

# South Lee County Watershed Hydrologic Modeling

## PROJECT DESCRIPTION

### GENERAL INFORMATION

**Title of Project:** South Lee County Watershed Initiative Hydrologic Modeling

**Date of Proposal:** 5/10/18

**Potential Funder:** South Florida Water Management District

### CONTACT INFORMATION

#### Implementing Trustee

**Local Contact:** Jennifer Hecker, Executive Director

**Name of Organization:** Charlotte Harbor National Estuary Program (CHNEP)

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#### Other Project Contact

**Local Contact:** Kim Fikoski, Senior Project Manager

**Name of Organization:** South Florida Water Management District

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### PROJECT LOCATION AND PARTNERS

**Project Location:** Lee County

#### **Other Project Partners:**

Southwest Florida Regional Planning Council, City of Bonita Springs, Lee County, Village of Estero, Bonita Springs Utilities, Florida Department of Transportation, Conservancy of Southwest Florida, Audubon Society, and the Estero Council of Community Leaders.

### PROJECT RESTORATION GOAL

**Goal:** Restore more natural hydrology and water quality to improve environmental conditions, as well as increase storage and moderation of high flow events to provide greater flood protection.

## BRIEF PROJECT DESCRIPTION

### **Project Goals and Objectives:**

The goal of this project is to develop a science-based, data-driven, Strategic Hydrological Planning Tool that will provide guidance to resource management agencies related to the appropriate restoration and management of surface waters currently flowing from the South Lee County Watershed (SLCW) comprised of the Estero River, Spring Creek and Imperial River watersheds, and discharging into the Estero Bay Aquatic Preserve. The conversion of native wetland habitats to agriculture or development, installation of drainage canals, surface mining, and construction of major roadways such as Corkscrew Road, SR. 82, US 41 and I-75, has significantly altered the historic sheet flow from the southern region of Lehigh Acres south to the Corkscrew Sanctuary and southwest to Estero Bay – resulting in flooding, water quality degradation and decreased water storage.

This project will update and enhance the existing South Lee County Watershed Plan Update (SLCWP) MIKE SHE/MIKE 11 integrated surface/ground water model by reducing the grid files size from 750' to 500' and use ecological data to determine the appropriate hydropatterns, timing and quantity of water flows required to improve the hydrological conditions to wetlands, flowways, tributaries and coastal waters as well as habitat. The flood model recently completed for the Village of Estero will be used as the base for this proposed model. Appropriate ecological data will be used from the DRGR studies in Lee County and Bonita Springs. The South Lee County Watershed Initiative Stakeholder group, comprised of the diverse project partners identified above, prioritized this modeling effort as the top need for moving watershed restoration efforts forward in the region.

The first model run, the natural systems model, will establish an accurate portrayal of the historic, pre-development hydrological conditions in this mega-watershed. The second model run, an existing conditions model, will explain the current hydropatterns and identify those areas and activities within the project area that have impacted the hydrology and ecosystems, and exacerbated flooding during storm events. It will also identify appropriate cost-effective restoration projects to increase surface water storage and restore hydropatterns. The third model run, the future conditions model, will evaluate future scenarios, with different combinations of the selected restoration and management activities.

The final report produced will be a Strategic Hydrological Planning Tool, which will summarize the results of each model run and provide recommendations on priority restoration and management projects and actions, the resulting benefits, and approximate implementation costs. Ultimately, this project will provide SLCW project partners with the tools needed to move forward with comprehensive collaborative projects to improve the hydrological conditions and habitat in this region.

This comprehensive approach of data collection, evaluation, analysis and recommendation development will ensure the success of the selected restoration projects, encourage stakeholder participation and identify appropriate ecosystem management in an area where water resources have been historically impacted by past development for agriculture and mining, are under increasing pressure from proposed housing and urban development, which have recently been impacted by flooding events such as Hurricane Irma and be affected by climate change factors.

