1.0 Performance Measure Title

Greater Everglades Wetlands Total Phosphorus Concentrations in Surface Water

Last Date Revised: March 1, 2007

2.0 Justification

Elevated concentrations of organic and inorganic forms of total phosphorus (TP) in Greater Everglades Wetlands surface is a critical short-term measure of water quality, and is significantly correlated to habitat and periphyton community successional changes.

Elevated nutrients in the water column, attributed to anthropogenic activities, have resulted in significant shifts in the nutrient sensitive biological communities in the oligotrophic Everglades. Depending on location, season and hydrologic conditions, it is not unusual for TP in the water column of Greater Everglades Wetlands to range from 6 parts per billion (ppb) to 200 ppb. However, less than 10 pbb is a reasonable approximation of long-term average TP at interior marsh locations.

Extensive studies (Gleason and Sparkman 1974, Reddy et al. 1999, and Newman et al. 2000) have examined phosphorus (P) concentrations in the water column and documented the biological changes observed in the Greater Everglades Wetlands ecosystem caused by elevated concentrations. During the development of the numeric P criterion for the Everglades, the Florida Department of Environmental Protection, South Florida Water Management District, and others conducted extensive analyses of the available biological, water quality, and sediment quality data. The results of these analyses are presented in the Everglades Phosphorus Criterion Technical Support Documents (Payne et al. 1999, 2000, 2001a) and summarized by Payne et al. in the annual Everglades Consolidated Reports (Payne et al. 2001b, 2002, 2003). The analyses indicate that significant changes in the structure and function of the native biological communities occur as TP concentrations in the water column increase above 10 ppb. The average change point for all communities was determined based on transect data to be 10 micrograms per liter (µg/l) of TP. Based on analyses of the available data, the Florida Department of Environmental Protection has recommended a protective numeric P water quality criterion of 10 ppb (as a long-term geometric mean) (Rule 62-302.540, FAC). This is believed to adequately protect the native flora and fauna of the oligotrophic Everglades.

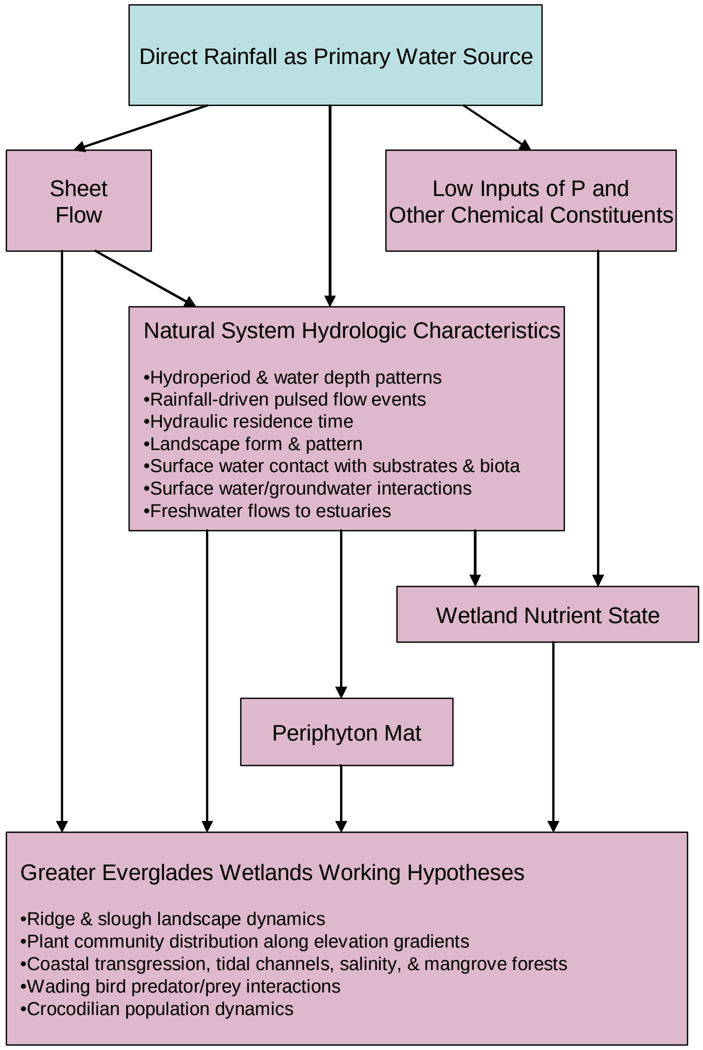
Most P control efforts in the Everglades region are outside CERP’s purview and are not CERP’s responsibility.

