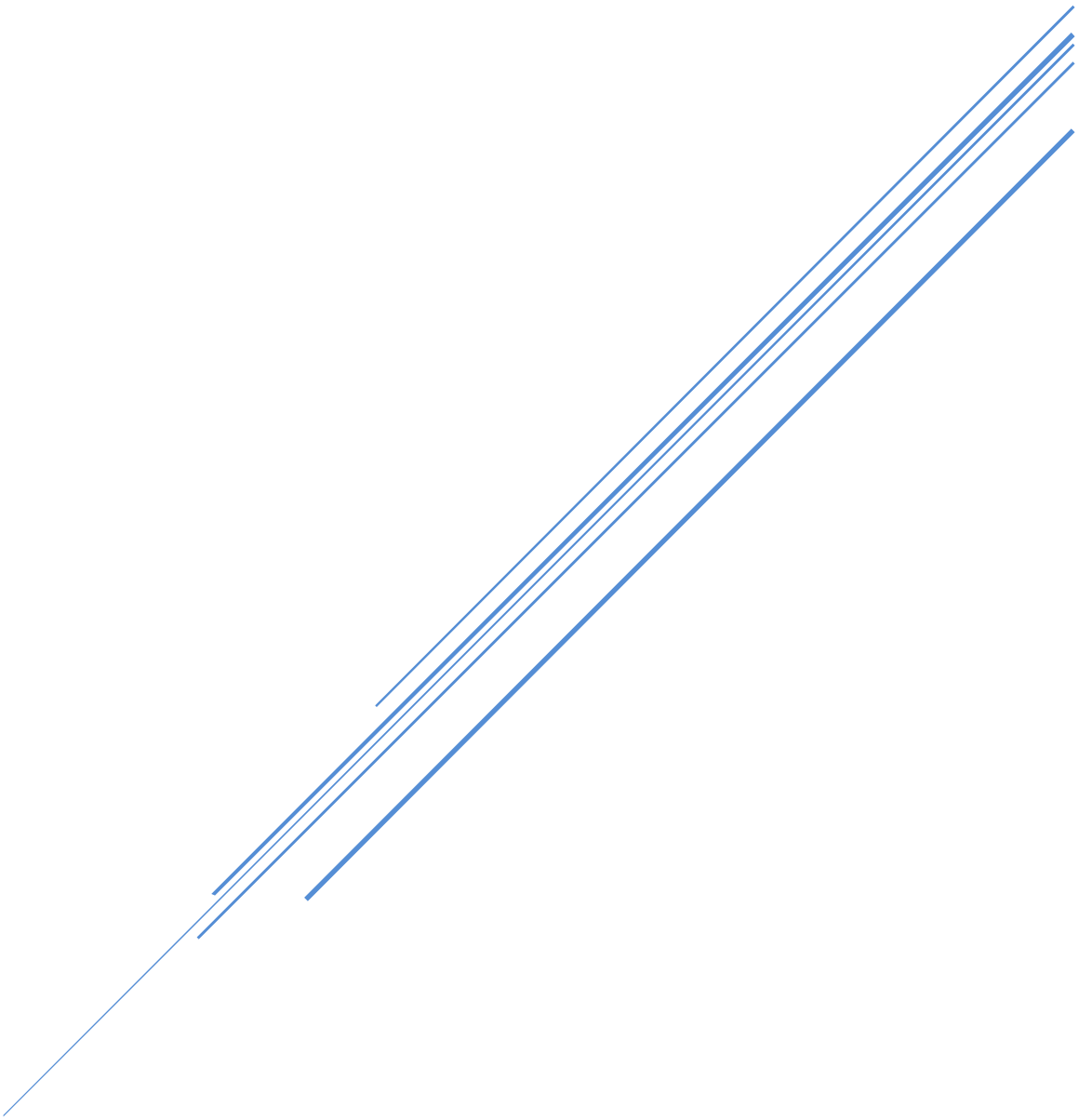
APPENDIX 1A

Data Discovery Memorandum



Lower Charlotte Harbor Flatwoods Strategic Hydrologic Restoration Plan

Lower Charlotte Harbor Flatwoods Strategic Hydrologic Restoration Plan

1A - Data Discovery Memorandum

PREPARED FOR:

1050 Loveland Boulevard
Port Charlotte, Florida 33980

PREPARED BY:

Water Science Associates

IN CONJUNCTION WITH:

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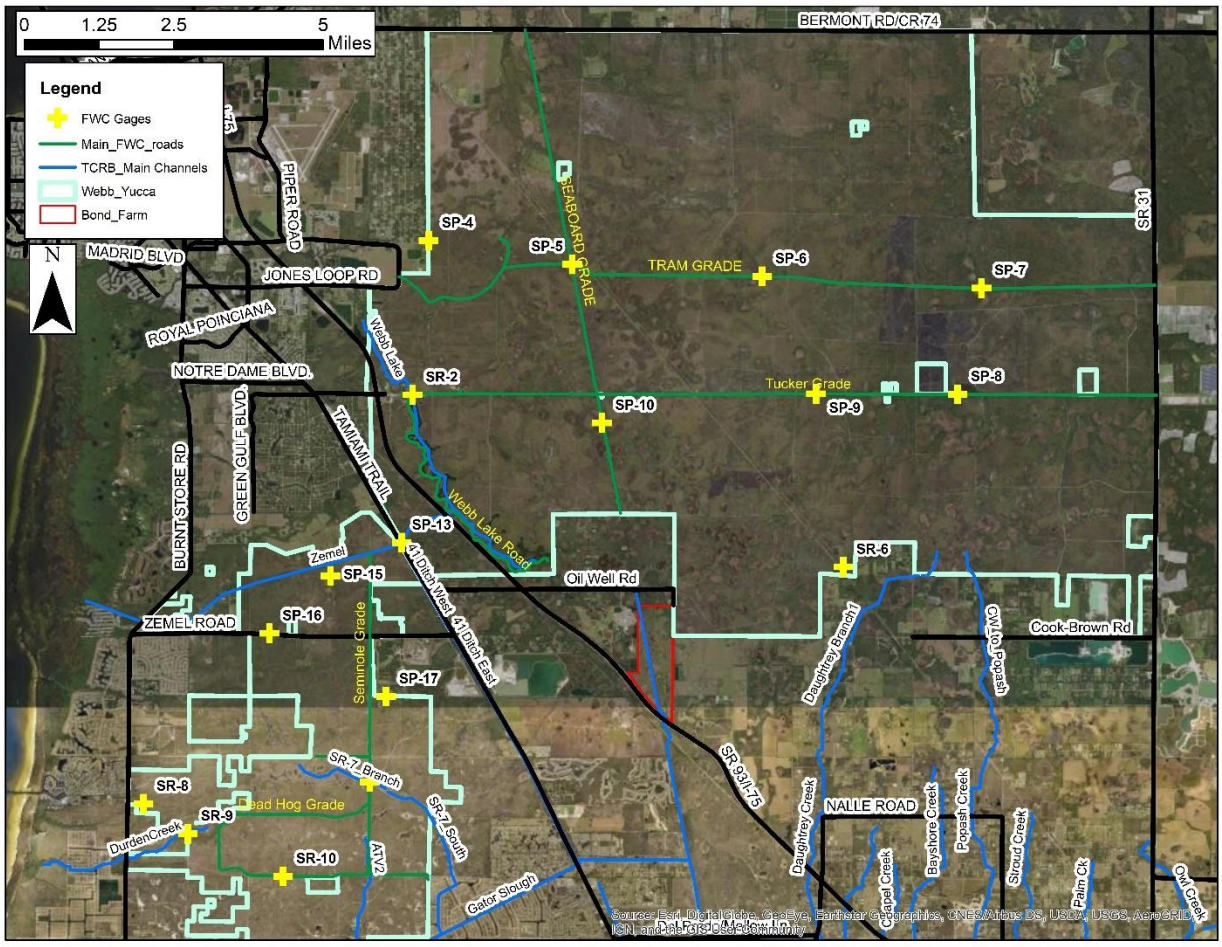

This study provides a description of Babcock Webb (then called Cecil Webb) Wildlife Management Area (WMA) with the objective of developing a water management plan for the WMA to improve fish and wildlife habitat, enhance vegetative communities, manage water to better attenuate extremes of the wet and dry periods, and incorporate elements which would assist in alleviating peripheral flooding problems of adjoining land owners (Johnson Engineering, 1983). High water levels were observed south of the WMA in North Fort Myers between Cook-Brown Road and Nalle Grade Road. The flooding problems were attributed to development in North Fort Myers rather than any management changes in Babcock Webb that might exacerbate downstream flooding. Washouts were reported during the 1982 wet season for the North Tram Road, Tuckers Grade, and Seaboard Grade. High water levels were noted in southwest Babcock Webb at Seaboard. The report recommended a water storage area (currently in place) north of Tuckers Grade Road 3.2 miles west of SR 31 and construction of a water control structure in the North Prong Alligator Creek east of Strasse Road (SP-4), which was ultimately built. 25

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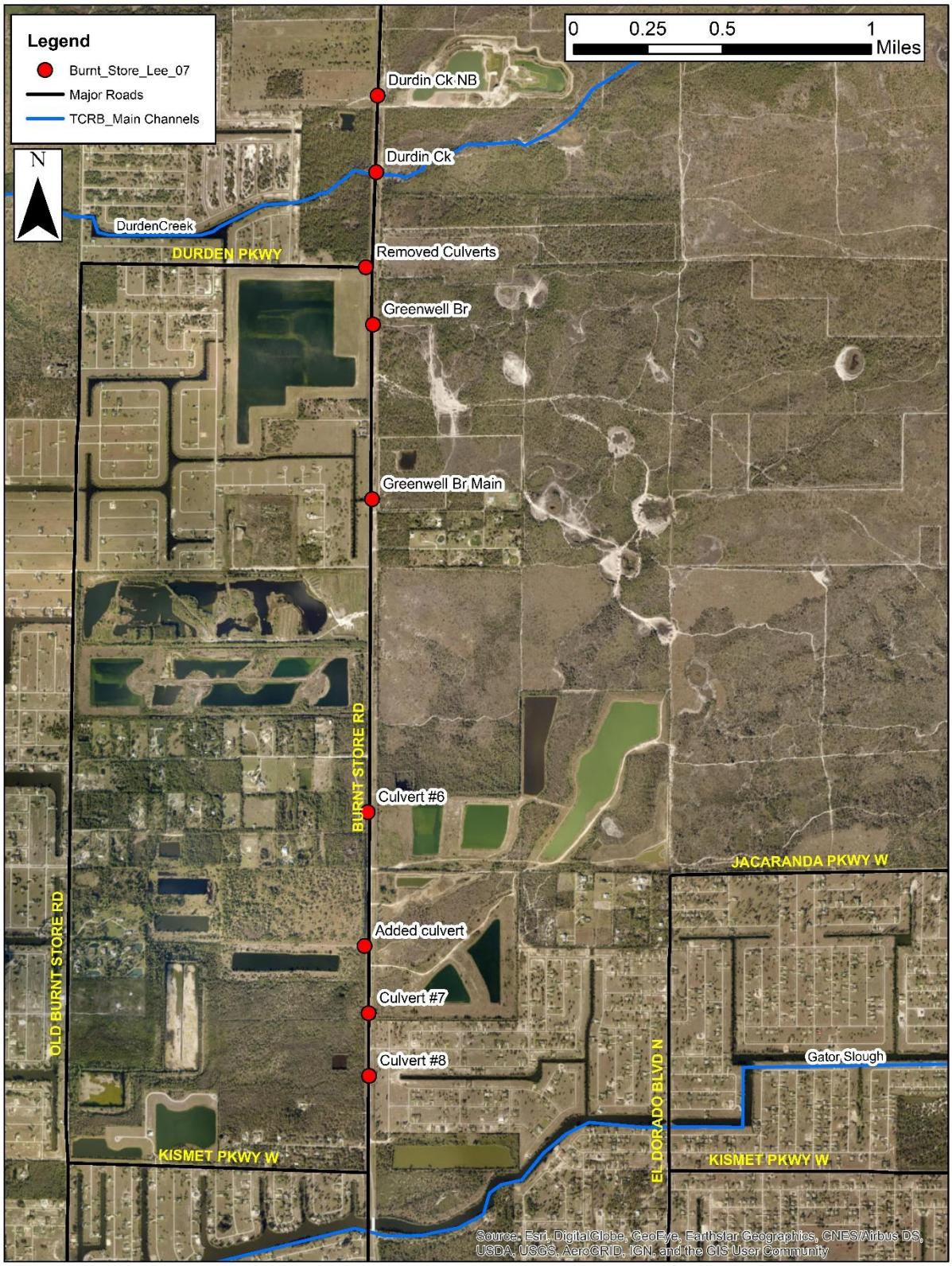

The Yucca Pens Hydrologic Restoration Plan, conducted by the BPC Group for SFWMD, provided a detailed evaluation of the Yucca Pens area including field work to collect GPS horizontal coordinates of culverts, bridges, and other hydraulic control structures (BPC, 2010). The study also gathered land use and topographic data for the area and developed a hydrologic model using ICPR. Water quality modeling was also conducted using a Watershed Management Model (developed for USEPA by CDM) that predicted annual runoff volumes based on annual rainfall, percent imperviousness, land use, a simple runoff equation, and event mean pollutant concentrations based on land use. 29

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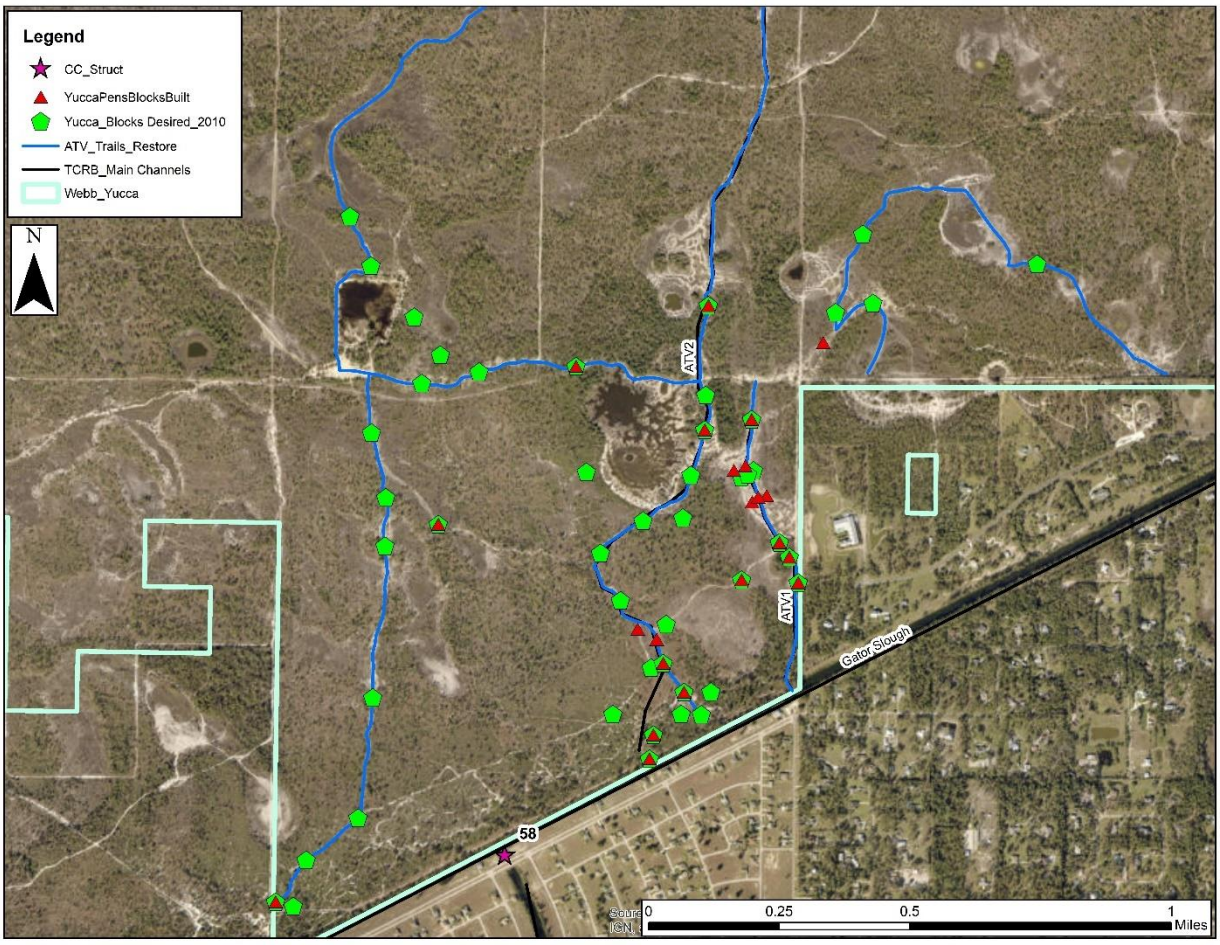
- Flow diversions in swales or ditches 29
  - Seaboard Grade in Babcock Webb west along Oil Well Road to U.S. 41 29
  - The Oil Well Road swale would then flow south along U.S. 41 to Zemel Road and would then flow west to the western side of the Charlotte Landfill, thereby entering DT-1 (see Distribution Treatment Cells discussion below) 29
  - Sandy Hartman bridge at I-75 north of the Oil Well Road Diversion 29
  - Ditch from north end of Prairie Pines Preserve along the County line to U.S. 41, and then north to a proposed flow-way south of the Charlotte County landfill. Note that this ditch would re-direct flows north along the U.S. 41 ditches from the County line approximately one mile to a proposed flow-way through existing privately-owned lands south of the Charlotte County landfill 29
  - Swale along Burnt Store Road to direct flow south from the County line to Yucca Pens Creek and north from BP-2 to Durden Creek 29
- Distribution Treatment (DT) cells 29
  - DT-1 from Zemel Canal west of the Charlotte Landfill south for 1.2 miles and then southeast towards DT-2. The western portion of DT-1 would be designed to provide sheet flows towards Durden Creek. 29
  - DT-2 that runs south along the east side of Yucca Pens from the Landfill/WMA boundary to the County Line 29
- Capture of flows in Existing Borrow Pits (BP) east of Burnt Store Road 29
  - BP-1 in the Durden Creek watershed just east of Burnt Store Road 29
  - BP-2 located 1.3 miles north of Gator Slough east of Burnt Store Road 29

2010 –Yucca Pens ATV Trails Restoration 29

SFWMD contracted with A.D.A. Engineering, Inc. to design and obtain environmental resources permits to construct a number of channel blocks of existing all-terrain vehicle (ATV) trails that were shown to accelerate runoff rates from the southern portion of Yucca Pens to Gator Slough (ADA, 2010). As shown in **Figure 3**, a total of 47 ditch blocks were identified for potential implementation and 22 were constructed with funds that were available in early 2013. The blocks continue to be effective throughout most of the area and have resulted in longer wetland hydroperiods in the wetland area

identified in **Figure 3**. Low-lying areas south of that wetland continue to indicate vegetation stress due to the continued impact of drainage associated with Gator Slough. This section of Yucca Pens will be a focus area during the subsequent phases of this project. 29



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Florida Department of Transportation (FDOT) participated in the Charlotte Harbor Flatwoods Initiative by funding hydrologic studies of Babcock Webb and Yucca Pens and conducting stormwater management alternatives analyses to evaluate impacts of the I-75 road widening project on regional hydrology (ADA, 2013). The hydrologic assessment included enhancement of the Tidal Caloosahatchee River Basin (TCRB) MIKE SHE/MIKE 11 model. Surveying of 29 cross sections, presented in **Figure 4**, was conducted to enhance the ability of the model to simulate conveyance through the I-75 right-of-way. In addition, information from the original 1978 design of I-75 was reviewed and information from numerous prior studies (e.g. BPC, 2010, A.D.A. Engineering, Inc. 2010, Johnson Engineering, 2004, SWFFS, 2013) was utilized to update the model. GIS files of surveyed channel cross sections from the North Fort Myers Surface Water Management Plan were obtained from Lee County and were used in this model. In addition, field studies were conducted to identify additional flow constrictions between Babcock Webb and U.S. 41. Utilizing all available information, the surface flow

