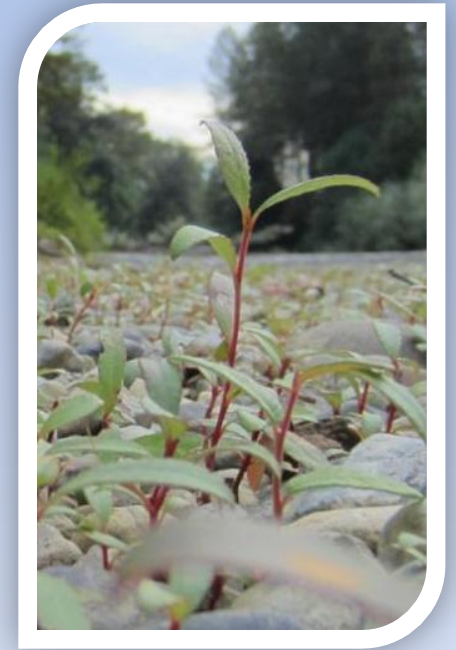
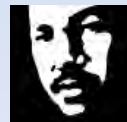


Effects of levee removal on channel dynamics and fish habitat in the Lower Tolt River



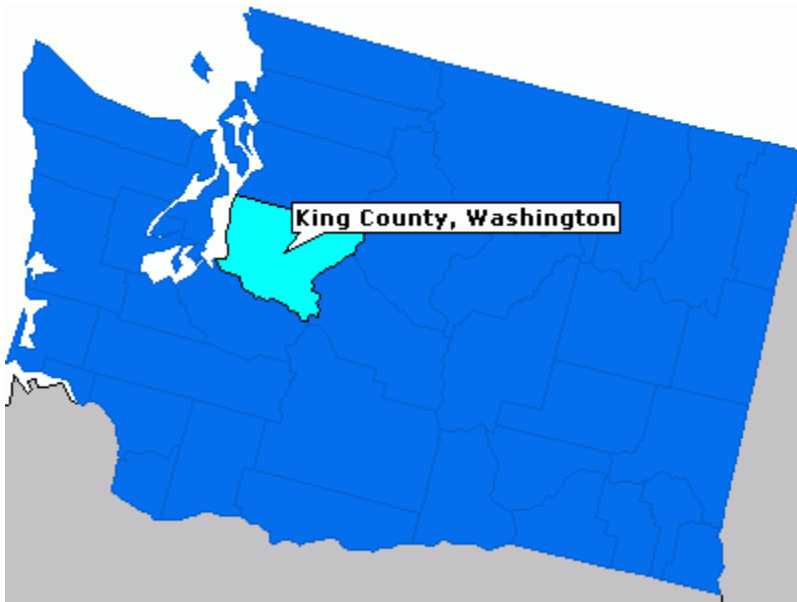
J. Latterell | D. Eastman | L. Hartema | H. Berge | R. Timm



King County

BACKGROUND

King County



1.9 million people
12th largest population in U.S.

Water & Land Resources Division

- Implementing habitat plans to recover Puget S. fall Chinook
- Rural jurisdiction
- Primary tasks
 - Acquire, preserve, & enhance
 - Re-establish forests
 - **Remove levees**
 - 5 projects completed
 - 4 more by 2014
- **PROCESS-BASED APPROACH**

PROJECT SETTING – TOLT RIVER

1936

2009

212 km² forested drainage

575 cfs mean discharge

Mod. flooding at 5,000 cfs

Adjacent to city, park, hwy

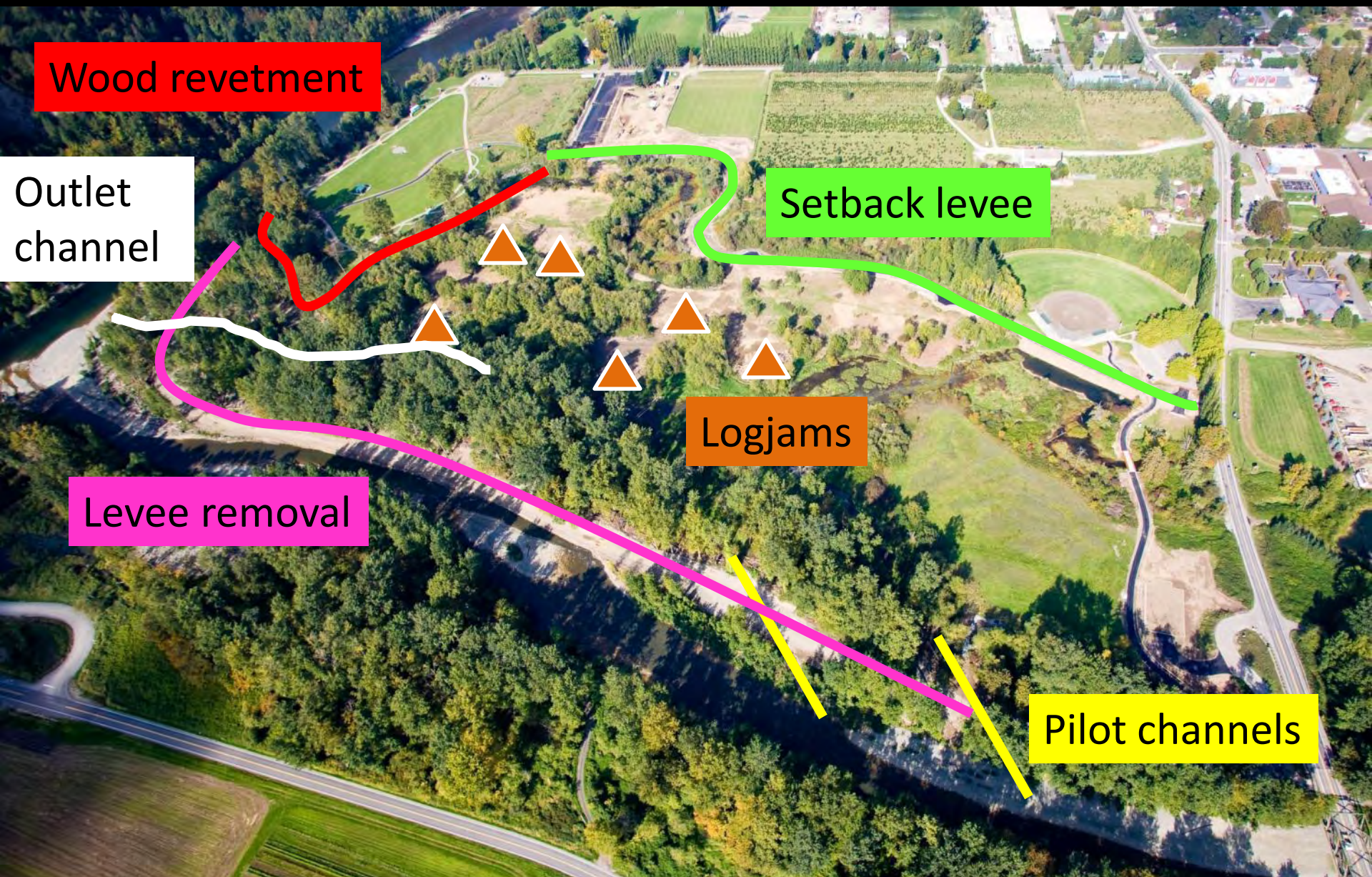
Alluvial fan, confluence

PROBLEM:

Levee prevents channel migration and floodplain connectivity

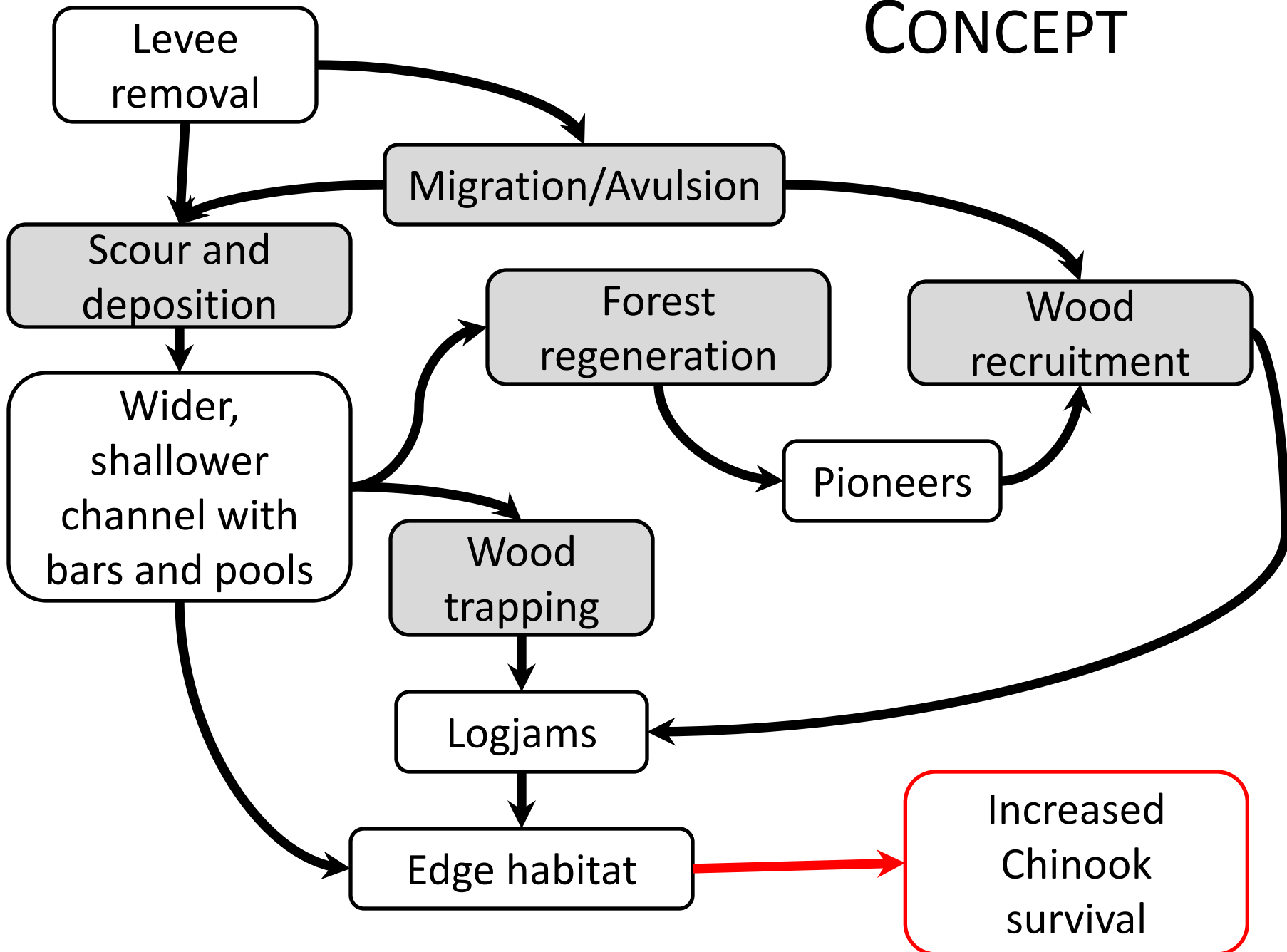


Project Goals and Objectives



...give the river 'right of way'

