

Using GIS to Target Road Management in the Lake Tahoe Basin

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USFS Lake Tahoe Management Unit

BLM Southern Nevada Public Land Management Act (SNPLMA)

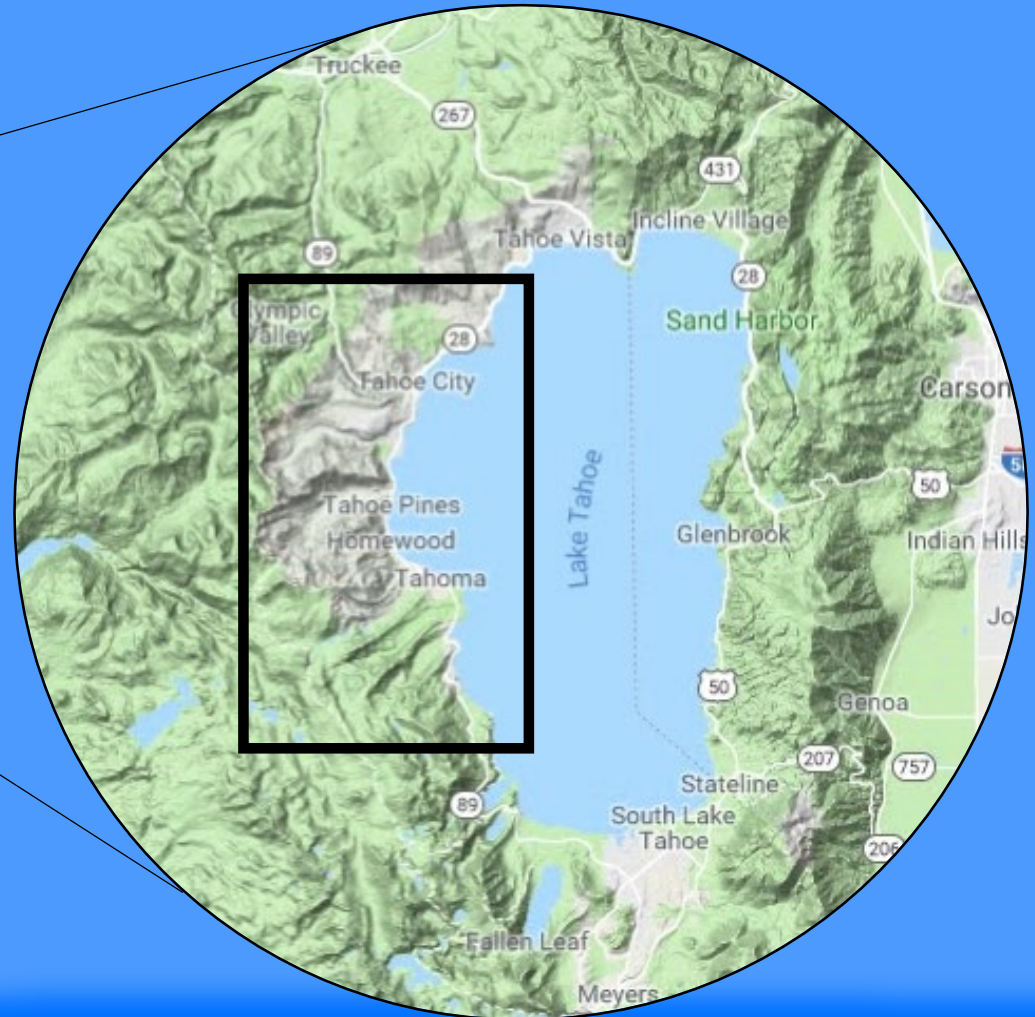


Approach

- **Motivation**
- **Methods**
- **Model results**
- **Limitations**

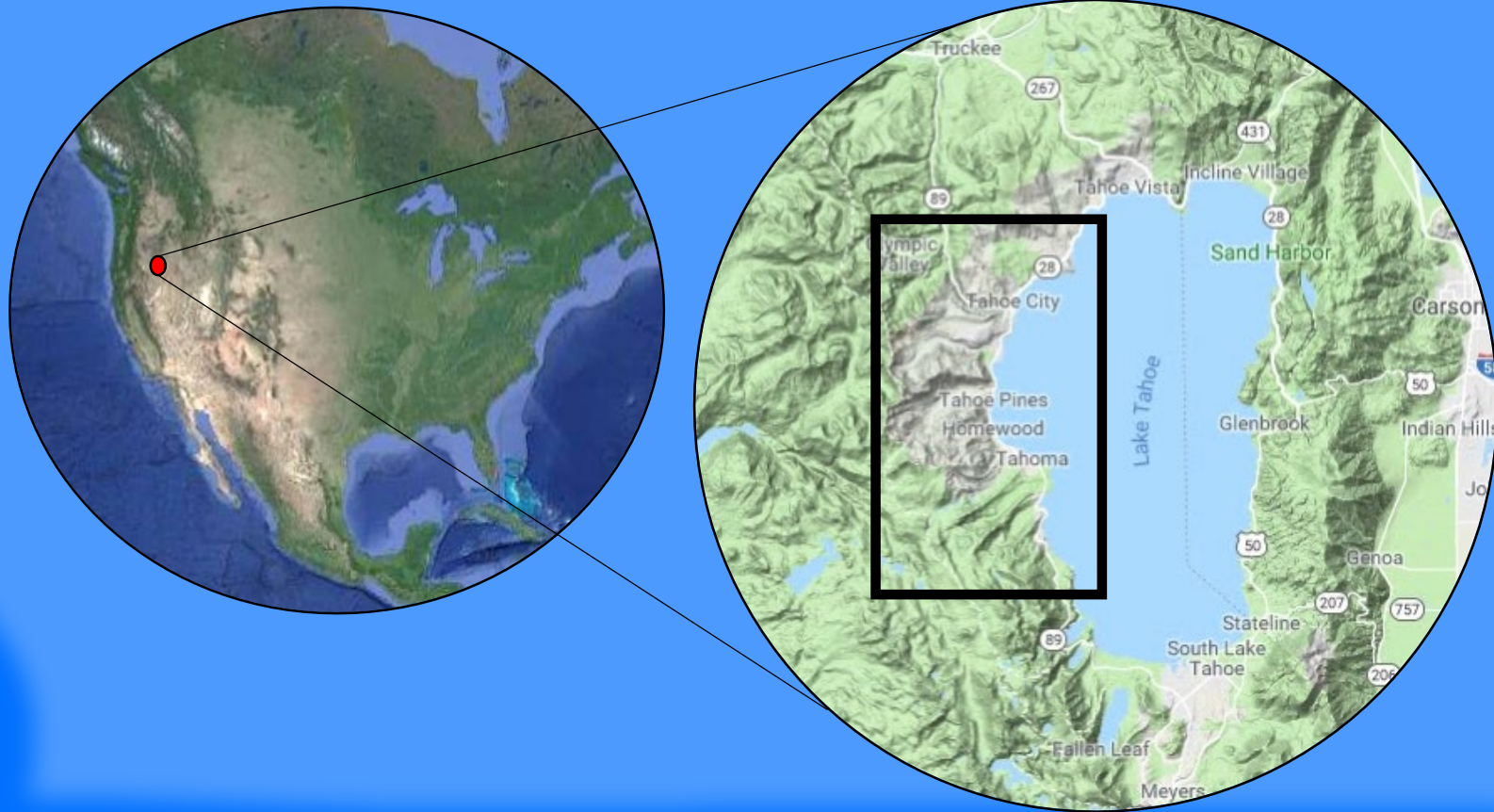
Motivation

- Preservation – low impact watershed restoration projects.



