Section B
SURFACE AND POINT SOURCE EROSION
(ROADS/SKID TRAILS)

INTRODUCTION

The surface and point source erosion module examines the past and present soil erosion from roads and skid trails of the Mendocino Redwood Company (MRC) ownership in the Southcoast Streams watershed, the Southcoast Streams watershed analysis unit (WAU). This module also provides a hazard assessment of the potential for future surface and point source erosion from roads in the Southcoast Streams WAU. The potential erosion assessment is to assist in development of mitigation measures and actions to minimize future soil erosion from the road network. The road data that is the basis for most of this analysis was collected by MRC during a road inventory of the Southcoast Streams WAU. The erosion estimates utilize a combination of field observations and the use of the surface erosion model presented in the Standard Methodology for Conducting Watershed Analysis (Version 4.0, Washington Forest Practices).

Surface erosion is defined as the removal of soil particles from the surface of the soil. Processes such as rill erosion, sheetwash, biogenic transport (animal burrows, treefall, etc.) and ravel are considered surface erosion. Gullies, road crossing wash-outs, and large erosion features created by erosion from overland flow of water are considered point source erosion. In contrast, the largest discrete erosion events, landslides, are considered mass wasting.

This report examines road and skid trail associated surface and point source erosion delivering sediment into watercourses. Excessive levels of fine sediments from surface and point source erosion can get trapped in porous streambed gravels; and can increase water turbidity and suspended sediment concentrations. Excessive coarse sediments from point source erosion can adversely affect stream channel morphology. These can reduce the survival of salmonids in their redds or affect habitat needs and physiological characteristics of rearing salmonids. Excessive surface and point source erosion when delivered to a watercourse can also affect other downstream uses such as water supplies, agricultural diversions and recreation users. It is important that best management practices be utilized in forest management operations to minimize the impacts of surface and point source erosion.

SURFACE AND POINT SOURCE EROSION FROM ROADS

Methods

Road Inventory
A road inventory of the roads with the Southcoast Streams WAU was completed in 2012. The road inventory consisted of traveling all roads with a Global Positioning System (GPS) unit and identifying, mapping and inventorying all major features of the road network. Some of the features that are inventoried include watercourse-crossings and crossing structures (culverts,

bridges, etc.), landings, erosion features and controllable erosion amounts (as defined below). Information relating to erosion and sediment delivery from the road inventory is analyzed in this report. Dimensions of the road network such as length, width and sediment contributing road lengths are also summarized. The road inventory collects information on the entire road infrastructure. This road infrastructure information allows for better management and tracking of the road network.

Estimating controllable erosion

Future or potential point source erosion (gully or road fill wash-outs, not sheetwash) observations were also collected during the road inventory. This potential future erosion is called controllable erosion[a], a term developed by the North Coast Regional Water Quality Control Board for Total Maximum Daily Load (TMDL) purposes. Typically, controllable erosion is a measure of the fill material from a road that could erode if a road feature is left un-maintained or fails in the next 40 years. The controllable erosion amount is the volume of soil that can be controlled with high design standards for a road feature (i.e. watercourse crossing, side-cast fill, etc.).

The controllable erosion sites are further designated by the potential for sediment delivery and the immediacy of treatment for the site. Both the sediment delivery potential and the treatment immediacy are ranked low, moderate, or high. The ranking of each controllable erosion site by these variables provides a hazard or risk assessment of the controllable erosion. This allows prioritization of road improvements and erosion control work based on potential point source erosion hazard.

Another important variable of potential future point source erosion from a road is the likelihood of diversion of water down the road prism. This diversion potential, as it is called, was evaluated for every watercourse crossing of every road in the Southcoast Streams WAU. A site has a diversion potential if when the watercourse crossing plugged, dammed or failed water could be diverted out of the "natural" watercourse channel and down the road prism. Water diverted out of its "natural" channel would erode the road prism creating potentially high sediment delivery. Sites with a diversion potential can be engineered such that the diversion of water down a road prism does not occur if the watercourse crossing plugged, dammed, or failed.

A prioritization of potential point source erosion sites for the Southcoast Streams WAU is presented (Appendix B). This prioritization is based on amount of controllable erosion of the site, the treatment immediacy, and a high diversion potential.

Culvert size analysis

Proper culvert sizing is another important characteristic for consideration of road erosion potential. Culverts that do not have the capacity to pass debris, water and sediment in high flow events can plug creating road prism failures with high sediment inputs. MRC currently designs all new culvert installations to pass the 100 year flood to ensure enough capacity in the pipe to pass water, debris and sediment in high flows. To determine if culvert sizing is appropriate for

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[a] Three important points qualify the definition of controllable erosion:

- Human action created the condition.
- Human action can reasonably control the condition.
- Estimated potential for sediment delivery, within 40 years, is greater than 10 yd^{3}.

existing culverts the area behind each culvert inventoried was determined from topography data in the MRC Geographic Information System (GIS). The regression equation for the North Coast region (Waananen and Crippen, 1977) is used to predict the 50 and 100 year peak flow. A culvert sizing nomograph is used to determine the appropriate size for 50 and 100 year peak flow magnitudes and the predicted size are compared to the existing culvert sizing to determine if the culvert is large enough.

The culvert sizing analysis must be interpreted carefully as it was often difficult to tell what area of watershed drained to a culvert from a map based analysis. This culvert sizing analysis is only meant to be “first cut” at determining if a culvert is properly sized. From this analysis a field visit to the site will determine if indeed the appropriate watershed drainage area was used and the culvert is indeed under-sized. The results from the culvert sizing analysis are presented in Appendix B.

Road surface erosion modeling
Surface erosion (sheetwash and minor rills) from roads was not directly estimated in the field. The contributing length or extent of road that delivers erosion to a watercourse is measured in the field then used for surface erosion calculations. The contributing length of a road is the length of road prism that drains water and associated eroded soil into a watercourse. Thus it defines the length of surface erosion of any particular site on the road. The model used to calculate surface erosion from roads is based on the Standard Methodology for Conducting Watershed Analysis (Version 4.0, Washington Forest Practices Board) and is described below. Modifications to the standard methodology are also indicated below.

Surface erosion from the road surface is influenced by the amount of road traffic (high use mainline, moderate use, active secondary, etc.), the type of road surface material, precipitation, width and size of road (the more surface area to erode, the more erosion), proximity to the watercourse, and vegetative cover (Reid, 1981). The Standard Methodology for Conducting Watershed Analysis (Version 4.0, Washington Forest Practices Board) provides relationships based on these factors to estimate the amount of surface erosion from different road types and conditions.

Field observations from the road inventory determined the length of the road delivering sediment to a watercourse (contributing length) from individual features of the road (culverts and crossings), the road width, the road surface material and the type of road (seasonal or temporary) to aid in the surface erosion calculations.

The road inventory lacked contributing road length for road segments adjacent to a watercourse but not associated with a culvert or crossing. Using an analysis from GIS, the amount of road within 50 feet, 50-100 feet and 100-200 feet of a watercourse was determined for all road segments not associated with a culvert or crossing. It was assumed that within 50 feet, 100 percent of erosion from the road delivers sediment to a watercourse. At 50-100 feet 35 percent and at 100-200 feet 10 percent of erosion from the road was assumed to deliver sediment to a watercourse. These assumptions were based on sediment delivery ratios used in a road erosion model called SEDMOD.

The following model parameters were used to calculate surface erosion from roads in the Southcoast Streams WAU. All of the observed roads were assumed to be older than two years and a base erosion rate of 60 tons/acre/year was applied to seasonal, temporary and permanent roads. A base erosion rate of 6 tons/acre/year was applied to decommissioned and historic road types since those road types are no longer used for normal operations and typically have competent surfaces.

This base erosion rate was altered (multiplied) by the unitless factors of traffic on the road, cut- and fill-slope vegetation cover, road surface type, road slope, annual precipitation, and road type in an attempt to model the actual sediment volume contributed by a given road segment. The road tread width was determined in the field during the road inventory and is assumed to be 40% of the road prism. The cut- and fill-slopes are assumed to encompass 60% of the road prism; their dimensions for the surface erosion model were determined by multiplying the tread width by 1.5.

Road cut- and fill-slopes usually had approximately 50% vegetative cover, giving a cover factor of 0.37. The majority of hauling on roads occurs during drier times of the year (i.e. late spring, summer and early fall). Therefore the lowest annual precipitation category is used (<47 in. precipitation annually). Precipitation impacts the road surface by eroding off unconsolidated material. A road tread factor was assigned to each type of road surface (rocked, native, paved or decommissioned). All road tread types were categorized within this annual precipitation category described above. A road with at least a 6 inch rock surface is given a tread factor of 0.2, a native surface road has a factor of 1 and paved roads were assigned a road tread factor of 0.03. MRC chose a road tread factor of 0.03 also for decommissioned roads since these are assumed to achieve competent surfaces within a relative short time period after decommissioning. MRC assigned a road tread factor of 1 for road segments where the road surface type was undetermined.

Road segments with a slope of 15% or greater were assigned a slope factor of 2.5 and all other segments (including undetermined) were assigned a slope factor of 0.2.

Road widths were determined in the road inventory and undetermined widths were assigned a standard width of 18 feet.