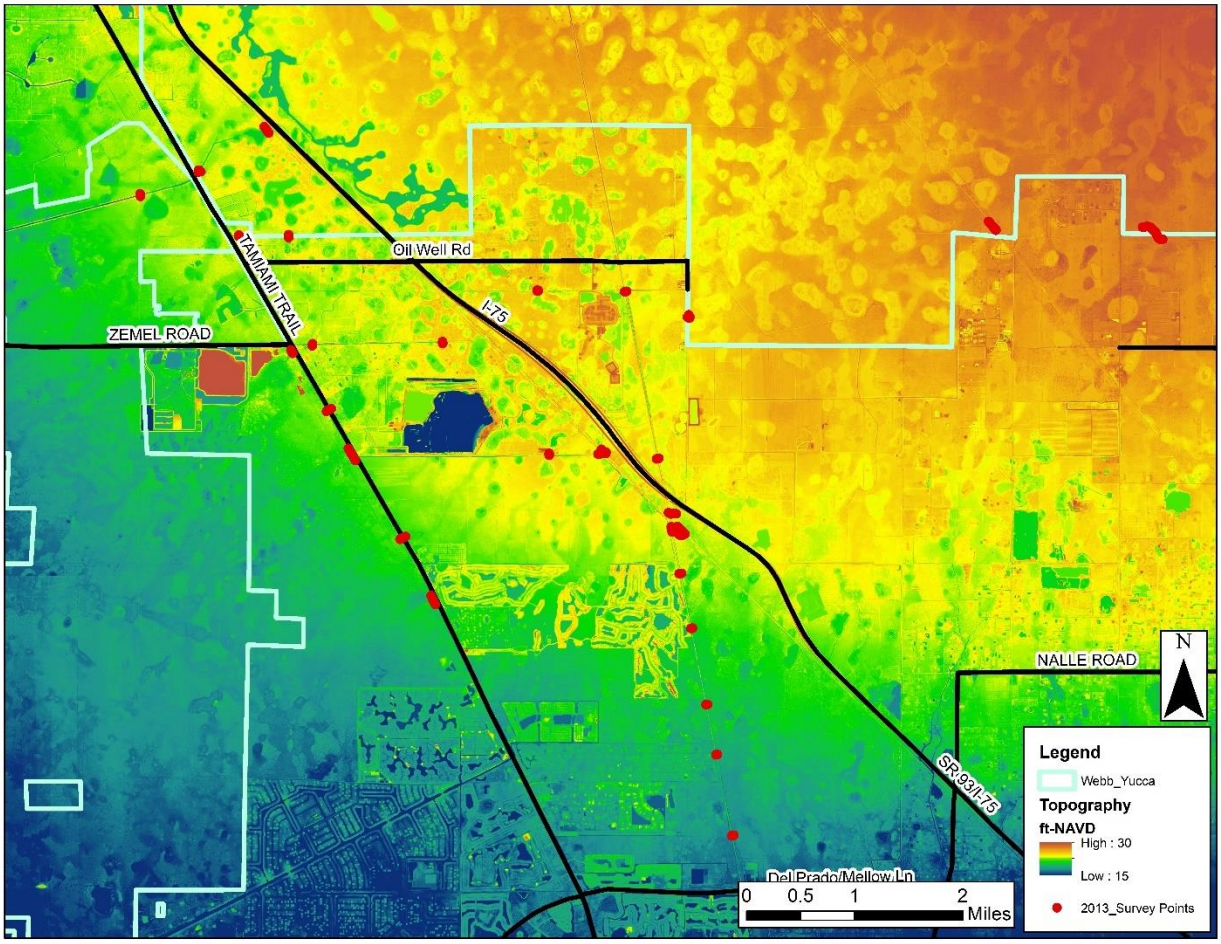
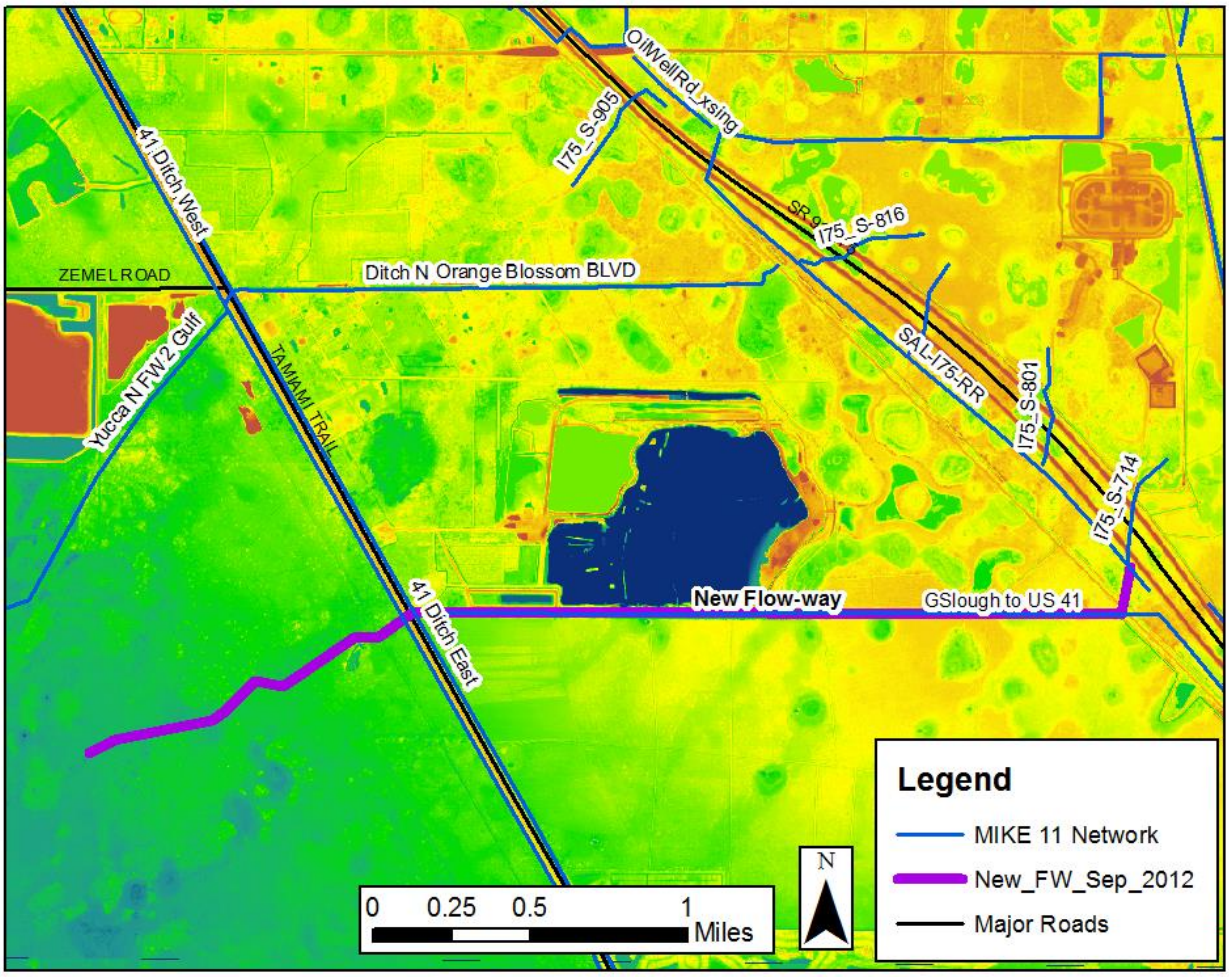


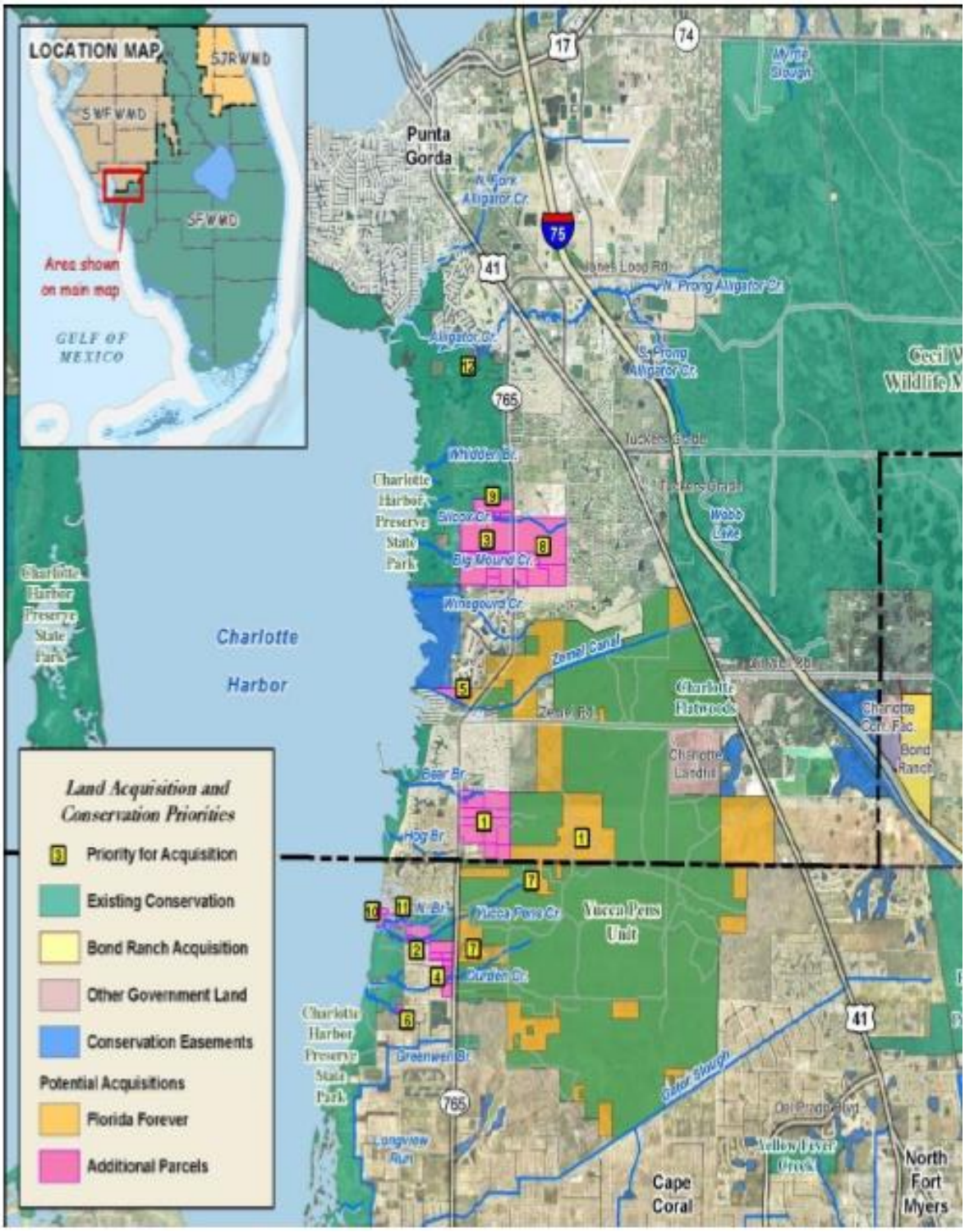
Figure 4 – Surveyed Cross Sections for the FDOT I-75 Widening Project

The hydrologic modeling conducted for FDOT found that implementing stormwater detention within the I-75 right-of-way to capture excess runoff generated by the widening project would not have a detrimental or beneficial impact on regional hydrology. One alternative evaluated during the hydrologic assessment evaluated a solution that included limited stormwater treatment within the right-of-way and FDOT financial assistance to FWC to improve hydrologic conditions in Babcock Webb. FDOT adopted the solution and provided more than $1,500,000 towards the purchase of the Bond Farm. The plan described utilization of the Bond Farm for storage of excess water impounded in southwestern Babcock Webb. The FDOT study also identified a number of potential flow pathways to convey runoff captured in the Bond Farm storage area to Yucca Pens during the late season with the objective of extending wetland hydroperiods that have been shortened by reduced inflows and accelerated outflows via eroded ATV trails. **Figure 5** illustrates one such potential pathway. 31

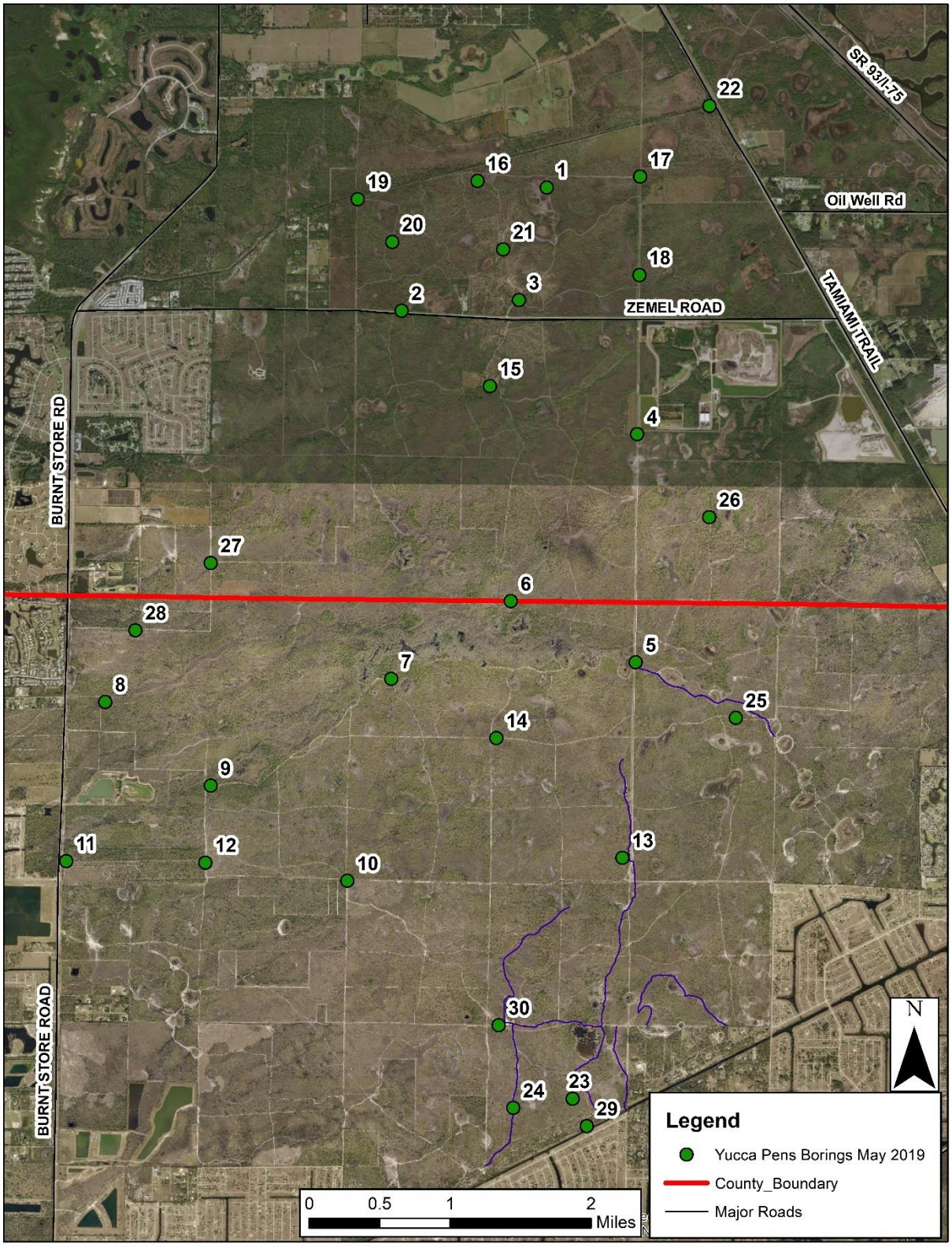


This regional ecosystem restoration plan identified a range of ecosystem restoration goals for the large study area including habitat conservation and restoration, water quality restoration, replenish and protect living coastal resources, and enhancement of community resilience (US ACE, 2013). The plan included a recommendation to obtained funding to support the Charlotte Harbor Flatwoods Initiative. Appendix A (see **Attachment 2** for details) of the Southwest Florida Feasibility Study (previous name of the Comprehensive Watershed Plan) identified a number of recommended restoration measures for Yucca Pens, including:

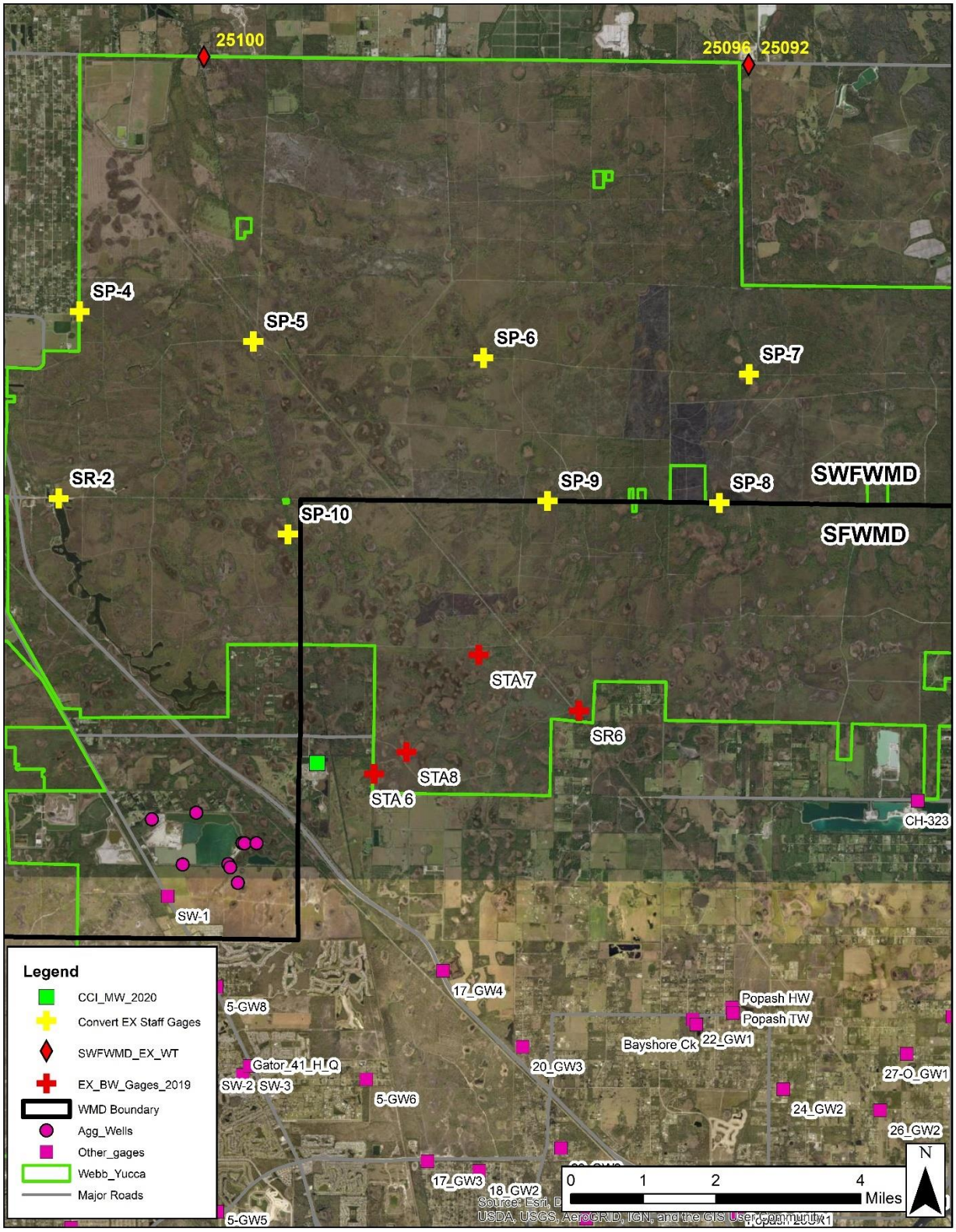
- Construction of weir structures along US 41 on the east side of Yucca Pens, diverting flows under the roadway into the project area
- Modification of cross drains under US 41 to accommodate additional flows described above
- Installation of culverts to increase overland flow under the FPL access road (Seminole Grade in **Figure 1**)
- A seepage management structure along the southern boundary of Yucca Pens

