MEMORANDUM

To: Elizabeth Wong, PE (City of North Port)
From: Dave DeLoach, PE; Trillian Baldassari, PE
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File: 14-00400-00

Subject: Task 1.2 Big Slough Flood Reduction Study, Definition of Existing Flooding Problems

January 30, 2017

Definition of Existing Flooding Problems

This memorandum briefly describes existing flooding problems that are routinely experienced in portions of the Big Slough watershed, specifically along Myakkahatchee Creek near I-75 and within the Jockey Club. Information presented in this memorandum addresses the following elements of the Project Plan (Task 1.2).

- Define Existing Flooding Problems
  - Confirm Ability to Reproduce WMP Project Model Results
    - Simulations of Mean Annual to 100-Year Events
    - Flood Mapping and Comparison to Ardaman Results
    - Update Model to include a Small Number of Prior Conveyance Improvements
    - Flood Mapping and Comparison of Updated Model to Ardaman Results
  - Characterize Local Flooding Conditions
    - Myakkahatchee Creek at I-75
    - Jockey Club

<u>Ability to Reproduce WMP Project Model Results</u>

As discussed in the Big Slough Flood Reduction Study Project Plan, this project builds upon prior work performed and utilizes modeling tools previously developed by others under the Southwest Florida Water Management District (SWFWMD) Watershed Management Program (WMP). Before using those modeling tools for evaluation and development of flood reduction alternatives, it is important to confirm the ability to reproduce simulation results and inundation mapping of previous studies.

Simulations of Mean Annual to 100-year Events

Simulations were performed for the mean annual, 10-year, and 100-year 24-hour design storm events using both the 2012[1] and 2014[2] Versions of the 2004 Condition model (by Ardaman). Model network and runtime control files were retrieved directly from WMP project deliverable folders and used to perform the simulations. No changes were made to the retrieved model parameters or runtime controls.

Computed peak stages for each simulation were tabulated and compared to results taken directly from files provided as deliverables by Ardaman under the WMP project. Table 1 presents comparisons of Ardaman results to DES results for each design storm event and model version. Only those nodes with differences greater than 0.01-foot are shown.

Table 1 - Comparison of Computed Peak Stage for 24-Hour Design Storm Events, 2012 to 2014 Versions (A=Ardaman, D=DES)

Node	Version 2012									Version 2014								
	2.33-Yr			10-Yr			100-Yr			2.33-Yr			10-Yr			100-Yr		
	A	D	**Δ**	A	D	**Δ**	A	D	**Δ**	A	D	**Δ**	A	D	**Δ**	A	D	**Δ**
NU9091	26.42	26.42	-	26.65	26.65	-	26.92	26.91	***-0.01***	26.42	26.42	-	26.65	26.65	-	26.91	26.91	-
NB4856	18.71	18.73	***0.02***	20.40	20.40	-	21.39	21.39	-	18.71	18.71	-	20.40	20.40	-	21.39	21.39	-

Computational differences between Ardaman and DES results are very few in number and very small in magnitude, and may result from different runtime environments (computers, operating systems, etc.). It is possible that some model parameters or controls were slightly different at the time that the Ardaman simulations were performed and results compiled as compared to those that made their way into final project deliverables. Regardless, **simulation results indicate that DES can replicate Ardaman results reasonably well with the files retrieved from WMP project deliverables**. Mapping of 100-year inundation areas was performed and confirmed the ability to replicate prior Ardaman floodplain mapping.

Differences between the 2012 and 2014 versions of the model, as depicted in Figure 1 and Table 2, are substantially larger in magnitude than the foregoing computational differences and are owing to several specific model updates that were performed by Ardaman over the period from 2012 to 2014. These differences in computed peak stage reflect modifications that were made to the conveyance system (e.g., accounting for drainage improvements in the vicinity Price Boulevard) and/or changes in the accuracy of the model input data in describing certain features (e.g., using field survey data collected by a PLS in the vicinity of WCS-162). The 2014 results are considered more representative of conditions in the watershed in those local areas that were updated, but it should be noted that both the 2012 and 2014 models generally reflect a 2004 land use condition.