There were 3 traffic factors used in surface erosion modeling:
1) *Mainline roads with moderate traffic* have a factor of 2; these roads are used for log haul traffic 2-3 times each decade.
2) *Seasonal (and undetermined) roads* have a traffic factor of 1.2; these are tributary roads which receive moderate log haul traffic 1-2 years each decade and light traffic the remainder of the time.
3) *Temporary roads* receive a traffic factor of 0.61; these roads receive moderate log haul traffic 1-2 times per every 1-2 decades with little to no use in between.
4) *Decommissioned and Historic roads* have a traffic factor of 0.001; these roads do not receive any log haul traffic but are occasionally traveled on with all-terrain vehicles. We assumed that most erosion from these road types would have little do with traffic and more to do with exposed cut and fill slopes.

The result of the surface erosion modeling (including the near stream surface erosion) is normalized by road length and presented as tons/mile/year of sediment delivery (see Appendix B for erosion estimates of each road in the Southcoast Streams WAU). For relative sediment contributions from each planning watershed for road-associated sediment input evaluation, the tons/year calculations for all roads was totaled by planning watershed and normalized by dividing by the MRC ownership, in square miles, for the planning watershed. The result is a tons/square mile of MRC ownership/year estimate of road surface and point source erosion.

Erosion Hazard Rating
Finally, with this information each road in the Southcoast Streams WAU is assigned an erosion hazard class. The erosion hazard class is used to classify the road features (culverts, crossings and road segments) in the Southcoast Streams WAU by their current and potential erosion hazard. The erosion hazard class was determined by the amount of erosion a feature produced and the likelihood for that erosion to be delivered to a watercourse. High levels of traffic, road surface, proximity to the stream, and high modeled surface erosion all were considered when ranking roads for their erosion hazard.

Road segments with deliverable sediment to crossings and culverts were classified into high, moderate, and low categories based on the natural breaks in the sediment delivery data (for example, the top third were categorized as high erosion hazard). Road segments not draining to a culvert a crossing were categorized similarly, with the following exceptions: segments within 50 feet of a watercourse were categorized only as high and moderate and segments within 200 feet were categorized only as moderate and low.

Results and Discussion – Roads

Erosion Hazard Rating
The road erosion hazard rating for each road in the Southcoast Streams WAU is presented on Maps B-1(a) and B-2(b) in Appendix B of this report. The categorizing of road segments into hazard classes is intended to identify current problem areas, consider reconstruction and prioritize maintenance. Hazard ratings for road segments are normalized by the segment length. The following are the definitions for each erosion hazard class.

<u>High Erosion Hazard Class</u> - These features have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion. Often features in this class are close to watercourses creating a high sediment delivery potential. Erosion is typically due to long contributing road lengths or road with native surfaces near watercourses: a result of too few waterbars and/or rolling dips or lack of rock surface. Erosion may also be a product of problem areas such as watercourse crossing wash-outs, poor road drainage, plugged road watercourse crossings, water diverted down the road surface, culverts not fitted with downspouts, etc. Active roads in this class should get the highest priority for maintenance or improvements.

<u>Moderate Erosion Hazard Class</u> - These features have moderate amounts of recent deliverable surface erosion to watercourses and potential for future deliverable erosion. Erosion problems on roads in this class can usually be handled with good road maintenance. Erosion is typically from problem areas such as poor road drainage, water diverted down the road surface, culverts not fitted with downspouts, and an occasional plugged culvert or watercourse crossing wash-out. Active roads in this class should be a priority for maintenance.

<u>Low Erosion Hazard Class</u> - These features have low amounts of recent deliverable surface erosion to watercourses and low potential for future deliverable erosion. These roads can be active, abandoned or closed. Active roads in this class do not need to be a priority for maintenance.

Road features from the road inventory
The mapped roads and road features (culverts, crossings, and landings) are presented in map B-2 for the Southcoast Streams WAU. The associated treatment immediacy of the road feature is also shown on these maps. Potential controllable (point source) erosion sites were identified and prioritized in the Southcoast Streams WAU. In the Southcoast Streams WAU 73 controllable erosion sites have high treatment immediacy and 14 controllable erosion sites have moderate treatment immediacy. In addition to these controllable erosion sites 66 culverts or crossings in the Southcoast Streams WAU have a diversion potential. These diversion potential sites need to be considered a high priority for road improvement as they can represent a significant potential point source erosion hazard. The site identification, treatment immediacy and amount of controllable erosion estimated are found in Appendix B of this report.

Culvert size analysis
The culvert size analysis has determined that, out of a total of 177 watercourse culverts, approximately 69% are potentially too small to pass the 50 year flood flow and 70% for the 100-year flow. The analysis of culvert sizing is only an estimate based on culvert location from the MRC road inventory and area draining to the culvert based on MRC GIS topographic data. All culverts were analyzed with a headwall-to-pipe diameter ratio of 0.75 and a mean annual precipitation of 55 inches (or a 100-year rainfall intensity of 3.1 inches per hour with a runoff coefficient of 0.4). A field review will be required at each site to validate the culvert size analysis results and determine if the culvert is indeed under-sized. However, the identification of these culverts as under-sized provides information to address potential road problems in Southcoast Streams WAU. These culverts identified as potentially too small need to be a high priority for upgrade if after field review the culverts are determined to be under-sized. The culvert sizing results are found in Appendix B of this report.

Table B-1. Culvert size analysis for the Southcoast Streams WAU.

Planning Watershed	Number of watercourse culverts	Percentage of culverts NOT passing 100-yr flow requirements	Percentage of culverts NOT passing 50-yr flow requirements
Lower Alder Creek	11	45%	45%
Lower Brush Creek	1	100%	100%
Mallo Pass Creek	18	67%	67%
North Fork Alder Creek	17	71%	71%
Point Arena Creek	13	62%	54%
Upper Brush Creek	1	0%	0%
Total	*61*	*62%*	*61%*

Road density
It was determined that there are 184 miles of truck roads in the Southcoast Streams WAU (skid trails not included). This represented an average road density of 8.7 miles of road per square mile of property owned by MRC. Table B-2 breaks shows the road lengths and densities for the Southcoast Streams WAU.

Table B-2. Road Lengths and Density by Planning Watershed for the Southcoast Streams WAU.

Planning Watershed	**Watershed area (mi^2)**	**MRC owned (mi^2)**	**Road Length (miles)**	**Contributing* Road Length (miles)**	**Road Density** (mi/mi^2)**
Lower Alder Creek	16.7	9.2	51.6	2.6	5.6
Lower Brush Creek	10.0	0.6	5.6	1.0	9.5
Mallo Pass Creek	13.7	3.9	81.8	2.6	20.9
North Fork Alder Creek	13.3	3.2	14.9	5.0	4.6
Point Arena Creek	20.2	3.4	24.8	6.4	7.3
Upper Brush Creek	7.7	0.4	3.5	0.3	7.9
Cuffey's Point	6.0	0.4	1.7	0.7	4.5

**Contributing road length is defined as the amount of road potentially draining to a watercourse that could lead to a deliverable amount of surface erosion. It is determined during the road inventory.*

***Road density is calculated by dividing the road length by the amount of MRC-owned land within each planning watershed.*

Road densities are something that should be managed for in the Southcoast Streams WAU. Not all roads can be abandoned, but by converting many of these roads to a temporary status or putting them to bed after use, the amount of road that can contribute erosion at any given time is reduced.

Surface and point source erosion

The surface and point source erosion estimates by planning watershed are presented in Table B-3. The breakdown of estimated erosion, road lengths and hazard rating by individual roads is in Appendix B of this report. Road segments within 50 feet of watercourses are assumed to deliver 100% of their estimated sediment yield. At 50-100 feet, segments are assumed to deliver 35% of their estimated sediment yield and 10% for segments within 100-200 feet of watercourses. No delivery was assumed for segments beyond 200 feet from a watercourse. Roads in the MRC ownership in the Southcoast Streams WAU are estimated to generate, on average, 32 tons/mi^2/yr of sediment from road-associated surface and point source erosion. This rate of erosion from roads within the Southcoast Streams WAU is relatively moderate in comparison with other typical erosion rates on MRC land.

Table B-3 Road Associated Surface and Point Source Erosion Estimates for the Southcoast Streams WAU.

Planning Watershed	**MRC owned (mi^2)**	**Surface Erosion (tons/sq mi/yr)**	**Point Source Erosion (tons/sq mi/yr)**	**Total (surface + point source) (tons/sq mi/yr)**
Lower Alder Creek	9.2	0	26	26
Lower Brush Creek	0.6	0	8	8
Mallo Pass Creek	3.9	0	32	32
North Fork Alder Creek	3.2	18	29	47
Point Arena Creek	3.4	4	35	39
Upper Brush Creek	0.4	1	3	4
Cuffeys Point	0.4	1	37	38
Southcoast Streams WAU	***21.1***	***3+***	***28+***	***32+***

+*Area-weighted average*

Controllable erosion

The future potential for point source erosion was evaluated in the Southcoast Streams WAU. This potential erosion or controllable erosion was identified during the road inventory during 2012. A total of 6,544 cubic yards of controllable erosion was identified in the Southcoast Streams WAU (Table B-4).

Table B-4. Controllable Erosion Volume Estimates by Road Feature and Treatment Immediacy for the Southcoast Streams WAU.

Road Feature	**Controllable Erosion by Treatment Immediacy (yd^3)**		
	High	**Moderate**	**Low**
Culverts	906	171	1557
Crossings	447	110	656
Landings	0	0	157
Erosion Sites	0	16	86
Road slides	134	1489	815
Total	***1487***	***1786***	***3271***

The majority of controllable erosion (by volume) is at culverts and road slides. There are a total of 490 controllable erosion sites within the Southcoast Streams WAU (Table B-5), of which approximately 75% (363) have already been controlled. Table B-6 indicates the number of non-functional culverts. Appendix B contains more details for each feature.

