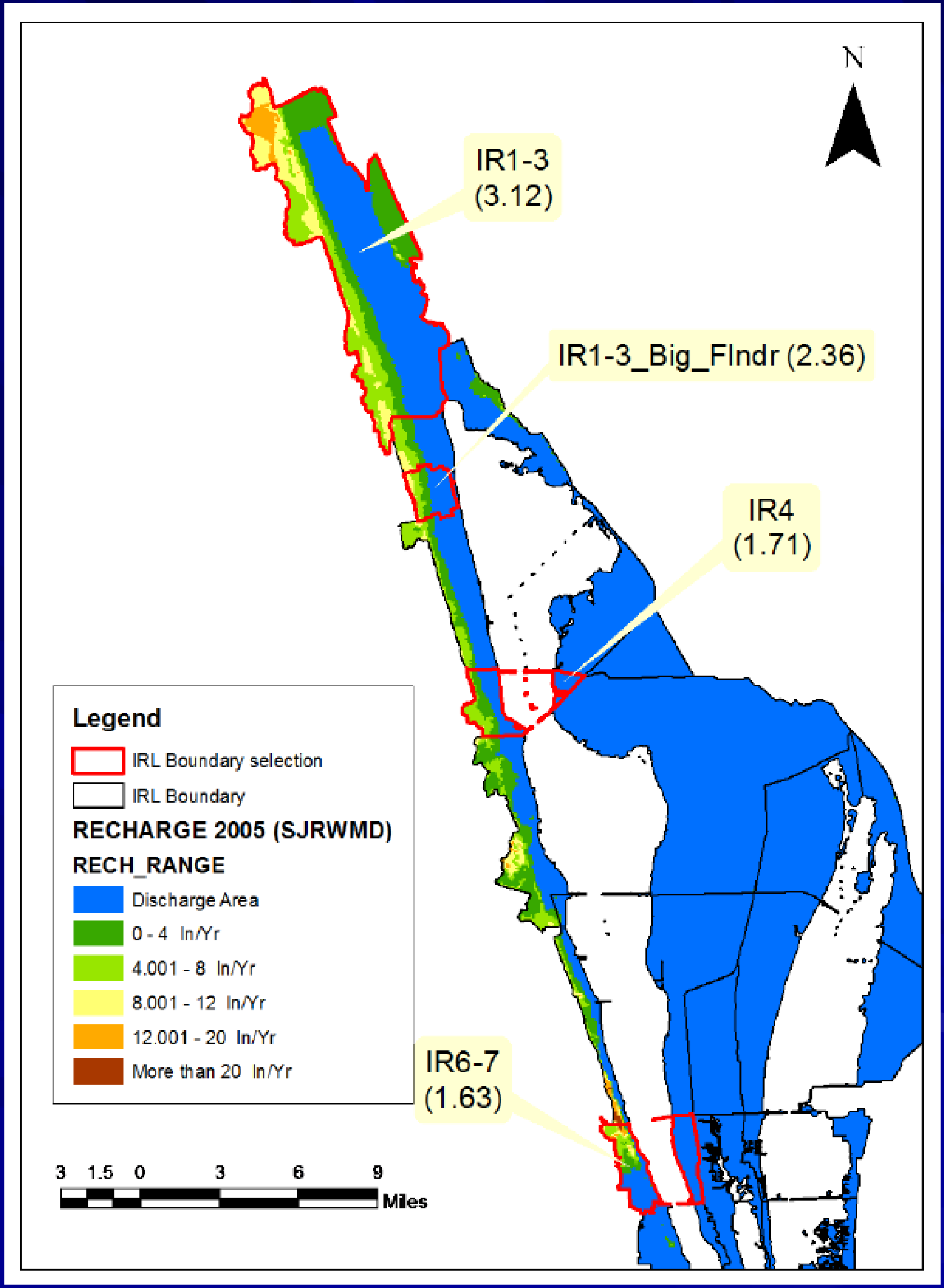
FDEP Requests

- Analysis of confining layer assumptions for the Northern IRL
- Comparison of 12 vs 192 sets of runoff coefficients for SWIL
- Minimizing monthly error between model simulated and measured total flow
- Calibration of model simulated nutrient loads with measured load

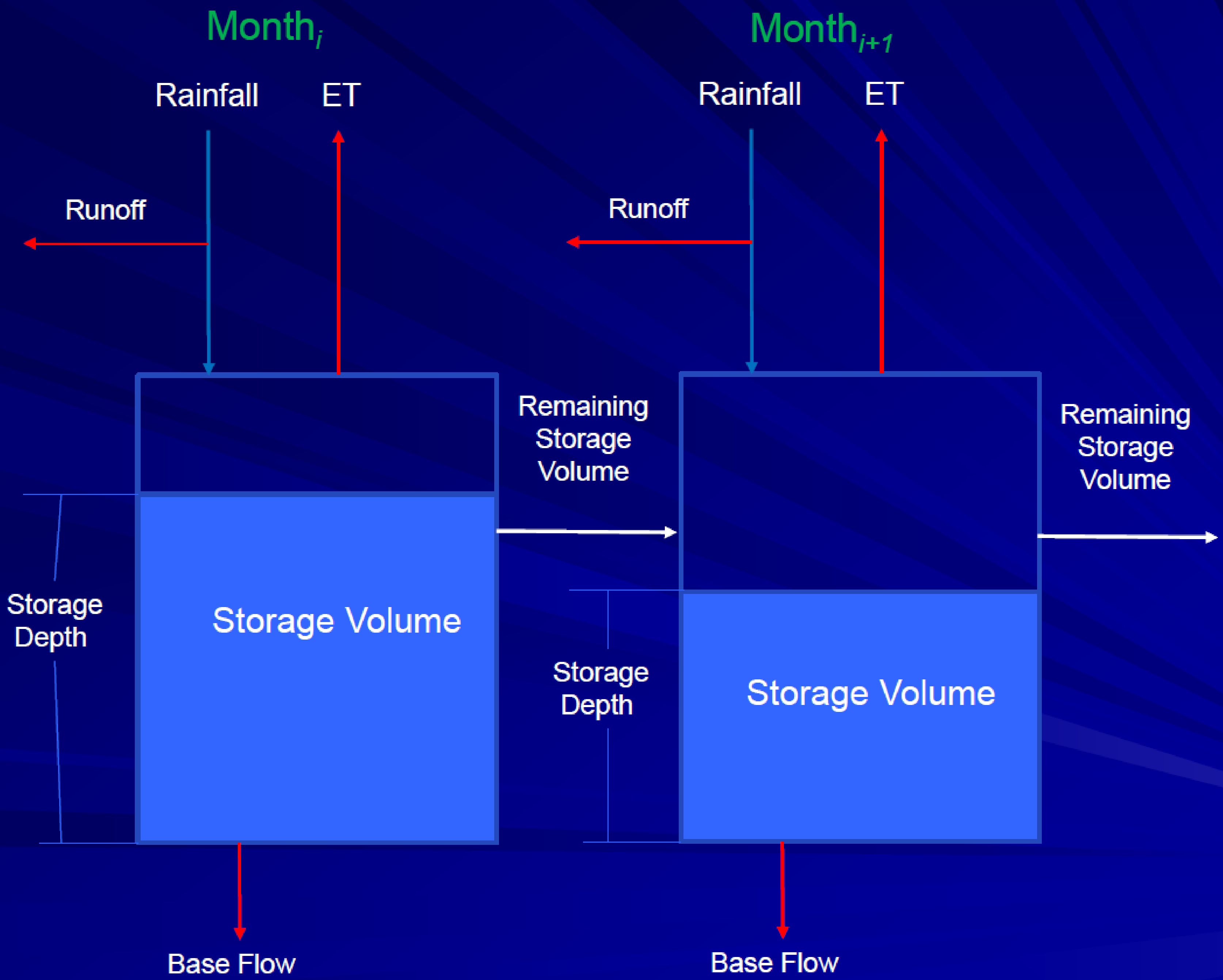
Expanded View of IRL Recharge Areas

Recharge is equivalent to 0.3 inches over the IRL basin (0.6% of rainfall)



