Collier County

Watershed Management Plan

February 24, 2011 DSAC Subcommittee

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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 May 2011.

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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

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Project Team Organization

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Principal-in-charge

QA/QC

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

Watershed Modeling	Water Resource Evaluation	Natural Systems Evaluation
Tim Hazlitt, P.G. - DHI	Dave Tomasko, Ph.D. – PBS&J	Ed Cronyn – PBS&J
Preston Manning – DHI	Peter deGolian – PBS&J	Dave Tomasko, Ph.D. – PBS&J
Peter deGolian – PBS&J	Eric Fontenot, P.E. - DHI	

Other Support Services

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Agenda - WMP Background

- Study Area and H&H Model Description
- Summary of Existing Conditions and Issues
  - Water Quantity
  - Water Quality
- Initial Identification of Potential Projects
- Natural Resources/Functional Assessment
- Performance Measures
- Regulatory Review

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Watersheds

- Top Priority Watersheds
  - Cocohatchee Corkscrew
  - Golden Gate
  - Rookery Bay
- Additional Watersheds
  - Faka Union
  - Fakahatchee
  - Okaloacoochee SR 29

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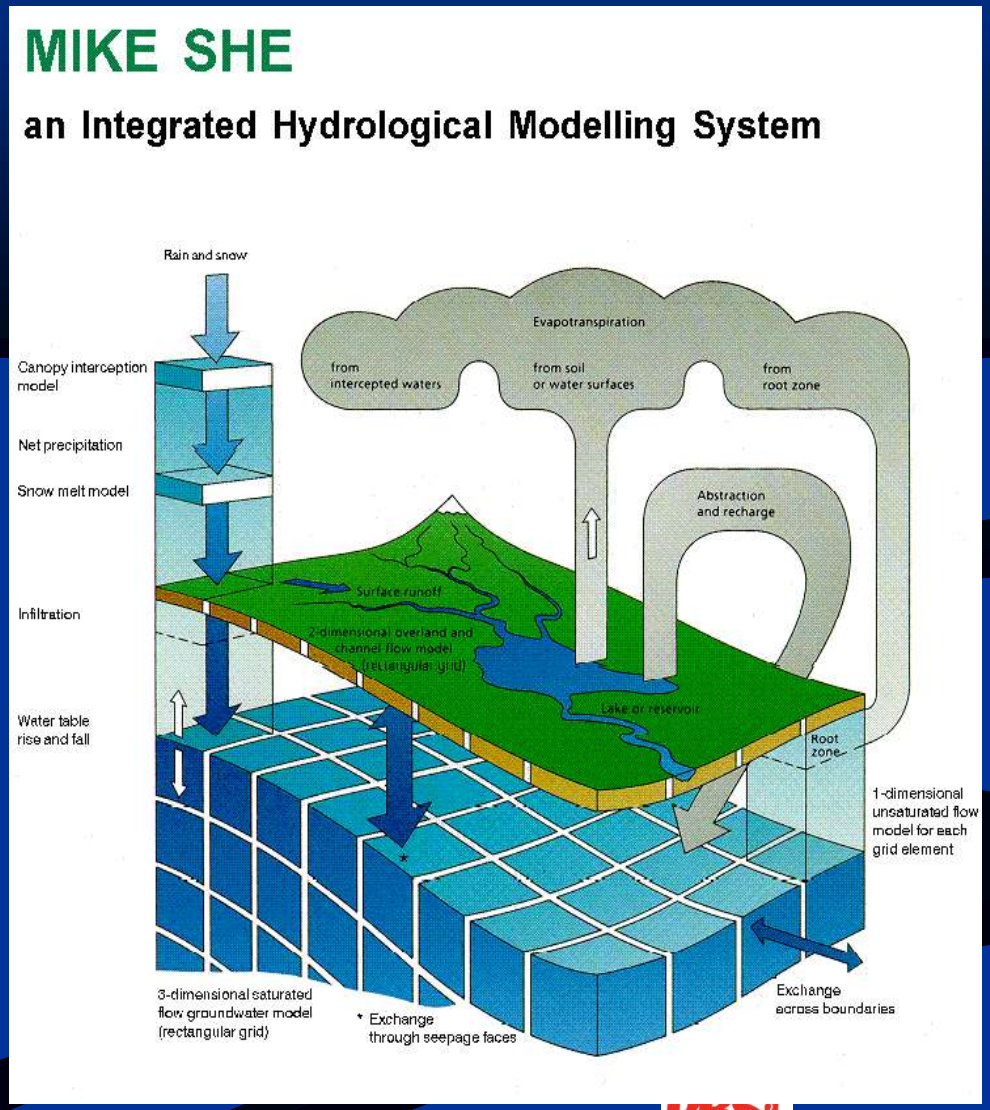
Existing Conditions Model

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



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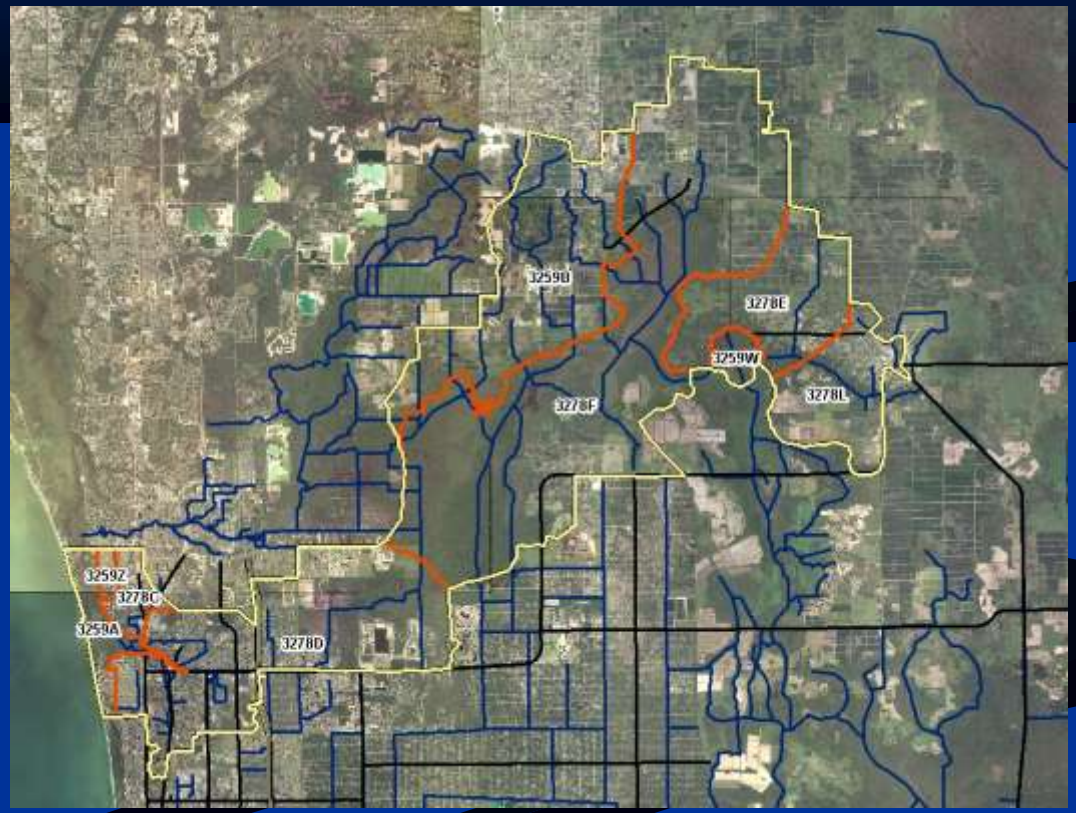
Cocohatchee Corkscrew Watershed

- Area : ~200 sq. miles
- FDEP subdivided into 9 "WBIDs"
- Development centered in Immokalee and near I-75 at Immokalee Rd.
- Primarily wetlands in the central portion of the basin



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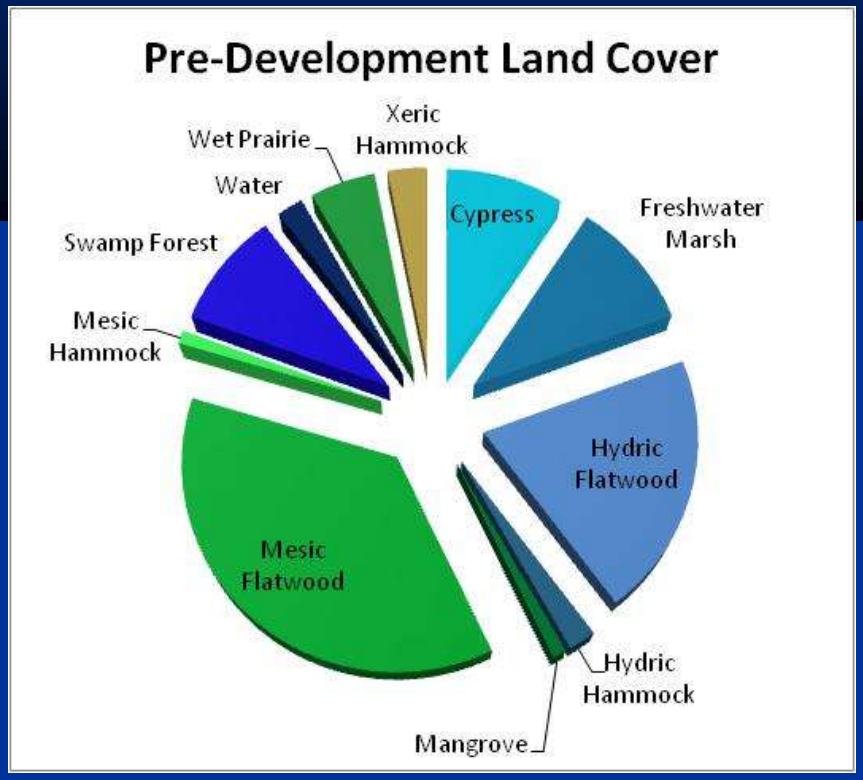
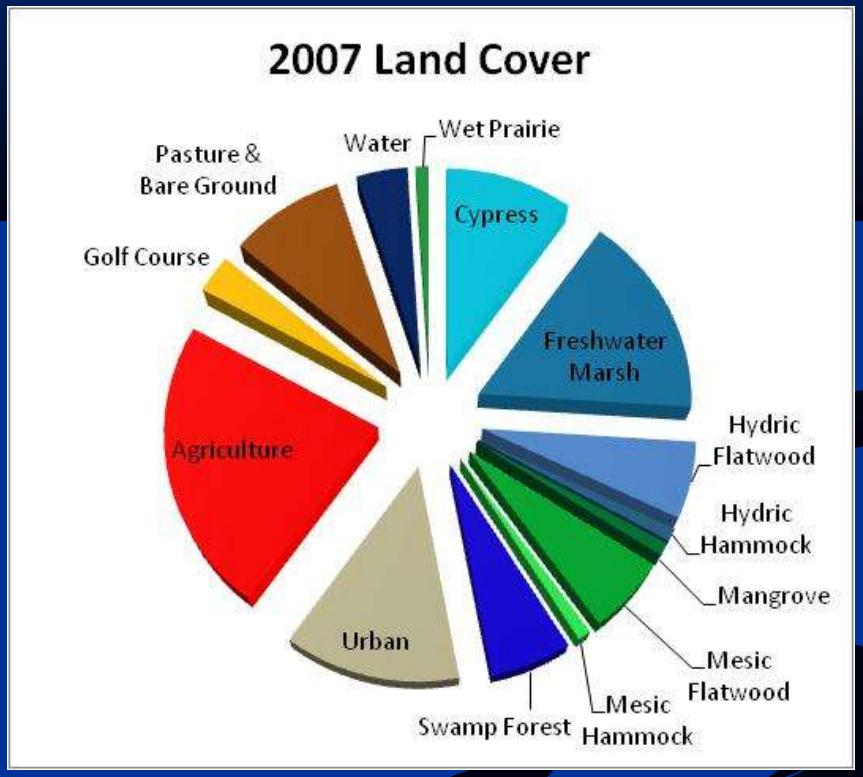
Cocohatchee Corkscrew Land Use Comparison





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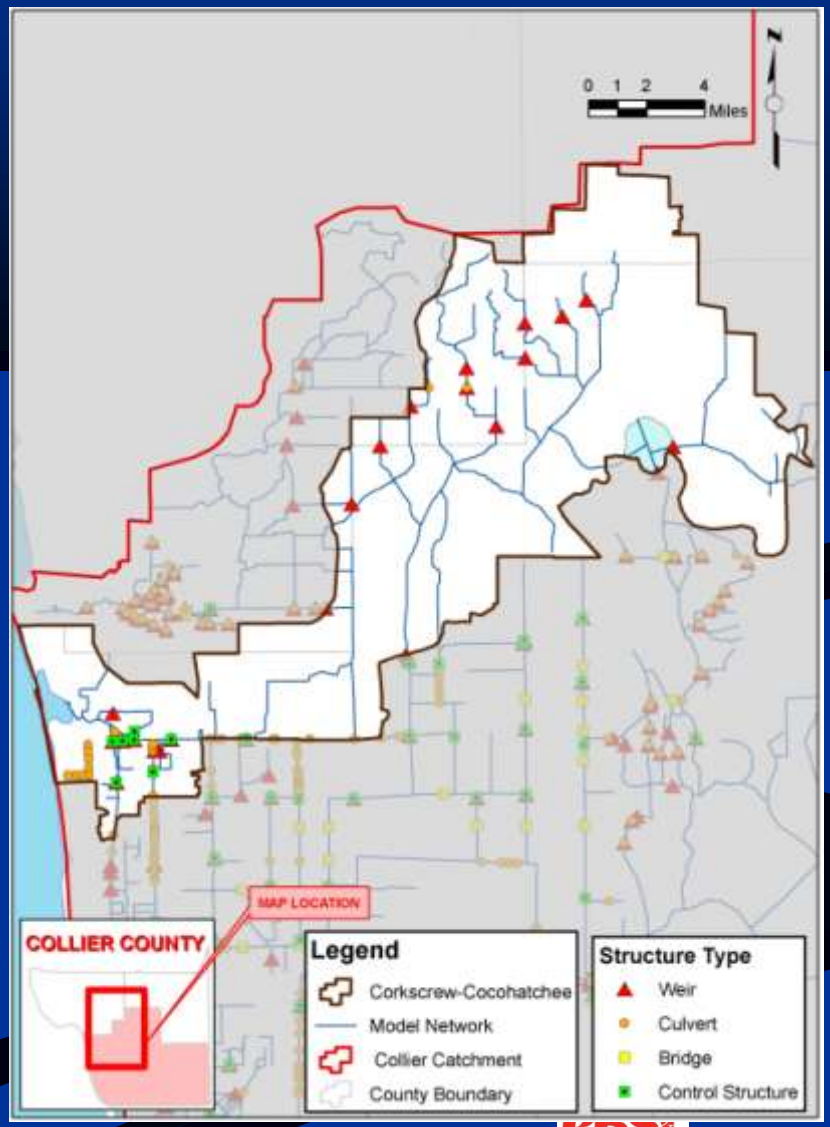
Cocohatchee Corkscrew

- Primary drainage is Cocohatchee Canal
- Wet season water transfers with Golden Gate, Fakahatchee, and Imperial River watersheds



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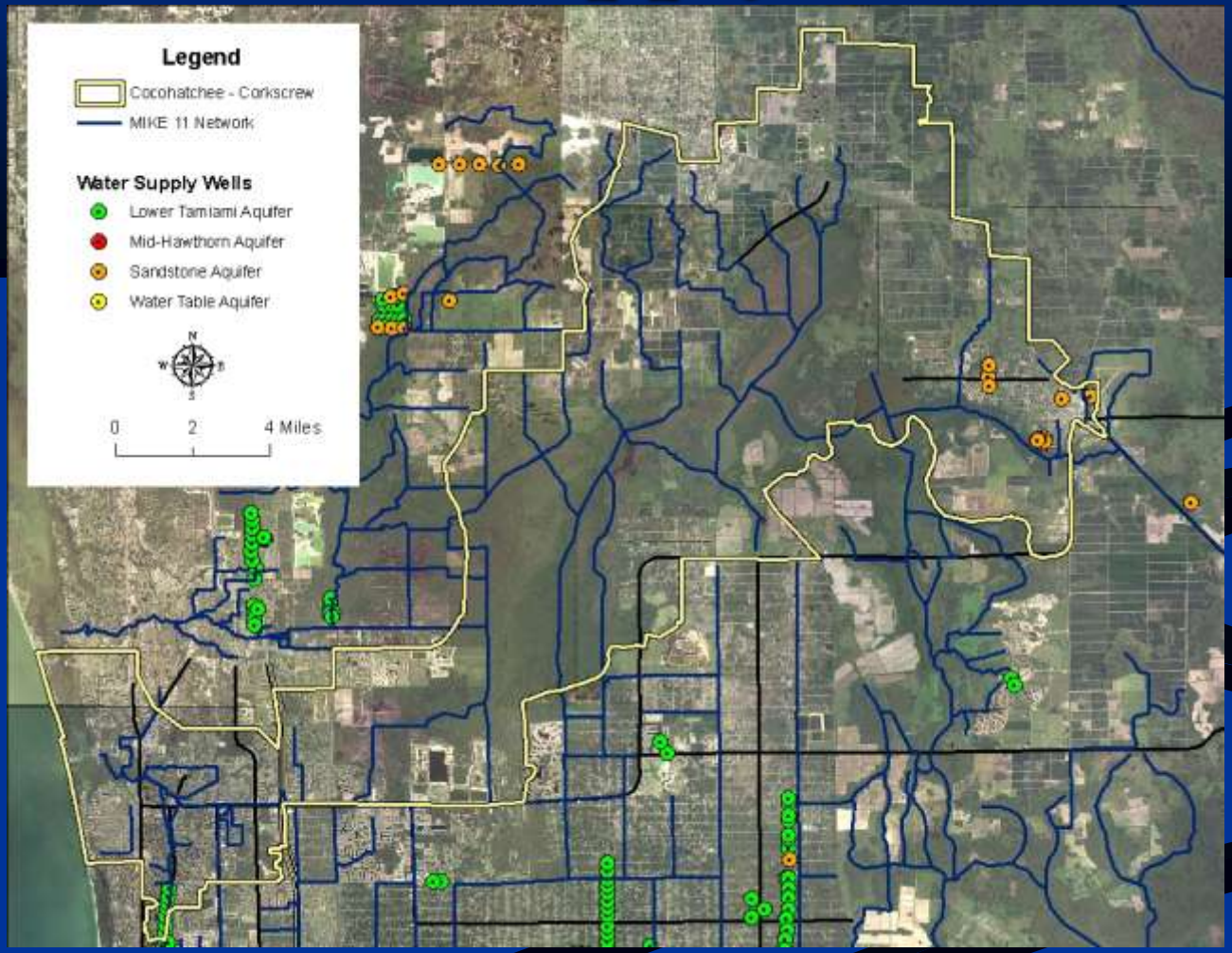
Cocohatchee Corkscrew Watershed Water Supply Wells



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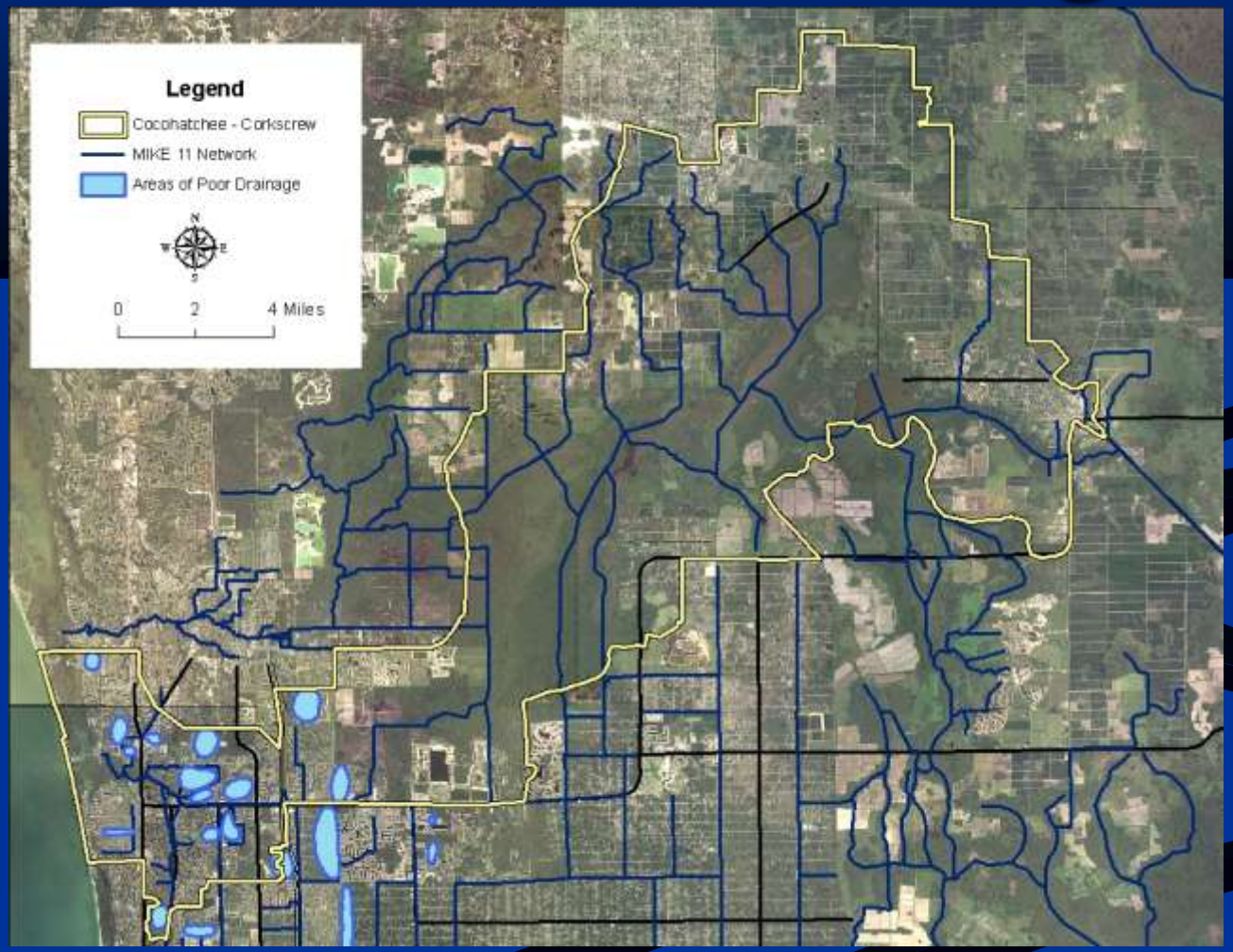
Cocohatchee Corkscrew Areas of Poor Drainage



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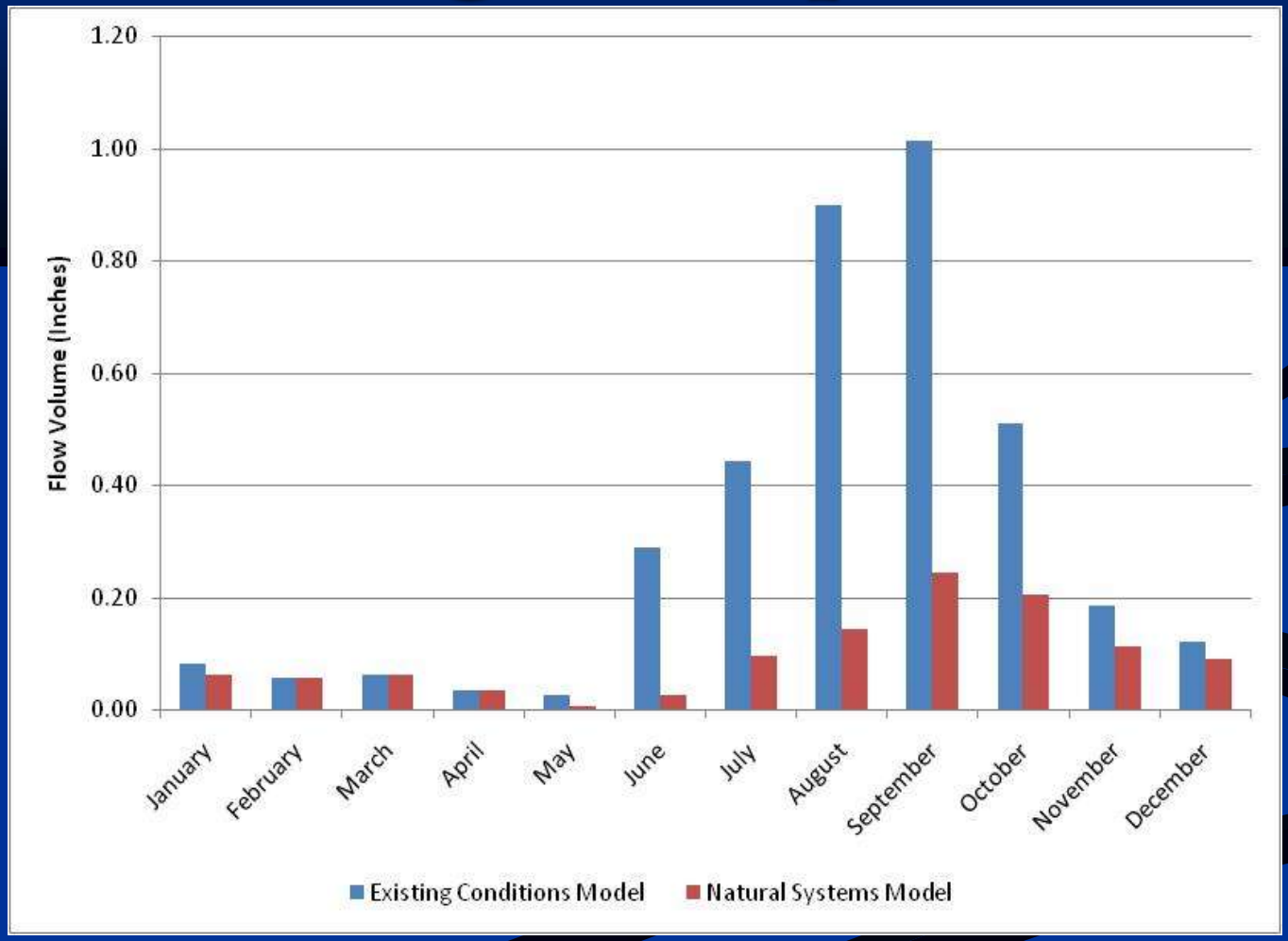
Cocohatchee Corkscrew Discharge Comparison



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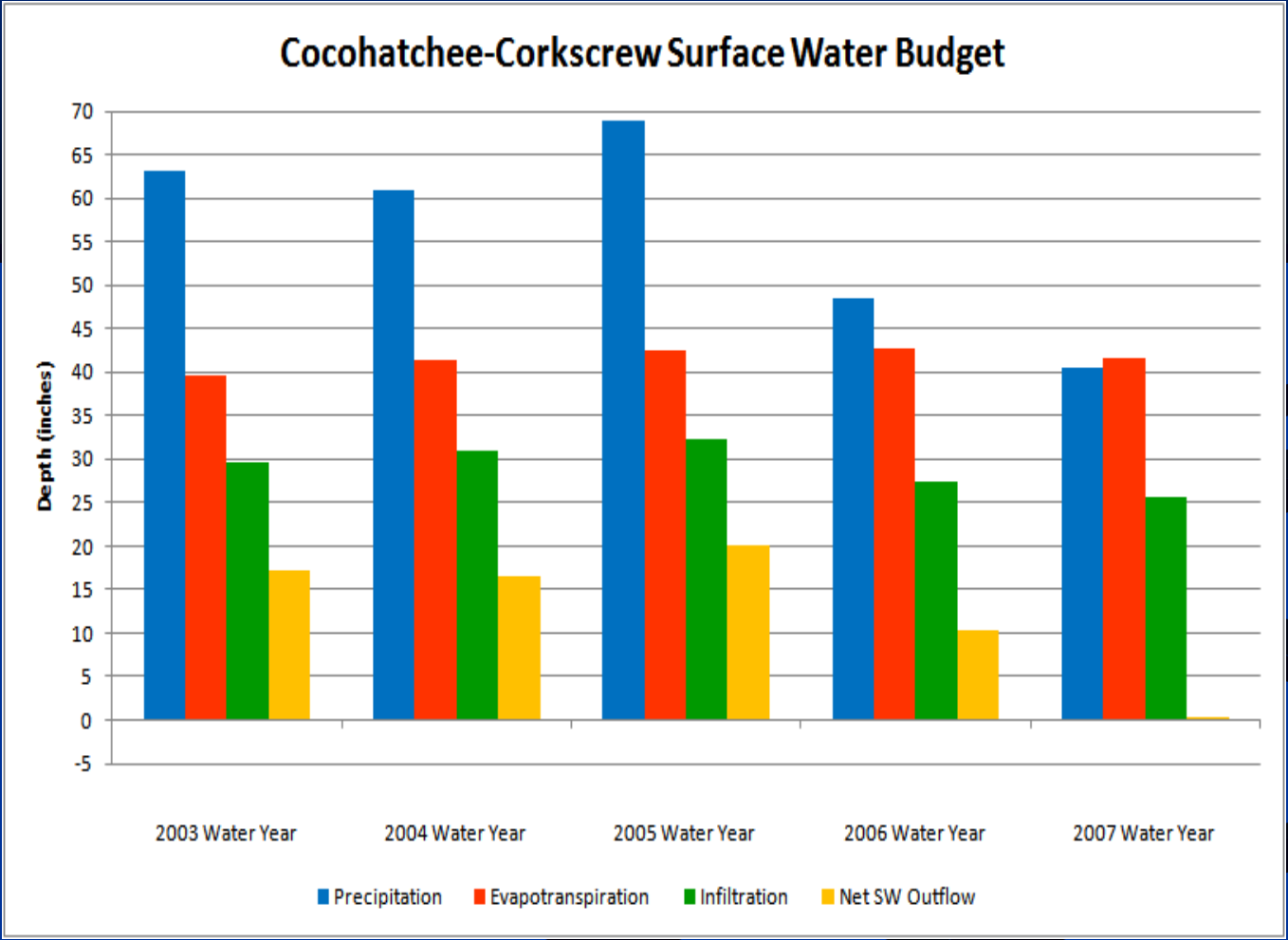
Cocohatchee Corkscrew Surface Water Budget



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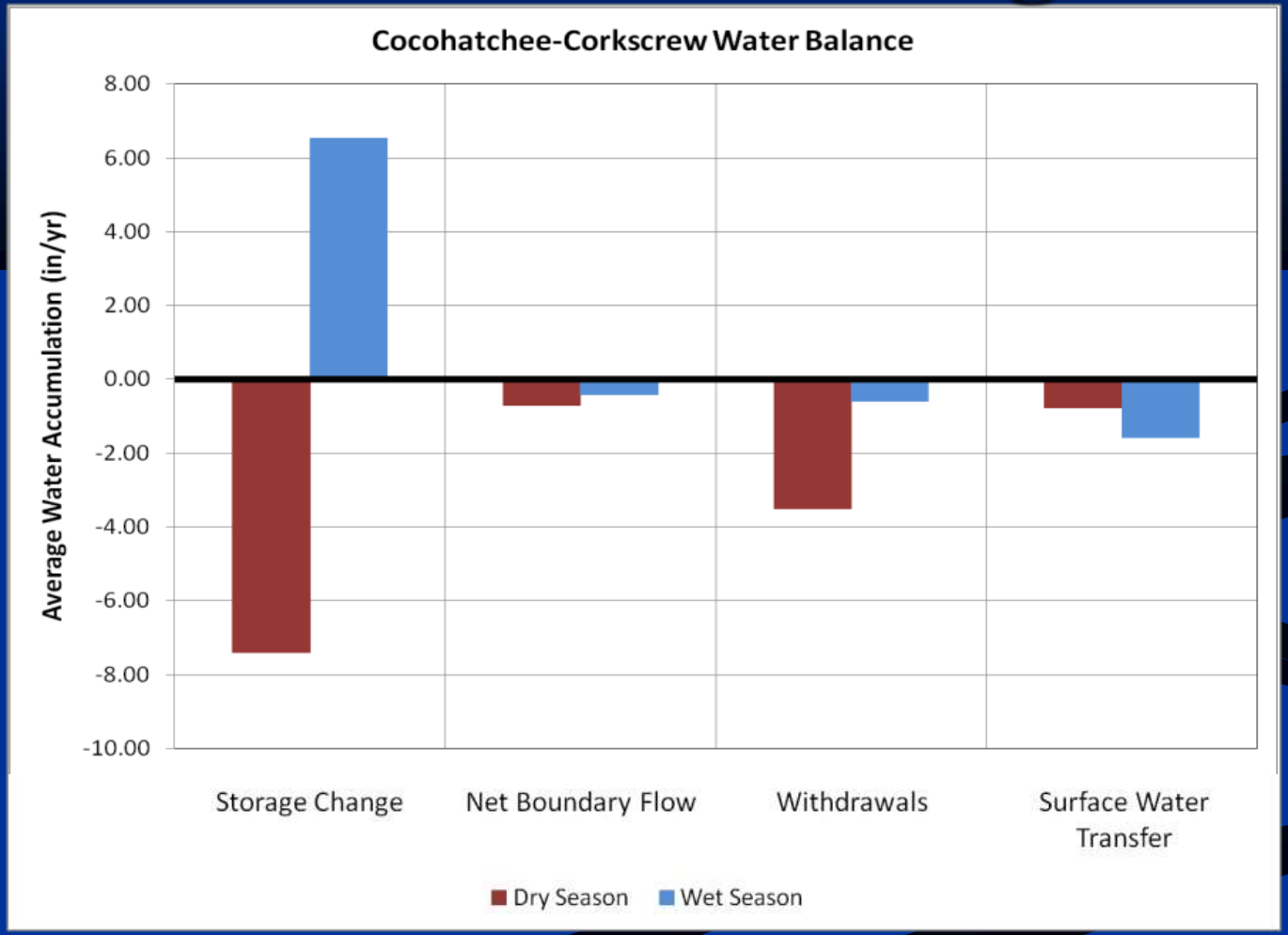
Cocohatchee Corkscrew Groundwater Budget



