



The Stochastic Empirical Loading and Dilution Model (SELDM) for stormwater-quality risk analyses

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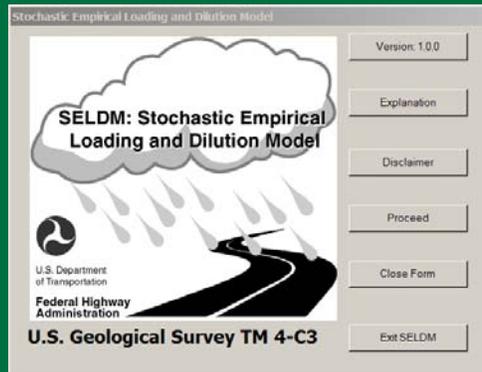
U.S. Department of Transportation
Federal Highway Administration

SELDM was tested and/or reviewed by 43 professionals from USGS, USEPA, USFWS, and 16 state agencies

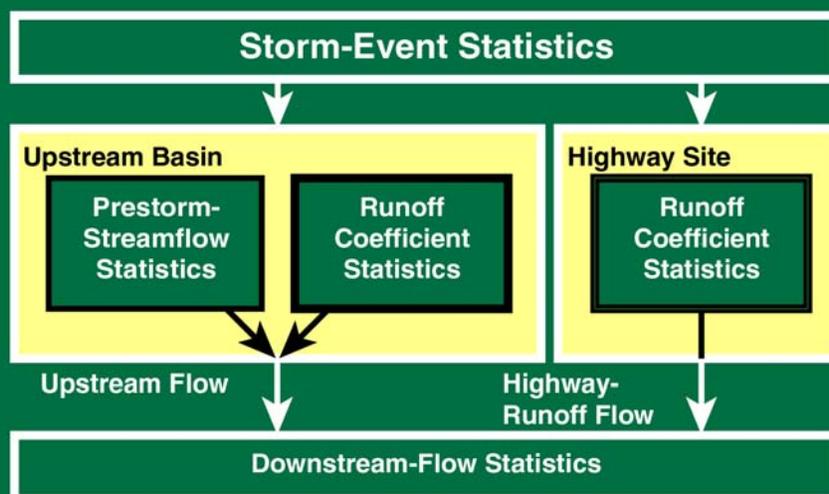


SELDM is the Stochastic Empirical Loading and Dilution Model

- Stochastic—Uses Monte Carlo methods to create a sample of events representing combinations of flows concentrations and loads
- Empirical—Based on data and statistics rather than pure theory
- Loading—Provides storm and annual loads
- Dilution—Mixing of upstream and highway indicates chance of exceeding a target value



SELDM generates precipitation events, prestorm flows and runoff coefficients

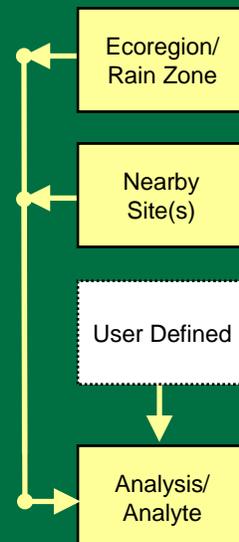


SELDM uses a simple mass balance approach to calculate flows, concentrations, and loads by storm and by year