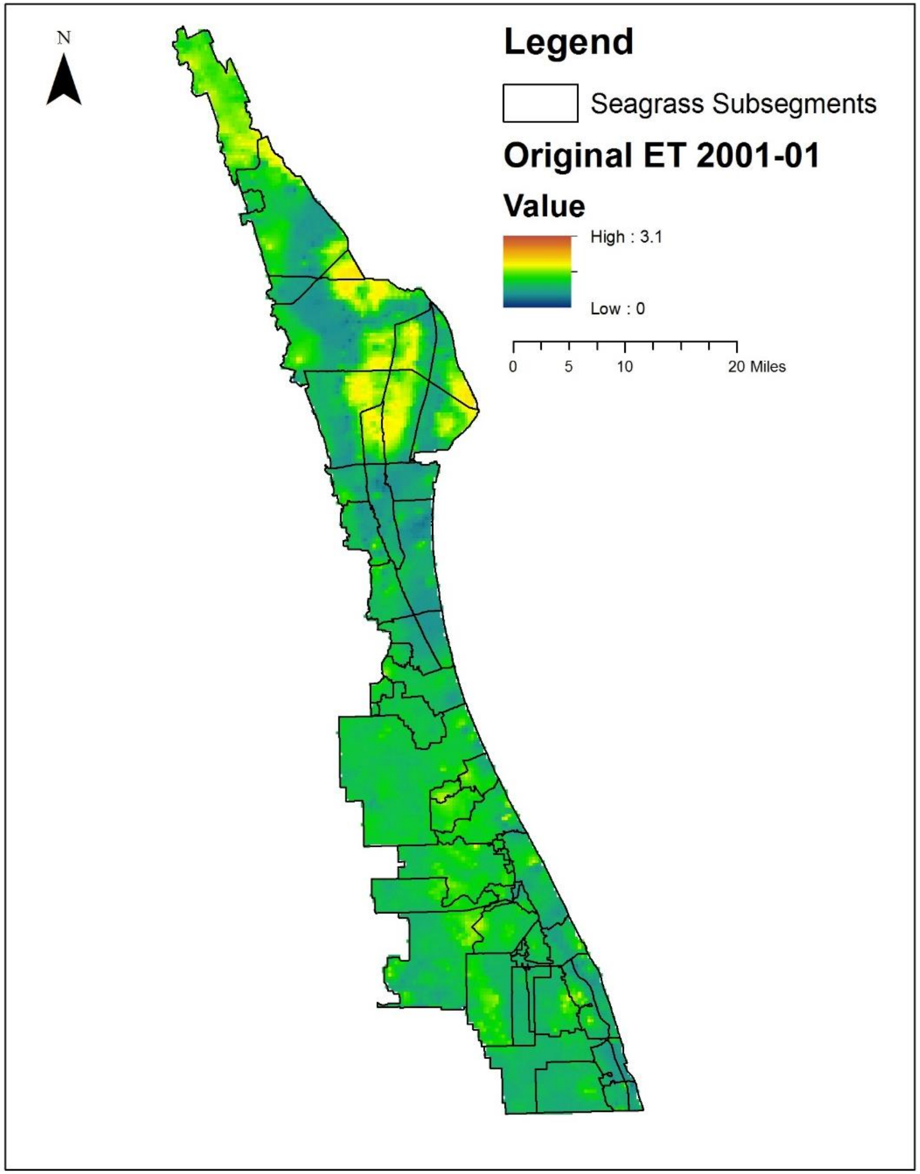
Comparison of 12 vs 192 sets of runoff coefficients for SWIL

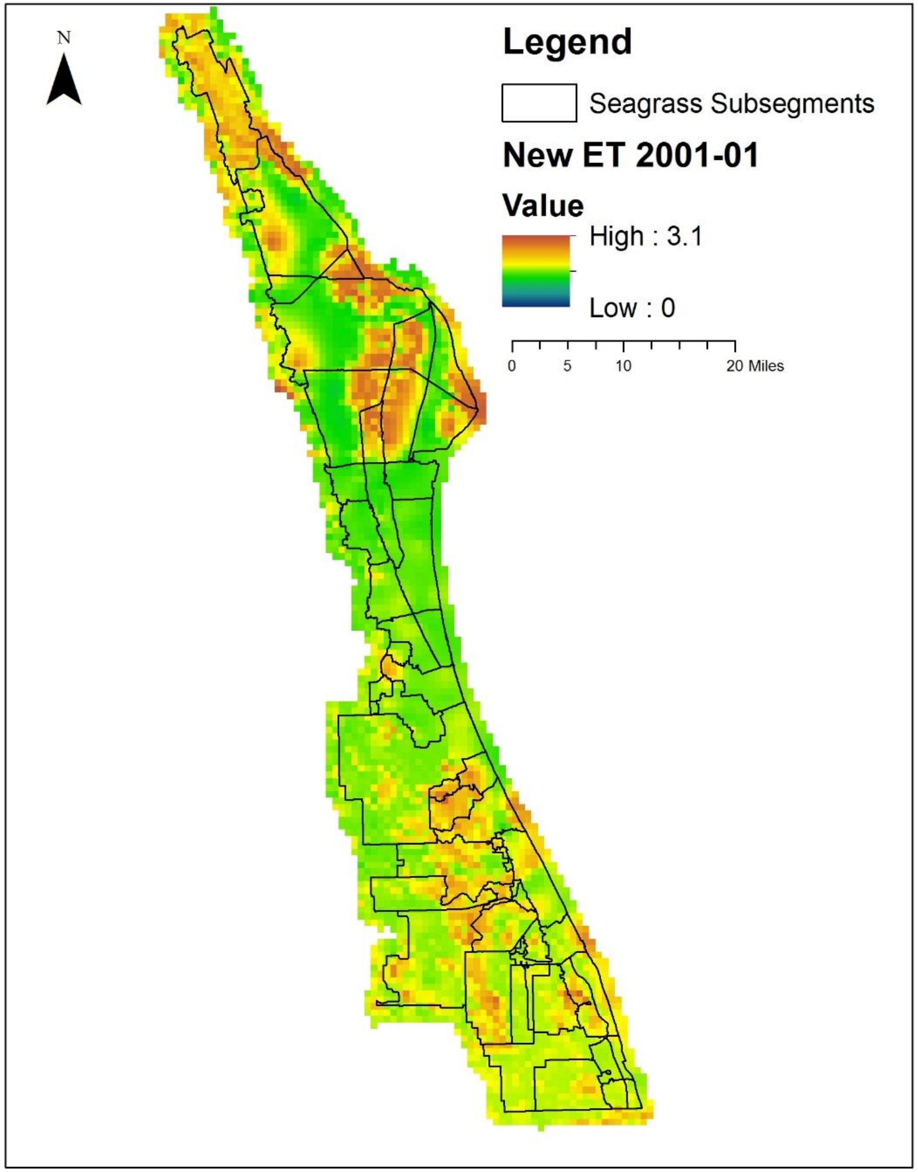
Base Flow NSE Values					
Tributary Basin	Original 12 C Value Model with Old ET	12 C Value Model with New ET		192 C Value Model with New ET	
	Storage Lag Factor	Storage Lag Factor	Storage Lag Factor and Depth	Storage Lag Factor	Storage Lag Factor and Depth
Crane's Creek	0.72	0.86	0.92	0.85	0.92
North Prong	0.60	0.55	0.63	0.51	0.57
South Prong	0.56	0.88	0.90	0.87	0.89
Fellsmere Canal	0.70	0.48	0.55	0.42	0.49
Hickory St. Canal	0.67	0.86	0.90	0.86	0.87
Mean	**0.65**	**0.73**	**0.78**	**0.70**	**0.75**

