Appendix A: Model Fact Sheets

City of Milwaukee Closure Guidelines

1. Distributor:

City of Milwaukee Health Dept.
841 Broadway, Room 105
Milwaukee, WI 53202
(414) 286-3538

2. Type of Modeling/Application:

- Beach closure predictive tool
- Development of regression relationship between rainfall and fecal coliform bacteria

3. Model Processes:

- Correlation of observed rainfall and fecal coliform data
- Correlation of observed fecal coliform concentrations at wastewater treatment plant outfalls and beach sites.

4. Method/Techniques:

Regression analyses were conducted using rainfall data from General Mitchell field and observed fecal concentration at South Shore beach. Rainfall based closure guidelines were established based on the positive correlation found between the amount of rainfall and the fecal concentration at the sampling sites.

5. Limitations:

- Model is specific for the South Shore beach, Milwaukee, WI

6. Experience:

Rainfall based closure guidelines that are specific to South Shore beach.

7. Updating Version and System Requirements:

Model database require continuous updating of rainfall amounts and pathogen concentration to improve the predictive ability of the model.

8. Input Data Requirements:

Cumulative rainfall data at General Mitchell Field.

9. Outputs:

The output of the model is whether closure of South Shore beach is required or not.

10. References available:

City of Milwaukee Health Department, personal communication, 1998.

Milwaukee Metropolitan Sewerage District, personal communication, 1998.

City of Stamford Closure Guidelines

1. Distributor

City of Stamford
Health Department
888 Washington Blvd.
PO Box 10152
Stamford, CT 22030

2. Type of Modeling/Application:

- Beach closure predictive tool for Stamford area beaches.
- Relates rainfall measurements to unsafe levels of enterococcus bacteria.

3. Model Processes:

- Correlation of rainfall data and enterococcus bacteria concentrations
- Observed bacterial concentration frequency of exceedance

4. Method/Techniques:

Enterococcus concentrations at eleven locations near Stamford, CT were compared with cumulative rainfall measurements. A statistically significant correlation between bacteria levels and rainfall was found over the 8-year study period.

Enterococcus levels exceeded the state criteria regularly after rainfall events of greater than 1 inch. Further analysis showed that near drought conditions had a significant effect on the bacteria levels. Areas downstream from highly urbanized areas also showed elevated levels after rains of as little as 0.5 inch. Rainfall events greater than 0.75 inch after periods of drought were found to cause bacteria levels in excess of the standard.

Bacterial decay is assumed to occur rapidly over time. Bacteria levels were estimated to be at normal levels within 24 hours of the rainfall event.

5. Limitations:

- Method is applicable at many sites; however, the results presented are valid only for Stamford, Connecticut.

6. Experience:

Applied to Stamford area beaches since 1990.

7. Updating Version and System Requirements:

Continuous updating of rainfall-bacteria database to improve the model sensitivity and predictive ability.

8. Input Data Requirements:

- Cumulative rainfall measurements.
- Observed bacteria measurements taken immediately after rainfall event for all locations of concern.

9. Outputs:

Beach closure alert curves based on season, and rainfall amounts.

10. References available:

Kuntz, J.E., personal communication, 1998.

Kuntz, J.E., and R. Murray. 1996. *Non-Point Sources of Bacteria at the Beach*, City of Stamford, Health Department Laboratory, Stamford, CT.

McBride, A., and J.E. Kuntz. 1989. Beach Water Closing Policy. In *Guidelines for Monitoring Bathing Waters and Closure Protocol.* Connecticut Department of Health Services, Stamford, CT.

CORMIX: Cornell Mixing Zone Expert System

1. Distributor:

Model Distribution Coordinator
Center for Exposure Assessment Modeling (CEAM)
USEPA
960 College Station Road
Athens, GA 30605-2700
(706) 546-3549
Web-site www.epa.gov/ceam

2. Type of Modeling/Application:

· May be applied to most waterbodies.

· Near-field hydrodynamic mixing processes

· Point source buoyant or submerged discharges

· Single- or multiple-port discharges

3. Model Processes:

· Computation of physical parameters and length scales to allow hydrodynamic classification of the given discharge/ambient situation into one of many possible generic flow configurations.

· Detailed numerical prediction of effluent plume characteristics.

4. Method/Techniques:

CORMIX predicts plume geometry and dilution characteristics within a receiving water's initial mixing zone and allows an analysis of toxic or conventional pollutant discharges into diverse waterbodies. The model is able to consider non-conservative pollutants with first-order decay and wind effects on plume mixing.

Submodels within the CORMIX system can be used to predict the geometry and dilution characteristics of effluent flow from different discharging systems. The first submodel considers a submerged single-port diffuser discharging into a waterbody that may have ambient stratification of different types. The second submodel applies to commonly used types of submerged multiport diffuser discharges under the same general effluent and ambient conditions as the first submodel. The third submodel considers buoyant surface discharges that result when an effluent enters a larger waterbody laterally through a canal, channel, or near-surface pipe.

As the name implies, CORMIX is embedded in an expert system shell that greatly facilitates data input, provides range checking for inputs, and allows convenient output analysis.

5. Limitations:

· The waterbody cross section has to be described as a rectangular channel.

· All CORMIX submodels assume steady-state ambient and discharge conditions.

6. Experience:

The CORMIX system has been extensively verified by the developers and independent users through comparison of simulation results to available field and laboratory data on mixing processes, and has undergone extensive peer review. The system has been used for a wide range of applications, ranging from a single submerged pipe discharging into a small stream with rapid cross-sectional mixing to complicated multi-port diffuser installations in deep, stratified coastal waters.

Washington State Department of Health, Shellfish Program, is currently using CORMIX to delineate shellfish closure zones around wastewater treatment plant outfalls. Simulations of the water quality are based on input parameters that yield a conservative (maximum) pathogen concentrations in the receiving water.

7. Updating Version and System Requirements:

Version 3.00 (1994). PC-compatible.

8. Input Data Requirements:

All inputs are entered interactively and include complete specification of the site or case, ambient conditions, discharge characteristics, level of output detail, and regulatory definitions.

9. Outputs:

The output consists of qualitative descriptions and detailed quantitative numerical predictions. Qualitative information includes physical information and insight into the reasoning employed by the system and flow class descriptions. Quantitative output provides details on the effluent plume trajectory and mixing and regulatory compliance.

10. References available:

Jirka, G.H., and P.J. Akar. 1991. Hydrodynamic classification of submerged multiport diffuser discharges. *Journal of Hydraulic Engineering* 117(9):1113-1128.

Jirka, G.H., and R.L. Doneker. 1991. Hydrodynamic classification of submerged single port discharges. *Journal of Hydraulic Engineering* 117(9):1095-1112.

Jirka, G.H., and S.W. Hinton. 1992. *User's Guide for the Cornell Mixing Zone Expert System (CORMIX)*. Technical Bulletin 624. National Council of the Paper Industry for Air and Stream Improvement, Inc.

