

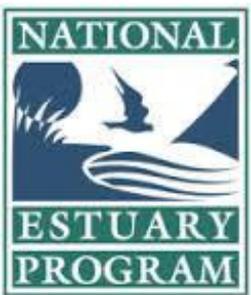
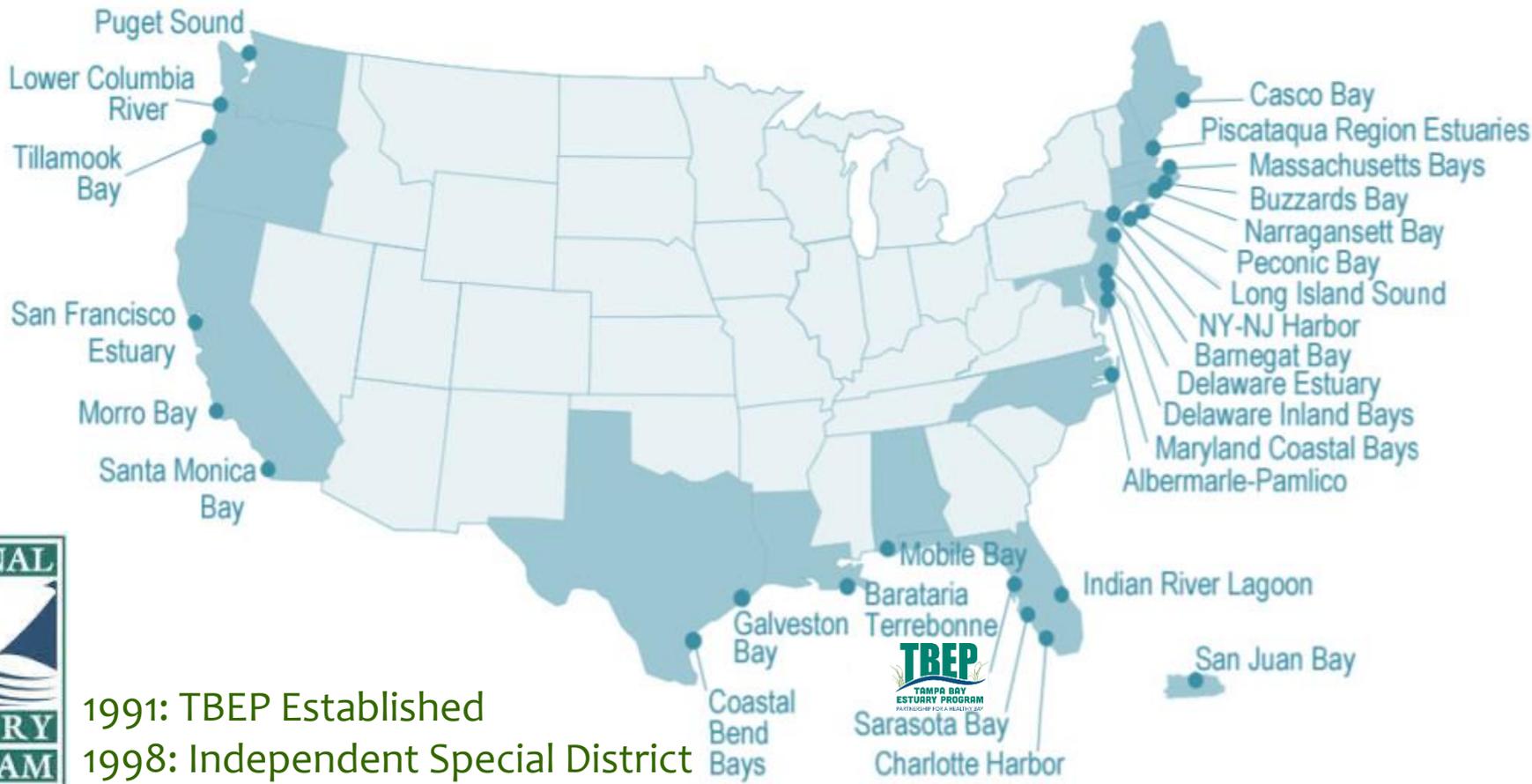


Monitoring Long-Term Recovery of the Tampa Bay Estuary through Regional Partnerships

March 28, 2019

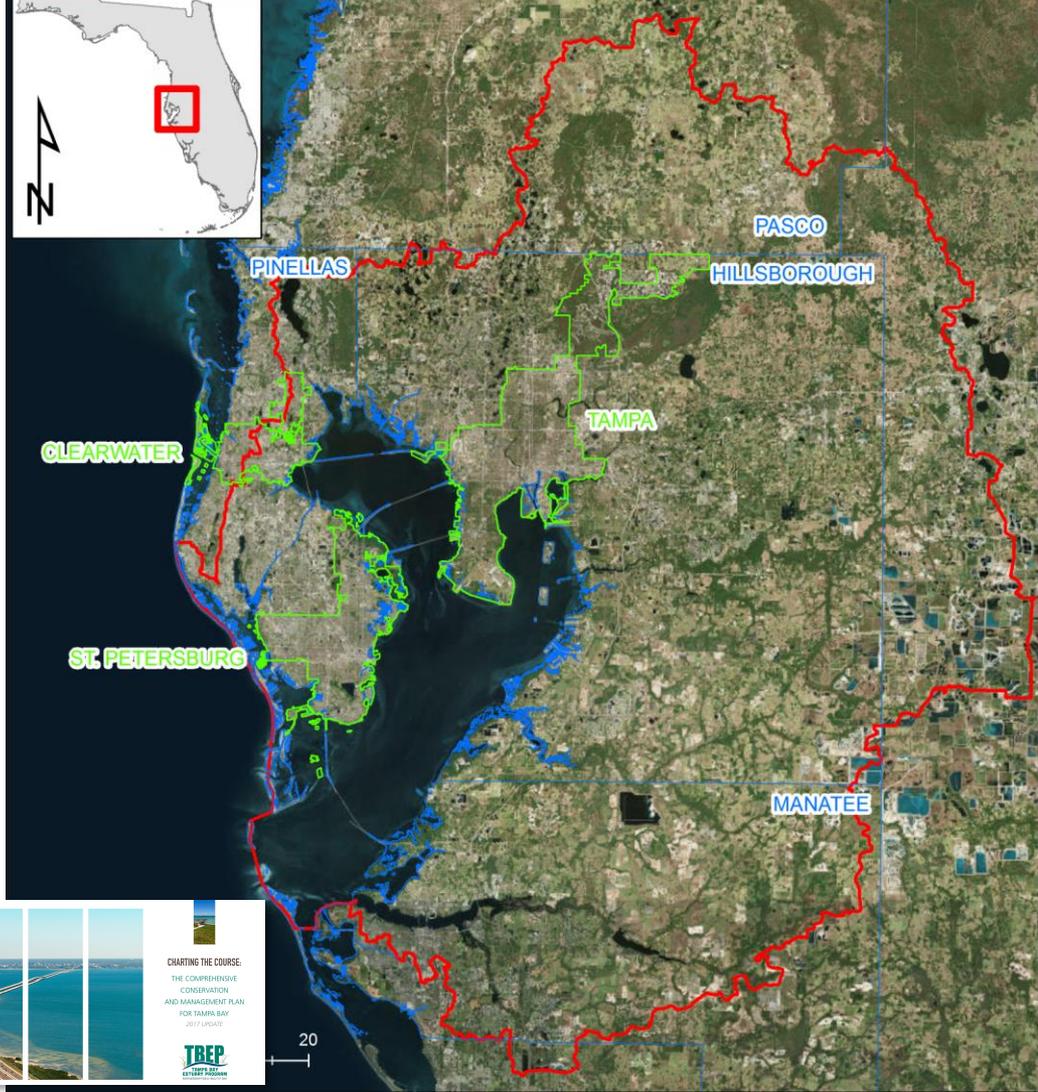
Ed Sherwood
Executive Director, TBEP

TBEP PARTNERSHIP FOR A HEALTHY BAY



1991: TBEP Established
1998: Independent Special District





Mission: Develop and foster partnerships to implement a science-based, management and restoration plan for the Tampa Bay estuary



20



Tampa Bay in the 1970s - Early 1980s

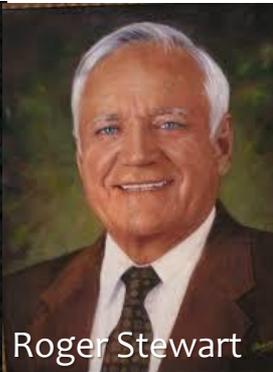
- Poorly-treated Domestic Point Sources, Untreated Industrial Point Sources & Stormwater, Rampant Dredge & Fill Activities
- Phytoplankton and macroalgae dominated
- 50% loss of seagrass coverage between 1950 and 1980
- Newspapers declared Tampa Bay “dead”



