Using GIS to Evaluate Watershed Condition

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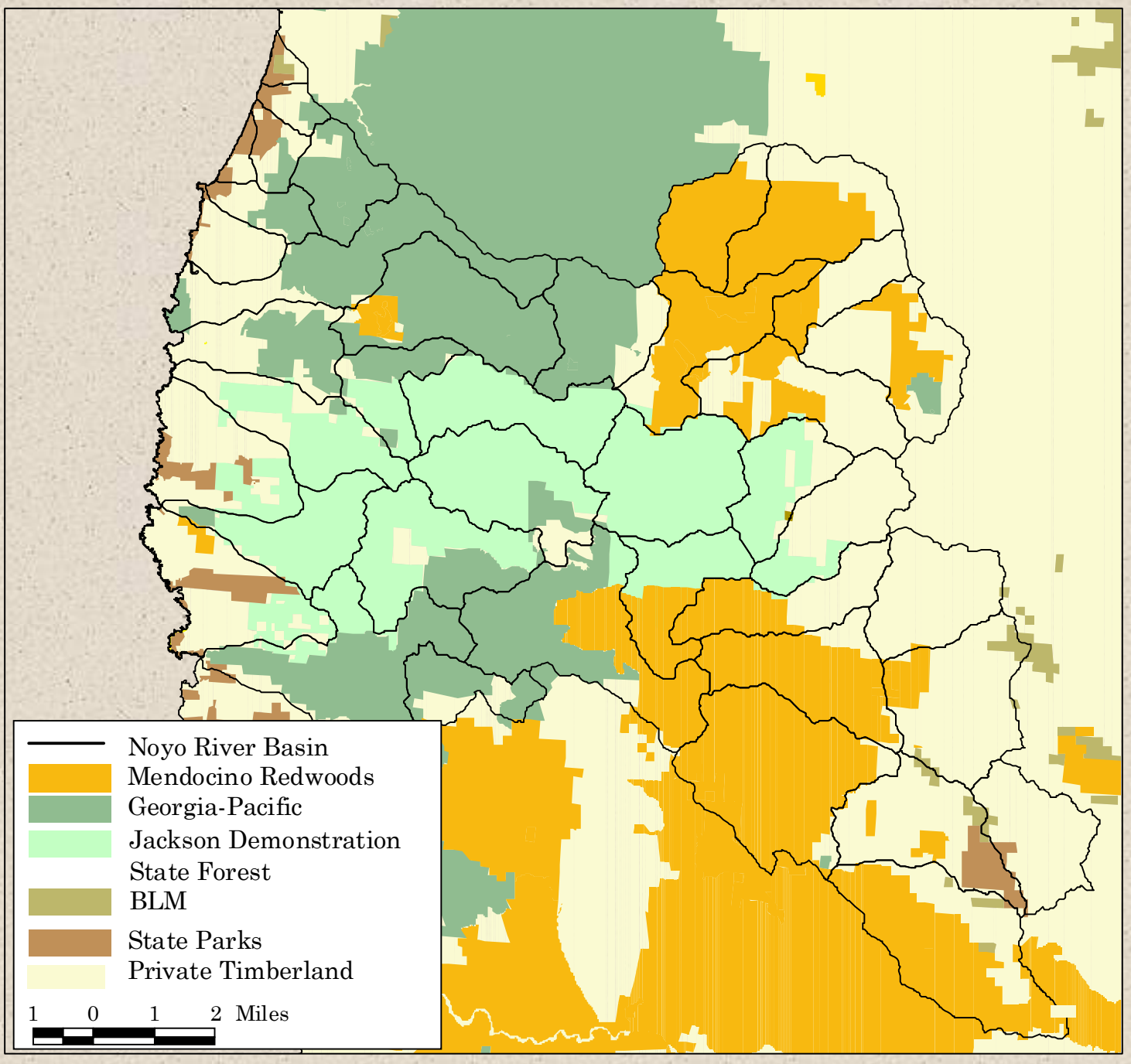
Goals and Objectives

- Conduct a coarse level assessment of hillslope and stream conditions.
- Assess potential large woody debris recruitment from streamside vegetation.
- Assess potential sediment delivery from timber harvesting and roads.
- Develop a method for evaluating impacts of land use practices that allows for comparison among sub-basins.

Study Area
Land Ownership



Methodology

- Habitat assessment was conducted at multiple scales: stream reaches, sub-basin and watershed.

- Stream condition was estimated at 100 meter intervals.

- Data was aggregated to assess average and overall conditions at the sub-basin and watershed level.

