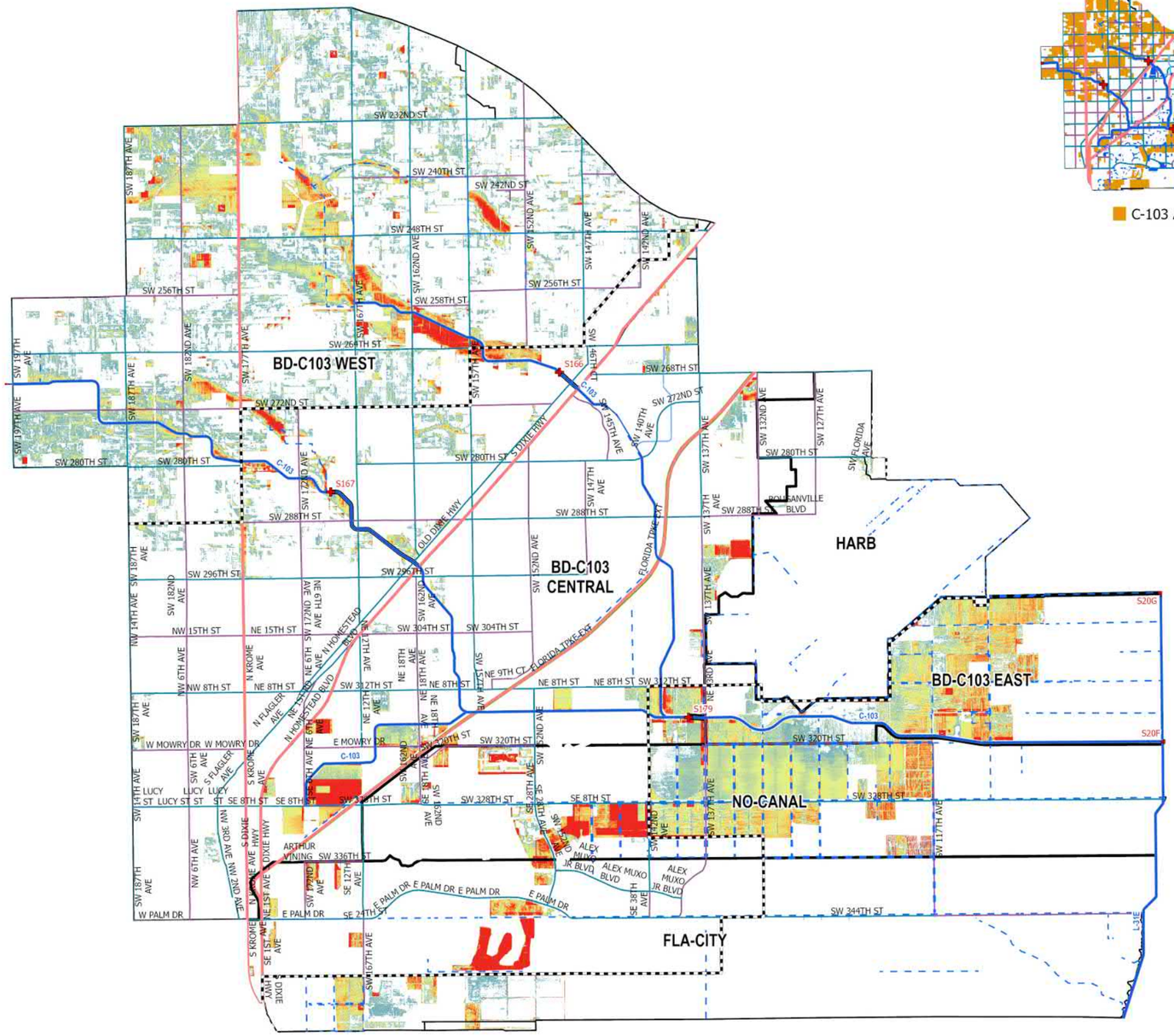
Flood Depth (ft)

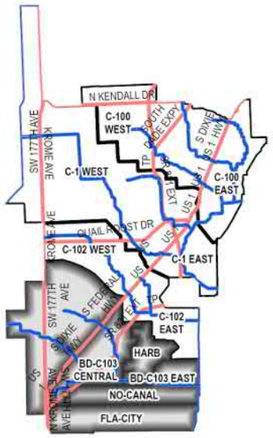
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-325. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas

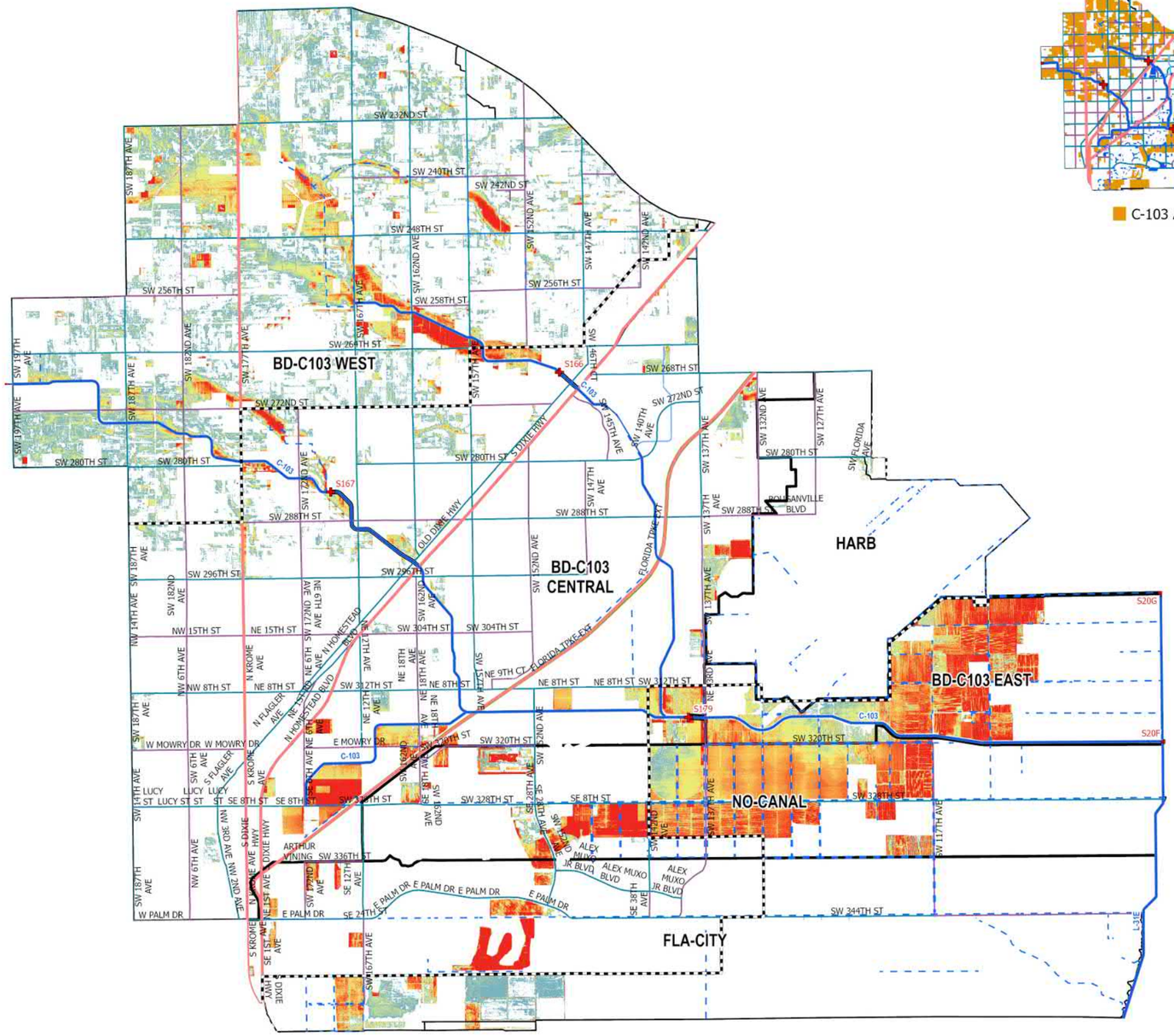


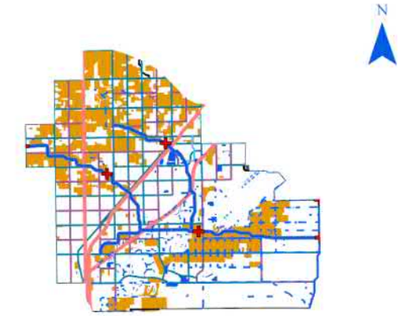
C-103 Watershed


BD-C103 WEST
BD-C103 CENTRAL
HARB
BD-C103 EAST
NO-CANAL
FLA-CITY
S166
S167
S179
S20G
S20F
C-103
SW 232ND ST
SW 240TH ST
SW 242ND ST
SW 248TH ST
SW 256TH ST
SW 258TH ST
SW 268TH ST
SW 272ND ST
SW 280TH ST
SW 288TH ST
SW 296TH ST
SW 304TH ST
SW 312TH ST
SW 320TH ST
SW 328TH ST
SW 336TH ST
SW 344TH ST
NW 15TH ST
NE 15TH ST
NW 8TH ST
NE 8TH ST
SE 8TH ST
W MOWRY DR
E MOWRY DR
W PALM DR
E PALM DR
SE 24TH ST
S DIXIE HWY
OLD DIXIE HWY
FLORIDA TPKE EXT
ROUSANVILLE BLVD
ALEX MUXO JR BLVD
N HOMESTEAD BLVD
N FLAGLER AVE
S KROME AVE
SW 187TH AVE
SW 182ND AVE
SW 177TH AVE
SW 162ND AVE
SW 152ND AVE
SW 147TH AVE
SW 142ND AVE
SW 137TH AVE
SW 132ND AVE
SW 127TH AVE
SW 117TH AVE
SW 137TH AVE
SW 147TH AVE
SW 167TH AVE
SW 172ND AVE
SW 197TH AVE
SW 140TH AVE
SW 145TH AVE
SW FLORIDA AVE
NW 6TH AVE
NW 14TH AVE
NW 3RD AVE
NW 2ND AVE
SE 1ST AVE
SE 12TH AVE
SE 28TH AVE
SE 38TH AVE
NE 6TH AVE
NE 12TH AVE
NE 18TH AVE
NE 9TH CT
SW 152ND AVE
SW 162ND AVE
SW 167TH AVE
SW 172ND AVE
SW 177TH AVE
SW 187TH AVE
SW 197TH AVE
SW 137TH AVE
SW 147TH AVE



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

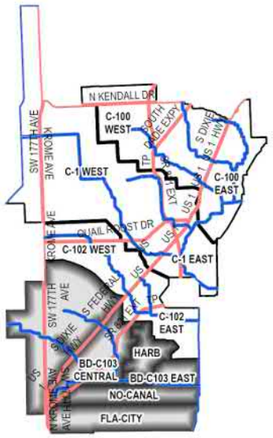
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

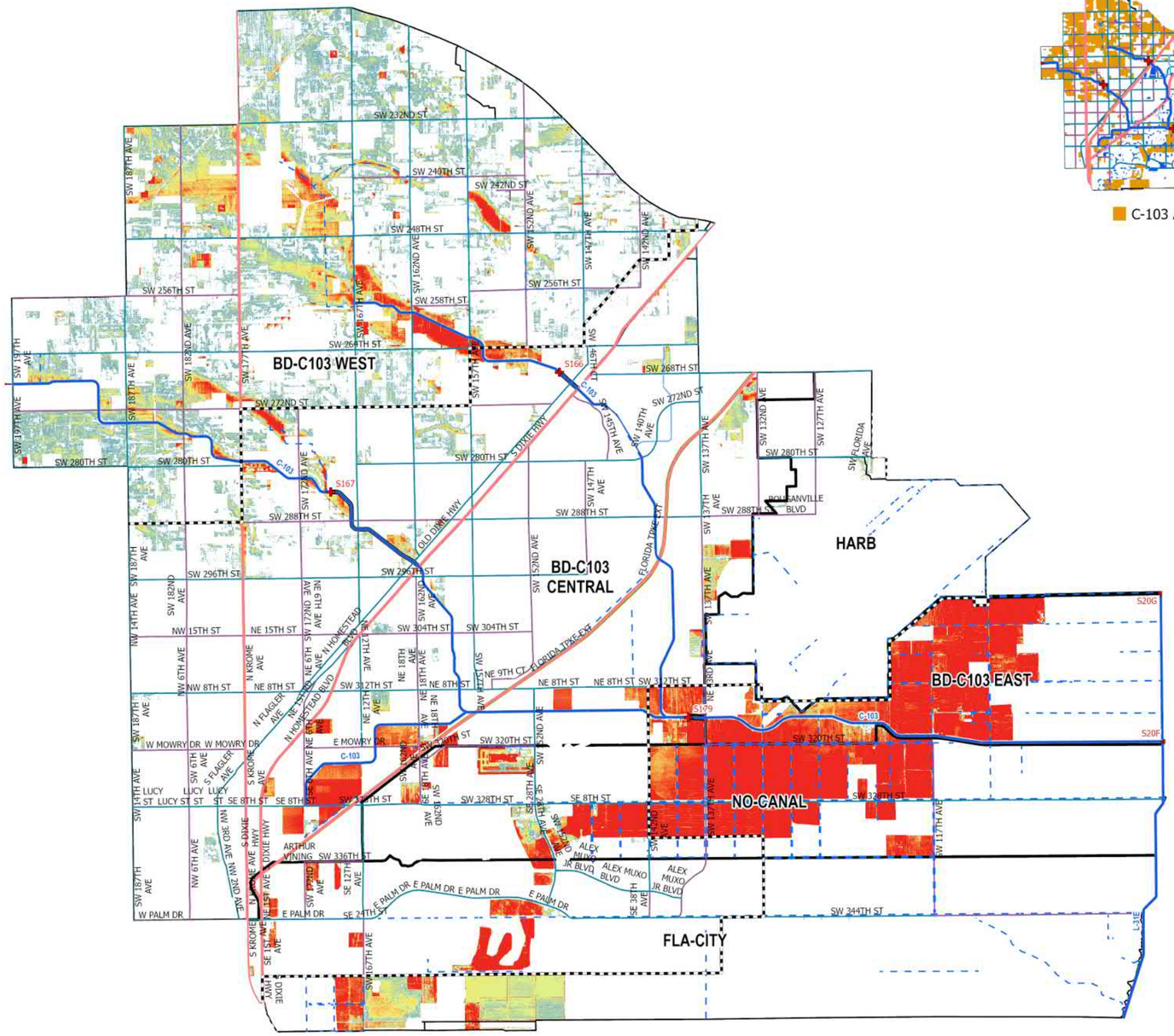
0 0.5 1 2 3 4 Miles

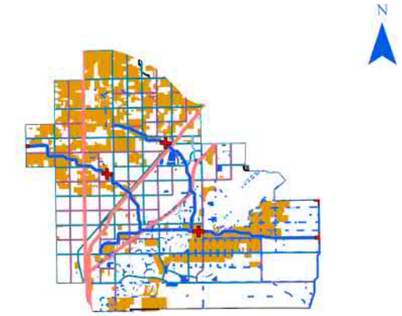
Figure A-327. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

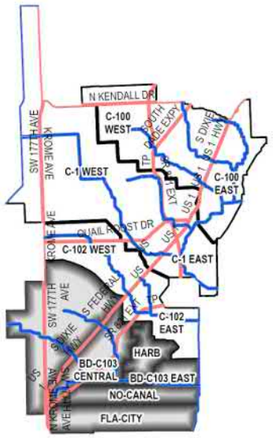
10-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

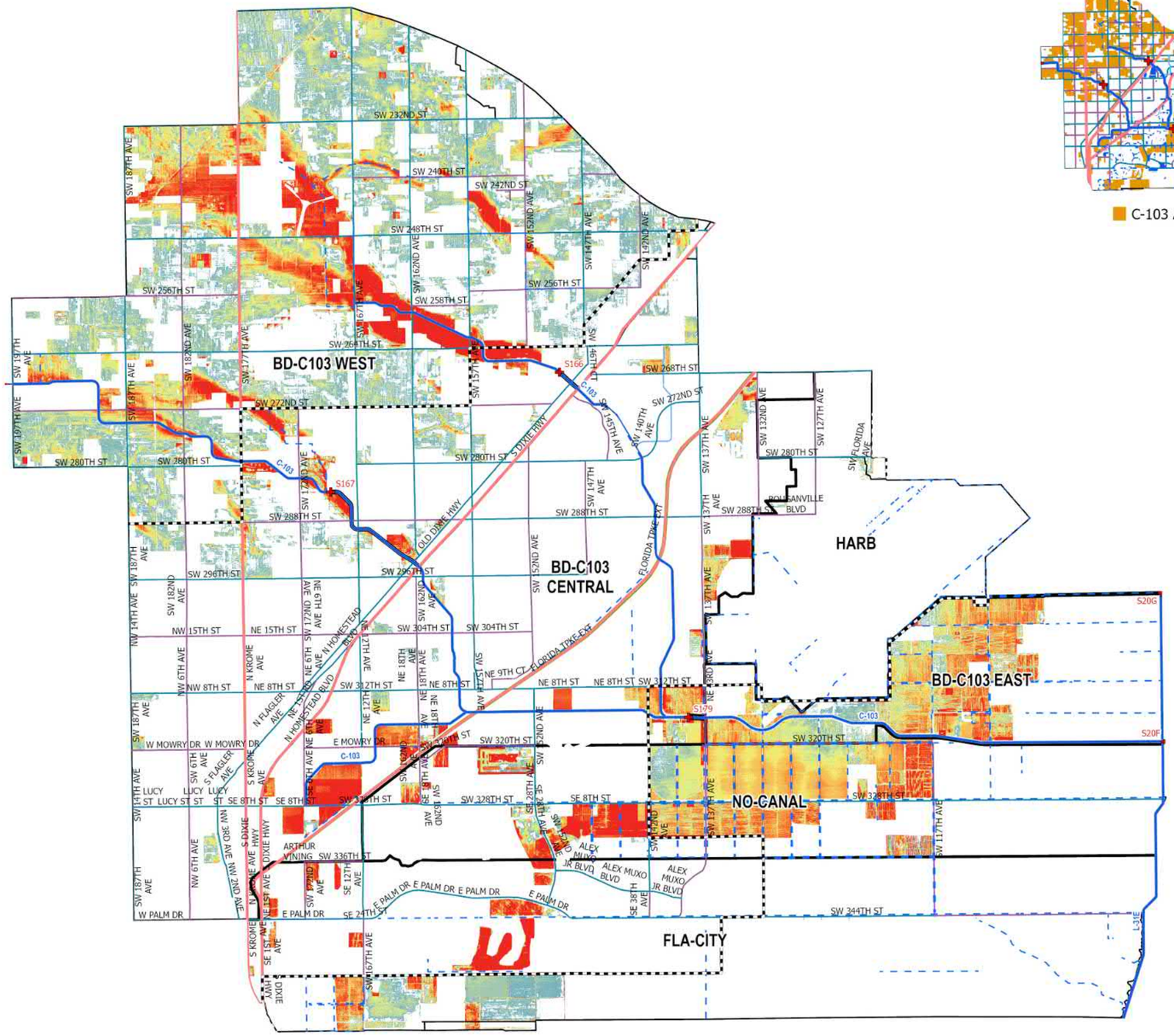
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-328. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

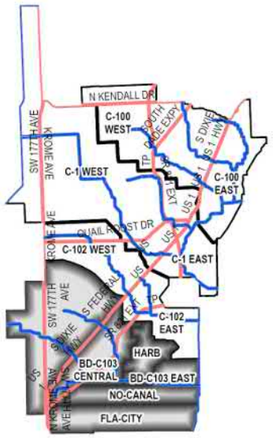
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

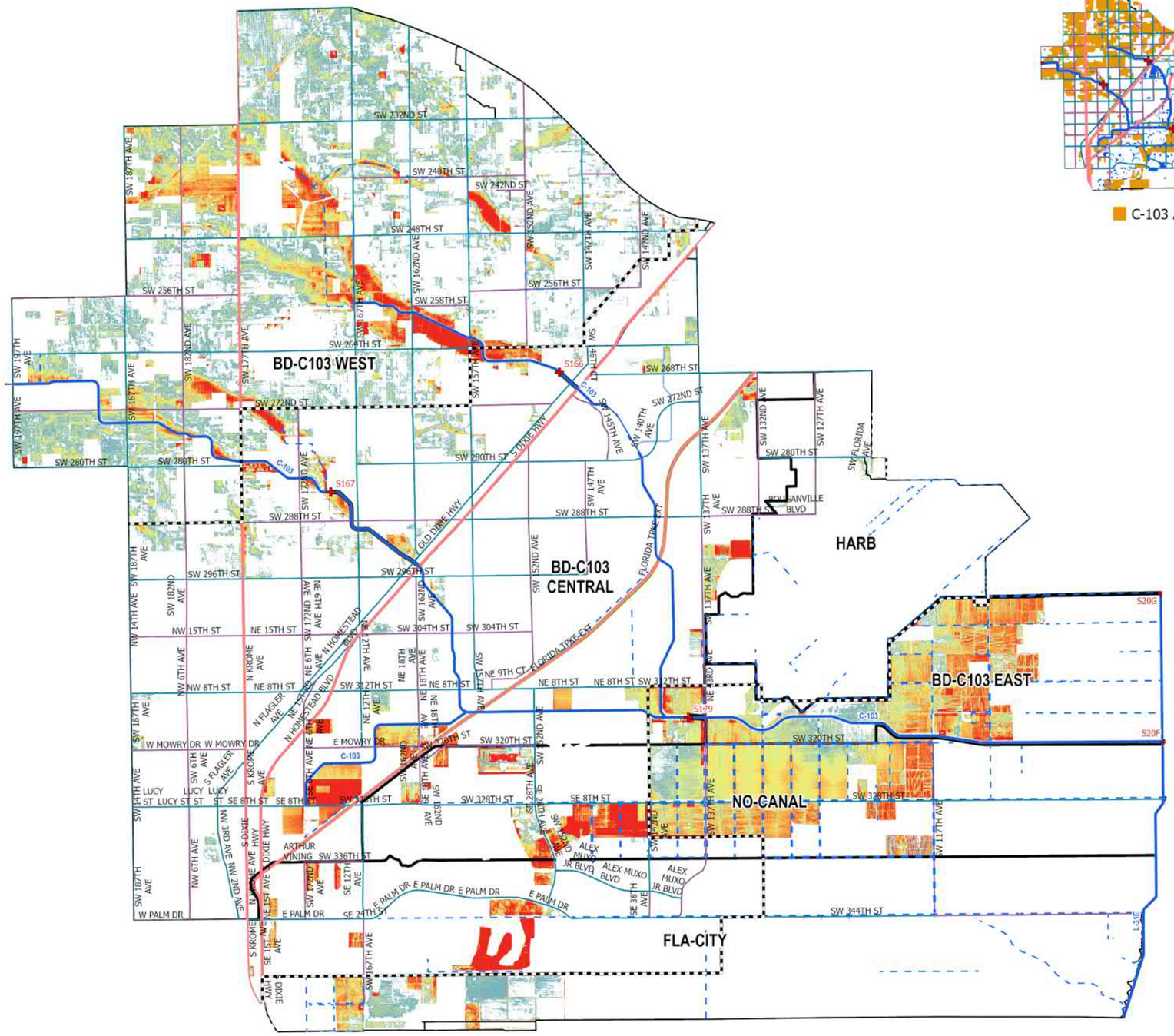
Flood Depth (ft)

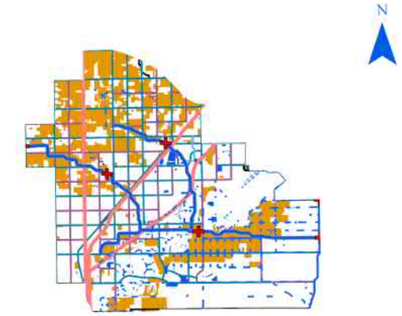
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-329. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

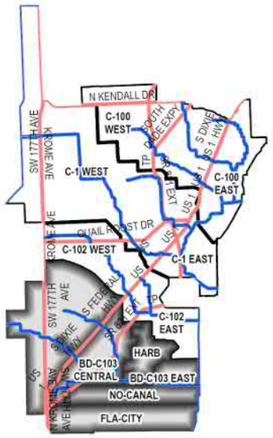
25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

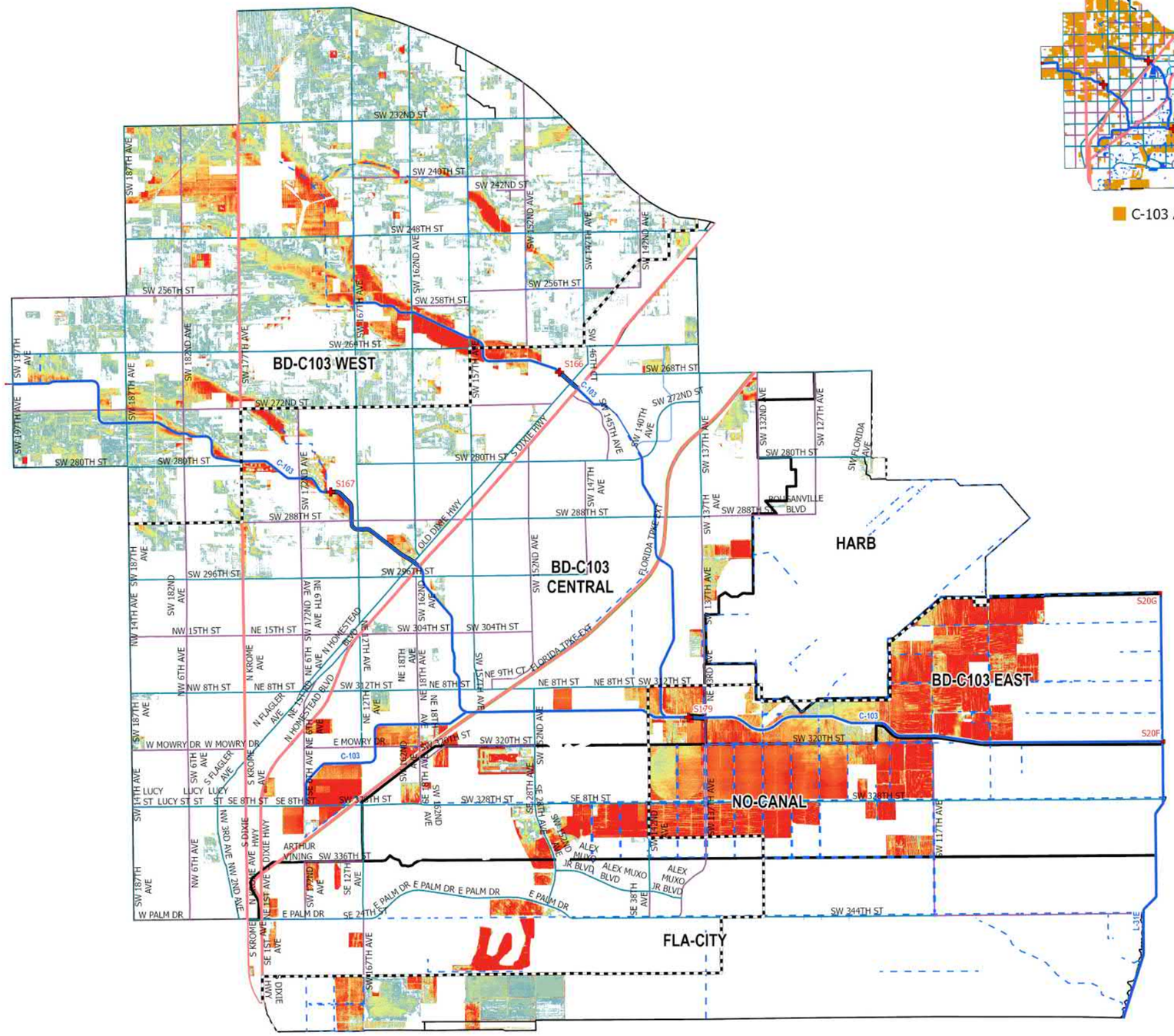
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

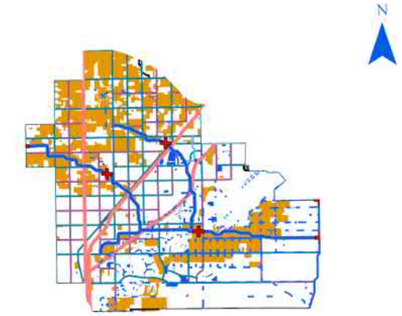
0 0.5 1 2 3 4 Miles

Figure A-330. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

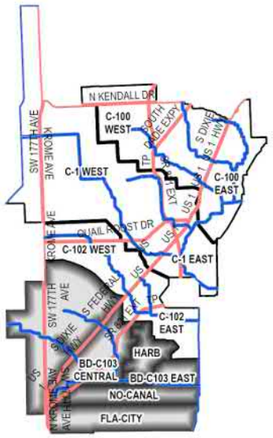
25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

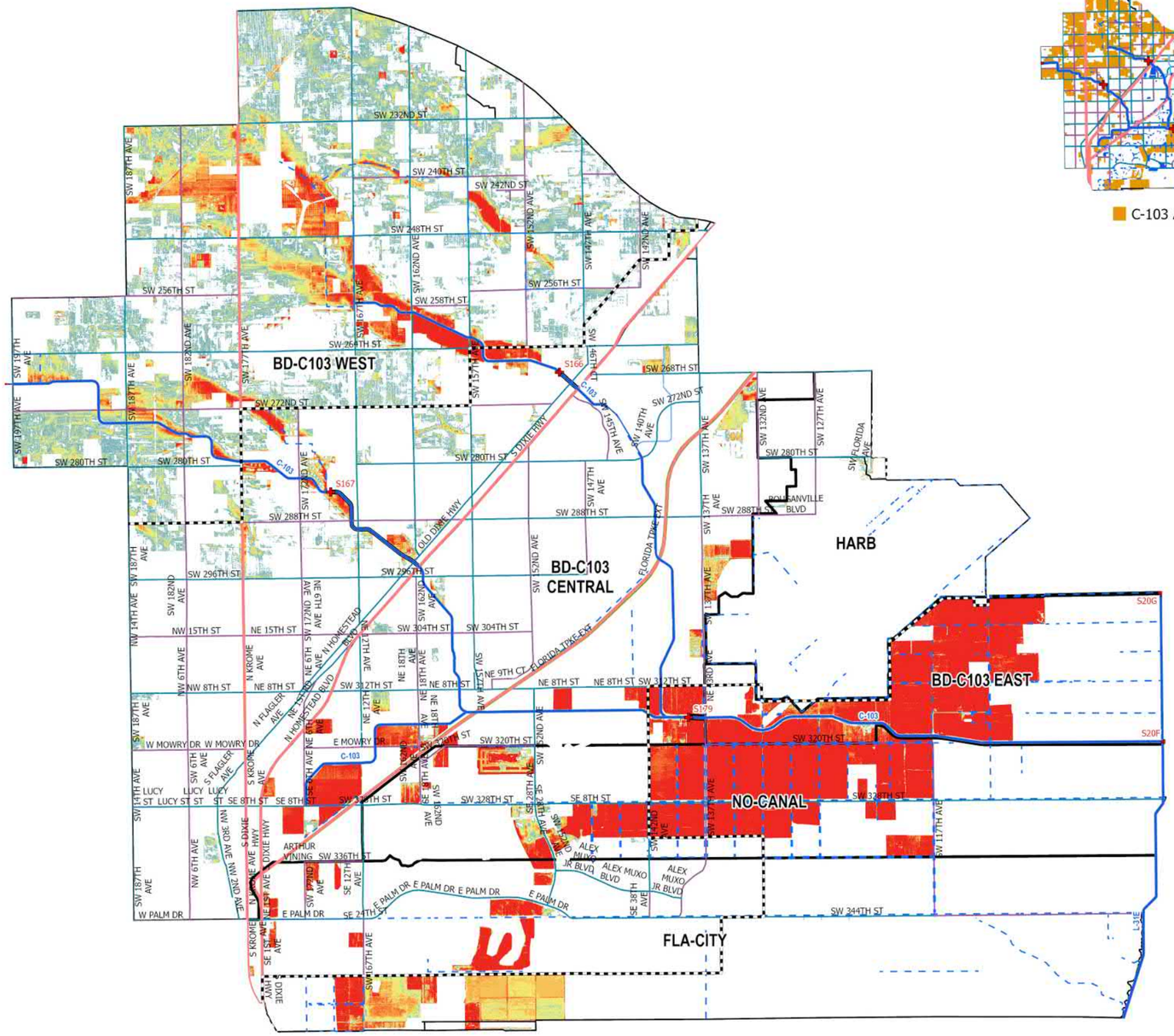
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