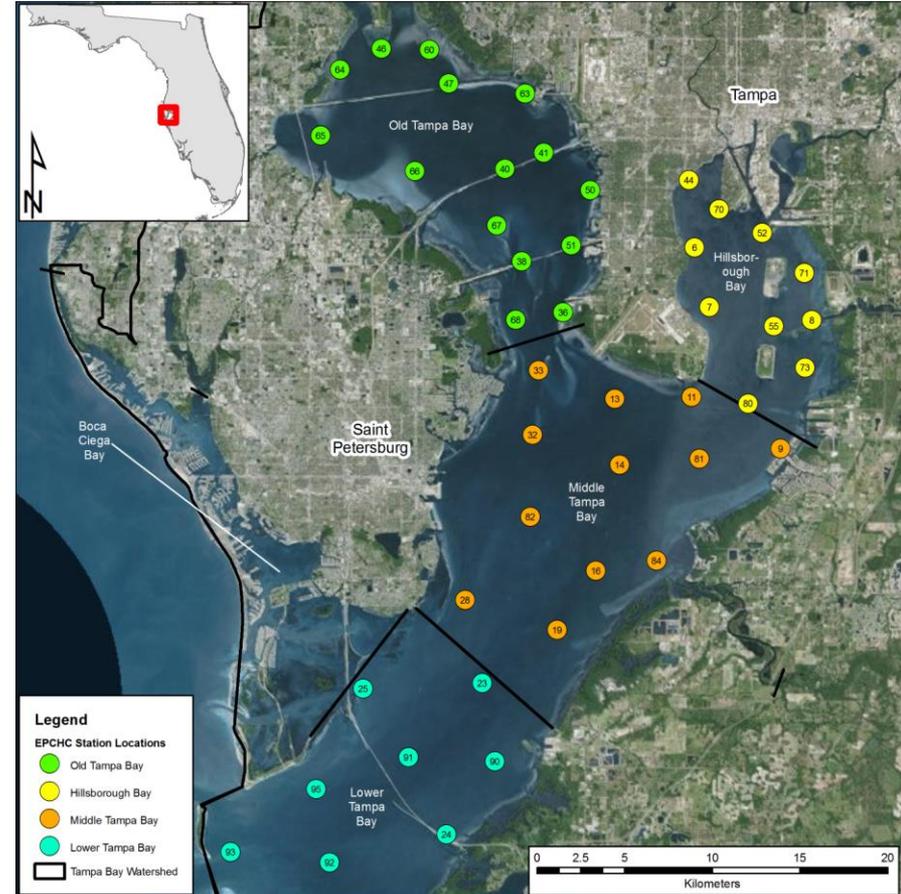


Early Monitoring Provides Foundation for WQ Target Development: Focus on Restoring Seagrass Coverage

- 1972: Hillsborough County establishes fixed station, monthly monitoring program throughout Tampa Bay
- Originally designed to understand domestic WWTP impacts to the Bay

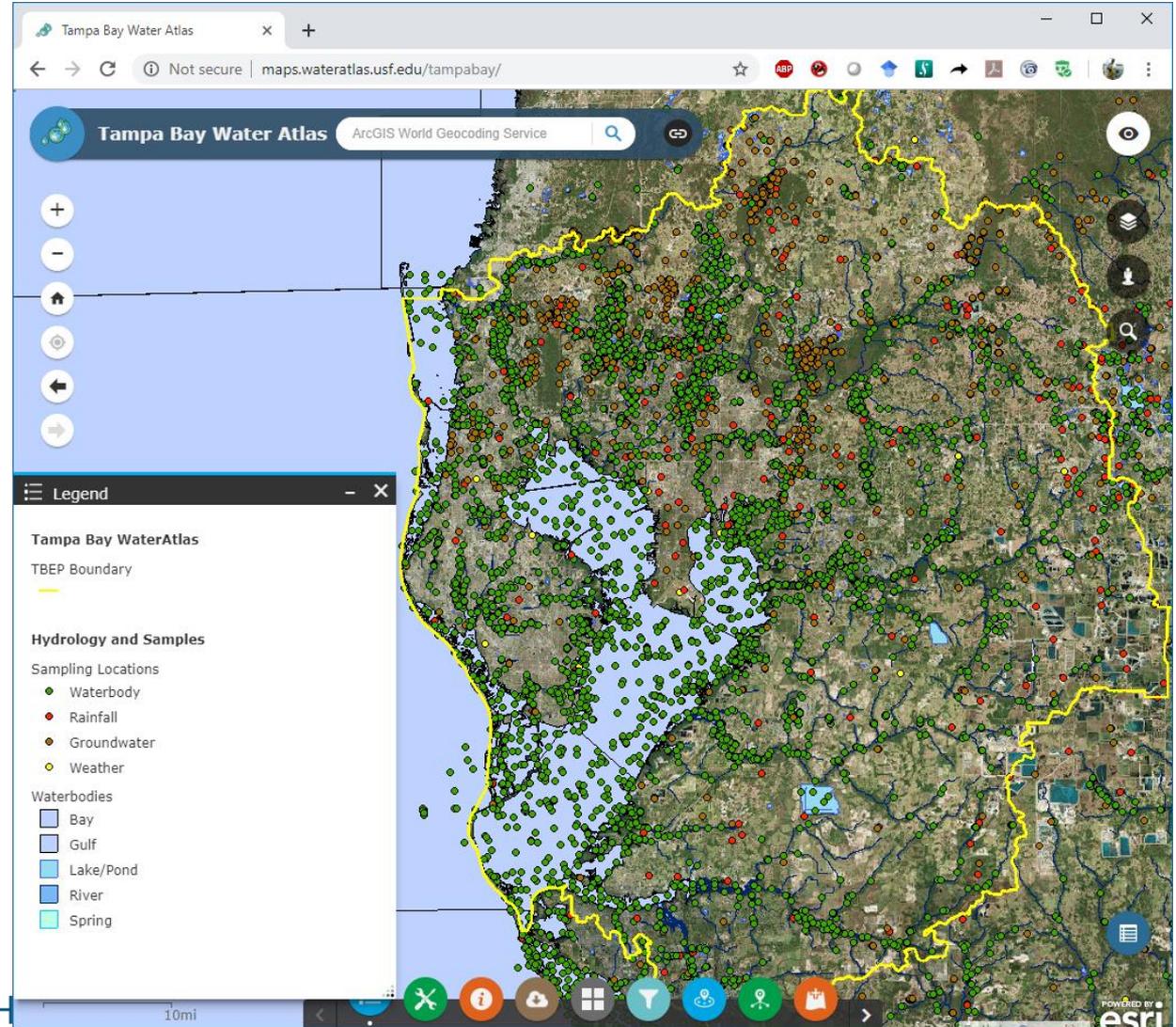


Roger Stewart



Regional Monitoring Expands

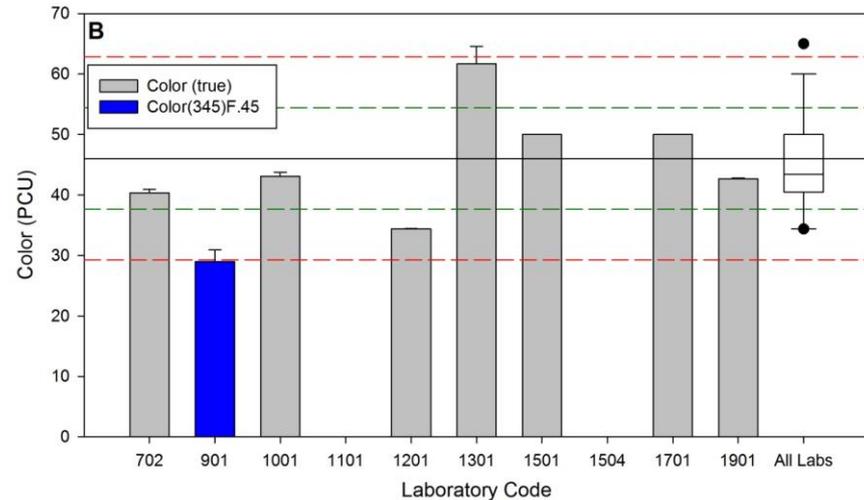
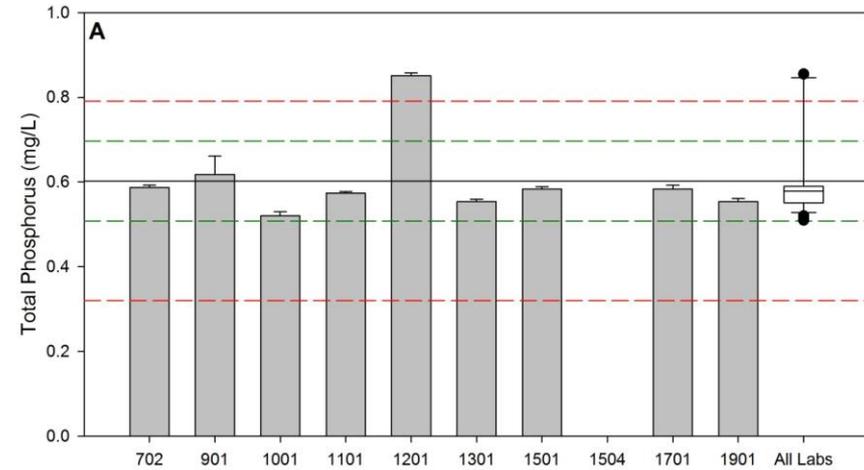
- Water Quality
 - Hillsborough, Manatee & Pinellas Counties
 - SWFWMD
- Surface & Groundwater Hydrology
 - USGS
 - SWFWMD





