Pre Wildfire Decision Support

Identifying At-Risk Infrastructure & Aquatic/Riparian Habitats

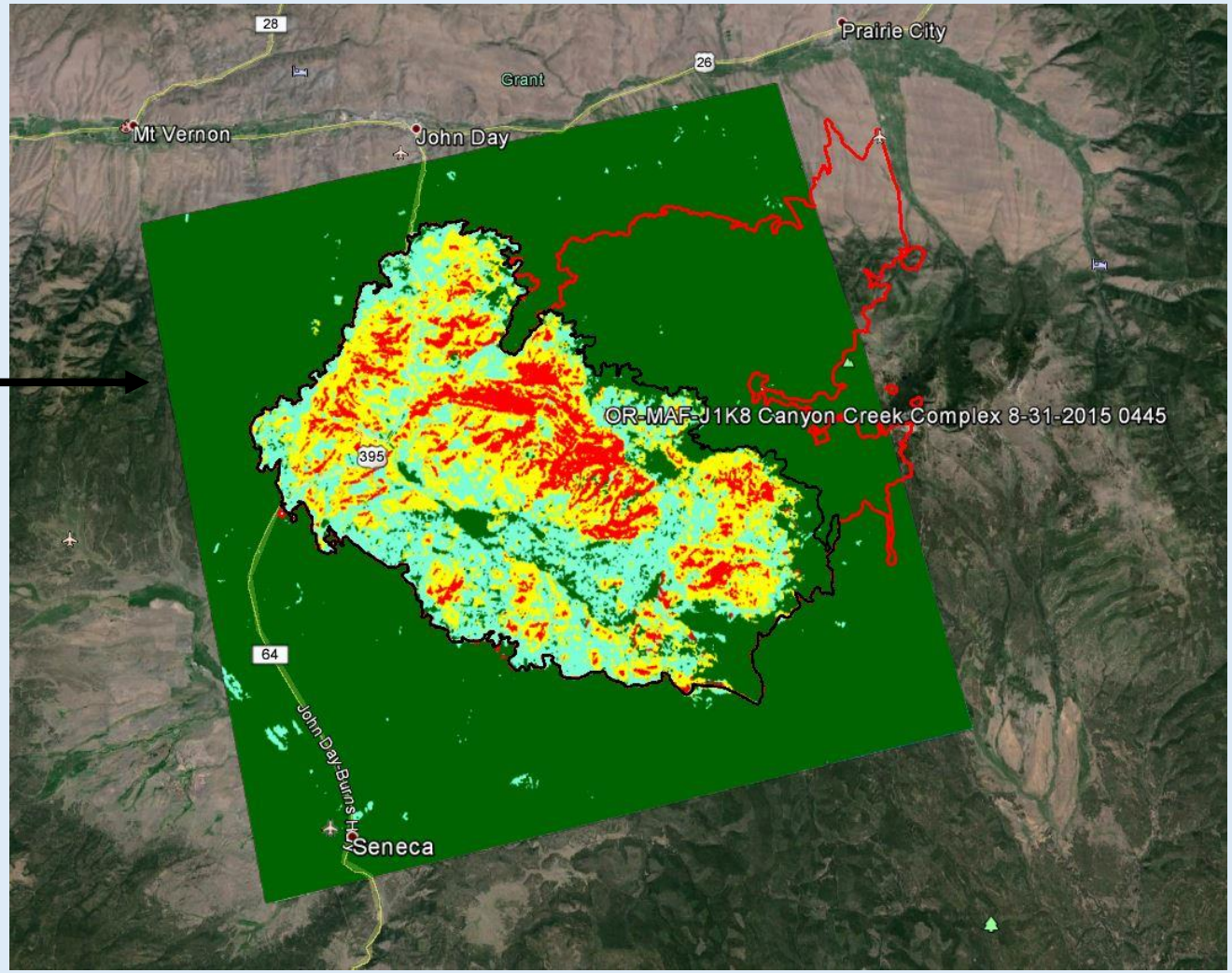
(Malheur National Forest, Eastern Oregon)

TerrainWorks (NetMap), in Collaboration with US Forest Service, PNW Corvallis and Malheur National Forest

Summer, 2015

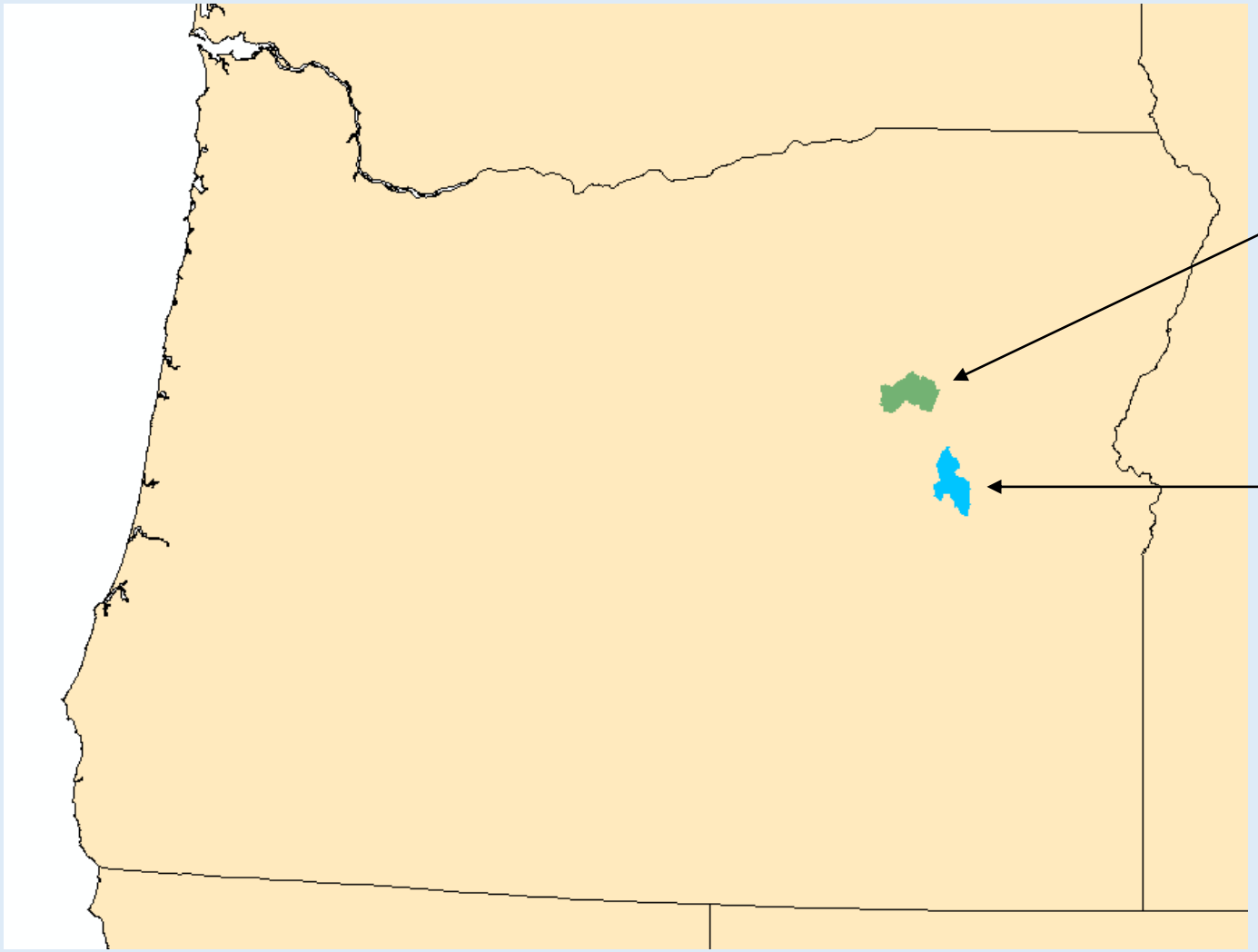
For the Post fire (BAER) analysis in the Canyon Creek Complex Fire, Eastern Oregon (9/2015), go to: http://http://www.netmaptools.org/Pages/Canyonlakecreekfire_Netmap.pdf

Canyon Creek BAER-NetMap analysis area (colored)



Continue with pre fire analysis, next slide…..

Pre fire analysis, pilot areas (preliminary)



Camp Creek watershed
(1 m LiDAR DEM)

Upper North Fork Malheur
(10 m DEM)

Decision Support, Data Uses

Pre Fire Management Activities	Data layers	Purpose
Forest Restoration (fuels reduction, thinning including in riparian zones, prescribed burns)	-Fire severity and fire probability -Post fire surface erosion -Post fire landslide/gully erosion -Flash floods -Fish habitats -Thermal refugia (impacts to)	-Reduce potential for post fire erosion/floods and sediment delivery to streams (impacts on infrastructure and sensitive aquatic habitats) -Protect critical fish-riparian habitats (key habitats, refuges)
Road Restoration (upgrade surfacing, increase drains, improve stream crossings, storage, decommissioning)	-Road surface erosion & sediment delivery potential (fire impacts on increased sediment delivery potential) -Road instability potential/fire increased -Roads in floodplains -Cumulative habitat above roads crossings	-Reduce potential for post fire erosion and sediment delivery (also in non-fire conditions) -Reduce potential for road related landsliding/gullying -Remove fish barriers
Firefighting	**Data layers**	**Purpose**
Firefighting, including retardant use	-All stream buffered (300') - avoidance -Perennial stream buffered only - avoidance -Identify high value aquatic/riparian – non avoidance	-Avoid retardant pollution in surface waters -Protect critical aquatic/riparian habitats

Models and Sources

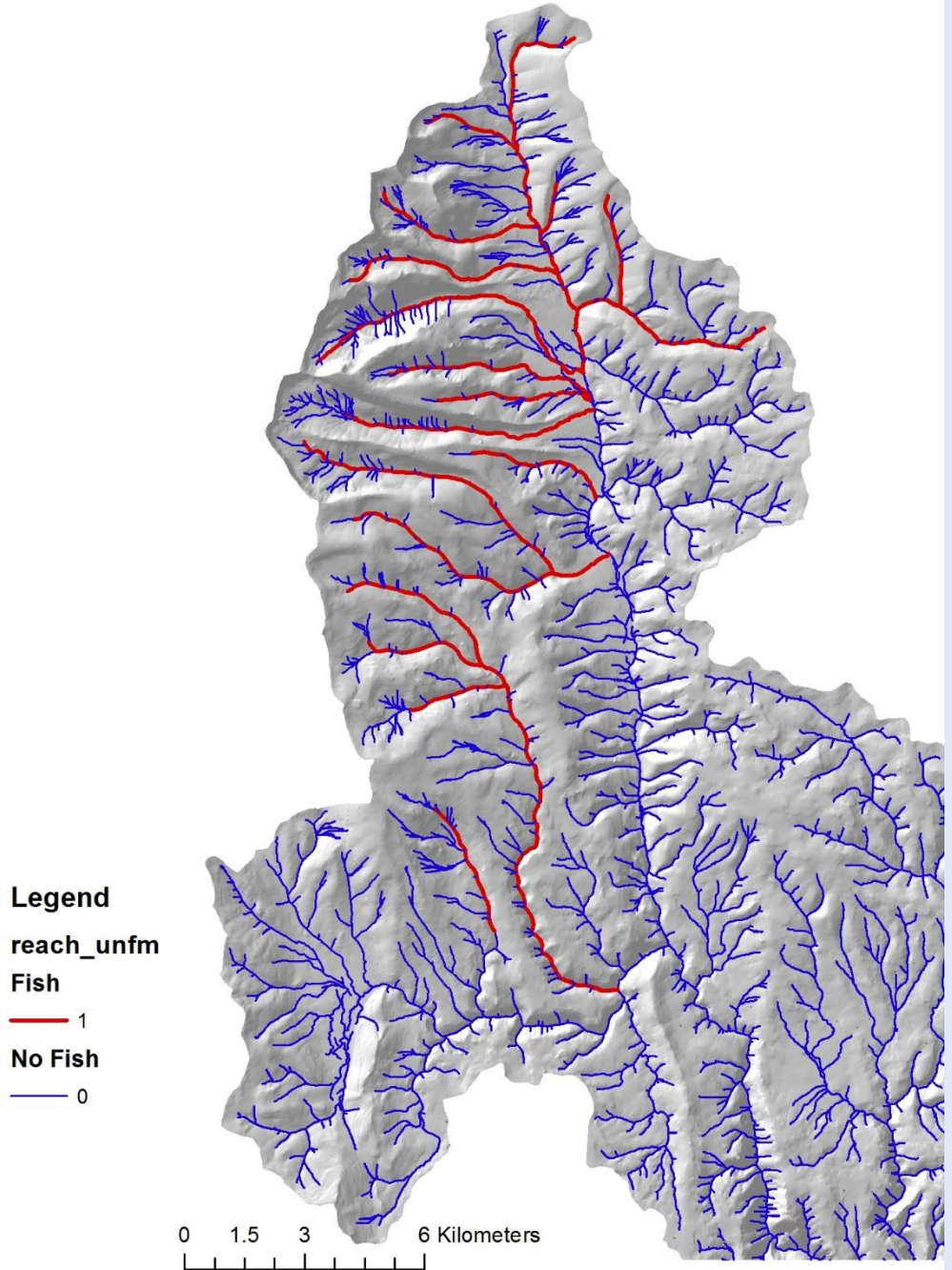
DEMs – LiDAR and 10 m
Synthetic River Networks (stream layers) NetMap (www.terrainworks.com)
Fire severity and probability (Flammap)
Post fire surface erosion (WEPP – Disturbed)
Post fire gully potential (Parker et al. 2010)
Post fire landsliding/gullying (Miller and Burnett 2007, 2008, NetMap)
Post fire road surface erosion and sediment delivery (GRAIP-Lite w/ modified sediment delivery)
Flash floods (NWS model)
Bull Trout Habitat (NorWest and US Forest Service stream layer)
Salmon habitat (Intrinsic Potential Chinook and steelhead, Burnett et al. 2007)
Shade/thermal loading/thermal refugia (NetMap and Groom et al. 2011)
Road – stability (NetMap)
Cumulative habitat length above roads (NetMap)