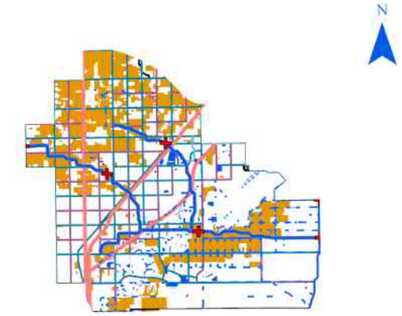
0 0.5 1 2 3 4 Miles

Figure A-331. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

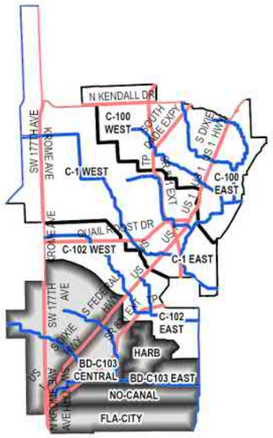
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

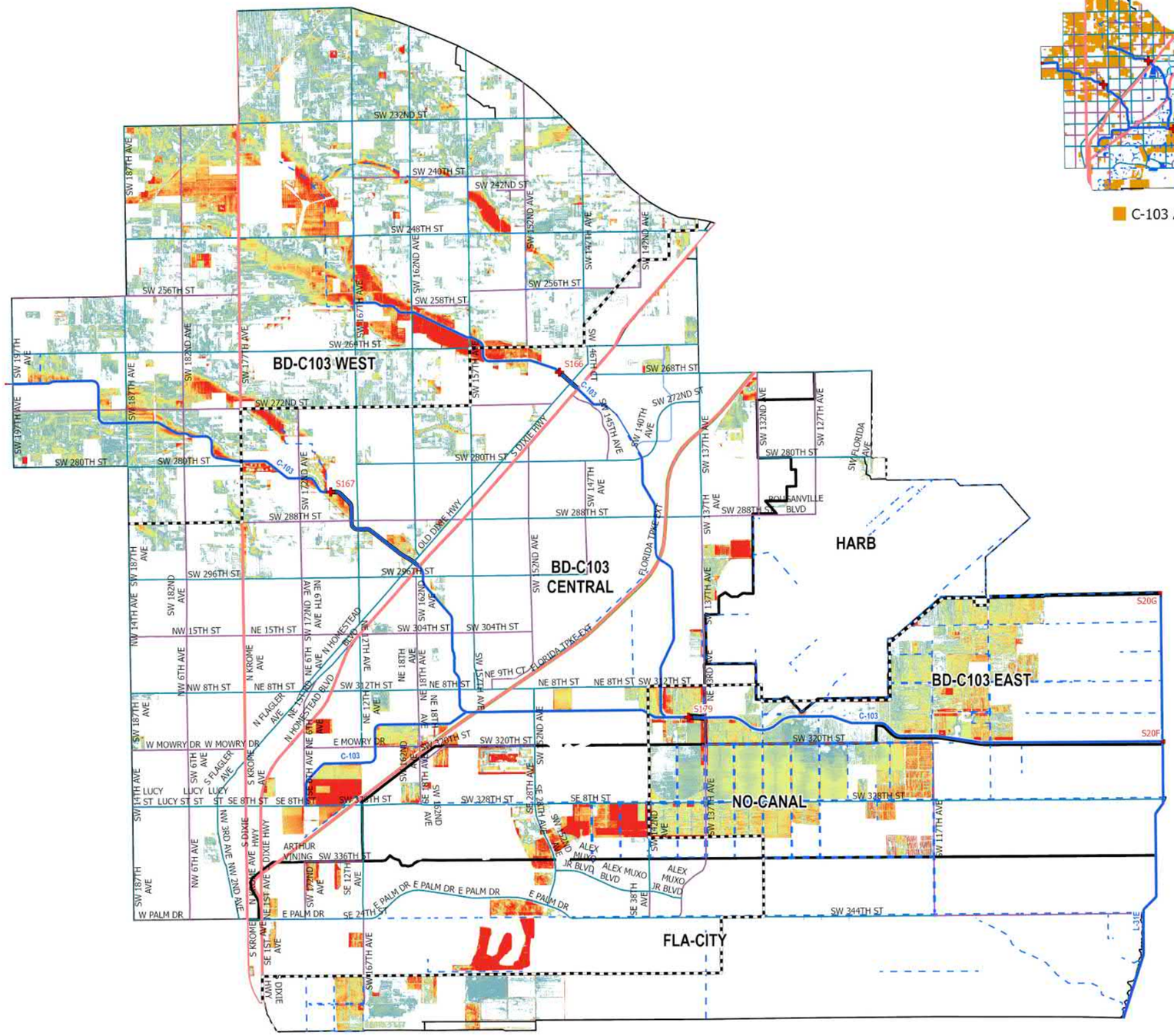
0 0.5 1 2 3 4 Miles

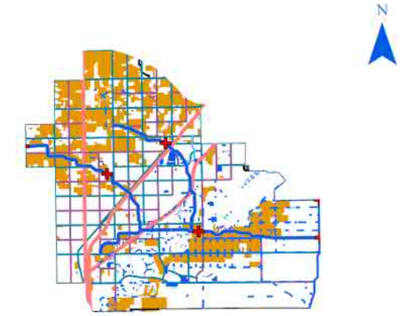
Figure A-332. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

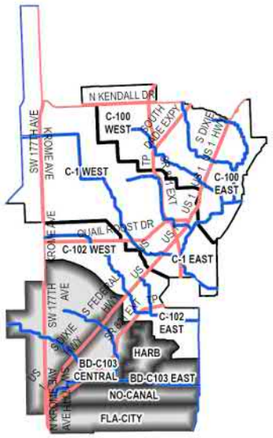
- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

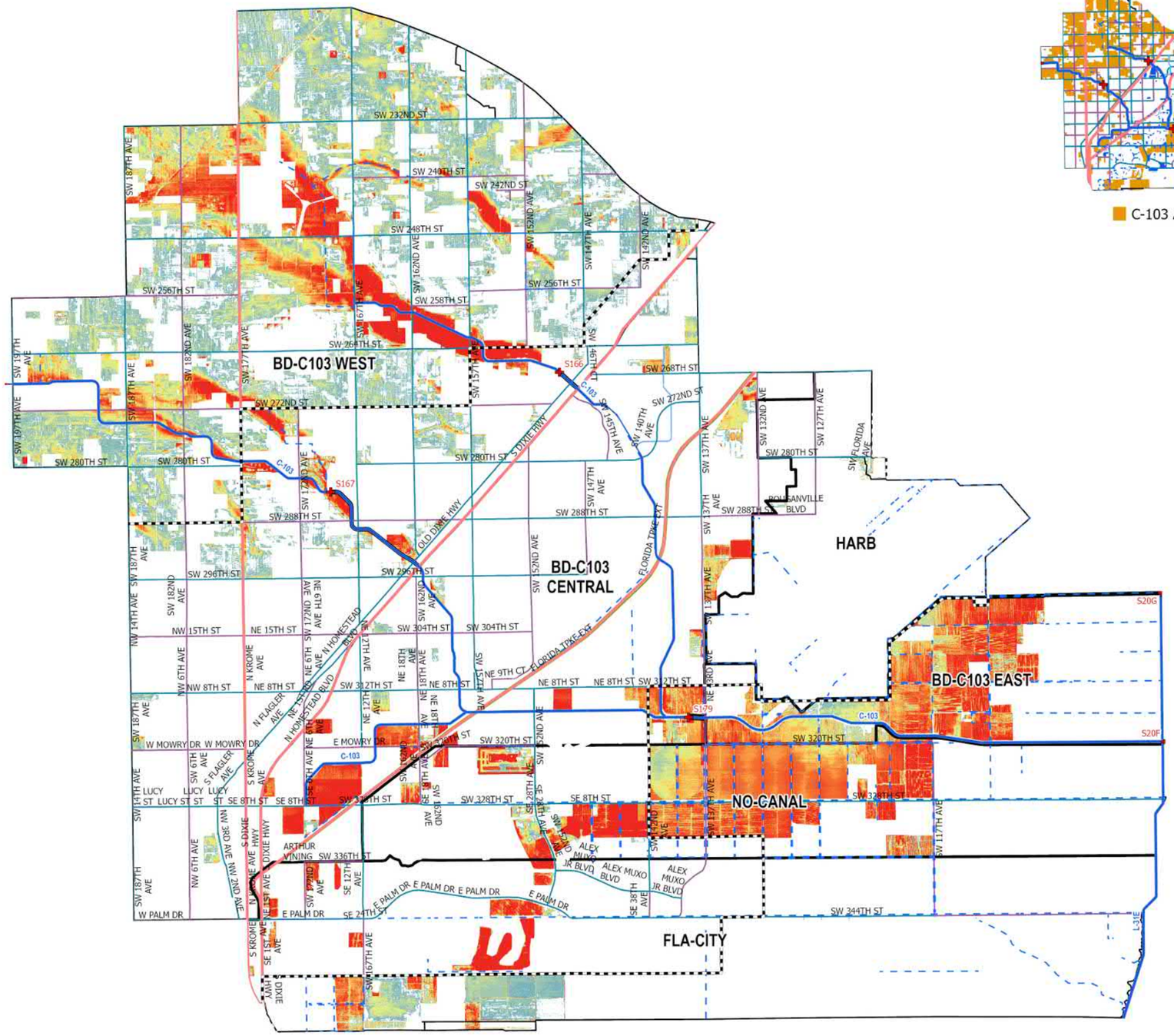
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-333. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas



C-103 Watershed



C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

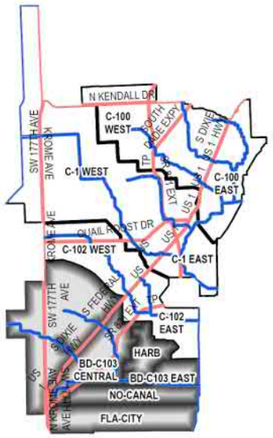
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

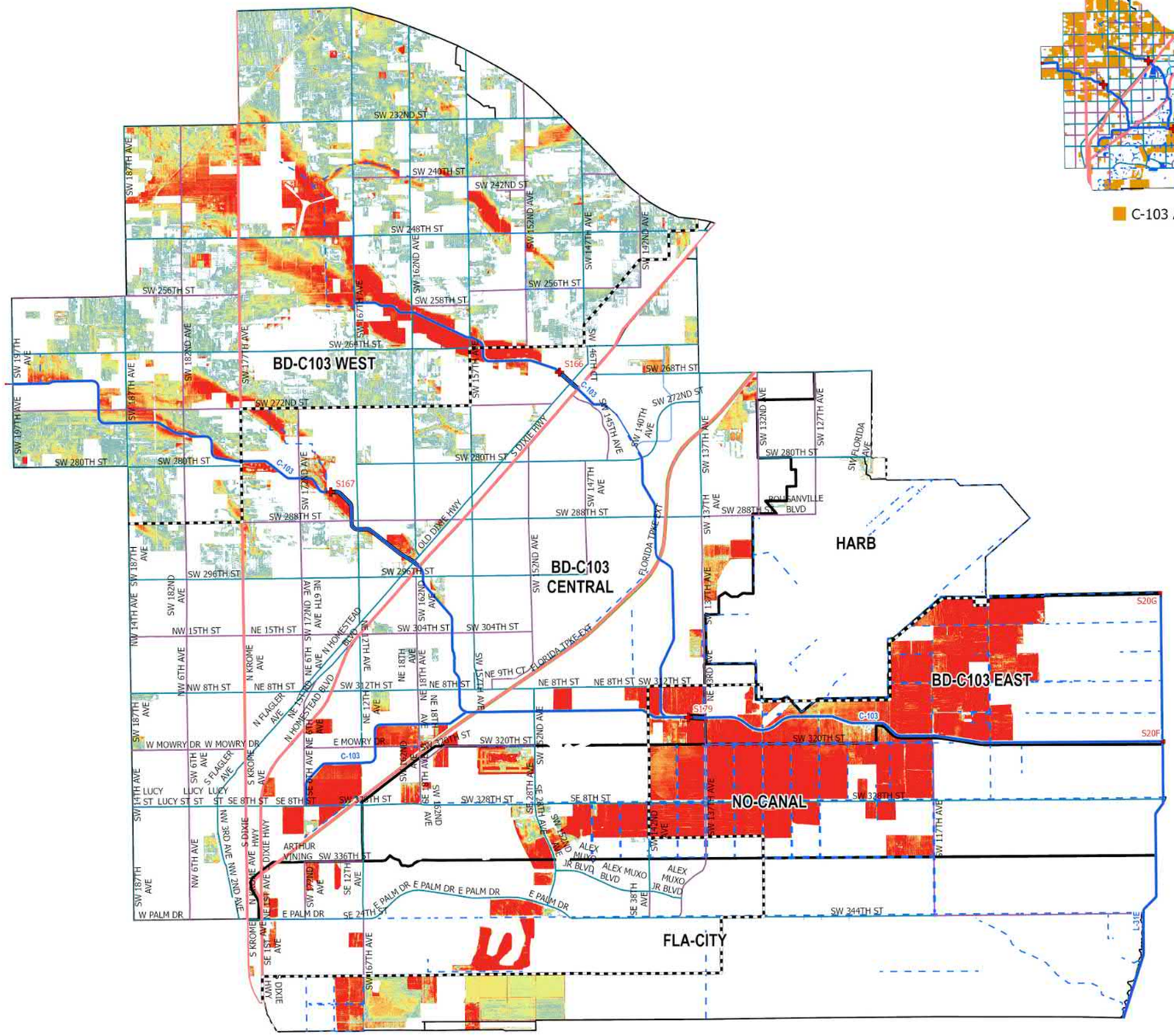
0 0.5 1 2 3 4 Miles

Figure A-334. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-103 Watershed



C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

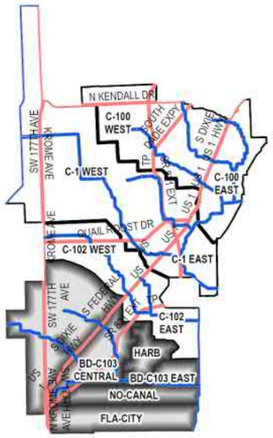
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

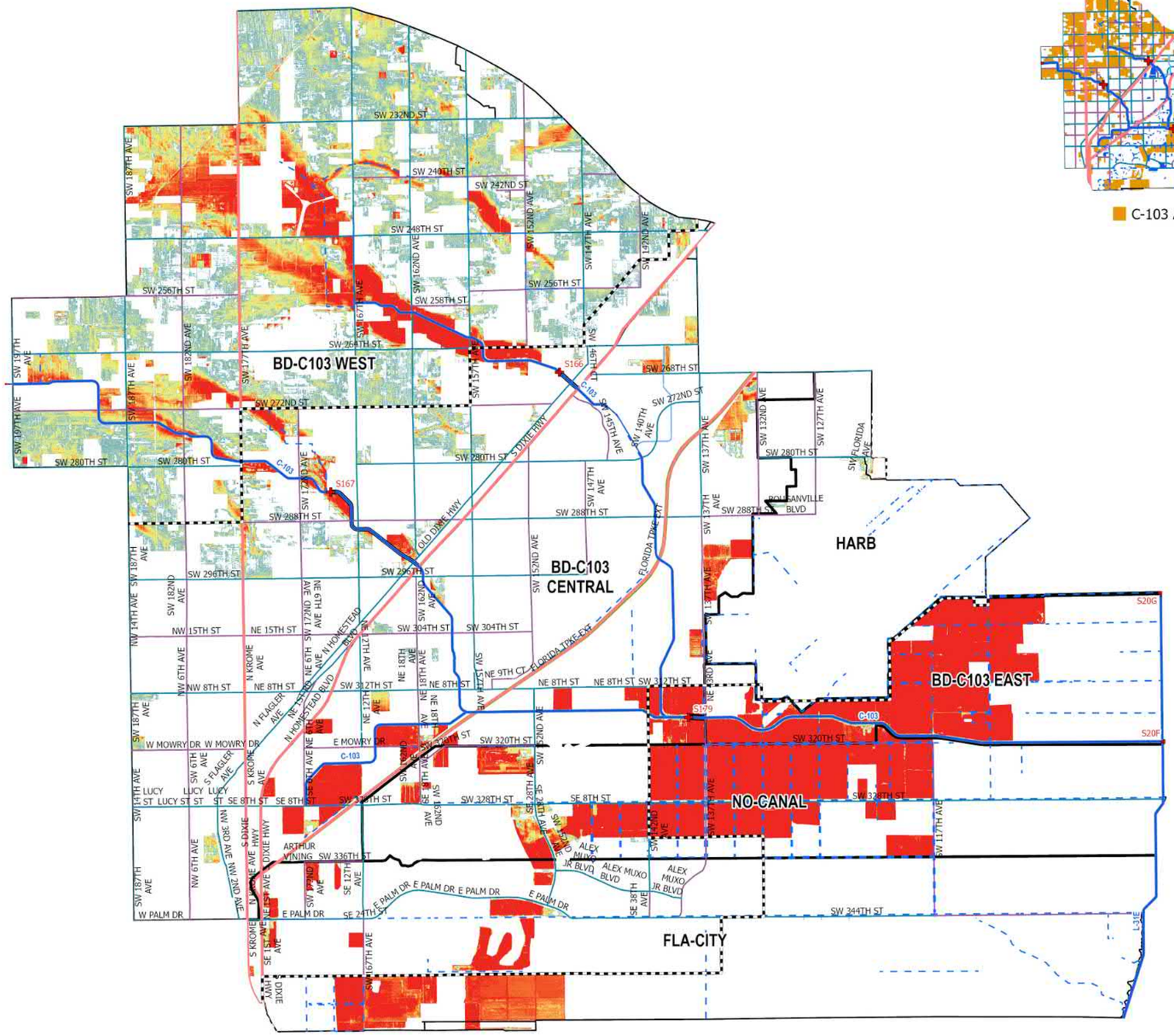
0 0.5 1 2 3 4 Miles

Figure A-335. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-103 Watershed



C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

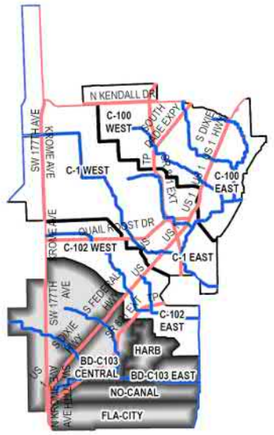
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

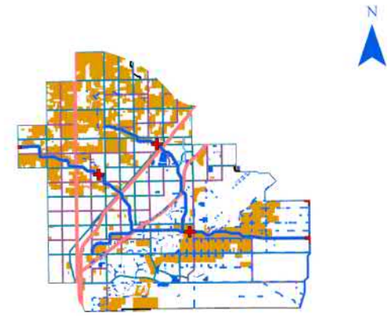
Figure A-336. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

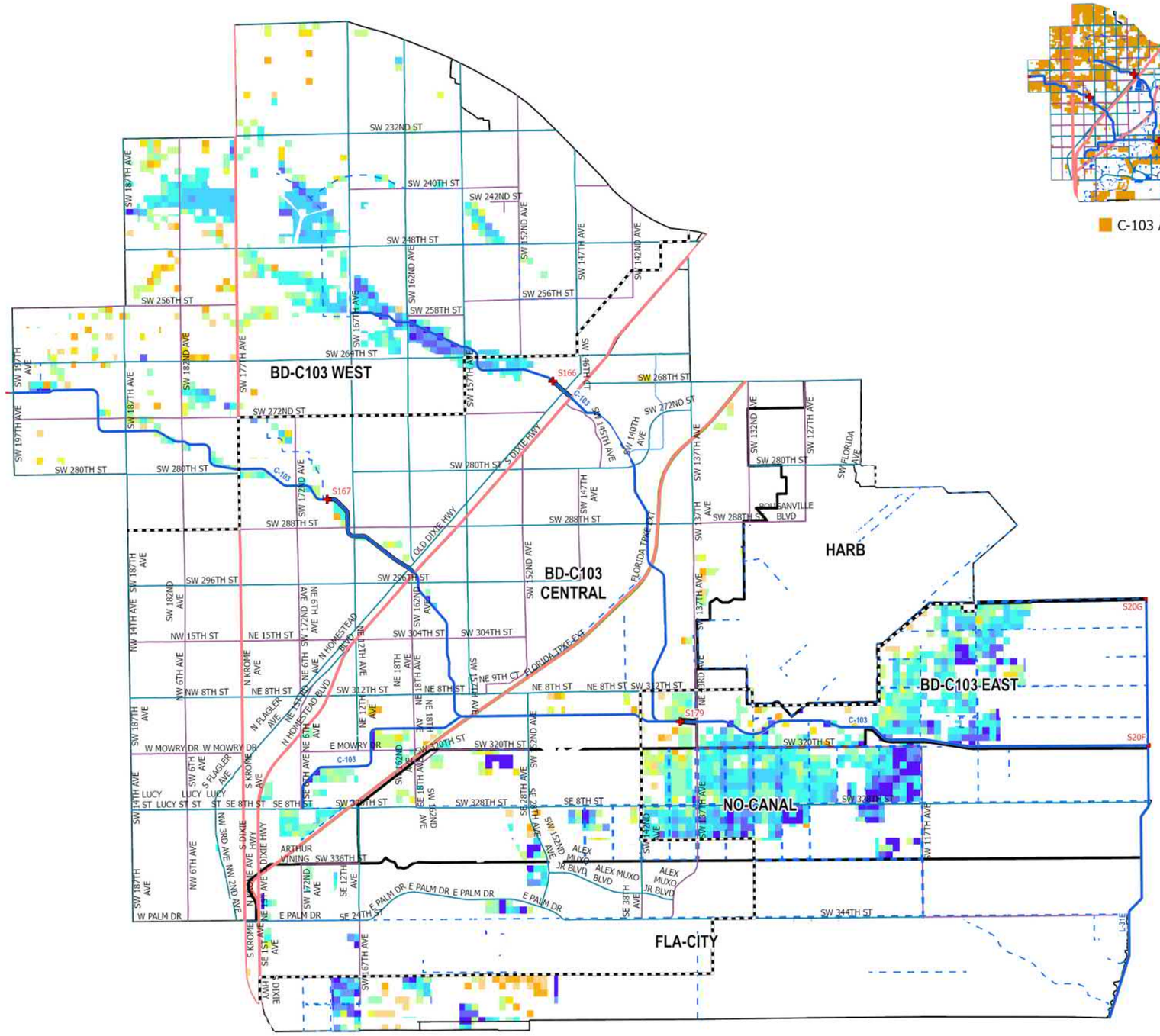
WATERSHED C-103: Flood Duration in Agricultural Areas



C-103 Watershed



C-103 Agricultural Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

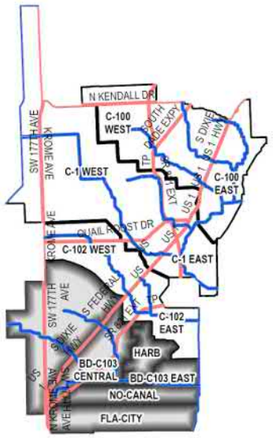
5-Yr/72-Hr SLR = 0

Flood Duration (hr)

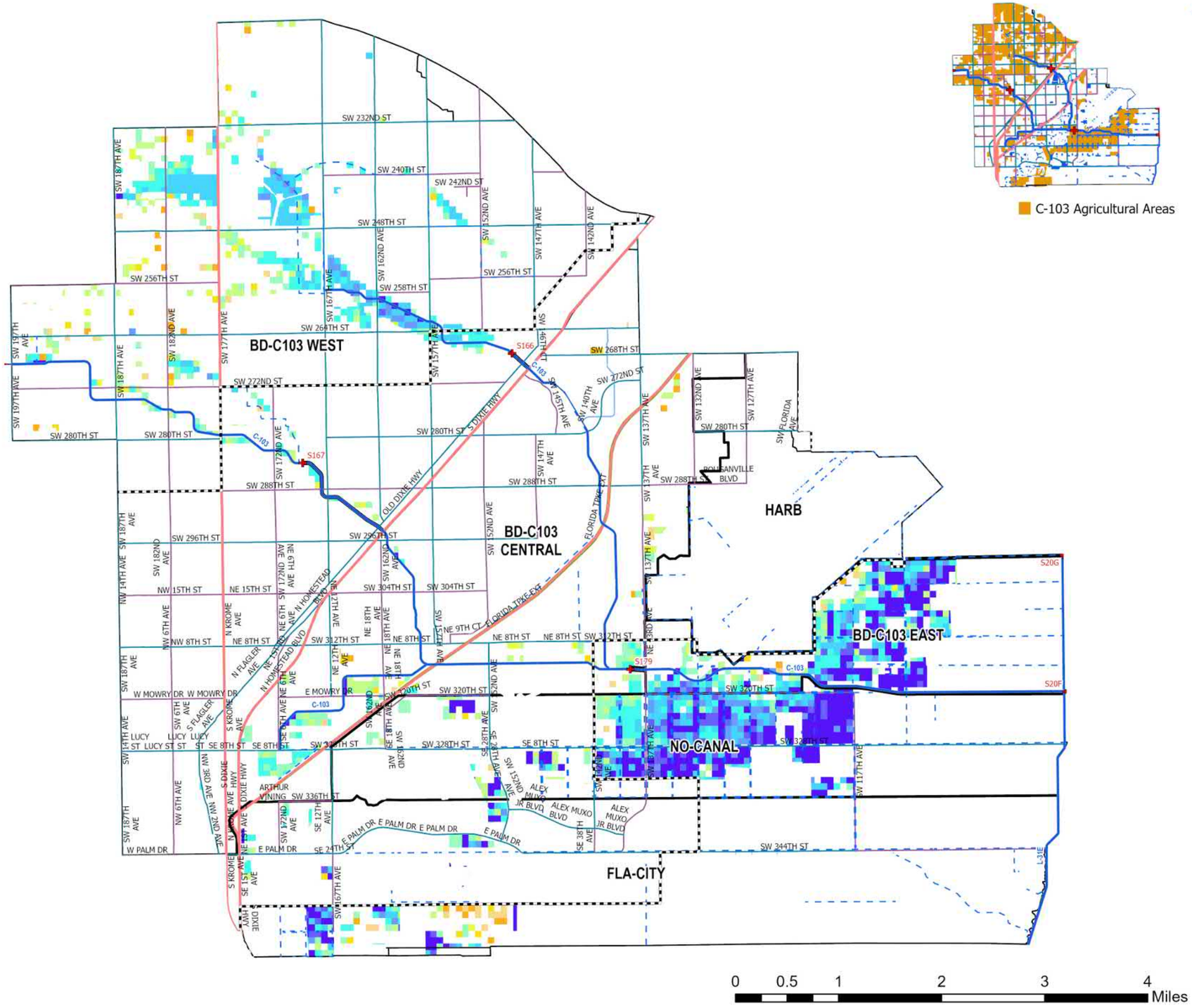
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

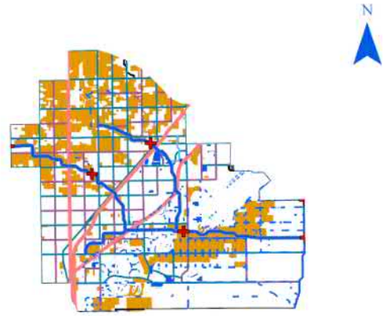
Figure A-337. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

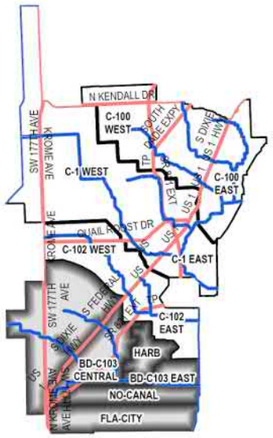
5-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

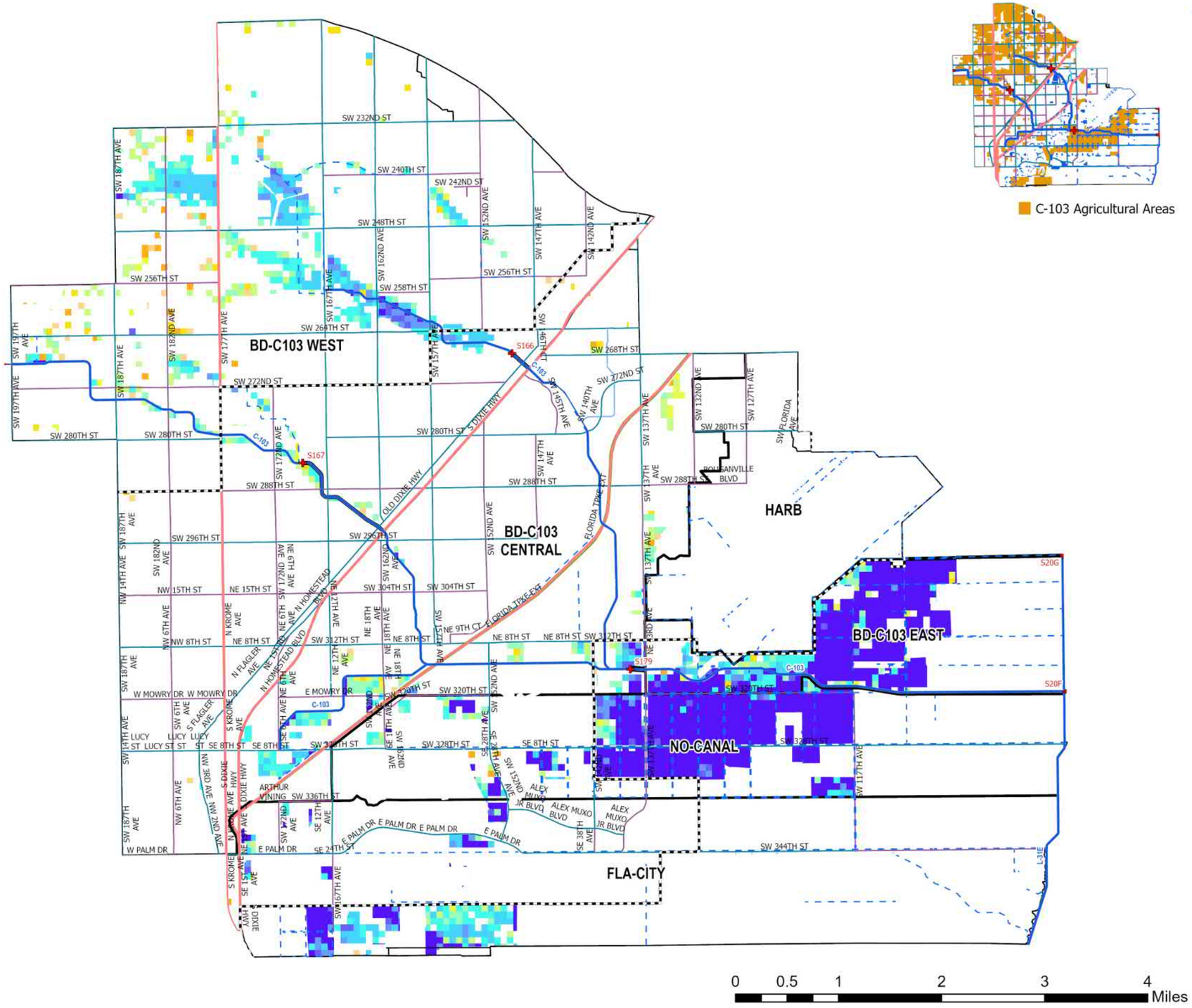
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-338. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

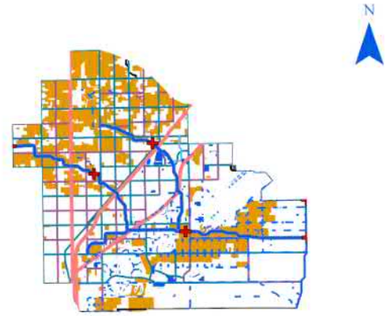
Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

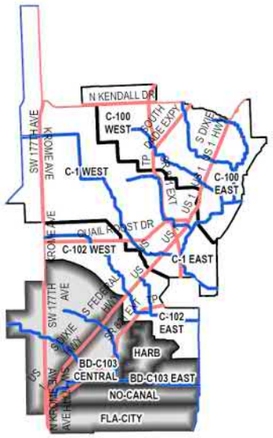
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

