From Tahoma to Tacoma: Using basin-scale planning to restore the Puyallup River Watershed, Washington

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Overview of Presentation

- Pierce County Rivers Flood Hazard Management Planning
- Major Studies
  - Economic Analysis
  - USGS Joint Agreement Studies
- Flood Plan Recommendations
  - Policy, Programs, Capital Projects
- Rapid Geomorphic Assessment
  - Height above water surface (HAWS)
  - Inform conceptual designs
Pierce County Rivers Flood Hazard Management Plan

Mt. Rainier to Puget Sound
(Commencement Bay, Nisqually Delta)

Transition from Forest, Rural/Agriculture to Urban
Rivers Flood Hazard Management Plan - Geographic Scope

Pierce County Rivers

Four Major Rivers:
1. Puyallup River
2. White River
3. Carbon River
4. Nisqually River

Three Large Tributaries (> 5,000 cfs peak flow):
5. Greenwater River
6. South Prairie Creek
7. Mashel River
Humans have developed in the floodplain and attempted to manage rivers and flooding since late 1800s.

Port, industrial, commercial and residential development
Watershed, Development and Landscape Change

Historical Changes:
- Great flood of 1906
- 1916 – Permanent diversion of White River to Puyallup River
- Development of Port, Tacoma and lower valley - began in early 1900s
- Levees/revetments in Middle Puyallup valley (1930s – 60s)
- Puyallup and Lower White development (1960s – present)
Flood History in the Puyallup River Basin

- 26 significant flood events in last 100 years
- 1933 – 57,000 cfs
- 1948 – MMD construction
- 14 federally declared disasters since 1962
- $Q_{100} = 48,000$ cfs
- 1996 – 46,700 cfs
- 2009 – 47,700 cfs
Pierce County Flood Hazard Management Plan Goals:

- Reduce risks to life and property
- Identify and implement flood hazard management activities in a cost-effective and sustainable manner
- Support compatible human uses, economic activities, and improve habitat conditions
- Develop a long-term and flexible funding strategy

Puyallup River Flooding, January 2009

South Prairie Creek Flooding, November 2004
River Management – Desired Outcomes

**Policies:**
- Dictate how projects and programs are developed
- Guide current and future decisions about river and floodplain management
- Address projects, floodplain development regulations, flood warning and emergency response, funding, and other general issues

**Programs:**
- Implementation of flood hazard management actions:
  - facility maintenance and repair, flood warning and emergency response, education/outreach, technical assistance, floodplain and channel migration mapping, river channel management.
- Enhancement or improvement of existing as well as new programs:
  - Adaptive management, climate change, advance habitat mitigation, public access, water quality, incidental take authorization

**Projects:**
- Typically address a specific problem at a particular location
- Implementation guided largely by priority and funding availability
Facilitation to Reach Plan Objectives

- Consensus model
- 18 monthly meetings
- 27 diverse members
- 11 Public Meetings
- Workshop for Elected Officials
- Pierce County Participation:
  Surface Water Management, Transportation, Planning and Land Services, Emergency Management, Parks & Recreation, Economic Development, Government Relations, Agricultural Programs

Non-Flood Plan Advisory Committee

- Nisqually Tribe
- Puyallup Tribe of Indians
- City of Fife
- City of Sumner
- City of Tacoma
- City of Orting
- City of Puyallup
- City of Pacific
- Town of South Prairie
- NOAA Fisheries
- Mt. Rainier National Park
- Washington Dept. of Fish & Wildlife
- Washington Dept. of Ecology
- Pierce Conservation District
- Drainage District #10

- Port of Tacoma
- MBA of Pierce County
- Agricultural Community
- Tacoma-Pierce County Assoc. of Realtors
- Watershed Councils (Puyallup & Nisqually)
- Citizens for a Healthy Bay
- Tacoma Audubon Society
- Citizen Representatives – Floodplain residents, property owners
Summary of Economic Analysis Findings

- Threats to human health and safety
- Economic Impacts
- Transportation Impacts
- Recreational Impacts
Economic Impacts and Flood Losses

Pierce County faces potential flood related losses in excess of $725 million

• Health and Safety (in Floodplain)
  – Population 21,193
  – Jobs (in floodplain and with ripple effect) 11,868/17,596
  – Homes 9,340
  – People served by 3 wastewater treatment plants 216,000
  – Raw sewage discharged to floodwater and rivers
  – 1 week to 4 months to restore primary/secondary treatment
Water and Sediment Loading into Puget Sound

Magril, USGS 2011

Puyallup River MAF is 1/5 of Skagit River

Annual sediment load – Three largest have Cascade volcanoes
USGS Study of Carrying Capacity and Sedimentation Trends (USGS 2010)

USGS Study of Carrying Capacity and Sedimentation Trends

Orting – Calistoga reach options to reduce flooding:

- Setback levee
- Gravel bar scalping
USGS Study of Carrying Capacity and Sedimentation Trends

Initial Change in 100-yr Water-Surface Elevation
Sediment Yield
Nisqually River: 1945-2010

Nisqually River:
\[1,070 \text{ m}^3/\text{km}^2/\text{yr}\]

Little Nisqually River:
\[80 \text{ m}^3/\text{km}^2/\text{yr}\]
(to scale)

> 13 times

Preliminary results subject to change
Estimated Annual Sediment Load (May 2010 – March 2011):
~540,000 m³ / yr