CONCEPT



2009 - BEFORE



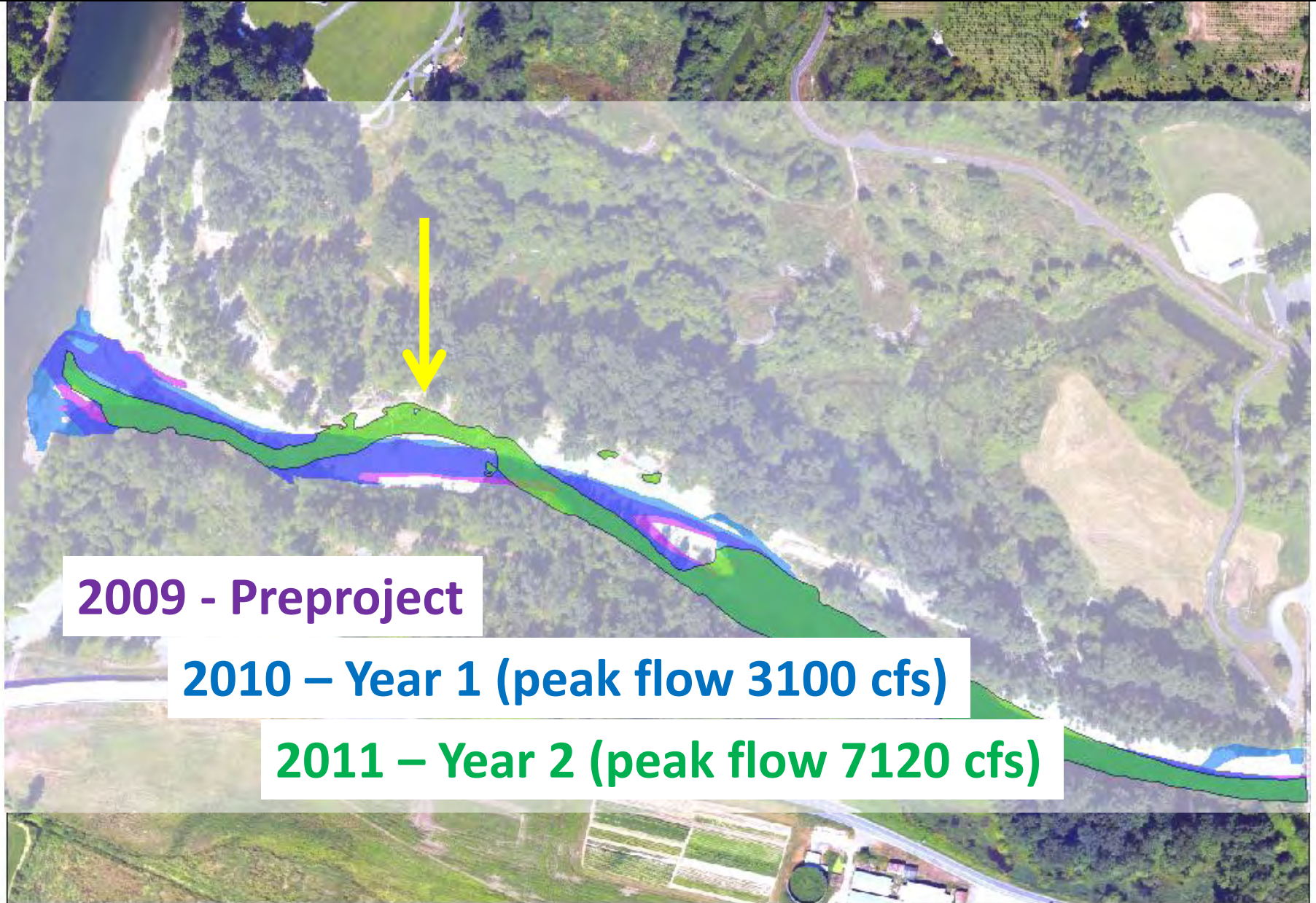
2011 - AFTER



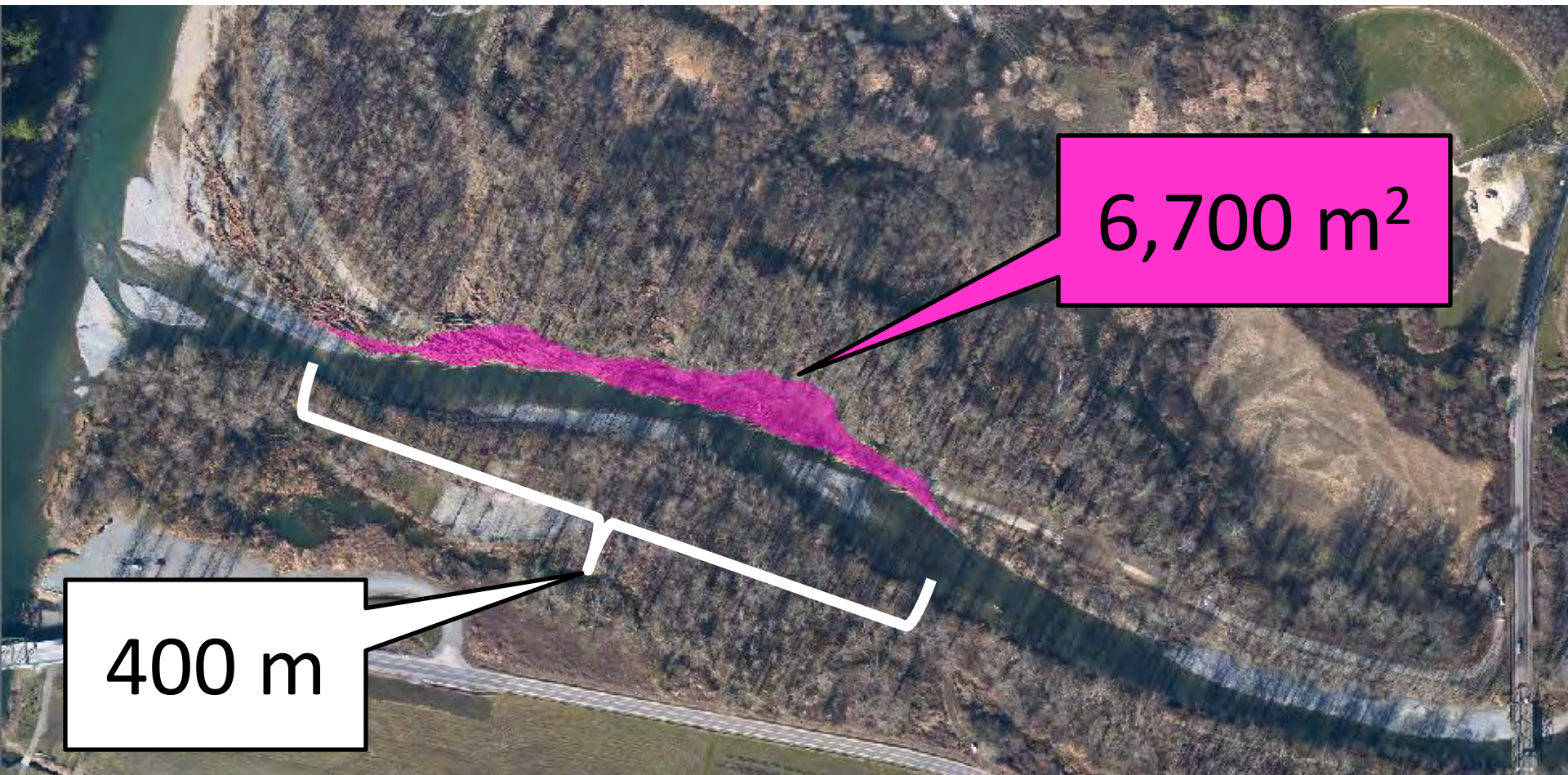
BEFORE - 2009



AFTER - 2011

