



# Emergency Bridge Flood Damage Repairs



## Technical Session Agenda

### **Introduction & Response Program (Jim Markus, King County)**

- a. November 2006 King County Flooding
- b. Planning & Response Program
- c. Vicinity Mapping and Emergency Repair Projects

### **Preston Frontage Road Response (Ken Wilson, ISE)**

- a. Flooding Damage at Preston Frontage Road Bridge
- b. Emergency Response Requirements
- c. Construction and Repair Implementation
- d. Bridges Open to Community and Conclusions

**Q&A**

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Introduction

Planning

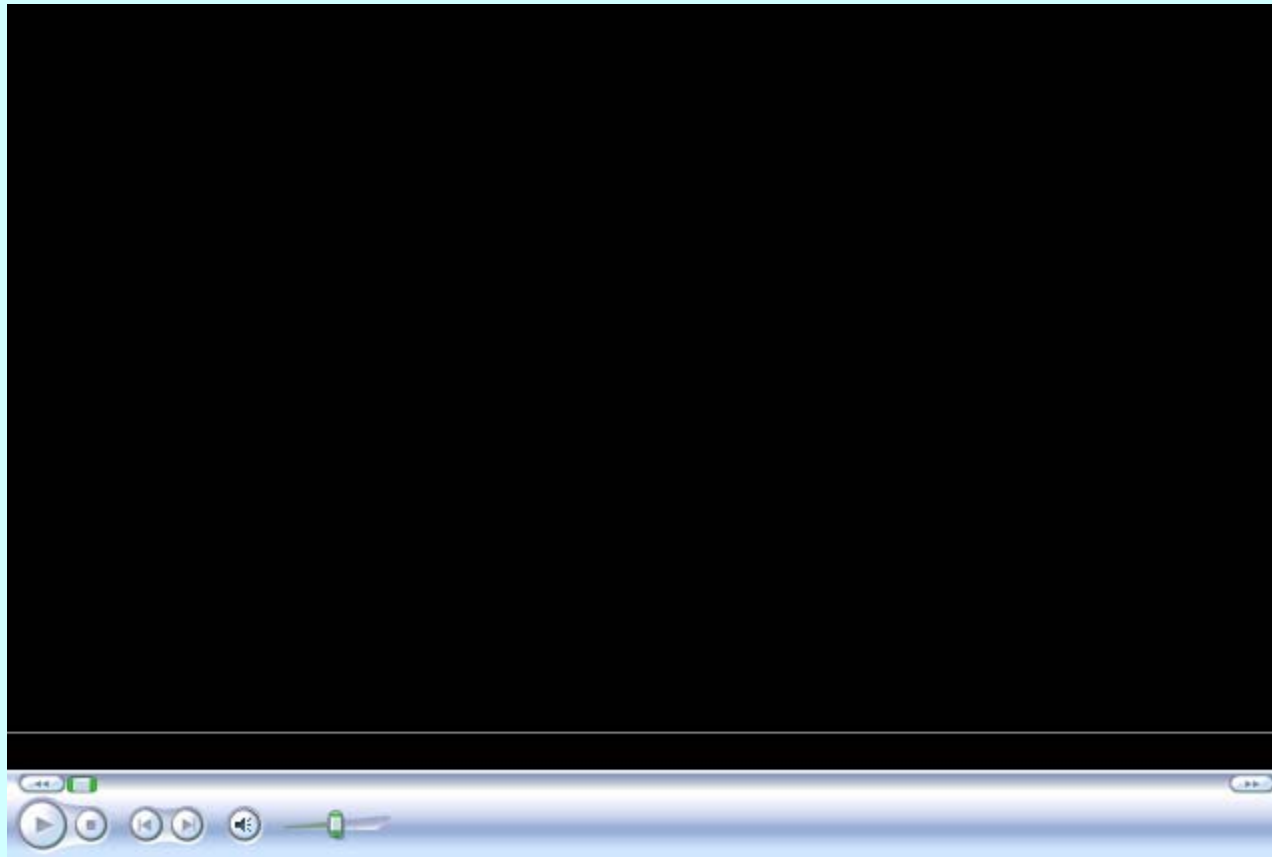
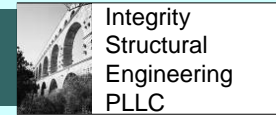
Flood Damage