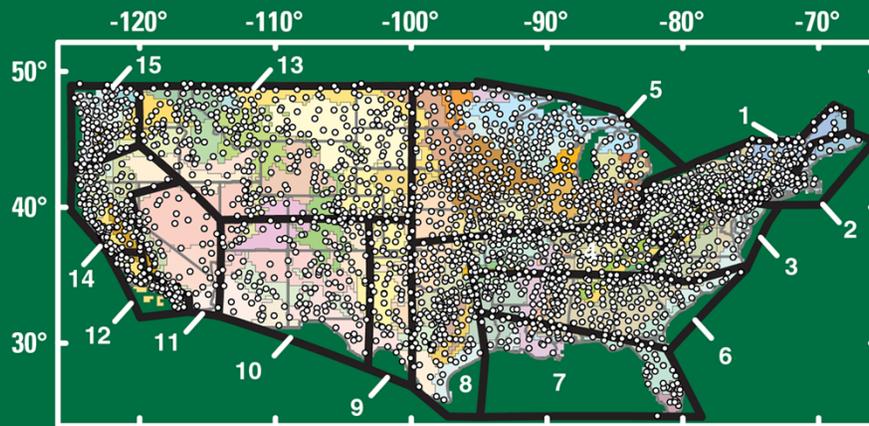


Supports the Environmental Decision-Making Process

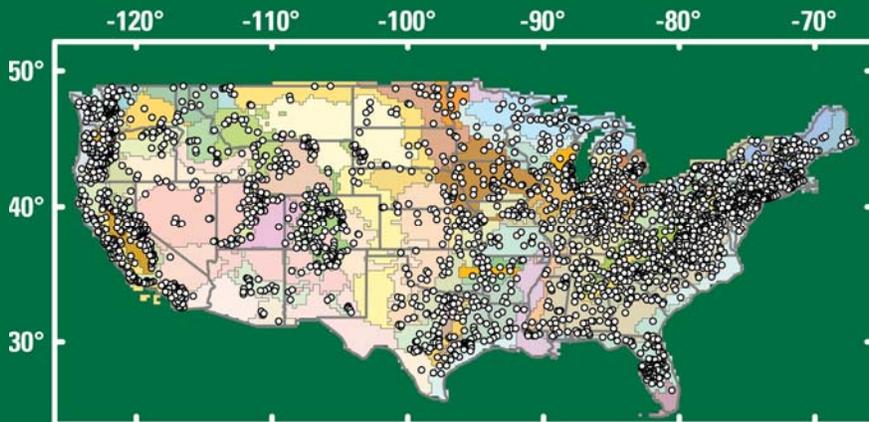
- First Level: Regional Inputs
 - Hydrologic Similarity
 - Ecoregions: pre-storm flow, precipitation, QW
 - Rain Zones: precipitation
- Second Level: Nearby Sites
 - Hydrologic Similarity
 - Proximity
- Third Level: User-Defined Statistics from Data Collected On Site
 - Expensive
 - Delays: one or more years of data collection



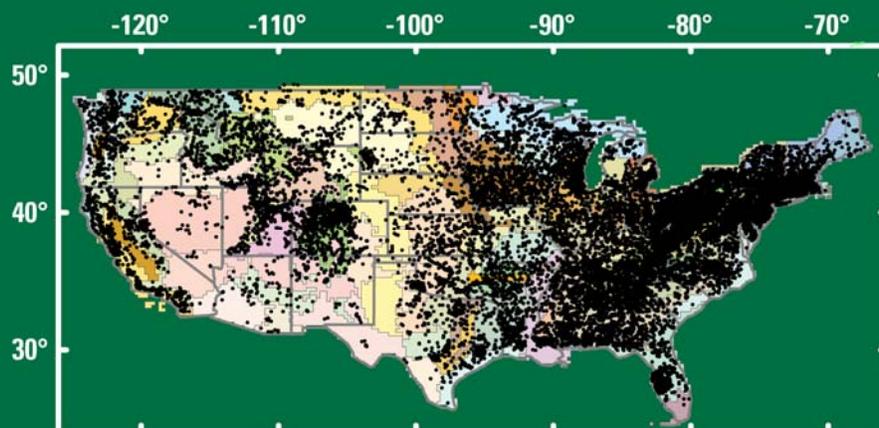
You can select precipitation statistics by region or by using values from one or more of the 2,610 hourly-precipitation data stations that are preloaded into SELDM



You can select streamflow statistics by region or by using values from one or more of the 2,783 streamgages that are preloaded into SELDM