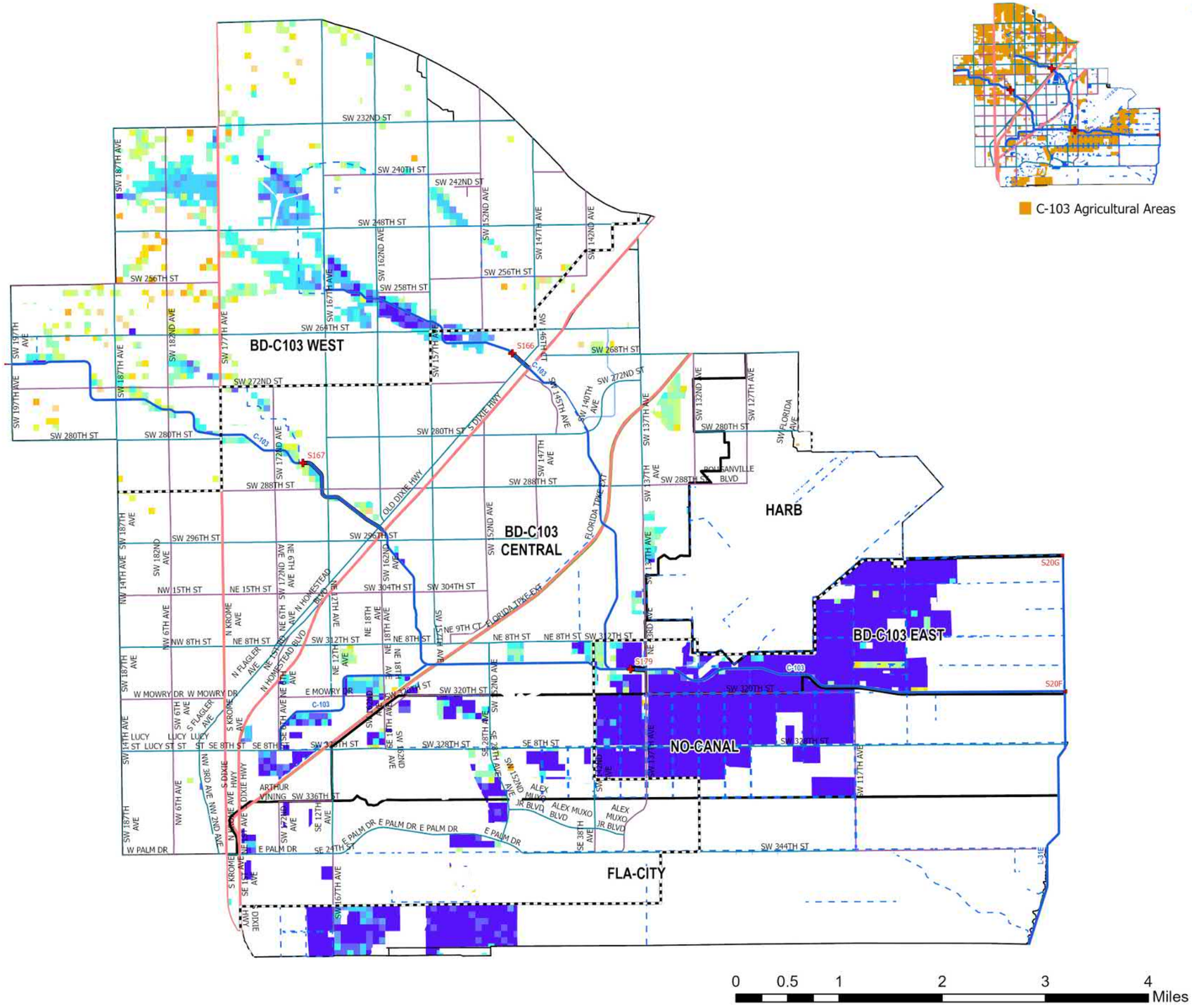


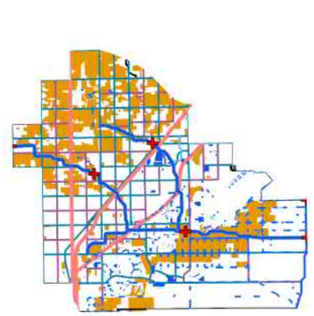
C-103 Agricultural Areas

Figure A-339. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

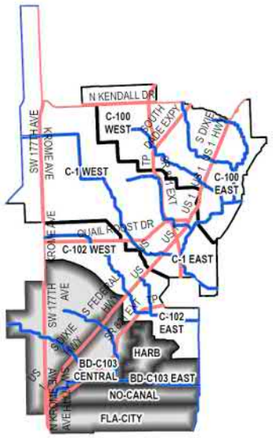
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

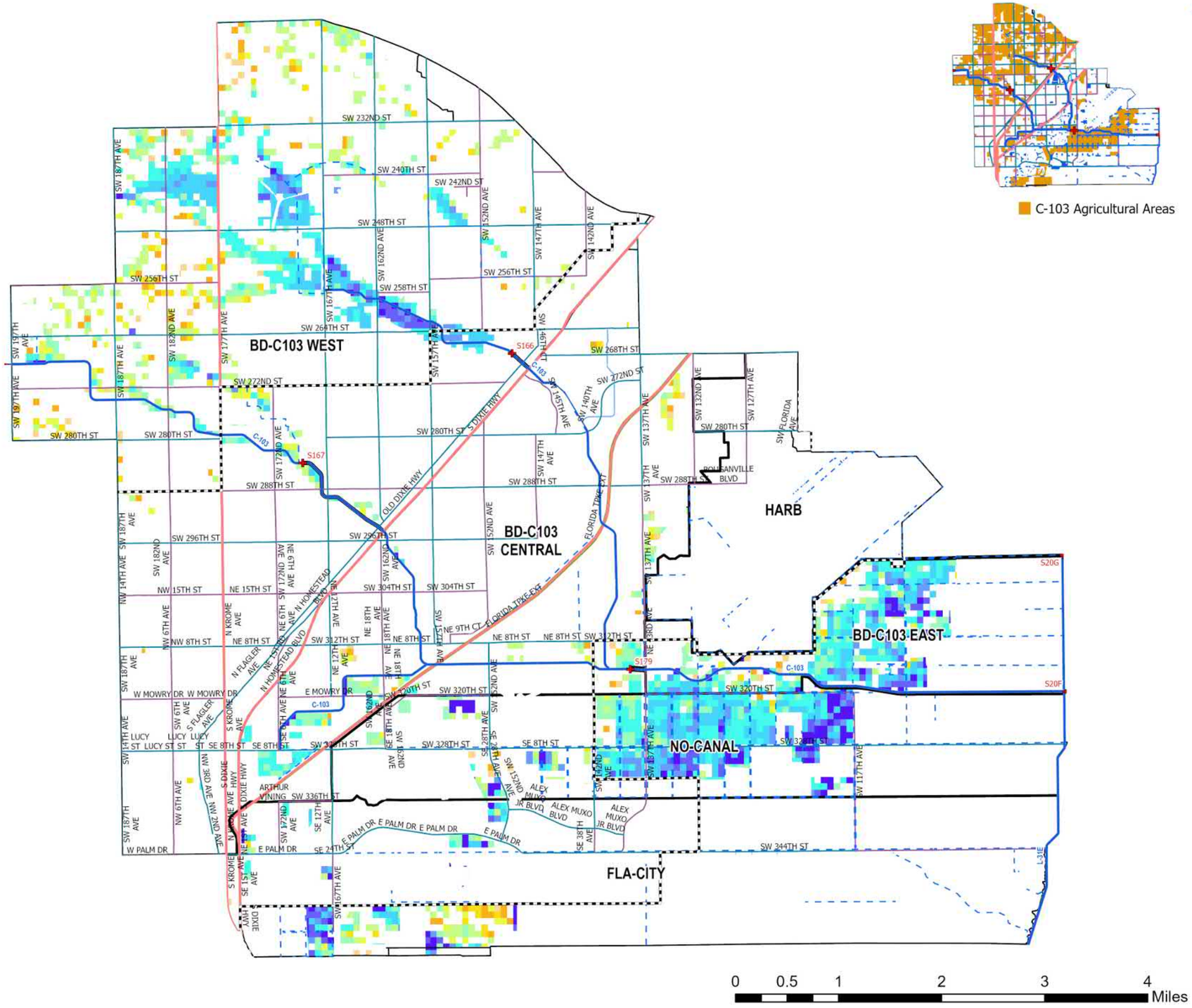
0 0.5 1 2 3 4 Miles

Figure A-340. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-103 Watershed



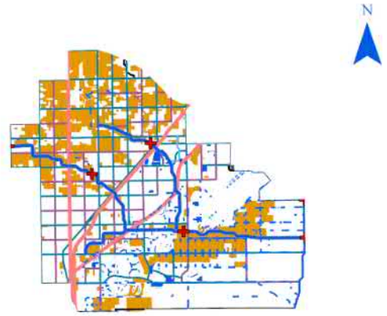
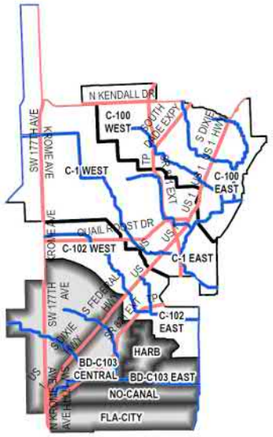
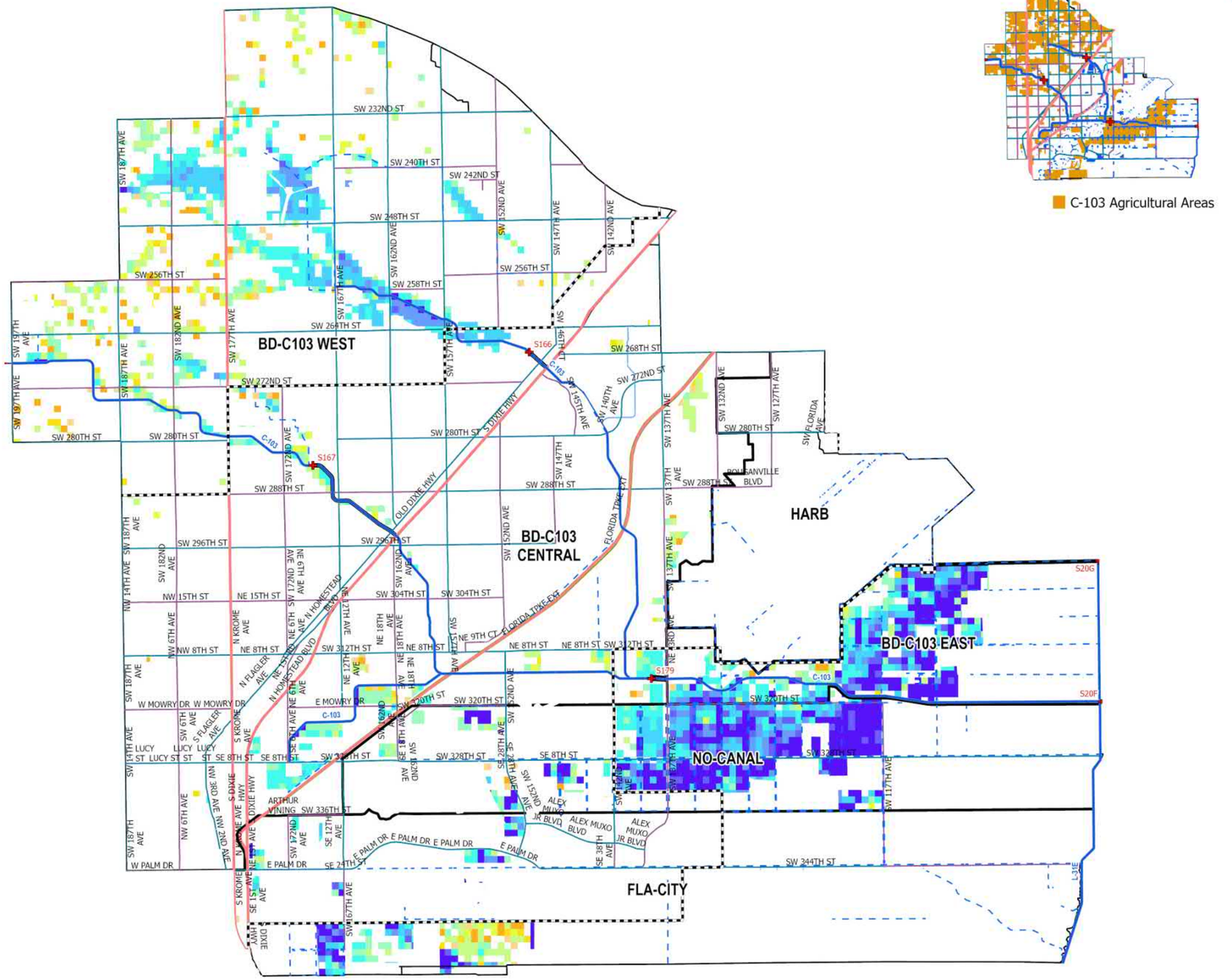
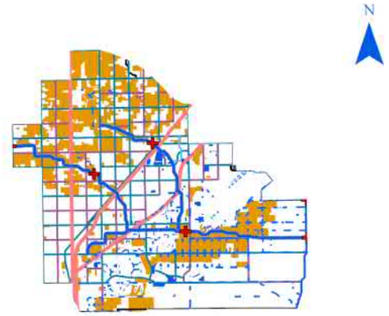


Figure A-341. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

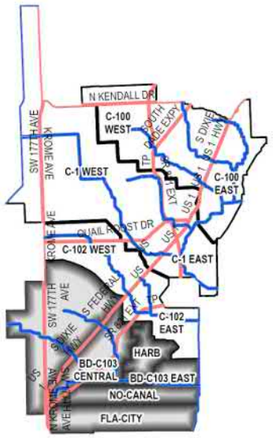
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

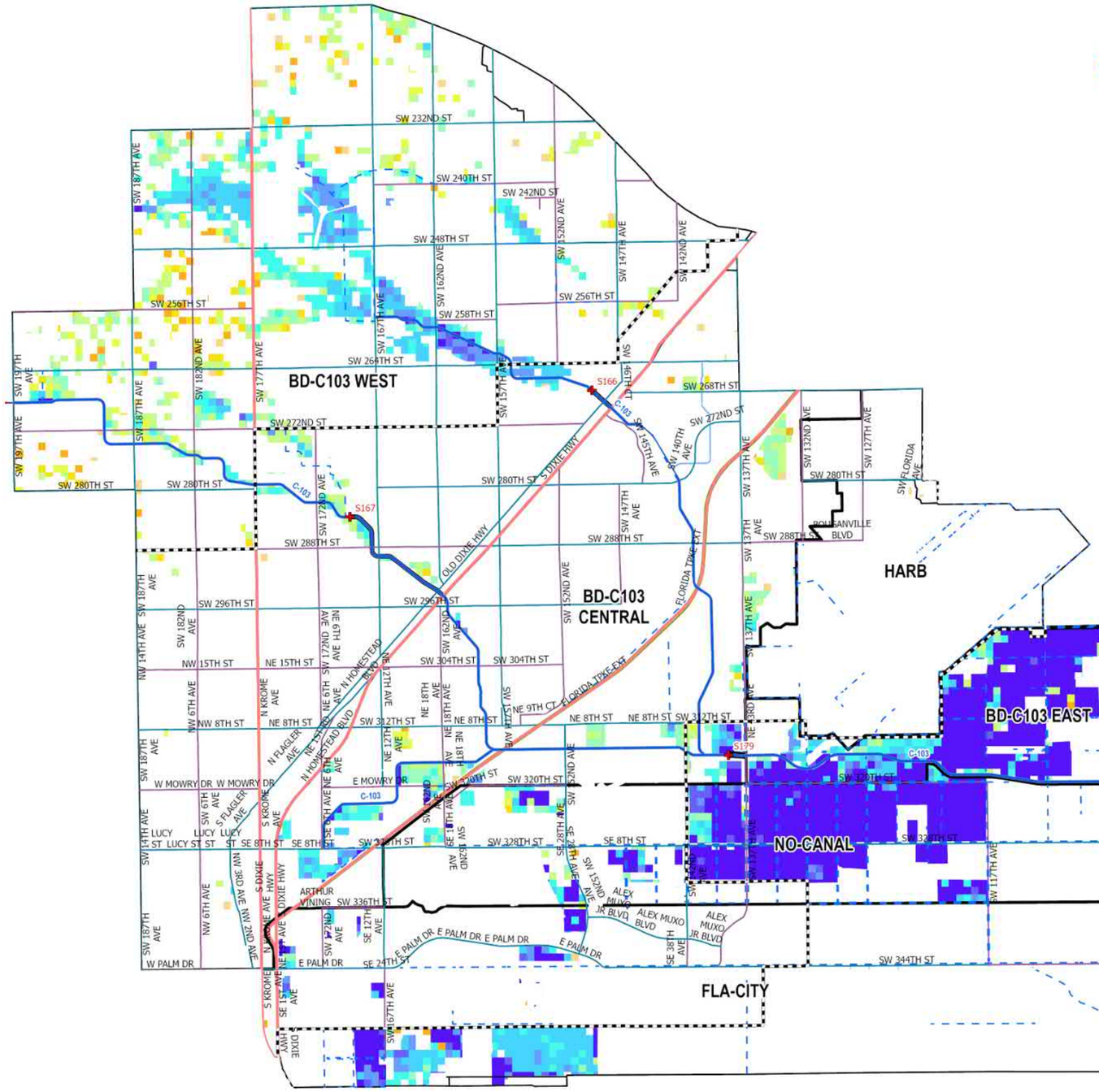
0 0.5 1 2 3 4 Miles

Figure A-342. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-103 Watershed



C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

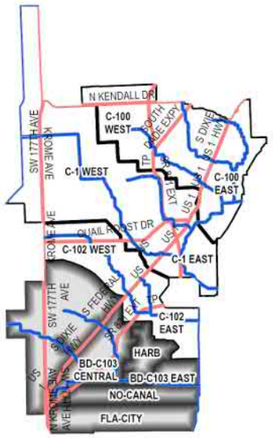
10-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

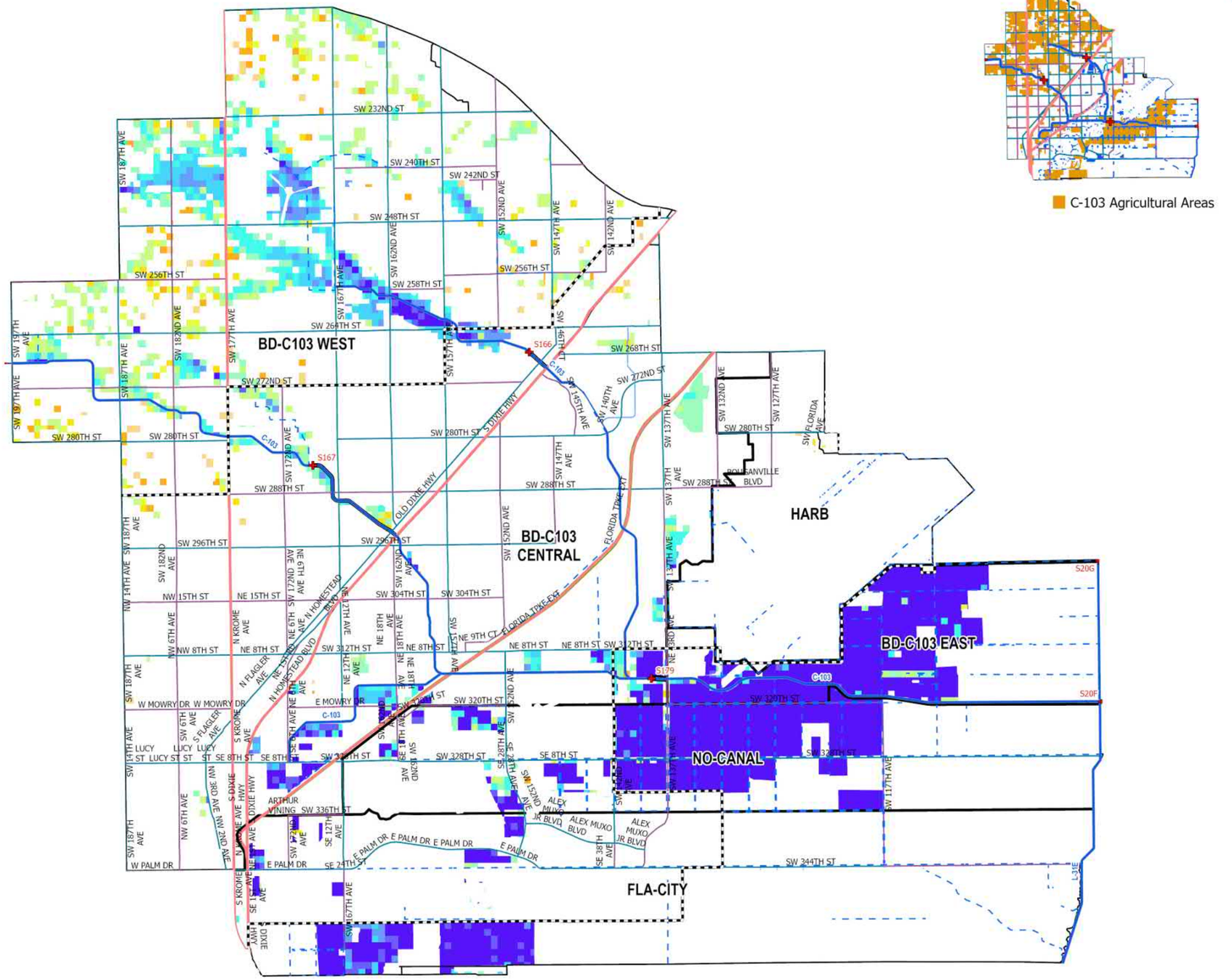
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

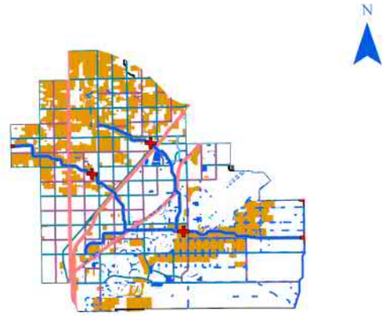
0 0.5 1 2 3 4 Miles

Figure A-343. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

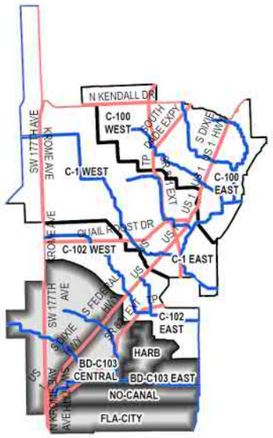
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

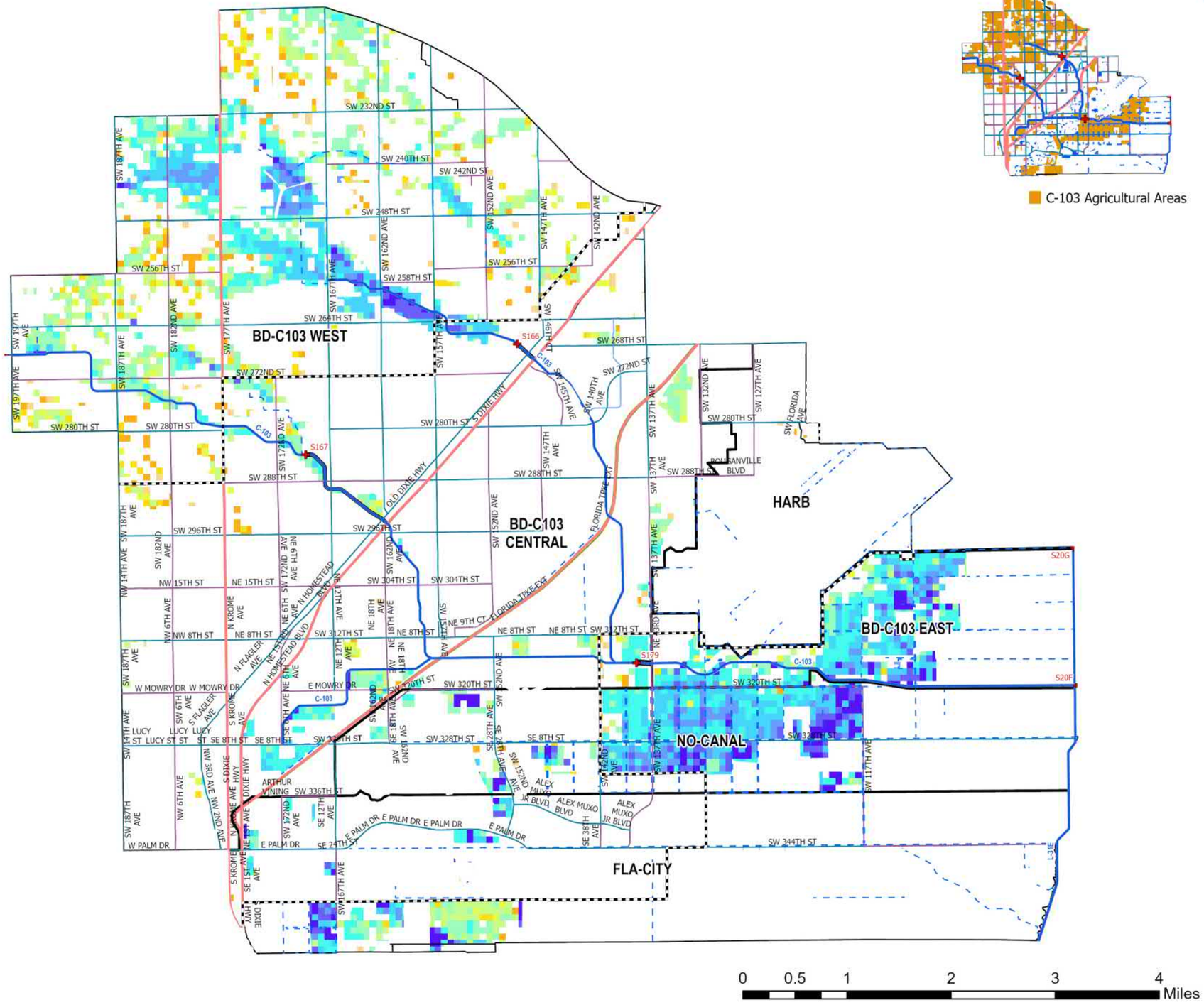
0 0.5 1 2 3 4 Miles

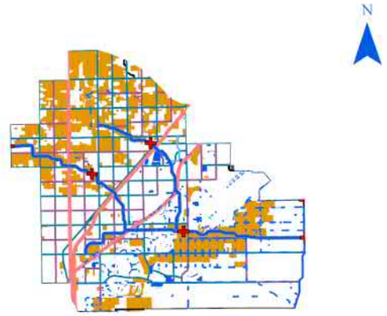
Figure A-344. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

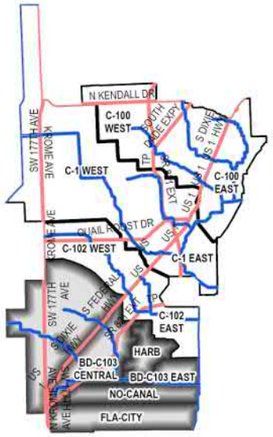
25-Yr/72-Hr SLR = 0

Flood Duration (hr)

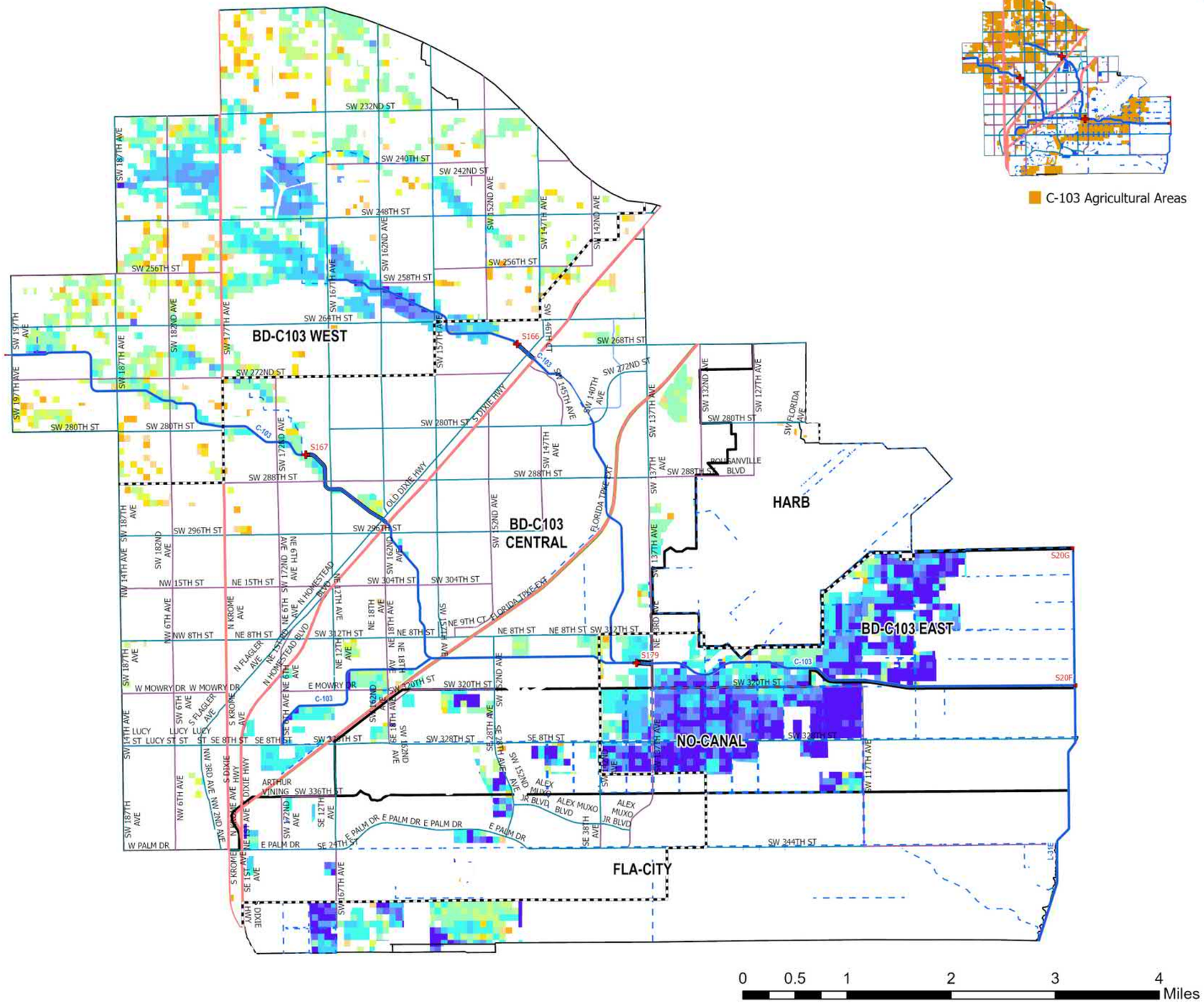
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

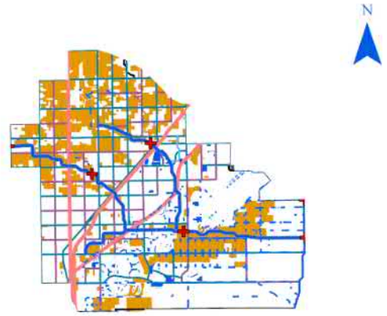
0 0.5 1 2 3 4 Miles

Figure A-345. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

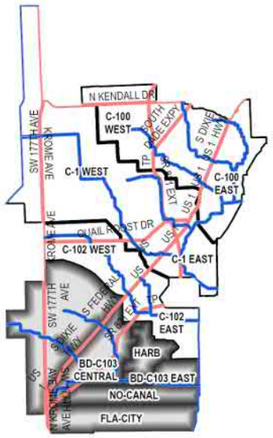
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