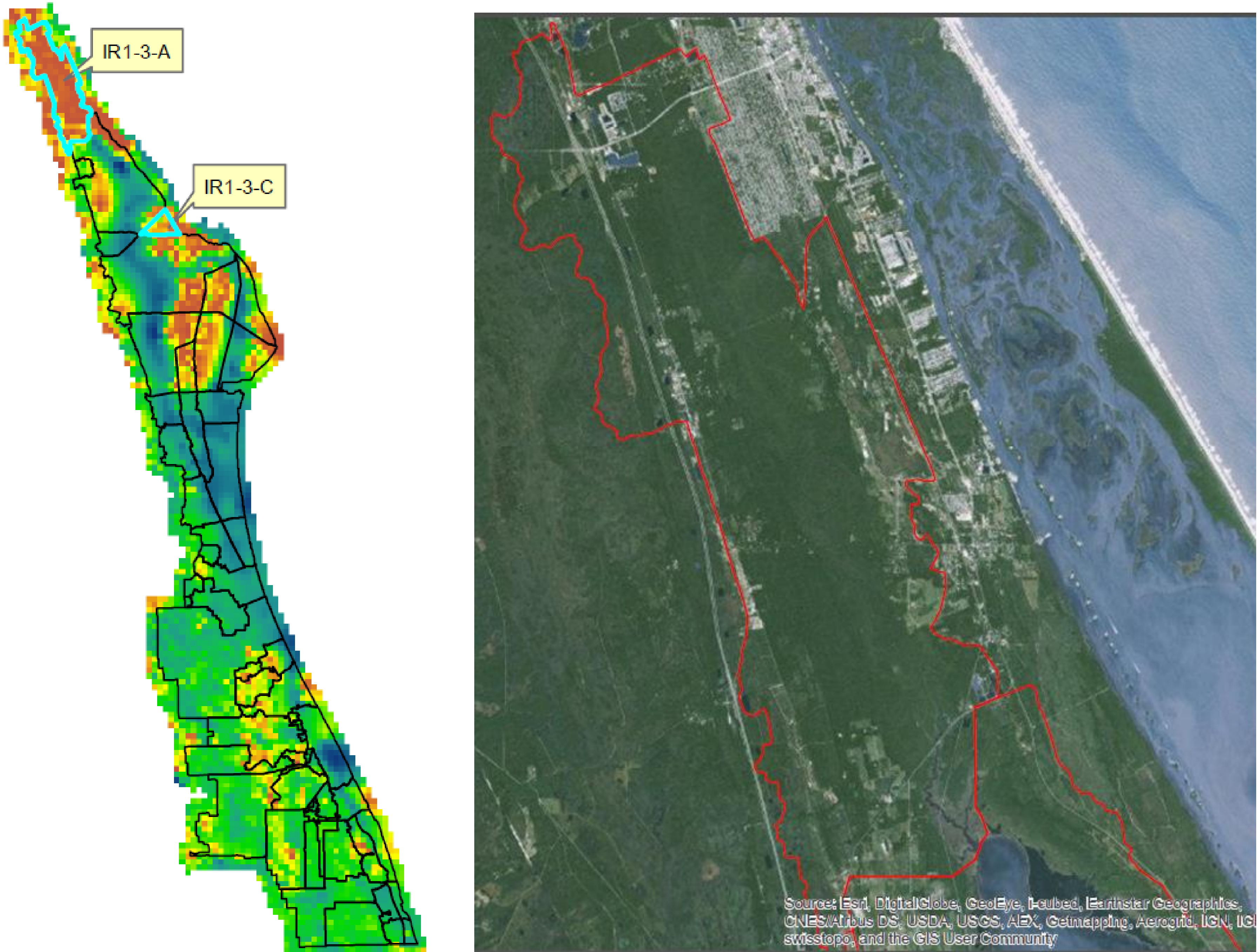


Month$_i$
Rainfall
ET
Runoff
Remaining Storage Volume
Storage Depth
Storage Volume
Base Flow
Month$_{i+1}$
Rainfall
ET
Runoff
Remaining Storage Volume
Storage Depth
Storage Volume
Base Flow

ET Comparison






IR1-3-A
IR1-3-C
Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics,
CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,
swisstopo, and the GIS User Community

