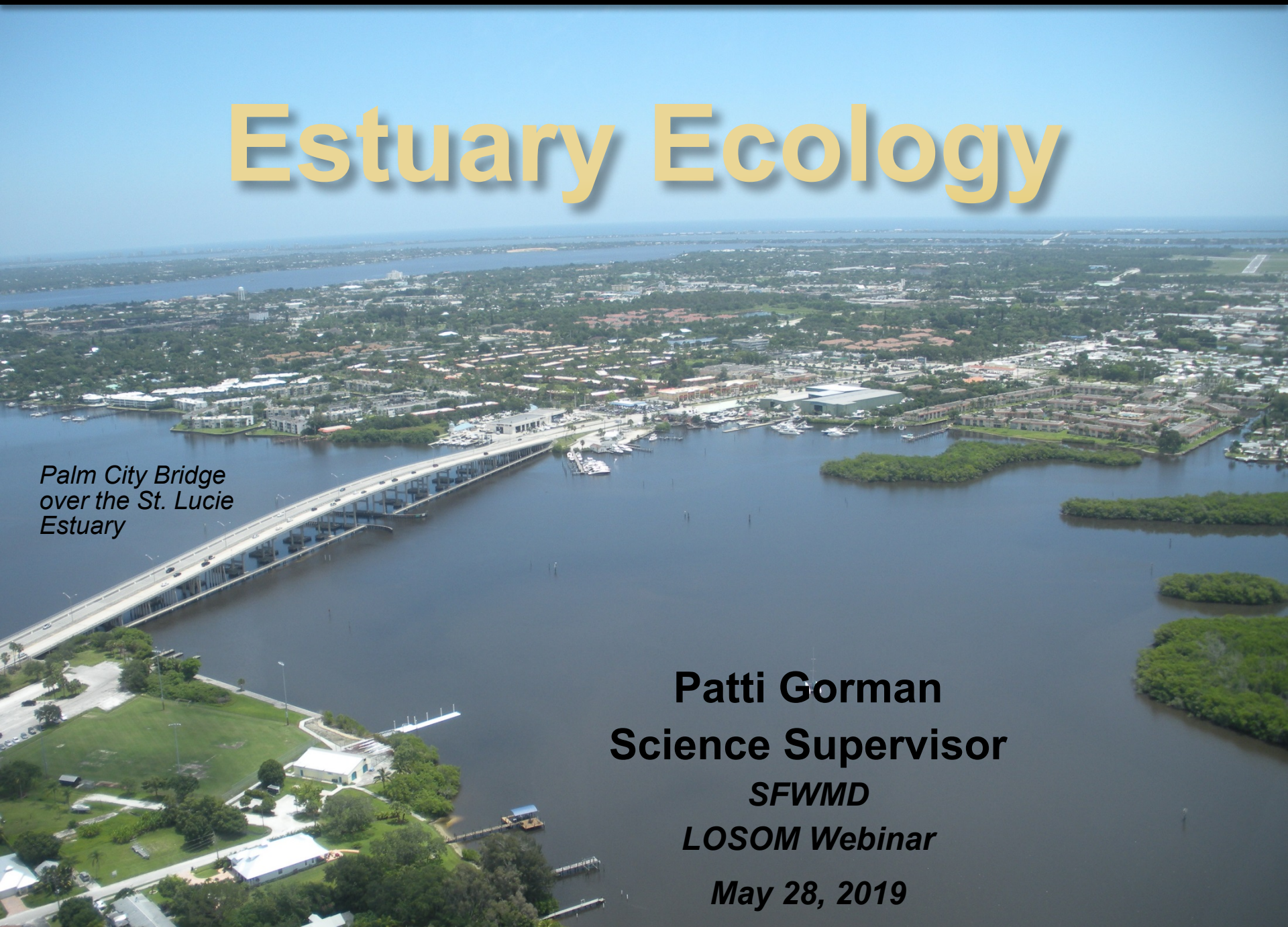
Estuary Ecology



Palm City Bridge over the St. Lucie Estuary

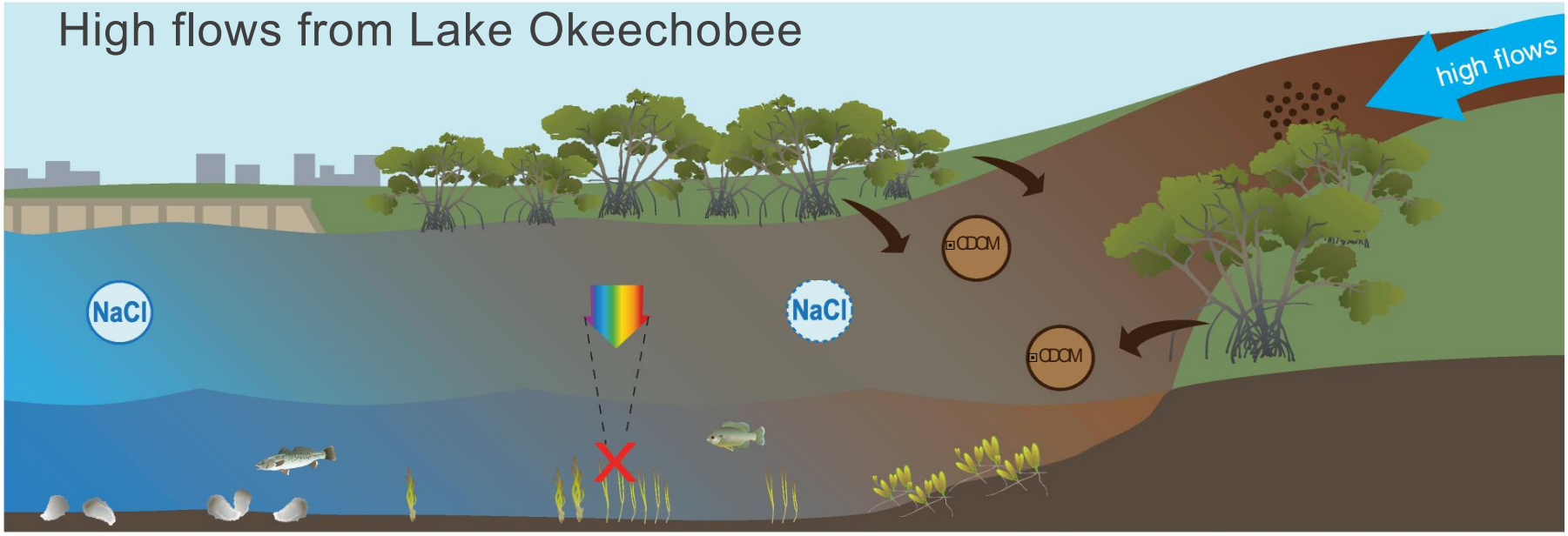
Patti Gorman
Science Supervisor
SFWMD

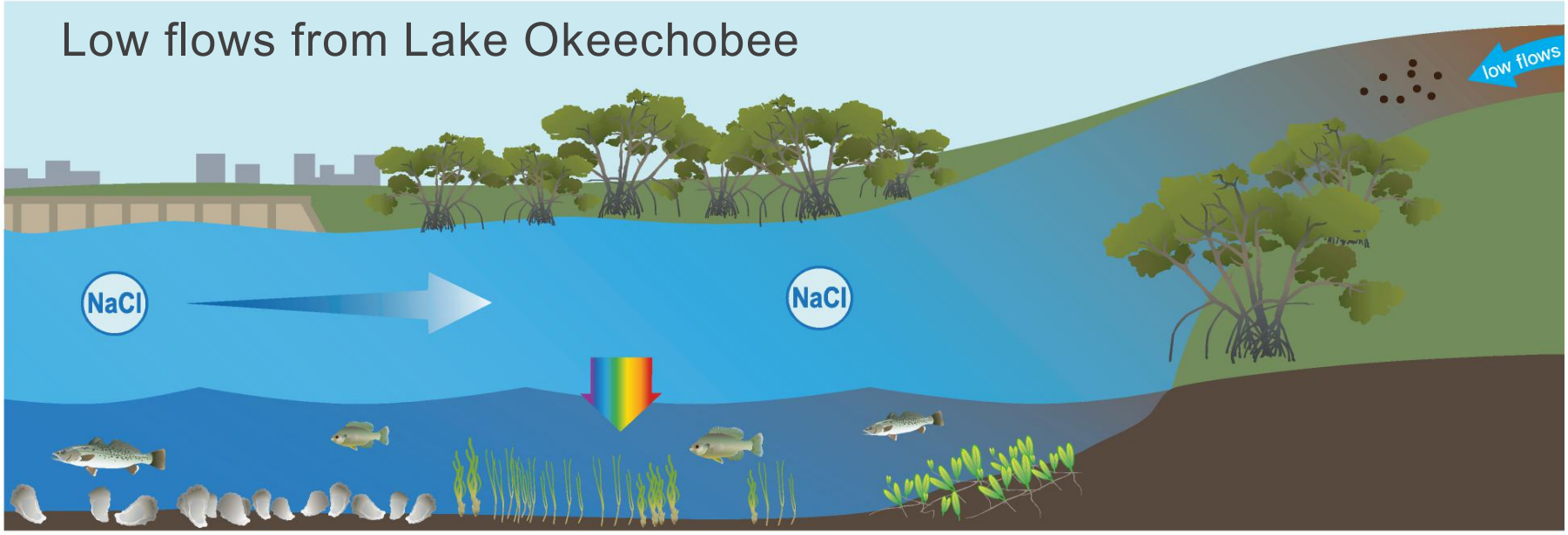
LOSOM Webinar

May 28, 2019

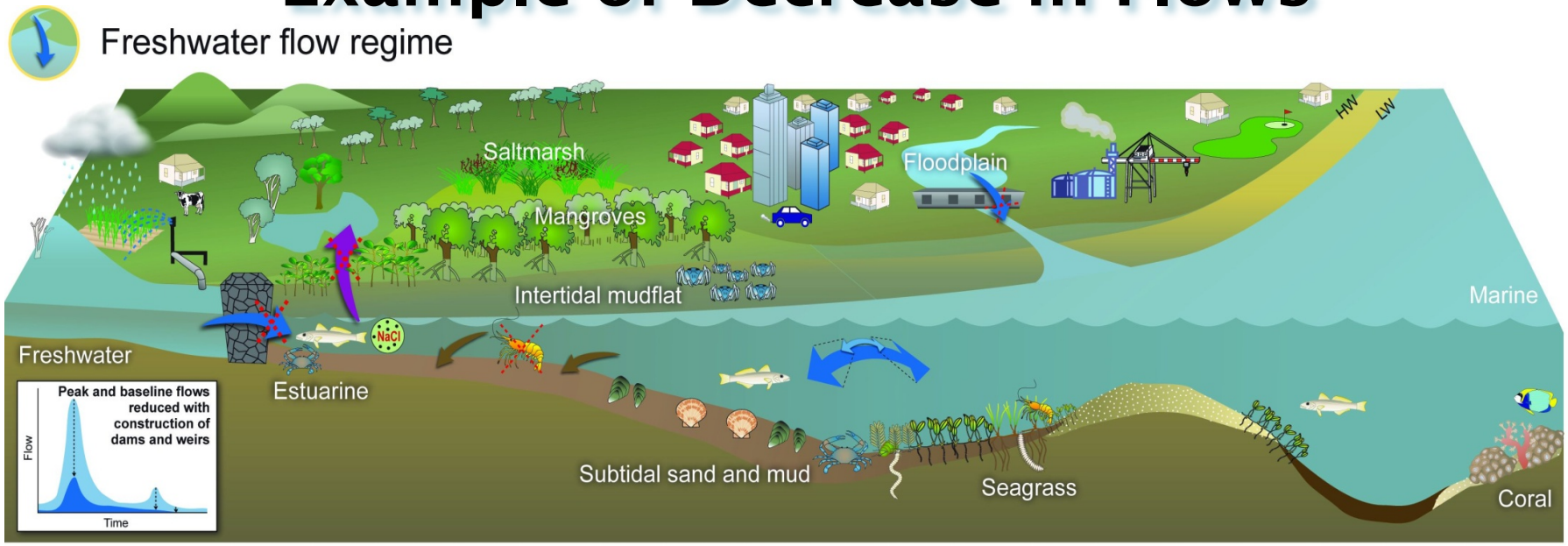
Todays Topics

- General Information on Estuaries
- How we establish inflow requirements
- Caloosahatchee background, problems and restoration efforts
- St. Lucie background, problems and restoration efforts


High flows from Lake Okeechobee
high flows
NaCl
NaCl
CDOM
CDOM


Low flows from Lake Okeechobee
low flows
NaCl
NaCl

Response of an Estuary to Change In Freshwater Inflow Can Be Complicated - Example of Decrease in Flows