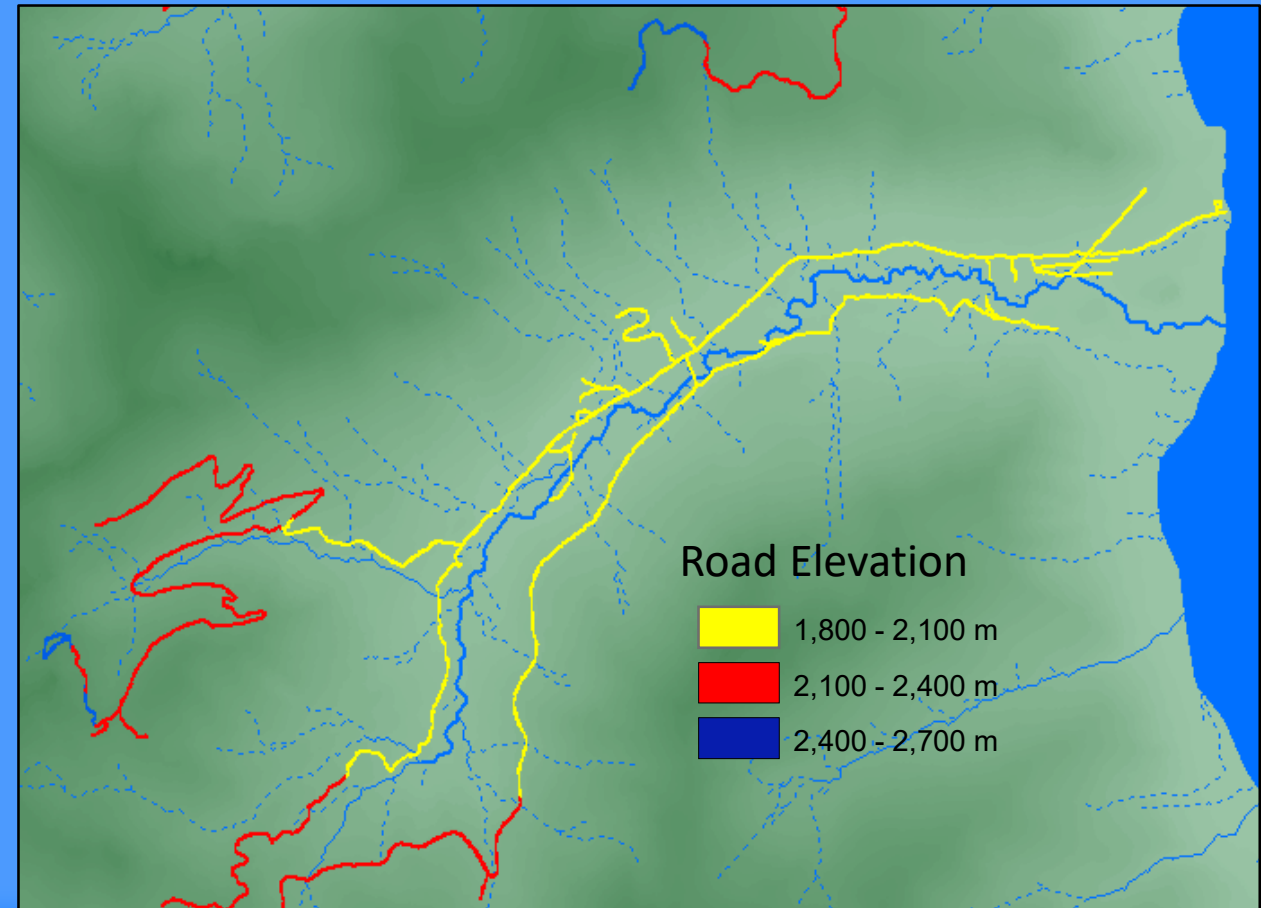
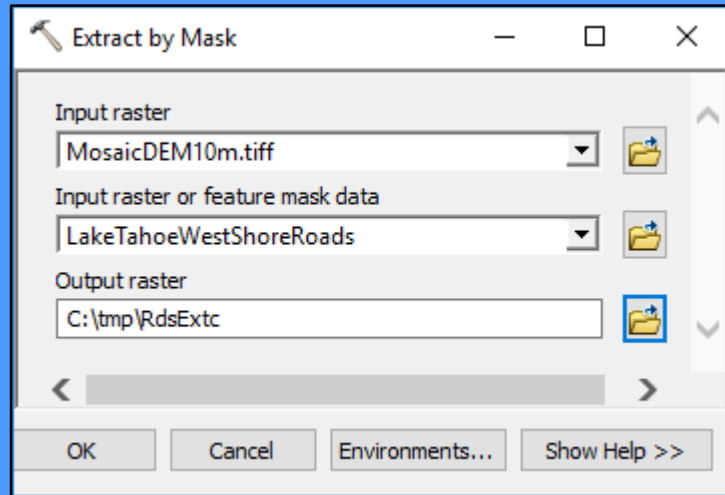
Motivation

- Preservation – low impact watershed restoration projects.
- Roads – limiting sources of sediment



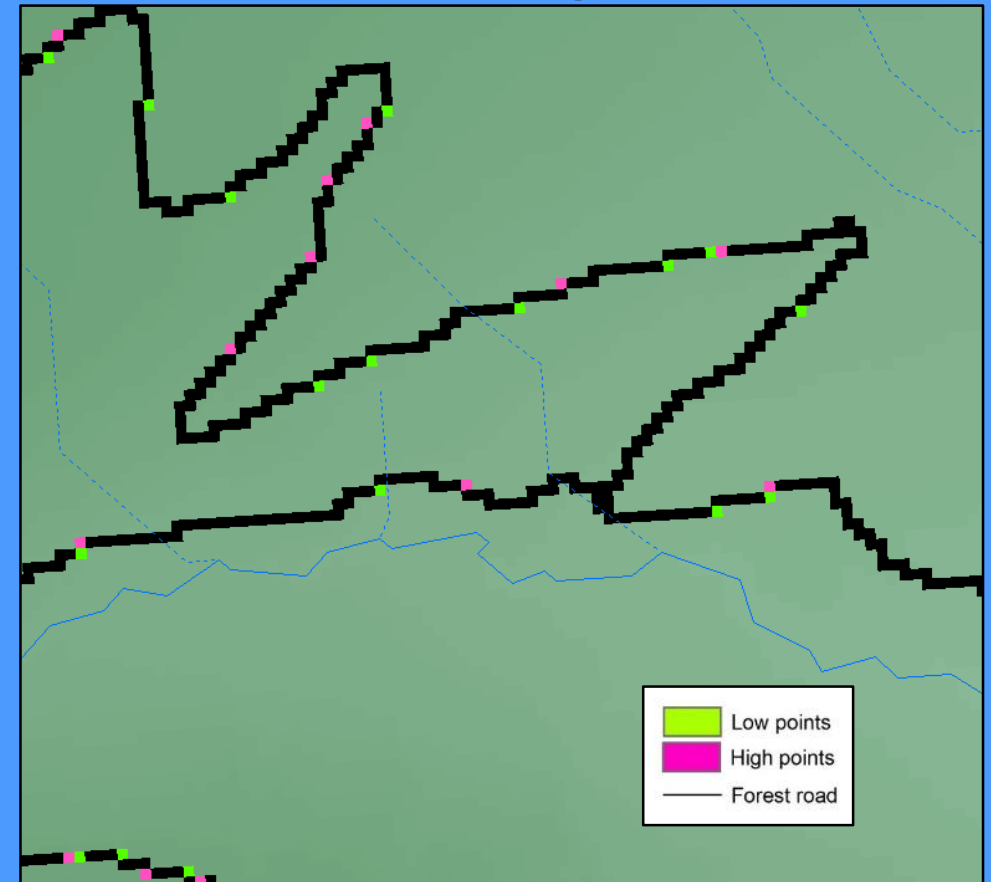
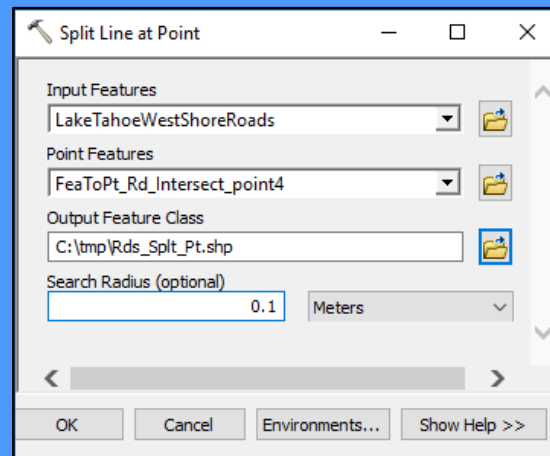
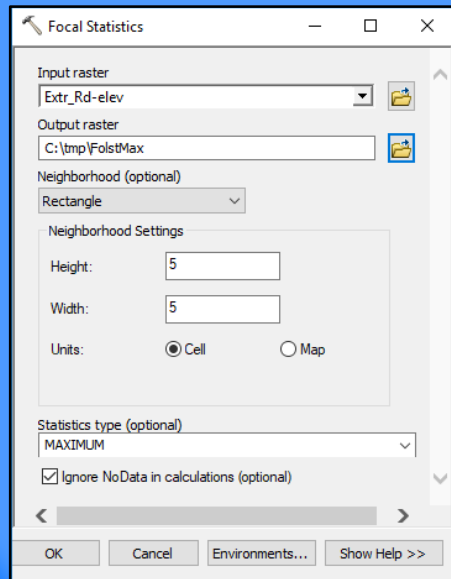
Methods

- Analysis method developed by Longxi Cao
 - Extraction of the road elevation with a 10 m DEM