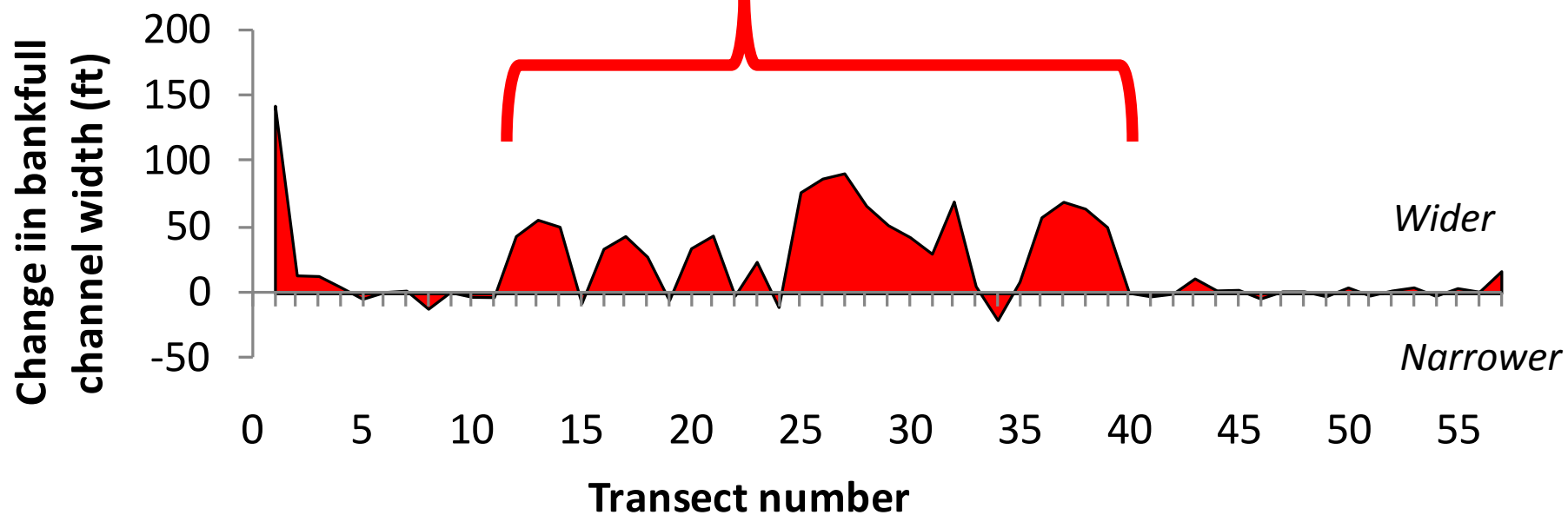


BANK RETREAT

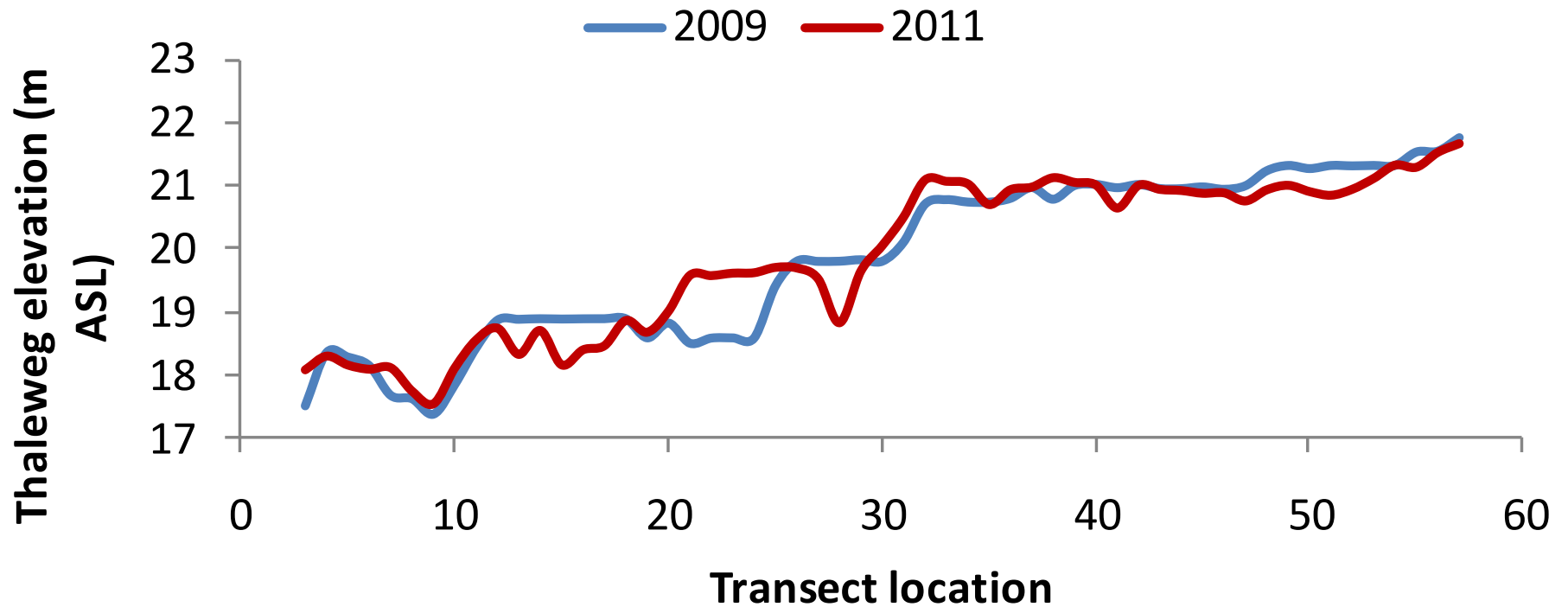


AVERAGE ANNUAL RATE: 3,400 m²/yr or 17 m/yr (in pink zone)

