AGENDA
St. Lucie River Watershed Protection Plan
Working Team Meeting #7

Tuesday, May 27, 2008
1330 - 1630

SFWMD Martin/St. Lucie Service Center
780 Southeast Indian Street
Stuart, FL 34997
(772) 223-2600

Conference Call Information:
Local: 561-682-6700
Toll-Free: 866-433-6299
MEETING ID# 0277

1. Introduction and Opening Remarks

2. Coordinating Agencies Update

3. Project Status and Schedule

4. Pollutant Control Program
    a. Statewide Stormwater Rule
    b. Environmental Resource Permit Special Basin Rule (ERP)
    c. Works of the District (WOD)

5. Status of Hydrologic Modeling

6. Water Quality Spreadsheet Analysis
    a. Nutrient Loading Rates and Best Management Practices Efficiencies
    b. Alternative 1 Results

7. Public Comment Period*

8. Closing Remarks and Action Items (Next Meeting – Tuesday, June 24, 2008)

* As time permits, brief Public Comment Periods may be held after major discussion items in the agenda

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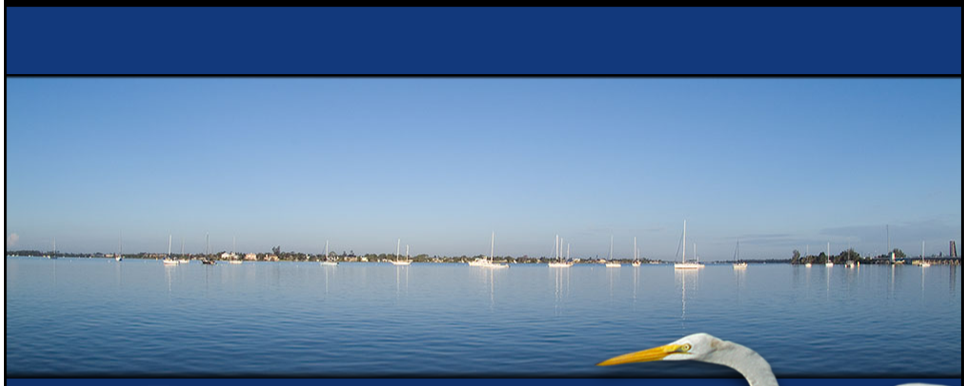

St. Lucie River Watershed Protection Plan

Working Team Meeting #7
May 27, 2008

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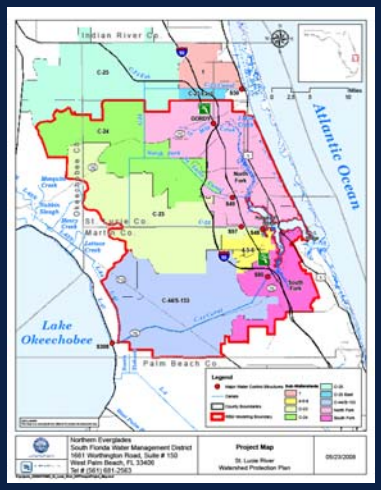
St. Lucie River Watershed



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Proposed Schedule

- Formulation and Evaluation – April through July
- DRAFT Plan - October 2008
- Final Plan - December 2008
- Submit by January 1, 2009

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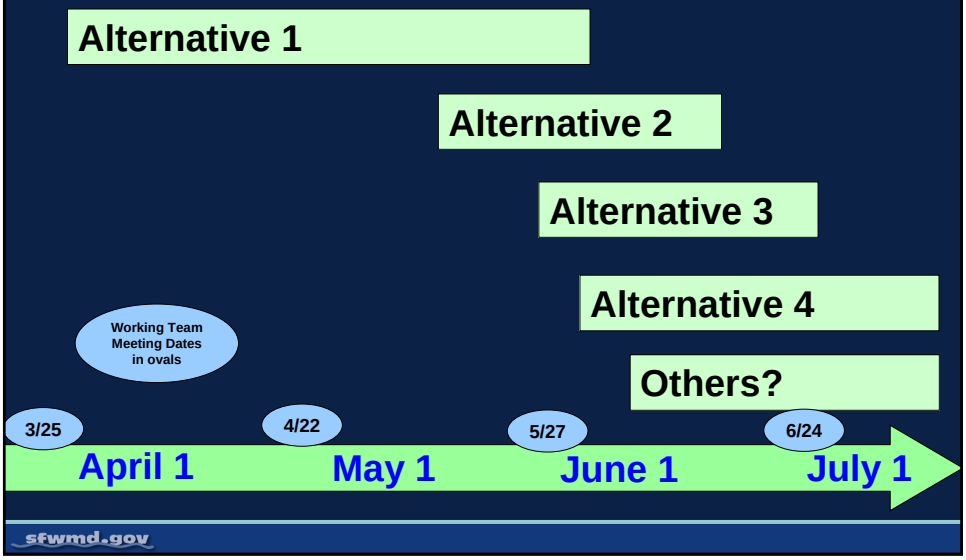
Project Alternatives Formulation and Evaluation



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Draft Plan Development Proposed Schedule

- **Project Area Map** — **5/27/08**
- **Preliminary Draft Chapter 2** — **6/2/08**
  (Introduction)
- **Preliminary Draft Chapter 3** — **6/2/08**
  (Planning Process)

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Draft Plan Development Proposed Schedule

- **Preliminary Draft MM Sheets** — **6/9/08**
- **Preliminary Draft Chapter 6.1** — **6/9/08**
  (Summary of MMs)
- **Preliminary Draft Ch. 6.2 and 6.3** — **6/23/08**
  (Water Quality and Quality Analysis)
- **Preliminary Draft Ch 6.4** — **7/2/08**
  (Formulation of Alternatives)

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

5/5/5 Initiative Projects

- Old Palm City Phase 3 Stormwater Quality Improvement Project
- Manatee Creek Water Quality Retrofit Phases 2 and 3
- North River Shores Vacuum Sewer System
- Manatee Pocket Dredging Project

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Questions

my.sfwmd.gov/northerneverglades

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New Rule Development for Unified Stormwater Quality Rules "ERP Phase Two"

St. Lucie River Watershed Protection Plan
Working Team Meeting #7
Tuesday, May 27, 2008

Damon Meiers and
Susan Roeder Martin
South Florida Water Management District

Introduction

DEP, in coordination with the water management districts (WMDs), initiated rule development to provide additional protection of water quality.

Jurisdictional Limitations

Pursuant to Part IV of Chapter 373, Fla. Stat.:

- **Rule pertains to treatment of stormwater from new development.**
- **Retrofit component will be included.**

- **A new Chapter, 62-347, F.A.C., will be promulgated.**
- **The SFWMD also authorized the initiation of rule development to incorporate new Rule 62-347, F.A.C.**

Format of Presentation

Damon will discuss:

- The history of the stormwater program;
- How we currently protect impaired waters;
- Additional protection provide to water quality in the new rule; and
- Lake Okeechobee & Estuary Special Basin Rule.

Susan will discuss:

- If we already protect impaired waters, why do we need a new rule?

Unified Statewide Stormwater Rule

Benefits:

- Rule is more protective of the environment;
- Provides more certainty;
- Quantifies and provides for more beneficial water quality treatment options;
- May address new development in the TMDL Basin Management Action Plan (BMAP) process.

History of Stormwater Rules

- Florida was the first state in the country to require the treatment of stormwater from new development.
- Original rule was promulgated in 1982.
- Focus was on Total Suspended Solids (TSS).
- At that time, this rule required state-of-the-art treatment.

Delegation to Districts

In the mid-1980s, authority for the permitting program was delegated to the WMDs (except NWFWMD).

Independent ERP Water Quality Rules

- Each WMD then promulgated its own rules.
- Each WMD has technology based rules which include performance standards or desired level of treatment.
- Design and performance criteria vary greatly.
- Compliance with the criteria results in a rebuttable presumption that water quality standards will be met.

Emphasis of the Rule

- The rules emphasize the removal of TSS.
- This is primarily done through retaining and detaining surface water in swales, lakes, canals, etc.
- In SFWMD, applicants treat first inch of runoff or 2½ times the impervious area, whichever is greater.

Old Surface Water Management Rules

- Required applicants to provide reasonable assurances that the surface water management system will not cause adverse water quality and quantity impacts on receiving water and adjacent lands regulated pursuant to Chapter 373, F.S.
- "Impaired Water Bodies" were not specifically addressed.

Rule 40E-4.301(b), F.A.C. (1994)

ERP Program

- In 1994, the Environmental Reorganization Act provided the WMDs independent authority to regulate stormwater quality under the Environmental Resource Permit (ERP) program.
- The Act requires the Department and the WMDs to seek to achieve a statewide, coordinated and consistent permitting approach to activities regulated under Part IV of Chapter 373, F.S.

Consistent wetlands environmental permitting criteria was adopted in 1995, but consistent statewide rules pertaining to the regulation of stormwater have not yet been developed.

WETLAND CRITERIA PROVIDES A VEHICLE FOR THE DISTRICT TO PROTECT IMPAIRED WATERBODIES UNDER EXISTING CRITERIA

Water Management Districts Adopted New ERP Conditions for Issuance

Applicants must provide reasonable assurances that the proposed surface water management system will not adversely affect the quality of receiving waters such that state water quality standards will be violated.

Rule 40X-4.301(1)(e), F.A.C.

Environmental Criteria Provides Additional Protection for Impaired Waters

- **ERP environmental criteria must also be applied in conjunction with the design and performance standards.**
- **The ERP environmental criteria is "in addition" to the performance standards.**
- **ERP environmental criteria provides "…an applicant must provide reasonable assurance that the regulated activity will not violate water quality standards."**

4.2.4, SFWMD BOR, 12.2.4, SJRWMD Applicant's Handbook, 3.2.4 SWFWMD BOR.

Environmental Criteria Provides Additional Protection for Impaired Waters (continued)

- "The applicant must demonstrate that the proposed activity will not contribute to the existing violation."

  4.2.4.5, SFWMD BOR; 12.2.4.5 SJRWMD Applicant's Handbook; 3.2.4.5, SWFWMD BOR.

- Environmental criteria gives the Districts the ability to require additional reasonable assurances to protect impaired waters.

Historically

- Applicants have provided an additional 50% treatment when discharging to an Outstanding Florida Water (OFW) or Class I or II waterbodies.
- Same additional criteria may be used to address impaired waters.
- Other source controls, BMPs and other protective measures should also be considered for impaired waters under existing rules.

Existing Rules

The existing rules do not set forth specific criteria on how to protect impaired waters.

Potential Measures to Aid in Demonstrating that an Activity will not Degrade an OFW or Contribute to a Violation of an Impaired Water

- stormwater pollution prevention plan - during construction
- operation plan - long term plan addressing routine maintenance of the system
- planted littoral zones or constructed wetlands
- increased contact time with in-water baffle systems or increased lake width and travel distance
- utilize on-site wetlands for additional treatment downstream of SWM system
- site specific water quality evaluation pre and post treatment
- WQ monitoring

(This is not an exhaustive list)

Existing BMPS

- BMPs do provide additional water quality protection and/or treatment.
- However, under the current rules, the amount of treatment is not quantified.

HOW IS INCREASED ENVIRONMENTAL PROTECTION PROVIDED BY THE NEW PROPOSED RULE?

