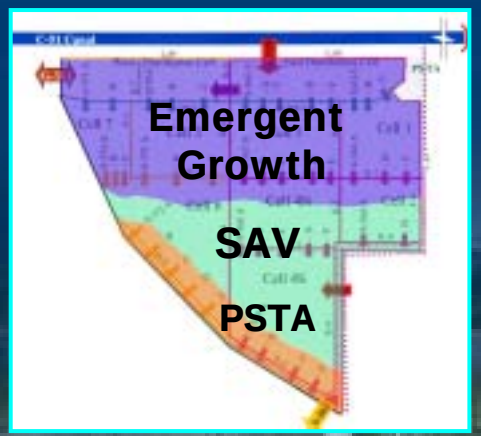


STA-1E (PSTA/SAV)

Advanced Treatment Technology Implementation

January 2004

Introduction

- PSTA/SAV Theory and Studies
- STA-1E PSTA/SAV Field Scale Study
- Implementation Plan to achieve 10 ppb P by 2006
- Modeling
- Remote Sensing (Hyperspectral imagery)

Chemical & Biological Reactants Naturally Found in the Everglades Marsh

- Calcium - abundant
- Magnesium - trace
- Iron - trace
- Aluminum - trace
- Manganese – trace

Require Chemical Treatment

Calcium-based treatment technology only logical option

Hypothesis – Factors for Developing Calcareous Periphyton

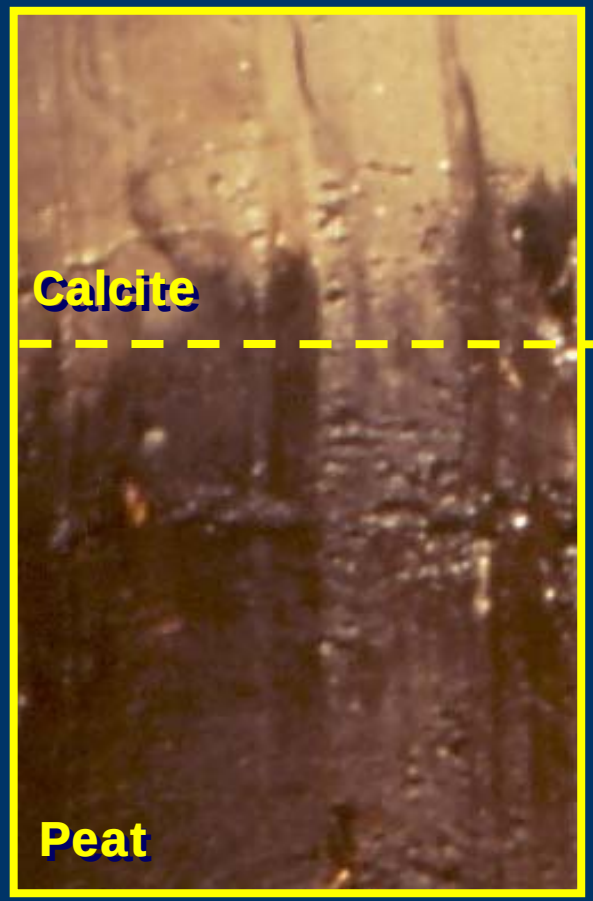
- High solar radiation
- High temperature
- Low phosphorous
- Dry-out

Manipulate hydroperiod – forced dry-outs

Corps Activated Periphyton:

Water Treatment Based on Observations in Nature

(natural system enhanced through more frequent dry-outs)



Post-Tamiami Trail Construction

- Low Phosphorus
- Rainfall Driven
- Periodic Dryouts (cyano bacteria dominance)
- Calcite (precipitated periphyton)

1920s

Pre-Tamiami Trail Construction
(no obstruction to sheetflow in Everglades)

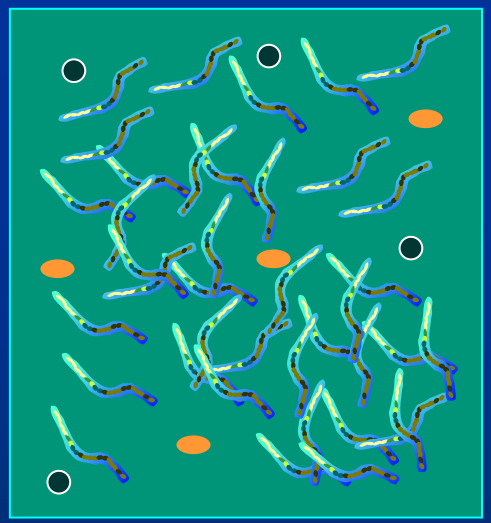
- Low Phosphorus
- Always Wet

Core Sample South of Tamiami Trail
Natural Conditions

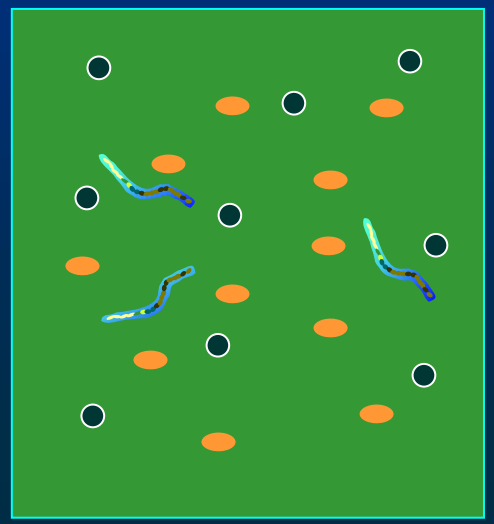
Natural System

Seasonal Dryout

CYANO DOMINANT
Dry conditions
Summer/Fall

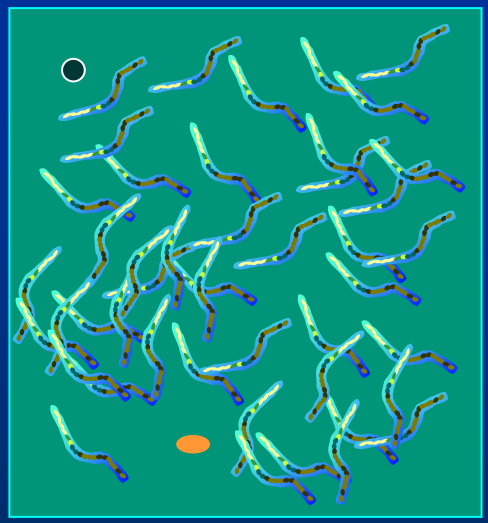


DIATOM DOMINANT
Wet conditions
Winter/Spring



Corps PSTA

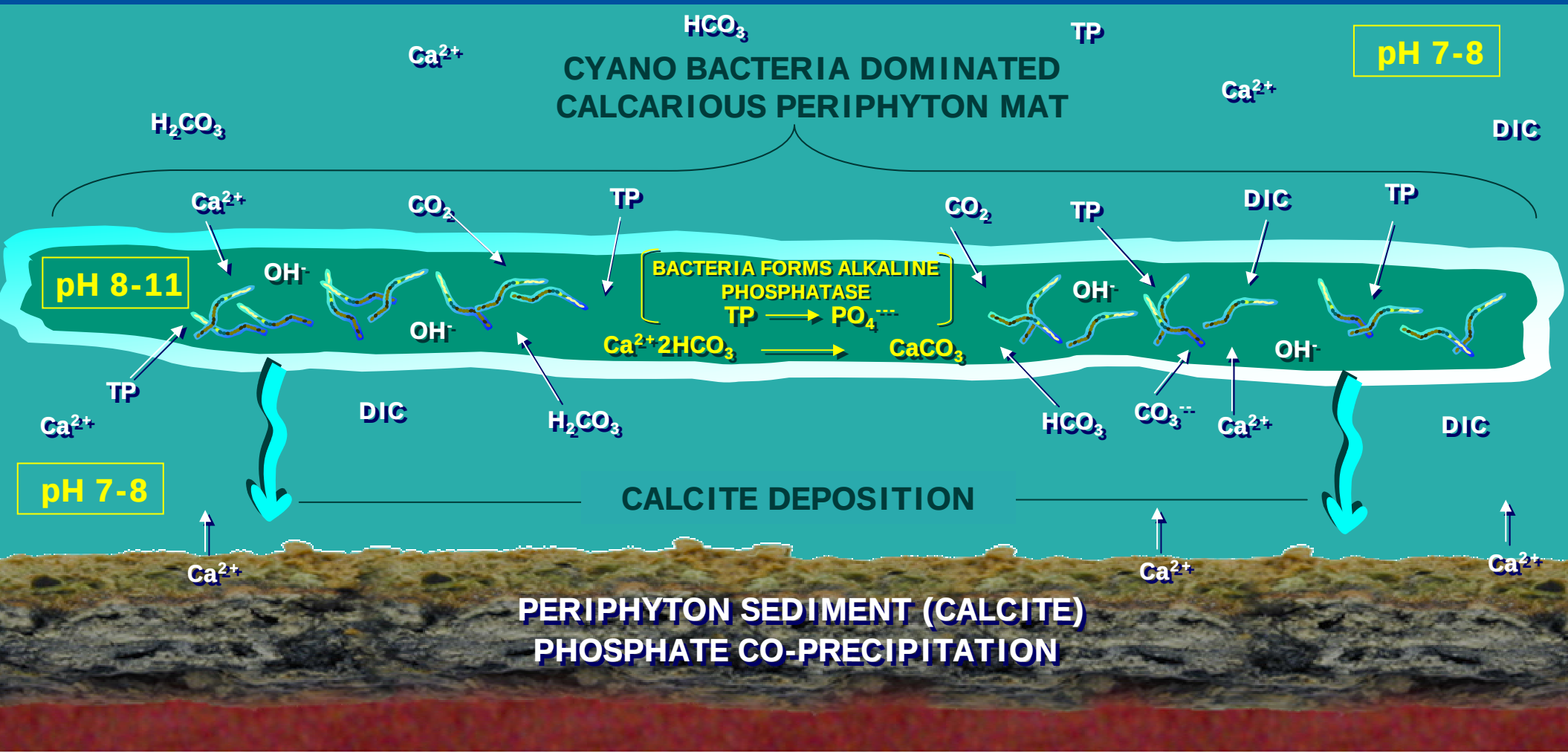
Repeated (forced) Dryouts
Activated Periphyton