Refer to NetMap's online technical help manuals for additional information

Data Deliverable: Fish Habitat

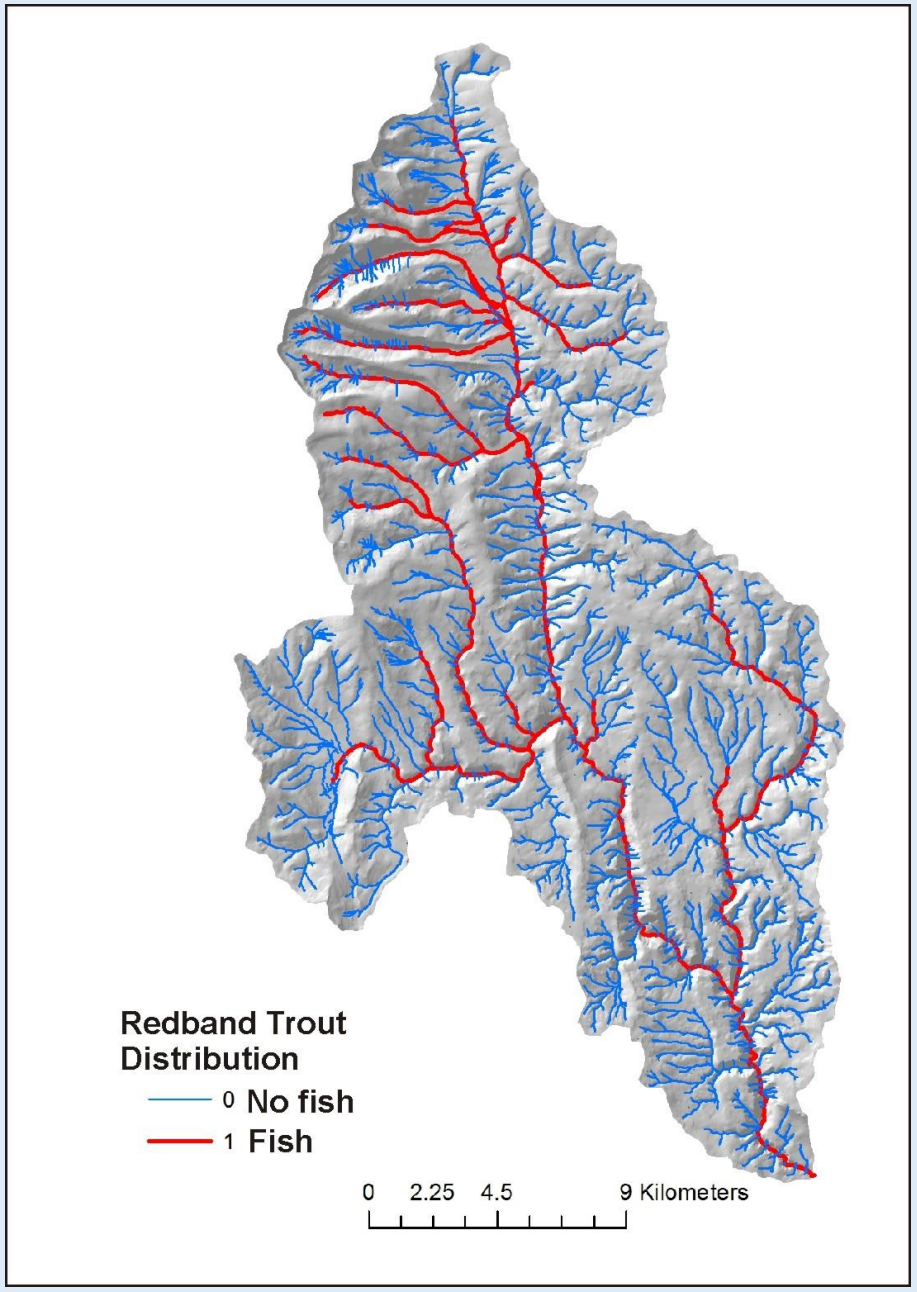
Use habitat intrinsic potential models in NetMap

Bull Trout (*Salvelinus confluentus*)

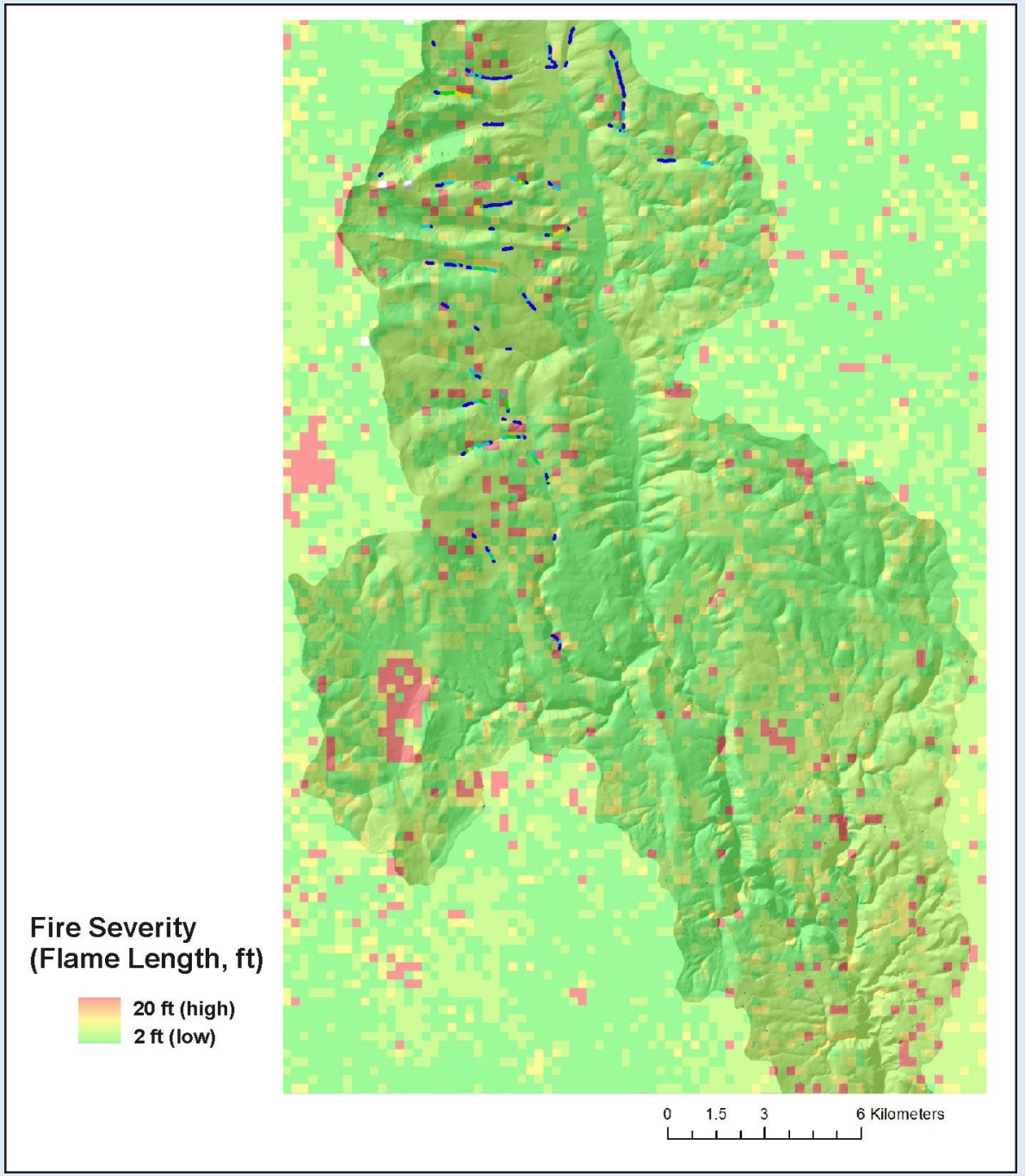


Fish Habitat: Redband Trout (subspecies of *Oncorhynchus mykiss)*

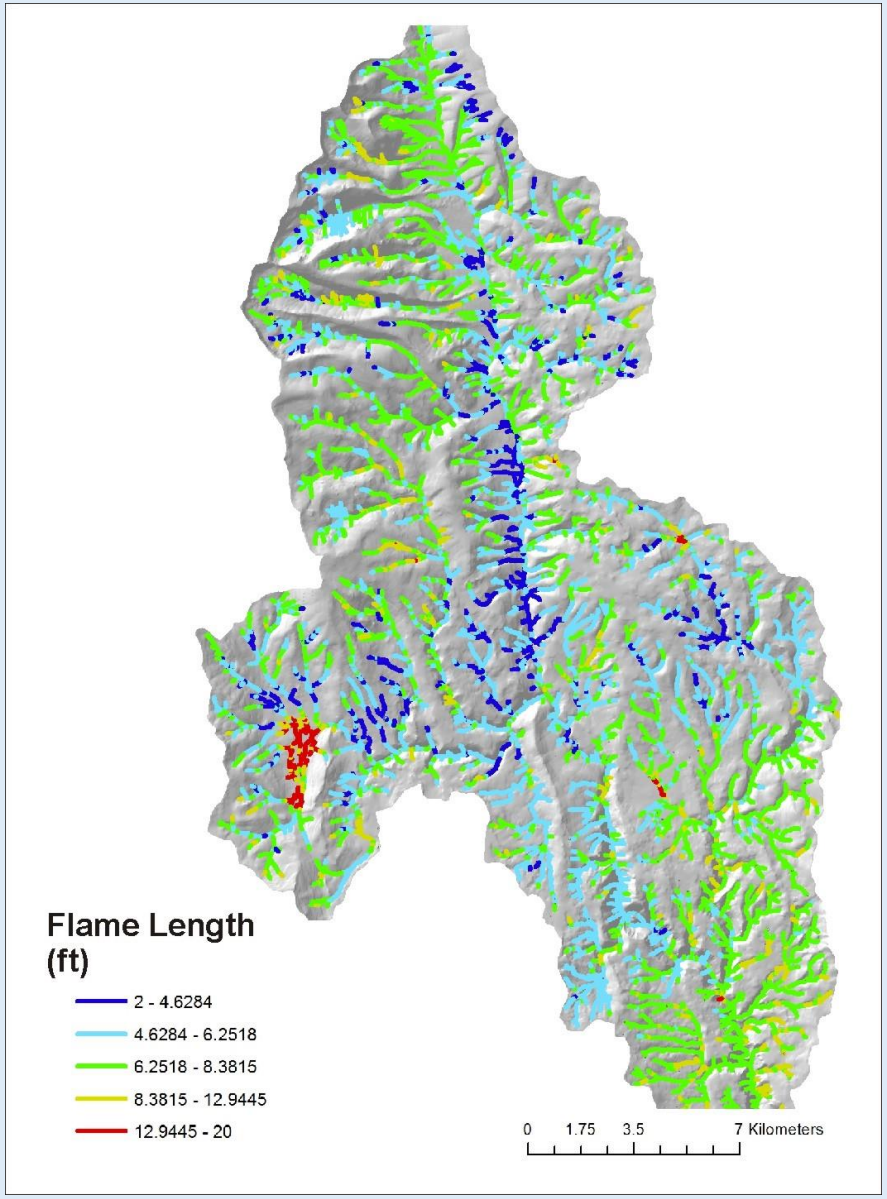
Use habitat intrinsic potential models in NetMap



