Identifying and quantifying restorable water storage in the Wenatchee Basin

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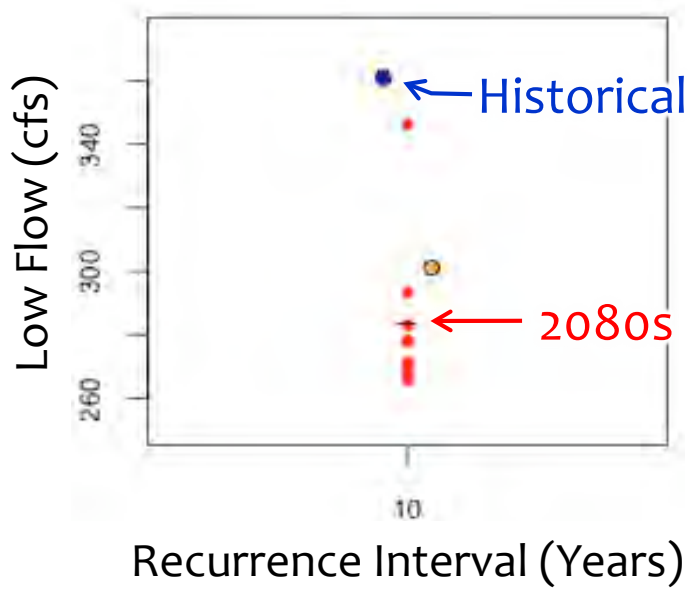
1 Natural Systems Design
2 Chelan County Natural Resource Department
3 Kane Natural Resources

Motivation

Motivation: Current Shortages + Projected Decreases

Wenatchee River - 2080s

Decreases in Low Flows
(7-day, 10-year low flow metric)



Climate Scenario A1B (moderate emissions), Wenatchee River at Monitor
UW Climate Impacts Group (Hamlet et al., 2010)
at http://warm.atmos.washington.edu/2860/

Legacy Impacts: Removal of Wood

Reduced Roughness = Simplified Habitat

Log Jam on the Newaukum River,
Chehalis Watershed, WA

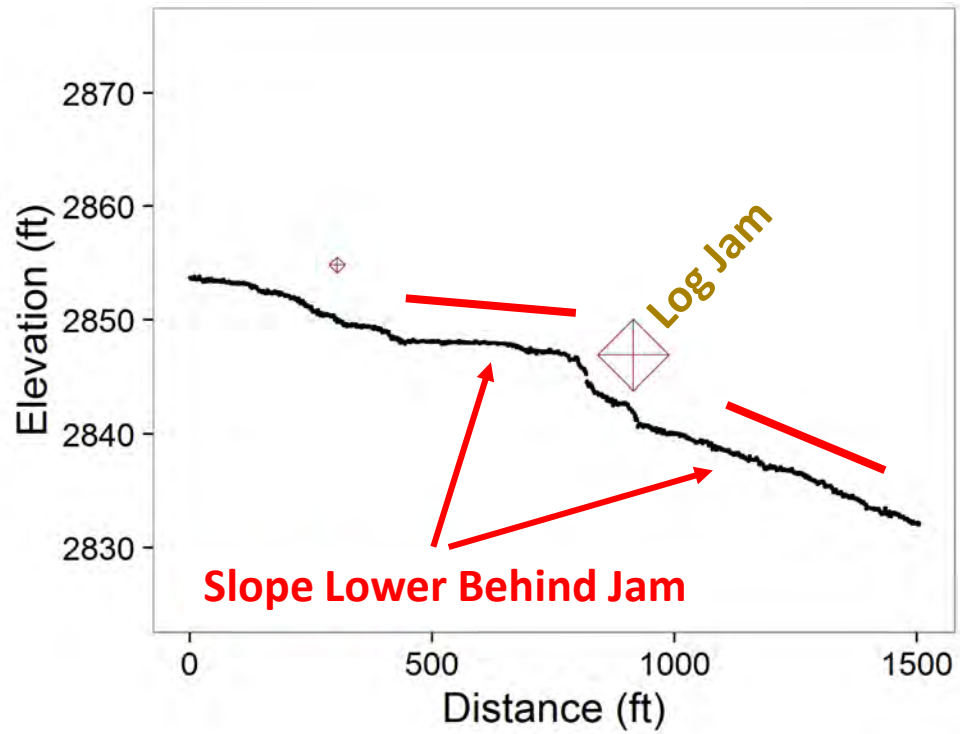
Legacy Impacts: Removal of Wood

Reduced Roughness = Simplified Habitat

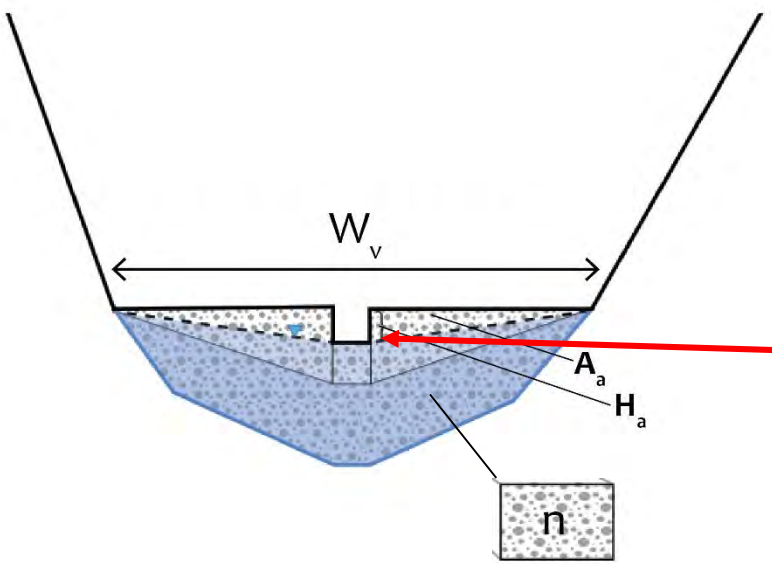
Reduced Roughness = More Erosive Power

Log Jam on the Newaukum River, Chehalis Watershed, WA

Sediment Stored behind Log Jam Sullivan Creek, NE WA



Incised Channels Reduce Groundwater Storage

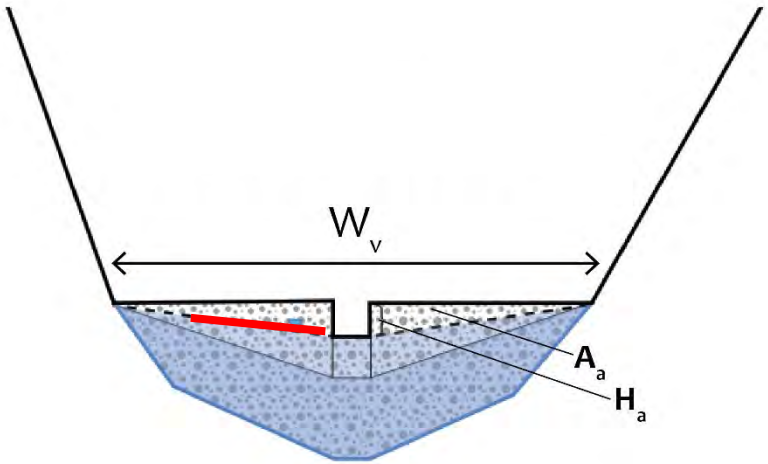


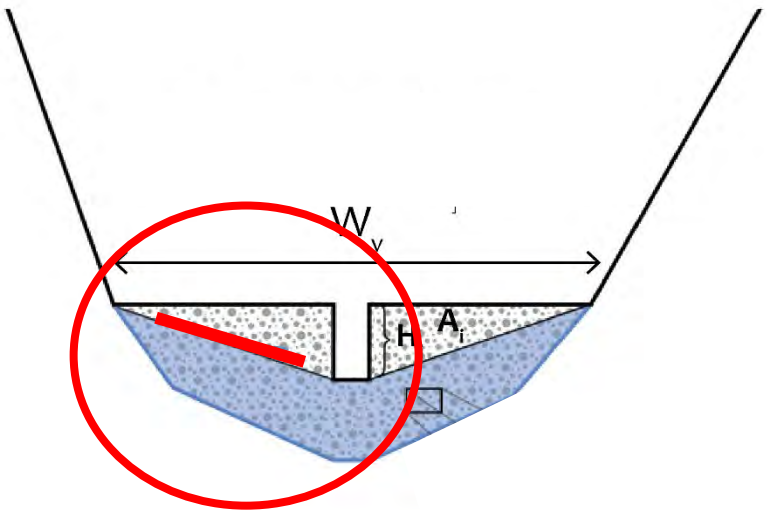
Groundwater storage in stream valleys controlled by:

- Valley Width (W_v)
- Porosity (n)
- Elevation of channel

Incised Channels Reduce Groundwater Storage

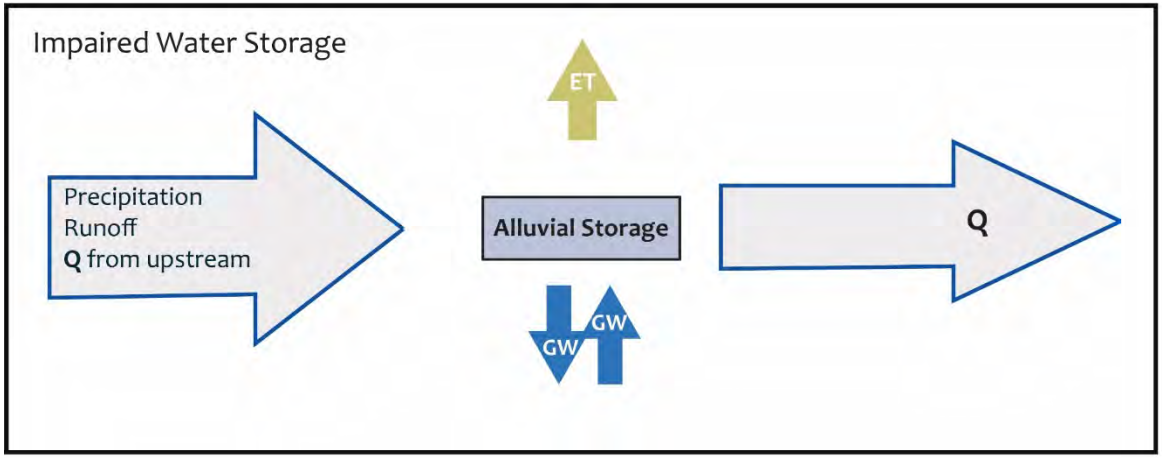
Channel elevation controls groundwater elevation -> **Drains groundwater**





Storage Affects Streamflow Timing and Forest Health

March Water Balance



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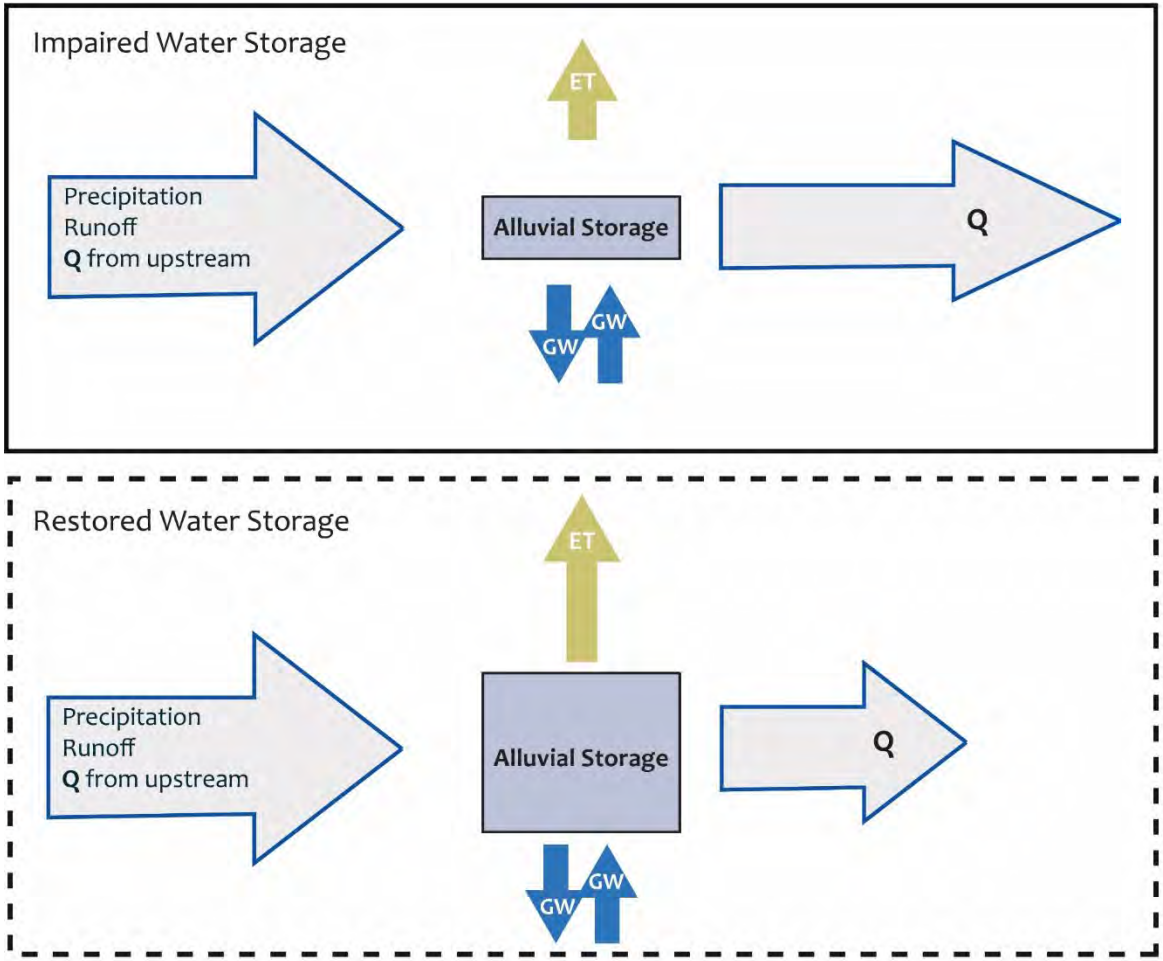