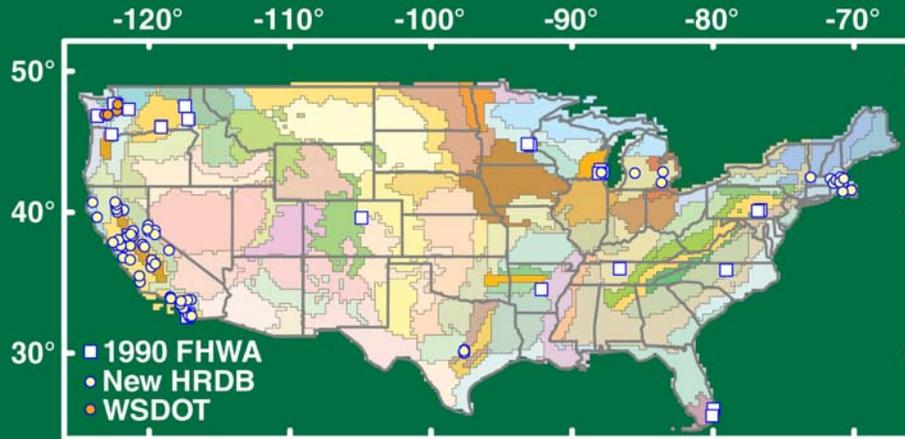
You can select water-quality statistics by ecoregion or by obtaining statistics from the 24,581 station 1,876,000 sample data set



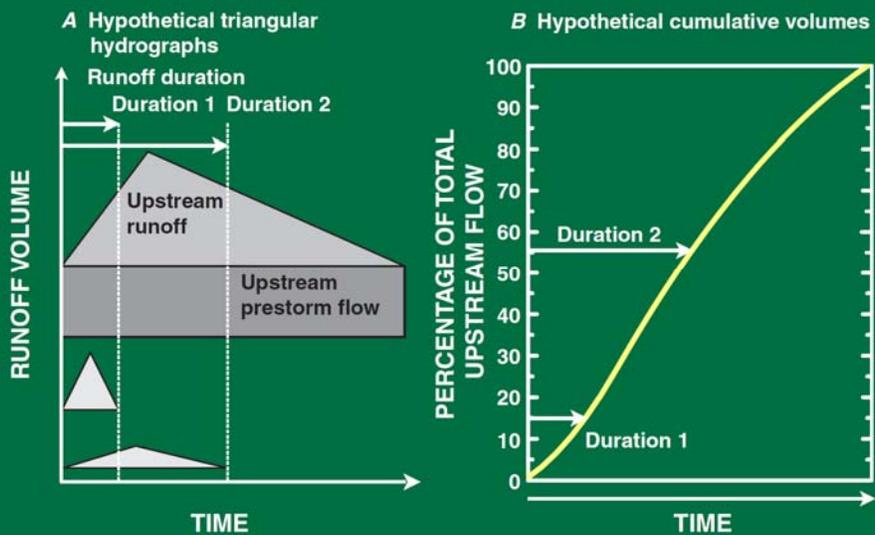
The HRDB has 10 data sets, 118 sites, 4,216 storms, and 55,311 EMC values

Data set	Sites	Storms	EMC
FHWA 1990	24	937	8,428
CA 2003	52	981	26,104
MA 2002	4	285	1,236
MA 2010	14	1,553	15,490
MI 1998	3	9	198
OH 1997	1	13	169
TX 1997	6	187	1,925
WA 2005	12	155	1,486
WI 2000	2	96	725
Sum	118	4,216	55,311