Methods

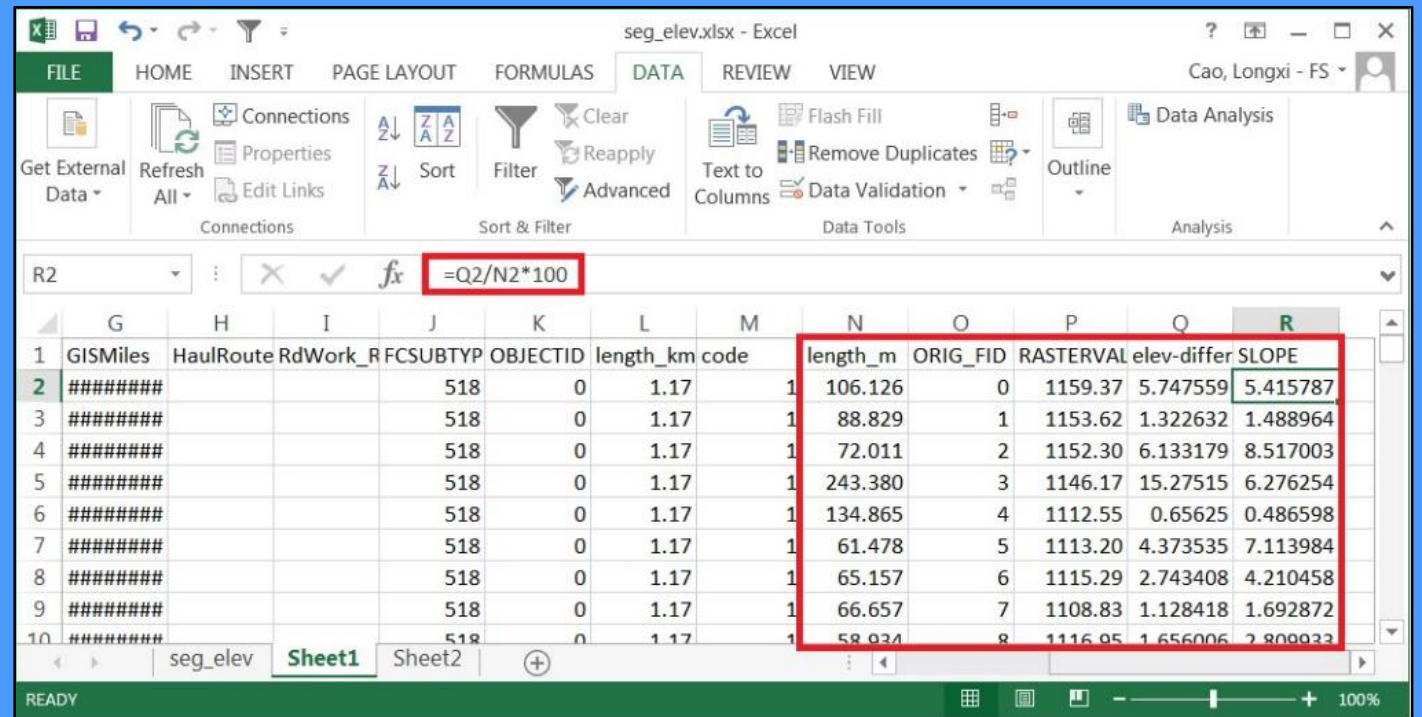
- Analysis method developed by Longxi Cao
 - Extraction of the road elevation with a 10 m DEM
 - Determine high and low elevation points along road and split at points



Methods

- Analysis method developed by Longxi Cao
 - Extraction of the road elevation with a 10 m DEM
 - Determine high and low elevation points along road and split at points
 - Calculate road segment length, and slope gradient

- 1360 road segments
- Average length ≈ 133 m
- Road grade $\approx 5.4\%$



seg_elev.xlsx - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

Get External Data Refresh All Connections Properties Edit Links Sort Filter Clear Reapply Advanced Text to Columns Data Validation Outline Data Analysis

R2 $=Q2/N2*100$

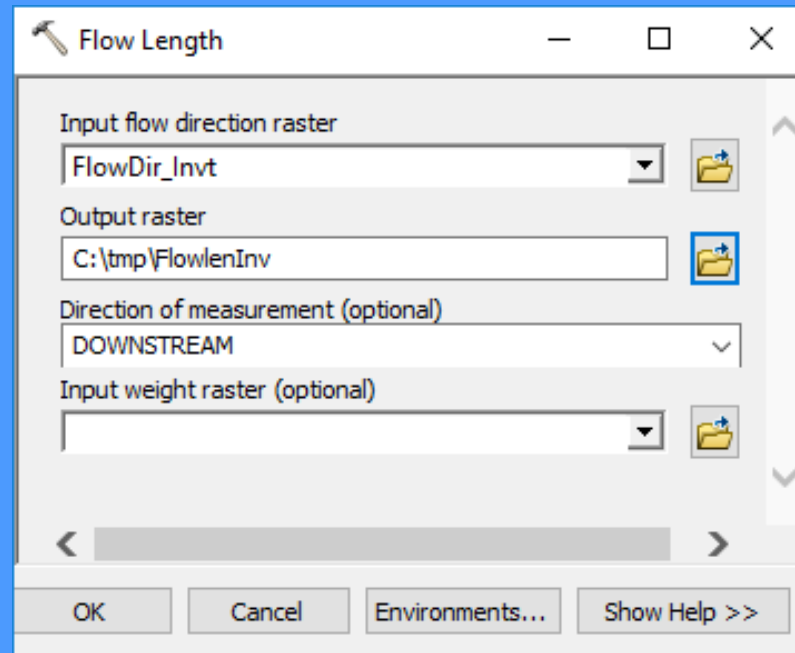
	G	H	I	J	K	L	M	N	O	P	Q	R
	GISMiles	HaulRoute	RdWork_R	FCSUBTYP	OBJECTID	length_km	code	length_m	ORIG_FID	RASTERVAL	elev-differ	SLOPE
2	#####			518	0	1.17	1	106.126	0	1159.37	5.747559	5.415787
3	#####			518	0	1.17	1	88.829	1	1153.62	1.322632	1.488964
4	#####			518	0	1.17	1	72.011	2	1152.30	6.133179	8.517003
5	#####			518	0	1.17	1	243.380	3	1146.17	15.27515	6.276254
6	#####			518	0	1.17	1	134.865	4	1112.55	0.65625	0.486598
7	#####			518	0	1.17	1	61.478	5	1113.20	4.373535	7.113984
8	#####			518	0	1.17	1	65.157	6	1115.29	2.743408	4.210458
9	#####			518	0	1.17	1	66.657	7	1108.83	1.128418	1.692872
10	#####			518	0	1.17	1	58.934	8	1116.95	1.656006	2.800933

seg_elev Sheet1 Sheet2

READY 100%

Methods

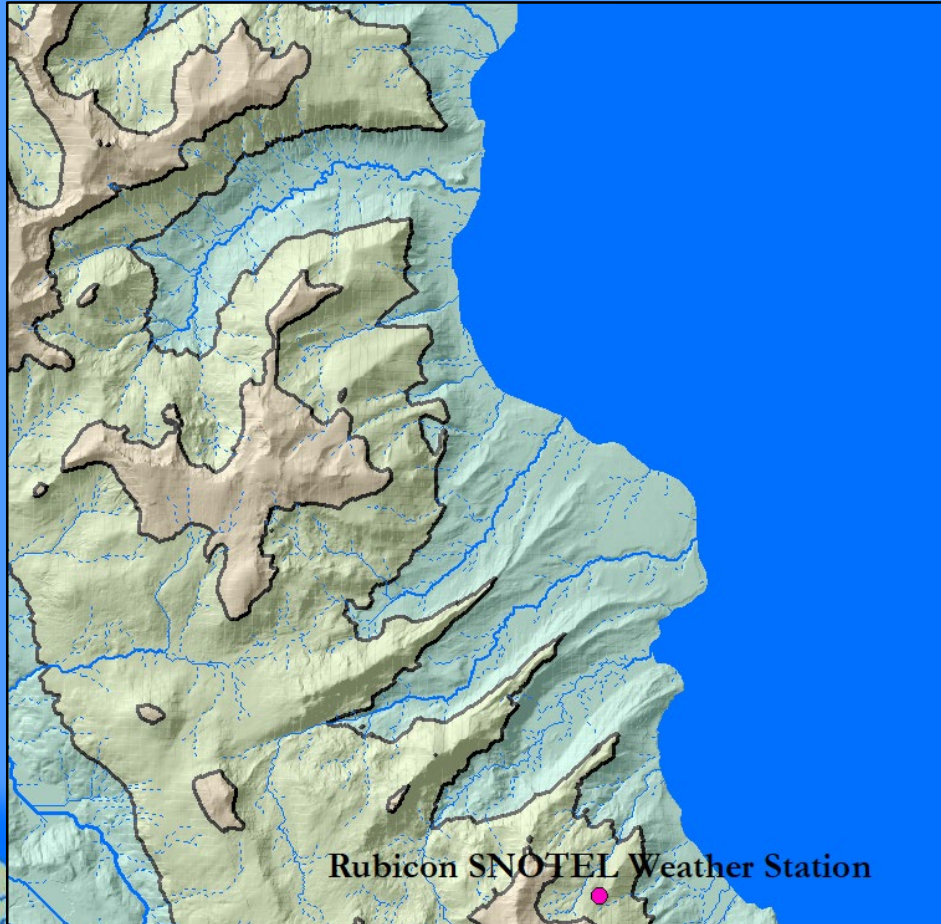
- Analysis method developed by Longxi Cao
 - Extraction of the road elevation with a 10 m DEM
 - Determine high and low elevation points along road and split at points
 - Calculate road segment length, and slope gradient
 - Determine flow length from roads to streams = road buffer



Methods

Using PRISM and Rubicon Snow Tel weather records, define climate layers.