[1] SWFWMD Governing Board approved (May 22, 2012)
[2] Big Slough Watershed Study, K883 (October 10, 2014)

Table 2 - Difference Between Computed Peak Stages for 2012 and 2014 Model Versions

Node	2.33-Yr			10-Yr			100-Yr		
	2012	2014	**Δ**	2012	2014	**Δ**	2012	2014	**Δ**
NB0905	16.12	15.54	***-0.58***	16.62	16.23	***-0.38***	16.89	16.68	***-0.20***
NB0907	16.12	15.93	***-0.19***	16.62	16.23	***-0.38***	16.94	16.69	***-0.26***
NB0934	15.57	13.98	***-1.58***	15.87	14.99	***-0.88***	16.26	15.54	***-0.72***
NB0935	15.56	14.93	***-0.64***	15.85	15.25	***-0.60***	16.16	15.57	***-0.59***
NB0936	15.89	15.60	***-0.29***	16.16	15.65	***-0.51***	16.36	15.70	***-0.67***
NB0938	16.42	15.78	***-0.64***	16.47	16.06	***-0.42***	16.53	16.79	***0.26***
NB0943	14.27	14.27	-	14.95	14.95	-	16.09	15.42	***-0.68***
NB0945	14.93	14.93	-	15.14	15.14	-	16.15	15.51	***-0.64***
NB9035	18.07	19.37	***1.30***	18.10	19.40	***1.30***	18.14	19.43	***1.29***
NB9045	17.54	16.36	***-1.18***	17.94	17.27	***-0.67***	18.07	17.88	***-0.20***
NB9073	16.89	14.58	***-2.31***	17.03	16.02	***-1.01***	17.17	16.86	***-0.31***
NB9080	16.89	14.37	***-2.52***	17.03	16.01	***-1.02***	17.17	17.02	***-0.15***
NB9090	16.16	14.43	***-1.73***	16.27	14.50	***-1.77***	16.48	16.13	***-0.34***
NB9095	16.48	16.48	-	16.59	16.58	-	16.81	16.66	***-0.15***
NB9100	16.14	12.30	***-3.84***	16.19	14.48	***-1.71***	16.37	16.13	***-0.23***
NB9110	15.22	14.11	***-1.11***	15.87	14.16	***-1.71***	16.26	15.52	***-0.74***
NB9120	14.30	12.11	***-2.19***	15.87	13.44	***-2.43***	16.26	15.52	***-0.74***

Update of Selected Model Parameters Using Existing Available Data

The base model for this project was planned to be the SWFWMD Governing Board-approved 2012 Version of 2004 Condition model. City of North Port staff requested, and DES agreed, that a specific set of model features be updated in that 2012 Version of the model, as follows:

- add a single 24-inch PVC pipe from Public Works site to Creighton WW (check)
- utilize available as-built survey data and add two (2) gates at WCS 101
- incorporate available survey and storm pipe data in Price Blvd area
- change 30-inch ADS pipe, flowing from Price Blvd to R-32, to 36-inch ADS
- add three (3) 48-inch CMP beneath Appomattox Blvd (Stantec plans available)

It is evident from review of prior WMP project reports that many of these same revisions were already implemented by Ardaman over the period from 2012 through 2014, with the SWFWMD Governing Board-approved 2012 Version of 2004 Condition model as a base. In some cases, during Ardaman's development of the 2014 Version of 2004 Condition model, design-level (not "as-built") information was employed and will need to be revised. However, in other cases, site-specific field survey data was collected by a Professional Land Surveyor (PLS) and employed in Ardaman model updates. Specifically, Ardaman incorporated field survey data that was collected by a PLS at Water Control Structure WCS-162 and throughout the vicinity of Price Boulevard.

In the Ardaman WMP Project report, entitled "North Port/Big Slough Watershed Management Program (K883), Work Order #4, Completion Report for Task 1.1.3.7b – Formulation and Evaluations of BMPs for WCS-162" (Sep 2, 2014), reference is made to model revisions near WCS-162:

> "To evaluate BMPs at WCS-162, Ardaman requested to survey the structure to better understand the geometry of the structure and canal with the purpose of assessing availability of adequate space for additional gates. The survey data provided by Van Buskirk/Fish & Associates, Inc. is included in Attachment A, and the structure pictures are provided in Attachment B. The existing condition model was revised using the latest (2014) survey information for this BMP Evaluation. The update model simulated results rendered no change in model results compared to the May 2012 Governing Board approved model."

