Lessons Learned from Large-scale Wetland Design, Construction and Operation

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Overview

- Everglades Construction Project
- Lessons learned
  - Planning
  - Design
  - Construction
  - Operation

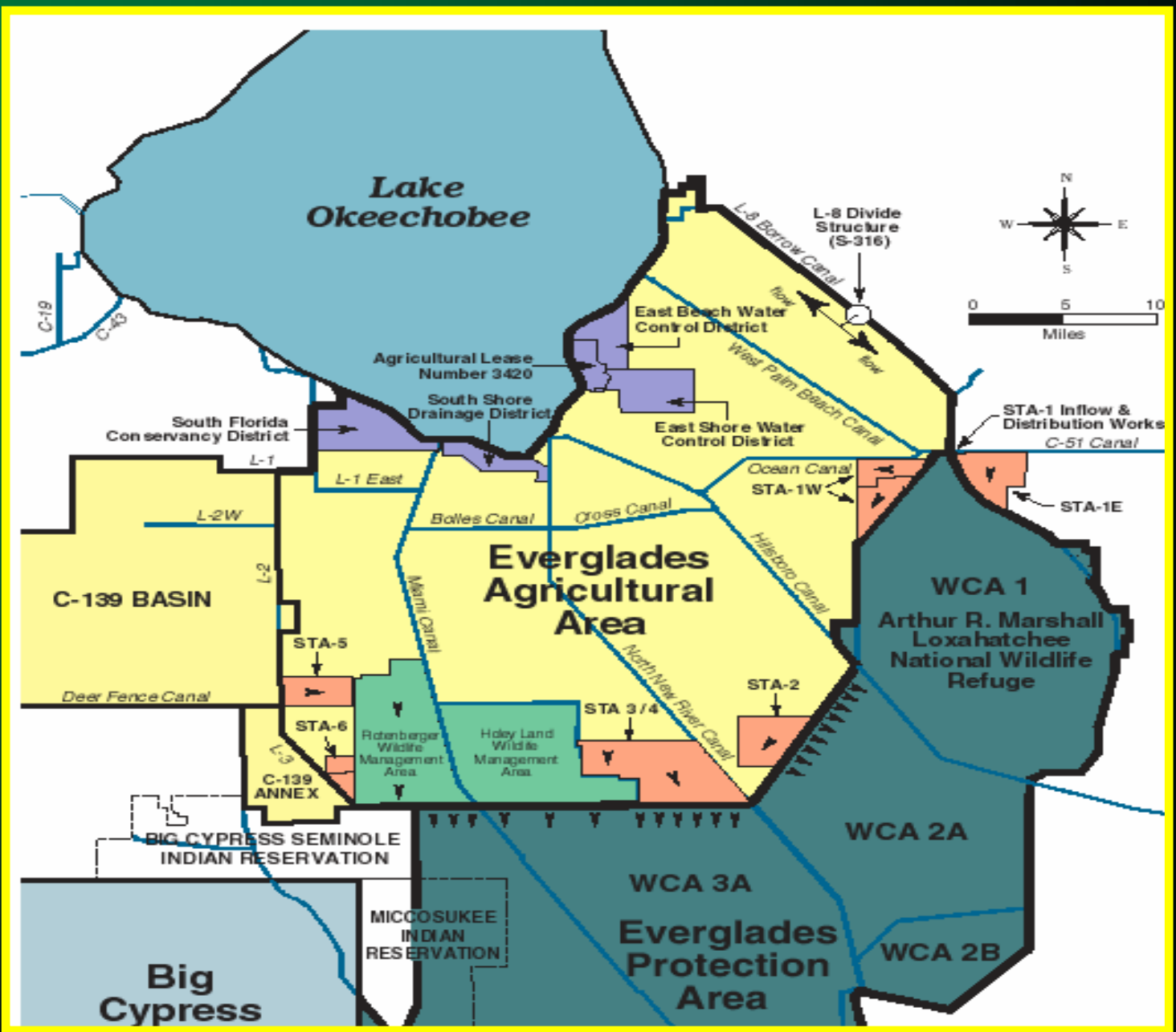

You are here
Everglades

Everglades Restoration

- 4 major problems facing Everglades ecosystem:
  - Reduction in spatial extent of wetlands
  - Degradation of water quality (e.g., phosphorus and mercury)
  - Disruption of hydropatterns (i.e., timing, volume & distribution)
  - Infestation by exotic plant species
- ECP designed to address first 3