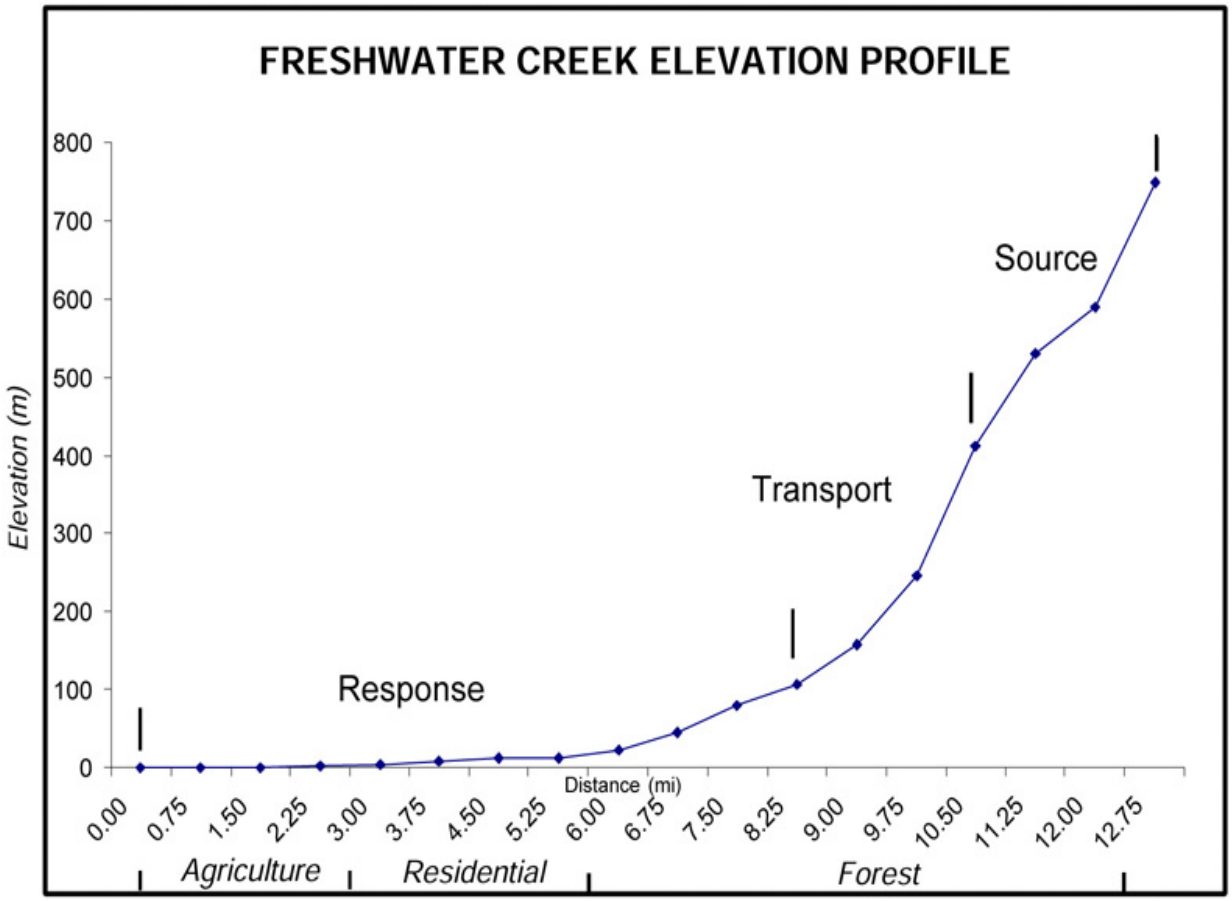
Stream Condition

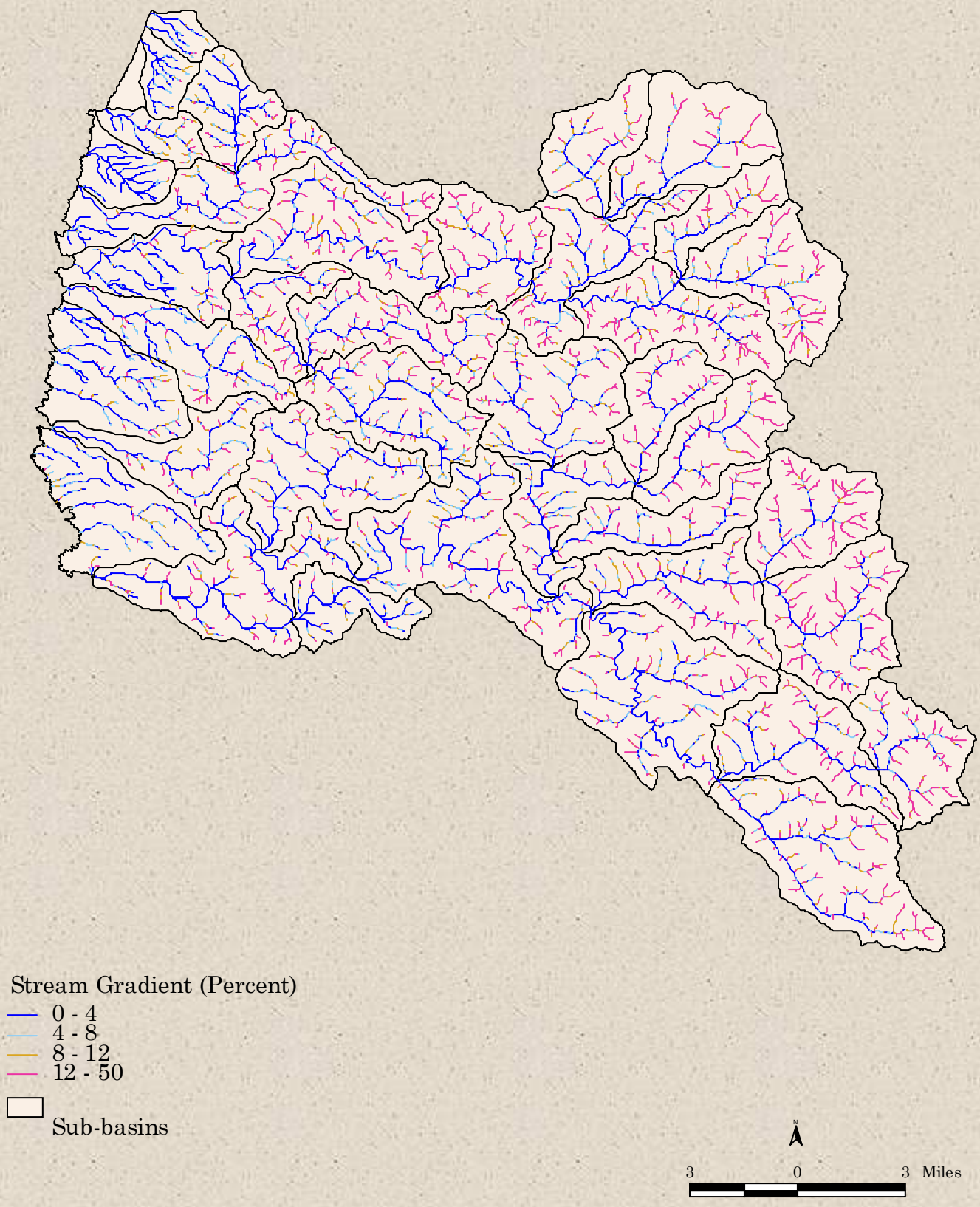
- Potential stream habitat was inferred from stream gradient and channel confinement.
- Stream gradient classes were designed to represent: source, transport, and response reaches.
- Stream network was developed using USGS 1:24k hydrology and DEM modeled streams.

