

## **Review of Programs to Protect Southeast Florida's Coral Reefs**

Southeast Florida Coral Reef Initiative  
Land Based Sources of Pollution  
Local Action Strategy Projects 3&19



Southeast  
Florida  
Coral Reef  
Initiative

*Acting above to protect what's below.*

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**Land Based Sources of Pollution  
(LBSP) Project 21 - Overview of Programs in Southeast Florida to  
Reduce Land-Based Sources of Pollution and Recommendations to  
Improve These Programs**

Final Report

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Land Based Sources of Pollution  
Local Action Strategy Project 3&19**

**and**

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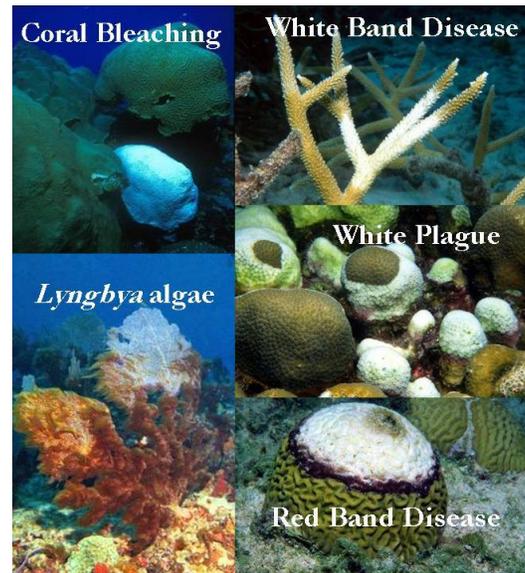
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## EXECUTIVE SUMMARY

### Background

The northern third of the Florida reef tract spans over 100 miles from the northern end of the Biscayne National Park in Miami-Dade County to the St. Lucie inlet in Martin County (Collier et al., 2008). These coral reefs, just off the beaches of the most urbanized coastal region in the state, are an extraordinary biological, geological and economic resource. Land Based Sources of Pollution (LBSP), combined with other stressors, threaten the reef system. The southeast Florida region supports approximately one third of Florida's total population of sixteen million residents (U.S. Census Bureau, 2006). The highly developed coastline in southeast Florida contributes to the degradation of coastal water quality by increasing the amount of stormwater runoff from impervious surfaces, destruction of natural landscapes, and the discharge of wastewater into the nearshore environment.



Land Based Sources of Pollution contribute to coral disease. Source: SEFCRI.

Coral reefs are one of the most valuable ecosystems in the world. Coral reefs provide multiple ecosystem services that include economic benefit to local communities, environmental services such as habitat, recreation, food, and protection for coastlines (Andrews et al. 2005). Coral reef threats and pressures include coral bleaching and climate change, land based sources of pollution, and overfishing. In many coastal areas, such as southeast Florida, coral reefs are in decline and restoration/protection efforts are underway (e.g., staghorn coral recruitment in Broward County). The reef system extends from Monroe County to Martin County in southeastern Florida. Recreation and tourism in southeast Florida are the highest economic benefits from the coral reef. For example, tourism generated over \$16 billion from June 2000 to May 2001 (Andrews et al. 2005).

In response to the degradation of coral reefs around the country, the US Coral Reef Task Force (USCRTF) and member states developed a "Local Action Strategy" to preserve their coral reef system. The Southeast Florida Coral Reef Initiative (SEFCRI) Local Action Strategy identified threats in Miami-Dade, Broward, Palm Beach and Martin Counties, and targets four key focus areas: Land Based Sources of Pollution (LBSP), Fishing Diving and Other Uses (FDOU), Awareness and Appreciation (AA), and Maritime Industry Coastal Construction Impacts (MICCI). The Florida Department of Environmental Protection Coral Reef Conservation Program (FDEP-CRCP) manages all SEFCRI projects under these key focus areas.

## Project Overview

In addition to understanding the sources of LBSP to the southeast Florida reef system, SEFCRI sought to identify the programs in place to reduce LBSP, and to recognize gaps in Best Management Practices (BMPs) in southeast Florida. In response to this need, the SEFCRI LBSP focus team initially gathered a comprehensive list of government agencies at the federal, state and local levels, as well as non-profit organizations such as watershed groups that deal with LBSP in the SEFCRI region. Next, a survey was composed in attempts to generate a list of programs, projects, and activities in place that address pollution and to identify gaps and needs in best management practices (BMPs). The surveys were mailed to agencies and organizations throughout the region and the resulting survey responses were compiled into a database in February 2008.

Between 2008 and 2009, the Center for Watershed Protection (CWP), working jointly with the SEFCRI LBSP focus team and NOAA CRCP, reviewed, analyzed and evaluated the results of the initial survey and conducted an additional literature survey to highlight key data gaps. The survey review was structured using the “Eight Tools of Watershed Protection” approach to watershed management (Schueler, 2000a). The “Eight Tools” is a comprehensive view of watershed management, which tracks development from conception to implementation, and focuses on eight key elements that are critical to reducing LBSP (Figure 1).

### *Original Recommendations*

Based on the data available, CWP and the SEFCRI LBSP focus team, with the guidance of an advisory committee including members from each county, made thirty draft recommendations to more effectively address LBSP that threatens coral reefs in the SEFCRI region. The recommendations range from programmatic changes to technical BMP suggestions and are arranged according to the Eight Tools approach. While some of the recommendations are far reaching in nature, the intent of the recommendations was to identify concrete, implementable actions that can be implemented in the short term.

### *Workshops*

In January of 2011, CWP and FDEP CRCP conducted two workshops, one in Miami with attendees primarily from Miami-Dade and Broward counties, and one in West Palm Beach with attendees from Palm Beach and Martin counties. Workshop attendees included a broad spectrum of individuals directly involved in watershed protection, including environmental and citizens’ groups, as well as representatives from federal, state and local levels of



Figure 1. The Eight Tools of Watershed Protection (Schueler, 2000a).

government. The purposes of these workshops were three-fold; first, to introduce the project and recommendations to the participants and allow for communication and information sharing among participants. Second, to solicit feedback on programs activities currently occurring to better improve water quality, in order to fill some of the data gaps from the original survey, and finally, input from the workshops was used to refine recommendations outlined in the draft report.

Thirty three individuals attended the workshops, and products included:

- 1) Notes summarizing discussions and identifying ongoing activities within each area.
- 2) A revised list of 33 recommendations. This list included slightly or heavily revised versions of the 31 original draft recommendations, as well as some additional recommendations from workshop participants.

#### *Surveys of Workshop Participants*

Following the workshops, SEFCRI conducted an on-line survey of workshop participants to identify the top five recommendations, in order to better focus future projects on these high priority areas. Overall, eighteen of thirty three attendees responded (a 54% response rate). Of these eighteen, three were incomplete and were consequently not included in summary data. Each individual was asked to select his or her top five recommendations. Of the 33 recommendations, seven received 4 or more votes (see Table 1).

**Table 1. Top Recommendations from Survey Results.**

- |   |
|---|
| <ul style="list-style-type: none"> <li>• Complete watershed planning to identify and address pollutant sources throughout the region.</li> <li>• Review and apply regional and in some cases, water-body specific - pollutant load targets in numeric nutrient criteria to guide land use and stormwater management practice decisions for impacts to coral reefs. Develop multi-agency coastal restoration working groups.</li> <li>• Actively restore and protect existing coastal and non-coastal wetlands and form regional partnerships to use the wetland mitigation process to establish and expand regionally important wetlands.</li> <li>• Promote vegetated buffers or littoral planting between waterways and development sites.</li> <li>• Classify the canal system, assess existing best management practices, and identify best management practices for canals and water bodies that reduce sediment and nutrient impacts to receiving waters. During construction, implement and enforce techniques to reduce sedimentation from canal banks.</li> <li>• Using the data in Recommendation 5 and from the South Florida Water Management District, combined with land use and other data, assist with regional stormwater retrofit inventories in priority watersheds for coral reef conservation to identify potential retrofit opportunities and provide funding mechanisms.<sup>1</sup></li> <li>• Seek funding for priority projects.</li> </ul> |
|---|

<b>Table 1. Top Recommendations from Survey Results.</b>
<sup>1</sup> “Recommendation 5” refers to assembling a consistent digital layer of storm drain and other infrastructure.

### Complete List of Recommendations

The final list of 33 recommendations is summarized below, with the highest ranked recommendations highlighted.

#### Tool 1: Watershed Planning

- 1a. Complete watershed planning assessments to guide water quality and land use change decisions throughout the region, and coordinate with and influence regional planning councils (e.g., Treasure Coast RPC) and county/city commissions regarding watershed planning efforts. (Palm Beach/Martin)<sup>1</sup>
- 1b. Complete watershed planning to identify and address pollutant sources throughout the region. (Miami-Dade/Broward)**
2. Establish a baseline and frequency in impervious cover, forests, native vegetation, mangroves, canopy, and wetlands throughout the region to enhance and preserve natural areas in transferrable data format (e.g., GIS). Use existing resources such as the Florida Forever Program (FDEP, 2009), Conserving the Gaps survey, county endangered lands programs to identify key parcels for land acquisition and influence land-buying programs at local/state/federal level.
3. Coordinate a workgroup to address population change in the region.
4. Adopt a more transparent, streamlined, permitting review and approval process.
5. Assemble existing digital data to create a consistent layer of stormwater conveyance features (e.g., storm drains, ditches) stormwater management, and times of discharge in user friendly format.
- 6. Review and apply regional and in some cases, water-body specific pollutant load targets in numeric nutrient criteria to guide land use and stormwater management practice decisions for impacts to coral reefs. Develop multi-agency coastal restoration working groups.**

#### Tool 2: Land Conservation

- 7. Actively restore and protect existing coastal and non-coastal wetlands and form regional partnerships to use the wetland mitigation process to establish and expand regionally important wetlands.**

#### Tool 3: Aquatic Buffers

- 8. Promote vegetated buffers or littoral planting between waterways and development sites.**

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<sup>1</sup> For the first recommendation, the workshop attendees in Palm Beach made a different recommendation from those in Miami, with the resulting “1a/1b” classification.

9. **Classify the canal system, assess existing best management practices, and identify best management practices for canals and water bodies that reduce sediment and nutrient impacts to receiving waters. During construction, implement and enforce techniques to reduce sedimentation from canal banks.**

#### Tool 4: Better Site Design

10. Promote low impact development techniques on new development and redevelopment sites.
11. Revise and/or create landscaping standards to promote “Florida Friendly” plants that require minimal watering, explicitly reduce the amount of managed turf permitted on new developments and in the right-of-way, and promote fertilizer ordinances that reduce water needs and nutrient loading.
12. Review and update codes and ordinances of counties and municipalities to ensure that existing development codes are consistent with low impact development practices that reduce impervious cover, preserve open space, and treat and retain stormwater on-site.

#### Tool 5: Erosion and Sediment Control

13. Increase compliance with funding for construction site inspections and develop a core staff of certified inspectors.
14. Document and repair over beach stormwater discharges.

#### Tool 6: Stormwater Management

15. Form a Southeast Florida stormwater review committee. Coordinate activities and projects with the FDEP/EPA TMDL process to address specific parameters within watersheds and impaired waters.<sup>2</sup>
16. **Using the data in Recommendation 5 and from the South Florida Water Management District, combined with land use and other data, assist with regional stormwater retrofit inventories in priority watersheds for coral reef conservation to identify potential retrofit opportunities and provide funding mechanisms.**
17. Track maintenance of all stormwater practices and infrastructure including both publicly and privately owned facilities in a streamlined format and accessible database.

#### Tool 7: Non-Stormwater Discharges

18. Supplement existing permitting programs with a “Hot Spot” inventory of areas with high pollutant loads in select watersheds of neighborhoods to refine pollution prevention methods.
19. Create an incentive system and funding mechanism to provide sewage treatment and retire septic systems throughout the watershed that are based on prioritization performed in Recommendation 16.
20. Provide free pump out of boat sanitary waste in all four counties and promote through educational efforts.

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<sup>2</sup> The second sentence of this recommendation was submitted after the workshop. When the follow-up survey was completed to rank the top 5 recommendations, this language was not included as a part of this recommendation.

21. Require installation of wastewater reuse infrastructure (purple pipes) concurrent with new developments and redevelopment projects, where appropriate.
22. Use the data developed in Recommendation 5 to help agencies coordinate data sharing and work together to identify illicit discharges.

#### Tool 8: Watershed Stewardship

23. Secure long term funding to support monitoring efforts and integrate these data to provide consistent data quantifying pollutant loads from the St. Lucie, Jupiter, Lake Worth, Boynton, Boca Raton, Hillsboro, Port Everglades, and Port of Miami inlets.
24. Expand monitoring and modeling efforts to characterize reef quality in concert with monitoring of land-based pollutant loads.
25. Integrate nonprofit organizations, community groups, and citizens to provide education and enhance watershed quality and water conservation, and identify target audiences and issues for public outreach.
26. Expand homeowner education programs to all regions that include sounder landscape practices, a broader suite of stormwater management practices, and reduced fertilizer application practices.
27. Use public and private properties to demonstrate innovative stormwater practices.

#### Overarching Issues

- 28. Seek funding for priority projects.**
29. Encourage compliance of regulations and/or policies through education and/or enforcement.
30. Revise penalties to make negative actions prohibitive.
31. Coordination between and within agencies (e.g., for enforcement).
32. Explore monitoring standards, parameters, and methods to ensure that useful, streamlined data is collected and shared in a timely manner (e.g., municipalities).
33. Stabilize and scrape existing spoil areas (e.g., islands, piles adjacent to tidal waters) to improve sediment and erosion control.

## 1.0 INTRODUCTION

### 1.1 Purpose of this Report

This report addresses the Land Based Sources of Pollution (LBSP) Local Action Strategy Project 21 – *Evaluate the outcomes of LBSP Project 3 and 19 to identify gaps in best management practices*. Specifically, it provides a preliminary overview of the programs already in place to reduce LBSP, and makes initial recommendations for improving both state and local programs that affect coral reef habitat. This final report presents the first phase of this project, and as such it assesses the program database from LBSP Project 3/19 for gaps, determines priority areas of concern, and establishes a set of recommendations to reduce LBSP for southeast Florida.

### 1.2 Organization of This Report

This report is organized as follows:

- **Section 1.0 Introduction**
- **Section 2.0 Sources of Land-Based Sources of Pollution, and Impacts on Coral Reefs and Hardbottom Communities**  
Provides an overview of the impacts of pollutants on the reef and potential pollutant sources.
- **Section 3.0 Unique Watershed Planning Considerations in Southeast Florida**  
Southeast Florida has unique environmental conditions, combined with a suite of human-induced pressures. This section describes these issues and their impact on watershed planning.
- **Section 4.0 The Eight Tools of Watershed Protection**  
The “Eight Tools” framework developed by the Center for Watershed Protection provides guidance on protecting water resources throughout the development process and was used as the framework for evaluating programs and making recommendations in this report.
- **Section 5.0 Project 3/19 Survey to Identify Programs in Place and Identify Best Management Practice (BMP) Gaps**  
This survey of state, local and federal agencies with programs designed to protect coral reefs completed by Southeast Coral Reef Initiative (SEFCRI) Team members and Florida Department of Environmental Protection (FDEP) Coral Reef Conservation Program (CRCP) staff. It served as the starting point to describe ongoing programs producing and reducing LBSP in southeast Florida.
- **Section 6.0 Goals to Protect the Southeast Florida Reef from LBSP**  
This section identifies overarching pollutant reduction and programmatic goals to reduce LBSP.
- **Section 7.0 Workshop Process and Recommendations**  
This section identifies LBSP program recommendations to achieve the watershed goals highlighted in Section 6.0 using existing local, state, and

federal programs as examples, and describes the workshop process used to arrive at the final recommendations.