Direction of New Rule Will Provide Increased Environmental Protection

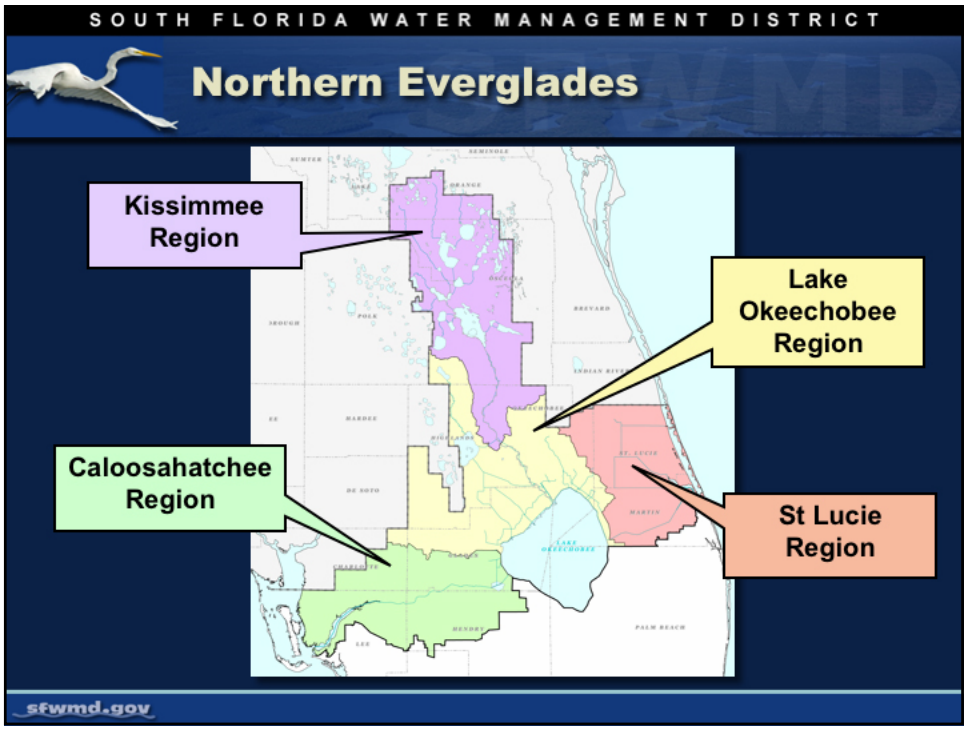
- Main issue for most impaired water bodies is nutrients.
- New rules will emphasize nutrient reduction.

Unified Stormwater Rule Development

- New rule will reflect new research on design and performance standards.
- The focus should not be on total suspended solids.
- Rules will emphasize today's understanding of the impact of nutrient discharges from surface water management systems on water quality.

Greater Protection of Water Quality

- Goal: no net increase in pollutants from what would be discharged in a pre-development/natural condition.
- Post-development nutrient loads (total phosphorus (TP) and total nitrogen (TN) will be less than or equal to an undeveloped/ natural condition on an average annual basis.
- TP and TN are generally the most difficult to address. Presumption that other pollutants will be sufficiently treated removal requirements are based on the 2 most difficult.



Lake Okeechobee & Estuary Special Basin Rule

- This rule will supplement existing criteria and new criteria in the statewide stormwater rule.
- Since the statewide stormwater rule will address quality, this rule will address focus on volume.
- A focus on volume will also provide incidental water quality benefits.

Current ERP Rules

QUANTITY

- Discharge off-site at a rate no greater than the existing conditions or a discharge formula for a specified event
- The rate criteria addresses the potential for flood impacts to off-site property during design storm events

Lake Okeechobee & Estuary Watersheds Basin Rule

- Proposed rule will supplement existing quantity requirements.
- Proposed rule will require that discharge volumes are reduced.
- Two scenarios: average annual discharge volumes and specific storm event discharge volumes.

Timeline Goals

Statewide Rule

- TAC Workshops
  - (March – Sept. 2008)
- Rule Workshops
  - (Oct. 2008 – Feb. 2009)
- Rule Adoption (May 2009)
- Rule Effective (July 2009)

Lake O & Estuaries Rule

- Criteria Development
  - (March – July 2008)
- Rule Workshops
  - (Aug. 2008 – April 2009)
- Rule Adoption (July 2009)
- Rule Effective (Sept. 2009)

IF WE ALREADY ADDRESS IMPAIRED WATER BODIES, WHY DO WE NEED A NEW STORMWATER QUALITY RULE?

Treatment to Existing Conditions

- **Under our current criteria, we require applicants to demonstrate that they will not contribute to the existing impairment.**
- **Discharge cannot exceed the current discharge for the impaired parameter.**
- **Under the new rule, applicants will be required to demonstrate that they will not exceed the amount of TP and TN that would be discharged from a pre-developed natural condition.**

Uncertainty

- Goal is to address uncertainty by providing stormwater quality treatment design and performance standards that can be applied statewide.
- Current criteria is only narrative, leaving everyone wondering if impaired waters are getting the correct level of protection.
- Rules do not currently demonstrate how much removal efficiency is attained by various BMPs.

Certainty

- Standard methodologies will be set forth for the calculation of pre-development hydrology and loading.
- Standard calculations for determining how much credit is provided by each BMP.
- There will be a consistent statewide criteria taking into account regional differences in rainfall and soil.

TMDL

- DEP is developing Basin Management Action Plans (BMAPs).
- Certainty in BMAP process for development using new Stormwater Rule.
- Treatment to level of natural predevelopment condition should satisfy requirements for new development.

Will the New Rule Create an Unreasonable Burden on Development?

- No – more options will be available to meet criteria
- Reduction in stormwater volume
  - Low Impact Design and BMPs
  - Reuse – recycling of stormwater
- Treatment Train

How Does the Treatment Train Work?

- A treatment train is a series of BMPs or other treatment options set forth in a series, like cars on a train.
- At each state there are less nutrients to be removed.
- Our rules do not currently encourage the use of treatment trains.

Best Management Practices (BMPs)

BMPs are expected to include:

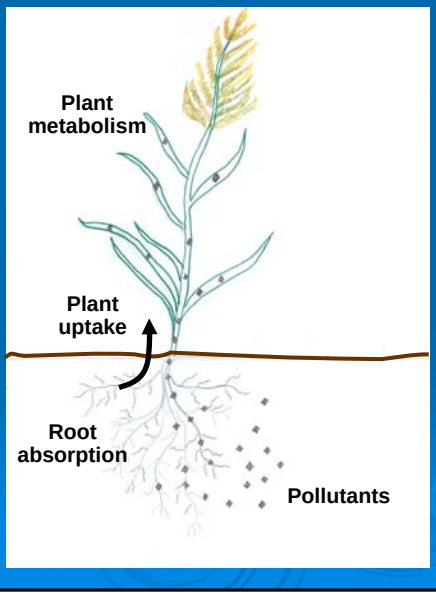
- Retention systems
- Biofiltration systems
- Exfiltration trenches
- Swale systems
- Wet detention
- Wetland SWM systems
- Reuse
- Vegetated natural buffers

New Credit Options Available Under the Stormwater Rule Will Make the Rule Effective

- Pervious pavement
- Green roofs
- Treatment train
- Bioretention swales
- Stormwater recycling (reuse)

- These options have been available and improved over the years.
- No credit has been given in the past.
- Stormwater rule will set forth the amount of treatment expected to be provided by these options.

How do Plants Remove Pollutants?



Green Roofs – Provide Water Quality and Other Public Benefits

- Reduces Storm water runoff that contains pollution
- Reduces air temperature and heat island effect (Chicago 90/170)
- Cleans the air of dust and gases

- Beautifies the roof
- Provides open space for recreation/agriculture
- Creates habitat for birds, bees, and butterflies
- Reduces Carbon Footprint

Green Roofs - Private Benefits

- Saves on energy costs
- Ambient temperature on roof is lower
- 3º cooler in top story
- Extends the life of the roof
- Sound insulation
- Increases property values
- Attractive

Typical Roof – appliances, gray gravel, ugly.

Green Roof - Case Study

Chicago City Hall

Before Green Roof Installed

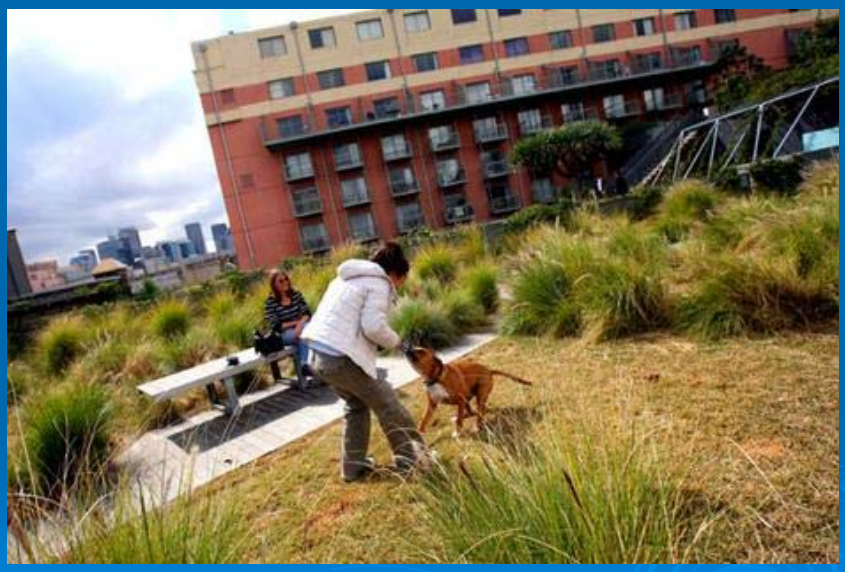
After Green Roof Installed, 2001

The Green Roof Attracts Birds and Insects – there are even Beehives – and 150 types of plant were installed!

WHY WOULD A DEVELOPER MAKE THE INVESTMENT TO INCLUDE A GREEN ROOF?

Putting Green

Green roofs for socializing



Dog parks on the roof

Florida Green Roof

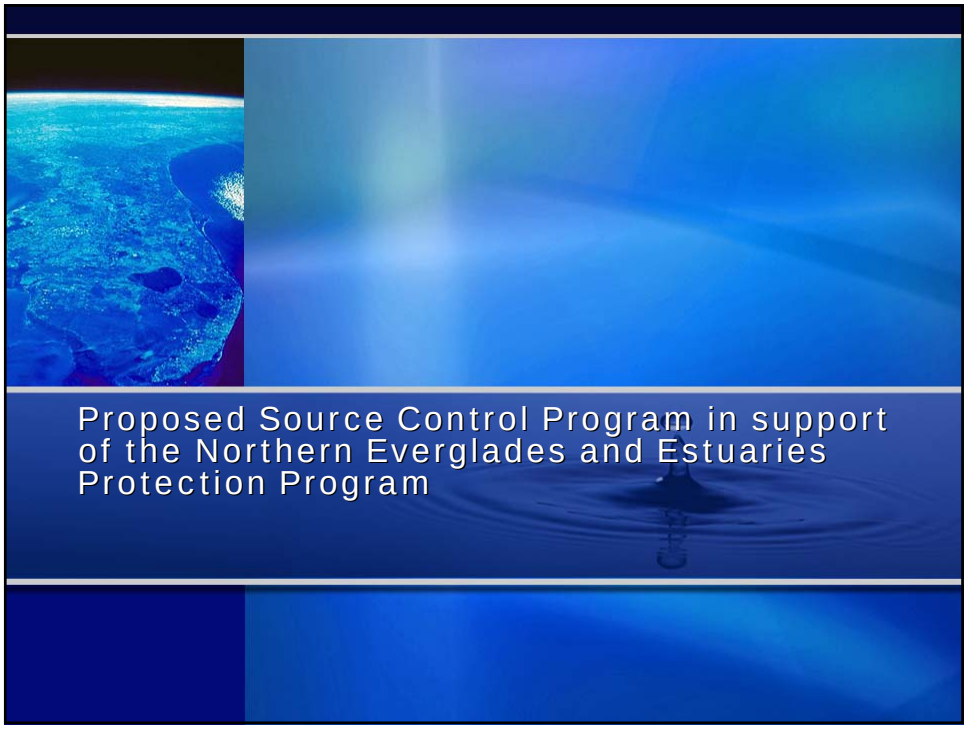
- Requirements of Success
- Native Vegetation
- Rain Barrel or Cistern
- Hydration of plants

