



Watershed Management Plan

August 4, 2010



Project Objectives

- Develop watershed management plans that will help protect estuaries and wetland systems to
 - Restore historical water quantity and estuarine discharges
 - Improve water quality within the watersheds and estuaries
 - Address flood control and water supply issues
- Project will be completed in December 2010.

Project Specific Tasks

- Update the BCB hydrologic/hydraulic computer model
- Evaluate watershed and estuarine existing conditions
 - Water quantity
 - Water quality
 - Natural resources
- Define performance measures
- Evaluate alternatives and identify recommended improvement projects
- Prepare Watershed Management Plans

Project Team Organization

Collier County

**Project Manager – Moris Cabezas, Ph.D., P.E. –
PBS&J**

Principal-in-charge

QA/QC

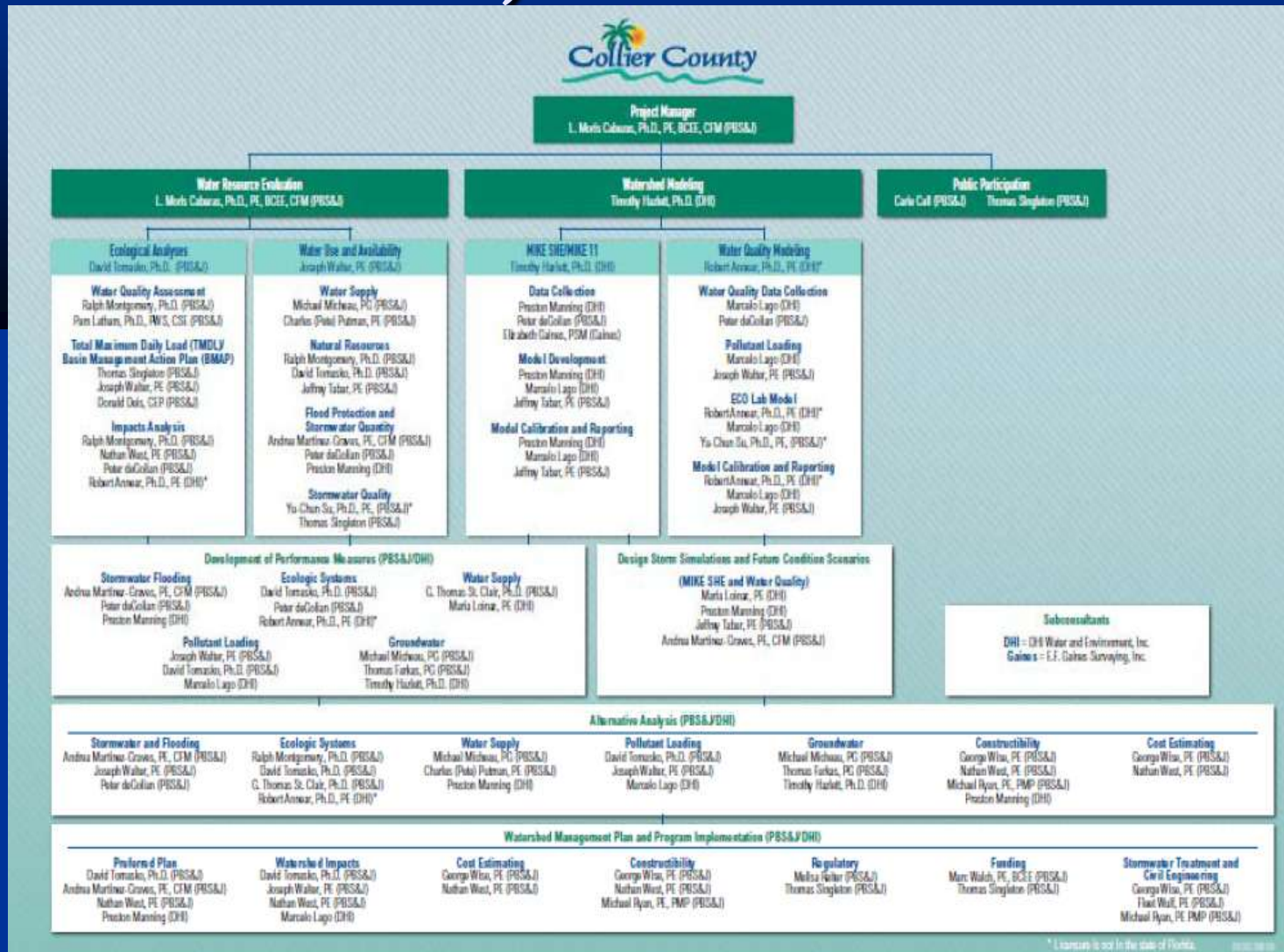
Watershed Modeling
Tim Hazlett, Ph.D. - DHI
Preston Manning – DHI
Peter deGolian – PBS&J

Water Resource Evaluation
Dave Tomasko, Ph.D. – PBS&J
Peter deGolian – PBS&J
Eric Fontenot, P.E. - DHI

**Natural Systems
Evaluation**
Ed Cronyn – PBS&J
Dave Tomasko, Ph.D. – PBS&J

Other Support Services

Project Team



* Licensure is not in the state of Florida.

Watersheds

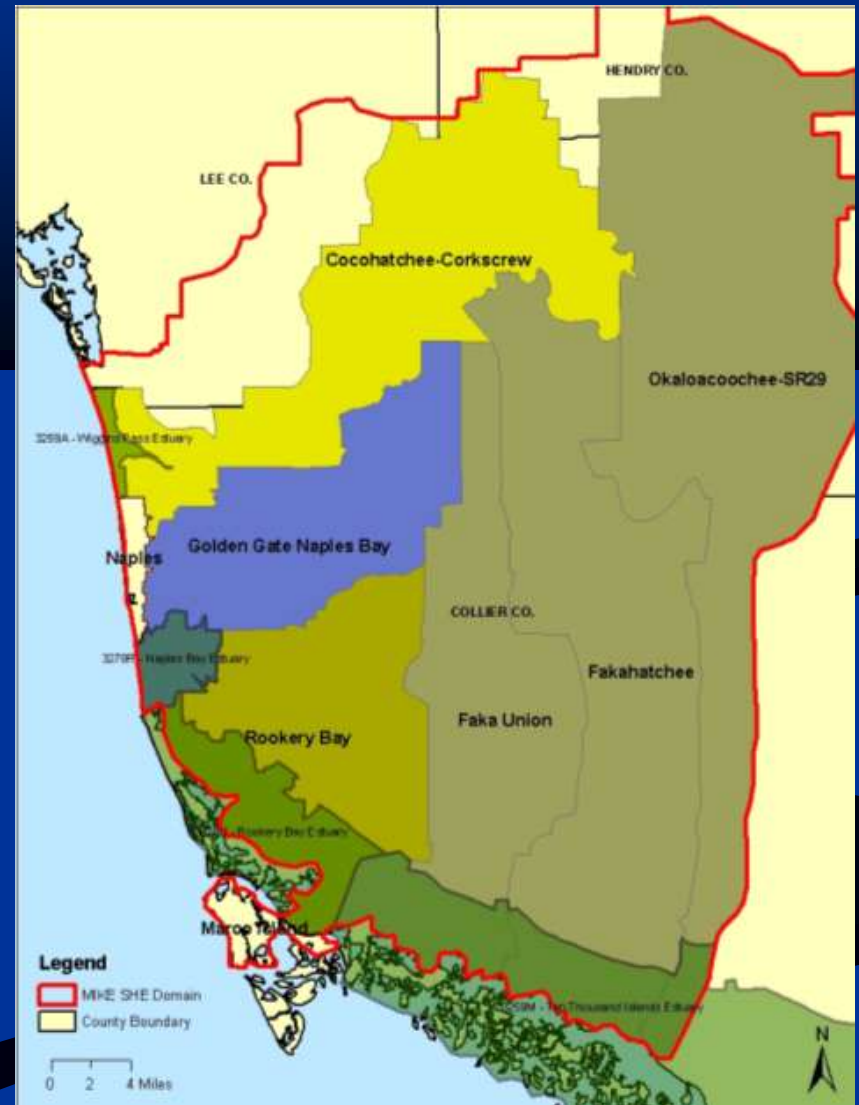
■ Top Priority Watersheds

- Cocohatchee Corkscrew
- Golden Gate
- Rookery Bay

■ Additional Watersheds

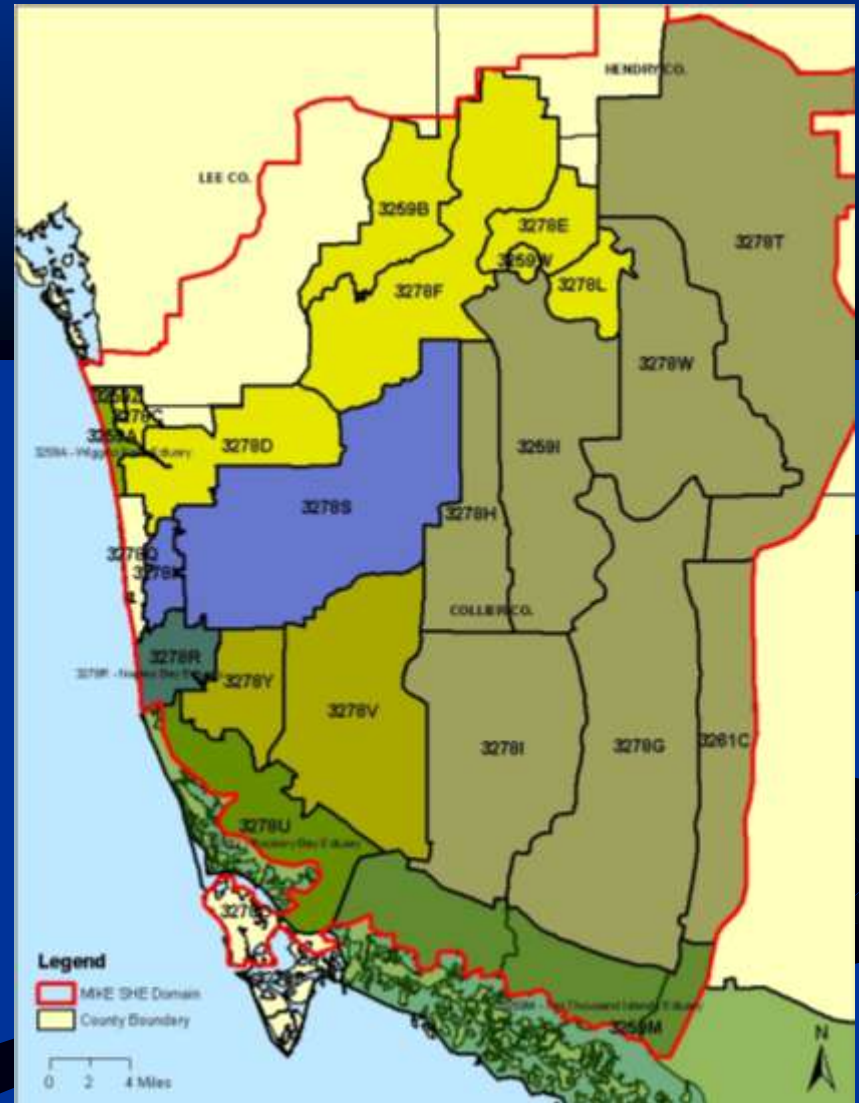
- Faka Union
- Fakahatchee
- Okaloacoochee SR 29

■ Estuaries



Water Body IDs (WBIDs)

- FDEP Run 40
- Coastal WBIDs clipped to match model extent
- WBID 3259M subdivided by watershed



Agenda

- Water Quantity Analysis
 - Existing conditions model update
 - Assessment of watershed H&H conditions and discharge to estuaries
- Water Quality Analysis
 - Stream impairment
 - Estuarine water quality
- Natural Systems Evaluation
 - Functional watershed assessment
 - Coastal habitats assessment
- Next Steps

Water Quantity Analysis

- Objective
 - Assess the deficit or surplus of freshwater discharges to each estuarine system from the contributing watersheds

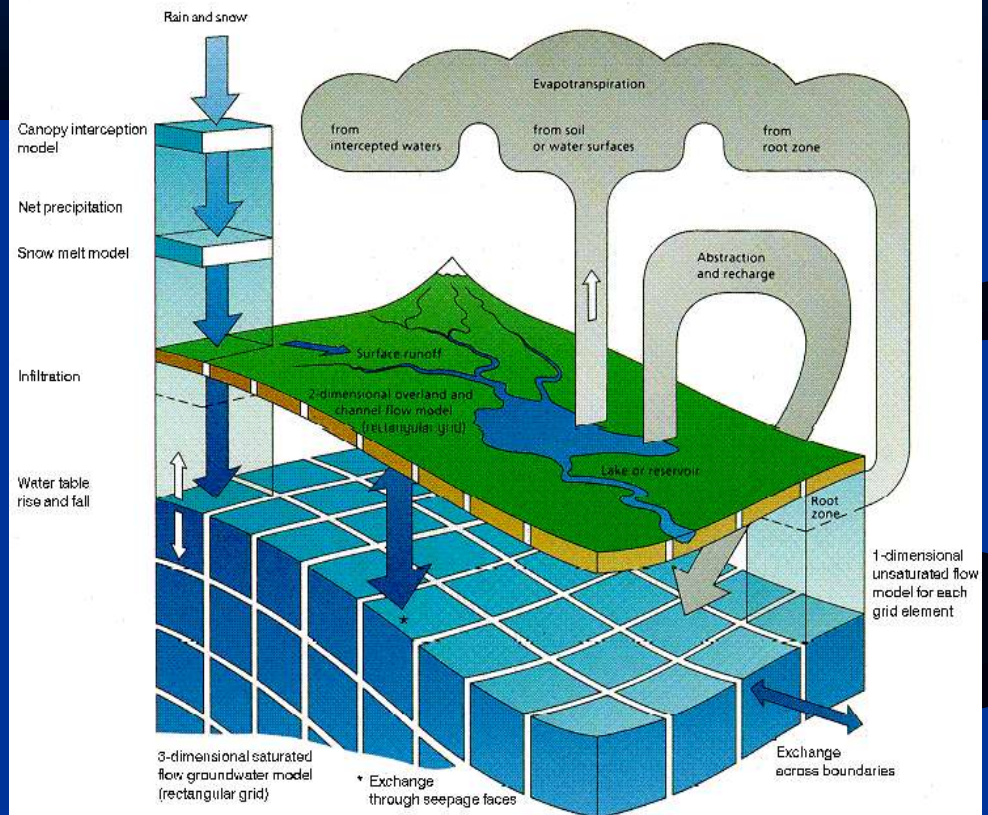


Existing Conditions Model

- Integrated surface water and groundwater model
- Simulation period is 2002 – 2007

MIKE SHE

an Integrated Hydrological Modelling System



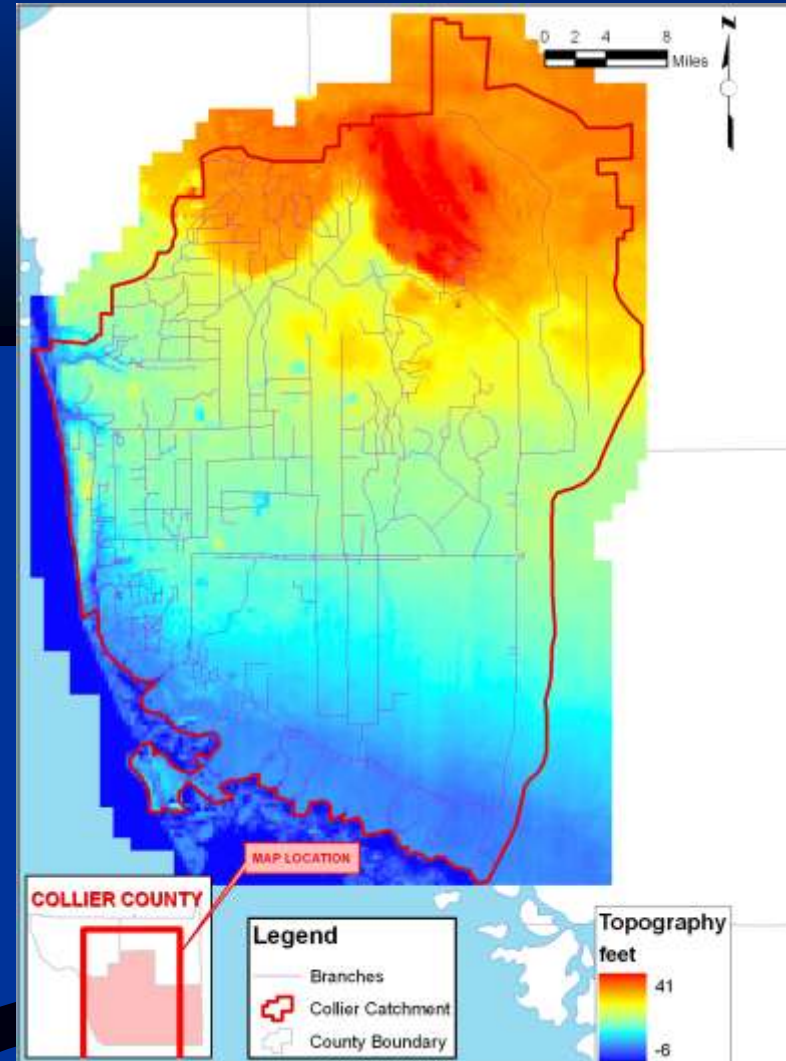
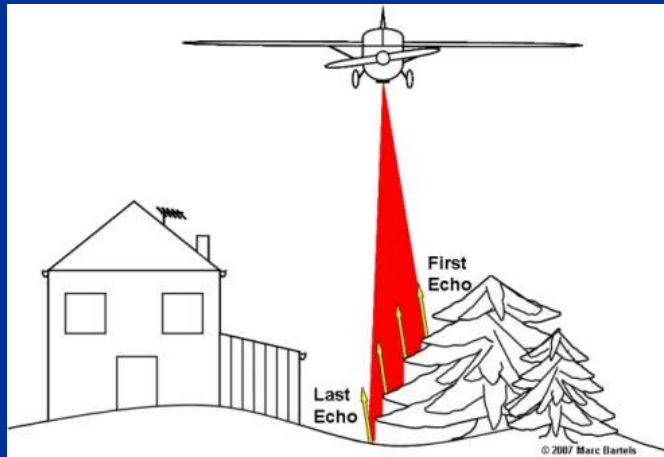
Computer Model Grid

- Consistent with previous Big Cypress Basin models
- Model area is 1400 square miles
- Grid size is 1500 feet



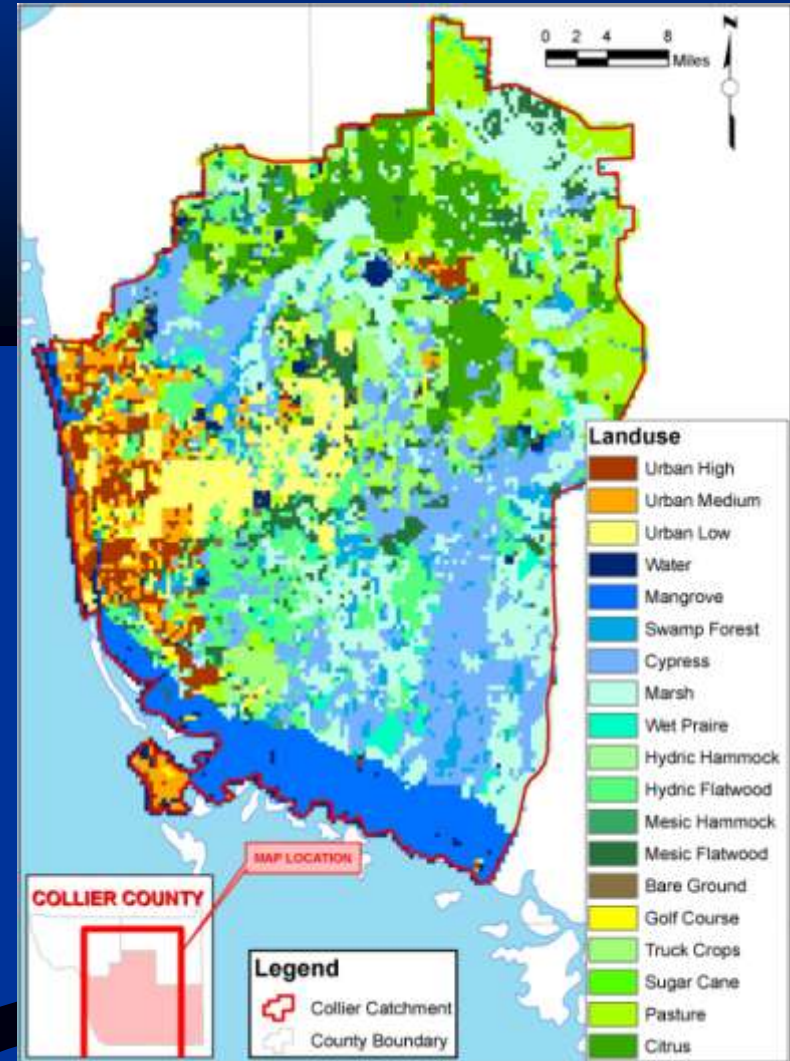
Topography

- LiDAR generated
- 5-ft digital elevation model (DEM)
- Elevation averaged over grid cell