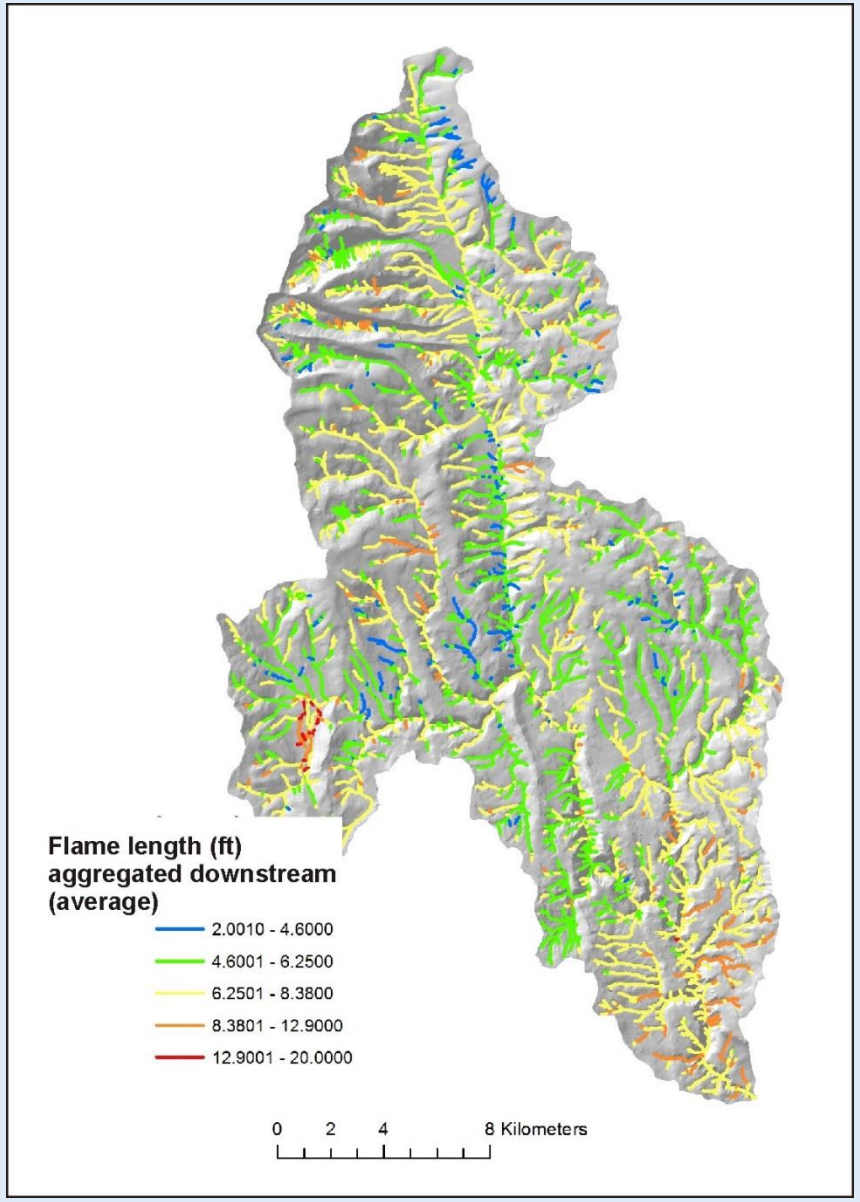
Data Deliverables
Fire Severity (hillside, Flammap)



Fire Severity (channel, fish eye)



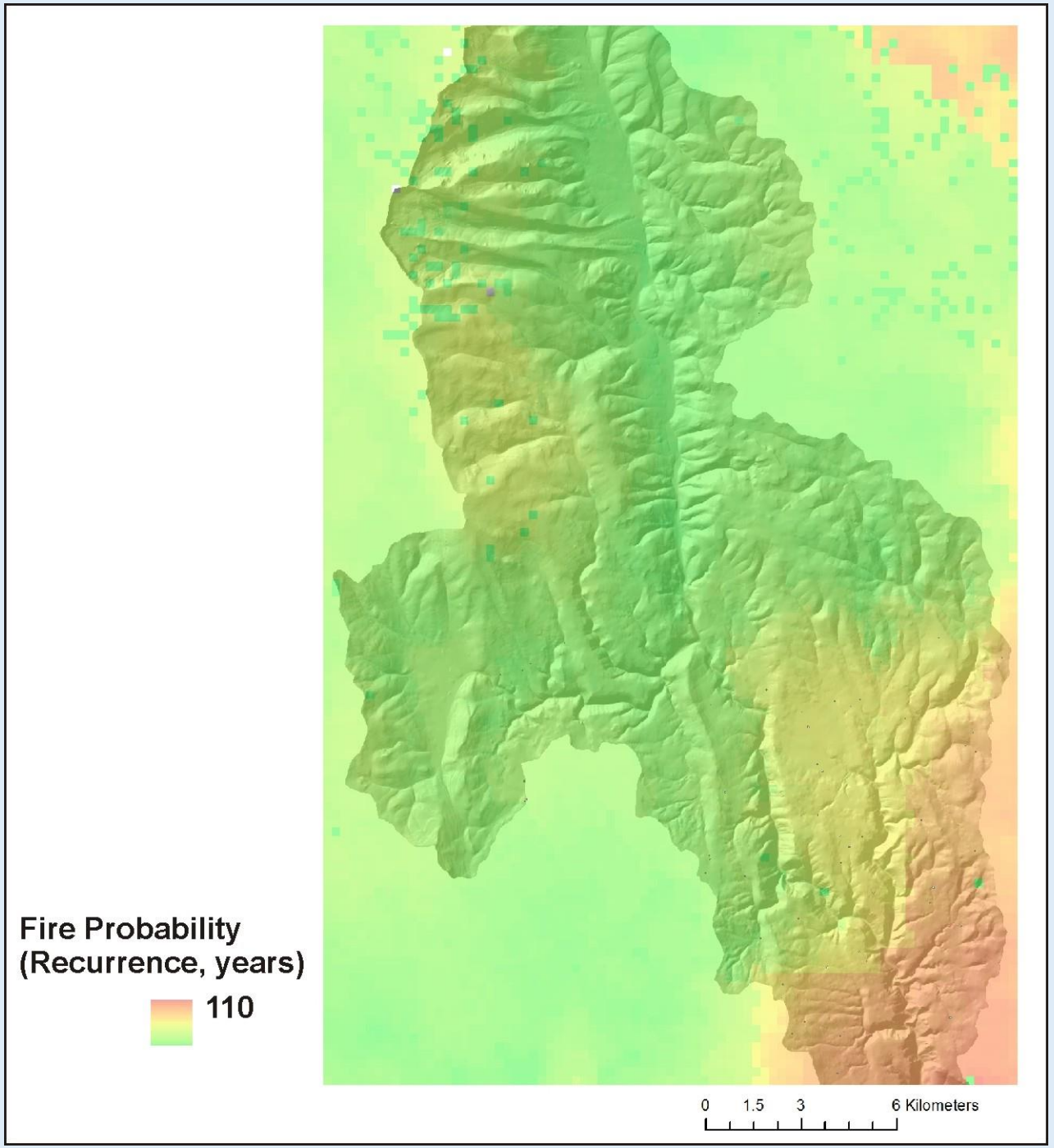
Fire Severity, Aggregated Downstream (tributary scale patterns)



Why are hillslope attributes reported to channels, via drainage wings?

This facilitates comparing hillslope related stressors (fire severity, erosion, roads etc.) to fish habitats, a channel attribute.

Fire Probability



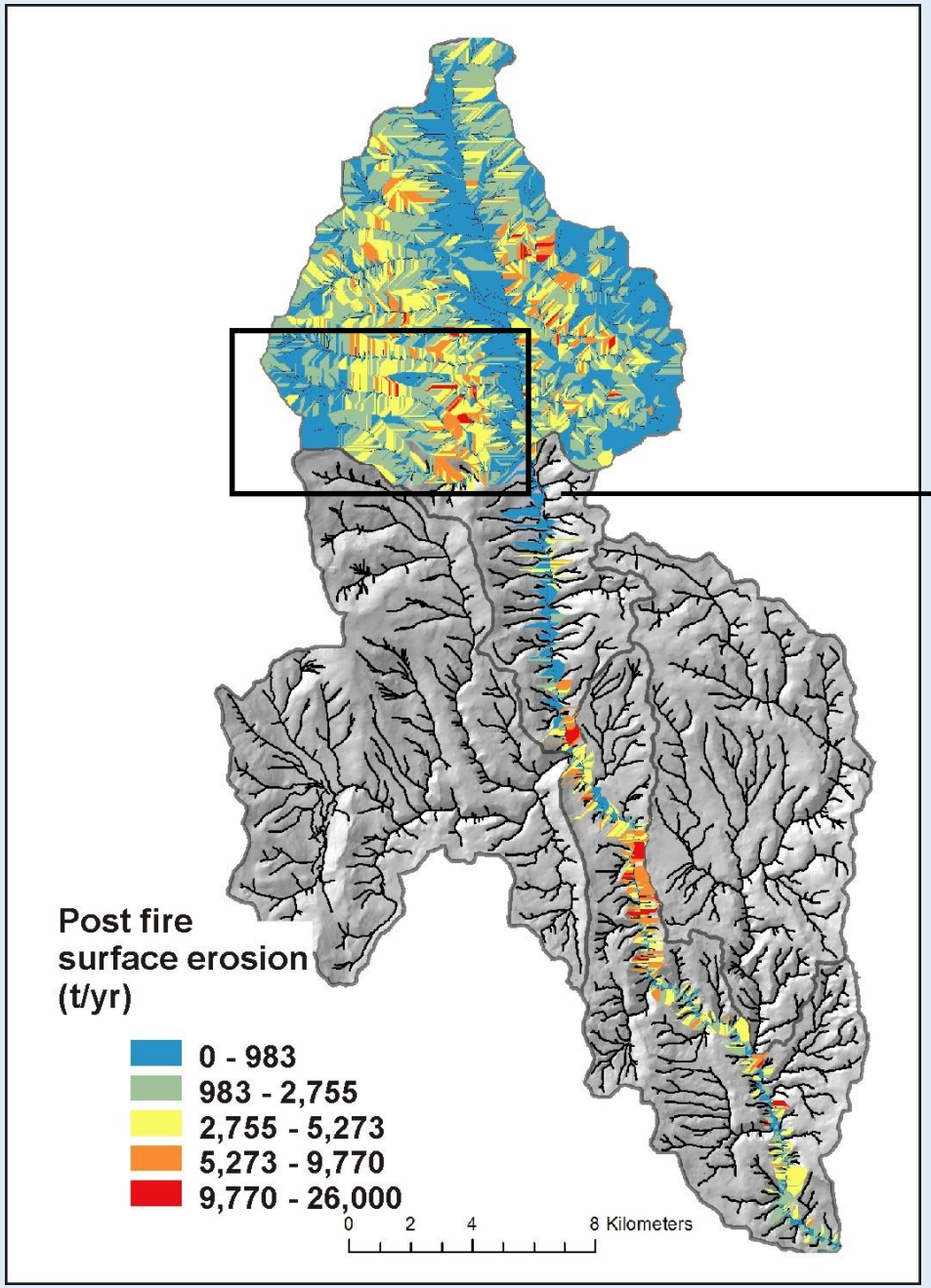
Fire Cascade Impacts on Aquatic Ecosystems

