Evidence that removing a levee and restoring the floodplain can replace a flood-prone mobile-home park with a refuge for salmon

Josh Latterell Ph.D.
Josh.Latterell@kingcounty.gov
What’s the problem?
People and industry rely on aging flood control facilities. The same facilities damage habitat for threatened Chinook salmon.
Reduce flood risk with flood buyouts and relocations
Restore habitat by removing the levee
Remove levees to ‘make room for the river’

Channel migrates and adjusts its form

Trees fall into river

Logjams form

Edge habitat increases

Excavate deformable channels

Place wood

Forests regenerate

Increased production & stream rearing

Plant trees
Project Features

(OCT. 29\textsuperscript{TH}, 2013, 660 CFS)
Before construction
What do we need to know?
Does ‘making room for the river’ actually produce critical habitat that salmon need?

Is the project working as the design team intended?
Study Sites

- Cedar River
- Project Site
- Control Site
- Reference Site

Cedar River
184 mi²
METHODS
Edge habitat surveys
Snorkel surveys
LiDAR+bathymetry
Orthoimagery
Wood counts
Time-lapse cameras
Water level loggers
Controlled exprmrnts
Has habitat improved?
BEFORE 1,230 cfs
AFTER 1,240 cfs
Habitat has increased across the range of flows
Habitat has improved, but has farther to go

Edge Habitat Area per CW (ft²) at ~700 cfs

- Before
- After
- Reference
How is the river responding?
Pre-Project

October 30, 2012 657 cfs
Construction complete

October 1, 2013 840 cfs
After three winters

March 1, 2016

2,500 cfs

26 years ago
Change in streambed elevations 2 years after construction
Fox & Bolton recommend another 1,800 pieces and 36 key logs.
Stage-discharge relationship shifted = more connectivity
This shift compensated for aggradation at the inlet.
Channel deformation = gradual shift toward complexity
What do these changes mean to salmon?
Combine two factors to estimate change in habitat capacity

- Rainbow Bend
- Fish Density
- Multiple sites
- Change in capacity
- Δ Edge habitat

BEFORE

AFTER
Snorkel surveys: Juvenile Chinook like backwaters

Chinook density (fish/m²)

Edge type
- Rip Rap
- Bank
- Bar
- S. Chan. Backwtr.

The graph shows the variation in Chinook density (fish/m²) across different edge types. The density is highest in backwaters, indicating a preference for this type of environment by juvenile Chinook.
Habitat capacity increased by about 500-1,000 Chinook

Would need ~10 acres of backwaters to double parr capacity (from 25,000 per year to 50,000); 1/3rd acre/mile
Adult Chinook liked the side channel in the first year

19 out of 204 redds in ~60 miles of river (Year 1)
9% of the redds in only 0.3% of the river

Source: Karl Burton & Dan Lantz
What have we learned?
Habitat capacity increased
Deformable features provided near-term benefits
The first flood triggered the most change
Positive feedbacks are helping to change the system state
Channel dynamics are hard to predict with precision—plan accordingly.
What could this mean for future projects?
To rebuild floodplain river systems that support more salmon *in the next 5 to 10 years*...and beyond,

....make room for the river

....and give it a head start
Multi-phased project developed, implemented, and funded by:
City of Seattle – Cedar River Watershed Habitat Conservation Plan
Federal Emergency Management Agency
King Conservation District
King County
King County Conservation Futures
King County Flood District
Puget Sound Acquisition and Restoration Fund (directed by WRIA 8)
Washington Salmon Recovery Funding Board (directed by WRIA 8)
Washington Aquatic Lands Enhancement Account

Effectiveness monitoring funded by:
King County Department of Natural Resources and Parks
King County Flood Control District
King Conservation District
Cedar River Watershed Forum

Restoration project design team:
Manager: Jon Hansen
Ecologists: Dan Eastman, Cindy Young, Kate Akyuz
Engineers: Will Mansfield, P.E.
Geologist: John Bethel, L.G.
Seattle Public Utilities: Cindy Holtz, Paul Faulds
How has flood and erosion risk changed?

Home buyouts

- As a consequence of the first phase of the project, localized flooding no longer threatens residences or endangers people. Flood risks have been reduced and emergency responses and evacuations have been avoided by helping residents to move to safer homes.

Flow diversion

- By diverting a portion of the river flow away from Cedar River trail, the project’s second phase reduced the risk of damage from erosion and the need for future maintenance by slowing down the water along the left bank.
Progress toward salmon recovery in King County Rivers

- Recovery Target
- Current status (2006-2010)

<table>
<thead>
<tr>
<th>Numbers of adult Chinook salmon</th>
<th>Recovery Target</th>
<th>Current status (2006-2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>64,200</td>
<td>3,600</td>
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</tbody>
</table>

Includes King County Rivers: Snoqualmie, Sammamish, Cedar, Green (insufficient data for White; did not include Skykomish). Data Source: NWFSC Salmon Population Database and Puget Sound Partnership. Based on high productivity planning targets from Table 2 “Chinook Spawner Abundance Planning Targets and Ranges for Puget Sound Region” in Final Supplement to the Shared Strategy’s Puget Sound Salmon Recovery Plan. Nov. 2006. NMFS.