• **Section 8.0**

**Revised Program Review**

This section acts as an update to the program review, incorporating feedback and information derived from the workshop process.

**1.3 Background**

The northern third of the Florida reef tract spans over 100 miles from the Northern end of the Biscayne National Park in Miami-Dade County to the St. Lucie inlet in Martin County (Collier et al., 2008). These coral reefs, lying just off the beaches of the most urbanized coastal region in the state are an extraordinary biological, geological, and economic resource (Figure 1).

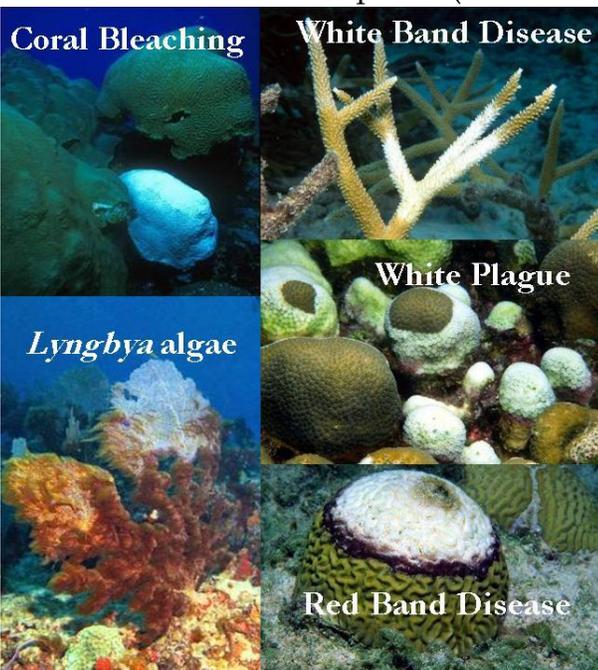


**Figure 1. Queen Angelfish are one of the many inhabitants of Florida's Coral Reef (Photo Copyright 2006 Dominick Senna).**

Unfortunately, many stressors threaten the long-term viability of this unique and beautiful resource.

One of southeast Florida's greatest stressors is the tremendous population the region supports,

approximately one third of Florida's total population of sixteen million residents (U.S. Census Bureau, 2006). The "State of the Reef" report identifies several stressors, ranging from tropical storms to trade in coral species (Collier et al., 2008). Two important stressors, however, relate to LBSP, and these are the following: 1) Coastal Development and Runoff and 2) Coastal Pollution.



**Figure 2. Land Based Sources of Pollution, along with other threats, contribute to coral diseases (Source: Lad Akins, Dave Gilliam, Dana Williams).**

One result of these stressors is a suite of coral diseases (Figure 2). While current monitoring within the southeast Florida reef shows a relatively low prevalence, several coral diseases identified include black band disease, white band and white plague. Coral bleaching has also been observed, but not at the rates observed in the Caribbean (Collier et al., 2008).

As part of a larger effort to protect coral reefs in the United States and its Territories (the U.S. Coral Reef Task Force), the Southeast Coral Reef Initiative (SEFCRI) was established, and developed a Local Action Strategy. The SEFCRI Local Action Strategy identifies key threats to the southeast Florida coral reef system. It also establishes priority actions needed to reduce the

identified threats found throughout the region, which includes Martin, Palm Beach, Broward, and Miami-Dade counties. The Local Action Strategy targets four focus areas including LBSP, Fishing Diving and Other Uses (FDOU), Awareness and Appreciation (AA), and Maritime Industry and Coastal Construction Impacts (MICCI), this report focuses solely on measures to reduce the impacts from LBSP.

#### **1.4 Project 3/19 Program Surveys**

SEFCRI developed a survey of watershed management programs as part of two LBSP projects (Projects 3 and 19) with goals of creating a database of programs in place and to identify gaps and needs in BMPs. The resulting database includes agencies and entities with programs that address LBSP entering the coastal waters of southeast Florida. The team also identified existing BMPs that appropriately and effectively reduce pollution sources. The resulting surveys were mailed to programs throughout the region. The information from the surveys and interviews were entered into a Microsoft Access Database. Both the survey and interview process of LBSP Project 3/19 ended February 2008. This report assesses the data gathered as a part of that effort, identifies gaps within and between programs and BMPs, and generates recommendations for specific projects to target LBSP sources.

#### **1.5 Workshops**

The Center for Watershed Protection and FDEP CRCP conducted technical workshops to present initial findings to the agencies surveyed and other local stakeholders to solicit feedback needed to finalize recommendations. The workshops included a facilitated review and discussions on the outcomes of LBSP Project 3/19, develop participant consensus on high priority pollution sources (hotspots), and generate recommendations from participants for engineering and/or management actions to address the gaps and high priority areas identified.

## 2.0 SOURCES AND IMPACTS OF LAND-BASED SOURCES OF POLLUTION, AND IMPACTS TO CORAL REEFS AND HARDBOTTOM COMMUNITIES

In the initial phases of SEFCRI's LBSP effort, existing literature was compiled and summarized to determine both the impact of specific pollutants on the coral reef system and the sources of these pollutants. The resulting report, entitled, "Land-Based Sources of Pollution Local Action Strategy Combined Projects 1 & 2" (Trnka et al., 2006) identified ten major types of land-based pollution affecting southeast Florida's reefs (Table 1). The report went on to discuss the potential sources of these contaminants, including treated wastewater outfalls, navigational inlets, ocean wastewater outfalls, submarine groundwater discharge, effects of Everglades restoration, and carbon dioxide rise.

**Table 1. Impacts of Pollutants on Coral Reef Systems (adapted from Trnka et al., 2006).**

<b>POLLUTANT</b>	<b>IMPACTS</b>
<b>Nutrients (nitrogen and phosphorus)</b>	Algal blooms smother corals.
<b>Heavy Metals</b>	Can be toxic at threshold values. May have adverse affects on urchin larval development.
<b>Pharmaceuticals/ Organics</b>	Cause tissue thickening, and reduced growth in corals.
<b>Herbicides/ Pesticides</b>	Are toxic at very low levels. Inhibit photosynthesis and fertilization, and affect larval settlement. Have been known to affect seagrass productivity.
<b>Salinity</b>	Changing salinity appears to reduce corals' ability to adapt to changing conditions, such as sea level changes.
<b>Carbon Dioxide</b>	Decreases the saturation state of aragonite, a mineral needed for coral calcification.
<b>Temperature</b>	Changes in temperature may lead to coral bleaching (Figure 2).
<b>Turbidity</b>	Reduced light penetration reduces photosynthesis.
<b>Sedimentation</b>	Results in physical smothering of corals and ocean habitats.
<b>Disease, Pathogens, Viruses and Bacteria</b>	Bacterial and viral diseases can infect and damage coral. Up to 18 coral diseases have been identified, with 14 confined to the Caribbean.

### 2.1 Wastewater Disposal

Six large ocean outfalls in southeast Florida discharge approximately 300 million gallons per day of wastewater effluent to the coastal ocean. Although secondarily treated, the effluents are freshwater, contain elevated levels of turbidity and nutrients, and may be a source of pharmaceutical chemicals and microbotic contaminants.

In addition to these outfalls, wastewater is disposed of using deep well injection systems. Deep wells are installed at depths up to 3000 feet below the Floridan Aquifer. Migration of this effluent offshore may occur due to the porous limestone bedrock that makes up the Florida peninsula. Water injected in this manner can appear quite rapidly in groundwater and surface water. For example, according to one study in the Florida Keys, bacteriophage tracers in injected wastewater appear in the groundwater within 8 hours after injection, and in surface marine waters between 10 and 53 hours after injection (Paul et al., 1997). In southeast Florida, wastewater capacity, surface water plumes, cost, and water reuse were highlighted in Koopman et al. (2006). Surfacing plumes were present at all six southeast Florida wastewater treatment plants (WWTP) and dilution continues from the outfall downstream from six to forty one miles. A biomarker study indicated that reefs were impacted but the pollutant discharges from each WWTP were not conclusively linked to the plants. Improved technologies as well as water reuse were discussed as ways to protect water resources, including coral reefs (Koopman et al., 2006).

**2.2 Stormwater Runoff**

Florida’s surface waters discharge to the ocean via large navigational inlets (Figure 3). Inlets in the SEFCRI region and relative volumetric loading to the coastal waters are provided in Table 2 (Banks et al., 2008). Each of these inlets is fed by a series of canals which are influenced by activities in their watersheds, such as septic systems, urban runoff, and application of fertilizers on the land surface. Potential contaminants carried by these waters could include nutrients, metals and other toxins, and pesticides.



<b>Inlet</b>	<b>Tidal Prism (millions of m<sup>3</sup>)<sup>1</sup></b>
Lake Worth	24.0
Boynton	3.0
Boca Raton	4.9
Hillsboro	8.1
Port Everglades	18.0
Haulover Inlet	10.2
Port of Miami	2.7

1: Represents the difference in the volume of water between high tide and low tide at this inlet.

**Figure 3. Major Ocean Inlets of Southeast Florida.**

According to the Broward County Atlas, this system of canals includes two hundred and sixty-six miles of waterways in Broward County alone (Broward County, 2001). This analysis of approximately twenty-five years of monitoring data (from 1972 to 1997), coupled with data from a similar analysis of data from 1998 to 2003 (Broward County, 2007) indicates a distinct water quality difference between sampling sites in the western portions of the county (i.e., water conservation area) versus those in the eastern portions of the county, which also drain developed land. In particular, those sampling sites in the eastern portion of the county have higher levels of total phosphorus, nitrate and nitrite, and chlorophyll a, while those in the western portion have higher total nitrogen (largely organic) and ammonia concentrations. Two of the three canals with the worst water quality in the county have no connection to the conservation areas, and drain developed lands only.

### **2.3 Submarine Groundwater Discharge (SGD)**

SGD is the phenomenon that forces ground water to flow from beneath the seafloor into the overlying ocean regardless of its composition whether fresh, recirculated seawater, or a combination of both (Reich et al., 2009). The quality of this discharge is directly related to the quality of the groundwater. In southeast Florida, SGD is likely to account for 6-10% of the total water influx to coastal waters (Langevin, 2003). During the dry season, SGD can account for a greater quantity of water influx than surface drainage. Along the Florida coast, SGD is often associated with tidal pumping.

### **2.4 Water Management**

Currently, freshwater travels from Lake Okeechobee to the coast through canal systems. This freshwater, which recharges the groundwater and surface waters, is used by the coastal communities for drinking and potable uses. Nutrients and pathogens from agricultural areas around Lake Okeechobee enter the canals via stormwater runoff degrading the water quality. In addition, the water in the canals acquires contaminants from the stormwater runoff originating from urban development. These canals are directly and indirectly connected to several ocean inlets along the southeast Florida coast, and the inlets allow access for these nutrient laden waters to flow directly to the nearshore waters impacting the coral reef ecosystem.

### **2.5 Carbon Dioxide Rise**

Atmospheric deposition of anthropogenic carbon dioxide into marine waters is altering the seawater chemistry of the world's oceans by lowering pH levels. As pH levels fall, the ability of coral reefs to calcify decreases, negatively impacting the health of the reefs. According to Guinotte and Fabry (2008), a substantial decrease in pH will have serious implications for coral calcification rates and skeletal formation. Weaker coral skeletons may result from a reduction in pH, enabling erosional processes to occur at much faster rates than have occurred in the past. These slower growth rates may also reduce corals' ability to compete for space and light.

### 3.0 UNIQUE WATERSHED PLANNING CONSIDERATIONS IN SOUTHEAST FLORIDA

The climate and character of southeast Florida present unique challenges to the watershed manager. In particular, the physical character of the region, historic modification of its hydrology, and the extraordinary recent and projected rates of growth and development need to be considered. In addition, the Comprehensive Everglades Restoration Plan (CERP) will affect planning efforts by altering the water balance in the region. This section summarizes some of these unique considerations and their effects on LBSP efforts to protect coral reefs (Table 3).

**Table 3. Unique Watershed Planning Considerations in Southeast Florida.**

PLANNING CONSIDERATION	IMPACT ON CORAL REEFS	STRATEGIES
<p><b>Unique Topography, Soils, and Rainfall Patterns</b></p>	<p>Limited stormwater management and land development options due to the following factors:</p> <ul style="list-style-type: none"> <li>• Limited land area without existing wetlands</li> <li>• Very high percolation rates in limestone soils</li> <li>• High groundwater</li> <li>• Flat topography</li> <li>• Seasonal rainfall</li> </ul>	<ul style="list-style-type: none"> <li>• Conserve existing wetlands by promoting redevelopment and wetland conservation on existing sites</li> <li>• Pretreat any stormwater or wastewater that is injected into the ground</li> <li>• Preserve native vegetation to the extent possible on all sites</li> <li>• Promote landscaping that tolerates seasonal rainfall patterns</li> </ul>
<p><b>Explosive Growth and Population Density</b></p>	<ul style="list-style-type: none"> <li>• High wastewater loads from increased population</li> <li>• Conversion of natural lands to urban and suburban land increases loads in surface runoff</li> </ul>	<ul style="list-style-type: none"> <li>• Actively manage new development</li> <li>• Focus on on-site stormwater controls for existing development</li> <li>• Provide advanced wastewater treatment</li> <li>• Implement reuse of wastewater</li> </ul>
<p><b>Seasonal Population Increases</b></p>	<ul style="list-style-type: none"> <li>• Pollutant loads are higher in the winter (dry season)</li> </ul>	<ul style="list-style-type: none"> <li>• Focus on educational efforts that target this seasonal population</li> </ul>
<p><b>Concentrated Development on the Coast</b></p>	<ul style="list-style-type: none"> <li>• Coastal wetlands, which offer pollutant filtering, are no longer in place to perform this function</li> <li>• Loss of coastal habitat affects the shoreline and coastal environment</li> <li>• Riparian vegetated buffer losses increase pollutant loads</li> </ul>	<ul style="list-style-type: none"> <li>• Restore wetlands</li> <li>• Use on-site stormwater practices on developed coastal properties</li> <li>• Perform stormwater management retrofits</li> </ul>
<p><b>Altered Hydrology and Loss of Wetlands</b></p>	<ul style="list-style-type: none"> <li>• Increased pollutant loads due to wetland loss</li> <li>• Historic stream system performed a filtering function which has been lost</li> </ul>	<ul style="list-style-type: none"> <li>• Restore coastal wetlands and wetlands along the canal system and other riparian wetlands</li> <li>• Promote stormwater management practices that minimize both the</li> </ul>

**Table 3. Unique Watershed Planning Considerations in Southeast Florida.**

PLANNING CONSIDERATION	IMPACT ON CORAL REEFS	STRATEGIES
		volume and discharge rates of stormwater runoff
<b>Need for Water Conservation</b>	<ul style="list-style-type: none"> <li>• Directly reduces the wastewater loads delivered to the ocean</li> </ul>	<ul style="list-style-type: none"> <li>• Pursue stormwater management practices that also enhance water conservation</li> <li>• Integrate water conservation into new developments</li> <li>• Promote wastewater reuse</li> </ul>
<b>Water Management</b>	<ul style="list-style-type: none"> <li>• Freshwater discharges from Lake Okeechobee through a network of canals may impact coastal quality</li> </ul>	<ul style="list-style-type: none"> <li>• Integrate land use planning and better site design practices with the CERP</li> <li>• Conduct monitoring to ensure that coral reefs are not negatively impacted by these efforts</li> </ul>
<b>Groundwater Quality</b>	<ul style="list-style-type: none"> <li>• Poor groundwater quality could affect reefs through submarine discharge</li> </ul>	<ul style="list-style-type: none"> <li>• Consider groundwater protection in stormwater and septic system design</li> </ul>

### 3.1 Unique Topography, Soils and Rainfall Patterns

Southeast Florida is unique in both its geology and meteorological patterns. The combination of seasonal rainfall patterns, high groundwater table and extremely flat topography, and rapid percolation rates on some soils make traditional stormwater management somewhat challenging. Alternative stormwater practices that capture and reuse stormwater or preserve natural areas may be the most appropriate in this region.

