Using HEC-RAS to Project Effects of Increased Flooding with the Placement of Large Woody Debris

Jeff Burkey - King County DNRP

Project Team: Dan Eastman, Doug Chin, John Bethel, Meredith Radella
(May 2008)
Increasing Roughness Suggests Flows may seek alternative paths?

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(May 2008)
Effects to stream flooding with the introduction of solid phase matter in large quantities of CHO?
A Method Used to Evaluate Potential Effects on Flooding with the Placement of Large Woody Material

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Project Team: Dan Eastman, Doug Chin, John Bethel, Meredith Radella, Jeff Burkey
(May 2008)
Tributaries in basin with project
Add complexity and you might get this
Examples of complexity
Site Location
Site Conditions

- 26 Square Miles
- Land Use –
  - Agricultural
  - Residential
  - Forest Management
  - Commercial
Relevant Site Conditions

- Subbasin Flow Rates
- River Stage Conditions
- Topography
- Expected flow paths
Translate to Model Setup

• Boundary Conditions
• Landscape roughness
• Channel Geometry
• Overland Geometry
Upstream Boundary Conditions

Newaukum Creek Peak Annual Flow Frequency
USGS 12108500
(Water Year 1945 - 2006)

Return Period (years)
1 10 100

Peak Annual Flow Rate (cfs)
0 500 1000 1500 2000 2500 3000

Observed (Gringerton PP) 17B
Upper/Lower CI

2600 cfs

Does this flow create a steady-state condition?
Upstream Boundary Conditions

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17B
Upper/Lower CI

2600 cfs

Newaukum Creek February 1996 Storm Event
Assumed Steady state

Hourly Mean Flow Rate (cfs)
0 500 1000 1500 2000 2500 3000

Time (hourly increments)
24 25 26 27 28 29 30 31 1/1 1/2 1/3 1/4 1/5 1/6

Does this flow create a steady-state condition?
Not likely…
Upstream Boundary Conditions

Newaukum Creek Peak Annual Flow Frequency
USGS 12108500
(Water Year 1945 - 2006)

- Observed (Gringerton PP)
- 17B
- Upper/Lower CI

2600 cfs

Newaukum Creek February 1996 Storm Event
(USGS 12108500)

- Hourly Mean Flow Rate (cfs)

20 hrs & 50 hrs
Upstream Boundary Conditions

Not likely...

2600 cfs
Downstream Boundary Conditions
Estimates of Over Bank Roughness

**Newaukum Over bank area**

USGS $n = 0.10$

(n = 0.10)
Model Geometry

- Existing LiDAR
- Conducted Survey
- Composite (LiDAR + Survey) TIN
Expected Flow Paths

- Main Channel
- Over bank paths
However...
LiDAR shows a Historical Delta
Existing Conditions Model Design

- Cross-section alignment
- Divide not absolute
- Flows Exchange between reaches at higher flood flow rates
- Low point in divide shown with red arrow
Numerical Representation of Placed Large Woody Material

- Concept Abstracted from Tim Abby
- Multiple vertical obstructions allows flow around, and over
- Modified to assume 10-percent porosity
- Paired Cross-sections with obstructions.
An example of Placements of Large Woody Material
Design of models are dependant on the questions asked

- Is there an increase in over bank flooding in the pasture area as a result of the proposed LWM?
- With the landscape berm in place, what is the expected 100-year water surface elevation of the impoundment area?
- At what frequency is the over bank flooding expected to occur in the proposed impoundment area?
- What are the projected benefits gained from this project design with respect to flooding extents?
Design Methods for Simulating Flow Exchanges

Existing Conditions

Landscape Berm: Full Containment
Design Methods for Simulating Flow Exchanges

Landscape Berm:
Short Loop Reach

Landscape Berm:
Extend Cross-sections
Projection of Flooding

Results attempt to answer the following questions:

• Where will flooding occur?
• At what flow rates will flooding occur?
• How deep will flooding be?

Results are under review.
Thank you!

Photos shown were taken by Project team members