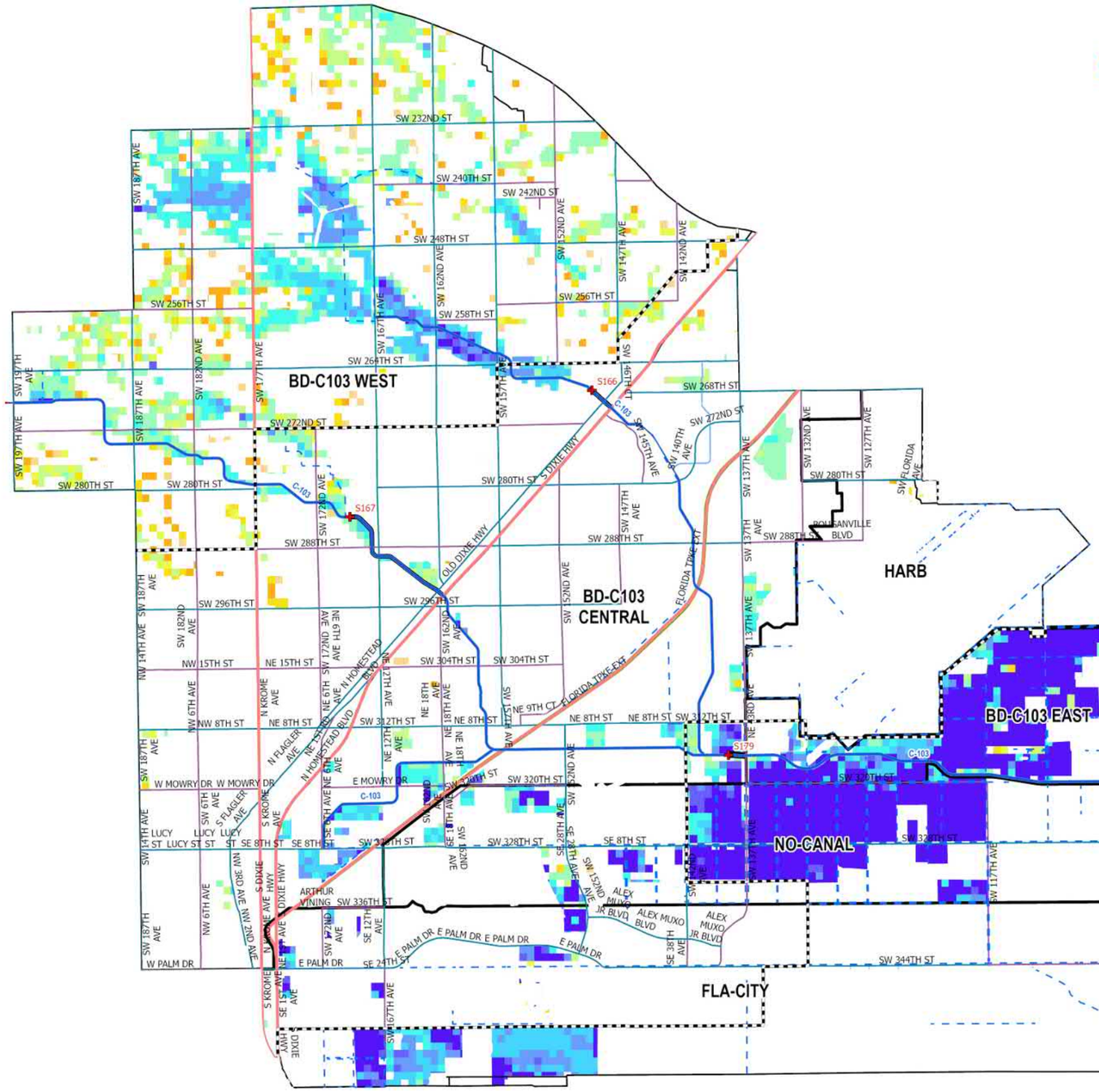
Flood Duration (hr)

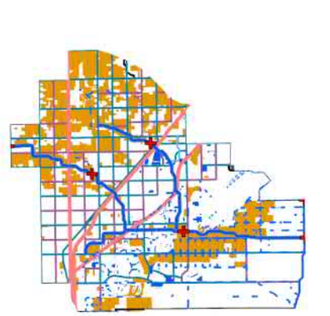
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-346. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +2.0

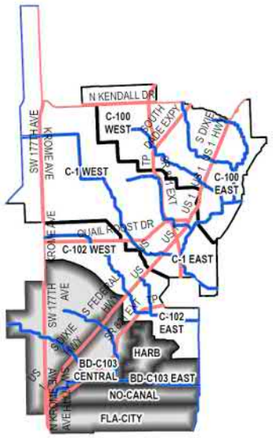
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

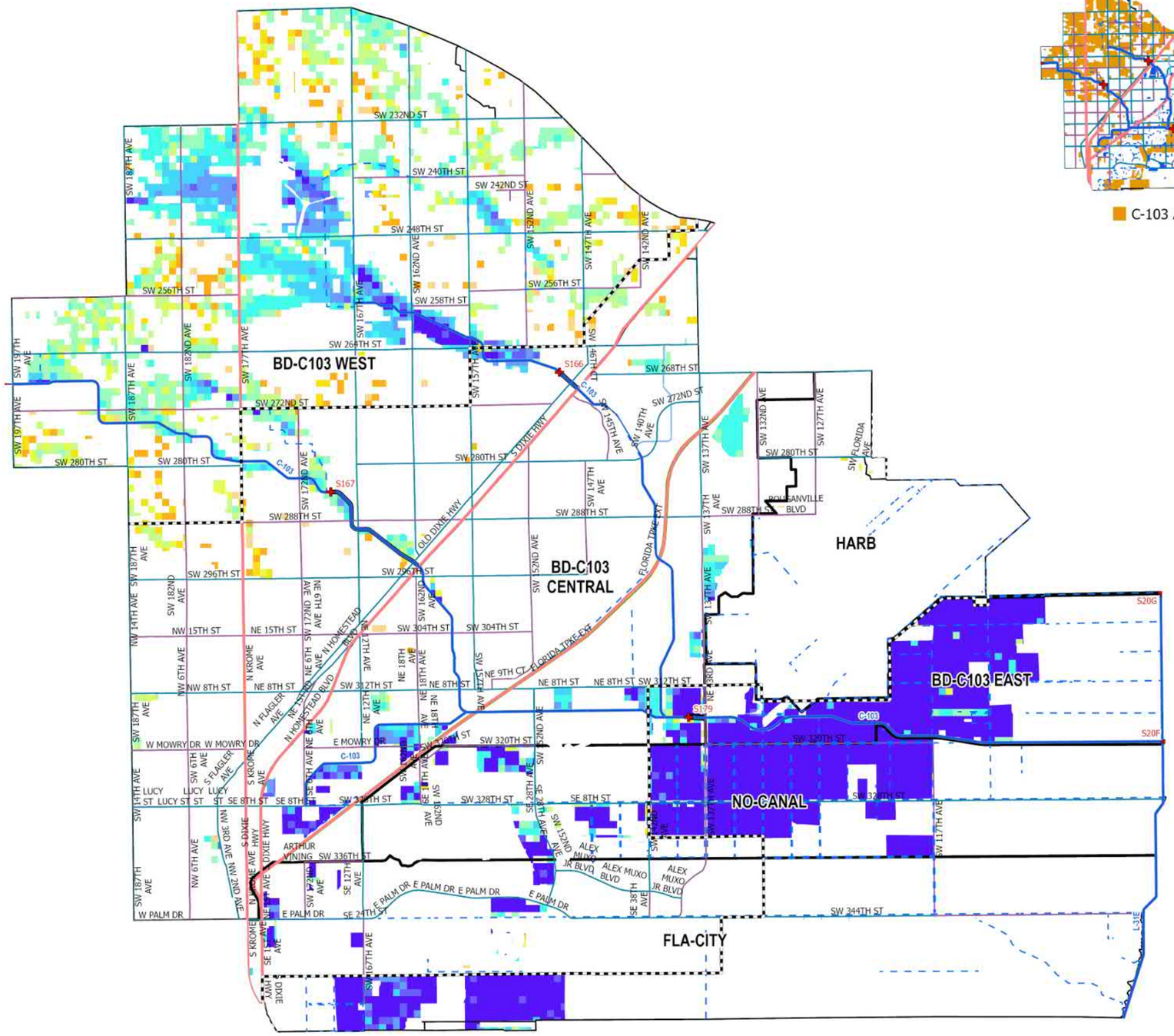
0 0.5 1 2 3 4 Miles

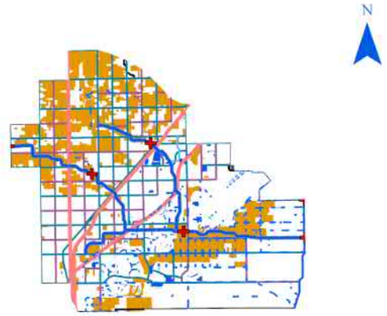
Figure A-347. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

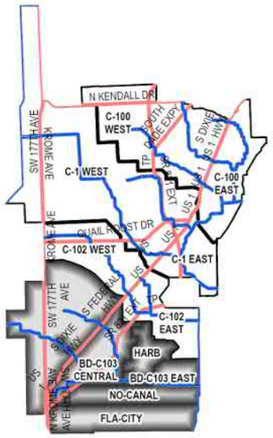
- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +3.0

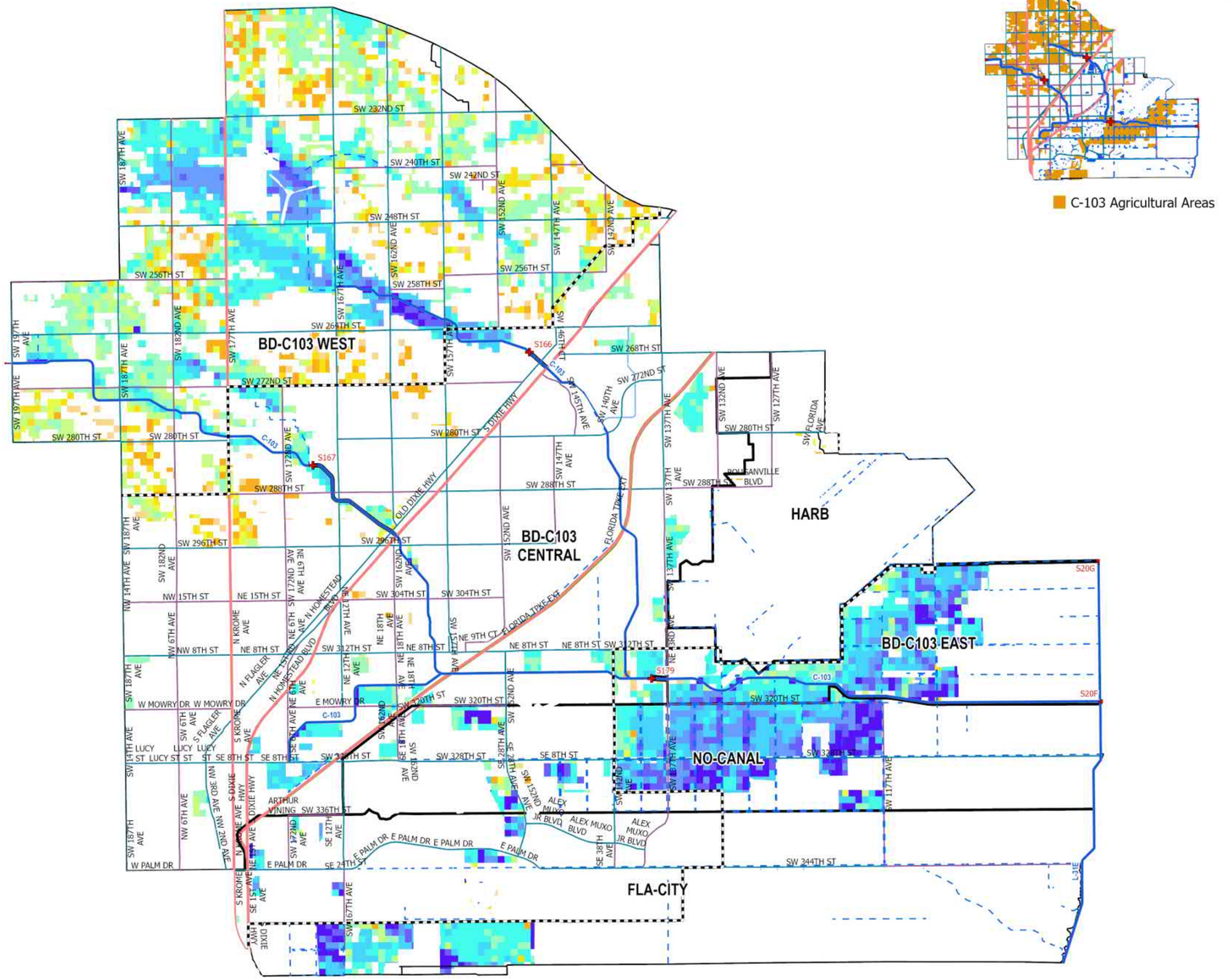
Flood Duration (hr)

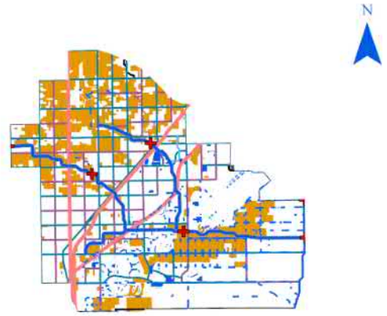
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-348. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Agricultural Areas



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

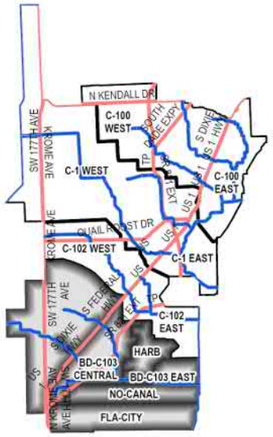
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

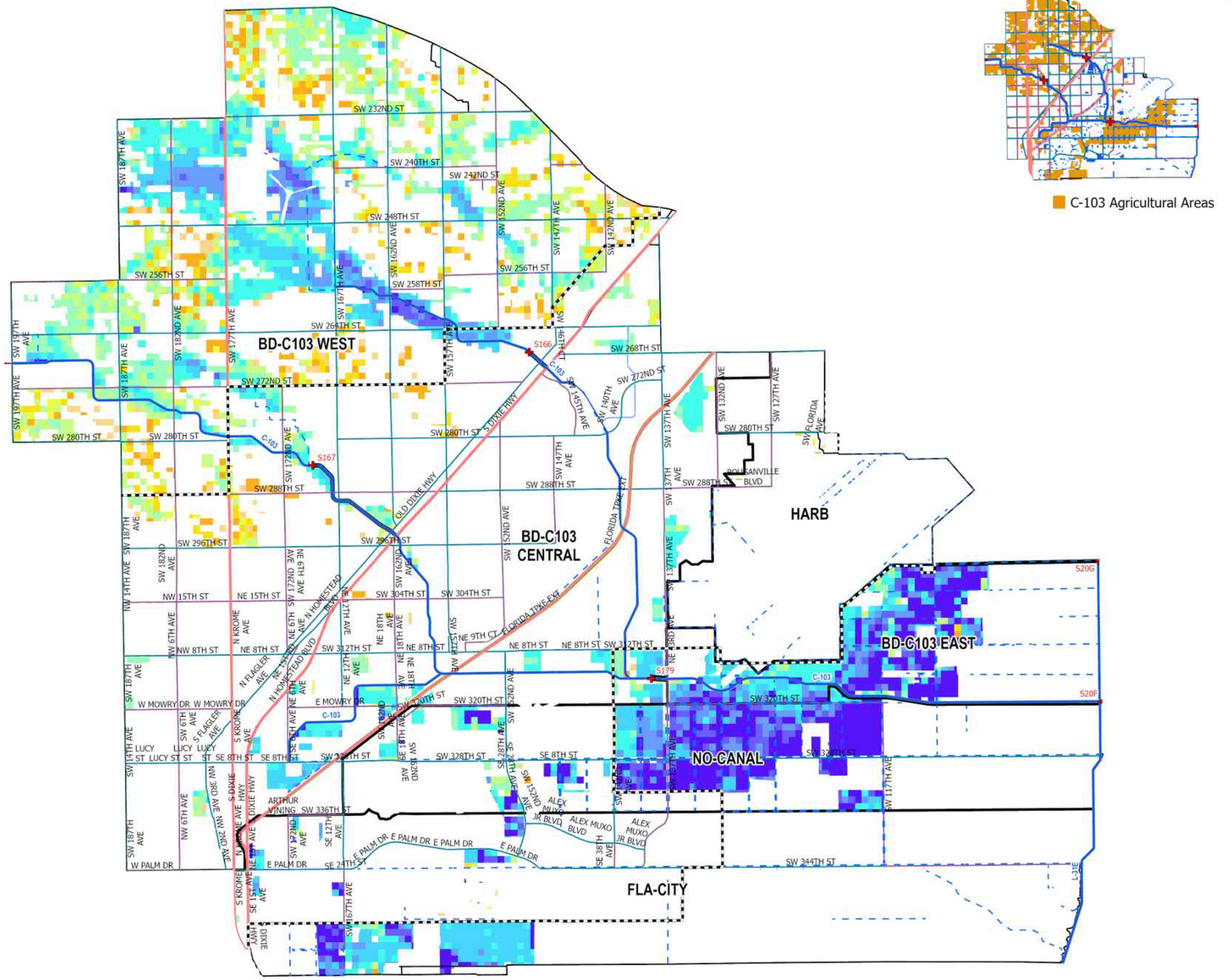
0 0.5 1 2 3 4 Miles

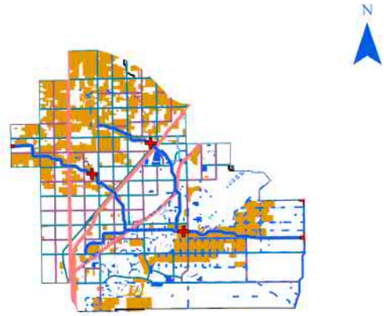
Figure A-349. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

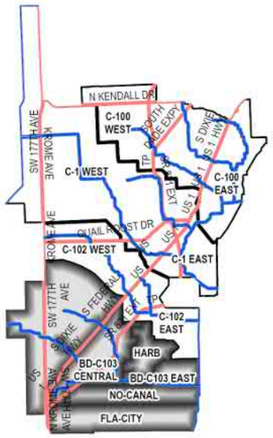
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

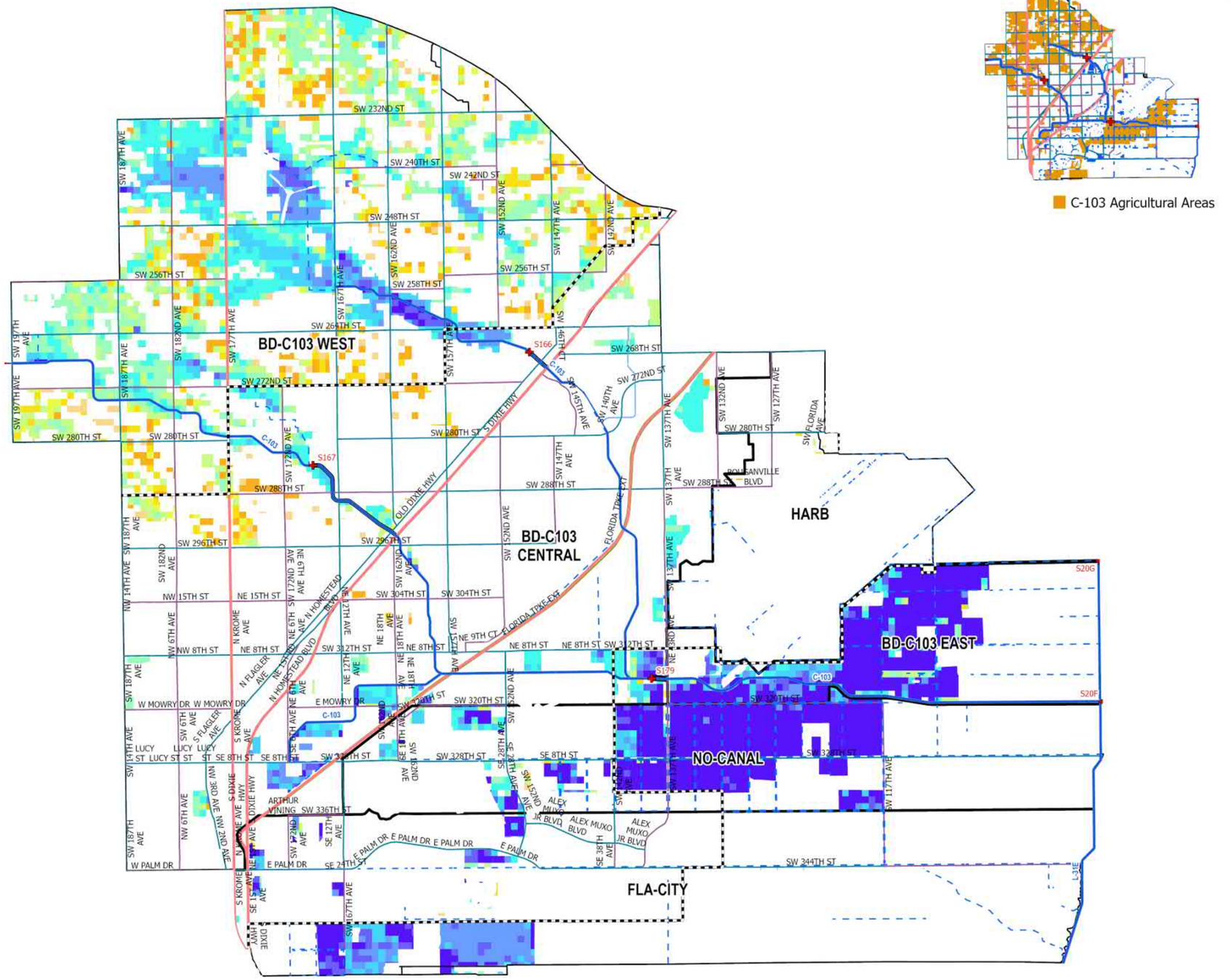
0 0.5 1 2 3 4 Miles

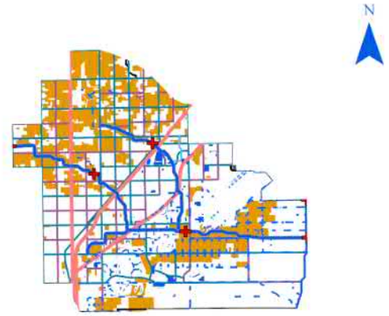
Figure A-350. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Agricultural Areas

Kimley»Horn



C-103 Watershed





C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

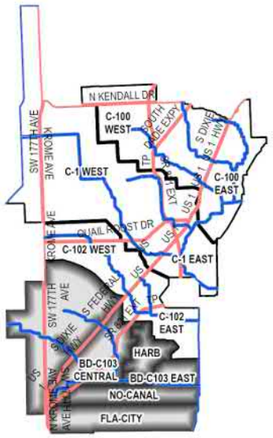
100-Yr/72-Hr SLR = +2.0

Flood Duration (hr)

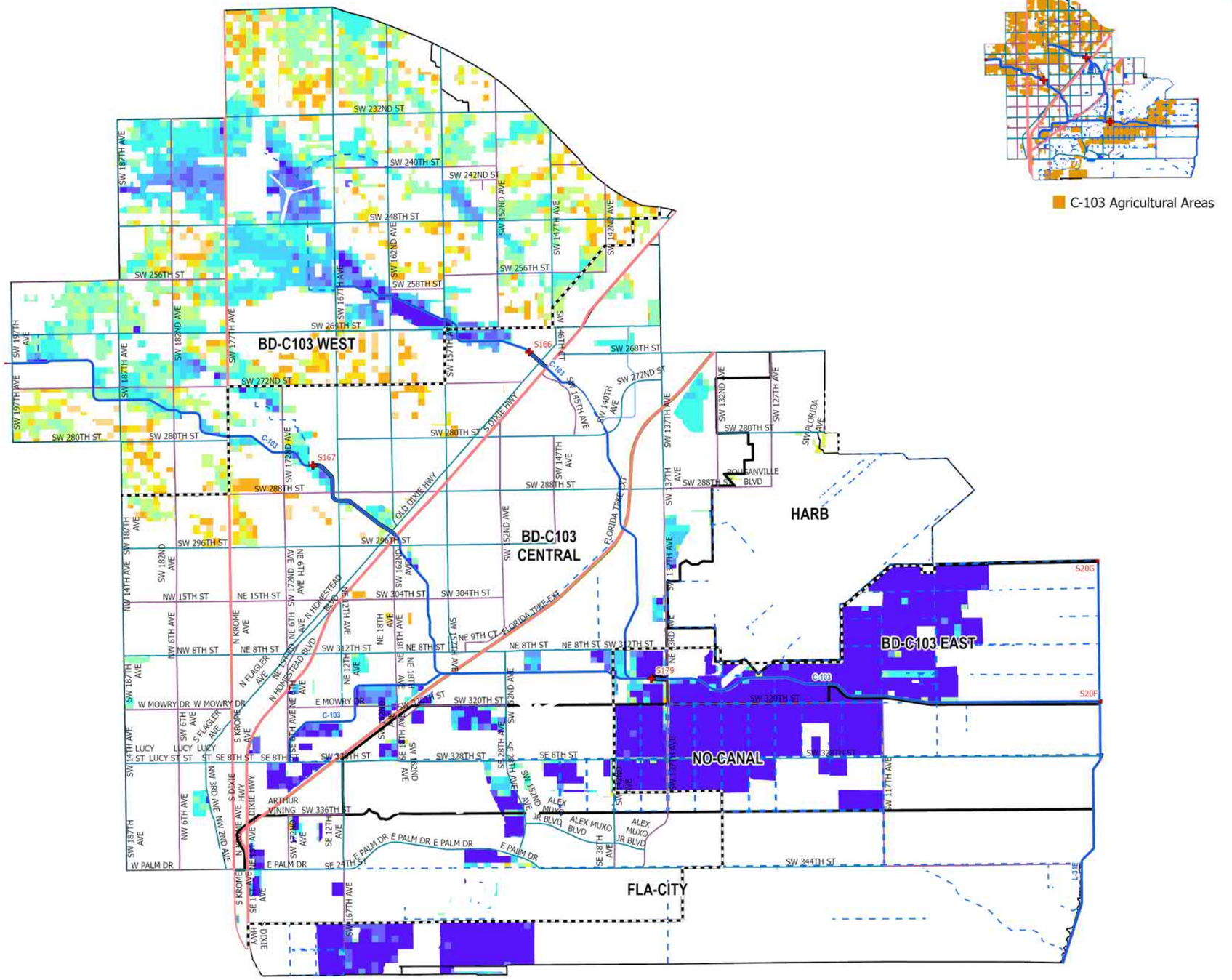
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-351. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Agricultural Areas

Kimley»Horn



C-103 Watershed



C-103 Agricultural Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

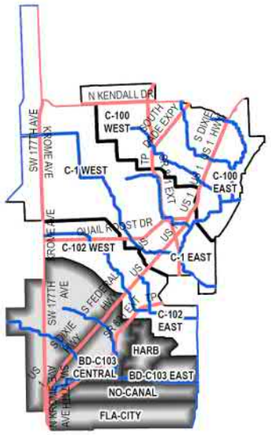
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

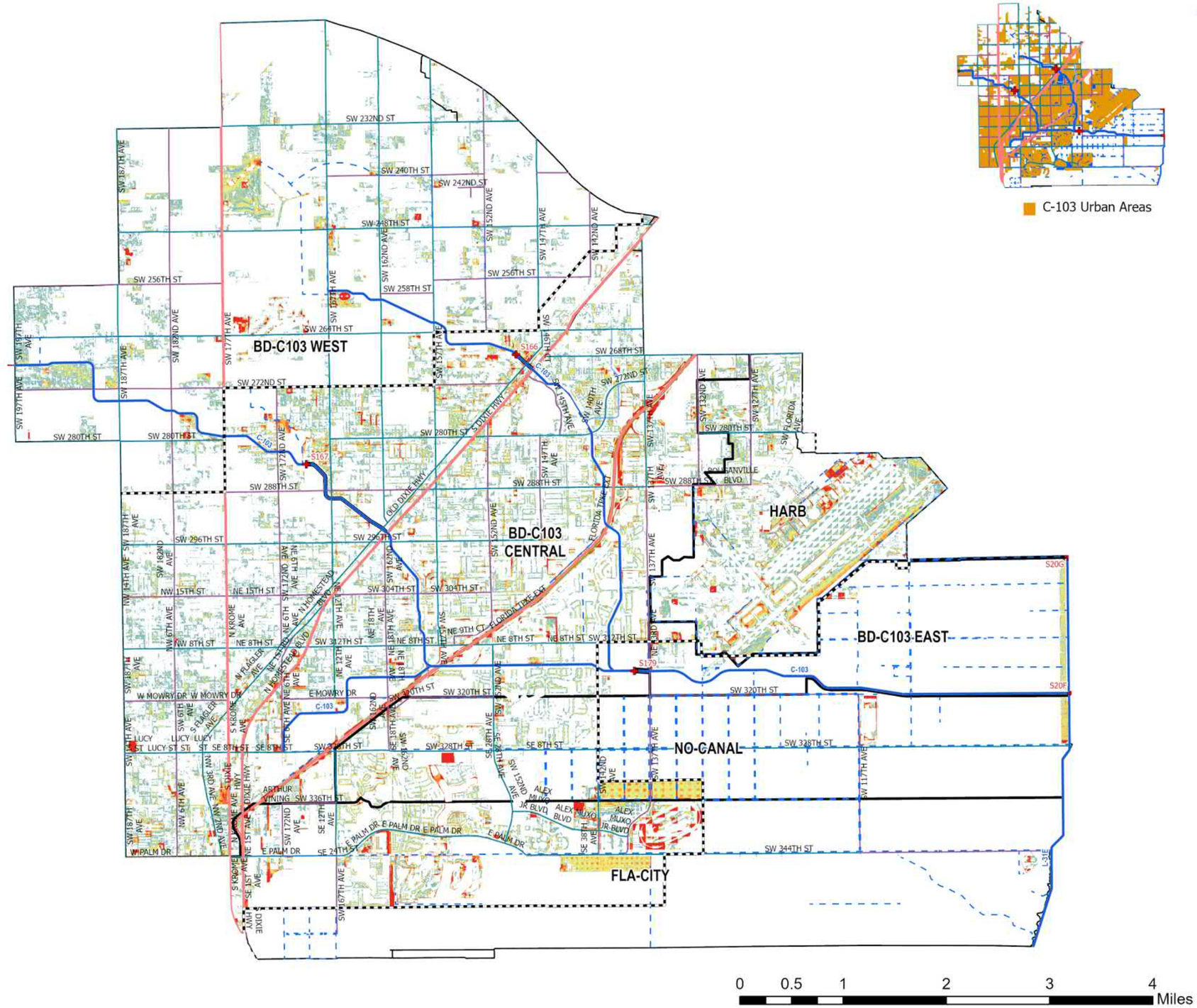
Figure A-352. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Agricultural Areas

Kimley»Horn

WATERSHED C-103: Flood Extent In Urban Areas



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

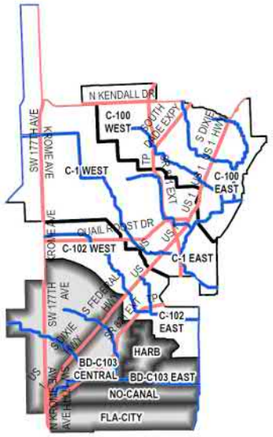
5-Yr/72-Hr SLR = 0

Flood Depth (ft)

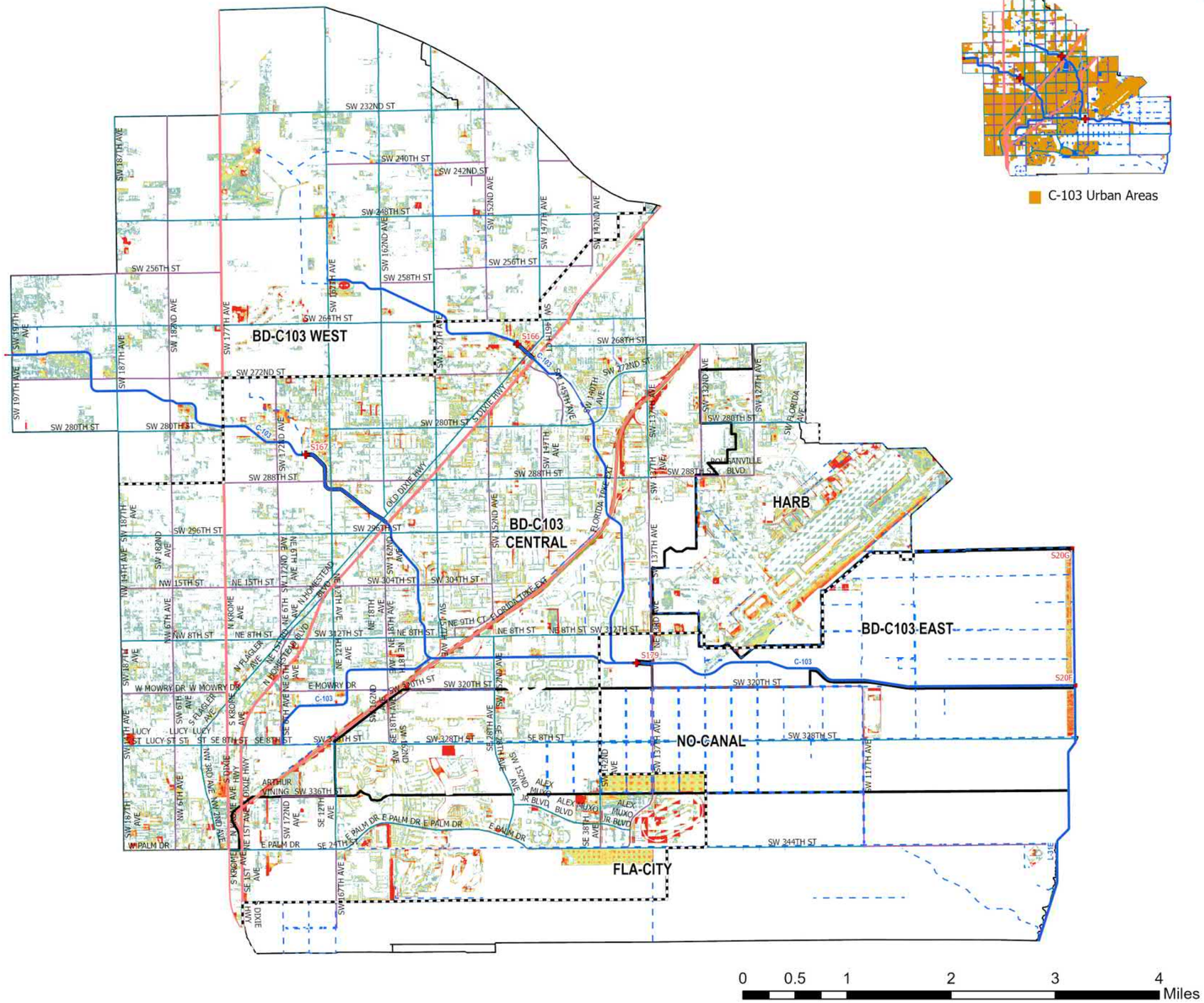
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-353. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