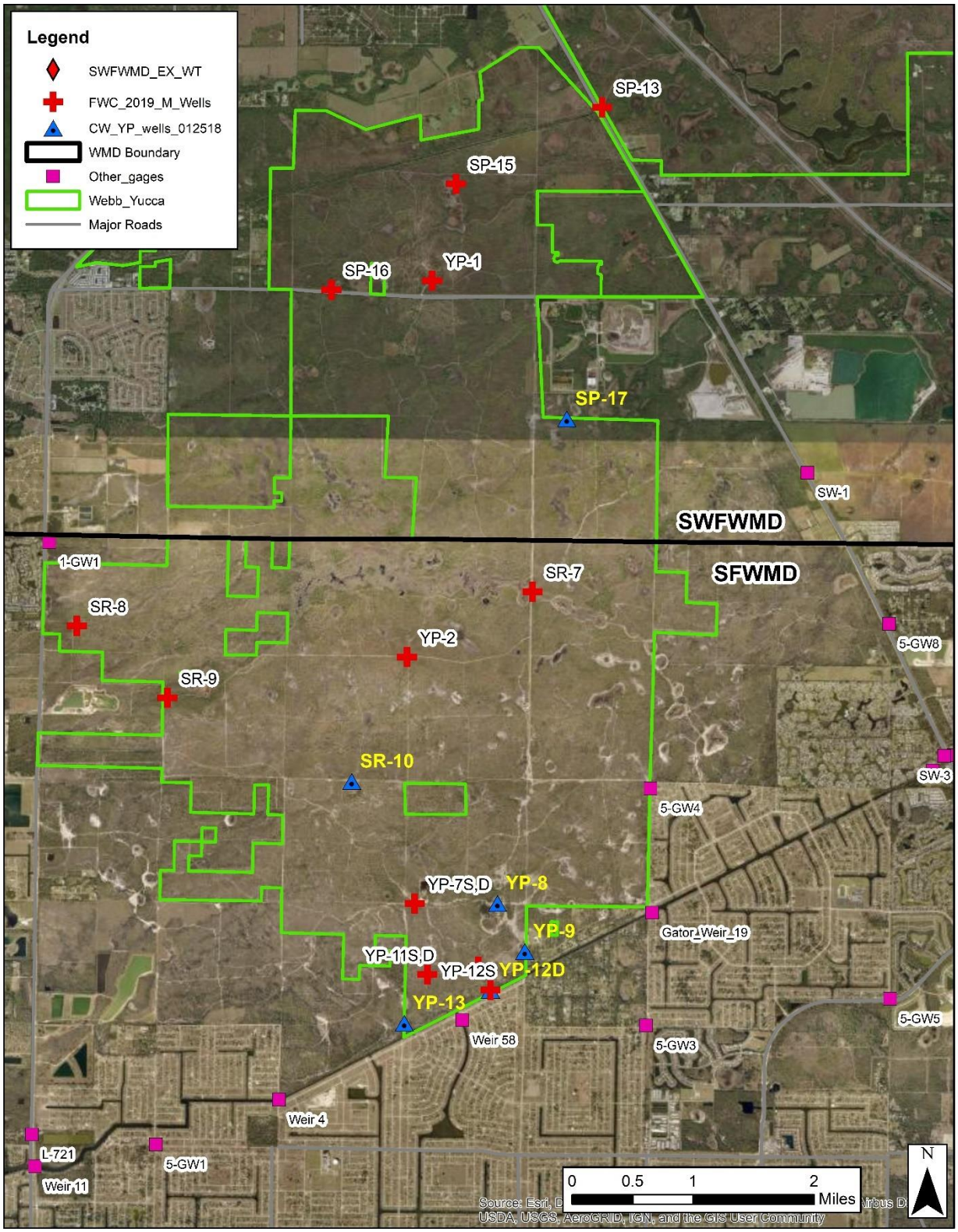


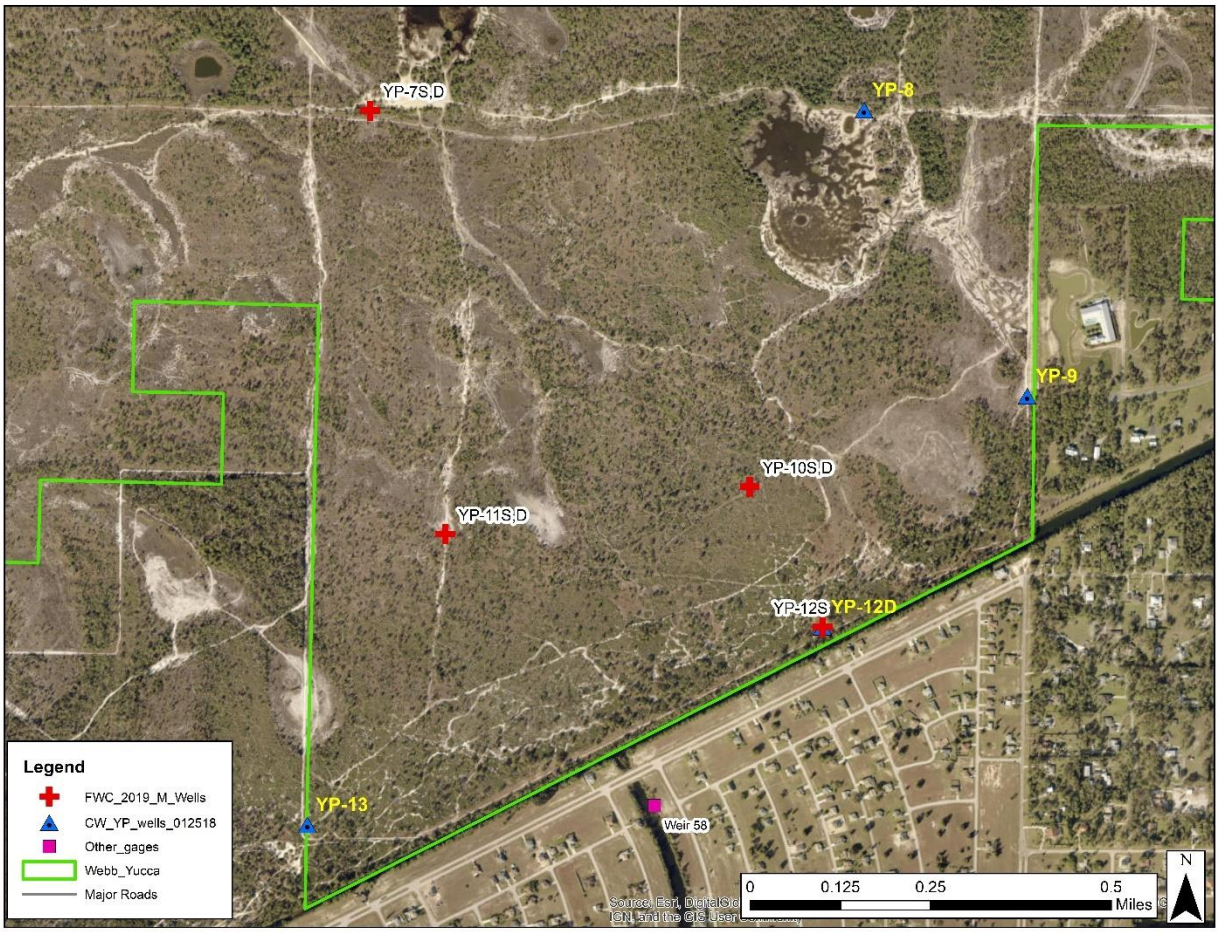
Tetra Tech and A.D.A. Engineering, Inc. prepared an evaluation of hydrology in Babcock Webb and Yucca Pens and evaluated the hydrologic and ecologic benefit of the proposed Bond Farm project as well as the addition to an off-line water storage facility in the Southwest Aggregates mining pits (Tetra Tech, 2016). Alternatives

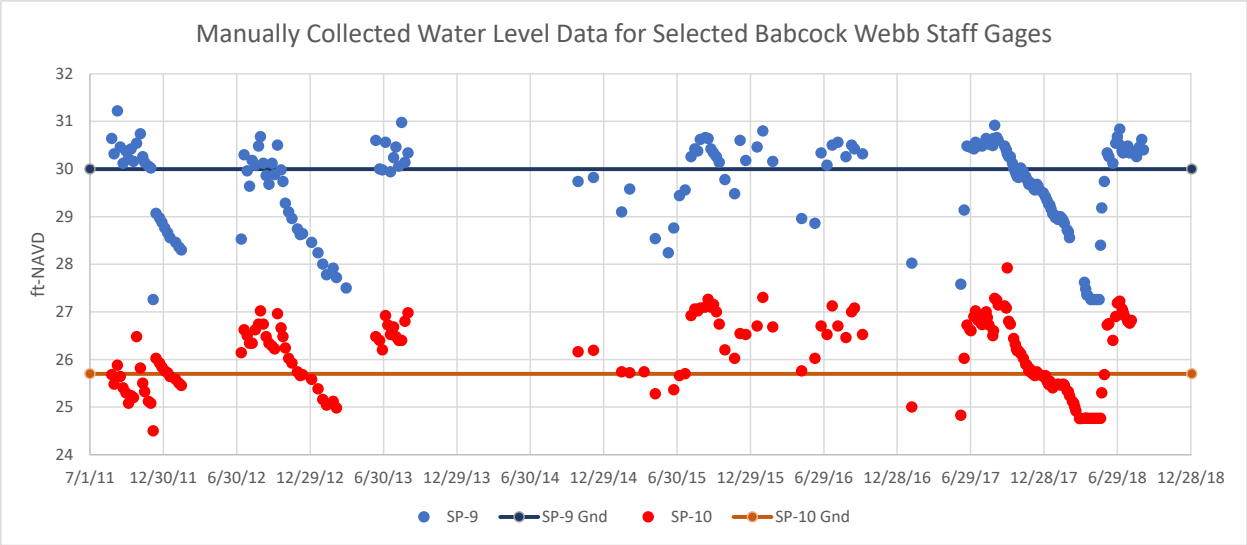


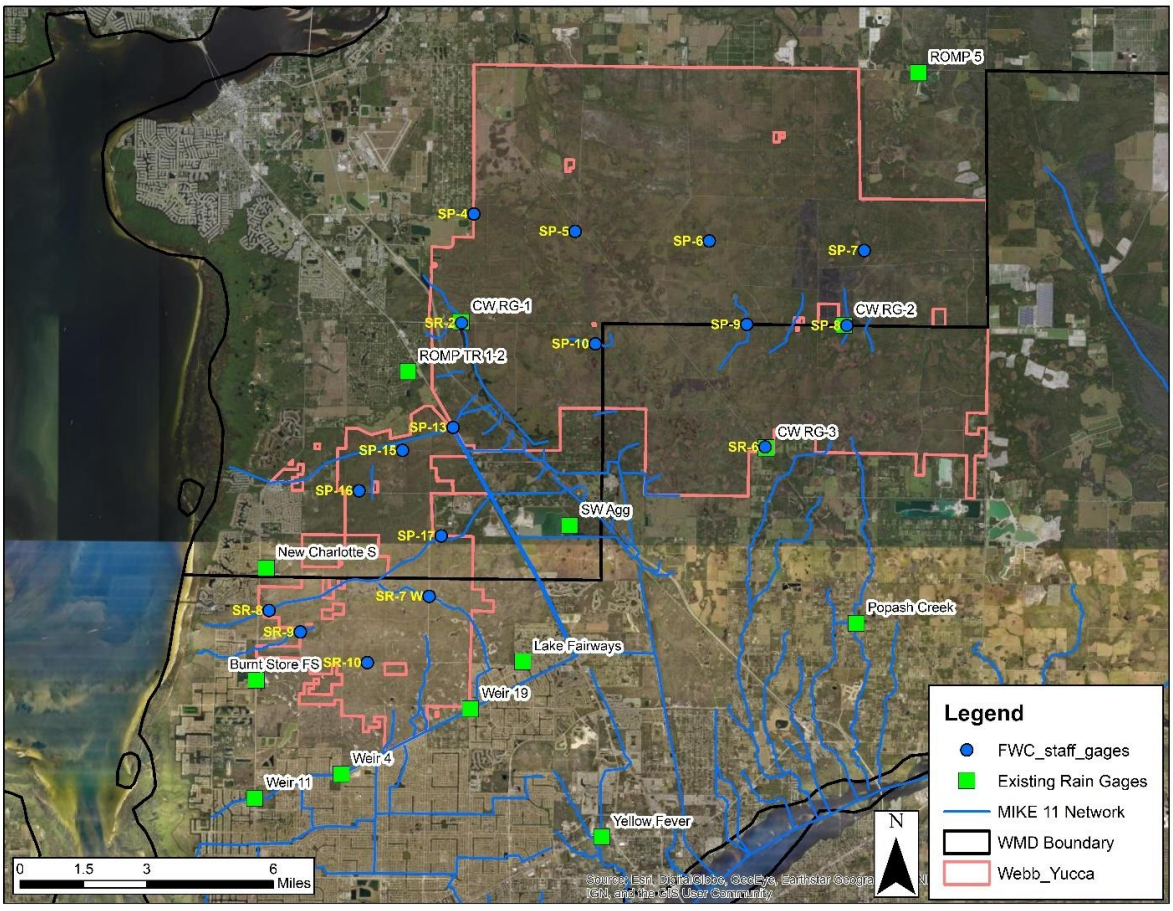
This section provides a description of existing hydrologic monitoring stations with historic and/or current hydrologic data that may be relevant to this project. Monitoring stations maintained by Lee County, Cape Coral, and USGS are included. However, only limited data tables or graphs are presented here as the data are commonly











Topographic and water conveyance cross sectional survey data have been collected as part of the I-75 Widening Project, Cape Coral Master Plan, Cape Coral Emergency Water Delivery Project, Yucca Pens Hydrogeologic Study, and the Babcock Webb South Walk-In Area Monitoring Station Project. During the 2013 modeling conducted for the FDOT I-75 Widening Project, surveys were conducted in canals and flow-ways, presented in **Figure 4** (see Section A) in order to provide a reasonable representation of concentrated flows within the model domain. This surveying effort provided accurate cross section data at 29 locations. Prior to the FDOT project, no cross-sectional data existed for the U.S. 41 ditches and the FDOT survey only provided information at three locations. Cross section surveys for Gator Slough were available from a 1992 study and the surveyed elevations did not appear to accurately represent the channel conditions in Gator Slough west of U.S. 41. In order to address this data gap, channel cross sections were obtained for the U.S. 41 ditches and Gator Slough west of U.S. 41 as part of the 2017 Emergency Water Delivery from Southwest Aggregates to the City of Cape Coral. (**Figure 16)**. Surveying was also performed at 53 locations as part of the 2019 Yucca Pens Hydrogeologic Assessment conducted for CHNEP and FWC to provide more accurate information on the conveyance characteristics of sloughs and flow-ways of Yucca Pens. 49

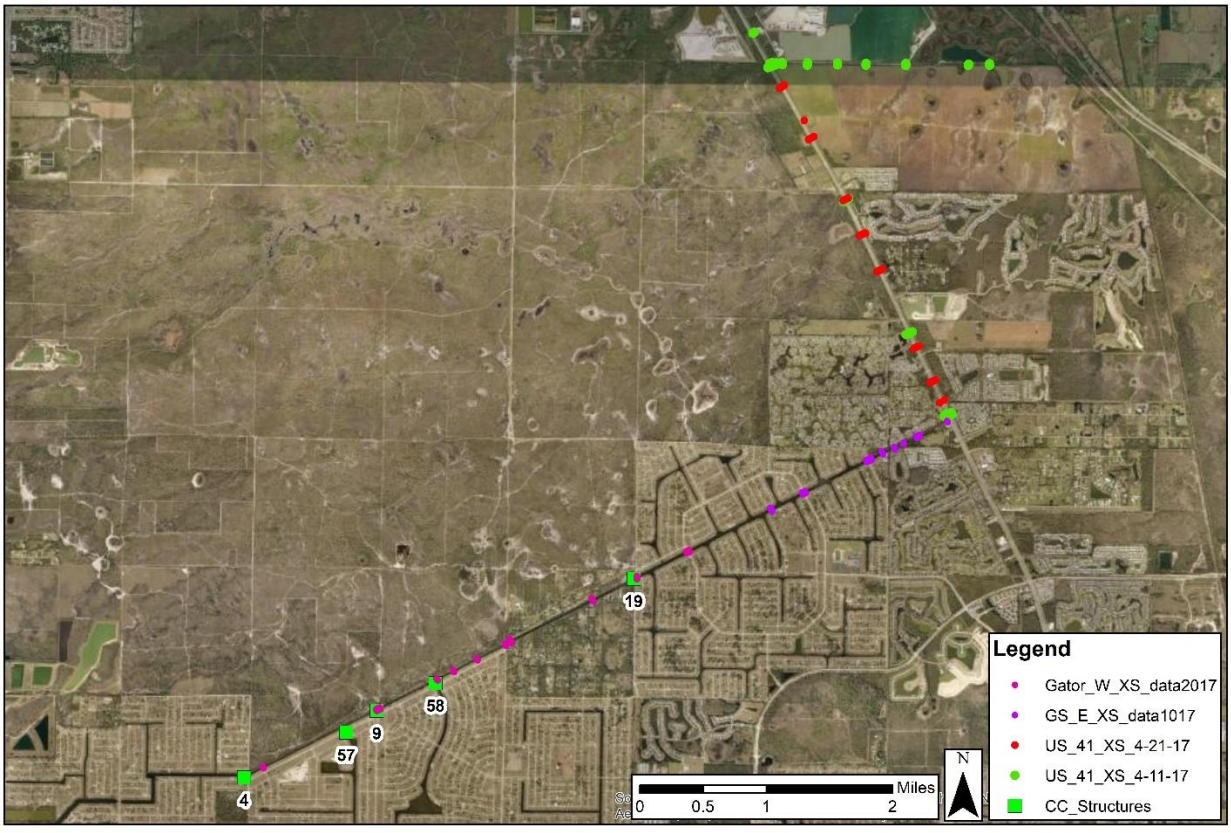


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Figure 16 – Surveyed Cross Sections Along U.S. 41 and Gator Slough West of U.S. 41 49

FWC obtained survey data for new wells installed in the southwestern portion of Babcock Webb WMA that is locally referred to as the South Walk-In Area. During the surveying of the new wells, a number of additional points were surveyed to check the accuracy of existing topographic data for the South Walk-In Area, which is typically

flooded. **Figure 17** illustrates the difference between surveyed point elevations and LiDAR data for the South Walk-In Area. Surveyed elevations are lower than LiDAR elevations at most of the locations surveyed during this assessment due to the LiDAR survey techniques are not able to detect actual ground elevations in flooded areas. 50

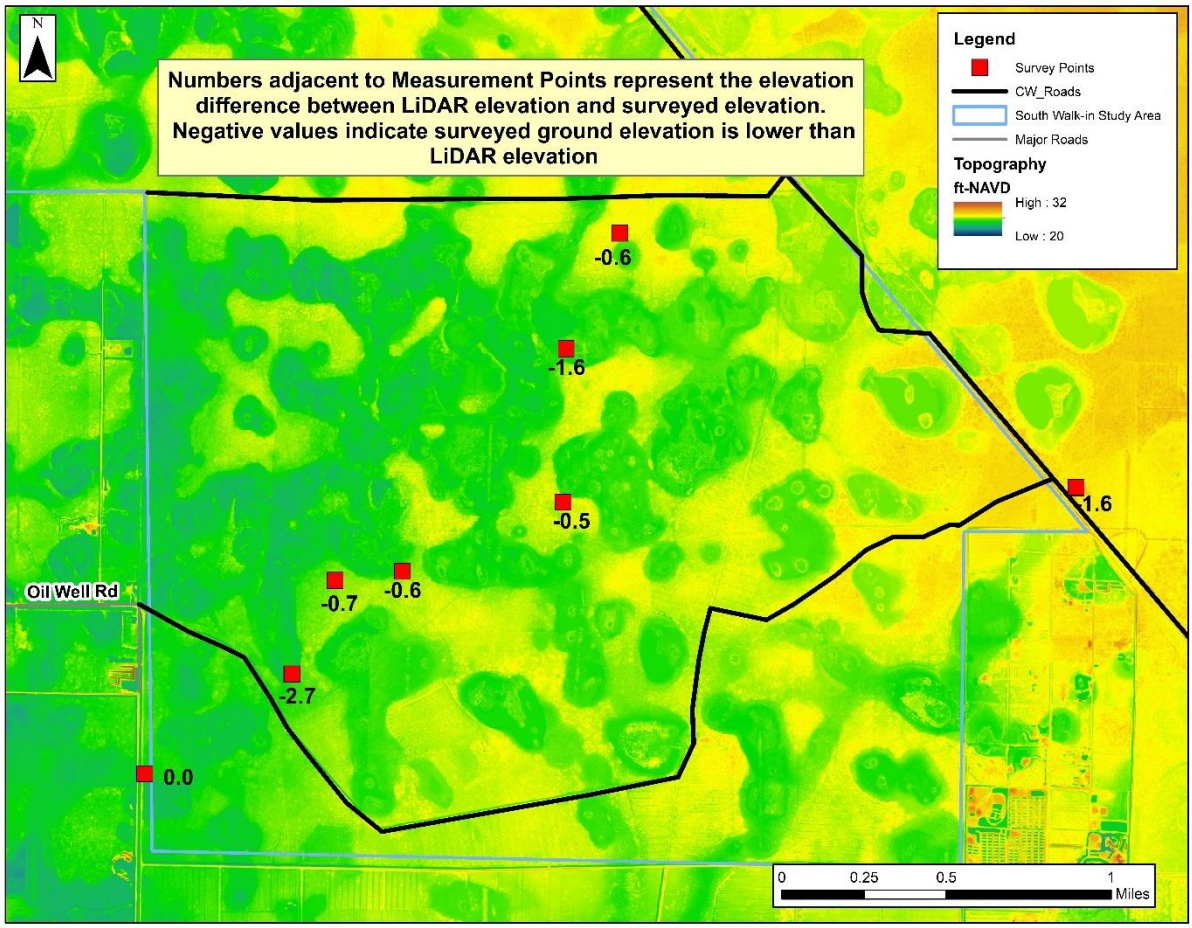

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Figure 17 – Elevation Differences Between Point Measurements and LiDAR in the South Walk-In Area..... 50

Water Science Associates was contracted by the Coastal & Heartland National Estuary Partnership (CHNEP) to develop a hydrologic restoration plan for the Lower Charlotte Harbor Flatwoods that will promote sheet flow enhancement and restore wetland hydroperiods in Babcock Webb and Yucca Pens Wildlife Management Area (WMA) and improve the timing and magnitude of flows to tidal creeks west of Yucca Pens WMA.

Project tasks include:

1. Compilation of existing hydrologic data,
2. Installation and of new surface and groundwater monitoring stations and rain gages,
3. Evaluation of vegetation indicators of wetland health,
4. Maintenance of the monitoring stations and downloading measured data,
5. Development of an existing conditions hydrologic model of the study area,
6. Evaluation of alternative management scenarios, and
7. Development of a Lower Charlotte Harbor Flatwoods Strategic Hydrological Restoration Planning Tool and Report.

Part of initial task of compiling existing hydrologic data includes development of a Data Discovery memorandum that identifies and describes existing data, studies, and modeling information for the Charlotte Harbor Flatwoods Initiative project area. Subsequent memoranda and reports will be provided as part of the documentation effort for Tasks 2 through 7 listed above. Results of the search and compilation of existing data and literature (including gray literature as well as agency data files and documents) and existing hydrologic/hydraulic/groundwater models pertinent to this effort and area are summarized in this technical memorandum. Data gaps in space, time, or type of information are identified where applicable, however, only limited analysis of data has been conducted for this memorandum as those efforts will be documented in subsequent technical reports. The overall effort is provided in support of the Lower Charlotte Harbor Flatwoods Hydrologic Modeling and "Strategic Hydrologic Restoration Planning" Project that is being conducted for the Coastal & Heartland National Estuary Partnership (CHNEP).

Section A describes prior studies, section B presents a summary of data from monitoring stations available at the start of this project, and Section C describes cross section and topographic survey data available from prior studies. Section D provides a summary of information to be utilized in subsequent phases of the project and outlines data gaps that will be addressed as part of the study.

