

PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT TECHNICAL POLICY

POLICY NAME: Standards for Floodplain Hydraulic Modeling

POLICY NUMBER: Technical Policy, TECH-019

EFFECTIVE DATE: November 19, 2012

PURPOSE:

To provide guidance and standards regarding floodplain hydraulic modeling with the intent of improving the consistency of modeling results which predict water surface elevations and floodplain limits for watercourses defined as regulatory by the Pima County Floodplain Management Ordinance.

BACKGROUND:

The Pima County Regional Flood Control District (District) endeavors to assure that new development is not subject to risks due to flooding or erosion hazards through enforcement of the criteria established by the Federal Emergency Management Agency (FEMA) National Flood Insurance Program, the Arizona Department of Water Resources and the Pima County Floodplain Management Ordinance. The primary elements that are assessed when determining flood and erosion hazard risk are the water surface elevation and floodplain and floodway limits of a watercourse for given flow events. These assessment elements are predicted from mathematical modeling of hydraulic processes. The water surface elevation and floodplain limits obtained by modeling are reasonable predictors of actual processes only with the best possible application of hydraulic models. By setting certain standards of practice, the District can obtain modeling results which are consistent with high standards of engineering practice.

Technical Policy TECH-016 identifies computational models which are acceptable to the District for use when preparing reports for floodplain use permitting, for development proposals, for basin studies and for FEMA Letters of Map Revision.

This technical policy identifies standards and resources which are considered acceptable inputs to floodplain hydraulic models.

POLICY:

In order to establish consistency between floodplain hydraulic models performed by different individuals and organizations within unincorporated Pima County, the following standards and resources shall be used to determine water surface elevations and floodplain limits for constructed channels, for natural riverine watercourses, for distributary flow channels and for sheet flooding areas.

A. **One-Dimensional Modeling or Two-Dimensional Modeling:** For constructed channels and riverine watercourses, a one-dimensional model is preferred by the District. For distributary channels and sheet flooding areas, two-dimensional modeling or depth approximations may be necessary.

1. ***One-dimensional modeling*** shall incorporate the guidance of State Standard 9-02, "Floodplain Hydraulic Modeling" and the Hydrologic Engineering Center River Analysis System (HEC-RAS) User's Manual, Hydraulic Reference Manual and Applications Guide for the following modeling inputs including but not limited to:

- i. Flow condition classification
- ii. Boundary conditions
- iii. Cross-section placement, orientation and detail
- iv. Channel bank location
- v. Encroachments, obstructions and ineffective flow areas and associated contraction/expansion coefficients
- vi. Hydraulic structures
 1. Hydraulic structures shall be included in HEC-RAS modeling for multiple cross-section backwater modeling, unless prior approval to use a separate analysis has been obtained from the District.
 2. To account for debris loading on piers, the following guidelines are to be used to increase pier widths unless otherwise demonstrated thorough acceptable engineering analysis.
 - a. For bridge piers less than 4 feet wide, the bridge pier width is to be doubled in width or increased to a width of 4 feet, whichever is greater.
 - b. For bridge piers 4 feet wide or wider, 4 feet is to be added to the pier to reflect debris loading.
 - c. The increase in width is to be equally added to both sides of the pier.
 - d. An evaluation of the watershed and relevant river reach shall be performed to assess the possibility of bridge pier debris loading in excess of the standard above.
- vii. Inflows and outflows
- viii. Pits in the floodplain
- ix. Floodway modeling

2. ***Two-dimensional modeling*** shall be approved on a case-by-case basis and shall follow the guidelines provided in appropriate user manuals or technical references for the model used. Guidance for two-dimensional modeling will be released by the District separately and will supersede this sub-part.

B. **Manning's Roughness Coefficient:**

1. ***Selection of roughness coefficient:*** Roughness coefficients may be chosen or scored using the following references. The chosen reference shall be cited in the drainage report submitted.

- i. Most current HEC-RAS Hydraulic Reference Manual. *HEC-RAS, River Analysis System, Hydraulic Reference Manual*, CPD-69, Hydraulic Engineering Center, Davis, CA.
- ii. Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona, Jeff V. Phillips and Saeid Tadayon, Scientific Investigations Report 2006-5108, U.S. Department of the Interior, U.S. Geological Survey.
- iii. Verification of Roughness Coefficients for Selected Natural and Constructed Stream Channels in Arizona, Jeff V. Phillips and Todd L. Ingersoll, U.S. Geological Survey Professional Paper 1584, 1998.
- iv. Roughness Coefficients for Stream Channels in Arizona, B. N. Aldridge and J.M. Garrett, Open-file Report, U.S. Geological Survey, 1973.

2. ***Roughness subdivision criteria for one-dimensional models:*** Where the roughness coefficient varies horizontally across the channel, the guidance in "Selection of Manning's Roughness Coefficient for Natural and Constructed Vegetated and Non-Vegetated Channels, and Vegetation Maintenance Plan Guidelines for Vegetated Channels in Central Arizona," Phillips and Tadayon, shall be used.

3. ***Roughness coefficient for two-dimensional models:*** Shall follow guidelines provided in appropriate user manuals or technical references for the model used. Guidance for two-dimensional modeling will be released by the District separately and will supersede this sub-part.

C. **Map Submittal Requirements to FEMA:** When submitting hydraulic models to FEMA as part of a Conditional Letter of Map Revision, or a Letter of Map Revision, additional modeling requirements may be required. All floodplain modeling and mapping information submitted to FEMA must follow FEMA's "Guidelines and Specifications for Flood Hazard Mapping Partners".

REFERENCES

Aldridge, B. and J. Garrett. 1973. Roughness Coefficients for Stream Channels in Arizona. US Department of the Interior Geological Survey. Tucson, AZ.

State Standard 9-02, 2002. "Floodplain Hydraulic Modeling" Arizona Department of Water Resources Dam Safety Section.

http://www.azdot.gov/Highways/Roadway_Engineering/Drainage_Design/PDF/StateStandardForFloodplainHydraulicModeling.pdf

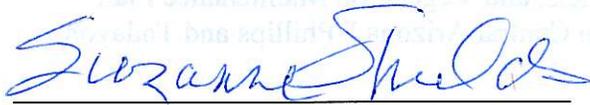
Phillips, J., and S. Tadayon. 2006. Selection of Manning's roughness coefficient for natural and constructed vegetated and non-vegetated channels, and vegetation maintenance plan guidelines for vegetated channels in central Arizona: U.S. Geological Survey Scientific Investigations Report 2006-5108, 41 p.

Phillips, J., and T. Ingersoll. 1998. Verification of Roughness Coefficients for Selected Natural and Constructed Stream Channels in Arizona. U.S. Geological Survey Professional Paper 1584.

US Army Corps of Engineers. 2008. HEC-RAS Hydraulic Reference Manual. *HEC-RAS, River Analysis System, Hydraulic Reference Manual*, CPD-69 V 4.0, Hydraulic Engineering Center, Davis, CA.,

http://www.hec.usace.army.mil/software/hecras/documents/HEC-RAS_4.0_Reference_Manual.pdf

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Date