Storage Affects Streamflow Timing

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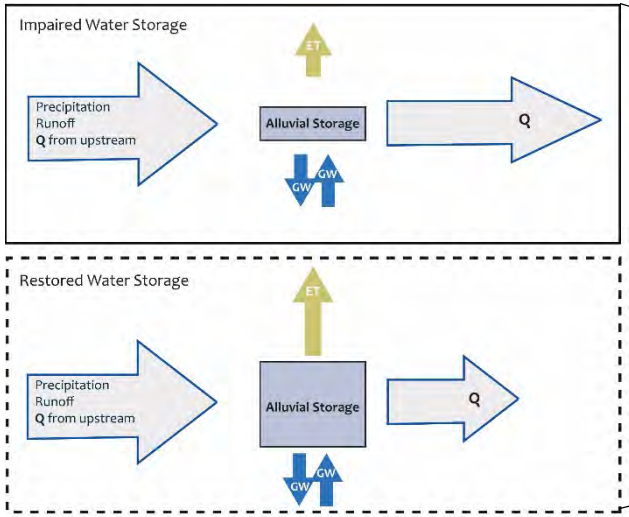
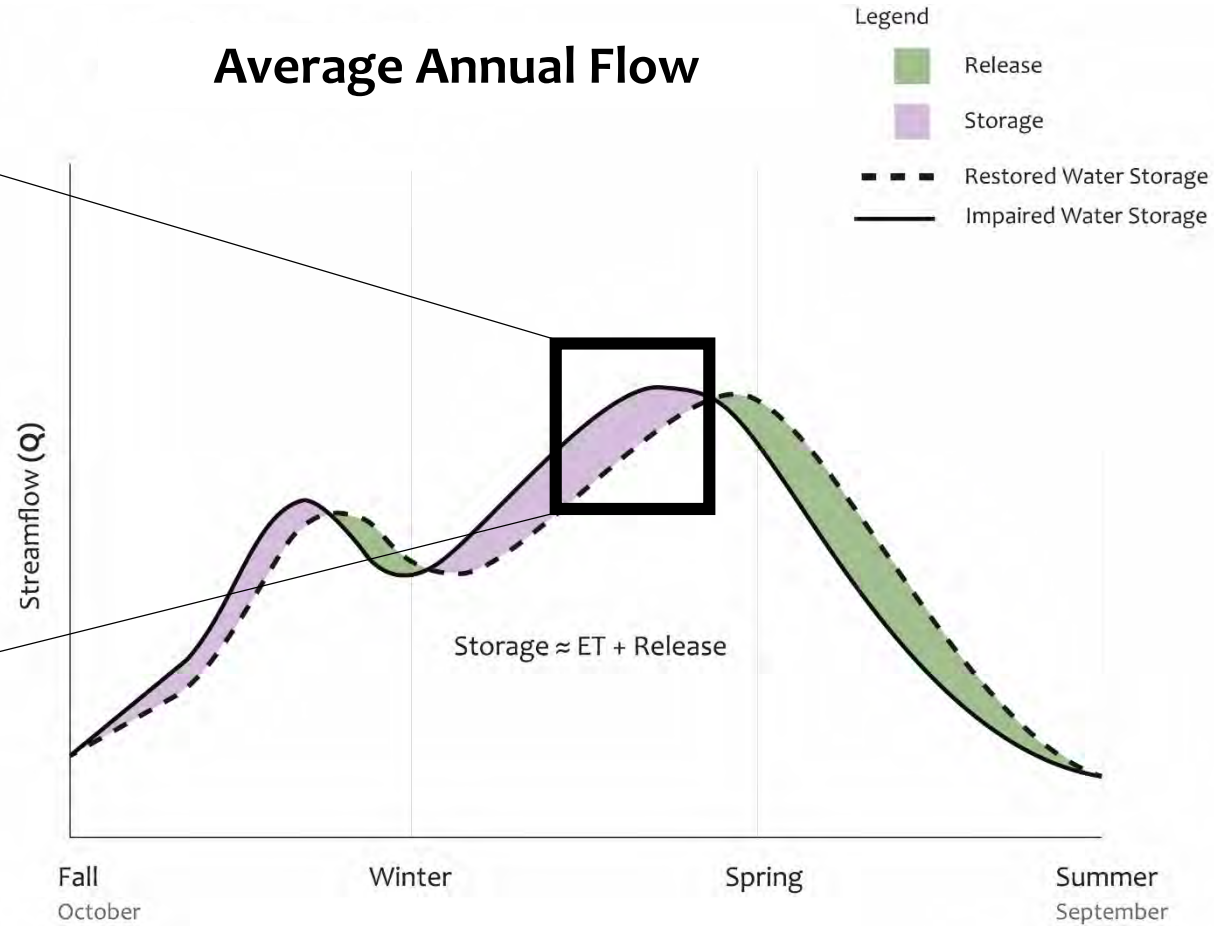


Average Annual Flow

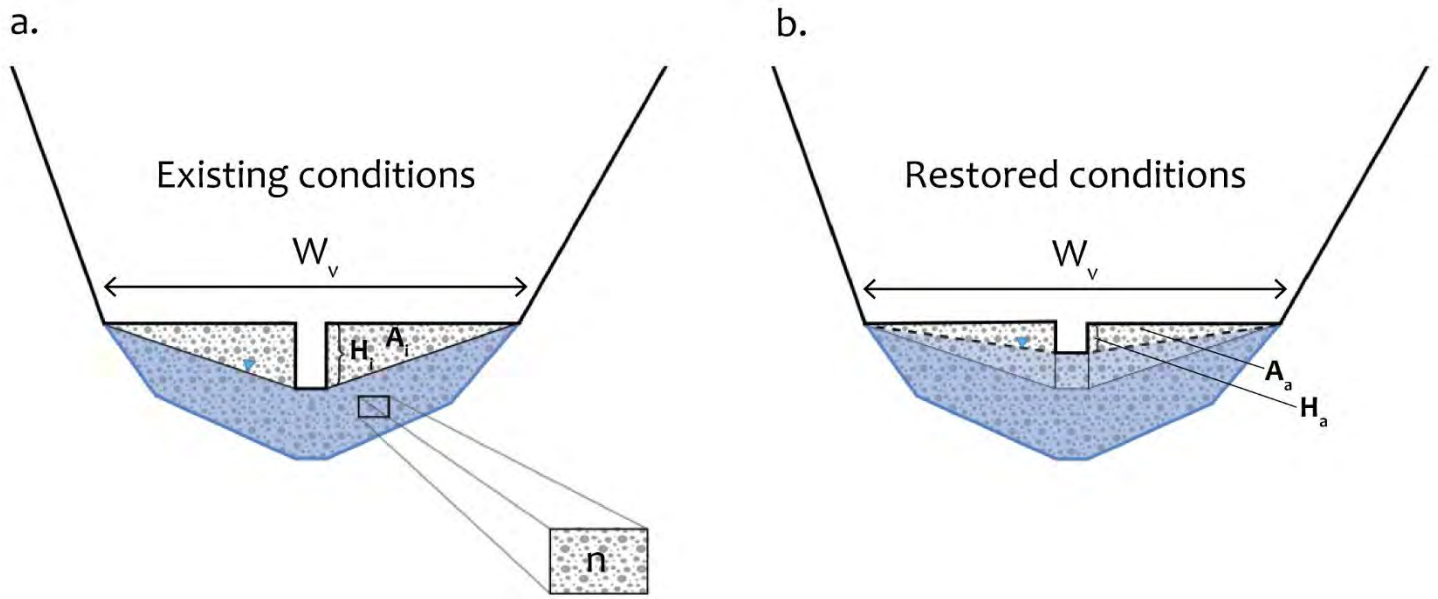


Pilot Project

Poison Creek before Restoration: Channel Depths of 3-5 feet

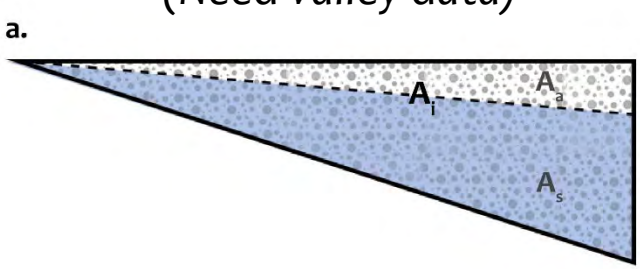
(drainage area: 3 mi^2)

How Much Restorable Water?