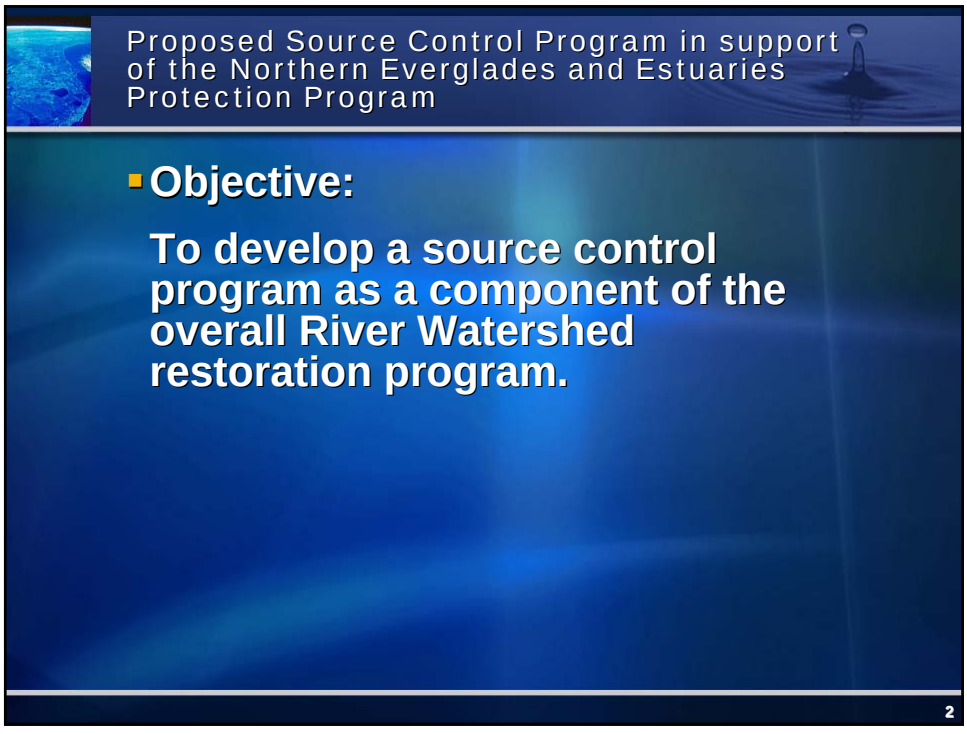
Green Architecture – Romano Law Group
City of Lake Worth

University of Central Florida Student Union

Summary
Why Should You Support the New Rule?

- Water quality will receive a greater degree of protection.
- Treatment will be required to a pre-development natural condition.
- Certainty - Specific information is set forth on what is necessary to protect water quality.
- The rule will effectively use available and new options:
  - Existing and new options will be assigned a removal efficiency assuring that the correct level of treatment is proposed by the applicant;
  - Treatment trains will increase removal efficiency; and
  - Stormwater recycling for irrigation will be encouraged.


Proposed Source Control Program in support of the Northern Everglades and Estuaries Protection Program


Proposed Source Control Program in support of the Northern Everglades and Estuaries Protection Program
Objective:
To develop a source control program as a component of the overall River Watershed restoration program.
2

Program History

- Surface Water Improvement and Management (SWIM) Act -1987
  - Chapter 40E-61 – Lake Okeechobee Works of the District rule - 1989
- The Lake Okeechobee Protection Act (LOPA) – 2000
- The Northern Everglades and Estuaries Protection Program (NEEPP) - 2007

3

District Mandates

- The Lake Okeechobee Protection Act (LOPA) and the Northern Everglades and Estuaries Legislation
  - Establish relationship of coordinating agencies
    - Florida Dept. of Environmental Protection
    - Florida Dept. of Agriculture and Consumer Services
    - South Florida Water Management District
  - Expand the restoration boundaries
  - Develop protection plans for the estuaries by January 1, 2009

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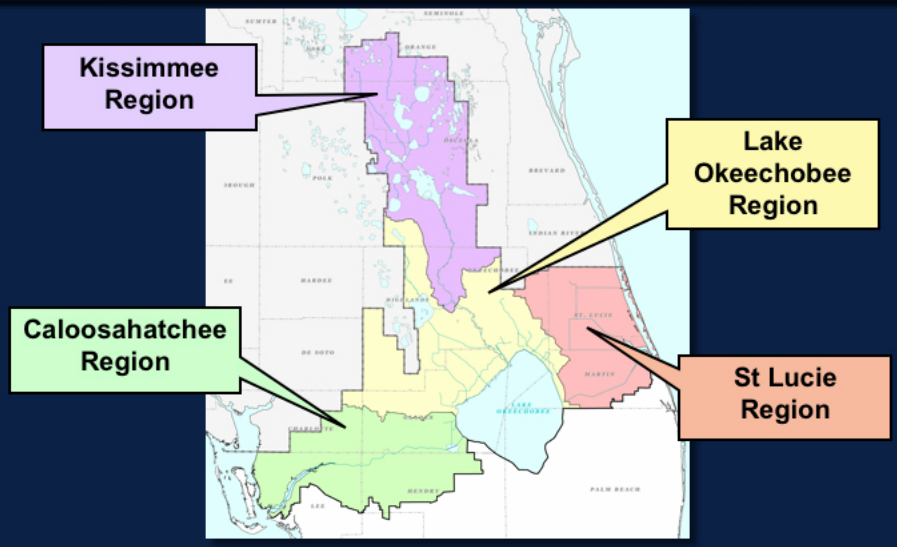
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Northern Everglades



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Steps to expand the Source Control Program to the Estuaries

- Develop a timeline for Amending Chapter 40E-61 FAC to include Estuary Watersheds
- Develop a source control program using best management practices for existing and future land uses
- Request notice of rule development for the river watersheds from the District's Governing Board

6

The Estuaries Source Control Program Concept

- Implement BMPs for all lands within the watershed.
- Ensure complementary efforts by agencies, e.g. Include a provision for agricultural land uses participating with FDACS to meet District regulatory requirements.
- Establish incentives for Demonstration Projects
- Establish a plan for verifying implementation and program effectiveness

7

Define the monitoring network necessary to:

- Monitor collective source control program effectiveness
- Use performance measures for the combined BMP source control programs.
- Optimize the BMP programs if WQ problems are detected.
- Identify priority areas of water quality concern.
- Provide data to enhance performance of downstream treatment facilities.

8

Summary

- Estuary source control programs will be similar to Lake Okeechobee BMP Program
- It will address agricultural and non-agricultural land uses
- It will be based on the estuary protection plan

9

Questions?

10

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Update on Hydrologic Modeling For St. Lucie River Watershed Protection Plan

5/27/08

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Presentation Outline

- Initial Model Run Assumptions
- Performance Measures
- Performance Indicators
- Initial Modeling Results:
  - LOWCP P2TP Current Base
  - Draft SLRWPP Base Run

5/27/08

Model Setup

- The link-node version of the Regional Simulation Model (RSM) is the regional tool used to evaluate alternatives for St. Lucie River Watershed Protection Plan (SLRWPP)
- NERSM = specific implementation of RSM covering the northern extent of the District down to Lake Okeechobee
- Current Base:
  - Represents conditions as they exist in the Northern Everglades Watershed in 2005.
  - Assumes no projects as defined by the Comprehensive Everglades Restoration Plan (CERP).
  - Period of record: 1970 to 2005.
  - Lake Okeechobee flood control releases to estuary and Water Conservation Areas are based on the existing WSE regulation schedule.
  - Same as LOWCP P2TP current base scenario.

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Model Setup

- SLRWPP Base Run:
  - Represents conditions likely to exist in Northern Everglades Watershed after implementation of Acceler8, Lower & Upper Kissimmee water resources projects such as:
    - C-44 reservoir and STA
    - C-43 reservoir
    - EAA Phase A-1 Reservoir
    - Kissimmee River Restoration Project and the Kissimmee River Headwaters Revitalization Project
    - Other projects south of Lake Okeechobee such as authorized MODWATERs and C-111 projects

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- **Model Setup**
  - **SLRWPP Base Run (con't):**
    - Represents future base conditions plus implementation of projects described in the Lake Okeechobee Watershed Construction Project Phase II Technical Plan
      - C-44 reservoir & STA operating with 50.25 kaf of effective storage; 9,700 acres; 1,060/1,060 cfs inflow/outflow capacity
      - C-43 reservoir used solely to meet EST05 targets in the Caloosahatchee estuary as in the C43 reservoir Phase I PIR
    - Based on the LOWCP P2TP ALT4 with refinements in the simulation of the St. Lucie River watershed
      - Additional level of detail in conceptualizing the St. Lucie River sub-watershed into component basins
      - Fewer boundary conditions driving the model, e.g. backflows from C-44 basin are now simulated relative to water level fluctuations in Lake Okeechobee

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SOUTH FLORIDA WATER MANAGEMENT DISTRICT

- **Model Setup**
  - **SLRWPP Base Run (con't):**
    - Based on the LOWCP P2TP ALT4 with refinements in the simulation of the St. Lucie River watershed
      - Addition of Ten-mile Creek Reservoir and STA:
        - » Reservoir/STA footprints: 524 /132 Acres
        - » Reservoir/STA operating depths: 13 / 2 ft
      - Update of C-44 reservoir and STA
        - » Reservoir/STA footprints: 3,400 / 6,300 Acres
        - » Reservoir/STA operating depths: 12 / 1.5 ft
      - Lake Okeechobee is not used in making environmental deliveries to the St. Lucie Estuary.

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Performance Measures Specific to SLRWPP

- An objective of the St. Lucie River Watershed Protection Plan is to reduce frequency and duration of harmful freshwater releases into the St. Lucie Estuary.
  - Number of Times St. Lucie Estuary High Discharge Criteria Exceeded (mean monthly flows > 2800 & 3000 cfs from 1970 – 2005)
    - Goal is to reduce the frequency of damaging discharges
    - > 2,000 cfs causes stress to the ecosystem and > 3,000 cfs causes severe damage
    - Targets of no more than twenty-one (21) occurrences between 2,000 and 3,000 cfs and six (6) occurrences over 3,000 cfs are used.
  - Number of Times Salinity Envelope Criteria NOT met for the St. Lucie Estuary
    - Goal is to have salinity concentrations that are conducive to estuary ecologic health by maintaining combined local inflows and Lake Okeechobee discharges. Specifically, "the goal is to avoid mean monthly flows less than 350 cfs and 14-day rolling average discharges from exceeding 2,000 cfs."