Jones, G.R., and G.H. Jirka. 1991. *CORMIX3: An Expert System for the Analysis and Prediction of Buoyant Surface Discharges*. Technical report. DeFrees Hydraulics Laboratory, School of Civil and Environmental Engineering, Cornell University, Ithaca, NY.

EFDC: Environmental Fluid Dynamics Computer Code

1. Distributor

Dr. John M. Hamrick
Virginia Institute of Marine Science
School of Marine Science
The College of William and Mary
Gloucester Point, VA 23062
(804) 642-7210

2. Type of Modeling/Application:

- General-purpose three-dimensional model applicable to most water bodies.
- Simulates density and topographically induced circulation, as well as tidal and wind-driven flows, and spatial and temporal distributions of salinity, temperature and sediment concentration.
- Applicable to a wide range of environmental flows that can be considered to be vertically hydrostatic and of the boundary layer type.

3. Model Processes:

The EFDC model solves the vertically hydrostatic, free-surface, variable-density, turbulent-averaged equations of motion and transport equations for turbulence intensity and length scale, salinity, and temperature in a stretched, vertical coordinate system, and horizontal coordinate systems that may be Cartesian or curvilinear-orthogonal. Equations describing the transport of suspended sediment and dynamically neutral conservative and nonconservative tracers are also solved. Sediment resuspension and deposition are accounted for by a bedload transport submodel. The wetting and drying of shallow areas, hydraulic control structures, vegetation resistance for wetlands, and Lagrangian particle tracking may also be simulated by the model.

4. Method/Techniques:

EFDC uses a finite difference scheme with three time levels and an internal-external mode splitting procedure to achieve separation of the internal shear or baroclinic mode from the external free-surface gravity wave or barotropic mode. An implicit external mode solution is used with simultaneous computation of a two-dimensional surface elevation field by a multicolor successive overrelaxation procedure. The external solution is completed by calculation of the depth-integrated barotropic velocities using the new surface elevation field. Various options can be used for advective transport in EFDC. These include the centered in time and space scheme, and the forward in time and upwind in space scheme.

5. Limitations:

- Considerable technical expertise in hydrodynamics is required to use the model effectively.

6. Experience:

EFDC has been integrated with a water quality model to develop a three-dimensional hydrodynamic-eutrophication model, HEM-3D (Park and Kuo, 1995). The model was used to develop a three-dimensional hydrodynamic and salinity numerical model of the Indian River Lagoon/Turkey Creek, with calibration and validation for St. Johns River Water Management District, Palatka, Florida (Tetra Tech, 1994).

7. Updating Version and System Requirements:

Version 1.0 PC compatible. A grid generation program, GEFDC is also available.

8. Input Data Requirements:

Basic input data required are time-varying water surface elevations at the open boundaries and freshwater inflows at the head of all tributaries. Time-varying salinity and temperature data must be prescribed at all inflow boundaries. Wind and surface heat exchange data must be prescribed at one or more locations.

9. Outputs:

Standard output parameters are water surface elevations, velocity, flow, salinity, dye tracer, and temperature in each cell of the grid at some user-specified time interval.

10. References available:

Hamrick, J.M. 1992. *A Three-dimensional Environmental Fluid Dynamics Computer Code: Theoretical and Computational Aspects.* SRAMSOE No. 317, The College of William and Mary, Gloucester Point, VA.

Park, K., and A.Y. Kuo. 1995. *A Three-dimensional Hydrodynamic-Eutrophication Model (HEM-3D):*

Description of Water Quality and Sediment Process Submodels. Special report. School of Marine Science, Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, VA.

Tetra Tech. 1994. *User's Guide for the Three-dimensional EFDC Hydrodynamic and Salinity Model of Indian River Lagoon and Turkey Creek.* Final Report. Tetra Tech, Inc., Fairfax, VA.

HSPF: Hydrological Simulation Program - FORTRAN

1. Distributor:

Model Distribution Coordinator
Center for Exposure Assessment Modeling (CEAM)
USEPA
960 College Station Road
Athens, GA 30605-2700
(706) 546-3549

2. Type of Modeling:

· Pollutant load and water quality in complex watersheds

· Continuous and storm event simulation

· Single, continuous, intermittent, multiple, and diffuse source/release

· Screening, intermediate, and detailed applications

· BMP evaluation and design criteria

3. Model Components:

· Watershed hydrology assessment

· Surface water quality analysis (conventional and toxic organic pollutants)

· Soil/groundwater contaminant runoff processes with instream hydraulic and sediment-chemical interactions (saturated and unsaturated zones)

· Pollutant decay and transformation

4. Method/Techniques:

This model calculates surface and subsurface pollutant transport from complex watersheds to receiving waters. Hydrolysis, oxidation, photolysis, biodegradation, volatilization, and sorption are used to describe the transfer and reaction processes. First-order kinetic processes are employed to model sorption. Water quality is simulated by a lumped-parameter model. Three sediment types (sand, silt, and clay) and a single organic chemical, as well as transformation products of that chemical, can be simulated. Currently, potency factors are used for all pervious areas, but enhancements are under way to use detailed agrochemical modules to better represent the impacts of agricultural BMPs. Calibration is required for model application. Because of the modular approach, detail of application can be varied depending on data availability and modeling needs.

5. Applications:

· Surface and subsurface pollutant transport to receiving water with subsequent simulation of instream transport and transformations

· Watershed hydrology and water quality for both conventional and toxic organic pollutants

· Evaluation of BMPs and development of design criteria

6. Number of Pollutants:

Seven pollutants: three sediment components (sand, silt, and clay), one pesticide or other toxic pollutant (user-specified), BOD, ammonia or nitrate, and orthophosphate

7. Limitations:

· The techniques used in the Stanford Watershed Model (SWM) are assumed to be appropriate for the area being modeled.

· Limited to well-mixed rivers and reservoirs.

· Extensive water quality sampling data required for calibration or verification.

· Highly trained staff required for model application.

8. Experience:

HSPF is being used by the Chesapeake Bay Program to model total watershed contributions of flow, sediment, nutrients, and associated constituents to the tidal region of the Bay (Donigian et al., 1990; Donigian and Patwardhan, 1992). Moore et al. (1992) describe an application to model BMP effects on a Tennessee watershed. Scheckenberger and Kennedy (1994) discuss how HSPF may be used in subwatershed planning. Ball et al. (1993) describe an application of HSPF in Australia. Lumb et al. (1990) describe an interactive program for data management and analysis that can be effectively used with HSPF. Lumb and Kittle (1993) have presented an expert system that can be used for calibration and application of HSPF.

9. Updating Version:

Version 10.11 (1995)

10. Input Data Requirements:

- Continuous rainfall records
- Continuous records of evapotranspiration, temperature, and solar intensity
- A large number of parameters need to be specified (some default values are available)

11. Simulation Output:

- Time series of the runoff flow rate, sediment load, and nutrient and pesticide concentrations
- Time series of water quantity and quality at any point in a watershed
- Frequency and duration analysis routine

12. References Available:

Ball, J.E., M.J. White, G. de R. Innes, and L. Chen. 1993. Application of HSPF on the Upper Nepean Catchment. In *Proceedings of Hydrology and Water Resources Symposium*, Newcastle, New South Wales, Australia, June 30- July 2, 1993, pp. 343-348.

