Collier County

Watershed Management Plan

April 13, 2011

ATKINS

DHI

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

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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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Watersheds

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

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Agenda

- Recommended Projects
- Regulatory and Policy Recommendations
- Summary and Conclusions

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Recommended Projects

- Alternative Analysis
- Recommended Projects
- Opportunities for Improved Structure Operations

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Identification of Potential Projects

- Methodology
  - Identify previously considered projects or projects that are scheduled for implementation
  - Better define previously identified projects
  - Identify new project opportunities based on:
    - Estuary freshwater surplus/deficit
    - Current property ownership
    - Existing conservation easements
    - Location within Sending/Receiving areas

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Identification of Potential Projects

- Previously considered projects or projects that are scheduled for implementation
  - Picayune Strand Restoration Project
  - Southwest Florida Feasibility Study
  - Belle Meade Area Stormwater Master Plan
  - Lely Area Stormwater Improvement Project
  - Immokolee Stormwater Master Plan
  - Master Plan for Regional Irrigation Distribution System (RIDS)

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Recommended Projects
Cocohatchee - Corkscrew

Corkscrew Regional Ecosystem Watershed

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Collier County Watershed Management Plan

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Cocohatchee Watershed

STATEMENT OF PROBLEM

These lands are located within the Corkscrew Regional Ecosystem Watershed. Development of residential areas included construction of drainage ditches and swales. These ditches and swales interconnect with stormwater management systems in downstream sub-divisions before discharge into the Cocohatchee Canal.

The man-made ditches and swales contribute to a modified hydroperiod and artificial draining of the wetland systems.

PROJECT BENEFITS

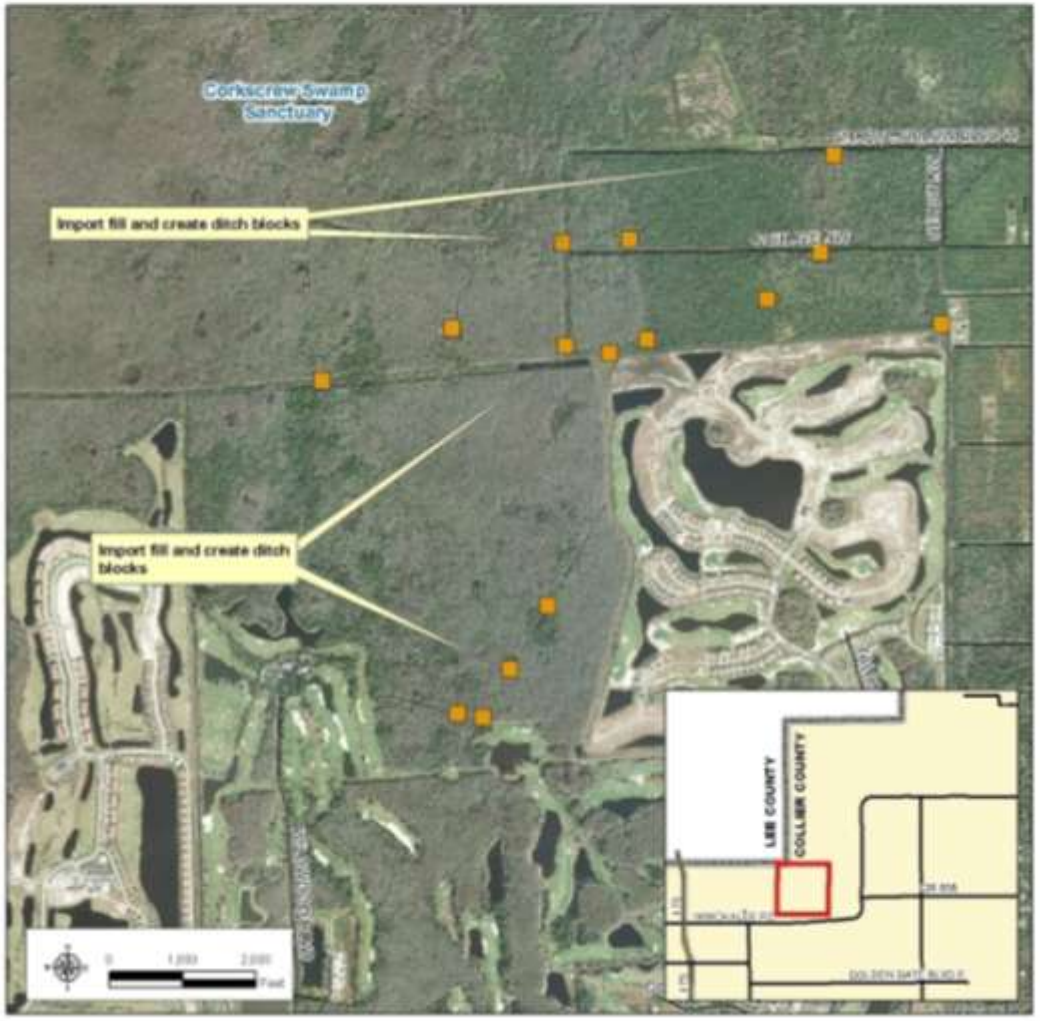
(1) Restoration of historical overland flow patterns

(2) Restored hydrology in wetlands upstream of ditch block locations

(3) Increased groundwater recharge

PROJECT DISADVANTAGES

(1) Increased depth of overland flow could affect golf courses and residential communities



SOLUTION

- Import material and backfill man-made drainage ditches at wetland outfall locations

- Use ditch blocks to encourage overland flow in existing conservation areas

DESIGN CONSIDERATIONS

- Coordination with CREW

- Potential impacts golf courses and surrounding residential communities

- Potential presence of exotic species

- Equipment access

- Investigate availability of potential onsite material

COST ESTIMATE

Construction	$68,000
Land Acquisition	N/A
Engineering and Contingency	$28,000
TOTAL	$96,000

Recommended Projects
Golden Gate – Naples Bay

Henderson Creek Diversion Pump Station

Collier County Watershed Management Plan

Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the golden Gate Main Canal almost tripled the size of the watershed draining to the Naples Bay estuary and greatly reduced the size of the watershed draining to the Rookery Bay estuary. As a result, Naples Bay receives significantly too much water and Rookery Bay receives too little water, negatively effecting both receiving water estuary systems.

PROJECT BENEFITS

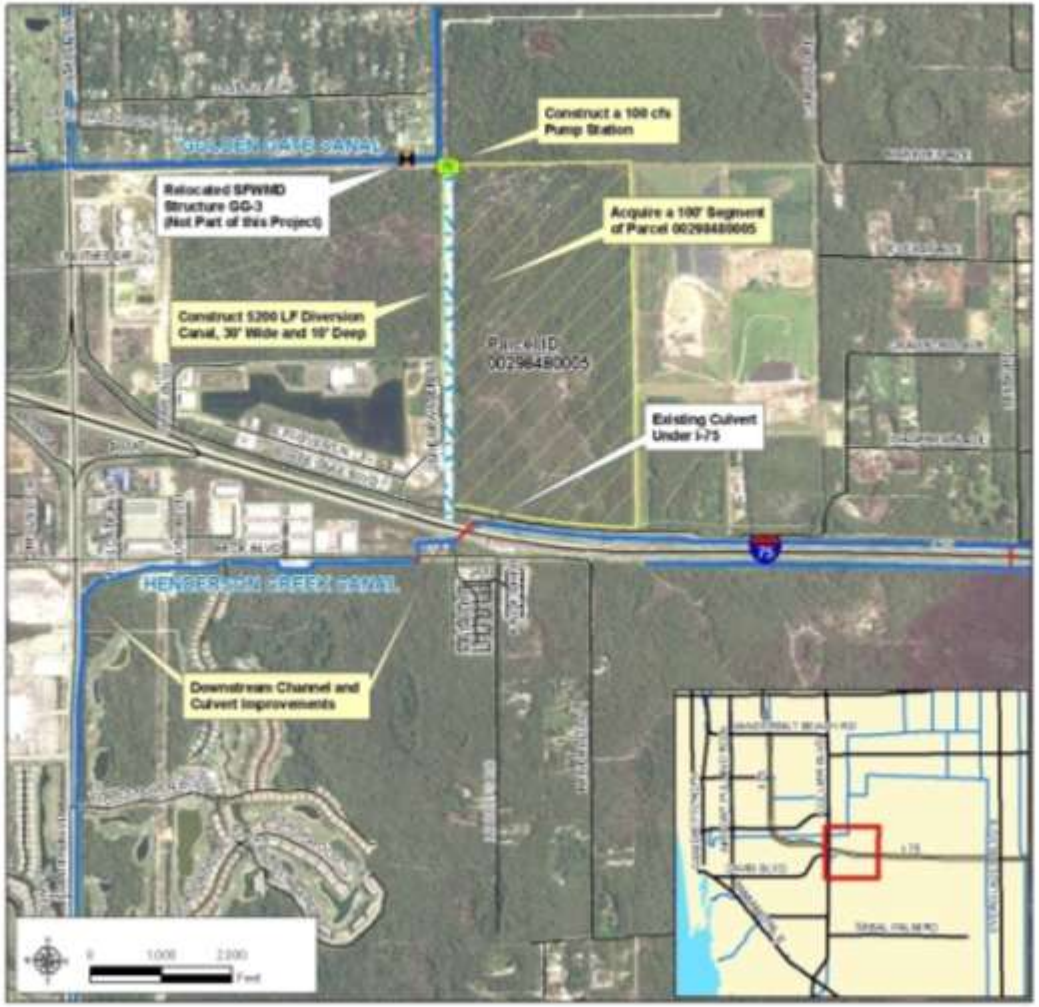
(1) Reduces freshwater discharges to the Naples Bay estuary and increases freshwater discharge to the Rookery Bay.

(2) Provides additional water to Henderson Creek that may augment supplies required for the Marco Island Water Treatment Plant located downstream.

PROJECT DISADVANTAGES

(1) The project would be dependant on the purchase of a portion of private property.

(2) Project provides no water quality benefit.



SOLUTION

This project has been conceptualized by the South Florida Water Management District and seeks to divert water from the Golden Gate Main Canal into Henderson Creek.

- Plans call for construction of a 100 cfs pump station to divert flows from the Golden Gate Canal to the Henderson Creek Canal.

- Diverted water will move south through a new 5200 LF dredged canal, 30' wide and 10' deep and water will flow into Henderson Creek through an existing box culvert under I-75.

- Channel and Culvert improvements will be required in Henderson Creek downstream I-75 to convey the addional flows.

DESIGN CONSIDERATIONS

This project has been conceptualized by the South Florida Water Management District and seeks to divert water from the Golden Gate Main Canal into Henderson Creek.

- Evaluate alternative pumping strategies to determine optimal operation.

COST ESTIMATE

Construction:	$4,065,000
Land Acquisition:	$423,000
Engineering and Contingency:	$1,220,000
TOTAL	$5,708,000

Recommended Projects
Golden Gate – Naples Bay

North Golden Gate Estates Flowway Restoration Project

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Collier County Watershed Management Plan

Collier County

Golden Gate and Faka Union Watersheds

STATEMENT OF PROBLEM

Construction of the Golden Gate drainage network and construction of residential roads fractured the connectivity of wetland systems through this region. Roadside drainage swales, coupled with a lack of culverts underneath the roads now serve to route flows directly into the canal system.

This increases the volume and speeds discharge to the estuary while negatively modifying the wetland hydrology. In addition, groundwater elevations in the northern Golden Gate Estates area are lower due to water diversion and the use of the Surficial and Lower Tamiami aquifers for water supply.

PROJECT BENEFITS

(1) Restores wetland hydrology, connectivity and habitat while increasing and attenuating freshwater storage.

(2) Increases groundwater recharge and helps maintain groundwater elevations.

(3) Provides water quality treatment.

(4) Project could be funded through mitigation credits.

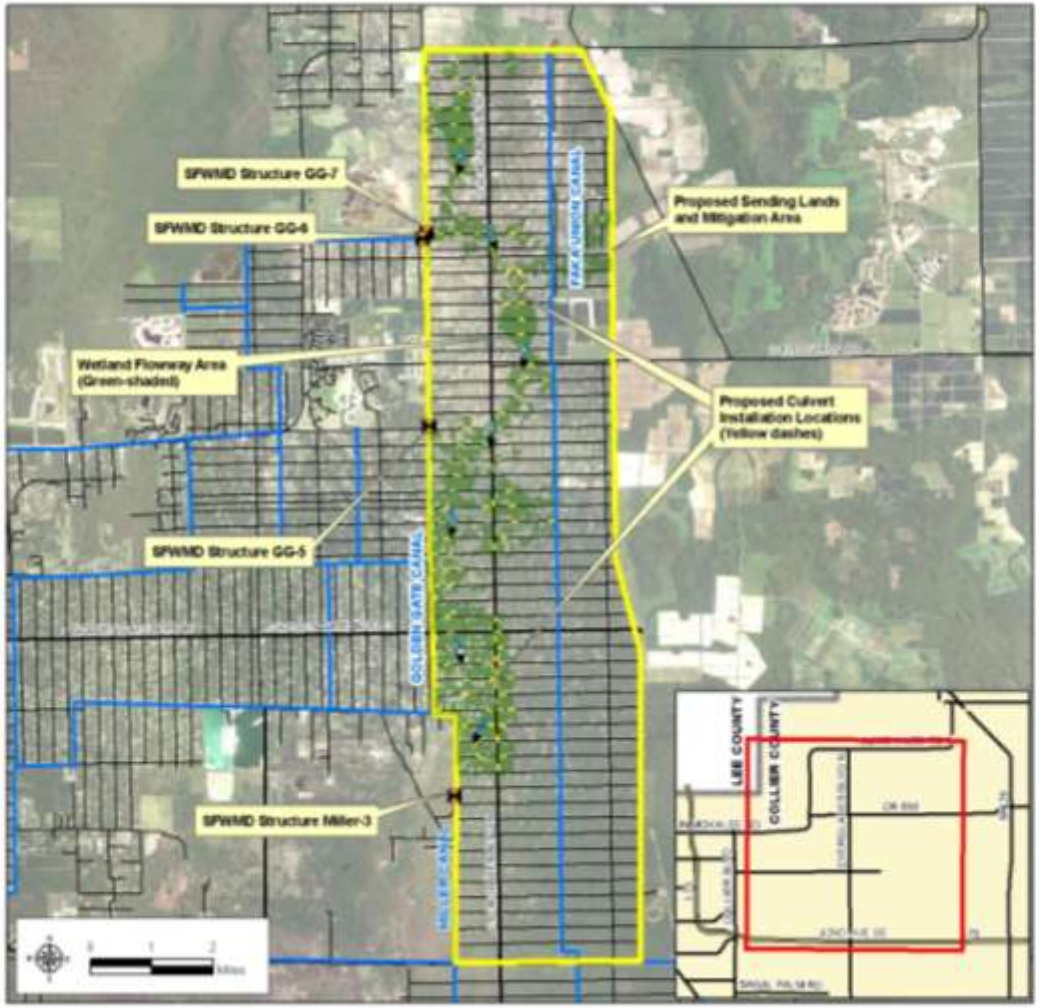
PROJECT DISADVANTAGES

(1) Area would be designated as a mitigation area and as Rural Fringe Sending Area.

(2) Elevated groundwater level may affect septic leach fields or increase flood risk for residential properties near the project.

(3) May require purchase of private properties within the primary flowway.

(4) Dependant on designation of the area as a new TDR program.



SOLUTION

- This is the Northern Golden Gates Estates Flowway Restoration Project. Project would utilize ditch blocks and equalization culverts to provide connectivity within the wetland system and re-establish historical flow regimes.

- Grading will likely be required to re-establish connectivity.

- Elimination of roadside berms may be necessary to promote overland flow south and re-direct runoff through the historical wetland slough and back into the Golden Gate and Faka Union Canals.

DESIGN CONSIDERATIONS

- Evaluate the presence of roadside berms that restrict sheet flow.

- Determine the maximum groundwater elevation that is allowed for proper function of septic systems in the immediate vicinity.

- Consider the affects of increased sheetflow on downstream properties.

- Evaluate flow rates and storage capacities within the system and size culverts accordingly.

COST ESTIMATE

Construction:	$1,691,000
Land Acquisition:	$0
Engineering and Contingency:	$677,000
TOTAL	$2,368,000

Recommended Projects
Golden Gate – Naples Bay

Upper Golden Gate Estates Canal Weir Construction

PBSJ

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal effectively tripled the size of the Golden Gate - Naples Bay watershed and increased the volume of freshwater discharged to the estuary. This has changed the saline balance of the estuary system.

In additional, the groundwater elevations in the northern Golden Gate Estates area have been lowered. This can be attributed to the presence of the canal system and use of the Surficial and Lower Tamiami aquifers for water supply.

PROJECT BENEFITS

(1) Provides storage of freshwater and decreases flow to the Naples Bay estuary.

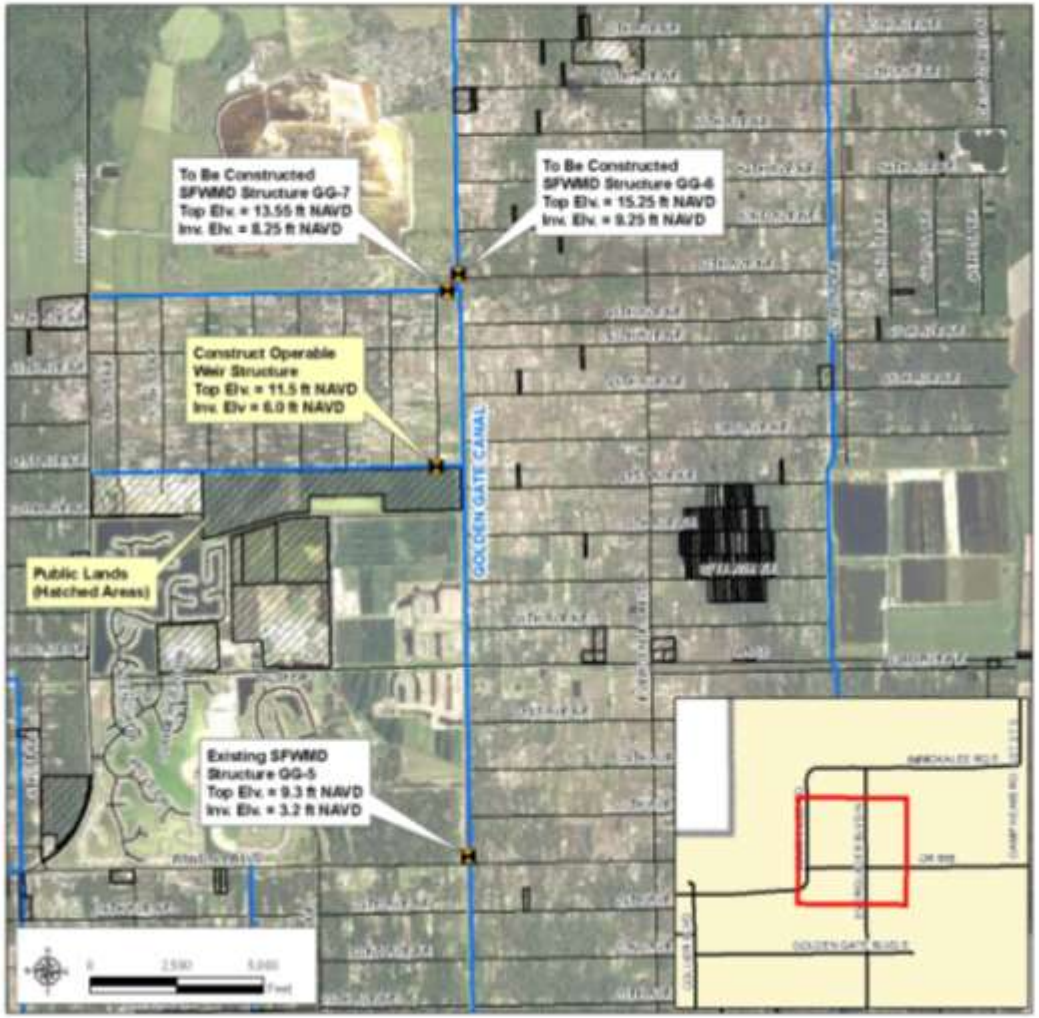
(2) Increases groundwater recharge and helps maintain groundwater elevations year-round.

(3) The operable weir alternative provides flexibility to manage groundwater and surface water elevations effectively.

PROJECT DISADVANTAGES

(1) Elevated groundwater level may affect septic leach fields or increase flood risk for residential areas near the canal.

(2) Permits for upstream water detention facility may have to be modified.



SOLUTION

- In conjuction with SFWMD projects to replace GG-6 and GG-7 with operable structures, construct an additional operable structure on the finger canal south of the GG-7 canal. The structure will allow the canal to be used as water storage feature. Additional storage capacity could be created by increasing the cross-section width into publicly owned lands south of the canal.

- The County already owns the property on the south side of the canal.

DESIGN CONSIDERATIONS

- Design and operational protocol would be coordinated with SFWMD projects to replace the GG-6 and GG-7 structures.

- Construction and operational access may require construction easement on the north side of the canal.

- Evaluate added benefit of additional storage by an increase of cross-section on portions of the adjacent publically-owned lands.

- A fixed sill weir with manual board operation would be a more inexpensive option.

COST ESTIMATE

Construction:	$394,000
Land Acquisition:	$0
Engineering and Contingency:	$158,000
TOTAL	$552,000

Recommended Projects
Golden Gate – Naples Bay

Wolfe Road
Wetland Treatment System

PBSJ

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

The Golden Gate - Naples Bay watershed has increased in size due to construction of the Golden Gate Main Canal. The result is that discharge has dramatically increased and has changed the saline balance of estuary system.

In this area, runoff from upstream is routed through the Island Walk subdivision. The stormwater runoff is also thought to contribute to nutrient and copper impairments in the Naples Bay Estuary.

PROJECT BENEFITS

(1) The project utilizes existing features.

(2) The project will reduce the volume and timing of flow to the Island Walk lake system and ultimately to the estuary.

(3) The project will provide water quality treatment.

(4) Increases groundwater recharge.

PROJECT DISADVANTAGES

(1) The required property (approximately 20 acres) is privately owned and permits have been requested for urban development.

(2) The existing permit for the Island Walk Subdivision would have to be modified to change the inflow characteristics.

SOLUTION

- Raise the invert of the existing structure that controls discharge from the drainage ditch into the Island Walk lake system to Elv. 11.5 ft NAVD.

- Extend the drainage ditch south and to the east into the series of existing borrow pits.

- Install culverts to convert the borrow pits into interconnected wetlands with sediment sumps and littoral shelf planting.

- Construct new control structure with at Elv. 9.75 with twin 36" RCPs to discharge treated stormwater back into the Island Walk lake system.