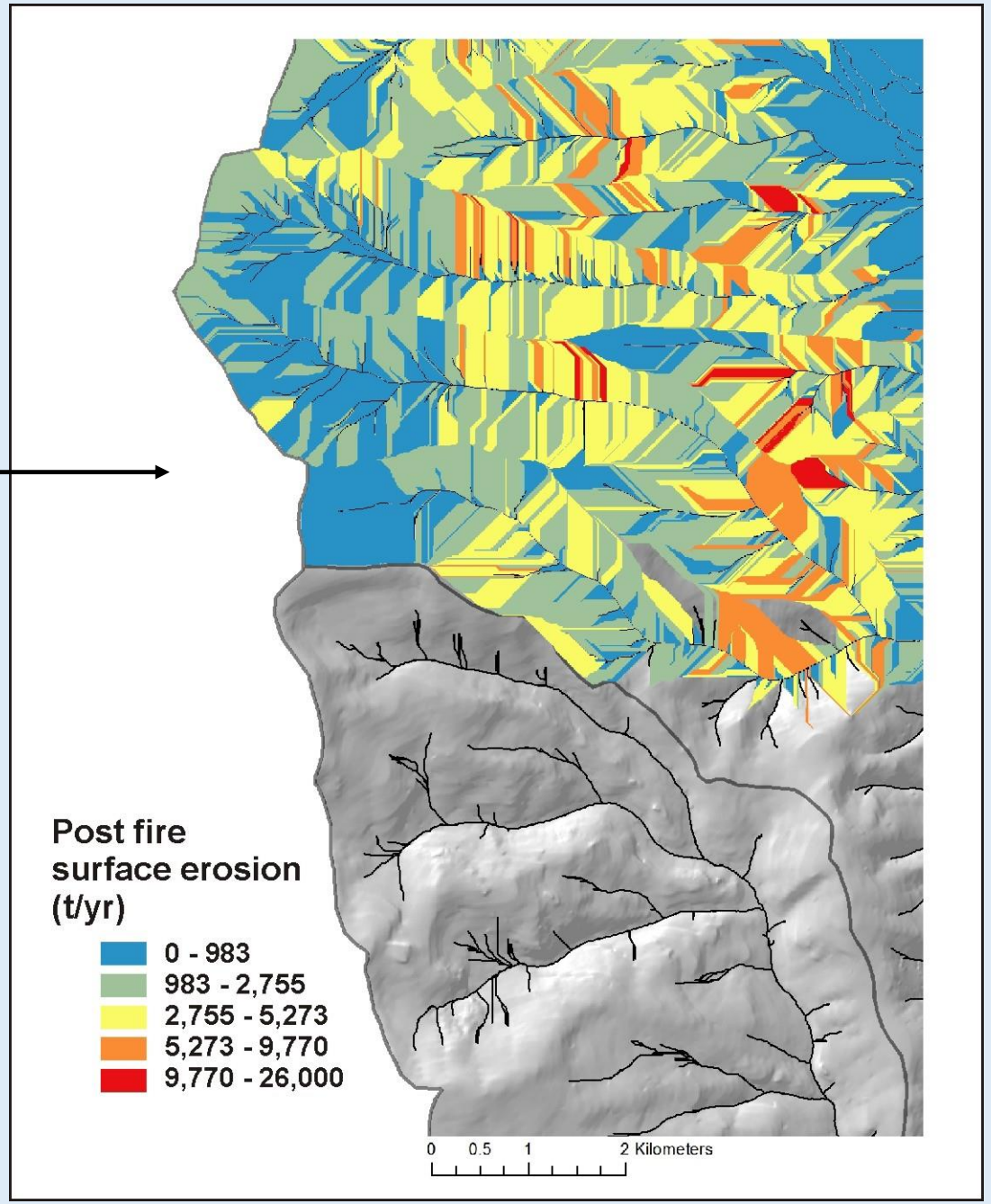
Fisheries/ Water Quality Impacts

Sedimentation

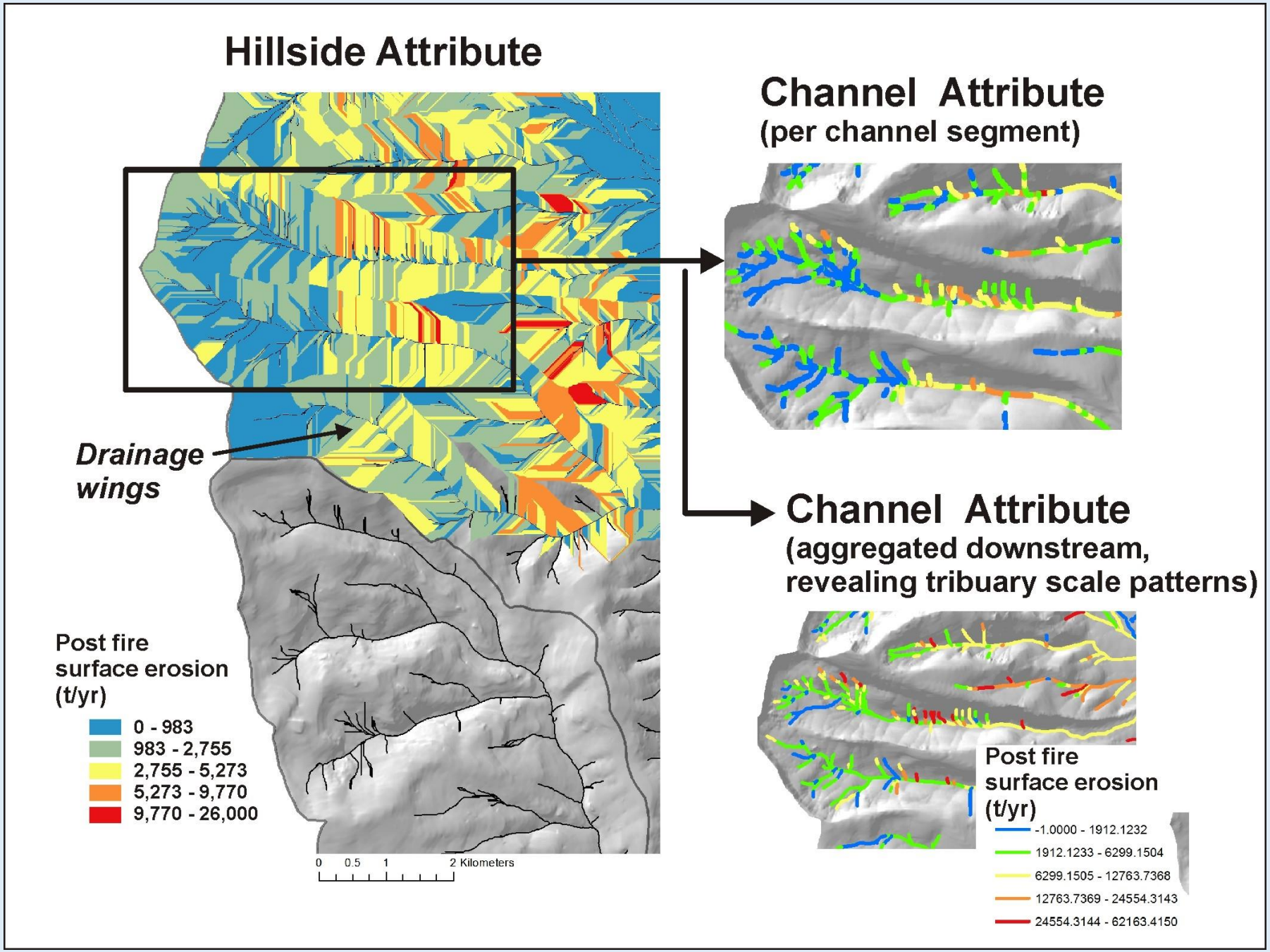
Post Fire Erosion

Post Fire Surface Erosion (WEPP, disturbed)

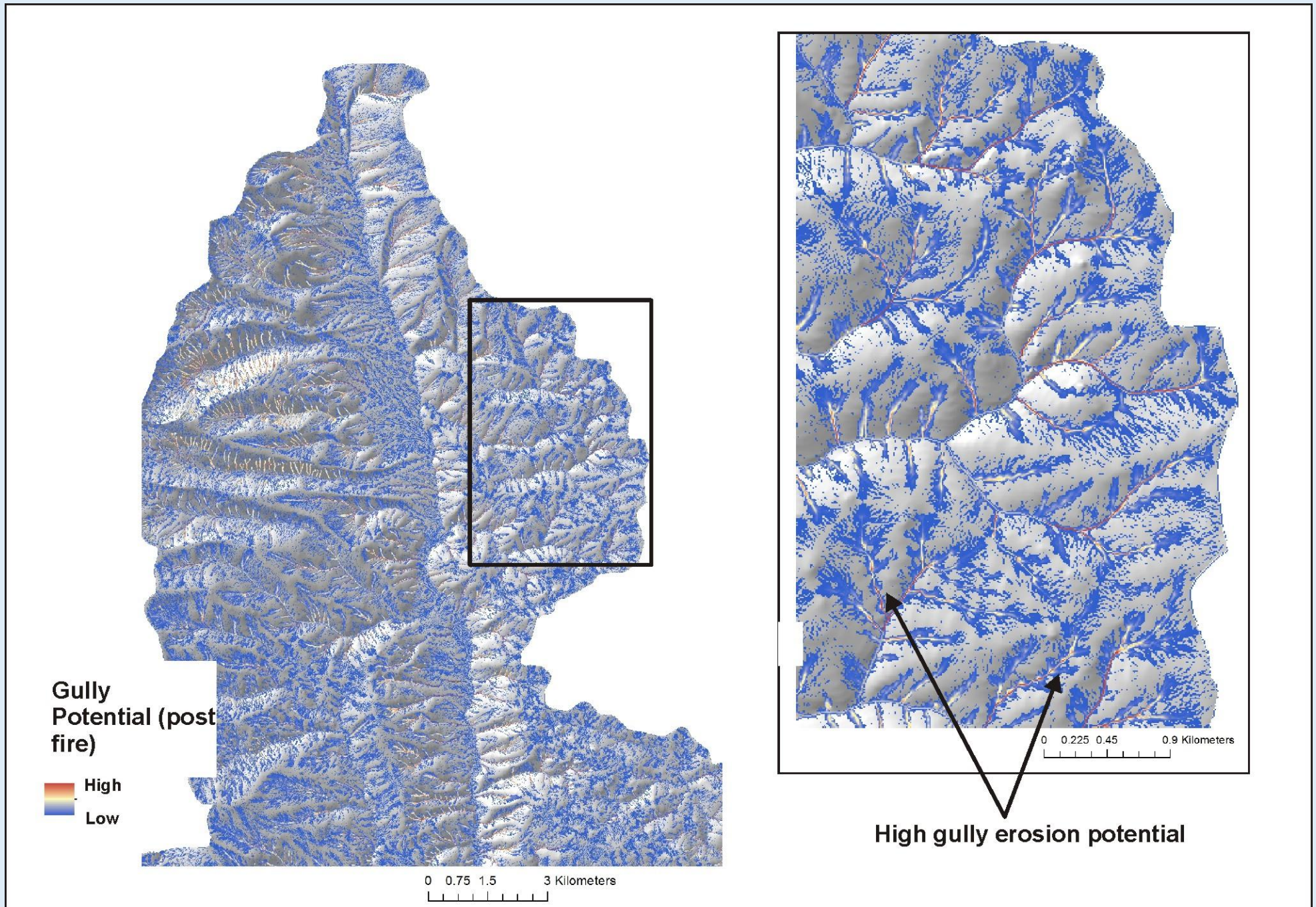




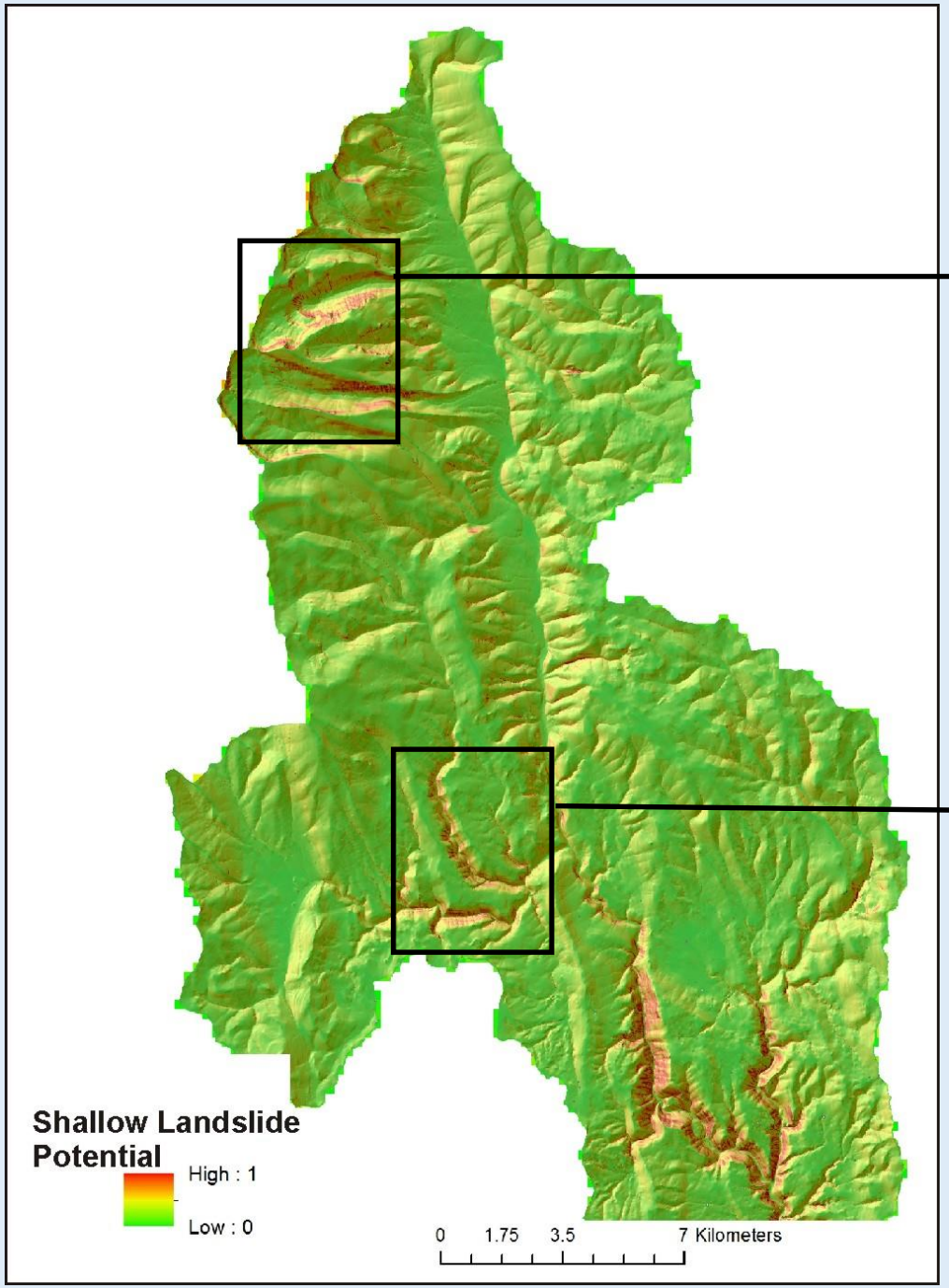
An example about how a hillside attribute (post fire erosion) is transferred to individual channel segments, and aggregated downstream