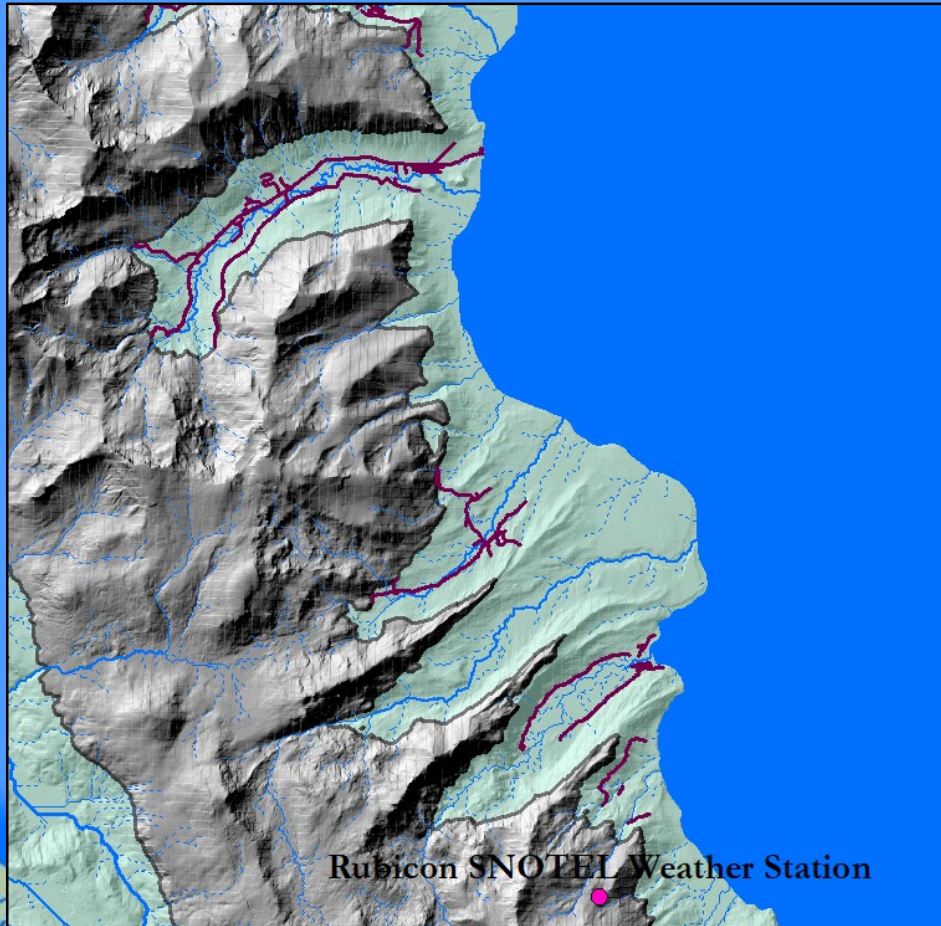
- 300 meter division



Methods

Using PRISM and Rubicon Snow Tel weather records, define climate layers.

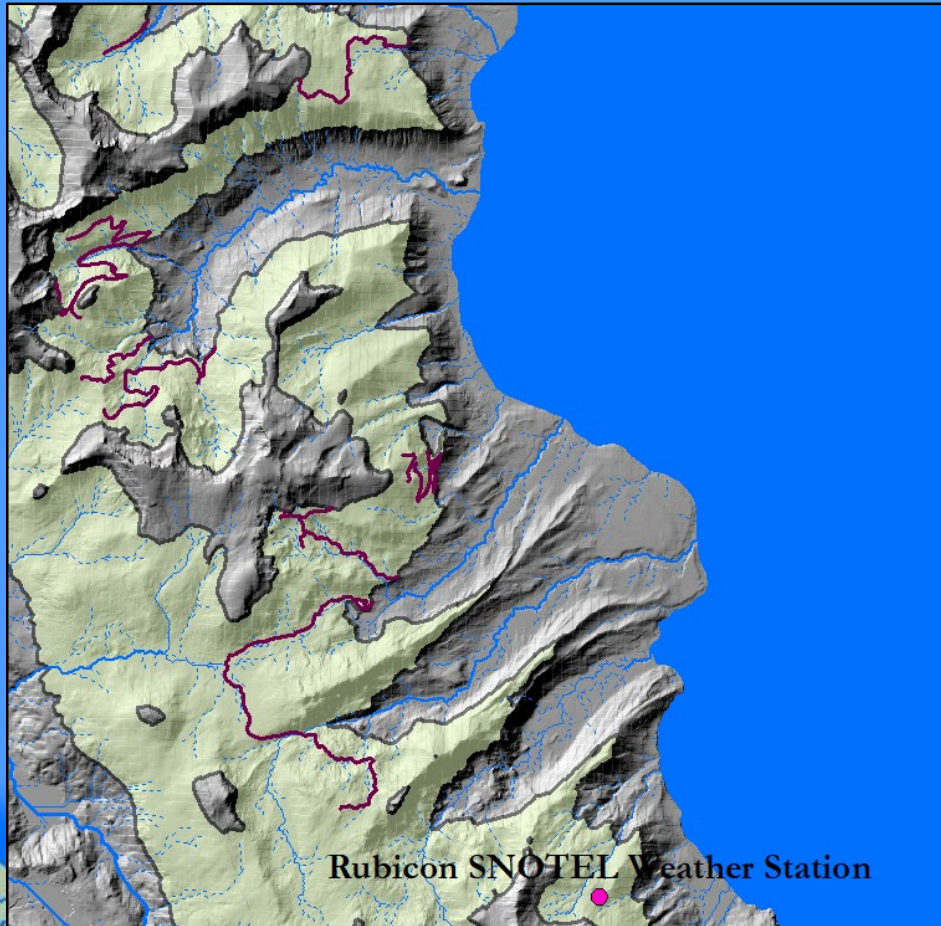
- 300 meter division
- 1800-2100 m



Methods

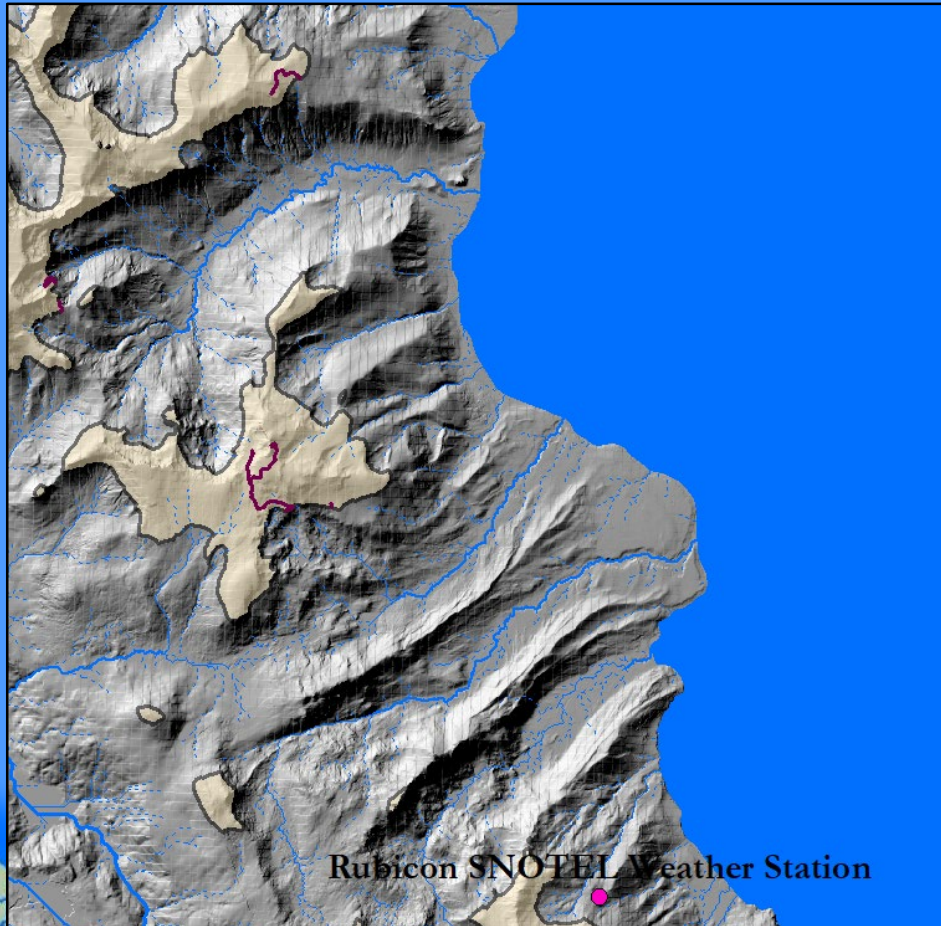
Using PRISM and Rubicon Snow Tel weather records, define climate layers.

