

1.0 Performance Measure Title

Greater Everglades Wetlands Nutrient Total Nitrogen Concentrations in Surface Water

Last Date Revised: March 1, 2007

2.0 Justification

Nutrient concentration and loading are widely used to estimate the nutrient enrichment impacts of discharges on water bodies. Understanding nitrogen (N) and phosphorus (P) dynamics is a fundamental component of ecosystem assessment. As P concentrations to the Greater Everglades and hydro patterns are altered by CERP and non-CERP projects, it is unclear how N concentrations, loading patterns, removal efficiency, availability, and transport may be affected. Because P is the limiting nutrient in most of the Greater Everglades wetlands, a large uncertainty exists as to the cycling and impact of N on the system. Current research suggests a possible consequence of effective P removal may be that N reaching the Everglades Protection Area may be more likely to be transported to the coast, i.e., the hypothesis that increased P limitation yields more conservative behavior for N. Estuaries are typically N limited, so N inputs to the coastal zones can impact CERP's plans for ecologic restoration. Consequently, total nitrogen (TN) should be monitored in the Greater Everglades wetlands region along with total phosphorus (TP). The 2002 CROGEE report emphasizes the need for additional N monitoring.

The Everglades Construction Project and future water management practices will affect the nutrient loads and concentrations in the Greater Everglades wetlands. CERP projects that change flows or water quality will also change nutrient concentrations and loads. All of these programs and projects need to be integrated to optimize stormwater treatment area performance and achieve overall objectives, especially regarding plant community and food web structure. To understand and wisely manage large-scale dynamics of interacting watersheds and estuaries, a nutrient budget as complete as possible for the system as a whole must be developed. By quantifying nutrient sources, flows and transformations through monitoring and assessment of freshwater marshes in the Greater Everglades, data will be available to develop evaluation tools and to better understand downstream effects of N export on estuaries. Therefore, if adaptive management of the system is to be successful, tools must be in place to identify and quantify nutrient sources and their links to CERP activities. We must be able to distinguish anthropogenic from natural influences, and understand how CERP actions impact both.

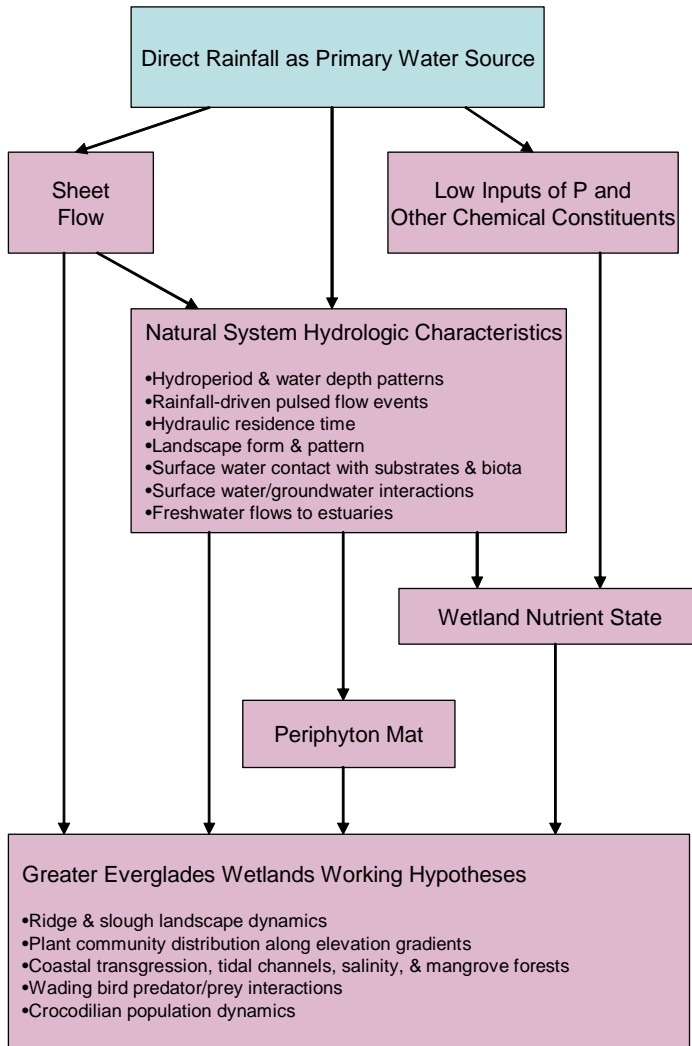
Current conditions of N loading to the Greater Everglades wetlands were reported annually in the Everglades Interim Report (McCormick 1999), Everglades Consolidated Reports (McCormick 2000, Payne et al. 2001, 2002, 2003, Payne and Weaver 2004), and the South Florida Environmental Report (Payne et al. 2005, 2006, 2007).