Bicknell, B.R., J.C. Imhoff, J.L. Kittle, A.S. Donigian, and R. C. Johanson. 1993. *Hydrological Simulation Program - FORTRAN (HSPF): User's Manual for Release 10.0.* EPA 600/3-84-066. Environmental Research Laboratory, U.S. Environmental Protection Agency, Athens, GA.

Donigian, A.S., Jr., B.R. Bicknell, L.C. Linker, J. Hannawald, C. Chang, and R. Reynolds. 1990. *Chesapeake Bay Program Watershed Model Application to Calculate Bay Nutrient Loadings: Preliminary Phase I Findings and Recommendations.* Prepared for the U. S. Chesapeake Bay Program, Annapolis, MD, by AQUA TERRA Consultants.

Donigian, A.S., Jr., and A.S. Patwardhan. 1992. Modeling nutrient loadings from croplands in the Chesapeake Bay Watershed. In *Proceedings of Water Resources Sessions at Water Forum '92*, Baltimore, MD. August 2-6, 1992. pp. 817-822.

Donigian, A.S., Jr., B.R. Bicknell, and J.C. Imhoff. 1994. Hydrological Simulation Program - FORTRAN (HSPF). Chapter 12. *Computer Models of Watershed Hydrology*, ed. V.P. Singh. Water Resources Publications. Littleton, CO.

Lumb, A.M., J.L. Kittle, and K.M. Flynn. 1990. *Users Manual for ANNIE, a Computer Program for Interactive Hydrologic Analyses and Data Management*. Water Resources Investigations Report 89-4080. U. S. Geological Survey, Reston, VA.

Lumb, A.M., and J.L. Kittle. 1993. Expert System for calibration and application of watershed models. In *Proceedings of the Federal Interagency Workshop on Hydrologic Modeling Demands for the 90's*. Fort Collins, CO, June 6-9, 1993. U.S. Geological Survey Water Resources Investigation Report 93-4018.

Moore, L.W., C.Y. Chew, R.H. Smith, and S. Sahoo. 1992. Modeling of Best Management Practices on North Reelfoot Creek, Tennessee. *Water Environment Research* 64(3):241-247.

Scheckenberger, R.B., and A.S. Kennedy. 1994. The use of HSPF in subwatershed planning. In *Current Practices in Modelling the Management of Stormwater Impacts*, ed. W. James, pp. 175-187. Lewis Publishers, Boca Raton, FL.

PLUMES: Dilution Models for Effluent Discharges

1. Distributor:

Model Distribution Coordinator
Center for Exposure Assessment Modeling (CEAM)
USEPA
960 College Station Road
Athens, GA 30605-2700
(706) 546-3549

2. Type of Modeling/Application:

- May be applied to most deep water bodies.
- Near-field hydrodynamic mixing processes
- Point source buoyant or submerged discharges
- Single or multiple inputs

3. Model Processes:

- Consists of two initial dilution models (RSB and UM) with two far-field algorithms automatically initiated beyond the initial dilution zone.
- Incorporates the flow classification scheme of the CORMIX modeling system and provides recommendations for model usage under a range of mixing conditions.

4. Method/Techniques:

PLUMES incorporates two relatively sophisticated initial dilution models(RSB and UM) and two relatively simple far-field algorithms.

RSB is based on experimental studies on multiport diffusers in stratified currents. UM is the latest in a series of models first developed for atmospheric and freshwater applications and later for marine applications. Outstanding UM features are the Lagrangian formulation and the projected area entrainment (PAE) hypothesis, which is a statement of forced entrainment—the rate at which mass is incorporated into the plume in the presence of current. The Lagrangian formulation offers comparative simplicity that is useful in developing PAEs.

The far-field algorithms are relatively simple implementations of dispersion equations applied to nearshore coastal waters, and confined channels.

5. Limitations:

- RSB is a an empirical model developed from experimental studies under stable ambient stratification, and it may have limited application in situations where ambient layers are unstratified or unstable.
- The PAE hypothesis, which was developed for plumes discharged to open, unbounded environments, free from interference, is assumed to be valid in UM.
- The farfield algorithms in PLUMES are relatively simplistic compared to the initial dilution models.

6. Experience:

The PLUMES modeling system is recommended for use in designing outfall diffusers.

Rhode Island Department of Environmental Management used PLUMES to assess the potential risks to shellfish growing areas due to the failure of the chlorination process in wastewater treatment plants.

7. Updating Version and System Requirements:

Version 3.0 (1994). compatible.

PLUMES is currently being updated. The new version of PLUMES, called Windows Interface for Simulating Plumes (WISP), includes additional capabilities such as use of time series input files, analysis of ambient data sets, and visualization and tracking of case studies and scenarios (Frick et al., 1998).

8. Input Data Requirements:

Port geometry, spacing, and total flow. Plume diameter and depth, effluent salinity and temperature. Ambient conditions in receiving water and far-field distance.

9. Outputs:

CORMIX flow classification, pollutant concentration and dilution ratios at various points in the plume.

10. References available:

Baumgartner, D.J., W.E. Frick, and P.J.W. Roberts. 1994. *Dilution Models for Effluent Discharges*. 3rd ed. EPA/600/R-93/139. U.S. Environmental Protection Agency, Newport, OR.

Frick, W.E., P.J.W. Roberts, and A.J. Baumgartner. 1998. *Dilution Models for Effluent Discharges*. 4th ed. USEPA, Athens, GA.

Goblick, G., 1995. *Assessment of Analytical Model PLUMES for Sizing Prohibitive Shellfish Closure Zones—A Technical Guidance Manual*. Rhode Island Department of Environmental Management, Providence, RI.

QUAL2E: The Enhanced Stream Water Quality Model

1. Distributor:

Model Distribution Coordinator
Center for Exposure Assessment Modeling (CEAM)
USEPA
960 College Station Road
Athens, GA 30605-2700
(706) 546-3549

2. Type of Modeling/Application:

- Water quality/eutrophication
- Far-field
- Stream/River
- 1-D, branching
- Steady flow
- Steady-state/Quasidynamic (diurnal variations in meteorological inputs)
- Advective/Dispersive transport
- Finite difference

3. Model Processes:

- Temperature
- Salinity
- DO-BOD
- Nitrogen cycle
- Phosphorus cycle
- Phytoplankton
- Conservative constituent
- Nonconservative constituent
- First-order kinetics of constituents
- Uncertainty analysis

4. Method/Techniques:

The QUAL2E model permits simulation of several water quality constituents in a branching stream system using an implicit backward-difference, finite-difference solution to the one-dimensional advective-dispersive equation. The stream is conceptually represented as a system of reaches of variable length, each of which is subdivided into computational elements that have the same length in all reaches. A mass and heat balance is applied for every element. Mass may be gained or lost from elements by transport processes, external sources and sinks, or internal sources and sinks. The UNCAS component allows quick implementation of uncertainty analysis using sensitivity analysis, first-order error analysis, or Monte Carlo simulation.