Everglades Construction Project

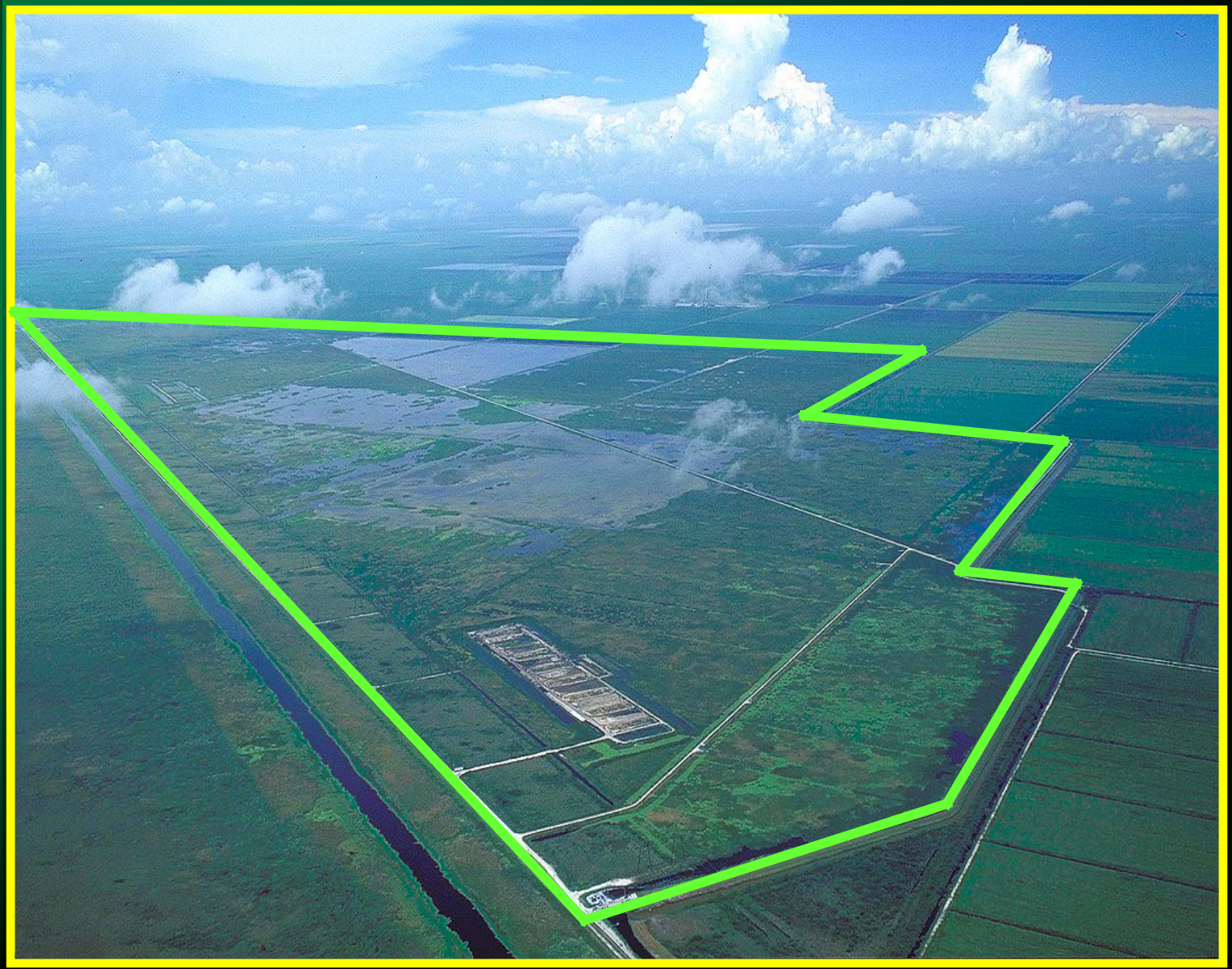
- Six large constructed wetlands
  - 870 acres to over 16,600 acres
  - 10-yr $700 million construction
  - “Passive” biological treatment - yet over 250 control structures, 150 miles of canals/levees
  - combination of emergent, SAV and existing wetland vegetation
  - four are complete; 2 under construction
- Critical for Everglades restoration
  - reduce phosphorus to 50 ppb and lower
  - increase quantity of inflows
  - improve distribution of inflows