- 300 meter division
- 1800-2100 m
- 2100-2400 m



Methods

Using PRISM and Rubicon Snow Tel weather records, define climate layers.



- 300 meter division
- 1800-2100 m
- 2100-2400 m
- 2400-2700 m

D
(I)















Develop cross-walk between Lake Tahoe West (LTW) design and database categories

LTW Designation	Design	Surface (default if not specified)	Traffic	Road width	Rk Frag	Tahoe Current Maintenance Levels*
Not maintained	OU	Native surface	no	12	rock 20%	0 - hold over - ignore
Basic custodial care (closed)	OU	Native surface	no	12	rock 20%	1- These are roads that have been placed in storage between intermittent uses.
High clearance vehicles	OU	Native surface	low	12	rock 20%	2 - Assigned to roads open for use by high clearance vehicles. ped - out sloped - 4x4 road
Suitable for passenger cars	OU	Native surface	low	18	rock 20%	3 - Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car.
Moderate degree of user comfort	OU	paved	high	24	na	4 - Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds.
High degree of user comfort	OU	paved	high	24	na	5 - Assigned to roads that provide a high degree of user comfort and convenience.
Decommissioned roads**						may use as future logging road
		Bituminous				4 - Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds.
		Improved native material				Graveled road - assigned to Levels 1 through 3 above.
Road lengths are at approx 140 m						

FS WEPP Road Batch

<https://forest.moscowfsl.wsu.edu/fswepp/>

Forest Service WEPP Interfaces

	WEPP:Road 2083 runs YTD	WEPP:Road Batch 218 runs, 12333 segments YTD	
	ERMiT 39579 runs YTD	ERMiT Batch (download) 88 runs YTD	
	Disturbed WEPP 30105 runs YTD	Disturbed WEPP batch (download) 90 runs YTD	
	Tahoe Basin Sediment Model 189 runs YTD	Biomass Sediment Model 8 runs YTD	
	FuME (Fuel Management) 64 runs YTD	Rock:Clima	
	WEPP Watershed Online GIS	Peak Flow Calculator	
	Lake Tahoe WEPP Watershed GIS Interface	WEPP Post-Fire Erosion Prediction (PEP)	

Units: ☐ metric ☒ U.S. customary ☐ [personality](#) (a to z)

Methods

Three scenarios:

- Current Conditions



Methods

Three scenarios:

- Current Conditions
- Logged = high traffic



Methods

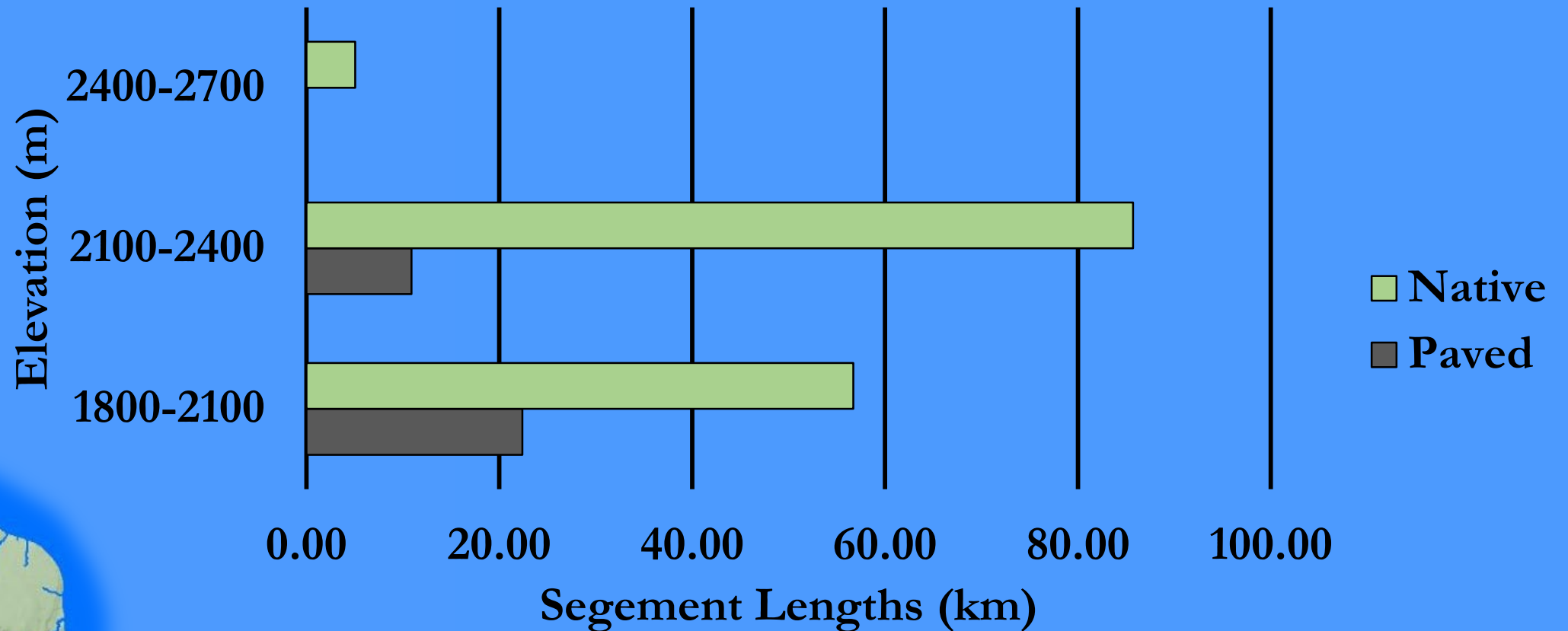
Three scenarios:

- Current Conditions
- Logged = high traffic
- Closed = no traffic



Model Results: Current Condition

Lengths and Types of Roads by Elevation



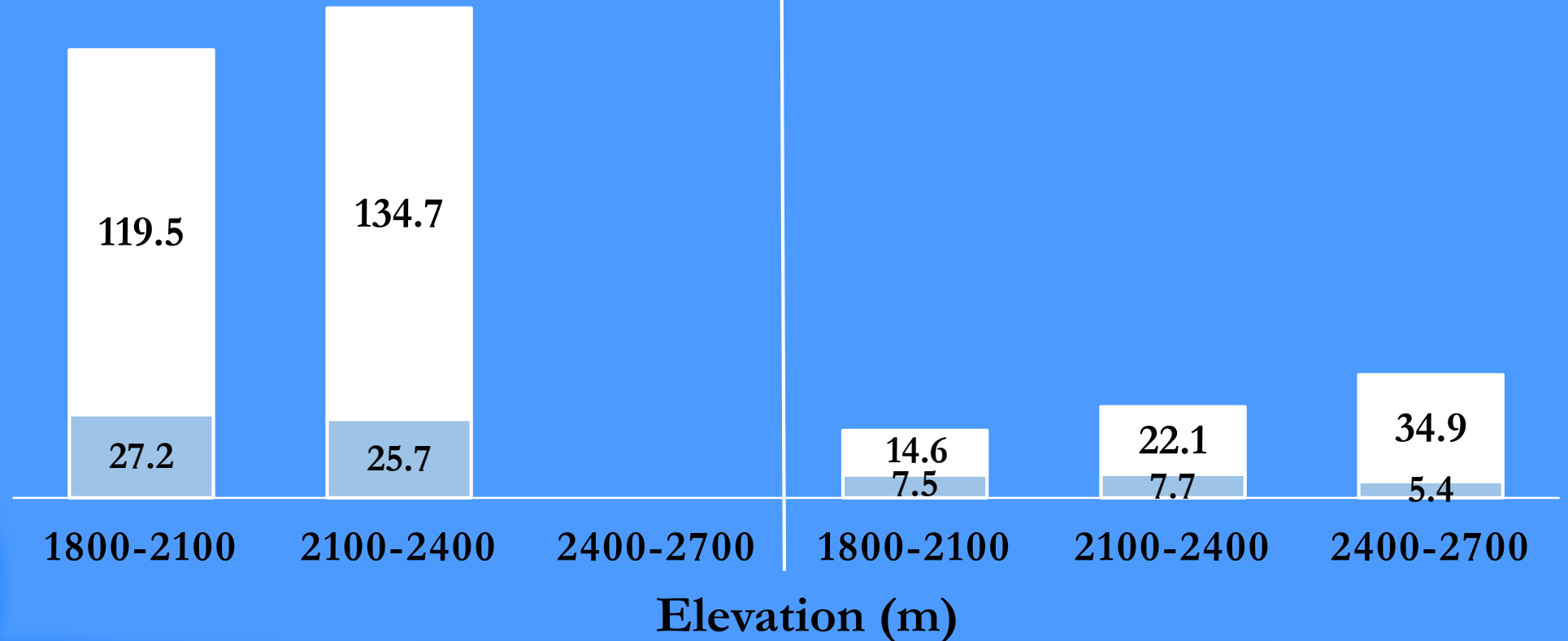
Model Results: Current Condition

Road Runoff (mm)

