

Table 8-4. Overview of Several Available Watershed Models

Model Acronym	Source	Type		Level of Complexity			Time step			Hydrology		Water Quality					Type of BMPs							
		Landscape only	Comprehensive	Export coefficients	Loading functions	Physically based	Sub-daily	Daily	Monthly	Annual	Surface	Surface and ground water	User-defined	Sediment	Nutrients	Toxic/pesticides	Metals	BOD	Bacteria	Detention basin	Infiltration practices	Vegetative practices	Wetlands	Other structures
AGNPS (event-based)	USDA-ARS	●	●	—	—	●	●	—	—	—	●	—	—	●	●	●	—	—	—	●	—	●	—	—
AnnAGNPS	USDA-ARS	—	●	—	—	●	—	●	—	—	●	—	—	●	●	●	—	—	—	●	—	●	—	—
BASINS	EPA	—	●	●	●	●	●	●	—	—	●	●	●	●	●	●	●	●	●	—	●	—	—	●
DIAS/IIDLMS	Argonne National Laboratory	—	—	—	—	—	—	—	●	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—
DRAINMOD	North Carolina State University	—	—	—	—	●	●	—	—	—	—	—	—	●	—	—	—	—	—	—	—	—	—	●
DWSM (event-based)	Illinois State Water Survey	—	●	—	—	●	●	—	—	—	●	—	—	●	●	●	—	—	—	●	●	—	—	—
EPIC	Texas A&M University–Texas Agricultural Experiment Station	—	—	—	—	—	—	●	—	—	●	—	—	●	●	●	—	—	—	●	●	—	—	●
GISPLM	College of Charleston, Stone Environmental, and Dr. William Walker	—	●	—	●	—	—	●	—	—	●	—	—	—	●	—	—	—	—	—	—	—	—	—
GLEAMS	USDA-ARS	—	—	—	—	—	—	●	—	—	●	—	—	●	●	●	—	—	—	—	—	—	—	—
GSSHA	USACE	●	●	—	—	●	●	—	—	—	—	●	—	●	—	—	—	—	—	●	●	—	—	●
GWLF	Cornell University	—	●	—	●	—	—	—	●	—	—	—	—	●	●	—	—	—	—	—	—	—	—	●
HEC-HMS	USACE	—	●	—	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
HSPF	EPA	—	●	—	—	●	●	—	—	—	—	—	—	●	●	●	●	●	●	—	—	—	—	—
KINEROS2 (event-based)	USDA-ARS	—	●	—	—	●	●	—	—	—	●	—	—	●	—	—	—	—	—	●	—	—	—	●
LSPC	EPA and Tetra Tech, Inc.	—	●	—	—	●	●	—	—	—	—	—	—	●	●	●	●	●	●	—	—	—	—	●
Mercury Loading Mode	EPA	—	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MIKE SHE	Danish Hydraulic Institute	—	●	—	—	●	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MINTEQA2	EPA	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MUSIC	Monash University, Cooperative Research Center for Catchment Hydrology	—	—	—	—	●	●	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—	●

Table 8-4. Overview of Several Available Watershed Models (continued)