5. Limitations:

- Considers only steady flow.
- Only time-varying forcing functions are the climatologic variables that primarily affect diurnal temperature and dissolved oxygen.

6. Experience:

The QUAL series of models has a two-decade history in water quality management and wasteload allocation studies. Paschal and Mueller (1991) used QUAL2E to evaluate the effects of wastewater effluent on the South Platte River from Chatfield reservoir through Denver, Colorado. Cubilo et al. (1992) applied QUAL2E to the major rivers of the Comunidad de Madrid in Spain. Little and Williams (1992) describe a nonlinear regression programming model for calibrating QUAL2E. Johnson and Mercer (1994) report a QUAL2E application to the Chicago waterway and Upper Illinois River waterway to predict DO and other constituents in the DO cycle in response to various water pollution controls.

7. Updating Version and System Requirements:

Version 3.21 (1995). PC-compatible. A Windows-based pre- and post-processor is available from EPA's Office of Science and Technology.

8. Input Data Requirements:

The stream is represented by a network of headwaters, reaches, and junctions. Twenty-six physical, chemical, and biological properties have to be specified for a reach.

9. Outputs:

Dissolved oxygen, biochemical oxygen demand, temperature, chlorophyll *a*, ammonia-N, nitrite-N, nitrate-N, organic N, organic P, dissolved P, coliforms, arbitrary nonconservative constituents, three conservative constituents.

10. References Available:

Brown, L.C., and T.O. Barnwell. 1987. *The Enhanced Stream Water Quality Model QUAL2E and QUAL2E-UNCAS: Documentation and User Manual*. EPA-600/3-87/007, U.S. Environmental Protection Agency, Athens, GA.

Cubilo, F., B. Rodriguez, and T.O. Barnwell, Jr. 1992. A system for control of river water quality for the community of Madrid using QUAL2E. *Water Science and Technology* 26(7/8):1867-1873.

Goblick, G., 1995. *Assessment of Analytical Model PLUMES for Sizing Prohibitive Shellfish Closure Zones - A Technical Guidance Manual.* Rhode Island Department of Environmental Management, Providence, RI.

Johnson, C.R., and G. Mercer. 1994. Modeling the water quality processes of the Chicago waterway. In *Proceedings of the National Symposium on Water Quality,* American Water Resources Association, Chicago, IL, November 6-10, 1994, p. 315

Little, K.W., and R.E. Williams. 1992. Least-squares calibration of QUAL2E. *Water Environment Research* 64(2):179-185.

Paschal, J.E., Jr., and D.K. Mueller. 1991. *Simulation of Water Quality and the Effects of Wastewater Effluent on the South Platte River from Chatfield Reservoir Through Denver, Colorado*. Water-Resources Investigations Report 91-4016. U.S. Geological Survey, Denver, CO.

Regional Bypassing Model

1. Distributors:

Howard Golub
Interstate Sanitation Commission
311 West 43rd Street, Room 201
New York, NY 10036
(212) 582-0380

Wayne Jackson
Environmental Protection Agency
Region 2
290 Broadway - 26th Floor
New York, New York 10007-1866
Main Number: 212-637-5000

2. Type of Modeling/Application:

- Pathogen concentration predictive tool designed to estimate spatial extent of contamination due to an unplanned sewage bypass in the New York-New Jersey-Connecticut metropolitan area.
- Based on the 3-dimensional, finite differencing System-Wide Eutrophication Model (SWEM).

3. Model Components:

- User interface for the selection of coliform concentration, spill site location, discharge volume, water temperature, bacteria type (defaults: total coliform), and threshold concentration (default = 0).
- Graphical outputs for time series maximum concentrations and concentration profiles at all receptor sites for 12, 24, and 96 hours of discharge duration..
- Time series tabular output of maximum coliform concentrations within the specified time interval at all receptor sites for 12, 24, and 96 hours of discharge duration..

4. Method/Techniques:

The Regional Bypass Model uses the results from multiple SWEM simulations as a basis for user analysis. These simulations were developed for 29 discharge locations and 53 receptor sites in the New York-New Jersey-Connecticut metropolitan area. A 10-layer, variable capacity, 3-dimensional finite element grid was created for the harbor system. Site specific parameter values for dimensions, tidal influences, and velocity profiles were determined for each cell in the system. Simulations were run using constant discharge volume, coliform concentration, and decay rate. The simulations were repeated for three temperatures and three discharge periods. The results are steady state estimates of contaminant concentrations.

The postprocessor accesses the preprocessed results of these simulations to allow the user to evaluate a variety of scenarios based upon discharge location, duration, and receptor site location. The system extrapolates water column concentration levels for user specified discharge volume, concentration, and temperature for each scenario. The results can be used to determine the spatial and temporal extent of coliform contamination.

5. Limitations:

- Applicable only to predefined discharge and receptor sites in the New York-New Jersey-Connecticut metropolitan area.
- Assumes that the horizontal dimensions of the waterbody are significantly greater than the depth.
- Constant temperature assumption neglects problem areas such as tidal creeks and shallow bays.

6. Experience:

The regional bypass model is used by the various local environmental and health department to predict pathogen concentrations following sewage spills into the New York-New Jersey-Connecticut metropolitan area.

7. Updating Version and System Requirements:

Results based on output from SWEM Version 3.0 (1998). PC-compatible. Pre- and post-processors are supplied with the model.

8. Input Data Requirements:

Data requirements are minimal since it uses pre-processed simulation results of several discharge scenarios. Extensive site characterization was performed to develop the model configuration. The user must select a discharge location and receptor sites and temperature. They must also specify a discharge volume, and concentration.

9. Outputs:

The model includes a simple to use processor allowing convenient output analysis. The post-processor produces graphical plots for time-variable coliform concentrations and spatial distributions. It will also produce tabular results of maximum concentrations.

10. References available:

HydroQual. 1998. *Modeling Evaluations and Users Guide* HydroQual Inc., New York.

Jackson, W., EPA Region 2, personal communication, 1998.

SMTM: Simple Mixing and Transport Model

1. Distributor:

SMTM can be requested from:

Mary Wright
Virginia Department of Health
Division of Shellfish Sanitation
1500 E. Main St., Room 109
Richmond, VA 23219
(804) 786-7937

2. Type of Modeling/Application:

- Steady-state advective-dispersive model for prediction of the horizontal distribution of fecal coliform around continuous point source discharges.
- General tidally averaged mass balance transport equations including simple first-order decay.
- Applicable to discharge points located on wide channels, narrow channels, and semi-enclosed bays or basins.