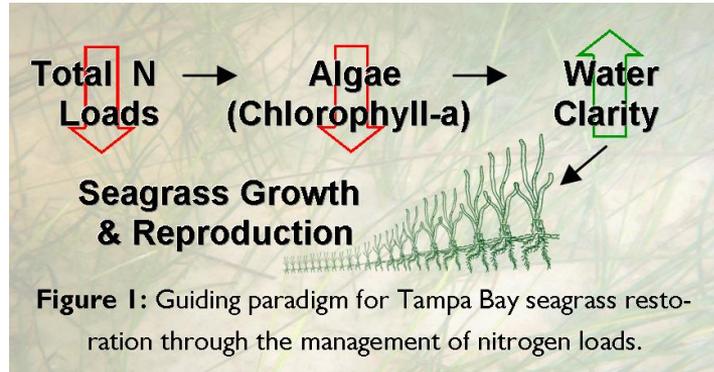
Regional Monitoring Efforts Expanded & Cross-Validated

- 1990s: Other County programs established to fill-in spatial gaps (both fixed and stratified-random approaches employed)
- Regional Ambient Monitoring Program (RAMP) established to ensure data comparability among field & laboratory procedures
- To date, 89 quarterly round robins conducted
<http://www.tbep.tech.org/committees/swfl-ramp>





Adopted Water Quality Management Targets & Regulatory Thresholds



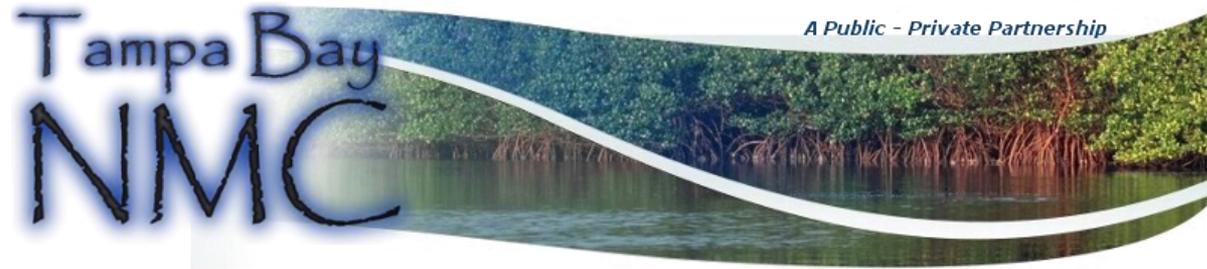
Tampa Bay Nitrogen Management Strategy

Bay Segment	TBEP Management Targets Established ~2000 (Desired Conditions)		Regulatory Threshold Adopted 2002 (Adverse Impacts Expected)
	Chl-a Management Target (ug/L)	K_d (m^{-1}) Management Target	Chl-a Regulatory Threshold (ug/L)
Old Tampa Bay	8.5	0.83	9.3
Hillsborough Bay	13.2	1.58	15.0
Middle Tampa Bay	7.4	0.83	8.5
Lower Tampa Bay	4.6	0.63	5.1

Annual WQ Report Card

Assess Annual TN Load Reduction Effectiveness

- “Hold the Line” on TN Loads: Preclude 17 tons/yr to offset for future growth in region ([TBEP Tech Pub. #06-96](#))



Tampa Bay Nitrogen Management Consortium of Tampa Bay NEP
Tampa Bay Estuary Program



COASTAL & ESTUARINE
RESEARCH FEDERATION

Public Partners:

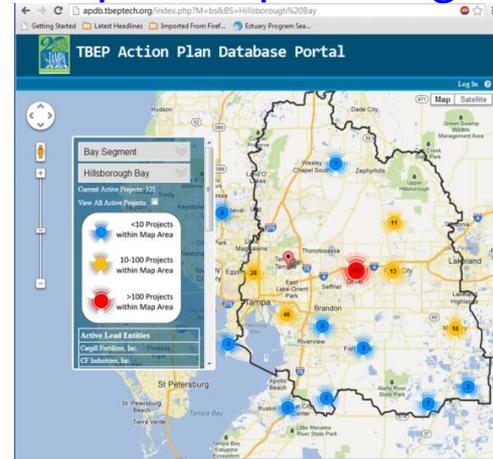
- Hillsborough County
- Manatee County
- Pinellas County
- Pasco County
- Polk County
- Sarasota County
- City of Tampa
- City of St. Petersburg
- City of Clearwater
- City of Palmetto
- City of Bradenton
- City of Largo
- City of Lakeland
- City of Oldsmar
- City of Gulfport
- City of Mulberry
- City of Plant City
- City of Safety Harbor
- SWFWMD
- US EPA
- FDEP
- FDACS
- FDOH
- FDOT
- MacDill AFB
- TBRPC
- Tampa Bay Water
- Tampa Port Authority
- EPC of Hillsborough County
- AEDC of Hills. County

Private Partners:

- Eastern Terminals
- Mosaic
- CSX Transportation
- Florida Power & Light
- CF Industries
- Tampa Electric Co.
- Kinder Morgan Bulk T., Inc.
- Progress Energy
- Tropicana Products, Inc.
- Kerry I&F
- Trademark Nitrogen
- Yara N.A.
- Alafia Preserve, LLC
- Eagle Ridge, LLC
- LDC Donaldson Knoll Investments, LLC

- Formed in 1998, now includes 45+ public/private partners
- Members include TBEP government and regulatory agency participants, local phosphate companies, agricultural interests and electric utilities
- Mid-1990s, collectively accepted responsibility for meeting nitrogen load reduction goals
- Consortium members may choose to implement any combination of projects to maintain loads to Tampa Bay at 1992-1994 levels
- **1992-2017: 470+ Projects, 530 Tons TN Prevented from entering TB >\$2.5 Billion Invested in Restoration & Infrastructure Improvements**

apdb.tbep.tech.org

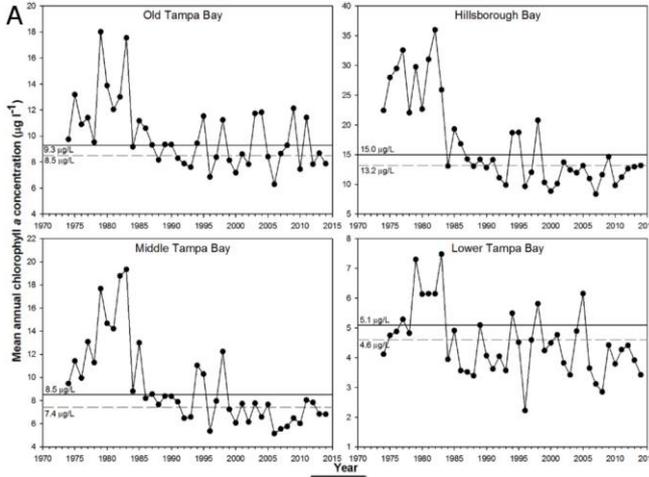


PARTNERSHIP FOR A HEALTHY BAY

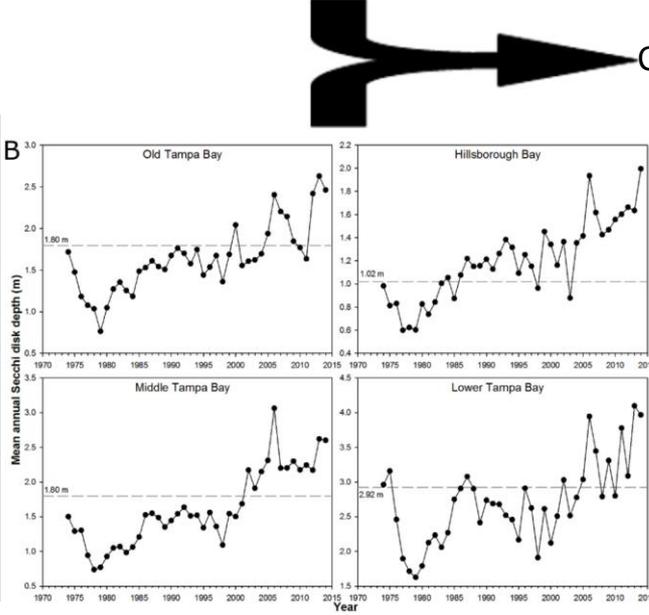


Tracking Progress

- (A) Chl-a and (B) secchi disk depths annually assessed relative to targets & thresholds
- (C) Management Response Defined Given Results