Compute Area of Wedge

(Need valley data)



Poison Creek Construction

Channel Aggradation - 1 Year Post-Construction

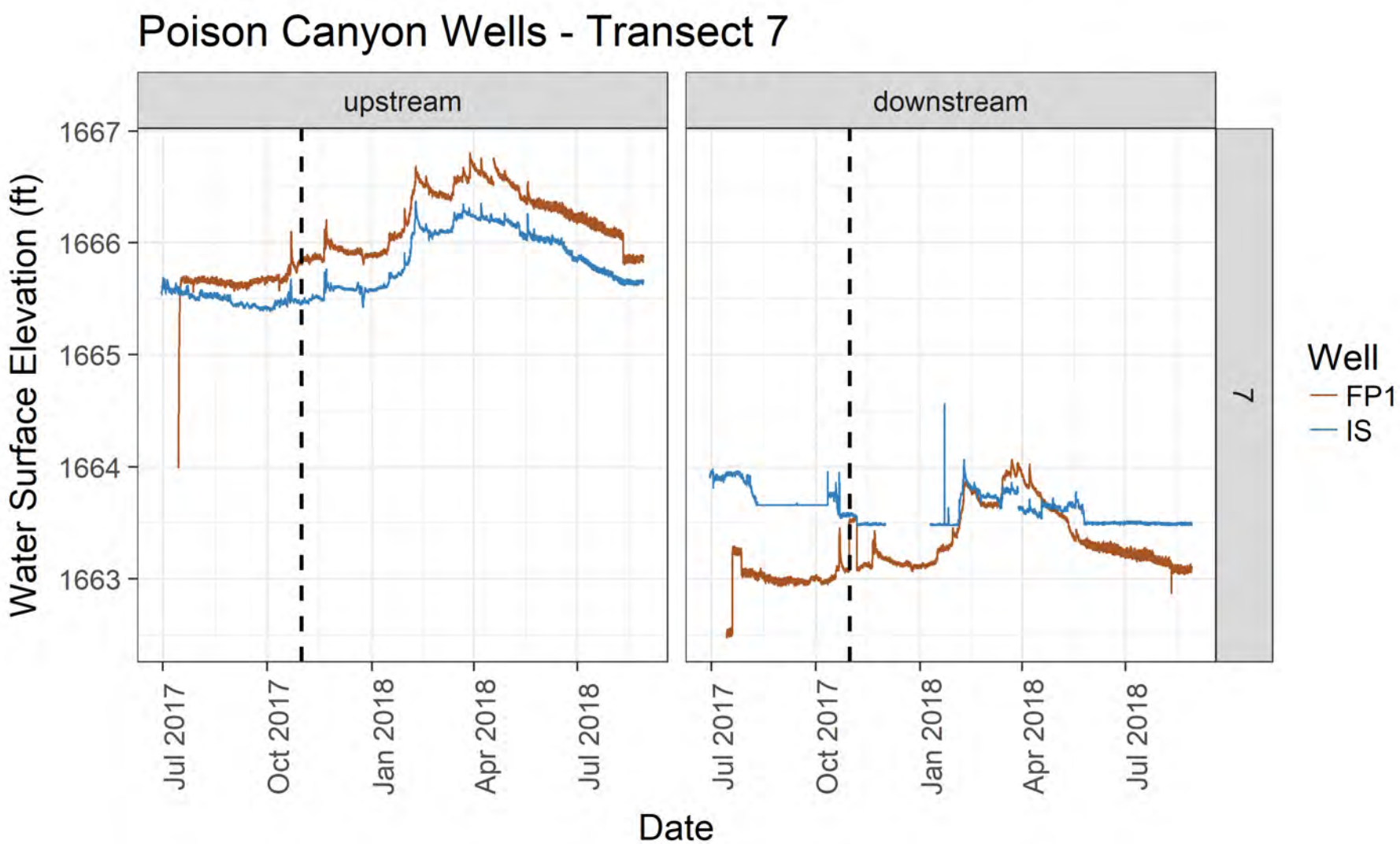
Channel Aggradation - 1 Year Post-Construction

Post-project Survey:

- Reduction in local gradient from **5-7% to ~1%**
- Storing **1-5 cubic yards of sediment** behind each structure

Flow-Splits and Surface Water in Floodplain in August

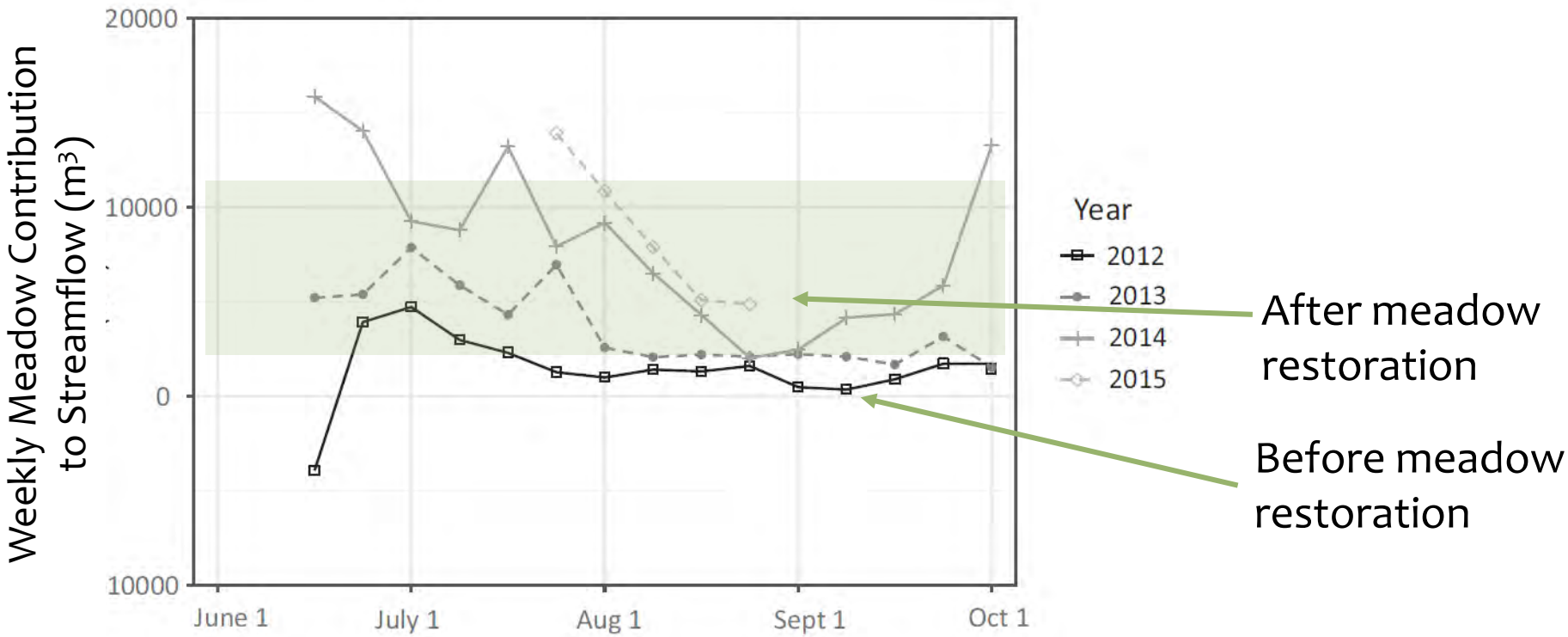
Groundwater



Streamflow Timing

Two studies have shown summer streamflow contributions from restored meadows

(Tague et al 2008 and Hunt et al 2018 (below))