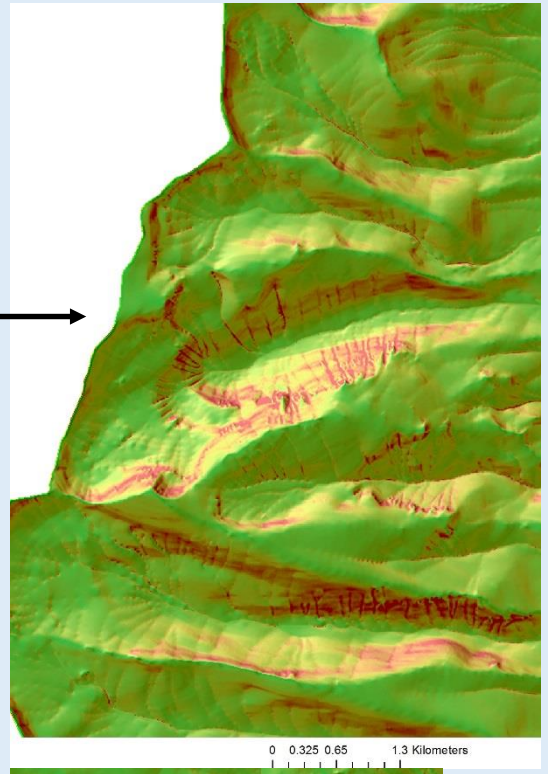


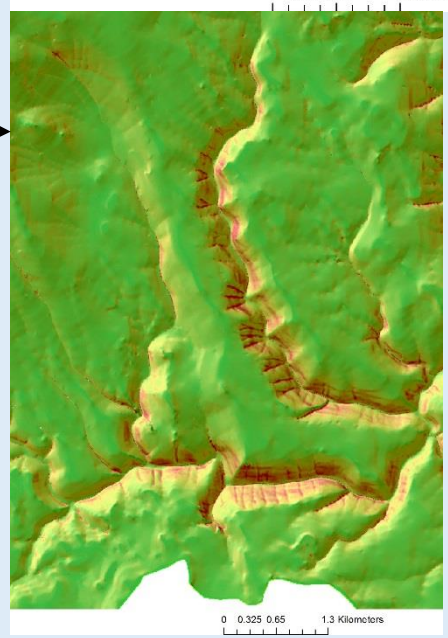
Post Fire
Gully Potential



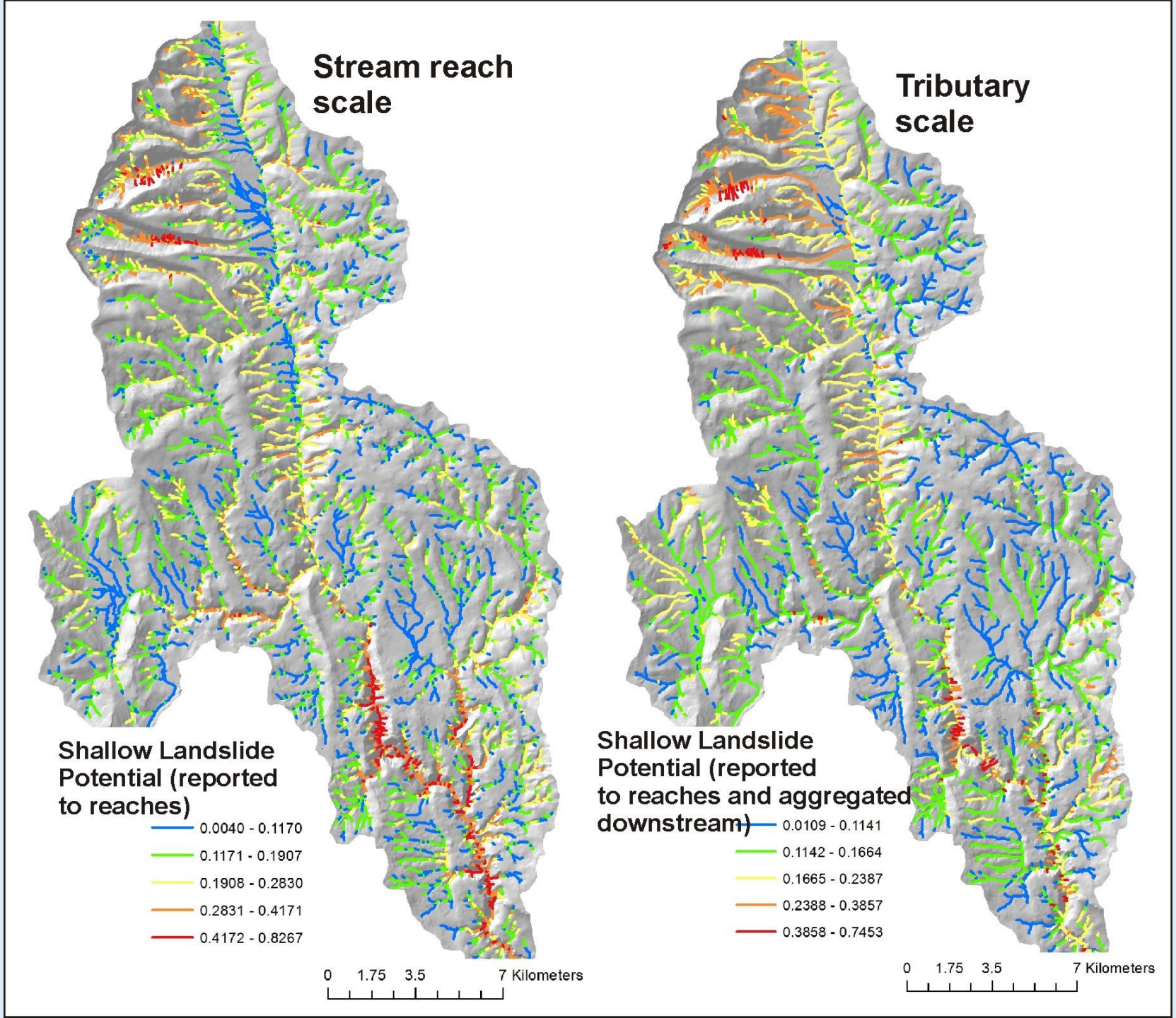
Shallow Landslide-Debris Flow Potential







Shallow landslide potential reported to channel segments and aggregated downstream



FLASH FLOOD Potential

A dimensionless index developed by the National Weather Service. The Flash Flood Potential Index (FFPI) consists of four factors:

1) **hillslope gradient**
2) **soils (percent silt, clay and sand)**
3) **vegetation density (forest, shrubs, grasses)**
4) **fire impacts on soils and vegetation.**

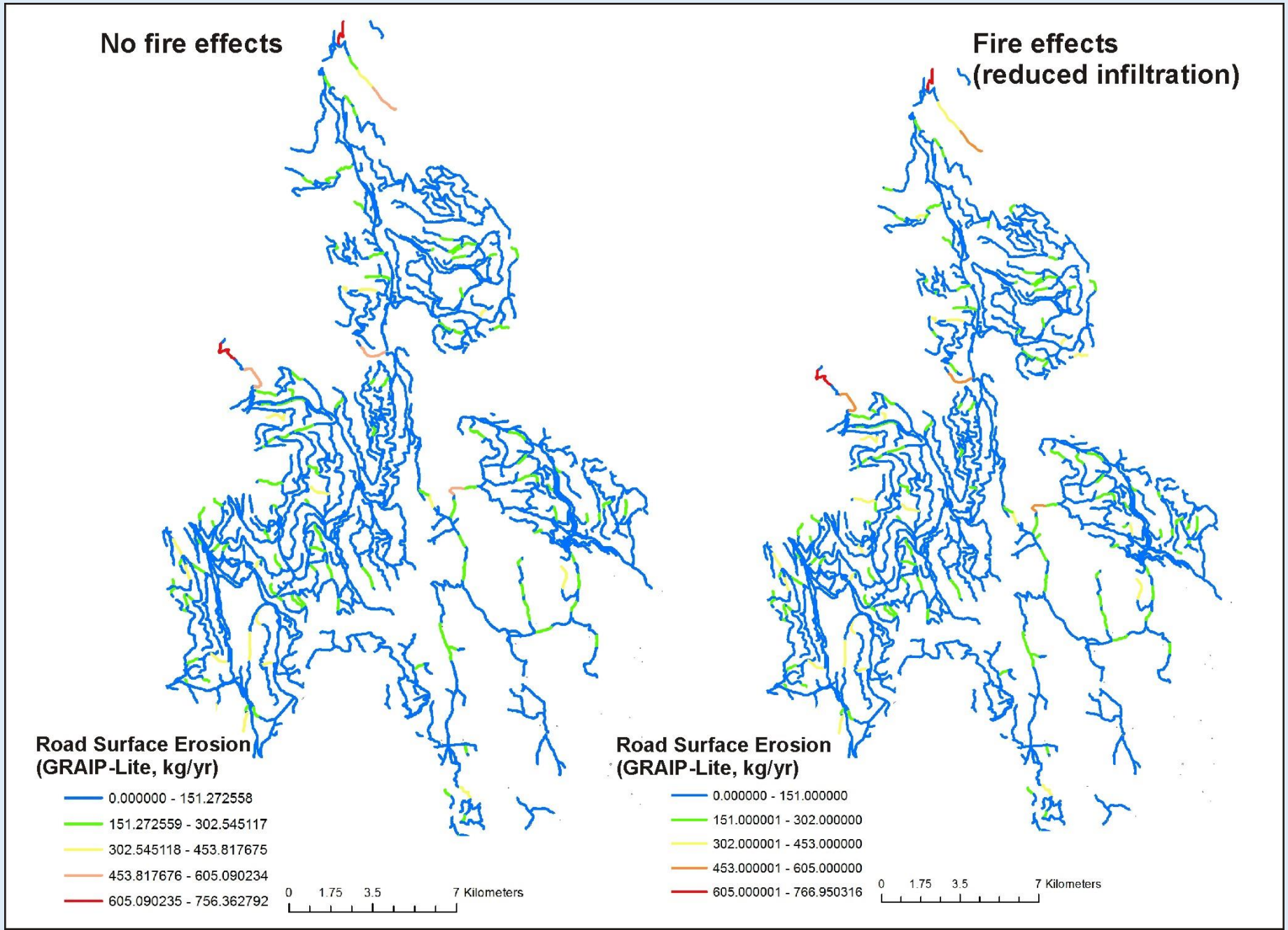
See NetMap's online technical help manual for additional details.