5/27/08

Performance Indicators

- Maintain other water-related needs for the other parts of the system; provides a way to evaluate water supply impacts of different alternatives.
  - Lake Okeechobee performance measures as used in LOWCP P2TP
  - Mean annual EAA/LOSA supplementation irrigation (4-in-1)
  - LOSA demand cutback volumes for 7 water years in the simulation period with the largest cutbacks

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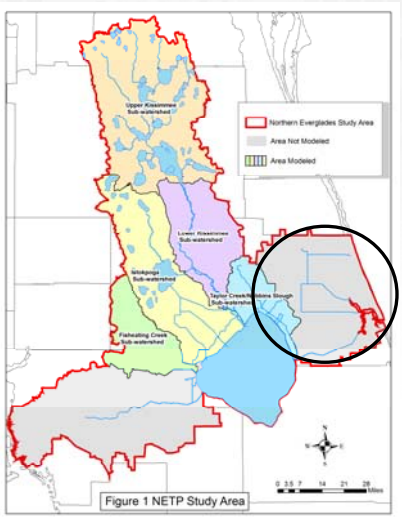
- **Modeling Domain**



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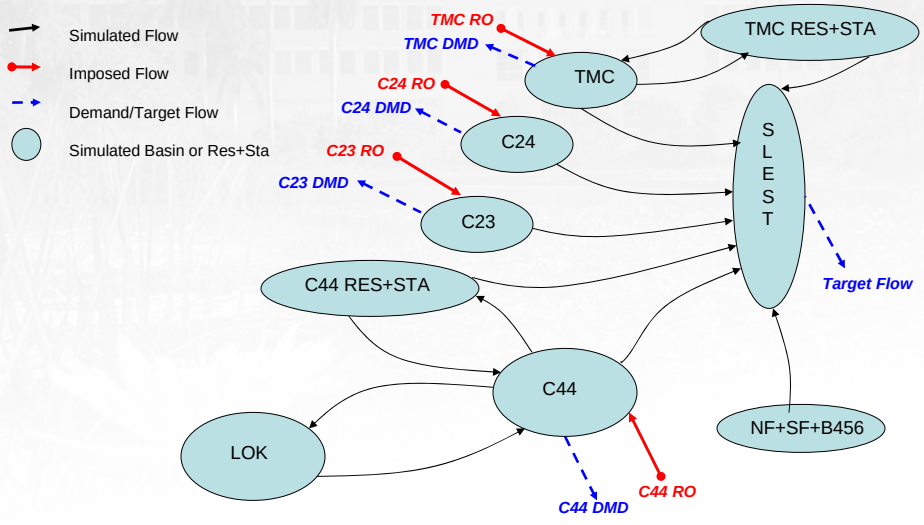
Node-Link Representation of the St. Lucie Sub-watershed in the NERSM for Draft SLRWPP Base



Initial Modeling Results

- Comparison of LOWCP P2TP Current Base Scenario {CBASE} and Draft SLRWPP Base Run {RWPPB} using performance measures and indicators
- Alternative scenarios will be compared against CBASE and RWPPB incrementally as they become available

5/27/08

Recap: Scenario Comparison Using Performance Measures and Indicators

- goal is to re-establish salinity regimes suitable for the maintenance of healthy, naturally-diverse and well-balanced estuarine ecosystems while meeting the other water related needs of the region including water supply.
  - Number of times SLE Estuary High Q Criteria Exceeded
  - Number of times salinity envelope criteria NOT met for SLE estuary
  - Water year (Oct-Sep) LOSA demand cutback volumes (7-worst years)
  - Mean Annual EAA/LOSA supplemental Irrigation: demands and demands-not-met (4-in-1 WS indicator)

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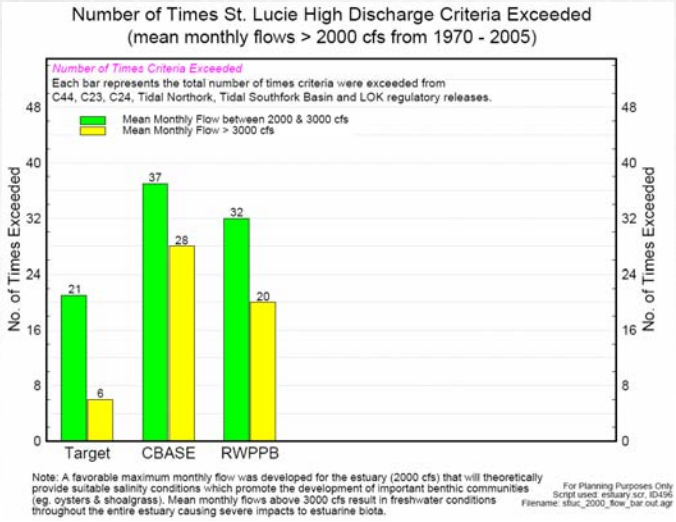

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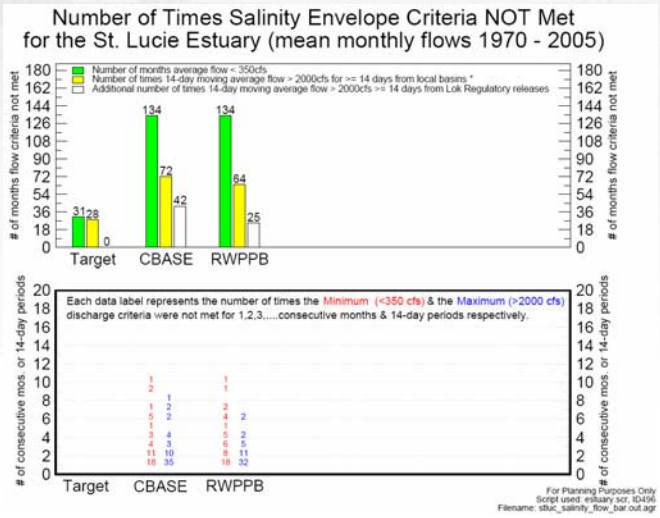
Source*	Mean Monthly Flow > 2000 cfs	Mean Monthly Flow > 3000 cfs	Mean Monthly Flow Between 2000 and 3000 cfs
Lake Okeechobee	5	0	2
Tributary Basin	41	10	24
Combined Tributary Basin + Lake Okeechobee	6	10	6
Total	52	20	32

*** When flows greater than 2000 cfs occur AND are combined with other sources to produce flows above 3000 cfs, the occurrence is attributed to combined source**


Number of Times Salinity Envelope Criteria NOT Met
for the St. Lucie Estuary (mean monthly flows 1970 - 2005)
Number of months average flow < 350cfs
Number of times 14-day moving average flow > 2000cfs for >= 14 days from local basins *
Additional number of times 14-day moving average flow > 2000cfs >= 14 days from Lok Regulatory releases
# of months flow criteria not met
31
28
0
134
72
42
134
64
25
Target
CBASE
RWPPB
Each data label represents the number of times the Minimum (<350 cfs) & the Maximum (>2000 cfs)
discharge criteria were not met for 1,2,3,.....consecutive months & 14-day periods respectively.
# of consecutive mos. or 14-day periods
For Planning Purposes Only
Script used: estuary.scr, ID496
Filename: stluc_salinity_flow_bar.out.agr

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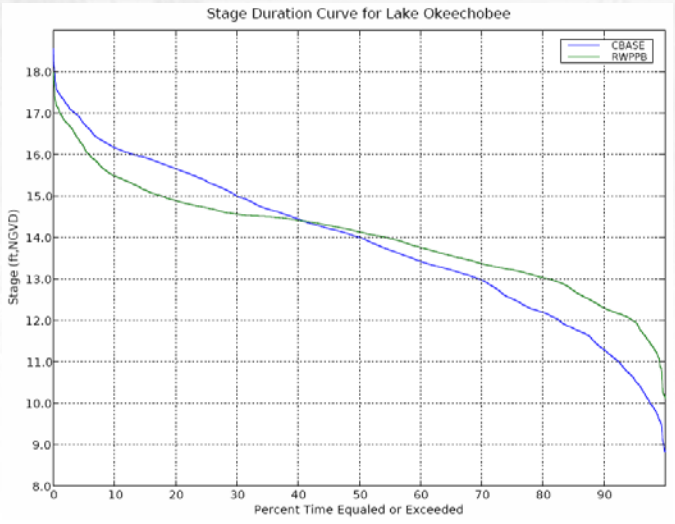
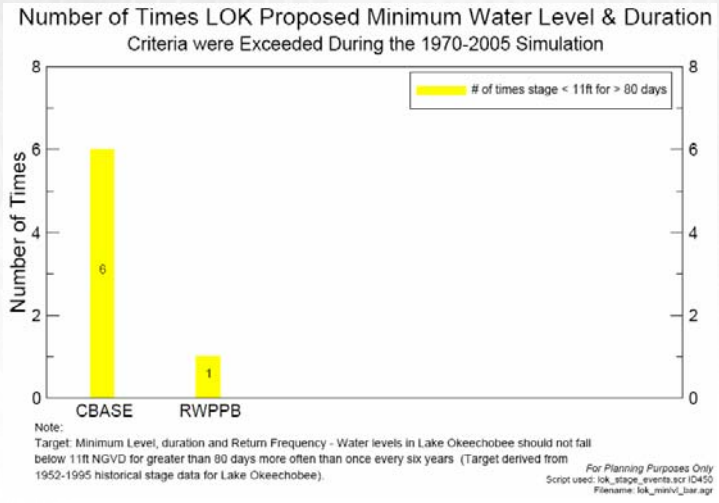
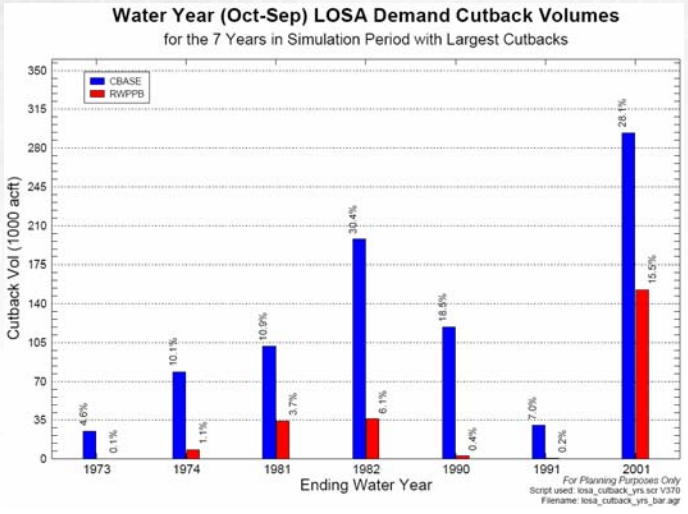

Stage Duration Curve for Lake Okeechobee
CBASE
RWPPB
Stage (ft,NGVD)
Percent Time Equaled or Exceeded

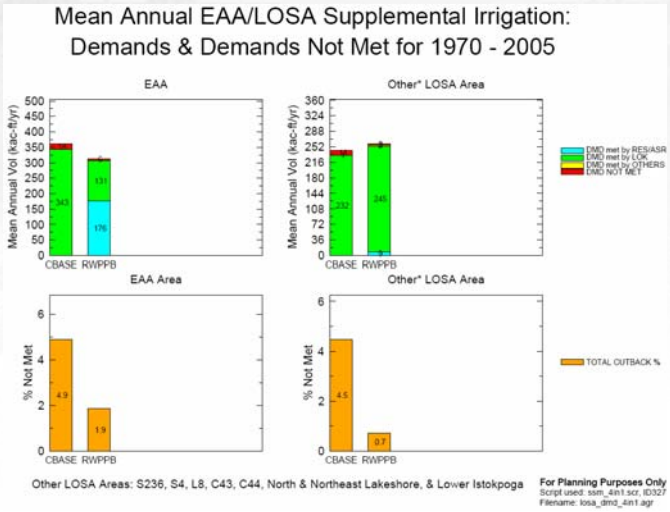
5/27/08


Number of Times LOK Proposed Minimum Water Level & Duration
Criteria were Exceeded During the 1970-2005 Simulation
# of times stage < 11ft for > 80 days
Number of Times
0
2
4
6
8
6
1
CBASE
RWPPB
Note:
Target: Minimum Level, duration and Return Frequency - Water levels in Lake Okeechobee should not fall below 11ft NGVD for greater than 80 days more often than once every six years (Target derived from 1952-1995 historical stage data for Lake Okeechobee).
For Planning Purposes Only
Script used: lok_stage_events.scr ID450
Filename: lok_min\rl_bar.agr

5/27/08


Water Year (Oct-Sep) LOSA Demand Cutback Volumes
for the 7 Years in Simulation Period with Largest Cutbacks
CBASE
RWPPB
Cutback Vol (1000 acft)
0
35
70
105
140
175
210
245
280
315
350
4.6%
0.1%
10.1%
1.1%
10.9%
3.7%
30.4%
6.1%
18.5%
0.4%
7.0%
0.2%
28.1%
15.5%
1973
1974
1981
1982
1990
1991
2001
Ending Water Year
For Planning Purposes Only
Script used: losa_cutback_yrs.scr V370
Filename: losa_cutback_yrs_bar.agr