PRIOR STUDIES

A number of hydrologic studies have been completed for the CHNEP and surrounding area. These include investigations by Florida Fish & Wildlife Conservation Commission (FWC), South Florida Water Management District (SFWMD), Southwest Florida Water Management District (SWFWMD), Florida Department of Transportation (FDOT), U.S. Army Corps of Engineers, and Lee County. Typical information that is useful from previous studies include land use data, water level data, rainfall data, survey data including LiDAR, point elevation measurements, and surveyed cross sections of existing water conveyances. The purpose of this memorandum is to document the compilation of available hydrologic information, make it available to the project team, provide a basis for identification of existing data gaps and new data acquisition efforts, and provide a platform for subsequent analysis of all available data.

Prior studies summarized in this memo include:

- 1983 – Cecil Webb Water Management Study
- 1990 – Lee County Interim Surface Water Management Master Plan
- 2002 – Tidal Caloosahatchee Basin Model
- 2004 – South Charlotte, North Lee County, and Babcock Webb Surface Water Management Conceptual Plan
- 2005 – NW Lee County Surface Water Management Plan
- 2006 – North Fort Myers Drainage Restoration Project
- 2007 – Matlacha Pass Hydrologic Restoration Project
- 2008 – Lower Charlotte Harbor SWIM Plan
- 2008 – Conceptual Management Plan for Fred C. Babcock – Cecil M. Webb Wildlife Management Area 2003 – 2008
- 2010 – North Fort Myers Surface Water Management Plan
- 2010 – Yucca Pens Hydrologic Restoration Plan
- 2010 – Yucca Pens ATV Trails Restoration
- 2013 – FDOT I-75 Widening Permit, Initial Bond Farm Modeling
- 2015 – Southwest Florida Comprehensive Watershed Plan, US ACE, CHNEP, Sarasota County Estuary Program, Tampa Bay Estuary Program
- 2015 – City of Cape Coral Stormwater Model
- 2015 – A Management Plan for Fred C. Babcock – Cecil M. Webb Wildlife Management Area, 2014- 2024
- 2015 – Tidal Creeks Land and Conservation Prioritization Report
- 2016 – Basis of Design Report – Southwest Aggregates Storage Reservoir
- 2016 – SWFWMD LiDAR
- 2017 – Cape Coral Emergency Water Delivery from Southwest Aggregates
- 2018 – Bond Farm Acquisition
- 2018 – Yucca Pens Hydrological Study
- 2018 – SFWMD 2018-2023 Strategic Plan
- 2019 – RESTORE funding proposal for Bond Farm construction
- 2019 – Executive Order 19-12: “Focus on rapid improvement for water quality, quantity, and supply

2019 – Yucca Pens Hydrogeological Assessment
2020 – Southwest Aggregates Water Use Permit Application
2020 – Bond Farm Environmental Resource Permit Application

A brief description of each of these studies is provided below. Descriptions of each study or investigation includes notations of roads, conveyances from Babcock Webb, and other features pertinent to the study. **Figure 1** presents a map of the study to provide the reader with reference to major features mentioned in the study overviews.

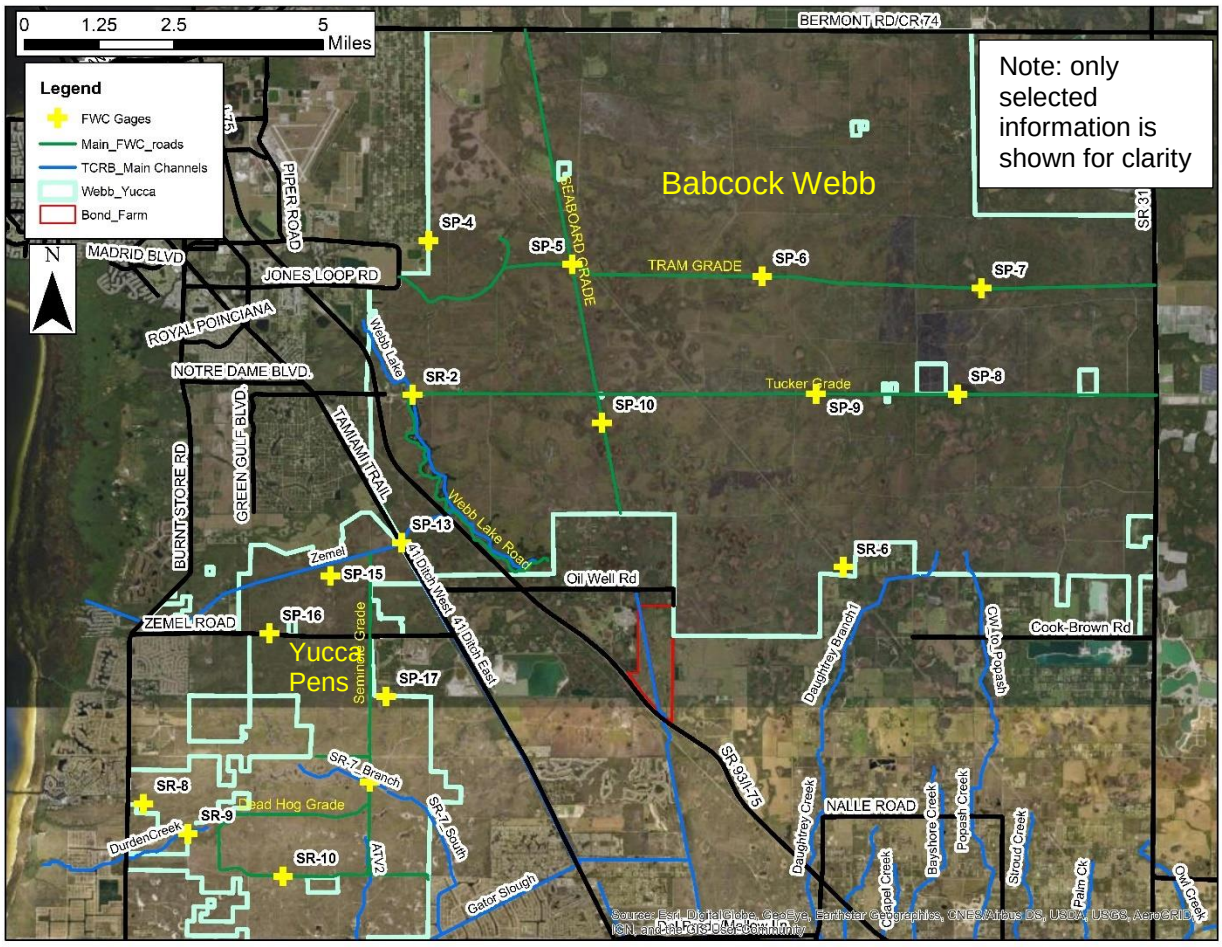

Figure 1 – Map of Charlotte Harbor Flatwoods Study Area

1983 – Cecil Webb Water Management Study

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2005 – Northwest Lee County Surface Water Management Plan

This effort was primarily a flood management study that was limited to areas west of U.S. 41 with particular focus on improvements to address flooding along Burnt Store Road (Boyle Engineering, 2005). A number of improvements were recommended, such as conveyance improvements in Durden Creek and removal of sedimentation and vegetation at culverts under Burnt Store Road. This study also mentioned flows by-pass issues with the USGS gaging station east of US 41 and recommended moving the gaging station to the western side of US 41.

2007 – Matlacha Pass Hydrologic Restoration Project

The project (Boyle, 2007) included the improvement of southward directed conveyance along both sides of Burnt Store Road from Gator Slough to approximately 1.2 miles north at Culvert #6 (see **Figure 2**). This was accomplished by increasing the dimensions (both increased width and lower invert elevations) of the roadside ditches. Culvert #6 was replaced with larger culverts. Inter-basin transfer from Durden Creek and Greenwell Branch was increased due to side-drain improvements, such as protecting the inlet and outlets of culverts under roadways and increased ditch dimensions. A north-south cross culvert under Durden Parkway was removed to reduce the inter-basin transfer from the Durden Creek Basin to the Greenwell Branch Basin. Information from this plan was utilized during the I-75 widening project MIKE SHE/MIKE 11 modeling effort.

2008 – Lower Charlotte Harbor SWIM Plan

There was no specific mention of either Babcock Webb or Yucca Pens WMA in the 2008 Lower Charlotte Harbor SWIM Plan (SFWMD, 2008). There were general recommendations to balance the large extremes between high and low flows to tidal waters and to increase storage within the watersheds.

2010 – North Fort Myers Surface Water Management Plan

This study was a flood management study that identified flooding problems in North Fort Myers but did not explicitly address Babcock Webb WMA other than to state that flows from Babcock Webb resulted in flooding problems in North Fort Myers (AECOM, 2010). Information from this study, especially for dimensions and invert elevations of bridges was used during the development of the MIKE SHE/MIKE 11 model for the 2013 FDOT Widening Project.

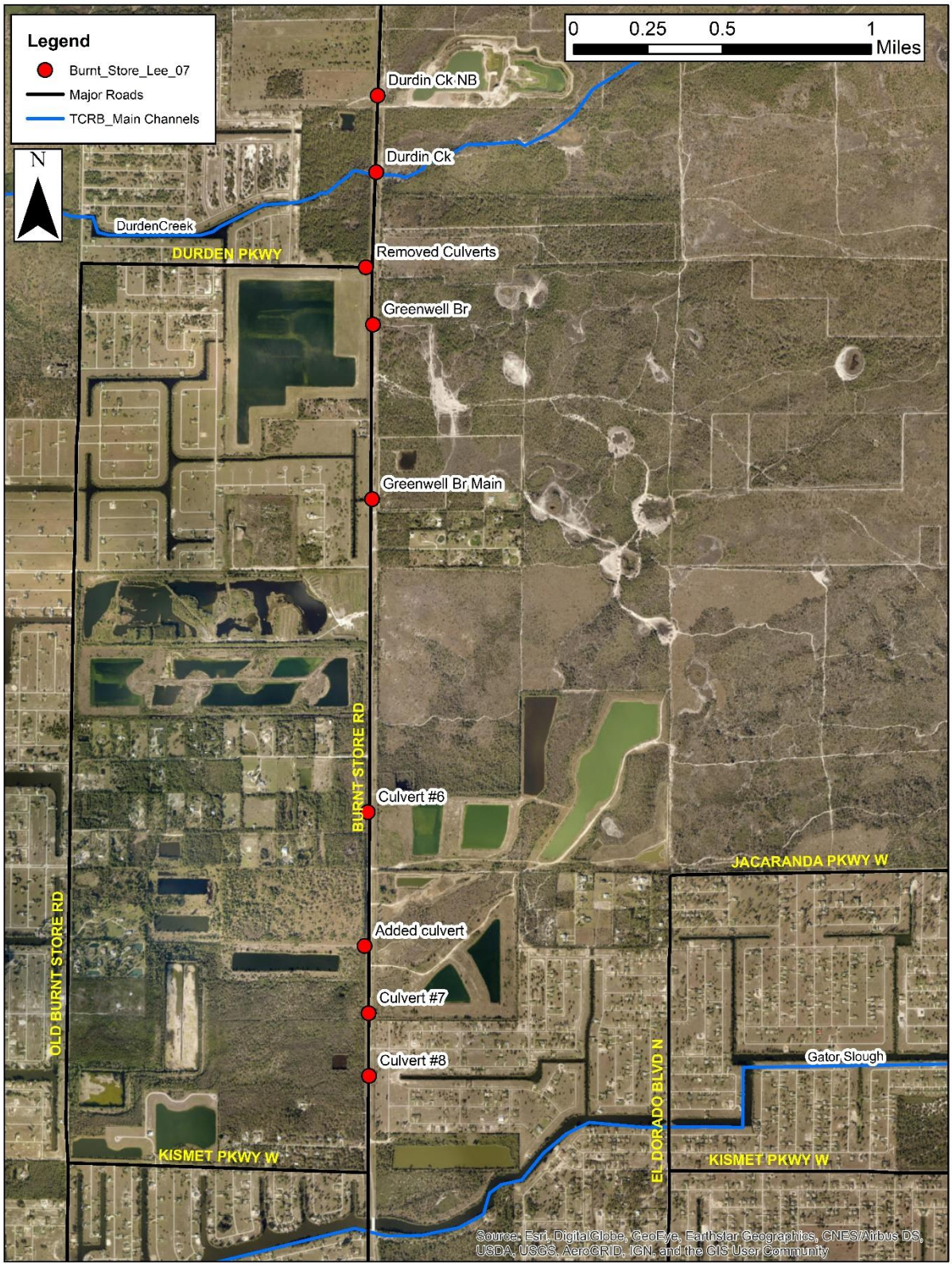

Figure 2 – Map of Burnt Store Road North of Gator Slough Identifying Selected Improvements from Matlacha Pass Hydrologic Restoration Project

2010 – Yucca Pens Hydrologic Restoration Plan

The Yucca Pens Hydrologic Restoration Plan, conducted by the BPC Group for SFWMD, provided a detailed evaluation of the Yucca Pens area including field work to collect GPS horizontal coordinates of culverts, bridges, and other hydraulic control structures (BPC, 2010). The study also gathered land use and topographic data for the area and developed a hydrologic model using ICPR. Water quality modeling was also conducted using a Watershed Management Model (developed for USEPA by CDM) that predicted annual runoff volumes based on annual rainfall, percent imperviousness, land use, a simple runoff equation, and event mean pollutant concentrations based on land use.

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    - Sandy Hartman bridge at I-75 north of the Oil Well Road Diversion
    - Ditch from north end of Prairie Pines Preserve along the County line to U.S. 41, and then north to a proposed flow-way south of the Charlotte County landfill. Note that this ditch would re-direct flows north along the U.S. 41 ditches from the County line approximately one mile to a proposed flow-way through existing privately-owned lands south of the Charlotte County landfill
    - Swale along Burnt Store Road to direct flow south from the County line to Yucca Pens Creek and north from BP-2 to Durden Creek
- Distribution Treatment (DT) cells
    - DT-1 from Zemel Canal west of the Charlotte Landfill south for 1.2 miles and then southeast towards DT-2. The western portion of DT-1 would be designed to provide sheet flows towards Durden Creek.
    - DT-2 that runs south along the east side of Yucca Pens from the Landfill/WMA boundary to the County Line
- Capture of flows in Existing Borrow Pits (BP) east of Burnt Store Road
    - BP-1 in the Durden Creek watershed just east of Burnt Store Road
    - BP-2 located 1.3 miles north of Gator Slough east of Burnt Store Road

2010 –Yucca Pens ATV Trails Restoration

SFWMD contracted with A.D.A. Engineering, Inc. to design and obtain environmental resources permits to construct a number of channel blocks of existing all-terrain vehicle (ATV) trails that were shown to accelerate runoff rates from the southern portion of Yucca Pens to Gator Slough (ADA, 2010). As shown in **Figure 3**, a total of 47 ditch blocks were identified for potential implementation and 22 were constructed with funds that were available in early 2013. The blocks

continue to be effective throughout most of the area and have resulted in longer wetland hydroperiods in the wetland area identified in **Figure 3**. Low-lying areas south of that wetland continue to indicate vegetation stress due to the continued impact of drainage associated with Gator Slough. This section of Yucca Pens will be a focus area during the subsequent phases of this project.

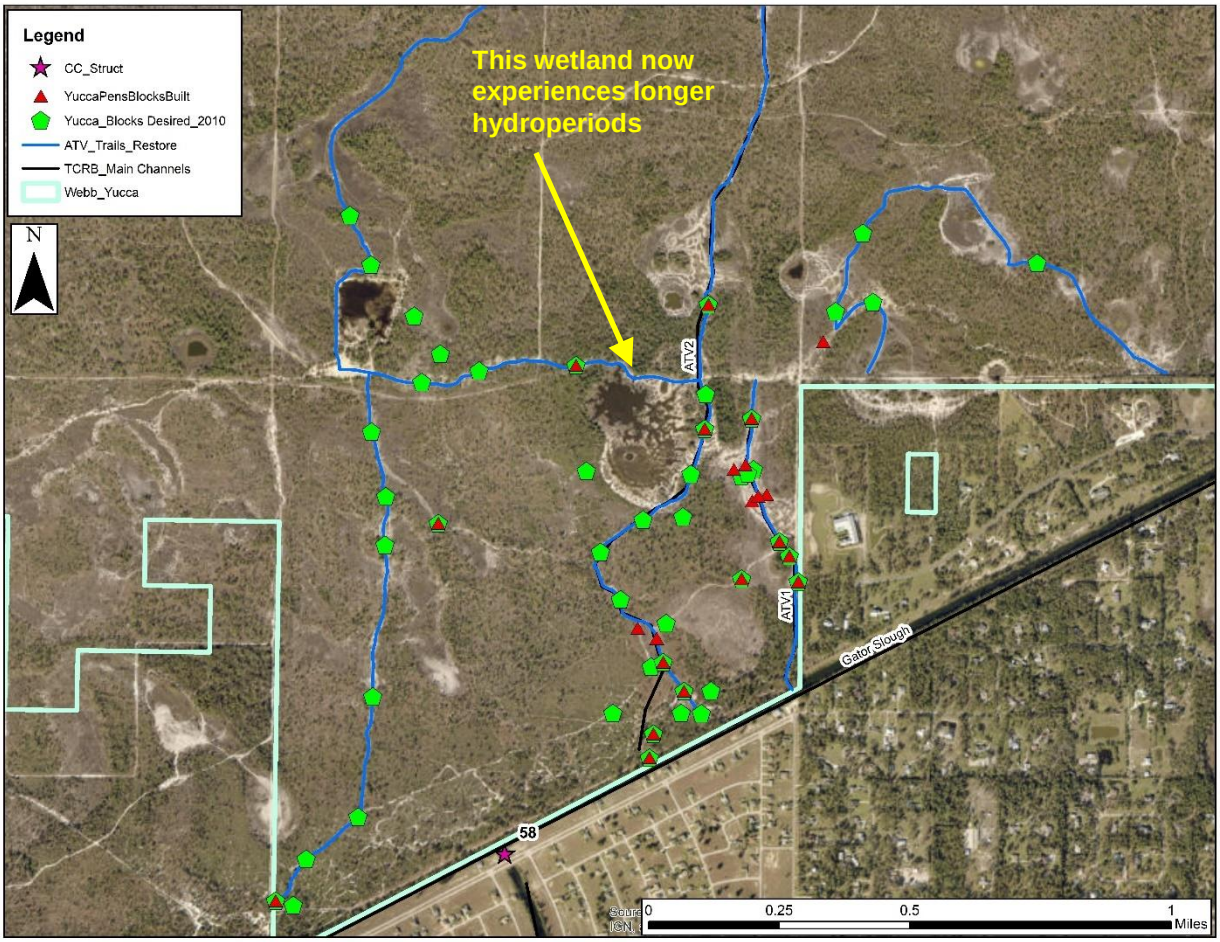

Figure 3 – ATV Ditch Blocks Planned and Installed

2013 – FDOT I-75 Widening Permit and Initial Bond Farm Modeling

Florida Department of Transportation (FDOT) participated in the Charlotte Harbor Flatwoods Initiative by funding hydrologic studies of Babcock Webb and Yucca Pens and conducting stormwater management alternatives analyses to evaluate impacts of the I-75 road widening project on regional hydrology (ADA, 2013). The hydrologic assessment included enhancement of the Tidal Caloosahatchee River Basin (TCRB) MIKE SHE/MIKE 11 model. Surveying of 29 cross sections, presented in **Figure 4**, was conducted to enhance the ability of the model to simulate conveyance through the I-75 right-of-way. In addition, information from the original 1978 design of I-75 was reviewed and information from numerous prior studies (e.g. BPC, 2010, A.D.A. Engineering, Inc. 2010, Johnson Engineering, 2004, SWFFS, 2013) was utilized to update the model. GIS files of surveyed channel cross sections from the North Fort Myers Surface Water Management Plan were obtained from Lee County and were used in this model. In addition, field

studies were conducted to identify additional flow constrictions between Babcock Webb and U.S. 41. Utilizing all available information, the surface flow conveyances were represented in the MIKE 11 channel network in far greater detail relative to the 2002 TCRB model.

