Water Resources Advisory Commission
June 4, 2009

Phase I Planning Update

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Phase I Planning Process

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Planning Process

- Where We Have Been and Where We Are Headed
  - ✓ Development of Vision and Goal Statements
  - ✓ Development of Problems, Objectives, and Constraints
  - ✓ Development of Tools (including modeling and maps)
  - ✓ Development of Team Configurations
  - Evaluation of Stakeholder Team Configurations (You are here)
  - Evaluation of Relationships, Tradeoffs, Other Considerations
  - Discuss Viable Concepts/Features and Common Elements
  - Discuss Concepts for more Detailed Analysis
  - Utilize Analysis to Support Decision Making for Concepts in Phase II Planning

Planning Process- Evaluation of Stakeholder Team Configurations

- June 2nd
  - Provided Preliminary Results and Planning Level Cost Estimates
  - Perspectives Regarding Review of Results and Evaluation of Relationships, Tradeoffs, etc.
- June 18th
  - Breakout Sessions with Evaluation Teams/Technical Staff for Q&A and Discussion re: Preliminary Results
  - Group Discussion - Initial Thoughts on Lessons Learned, Relationships, Tradeoffs, Other Considerations

Planning Process- Evaluating Relationships and Developing Refined Concepts

- After June…
  - Evaluate Relationships
    - Tradeoffs between Benefits, Impacts, and Costs for -
      - Different Types of Features
      - Within Various Portions of the System
  - Discuss Viable Concepts/Features and Common Elements
    - What features are fundamental/common to all plans?
    - What features show promise but require more detailed information or a greater understanding?
    - What features show less promise?
    - Other considerations
  - Discuss Concepts for more Detailed Analysis

Methodology for Evaluating Water Quality Performance of Team Configurations

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Water Quality Modeling Overview

- Water Quality Modeling Approach
  - Work in concert with RESOPS
  - Capable of quickly evaluating a large number of team configurations
- Steady State Design Model (Kadlec and Knight 1996)
  - Simpler approach than dynamic model (e.g., DMSTA)
  - Strength - efficiently evaluates long-term average performance of a large number of alternatives identified in Phase I Planning
  - Weakness – forecasting short-term dynamic treatment performance and long-term performance of high hydraulic pulses
  - Previously focused on treatment in reservoirs and STAs
  - Updated to evaluate treatment potential of other features
  - Phase 2 Planning study will include more detailed water quality analyses

Water Quality Treatment Assumptions

- Northern Features
  - Did not evaluate features delivering water to LO, being addressed in the Northern Everglades Lake Okeechobee Technical Plan
- Western Features
  - Did not evaluate features delivering water to the Caloosahatchee River, being addressed in the River Watershed Protection Plan
- Water Quality
  - Lake Okeechobee- 40 ppb to 200 ppb
  - EAA current conditions – 87 ppb
  - S5A Basin – 180 ppb
  - S4 Basin – 227 ppb

Potential Treatment of Other Features

- Reservoirs
  - Inherent uncertainty of water quality performance - established a range
  - With treatment - using data from Florida lakes
  - Without treatment – due to dry out and other factors
- STAs
  - Based on the best performing STA (STA-3/4)
  - 13-23 ppb, continuing efforts to improve performance

Potential Treatment of Other Features

- Flow-ways
  - High uncertainty in predicting performance
  - Minimal vegetation or operational management
    - Less treatment compared to STA
  - May not be able to sustain a long-term positive phosphorus removal if allowed to go dry
  - If optimal treatment is preferred then flow-way will need to remain wet
    - RESOPS calculates the supplemental water needed to keep hydrated
    - May have an impact on meeting downstream hydrologic targets
- Shallow storage areas
  - For preliminary estimate of performance, evaluated as a flow-way

Potential Treatment of Other Features

- Wetlands – Managed Aquatic Plant Systems
  - Forested wetlands
    - Anecdotal information that outflows were 40 ppb, however, inflows from Lake may also have been 40 ppb, so treatment is uncertain
    - Recent scientific literature (Ewel and Odum 1986, Kadlec and Wallace 2009)
      - Mixed results, including die-off, export of TP, minimal treatment
    - Although trees have aesthetic and wildlife habitat value, from the limited performance data available, a specific phosphorus removal cannot be assigned for forested wetlands
  - Non-forested wetlands – dominated by marsh vegetation
    - Evaluated as a flow-way

Potential Treatment of Other Features

- Lake Technology Ecosloughs
  - High uncertainty in predicting performance
  - Evaluated as a flow-way
- Lake Technology Ecoreservoir
  - High uncertainty in predicting performance
  - Evaluated as a reservoir

Questions?

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Phase I Planning – Preliminary Results

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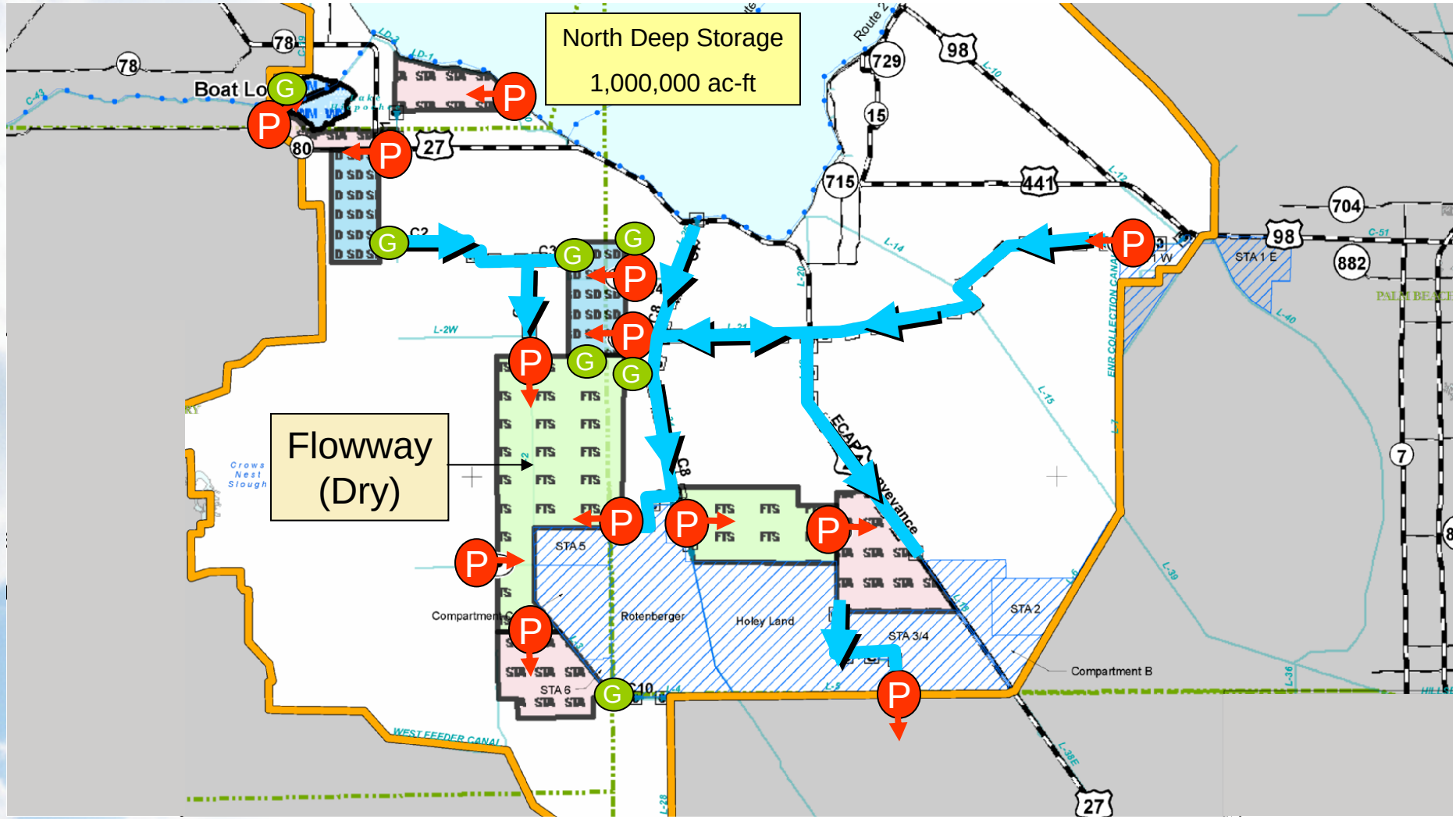
Benefits Summary

Configuration Titles/Abbreviations

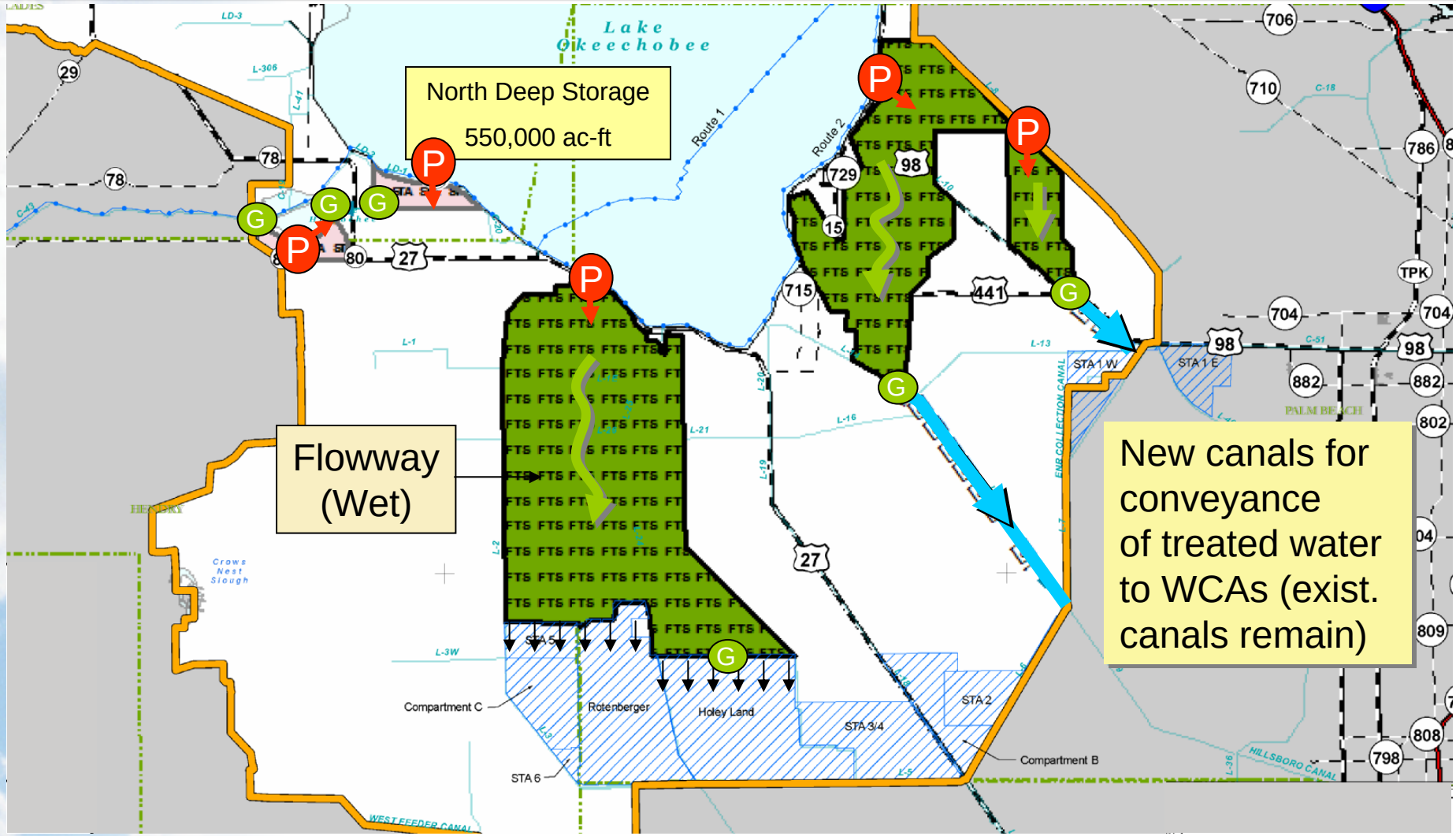
Estuary Driven Everglades Restoration	EDER
Everglades River of Grass Northern Expansion	ERNE
Chain of Lakes	CL
Florida Crystals	FC
Restoration Plus Employment	RPE
Marshall Plan Element 6	MP6
Performance	P
Performance – Cost Plan	PCP
Reservoir Within Lake Okeechobee	RWL

Estuary Driven Everglades Restoration - EDER

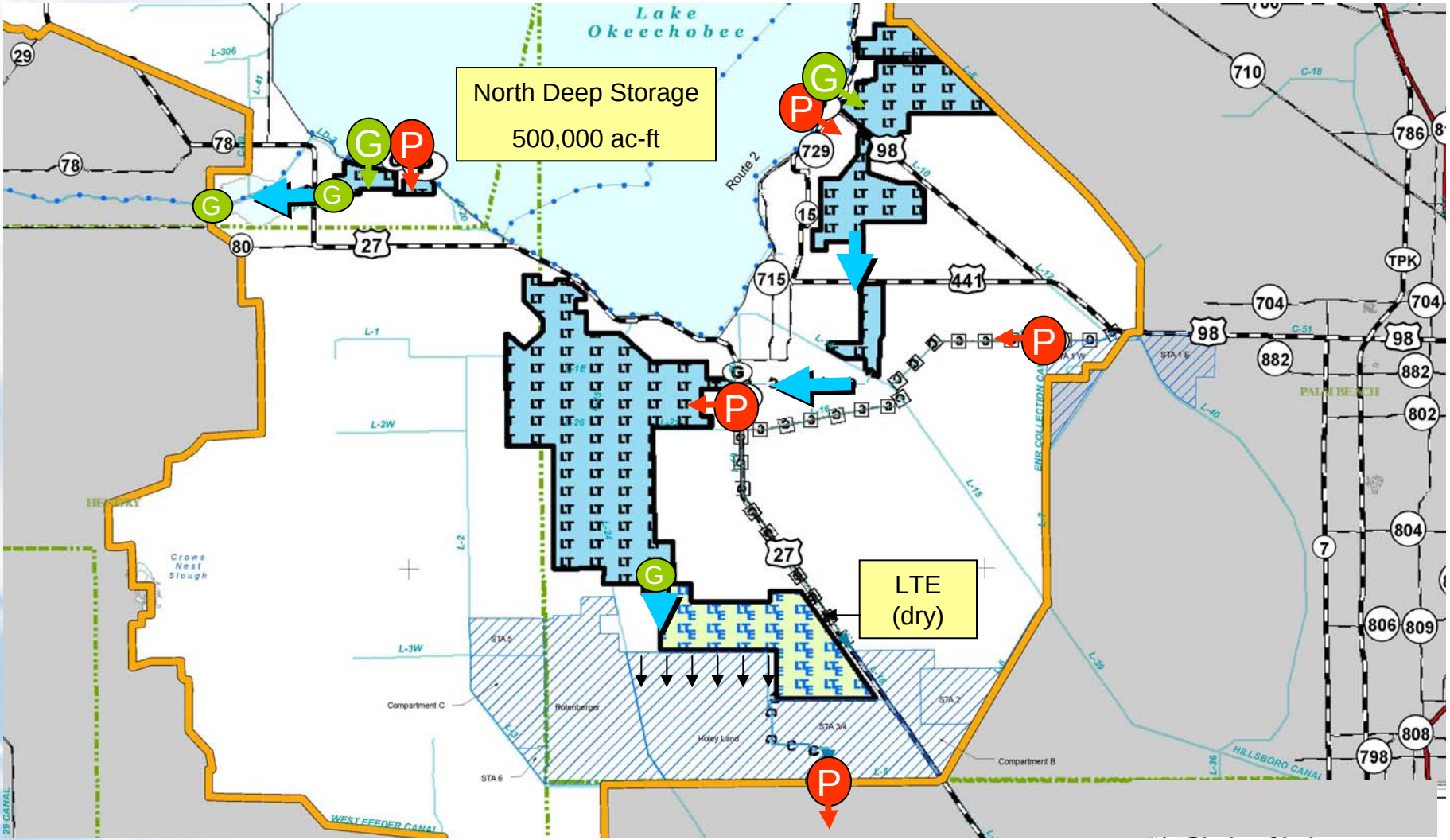
Conceptual Configuration



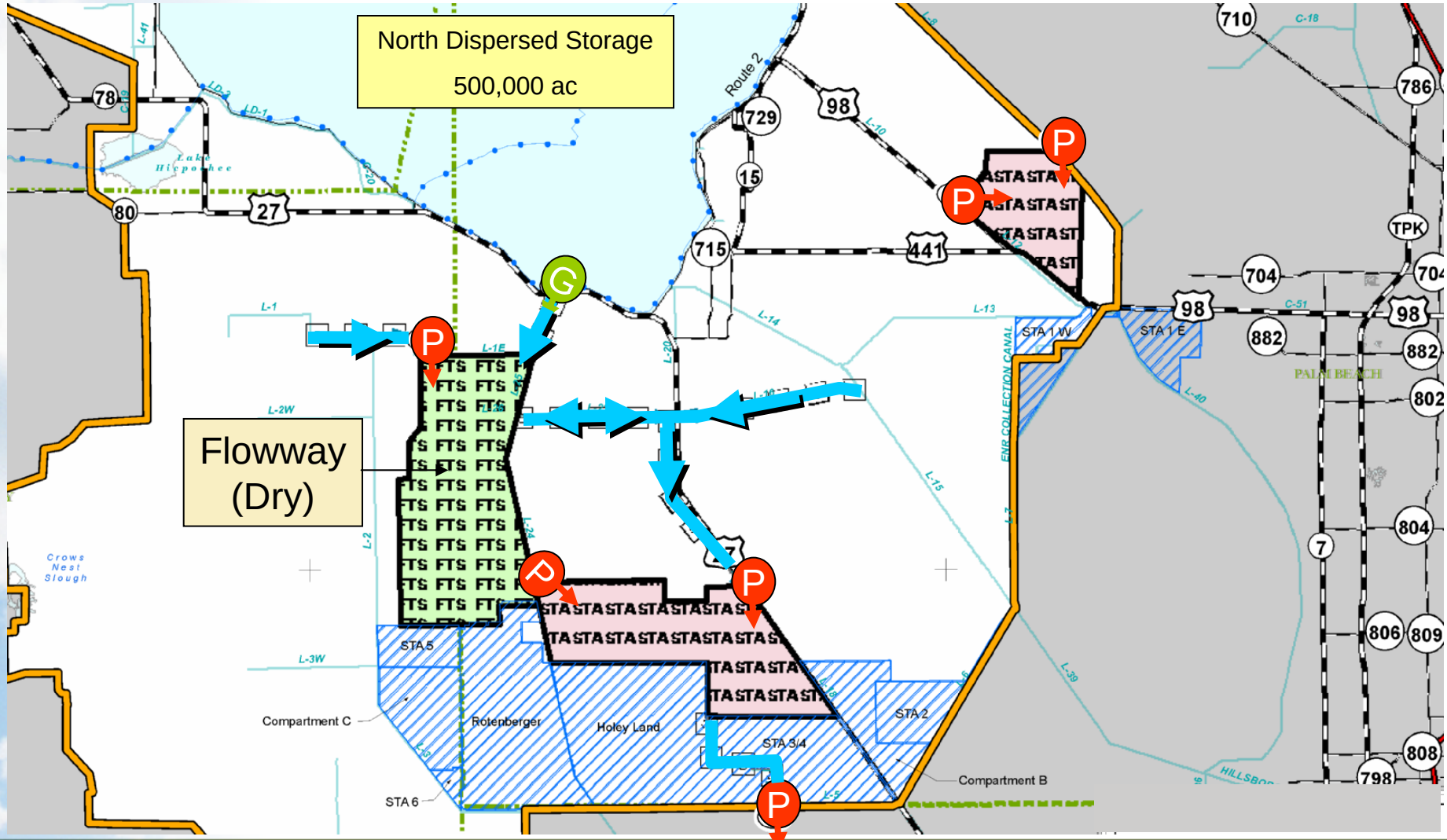
Everglades River of Grass Northern Expansion - ERNE
Conceptual Configuration



