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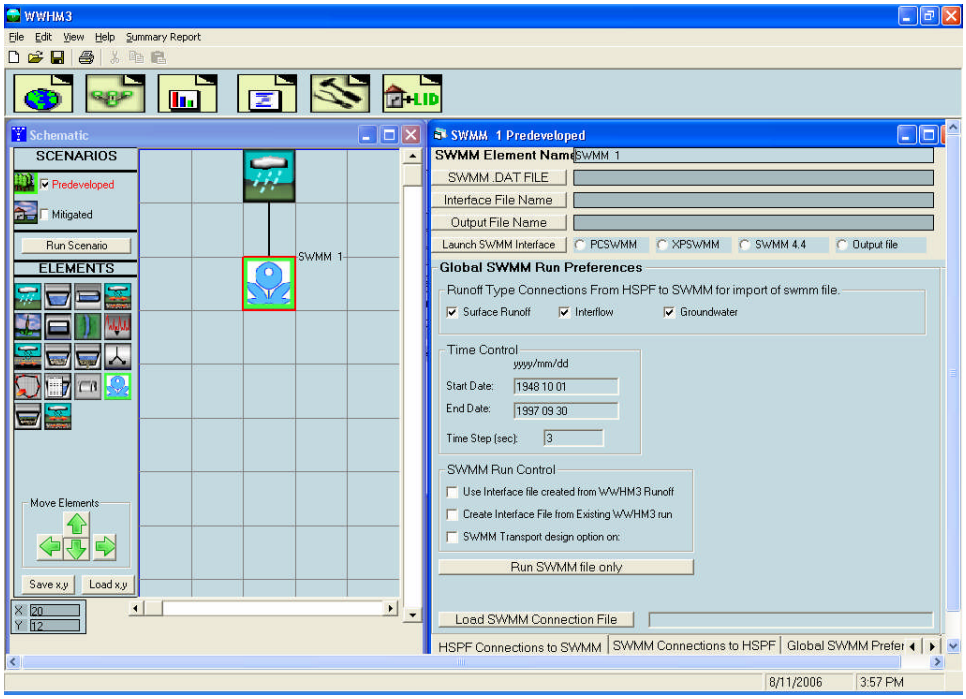
Hydrologic and Hydraulic Modeling of Urban Stormwater Systems

Using WWHM3 SWMM

The hydrologic and hydraulic modeling of urban stormwater systems requires accurate and easy-to-use visually-oriented interactive computational tools. Clear Creek Solutions has taken the most accurate urban hydrologic model (HSPF) and married it with the most accurate urban hydraulics model (SWMM), all within the easy-to-use WWHM3 package.

WWHM3 SWMM produces a seamless (invisible to the user) linkage between the HSPF-generated runoff and the SWMM routing. The SWMM routing is computed continuously at the user-specified time step inside WWHM3. WWHM3 transfers the SWMM-generated routing output to WWHM3 downstream elements and/or the WWHM3 WDM database. This means that the user does not have to run SWMM separately; everything is done inside WWHM3.



The user has the choice of using either EXTRAN or Transport for the SWMM routing.

SWMM input files are created in their native SWMM programs. WWHM3 SWMM reads PCSWMM, XPSWMM, and SWMM 4.4 (or earlier) input files.

GIS land use and stormwater infrastructure data can be directly read to create the HSPF and SWMM input using WWHM3 features and options. Existing SWMM input files can be easily imported into WWHM3 and used “as is”.

WWHM3 is capable of using both historic and synthetic (single event) precipitation data thus providing the ability to analyze a full range of events to determine drainage system performance and evaluate performance target goals.

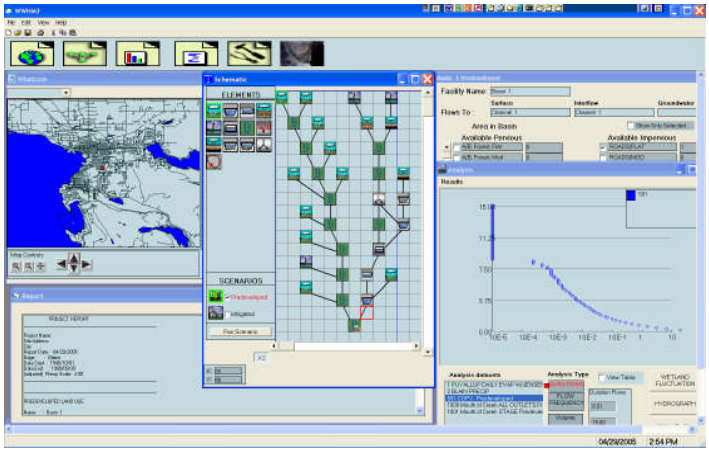
The ability to merge HSPF and SWMM using the WWHM3 allows for the most accurate evaluation of the drainage system using an environment that is very simple and efficient to use.