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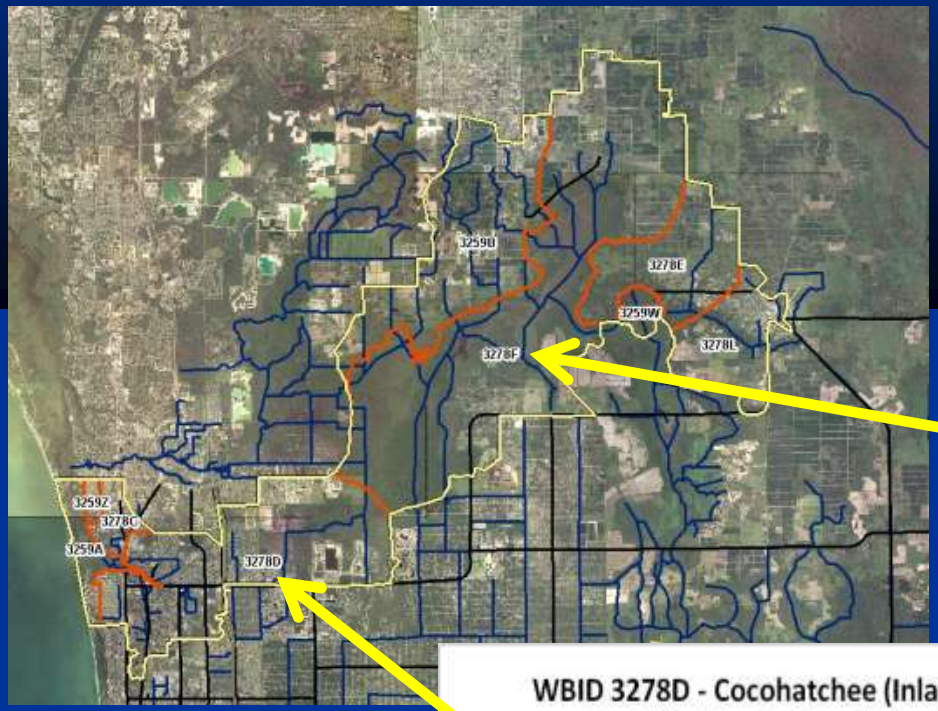
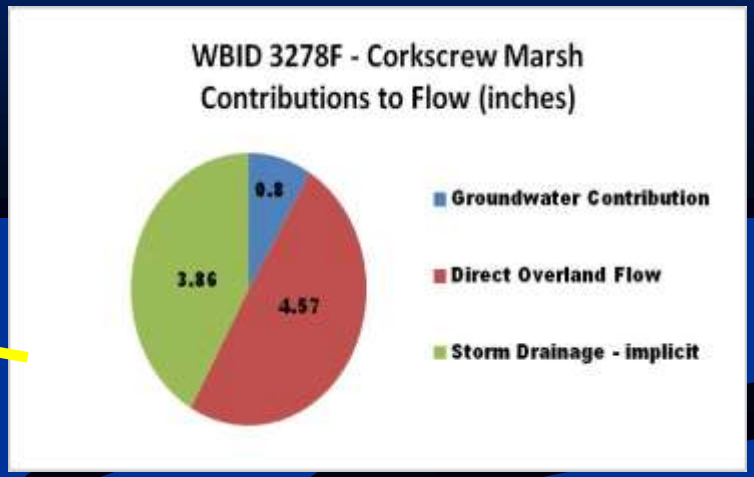
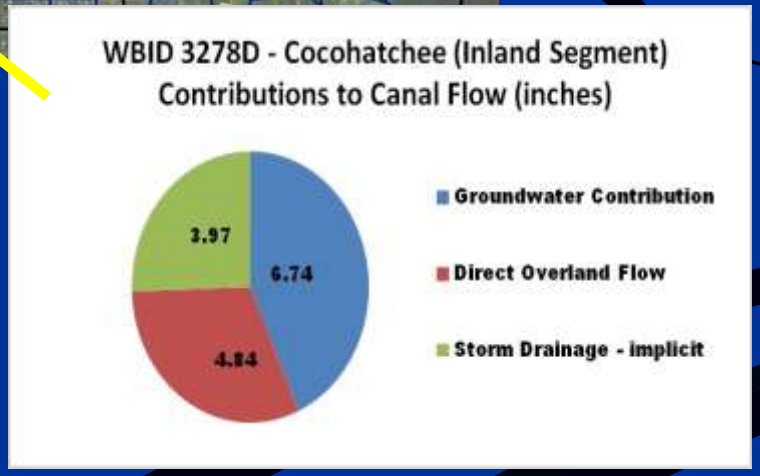
Cocohatchee Corkscrew WBID Contributions to Canal







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Cocohatchee Corkscrew Summary of Water Quantity Issues

- Watershed area has not changed significantly
  - Land Use has changed significantly (50% urban/ag)
- Hydrology of remaining wetlands has changed
  - Shorter hydro-period and less water stored
- Greater discharge to the estuary
  - Approximately two inches (2”) in the wet season
- High groundwater contribution to canals
  - Approximately 6.5” to the Cocohatchee Canal WBID

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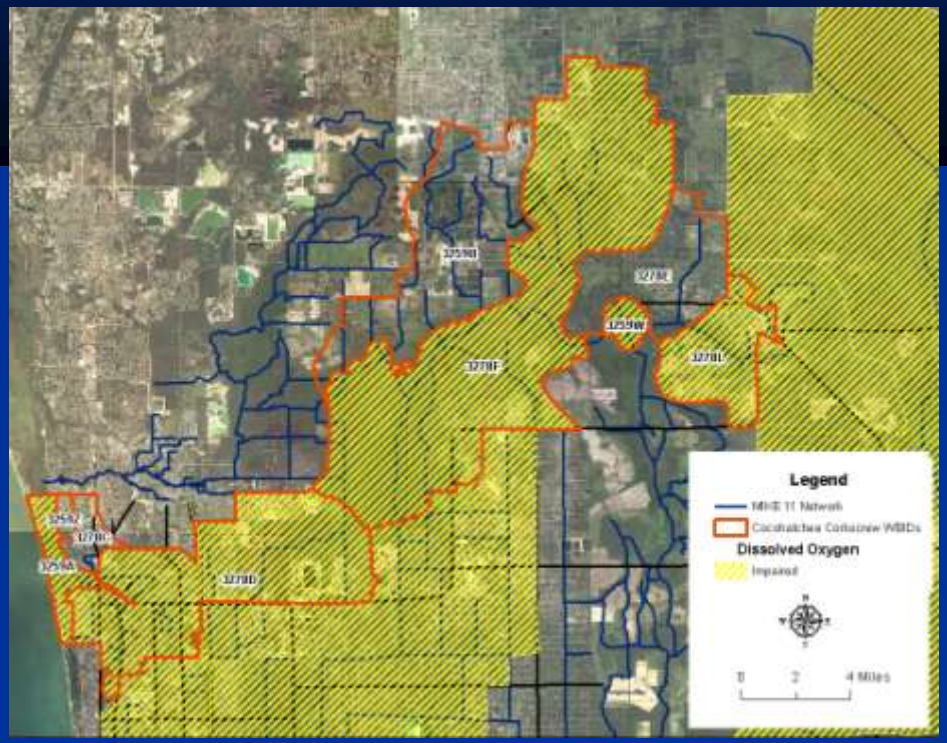
Cocohatchee Corkscrew FDEP Identified Impairments

Dissolved Oxygen



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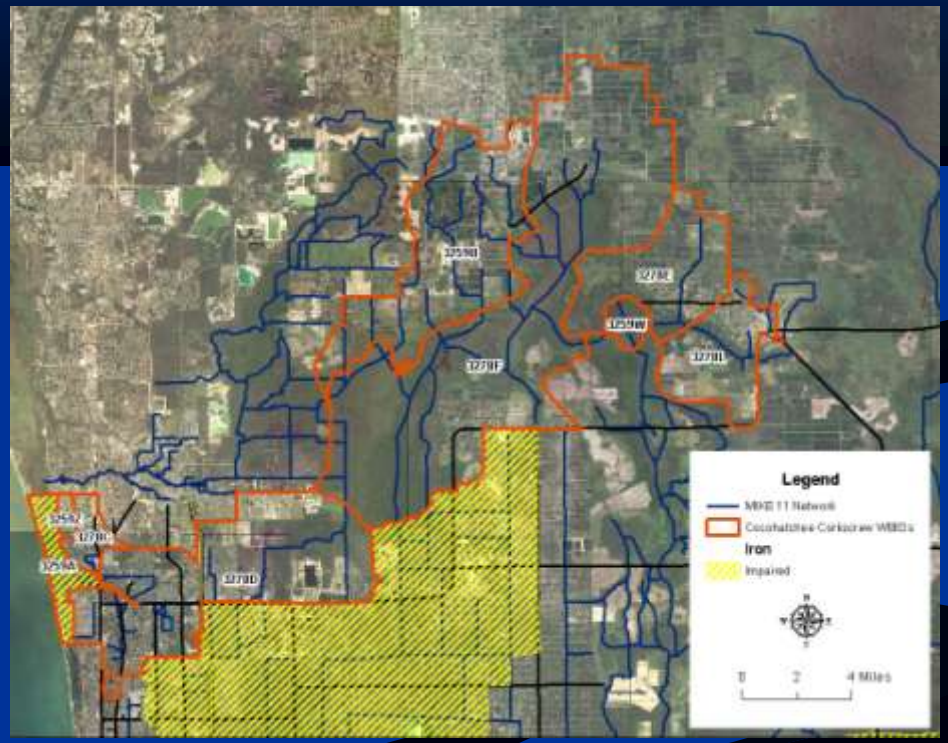

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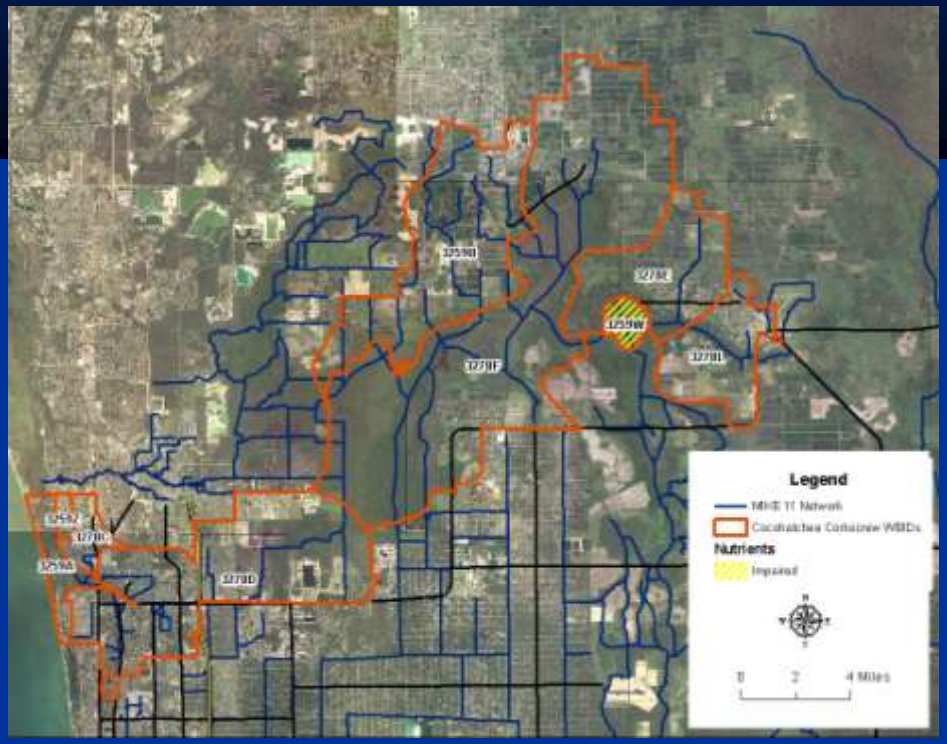
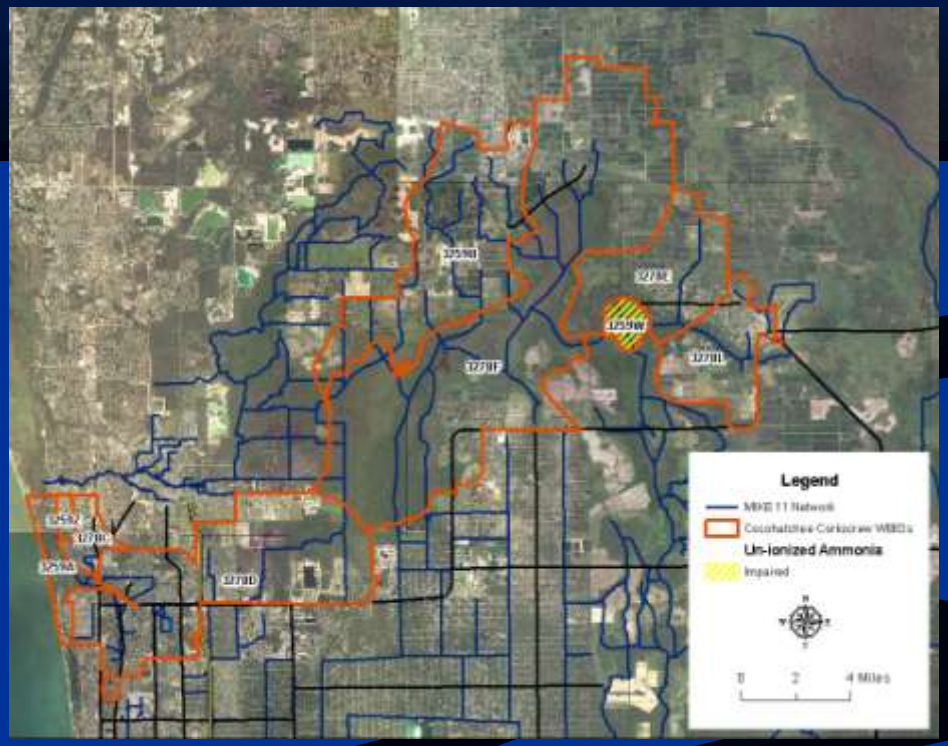
Cocohatchee Corkscrew FDEP Identified Impairments

Nutrients (Chlorophyll a)



Un-ionized Ammonia



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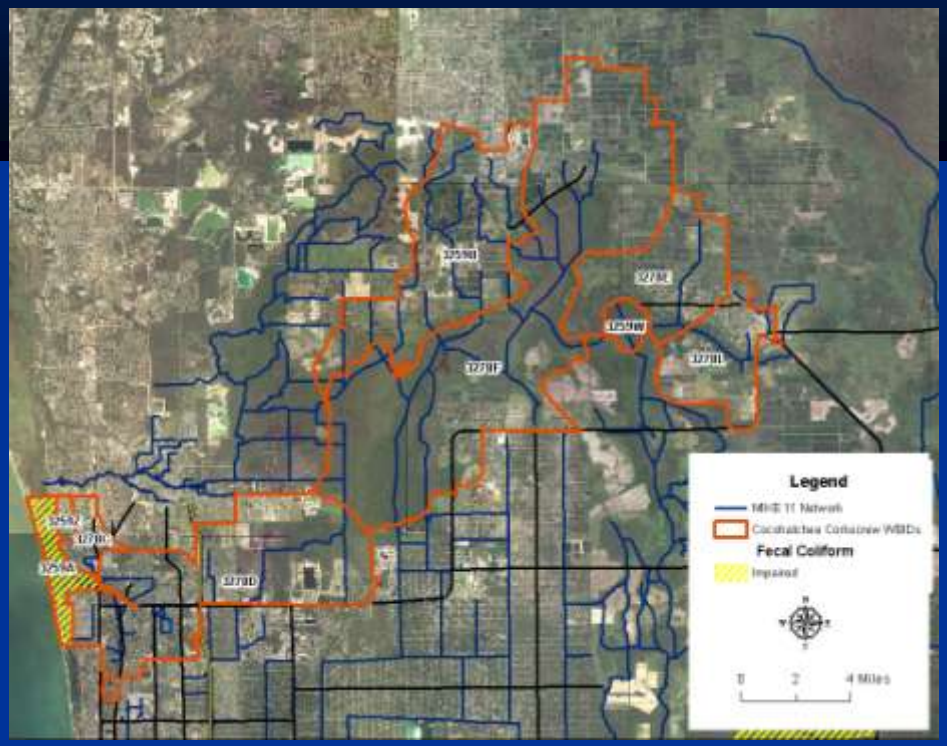
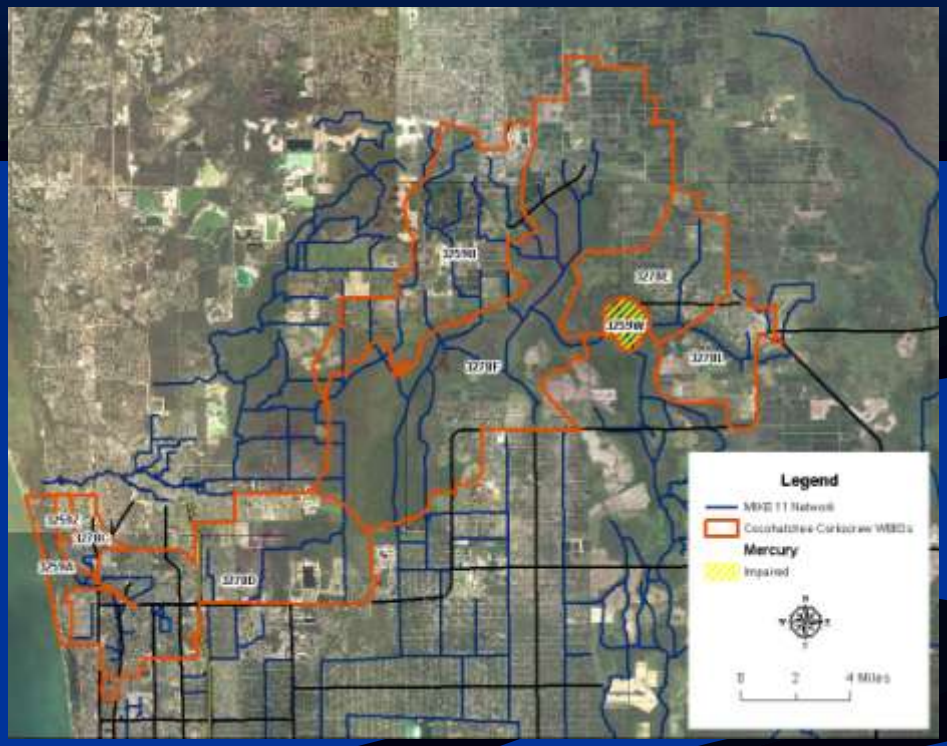
Cocohatchee Corkscrew FDEP Identified Impairments

Fecal Coliform



Mercury



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Cocohatchee Corkscrew Summary of Water Quality Issues

- Lake Trafford is impaired for five parameters
  - Impairments based on data collected prior to dredging project
- Wiggins Pass Estuary is identified as impaired for three parameters; TMDL Fecal Coliform
- Five WBIDs impaired for Dissolved Oxygen
  - Is the cause nutrient concentrations, groundwater inflow, wetland discharges, or all of the above?

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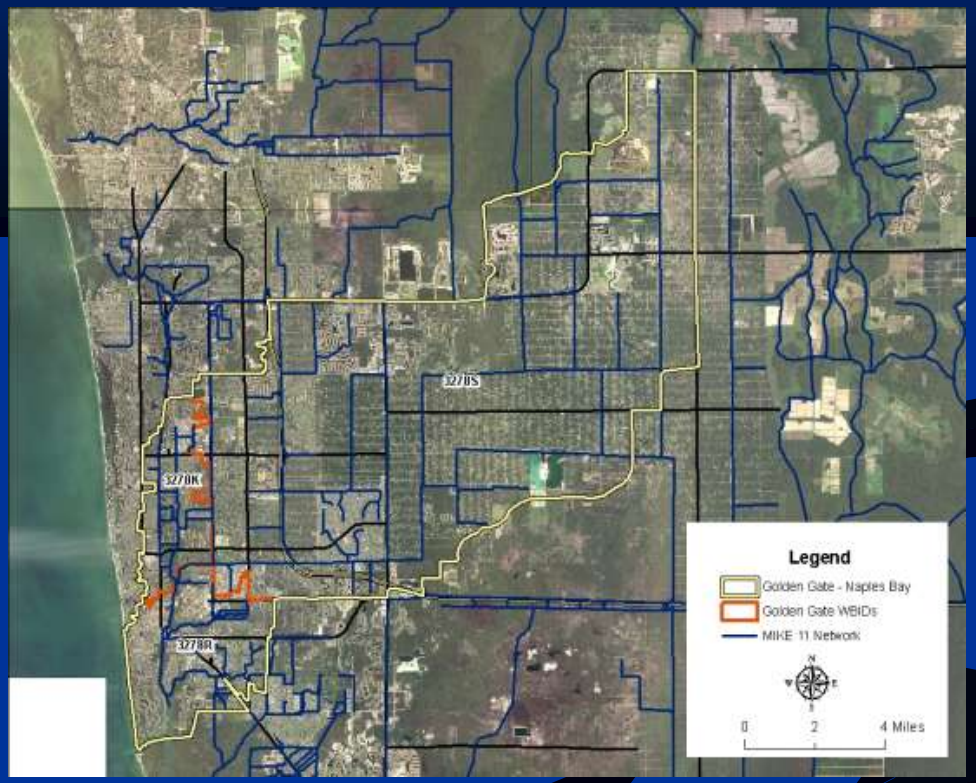
Golden Gate – Naples Bay Watershed

- Area : ~135 sq. miles
- Mainly Urban Land Uses
- Most lots platted in 1960's; wetland connectivity was lost
- FDEP subdivided into 3 "WBIDs"



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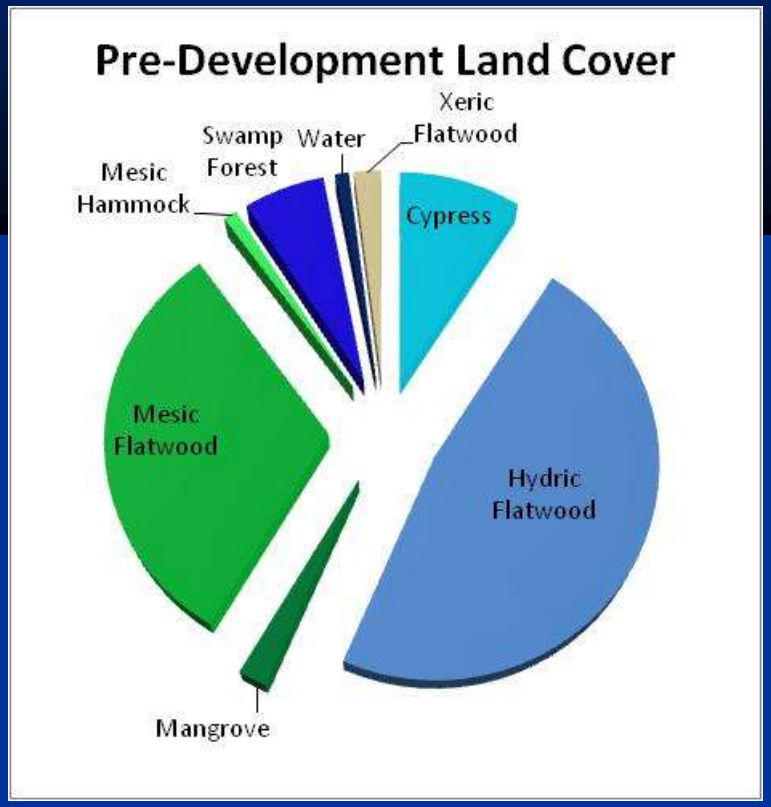
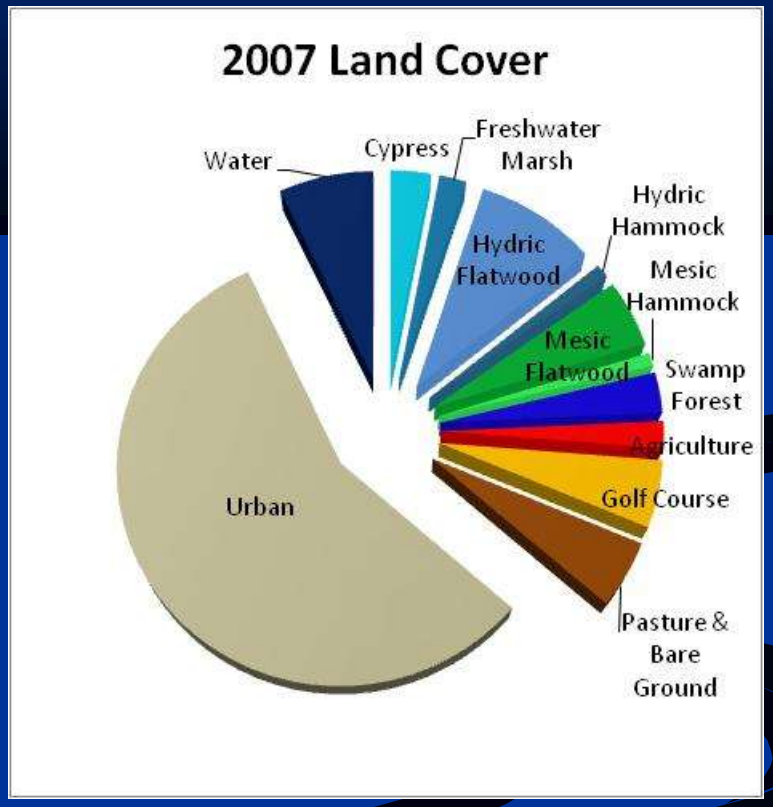
Golden Gate – Naples Bay Land Use Comparison





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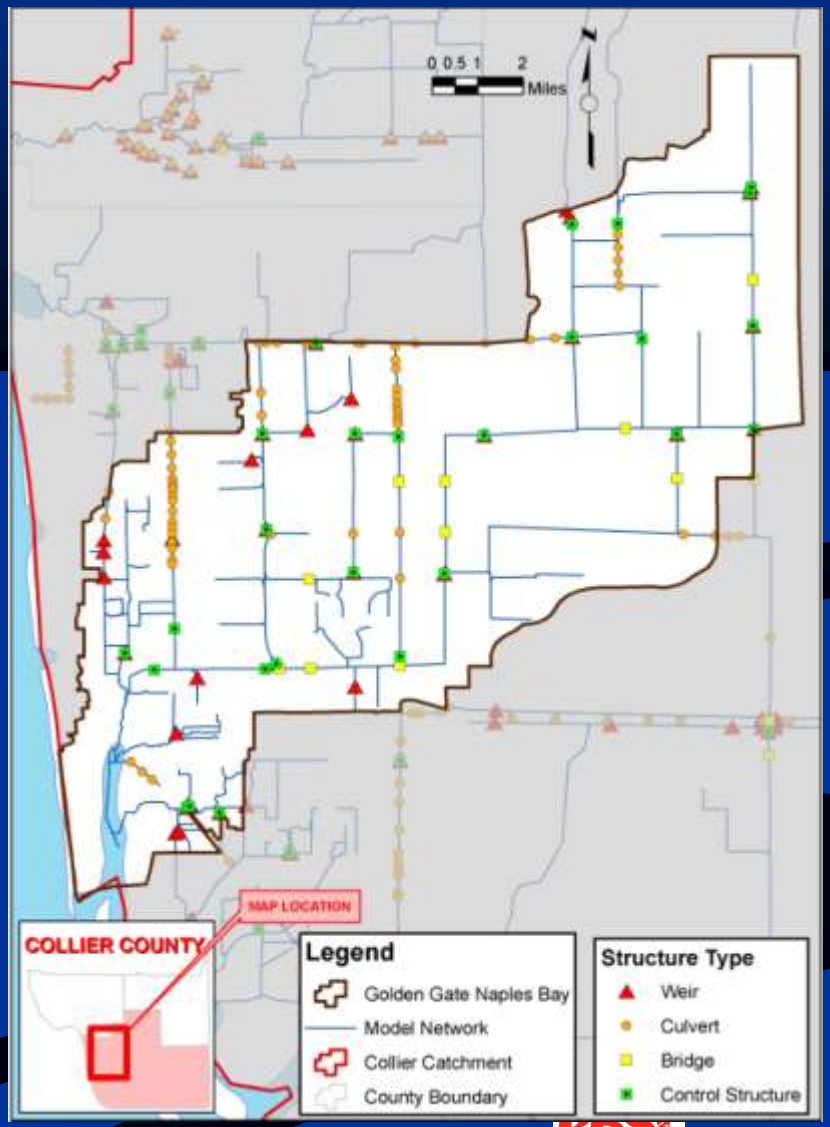
Golden Gate – Naples Bay

- Primary drainage is Golden Gate Main Canal that discharges to Naples Bay
- Drainage pattern changed due to development
- Watershed almost 10X larger than pre-development



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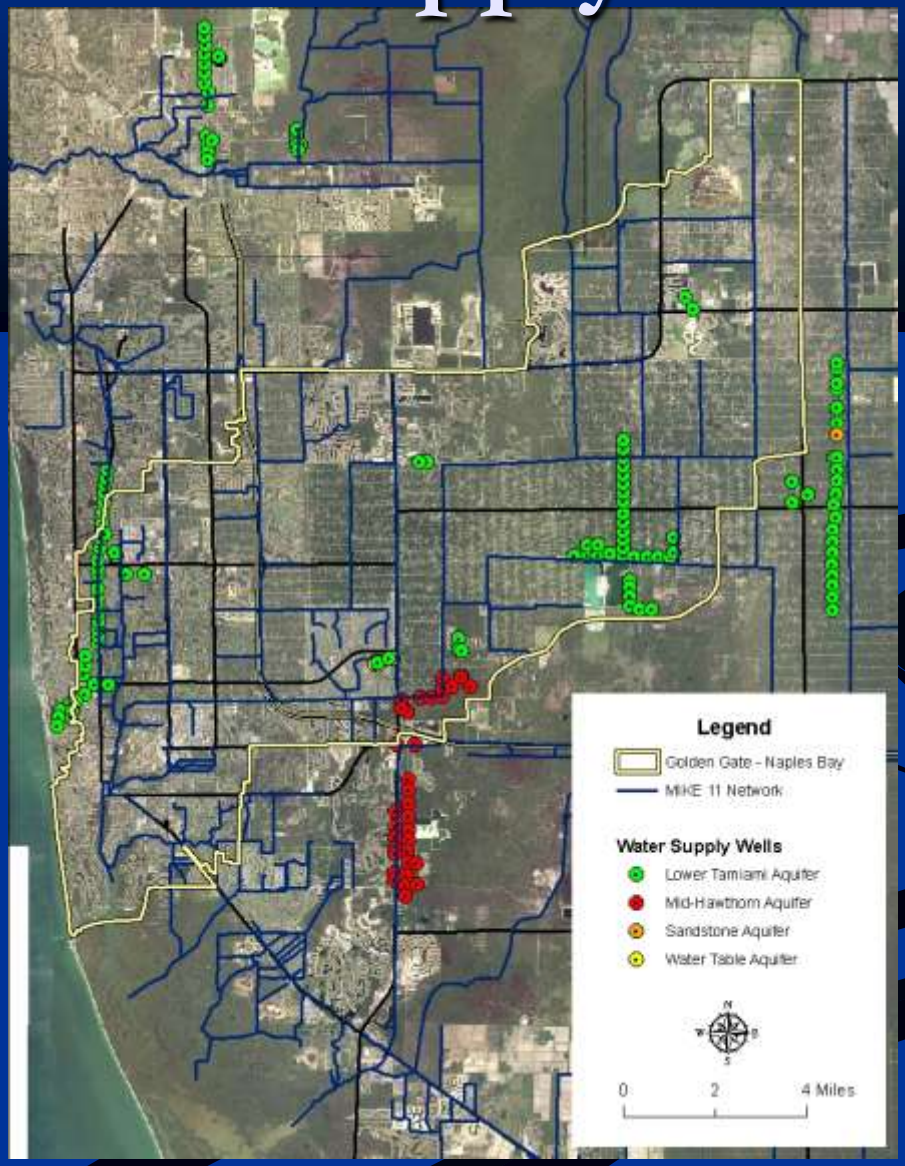
Golden Gate – Naples Bay Water Supply Wells