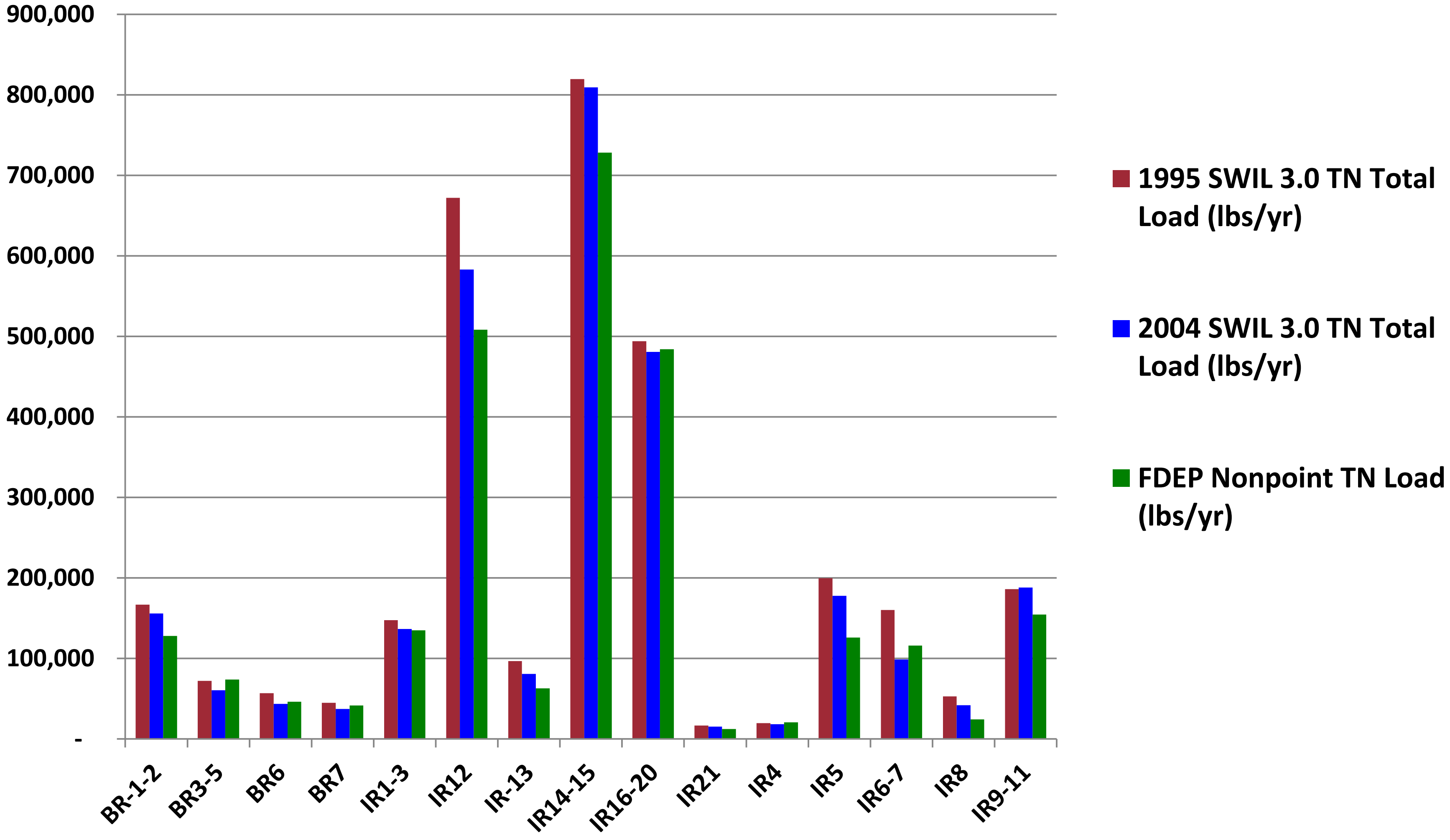
ET Values by Land Use

Land Use	Mean Percent of Pixel	Number of Pixels	Minimum ET (in)	Maximum ET (in)	Mean ET (in)
2100 - Cropland and Pastureland	89	36	27.1	39.1	30.8
2200 - Tree Crops	93	103	27.4	51.2	33.6
2400 - Nurseries and Vineyards	89	1	29.6	29.6	29.6
2600 - Other Open Lands (Rural)	85	4	26.5	32.6	30.2
3100 - Herbaceous (Dry Prairie)	82	4	27.4	49.6	38.2
3200 - Shrub and Brushland	83	15	26.8	51.5	33.3
4100 - Upland Coniferous Forests	82	20	27	51.8	38.4
4200 - Upland Hardwood Forests	86	7	42.7	52.8	48.4
4300 - Upland Hardwood Forests Continued	88	1	51.9	51.9	51.9
4400 - Tree Plantations	77	1	39.1	39.1	39.1
6100 - Wetland Hardwood Forests	86	21	45.4	52.6	51
6200 - Wetland Coniferous Forests	85	2	36.6	43.2	39.9
6400 - Vegetated Non-Forested Wetlands	86	25	24.7	50.4	31.1
6500 - Non-Vegetated Wetlands	81	1	24.2	24.2	24.2
7400 - Disturbed Lands	86	2	31.9	33.4	32.6

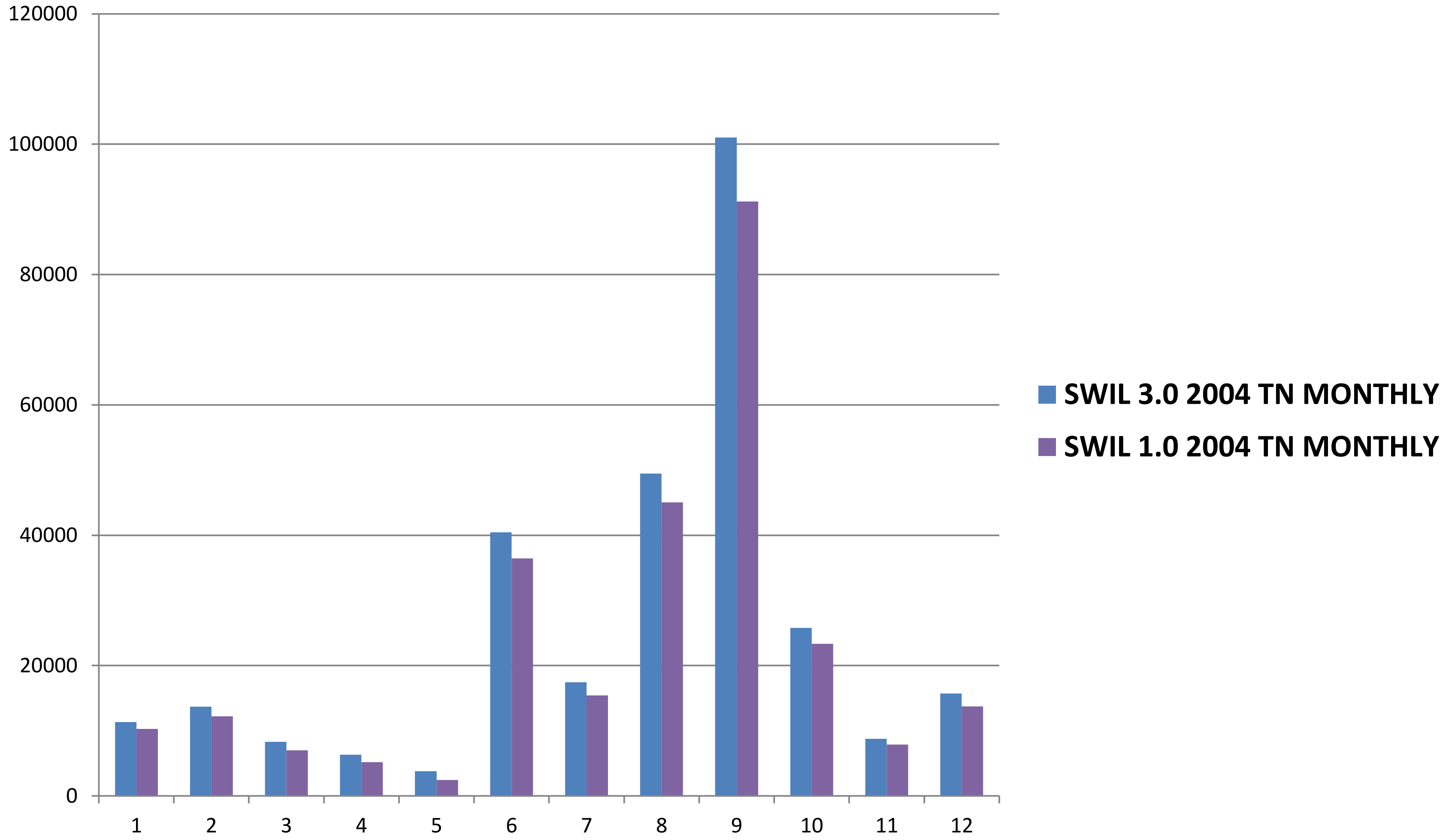
Turnbull Creek at Oak Hill

Year	Month	Turnbull Creek Discharge (cfs)
2013	9	5.8
2013	10	-3.98
2013	11	-3.69
2013	12	-1.3
2014	1	-0.907
2014	2	5.48
2014	3	10
2014	4	7.75
2014	5	
2014	6	
2014	7	28.6
2014	8	41.4
2014	9	28.5