Construction

Bridges Open



# Emergency Bridge Flood Damage Repairs





# Emergency Bridge Flood Damage Repairs

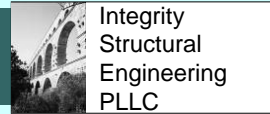
## Response to Bridge Structure Flooding Emergency

- **Bridge Pre-Flood Planning**

- ✓ Creation of Flood Watch Listing of Bridges
- ✓ Assignment of Inspection Responsibilities
- ✓ Emergency Contact Succession
- ✓ Organized Inspection Plan
- ✓ Contact Listing for Utilities, Fire, & Safety
- ✓ Implementation of Risk Reduction Activities



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## Response to Bridge Structure Flooding Emergency

- Emergency Response to Flood Hazard
  - County Flood Warning System
  - Monitor USGS Stream Gauges
  - Inspection of Critical Bridges on Flood Watch
  - Automated data Sharing via “*E-Track*”
  - Immediate Response from On-Call Consultant
  - Immediate/Timely Response to Public
  - Initiating Emergency Construction Contracts



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## King County Bridge Flood Planning

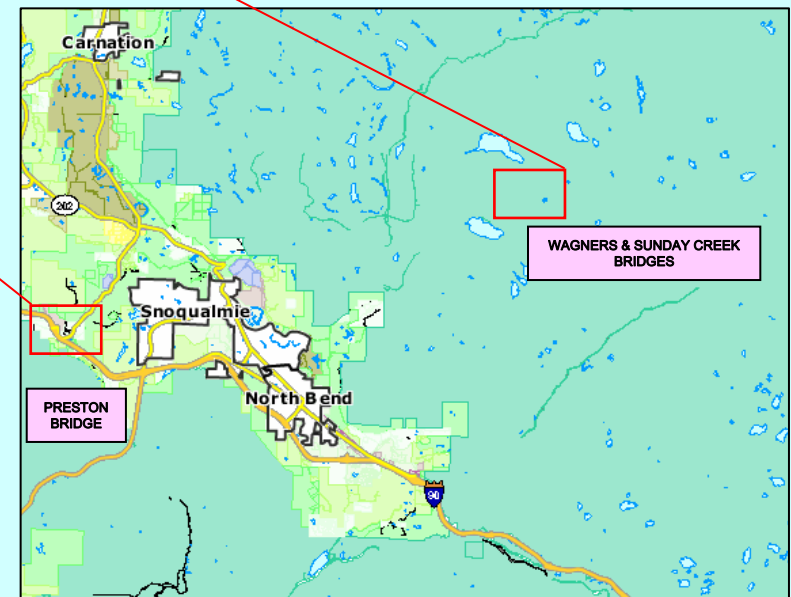
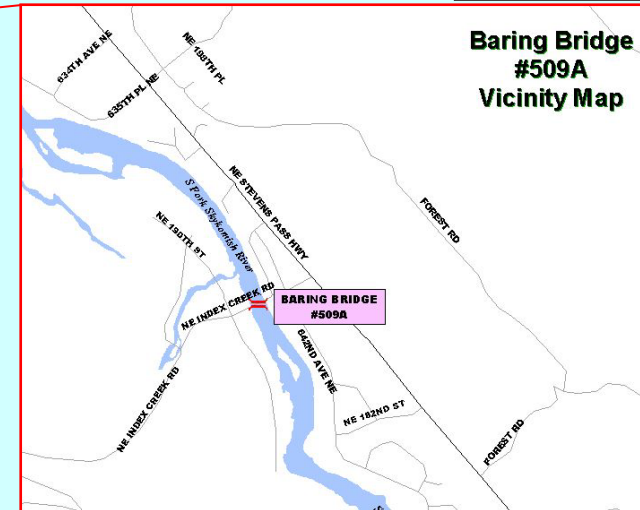
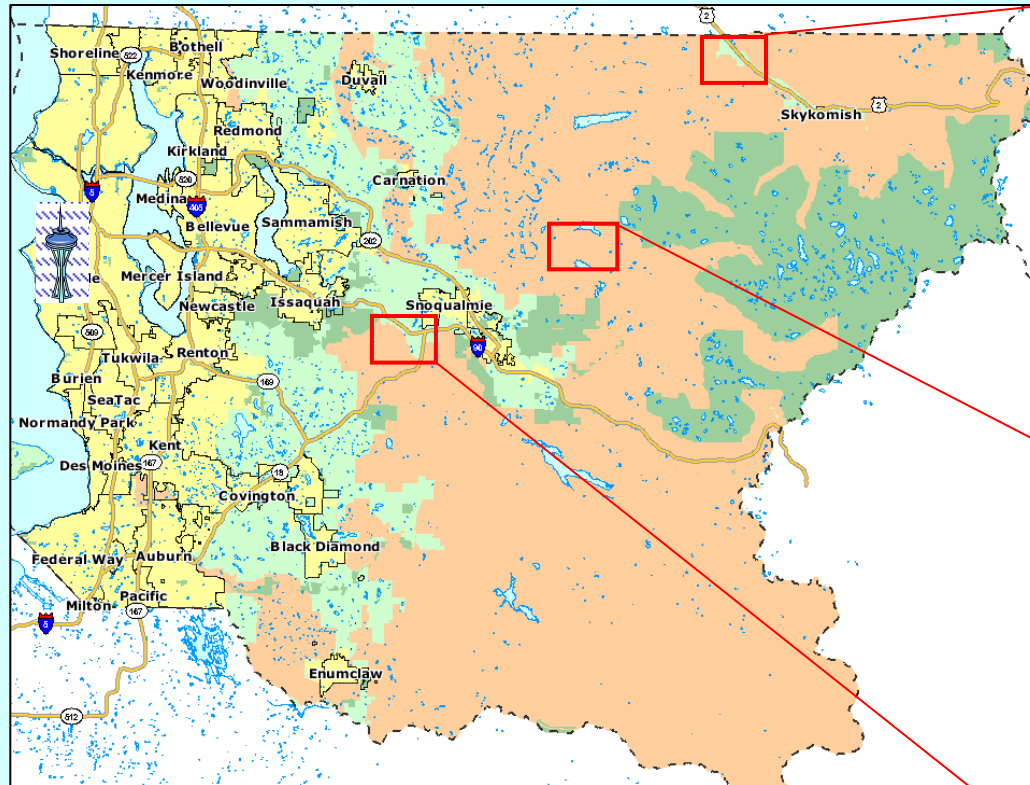
- **Bridge Flood Hazard Management**
  - King County Surface Water Design Standards
  - Avoid Creation of New Bridge Flood Risks
  - Protect & Enhance Aquatic and Riparian Habitat
  - Routine ( Biennial or Annual) Scour Inspections
  - Underwater Inspections every 5 years (max)
  - Map Upstream and Downstream Channel
  - Comparative Analysis of Streambed Stability



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Structural  
Engineering  
PLLC



## KING COUNTY VICINITY

- Major Flooding Throughout
- Access Roads Closed to Tolt, Novelty, & Duvall Bridges
- Emergency Repair Response to Baring, Wagners, Sunday Creek, & Preston Frontage Road Bridges