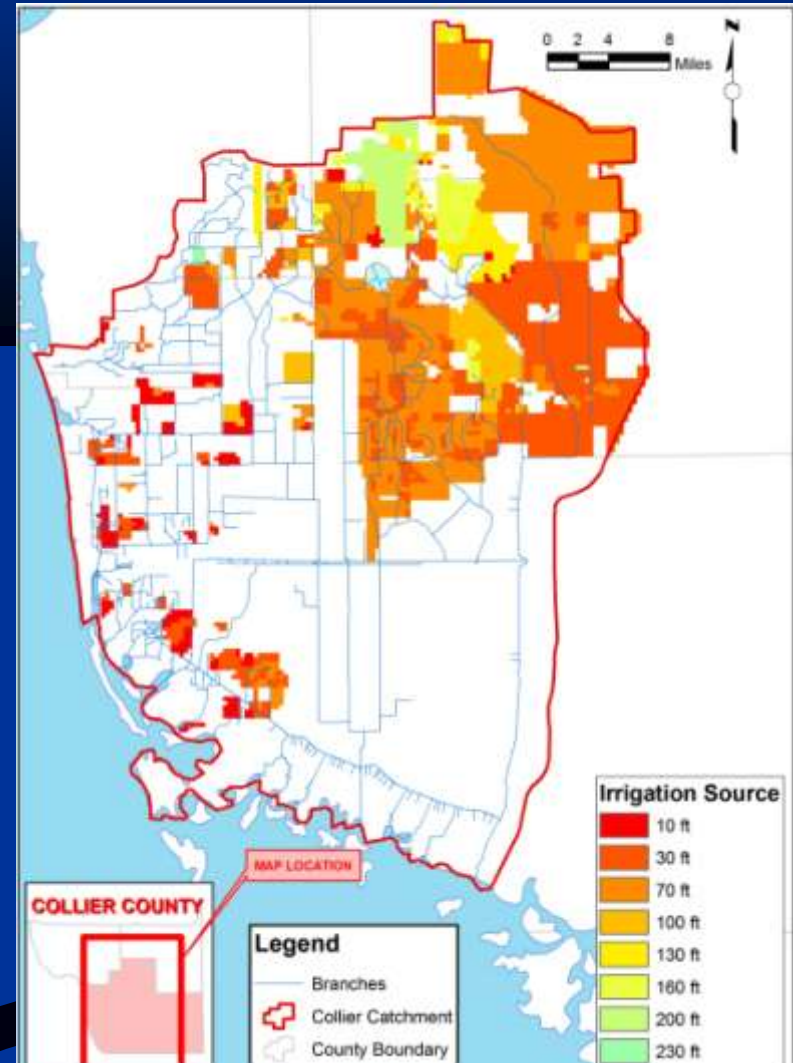
Land Use

- Land use categories developed from FLUCCS classifications
- Hydrologic parameters are assigned based on land use categories



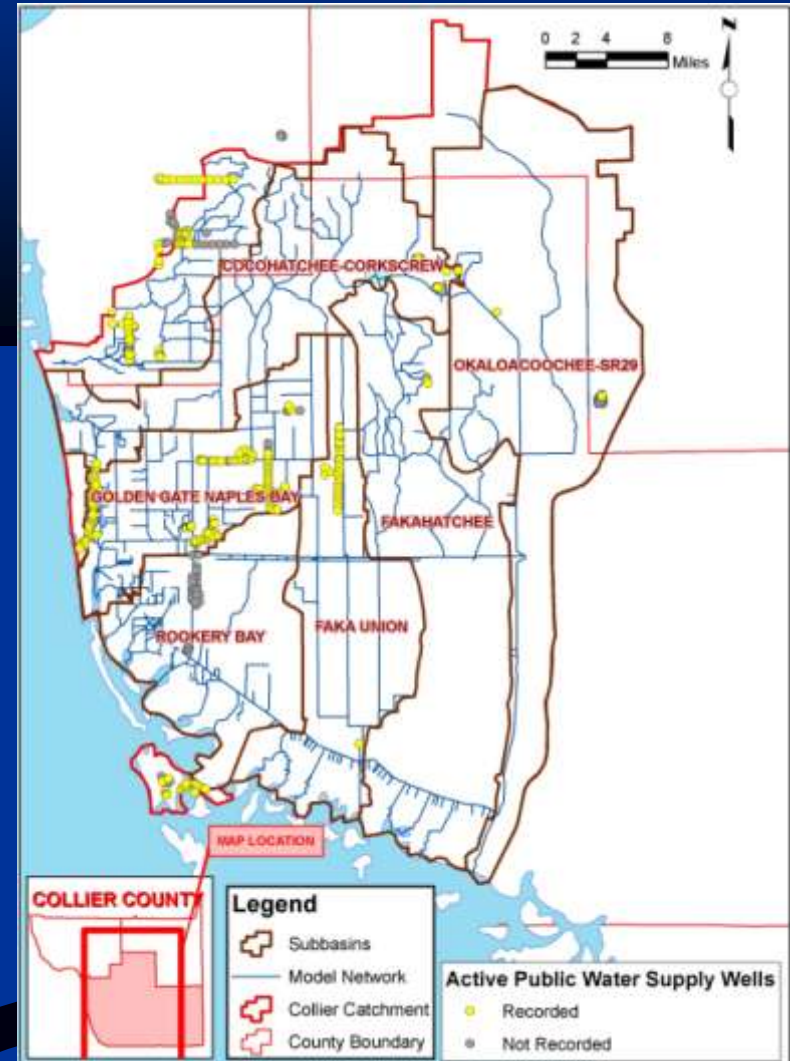
Irrigation

- Irrigation volume is determined by soil moisture
- Application rate and source defined by water use permits



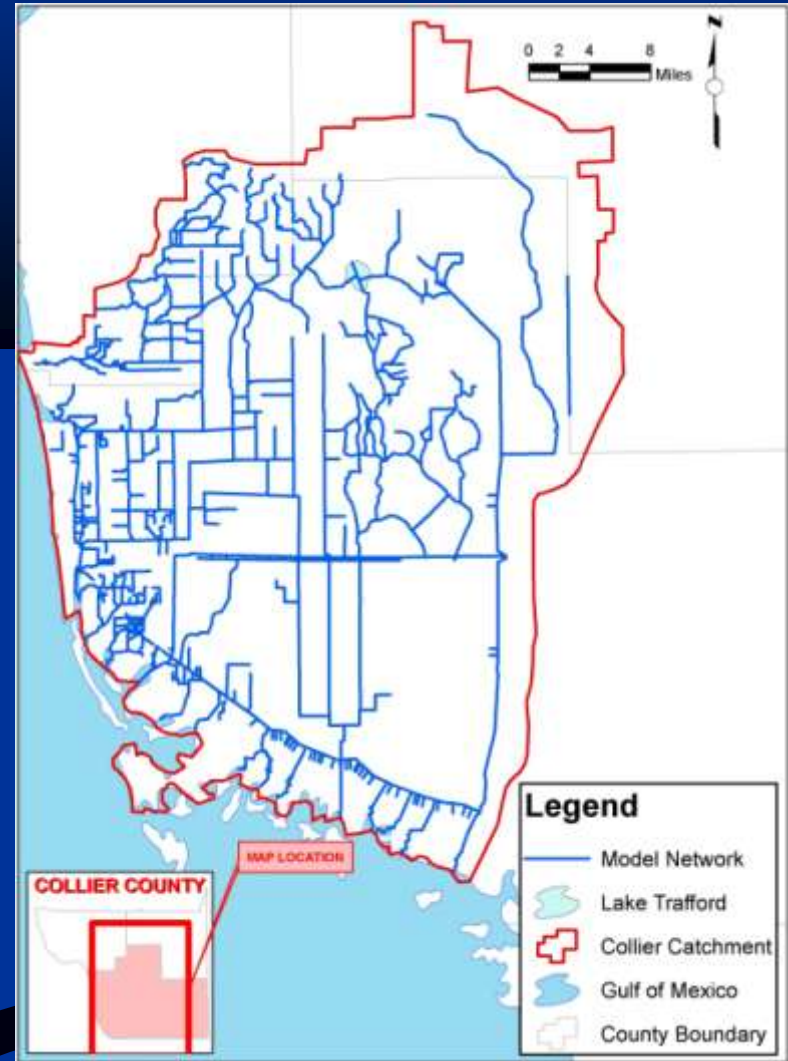
Water Supply Wells

- Primary users
 - City of Naples
 - Collier County
 - Marco Island
- Timing and volume is determined by withdrawal information provided by SFWMD



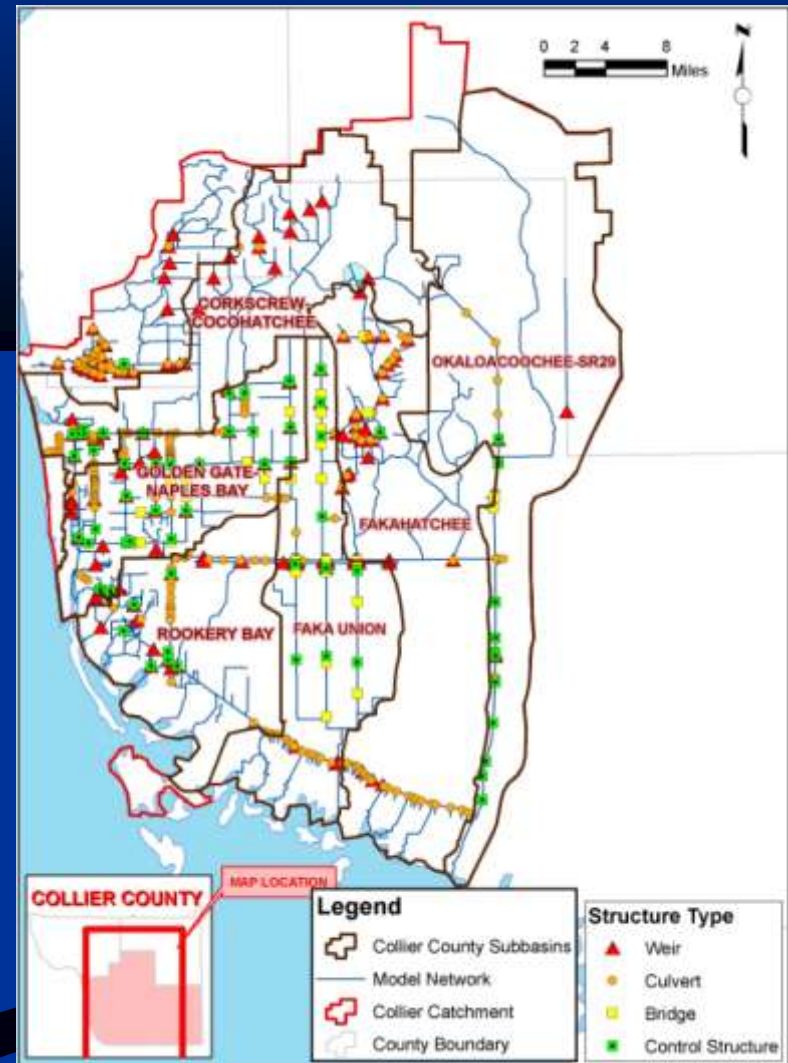
Canal and Stream Network

- 825 miles of rivers, streams and canals
- Primary drainage network managed by BCB
- Collier County secondary canals
- Imperial River drainage



Control Structures

- Flow and water levels are controlled to maintain desired in-stream conditions
- Structures include weirs, culverts, bridges and gates



Control Structures Operations

■ Cocohatchee Canal Structure 1

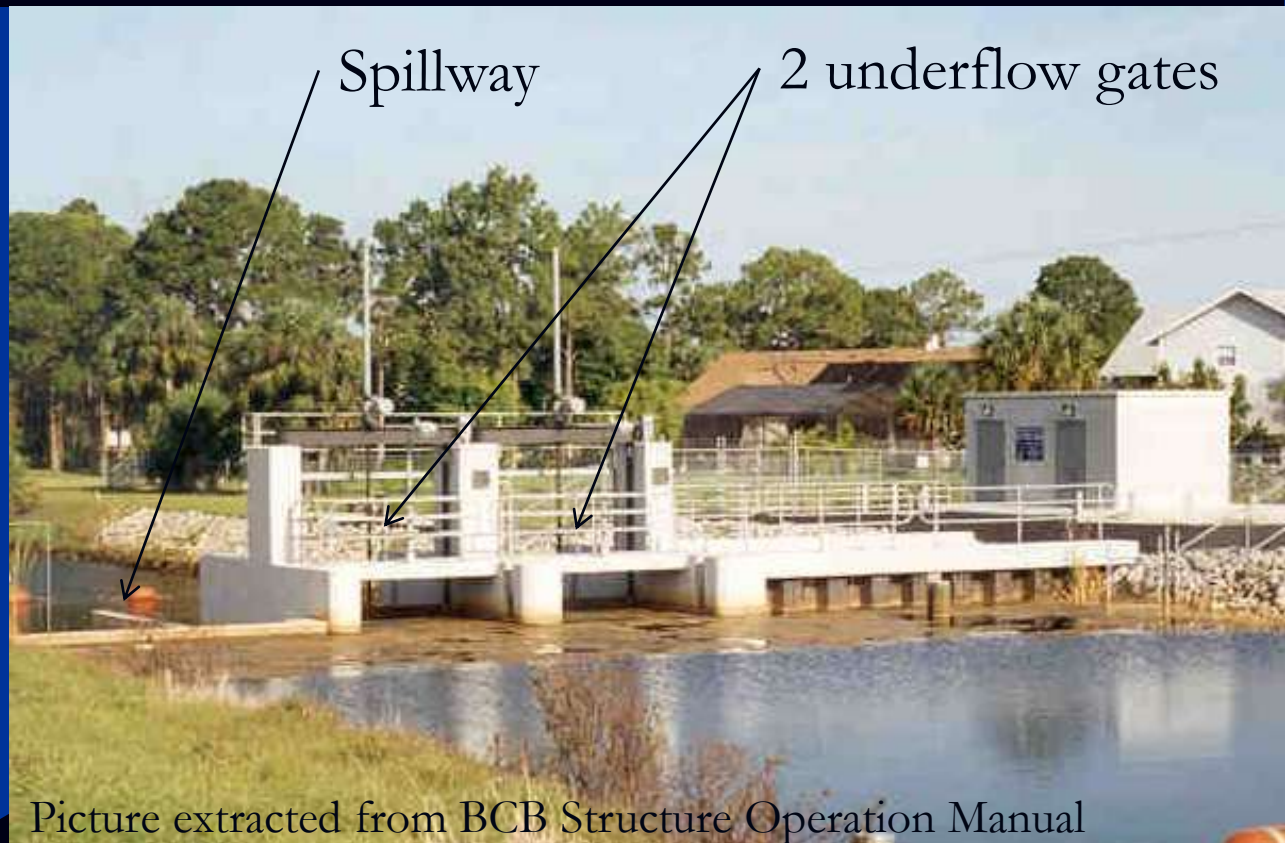
Rules:

Dry season- Head water elevation desired at \approx 4.8 feet NAVD.

Above 5.5 feet, gates open.
Below 4.0 feet, gates close.

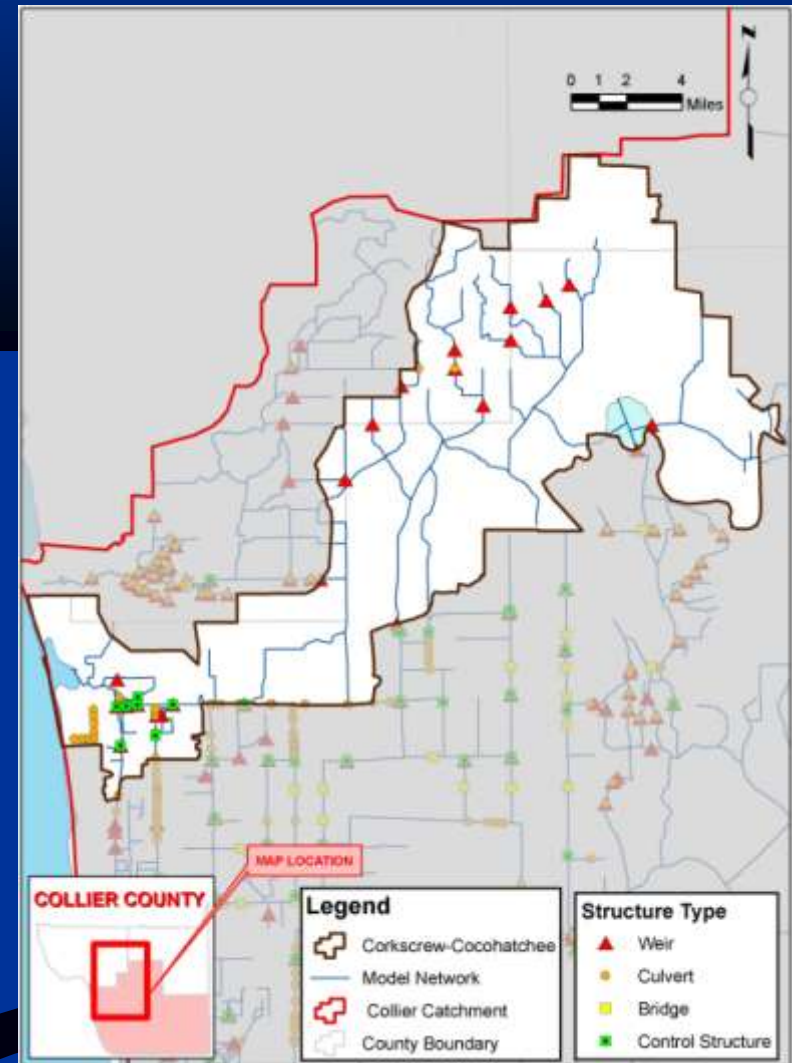
Wet season- Head water elevation desired at \approx 4.3 feet NAVD.

Above 5.5 feet, gates open.
Below 2.8 feet, gates close.



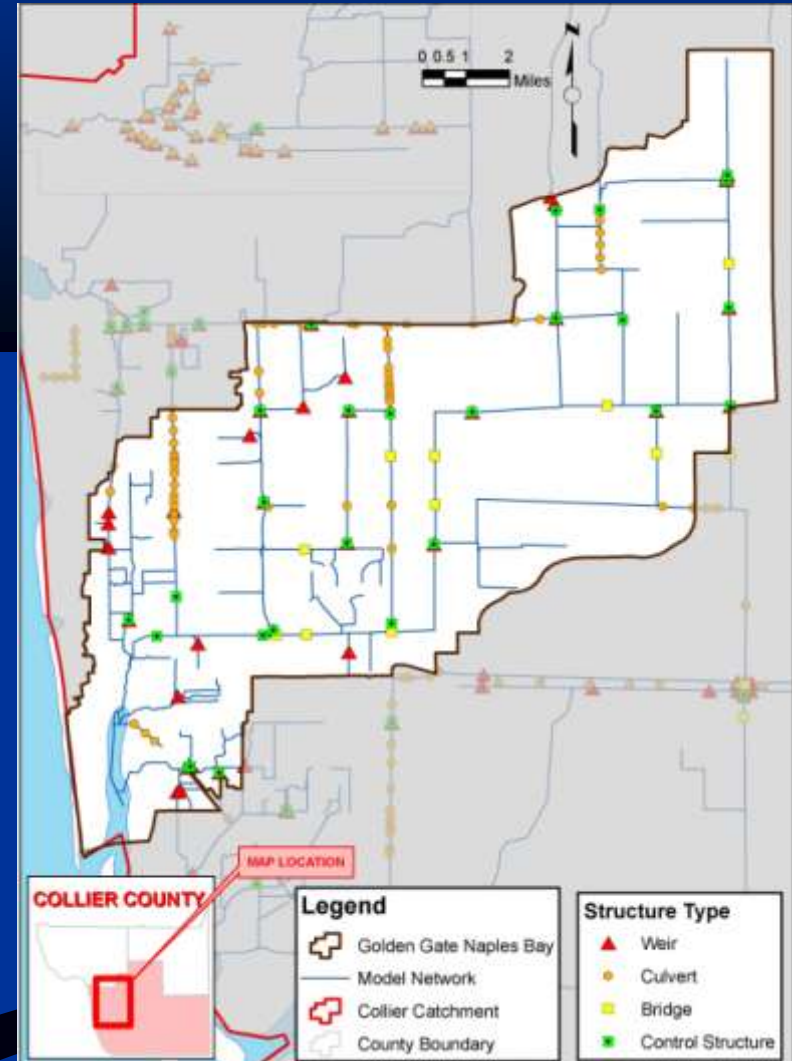
Cocohatchee Corkscrew

- Primarily natural areas in the upper basin
- Water transfers with Golden Gate and Imperial River watersheds



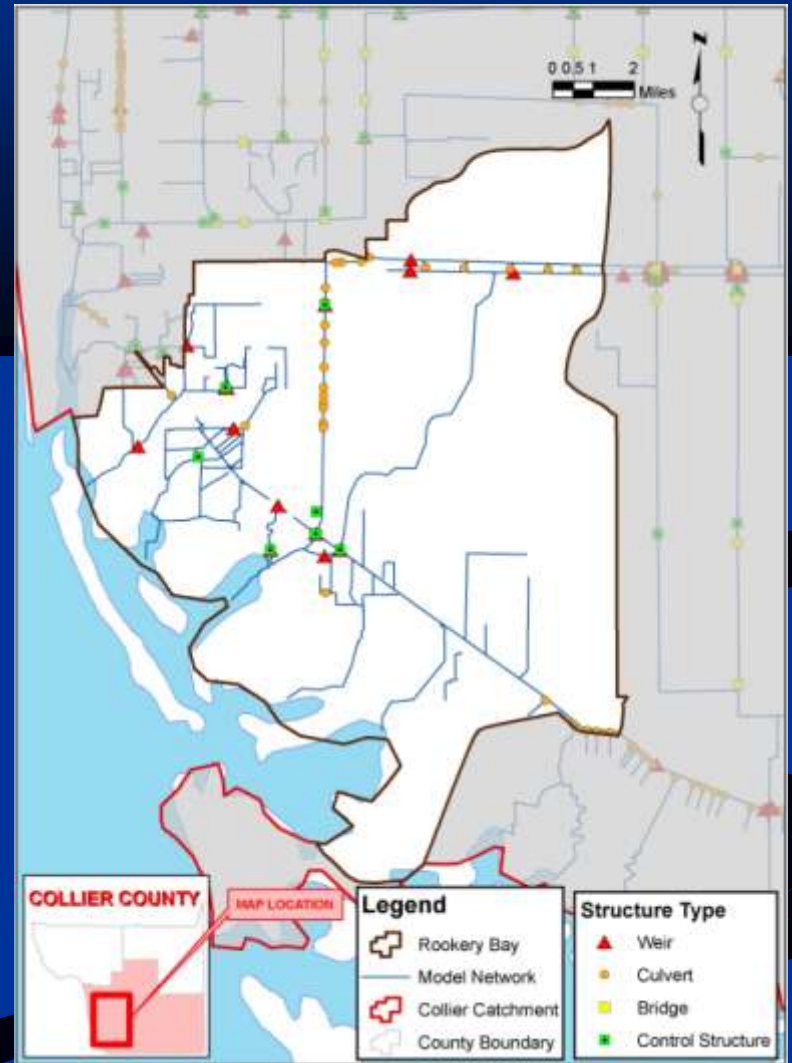
Golden Gate

- Mainly Urban Land Uses
- Discharges to Naples Bay
- Drainage pattern changed due to development