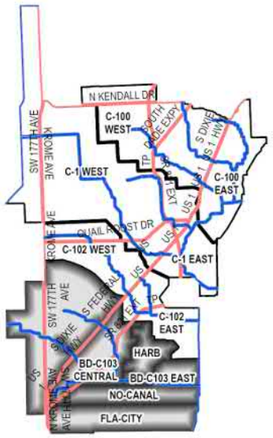
- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

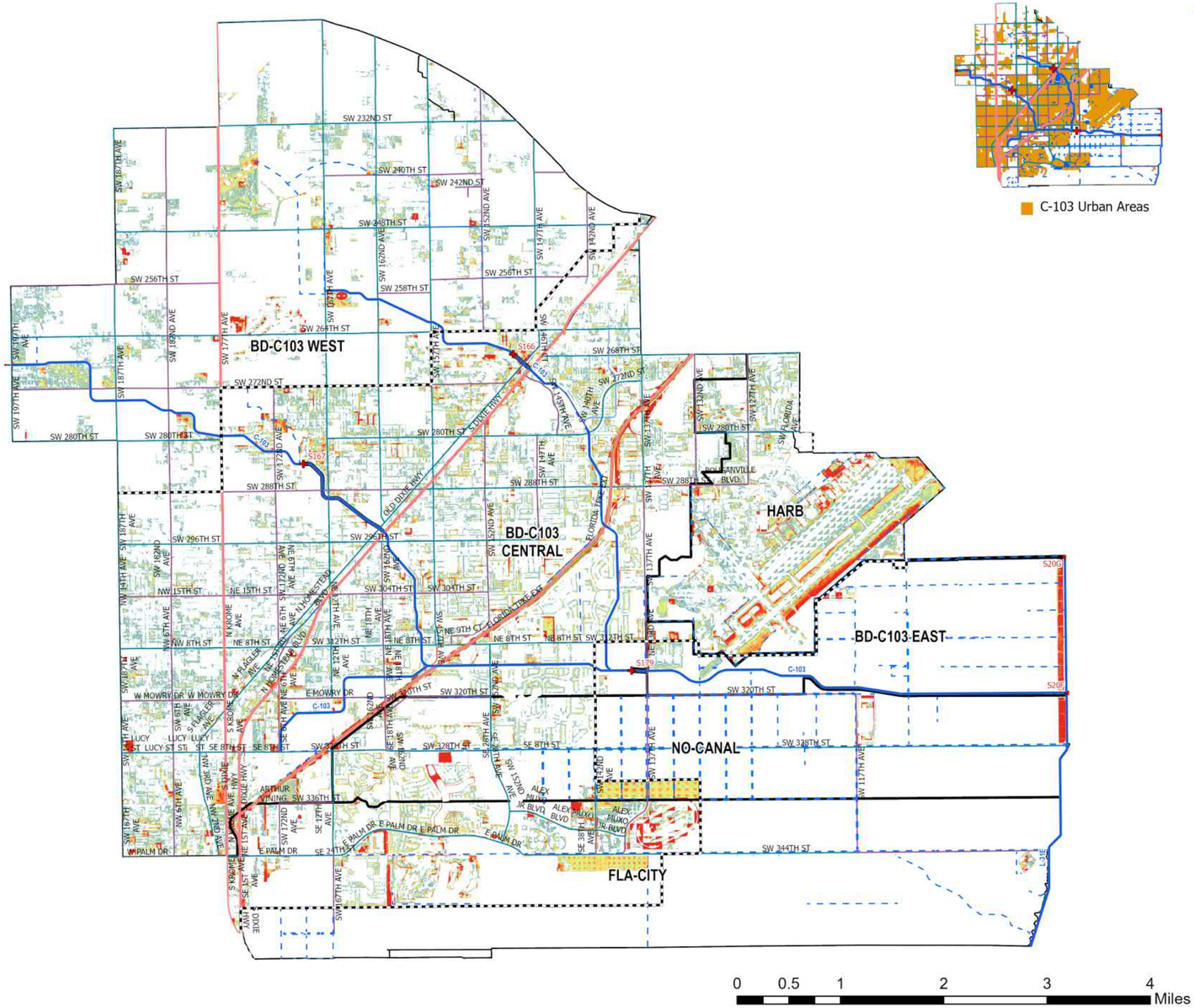
Flood Depth (ft)

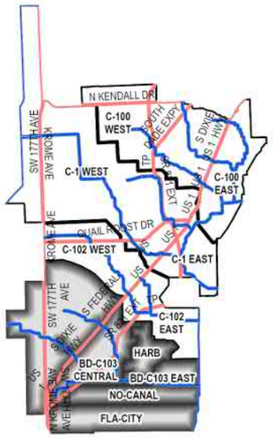
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-354. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

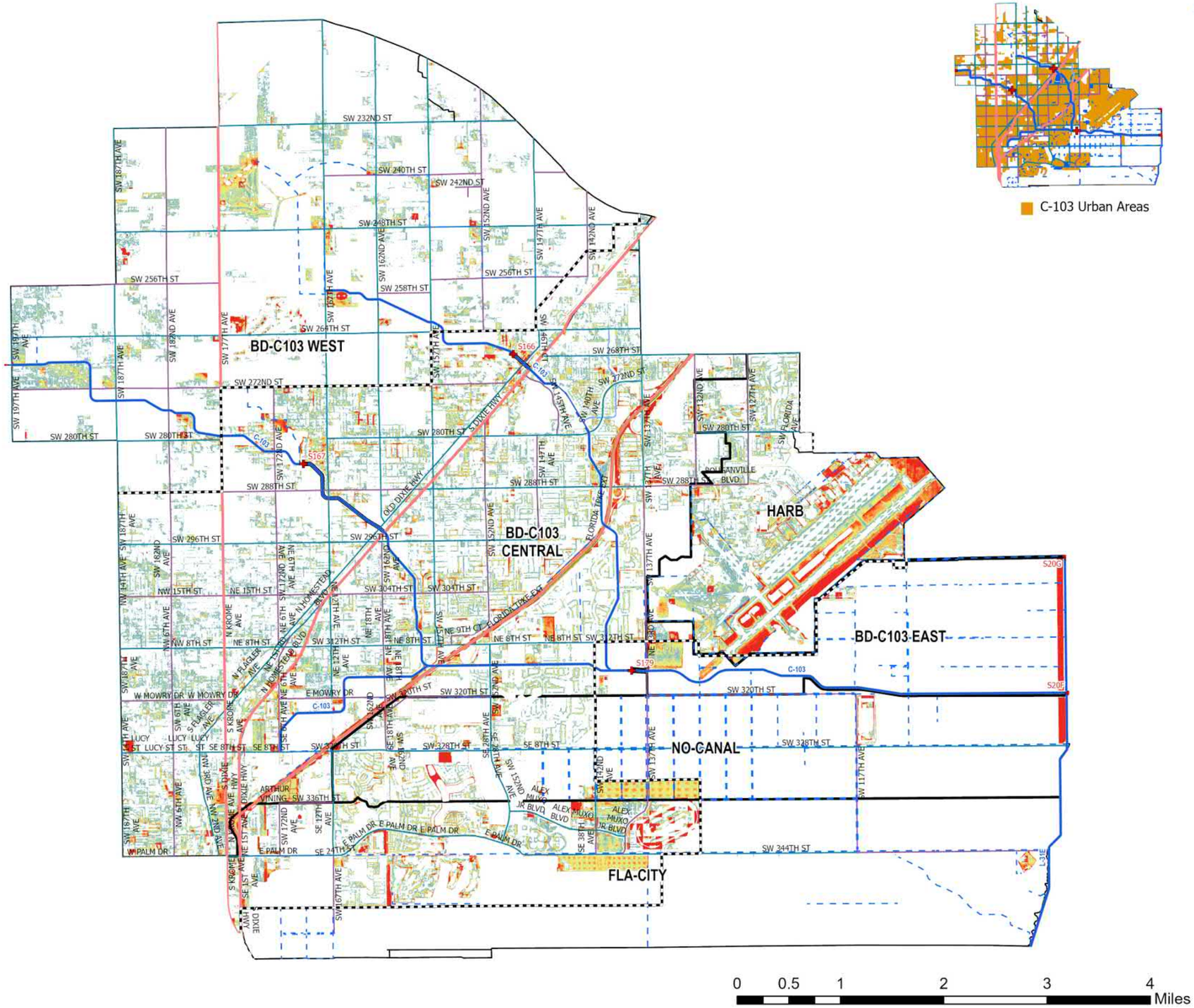


C-103 Watershed


BD-C103 WEST
BD-C103 CENTRAL
HARB
BD-C103-EAST
NO-CANAL
FLA-CITY
S166
S167
S179
S20G
S20F
C-103
SW 232ND ST
SW 240TH ST
SW 242ND ST
SW 248TH ST
SW 256TH ST
SW 258TH ST
SW 268TH ST
SW 272ND ST
SW 280TH ST
SW 288TH ST
SW 296TH ST
SW 304TH ST
SW 312TH ST
SW 320TH ST
SW 328TH ST
SW 336TH ST
SW 344TH ST
SW 177TH AVE
SW 187TH AVE
SW 197TH AVE
SW 152ND AVE
SW 147TH AVE
SW 137TH AVE
SW 127TH AVE
SW 117TH AVE
S DIXIE HWY
OLD DIXIE HWY
FLORIDA TPKE EXT
ROBERTA LEE BLVD
W MOWRY DR
E MOWRY DR
W PALM DR
E PALM DR
ALEX MUXO JR BLVD
ARTHUR VINING
LUCY ST
N KROME AVE
S KROME AVE
N FLAGLER AVE
N HOMESTEAD BLVD
SW 172ND AVE
SE 12TH AVE
SW 167TH AVE
NW 15TH ST
NE 15TH ST
NW 8TH ST
NE 8TH ST
SE 8TH ST
SE 24TH ST
NE 9TH CT
SW 152ND AVE
SW 142ND AVE
SW 132ND AVE
SW 280TH ST
SW 288TH ST
SW 320TH ST
SW 328TH ST
SE 38TH AVE
SE 152ND AVE
SE 137TH AVE
SE 117TH AVE
SW 162ND AVE
SW 157TH AVE
SW 147TH AVE
SW 137TH AVE
SW 127TH AVE
SW 117TH AVE
SW 182ND AVE
SW 172ND AVE
SW 162ND AVE
SW 152ND AVE
SW 142ND AVE
SW 132ND AVE
SW 122ND AVE
SW 112ND AVE
SW 102ND AVE
SW 92ND AVE
SW 82ND AVE
SW 72ND AVE
SW 62ND AVE
SW 52ND AVE
SW 42ND AVE
SW 32ND AVE
SW 22ND AVE
SW 12ND AVE
SW 2ND AVE
NW 2ND AVE
NE 2ND AVE
SE 2ND AVE
SE 12TH AVE
SE 22ND AVE
SE 32ND AVE
SE 42ND AVE
SE 52ND AVE
SE 62ND AVE
SE 72ND AVE
SE 82ND AVE
SE 92ND AVE
SE 102ND AVE
SE 112ND AVE
SE 122ND AVE
SE 132ND AVE
SE 142ND AVE
SE



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

0 0.5 1 2 3 4 Miles

Figure A-356. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn

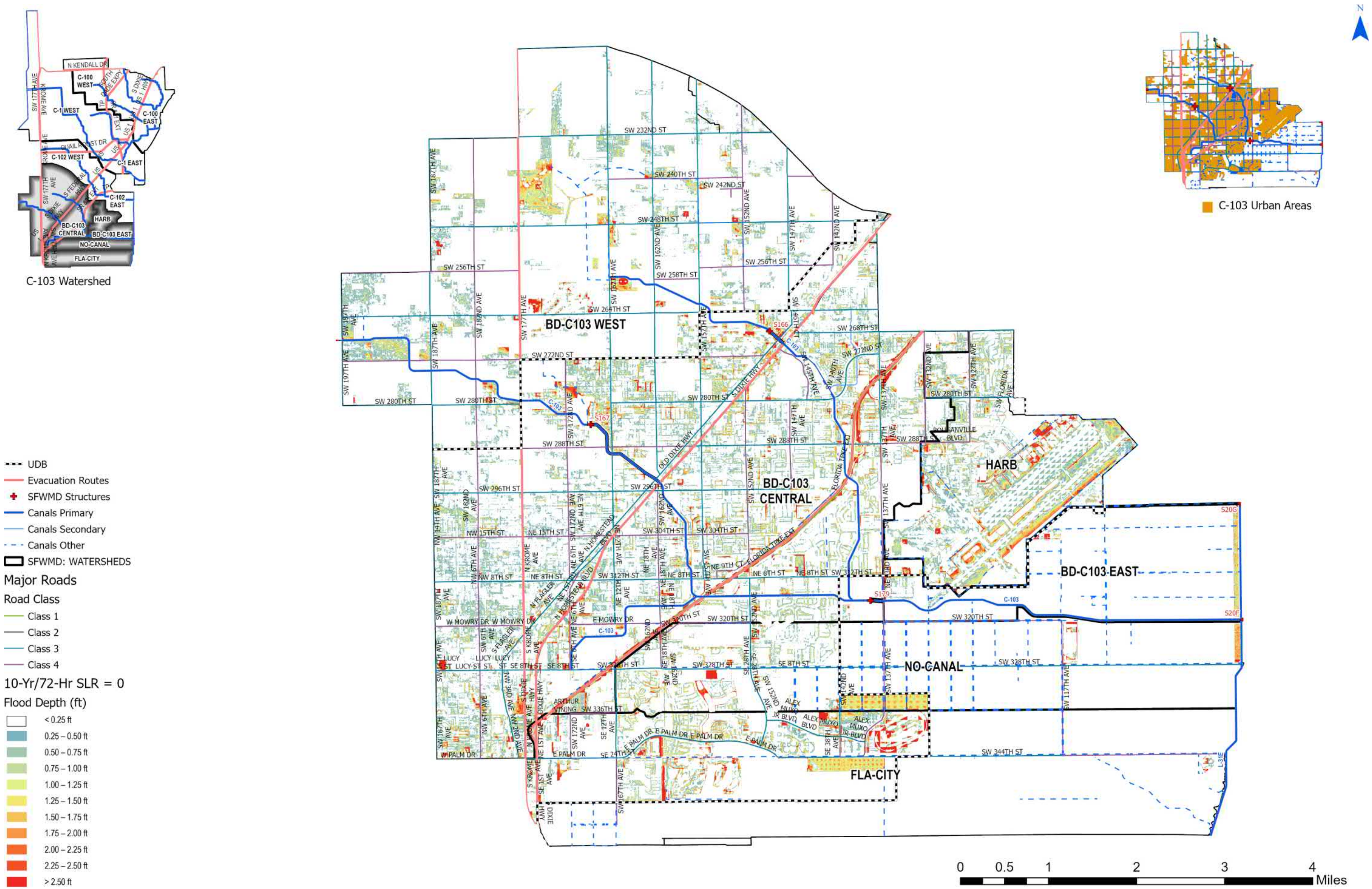
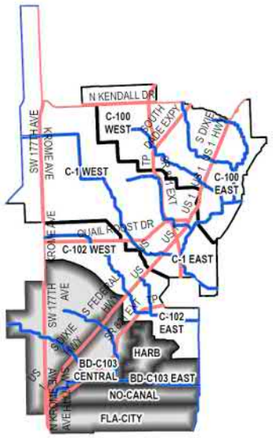
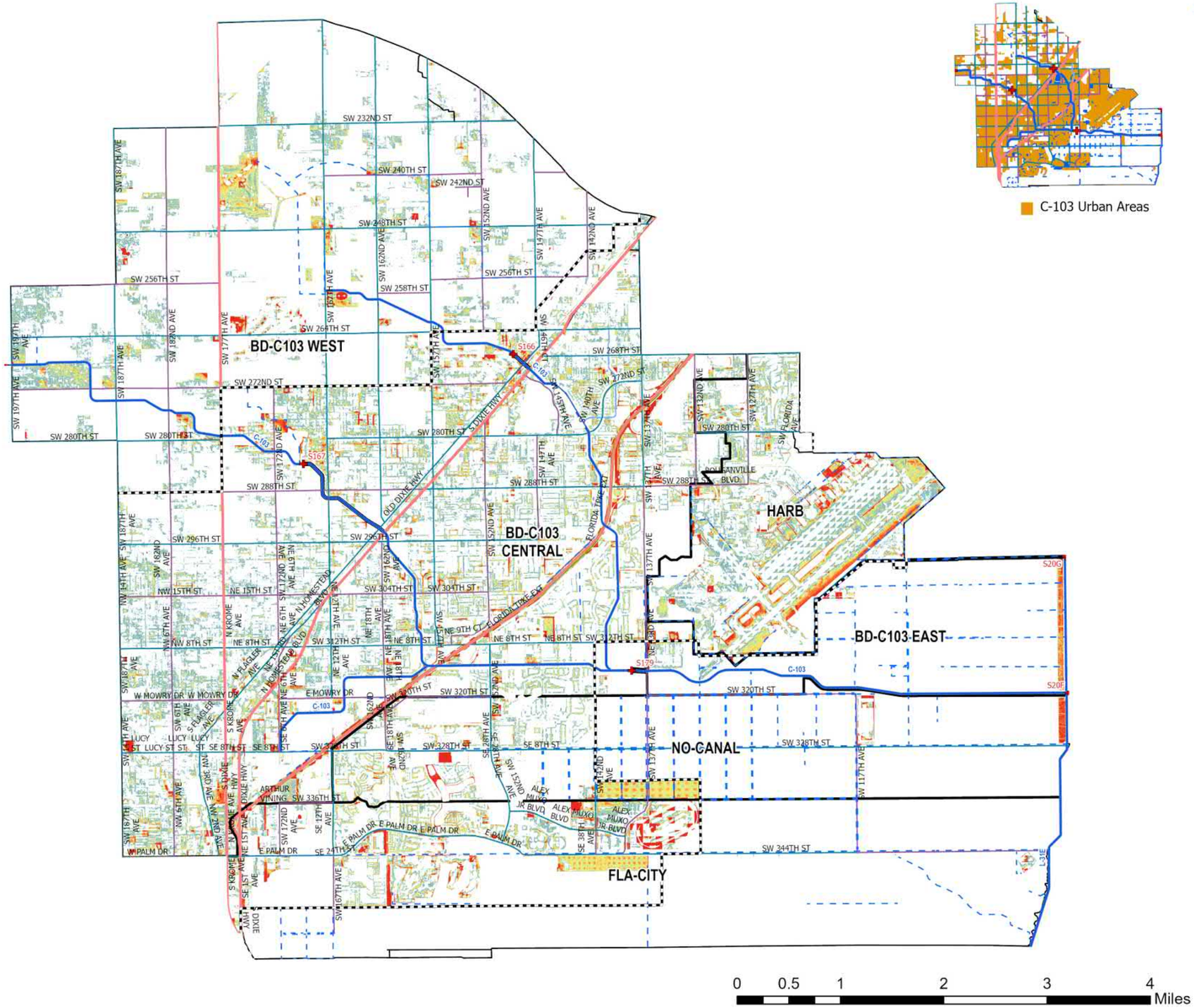


Figure A-357. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

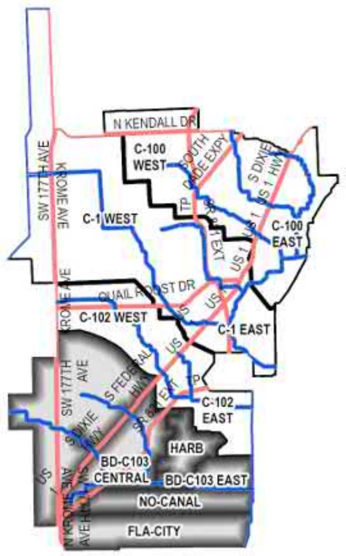
10-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

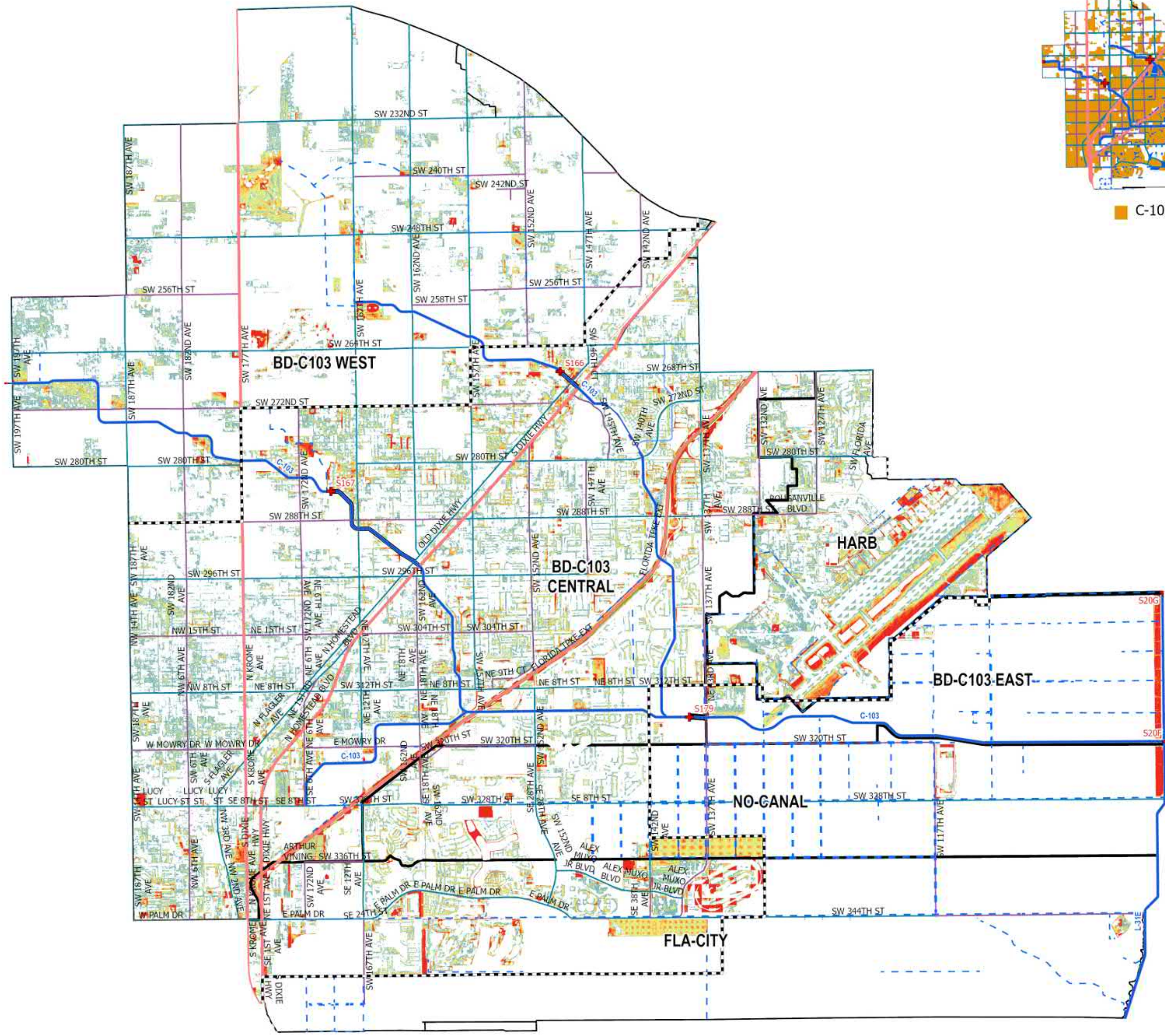
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-358. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

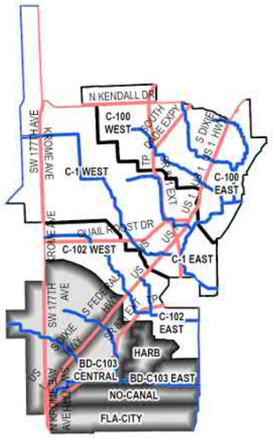
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

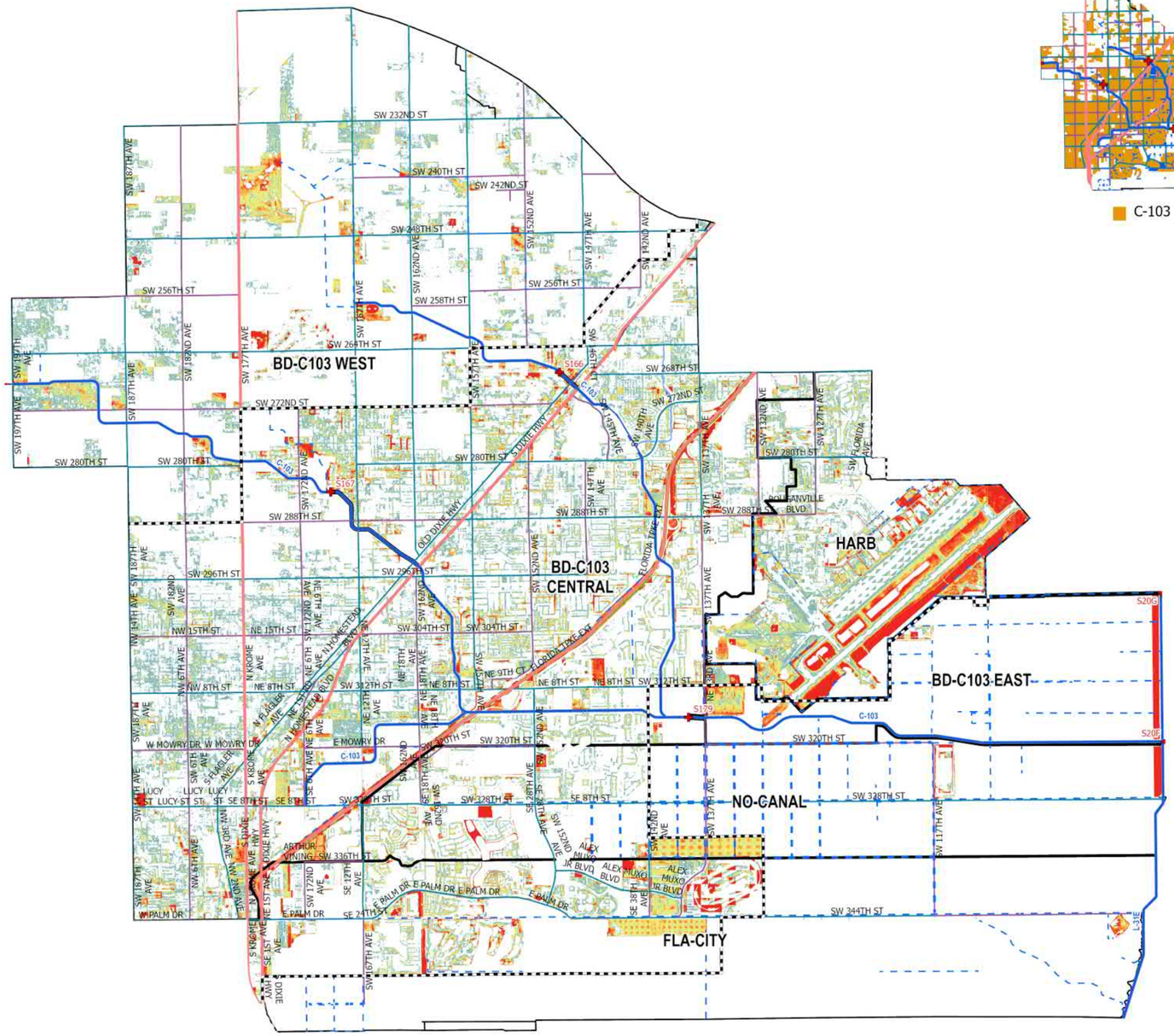
0 0.5 1 2 3 4 Miles

Figure A-359. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

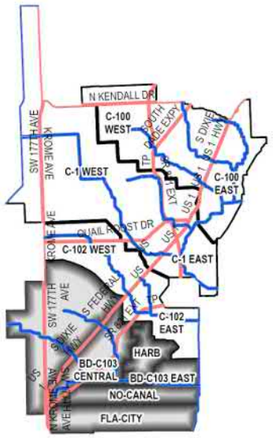
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

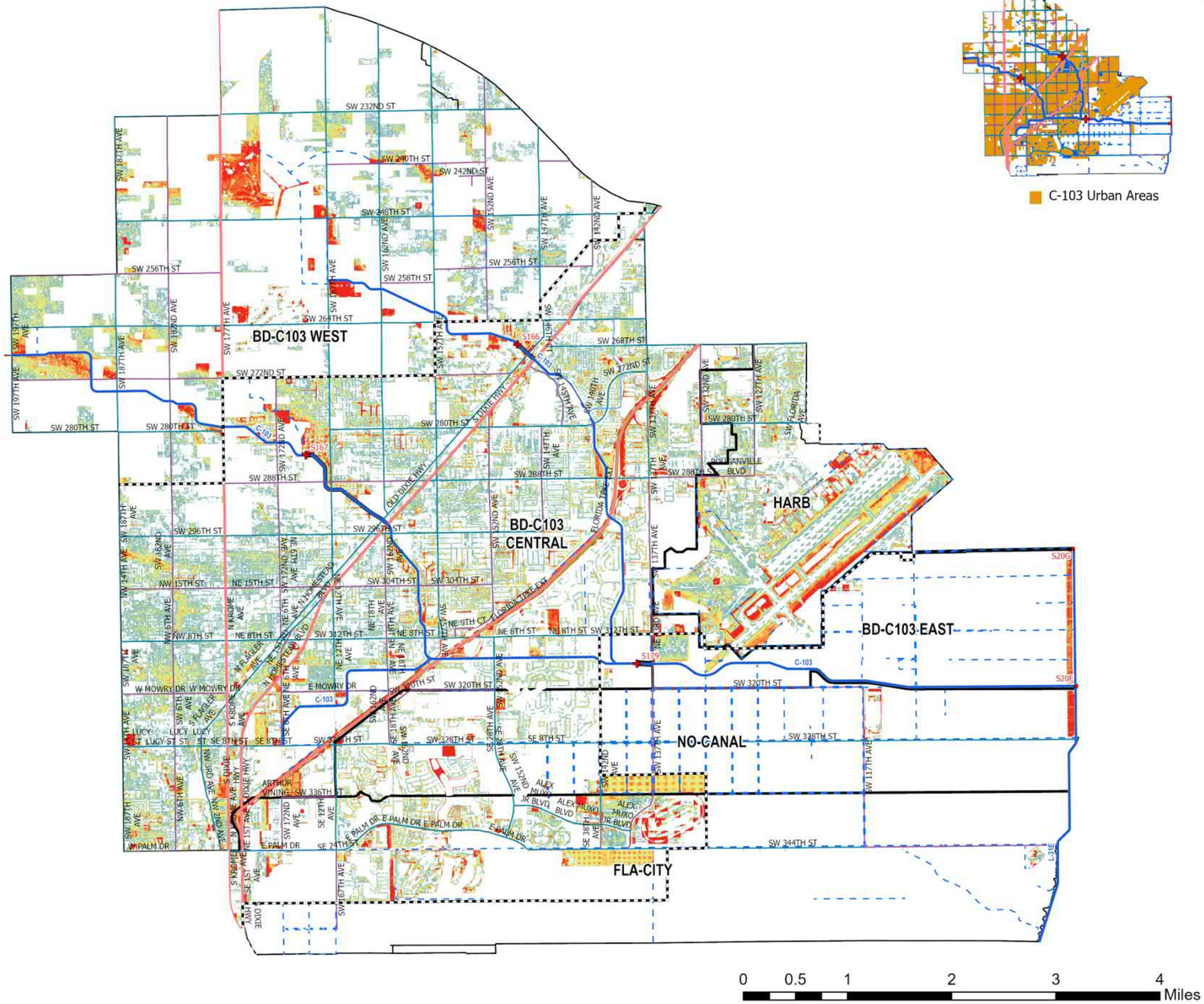
0 0.5 1 2 3 4 Miles

Figure A-360. Watershed C-103 Flood Extent Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