Table B-5. Number of features by Treatment Immediacy for the Southcoast Streams WAU.

Road Feature	High	Moderate	Low	Controlled
Culverts	22	2	32	22
Crossings	2	3	21	66
Landings	0	0	5	257
Erosion Sites	0	2	10	6
Road slides	1	9	18	12
Total	***25***	***16***	***86***	***363***

Table B-6. Non-functional culverts in the Southcoast Streams WAU.

Culvert type	Functional	Non-functional
Watercourse	54	7
Ditch-relief	19	4

Fish passage barriers in the Southcoast Streams WAU

There are no identified barriers to fish passage in the Southcoast Streams WAU.

Road Associated Erosion Control Measures for the Southcoast Streams WAU 1998-2008

Since Mendocino Redwood Company's ownership in the Southcoast Streams WAU (starting in 1998), MRC has conducted erosion control and road upgrade work to address and improve road erosion sites. The initial road inventory survey of Southcoast Streams WAU was conducted in 2012. On-going erosion control work has improved sedimentation conditions in Southcoast Streams WAU since MRC has taken ownership of the property, but credit for treating controllable erosion sites cannot be taken since the road inventory was just completed. Map B-3 displays erosion control work completed since 1998 and Table B-6 lists recent road work completed.

Table B-7. Controlled sediment by Area for the Southcoast Streams WAU.

Year	Brief Work Description	Sediment controlled (yd^3)
2005	Road work, culvert installation	30
2011	Culvert upgrades	240
2013	Crossing upgrade	540
	Total	***810***

SURFACE AND POINT SOURCE EROSION FROM SKID TRAILS

Methods

Sediment delivery from surface and point source erosion from skid trails was determined from aerial photograph interpretation and sediment delivery estimates developed in previous MRC watershed analyses (MRC, 1998 and MRC, 2000). Aerial photographs were analyzed from the 1952, 1963, 1978, 1987, 2000, 2004 photo years. MRC owned photographs from 2004, 2000 1987, and 1978. Photocopies on file at the Mendocino County Resource Conservation District in Ukiah for the 1963 and 1952 series were used to analyze older skid trail activity, but without the aid of a stereoscope. The aerial photographs were used to identify skid trail activity for each decade from 1940 to the end of the 1990s.

The aerial photograph interpretation for skid trail activity consisted of determining the area harvested with ground based yarding by skid trail density (high, moderate, low) for each photo year. High-density skid trail activity is defined as having greater than 100 watercourse crossings per square mile. Moderate-density skid trail activity is defined as having between 50-100 watercourse crossings per square mile. Light skid trail density has less than 50 watercourse crossings per square mile or trails with significant re-vegetation observed in the aerial photograph.

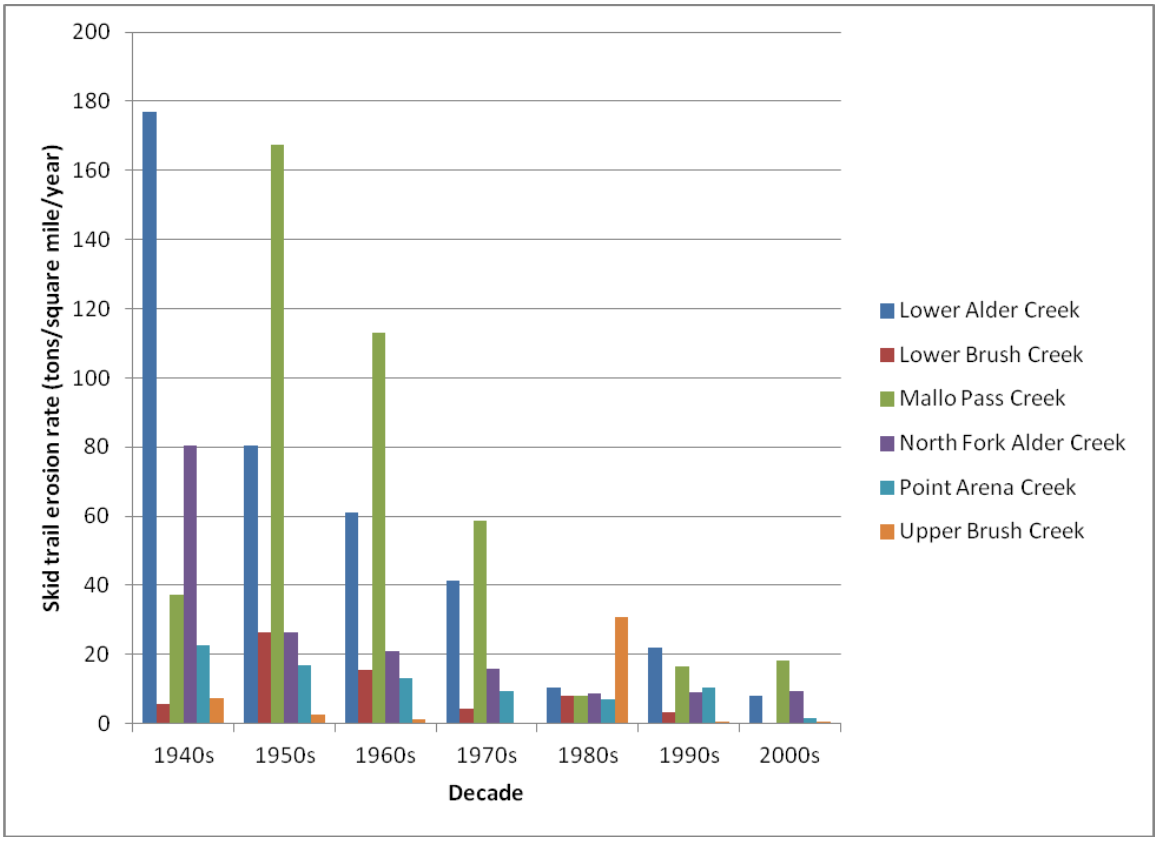
The amount of sediment delivery from the various densities of skid trail activity was estimated from sediment delivery rates during previous watershed analyses by MRC (MRC, 1998 and MRC, 2000). A combination of surface erosion modeling and field observations of point source erosion from skid trails, from previous watershed analysis, was used to develop the skid trail estimates. High skid trail density is estimated to contribute 600 tons/square mile/year of sediment. Moderate skid trail density is estimated to contribute 400 tons/square mile/year of sediment, while low skid trail density contributing 100 tons/square mile/year. Results from the South Fork Caspar Creek in the early 1970's suggested that high density tractor logging, with practices used at that time, generated approximately 600 tons/square mile/year (Rice et. al., 1979).

For each photo year the area in each skid trail density category was multiplied by the sediment delivery rate for that density. The estimate was then divided by the MRC ownership in each Calwater planning watershed to provide a sediment rate (tons/square mile/year) for each planning watershed. The estimated rate was then assumed to represent the decade previous to the photo year observed (i.e. 1978 photos represent activity in the 1970s), but an average value of the previous and subsequent decades (1963 and 1978 photo sets) was used for the 1960s.

Results and Discussion - Skid Trail Erosion

The results by time period for the skid trail sediment delivery estimates are summarized in Chart B-1. The estimates should be considered a minimum sediment delivery for skid trails constructed and used in the decade. Undoubtedly some, if not many, sediment delivering skid trails were vegetated enough to be overlooked during the inventory. In particular are those trails constructed or used greater than five years prior to aerial photograph reconnaissance.

Chart B-1. Skid Trail Sediment Delivery Rates for Southcoast Streams WAU, 1940s-1990s.


200
180
160
140
120
100
80
60
40
20
0
Skid trail erosion rate (tons/square mile/year)
1940s
1950s
1960s
1970s
1980s
1990s
2000s
Decade
Lower Alder Creek
Lower Brush Creek
Mallo Pass Creek
North Fork Alder Creek
Point Arena Creek
Upper Brush Creek