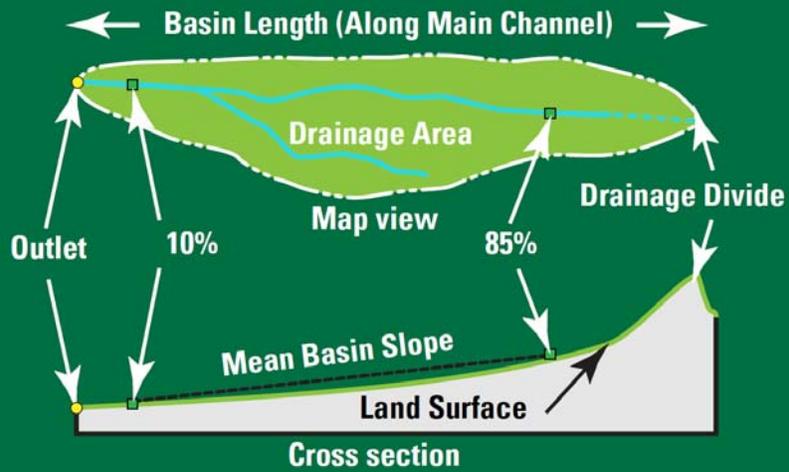
HRDB has a lot of data, but more is needed,
please donate your (good) data



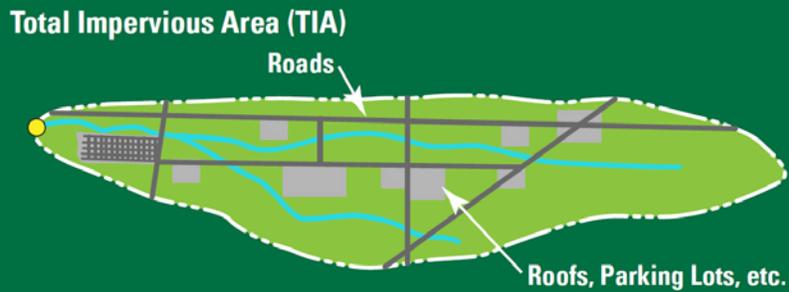
Hydrograph durations determine the proportion
of upstream stormflow available for mixing



The drainage area, basin length, and mean basin slope are physiographic basin properties



The total impervious area (TIA), which is the fraction or percentage of anthropogenic impervious surfaces in a basin, is the primary anthropogenic basin property

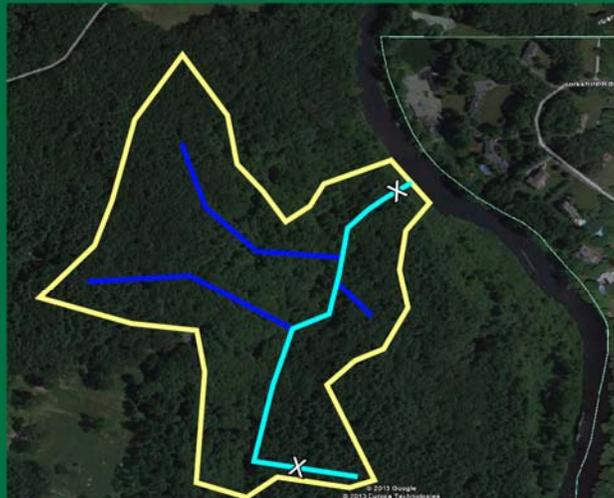


SELDM was developed as a highway runoff model, but can be used for many types of site



— Boundary — Main Channel — Tributary XX Slope
100 Imperviousness 12 Basin Development Factor

SELDM can be used to model the predevelopment condition



— Boundary — Main Channel — Tributary XX Slope
0 Imperviousness 0 Basin Development Factor

