

1.0 Performance Measure Title

Total Phosphorus Concentrations in Soil

Last Date Revised: March 2, 2007

2.0 Justification

Elevated soil nutrient concentrations, attributed to anthropogenic activities, have resulted in significant shifts in the nutrient sensitive biological communities in the oligotrophic Everglades. Current conditions are variable in space, but range from 200 to 2,200 milligrams per kilogram (mg/kg) total phosphorus (TP) in the upper 10 centimeters (cm) of soil. In portions of the Everglades with inorganic soil, such as Everglades National Park, soil TP greater than 500 mg/kg alone is not necessarily indicative of phosphorus enrichment as the phosphorus is sequestered as hydroxy apatite minerals (Scheidt et al. 2000).

Extensive studies have focused efforts on determining the phosphorus (P) concentrations for both the water column and peat soil responsible for the biological changes observed in Greater Everglades wetlands. During the development of the numeric P criterion for the Everglades, the Florida Department of Environmental Protection 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 were summarized by Payne et al. in the annual Everglades Consolidated Reports (Payne et al. 2001b, 2002, 2003). Sediment P concentrations between 500 and 600 mg/kg have been used by researchers to indicate areas of enrichment in the Everglades (Payne et al. 1999, 2000, 2001a, DeBusk et al. 2001), while other studies have indicated that soil P concentrations of 650 mg/kg facilitate the expansion of cattails (*Typha* spp.) resulting in the loss of native marsh communities dominated by sawgrass (*Cladium jamaicense*) (Wu et al. 1997). Additionally, based on Florida Department of Environmental Protection's extensive analyses, sediment P concentrations in the 500 to 600 mg/kg range appear to correspond to areas exhibiting long-term water column TP concentrations above 10 parts per billion (ppb). This observation is further supported by the use of the Everglades Phosphorus Gradient Model (EPGM), an extension of the stormwater treatment area design model that considers both water column and soils (Walker and Kadlec 1996). In other words, the application of a 10 ppb TP criterion for the water column, which is above background concentrations of 5-8 ppb, will maintain a long-term geometric mean TP concentration in soil at slightly above background levels of 200 to 400 mg/kg.

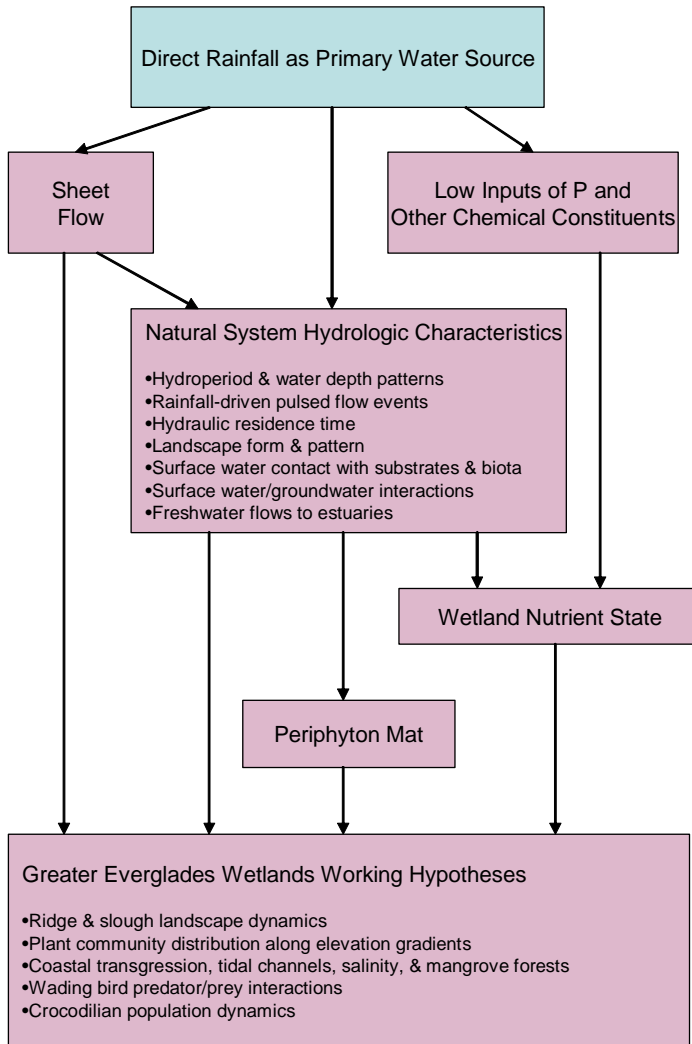
Based on analysis of available data and discussions among South Florida Water Management District, the United States Environmental Protection Agency, and the United States Fish and Wildlife Service scientists, a numeric sediment TP concentration target in the range of 200 to 400 mg/kg in the top 10 cm of soil column, including the overlying layer of flocculent or unconsolidated sediment, will be used to delineate areas minimally impacted (biologically) from those in which the structure and function of the native biological communities have been significantly altered by P enrichment. This target is variable in space and only applicable to peat soils.

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

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

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.

4.0 Restoration Expectation

4.1 Predictive Metric and Target
This performance measure does not have an evaluation metric.
4.2 Assessment Parameter and Target
Decrease the areal extent of TP concentrations exceeding 500 mg/kg and maintain or reduce long-term average concentrations to 400 mg/kg or less in the upper 10 cm of soil.
5.0 Evaluation Application
5.1 Evaluation Protocol
5.2 Normalized Performance Output
An established normalization protocol does not exist for this performance measure.
5.3 Model Output
A predictive model is not available for this performance measure.
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 3.1.3.2 (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
Currently no soil P model is used for the Greater Everglades region.
7.2 Assessment Tools Needed
A well established soil sampling network exists throughout the Greater Everglades.
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). This performance measure supersedes and addresses GE-8 Total Phosphorus Concentrations in Soil (Last Date

Revised: January 10, 2005).

9.0 Working Group Members

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10.0 Acceptance Status

GE Working Group January 10, 2005

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Public Review

Final Acceptance Date

11.0 References

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