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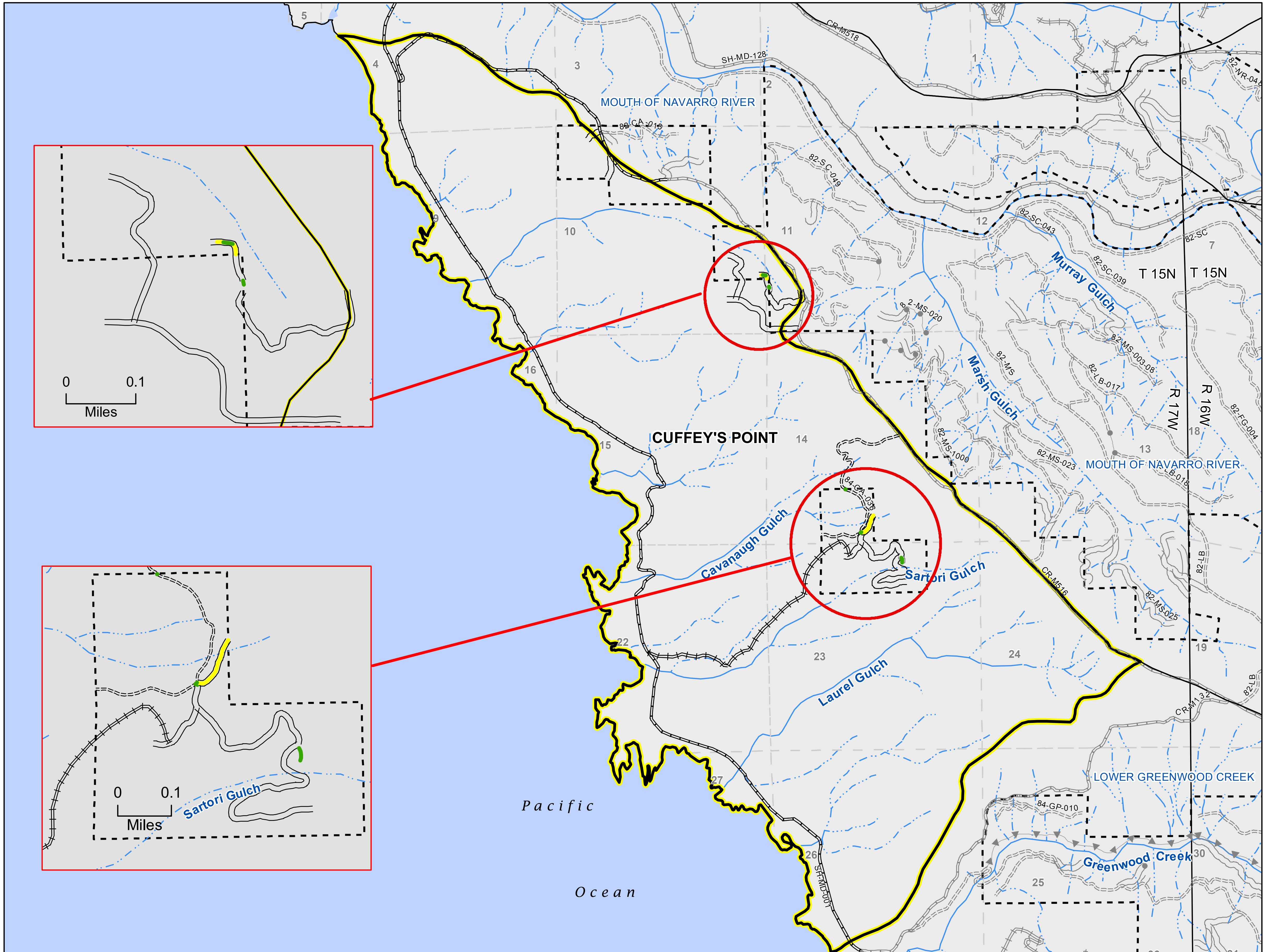
APPENDIX B
Surface and Point Source Erosion Module



Southcoast Streams Watershed Analysis Unit

Cuffey's Point Planning Watershed

Map B-1 Erosion Hazard Rating Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaining watercourse crossings within the watershed.

Erosion Hazard Rating

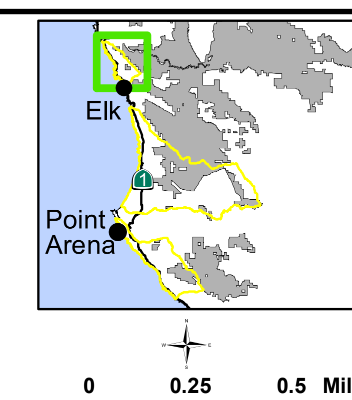
- Low
- Moderate
- High

Road Classification

- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class

- Class I
- Class II
- Class III



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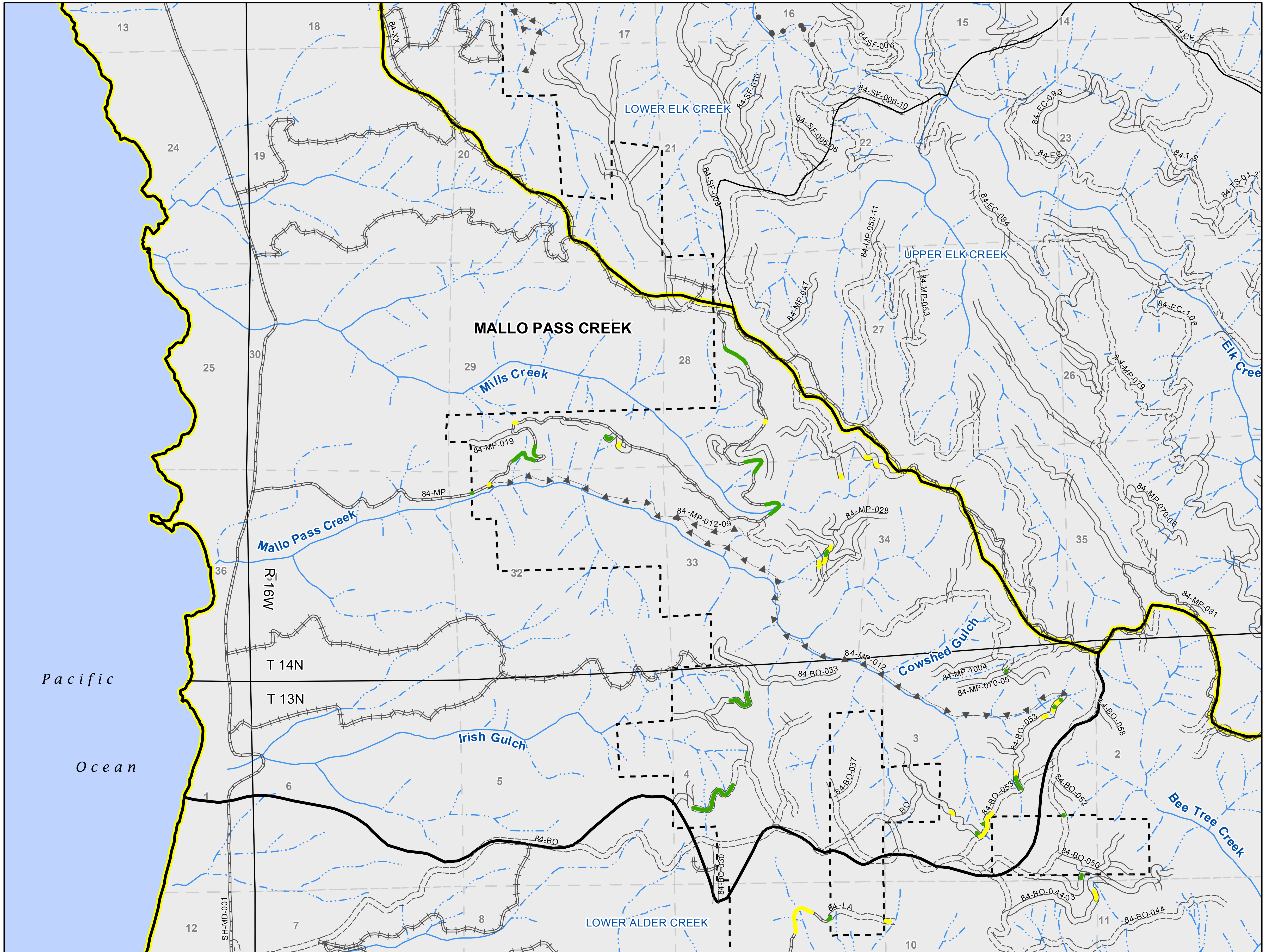


Southcoast Streams Watershed Analysis Unit

Mallo Pass Creek Planning Watershed

Map B-1 (b)
Erosion Hazard Rating Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaing watercourse crossings within the watershed.