Stream Gradient Classes

Class 1 (response):	0.0 - 4.0
Class 2 (response):	4.1 - 8.0
Class 3 (transport):	8.1 - 12.0
Class 4 (source):	> 12.0

Stream Channel Profile





Noyo and Big River Stream Gradient

Assessment of Vegetation Condition

- Riparian vegetation provides a proxy for large woody debris recruitment and canopy cover.
- Assumed that larger and older conifers are most beneficial for LWD.
- Riparian vegetation was assessed at 100 m. intervals using a 60 meter buffer.

Forest Vegetation

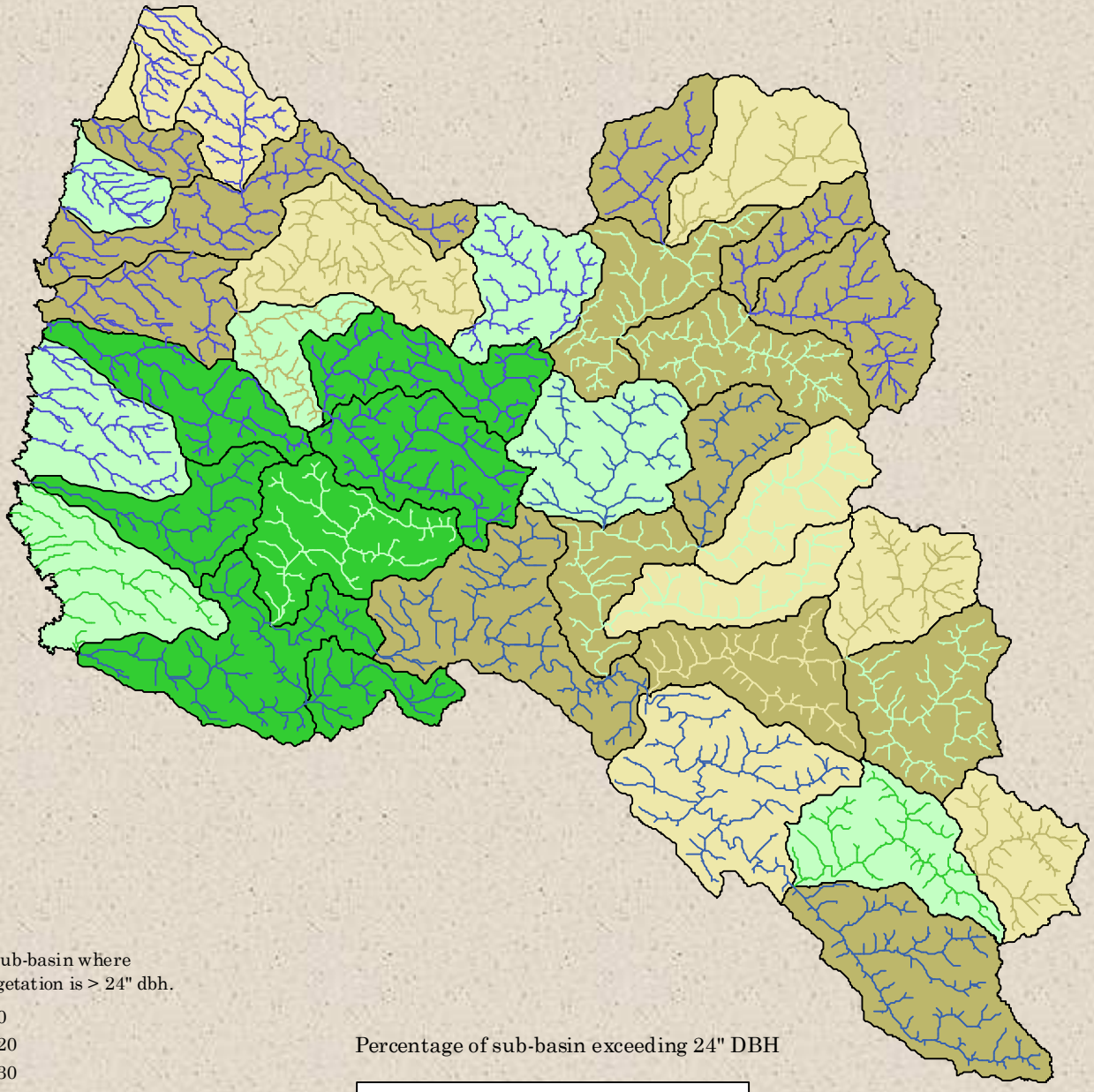
Source:

Timberland Task Force

Vegetation Classes:

Early seral	< 11” dbh
Mid seral	11” - 24” dbh
Mid-late seral	24” - 36” dbh
Late seral	> 36” dbh

Example Mid Seral Riparian Forest



Percent of sub-basin where riparian vegetation is > 24" dbh.

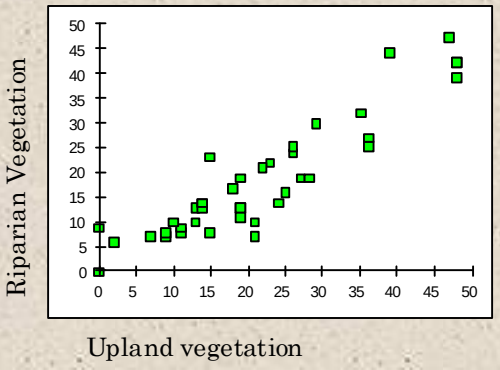
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 60

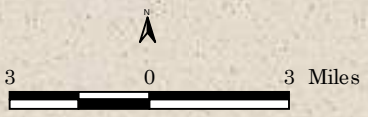
Percent of sub-basin where upland vegetation is > 24" dbh.

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 60

Riparian and upland conditions are similar.