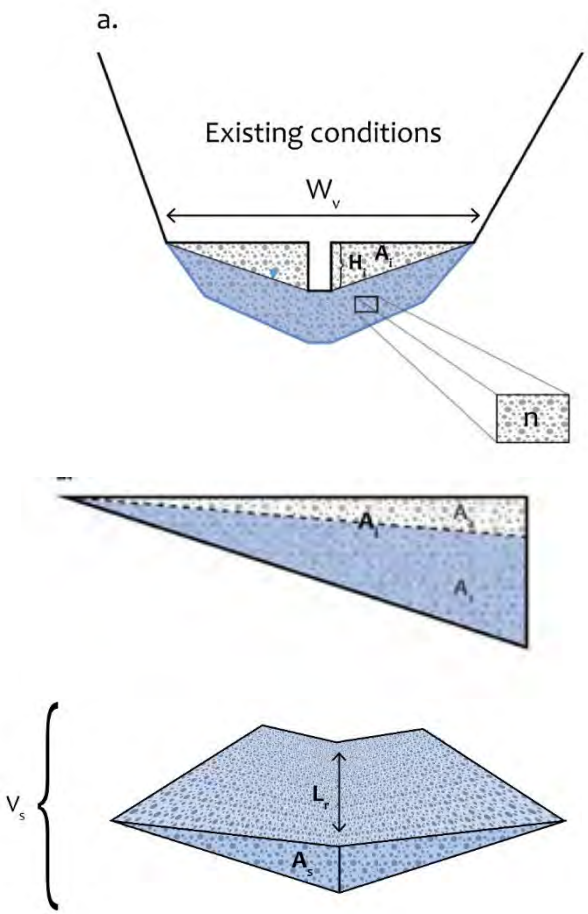


June - October

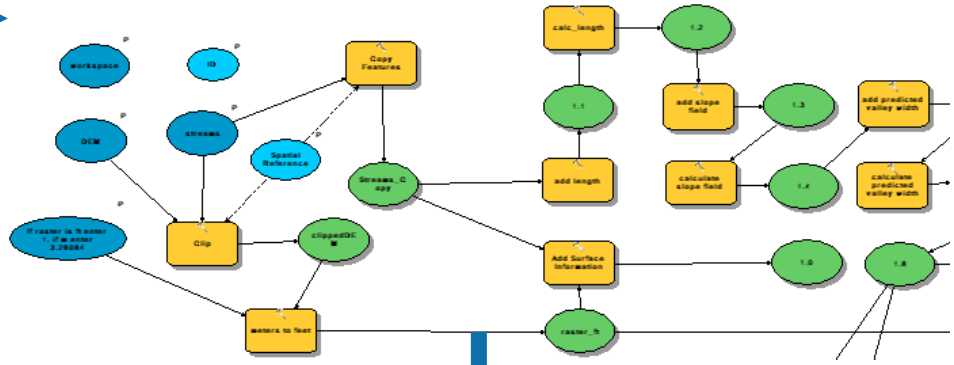
Watershed-Scale Screening

Estimating Restorable Water Volume

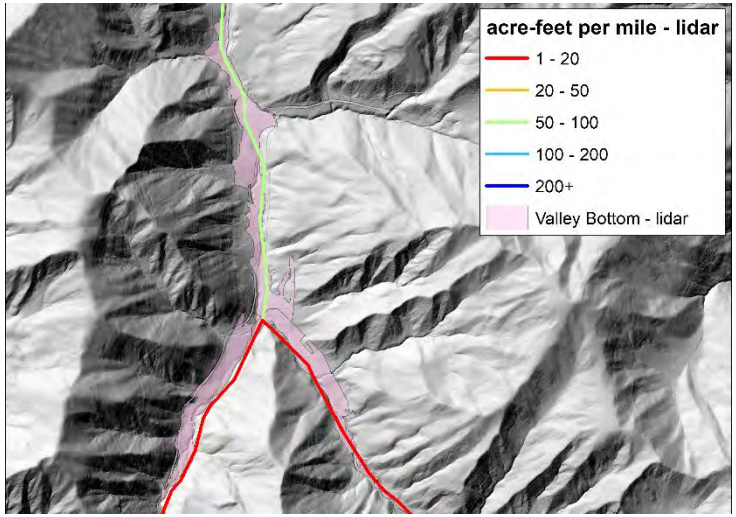
Geometric calculations



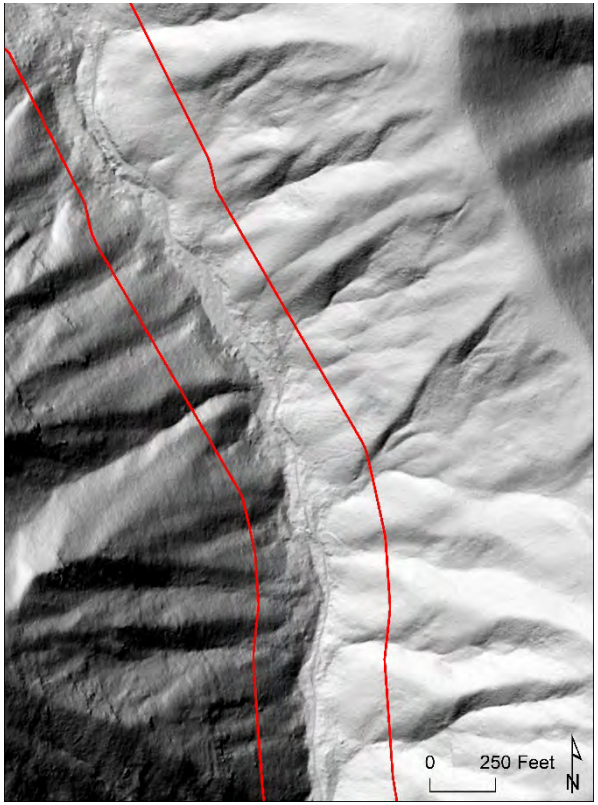
Spatial Analysis in a Model-Builder Framework



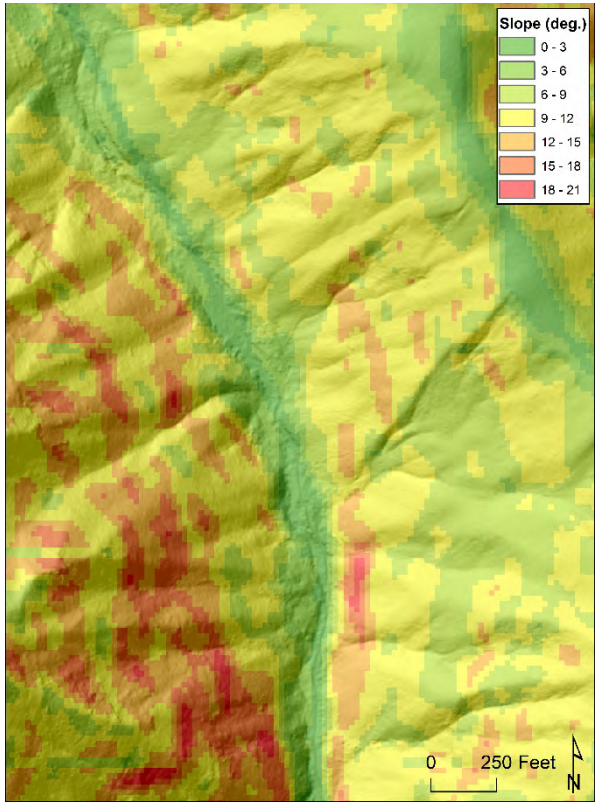
Distributed Water Storage Potential



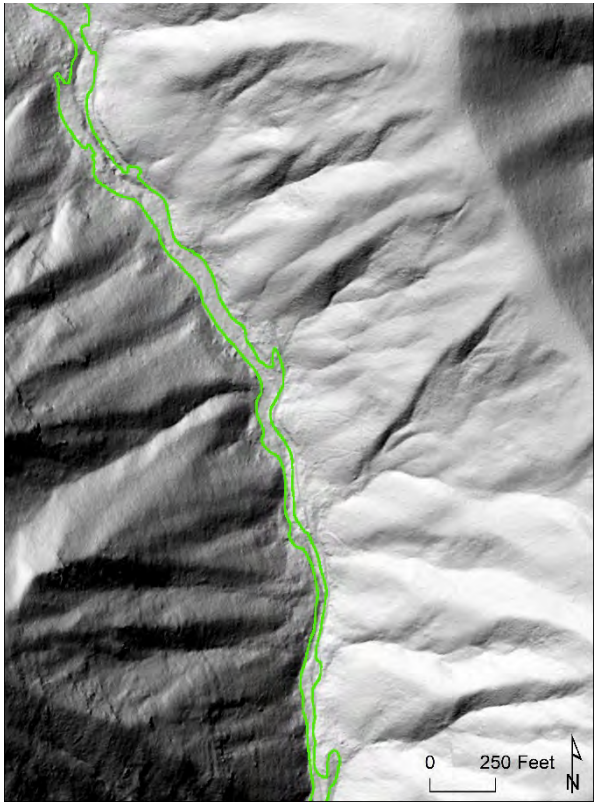
Spatial Analysis + Computational Framework