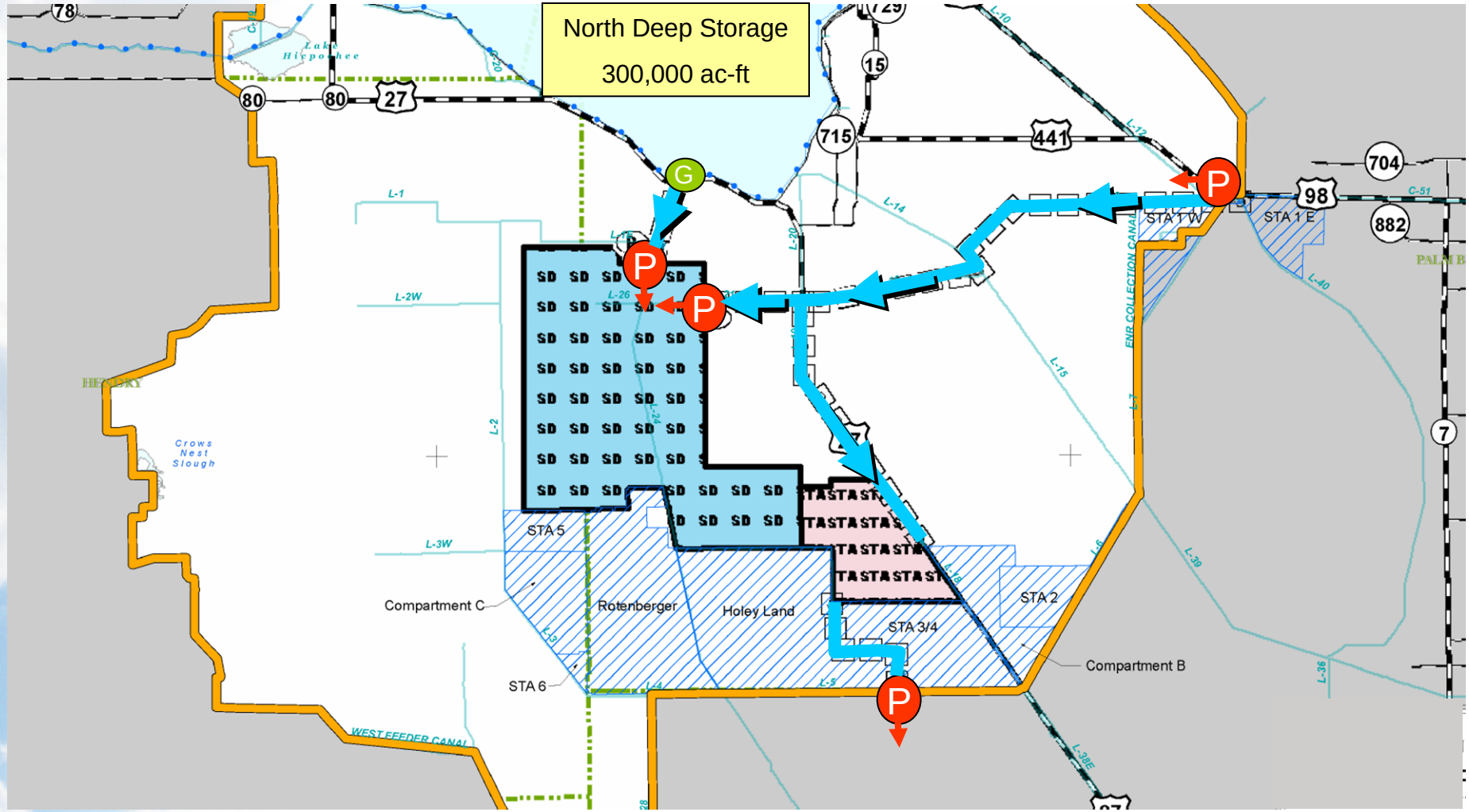
Chain of Lakes - CL
Conceptual Configuration



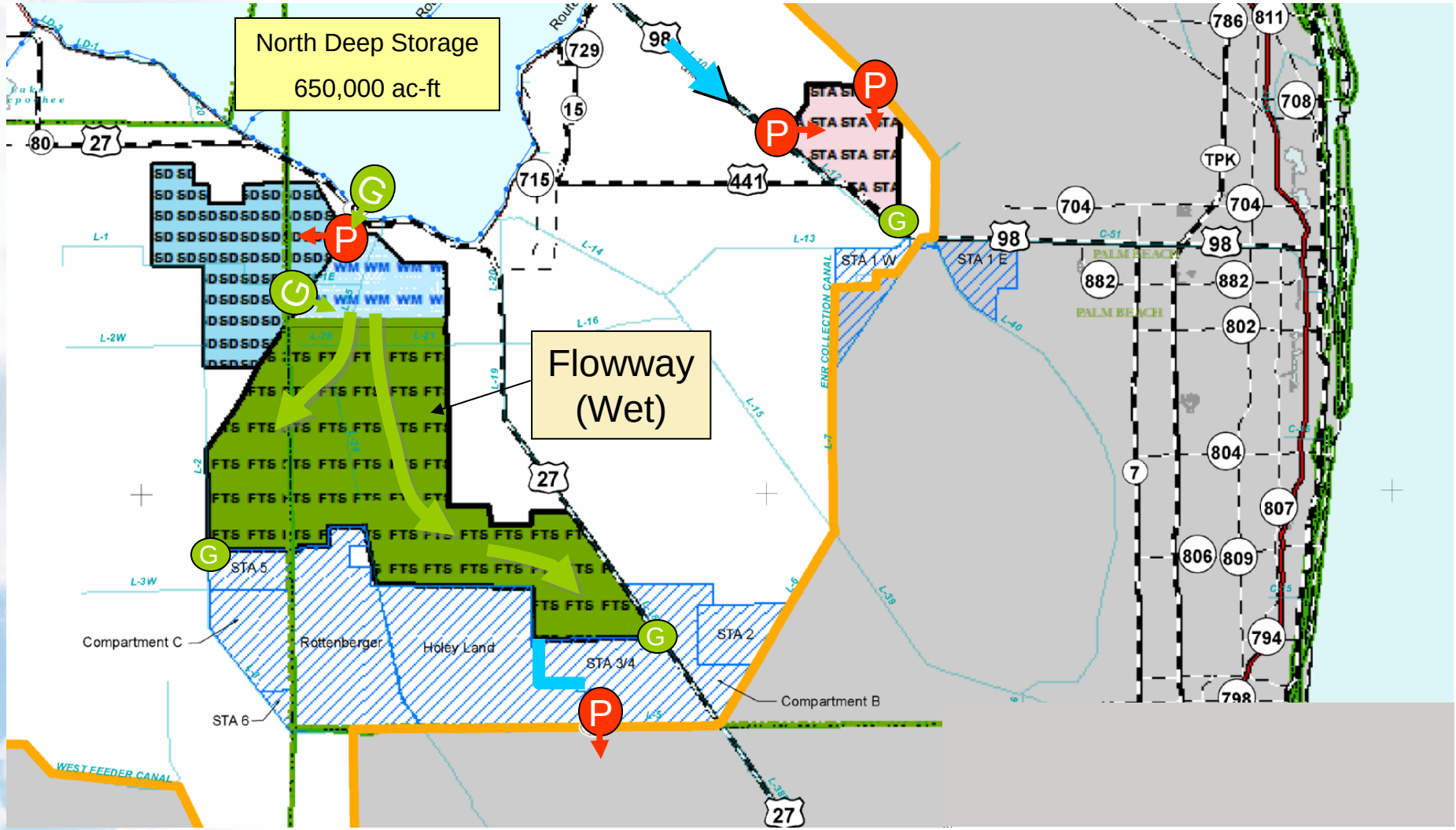
Florida Crystals - FC
Conceptual Configuration



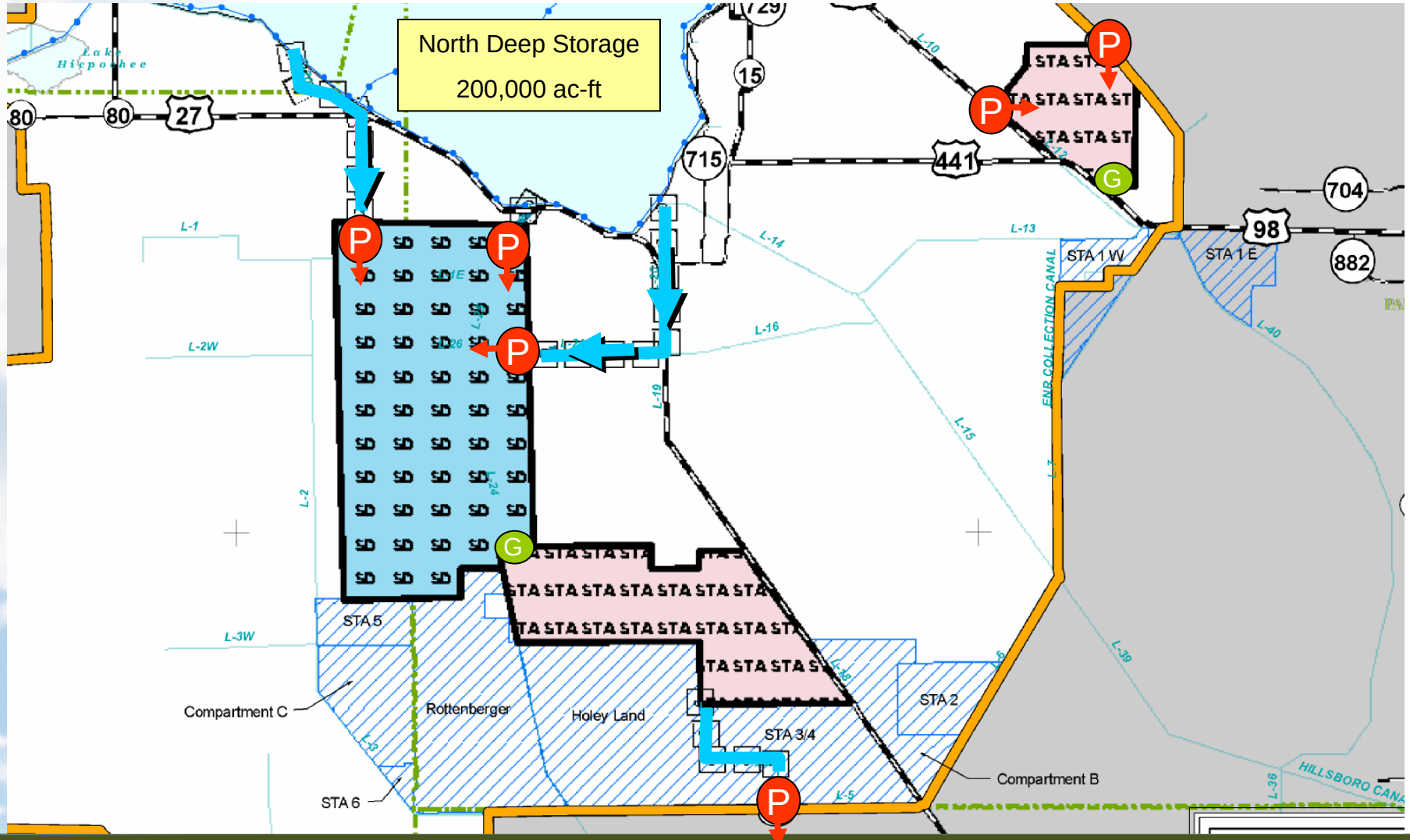
Restoration Plus Employment - RPE
Conceptual Configuration



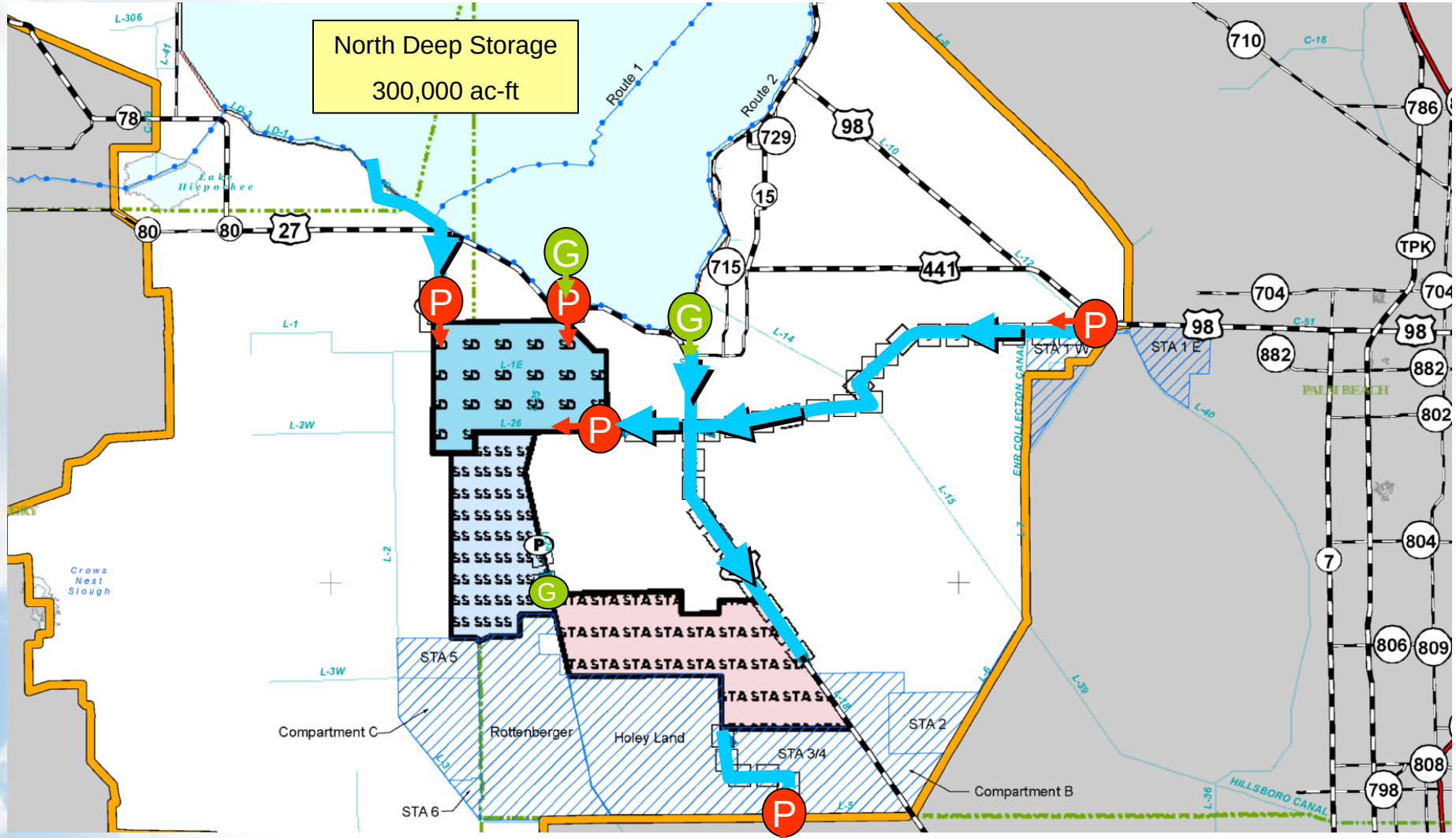
Marshall Plan Element 6 – MP6
Conceptual Configuration



Performance - P
Conceptual Configuration

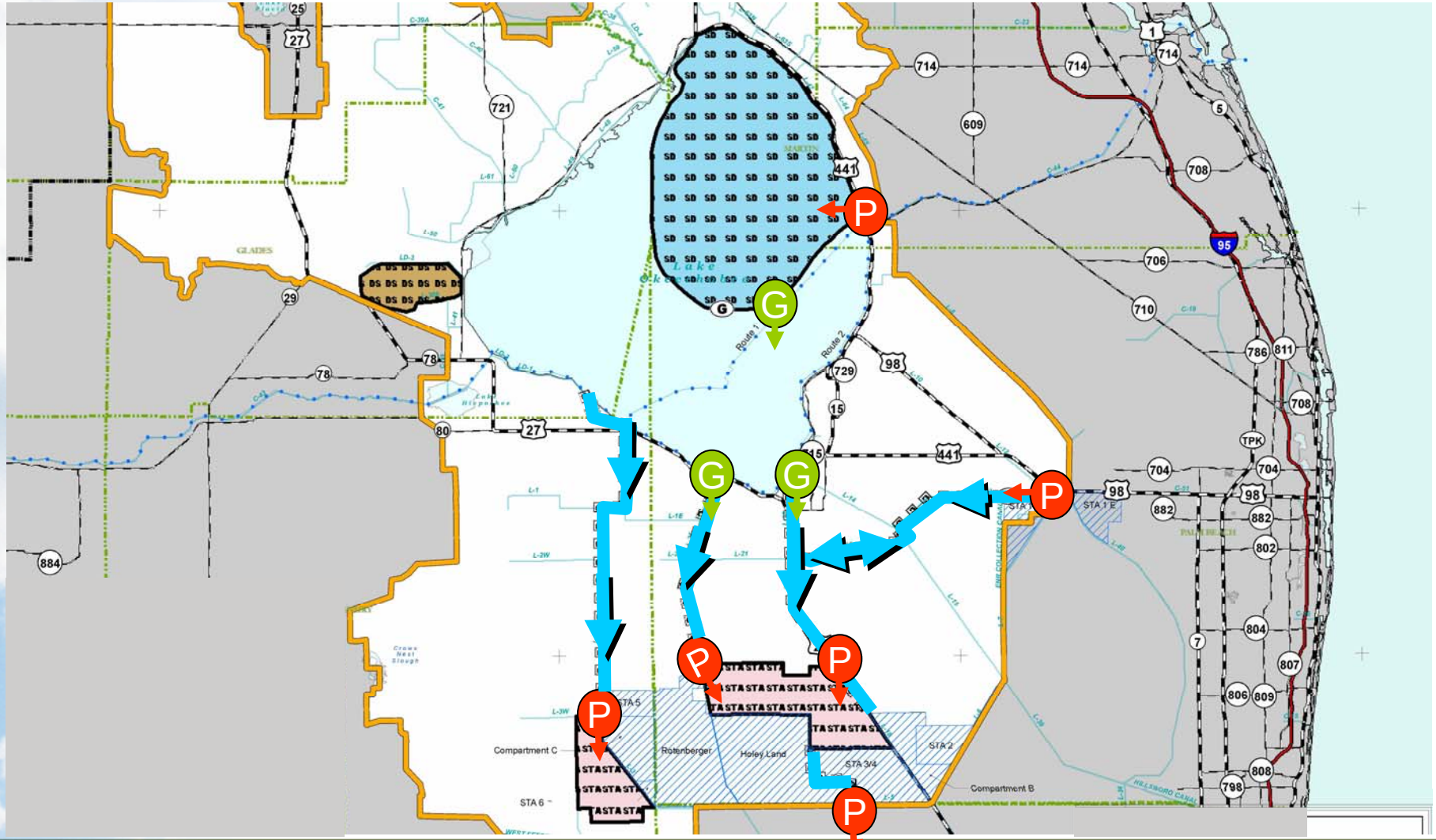


Performance Cost Plan - PCP
Conceptual Configuration



Reservoir Within Lake Okeechobee - RWL

Conceptual Configuration



Water Quality Summary

If Wet Conditions are Maintained

Additional STA Acreage Needed for Assumed Lake Okeechobee Concentration

	40 ppb	80 ppb	100 ppb	150 ppb	200 ppb
Chain of Lakes (CL)	10,100	10,100	10,100	10,100	11,600
Estuary Driven Everglades Restoration (EDER)	0	0	0	700	2,900
Everglades ROG Northern Expansion (ERNE)	2,900	2,900	2,900	2,900	2,900
Florida Crystals (FC)	0	0	0	0	0
Marshall Plan Element 6 (MP6)	3,900	3,900	3,900	3,900	3,900
Performance (P)	0	0	0	0	0
Performance-Cost Plan (PCP)	0	0	0	800	4,400
Reservoir Within Lake Okeechobee (RWL)	0	0	0	1,600	9,400
Restoration Plus Employment (RPE)	0	2,000	3,800	7,800	11,100

