NetMap

Desktop watersheds and analysis tools

Earth Systems Institute
Seattle/Mt. Shasta/Fort Collins

A Collaborative Enterprise since 2007

-National Forests (WA, OR, NCA, AK, ID, MT)
-Forest Service Research: PSW, PNW; RMRS
-NOAA
-BLM
-EPA
-Oregon Dept. Forestry
-NGOs
-Watershed Councils
-Universities
-Private timber

Applications

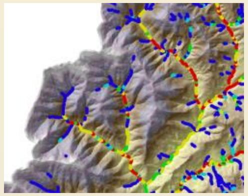
Forestry: Timber harvest riparian management

Roads

Restoration

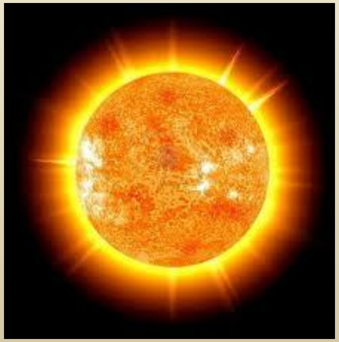
Conservation

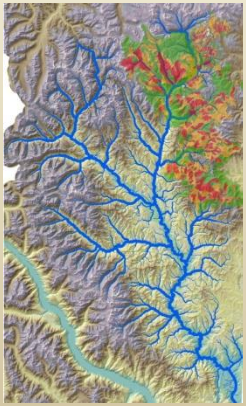
Aquatic Habitats



Pre-fire planning

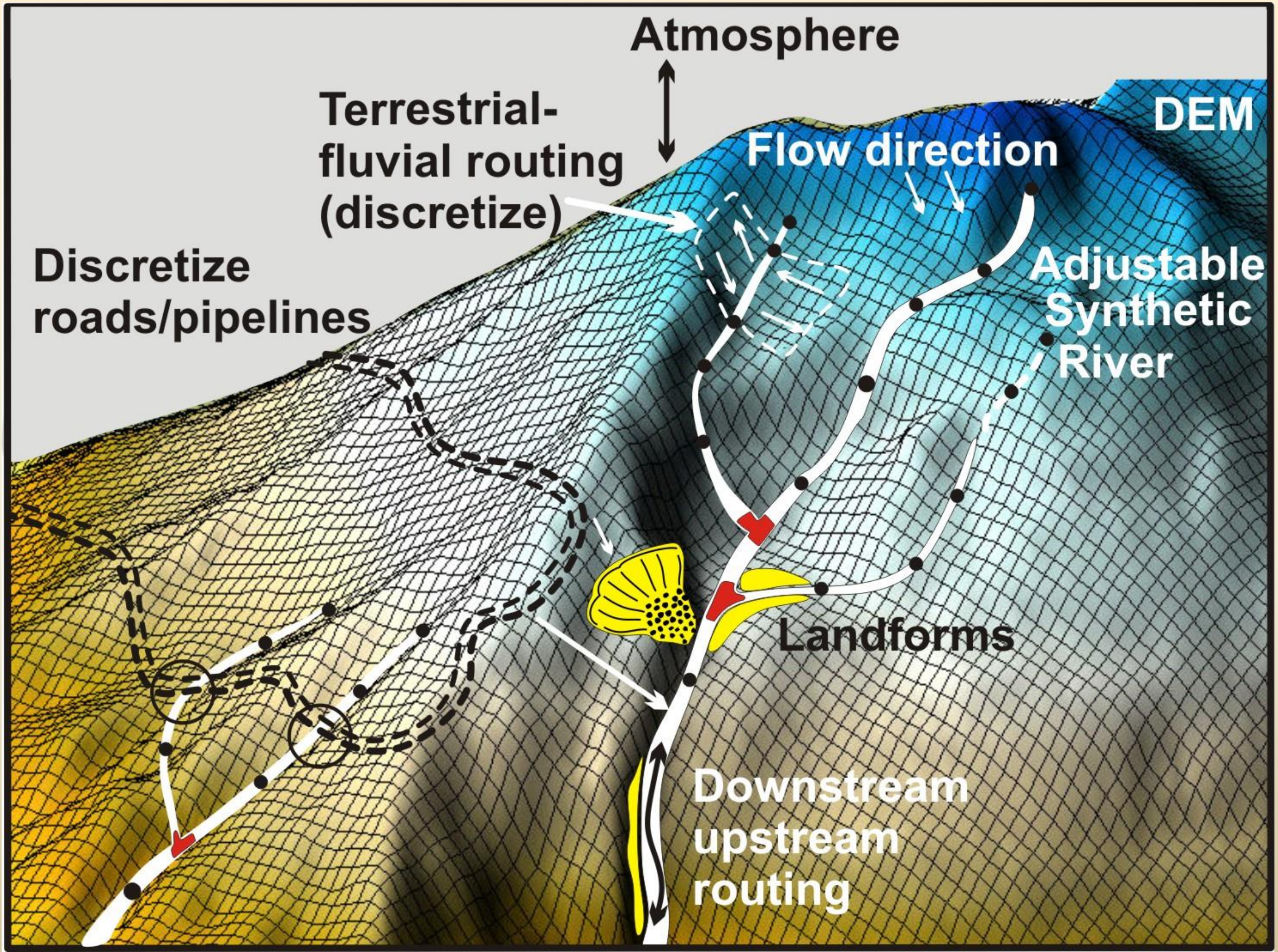
Climate change



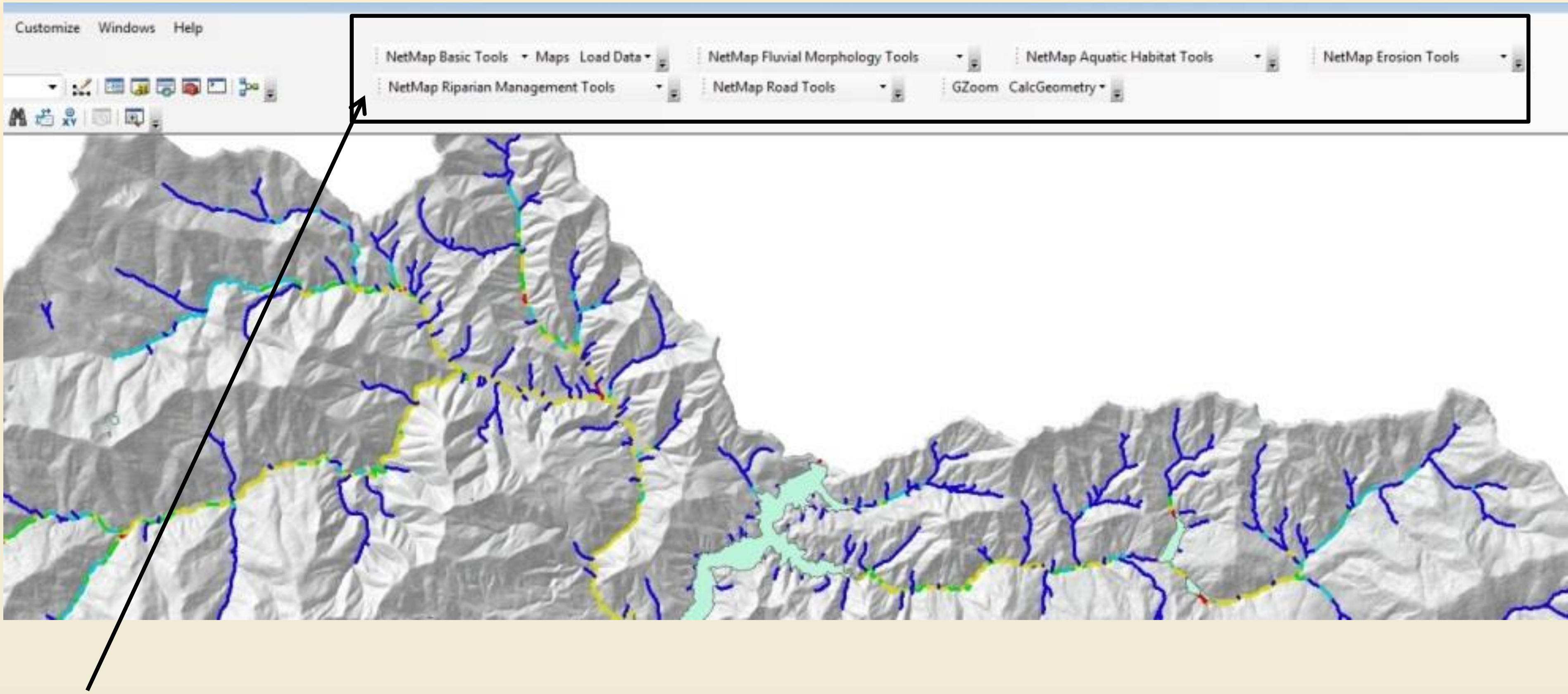


Post-fire (BAER) planning

A <u>desktop watershed</u> is a virtual environment where landforms and physical and biological processes are placed in context with spatial patterns of human activities and infrastructure

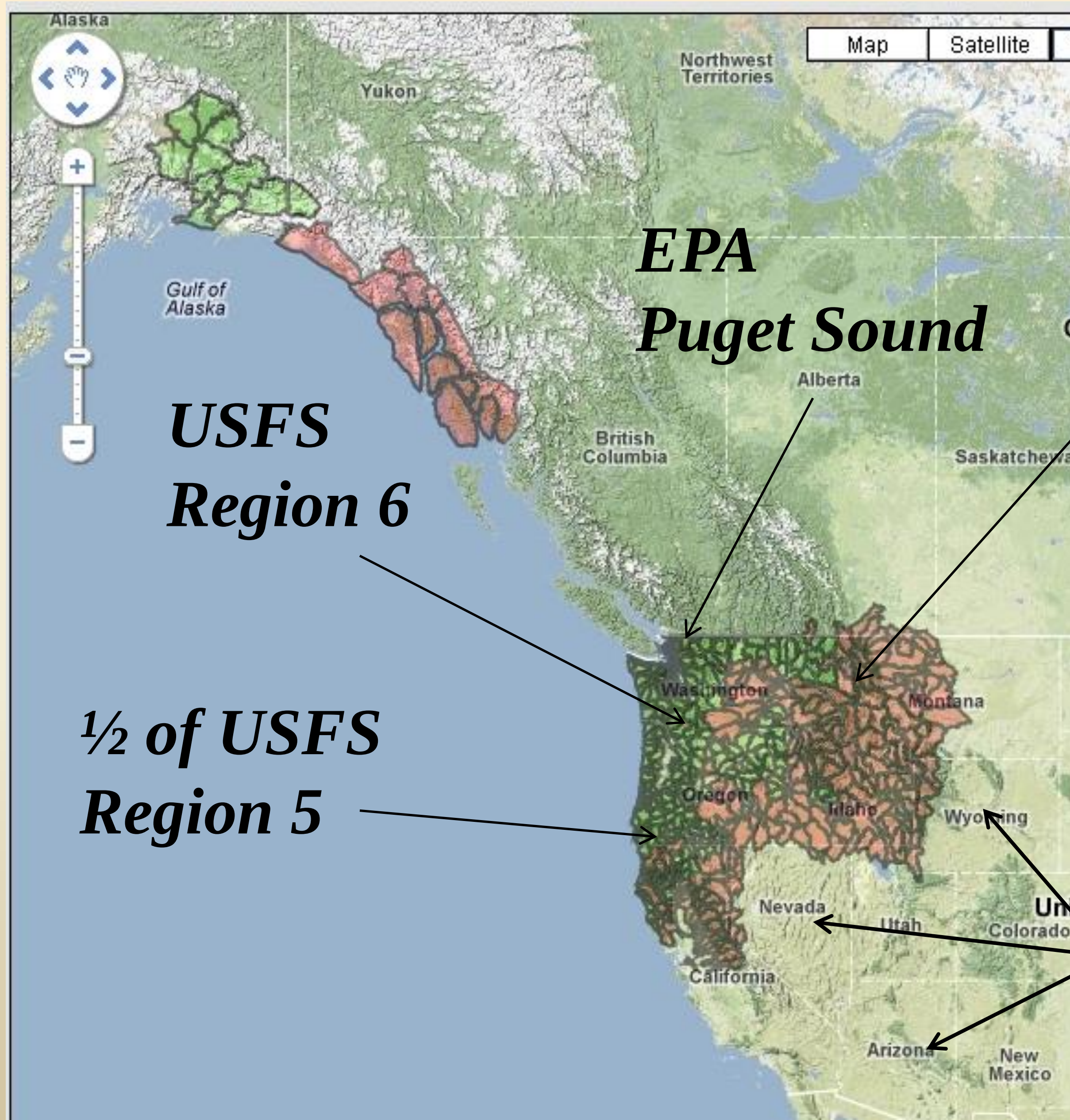


NetMap in ArcMap 10/10.1



~70 tools/100+ parameters
-River Builder (create your own)
-Basic Tools
-Fluvial Morphology
-Aquatic Habitat
-Erosion
-Riparian Management
-Transportation/Energy