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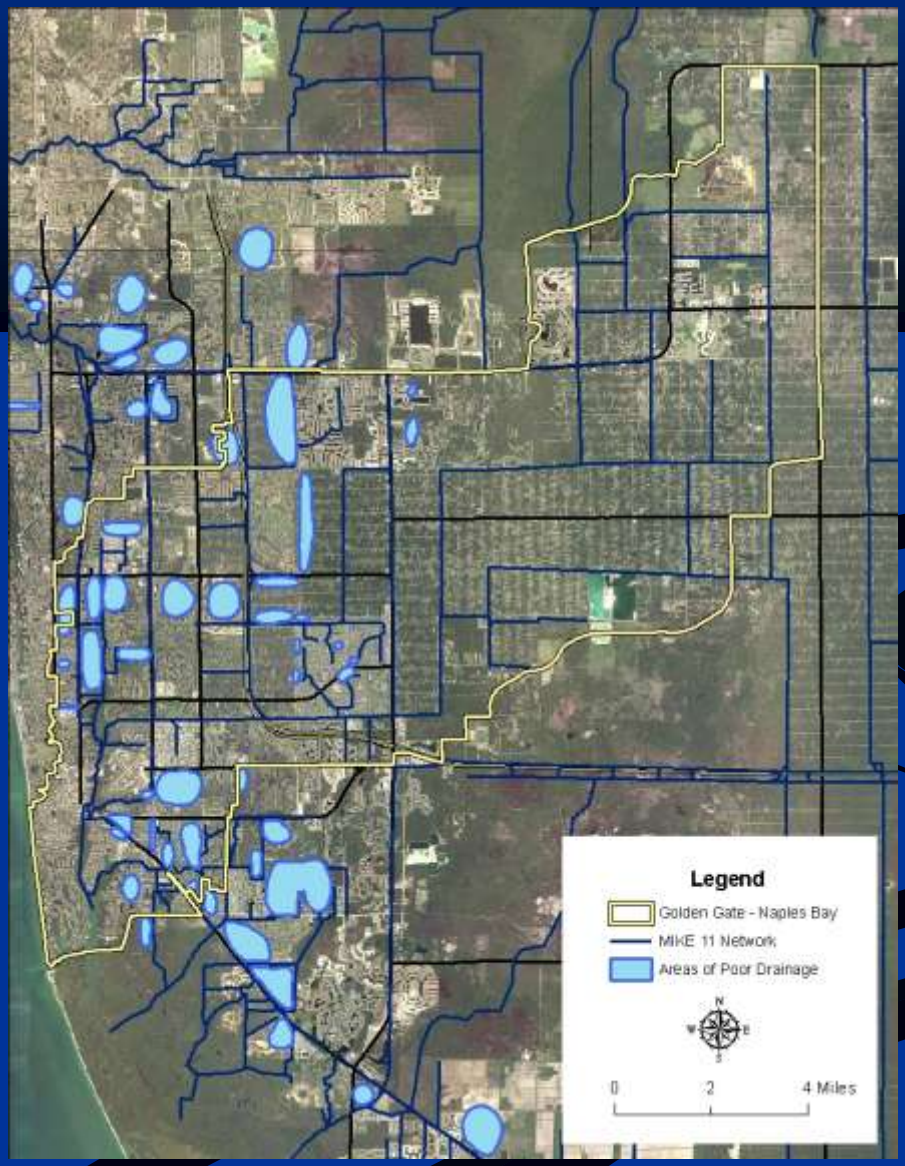
Golden Gate – Naples Bay Areas of Poor Drainage



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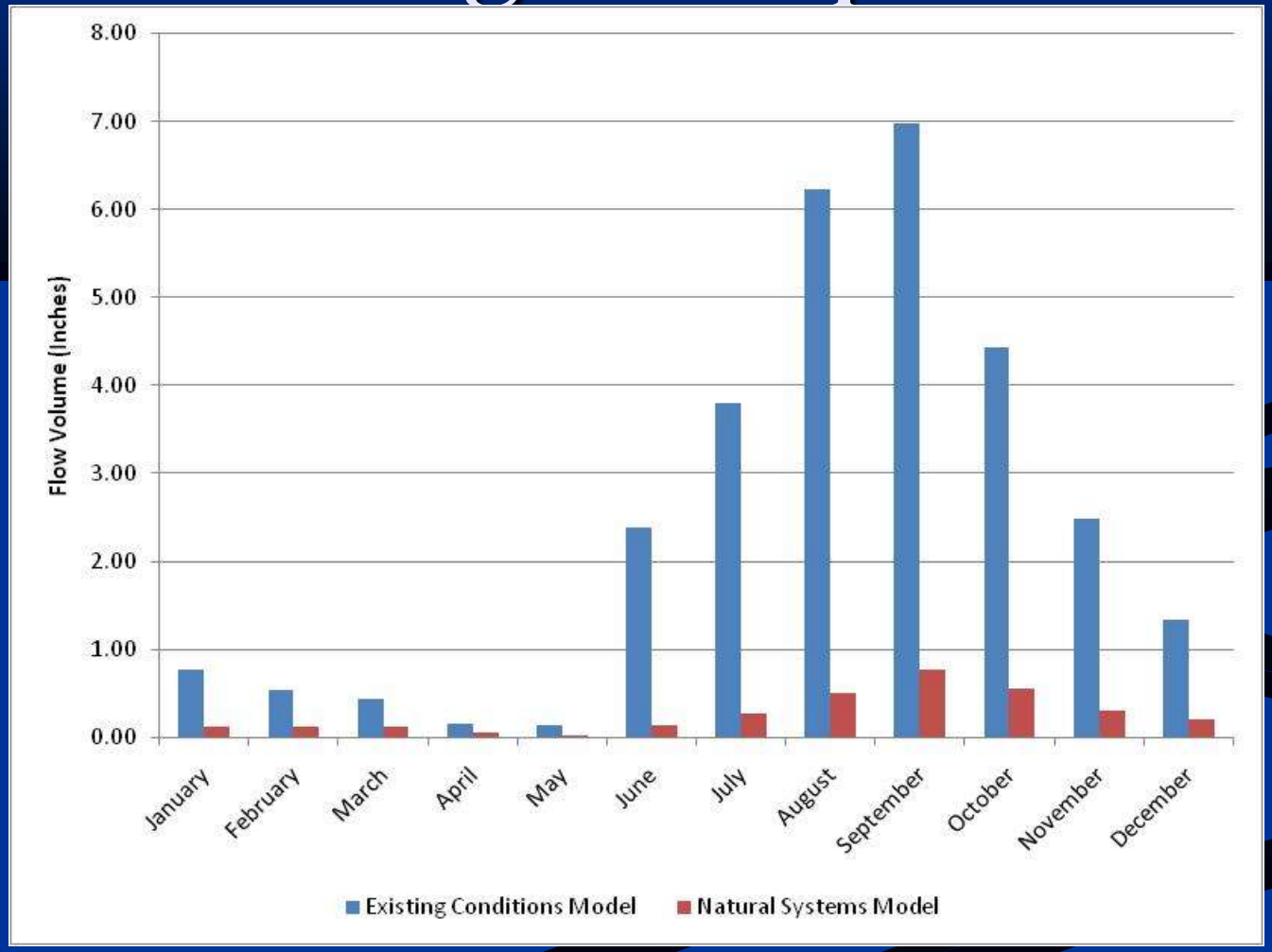
Golden Gate – Naples Bay Discharge Comparison



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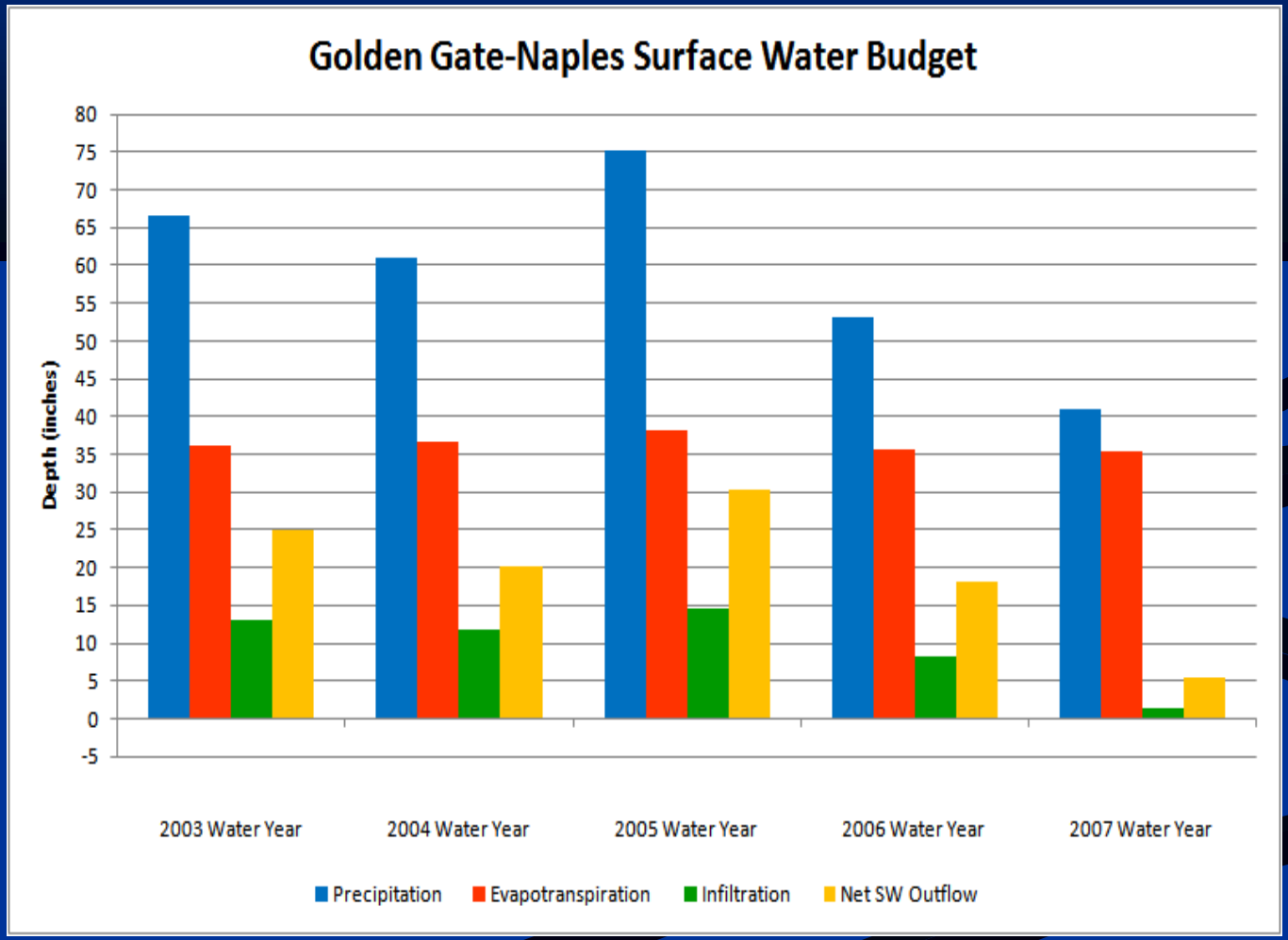
Golden Gate – Naples bay Surface Water Budget



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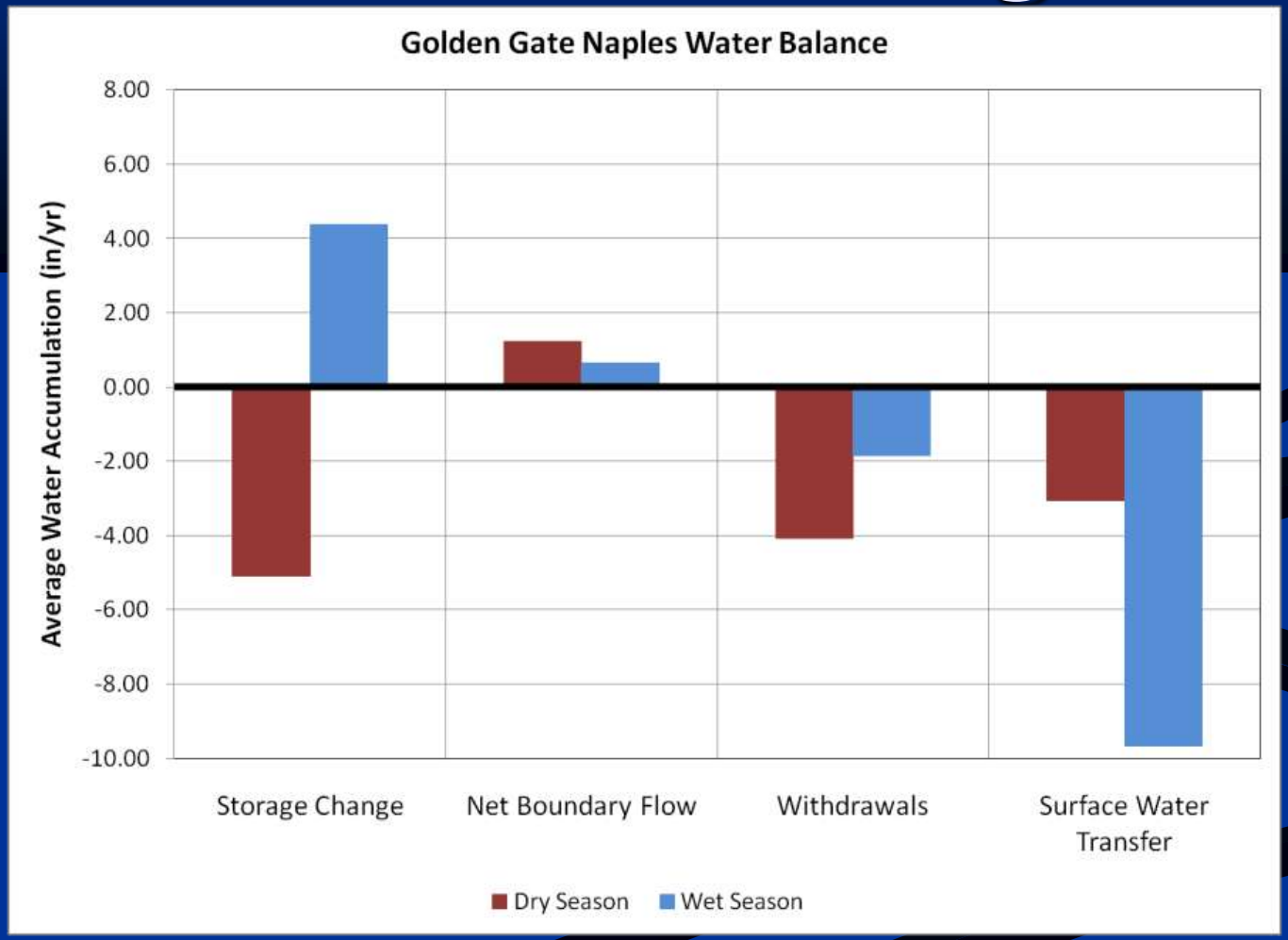
Golden Gate – Naples Bay Groundwater Budget



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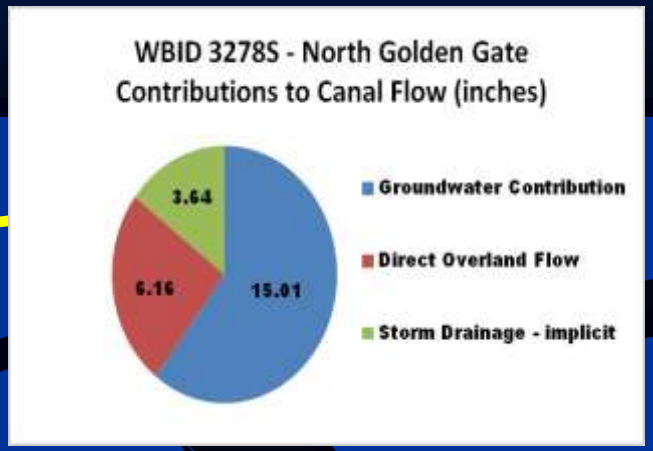
Golden Gate – Naples Bay WBID Contributions to Canal



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Golden Gate – Naples Bay Summary of Water Quantity Issues

- Watershed area has increased 10 times due to construction of drainage system
- Hydrology of remaining wetlands has changed
  - Shorter hydro-period and less water stored
  - Wetland connectivity has been broken
- Greater discharge to the estuary
  - Approximately 19" in the wet season
- High groundwater contribution to canals
  - Approximately 15" to the canal network

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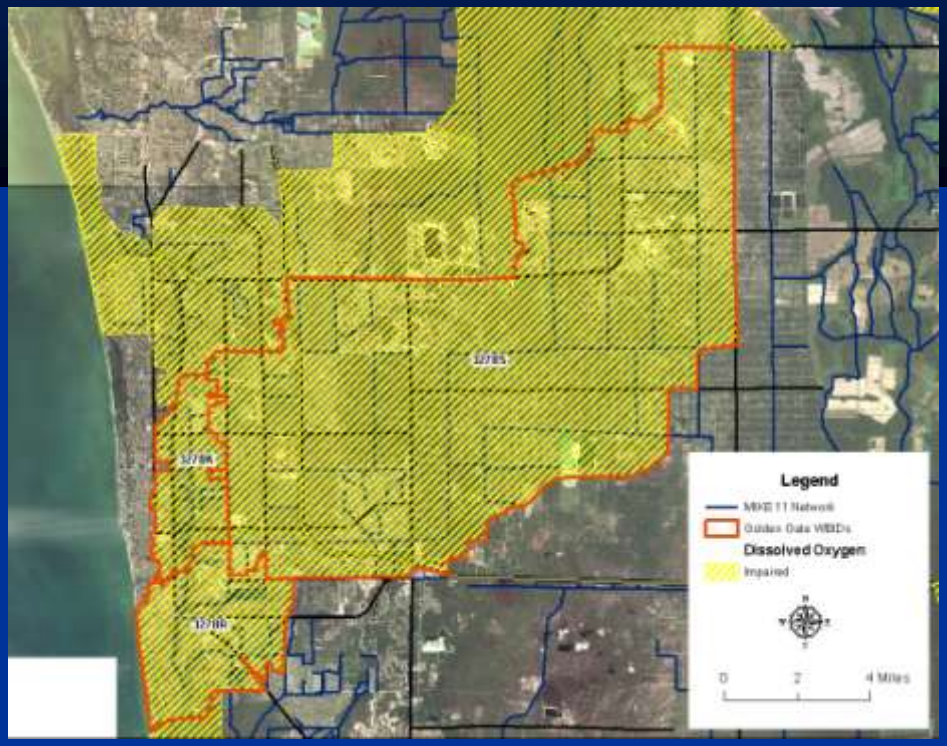
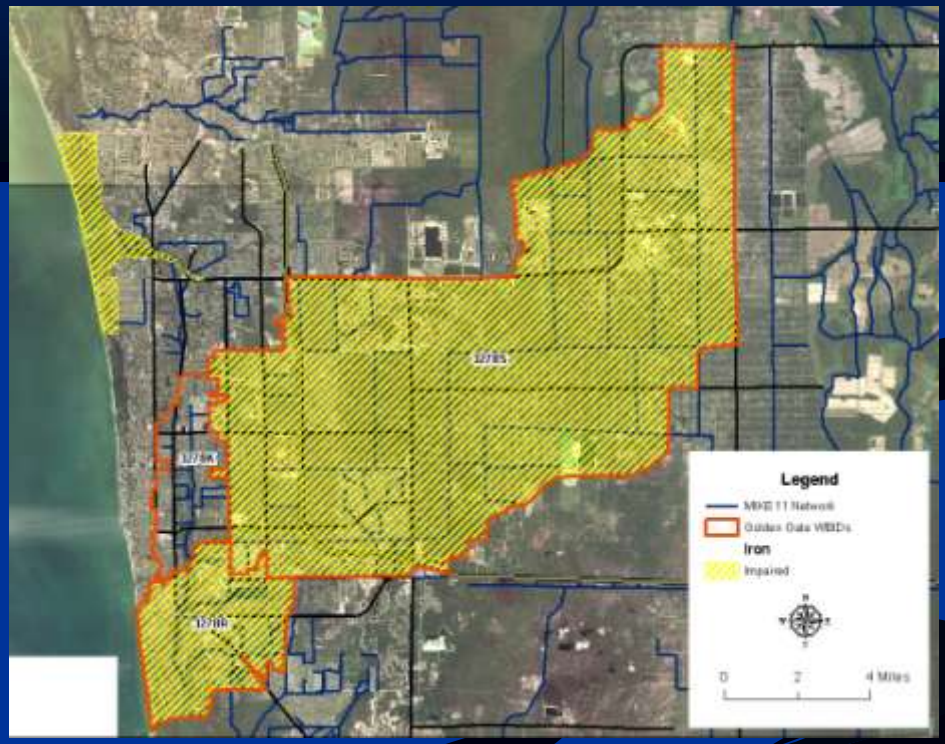
Golden Gate – Naples Bay FDEP Identified Impairments

Dissolved Oxygen



Iron



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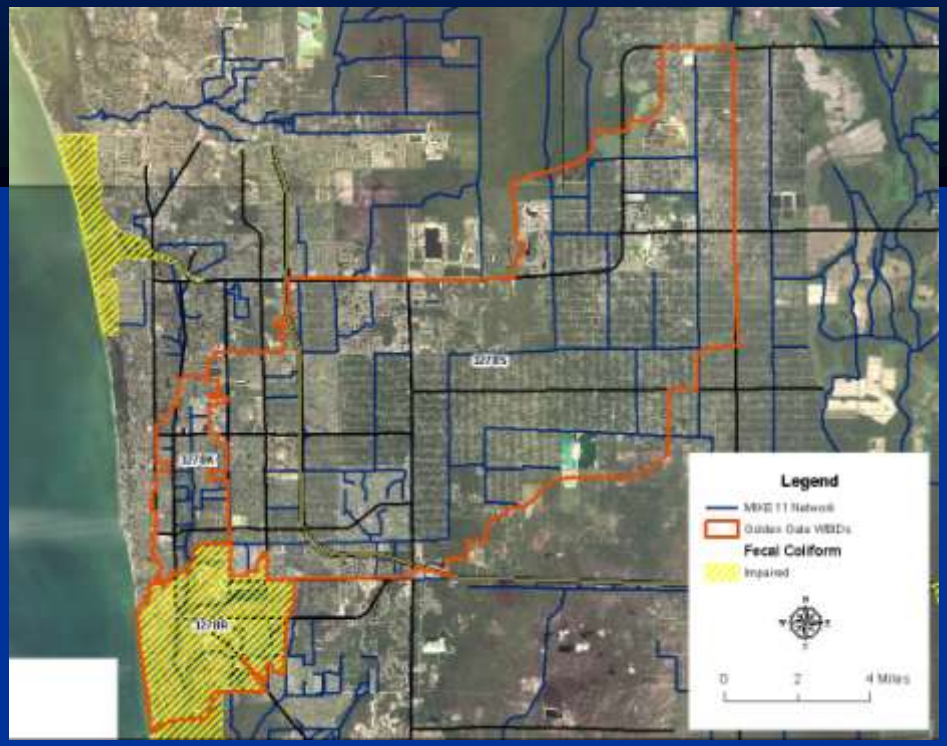
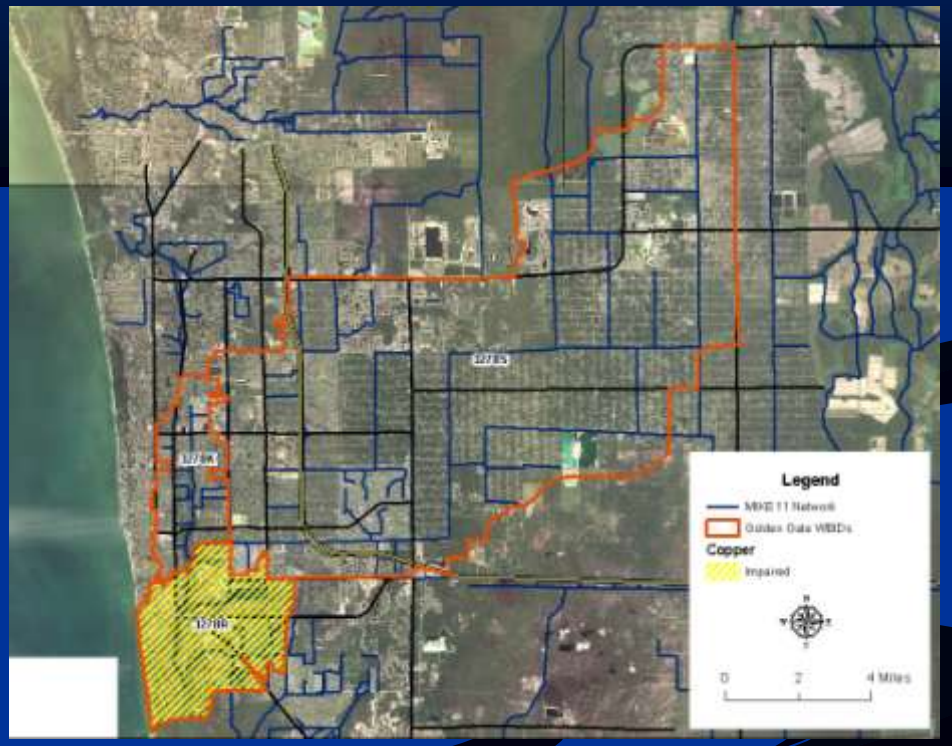
Golden Gate – Naples Bay FDEP Identified Impairments

Fecal Coliform



Copper



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Golden Gate – Naples Bay Summary of Water Quality Issues

- All WBIDs identified as impaired for DO
- Cause of DO impairment not well defined
- Naples Bay WBID is impaired for three (3) parameters
  - Are D.O. and Iron impairments associated with groundwater flow to canals?
- Naples Bay WBID also identified as impaired for copper
  - May be related to use of copper sulfate

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Golden Gate – Naples Bay Other Issues

- Residential lot owners are able to dredge or fill up to 4,000 square feet of wetlands; plus additional clearing up to 6,000 square feet
- Canal system has limited capacity; full build out could overwhelm the system

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Rookery Bay Watershed

- Area : ~145 sq. miles
- FDEP subdivided into 3 "WBIDs"
- Includes natural areas, agricultural lands, and urban development
- Urban areas mostly west of Collier Boulevard

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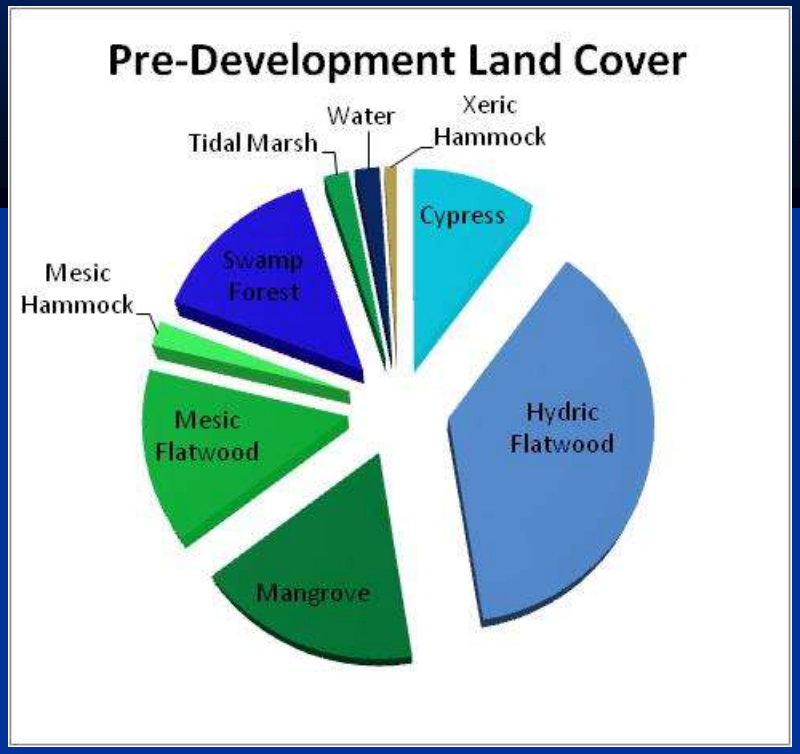
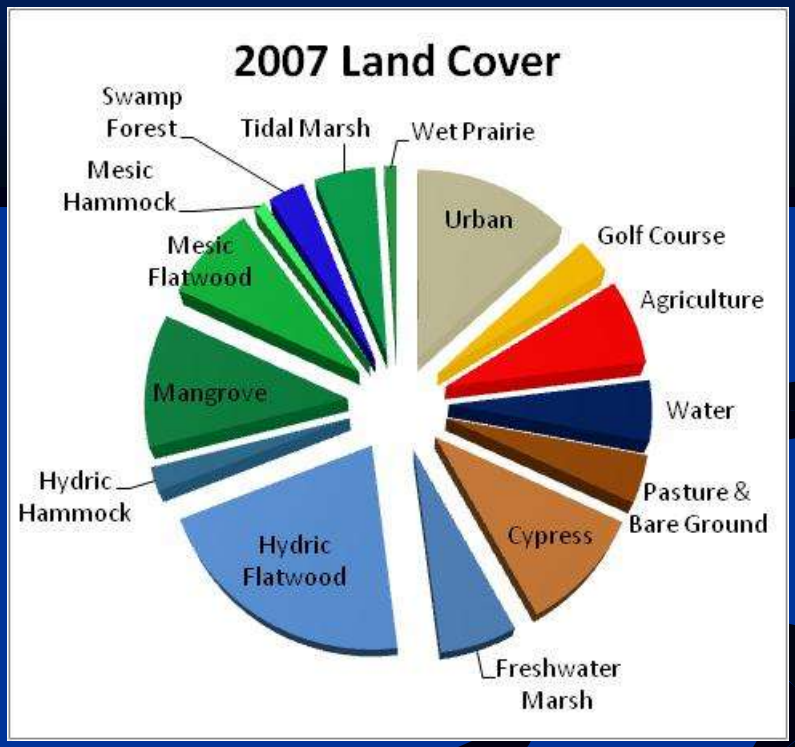
Rookery Bay Watershed Land Use Comparison





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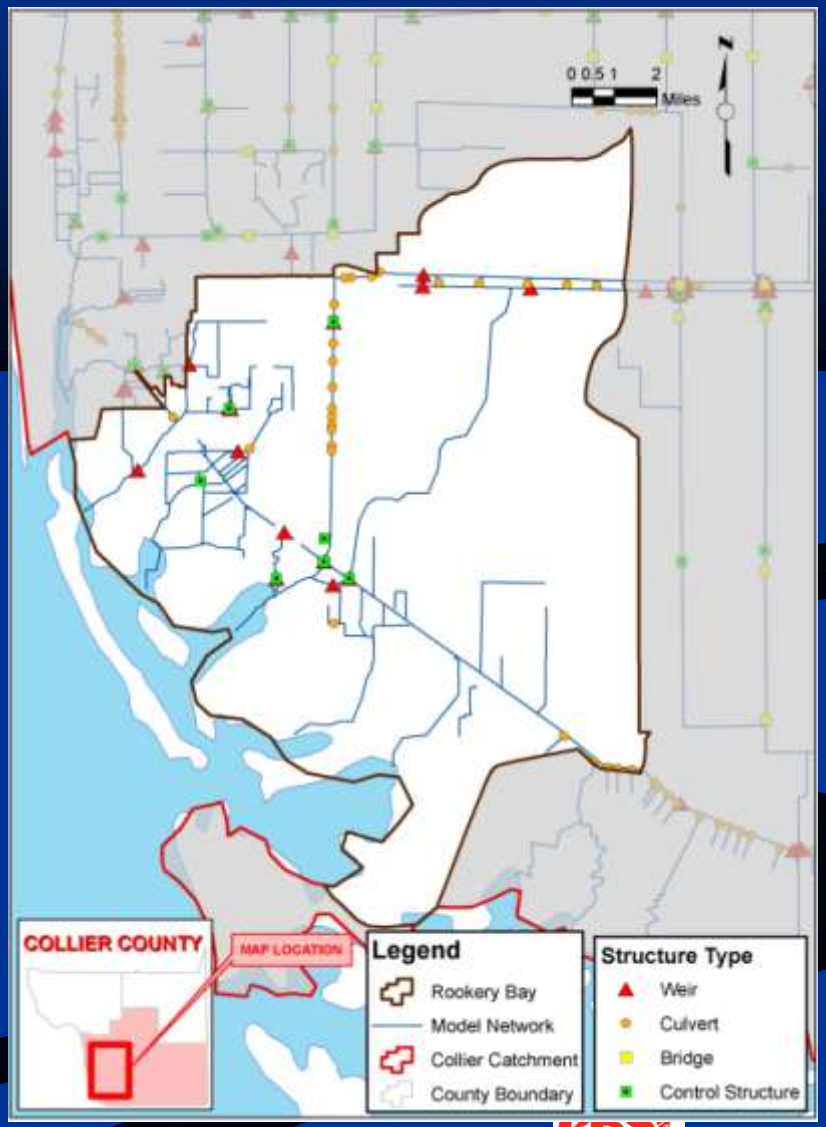
Rookery Bay Watershed