"Maximum" valley width from stream gradient and drainage area



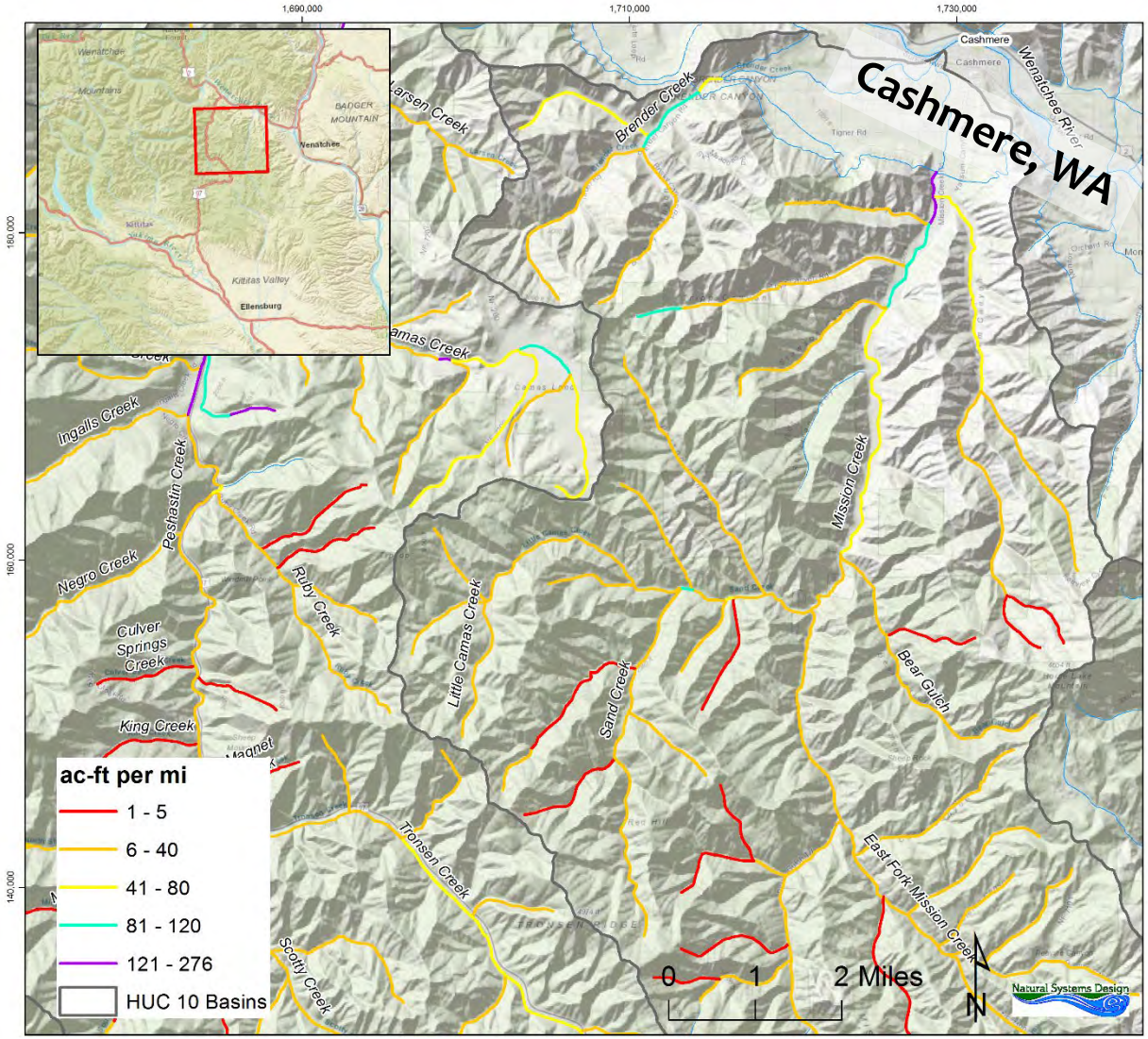
Slope raster to identify valley bottom pixels



Valley bottom polygon

Watershed-Scale Screening

- 3 watersheds in the Wenatchee Basin
- **> 11,000 ac-ft** over 370 miles of stream
- Prioritize reaches for pilot project recon



Screening of Sites at Watershed-Scale

Chumstick Watershed

Peshatin Watershed

Thanks!

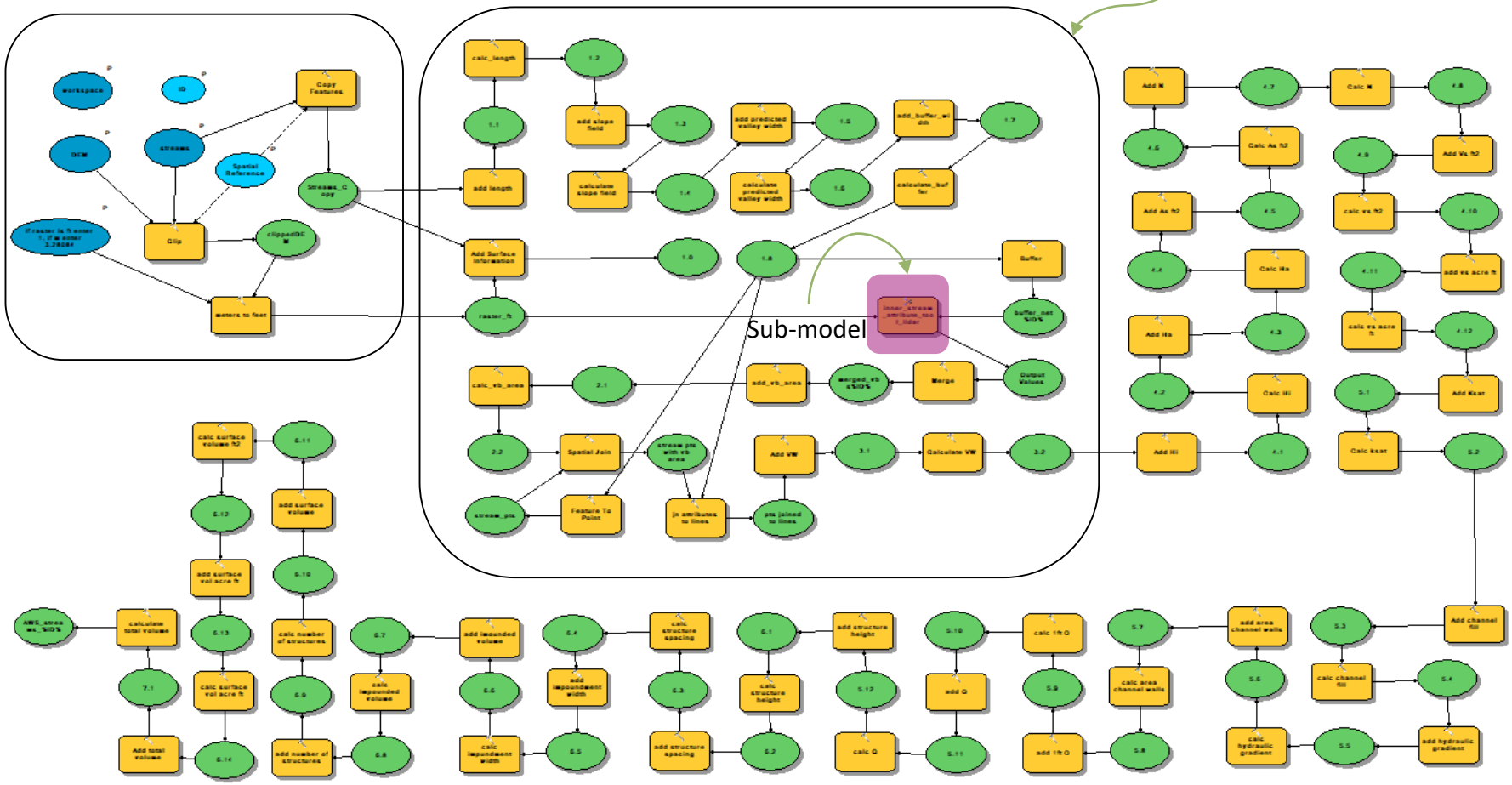
Susan Dickerson-Lange
susan@naturaldes.com