Furthermore, the remaining developable land within the area is dotted with remnant wetlands. Consequently, future land use planning need to consider these remaining natural areas.

### 3.2 Explosive Growth and Population Density

Southeast Florida has grown at an increased rate over the past several decades. The population of the four-county region increased almost 25% between the 1990 and 2000 census. Between 2000 and 2006, it increased to 5.6 million. This 9.1% increase between 2000 and 2006 is consistently higher than the growth rate in the United States, which was an estimated 6.4% (US Census Department, 2006). This population growth results in a corresponding increase in wastewater loads, as well as an associated increase in impervious cover and loss of wetlands throughout the region. Taken together, these impacts result in greater pollutant loads to the Florida Reef Tract.

As of the writing of this report, however, the region is suffering an economic downturn. One indicator is the extremely high home foreclosure rate in the region in 2008, with rates of 4.91 %, 4.66% and 2.62% in Miami-Dade, Broward, and Palm Beach Counties, respectively (South Florida Business Journal, 2009). As a direct result of this downturn, current population forecasts estimate much slower population growth over the next few decades. The population in the state of Florida is anticipated to grow at a rate of only 1.1% per year by 2020 and 0.8% per year by 2035 (Smith & Rayer, 2009). Southeast Florida (including Miami-Dade, Broward, Palm Beach and Martin Counties) is forecast to have even slower growth rates, with an annual population increase of 0.6% by 2020 and only 0.4% by 2035.

If these forecasts are accurate, the downturn may offer program managers an opportunity to put programs in place to reduce LBSP in anticipation of future development. At the same time, however, the loss of tax revenues associated with these hard economic times may prove a challenge to program managers.

### 3.3 Seasonal Population Increases

In addition to its permanent resident population, southeast Florida has a significant annual tourist and seasonal population increase. As of 2008, the Florida coast had more seasonal coastal homes than any other state, with over 500,000 homes in coastal counties, or 24% of the nation's total (Crossett et al., 2004). While tourists visit the beaches of southeast Florida year round, the seasonal population throughout Florida increases dramatically in the winter (dry season) months, due to "snowbirds" who travel to the region for the winter months only, or "sunbirds," permanent residents of Florida who leave for at least 30 days during the summer months (Smith & House, 2006).

This seasonal migration impacts planning efforts in two ways. First, planners need to consider both water demand and waste load increase during the winter (dry season). Second, any public education and outreach efforts in the watershed need to consider this significant seasonal population.



Figure 3. New Homes in Western Miami-Dade County (January, 2008). Source: CWP.



Figure 4. Coastal Development in Miami-Dade County. Photo Source: [www.floridata.com/tracks/ray/chap10\\_boat.cfm](http://www.floridata.com/tracks/ray/chap10_boat.cfm)

### 3.4 Concentrated Development on the Coast

In southeast Florida, as in much of the United States, development is concentrated along the coasts (Figures 4 and 5). This very high density of development along the coastal fringe replaced the historic, natural wetlands and mangroves, which previously characterized the coastal environment. Retention of wetlands and mangroves would have lessened the impacts of upland development on the Florida Reef Tract by filtering pollutants and providing habitat for native coastal flora and fauna. The current development pattern, however, allows no buffer between development and the sensitive coastal ecosystem.

In an attempt to mimic the historical function of these wetlands, the watershed manager needs to focus on strategies that remove pollutants from coastal development sources at their point of origin, and more nearly mimic the original hydrology of the region. Wherever possible, strategies that restore coastal wetlands can also replenish to some extent the natural function of the coast line.

### 3.5 Altered Hydrology and Loss of Wetlands

Historically, southeast Florida was covered by forests and wetlands of the Everglades. Over the course of the 20th Century, the Everglades system was dammed, diked and diverted, resulting in a much smaller wetland area, and a system of canals to drain the land surrounding the historic wetlands (Figures 6 and 7).

These surface alterations have significantly modified the hydrology of the region. Prior to alteration, the Everglades system converted the majority of rainfall into evaporation, and some to groundwater recharge. Only a small fraction was discharged to the ocean, or “lost to tide”, via the Caloosahatchee or St. Lucie. The surface modifications have increased the amount of water discharged to the ocean via navigation inlets in continental southeast Florida. At the same time, use of the Biscayne Aquifer as a water source for increasing human population has reduced the quantity of available groundwater.



**Figure 5. Beach in Fort Lauderdale. Development is extremely close to the shore in this region. Photo Source: CWP.**



**Figure 6. Edge of the Everglades taken from Route 869 in Broward County. Dams constructed in the early 20<sup>th</sup> century confined the Everglades to a fraction of its original surface area. Photo Source: CWP.**



**Figure 7. The "stream network" of Southeast Florida is now dominated by a series of canal systems.**

While the natural hydrology of the region can never be truly reproduced, a combination of on-site stormwater management and larger capital projects can recreate some of the function of this natural system. On individual properties and development sites, practices that harvest runoff for reuse, landscaping practices that incorporate trees and native vegetation, and site assessment techniques that preserve existing wetlands would help to achieve this goal. In addition, techniques such as preservation of buffers at the edge of canals when appropriate would help to restore their natural hydrologic function. Finally, larger scale efforts such as the CERP and other associated Everglades restoration projects attempt to restore the natural function of this large wetland area.

### **3.6 Need for Water Conservation**

The availability of potable water for drinking water, irrigation, and other residential and commercial uses is a major concern in

southeast Florida. The citizens of this region consume 179 gallons of water per day (SFWMD, 2008), up to twice the national average, largely due to the huge demand for irrigation in this hot, seasonally dry climate. The population of Miami-Dade and Broward counties rely solely on water from the Biscayne Aquifer, a sensitive aquifer which is highly connected to surface waters due to its shallow depth. Most of Palm Beach and Martin County use a shallow non-artesian aquifer as their major source of groundwater. As demand on this water supply has increased, quantity in the aquifer has become a concern. Drought conditions and frequent withdrawals have decreased flow rates leading to salt water intrusion from the coast. Recognizing this concern, Florida has charged its Water Management Districts with creating plans to ensure that potable water is available.

Reducing household water use directly reduces pollutant loads to the reef system by achieving a corresponding reduction in the total wastewater load. Conserving water used for landscape irrigation also reduces pollutant loads, since irrigating landscapes can create saturated ground and result in increased surface runoff, and leaching of fertilizers and pesticides to the groundwater, which are subsequently carried to the coastal systems. Some strategies to conserve water include:

- Reusing both wastewater and stormwater;
- Landscaping that reduces water use;
- Educating the public to reduce household water use;
- Promoting compact forms of development which reduce the expansion of lawns;
- Identifying and protecting groundwater recharge areas;
- Preserving pre-development hydrology at individual development sites to maintain recharge to groundwater resources.

### 3.7 Comprehensive Everglades Restoration Plan (CERP)

The CERP seeks to restore habitat of South Florida, including the Florida Everglades. The Plan includes more than 60 elements, will take more than 30 years to construct and the current estimate in Oct 2007 dollars is \$9.5 billion for projects (\$11.9 overall including PLA and AAM). An overarching goal is to closely mimic historic hydrology by capturing freshwater that currently flows to tide, and redirect it to areas where it is needed most.

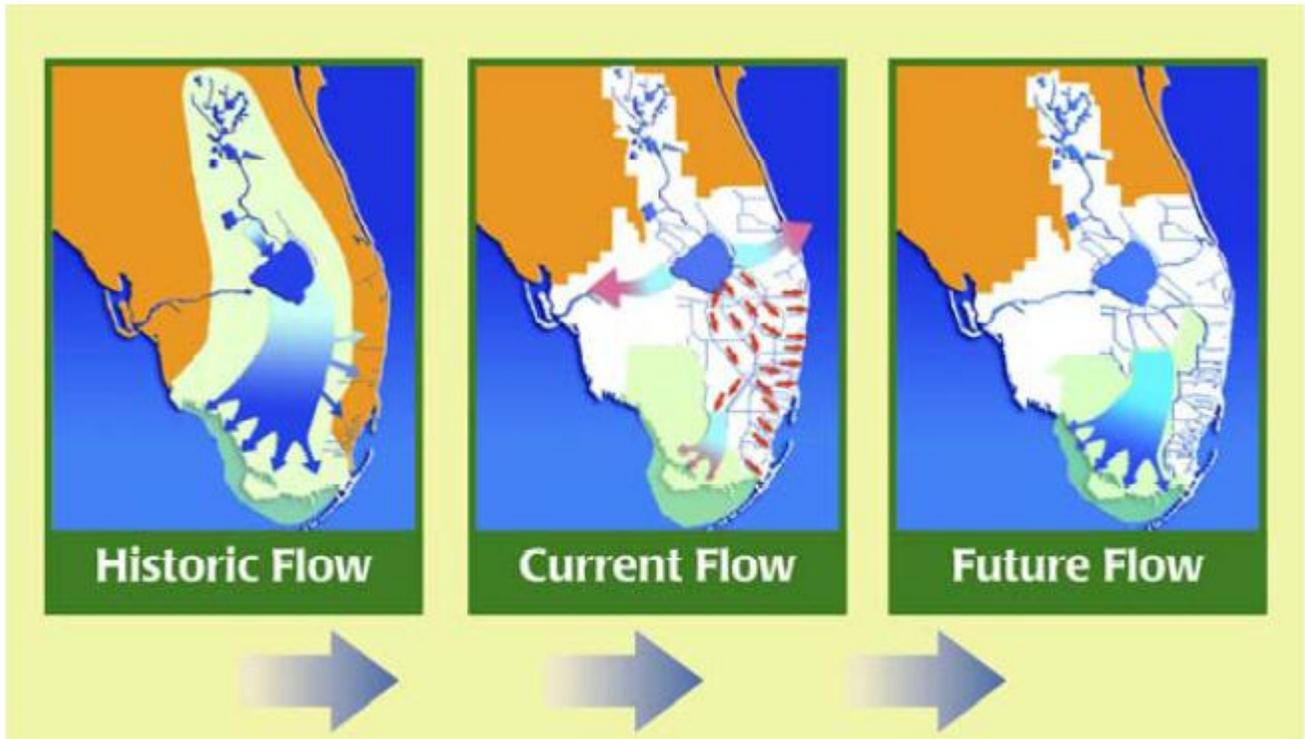


Figure 8. The CERP Plan will attempt to more nearly replicate the historic hydrology of the Everglades system by allowing water from Lake Okeechobee, which is currently diverted directly to the Atlantic Coast and the Gulf of Mexico, to flow through the Everglades systems. Source: CERP, nd.

The CERP seeks to restore habitat and the ecosystem of South Florida, including the Everglades. In order to achieve this goal, the Everglades Plan outlines four factors that need to be achieved ([www.evergladesplan.org](http://www.evergladesplan.org)) as follows:

1. **Quantity:**  
Increase the total spatial extent of natural areas.
2. **Quality:**  
The quality of the water must be healthy for the environment.
3. **Timing:**  
The timing of water held and released into the ecosystem will be modified to mimic natural flow patterns.

#### 4. **Distribution:**

Water will be captured to distribute to the ecosystem, as well as urban and agricultural users in the future.

The implementation of the CERP has important implications for southeast Florida, and to the health of the reefs. As the plan is implemented, opportunities are arising to implement projects to both protect and improve the water quality of the coral reef system and support the goals of the CERP. Some example projects in the southeast Florida region include restoration of wetlands in the Biscayne Bay, C-111 canal modifications to retain water within the Everglades system while retaining flood protection for development in South Dade County; creation of impoundments and a secondary canal system that collectively will reduce seepage, provide urban water supply, recharge aquifers, prevent saltwater intrusion; and stormwater treatment areas in West Palm Beach, to name a few.

As the project is implemented, it will be critical for multiple agencies to work together both to achieve the goals of the CERP and to ensure that, as projects are implemented, coastal reef quality remains a high priority and is incorporated into planning considerations.

- **For more information about the Everglades Plan, some useful documents include the following resources:** The South Florida Water Management District, at: <http://www.sfwmd.gov/portal/page/portal/xweb%20protecting%20and%20restoring/protecting%20and%20restoring%20ecosystems>
- The CERP Website at: <http://www.evergladesplan.org/>

### **3.8 Groundwater Quality**

The groundwater table is extremely high throughout south Florida. Consequently, septic systems, and stormwater BMPs that discharge to the groundwater receive relatively little soil filtration compared with other areas. Miami-Dade County's stormwater regulations currently require no off-site discharge. This policy reduces the volume of stormwater runoff leaving development sites, and increases the reliance on practices such as exfiltration trenches, which discharge treated stormwater to the groundwater. While common practice and many studies suggest that most pollutants are filtered by the native soil, some data suggest that pollutants such as nitrogen may have the potential to migrate to groundwater resources (Murakami et al., 2008).