SWIL 3.0 vs PLSM TN Output



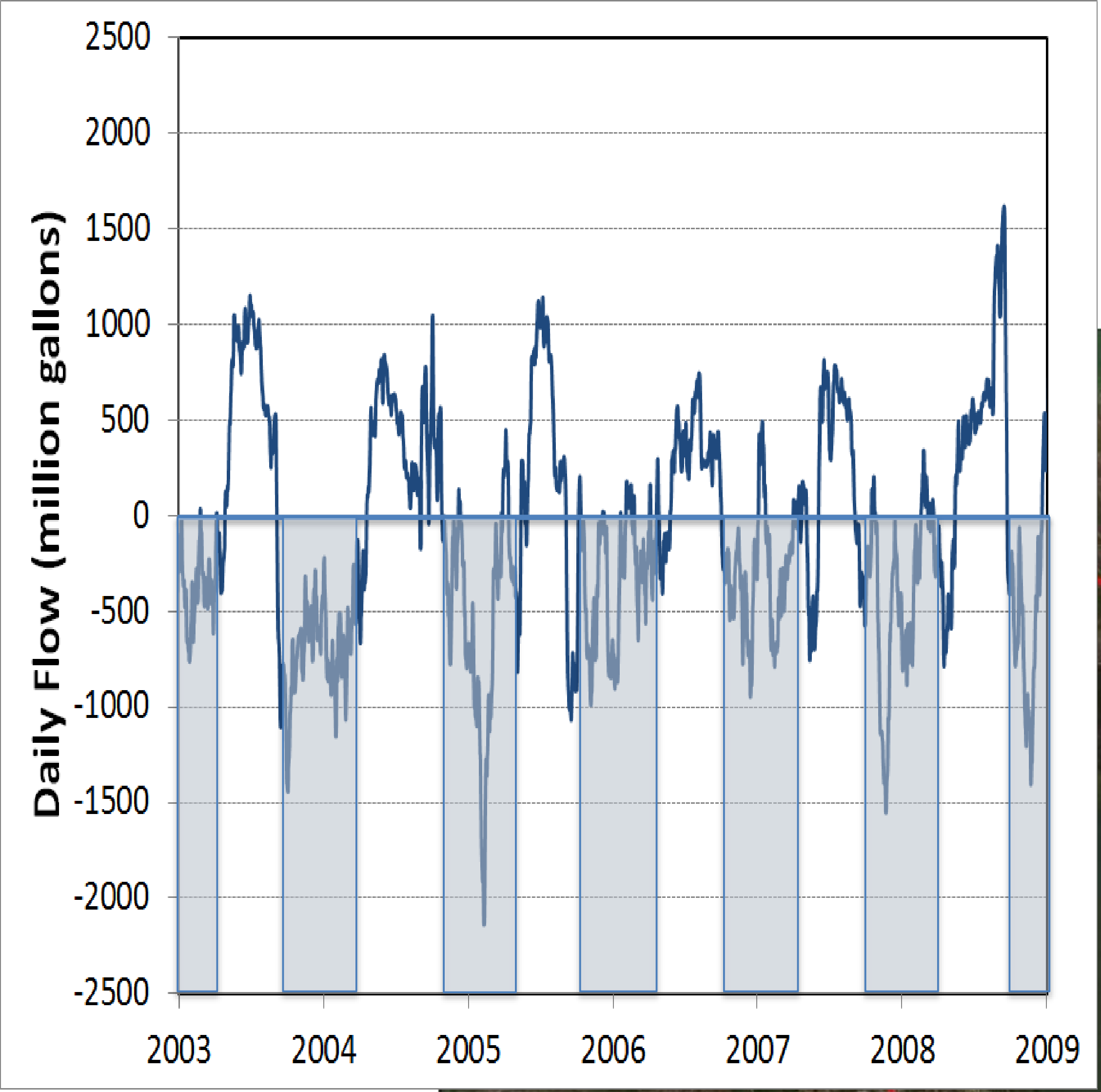
IR-12 SWIL 1.0 AND 3.0 MONTHLY

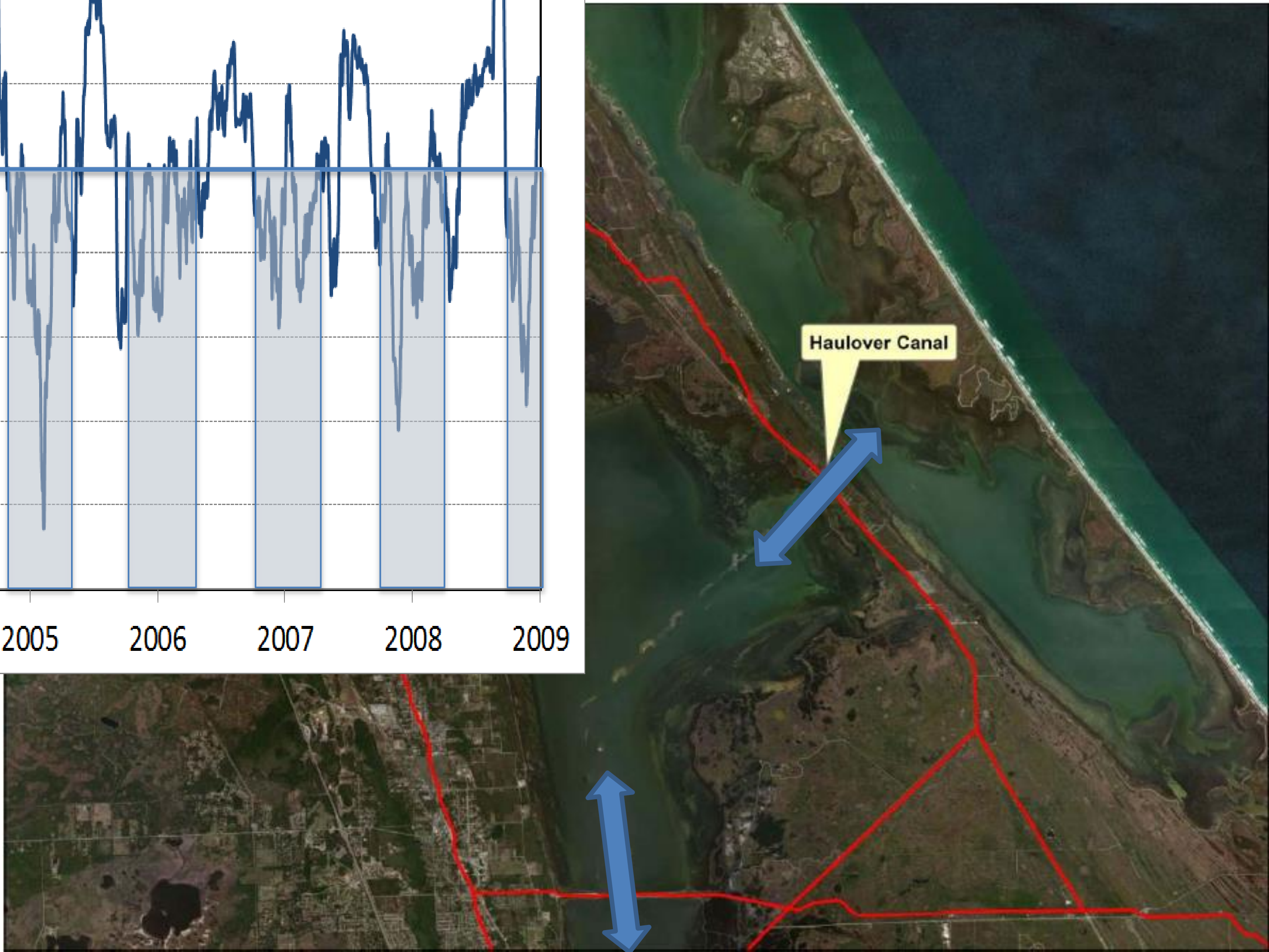


Next Steps

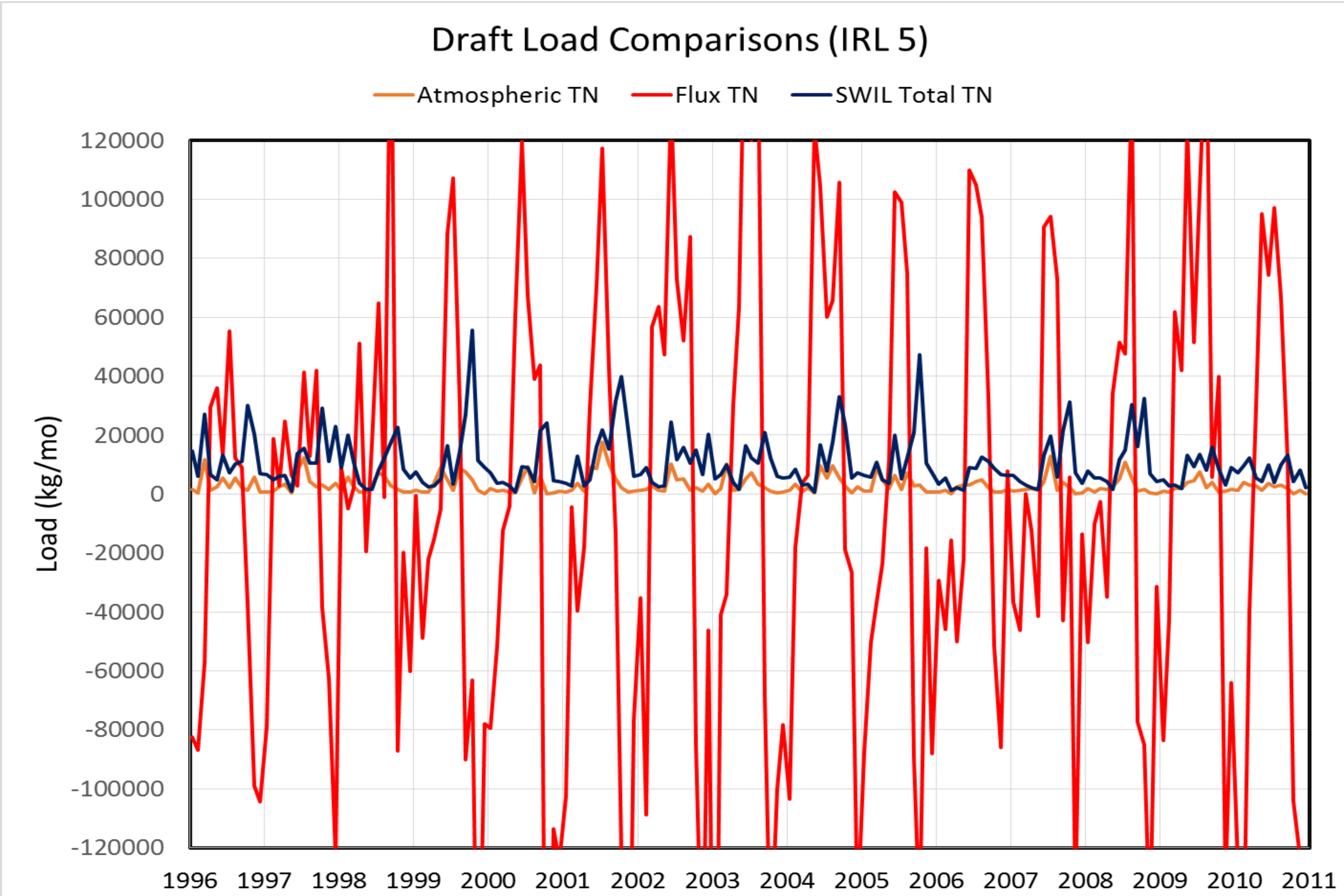
- Add SWIL loads to all other loads
- Test for load-response relationships
- Set seagrass/water quality targets for the IRL
- Find maximum allowable loads (TMDLs)
- Determine load reductions
- Allocate load reductions