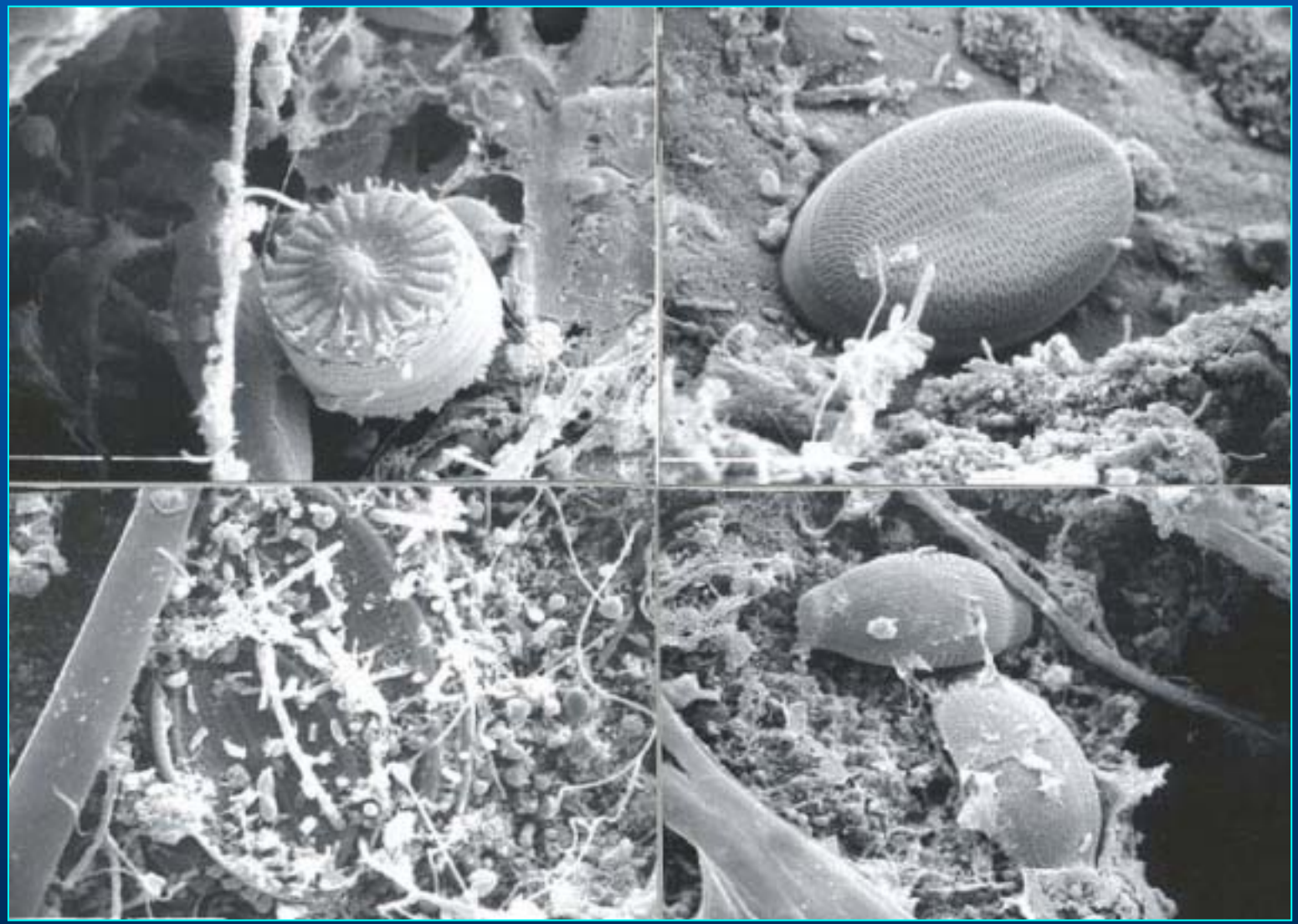


CYANO DOMINANT
Extreme conditions

PSTA Phosphorus (P) Removal Process within a Calcareous Periphyton Mat

- Calcium (Ca^{2+})
- Dissolved Inorganic Carbon – DIC (e.g. CO_3^{--} , H_2CO_3, HCO_3^-, CO_2)
- High pH
- Nucleation Sites





Enlargement of Calcareous Periphyton Assemblage

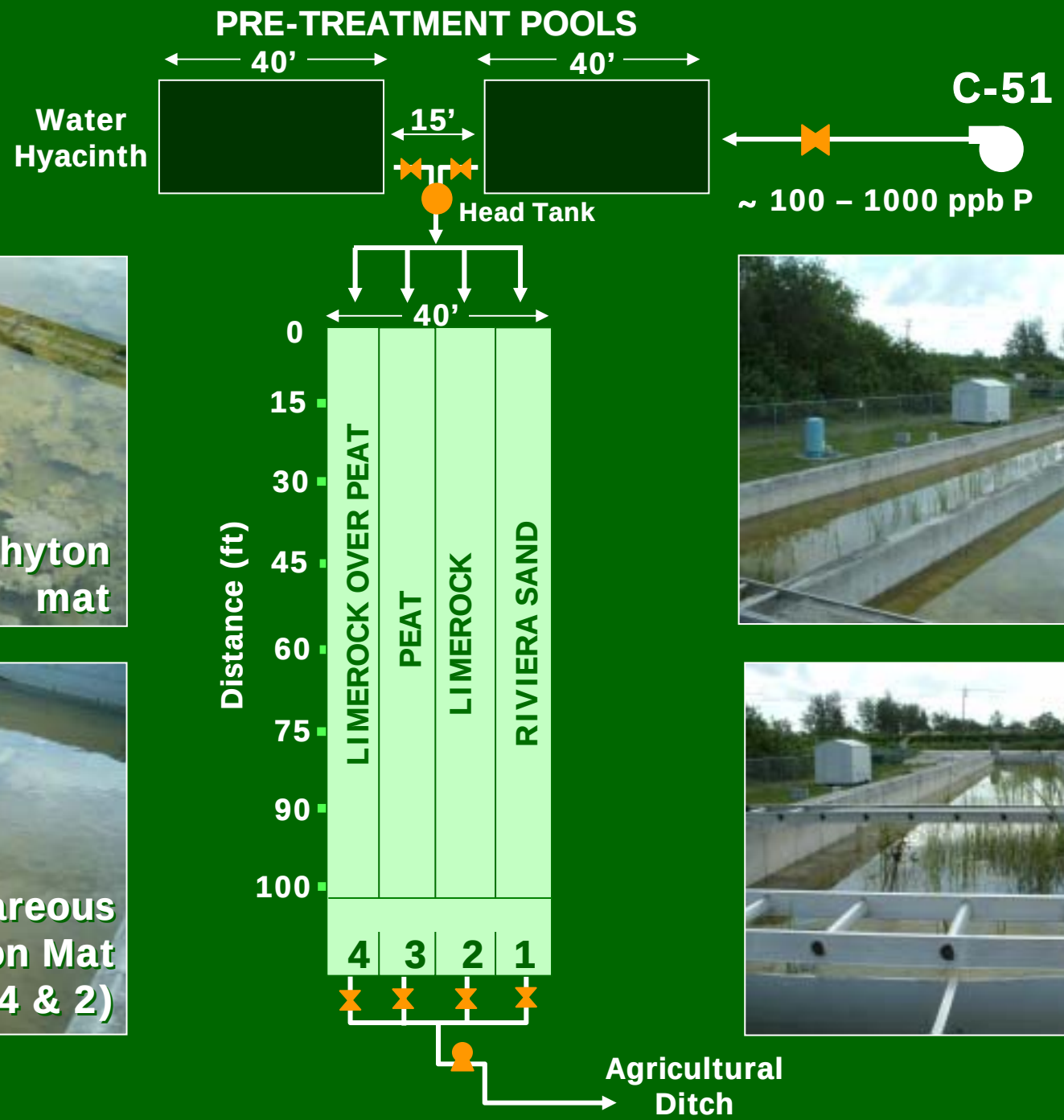
calcium carbonate precipitation functional groups

PSTA Studies

- STA-1E Test Cells ~ 90 m2 (Corps)
- C-111 Frog Pond & Spoil Mounds Removal Area (Corps) - > 50 acre naturally established calcareous periphyton – seasonal dry-outs
- 1’ x 145’ shallow raceways SFWMD (DB Environmental)
- ~ 500 m2 test cells Wellington (CH2MHill)
- 6 m2, 18 m2, ½ acre, 5 acre, ~100 acre PSTA test cells (SFWMD – CH2MHill)