Example WWHM3 SWMM Project: City of Bellingham, Washington

An example of using WWHM3 SWMM is the modeling of the entire stormwater system for the City of Bellingham, Washington. The City of Bellingham contracted with Clear Creek Solutions to provide hydrologic and hydraulic modeling services to develop a prioritized list of capital improvements related to drainage problems throughout the city.

The stormwater system included the Silver Creek, Squalicum Creek (including Baker Creek), Silver Beach Creek, Whatcom Creek (including Hannah, Fever, Cemetery, and Lincoln creeks), Padden Creek (including Connelly Creek), and Chuckanut Creek watersheds. This is a total drainage area of approximately 41,000 acres (64 square miles).

For each watershed the City of Bellingham GIS provided land use layers that included soils, land use categories, and topography. This information was used to identify and determine the drainage area (acres) for each pervious land type (PERLND) and associated impervious area for each subbasin. The WWHM3 GIS Import feature was used to group the land use data for each subbasin and automatically enter it into the WWHM3 model. GIS conveyance system data were directly imported to the WWHM3 SWMM module for the stormwater model routing. This included approximately 23 linear miles of pipe systems modeled by SWMM.



The SWMM stormwater conveyance system modeling identified capacity limitations and surcharge locations. Problem pipes were resized.

The hydrologic and hydraulic model results for each watershed were summarized together with the proposed capital improvements in a comprehensive stormwater management plan.

Flood frequency and other flow statistics were generated from the WWHM3 results. Capital improvements were included in the models to evaluate their performance prior to determining their recommended priority for implementation.

WWHM3 Modeling Approach Options

There are four WWHM3 modeling approach options that can be used by a city or county to model urban stormwater systems depending on the level of complexity.

1. **Import GIS land use data into WWHM3 and create routing within WWHM3.**

   This approach requires that each culvert be setup using the WWHM3 PRO culvert element and HY8 option within the WWHM3. Land use data will be imported to WWHM3 using the WWHM3 PRO GIS Import feature. There will be no SWMM routing.

   Cost: Purchase WWHM3 PRO GIS at $2,500 per desktop or 6 copies for $10,000.

2. **Import GIS conveyance data into PCSWMM TRANSPORT routing block and link with GIS land use data imported into WWHM3.**

   This approach assumes that the GIS culvert data is complete enough to import into SWMM. Both PCSWMM and the WWHM3 SWMM will be required. CCS assist in data preparation and initial model setup. The level of involvement for CCS will be dependent on the needs of the client. Rates below are for only advisory assistance with model setup.

   Cost: Purchase PCSWMM - $1,000; CCS model assistance setup fee $10,000 and includes 4 free copies of WWHM3 SWMM.

3. **Import GIS conveyance data into PCSWMM TRANSPORT routing block and link with GIS land use data imported into WWHM3 with synthetic storm events added.**

   Same as Approach 2 above plus CCS will also adjust the precipitation time series to include at least one synthetic storm event (for example, 25-year storm).

   Cost: Purchase PCSWMM - $1,000; CCS model assistance setup fee $12,000 and includes 4 free copies of WWHM3 SWMM.

4. **Import GIS conveyance data into PCSWMM TRANSPORT routing block and link with GIS land use data imported into WWHM3 with synthetic storm events added plus project assistance.**

   Same as Approach 3 above plus CCS will also provide additional assistance throughout the project to ensure that model setup and model execution are correct.

   Cost: Purchase PCSWMM - $1,000; CCS model assistance setup fee $12,000; CCS project assistance fee – $10,000; includes 4 free copies of WWHM3 SWMM.

For more information contact Joe Brascher at 360-943-0304.