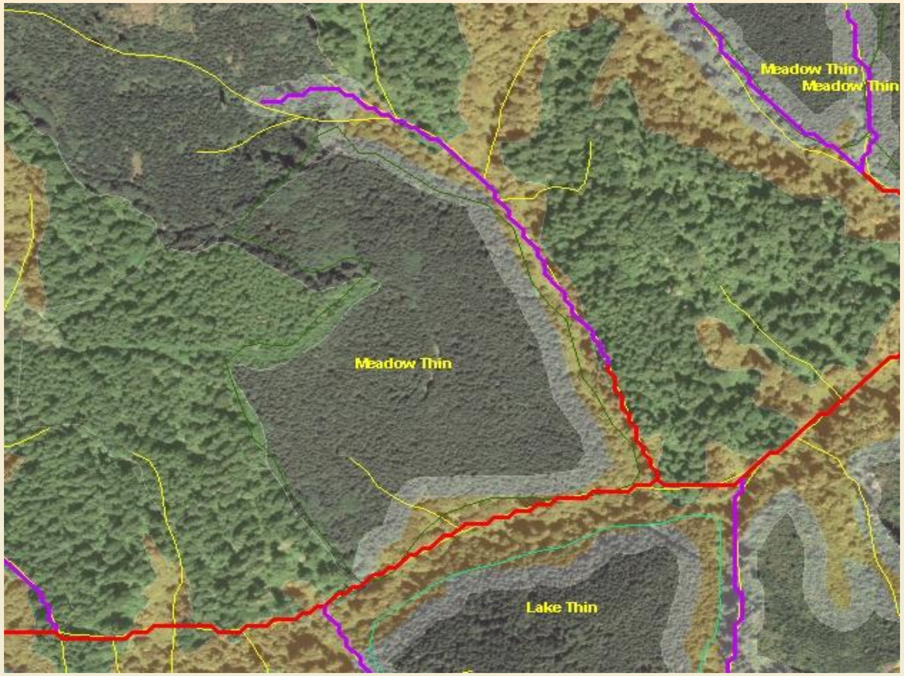
Current and Pending Coverage



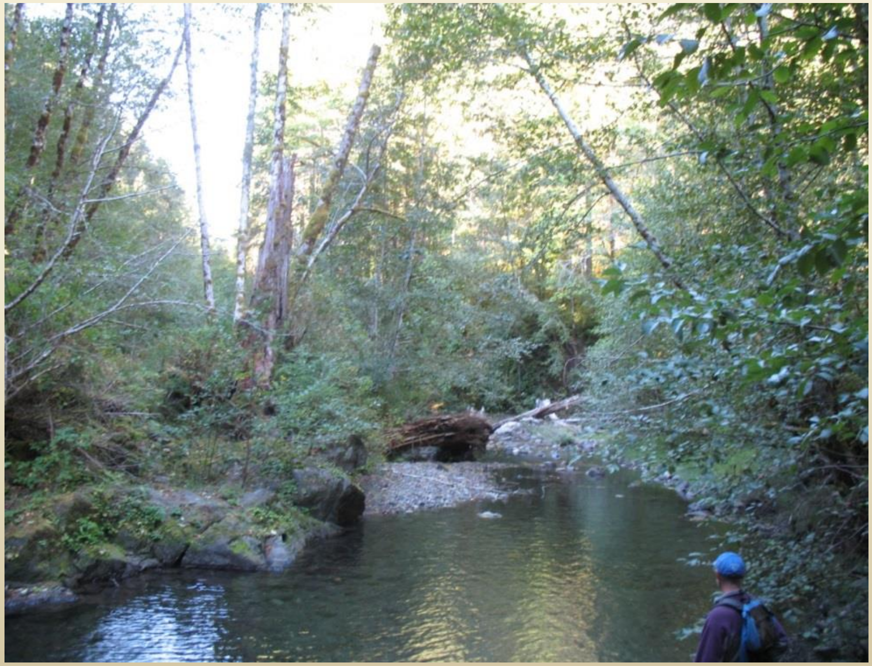
NetMap Tools

Over to Sam…

Spatially Explicit Riparian Management

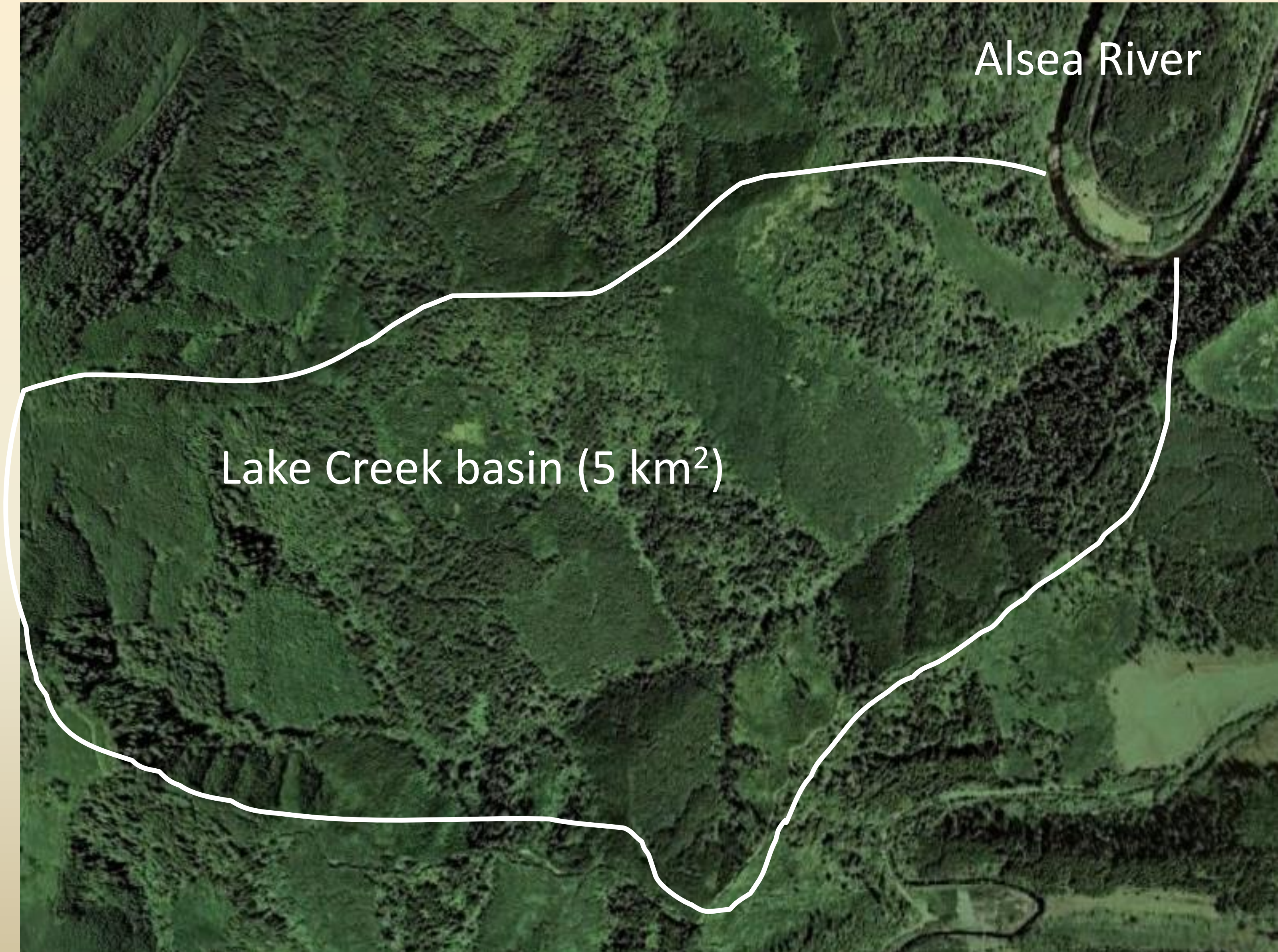


A stepwise procedure for riparian management planning based on:

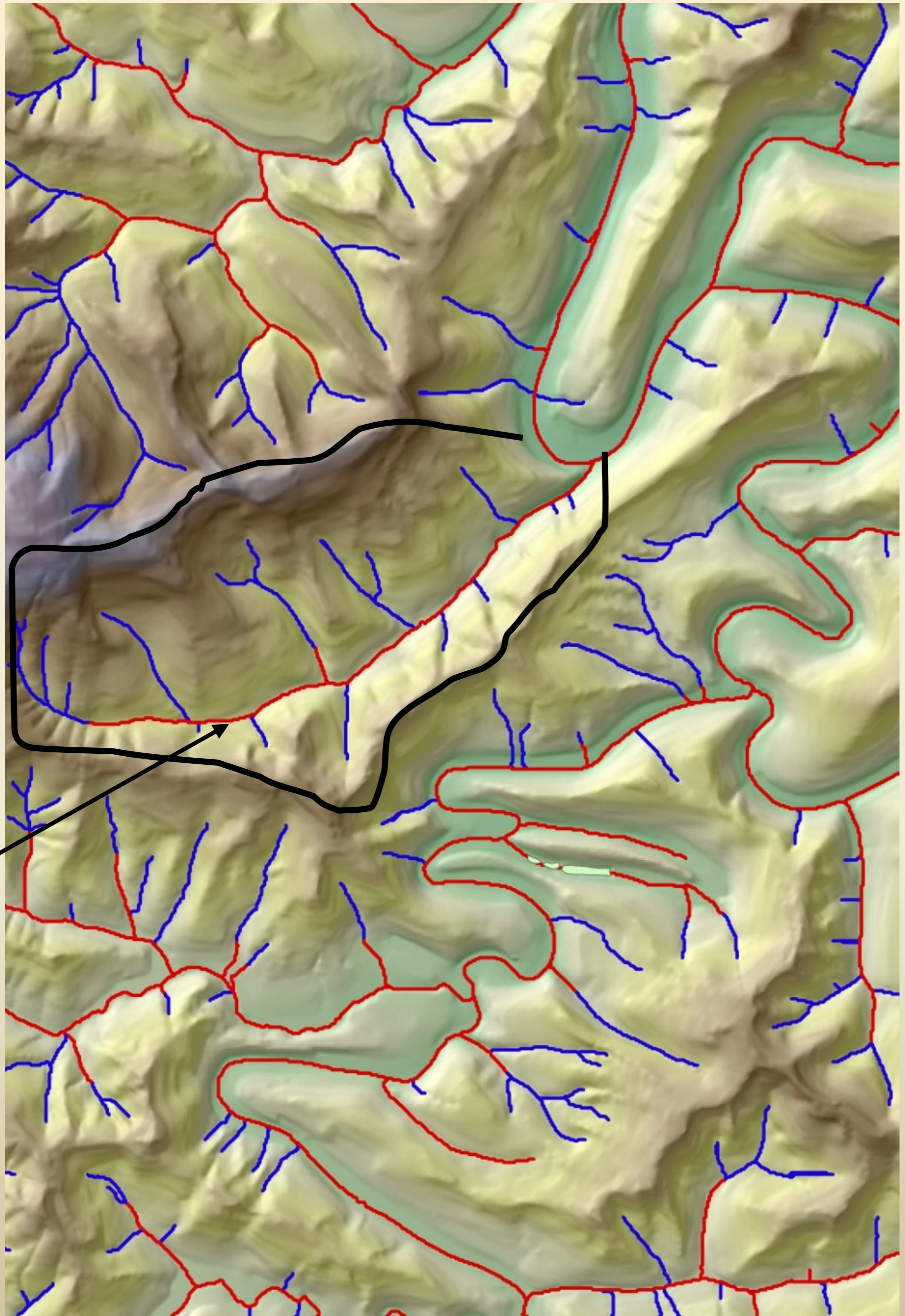


- ❖ fish habitat distribution,
- ❖ debris flow risk & upslope wood recruitment,
- ❖ streamside mortality wood recruitment
- ❖ thermal loading

Example area: Lake Creek, a tributary to the Alsea River



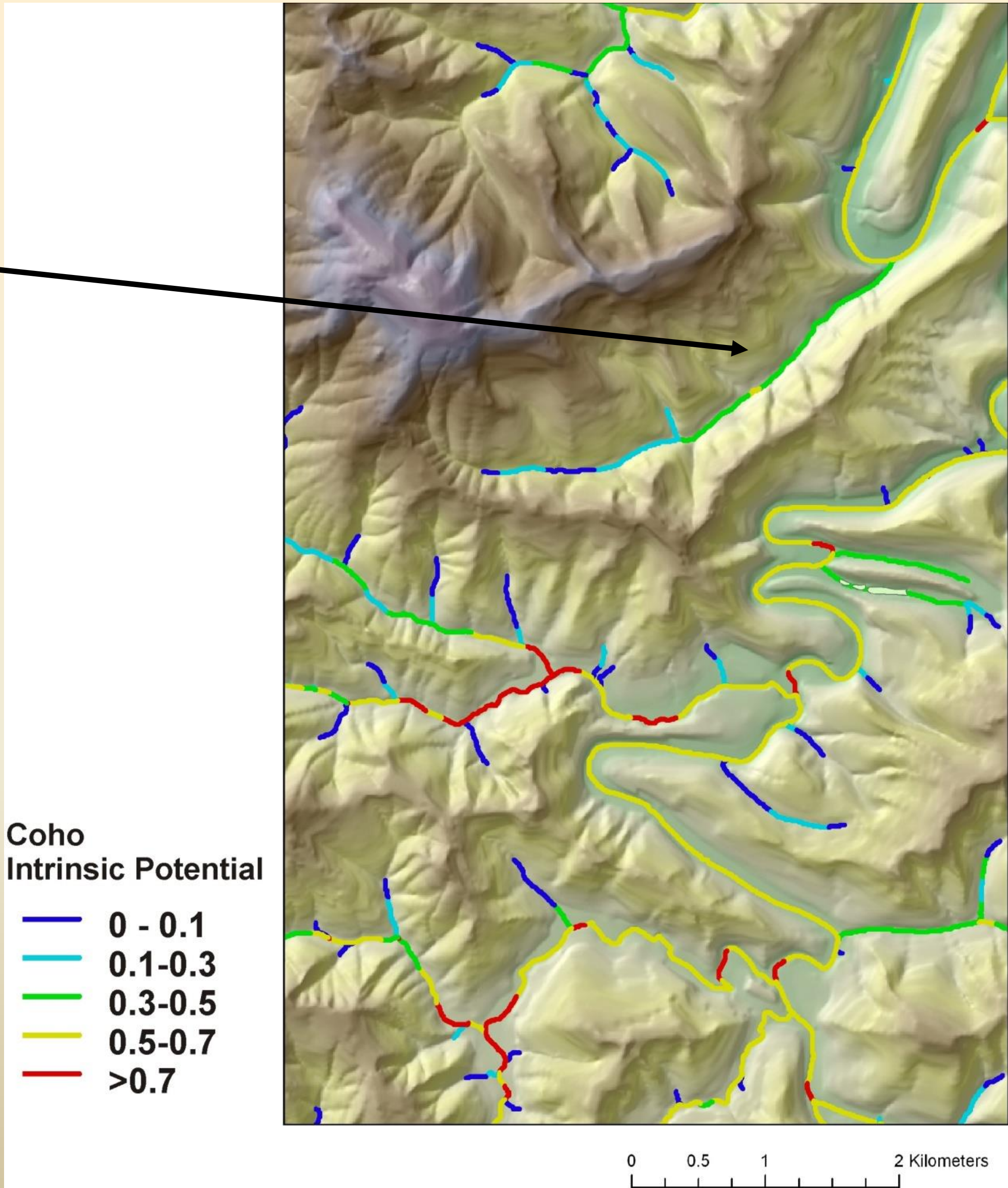
Step 1 – Define fish habitat distribution and quality



Define fish-bearing streams: e.g., Coho habitat (gradient < 8%; in red)

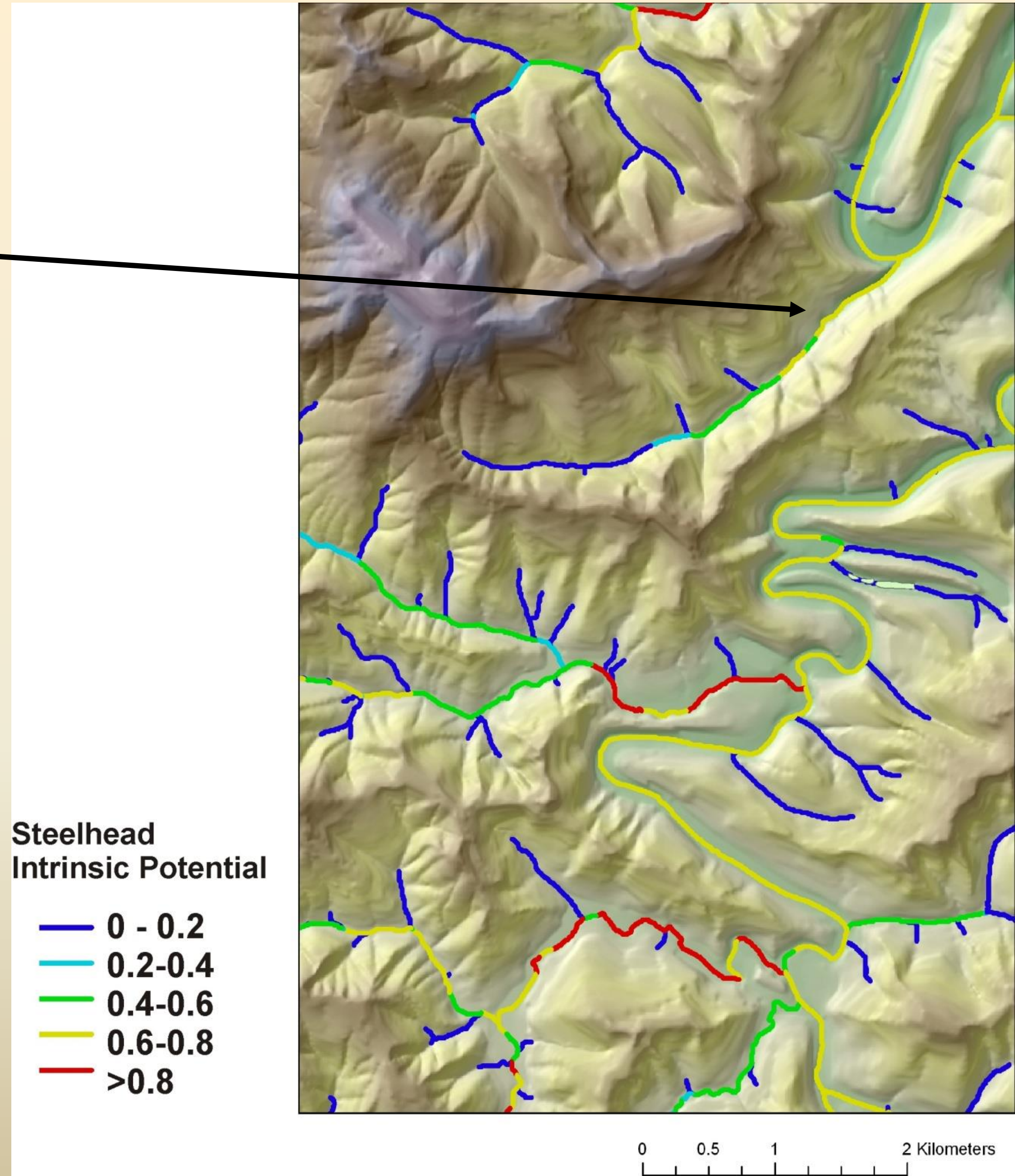
Step 2 – Define habitat distribution and quality by species