DESIGN CONSIDERATIONS

- Evaluate stage and volume of stormwater flowing through the existing structure into Island Walk lake system.

- Estimate maximum volume that can be treated in the proposed wetland treatment system.

- Consider requirements to change the Island Walk permit.

COST ESTIMATE

Construction:	$353,000
Land Acquisition:	$921,000
Engineering and Contingency:	$142,000
TOTAL	$1,416,000

Recommended Projects
Golden Gate – Naples Bay

Orange Tree Canal
Control Structure Installation

PBS&J

Collier County Watershed Management Plan

Collier County

Golden Gate Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal effectively tripled the size of the Golden Gate - Naples Bay watershed and increased to volume of freshwater discharged to the estuary. This has changed the saline balance of the estuary system.

In addition, the groundwater elevations in the Golden Gate Estates area have been lowered. This can be attributed to the presence of the canal system and the use of the Surficial and Lower Tamiami aquifers for water supply.

PROJECT BENEFITS

(1) Provides storage for freshwater and decreases flow to the Naples Bay estuary.

(2) Decreases groundwater baseflow and helps maintain groundwater elevations year-round.

(3) The operable weir alternative provides flexibility to manage groundwater and surface water elevations effectively.

PROJECT DISADVANTAGES

(1) Elevated groundwater level may affect septic leach fields or increase flood risk in developed areas near the canal.

SOLUTION

- Construct an operable weir structure near the intersection of the Orange Tree Canal and 14th Avenue NE to increase storage capacity and groundwater recharge.

- Properties on either side of the canal near the structure location may be required to provide construction and maintenance access.

DESIGN CONSIDERATIONS

- Coordinate operational protocols with SFWMD Structure GG-4.

- Evaluate affect of increased stage in the canal upstream of the structure. Evaluation should include changes in groundwater elevation relative to septic tanks and potential changes in flood risk.

- A fixed sill weir with manual board operation could be a more inexpensive option.

COST ESTIMATE

Construction:	$394,000
Land Acquisition:	$0
Engineering and Contingency:	$158,000
TOTAL	$552,000

Recommended Projects
Rookery Bay

North Belle Meade/Southern Horsepen Strand Redydration

PBSJ

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal interrupted the historical sheet flow pattern to the south and Rookery Bay. The water is now diverted west toward the Naples Bay estuary. Overall, this redirection of stormwater flow has resulted in decreased salinity levels in Naples Bay and increased salinity levels in Rookery Bay. Additionally, the reduction of stormwater runoff to the south has decreased wetland hydroperiods in areas where sheetflow used to occur.

PROJECT BENEFITS

(1) Diverts water from the Golden Gate Main Canal and decreases flow to Naples Bay.

(2) Increases hydroperiods of wetland areas in the North Belle Meade area.

(3) Increases groundwater recharge.

(4) Provides water quality treatment to diverted water.

(5) Increases flows to Rookery Bay.

(6) Implementation could be tied to mining permit.

PROJECT DISADVANTAGES

(1) Primary concept is dependant on acquisition of privately-owned property for the diversion canal construction.

(2) Culverts underneath I-75 may have insufficient capacity to handle additional flow.

SOLUTION

- Purchase portions of properties on the south side of the Golden Gate Canal and construct a 5200 LF, 30' wide finger canal to the south connected to the Golden Gate canal.

- Construct 6000' LF, 66' wide spreader swale with 5 - 75' long spreader weirs to discharge water to the wetland area south of the spreader.

- Construct a 100 cfs pump station to drew water from the southern end of the constructed finger canal into the spreader swale system to feed the spreader.

DESIGN CONSIDERATIONS

- An alternative design would be to build the diversion canal in conjunction with and adjacent to the Wilson Blvd extension. Water could be pumped from the diversion canal and over to the spreader swale. Although this would require the construction of over 1000 LF of force main.

- Flows north of the constructed spreader swale may need to be graded slightly east to the constructed finger canal.

- Consider constructing in conjuction with the Wilson Blvd. extension.

- Project discharge area lies with a Rural Fringe Sending area. the development rights for this area would need to be transferred prior to construction.

COST ESTIMATE

Construction:	$4,768,000
Land Acquisition:	$322,000
Engineering and Contingency:	$1,916,000
TOTAL	$7,026,000

Recommended Projects
Rookery Bay

South I-75 Canal Spreader Swale and Wetland Restoration

Collier County Watershed Management Plan

Rookery Bay Watershed

STATEMENT OF PROBLEM

Construction of the Golden Gate Main Canal interrupted the historical sheet flow pattern to the south toward Rookery Bay. The water is now diverted west toward the Naples Bay estuary. Due to the redirection of flow and the impedence to overland flow caused by I-75, the wetland area south of I-75 within the Picayune Strand State Forest has a decreased hydroperiod and a change in wetland habitat.

PROJECT BENEFITS

(1) Increases hydroperiod of wetland areas within the State Forest

(2) Increases groundwater recharge by rehydrating wetland areas

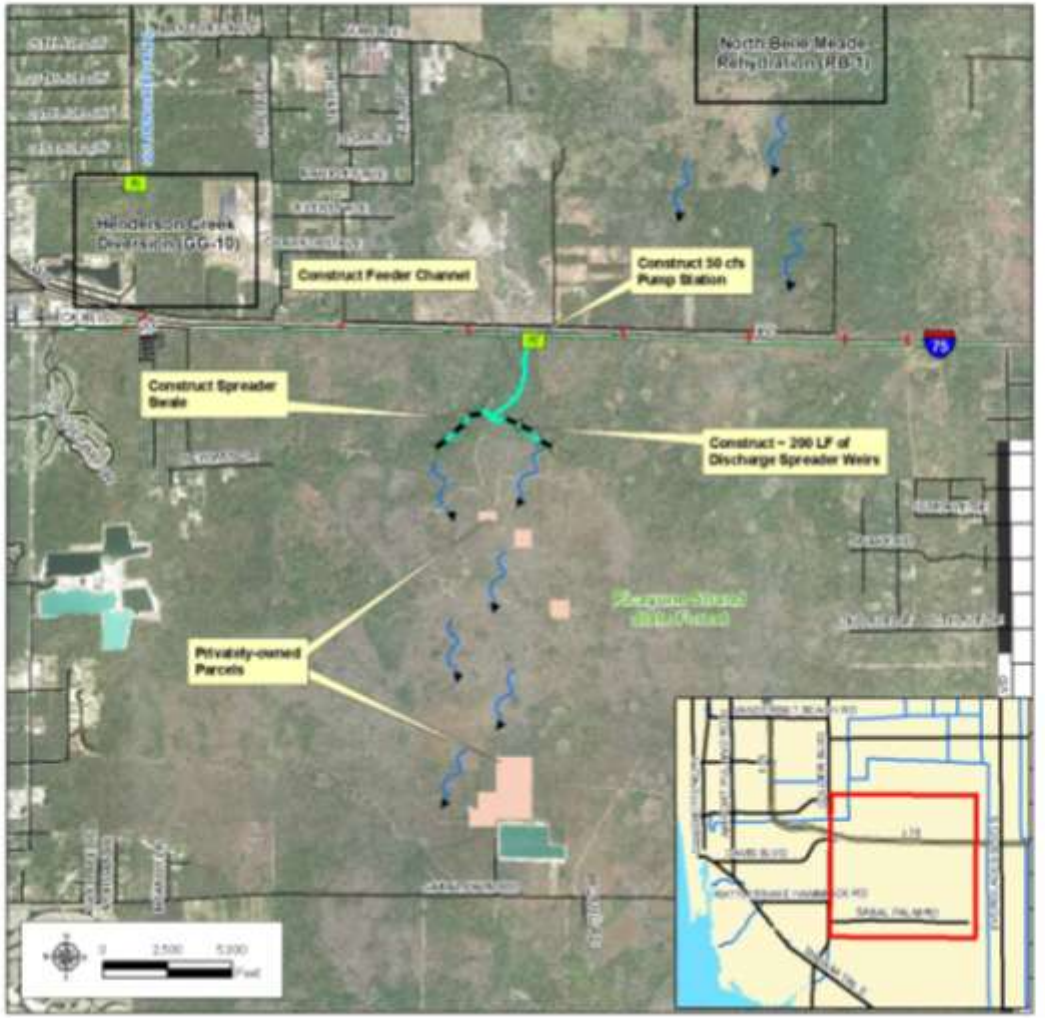
(3) Provides some water quality treatment to diverted flows

(4) Utilizes existing stormwater infrastructure/waterways and existing public lands

PROJECT DISADVANTAGES

(1) The project would require negotiation with the managers of the Picayune Strand State Forest

(2) Privately owned out-parcels exist in the Picayune Strand State Forest. Properties may have to be purchased, conservation easement obtained or diversion berms constructed



SOLUTION

- Construct a 50 cfs Pump Station to pump water from within the interconnected I-75 Canal Network to feeder channel that flows south to the spreader swale site.

- Construct a 5000 LF Spreader swale with weirs that discharge at topographic lows along the spreader during the wet season when flows are available to extend the hydroperiod and depth of water in the wetland area within the Picayune Strand State Forest

DESIGN CONSIDERATIONS

- Consider the affect of increased sheet flow on privately owned parcels within the Picayune Strand State Forest

- Consider the capacity of the culverts underneath I-75 when defining the volume of water to be diverted to this project.

- Consider removing the ditch block along the north I-75 canal to allow additional flows from the GG-10, Henerson Creek Diversion Project to replenish the I-75 canal water source

- Additional flows from RB-1, North Belle Meade Rehydration (if implemented), could allow for increased spreader capacity

- Consider any additional flows from the Wilson Blvd Extension project

COST ESTIMATE

Construction:	$2,326,000
Land Acquisition:	$0
Engineering and Contingency:	$932,000
TOTAL	$3,131,000

Recommended Projects
Rookery Bay

Henderson Creek
Off-Line Storage Reservior

PBSJ

Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

The Henderson Creek Canal discharges to the south, directly to Rookery Bay. Rookery Bay experiences a freshwater inflow surplus during the wet season (June -September) and freshwater deficit during the dry season. These flow deficits/surpluses have a negative impact on the salinity levels within the receiving water estuary.

PROJECT BENEFITS

(1) Decreases freshwater flows to Rookery Bay during the wet season, consequently benefiting salinity levels in the estuary.

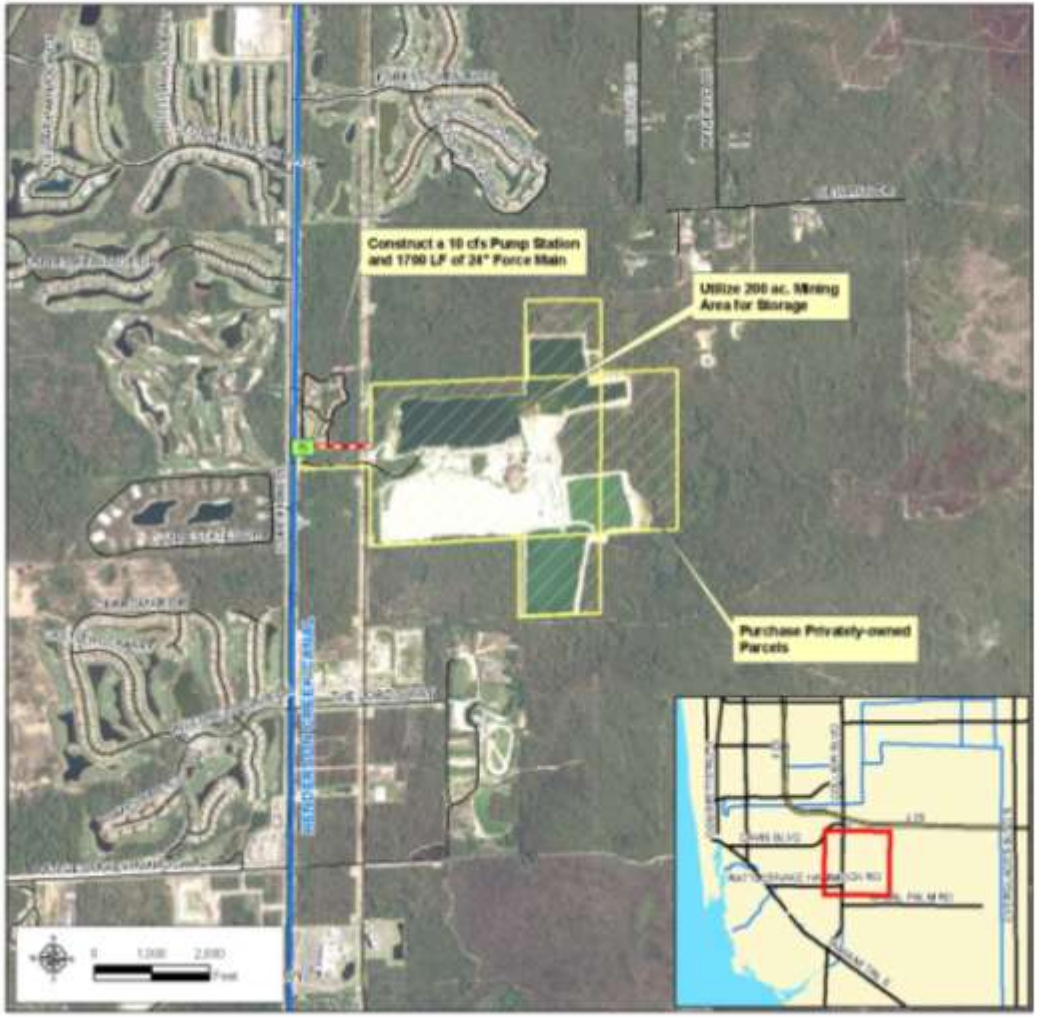
(2) Would increase groundwater recharge.

(3) Reduces pollutant loadings to the estuary.

PROJECT DISADVANTAGES

(1) Property is currently private-owned and is actively mined.

(2) A portion of the stored water may seep back into the canal as groundwater.



SOLUTION

- Obtain the rights to the mining property after the mine is closed.

- Utilize storage volume in the abandoned mine by constructing a 10 cfs pump station to divert excess wet season flows (August-September) into the reservoir when in-stream canal flows exceed 50 cfs.

DESIGN CONSIDERATIONS

- Pumping rate and schedule should be coordinated with Henderson Creek Diversion Pump Station project.

- Determine the leakage rate through the bed of the mining pit to the canal.

- Re-evaluate storage/pump capacity if additional area is mined.

- Determine the MFL to Rookery Bay.

COST ESTIMATE

Construction:	$671,000
Land Acquisition:	$1,989,000
Engineering and Contingency:	$269,000
TOTAL	$2,929,000

Recommended Projects
Rookery Bay

US Highway 41 Stormwater Treatment Area

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Collier County Watershed Management Plan

Collier County

Rookery Bay Watershed

STATEMENT OF PROBLEM

The Rookery Bay watershed is identified as impaired for nutrients and dissolved oxygen. In addition, this wetland area was identified as having a reduced depth and hydroperiod relative its pre-development condition

PROJECT BENEFITS

(1) The project will provide water quality treatment to remove nutrients from the HWY 41 canal system

(2) The project will rehydrate this wetland area during the wet season by extending the depth and length of the hydroperiod

(3) The lands are publically-owned

PROJECT DISADVANTAGES

(1) The project is relatively small and may not provide a large water quality benefit

(2) There is only ~ 3 month window of freshwater flows to pump into the STA per year.

(3) The increased groundwater elevations could effect the adjacent subdivision

SOLUTION

- Construct a 52-acre wetland stormwater treatment area (STA) on publicly owned land on the north side of US Highway 41. A 5 cfs pump station will pull water out of the US 41 canal into the STA for treatment during the wet season

- The STA will include a sump at the pump STA inflow site to remove sediment.

- Treated water would be released into the wetland downstream via gravity flow over a 2' concrete spillway to optimize detention time.

DESIGN CONSIDERATIONS

- Determine wetland characteristics to determine final wetland inundation depth

- Determine the sump size

- Consider installing a manual stop-log structure on the concrete sill to retain the last pumped cycle and further extend the STA wetland hydroperiod.

COST ESTIMATE

Construction:	$388,000
Land Acquisition:	$0
Engineering and Contingency:	$156,000
TOTAL	$544,000

Recommended Projects
Fakahatchee Watershed

Fakahatchee Wetland Restoration - Area 1

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Collier County Watershed Management Plan

Collier County

Fakahatchee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, this wetland discharged at a higher elevation via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. This canal dredging also negatively impacted the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which have been artificially drained.

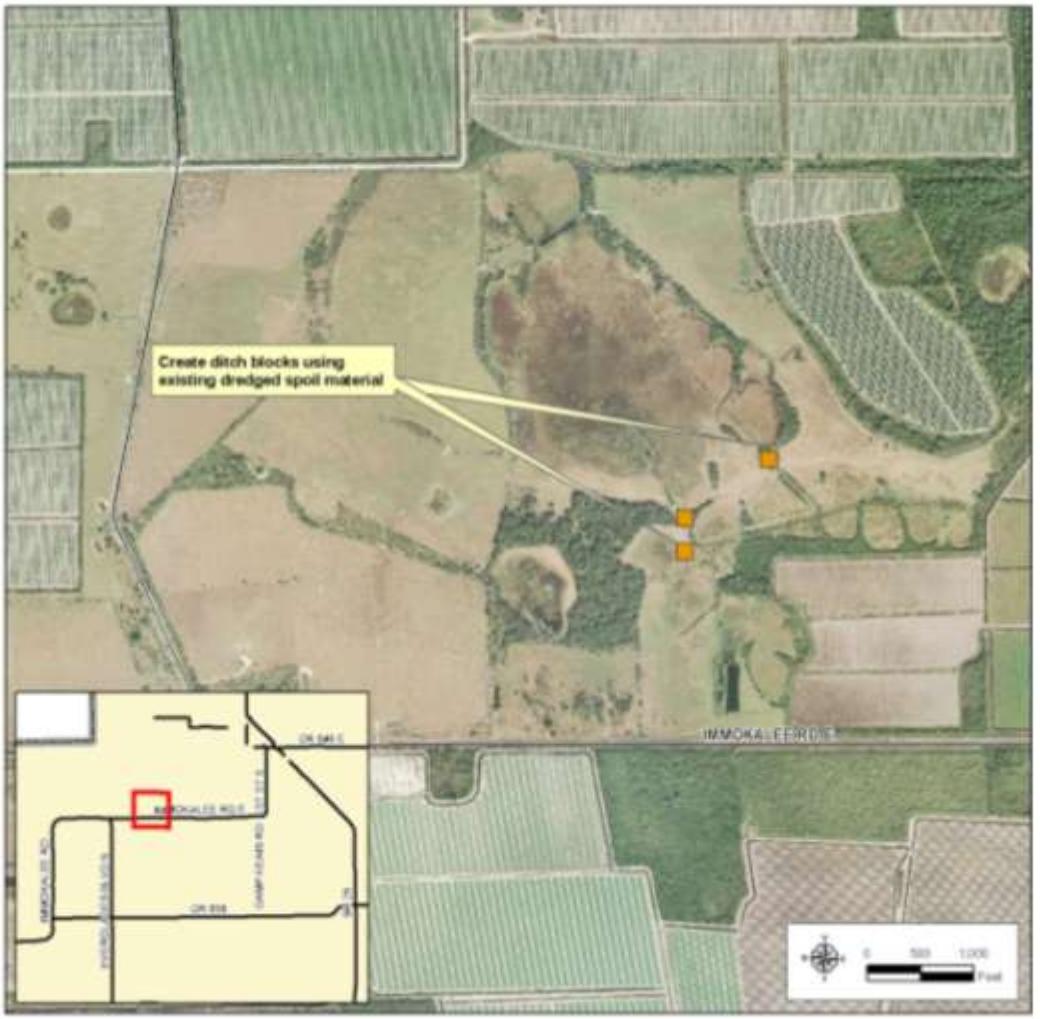
(2) Promotes the restoration of natural wetland vegetation.

(3) Increases groundwater recharge.

(4) Provides on-site storage and water quality treatment of agricultural runoff.

PROJECT DISADVANTAGES

(1) Increased groundwater and surface water elevations may affect adjacent farming activities.



SOLUTION

- Use existing dredge spoil material on the canal banks to backfill drainage ditches and create ditch blocks at the wetland outfall locations to allow wetlands to discharge via overland flow.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

- Potential presence of exotic species.

- Equipment access.

COST ESTIMATE

Construction:	$13,000
Land Acquisition:	N/A
Engineering and Contingency:	$15,000
TOTAL	$28,000

Recommended Projects
Fakahatchee Watershed

Fakahatchee Wetland Restoration - Area 2

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Collier County Watershed Management Plan

Collier County

Fakahatchee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages vial a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which currently have been artificially drained.

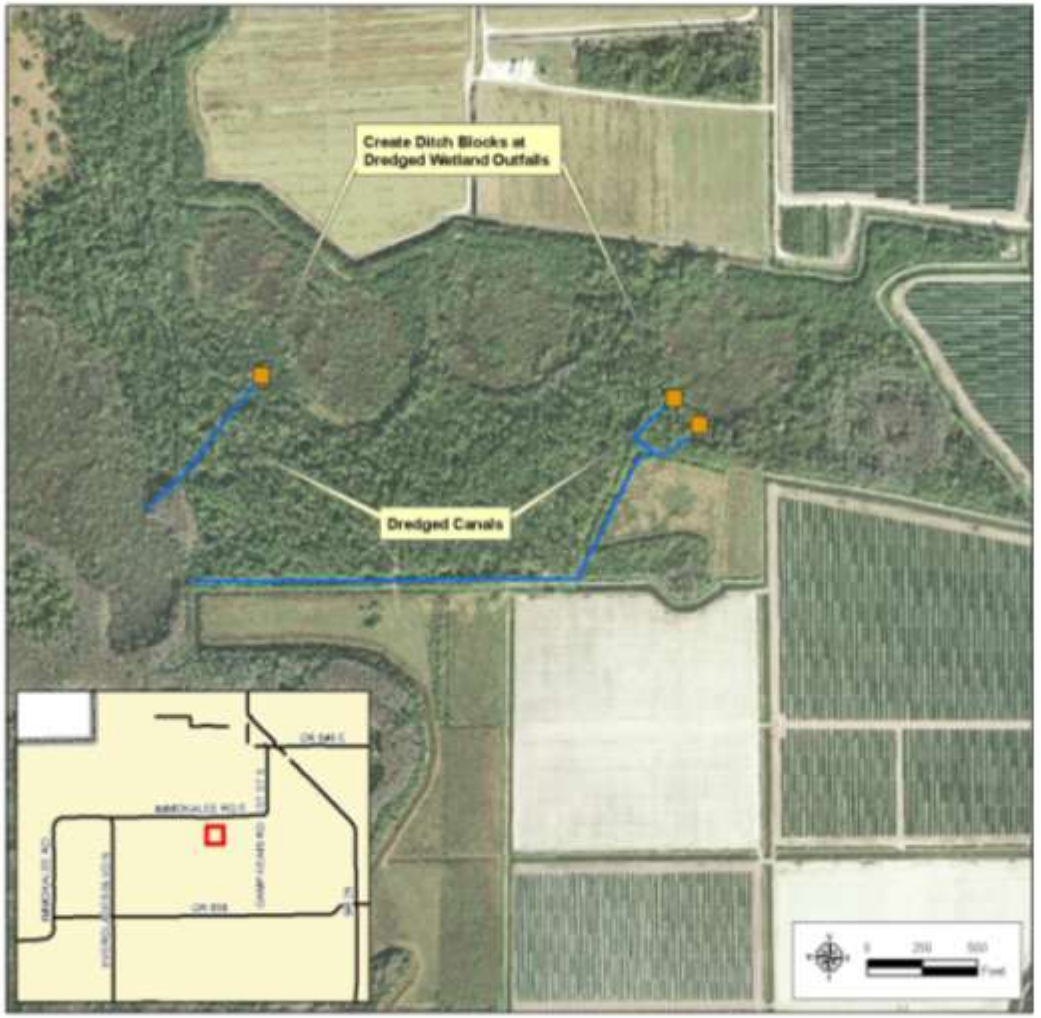
(2) Promotes the restoration of natural wetland trees and vegetation.