Test Facility Layout

PSTA

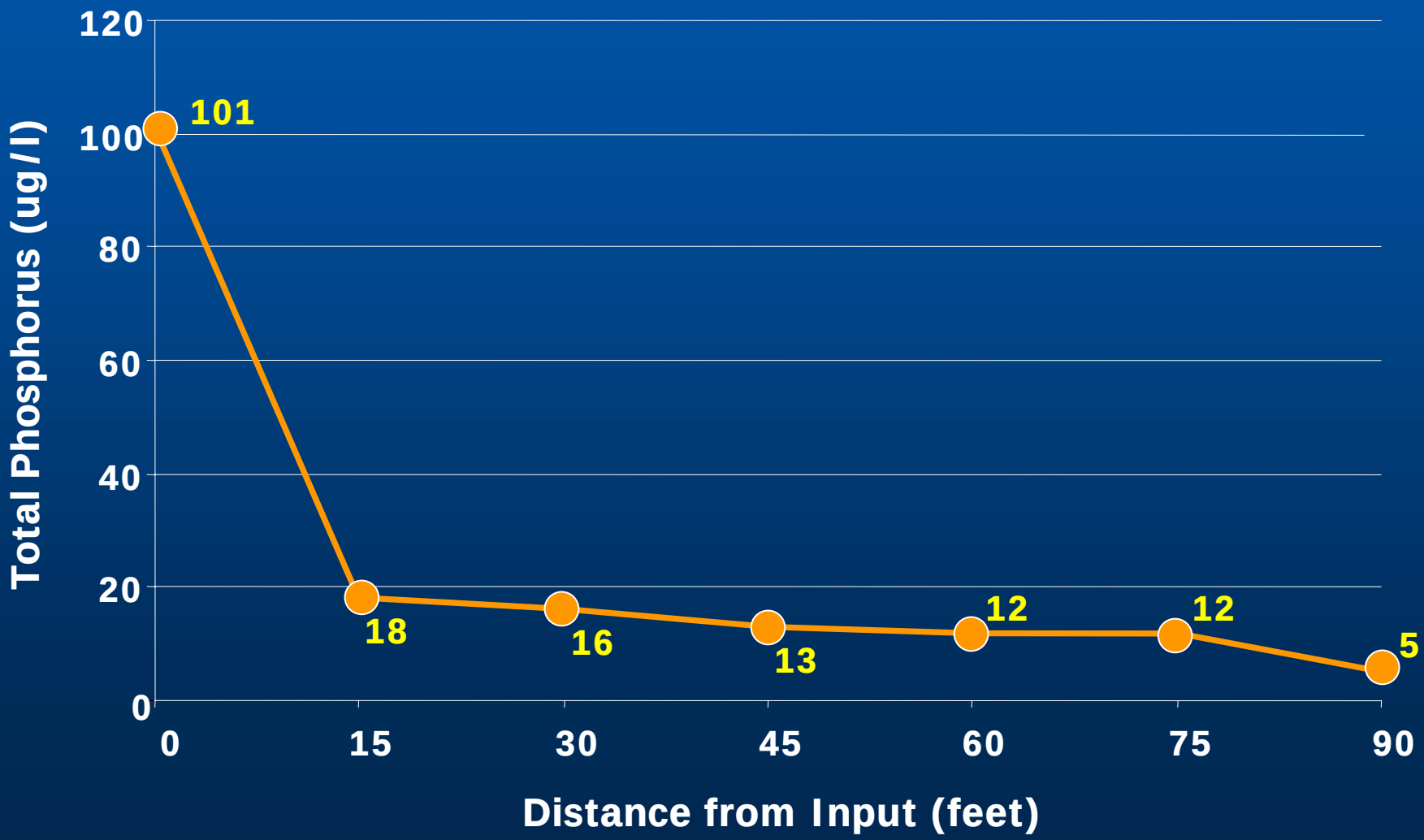

PRE-TREATMENT POOLS
40’
40’
Water Hyacinth
15’
C-51
~ 100 – 1000 ppb P
Head Tank
40’
0
15
30
45
60
75
90
100
Distance (ft)
LIMEROCK OVER PEAT
PEAT
LIMEROCK
RIVIERA SAND
4
3
2
1
Agricultural Ditch


Periphyton mat


Calcareous Periphyton Mat (Cells 4 & 2)