Erosion Hazard Rating

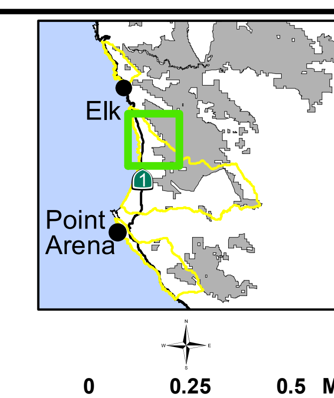
- Low
- Moderate
- High

Road Classification

- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class

- Class I
- Class II
- Class III



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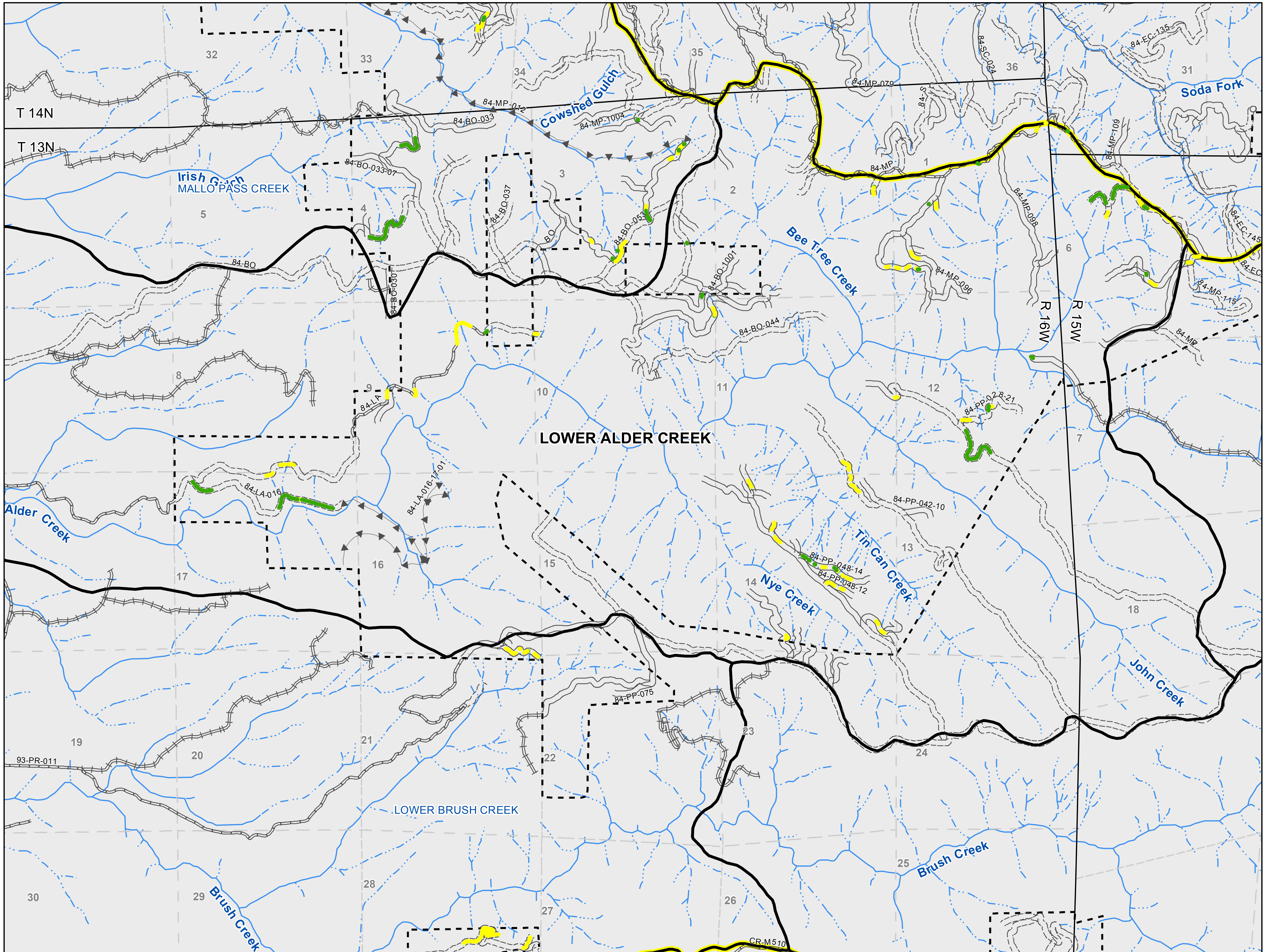


Southcoast Streams Watershed Analysis Unit

Lower Alder Creek Planning Watershed

Map B-1 (c)
Erosion Hazard Rating Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaining watercourse crossings within the watershed.

Erosion Hazard Rating

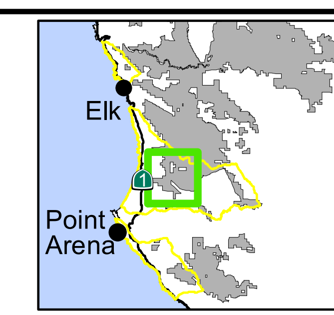
- Low
- Moderate
- High

Road Classification

- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

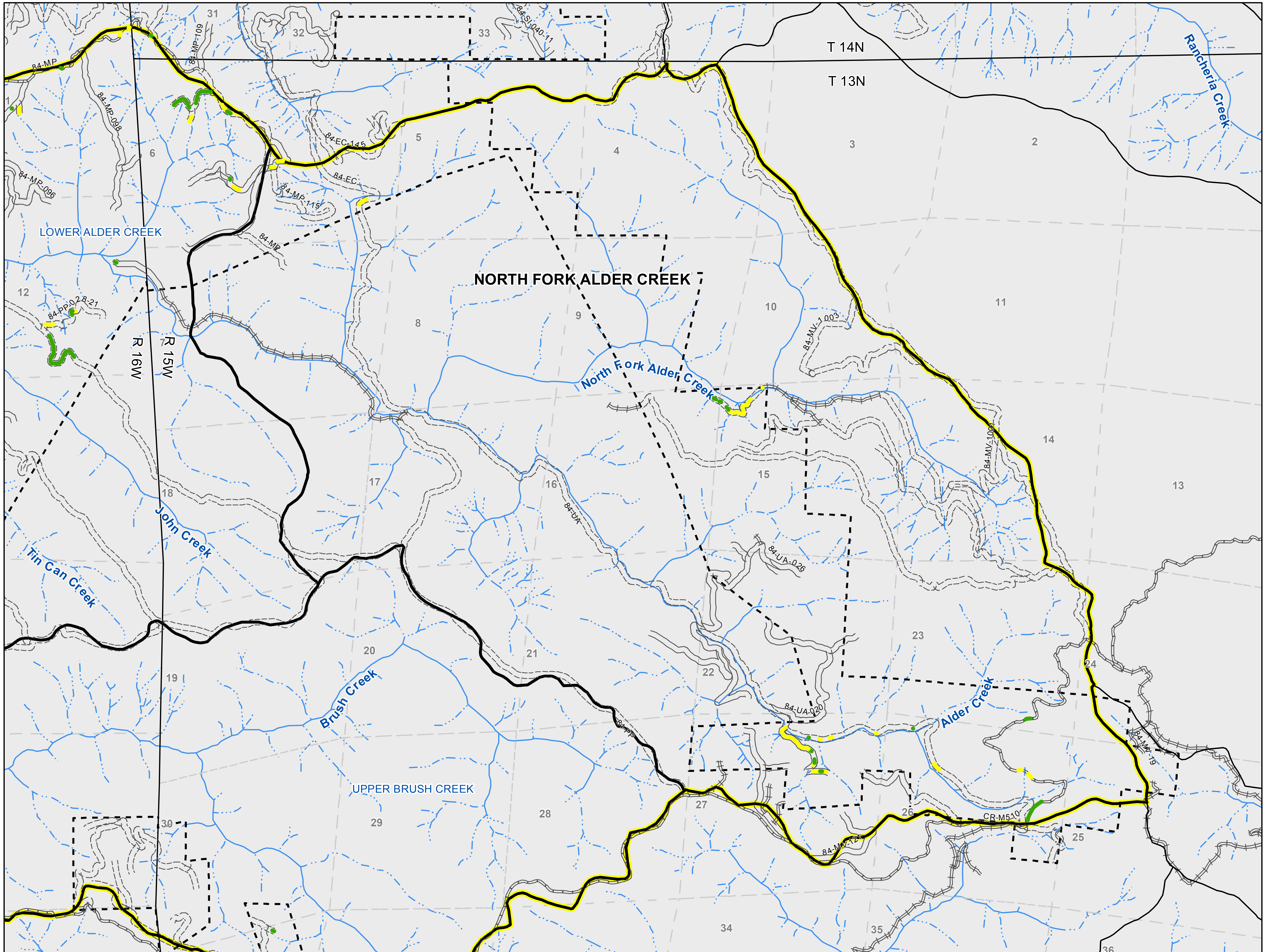
Flow Class

- Class I
- Class II
- Class III



0 0.25 0.5 Miles

April 2014



Southcoast Streams Watershed Analysis Unit

North Fork Alder Creek Planning Watershed

Map B-1 (d)

Erosion Hazard Rating Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaining watercourse crossings within the watershed.