■ Rainfall ■ Snowmelt

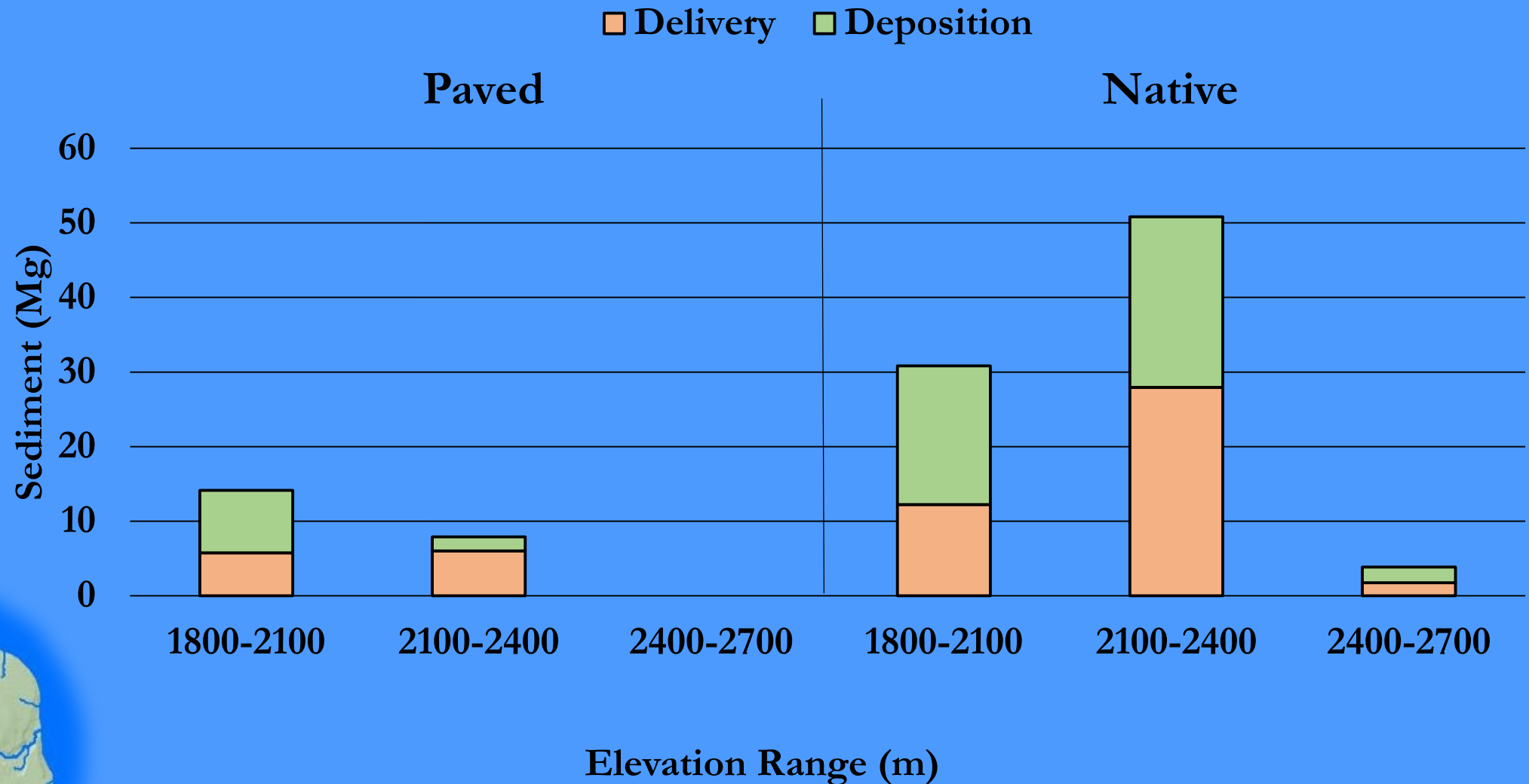
Paved

Native



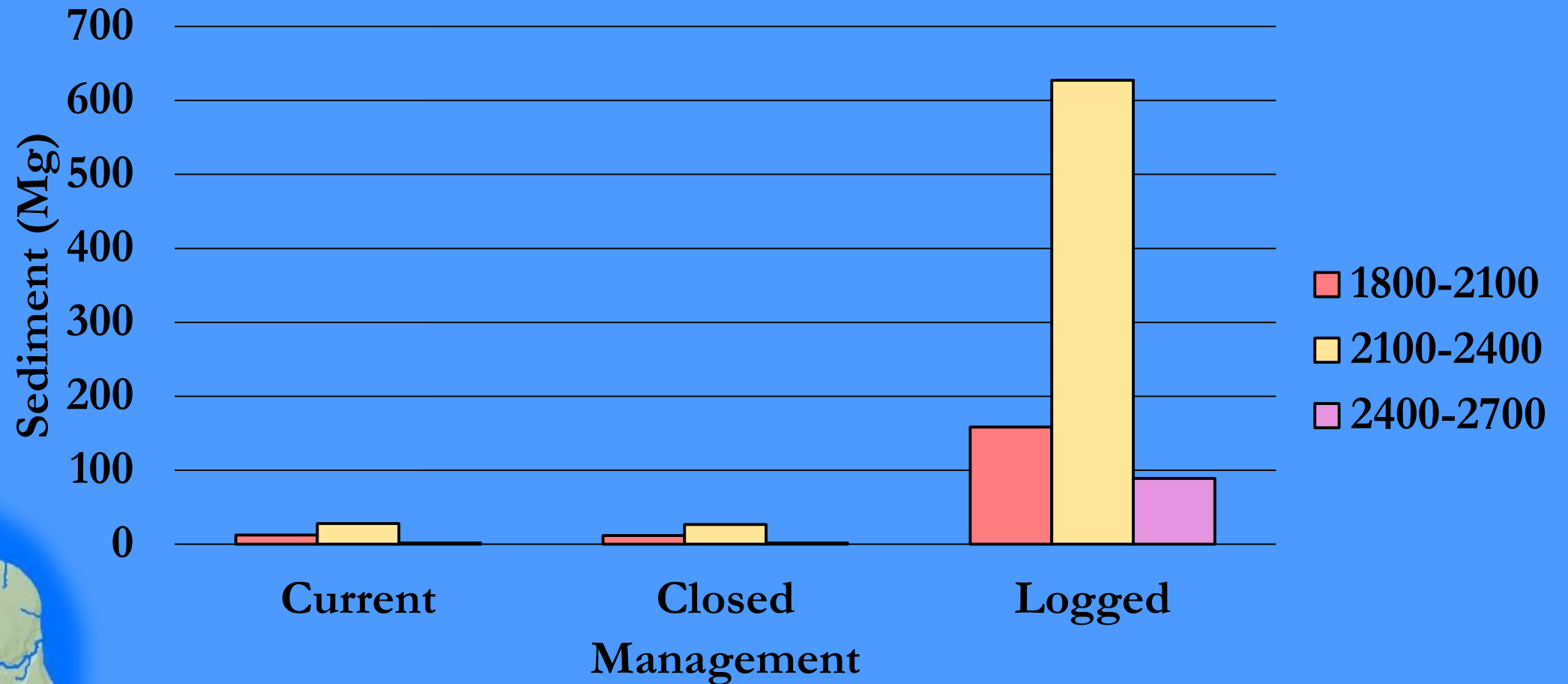
Model Results: Current Condition

Sediment Deposition and Delivery by Elevation



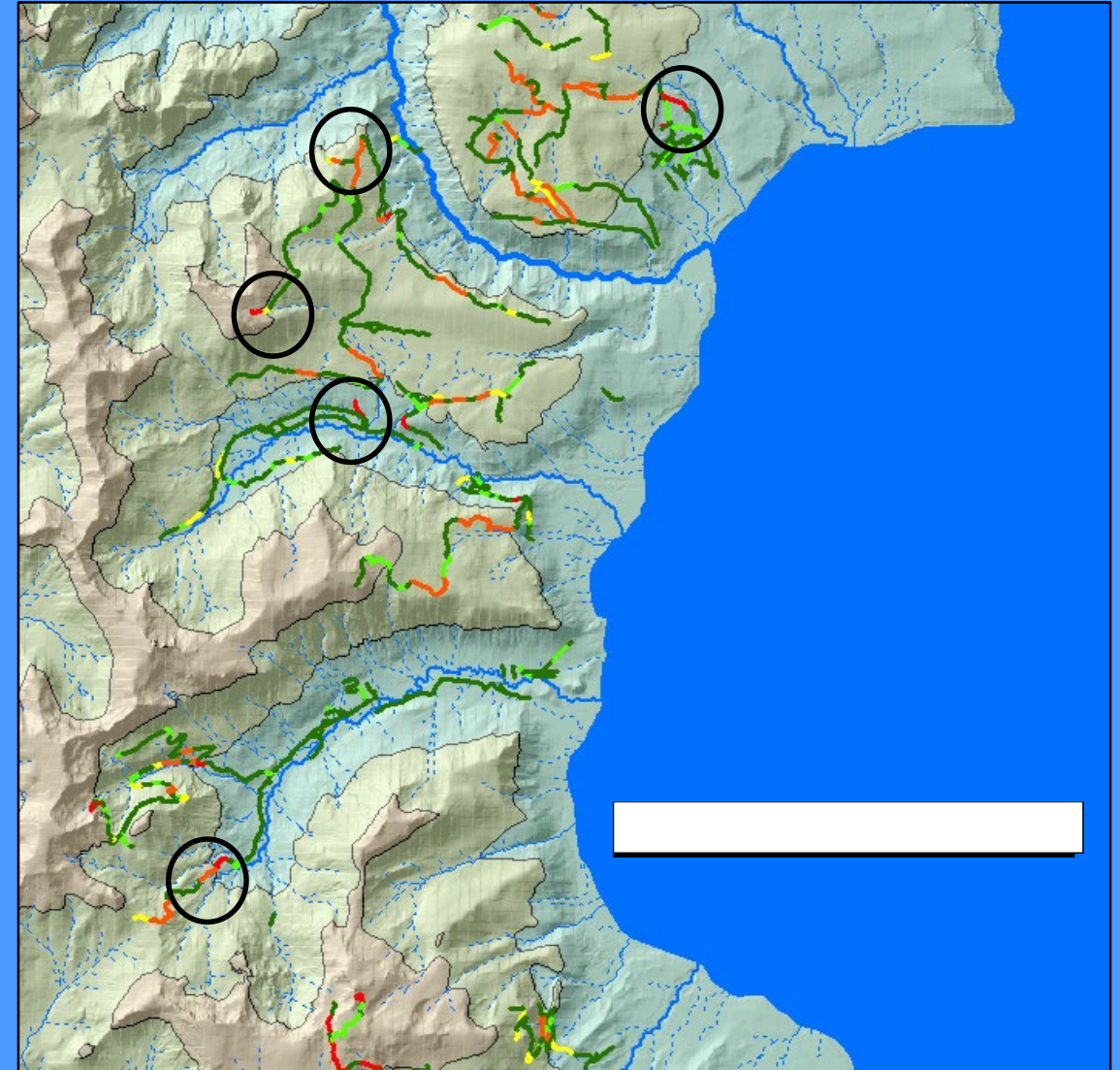
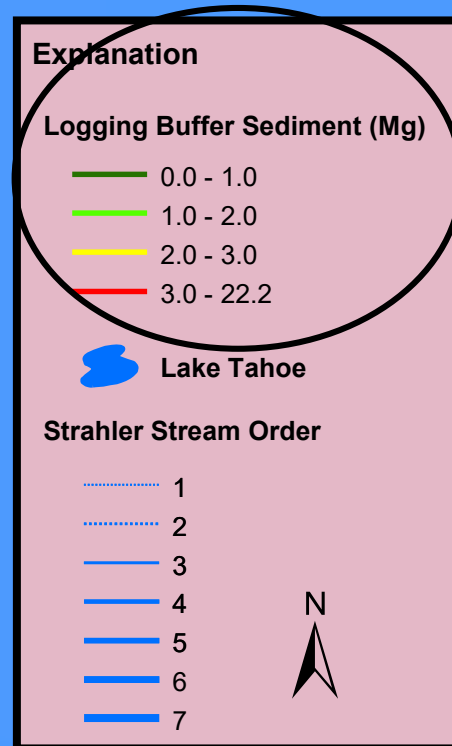
Model Results

Sediment Leaving Buffer by Scenario



2019 West Shore Lake Tahoe Road Sediment Analysis

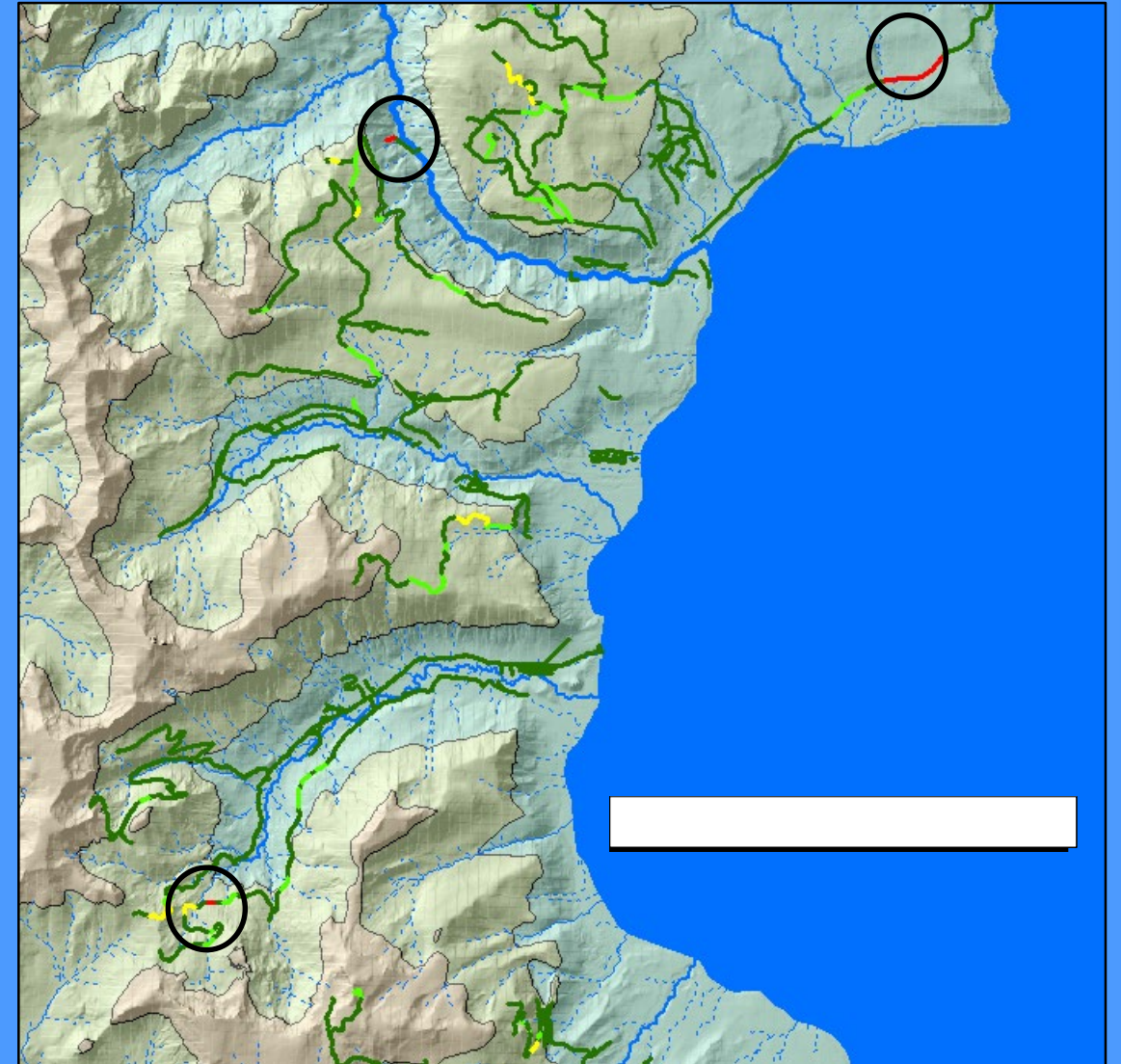
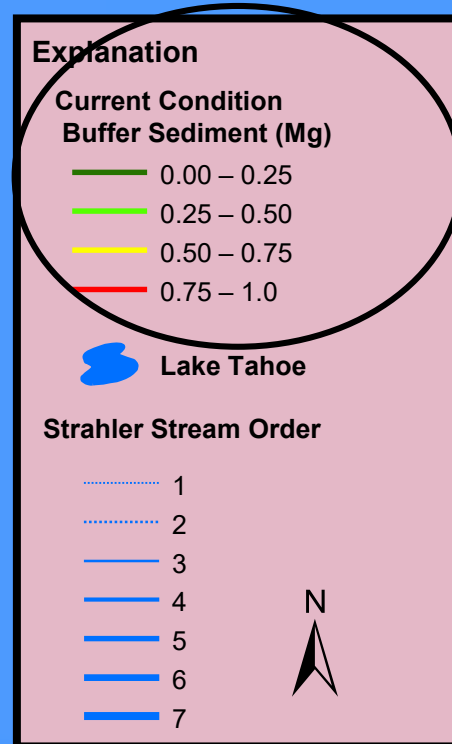
Logging:
Sediment reaching
the channel