5/27/08



5/27/08

- **Future Modeling Using NERSM**
  - **Incorporation of SLRWPP-specific Alternative 1 management measures**
  - **Integration with Alternative 1 management measures for the Caloosahatchee River Watershed Protection Plan (CRWPP)**
  - **Continued alternative formulation, simulation and evaluation**

5/27/08

- **Website: www.sfwmd.gov/northerneverglades**
- **Questions?**

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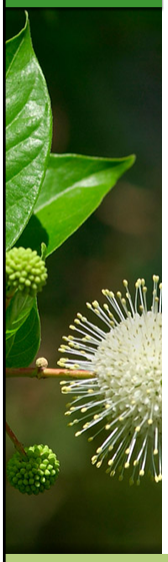

Nutrient Loading Rates, Reduction Factors and Implementation Costs Associated with BMPs and Technologies

SLRWPP Working Team Meeting
May 27, 2008

Joyce Zhang, Principal Engineer
Lake Okeechobee Division
South Florida Water Management District

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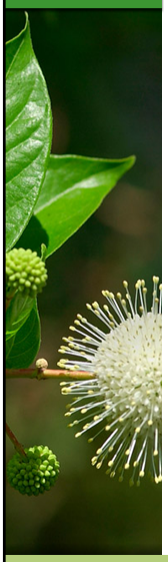

Nutrient Loading Rates, Reduction Factors and Implementation Costs Associated with BMPs and Technologies

Based on the Draft Report by

Soil and Water Engineering Technology, Inc

For

South Florida Water Management District

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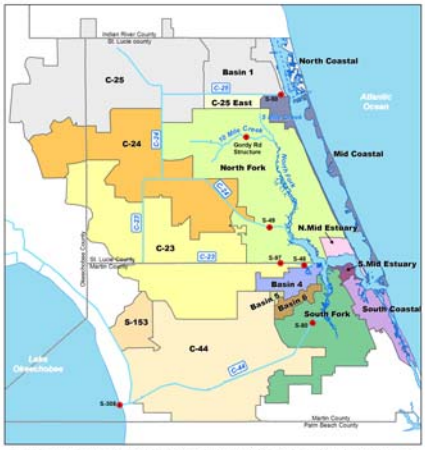

Indian River Lagoon and St. Lucie Estuary Watershed With Primary Basins

* C-25, Basin 1, and North Coastal Drainage Basins Flow directy into the Indian River Lagoon

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Objectives

- ***Task 1.*** **Develop the land use based P and N loading rates in the Caloosahatchee and St. Lucie watersheds**
- ***Task 2.*** **Develop P and N load reduction rates due to BMP implementations**
- ***Task 3.*** **Provide cost estimates for BMP implementations**

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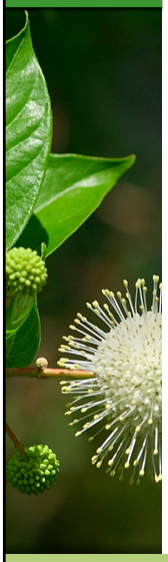
Six New Land Use Categories



- low density residential
- medium density residential
- high density residential
- horse farms
- transportation
- utilities

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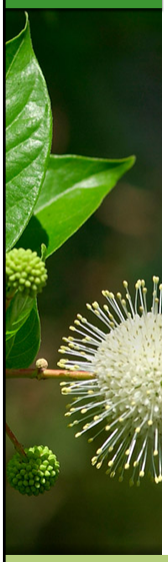
Methodology – Units Loads



- Start with Lake Okeechobee P unit loads
- Search literature and data resources for N and P units within the two Watersheds
- Update N and P unit loads and compare net loads to measured data
- Iteratively adjust unit loads until reasonable net load agreement was reached

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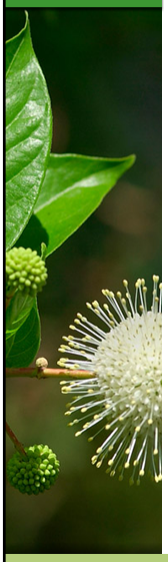

Data Sources

- BMP Letter Report (Bottcher, 2006)
- Harper and Baker (2003 and 2007)
- WMM EMC estimates developed by CDM (2007)
- WAM modeling results for the USACE (SWET, 2008)
- Graves et al. (2004)
- IFAS/UF Reports

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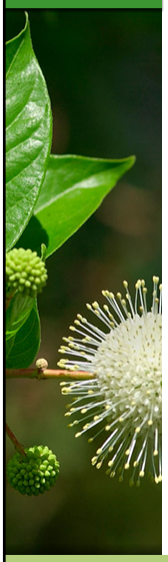

Land Use Distribution in the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Area (ac)	Percent	Sum_Area (ac)	Percent
Residential Low Density	Residential Low Density	1100	22,050	4.29%	22,050	4.30%
Residential Medium Density	Residential Medium Density	1200	38,206	7.43%	38,206	7.40%
Residential High Density	Residential High Density	1300	7,698	1.50%	7,698	1.50%
Other Urban	Commercial and Services	1400	5,090	0.99%	15,907	3.10%
Improved Pastures	Improved Pastures	2110	106,321	20.67%	106,321	20.70%
Unimproved Pastures	Unimproved Pastures	2120	15,033	2.92%	15,033	2.90%
Woodland Pastures/Rangeland	Woodland Pastures	2130	25,205	4.90%	39,351	7.70%
Row Crops	Row Crops	2140	7,881	1.53%	7,881	1.50%
Sugar Cane	Sugar Cane	2156	5,562	1.08%	5,562	1.10%
Citrus	Citrus	2210	116,442	22.64%	116,442	22.60%
Sod Farms	Sod Farms	2420	294	0.06%	294	0.10%
Ornamentals	Ornamentals	2430	1,246	0.24%	1,246	0.20%
Horse Farms	Horse Farms	2510	784	0.15%	784	0.20%
Dairies	Dairies	2520	419	0.08%	419	0.10%
Other Areas	Field Crops	2150	2,800	0.54%	4,108	0.80%
Tree Plantations	Tree Plantations	4400	0	0.00%	0	0.00%
Water	Water	5000	11,411	2.22%	11,411	2.20%
Natural Areas	Upland Forests	4000	37,608	7.31%	105,380	20.50%
Transportation	Transportation	8100	5,665	1.10%	5,665	1.10%
Communication/Utilities	Communication	8200	91	0.02%	10,529	2.00%
Total			**514,287**	**100.00%**	**514,287**	**100.00%**

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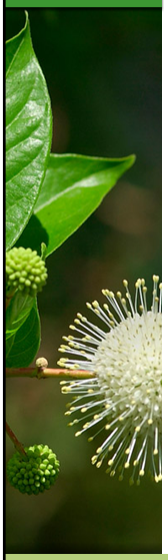

Summary of Measured / Modeled Annual Flow and Loads for TP and TN to SLE

Sub-watershed	Area (acres)	Average Annual Discharge[1] (1995-2005) (Acre-ft)	Calculated Runoff (in)	Average Annual TN Load[2] (1995-2005) (MTons)	Average Annual TN Conc. (Calculated) (1995-2005) (ppb)	Average Annual TP Load[2] (1995-2005) (MTons)	Average Annual TP Conc. (Calculated) (1995-2005) (ppb)
Basins 4 5 6	15,055	23,620	18.8	34	1182	6	219
C-23	112,675	152,789	16.3	330	1750	91	481
C-24	87,706	178,853	24.5	355	1609	76	343
C-44&S-153	129,719	158,194	14.6	300	1540	40	203
North Fork*	119,168	126,152	12.7	185	1191	43	278
Tidal St. Lucie**	49,965	59,408	14.3	91	1244	21	285
Lake Okeechobee	-	414,754		922	1802	96	188
Total	514,287	1,113,771		2218	1615	373	271

*North Fork basin includes North Fork and N. Mid. Estuary
**Tidal St. Lucie basin includes South Fork and S. Mid. Estuary
(1) Measured data are used for flow from C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for flow from North Fork basin, South Fork basin, and Basin 4 5 6.
(2) Measured data are used for TN concentration for C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for TN concentration for North Fork basin, South Fork basin, and Basin 4 5 6.

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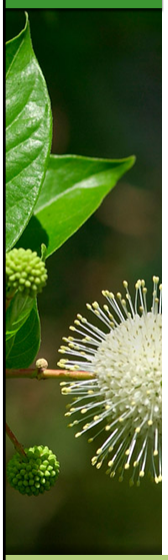

Estimated Runoff, Unit N and P Loads and Concentration for 2004 Land Uses in the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Runoff (in/yr)	Unit N Load (lbs/acre/yr)	N Conc. (mg/l)	Unit P Load (lbs/acre/yr)	P Conc. (mg/l)
Residential Low Density	Residential Low Density[1]	1100	17.57	4.95	1.25	0.49	0.12
Residential Medium Density	Residential Medium Density[2]	1200	20.76	7.20	1.53	1.40	0.30
Residential High Density	Residential High Density[2]	1300	23.96	10.80	1.99	3.00	0.55
Other Urban	Commercial and Services[2]	1400	25.55	9.90	1.71	1.40	0.24
Improved Pastures	Improved Pastures	2110	19.16	9.99	2.30	1.90	0.44
Unimproved Pastures	Unimproved Pastures	2120	15.97	4.95	1.37	0.92	0.25
Woodland Pastures/Rangeland	Woodland Pastures	2130	15.97	3.69	1.02	0.88	0.24
Row Crops	Row Crops	2140	22.36	13.50	2.67	4.50	0.89
Sugar Cane	Sugar Cane	2156	19.16	7.20	1.66	0.63	0.15
Citrus	Citrus	2210	19.16	7.65	1.76	1.80	0.42
Sod Farms	Sod Farms	2420	19.16	8.10	1.87	2.52	0.58
Ornamentals	Ornamentals	2430	19.16	10.80	2.49	2.90	0.67
Horse Farms	Horse Farms	2510	15.97	14.40	3.99	1.82	0.50
Dairies	Dairies	2520	15.97	18.00	4.98	9.38	2.60
Other Areas	Field Crops	2150	15.97	5.96	1.65	2.96	0.82
Tree Plantations	Tree Plantations	4400	15.97	2.79	0.77	0.18	0.05
Water	Water	5000	3.19	0.81	1.12	0.05	0.07
Natural Areas	Upland Forests (not including 4400's)	4000	14.37	2.25	0.69	0.28	0.09
Transportation	Transportation	8100	27.15	8.28	1.35	1.65	0.27
Communication/Utilities	Communications	8200	15.97	5.40	1.49	0.48	0.13

[1] Assumed on Septic
[2] Assumed Discharge from WWT outside basin

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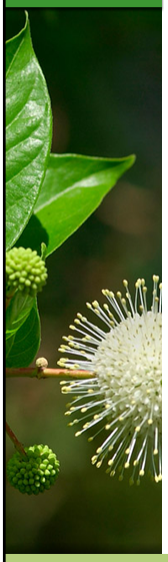

Comparison of Measured vs. Calculated Runoff, TN, and TP for the St. Lucie River Watershed (including LO discharge)

Constituent		Measured (1995-2005)	Calculated
Runoff	**ac-ft/yr**	**1,113,771**	**1,113,686**
TN	**mt/yr**	**2,218**	**2,417**
	ppb	**1615**	**1760**
TP	**mt/yr**	**373**	**393**
	ppb	**271**	**286**

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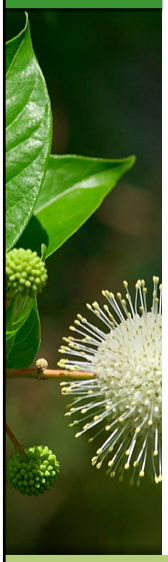

