US Army Corps of Engineers®
Engineer Research and Development Center

National Regional Sediment Management Program
Kansas City District (NWK):
Improving Floodplain Sedimentation Analysis

Description

One-Dimensional (1D) morphodynamic models tend to overpredict floodplain deposition. Both 1D and2D models simplify vertical concentration gradients, and most 1D models apply deposition uniformly across the cross section. In actual rivers, only the finer materials can deposit on the floodplain and deposition is concentrated in a narrow zone close to the channel. This work unit introduces a quasi-2D (vertical) Rouse algorithm that limits the floodplain deposition and a floodplain deposition algorithm that distributes floodplain deposits laterally.

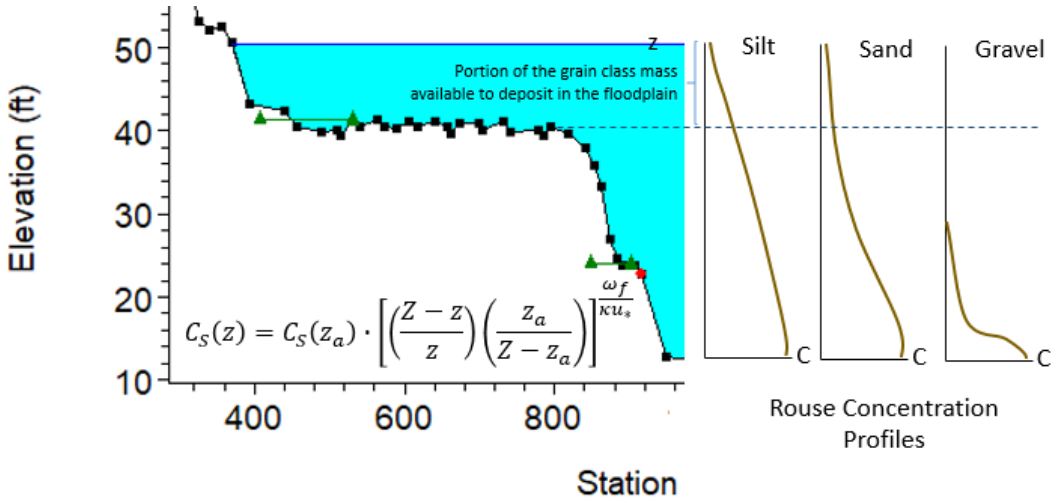

Figure 1. Computing possible 1D Floodplain deposition with a Rouse Distribution

Issue/Challenge To Address

Since the early 1990's the Missouri River has flooded several times. Each of these floods has deposited tens-of-millions of tons of sediment on the floodplain. Sediment deposited on the floodplain leads to sediment-starved water in the channel, which can lead to bed degradation and associated damage to the federal navigation project (Gibson and Shelley, 2020). NWK has modeled the 1993 and 2011 floods successfully with HEC-RAS by specifying mass lost to floodplain deposition. But this approach required independent estimates of floodplain deposition, which are very difficult to project for future synthetic events, and are often are not even available for historic events. The standard veneer methods in HEC-RAS, moreover, dramatically over-predict floodplain deposition, because they deposit all grain classes across the entire floodplain, which can be miles wide. These models would be more robust, accurate, and faster to develop if the 1D model included some slightly more sophisticated floodplain deposition algorithms.

Successes Lessons Learned

This is a new work unit. But, to date, we have developed several algorithms to test and have applied a "linear decay" floodplain deposition model in HEC-RAS. We have developed a 1D HEC-RAS model of a laboratory floodplain deposition experiment and are running that experiment with this new, lateral deposition method that already better represents the actual deposition.

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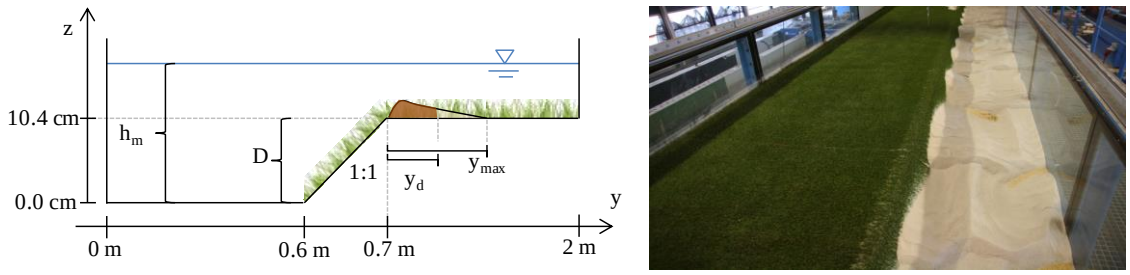

Figure 2. Floodplain Deposition Flume Experiments

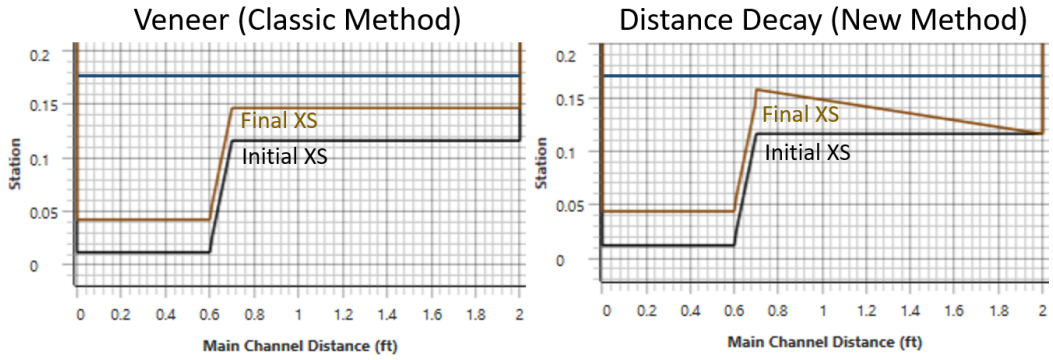

Figure 3. Initial HEC-RAS Simulations of Floodplain Experiments with First New Approach.

Projected Benefits Cost Savings Value Added

This work will improve floodplain sediment management analyses which will inform project design on multiple, high value, flood risk management and ecosystem projects including the Missouri River, Kansas River, and Grand River. This work also provides a stepping stone to improved sediment transport modeling over lateral weirs and through reservoir hydraulic structures

Expected Products

- New Rouse-Limited, (quasi-2D) Floodplain-Deposition Algorithm in HEC-RAS 6.1.
- New Distance-Decay Floodplain Deposition Algorithms in HEC-RAS 6.1.
- Validation and Verification HEC-RAS Model of the Flume Pictured Above
- Updated Training Documentation
- Training Web Video and Sediment Floodplain Modeling Master Class (at the IPR)
- Tech Note on New Algorithms

Stakeholders/Users

The RSM team is coordinating with several District partners who are interested in this feature, including districts with predominately gravel and cobble streams to supplement the NWK perspective on large sand-bed rivers. NWK will also present the results to the Missouri River Natural Resources Conference or other Missouri River meeting with interested stakeholders and HEC will collaborate with the California Department of Water Resources who is interested in this feature.

Leveraging Opportunities

This work leverages ongoing Missouri River modeling studies and continued HEC-RAS sediment development.

Points of Contact

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