#### 4.0 THE EIGHT TOOLS OF WATERSHED PROTECTION

The practice of watershed protection involves developing programs and strategies to protect or restore a watershed's aquatic and terrestrial resources. In southeast Florida this means choosing the right management techniques to address the issues described above (Section 2.0 and 3.0). The Center for Watershed Protection's "Eight Tools of Watershed Protection" address each phase of the watershed protection development process, from the initial land use planning, site design, and construction through home ownership and can be used to develop a comprehensive and effective watershed protection strategy (Schueler, 2000a). Throughout the remainder of this document, these eight tools serve as the framework to summarize the programs already in place to address LBSP in southeast Florida, make initial recommendations on how these programs can be improved, and provide recommendations for additional programs needed to meet the stated goals. The Eight Tools of Watershed Protection are as follows:

- Tool 1. Land Use and Watershed Planning  
*Land use planning that is informed by larger watershed goals.*
- Tool 2. Land Conservation  
*Preservation of conservation areas are identified and preserved.*
- Tool 3. Aquatic Buffers  
*Special conservation areas bordering streams, rivers, lakes, wetlands and other waterways.*
- Tool 4. Better Site Design  
*Decisions made at the site level to minimize impervious cover and encourage conservation of open space and better treatment of stormwater runoff.*
- Tool 5. Erosion and Sediment Control  
*Measures that reduce erosion during the construction process, and near the shore.*
- Tool 6. Stormwater Best Management Practices (BMPs)  
*Practices that capture and treat stormwater runoff and provide storage within the watershed to recharge groundwater, improve water quality, protect channels, and prevent flooding.*
- Tool 7. Non-Stormwater Discharges  
*Measures to reduce pollutant loads from non-storm discharges such as sewage discharge and highly polluted "hotpot areas" such as marinas.*
- Tool 8. Watershed Stewardship Programs  
*Programs that reduce pollutant loadings and protect resources once development is in place.*

## **5.0 PROJECT 3 AND 19 SURVEY TO IDENTIFY PROGRAMS IN PLACE AND IDENTIFY BMP GAPS**

SEFCRI LBSP focus team members developed a survey (Appendix A) of local, state and federal programs to meet two goals (Projects 3 and 19): create a database of programs, projects and activities in place and to identify gaps and needs in BMPs. In the first effort, only eight surveys were returned. In March 2007 additional agencies and entities were identified to include municipalities and towns. A letter and the survey were sent out to previously identified and newly identified constituents (local cities, municipalities, state, and federal agencies) explaining the importance of the survey.

A Microsoft Access database was developed to track the survey information in March 2007. After the surveys were returned, they were entered into the Access database and an interview was scheduled to learn more about the projects and programs. From March 2007 to December 2007, 96 surveys were sent out with 35 returned (36% return rate), and 23 interviews were conducted. The results of the survey process are included as an Appendix to this document (Appendix B and C).

### **5.1 Approach to Evaluating Programs**

Using the “Eight Tools” Framework (described in Section 4.0) this report summarizes known programs in place throughout the region and makes initial recommendations to reduce land based sources of pollution reaching the coral reef system. While the survey data were the primary source of information, these data were supplemented with targeted searches, primarily using county and state program web sites.

### **5.2 Data Gaps in the Survey**

Although the survey results were a useful starting point for evaluating programs within the region, there were some geographic, programmatic and topical information gaps, as follows:

#### Geographic

Although the survey was sent throughout the region, only one survey was returned from Miami-Dade County so the initial data included limited information on these programs. Consequently, publicly available information was used to supplement data from Miami-Dade County.

#### Topical

The “Eight Tools” approach to watershed planning was chosen as a starting point to evaluate programs because of its comprehensive nature. However, because of the nature of the survey, some of the tools were not well-represented. For example, only one watershed planning effort was described in the survey, but all four counties in the southeast Florida region have regional planning efforts that encourage “Smart Growth.” Similarly, no efforts to preserve conservation areas were described in the surveys. Again, a targeted web search was used to summarize these data, relying primarily on the web sites of the four counties.

### Programmatic

While the survey tool asked participants to summarize obstacles to their programs and provide a total program budget, these data were insufficient to complete a program review. For example, while staffing was raised as an issue for some programs, it was not possible to evaluate if the budget was substantial enough to complete these programs.

## **6.0 GOALS TO PROTECT THE SOUTHEAST FLORIDA REEF FROM LBSP**

The recommendations in the following section of this document (Section 7.0) ultimately protect the northern third of the Florida Reef Tract by reducing loads of LBSP (Goal 1 below). The remaining overarching goals identified in this section (Section 6) either directly or indirectly result in reduced pollutant loads to the reef system. These goals are based on an initial review of the programs in place in southeast Florida (from the survey described in Section 5), combined with the specific management needs to protect the southeast Florida Reef system.

- Goal 1. Reduce pollutant loads to the reef system
- Goal 2. Restore and protect natural areas such as wetlands, mangroves, and forest
- Goal 3. Reduce water consumption through policies that reduce water demand and allow for storage and reuse of both stormwater and wastewater
- Goal 4. Protect both the quality and quantity of groundwater
- Goal 5. Improve understanding of the linkages between watershed management, water quality, and the health of the reef
- Goal 6. Foster cooperation between the multiple agencies, municipalities and organizations working to reduce land-based pollution to Florida's coast
- Goal 7. Encourage planning and personal behaviors that reduce the region's carbon footprint, thus reducing the impacts of global warming on the reef system
- Goal 8. Encourage appreciation and enjoyment of the reef system and other natural resources of southeast Florida

## 7.0 WORKSHOP PROCESS TO DEVELOP FINAL RECOMMENDATIONS

In January of 2011, CWP and the FDEP CRCP conducted two workshops, one in Miami with attendees primarily from Miami-Dade and Broward Counties on January 26, 2011, and one in West Palm Beach with attendees from Palm Beach and Martin Counties on January 27, 2011. Workshop attendees included a broad spectrum of individuals directly involved in watershed protection, including environmental and citizens' groups, as well as representatives from federal, state and local levels of government (see Appendix D for a list of attendees and invitees). The purposes of these workshops were three-fold. First, they introduced the project and recommendations to the participants and allowed for communication and information sharing among participants. Second, they solicited feedback on programs activities currently occurring to better improve water quality, in order to fill some of the data gaps from the original survey by breaking into smaller groups. Finally, input from the workshops was used to refine recommendations outlined in the draft report (see Appendices E, F, and G for workshop notes and results).

Thirty three individuals attended the workshops, and products included:

- 1) Notes summarizing discussions and identifying ongoing activities within each area.
- 2) A revised list of 33 recommendations. This list included slightly or heavily revised versions of the 31 original draft recommendations, as well as some additional recommendations from workshop participants (Table 4).

It is important to note that some of these recommendations were in the process of being implemented at the time of the workshop, workshop attendees agreed to emphasize the importance of continuing ongoing and future efforts.

<b>Table 4. Final Recommendations.</b>	
<b>Recommendations</b>	<b>Goals</b>
<b><i>Land Use and Watershed Planning</i></b>	
1a. Complete watershed planning assessments to guide water quality and land use change decisions. (Palm Beach/Martin)	1-4,6-8
1b. Complete watershed planning to identify and address pollutant sources throughout the region. (Miami-Dade/Broward)	
2. Establish a baseline and frequency in impervious cover, forests, native vegetation, mangroves, canopy, and wetlands throughout the region to enhance and preserve natural areas in transferrable data format (e.g., GIS). Use existing resources such as the Florida Forever Program, Conserving the Gaps survey, County endangered lands programs to identify key parcels for land acquisition and influence land-buying programs at local/state/federal level.	5-6
3. Coordinate a workgroup to address population change in the region.	1-4,6-7
4. Adopt a more transparent, streamlined, permitting review and approval process.	1-4,6-7
5. Assemble existing digital data to create a consistent layer of stormwater conveyance features (e.g., storm drains, ditches) stormwater management, and times of discharge in a user friendly format.	6
6. Review and apply regional and- in some cases, water-body specific pollutant load targets in numeric nutrient criteria to guide land use and stormwater management practice decisions for impacts to coral reefs. Develop multi-agency coastal restoration working groups.	1-3, 5,6
<b><i>Land Conservation</i></b>	
7. Actively restore and protect existing coastal and non-coastal wetlands and form regional partnerships to use the wetland mitigation process to establish and expand regionally important wetlands.	1, 2, 4,6, 7
<b><i>Aquatic Buffers</i></b>	
8. Promote vegetated buffers or littoral planting between waterways and development sites.	1, 2, 4, 6, 7
9. Classify the canal system, assess existing best management practices, and identify best management practices for canals and water bodies that reduce	1, 2, 4, 5,6,7

<b>Table 4. Final Recommendations.</b>	
<b>Recommendations</b>	<b>Goals</b>
sediment and nutrient impacts to receiving waters. During construction, implement and enforce techniques to reduce sedimentation from canal banks.	
<b><i>Better Site Design</i></b>	
10. Promote low impact development techniques on new development and redevelopment sites.	1-4, 7
11. Revise and/or create landscaping standards to promote “Florida Friendly” plants that require minimal watering, explicitly reduce the amount of managed turf permitted on new developments and in the right-of-way, and promote fertilizer ordinances that reduce water needs and nutrient loading.	1-4, 7
12. Review and update codes and ordinances of counties and municipalities to ensure that existing development codes are consistent with low impact development practices that reduce impervious cover, preserve open space, and treat and retain stormwater on-site.	1-4, 6,7
<b><i>Erosion and Sediment Control</i></b>	
13. Increase compliance with and funding for construction site inspections and develop a core staff of certified inspectors.	1, 6
14. Document and repair over beach stormwater discharges.	1, 8
<b><i>Stormwater Management</i></b>	
15. Form a southeast Florida stormwater review committee. Coordinate activities and projects with the FDEP EPA TMDL process to address specific parameters within watersheds and impaired waters. <sup>3</sup>	1-4,6
16. Using the data in Recommendation 5 and from the South Florida Water Management District, combined with land use and other data, assist with regional stormwater retrofit inventories in priority watersheds for coral reef conservation to identify potential retrofit opportunities and provide funding mechanisms.	1,3,6
17. Track maintenance of all stormwater practices and infrastructure including both publicly and privately owned facilities in a streamlined format and accessible database.	1,6
18. Supplement existing permitting programs with a “Hot	1-4, 6

<sup>3</sup> The second sentence of this recommendation was submitted after the workshop. When the follow-up survey was completed to rank the top 5 recommendations, this language was not included as a part of this recommendation.

<b>Table 4. Final Recommendations.</b>	
<b>Recommendations</b>	<b>Goals</b>
Spot" inventory of areas with high pollutant loads in select watersheds of neighborhoods to refine pollution prevention methods.	
19. Create an incentive system and funding mechanism to provide sewage treatment and retire septic systems throughout the watershed that are based on prioritization performed in Recommendation 16.	1, 4
20. Provide free pump out of boat sanitary waste in all four counties and promote through educational efforts.	1, 8
21. Require installation of wastewater reuse infrastructure (purple pipes) concurrent with new developments and redevelopment projects, where appropriate.	1,3,4
22. Use the data developed in Recommendation 5 to help agencies coordinate data sharing and work together to identify illicit discharges.	1,6
<b><i>Watershed Stewardship</i></b>	
23. Secure long term funding to support monitoring efforts and integrate these data to provide consistent data quantifying pollutant loads from the St. Lucie, Jupiter, Lake Worth, Boynton, Boca Raton, Hillsboro, Port Everglades, Haulover and Port of Miami inlets.	5,6
24. Expand monitoring and modeling efforts to characterize reef quality in concert with monitoring of land-based pollutant loads.	5,6
25. Integrate nonprofit organizations, community groups, and citizens to provide education and enhance watershed quality and water conservation, and identify target audiences and issues for public outreach.	1-8
26. Expand homeowner education programs to all regions that include sounder landscape practices, a broader suite of stormwater management practices, and reduced fertilizer application practices.	1-4,6-8
27. Use public and private properties to demonstrate innovative stormwater practices.	1-4,6-8
<b><i>Overarching Issues</i></b>	
28. Seek funding for priority projects.	1-8
29. Encourage compliance of regulations and/or policies through education and/or enforcement.	1-7
30. Revise penalties to make negative actions prohibitive.	1-4
31. Coordination between and within agencies (e.g., for	1-4,6

<b>Table 4. Final Recommendations.</b>	
<b>Recommendations</b>	<b>Goals</b>
enforcement).	
32. Explore monitoring standards, parameters, and methods to ensure that useful, streamlined data is collected and shared in a timely manner (e.g., municipalities).	5,6
33. Stabilize and scrape existing spoil areas (e.g., islands, piles adjacent to tidal waters) to improve sediment and erosion control.	1,2,8

### 7.1 Workshop Process

In order to arrive at the list of recommendations included in Table 4, the workshops included three phases:

- In Phase 1, attendees were sent a “homework” document designed to fill in gaps to better understand existing programs. While very few participants completed these documents before the workshop, the same forms were used during the workshop when participants separated into small break-out groups.
- In Phase II, workshops were conducted, and each workshop included 1) presentations of initial findings and recommendations; 2) a session for feedback using the “homework” documents in Appendix E for notes, and 3) a session for soliciting feedback on initial recommendations (see Appendix F for more detail on the editing process).
- In Phase III, a “post-workshop survey was sent out to attendees, to determine the top recommendations (see Appendix G for Results).

While the primary original intent of the workshop process was to fill data gaps, its greater value was in refining the recommendations to better reflect the needs of the communities.

Some key modifications included:

- 1) Refining vocabulary terms to better reflect the terms and knowledge of the southeast Florida community.
- 2) Combining recommendations where appropriate to avoid duplication.
- 3) Creating flexibility in recommendations that were at first glance too stringent.
- 4) Adding a series of overarching recommendations that reflected concerns over issues such as funding and interagency cooperation.

Workshops were presented in two separate days (one in Miami and one in West Palm Beach), in order to allow for greater attendance from both groups. This had the potential to create some confusion, since recommendations were edited separately by the two groups. In order to minimize this confusion, the West Palm Beach group was presented recommendations as already edited by the Miami group, so that the second round of edits started after progress from the first day. Finally, all attendees were sent the final list of recommendations to ensure that the final recommendations were acceptable. In one case, a separate recommendation was

used for the Miami-Dade/Broward group versus the Palm Beach/ Martin group; recommendation 1 is divided into “1a” and “1b.”

The two-workshop format was informative, however, as it pointed out some important differences between the southern counties versus the northern counties. Since Miami-Dade and Broward counties are more highly developed and regulated, there was less focus on practices that focus on land use planning, and a greater focus on pollutant tracking. Second, greater complexity of government agencies exists in these lower counties, due largely to the high resident populations represented by them. Finally, both Miami-Dade and Broward counties have been subject to a greater degree of regulatory pressures, particularly with regard to water reuse. Consequently, these workshops provided much more detail to eliminate phrasing that appeared too sweeping or regulatory.

In Martin and Palm Beach counties, on the other hand, a significant amount of rural land remains. There was a greater focus in this workshop on watershed planning efforts, and opportunities within the stream (i.e., canal) corridor. This change in focus is attributable largely to the greater opportunities in these counties to preserve remaining resources.

In spite of these differences, both communities shared some important similarities. There was a commitment in both groups to improve water quality, and both expressed concerns over lack of funding, inadequate or inconsistent data, and the need for greater coordination between government agencies at all levels. The resulting recommendations (Table 2) reflect the combined efforts of both groups.