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

Everglades Ridge and Slough Conceptual Ecological Model (Ogden 2005) and Everglades Mangrove Estuaries Conceptual Model (Davis et al. 2005) stressor

9.2.3 Integrated Hydrology and Water Quality (RECOVER 2006) Hypothesis Cluster

Integrated Hydrology and Water Quality Conceptual Ecological Model



Hypothesis 3: Nitrogen Dynamics in the Everglades

N dynamics, such as rates of nitrification, denitrification, uptake of inorganic N species, and production of organic N, are dominated by local cycling and processing under natural conditions in the Everglades.

Rationale. The importance of local N cycling and processing presently increases with distance from surface water inflow locations, while the importance of surface water N loading concurrently decreases. This trend is expected to continue under restored water inflows and associated N loadings.

4.0 Restoration Expectation

4.1 Predictive Metric and Target

4.2 Assessment Parameter and Target
<p>The mean concentration target for total nitrogen (TN) in Everglades wetlands should be less than or equal to baseline mean N concentrations determined by a 10-year period of record from 1994-2004.</p> <p>Where determined by RECOVER’s Assessment Team to be appropriate, the targets will be adjusted to account for annual rainfall or discharge in a manner similar to that used in the South Florida Water Management District’s Best Management Practice Rule. Targets will be evaluated on a subregional basis consistent with the Everglades Protection Area Tributary Basins Long-Term Plan for Achieving Water Quality Goals (Burns & McDonnell 2003), but including other Everglades basins such as the Rotenberger and Holey Land Wildlife Management Areas and the Lake Belt.</p>
5.0 Evaluation Application
5.1 Evaluation Protocol
An evaluation protocol is not available at this time.
5.2 Normalized Performance Output
Established normalization protocol does not exist for this performance measure. In some cases, a best and worst case scenario can be used to derive a water quality index curve upon which alternative assumptions can be overlaid to derive a performance index.
5.3 Model Output
5.4 Uncertainty
Recognition of model uncertainty is needed when interpreting the ecological significance of model output. The Model Uncertainty Workshop Report provides guidance on the potential implications of uncertainty on model output interpretation (RECOVER 2002).
6.0 Monitoring and Assessment Approach
See CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research - Greater Everglades Wetlands Module section 3.1.3.1 (RECOVER 2004)
7.0 Future Tool Development to Support Performance Measure
7.1 Evaluation Tools Needed
Water quality and ecological models capable of predicting N loading, cycling, resultant concentrations, and transport still need to be developed. Such models need to account for major N sources (from surface water, ground water, atmospheric deposition, N fixation) and sinks (denitrification, burial). An important goal of these models is to estimate N export to the coastal boundary as a function of changing freshwater flow and P and N loads into the Greater Everglades wetlands.
7.2 Assessment Tools Needed
A better understanding of the effects of flow, reduced P concentrations, and hydroperiod on N transformations is needed. Linking fate and transport from Greater Everglades to the Southern Estuaries is required for a more

complete understanding of estuarine nutrient budgets.

8.0 Notes

Please note this performance measure is also related to Hypotheses 1-3 in the Wetland Landscape and Plant Community Dynamics hypothesis cluster of the Assessment Strategy (RECOVER 2006).

Without a water quality model, caution must be used in interpreting hydrologic performance. It is not only necessary to attain the correct timing and distribution of water, but it is also necessary to attain appropriate water quality.