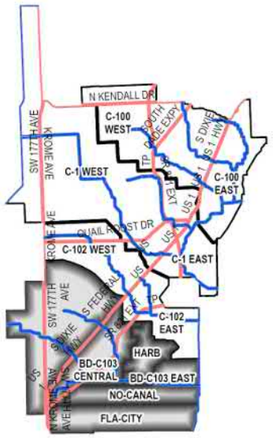
25-Yr/72-Hr SLR = 0

Flood Depth (ft)

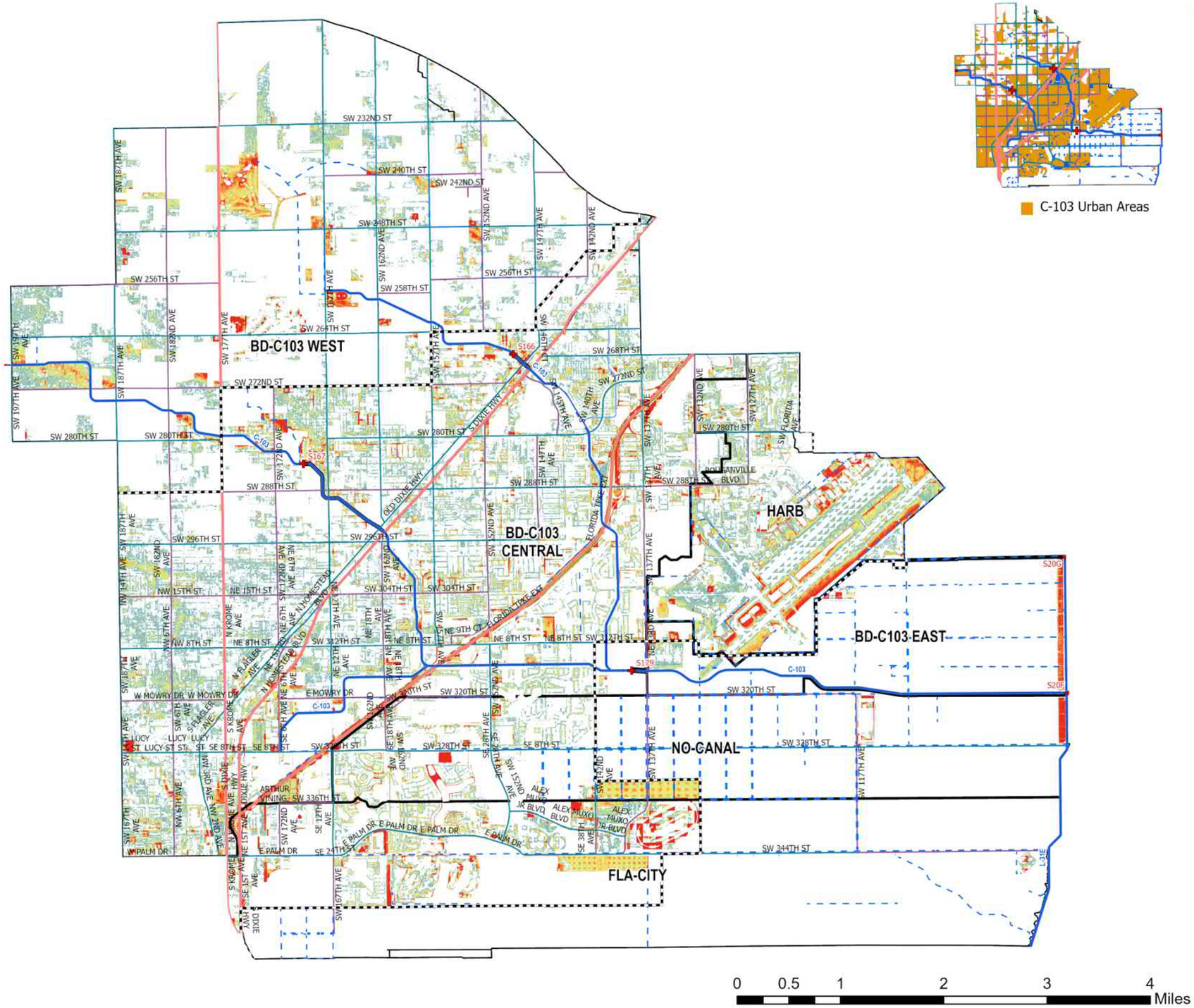
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-361. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

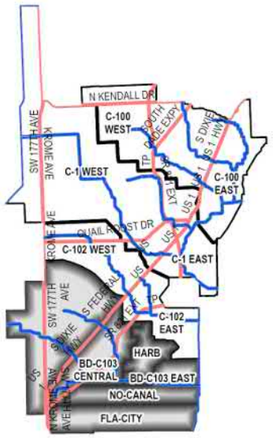
25-Yr/72-Hr SLR = +1.0

Flood Depth (ft)

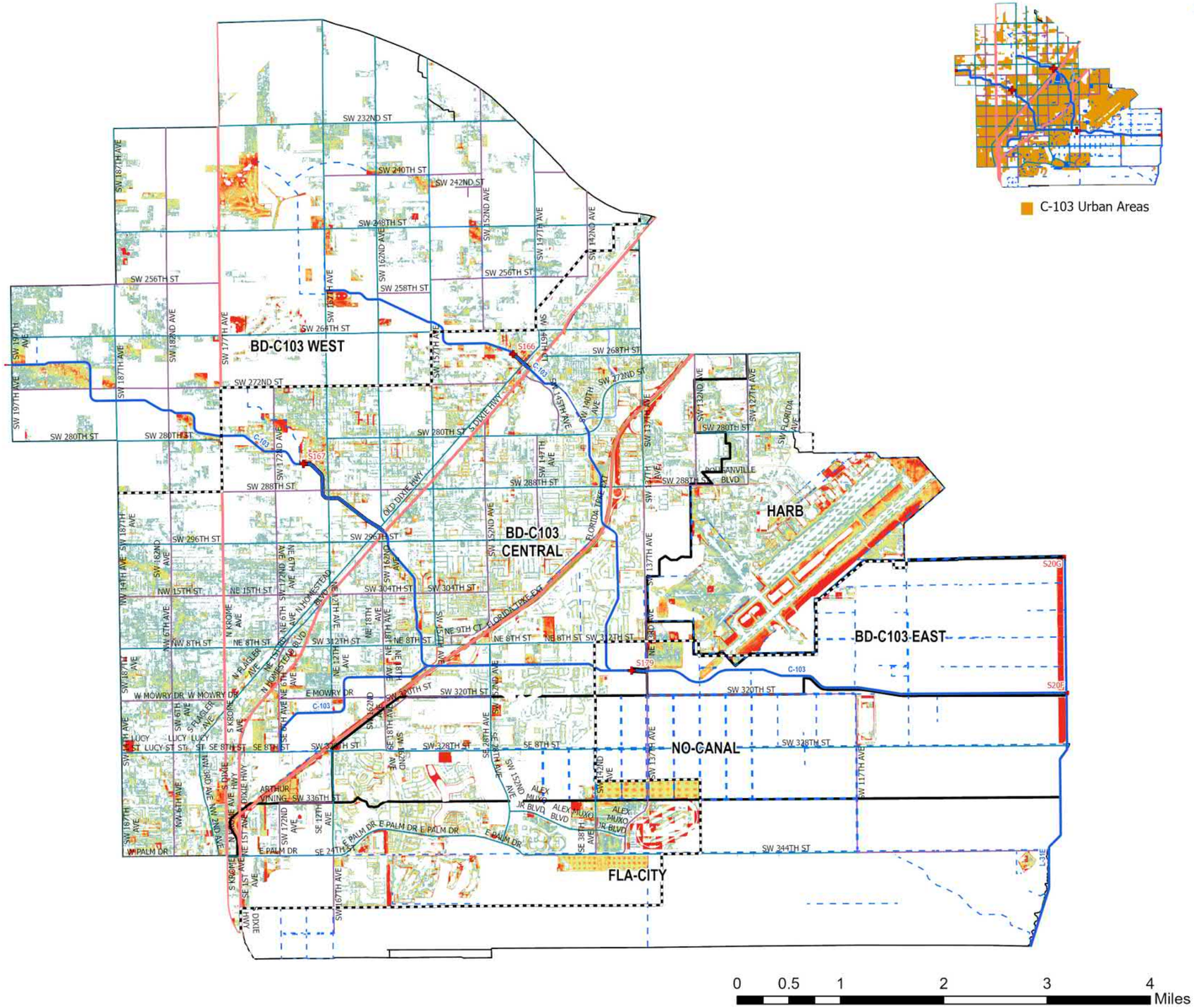
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-362. Watershed C-103 Flood Extent Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

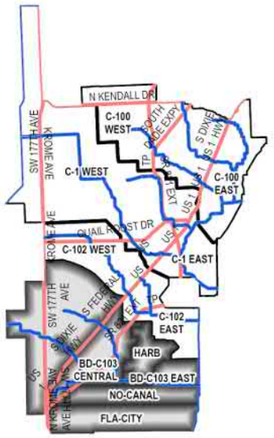
25-Yr/72-Hr SLR = +2.0

Flood Depth (ft)

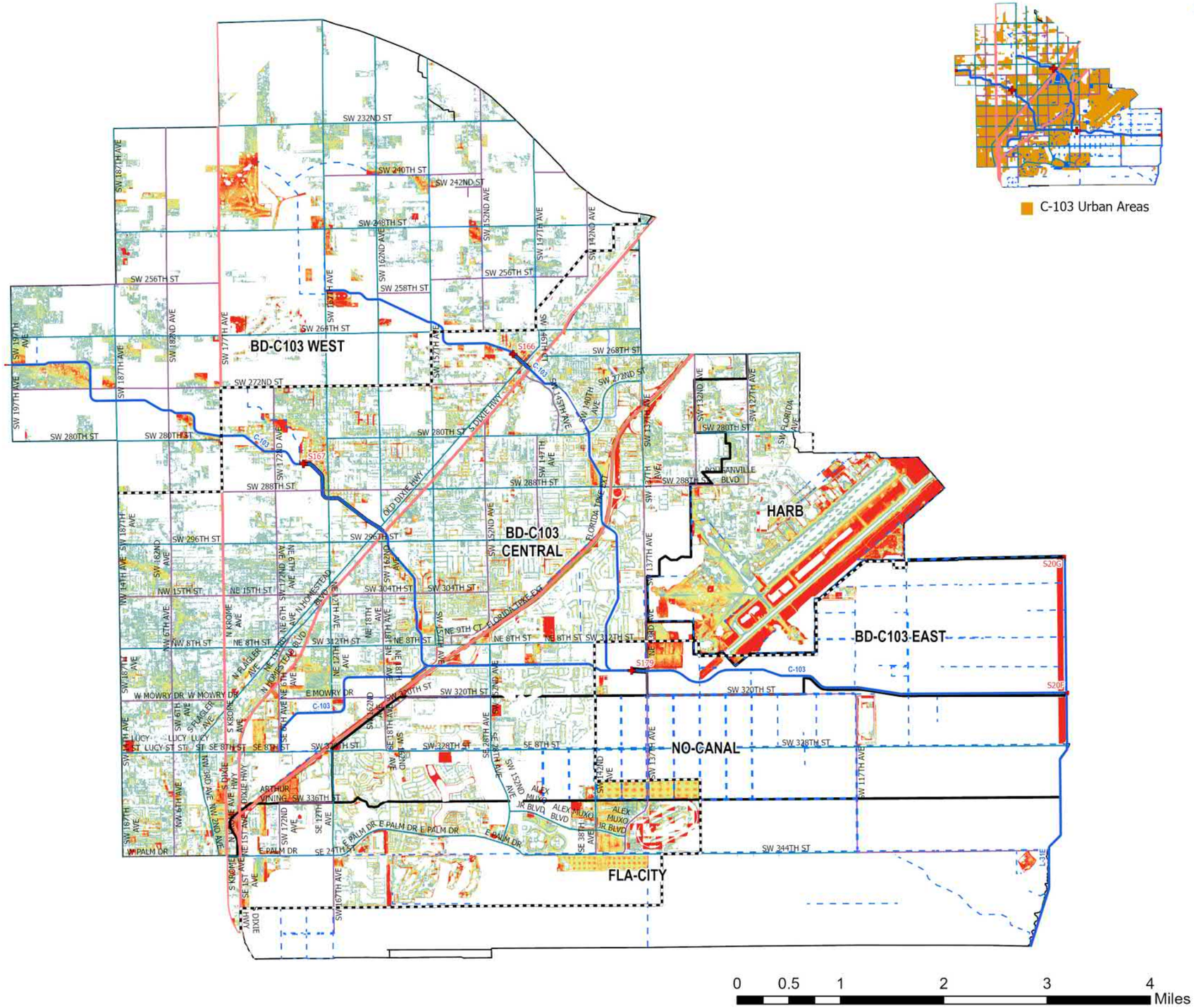
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-363. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

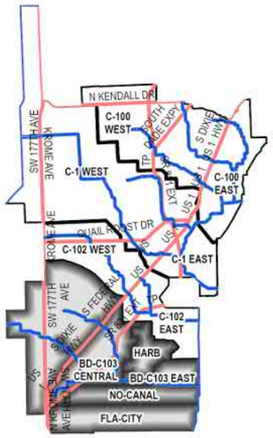
25-Yr/72-Hr SLR = +3.0

Flood Depth (ft)

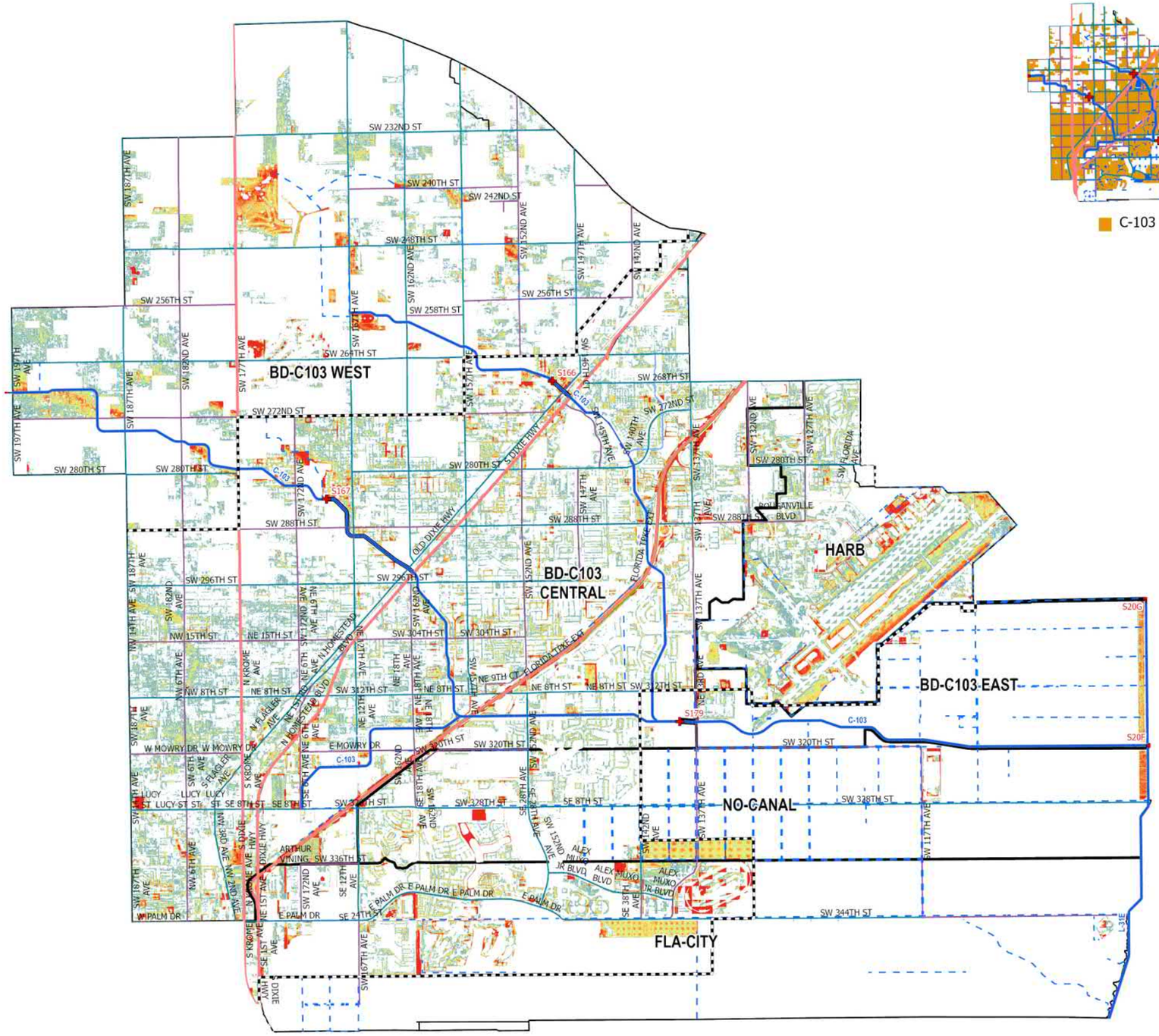
- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

Figure A-364. Watershed C-103 Flood Extent Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

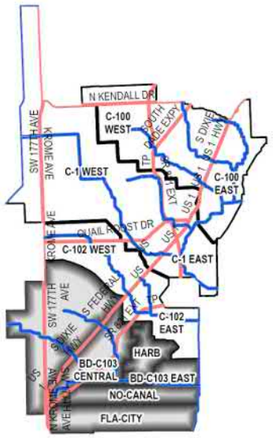
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

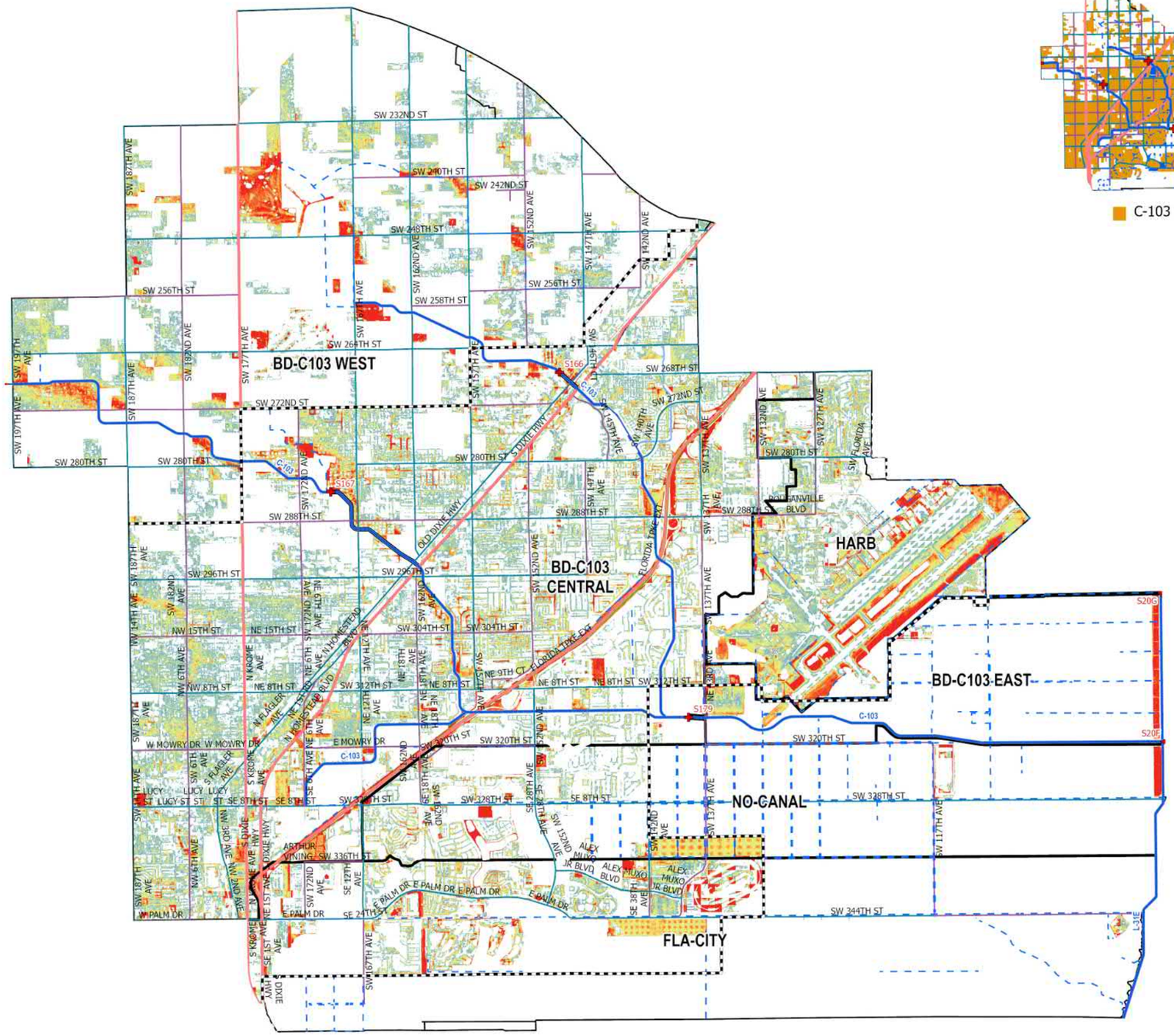
0 0.5 1 2 3 4 Miles

Figure A-365. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

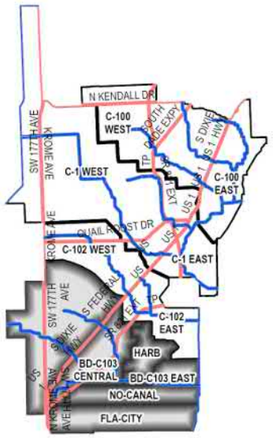
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

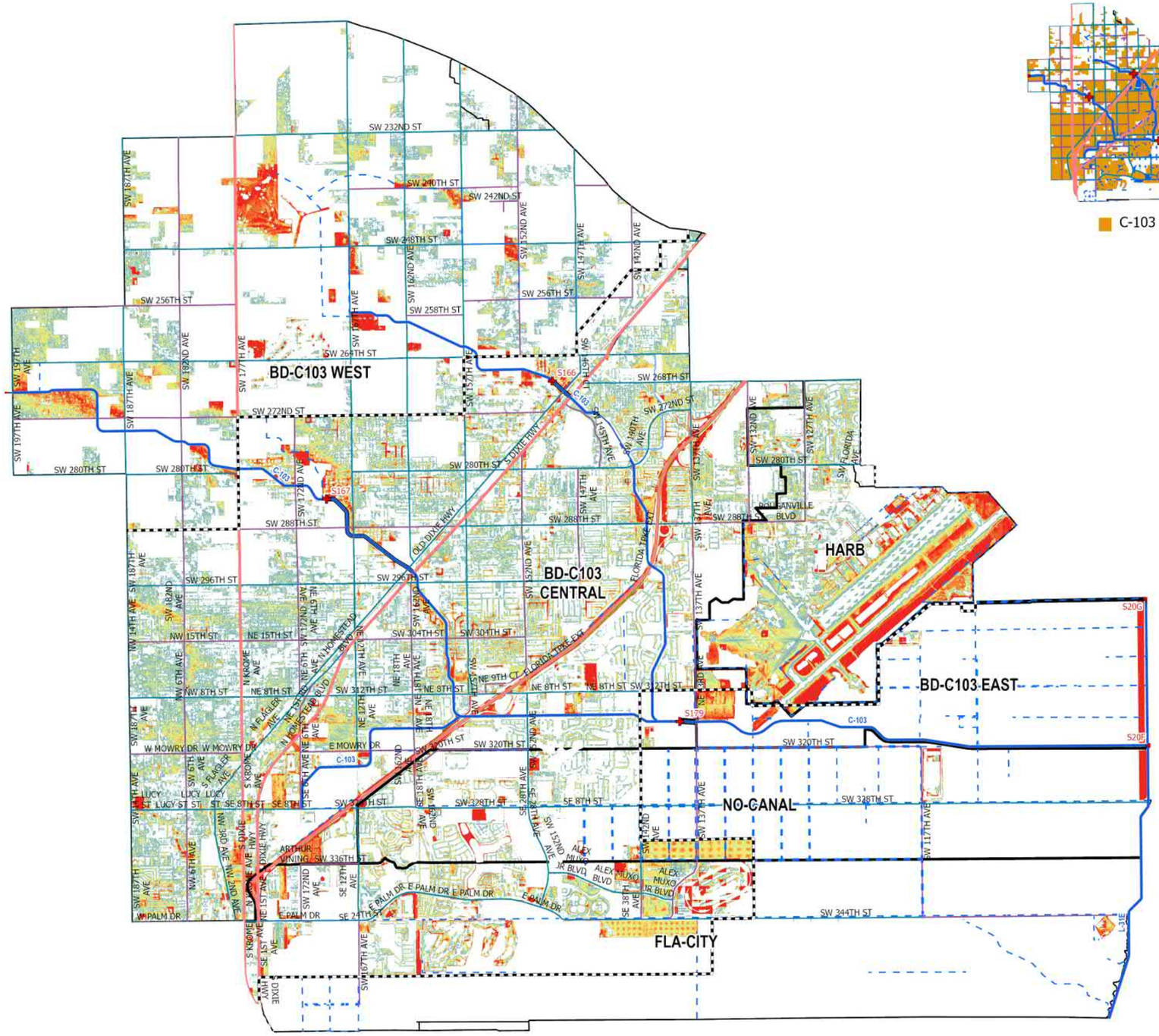
0 0.5 1 2 3 4 Miles

Figure A-366. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

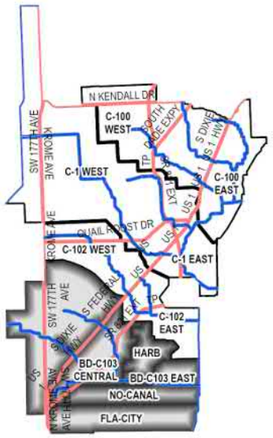
Flood Depth (ft)

- < 0.25 ft
- 0.25 – 0.50 ft
- 0.50 – 0.75 ft
- 0.75 – 1.00 ft
- 1.00 – 1.25 ft
- 1.25 – 1.50 ft
- 1.50 – 1.75 ft
- 1.75 – 2.00 ft
- 2.00 – 2.25 ft
- 2.25 – 2.50 ft
- > 2.50 ft

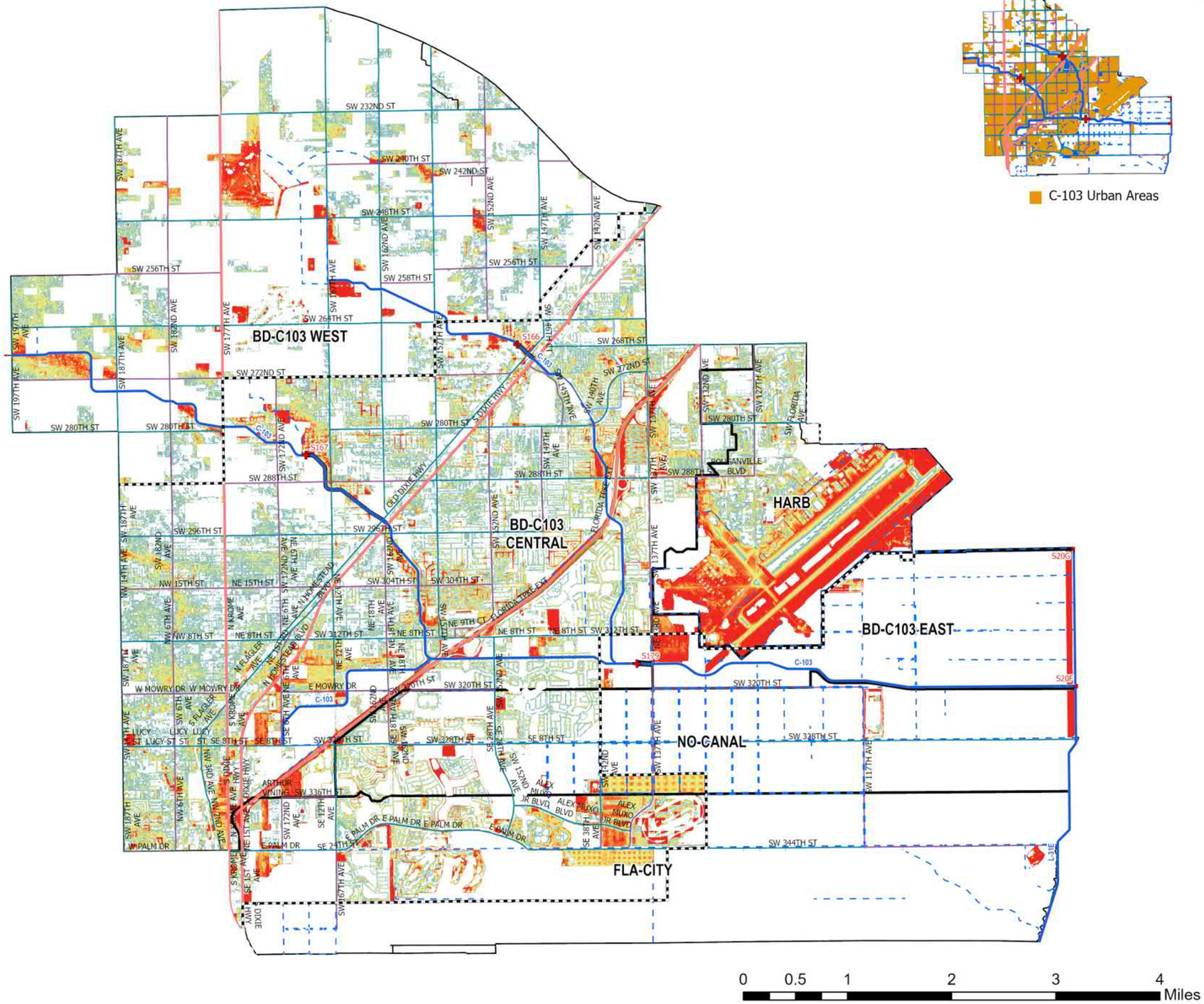
0 0.5 1 2 3 4 Miles

Figure A-367. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed

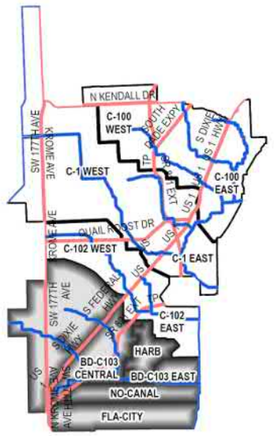


C-103 Urban Areas

Figure A-368. Watershed C-103 Flood Extent Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

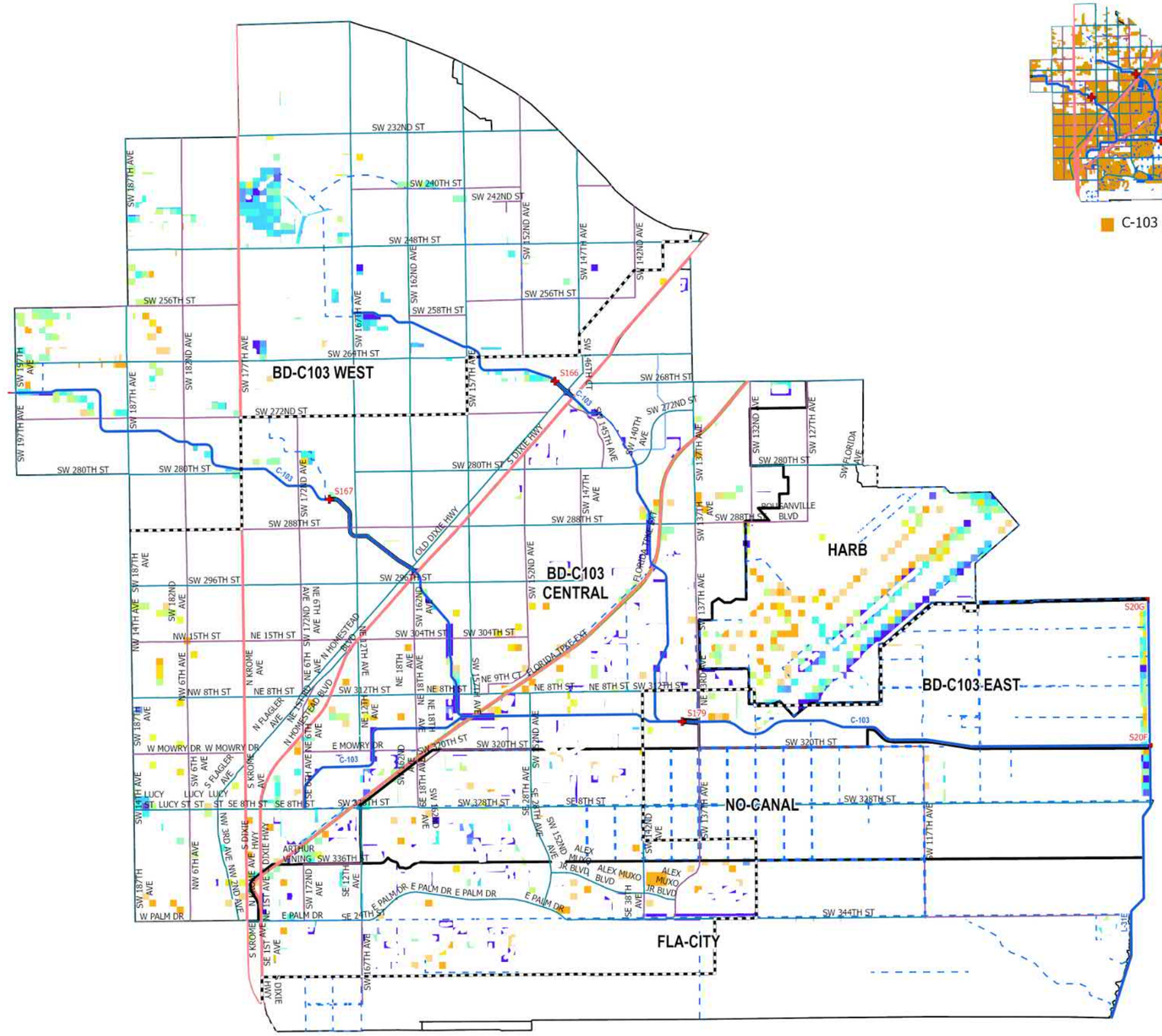
Kimley»Horn

WATERSHED C-103: Flood Duration in Urban Areas



C-103 Watershed

C-103 Urban Areas



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

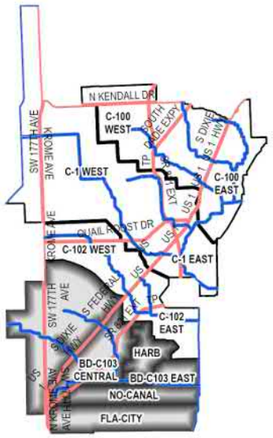
5-Yr/72-Hr SLR = 0

Flood Duration (hr)