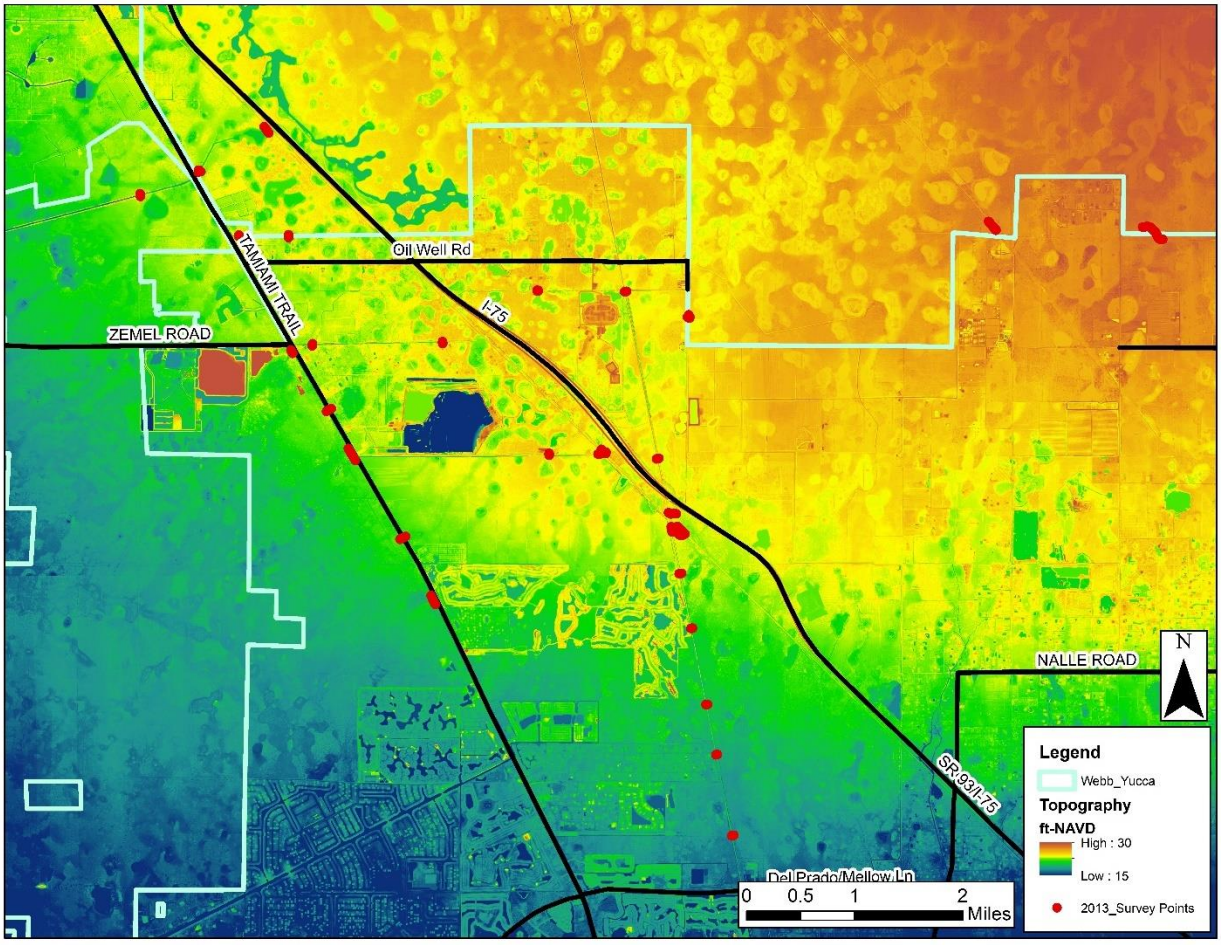

Figure 4 – Surveyed Cross Sections for the FDOT I-75 Widening Project

The hydrologic modeling conducted for FDOT found that implementing stormwater detention within the I-75 right-of-way to capture excess runoff generated by the widening project would not have a detrimental or beneficial impact on regional hydrology. One alternative evaluated during the hydrologic assessment evaluated a solution that included limited stormwater treatment within the right-of-way and FDOT financial assistance to FWC to improve hydrologic conditions in Babcock Webb. FDOT adopted the solution and provided more than $1,500,000 towards the purchase of the Bond Farm. The plan described utilization of the Bond Farm for storage of excess water impounded in southwestern Babcock Webb. The FDOT study also identified a number of potential flow pathways to convey runoff captured in the Bond Farm storage area to Yucca Pens during the late season with the objective of extending wetland hydroperiods that have been shortened by reduced inflows and accelerated outflows via eroded ATV trails. **Figure 5** illustrates one such potential pathway.

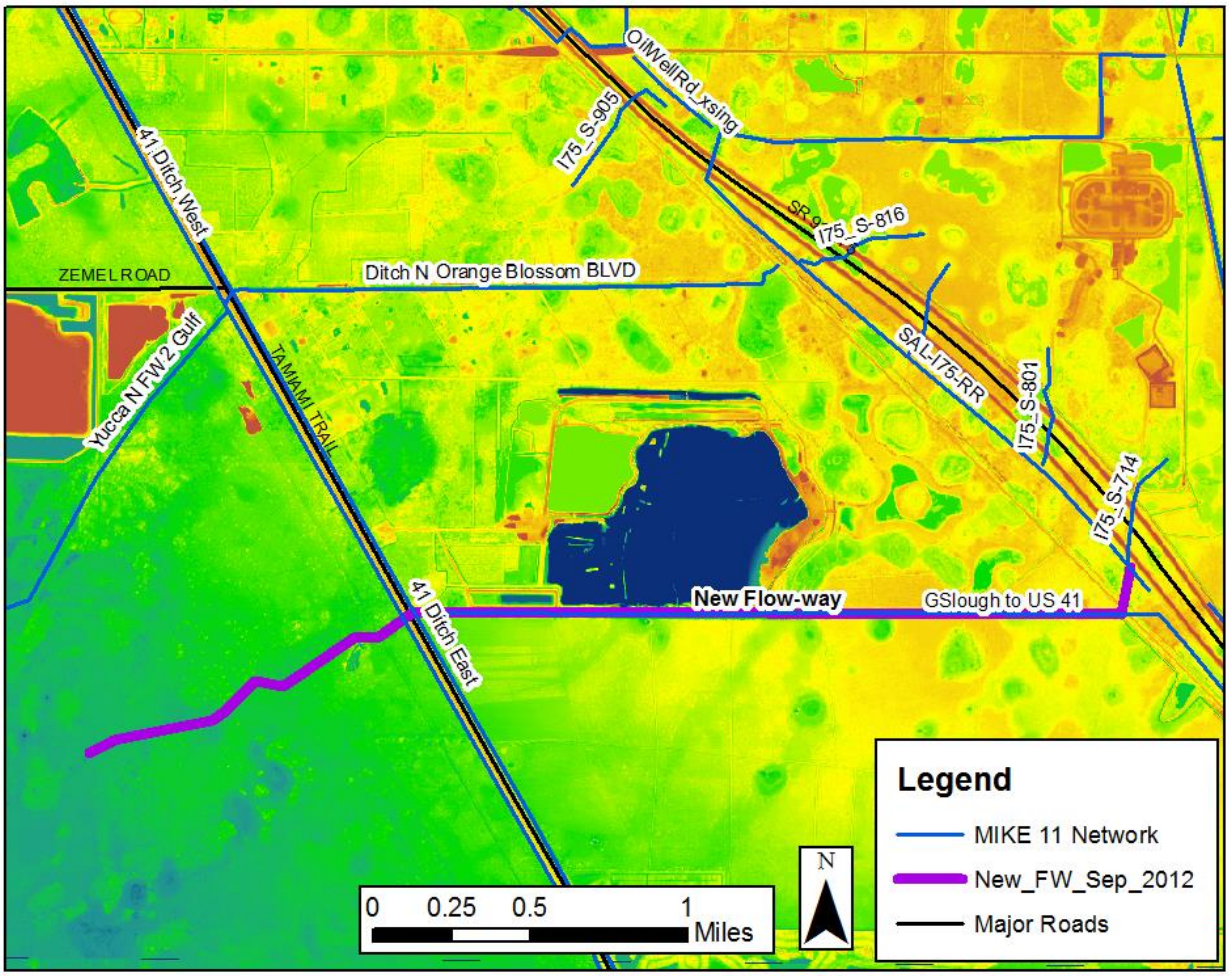

Figure 5 – Potential Flow Pathway from Bond Farm to Yucca Pens

2015 – Southwest Florida Comprehensive Watershed Plan, USACE, CHNEP, Sarasota Estuary Program, Tampa Bay Estuary Program

This regional ecosystem restoration plan identified a range of ecosystem restoration goals for the large study area including habitat conservation and restoration, water quality restoration, replenish and protect living coastal resources, and enhancement of community resilience (US ACE, 2013). The plan included a recommendation to obtained funding to support the Charlotte Harbor Flatwoods Initiative. Appendix A (see **Attachment 2** for details) of the Southwest Florida Feasibility Study (previous name of the Comprehensive Watershed Plan) identified a number of recommended restoration measures for Yucca Pens, including:

- Construction of weir structures along US 41 on the east side of Yucca Pens, diverting flows under the roadway into the project area
- Modification of cross drains under US 41 to accommodate additional flows described above
- Installation of culverts to increase overland flow under the FPL access road (Seminole Grade in **Figure 1**)
- A seepage management structure along the southern boundary of Yucca Pens

- Modifications to existing culverts along Burnt Store Road to allow improved flows to tidal waters

In addition, members of the SWFFS team have attended Charlotte Harbor Flatwoods Initiative meetings and mentioned an effort that was conducted to identify isolated wetlands that have been drained by Yucca Pens land management activities prior to State ownership. Eliminating drainage of these areas could promote increased groundwater recharge, enhance wetland habitat, and reduce wet season peak discharges to tide. An effort is underway to find the results of that investigation or to repeat the analysis.

2015 – City of Cape Coral Stormwater Model

A modeling study was conducted for the City of Cape Coral using the MIKE SHE/MIKE 11 model developed for FDOT (A.D.A. Engineering, Inc., 2015). The focus of this model was to evaluate flooding problems within the City of Cape Coral. As part of improving the representation of Cape Coral hydraulic control structures on Gator Slough, the overall calibration of the model inside and outside of the City was improved.

2015 – Management Plan for Fred C. Babcock – Cecil Webb Wildlife Management Area

The 2015 management plan for Babcock Webb WMA provides an updated set of management recommendations needed since the publication of the 2008 management plan (FWC, 2015). The 2015 plan includes a detailed description of hydrologic conditions on Babcock Webb and Yucca Pens. This plan identified excess flooding in southwest Babcock Webb due to reductions in downstream conveyance caused by development in the historic flow-ways west of Babcock Webb. The management plan identifies an FWC goal to coordinate with the Charlotte Harbor Flatwoods Initiative and conduct additional studies to address the hydrologic challenges in both WMAs.

2015 – Tidal Creeks Land and Conservation Prioritization Report

An interdisciplinary team of biologists, land use planners, GIS professionals, land managers, and agency staff worked together to identify and rank 12 acquisition objectives (CHFI, 2015). The objective of the land acquisitions is to restore historic surface water flows and hydroperiods on existing publicly owned lands and restore the quality, quantity, and timing of flows to essential tidal creeks. This document continues to guide land acquisition efforts in 2020. **Figure 6** presents the location of the identified parcels.

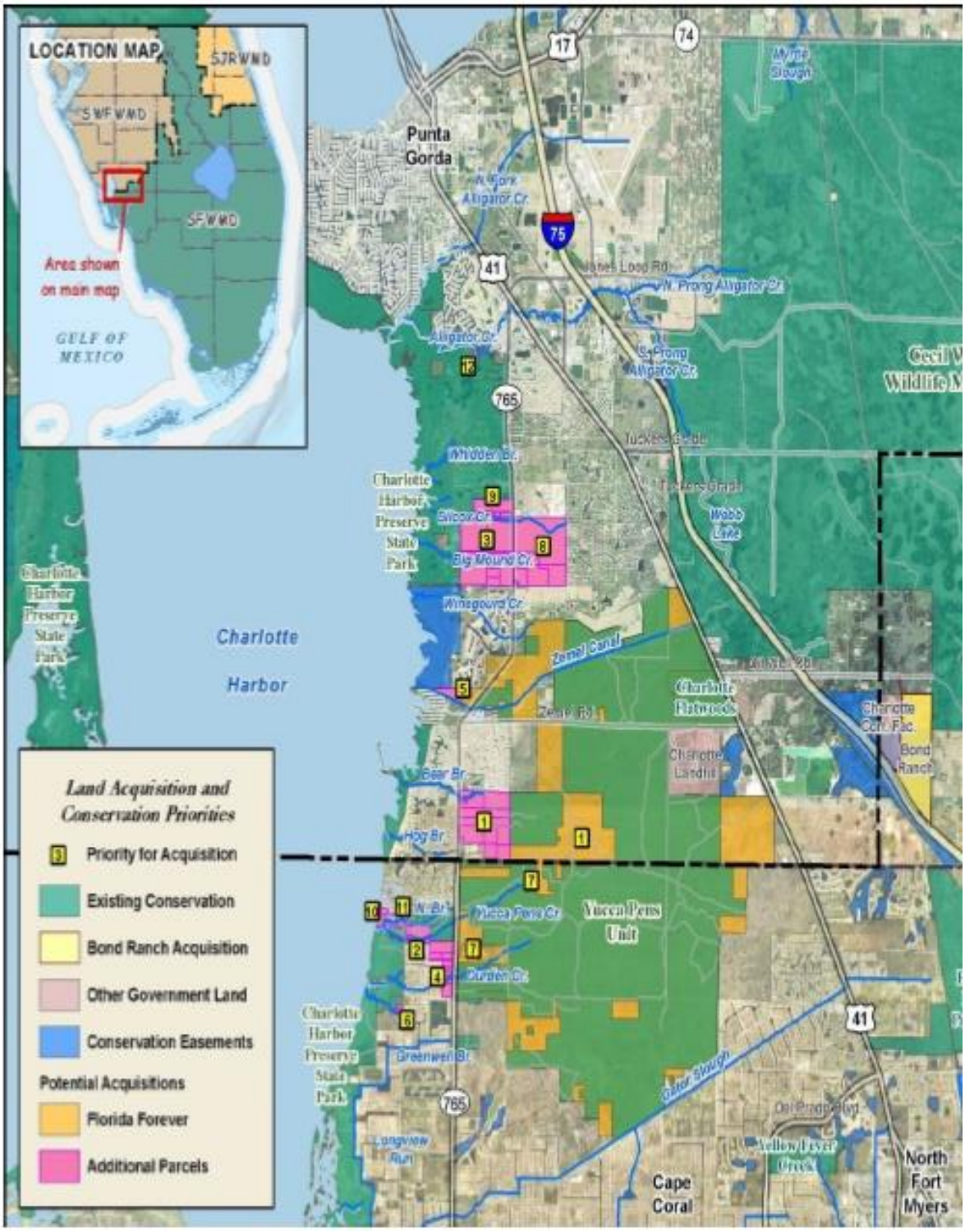

Figure 6 – Land Acquisition and Conservation Priorities, 2015 Study

2016 – Basis of Design Report – Southwest Aggregates Storage Reservoir

Tetra Tech and A.D.A. Engineering, Inc. prepared an evaluation of hydrology in Babcock Webb and Yucca Pens and evaluated the hydrologic and ecologic benefit of the proposed Bond Farm project as well as the addition to an off-line water storage facility in the Southwest Aggregates mining pits (Tetra Tech, 2016). Alternatives analysis indicated that seepage impacts to adjacent properties would be reduced to minimum levels with the inclusion of a seepage management barrier around the perimeter of the proposed Southwest Aggregates reservoir. The analysis indicated only a minor ecologic response to storage of water in the Bond Farm and a more significant response if additional water was stored in the Southwest Aggregates mining pits. The study assumed that water stored in the Bond Farm would be routed to Yucca Pens at the end of the wet season while water stored in the Southwest Aggregates would be utilized as an irrigation water supply during the mid to late spring.

2016 – SWFWMD LiDAR

SWFWMD provided grant funding to collect more accurate LiDAR data for Yucca Pens and portions of southwestern Babcock Webb WMA. A main objective of this survey was to resolve an apparent abrupt change in elevation in Yucca Pens just south of the Lee/Charlotte County line that was due to problems merging LiDAR data from two different sources. Data from this surveying effort largely resolved the problem present in the compiled topographic data along the Lee/Charlotte County border in Yucca Pens. Elevation data in the SWFWMD LiDAR file for uplands more closely matches ground survey elevations obtained in the CHNEP/FWC 2019 Hydrogeologic Assessment, however the SWFWMD LiDAR data does not properly identify the dimensions and elevations of Yucca Pens flow-ways. The dry season of 2016 experienced higher than normal amounts of rainfall resulting in standing water within low-lying areas during the period when the flights were conducted. Accordingly, the LiDAR data is not as accurate as desired for certain areas of Yucca Pens and southwestern Babcock Webb that were inundated at the time of the flights.

2017 – Cape Coral Emergency Water Delivery from Southwest Aggregates

Cape Coral conducted a pilot water delivery project during late April through early June 2017 from the Southwest Aggregates mine to Gator Slough (Water Science Associates, 2017). During the design and permitting of the project, cross sections were surveyed within the Southwest Aggregates property, at multiple locations in the U.S. 41 ditches, and in 21 locations in Gator Slough between US 41 and Chiquita Blvd in Cape Coral. These cross sections have been added to the latest version of the regional MIKE SHE/MIKE 11 model. Monitoring wells were installed in the vicinity of the mine and surface water monitoring stations were installed in the main mining pit and at three locations in the US 41 ditches. Those stations are still in operation, and data is available from the City of Cape Coral. Flows were measured approximately 8 times in the US 41 ditches at the three monitoring stations during 2017.

2018 – Bond Farm Acquisition

The Bond Farm was purchased by the State of Florida in late 2014. The property was transferred from the Division of State Lands to FWC in 2015, and design of the Bond Farm storage facility began in 2017. An interim design engineering report was published in October 2018 that

describes data collection efforts, including surveying and a geotechnical investigation (A.D.A. Engineering, Inc. and HDR Engineering, Inc. 2018). Hydrologic and hydraulic modeling were conducted with a sub-model of the model used for the Southwest Aggregates Basis of Design report. The proposed Bond Farm water storage facility was evaluated as a Phase 1 facility with a maximum storage depth of 2 feet and a Phase II facility with a maximum storage depth of 4 feet. The report provided descriptions of changes in water levels both in Babcock Webb and Yucca Pens.

2018 – Yucca Pens Hydrological Study

The City of Cape Coral provided funding for the installation of five monitoring wells in Yucca Pens north of Gator Slough. The wells were installed to simplify collection of water level information that has difficult access for FWC staff and to provide additional information regarding Yucca Pens hydrology. Water level data loggers were installed in the monitoring wells and the monitoring stations are being maintained by FWC staff. Data from these monitoring wells will be discussed in **Section B** on existing monitoring stations.

2018 – SFWMD 2018-2023 Strategic Plan

The SFWMD strategic plan lists a commitment to coordinate the Charlotte Harbor Flatwoods Initiative and collaborate with counties to improve natural flow-way conveyances (SFWMD, 2018). This enables the WMD to dedicate staff resources to assist in implementing the objectives of the CHFI.

2019 – RESTORE funding proposal for Bond Farm construction

SFWMD staff have been working collaboratively with a number of agencies to obtain financial support for major projects of the Charlotte Harbor Flatwoods Initiative (CHFI). One success story is obtaining NRDA funding for this study. In addition, SFWMD staff have worked with FDEP to get the Bond Farm AGI Hydrologic Enhancement Impoundment listed on the RESTORE Council funding priority list 3B as a potential priority for construction funding.

2019 – Executive Order 19-12: "Focus on rapid improvement for water quality, quantity, and supply"

Executive Order 19-12 is primarily focused on Everglades Restoration, establishing a Blue-Green Algae Task Force, and accelerating implementation of the C-43 and C-44 storage reservoir projects to include water quality treatment. The EO may apply to the CHFI in the following areas:

- Section 1.M. recommends engaging local governments and water management districts to identify viable alternative water supply sources. The potential Southwest Aggregates Reservoir project is an alternative water supply project and increasing groundwater levels in Yucca Pens will result in increased water availability for the region.
- Section 3 of the EO directs DEP to ensure Florida's valuable and vulnerable coastlines and natural resources are protected. Increasing the hydroperiod of tidal creeks on the west side of Yucca Pens is consistent with this goal.

2019 – Yucca Pens Hydrogeologic Assessment

FWC obtained mitigation funds from Charlotte County in 2018 associated with the widening of Burnt Store Road. In cooperation with FWC, Charlotte County directed those funds to CHNEP to be used for a hydrogeologic assessment of Yucca Pens WMA (Water Science Associates and Southwest Engineering & Design, 2019). CHNEP engaged Southwest Engineering & Design, with assistance from Water Science Associates, to conduct the hydrogeologic assessment. Lithologic borings were constructed at 30 locations, shown in **Figure 7**, to determine the thickness and stratigraphy of the surficial aquifer. Continuous sampling of each boring provided details on the composition of the surficial aquifer. Limestone, shell, and/or coarse sand were encountered in 90% of the borings. This information will be used to update the hydro-stratigraphy of the MIKE SHE/MIKE 11 model for this project. In addition, the project included installation of ten 30-foot deep monitoring wells and four 6-foot deep wells. Each well was outfitted with a water level data logger, and water level data has been collected since early June 2019. The shallow wells were installed adjacent to deeper wells in the southern portion of Yucca Pens near Gator Slough to quantify the effect of Gator Slough on groundwater flow patterns in the area of Yucca Pens that is experiencing reduced wetland hydroperiods. Data from these monitoring wells will be discussed in **Section B**. Surveying was also performed at 53 locations to provide more accurate information on the conveyance characteristics of sloughs and flow-ways of Yucca Pens. These cross sections will be added to the MIKE 11 surface water conveyance model.

2020 – Southwest Aggregates Water Use Permit Application

The City of Cape Coral has submitted a water use permit application for the construction of a pipeline along U.S. 41 from Southwest Aggregates to Gator Slough and conversion of the mining pits to a reservoir (Water Science Associates, 2020). This project will have beneficial impacts to the CHFI since it will provide a pathway for water deliveries from I-75 to U.S. 41, and storage of excess wet season runoff from Babcock Webb WMA will enhance habitat restoration in flooded areas of Babcock Webb WMA.

2020 – Bond Farm Environmental Resource Permit Application

Studies and engineering design of the Bond Farm project are described in the Bond Farm Environmental Resource Permit application (Application 200421-6, DEP permit number 0375475-001 EI). FWC, in cooperation with SFWMD, has obtained this permit, which allow for construction of the first phase of the project. An ERP modification will be needed for the southwestern discharge from Bond Farm to a future-designated flow-way from I-75 to U.S. 41. The U.S. Army Corps of Engineers permit and Charlotte County entitlements are anticipated to be obtained by the end of 2020.