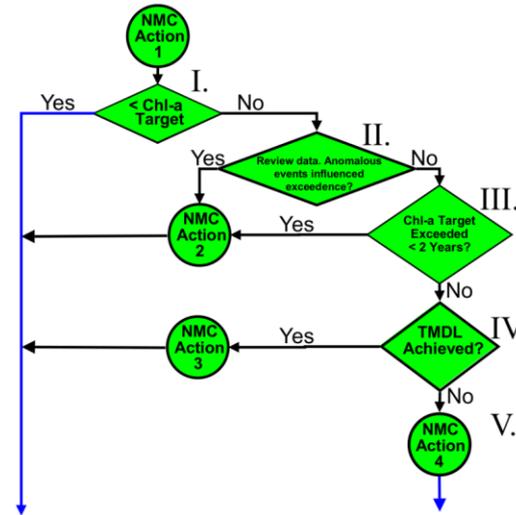
Year	Old Tampa Bay	Hillsborough Bay	Middle Tampa Bay	Lower Tampa Bay
1975	Red	Red	Red	Green
1976	Red	Red	Red	Yellow
1977	Red	Red	Red	Red
1978	Red	Red	Red	Yellow
1979	Red	Red	Red	Red
1980	Red	Red	Red	Red
1981	Red	Red	Red	Red
1982	Red	Red	Red	Red
1983	Red	Yellow	Red	Red
1984	Red	Green	Red	Yellow
1985	Red	Red	Red	Yellow
1986	Red	Yellow	Red	Green
1987	Red	Yellow	Red	Green
1988	Yellow	Green	Yellow	Green
1989	Red	Yellow	Red	Yellow
1990	Red	Green	Red	Yellow
1991	Green	Yellow	Yellow	Yellow
1992	Yellow	Green	Yellow	Yellow
1993	Yellow	Green	Yellow	Yellow
1994	Yellow	Yellow	Red	Red
1995	Red	Yellow	Red	Yellow
1996	Yellow	Green	Red	Green
1997	Yellow	Green	Red	Yellow
1998	Red	Red	Red	Red
1999	Yellow	Green	Yellow	Yellow
2000	Green	Green	Yellow	Yellow
2001	Yellow	Green	Yellow	Yellow
2002	Yellow	Green	Green	Green
2003	Red	Yellow	Green	Yellow
2004	Red	Green	Green	Yellow
2005	Green	Green	Yellow	Yellow
2006	Green	Green	Green	Green
2007	Green	Green	Green	Green
2008	Yellow	Green	Green	Yellow
2009	Yellow	Yellow	Green	Green
2010	Green	Green	Green	Green
2011	Red	Green	Yellow	Green
2012	Green	Green	Green	Green
2013	Green	Green	Green	Green
2014	Green	Green	Green	Green
2015	Yellow	Green	Yellow	Green
2016	Yellow	Green	Green	Green
2017	Yellow	Green	Green	Green
2018	Yellow	Green	Green	Green



Green	“Stay the Course.” Continue planned projects. Report data via annual progress reports and Baywide Environmental Monitoring Report.
Yellow	“Caution Alert.” Review monitoring data and nitrogen loading estimates. Begin/continue TAC and Management Board development of specific management recommendations.
Red	“On Alert.” Finalize development and implement appropriate management actions to get back on track.

Consequences for Not Meeting WQ Thresholds

- Annual chlorophyll-a concentrations drive entity allocation assessments
- If WQ is poor, nitrogen load responsibilities re-evaluated



NMC Action 1: Document annual bay segment specific chlorophyll-a levels relative to regulatory thresholds using the long-term EPCHC monitoring dataset.

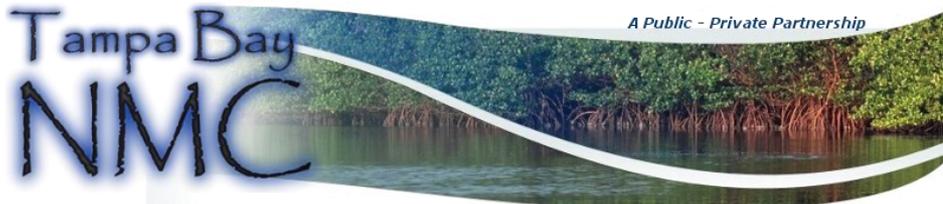
NMC Action 2: A full report of the anomalous event(s) or data which influenced the annual bay segment chlorophyll-a exceedence will be delivered to regulatory agencies after TBNMC review.

NMC Action 3: Consider re-evaluation of the bay segment assimilative capacity based on nonattainment of bay segment chlorophyll-a threshold while meeting federally-recognized TMDL.

NMC Action 4: If federally-recognized TMDL not achieved, compile nitrogen load data for regulatory review and identify potential further actions needed to achieve reasonable assurance for bay segment nitrogen load allocations.

Regulatory Agency Actions

Assessment Step Linked to Roman Numerals of Figure Above	Result	Action
I. Determine annual bay segment specific chlorophyll-a regulatory threshold attainment.	Yes	NMC Action 1
	No	NMC Action 1
II. Review data and determine if an anomalous event(s) influenced non-attainment of the bay segment specific chlorophyll-a threshold.	Yes	NMC Action 2
	No	Go to III.
III. Determine if the chlorophyll-a thresholds have been exceeded for <2 consecutive years.	Yes	NMC Action 2
	No	Go to IV.
IV. Determine if the bay segment specific federally-recognized TMDL has been achieved.	Yes	NMC Action 3
	No	Go to V.
V. For a given year or for multiple years, compile and report entity-specific combined source loads in comparison to source allocations.	Compile & Report	NMC Action 4