3. Model Components:

- Set of guidelines based upon system geometry for the selection of an appropriate simple contaminant transport model.
- Zero-, one-, and two-dimensional models to estimate the buffer zone around marina and wastewater treatment plant discharges within which shellfish should not be harvested.

4. Method/Techniques:

SMTM consists of a set of three mixing and transport models and general guidance for the cases where each model is applicable. The selection guidelines are based upon channel geometry, tidal velocity, and the net freshwater flow.

Discharge sites can usually be classified as one of the following types; (1) wide channel, (2) narrow channel, or (3) semi-enclosed bays.

Wide channel sites are locations where the channel width is greater than 100 meters and have a measurable fresh water inflow. Contaminant concentrations are assumed to be uniformly distributed across the water column and that the change in water depth due to tides is negligible compared to the average depth. This assumption allows wide channel sites to be modeled using a two-dimensional advective-dispersion equation. A steady state analytical solution is found by assuming constant values for tidal velocity, depth, lateral and longitudinal dispersion coefficients, and contaminant distribution coefficient.

Narrow channel sites are assumed to be well mixed with respect to width and depth and have negligible fresh water inflow. This simplifies the model to a one-dimensional advective-transport equation. A steady state analytical solution is found by assuming constant values for tidal velocity, width, depth, lateral and longitudinal dispersion coefficients, and contaminant decay rate coefficient.

Semi-enclosed bays or sites are assumed to be completely mixed in all dimensions. This solution is valid in cases where the depth of the bay is much greater than the tidal range. The results from this model represent the basin average fecal coliform concentrations from a continuous point source discharge.

These models are analytical solutions to contaminant mass balance equations. Each model is based upon the assumption of continuous injection of material and results in a steady-state solution. The result of a simulation using these models is an estimate of the radius within which the contaminant concentration is greater than the user specified level.

5. Limitations:

- Assumes a straight, constant depth and width channel having uniform longitudinal mass transport velocity.
- Does not allow variable contaminant discharge.
- Neglects temporal variability of tidal heights and currents.

6. Experience:

The State of Virginia Department of Health, Division of Shellfish Sanitation uses this model to determine the size of the buffer required surrounding marinas and wastewater discharges. Results from the models compare favorably with state guidelines used to provide protection from contaminated shellfish.

7. Updating Version and System Requirements:

PC compatible, 386 processor or better.

8. Input Data Requirements:

Input requirements are minimal and should be available for most applications. Required parameters are loading rate, decay rate channel geometry, tidal period and velocity.

9. Outputs:

The output is a table of the horizontal fecal coliform distribution. The user selects the lateral and longitudinal distances within which the concentrations exceed the specified water quality criteria.

10. References available:

Hamrick, J.M., and B.J. Neilson. 1989. *Determination of Marina Buffer Zones Using Simple Mixing and Transport Models.* Virginia Institute of Marine Sciences, Gloucester Point, MD.

Thomann, R.V., and J.A. Mueller. 1987. *Principles of Surface Water Quality Modeling and Control*. Harper and Row, New York, NY.

State of Delaware Closure Guidelines

1. Distributor

Delaware Department of Natural Resources
Watershed Assessment Section
89 Kings Highway
P.O. Box 1401
Dover, DE 19903

2. Type of Modeling/Application:

- Beach closure predictive tool
- Development of regression relationship between rainfall and enterococcus bacteria concentrations.
- Epidemiologically based linear relationship between potential illnesses and water quality.

3. Model Processes:

- Regression analysis of rainfall and instream enterococcus bacteria concentrations.
- Assessment of the impact of landuse and Best Management Practices on bacteria concentrations.
- Analysis of seasonality on bacteriological water quality.

4. Method/Techniques:

Epidemiological data was used to determine a relationship between the number of water quality-induced illnesses per year and fecal coliform levels at Delaware beaches. This relationship was assumed to be linear. Establishing the maximum number of illnesses/year at 12.5, a 1-day fecal coliform concentration was estimated. Single sample advisory standards for marine and fresh waters were derived using the EPA's Quality Criteria for Water (1986) formula. The Delaware Study was developed to assess the impact of landuse with regards to these marine and fresh water standards.

Three-day and 24-hour cumulative rainfall measurements were made prior to water quality sampling events. Regression analyses were conducted using rainfall data from Georgetown, Delaware and enterococcus concentrations at twelve representative sites in Sussex Count, Delaware. A strong positive correlation was found between the amount of rainfall and the geometric mean fecal concentration at the sampling sites.

The resulting guidelines were as follows:

Marine waters are considered unsafe for swimming at least 12 hours after a rainfall event of 3.5 in. in 24 hours or 3 in. in 12 hours.

Fresh waters are considered unsafe for 24 hours after a rainfall event of 2.5 in. in 24 hours.

5. Limitations:

- Assumes a linear relationship between bacteria concentration and number of illnesses.
- Regression analysis of observed rainfall and pathogen data are site-specific.

6. Experience:

The Delaware Study was developed by the State of Delaware. The rainfall closure guidelines specified are used as one of a number of water quality/ health-risk assessment tools.

These tools have proven reliable in providing protection against water-quality related illnesses.

7. Updating Version and System Requirements:

Simple and easy statistical regression analysis program that requires continuous updating of rainfall-bacteria data to improve the predictive capability of the model.

8. Input Data Requirements:

Basic inputs required are 3-day cumulative rainfall measurements, 24-hour cumulative rainfall measurements, and instream bacteriological measurements.

9. Outputs:

The output of the procedure is a guideline that specifies the amount of rainfall that would result in a high bacteria concentrations, which would lead to beaches closure.

10. References Available:

DNREC. 1998. *1998 Recreational Water Guidelines.* Delaware Department of Natural Resources and Environmental Control, Dover, DE.

STORM: Storage, Treatment, Overflow, Runoff Model

1. Distributor:

Mainframe version:

U.S. Army Corps of Engineers
Hydrologic Engineering Center (HEC)
609 Second Street
Davis, CA 95616

Enhanced PC version (ProStorm) with pre- and post-processors:

Dodson & Associates, Inc.
5629 FM 1960 West, Suite 314
Houston, TX 77069-4216
(713) 440-4742

2. Type of Modeling:

· Urban runoff processes

· Continuous simulation (hourly time steps)

· Continuous and diffuse source/release

· Screening application

3. Model Components:

· Rainfall/runoff assessment

· Water quality analysis

· Statistical and sensitivity analysis

4. Method/Techniques:

This is a quasidynamic program. A modified rational formula is used for hydrology simulation. Rainfall/runoff depth and volumes are computed by means of an area-weighted runoff coefficient and the SCS curve number equation, respectively. The Universal Soil Loss Equation (USLE) is applied to simulate erosion. Water quality is simulated by linear buildup and first-order exponential wash-off coefficients. Calibration is advisable, but relative comparisons can be evaluated without calibration.

5. Applications:

· Storm and combined sewer overflows including dry-weather flow

· Surface water quantity and quality routing with storage/treatment option

· Urban areas assessments

6. Number of Pollutants:

Six prespecified pollutants: suspended solids, settleable solids, BOD, total coliforms, ortho-phosphate, and total nitrogen

7. Limitations:

· Little flexibility in parameters to calibrate to observed hydrographs.