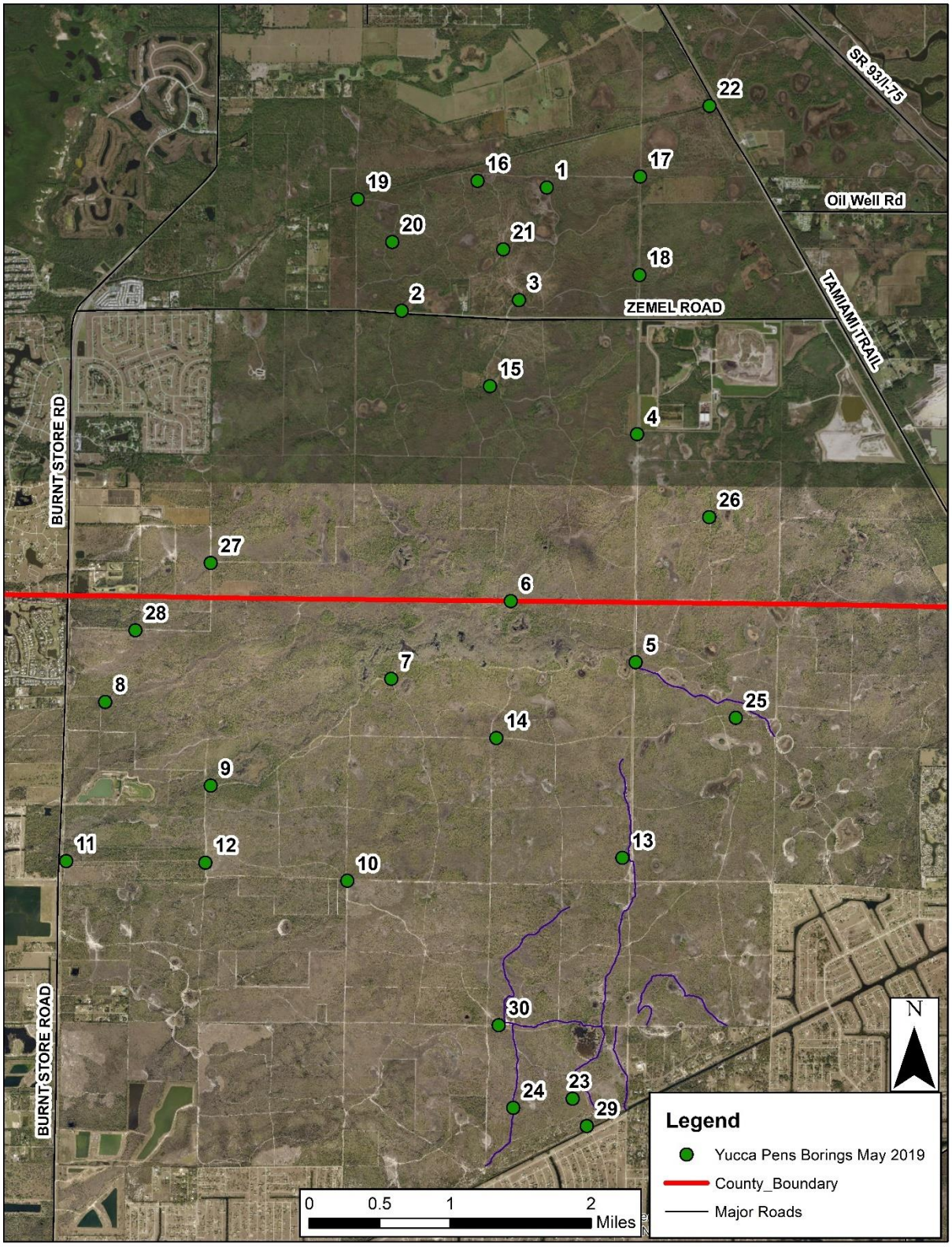

Figure 7 – Location of Borings from 2019 Hydrogeologic Assessment

EXISTING MONITORING DATA

This section provides a description of existing hydrologic monitoring stations with historic and/or current hydrologic data that may be relevant to this project. Monitoring stations maintained by Lee County, Cape Coral, and USGS are included. However, only limited data tables or graphs are presented here as the data are commonly available via agency websites. The purpose of this section is to summarize data available for Cecil Webb and Yucca Pens that has been collected as part of a number of separate but related efforts including recent installation of monitoring wells in southern Yucca Pens by the City of Cape Coral and monitoring wells installed in Babcock Webb using funds provided by FWC. All of the data described here will be uploaded to the CHNEP Water Atlas as well as provided to CHNEP on a flash memory drive once subjected to a QA/QC analysis.

Monitoring Station Locations

The locations of existing hydrologic monitoring stations located within the study area are shown in **Figures 8** through **10. Table 1** presents a list of monitoring stations being monitored by FWC and presents existing and updated station names along with the history of when stations were established. Manual water level data for the staff gages installed in 2011 are available on the CHNEP Water Atlas.

Monitoring stations shown in **Figures 8** through **10** are maintained by other entities such as USGS, SWFWMD, Lee County, and the City of Cape Coral. **Table 2** provides a summary of the agency responsible for maintaining these monitoring stations and when these stations were installed.

A number of monitoring wells were also installed in 2018 and 2019 in the southern portion of Yucca Pens, including YP-7S&D, YP-8, YP-9, YP-11S&D, YP12S&D, and YP13 (see **Figures 9** and a zoomed in view in **Figure 10**). These stations were installed to document the effect of seepage from Gator Slough on the hydrology of the southern portion of Yucca Pens.

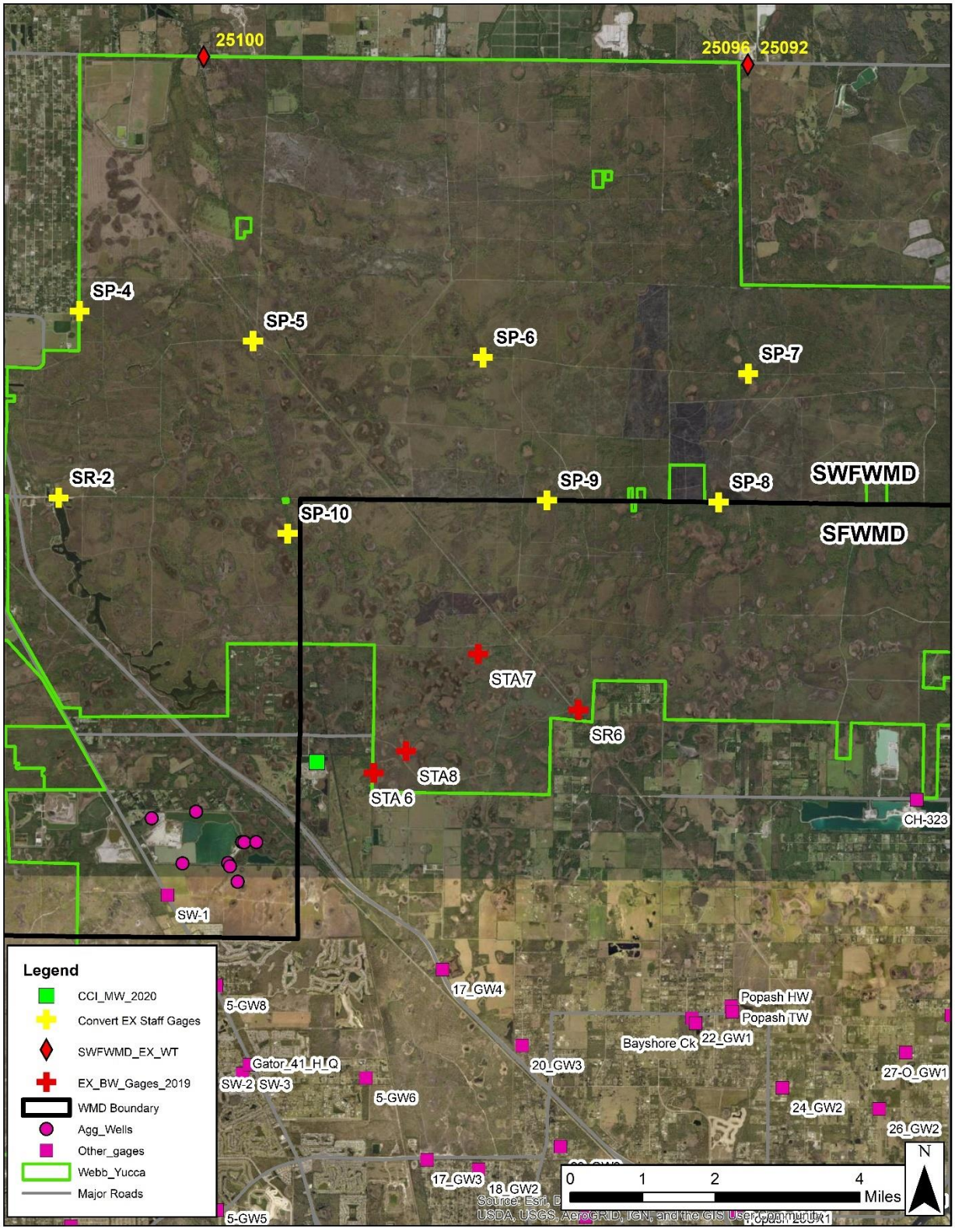

Figure 8 – Existing Monitoring Stations in Babcock Webb WMA and the Surrounding Area

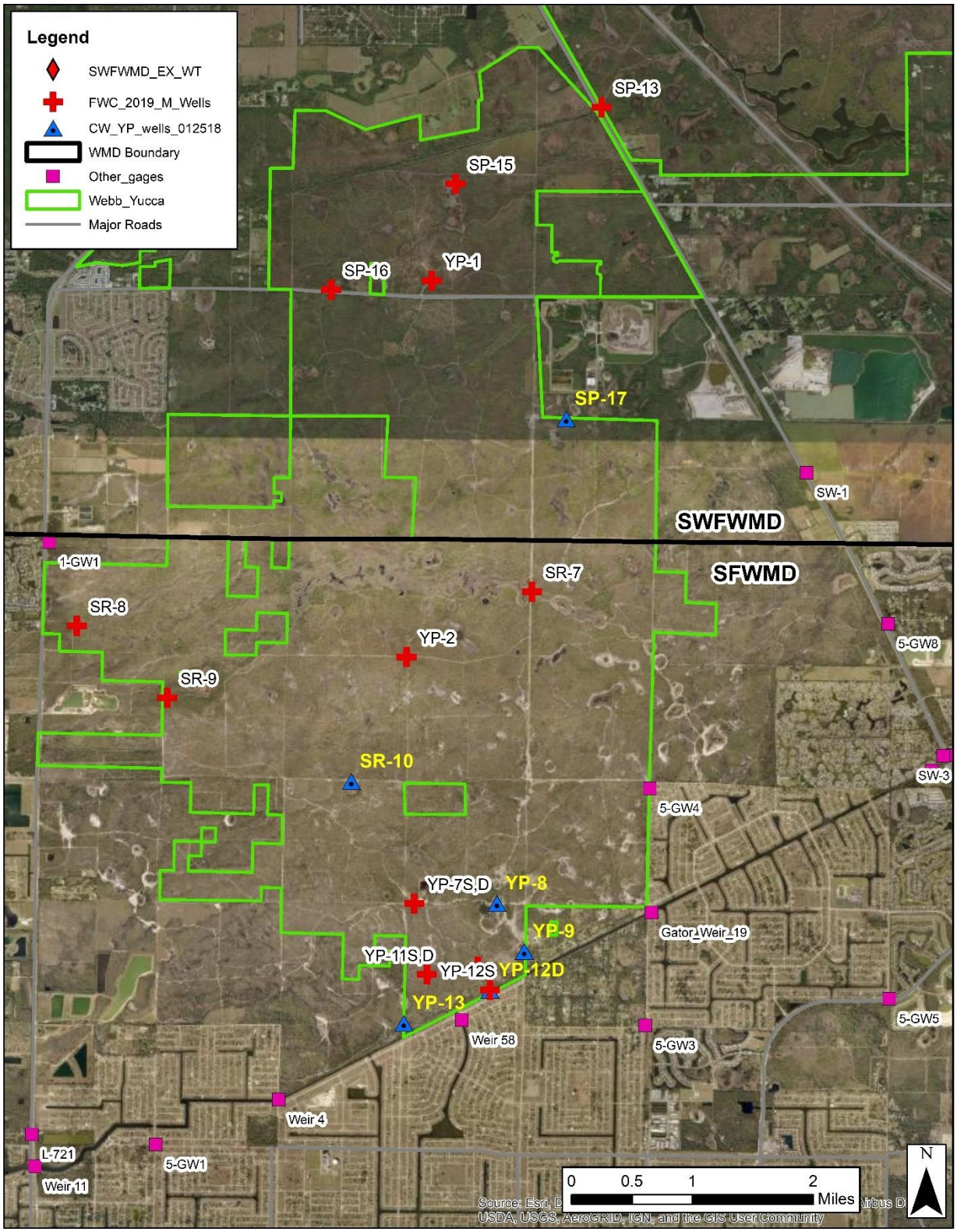

Figure 9 – Existing Monitoring Stations in Yucca Pens WMA and the Surrounding Area

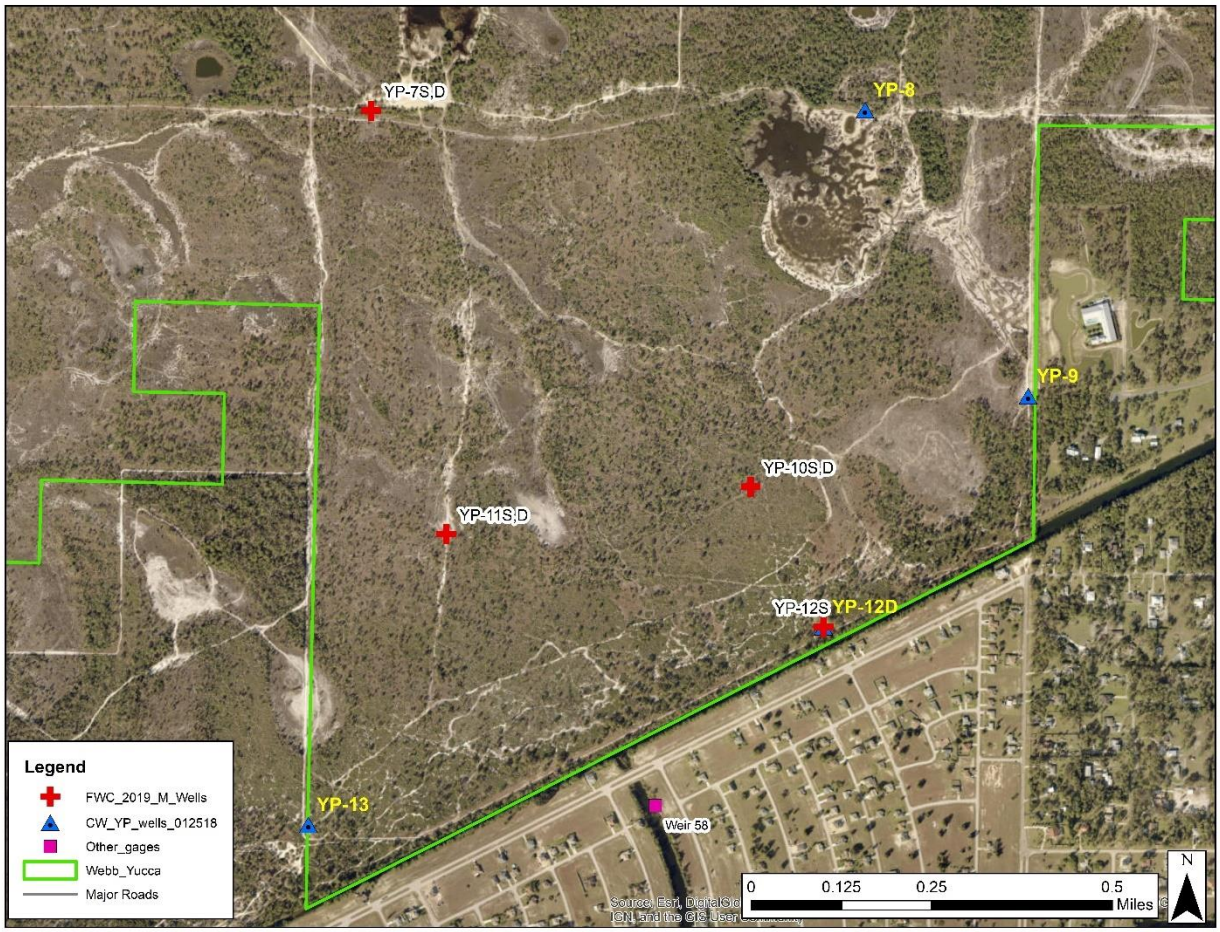

Figure 10 – Location of Monitoring Stations in the Southern Portion of Yucca Pens WMA

Table 1 – Monitoring Station Installation History and Updated Station Names

Existing Station Name	Updated Station Name	Year Installed	Date When Data Logger Installed
STA-6	No change	2017	2017
STA-7	No change	2019	2019
STA-8	No change	2019	2019
SR-6	No change	2011	2019
SP-13	SP-13	2019	2019
1	SP-15	2011	2019
2	SP-16	2011	2019
3	YP-1	2011	2019
5	SR-7	2011	2019
8	SR-8	2011	2017
9	SR-9	2011	2017
14	YP-2	2019	2019
30S, 30D	YP-7S, YP-7D	2019	2019
YP-3	YP-8	2018	2018
YP-1	YP-9	2018	2018
YP-2	YP-12D	2018	2018
23S, 23D	YP-10S, YP-10D	2019	2019
24S, 24D	YP-11S. YP-11D	2019	2019
29S	YP-12S	2019	2019
YP-5	YP-13	2019	2019

Table 2 – Monitoring Station Information

Station Name	Agency Maintaining Station	Year Installed
25100	SWFWMD	1989
25092	SWFWMD	1999
CH-323	USGS	2001
L-721	USGS	1970
Gator Slough, US-41	USGS/Lee County	2009
SW Aggregates wells	Cape Coral	2017
SW-1, -2, -3	Cape Coral	2017
CCI	Cape Coral	2020
Gator Slough Weir 11	USGS/Cape Coral	1992-2013
Gator Slough Weirs 19, 58, 11	Cape Coral	2014
Gator Slough Weir 4	Cape Coral	2018
1-GW1	Lee County	1991
5-GW1, 3, 5, 6, 8	Lee County	1991
17-GW3, 4, 18-GW2	Lee County	1991/1992
20-GW3, 22-GW1	Lee County	1992
27O-GW1, 28-GW2	Lee County	1997, 1993
Bayshore, Popash	Lee County	2011

Barometric pressure is being recorded at three locations within the study area. InSitu Baro-Trolls have been deployed at station SR-7 in Yucca Pens (see **Figure 9**), Southwest Aggregates (just east of the mining pits shown on **Figure 9**), and station SR-6 in Babcock Webb (location shown on **Figure 8**).

Monitoring Data Overview

The discussion below provides a limited analysis of selected monitoring stations in Yucca Pens with the objective of identifying key trends that will guide the execution of subsequent tasks of this hydrologic restoration project. A more detailed analysis will be conducted as part of Task 5, development of an existing conditions hydrologic model of the study area.

Stations YP-7, 11, and 13 (**Figure 11)** represent a north south transect in southern Yucca Pens with the southernmost station (YP-13, a 25-foot deep monitoring well) located just north of Gator Slough Canal. Measured data for these stations show similar water levels and magnitude of seasonal response in YP-7 and 8 which lie essentially in the same position of the hydrologic gradient but lower water levels and a larger seasonal response for YP-13 lying adjacent to the Gator Slough Canal. YP-11 which lies between YP-7 and YP-13 shows an intermediary water level between the two. **Figure 12** presents measured water levels for YP-12 and YP-13. Both stations are located close to Gator Slough, and both stations have large differences between wet and dry season water levels. YP-12 has a shallow (YP-12S) and deep monitoring well (YP-12D)

adjacent to each other. YP-12S is 6 feet deep, and YP-12D is 25 feet deep. Measured water levels are lower for YP-12D, potentially due to drainage effects of Gator Slough that has dry season water levels below 7.3 ft-NAVD. These data will be compared to vegetation indicators collected as part of Task 3 and will be used to calibrate the model's ability to simulate dry season water levels in southern Yucca Pens.

