DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Design

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Project Title:
Gravel-Bed River Assessment Tool for Improved Resiliency of Engineering Design

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Gravel-Bed River Assessment Tool for Improved Resiliency of Engineering Design

Widely available methods for assessing channel dynamics and hazards are based on sand-bed rivers, like the Mississippi River, that do not apply to gravel-bed rivers found throughout the United States. This study will determine the gravel-bed river assessment tool that accounts for changes in gravel-bed rivers from glacial melt and extreme flooding associated with projected future climate change.

WHAT IS THE NEED?

The world's rivers and streams are adjusting to changes in climate. In Washington State, stream channels are becoming more dynamic – especially in the vicinity of gravel-bed rivers. Federal, state, tribal, and private roads are increasingly compromised or destroyed due to progressively more dynamic channel processes.

A river's bedload (sediment transported along the channel bed) drives how rivers move into or away from road infrastructure. In order to design durable roads and bridges, California Department of Transportation (Caltrans) needs high quality information on how the natural material in the river system will move and deposit in the vicinity of road infrastructure.

Widely available methods for assessing channel dynamics and hazards are based on sand-bed rivers, like the Mississippi River, that do not apply to gravel-bed rivers found throughout the United States. Caltrans need a gravel-bed river assessment tool that accounts for changes in gravel-bed rivers from glacial melt and extreme flooding associated with projected future climate change.

Caltrans

DRISI provides solutions and knowledge that improves California's transportation system

In this pilot, Washington State Department of Transportation (WSDOT) proposes to develop practical guidance and methods for assessing bedload transport in gravel-bed rivers for more resilient road infrastructure. This guidance will inform engineering design, hazard assessment, and maintenance strategies of roads along or near gravel-bed rivers.

Other federal and state agencies support the pilot and are willing to assist in the development and review process. WSDOT anticipates that US Forest Service, US Fish and Wildlife Service, Oregon DOT, Caltrans and other public works agencies will use the gravel-bed assessment tool developed by this pilot project.

WHAT ARE WE DOING?

WSDOT will test the sediment transport modeling capabilities of the Sedimentation and River Hydraulics Two-Dimensional model (SRH-2D), now the preferred hydraulic modeling software by Federal Highway Administration (FHWA), and compare the results obtained from current FHWA Guidance Hydraulic Engineering Circular (HEC-)18. The pilot study will also consider future extreme weather conditions using the methods described in HEC-17.

The pilot will closely examine the state-of-art technology for collecting direct and indirect measurements of bedload (e.g., passive and active hydroacoustic, Acoustic Doppler Profiler, Apparent Bedload Velocity, photosieving, accelerometers, Passive Integrated Transponder tags, remote sensing, and geographic information system).

WSDOT's hydraulics staff have experienced many challenges in collecting physical bedload samples: it is often dangerous and untenable. Advancements in data collection techniques offer opportunities for indirect measurement of bedload while ensuring safety of DOT staff and contractors. These data could greatly improve the calibration – and therefore the results – of sediment transport models within acceptable limits of accuracy

Physical sampling of bedload (for calibrating sediment transport models) will be compared to data obtained from modern tools in data collection in three case studies. The outcomes will be applied towards guidance development. The goal is to identify data collection techniques that refine inputs into sediment transport models within acceptable limits of accuracy when field-based site calibration is unsafe or untenable.

WHAT IS OUR GOAL?

The goal is to identify data collection techniques that refine inputs into sediment transport models within acceptable limits of accuracy when field-based site calibration is unsafe or untenable.

WHAT IS THE BENEFIT?

The pilot will conduct three case studies in order to develop the guidance and test methods with a focus on:

- Stream Simulation culvert design for fish passage and geomorphic stability, particularly in dynamic settings such as alluvial fans and transitions of channel slope or confinement.
- Design criteria for bridge and roadway projects at risk from channel migration and spatially-extensive bed scour or gravel accumulation.
- Design of bank stabilization projects in a manner that maintains integrity of habitat and adjacent streambanks.

The key benefits are:

- Maintenance strategies for DOT infrastructure in rivers and streams, such as reconfiguring culverts on small creeks to prevent blockage from heavy aggradation that requires annual dredging.
- Advancements in data collection techniques offer opportunities for indirect measurement of bedload while ensuring safety of DOT staff and contractors.

- Following the completion of the three case studies, WSDOT will prepare the guidance document. The final product of the pilot study will be the publication of WSDOT's guidance and methods. These will be applicable to state DOTs and other highway asset managers across the nation wherever gravel-bed rivers are found.

WHAT IS THE PROGRESS TO DATE?

Case study development has begun with the Methow River and Glacier Creek sites. A SRH2D model is under development for the Methow River. The United States Geological Survey(USGS) is scheduled to review results of their topographic analyses for the Methow River and Glacier Creek in May. The USGS was on standby for bedload sampling of the Upper Skagit River over the winter. However, low rainfall in the fall set up conditions for minimal flow releases from Ross Dam in the upper watershed. Flows did not reach the minimum for bedload sampling over the winter due to dam management. Seattle City Light has confirmed that elevated releases during spring runoff are very unlikely.

Additional information can be found at:
https://www.pooledfund.org/Details/Study/638