Water Quality Constrains Hydrologic Management Options for a Northern Everglades Peatland

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Changes in water sources have altered both the hydrology and chemistry of the Everglades

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<tr>
<th>Predrainage Ecosystem:</th>
<th>Managed Ecosystem:</th>
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<td>• Hydrology controlled by rainfall</td>
<td>• Hydrology influenced by canal discharges</td>
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<td>• Oligotrophic, P-limited conditions</td>
<td>• Phosphorus enrichment near discharge points</td>
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<td>• Low-TDS (soft-water) conditions in peat-forming areas</td>
<td>• Larger areas exposed to increased TDS loads (e.g., Ca^{2+}, HCO_{3}^{-}, SO_{4}^{2-}, K^{+})</td>
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Conflicts between hydrologic and water quality needs of the natural system

- Poor quality of source waters
- Phosphorus reduction efforts (BMPs and STAs) have yet to meet environmental targets
- Other contaminant loads (e.g., sulfate, TDS) are not regulated

Increased Flows $\rightarrow$ Increased Contaminant Loads $\rightarrow$ Ecological Impacts
Loxahatchee National Wildlife Refuge (WCA1)
Most Flow Conveyed Through Rim Canals
Major Environmental Gradients

- **Hydrology**
  - North-South depth gradient

- **Water Quality**
  - Phosphorus elevated near the perimeter
  - Major ions (TDS) elevated across a large area
Hydrologic Management Options
Option 1: Flow Restoration

- **Ecological Benefits:**
  - Re-establish a major hydrologic driver
  - Reduce unnatural north-south depth gradient

- **Water-Quality Constraints:**
  - Forces P-rich, high-TDS canal water across the Refuge
  - STAs may achieve P targets but not designed to remove sulfate or other major ions

- **Engineering and Operational Constraints**
  (Insurmountable)
Hydrologic Management Options
Option 2: Improve Impoundment Management

- **Ecological Benefits:**
  - Retard undesirable vegetation changes and soil oxidation
  - Support target fish & wildlife populations

- **Water-Quality Constraints:**
  - Can promote canal-water intrusion
  - STAs may achieve P targets but not designed to remove sulfate or other major ions

- **Engineering and Operational Constraints**
  (Surmountable)
Refuge Hydrologic Performance Measures

• **Seasonal High Stage**
  – Reach Full Pool for 3-4 weeks in most years
  – Maintain slough habitats and retard expansion of woody and invasive species

• **Spring Recession**
  – Gradual stage decline without significant reversals
  – Support breeding fish and wildlife
Refuge Water-Quality “Performance Measure”

• Minimize Canal-Water Intrusion
  – P, SO$_4$, TDS enrichment
  – Maintain desirable vegetation
  – Maintain habitat quality for fish and wildlife
“Soft-Water” Refuge Vegetation.

Xyris  Nymphoides  Eriocaulon

Periphyton
Refuge Hydrology vs. Water Quality: Compatibility and Potential Conflicts

- **Spring Recession PM: Compatible**
  - Gradual stage recession without major reversals avoids intrusion

- **Seasonal High Stage PM: Potential Conflict**
  - Large inflows provide water but can cause intrusion if not properly managed
Refuge Regulation Schedule

Water Elevation (feet)

ZONE A1

ZONE A2

ZONE B

ZONE C

Calendar Month

J F M A M J J A S O N D J
Canal-Water Intrusion

Dry Season (and “Dry” Wet Season)

P, TDS

Reversal

P, TDS

West Canal

Refuge

East Canal

Wet Season

P, TDS

P, TDS

West Canal

Refuge

East Canal
Refuge Outflow Structures (S10s)

Outflows did not balance inflows.
Intrusion (Reversal) Management

Synchronized Inflows and Outflows

Upstream Storage (Reduce Unwanted Inflows)
Conclusions and Recommendations

• **Conflicts between hydrologic and water-quality objectives are inevitable under current conditions:**
  – Refuge competes for poor quality water when conditions are dry
  – Refuge receives unwanted poor quality water as pulsed releases when conditions become wet

• **Near-term improvements:**
  – Synchronize inflows and outflows (structure automation)
  – Refine operational guidance for managing inflows and releases in Zone A1

• **Long-term improvements:**
  – Construct alternative water storage areas
  – Further reduce inflow P loads and concentrations
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