Inflow, water quality, and flushing of Lake Worth Lagoon

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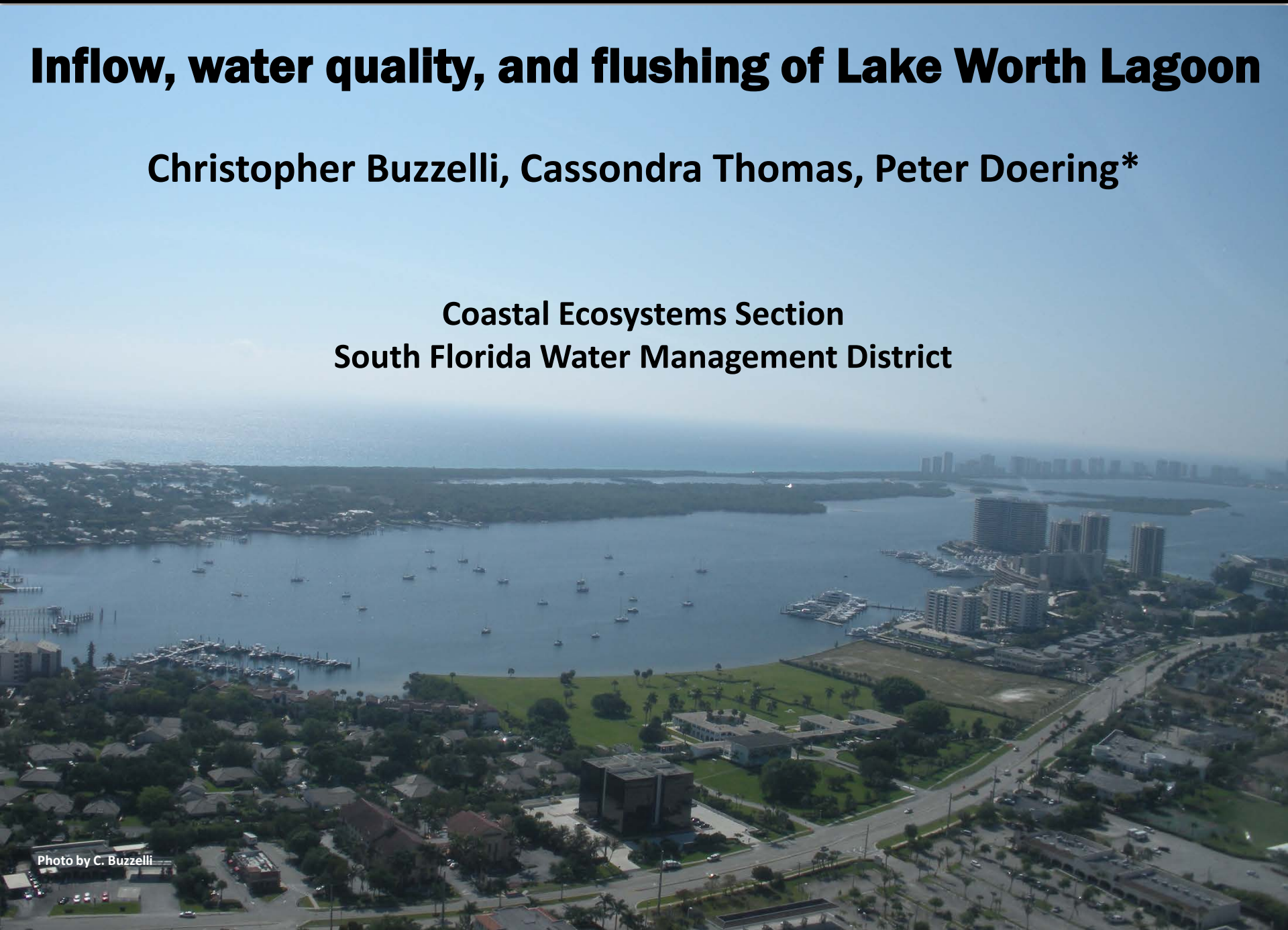
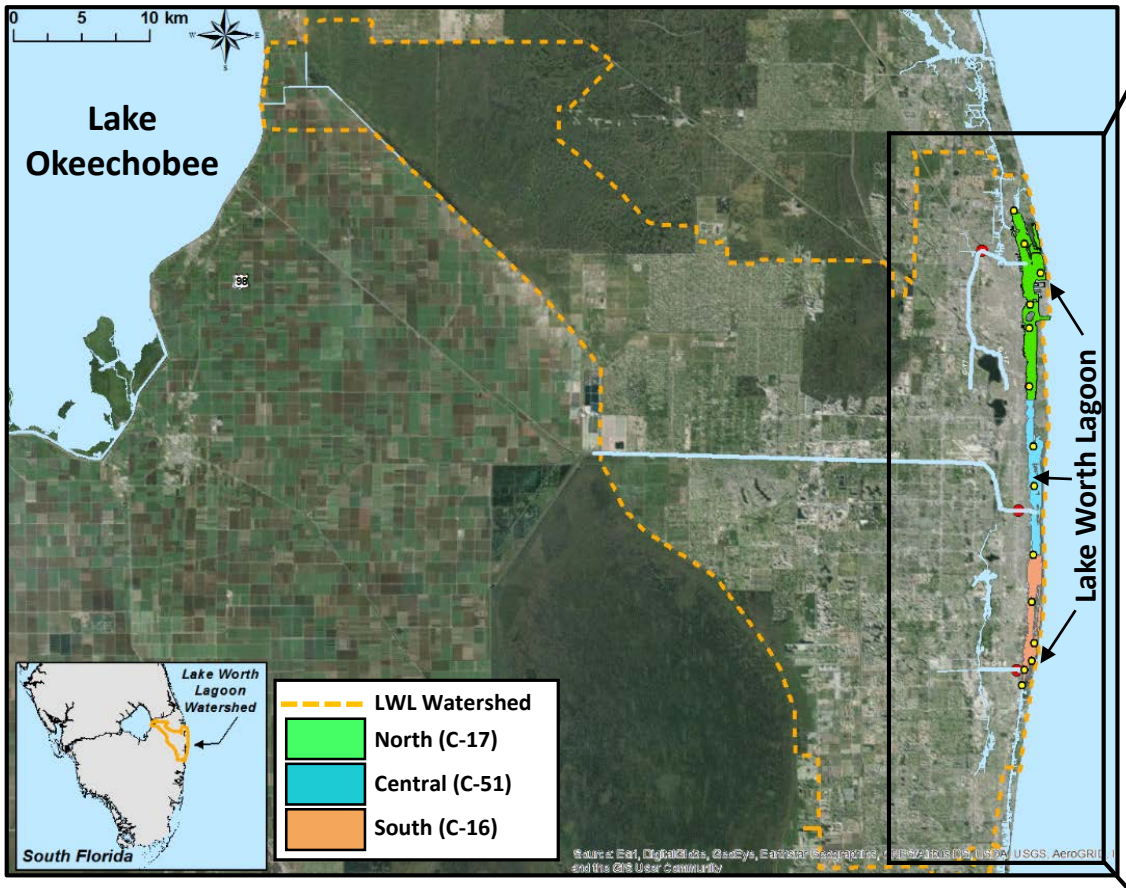


