

## River Spanning Structures Research: FY07 Third Quarter Activities

Chris Holmquist-Johnson and Kent Collins

### Field Analysis – Evaluation of field performance

- Qualitative field evaluations identified several failure mechanisms: scour and slumping, flanking, loss of pool depth, and incipient motion. Quantitative analysis is currently underway to examine relationships between reach characteristics, structure geometry, and failure mechanisms.
- Field measurements are being used to validate laboratory and numerical investigations.

### Alphabet Weir Physical Model Testing – Rock weir scour hole development

- Physical model testing of U-, A-, and W-weirs for the small bed material (prototype  $d_{50}=22.63\text{mm}$ ) has been completed. Flume construction for U-, A-, and W-weirs for the large bed material (prototype  $d_{50}=90.51\text{mm}$ ) is underway and testing is expected to begin in July.
- Laboratory physical modeling confirmed observed failure mechanisms and found scour depths exceed existing predictive equations while matching erosion and flow patterns seen in the field.
- Analysis of laboratory data is being used to develop scour prediction methods and rating curves.

### Interstitial Flow Physical Model Testing – Flow loss through steep rock ramps

- Flume construction for the evaluation of interstitial flow on steep rock ramps has been completed. The flume is currently configured to test a 5% bed slope with a  $d_{50}$  between 8 and 24 in. and uniformity coefficient of 1.65.
- Initial evaluation of physical testing methods and measurement techniques is complete.
- Physical modeling of the effects of changes in ramp gradation, slope, and choking techniques on interstitial flow through steep rock ramps is underway.

### Numerical Modeling – Rock weir flow patterns and scour

- Numerical modeling confirmed both field observations and lab results by quantifying high shear zones near field and lab scour areas and low shear zones near field and lab depositional areas.
- Computer simulations are currently being conducted to extend the range of applicability of the field and laboratory data.

### Future Tasks and Funding

Additional numerical modeling, analysis and synthesis of the results, and preparation of the final design guidelines will need to be completed after laboratory testing concludes. The current schedule for laboratory testing shows that the testing will be completed in December 2007 for the alphabet weirs and February 2008 for the interstitial flow model. The laboratory testing, numerical modeling, and analysis and synthesis of data conducted during FY07 is scheduled to continue in FY08, with the final design guidelines being completed in FY08. Analysis and development of the final design guidelines in FY08 is expected to cost \$400,000, with the PN Region proposed amount being \$150,000.

| Funding Source:         | FY07             | FY08             | Source Total     |
|-------------------------|------------------|------------------|------------------|
| Science and Technology  | \$156,000        | \$120,000        | <b>\$276,000</b> |
| PN Region               | \$192,000        | \$150,000        | <b>\$342,000</b> |
| Other                   | \$52,000         | \$55,000         | <b>\$107,000</b> |
| COE                     | \$55,000         | ?                | <b>\$55,000</b>  |
| Snake River Area Office |                  | ?                | ?                |
| In-kind Services        | \$65,000         | \$75,000         | <b>\$140,000</b> |
| <b>Totals</b>           | <b>\$520,000</b> | <b>\$400,000</b> | <b>\$920,000</b> |

Additional information pertaining to the river spanning structures research project can be found on the Reclamation website:

<http://www.usbr.gov/pmts/sediment/kb/restructs>

## Field Analysis – evaluation of field performance



A-weir with throat buried by sediment



Redirection of flow at bankfull Q (U-weir)



Displacement of Header rocks along arm

## Alphabet Weir Physical Model Testing – scour hole development



U-weir generated 2 defined scour hole locations



A-weir max scour located near cross-bar tie-in



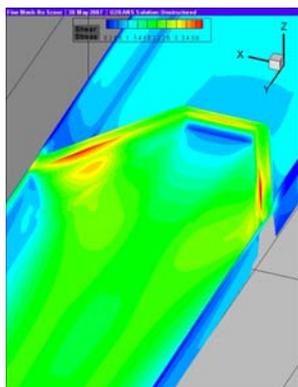
W-weir max scour located at US crest pts

## Interstitial Flow Physical Model Testing –

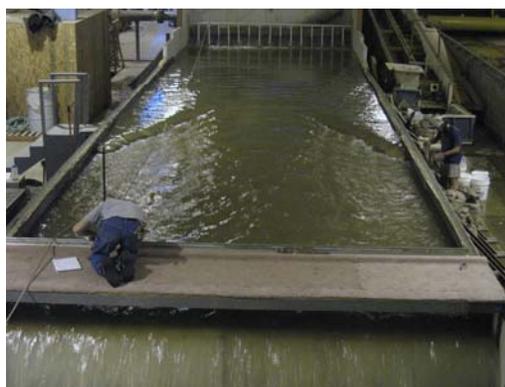


Rock ramp physical model: 5% slope,  $d_{50}=8-24"$ ,  $C_u=1.65$

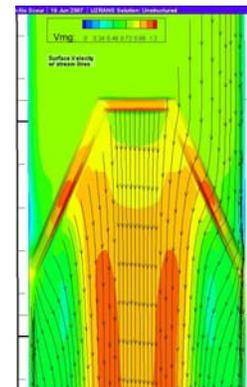
## Numerical Modeling – flow patterns and scour



U-weir bed shear stress distribution at  $Q_{bkfull}$



Lab U-weir at  $Q_{bkfull}$



U-weir surface velocity and stream lines at  $Q_{bkfull}$