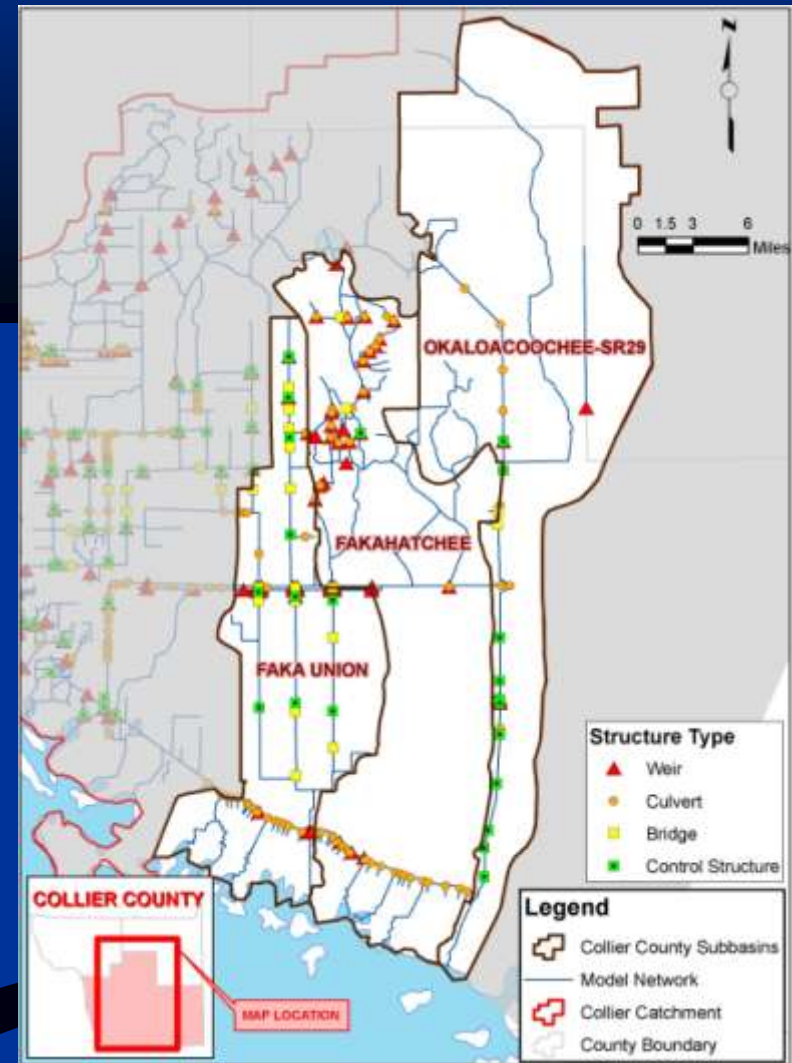
Rookery Bay

- Includes natural areas, agricultural lands, and urban development
- Overland flow and channel flow



FakaUnion, Fakahatchee, Okaloacoochee – SR29

- Primary drainage features:
 - Miller Canal
 - FakaUnion Canal
 - Merritt Canal
 - SR 29 Canal
- Picayune Strand Restoration Project

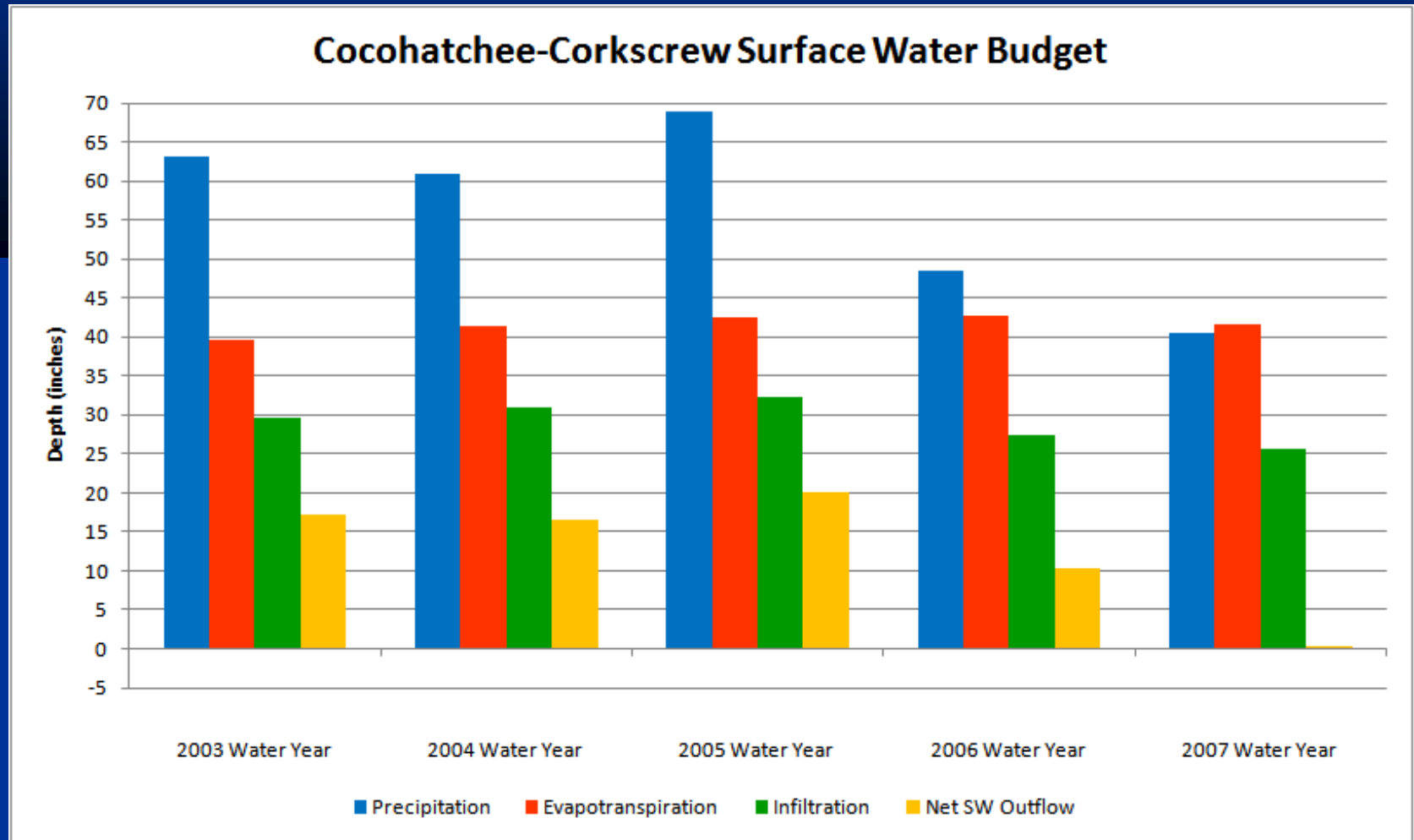


Surface Water Budget

- Prepared for each watershed
- Budget Components
 - Precipitation/ET
 - Infiltration
 - Surface Runoff
- Prepared for water year and wet and dry seasons



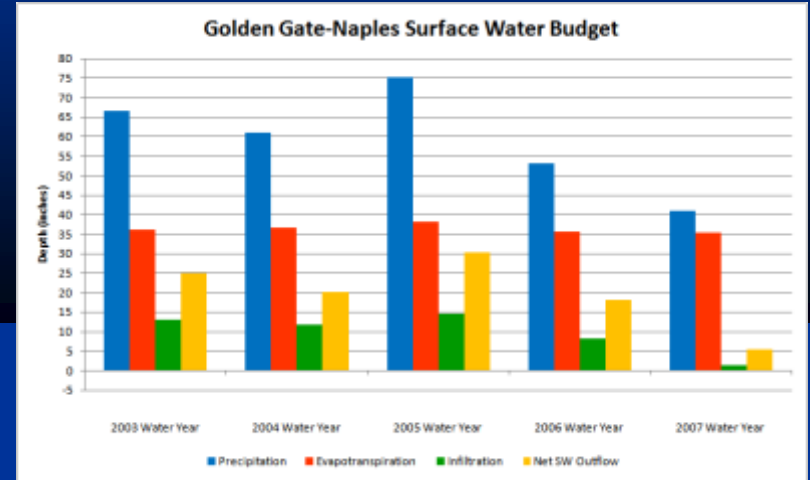
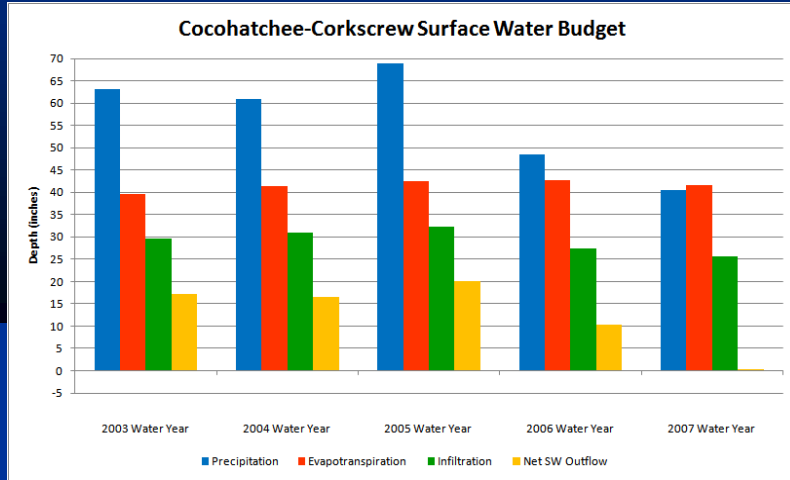
Surface Water Budget



Surface Water Budget

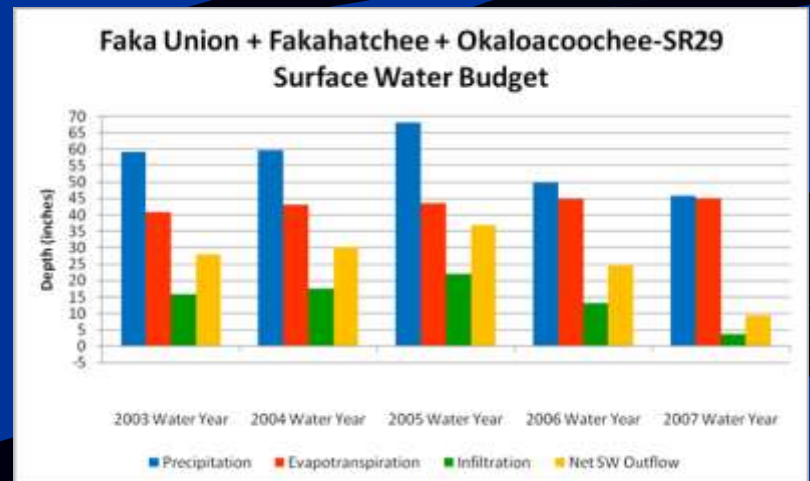
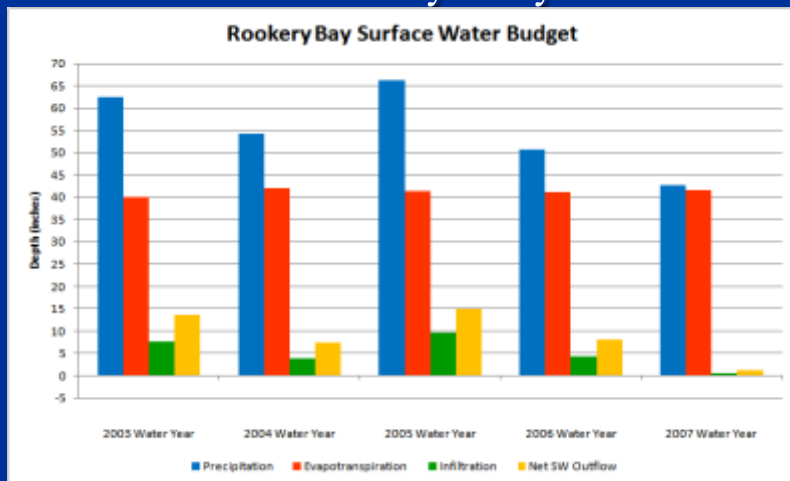
Cocohatchee – Corkscrew

Golden Gate



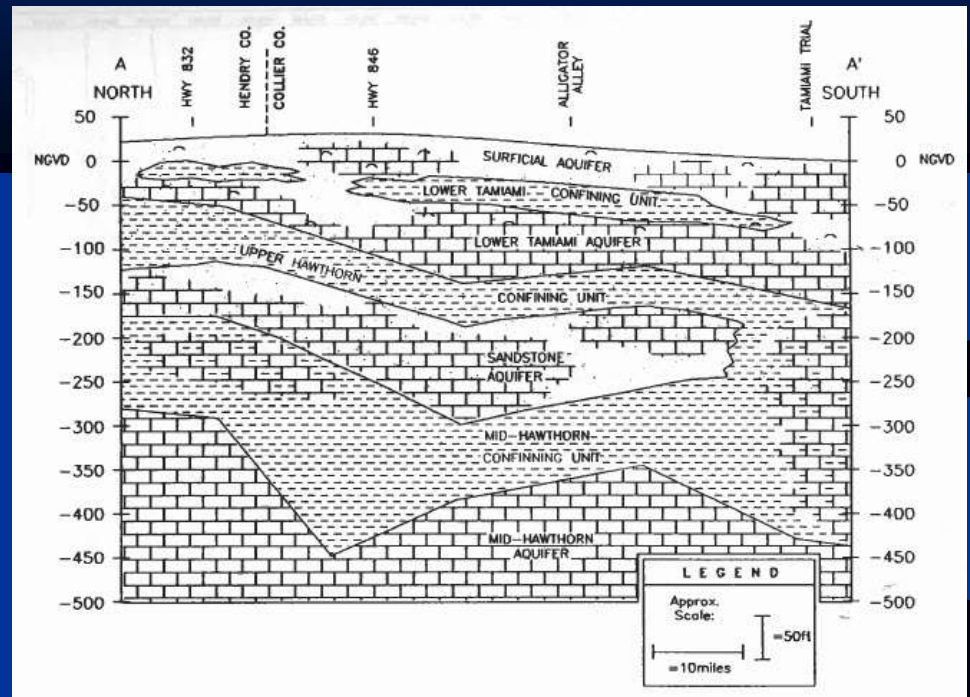
Rookery Bay

Additional Basins

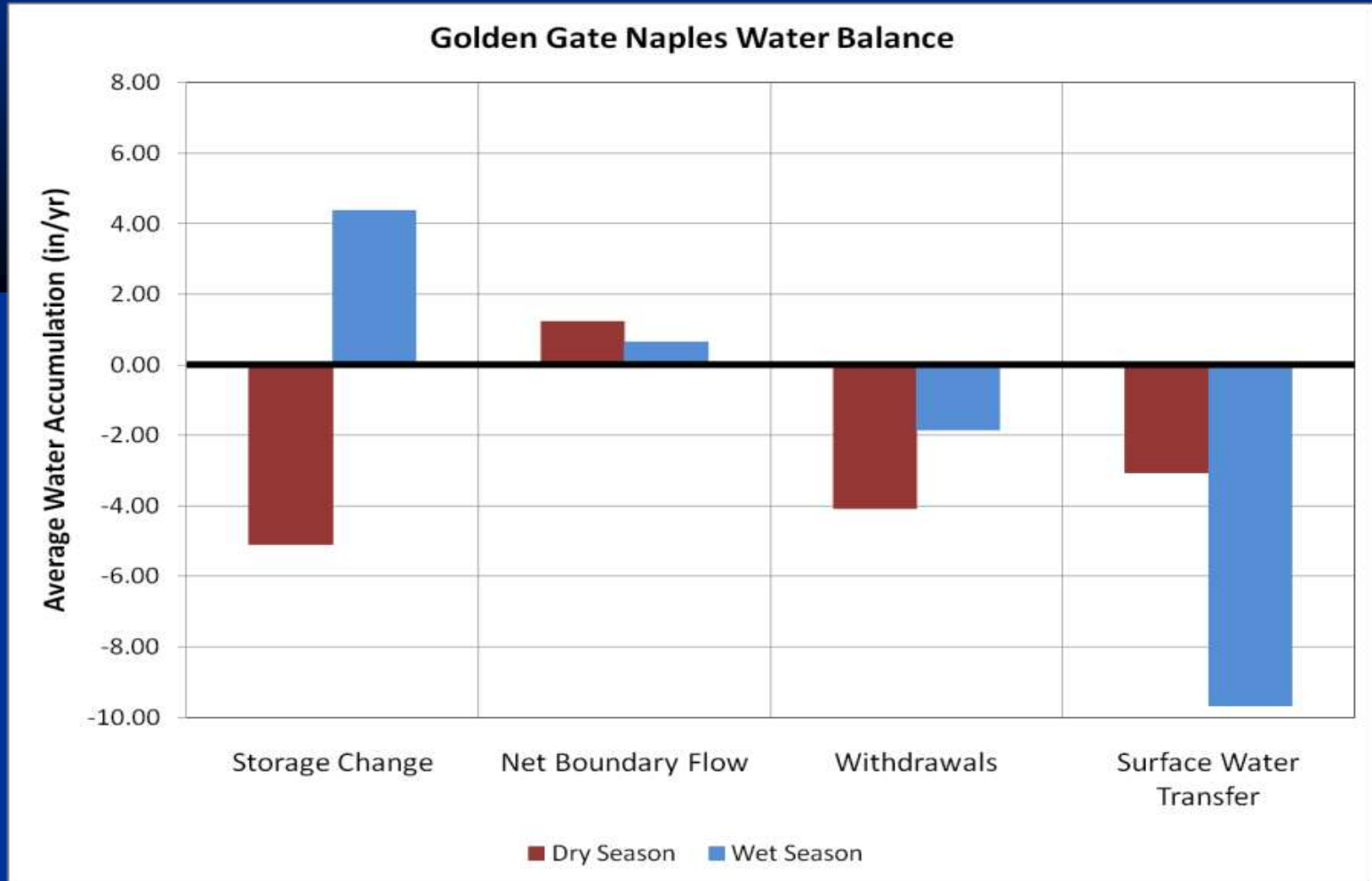


Groundwater Budget

- Budget Components
 - Flows across watershed boundaries
 - Withdrawals
 - Change in storage
 - Surface water interaction
- Average for wet and dry seasons



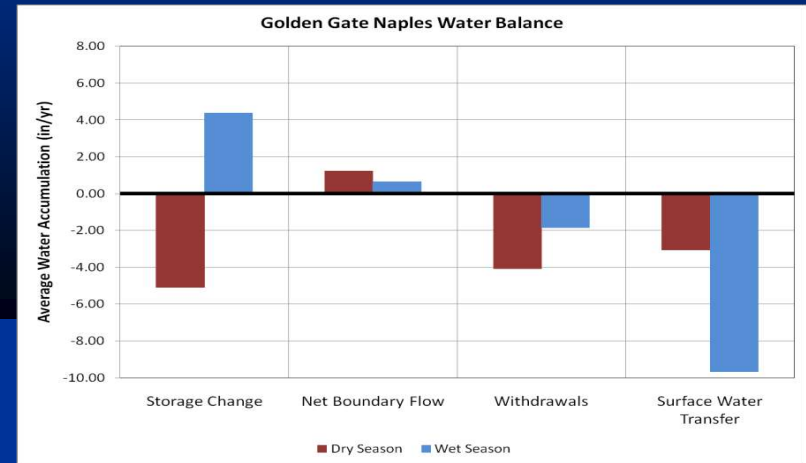
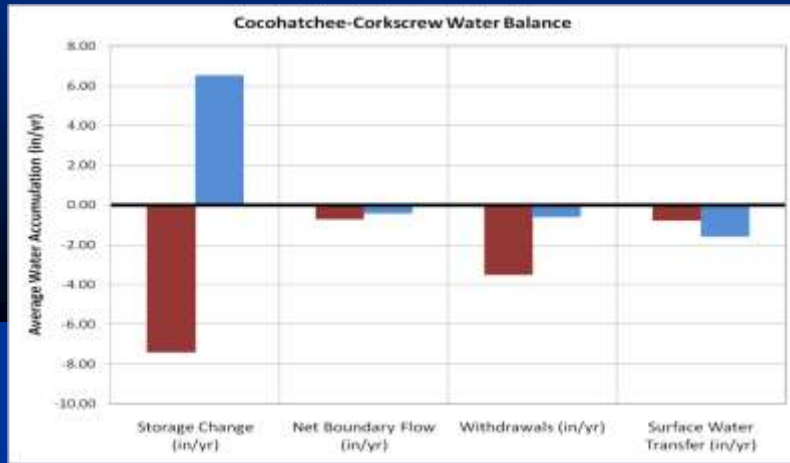
Groundwater Budget