Erosion Hazard Rating

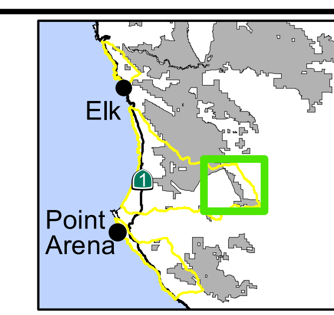
- Low
- Moderate
- High

Road Classification

- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class

- Class I
- Class II
- Class III



0 0.25 0.5 Miles

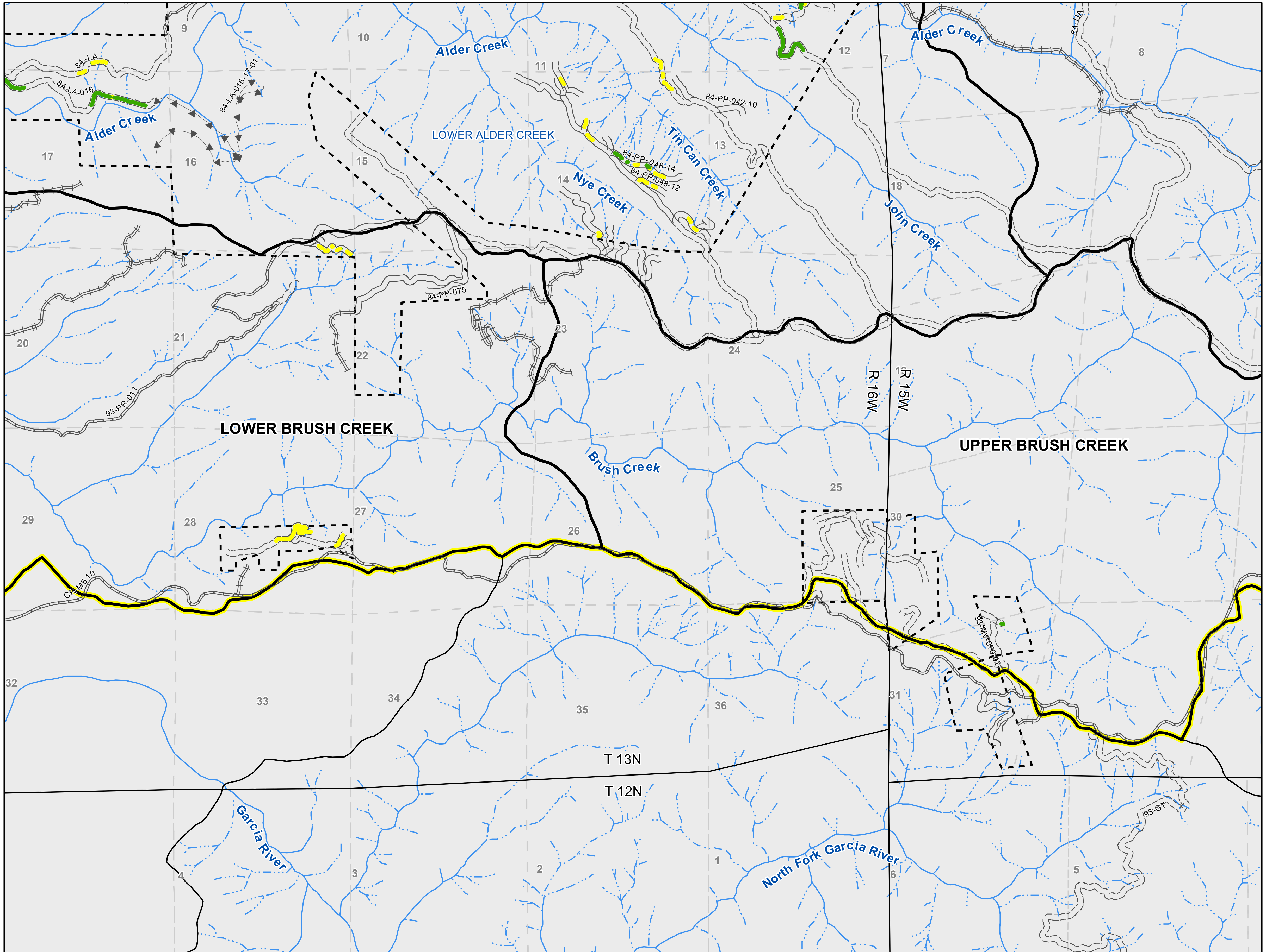
April 2014

Southcoast Streams
Watershed Analysis Unit

Upper & Lower Brush Creeks
Planning Watershed

Map B-1 (e)
Erosion Hazard Rating
Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaining watercourse crossings within the watershed.



Erosion Hazard Rating

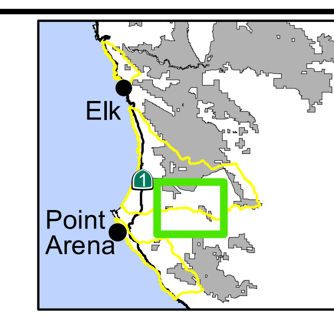
- Low
- Moderate
- High

Road Classification

- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

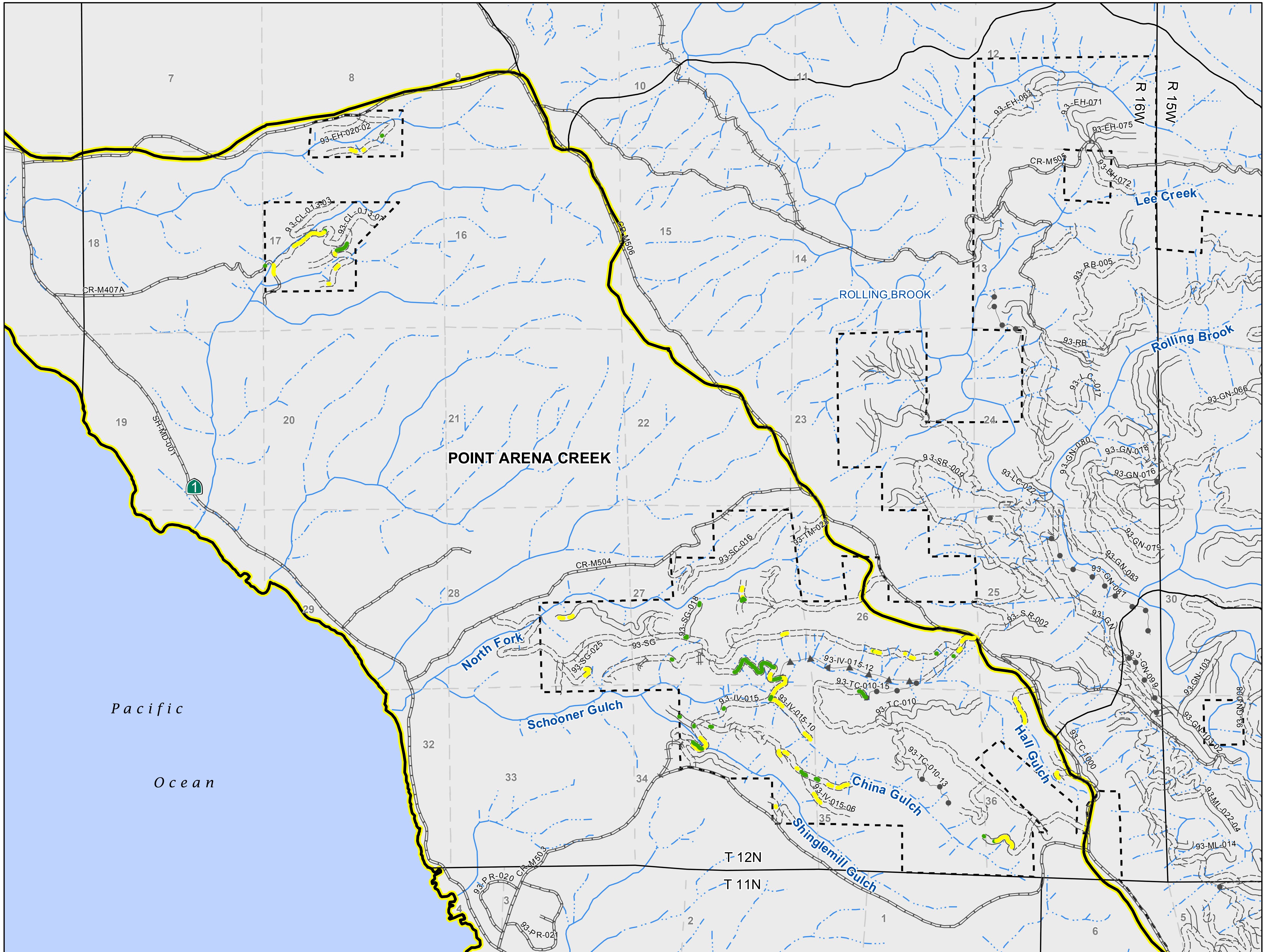
Flow Class

- Class I
- Class II
- Class III



0 0.25 0.5 Miles

April 2014



Southcoast Streams Watershed Analysis Unit

Point Arena Creek Planning Watershed

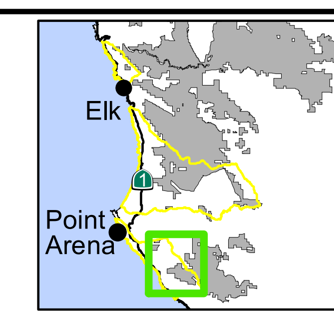
Map B-1 (f)
Erosion Hazard Rating Classifications

This map presents an erosion hazard rating and road classification for MRC roads. High erosion hazard road segments have the highest amount of recent deliverable surface erosion to watercourses and a high potential for future deliverable erosion in comparison to moderate and low erosion hazard rated segments. This information is estimated using road inventory data and should be used to aid in prioritizing road segments for repairs such as road outsloping,increasing waterbreak spacing, or adding rolling dips. Roads currently classified as seasonal roads should be converted to temporary roads,where feasible, to increase the number of self-maintaining watercourse crossings within the watershed.