Lake Okeechobee
L-8 Divide Structure (S-316)
L-8 Borrow Canal
flow
flow
East Beach Water Control District
West Palm Beach Canal
Agricultural Lease Number 3420
South Shore Drainage District
East Shore Water Control District
South Florida Conservancy District
STA-1 Inflow & Distribution Works
C-51 Canal
STA-1E
Ocean Canal
STA-1W
C-19
C-43
L-1
L-1 East
L-2W
L-2
Bolles Canal
Cross Canal
Hillsboro Canal
Miami Canal
North New River Canal
Everglades Agricultural Area
C-139 BASIN
WCA 1
Arthur R. Marshall Loxahatchee National Wildlife Refuge
STA-5
Deer Fence Canal
STA-6
L-3
C-139 ANNEX
Rotenberger Wildlife Management Area
Holey Land Wildlife Management Area
STA 3/4
STA-2
BIG CYPRESS SEMINOLE INDIAN RESERVATION
WCA 2A
WCA 3A
MICCOSUKEE INDIAN RESERVATION
Everglades Protection Area
WCA 2B
Big Cypress
N
W
E
S
0
5
10
Miles

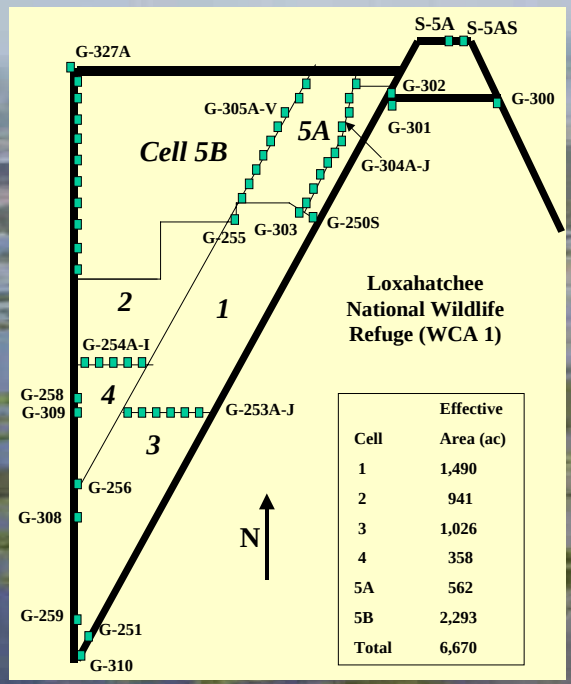
40,000 of prior agriculture lands

5,000 acres of remnant Everglades habitat

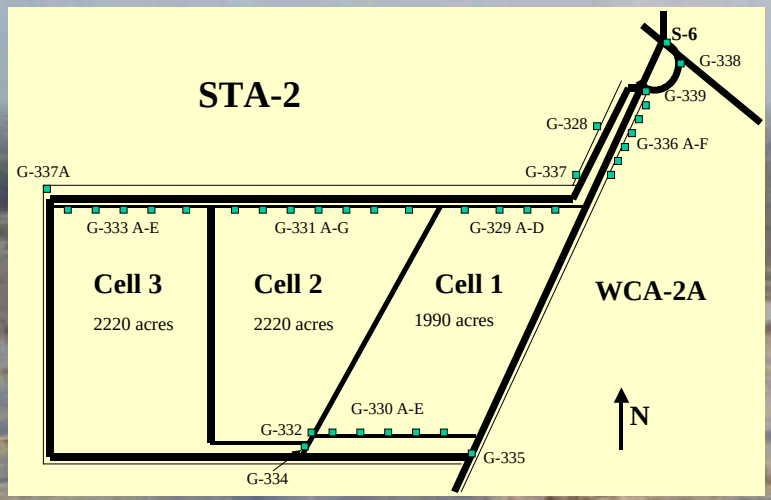
Everglades Nutrient Removal Project - 3,800-ac demonstration project



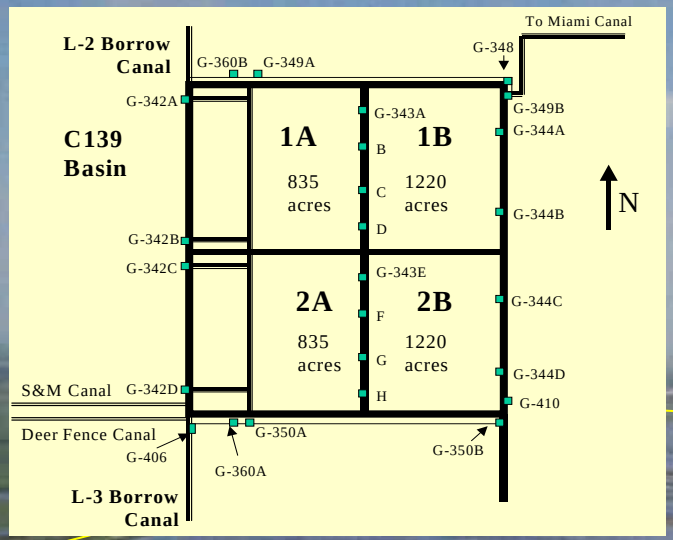
Cell 1 - self organizing vegetation communities



