# Water Quality Analysis Simulation Program (WASP)

## Version 7.52

**Watershed and Water Quality Modeling**

**Technical Support Center**

**US EPA**

**Office of Research Development**

**National Exposure Research Laboratory**

**Ecosystems Research Division**

**Athens, GA**

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## Introduction

EPA region 4 is pleased to release version 7.52 of the Water Quality Analysis Simulation Program (WASP). This release of WASP contains the linkage of the sediment diagenesis (SOD) module to the Advanced Eutrophication Model. See release notes below for implementation of the SOD module in the user interface.

This release also adds the capability of accessing the Water Resources Database graphing program from the WASP User Interface Menu.

## Sediment Diagenesis Module

The sediment diagenesis module is a separate model that is dynamically linked to WASP when the option is enabled. While the SOD module is specific to WASP but it could be invoked from virtually any program. Figure 1illustrates the relationship between the WASP Graphical User Interface, Advanced Eutrophication Model and the SOD module. The SOD module retrieves user specified SOD segmentation definitions, initial conditions, and kinetic constants from the user interface. While the Advanced Eutrophication model is simulating, it is accumulating depositional fluxes and at user defined intervals the SOD module is updated and new SOD and nutrient flux rates are computed.

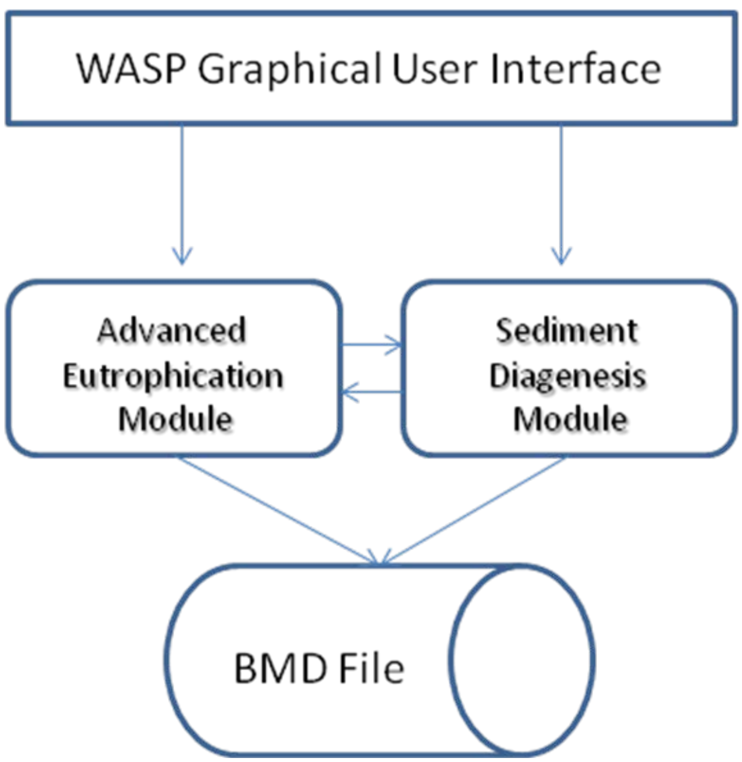


**Figure 1 SOD Module Implementation in WASP**

The SOD module maintains its own segmentation, the user is responsible for defining the number of SOD segments and which WASP segments provides and receives fluxes from the SOD module. The SOD module was designed so that several overlaying WASP segments could be linked to a single SOD module segment. The justification for this is that SOD and sediment nutrient fluxes do not vary that much and to save simulation time. Figure 1shows the relationship between WASP and SOD segments. It should be noted that SOD segments do not need to be added to your WASP network, they are created in the SOD model; you just simply have to assign an SOD segment to WASP segment or segments.

