SR20 MP 100.7 Skagit River Case Study

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Secretary of Transportation
Project Goal and Objectives

Goal
• Maintain a safe and functioning highway by providing a long-term, environmentally suitable solution for protecting SR 20 from Skagit River bank erosion.

Objectives
• Minimize repetitive maintenance and repair.
• Mitigate environmental and cultural impacts.
• Protect and enhance aquatic and riparian conditions.
• Consistent with Wild & Scenic River setting.
• Minimize traffic impacts during construction.
Study Reach
Ongoing Maintenance and Repair Site:
Repetitive Damage and Funding

- Failure of emergency measures installed under a declared disaster
- Chronic Environmental Deficiency (CED)
- Preliminary Reach Assessment
- WSDOT proposal for “Betterment” to FHWA
- Success—funding approved
Alternatives Analysis
Realignment?

- Local opposition to relocation — (“We like having your road between us and the river”) …

- Trust Land and Cultural Resources

- North wall entrainment
Why not a more conventional ELJ Design?

- Difficult site conditions
- Substrate unsuitable for driving pilings, sheet pile
- Deep, swift surface flows
- Hyporheic flows make de-watering impossible
- Wild & Scenic River
- Habitat considerations
Comparison

Dolo Anchor and Ballast

Piling and Rock Ballast

Photo Tim Abbe
Comparison Pros

• Modular and interlocking

• Anchor and ballast in-one

• Less construction impact
  no steel H-piles
  less/no dewatering
  limited/no excavation

• Good application in deep
  water and/or difficult
  substrate conditions

• Greater in-stream
  complexity and quantity of
  wood

Photo Tim Abbe
Comparison Cons

• Still “experimental”

• Short track record in ELJ applications

• Aesthetics—“the yuck factor”

• Skeptical regulatory agencies

• Complex design

Photo Tim Abbe
# Comparison of Habitat Availability For 40 River-Foot Jam

<table>
<thead>
<tr>
<th>Dolo-based jam</th>
<th>Piling and rock based jam</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Footprint 4000 sq. ft.</td>
<td>• Footprint 4000 sq. ft.</td>
</tr>
<tr>
<td>• Interstitial space 37,400</td>
<td>• Interstitial space 14,500</td>
</tr>
<tr>
<td>• Total surface area of wood 30,800 sq. ft.</td>
<td>• Total surface area of wood 10,647 sq. ft.</td>
</tr>
<tr>
<td>• Effective surface area of wood 6,100 sq. ft.</td>
<td>• Effective surface area of wood 3,000 sq. ft.</td>
</tr>
</tbody>
</table>
SR20 MP100.7 Design
Design--Modular Types
Typical Wood Structure Cross Section
Hydraulic Modeling
Hydraulic Modeling

- HEC-RAS-- backwater and scour
- River 2D--Channel bathymetry and structure hydraulic functions—
  - Flow vectoring
  - Velocity
  - Shear
  - Habitat
## Design Flows

<table>
<thead>
<tr>
<th>Recurrence Interval (Years)</th>
<th>Annual Exceedance Probability (%)</th>
<th>Peak Flow (cfs)</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>50</td>
<td>36000</td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td>46200</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>55000</td>
</tr>
<tr>
<td>25</td>
<td>4</td>
<td>68100</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>79300</td>
</tr>
<tr>
<td>100</td>
<td>1</td>
<td>92500</td>
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</table>
2D Model Domain
100-YR Velocity - Difference
Hydraulic Modeling Coupled with Chinook Redd Surveys
## Incipient Motion Analysis

<table>
<thead>
<tr>
<th>Shear Stress (lb./ft²)</th>
<th>Assumed Dimensionless Critical Shear Stress</th>
<th>D₅₀ (In.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.06</td>
<td>0.4</td>
</tr>
<tr>
<td>0.2</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td>0.4</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>0.5</td>
<td></td>
<td>1.9</td>
</tr>
<tr>
<td>0.75</td>
<td></td>
<td>2.8</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>3.8</td>
</tr>
<tr>
<td>1.25</td>
<td></td>
<td>4.7</td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td>5.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particle</th>
<th>Particle Size (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt / Clay</td>
<td>0 - 0.04</td>
</tr>
<tr>
<td>Sand</td>
<td>0.04 - 0.08</td>
</tr>
<tr>
<td>Gravel</td>
<td>0.08 - 2.5</td>
</tr>
<tr>
<td>Cobbles</td>
<td>2.5 - 10</td>
</tr>
<tr>
<td>Boulders</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Boulders</td>
<td>20 - Bedrock</td>
</tr>
</tbody>
</table>
SR20 MP100.7 Skagit River

Existing Condition
Velocity
Q = 9000 cfs

Proposed – Change
Velocity
Q = 9000 cfs
Flow Characteristics Overlaid with Surveyed Redds
Permitting
Project Schedule

- Oct.1 2013 site clearing
- Dec.1 2013 temp. SR 20 bypass
- Feb.1—April 30 2014 in-water work phase 1
- Project completed April 30 2014
- August 2014 in-water work phase 2 (Canceled)
- Contractor—Trimaxx Const. Inc.
- Cost $7.54 million
Monitoring

• Hydraulic function
• Geomorphic processes
• LWD
• Vegetation
• Fish Habitat
Acknowledgments;
“A Cast of Thousands”

• Upper Skagit Tribe
• Sauk Suiattle Tribe
• Swinomish Tribe
• Nature Conservancy
• Local Landowners
• NHC
• Cardno-Entrix
• Dr. Tim Abbe

• USFS
• Skagit County
• Ecology
• USFWS
• NMFS
• WDFW
• USACE
• WSDOT  NWR and HQ
Questions?

Contact Information

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