SELDM also may be used to model storm flows from other land uses

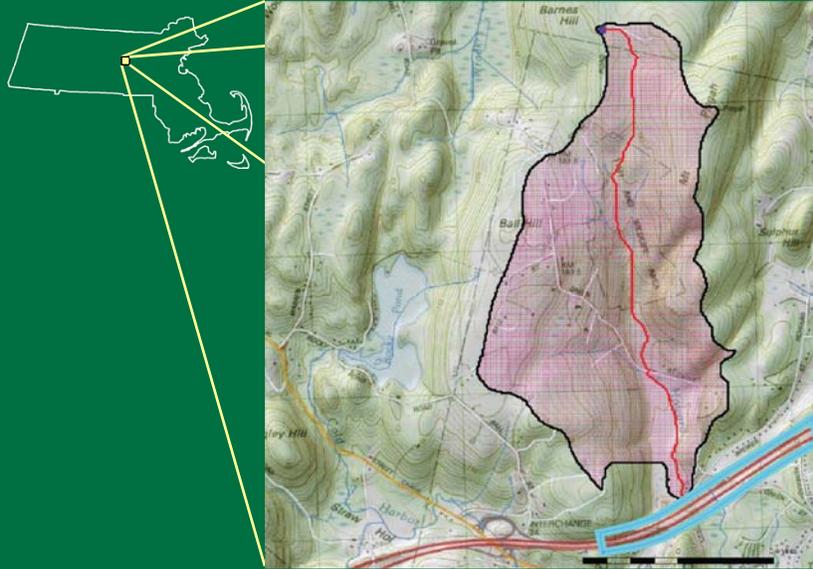


— Boundary — Main Channel — Tributary X X Slope
99 Imperviousness 12 Basin Development Factor

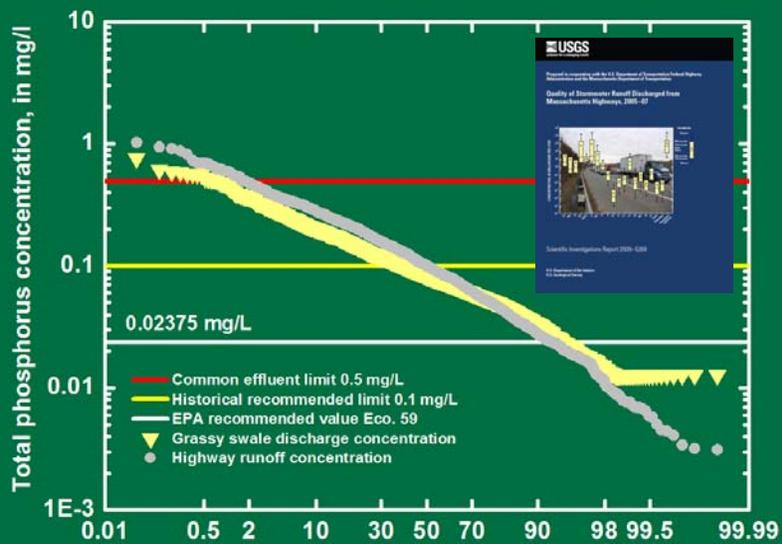
SELDM uses a “Black Box” approach to model flow reduction, hydrograph extension and concentration reduction from BMP(s)



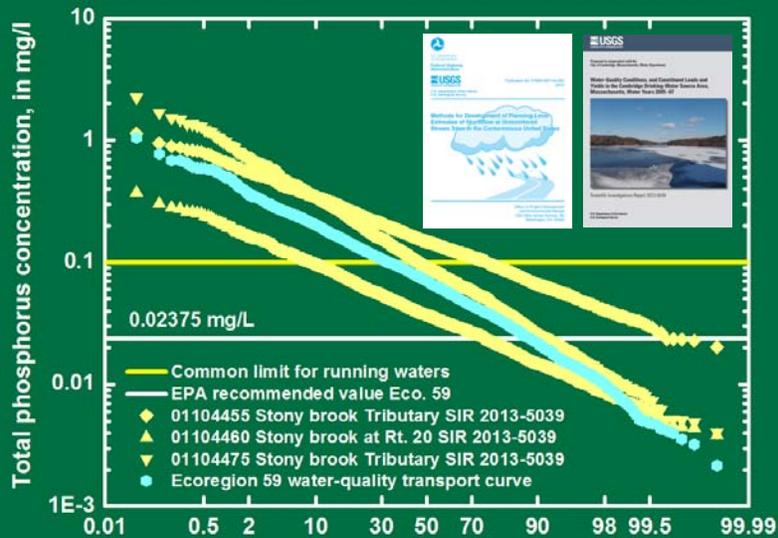
The case study will be Howard Brook a 1.34 square mile basin in Northborough MA