Erosion Hazard Rating
- Low
- Moderate
- High

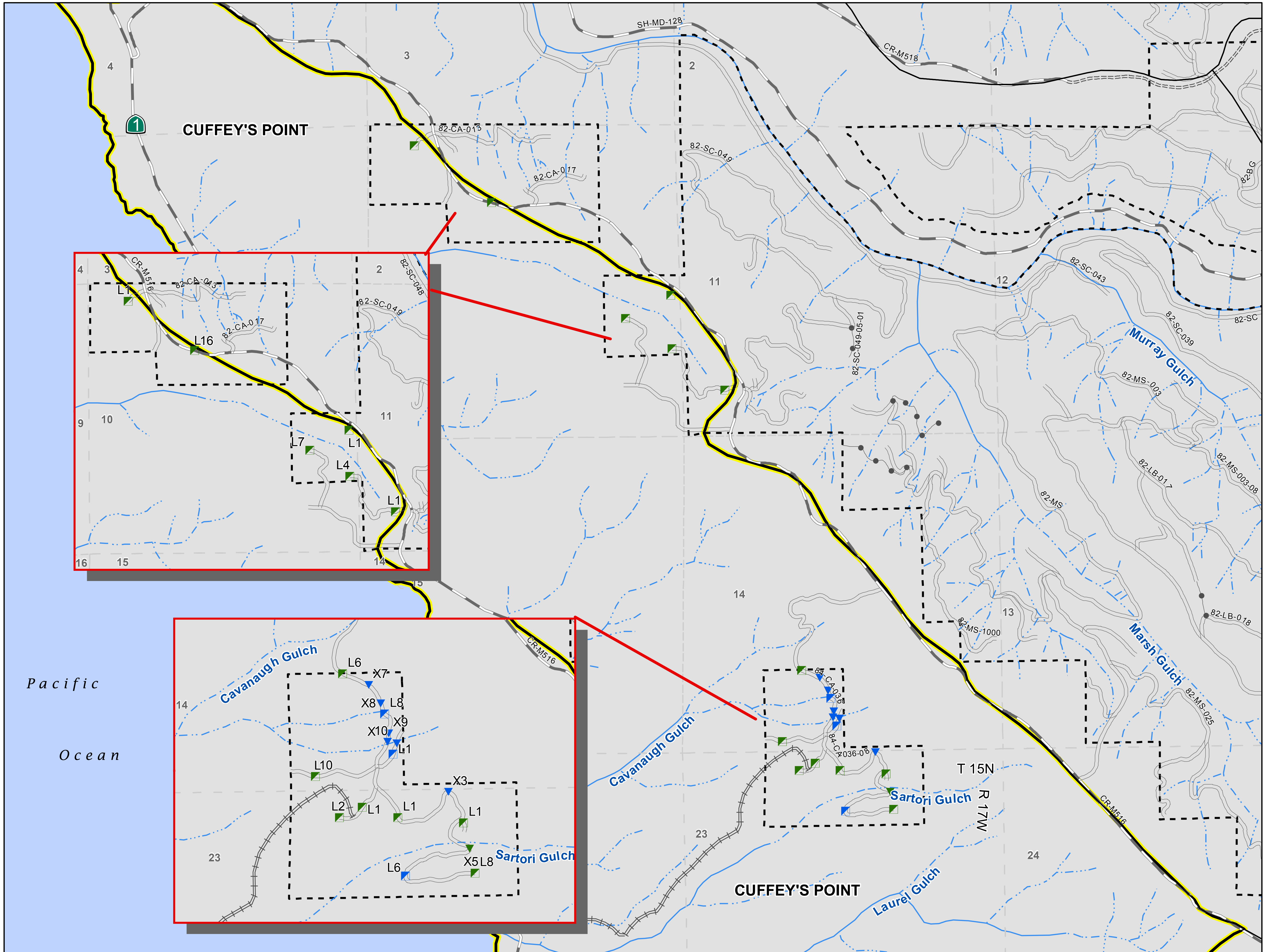
Road Classification
- Permanent
- Seasonal
- Temporary
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class
- Class I
- Class II
- Class III



0 0.25 0.5 Miles

April 2014



Southcoast Streams Watershed Analysis Unit

Cuffey's Point Planning Watershed

Map B-2 (a)
Road Feature
Treatment Immediacy

This map presents select results from MRC's road inventory. The entire road network and road features were mapped using geographic positioning system (GPS) from 2006. For each feature with the potential to create erosion (culverts, landings, crossings) the treatment immediacy for the feature was assigned. The treatment immediacy represents the level of concern for either upgrading or maintenance to the feature.

Treatment Immediacy

Culverts	Crossings	Landings
high	high	high
moderate	moderate	moderate
low	low	low
none	none	none

L = Landing; C = Culvert; X = Crossing

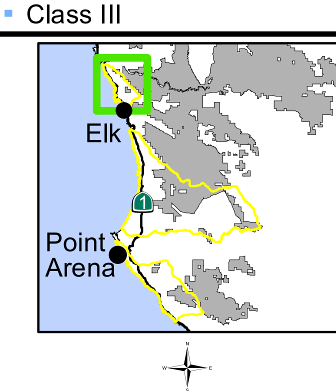
Road Surface

- Paved Road
- Rocked Road
- Native Road
- Jeep Trail
- Undetermined
- Decommissioned
- Historic

- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

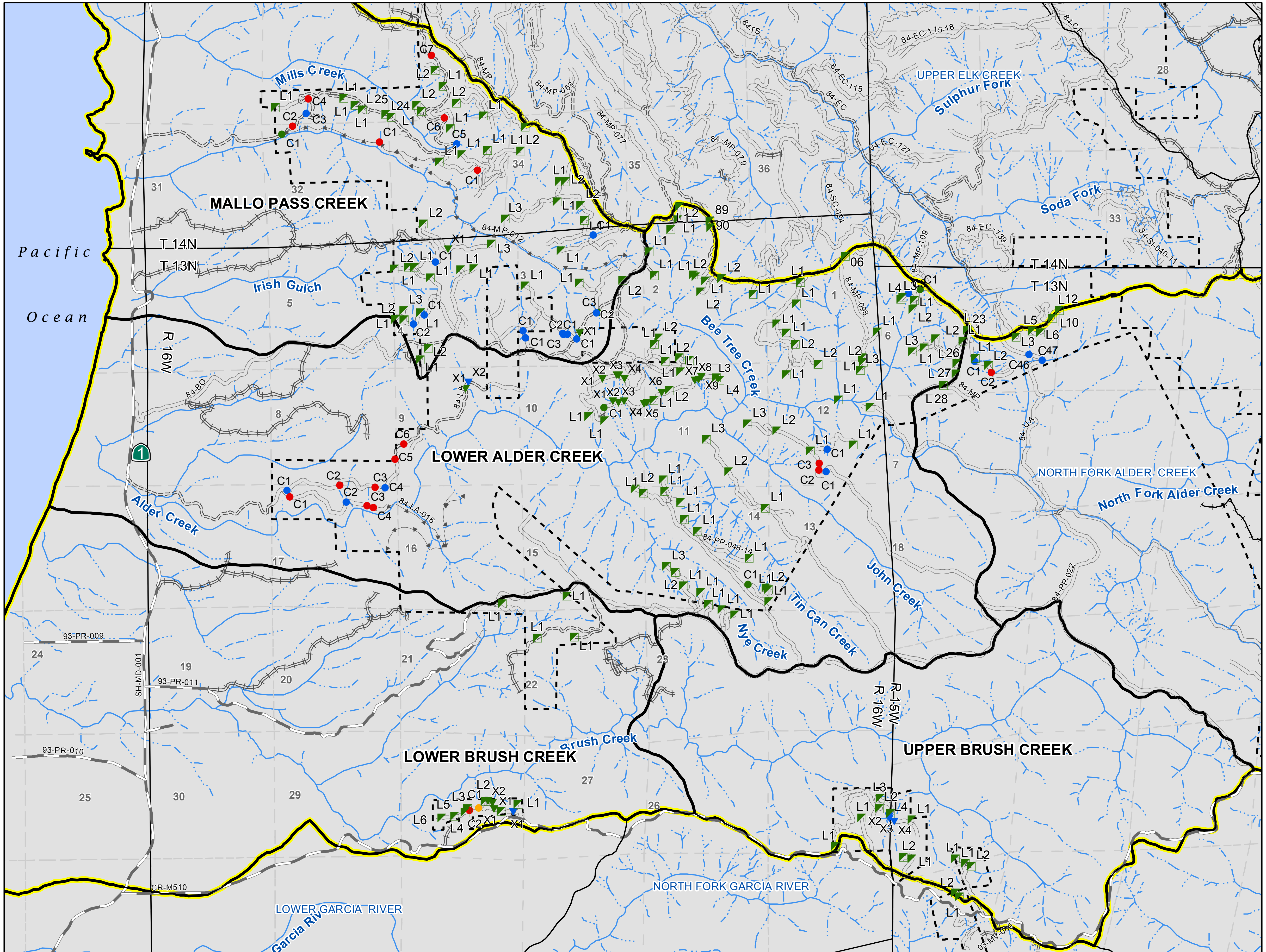
Flow Class

- Class I
- Class II
- Class III



0 0.2 0.4 Miles

April 2014



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Southcoast Streams
Watershed Analysis Unit
Mallo Pass, Lower Alder, Lower & Upper Brush Creeks Planning Watershed

Map B-2 (b)
Road Feature Treatment Immediacy

This map presents select results from MRC's road inventory. The entire road network and road features were mapped using geographic positioning system (GPS) from 2006. For each feature with the potential to create erosion (culverts, landings, crossings) the treatment immediacy for the feature was assigned. The treatment immediacy represents the level of concern for either upgrading or maintenance to the feature.

Treatment Immediacy

Culverts	Crossings	Landings
high	high	high
moderate	moderate	moderate
low	low	low
none	none	none

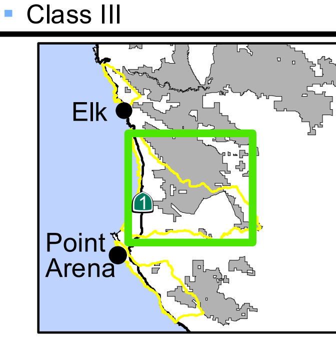
L = Landing; C = Culvert; X = Crossing

Road Surface

- Paved Road
- Rocked Road
- Native Road
- Jeep Trail
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