Percentage of sub-basin exceeding 24" DBH





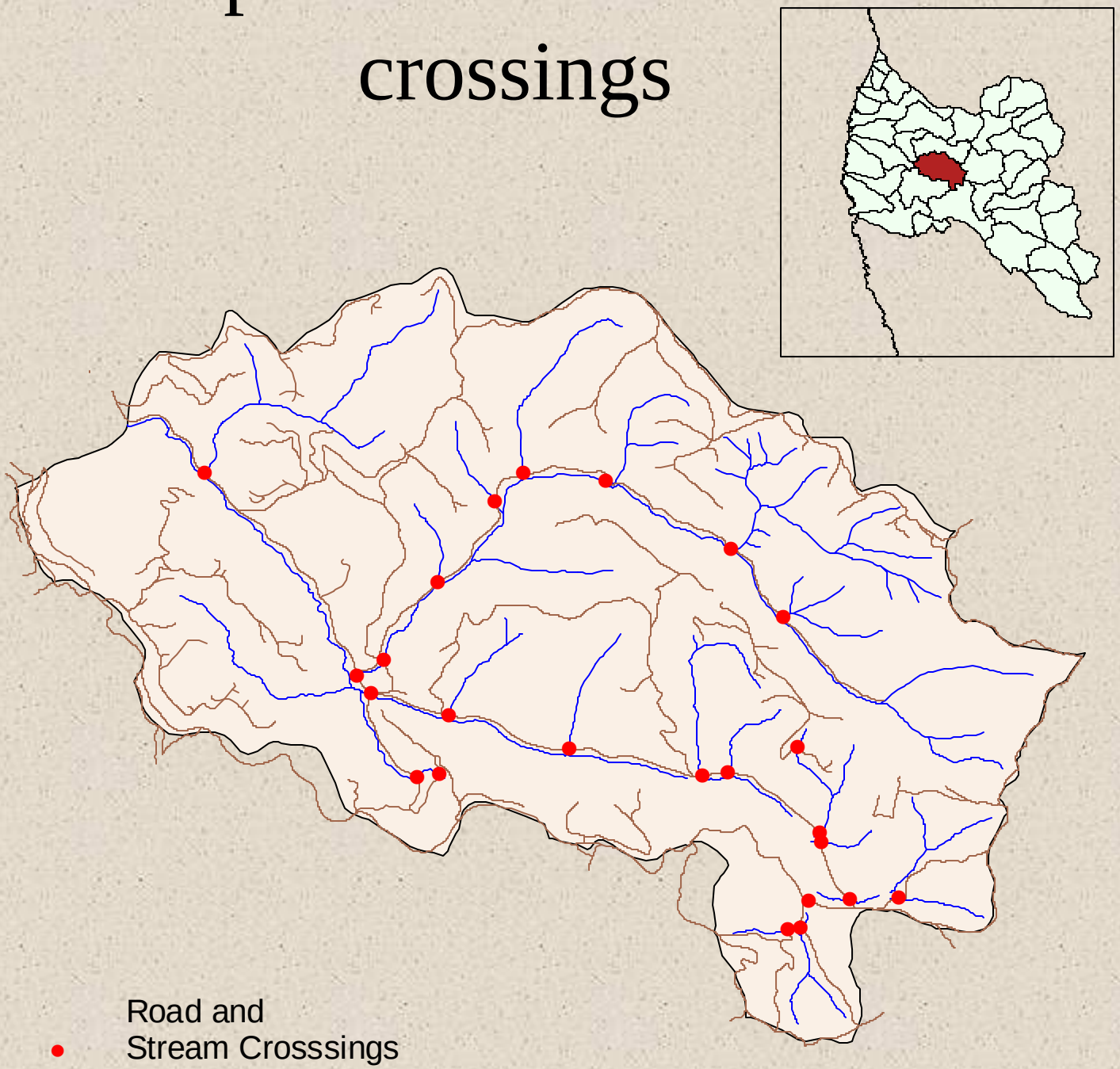
Comparison of riparian and upland vegetation

Evaluating Potential Sediment Delivery

Factors

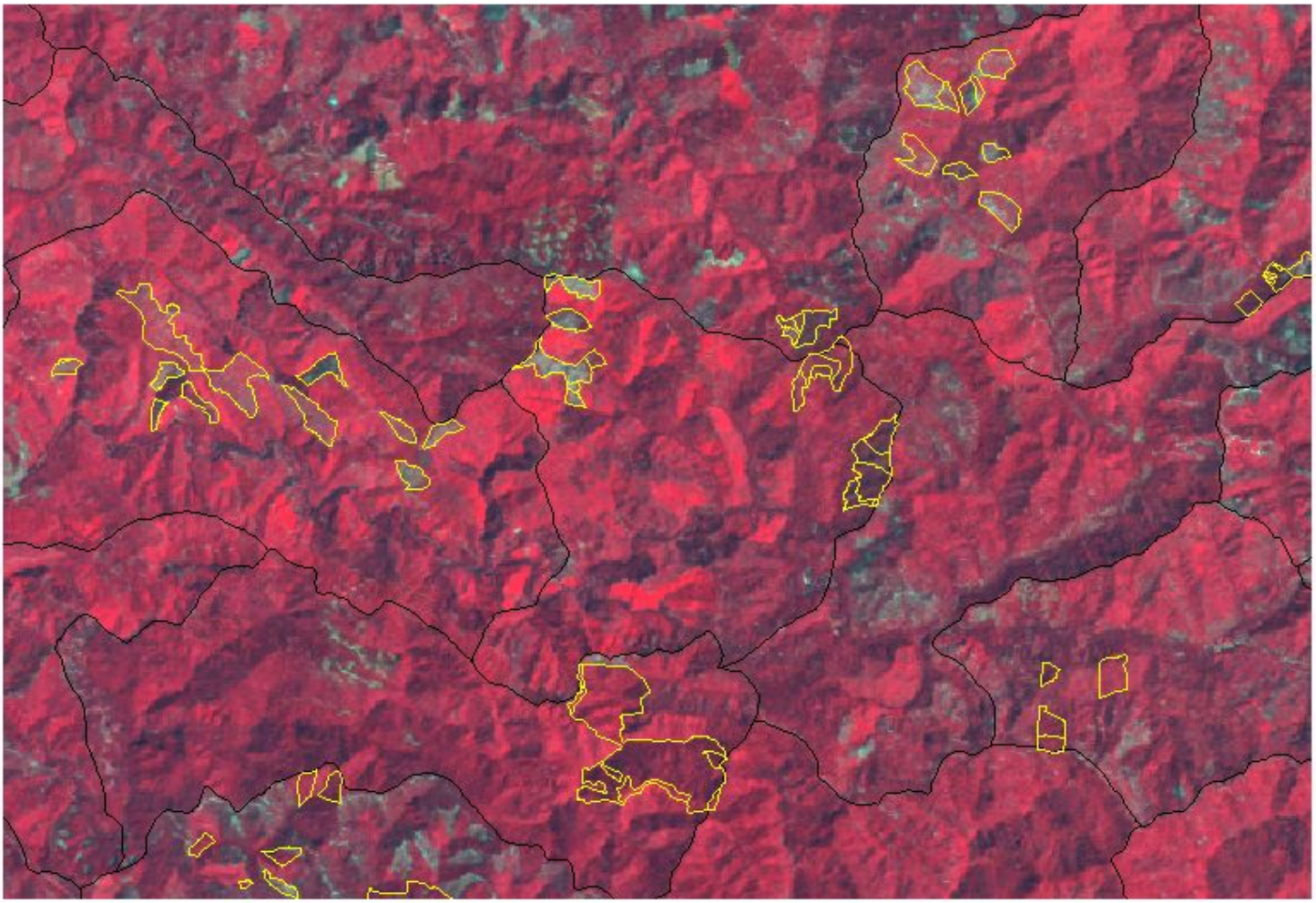
- roads - location of roads with a watershed
- timber harvesting - management prescription and terrain position.
- slope stability: existing and potential landslides