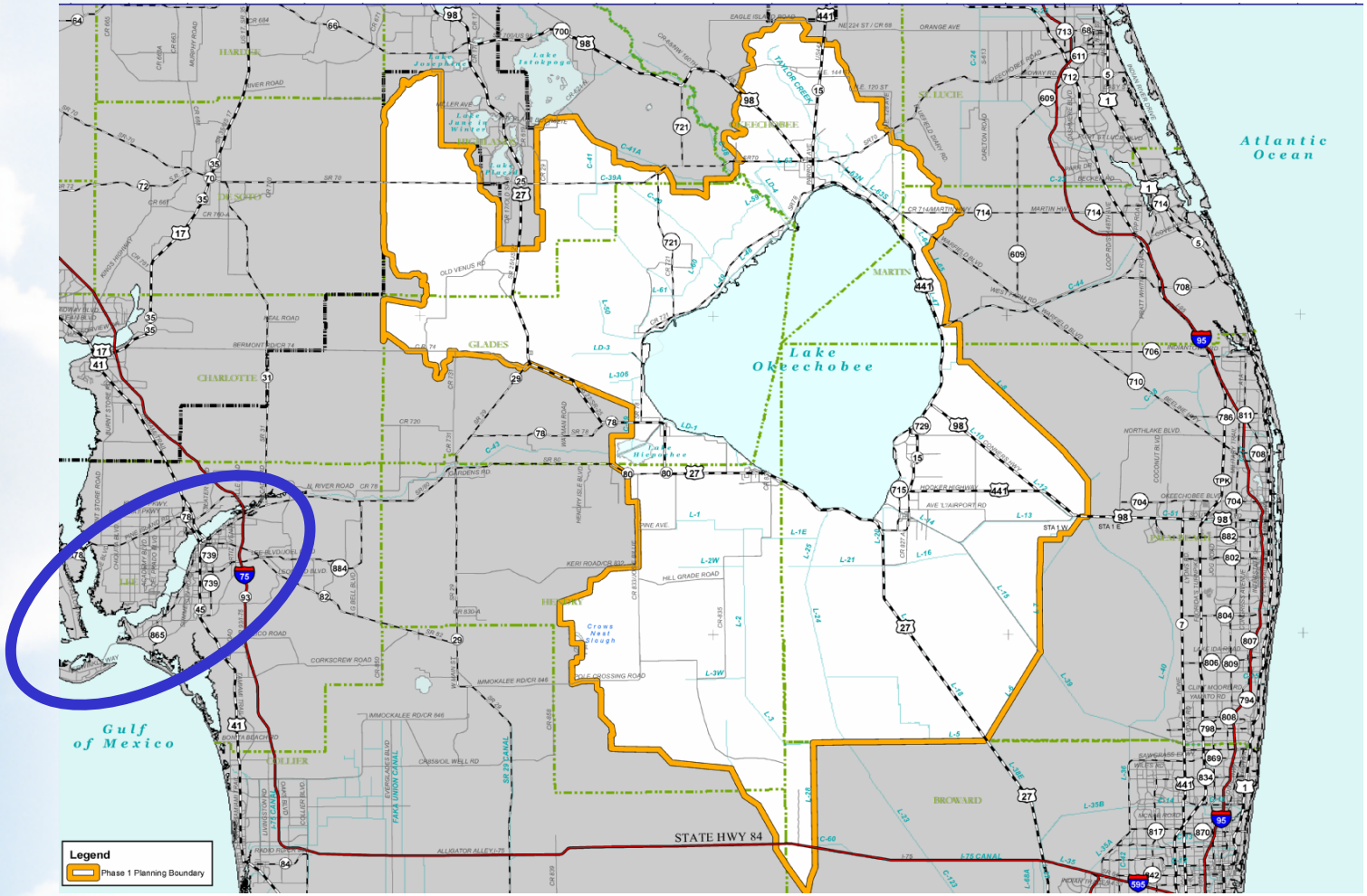
Water Quality Summary

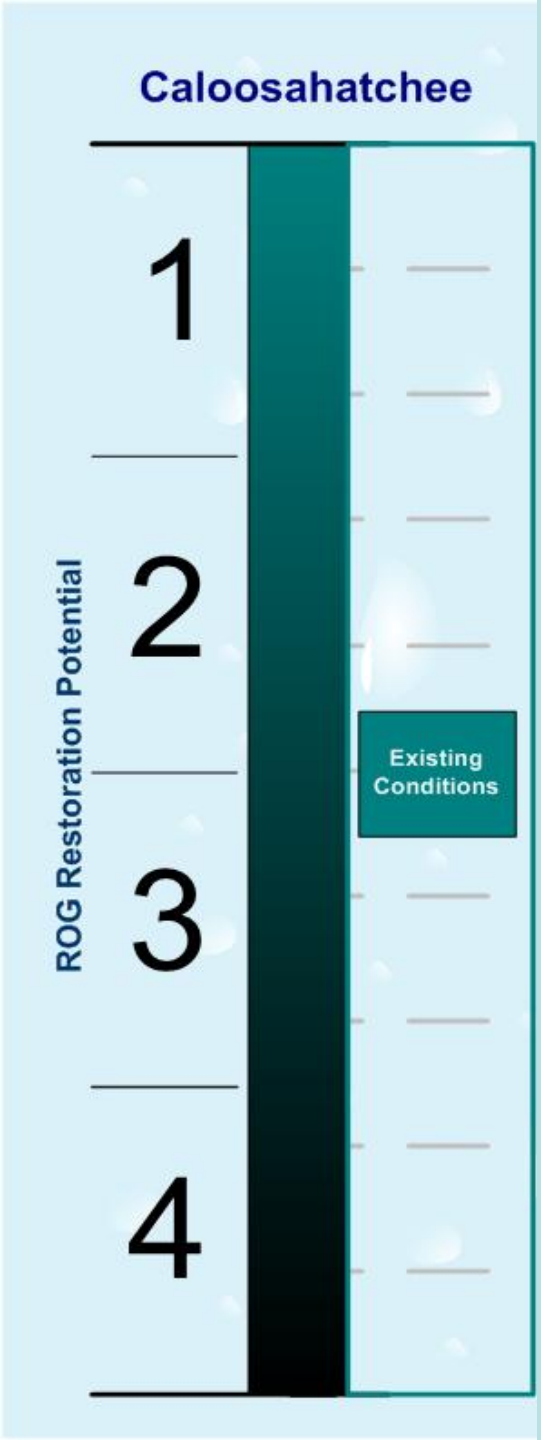
If Dry Conditions are Allowed

Additional STA Acreage Needed for Assumed Lake Okeechobee Concentration

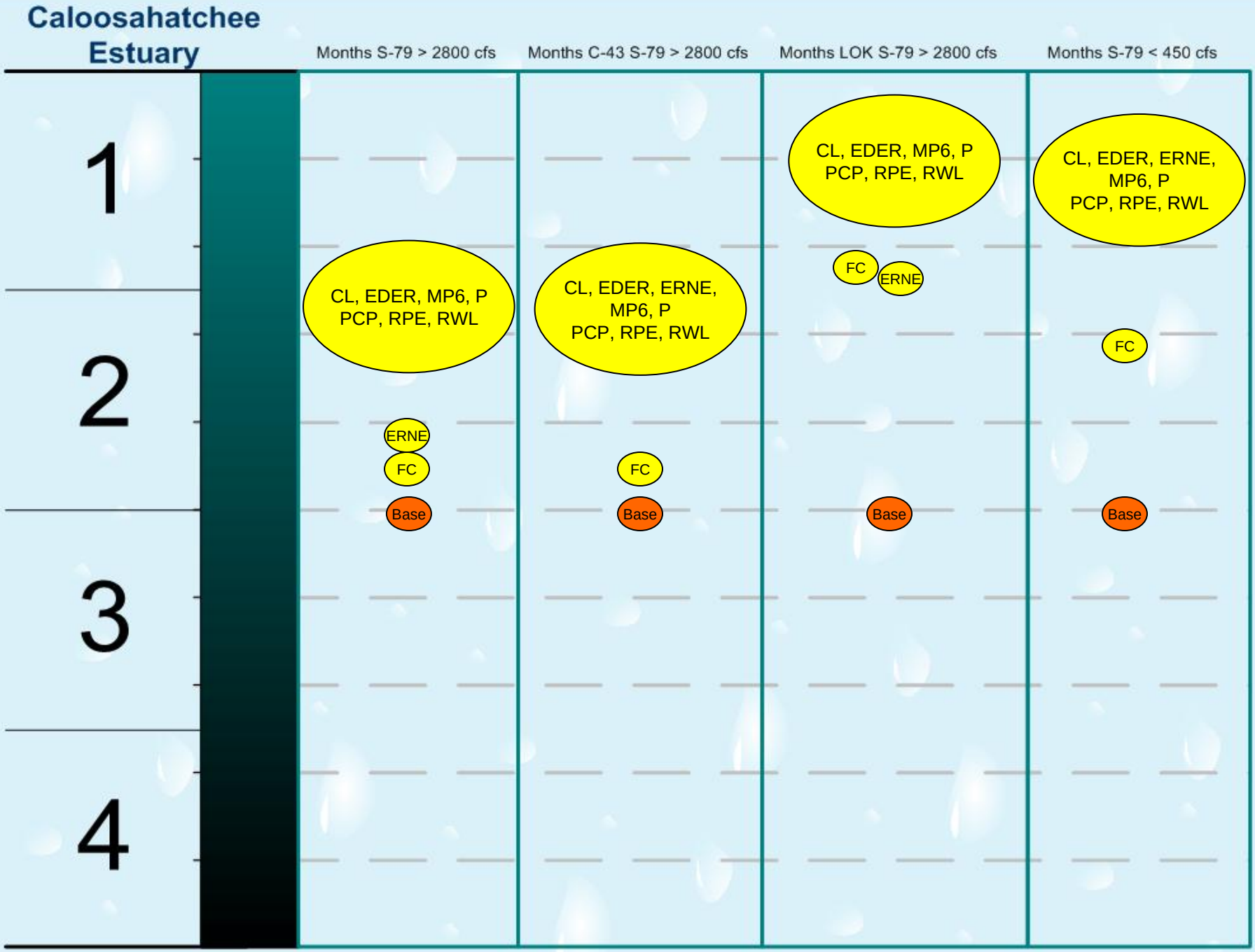
	40 ppb	80 ppb	100 ppb	150 ppb	200 ppb
Chain of Lakes (CL)	10,700	18,000	22,600	32,000	37,200
Estuary Driven Everglades Restoration (EDER)	0	1,600	3,000	9,200	14,300
Everglades ROG Northern Expansion (ERNE)	2,900	2,900	2,900	2,900	2,900
Florida Crystals (FC)	0	0	0	0	0
Marshall Plan Element 6 (MP6)	3,900	3,900	3,900	3,900	3,900
Performance (P)	0	0	0	0	5,000
Performance-Cost Plan (PCP)	0	0	0	3,700	8,700
Reservoir Within Lake Okeechobee (RWL)	0	0	0	1,600	9,400
Restoration Plus Employment (RPE)	0	6,000	8,800	14,500	19,100

Caloosahatchee Estuary

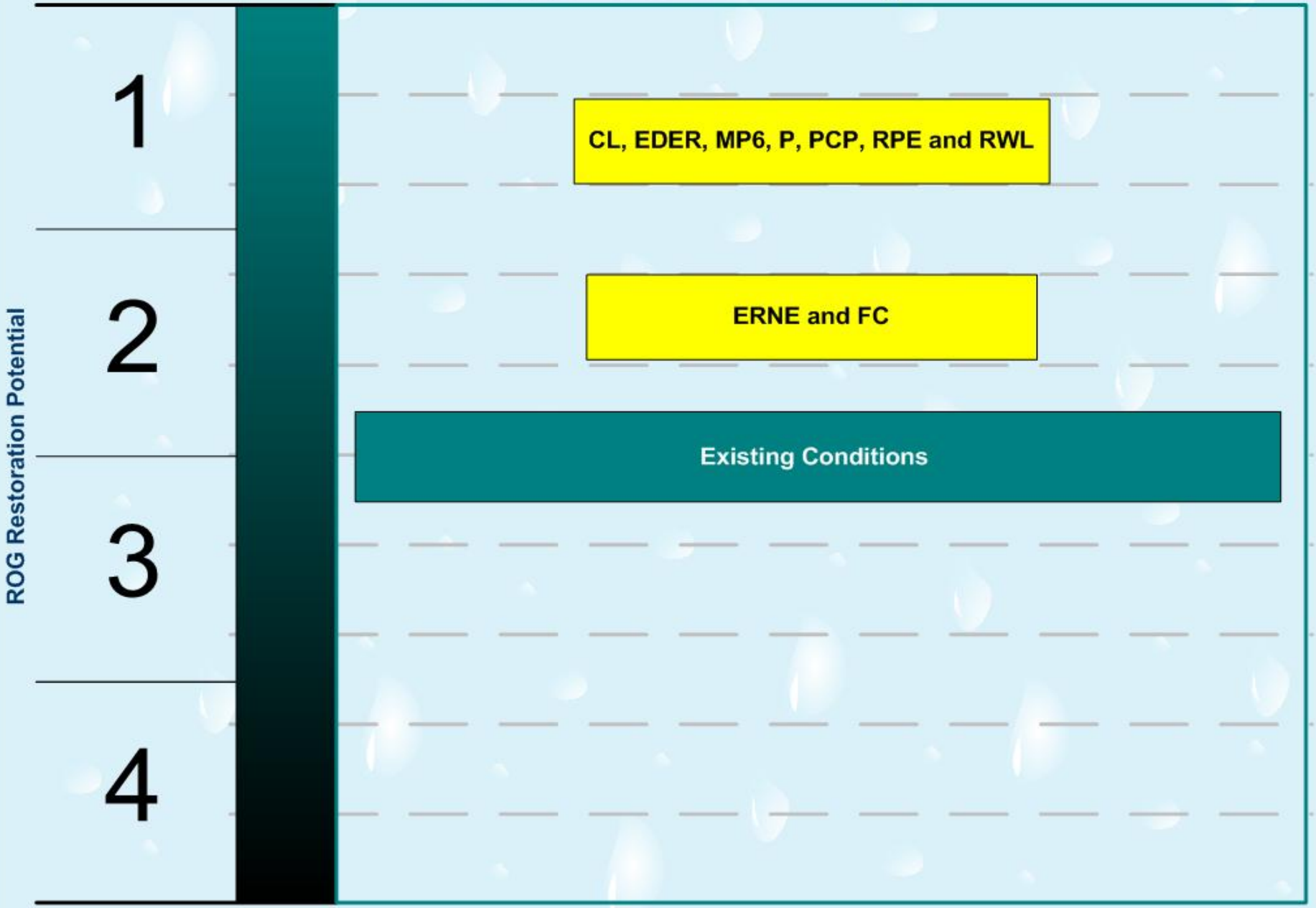




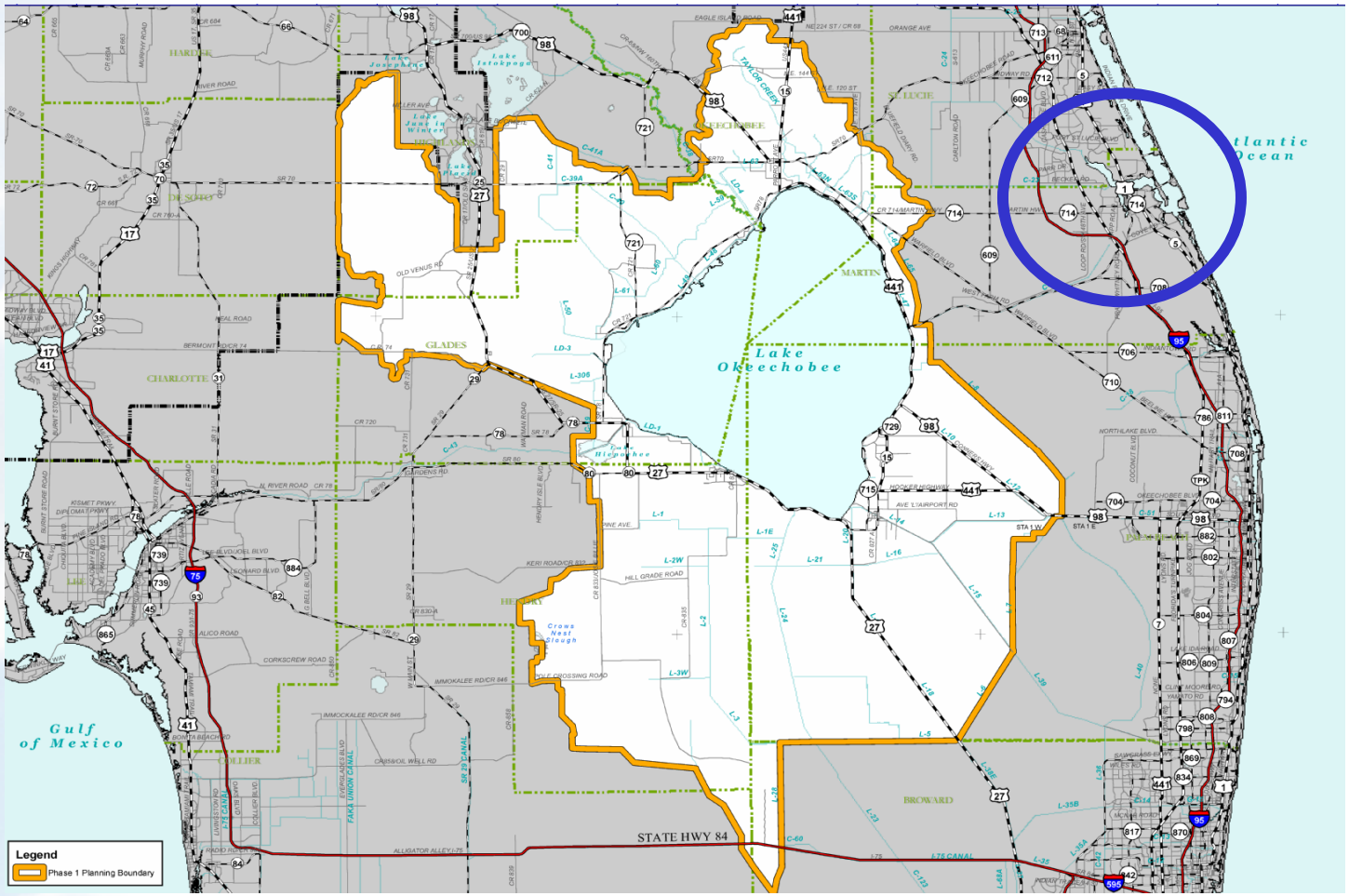
- **1** (If the model flows were achieved)
  - Permanent oyster reefs in the lower estuary
  - Permanent beds of Vallisneria in the upper estuary
  - Nursery function of the upper estuary would be maximized
  - With the sustained presence of habitat, fish and shellfish populations would reach high levels
- **2**
  - Mortality of Vallisneria and oysters once every 4 years
  - Vallisneria present in the upper estuary at least once in every 4 years
  - Oysters could maintain almost permanent populations with residents contributing to the supply of recruits
  - Upper estuary would serve as a viable nursery area for 3 of every 4 years
- **3**
  - Oyster and Vallisneria mortality events once every 2 years
  - Vallisneria would not be present in the upper estuary
  - Oysters would settle successfully every other year. The high frequency of mortality would prevent the establishment of a resident population.
  - Estuarine dependent fish populations would return to present day levels
- **4**
  - Frequency of Vallisneria and oyster mortality 3 of every 4 years
  - Unlikely that Vallisneria would be present in the upper estuary
  - Lack of structural habitat would impair its fish nursery function
  - Oysters would form oyster reefs once every 4 years, recruits from outside the estuary