Road Surface Erosion and Sediment Delivery to Streams, Post Fire

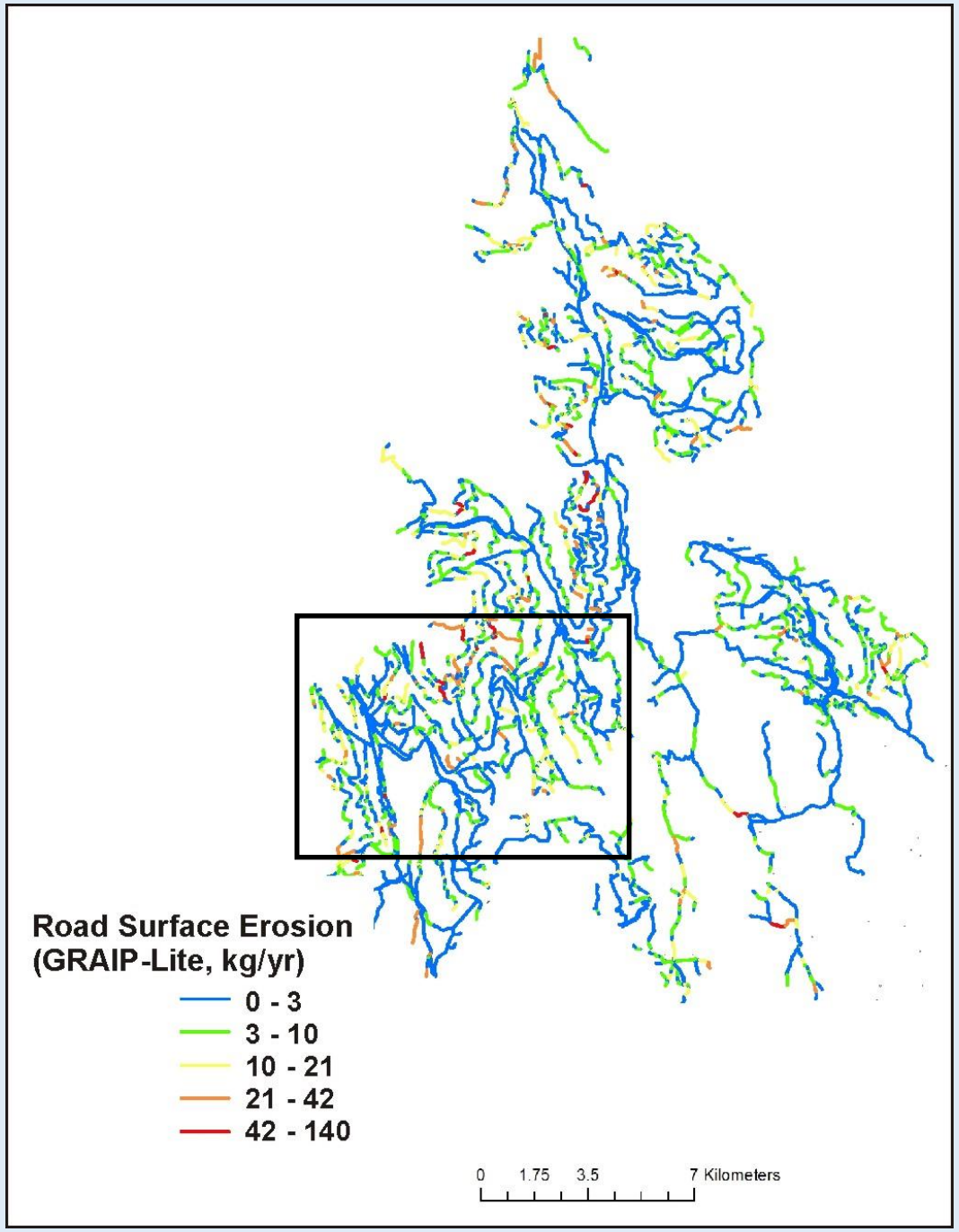
Road erosion results, pre and post fire

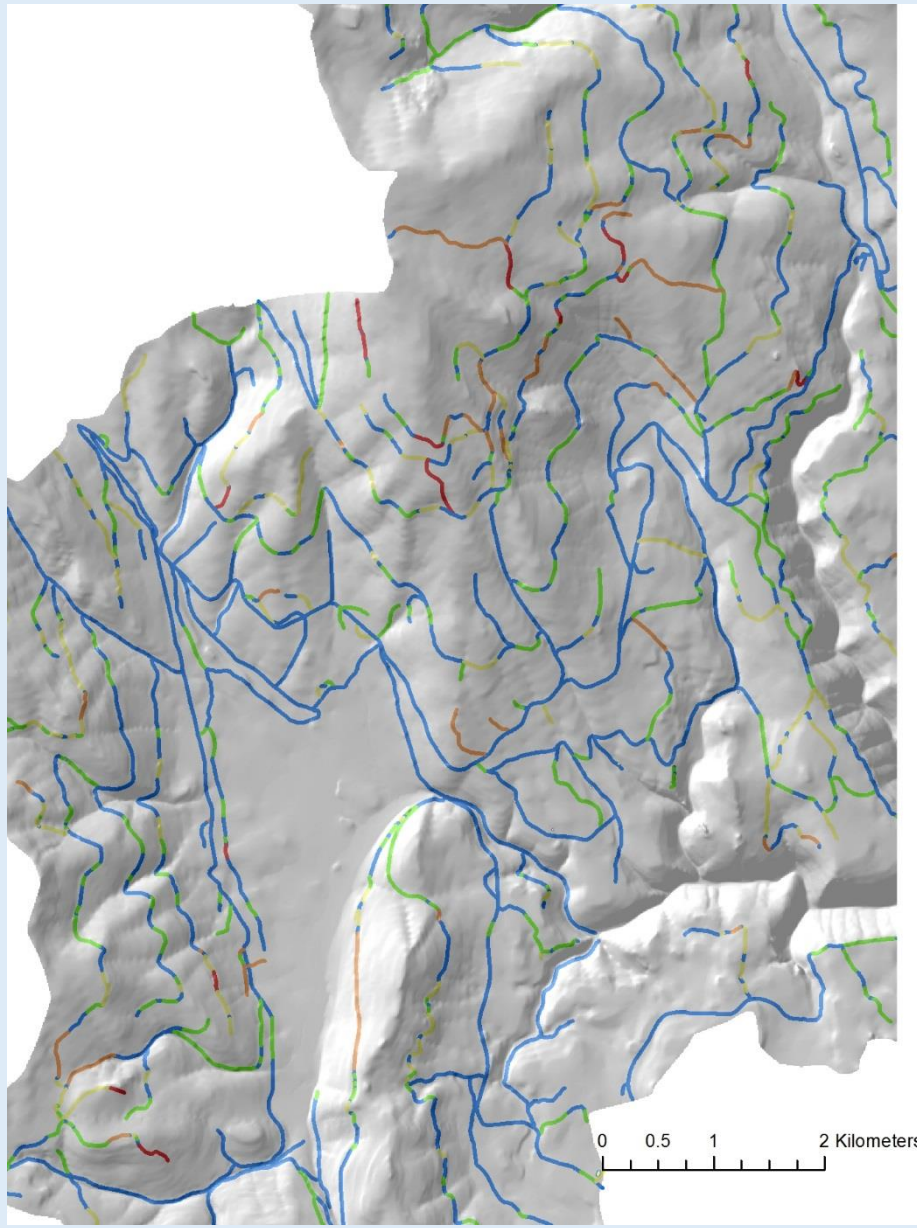
It is difficult to see the changes in these maps because of the broad legend categories.

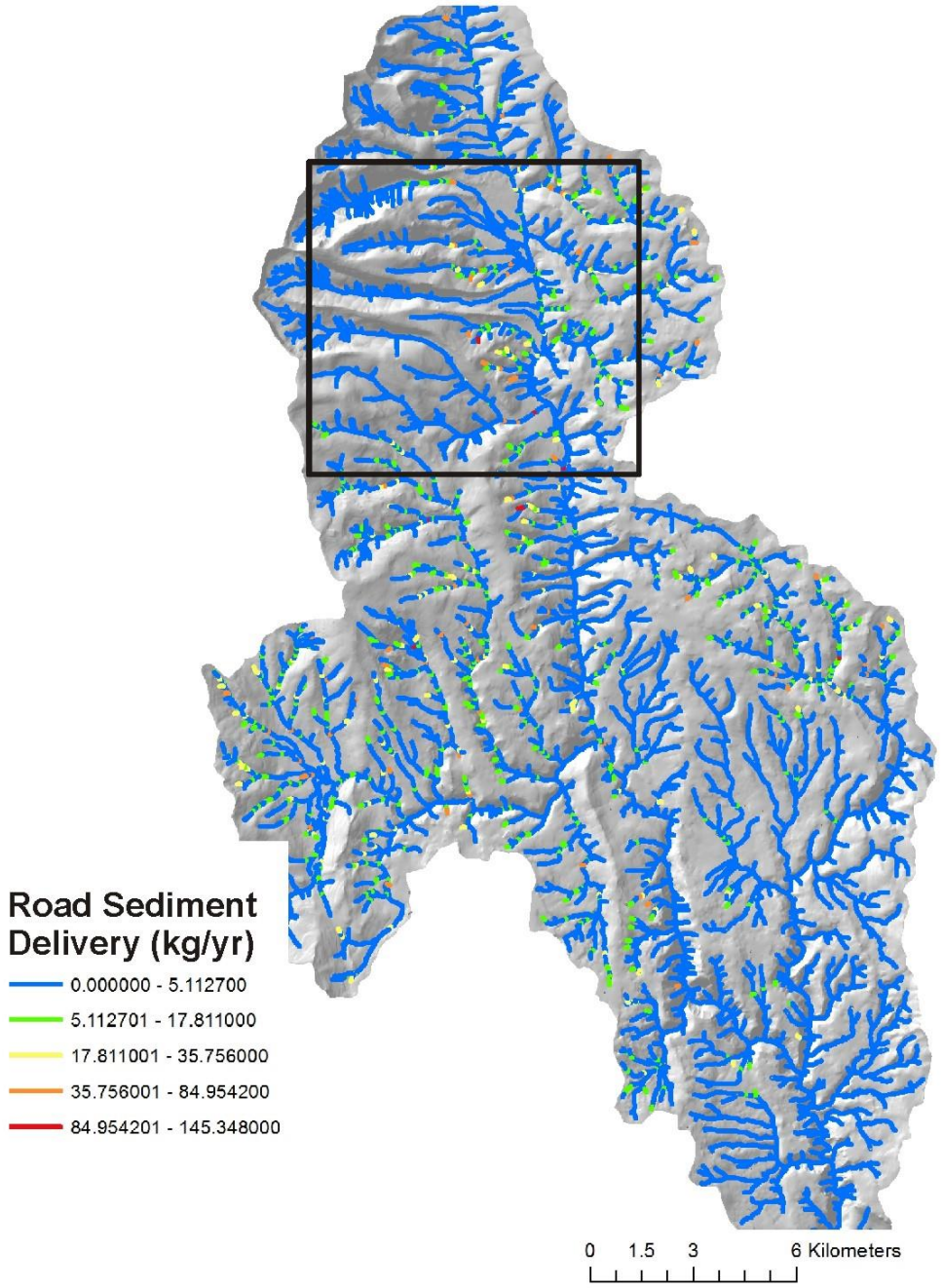
See following slide for the difference between no fire and fire.

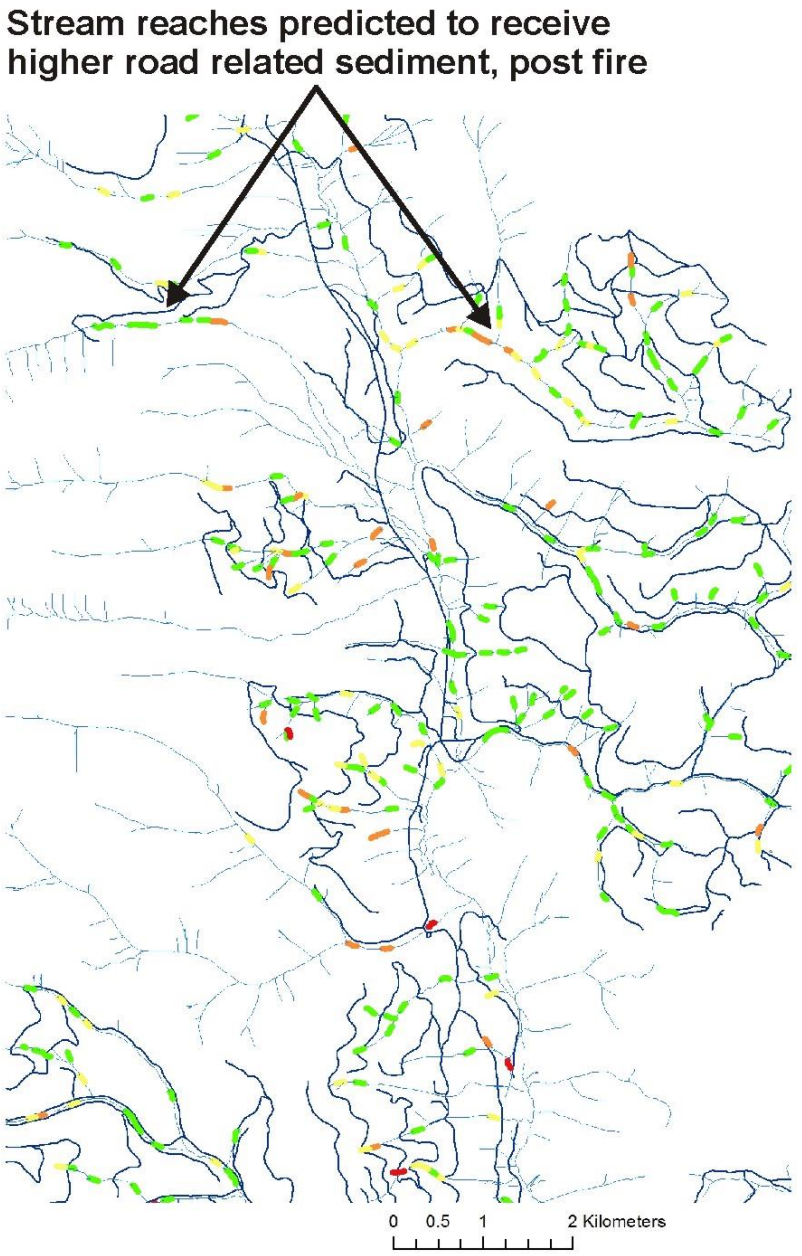


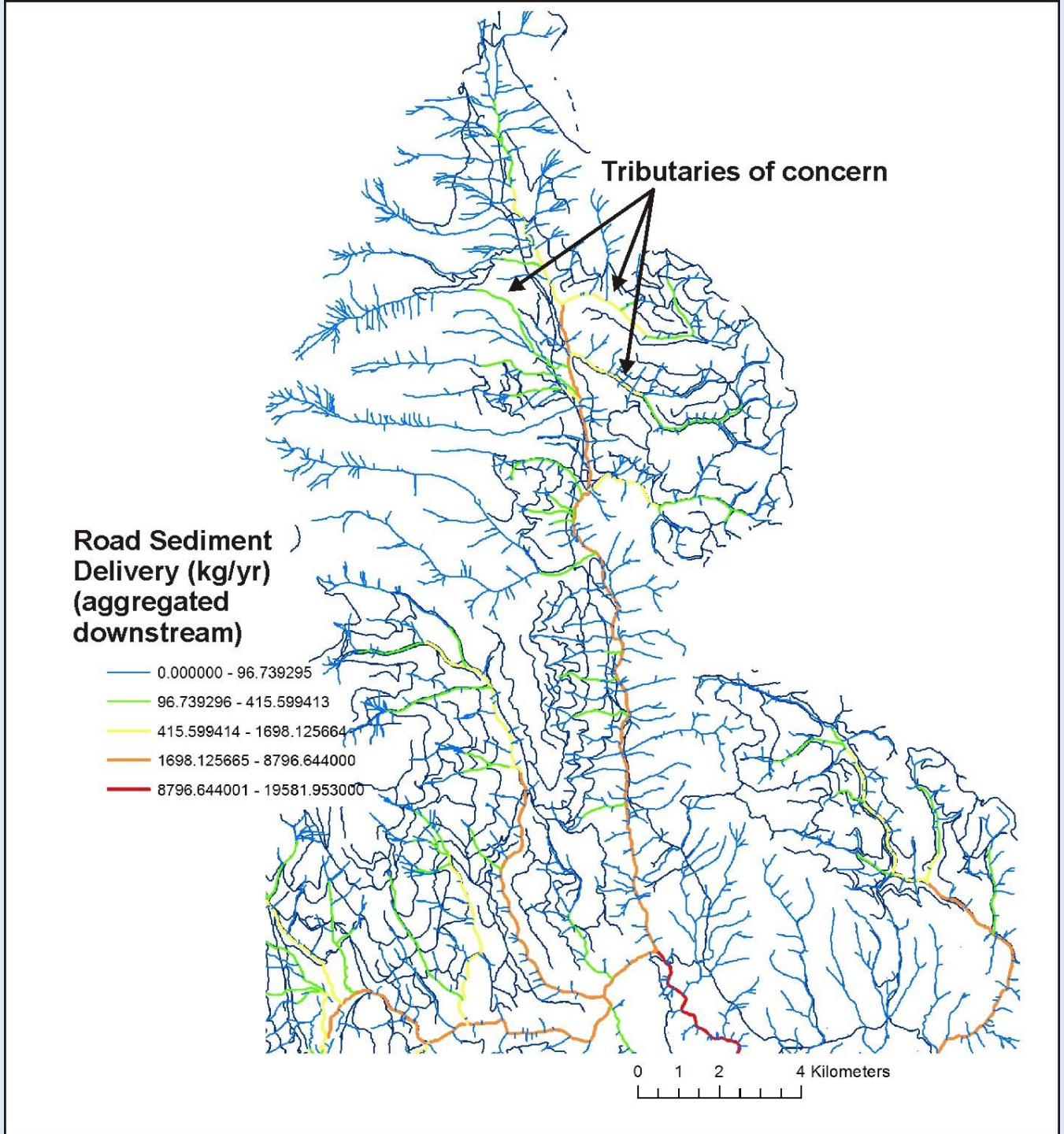
Road erosion difference map, where fire should have the largest effect of increasing sediment delivery