· Lacks microcomputer version.

· Requires a large amount of input data.

8. Experience:

STORM was extensively used in the late 1970s and early 1980s. The model was applied to the San Francisco master drainage plan for abatement of combined sewer overflows. STORM continues to be used to assess runoff and management practices in urban areas.

9. Updating Version and System requirements:

Version 1.0 (1977) for mainframe systems. PC version (ProStorm) also available.

10. Input Data Requirements:

· SCS curve number, buildup and wash-off parameters

· Runoff coefficient and soil type

11. Simulation Output:

· Storm event summaries (runoff volume, concentrations, and loads)

· Summaries of storage and treatment, utilization, total overflow loads and concentrations

· Hourly hydrographs and pollutographs (concentration vs. time)

· Statistical summaries on annual and total simulation period basis (percentage of runoff passing through storage and the number of overflows)

12. References Available:

Abbott, J. 1977. *Guidelines for Calibration and application of STORM.* Training Document No. 8. U.S. Army Corps of Engineers, Hydrologic Engineering Center. Davis, CA.

Abbott, J. 1978. *Testing of Several Runoff Models on an Urban Watershed.* Technical Memorandum No. 34. ASCE Urban Water Resources Research Program, ASCE, New York, NY.

Donigian, A.S., Jr., and W.C. Huber. 1991. *Modeling of Nonpoint Source Water Quality in Urban and Non-urban Areas.* EPA/600/3-91/039. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

Hydrologic Engineering Center. 1977. *Storage, Treatment, Overflow, Runoff Model, STORM, User's Manual.* Generalized Computer Program 723-S8-L7520. U.S. Army Corps of Engineers, Davis, CA.

Najarian, T.O., T.T. Griffin, and V.K. Gunawardana. 1986. Development impacts on water quality: A case study. *Journal of Water Resources Planning and Management, ASCE*, 112(1):20-35.

Pantalion, J., A. Scharlach, and G. Oswald. 1995. Water quality master planning in an urban watershed. In *Watershed Management: Planning for the 21st Century*, proceedings of the ASCE's First International Conference of Water Resources Engineering, San Antonio, TX, August 14-16, 1995. pp. 330-339.

Shubinski, R.P., A.J. Knepp, and C.R. Bristol. 1977. *Computer Program Documentation for the Continuous Storm Runoff Model SEM-STORM.* Report to the Southeast Michigan Council of Governments, Detroit, MI.

SWMM: Storm Water Management Model

1. Name of Distributor:

Model Distribution Coordinator
Center for Exposure Assessment Modeling (CEAM)
USEPA
960 College Station Road
Athens, GA 30605-2700
(706) 546-3549

2. Type of Modeling:

- Urban stormwater processes
- Continuous and storm event simulation with variable and user-specified time steps (wet and dry weather periods)
- Single, continuous, intermittent, multiple, and diffuse source/release
- Screening, intermediate, and detailed planning applications
- Evaluation of BMPs and development of design criteria

3. Model Components:

- Rainfall/runoff assessment
- Water quality analysis
- Point source inputs available

4. Method/Techniques:

This model simulates overland water quantity and quality produced by storms in urban watersheds. Several modules or blocks are included to model a wide range of quality and quantity watershed processes. A distributed parameter submodel (RUNOFF) describes runoff based on the concept of surface storage balance. The rainfall/runoff simulation is accomplished by the nonlinear reservoir approach. The lumped storage scheme is applied for soil/groundwater modeling. For impervious areas, a linear formulation is used to compute daily/hourly increases in particle accumulation. For pervious areas, a modified Universal Soil Loss Equation (USLE) determines sediment load. The concept of potency factors is applied to simulate pollutants other than sediment.

5. Applications:

- Urban stormwater and combined systems
- Surface water routing
- Urban watershed analysis, including baseflow contributions

6. Number of Pollutants:

Limited to 10 pollutants, including sediment

7. Limitations:

- Lack of subsurface quality routing
- No interaction of quality processes (apart from adsorption)
- Weak scour-deposition routines

8. Experience:

Applied to urban hydrologic quantity/quality problems in scores of U.S. cities as well as extensively in Canada, Europe, and Australia. The model has been used for very complex hydraulic analysis for combined sewer overflow mitigation, as well as for many stormwater management planning studies and pollution abatement projects, and there are many instances of successful calibration and verification (Huber, 1992). Warwick and Tadepalli (1991) describe calibration and verification of SWMM on a 10-square-mile urbanized watershed in Dallas, Texas. Tsihrintzis et al.(1995) describe SWMM applications to four watersheds in South Florida representing high- and low-density residential, commercial, and highway land uses. Ovbiebo and She (1995) describe an application of SWMM in a subbasin of the Duwamish River, Washington.

9. Updating Version, System Requirements:

Version 4.30 (1994)

10. Input Data Requirements:

- Rainfall hyetographs, antecedent conditions, land use, and topography
- Dry-weather flow and soil characteristics
- Gutters/pipes - hydraulic inputs
- Pollutant accumulation and wash-off parameters
- Hydraulics and kinetic parameters

11. Simulation Output:

· Time series of flow, stage, and constituent concentration at any point in watershed

· Seasonal and annual summaries

12. References Available:

Donigian, A.S., Jr., and W.C. Huber. 1991. *Modeling of Nonpoint Source Water Quality in Urban and Non-urban Areas*. EPA/600/3-91/039. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

Huber, W.C., and R.E. Dickinson. 1988. *Storm Water Management Model Version 4, User's Manual*. EPA600/3-88/001a (NTISPB88-236641/AS). U.S. Environmental Protection Agency, Athens, GA.

Huber, W.C. 1992. Experience with the US. EPA SWMM Model for analysis and solution of urban drainage problems. *Proceedings, Inundaciones Y Redes De Drenaje Urbano*, ed. J. Dolz, M. Gomez, and J. P. Martin, eds., Colegio de Ingenieros de Caminos, Canales Y Puertos, Universitat Politecnica de Catalunya, Barcelona, Spain, pp. 199-220.

Ovbiebo, T., and N. She. 1995. Urban runoff quality and quantity modeling in a subbasin of the Duwamish River using XP-SWMM. *Watershed Management: Planning for the 21st Century,* American Society of Civil Engineers, San Antonio, TX, August 14-16, 1995, pp.320-329.

Tshihrintzis, V.A., R. Hamid, and H.R. Fuentes. 1995. Calibration and verification of watershed quality model SWMM in sub-tropical urban areas. In *Proceedings of the First International Conference - Water Resources Engineering.* American Society of Civil Engineers, San Antonio, TX. August 14-16, 1995, pp 373-377.

Warwick, J.J., and P. Tadepalli. 1991. Efficacy of SWMM application. *Journal of Water Resources Planning and Management* 117(3):352-366.