Model Acronym	Source	Type		Level of Complexity			Time step				Hydrology		Water Quality					Type of BMPs						
		Landscape only	Comprehensive	Export coefficients	Loading functions	Physically based	Sub-daily	Daily	Monthly	Annual	Surface	Surface and ground water	User-defined	Sediment	Nutrients	Toxic/pesticides	Metals	BOD	Bacteria	Detention basin	Infiltration practices	Vegetative practices	Wetlands	Other structures
P8-UCM	Dr. William Walker	—	—	●	●	—	●	—	—	—	●	—	●	●	●	—	●	—	—	●	●	●	—	●
PCSWMM	Computational Hydraulics Int.	—	●	—	●	●	●	—	—	—	—	●	●	●	●	●	—	●	●	●	—	—	—	●
PGC-BMP	Prince George's County, MD	—	—	—	●	—	●	—	—	—	—	—	●	●	—	●	—	—	●	●	●	●	●	●
REMM	USDA-ARS	—	—	—	—	—	—	—	—	—	—	—	●	●	●	●	—	—	—	—	●	—	—	—
SHETRAN	University of Newcastle (UK)	—	●	—	—	●	●	●	—	—	—	●	—	●	—	—	—	—	—	—	—	—	—	—
SLAMM	University of Alabama	—	—	—	—	—	●	—	—	—	●	—	—	●	●	—	●	—	—	●	●	●	●	●
SPARROW	USGS	—	●	—	—	—	—	—	—	●	●	—	—	●	●	●	—	—	—	—	—	—	—	—
STORM	USACE (mainframe version), Dodson & Associates, Inc. (PC version)	—	—	●	—	●	●	—	—	—	●	—	—	●	●	—	—	—	●	—	—	—	—	●
SWAT	USDA-ARS	—	●	—	—	●	—	●	—	—	—	●	—	●	●	●	●	—	—	●	●	●	—	●
SWMM	EPA	—	●	—	—	●	●	—	—	—	—	●	●	●	●	●	●	●	●	●	—	—	—	—
TMDL Toolbox	EPA	—	●	—	—	●	●	—	—	—	—	●	●	●	●	●	●	●	●	—	●	—	—	●
TOPMODEL	Lancaster University (UK), Institute of Environmental and Natural Sciences	—	—	—	—	●	●	●	—	—	—	●	—	—	—	—	—	—	—	—	—	—	—	—
WAMView	Soil and Water Engineering Technology, Inc. (SWET) and EPA	●	●	—	—	●	●	—	—	—	—	●	—	●	●	●	●	—	●	●	●	●	●	●
WARMF	Systech Engineering, Inc.	—	●	—	—	●	—	●	—	—	—	●	—	●	●	●	●	●	—	—	—	—	●	●
WEPP	USDA-ARS	—	—	—	—	●	—	●	●	●	—	●	—	—	—	—	—	—	—	—	●	—	—	—
WinHSPF	EPA	—	●	—	—	●	●	—	—	—	—	●	●	●	●	●	●	●	—	—	—	—	—	—
WMS	Environmental Modeling Systems, Inc.	—	●	—	—	●	●	—	—	—	—	●	●	●	●	●	●	●	●	●	—	—	●	●
XP-SWMM	XP Software, Inc.	—	●	—	—	●	●	—	—	—	—	●	●	●	●	●	●	●	●	●	—	—	—	●

Notes: BMPs = best management practices. — Not supported ● Supported

Source: USEPA. 2005. *TMDL Model Evaluation and Research Needs*. EPA/600/R-05/149. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH. www.epa.gov/nrmrl/pubs/600r05149/600r05149.htm

Table 8-5. Water Quality Endpoints Supported by the Selected Watershed Models

Parameter/Endpoint	AGNPS	STEPL	GWLF ^a	HSPF	P8-UCM	SWAT	SWMM
Total phosphorus (TP) load	▶	○	▶	●	●	▶	●
TP concentration	▶	—	▶	●	●	▶	●
Total nitrogen (TN) load	▶	○	▶	●	●	▶	●
TN concentration	▶	—	▶	●	●	▶	●
Nitrate concentration	—	—	—	●	—	▶	●
Ammonia concentration	—	—	—	●	—	▶	●
TN:TP mass ratio	—	—	▶	●	—	▶	●
Dissolved oxygen	▶	—	—	●	—	▶	●
Chlorophyll a	—	—	—	●	—	▶	—
Algal density (mg/m ²)	—	—	—	—	—	—	—
Net total suspended solids load	—	○	—	●	●	—	●
Total suspended solids concentration	▶	—	—	●	●	▶	●
Sediment concentration	▶	—	▶	●	●	▶	●
Sediment load	▶	○	▶	●	—	▶	●
Metals concentrations	—	—	—	●	—	▶	●
Conductivity	—	—	—	●	—	—	—
Pesticide concentrations	▶	—	—	●	—	▶	—
Herbicide concentrations	▶	—	—	●	—	▶	—
Toxics concentrations	—	—	—	●	—	—	—
Pathogen count (<i>E. coli</i> , fecal coliform bacteria)	—	—	—	●	—	▶	●
Temperature	—	—	—	●	—	▶	—

Key: — Not supported ○ Annual ▶ Daily ● Hourly

^aGWLF calculations are performed on a daily basis, but the results are presented on a monthly basis.

