POLLUTANT LOAD REDUCTION MODEL (PLRM)

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Abstract The Pollutant Load Reduction Model (PLRM) is a catchment-scale runoff quality model designed to predict average annual storm water pollutant loads delivered to receiving waters based on a long-term, continuous simulation. The primary purpose of the PLRM is to assist water quality planners and project designers to quantitatively evaluate storm water quality improvement alternatives for a project that that may involve complex combinations of source controls and storm water treatment. The PLRM uses an integrated database of local meteorological and storm water quality data to quantify surface runoff and pollutant loading, and compares the load reduction performance of project alternatives. The PLRM reports pollutant loads for total suspended sediment, ultra-fine sediment (<20 µm), and total and dissolved species of phosphorus and nitrogen.

Figure 1 illustrates the three elements used for simulating pollutant loads in the PLRM: 1) hydrology and hydrologic source controls (HSC), 2) pollutant load generation and pollutant source controls (PSC), and 3) storm water treatment (SWT). User input is required for each element, and computed pollutant loads represent combined effectiveness of the three elements.

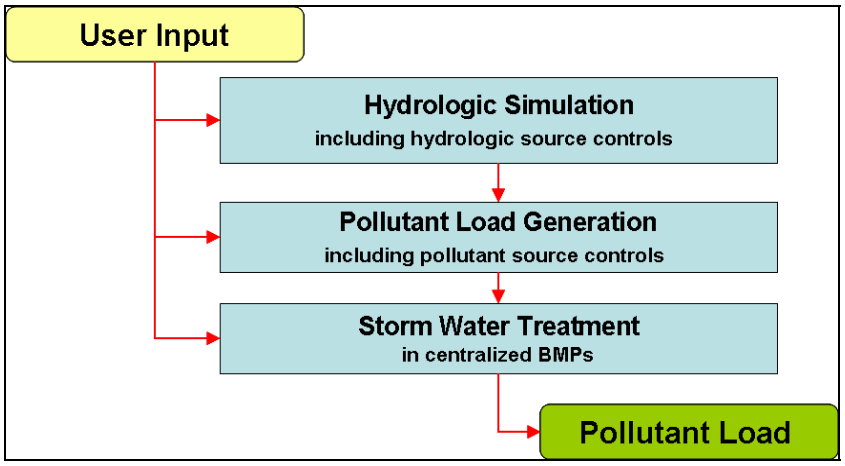

Figure 1 Elements of Pollutant Load Calculation

The definition of each element is as follows:

> Hydrology and Hydrologic Source Controls (HSCs) Hydrology is reported as average annual runoff volumes based on long-term continuous simulations of precipitation and runoff. HSCs reduce runoff volumes and minimize the concentration of storm water runoff through distributed controls that disconnect impervious surfaces and infiltrate runoff. Example HSCs include infiltration trenches and pervious dispersion areas.

Pollutant Generation and Pollutant Source Controls (PSCs) Pollutant generation focuses on estimating the total pollutant load from a catchment based on the land uses within the catchment and the condition of those land uses. PSCs reduce the generation of pollutants of concern at their sources by limiting pollutant accumulation, or reducing mobilization and transport of pollutants. Example PSCs include street sweeping and road shoulder stabilization.

Storm Water Treatment (SWT) SWTs are centralized best management practices (BMPs) that remove pollutants of concern after they have entered concentrated runoff flow paths via infiltration, filtration, or detention/retention based treatment. Example SWTs include wet ponds, dry extended detention basins, infiltration basins, media filters, and hydrodynamic separators.

The PLRM is a publicly available model customized from EPA's Storm Water Management Model version 5 (SWMM5). The PLRM program code augments source code for the SWMM5 graphical user interface (GUI) to include customized input forms that facilitate representation of local storm water management practices. The customized user input forms are backed by a Microsoft Access® database that contains location specific data as well as many of the default parameters necessary for running a continuous SWMM5 simulation. The database significantly reduces the data preparation and data input burden on the user relative to what is typically required to build a runoff quality and treatment simulation model in SWMM5. The database dynamically generates several user interface components and recommended defaults instead of "hard coding" components of the PLRM GUI. This database design provides an application that is simple to use while allowing flexibility for customization through database modifications or additions. The database executes complex queries on certain data sets to support algorithms that are initiated based on user entry in the PLRM GUI. For example, meteorological input parameters that drive runoff (including snowmelt) algorithms are generated by the database based on the project location (800m grid cell resolution).

The PLRM merges user inputs with information supplied by the PLRM database to automatically generate a SWMM5 input file, execute the SWMM5 engine, and summarize results as average annual pollutants loads and runoff volumes for each modeled scenario. Modeled scenarios can include many user specified inputs that affect pollutant load generation and reduction, which can include variations in: land use types and land use conditions, pollutant source controls, hydrologic source controls, and centralized storm water treatment BMPs.

The current version of the PLRM was designed to support storm water quality project alternative analysis of urban pollutant loading to Lake Tahoe. The clarity of Lake Tahoe has declined at a rate of 9 inches per year since the late 1960s. Ultra-fine sediment (<20 µm) and nutrients (phosphorus and nitrogen) that stimulate algae production are the primary stressors causing the clarity decline. The Lake Tahoe TMDL has identified the storm water retrofit of existing development as the key to reducing pollutant loading to Lake Tahoe. With an estimated cost of more than $1.3 billion to complete retrofit of existing development, the PLRM is a key decision support tool that allows Tahoe Basin program managers to cost-effectively maximize pollutant load reductions from their projects. The PLRM setup program, supporting documentation, and source code can be downloaded from www.tiims.org.