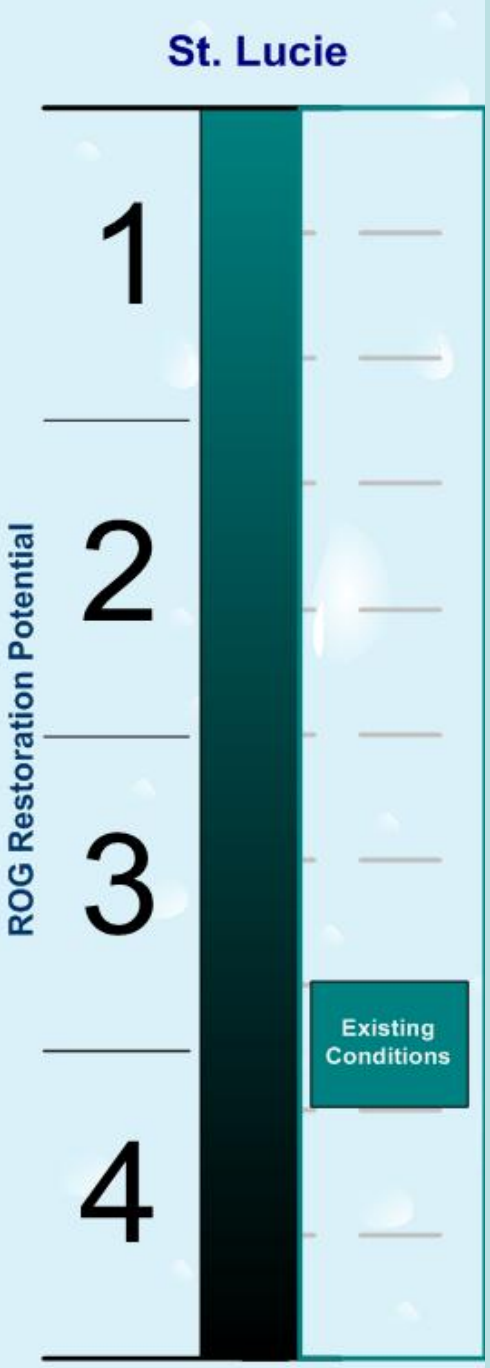

Caloosahatchee Estuary
Months S-79 > 2800 cfs
Months C-43 S-79 > 2800 cfs
Months LOK S-79 > 2800 cfs
Months S-79 < 450 cfs
1
2
3
4
CL, EDER, MP6, P
PCP, RPE, RWL
ERNE
FC
Base
CL, EDER, ERNE,
MP6, P
PCP, RPE, RWL
FC
Base
CL, EDER, MP6, P
PCP, RPE, RWL
FC
ERNE
Base
CL, EDER, ERNE,
MP6, P
PCP, RPE, RWL
FC
Base

Caloosahatchee Estuary

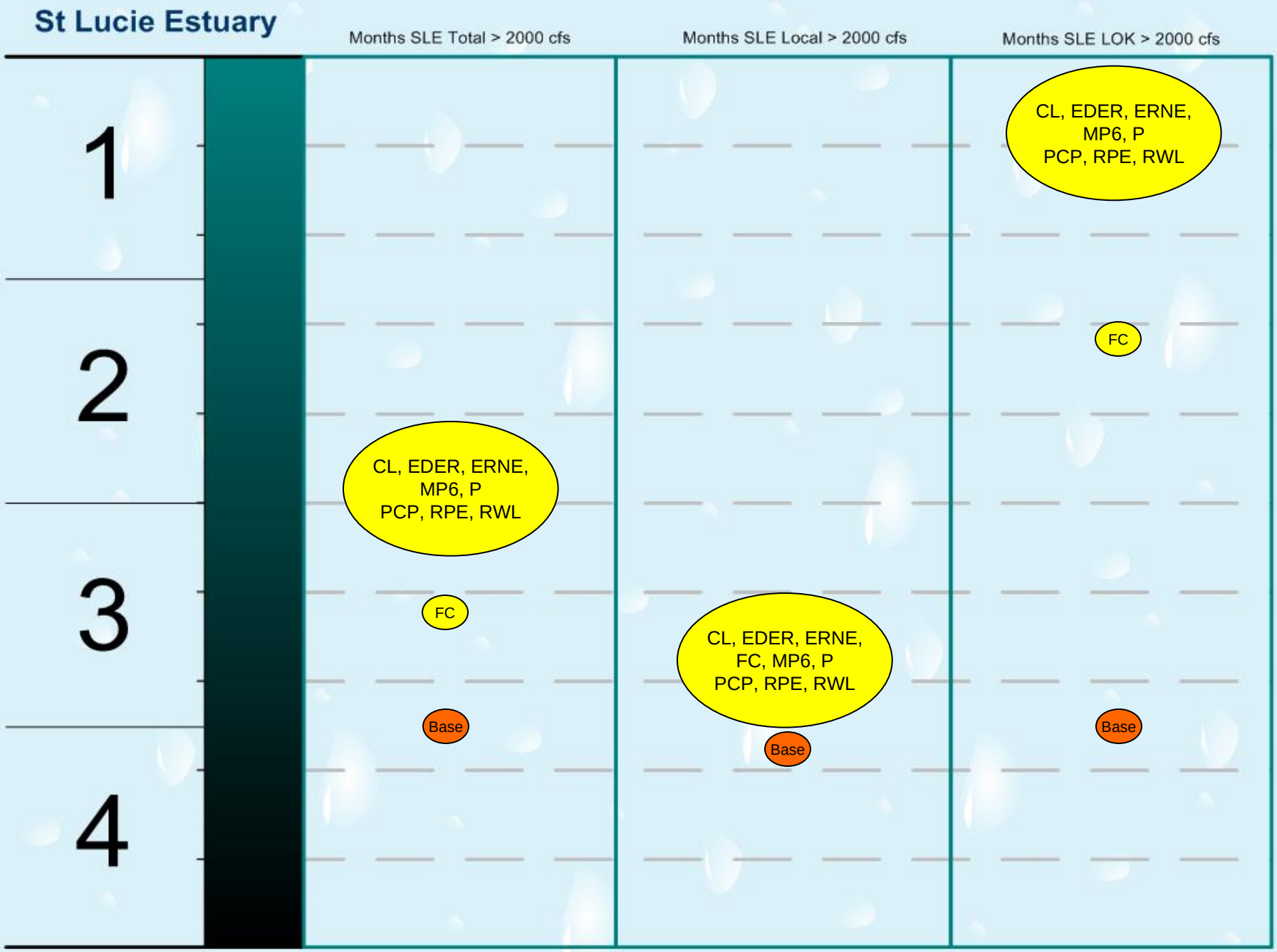


St. Lucie Estuary

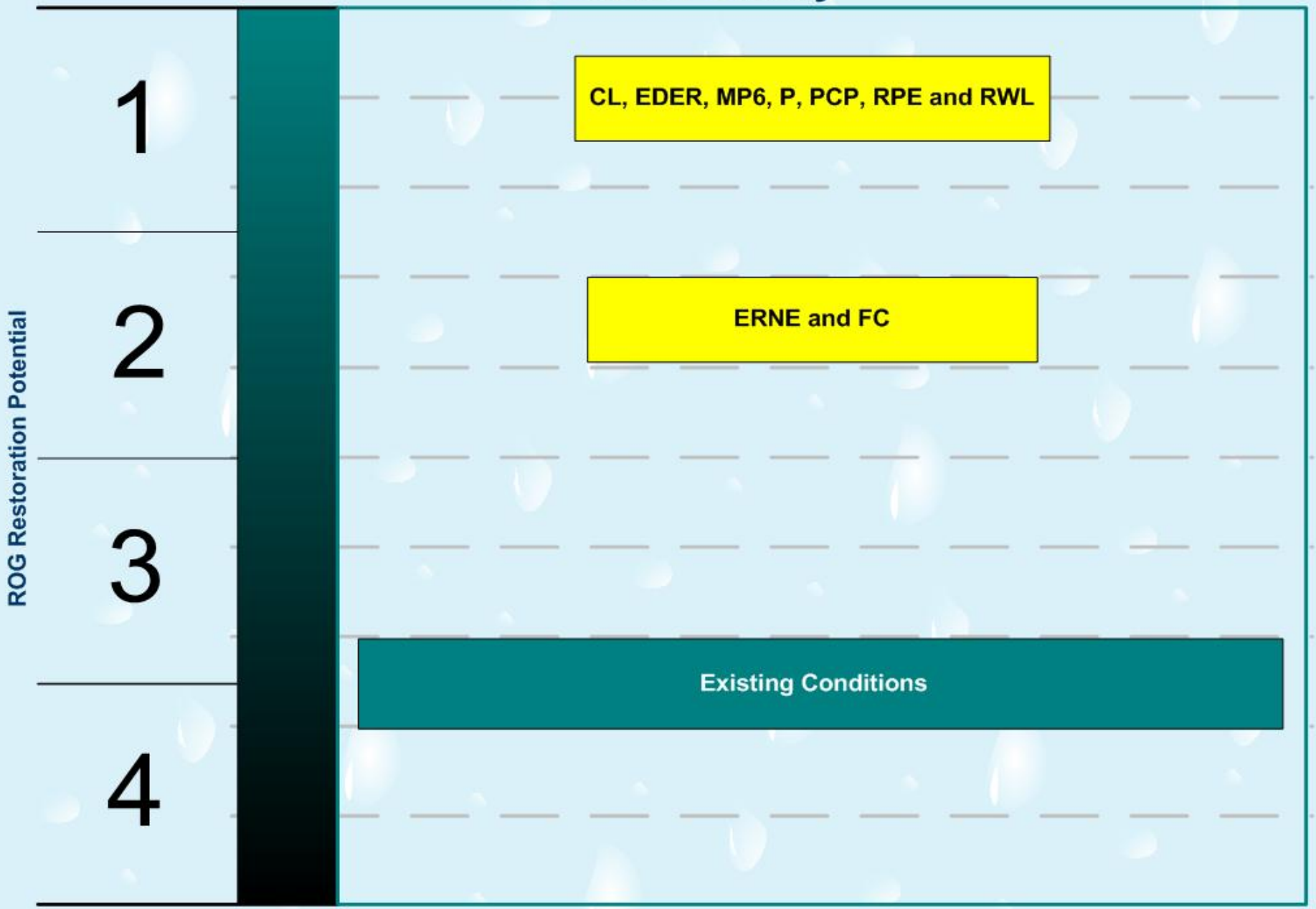




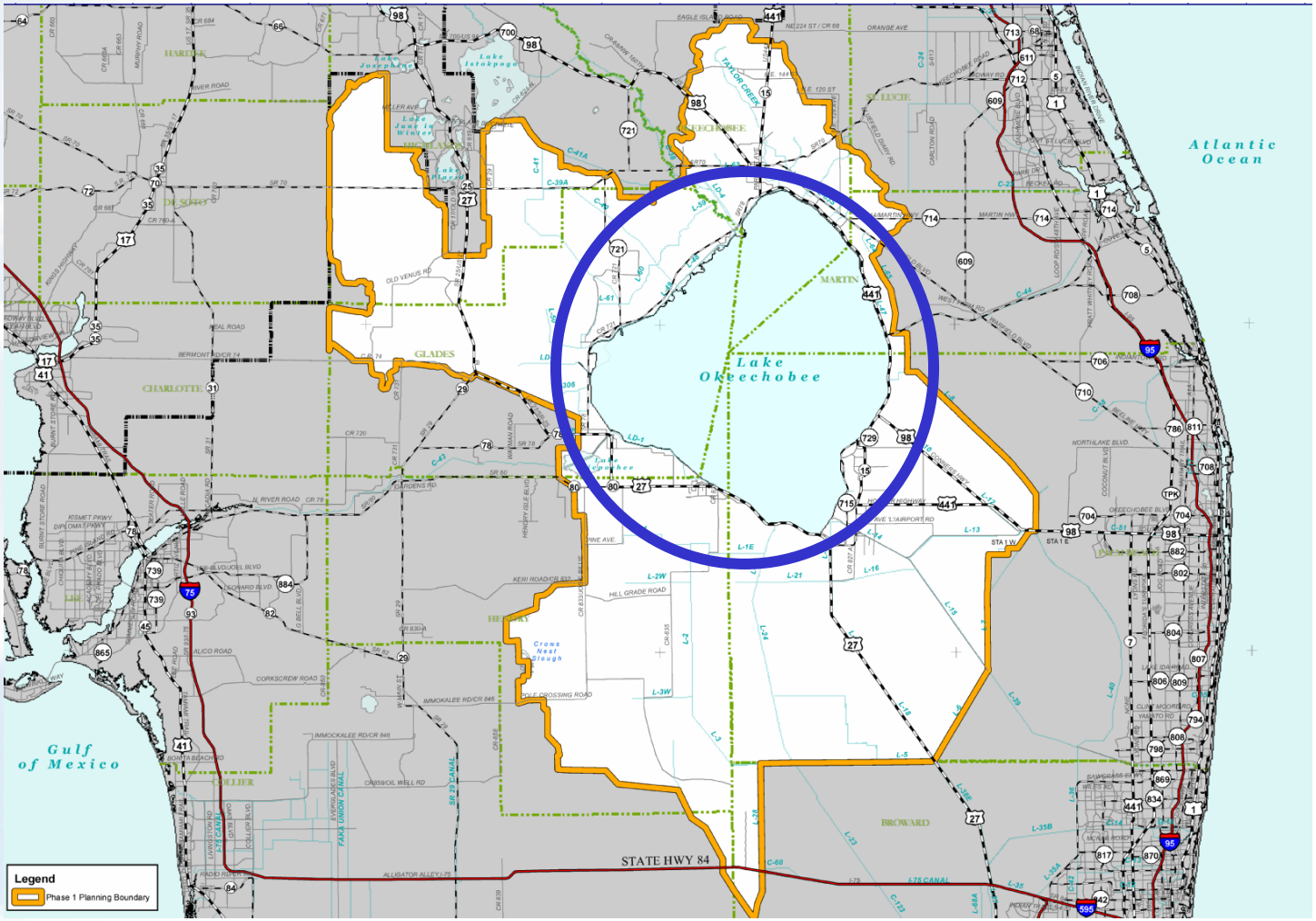
- **1**
  - Persistent Oyster reefs with extreme mortality once every 6 years
  - Oyster recruits from both inside and outside the estuary
  - Seagrasses in the adjacent IRL would improve
  - As habitat improves, the fish and shell fish will also become more abundant
- **2**
  - Oyster mortality once every 4 years with time to spawn once or twice before dying
  - Estuary larvae would contribute substantially to the population
  - Seagrasses would be present most of the time in the adjacent lagoon
- **3**
  - Oyster mortality occurs about once every 3 years and stress once every 8 months
  - Oysters present much of the time, but would not reach high densities or wide distribution
  - Seagrasses in the IRL would suffer mortality once every three years
  - Species sensitive to low salinity would show substantial recovery before the next episode of mortality
- 4
  - Oysters mortality once every 2.5 years (less than life span) and stress once every 6 months
  - High oyster mortality due to the high percentage of low flow months during the dry season caused by disease and predation
  - Permanent oyster populations would not be established in the estuary
  - Seagrasses in the adjacent IRL would suffer some mortality every three years.