Legend:

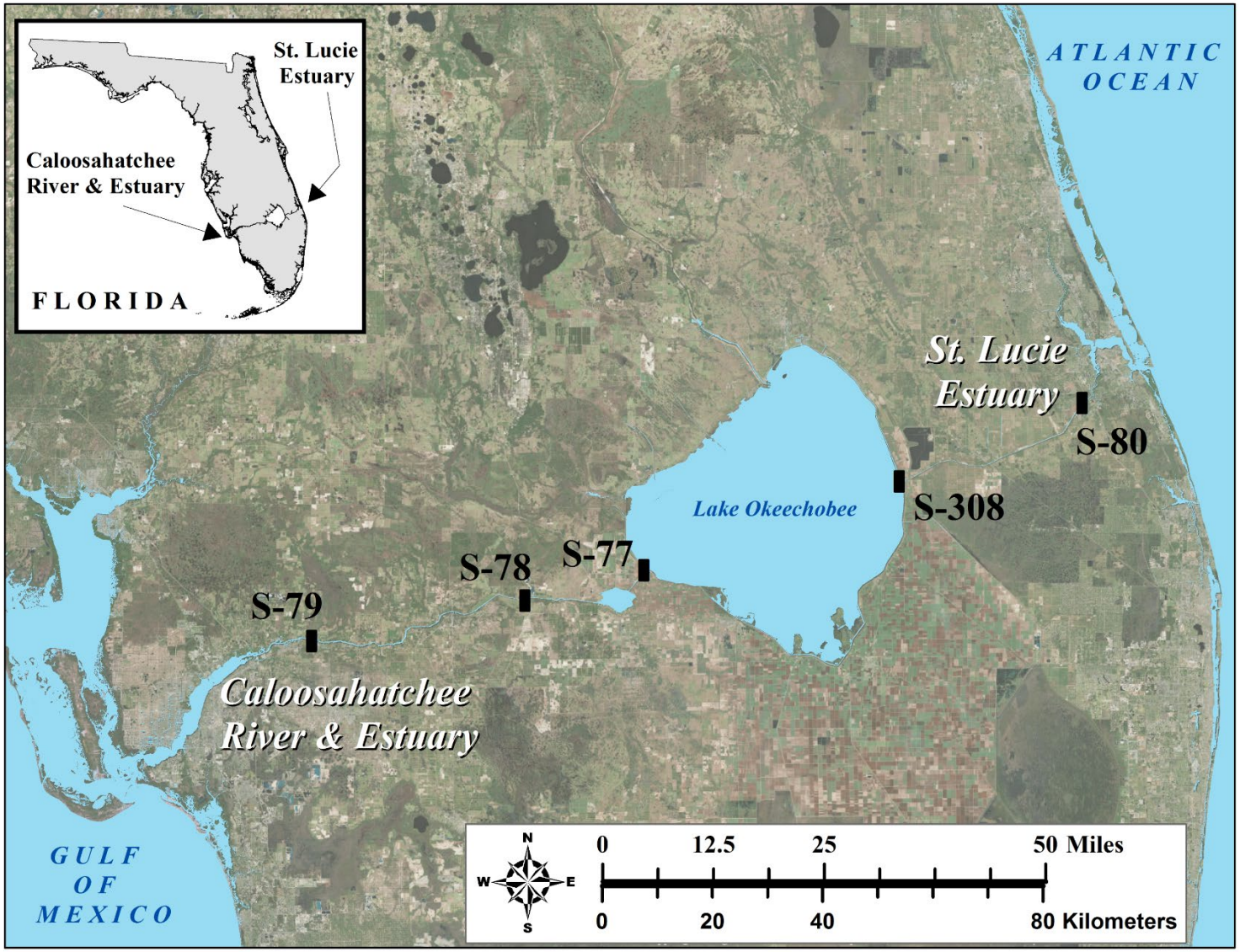
- Construction of impoundments (e.g. dams and weirs) and water extractions ( ) reduce the inflow of freshwater ( ) into estuaries
- Flushing is reduced in the upper and mid reaches of the estuary
- Salinity increases upstream
- Mangroves and other salt tolerant species (e.g. estuarine/marine fish) ( ) extend further upstream with increased salinity
- Reduced freshwater inflows (i.e. reduced flooding) may result in a loss of connectivity ( ) with adjacent habitats (e.g. floodplain billabongs)
- Siltation is increased in mid and upper estuarine reaches
- The lack of freshwater pulses impacts on the spawning/reproduction, migration and production of estuarine species