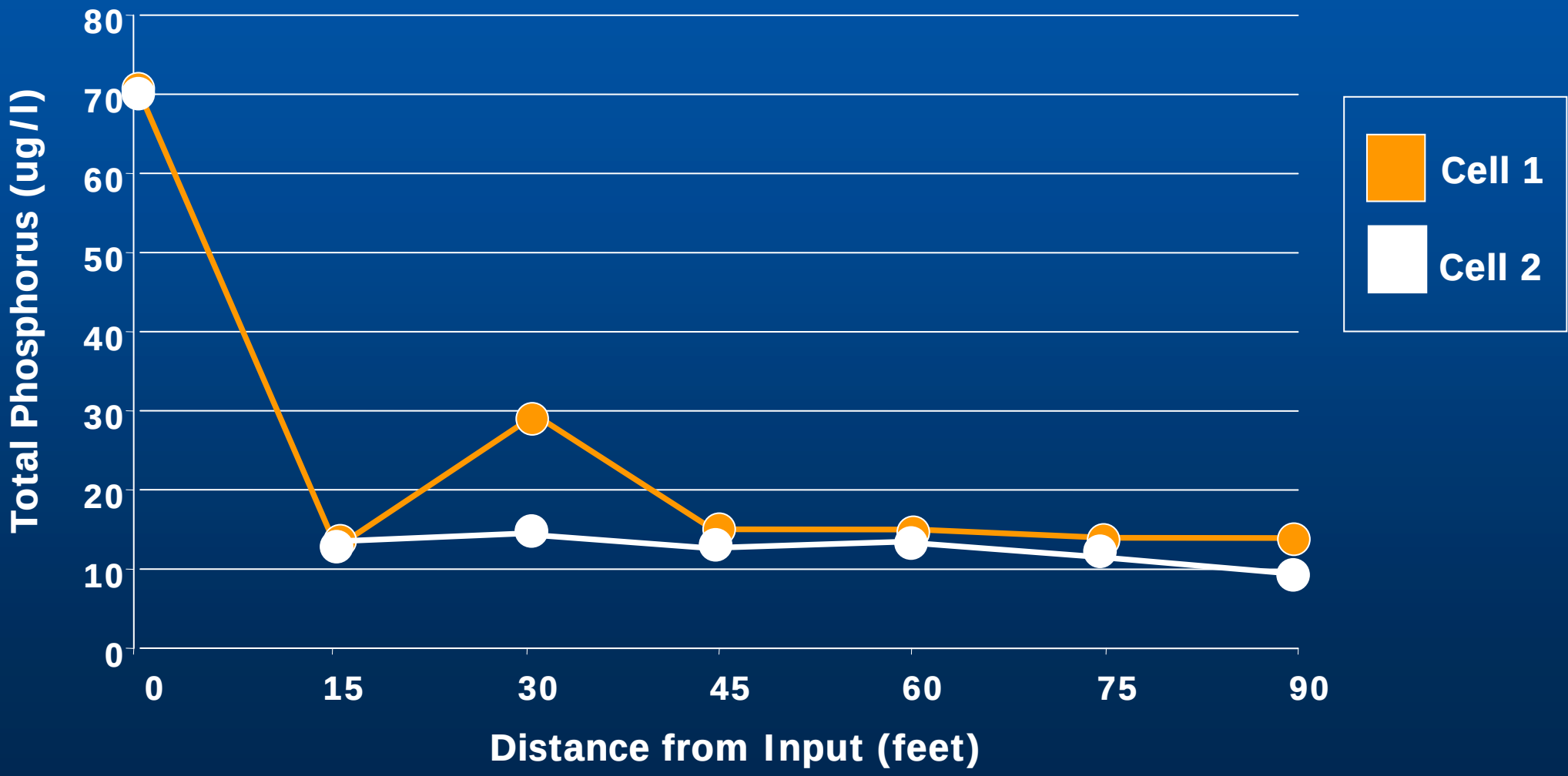
Cell 4 Phosphorus Transect

1’ depth, 7 day HRT – 6/06/03



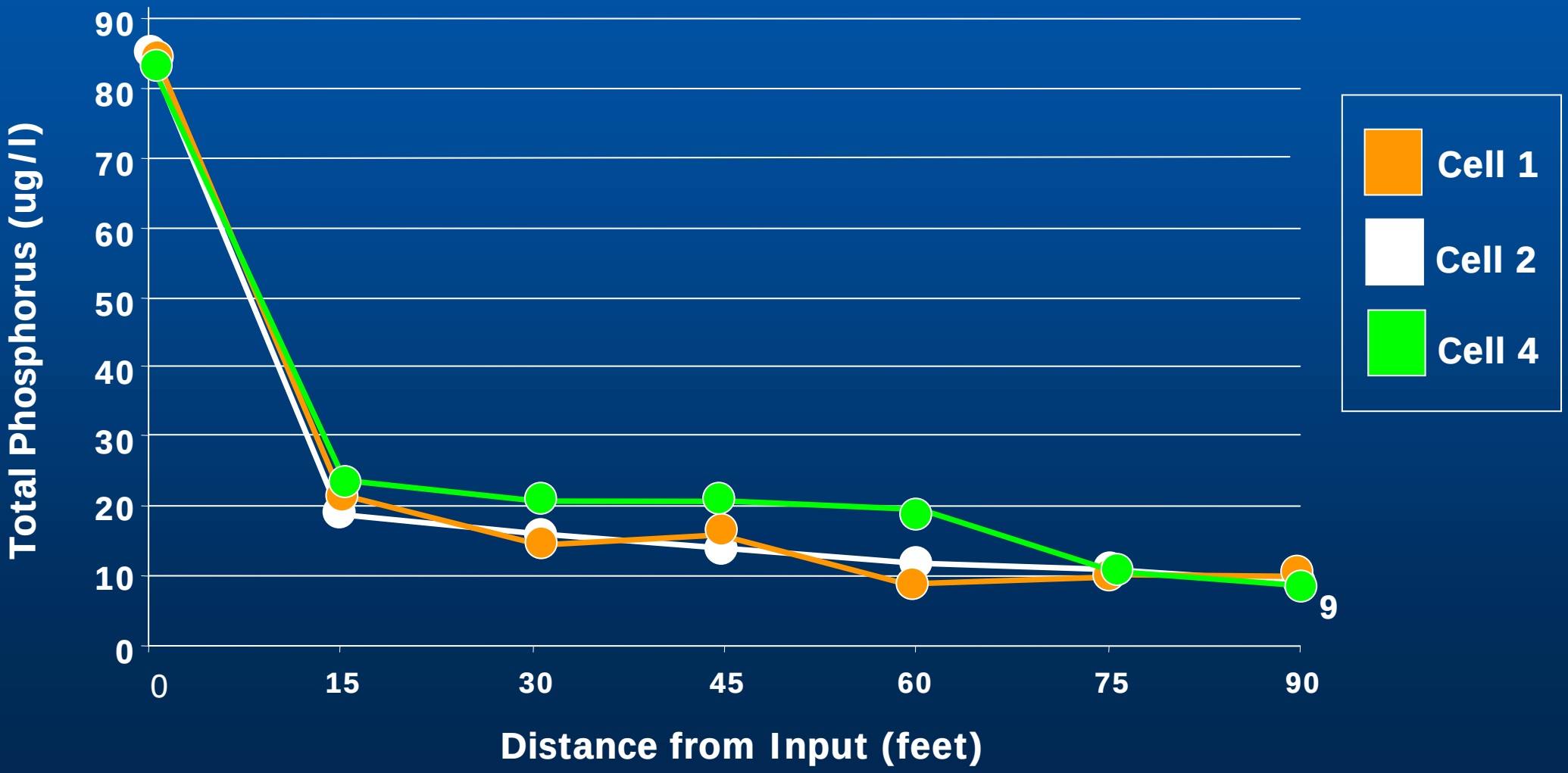
Cells 1 & 2 - Phosphorus Transect

1’ depth, 14 day HRT – 6/06/03



Cells 1,2 & 4 Phosphorus Transect

6” depth, 14 day HRT – 4/25/03



Periphyton covered SAV

SAV provides a platform for periphyton mat formation in deeper water

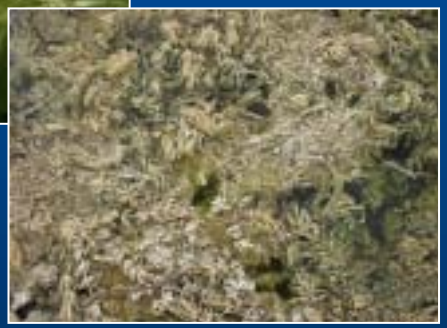
Typical calcium carbonate precipitate within periphyton mat

STA-1E

Conceptual Plan to Achieve 10 ppb Phosphorus (2006)

Emergent Growth

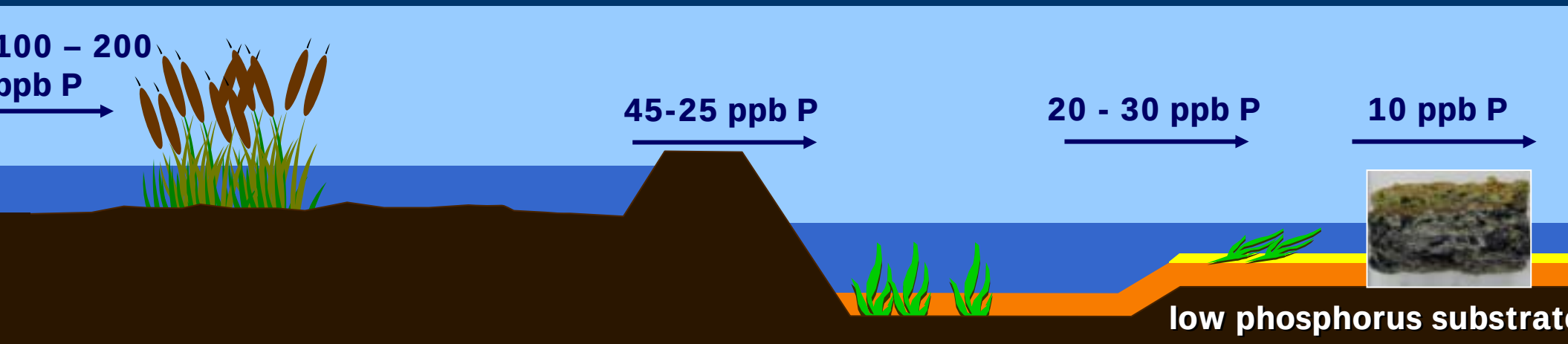
SAV



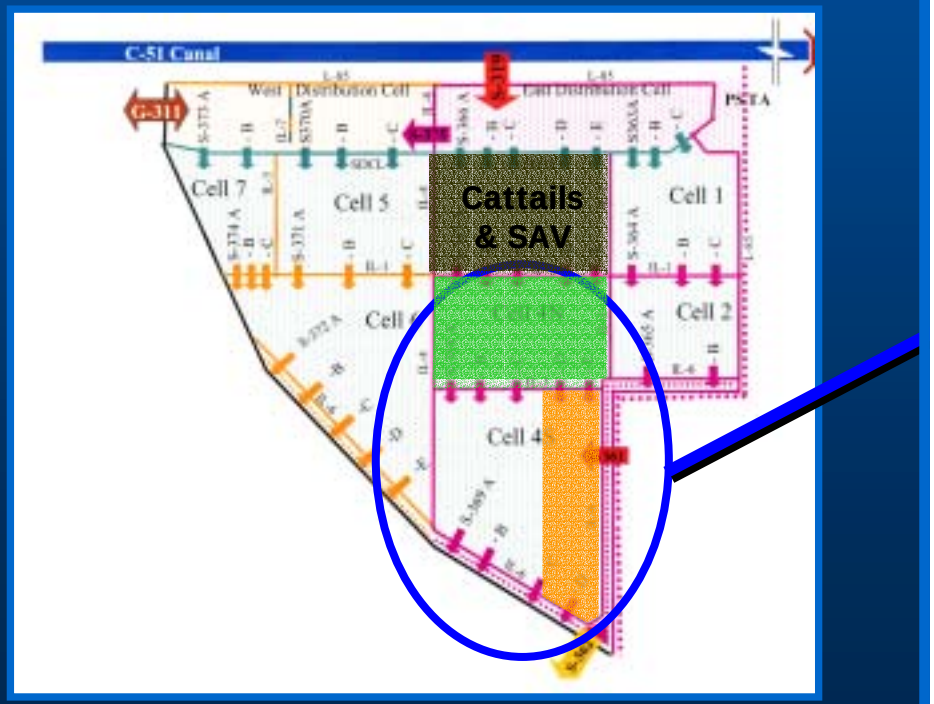
Periphyton sweatered SAV

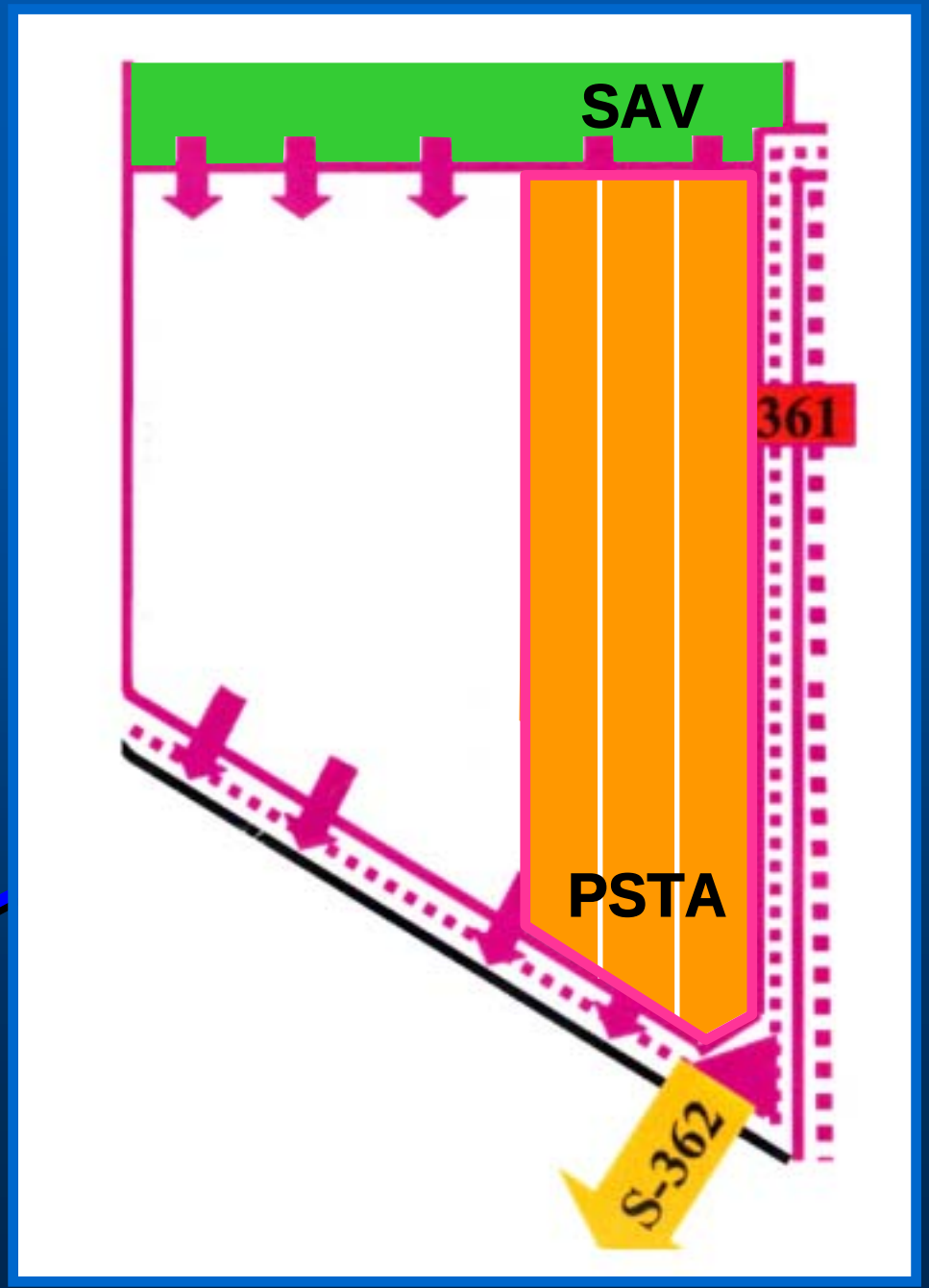
Periphyton

Cyano dominated Periphyton (activated)