Introduction

Planning

Flood Damage

Construction

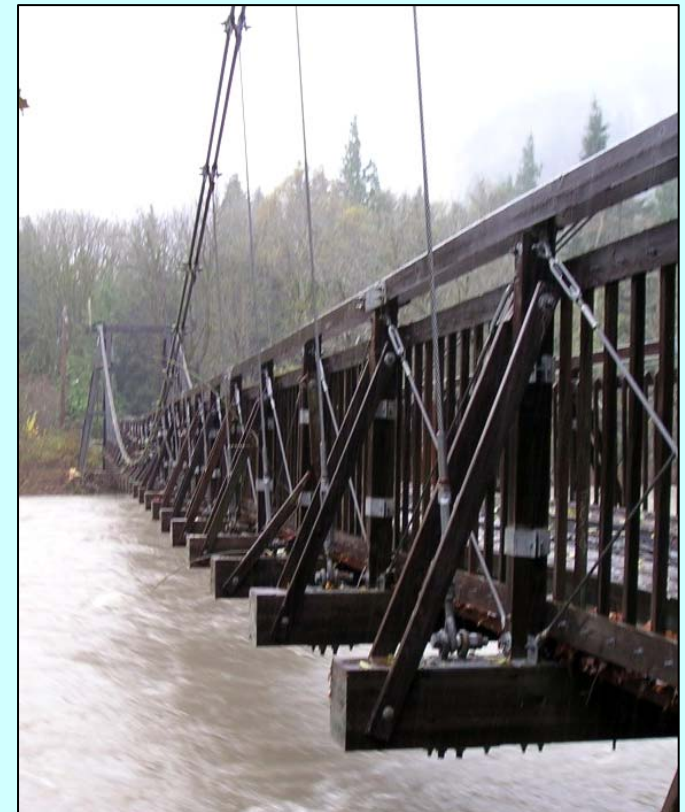
Bridges Open



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## **BARING BRIDGE (Skykomish)**

- Sole Access to 43 Residential Sites
- Historic County Landmark, 272-foot Timber & Cable Suspension



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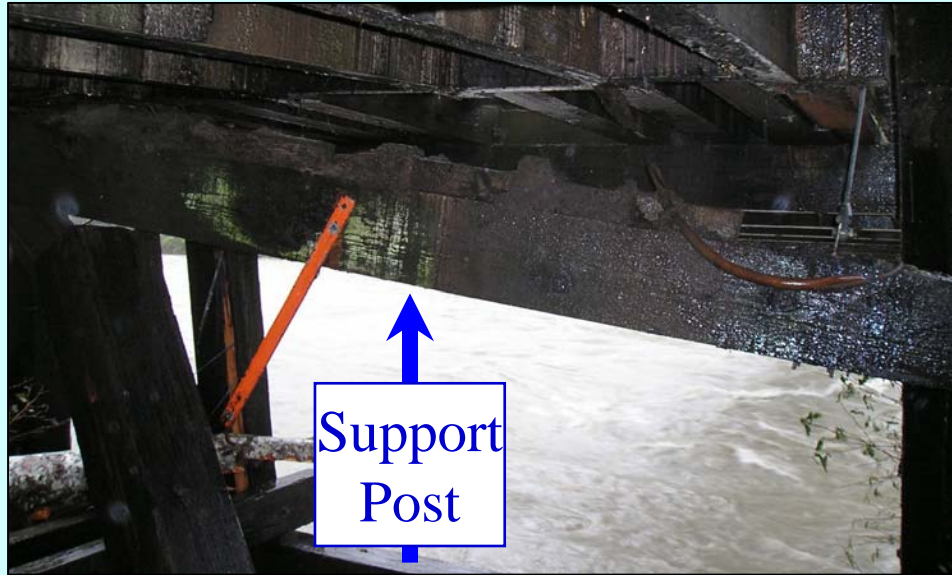
## **BARING BRIDGE**

- Scouring/Flooded Support Towers
- Heavy Debris Accumulation





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**BARING BRIDGE**  
- Loss of two Approach Support Posts below West Tower



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**BARING BRIDGE**  
- Log Damage to Deck, Rails, Vertical, and Brace Cables



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Scour Critical Piers

## WAGNERS BRIDGE (North Fork Snoqualmie)

- Logging & Mining Access
- Recreational Area Road





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**Very Important Rock (VIR)**



## **WAGNERS BRIDGE**

**(North Fork Snoqualmie)**

- Flood Water Overtops “VIR”
- Road Closed During Flood



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## UPPER PRESTON ROAD SE (Raging River)