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

Everglades Ridge and Slough Conceptual Ecological Model stressor (Ogden 2005)

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

Integrated Hydrology and Water Quality Conceptual Ecological Model



Hypothesis 2: Nutrient Inputs and Sheet Flow as Determinants of Wetland Nutrient State in the Everglades

The dominance of direct rainfall as the primary source of water and P, in combination with sheetflow and related hydrologic and climatic characteristics, resulted in an oligotrophic, P-limited nutrient state throughout the greater Everglades wetlands prior to drainage.

Rationale: Increased P concentrations and loads in agricultural runoff water, and replacement of sheet flow with canal flows and point-source discharges, have produced P concentration gradients downstream of canal discharge structures, shifting wetlands from oligotrophic to eutrophic states. Water column total P concentrations are below ~10 ppb under non-enriched conditions in the Everglades. Most harmful ecological responses to P enrichment occur within a range of mean annual water column total P concentrations between ~10-30 ppb.

Hypothesis 4: Periphyton Mat as an Indicator of Integrated Hydrology and Water Quality in the Everglades

Periphyton mat structure and community composition integrate hydrology and water quality across the entire wetland system of the Everglades. Hydrology and water quality interact to create a mosaic of periphyton community types throughout the Everglades.

Rationale: Periphyton responds quickly (weeks to months) to alterations in water management and can serve as early warning indicators of ecosystem change.

Shortened hydroperiods cause:

- Reduced proportion of diatoms and green algae relative to cyanobacteria
- Increased calcareous blue-green algae, possibly reducing food value of periphyton
- Increased proportion of sediment or plant-stem associated mats as opposed to floating mats attached to floating macrophytes (such as Utricularia purpurea).
- Decreased organic ash weight ratio of periphyton

Phosphorus enrichment through increased loading causes:

- Elevated nutrient content of periphyton material
- Increased organic content of periphyton communities
- Reduced calcareous floating and epiphytic periphyton mats
- Replacement of low nutrient-tolerant species by non-mat forming filamentous green algal species

Periphyton productivity is very high in the oligohaline zone of the southern Everglades. Increased freshwater delivery may broaden this zone of high periphyton productivity.

Detection of periphyton response to changes in hydrology and water quality needs to be based on comparison to a habitat-specific baseline (i.e. ridge and slough, marl prairie, rocky glades, or oligohaline zone). In addition, the effects of grazing on the periphyton community composition should be quantified.

4.0 Restoration Expectation

The TP concentration is not to exceed 10 pbb.

4.1 Predictive Metric and Target

The TP concentration is not to exceed 10 ppb for both the annual geometric mean concentration at surface water monitoring points and the flow-weighted annual geometric mean at water control structures, and should not exceed O.F.W. concentration levels.

4.2 Assessment Parameter and Target

The long-term TP requirement is 10 ppb for a location. If long-term TP is greater than 10 ppb, the annual trend must be flat or decreasing. If the trend is increasing, determine why, and whether a CERP activity is directly responsible for TP increasing.

5.0 Evaluation Application

5.1 Evaluation Protocol

An evaluation protocol has not been yet been developed. The Everglades Landscape Model (ELM) recently became available for CERP use and is a potential tool to evaluate this performance measure. The Greater Everglades Subteam will determine if ELM should be pursued as a TP evaluation tool. Currently, a series of proxies, including dry down, stormwater treatment bypass, and P concentration/loading reduction estimates, are used to evaluate this performance measure.

5.2 Normalized Performance Output

No established normalization protocol exists. In some cases, a best and worst case scenario can be used to derive a water quality index curve.

5.3 Model Output (example attached)

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)

See The RECOVER Team's Recommendations for Interim Goals and Interim Targets for the Comprehensive Everglades Restoration Plan – Interim Goal 3.5 Everglades Wetlands Total Phosphorus (RECOVER 2005b)

7.0 Future Tool Development to Support Performance Measure

7.1 Evaluation Tools Needed

A water quality evaluation tool is needed for the Greater Everglades.

7.2 Assessment Tools Needed

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 get the timing and distribution of water correct, but it is also necessary to attain appropriate water quality.

This performance measure supersedes and addresses GE-4 Greater Everglades Wetlands TP Concentrations in Surface Water (Last Date Revised: July 7, 2005).

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10.0 Acceptance Status

GE Working Group July 7, 2005

ET
AT
Public Review
Final Acceptance Date

11.0 References

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