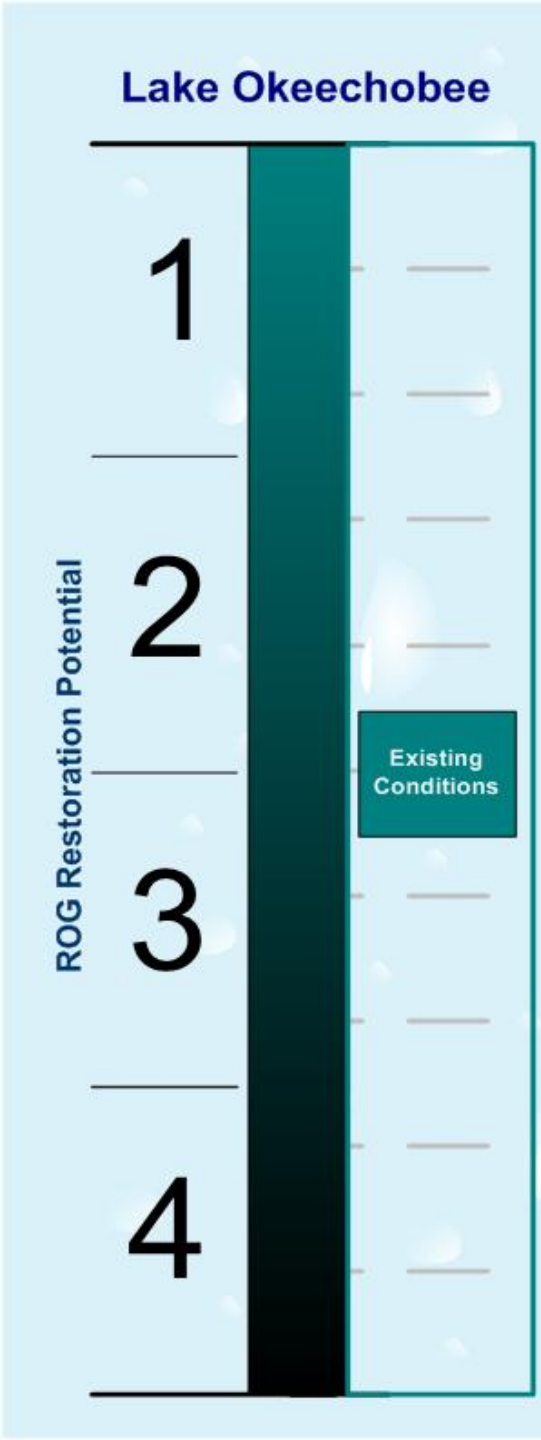

St Lucie Estuary
Months SLE Total > 2000 cfs
Months SLE Local > 2000 cfs
Months SLE LOK > 2000 cfs
1
2
3
4
CL, EDER, ERNE, MP6, P PCP, RPE, RWL
FC
Base
CL, EDER, ERNE, FC, MP6, P PCP, RPE, RWL
Base
CL, EDER, ERNE, MP6, P PCP, RPE, RWL
FC
Base

St. Lucie Estuary



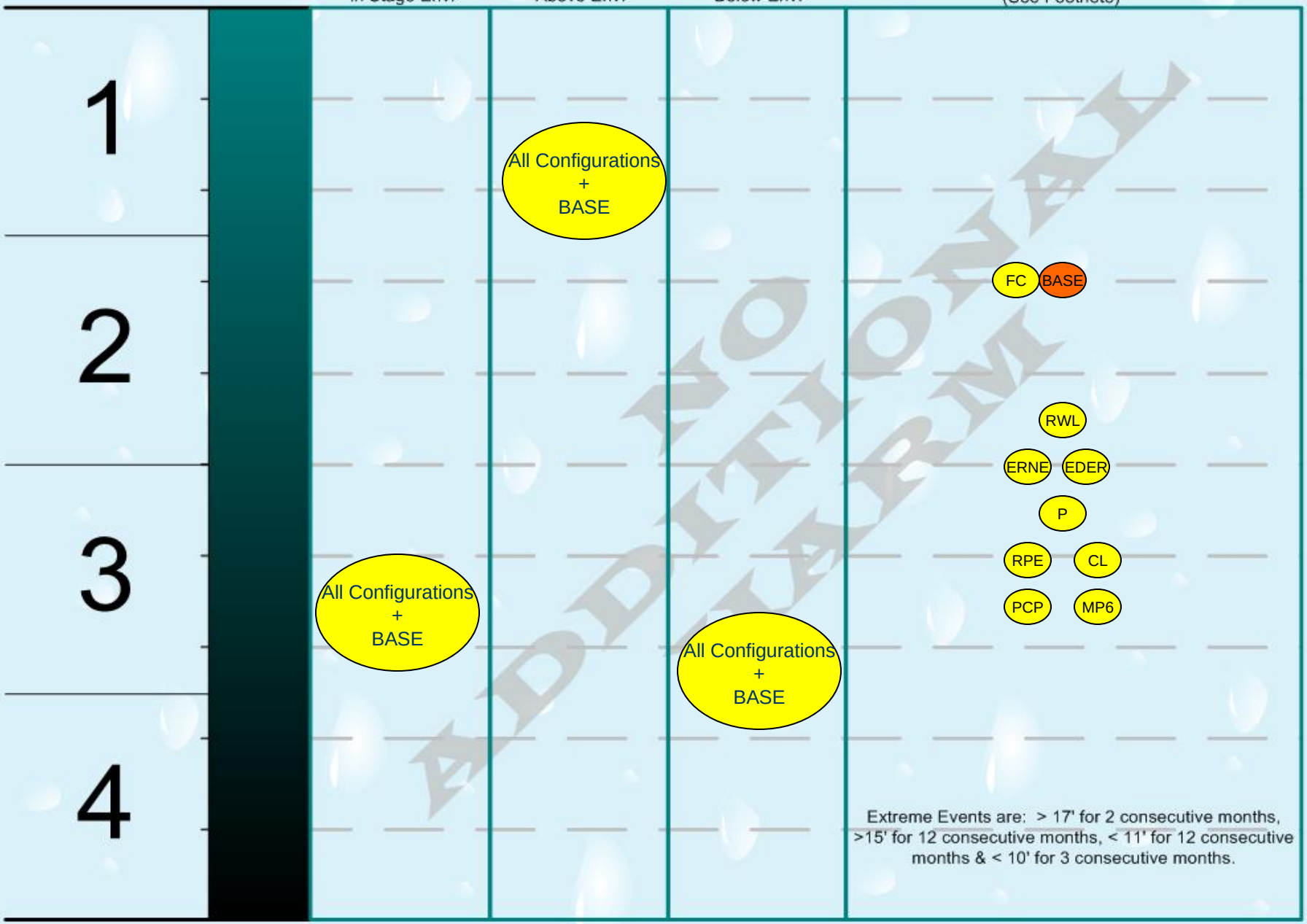
Lake Okeechobee and LOSA



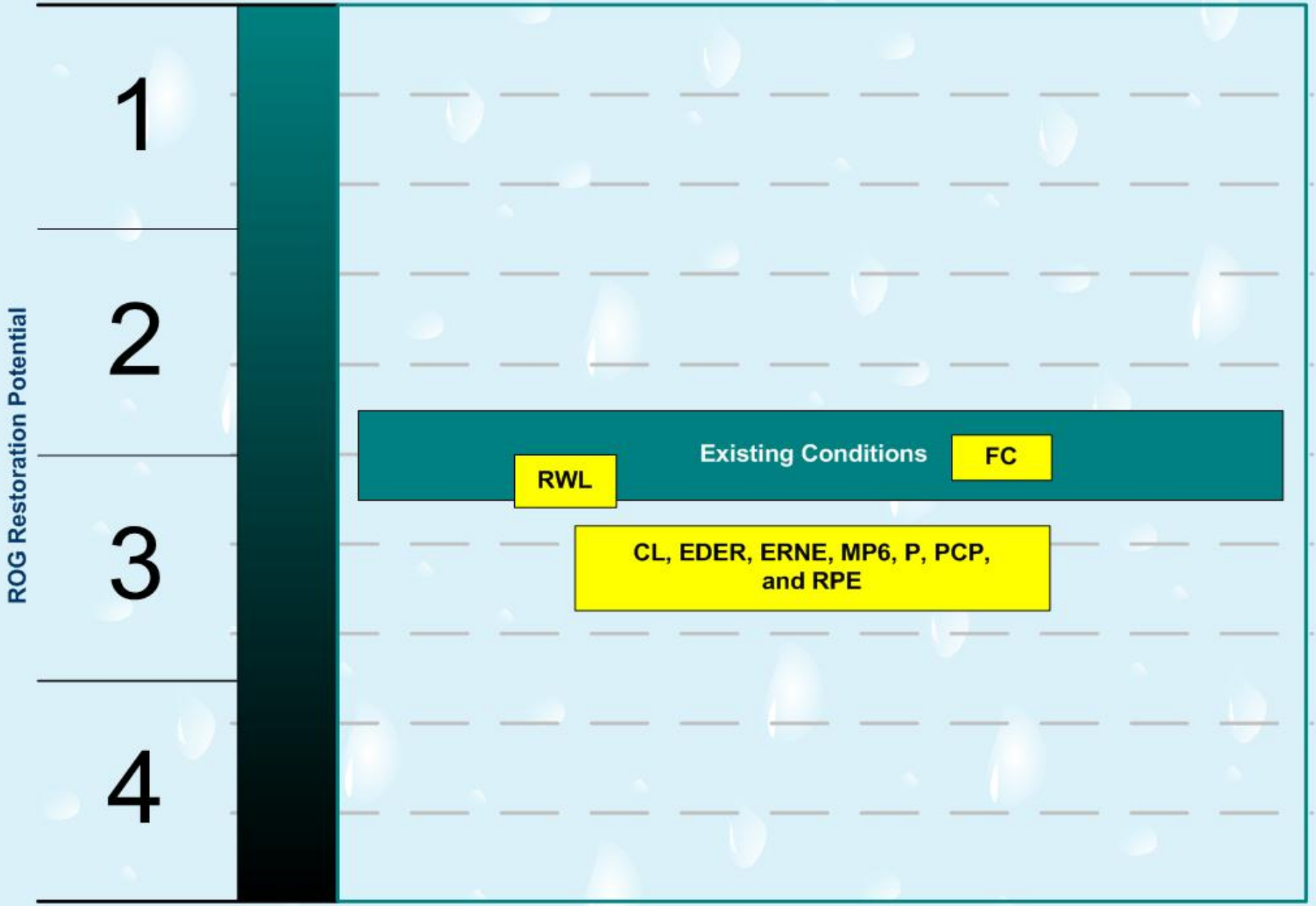


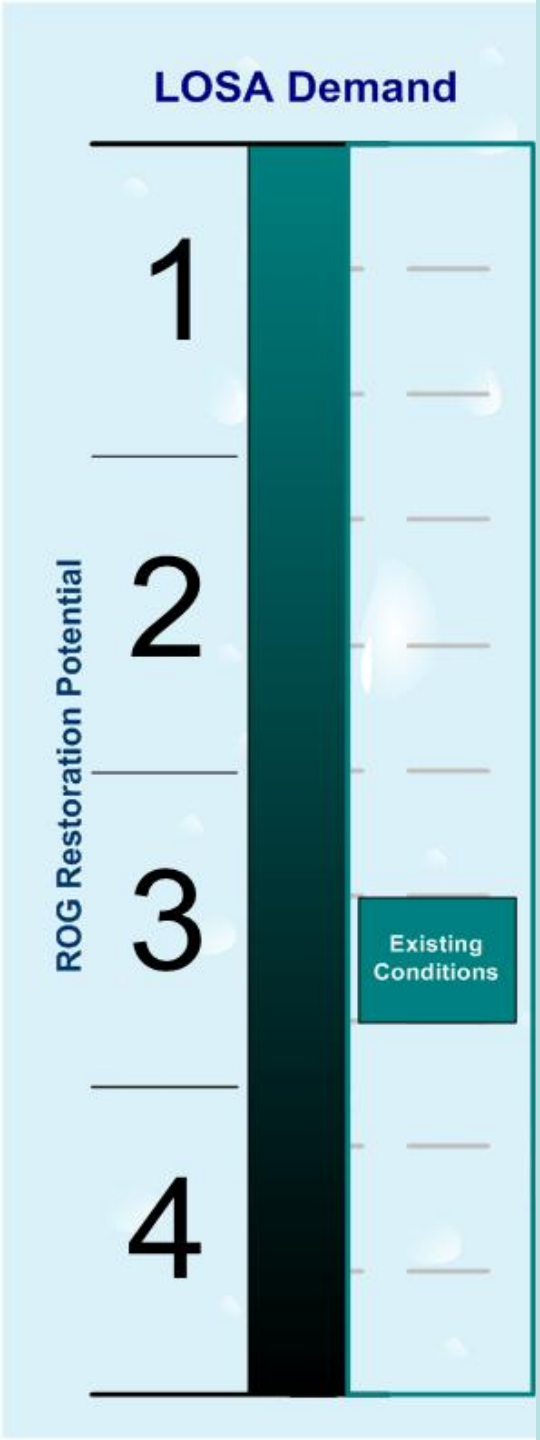
- 1
  - Lake Okeechobee would remain within the stage envelope virtually at all times
  - Maintain an extensive submerged aquatic vegetation community
  - A stable or expanding bulrush community
  - A health sport and commercial fish population
  - Good wading bird foraging and nesting
- 2
  - Characterized by 5 high or low deviation events over the 41 year simulation period. The lake is in a state of excessive high or low or in recovery for 10 years of the 41 year simulation.
- 3
  - Characterized by 10 to 15 high or low deviation events. The lake is in a state of excessive high or low or in recovery for 20 to 30 years of the 41 year simulation period.
- 4
  - Lake Okeechobee would be in a continual state of either excessive high, or excessive low years, or in recovery from one or the other condition
  - Always at extreme stage or in recovery from extreme events
  - Loss of native submerged and emergent plant communities
  - Phytoplankton dominated system with related negative impacts to aquatic fauna, including fish, apple snails, wading birds, amphibians, and reptiles
  - Depending on the particular mix of extreme high and low events, additional negative effects might include dominance of the littoral zone by cattail (extreme highs) or dominance of the littoral zone by exotic invasive or terrestrial vegetation (extreme lows) and the faunal effects of the resulting loss of habitat

Lake Okeechobee

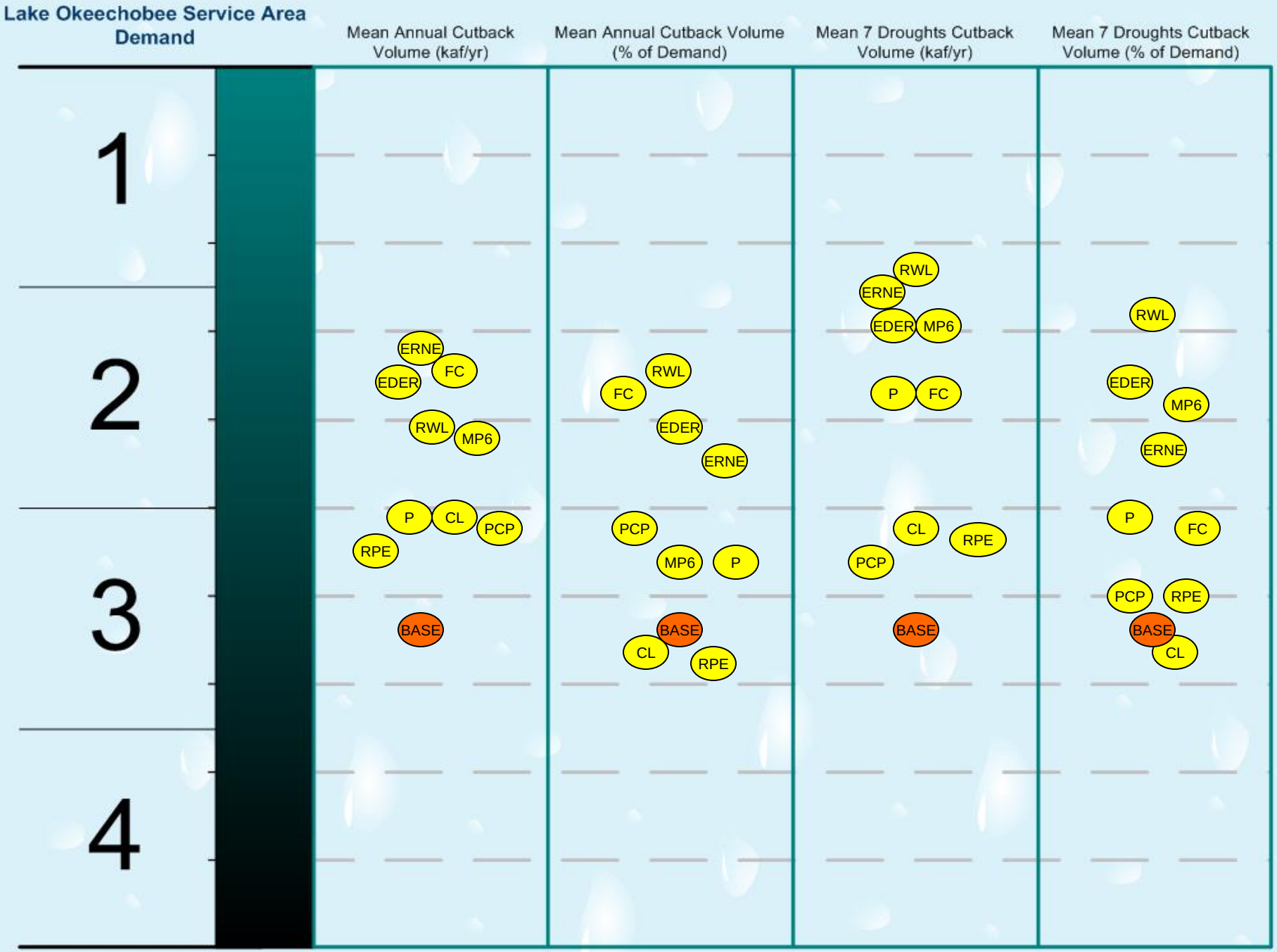


Lake Okeechobee



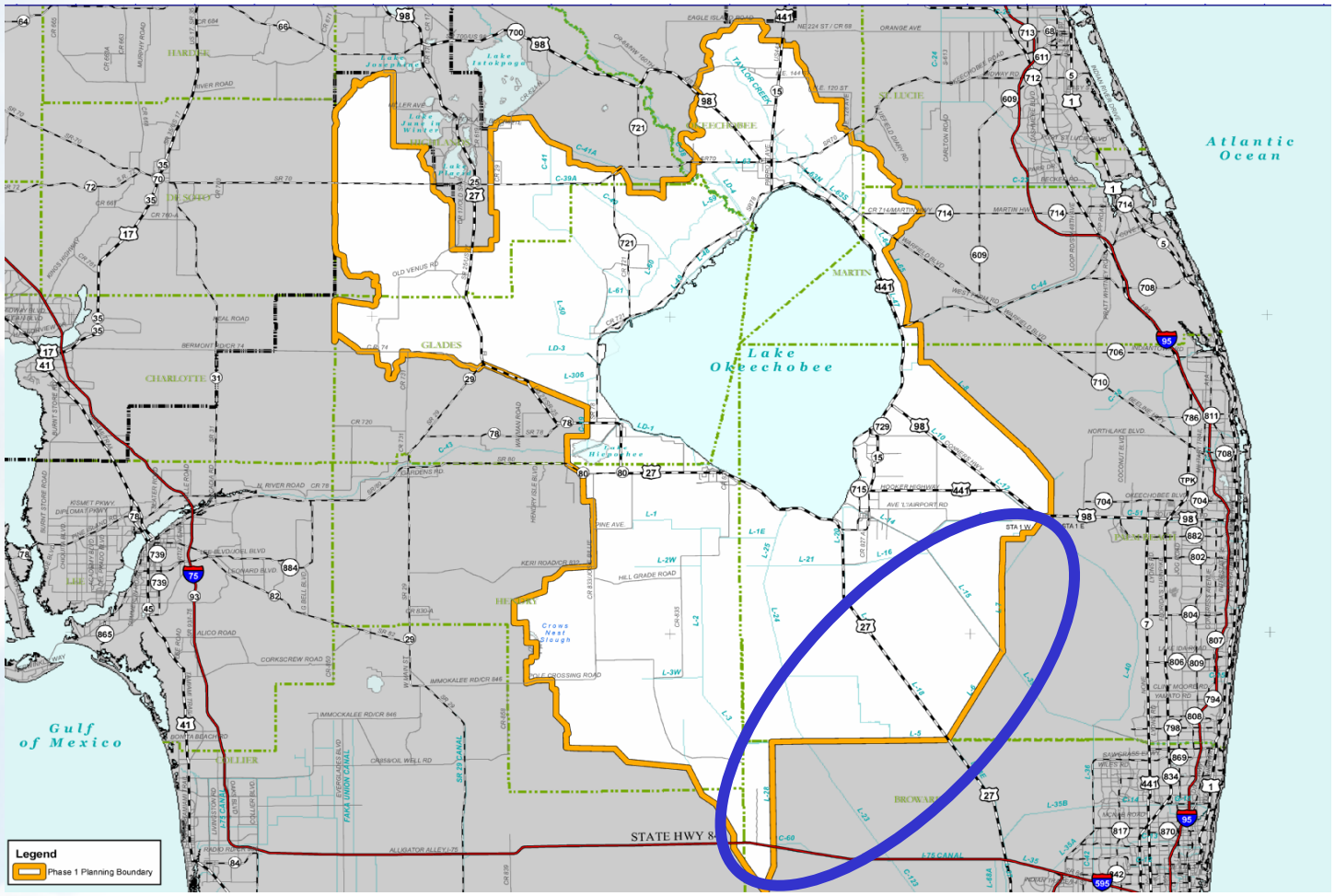


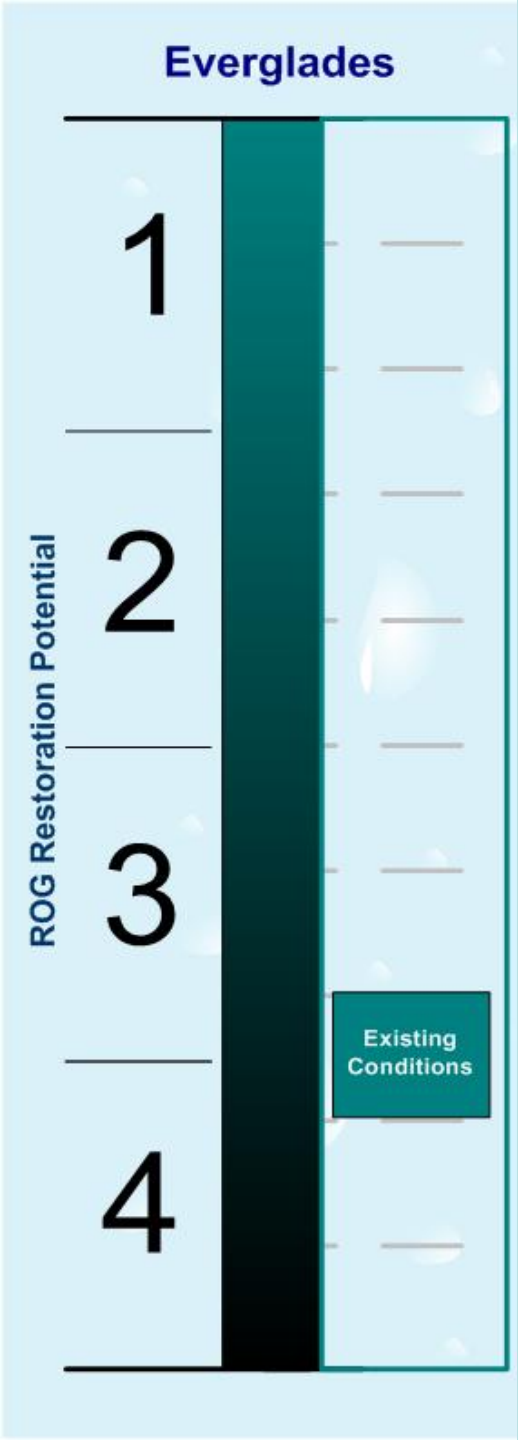
- **1**
  - Greater than 40% reduction in the volume and percentage of cutbacks required during the 41 year period of record as well as the Average of the 7 worst drought years. This results in greater ability of the agricultural community to maximize crop yields during dry as well as average years. Activities that would be improved and sustained would include sugarcane, rice and other crops.
- **2**
  - 20 to 40% reduction in the volume and percentage of cutbacks for both averages.
- **3**
  - 10 to 20% reduction in the volume and percentage of cutbacks for both averages.
- **4**
  - Less than 10% reduction in the volume and percentage of cutbacks for both averages.