Methodology – Load Reductions with BMPs

- Start with the BMP Letter Report for the LO watershed (P only)
- Review and update BMP effectiveness and cost data based on literature
- Link to land use data for determining potential N and P reductions due to BMP implementation

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BMPs for Citrus — Phosphorus

Assume for Typical Condition

Two row crown bedded
Assumed average farm size of 200 ac
Grass Management between Trees
Pond retention with limited wetland restoration
Micro jet irrigation and fertigation of young stock

Existing P Load	1.80	lbs-P/ac/yr
Existing P Concentration	0.41	mg/l
Average Annual Runoff	19.16	in/yr

BMPs	Type	P Reduction[1] Range %	P Reduction[1] Typical %	Initial Cost of BMP[2] ($/ac)	Annual Cost[3] per acre ($/ac/yr)	Annual Cost[3] P Removed ($/lb/ac/yr)	Quickness of Response
Fertility							
Reduced P Fertilization (testing, placement, and type)	Owner	0 to 25	10	0	0	0	Slow
Better N and Micros Fertilization	Owner	0 to 5	2	0	0	0	Slow
Water Management (irrigation and drainage)	Typical	0 to 20	5	0	0	0	Fast
Water Reuse from Retention/Detention Ponds[4]	Typical	0 to 50	10	33	11	59	Fast
Grass Management between Trees	Owner	0 to 5	2	22	7	196	Moderate
Grassed Waterways	Alternative	0 to 15	5	110	35	391	Fast
Stormwater R/D[5]	Typical	10 to 60	40	440	141	196	Fast
Wetland Restoration	Typical	5 to 20	10	44	14	78	Fast
Edge-of-farm Stormwater R/D and Chemical Treatment[6]	Alternative	20 to 90	70	220	70	56	Fast
Typical/Owner BMP Program Reduced P Fertilization, Better N Management, Grass Management between Trees, additional Stormwater Retention, and limited Wetland Restoration/Retention		10 to 50	32	75	24	130	Moderate
Owner BMP Program Reduced P Fertilization, Better N Management, and Grass Management between Trees		0 to 25	12	5.5	0	0	Slow
Typical BMP Program Stormwater R/D and Wetland Restoration		5 to 50	20	77	25	68	Fast
Alternative BMP Program Fertigation, Grassed Waterways, and Edge-of-farm Stormwater R/D with Chemical Treatment		20 to 90	42	242	77	102	Fast

1 Estimated values assume no other BMPs applied. Note, combined BMPs will reduce effectiveness of individual BMP
2 Costs presented on per acre of entire farm basis unless otherwise noted. Costs value only include implementation cost, i.e. does not include O&M Costs.
3 The annual cost include amortized capital costs at 10% interest over a twenty-year life span and a 20% per year of capital cost for annual O&M.
4 Values shown are for using existing ponds for water reuse, if new facilities are needed then cost would increase significantly.
5 Average of pre/post 1984 stormwater management requirements, i.e. P > .6ppm if developed prior to 1984 and less if developed after 1984. Groves developed after 1984 would probably have stormwater R/D systems, so little addition benefit would be expected for newer groves.
6 High O&M Costs

BMPs for Citrus — Nitrogen

Assume for Typical Condition

Two row crown bedded
Assumed average farm size of 200 ac
Grass Management between Trees
Pond retention with limited wetland restoration
Micro jet irrigation and fertigation of young stock

Existing N Load at 160 lb-N/ac/yr fertilizer	7.65	lbs-N/ac/yr
Existing N Concentration	1.76	mg/l
Average Annual Runoff	19.16	in/yr

BMPs	Type	N Reduction[1] Range %	N Reduction[1] Typical %	Initial Cost of BMP[2] ($/ac)	Annual Cost[3] per acre ($/ac/yr)	Annual Cost[3] N Removed ($/lb/ac/yr)	Quickness of Response
Fertility							
Reduced N Fertilization (IFAS, placement, and type)	Owner	0 to 25	10	20	6.4	8	Fast
Better Micros Fertilization	Owner	0 to 5	2	0	0	0	Fast
Water Management (irrigation and drainage)	Typical	0 to 20	5	0	0	0	Fast
Water Reuse from Retention/Detention Ponds[4]	Typical	0 to 50	10	33	10.56	14	Fast
Grass Management between Trees	Owner	0 to 5	2	22	7.04	46	Fast
Grassed Waterways	Alternative	0 to 15	5	110	35.2	92	Fast
Stormwater R/D[5]	Typical	10 to 60	40	440	140.8	46	Fast
Wetland Restoration	Typical	5 to 20	10	44	14.08	18	Fast
Edge-of-farm Stormwater R/D and Chemical Treatment[6]	Alternative	5 to 70	50	220	70.4	18	Fast
Typical/Owner BMP Program Reduced P Fertilization, Better N Management, Grass Management between Trees, additional Stormwater Retention, and limited Wetland Restoration/Retention		10 to 50	30	490	156.8	68	Fast
Owner BMP Program Reduced N Fertilization (IFAS, placement, and type) Better Micros Fertilization		0 to 25	10	20	6.4	8	Fast
Typical BMP Program Stormwater R/D and Wetland Restoration		5 to 50	20	470	150.4	98	Fast
Alternative BMP Program Fertigation, Grassed Waterways, and Edge-of-farm Stormwater R/D with Chemical Treatment		5 to 70	42	242	77	24	Fast

1 Estimated values assume no other BMPs applied. Note, combined BMPs will reduce effectiveness of individual BMP
2 Costs presented on per acre of entire farm basis unless otherwise noted. Costs value only include implementation cost, i.e. does not include O&M Costs.
3 The annual cost include amortized capital costs at 10% interest over a twenty-year life span and a 20% per year of capital cost for annual O&M.
4 Values shown are for using existing ponds for water reuse, if new facilities are needed then cost would increase significantly.
5 Average of pre/post 1984 stormwater management requirements, i.e. P > .6ppm if developed prior to 1984 and less if developed after 1984. Groves developed after 1984 would probably have stormwater R/D systems, so little addition benefit would be expected for newer groves.
6 High O&M Costs

BMPs for Medium Density Residential

Phosphorus

Assume for Typical Condition
- Medium Density Residential
- Assumed average development size of 200 ac
- Moderately Managed Lawns
- Limited Pond retention
- Limited Lawn Irrigation

Existing P Load	1.40	lbs-P/ac/yr
Existing P Concentration	0.30	mg/l
Average Annual Runoff	20.76	in/yr

BMPs	Type	P Reduction[1] Range %	P Reduction[1] Typical %	Initial Cost of BMP[2] ($/ac)	Annual Cost[3] per acre ($/ac/yr)	Annual Cost[3] P Removed ($/lb/ac/yr)	Quickness of Response
Fertility							
Reduced P Fertilization (testing, placement, and type)	Owner	0 to10	5	0	0	0	Slow
Dry Retention/Swales 0.25"	Typical	20 to 80	50	6400	2048	2926	Fast
Wet Detention - 0.25"	Typical	30 to 90	80	8000	2560	2286	Fast
Street Sweeping	Typical	0 to 25	15	20	6.4	30	Fast
Sediment/Baffle Boxes	Typical	10 to 60	20	440	140.8	503	Fast
Dry Detention - Regional	Alternative	15 to 35	25	3200	1024	2926	Fast
Wet Detention - Regional	Alternative	40 to 80	65	4000	1280	1407	Fast
Stormwater R/D and Chemical Treatment[4]	Alternative	20 to 90	70	3200	1024	1045	Fast
Typical/Owner BMP Program Reduced P Fertilization, Swales, and limited Dry Retention/Sweeping		0 to 20	10	6400	2048	14629	Moderate
Owner BMP Program Reduced P Fertilization		0 to 10	5	0	0	0	Slow
Typical BMP Program Limited Dry Retention, Street Sweeping, Sediment R/D and Wetland Restoration		5 to 50	5	6400	2048	29257	Fast
Alternative BMP Program Stormwater R/D with Chemical Treatment		20 to 90	70	3200	1024	1045	Fast

1 Estimated values assume no other BMPs applied. Note, combined BMPs will reduce effectiveness of individual BMPs
2 Costs presented on per acre of entire development basis unless otherwise noted. Costs value only include implementation cost, i.e. does not include O&M Costs.
3 The annual cost include amortized capital costs at 10% interest over a twenty-year life span and a 20% per year of capital cost for annual O&M.
4 High O&M Costs

BMPs for Medium Density Residential

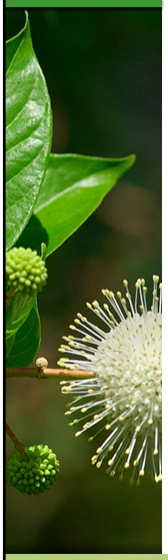
Nitrogen

Assume for Typical Condition
- Medium Density Residential
- Assumed average development size of 200 ac
- Moderately Managed Lawns Mid-IFAS 3.5 lb-N/1000ft2
- Limited Pond retention
- Limited Lawn Irrigation

Existing N Load	7.20	lbs-N/ac/yr
Existing N Concentration	1.53	mg/l
Average Annual Runoff	20.76	in/yr

BMPs	Type	N Reduction[1] Range %	N Reduction[1] Typical %	Initial Cost of BMP[2] ($/ac)	Annual Cost[3] per acre ($/ac/yr)	Annual Cost[3] N Removed ($/lb/ac/yr)	Quickness of Response
Fertility							
Reduced N Fertilization (IFAS low, placement, and type)	Owner	0 to 50	25	15	4.8	3	Fast
Dry Retention/Swales[4] 0.25"	Typical	10 to 50	25	6400	2048	1138	Fast
Wet Detention - 0.25"	Typical	10 to 40	20	8000	2560	1778	Fast
Street Sweeping	Typical	0 to 10	2	20	6.4	44	Fast
Sediment/Baffle Boxes	Typical	2 to 30	15	440	140.8	130	Fast
Dry Detention - Regional	Alternative	5 to 35	15	3200	1024	948	Fast
Wet Detention - Regional	Alternative	5 to 30	15	4000	1280	1185	Fast
Typical/Owner BMP Program Reduced N Fertilization, Swales, and limited Dry Retention/Sweeping		0 to 70	50	6415	2052.8	570	Fast
Owner BMP Program Reduced N Fertilization		0 to 60	25	15	4.8	3	Fast
Typical BMP Program Limited Dry Retention, Street Sweeping, Sediment R/D and Wetland Restoration		5 to 50	25	6400	2048	1138	Fast
Alternative BMP Program Stormwater R/D with Chemical Treatment		5 to 35	15	3200	1024	948	Fast

1 Estimated values assume no other BMPs applied. Note, combined BMPs will reduce effectiveness of individual BMPs
2 Costs presented on per acre of entire development basis unless otherwise noted. Costs value only include implementation cost, i.e. does not include O&M Costs.
3 The annual cost include amortized capital costs at 10% interest over a twenty-year life span and a 20% per year of capital cost for annual O&M.
4 Adjusted down to correct for reported Dry Detention reductions not including ground water re-emergent N loads.