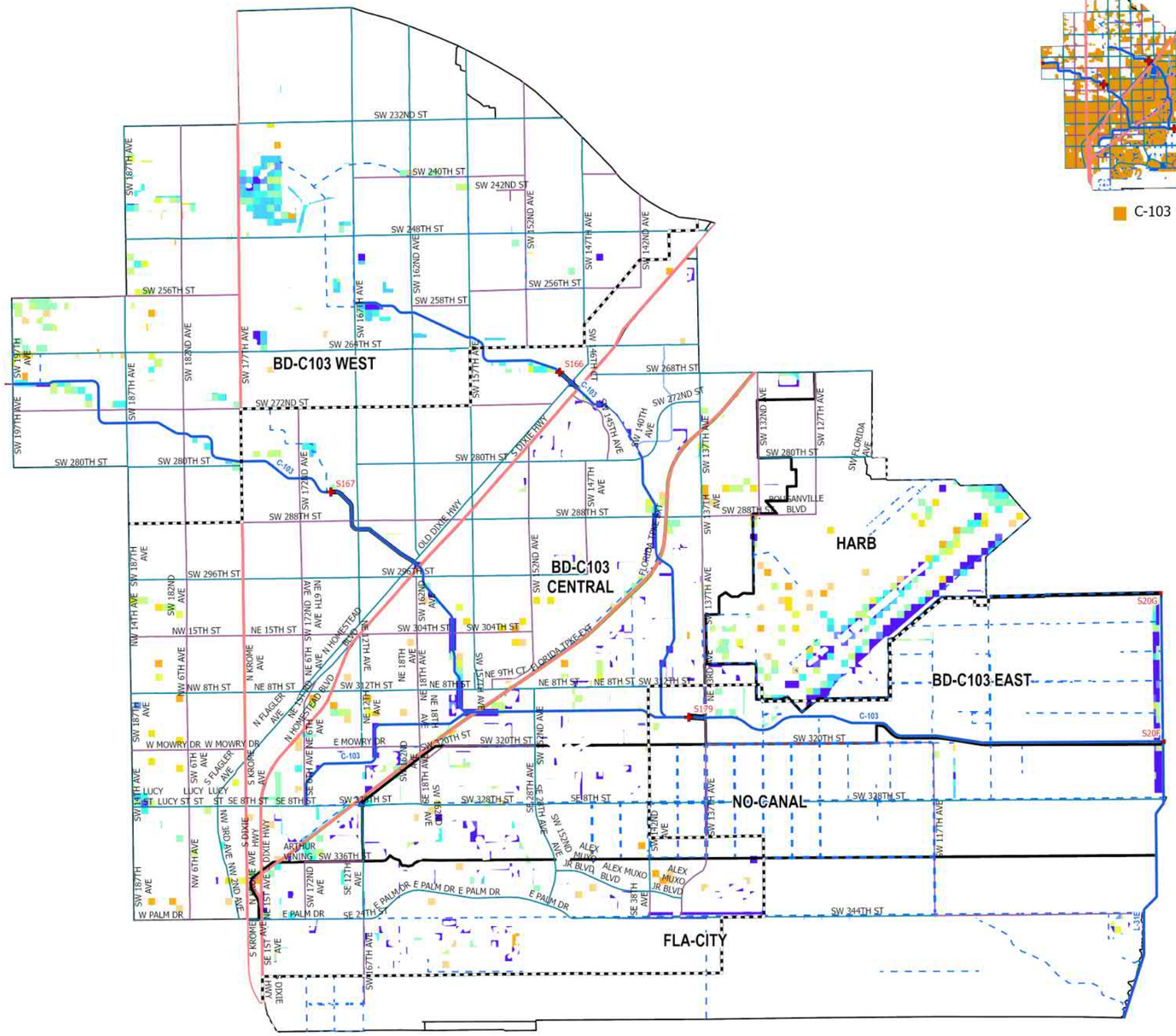
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-369. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +1.0

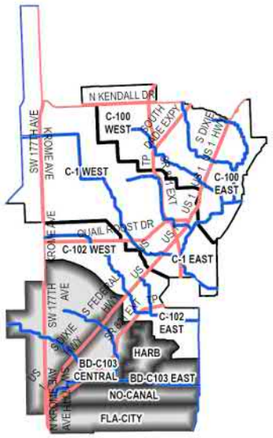
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

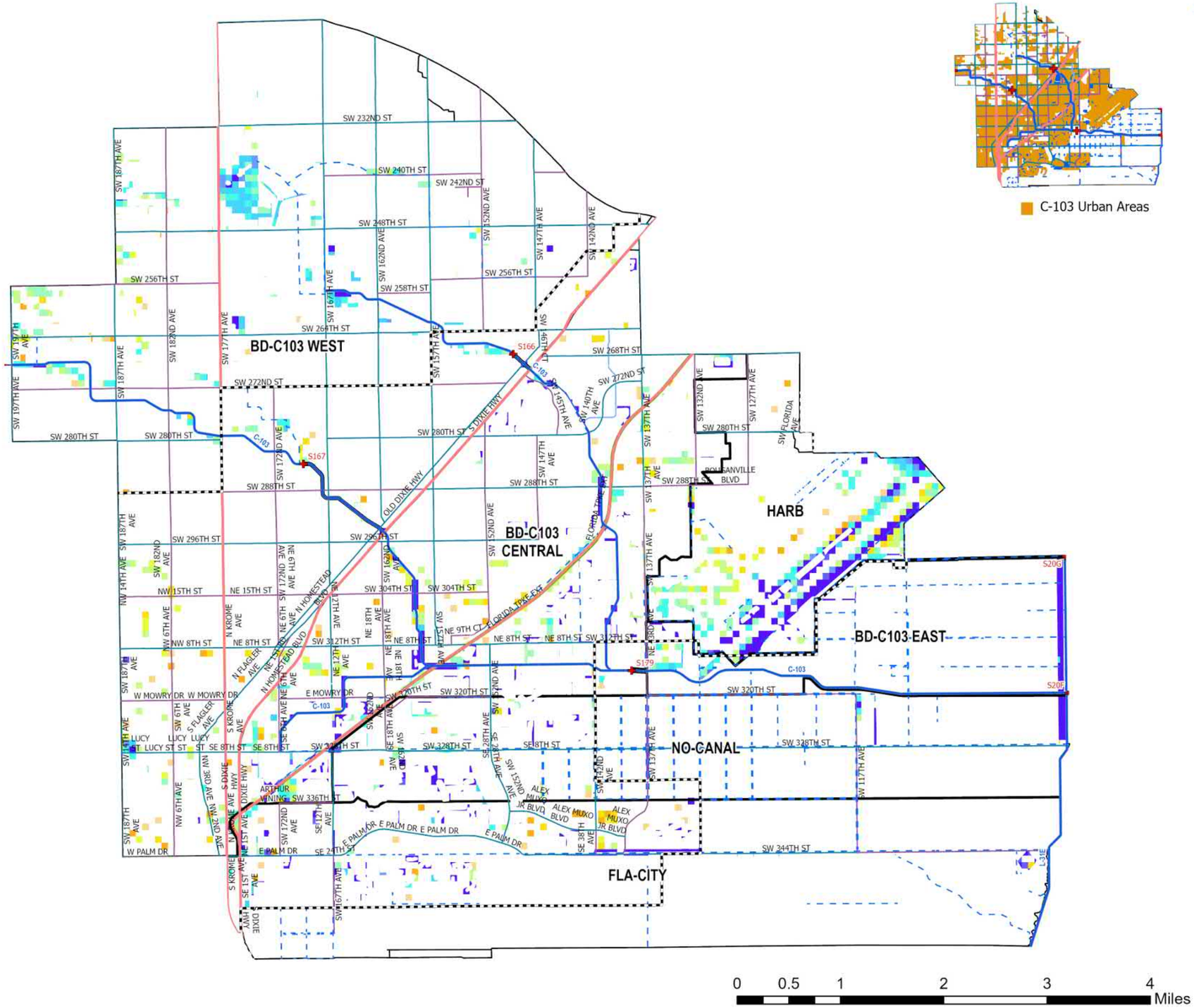
0 0.5 1 2 3 4 Miles

Figure A-370. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

5-Yr/72-Hr SLR = +2.0

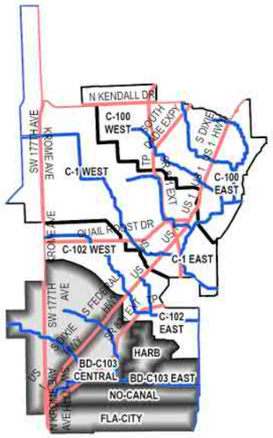
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

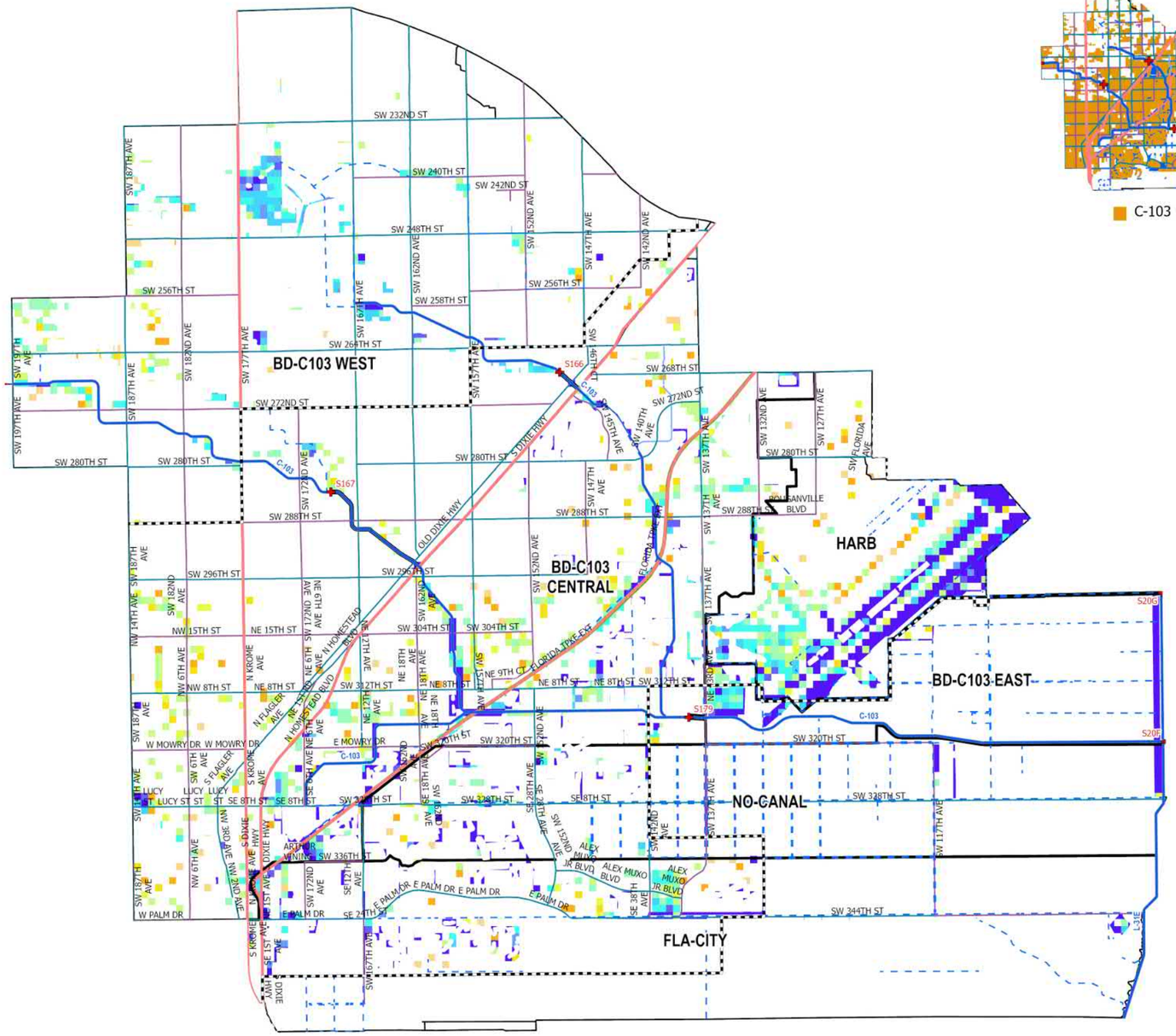
0 0.5 1 2 3 4 Miles

Figure A-371. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

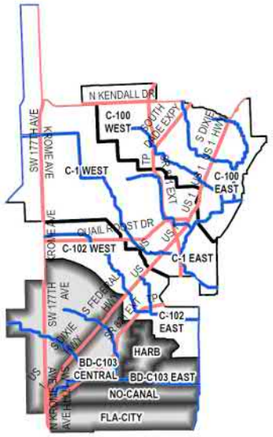
5-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

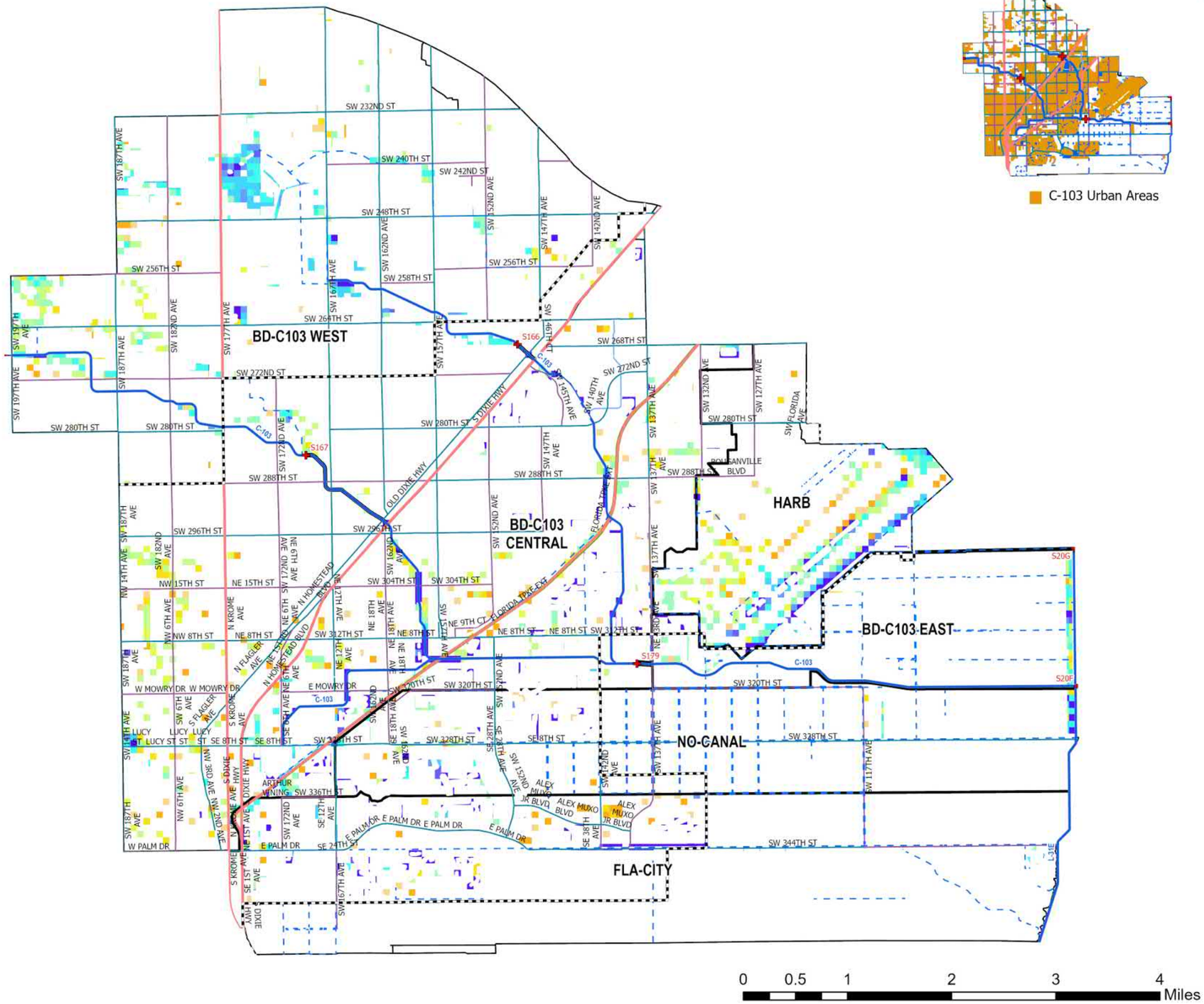
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

Figure A-372. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = 0

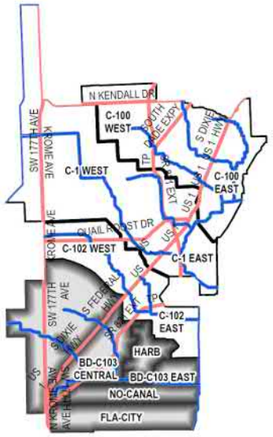
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

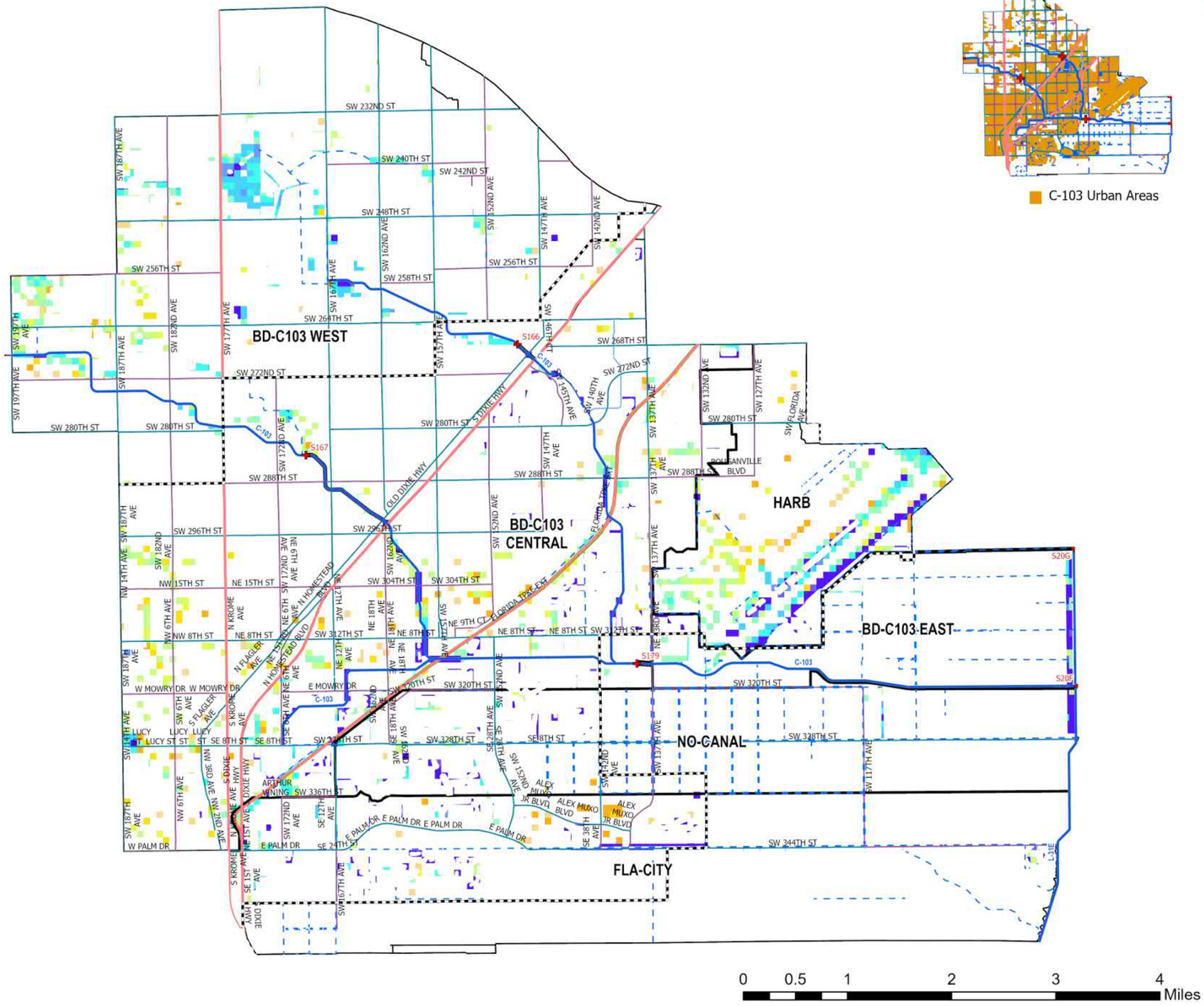
0 0.5 1 2 3 4 Miles

Figure A-373. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +1.0

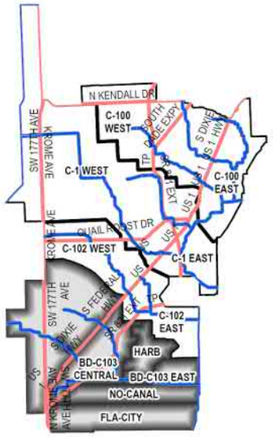
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

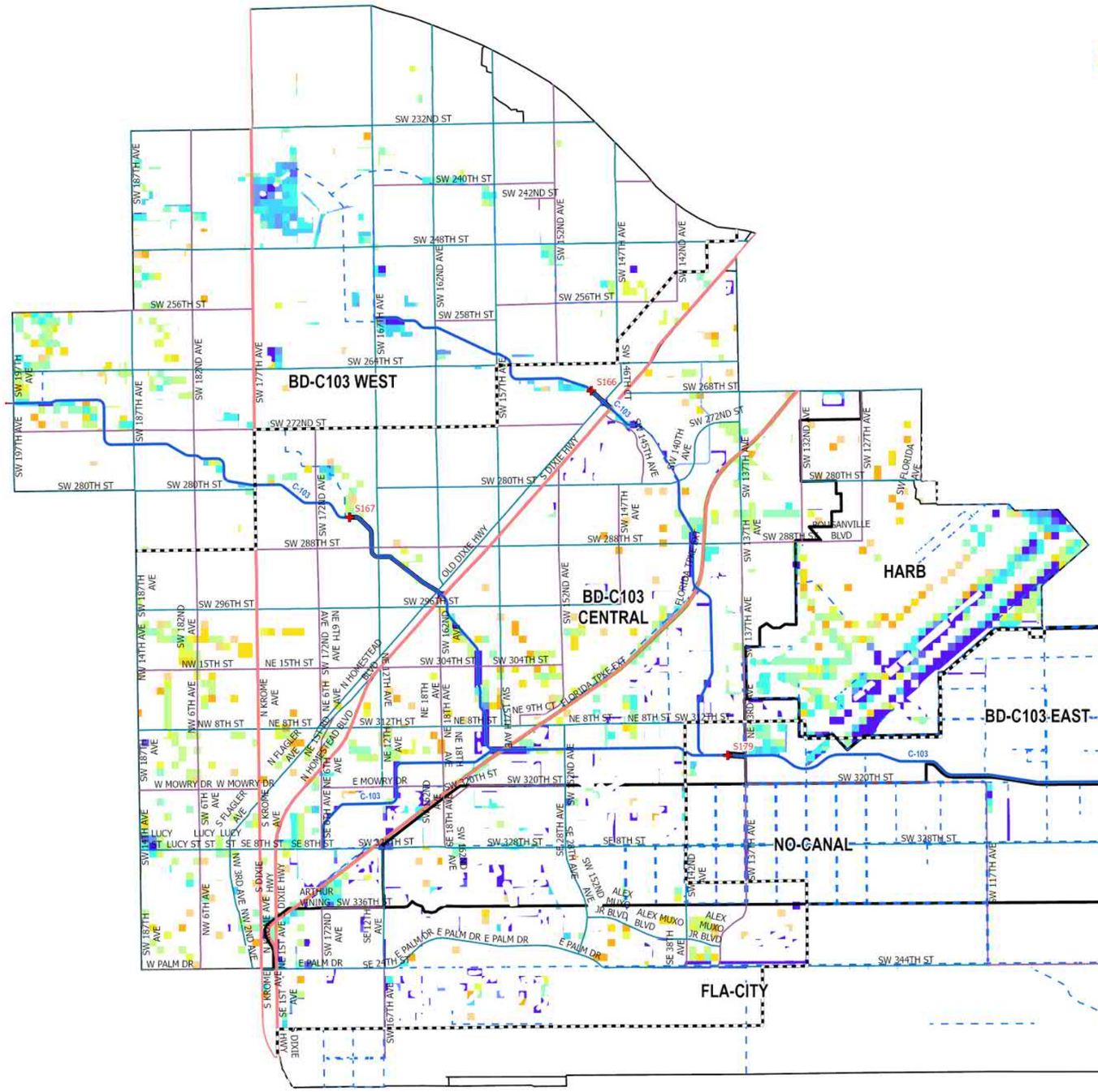
0 0.5 1 2 3 4 Miles

Figure A-374. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +2.0

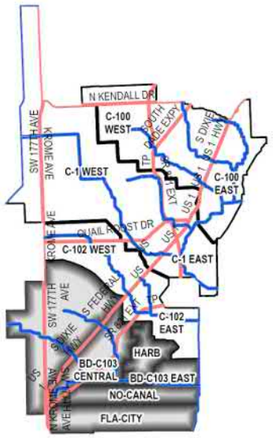
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

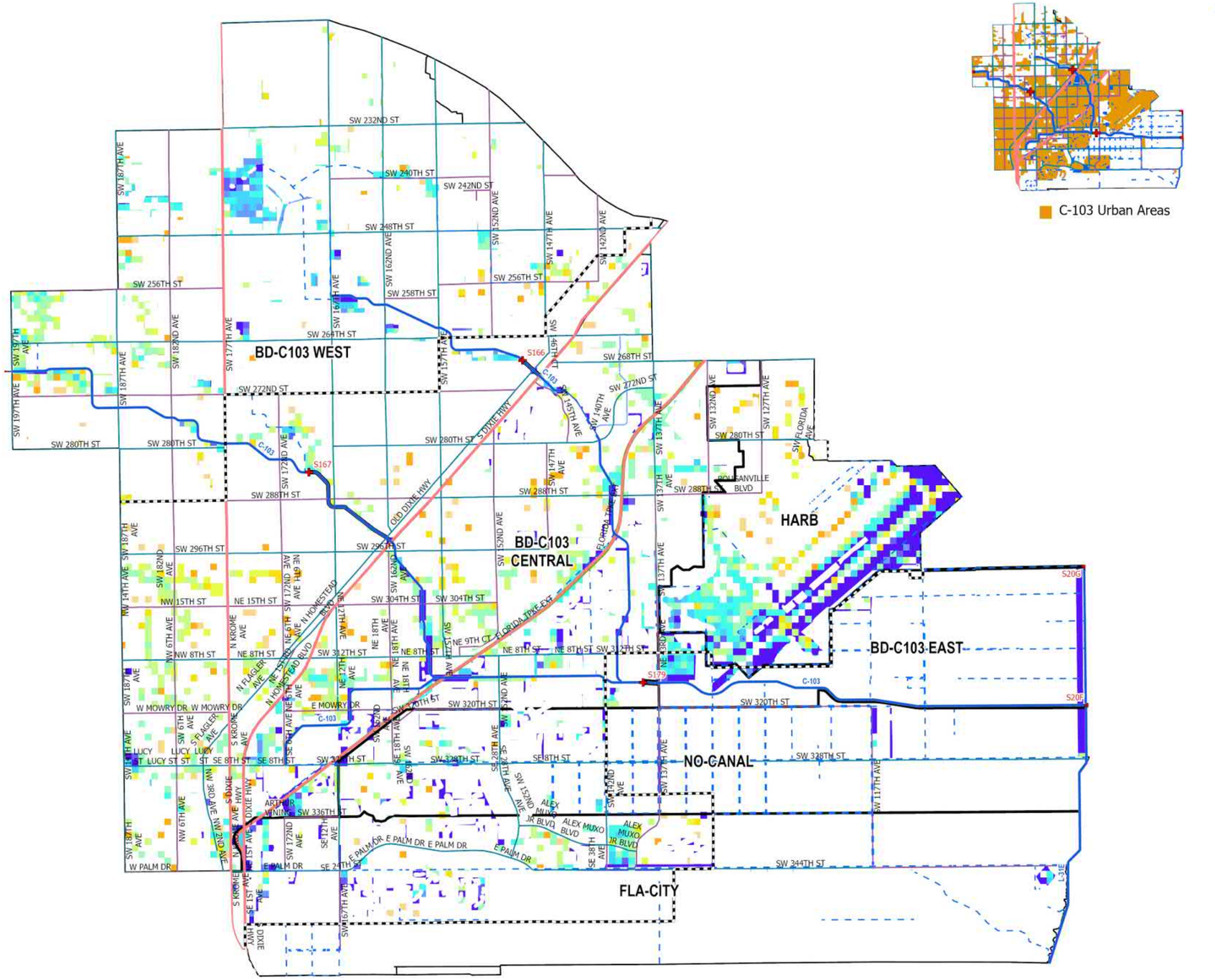
0 0.5 1 2 3 4 Miles

Figure A-375. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

10-Yr/72-Hr SLR = +3.0

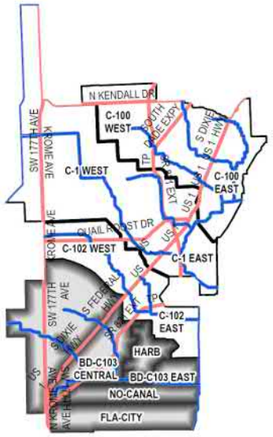
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