In the Ardaman report, entitled "North Port/Big Slough Watershed Management Program (K883), Work Order #4, Completion Report for Task 1.1.3.7b – Formulation and Evaluation of BMPs for Price Boulevard to Improve LOS" (Sep 22, 2014), reference is made to model revisions along Price Boulevard:

> "Ardaman staff reviewed the May 2012 Governing Board approved model setup within the area of interest (AOI) to verify whether the current model adequately represents the 2014 condition. With desktop and field reconnaissance of the area, it was observed that a section of the surface and sub-surface drainage systems near the North Port High School had been recently updated. Ardaman recommended surveying the AOI to better represent the existing condition…"

> "Based on recent survey, stormwater runoff collected from the north and south swales of West Price Boulevard generally flows west from the North Port Utilities Building, whereas stormwater runoff from the remaining areas flows east from this location. Accumulated stormwater runoff going west from the North Port Utilities Building ultimately flows north via the Indian burial ground toward the R-32 canal. Stormwater runoff going east toward Big Slough is routed through a series of surface water features (ditches, swales and inlets) which connects to a sub-surface system along the north side of West Price Boulevard…"

> "The May 2012 Governing Board approved model was updated using the 2014 survey provided by Van Buskirk/Fish & Associates, Inc. The revised 100-year storm event model results indicate that West Price Boulevard would not flood near the North Port High School as previously predicted. However, the stretch of West Price Boulevard north of Little Salt Spring would still flood by 0.4 feet at the crown during the 10-year storm event."

It is evident from those prior reports that the model network input data changes, particularly in the Price Boulevard area, were quite extensive. It is also understood that most of the other requested model updates (see bulleted items, above) were already incorporated and tested prior to development of the September 22, 2014 version of the Existing Condition model by Ardaman.

To expedite the 2016 model update, the September 22, 2014 version of the 2004 Condition model was used as a starting point. An added benefit to using this model as a starting point is that model element naming conventions are preserved and will match all references in reports, notes, and correspondence generated by Ardaman during the period from 2012 through 2014.

Rather than replicating modifications already made, DES staff reviewed and supplemented the 2014 model revisions as discussed in the following.

- **Add a single 24-inch PVC pipe from Public Works site to Creighton WW (check).**
  The Ardaman Sep 22, 2014 model was found to contain the 24-inch PVC pipe. Specifically, model Reach RI0016 from Node NI0016 to Node NI0020 contains a 77-foot 24-inch pipe with upstream invert 20.21 feet, NAVD, and downstream invert 17.65 feet, NAVD. A Network_Arc feature was added to the project geodatabase as the pipe was not included in the Ardaman geodatabase.

- **Utilize available as-built survey data and add two (2) gates at WCS 101**
  The Ardaman Sep 22, 2014 model does not contain up to date control structure data for the additional gates. As-built drawings provided to DES by the City of North Port were used to update model reach data for the gates as well as to correct adjacent weir lengths. Specifically, no changes were made to RB1060A representing the four original gates, RB1060B was added to represent the two new gates, and weir reaches RB1060E, F, and G were replaced with RB1060C. Network_Arcs were edited in the project Geodatabase to reflect these changes.

- **Incorporate available survey and storm pipe data in Price Blvd area**
  The Ardaman Sep 22, 2014 model was found to incorporate site-specific field survey data collected in the Price Boulevard area. Model input was compared to survey drawings (Van Buskirk / Fish & Associates, June 17, 2014) for consistency, and no revisions were deemed necessary.

- **Change 30-inch ADS pipe, flowing from Price Blvd to R-32, to 36-inch ADS**
  The Ardaman Sep 22, 2014 model was found to correctly reflect a 36-inch diameter pipe with inverts as indicated on field survey Sheet 5 of 7 Van Buskirk / Fish & Associates dated June 17, 2014.

- **Add three (3) 48-inch CMP beneath Appomattox Blvd (Stantec plans available)**
  The Ardaman Sep 22, 2014 model does not include these conveyance features. Three (3) 48-inch corrugated metal pipes (CMPs) were added to the model input data set per information contained in plans provided to DES by the City of North Port. Specifically, model Reach RH0110A was added from Node NH0110 to Node NH0130, containing three 48” CMPs with upstream inverts 3.09, 2.92, and 2.87 feet, NAVD, and downstream inverts 2.51, 2.79, and 2.76 feet, NAVD. Information was taken from Stantec design drawings provided by the City of North Port for Phase 3 Reclaimed Water Main Extension Appomattox Drive (2014), assuming NAVD and estimating 100-ft pipe lengths. One Network_Arc was added to the project Geodatabase to reflect pipe connectivity.

Flood Mapping and Comparison of Updated Model to Ardaman Results

Simulations were performed for the mean annual, 10-year, and 100-year 24-hour design storm events to allow comparison of the 2016 Version (DES) to the 2014 Version (Ardaman) of the 2004 Condition. The sole differences between the 2016 and 2014 versions of the model include WCS-101 control structure improvements and three 48-inch CMP culverts at Appomattox Boulevard using as-built information.

Differences in computed peak stage between the 2014 and 2016 versions of the model are depicted in Figure 2 and Table 3. Mapping of inundation areas was performed to confirm the very small spatial extent of changes resulting from the revisions. Stage differences, found only in results of simulations of the 100-year storm event, are related to model stability and result from a change in the computational time step from 0.1 seconds (for the 2014 model) to 1 second (for the 2016 model).