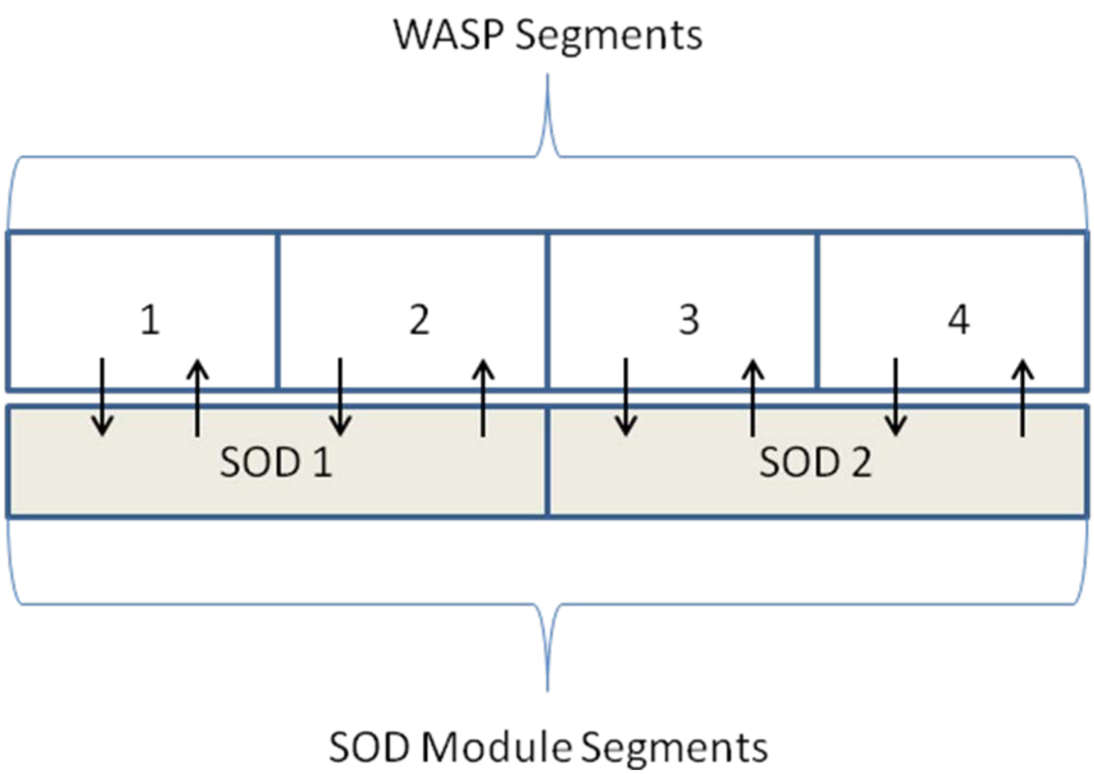


**Figure 2 WASP/SOD Segmentation Schematic**

Figure 3 is a picture of the segment parameter screen which is found as tab in the segment information data entry screen. Using the schematic in Figure 1, this illustrates how to assign WASP segments to SOD segments (first column shown). This model setup would have 4 WASP segments and 2 SOD segments (WASP Segment 1 & 2 is linked with SOD segment 1. WASP Segment 3 & 4 is linked with SOD segment 2. The remaining columns shown are used to set initial conditions for the SOD segments and the fraction for each G class and constituents. User specifies the fraction for the first two G classes and the model calculates the third G class.

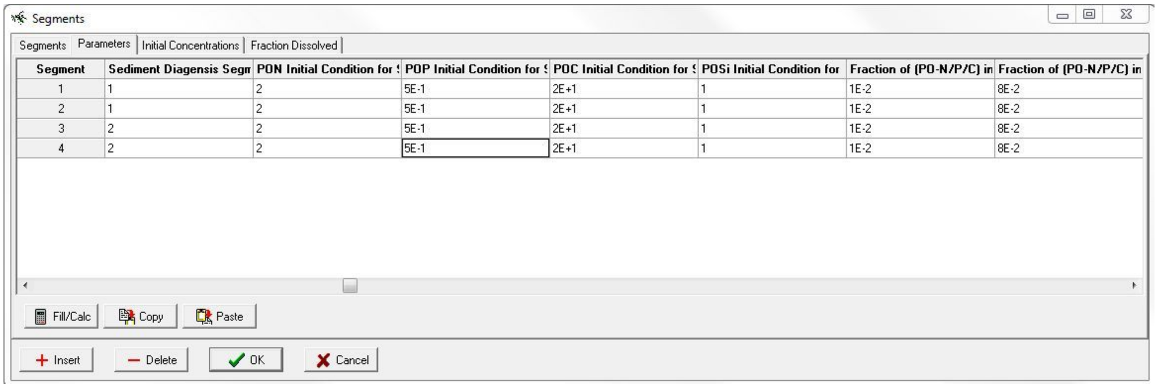


**Figure 3 Assigning SOD Segments to WASP Segments**

Figure 4 shows that you use the Bed Compaction Timestep for setting the time step in which the SOD module is called to update SOD and nutrient fluxes. WASP accumulates all of the downward fluxes from the water column for the simulation period between calls to the SOD module.