## **7.2 Post-Workshop Survey and Top Recommendations**

Following the workshops, FDEP CRCP staff conducted an on-line survey of workshop participants to identify the top five recommendations, in order to better focus future projects on these high priority areas. Overall, eighteen of thirty three attendees responded (a 54% response rate). Of these eighteen, three were incomplete and were consequently not included in summary data. Each individual was asked to select his or her top five recommendations. Of the 33 revised recommendations, seven received 4 or more votes (Table 5).

**Table 5. Top Recommendations from Survey Results.**

- Complete watershed planning to identify and address pollutant sources throughout the region. (Recommendation 1b)
- Review and apply regional and- in some cases, water-body specific - pollutant load targets in numeric nutrient criteria to guide land use and stormwater management practice decisions for impacts to coral reefs. Develop multi-agency coastal restoration working groups. (Recommendation 6)
- Actively restore and protect existing coastal and non-coastal wetlands and form regional partnerships to use the wetland mitigation process to establish and expand regionally important wetlands (Recommendation 7).
- Promote vegetated buffers or littoral planting between waterways and development sites. (Recommendation 8)
- Classify the canal system, assess existing best management practices, and identify best management practices for canals and water bodies that reduce sediment and nutrient impacts to receiving waters. During construction, implement and enforce techniques to reduce sedimentation from canal banks. (Recommendation 9)
- Using the data in Recommendation 5 and from the South Florida Water Management District, combined with land use and other data, assist with regional stormwater retrofit inventories in priority watersheds for coral reef conservation to identify potential retrofit opportunities and provide funding mechanisms.<sup>1</sup> (Recommendation 16)
- Seek funding for priority projects. (Recommendation 28)

<sup>1</sup>“Recommendation 5” refers to assembling a consistent digital layer of storm drain and other infrastructure.

## 8.0 REVISED PROGRAM REVIEW

The initial draft report included a program review based on the original survey data and a literature survey. The review was structured based on the Eight Tools, and included some program highlights for each recommendation. This section incorporates elements from the original review, with additional data and revised recommendations from the workshop process.

### 8.1 Land Use and Watershed Planning

Partially because of the high density development particularly in Miami-Dade and Broward counties, and the lack of distinct small “subwatersheds” (i.e., 10-square mile) watershed scale units promoted as the planning by Schueler (2000b). The recommendations highlighted in this section point to a greater need to link watershed planning efforts with reef preservation, and to refine existing regulations and data sources to allow for more transparency in future decision making.

*Recommendation 1a. Complete watershed planning assessments to guide water quality and land use change decisions. (Palm Beach/Martin), and*

*Recommendation 1b. Complete watershed planning to identify and address pollutant sources throughout the region. (Miami-Dade/Broward)*

Since the coral reefs drain a huge area, one challenge is to ensure that the key pollutants of concern (and nutrients in particular) are incorporated into local and regional land use and watershed planning decisions. Although this did not appear to be happening, there were some examples of large- and small-scale efforts to relate larger watershed planning goals to local land use decisions.

One effort to directly relate land use to a plan for smaller sub-watersheds is the South Miami-Dade Watershed Plan, which developed specific land use recommendations based on watershed modeling results. Elements of this plan that can be adapted to other areas include:

- Using hydrologic modeling at the small catchment scale to make detailed recommendations and;
- Model result translations that recommended zoning categories.

#### Workshop Input

Watershed planning efforts highlighted during the workshops were primarily larger scale, and included the following:

- Lower & Upper East Coast Water Supply Plan (updated every 5 years): The South Florida Water Management Division develops and implements regional water supply plans, and identifies programs and projects that will ensure adequate and sustainable water supplies to meet future needs while also protecting the environment and water quality.

- Stormwater Management and Master Plans are in place within Martin County, as well as some major cities including Fort Lauderdale.
- Lake Worth Lagoon Management Plan and the Northern Everglades and Estuaries Protection Program (NEEP) were highlighted as two large scale planning efforts that affect land use decisions.
- SFWMD provides technical assistance in core mission areas for local government to devise comprehensive plans supporting policies on water quality.
- Southeast Florida sustainability initiative (\$4.5 million) from Indian River County to Monroe, a 2-3 year effort looking at all smart growth. The regional planning council is driving this initiative.

*Recommendation 2. Establish a baseline and frequency in impervious cover, forests, native vegetation, mangroves, canopy, and wetlands throughout the region to enhance and preserve natural areas in transferrable data format (e.g., GIS). Use existing resources such as the FL Forever Program, Conserving the Gaps survey, county endangered lands programs to identify key parcels for land acquisition and influence land-buying programs at local/state/federal level.*

An important part of watershed planning is using simple metrics to initially understand the relationship between land use and watershed health. Metrics such as impervious cover, fraction of watershed developed, and tree canopy are all excellent indicators of watershed health. Communities within southeast Florida have made efforts to track the success of programs, as well as stresses on environmental indicators. For example, Broward County's "Environmental Benchmarks" report (Broward County, 2008) tracks the acres of wetlands impacted by development over time. However these statistics are summarized by county rather than by watershed.

While other counties and agencies have tracked specific metrics over time, no unified set of land cover metrics has been identified and tracked throughout the region. A unified set of land cover metrics, such as impervious cover, forest canopy, mangroves, wetland cover, and vegetation should be assembled for all of southeast Florida. These data will help managers to more effectively make decisions on a regional basis regarding land purchases, zoning decisions, and restoration efforts. Interestingly, impervious cover, which has a proven strong influence on water quality, does not appear to be tracked in any jurisdiction (Holland et al., 2004; CWP, 2003).

*Recommendation 3. Coordinate a workgroup to address a population change in the region.* Rapid growth in southeast Florida has resulted in widespread development, which is concentrated in the eastern (i.e., closer to the shore) portion of the region because of conservation areas encompassing the western portion of all four counties. Historically, the region has experienced sprawling development. Each of the four counties uses a comprehensive planning process to guide growth and development, as required by Florida Law. Although each county uses land development tools to concentrate development in urban corridors, their approaches vary slightly (Table 6; Figure 9). Further, while data are available to

forecast growth in each county and the region as a whole, no group including representatives from planning departments of each county has coordinated planning efforts.

**Table 6. Land Use Planning Tools to Reduce Sprawl in Southeast Florida.**

<b>County</b>	<b>Primary Planning Tools</b>
Miami-Dade	<ul style="list-style-type: none"> <li>• Urban Growth Boundary with land use density of 0.2 units per acre beyond this point</li> <li>• Community Redevelopment and Economic Policy Analysis Division to encourage redevelopment.</li> </ul>
Broward	<ul style="list-style-type: none"> <li>• County effectively built-out</li> <li>• Planning tracks remaining open land within the county</li> <li>• Broward County Redevelopment Initiative</li> </ul>
Palm Beach	<ul style="list-style-type: none"> <li>• Urban Services Boundary</li> <li>• Agricultural Land Use</li> <li>• Plan designates a Revitalization, Redevelopment, and Infill Overlay</li> <li>• Urban Redevelopment Area</li> </ul>
Martin County	<ul style="list-style-type: none"> <li>• County is largely zoned as “Agriculture” at a 20-acre lot density</li> <li>• Comprehensive Plan designates seven community redevelopment areas</li> </ul>

Southeast Florida achieves greater urban density requirements by “relaxing” existing regulations (e.g., height restrictions). This method can be controversial because of the impacts on the highly developed areas, and the coast in particular. At the same time, it potentially allows for greater preservation of open space and natural areas by concentrating future growth. One example of such an effort is the City of Miami’s “Miami 21,” which revises the existing code and is much less restrictive, particularly in urban zones designed to receive more development in the future. This “form-based code” describes the form of development desired in each zone, but allows much more flexibility in achieving these goals.

For more information, go to: [www.miami21.org](http://www.miami21.org)

### Workshop Input

Key discussion points during the workshop included:

- Better understanding of future development. Since southeast Florida has experienced explosive growth over a long period of time, but in recent years appears to be losing population, what are the best ways to plan for future population changes?
- Some efforts are underway to focus on “smart growth” and these can be linked with efforts to understand population growth and its impacts.
- In Miami-Dade/Broward counties one attendee recommended educating the Department of Community Affairs (DCA) about LBSP as a way of achieving greater integration of

pollutant removal goals with the planning process. DCA has now merged with other programs to become the Florida Department of Economic Opportunity (DEO).

- In Broward County, Regional Council of Governments (COG) meetings have been used to achieve this goal.
- Participants also noted some ongoing efforts to plan with population growth in mind. For example, the Lower & Upper East Coast Water Supply Plan (updated every 5 years): SFWMD develops and implements regional water supply plans. This plan identifies programs and projects that will ensure adequate and sustainable water supplies to meet future needs while also protecting the environment and water quality.

*Recommendation 4. Adopt a more transparent, streamlined, permitting review and approval process.*

Plan review can include environmental permits, at the local, state and federal level. From available information, it appears that these three reviews are separate and that an individual would submit permit applications to separate agencies. This can lead to confusion of all interested parties. Based on workshop feedback, it is often unclear to citizen groups which permits are required for a given project.

In addition, while an Environmental Resource Permit (ERP) is required for all sites which generate greater than two acres of impervious cover, sites that are not subject to this permit are subject to a wide variety of regulations, depending on the location (i.e., the county or city where the development occurs). While different standards for development may be warranted, two steps can make this process simpler to understand. First, a single “fact sheet” which summarizes permits required and development standards for each size of development and location should be assembled by the local and state agencies of the region. Second, a single database of development sites and permits obtained should be publicly available.

#### Workshop Input

While this recommendation remained with minor changes, there were some mixed responses. While many workshop attendees felt that there were some inconsistencies in the existing process, others specifically commented that the existing regulatory process lays out a clear path for regulated entities.

*Recommendation 5. Assemble existing digital data to create a consistent layer of stormwater conveyance features (e.g., storm drains, ditches) stormwater management, and times of discharge in user friendly format.*

Most of the communities surveyed have a program in place to maintain stormwater infrastructure and have some digital data cataloging this infrastructure (see Figure 9). Some survey respondents, however, identified the need to better track these maintenance activities. Similarly, while each community has a program in place to track down and eliminate illicit discharges, these investigations are made more complicated when the source of a discharge is from another community. This single, regional layer would include the following information:

1) stormwater infrastructure, including canal systems; 2) storm drains; 3) stormwater management practices; and 4) times of discharge (for canal structures). These data would help managers to maintain infrastructure and conduct watershed planning and restoration efforts more efficiently.

#### Workshop Input

One workshop participant recommended that the NPDES permit process (reviewed every five years) could be used as a technique for achieving this goal. Since the NPDES MS4 permittees have data retention requirements, there is an opportunity to better integrate data gathered from these permits to create a consistent storm layer.

*Recommendation 6. Review and apply regional and in some cases, water-body specific pollutant load targets in numeric nutrient criteria to guide land use and stormwater management practice decisions for impacts to coral reefs. Develop multi-agency coastal restoration working groups.*

While Total Maximum Daily Loads (TMDLs) have been established for several of the waterbodies in this region and several pollutant reduction efforts associated with the CERP are in place, the pollutant loads to the near shore environment are not used as a decision point to guide management activities. Establishing pollutant load limits for pollutants, and tracking these loads over time would provide several benefits. First, it would help to prioritize funding for projects that provide the greatest pollutant removal to the reef system. Second, it would foster communication and coordination between the agencies that work within the region. Third, it would help to set realistic goals about the amount of growth the region can support without irrevocably damaging the reef system. Finally, it would raise reef protection to a level similar to that currently achieved for the Everglades.

#### Workshop Input

During the workshop process, participants highlighted two key issues. First, while many TMDLs have been implemented throughout the region, few have been focused specifically on protecting coral reefs. In particular, focusing on nutrients, even in smaller water bodies not impaired by nutrients, should be a future focus. Second, while the original report (Caraco et



**Figure 9. The detailed storm drain network data available in the City of Fort Lauderdale is a powerful resource for the watershed manager, but ends at the city line (unshaded area).**

al., 2009) focused primarily on watershed boundaries, several workshop participants recommended focusing on the Water Body Identification (WBID) as a management unit.

## 8.2 Land Conservation

This tool includes both actual conservation and protection of existing resources, as well as restoration of degraded resources.

*Recommendation 7. Actively restore and protect existing coastal and non-coastal wetlands and form regional partnerships to use the wetland mitigation process to establish and expand regionally important wetlands.*

Restoring historic wetlands or constructing replacement wetlands to serve comparable ecosystem services, is an important component of both reducing pollutant loads and providing habitat for native plants and animals throughout the region. In

addition, these efforts can help provide distributed wastewater treatment storage areas that result in groundwater recharge (Broward County, 2009). The SEFCRI LBSP survey indentified three current wetland restoration projects (Table 7), which represent only a small fraction of the wetland restoration projects actively occurring in southeast Florida.

For example, many additional wetland restoration efforts are underway, largely as a part of the CERP program. Additional information about the ongoing wetland restoration projects is available online at:

[http://www.evergladesplan.org/pm/projects/project\\_list.aspx](http://www.evergladesplan.org/pm/projects/project_list.aspx)

Other wetlands have been created in concert with wastewater reuse programs. For example, the Wakodahatchee Wetland (Figure 10), a fifty acre wetland in Palm Beach County, supports over 140 species of birds and provides additional treatment for over 2 million gallons of domestic wastewater each day (Palm Beach County Water Utilities, nd). The Palm Beach Environmental Resources Management Division has also restored a significant amount of wetland habitat, particularly in estuarine areas. Examples for these projects are available online at:

<http://www.co.palm-beach.fl.us/erm/lakes/estuarine/>



**Figure 10. The Wakodahatchee Wetlands are created wetlands in Palm Beach County, and are fed by highly treated wastewater. Source:**

<http://www.pbcgov.com/waterutilities/wakodahatchee/tour-05.htm>

**Table 7. Wetland Restoration Efforts Identified in the LBSP Survey.**

<b>Project</b>	<b>Description</b>	<b>Location</b>	<b>Partners</b>
Kitching Creek/Flora Avenue Water Quality Improvement Project	Wetland rehydration by redesigning road culverts	Martin County at Flora Avenue	Martin County, SFWMD, FDEP, Jonathon Dickinson State Park
Hydrologic Restoration of the North Fork St. Lucie River	Breaching artificial (dredge) riverbanks to rehydrate floodplain communities and to reconnect historical oxbows	Martin County, North Fork St. Lucie River	FFWCC, FDEP, SFWMD, St. Lucie Issues Team, FDOT, USFWS
Biscayne Bay Surface Water Quality and Biological Monitoring Program	Examine the suitability of rehydrating the coastal wetlands near Black Point, the near shore zone, and determine water inflow targets	Miami-Dade County, Biscayne Bay	SFWMD
SFWMD: South Florida Water Management District; FDEP: Florida Department of Environmental Protection; FFWCC: Florida Fish and Wildlife Conservation Commission; FDOT: Florida Department of Transportation; USFWS: United States Fish and Wildlife Service			

Wetlands are almost inevitably disturbed during the development process, and this disturbance is regulated through separate agencies including the US Army Corps of Engineers, the South Florida Water Management District (SFWMD), and the Florida Department of Environmental Protection as part of the ERP application.