Groundwater Budget

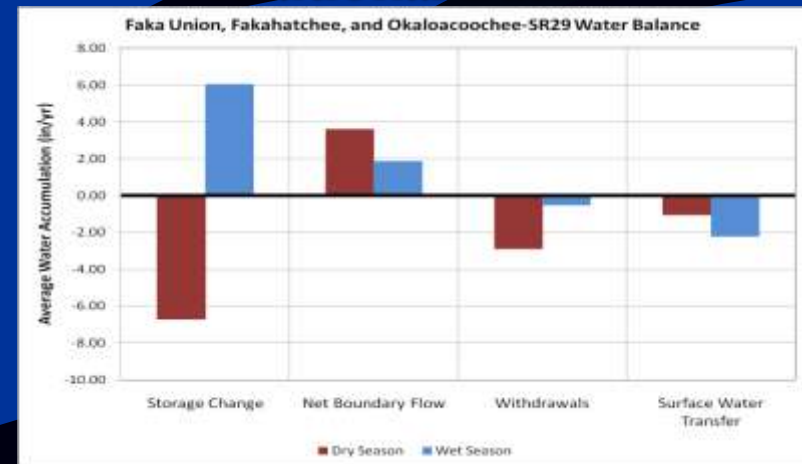
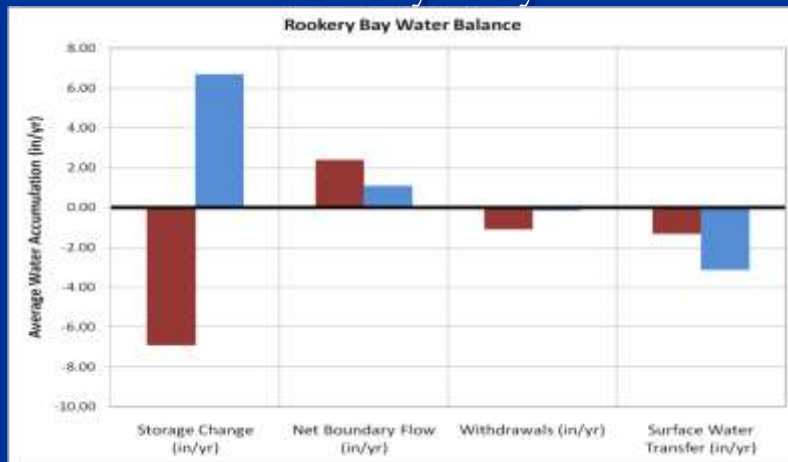
Cocohatchee – Corkscrew

Golden Gate

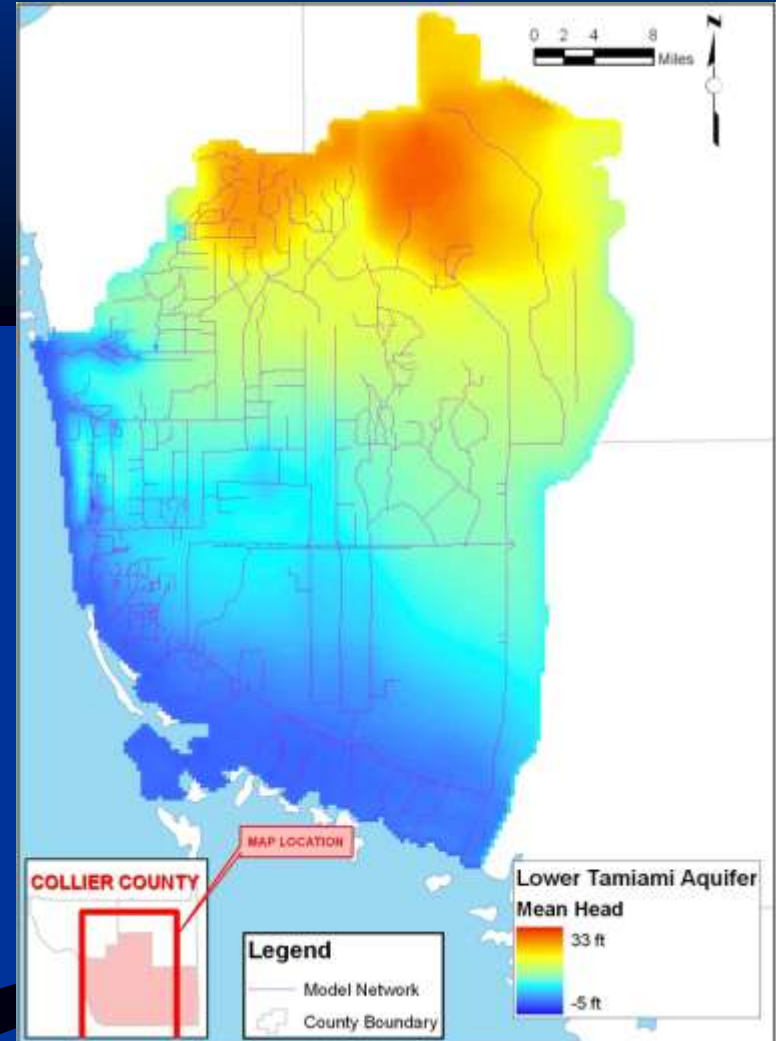
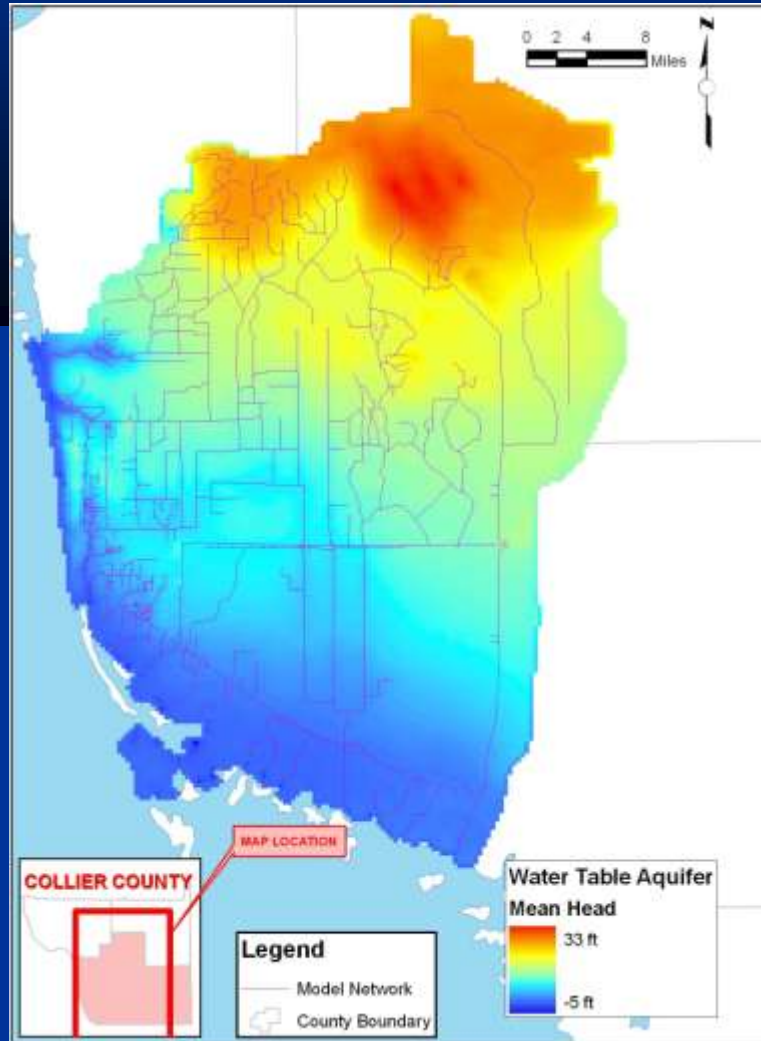


Rookery Bay

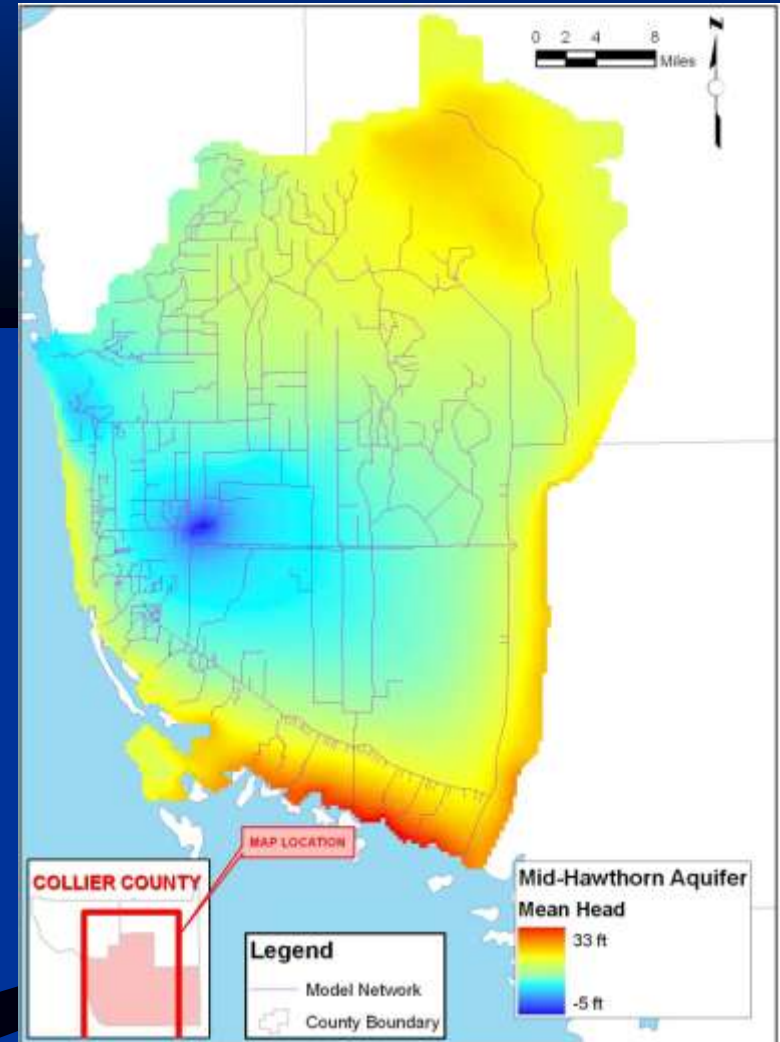
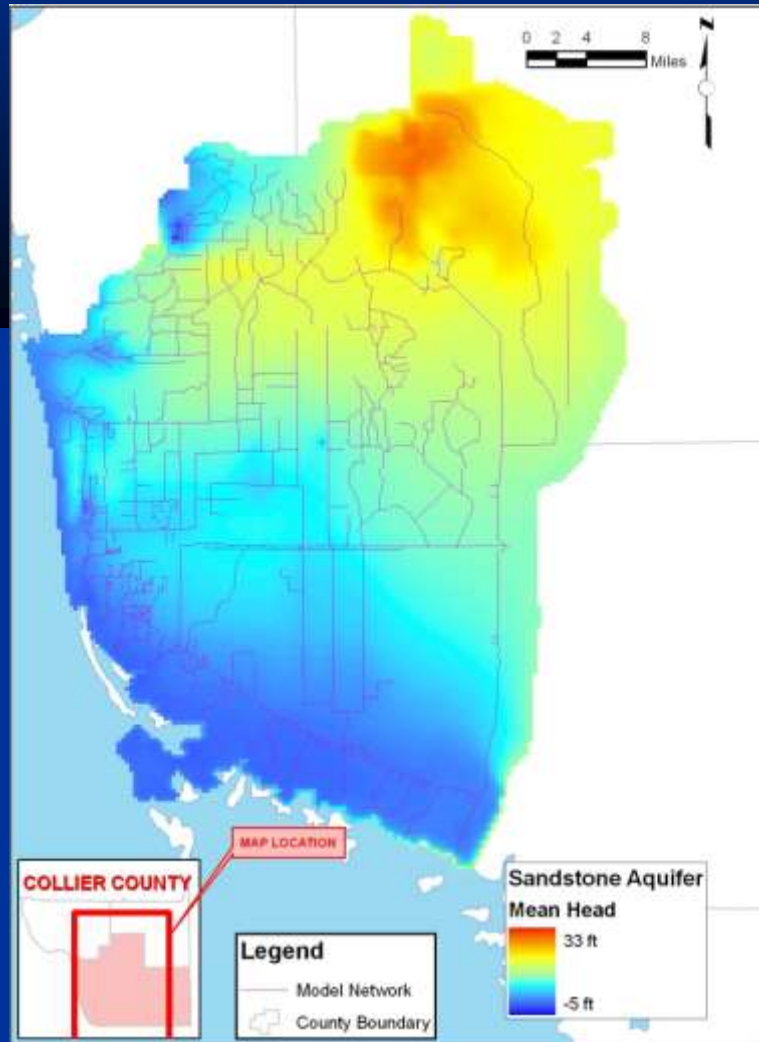
Additional Basins



Surficial and Lower Tamiami Aquifers Head Elevation



Sandstone and Mid-Hawthorn Aquifers Head Elevation



Comparison of Estuarine Flow Calculation Methods

- Objective is to define the flow deficit or surplus for each estuary
- ECM versus NSM
 - Existing Conditions Model Results
 - Pre-development (Natural Systems) Model Results
- Salinity Based Flow Analysis

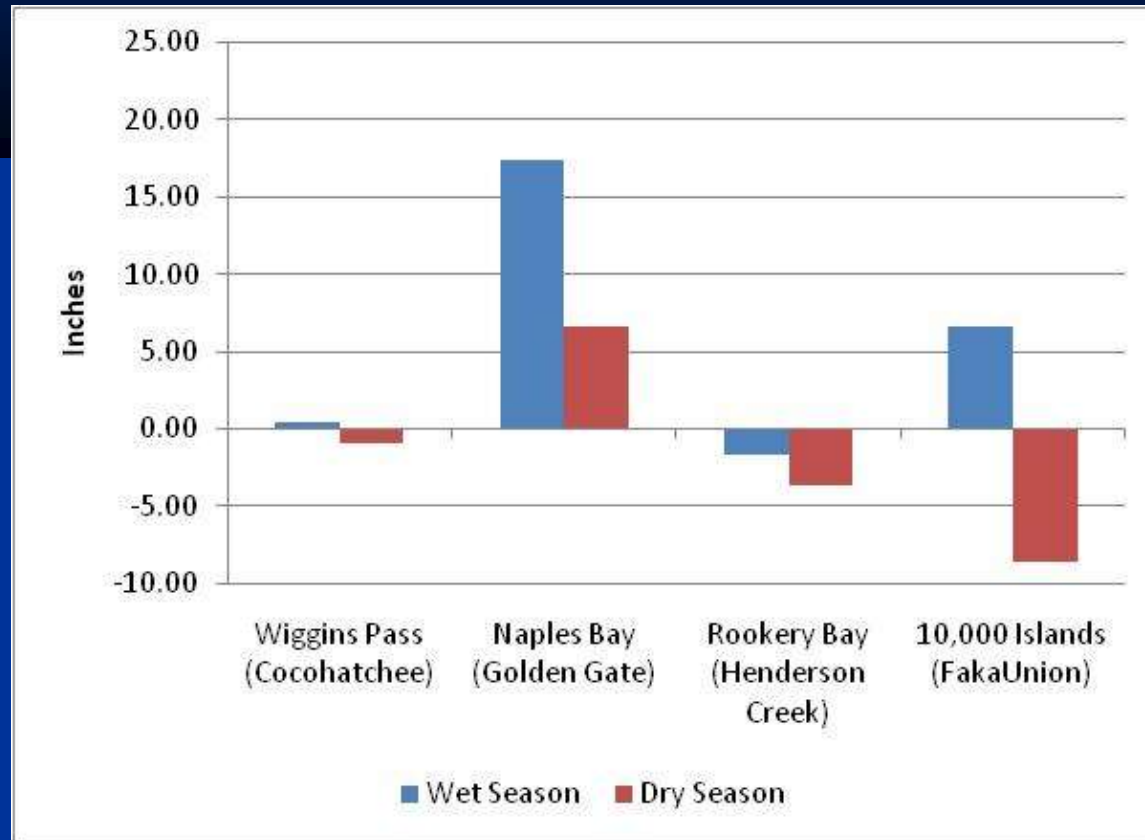
Natural Systems Model

- Pre-development condition
- Developed for the SWFFS
- Simulation period is 1978 – 1986
- Recognized limitations due to topography and other issues



Existing Conditions Model vs Natural Systems Model

- Calculated deficit/surplus (inches)

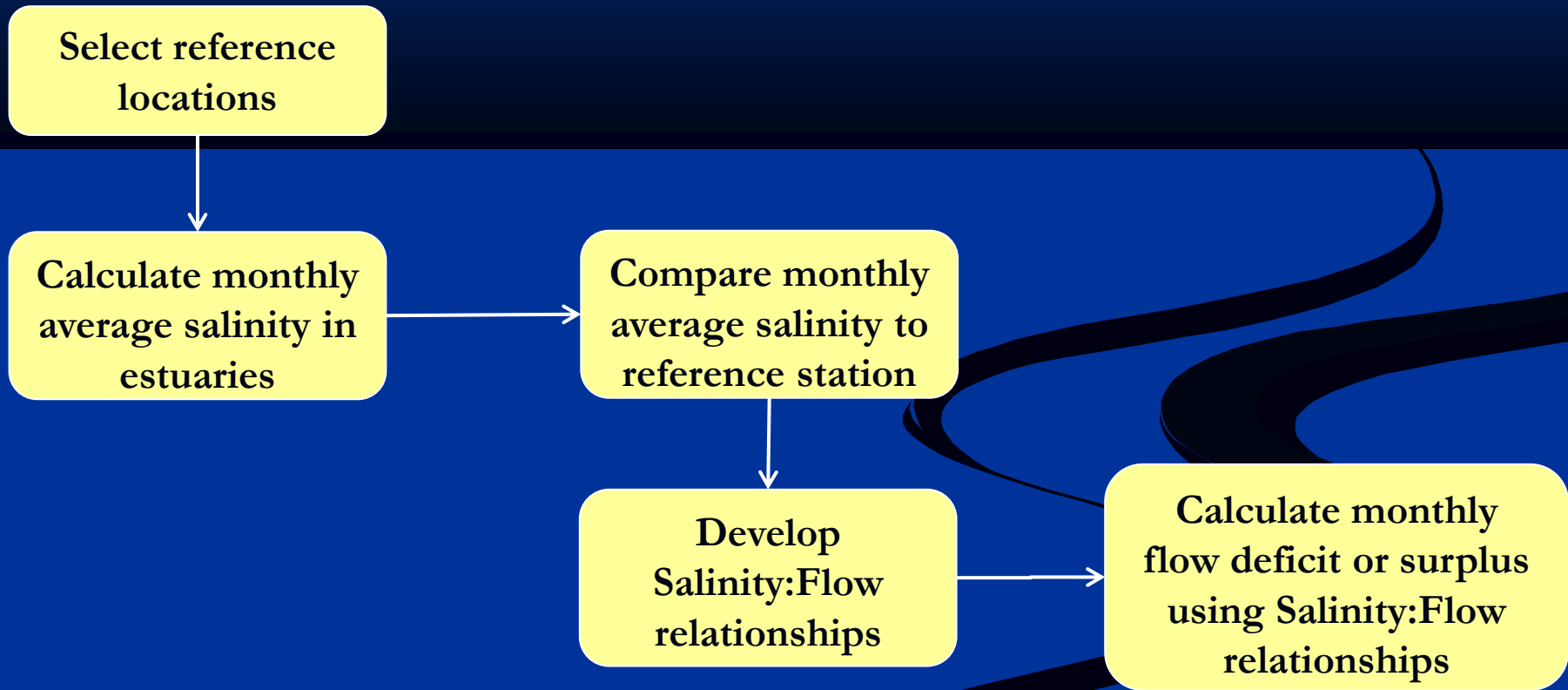


Salinity Based Flow Analysis

- Salinity at a reference station used to determine flow deficit or surplus at the watershed outfall into the estuary

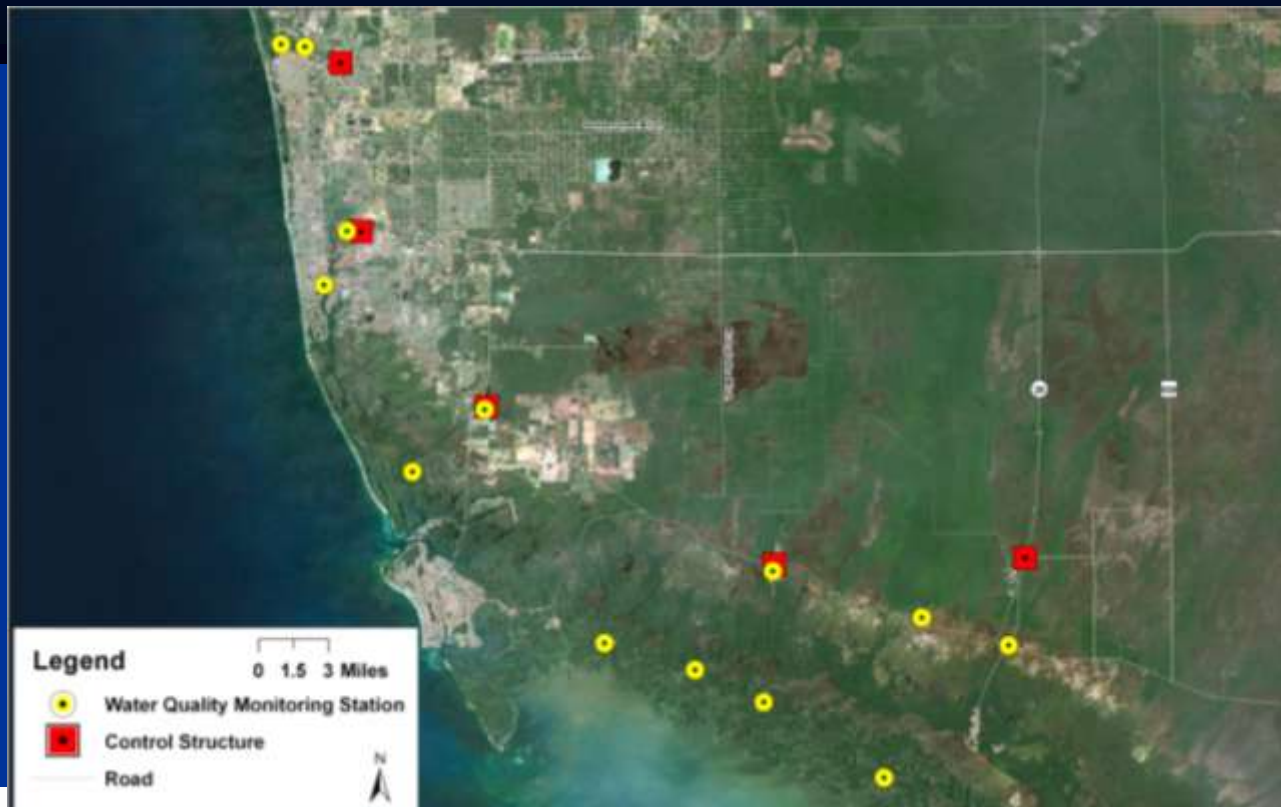


Salinity Based Flow Analysis Methodology



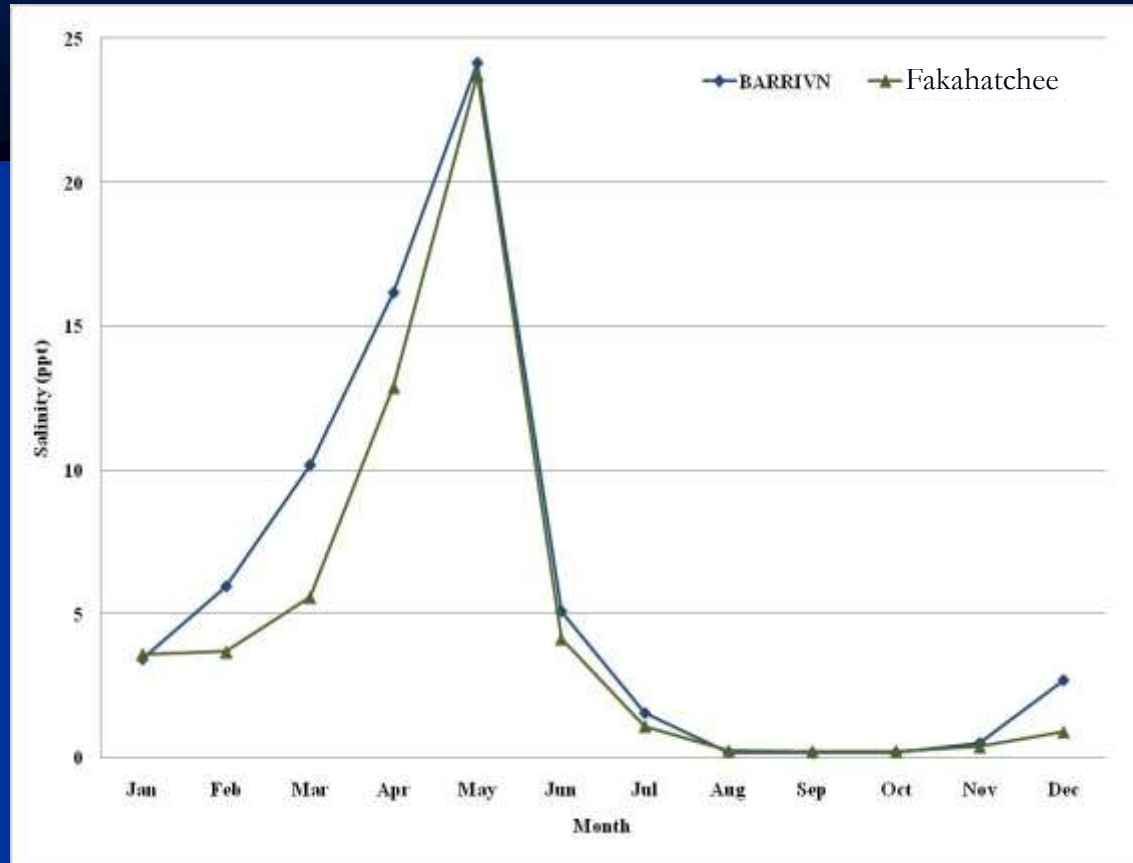
Selecting Reference Stations

- Flow and salinity data is required
- Drainage area with little or no hydrologic alteration in basin