Natural Systems Design

Model Builder – Internal Structure of Model

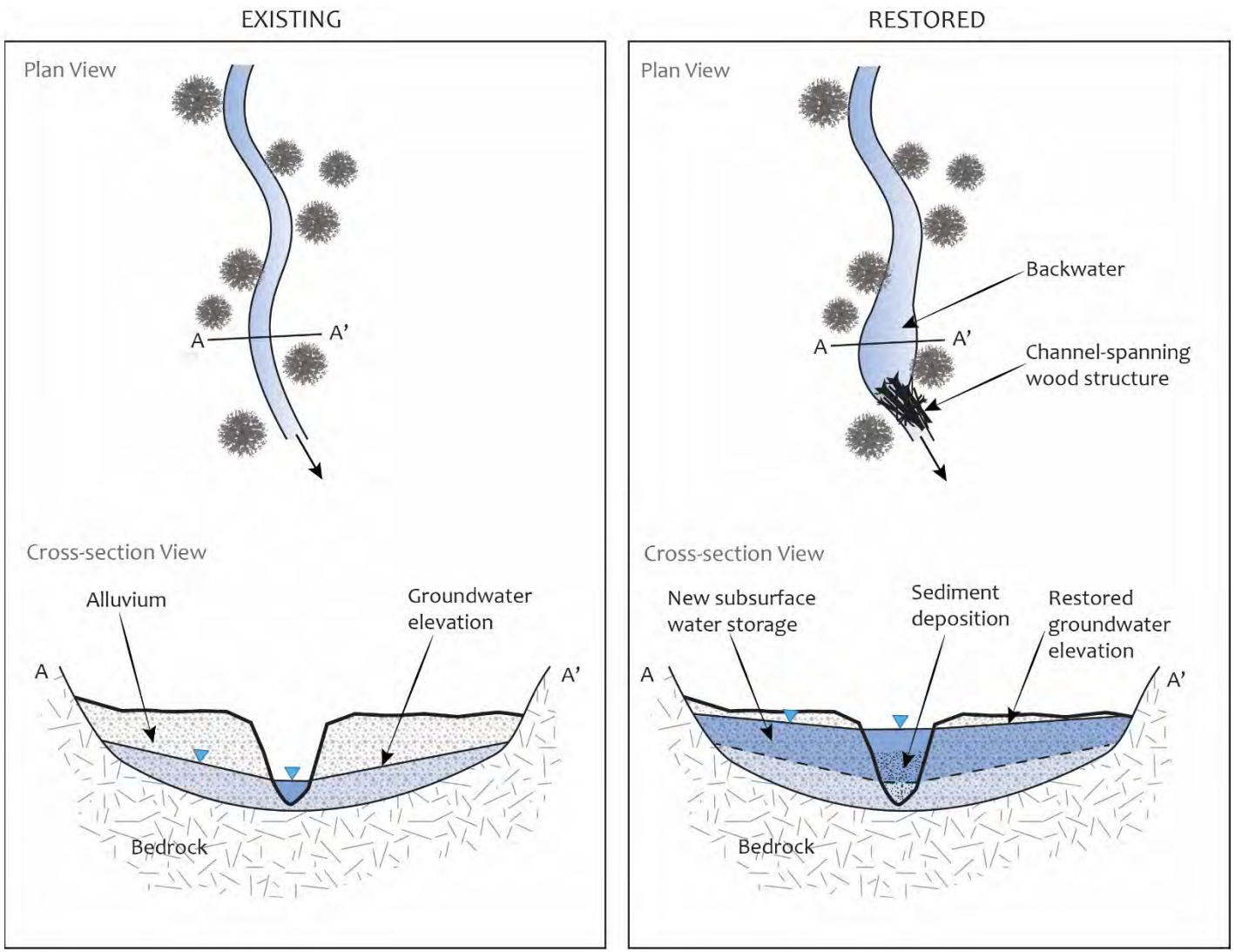
Inputs and processing controls

Valley Bottom Delineation



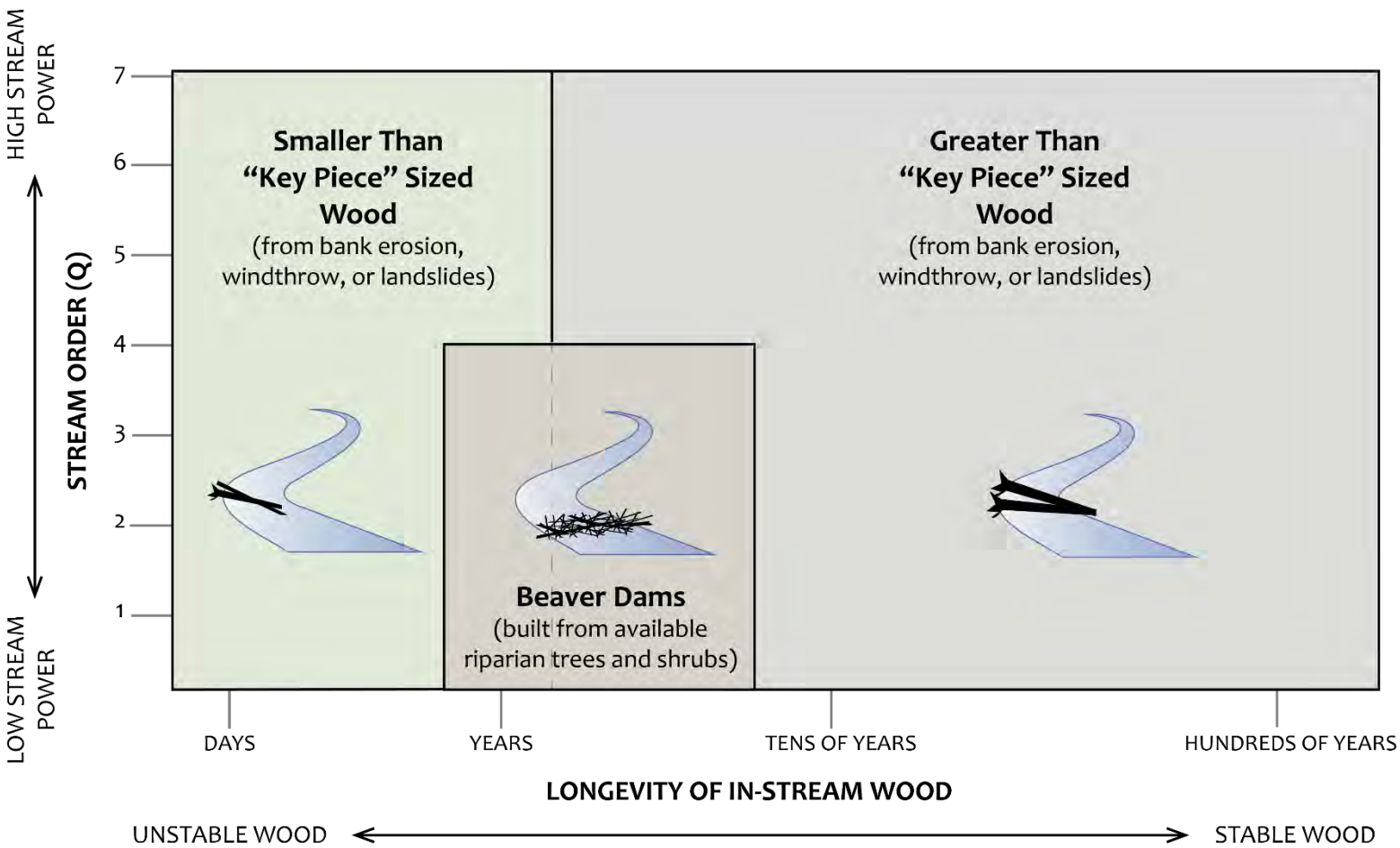
Definition and calculation of water storage parameters