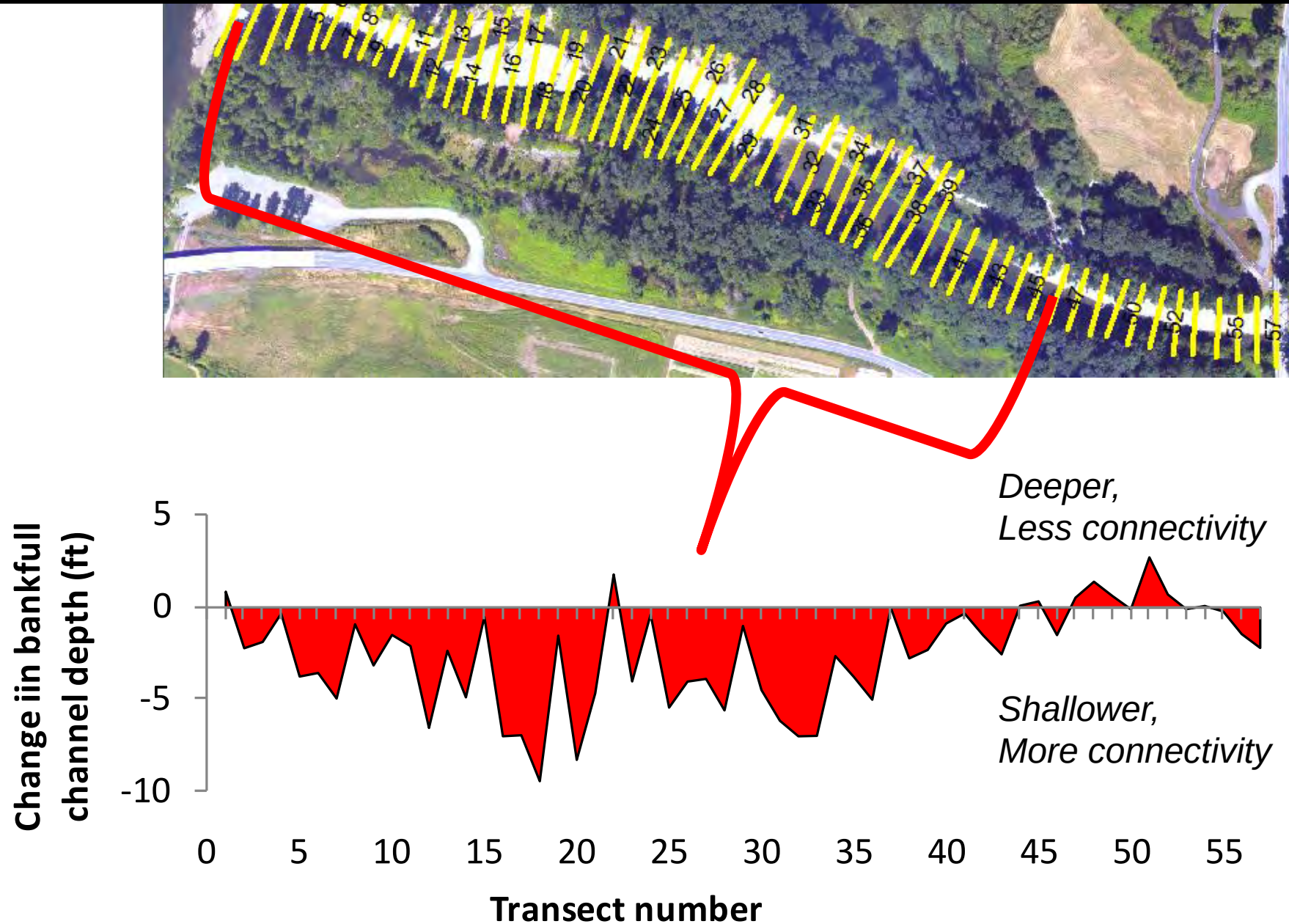
CHANGE IN CHANNEL WIDTH



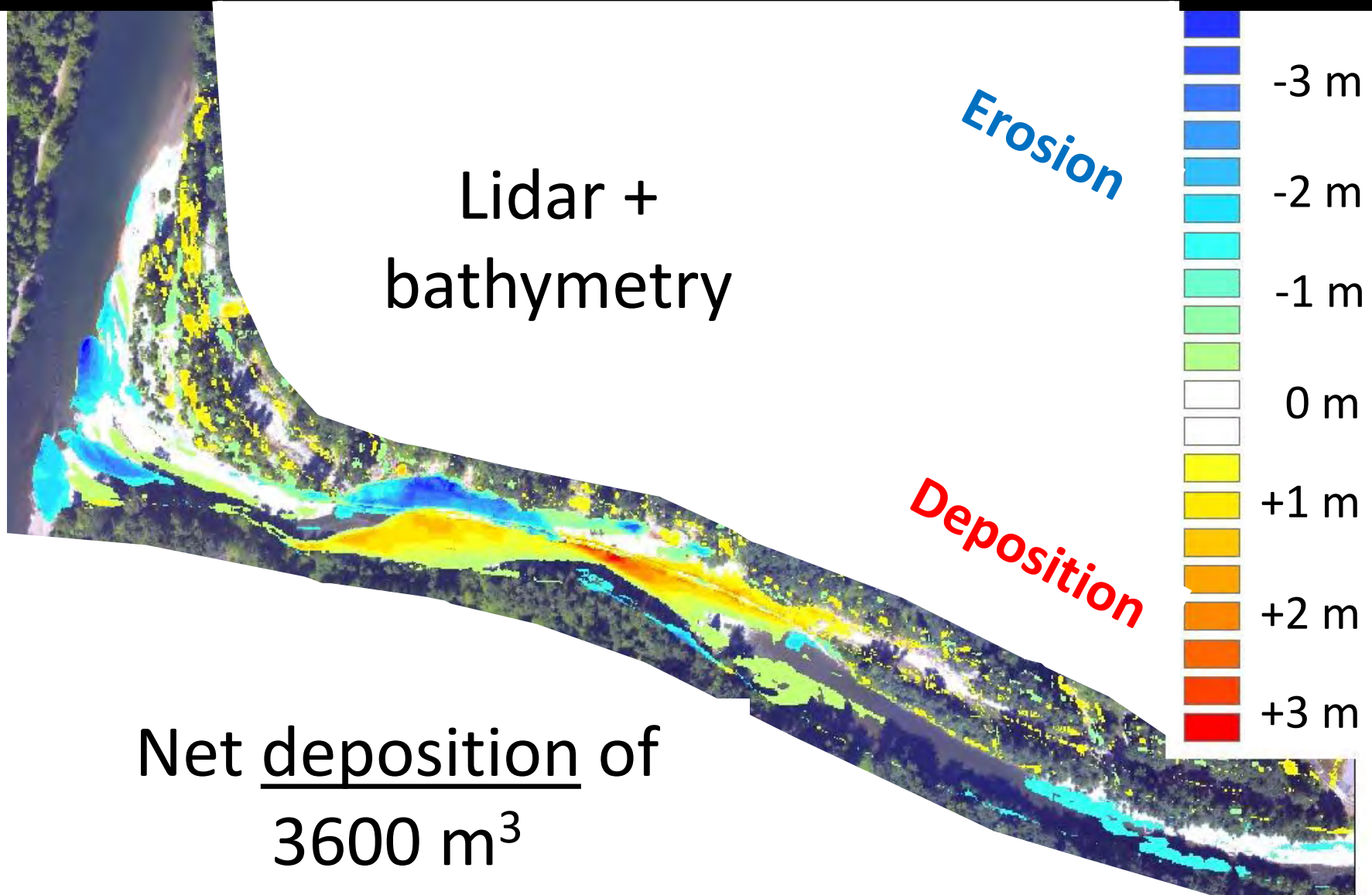
CHANGE IN THALWEG PROFILE



CHANGE IN BANKFULL DEPTH



3-D ELEVATION CHANGES

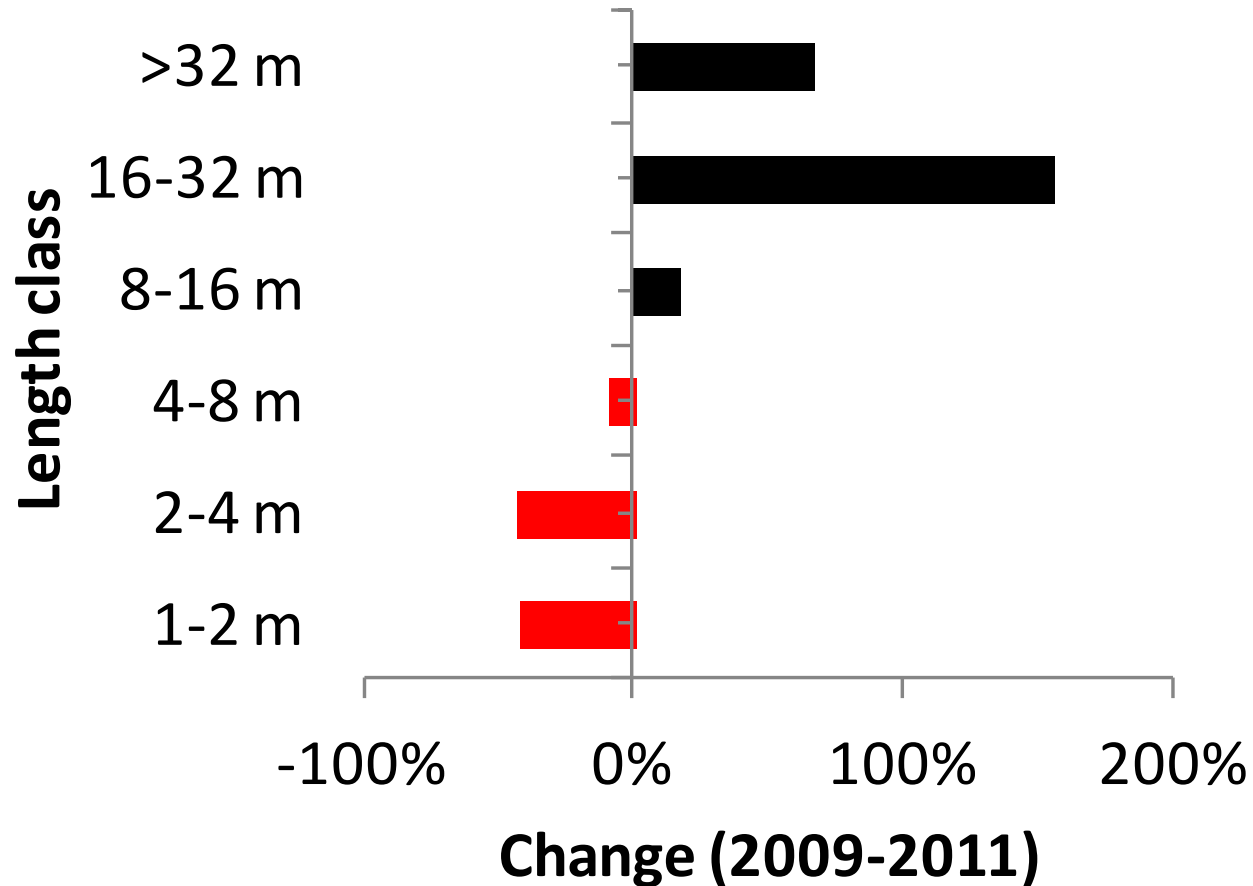


An aerial photograph of a river flowing through a wooded area. The river is light green, indicating turbidity. There are several large, light-colored sandbars or gravel bars in the river. The surrounding forest is mostly bare trees, suggesting late autumn or winter. In the background, there are some buildings and a parking lot. Two white arrows point from text labels to specific areas in the river. One arrow points to a section where a large log is partially submerged, and the other points to a section where a large log is completely submerged.