- Sole Access to About 200 Homes
- Temporary I-90 Access Added

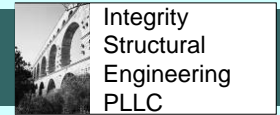


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**UPPER PRESTON ROAD SE**  
**(Raging River)**

- Stabilize Road
- Repair and Re-Build Embankment



## **Preston Frontage Road Bridge Emergency Response**

- a. Flooding Damage**
- b. Emergency Response Required**
- c. Construction and Repair Implementation**
- d. Conclusions and Bridges Open**



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## PRESTON FRONTAGE ROAD (Raging River)

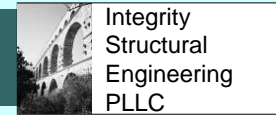
- Providing Access to Area Residents
- 316-foot Curved Reinforced Concrete Box Girder Bridge







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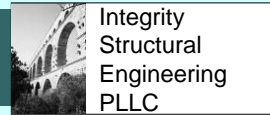
## Day 1



Scour  
Attack



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**Preston Fr. Rd. Bridge**



**Major Fiber Optic Utilities**



**Upper Preston Road SE**



# Emergency Bridge Flood Damage Repairs



## Emergency Response Objectives:

- Redirect Raging River Allowing Access
- Support Bridge and Remove Pending Collapse
- Stabilize Steep Slopes
- Address Scour/Install Permanent Countermeasures

## Immediate Challenges:

- Flooding Conditions and Continued Rains
- Limited Material Availability
- Poor Access and Steep Slopes
- Unsafe Conditions with On-going Scour and Jeopardy of Bridge Collapse



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## Day 1



### **Construct Guide Bank to Protect Bridge and Redirect Flood**

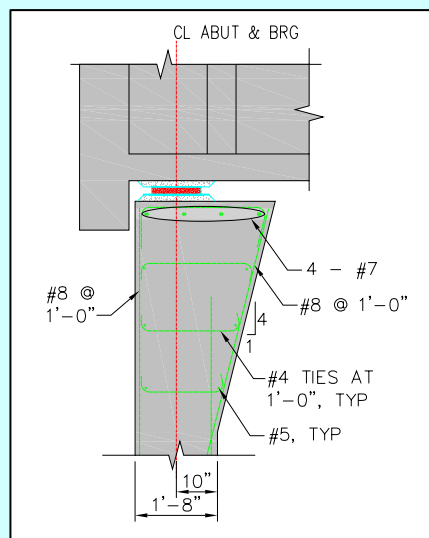
- HEC-23 countermeasures considered
- Most direct response with riprap (limited availability)
- Sized riprap and mapped out placement sequence



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## Day 1



### Abutment Analysis

- Acting as a cracked, inverted T-beam
- #7 bars yielding, but layers of #5 bars engaged
- System ductile and temporarily stable



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## Day 2



### Provide Abutment Support

- River redirected
- Crane support added for safety
- Some slope stabilization work
- Constructed precast foundation support using on-hand materials





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## Day 3



### Jacking and Scour Countermeasures

- Installed steel bearing shims
- 160-tons of jacking force
- Placed foundation enclosure
- Pumped rapid set/high cement concrete below the abutment
- Continued riprap placement





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## Bridges Open to Community







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## Results

### Closure Duration

- All Bridges and Community Access Opened by Day 4
- Upper Preston Road SE Complete in December

### Flood Repair Costs

- Baring Bridge at \$30,000
- Upper Preston Road SE at about \$2.2 Million
- Preston Frontage Road Bridge Repair Cost at \$600,000  
(compared to \$5 million for Replacement)

## Conclusion

- ✓ Preplanning and Pre-Assigned Responsibilities were Critical to Saving the Bridges
- ✓ On-Call Engineering/Technical Support was Fundamental to Response Time
- ✓ Repairs were Cost-Effective and provided Substantial Public Benefit
- ✓ Public Safety, Welfare, and Goodwill were Enhanced



# Emergency Bridge Flood Damage Repairs



## Team Acknowledgements:

### King County Department of Transportation

Jim Markus, PE, KC Managing Engineer

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### Wilder Construction

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Q & A