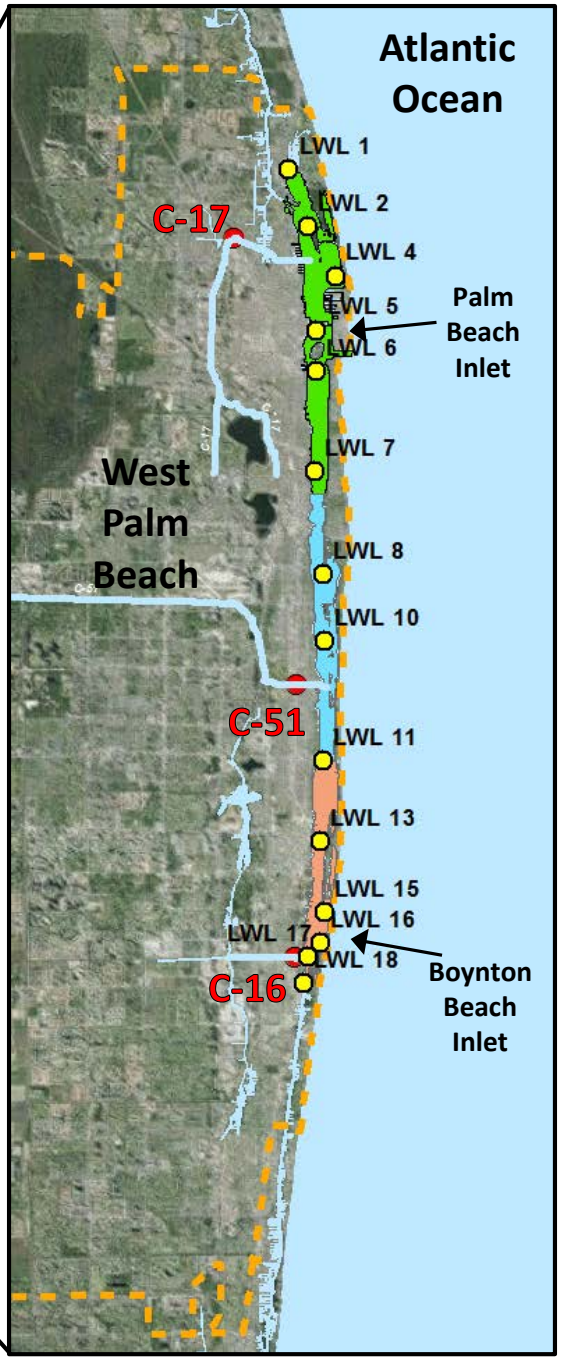
Photo by C. Buzzelli

OBJECTIVES FOR PRESENTATION

- **Lake Worth Lagoon watershed & estuary attributes**
- **Summary of inflow & water quality patterns 2007-2015**
- **Effects of estuary flushing on water quality**