(3) Increases groundwater recharge.

(4) Potentially provides on-site storage and water quality treatment of agricultural runoff.

PROJECT DISADVANTAGES

(1) Increased groundwater and surface water elevations may affect adjacent farming activities.



SOLUTION

- Import material and backfill man-made ditches to create ditch blocks at the wetland outfall locations.

- Ditch blocks will encourage overland flow in the artificially drained wetlands.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

COST ESTIMATE

Construction:	$23,000
Land Acquisition:	N/A
Engineering and Contingency:	$15,000
TOTAL	$38,000

Recommended Projects
Okaloacoochee – SR29

Upper Okaloacoochee Slough Wetland Restoration

PBSJ

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Slough was dredged to drain the upstream wetland areas for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the surrounding wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by reducing drainage

(2) Promotes the restoration of natural wetland trees and vegetation

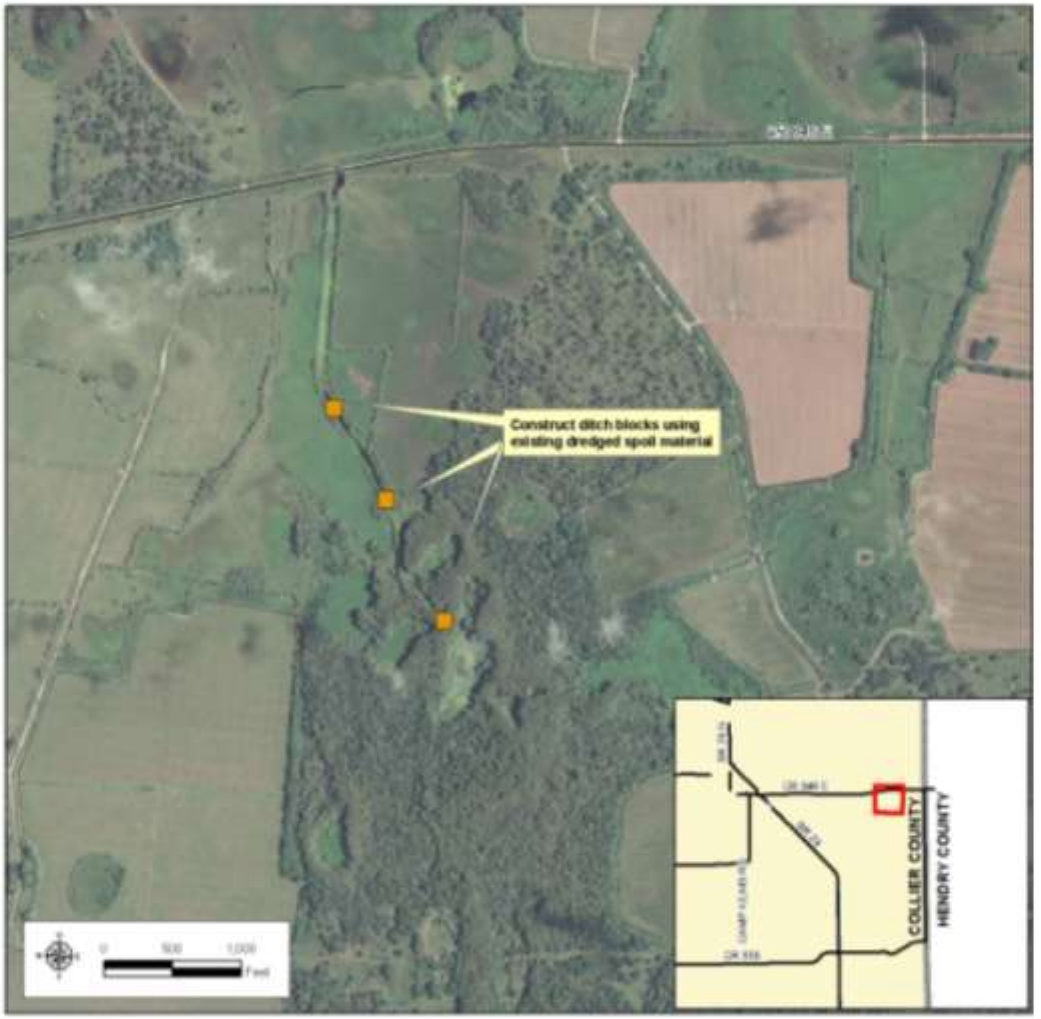
(3) Increases groundwater recharge

(4) This area lies within the Okaloacoochee Slough Flowway Stewardship Area (FSA)

PROJECT DISADVANTAGES

(1) Reduced drainage capacity could increase flood risk of SR 846 and upstream lands.

(2) Increase depth of surface water could affect agricultural areas of surrounding properties.



SOLUTION

- Use existing dredge spoil material on the canal banks to backfill ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the slough will re-hydrate wetlands and provide natural sedimentation in the dredged canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

- Verify no flooding impacts are generated at SR 846 and the lands to the north of SR 846.

COST ESTIMATE

Construction:	$47,000
Land Acquisition:	N/A
Engineering and Contingency:	$19,000
TOTAL	$66,000

Recommended Projects
Okaloacoochee – SR29

Middle Okaloacoochee Slough Wetland Restoration

PBSJ

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Slough was dredged to drain the upstream wetland area for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the upstream wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which currently have been artificially drained.

(2) Promotes the restoration of natural wetland trees and vegetation.

(3) Increases groundwater recharge.

(4) This area lies within the Okaloacoochee Slough Flowway Stewardship Area (FSA).

PROJECT DISADVANTAGES

(1) Increased depth of water could negatively impact surrounding farming activities.

SOLUTION

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the slough will provide natural sedimentation in the canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

COST ESTIMATE

Construction:	$96,000
Land Acquisition:	N/A
Engineering and Contingency:	$39,000
TOTAL	$135,000

Recommended Projects
Okaloacoochee – SR29

Lower Okaloacoochee Slough Wetland Restoration

PBSJ

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

This portion of the Okaloacoochee Slough was dredged to drain the upstream wetland areas for farming activities. This resulted in shorter wetland hydroperiods and less groundwater recharge. The dredged canal also negatively impacted the ecology of the surrounding wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by reducing drainage

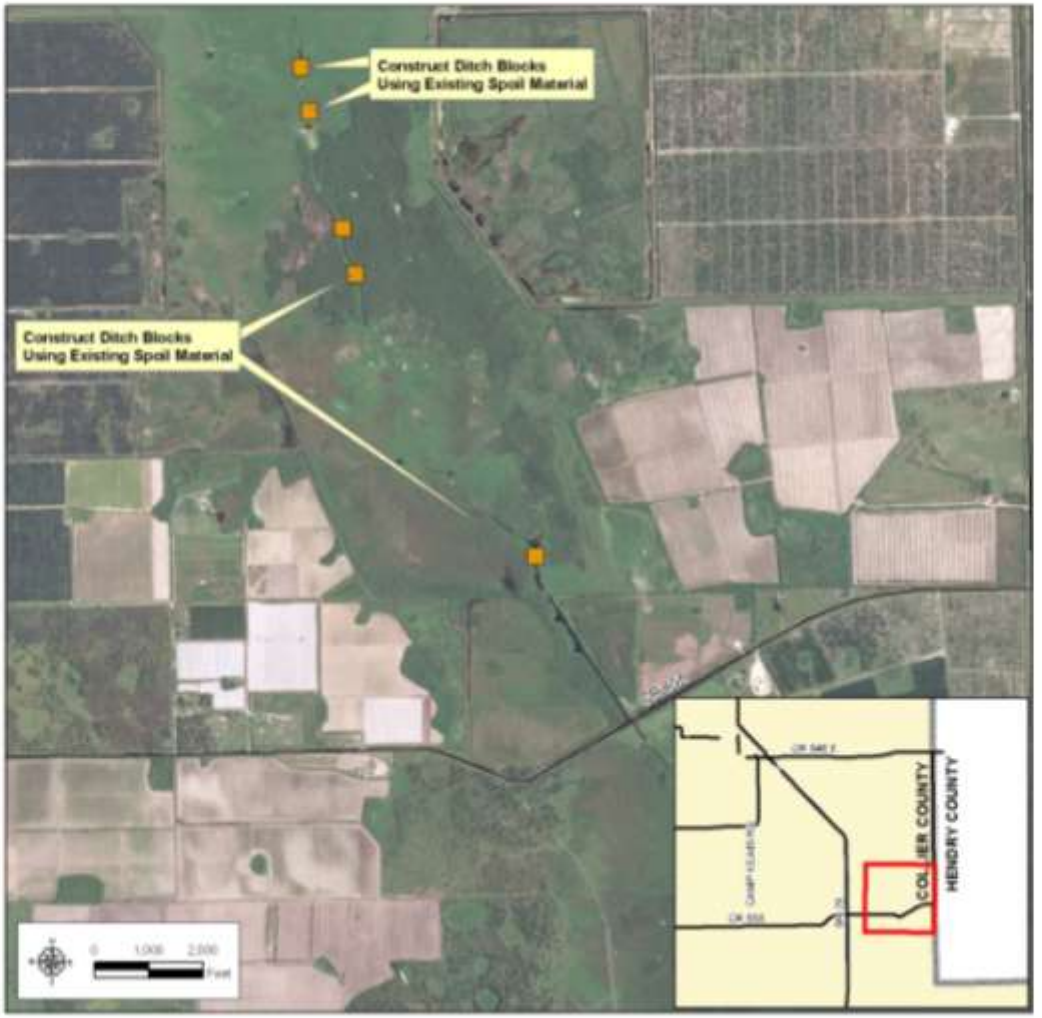
(2) Promotes the restoration of natural wetland trees and vegetation

(3) Increases groundwater recharge

(4) This area lies within the Okaloacoochee Slough Flowway Stewardship Area (FSA)

PROJECT DISADVANTAGES

(1) Modified depth of surface water could increase flood risk of surrounding agricultural areas



SOLUTION

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks. The ditch blocks created within the slough will rehydrate wetlands and provide natural sedimentation to raise the ditch profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

COST ESTIMATE

Construction:	$72,000
Land Acquisition:	N/A
Engineering and Contingency:	$29,000
TOTAL	$101,000

Recommended Projects
Okaloacoochee – SR29

Okaloacoochee Wetland Restoration - Area 1

PBSJ

Collier County Watershed Management Plan

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Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which currently have been artificially drained.

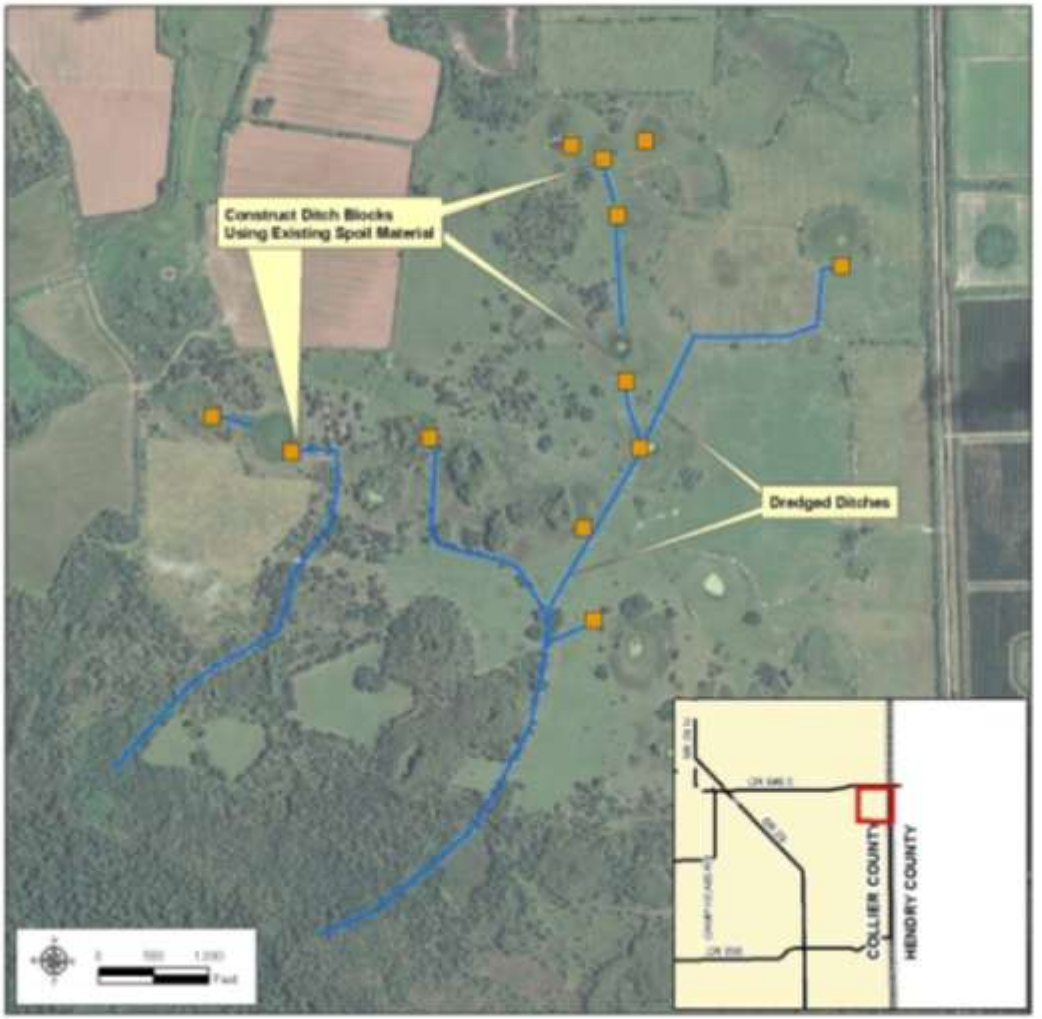
(2) Promotes the restoration of natural wetland trees and vegetation.

(3) Increases groundwater recharge.

(4) Wetlands are located within a Stewardship Sending Area (SSA).

PROJECT DISADVANTAGES

(1) Increased groundwater and surface water elevations may affect adjacent farming activities.



SOLUTION

- Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the canals will contain the wetland inflows which will increase the hydroperiods and groundwater recharge in the area.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

COST ESTIMATE

Construction	$35,000
Land Acquisition	N/A
Engineering and Contingency	$15,000
TOTAL	$50,000

Recommended Projects
Okaloacoochee – SR29

Okaloacoochee Wetland Restoration - Area 2

PBSJ

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which currently have been artificially drained.

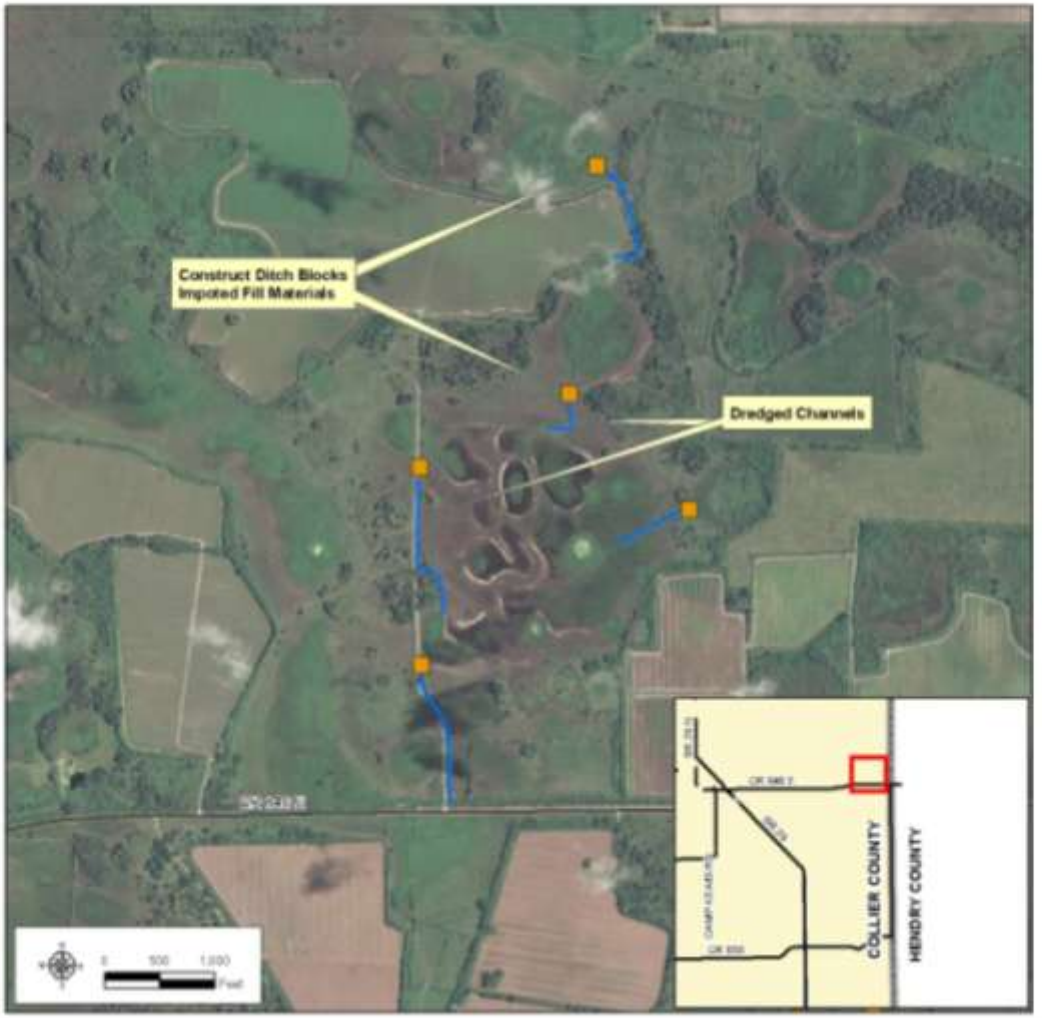
(2) Promotes the restoration of natural wetland trees and vegetation.

(3) Increases groundwater recharge.

(4) Wetlands are within a Stewardship Sending Area (SSA).

PROJECT DISADVANTAGES

(1) Increased groundwater and surface water elevations may affect adjacent agricultural areas.



SOLUTION

- Import fill material to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the canals will contain the wetland inflows which will increase the hydroperiods and groundwater recharge in the area.

DESIGN CONSIDERATIONS

- Determine if any on-site dredge spoil material is available for backfill requirements.

COST ESTIMATE

Construction:	$19,000
Land Acquisition:	$0
Engineering and Contingency:	$15,000
TOTAL	$34,000

Recommended Projects
Okaloacoochee – SR29

Okaloacoochee Wetland Restoration - Area 3

PBSJ

Collier County Watershed Management Plan

Collier County

Okaloacoochee Watershed

STATEMENT OF PROBLEM

During agricultural development, many isolated wetlands were drained for logging or planting. Historically, these wetlands discharged at higher stages via a natural slough or overland flow.

These drained wetlands currently have a shorter hydroperiod and provide less groundwater recharge. The wetland dredging also negatively affected the ecology of the wetlands by decreasing natural marsh and wetland vegetation. Native species habitat was likely impacted as well.

PROJECT BENEFITS

(1) Re-establishes wetland hydroperiods by containing inflows which currently have been artificially drained.

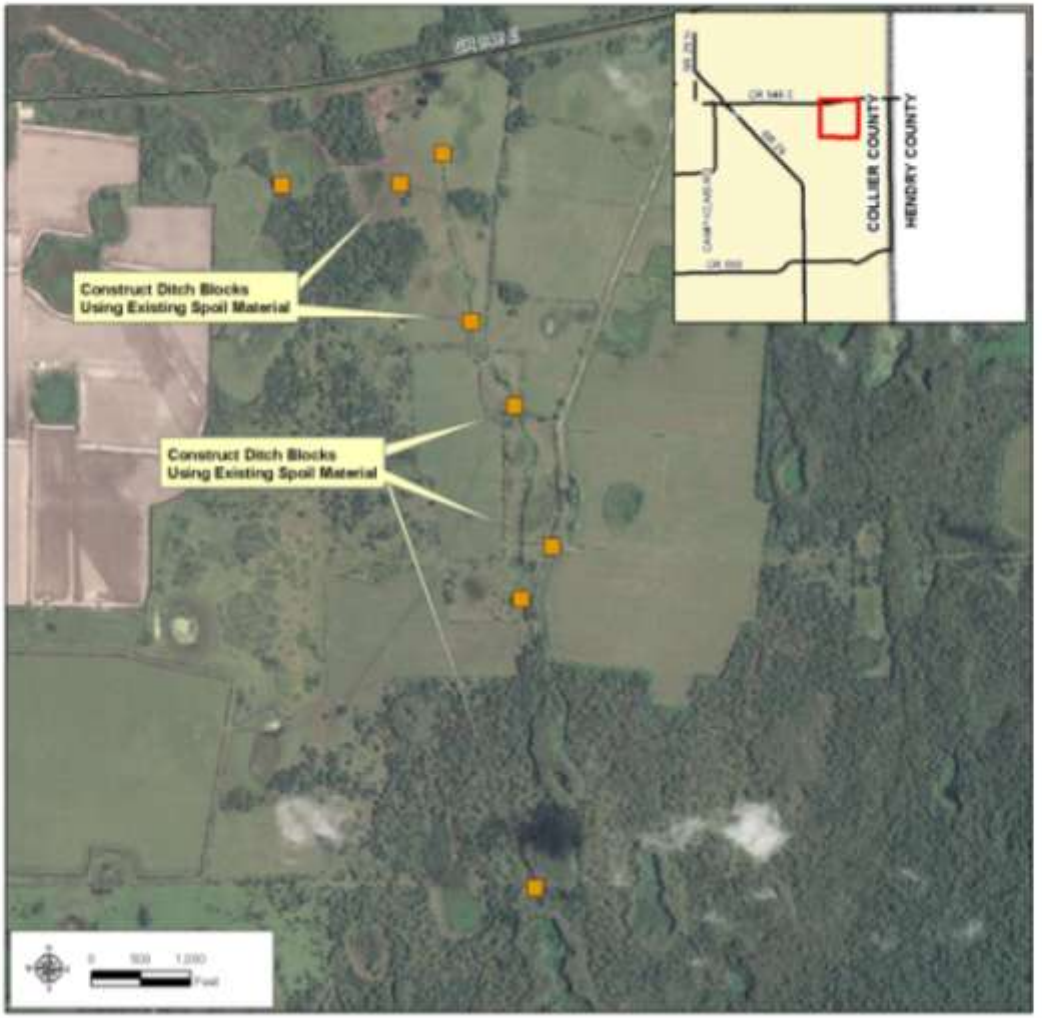
(2) Promotes the restoration of natural wetland trees and vegetation.