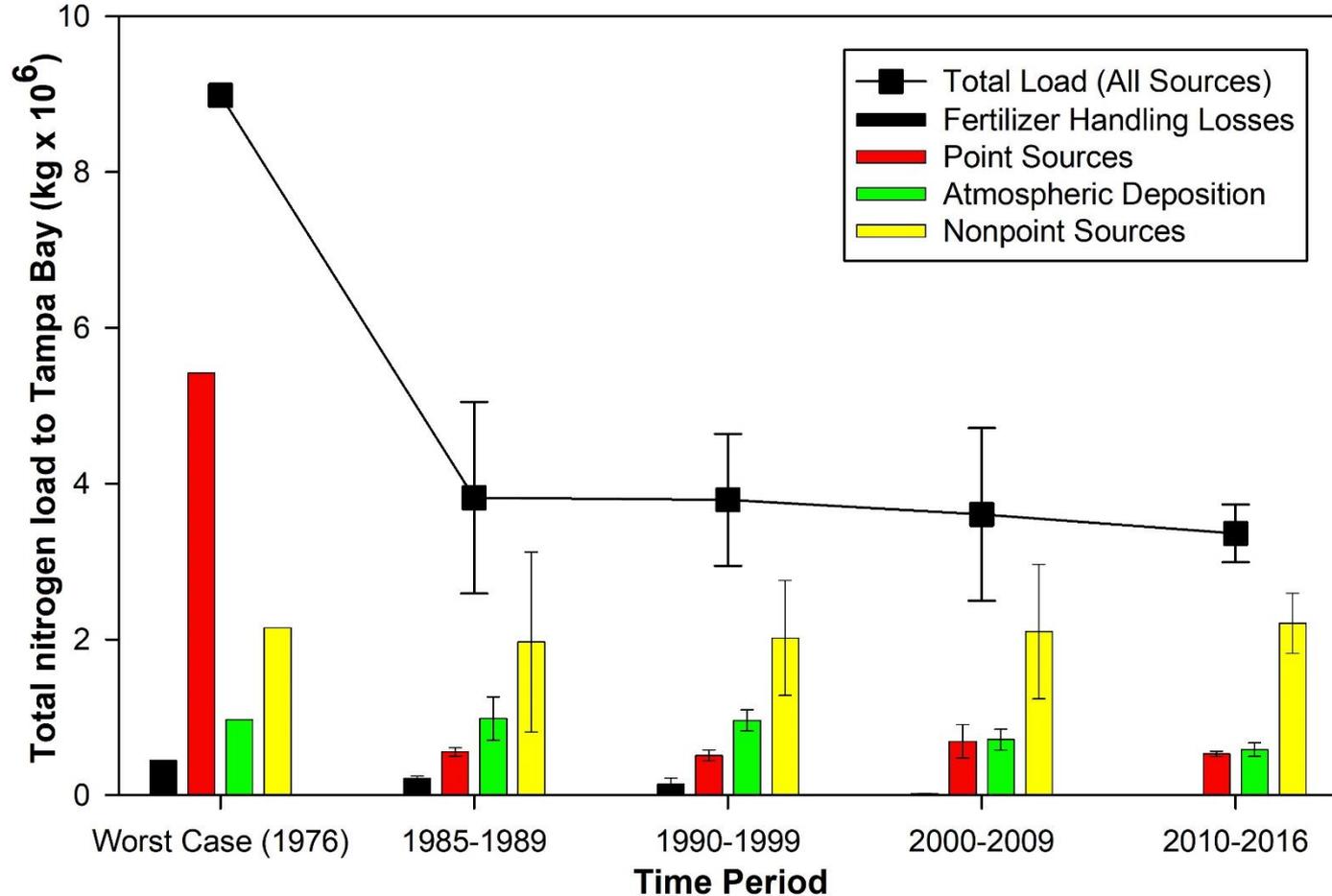
Example Compliance Assessment Steps

Bay Segment Reasonable Assurance Assessment Steps	EXAMPLE DATA USED TO ASSESS INTERIM REASONABLE ASSURANCE					Comment
	Year 1	Year 2	Year 3	Year 4	Year 5	
NMC Action 1: Determine if observed chlorophyll-a exceeds hypothetical regulatory threshold of 10.0 µg/L	12.0 µg/L (Yes)	14.0 µg/L (Yes)				Chlorophyll-a exceedences occurred during first 2 years of assessment period necessitating further NMC actions
NMC Action 2: Determine if any observed chlorophyll-a exceedences occurred for 2 consecutive years	No	Yes				Year 2 triggers additional NMC Action 3
NMC Action 3: Determine if observed hydrologically-normalized total load exceeds hypothetical federally-recognized total maximum daily load (TMDL) of 1000 tons/year	900 tons/yr (No)	1100 tons/yr (Yes)				Year 2 exceeds the TMDL after accounting for hydrology, NMC performs NMC Actions 4-5
NMC Actions 4-5: Determine if any entity/source/facility specific exceedences of 5-yr average allocation occurred during implementation period						At end of 5-year period, facility/source-specific exceedences listed in this column ↓

ENTITY	SOURCE	Allocation	EXAMPLE DATA USED TO ASSESS INTERIM REASONABLE ASSURANCE					5-Yr Average
			Year 1	Year 2	Year 3	Year 4	Year 5	
Entity A	Set Allocation – Domestic PS A	300 tons	290 tons	380 tons				
	NPS % Contribution (normalized tons)	30.0%	29.0%	38.0%				
Entity B	Set Allocation – Domestic PS B	200 tons	180 tons	190 tons				
	NPS % Contribution (normalized tons)	50.0%	48.0%	49.0%				
Entity C	Set Allocation – Industrial PS C	50 tons	45 tons	48 tons				
	NPS % Contribution (normalized tons)	20.0%	23.0%	13.0%				

Reduce
Nitrogen
Loads

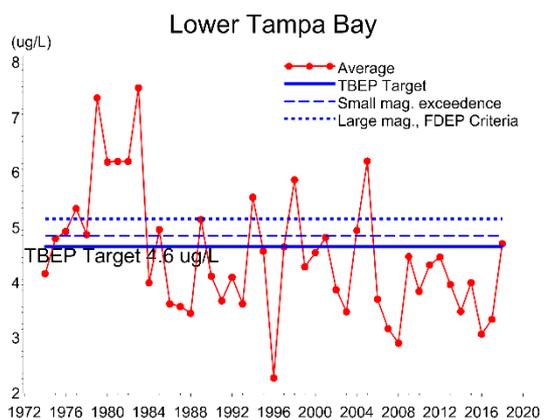
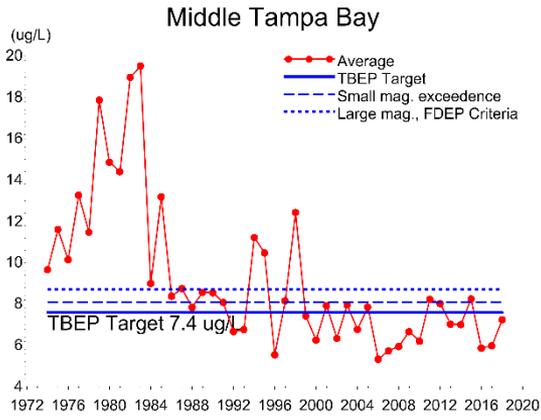
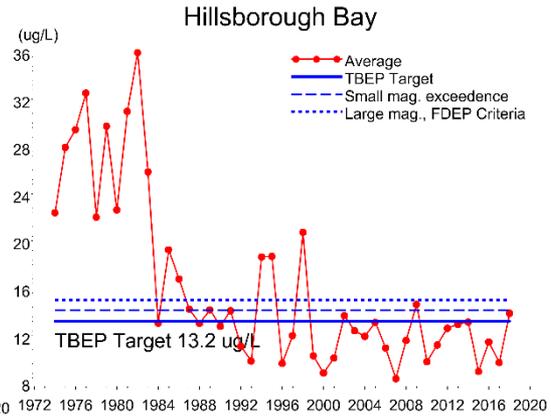
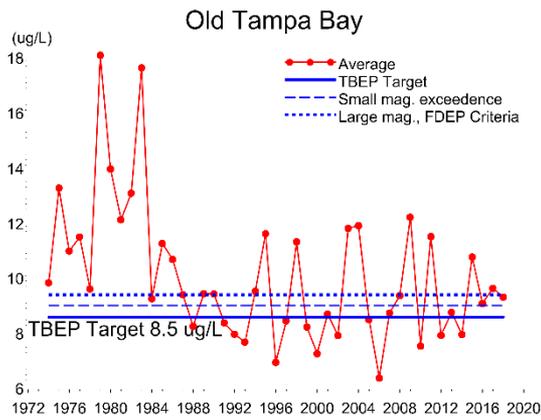
Reduced TN Loads to Tampa Bay ...



... Water Quality Has Improved ...



Chlorophyll - a (µg/L)