LAKE WORTH LAGOON ATTRIBUTES





Watershed = 305,710 acres

Estuary = 7363 acres

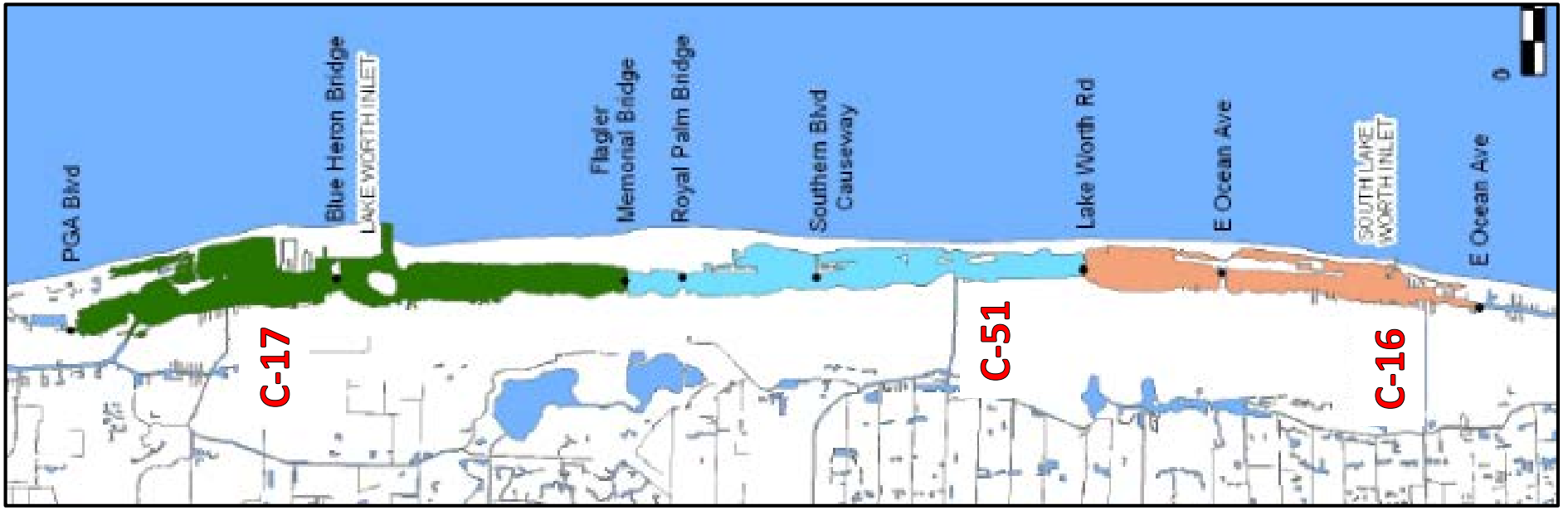
Ratio = 41.5:1

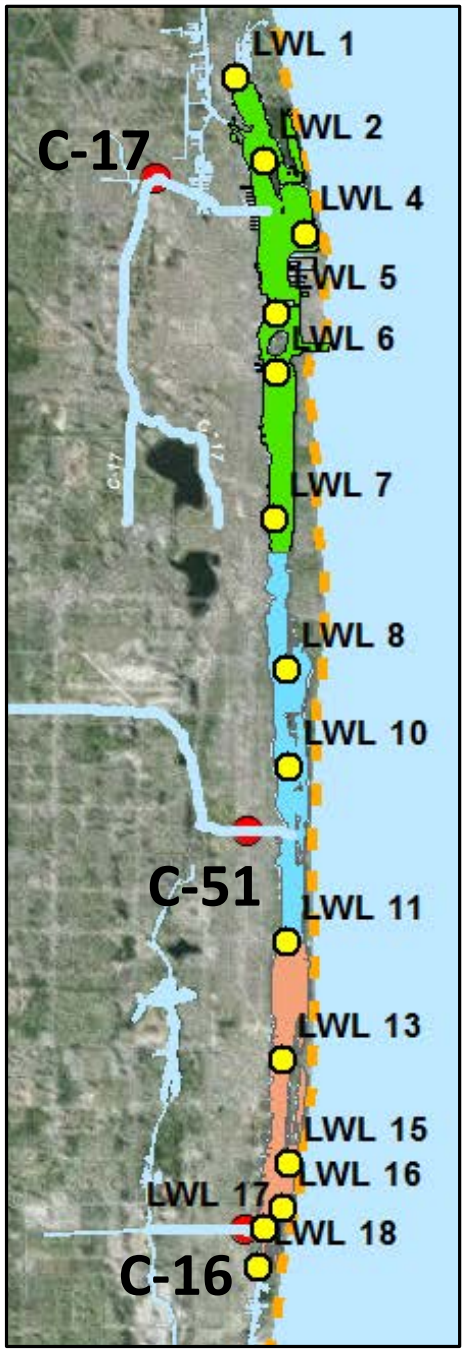
LAKE WORTH LAGOON ATTRIBUTES

NORTH
Distance = 8.6 miles
Depth = 3.4±2.6 m
Area = 8.2 km^2 (2018 acres)
Volume = 34.5 x 10^6 m^3
S-44 (C-17)
WQ Stations 1,2,4,5,6

CENTRAL
Distance = 7.1 miles
Depth = 2.6±1.6 m
Area = 8.8 km^2 (2168 acres)
Volume = 17.7 x 10^6 m^3
S-155 (C-51)
WQ Stations 7,8,10,11

SOUTH
Distance = 6.0 miles
Depth = 2.3 ± 1.1 m
Area = 12.9 km^2 (3184 acres)
Volume = 17.9 x 10^6 m^3
S-41 (C-16)
WQ Stations 12,13,15,16,18