- Almost 100 sq. miles smaller than pre-development
- Overland flow and channel flow



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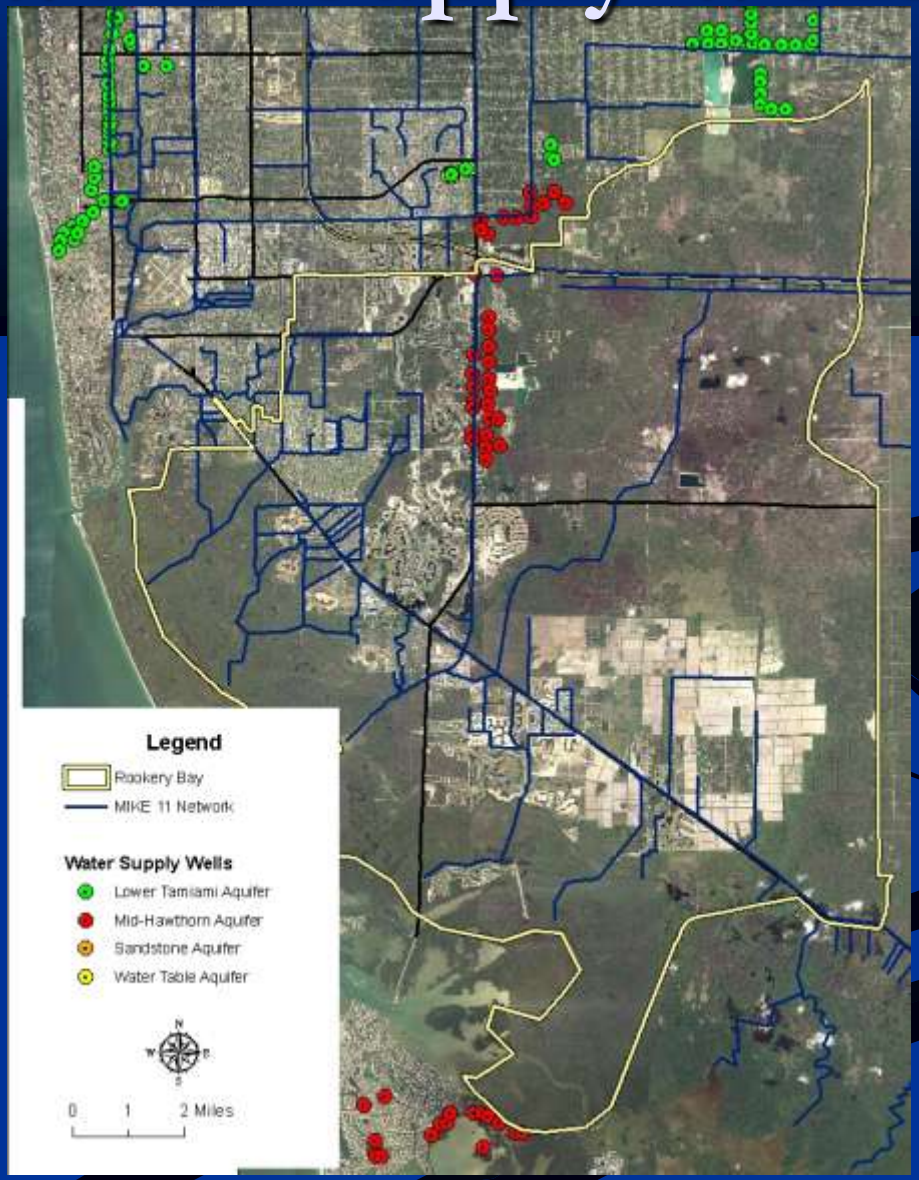
Rookery Bay Watershed Water Supply Wells



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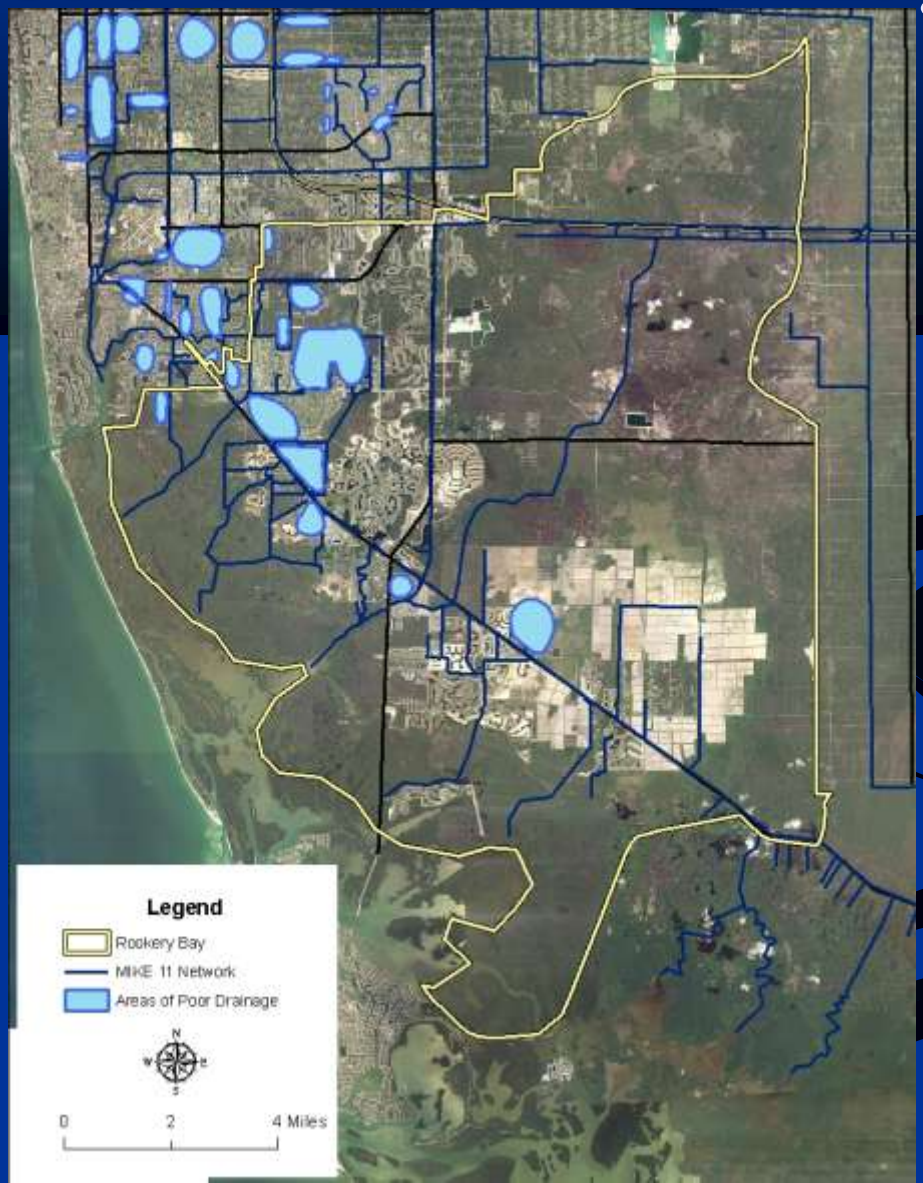
Rookery Bay Watershed
Areas of Poor Drainage



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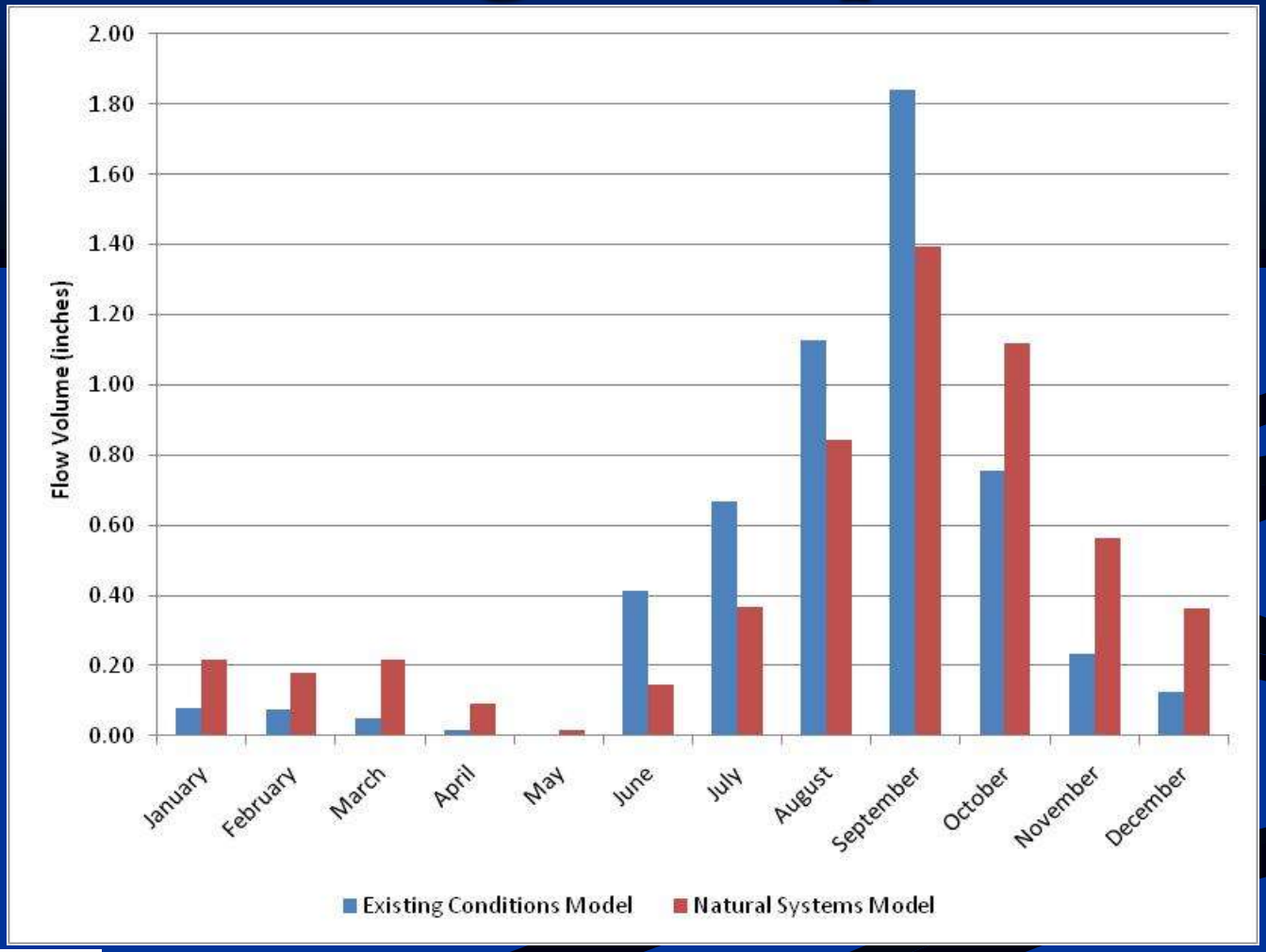
Rookery Bay Watershed Discharge Comparison



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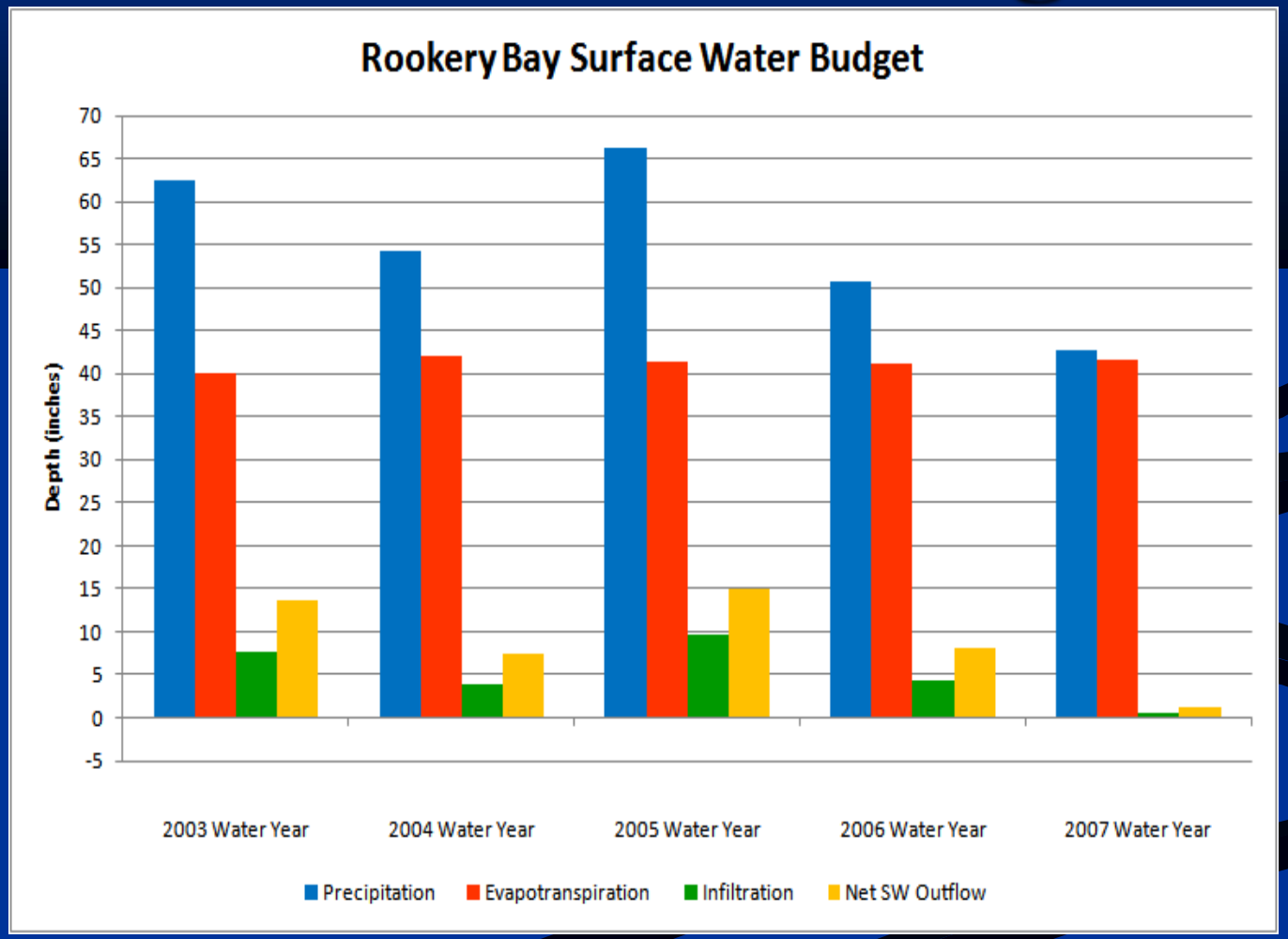
Rookery Bay Watershed Surface Water Budget



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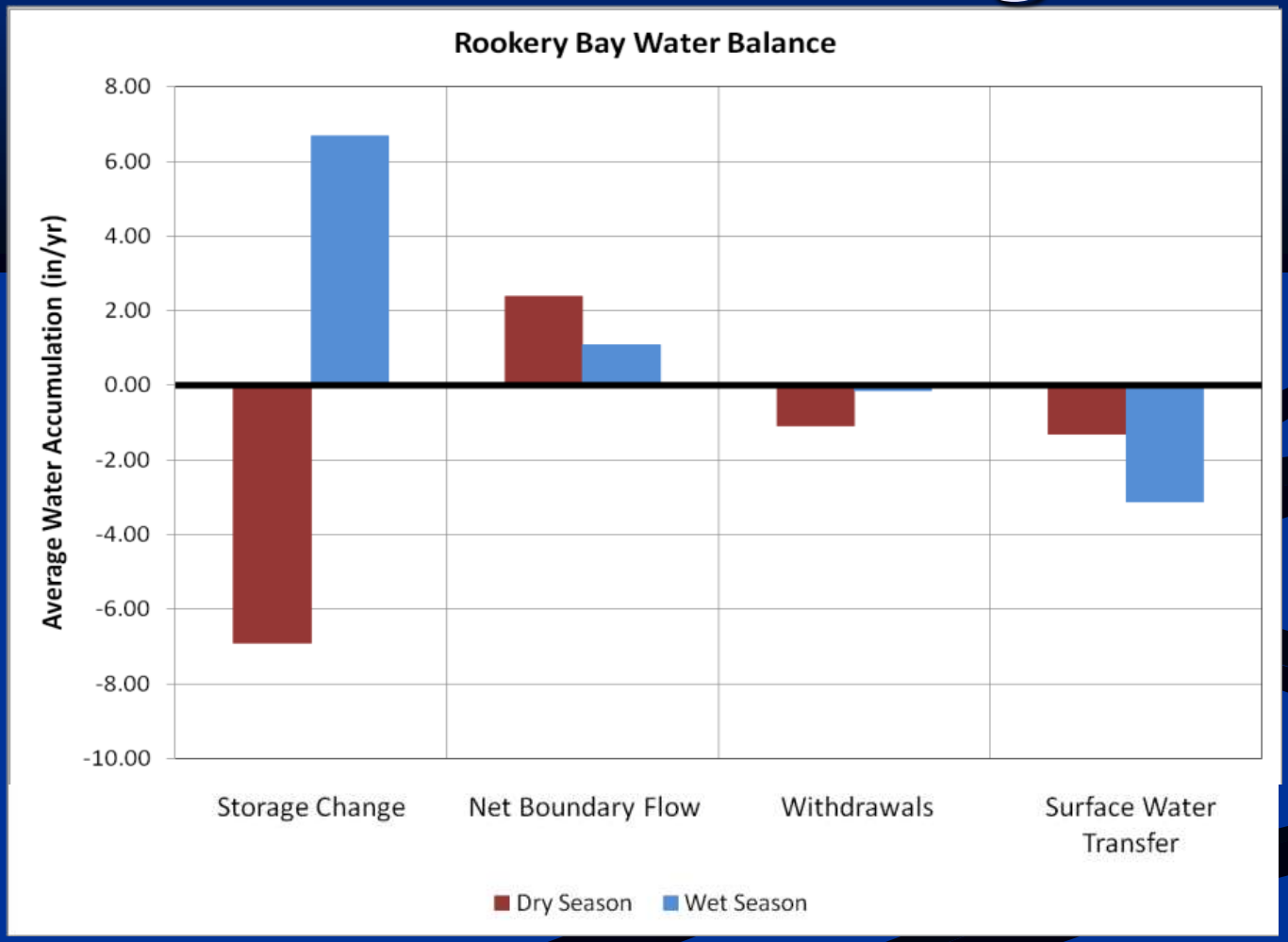
Rookery Bay Watershed Groundwater Budget



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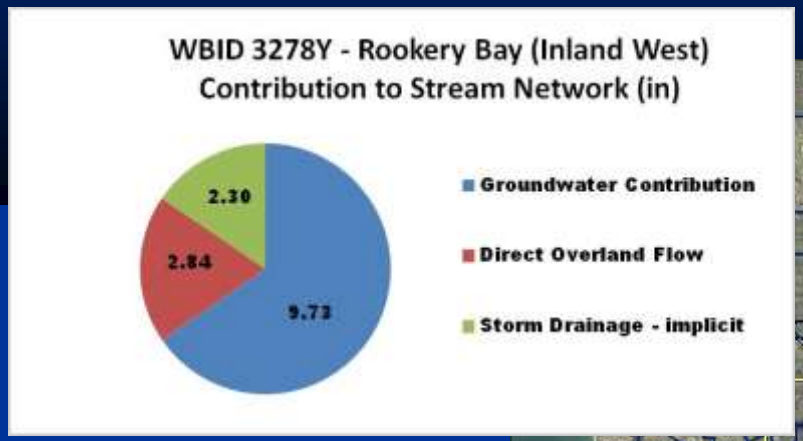
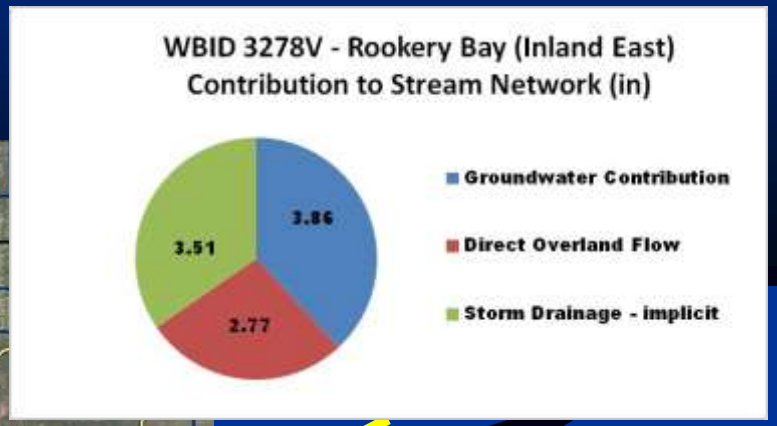
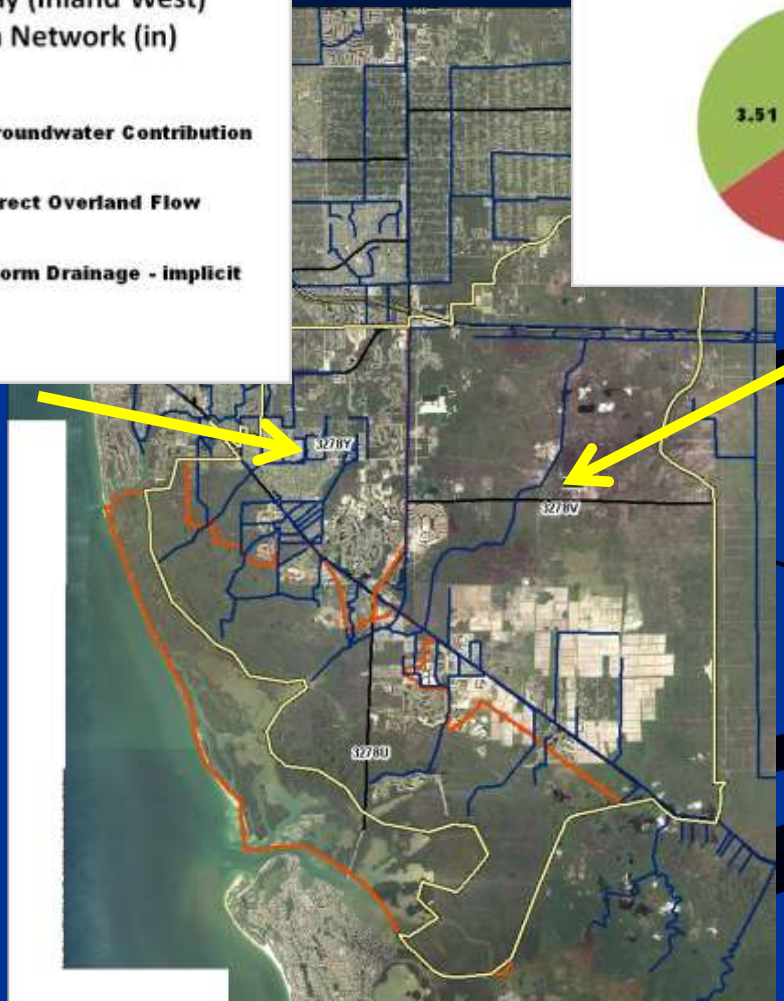
Rookery Bay Watershed
WBID Contributions to Canal







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Rookery Bay Watershed Summary of Water Quantity Issues

- Watershed area has decreased by about 100 square miles due to construction of canals.
- Hydrology of remaining wetlands has changed
  - Shorter hydro-period and less water stored
- Pattern of discharge to the estuary has changed
  - Dry season deficit and wet season surplus

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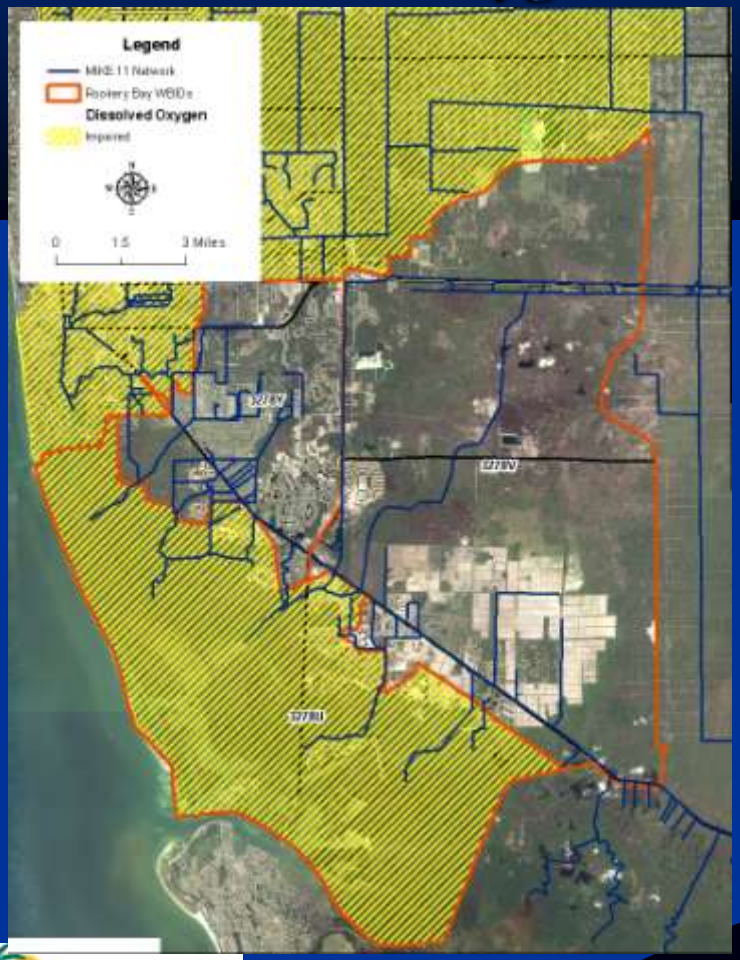
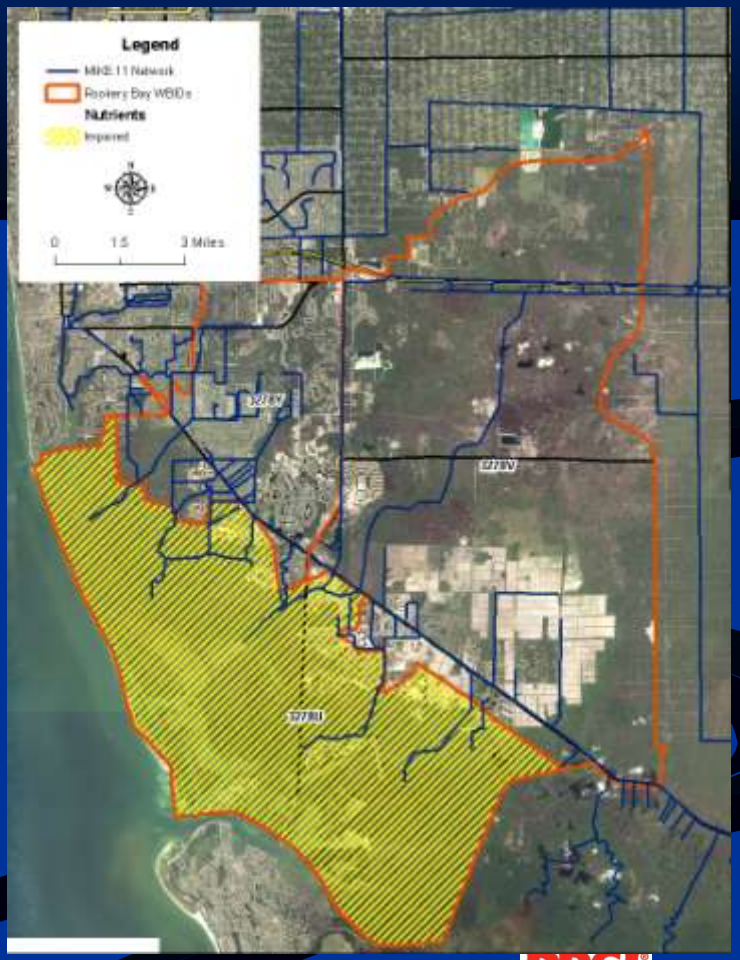
Rookery Bay Watershed
FDEP Identified Impairments

Dissolved Oxygen



Nutrients



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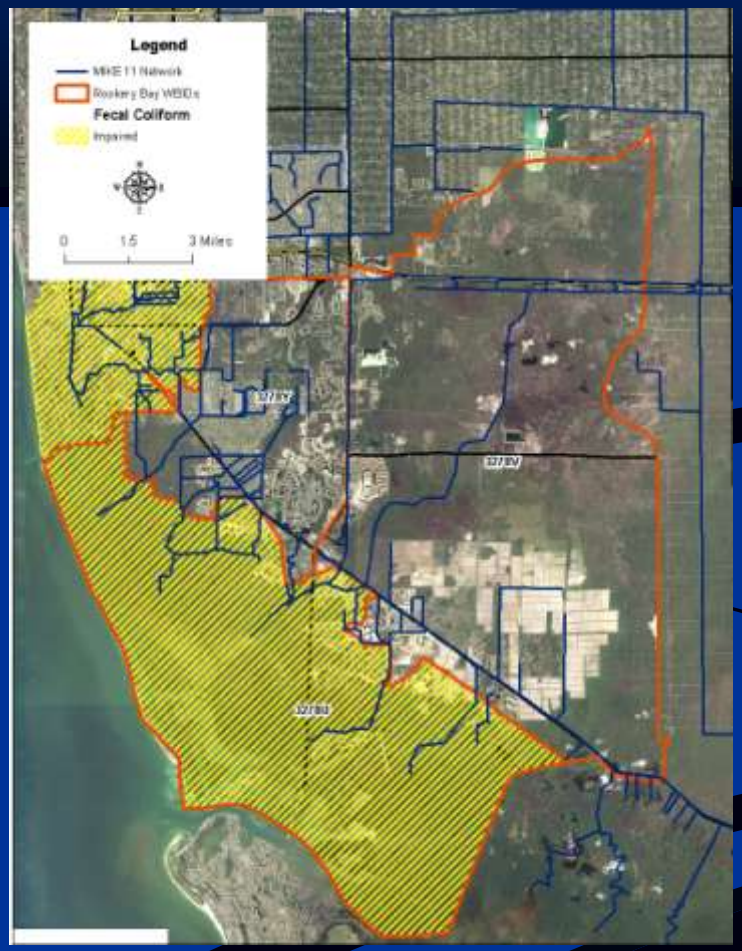
Rookery Bay Watershed
FDEP Identified Impairments

Fecal Coliform



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Rookery Bay Watershed Summary of Water Quality Issues

- Rookery Bay Estuary is only WBID identified as impaired
  - Nutrient impairment may be related to change in sampling location. Results should be verified.