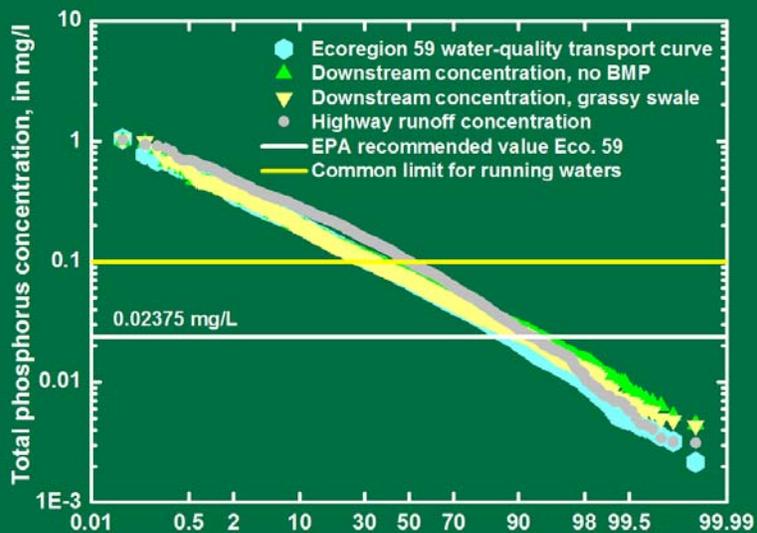
SELDM generated 1,648 storms in 29 years



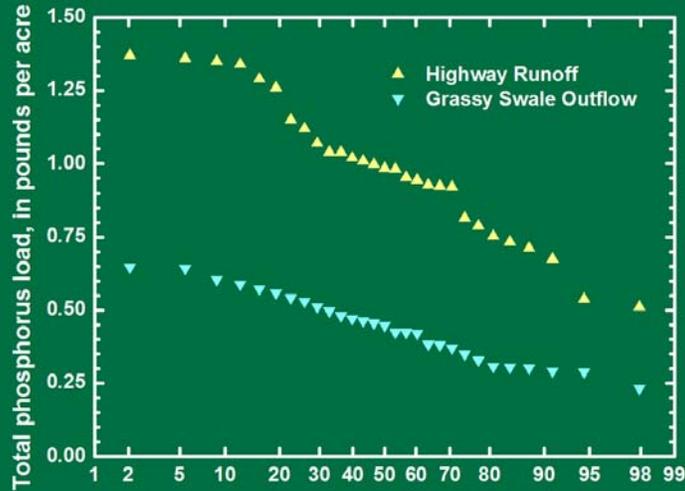
Background water-quality values also exceed the recommended values



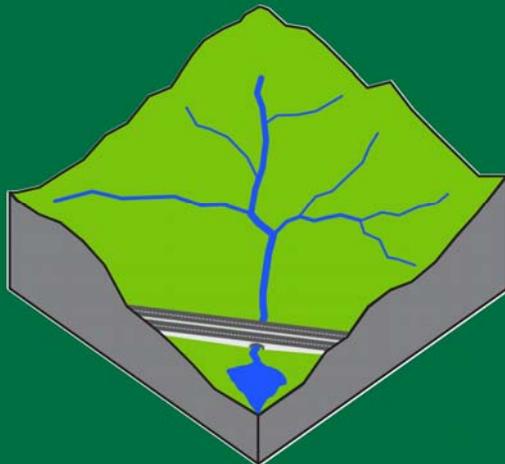
The effects of total phosphorus in Highway runoff is small for most storms