Table 3 - Comparison of Computed Peak Stage for 24-Hour Design Storm Events, 2014 to 2016 Versions (2014 Version by DES)

Node	2.33-Yr			10-Yr			100-Yr		
	2014	2016	***Δ***	2014	2016	***Δ***	2014	2016	***Δ***
NE7053	13.07	13.07	-	13.68	13.68	-	14.19	14.32	***0.12***
NS5578	17.65	17.65	-	17.99	17.99	-	18.30	18.51	***0.21***
NS2810	20.91	20.91	-	21.07	21.07	-	21.24	21.13	***-0.11***
NU9087	26.95	26.95	-	27.14	27.14	-	27.13	27.31	***0.18***

Characterize Local Flooding Conditions

The City has routinely experienced flooding in the Big Slough Watershed. Two such flood zones are the areas near Myakkahatchee Creek at I-75 and the areas in and around the Jockey Club.

Myakkahatchee Creek at I-75

The Myakkahatchee Creek at I-75 Study Area covers approximately 335 acres adjacent to the Myakkahatchee Creek. The area is bounded on the east by Sumter Boulevard and traversed from east to west by Interstate Highway 75. Figure 2a depicts existing mean annual and 10-year floodplains within the I-75 study area adjacent to Myakkahatchee Creek, both north and south of the interstate, as developed during the North Port/Big Slough WMP project. Figure 2b shows sub-basin delineations and the model network features used to simulate response to rainfall during the WMP project. Figure 2c depicts hydrologic soils groups.

Routine flooding of the area is due to Myakkahatchee Creek exceeding its banks in low areas of poorly drained soils. Comparison of hydrologic soil groups to areas of inundation suggest that the slough has historically flooded these low areas on a frequent basis. Alternative development will focus on reducing flows in this section of Myakkahatchee Creek, through diversion, storage, bypass, or other means.

Myakkahatchee Creek at Jockey Club

The northern section of the Jockey Club Study Area covers approximately 62 acres and is bounded on the north by Appomattox Drive, on the west by Pan American Boulevard, and on the east by Myakkahatchee Creek. The southern section of the Jockey Club Study Area near Ketona Road is also included and is approximately 82 acres in size. Figure 3a depicts existing mean annual and 10-year floodplains within the Jockey Club study area adjacent to Myakkahatchee Creek, both north and south of the interstate, as developed during the North Port/Big Slough WMP project. Figure 3b shows sub-basin delineations and the model network features used to simulate response to rainfall during the WMP project. Figure 3c depicts hydrologic soils groups.

Flooding may result from either backwater effects or local collection system capacity, depending upon the event. Recent improvements to the collection system (ditch lining) may improve capacity during short-duration local rainfall events. Alternative development will focus on improving flooding conditions related to backwater conditions.