Key Questions for Effective Management

How to quantify a freshwater inflow regime that maintains the structure, function and sustainability of an estuarine eco-system?

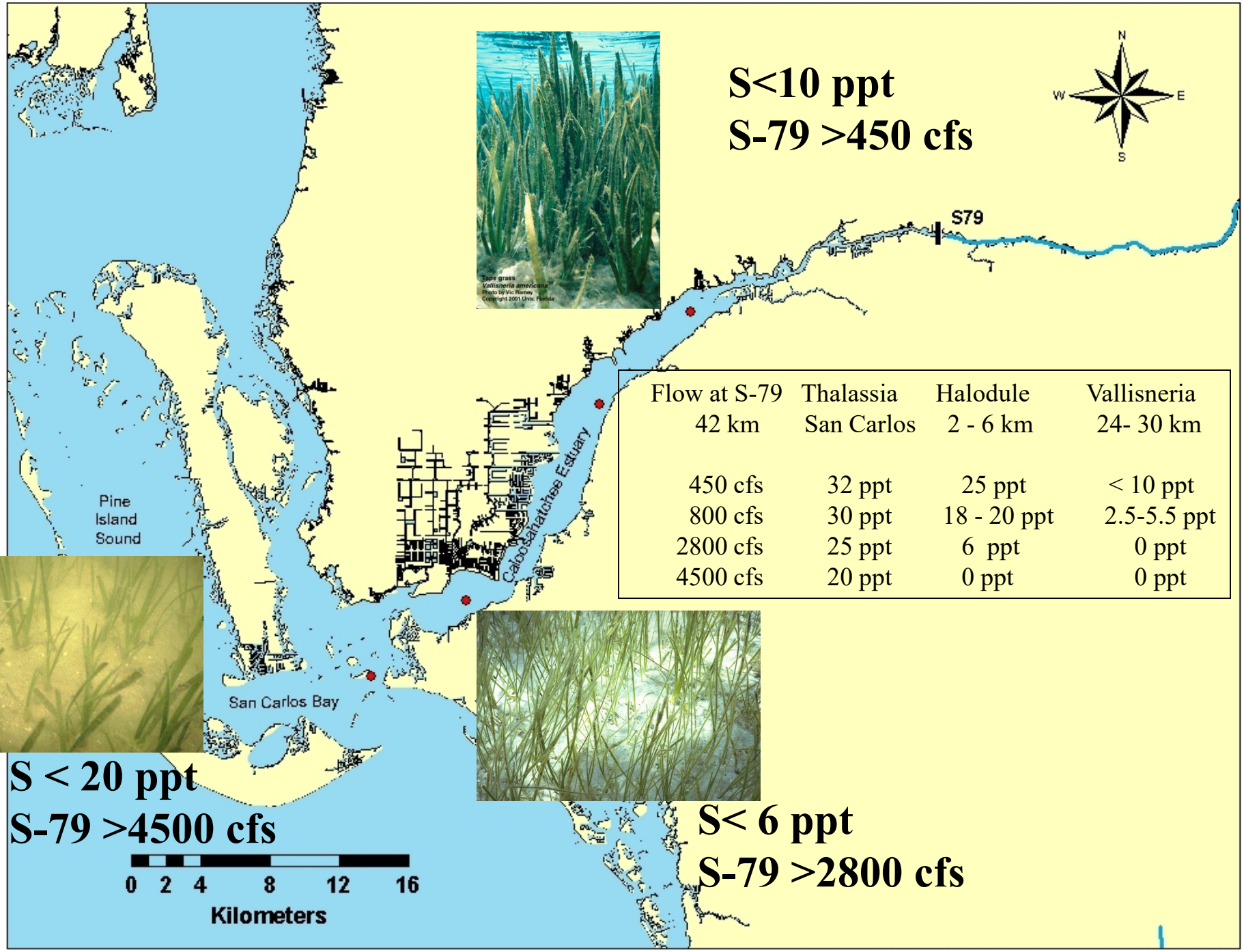
- *Species Specific needs are fairly easy to establish*
- *Gets more difficult at the Ecosystem Level*

Estuary Locations



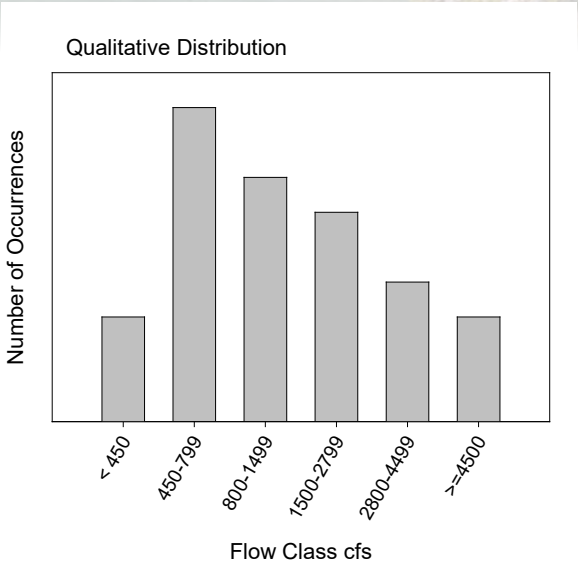
How do we establish inflow requirements for an estuary

- Indicator species and their individual salinity tolerances are used to establish appropriate flow regimes
- Location of those desired salinity zones is important
- Location of static (mangroves or oyster reefs) vs. dynamic (changing salinity) habitat is important to match up



Flow at S-79 42 km	Thalassia San Carlos	Halodule 2 - 6 km	Vallisneria 24- 30 km
450 cfs	32 ppt	25 ppt	< 10 ppt
800 cfs	30 ppt	18 - 20 ppt	2.5-5.5 ppt
2800 cfs	25 ppt	6 ppt	0 ppt
4500 cfs	20 ppt	0 ppt	0 ppt

Early Work to Determine Preferred C-43 Flow Distributions

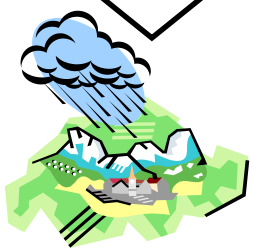


Qualitative
Ecological Flow Distribution

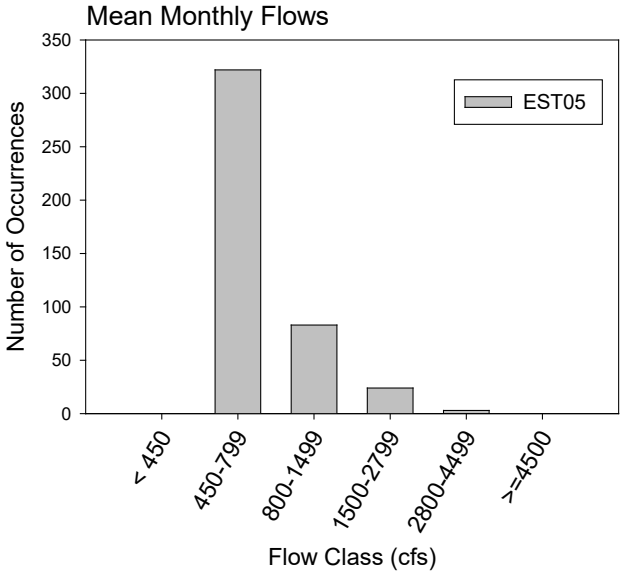
Based on resulting salinity preferences of: seagrass, oysters, adult fish, fish and shellfish larvae, crabs, shrimp, and zooplankton.