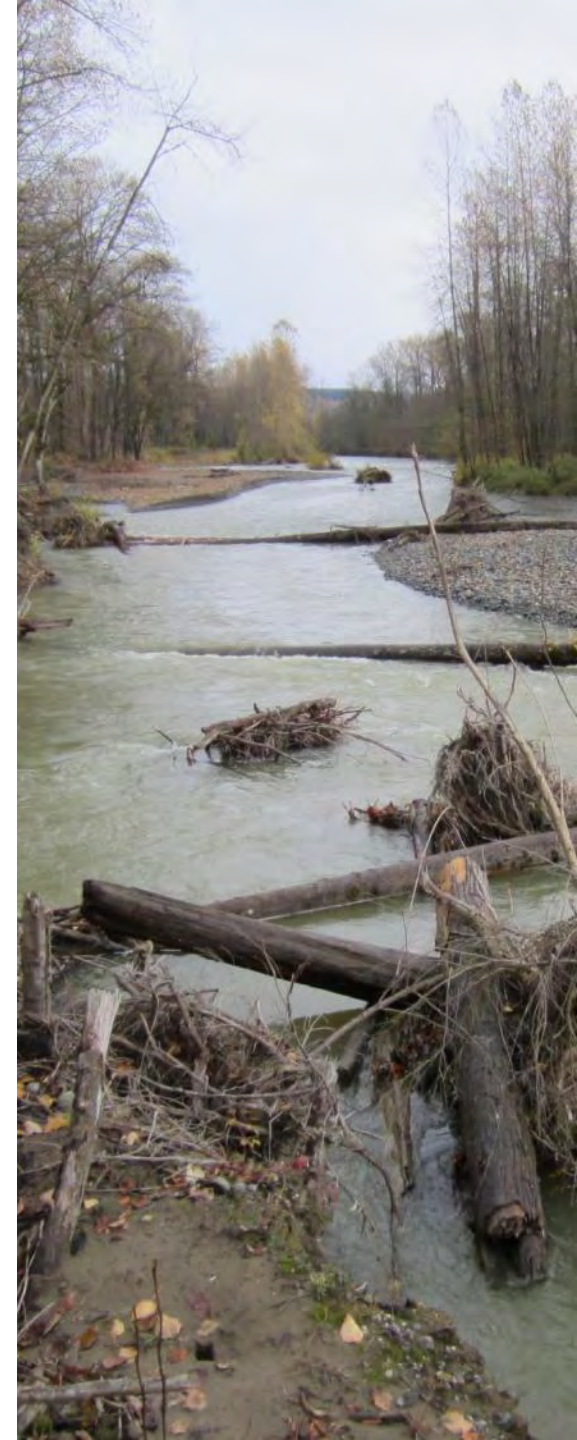
Wood recruitment

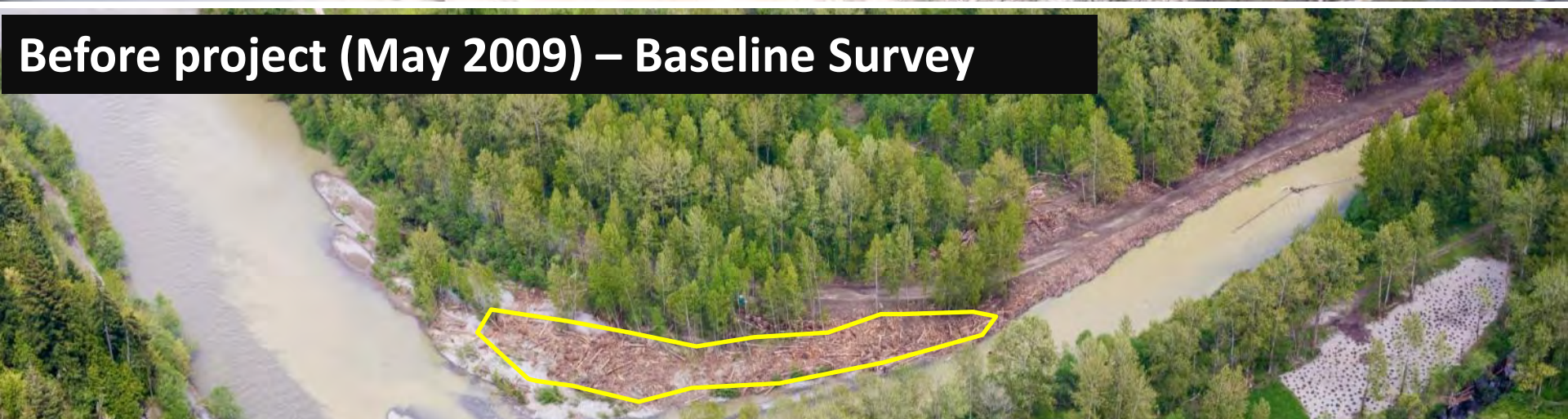
Wood
trapping

LARGE WOOD SURVEYS



34% decrease overall



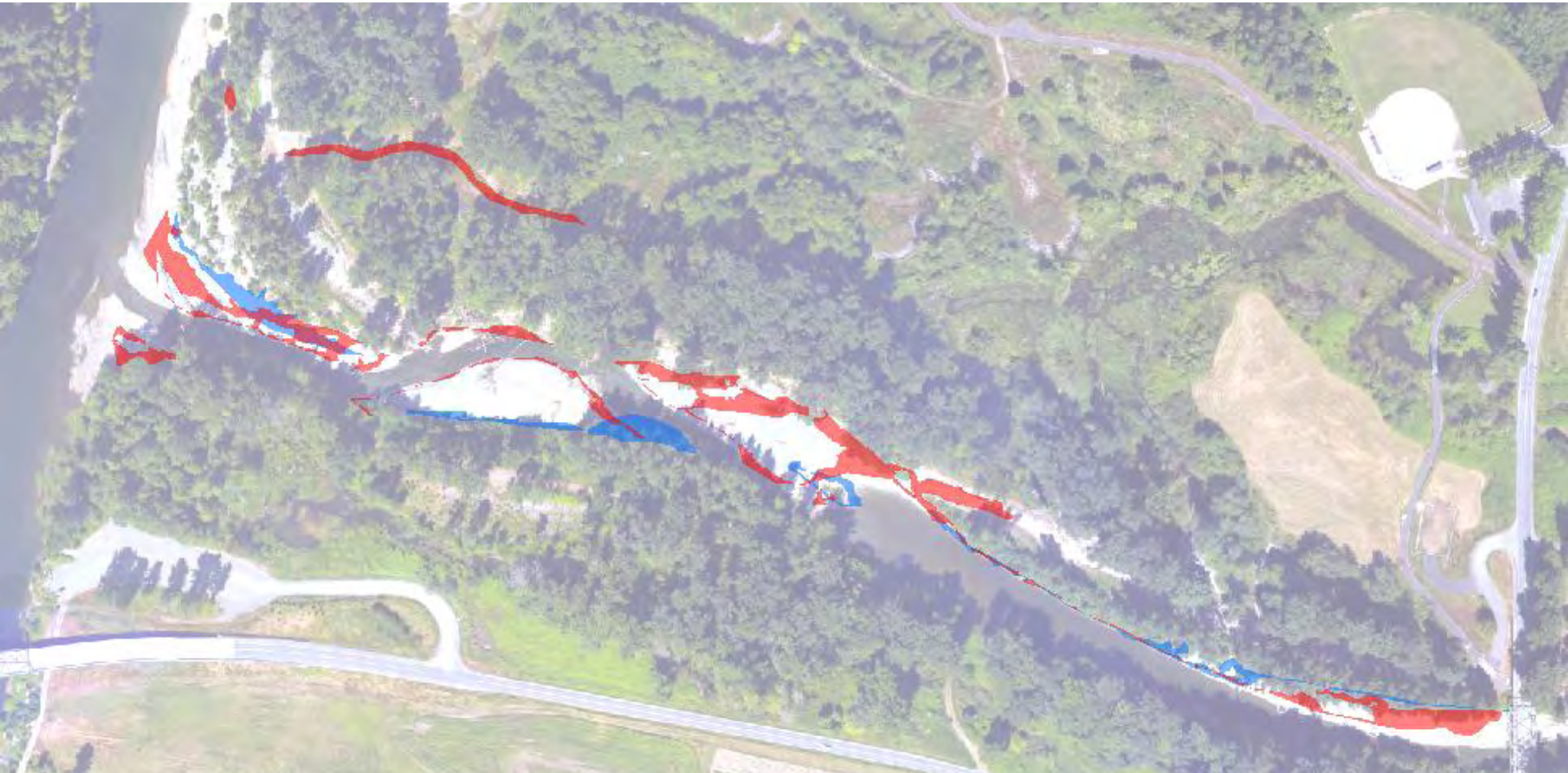


LOW-VELOCITY EDGE MAPPING

Adapted from Beechie et al. 2005



EDGE HABITAT AT HIGH FLOW



Flow level

High (>80th percentile)