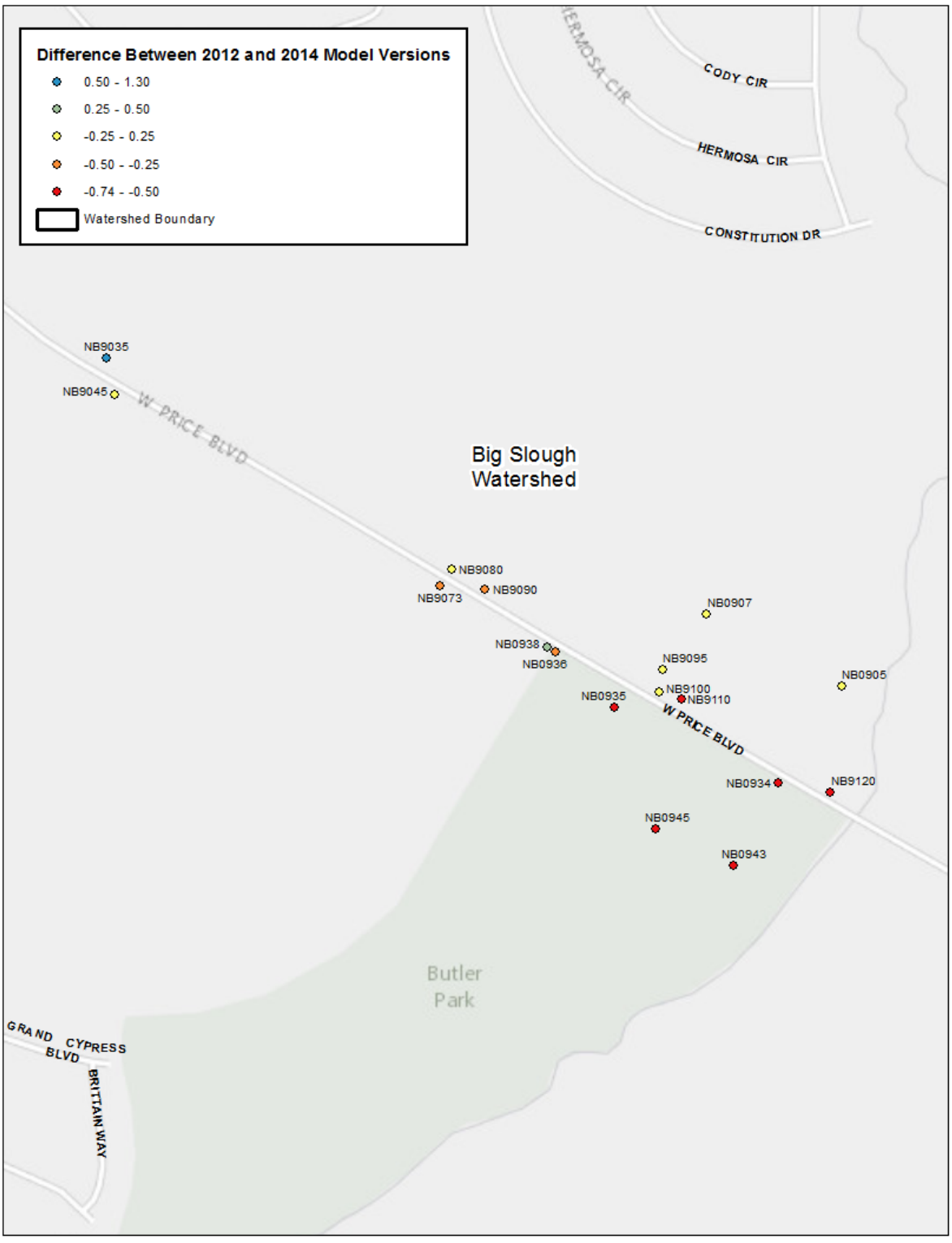

Figure 1 – Locations of Differences in Computed Peak Stages between 2012 and 2014 Model Versions