Intersegment Transport

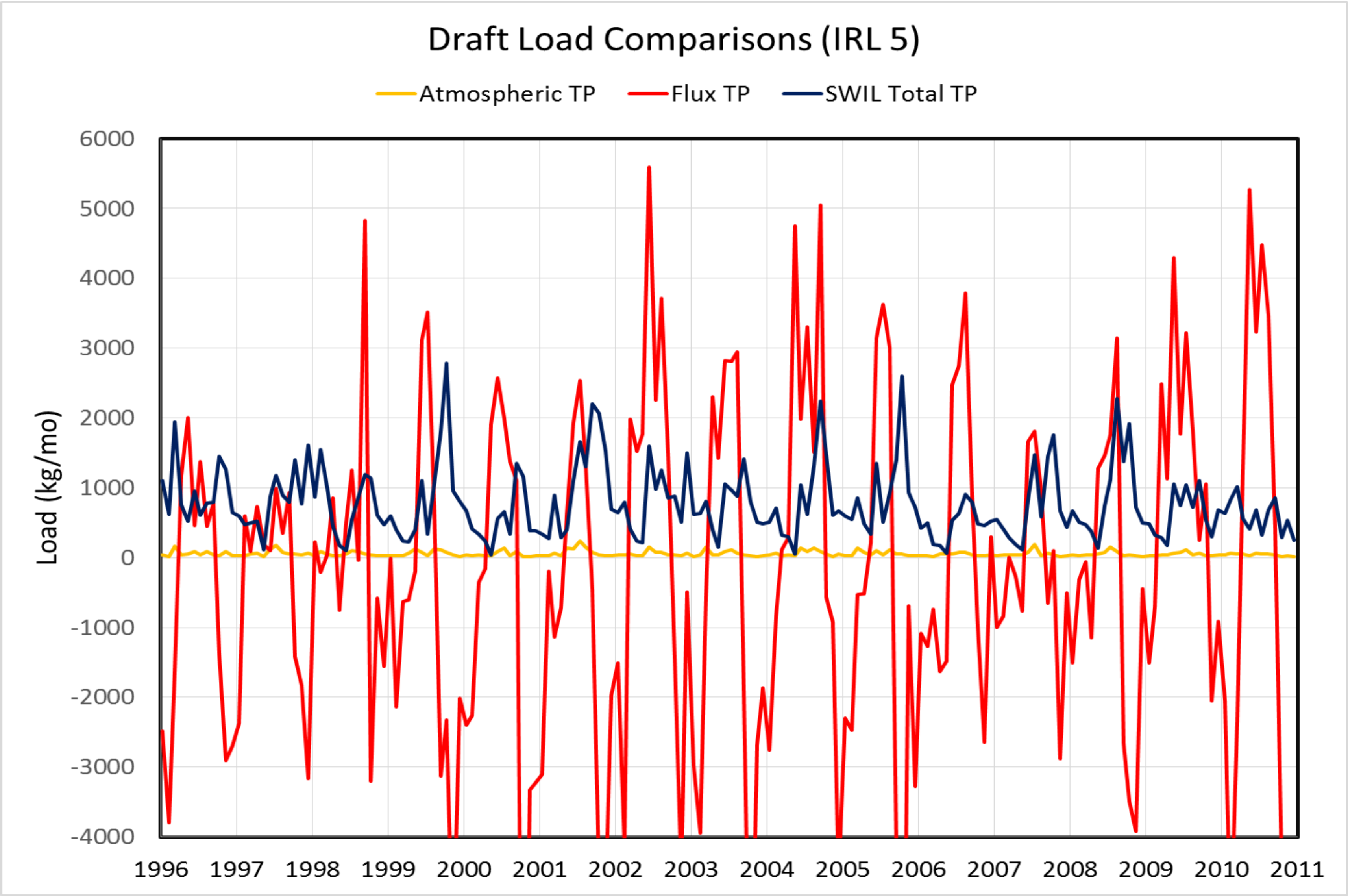




- A



Draft Load Comparisons (IRL 5)
Atmospheric TN
Flux TN
SWIL Total TN
Load (kg/mo)
120000
100000
80000
60000
40000
20000
0
-20000
-40000
-60000
-80000
-100000
-120000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011


Draft Load Comparisons (IRL 5)
Atmospheric TP
Flux TP
SWIL Total TP
Load (kg/mo)
6000
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011

Biological Responses to Muck Removal

Co-PIs: K. Johnson, M. Roffer, J. Shenker, R. Weaver

Project Concept

- Determine Responses of Algal Blooms
- Determine Responses of Invertebrate Animals
- Determine the Responses of Seagrasses
- Determine Responses of Fish Populations
- Integrate Biological Responses with Hydrology programs

Requirements/Goals/Objectives

Description: This proposal will provide a high-resolution analysis of the responses of the biota in and around the muck dredging site(s) to dredging, and evaluate ways to enhance biotic recovery to the newly cleaned habitat.

Goals:

1. Devise sampling strategies and combined research team for high resolution (spatial and temporal) biotic assessments
2. Collect samples before, during and after muck removal
3. Assess impacts of muck removal on biotic assemblage
4. Determine if muck removal and sediment resuspension harms adjacent healthy communities
5. Assess recovery of communities after muck removal
6. Combine results with Physical Responses studies to evaluate overall impacts of muck removal and restoration

Proposed Approach/Deliverables

- Intense sampling will be conducted in and around the dredged areas to evaluate the biotic responses to dredging and habitat recovery
- Biotic sampling will be conducted using approved protocols for each type of organism following rigorous systematic sampling schedules.
- Deliverables include: high-resolution definition of the temporal and spatial patterns of organisms during pre-dredging, dredging and post-dredging periods at impacted and control sites; determine impacts of dredging on adjacent sites; integration of biological responses with Water Quality and Hydrology assessment programs.

Cost Schedule

Proposed Dates: 3 months prior to dredging start to 3 months after dredging completion

Total Cost Estimate:

$361,664

Indian River Lagoon Research Institute
Florida Institute of Technology

Efficiency of Muck Removal from the Indian River Lagoon and Water Quality After Muck Removal

PI: John H. Trefry

Monitoring Impacts of Muck Removal

Sediment core with muck layer

Project Concept

Muck removal from the IRL is an essential component of the restoration process. Removal must be efficient because a few centimeters of residual muck impedes recovery. This project will determine the efficiency of muck removal and provide measurements of water quality before, during and after removal.

Determining muck thickness

Requirements/Goals/Objectives

Objectives:

- Determine muck removal efficiency (250-m resolution) and pre-, during and post-muck removal water quality.
- Assess linkages among (1) water quality at muck removal site, (2) location and impacts of nearest muck inputs, and (3) efficiency of muck removal at the site.

Proposed Approach: Water samples will be collected monthly before muck removal, weekly during dredging and for 3 months after removal, then monthly. At least four stations at the muck site and 2 reference sites will be sampled at 3 depths. All samples will be analyzed using state-of-the-art techniques with reliable QA/QC.

Proposed Approach/Deliverables

- Data set for muck depths and sediment composition (grain size, Al, Fe, Si, $CaCO_3$, organic matter)
- Data set for the following parameters with QA/QC: conductivity, salinity, temperature, pH, dissolved oxygen, turbidity (NTU), total suspended solids (TSS in mg/L), photosynthetically active radiation (PAR), particulate Fe, Al, Si, N, P and C (POC), and dissolved NO_3^--NO_2^-, NH_4^+, organic C (DOC), ΣN and ΣP
- Work with colleagues at HBOI or ORCA for continuous monitoring device at muck removal site
- GIS maps showing linkages among muck removal efficiency, water quality and proximity to muck site
- Peer-reviewed publication from the study

Cost Schedule

Total Cost Estimate:

$139,500

Indian River Lagoon Research Institute

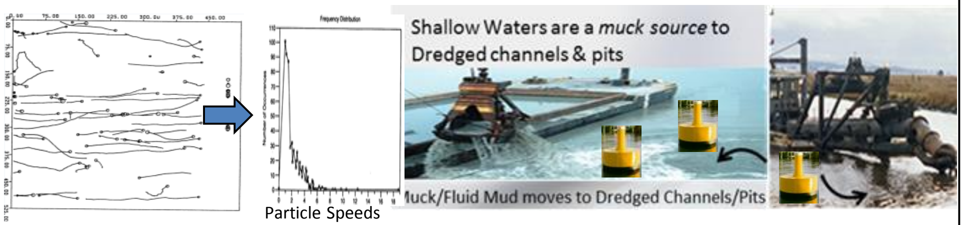
Florida Institute of Technology

Movement Measurements of Muck & Fluidized Mud at Selected Dredge Sites

PI: Charles Bostater

Project Concept

Measure muck and fluid mud *movement* in and around dredging sites (before, during, after dredging at Brevard County selected sites) using directional particle "velocimetry probe imaging"



In-Situ Particle trajectories (left) used for probe based velocity/motion (speed) determinations using techniques by Bostater (1988, 2004) for subsurface imaging.

Requirements/Goals/Objectives

A necessary approach to estimate environmental benefits of any dredging technology used by the county is determination of pre, operational, and post muck & fluid mud movement into dredged areas. During year one the PI will utilize ***science and engineering based rheological imaging probes*** to measure muck movement and fluidized mud motion *(rheology)* during the dredging project. The objective will be to evaluate the benefits of the dredging operations used to maintain sustainable water depths.

