



# **CHAPTER 12 COMPUTER PROGRAMS**



## Chapter 12 COMPUTER PROGRAMS

### SYNOPSIS

The procedures covered in this manual can, in general, be performed using computer programs. To promote consistency in the analysis and review of projects, general guidance is presented in this chapter for selecting appropriate computer programs dealing with flood hydrology, open channel hydraulics, culverts, storm sewers, detention flood routing, and bridge hydraulics.

#### 12.1 General Guidance

Many hydrologic and hydraulic computer programs have been developed for the analysis and design of stormwater facilities. Each program is generally intended to meet a specific type of application. It is not the intent of MWS to restrict stormwater analysis to a select group of programs, but to encourage engineers to select the computer model best suited to the task at hand. However, if site characteristics and project requirements allow, MWS would prefer the use of the models identified in this chapter, which have proven useful in the Metro area. MWS personnel are familiar with their application and will be better able to review and evaluate plans based on these models.

Computer modeling must not replace engineering judgment and experience in stormwater analysis and design. The theory behind the model must be fully understood by the engineer to produce meaningful results. Modeling parameters must be calibrated or verified by field measurements or other comparisons to give confidence to the results. Accuracy of the results should not be based on the sophistication of the computer model, but on the experience of the modeler and on the correlation of results with observed data.

#### 12.2 Flood Hydrology

MWS has developed flood hydrograph models for selected watersheds in the Metro area using the HEC-1 computer program developed by the U. S. Army Corps of Engineers (1990). Data for these models have been carefully developed and verified using calibration storms and long-term stream gage records. Available basin-specific HEC-HMS (1998) or HEC-1 (predecessor to HEC-HMS) data files can be obtained from MWS on microcomputer diskettes so that an applicant can perform consistent hydrologic analyses in these areas. The existing models should be limited to the analysis of drainage areas of 0.5 square mile or larger.

For drainage areas smaller and more detailed than the original HEC-HMS or HEC-1 setup, a new HEC-HMS or other model may be necessary; however, the results should be consistent with the HEC-HMS or HEC-1 models on file at MWS. Alternatively, the Stormwater Management Model (SWMM) developed by the Environmental Protection Agency (Huber et al, 1992;



Roesner et al, 1994) may be used. The ability to link or incorporate water quality data may warrant the use of this model, particularly in considering water quality impacts of on-site and regional facilities.

If hydrologic models other than HEC-HMS or SWMM are used, MWS prefers programs that utilize NRCS (formerly SCS) rainfall-runoff procedures and unit hydrograph theory to develop flood hydrographs. Methods of analysis and results should be consistent with previous studies wherever possible.

### **12.3 Open Channel Hydraulics**

MWS has developed water surface profile models of many streams throughout the Metro area using the HEC-RAS and HEC-2 computer program developed by the U.S. Army Corps of Engineers (1998 and 1982). Data for these models have been carefully developed and verified where historic information was available. Available site-specific HEC-RAS and HEC-2 data files can be obtained from MWS on microcomputer diskettes to facilitate consistency when changes are proposed for these areas. Alternatively, the Stormwater Management Model (SWMM) developed by the Environmental Protection Agency (Huber et al, 1992; Roesner et al, 1994) may be used. New HEC-RAS or SWMM data files should be developed using field-surveyed data consistent with the requirements of Chapter 11, Section 11.5.3.

### **12.4 Culverts**

The FHWA microcomputer program HY8 is useful in hydraulic analysis of culverts. This computer program is based on HDS-5 (USDOT, FHWA, 1985) and can perform reservoir routing in addition to evaluating culvert hydraulics. The program is primarily analysis oriented, but may be revised to provide design capabilities.

### **12.5 Storm Sewers**

Many flood hydrology models do not have the capability to handle pressure flow in storm sewers. The EXTRAN block of the U. S. Environmental Protection Agency (EPA) Stormwater Management Model (SWMM) has this capability and is recommended for evaluating pressure flow in closed conduits. Flood hydrographs can be generated using the RUNOFF block of SWMM or can be computed externally and input as data files for use by EXTRAN.

### **12.6 Detention Flood Routing**

Most hydrologic models, including HEC-HMS, are capable of performing flood routing through detention ponds. For watersheds covered in the master plans appended to this manual, the HEC-HMS data files should be obtained from MWS to evaluate flood detention requirements for a project (note that subbasin areas for these data files are greater than 0.5 square mile). When using models other than HEC-HMS to generate flood hydrographs for areas studied previously,



consistent methods of analysis and results should be achieved.

### **12.7 Bridge Hydraulics**

The preferred computer program for bridge hydraulic analysis are the HEC-RAS or SWMM models.

### **12.8 Water Quality**

There are a wide variety of software packages that are designed to model stormwater quantity and/or quality. Some models are intended for very detailed, data intensive analysis of water quality. While most applications of water quality management practices will not require modeling and can be designed with criteria established in Volume 4, there may be large systems requiring modeling. The preferred water quality model is the Watershed Management Model 4.15 or later developed for the Rouge River National Wet Weather Demonstration Project (2000) applying principals discussed in the users manual (1998) to comparatively determine the optimal location of various management practices. This model is available at: <http://www.waynecounty.com/rougeriver/proddata/wmm.html>. With permission from MWS, other models discussed in "Compendium of Tools for Watershed Assessment and TMDL Development" (1997) may be used to perform water quality analyses.