Lake creek is a moderate value Coho stream with Intrinsic Potential = 0.1 – 0.5



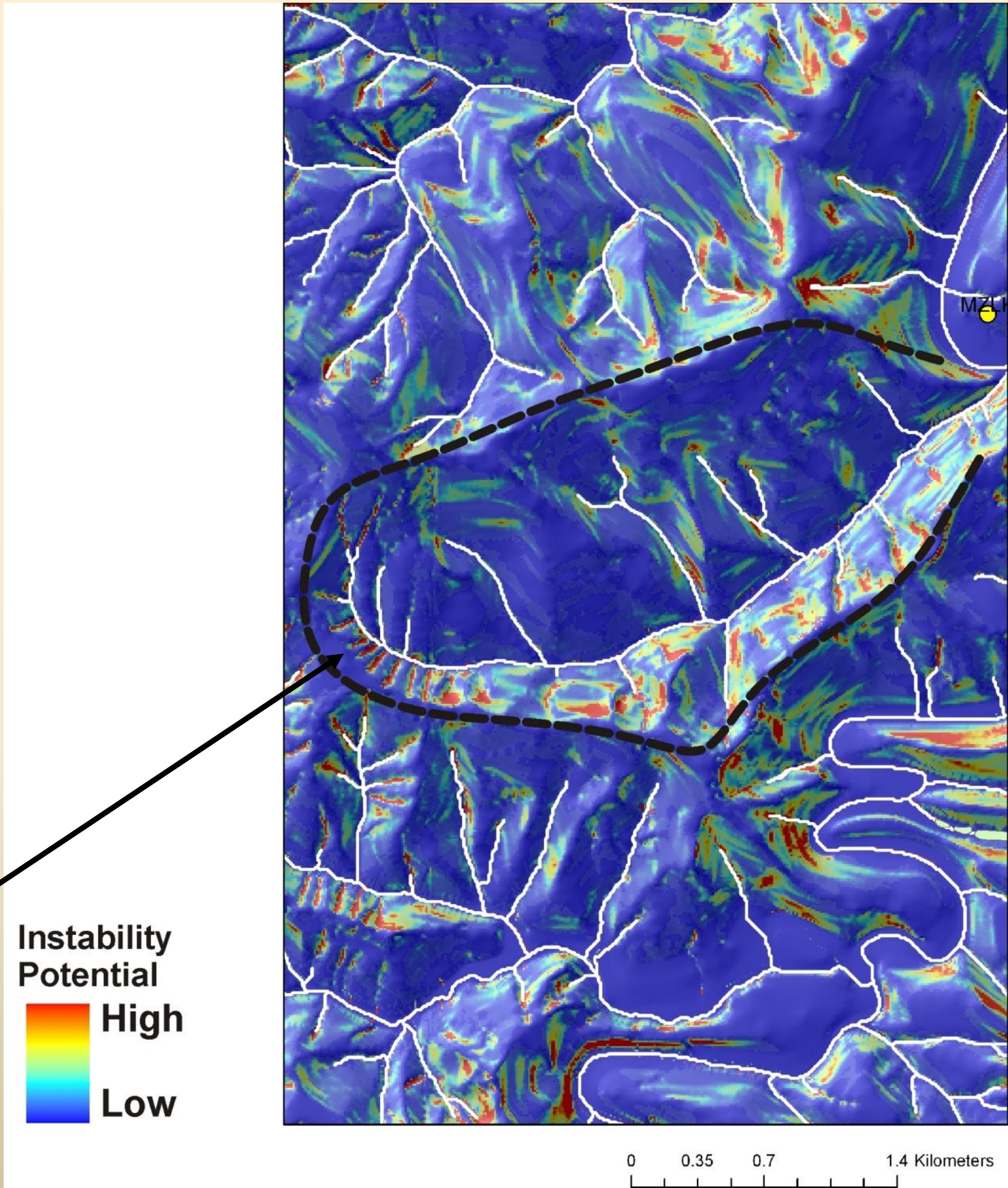
Step 3 – Identify other species of concern (steelhead)

Lake creek is a better steelhead (than Coho) stream: IP values up to 0.8



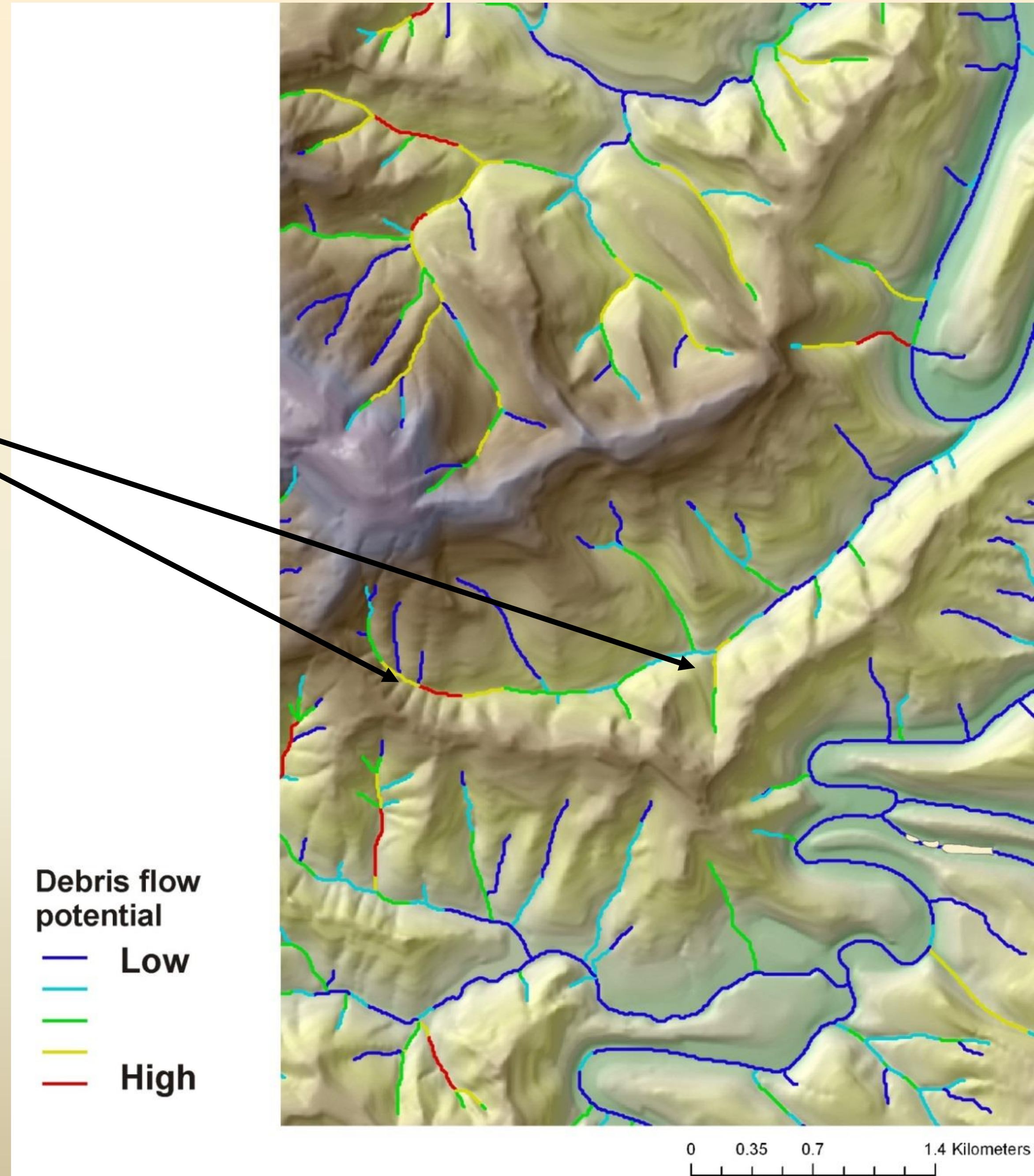
Step 4 – Determine slope stability concerns, including landsliding

Certain areas in the Lake Creek basin are potentially unstable (in red)



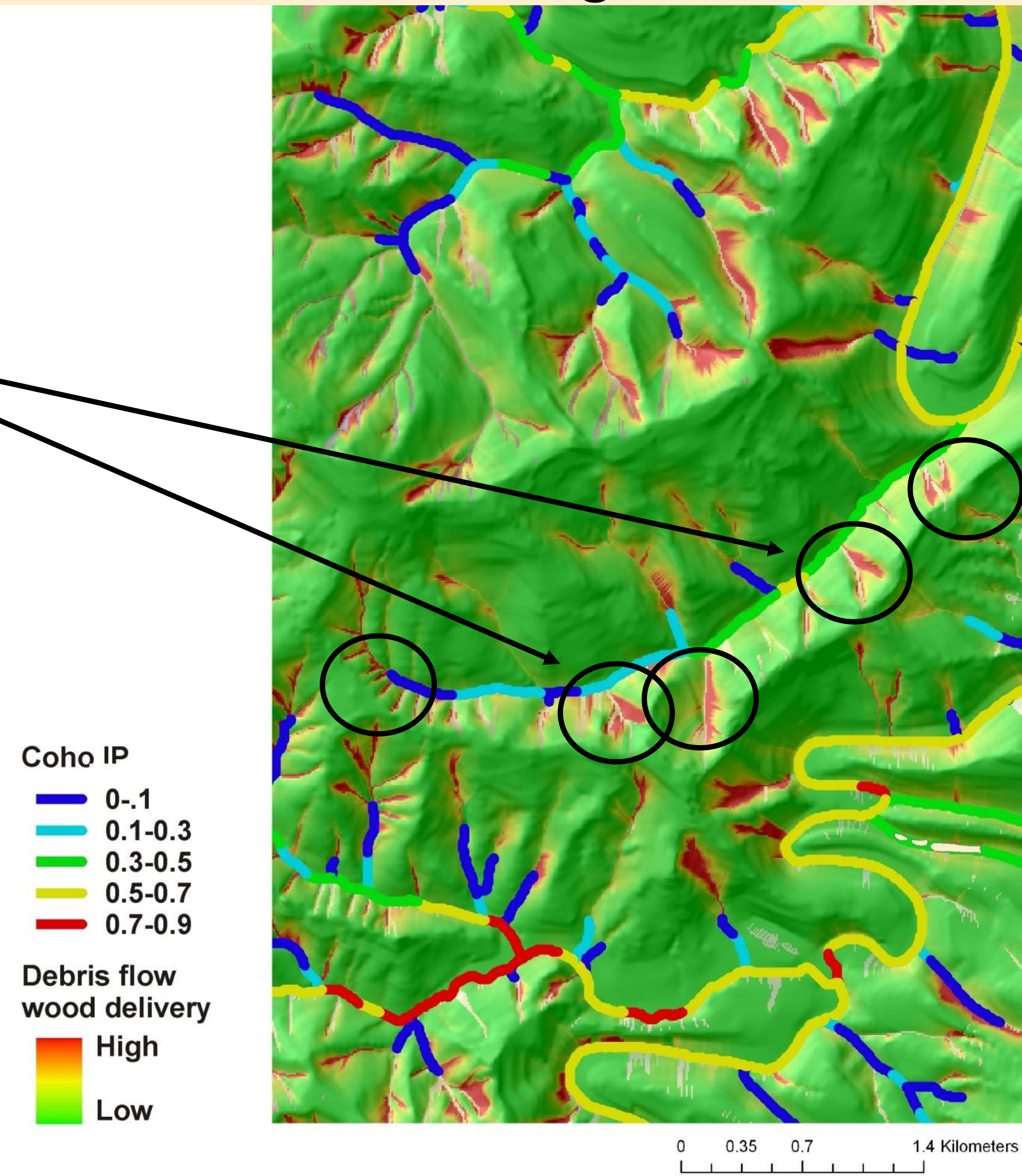
Step 5 – Predict debris flow risk

Only a few tributaries in Lake Creek basin are very prone to debris flows



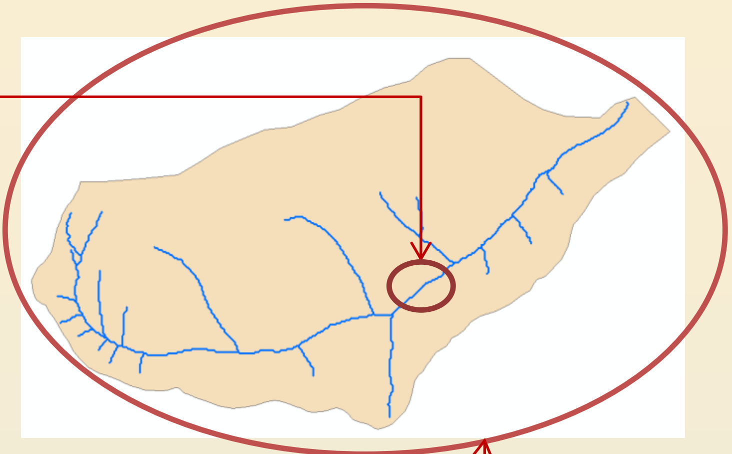
Step 6 – Predict debris flow contribution of large wood to streams

Identify likely sources of large wood to anadromous fish bearing streams from shallow failures & debris flows



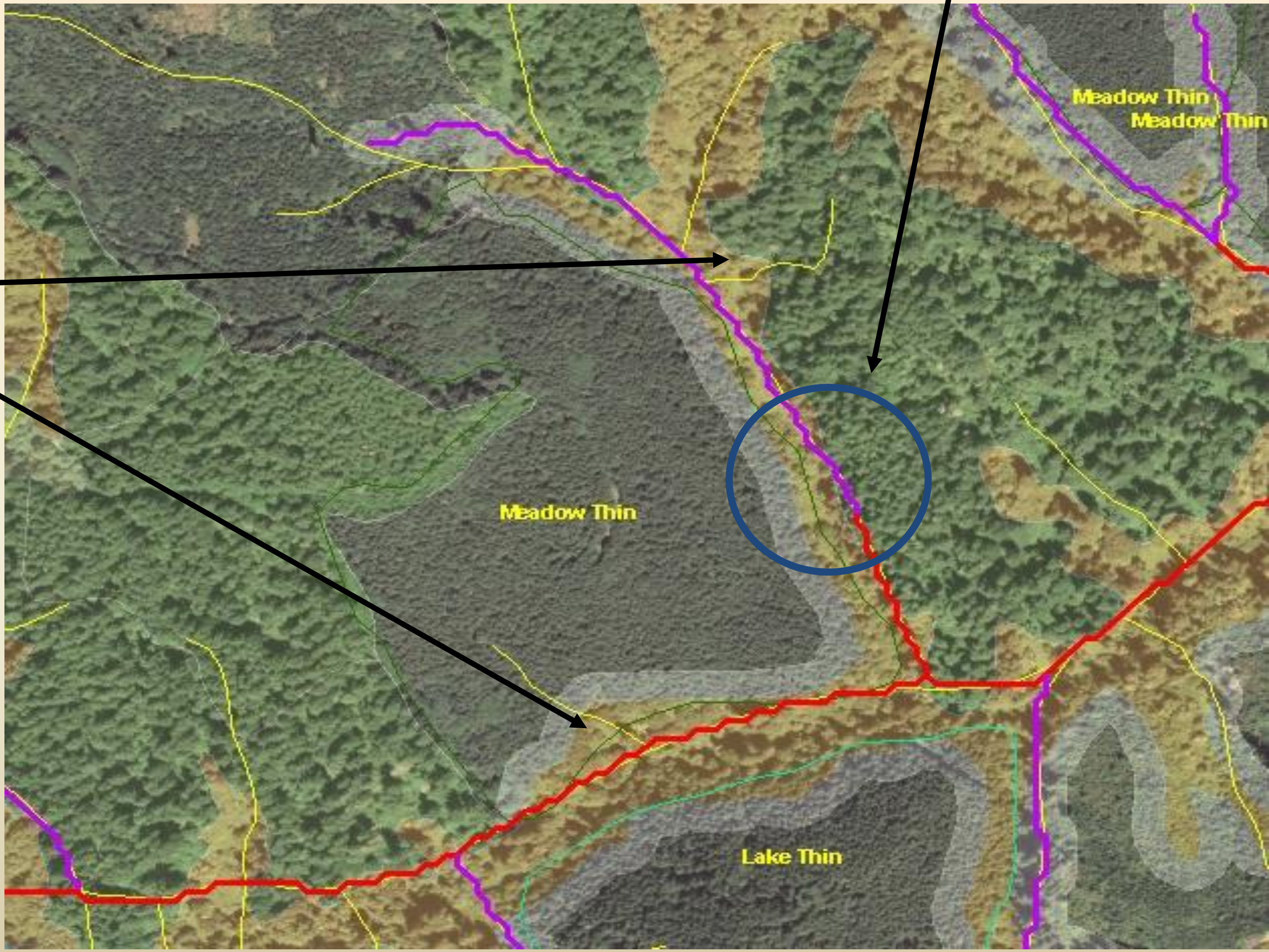
Steps 7,8,9 – Evaluate effects of thinning on in-stream wood recruitment

- Reach scale
  - Per 100m reach or project
  - For selected piece sizes
  - Temporally and spatially explicit
  - Up to 3 stands on each bank
  - Plots of volume and number of pieces
- Watershed scale
  - Temporally and spatially explicit
  - CE analysis of management scenarios
  - Based on RSWM technology
  - Plots and maps available
- SnapShot scale
  - Spatially explicit
  - Uses GNN tree data



