Unit: Urban Storm Hydrograph Modeling with the Rational Method for the Urban Desert Southwest USA

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Benjamin L. Ruddell, Arizona State University, Mesa, AZ, USA
Roy Schiesser, Chandler-Gilbert Community College, Gilbert, AZ, USA

Abstract

This unit applies a spreadsheet based stormwater hydrograph modeling module applies the widely utilized Rational Method to estimate hydrographs and flooding for urban watersheds. The specific structure of the model is based on assumptions encoded for Maricopa County, Arizona, which is an urbanized area in the Desert Southwest of the USA, so the model is directly applicable to any similar climate. The model is broadly applicable to urban watersheds anywhere in the world, if appropriate adjustments are made to model parameters and if the necessary input data can be obtained. This model is designed to be utilized in parallel with a modeling guide by the same authors, and alongside conceptual instruction in the hydrological concepts of rainfall and runoff processes in the undergraduate classroom. Hydrology and/or computational learning outcomes are assessed using a validated pre/post assessment instrument included with the unit.

Educational Level(s)

This unit is intended for undergraduate students in hydrology, including lower-division geoscience hydrology students and non-Engineering hydrology students.

Unit Document(s) and Files

- Lesson: Developing a Rational Method Hydrograph Model
- Lesson: Calibrating a Rational Method Hydrograph Model
- Assessment Rubric for Lesson: Developing a Rational Method Hydrograph Model
- Assessment Rubric for Lesson: Calibrating a Rational Method Hydrograph Model
- Pre/Post Assessment on Hydrology Concepts
- Rubric for Pre/Post Assessment on Hydrology Concepts
- Concepts Guide for the Unit
- Schiesser's River Flooding Lab Manual Chapter 9 (©2011 Kendall Hunt Publishing Company)
- This Unit overview document

Hydrology Learning Outcomes

- Students demonstrate understanding of the physical causes of flood frequency and intensity, especially the roles of land use and climate.
- Students can identify the roles and responsibilities of U.S. Federal hydrology and flood management organizations.
- Students demonstrate increased perception of the value of geoscience and hydrology education and information.
- Students demonstrate understanding of the utility of mathematical geoscience models, especially for prediction and risk management.

Computing, Data, and Modeling Learning Outcomes

- MS Excel and spreadsheet-based calculation and visualization of a simple model
- Use of published charts, figures, and tables to obtain design rainfall intensities and frequencies for an urban area
- Manual calibration of a simple model to produce results that match observations for an example
- Prediction and estimation of the effects of varying a key model parameter on model results

Hydrology Concepts

1. Surface Runoff
    a. Drainage Basins and Storm Hydrographs
    b. Rainfall-Runoff
    c. Rational Method for Modeling Floods in Small Watersheds
    d. Runoff Coefficients and Land Use
2. Probability and Risk
    a. Hydrologic Frequency and Flood Frequency
    b. Effects of land use change on Flood Frequency and Intensity
    c. Effects of climate change on Flood Frequency and Intensity
3. Flood Control and Flood Management
4. Open Channel Flow