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Faka Union, Fakahatchee, and Okaloacoochee – SR29 Watersheds

- The three watersheds encompass 770 sq.mi.
- Three watersheds divided into 8 "WBIDs"
- Faka Union is most modified:
  - Miller Canal
  - Faka Union Canal
  - Merritt Canal

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Faka Union, Fakahatchee, and Okaloacoochee – SR29 Watersheds

- Fakahatchee watershed is often used as a reference station and remains mostly natural
  - Agriculture in headwaters
- Okalocoochee partially developed
  - Ave Maria
  - Agricultural lands
  - SR 29 Canal to south

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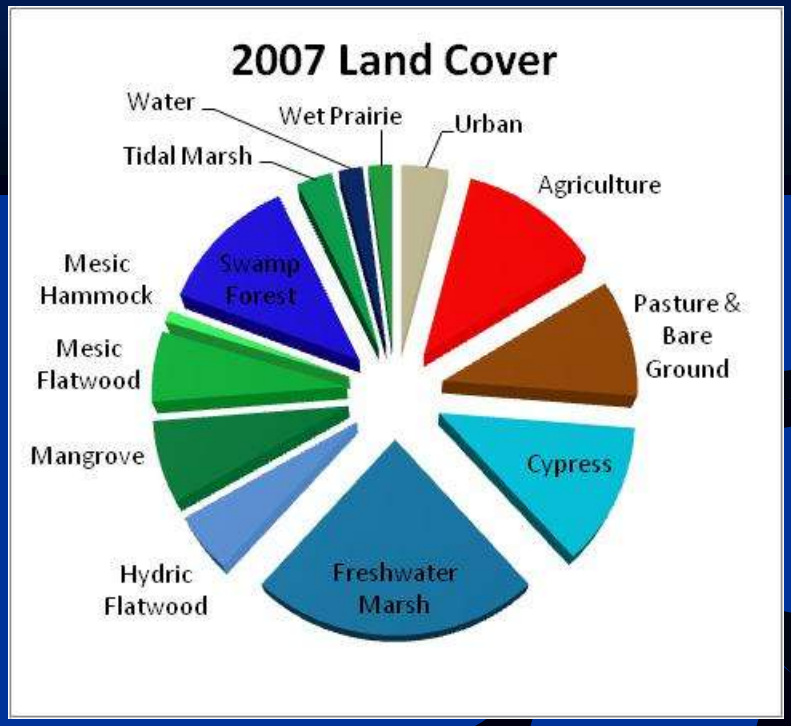
Eastern Watersheds Land Use Comparison



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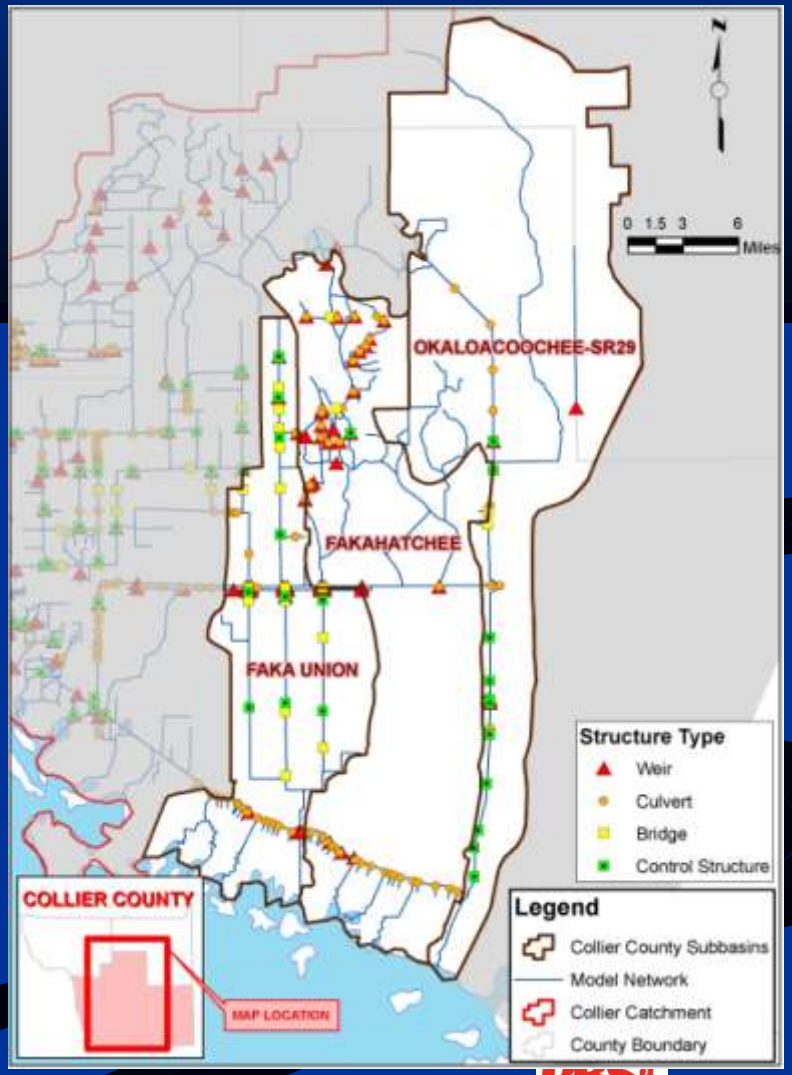
Faka Union, Fakahatchee, and Okaloacoochee – SR29 Watersheds

- Primary drainage features:
  - Miller Canal
  - Faka Union Canal
  - Merritt Canal
  - SR 29 Canal
- Area of the Faka Union watershed has increased by ~35 sq.mi.



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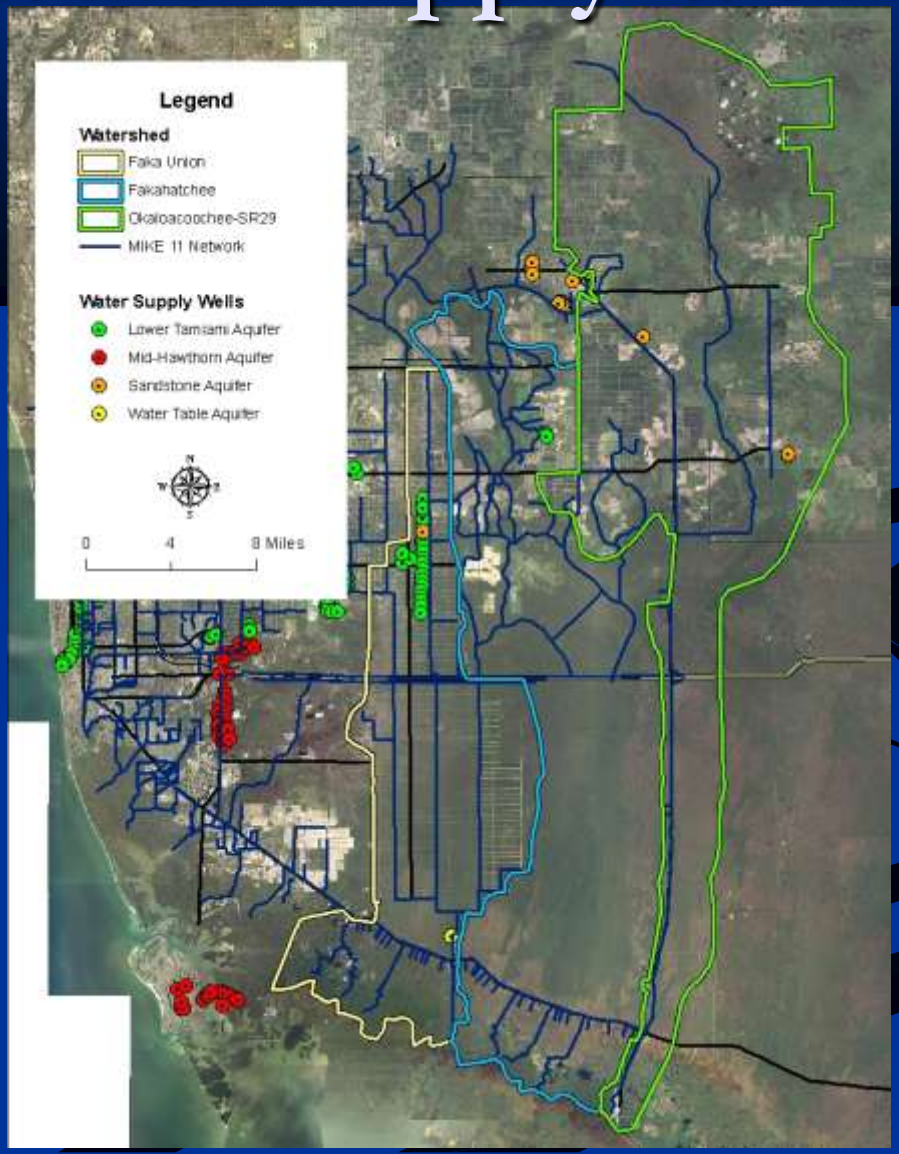
Eastern Watersheds Water Supply Wells



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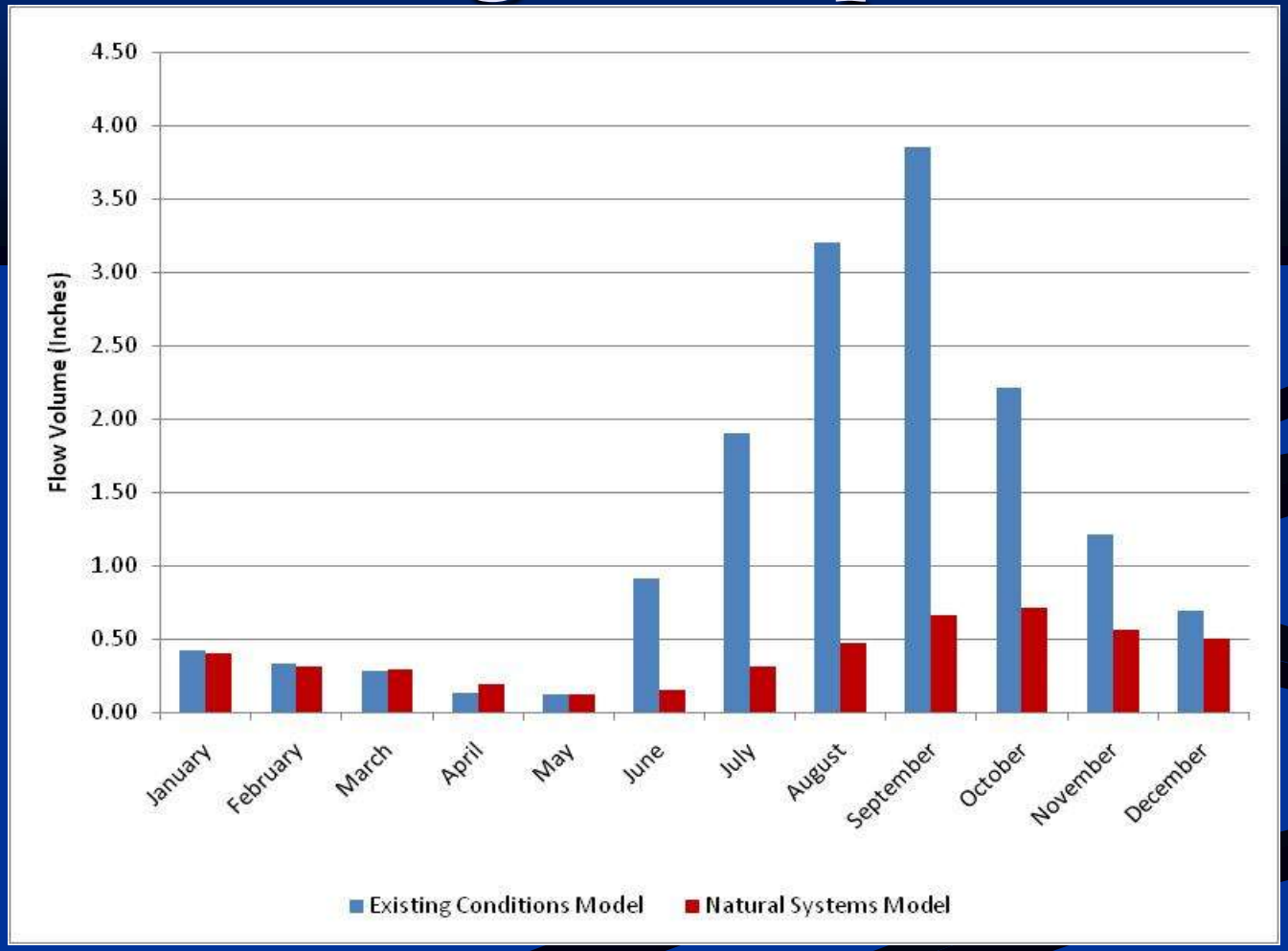
Eastern Watersheds Discharge Comparison



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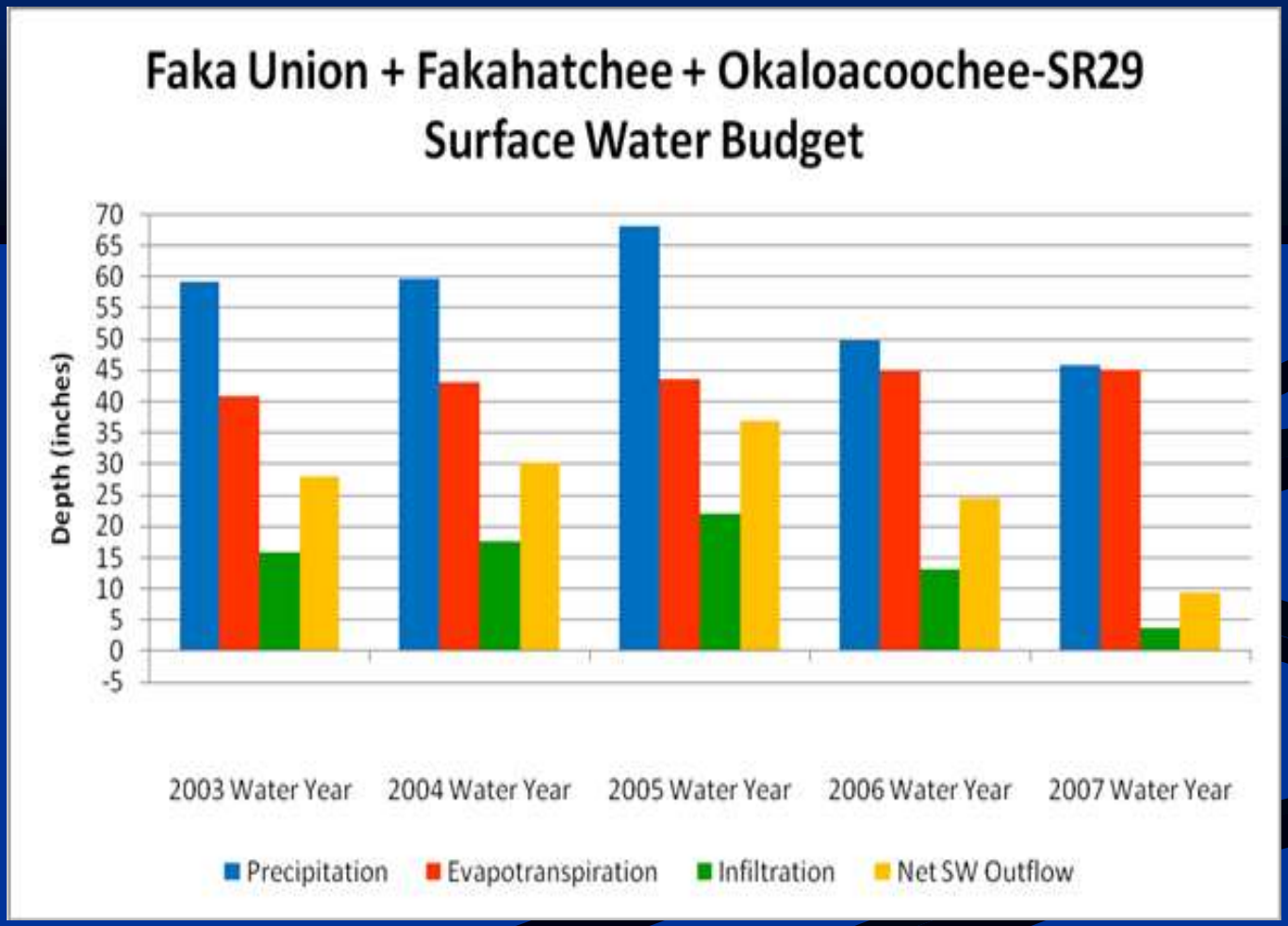
Eastern Watersheds Surface Water Budget



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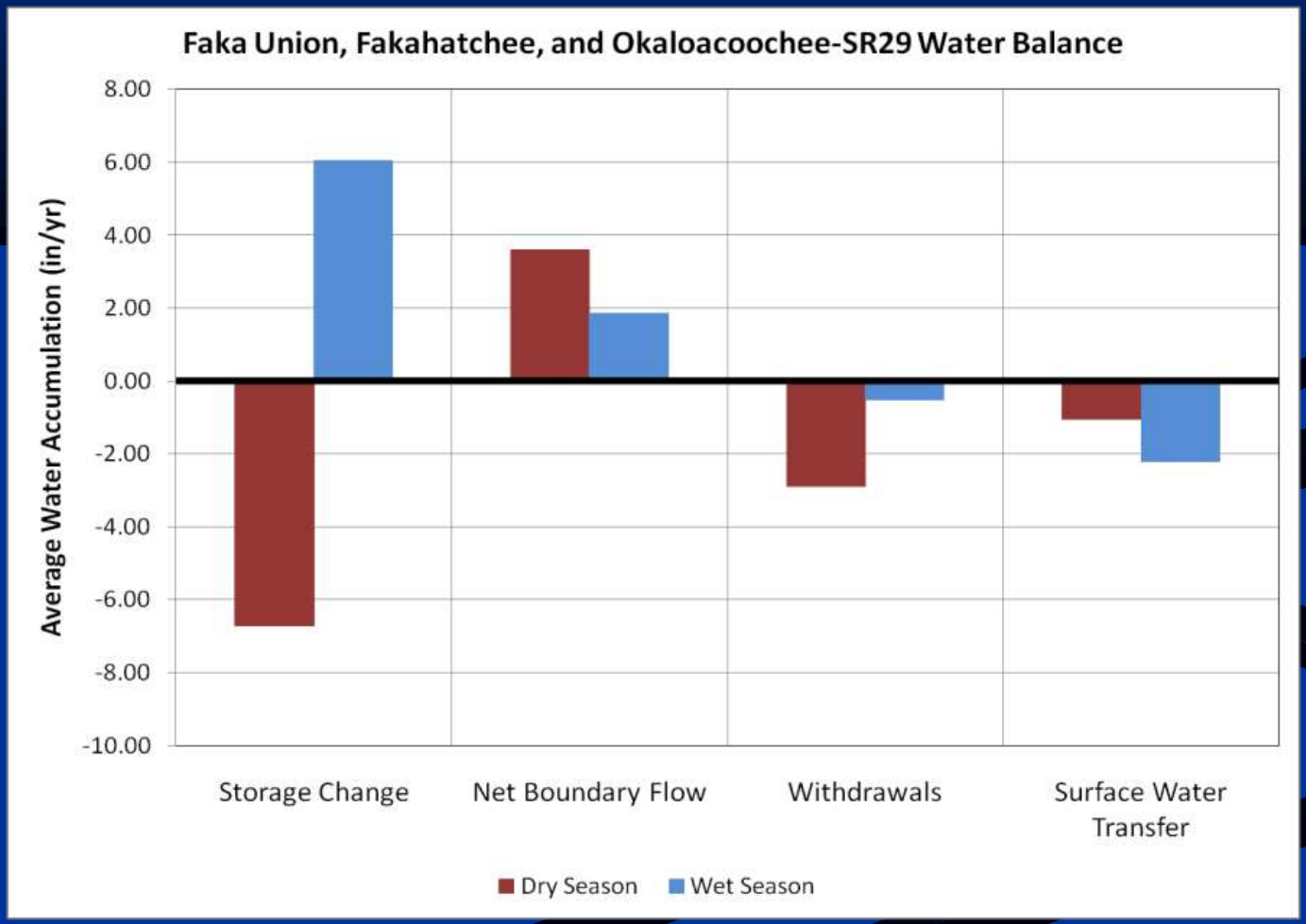
Eastern Watersheds Groundwater Budget



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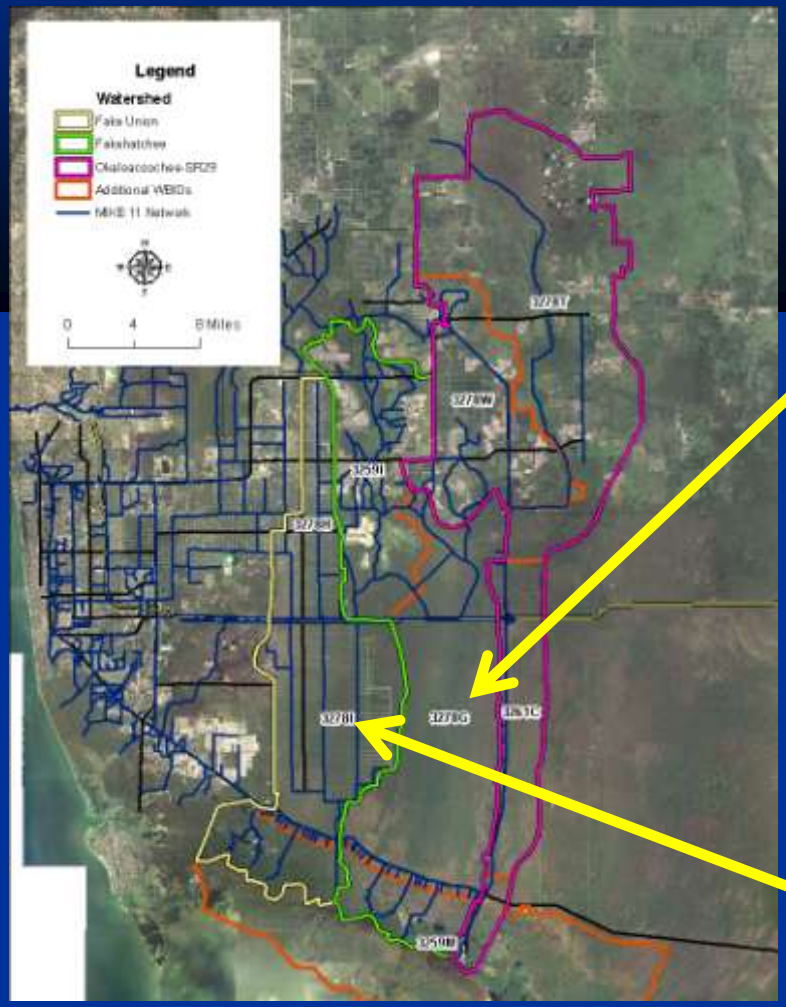
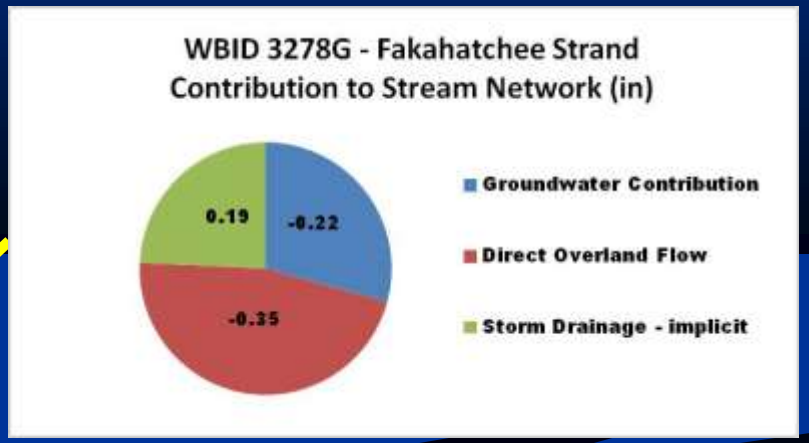
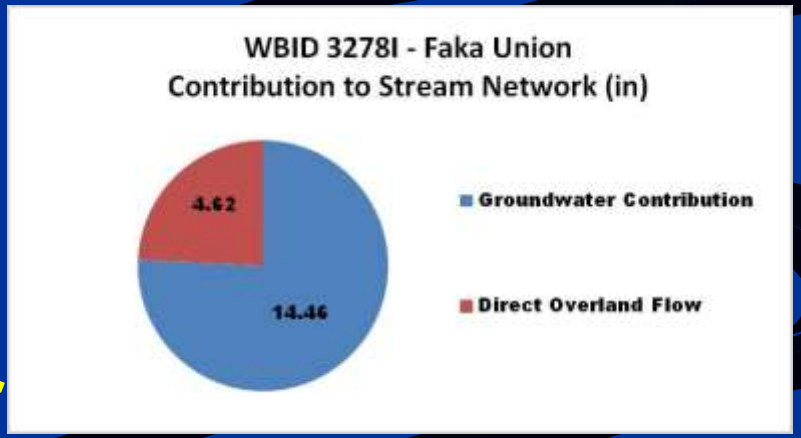
Eastern Watersheds
WBID Contributions to Canal







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Eastern Watershed
Summary of Water Quantity Issues

- Watershed area is increased in headwaters of Faka Union watershed
  - Dredging of canals in GGE changed hydrology
- Hydrology of remaining wetlands has changed
  - Shorter hydro-period and less water stored
- Large increase in wet season flow to estuary
  - Approximately 9” increase during wet season
  - Existing dry season flows are very similar to NSM

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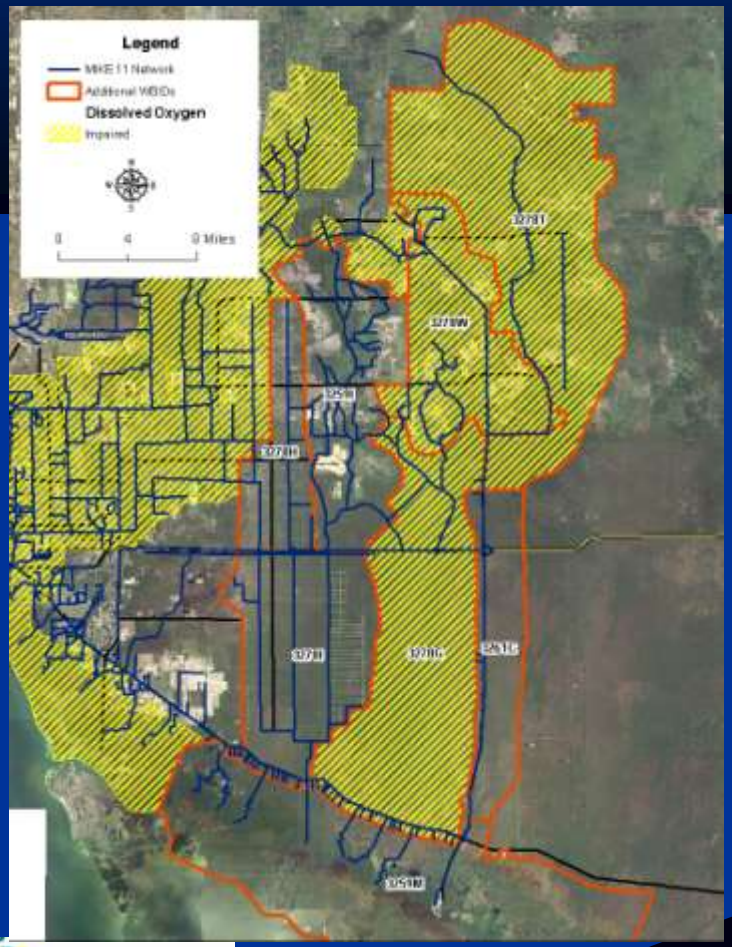
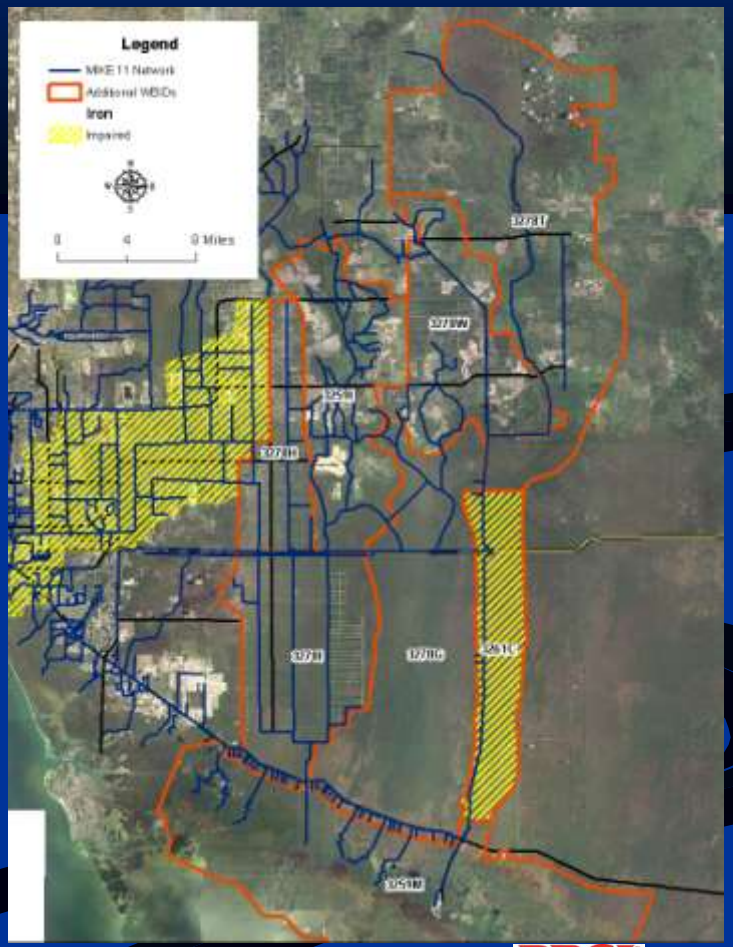
Eastern Watersheds
FDEP Identified Impairments

Dissolved Oxygen



Iron



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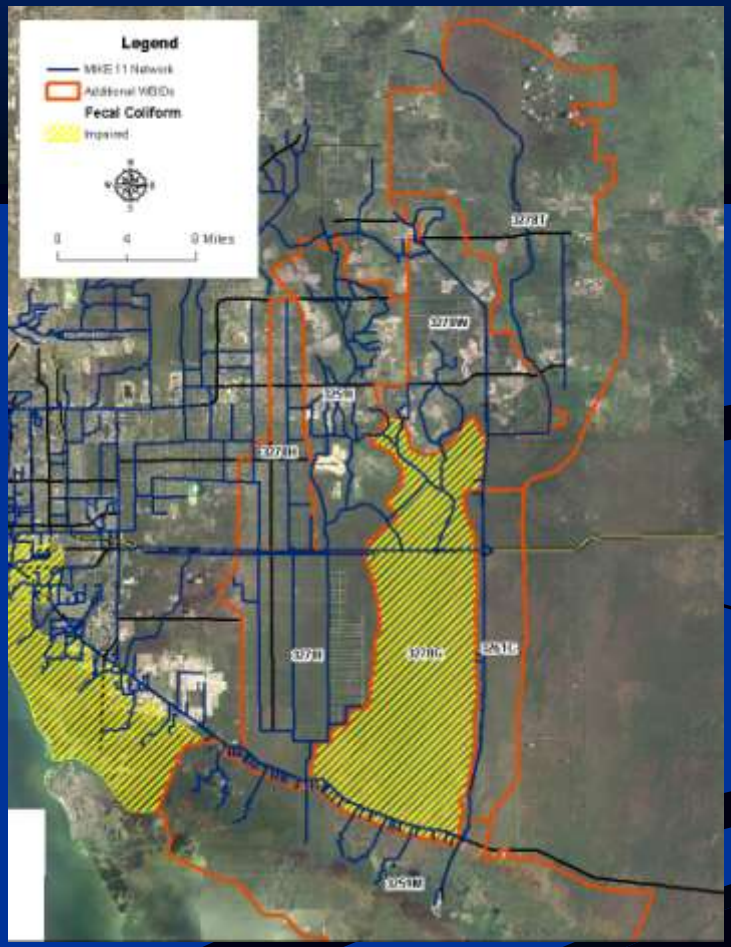
Eastern Watersheds
FDEP Identified Impairments

Fecal Coliform



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Eastern Watersheds Summary of Water Quality Issues

- Camp Keais Strand, Okaloacoochee Strand, and Fakahatchee Strand identified as impaired for Dissolved Oxygen
  - Fakahatchee Strand is considered a reference station
  - What is role of wetland activity on low D.O. level?
- SR29 Canal identified as impaired for Iron
  - Is there a groundwater contribution?