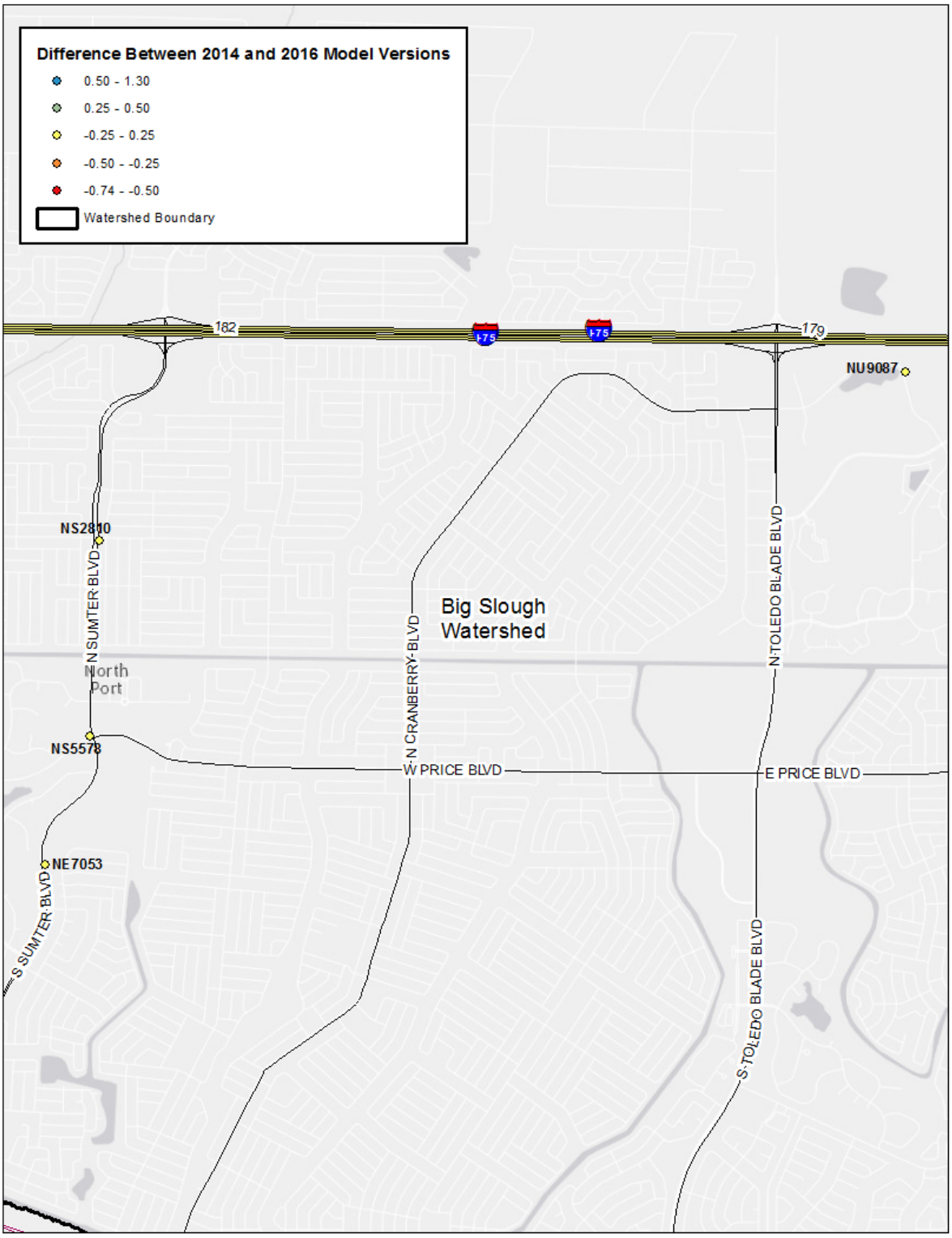

Figure 2 - Locations of Differences in Computed Peak Stages between 2014 and 2016 Model Versions