Map of road and stream crossings



Road and
Stream Crosssings
Roads
Streams
Watershed Boundary

Timber Harvesting on the Upper Noyo 1997



Slope Instability Model

Existing Models

- SINMAP and SHALSTAB

Primary data set:

- topography 10 meter DEM

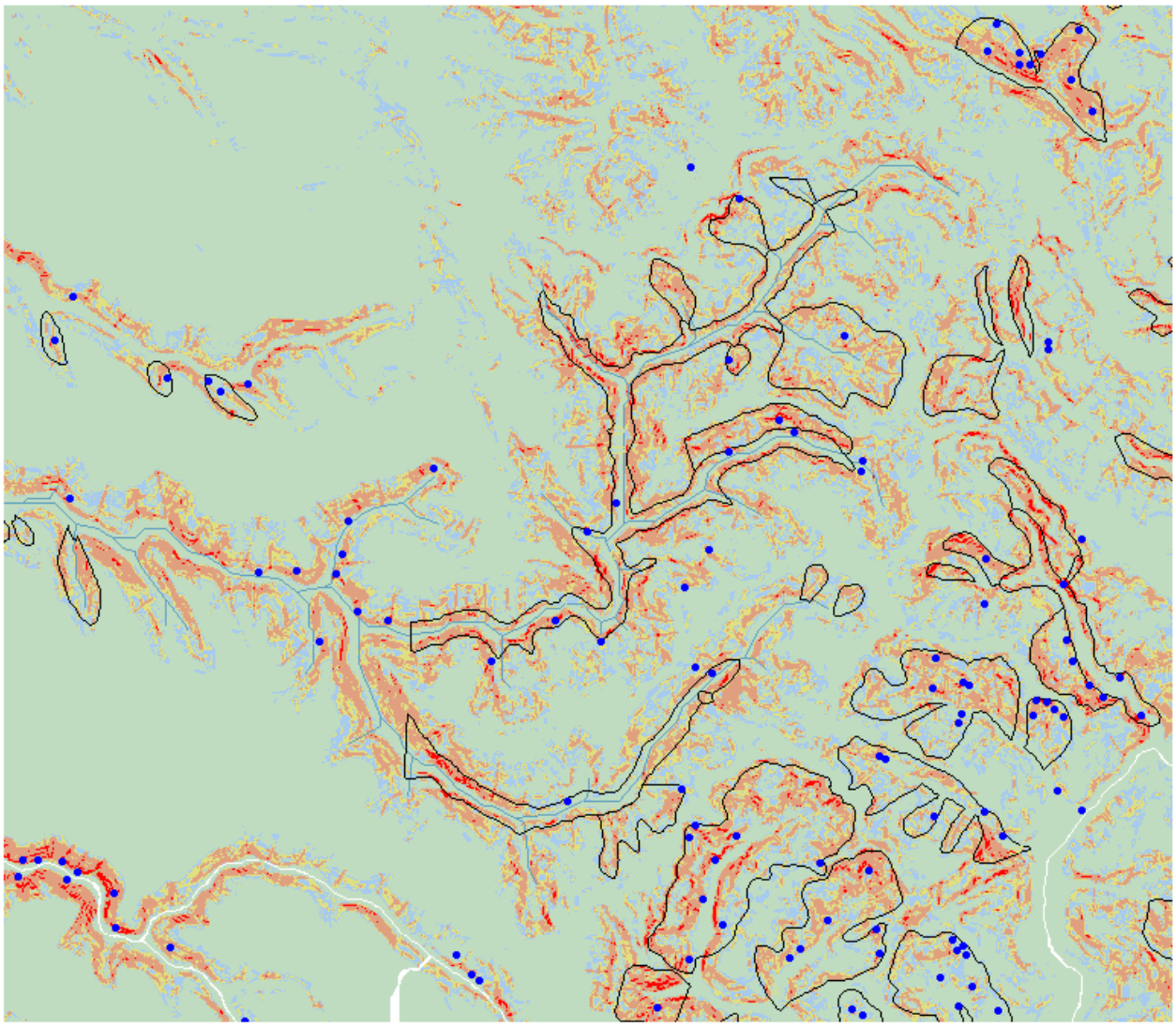
Parameters may be adjusted based on:

- Soils data
- vegetation data
- geologic data

Assumptions:

- Modeling approach applies to shallow translational landslides.