While wetland disturbances are mitigated under this permit, the mitigated areas are often out of watershed or even out of county. Ideally, wetland mitigation should occur within the same watershed in order to mitigate the effects of wetland loss during construction and benefit those ecosystems that are being depleted. This concept (of retaining wetlands within the same watershed) was reiterated during the workshop process. For example, Broward County (2008) tracks the wetland mitigation sent out of county each year, and this fraction can be up to 50 percent of the total wetland mitigation. As a solution, Broward County is developing partnerships to restore wetlands on county public lands (e.g., parks and schools). These partnerships can help to maintain wetland cover in highly urbanized watersheds or to “send” wetland mitigation to highly valued wetland locations.

Workshop Input

Workshop participants highlighted special protections for wetlands, including:

- Mangroves growing along the shoreline Riparian mangrove fringe [403.9323(7)] and 1st GP with S.403.9327(1)(a)4 and the Mangrove Act [S.403.9324(2)]
- In agricultural areas, several programs in place included:

- \$140 million spent on state wide easement program, the majority spent in south Florida for wetland conservation by the USDA.
- USDA Farm Bill, which is rewritten every 5 years, provides conservation opportunities for farmers and ranchers. They simplify existing programs and create new programs to address high priority environmental goals: water conservation, water quality, drainage water management, soil erosion, wildlife habitat conservation, invasive species, and wetland conservation.
- The Wetlands Reserve Program is run by the USDA's Natural Resources Conservation Service (NRCS), who provide technical assistance and financial support. It is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property.

### 8.3 Aquatic Buffers

Aquatic buffers are the areas directly adjacent to streams, rivers, wetlands and other waterways. In southeast Florida, much of the original stream system has been altered and converted to canals. The aquatic corridor is largely regulated by the SFWMD. However, individual communities can also adopt and enforce separate regulations to help protect these critical areas.

*Recommendation 8. Promote vegetated buffers or littoral planting between waterways and development sites.*

Setbacks from waterways are required to apply for a general ERP permit. However, supplemental local ordinance and codes have buffer programs that allow for management of the buffer and more immediate oversight. One excellent example is Martin County, which has adopted a buffer requirement ranging from 50 feet to 100 feet, including vegetation targets (Martin County Code). Although Martin County is the most rural county in southeast Florida, these policies could, at a minimum, be selectively applied in the remaining counties. A flexible criterion with a minimum (e.g., 25 feet) buffer in urbanized areas with wider buffers in open areas could be applied throughout the region.

For Martin County regulations, go to:

<http://www.municode.com/resources/gateway.asp?pid=13592&sid=9>

#### Workshop Input

While other communities do not have buffer ordinances, some programs did arise during the workshop including:

- Martin County provides tax breaks for conservation easement areas that can be applied to buffers.
- Palm Beach County has no ordinance, but references buffers in its comprehensive plans.

- Although FDEP has no enforcement authority regarding many buffer areas, they do conduct outreach at site visits.
- Broward County also educates the public on the importance of shoreline plantings, with the brochure: “Planting on the Edge” information and guidance on littoral plantings for habitat and water quality treatment”
- An opportunity may be the Army Corps grants for “Natural Shorelines” that may offer opportunities to encourage buffers.

Workshop participants also highlighted some potential obstacles to this recommendation, including:

- For actual navigational canals, actually taking out canal walls may be a challenge. Palm Beach had tried this in the past, and there was a lot of opposition from the Canal Drainage District. Some issues included: invasives, and overall maintenance.
- Since the state’s protection under the ERP program is a “proprietary stature” (i.e., applying only to waters of the state), much of the canal system and contributing ditches are not regulated and therefore do not receive protections.

*Recommendation 9. Classify the canal system, assess existing best management practices, and identify best management practices for canals and water bodies that reduce sediment and nutrient impacts to receiving waters. During construction, implement and enforce techniques to reduce sedimentation from canal banks.*

The historic southeast Florida stream and river network has been replaced by a series of canals and structural stormwater management systems. Some of the original, beneficial stream and river functions can be established along these canals by preserving or enhancing native vegetation at the edge of the canals, providing vegetated buffers around the canals, and reconnecting canals to their original floodplain. These canals could be used to help develop green infrastructure corridors to link less disturbed natural areas to one another. The results would offer wildlife migration corridors and provide a host of environmental benefits.

In more urbanized areas, canals can act as a public destination by creating walking paths and planting vegetation along the canals. The Loxahatchee Greenways Project and Northern Everglades Natural Area (NENA) program in Palm Beach and Martin counties incorporate canals into the greenway system, using trails along canals to connect more extensive conservation areas in the region. For more information go to:

<http://www.co.palm-beach.fl.us/erm/vena/> and;  
<http://www.1000friendsofflorida.org/pubs/loxahatchee/page8.asp>

### Workshop Input

Some of the concerns raised for recommendation 8 apply to this recommendation, and caused the original recommendation to be carefully reworded. Some key areas of focus during workshop discussions included the following:

- The entire canal system is unregulated by buffer ordinances.

- While the upper reaches of the system may allow for natural plantings, a different strategy would be needed for true “navigation” canals.
- Since this land is mostly privately held, an engaged citizenry is critical to achieving improvements.
- Classifying canals should involve a process to identify (perhaps to the neighborhood or parcel level) best locations for improving the canal system.

Erosion of canal banks during construction was raised as an important issue at both workshops, and as a result was explicitly incorporated into this recommendation.

#### 8.4 Better Site Design

Better site design, also known as Low Impact Development (LID), is a suite of natural resource protection, stormwater management practices, and techniques that reduce runoff and protect water quality at the site level. LID includes techniques that minimize stormwater runoff, protect resources on site, minimize the creation of new impervious and disturbed pervious cover, and encourage small stormwater practices that promote infiltration and reuse stormwater runoff.

*Recommendation 10. Promote low impact development techniques on new development and redevelopment sites.*

While regulations govern new development in southeast Florida, there are no requirements to use LID site design techniques. Requiring these techniques would help to minimize pollutant loads from new developments, preserve natural areas, and reduce the cost of stormwater management requirements. Several communities have implemented regulations that require LID elements in new development, such as: impervious cover limits, or use of non-structural stormwater practices. Two collections of stormwater LID ordinance materials and guidance are provided below:

Example materials from the Low Impact Development Center

<http://www.lowimpactdevelopment.org/ordinances.htm>

Ordinances from the Puget Sound Partnership:

[http://www.psparchives.com/our\\_work/stormwater/stormwater\\_resources.htm#ordinances](http://www.psparchives.com/our_work/stormwater/stormwater_resources.htm#ordinances)



Figure 11. Broward County's NatureScape Program encourages use of native plants, minimal lawn area, and using plants that attract wildlife. Source: <http://www.broward.org/naturescape/islands>

### Workshop Input

Based on workshop input, the LID process appears to be just beginning in southeast Florida. While the SFWMD does score projects that use LID techniques higher, there are several obstacles, including: 1) lack of space, 2) lack of funding, and 3) that LID is not required by most local laws.

*Recommendation 11. Revise and/or create landscaping standards to promote “Florida Friendly” plants that require minimal watering, explicitly reduce the amount of managed turf permitted on new developments and in the right-of-way, and promote fertilizer ordinances that reduce water needs and nutrient loading.*

The “NatureScape” program in Broward County provides excellent information to homeowners to construct native habitat on their property and to reduce water use through native plantings and proper irrigation practices (Figure 11). This recommendation would be applicable on both redevelopment and new development sites, thus affecting a much larger area of the watershed. The criteria should be developed using existing materials from the NatureScape program.

Other online resources are available, such as the “Florida Yards” program developed by the University of Florida Extension, the FDEP, the Southwest Florida Water Management District and Florida Yards and Neighbors, which includes an extensive database of native and drought tolerant plants, available at: <http://www.floridayards.org>

This landscape guidance should also be accompanied by specific regulations to retain or enhance on-site tree canopy and other native vegetation. One technique is to establish specific tree canopy requirements based on the land development type. These are typically expressed as a percentage of the site area to be conserved or reforested as new development occurs. In addition to setting these vegetated targets, these ordinances typically allow for funds to be provided in lieu of forestation to enhance regional tree planting efforts.

The Maryland Forest Conservation Act is one example of a tree preservation standard available at:

[www.dnr.state.md.us/forests/download/sfla\\_report.pdf](http://www.dnr.state.md.us/forests/download/sfla_report.pdf).

For other techniques to preserve tree cover at the site level, the Urban Forestry Manual (Cappiella et al., 2005), prepared by the Center for Watershed Protection and the USDA Forest Service is a good guide. Information can be found at:

<http://www.cwp.org/categoryblog/98-forestry.html>

### Workshop Input

Based on input from workshop participants, landscape codes and landscaping education are an area of strength in southeast Florida. Some examples include:

- Draft Model Landscape Ordinance in Broward County for residential and commercial properties developed in cooperation with municipal zoning and planning divisions meets requirements for: 1) SFWMD-consumptive water use; 2) TMDL-impaired water use; 3) NPDES permit. This has been adopted in the Town of Davie.
- Pompano Beach currently developing a fertilizer ordinance
- Under NPDES, fertilizer/ landscape ordinances will be required
- Regulations on the amount of phosphorus in fertilizer will be implemented statewide.

*Recommendation 12. Review and update codes and ordinances of counties and municipalities to ensure that existing development codes are consistent with low impact development practices that reduce impervious cover, preserve open space, and treat and retain stormwater on-site.*

Many communities across the country have found that their own local development rules (e.g., subdivision ordinances, zoning ordinances, and parking lot and street design standards) have prevented better site design techniques from being applied during the site planning and design process (CWP, 1998; Figure 12). These communities have found that their own development rules are responsible for the wide streets, expansive parking lots, and large lot subdivisions that are crowding out the very natural resources that they are trying to protect.



**Figure 12. A combination of local codes, such as off-site parking requirements, street widths, and sidewalk requirements work together to increase impervious cover in this residential development.**

**Photo Source: CWP.**

While this report provides a summary of some programs in place, it does not delve into any details of design standards for new development. Obviously, it will be difficult to make use of better site design techniques if local development rules restrict their use. Although the Center for Watershed Protection (CWP, 1998) has developed a process that communities can use to review and revise their own “development rules,” it often takes some time to work through this process. Therefore, this review process would allow individual communities to identify opportunities to decrease the impacts of development throughout the watershed.

The “Codes and Ordinances Worksheet” from the Center for Watershed Protection provides a framework for reviewing new development codes. This worksheet, along with a description of the roundtable process is included in the following document:

Center for Watershed Protection’s Codes and Ordinances Worksheet is available at:  
[http://www.cwp.org/documents/cat\\_view/77-better-site-design-publications.html](http://www.cwp.org/documents/cat_view/77-better-site-design-publications.html)

Each county and several towns and cities have developed guidance for redevelopment projects, but none directly address land based sources of pollutants. Principles of development that directly address the management of stormwater runoff, preservation of on-site resources, and minimize the creation of impervious cover will directly achieve these goals.

If managed correctly, redevelopment projects can be used to improve conditions in areas that were developed without stormwater controls. Redevelopment is one of the few opportunities to address existing impairments in urbanized watersheds. However, applying stormwater management practices on redevelopment projects can be a challenge. Land availability, cost, and other site constraints often limit the stormwater management options that can be applied in redevelopment situations.

Communities across the US and Canada have used a variety of approaches in their efforts to manage the stormwater impacts created by redevelopment projects, requiring that:

- Existing impervious cover or pollutant loads be reduced by at least 20% (Virginia)
- Water quality treatment be provided for at least 30 percent of the existing on-site impervious cover and any new impervious cover (New York State, Maryland)
- Innovative site design and low impact development practices (e.g., green roofs and porous pavement) used to reduce stormwater impacts on-site (Maryland, Virginia, New York, and Minnesota)
- Water quality issues to be addressed by providing equivalent stormwater treatment at an off-site facility (Maryland)
- Water quantity issues (e.g. downstream channel erosion, and flooding) be addressed through channel restoration and other off-site remedies (Maryland)
- Water quality and quantity issues be addressed by contributing to a watershed by contributing to a watershed restoration fund (Maryland)

The following document summarizes principles for design of redevelopment projects: Redevelopment Roundtable Consensus Agreement: Smart Site Practices for Redevelopment and Infill Projects (CWP, 2001):

[http://www.cwp.org/documents/cat\\_view/77-better-site-design-publications.html](http://www.cwp.org/documents/cat_view/77-better-site-design-publications.html)

The “Maryland Critical Areas” requirements are a good example of stormwater management requirements for redevelopment, requiring a 10% reduction in pollutant load (post-developed to pre-developed) for redevelopment sites:

[www.mde.state.md.us/assets/document/sedimentstormwater/Appnd\\_D4.pdf](http://www.mde.state.md.us/assets/document/sedimentstormwater/Appnd_D4.pdf)

### Workshop Input

While few localities had gone through the process of revising local codes, this need was recognized by workshop participants.

## 8.5 Erosion and Sediment Control

This tool addresses erosion controls during the construction process and at the shore line.

*Recommendation 13. Increase compliance with and funding for construction site inspections and develop a core staff of certified inspectors.*

Most jurisdictions throughout the southeast Florida region had some form of erosion and sediment control program, although lack of inspectors to monitor these programs was noted as a weakness. Achieving government inspections at more sites to supplement contractors' self-inspection can be achieved in three ways. First, communities may need to hire additional inspectors to manage construction sites. Ideally, these staff would have completed the "Certified Inspector" program required of contractors in the State of Florida. Second, the communities can cross-train building inspectors to provide additional oversight during the building process. Finally, the smaller communities appear to have more difficulties with manpower. A sharing arrangement between cities and counties may be possible to achieve full coverage at construction sites.

### Workshop Input

Workshop participants strongly supported the need for consistent and funded construction inspections. Some examples of program components raised during the workshop included:

- Certified inspectors in Martin County, with builder/ developer reports after .5"/24 hr rainfall.
- In Fort Lauderdale, there is only one municipal inspector. One to 1.5 private inspectors inspect weekly or monthly, depending on the project.

Participants also highlighted dewatering as an erosion control concern, as well as confusions over authority, jurisdiction, and responsibility at construction sites.

*Recommendation 14. Document and repair over beach stormwater discharges.*

Often, direct discharge from development at or near the shore can result in erosion from beaches and directly to the reef system. Broward County has actively sought to limit these problem areas by cataloging areas where discharges to the beach result in erosion at the shoreline. Some projects have specifically sought to limit these sources of erosion. For example, the "Portals to the Sea" project at the Town of Lauderdale by the Sea, the town is elevating six beach access points to reduce flow from streets to the beach, thus minimizing this erosion source.

### Workshop Input

Some workshop participants pointed to overbeach discharges as a potential source of sediment. Participants raised examples of stronger enforcement for beach erosion from Tallahassee.

## 8.6 Stormwater Management

This section makes specific recommendations regarding stormwater criteria and management of stormwater infrastructure. As a part of their NPDES permits, all of the communities have a program in place to regulate post-construction stormwater runoff. At the same time, several survey participants commented that they lacked staff to adequately enforce these permits. In addition, each of the communities has a program in place to maintain stormwater infrastructure under this program. The details of these programs were not provided by survey participants and more data is needed to better understand how the programs are structured, and where additional resources, or cooperation between municipalities is needed.