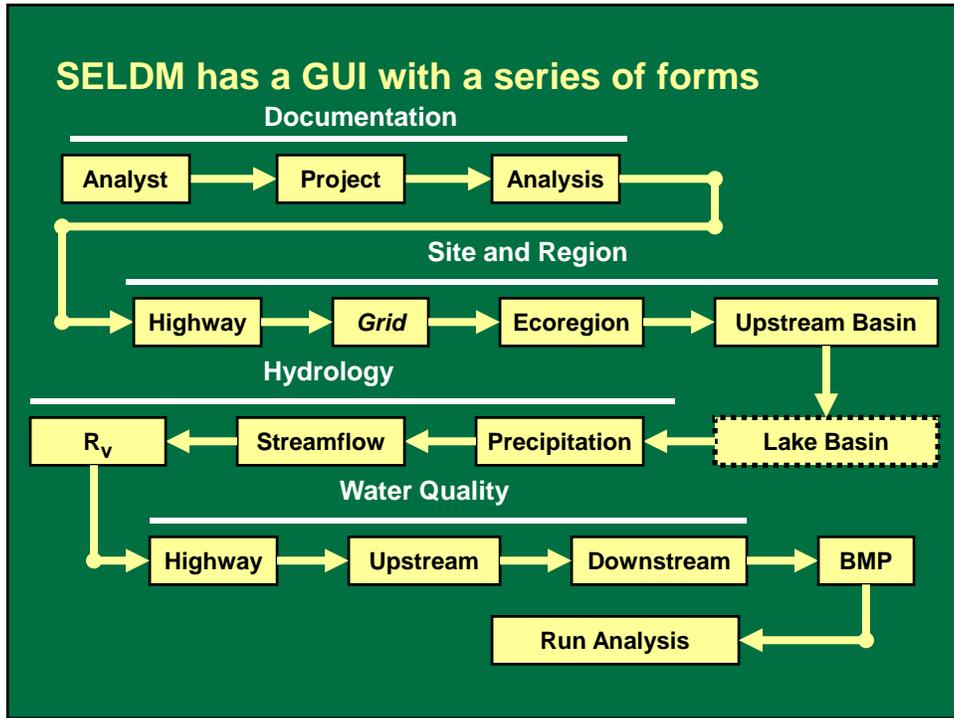
SELDM can be used to estimate annual loads with and without BMPs for a site or by acre



SELDM uses an annual mass balance approach to do a simple lake analysis; annual loads are good for TMDLs



- Lake Analysis:**
Annual Mass-Balance Analysis of Flows, Concentrations, & Loads
- Mass In Lake:**
 $Mass = Input - (Output + Attenuation)$
 Input = Highway + Other
 Output = Annual Flux * Average Concentration
 Attenuation = First-Order Decay
- Lake Concentration:**
Mass In Lake / Volume of Lake
- Highway Site Input:**
Storm Flows & Loads Aggregated to Years
- Lake Basin Input:**
 Entire Basin Area (minus highway)
 Annual Water Flux from Streamflow Statistics
 Random Daily Loads Aggregated to Years



The web site has links to reports, software, and SELDM version 1.0.1 at <http://webdmamrl.er.usgs.gov/g1/fhwa/SELDM.htm>

The collage includes several USGS reports and technical documents:

- Methods for Development of Planning Level Estimates of Stormflow at Unmonitored Stream Sites in the Conterminous United States
- Stochastic Empirical Leading and Dilution Model (SELDM) Version 1.0.1
- Computer Programs for Obtaining and Analyzing Daily Mean Streamflow Data from the U.S. Geological Survey National Water Information System Web Site
- Assessing Potential Effects of Highway Runoff on Receiving Water Quality at Selected Sites in Oregon with the Stochastic Empirical Leading and Dilution Model (SELDM)
- Statistics for Stochastic Modeling of Volume Reduction, Hydrograph Extension, and Water-Quality Treatment by Structural Stormwater Runoff Best Management Practices (BMPs)
- Estimating Basin Lagtime and Hydrograph-Timing Indices Used to Characterize Conditions for Runoff-Quality Analysis
- Randall Thiel Robust Line (KTR) Line—version 1.0: A Visual Basic Program for Calculating and Graphing Robust Nonparametric Estimates of Linear Regression Coefficients Between Two Continuous Variables
- Stochastic Empirical Leading and Dilution Model for Analysis of Flows, Concentrations, and Levels of Highway Runoff Constituents
- Highways of A Data Via Stochastic
- Techniques and Methods Book 4-C2