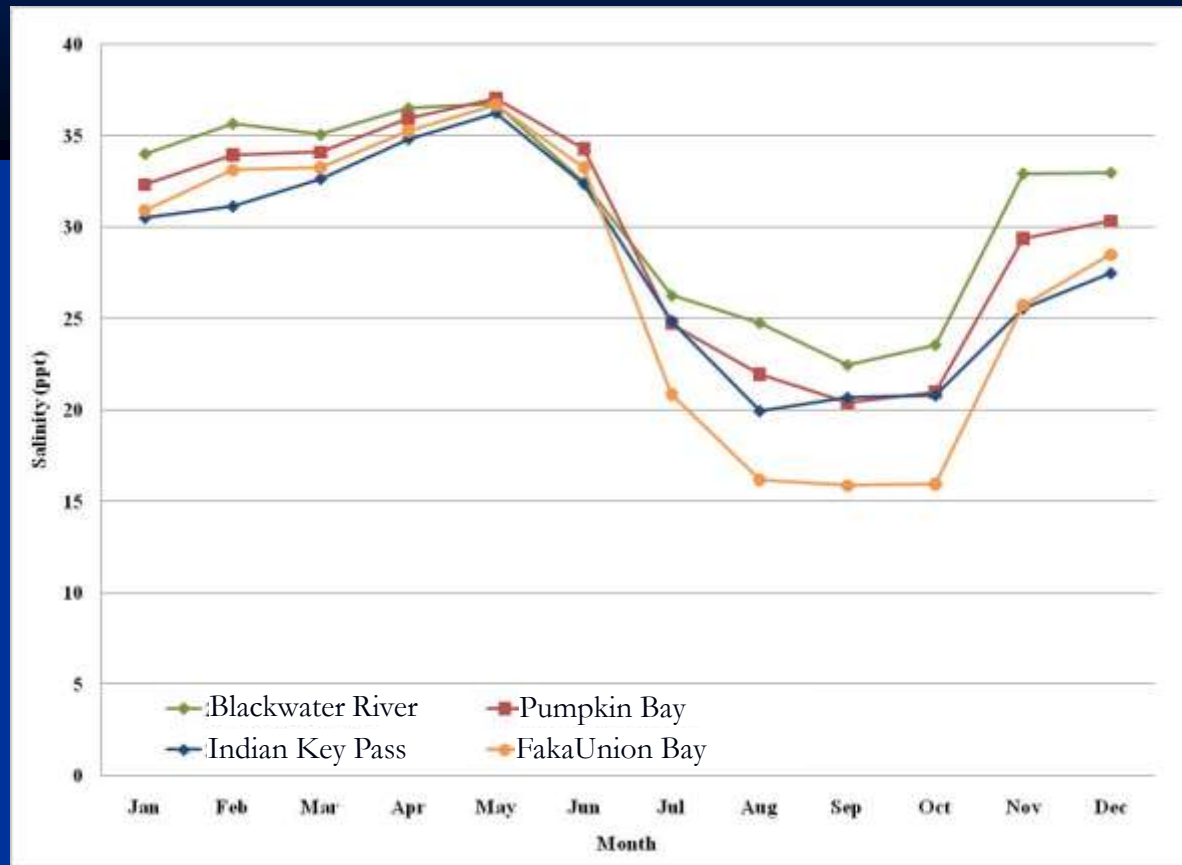
Potential Reference Site

- Comparison to previously used reference sites



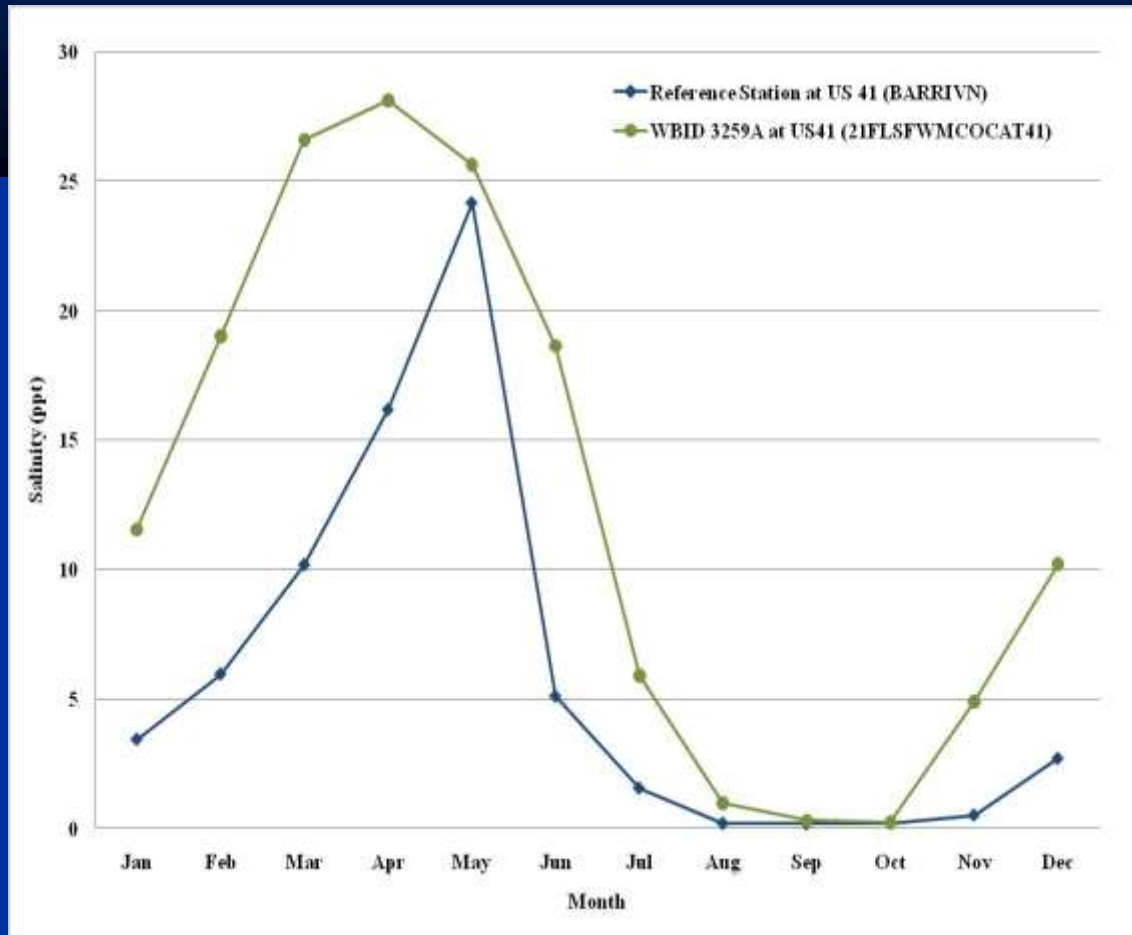
Potential Reference Site

- Comparison to previously used reference sites



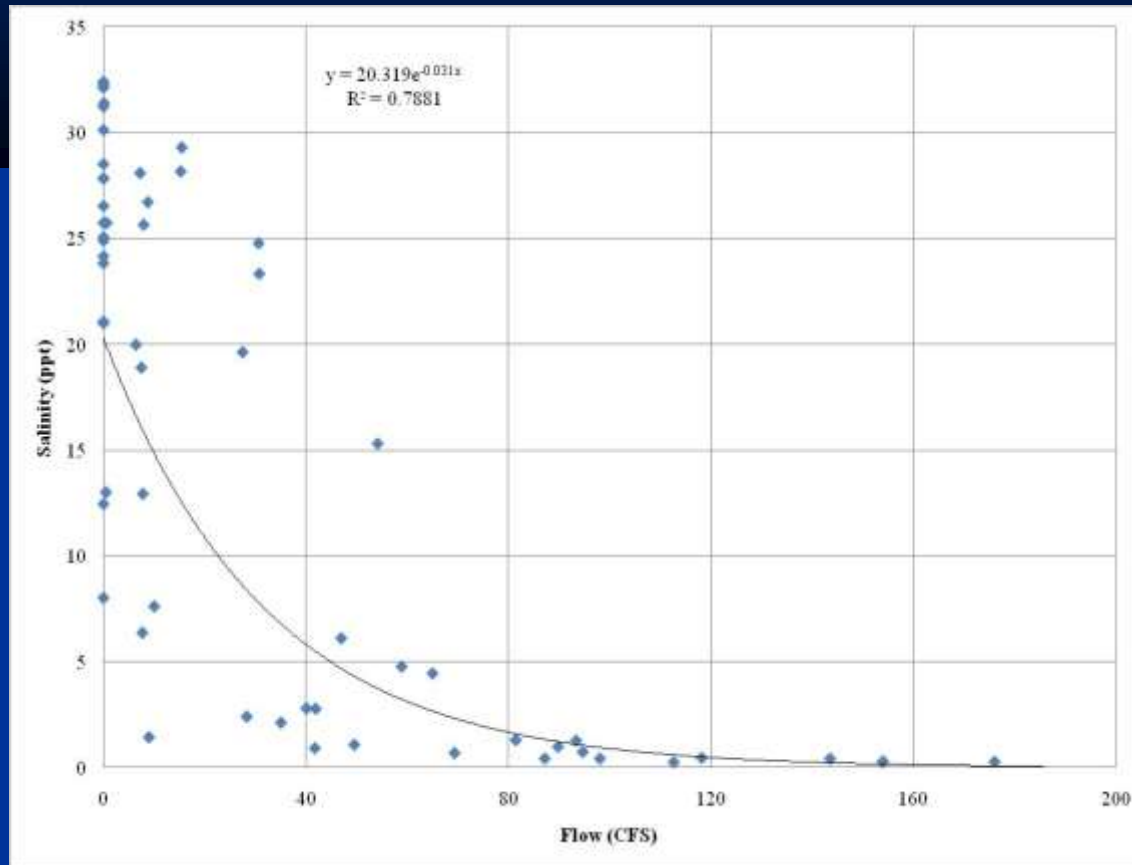
Cocohatchee Corkscrew

■ Salinity Comparison at US 41



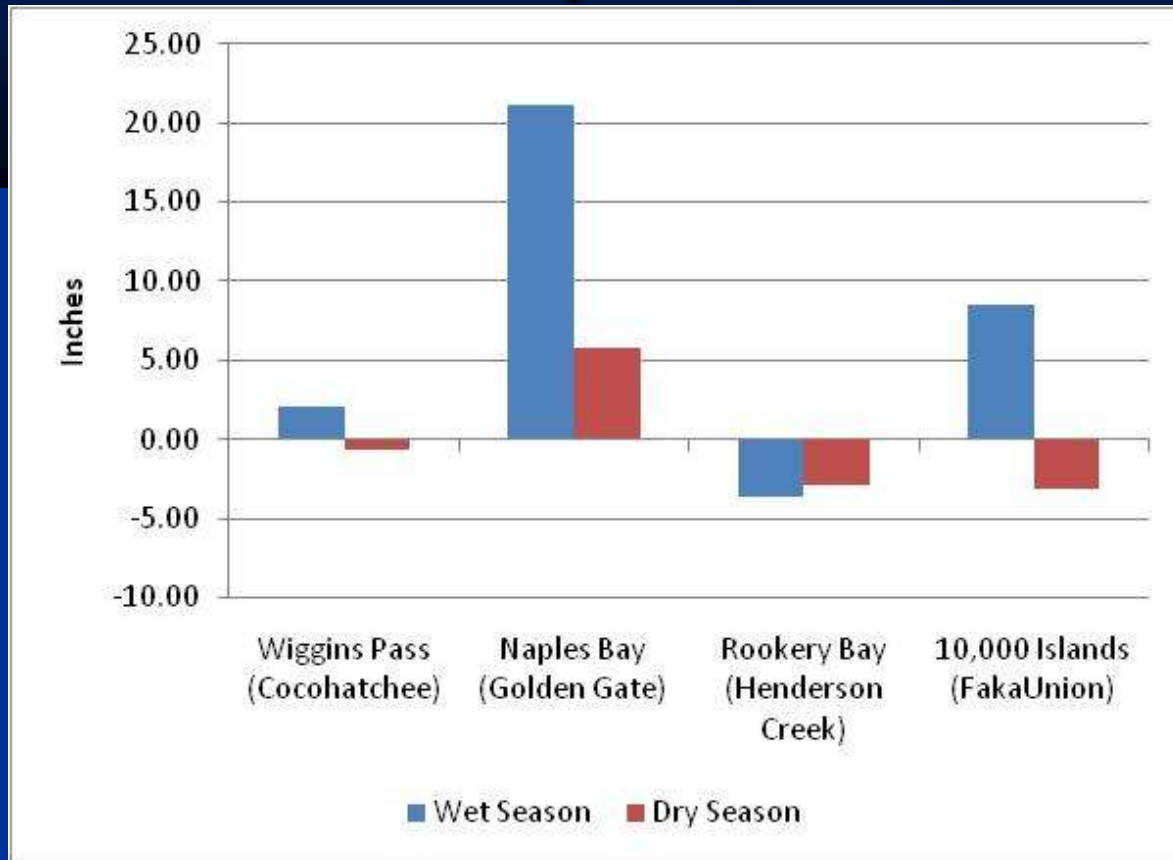
Cocohatchee Corkscrew

- Dry Season Salinity:Flow relationship at US 41



Salinity:Flow Analysis

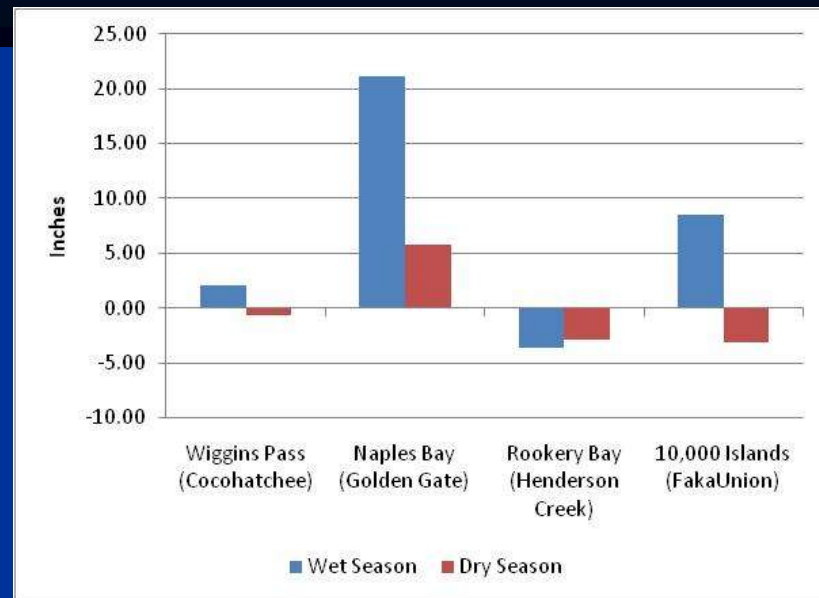
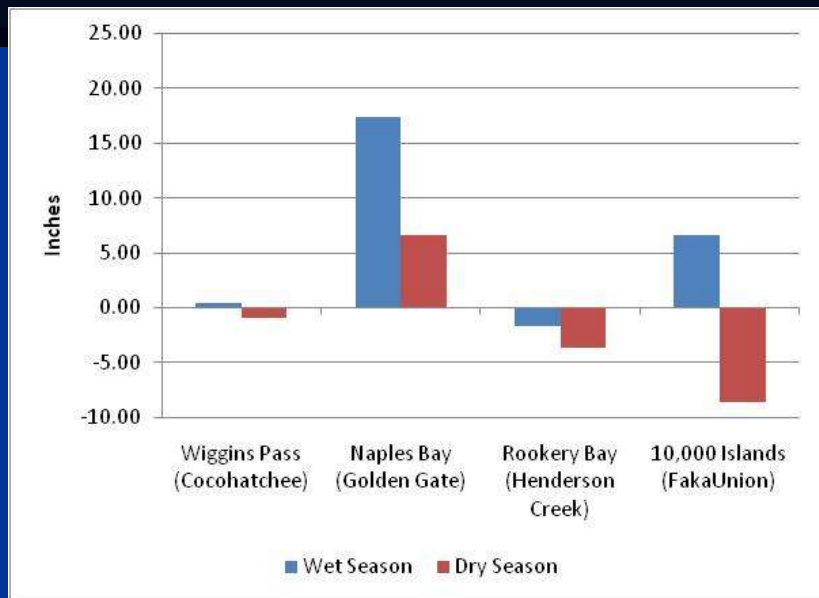
- Calculated deficit/surplus (inches)



Comparison of Alternative Discharge Calculation Methods

Calculated deficit/surplus
ECM vs NSM

Calculated deficit/surplus
Salinity:Flow Relationship



Water Quantity

General Conclusions

- Comparison of flow surplus/deficit calculation methods validates the use of models to define performance measures and evaluate alternatives
- Limitations of the calculation methods must be well understood and documented prior to development of the performance measures

Water Quality

- WBIDs, TMDL Process
- Watersheds, Impairments, DO, Nutrients
- Estuaries

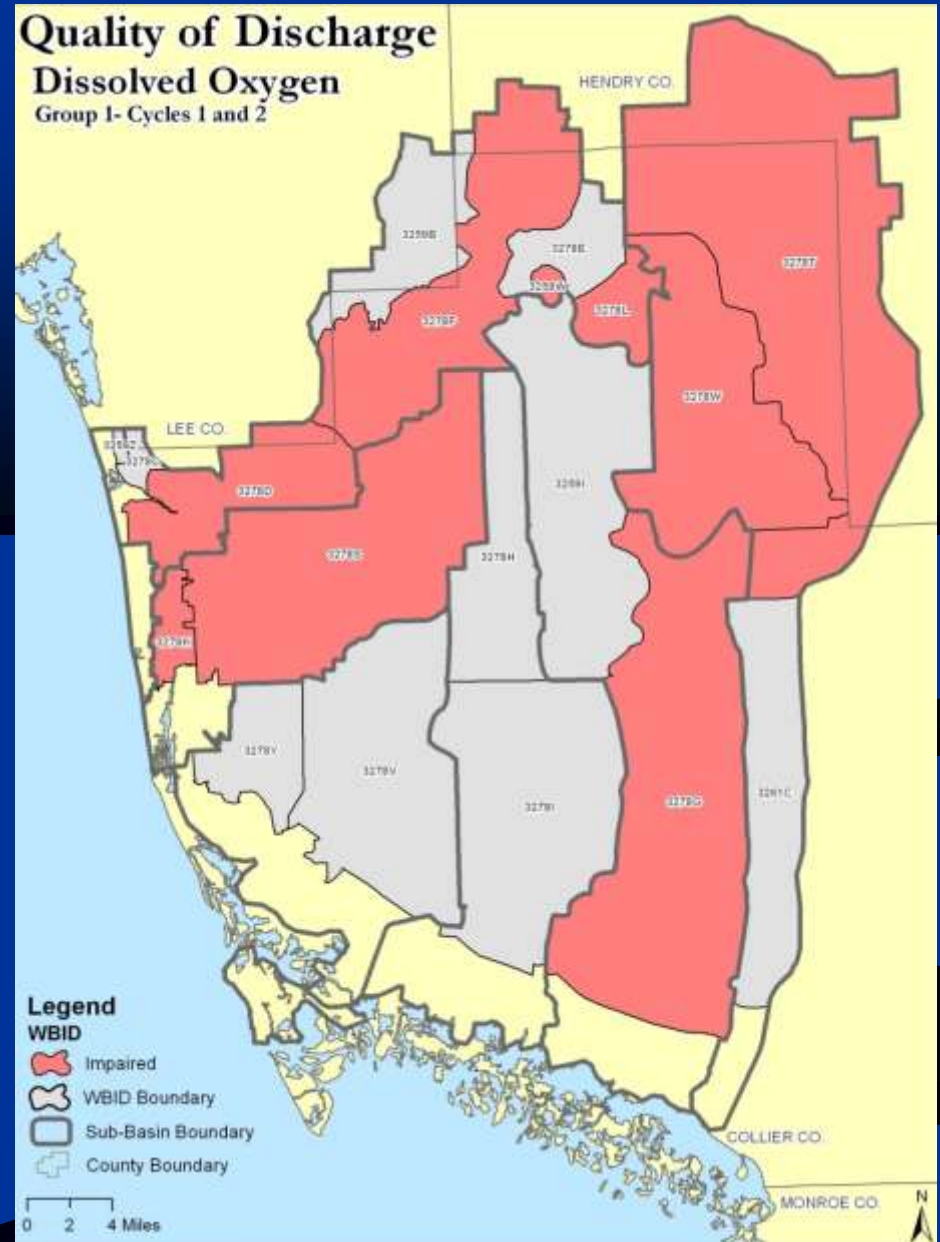


- Group 1
- Group 2
- Group 3
- Group 4
- Group 5

Efforts
focused on
six main
watersheds,
and the
estuaries
influenced by
them



Within these watersheds, there are numerous WBIDs, many of which have been determined to be “impaired” by FDEP as per the Impaired Waters Rule (here, dissolved oxygen)