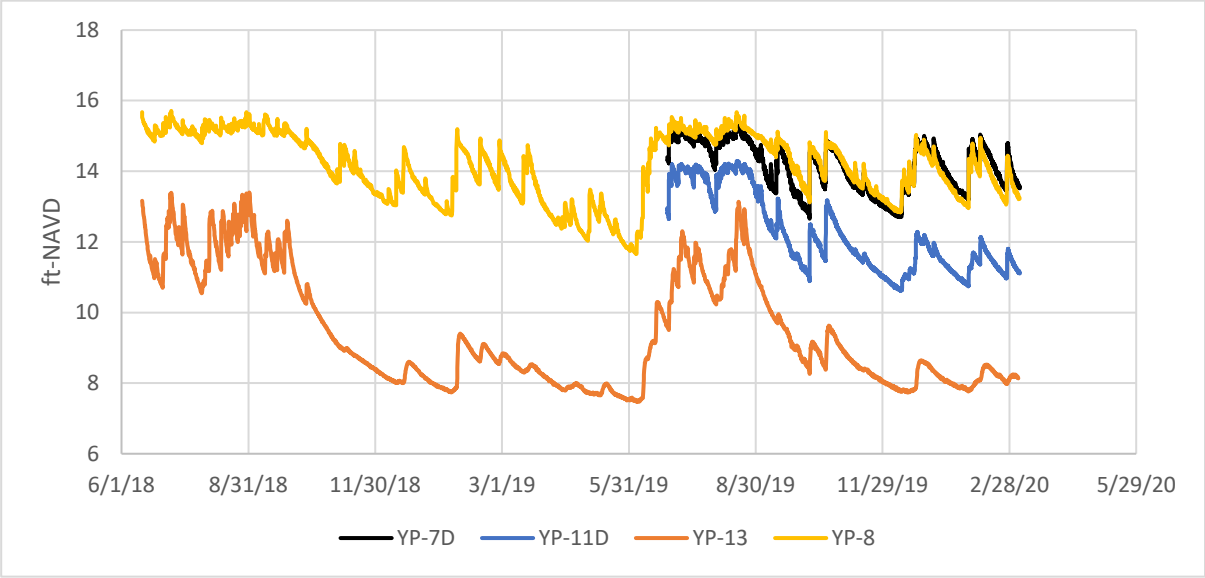

Figure 11 – Measured Water Elevations at YP-7D, YP-11D and YP-13

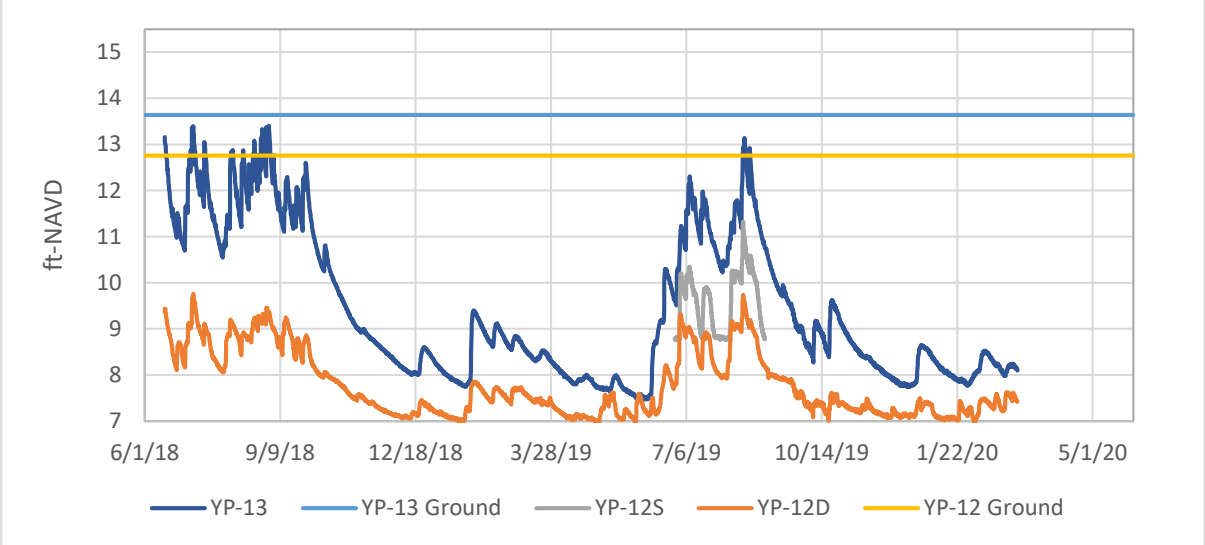

Figure 12 – Measured Water Levels and Ground Elevations for YP-12 and YP-13

Monitoring stations SR-8 (Yucca Pens Creek) and SR-9 (Durden Creek) were staff gages originally installed by USGS with water levels recorded only during the wet season when water levels were above ground. Additionally however, because both stations are on the western side of Yucca Pens that experiences high water depths during the wet season, collection of water level data was often not possible during the peak of the wet season in years when rainfall exceeded

average accumulations. FWC purchased water level data loggers that were installed in January 2017. These water level data loggers were only able to measure water depths over a 2-meter range and the Durden Creek gage was not able to capture low water elevations during the drought experienced in April and May 2017 (see **Figure 13**). Additional monitoring wells were installed in 2018 and 2019 with depths of 6 and 30 feet. Data from those monitoring wells are being reviewed and will be presented once the quality assurance/quality control effort has been completed.

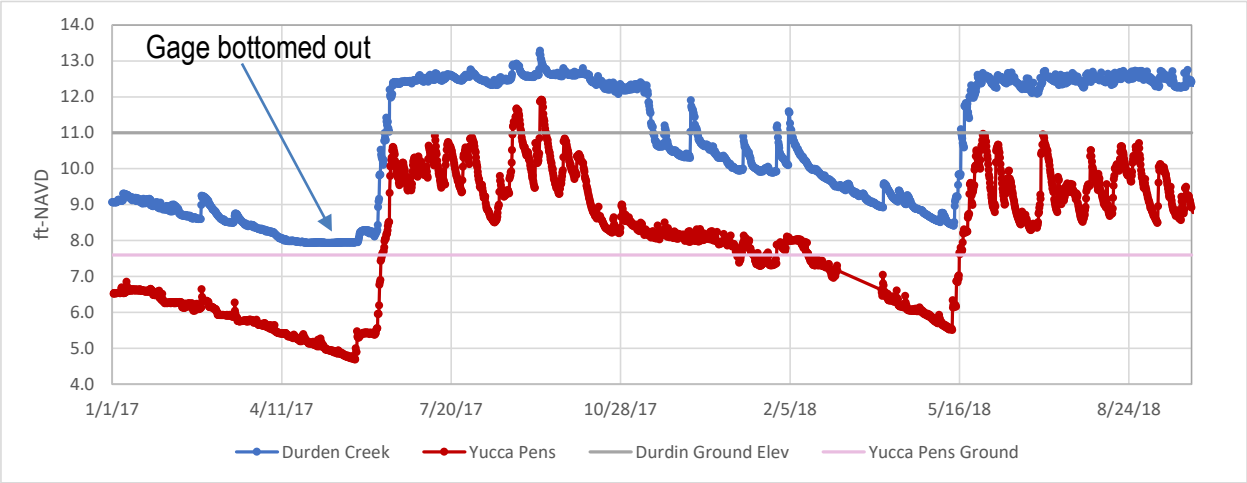

Figure 13 – Measured Data for Yucca Pens (SR-8) and Durden Creek (SR-9)

Babcock Webb monitoring stations are primarily manually read staff gages. Data for selected manual staff gages are presented in **Figure 14** for stations shown in **Figure 8.** Four automatic monitoring data logging stations were installed in 2017 in southwest Babcock Webb. Collected water level data for those stations are still being processed.

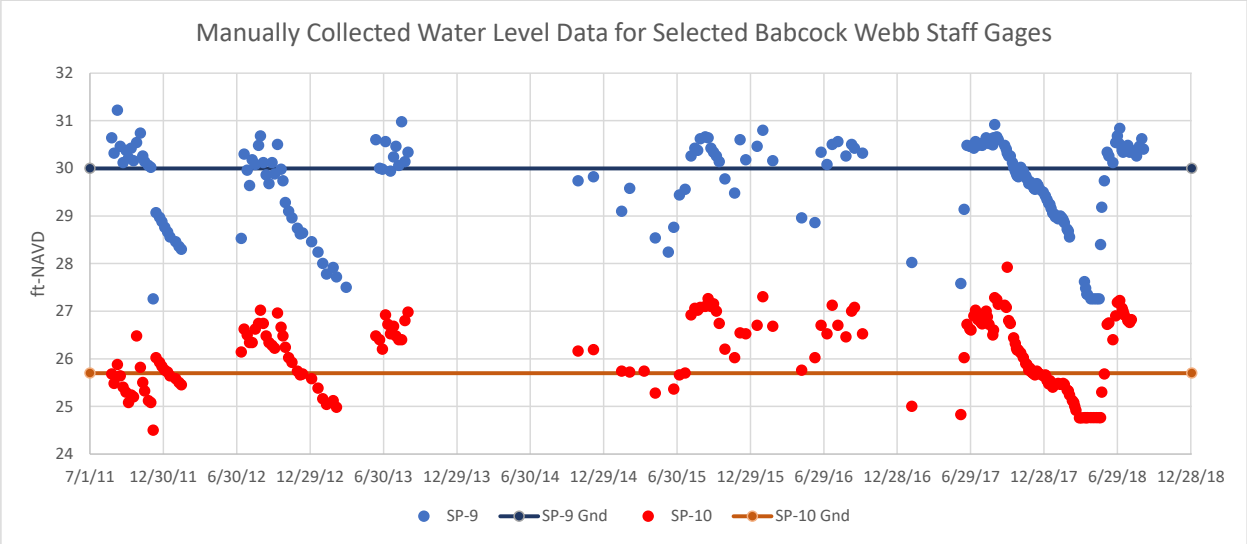

Figure 14 – Selected Water Level Data for Babcock Webb Staff Gages

There are 14 existing rain gages in the project area, as shown in **Figure 15 and Table 3**. SWFWMD has two rain gages that are located on the north part of the study area. Lee County has eight rain gages, and Cape Coral has four rain gages.

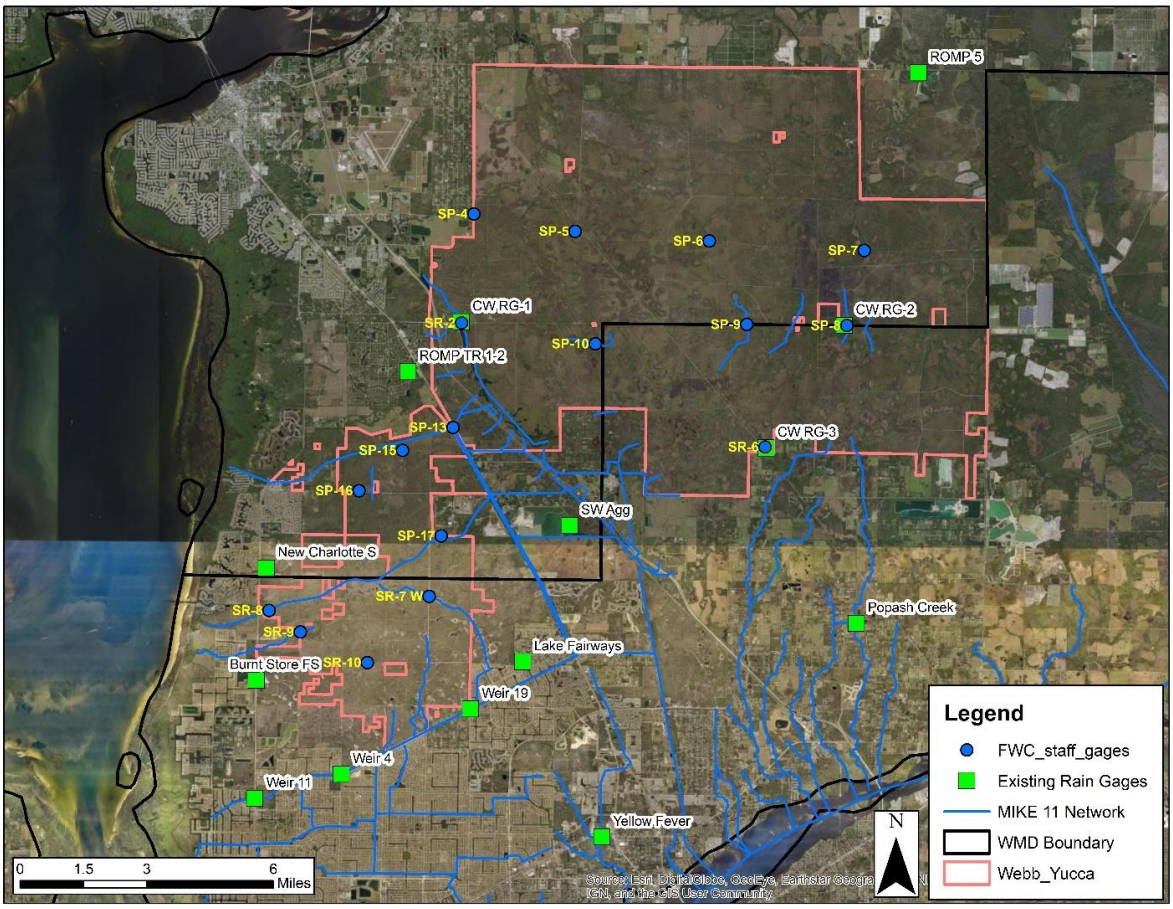

Figure 15 – Existing Rain Gages in the Vicinity of Babcock Webb and Yucca Pens

Table 3 – Existing Rain Gages in Study Area

Station Name	Agency Maintaining Station
ROMP 5	SWFWMD
ROMP TR 1-2	SWFWMD
CW-RG-1	Lee County
CW-RG-2	Lee County
CW RG-3	Lee County
New Charlotte S	Lee County
Popash Creek	Lee County
Lake Fairways	Lee County
Burnt Store FS	Lee County
Yellow Fever	Lee County
SW Agg	Cape Coral
Weir 19	Cape Coral
Weir 4	Cape Coral
Weir 11	Cape Coral

SURVEY DATA

Topographic and water conveyance cross sectional survey data have been collected as part of the I-75 Widening Project, Cape Coral Master Plan, Cape Coral Emergency Water Delivery Project, Yucca Pens Hydrogeologic Study, and the Babcock Webb South Walk-In Area Monitoring Station Project. During the 2013 modeling conducted for the FDOT I-75 Widening Project, surveys were conducted in canals and flow-ways, presented in **Figure 4** (see Section A) in order to provide a reasonable representation of concentrated flows within the model domain. This surveying effort provided accurate cross section data at 29 locations. Prior to the FDOT project, no cross-sectional data existed for the U.S. 41 ditches and the FDOT survey only provided information at three locations. Cross section surveys for Gator Slough were available from a 1992 study and the surveyed elevations did not appear to accurately represent the channel conditions in Gator Slough west of U.S. 41. In order to address this data gap, channel cross sections were obtained for the U.S. 41 ditches and Gator Slough west of U.S. 41 as part of the 2017 Emergency Water Delivery from Southwest Aggregates to the City of Cape Coral. (**Figure 16)**. Surveying was also performed at 53 locations as part of the 2019 Yucca Pens Hydrogeologic Assessment conducted for CHNEP and FWC to provide more accurate information on the conveyance characteristics of sloughs and flow-ways of Yucca Pens.

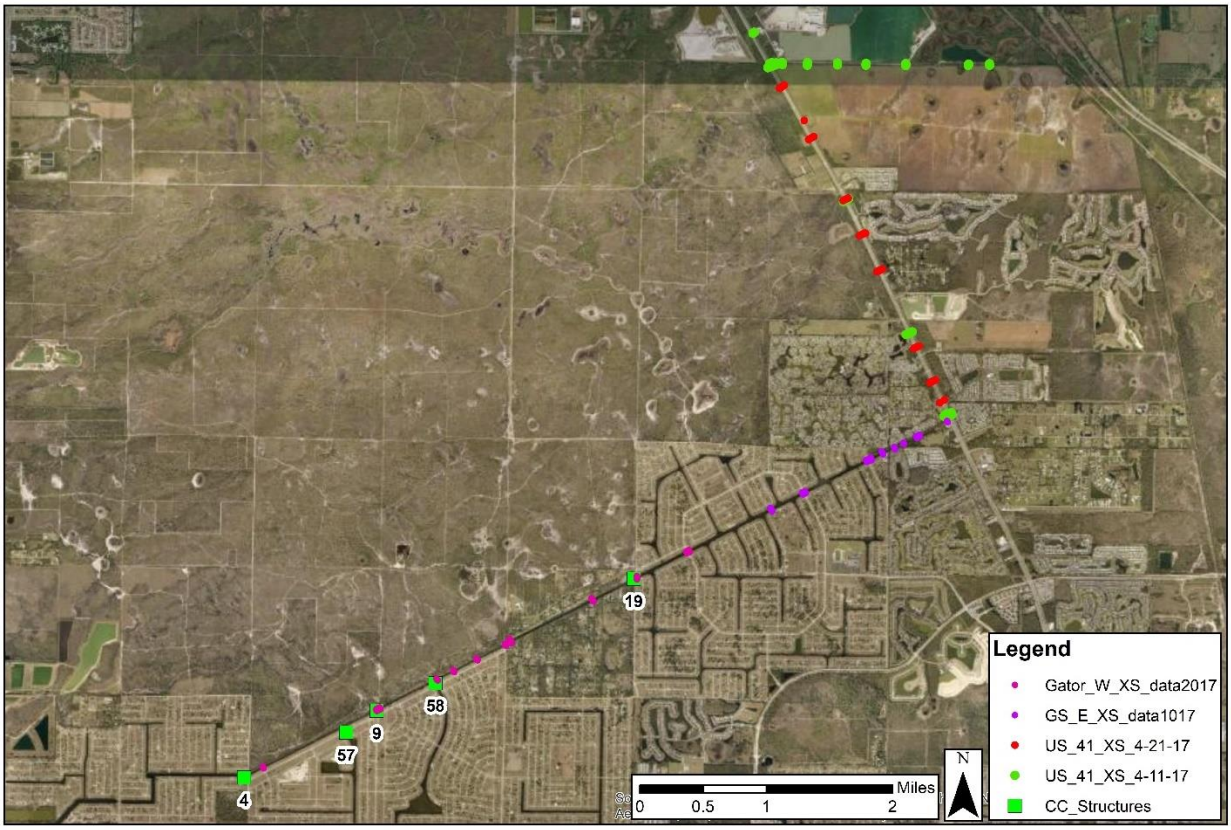

Figure 16 – Surveyed Cross Sections Along U.S. 41 and Gator Slough West of U.S. 41

FWC obtained survey data for new wells installed in the southwestern portion of Babcock Webb WMA that is locally referred to as the South Walk-In Area. During the surveying of the new wells, a number of additional points were surveyed to check the accuracy of existing topographic data for the South Walk-In Area, which is typically flooded. **Figure 17** illustrates the difference between surveyed point elevations and LiDAR data for the South Walk-In Area. Surveyed elevations are lower than LiDAR elevations at most of the locations surveyed during this assessment due to the LiDAR survey techniques are not able to detect actual ground elevations in flooded areas.

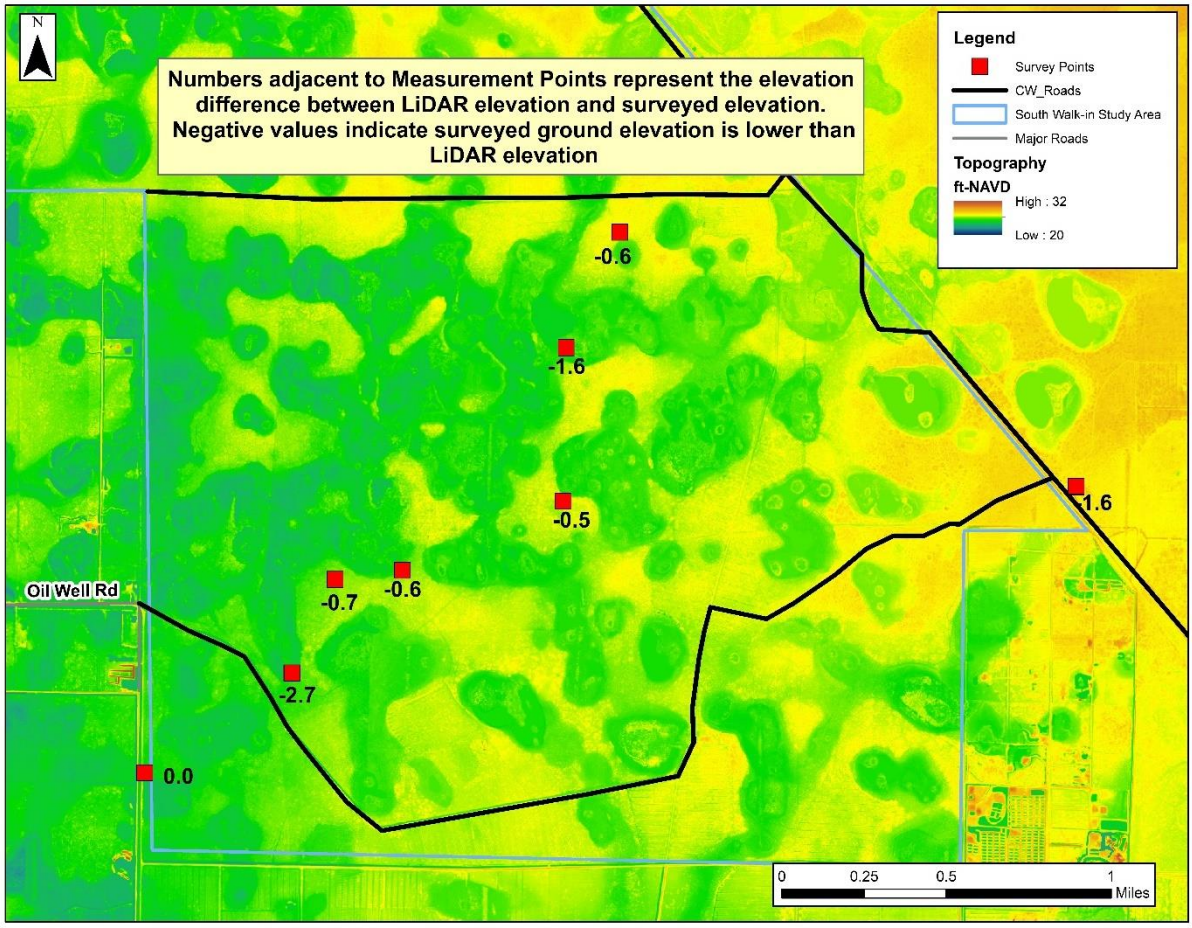

Figure 17 – Elevation Differences Between Point Measurements and LiDAR in the South Walk-In Area

SUMMARY AND NEXT STEPS

This report describes studies, measured data, and survey data from a variety of watershed management efforts that have been conducted since the early 1980's through 2020. The information has been compiled in one location on the CHNEP Water Atlas. The Lower Charlotte Harbor Flatwoods Hydrologic Modeling & Restoration (LCHFHMR) project will utilize the information from these various sources during the execution of the planning process. Previous survey data and hydrogeologic boring findings will be incorporated into the model input files, and measured water levels and rainfall will be used during model calibration. Information from the data collection effort associated with the LCHFHMR project will also be utilized to augment the data available from prior studies. The ground and surface water monitoring stations and rain gages described in the approved Groundwater Monitoring Plan and Flow Monitoring Plan (task 2a) will fill existing information gaps. There are a number of on-going activities that are underway that will enhance the overall planning effort, as summarized below:

- Obtain more accurate topographic data for the South Walk-In Area. FWC has developed a scope-of-work for this surveying effort that is slated to begin during the fall of 2020.
- Determine the best method to merge elevation data from the SWFWMD LiDAR survey with elevation data available from earlier LiDAR topographic data sources that define flow-ways in greater detail.
- Continue to compare the surveyed cross sections in Yucca Pens (Water Science Associates and Southwest Engineering & Design, 2019) to LiDAR data so that top-of-bank elevations of the cross sections added to the MIKE 11 model are reasonably similar to topographic data used in the MIKE SHE model.
- Complete QA/QC of data collected for a number of monitoring stations, including SR-8 and SR-9 in Yucca Pens and STA-6, STA-7, STA-8, and SR-6 in the Babcock Webb South Walk-In area.
- Carefully review results from the nested wells in south Yucca Pens to confirm that all measured elevations are on the same datum.