Lake Okeechobee Service Area Demand
Mean Annual Cutback Volume (kaf/yr)
Mean Annual Cutback Volume (% of Demand)
Mean 7 Droughts Cutback Volume (kaf/yr)
Mean 7 Droughts Cutback Volume (% of Demand)
1
2
3
4
ERNE
FC
EDER
RWL
MP6
P
CL
PCP
RPE
BASE
RWL
FC
EDER
ERNE
PCP
MP6
P
BASE
CL
RPE
RWL
ERNE
EDER
MP6
P
FC
CL
RPE
PCP
BASE
RWL
EDER
MP6
ERNE
P
FC
PCP
RPE
BASE
CL

LOSA Demand
ROG Restoration Potential
1
2
3
4
All Configurations
Existing Conditions

Everglades


Atlantic Ocean
Lake Okeechobee
Gulf of Mexico
GLADES
CHARLOTTE
MARTIN
HENDRY
COLLIER
BROWARD
Crows Nest Slough
STATE HWY 84
Legend
Phase 1 Planning Boundary



•1

- Water moves as unobstructed sheetflow over full width of remaining landscape
- Long term average water depths match pre-drainage depths
- Depths and flows vary according to pre-drainage linkage to weather variation
- Depths and flows sustain peat processes and in turn sustain shapes, elevations, and vegetation of ridges and tree islands
- Populations of large multi-year fish persist; wading bird prey base present
- Flows into Florida Bay continue through most of the year, preventing hyper-salinity and sustaining diverse submerged aquatic vegetation, fish and shrimp

•2

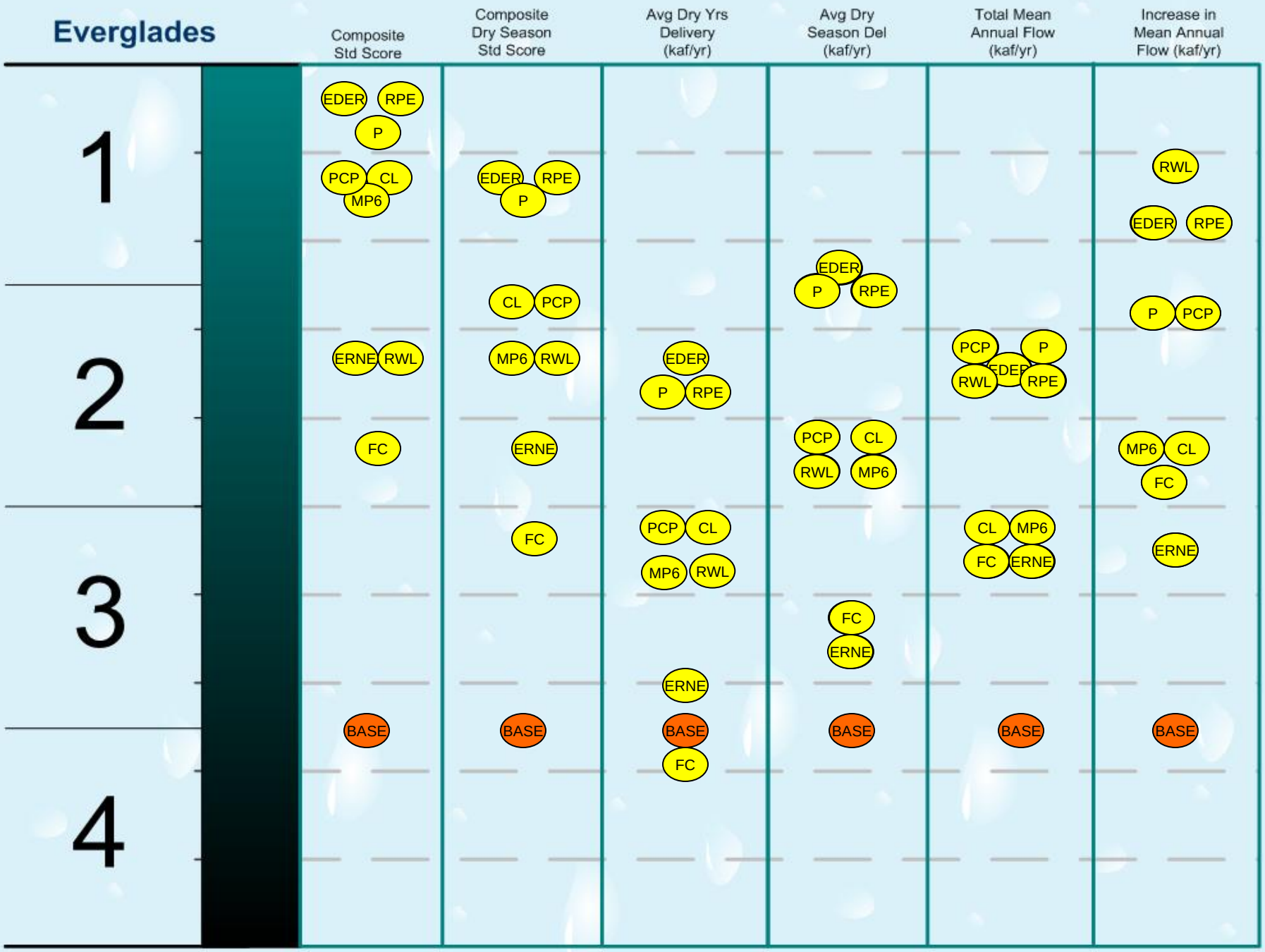
- Ecologically sub-optimal condition, but sustainable
- Hydrology cannot restore landscape to optimal condition, but can sustain in Condition 2
- Everglades ecology is very sensitive to hydrologic change - modest hydrologic improvements can tip ecological conditions from 2 to 1

•3

- “Tipping point:” landscape on degrading ecological trajectory toward Condition 4
- Ecologically, very different from Condition 2 because of downward trajectory
- Everglades ecology is very sensitive to hydrologic change - modest hydrologic improvements can tip ecological conditions from 3 to 2

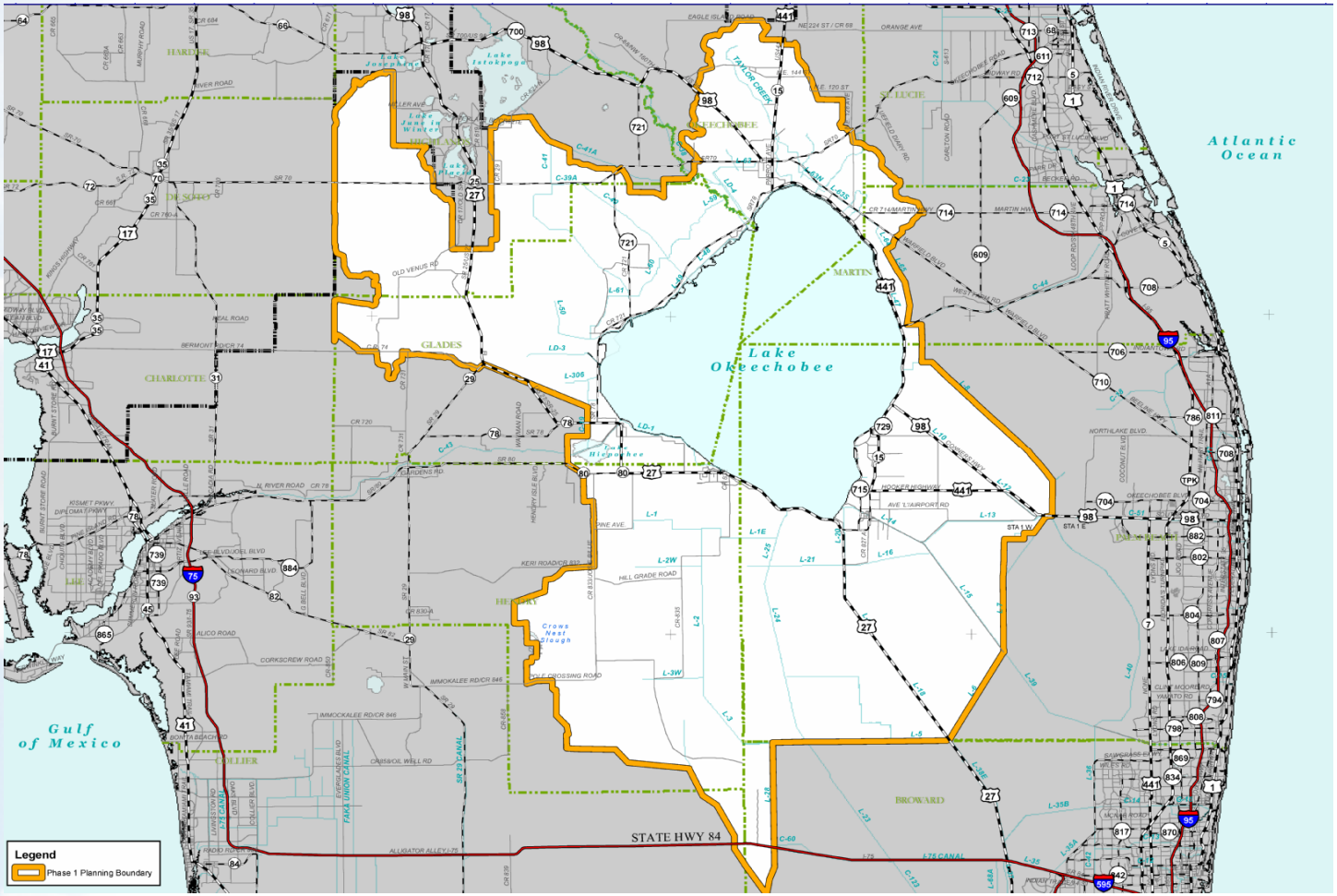
•4

- Sloughs are dry (water depths zero) for more than four months of the year
- Flows zero for more than six months of the year; annual flows to FL Bay near zero
- Multi-year large fish populations eliminated; small fish populations greatly reduced
- Wading bird prey base essentially eliminated
- Widespread oxidation and/or burning of peat
- Elevations of ridges and tree islands reduced to level of sloughs (landscape flattened)
- Water lilies gone; sloughs invaded by sawgrass / dryland species; tree islands gone.


Everglades
Composite Std Score
Composite Dry Season Std Score
Avg Dry Yrs Delivery (kaf/yr)
Avg Dry Season Del (kaf/yr)
Total Mean Annual Flow (kaf/yr)
Increase in Mean Annual Flow (kaf/yr)
1
2
3
4
EDER
RPE
P
PCP
CL
MP6
ERNE
RWL
FC
BASE

Everglades
ROG Restoration Potential
1
2
3
4
EDER, P and RPE
CL, MP6 and PCP
ERNE, FC and RWL
Existing Conditions

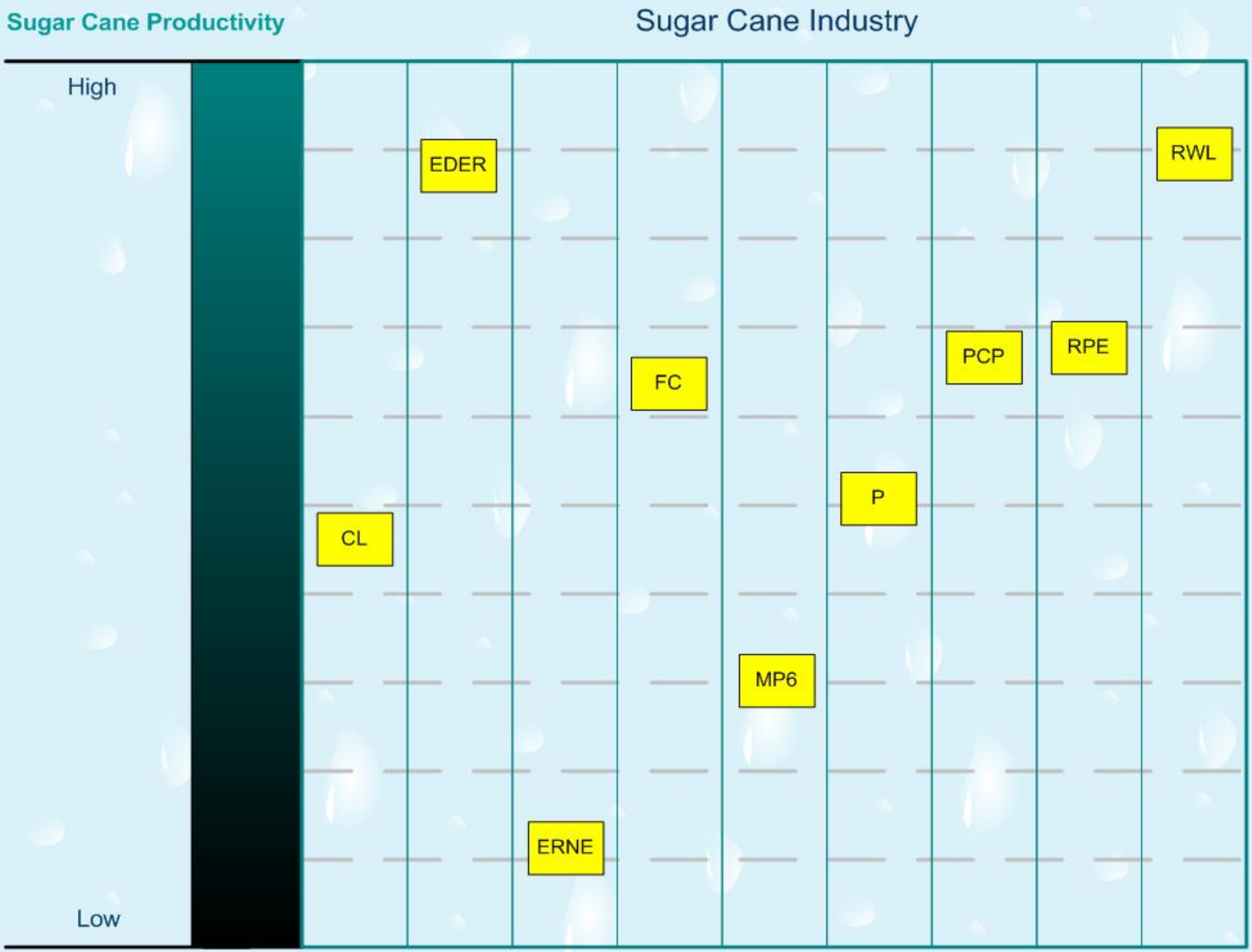
System Wide


Atlantic Ocean
Gulf of Mexico
Lake Okeechobee
Lake Istokpoga
Lake Josephine
Lake June in Winter
Lake Placid
Lake Hicpochee
Crows Nest Slough
HARDEE
DE SOTO
CHARLOTTE
GLADES
HENDRY
COLLIER
MARTIN
ST. LUCIE
BROWARD
STATE HWY 84
Legend
Phase 1 Planning Boundary

ROG Restoration Potential	Caloosahatchee Estuary	St. Lucie Estuary	LOSA Demand	Lake Okeechobee	Everglades
1	CL, EDER, MP6, P, PCP, RPE and RWL	CL, EDER, MP6, P, PCP, RPE and RWL			EDER, P and RPE
2	ERNE and FC Existing Conditions	ERNE and FC	All Configurations	FC Existing Conditions	CL, MP6 and PCP
3		Existing Conditions	Existing Conditions	CL, EDER, ERNE, MP6, P, PCP and RPE, RWL	ERNE, FC and RWL Existing Conditions
4					

Summary of Planning Level Cost Estimates & Sugar Cane Productivity for Team Configurations

sfwmd.gov/riverofgrass


Sugar Cane Productivity
Sugar Cane Industry
High
Low
EDER
RWL
PCP
RPE
FC
P
CL
MP6
ERNE