Project analysis

30-100ft deciduous stand



Thinning in uplands and in riparian areas

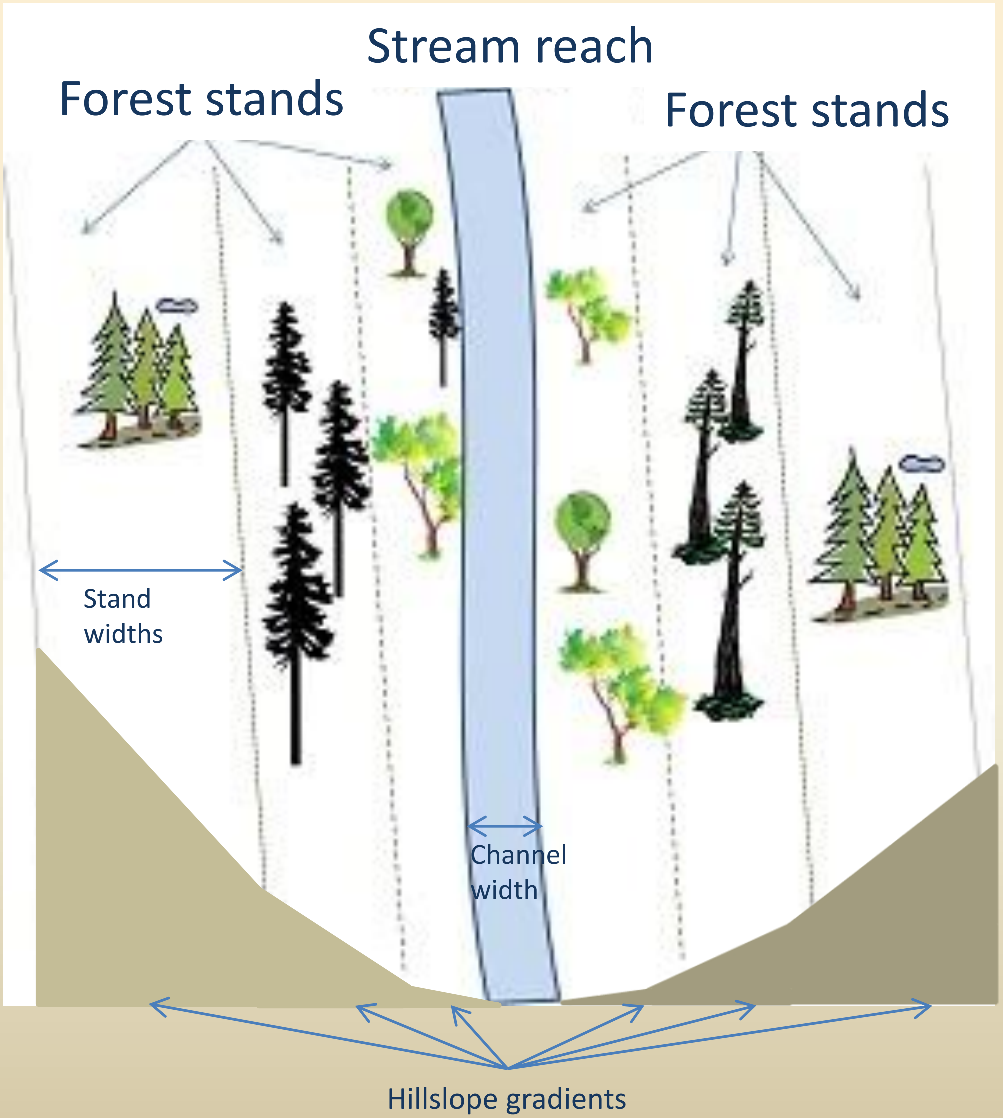
Reach Scale Wood Model (RSWM)

Mortality types include suppression, fire, insect, disease, & wind-throw.

Bells and Whistles:

- ❖ channel width,
- ❖ stand width,
- ❖ hillslope gradient,
- ❖ bank erosion,
- ❖ wood decay,
- ❖ taper equations,
- ❖ thinned trees that are tipped, and
- ❖ size of resulting wood pieces

Inputs: stand tables from forest growth models
Outputs: 10 types of plots



Kozak, 1988; Bilby et al, 1999; Benda and Sias 2003; Sobota et al, 2006; Hibbs et al, 2007; and more.

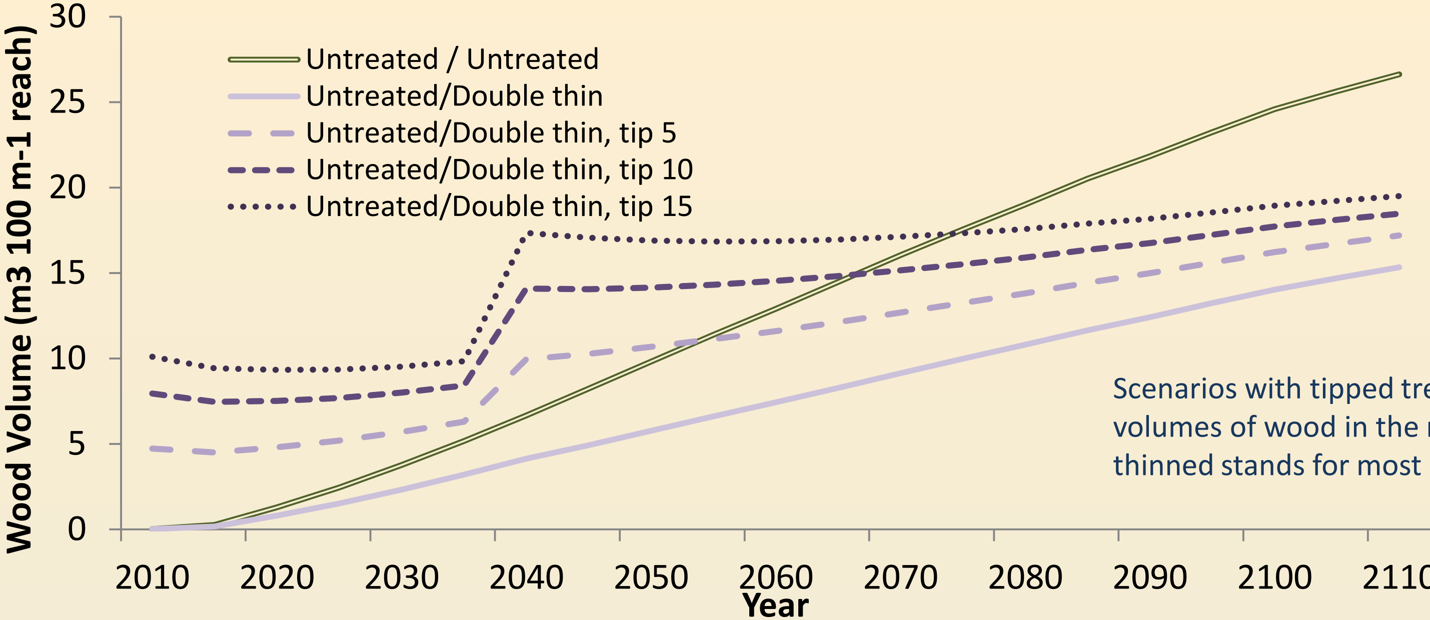
RSWM Scenarios

- Left bank is always no action scenario (70 m)
- Right bank treatment scenarios (11) with and without a no action buffer
- Double entry thin, 70 TPA: 2010, 2040
- All other parameters held constant (bank erosion, channel width, gradient, taper equations)

Right bank scenarios

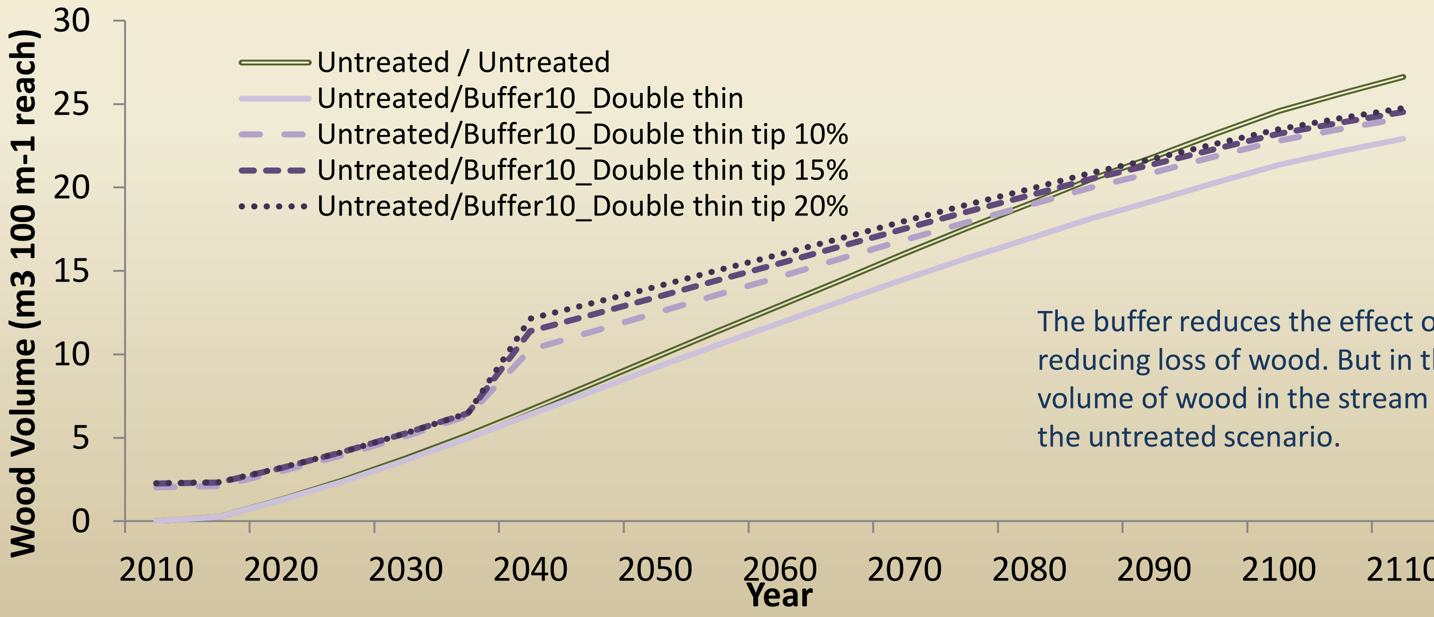
Stand1	Stand2
No action buffer (**10 m**)	No action (**60 m**)
No action buffer	Thinned
No action buffer	Thin & tip 5%
No action buffer	Thin & tip 10%
No action buffer	Thin & tip 15%
No action buffer	Thin & tip 20%
Thinned (**70 m**)	
Thin & tip 5%	
Thin & tip 10%	
Thin & tip 15%	
Thin & tip 20%	

Cumulative wood volume using 2 bank scenarios, no buffer



Scenarios with tipped trees produce higher volumes of wood in the reach than untreated or thinned stands for most of the time simulated.

Cumulative wood volume using 2 bank scenarios, 10 m buffer



The buffer reduces the effect of the thin and tip by reducing loss of wood. But in the long term the volume of wood in the stream increased to close to the untreated scenario.

Total volume of cumulative wood over time

(sorted by increasing volume)

Total cumulative wood	Volume (m^3 100 m^{-1} reach) (percent change from reference)
Untreated/Double thin	156 (-42%)
Untreated/Double thin, tip 5%	232 (-14%)
Untreated/Buffer10_Double thin	243 (-10%)
Untreated/Untreated (reference condition)	271
Untreated/Double thin, tip 10%	284 (5%)
Untreated/Buffer10_Double thin tip 10%	288 (6%)
Untreated/Buffer10_Double thin tip 15%	299(10%)
Untreated/Buffer10_Double thin tip 20%	305 (13%)
Untreated/Double thin, tip 15%	324 (20%)

Tree tipping from thinning operations combined with riparian buffers offer the highest volumes of wood loadings

Step 8. Watershed Scale Wood Model

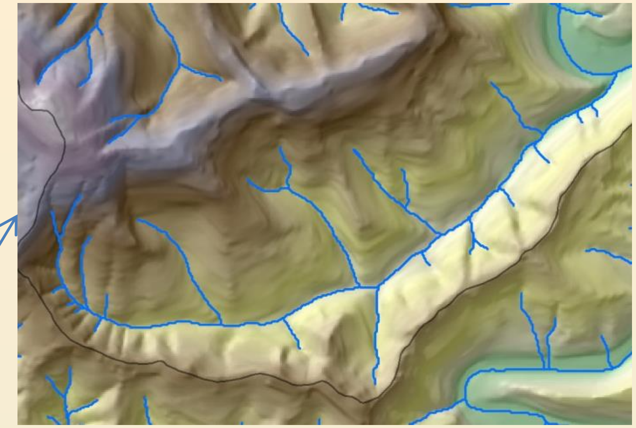
Stand tables from forest growth models (FVS, Organon, Zelig) pre-processed in RSWM

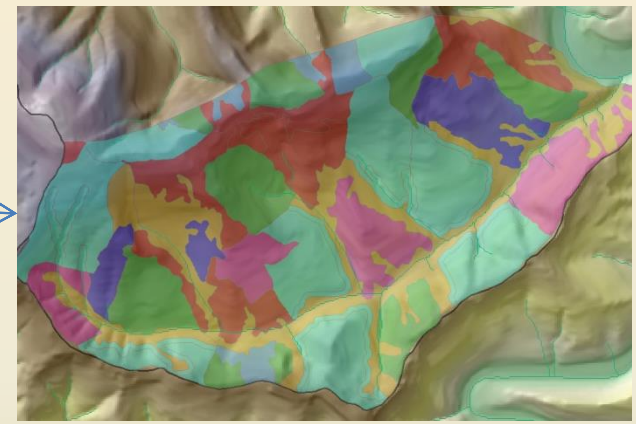
↓

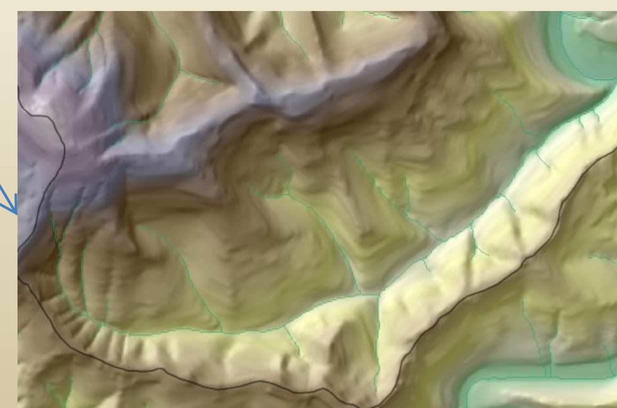
Tabular data integrated with GIS: stream segments, stands, and DEM