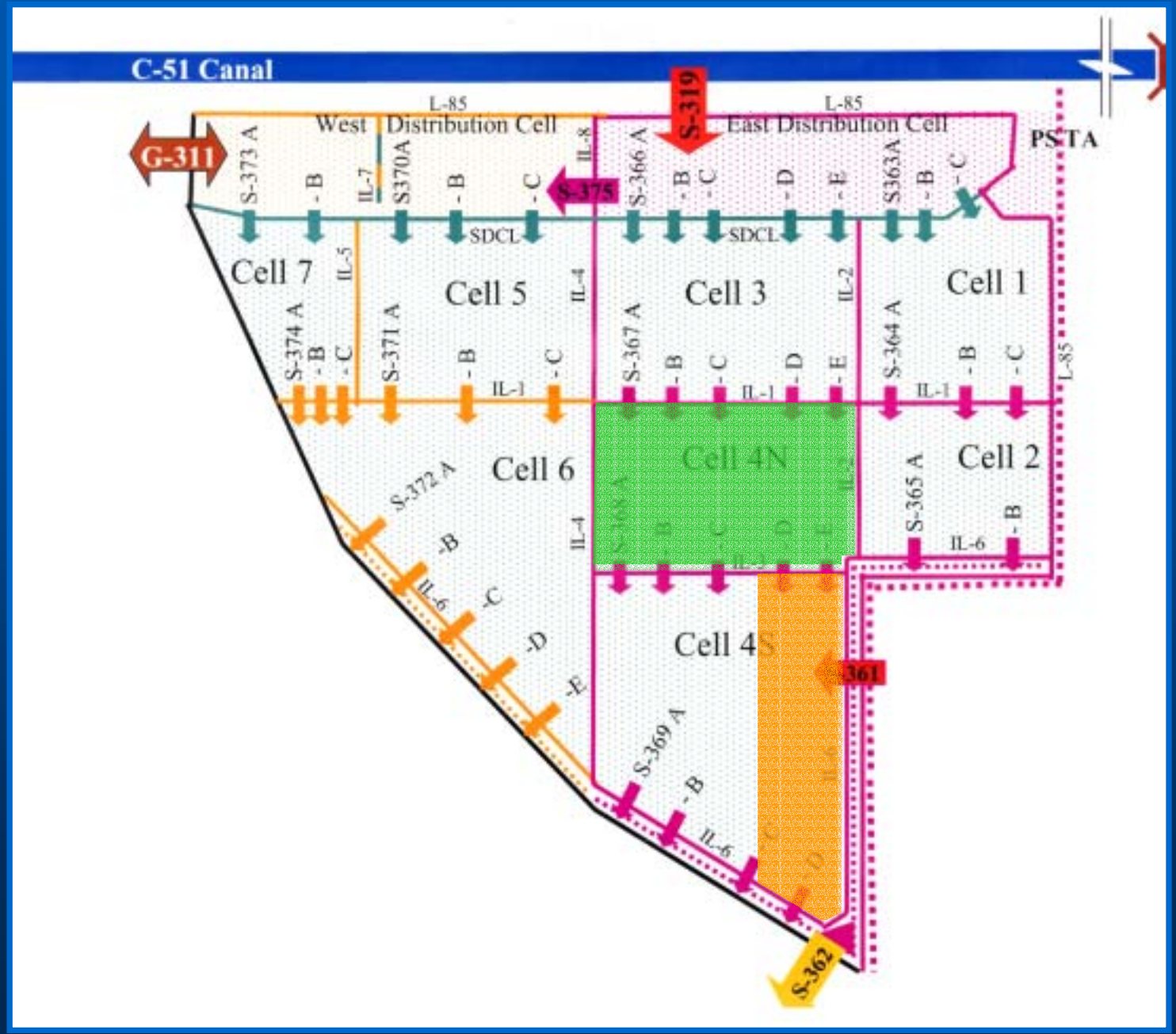


STA-1E PSTA/SAV Field Scale Layout (Cell 4N & 4S)