Goal:

1. Determine effectiveness and efficiency of selective shallow water muck removal & related muck movement
2. Determine the benefits of dredging muck from shallow waters for sustaining water depths using *GIS based muck & fluidized mud motion modeling & near continuous imaging & acoustic echo soundings*

Proposed Approach/Deliverables

At designated dredging site(s) in the IRL (Banana River/Eau Gallie area) to be used for measurements:

- Estimate effectiveness and efficiency of removing muck and fluid mud based on rheological science and engineering
- Monitor muck movement from surrounding shallows into channels/pits using standard subsurface *in-situ* imaging
- Estimate efficiency of dredging and muck traps for sustained dredging benefits based upon ***GIS*** *muck movement modeling* at selected sites and aerial imaging
- Determine effectiveness of the selected dredging technologies at removing muck with minimal post dredging movement and re-suspension using infill rate estimation based upon collected data
- Establish benefits of dredging effectiveness at selected dredging of basins, pits and waterways

Cost Schedule

Proposed Dates: July 2014–June 2015

<u>Total Cost Estimate</u>:

$145,000

Indian River Lagoon Research Institute

Florida Institute of Technology

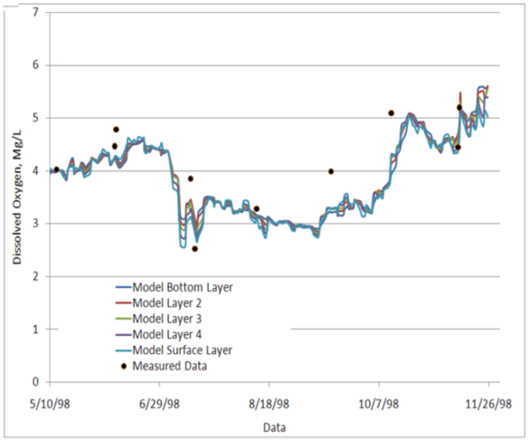
Hydrologic and Water Quality Model: Managing and Forecasting Water Quality Improvement

PI: Gary A. Zarillo

Project Concept

Model Grid Example

Model Simulation - DO



Requirements/Goals/Objectives

Description: The overall goal of this project is to apply a well-tested and documented state-of-the-art numerical hydrodynamic water quality model to be used as a tool for managing and tracking water quality. The model, supported with monitoring data primarily available from the St. Johns River Water Management District, will be used to evaluate IRL restoration strategies.

Project Objectives:

- Support IRL management decisions
- Support IRL TMDL goals
- Guide and evaluate IRL muck dredging
- Technology Transfer to Brevard County

Proposed Approach/Deliverables

- Construct Hydro/WQ model grid of the Northern IRL through Brevard County (EFDC/HEM3D)
- Model Boundary Conditions and WQ input files
- Calibration of hydro and WQ model data (Trefy-Belanger-Heck)
- Assimilation of sediment chemistry field data acquired by Florida Tech (Trefry)
- Simulation of Northern IRL ecosystem with/without muck sediment layers at decade time scale
- Optimize muck removal project
- Forecast benefits of water quality management strategies at the decadal time scale and beyond
- HAB forecasting

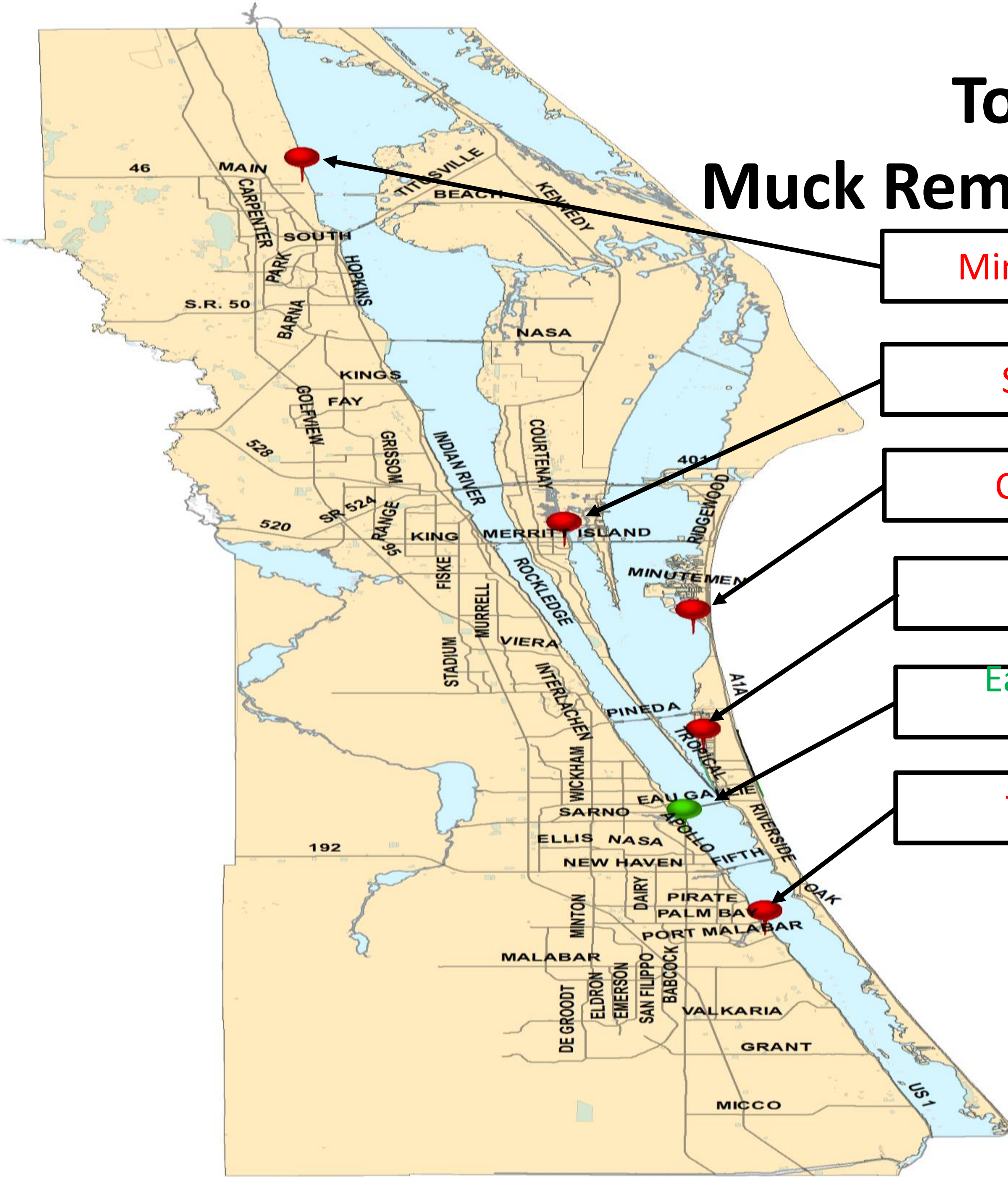
Cost Schedule

Proposed Dates: October 2014 to September 2015

<u>Total Cost Estimate:</u>

$170,000

Top Priority Muck Removal Sites



Mims Boat Ramp

Sykes Creek

Cocoa Beach

Grand Canal

Eau Gallie River (SJRWMD)

Turkey Creek

Questions

SWIL TN Output