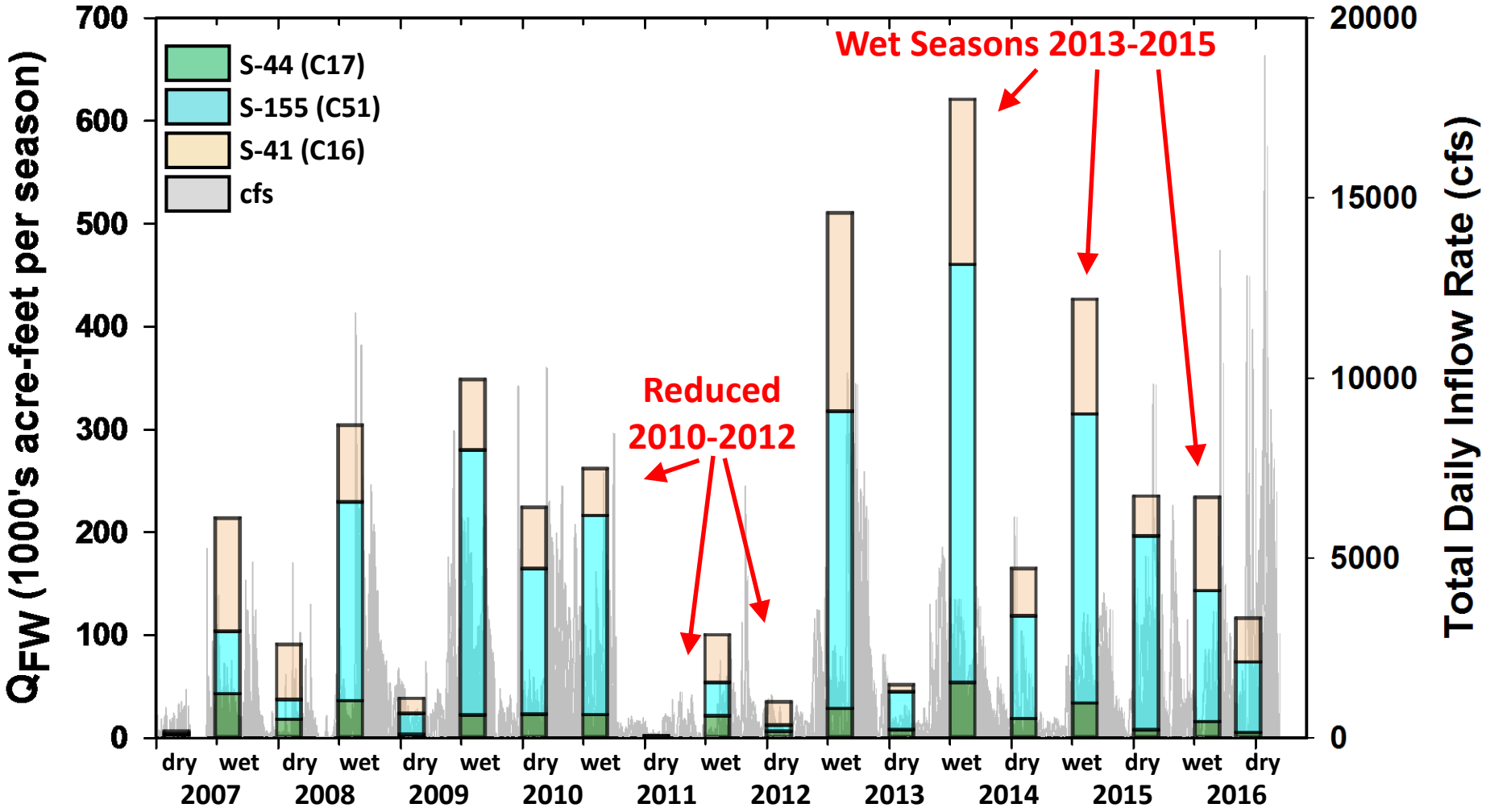


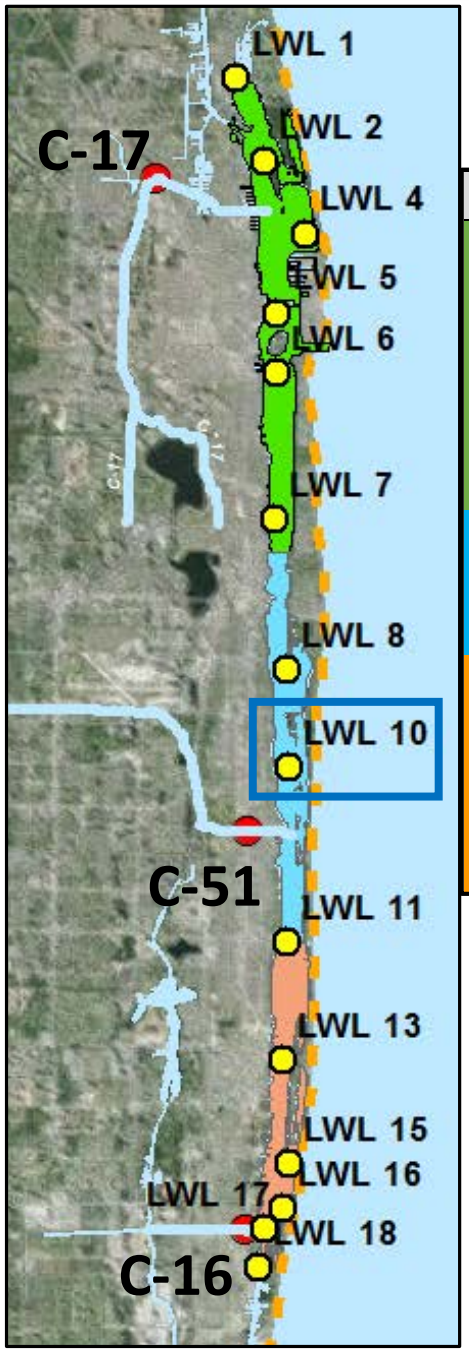
LWL INFLOW & WATER QUALITY

- **Cooperative agreement PBC-DERM and SFWMD**
- **13 stations monitored monthly 2007-2015**
- **Salinity (S), chlorophyll *a* (CHL), total N & P (TN & TP), turbidity, (NTU), total suspended solids (TSS)**
- **Analytical objectives (2016)**
  - **Spatial patterns**
  - **Temporal trends**
  - **Relationships between inflow and variables**