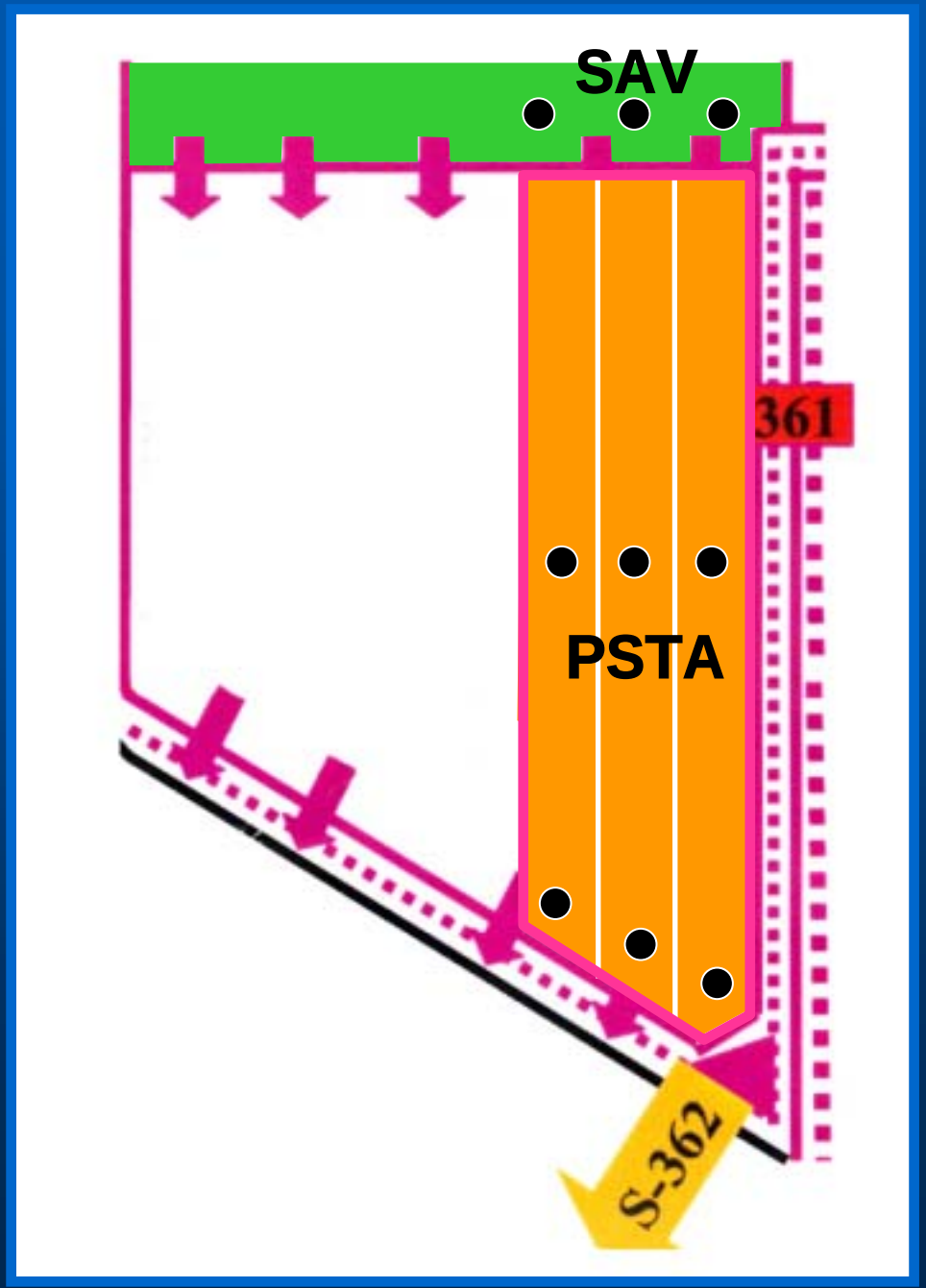
STA-1E

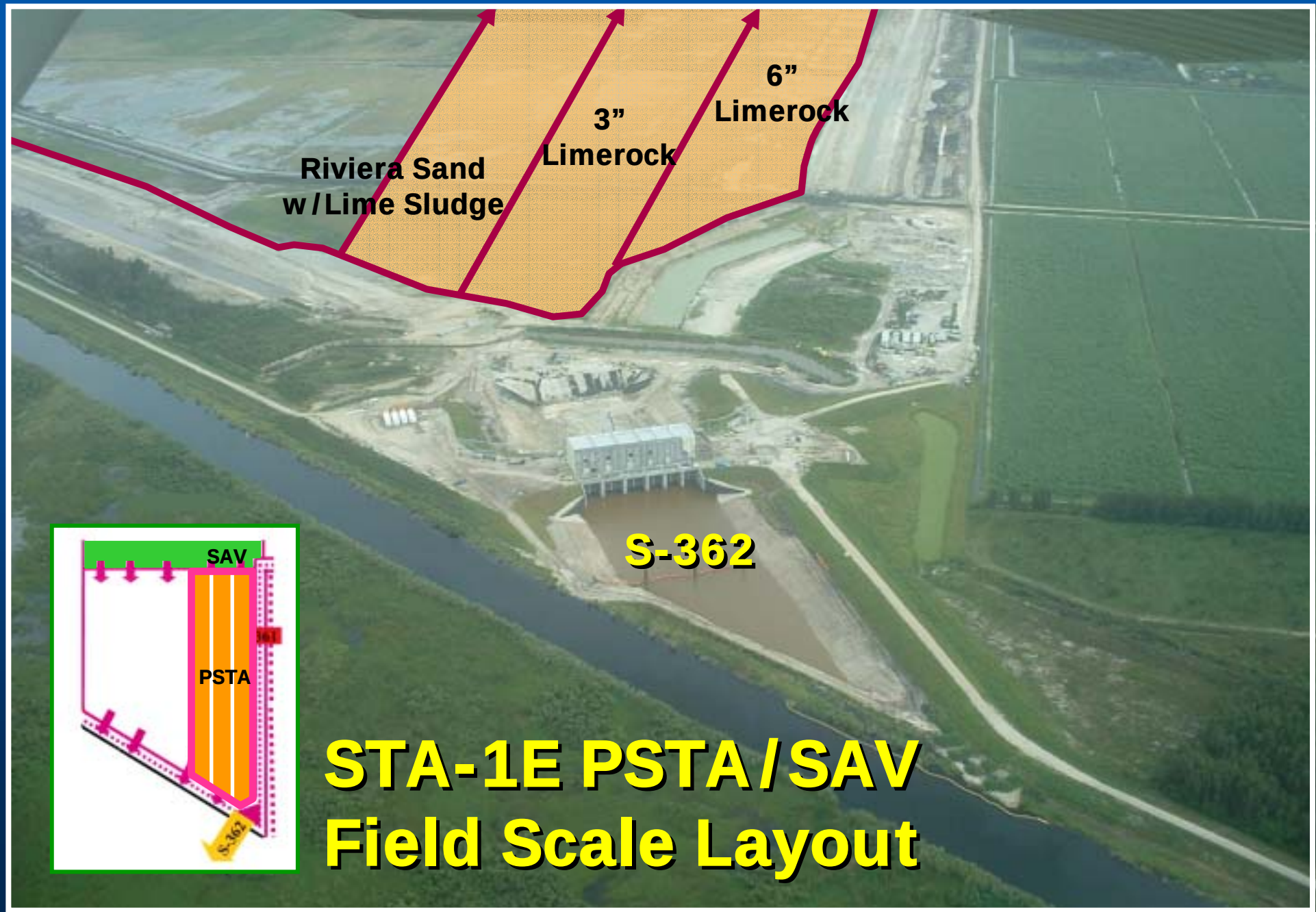

C-51 Canal
G-311
S-319
S-375
L-85
West Distribution Cell
L-85
East Distribution Cell
PSTA
S-373 A
S370A
S-366 A
S363A
IL-8
IL-7
SDCL
SDCL
Cell 7
Cell 5
Cell 3
Cell 1
IL-5
IL-4
IL-2
S-374 A
S-371 A
S-367 A
S-364 A
IL-1
IL-1
L-85
Cell 6
Cell 4N
Cell 2
S-372 A
S-365 A
IL-4
IL-6
IL-6
Cell 4S
361
S-369 A
IL-6
S-362

PSTA/SAV Field Scale Monitoring Locations

(Hydrolab and Isco Samplers)