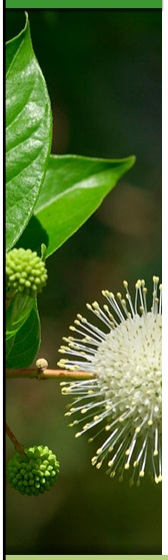


P Unit Loads and Reduction Factors

Land Use Category	Land Use Description	FLUCCS	Unit P Load (lbs/acre/yr)	Estimated Phosphorus Reduction		
				Owner Implemented BMPs (1)	Typical Cost Share BMPs	Alternative Practices
Residential Low Density	Residential Low Density[1]	1100	0.49	5%	0%	0%
Residential Medium Density	Residential Medium Density[2]	1200	1.40	5%	0%	0%
Residential High Density	Residential High Density[2]	1300	3.00	5%	5%	0%
Other Urban	Commercial/Industrial[2]	1400-1800	1.54	5%	5%	0%
Improved Pastures	Improved Pastures	2110	1.90	11%	19%	49%
Unimproved Pastures	Unimproved Pastures	2120	0.92	7%	13%	44%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	0.66	4%	6%	35%
Row Crops	Row Crops	2140	4.50	30%	30%	50%
Sugar Cane	Sugar Cane	2156	0.63	10%	23%	52%
Citrus	Citrus	2210	1.80	12%	20%	42%
Sod Farms	Sod Farms	2420	2.52	20%	27%	50%
Ornamentals	Ornamentals	2430	2.90	32%	35%	50%
Horse Farms	Horse Farms	2510	1.82	20%	22%	49%
Dairies	Dairies	2520	9.38	9%	28%	48%
Other Areas	Other Areas	2150-2610	2.78	15%	25%	36%
Tree Plantations	Tree Plantations	4400	0.18	1%	10%	50%
Water	Water	5000	0.05	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	0.14	0%	0%	0%
Transportation	Transportation	8100	1.65	10%	23%	52%
Communication/Utilities	Communication/Utilities	8200/8300	0.48	5%	5%	0%

1 Assumed on Septic
2 Assumed all of Discharge from WWT outside basin

SOUTH FLORIDA WATER MANAGEMENT DISTRICT



P Reductions

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit P Load (lbs/acre/yr)	Total P (MT/yr)	Estimated P Reduction	
						(percent)	(MT/yr)
Residential Low Density	Residential Low Density[1]	1100	4.3%	0.49	4.9	5%	0.2
Residential Medium Density	Residential Medium Density[2]	1200	7.4%	1.40	24.3	5%	1.2
Residential High Density	Residential High Density[2]	1300	1.5%	3.00	10.5	10%	1.0
Other Urban	Commercial/Industrial2	1400-1800	3.1%	1.54	11.2	10%	1.1
Improved Pastures	Improved Pastures	2110	20.7%	1.90	91.8	30%	27.5
Unimproved Pastures	Unimproved Pastures	2120	2.9%	0.92	6.3	20%	1.3
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.7%	0.66	11.9	10%	1.2
Row Crops	Row Crops	2140	1.5%	4.50	16.1	60%	9.7
Sugar Cane	Sugar Cane	2156	1.1%	0.63	1.6	33%	0.5
Citrus	Citrus	2210	22.6%	1.80	95.3	32%	30.5
Sod Farms	Sod Farms	2420	0.1%	2.52	0.3	47%	0.2
Ornamentals	Ornamentals	2430	0.2%	2.90	1.6	67%	1.1
Horse Farms	Horse Farms	2510	0.2%	1.82	0.6	42%	0.3
Dairies	Dairies	2520	0.1%	9.38	1.8	37%	0.7
Other Areas	Other Areas	2150-2610	0.8%	2.78	5.2	40%	2.1
Tree Plantations	Tree Plantations	4400	0.0%	0.18	0.0	11%	0.0
Water	Water	5000	2.2%	0.05	0.3	0%	0.0
Natural Areas	Forrests/wetlands/Open	4000/6000	20.5%	0.14	6.5	0%	0.0
Transportation	Transportation	8100	1.1%	1.65	4.2	33%	1.4
Communication/Utilities	Communication/Utilities	8200/8300	2.0%	0.48	2.3	10%	0.2
Total Basin			**100.0%**	**1.22**	**286**	**28%**	**79**

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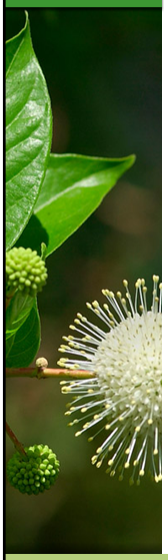
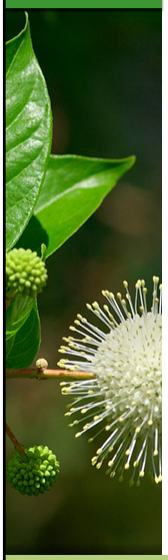


N Unit Loads and Reduction Factors

Land Use Category	Land Use Description	FLUCCS	Unit N Load (lbs/acre/yr)	Estimated Nitrogen Reduction		
				Owner Implemented BMPs	Typical Incentive BMPs	Alternative Practices
Residential Low Density	Residential Low Density[1]	1100	4.95	15%	15%	15%
Residential Medium Density	Residential Medium Density[2]	1200	7.20	25%	25%	15%
Residential High Density	Residential High Density[2]	1300	10.80	30%	25%	15%
Other Urban	Commercial/Industrial[2]	1400-1800	7.80	25%	25%	15%
Improved Pastures	Improved Pastures	2110	9.99	17%	10%	30%
Unimproved Pastures	Unimproved Pastures	2120	4.95	11%	8%	30%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	3.69	4%	6%	20%
Row Crops	Row Crops	2140	13.50	30%	30%	50%
Sugar Cane	Sugar Cane	2156	7.20	10%	23%	52%
Citrus	Citrus	2210	7.65	10%	20%	42%
Sod Farms	Sod Farms	2420	8.10	20%	27%	50%
Ornamentals	Ornamentals	2430	10.80	25%	25%	25%
Horse Farms	Horse Farms	2510	14.40	30%	22%	30%
Dairies	Dairies	2520	18.00	20%	40%	48%
Other Areas	Other Areas	2150-2610	7.91	15%	25%	36%
Tree Plantations	Tree Plantations	4400	2.79	5%	10%	25%
Water	Water	5000	0.81	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	1.88	0%	0%	0%
Transportation	Transportation	8100	8.28	20%	23%	25%
Communication/Utilities	Communication/Utilities	8200/8300	5.40	30%	25%	15%

1 Assumed on Septic
2 Assumed all of Discharge from WWT outside basin

SOUTH FLORIDA WATER MANAGEMENT DISTRICT



N Reductions

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit N Load (lbs/acre/yr)	Total N (MT/yr)	Estimated N Reduction (percent)	Estimated N Reduction (MT/yr)
Residential Low Density	Residential Low Density[1]	1100	4.29%	4.95	49.6	30%	14.9
Residential Medium Density	Residential Medium Density[2]	1200	7.43%	7.20	125.0	50%	62.5
Residential High Density	Residential High Density[2]	1300	1.50%	10.80	37.8	55%	20.8
Other Urban	Commercial/Industrial2	1400-1800	3.09%	7.80	56.4	55%	31.0
Improved Pastures	Improved Pastures	2110	20.67%	9.99	482.8	27%	130.4
Unimproved Pastures	Unimproved Pastures	2120	2.92%	4.95	33.8	19%	6.4
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.65%	3.69	66.0	10%	6.6
Row Crops	Row Crops	2140	1.53%	13.50	48.4	60%	29.0
Sugar Cane	Sugar Cane	2156	1.08%	7.20	18.2	33%	6.0
Citrus	Citrus	2210	22.64%	7.65	404.9	30%	121.5
Sod Farms	Sod Farms	2420	0.06%	8.10	1.1	47%	0.5
Ornamentals	Ornamentals	2430	0.24%	10.80	6.1	50%	3.1
Horse Farms	Horse Farms	2510	0.15%	14.40	5.1	52%	2.7
Dairies	Dairies	2520	0.08%	18.00	3.4	60%	2.1
Other Areas	Other Areas	2150-2610	0.80%	7.91	14.8	40%	5.9
Tree Plantations	Tree Plantations	4400	0.00%	2.79	0.0	15%	0.0
Water	Water	5000	2.22%	0.81	4.2	0%	0.0
Natural Areas	Forrests/wetlands/Open	4000/6000	20.49%	1.88	90.1	0%	0.0
Transportation	Transportation	8100	1.10%	8.28	21.3	43%	9.2
Communication/Utilities	Communication/Utilities	8200/8300	2.05%	5.40	25.8	55%	14.2
Total Basin			**100%**	**6.23**	**1,457**	**31%**	**446**

1 Assumed on Septic
2 Assumed all of Discharge from WWT outside basin

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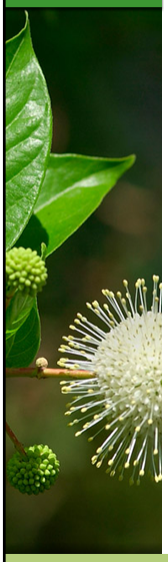
Summary



- Developed N and P loading rates for the Caloosahatchee and St. Lucie watersheds
- Provided N and P load reduction rates and associated costs with BMP Implementation
- Linked to land use data for determining potential N and P reductions due to BMP implementation

St. Lucie River Watershed Protection Plan

Table 1 - ALTERNATIVE 1
WORKING DRAFT - MAY 27, 2008

MM#	Sub-Watershed	Project Feature/Activity	Level	Alternative
LO 14	C-44	CERP - IRL South: C-44 Reservoir/STA	B	0
SLE 45	North Fork	10 Mile Creek - Reservoir and STA	B	0
LO 1	SLE Watershed	Agricultural BMPs - Owner Implemented , Funded Cost Share, and Cost Share Future Funding (Combined LO 1, 2, and 49)	1	1
LO 12		Alternative Water Storage (AWS) - Lake Okeechobee and Estuary Recovery	-	1
LO 12f		AWS - Indiantown Citrus Growers Association	1	1
LO 12j		AWS - Dupuis	4	1
LO 12m		AWS - Waste Management St. Lucie Site	4	1
LO 12q		AWS - Caulkins	4	1
LO 15	SLE Watershed	St. Lucie River Watershed Works of the District Rule Regulatory Phosphorus Source Control Program	2	1
LO 21	SLE Watershed	LO and Estuary Watershed Basin Rule (LOER)	3	1
LO 3	SLE Watershed	Urban Turf Fertilizer Rule (LOER)	1	1
LO 4	SLE Watershed	Land Application of Residuals	1	1
LO 5	SLE Watershed	Florida Yards and Neighborhoods	1	1
LO 50	SLE Watershed	Agricultural BMPs - Additional Agricultural BMPs	1	1
LO 63	SLE Watershed	Wastewater and Stormwater Master Plans	4	1
LO 64	SLE Watershed	Unified Statewide Stormwater Rule	4	1
LO 68	SLE Watershed	Comprehensive Planning-Land Development Regulations	3	1
LO 7	SLE Watershed	ERP Regulatory Program	1	1
LO 8	SLE Watershed	NPDES Stormwater Program	1	1
LO 87a_1	C-25	Alderman-Deloney Ranch (C-25 basin)	1	1
LO 87c	SLE Watershed	Florida Ranchlands Environmental Services Project- full implementation	5	1
LO 9	SLE Watershed	Coastal and Estuarine Land Conservation Program	1	1
SLE 02	North Fork	White City Drainage Improvements (canals B, C,D, E, F, G) SLE2a and 2b	2	1
SLE 03	North Fork	White City Drainage Improvements (Citrus/Saeger)	1	1
SLE 06	North Fork	Indian River Estates/Savannas Ecosystem Management Project	1	1
SLE 07	North Fork	Platt's Creek Wetland Restoration	1	1
SLE 09a	C-44, South Fork	CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	1	1
SLE 09b	C-23	CERP - IRL South: Allapattah Complex - Natural Storage and Water Quality Area	1	1
SLE 09c	C-23	CERP - IRL South: Cypress Creek/Trail Ridge Complex - Natural Storage and Water Quality Area	2	1
SLE 11	Estuary	Creation of suitable oyster substrate in the St. Lucie Estuary at Various sites identified in IRL-South PIR (Artificial Habitat Creation)	1	1