- Bedload
  49,000 m³/yr
  9%

- Suspended Sand
  290,000 m³/yr
  54%

- Suspended Silt/Clay
  200,000 m³/yr
  37%

Preliminary results subject to change
Mt. Rainer Rivers – Sediment Deposition Areas

White River

Upper Nisqually River

Puyallup River

Carbon River

Preliminary results subject to change
Problem Identification (250 problems)

- Flooding of Infrastructure (48)
- Levee Overtopping/Breaching (45)
- Facility Maintenance/Repair (37)
- Fish Habitat Problem Areas (30)
- Channel Migration (22)
- Gravel Accumulation-sediment deposition (19)
- Tributary Backwater Flooding (17)
- Public Access (13)
- Public Safety (12)
- Development/increase flooding risk (7)
Programmatic Recommendations

35 Programmatic recommendations including:

- Information/Mapping/Technical Assistance
- Education and Flood Preparedness, Flood Warning and Emergency Response
- Fish Habitat and Riparian Area Mitigation
- Land Use/Regulatory/Acquisition/Structure Elevation
- River Channel Management (levees, revetments, flood gates, engineered log jams, pump stations)
- Facility Repair/Maintenance
- Habitat Conservation Planning
- Climate Change
- Water Quality Impacts of Flooding
- Public Access

Carbon River Levee Repair
Capital Improvement Project Recommendations

36 recommendations including:

- Channel migration resistance (ELJs)
- Setback levee
- Flood walls
- Acquisitions

Setback Levee on the Puyallup River
Management Strategies/Level of Protection

**Levee Reaches**
- 200-year design + 3 feet of freeboard
- 100-year design + 3 feet of freeboard
- Maintain existing level of protection (based on USGS 2009 carrying capacity)
- Maintain existing levee prism

**Revetment Reaches**
- Channel migration resistance design
- Channel migration prevention design

**Non-structural approaches**
- Floodplain acquisition/home buyouts
- Floodplain development regulations

Bio-Revetment on White River in King County
Flood Hazard Management Plan Accomplishments 2009-2011

- Developed goals, objectives, guiding principals
- Identified and prioritized among >250 problems
- Developed solutions for priority problems
- Devised strategies/levels of protection for 7 rivers
- Agreed on 30 river management policies
- Agreed on 35 Programmatic Recommendations
- Agreed on 34 Capital Project Recommendations
- Completed an Economic Analysis of flood impacts
- Collaborated with USGS on Joint Agreement
- Analyzed adverse environmental impacts (SEPA)
- Completed draft plan – October 2011
- Release of draft plan and EIS to public – Feb. 2012

1933 Flood: 57,000 cfs
Early Action Projects - Assessment and Implementation

- Priority locations for river/flood management actions
- Integrated with planning-level policies and recommendations
- Previously identified with funds allocated

Upper Puyallup – Neadham Road Levee Failure
November 2008 Levee Failures

Channel Migration on the Nisqually River –
November 2006
River Assessment & Concept Solutions

Rapid Geomorphic Assessment:
- channel migration problem areas,
- levee/revetment breaching problem areas,
- sediment/gravel accumulation,
- habitat problem areas (e.g., facility maintenance activities affecting spawning/rearing habitat),
- climate change issues (e.g., glacial retreat & greater precipitation impacts on sediment transport)
- Concept-level solutions

Application Projects:
- Upper Puyallup Orville Road Channel Migration Protection
- Carbon River Levee Bank Stabilization/ Flow Deflection
- Nisqually Park Levee Protection
River Mgmt Tools—Height Above Water Surface Mapping

Height Above Water Surface Map Including the Channel Migration Zone
Nisqually River, Pierce County, Washington

Data source: GeoEngineers (2007). Channel Migration and Avulsion Potential Analyses, Upper Nisqually River.
Modified by ENTRIX
Nisqually River Engineered Log Jams

**ELJs Outside Levee Prism**

- Approved by ACOE in concept
- Deflect flows and promote sediment deposition
- Designed to work in conjunction with stabilization methods implemented by Mt. Rainier National Park
Upper Puyallup – Orville Road

**Problem:**

- Orville Road lifeline arterial
- Channel migration on left bank threatens Rd
- Levee damaged in numerous locations
- Threatens 2.5 miles of Rd and private property
Upper Puyallup / Orville Road

Environmental Permits likely required:
- Shoreline and Critical Areas Approval, Pierce County
- Section 404 - US Army Corps of Engineers
- Section 401 - WA Dept. Of Ecology
- HPA - Dept. of Fish and Wildlife

Coordination:

Threatened Fish Use:
- Puget Sound Chinook, steelhead, and bull trout
Upper Puyallup / Orville Road

Proposed Solution:
Increase flood plain connectivity & improve salmonid habitat (~$17M):
- 8,500’ of setback revetment
- 3000’ of setback Levee
- 30 Engineered Log Jams (ELJs)
- Dolotimber system

Alternative long-term solution (~$38M):
- Relocate 2.7 miles of Orville Rd
Next steps

Pierce County has begun the process of adopting the Flood Plan:

1) Draft plan presented to Surface Water Management Advisory Board and Planning Commission for review and recommendations to Pierce County Council

2) Council will review and formally adopt plan

3) Adoption by valley cities?

Visit www.piercecountywa.org/floodplan for more information
Questions?
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