Recommendation for:
Routing Steps with HEC-HMS
(Revised 02/14/2002)

Goal: To provide a consistent method for determining the number of steps to be used in reach routing using the Modified Puls method.

Recommended Procedure: The number of routing steps used to simulate the travel time from the upstream end of the routing reach to the downstream end of the same routing reach is an important factor and should be averaged from several stream profile calculations. The number of routing steps is input onto the Modified Puls routing method in HEC-HMS in the cell denoted "Number of Subreaches." The number of routing steps can be estimated by dividing the travel time through the reach (reach length divided by the average velocity) by the HEC-HMS computation interval. [Please note that if the computational time interval is modified, the number of routing steps should also be adjusted.] The velocity used for this computation is the velocity of the flood wave in the stream channel. This is different from the channel flow velocity. In fact, the flood wave velocity in a stream channel is generally 1.3 to 1.7 times faster than the average flow velocity.[1] Therefore, the flood-wave travel time can be estimated by multiplying the average flow velocity (computed dividing the length of the reach by the HEC-RAS output variable "Trvl Tme Avg") by a factor of about 1.5.

Assumptions: The use of the factor of 1.5 assumes that most channels in Harris County (including those which have been modified) continue to operate similar to natural channels. The types of channels which cover the 1.3 to 1.7 range include wide rectangular channels at 1.67, wide parabolic channels at 1.44, and triangular channels at 1.33. From these shapes and knowledge of Harris County flood plains, it would seem adequate to use a factor of 1.5 for Harris County stream systems.

Testing Procedure: No testing performed.

Test Results: No testing performed.

Final Notes: If the average velocity in the reach is found to be less than 1.0 feet per second, it may be reasonable to assume that the reach is functioning as a linear reservoir. Therefore, instead of a high number of routing steps produced by the low velocity, the number of routing steps should be set to one (i.e., reservoir).

Committee Resolution: Determine the need to make adjustments to standard approach on a case-by-case basis. The following questions can be used to determine whether and how adjustments should be made:

- Is the reach extremely long? If so, perhaps it should be broken into shorter reaches.
- Is the average velocity across the cross sections through the reach less than 1.0 fps? If so, it may be reasonable to assume that the reach is acting as linear detention and the number of steps could be reduced to one.
- Is the average energy slope through the reach less than 0.00005 ft/ft (0.005%)? If so, it may be reasonable to assume that the reach is acting as linear detention and the number of steps could be reduced to one.

[1] U.S. Army Corps of Engineers, *Routing of Floods Through River Channels*, USACE EM 1110-2-1408, March 1960.