LWL INFLOW & WATER QUALITY

(freshwater inflow 2007-2015)





LWL INFLOW & WATER QUALITY

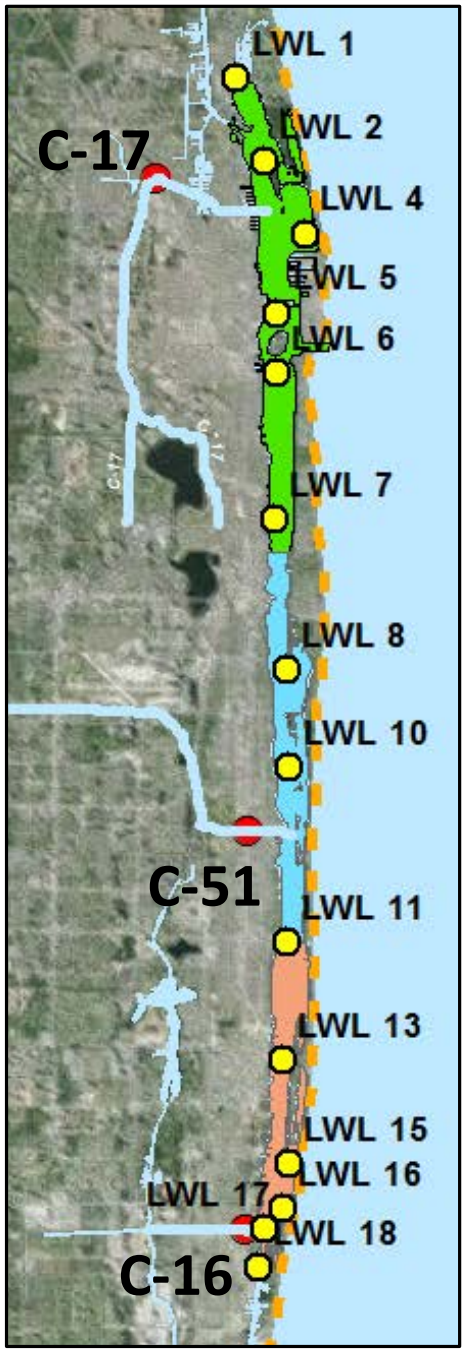
(trends from 2007-2015 by station)

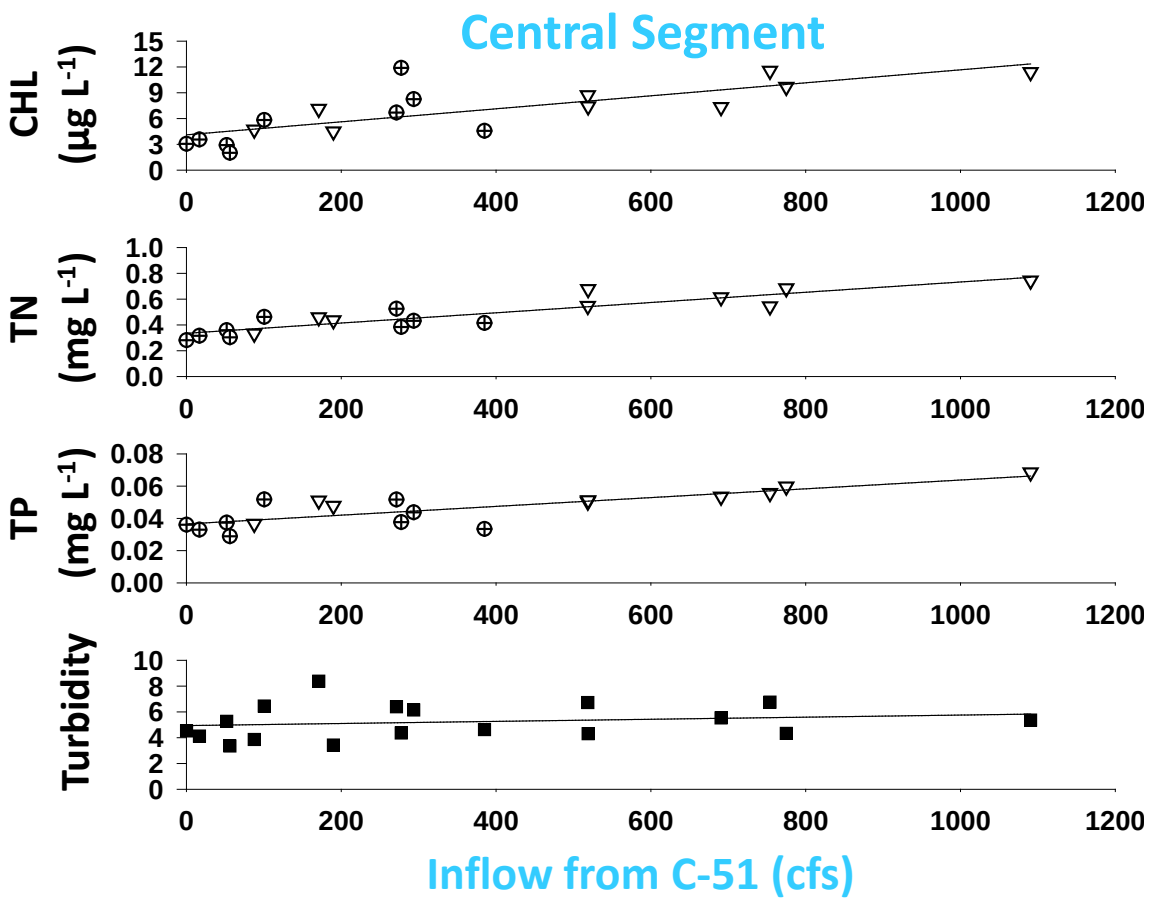
Segment	Stations	Salinity	CHL	TN	TP	NTU	TSS
North	1						(-)
	2						
	4						(-)
	5						(-)
	6						(-)
	7		(+)				
Central	8		(+)				
	10		(+)		(+)	(+)	
	11		(+)				
South	13		(+)				(-)
	15						(-)
	16						(-)
	17						(-)
	18						(-)