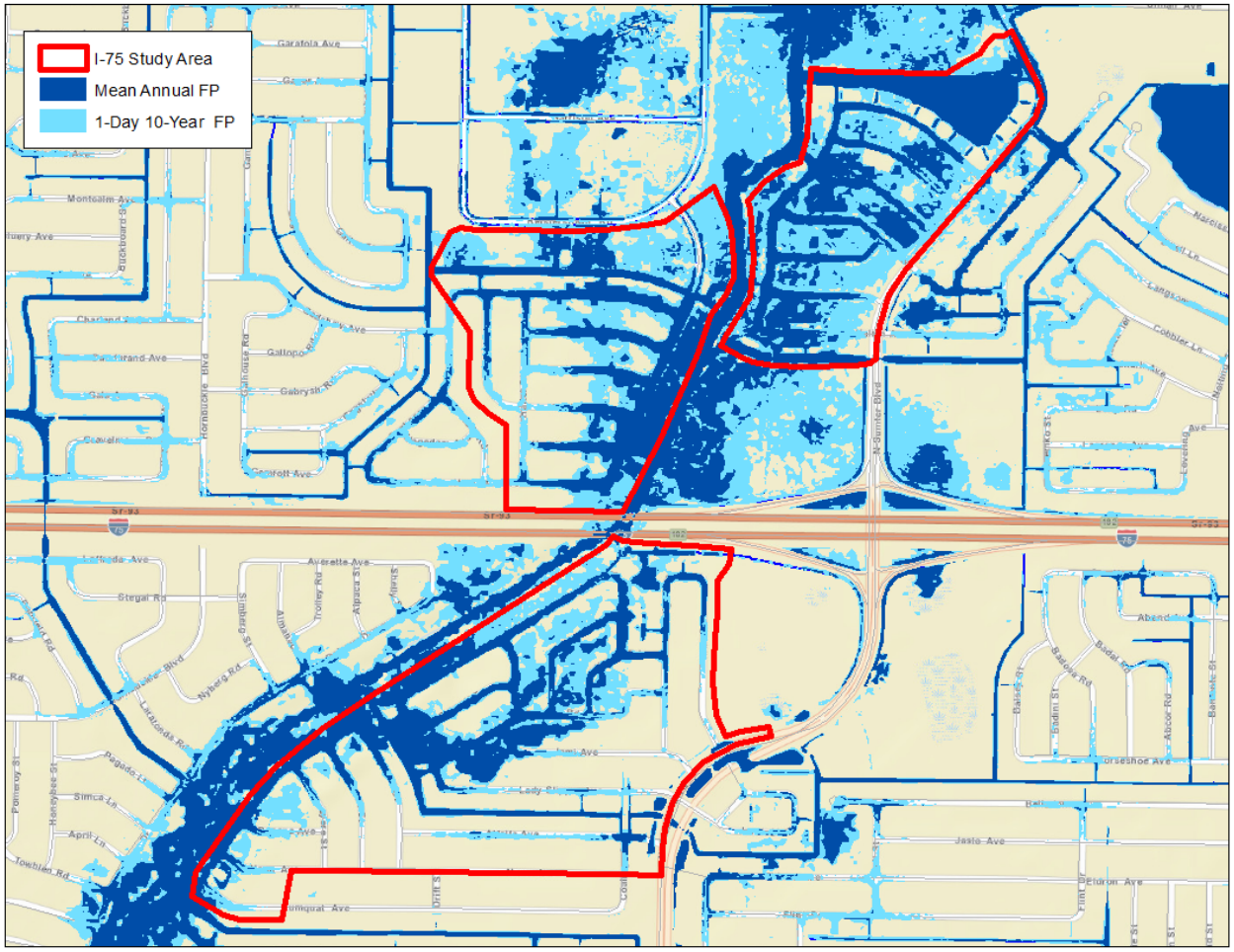

Figure 3a: I-75 Study Area, Mean Annual and 10-Year Floodplains

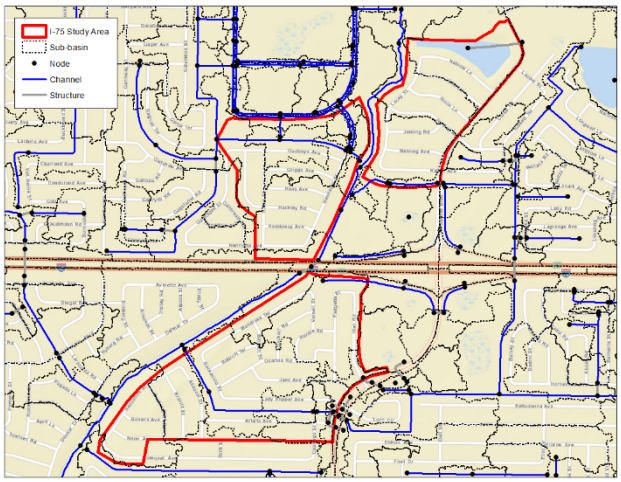

Figure 3b: I-75 Study Area, Model Network

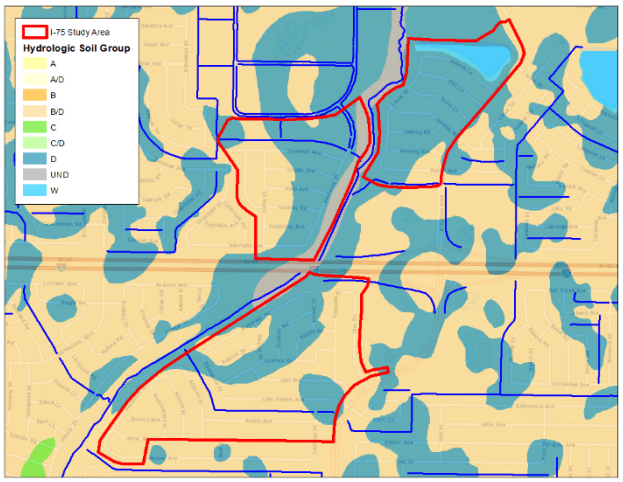

Figure 3c: I-75 Study Area, Hydrologic Soil Groups