(3) Increases groundwater recharge.

(4) Wetlands lie within a Stewardship Sending Area (SSA).

PROJECT DISADVANTAGES

(1) Increased groundwater and surface water elevations may affect adjacent agricultural activities.



SOLUTION

-Use existing dredge spoil material on the canal banks to backfill man-made ditches and create ditch blocks at the wetland outfall locations. The ditch blocks created within the isolated wetlands and slough will provide natural sedimentation in the canal to raise the slough profile and promote the natural restoration of the waterway.

DESIGN CONSIDERATIONS

- Determine if volume of on-site dredge spoil material is adequate to meet backfill requirements.

COST ESTIMATE

Construction:	$60,000
Land Acquisition:	$0
Engineering and Contingency:	$24,000
TOTAL	$84,000

Project Weighting Factors

- Importance of criteria for overall restoration purposes
  - Water discharges to estuaries: 2
  - Pollutant load and watershed hydrology: 1
- Watershed characteristics by benefit-type
  - Watershed drainage area
  - Size of the receiving estuary
  - Land use distribution

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Watershed Characteristics Weighting Factor

- The weighting factor was calculated per watershed by benefit-type
- Factors are calculated relative to the drainage area
  - Water Quantity: estuary area/drainage area
  - Water Quality: urban or agricultural area/drainage area
  - Natural Resources/Hydrology: existing inland wetland area/drainage area
- Example:
  - For Golden Gate, the Natural Resources/Hydrology weighting factor:

    10 – (10 x (35,414 / 85,600) = 5.86

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Watershed Characteristics Weighting Factor

Watershed	Weighting Factor		
	Water Quantity	Hydrology	Water Quality
Golden Gate/Naples Bay	19.50	5.86	6.06
Rookery Bay	13.11	4.89	2.45
FU-FA-Ok/Ten Thousand Islands	14.54	1.17	1.81
Cocohatchee-Corckscrew/Wiggins Pass	19.51	3.87	4.01

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Initial Project Ranking

RECOMMENDED PROJECT	WATER QUANTITY BENEFIT		WATER QUALITY BENEFIT		HYDROLOGIC BENEFIT		Total Project Score
	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score	
Henderson Creek Diversion Pump Station (100 cfs)	2.4553	47.8762	0.0000	0.0000	0.0000	0.0000	47.88
North Belle Meade Rehydration	1.9603	25.6914	0.4354	1.0658	0.0358	0.1751	26.93
North Golden Gate Estates Flowway Restoration Project	0.0095	0.1853	0.6822	4.1330	0.1177	0.6903	5.01
South I-75 Canal Spreader Swale and Wetland Rehydration	0.0000	0.0000	0.1759	0.4304	0.1339	0.6551	1.09
Henderson Creek Off-Line Storage Reservior	0.0359	0.4703	0.0237	0.0581	0.0000	0.0000	0.53
Middle Okaloacoochee Slough Wetland Restoration	0.0000	0.0000	0.2779	0.5033	0.0154	0.0180	0.52
Corkscrew Regional Ecosystem Watershed	0.0000	0.0000	0.0000	0.0000	0.0314	0.1214	0.12
Lower Okaloacoochee Slough Wetland Restoration	0.0000	0.0000	0.0588	0.1065	0.0024	0.0028	0.11
Fakahatchee Wetland Restoration - Area 1	0.0000	0.0000	0.0415	0.0751	0.0001	0.0001	0.08
Fakahatchee Wetland Restoration - Area 2	0.0000	0.0000	0.0309	0.0560	0.0001	0.0001	0.06
Wolfe Road Wetland Treatment System	0.0000	0.0000	0.0076	0.0462	0.0000	0.0000	0.05
US HWY 41 Stormwater Treatment Area & Wetland Hydration	0.0000	0.0000	0.0058	0.0143	0.0015	0.0076	0.02
Upper Okaloacoochee Slough Wetland Restoration	0.0000	0.0000	0.0023	0.0042	0.0004	0.0005	0.0046
Upper Golden Gate Estates Canal Control Structure Installation	0.0001	0.0011	0.0000	0.0000	0.0000	0.0000	0.0011
Orange Tree Canal Control Structure Installation	0.0001	0.0010	0.0000	0.0000	0.0000	0.0000	0.0010
Okaloacoochee Wetland Restoration - Area 2	0.0000	0.0000	0.0000	0.0000	0.0002	0.0003	0.0003
Okaloacoochee Wetland Restoration - Area 3	0.0000	0.0000	0.0000	0.0000	0.0002	0.0003	0.0003
Okaloacoochee Wetland Restoration - Area 1	0.0000	0.0000	0.0000	0.0000	0.0002	0.0002	0.0002

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Initial Project Ranking

RECOMMENDED PROJECT	Total Project Score	PROJECT COST Cost (In Million of Dollars)	Benefit-to-Cost Ratio
Henderson Creek Diversion Pump Station (100 cfs)	47.88	$5.708	**8.388**
North Belle Meade Rehydration	26.93	$7.026	**3.833**
North Golden Gate Estates Flowway Restoration Project	5.01	$2.368	**2.115**
South I-75 Canal Spreader Swale and Wetland Rehydration	1.09	$3.131	**0.347**
Henderson Creek Off-Line Storage Reservior	0.53	$2.929	**0.180**
Middle Okaloacoochee Slough Wetland Restoration	0.52	$0.135	**3.862**
Corkscrew Regional Ecosystem Watershed	0.12	$0.096	**1.264**
Lower Okaloacoochee Slough Wetland Restoration	0.11	$0.101	**1.082**
Fakahatchee Wetland Restoration - Area 1	0.08	$0.028	**2.688**
Fakahatchee Wetland Restoration - Area 2	0.06	$0.038	**1.475**
Wolfe Road Wetland Treatment System	0.05	$1.416	**0.033**
US HWY 41 Stormwater Treatment Area & Wetland Hydration	0.02	$0.544	**0.040**
Upper Okaloacoochee Slough Wetland Restoration	0.0046	$0.066	**0.070**
Upper Golden Gate Estates Canal Control Structure Installation	0.0011	$0.552	**0.002**
Orange Tree Canal Control Structure Installation	0.0010	$0.552	**0.002**
Okaloacoochee Wetland Restoration - Area 2	0.0003	$0.034	**0.008**
Okaloacoochee Wetland Restoration - Area 3	0.0003	$0.084	**0.003**
Okaloacoochee Wetland Restoration - Area 1	0.0002	$0.050	**0.005**

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Conclusions

- Projects that divert water between watersheds will provide benefits that protect the estuaries
- Relatively inexpensive wetland restoration activities can provide significant hydrologic restoration benefits
- Non-structural and policy issues will have a significant role in managing water supply and quality in the future

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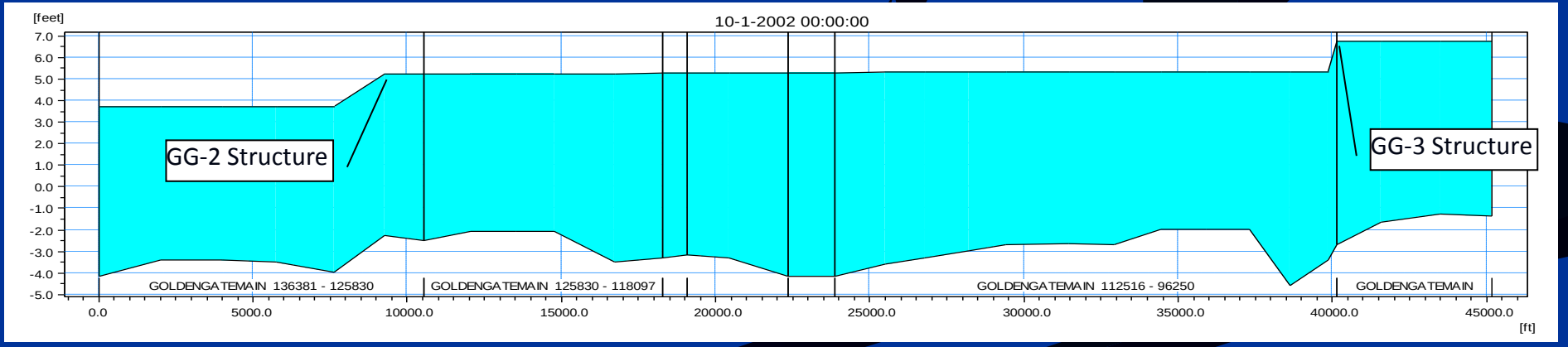
Structure Operations

- Two Primary Issues in Golden Gate Watershed
  - Reduce baseflow contributions
  - Direct water to other watersheds
- Currently wet season structure control elevations are below dry season control elevations



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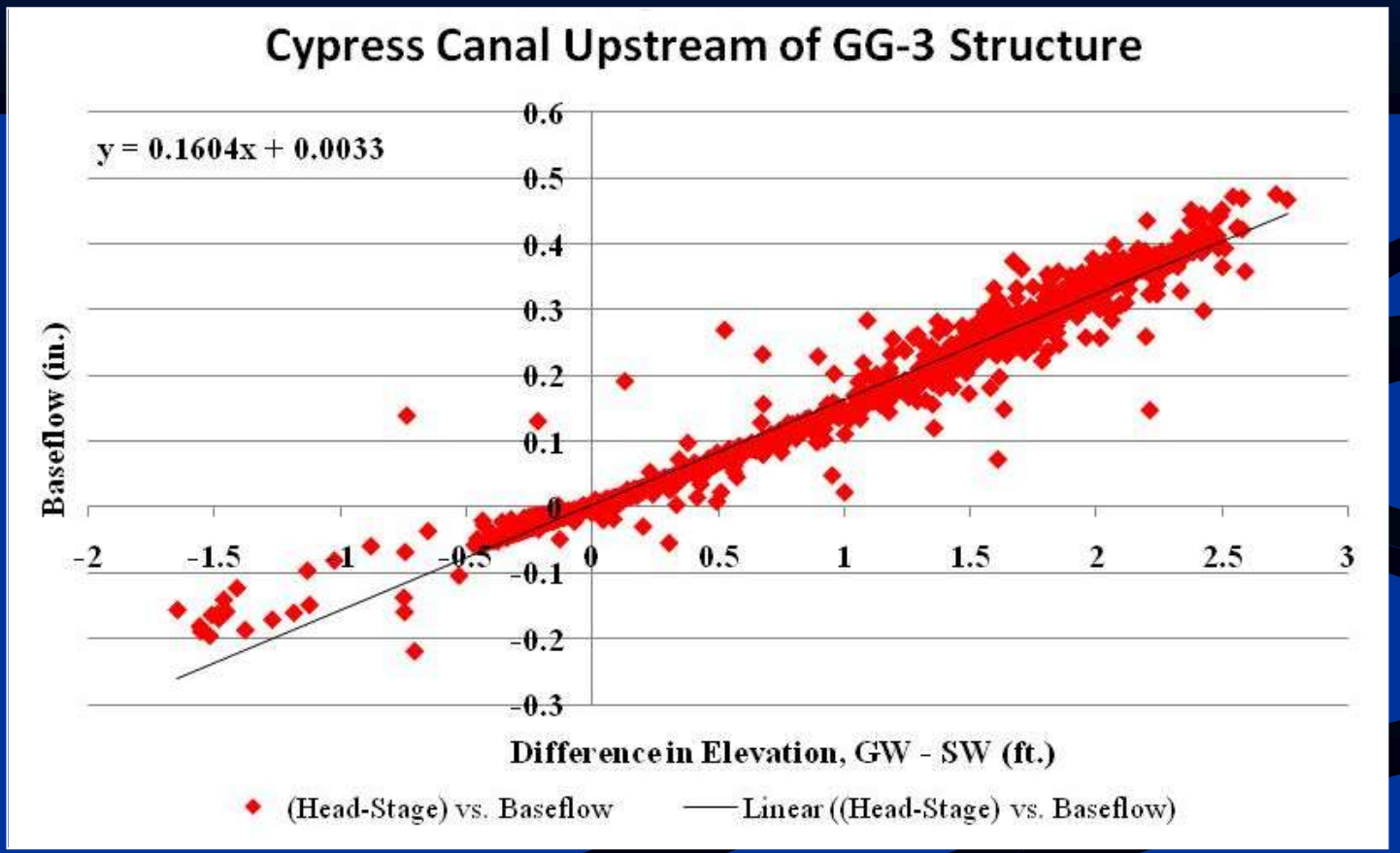
Water Control Structure Operations

- Difference between groundwater elevation and surface water elevation determines baseflow



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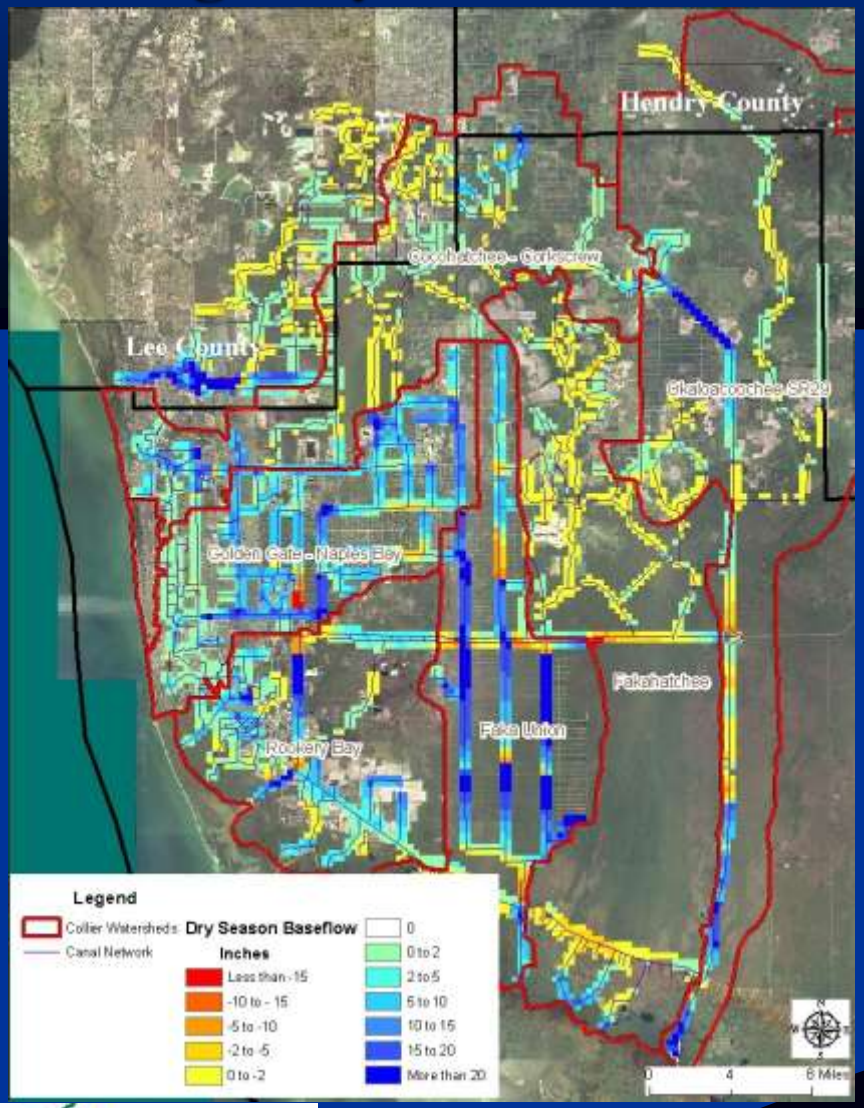
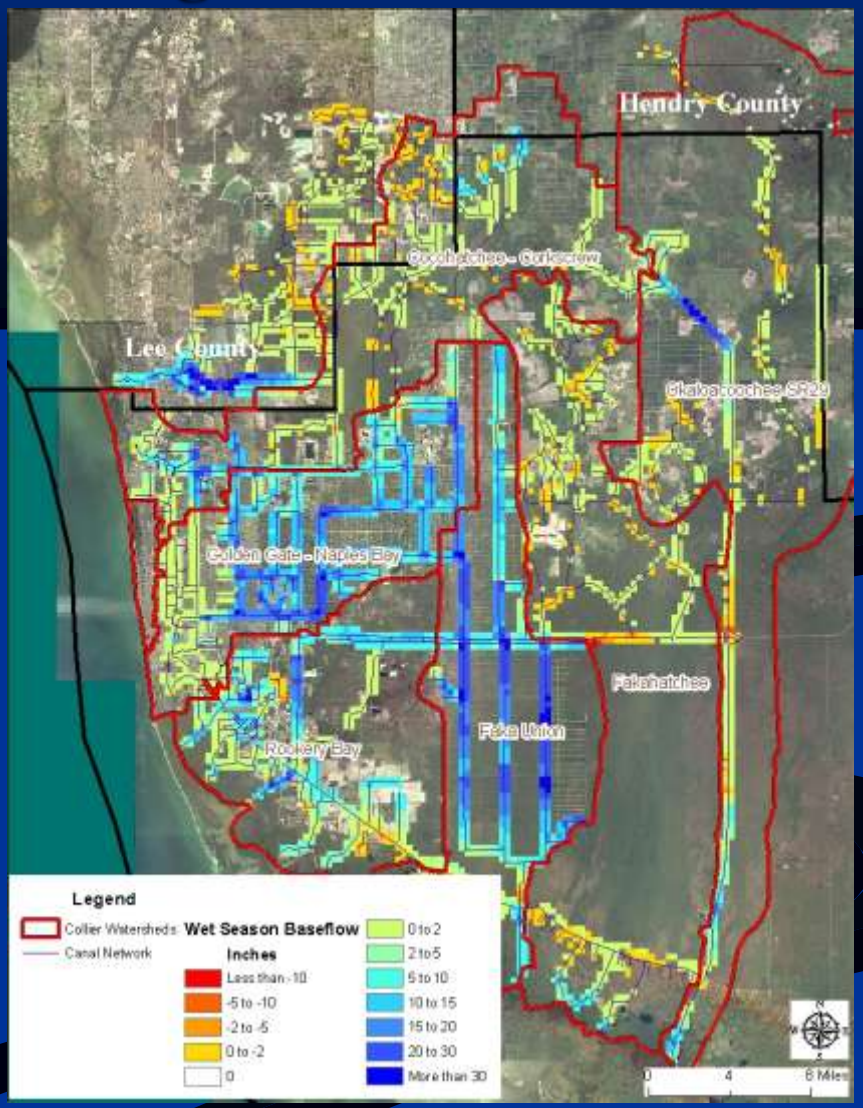
Water Control Structure Operations

