US Army Corps of Engineers
Engineer Research and Development Center

National Regional Sediment Management Program Philadelphia District (NAP):

Bloomsbury Dam Removal: Removing Systemic Bias from Dam Removal Evaluations

Description

Current "Active Layer" sediment modeling approaches include a numerical artifact that leads to conservative management decisions. NAP will monitor the Bloomsbury dam removal, use the data to evaluate their model, and improve the modeling tools.

Figure 1. Bloomsbury Dam Site Location

Issue/Challenge To Address

NAP plans to remove the Bloomsbury Dam, on the Musconetcong River, New Jersey this FY. A sediment transport model using HEC-RAS was developed to predict downstream deposition and impacts to flood risk. Some versions of the model predicted several feet of deposition downstream that increased flood risk and persisted for years after the removal. These simulations led NAP to pursue a more conservative and costly "staged removal" approach, in which the dam is removed in phases with multiple mobilizations, added cost.

Given the uncertainty surrounding the analysis and the equivocal model results, selecting the more conservative staged removal alterative was prudent - however, there is reason to doubt some of the model predictions. Many moderate size dam removals, including larger removals with substantial gravel and cobble loads, erode through their downstream deposits within a year (e.g. Constain, Big Rapids). The repeated cross sections from the Big Rapids dam removal in central Michigan, and others, suggest that a dam like Bloomsbury should erode the downstream deposits in less than a year, with no persistent elevated flood risk.

Over-predicting the depth and duration of downstream deposits is a systemic bias of active layer sediment transport models downstream of dam removals, particularly in coarse sediment. Active layer models mix sediment at each computational node in a computational layer close to the surface. This is the standard approach to mobile bed modeling and provides many computational advantages - however, dam removals demonstrate an unintended consequence. Mixing the fine reservoir sediment with the pre-removal downstream bed, artificially mixes the coarse bed material into the dam deposits.

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When the deposits erode, those bed particles form an armor layer above the former bed elevation, causing persistent bed change in simulations. As such, some dam removal models can over predict the persistence of downstream deposition because of this numerical artifact of active layer transport methods.

In this study, NAP and HEC will monitor the dam removal, collecting repeated cross sections downstream of the dam to verify if the dam removal causes persistent deposition or if it quickly returns to the original bed elevation. The study team will revisit the model, and develop a model of a similar dam removal in Big Rapids, MI, to evaluate the model results. Finally, the study team will augment the active layer methods or develop a new method that avoids the systemic bias.

Successes Lessons Learned

Lessons learned will be compiled throughout the duration of the project.

Projected Benefits Cost Savings Value Added

Updating the model to avoid downstream deposition biases and formalizing lessons learned from USACE dam removal experiences will help other districts evaluate dam removal impacts effectively and remove obsolete and/or unsafe structures more efficiently. Additionally, these tools will also be useful for reservoir flushing analyses which also send fine pulses downstream and can encounter these biases.

Expected Products

- Enhancement of HEC-RAS sediment transport functionality for dam removal applications
- RSM Technical Note
- SEDHYD 2019 Conference proceedings

Stakeholders/Users

The project will engage the Musconetcong Watershed Association, which has actively monitored dam removals in the region, and specifically on this river, to monitor TSS during the removal. Users include other USACE Districts, as well as any outside users (e.g. other Federal agencies, consultants, etc.), engaged in dam removal assessment, using HEC-RAS sediment transport functions.

Leveraging Opportunities

This proposal will leverage project funds that will provide for downstream monitoring, which is sufficient for adaptive management decisions, but not to evaluate and update the modeling tools. It also leverages Flood and Coastal R&D which is funding HEC-RAS sediment development.

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Participating Partners

Musconetcong Watershed Association
NJDEP, Office of Natural Resource Restoration