↓

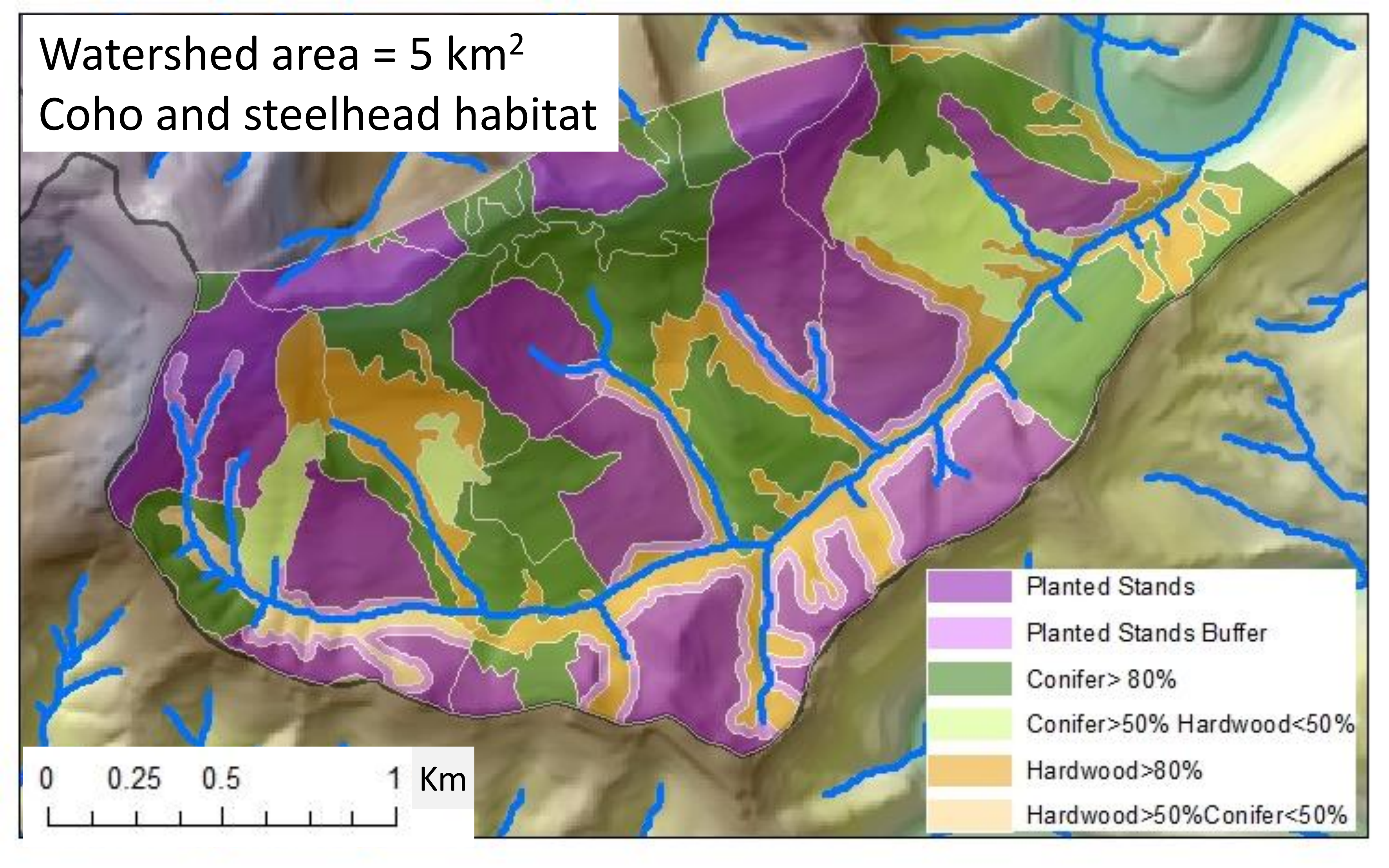
Generate output: plots and maps





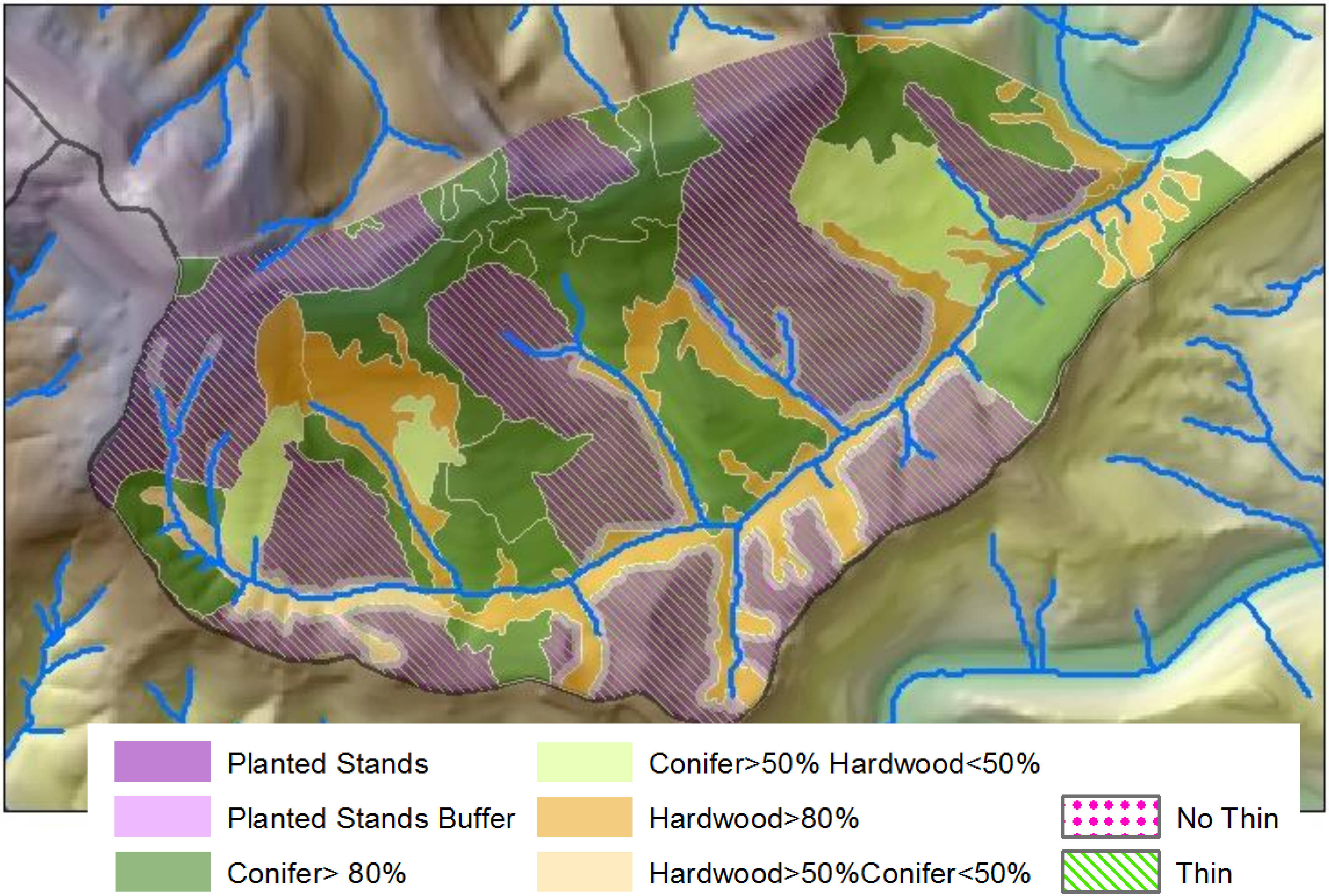


Step 11 - Consider 'cumulative effects' of thinning at watershed scale (example, wood recruitment) – a key part of the analysis (not complete)

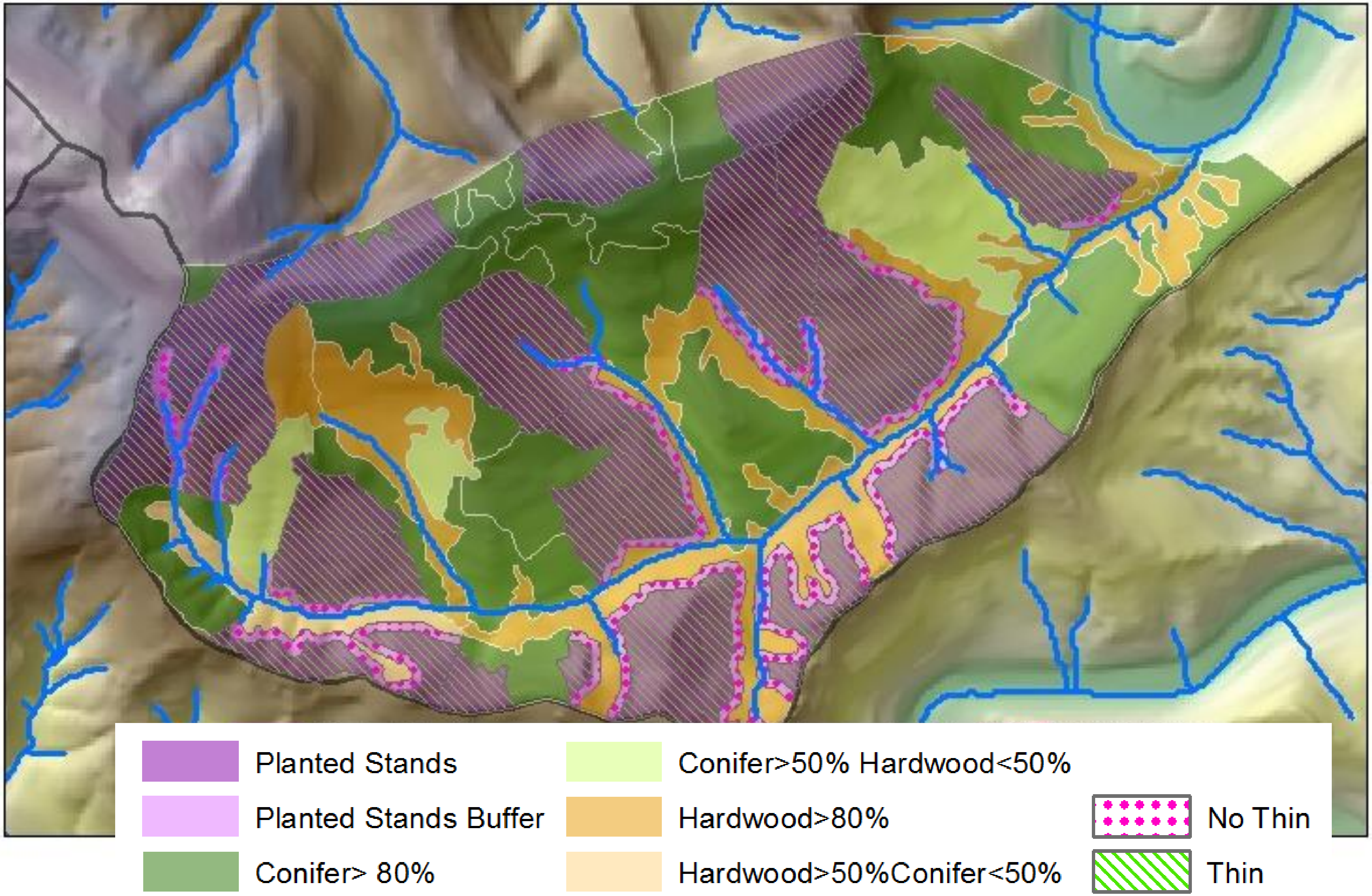


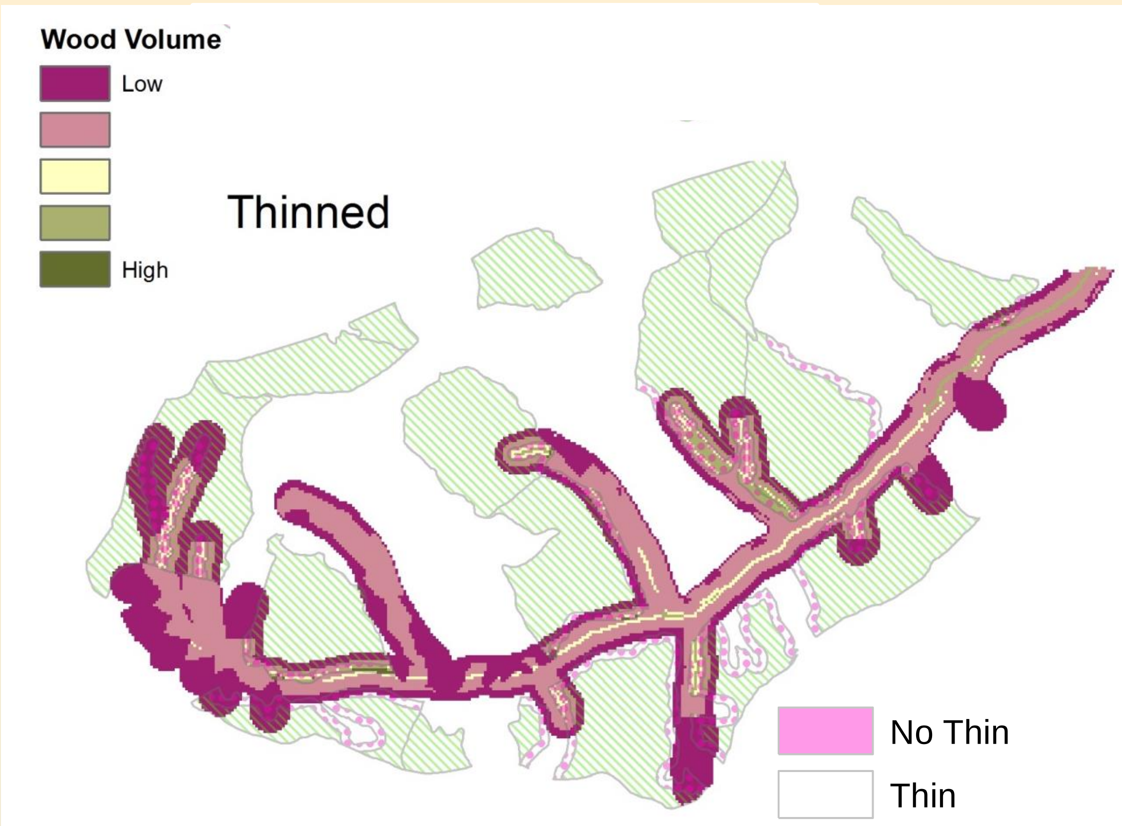
Parameters: variable age stands, variable thinning timing and location over 30 years, numerous stream segments, 100 years

Stand treatments – thin to 70 TPA from the bottom (47% of watershed thinned)



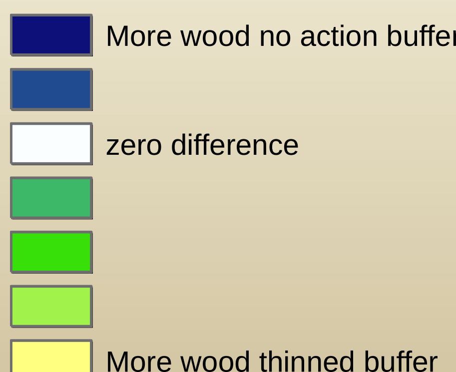
Stand treatments – no action buffer & thin (39% of watershed thinned)

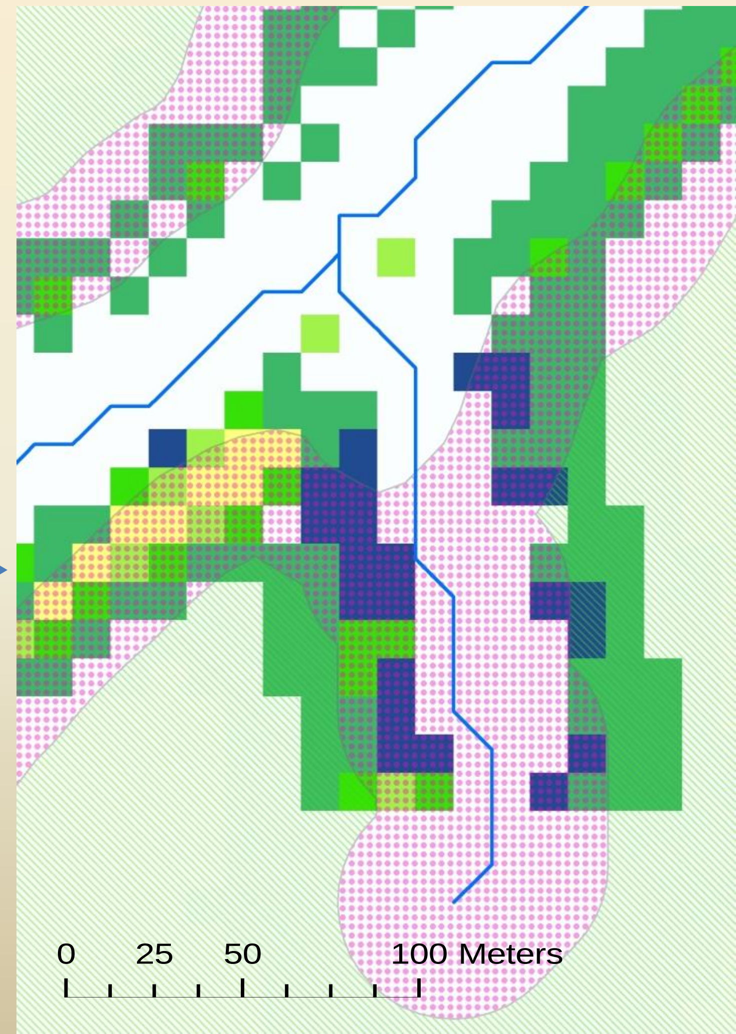




Spatial distributed sources of wood volume, year 2055

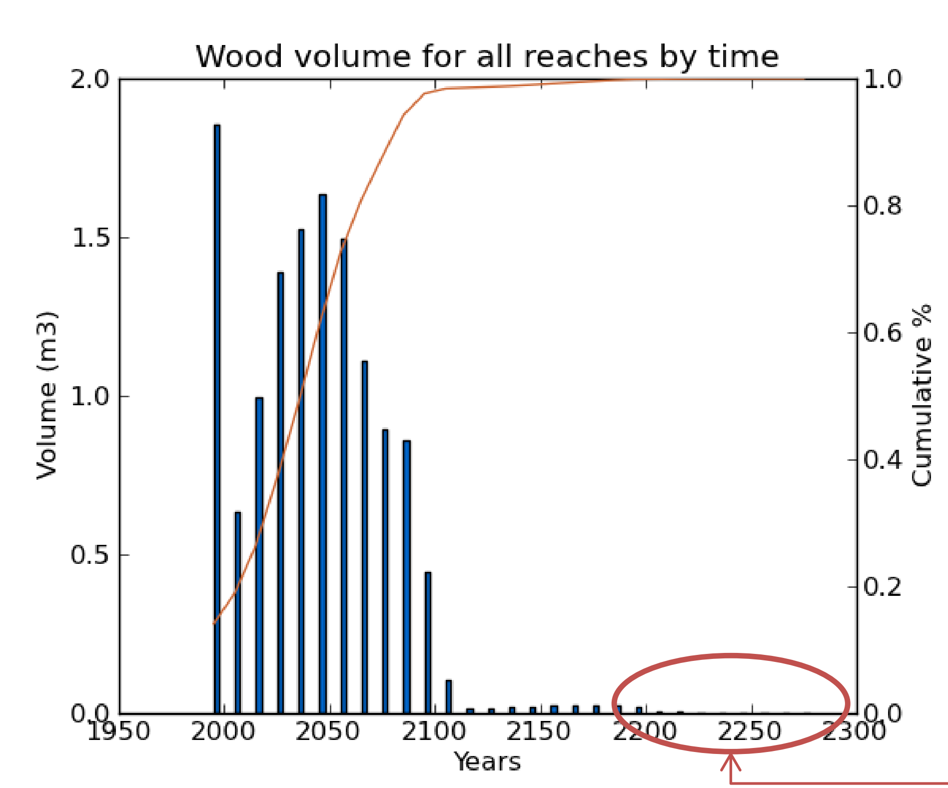
Difference between wood volumes, thinned and no action buffers, year 2055.