Source: USEPA. 2005. *TMDL Model Evaluation and Research Needs*. EPA/600/R-05/149. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH. www.epa.gov/nrmrl/pubs/600r05149/600r05149.htm

Table 8-6. Land and Water Features Supported by the Selected Watershed Models

Land and Water Feature	AGNPS	STEPL	GWLF	HSPF	P8-UCM	SWAT	SWMM
General Land and Water Features							
Urban	—	○	◐	◐	◐	◐	●
Rural	●	○	◐	●	○	●	◐
Agriculture	●	○	◐	●	○	●	○
Forest	—	○	◐	●	○	●	○
River	—	—	○	●	○	○	○
Lake	—	—	—	◐	—	○	○
Reservoir/impoundment	—	—	—	◐	◐	○	◐
Estuary (tidal)	—	—	—	—	—	—	—
Coastal (tidal/shoreline)	—	—	—	—	—	—	—
Detailed Land Features							
Air deposition	—	—	—	○	—	—	—
Wetlands	—	—	—	◐	○	○	○
Land-to-land simulation	○	—	—	○	—	—	—
Hydrologic modification	—	—	—	◐	—	—	◐
BMP siting/placement	●	—	—	○	◐	—	◐
Urban Land Management							
Street sweeping and vacuuming	—	—	○	—	◐	○	◐
Nutrient control practices (fertilizer, pet waste management)	◐	—	—	○	○	○	○
Stormwater structures (manhole, splitter)	—	—	—	—	○	—	◐
Detention/retention ponds	◐	—	—	○	◐	○	◐
Constructed wetland processes	—	—	—	—	○	○	○
Vegetative practices	◐	—	○	○	○	○	○
Infiltration practices	—	—	—	○	○	—	—
Rural Land Management							
Nutrient control practices (fertilizer, manure management)	●	○	○	●	—	●	○
Agricultural conservation practices (contouring, terracing, row cropping)	●	○	○	●	—	●	○
Irrigation practices/tile drains	○	—	—	—	—	●	—
Ponds	◐	—	—	◐	◐	◐	◐
Vegetative practices	◐	○	○	○	—	◐	—

Key: — Not supported
 ○ Low: Simplified representation of features, significant limitations
 ◐ Medium: Moderate level of analysis, some limitations
 ● High: Detailed simulation of processes associated with land or water feature

Source: USEPA. 2005. *TMDL Model Evaluation and Research Needs*. EPA/600/R-05/149. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH. www.epa.gov/nrmrl/pubs/600r05149/600r05149.htm

the practical considerations affecting their application. Models with filled circles are generally easier to use and require less data and time for application.

Table 8-7. Application Considerations of the Selected Watershed Models

Application Considerations	AGNPS	STEPL	GWLF	HSPF	P8-UCM	SWAT	SWMM
Experience required	▶	●	●	—	●	○	—
Time needed for application	▶	●	●	—	●	▶	○
Data needs	▶	●	●	○	●	▶	○
Support available Support available	▶	○	○	●	○	▶	▶
Software tools	▶	●	●	●	○	●	○
Cost to purchase	●	●	●	●	●	●	●

Key:

Experience:

- Substantial training or modeling expertise required (generally requires professional experience with advanced watershed and/or hydrodynamic and water quality models)
- Moderate training required (assuming some experience with basic watershed and/or water quality models)
- ▶ Limited training required (assuming some familiarity with basic environmental models)
- Little or no training required

Support Available:

- None
- Low
- ▶ Medium
- High

Time Needed for Application:

- > 6 months
- > 3 months
- ▶ > 1 month
- < 1 month

Software Tools:

- None
- Low
- ▶ Medium
- High

Data Needs:

- High
- ▶ Medium
- Low

Cost to Purchase:

- Significant cost (> \$500)
- Nominal cost (< \$500)
- ▶ Limited distribution
- Public domain

Source: USEPA. 2005. *TMDL Model Evaluation and Research Needs*. EPA/600/R-05/149. U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH. www.epa.gov/nrmrl/pubs/600r05149/600r05149.htm

8.4 Model Application Process for the Selected Models

Previous sections discussed the basic features of models, how to select appropriate models for your project, and general steps in applying models. This section discusses the decisions made during model application. Although the models have different features and capabilities, some basic decisions regarding data and data processing are required for every model application. The major data needs for the selected models reviewed here are summarized in table 8-8. These are the decisions that result in tailoring the model to your specific site. Each major decision point is discussed, along with some suggestions for how to decide the appropriate level of detail.

For loading analysis you need to think carefully about the area being modeled. A watershed is usually composed of areas with diverse land uses and activities. Some watersheds have regional differences, such as a densely populated areas surrounded by countryside. When applying a model to a watershed, the diversity within the watershed is simplified into major categories so that the loads can be estimated. If the analysis is too detailed, the modeling becomes very difficult to apply and test. If the analysis is too simplified, some important