Modeling

36 years Rainfall/Climate



Target Distributions

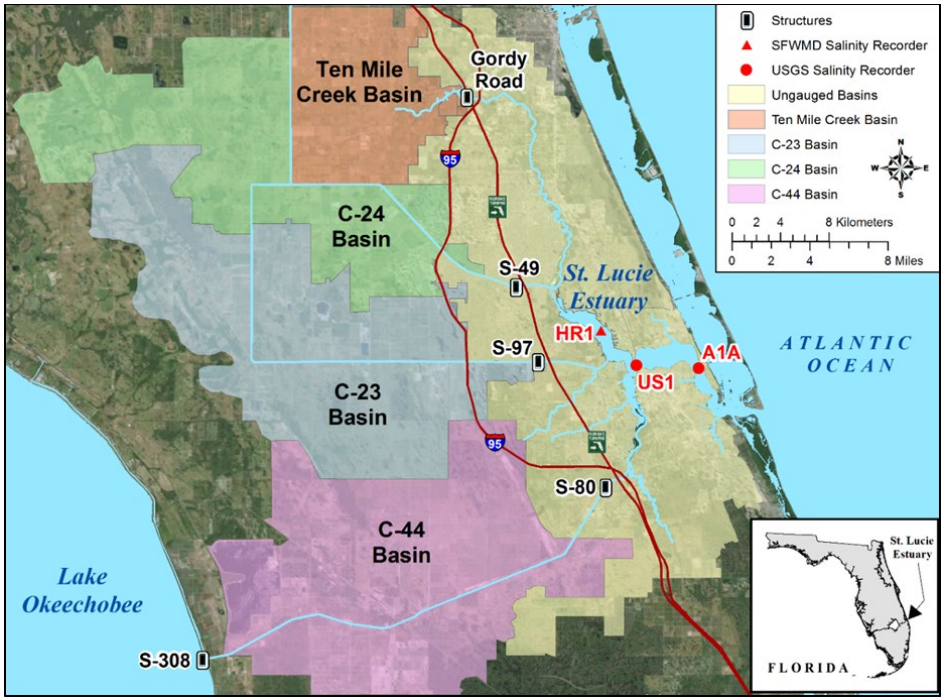


Problems in Both Caloosahatchee and St. Lucie Estuaries

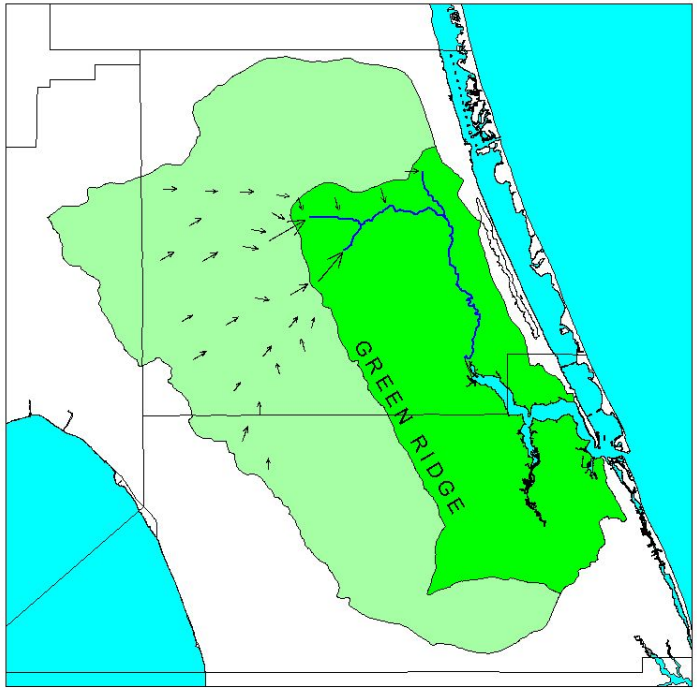
- Quantity, Quality and Timing of Freshwater
  - Too much freshwater inflow during the wet season
    - Low salinity during wet season causes mortality of marine organisms
  - Too little during the dry season
    - Saltwater intrusion during the dry season causes mortality to some species and increases disease and predation

St. Lucie Estuary Background

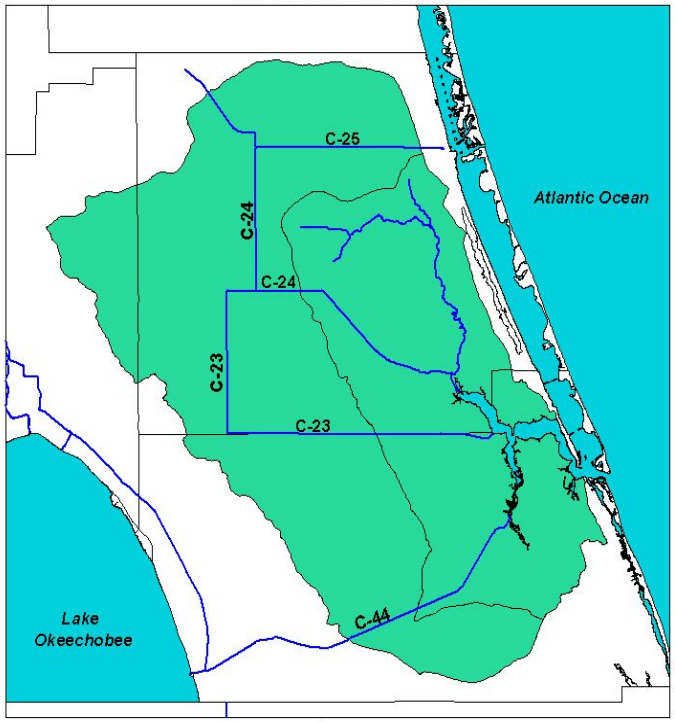
- Located on southeast coast, intersects with The Southern Indian River Lagoon at the St. Lucie Inlet
- Western boundary extends to open channel headwaters of the north and south forks
- Inflows from Lake Okeechobee through S-308 which leads downstream to S-80 on C-44
- Extensive watershed influence with a watershed to estuary ration of ~100:1



Historic Watershed



Current Watershed



- Less storage (loss of 3 inches or 125,000 ac-ft)
- More storm runoff at higher peak runoff rates: wet season flows are higher
- Less flow at NF (from 60% of all flow to 25%)
- More flow at C-23 (from 3% of flow to 25%)
- Modeling indicates that low monthly flows (<350 cfs) are less frequent under present conditions

Issues facing the St. Lucie Estuary

Quantity of Freshwater

- High freshwater inflows
  - **Low salinity causes mortality of estuarine organisms**
  - **High turbidity decreases light available to seagrass**
  - **Fish lesions (fungal origin)**
  - **High nutrients and HAB's transported into estuary**
  - **Accumulation of fine grain "mucky" sediments**
  - **Long term loss of submerged aquatic vegetation**

- Low freshwater inflows
  - **The North Fork St. Lucie needs minimum flows during dry times**
  - **High salinity can be a problem for some organisms, increases disease and predation on oysters**