Average Dry Season Baseflow



Average Wet Season Baseflow



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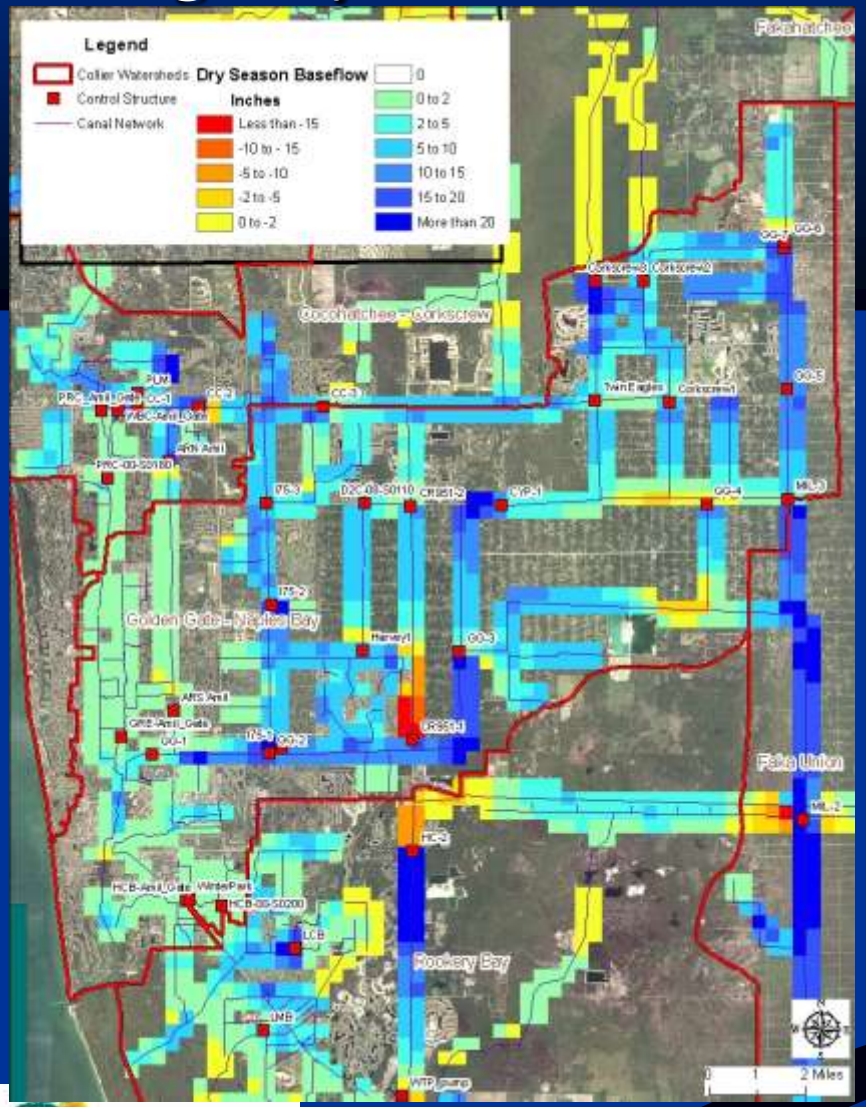
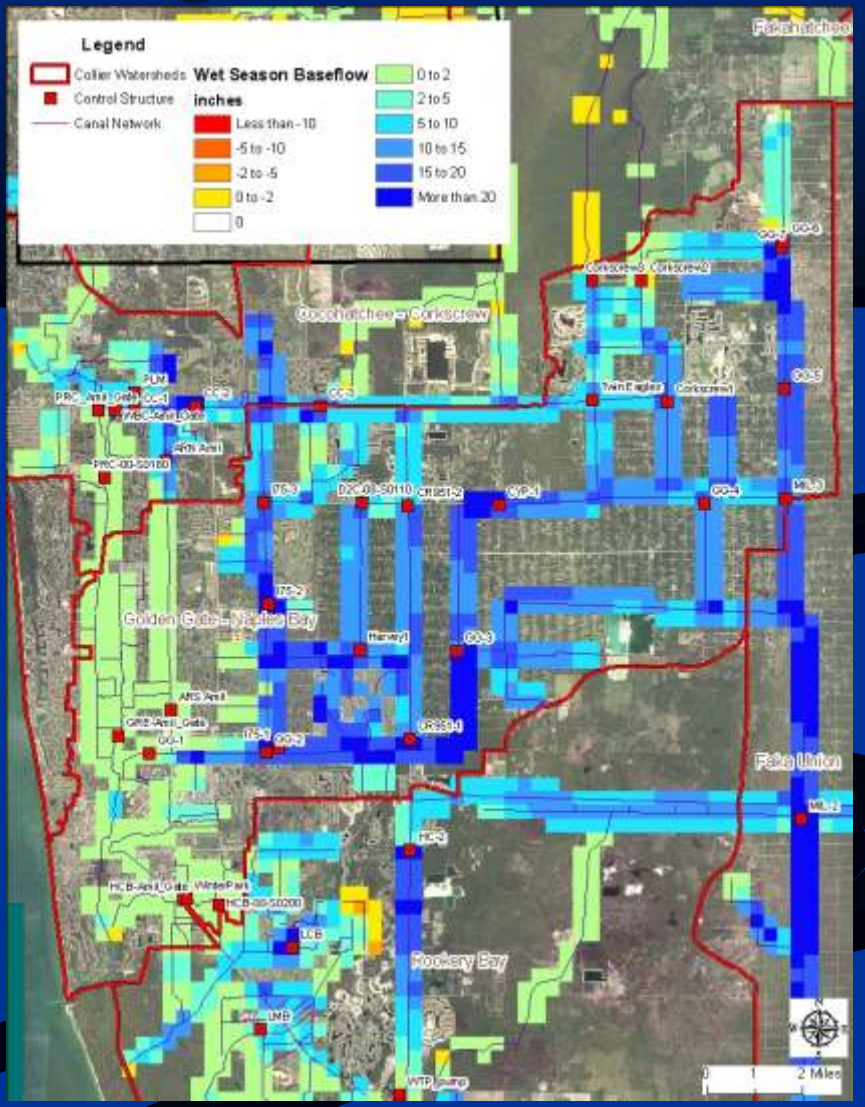
Water Control Structure Operations

Golden Gate Watershed

Average Dry Season Baseflow



Average Wet Season Baseflow



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Structure Operations in the Golden Gate Watershed

- Work with SFWMD to optimize structure operations so that canal stage more closely matches groundwater elevation
- More important in dry season than wet; but wet season can be adjusted to further reduce baseflow
- Coordinate with SFWMD to direct excess water to Faka Union watershed during rainy season (Miller 3 and C-1 Connector Canal)

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Regulatory Review and Recommendations

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Current Stormwater Management Approach

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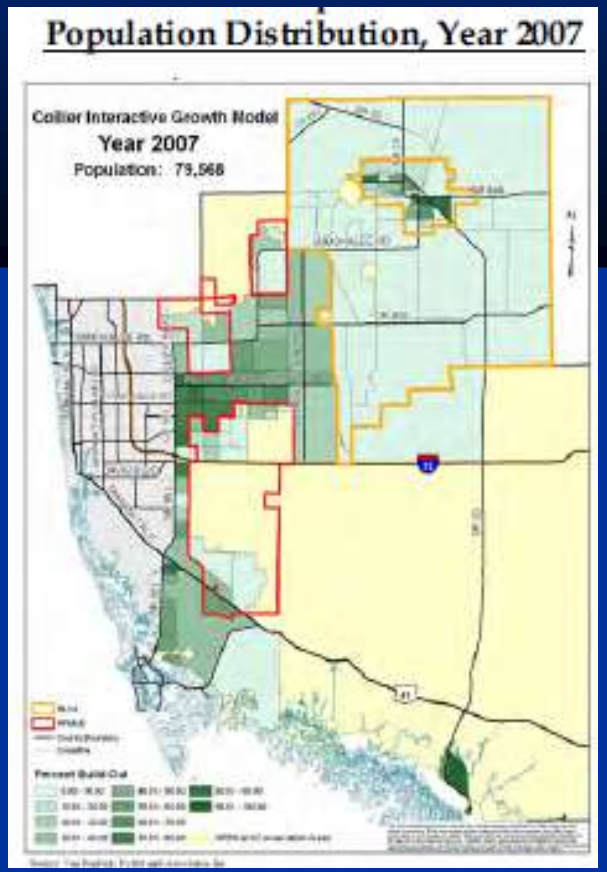
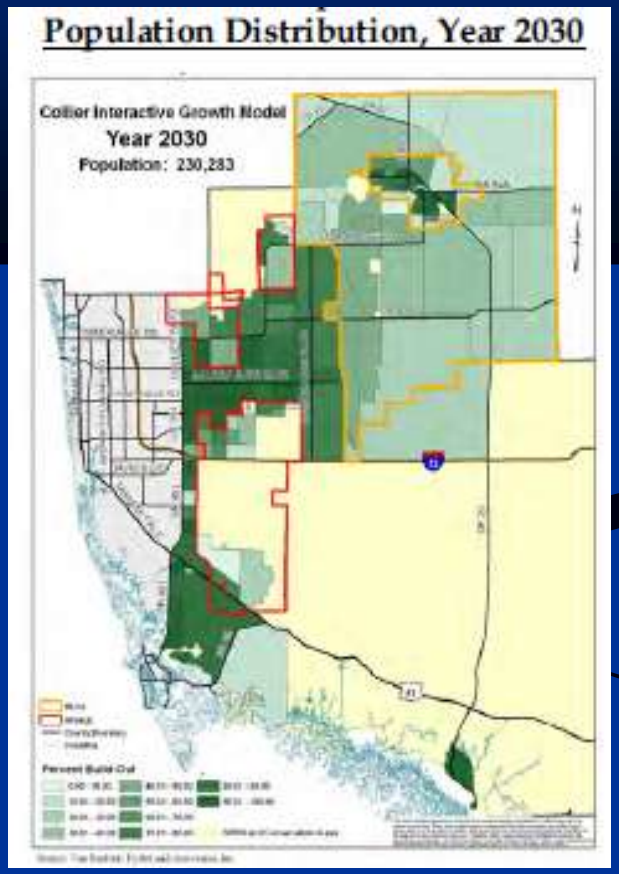
County Growth Projections





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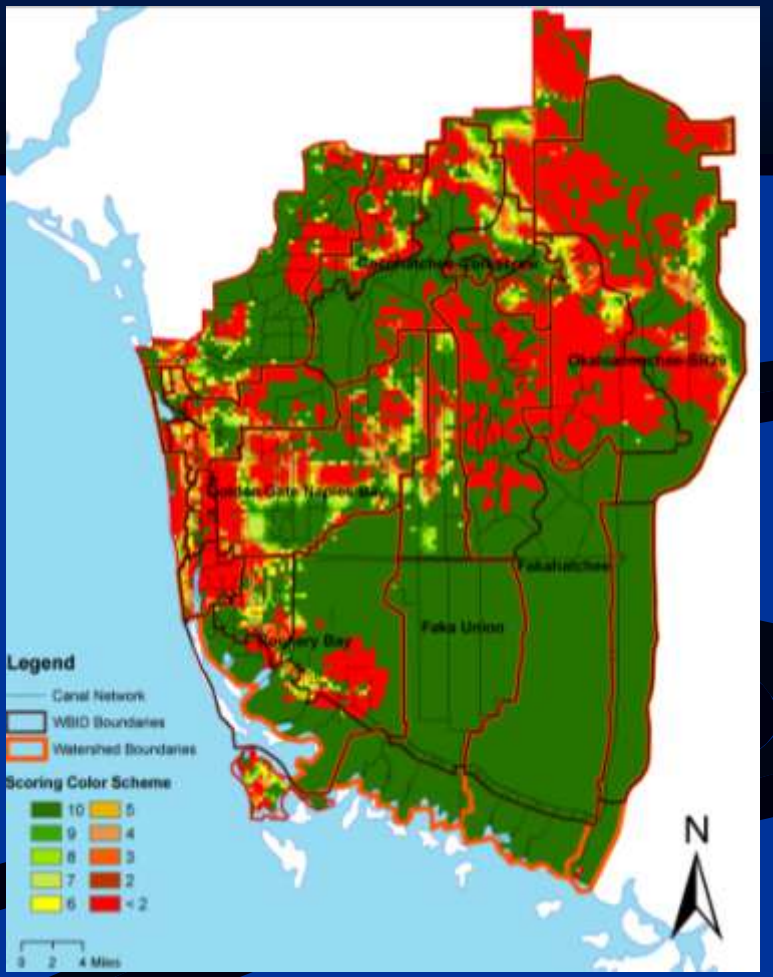
Water Quality and Pollution Load Issues

- Several impaired water bodies
- Numerous areas with no runoff pollution control

Total Nitrogen Load



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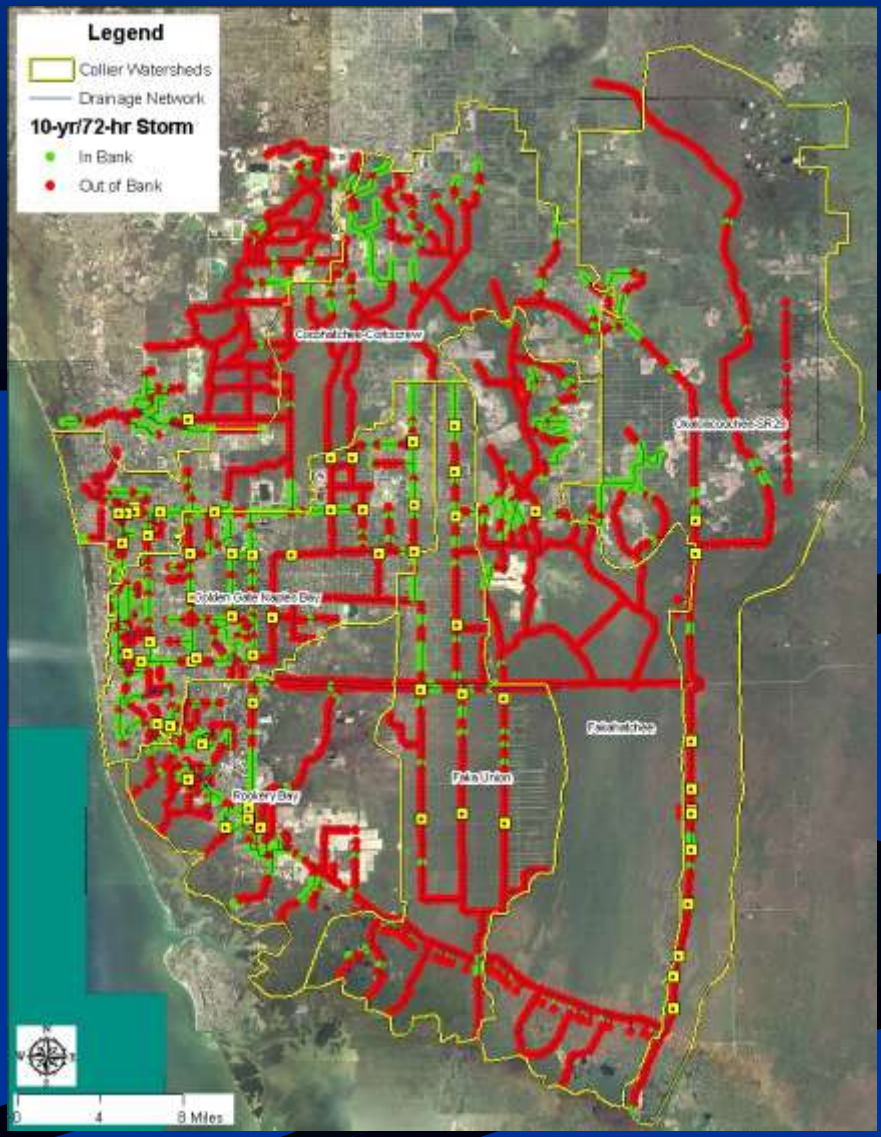
Current Canal Capacity

- Model results show limited conveyance capacity in numerous canal segments



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Objective

- 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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Water Quality Regulations Promote Low Impact Development (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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Water Quality Regulatory Issues

- Main Issue: How to provide water quality credits for development
- Not feasible under current State regulations. Feasible under proposed new stormwater rules.

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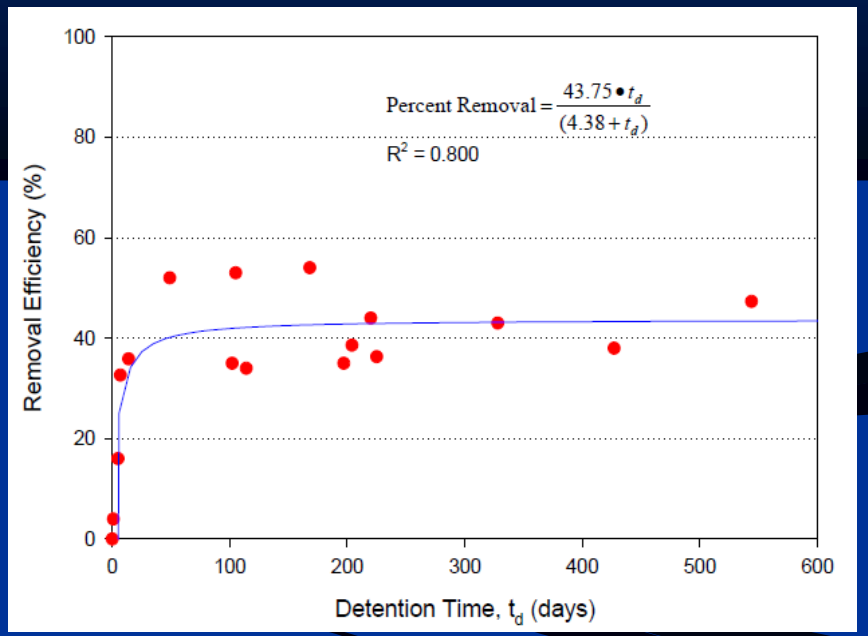
Water Quality Treatment Requirement Ordinance 90-10 is 150% of ERP



Removal Efficiency of TN

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Recommendation

- Modify Ordinance 90-10 to require treatment by LID of 50% of runoff volume (i.e. provide retention of additional 0.5" of runoff over the drainage area)
- Provide incentives for further treatment

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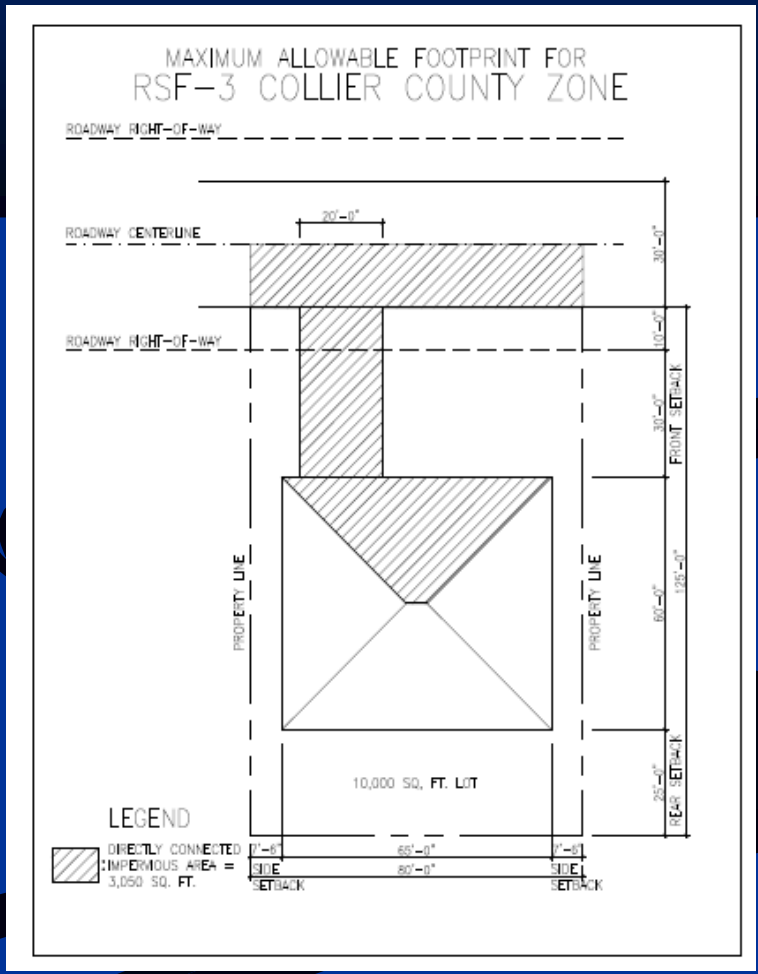
Directly Connected Impervious Area (DCIA) Current Conditions

Current Code Design Standards:

- Maximum impervious area in RSF-3 – RSF-6 areas is 43%
- Maximum DCIA in RSF-3 to RSF-6 areas ranges from 25% to 29%
- Road design using valley gutters



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Directly Connected Impervious Area (DCIA) Incentives

Recommendation

- Allow cluster development design standards if DCIA is reduced to 15%
- Allow use of drainage swales on local streets

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Retrofit Opportunities

- Construction of large projects alone will not solve the problems of excess water to the estuaries
- Construction of large projects alone will not significantly reduce pollutant load

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LID Retrofit of Public Facilities

- Identify locations where retrofit is possible, i.e. parking lots in government buildings and schools

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Golden Gate High School
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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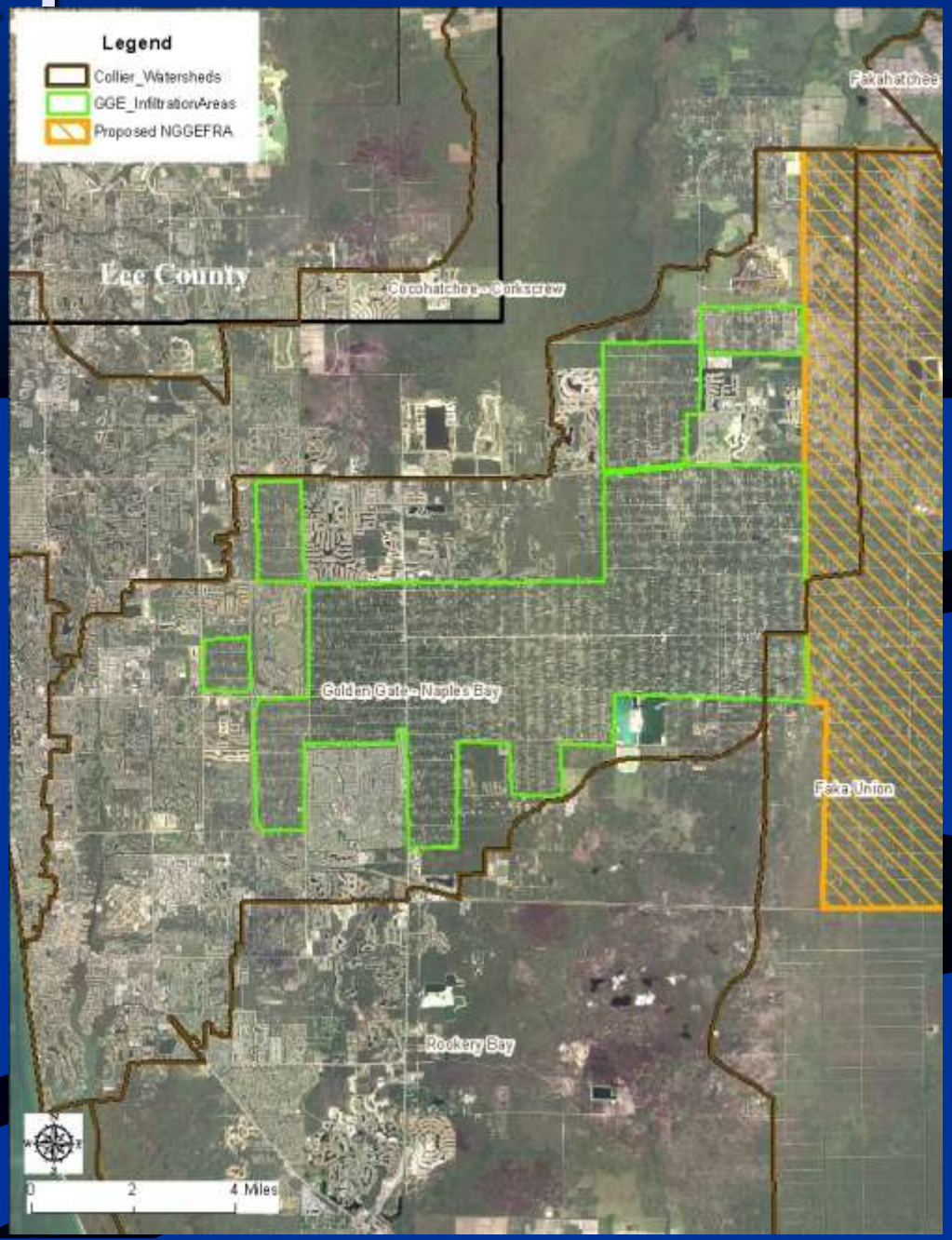
Retrofit Opportunities

- Golden Gate Estates Stormwater Management
  - Road side swales and canals comprise current stormwater management
  - More than 400 residential streets in GGE that dead end at a canal
  - Divert roadside swales to infiltration basins
  - Develop a program to purchase 5-acre lots on as many streets as possible