AWT & Reuse Standards Implemented

Stormwater Regulations Enacted

TBEP Partner & NMC Actions Implemented

Power Plant Upgrades

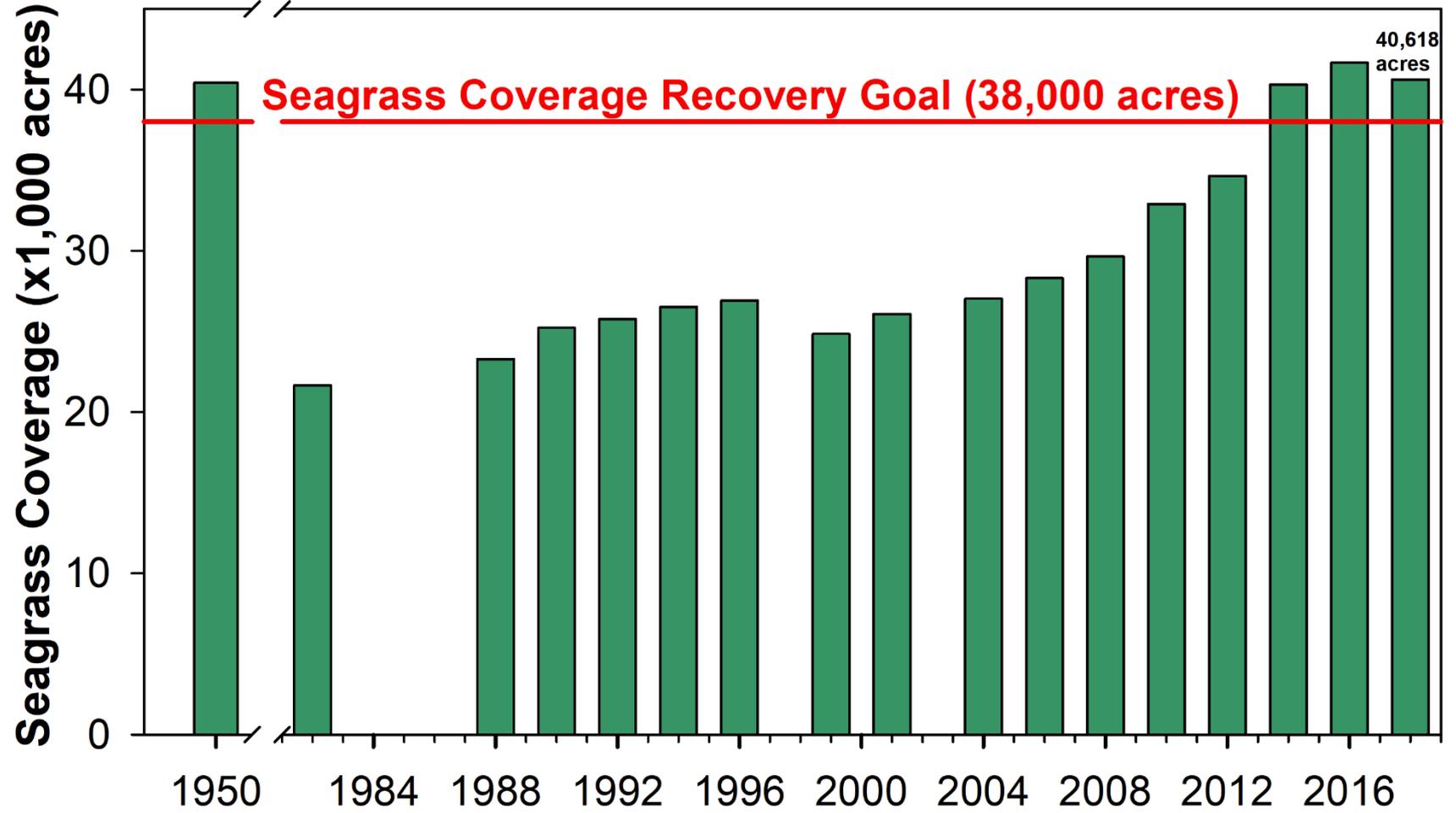
Port Facility Upgrades

Fertilizer Restrictions

Year	Old Tampa Bay	Hillsborough Bay	Middle Tampa Bay	Lower Tampa Bay
1975	Red	Red	Red	Green
1976	Red	Red	Red	Yellow
1977	Red	Red	Red	Red
1978	Red	Red	Red	Yellow
1979	Red	Red	Red	Red
1980	Red	Red	Red	Red
1981	Red	Red	Red	Red
1982	Red	Red	Red	Red
1983	Red	Yellow	Red	Red
1984	Red	Green	Red	Yellow
1985	Red	Red	Red	Yellow
1986	Red	Yellow	Red	Green
1987	Red	Yellow	Red	Green
1988	Yellow	Green	Yellow	Green
1989	Red	Yellow	Red	Yellow
1990	Red	Green	Red	Yellow
1991	Green	Yellow	Yellow	Yellow
1992	Yellow	Green	Yellow	Yellow
1993	Yellow	Green	Yellow	Yellow
1994	Yellow	Yellow	Red	Red
1995	Red	Yellow	Red	Yellow
1996	Yellow	Green	Yellow	Green
1997	Yellow	Green	Red	Yellow
1998	Red	Red	Red	Red
1999	Yellow	Green	Yellow	Yellow
2000	Green	Green	Yellow	Yellow
2001	Yellow	Green	Yellow	Yellow
2002	Yellow	Green	Green	Green
2003	Red	Yellow	Green	Yellow
2004	Red	Green	Green	Yellow
2005	Green	Green	Yellow	Yellow
2006	Green	Green	Green	Green
2007	Green	Green	Green	Green
2008	Yellow	Green	Green	Yellow
2009	Yellow	Yellow	Green	Green
2010	Green	Green	Green	Green
2011	Red	Green	Yellow	Green
2012	Green	Green	Green	Green
2013	Green	Green	Green	Green
2014	Green	Green	Green	Green
2015	Yellow	Green	Yellow	Green
2016	Yellow	Green	Green	Green
2017	Yellow	Green	Green	Green
2018	Yellow	Green	Green	Green



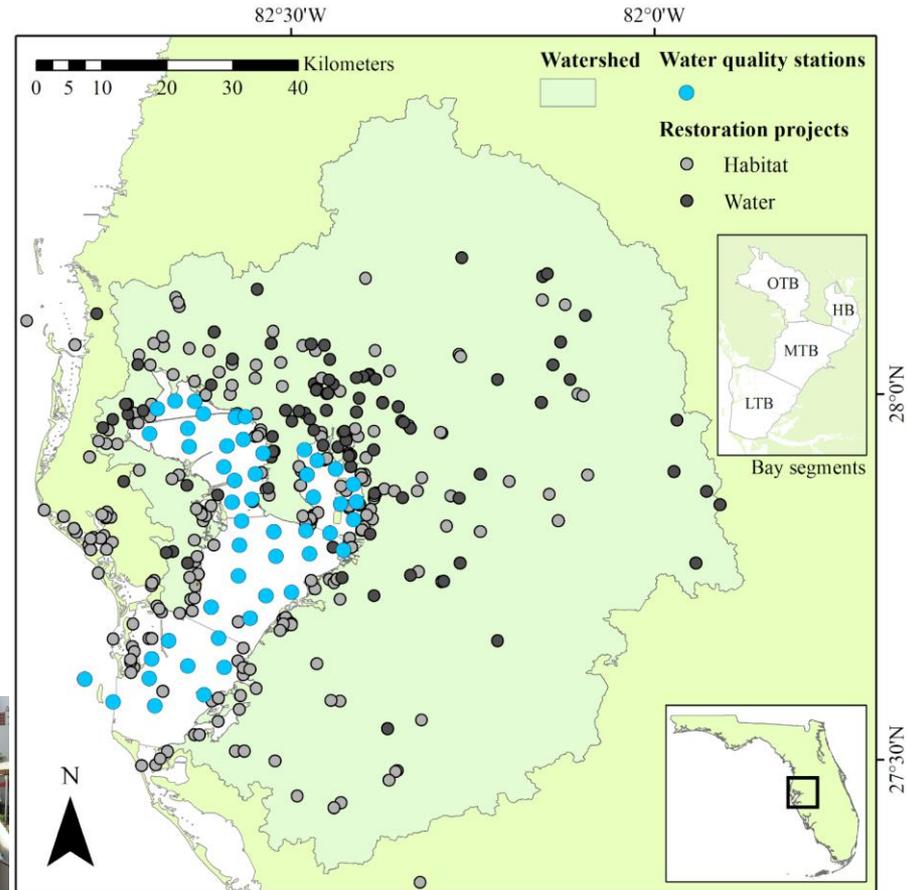
... & Seagrass Coverage Exceeds Goal & 1950's Estimates





Tampa Bay - Open Data Synthesis

- **Water quality** monitoring dataset:
 - 1974 to present
 - 515 monthly obs. per site
- **Restoration projects** dataset
 - Tampa Bay Water Atlas (1971-2007)
 - EPA NEP Mapper (2008-2017)
 - TBEP Action Plan Database Portal (1992-2016) Infrastructure Improvements