2019 West Shore Lake Tahoe Road Sediment Analysis

**Current Conditions:
Sediment reaching
the channel**

**Note the much
lower sediment
values**



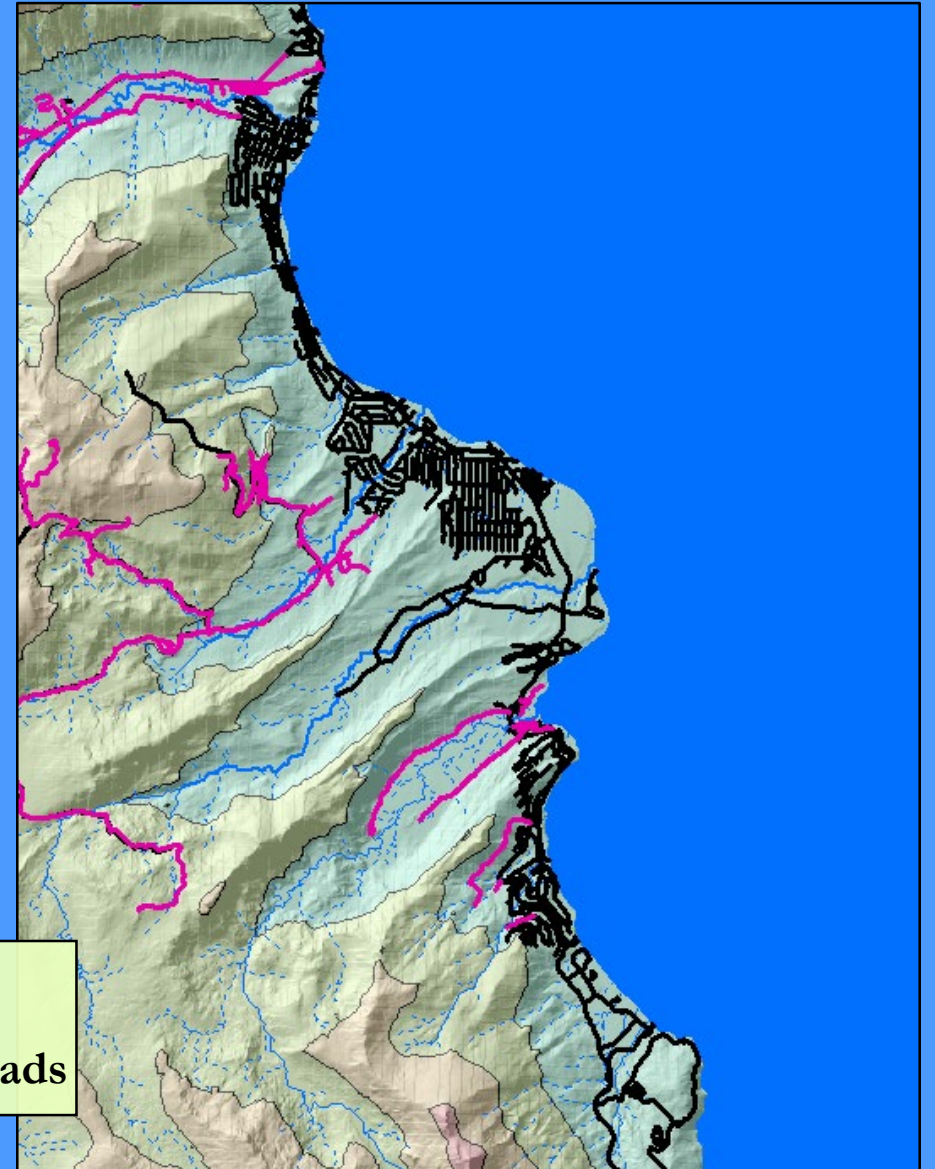


Limitations

- **Over prediction of sediment erosion? WEPP:Road soils are subject to erode more than Tahoe Soils**
 - Foltz et al., 2011 suggest maybe 5 times as much
- **Current sediment management practices were not considered in analysis**

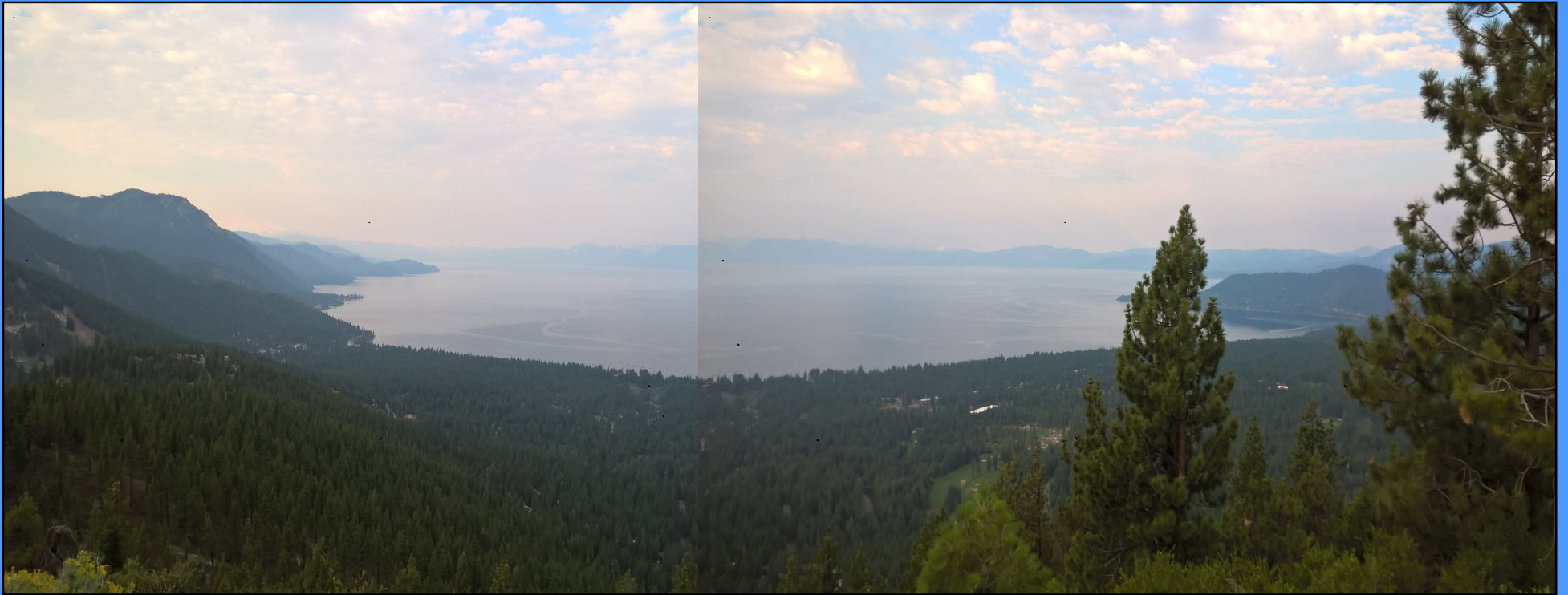
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 - Foltz et al., 2011 suggest maybe 5 times as much
- Current sediment management practices were not considered in analysis
- Roads layer did not include all roads



Questions?

- <https://forest.moscowfsl.wsu.edu/fswepp/>



sue.miller3@usda.gov



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