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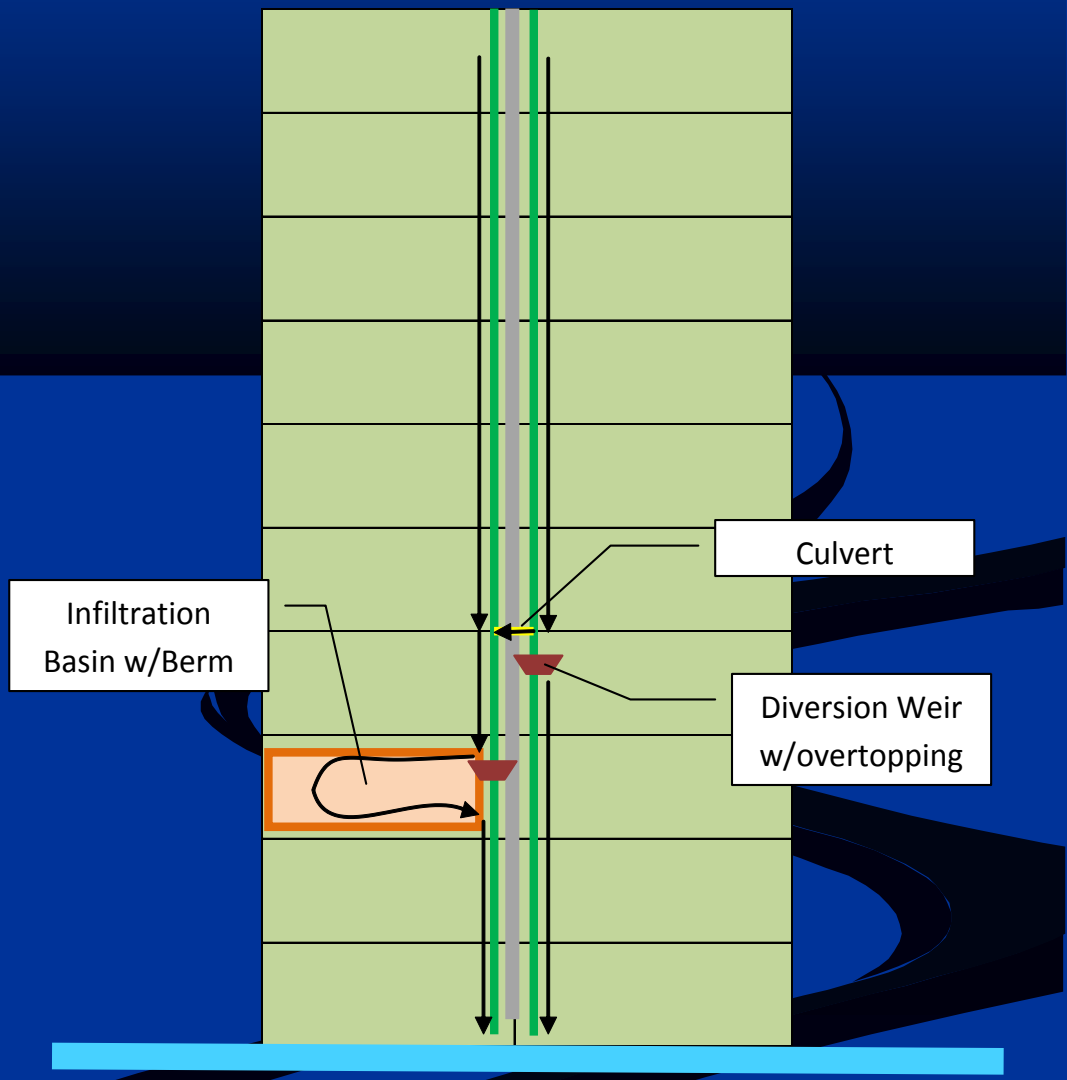
Retrofit Opportunities

- Golden Gate Estates Retrofits
  - Develop 4-acre infiltration basins
  - Typical Drainage Area is approximately 70 acres
  - Treats approximately 60% of total runoff



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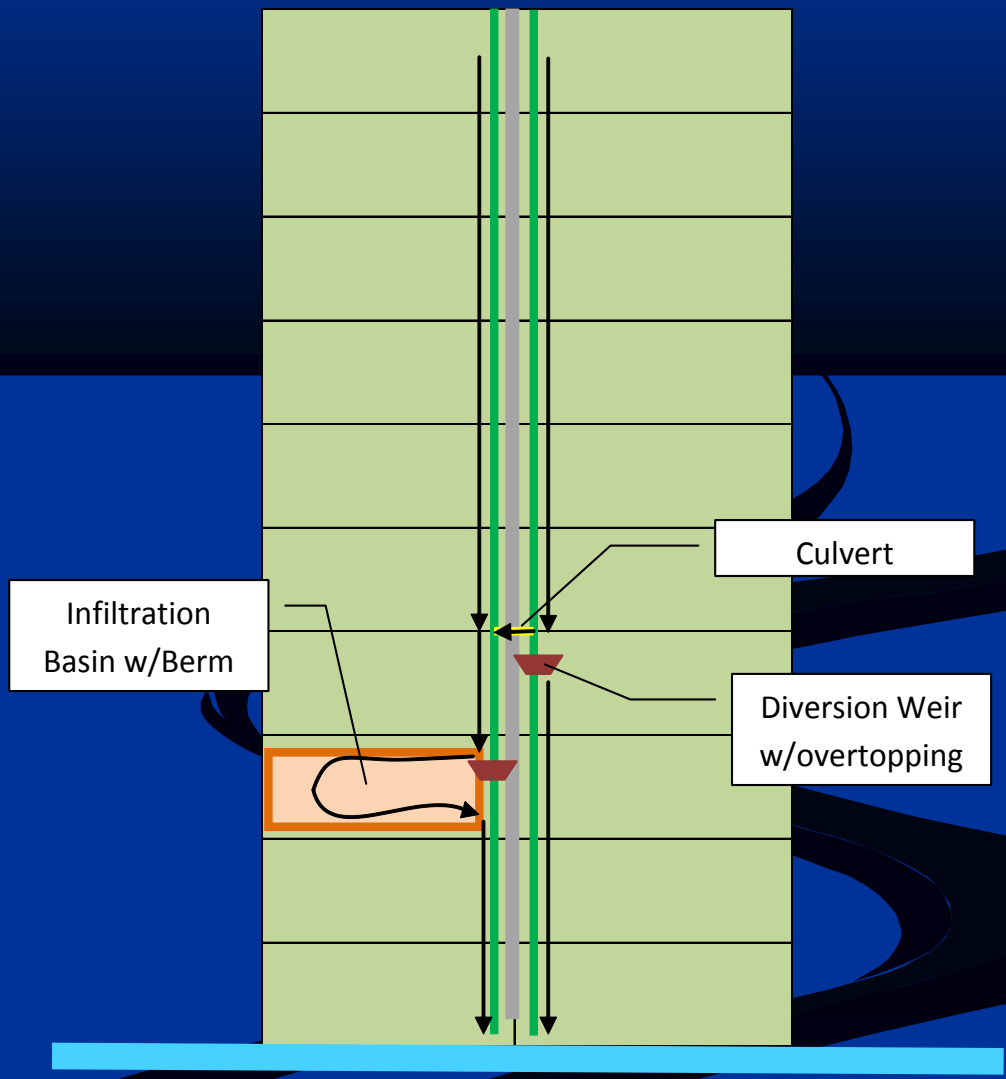
Retrofit Opportunities

- Benefits
  - Moves surface water runoff pollutant load score from 1 to 7
  - Could be used as a small neighborhood park/ educational facility
  - Will require periodic maintenance
  - Avoid Impacts to septic tank drain fields



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LID Redevelopment and Retrofits Private Property

- Provide incentives by changing the focus of the County's Stormwater Utility
- Promote LID redesign through MSTUs

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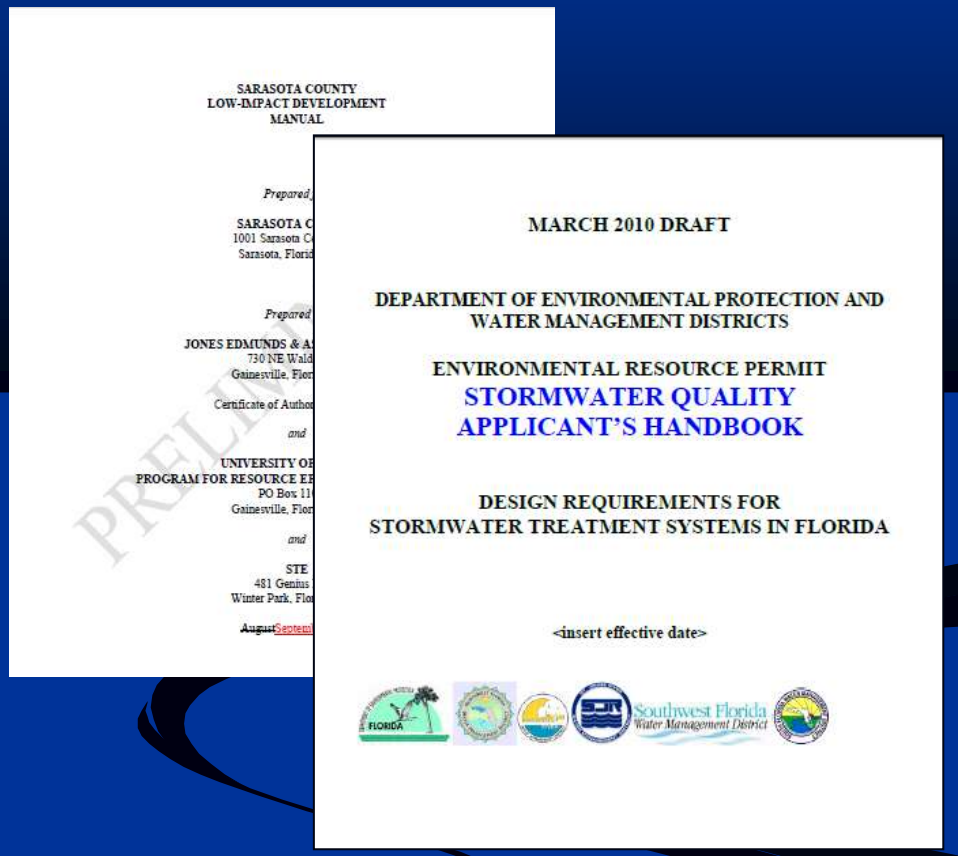
LID Design Standards

- Adopt standards in the Draft Proposed Stormwater Rule.
- Adopt by reference Sarasota County LID Manual



http://dep.state.fl.us/water/wetlands/erp/rules/stormwater/index.htm

http://www.scgov.net/EnvironmentalServices/Water/SurfaceWater/LowImpactDevelopment.asp

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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/72-hour design event.
- Recommendation 1:
  - Require volume control for the 25-year/24-hour design event (allow control of peak, volume and timing of stormwater discharges)

Percent of Site Needed to Control Additional Volume

DCIA for Developed Area*	% of Overall Site
50	14.07
40	12.1
30	9.87
25	8.89
20	7.9
15	6.66

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Water Quantity and Flood Risk

- Issue: Peak control at a site does not guarantee no downstream impacts
- Recommendation 2:
  - No increases in 100-year/72 hour flood elevations upstream or downstream

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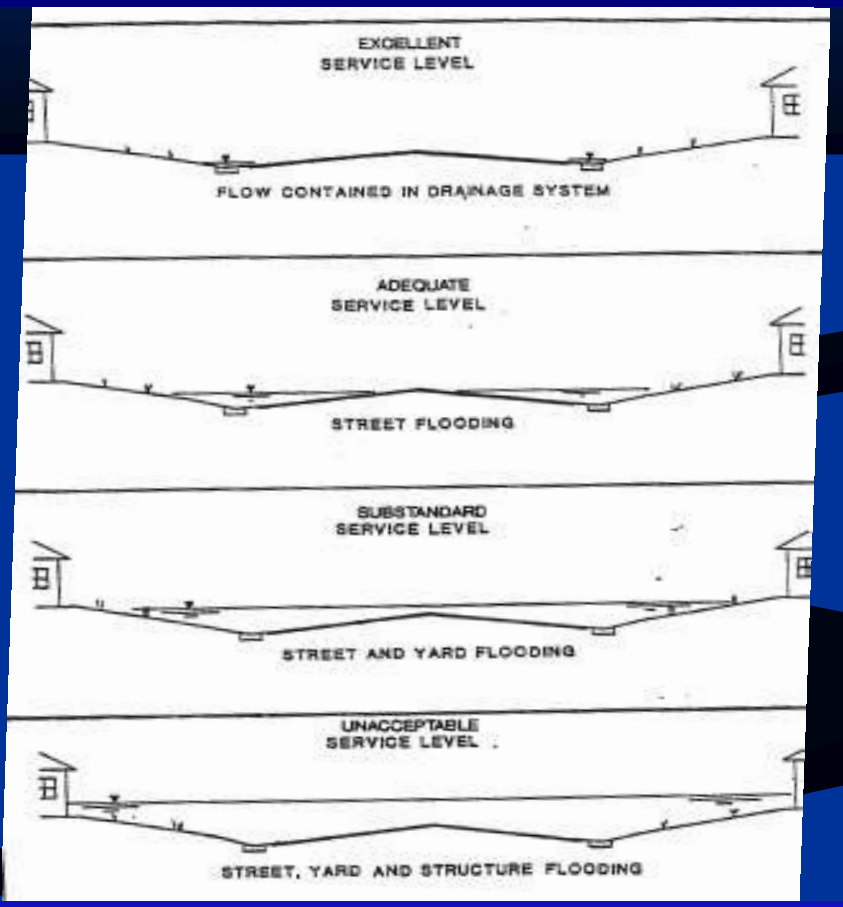
Water Quantity and Flood Risk

- Issue: Current flood protection levels of service (FPLOS) define conditions from Levels A–F
- County roads only meet Level D

Current FPLOS



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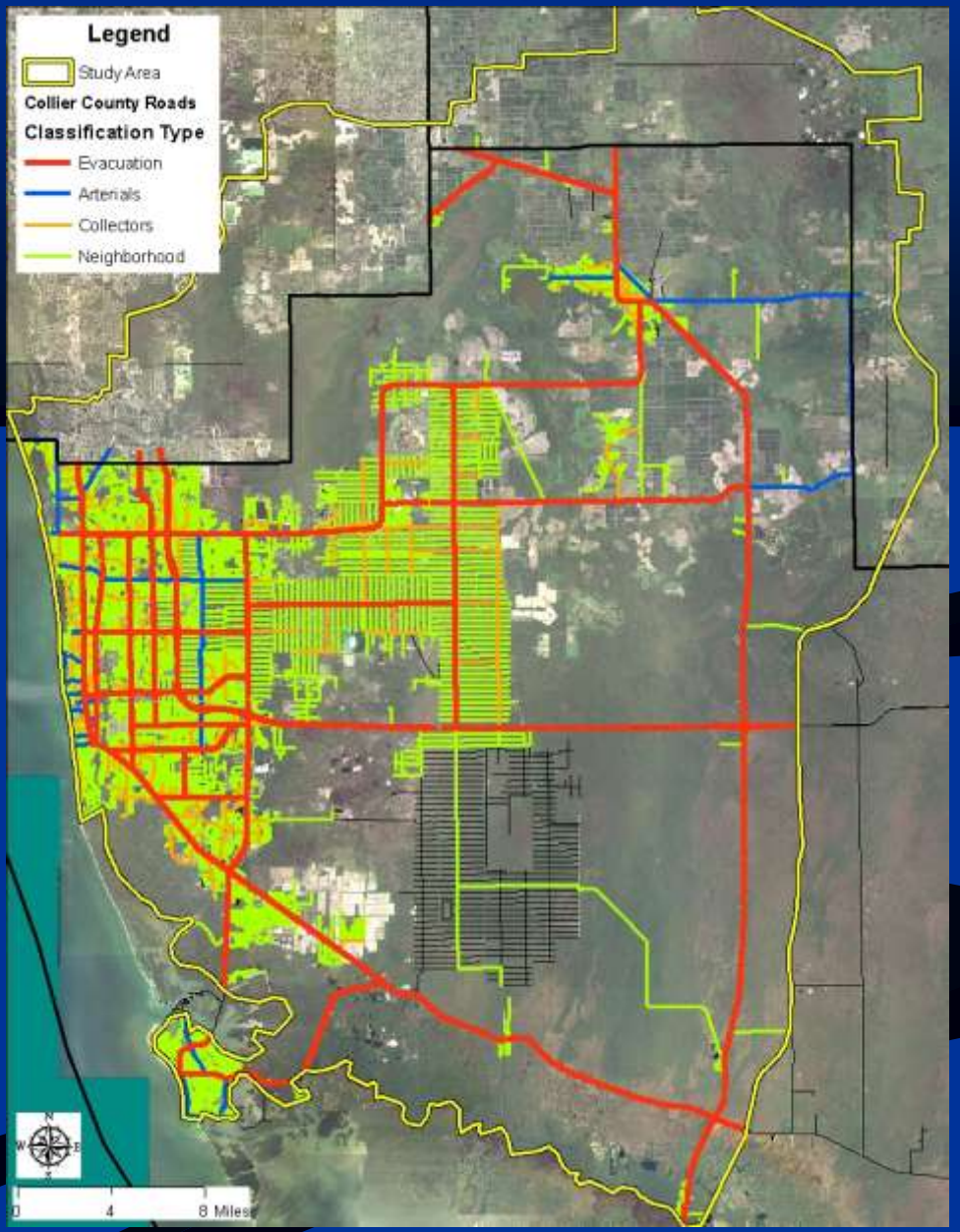
Water Quantity and Flood Risk

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			



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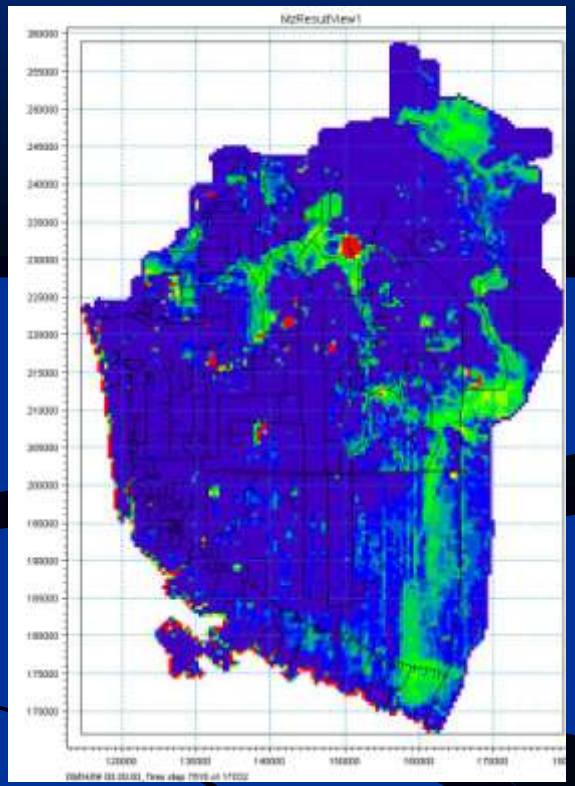
100-yr/72-hr Inundation Maps

FEMA Map

MIKE SHE Map

Initial Conditions



September 4, 2004

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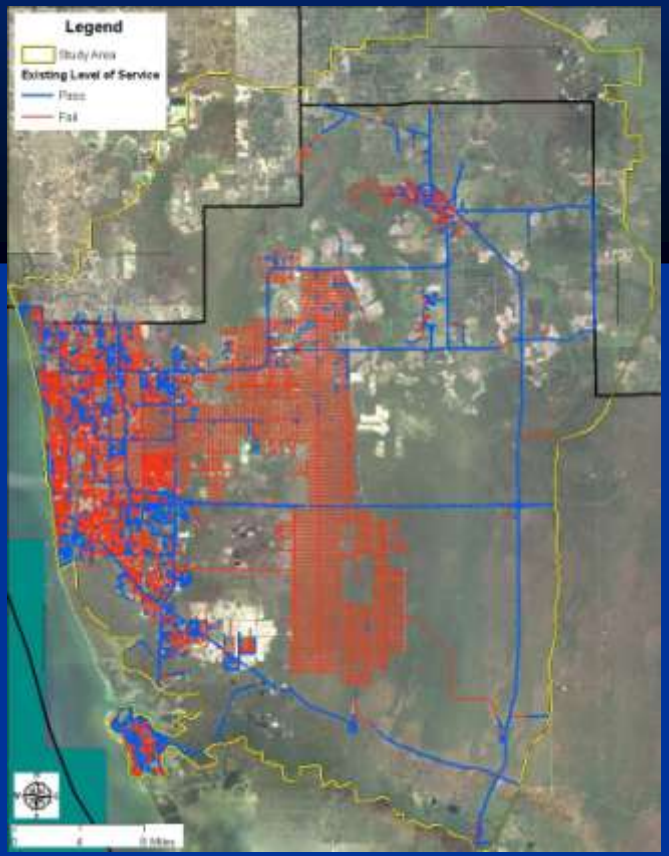
Existing Level of Service

All Roads



Evacuation Routes

Arterial Roads

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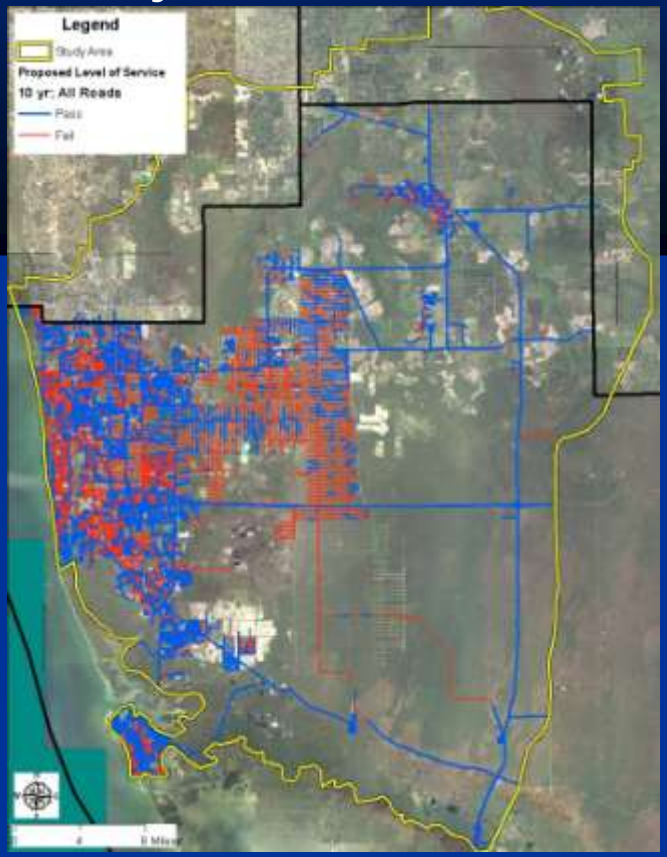
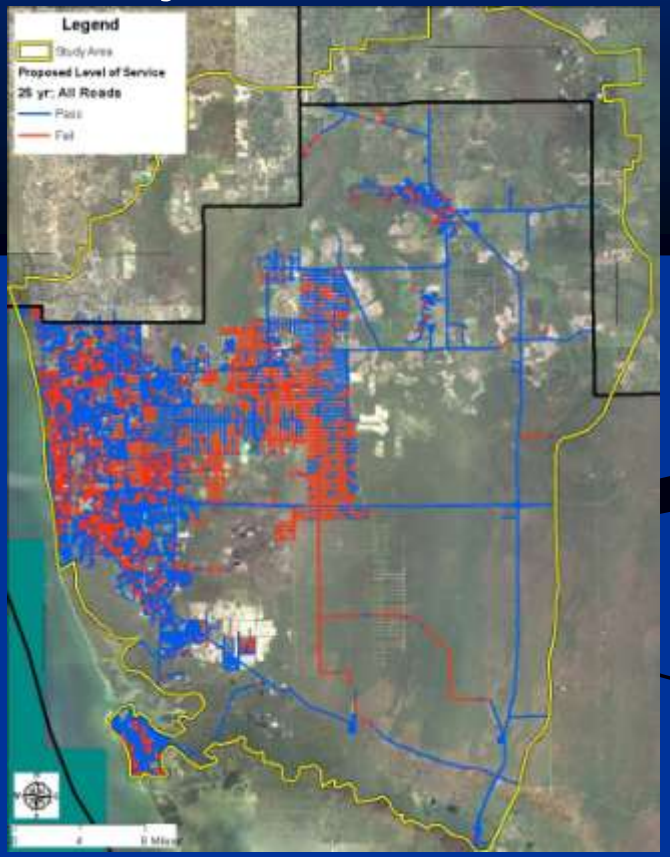
Proposed Level of Service