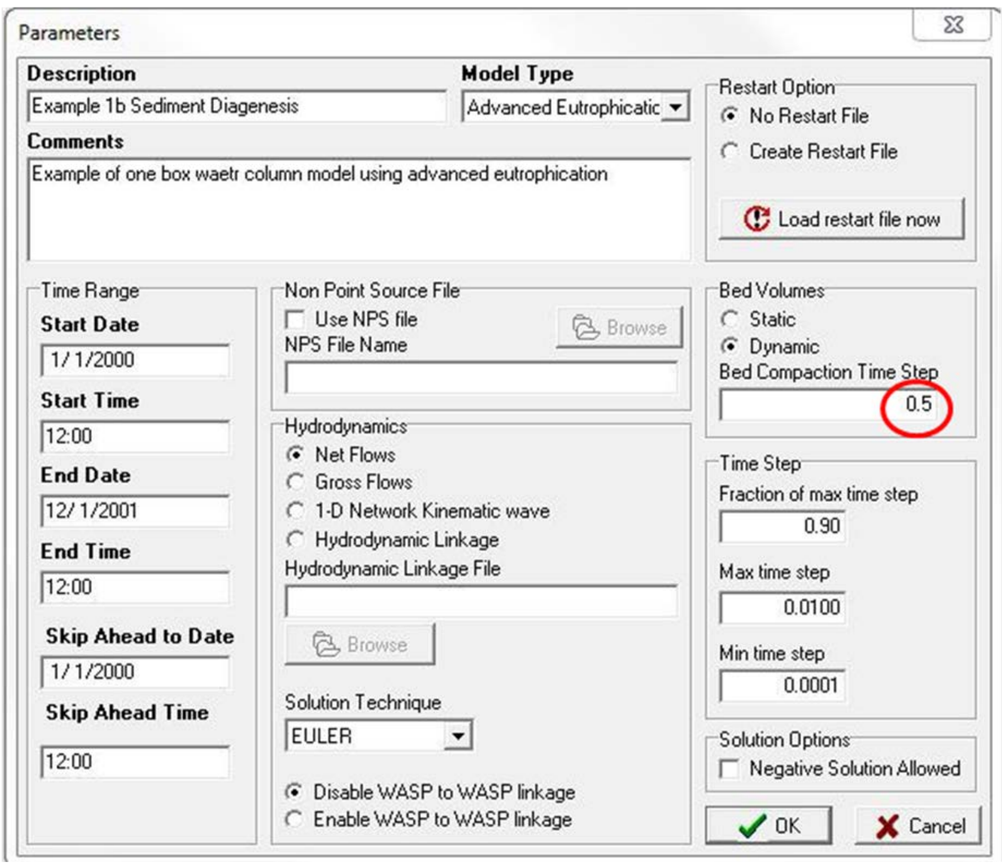


**Figure 4 SOD Module Time Step**

Table 1provides a list of the SOD module constants and default values to use. Note: the constants are entered in the Kinetic Constants screen in the user interface.

**Table 1 Sediment Diagenesis Constants**

| Constant | Value |
|---|---|
| Activate Sediment Diagenesis Model (1=On, 0=Off) | 1 |
| Determines if a steady-state calculation sets initial conditions (1=No,0=Yes) | 0 |
| 2 = Read Initial Conditions from File (SOD_IC.IN) | 1 |
| 1 = Write Restart File (SOD_IC.OUT) | 1 |
| Maximum error for testing convergence of the steady-state solut | 0.001 |
| Maximum number of iterations of steady-state solution | 1000 |
| Salinity con. (ppt) for determining whether methane or Sulfide SOD | 1 |
| Determines whether fresh or saltwater nitrification/denitrification rates | 1 |
| Solids concentration in Layer 1 kg/L | 0.5 |
| Solids concentration in Layer 2 kg/L | 0.5 |
| Diffusion coefficient between layers 1 and 2 (m2/day) | 0.0025 |
| Temperature coefficient for Dd | 1.08 |
| Thickness of active sediment layer cm | 0.1 |
| Burial velocity for layer 2 to inactive sediments (m/day)(0.00000685) | 6.85E-06 |
| Diffusion coefficient for particle mixing (m2/day) | 6.00E-05 |
| Temperature coefficient for Dp | 1.117 |
| Reference POC (O2 EQ. =0.*2.67) measurement for particle mixing | 0.2667 |
| Decay constant for benthic stress (1/day) | 0.03 |
| Particle mixing half-saturation constant for oxygen (gO2/m3) | 4 |
| Nitrogen Constants: Fraction PON to G1 | 0.65 |
| Fraction PON to G2 | 0.25 |
| Diagenesis rate for PON G1 | 0.035 |
| Temperature coefficient for diagenesis of PON G1 | 1.1 |
| Diagenesis rate for PON G2 | 0.0018 |
| Temperature coefficient for diagenesis of PON G2 | 1.15 |
| Diagenesis rate for PON G3 | 0 |
| Temperature coefficient for diagenesis of PON G3 | 1.17 |
| Freshwater nitrification reaction velocity (m/day) | 0.1313 |
| Saltwater nitrification reaction velocity (m/day) | 0.1313 |
| Temperature coefficient for nitrification | 1.123 |
| Half-saturation coefficient for ammonia in the nitrification reaction (mg/L) | 0.728 |
| Half-saturation coefficient for oxygen in the nitrification reaction (mg/L) | 0.37 |
| 2nd step reaction velocity for nitrification (NO2 to NO3) (m/day) | 100 |
| Temperature coefficient for 2nd step reaction velocity | 1.123 |
| Half-saturation coefficient for oxygen in the 2nd reaction step (mg O2/L) | 0.37 |
| Freshwater denitrification reaction velocity in layer 1(m/day) | 0.1 |