The vast wetland ecosystems within the study area are highly susceptible to over-drainage, flooding, and climate change stressors. Restoring wetland hydroperiods will extend hydroperiods, improve water quality, improve habitat for wetland-dependent wildlife species as well as for the human population that depends on this area to supply their public drinking water.

The proposed modeling will also provide the needed information to determine the timing, distribution, quantity and quality of the water needed to improve the historic surface water flows of the Estero River, Spring Creek, Imperial River to Estero Bay. These riverine and tidal creek systems are primary nursery areas for fisheries, providing food and habitat to numerous species of fish and shellfish including snook, redfish, tarpon and oysters. The rivers and creeks draining the SLCW area have been heavily impacted by changes in hydrology over the past 100 years and are now experiencing significant flooding during storm events and very low flows during the dry season.

### **Activities to be Funded**

This proposal describes modifications to the MIKE SHE/MIKE 11 model recently completed for the Village of Estero, to include ecological parameters and a reduced grid size to increase accuracy. Permission to utilize the files will be required from the Village of Estero prior to the start of work, and it is assumed that the updated files will be provided to the Village at the completion of the project.

#### **Task 1 – Resample Input Grid Files from 750 to 500 Feet**

All grid input datasets will be re-created from original source files. The grid files to be resampled include topography, land use, irrigated areas, flood codes, overland flow roughness, detention, drainage, and groundwater files such as lower level, horizontal hydraulic conductivity, vertical hydraulic conductivity, lateral extent of confining units, boundary conditions, and initial water depths.

Task 2 - Recent and historic, natural water level indicators will be located in the field as needed. Additionally, approximately 6 rain gauges will be installed and monitored in the study area.

Task 3 - A GPS survey (horizontal and vertical) all piezometers and natural water level indicators will be completed.

Task 4 - Land-use and cover mapping of historical conditions (1953) in the study area, not previously mapped in the Lee County and Bonita Springs DRGR studies, will be completed.

Task 5 - Update Existing Land-Use Mapping and Add Land Use Categories. The current model files include wet prairie, marsh, swamp forest, cypress, hydric flatwood, and hydric hammock. Additional land use categories that have unique vegetation and evapo-transpiration parameters may be added.

Task 6 - Compare model calibration to ecological indicators. The project ecologist will confirm model calibration using known ecological parameters and groundtruthing.

Task 7 – Update Agricultural Representation. The existing model files will be revised to include increased detailed representation of farm canals and stormwater detention facilities. The irrigation routines for farms will be verified and revised as necessary to provide a realistic representation of the irrigation impact on the farm water budget. Reported farm irrigation flows will be obtained and prepared for use in the calibration effort.

Task 8 – Extend Calibration Input Files. Update files through September 2017 for rainfall, evapotranspiration, vegetation database, and measured water levels and/or flows for more than 210 calibration stations.

Task 9 – Calibration for 2013 – 2014. The model calibration will be continued with a focus on hydrology of the Corkscrew Swamp headwaters, the Estero and the Imperial Rivers and Spring Creek. The Village of Estero model simulated flows for the Imperial River are less than measured flows, simulated stages in portions of the Corkscrew Swamp headwaters appear to be higher than measured stages, and dry season calibration could be improved. The calibration effort will adjust surface water parameters (flow-way widths and bed roughness) as well as ground water parameters (hydraulic conductivity of the surficial aquifer and connectivity between the surficial aquifer and the Lower Tamiami aquifer).

Task 10 – Calibration through 2018. The simulation period will be January 2013 through October 2018. The calibration will include the drought of January – May of 2017.

Task 11 - Scenarios (pre-development, existing with restoration projects, future land use). The modeling process will run different scenarios to determine the pre-development hydrological and ecological conditions, a future development scenario of existing with future projected land use and water management changes, and then a scenario that models restoration projects with land use assumptions to be determined collectively between Funder, Implementing Trustee and Contractor/Consultant.