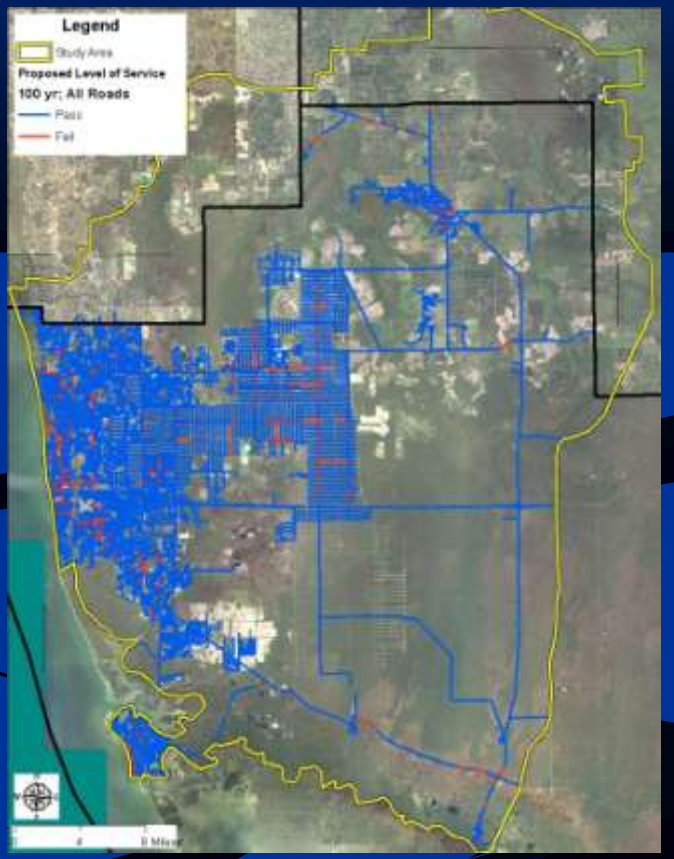
10-yr; 72-hr Storm



25-yr; 72-hr Storm



100-yr; 72-hr Storm



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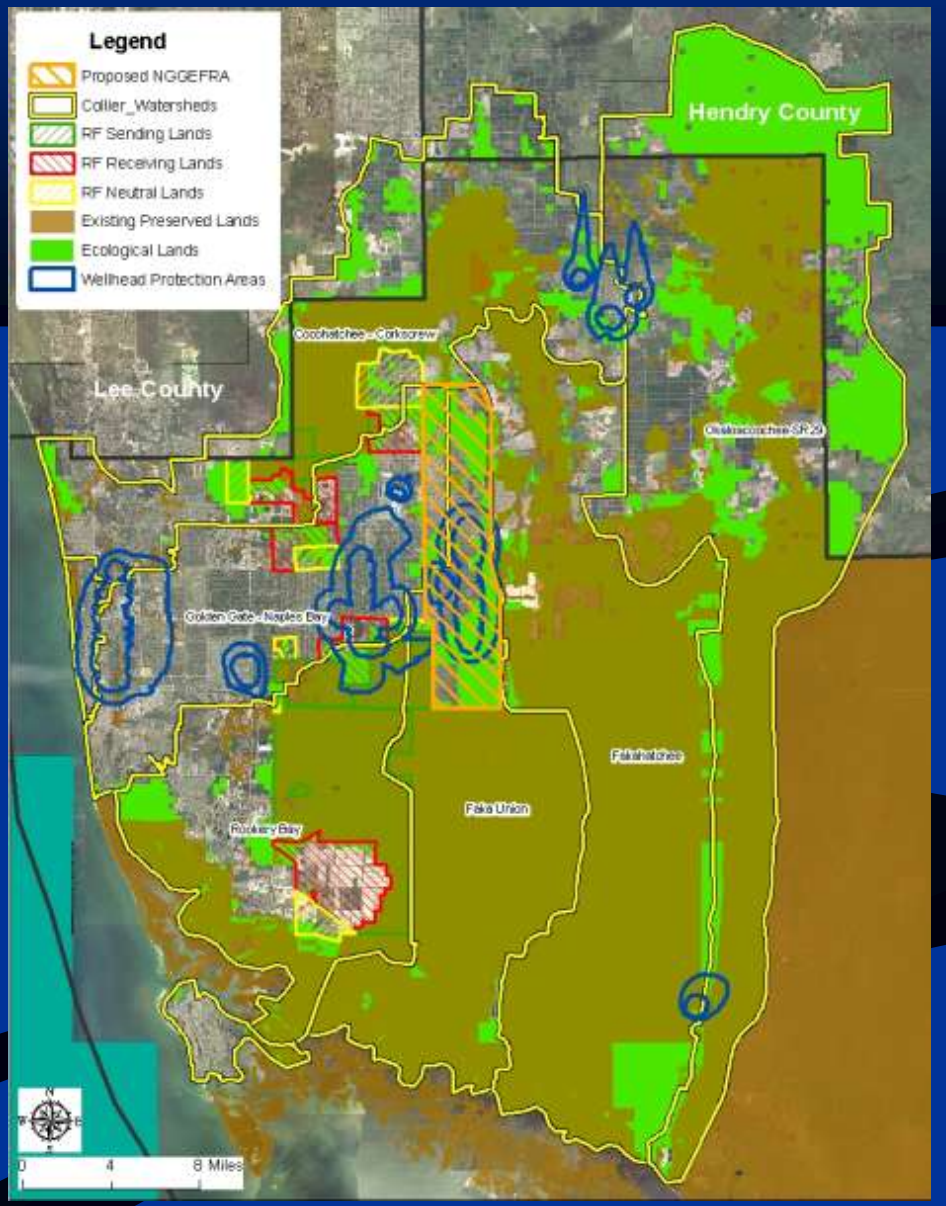
Recommended TDR Program for Golden Gate Estates

- Recommended Area includes valuable Ecological lands
- Wellhead protection area



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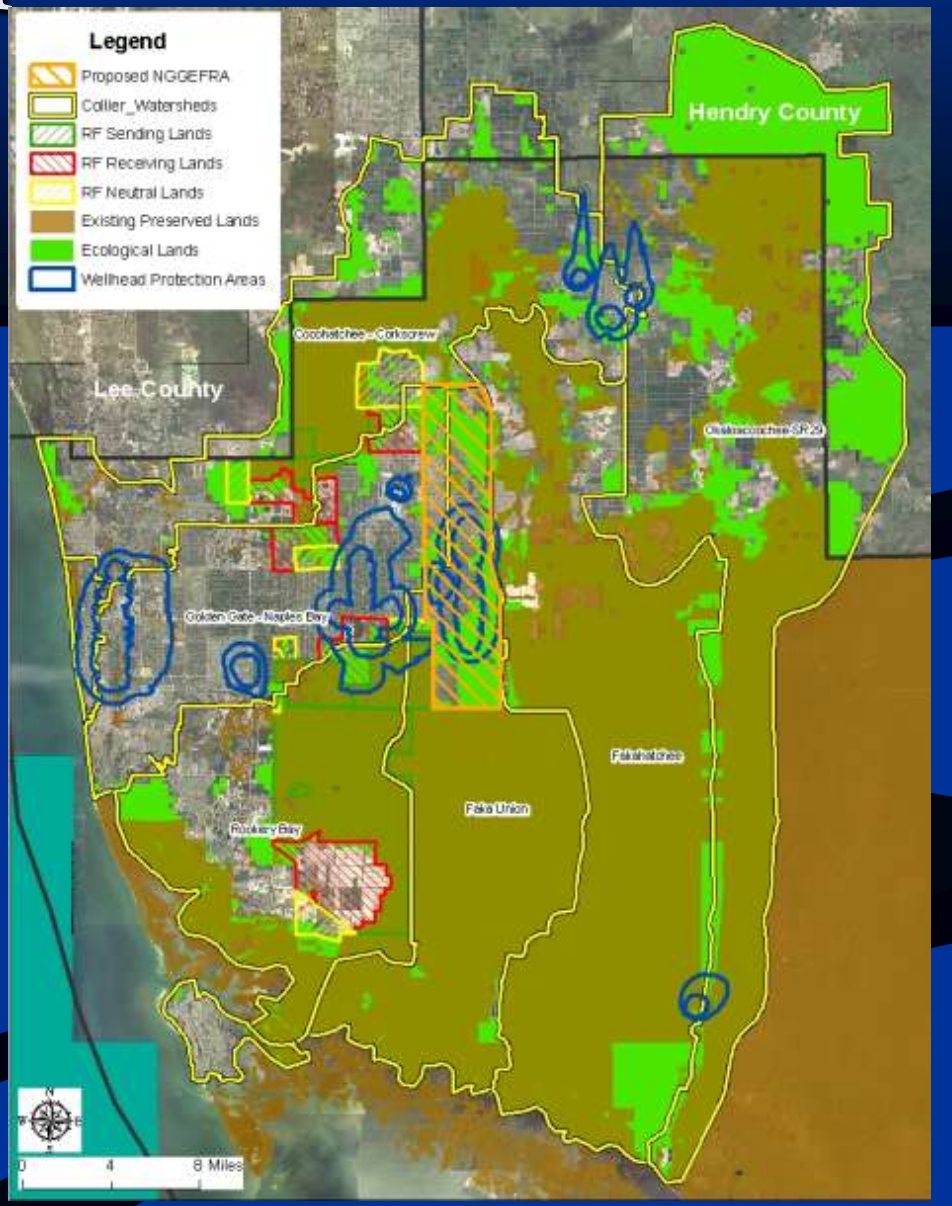
TDR Program for GGE Key Components

- Distinct from existing TDR programs that have been ineffective
- Goal is to provide sufficient market attraction
- Utilize existing receiving lands



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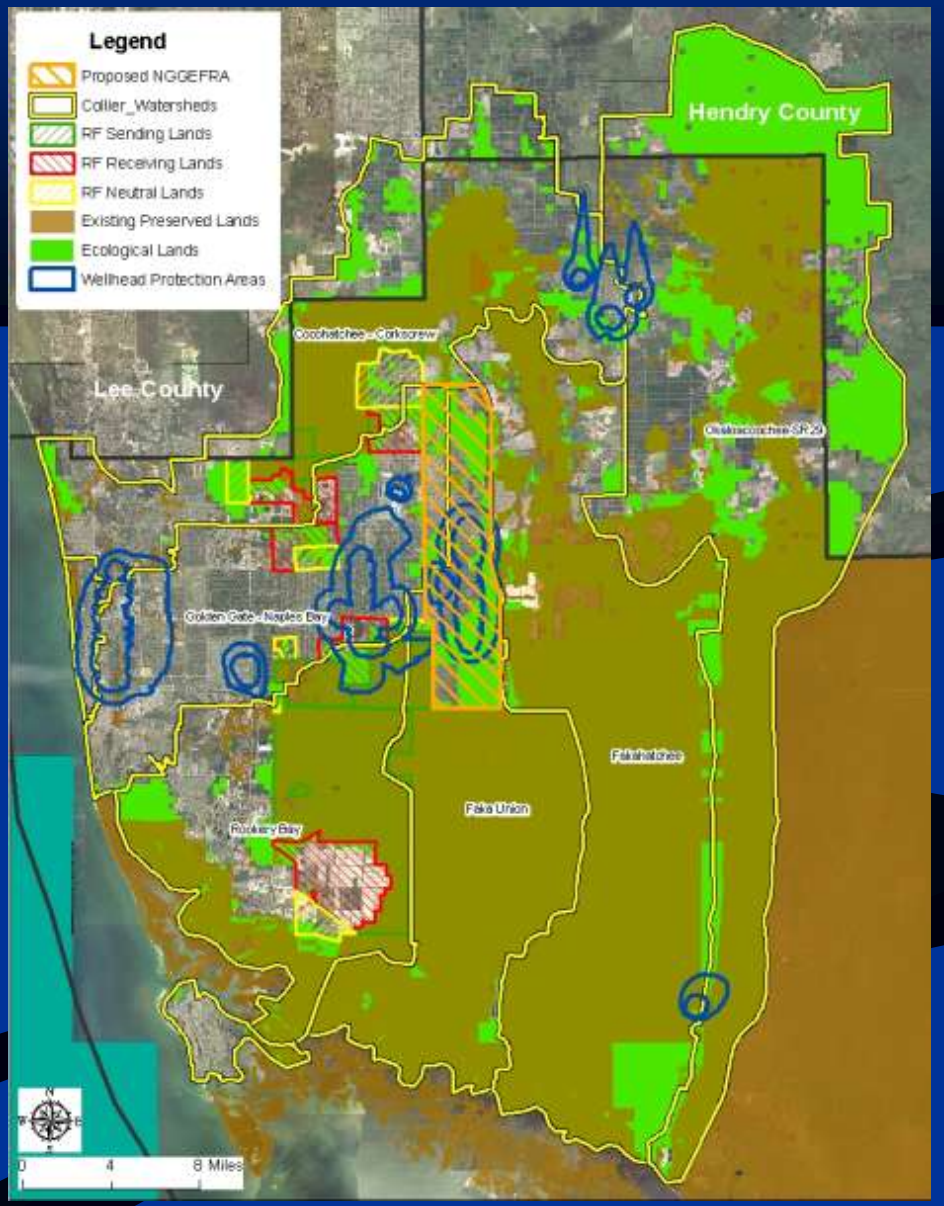
TDR Program for GGE Benefits

- Allow transfer for urban infill
- Program is voluntary – with incentives
- Use incentives to encourage aggregation of parcels
- Used for mitigation within the NGGE



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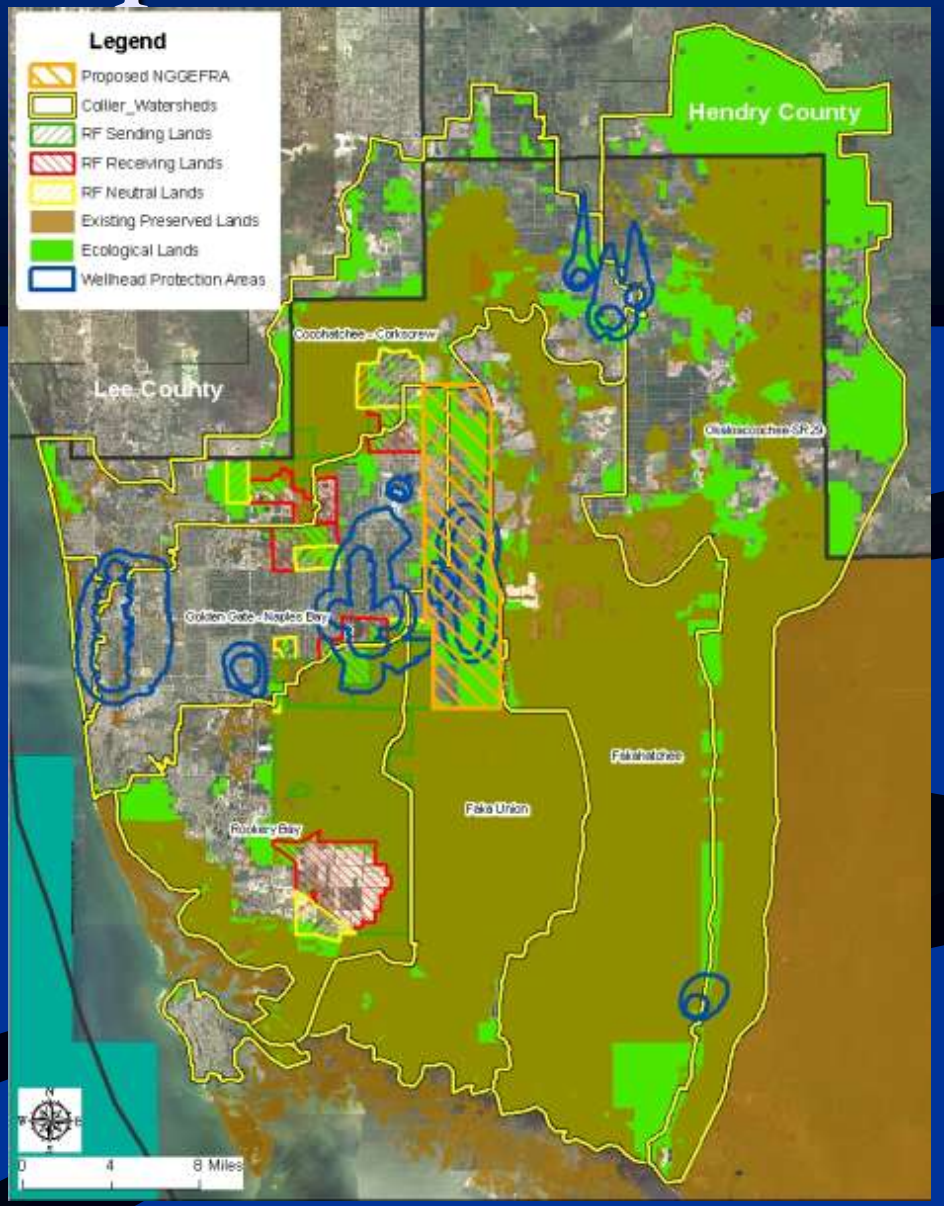
TDR Program for GGE Next Steps

- Establish 9 person Oversight Committee to develop specifics of the program
- Quantify the number of nonconforming and conforming parcels



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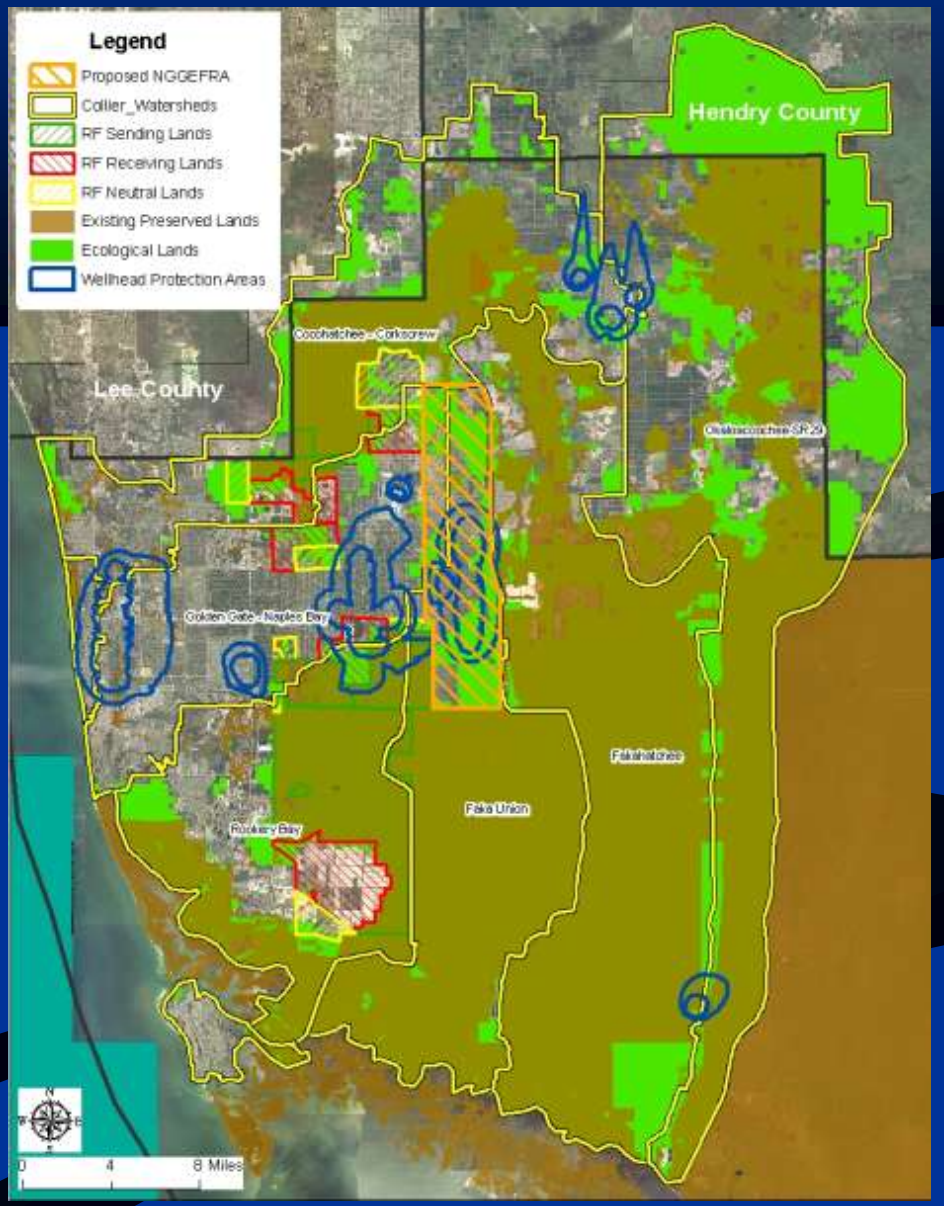
TDR Program for GGE
Key Issues to be Resolved

- Extent of the Protection Area
- Economics and Relationship to Existing TDR Program
- Receiving Lands
- Funding



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TDR Program for GGE Conceptual Timeline