Cell	Effective Area (ac)
1	1,490
2	941
3	1,026
4	358
5A	562
5B	2,293
Total	6,670


STA-2
S-6
G-338
G-339
G-328
G-336 A-F
G-337A
G-337
G-333 A-E
G-331 A-G
G-329 A-D
Cell 3
2220 acres
Cell 2
2220 acres
Cell 1
1990 acres
WCA-2A
G-330 A-E
G-332
G-335
G-334
N

STA-5 - start-up



Cell 1B

Cell 1A


STA-6

STA Sizing

STA	Flow AF/yr	Load MT/yr	Size ha
STA 1E	124,876	29.4	2,170
STA 1W	142,860	37.7	2,700
STA 2	174,641	33.7	2,600
STA-3/4	604,655	87.3	6,745
STA 5	78,340	25.3	1,670
STA 6	53,877	13.2	960

STA Summary

- 6 large constructed wetlands totaling over 19,300 ha to treat 331,174 ha of tributaries (6%)
- ~1,180,000 AF/yr & ~227 MT/yr
- Goal is 50 ppb outflow; ~164 MT/yr removal
- Peat soils that vary in organic content
- Surface flow wetland treatment systems
- Long-term P removal through peat accretion
- Utilizing a combination of existing wetland plants, volunteer recruitment, and management to encourage submerged aquatic vegetation/algal communities
- Performance to date has exceeded expectations!

Lessons Learned

- Still writing the book
- Have spent hundreds of hours compiling lessons learned
- Will highlight significant lessons learned to date

Planning

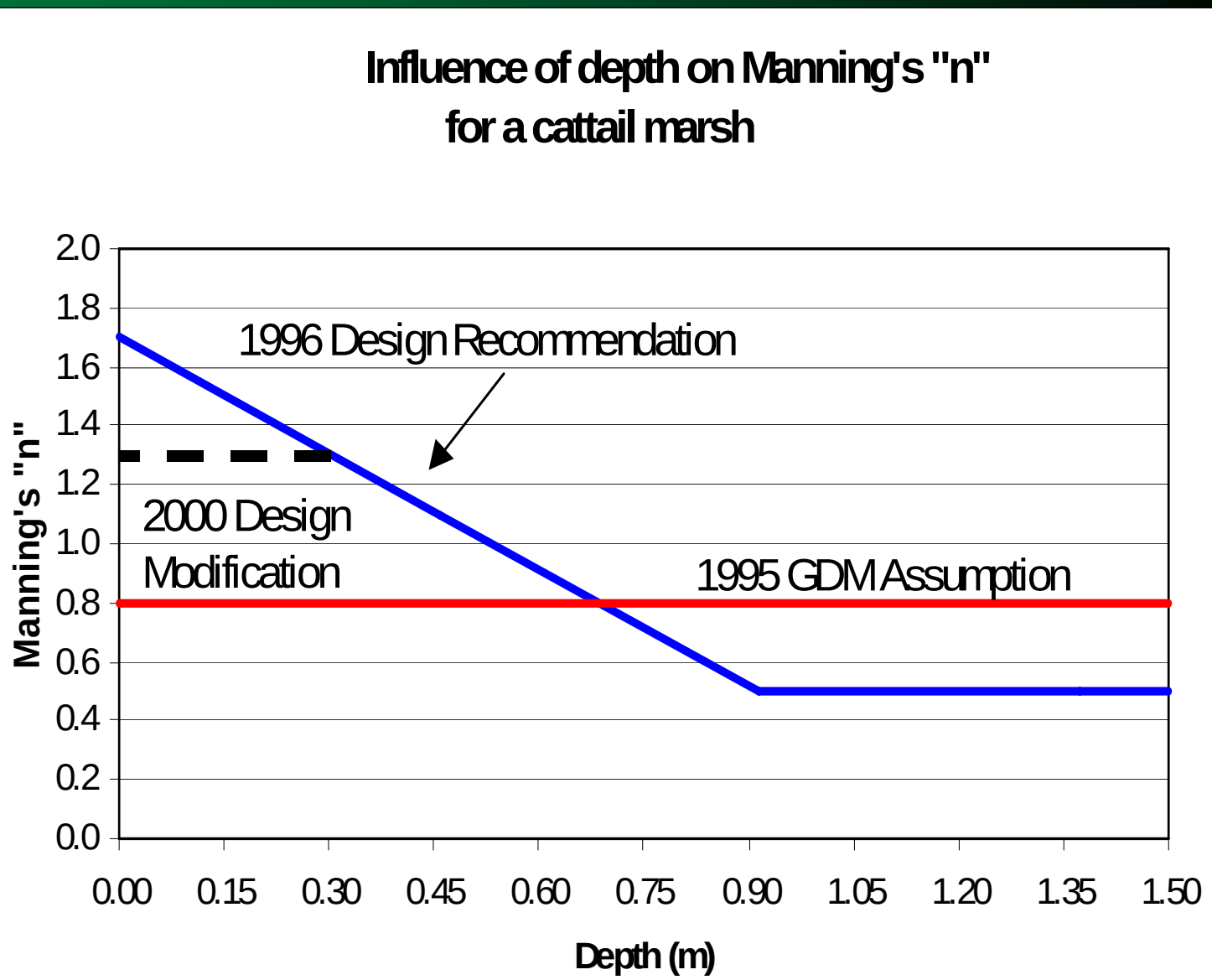
- Establish effective teams
  - internal: scientists and engineers
  - external: agencies, stakeholders and technical experts
- Establish clear project targets
- Characterize hydrologic and nutrient inputs
- Identify and evaluate alternatives
- Retool business practices