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Identification of Potential Projects

- Methodology
  - Previously considered projects or projects that are scheduled for implementation
    - Picayune Strand Restoration Project
    - Southwest Florida Feasibility Study
    - Belle Meade Area Master Plan
    - Northern Golden Gate Estates Flowway Restoration Plan (Horsepen Strand Restoration)
    - Lely Area Stormwater Improvement Project
    - Immokalee Stormwater Master Plan
    - Master Plan for Regional Irrigation Distribution System (RIDS)

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Previously Proposed Projects

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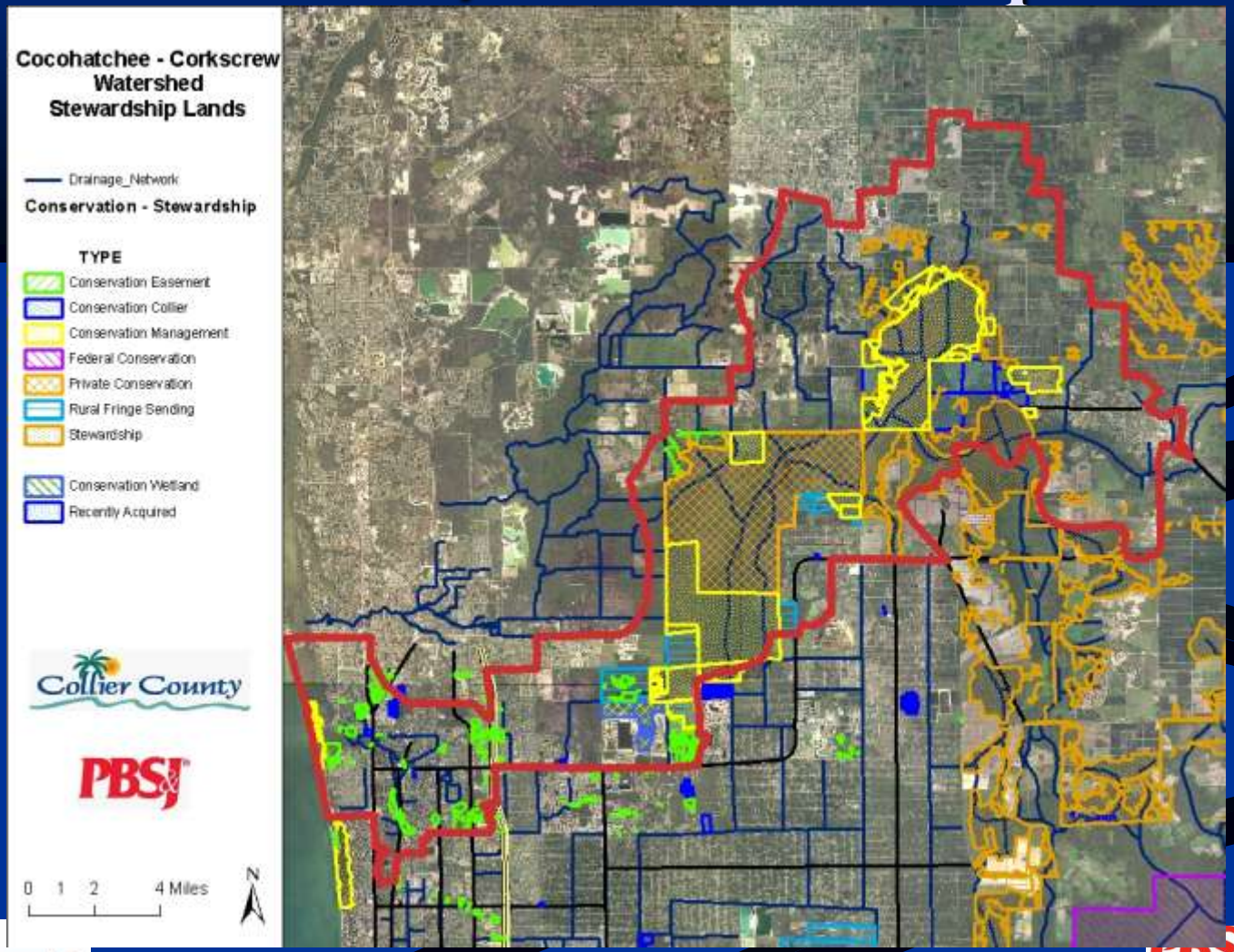
Cocohatchee-Corkscrew Conservation/Stewardship Lands



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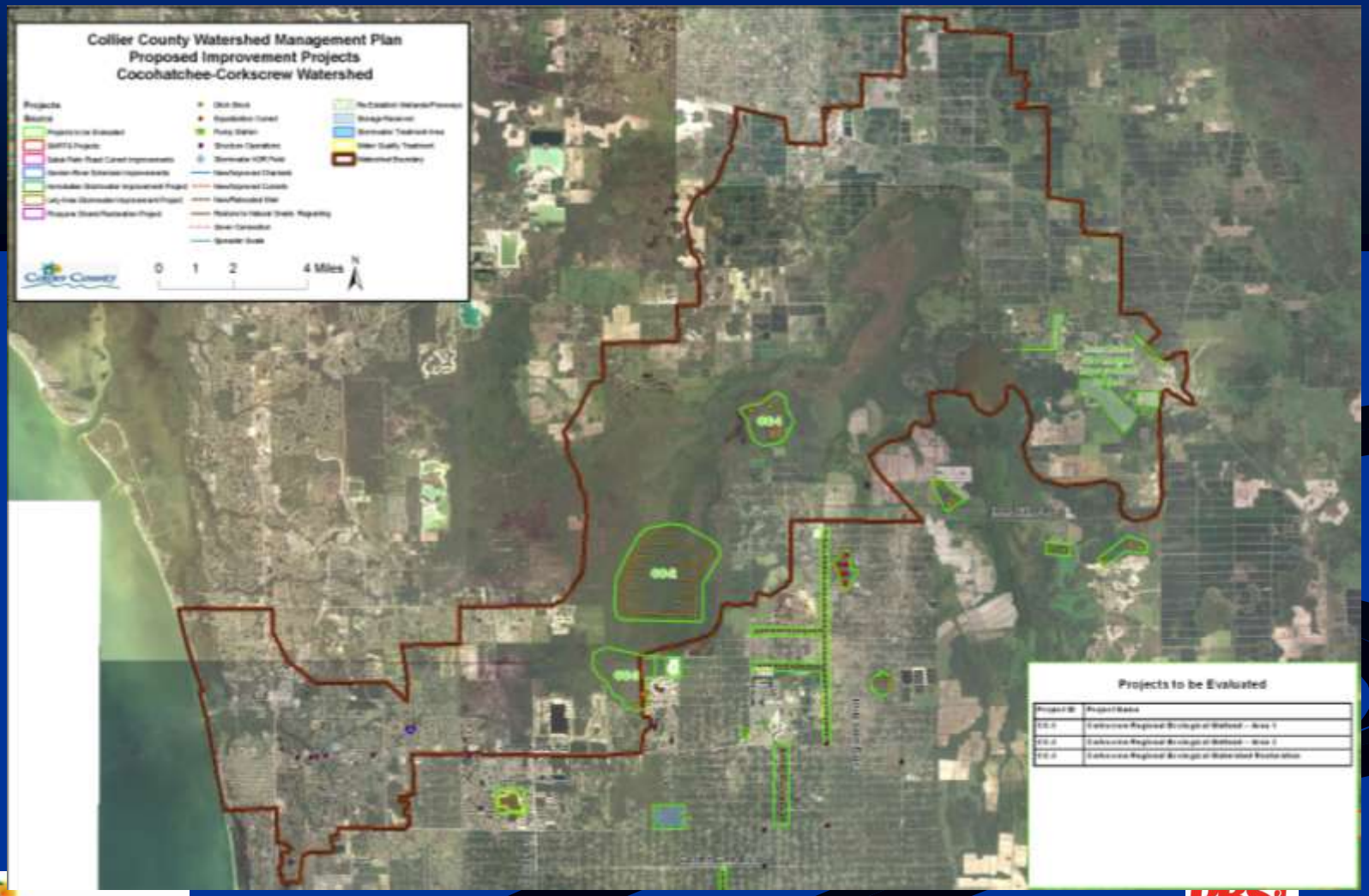
Potential Projects: Cocohatchee-Corkscrew



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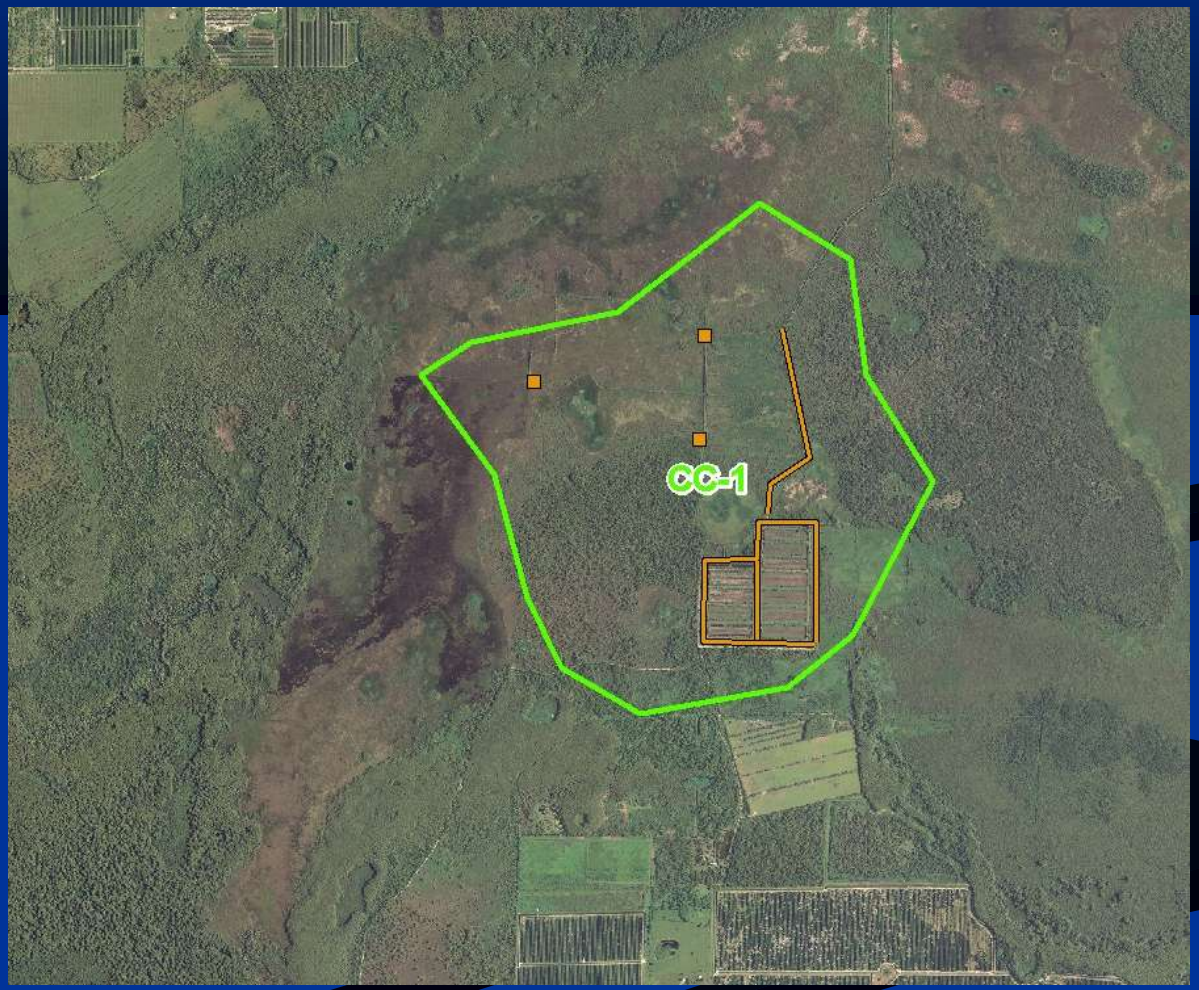
Potential Projects: Cocohatchee-Corkscrew

- CC-1
  - Ditch blocks to force overland flow
  - Regrade area to remove berms



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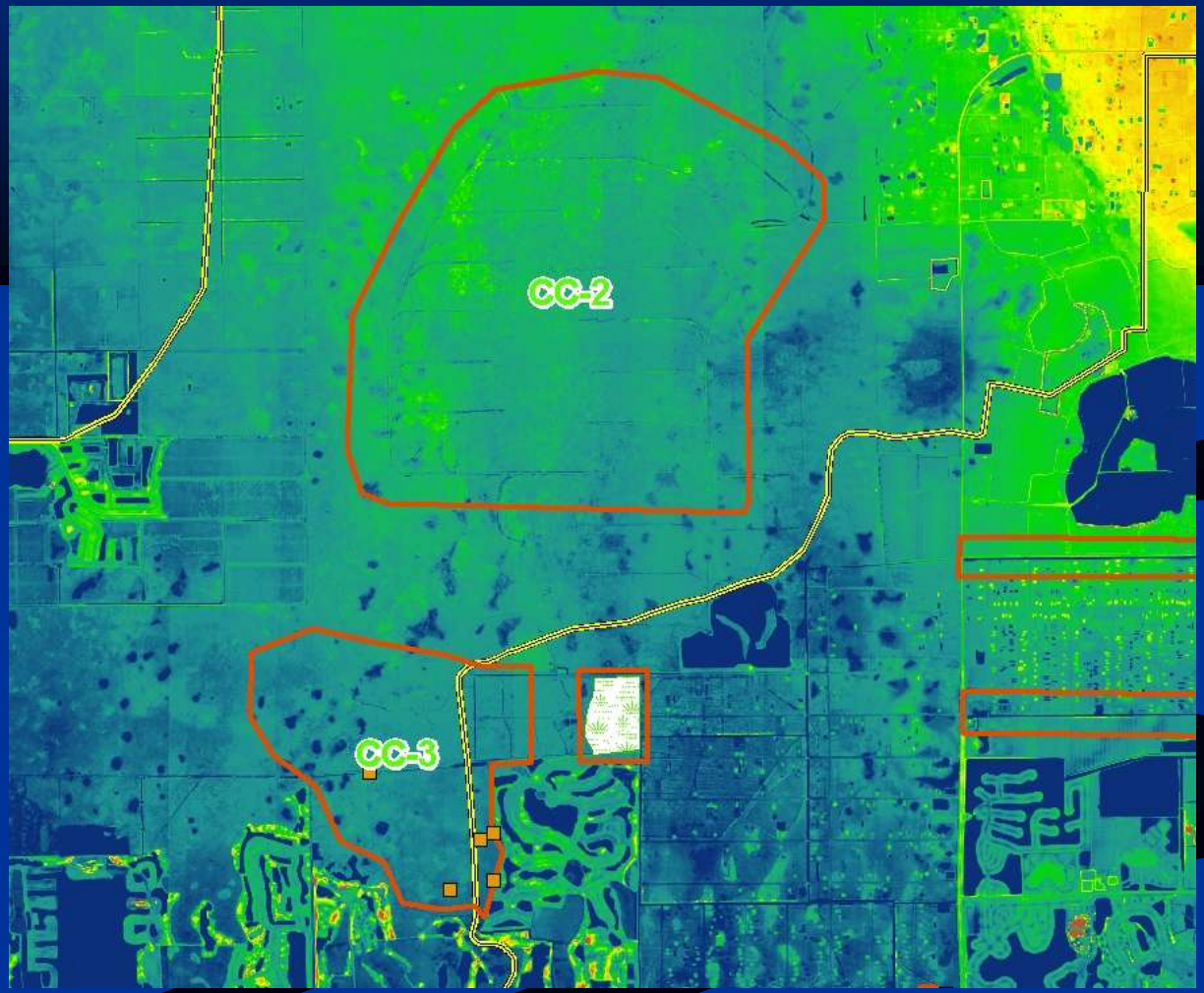
Potential Projects: Cocohatchee-Corkscrew Watershed

- CC-2
  - Regrade to natural elevation
- CC-3
  - Ditch blocks to encourage overland flow



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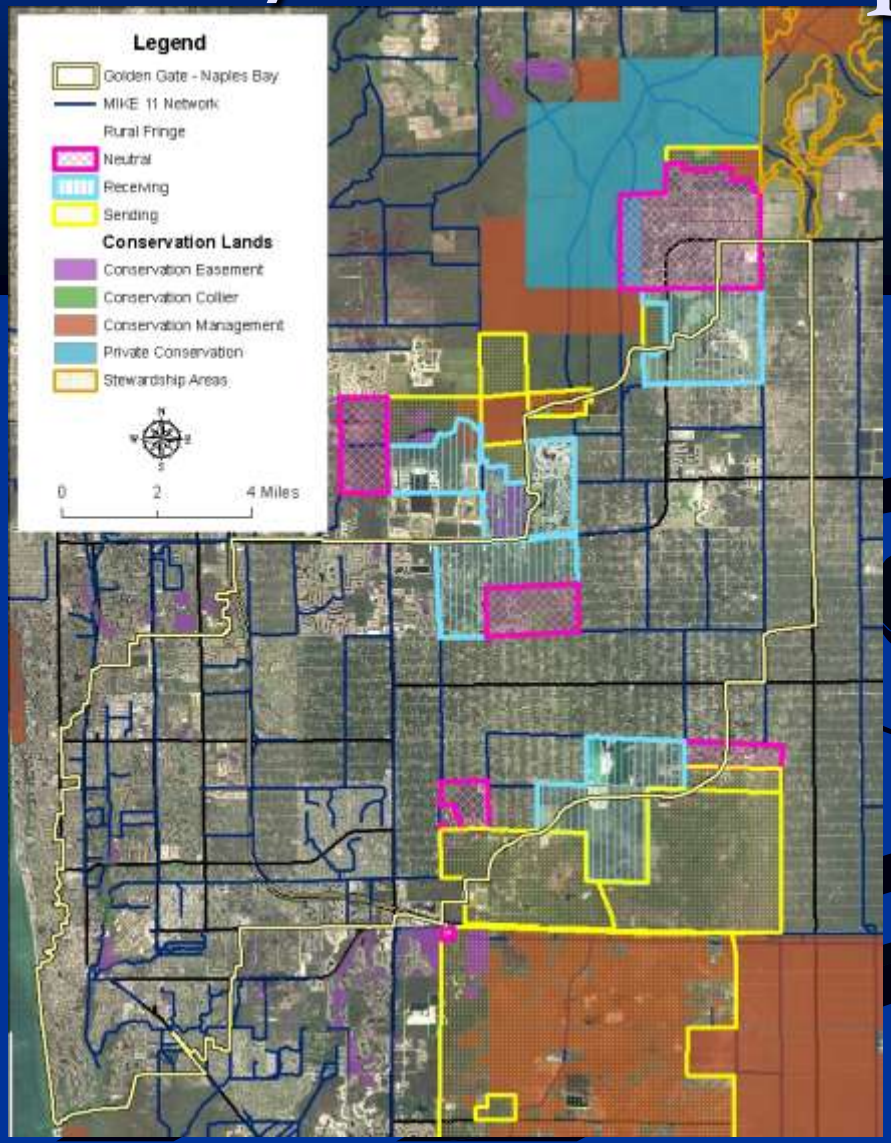
Golden Gate – Naples Bay Conservation/Stewardship Lands



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Potential Projects: Golden Gate – Naples Bay Watershed

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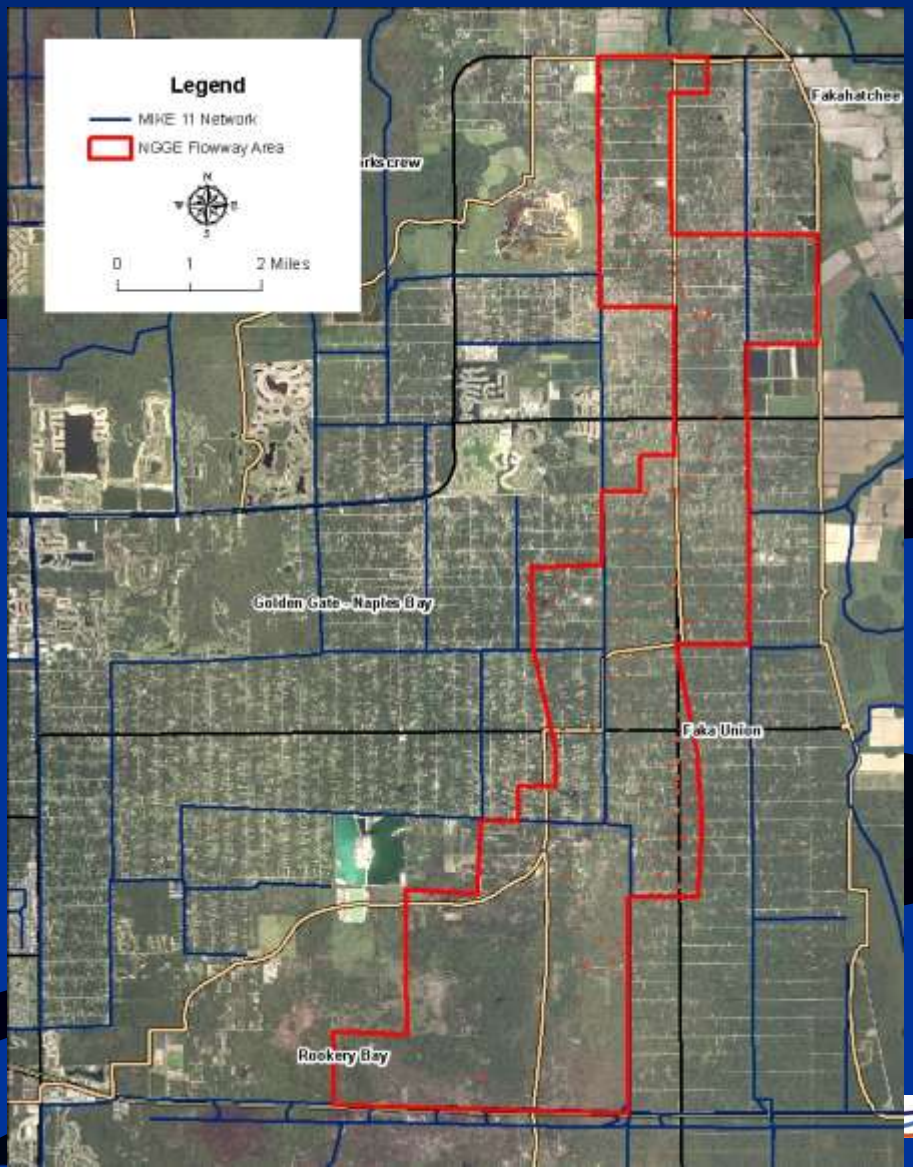
Potential Projects: NGGE Flowway Restoration

- Goal is to restore wetland connectivity
- Currently defined area falls within three (3) watersheds
- Key issues
  - Interaction with primary canal network
  - Influence on septic systems



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Potential Projects: Golden Gate – Naples Bay Watershed

- GG-1
  - New weirs to stage water in canals
- GG-2
  - Ditch blocks and equalization culverts to allow more storage
- GG-3
  - Ditch blocks to force overland flow

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Potential Projects: Golden Gate – Naples Bay Watershed

- GG-4
  - Ditch blocks to force overland flow
- GG-5
  - Divert water for water treatment
- GG-6
  - Off-line stormwater reservoir
- GG-7
  - New weirs in canal

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Potential Projects: Golden Gate – Naples Bay Watershed

- GG-5
  - Divert water for water treatment

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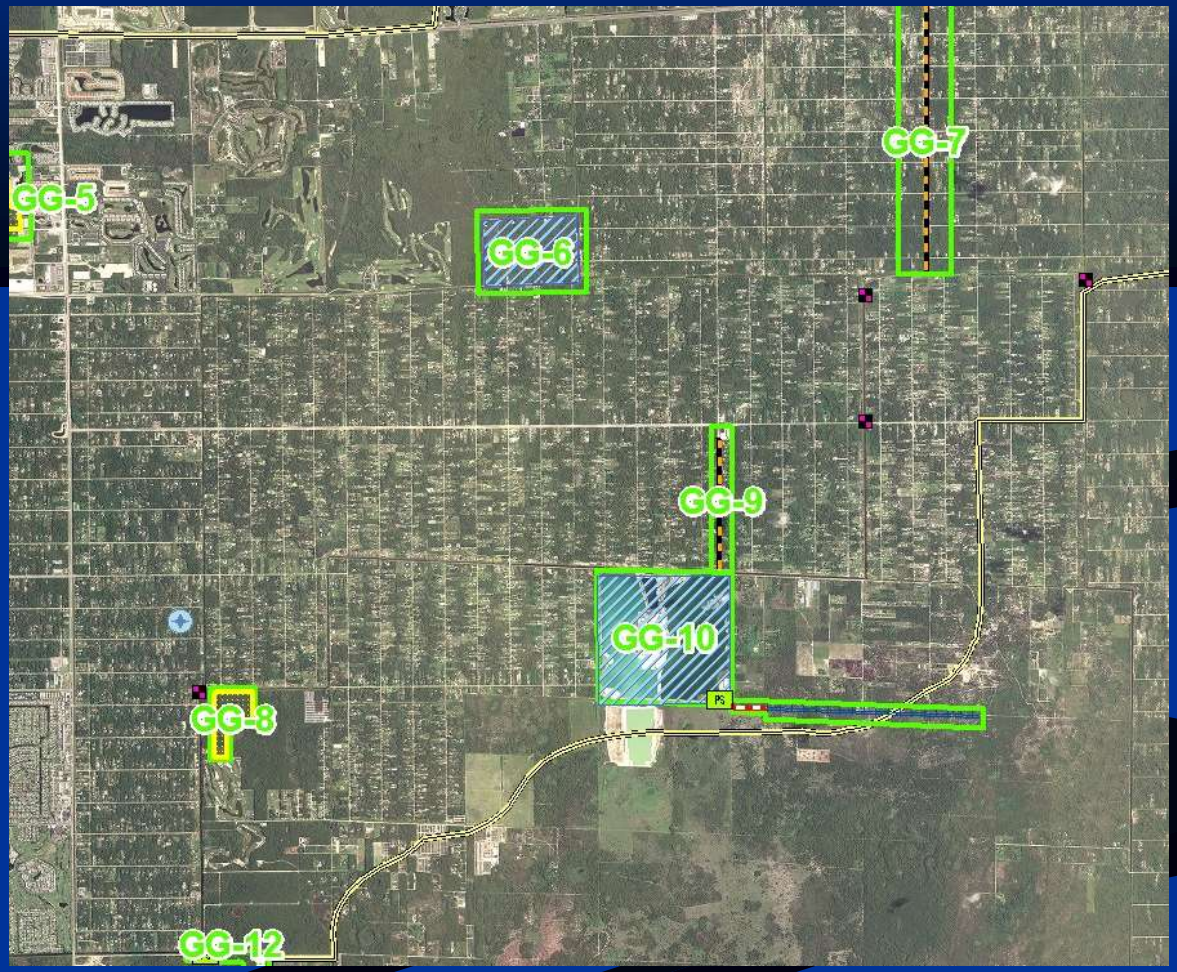
Potential Projects: Golden Gate – Naples Bay Watershed

- GG-8
  - Wetland flow
- GG-9
  - New weirs to stage water
- GG-10
  - Off-line storage reservoir



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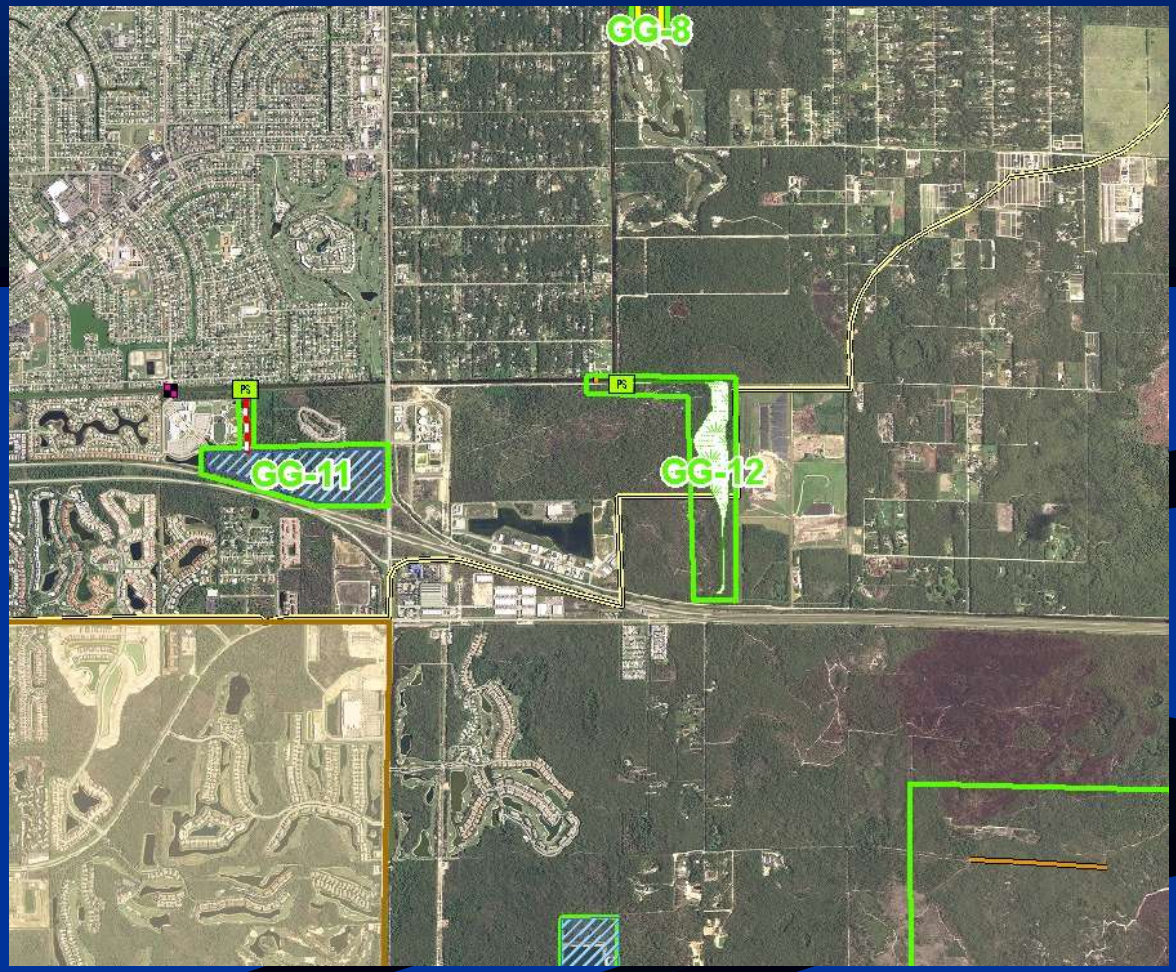
Potential Projects: Golden Gate – Naples Bay Watershed

- GG-11
  - Off-line storage reservoir
- GG-12
  - Diversion to Rookery Bay watershed



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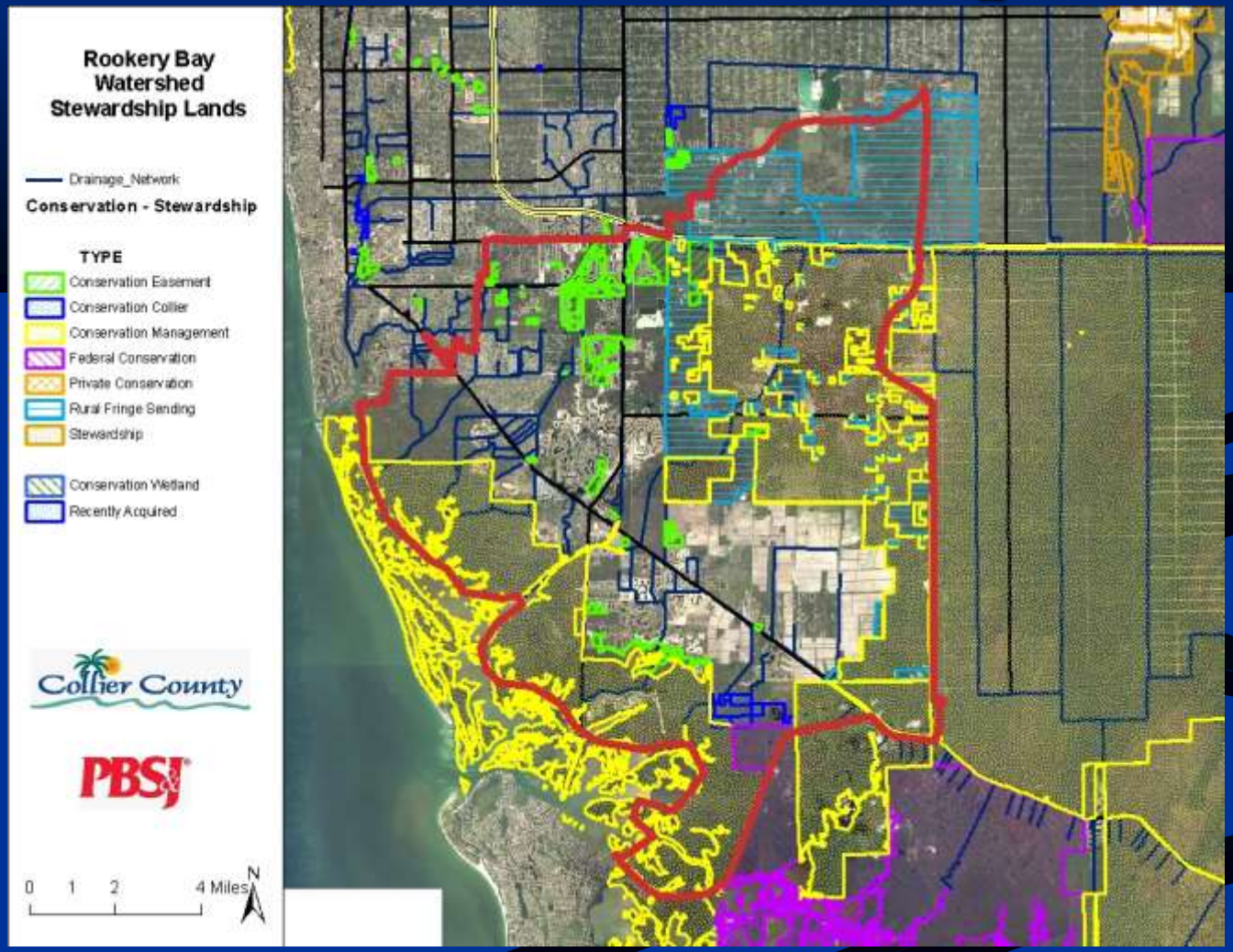
Rookery Bay Watershed Conservation/Stewardship Lands