TPM: Tidal Prism Model

1. Distributor:

Albert Y. Kuo
Virginia Institute of Marine Science
School of Marine Science
The College of William and Mary
Gloucester Point, VA 23062
(804) 642-7212

2. Type of Modeling/Application:

- Primarily applicable to small coastal basins and tidal creeks
- May be applied to marinas where tidal forces are predominant with oscillating flow (e.g. an estuary or a tidal river)
- Steady-state model capable of simulating up to 23 water quality variables

3. Model Processes:

- Simulates physical transport processes in terms of the concept of tidal flushing
- Relatively detailed kinetic model that allows a more complete description of the eutrophication process
- Includes a sediment process model that considers the depositional flux of particulate organic matter, their diagenesis, and the resulting sediment flux

4. Method/Techniques:

TPM predicts the longitudinal distribution of conservative and nonconservative substances at slack-before-ebb (high slackwater). The model is best applied to an elongated embayment or tidal creek, where the creek is branched and/or freshwater discharge is negligibly small. The basic assumptions in the model are that the tide rises and falls simultaneously throughout the waterbody and that the system is in hydrodynamic equilibrium. Kinetic processes included in TPM are based on the formulations used in CE-QUAL-ICM (Cerco and Cole, 1994). Twenty-three state variables are considered including total active metal, fecal coliform bacteria, and temperature. The sediment process model in TPM has 16 water-quality-related model state variables and fluxes. Benthic sediments are represented as two layers in the sediment model. The lower layer is permanently anoxic, while the upper layer may be oxic or anoxic depending on dissolved oxygen concentration in the overlying water.

5. Limitations:

- The waterbody being simulated must be in hydrodynamic equilibrium.
- Only applicable to waterbodies where tidal forces are predominant with oscillating flow; the model therefore is not applicable to marinas located on a sound or an open sea.

6. Experience:

The model has been applied to a number of tidal creeks and coastal embayments in Virginia (Kuo and Neilson, 1988).

7. Updating Version and System Requirements:

Latest version released in September 1994. PC Compatible.

8. Input Data Requirements:

Two basic types of input data are required—geometric and physical. Geometric data define the system being simulated, including the returning ratio, initial concentration, and boundary conditions. Physical data include water temperature, reaction rates, point and nonpoint sources, and initial and boundary conditions for water quality parameters modeled.

9. Outputs:

Temperature, salinity, inorganic suspended solids, diatoms, blue-green algae and other phytoplankton, dissolved, labile, and refractory particulate organic carbon, organic nitrogen, and organic phosphorus ammonium, nitrite and nitrate, total phosphate, dissolved oxygen, chemical oxygen demand, dissolved silica, particulate biogenic silica, total active metal, and fecal coliform bacteria.

10. References available:

Cerco, C.F., and T. Cole. 1993. Three-dimensional eutrophication model of the Chesapeake Bay. *Journal of Environmental Engineering* 119(6): 1006-1025.

Kuo, A.Y., and B.J. Neilson. 1988. A modified tidal prism model for water quality in small coastal embayments. *Water Science Technology* 20(6/7):133-142.

Kuo, A.Y., and K. Park. 1994. *A PC-based Tidal Prism Water Quality Model for Small Coastal Basins and Tidal Creeks.* SRAMSOE No. 324. College of William and Mary, Gloucester Point, VA.

Appendix B: BASINS Fact Sheet

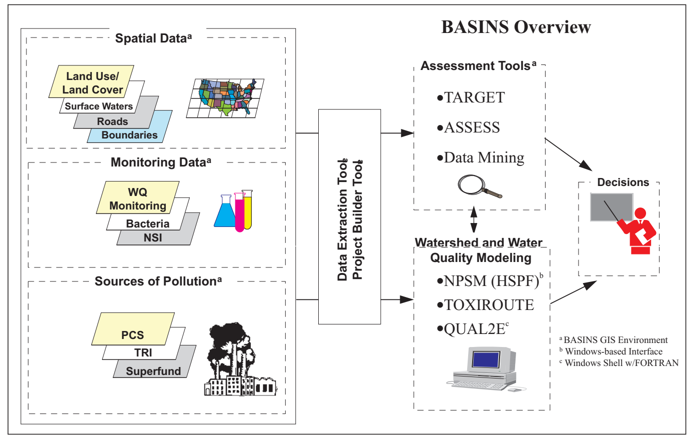
United States Environmental Protection Agency
Office of Water (4305) Washington, DC 20460
EPA-823-F-99-001
February 1999

FACT SHEET

BASINS 2.0 *A powerful tool for managing watersheds*

BASINS is a multipurpose environmental analysis system for use by regional, state, and local agencies in performing watershed- and water quality-based studies. This new software makes it possible to quickly assess large amounts of point source and nonpoint source data in a format that is easy to use, easy to understand. Installed on a personal computer, BASINS allows the user to assess water quality at selected stream sites or throughout an entire watershed. It is an invaluable tool that integrates environmental data, analytical tools, and modeling programs to support development of cost-effective approaches to environmental protection.

The U.S. Environmental Protection Agency's water programs and their counterparts in states and pollution control agencies are increasingly emphasizing watershed- and water quality-based assessment and integrated analysis of point and nonpoint sources. Better Assessment Science Integrating point and Nonpoint Sources (BASINS) is a system developed to meet the needs of such agencies. It integrates a geographic information system (GIS), national watershed data, and state-of-the-art environmental assessment and modeling tools into one convenient package.



Originally released in September 1996, BASINS addresses three objectives: (1) to facilitate examination of environmental information, (2) to provide an integrated watershed and modeling framework, and (3) to support analysis of point and nonpoint source management alternatives. It supports the development of total maximum daily loads (TMDLs), which require a watershed-based approach that integrates both point and nonpoint sources. BASINS can support the analysis of a number of pollutants at a variety of scales, using tools that range from simple to sophisticated.

Overcoming the lack of integration, limited coordination, and time-intensive execution typical of more traditional assessment tools, BASINS makes watershed and water quality studies easier by bringing key data and analytical components together "under one roof."

The heart of BASINS is its suite of interrelated components essential for performing watershed and water quality analysis. These components are grouped into five categories: (1) national databases; (2) assessment tools (TARGET, ASSESS, and Data Mining) for evaluating water quality and point source loadings at a variety of scales; (3) utilities including local data import, land-use and DEM reclassification, watershed delineation, and management of water quality observation data; (4) watershed and water quality models including NPSM (HSPF), TOXIROUTE, and QUAL2E; and (5) post processing output tools for interpreting model results. BASINS' databases and assessment tools are directly integrated within an ArcView GIS environment. By using GIS, a user can fully visualize, explore, and query to bring a watershed to life. The simulation models run in a Windows environment, using data input files generated in ArcView.