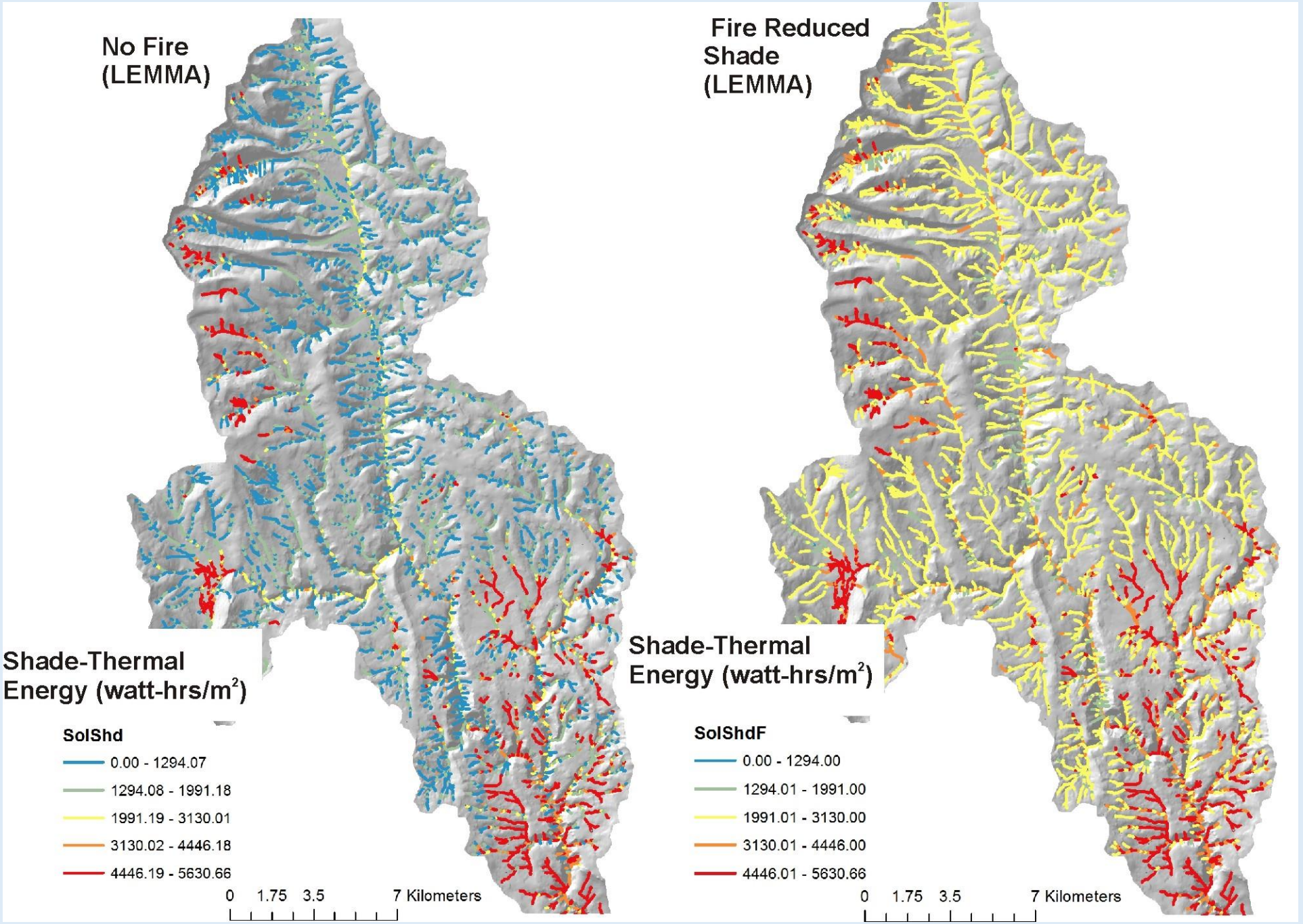

Road Sediment Delivery (kg/yr)
0.000000 - 5.112700
5.112701 - 17.811000
17.811001 - 35.756000
35.756001 - 84.954200
84.954201 - 145.348000
0 1.5 3 6 Kilometers


Stream reaches predicted to receive higher road related sediment, post fire
0 0.5 1 2 Kilometers


Tributaries of concern
Road Sediment Delivery (kg/yr) (aggregated downstream)
0.000000 - 96.739295
96.739296 - 415.599413
415.599414 - 1698.125664
1698.125665 - 8796.644000
8796.644001 - 19581.953000
0 1 2 4 Kilometers

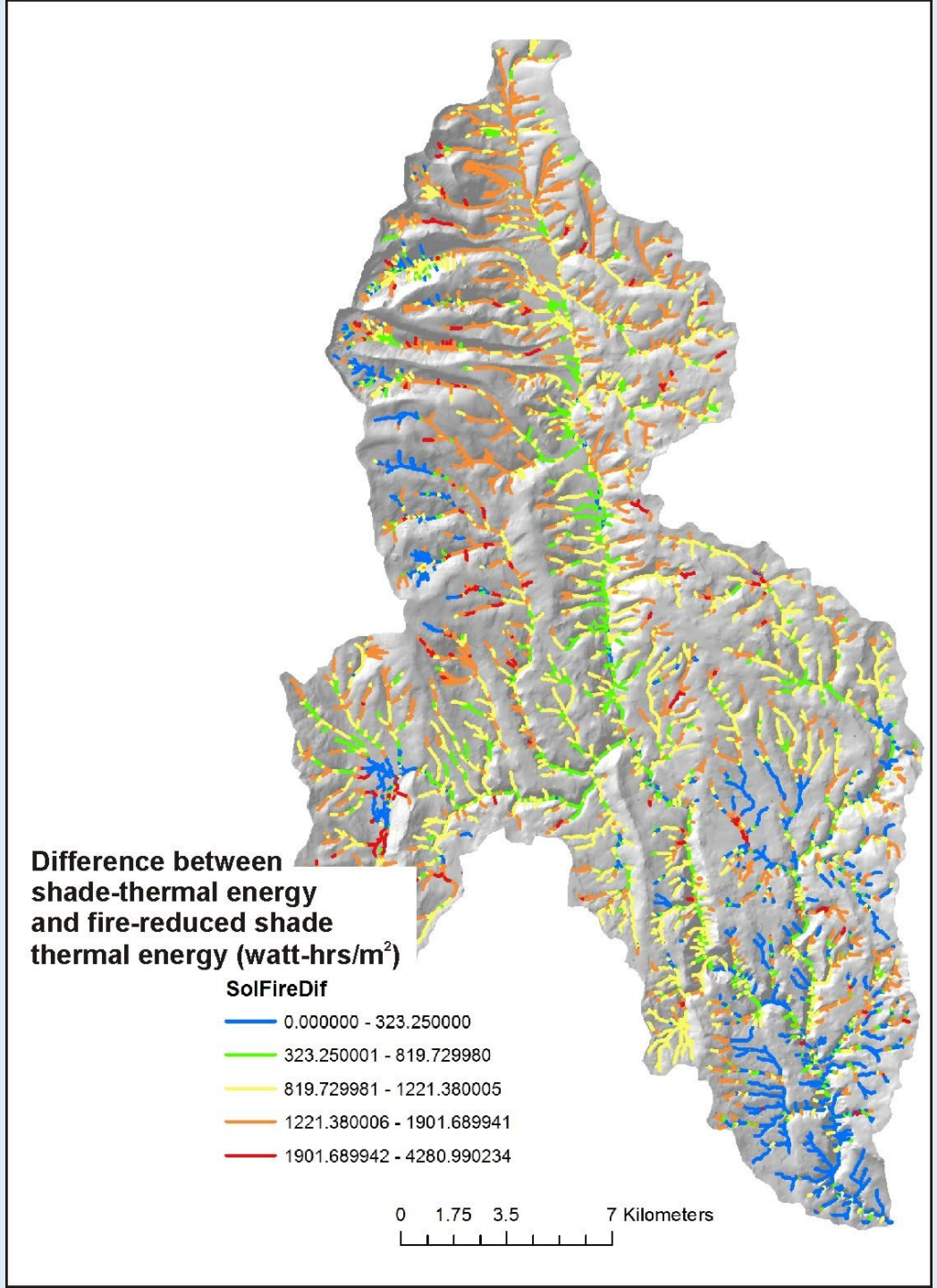
Riparian Zones: Impacts from Fire, Loss of Shade, Increases in Thermal Loading and Loss of Cool Water Refugia

Riparian – Current Shade/ Thermal Energy



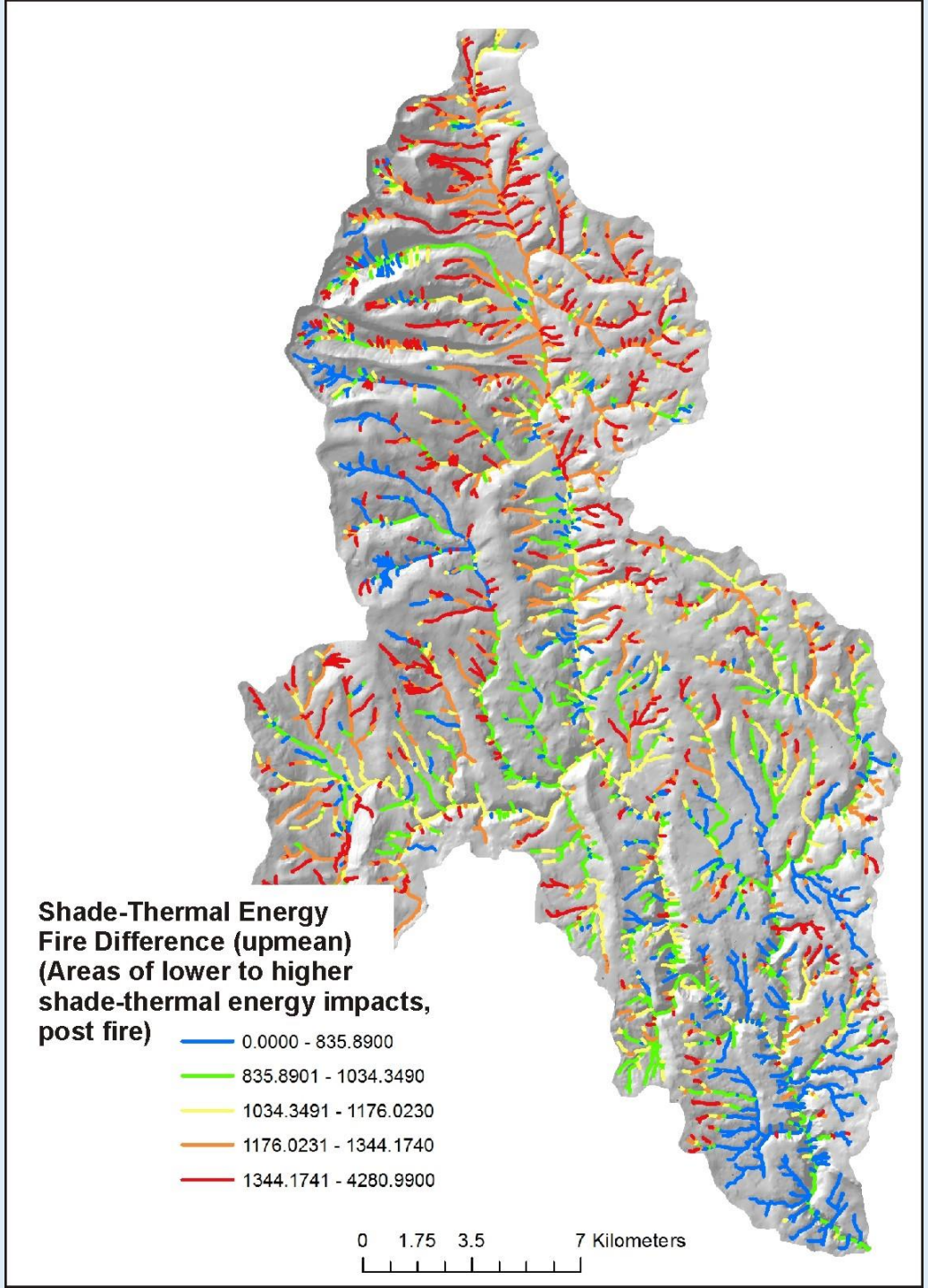
Difference between current shade-thermal energy and fire reduced shade thermal energy.