Caspar Creek
Slope Stability Map



Stability Index

- Stable
- Moderately Stable
- Quasi-stable
- Lower Threshold
- Upper Threshold
- Defended

- Landslides points
- Landslides
- Streams

Evaluating Riparian Habitat

Miles of stream by gradient classes

	Class 1 **0 – 4%**	Class 2 **4 – 8%**	Class 3 **8- 12%**	Class 4 **> 12%**
Noyo	**192 mi.**	**73 mi.**	**115 mi**.	**47 mi.**
Big River	**214 mi.**	**66 mi.**	**123 mi.**	**69 mi.**

Percentage of vegetation in seral stage classes

	Early Seral < 11” dbh	Mid Seral 11 – 24” dbh	Mid –Late Seral 24- 36” dbh	Late Seral > 36” dbh
Noyo	**7%**	**69%**	**18%**	**6%**
Big River	**4%**	**74%**	**17%**	**6%**

Riparian Habitat Summary

- 40% of the total stream lengths were classified as low gradient response reaches.
- 23% of the area bordering response reaches contain mature forests, exceeding 24” dbh.
- Late seral stage forests were found in less than 10% of the area bordering response reaches.

Road and Timber Harvesting

- One third of the sub-basins have 10% or more of the roads crossing unstable slopes.

- 30% of the Noyo and Big River basins were harvested over the last 10 years.

- 15% of the two basins were harvested with even aged management.

- 20% or more of the basin area was harvested on steep and potentially unstable slopes.