TMDL process

- FDEP-led process with 5 basic phases
 - Assess the quality of surface waters--are they meeting water quality standards?
 - Determine which waters are impaired--which ones are not meeting water quality standards
 - Establish and adopt, by rule, a TMDL for each impaired water for the pollutants of concern
 - Develop a Basin Management Action Plan (BMAP)
 - Implement the strategies and actions in the BMAP

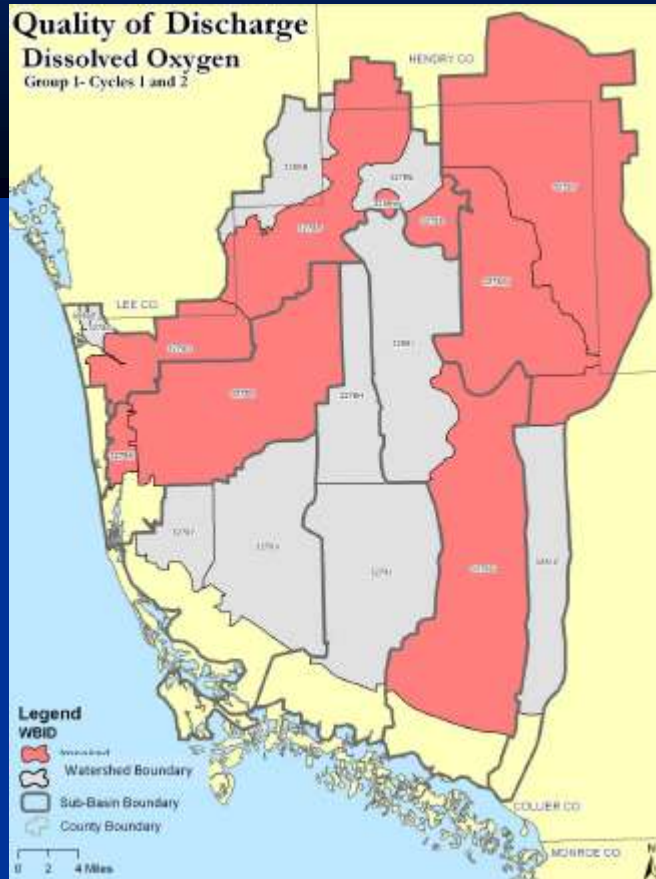
Within the watersheds themselves, 15 WBID-impairment combinations

WBID#	WBID Name	Impaired Parameter	Watershed
3259W	Lake Trafford	Dissolved Oxygen	Cocohatchee-Corkscrew
3259W	Lake Trafford	Mercury	Cocohatchee-Corkscrew
3259W	Lake Trafford	Nutrients	Cocohatchee-Corkscrew
3259W	Lake Trafford	Un-ionized Ammonia	Cocohatchee-Corkscrew
3278D	Cocohatchee Inland	Dissolved Oxygen	Cocohatchee-Corkscrew
3278F	Corkscrew Marsh	Dissolved Oxygen	Cocohatchee-Corkscrew
3278L	Immokalee Basin	Dissolved Oxygen	Cocohatchee-Corkscrew
3278K	Gordon River Extension	Dissolved Oxygen	Golden Gate - Naples Bay
3278S	North Golden Gate	Dissolved Oxygen	Golden Gate - Naples Bay
3278S	North Golden Gate	Iron	Golden Gate - Naples Bay
3278G	Fakahatchee Strand	Dissolved Oxygen	Fakahatchee
3278G	Fakahatchee Strand	Fecal Coliform	Fakahatchee
3261C	Barron River Canal	Iron	Okaloacoochee-SR29
3278T	Okaloacoochee	Dissolved Oxygen	Okaloacoochee-SR29
3278W	Silver Strand	Dissolved Oxygen	Okaloacoochee-SR29

Watersheds

Spatial extent of impairments

Dissolved Oxygen



Nutrients (Chl-a)



Watersheds

Spatial extent of impairments

Fecal Coliform Bacteria



Un-ionized Ammonia



Watersheds

Spatial extent of impairments

Iron



General findings - watersheds

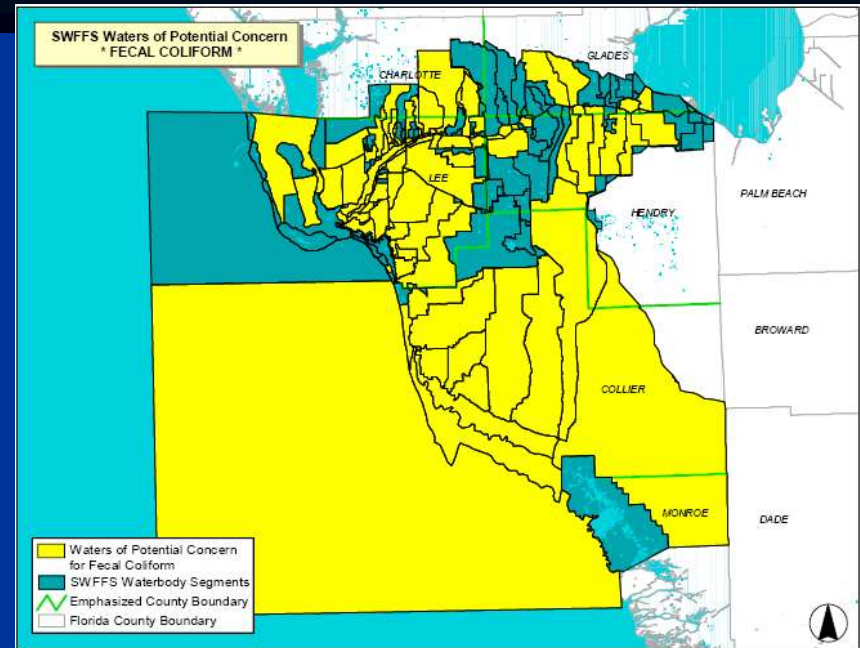
- Lake Trafford had most impairments
 - DO, nutrients (Chl-a), un-ionized ammonia
- North Golden Gate and Fakahatchee Strand were second highest impairments
- Most common impairment was for dissolved oxygen (DO)
 - 9 of 15 impairments were for low DO
- Iron was second most common impairment
 - North Golden Gate and Barron River Canal

For watersheds, these “impairments” were verified by PBS&J, and consistent with prior reports (e.g., Tetra Tech and Janicki Environmental 2004)

Dissolved Oxygen



Fecal Coliform Bacteria



Impairments listed by FDEP also assessed for the estuarine receiving water bodies

WBID#	WBID Name	Receiving Water
3259A	Cocohatchee River	Wiggins Pass
3278R	Naples Bay (Coastal Segment)	Naples Bay
3278U	Rookery Bay (Coastal Segment)	Rookery Bay
3259M	Ten Thousand Islands	Ten Thousand Islands

Estuaries

Spatial extent of impairments

Dissolved Oxygen



Nutrients (Chl-a)



Estuaries

Spatial extent of impairments

Fecal Coliform Bacteria



Estuaries

Spatial extent of impairments

Iron



Copper



General findings - estuaries

- Naples Bay had most impairments
 - DO, fecal coliform bacteria, iron, copper
- Rookery Bay had second highest impairments
 - DO, nutrients (Chl-a), fecal coliform bacteria
- Most common impairments were DO and fecal coliform bacteria
- Iron as second most common impairment
 - Naples Bay and Wiggins Pass

Issues for Collier County

- Are standards appropriate?
 - Does existing DO standard make sense in SW Florida?
 - Class II standards for bacteria in marine waters
- Are locations sampled representative of system being assessed?
- Are portions of Collier County truly problematic, or is TMDL process flawed?

Appropriateness of standards

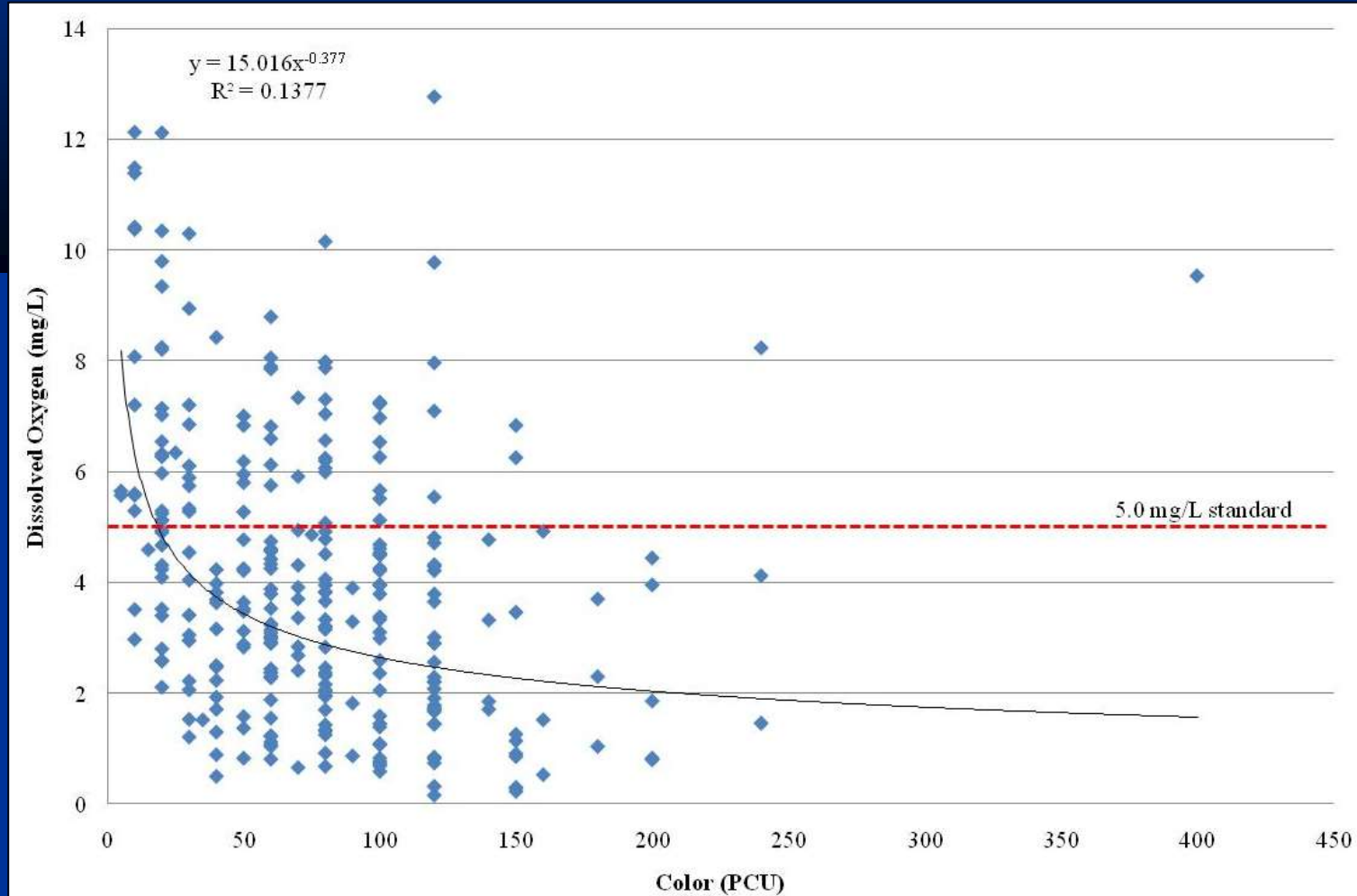
Dissolved Oxygen

- Florida's Surface Water Quality Standard (Rule 62-302, F.A.C.) states that, for Class III freshwater –
 - *Shall not be less than 5.0 (mg/L). Normal daily and seasonal fluctuations above these levels shall be maintained.*
- For Class II and III marine water -
 - *Shall not average less than 5.0 in a 24-hour period and shall never be less than 4.0. Normal daily and seasonal fluctuations above these levels shall be maintained.*
- Problems
 - DO often fails standard in “reference” locations
 - DO shows strong evidence of influence from wetlands, rather than human-induced

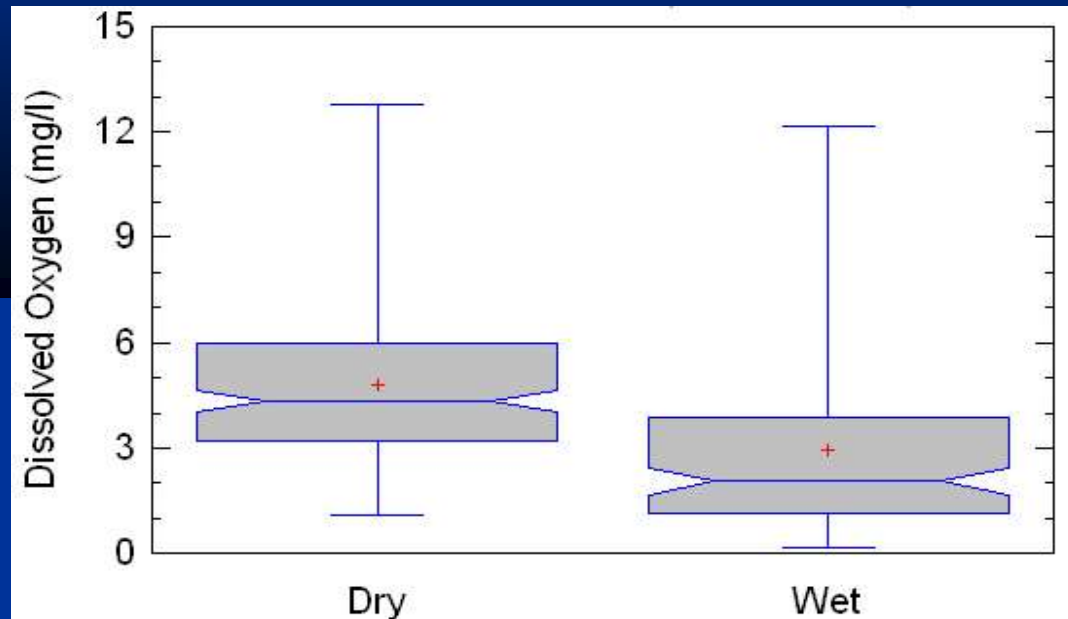
Among more developed watersheds, Fakahatchee Strand (83% forested) had the lowest DO average and minimums

WBID	WBID Name	Average (mg/L)	Median (mg/L)	Minimum (mg/L)	Maximum (mg/L)
3278G	Fakahatchee Strand	4.1	3.7	0.2	12.8
3278H	Faka-Union (North Segment)	5.3	5.2	1.6	12.8
3278I	Faka-Union (South Segment)	6.2	6.4	1.2	12.9
3278V	Rookery Bay (Inland East Segment)	6.2	6.4	2.1	11.4

Within Fakahatchee Strand, DO levels decrease with increased color (i.e., increased wetland influence)



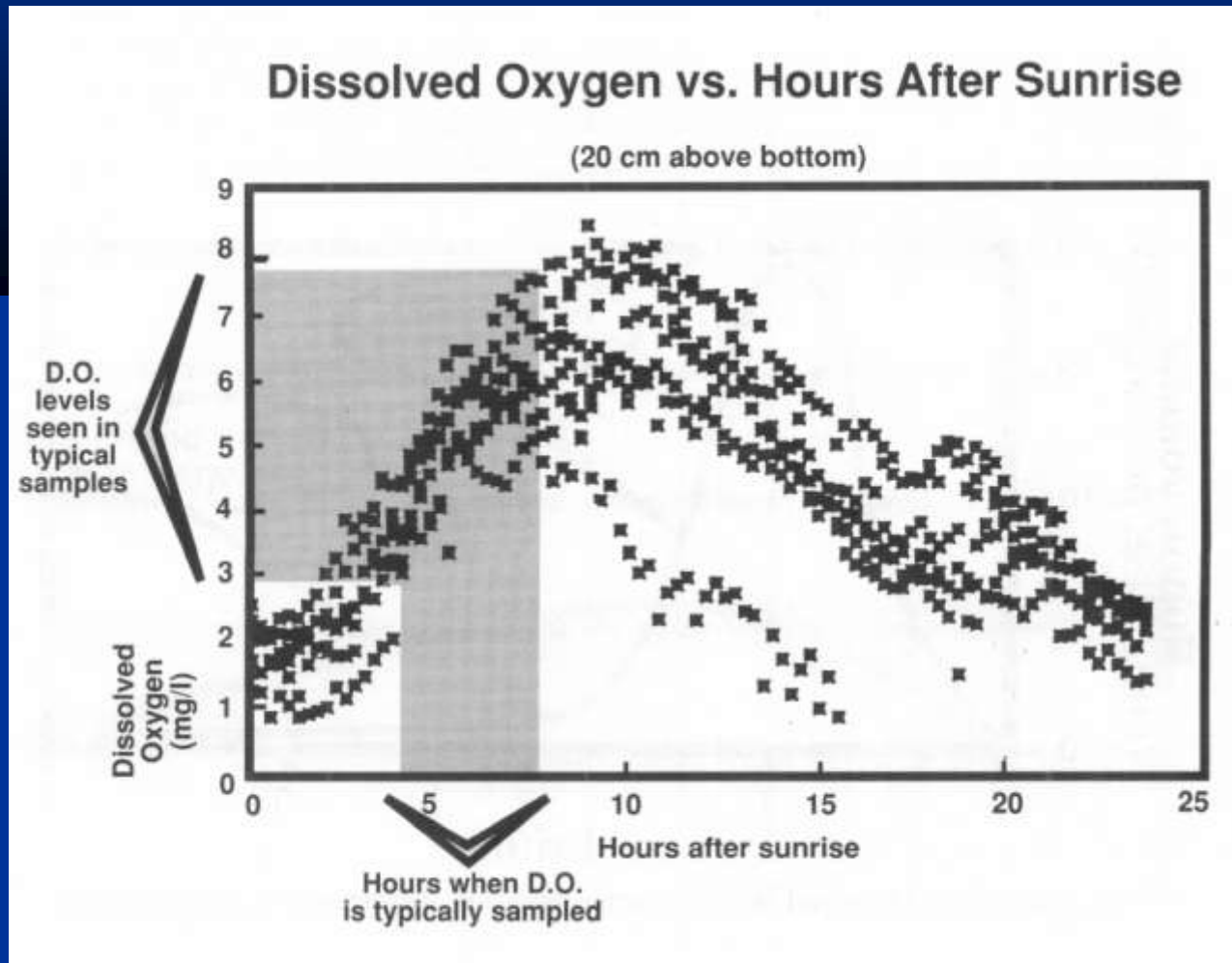
Using Fakahatchee Strand as a “reference” condition for watersheds...



Dry season: 4.3 mg DO / liter
Wet season : 2.1 mg DO / liter

Perhaps “impairment” in urbanized portions of Wiggins Pass, Naples Bay, etc. watersheds should use other than existing standards?

For estuaries, does the numeric DO standard of 5 mg / L (avg.) and 4 mg /L (minimum) make sense?



Data from Sarasota Bay (Tomasko et al. 1992)

Appropriateness of standards Fecal Coliform Bacteria

- Freshwater standard of 400 # / 100 ml
 - Typical screening level for recreation and bodily contact
- Marine standard for Class II of 43 # / 100 ml
 - Standard for shellfish harvesting
- Bacteria of genus *Klebsiella* can be natural soil organisms, but can also test positive as “fecal coliform bacteria”
- Additional source identification efforts warranted

Are sample locations appropriate – example from Rookery Bay. What happened in 2006?

Year	Sample Size	Chlorophyll a ($\mu\text{g/l}$)	
		Corrected	Uncorrected
1999	4		4.6
2000	4		5.8
2001	4		5.4
2002	4		5.7
2003	4		4.9
2004	4		5.0
2005	4		7.3
2006	4	14.0	

2006 – roadside sampling, not ambient
within the bay. Station location matters.



Are portions of Collier County truly problematic, from a nutrient perspective?