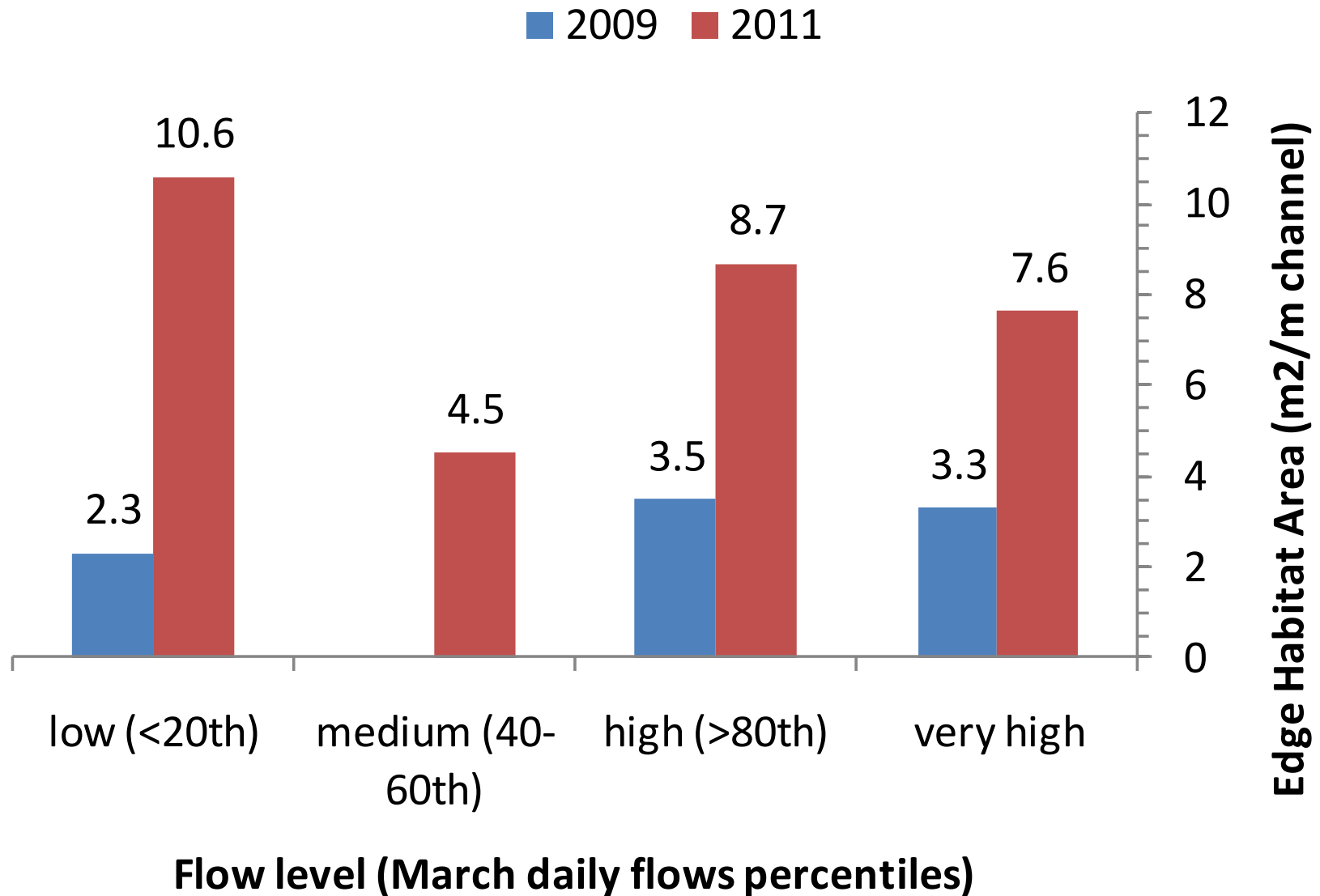
2009

760 cfs

2011

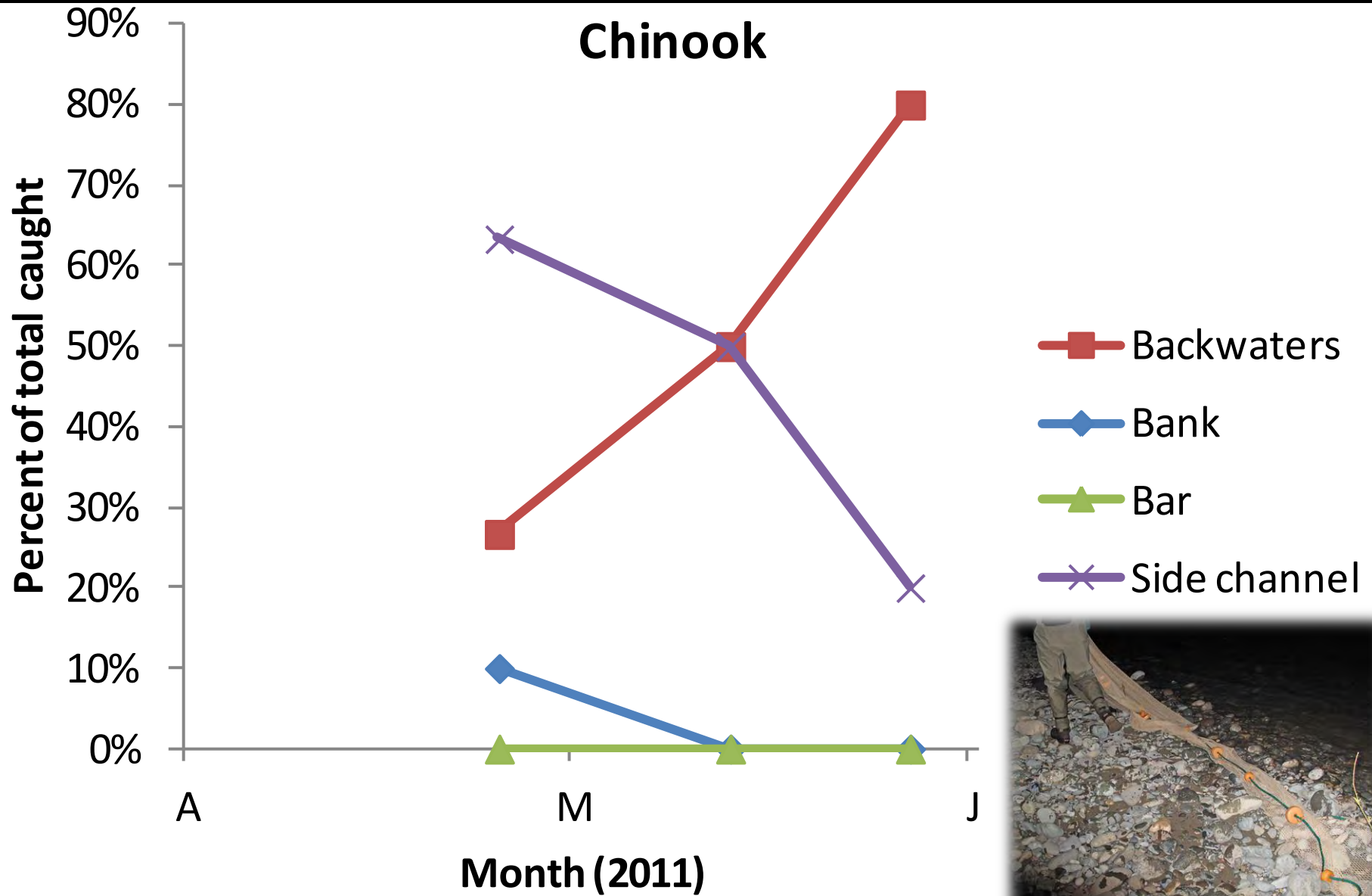
725 cfs

EDGE HABITAT COMPARISON





FISH USE



SUMMARY:

2 YEARS AFTER LEVEE REMOVAL

Expectations Met

- Channel did migrate
- Wider and shallower
- Deposition > erosion
- More wood recruitment
- New trapping sites formed
- More edge habitat;
 - behind gravel bars
 - near logjams

Surprises (so far)

- No avulsion to the wetland
 - Should we intervene?
- Net decrease in large wood
 - Temporary
- River keeps exposing new rock

NEED TO KEEP MONITORING!

LESSONS FOR FUTURE PROJECTS

- 
- An aerial photograph showing a river winding through a dense forest. The river has a sandy bar on the left and a small pond on the right. A road is visible on the right side of the image.
- Make sure channel can migrate and evolve
 - Prepare for multiple scenarios
 - Unlikely to anticipate the actual outcome
 - Consider “principle of least action”
 - Phased or adaptive implementation?
 - Could save lots of money

Acknowledgments

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KC Ecological Restoration Unit, Rivers, Parks, DOT Materials Lab
Herrera Environmental, Cascade Design Consultants

Monitoring Assistance:

D. Lantz, C. Toal, Washington Conservation Corps, T. Beechie, G. Pess

Monitoring Funding:

KC Water and Land Resources Division, King Conservation District



King County