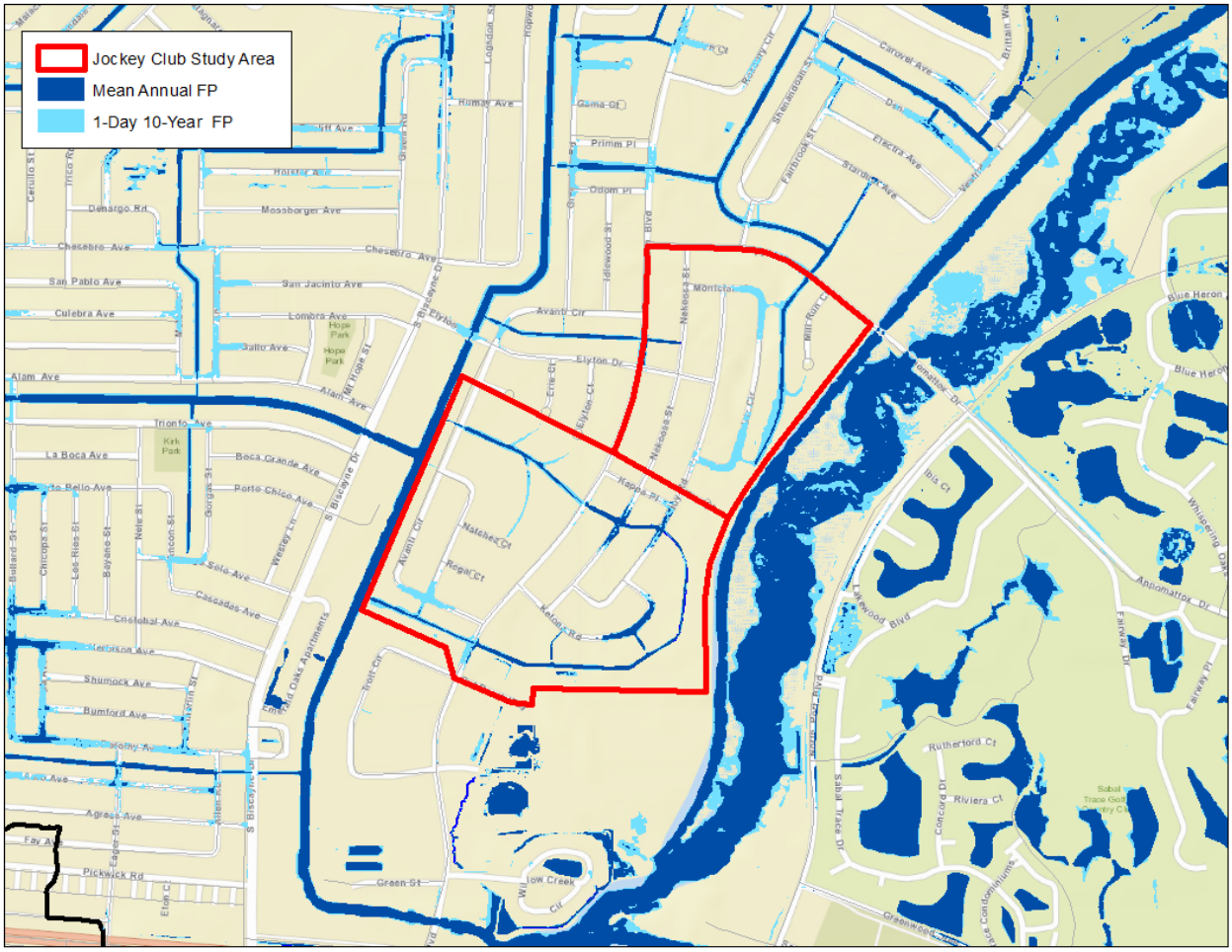

Figure 4a: Jockey Club Study Area, Mean Annual and 10-Year Floodplains

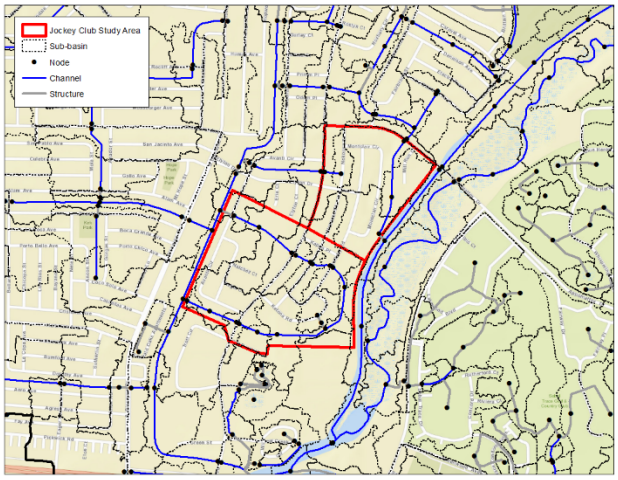

Figure 4b: Jockey Club Study Area, Model Network

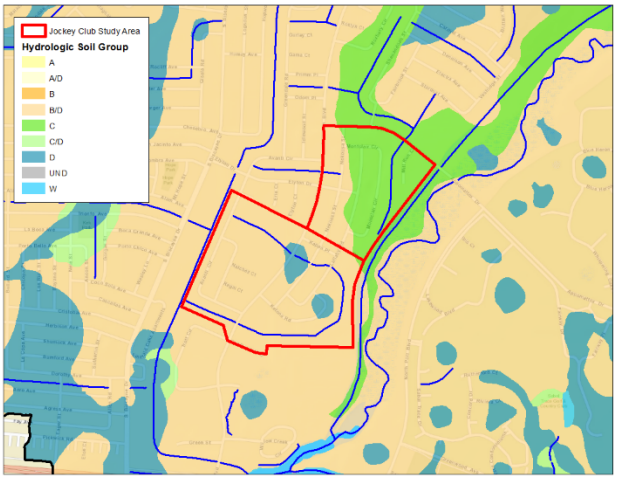

Figure 4c: Jockey Club Study Area, Hydrologic Soil Groups