This performance measure supersedes and addresses GE-6 Greater Everglades Wetlands Nutrient TN Concentrations in Surface Water (Last Date Revised: July 14, 2005).

9.0 Working Group Members

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10.0 Acceptance Status

GE Working Group July 14, 2005

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Public Review

Final Acceptance Date

11.0 References

- Burns & McDonnell. 2003. Conceptual Plan for Achieving Long-Term Water Quality Goals. World Wide Web, <http://www.sfwmd.gov/org/erd/bsfboard/waterquality.pdf>.
- CROGEE. 2002. Florida Bay Research Programs and Their Relationship to the Comprehensive Everglades Restoration Plan. Committee on Restoration of the Greater Everglades Ecosystem, Water Science and Technology Board, National Research Council, National Academy Press, Washington, D.C.
- Davis, S.M., D.L. Childers, J.J. Lorenz, and T.E. Hopkins. 2005. A conceptual model of ecological interactions in the mangrove estuaries of the Florida Everglades. *Wetlands* 25(4):832-842.
- McCormick, P., S. Newman, S. Miao, R. Reddy, D.Gawlik, C. Fitz, T. Fontaine, and D. Marley. 1999. Chapter 3: Ecological Needs of the Everglades. In: South Florida Water Management District (eds), Everglades Interim Report, West Palm Beach, Florida.
- McCormick, P., S. Newman, G. Payne, S. Miao, and T. Fontaine. 2000. Chapter 3: Ecological Effects of Phosphorus Enrichment in the Everglades. In: South Florida Water Management District (eds), Everglades Consolidated Report, West Palm Beach, Florida.
- Ogden, J.C. 2005. Everglades ridge and slough conceptual ecological model. *Wetlands* 25(4):810-831.
- Payne, G., T. Bennett, and K. Weaver. 2001. Chapter 3: Ecological Effects of Phosphorus Enrichment in the Everglades. In: South Florida Water Management District (eds), 2001 Everglades Consolidated Report,

West Palm Beach, Florida.

- Payne, G., T. Bennett, and K. Weaver. 2002. Chapter 5: Development of a Numeric Phosphorus Criterion for the Everglades Protection Area. In: South Florida Water Management District (eds), 2002 Everglades Consolidated Report, West Palm Beach, Florida.
- Payne, G., K. Weaver, and T. Bennett. 2003. Chapter 5: Development of a Numeric Phosphorus Criterion for the Everglades Protection Area. In: South Florida Water Management District (eds), 2003 Everglades Consolidated Report, West Palm Beach, Florida.
- Payne, G. and K. Weaver. 2004. Chapter 2C: Status of Phosphorus and Nitrogen in the Everglades Protection Area. In: South Florida Water Management District (eds), 2004 Everglades Consolidated Report, West Palm Beach, Florida.
- Payne, G.G., K.C. Weaver, G. Goforth, and T. Piccone. 2005. Chapter 2C: Status of Phosphorus and Nitrogen in the Everglades Protection Area. In: South Florida Water Management District (eds), 2005 South Florida Environmental Report, Volume I The South Florida Environment Water Year 2004, West Palm Beach, Florida.
- Payne, G.G., K.C. Weaver, and S.K. Xue. 2006. Chapter 2C: Status of Phosphorus and Nitrogen in the Everglades Protection Area. In: 2006 South Florida Environmental Report, Volume I - The South Florida Environment, West Palm Beach, Florida.
- Payne, G.G., K.C. Weaver, and S.K. Xue. 2007. Chapter 3C: Status of Phosphorus and Nitrogen in the Everglades Protection Area. In: 2007 South Florida Environmental Report, Volume I - The South Florida Environment, West Palm Beach, Florida.
- RECOVER 2002. Model Uncertainty Workshop Report: Quantifying and Communicating Model Uncertainty for Decision Making in the Everglades, Restoration Coordination and Verification Program (RECOVER), United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- RECOVER. 2004. CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research. Restoration Coordination and Verification Program, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.
- RECOVER. 2006. Assessment Strategy for the Monitoring and Assessment Plan. Final Draft. Integrative Assessment Sub-team, c/o United States Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, and South Florida Water Management District, West Palm Beach, Florida.