A strong stormwater management program will have several key elements including:

- Integration of land use planning with stormwater management
- Unified stormwater design criteria
- Legal authority
- Plan review for stormwater design
- Inspection during construction
- Practice inspection and maintenance
- Program tracking.

For a recent publication that provides a useful overview of post-construction stormwater management, consult the following recent document:

Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program. (Hirschman and Kosco, 2008) is available at:

[http://www.cwp.org/documents/cat\\_view/76-stormwater-management-publications/90-managing-stormwater-in-your-community-a-guide-for-building-an-effective-post-construction-program.html](http://www.cwp.org/documents/cat_view/76-stormwater-management-publications/90-managing-stormwater-in-your-community-a-guide-for-building-an-effective-post-construction-program.html)

*Recommendation 15. Form a Southeast Florida stormwater review committee. Coordinate activities and projects with the FDEP EPA TMDL process to address specific parameters within watersheds and impaired waters.<sup>4</sup>*

### 8.6.1 Stormwater Management Objectives and Techniques

In southeast Florida, larger watershed protection and restoration goals can be achieved through practices that more nearly mimic natural hydrology and reduce the consumption of drinking water for irrigation and other non-potable uses. Further, stormwater practices should enhance or restore natural habitat and provide the greatest pollutant removal achievable on each site. Finally, stormwater management criteria should reward site design techniques that minimize impervious cover and preserve existing resources on site.

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<sup>4</sup> The second sentence of this recommendation was submitted after the workshop. When the follow-up survey was completed to rank the top 5 recommendations, this language was not included as a part of this recommendation.

Some key specific measures to achieve these goals include:

- Require a Natural Resources Inventory as the first step in the site planning and design process
- Require that primary conservation areas be protected from the direct impacts of land development
- Specifically require a “runoff reduction” or water reuse volume on each site
- Incorporate on-site stormwater practices such as cisterns and rain gardens to achieve runoff reduction goals
- Design stormwater ponds to provide water reuse on site (Figure 13)
- Allow credit for site design features, such as aquatic buffer protection, rooftop disconnection, and tree conservation
- Incorporate “state of the art” stormwater designs that provide optimal pollutant removal

### 8.6.2 Current Stormwater Management Criteria

Post-construction stormwater management is currently regulated by a combination of local and state codes. The standards of design, however, are primarily guided by the SFWMD’s “Environmental Resource Permit Information: Manual IV.” While Manual IV provides reasonable design guidance, it does not address some more recent innovations in stormwater management. For example, no LID practices are currently incorporated into the standards.

Some specific elements of the criteria include:

- The criteria primarily rely on traditional stormwater practices, such as ponds or dry basins;
- Stormwater quality volumes are based on site area (1 inch per acre) or impervious cover (2.5 inches per acre);
- Flood control is required for larger storm events;
- Design recommendations such as promoting wetland vegetation within pond systems, ease of maintenance, and irregular geometry.



**Figure 13.** This pump draws water from the stormwater pond in Figure 14, and this water is used for site irrigation. Photo Source: CWP.



**Figure 14.** This pond, in Miami-Dade County does not incorporate some features that would improve its performance, such as shallow side slopes, an “aquatic bench” that promotes growth of wetland vegetation and irregular geometry. Photo Source: CWP.

### 8.6.3 Proposed State Stormwater Management Criteria

The Florida Department of Environmental Protection is currently developing universal statewide criteria for post-construction stormwater management. These criteria are being developed through a series of Technical Advisory Committees. While the proposed regulations have not been released, committees have discussed some topics such as Low Impact Development and Stormwater Reuse.

The current state of the stormwater rule development can be found at:

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

### 8.6.4 Technical Advisory Committee Role

The Southeast Florida Stormwater Review Committee recommended here would be composed of representatives of southeast Florida communities. It would identify areas where a more specific regional criteria or design guidance would help to supplement the proposed state criteria by:

1. Identifying areas where specific criteria are needed for South Florida;
2. Enforcing statewide stormwater regulations with supplemental criteria in this region;  
and
3. Applying criteria on small sites that are not regulated by the State of Florida.

Although statewide criteria are valuable for consistency, special criteria for southeast Florida may also be warranted because of its unique coastal resources. This approach has recently been adapted in Georgia, where specific stormwater criteria for the Coastal Plain were included in a Stormwater Supplement for the coastal region (CWP, 2009).

### Workshop Input

Workshop participants emphasized the need for interagency coordination to better clarify the role of EPA, FDEP, and local governments in the development and stormwater management process. Some highlights of the discussion include:

- Tri-county meeting including Martin County to create coordination and uniformity between municipalities with each county and between the tri-counties
- In Martin County, an effort to create uniformity of language and identify where language and activities to protect water quality that can be included in Stormwater Master Plans
- Pilot Study for the Division of Environmental Assessment and Restoration (DEAR) to process a Basin Management Action Plan (BMAP) to address TMDLs for several watersheds with local partner
  - Local partners assert that permitted stormwater systems are not functioning as designed and DEP/WMD should do compliance/enforcement actions.
  - DEAR requested help to do a small pilot study to investigate permitted facilities and document conditions

*Recommendation 16. Using the data in Recommendation 5 and from the South Florida Water Management District, combined with land use and other data, assist with regional stormwater retrofit inventories in priority watersheds for coral reef conservation to identify potential retrofit opportunities and provide funding mechanisms.*

Several individual retrofit practices were identified as a part of the survey (Table 8). Additionally, these practices were a part of larger state-wide watershed planning efforts. Other retrofits have been completed, but were not reported in the survey. For example, the Lake Worth Lagoon Partnership Program, a partnership between the Lake Worth Lagoon Initiative, which distributes funds to local sponsors of projects identified in the Lake Worth Management Plan.

A comprehensive review of existing stormwater practices should be used to conduct field surveys for potential stormwater retrofits as a part of specific watershed planning efforts, crossing jurisdictional boundaries. The following resource is a good guide to the stormwater retrofitting process:

*Urban Subwatershed Restoration Manual No. 3: Urban Stormwater Retrofit Practices (Schueler et al., 2007).* Available at: <http://www.cwp.org/categoryblog/92-urban-subwatershed-restoration-manual-series.html>

<b>Table 8. Stormwater Retrofit Practices Identified in the LBSP Survey.</b>			
<b>Project</b>	<b>Description</b>	<b>Location</b>	<b>Partners</b>
Little Club Drive Stormwater Improvement Project	<ul style="list-style-type: none"> <li>Design and construct a stormwater detention pond, a stormwater treatment area, and stormwater conveyance systems (roadway swales, culverts, and catch basins)</li> </ul>	Martin County	FDEP and Martin County
Flood Control Projects	<ul style="list-style-type: none"> <li>Maintain a schedule for the flood control &amp; water quality improvements</li> <li>Maintain a list of the priority projects proposed for design and construction during the 5-year term of this permit</li> <li>Provide additions and/or deletions to this list in each subsequent Annual Report</li> </ul>	Delray Beach (Palm Beach County)	ESD/Engineering
Evaluation of Full Scale Stormwater Treatment Area Enhancements	<ul style="list-style-type: none"> <li>Demonstrate and document the ability of a limerock berm to contribute to improved treatment effectiveness and demonstrate and document effective means of converting emergent vegetation treatment effectiveness</li> <li>Demonstrate and document effective means of converting emergent vegetation treatment cells to Submerged Aquatic Vegetation treatment cells</li> </ul>	Palm Beach County	FDEP and SFWMD
Old Palm City Water Quality Improvement Project	Construction of a 2 acre detention area and the creation of a 1.5 acre wetland area in Old Palm City for the treatment of stormwater flowing from west to east into the South Fork of the St. Lucie River and into the Indian River Lagoon.	Martin County	FDEP and Martin County
Arch Creek Drainage Wells	Installation of drainage wells (11) and pollutant control devices (2) to improve water quality entering Arch Creek Canal. Installation of approximately 3,000 lf of exfiltration trench (water quality treatment).	North Miami	Miami-Dade County and DERM Water Pollution Control
Salerno Creek	Retention area will capture and treat	Stuart	Martin County,

<b>Table 8. Stormwater Retrofit Practices Identified in the LBSP Survey.</b>			
<b>Project</b>	<b>Description</b>	<b>Location</b>	<b>Partners</b>
Stormwater Retrofit	water (3/4 of an inch) from a 780-acre watershed (primarily the City of Stuart).	(Martin County)	FDEP, FDOT, University of Florida's Institute of Food and Agricultural Sciences, and SFWMD
Stormwater Master Plan/Baffle Box Program	Improvements to stormwater drainage systems within the City of Stuart by installing baffle box control structures to reduce pollutant loads to receiving waters.	Stuart (Martin County)	Florida "Yes" Program and SFWMD
Town of Ocean Ridge Stormwater Management System	Design, construct, and install a stormwater detention pond, two pump stations, and 5 baffle boxes.	Ocean Ridge, (Palm Beach County)	FDEP, Town of Ocean Ridge, and Palm Beach County's Lake Worth Lagoon Grant
Tropic Vista Stormwater Improvement Project	Captures stormwater runoff from the Tropic Vista neighborhood (350 single-family homes) in a stormwater retention area.	Martin County	Martin County, Jonathon Dickinson State Park, and FDEP
Local Government Partnerships for Stormwater Retrofits	"Turn-dirt" projects that focus on retrofitting stormwater and/or wastewater systems to result in improved water quality in receiving water bodies.	All	SFWMD and Counties in the region
SFWMD: South Florida Water Management District; FDEP: Florida Department of Environmental Protection; FDOT: Florida Department of Transportation; DERM: Department of Environmental Resource Management			

### Workshop Input

Workshop participants identified several individual stormwater retrofits. Some examples include:

- Stormwater treatment ponds in waters of the state are used as urban retrofits in WMDs, including: Wheeler property retrofit project - creating a wet detention system within the Sotille canal, a Class 3 water body, instead of creating an offline system and SFWMD - Indiantown Retrofit project
- Voluntary Constructed Wetland with Conservation Easement at Regency Lakes Village Center and Inverrary Falls shopping center
- Dry retention area and pervious rubber surface at Kinds in Distress Leo Goodwin Foundation Campus

- Composite underground tank storage allowed a passive park and two parking lots to be constructed in place of a traditional lake at Bella Vista Lauderdale Lakes, FL
- Two stormwater retrofits (baffle boxes) in Ft Lauderdale that drain 300 acres and 200 acres (discharge in N. Fork River) and prioritized based on Waterbody ID (WBID)
- Martin County prioritized areas for future retrofits and have constructed 19 stormwater retrofits over the last 8 years
  - Retrofits have 50 to 100 acre drainage areas
  - Martin County would like to obtain more state and federal funds, but are having a hard time making the match requirements
  - Retrofits consist of ponds, constructed wetlands (learning that deeper cells are needed for nutrient removal)
  - Alum injection in ponds to strip the nitrogen

*Recommendation 17. Track maintenance of all stormwater practices and infrastructure including both publicly and privately owned facilities in a streamlined format and accessible database.*

Given the extent of development throughout this region, each jurisdiction has a tremendous amount of infrastructure to maintain (Figure 15). For example, Broward County reported having 4,800 stormwater outfalls. Several communities reported having insufficient staff, limited time or inadequate equipment to conduct appropriate maintenance. Using the database established in recommendation 5, supplemented with data from regular maintenance or inspection visits, communities can determine if they have sufficient staff to inspect existing facilities.



**Figure 15. Canal maintenance is completed by the local government or the SFWMD. Photo Source: CWP.**

A “Program Audit” tool to help estimate needed resources is available from Hirschman and Kosco (2008) at the following site:  
[http://www.awsps.org/center-publications/cat\\_view/64-manuals-and-plans/82-stormwater-management-manuals-plans-and-guidance.html](http://www.awsps.org/center-publications/cat_view/64-manuals-and-plans/82-stormwater-management-manuals-plans-and-guidance.html)

While community governments are responsible for maintaining stormwater infrastructure, implementing stormwater practices are held in private ownership. Typically, communities inspect these BMPs, but maintenance is completed by the property owner. Although these practices are privately owned, inspection records should be included in the same database to evaluate how well these private facilities are maintained.

### Workshop Input

Long term maintenance of stormwater practice was not a major focus of discussion, but participants did support the idea of a consistent, user friendly database of infrastructure.

### **8.7 Non-Stormwater Discharges**

This tool includes measures to reduce pollutant loads from non-storm discharges such as sewage discharge and highly polluted “hotpot areas” such as marinas.

*Recommendation 18. Supplement existing permitting programs with a “Hot Spot” inventory of areas with high pollutant loads in select watersheds of neighborhoods to refine pollution prevention methods.*

Communities in southeast Florida regulate discharges from commercial and industrial land uses through the following:

- Administering NPDES Industrial Permits
- Hazardous waste discharge permits

These existing permits are enforced using a combination of cold calls (as reported by Broward County), inspections, as implemented in Miami-Dade County, and reliance on complaints. In the Delray Beach region of Palm Beach County, the county maintains a database of high risk dischargers and prioritizes inspection activity based on this information.

These local efforts are supplemented with statewide education efforts targeted at specific industries. Two programs identified in the survey are as follows:

- The voluntary statewide “P2” program provides technical assistance and outreach to industries
- The Best Management Practices for Florida's Green Industries: Education Program offers certification for lawn care industry and pesticide management professionals

These programs collectively attempt to limit discharges from businesses, but this is a challenging task, given the number of industries and businesses in this large and densely populated region. Some relatively simple field surveys can be used to identify key problems throughout a watershed. One example is the “Hotspot Inventory (HSI), which identifies areas within a site, such as dumpsters and loading areas, which have a high discharge and pollutant loading potential.

The HSI field sheet, as well as approaches for assessing upland pollution are presented in the document:

*Unified Subwatershed and Site Reconnaissance: A User's Manual-Version 2.0.* (Wright et al., 2005)

Available online at:

<http://www.cwp.org/categoryblog/92-urban-subwatershed-restoration-manual-series.html#Manual 11>

### Workshop Input

Workshop participants highlighted some other examples of specialized hotspots, including the following:

- Industrial and Commercial hotspots are regulated by the following:
  - Inspections- facility permit
  - Well field protection
  - Regulations
  - Call in hotlines
- Tree farms and nurseries are regulated by Broward County and the SFWMD, with a focus on BMPs to manage phosphorus
- DEP, the SFWMD and counties regulate horse farms and ranches, and manage waste redistribution to agriculture

*Recommendation 19. Create an incentive system and funding mechanism to provide sewage treatment and retire septic systems throughout the watershed that are based on prioritization performed in Recommendation 16.*

According to data collected by the Florida Department of Health, the potential cumulative number of septic systems are 212,708 in Miami-Dade, 106,886 in Broward, 79,960 Palm Beach and 28,002 in Martin Counties<sup>5</sup>. The most recent census data regarding the number of homes serviced by septic systems are from 1990 (US Census, nd), and reflect that the fraction of homes on septic systems were 17% in Miami-Dade, 11% in Broward, 14% in Palm Beach and 51% in Martin Counties. Since that time, communities, in cooperation with the Florida Department of Health and the SFWMD, have been gradually working to convert existing septic systems to municipal sewer.