- Cost: $1.8 million
- 18 months





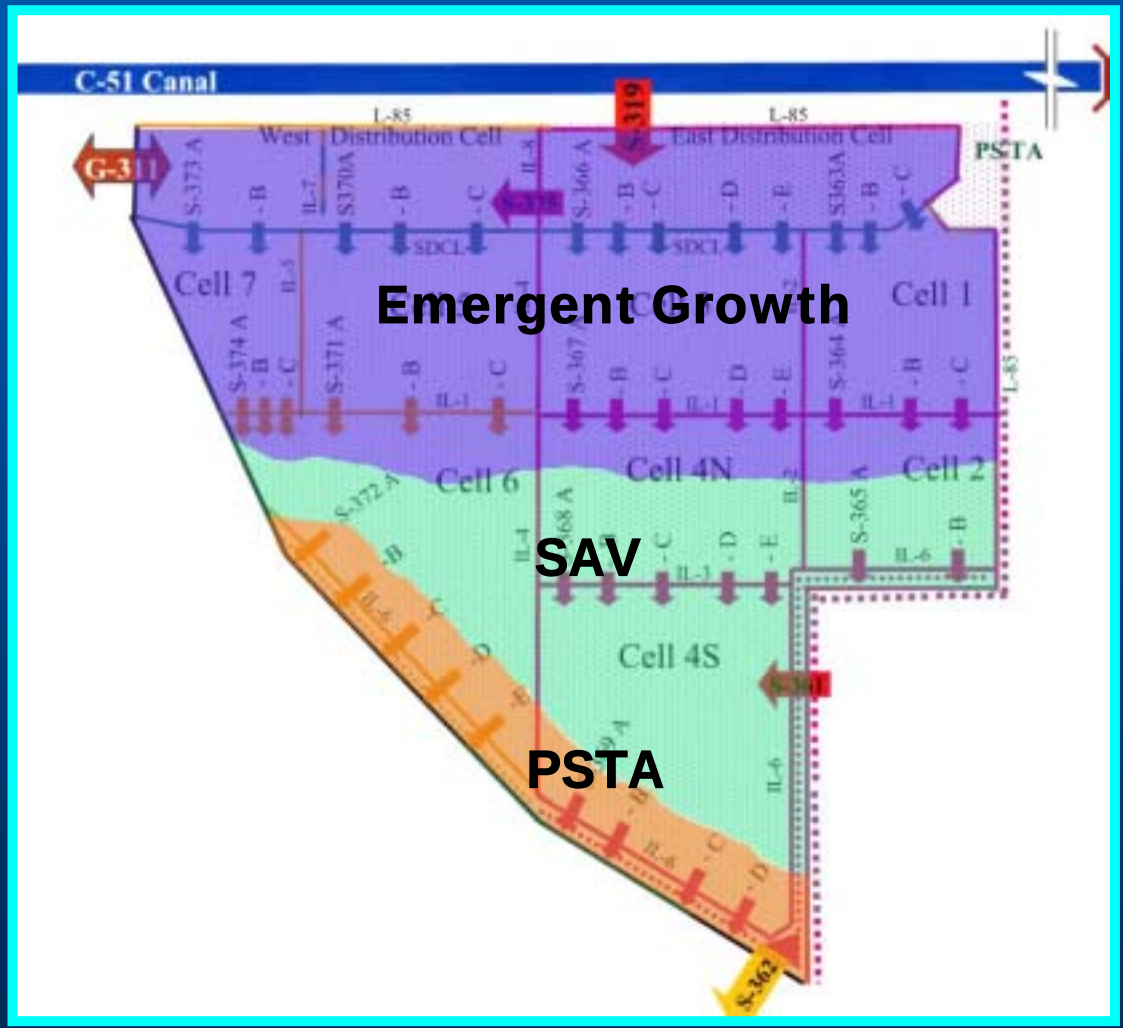
STA-1E PSTA/SAV Field Scale Layout

STA-1E Conceptual PSTA/SAV Full-scale Implementation

Corps Minimization Management Strategy *

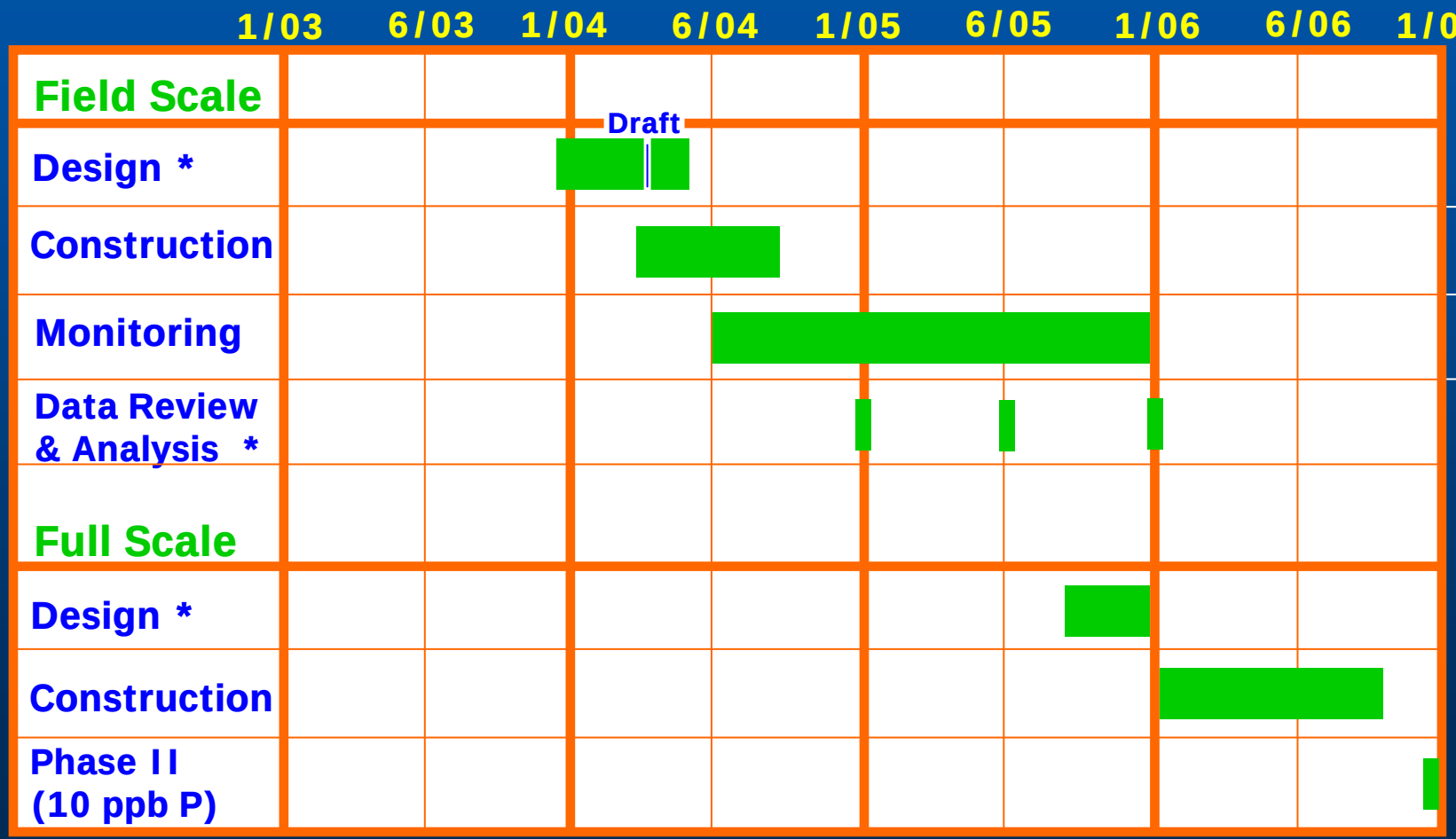
Delineation of species and functional groups are correlated to:

- **Soil chemistry**
- **Hydroperiod management**
  - **Water depth**
  - **Dry-out (seasonal or forced)**
  - **Activated periphyton**



Advanced Treatment Technology Implementation (STA 1-E)

June 2003 – December 2006



$ 300,000

$ 3,000,000

$ 1,700,000

$ to be determined

* Peer Review included

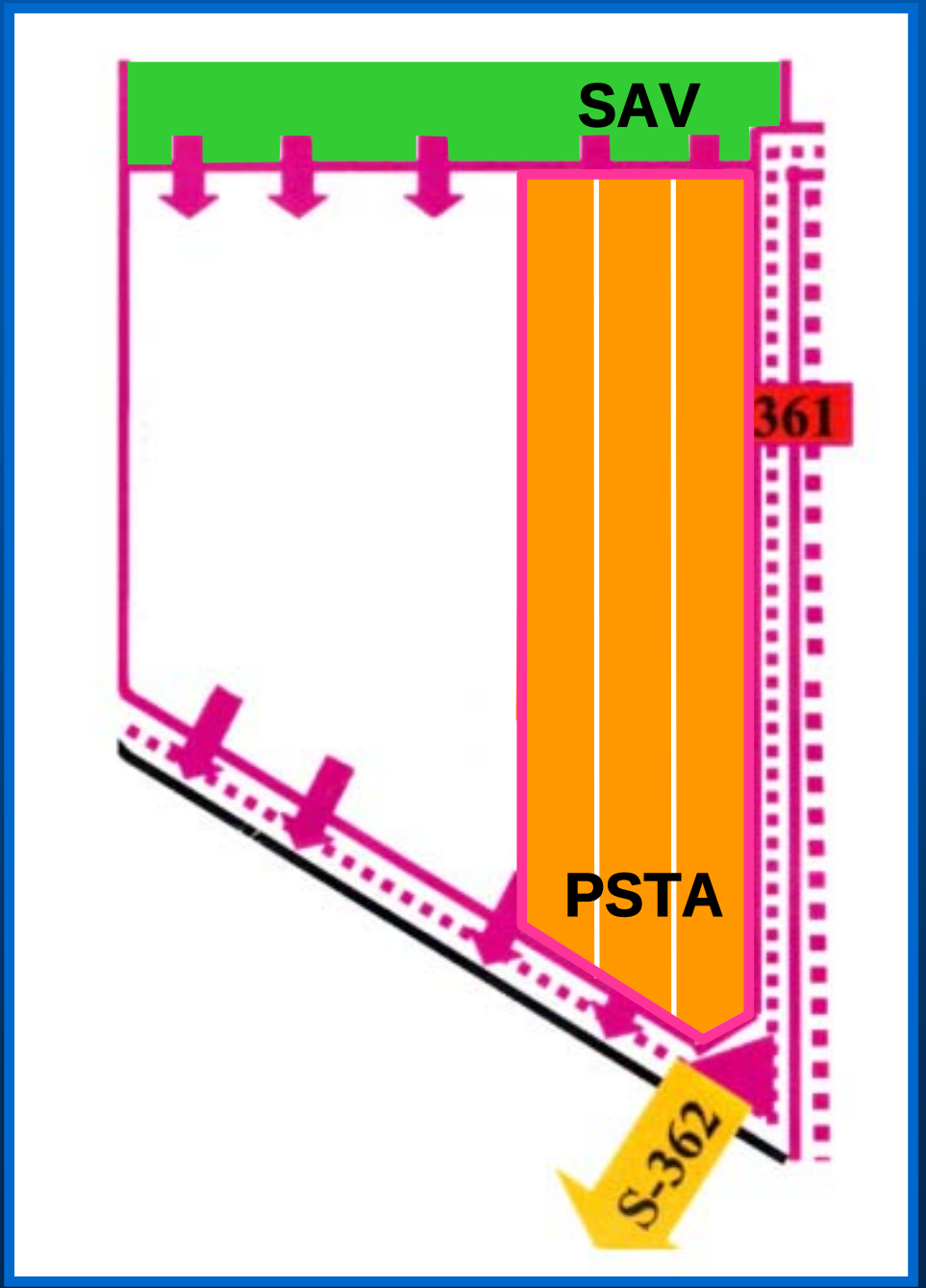
Field Scale Total Cost: $ 5,000,000

2/1/2004

Design Factors to Meet Primary Objective

Meet 10 ppb TP by 2006

1. Length - achieve 10 ppb TP
2. Width - Impact from adjacent features
3. Minimizing uncertainty - a larger test scale will produce results that are more indicative of full-scale implementation
4. Time



PSTA/SAV Implementation Status

- PSTA/SAV Field Scale Test – 100% Federal funds approved
- Full implementation throughout STA-1E – pending further review by HQ and Assistant Secretary of the Army (Civil Works)

STA-1E PSTA/SAV Implementation Consistency with SFWMD Long-term Plan

SAV critical component of implementation

- **Process also employs a PSTA polishing component to facilitate further reductions in phosphorus levels**

STA-1E PSTA/SAV Challenges to Successful Implementation

- Economics/construction needs
- Seasonal management of all treatment communities
  - extreme weather
    (hard freeze, drought, floods)

Modeling and Mapping

- Hyperspectral imagery study
  - Mapping
    - Vegetation
    - Water quality
    - Vegetation stress
- Modeling
  - Kadlec-Walker model
  - HydroQual model

~25 square miles of digital imagery

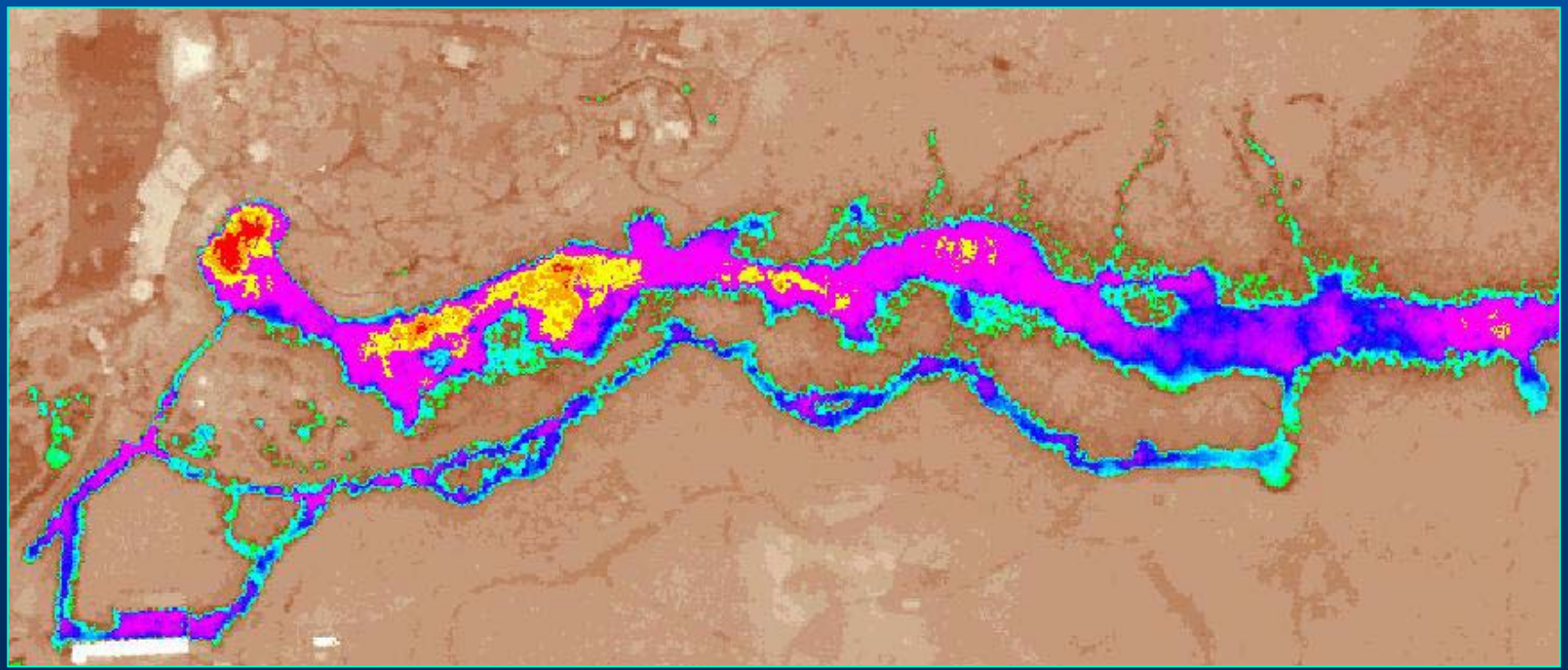
- quantify and classify vegetative communities (periphton, SAV, cattails, endangered species)
- correlate and map water quality
- define the impact of STA-1E on the Refuge