| | |
|---|---|
| Saltwater denitrification reaction velocity in layer 1 (m/day) | 0.1 |
| Temperature coefficient for denitrification | 1.08 |
| Denitrification reaction velocity in layer 2 (m/day) | 0.25 |
| Nitrogen partition coefficient (L/kg) | 1 |
| Phosphorus: Fraction POP to G1 | 0.65 |
| Phosphorus: Fraction POP to G2 | 0.2 |
| Diagnesis rate for POP G1 | 0.035 |
| Temperature coefficient for diagenesis of POP G1 | 1.1 |
| Diagnesis rate for POP G2 | 0.0018 |
| Temperature coefficient for diagenesis of POP G2 | 1.15 |
| Diagnesis rate for POP G3 | 0 |
| Temperature coefficient for diagenesis of POP G3 | 1.17 |
| Phosphorus partition coefficient in layer 2 (L/kg) | 20 |
| Incremental freshwater partition coefficient in layer 1 | 20 |
| Incremental saltwater partition coefficient in layer 1 | 20 |
| Critical oxygen concentration in layer 1 incremental phosphate sorption (mgO2/L) | 2 |
| Carbon Constants: Fraction CBODu to G1 | 0.65 |
| Fraction CBODu to G2 | 0.2 |
| Diagnesis rate for CBODu G1 | 0.035 |
| Temperature coefficient for diagenesis of CBODu G1 | 1.1 |
| Diagnesis rate for CBODu G2 | 0.0018 |
| Temperature coefficient for diagenesis of CBODu G2 | 1.15 |
| Diagnesis rate for CBODu G3 | 0 |
| Temperature coefficient for diagenesis of CBODu G3 | 1.17 |
| Methane oxidation reaction velocity (m/day) | 0.7 |
| Temperature coefficient for methane oxidation | 1.079 |
| Half-saturation coefficient for oxygen in oxidation of methane (mg/L) | 0.37 |
| Reaction velocity for dissolved sulfide oxidation in layer 1 (m/day) | 0.2 |
| Reaction velocity for particulate sulfide oxidation in layer 1 (m/day) | 0.4 |
| Temperature coefficient for sulfide oxidation | 1.079 |
| Sulfide oxidation normalization constant (mg/L) | 4 |
| Sulfide partition coefficient in layer 1 (L/kg) | 100 |
| Sulfide partition coefficient in layer 2 (L/kg) | 100 |
| Algae Constants: Fraction settled algae to G1 | 0.65 |
| Fraction settled algae to G2 | 0.2 |
| Dissolution Rate of particulate biogenic silica at 20c (1/day) | 0.5 |
| Temperature Effect on Silica Dissolution | 1.1 |
| Silica Saturation Concentration in Porewater (mg si/m**3) | 4000 |
| Incremental Change (Mult) for freshwater in Partition Coeff. Si as DO | 10 |
| Partition Coefficient between Dissolved/Sorbed Silica in Layer 2 | 100 |
| Half Saturation Constant of Dissolved Silica in Dissolution Reaction | 50000000 |

## Integration of the WRDB Graphing Program

With this release of WASP users of the Water Resources Database (WRDB) will be able to use the graphing program for model calibration and report preparation. To access the graphing utility from WRDB you will have install WRDB (www.wrdb.com), execute WRDB. The WRDB graphing utility will be loaded when clicking on this icon:


See the online tutorial for how to use WRDB and the Graphing utility to WASP. A link to the Tutorial can be found by clicking on the Help Menu→ Documentaiton.