- **TSS decreased (-) in North and South segment stations**
- **CHL increased (+) in stations 7-13**
- **CHL, TP, and turbidity (NTU) increased (+) at station 10**

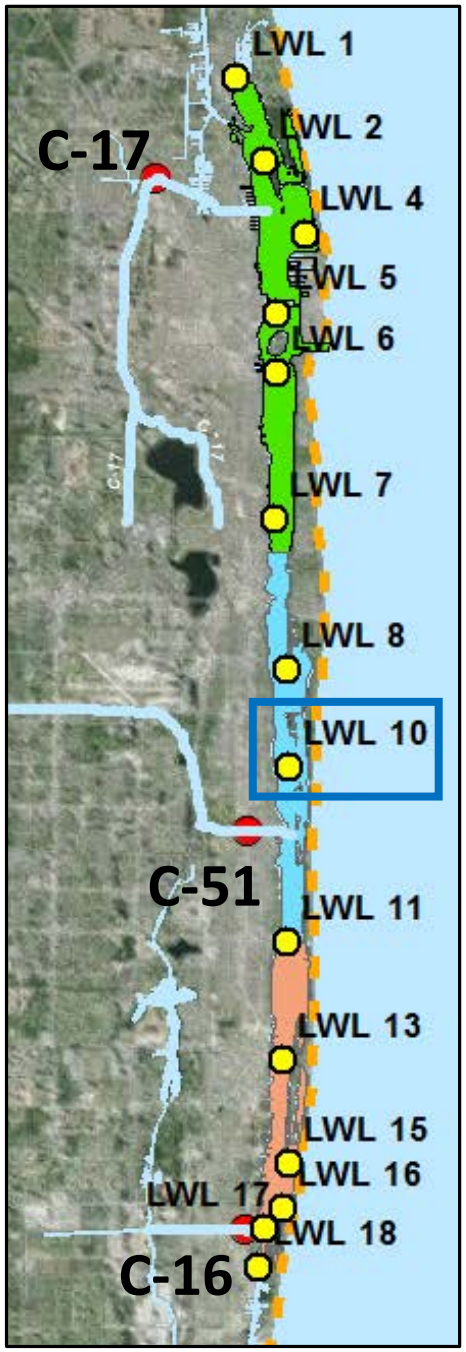
LWL INFLOW & WATER QUALITY

(relationships with water quality)

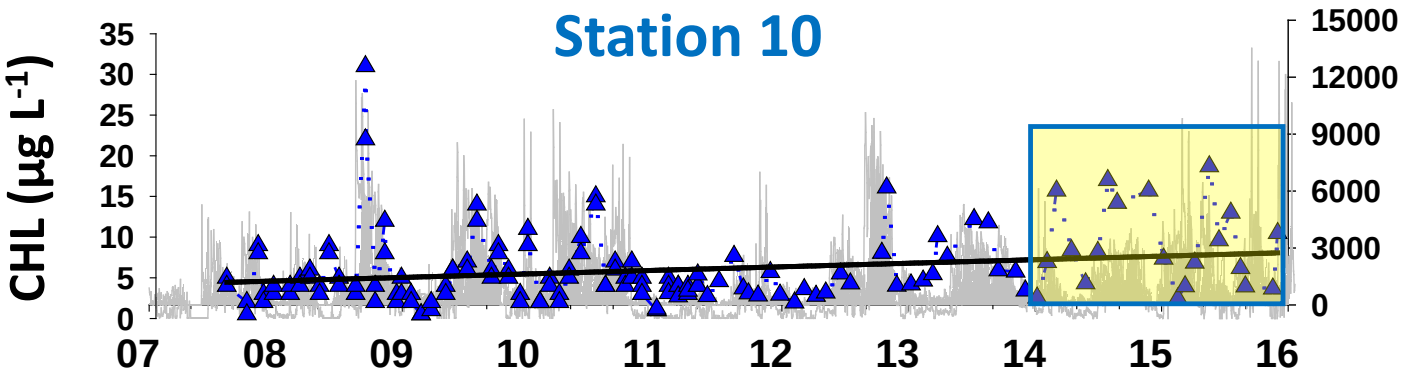




- C-51 inflow correlated to average seasonal CHL, TN, & TP
- C-51 inflow not correlated to turbidity in either season