Ecological Results

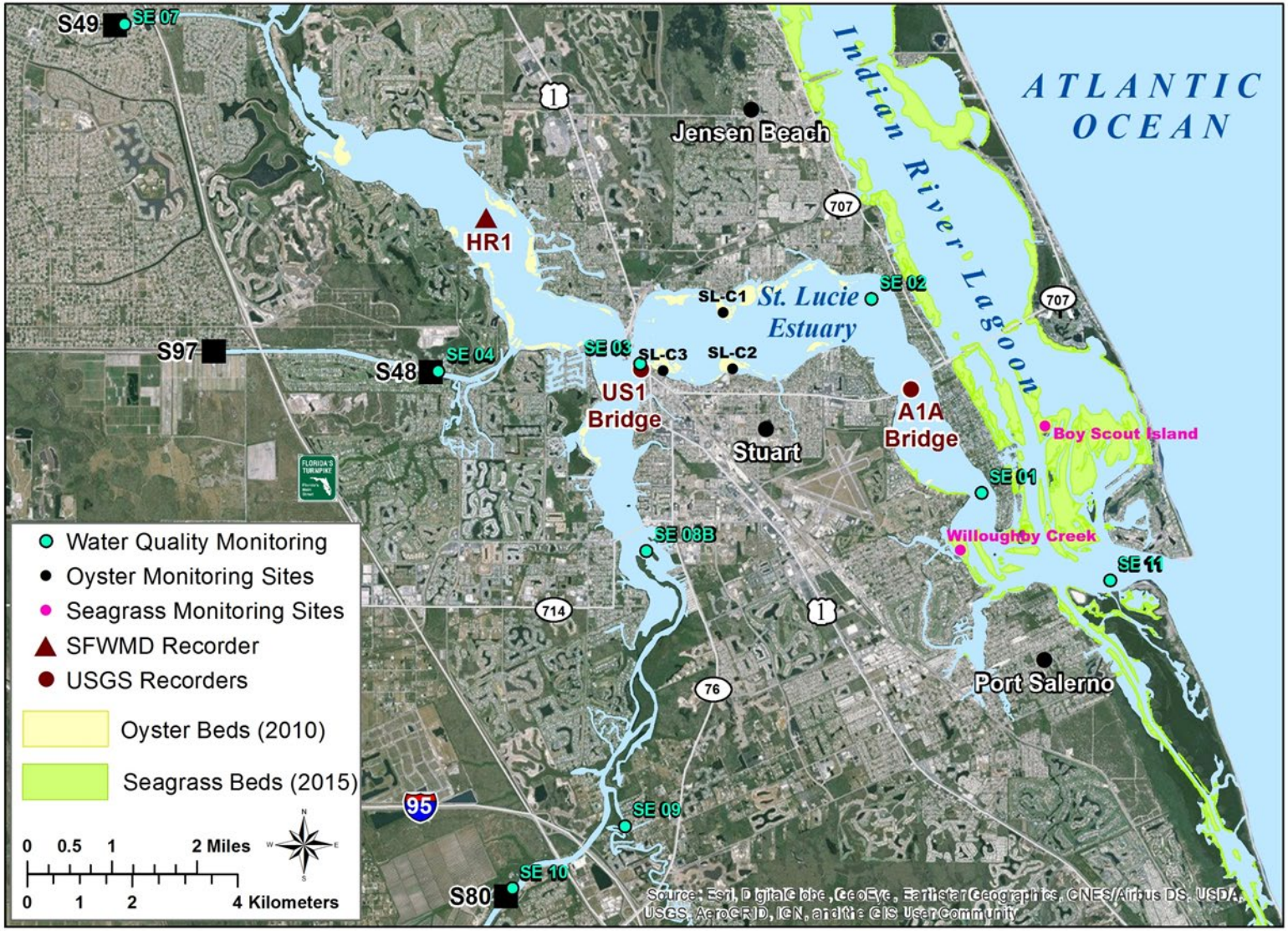
- Loss of Oyster Habitat
- Declines in Seagrass
- Fish and Marine Mammal Disease
- Algal Blooms

St. Lucie Estuary

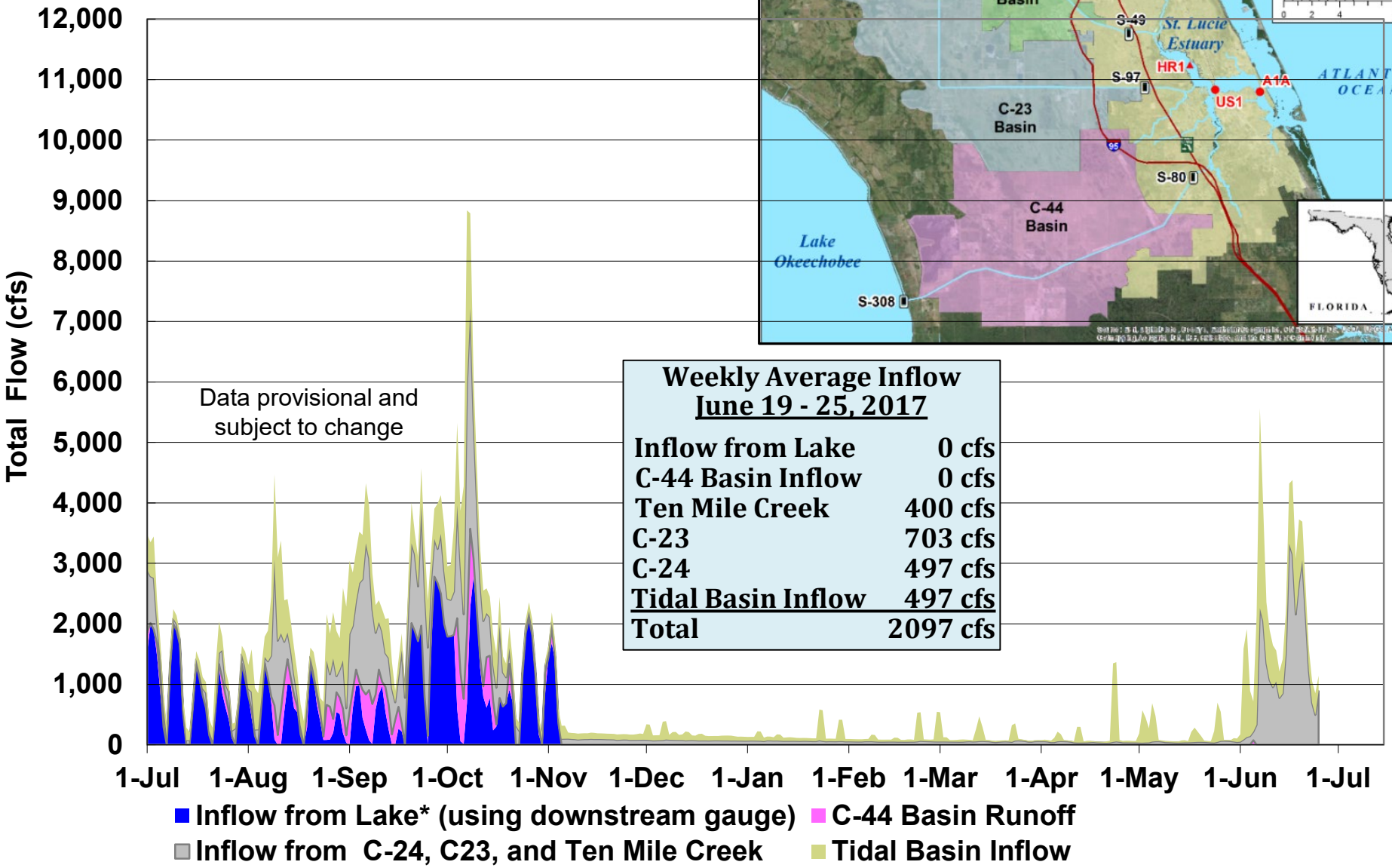
Projects designed to Improve Ecosystem Health