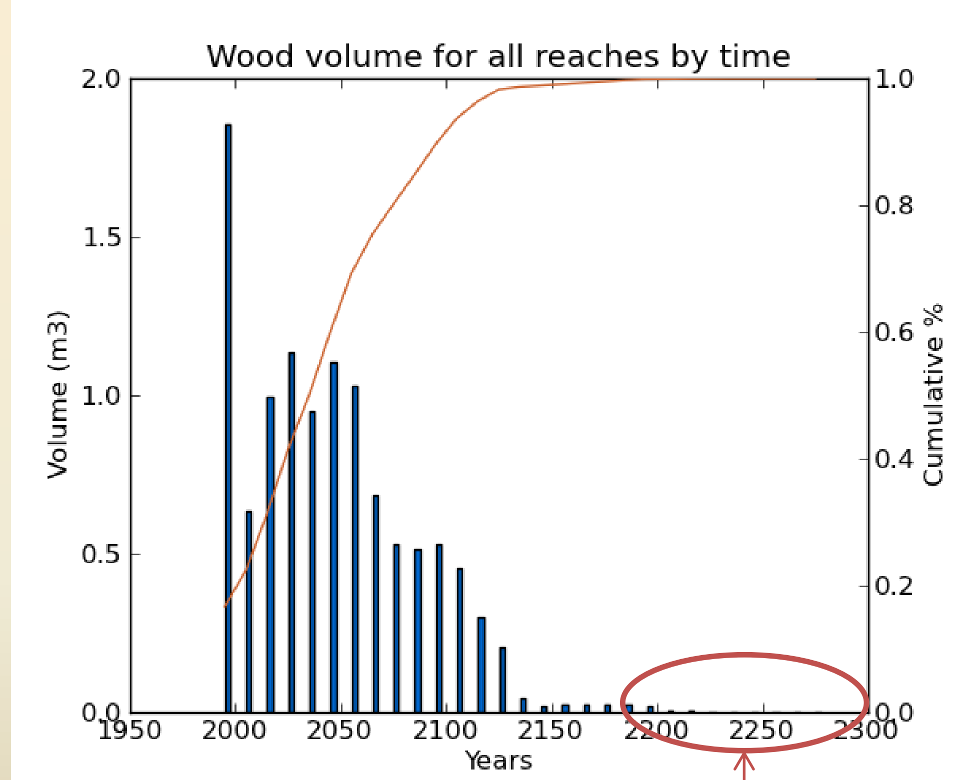


Wood volume by time (m^3 $100m^{-1}$ yr^{-1}) Thinned 2015

No action buffer



Thinned buffer

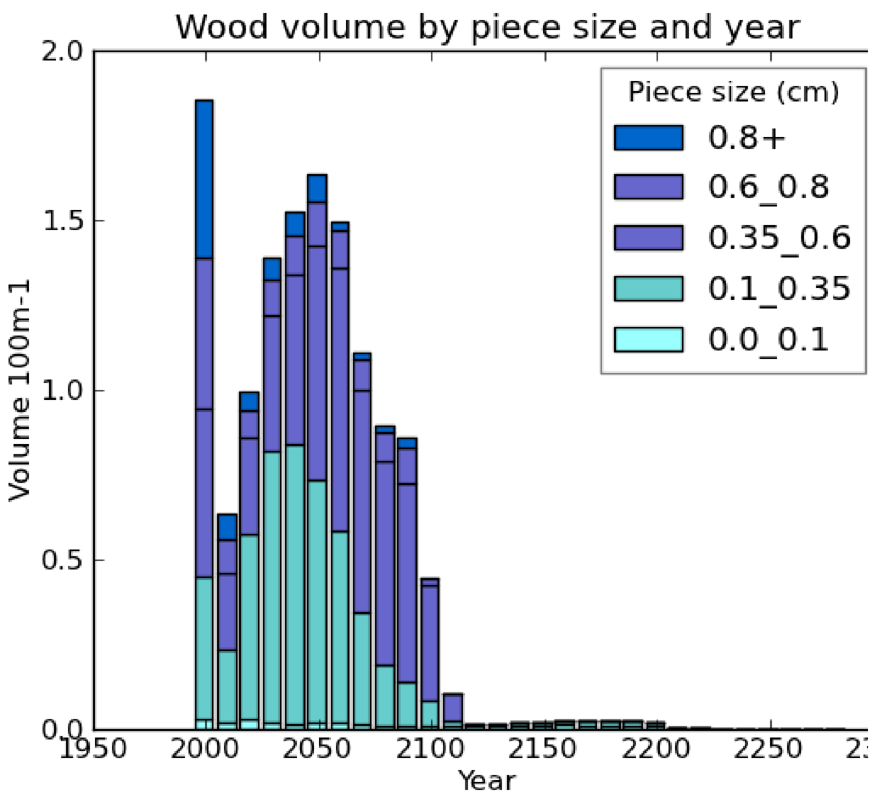


1995: high initial mortality – result of FVS model parameters
2015: thinned
2025 – 2085: no action buffer produces more wood
2095+ : thinned buffer scenario produces more wood

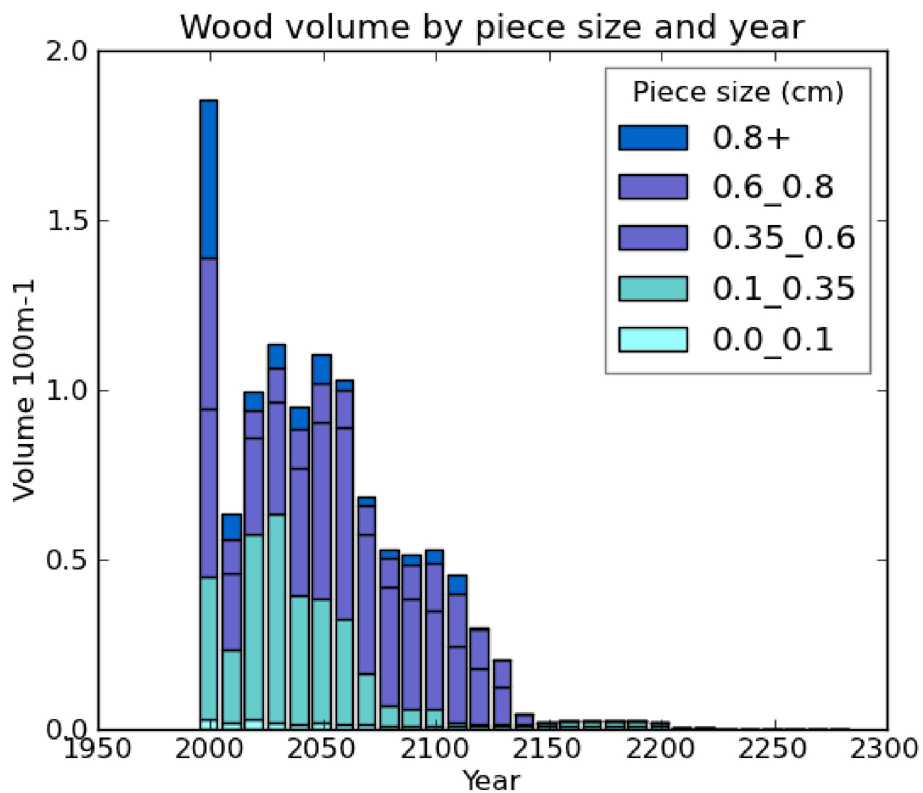
Only one stand had data to 2295, others ended at 2195, hence the low values after 2195

Wood volume by piece size and time (m^3 $100m^{-1}$ yr^{-1}), thinned 2015

No action buffer



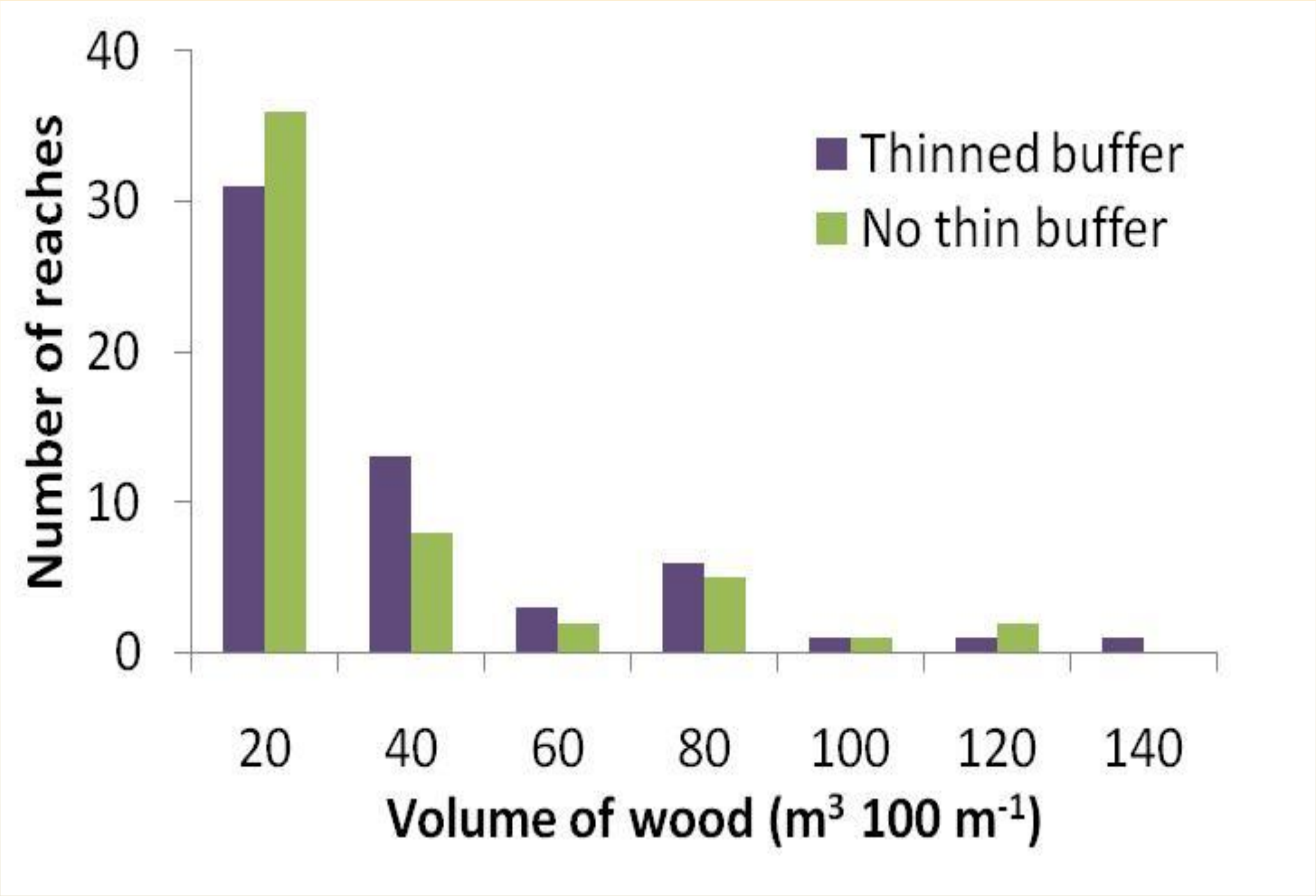
Thinned buffer



Thinned buffers resulted in a 15% decrease in wood volume

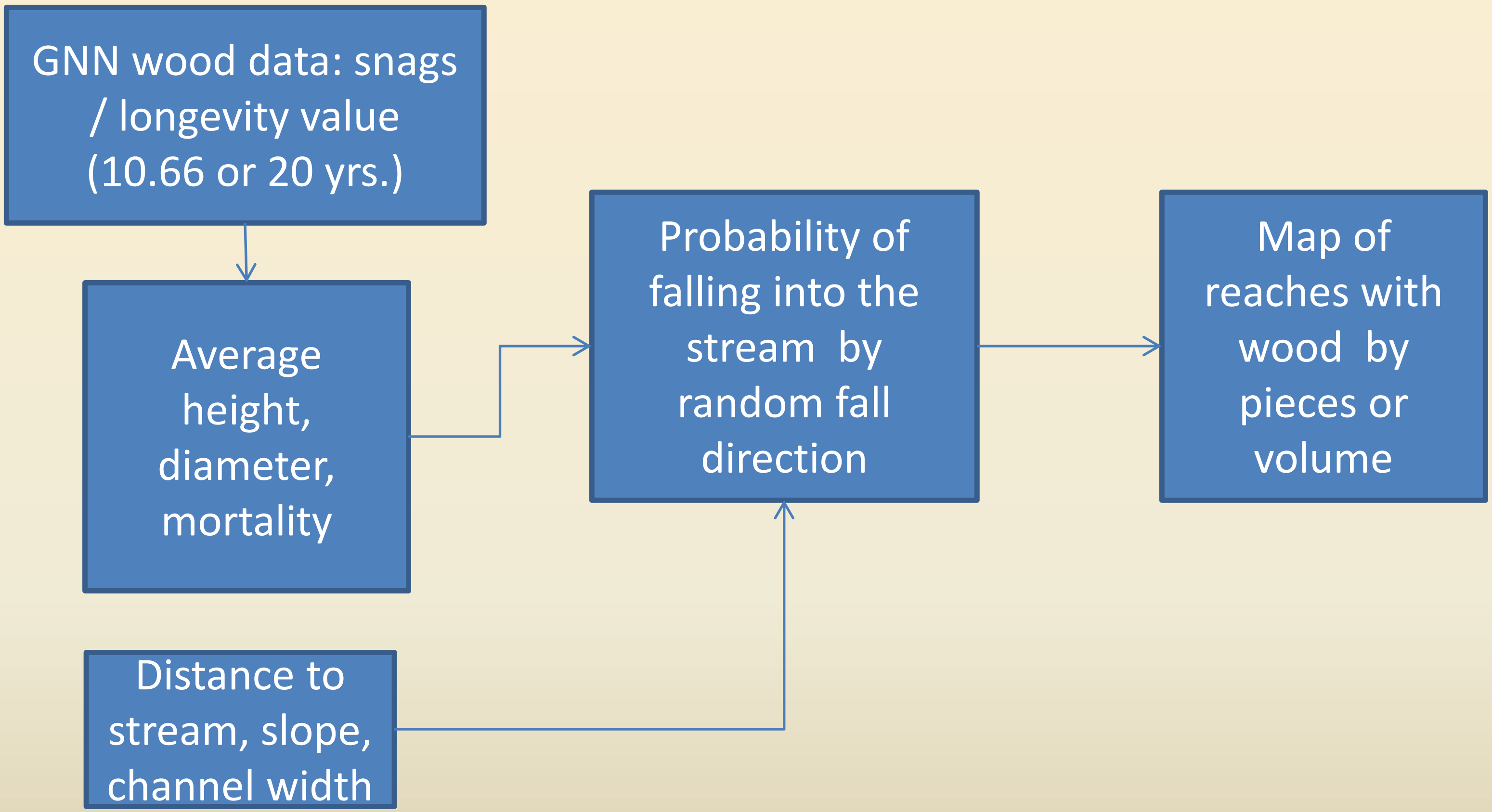
Percent changes in wood volume by piece size (cm) from no action to thinned buffer

Small reduction in the smallest volumes of wood in storage w/ thinning, increases in larger volumes of stored wood w/thinning