Timber Harvesting

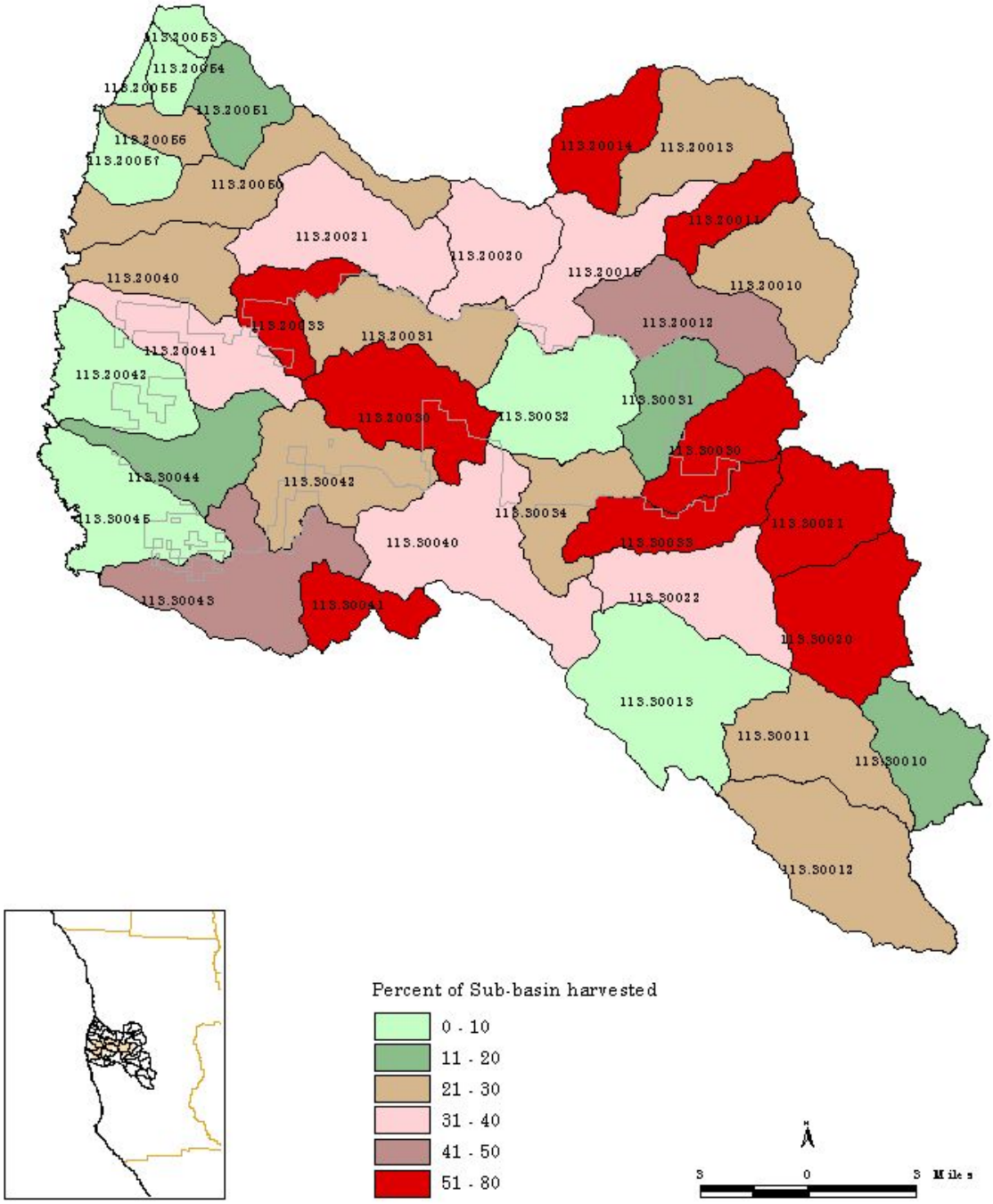


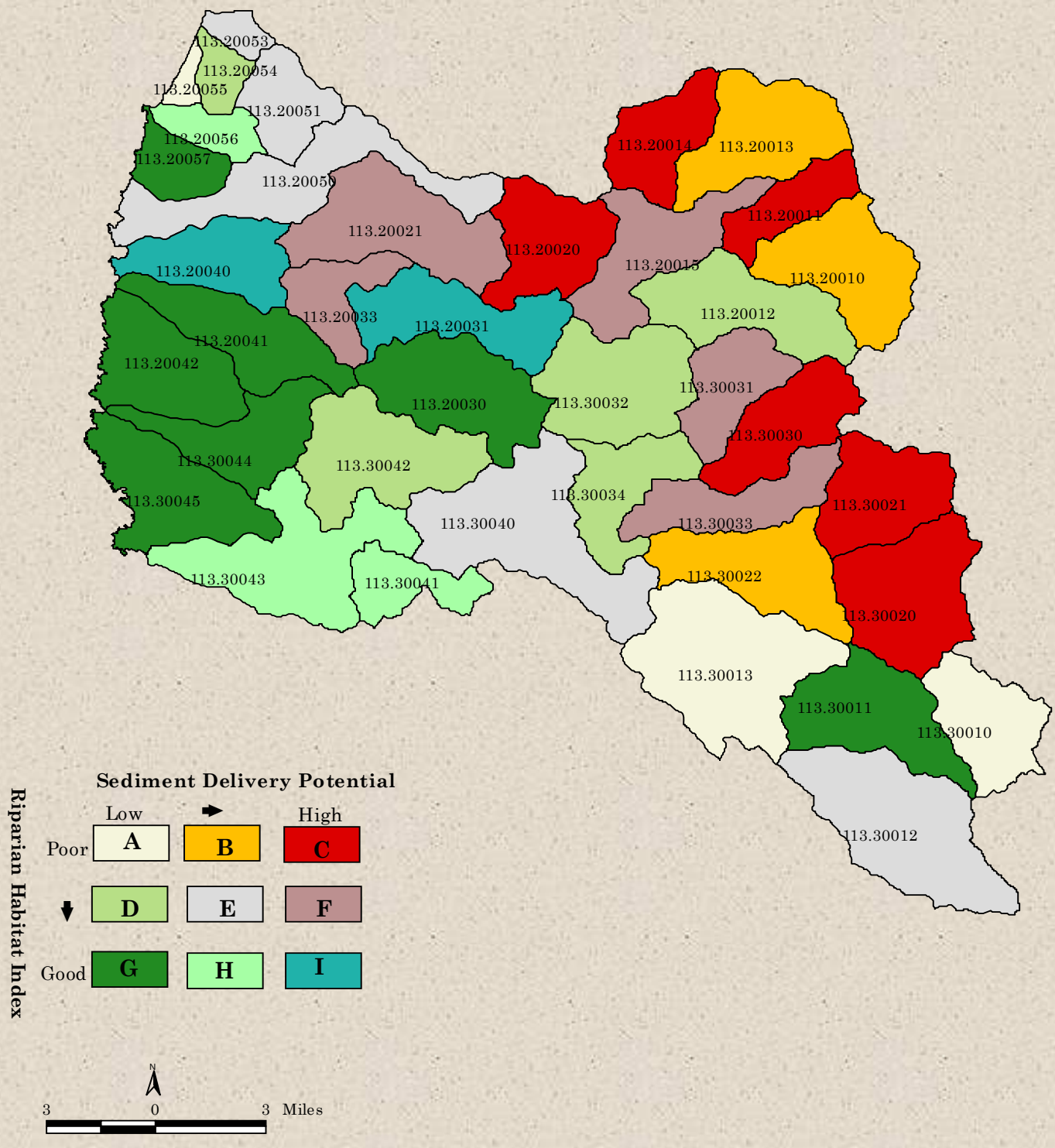
Figure 5:
Noyo and Big River Timber Harvesting: 1989 - 1988

Evaluating Restoration Potential

Sediment Delivery Potential

Riparian Habitat Indicators

	Low	*Medium*	*High*
Poor	**A** Limited restoration potential. Requires long term restoration of riparian habitat	**B** Limited restoration potential. Requires long term restoration of riparian habitat and sediment reduction.	**C** Limited restoration potential. Requires long term restoration efforts for both sediment reduction and riparian habitat
Adequate	**D** Near term restoration possible with improved riparian habitat	**E** Near term restoration possible with reductions in sediment and improved riparian habitat	**F** Requires long term sediment reduction and riparian habitat improvements
Good	**G** Good Conservation Potential	**H** Short term restoration possible with sediment reduction	**I** Requires long term sediment reduction