BASINS DATA AND COVERAGES

Spatially Distributed Data

Land use/land cover
Urbanized areas
Populated place locations
River Reach File version 1 (RF1) and; RF3 Alpha
Soils (STATSGO)
Elevation contours (DEM)
Major roads
USGS hydrologic unit boundaries (accounting unit, cataloging unit)
Drinking water supply sites
Dam sites
EPA regional, state and county boundaries
Federal and Indian Lands
Ecoregions

Environmental Monitoring Data

Water quality monitoring station summaries
Water quality observation data
Bacteria monitoring station summaries
Weather station sites
USGS gaging stations
Fish consumption advisories
National Sediment Inventory (NSI)
National Shellfish Register
Clean Water Needs Survey

Point Source Data

Permit Compliance System (PCS) sites and computed loadings
Industrial Facilities Discharge (IFD) sites
Toxic Release Inventory (TRI) sites
Superfund National Priority List (NPL) sites
Resource Conservation and Recovery Act (RCRA) sites
Mineral Industry Locations

BASINS ANALYTICAL TOOLS

TARGET is a watershed targeting tool that allows environmental managers to make a broad-based evaluation of a watershed's water quality and/or point source loadings. It operates on a large area such as a region or a state.

ASSESS operates on a single watershed (cataloging unit) or a limited set of watersheds and focuses on the status of specific water quality stations or discharge facilities and their proximity to water bodies.

Data Mining dynamically links different data elements using a combination of tables and maps. This unique linkage adds significant informational value to the raw data on water quality and loadings. Data Mining is a powerful tool that can assist in the integration and environmental interpretation of both geographic and historical information simultaneously.

BASINS MODELING SYSTEM

Three models are integrated into BASINS within an ArcView GIS environment. This allows the user to assess watershed loadings and receiving water impacts at various levels of complexity. ArcView geographic data preparation, selection routines, and visual output streamline the use of the models. A post processor graphically displays model results.

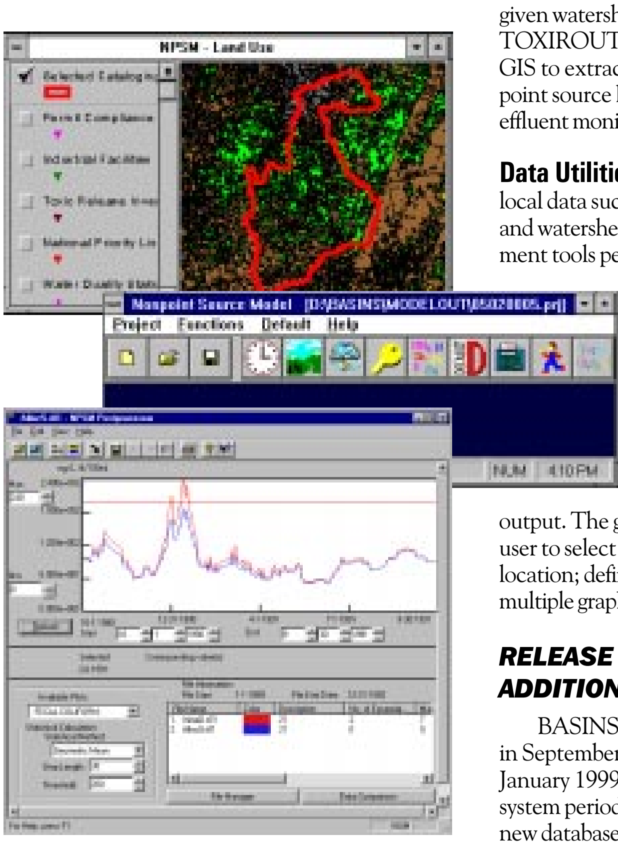
Nonpoint Source Model (NPSM) estimates land-use-specific nonpoint source loadings for selected pollutants at a watershed (cataloging unit or user-defined subwatershed scale). The model uses landscape data such as watershed boundaries and land use distribution to automatically prepare many of the input data it requires. NPSM combines a Windows-based interface with EPA's Hydrologic Simulation Program-FORTRAN (HSPF) model and is linked to ArcView.

QUAL2E is a one-dimensional, steady-state water quality and eutrophication model. It is integrated with ArcView to extract point source and stream network data and provides a Windows-based interface to facilitate parameter value assignment. It allows fate and transport modeling for multiple sources and pollutants.

TOXIROUTE is a screening-level stream routing model that performs simple dilution/decay calculations under mean or low flow conditions for a stream system within a given watershed (cataloging unit). TOXIROUTE integrates with the ArcView GIS to extract stream networks, as well as point source loadings computed from the effluent monitoring data.

Data Utilities streamline the importing of local data such as land use, stream networks, and watershed boundaries. Data management tools permit reclassification of land use and DEM data as well as manipulation of water quality observation data.

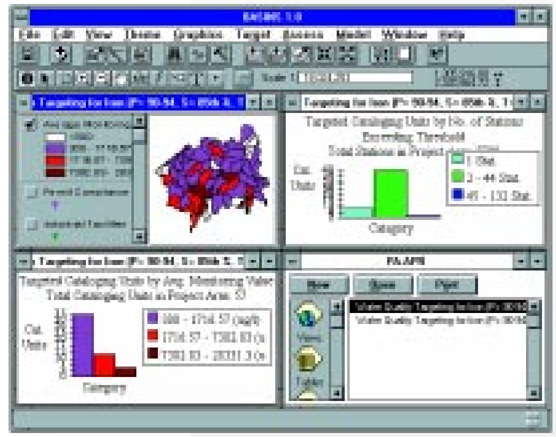
Post Processing. The BASINS modeling system includes a post processing tool to facilitate the evaluation and analysis of model output. The graphical interface allows the user to select data sets, parameters, and location; define output scales; and overlay multiple graphs and management scenarios.



BASINS Models

RELEASE SCHEDULE AND ADDITIONAL INFORMATION

BASINS 2.0 was released on the internet in September 1998 and on CD-ROM in January 1999. EPA plans to update the system periodically by adding new data layers, new databases, expanded state coverage, and enhanced modeling capabilities. EPA maintains a mailing list to notify users of system and data updates as they are developed. Updates are also available through the Internet.



BASINS Targeting Analysis

Minimum System Requirements

BASINS 2.0

Pentium IBM-compatible PC, 133-MHz; 400 mb hard disk space; 32 mb RAM, CD drive, Windows 95 or Windows NT 4.0 (except for QUAL2E); ArcView 3.0a or 3.1.

Obtaining BASINS

BASINS 2.0 is available through the Internet at www.epa.gov/ost/BASINS.

The final version of BASINS 2.0 CD-ROMs is available free of charge through the National Service Center for Environmental Publications (NSCEPI), P.O. Box 42419, Cincinnati, OH 45242. Tel: (513) 489-8190 or (800) 490-9198. Fax: (513) 489-8695. The package includes:

- User's Manual—Better Assessment Science Integrating Point and Nonpoint Sources. BASINS Version 2.0.
- Compact disks specific to one of 10 regions of interest within the conterminous U.S. (Be sure to indicate the EPA region of your choice in your request.)

For more information on content, availability, and training, please contact:

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