Task	Day to Complete
Policy Discussion Regarding NGGEFRA before EAC, CCPC, and BCC	90
Creation of Oversight Committee and Committee Work Period	250
Preparation of final draft GMP amendments for public hearings before EAC, CCPC, BCC (Transmittal Hearings) and Transmittal Hearings	150
DCA Review and issuance of Objection Recommendation and Comment (ORC) Report (issued 60 days after completion determination)	70
County review of ORC and Adjustments to address Objections (and Recommendations and Comments) (Note: Rule requires the adoption to occur within 60 days after receipt of ORC, but typically this is not accomplished within 60 days (given process requiring hearings before the EAC, CCPC and BCC) and DCA has been tolerant providing the County is working to address issues. Assuming Objections are not substantial, the County will simultaneously begin preparing LDC amendments.	120
DCA issues Notice of Intent (NOI) to find Plan Amendments in Compliance (or not) - within 45 days of receipt of a complete adopted plan amendment	50
LDC Amendment Final Preparation and hearings (again, EAC, CCPC,BCC)	100
Total Estimated Time for Completion	**830**

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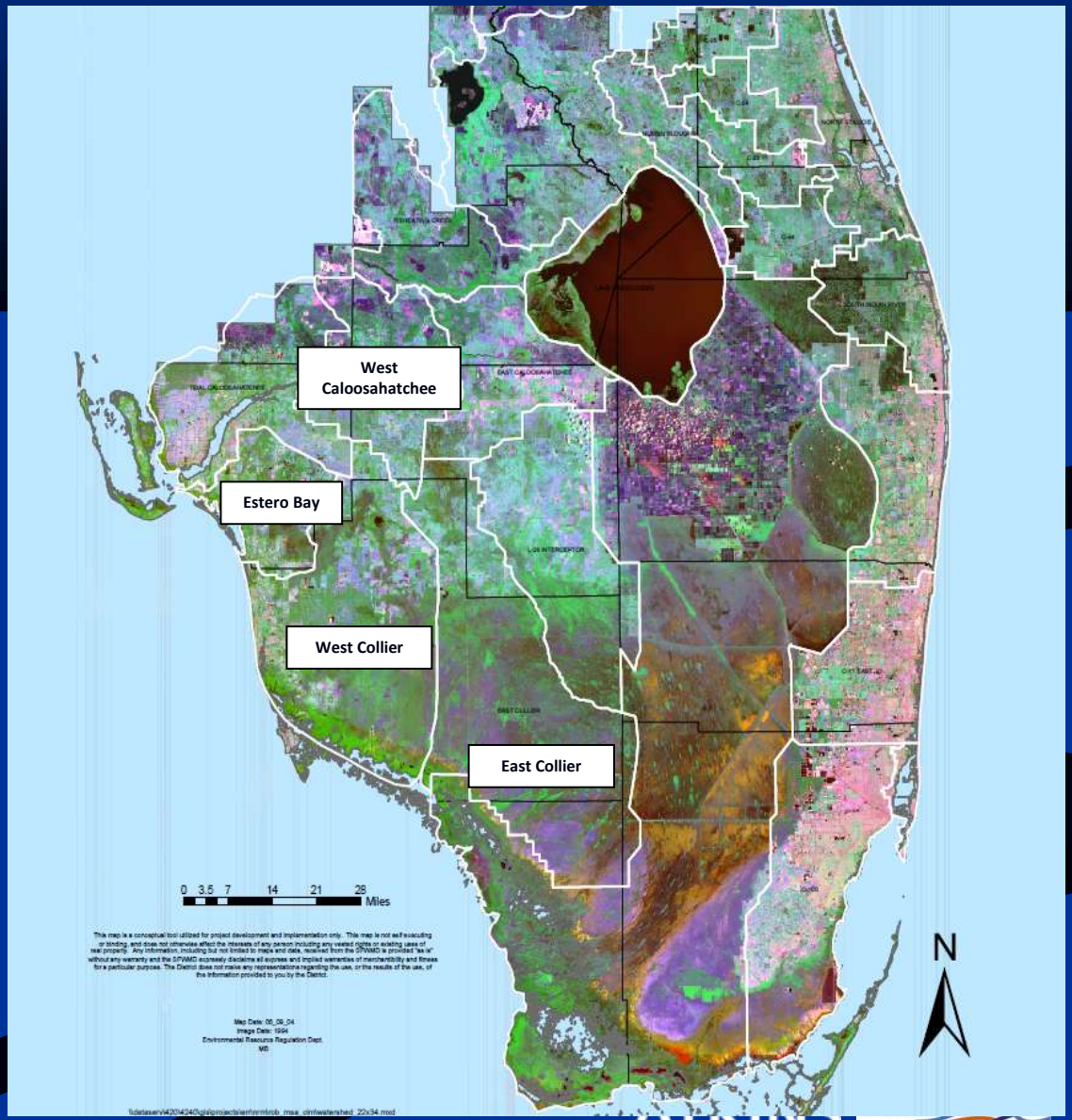
Mitigation Issues

- No regulatory mechanism to require mitigation within a functional watershed
- Economics determine where mitigation occurs



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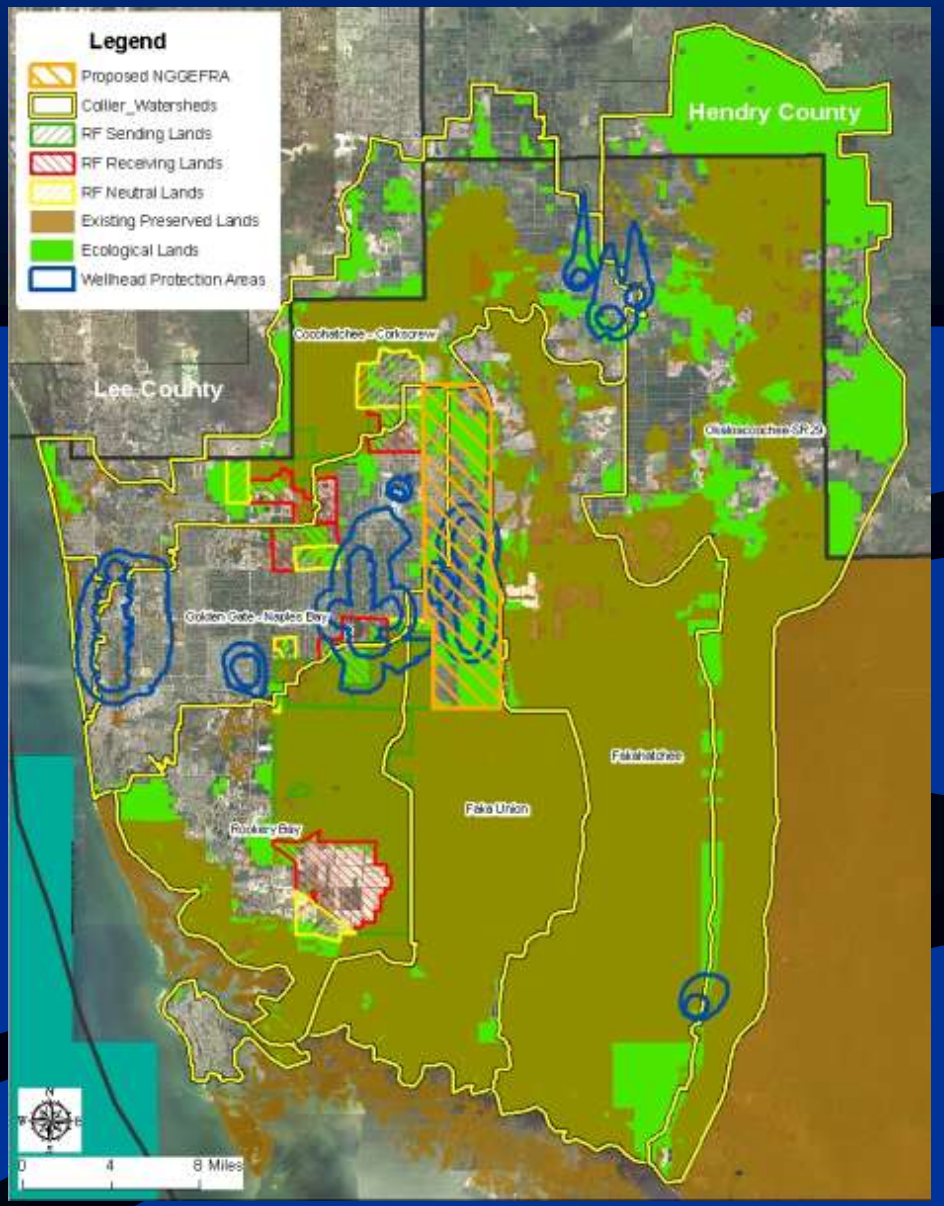
Recommendations to Establish Mitigation Area in NGGE

- Regional Offsite Mitigation Area located within proposed NGGE TDR area
- Phase I:
  - Permitted by FDEP for single family mitigation
  - Acquisition funded through TDR, grants, sale of credits, or direct County funding



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Recommendations to Establish Mitigation Area in NGGE

- Phase 2:
  - Permitted by SFWMD for public works projects
  - Funded by internal sale of credits (Collier County to Collier County)

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Factors that Favor Mitigation Within the NGGE

- Reduction in mitigation costs
- Serves wetland restoration and stormwater attenuation goals
- A regulatory precedent exists (Lee County)
- Pending statewide rules affect water quality criteria and allow credit-trading

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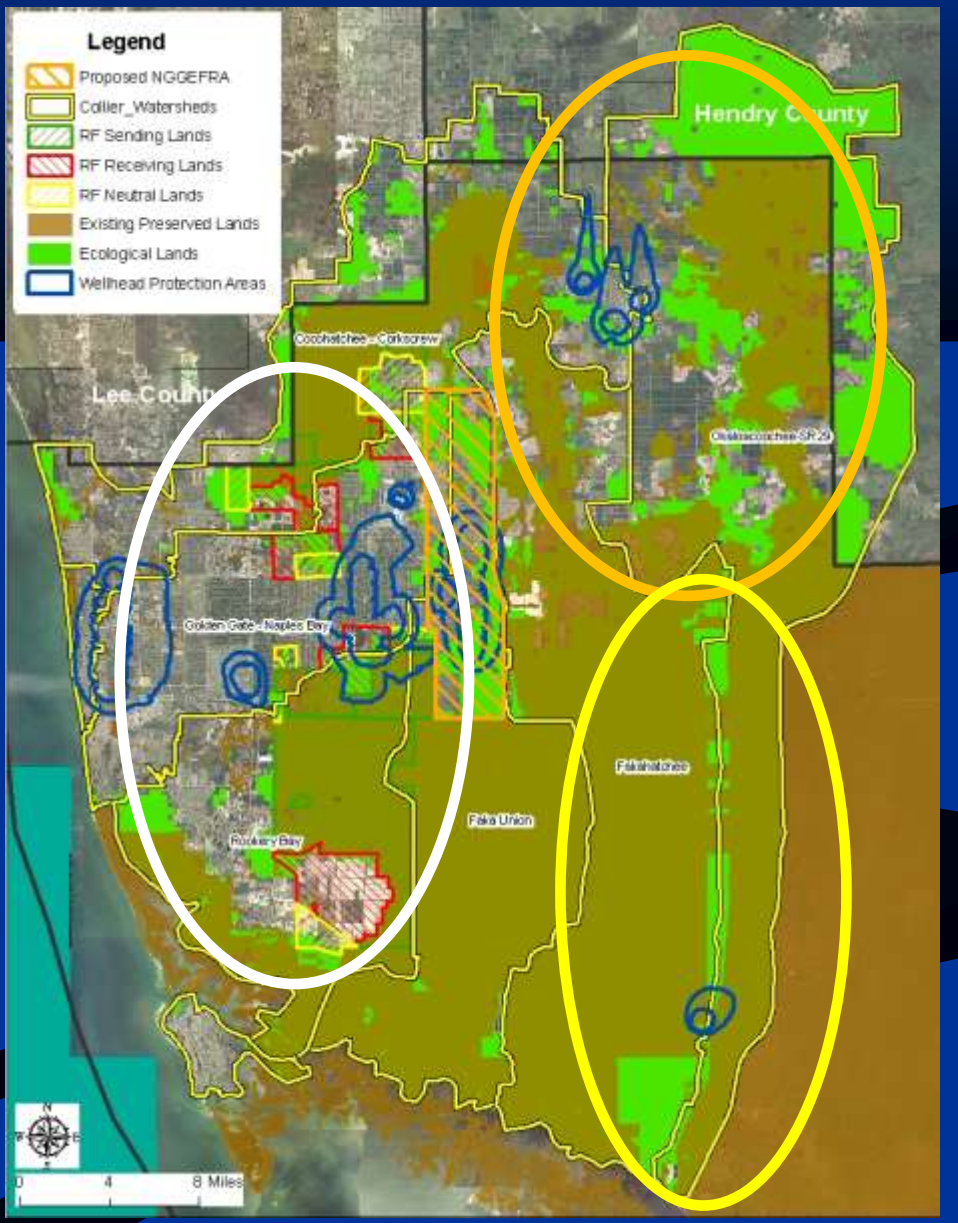
Recommended Additional Protection Areas

- Areas of localized restoration efforts
- Recyclable Water Containment agricultural areas
- Areas recommended for State acquisition



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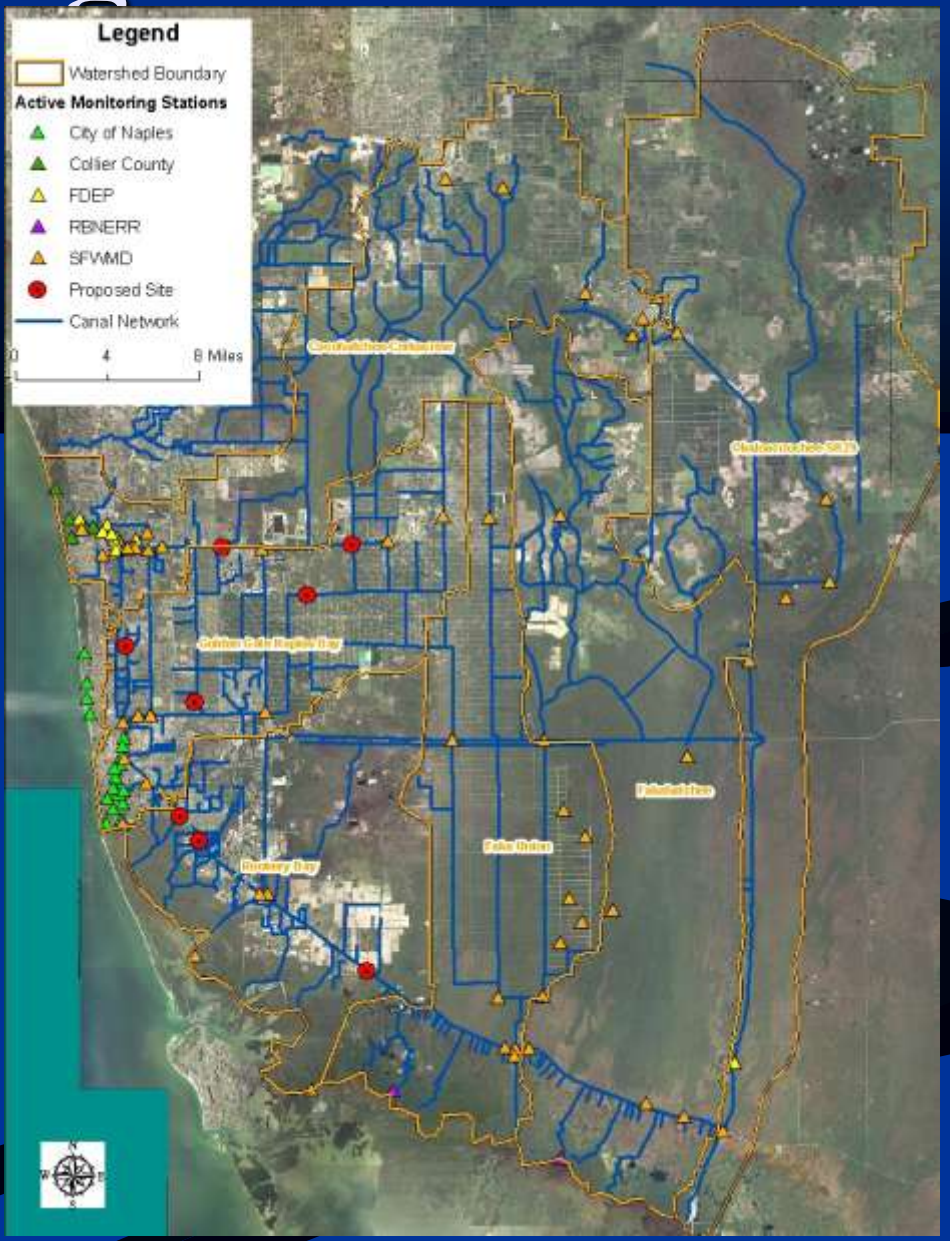
Monitoring Plan

- Surface Water Monitoring
  - Additional permanent monitoring stations
  - Wet weather monitoring program



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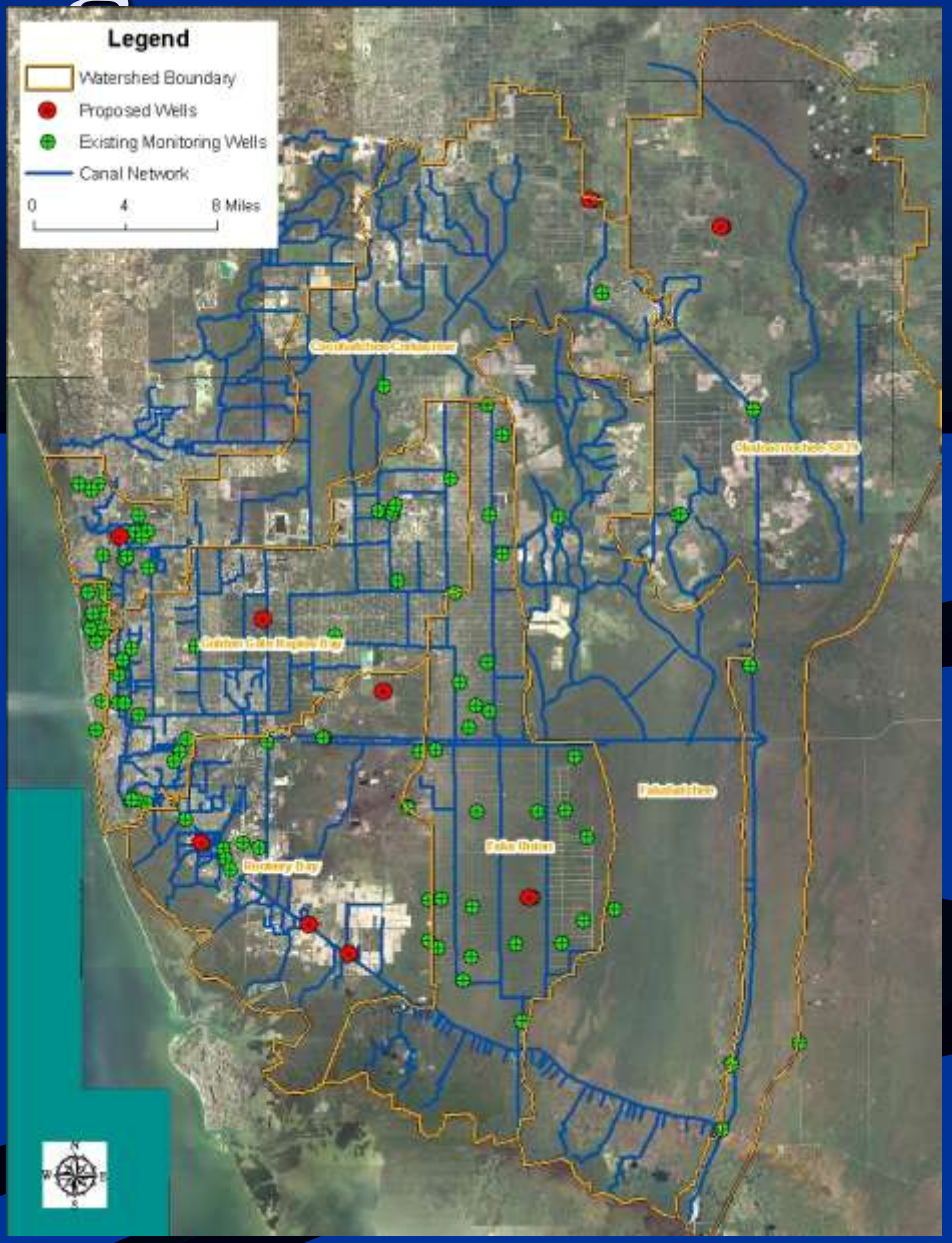
Monitoring Plan

- Groundwater Monitoring
  - Confirm extent of estimated pollutant concentrations
  - Coordinate with SFWMD for more regular sampling of wells in Picayune Strand and Okaloacoochee Slough
  - Report DO data



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Fertilizer Model Ordinance Requirements

- Training and Licensing
- Prohibited Period – Watches
- Application Rate – Label requirement
- Fertilizer Free Zone – Voluntary 10 feet
- Low Maintenance Area (buffers)
- Exemptions – Agriculture
- Application Practices – No fertilizer on impervious

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Provisions Considered

- Black Out Period – June 1 – Sept 30
- Reduction in N load to 4 lbs/1000 ft/yr
- 50 % Slow Release Nitrogen
- Mandatory 10 ft Buffer for Water Bodies

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FDEP - Watershed Restoration Bureau Chief

- Rainy Season Ban – Science incomplete
- Irrigation program to maintain slight Irrigation deficit
- Decompaction of urban landscape soils to decrease runoff
- Ensure citizens aware of saturated soil conditions
- 4 lb N per year – Less than minimum for Bermuda grass in S Fla

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Dept. Agriculture & Consumer Servc.

- Absent of scientific confirmation of need for more stringent standards recommend Model Ordinance
- Proposed restrictions jeopardize turf health and filtration capabilities

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U of Fl IFAS Chair of Environmental Horticulture Department

- Science supports fertilization during growth period (June – Sept) – minimal N loss
- UF-IFAS recommends 30% SRN at 1 lb per application until documentation supports higher
- Soluble N at proper rates have low leaching rates
- Proper irrigation important
- Keep plant debris off impervious

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Staff Recommendation

- Scientific support for Model Ordinance
- Lack of clear scientific support for more stringent fertilizer ordinance
- Model Ordinance and Public Education
- Include Collier buffer requirements
- Future evaluation of local conditions

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Education Program

- Education for residents – web and TV
- Ordinance requirements and guidance at retail
- Irrigation awareness
- Precipitation awareness
- Re-Use Nutrient awareness

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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

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