$460k: baseline data collection (2004) and post-discharge data collection (2005)

Lake Okeechobee

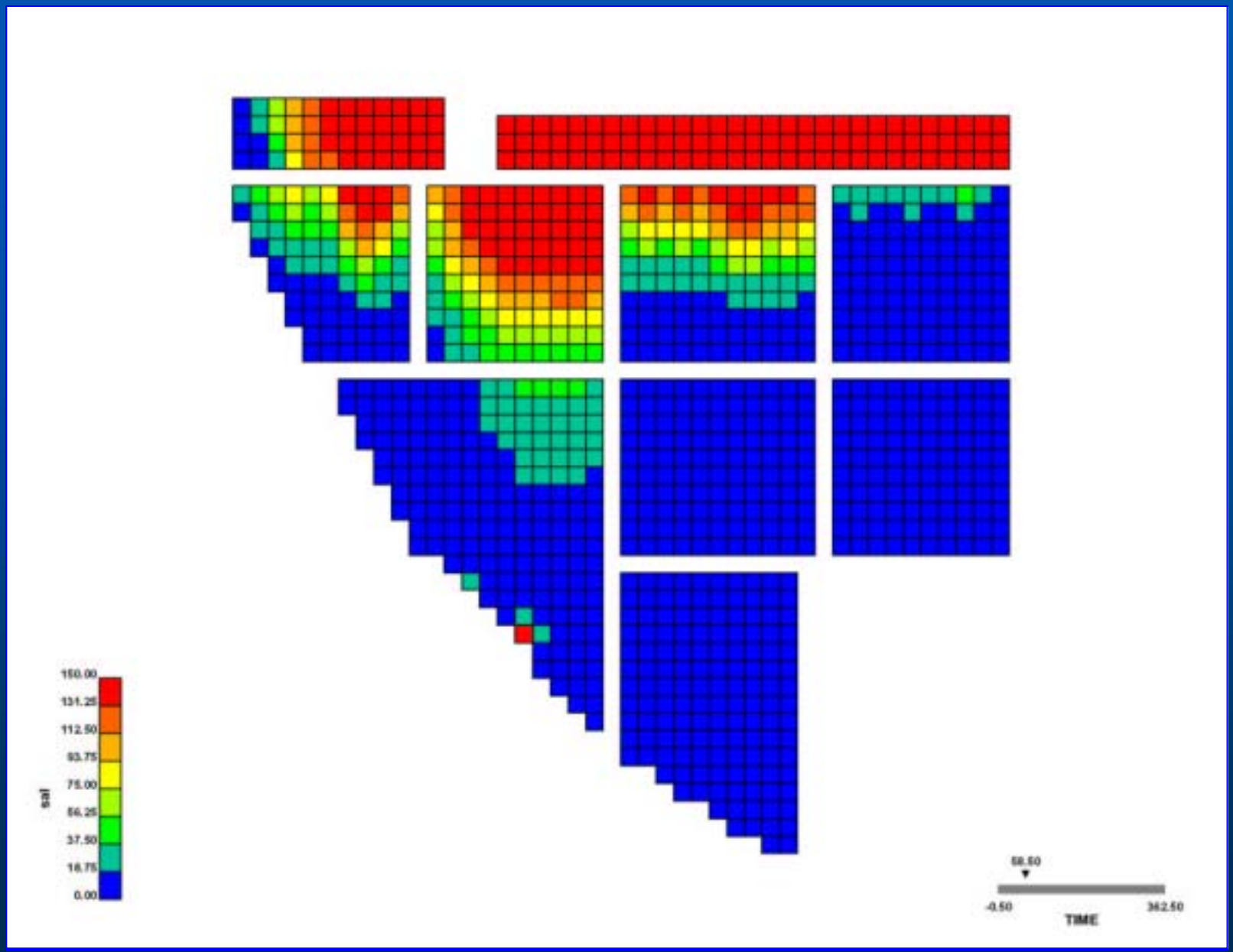
Loxahatchee Wildlife Refuge

Thermal Imagery – Monitoring Water Sources and Flows



warmer cooler

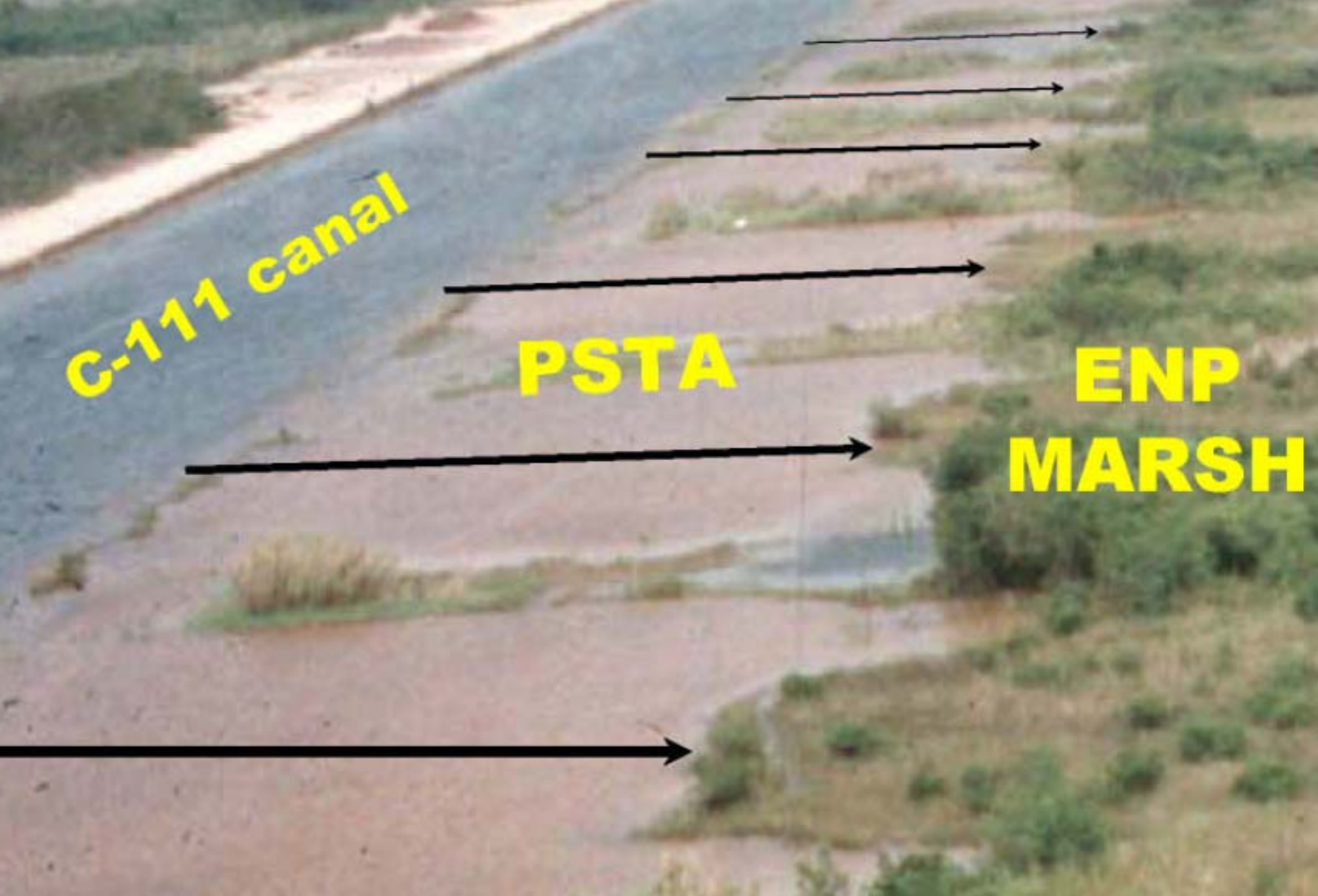
Example: Silver Spring, Florida
Approximate Cost: $30,000



HydroQual Model

The C-111 canal before the spoil mound removal


The C-111 canal after the spoil mounds removal
N


C-111 canal
PSTA
ENP
MARSH