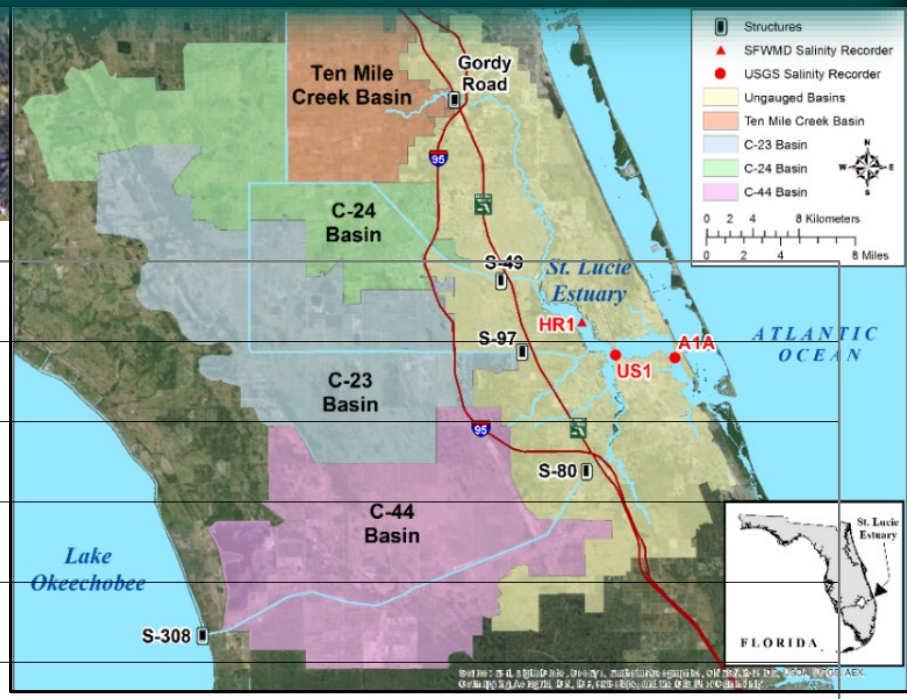
- Water quality monitoring
- Salinity monitoring
- SERFIS (Surveying Estuary Responses to Freshwater InflowS)
- RECOVER monitoring of benthic habitats
- North Fork Dissolved Oxygen Study
- Oyster and Seagrass modeling
- Light Attenuation Study
- IRL-S and C-44 Reservoir/STA
- North Fork Water Reservation
- 10-Mile Creek Reservoir

St. Lucie Estuary Monitoring



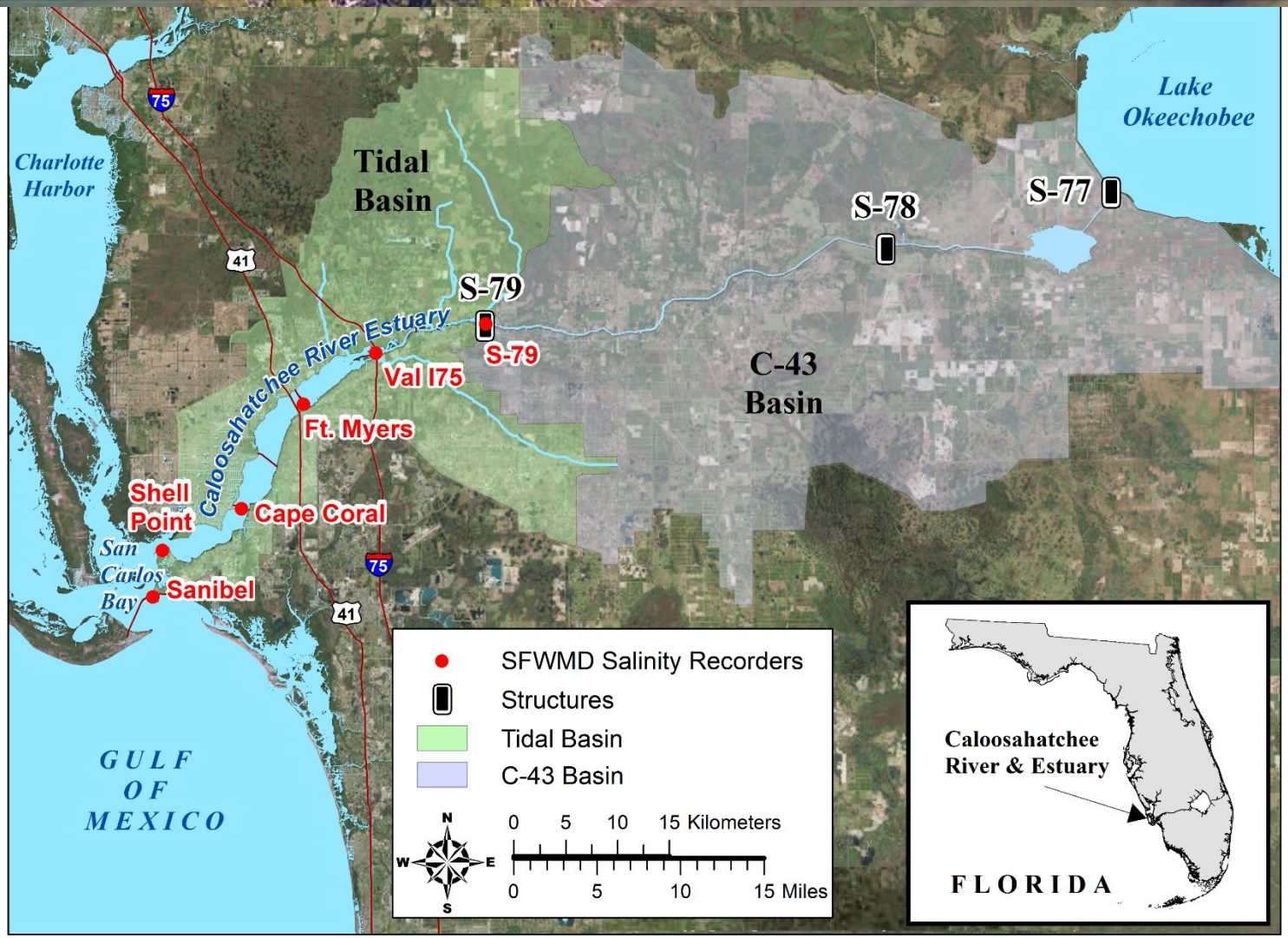
St. Lucie Estuary Freshwater Inflows





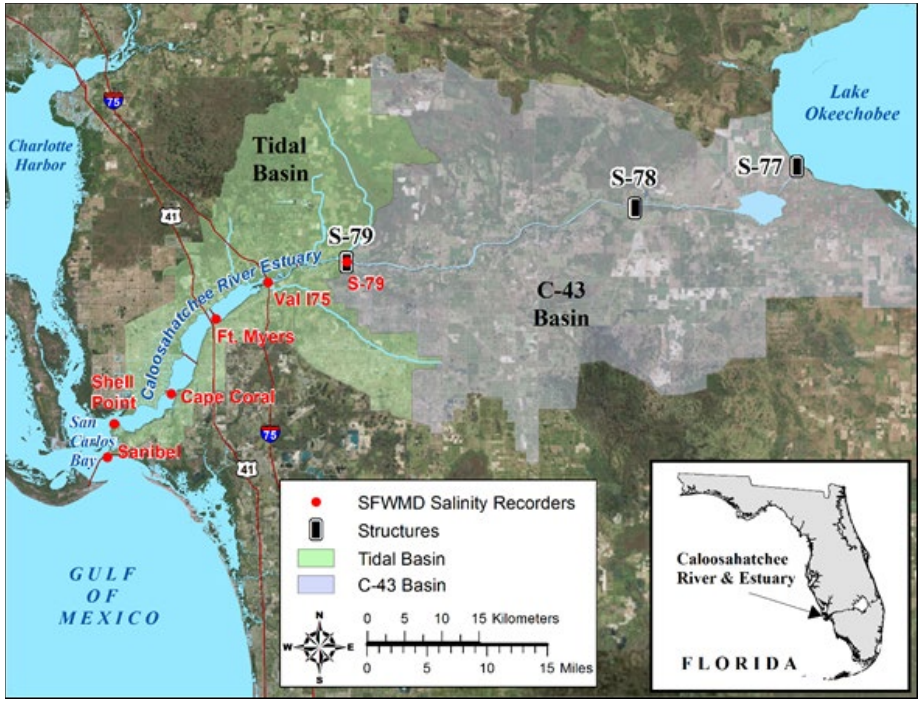
Weekly Average Inflow
June 19 - 25, 2017