System-Wide Approach

Program Overlap

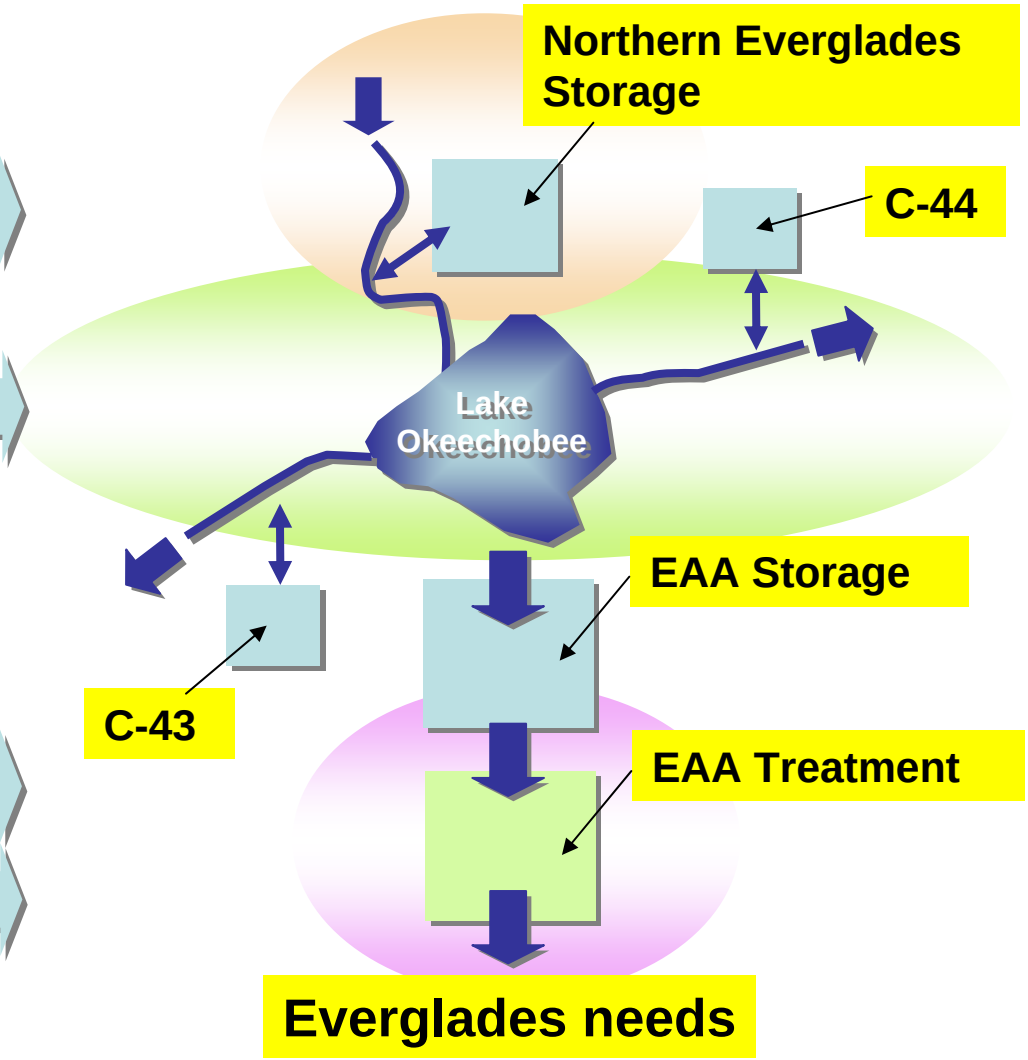
Lake Okeechobee Technical Plan

River Watershed Protection Plans

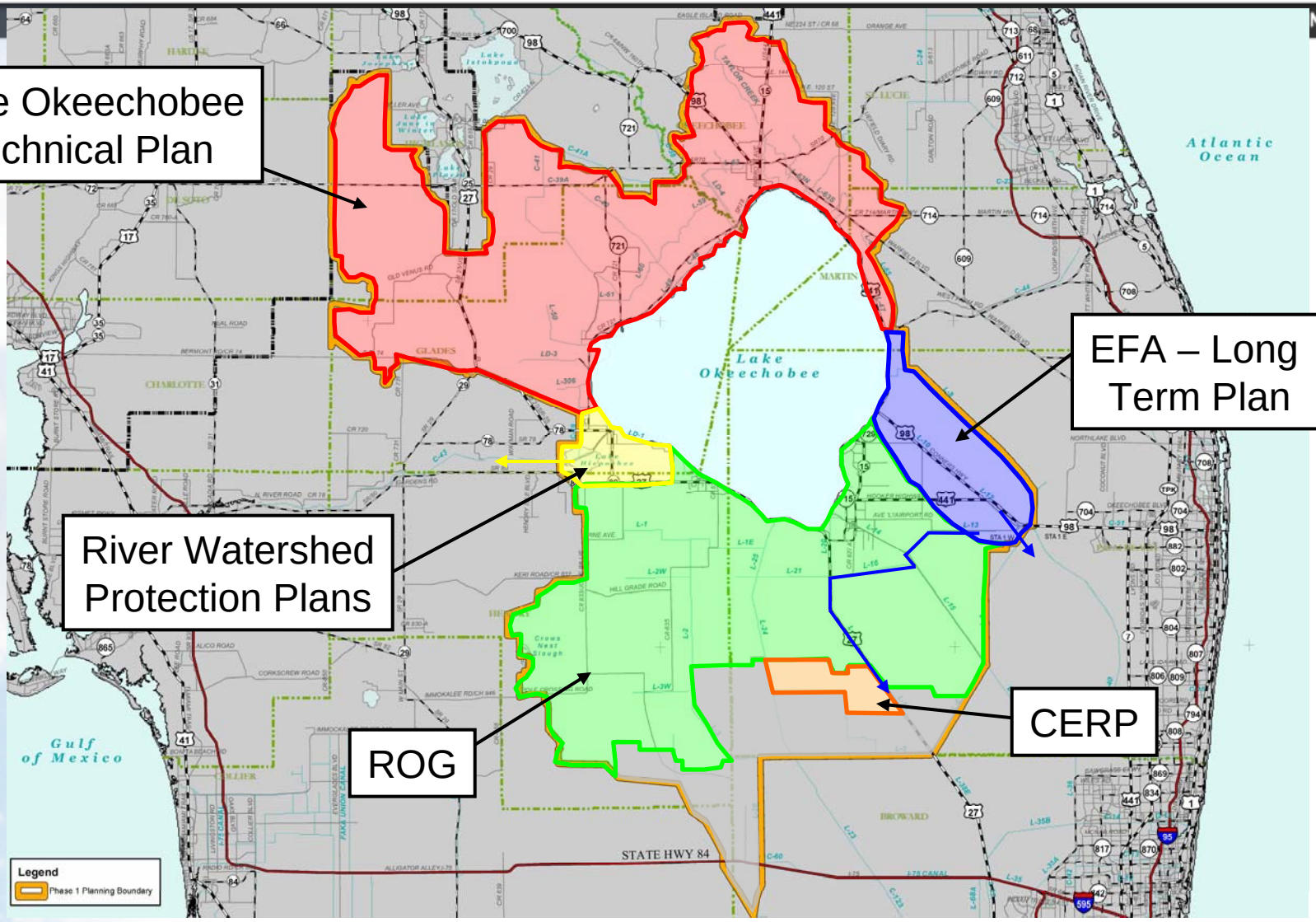
ROG

CERP

EFA -Long Term Plan



Program Areas



Summary of All Configurations

Estimates Include Remediation, Real Estate, Construction Costs, and 20 Years of Payment for Dispersed Storage

Funding Category Note: Estimates do not include design, permitting, engineering during construction and construction management costs.

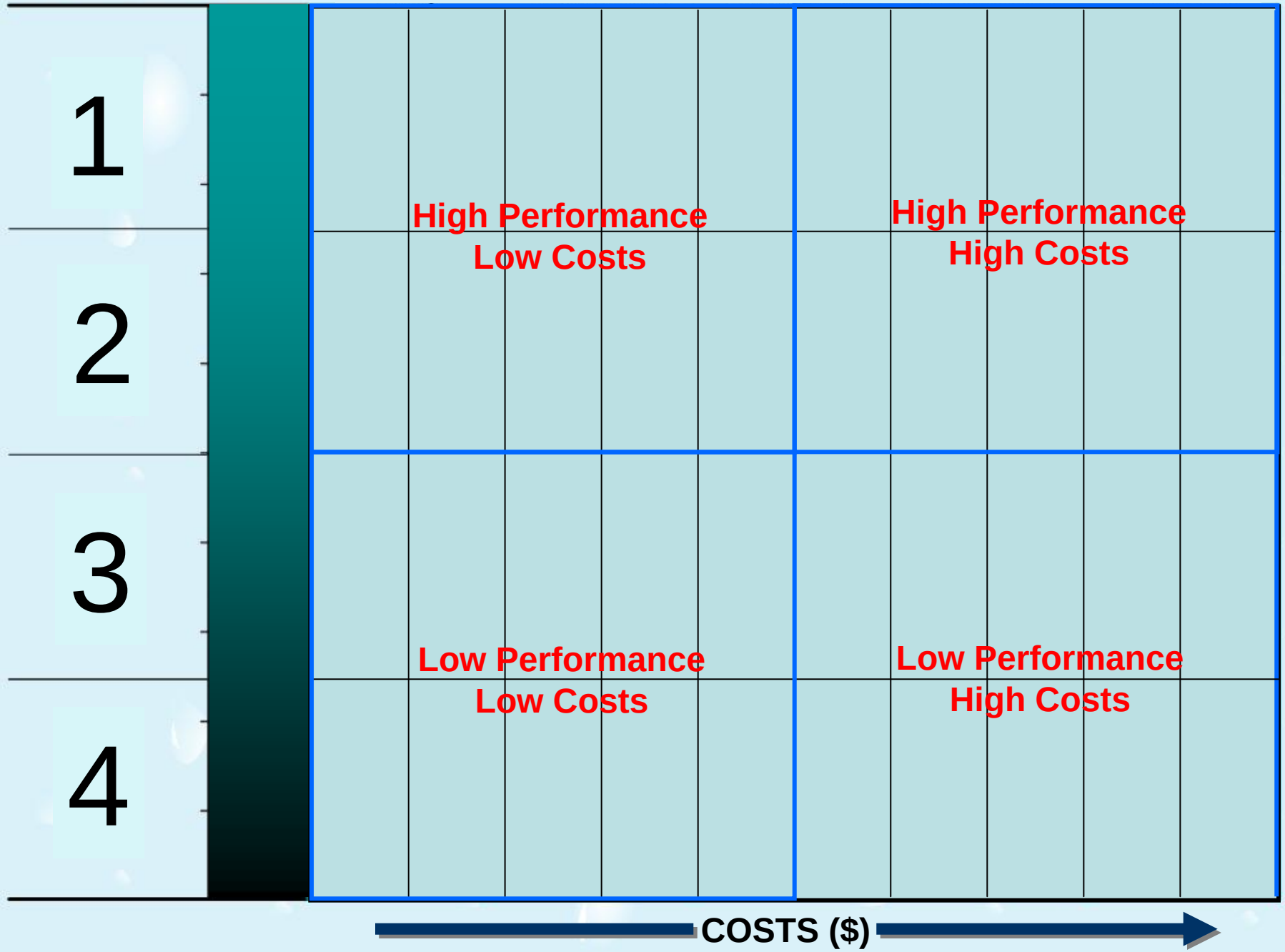
	LOTP*	RWPP*	LTP*	CERP*	ROG
Configuration Name					
Florida Crystals (FC)**	$1,335,000,000	$0	$958,898,867	$1,648,247,443	$924,668,481
Performance-Cost Plan (PCP)	$2,135,341,696	$0	$260,000,000	$1,432,029,069	$5,789,174,252
Reservoir Within Lake Okeechobee (RWLO)*	$7,007,672,785	$0	$260,000,000	$1,901,863,860	$746,749,296
Restoration Plus Employment (RPE)	$2,135,341,696	$0	$260,000,000	$2,268,205,688	$5,253,588,230
Marshall Plan Element 6 (MP)	$4,771,279,739	$0	$958,898,867	$128,129,538	$6,434,379,939
Everglades River of Grass Northern Expansion (ERNE)	$4,000,712,335	$405,979,459	$0	$663,016,104	$7,254,651,674
Performance (P)	$1,406,480,686	$0	$958,898,867	$1,432,029,069	$8,850,112,866
Estuary Driven Everglades Restoration (EDER)	$7,570,012,103	$120,437,352	$260,000,000	$1,517,183,061	$6,254,251,935
Chain of Lakes (CL)	$11,634,991,947	$2,309,168,822	$260,000,000	$1,603,216,111	$11,776,765,166

* These costs do not reflect the potential for any offsets that might occur to other programs as a result of implementing River of Grass features. For example, ROG may present the opportunity to reduce the number of ASR wells proposed under CERP, but these costs do not capture that potential difference in total restoration costs. These costs also do not reflect total program costs for these categories.