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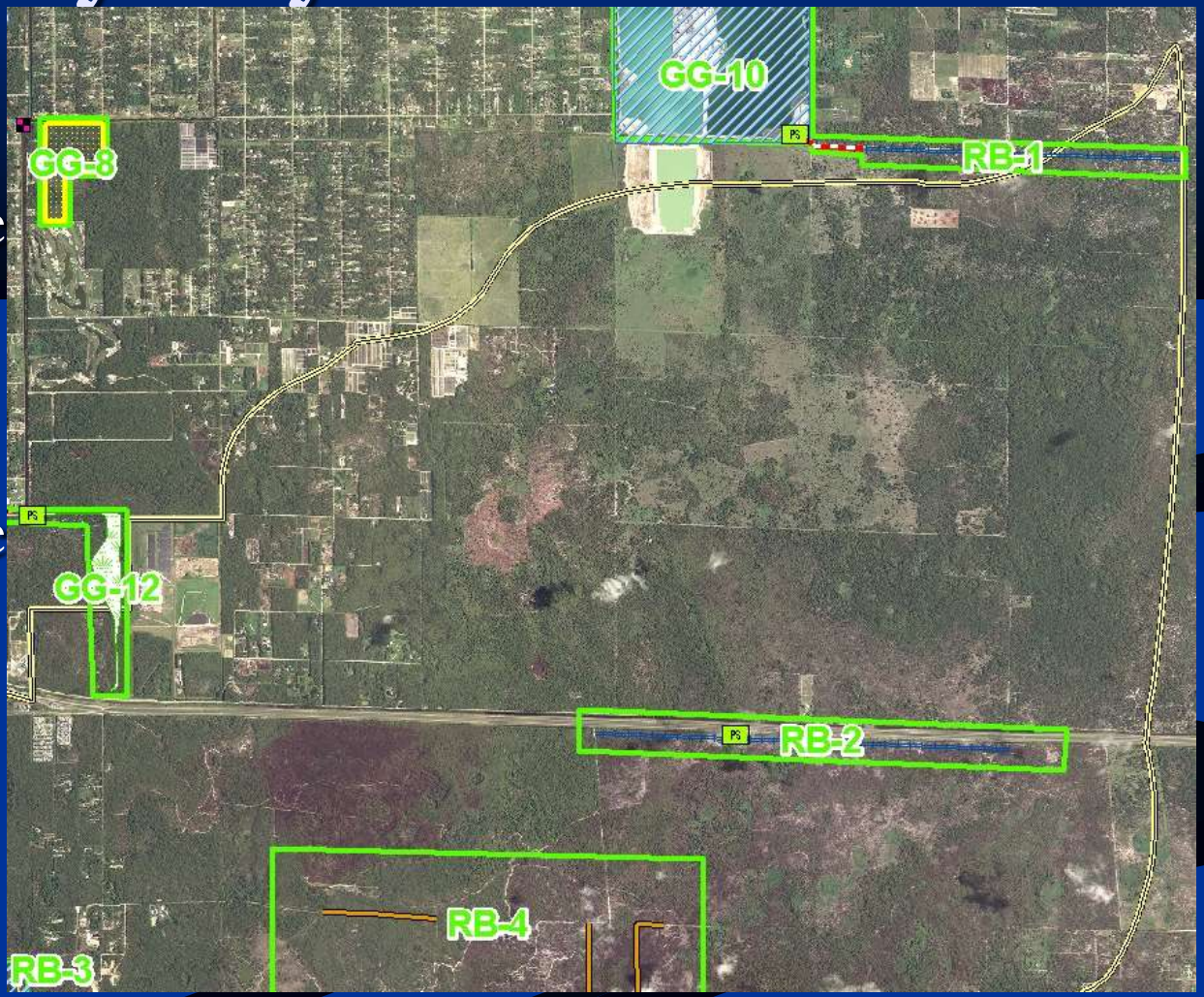
Potential Projects: Rookery Bay Watershed

Potential Projects
Rookery Bay Watershed

- RB-1
  - Spreader swale in RFS lands
- RB-2
  - Spreader swale south of I-75



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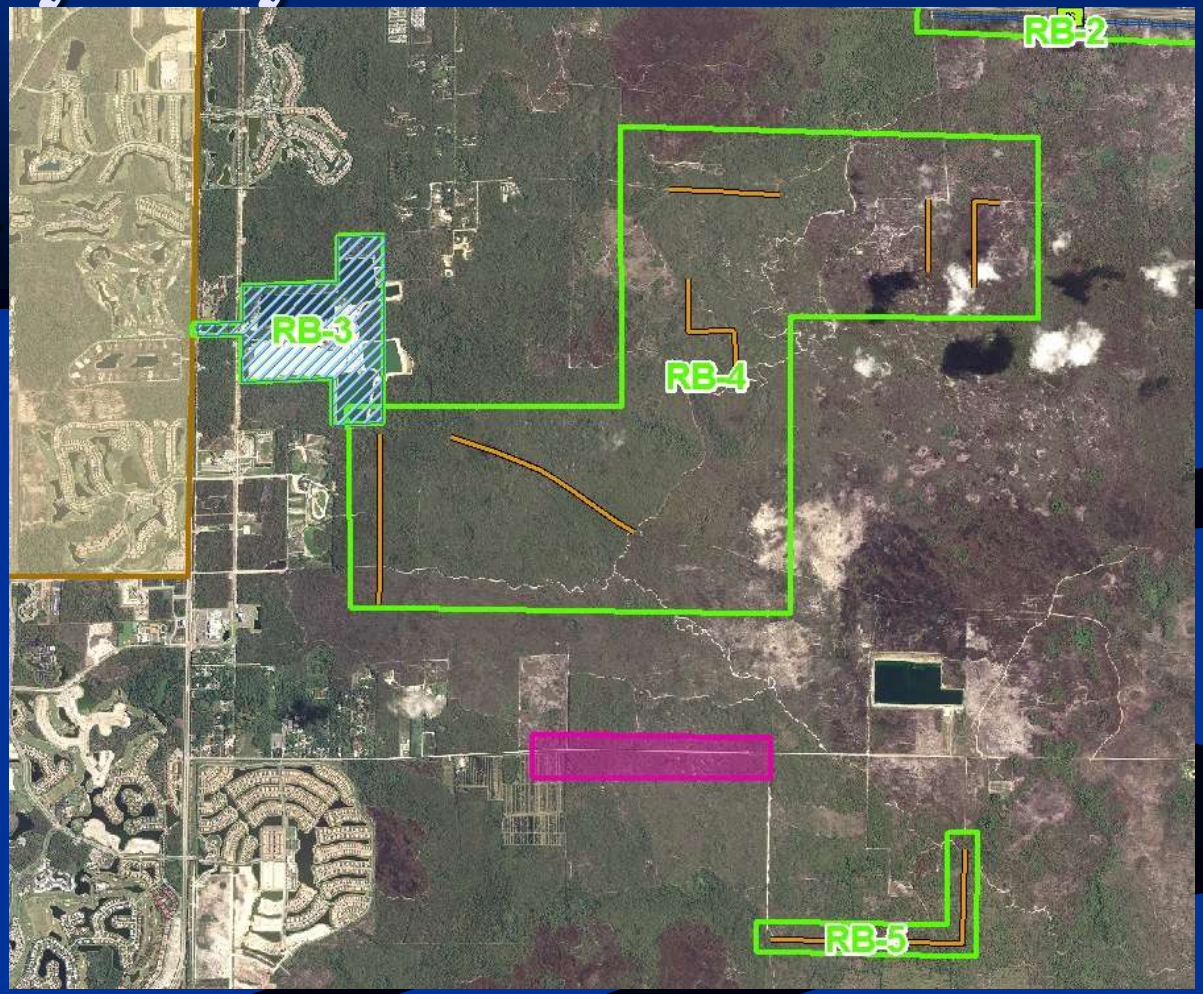
Potential Projects
Rookery Bay Watershed

- RB-3
  - Storage reservoir (SWFFS)
- RB-4 and RB-5
  - Regrading of roads and horse trails in PSSF



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Potential Projects
Rookery Bay Watershed

- RB-6 and RB-7
  - Drainage upgrades and spreader swale
- RB-8
  - Stormwater treatment area
- RB-9
  - Spreader swale

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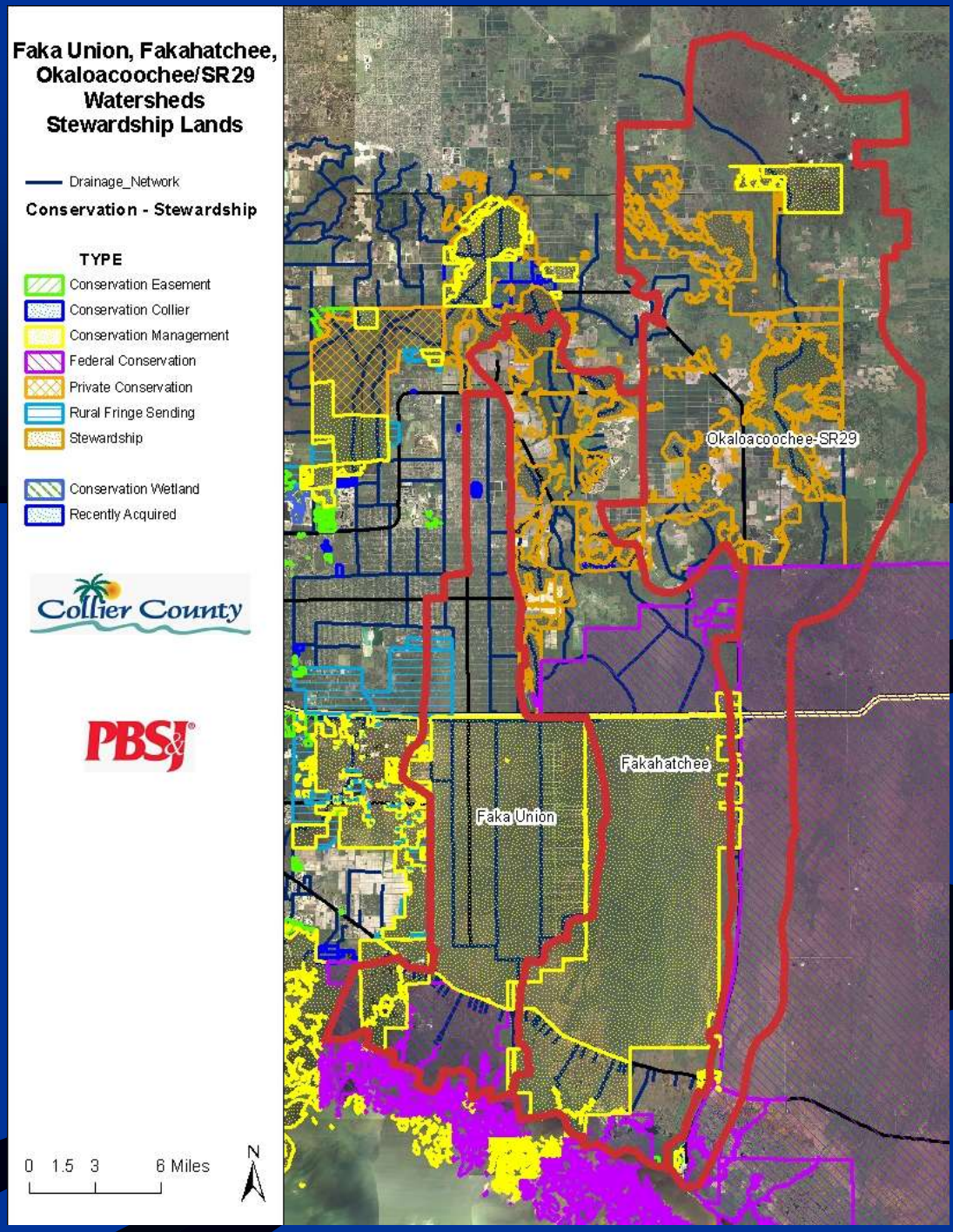
Eastern Watersheds Conservation/ Stewardship Lands



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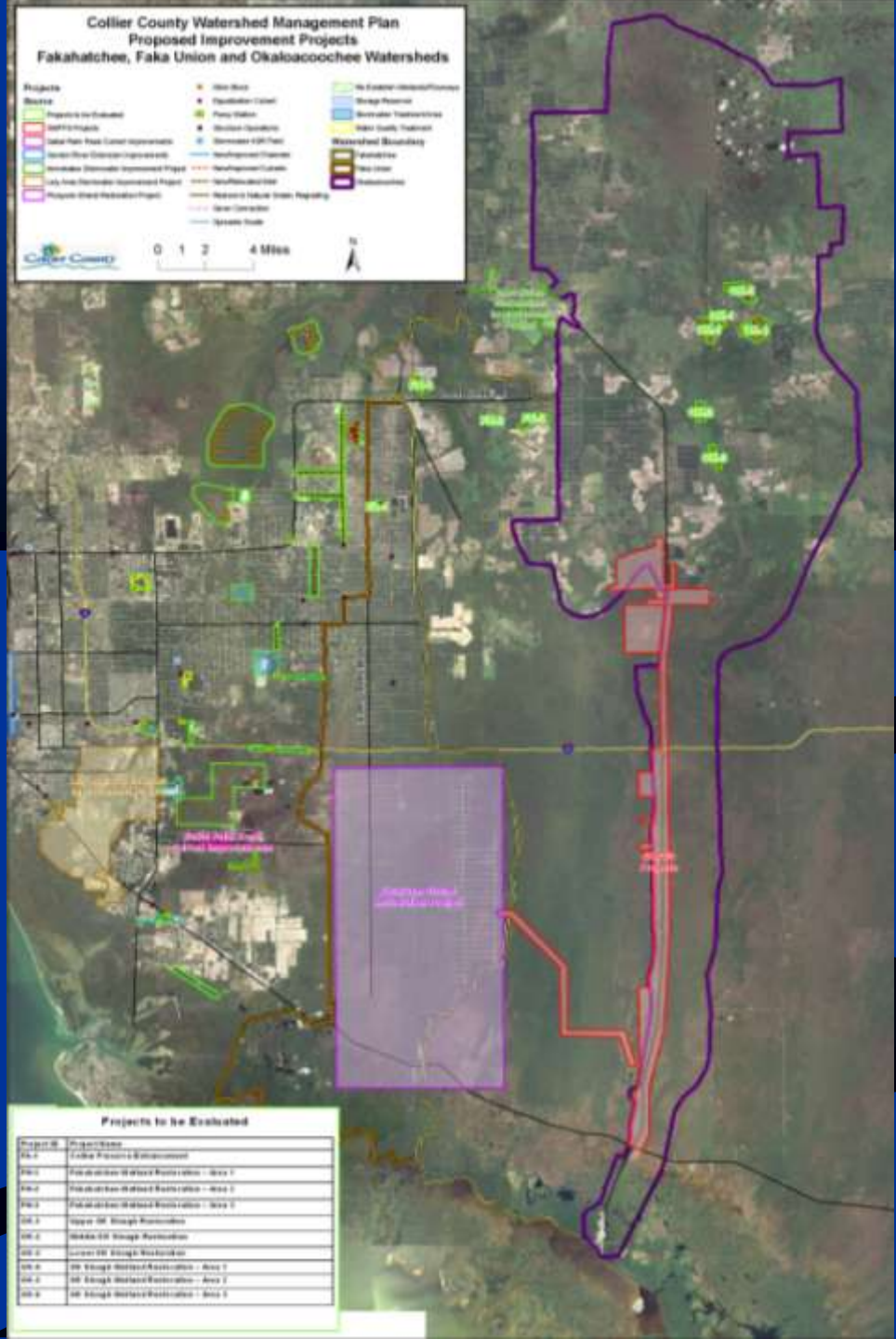
Potential Projects: Eastern Watersheds



Potential Projects Eastern Watersheds

- FA-1
  - Winchester Head in the Northern Golden Gate Estates Flowway Restoration Plan
  - Ditch blocks and equalization culverts for more storage

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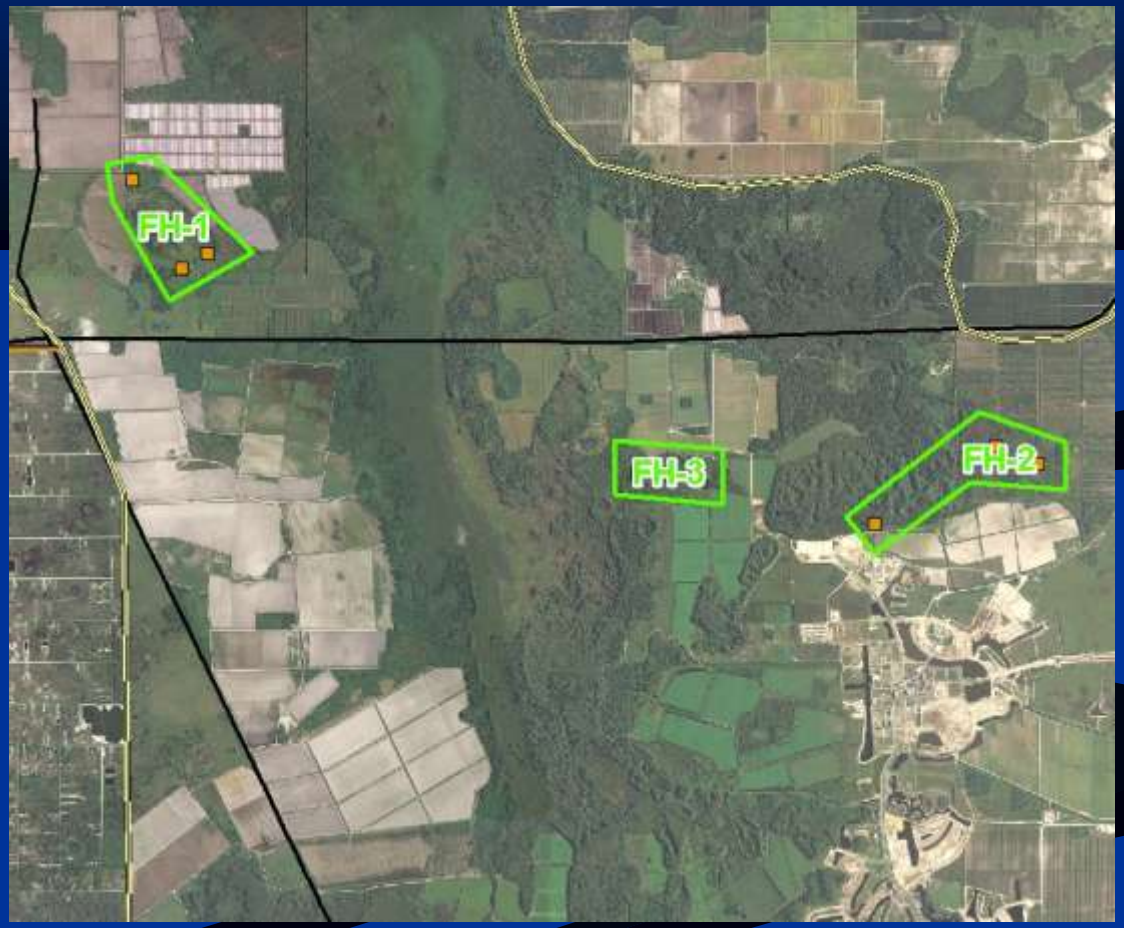
Potential Projects Eastern Watersheds

- FH-1 to FH-3
  - Ditch blocks to reduce drainage of isolated wetlands



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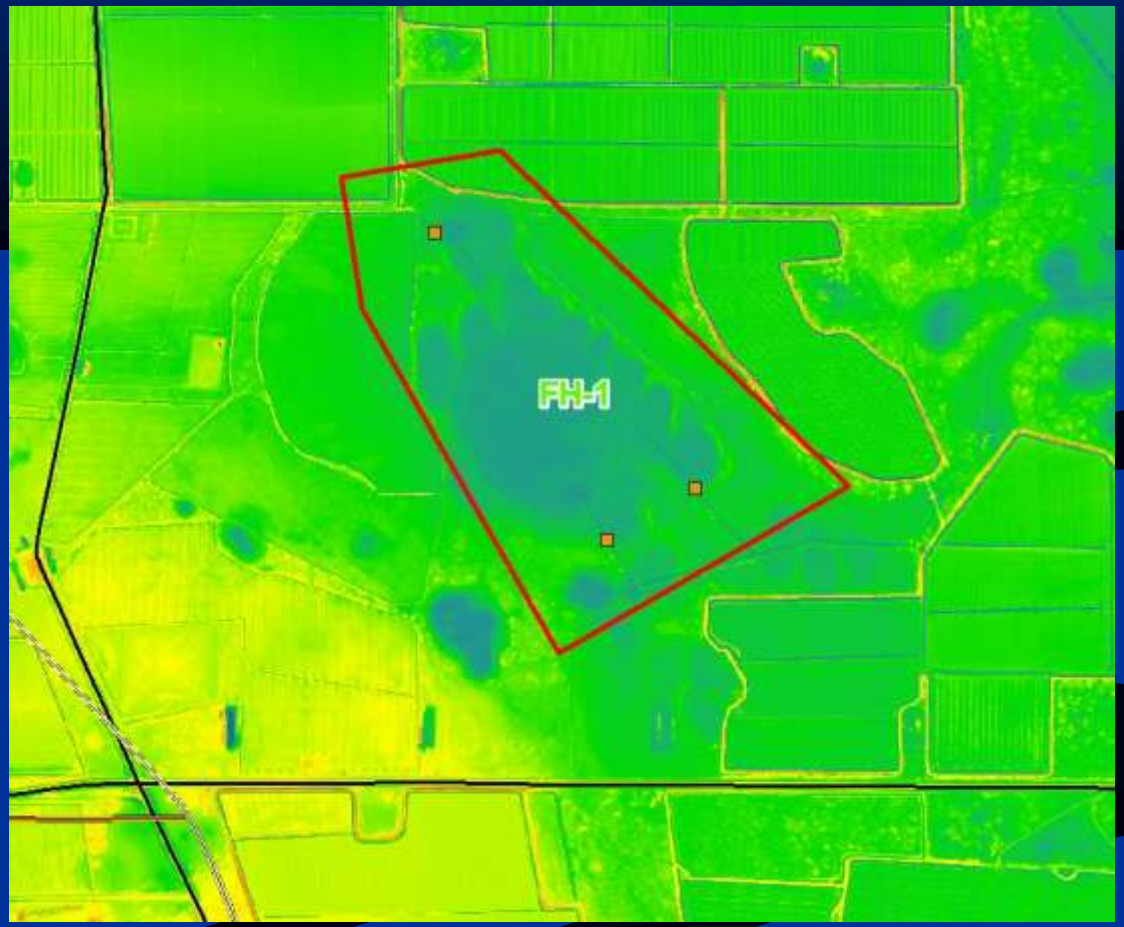
Potential Projects Eastern Watersheds

- FH-1
  - Ditch blocks to reduce drainage of isolated wetlands



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County-wide Projects

- Structure operations
- Public facilities (schools and parks) retrofits
  - Pervious paving
  - Infiltration basins
  - Rain gardens
- Incentive programs for retrofit of private property
- Agricultural Containment
- Aquifer Storage and Recovery (stormwater)

Public Facilities
Potential Retrofits

- Utilize islands as infiltration basins
- Install pervious pavement in low traffic areas
- Install rain gardens to capture roof runoff

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Functional Assessment

- Existing condition evaluated for:
  - Vegetation
  - Hydrology
  - Landscape Suitability Index (landscape position)

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Vegetation Score Methodology

- Concept – assume that pre-development vegetation communities provide optimal functional value
- For watershed-level application
  - 2007 FLUCCS compared to PDVM

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Vegetation Score by Category

Model Land Use Type	MIKE SHE Model Code	FLUCCS Code	Vegetation Score
Citrus	1	221, 222, 223	4
Pasture	2	211, 212, 213, 251, 260, 261, 832	6
Pasture	2	190,192, 193 (urban abandoned)	1
Sugar Cane & Sod	3	2156, 242	4
Truck (Row) Crops	5	214, 215, 216	4
Golf Course	6	180, 182	1
Bare Ground	7	161, 162, 163, 164, 181, 231, 740, 743, 744, 8113, 8115, 835	0
Urban Low Density	41	110, 111, 112, 113, 119, 148, 185, 240, 241, 243, 250	1
Rural Residential Low Density	41	118	3
Urban Medium Density	42	120, 121, 122, 123, 129, 176, 834	1
Urban High Density	43	130, 131, 132, 133, 134, 135, 139, 140, 1411, 1423, 146, 149, 154, 155, 156, 170, 171, 183, 184, 187, 252, 810, 811, 814, 820, 831, 833	0

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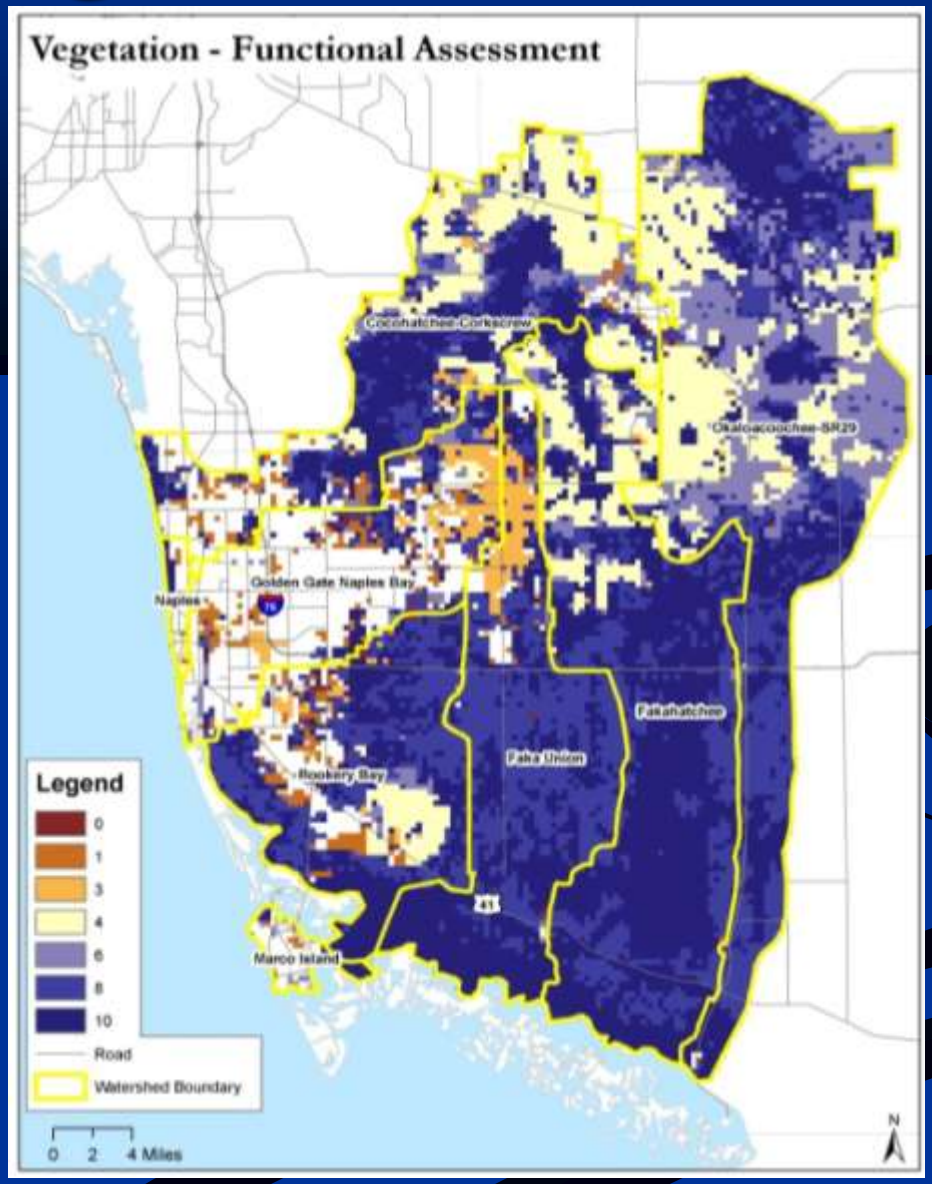
Vegetation Score Results



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Hydrology Score Methodology

- Concept – locations with similar water depths and hydroperiods over time provide optimal functional value
- Process: Compare existing conditions model hydrology against hydrology of PDVM vegetation
- Scoring computer based on:
  - Hydro-period
  - Seasonal Water Level

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PDVM Hydrology (Duever, 2004)

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

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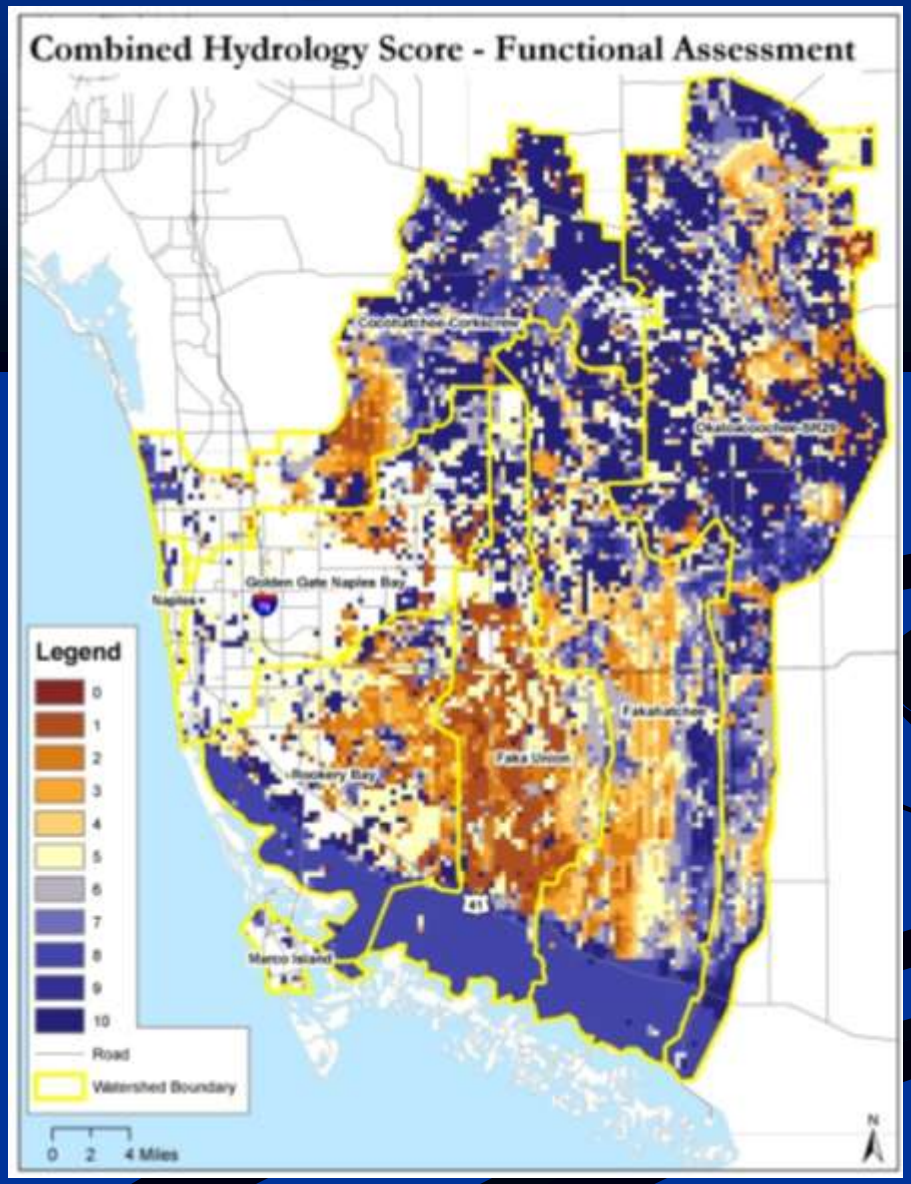
Hydrology Score Results



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Landscape Suitability Index Methodology

- Concept – evaluate habitat based on surrounding landuse
- Developed by Center for Wetlands (UF)
- For watershed-level application
  - 2007 FLUCCS into 1500 x 1500 foot cells
  - LSI for each cell calculated based on scores of adjacent cells
  - Scores reported by WBID and watershed