- Nutrient enrichment could explain impairments for DO (widespread)
 - But DO levels lowest in watersheds with greatest amount of wetlands
 - And estuaries have more dynamic natures than standard
- Nutrient enrichment could explain impairments in “nutrients” (actually Chl-a)
 - Rookery Bay impaired as per FDEP, not by PBS&J method
 - Naples Bay of concern, as per PBS&J

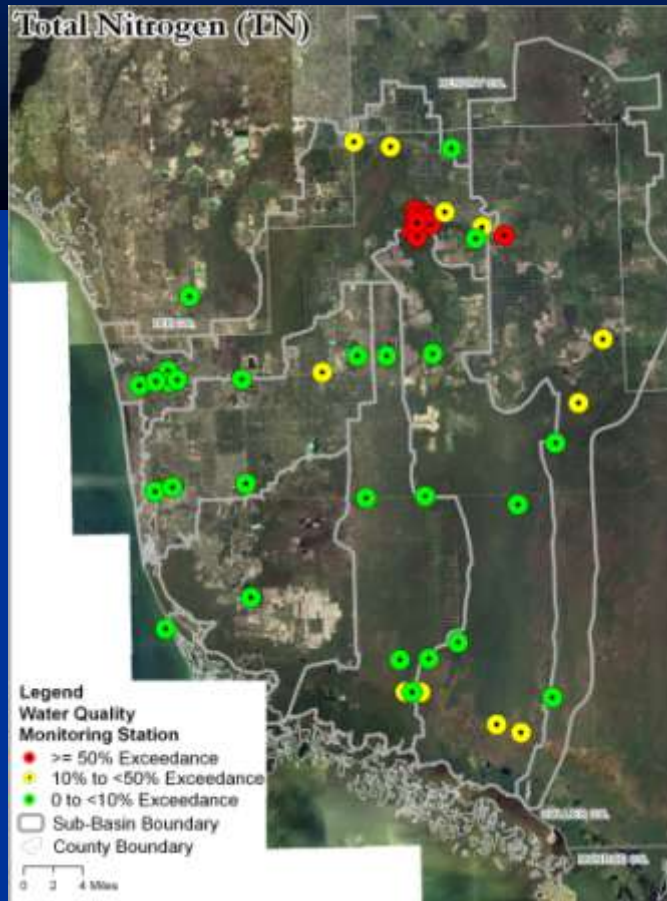
Developing Nutrient Criteria

- No state standards for nutrients
 - FDEP proposed, but not adopted
 - EPA's Numeric Nutrient Criteria – estuarine downstream protective values (DPV) withdrawn for further analysis
- Default FDEP approach is to develop screening levels per waterbody type as 70th percentile value state-wide
- Alternative approach – use TN and TP targets from Gordon River TMDL
 - Based on DO due to nutrients (not necessarily the case)
 - Gordon River reference sites also fail standard
 - Developed as 75th percentile of Everglades reference sites

Frequency of exceeding 70th percentile values statewide for lakes and/or stream within watershed

TN of 1.6 mg / L

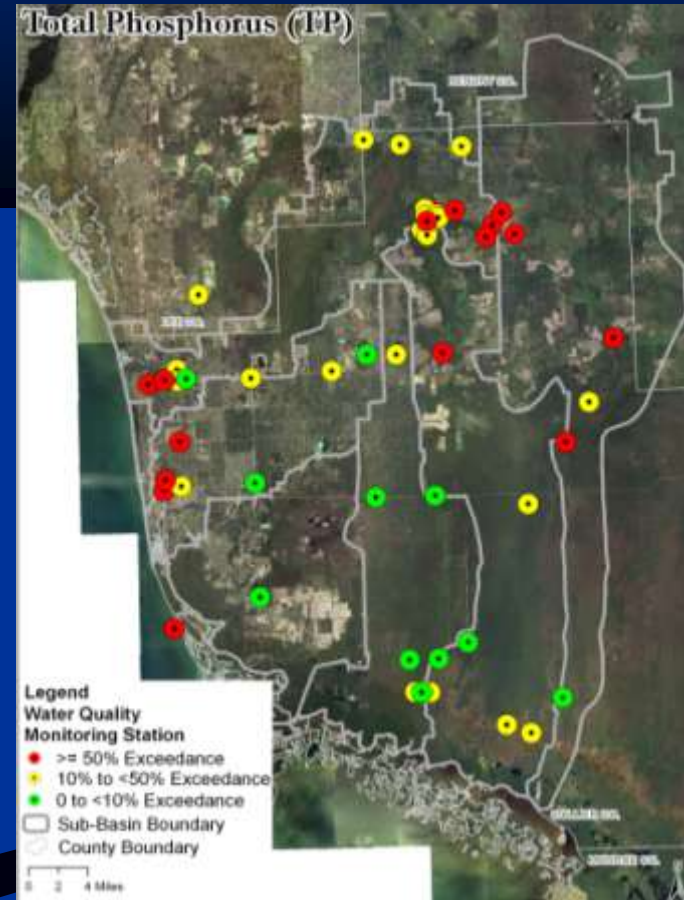
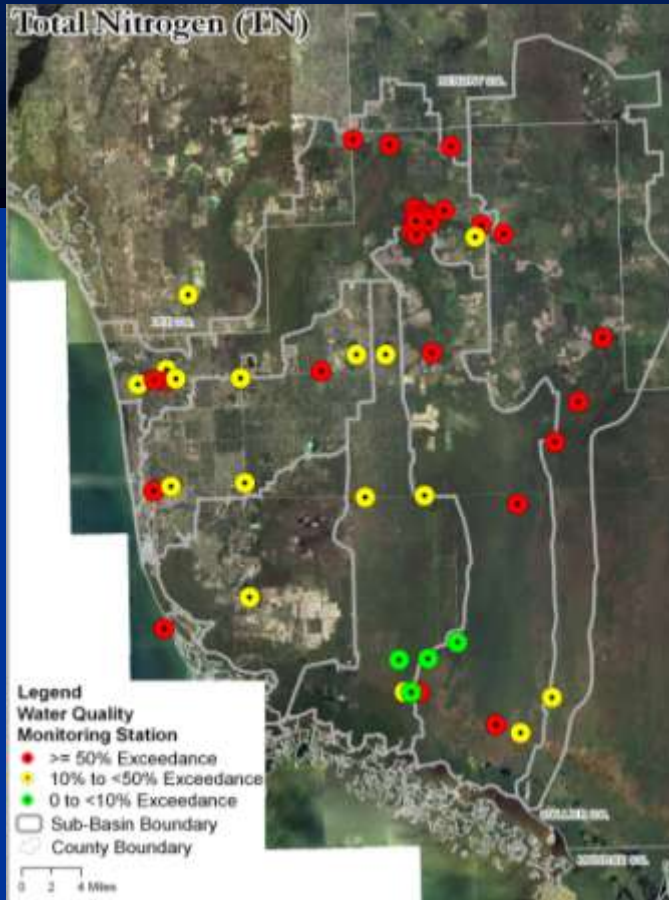
TP of 0.22 mg / L



Frequency of exceeding 75th percentile values for Gordon River TMDL reference sites for streams

TN of 0.74 mg / L

TP of 0.04 mg / L



Nutrient issues within Collier County

- Lake Trafford obviously impaired
 - But also improving water quality with dredging project
- For most of Collier County “impairment” for nutrients really means Chl-a higher than standards
 - Rookery Bay “impairment” likely due to 2006 sample sites
- Based on TN and TP screening using 70th percentile values statewide, nutrients not much of a concern in Collier County
- Based on TN and TP screening using 75th percentile values from Gordon River TMDL reference sites, nutrients elevated throughout much of County
 - But nutrient thresholds based on DO “impairment” caused by nutrients

Water Quality General Conclusions

- Dissolved oxygen
 - Lots of impairments, most likely due to inappropriate standard
 - Value to creating locally-relevant standard
- Fecal coliform bacteria
 - Class II standards in freshwater
 - Class II standards in marine waters - shellfish harvesting
- Appropriate to have source identification efforts

Water Quality

General Conclusions

- Nutrients (chlorophyll-a)
 - Impairment in Rookery Bay likely not realistic
 - Nutrient levels not very high in watershed
 - Level of concern over nutrients depends on screening criteria used
 - State-wide approach – not much of a problem
 - Reference sites in Everglades approach – more of a problem
- Various metals
 - Copper could be herbicide use
 - Iron likely from groundwater

Natural Systems

- Methodology
- Functional assessment of watersheds
- Coastal habitats assessment



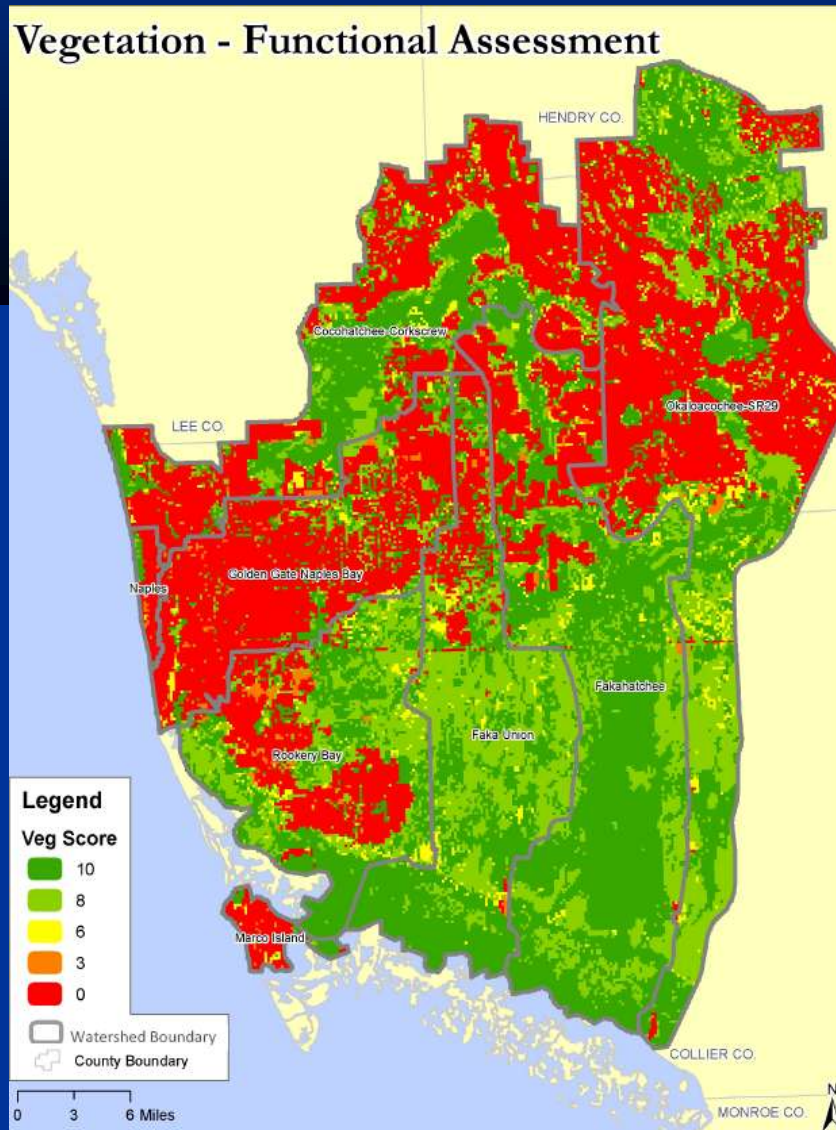
Functional Assessment

- Comparison of existing conditions to Pre-Development Vegetation Map (PDVM; Duever 2004)
- Uniform Mitigation Assessment Method (UMAM; FAC 62-345) as template
 - Modified for landscape level assessment
- Optimal condition defined
 - Vegetation
 - Hydrology
 - Landscape Suitability Index (landscape position)

Vegetation Score

- Concept – assumption that pre-development vegetation community provides optimal functional value
- For watershed-level application
 - 2007 FLUCCS compared to PDVM
 - Polygons with no difference (regardless of original type of community) assigned score of 10
 - Polygons with different strata but same ecosystem type (i.e., freshwater forested wetland to freshwater herbaceous wetland) assigned score of 8
 - Shift from mesic to hydric communities (or vice versa) scored as 8
 - Shift of both vegetation and ecosystem type (i.e., freshwater forested wetland to forested native upland) scored as 6
 - Shift to artificial water body scored as 3
 - Shift to developed land use scored as 0

Vegetation Index - Spatial Display of Values



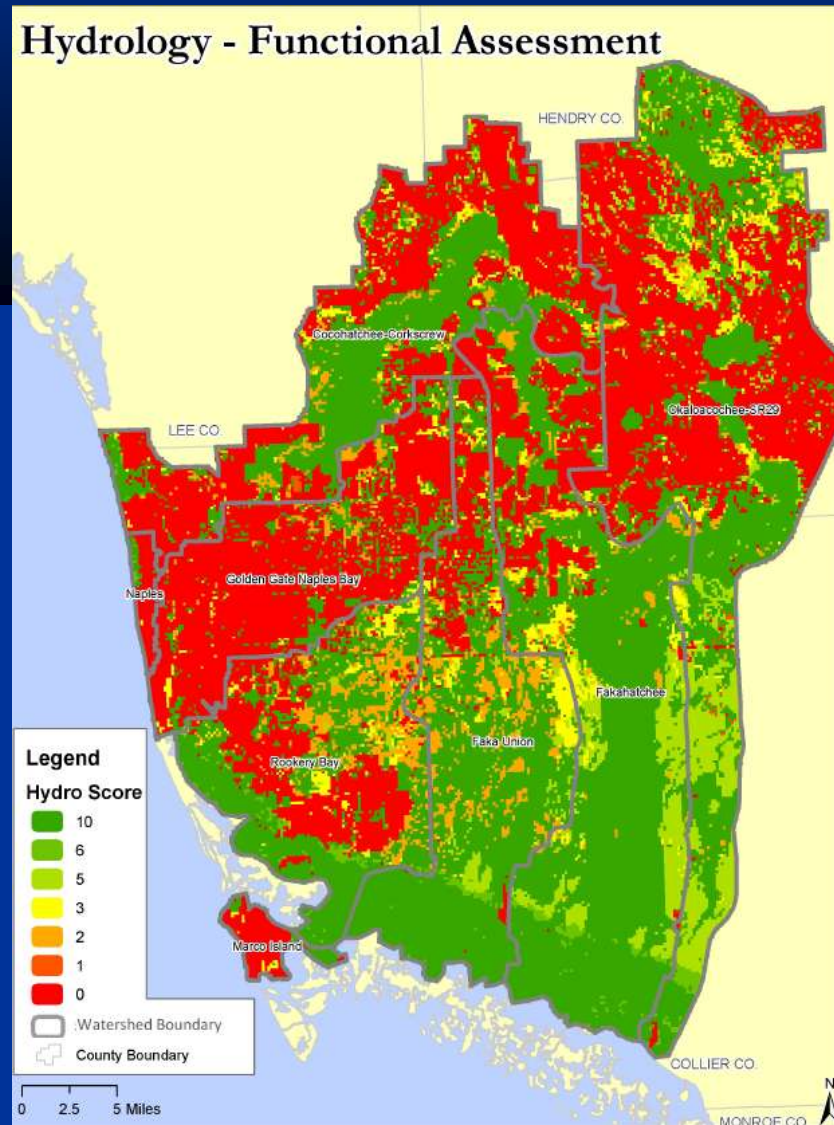
Hydrology Score

- Concept – locations with similar water depths and hydroperiods over time provide optimal functional value
- Use of vegetation as indicator of changes in levels and/or hydroperiods
 - Rerun with model results?
- For watershed-level application
 - 2007 FLUCCS compared to PDVM
 - Use of hydrologic regime table
 - Polygons with communities suggesting difference scored as percent change in hydroperiod (regardless of direction of change)
 - Polygons with development and/or newly formed water given max change score

Hydrology Factors

SW Florida Plant Communities	Hydroperiod (months)	Seasonal Water Level (inches)	
		Wet	Dry (1,10)*
Xeric Flatwood	0	≤-24	-60, -90
Xeric Hammock			
Mesic Flatwood	≤1	≤2	-46, -76
Mesic Hammock			
Hydric Flatwood	1 - 2	2 - 6	-30, -60
Hydric Hammock			
Wet Prairie	2 - 6	6 - 12	-24, -54
Dwarf Cypress			
Freshwater Marsh	6 - 10	12 - 24	-6, -46
Cypress	6 - 8	12 - 18	-16, -46
Swamp Forest	8 - 10	18 - 24	-6, -36
Open Water	>10	≥24	< 24, -6
Tidal Marsh	Tidal	Tidal	Tidal
Mangrove			
Beach			
* 1 = average year low water			
10 = 1 in 10 year drought			
			July 2002

Hydrology Score - Spatial Display of Values



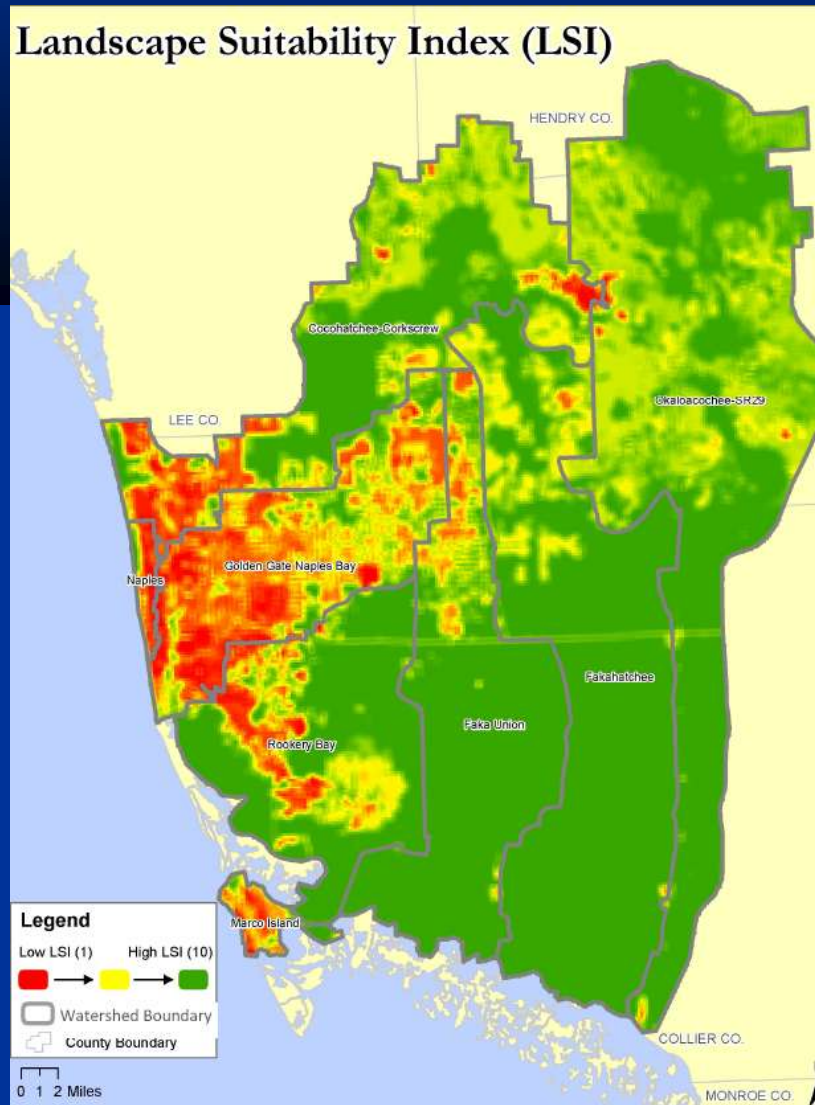
Landscape Position

- Landscape Suitability Index (LSI)
 - Concept – if good hydrology and vegetation, but what if in the median of an interstate?
 - Developed by Center for Wetlands (UF)
 - For watershed-level application
 - 2007 FLUCCS into 750 x 750 foot cells
 - LSI for each cell calculated based on LSI values from adjacent cells
 - LSI for a watershed or WBID calculated and percentage of cells with various scores calculated

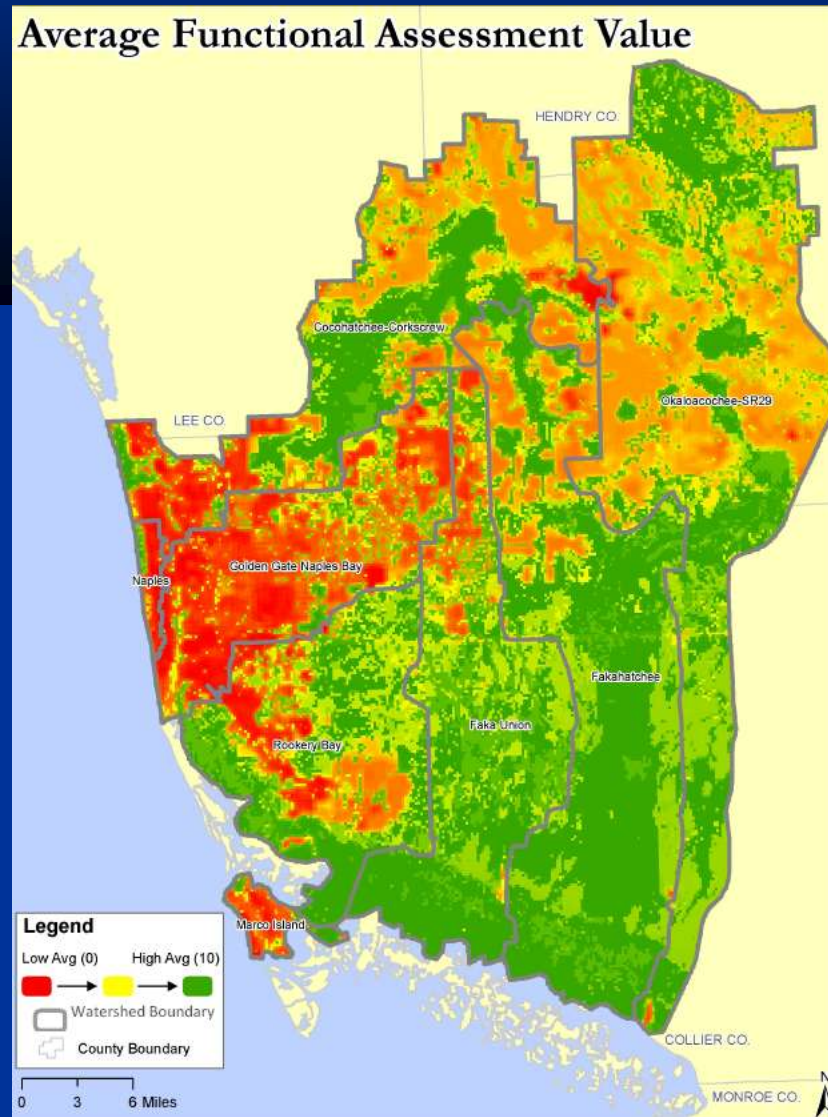
LSI Coefficients

Land Use/Land Cover	LSI Coefficients
Natural System	10.00
Natural Open water	10.00
Pine Plantation	9.36
Recreational / Open Space (Low-intensity)	9.08
Woodland Pasture (with livestock)	8.87
Pasture (without livestock)	8.03
Low Intensity Pasture (with livestock)	7.32
Citrus	7.02
High Intensity Pasture (with livestock)	6.96
Row crops	6.07
Single Family Residential (Low-density)	3.57
Recreational / Open Space (High-intensity)	3.42
High Intensity Agriculture (Dairy farm)	3.33
Single Family Residential (Med-density)	2.81
Single Family Residential (High-density)	2.72
Mobile Home (Medium density)	2.56
Highway (2 lane)	2.43
Low Intensity Commercial	2.22
Institutional	2.14
Highway (4 lane)	1.91
Mobile Home (High density)	1.90
Industrial	1.87
Multi-family Residential (Low rise)	1.49
High Intensity Commercial	0.91
Multi-family Residential (High rise)	0.90
Central Business District (Average 2 stories)	0.64
Central Business District (Average 4 stories)	0.00