The remaining septic systems are more difficult to regulate and pose a direct threat to the fragile aquifer system that acts as a drinking water source. They also have the potential to directly impact the ocean and reef system. Palm Beach County, Martin County, and the City of Fort Lauderdale were the only jurisdictions to specifically mention septic system management in the survey, and their role was confined to identifying septic system failures.

### Workshop Input

The approach to septic systems was different in Palm Beach/Martin versus Miami/Dade Counties. While these systems were not a high priority in the highly urbanized southern counties, both Palm Beach and Martin counties had complete mapping of septic systems. One participant pointed to a program in St. Lucie County and Boca Raton, which provided interest free loans to residents to bring septic systems on line.

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<sup>5</sup> These data are based on 1970 census information, plus the cumulative number of installed systems, and do not reflect systems taken out of service.

*Recommendation 20. Provide free pump out of boat sanitary waste in all four counties and promote through educational efforts.*

Marinas have a very high pollutant potential and are unique to coastal areas. Several communities in southeast Florida have adopted FDEP's Clean Marina Program, which includes techniques to minimize pollutant loads associated with boat storage, maintenance refueling, and docks. Another beneficial program is Martin County's MS-POOP (Martin Ship Pump-Out Operation) Program, in which Martin County offers free removal of sewage from wastewater holding tanks aboard vessels. Between October of 2000 and October of 2007, this program collected 195,500 gallons of sewage, which might otherwise have been discharged into coastal waters.

### Workshop Input

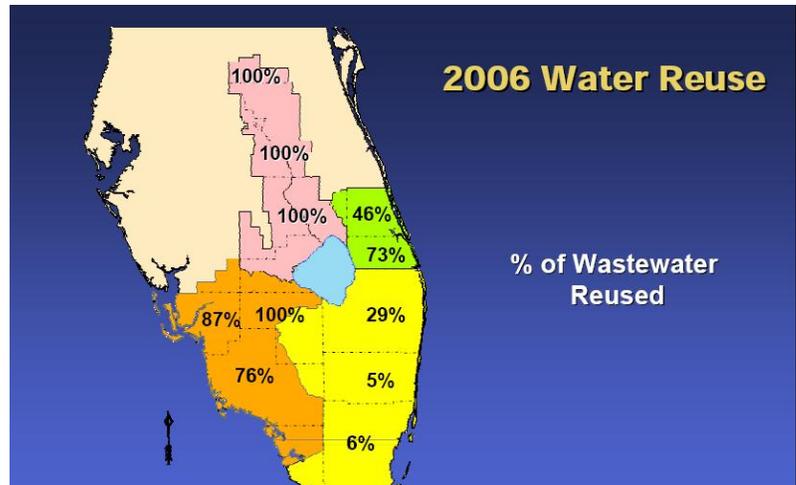
While participants agreed that boat sanitary waste is a problem, particularly for "live aboards" there was some disagreement about whether the pump outs should be free. Participants emphasized the need for education, since boat pump-outs are actually very inexpensive, even at locations that charge.

*Recommendation 21. Require installation of wastewater reuse infrastructure (purple pipes) concurrent with new developments and redevelopment projects, where appropriate.*

Wastewater reuse is a critical goal to minimize dependence on groundwater and reduce the wastewater load to coastal waters.

Typically, wastewater reuse focused on larger efforts such as wetland restoration. The following are wetland restoration examples:

- Creating the Wakodahatchee Wetlands in Palm Beach County;
- Broward County Waste-to-Energy Facility –uses over 1 million gallons per day (MGD) of reclaimed water for boiler cooling;
- IRIS Plant expansion in the City of Boca Raton that increased reuse capacity by 5 MGD, with a corresponding increase in reuse demand of 8 MGD through a distribution system;
- Investigating rehydration of the Biscayne Bay wetlands and groundwater recharge in Miami-Dade County; and



**Figure 16. Water Reuse by County.** While the highly populated Miami-Dade and Broward Counties reuse a small fraction of their total wastewater, more rural counties are able to use a greater fraction (Source: sfwmd.gov).

- Brackish water reuse to irrigate golf courses in Broward and Palm Beach Counties;

While some Florida counties reuse almost 100% of their wastewater, a relatively small fraction of wastewater is reused in southeast counties (Figure 16). One reason for this difference is that, while more rural counties can use reclaimed water to irrigate cropland or other large vegetated areas, options are limited in the fragmented suburban and urban environment. In fact, Broward County (2005) identified the infrastructure required to distribute reclaimed water as a major obstacle to wastewater reuse.

The 2008 outfall bill (Senate Bill 1302), however, would require six major treatment plants to reuse a total of 60% of their wastewater by 2025. Installing wastewater reuse pipes at redevelopment and new development sites will increase the demand for water reuse in two ways. First, it will allow access to reclaimed wastewater by urban and suburban residents. Even in dense, urbanized areas, this pipe network can be used for water sources and supplies in the following ways:

- Toilet tank water;
- Fountains;
- Car washing; and
- Landscape and lawn irrigation.

Second, it will gradually increase the network of reclaimed water pipe, ultimately allowing export of wastewater from urban areas that have less supply but greater demand for reclaimed wastewater.

### Workshop Input

This recommendation met with different opinions in West Palm Beach/Martin Counties versus Miami-Dade/Broward Counties. This is largely due to the challenges in achieving this goal in each municipality. In the highly urbanized southern counties, existing regulation is challenging for local water/ wastewater utilities, and the challenges of implementing this recommendation were raised. In West Palm Beach and Martin Counties, on the other hand, water reuse is more easily achieved through large scale projects such as wetland restoration, or reuse on agricultural lands.

Both groups agreed that the recommendation will likely be implemented over time through the passage of Senate Bill 1302. Some current efforts to comply with this regulation include:

- State Process:
  - WWTP all permitted
  - SFWMD & DEP meet quarterly to discuss reuse projects
  - State coordination meetings are held quarterly to discuss reuse projects (Shannon Spees Frost-FDEP coordinator)
- Local examples:
  - Delray Beach- major reuse program that has six phases

- Dewatering project in West Miami
- Coastal rehydration in Biscayne Bay
- Water Re-Use- Miami-Dade, Boca Raton, Broward (recharge, irrigation), and all planning through the SFWMD
- Martin County – Decommissioned two WWT plants and converted perk ponds to stormwater treatment basins
- Innovative reuse- Palm Beach County- gas power plant at 20 Mile Bend is reusing water to cool power plant
- Boynton Beach- wetland treatment project downtown and
- Many other project examples in Palm Beach County

*Recommendation 22. Use the data developed in Recommendation 5 to help agencies coordinate data sharing and work together to identify illicit discharges.*

Each community in southeast Florida conducts illicit discharge investigations as a part of its NPDES permit. However, the fragmented nature of storm drain system maps limits the ability to trace discharges that originate beyond the community to their source. In southeast Florida, this problem is exacerbated because stormwater systems are owned by a combination of county, city and town governments, and many are privately held. A regional data layer would allow for more sophisticated investigations and tracking of discharges.

#### Workshop Input

This recommendation was not a major focus on the workshop, and was kept more or less unmodified from its original version. There was more focus on the mapping component of this recommendation.

### **8.8 Watershed Stewardship**

Several watershed stewardship efforts, including monitoring and public education/involvement, were highlighted in the survey. The recommendations in this section suggest techniques to integrate these efforts to achieve specific watershed objectives or expand existing successful programs.

*Recommendation 23. Secure long term funding to support monitoring efforts and integrate these data to provide consistent data quantifying pollutant loads from the St. Lucie, Jupiter, Lake Worth, Boynton, Boca Raton, Hillsboro, Port Everglades, Haulover, and Port of Miami inlets.*

Currently, several inland water quality monitoring efforts are ongoing, but there is no nearshore coastal water quality monitoring at the mouth of these inlets, or a central monitoring database. In addition, the data collected often include different parameters or were conducted as part of a specific effort. Thus, it is difficult to understand trends or impacts to the coastal system. In fact, Trnka et al., (2006) identified several data gaps and recommended an integrated monitoring network. One mechanism to achieve this goal is to add ocean load estimates as a component of Inlet Management Plans which are required by State law and

managed by the FDEP. There is a need to assemble, organize, and summarize the data gathered by these water quality monitoring efforts.

### Workshop Input

This recommendation was supported by workshop participants, and additional monitoring recommendations were made in the “overarching” recommendation 32.

Some highlights of monitoring programs brought out during the workshops included the following:

- Numerical nutrient criteria development process (great example of coordination, monitoring, data, and reports)
- Lake Worth Lagoon- 18 monitoring sites
- FDEP – strategic TMDL monitoring out of southeast Florida

*Recommendation 24. Expand monitoring and modeling efforts to characterize reef quality in concert with monitoring of land-based pollutant loads.*

Efforts to characterize the southeast Florida reef system have been initiated only recently, leading to an initial understanding of the species composition, status, and trends within the coral reef system. This monitoring known as the Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP), should be expanded to 1) develop bioindicators of pollutant stress; 2) look for trends between biocriteria and water quality; 3) identify contributing sources of pollutants; and 4) expand the number of monitoring sites.

### Workshop Input

Workshop participants focused primarily on linking reef monitoring with water and stormwater quality monitoring to better understand how to set appropriate standards. In particular, one participant suggested reviewing current turbidity standards and revising them to be consistent with reef health.

*Recommendation 25. Integrate nonprofit organizations, community groups, and citizens to provide education and enhance watershed quality and water conservation, and identify target audiences and issues for public outreach.*

Non-profit organizations are active in southeast Florida, and could be integrated into existing or new government programs. Several of these non-profit organizations provide environmental education and could work with the municipalities to educate citizens.

In Miami, local watershed groups, state, and local groups collaborate and coordinate through the Environmental Education Providers of Miami-Dade County (<http://www.eepmiami.org/links.htm>).

Some groups, such as “Citizens for a Better South Florida” ([www.abettersouthflorida.org](http://www.abettersouthflorida.org)), which has its own native plant nurseries, could be integrated into planting efforts at key locations (e.g., canal restoration activities or demonstration projects in highly visible locations).

Educational efforts should always promote and incorporate direct citizen involvement, which lays the groundwork for future community stewardship and ownership to natural resource protection. The “Adopt a Canal” program in the South Broward County Drainage District is one example that could be used as a model for education efforts throughout the region (<http://www.sbdd.org/pdfs/AdoptaCanal072507.pdf>).

Another potential education model is the “Adopt-a-Pond” program, which encourages stormwater management practice maintenance and was created by the Center for Watershed Protection and Herring Run Watershed Association in Baltimore, MD. Available online at: [http://www.cwp.org/documents/cat\\_view/78-other-center-publications.html](http://www.cwp.org/documents/cat_view/78-other-center-publications.html)

These efforts, where possible, should reach beyond the watershed to address climate change and global warming, since these larger global impacts also impact coral reef health. Tree planting efforts and educational materials that reduce energy consumption are some examples.

The SEFCRI LBSP survey results identified current collaboration efforts between local communities and non-profit groups. For example, the City of Miami partners with the Miami River Commission to provide education in association with its City-Wide Sewer Cleaning Contract. In addition, Palm Beach County partners with both the Sandoway Nature Center and Keep Palm Beach Beautiful to manage beach cleanups.

#### Workshop Input

While this recommendation was not discussed at length, workshop participants agreed in general with the concept of reducing costs to local governments by working across all sectors to create a consistent educational message.

*Recommendation 26. Expand homeowner education programs to all regions that include sounder landscape practices, a broader suite of stormwater management practices, and reduced fertilizer application practices.*

Broward County’s NatureScape Program reduces water use by providing education and helping individuals integrate native landscaping into their residential property, and reducing fertilizer and pesticide use. This is an excellent example for community outreach and education that counties should use as a model to develop stormwater management programs in their respective counties. The NatureScape program emphasizes reducing stormwater runoff and recommends practices, such as alternative pavers and swales.

This stormwater management program should be expanded to incorporate practices that retain stormwater onsite such as:

- Permeable pavers;
- Cisterns and rain barrels;
- Rain gardens, and vegetated depressed areas that capture stormwater runoff; and
- Native plantings.

Several stormwater management practices are currently emphasized by other agencies and communities and would naturally fit with this program. For example, rain barrels have recently been emphasized, with training materials available from the SFWMD and Florida University. In fact, Palm Beach County even offers free rain barrels (Van Zile, 2008).

An important consideration when conducting any on-site measures is ensuring that the practices are compliant with other codes. For example, conversion of septic systems to cisterns was at one point recommended on the Florida Keys. However, recent information suggests that this practice is not in compliance with Department of Health regulations, and would require a specific variance.

#### Workshop Input

This recommendation was supported and communities have just begun to expand this component of education. One example is Broward County's "Innovative Stormwater Management" website and brochure provides tools and example projects. This website can be found at:

[www.Broward.org/waterresources](http://www.Broward.org/waterresources)

*Recommendation 27. Use public and private properties to demonstrate innovative stormwater practices.*

Public properties represent a unique opportunity to demonstrate innovative stormwater and landscaping practices. This will help to test out new practices and demonstrate to homeowners or businesses the value of applying these practices on their own property. Private properties offer an opportunity, but can present a challenge, unless the owner volunteers or is required to implement stormwater practices.

A publicly owned demonstration project is located at the City of North Miami Beach, which installed a 30,000 gallon rain harvesting system. The rain water captured in this system is used to irrigate municipal landscapes. The system can save up to 690,000 gallons of water per year and reduce stormwater runoff volume (SFWMD, 2008). Additional demonstration sites are needed in southeast Florida to continue to demonstrate the applicability and positive benefits for better stormwater management and how these practices will benefit individuals, local communities, and the southeast Florida region.

### Workshop Input

Workshop participants expanded this recommendation, which originally focused only on public properties, to include private properties as well.

### **8.9 Overarching Issues**

The last 6 recommendations were new recommendations that arose from workshop discussions. All of these recommendations represent comments that were arising in multiple other discussions, particularly the lack of funding to implement projects, difficulty enforcing standards, and greater transparency needed for data sharing. The last recommendation (Recommendation 33), focused more specifically on an aspect of sediment control, but also arose as part of other discussions, and transcends typical construction site erosion control measures discussed in Tool 5.

*Recommendation 28. Seek funding for priority projects.*

*Recommendation 29. Encourage compliance of regulations and/or policies through education and/or enforcement.*

*Recommendation 30. Revise penalties to make negative actions prohibitive.*

*Recommendation 31. Coordination between and within agencies (e.g., for enforcement).*

*Recommendation 32. Explore monitoring standards, parameters, and methods to ensure that useful, streamlined data is collected and shared in a timely manner (e.g., municipalities).*

*Recommendation 33. Stabilize and scrape existing spoil areas (e.g., islands, piles adjacent to tidal waters) to improve sediment and erosion control.*

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