Design - Process

- STA Design review group began 1991
- Utilized combination of consultants and in-house design
- Continual exchange of ideas between team members – scientists and engineers, etc.
- Site manager and operations staff active during design
- Extensive peer-review
- Creative land management - long-term plan

Design - details

- Good topographic surveys are critical
- Know what the desired vegetation type will be - design for min./max. and average operating depths
- Vegetation barriers necessary at all structures
- Consider prior land use
- Understand nutrient dynamics
- Utilize depth-dependent variable Manning's "n" for modeling flows


Influence of depth on Manning's "n"
for a cattail marsh
Manning's "n"
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1996 Design Recommendation
2000 Design
Modification
1995 GDM Assumption
0.00
0.15
0.30
0.45
0.60
0.75
0.90
1.05
1.20
1.35
1.50
Depth (m)

Design - details (cont'd)

- use of standard designs – structures, levees, etc.
  - passive split level gates to maintain operating depths
- consider monitoring equipment, structure calibration, flow monitoring during design
- prepare water management and dewatering plans prior to construction – keep water onsite to accelerate growth of wetland vegetation
- can never have too much geotechnical data – minimize contractor claims
- automated trash racks for pump stations

Design - concluded

- Performance related to hydraulic efficiency
  - minimize short circuiting
  - plug field ditches parallel to flow
  - leave transverse canals for redistribution
  - use spreader canals, collection canals
  - compartmentalization - hydraulic redistribution
- Seepage can be significant
- *Consider new information during design*

Permitting

- ***Meet early and often with regulatory agencies; educate the regulator***
- Plan resources for permit administration and acquisition
- Permit conditions should allow for operational flexibility
- Minimize monitoring requirements – long-term financial obligation and most data are not reviewed buy regulatory agencies
- Streamline reporting requirements to minimize resource commitments

Construction

- Hold mandatory pre-bid conferences
- Minimize number of different prime contractors
- Formal partnering agreements/kick-off meetings prior to construction for addressing problems
- Site manager active during construction
- Vegetation management plans

Operations

- ***Communication, communication, communication!***
- Keep the team together – monitor operations frequently
- Commit the staff and $ resources required
- Develop operation plan (construction, start-up and normal ops) early and obtain broad review
- Review operation plan frequently – every 6-12 months; document deviations immediately for posterity

Operations - cont'd

- Large-scale systems are self-designing – contingency plans
- Flush submerged aquatic vegetation periodically to avoid major build up and pump shut down
- Stay ahead of (i.e., herbicide) undesirable vegetation – early and appropriate periodicity
- Annual aerial photos are very beneficial

Operations - concluded

- Continue monitoring/researching ways to improve/optimize performance
- Performance – frequent review and analysis to catch and correct problems as soon as possible; run models frequently with actual data
- Communication, communication, communication!

For More Information:

- www.sfwmd.gov
  - Major Projects
  - Everglades Restoration
  - Everglades Construction Project
- Everglades Consolidated Report
  - Summary of all available data
  - http://www.sfwmd.gov/org/ema/everglades/index.html
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