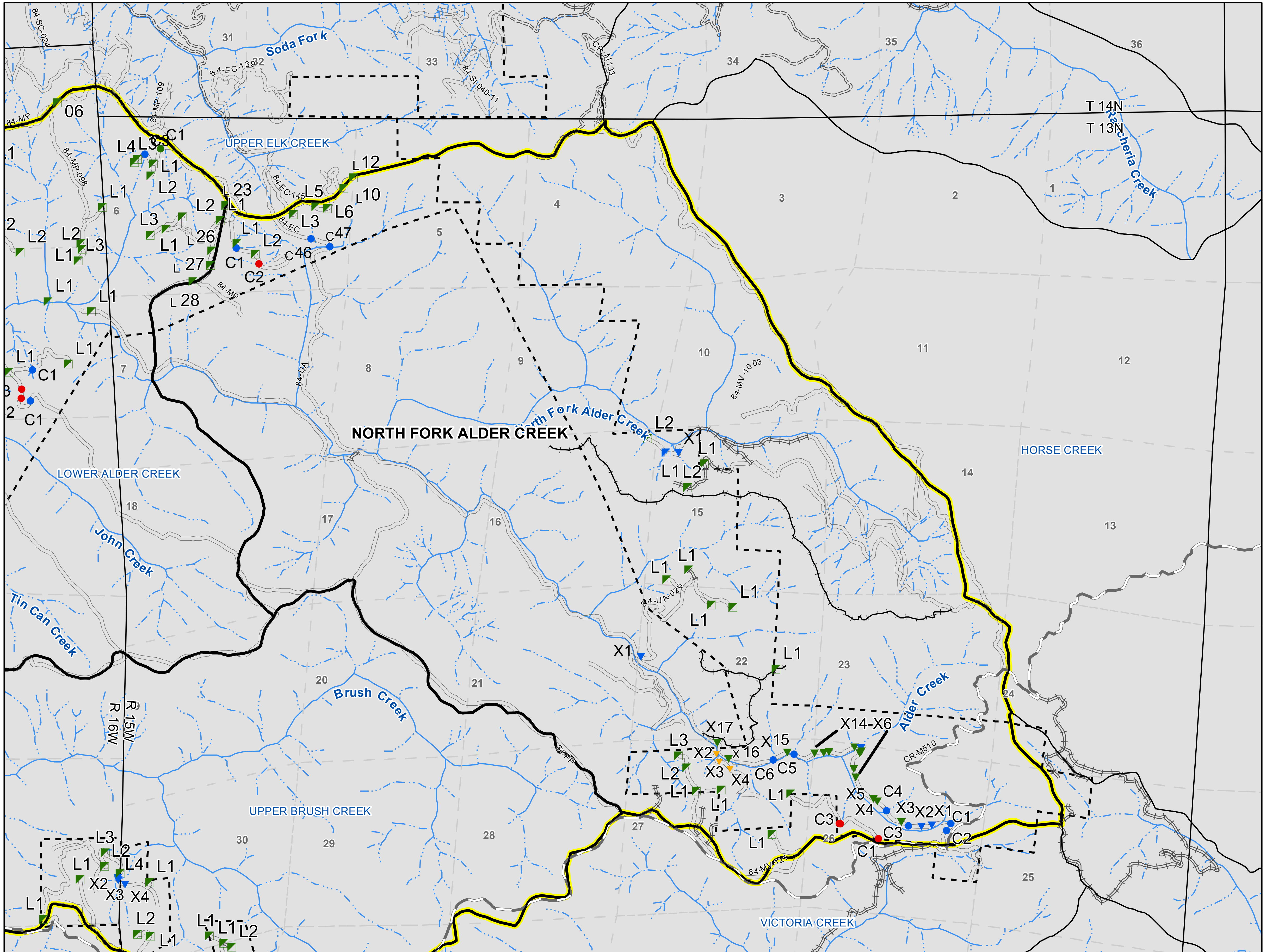
Flow Class

- Class I
- Class II
- Class III



0 0.5 1 Miles

April 2014



Southcoast Streams Watershed Analysis Unit

North Fork Alder Creek Planning Watershed

Map B-2 (c)
Road Feature Treatment Immediacy

This map presents select results from MRC's road inventory. The entire road network and road features were mapped using geographic positioning system (GPS) from 2006. For each feature with the potential to create erosion (culverts, landings, crossings) the treatment immediacy for the feature was assigned. The treatment immediacy represents the level of concern for either upgrading or maintenance to the feature.

Treatment Immediacy

Culverts	Crossings	Landings
high	high	high
moderate	moderate	moderate
low	low	low
none	none	none

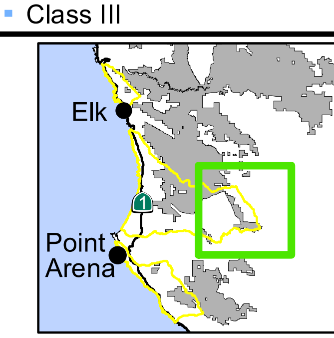
L = Landing; C = Culvert; X = Crossing

Road Surface

- Paved Road
- Rocked Road
- Native Road
- Jeep Trail
- Undetermined
- Decommissioned
- Historic
- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

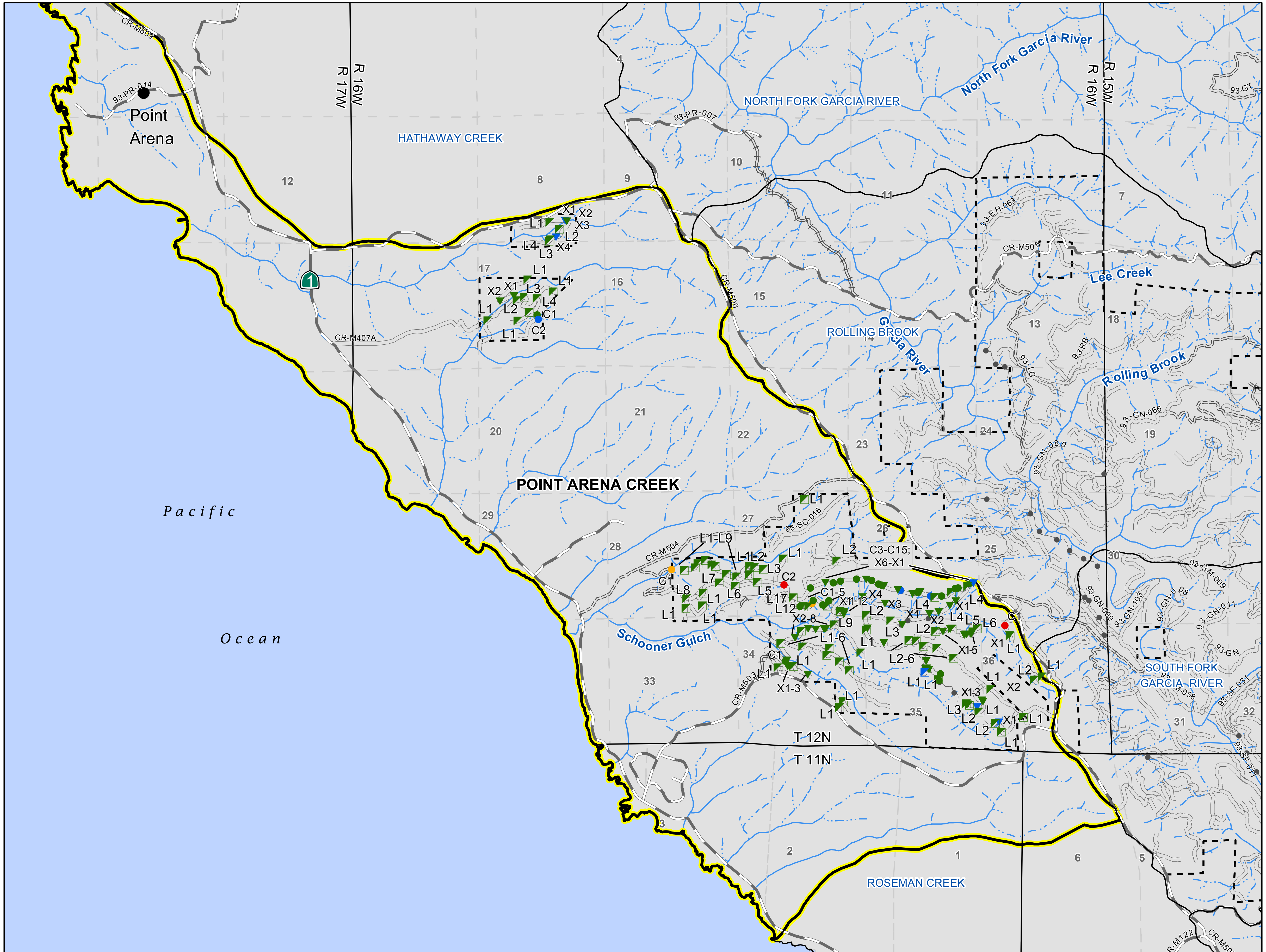
Flow Class

- Class I
- Class II
- Class III



0 0.25 0.5 Miles

April 2014



Southcoast Streams
Watershed Analysis Unit

Point Arena Creek
Planning Watershed

Map B-2 (d)
Road Feature
Treatment Immediacy

This map presents select results from MRC's road inventory. The entire road network and road features were mapped using geographic positioning system (GPS) from 2006. For each feature with the potential to create erosion (culverts, landings, crossings) the treatment immediacy for the feature was assigned. The treatment immediacy represents the level of concern for either upgrading or maintenance to the feature.

Treatment Immediacy

Culverts	Crossings	Landings
high	high	high
moderate	moderate	moderate
low	low	low
none	none	none

L = Landing; C = Culvert; X = Crossing

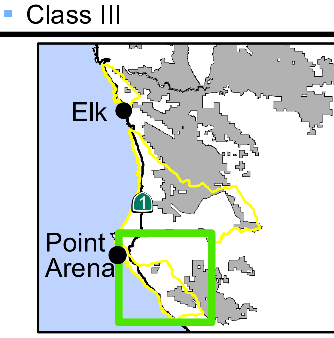
Road Surface

- Paved Road
- Rocked Road
- Native Road
- Jeep Trail
- Undetermined
- Decommissioned
- Historic

- MRC Ownership
- Planning Watershed Boundary
- Alder Creek/Schooner Gulch Watershed Analysis Unit Boundary
- 200' Contour Interval

Flow Class

- Class I
- Class II
- Class III



0 0.25 0.5 Miles

April 2014