LSI Spatial Display of Values



Combined – Functional Assessment Score



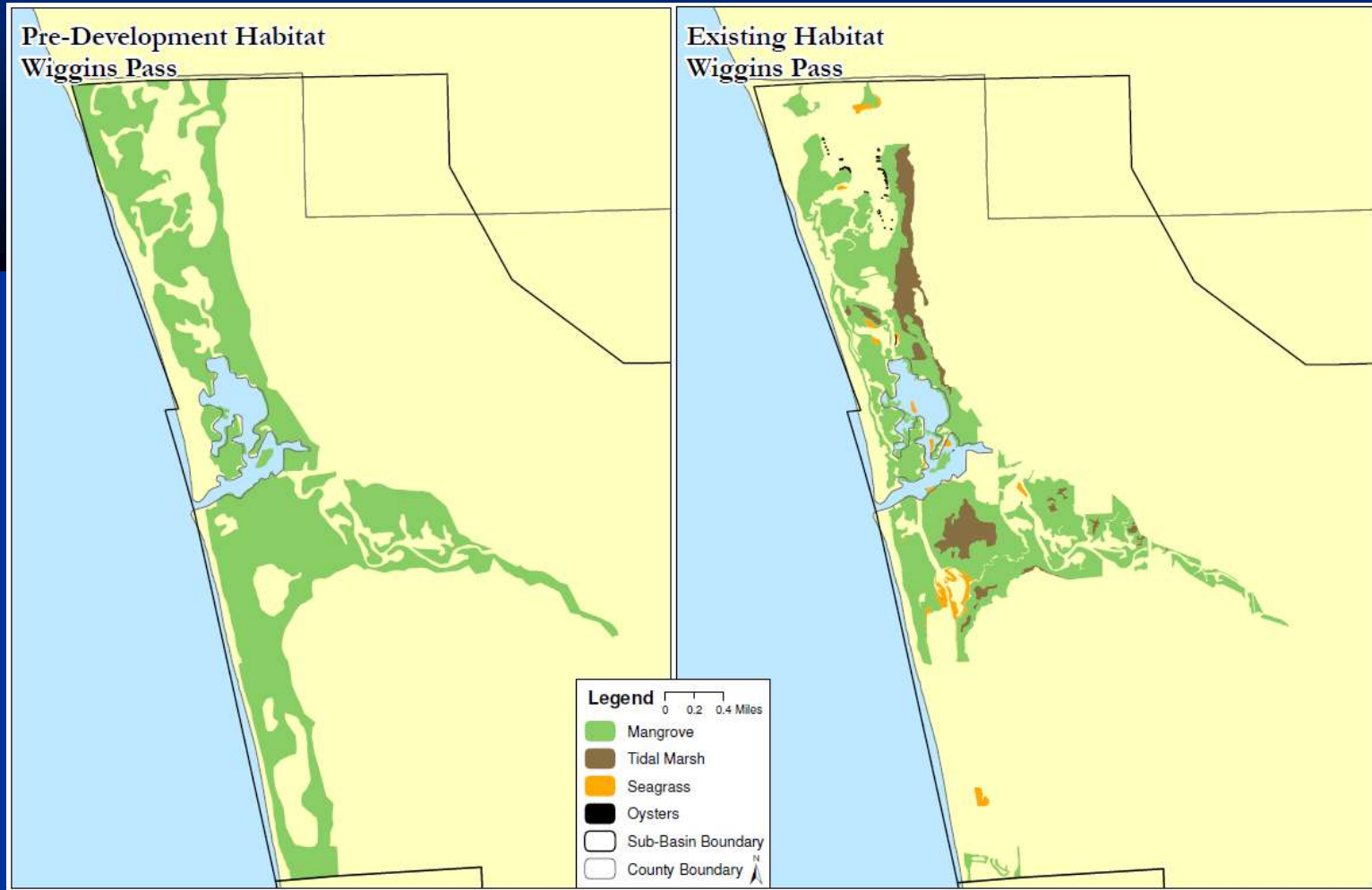
Results on a watershed level

Avg Functn	Cocohatchee- Corkscrew		Golden Gate Naples Bay		Rookery Bay		Faka Union, Fakahatchee, OK-29	
	Acres	% of Watershed	Acres	% of W'shed	Acres	% of W'shed	Acres	% of Watershed
0 - < 1	3,603	3%	9,155	10%	2,492	3%	258	0%
1 - < 4	67,549	50%	60,253	66%	25,762	26%	136,389	27%
4 - < 7	11,054	8%	7,012	8%	18,427	19%	41,090	8%
7 - < 10	27,027	20%	14,282	16%	27,686	28%	162,151	32%
10	25,129	19%	465	1%	24,367	25%	162,771	32%
Total Ac	134,362		91,167		98,735		502,660	

Coastal Habitats Assessment

- Mangrove, salt marsh, seagrass, oysters assessed
- GIS based comparison of all available and mappable data layers
- Issues
 - Not all areas with maps
 - Not all areas with maps were mapped at same time
 - Not all ecosystem types can be mapped with traditional GIS-based approaches
 - Seagrasses
 - Oysters (dead or alive)
 - Mangroves and salt marsh separated and combined

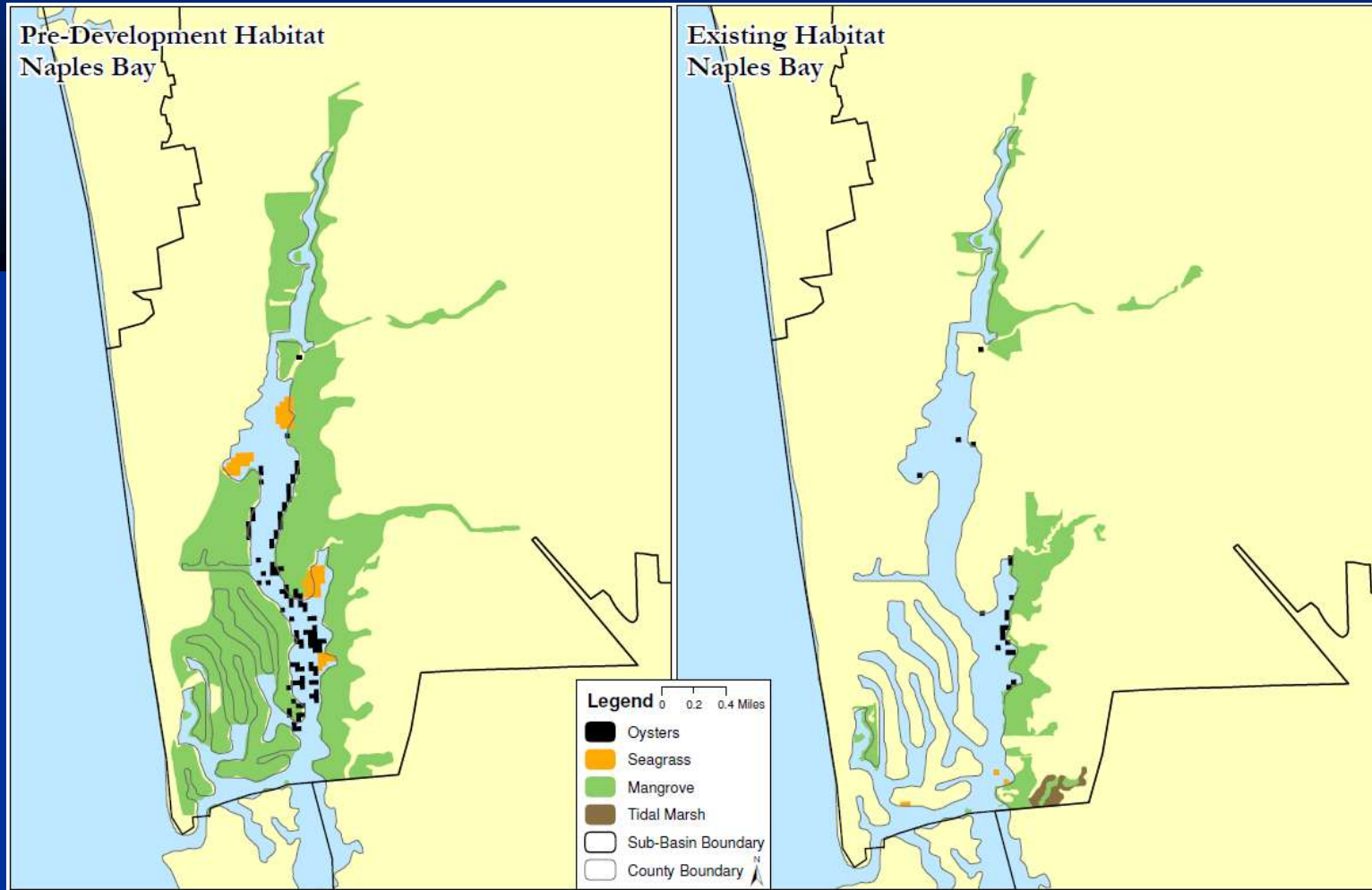
Wiggins Pass



Wiggins Pass

Wiggins Pass	Pre-Development	Current	Acres Lost	Percent Loss
Oyster (1999)	No Data	5		
Seagrass (2006)	No Data	39		
Tidal Marsh (Pre-Dev vs. 2007)	0	183	477	29
Mangrove (Pre-Dev vs. 2007)	1,660	999		

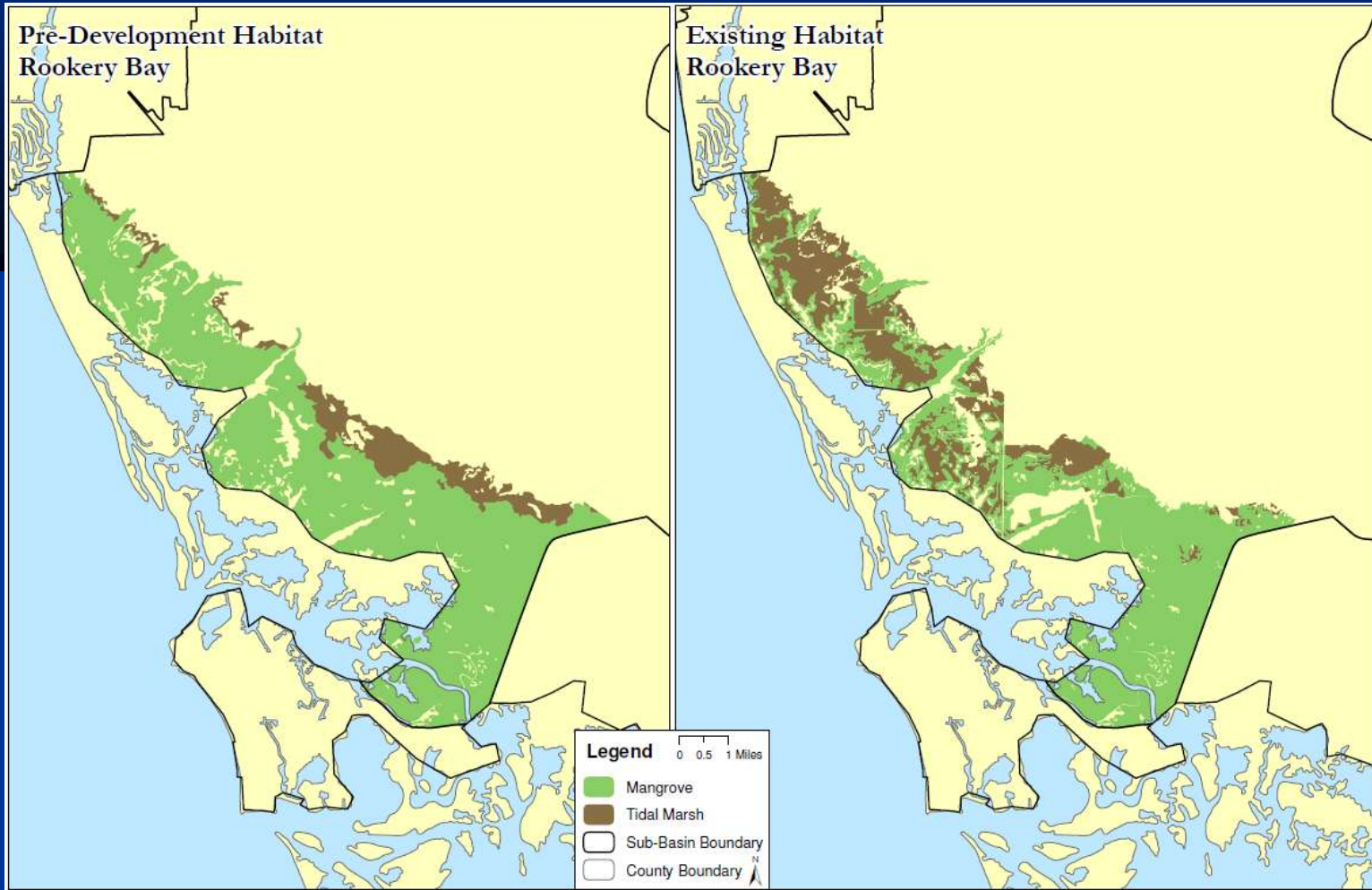
Naples Bay



Naples Bay

Naples Bay	Pre-Development	Current	Acres Lost	Percent Loss
Seagrass (1953 vs. 2005)	51	2	48	95
Oyster (1953 vs. 2005)	68	12	55	82
Tidal Marsh (Pre-Dev vs. 2007)	0	20	1,182	76
Mangrove (Pre-Dev vs. 2007)	1,549	347		

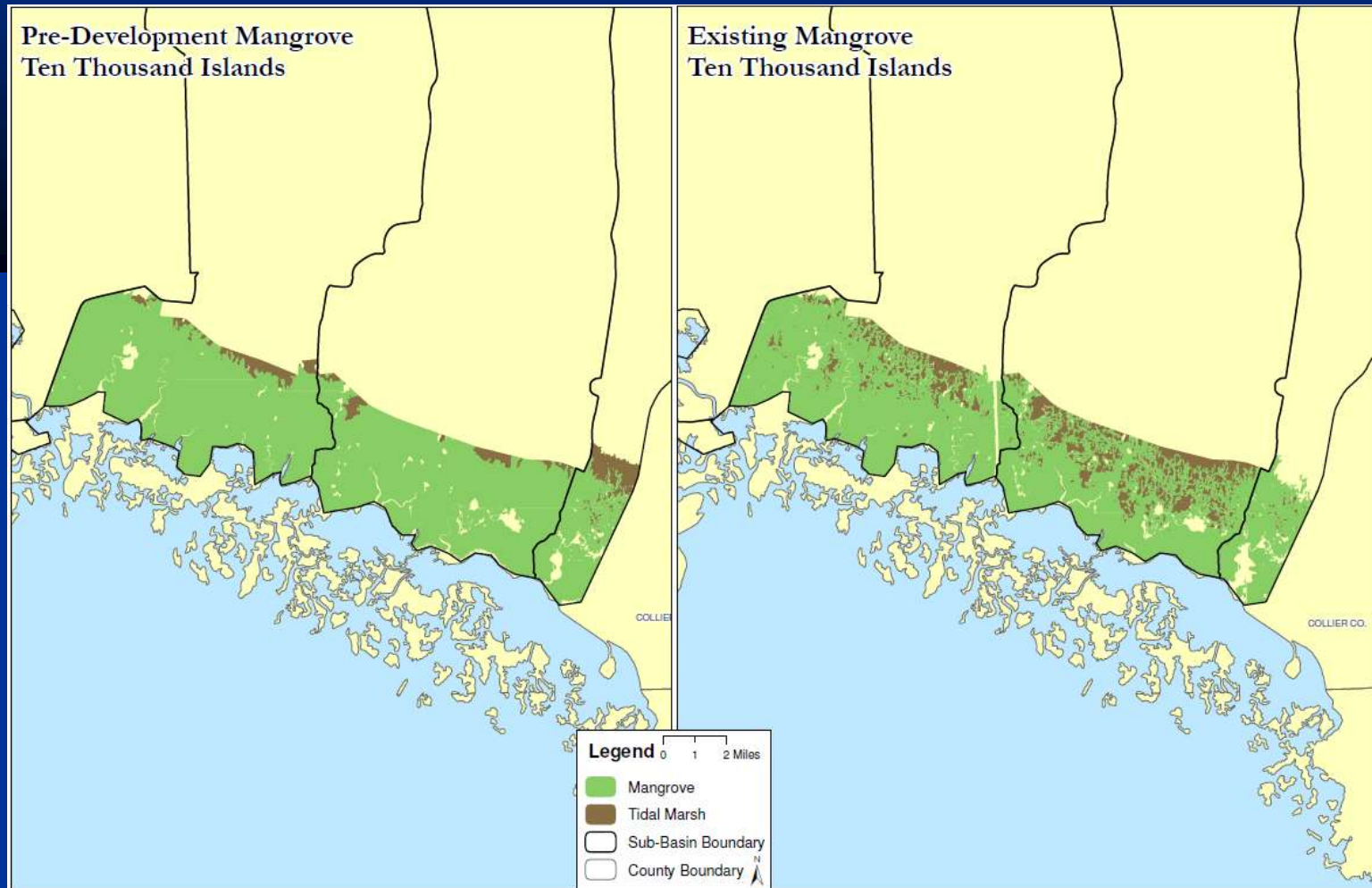
Rookery Bay



Rookery Bay

Rookery Bay	Pre-Development	Current	Acres Lost	Percent Loss
Tidal Marsh (Pre-Dev vs. 2007)	2,131	5,122	2,170	12
Mangrove (Pre-Dev vs. 2007)	15,735	10,575		

Ten Thousand Islands



Ten Thousand Islands

Ten Thousand Islands	Pre-Development	Current	Acres Lost	Percent Loss
Tidal Marsh (Pre-Dev vs. 2007)	2,711	7,737	1,916	5
Mangrove (Pre-Dev vs. 2007)	37,694	30,753		

Coastal Habitats Assessment

- Gradient of habitat loss
 - Naples Bay – 76 to 95 % decline in habitats
 - Wiggins Pass – 29% loss (that can be documented)
 - Rookery Bay – 12 % loss
 - Ten Thousand Islands – 5% loss
- These are only for mappable communities
- Hydrologic alteration may mean dead oyster reefs, even if still mappable

Existing Conditions

Major Conclusions

- Water quality can be a concern in portions of the most developed watersheds
- But, literature is quite clear...
- Most commonly cited concern with estuarine health is water quantity
 - Changes in amounts and timing of freshwater inflow
- Concerns with water quality shouldn't trump need to get hydrology corrected

What's Next

- Performance Measures
- Alternatives Analysis
- Preparation of Watershed Management Plans



Performance Measures

■ Surface Water Systems

■ Freshwater Discharge to Estuaries

- Build upon Reference Salinity:Flow Relationship

■ Hydroperiod, Water Depth

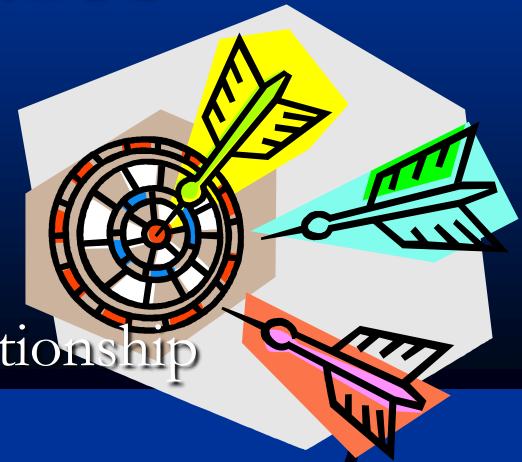
- Used to Evaluate Wetland Systems

■ Flood Protection

- Potential effects on flood depth – evaluation at regional scale

■ Water Quality and Pollutant Loads

- Tied back to TMDLs



Performance Measures

■ Groundwater Systems

- Aquifer yields (volume of available water)
- Groundwater recharge
- Salinity intrusion
- Wellhead Protection

■ Natural Systems

- Vegetation
- Hydrology
- Landscape Suitability Index



Alternatives Analysis

- Structural projects
 - Evaluate effect of current projects:
 - Picayune Strand
 - Golden Gate Diversion
 - LASIP
 - Consider projects identified in SWFFS, or Naples Bay SWIM plan, or Belle Meade Plan, etc.
 - Other potential projects



Alternatives Analysis

- Non-structural projects
 - Policy related issues
 - Low Impact Development
 - Land Development Regulations
 - Etc.
 - Operation Strategies
 - Public Education Strategies
 - Rain Barrels
 - Runoff Gardens
 - Etc.



Watershed Management Plans

- Separate Watershed Management Plans for each watershed.
 - Cocohatchee-Corkscrew
 - Golden Gate Naples Bay
 - Rookery Bay
 - Additional Watersheds
- Target date for submittal to Collier County is December 2010.

**Long-Term
Plan**



Wrap Up

- If you didn't sign in, please do so
 - Include your E-mail address and Phone Number
- Comments via E-Mail

machatcher@colliergov.net

- Formal position papers
 - Please mail to Mac Hatcher