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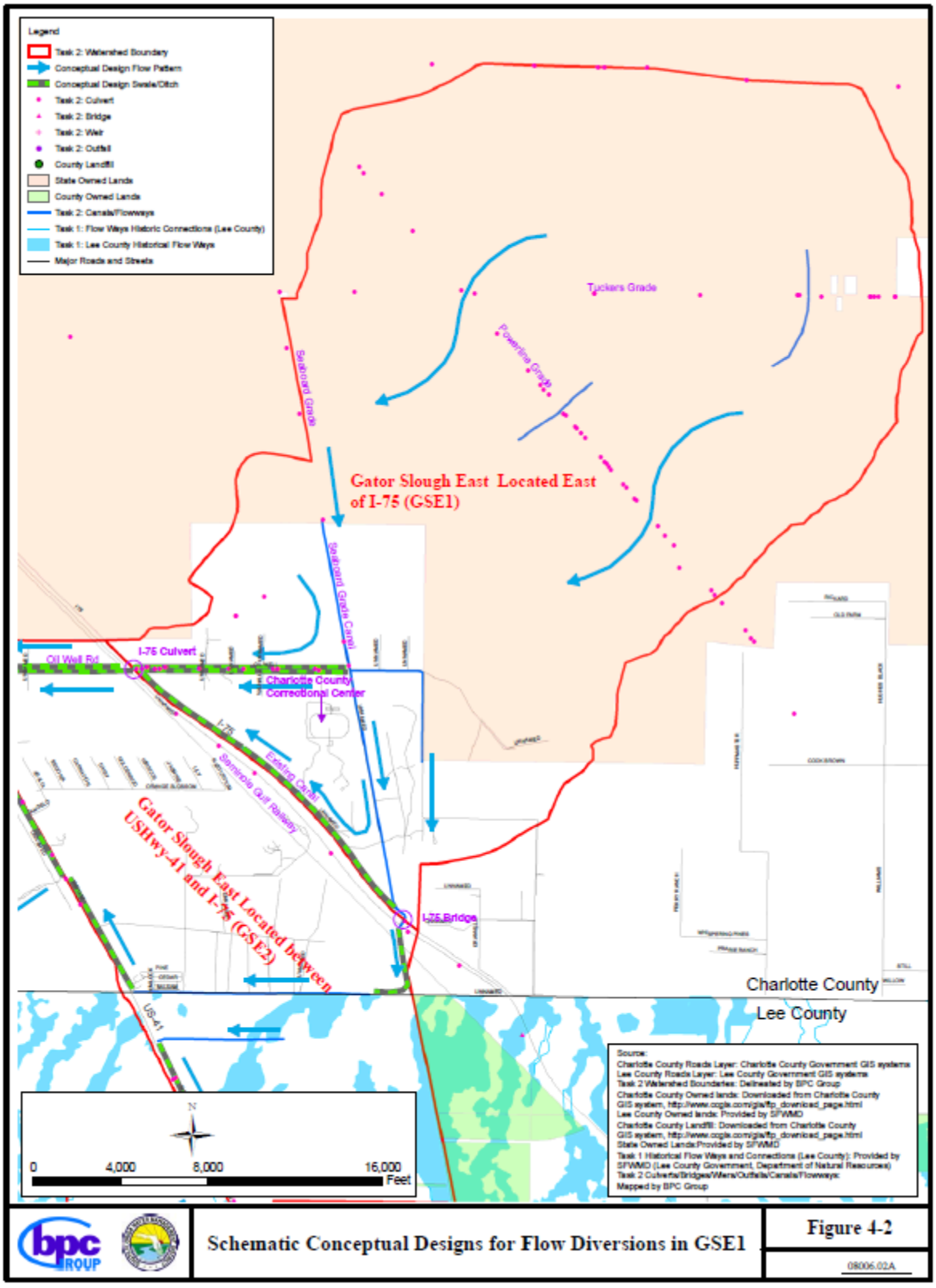
ATTACHMENT 1

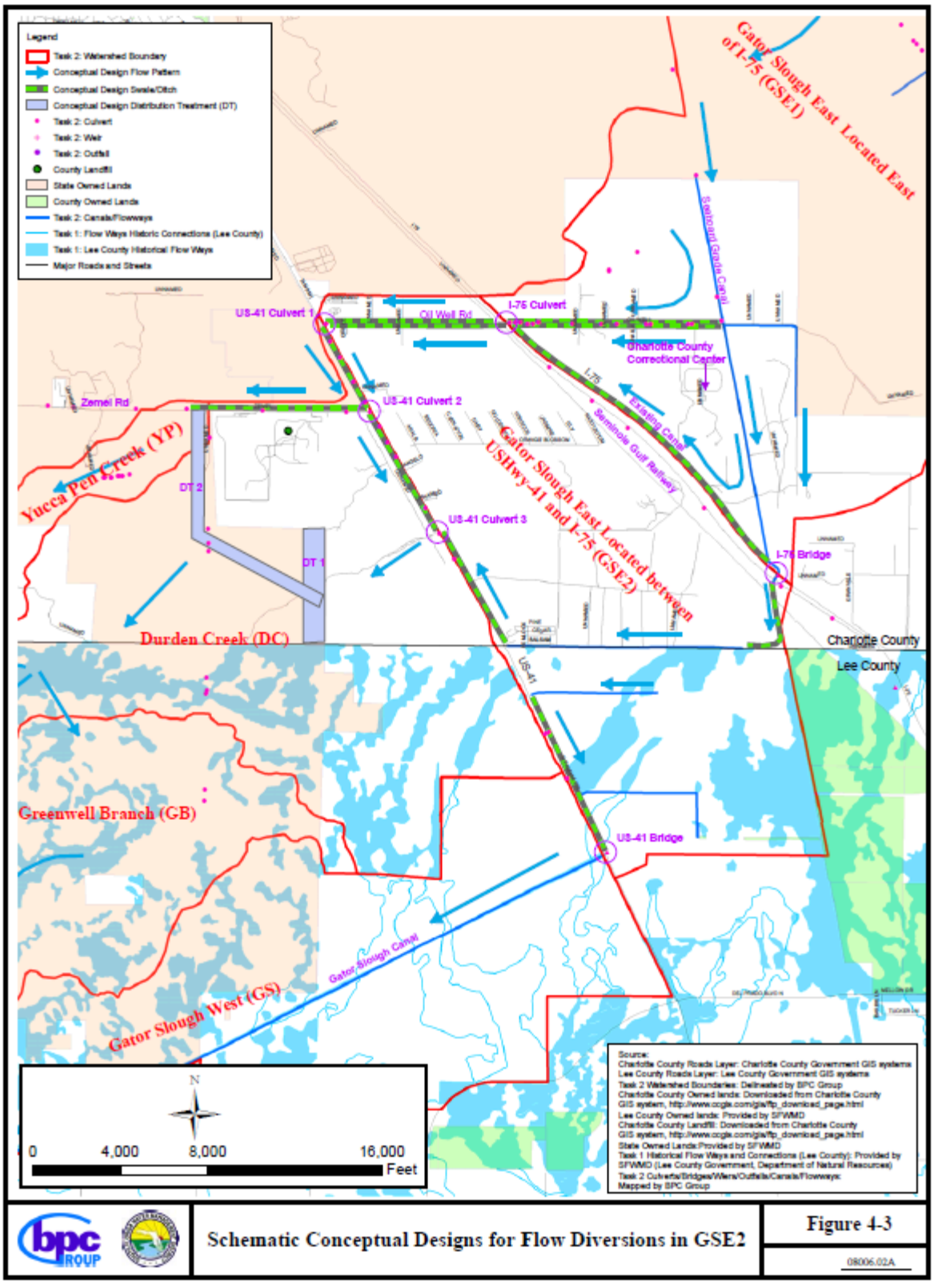
CONCEPTUAL FLOW DIVERSION PLANS FROM BPC (2010)



Schematic Conceptual Designs for Flow Diversions in GSE1

Figure 4-2

08006.02A



Schematic Conceptual Designs for Flow Diversions in GSE2

Figure 4-3

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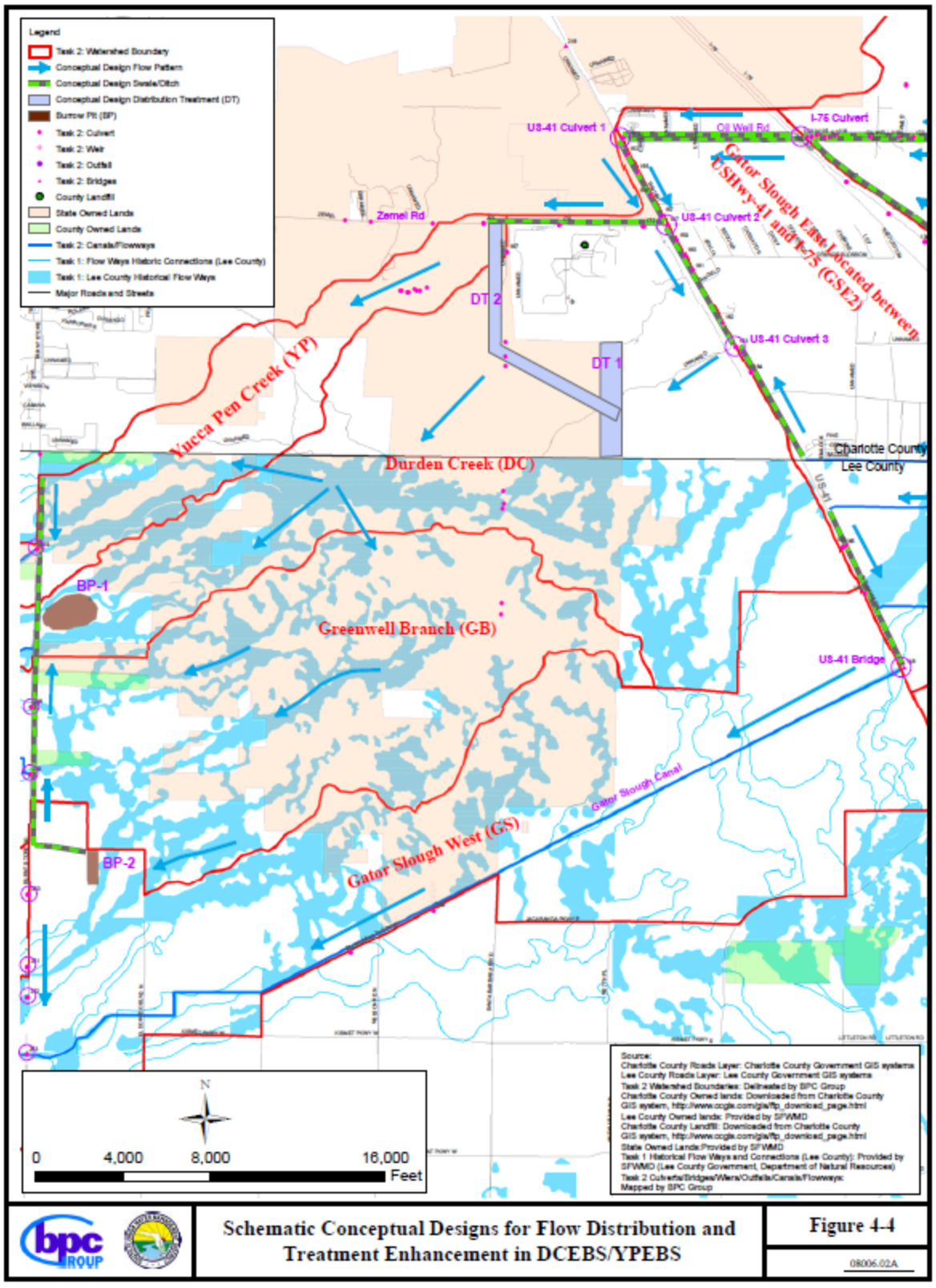
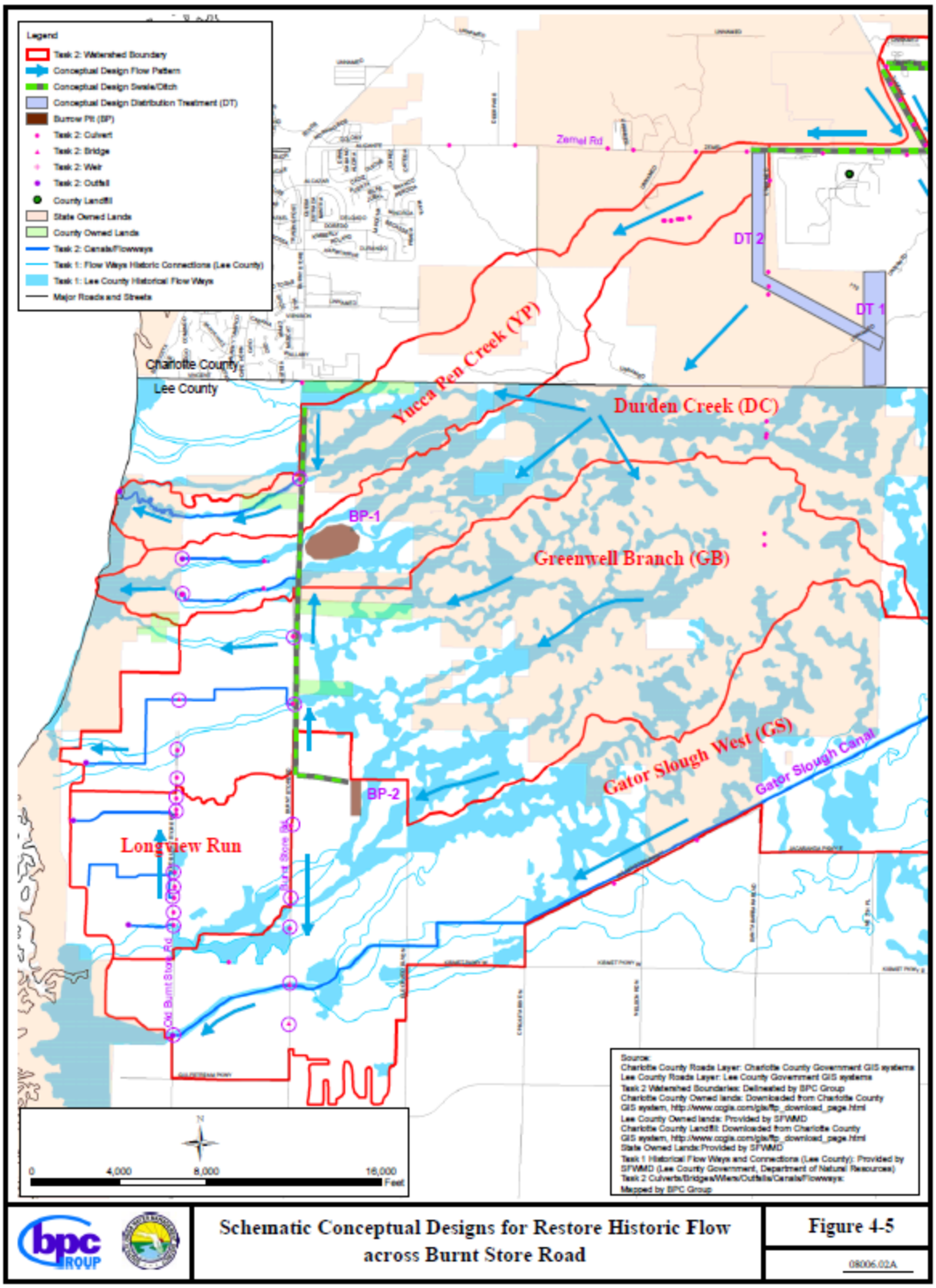


Schematic Conceptual Designs for Flow Distribution and Treatment Enhancement in DCEBS/YPEBS

Figure 4-4

08006.02A



bpc GROUP

Schematic Conceptual Designs for Restore Historic Flow across Burnt Store Road

Figure 4-5

08006.02A

ATTACHMENT 2

From SWFFS, 2013. Appendix A, Engineering, sheet 146-147 of 1570

A.3.1.3 Functional Group 56: Yucca Pens

Historically water north of the Caloosahatchee River flowed overland through sloughs and creeks from the Webb Wildlife area to the estuaries. Channelization from small scale ditches to the large Gator Slough Canal have dried the landscape and funneled larger than normal wet season flows to one outlet at the estuary. During the dry season the canals have also lowered the water table creating shorter periods of inundation.

Proposed features include (*Figure A-63*)[11]:

- Construction of weir structures along SR 41 on the east side of the Yucca Pens area, diverting flows under the roadway into the project area.
- Modifications of weir structures (cross drains) under SR 41 south of Avenida del Vera, and north of Pine Lakes Blvd to accommodate additional flows from the weirs describe above.
- Construction of a new conveyance channel north of French Creek Lane to direct flows farther west into Yucca Pens without adversely impacting adjoining lands.
- Installation of culverts to increase overland flow under an electric utility access road in the center portion of Yucca Pens to retain dry access in the proposed conditions.
- Installation of a seepage management structure for approximately 11 miles along the southern border of Yucca Pens area to limit groundwater flows into Gator Slough. An existing berm along most of this southern border will remain.
- Modifications, if required, to eight existing culverts along Burnt Store Road (County Road 765), in Lee County, and drainage canals to allow improved flows to the west into the Yucca Pens area. Four additional culverts located south of Durden Parkway immediately beyond the Yucca Pens area may also merit modifications.

[11] This figure refers to the SWFFS because it was completed prior to transition from a feasibility study to a comprehensive watershed plan.

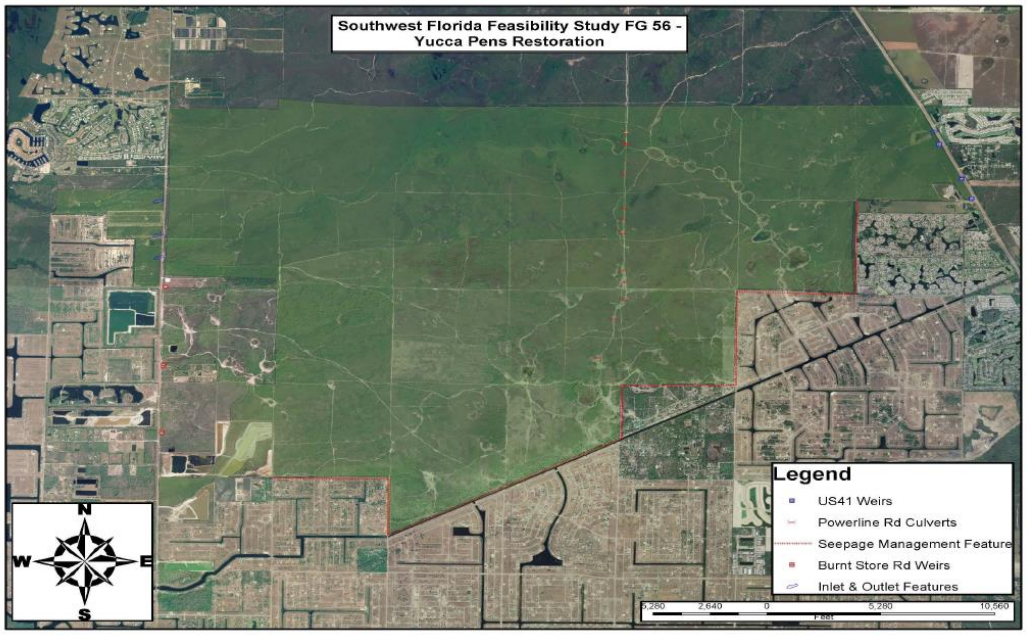


FIGURE A-63: PROPOSED FEATURES IN THE FUNCTIONAL GROUP 56 PROJECT
(These features are provided for visual representation only and are not intended as the final design)