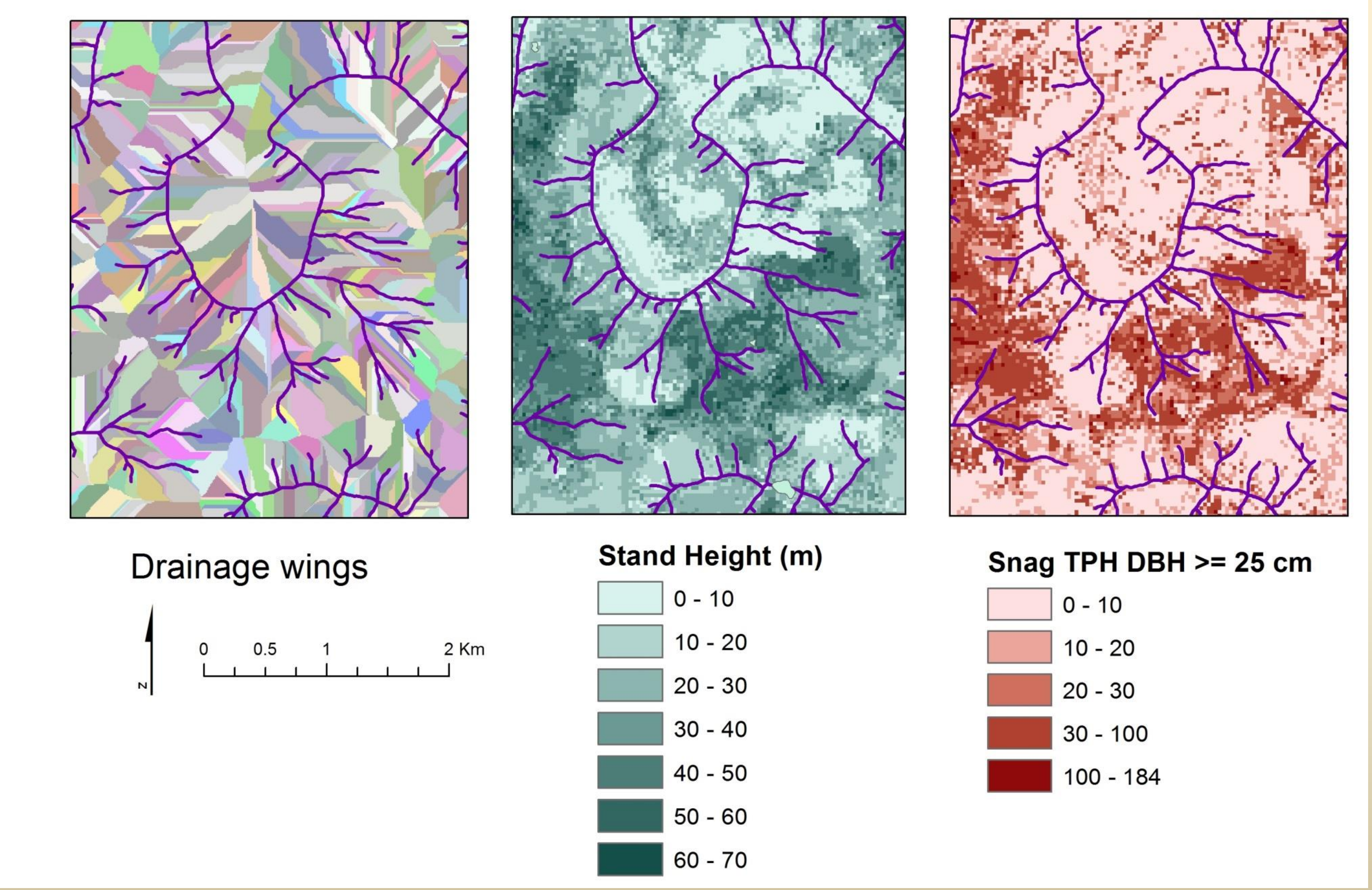
Compare the cumulative distributions of total wood storage, 1000 stream segments over 100 years – not available.

Step 9. SnapShot wood model (coming summer 2013)



Ohrmann and Gregory, 2002; Benda and Sias, 2003; Parish et al, 2010

SnapShot wood model – data availability (coming summer 2013)

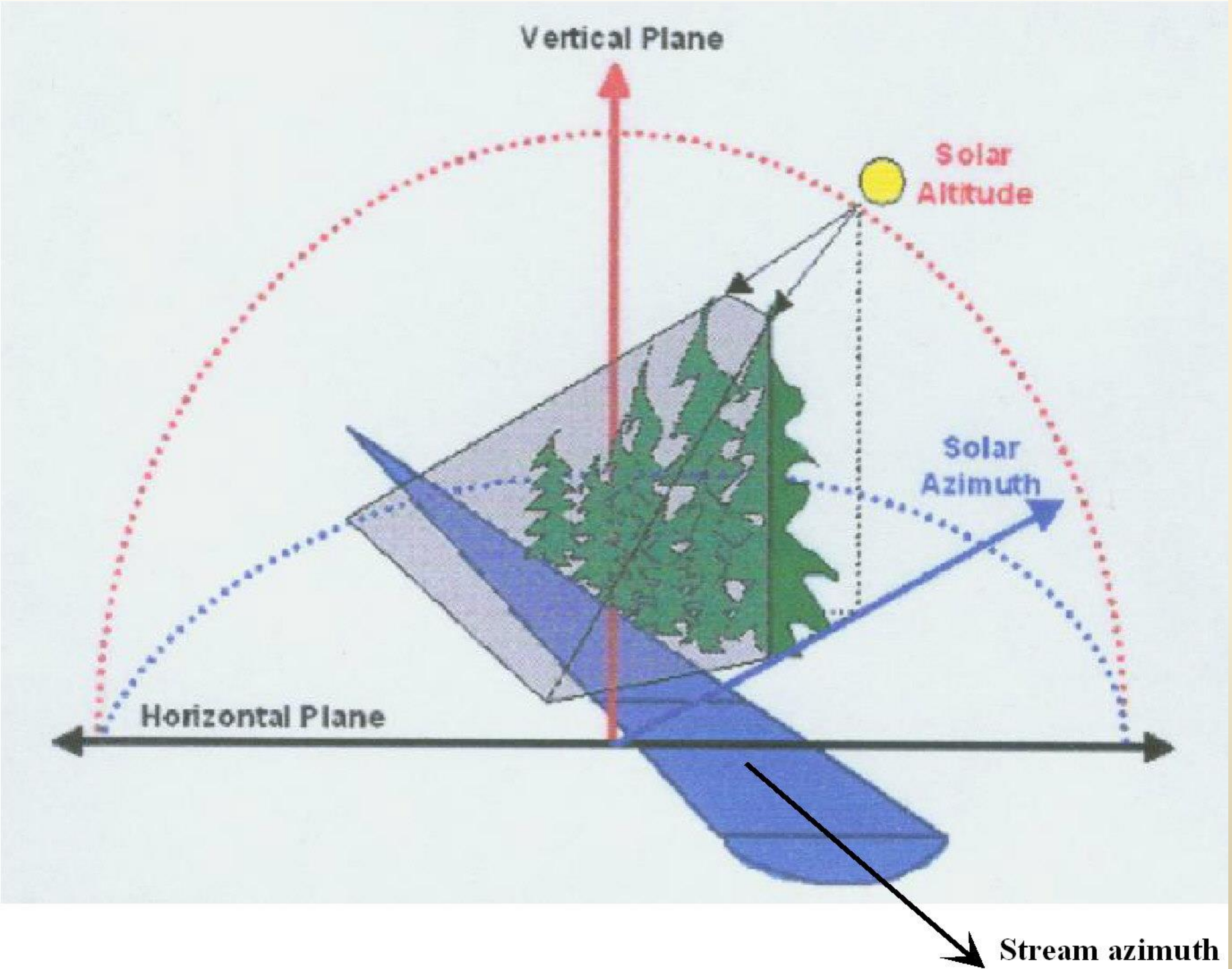


Applications for land management

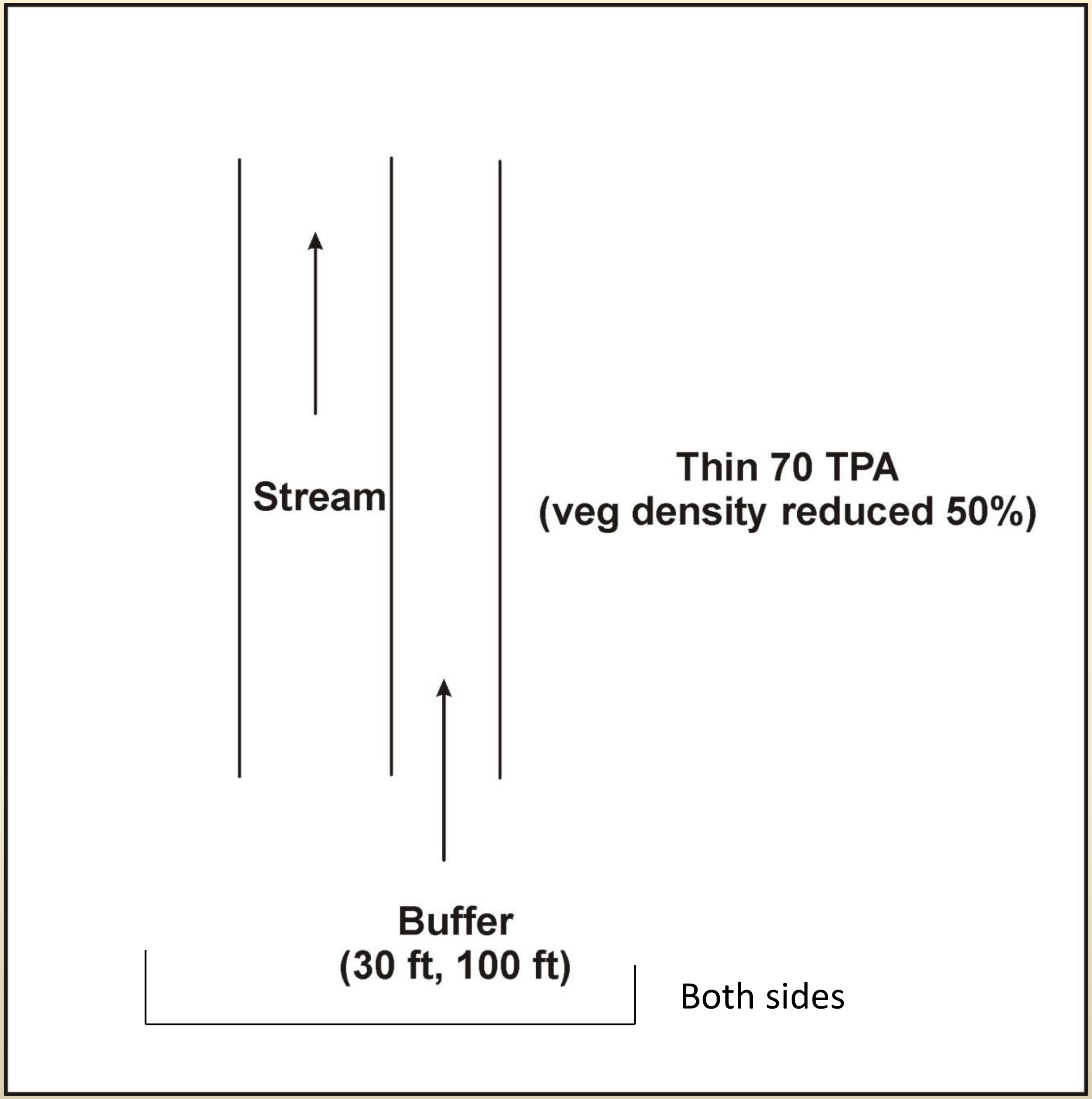
- Multi-scale: reach or project scale v. watershed scale management and analysis;
- Enables spatially variable approach and analysis;
- Designs for riparian treatments – thinning, buffers, habitat;
- Designs for mitigation, enhancement, tree tipping

Step 10. Modeling stream thermal loading for varying forest conditions

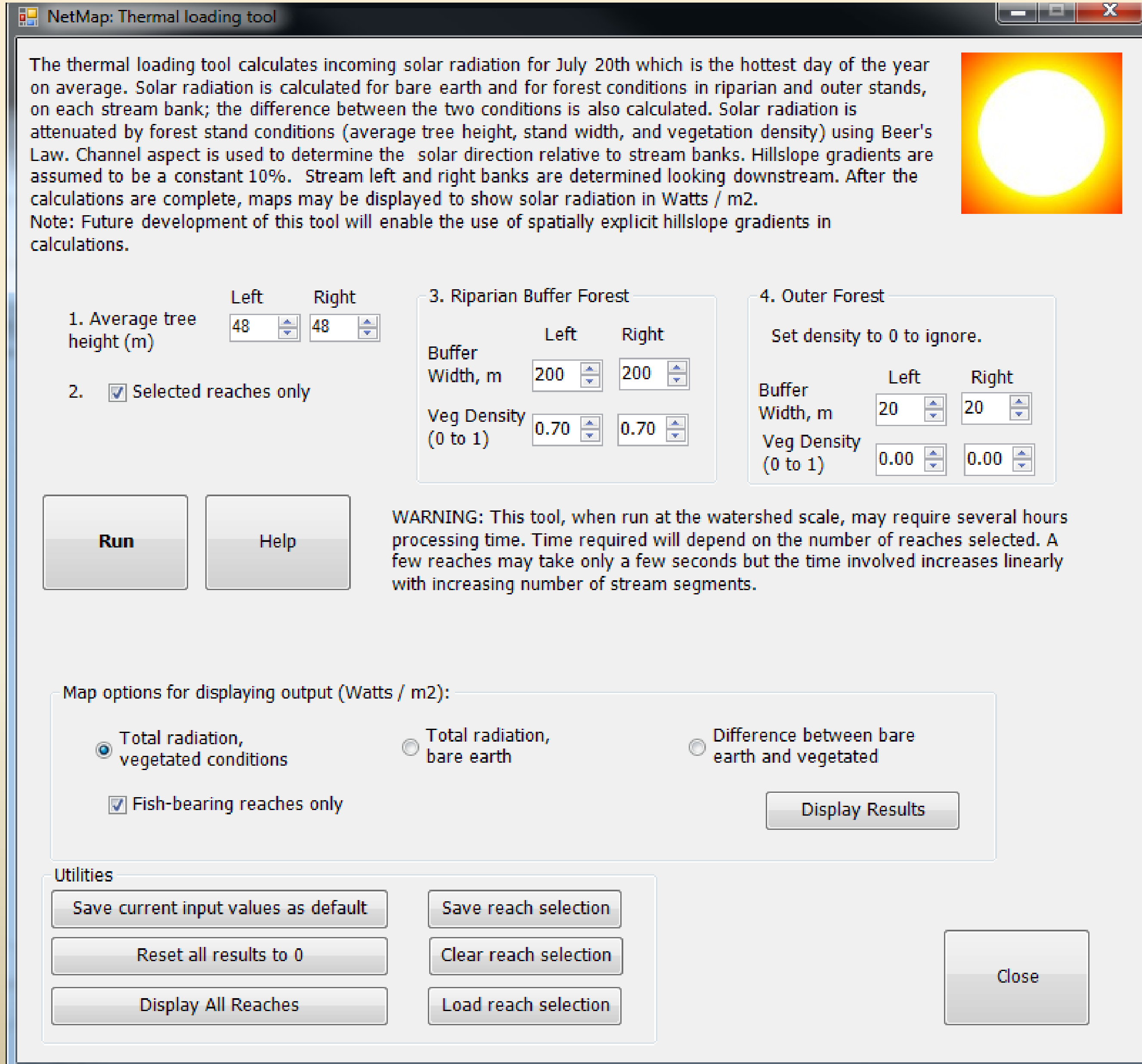
Examine the effect of thinning on thermal loading