Beck et al., 2019, in prep



The National Academies of
SCIENCES
ENGINEERING
MEDICINE



GULF RESEARCH PROGRAM



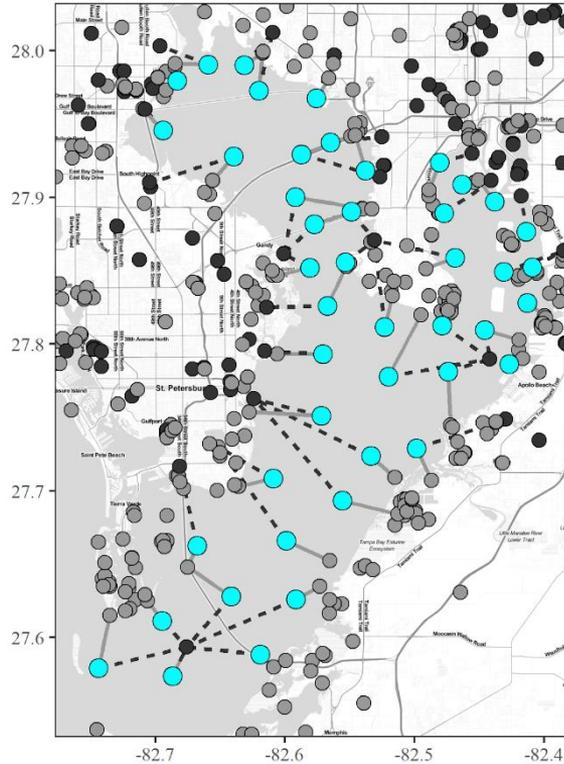


Link Water Quality & Restoration Activities

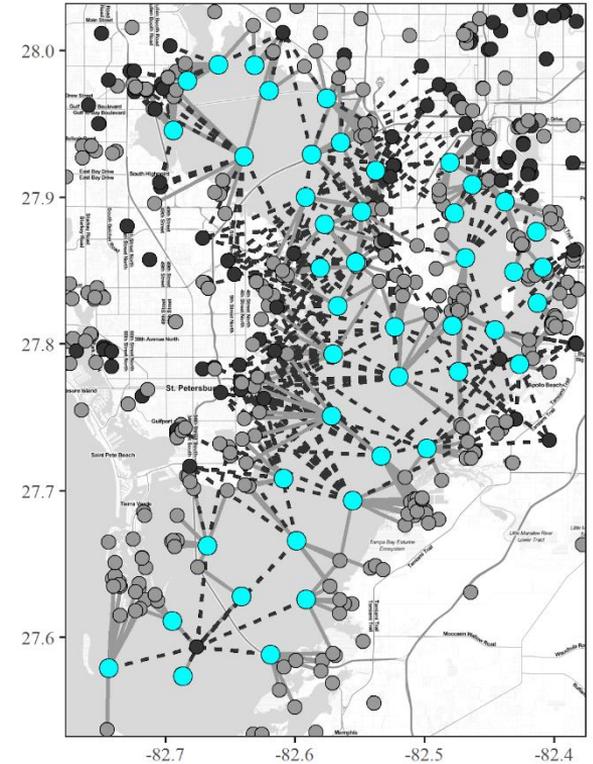
'Restoration projects' ● Habitat ● Water Infrastructure Water quality stations ●

Both
Spatially ...

Closest match by project type



Closest "n" matches

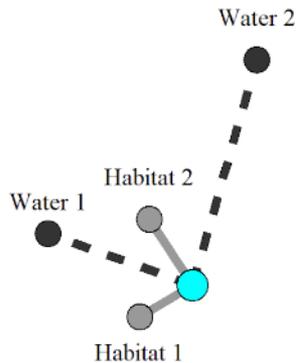




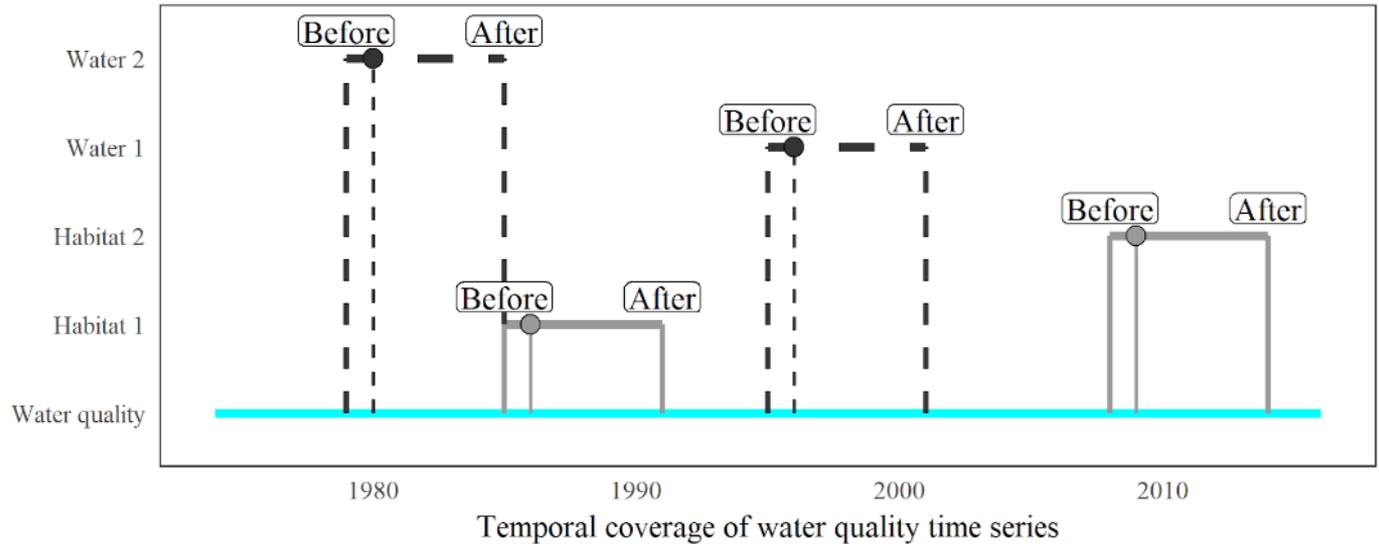
Link Water Quality & Restoration Activities

... & Temporally

(a) Spatial match

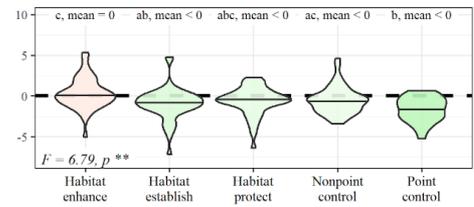
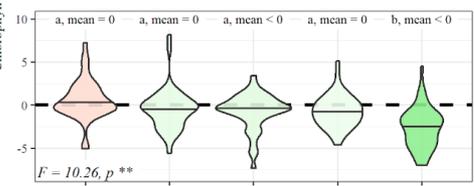
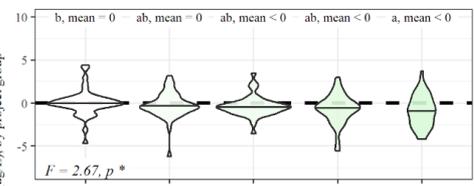
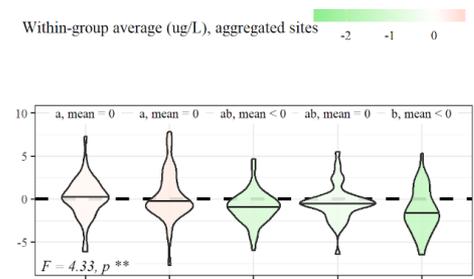
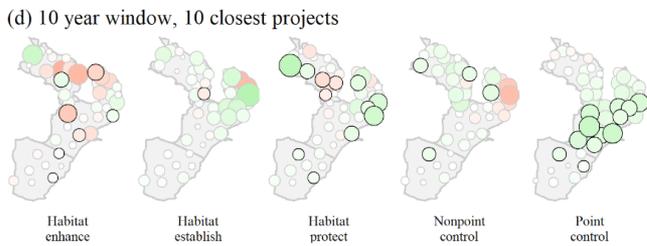
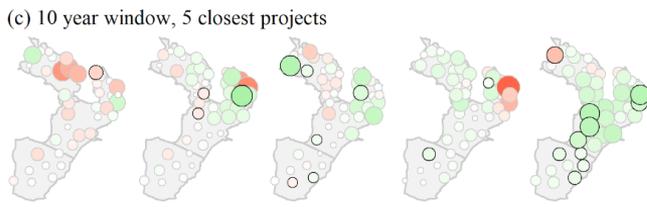
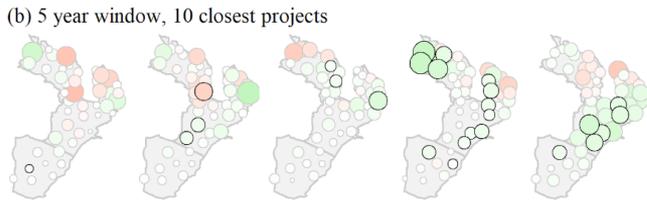
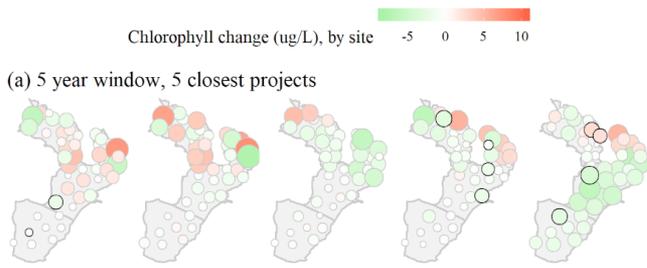


(b) Temporal match



Beck et al., 2019, *in prep*

Inform Future Baywide Management



Habitat enhance Habitat establish Habitat protect Nonpoint control Point control

Beck et al., 2019, in prep

- **Point and nonpoint source control projects** are more associated with overall chlorophyll-a improvements.
- **Habitat protection linked to chlorophyll reductions** regardless of assessment length and # of projects implemented.
- **Habitat protection and point source controls** observed water quality benefits in a **shorter time and with fewer projects.**



An Adaptable Decision Support Tool?