Shows reaches where the greatest impacts to shade and increases in thermal energy are predicted to occur



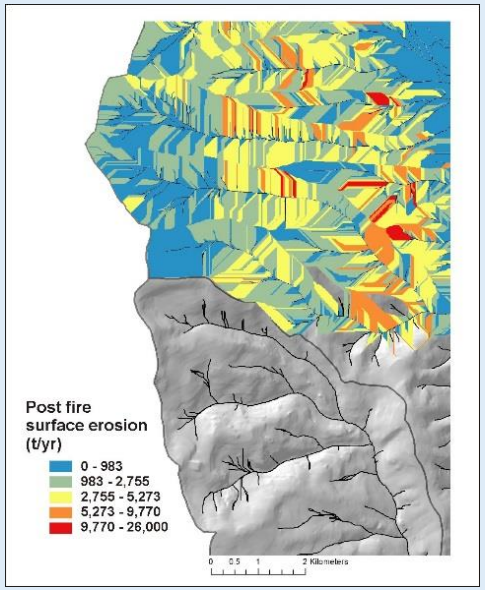
Difference between current shade-thermal energy and fire reduced shade thermal energy, but aggregated downstream (running average).

Shows multi-reach or tributary scale impacts to shade and increases in thermal energy, e.g., stream segments and tributaries where thermal refugia will be reduced.



Decision Space: Spatially Explicit Maps (visual - qualitative)

Surface erosion potential



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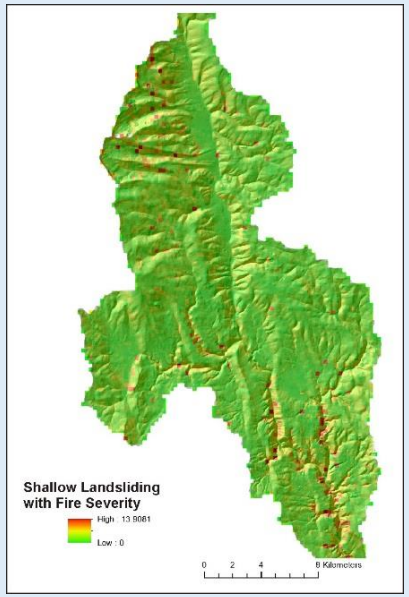
Landslide potential



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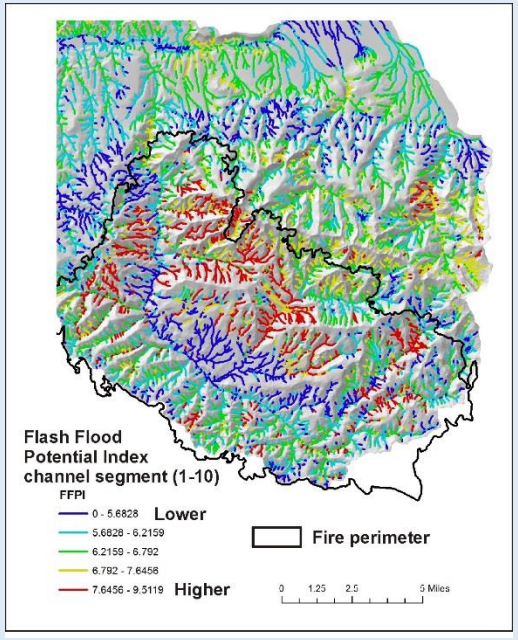
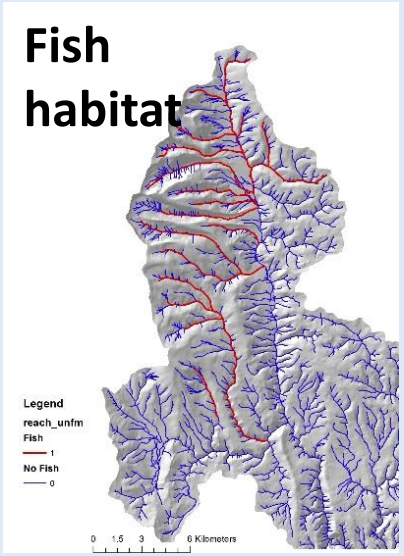
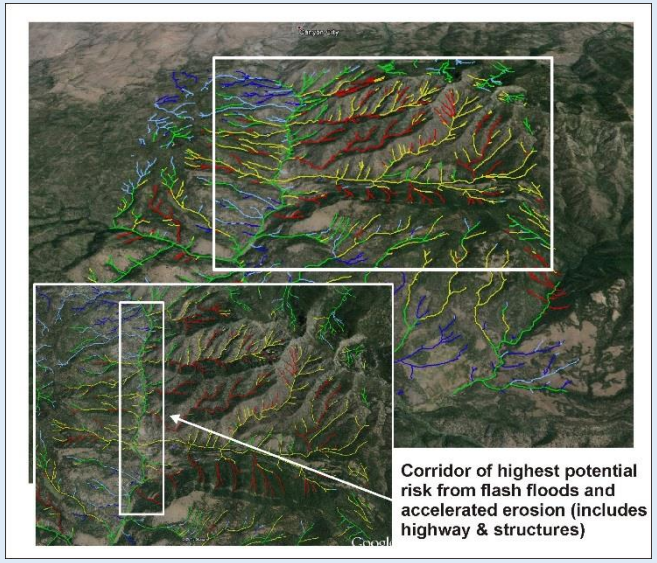
Flash flood potential



+ locations of aquatic habitats, or infrastructure (homes, highways, energy)

Fish habitat

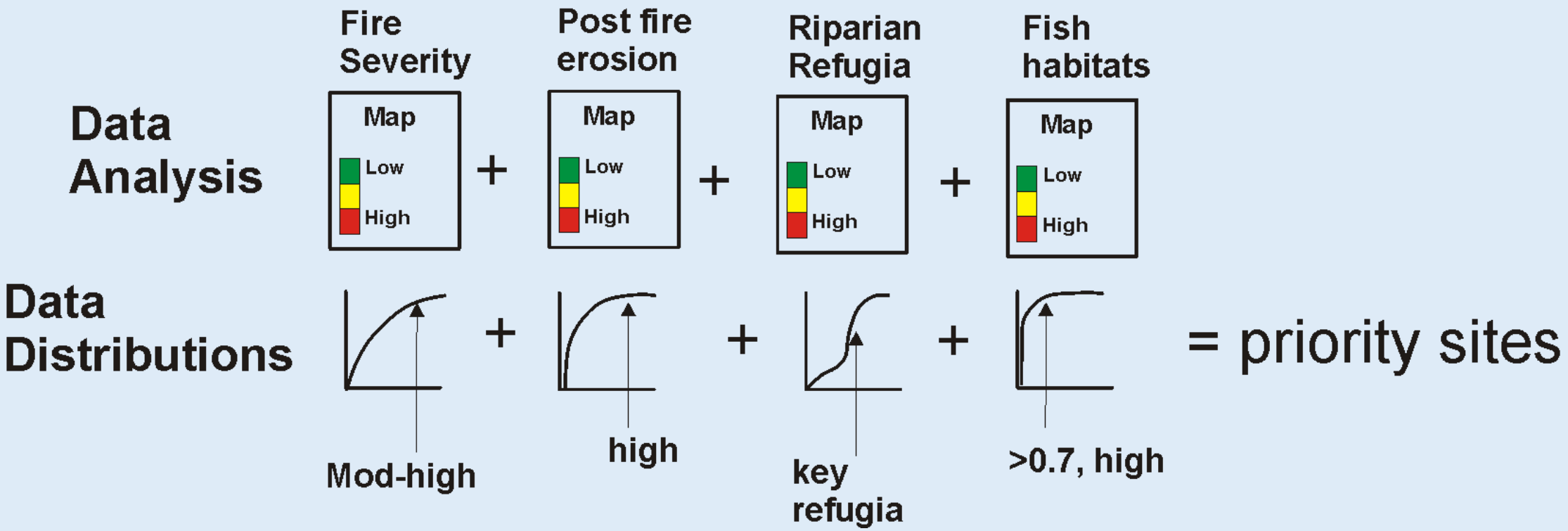


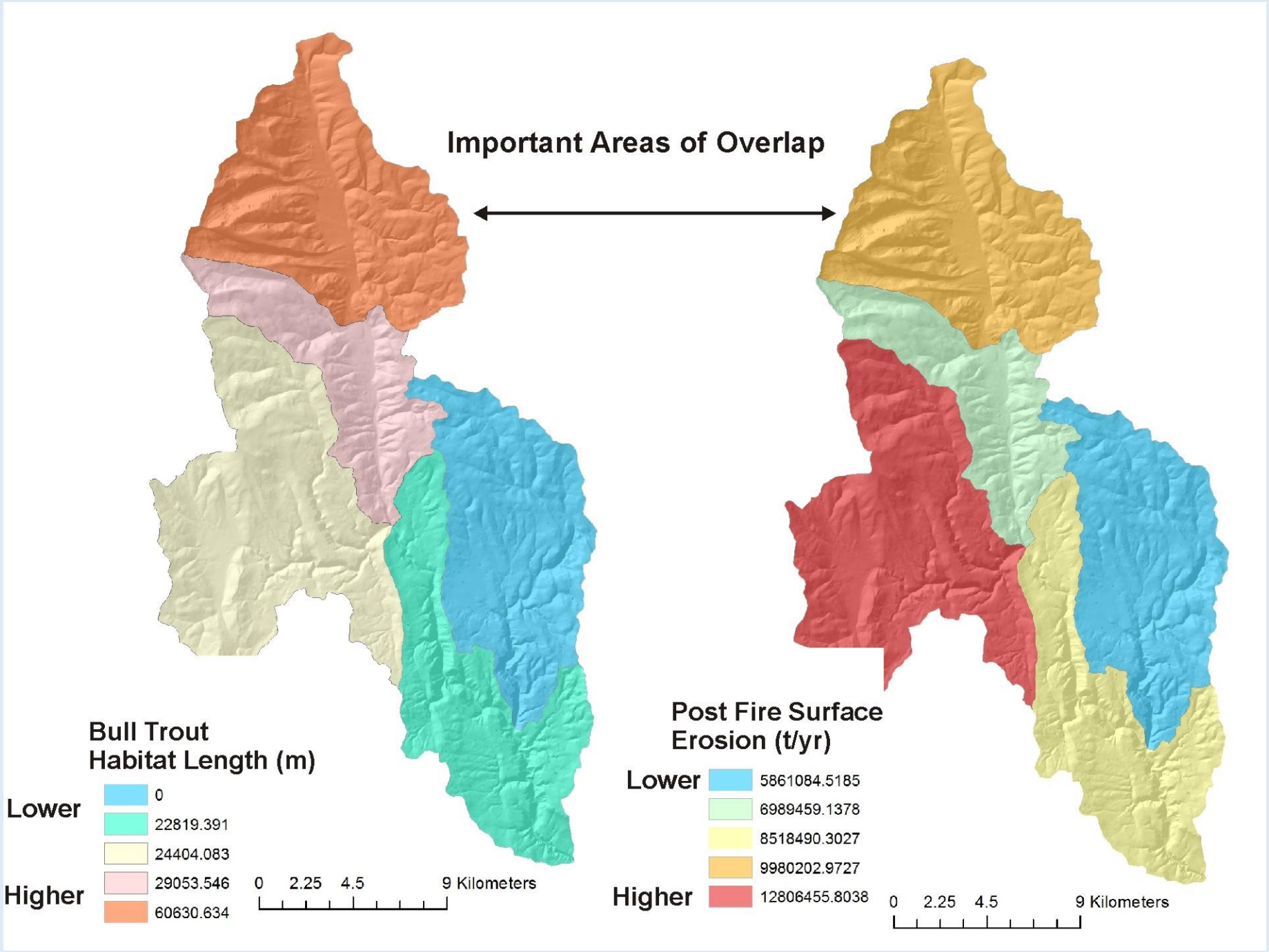


= priority sites for protection (pre fire management, firefighting)

Decision Space: Spatially Explicit Quantitative (using Quick Fire Tool)

Search for critical fire - fish interactions




Important Areas of Overlap
Bull Trout
Habitat Length (m)
Lower
Higher
0
22819.391
24404.083
29053.546
60630.634
0 2.25 4.5 9 Kilometers
Post Fire Surface
Erosion (t/yr)
Lower
Higher
5861084.5185
6989459.1378
8518490.3027
9980202.9727
12806455.8038
0 2.25 4.5 9 Kilometers

Presentation Complete

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