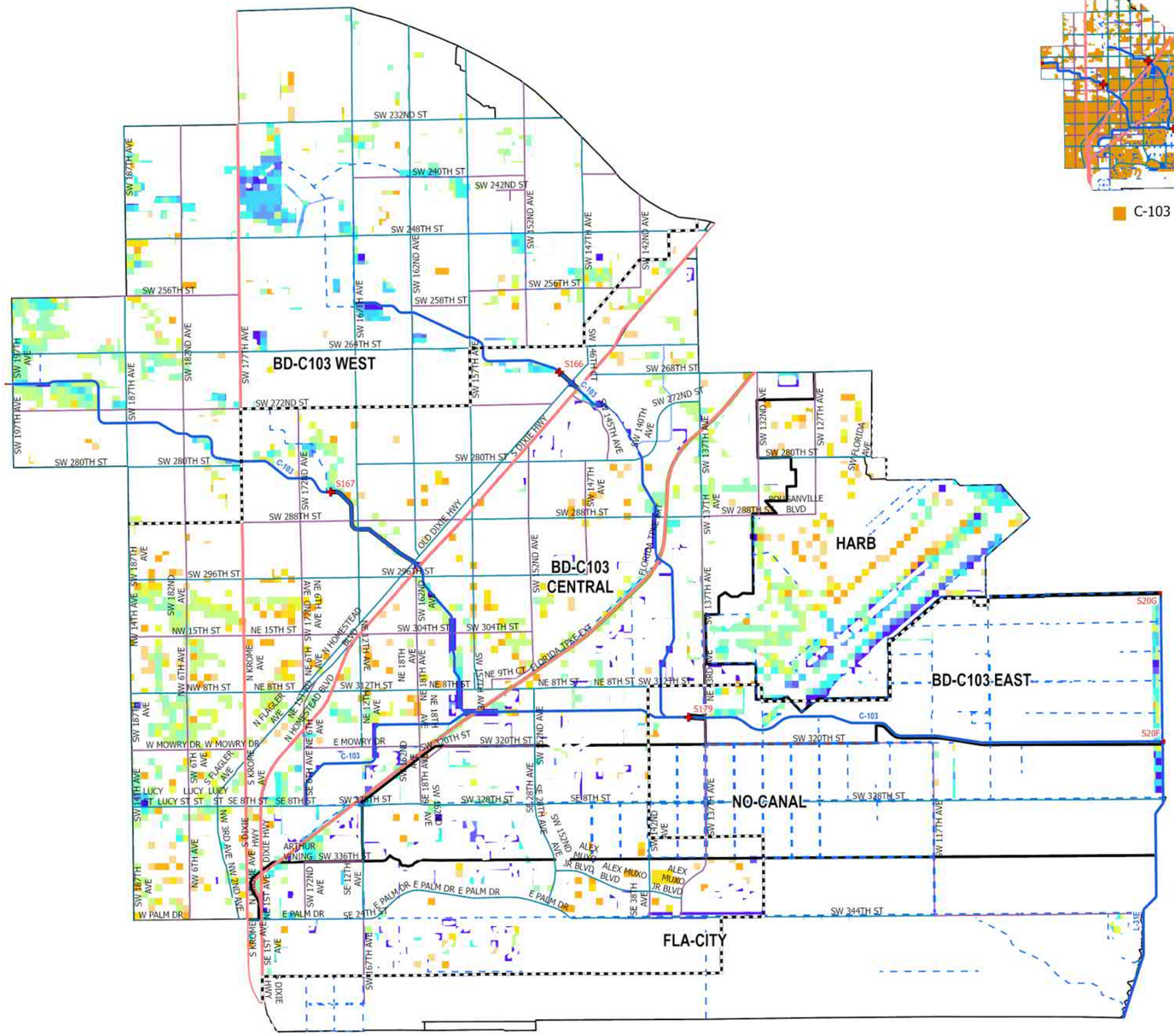
0 0.5 1 2 3 4 Miles

Figure A-376. Watershed C-103 Flood Duration Map for the 10-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = 0

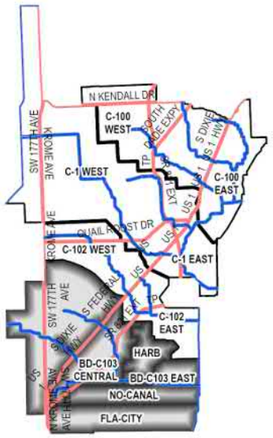
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

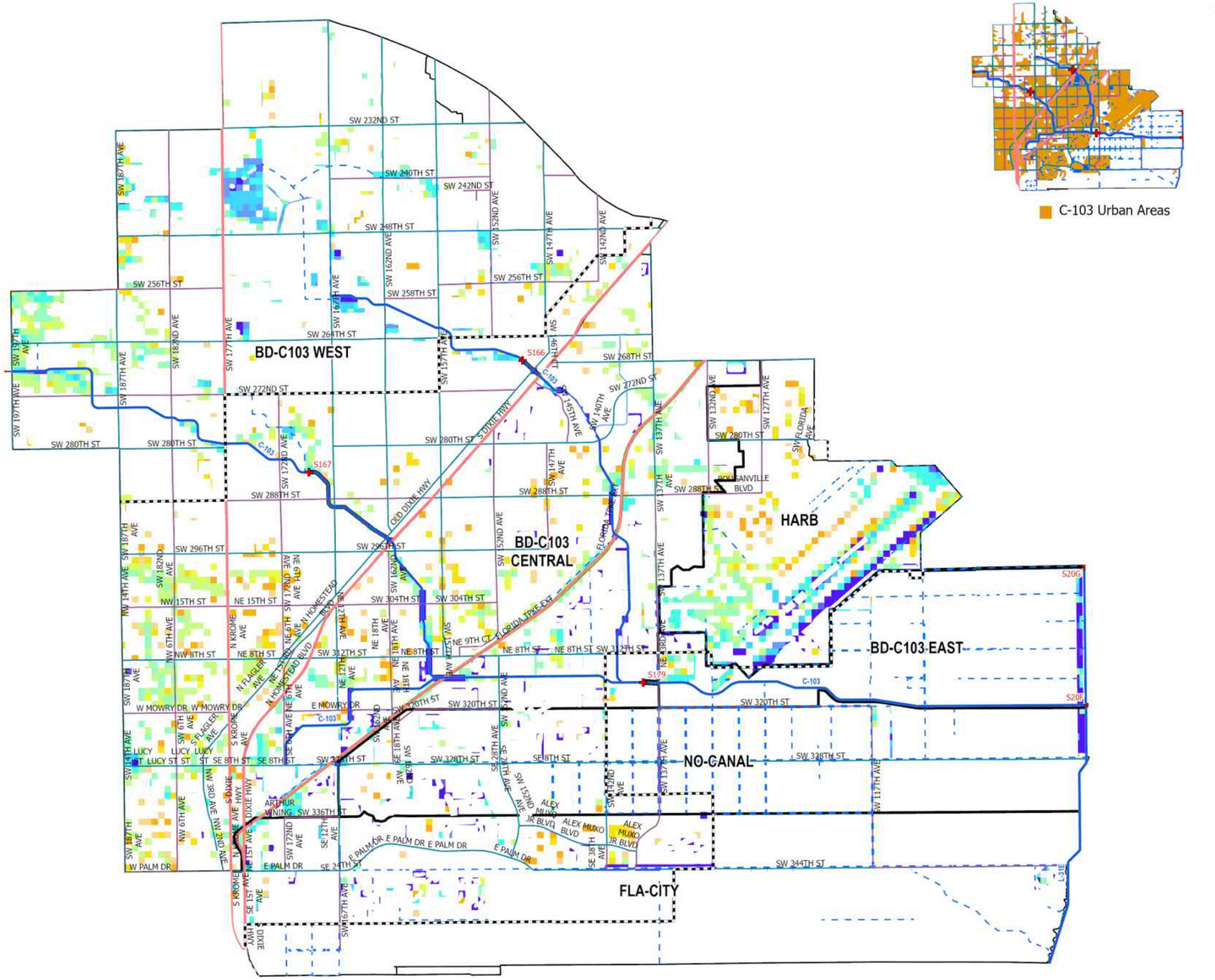
0 0.5 1 2 3 4 Miles

Figure A-377. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

25-Yr/72-Hr SLR = +1.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-378. Watershed C-103 Flood Duration Map for the 5-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn

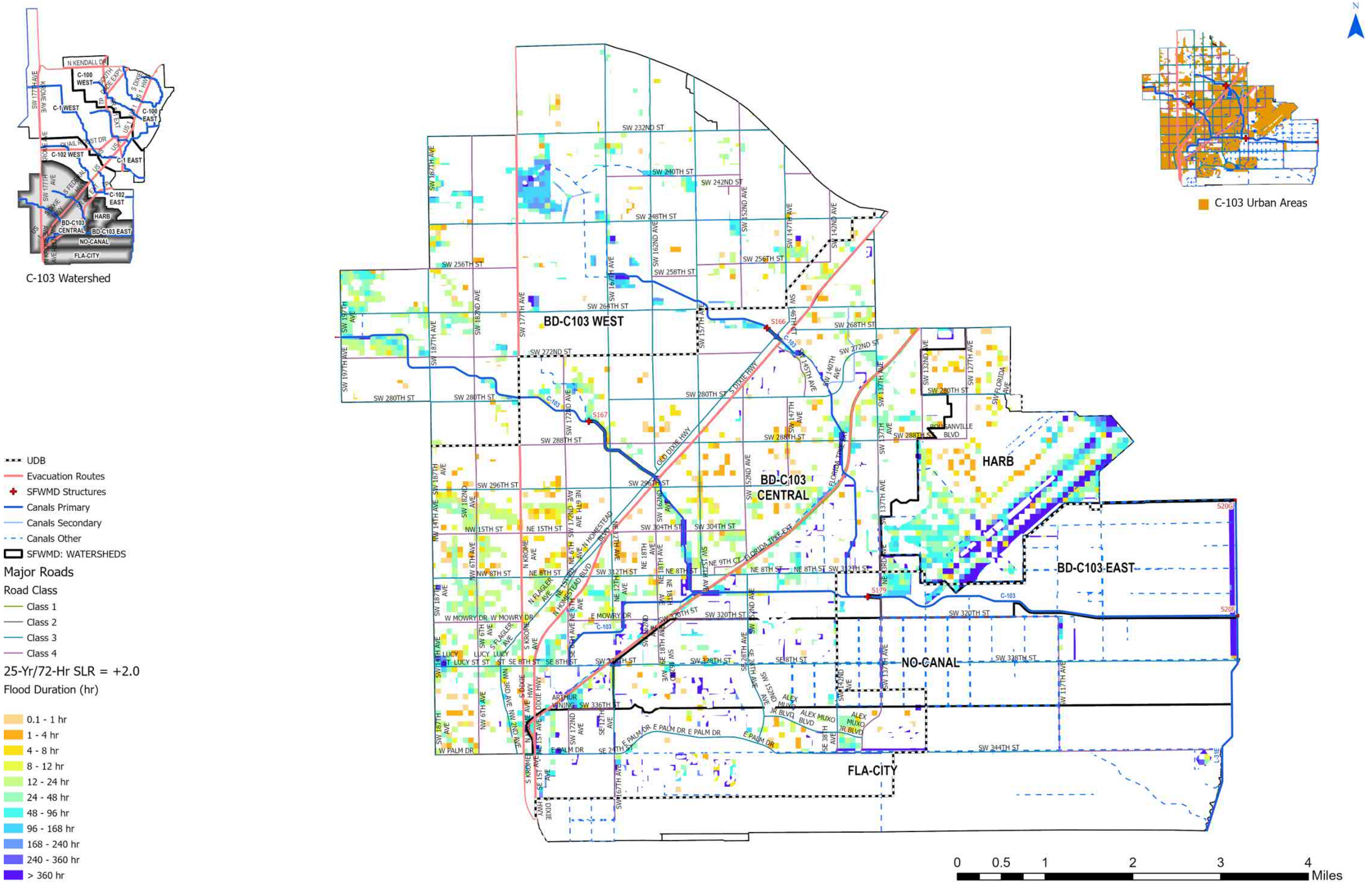
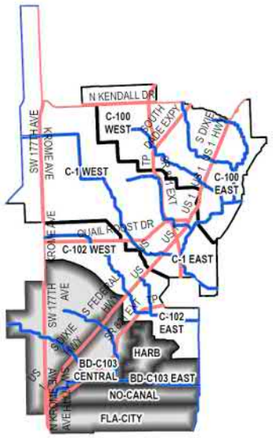
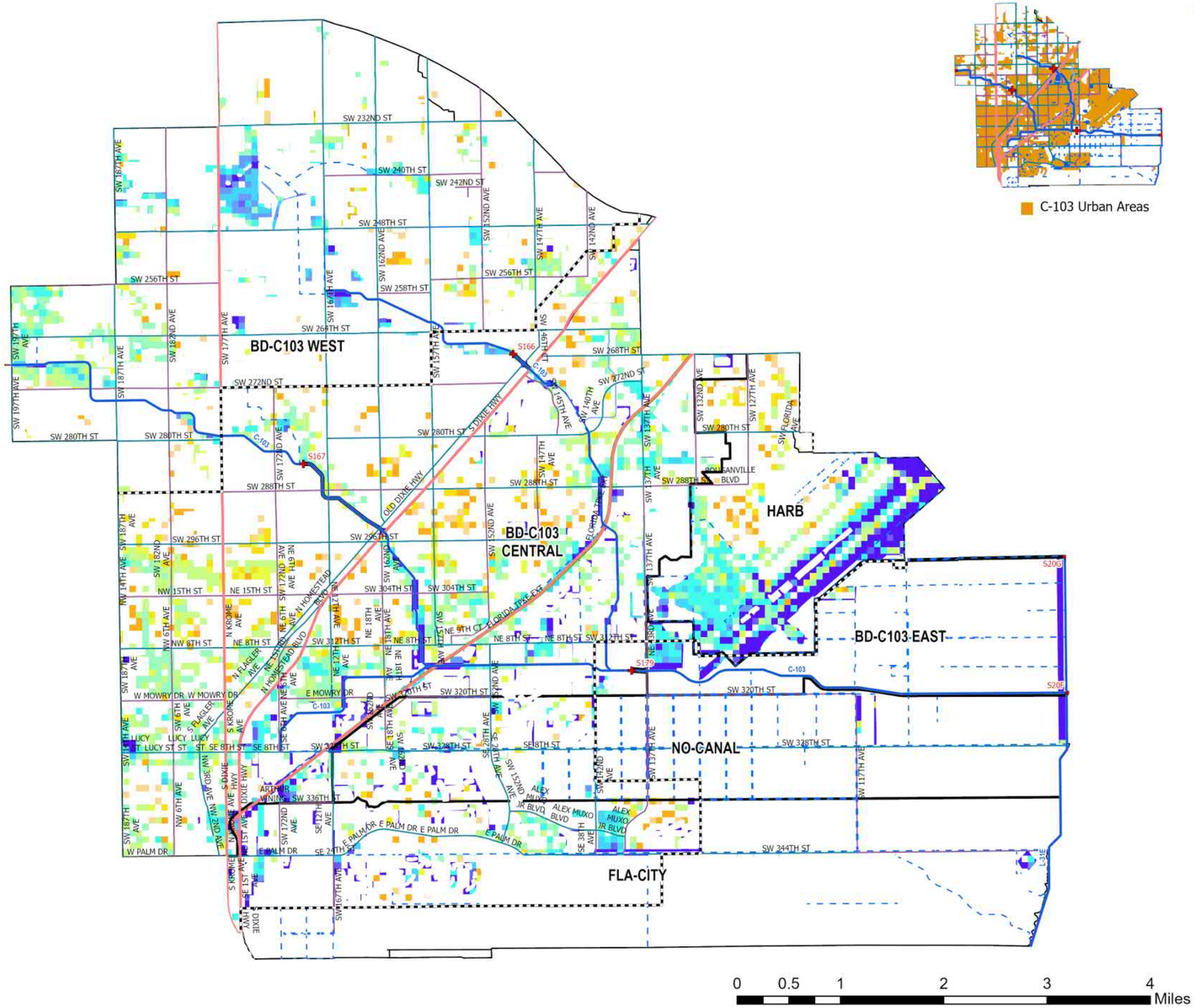


Figure A-379. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 2 in Urban Areas



C-103 Watershed



- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

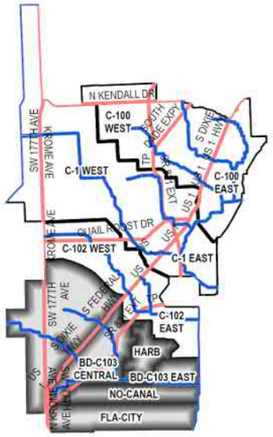
25-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

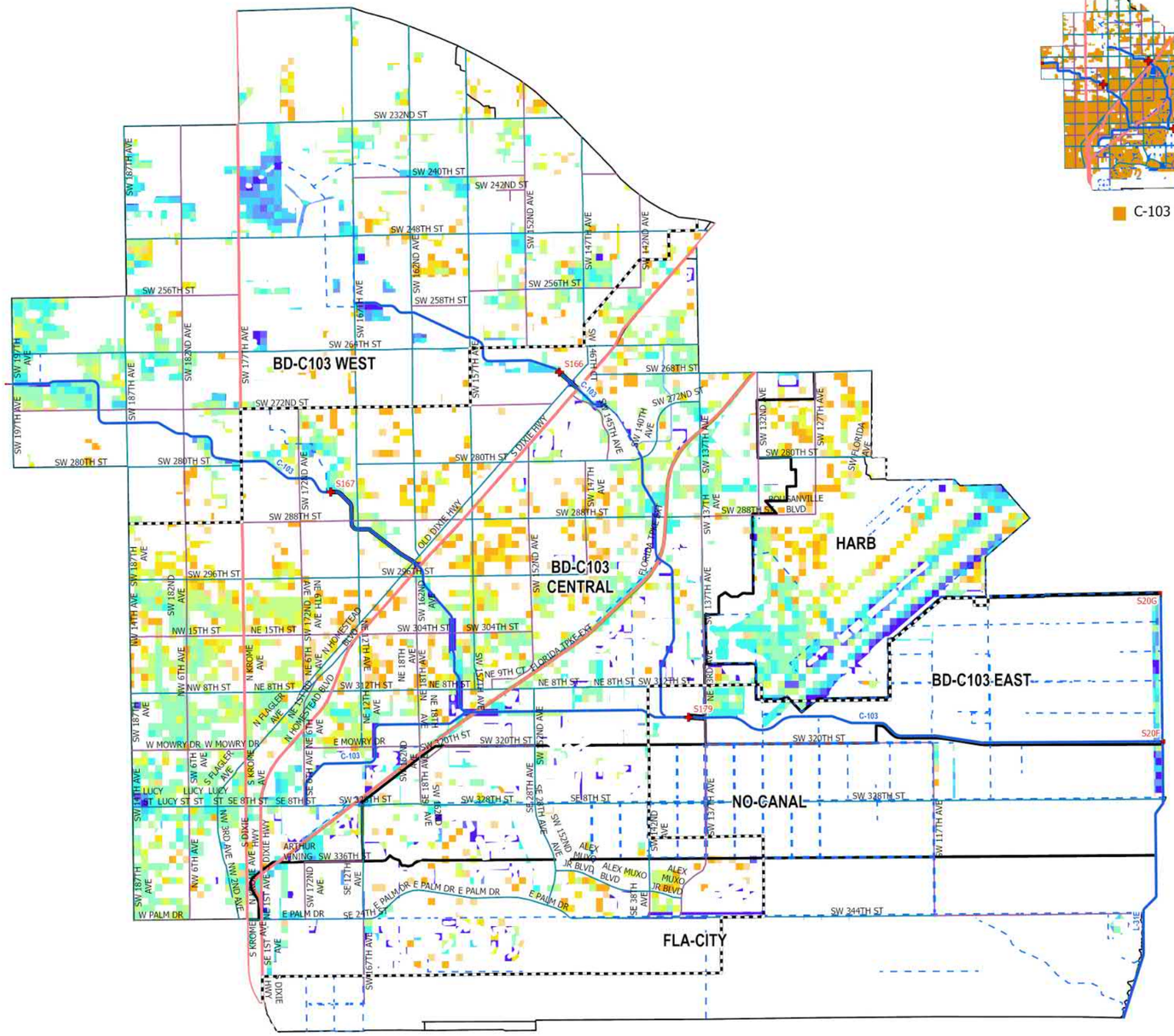
- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

C-103 Urban Areas

Figure A-380. Watershed C-103 Flood Duration Map for the 25-Year Design Storm Event for SLR 3 in Urban Areas



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = 0

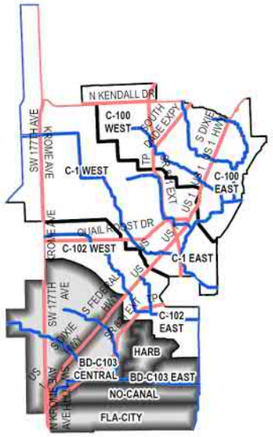
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

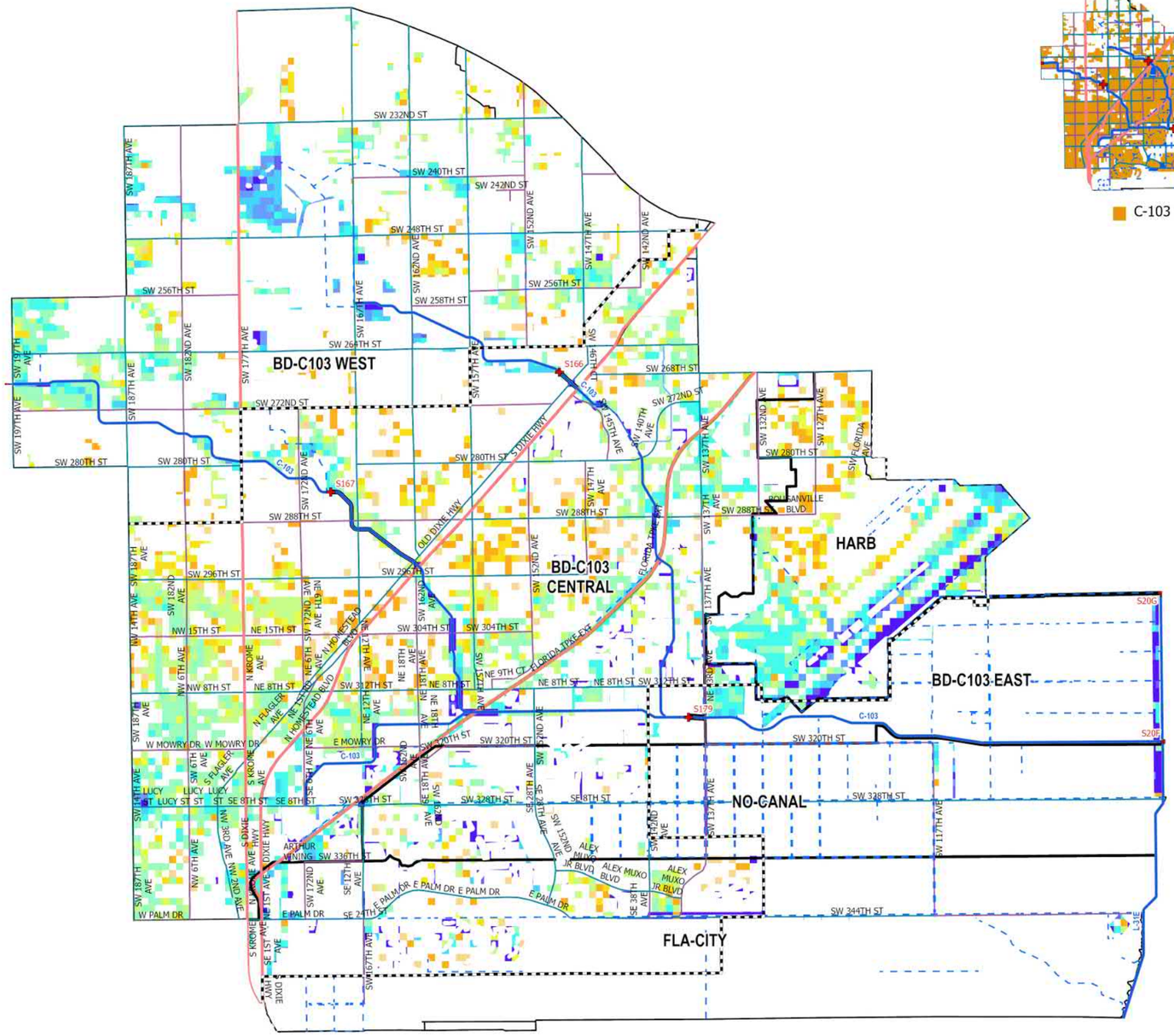
0 0.5 1 2 3 4 Miles

Figure A-381. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 0 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +1.0

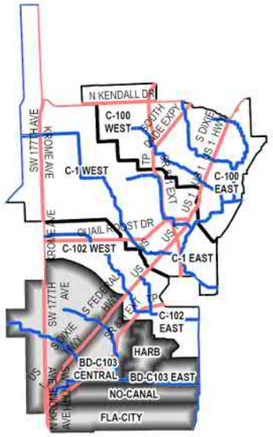
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

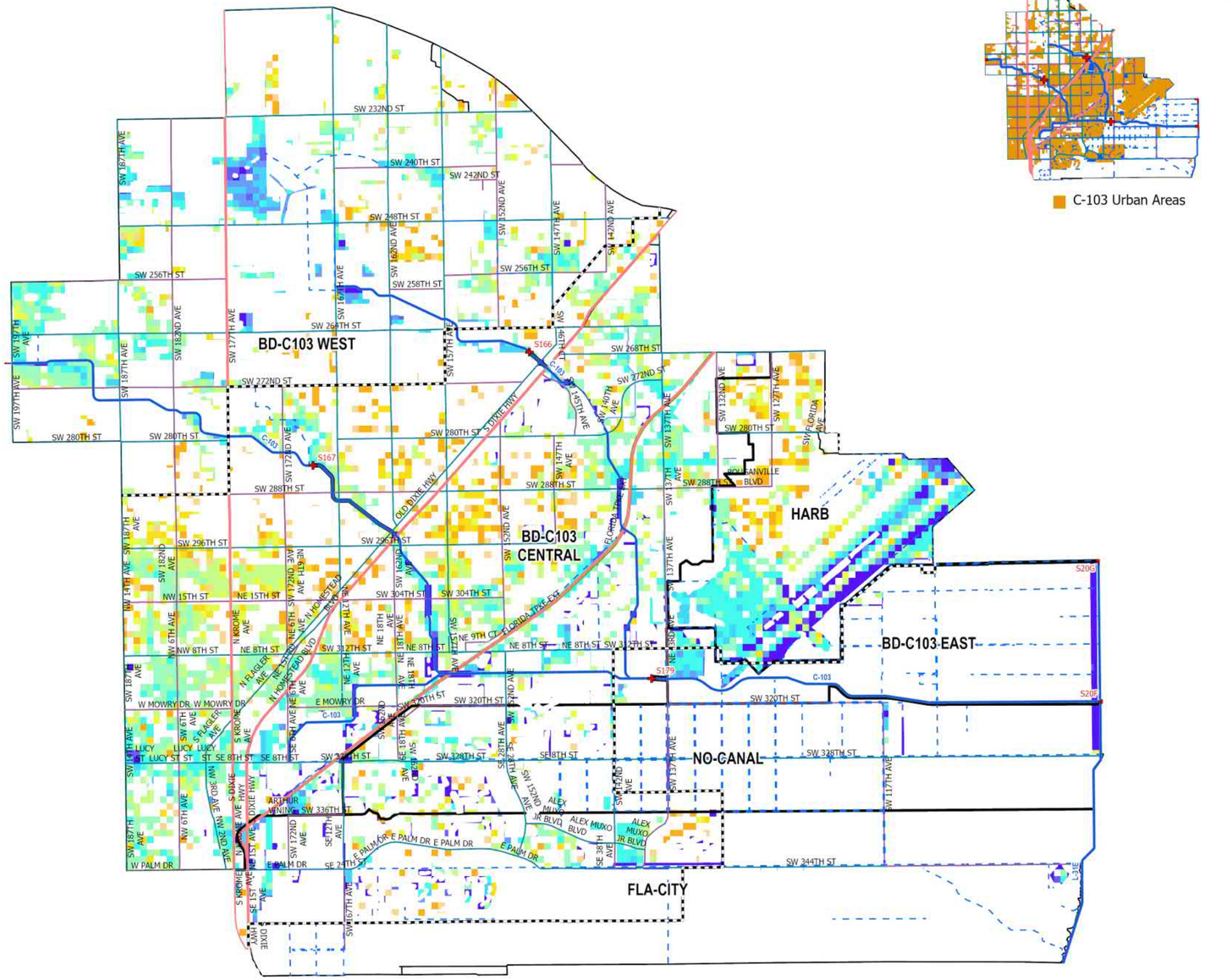
0 0.5 1 2 3 4 Miles

Figure A-382. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 1 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +2.0

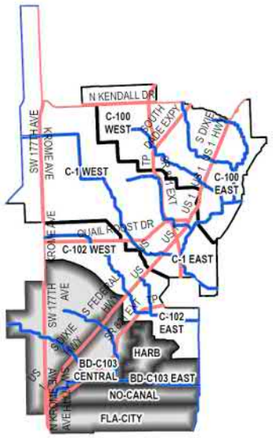
Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

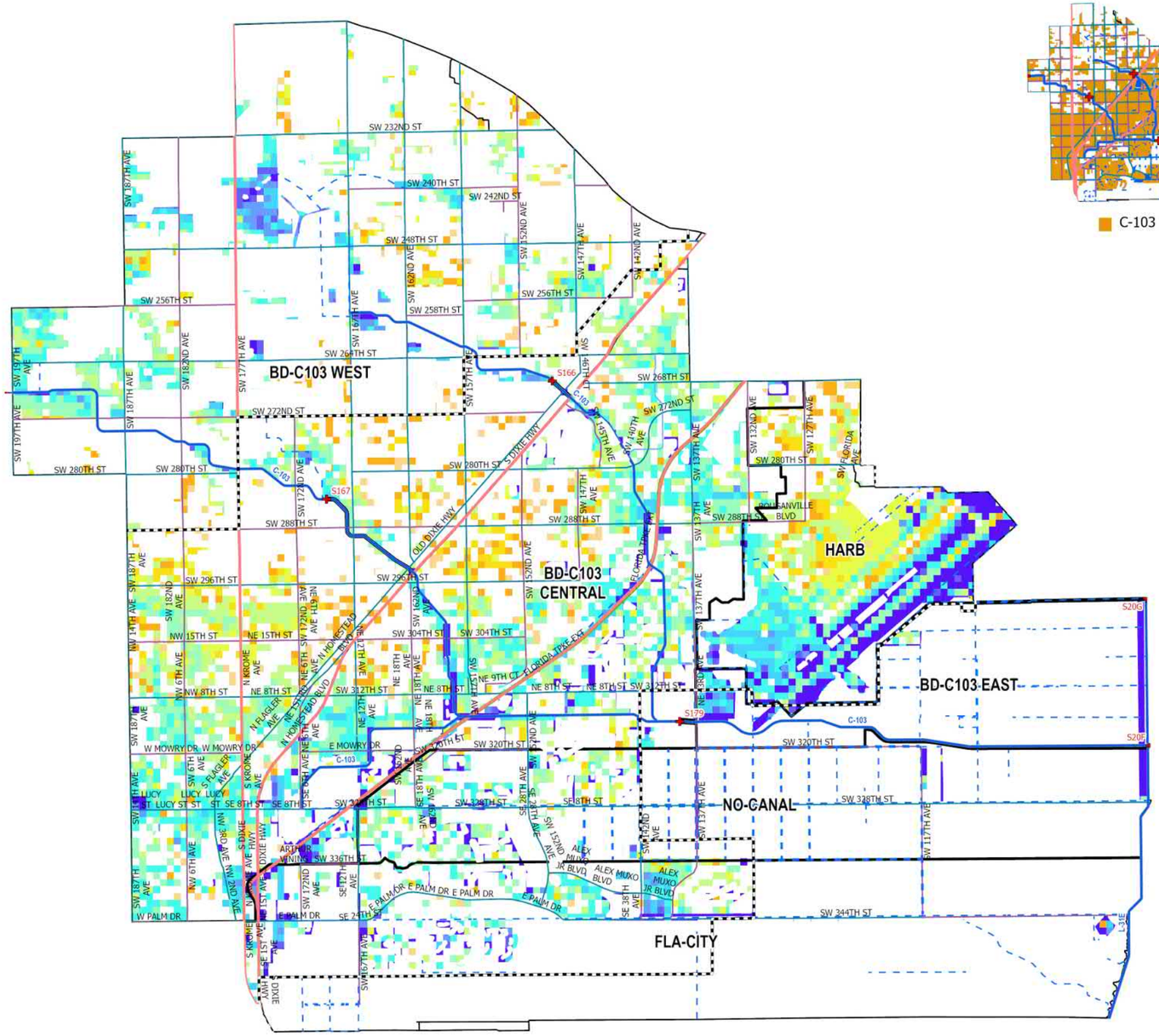
0 0.5 1 2 3 4 Miles

Figure A-383. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 2 in Urban Areas

Kimley»Horn



C-103 Watershed



C-103 Urban Areas

- UDB
- Evacuation Routes
- SFWMD Structures
- Canals Primary
- Canals Secondary
- Canals Other
- SFWMD: WATERSHEDS

Major Roads

Road Class

- Class 1
- Class 2
- Class 3
- Class 4

100-Yr/72-Hr SLR = +3.0

Flood Duration (hr)

- 0.1 - 1 hr
- 1 - 4 hr
- 4 - 8 hr
- 8 - 12 hr
- 12 - 24 hr
- 24 - 48 hr
- 48 - 96 hr
- 96 - 168 hr
- 168 - 240 hr
- 240 - 360 hr
- > 360 hr

0 0.5 1 2 3 4 Miles

Figure A-384. Watershed C-103 Flood Duration Map for the 100-Year Design Storm Event for SLR 3 in Urban Areas

Kimley»Horn