- Learn from historic changes in the estuary, and provide future context for water quality improvement expectations with further management interventions
- Flexible and simple approach that's highly adaptable to novel contexts:
 - Other estuaries with similar datasets
 - Spatial and temporal flexibility could accommodate different systems, parameters or management questions.
 - Open-Source and Reproducible:
 - <https://github.com/fawda123/restorebayes>
 - http://shiny.tbep.tech.org/restorebayes/ind_eval.Rmd



Studio®





THANK YOU!

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@ YouTube

youtube.com/user/TheTBEP

#**LOVE**
Tampa Bay

**Scoop
that
Poop!**
Pooches for the Planet

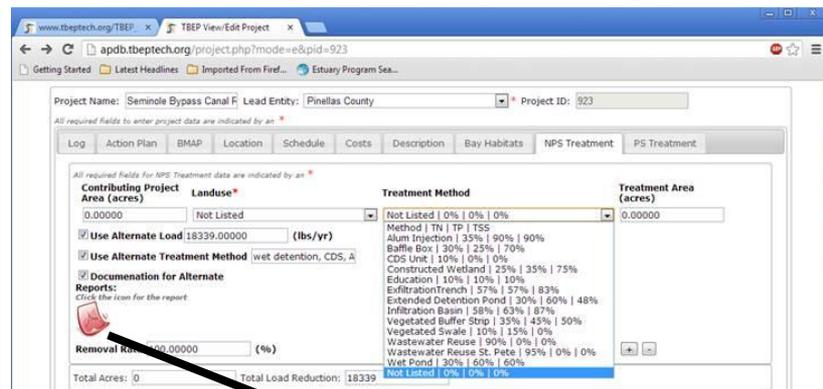
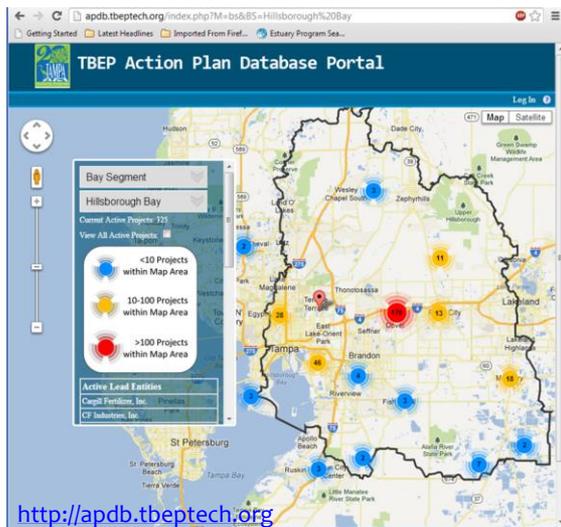
Be Floridian



PARTNERSHIP FOR A HEALTHY BAY



Partner-Driven Load Reduction Reporting



NEW ID#1 Seminole Bypass Canal Regional Stormwater Treatment Facility
 Lead Agency: Pinellas County
 Project summary: Diverted water from the Seminole Bypass Canal will be treated with alum to achieve a 90% reduction in TN, 35% reduction in TP, and 85% reduction in TSS.
 Subbasin location: 501 and 524
 Planned initiation: 10/2004
 Planned completion: 3/2007
 Drainage basin area (acres): 5120 acres

LAND USE	ACRES	%
RESIDENTIAL HIGH DENSITY	6536.2622	48.07%
COMMERCIAL AND SERVICES	1078.6667	7.44%
INDUSTRIAL	99.2264	0.84%
BAYS AND ESTUARIES	657.5327	5.01%
RECREATIONAL	877.2872	6.67%
LAKES	668.0181	4.61%
INSTITUTIONAL	578.0629	3.99%
OPEN LAND	662.7694	3.47%
TRANSPORTATION	415.7077	2.87%
RESIDENTIAL MED DENSITY 2-3 DWELLING UNIT	323.8621	2.23%
RESIDENTIAL	268.5369	2.11%
RESIDENTIAL LOW DENSITY + 2 DWELLING UNITS	268.5345	1.94%
PINE PLANTWOODS	235.9539	1.63%
HARDWOOD CONIFER MIXED	19.6533	1.32%
WETLAND FORESTED MIXED	178.4321	1.22%
UTILITIES	113.8842	0.79%
OTHER	585.3124	4.21%
TOTAL	14501.2407	100.00%

Treatment method (wet detention, CDS, etc): Alum
 Current load: 23,772 kg/yr (52,398 lbs)
 TN removal rate for alum injection: 35%
 Load reduction (lb/yr): 18,339 lb/yr
 Total estimated cost, if available: \$1,198,500
 Funding sources, if available: SWFWMD SWIM, FDEP 319(b), and Pinellas County

NEW ID#2 Alum treatment of five priority sub basins discharging to Lake Seminole
 Lead Agency: Pinellas County
 Project summary: Alum treatments of stormwater systems in Lake Seminole Subbasins 1.2,3,6 and 7.
 Subbasin location: 524
 Planned initiation: 10/2004
 Planned completion: Phase I: 3/2007; Phase II: 12/2009
 Drainage basin area (acres): 7,512

- Partners can enter either NPS or PS load reductions
- Default calculations and BMP efficiencies used based on land use, subbasin, and treatment method
- User-defined efficiencies & reductions can also be entered
- TBEP collates and reports to FDEP/EPA on a 5-yr basis by major bay segment
- 1992-2017: 470+ Projects, 530 Tons TN Prevented from entering TB**
 - >\$2.5 Billion Invested in Restoration & Infrastructure Improvements**
- [Guidelines for Calculating Nitrogen Load Reduction Credits. 1997. Technical Report #02-97 of the Tampa Bay National Estuary Program. Prepared by Coastal Environmental \(H.W. Zarbock and A.J. Janicki\).](#)

Facilitation of the TB Nitrogen Management Consortium

As part of the Tampa Bay Nitrogen Management Consortium, partners have implemented more than **470 projects** resulting in **530 tons** of nitrogen precluded from entering Tampa Bay since 1992.

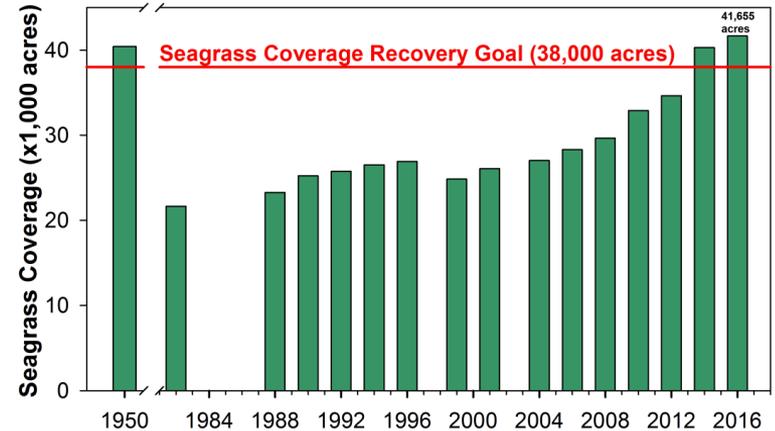


Coastal Stewardship Award for Stewardship (Organization)



Tampa Bay Nitrogen Management Consortium of Tampa Bay NEP
Tampa Bay Estuary Program

COASTAL & ESTUARINE
RESEARCH FEDERATION®



Tampa Bay now supports 41,685 acres of seagrass.

Exceeding goal & historic 1950's levels!



CHARTING THE COURSE:

THE COMPREHENSIVE
CONSERVATION
AND MANAGEMENT PLAN
FOR TAMPA BAY
2017 UPDATE



<https://indd.adobe.com/view/cf7b3c48-d2b2-4713-921c-c2a0d4466632>

TBEP CCMP Details

WATER AND
SEDIMENT
QUALITY



BAY
HABITATS



FISH AND
WILDLIFE



DREDGING
AND DREDGE
MATERIAL
MANAGEMENT



SPILL
PREVENTION
AND RESPONSE



INVASIVE
SPECIES



PUBLIC
EDUCATION AND
INVOLVEMENT



PUBLIC
ACCESS



CLIMATE
CHANGE



LOCAL
IMPLEMENTATION



39 Separate Actions; 166 Specific Activities