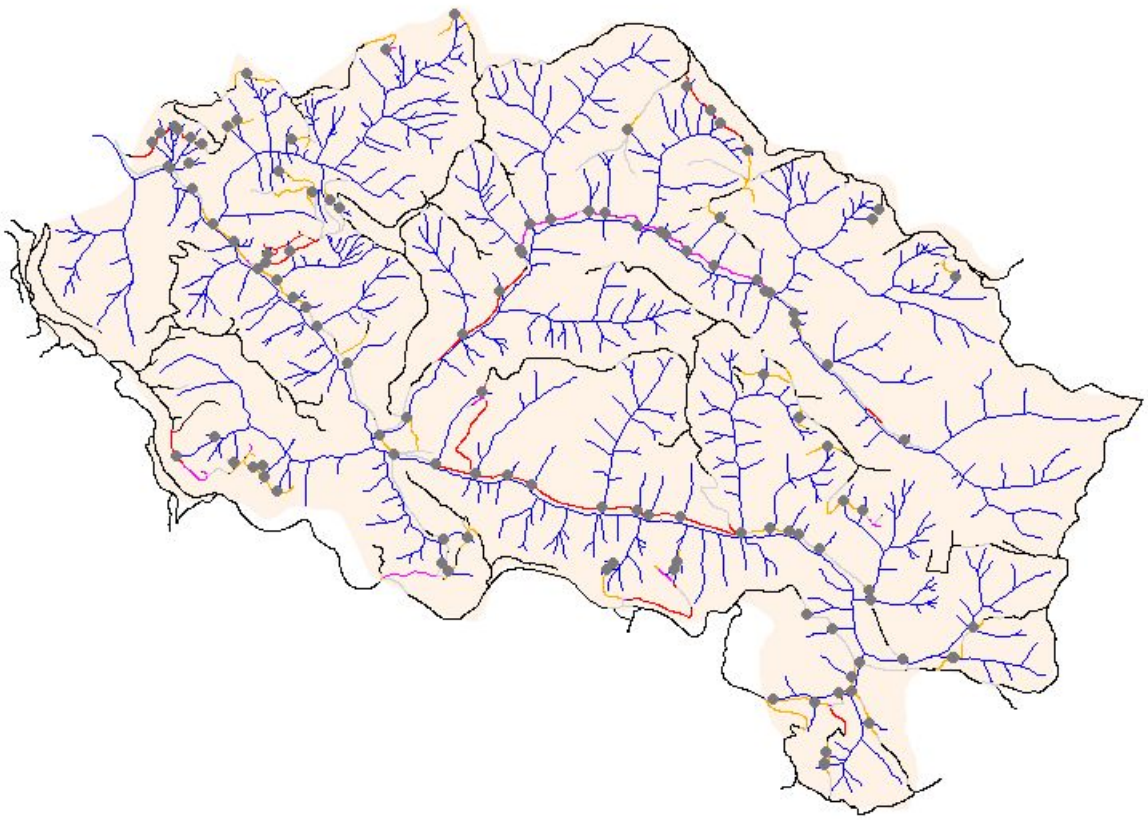


Noyo and Big River Watersheds: Restoration Potential

Conclusions

- Stream channels are deficient in LWD.
- LWD recruitment is dependent of management of mid seral stage forest.
- Position of roads in a watershed may serve as a proxy for road related sediment.
- The prioritization model provides an approach to maximize the increase of salmonid habitat.

Road Sedimentation Model



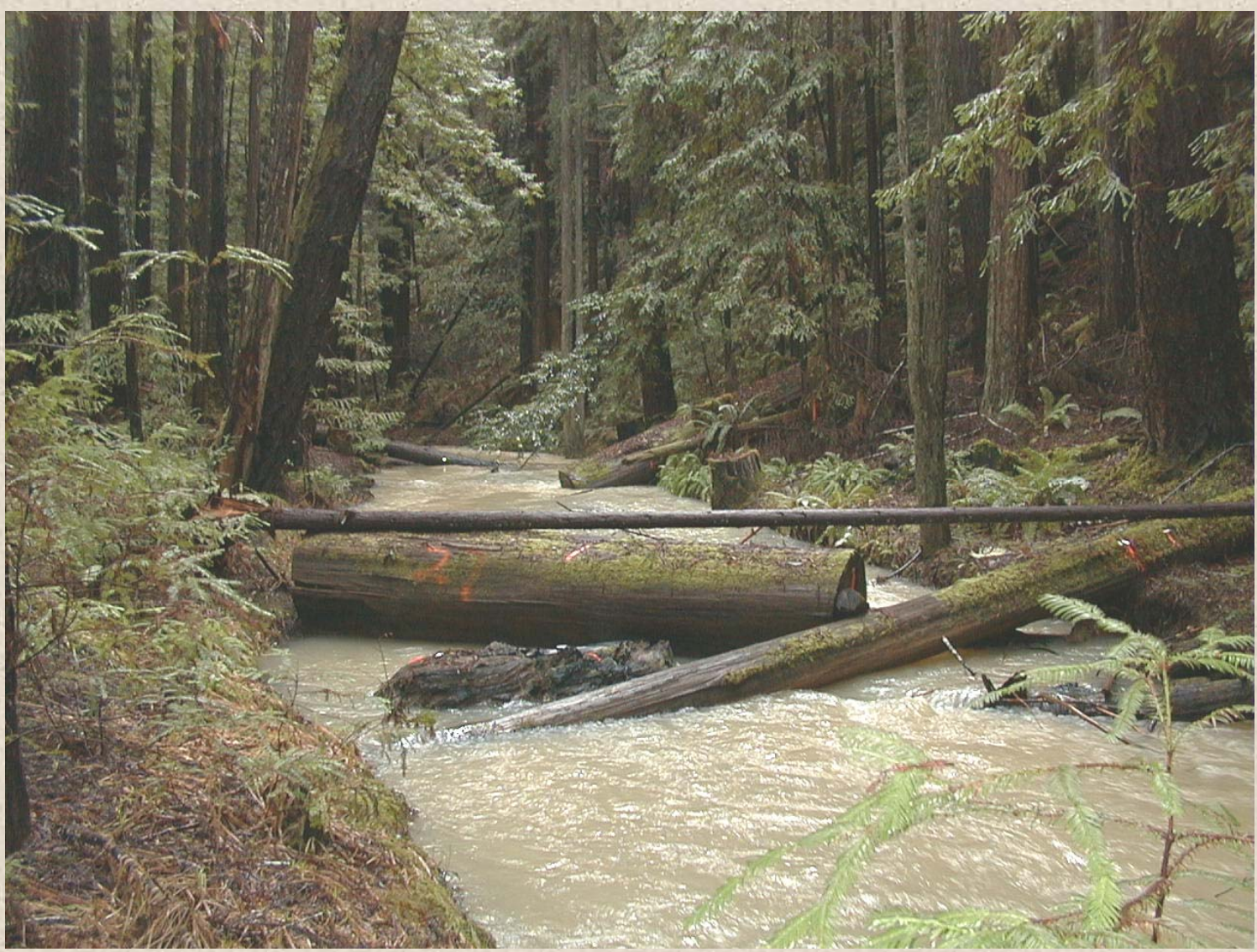
Total Estimated Road Sediment:..... 234 tons
Estimated Road Sediment per Mile:
(based on indirect delivery)... 1 tons
Estimated Tread Sediment:..... 201 tons
Estimated Cutslope Sediment:..... 33 tons
Background Sediment Total:..... 418 tons
Background/Road Sediment Ratio:..... 1
Road Direct Delivery Length:..... 20. miles
Mean Cutslope Height:..... 3 feet
Mean Road Width:..... 18 feet
Mean Precipitation Factor:..... 0.90

- Road and Stream Crossing
- Stream

Road Sediment Delivery

- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 35
- Roads
- Planning watersheds

Stream Improvement Projects



Data Visualization