Inflow from Lake	0 cfs
C-44 Basin Inflow	0 cfs
Ten Mile Creek	400 cfs
C-23	703 cfs
C-24	497 cfs
Tidal Basin Inflow	497 cfs
Total	2097 cfs

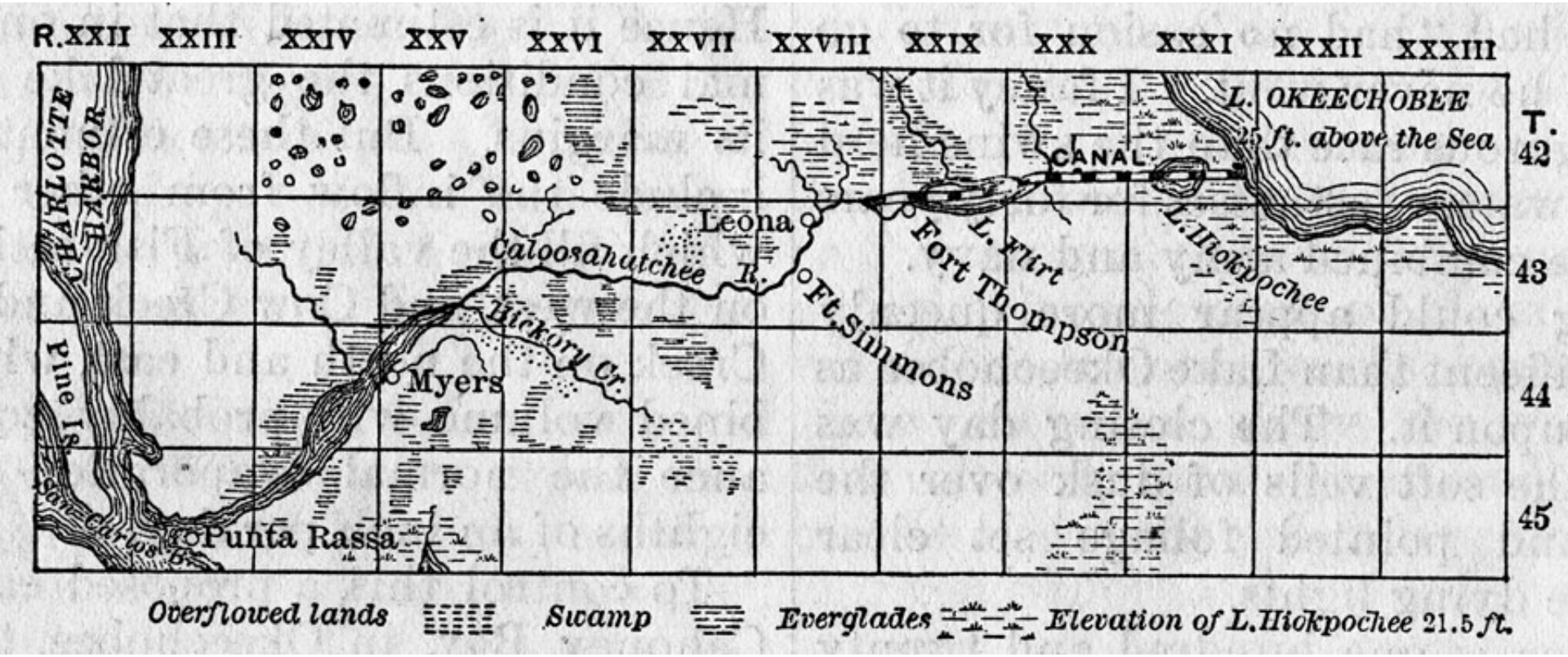

Charlotte Harbor
Tidal Basin
Lake Okeechobee
S-77
S-78
S-79
S-79
Caloosahatchee River Estuary
Val I75
Ft. Myers
C-43 Basin
Shell Point
Cape Coral
San Carlos Bay
Sanibel
75
41
GULF OF MEXICO
SFWMD Salinity Recorders
Structures
Tidal Basin
C-43 Basin
N
W
E
S
0 5 10 15 Kilometers
0 5 10 15 Miles
Caloosahatchee River & Estuary
FLORIDA

Caloosahatchee Background

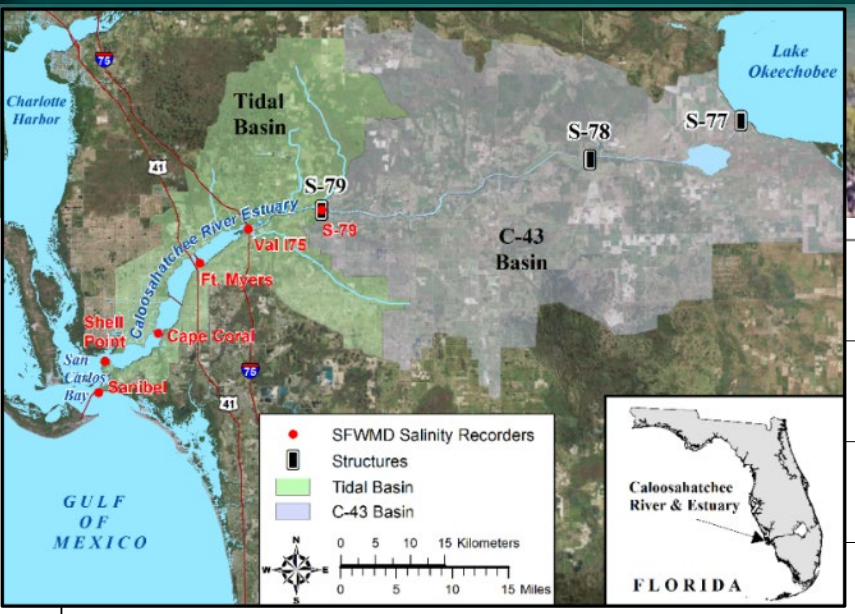
- Located on the Southwest Coast
- Extends 105 KM from Lake Okeechobee to San Carlos Bay
- Freshwater from Lake Okeechobee to S-79, one of three structures that control flow and stage
- Pre-development the river was sinuous and originated near Lake Flirt, 2 miles east of LaBelle
- Estuary portion is narrow and 42 KM long, resulting in a dynamic environment