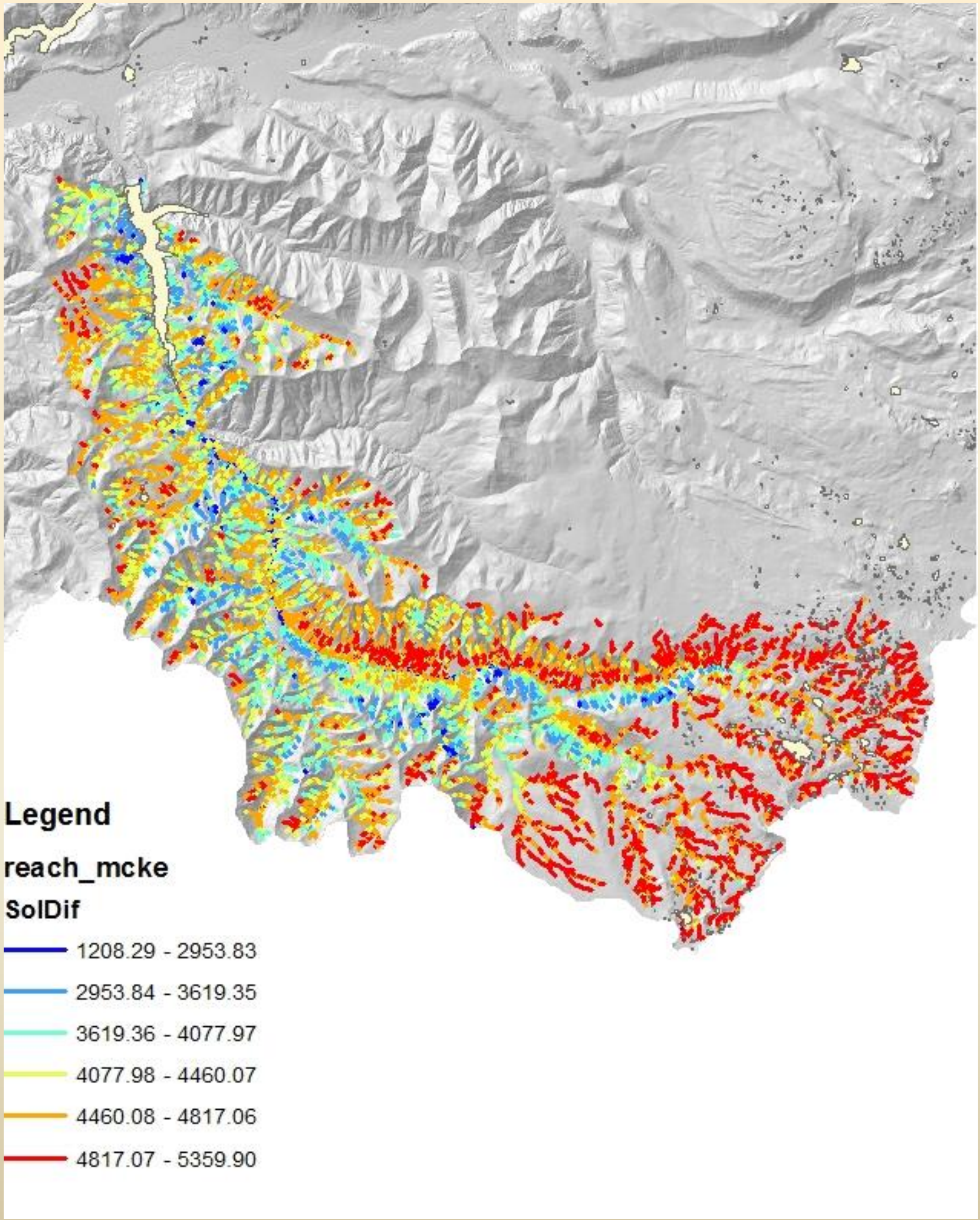
Evaluate buffer designs

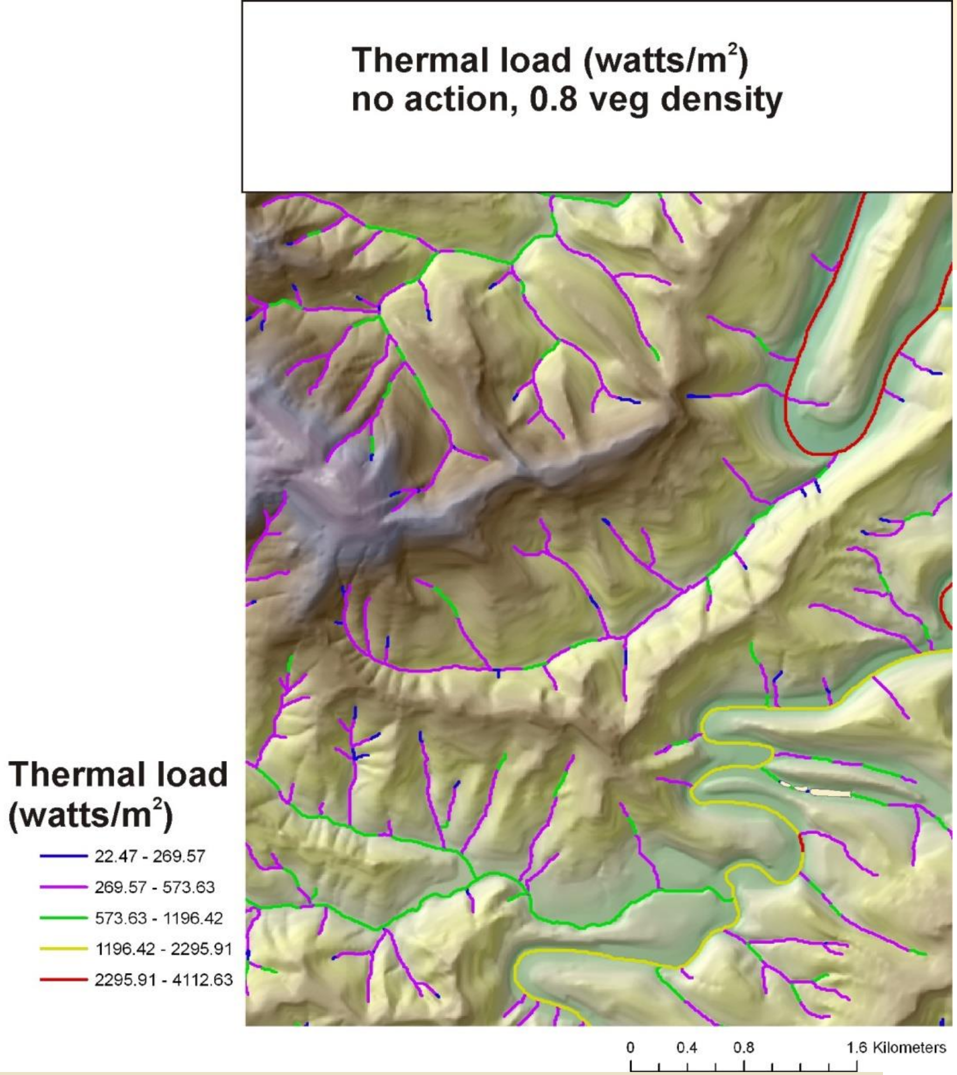


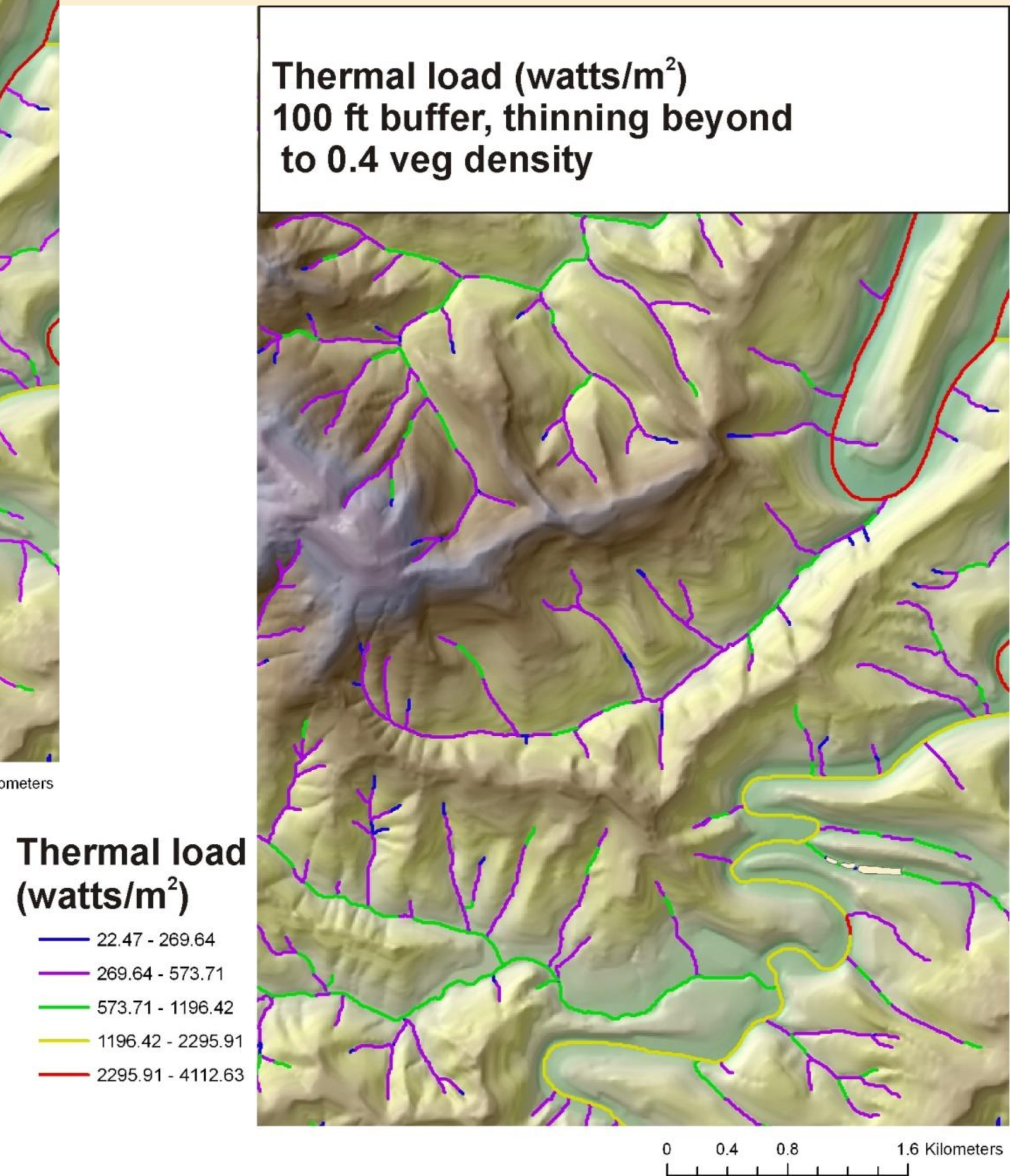
NetMap: Thermal Tool Interface



Thermal tool sensitivity analysis: difference between fully vegetated and bare earth







No thermal effect with
100 ft buffers w/thin beyond

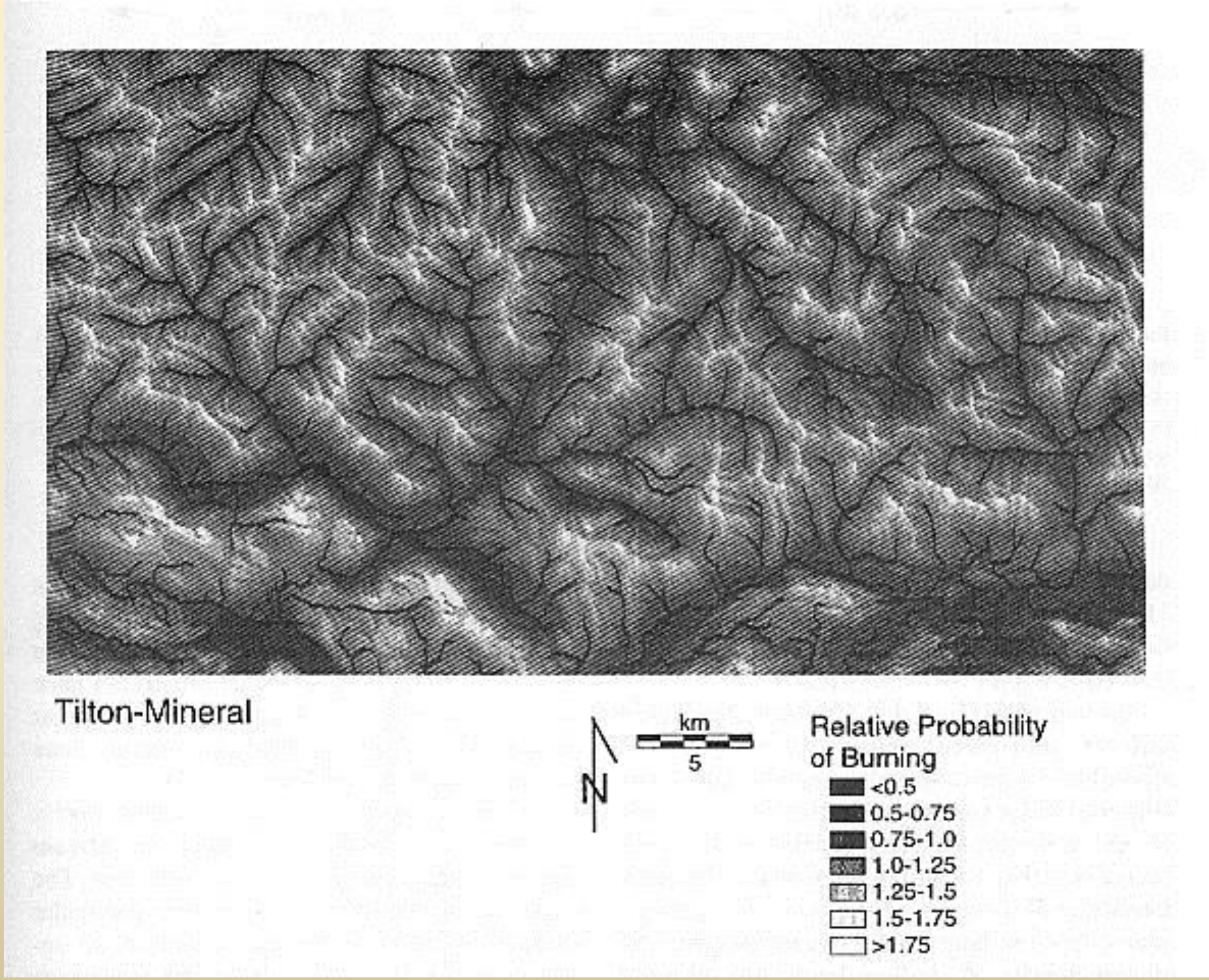
NetMap Tools

Back to Lee …

Step 12 - Assemble the pieces and design forest management and watershed restoration (one hypothetical example)

Add road restoration activities to reduce mass wasting & surface erosion

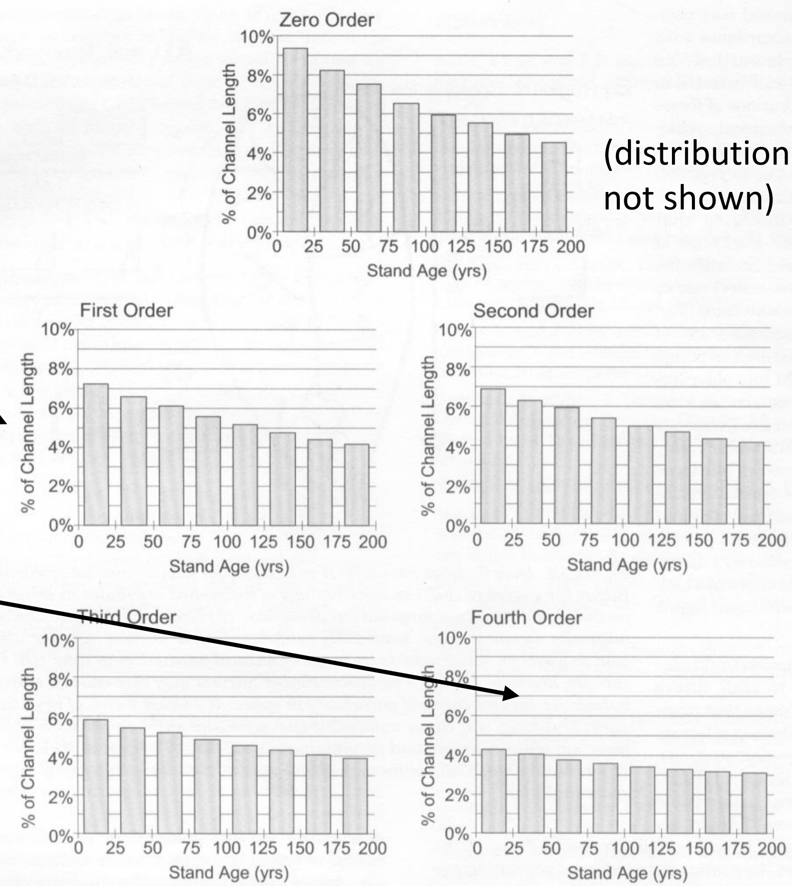
Spatially variable fire frequency based on landscape position



Step 13: (optional): Run forest fire simulation models (with topographic dependency on fire frequency) to predict spatially heterogeneous nature of forest ages, including in riparian zones

On average, over time, approx. 14% of the total length of first-order streams are predicted to have forests less than 50 yrs old

Drops to 8% along larger valley floors



(distribution > 200 yrs not shown)

Figure 11. Probability distributions of riparian forest ages, including for landslide sites. The average proportion of channel length with forest stands of a particular age, using 25-year bins up to 200 years (forests greater than 200 years not shown) was tabulated for zero-order (i.e., landslide sites) through fourth order. These predicted histograms indicate, that on average, the proportion of the channel length containing trees less than 100 years old varies from 30% (zero order), 24% (first-order), to 15% (fourth order). The decreasing amount of young trees with increasing stream size is a consequence of the field estimated susceptibility of fires. Fire frequency was the highest on ridges and low-order channels (~175 yrs) and the lowest (~400 yrs) on lower gradient and wide valley floors.

Results from southwest Washington (GTR-101-CD, 2002)

NetMap

Community Digital Watersheds & Shared Analysis Tools

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