LWL INFLOW & WATER QUALITY



Avg + SD	5.5±4.1 µg L^{-1}
N	143
$[CHL]_{ref}$*	6.1 µg L^{-1}
n > $[CHL]_{ref}$	32 of 143 (22%)
2014-2015	14 of 32 elevated samples
$[CHL]_{US1}$	8.8±8.0 µg L^{-1}
$[CHL]_{CES06}$	9.1±11.5 µg L^{-1}
$[CHL]_{FL}$**	11.0 µg L^{-1}

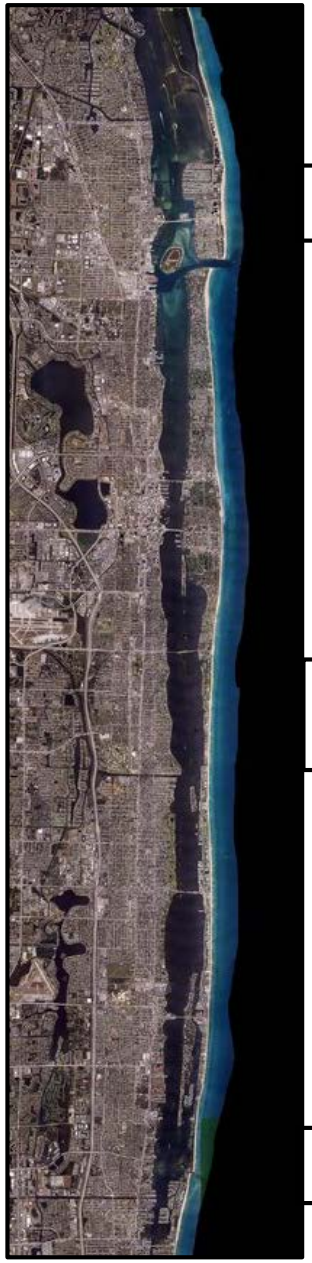
*The CHL reference concentration estimated as the value of the 75% percentile
**Florida DEP water quality reference for most estuaries

ESTUARY FLUSHING

If physical flushing is greater than the rate of phytoplankton growth:

If physical flushing is less than the rate of phytoplankton growth:

FLUSHING OF LAKE WORTH LAGOON



Q_{FW}

Q_{C17}

Q_{C51}

Q_{C16}

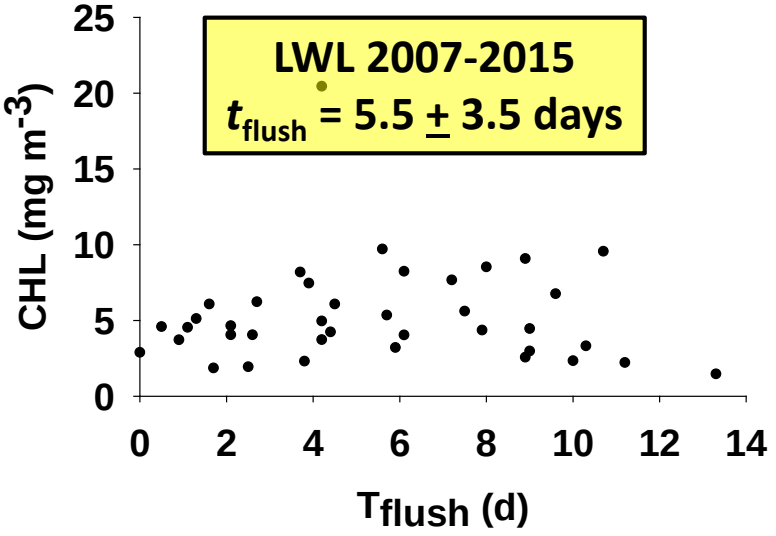
V_e estuary volume (m^3)