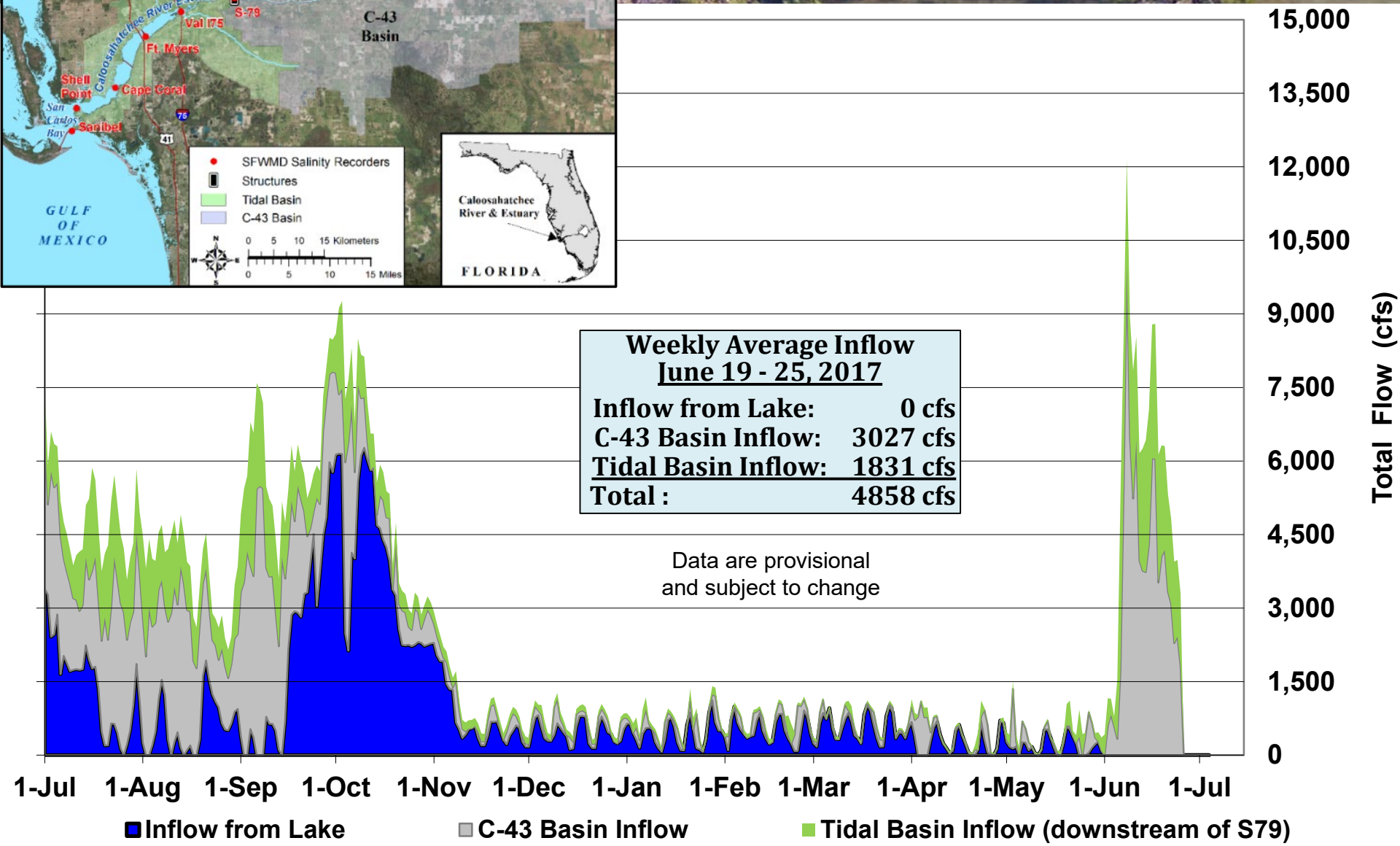


Caloosahatchee River and Estuary Prior to connection to Lake Okeechobee



Caloosahatchee Estuary Freshwater Inflows

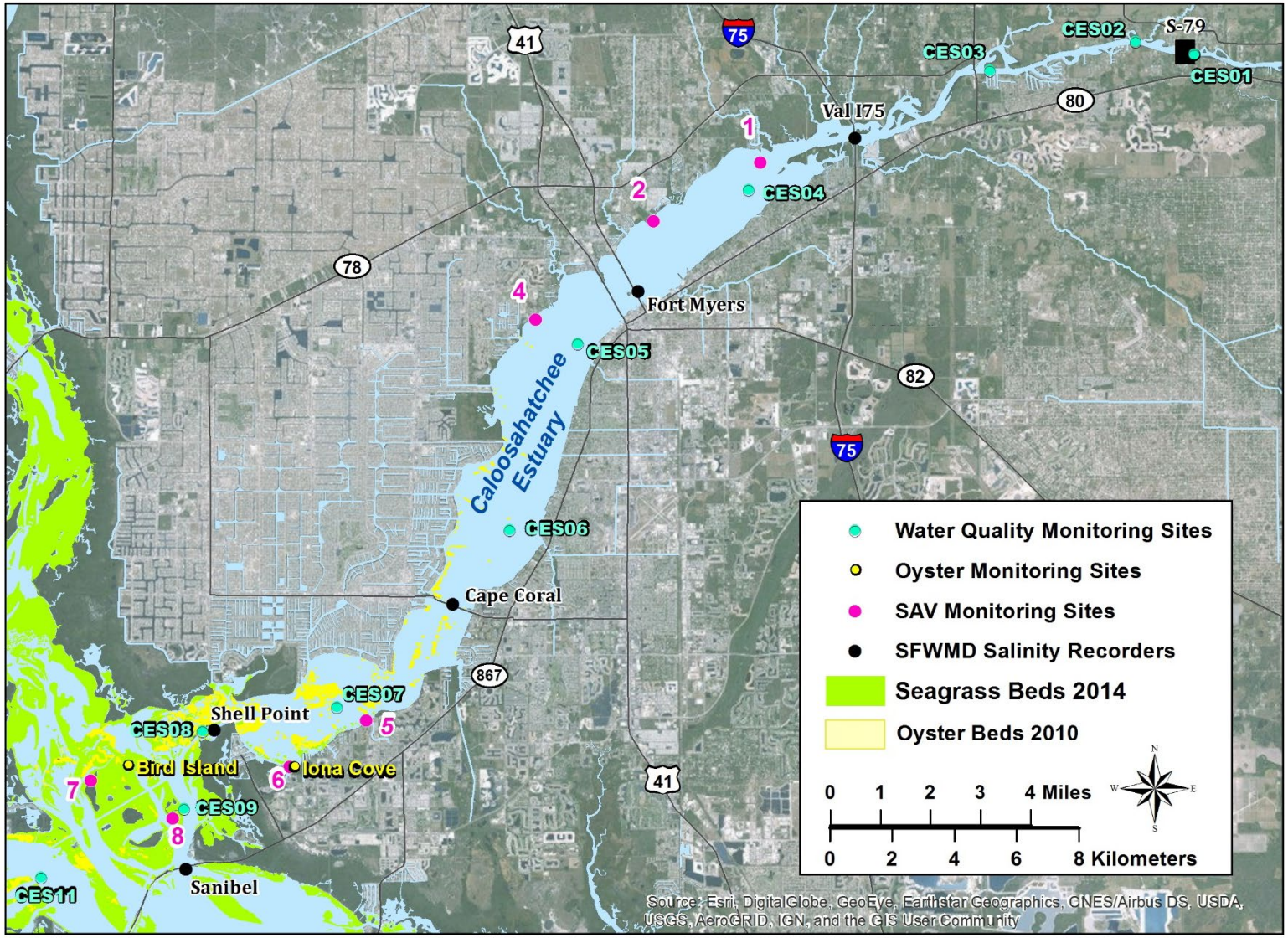




Caloosahatchee Estuary Problems

- Loss of Watershed Storage
- Higher Volumes of Stormwater Runoff
- Higher Peak Flows
- Reduced Base Flow result in violations of low flow targets
- HAB's/Red Tides
- Low Dissolved Oxygen
- Increased Nutrients

Caloosahatchee Monitoring Sites



Caloosahatchee Estuary

Projects Designed to Improve Ecosystem Health

- Water quality monitoring
- SERFIS (Surveying Estuary Responses to Freshwater InflowS)
- Salinity monitoring
- RECOVER monitoring of SAV and oysters
- C-43 Reservoir
- MFL Reevaluation
- Light Attenuation Study
- C-43 WQTA Mesocosm Study

Key Take Aways

- **Estuaries are varied and complicated environments so a "one shoe fits all" approach does not work when establishing flow targets from the Lake and Watersheds**
- **The St. Lucie and Caloosahatchee Estuaries have some similar problems but are very different in size and geometry so must be treated as such**
- **The watersheds of these estuaries have an even bigger impact on their health then inflows from Lake Okeechobee**

Questions?

Type a question into the Chat window or…

email to LakeOComments @usace.army.mil