Restoring Natural Water Storage



Restoration Approaches Vary with Stream Size

Range of In-Stream Wood Sources and Longevity



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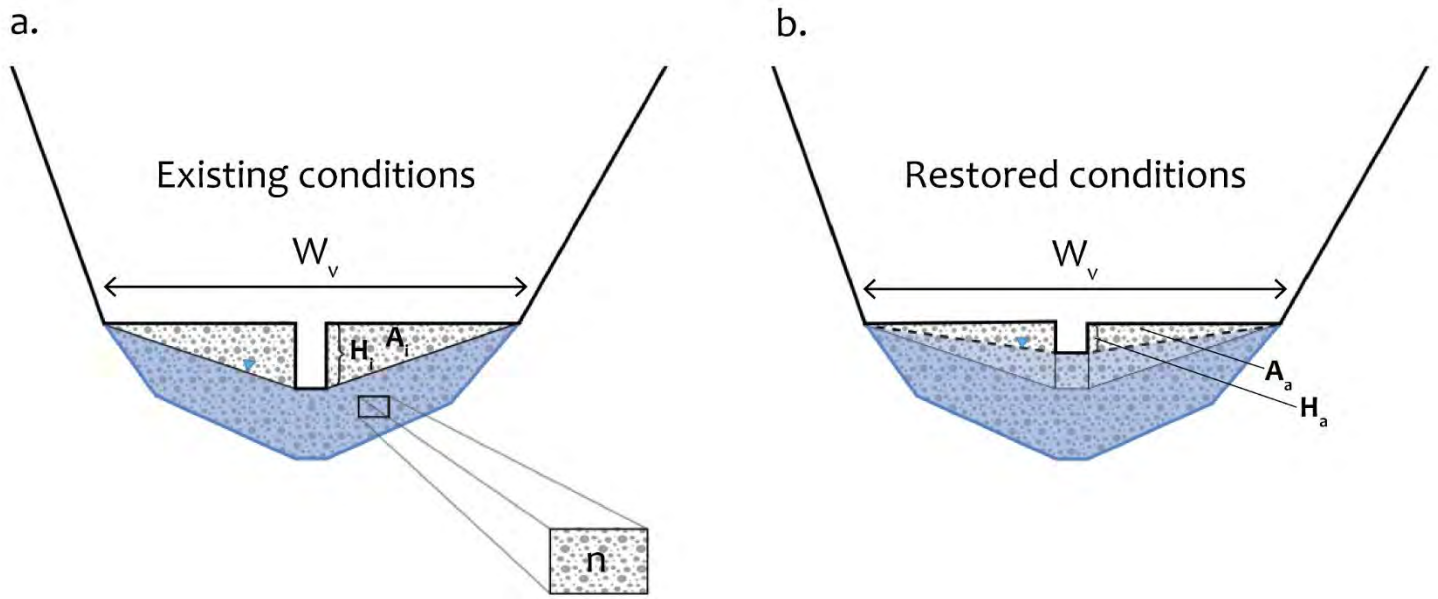

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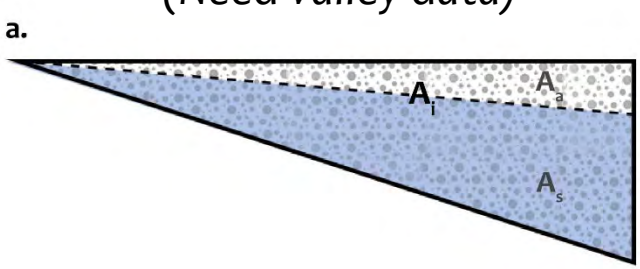

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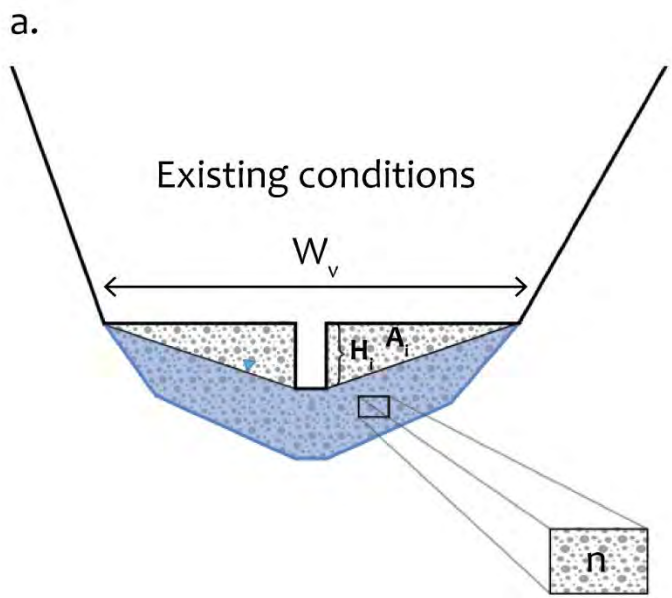
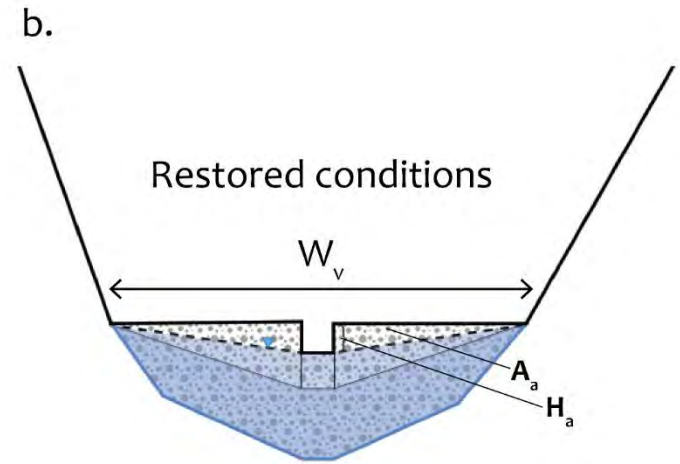
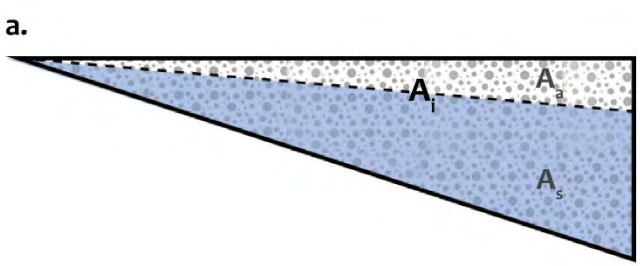
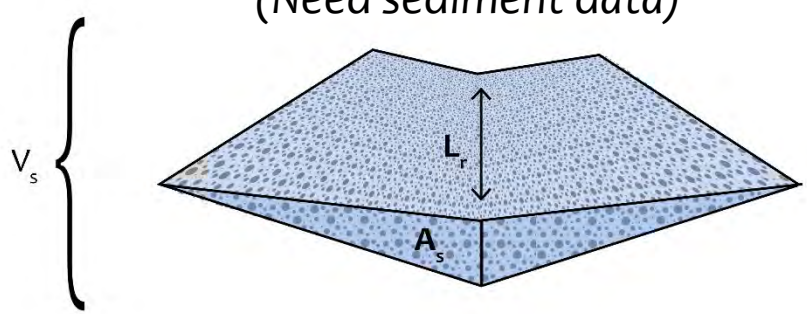




Compute Volume of Water

(Need sediment data)