MM#	Sub-Watershed	Project Feature/Activity	Level	Alternative
SLE 16	C-23/C-24	Improved management of sludge disposal in St. Lucie County through the use of an innovative technology (Plasma-Arc)	1	1
SLE 22	North Fork	North River Shores Vacuum Sewer System	1	1
SLE 24	C-23, C-24, North Fork	CERP - IRL South: C-23/24 Reservoir/STA	1	1
SLE 26	North Fork	CERP - IRL South: Northfork Natural Floodplain Restoration	2	1
SLE 27	Estuary	CERP - IRL South: Muck Remediation	3	1
SLE 28	South Fork	Tropical Farms Roebuck Creek Stormwater Quality Retrofit	1	1
SLE 29	4, 5, & 6	Old Palm City Phase III Stormwater Quality Retrofit	1	1
SLE 30	South Fork	Manatee Pocket Dredging Project	1	1
SLE 38	SLE Watershed	Urban BMP Program	1	1
SLE 40	C-23, C-44	CERP – IRL South: Southern Diversion C-23 to C-44 interconnect	1	1
SLE 42	North Fork	Jensen Beach Retrofit	1	1
SLE 43	North Fork	Leilani Hts/ Warner Creek Retrofit - Phase 1, 2 & 3	1	1
SLE 44	South Fork	Manatee Creek Water Quality Retrofit; PhII & PhIII; New Monrovia, Dixie Park	1	1
SLE 52	North Fork	E-8 Canal Storm Water Retrofit	1	1
SLE 53	South Fork	Frazier Creek Water Quality	1	1
SLE 54	South Fork	Haney Creek Wetland Restoration	1	1
SLE 55	South Fork	Poppleton Creek	1	1

St. Lucie River Watershed Protection Plan

Table 2 - Water Quality Benefits - Alternative 1 Management Measures
WORKING DRAFT - MAY 27, 2008

					Load Reductions	
MM#	**Project Feature/Activity**	**Sub-Watershed**	**Level**	**Project Scale**	**Total Phosphorus (MT/yr)**	**Total Nitrogen (MT/yr)**
LO 14	CERP - IRL South: C-44 Reservoir/STA	C-44	B	Regional	33.9	107.6
SLE 06	Indian River Estates/Savannas Ecosystem Management Project	North Fork	1	Local	0.76	0.83
SLE 09a	CERP - IRL South: PalMar Complex - Natural Storage and Water Quality Area	C-44, South Fork	1	Regional	3.43	13.39
SLE 09b	CERP - IRL South: Allapattah Complex - Natural Storage and Water Quality Area	C-23	1	Regional	8.47	32.73
SLE 09c	CERP - IRL South: Cypress Creek/Trail Ridge Complex - Natural Storage and Water Quality Area	C-23	2	Regional	6.49	25.29
SLE 22	North River Shores Vacuum Sewer System	North Fork	1	Local	2.18	8.57
SLE 24	CERP - IRL South: C-23/24 Reservoir/STA	C-23, C-24, North Fork	1	Regional	24	104.2
SLE 26	CERP - IRL South: Northfork Natural Floodplain Restoration	North Fork	2	Regional	0.57	2.23
SLE 28	Tropical Farms Roebuck Creek Stormwater Quality Retrofit	South Fork	1	Local	0.04	0.21
SLE 29	Old Palm City Phase III Stormwater Quality Retrofit	4, 5, & 6	1	Local	0.03	0.07
SLE 42	Jensen Beach Retrofit	North Fork	1	Local	0.01	0.03
SLE 43	Leilani Hts/ Warner Creek Retrofit - Phase 1, 2 & 3	North Fork	1	Local	0.16	0.41
SLE 44	Manatee Creek Water Quality Retrofit; PhII & PhIII; New Monrovia, Dixie Park	South Fork	1	Local	0.08	0.20
SLE 45	10 Mile Creek - Reservoir and STA	North Fork	B	Regional	4.45	18.5
LO 1	Agricultural BMPs - Owner Implemented , Funded Cost Share, and Cost Share Future Funding (Combined LO 1, 2, and 49	SLE Watershed	1	Source Control	N/A	N/A
LO 3	Urban Turf Fertilizer Rule (LOER)	SLE Watershed	1	Source Control	N/A	N/A
LO 4	Land Application of Residuals	SLE Watershed	1	Source Control	N/A	N/A
LO 5	Florida Yards and Neighborhoods	SLE Watershed	1	Source Control	N/A	N/A
LO 7	ERP Regulatory Program	SLE Watershed	1	Source Control	N/A	N/A
LO 8	NPDES Stormwater Program	SLE Watershed	1	Source Control	N/A	N/A
LO 15	St. Lucie River Watershed Works of the District Rule Regulatory Phosphorus Source Control Program	SLE Watershed	2	Source Control	N/A	N/A
LO 21	LO and Estuary Watershed Basin Rule (LOER)	SLE Watershed	3	Source Control	N/A	N/A
LO 50	Agricultural BMPs - Additional Agricultural BMPs	SLE Watershed	1	Source Control	N/A	N/A
LO 63	Wastewater and Stormwater Master Plans	SLE Watershed	4	Source Control	N/A	N/A
LO 64	Unified Statewide Stormwater Rule	SLE Watershed	4	Source Control	N/A	N/A
SLE 38	Urban BMP Program	SLE Watershed	1	Source Control	N/A	N/A

This list contains management measures included in Alternative 1 of the SLRWPP
Numbers represent estimates of potential load reductions for Total Nitrogen (TN) and Total Phosphorus (TP) in metric tons per year (MT/yr)
Status: DRAFT version of ALt 1 is complete, with minor adjustments in progress
Source: Simplified from the information compiled in the master alternatives work sheet updated 5/22/08

TABLE 3A
Summary of Estimated Total Phosphorus Load Reductions to the St. Lucie Estuary
Working DRAFT - May 27, 2008

		Water Quality Existing Condition			LOP2TP - Baseline Water Quality Condition				
Subwatershed	Area (acres)	Average Annual Discharge (1995-2005) (Acre-ft)	Average Annual TP Load (1995-2005) (Mtons)	Average Annual TP Conc. (Calculated) (ppb)	Load Red. (Mtons)	Remain. Load (Mtons)	Remain. Conc. - calculated (ppb)	Adjusted Remain. Load* (Mtons)	Base Load Reduction (%)
Basins 4 5 6	15,055	23,620	6.38	218.96	0.00	6.38	218.96	6.38	0%
C-23	112,675	152,789	90.57	480.55	0.00	90.57	480.55	90.57	0%
C-24	87,706	178,853	75.73	343.25	0.00	75.73	343.25	75.73	0%
C-44&S-153	129,719	158,194	39.69	203.38	26.10	13.58	69.61	15.83	60%
North Fork	119,168	126,152	43.26	278.00	4.45	38.81	249.40	38.81	10%
South Fork	49,965	59,408	20.90	285.16	0.00	20.90	285.16	20.90	0%
Lake Okeechobee	-	414,754	96.25	188.14	67.39	28.86	56.40	41.51	57%
Total	514,287	1,113,771	372.76	271.33	97.95	274.82	-	289.72	22%

* - When reductions were projected to results in concentrations less than 81 ppb, the remaining load was estimated by multiplying the basin flow by 81 ppb.

TABLE 3B
Summary of Estimated Total Phosphorus Load Reductions to the St. Lucie Estuary
Working DRAFT - May 27, 2008

	Alternative 1										
Subwatershed	Owner Implemented BMPs		Cost-Share BMPs		Local Projects		Regional Projects		Summary of Alternative 1		
	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Remain. Conc. - calculated (ppb)	Adjusted Remain. Load* (Mtons)	Alt 1 Load Reduction (%)
Basins 4 5 6	0.56	5.82	0.46	5.36	0.03	5.33	0.00	5.33	182.99	5.33	16%
C-23	10.52	80.04	14.22	65.83	0.00	65.83	39.00	26.83	142.36	26.83	70%
C-24	8.70	67.02	11.60	55.42	0.00	55.42	0.00	55.42	251.22	55.42	27%
C-44&S-153	4.44	11.39	6.20	5.19	0.00	5.19	2.65	2.54	13.01	15.81	60%
North Fork	3.62	35.19	3.67	31.52	3.11	28.41	0.57	27.84	178.92	27.84	36%
South Fork	2.66	18.23	2.73	15.51	0.12	15.39	0.00	15.39	210.01	15.39	26%
Lake Okeechobee	0.00	41.51	0.00	41.51	0.00	41.51	0.00	41.51	81.13	41.51	57%
Total	30.50	259.22	38.87	220.34	3.26	217.08	42.22	174.86	127.28	188.13	50%

* - When reductions were projected to results in concentrations less than 81 ppb, the remaining load was estimated by multiplying the basin flow by 81 ppb.

TABLE 4A
Summary of Estimated Total Nitrogen Load Reductions to the St. Lucie Estuary
Working DRAFT - May 27, 2008

		Water Quality Existing Condition			LOP2TP - Baseline Water Quality Condition				
Subwatershed	Area (acres)	Average Annual Discharge (1995-2005) (Acre-ft)	Average Annual TN Load (1995-2005) (Mtons)	Average Annual TN Conc. (Calculated) (ppm)	Load Red. (Mtons)	Remain. Load (Mtons)	Remain. Conc. - calculated (ppm)	Adjusted Remain. Load* (Mtons)	Alt 1 Load Reduction (%)
Basins 4 5 6	15,055.40	23,619.82	34.43	1.18	0.00	34.43	1.18	34.43	0%
C-23	112,674.50	152,789.15	329.78	1.75	0.00	329.78	1.75	329.78	0%
C-24	87,705.80	178,853.46	355.00	1.61	0.00	355.00	1.61	355.00	0%
C-44&S-153	129,718.90	158,194.28	300.49	1.54	85.00	215.49	1.10	215.49	28%
North Fork	119,167.90	126,151.97	185.31	1.19	18.50	166.81	1.07	166.81	10%
South Fork	49,964.70	59,407.72	91.13	1.24	0.00	91.13	1.24	91.13	0%
Lake Okeechobee	-	414,754.47	922.00	1.80	623.91	298.09	0.58	368.35	60%
Total	514,287.20	1,113,770.86	2,218.14	1.61	727.41	1,490.73	-	1,490.73	33%

* - When reductions were projected to results in concentrations less than 0.72 ppm, the remaining load was estimated by mulitplying the basin flow by 0.72 ppm.

TABLE 4B
Summary of Estimated Total Nitrogen Load Reductions to the St. Lucie Estuary
Working DRAFT - May 27, 2008

	Alternative 1										
Subwatershed	Owner Implemented BMPs		Cost-Share BMPs		Local Projects		Regional Projects		Summary of Alternative 1		
	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Load Red. (Mtons)	Remain. Load (Mtons)	Remain. Conc. - calculated (ppm)	Adjusted Remain. Load* (Mtons)	Alt 1 Load Reduction (%)
Basins 4 5 6	6.05	28.38	4.29	24.09	0.07	24.02	0.00	24.02	0.82	24.02	30%
C-23	44.90	284.88	38.36	246.52	0.00	246.52	162.20	84.32	0.45	135.70	59%
C-24	52.30	302.70	38.21	264.50	0.00	264.50	0.00	264.50	1.20	264.50	25%
C-44&S-153	30.78	184.71	31.12	153.59	0.00	153.59	10.57	143.02	0.73	143.02	52%
North Fork	34.25	132.56	29.06	103.50	9.84	93.66	2.23	91.43	0.59	112.04	40%
South Fork	16.20	74.93	11.47	63.46	0.41	63.05	0.00	63.05	0.86	63.05	31%
Lake Okeechobee	0.00	368.35	0.00	368.35	0.00	368.35	0.00	368.35	0.72	368.35	60%
Total	184.47	1,008.17	152.51	855.65	10.32	845.33	175.00	1,038.68	-	1,110.67	50%

* - When reductions were projected to results in concentrations less than 0.72 ppm, the remaining load was estimated by mulitplying the basin flow by 0.72 ppm.