** Includes Dispersed Storage

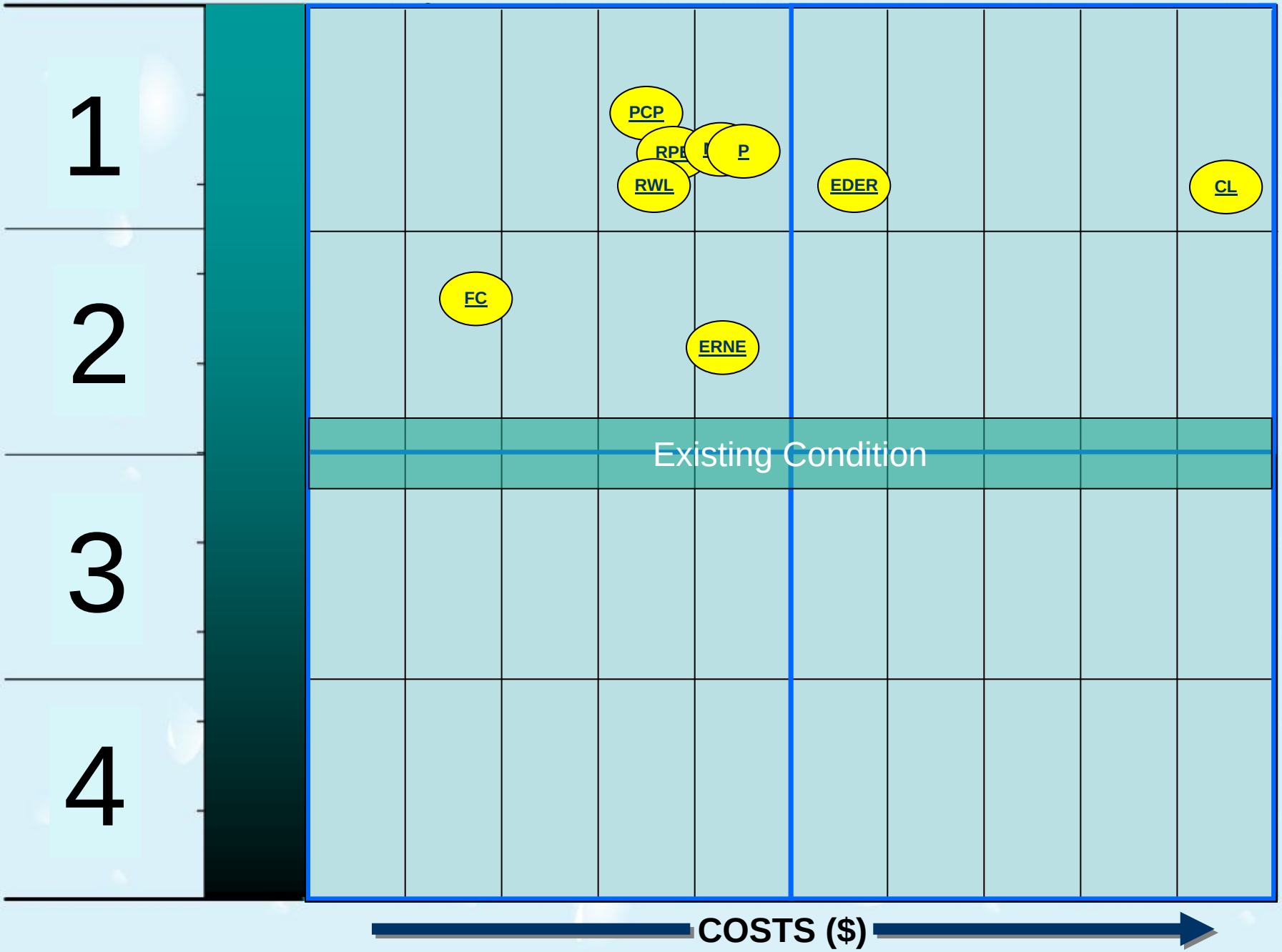
Benefits Costs Summary

Graphic Relationships



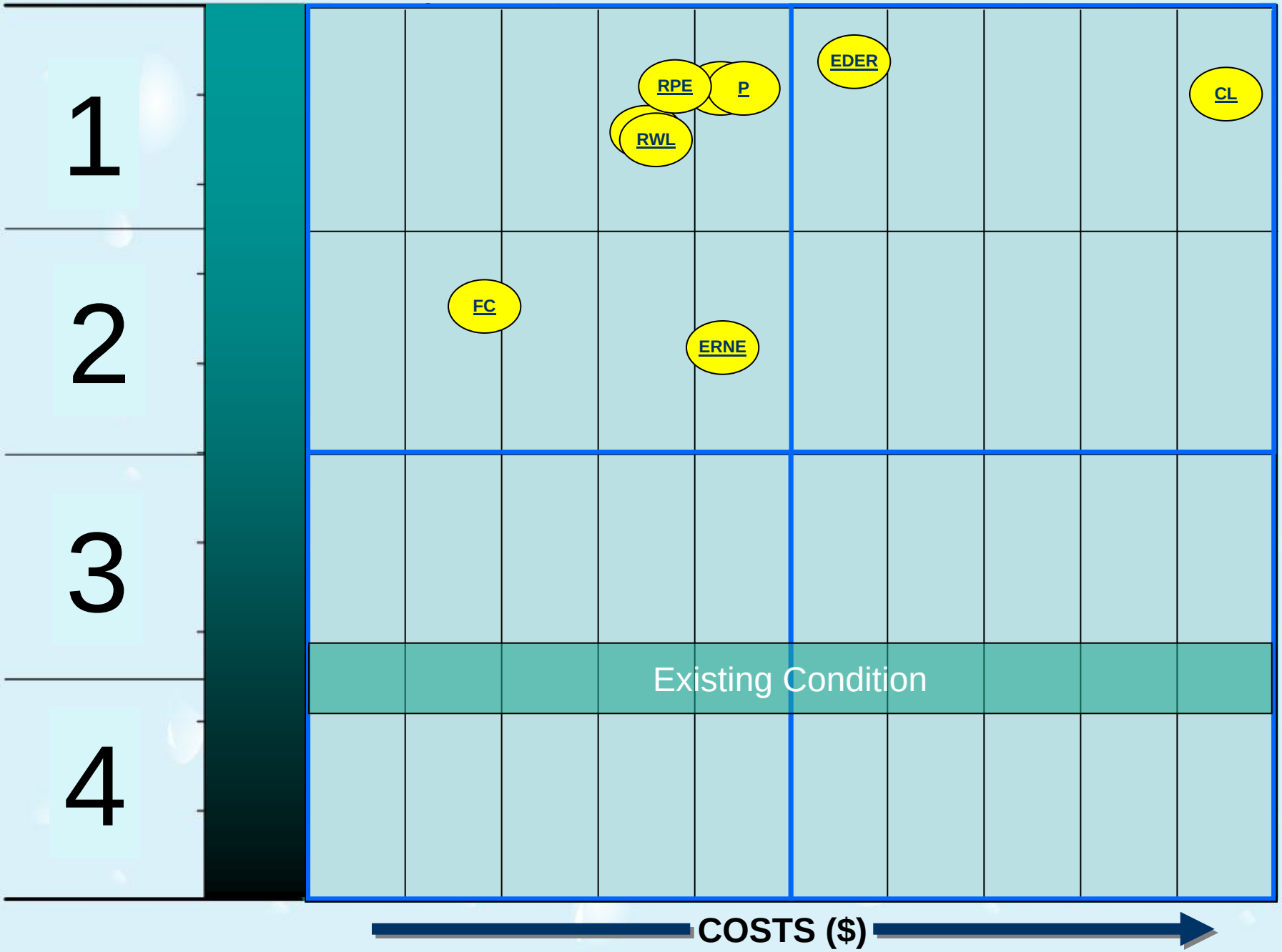
ROG Restoration Potential

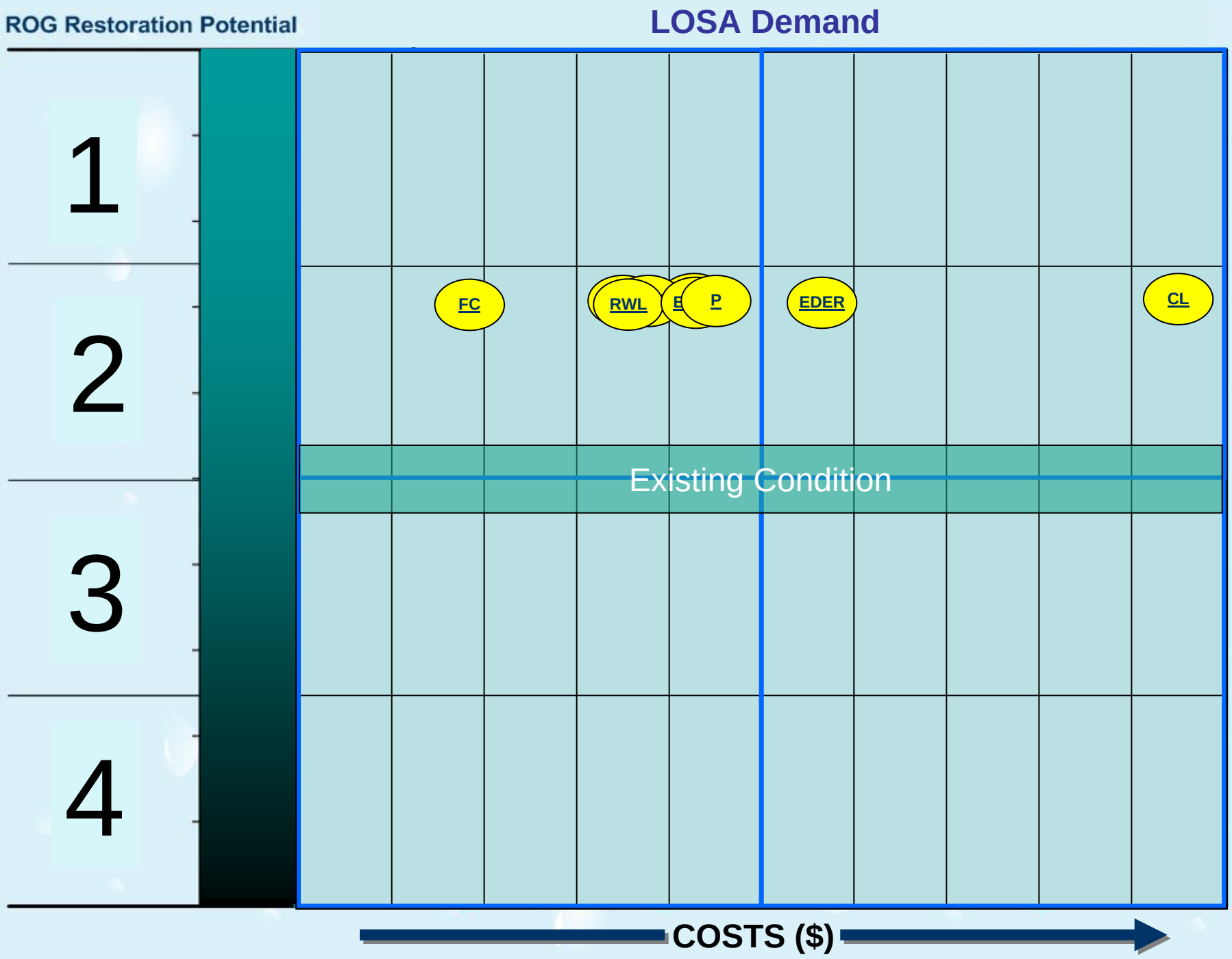
Caloosahatchee Estuary

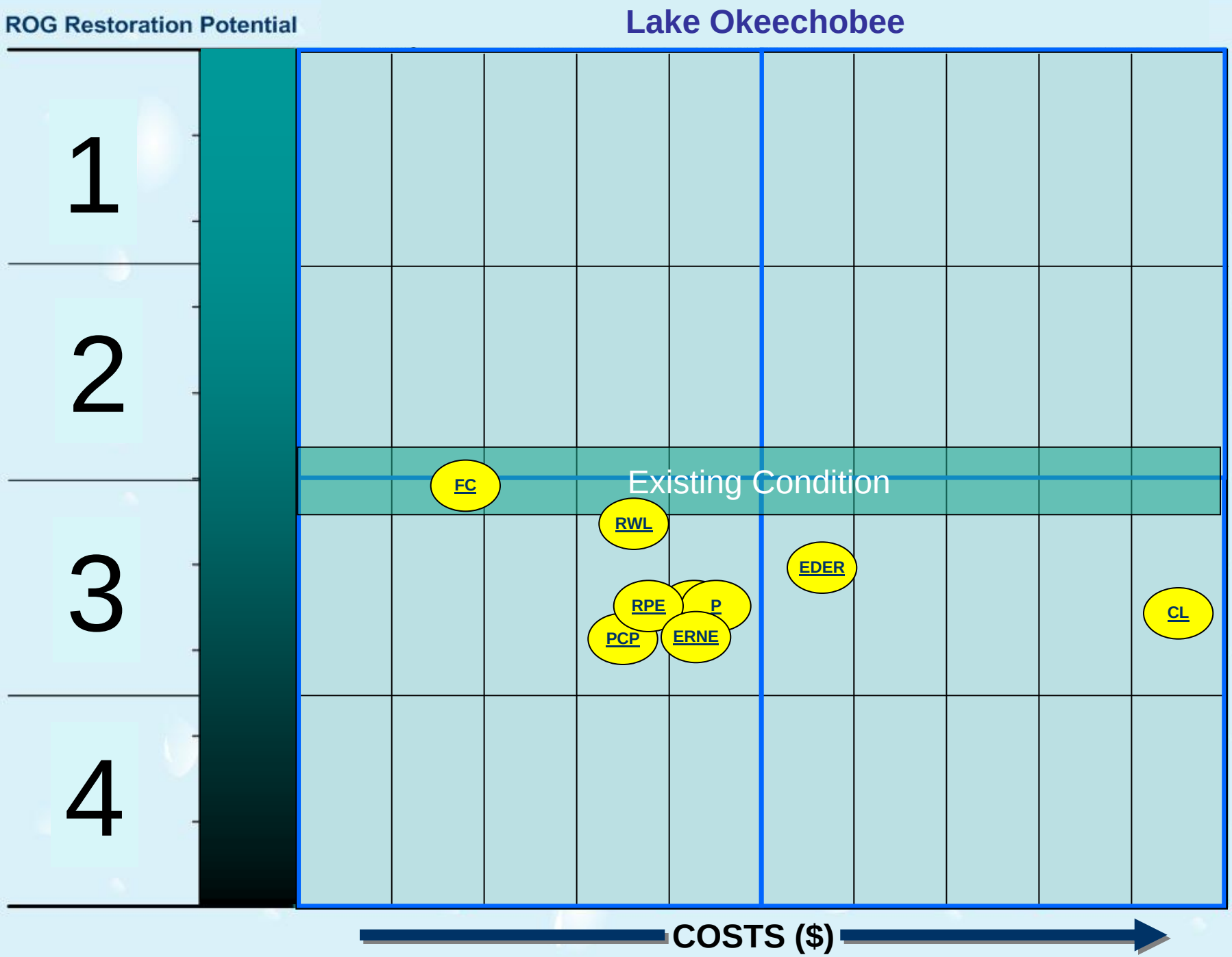


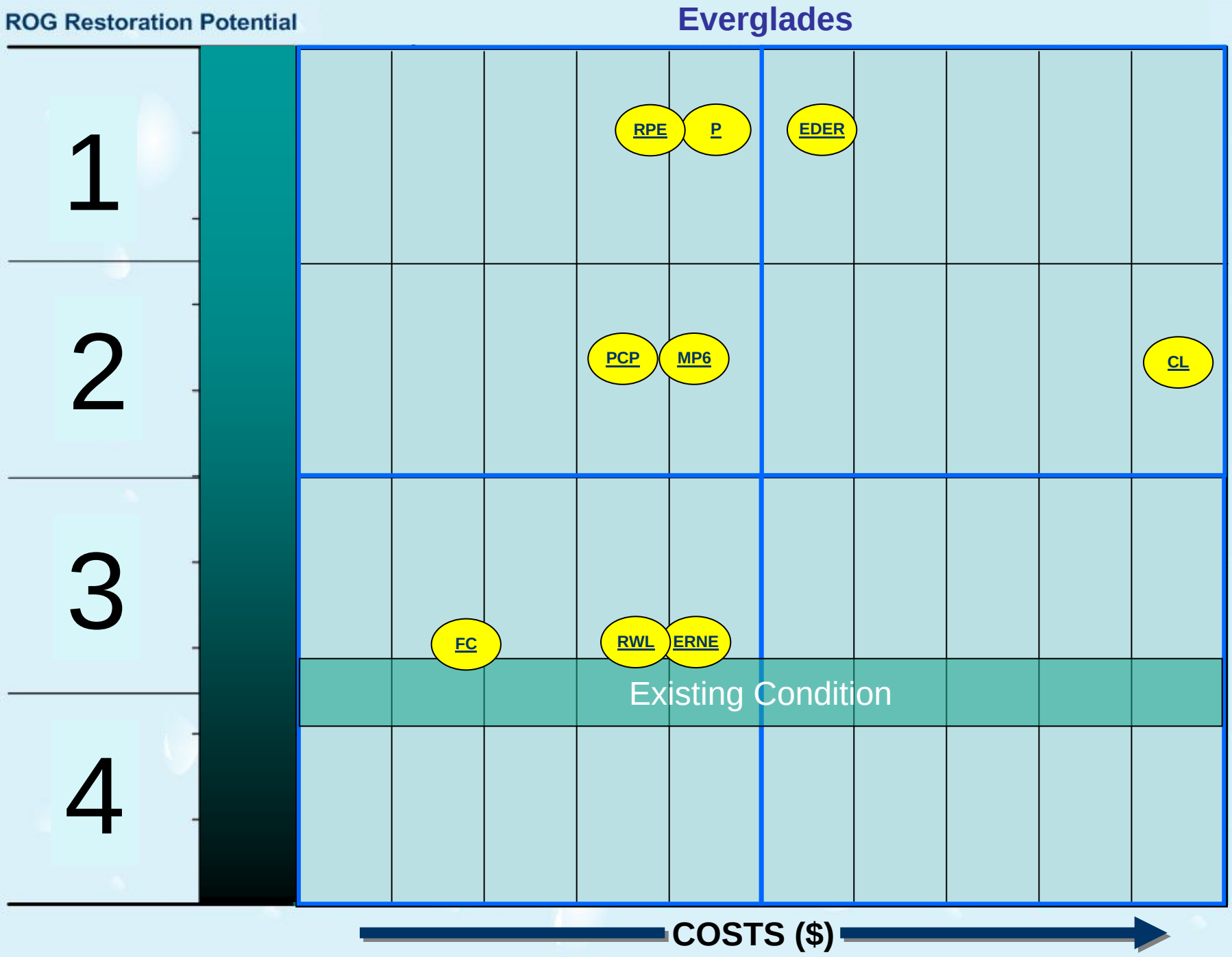
ROG Restoration Potential

St Lucie Estuary




ROG Restoration Potential
LOSA Demand
1
2
3
4
FC
RWL
E
P
EDER
CL
Existing Condition
COSTS ($)

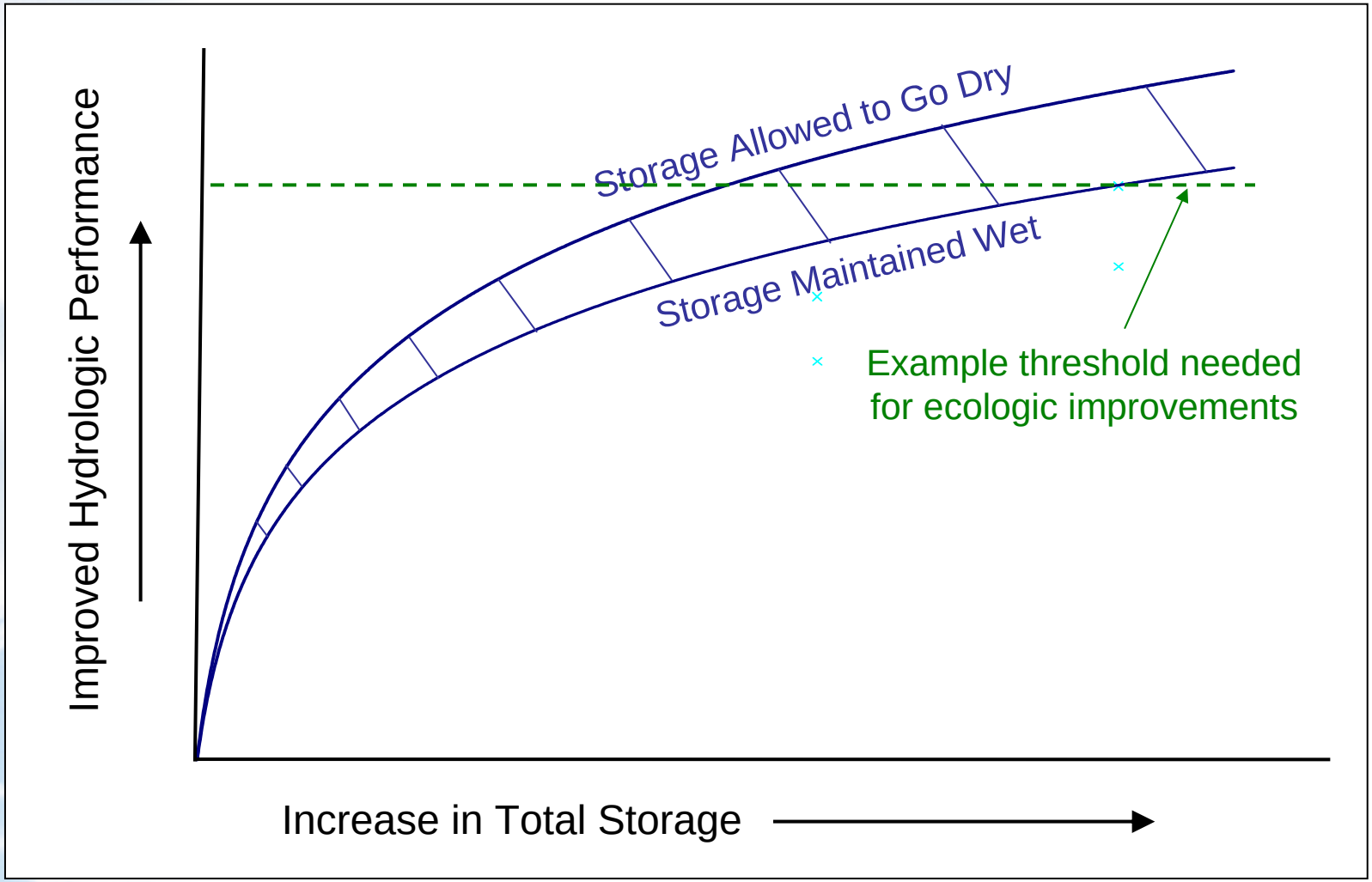

ROG Restoration Potential
Lake Okeechobee
1
2
3
4
Existing Condition
FC
RWL
EDER
RPE
P
PCP
ERNE
CL
COSTS ($)


ROG Restoration Potential
Everglades
1
2
3
4
RPE
P
EDER
PCP
MP6
CL
FC
RWL
ERNE
Existing Condition
COSTS ($)

Trend Analysis of Stakeholder Configurations

- In addition to the various evaluations (benefits, cost, etc…) completed on the stakeholder configurations, additional analysis can be used to analyze trends in performance.
- This analysis can examine the configurations as a whole, or focus on individual components of the idea such as
  - Effective use of storage (North, South or total)
  - Performance of conveyance features
  - Robustness checks to examine the ability to meet differing sets of system objectives

Example Trend Analysis Graphic



Observations of Example Trend Analysis

- Allowing storage areas to go dry maximizes potential hydrologic benefit to the Lake, estuary and Everglades systems.
- Maintaining storage areas wet improves treatment potential and, in the case of shallow storage, improves hydrologic performance within the project footprint.
- There is generally a range of diminishing returns where additional increase in storage capacity does not result in large hydrologic performance improvements
- Gains in hydrologic performance beyond the point of diminishing returns may be necessary to obtain desired ecological responses

Wrap-Up/Next Meeting/Future Meeting Topics

Temperince Morgan, River of Grass Project Liaison/Northern Everglades Program Implementation Manager

Input Received at WRAC Issues Workshop

- Positive feedback regarding the evaluation process and type of evaluation information that was presented; particularly the benefits evaluation
- Would like us to also consider the following in our analysis
  - Increased spatial extent
  - Ecotourism benefits
  - Ecosystem Services Values
  - Water quality benefits of features north of the lake
  - Operations and maintenance costs- particularly pumping costs
  - Carbon sequestration/carbon credits
- Concerns that flowways may provide better benefits than this analysis indicates

Input Received at WRAC Issues Workshop

- Florida Crystals would like to use an Everglades target time series other than the Synthetic High Demand Carryover time series for operation of plan components and Lake Okeechobee
- Concerns expressed by FFWCC and Audubon regarding the Reservoir within the Lake configuration
  - Recommendation to modify the existing evaluation of this configuration in regards to Okeechobee performance/benefits
- Need to study and perhaps engage others (e.g., NAS) in studying water quality and other benefits of flowways and some of these other features for which we have limited information
- If it is critical to keep flowways/shallow storage wet in order to obtain water quality benefits, consider using ASR wells as a source of water to maintain in a wetted condition

Next Meeting- Date and Location

Next WRAC Issues Workshop

June 18, 2009

SFWMD
3301 Gun Club Road
West Palm Beach, FL
10:00 a.m. – 4:00 p.m.

Next Meeting- Meeting Topics

Review and Discussion of Preliminary Results

- Break-out Sessions
  - Teams can rotate through topic specific break-out sessions with the evaluation teams
    - Lake Okeechobee/LOSA
    - Northern Estuaries
    - Everglades
    - Water Quality
    - Remediation/Real Estate Costs and Sugar Productivity
    - Construction Costs
- Group Discussion - Initial Thoughts on Lessons Learned, Relationships, Tradeoffs, Other Considerations

Phase I Planning
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Restoration Project Planning

On December 16, 2008, the South Florida Water Management District Governing Board voted to accept a contract with the United States Sugar Corporation to acquire more than 180,000 acres of agricultural land for Everglades restoration. This historic transaction provides water managers with the unprecedented opportunity to store and treat water on a scale never before envisioned for the benefit of America's Everglades, Lake Okeechobee and the St. Lucie and Caloosahatchee rivers and estuaries.

With full public involvement, the first phase of *River of Grass* restoration project planning is under way. Through a series of Water Resources Advisory Commission Issues Workshops, the Phase 1 planning process will determine viable configurations for constructing a managed system of water storage and treatment to support ecosystem restoration efforts.

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RELATED MATERIALS

- Public Workshops: Dates, Agendas, Presentations, Minutes
- News, Fact Sheets, Public Information
- Reservoir Sizing and Operations Screening (RESOPS) Model

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