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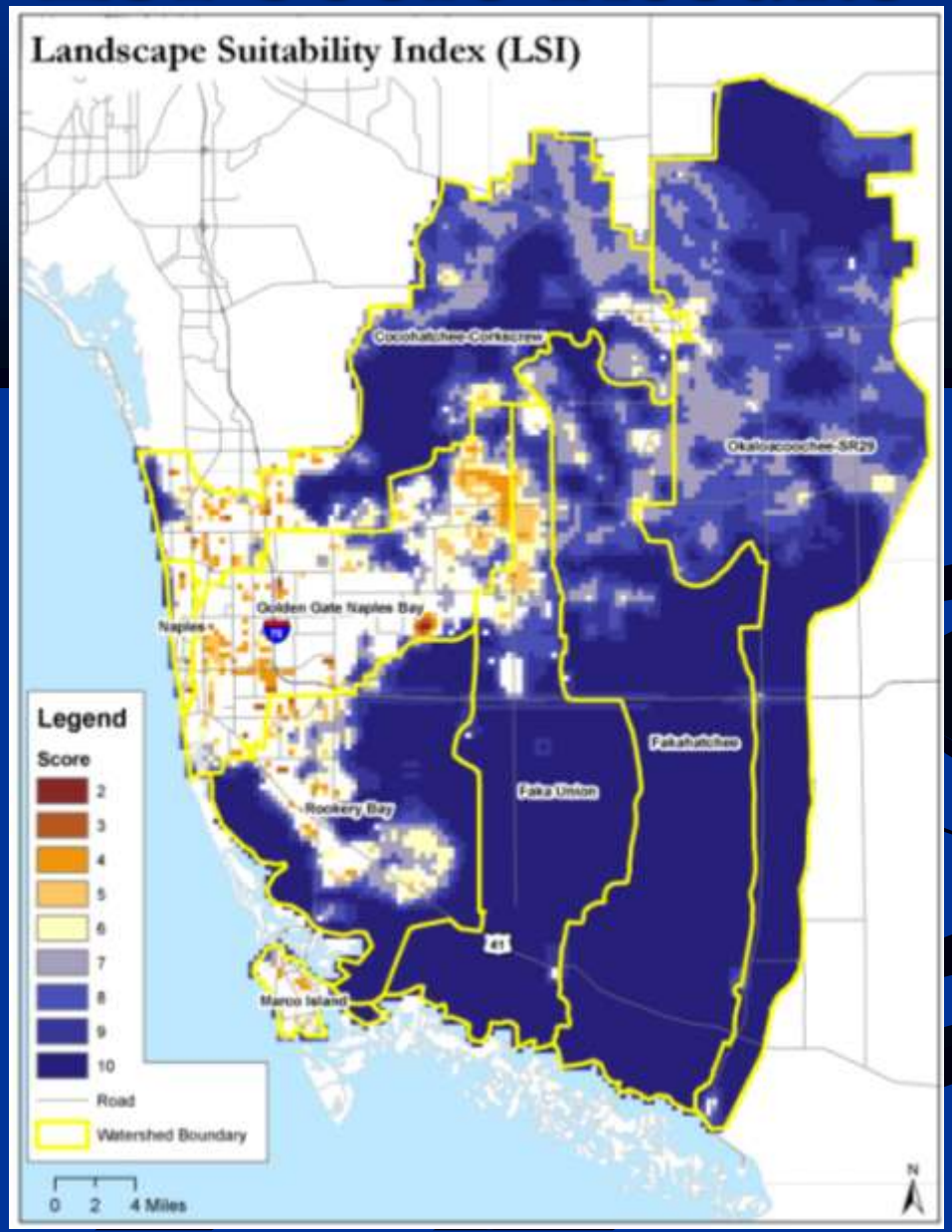
LSI Coefficients

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 Score Results



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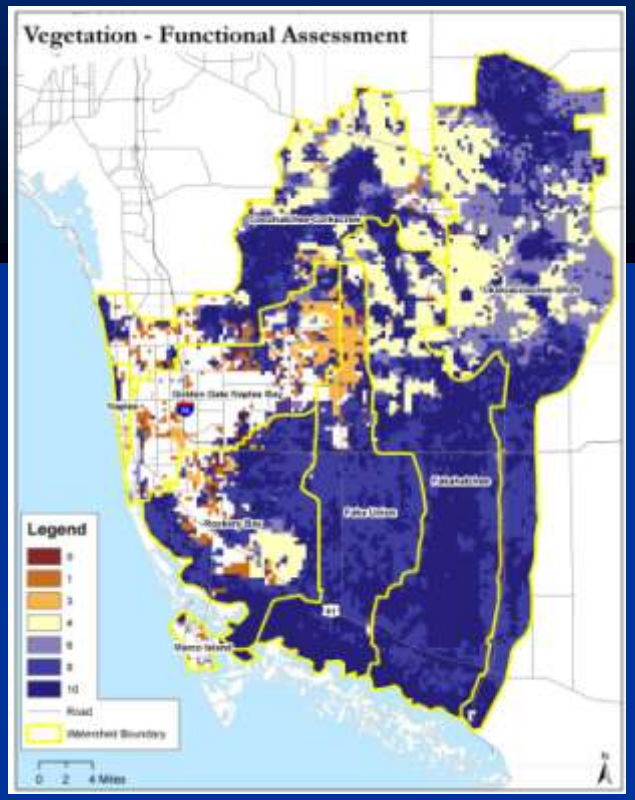
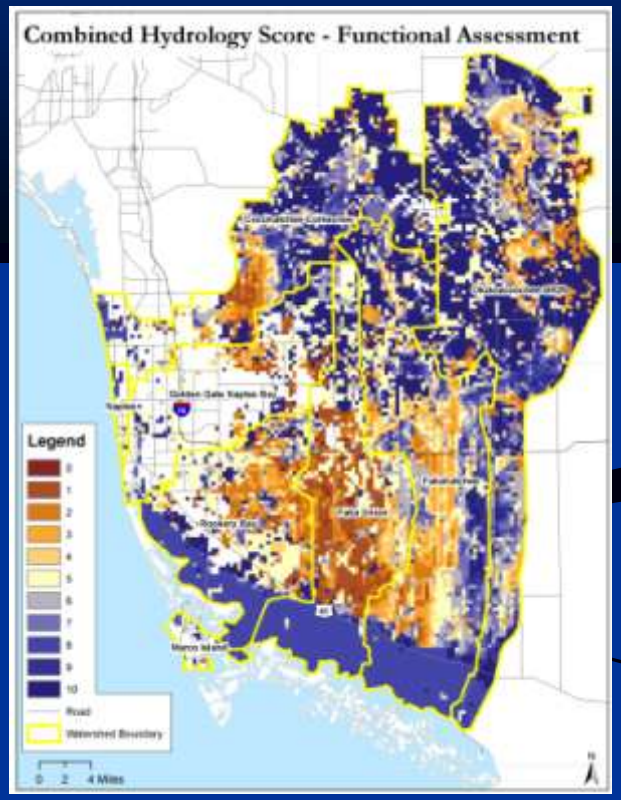
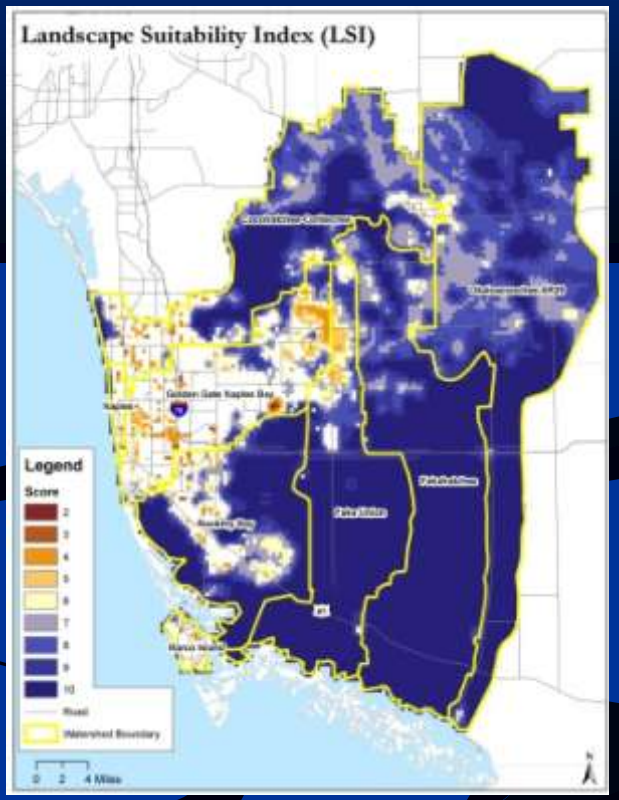
Functional Assessment Scores



Vegetation



Hydrology



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Application of Results

- Evaluation of Ecologically Valuable Lands
- Evaluation of Project Performance (Performance Measures)

Evaluation of Ecologically Valuable Lands

- Based on Vegetation and LSI scores
  - Ecologically Valuable Lands:
    - Vegetation Score = 8 – 10
    - LSI Score = 10
  - Ecologically Supportive Lands:
    - Vegetation Score = 6 – 8
    - LSI Score = 8 – 10
  - Agricultural Supportive Lands:
    - Vegetation Score = 4 – 6
    - LSI Score = 6 - 8

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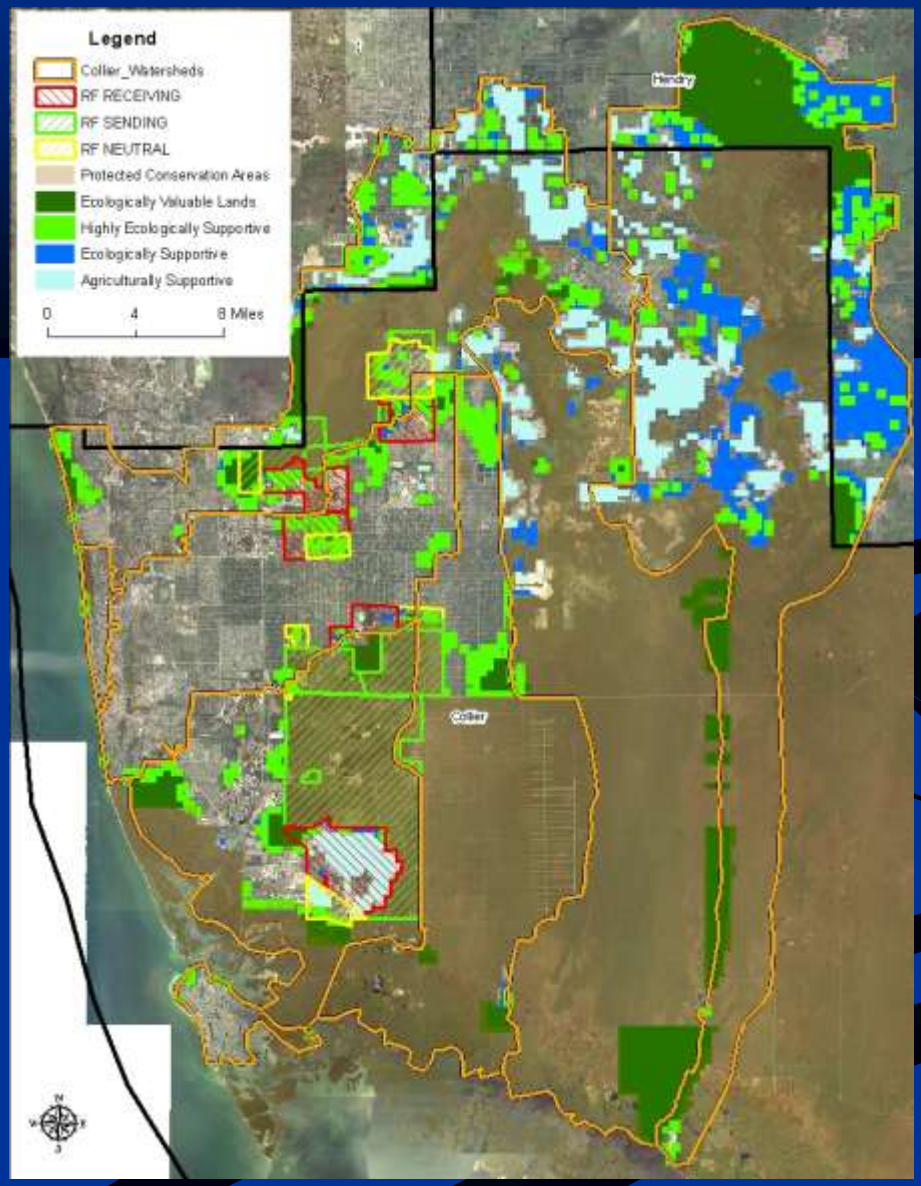
Ecologically Valuable Lands



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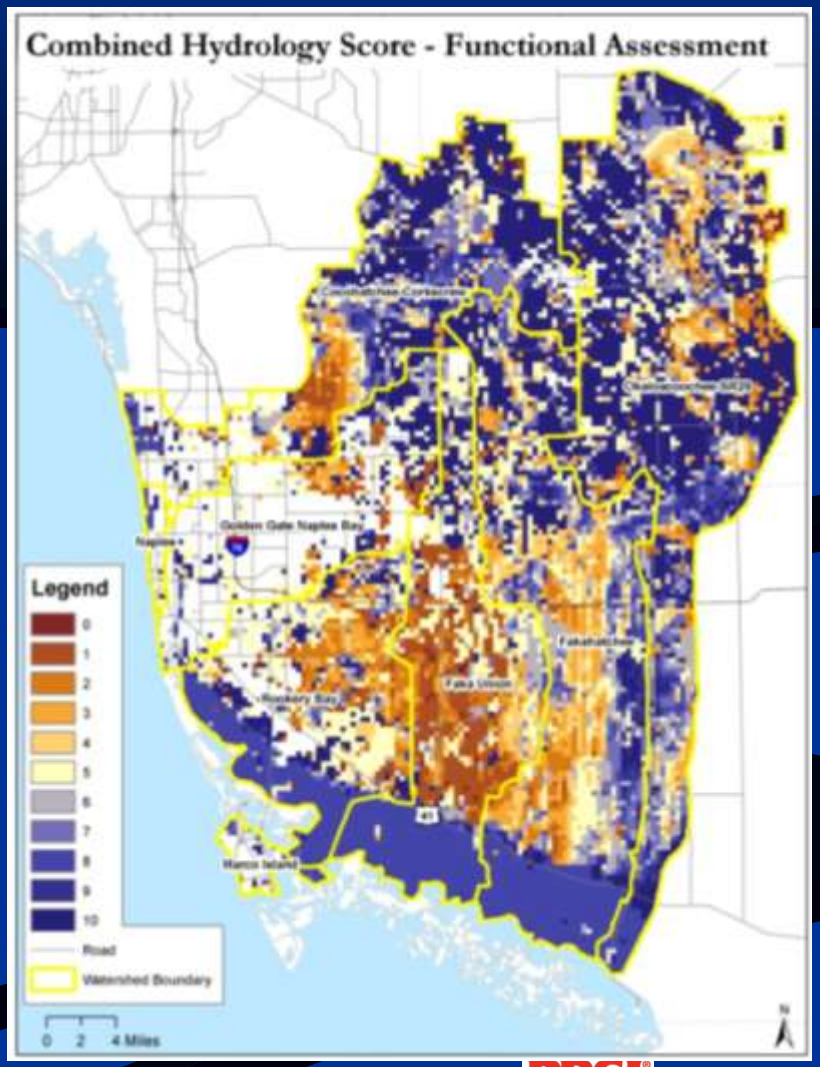
Natural Systems Performance Measure

- Projects being evaluated based on improved hydrology



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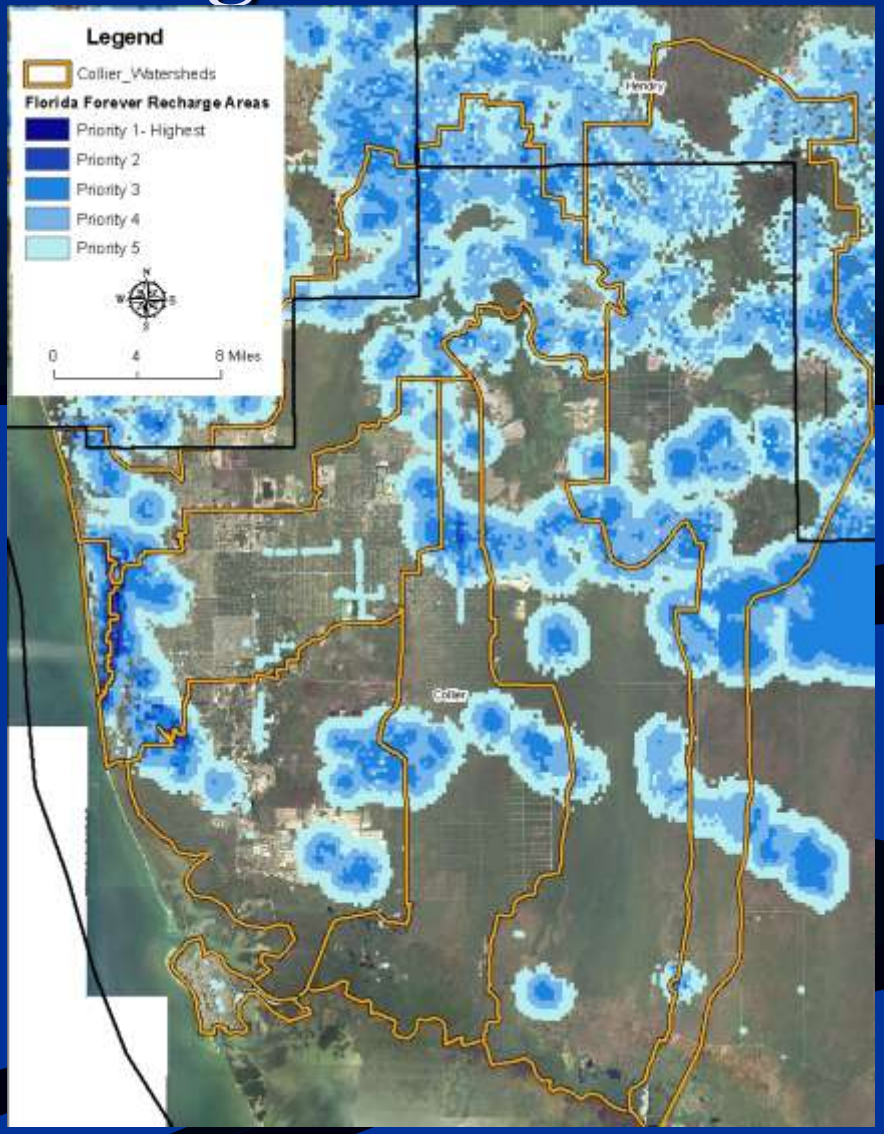
Groundwater Recharge Areas

- Priority recharge areas defined by Florida Forever
- Consistent with recharge results from NSM model
- Important for future development and aquifer protection



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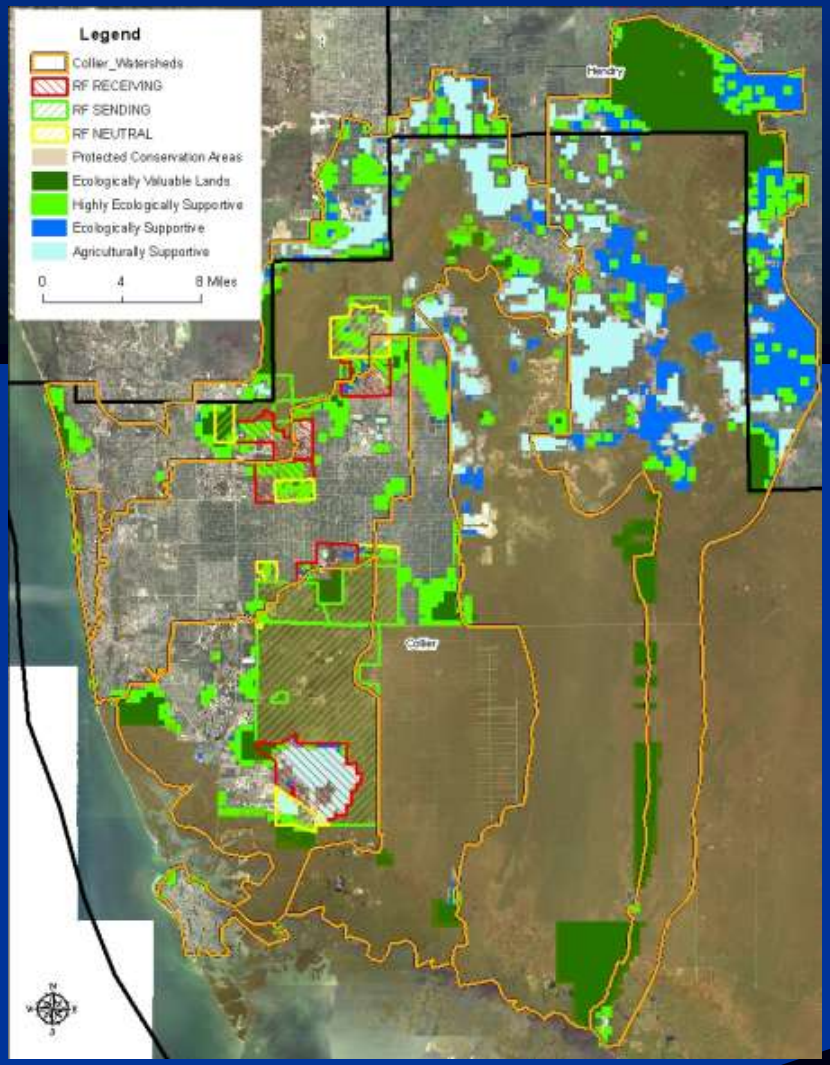
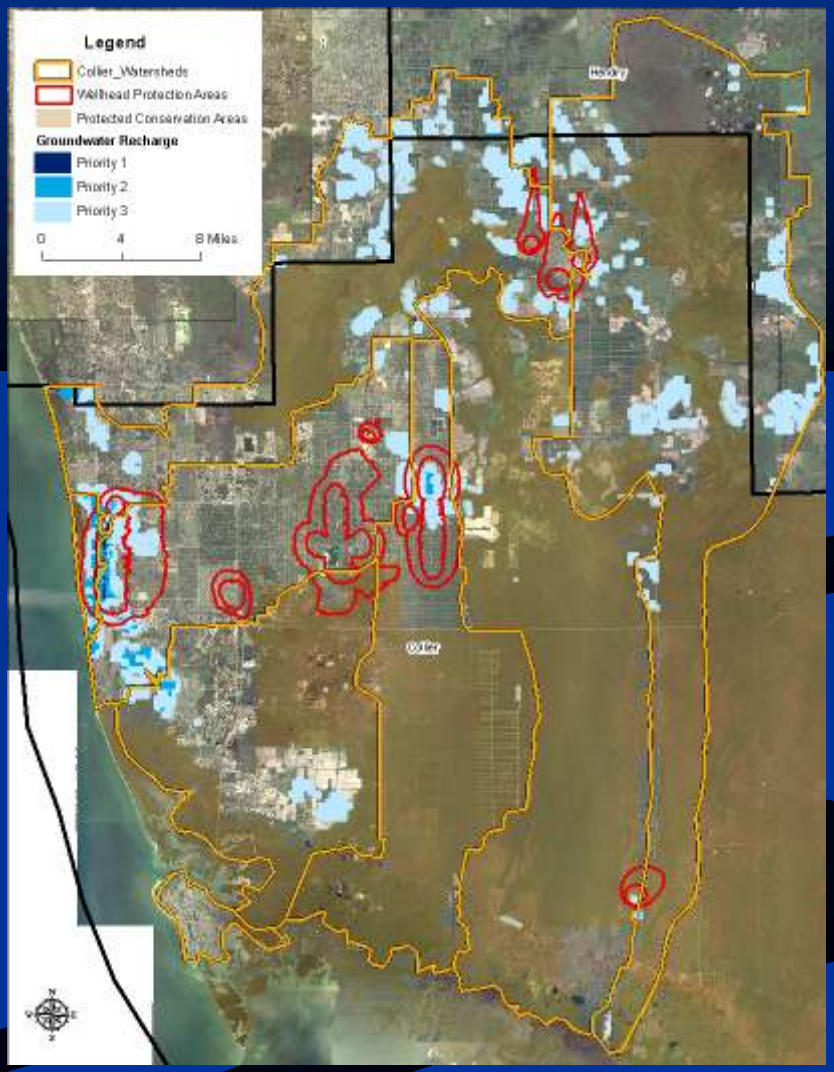
Groundwater Recharge Areas





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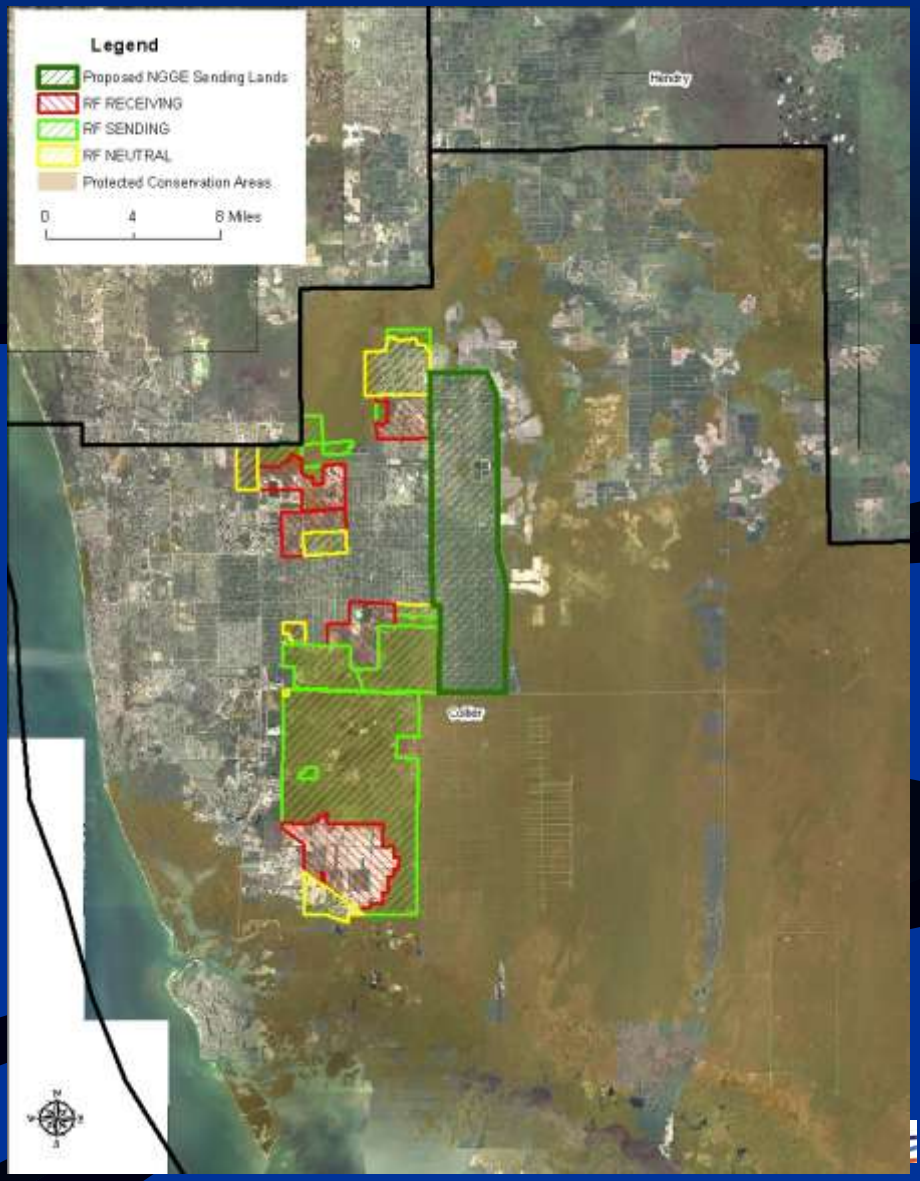
Recommendations for Additional Protection

- Expand Rural Fringe Sending Lands into NGGE
- Re-evaluate RF Neutral Lands in high value ecological areas
- Utilize LID policies to protect high recharge areas.
- Coordinate with SFWMD for land along SR 29



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Objective of Regulatory Review

- Help implement a Sustainable Stormwater Management Program
- The programs should aim to:
  - Promote more effective site planning to minimize anthropogenic impacts,
  - Promote preservation of the natural system
  - Help reduce development costs
  - Help reduce cost of future drainage system improvements

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Low Impact Development (LID)

- The program is based on the concept of LID
- LID promotes management of stormwater by:
  - Encouraging management of stormwater at the site
  - Minimize the extent of directly connected impervious areas.
  - Minimize site disturbance
  - Maintain or restore a site's natural hydrology
  - Maximize the site's assimilative capacity

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Low Impact Development (LID)

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Changes in Land Development Criteria

- Design recommendations
  - Directly connected impervious area
  - Recommended road widths
  - Parking lot design
- Combination of regulations and incentives

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Fertilizer Ordinances

FDEP Model Ordinance

- Nitrogen and Phosphorus application prohibition period
- A minimum of ten (10) feet from water bodies
- Nitrogen, Phosphorus formulation restriction
- Avoid impervious areas
- Agricultural exemptions
- Public education

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Comparison with Existing Ordinances

Ordinance	FDEP/DACS/UF	City of Naples	SWFRPC	Lee County	CSWF
Trianing	Applicators	Applicators	Applicators	Applicators	Applicators
Certification	Applicators	Applicators	Applicators	Applicators	All Venues
Prohibited Period	Watches	June-Sept	June-Sept	June-Sept	Watches + June-Sept
Application Rate	Label Req: 2-7 lbs N per yr based on species; not > 1 lb N per application; 0.5 lb P per year	50 % slow N, 4 lbs N per yr, <=2 % P,	<=2 % P, 70 % slow N, no blended fertilizer<= 6 times / year	>= 50 % Slow N, 0.50 lbs. P / 1,000 ft2 per yr, 4 lbs. of nitrogen per 1000 ft2 per year	<= 50 % Slow N, 4 lbs. of N per yr No P, 0.50 lbs. P per yr,
Fertilizer Free Zone	10 ft	10 ft	25 ft	10 ft	10 ft
Exceptions	Agriculture, research	Agriculture + vetables	Agriculture	Agriculture; new plants; vegtables	Agriculture + various others
Enforcement	Applicators	Applicators	Applicators	Applicators	Applicators and Property Owners
Others		Sales			Sales

Performance Measures

- Freshwater Discharge to Estuaries
- Pollutant Load
- Flood Risk
- Aquifer Recharge/Yield
- Natural Systems

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Water Quantity and Flood Risk

- Issue: Current regulations for large storms focus on control of peak discharge for the 25-year/24-hour design event.
- Recommendation:
  - Require volume control for the 25-year/24-hour design event.
  - It allows control of peak, volume and timing of stormwater discharges

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Water Quantity and Flood Risk

- Issue: Most County watersheds do not meet current flood protection levels of service (FPLOS).
- Recommendation:
  - Modify FPLOS to set realistic goals.

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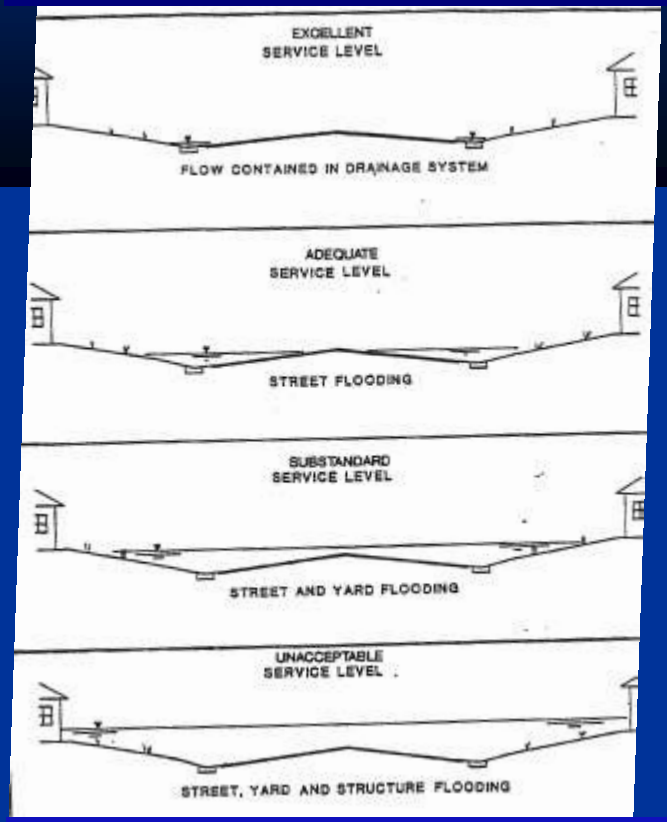
Water Quantity and Flood Risk

Current FPLOS



Proposed FPLOS

	Storm Return Period (years)		
Roadways	**10**	**25**	**100**
A. Evacuation Routes	None	None	None
B. Arterials	None	None	6 inches
C. Collectors	None	6 inches	9 inches
D. Neighborhood	6 inches	9 inches	12 inches
Open Space			
Flooding of open space is acceptable if it does not compromise public health and safety			

Summary

- There are opportunities to modify current regulations related to water quality, water quantity, land development, and zoning.
- The objective should be to implement a "sustainable stormwater management program".
- Encourage application of LID concepts
- Examine zoning and TDR program

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Future Meetings

- March 16 th Alternatives Analysis
- March ?? Low Impact Development & GOPs

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Wrap Up

- Comments via E-Mail

  machatcher@colliergov.net

- Formal position papers
  - Please mail to Mac Hatcher

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