<u>Attachment IV</u>

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CENTRAL AND SOUTHERN FLORIDA PROJECT

COMPREHENSIVE EVERGLADES RESTORATION PLAN

G.1 – WATER QUALITY MODELING

G.1.1 – RESERVOIR PHOSPHOROUS UPTAKE MODEL

EVERGLADES AGRICULTURAL AREA STORAGE RESERVOIRS - PHASE 1

US Army Corps of Engineers South Florida Water
Jacksonville District Management District

Assisted By:

(SFWMD Consultant Task 2.1.1)

http://www.evergladesplan.org/pm/projects/project_docs/pdp_08_eaa_store/060103_pdp_08_reservoir_phosphorous_model.pdf

G.1.1.3.1 DMSTA

DMSTA Overview

DMSTA is currently being used to support the evaluation of STAs, as part of the Everglades Construction Project (ECP) Basin-Specific Feasibility Studies. DMSTA provides a framework for integrating experimental and field-scale monitoring data for designing the next generation STAs. The phosphorous removal performance of the STAs has also been evaluated with DMSTA. This model was prepared by William Walker and Robert Kadlec for the U.S. Department of Interior (Walker and Kadlec 2002).
The DMSTA model has been prepared to provide a single platform for estimating the performance of a variety of treatment wetland options, including wetlands dominated by emergent macrophytes (classic STA), submerged aquatic vegetation (SAV), and periphytic algae (PSTA). This model provides an extremely flexible set of options for parameter selection, water balance issues, water flows, and internal hydraulics, and cell configurations.

DMSTA Formulation

DMSTA simulates daily water and mass balances in a user-defined series of wetland treatment cells, each with specified morphometry, hydraulics, and phosphorus cycling parameters. Up to six treatment cells can be linked in series and/or parallel to reflect compartmentalization and management to promote specific vegetation types. Each cell is further divided into a series of continuous stirred tank reactors (CSTR's) to reflect residence time distribution. Water-Balance terms for each cell include inflow, bypass, rainfall, evapo-transpiration, outflow, seepage in, and seepage out. Parameter estimates for the phosphorus cycling model have been developed for various vegetation types. The model is coded in Visual Basic for applications; the user interface is an Excel workbook.
The DMSTA phosphorus cycling model contains three parameters that require calibration to each vegetation type. Two parameters (C0, C1) define the effective concentration range and scale of biomass phosphorus (P) storage. These are calibrated using biomass P and water column P data from several systems. Another key parameter (Ks) reflects the turnover rate of biomass P. Turnover rate is calibrated to outflow concentration time series data.

DMSTA Required Input Parameters

A list of the DMSTA model input data requirements includes the following:
Morphometry (Length, Width, Area, Cell Configuration)
Hydraulic Efficiency (Number of Stirred Tanks in Series)
Daily Time Series:

- Inflow and Outflow Volume
- Inflow and Outflow Concentration

- Mean Depth
- Rainfall
- Evapotranspiration

Descriptive Data:

- Seepage Rates
- Community Description
- P Storage (metadata: macrophytes, periphyton, soil)

Daily time series data used for model calibration include:

- Outflow Volume
- Depth
- Velocity
- Inflow Concentration (flow-weighted, un-weighted)
- Outflow Load (using observed or predicted flows)

DMSTA Capabilities

The DMSTA can simulate the phosphorus load reduction of wetland systems. DMSTA can be used to model flows and phosphorus through existing and modified STAs. DMSTA can also be used to route flows through flow equalization basins and other components associated with chemical treatment facilities. The DMSTA model offers the following factors that are not included in a steady-state STA design model:

- Temporal Variations in Inflow Volume, Load, Rainfall, and ET
- Hydraulic Compartments (Cells, Internal Levees for Flow Redistribution)
- Hydraulic Efficiency (Number of Stirred Tanks in Series)
- Cell Aspect Ratio (Length/Width)
- Water Level Regulation
- Outflow Regulation (Discharge vs. Water Level)
- Compartmentalization of Biological Communities
- Dry-Out Frequency and Supplemental Water Needs
- Bypass Frequency, Quantity, and Quality
- Seepage Collection and Management

DMSTA Limitations

The following are some know limitations of the DMSTA model:

- DMSTA lacks level of detail in modeling reservoir hydrology.
- One important limitation of the DMSTA model is that certain SAV types that may have relatively low uptake rates (such as hydrilla) are not represented in the data sets. Therefore, they cannot be represented properly with DMSTA.
- The model is bound by the limitations of the available datasets (e.g., spatial scale, duration, and/or relatively steady inflows), so, for example, it cannot currently model reservoir performance
- DMSTA has not been calibrated for deep-level pools as those associated with
- reservoirs.
- DMSTA can only model phosphorus removal by a generalized (lumped) process

of transfer from a labile pool to a refractory pool. It cannot model phosphorus removal by the individual processes of particle settling, biological uptake and net refractory biomass storage, or chemical precipitation as a function of pH, alkalinity, redox, or temperature. It cannot model release of labile phosphorus from the sediment back to the water column as a function of wind, flow, depth, redox, or temperature.

- Although the model can be run on a daily time step, the empirically derived coefficients are long-term annual average values.
- It systematically overestimates the TP removal efficiency and underestimates the TP outflow concentrations in the low TP concentration range (< 50 ppb), e.g., STA-2.

DMSTA Developer/Distributor

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