Task 12 – Reporting. The Contractor/Consultant will prepare and present a written report that will describe the changes to the model files, calibration performance, existing conditions hydrology and hydroperiods, pre-development hydrology and hydroperiods, future development hydrology and hydroperiods, watershed and ecological restoration opportunities, proposed scenario results, conclusions, and recommendations. The restoration alternatives will include projects that improve wetland hydroperiods and increase groundwater recharge, while maintaining or improving flood protection.

Task 13 – Project Management. The Implementing Trustee will provide project oversight to ensure contractors/consultants are fulfilling task responsibilities and to prepare and submit quarterly Letter Reports to the funder detailing progress and financial expenses towards the project budget, processing invoices and making payments. The Implementing Trustee will also organize and facilitate stakeholder briefings to the South Lee County Watershed Initiative stakeholders on the project.

### **Estimated Cost**

The costs are presented below in **Table 1**. The cost is estimated based on a lump sum basis with monthly invoicing on a percent complete by task basis. A progress report from the Consultants/Contractors will be provided to describe work completed during the invoicing period. Letter Reports from Implementing Trustee will be submitted to funder quarterly.

## FINANCIAL INFORMATION

**Table 1 – Cost Estimates**

	<b>Task</b>	<b>Cost</b>
1	Resample Input Grid Files	\$ 9,000
2	Natural water level indicators, installation and monitoring of approximately 6 rain gauges	\$ 21,000
3	GPS survey	\$ 8,200
4	Mapping of Historical Land-use and Cover	\$ 17,500
5	Update Existing Land-Use Mapping and Add Land Use Categories	\$ 13,300
6	Compare model calibration to ecological indicators	\$ 15,000
7	Update Agricultural Representation	\$ 5,300
8	Extend Calibration Input Files	\$ 19,300
9	Calibration for 2013 – 2014	\$ 25,000
10	Calibration through 2018	\$ 30,500
11	Scenarios (pre-development, existing with restoration projects, future land use)	\$ 53,000
12	Reporting	\$ 20,200
13	Project Management	\$ 12,700
	<b>Total Costs</b>	<b>\$ 250,000</b>

### Contingencies:

It may be necessary to install new piezometers to collect shallow ground water and surface water levels in the study area where additional data is required. This will be determined within the first 30 days of the study and if needed, may require an additional partner such as Lee County or the City of Bonita Springs to provide funding.

## RESTORATION APPROACH, TECHNIQUES, AND BENEFITS

### **Identify mechanisms for providing benefits**

Approach: Restore hydropatterns, increase flood storage, reduce flooding, reduce pollution and hydrologic degradation to Estero Bay

Technique: Hydrologic Restoration

### **Describe direct benefits to Restoration:**

Estero Bay and the Coastal Communities; The hydrological restoration of the study area will assist in improving environmental conditions in restoring more natural water quantity and quality, as well as moderate high-volume flows to reduce flood risk to coastal communities.

The project report will identify where the redistribution of flows through restoration and management will provide the appropriate quantities and quality of water to natural systems.

## PROJECT IMPLEMENTATION DETAILS

**Timeline for commencement and completion (breakdown by activity/category of activities if known (e.g., planning, E&D, permitting, implementation/construction, monitoring):**

Project completion within 9 months of initiation.