S_e estuary salinity

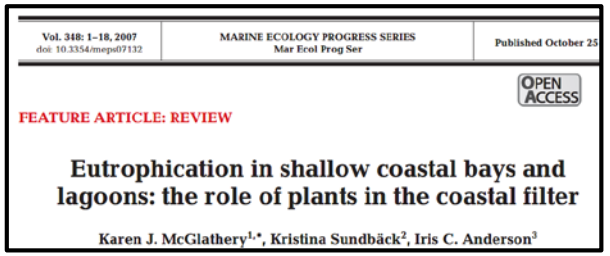
Coastal Ocean

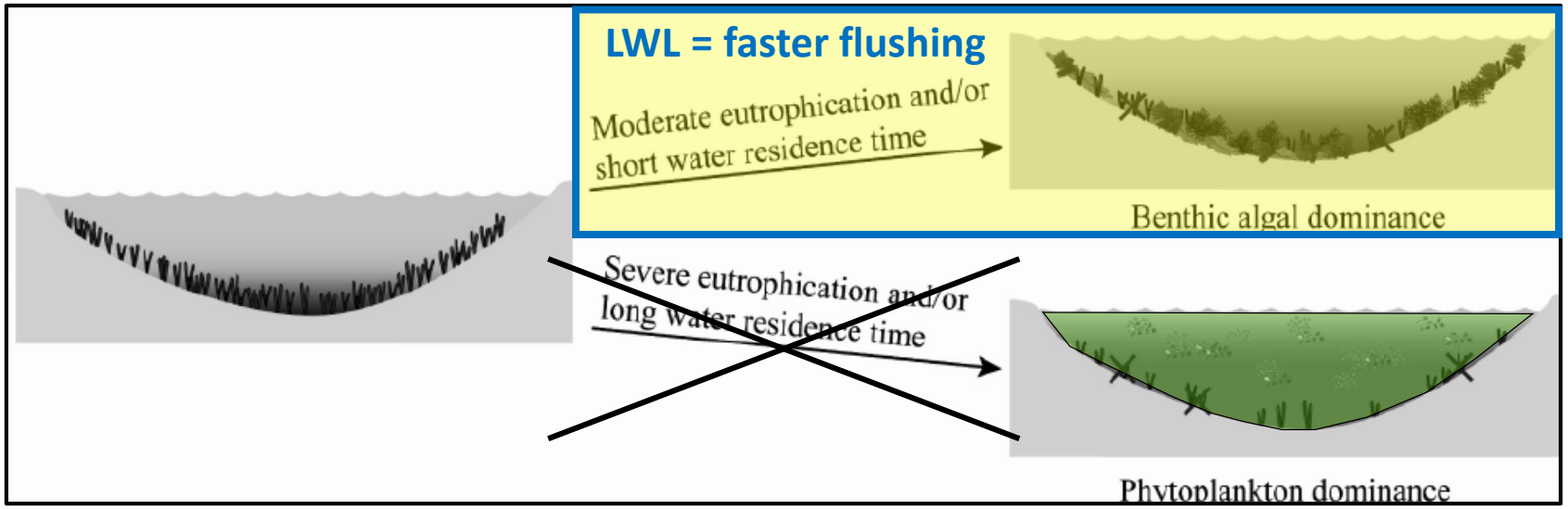
S_o = salinity of coastal ocean

$$\tau_{flush}(days) = \frac{V_e}{Q_{FW}} \frac{(S_o - S_e)}{S_o}$$

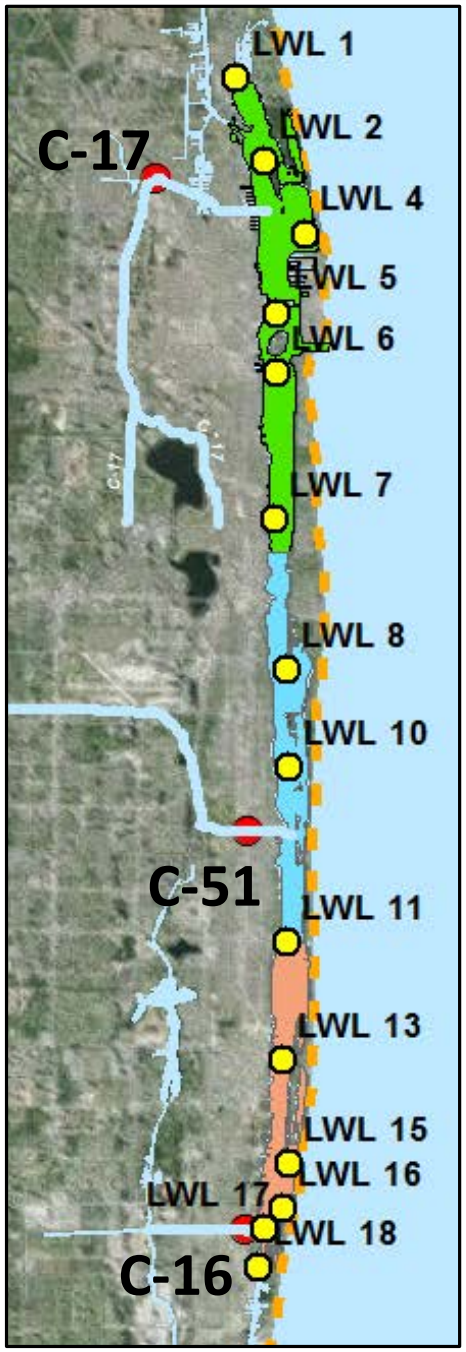


FLUSHING OF LAKE WORTH LAGOON





- Potential for water quality problems reduced with faster flushing
- Reduces potential for phytoplankton blooms
- Moderate eutrophication could affect benthic habitats (e.g. seagrass)



LWL INFLOW & WATER QUALITY
(2007-2015)

- Decrease in TSS in North & South; Increase in CHL in Central
- Q_{FW} NOT correlated to turbidity and TSS
- Q_{FW} correlated to CHL, TN, & TP in Central segment
- [CHL] increase, but less than estimated reference 78% of time
- Flushing time (τ_{flush}) of LWL
  - Average of 5.5 days to flush entire LWL
  - Flushing time ~1-2 days with increased inflow (Q_{FW})
  - τ_{SLE} = 2-20 days; τ_{CRE} = 5-60 days
- Severe water quality problems less likely due to fast flushing, but could affect benthic habitats such as seagrasses

THANKS FOR LISTENING!