**Permits or Environmental Compliance obtained to date:** N/A

**Potentially Required Permits:** N/A

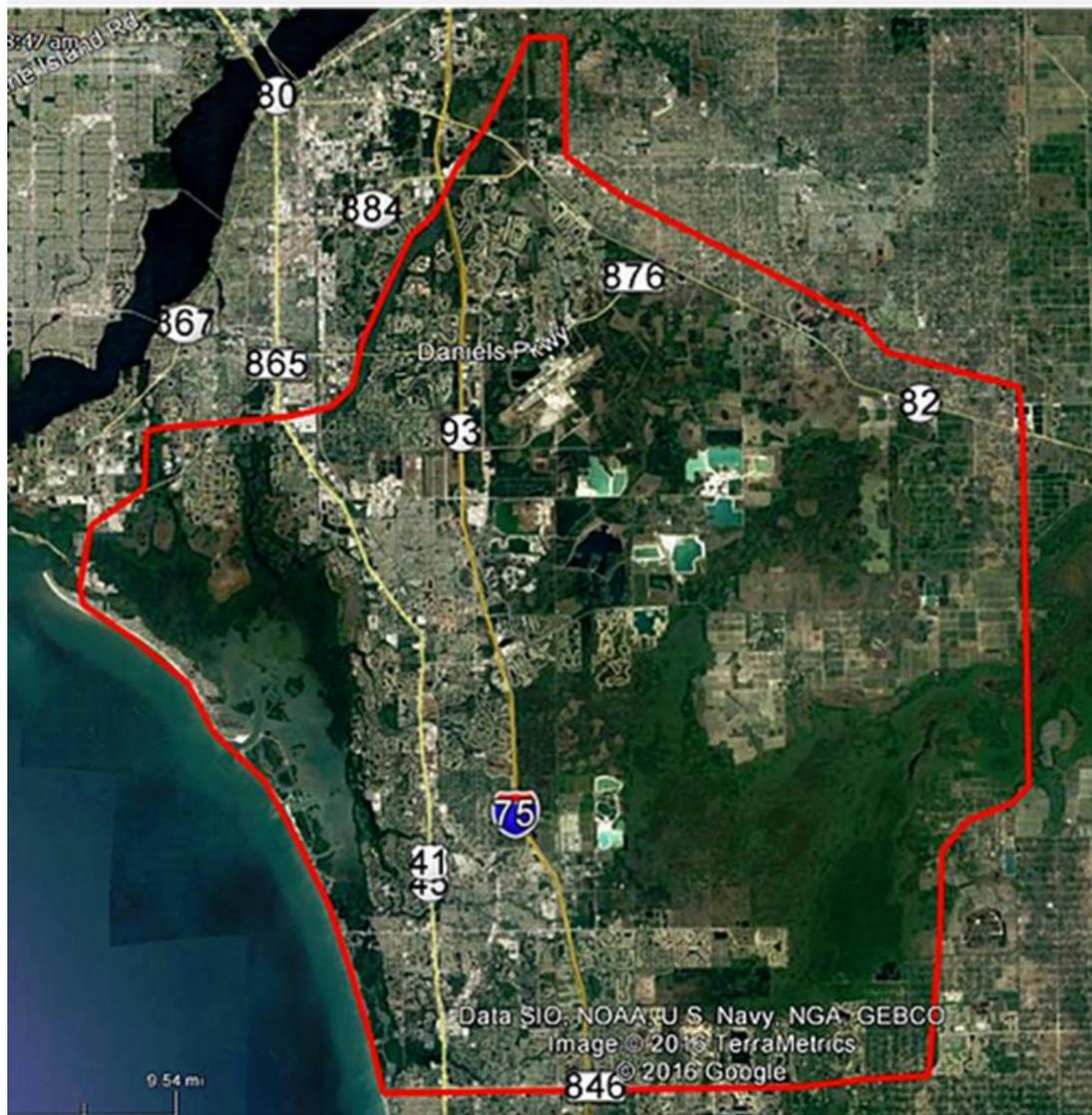
## MONITORING AND MAINTENANCE (INCLUDE ADAPTIVE MANAGEMENT ACTIVITIES)

**List anticipated project monitoring activities:**

Establish hydrologic and water quality conditions from monitoring sites, rainfall gauges during 2018.

## PHOTOS/MAPS/DEPICTIONS

Boundary of South Lee County Watershed area over an aerial:



Boundary of SLCW with topo shading:

