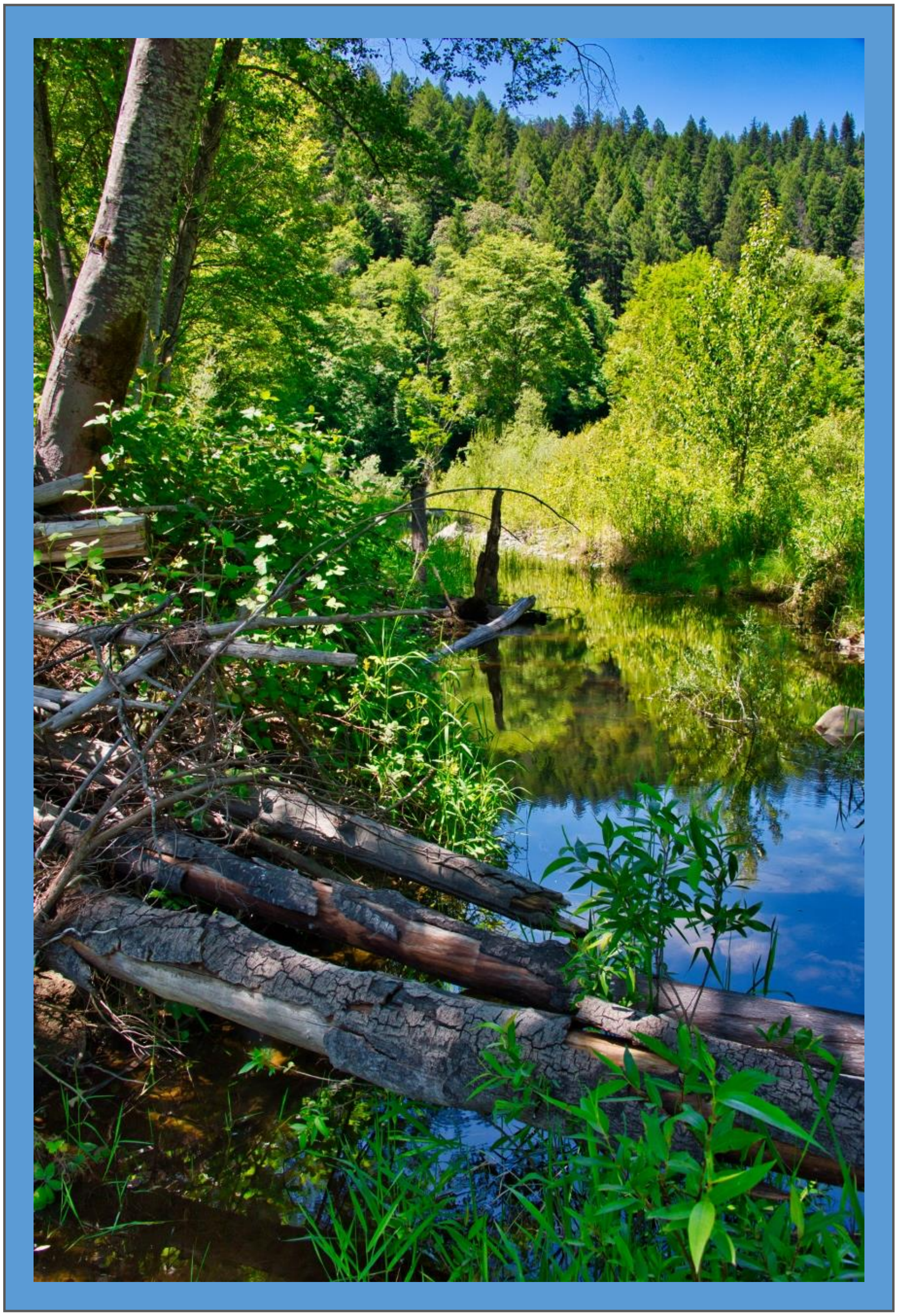
Landscape Level Restoration Gap and Trend Analysis for the Tributaries of the Trinity River, California



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1. Introduction

The Trinity River Watershed and its tributary subwatersheds have been analyzed and assessed for decades by different agencies for different reasons. This analysis examines subwatersheds within the Trinity River Watershed to assess and set restoration priorities. The existing plans, assessments and documents concerning the subwatersheds offer solid information on the attributes of the watersheds and past impacts. Depending on why and when each plan was completed, detailed restoration recommendations may or may not have been included in the final report. Many early assessments were completed by the US Forest Service with the goal of assessing the harvestable timber within the watershed. Others were written in response to devastating fires, while others were created to assess Total Maximum Daily Load (TMDL) criteria for listing the Trinity River as impaired with the Environmental Protection Agency.

For decades, *Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis* (August 1995, v. 2.2) provided guidance for thousands of natural resource professionals on what to include in a watershed analysis. The six key areas of analysis according to the *Federal Guide* are:

1) Characterization of the watershed; 2) Identifications of issues and key questions; 3) Description of current conditions; 4) Description of reference conditions; 5) Synthesis and interpretation of information; and 6) Recommendations.

This document seeks to create a new derivative of the old *Federal Guide* standards through GIS data analysis. As we are nearly two decades into the 21st century with incredible amounts of data easily accessible via the internet, the goal of this analysis is to include more information using larger scale datasets to look at watersheds on a landscape level and then zoom in to subwatersheds to view gaps and trends on a finer scale to create recommendations.

By combining some of the *Federal Guide* key areas, the analysis in this report is comprised of five sections:

1. Watershed Characteristics. This analysis focuses heavily on synthesis and interpretation of information gathered from multiple data sources and available in GIS, rather than only looking at current characterizations of the physical watershed. This section includes *"1) Characterization of the watershed"* and *"4) Description of reference conditions"* from the old Federal Guide.

2. Identification of Key Issues. Includes the traditional section "2) Identification of issues and key questions" but takes a slightly different tack. "Key Questions" are not formulated, but trends will be analyzed in section four. This section first reviews past impacts as these are typically the root of key issues. Then completed restoration projects are reviewed with GIS as they point to key issues that have been identified. Management recommendations from existing watershed assessments and stakeholder priorities are also reviewed in this section. The third section in the old Federal Guide *"Description of current conditions"* is viewed through the lens of past impacts on the landscape and is also covered in the Watershed Characteristics section (1).

3. Assessment of Possible Future Impacts. This section was not included under the old guidelines, but current GIS data on impacts of climate change and vulnerability are available and addressed in this analysis.

4. Analysis of Restoration Gaps and Trends. Reviewed at a landscape level and also by geographic region.

5. Restoration Project Recommendations. Project recommendations are based not only on data analysis, but also feedback from stakeholders, scientists, and surveys gathered by the Trinity County RCD.

For ease of use, sections are further divided for review by four geographic regions in the watershed: North Lake, Middle Trinity, South Fork, and Down River (Figure 1.1), allowing readers to focus in on particular regions.

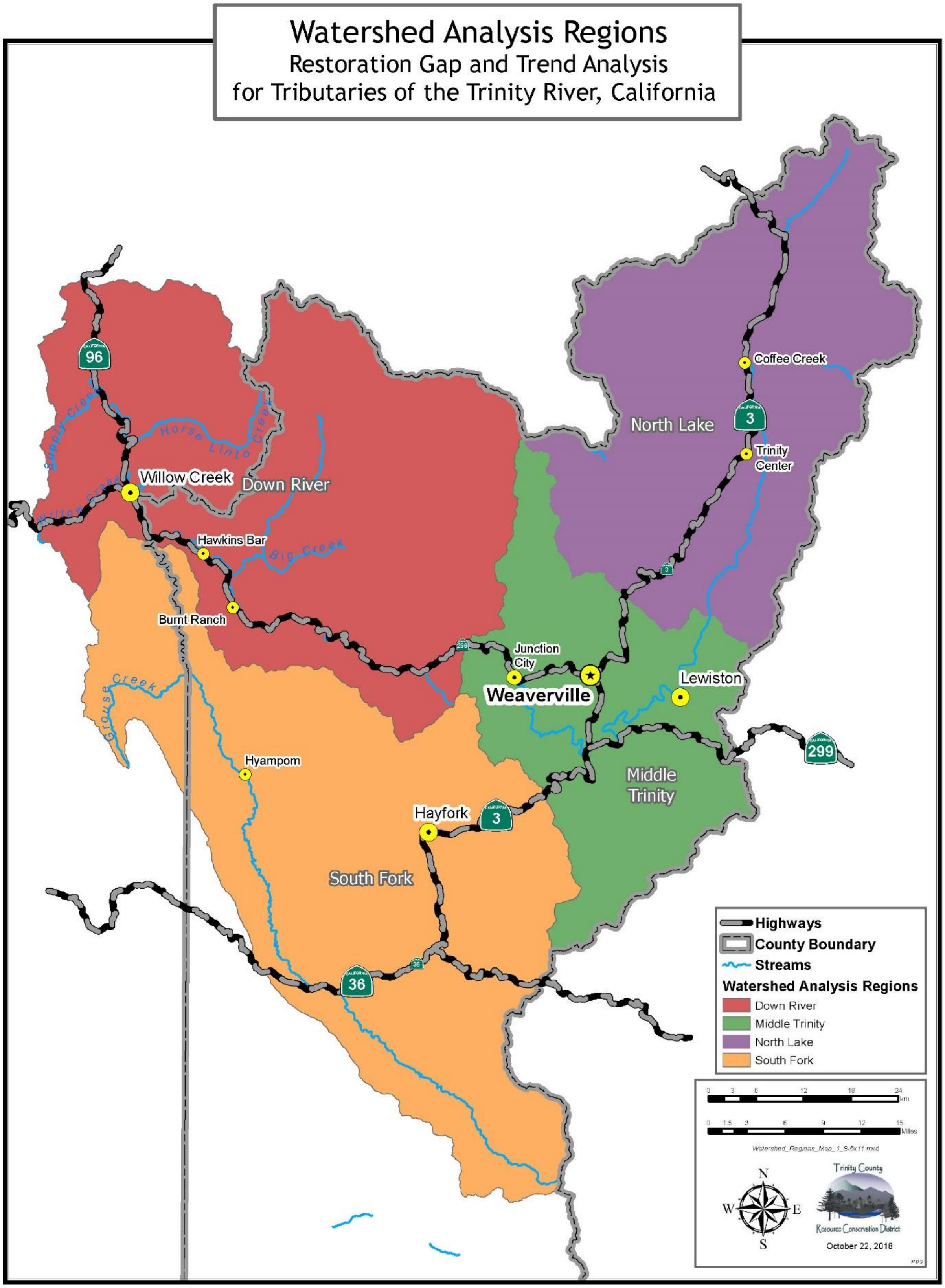


Figure 1.1 Watershed analysis regions.

An added outcome from surveying landscape level data and watershed plans is the creation of a web page containing documents regarding Trinity River tributaries and related information. Prior to this analysis, this data was spread across multiple websites from multiple agencies. It can now be found at the Trinity County Resource Conservation District's web page (www.tcrcd.net).

2. Need for Tributary Restoration and Analysis

Need for Restoration

The Society for Ecological Restoration (*www.ser.org, 2018*), offers an elegant definition for ecological restoration: "The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed." Due to enthusiastically egregious early gold mining and timber harvest practices, nearly every tributary in the Trinity River Watershed has seen some level of impact.

These impacts are recognized as affecting the health of the watershed, resulting in tributary restoration work which has been completed by several different agencies and organizations, including county, state, and federal agencies as well as special districts, tribal nations, and non-profit organizations.

Early efforts at restoration included riparian vegetation plantings and erosion control efforts in the 1980's and early 1990's. The earliest watershed assessments were completed around the same time. Often this early work, done with the best of intentions, was completed in a vacuum with little data and no view of impacts on the landscape level. Most of the earliest restoration work was not digitized.

Restoration work in the watershed has been driven by diminished and degraded salmonid habitat available in the mainstem due to dams and past impacts. These impacts led to several federal decisions and protection plans including the US Clean Water Act 303(d) listing of the Trinity River for excess sediment, setting a Total Maximum Daily Load (TMDL) recommendation; the Southern Oregon Northern California Coast Coho Recovery Plan (SONCC) to increase habitat for threatened and endangered coho (*O. kisutch)*; the USFS NW Forest Plan for managing multi-stage forests, water resources and northern spotted owl (*Strix occidentalis caurina*) habitat on national forests in Oregon, Washington and northern California. Many areas within tributary watersheds have been so badly damaged or destroyed that true restoration is an unattainable goal. In these destroyed areas of the watershed, natural resource professionals look to perform some form of rehabilitation for return of hydraulic function, connectivity and ecosystem health, even at a localized level.

Need for Analysis

Restoration work in the Trinity River tributaries has been driven by priorities outlined in past road inventories, threatened and endangered species recovery plans and watershed assessments, including TMDLs, and available funding. Much of the completed work is tied to improving salmonid fisheries in the watershed.

All of the existing priorities and completed projects are valuable in and of themselves. However the availability of databases that go beyond the scope of fisheries provide critical tools to extend the analysis. The goal of this analysis is to discover how past projects in each subwatershed can be linked together with commonalties found in GIS datasets to map trends and inform future priorities.

Another goal of this analysis is to look beyond salmonid concerns to habitat connectivity, source water, critical biodiversity areas, and create a more holistic view of the watershed. Using large datasets, including climate change vulnerabilities, we are able to view resiliency from a landscape level rather than by subwatershed. This restoration gap and trend analysis provides a keystone for future analyses to be built upon using GIS to observe emerging patterns on a landscape level, while still recognizing the unique values found in each subwatershed.

3. Approach

The year 2000 was chosen as the starting date to analyze completed restoration projects for several reasons. Much of the funding provided for restoration projects was driven by several legal actions that took place around 2000: the signing of the Bureau of Reclamation Record of Decision in 2000 establishing the legal impetus for river restoration on the Trinity River; the establishment of the Trinity River Total Maximum Daily Load (TMDL) for sediment in 2001 and the South Fork and Hayfork Creek TMDL in 1998; and the 2004 California Coho Recovery Strategy.

This plan relies heavily on Geographic Information System (GIS) analysis. GIS is a software program used to store, analyze and present geographical data in a visual format.

GIS capability has advanced exponentially since the year 2000. Many state and federal agencies use GIS to analyze current ecosystem function and health, and develop possible future conditions based on various inputs. These newly available government data and analyses, along with data that has been collected by local agencies, will help guide priorities for restoration work in the Trinity River tributary subwatersheds into the future. The drawback of having access to all of this available GIS data is that there is more available than can be analyzed at one time. All of the GIS data created and analyzed for this project is available to the public for on-going analysis on future projects. It is intended as a starting point for others to use in future analysis with different data sets.

The Hydrologic Unit Code (HUC) is a system used by US Geological Survey to catalog the size of watersheds. This analysis reviews Trinity River Watershed data at the HUC 6 subwatershed level. Selected HUC 7 subwatersheds in Weaver Basin and Conner Creek are also included due to the of amount of restoration work completed there.

Information regarding the mainstem Trinity River can be found at www.TRRP.net, in the data portal section. The Trinity River Restoration Program (TRRP) website houses a vast amount of restoration data on the mainstem Trinity River and background on the watershed as a whole.

Guidance and input from members of the Trinity River Watershed Council helped inform this analysis, including individuals from the following agencies: 5C Salmonid Conservation Program, California Department of Fish and Wildlife, Hoopa Valley Tribe, Natural Resources Conservation Service, Trinity County Department of Planning, Trinity County Resource Conservation District, Trinity River Restoration Program, US Forest Service, Shasta-Trinity National Forest, Watershed Research and Training Center, and the Yurok Tribe.

The initial impetus for this project was to view where restoration projects had already been completed within Trinity River subwatersheds. It took a great deal of time to gather, clean, and integrate that information into one dataset for this analysis. It is now available as a GIS file, with project locations included by subwatershed, but not precisely located within the subwatershed, as geolocation data was not available for all completed projects. Watershed characteristics, key issues, and possible future impacts provide context for the completed projects.

Due to the remote locations and rugged terrain in the Trinity River Watershed, not all of the tributary watersheds have data available. This becomes obvious when reviewing the GIS maps. It can be assumed that most remote subwatersheds have fairly healthy ecosystems, but not all maps reflect this because monitoring data has yet to be collected.

In the past, restoration efforts have focused on a literal translation of salmonid habitat – in-stream restoration and passage removal projects, sediment reduction through upland road work, revegetation for both sediment reduction and riparian cooling. Recommendations in plans still focus on these areas – as they are needed and effective – but this analysis attempts to include a more holistic approach to watershed rehabilitation.

This analysis is a starting point for reviewing current gaps and trends. As more data becomes available, more specific trends can be teased from the information by other interested parties. All GIS files, data and layers used in this analysis are available for public use upon request. A web-based interactive map is available at tcrcd.net.

4. Analysis of Data

This section provides a compilation of the available data for all of the subwatersheds in the Trinity River Watershed. It was sourced from multiple agencies, and in some instances researched and compiled specifically for this report.

Watershed Characteristics (4.1) Provides an overview of geography, climate, soils, vegetation, wildlife and fisheries complimented by unique GIS maps for each region. These characteristics are often reviewed in great detail in traditional watershed assessments. Rather than re-hashing existing information, links are provided for readers who wish to review existing watershed assessments in further detail.

Unique characteristics for each of the four regions includes GIS maps and analysis for land ownership; terrestrial rare species and connectivity; terrestrial game species and connectivity; aquatic significant habitat and native species richness; aquatic significant habitat with coho Intrinsic Potential (IP) and observed range; Total Maximum Daily Load (TMDL) reference streams as set by the US Environmental Protection Agency, and measured dissolved oxygen (DO); salmonid counts in select subwatersheds; and change in watershed condition and observed August stream temperatures. The data used to create the watershed characteristics maps were sourced from local, state and federal agencies.

Identification of Key Issues (4.2) Identification of key issues is established by analyzing four critical information areas key to assessing the state of the watershed and the need for future restoration. These critical areas are:

A. Past impacts - Covers impacts from mining, land use and planning, wildfire, and cannabis cultivation with maps analyzing each of these impacts.

B. Completed restoration projects – Covers completed restoration work based on geographic location by subwatershed. Completed restoration projects are an indicator of key issues in the watersheds as they illustrate what funding agencies have shown to be their top priorities by approving work on these projects.

C. Watershed assessments – Covers a review of “management recommendations” and priorities as listed in watershed assessments and analysis completed for subwatersheds since 2000.

D. Stakeholder priorities – Covers information gathered from public outreach events, surveys, major restoration project funders, and members of the Trinity River Watershed Council.

Assessment of Possible Future Impacts (4.3) Relies heavily on a report written in 2012 for the Shasta Trinity National Forest on vulnerability of the forest to climate change. Another plan written in 2011 focuses on the county. As such, neither document covers the entire watershed, but both provide good guidance for adaptation and resiliency planning.

4.1 Watershed Characteristics

This analysis focuses heavily on synthesis and interpretation of GIS data gathered from multiple data sources, rather than looking at current characterizations of the physical watershed. A brief overview of traditional watershed characteristics is provided here, followed by in depth review of data and discussion of the watershed characteristics in each of the four regions. All maps in this section are available as a high resolution pdf and also as ARC GIS shape files. Please request files from the TCRCD GIS manager.

Overview Watershed Characteristics

A quick summary of the overall watershed character is quoted from the US Environmental Protection Agency's 2001 "Trinity River Total Maximum Daily Load for Sediment" document:

> *"The Trinity River is the largest tributary to the Klamath River, draining an area of approximately 3,000 square miles. The Trinity River has historically been recognized as a major producer of chinook and coho salmon and steelhead trout. The terrain is predominately mountainous and forested, with elevations ranging from over 9,000 feet above sea level in the headwater areas, to less than 300 feet at the confluence with the Klamath River. The majority of the basin (approximately 70%) is under public ownership, including the Trinity Alps Wilderness areas, the Shasta-Trinity National Forest, Six Rivers National Forest, Bureau of Land Management, Bureau of Reclamation, and various state and county entities. The Hoopa Valley Tribe occupies 144 square miles of the lower basin, while industrial timber companies and other private landowners make up the remaining portions of the basin.*
>
> *Several geologic strata transect the basin including the Eastern Klamath Subprovince, Central Metamorphic Subprovince, Hayfork Terrain, Galice Formation, and others. Land use activities in the Trinity include mining, timber harvesting, road construction, recreation and a limited degree of residential development in certain locations. The construction of Trinity and Lewiston dams in the early 1960's had and continues to have a major impact on the flow, function and use of the Trinity River."*

Climate

Located in a Mediterranean climate, the watershed receives the majority of its precipitation between October and April. Precipitation levels have not remained true to historical norms and the watershed is facing increased pressure from climate change. See section 4.3 to review possible future impacts from climate change.

Temperatures can range from the low teens in a harsh winter, up to 112 F during a brutally hot summer. Dry summers with westerly winds make the watershed ripe for wildfire. The temperature ranges listed below are based on averages in Weaverville and do not reflect the wild swings in temperature that regularly happen within the watershed nor the precipitation variation between higher and lower elevations.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F:	48	55	61	67	77	85	94	94	87	75	56	46
Average low in °F:	31	31	33	36	42	47	52	50	44	38	33	31

Average annual precipitation – rainfall: 38.82 inches; Average annual snowfall: 8 inches. Source: www.usclimatedata.com

Soils

Soils play an integral role in watershed health. As this watershed covers approximately 3,000 square miles, the soils are as varied as the terrain. An entire report could be written only about the soils. Individual subwatershed assessments provide details on soils for those specific regions. They are located on the Trinity County Resource Conservation District website.

A wealth of soils information is also available online from the Natural Resources Conservation Service. The database is referred to as SSURGO – Soils Survey Geographic Database and is located on the web at https://websoilsurvey.nrcs.usda.gov/. Figure 4.1 provides a glimpse of the geologic complexity within the watershed.

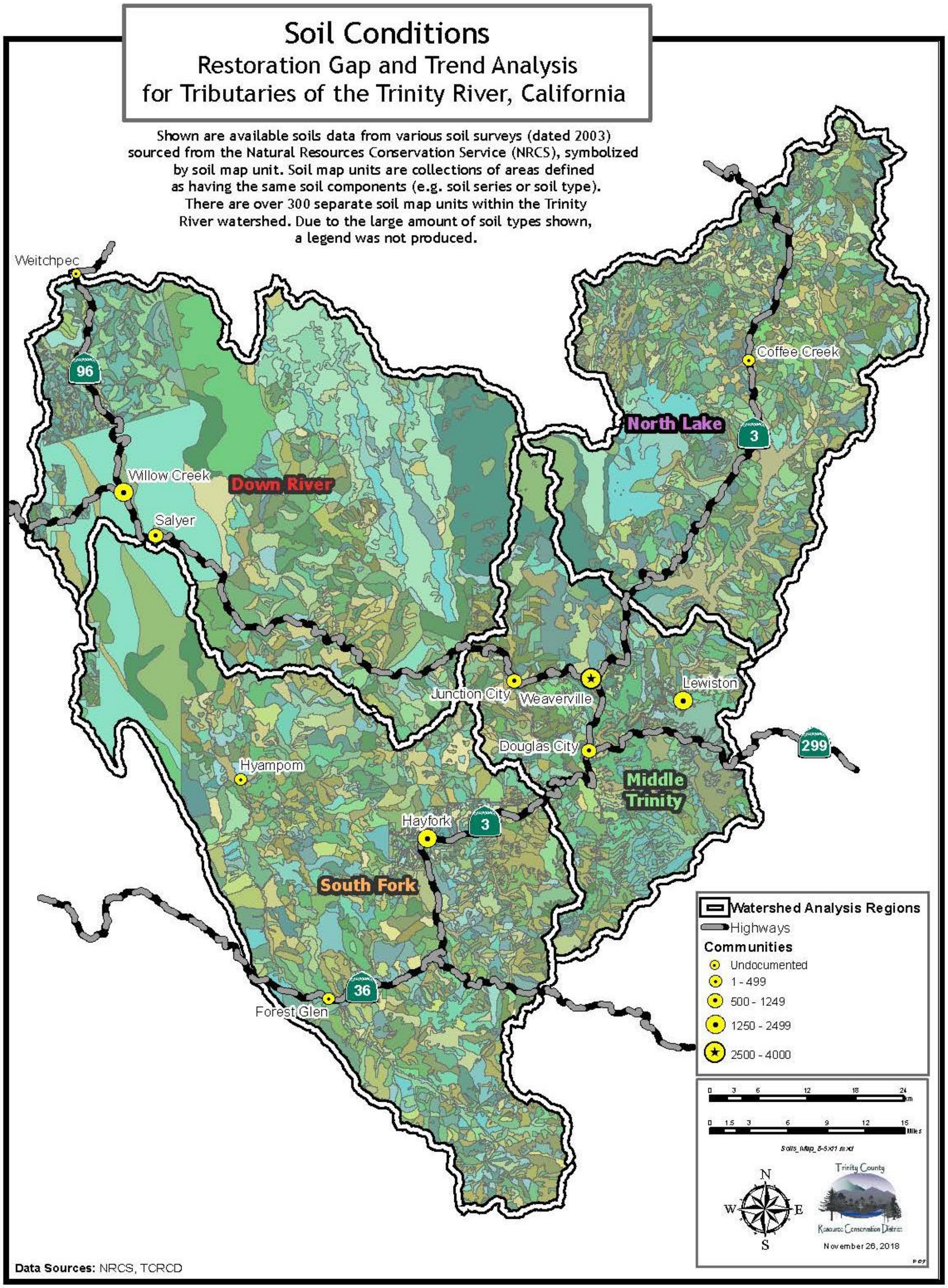


Figure 4.1 Soil conditions within the Trinity River Watershed.

Vegetation

The watershed is part of the Klamath-Siskiyou bioregion, and includes one of the most diverse coniferous forests on earth. Mixed conifer/fir forests dominate the area, with a small population of Port Orford cedar *(Chamaecyparis lawsoniana*) in the north lake region of the watershed. It is the only population on the west coast that is not infected with the Port Orford root disease (*Phytophthora lateralis*), and the Shasta-Trinity National Forest engages in management actions to keep this population healthy (USFS, Pacific SW Region, 2006).

Mixed hardwood and shrub lands are found within the watershed at lower elevations.

The watershed and Klamath-Siskiyou region is home to many endemic plant species. A comprehensive list is available on the Humboldt State University's digital commons website, written by James P. Smith Jr. : http://digitalcommons.humboldt.edu/botany_jps/66.

Wildlife

According the California Department of Fish and Wildlife (CDFW), this watershed contains diverse populations of wildlife species (Table 4.1).

Type	Number of species
Amphibians	7
Birds	150
Mammals	62
Reptiles	19

Table 4.1. Number and type of wildlife species in the Trinity River Watershed. Source: CDFW.

Of the 238 different wildlife species, 17 are considered rare in the state. Table 4.2 shows California rare wildlife species in the Trinity River Watershed, either observed or expected to be present based on modeling.

Scientific Name	Common Name	Observation	Model	Rare	Type
Rana boylii	foothill yellow-legged fro	Y	Y	Y	Amphibian
Ascaphus truei	coastal tailed frog	N	Y	Y	Amphibian
Juncus dudleyi	dudley's rush	Y		Y	Bird
Strix occidentalis caurina	northern spotted owl	Y		Y	Bird
Strix occidentalis occidentalis	california spotted owl	Y		Y	Bird
Haliaeetus leucocephalus	bald eagle	N	Y	Y	Bird
Asio otus	long-eared owl	N	Y	Y	Bird
Chaetura vauxi	vaux's swift	N	Y	Y	Bird
Contopus cooperi	olive-sided flycatcher	N	Y	Y	Bird
Progne subis	purple martin	N	Y	Y	Bird
Lanius ludovicianus	loggerhead shrike	N	Y	Y	Bird
Setophaga petechia	yellow warbler	N	Y	Y	Bird
Melospiza melodia	song sparrow	Y	Y	Y	Bird
Lepus americanus klamathensis	oregon snowshoe hare	Y		Y	Mammal
Pekania pennanti	fisher - west coast dps	Y		Y	Mammal
Taxidea taxus	american badger	N	Y	Y	Mammal
Actinemys marmorata	western pond turtle	Y	Y	Y	Reptile

Table 4.2 Rare species in the Trinity River Watershed. Source: CDFW ACE database.

The foothill yellow-legged frog was listed as a candidate endangered species in California by CDFW in June 2017. It is locally abundant throughout the lower elevations in the Trinity River Watershed.

Game species

The game species referred to in this analysis and shown on maps are based on those included in the CDFW Areas of Conservation Emphasis (ACE) dataset, which includes either observed species and/or those expected to be present based on modeling (Table 4.3).

Scientific Name	Common Name	Game	Type
Anas acuta	northern pintail	Y	Bird
Anas penelope	eurasian wigeon	Y	Bird
Anas platyrhynchos	mallard	Y	Bird
Anas strepera	gadwall	Y	Bird
Aythya affinis	lesser scaup	Y	Bird
Branta canadensis	canada goose	Y	Bird
Callipepla californica	california quail	Y	Bird
Oreortyx pictus	mountain quail	Y	Bird
Patagioenas fasciata	band-tailed pigeon	Y	Bird
Zenaida macroura	mourning dove	Y	Bird
Cervus elaphus	elk	Y	Mammal
Odocoileus hemionus	mule deer	Y	Mammal
Ursus americanus	black bear	Y	Mammal

Table 4.3 Game species in the Trinity River Watershed represented in GIS maps. Source: CDFW ACE database.

Fisheries

For thousands of years the anadromous fish of the watershed, steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and Chinook salmon (*O. tshawytscha*) and lamprey (*Entosphenus spp.)*, spent their adult lives in the Pacific, returned to spawn in the fresh waters of the watershed and then a new generation returned to the ocean to complete the cycle. Past impacts (see Section 4.2) included overfishing, timber harvest, mining, and water diversions and had major impacts on the fisheries of the watershed. Construction of the Trinity Dam in 1963 blocked approximately 109 miles of anadromous habitat where the salmon had previously spent the summer in cool pools. The dam nearly killed off the struggling natural populations, and the coho have yet to recover.

The Trinity River Hatchery produces steelhead, coho and Chinook salmon for release into the river. Subwatersheds above the dam support some stocked fish not found below the dam. Some subwatersheds below the dam support healthy populations of anadromous fish. Summer snorkel surveys have been conducted for several decades to count salmon in Canyon Creek, North Fork Trinity River, New River, South Fork Trinity River and Hayfork Creek.

Known native and non-native fish in the subwatersheds above and below the dam are listed in Table 4.4.

TRINITY LAKE	Scientific name
Chinook Salmon	*Oncorhynchus tshawytscha*
Kokanee Salmon	*Oncorhynchus nerka*
Brown Trout	*Salmo trutta*
Rainbow trout	*Oncorhynchus mykiss*
Smallmouth Bass	*Micropterus dolomieui*
Largemouth Bass	*Micropterus salmoides*
Brown Bullhead	*Ictalurus nebulosus*
White Catfish	*Ameiurus catus*
Green Sunfish	*Lepomis cyanellus*
Sucker	*Catostomus spp.*
Lamprey	*Entosphenus spp.*

ALPINE LAKES	Scientific name
Brown Trout	*Salmo trutta*
Brook Trout	*Salvelinus fontinalis*
Rainbow Trout	*Oncorhynchus mykiss*

ALL OTHER	Scientific name
Steelhead and resident trout	*Oncorhynchus mykiss*
Chinook salmon	O. *tshawytscha*
Coho salmon	*O. kisutch*
Klamath speckled dace	*Rhinichthys osculus klamathensis*
American shad	*Alosa sapidissima*
Brook trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Coast range sculpin	*Cottus aleuticus*
Lamprey	*Entosphenus spp.*
Klamath smallscale sucker	*Catostomous rimiculus*
Northern green sturgeon	*Acipenser medirostris*

Table 4.4 Native and non-native fish in the Trinity River Watershed. Source: CDFW

Watershed Characteristics Data Interpretation

Data for watershed characteristics was sourced from the California Department of Fish and Wildlife, California State Water Boards, National Oceanic and Atmospheric Administration, US Forest Service, personal communications, and several watershed assessments. Each source is credited on individual maps.

The California Department of Fish and Wildlife's Areas of Conservation Emphasis (ACE) maps and data provide a coarse-level view of information summarized in a standard 2.5 square mile hexagon grid format for terrestrial terrain and hydrologic units at the 12-digit code level (HUC 12) for the aquatic ecosystems. For a full explanation of the ACE datasets, see: https://www.wildlife.ca.gov/Data/Analysis/ACE#523731769-overview.

Caveats: All ACE data layers are limited by the accuracy, scale, extent of coverage, and completeness of the input data at the time they were run. It is apparent from some of the data fields that information is lacking in some layers. Many subwatersheds in the wilderness areas show no or low numbers of animal species and richness. Due to that lack of data, the decision was made to use the following datasets, which seem to better reflect the local knowledge of these subwatersheds.

ACE Terrestrial Connectivity Rank: this dataset summarizes information per hexagon including the presence of mapped corridors or linkages; the juxtaposition to large, contiguous natural areas; and the relative intactness score.

ACE Terrestrial Rare Species Richness Summary – Rare Species Count: This is a sum of the estimated numbers of rare California amphibian, reptile, bird, mammal and plant species within the shown hexagon.

ACE Terrestrial Native Species Richness – Native Game Species Count: This is a sum of the estimated numbers of game species that could potentially be found in this hexagon. It does not include all game species recognized by CDFW, and includes only those listed in Table 4.3.

ACE Aquatic Significant Habitats Rank - Ranks of 1-5 assigned to the statewide normalized aquatic significant habitat values, with all zero values removed and remaining values broken into 5 quantiles, each containing the same number of HUC 12 watersheds.

ACE Aquatic Native Species Richness Summary – Native aquatic species data was chosen over rare species data (as was used in the terrestrial analysis) because it includes both common and rare species. The dataset represents broad-based patterns and is limited by the accuracy and scale of input data. Counts are based on potential habitat models, not actual counts. models were based on expert-opinion species-habitat relationship tables, which may vary in accuracy based on the how well-studied a species is. The species-habitat relationship tables were made spatial by applying the information to the "best available" vegetation map. The set of species in a watershed includes those that could potentially occur within the area, but it is not likely that all would be found at any one time.

The aquatic invertebrate data is based on counts from monitoring results. This data was retrieved from the California Environmental Data Exchange Network (CEDEN) , which in turn came from the State Water Boards' Surface Water Ambient Monitoring Program (SWAMP). Several areas in this watershed have no aquatic invertebrate data. These subwatersheds show no aquatic invertebrate counts on the maps, but if fish are likely to be present, so are aquatic invertebrates. The rest of the data represents a count of the total number of aquatic species potentially present in each watershed based on species range and distribution information. Data for aquatic members of other taxonomic groups, including plants, mammals and birds have not yet been included in ACE.

California State Water Boards

California Environmental Data Exchange Network (CEDEN) Dissolved Oxygen (DO) actual data monitoring.

National Oceanic and Atmospheric Administration

Coho Intrinsic Potential (IP) is determined by calculating the weighted geometric mean of indices for mean annual discharge, channel gradient, and channel constraint. These are derived from 10 m Digital Elevation

Model (DEM) and PRISM (climate data sets - http://prism.oregonstate.edu/) precipitation data. The closer to 1.0, the higher the potential for suitable habitat. Figure 4.2 provides the coho IP data for the entire watershed. It will also be represented in the sections on the regional watershed characteristics.

US Forest Service

Northern spotted owl and marbled murrelet critical habitat areas are based on surveys of USFS managed properties. Due to the “checkerboard” ownership between the USFS and private timber concerns, the surveyed habitat follows the USFS property lines in many areas of the watershed. It is doubtful that the birds follow those exact lines.

Yurok Tribal Fisheries

This data set includes summer snorkel survey data for Canyon Creek, North Fork Trinity River, New River, South Fork Trinity River and Hayfork Creek. The Hayfork Creek counts are inconsistent by reach and will be analyzed with charts rather than maps. Fish counts for steelhead, ½ pounders (steelhead under 16” total length), Chinook and Jacks (Chinook under 22” total length) were typically conducted in late July through August. To analyze the data, the counts for steelhead and ½ pounders have been combined under “steelhead” counts; Chinook and Jacks have been combined under “Chinook”. Data from 2000-2017 is analyzed on a reach by reach basis for only steelhead for the four rivers, as the numbers are considerably higher than Chinook and converting this data for use in GIS is time intensive. The reach data is furthered aggregated by averaging together 4-5 years’ worth of counts into the following groups: 2000-2003, 2004-2007, 2008-2012 and 2013-2017. Reaches were digitized and then average counts for each of the four groups are compared for each reach on the map. Chinook numbers are analyzed with charts.

There were no surveys due to drought or fires during the following years in the following watersheds:

Canyon Creek: 2014, 2015
North Fork Trinity River: 2008
New River: 2015
South Fork Trinity River: 2015

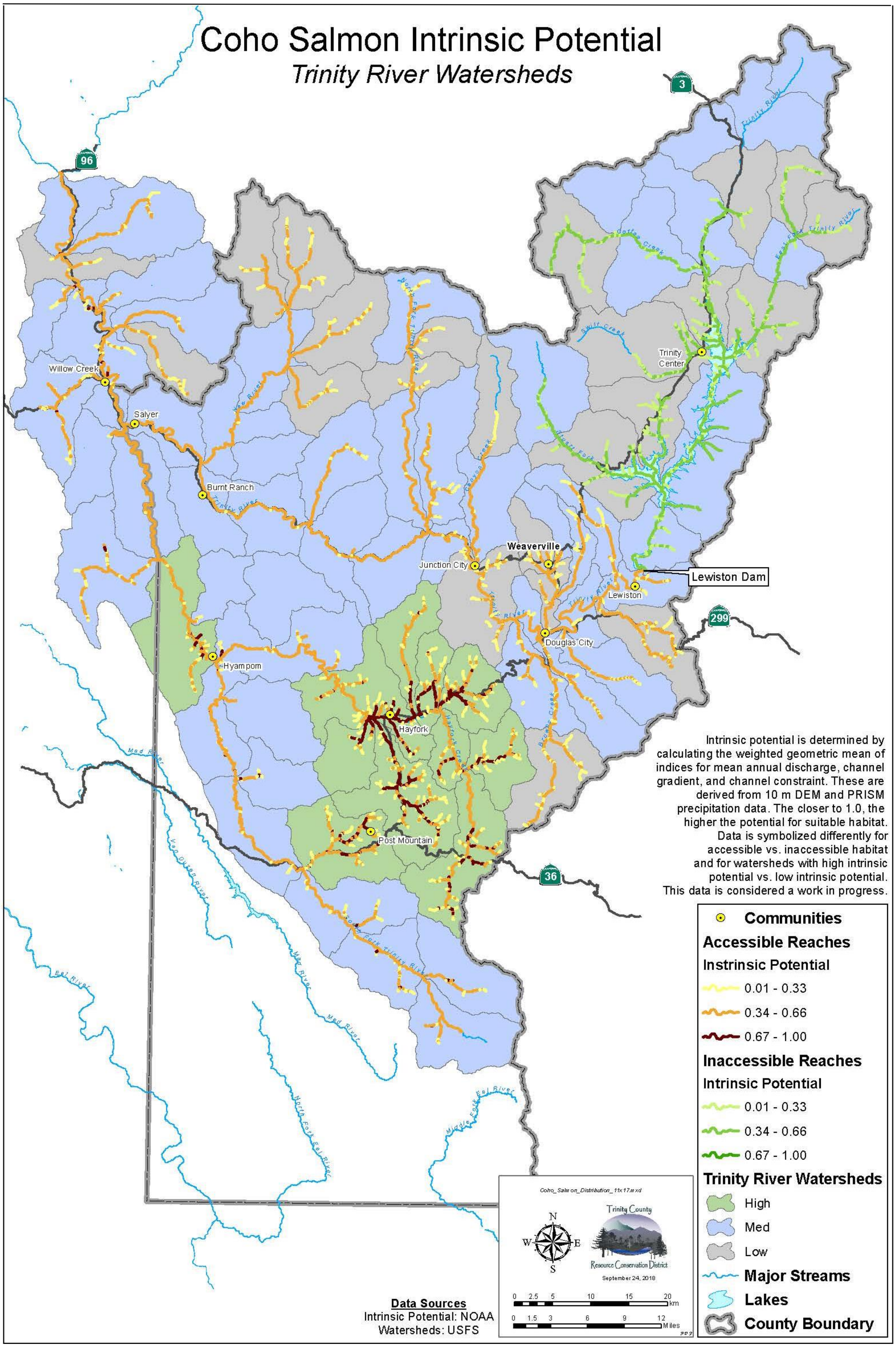


Figure 4.2 Coho Intrinsic Potential in the Trinity River Watershed. Note: the green, blue and gray symbology for the subwatersheds represents the same data as shown in the stream reaches, only averaged.

4.1.1 North Lake Watershed Characteristics

Land Ownership

Property ownership in this section of the watershed is almost 70% public lands managed by the US Forest Service. Over 26% is owned by private timber companies, with under 4% held by private citizens (Table 4.5 and Figure 4.3).

Ownership	Acres	Percent of Watershed
U.S. Forest Service	308,559	69.70
Private Timber Lands	117,114	26.40
Private (other)	15,888	3.60
Non-Private (county or state)	1,034	0.20
Bureau of Land Management	27	0.01

Table 4.5 North Lake region land ownership. Source: Trinity County RCD.

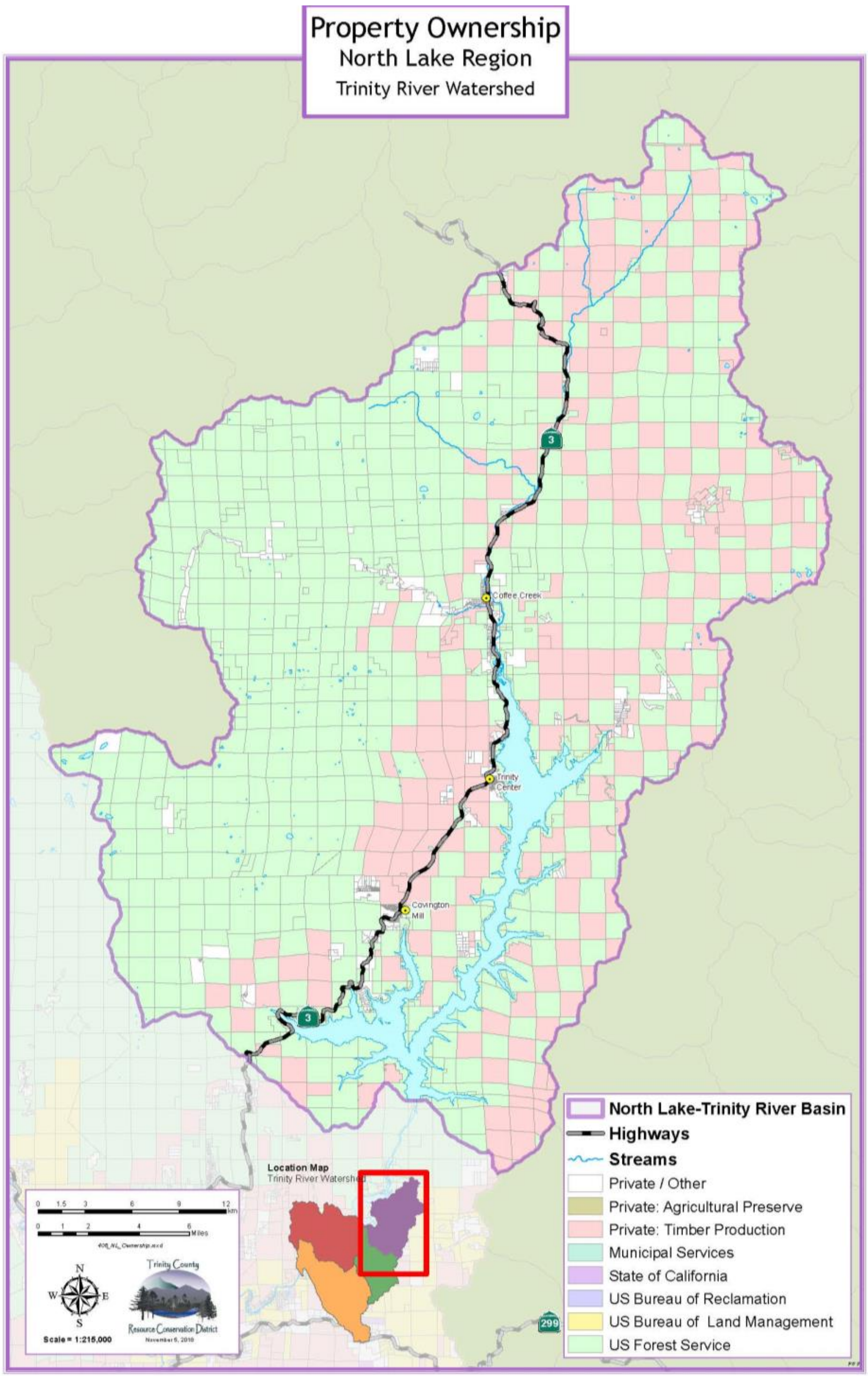


Figure 4.3 North Lake region land ownership.

Terrestrial Watershed Characteristics

The North Lake region of the watershed shows high connectivity in the subwatersheds abutting and containing the Trinity Alps Wilderness Area at the western edge of this region (Figure 4.4).

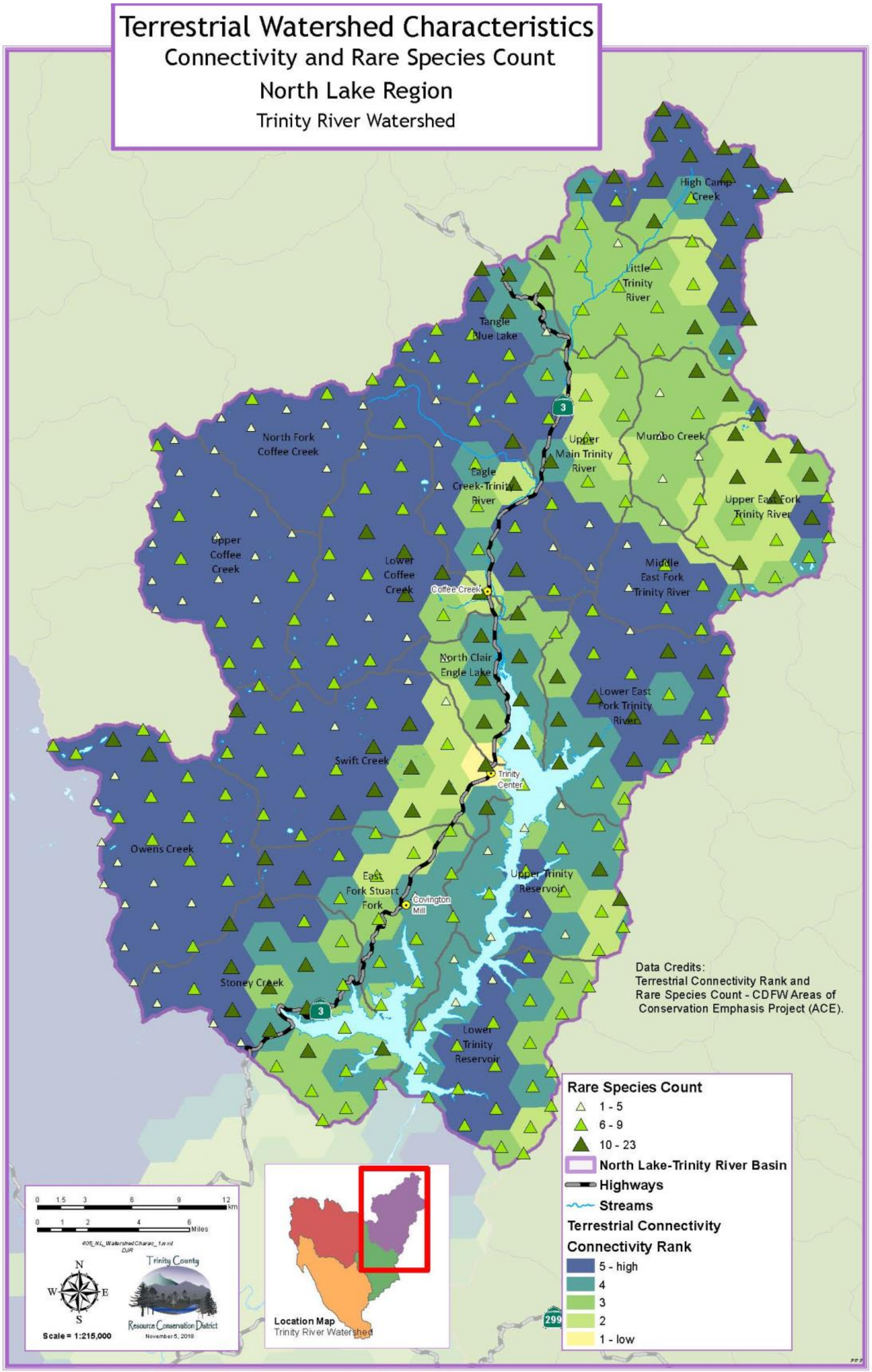


Figure 4.4 North Lake region terrestrial connectivity and rare species count.

With elevations generally rising as the subwatersheds go into the Trinity Alps Wilderness Area in the west, it is interesting to note the rare species counts trend higher in the mid-range elevations. Although this trend could be due to lack of data, or a combination of both elevation and data gaps.

Areas around the lake and the highway offer lower connectivity due to human impacts and property ownership on the west side of the lake, with the exception of a pocket of medium-high connectivity, rare species count, and critical northern spotted owl habitat between Covington Mill and the lake.

The east side of the lake provides good connectivity and nearly continuous northern spotted owl (NSO) critical habitat (Figure 4.5). The Upper Trinity River Watershed Report (TCRCD, 2004), states that there is a US Forest Service Wildlife Habitat Management area in the Bonanza King area, between Hwy 3 and the East Fork Trinity River. This area is directly east of Coffee Creek, as Bonanza King is at the point where the five watersheds come together (Eagle Creek-Trinity River, Upper Main Trinity River, Middle East Fork Trinity River, Lower East Fork Trinity River, and North Clair Engle Lake). The rare species count is low in this area according to the CDFW data, but without recent harvests and the required surveys, the species could be there. A continuance of NSO critical habitat could easily reach across this highly connected habitat area, connecting the north and south surveyed areas.

The far northern reaches of the watershed in High Camp Creek offer both high terrestrial connectivity and high rare species counts, despite the “checkerboard” property ownership between USFS and private timber concerns. The headwaters of the Trinity River lie in this area.

The swath of land covering Little Trinity River, Mumbo Creek and Upper East Fork Trinity River subwatersheds covers more “checkboard” ownership with mid-range connectivity and high to mid-range rare species counts (Figure 4.4). The low rare species counts represented in this area are likely due to inaccessibility to private lands or from estimating impacts from past timber harvests.

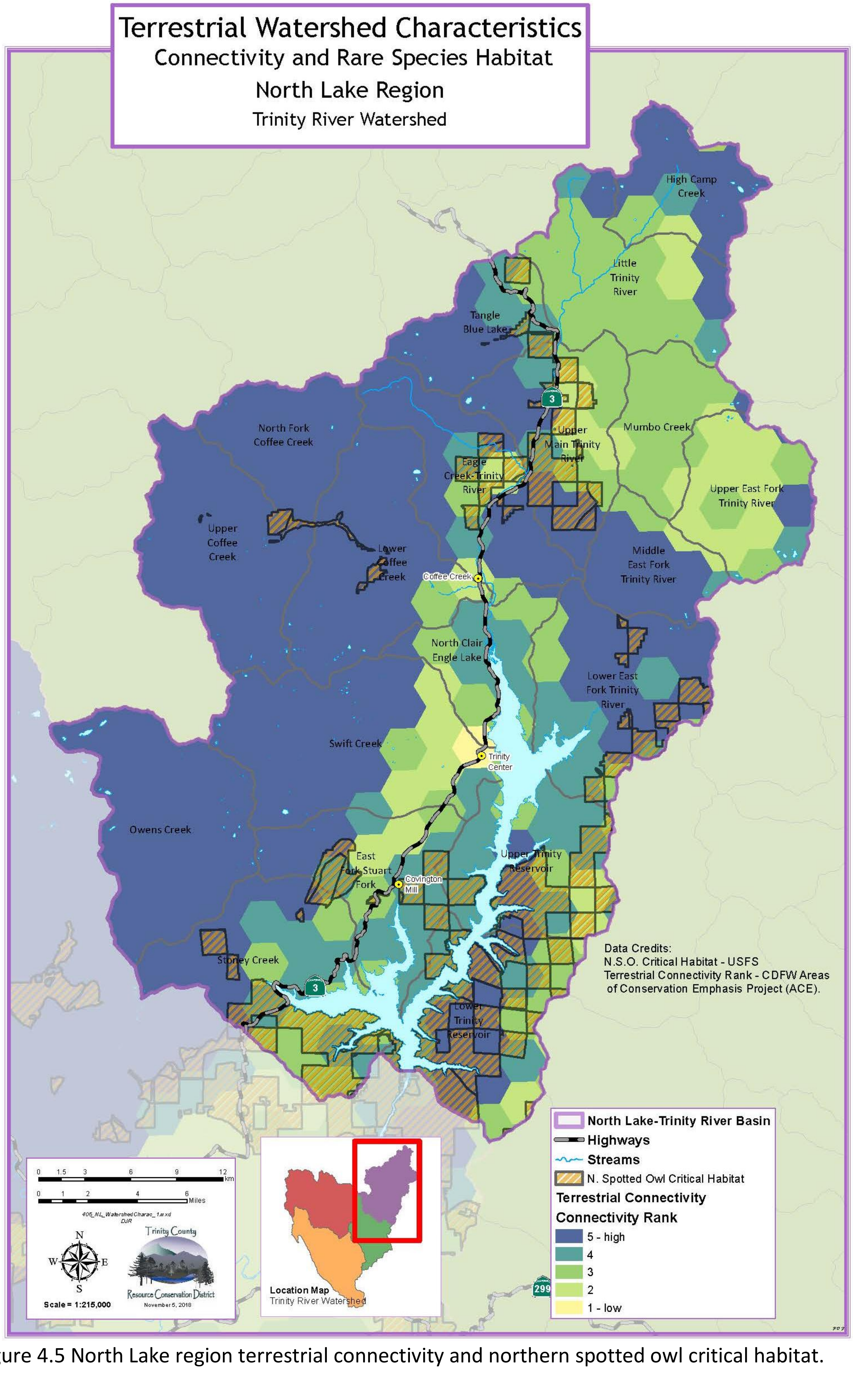


Figure 4.5 North Lake region terrestrial connectivity and northern spotted owl critical habitat.

The trend for game species abundance is obvious in the North Lake region (Figure 4.6), with highest numbers of game species living near the water. The game species list contains 10 birds, with several waterfowl species on the list. Hunters often prefer to go near the “checkboard” properties, as deer and elk need new growth for forage found on harvested properties. All of the North Lake region contains some form of game species, as the lowest number per hexagon is six. Please see Table 4.3 for the game species included in this data set.

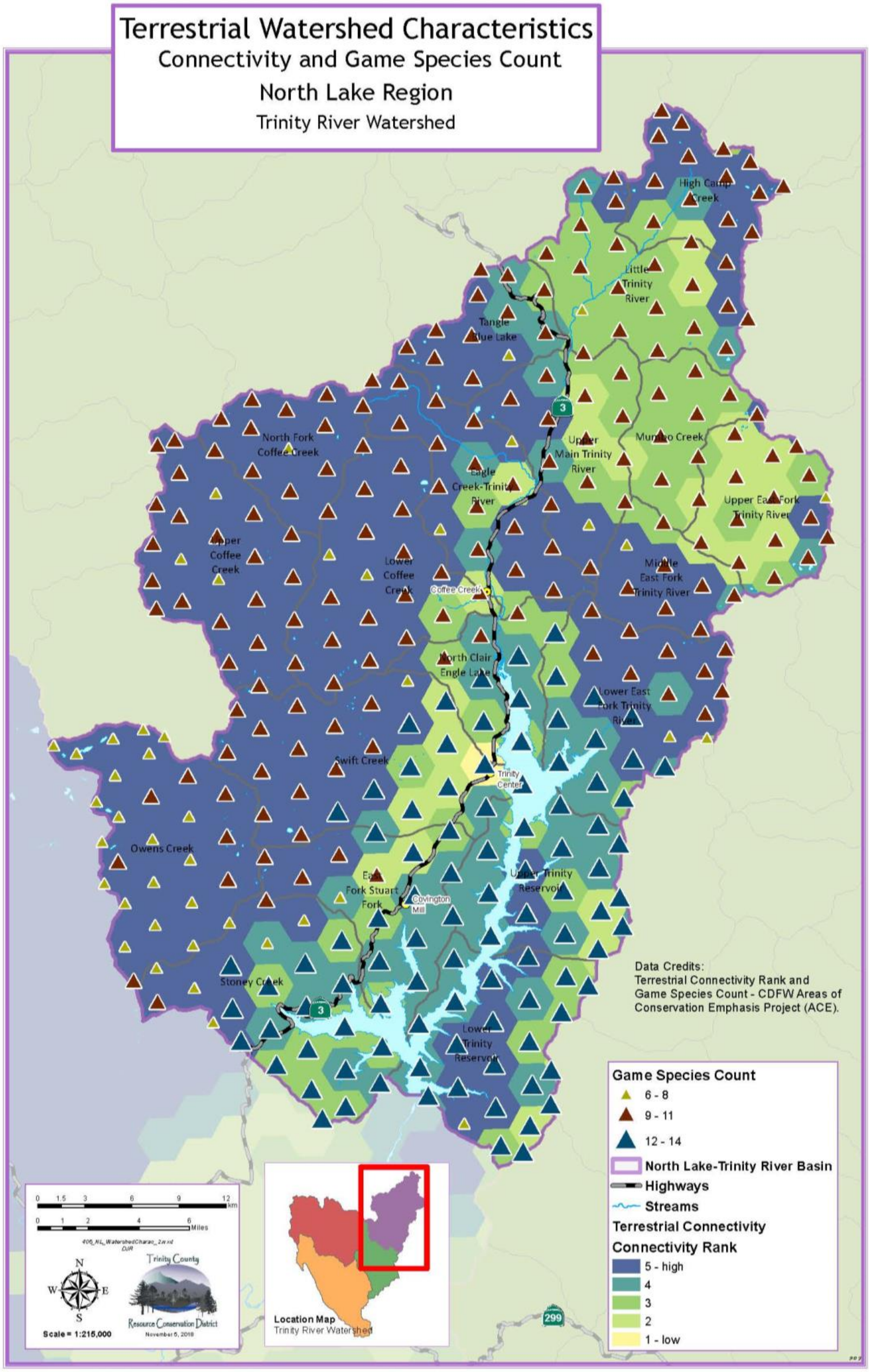


Figure 4.6 North Lake region terrestrial connectivity and game species count.

Aquatic Watershed Characteristics

The North Lake region is a good example of sparse monitoring data due to the remote location. Figure 4.7 indicates fish present in all subwatersheds, but only includes data for the other aquatic species in eight of the subwatersheds. Data for aquatic invertebrates are based on actual counts, rather than modeling. Mumbo Creek, Lower East Fork Trinity River and Stoney Creek all show high counts for invertebrates, but several subwatersheds in this region lack any aquatic monitoring.

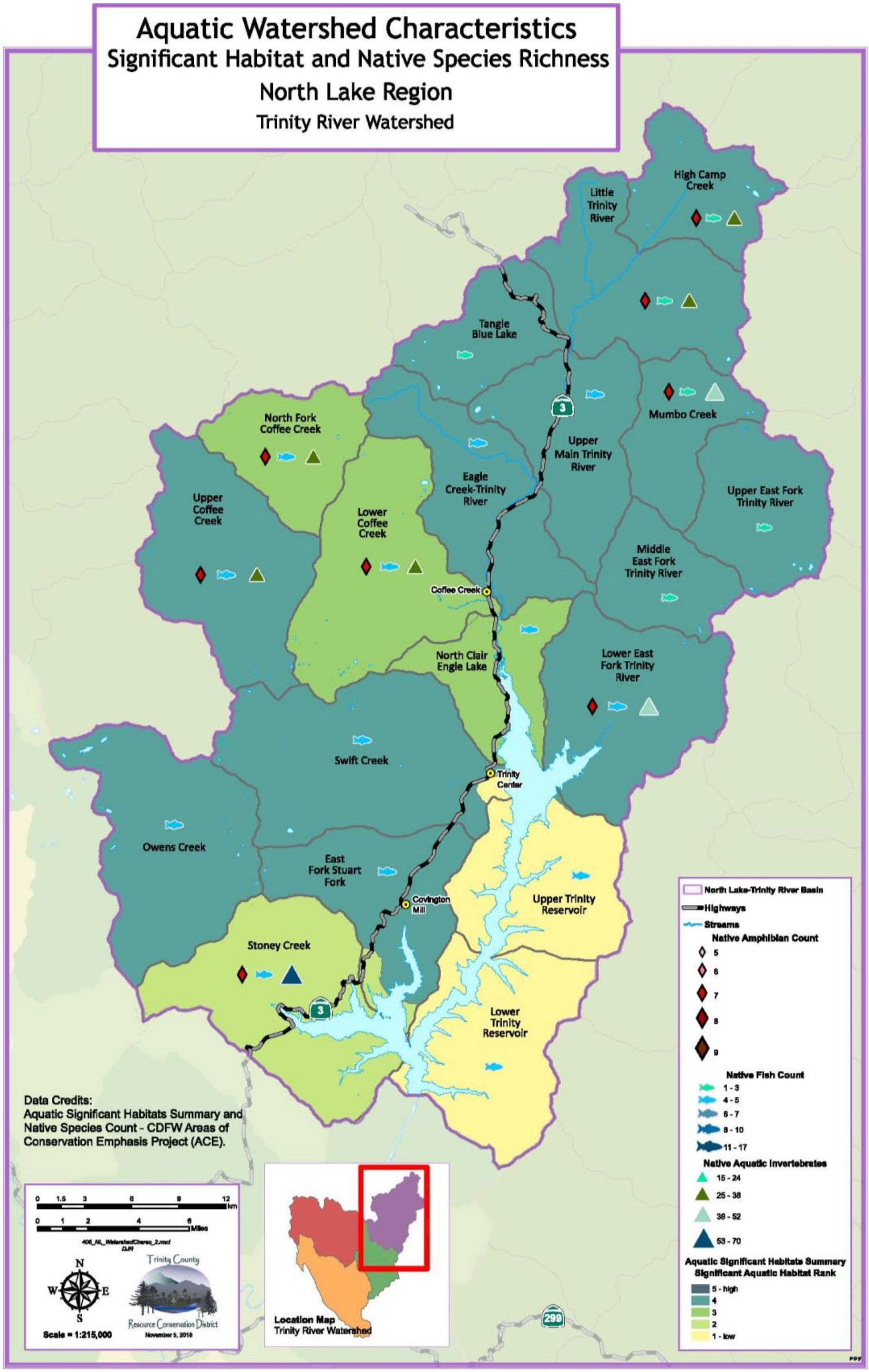


Figure 4.7 North Lake region significant aquatic habitat and native species richness.

Coho cannot migrate above the dam in the North Lake region, but by including the coho Intrinsic Potential (IP) data, a clearer image of the subwatersheds forms, as IP is based on mean annual discharge, channel gradient and channel constraint (Figure 4.8). Stoney Creek subwatershed appears as a healthy watershed with good levels of dissolved oxygen, medium to high IP ranking, and listing as a reference stream by EPA in the 2000 TMDL report. The Swift Creek subwatershed does have good IP and is also a TMDL reference stream. All monitored streams had normal or higher dissolved oxygen, another indicator of stream health.

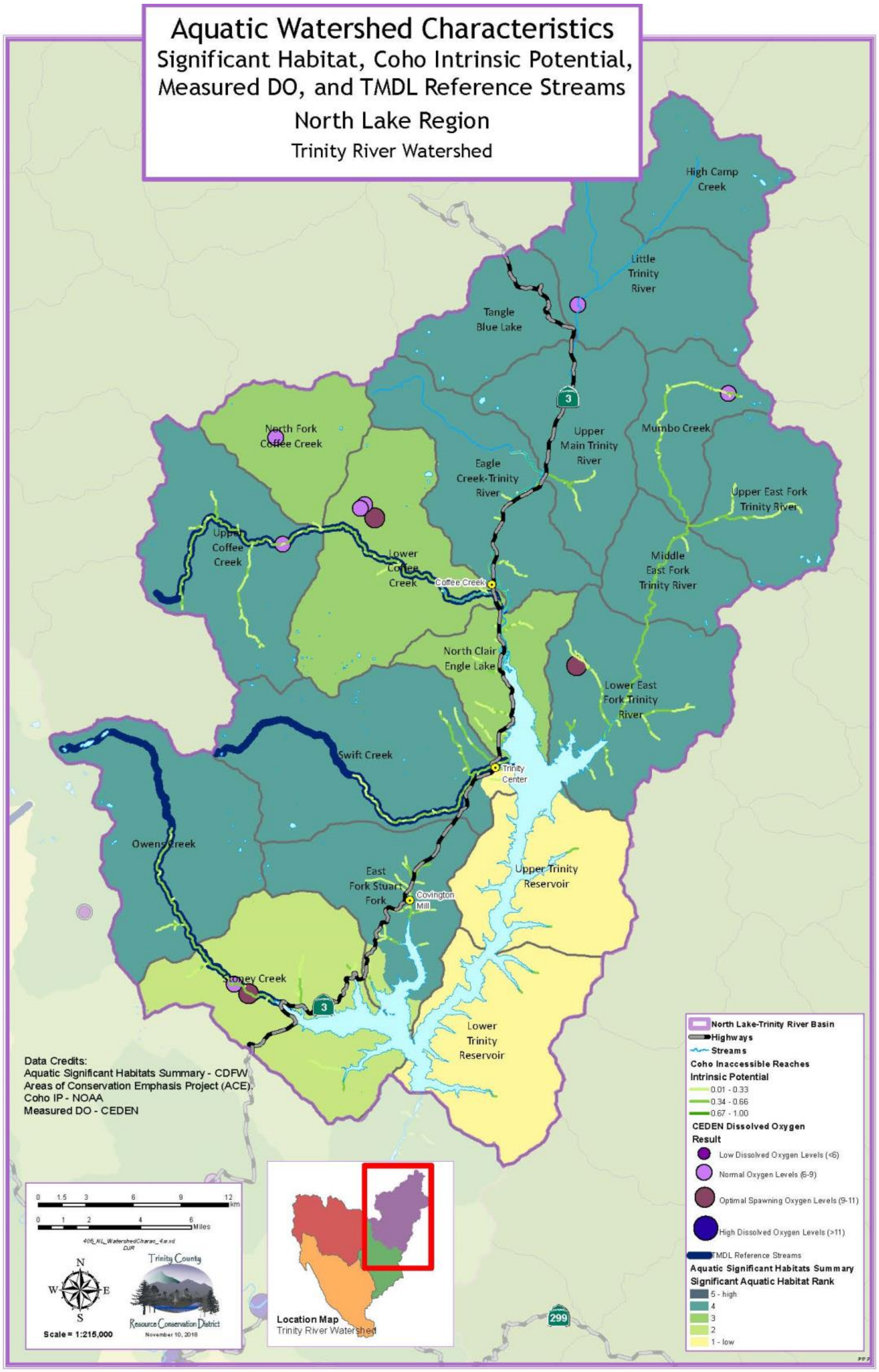


Figure 4.8 North Lake region significant aquatic habitat and stream health indicators.

The USFS NW Forest Plan indicates a slight decrease in watershed condition trend for the North Lake region (Figure 4.9). The coldest water temperatures measured are in the headwaters in the High Camp Creek Watershed, with the warmest measured where the Lower East Fork Trinity River joins Trinity Lake. Stoney and Coffee Creeks both show cool water temperatures.

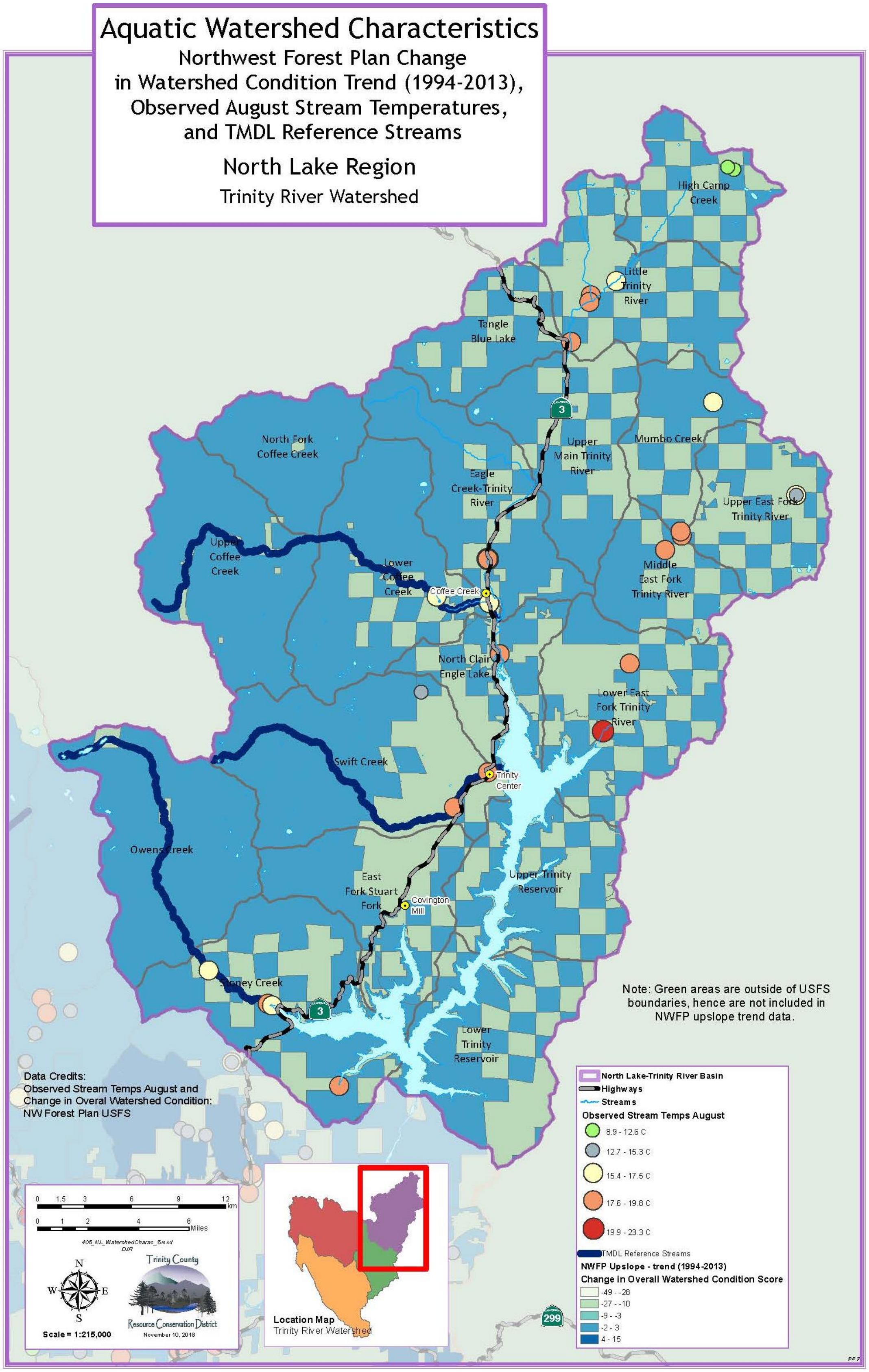


Figure 4.9 North Lake region watershed conditions and observed August stream temperatures.

4.1.2 Middle Trinity Watershed Characteristics

Land Ownership

Property ownership in this region represents the largest number of individual private property parcels, as four of the largest communities in the watershed are located in the Middle Trinity region. Private timber land ownership and US Forest Service managed lands are nearly equal, with Bureau of Land Management responsible for approximately 15-20% of the land as shown Figure 4.10.

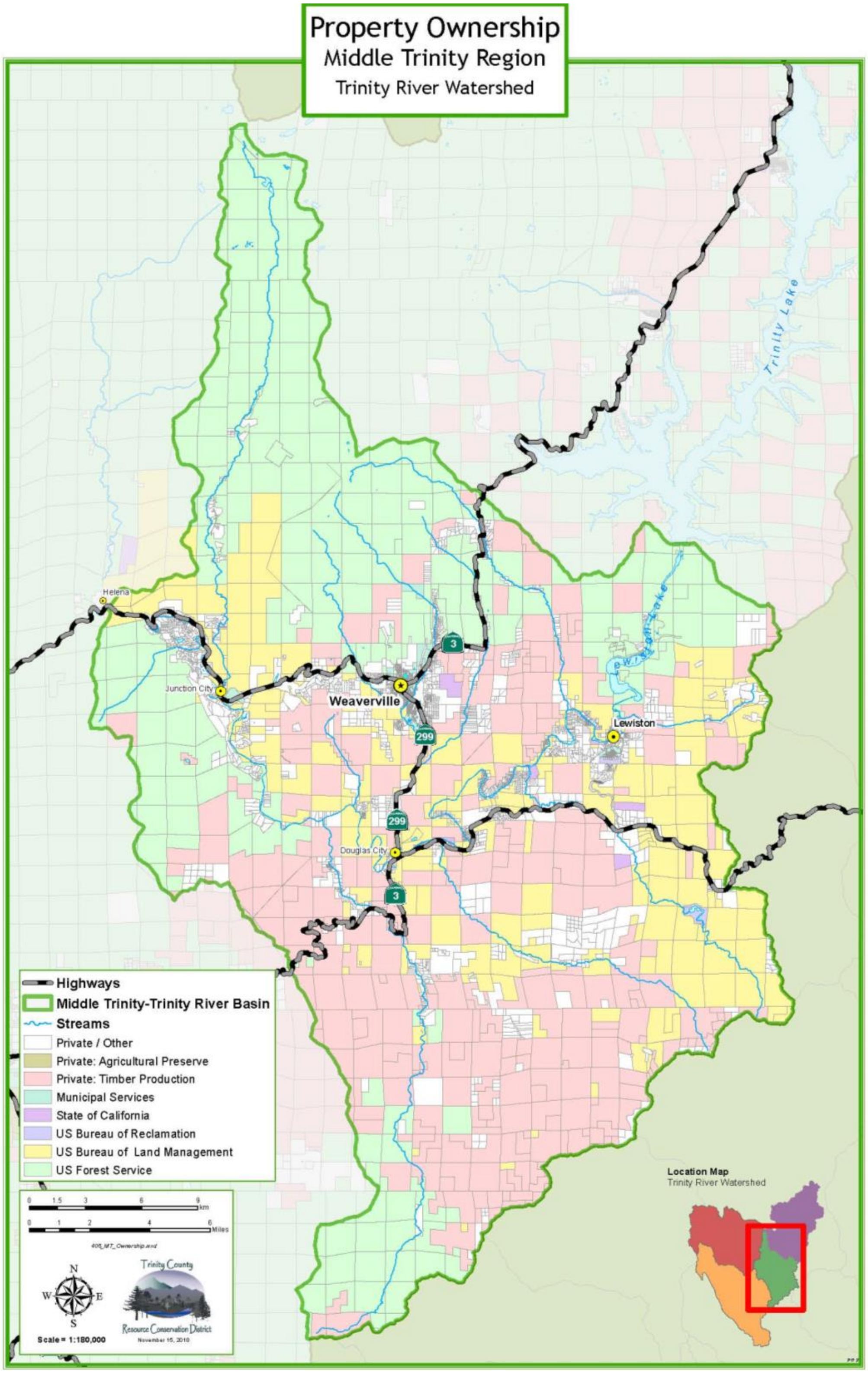


Figure 4.10 Middle Trinity region land ownership.

Terrestrial Watershed Characteristics

Terrestrial connectivity is high in the northern area of this region as it lies within the Trinity Alps Wilderness Area (Figure 4.11). On the western edge of the region there is a gap in the high ranking for connectivity as it runs north to south. The gap may be due to private timberlands in that area, Highway 3 interrupting connectivity, or it may be higher than indicated by the ACE data because of the gap in public lands. The Browns Creek corridor south of Highway 3 also provides good connectivity. The highest count of rare species is located closer to Lewiston Lake, as more water affords more and varied habitats.

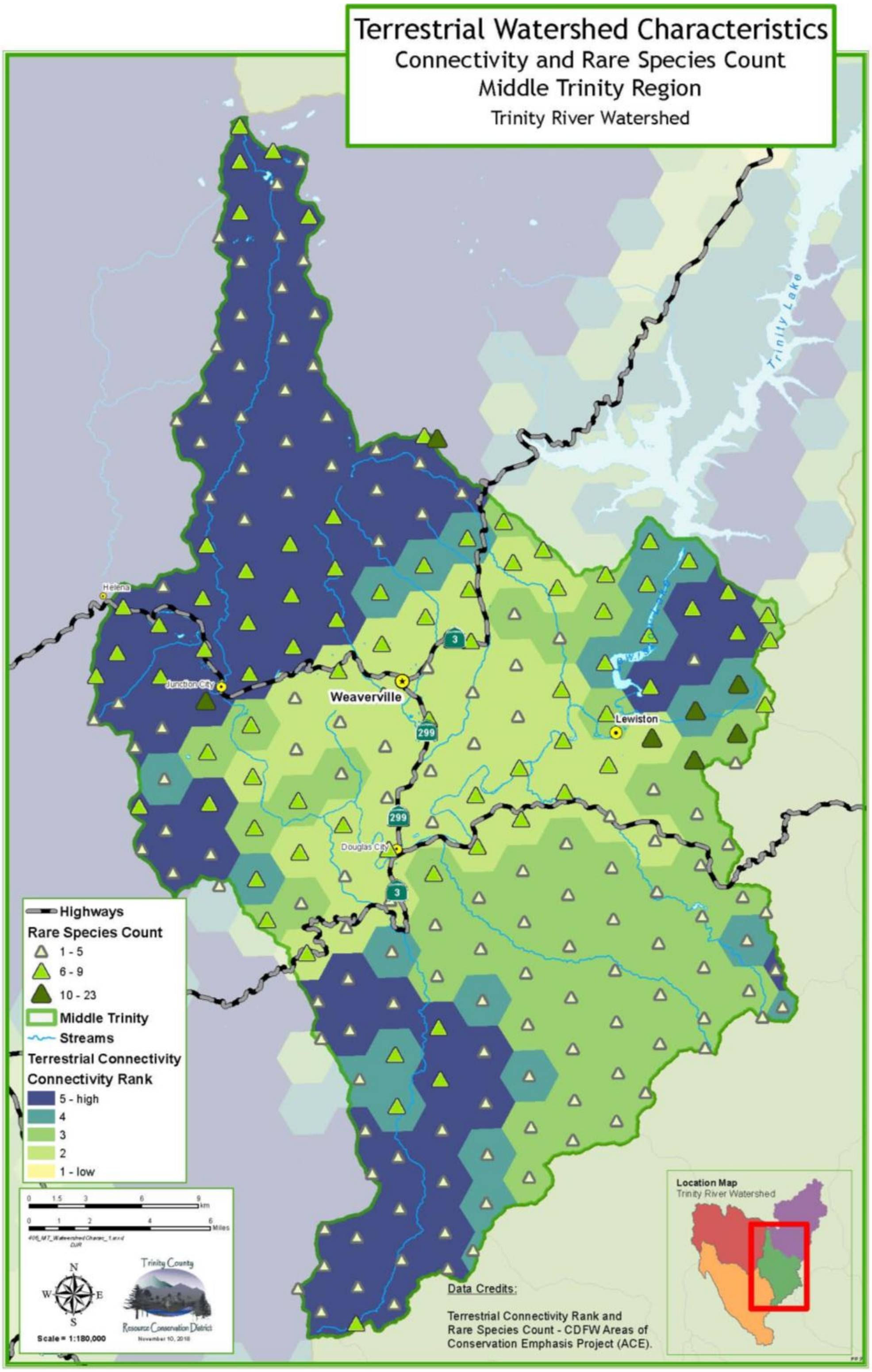


Figure 4.11 Middle Trinity region terrestrial connectivity and rare species count.

Northern spotted owl critical habitat (Figure 4.12) tends to follow the high ranking connectivity areas, except on the eastern edge of the region. The lowest connectivity is in the center of this region as that is where the highest population of humans reside.

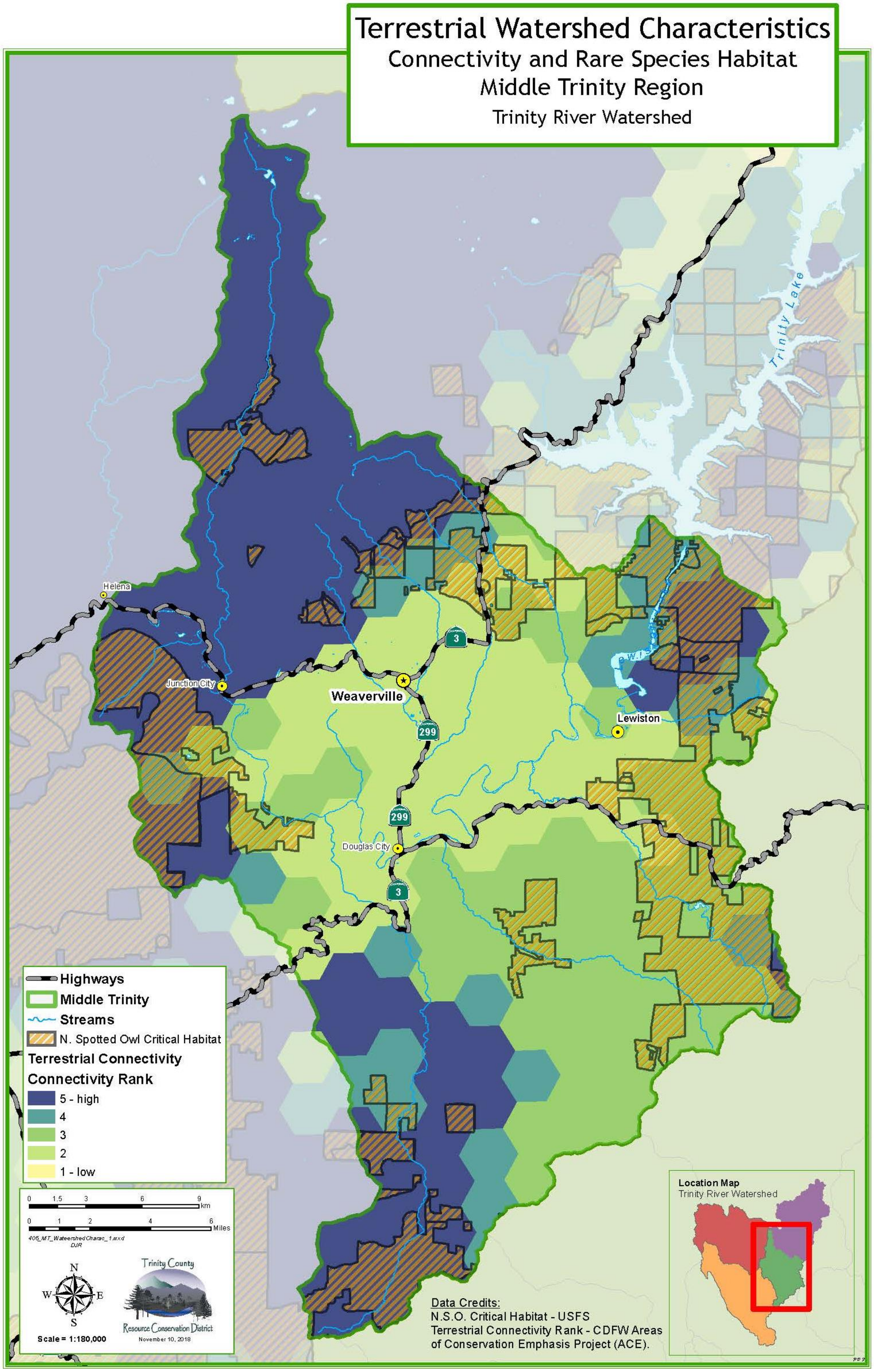


Figure 4.12 Middle Trinity region terrestrial connectivity and northern spotted owl critical habitat.

The highest counts for game species are nearer water, but don't seem to follow a pattern based on connectivity (Figure 4.13). This entire region contains game species, with the lowest count at six species per hexagon.

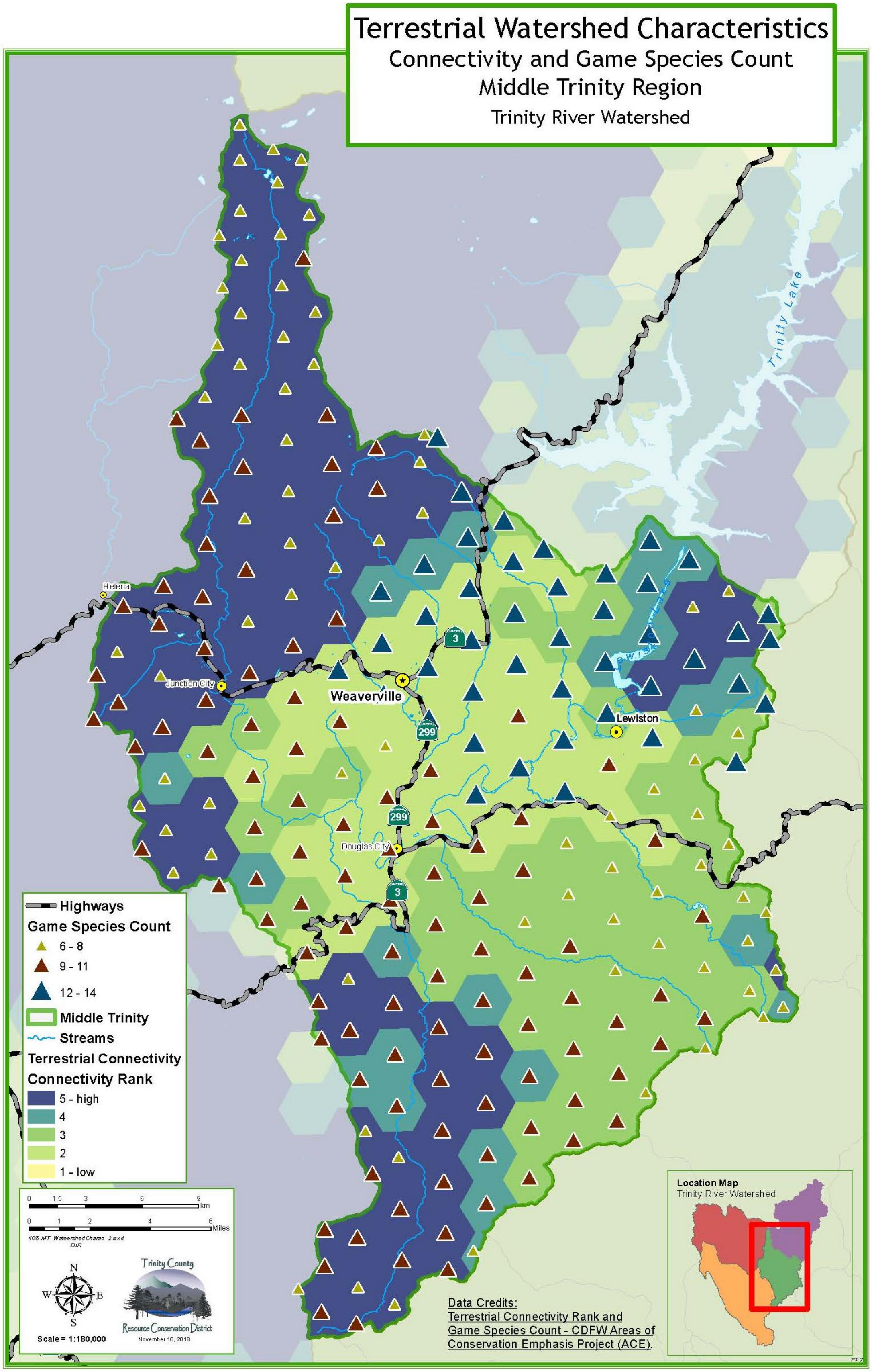


Figure 4.13 Middle Trinity region terrestrial connectivity and game species count.

Aquatic Watershed Characteristics

The ACE data in Figure 4.14 identifies Indian Creek, Reading Creek, and all of Browns Creek as lowest ranking for significant aquatic habitat. Yet all three drainages show solid numbers for native species richness, which leaves some doubt about the accuracy of the ACE ranking for those subwatersheds. Aquatic invertebrate counts are highest in the Weaver Creek subwatershed, but that may be because of frequent monitoring and ease of access. Other unmonitored streams may have high counts as well. Based on local observations and studies, Pacific lamprey are known to spawn and live as juveniles in Grass Valley Creek to the limit of anadromy.

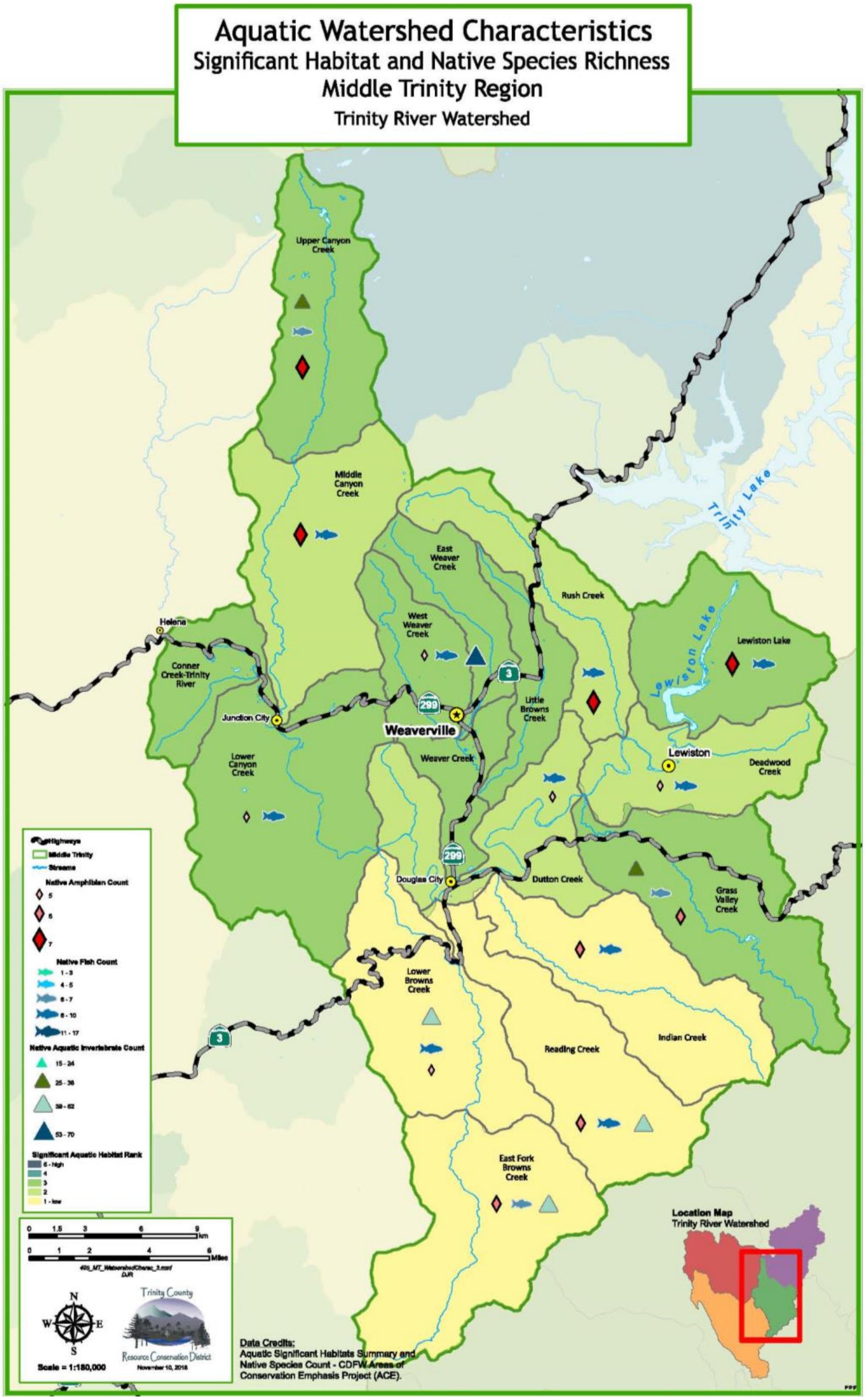


Figure 4.14 Middle Trinity region significant aquatic habitat and native species richness.

Coho have been observed in nearly every subwatershed in the region, except above natural and man-made barriers (hash-marked areas in Figure 4-15). The coho IP scores strongly in the middle range (orange lines), with dissolved oxygen normal or above in all streams that were monitored. This region was heavily impacted by gold mining, leading the EPA to not designate any reference streams within its boundaries.

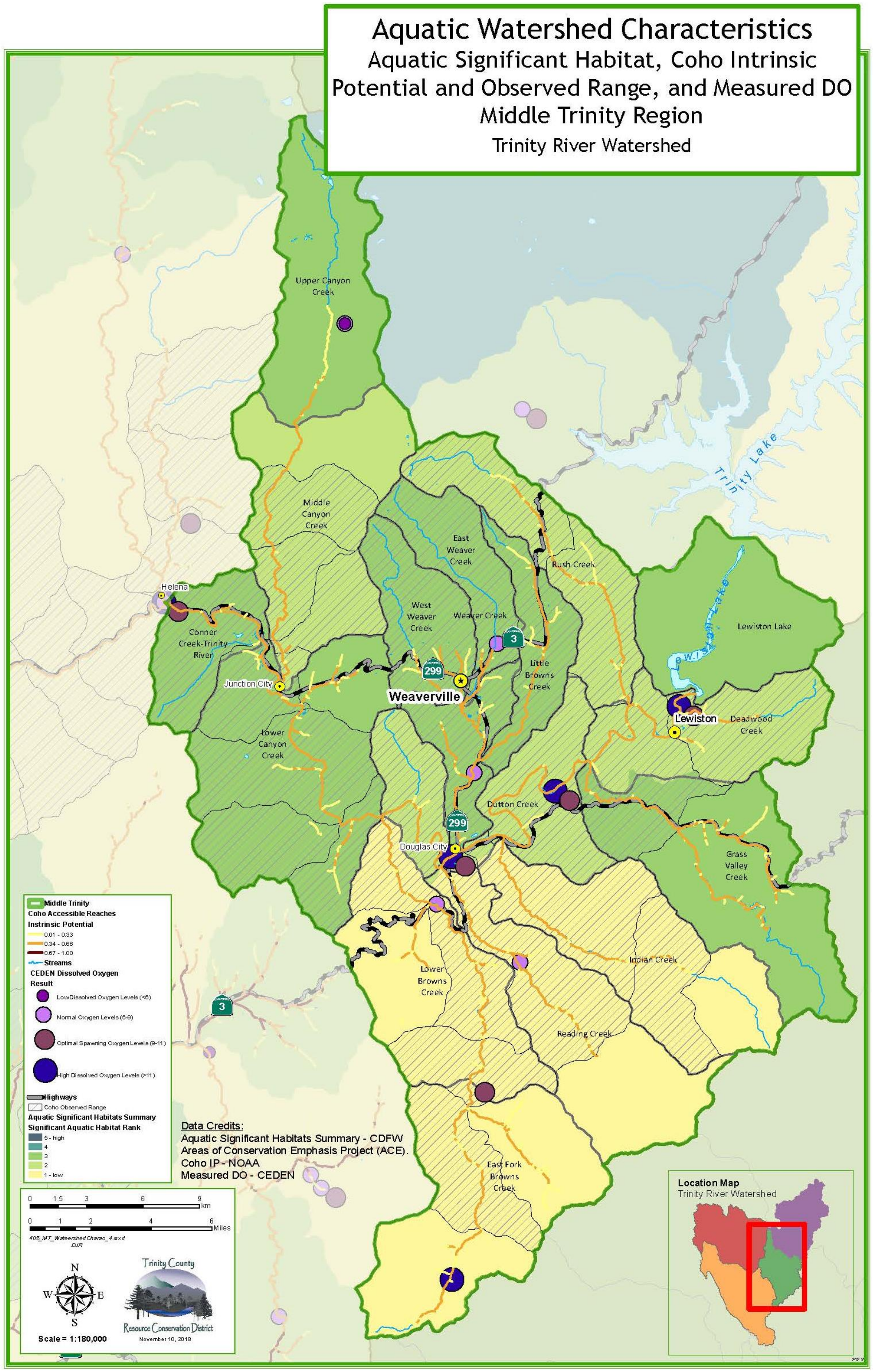


Figure 4.15 Middle Trinity region significant aquatic habitat and stream health indicators.

The US Forest Service NW Forest Plan indicates an increase in the overall watershed condition trend score in the Grass Valley Creek and Weaver Creek subwatersheds (Figure 4.16). The time frame for this score is from 1994-2013. A tremendous amount of sediment reduction work was completed in the Grass Valley Creek drainage between 1994 and 2000. The other areas in this region under US Forest Service management show a slight decrease in the score. Observed temperatures vary across the subwatersheds, with the majority of readings under 17.5 C.

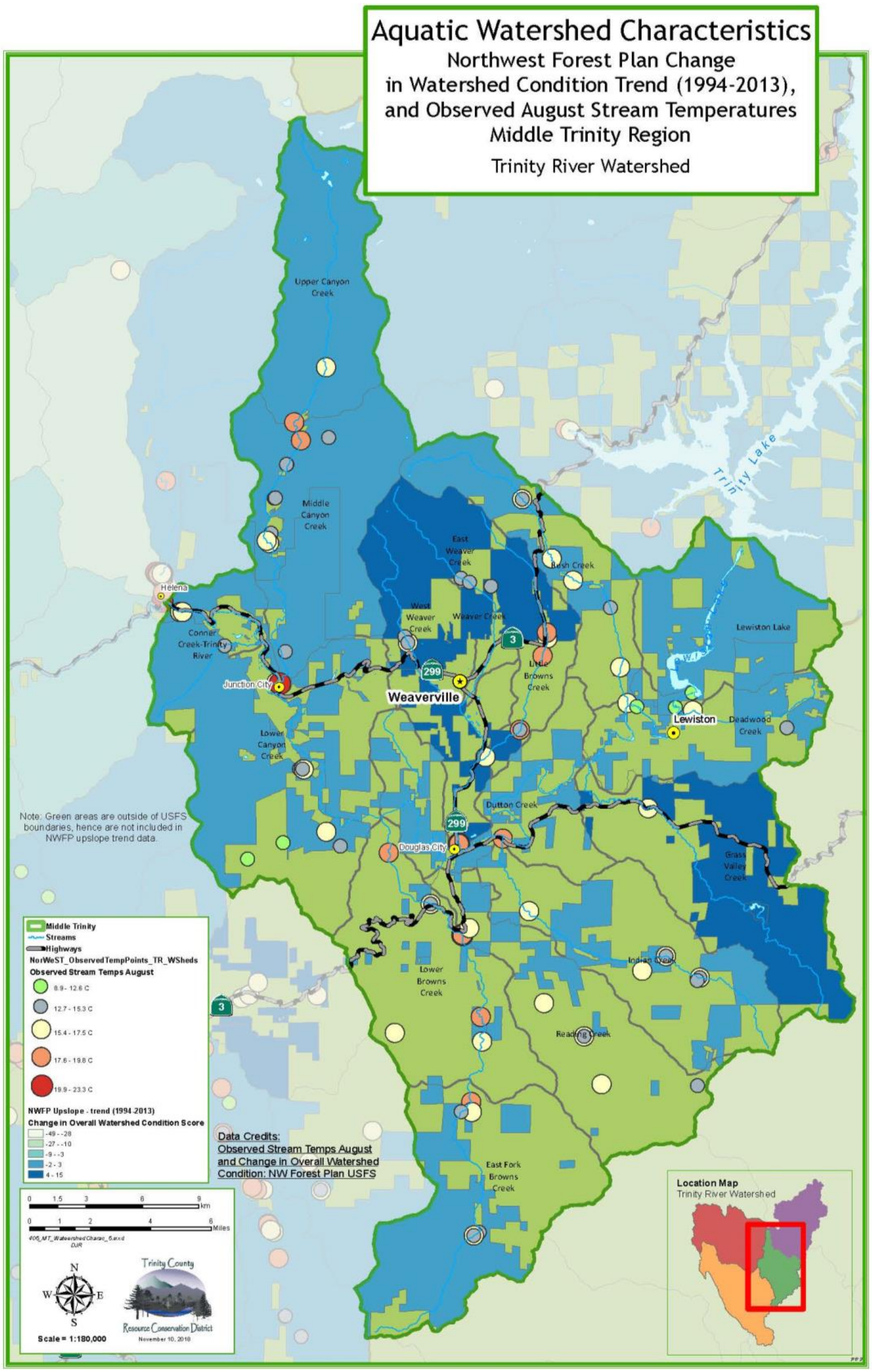


Figure 4.16 Middle Trinity region watershed conditions and observed August stream temperatures.

Middle Trinity Fisheries: Summer Snorkel Survey Salmonid Counts *(available for select subwatersheds)*

Canyon Creek Summer Snorkel Survey Salmonid Counts

Between July and August snorkel surveys are conducted on several streams in the Trinity River Watershed each year. Trained surveyors record numbers of steelhead, Chinook and coho observed. Canyon Creek counts for steelhead (Figure 4.17) and Chinook (Figure 4.18) are lower than the other waterways surveyed.

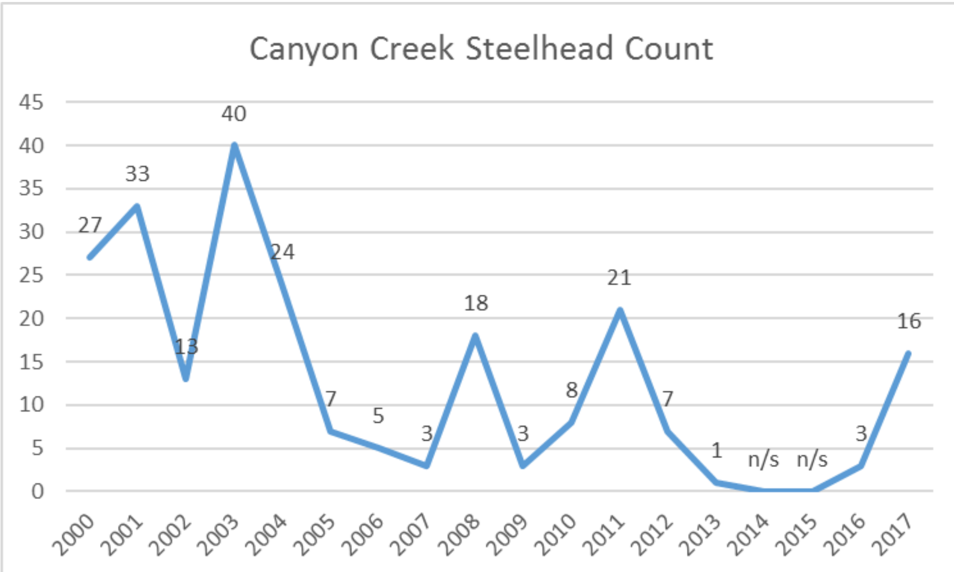


Figure 4.17 Canyon Creek summer snorkel survey steelhead counts 2000-2017 chart.
Note: n/s = no survey.

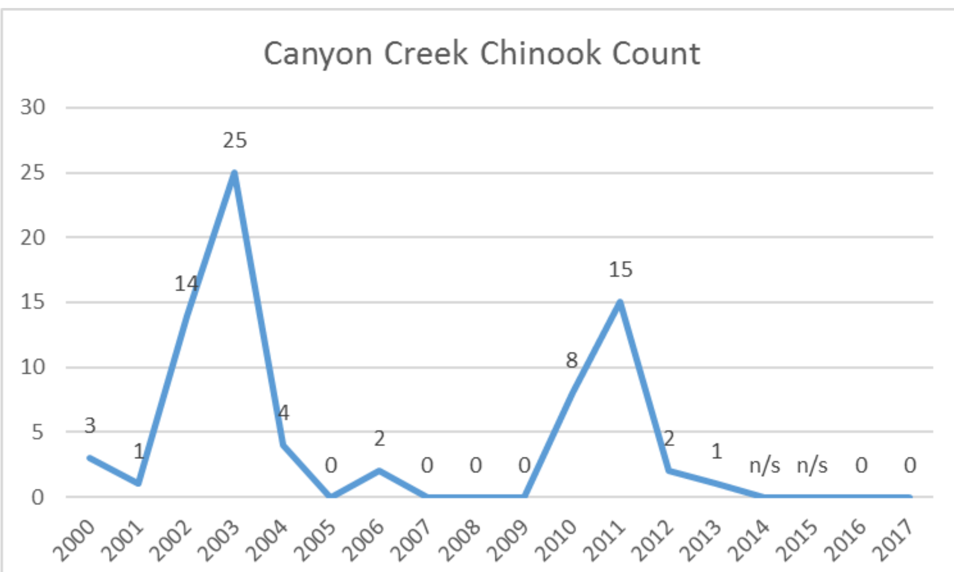


Figure 4.18 Canyon Creek summer snorkel survey Chinook salmon counts 2000-2017 chart.
Note: n/s = no survey.

Steelhead counts by reach are illustrated in Figure 4.19.

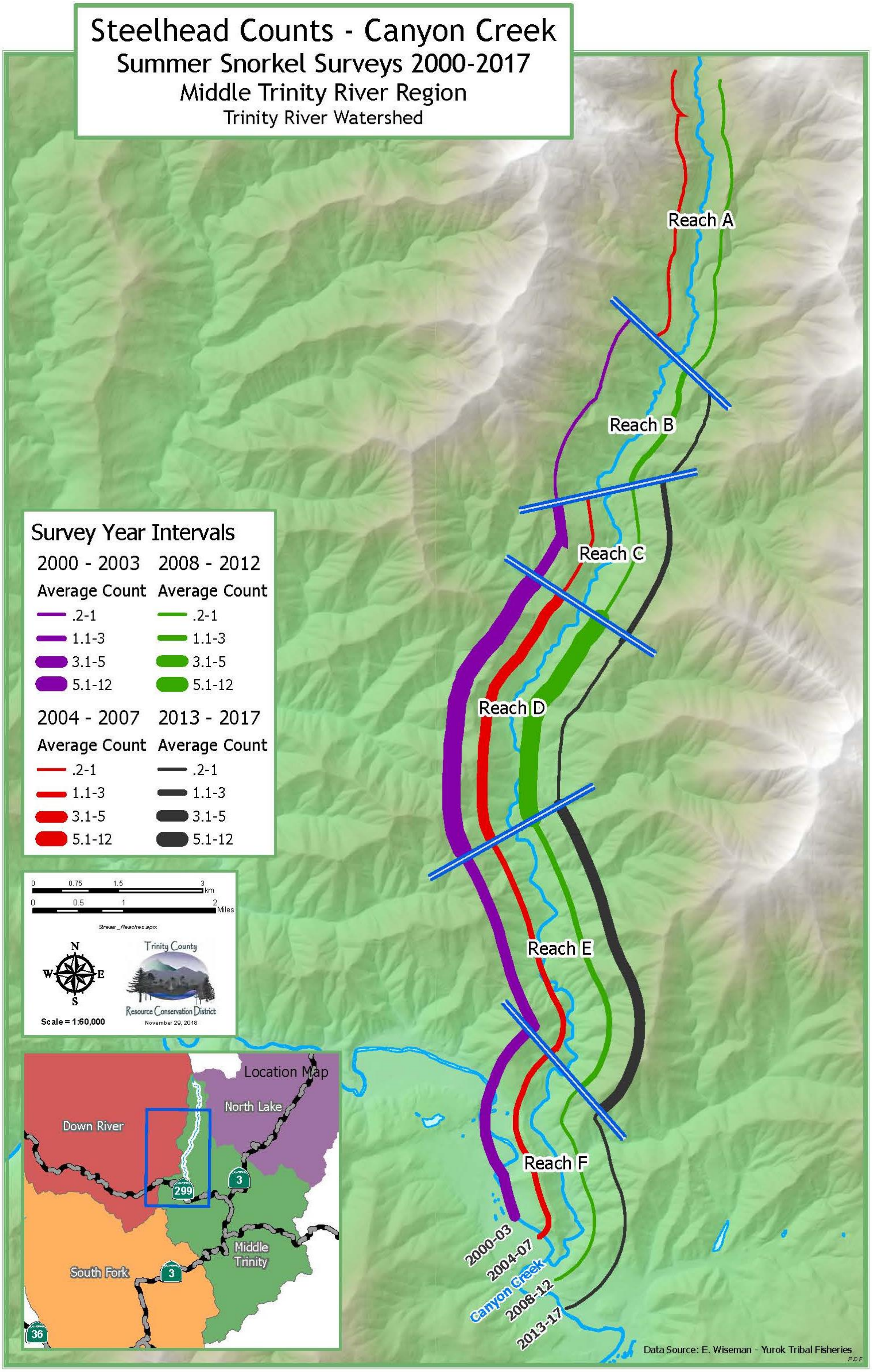


Figure 4.19 Canyon Creek steelhead counts by reach.

4.1.3 South Fork Region Watershed Characteristics

Land Ownership

Property ownership in this region is approximately 21% privately owned and 79% public, with the majority of the public land managed by the Shasta-Trinity National Forest and the remainder by the Six Rivers National Forest, as shown in Figure 4.20.

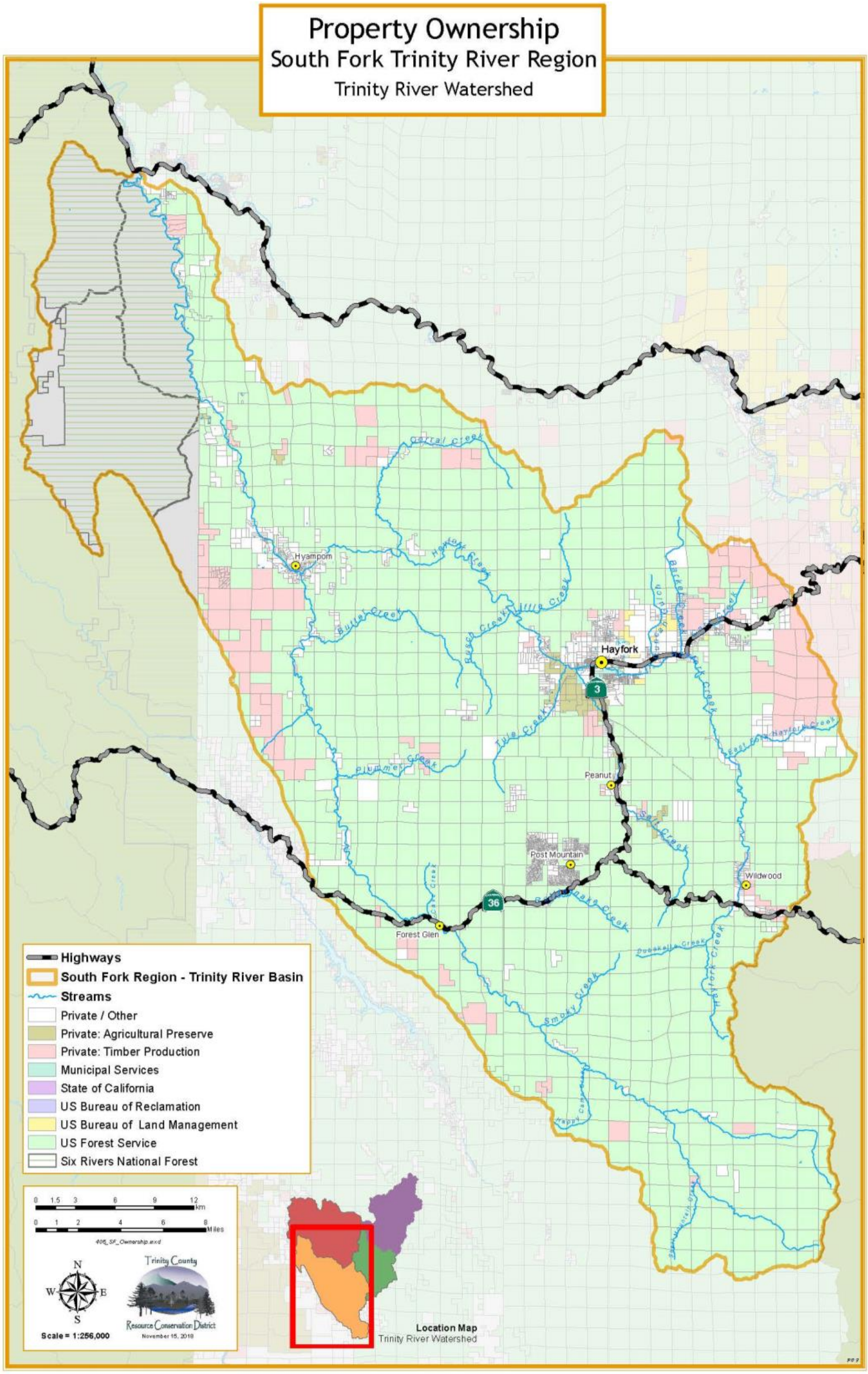


Figure 4.20 South Fork region land ownership.

Terrestrial Watershed Characteristics

With the wealth of public land in the South Fork region, nearly the entire area provides excellent terrestrial connectivity (Figure 4.21). The South Fork Mountain ridge, running along the western edge of this region, provides excellent terrestrial connectivity and habitat for rare species.

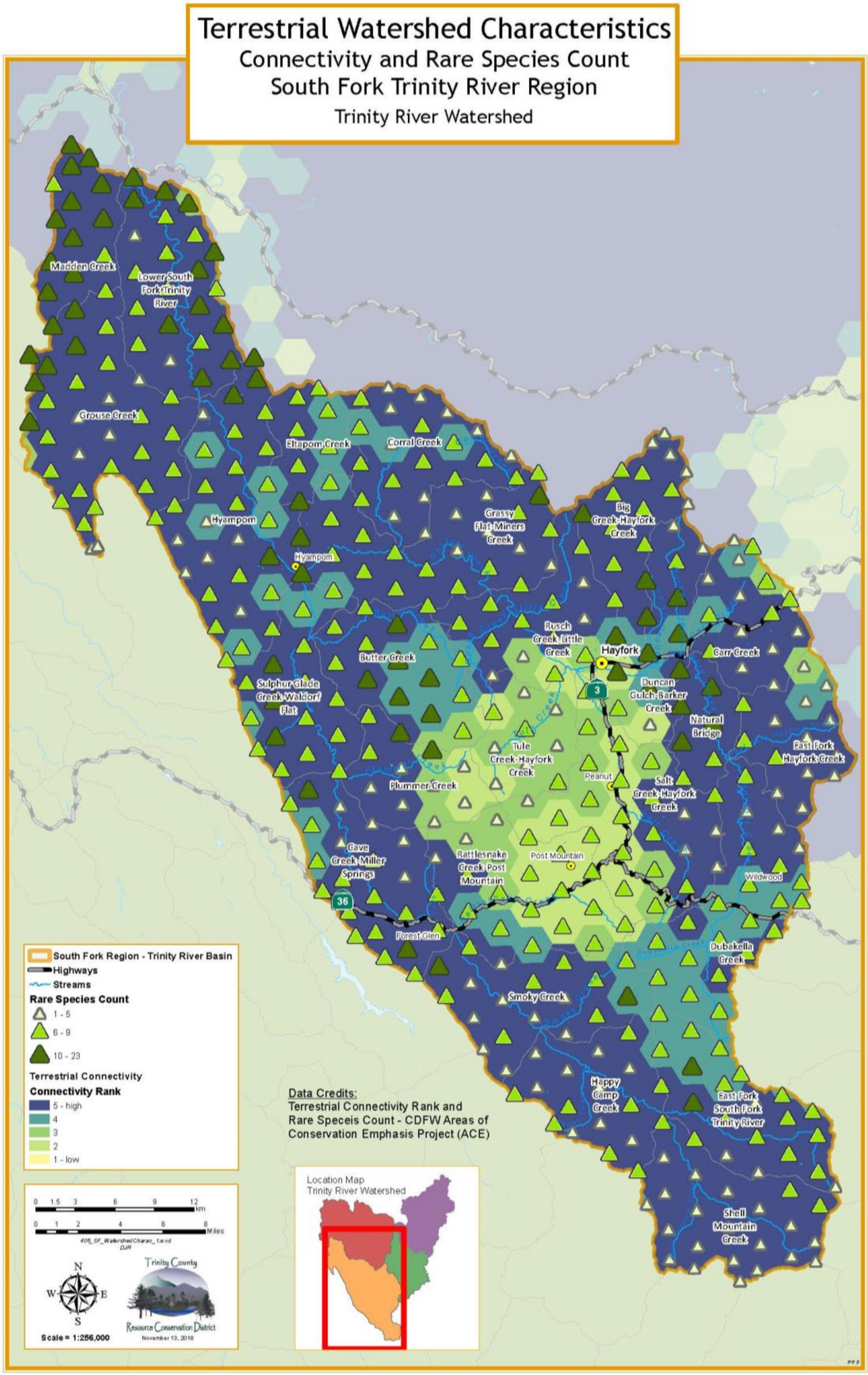


Figure 4.21 South Fork region terrestrial connectivity and rare species count.

The northwestern area that includes the Lower South Fork Trinity River, Madden Creek and Grouse Creek provides critical habitat for both the marbled murrelet and the northern spotted owl (Figure 4.22), as well showing a high rating for overall rare species counts (Figure 4.21).

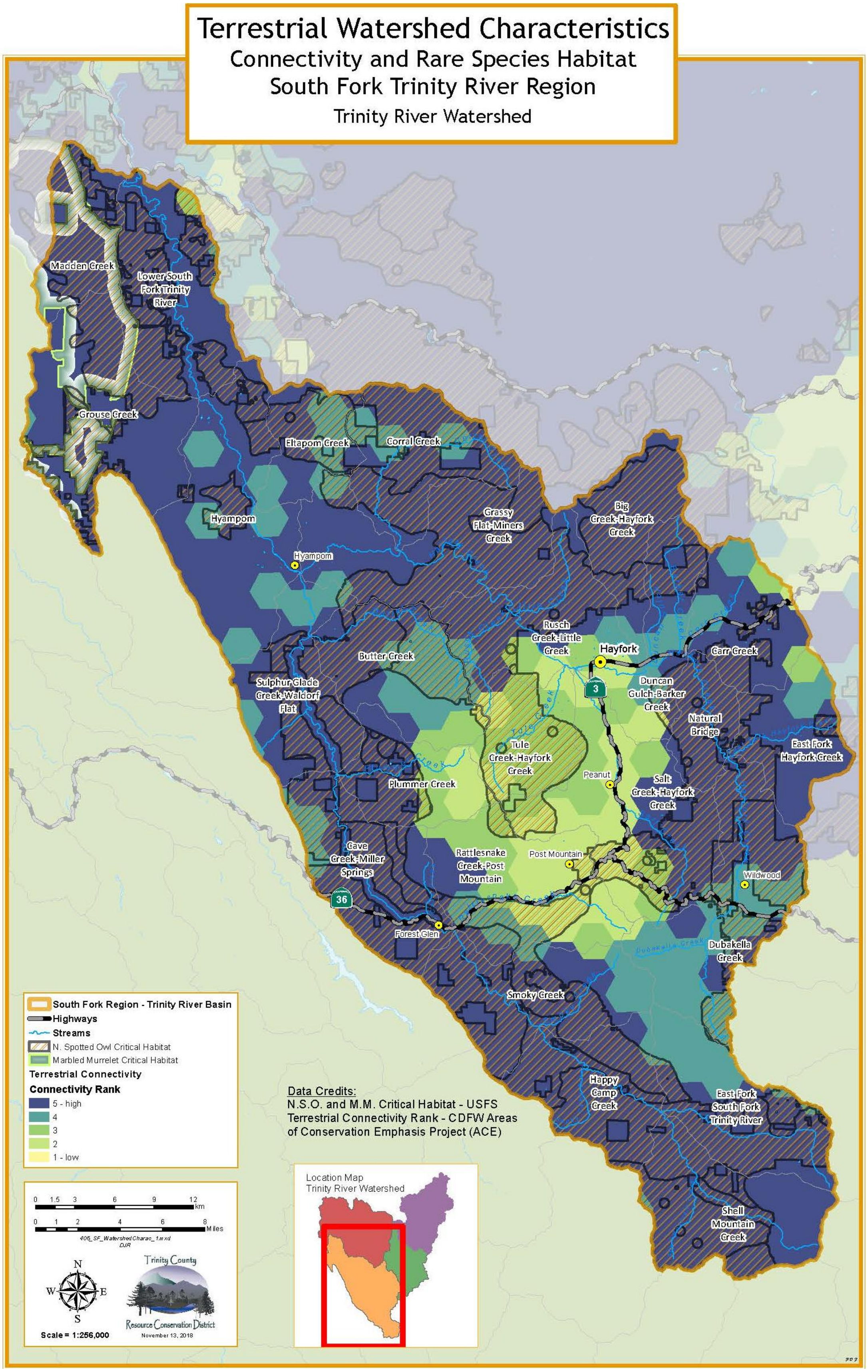


Figure 4.22 South Fork region terrestrial connectivity and marbled murrelet and northern spotted owl critical habitat.

As with the rare species, the game species are abundant and benefit from the high connectivity (Figure 4.23) . The Grouse Creek drainage on the north western edge of the region offers habitat for high numbers of game species. This entire region contains game species, as the lowest count is six per hexagon.

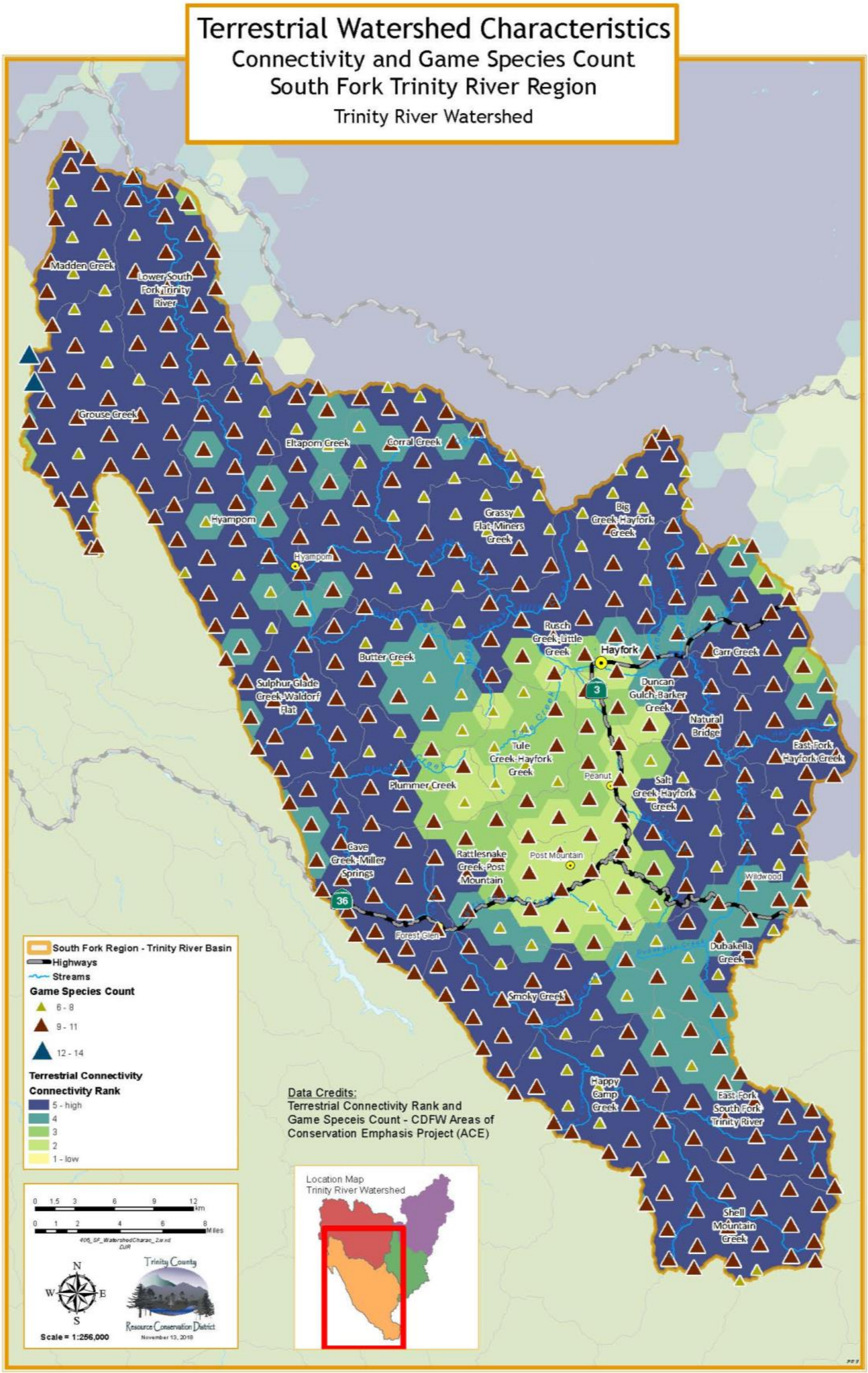


Figure 4.23 South Fork region terrestrial connectivity and game species count.

The ACE data (Figure 4.24) inexplicably identifies several subwatersheds in this region as the lowest ranking for significant aquatic habitat. There may be data gaps causing this ranking. Aquatic invertebrates have only been monitored in eight of the subwatersheds in the region, with Grassy Flat-Miners Creek (between Hayfork and Hyampom) having the highest count of the eight.

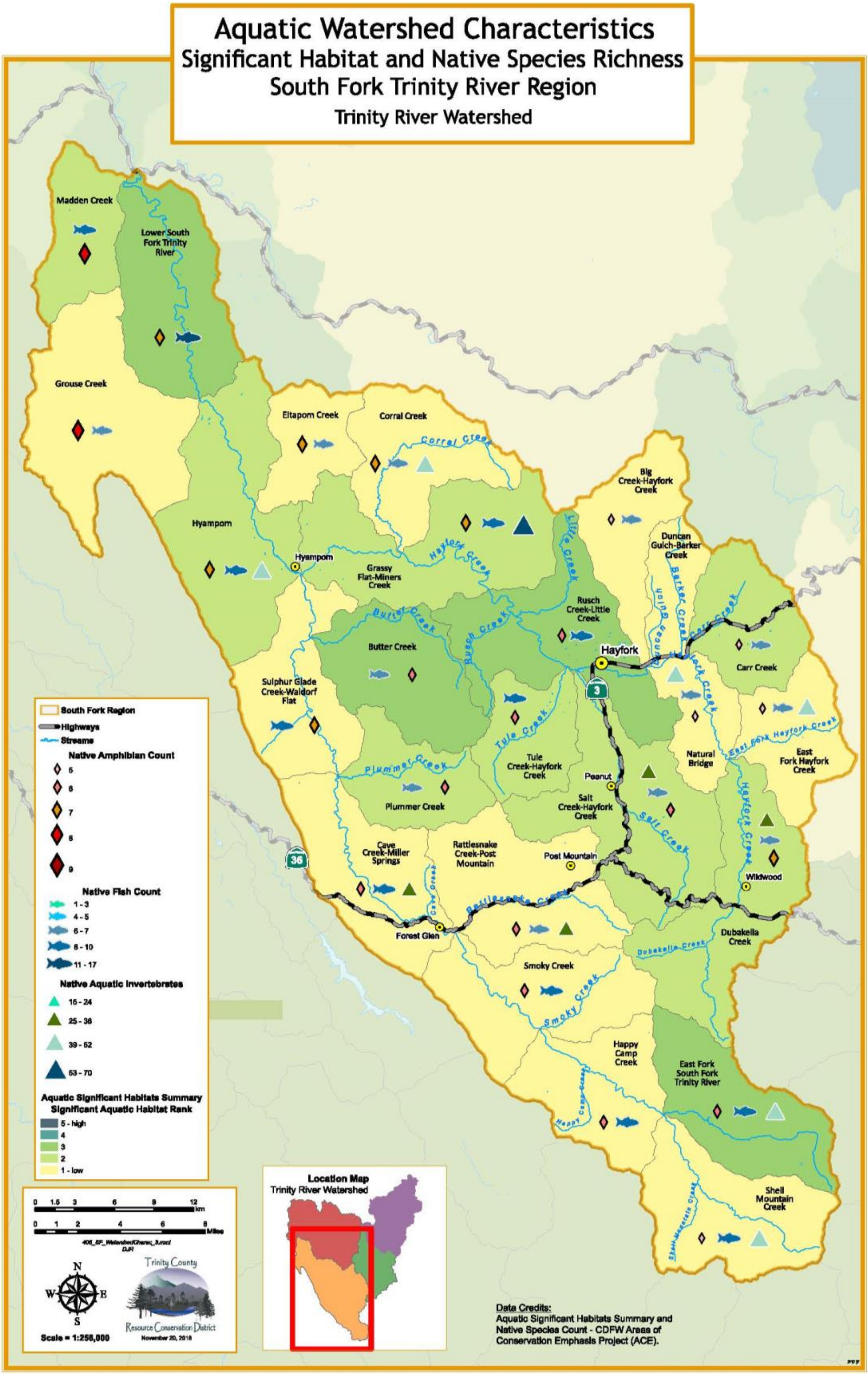


Figure 4.24 South Fork region significant aquatic habitat and native species richness.

Coho Intrinsic Potential (IP) is highest in this region (Figure 4.25) due to the low gradient and low constraint of the Hayfork Valley and surrounding subwatersheds. Coho have not been observed for over 20 years in the eastern portion of this region (hash marks indicate observations), but observation of juvenile coho were made in 2015 in Madden Creek (*WRTC, 2016*). Much of the upper South Fork Trinity River (from Forest Glen south) is considered too steep by many fish biologists for coho to inhabit. All but one of the dissolved oxygen monitoring sites came back at or above normal levels. The EPA rated Swift Creek, in the Cave Creek-Miller Springs subwatershed south of Highway 36, as a reference stream in the 2001 TMDL document.

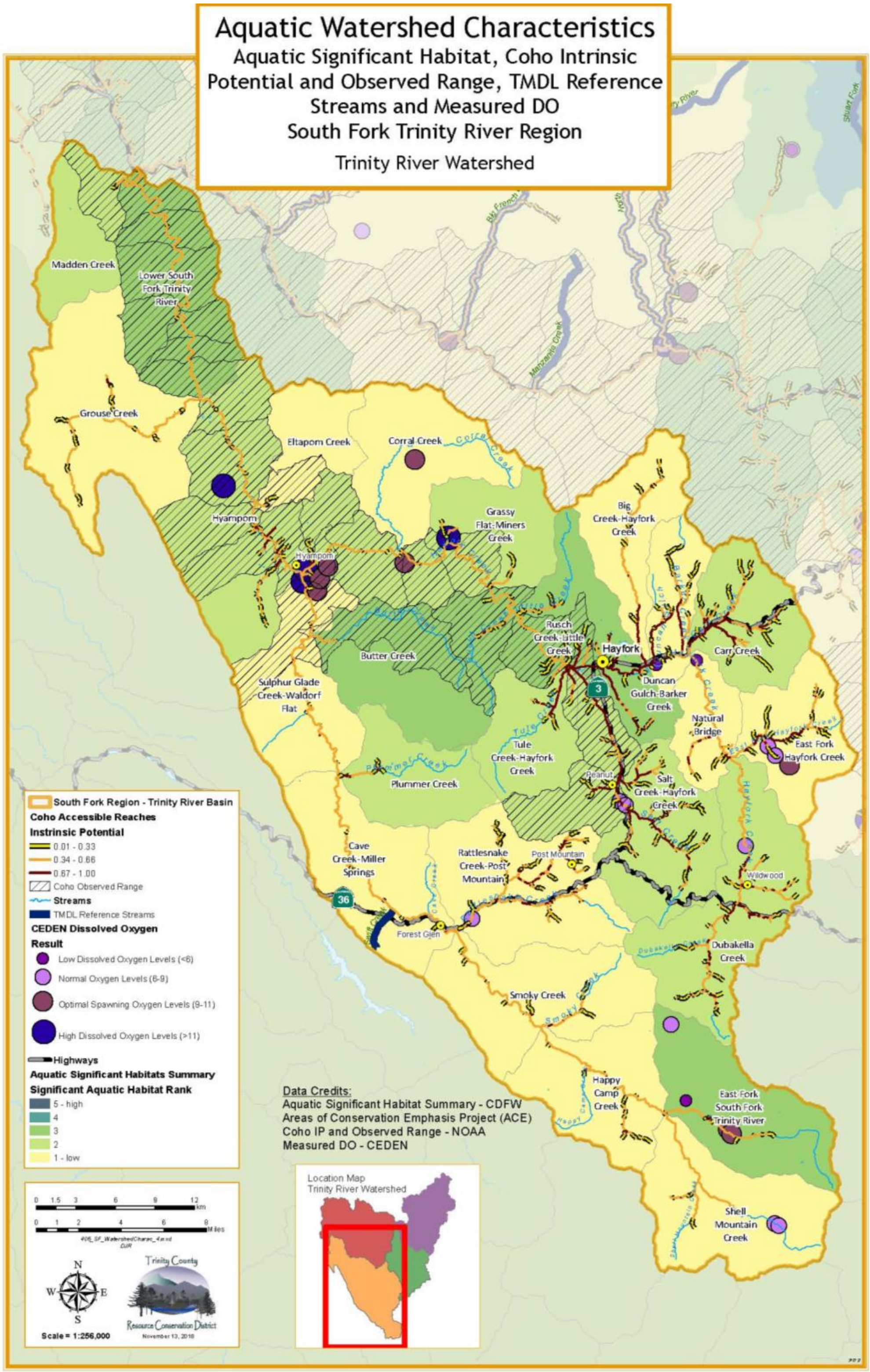


Figure 4.25 South Fork region significant aquatic habitat and stream health indicators.

East Fork South Fork Trinity River, Butter Creek and parts of Carr Creek and Grouse Creek subwatersheds saw a positive increase in the overall watershed condition trend score by the US Forest Service NW Forest Plan (Figure 4.26). Most of the remaining subwatersheds saw a small decrease with the exceptions of Hyampom, Sulphur Glade-Waldorf Flat, Happy Camp and Shell Mountain Creeks which show a larger decline. Observed August stream temperatures indicate lethally warm water for salmonids in the Hayfork Valley, and some reaches along the South Fork Trinity River. Higher altitude sampling sites offer cooler stream temperatures.

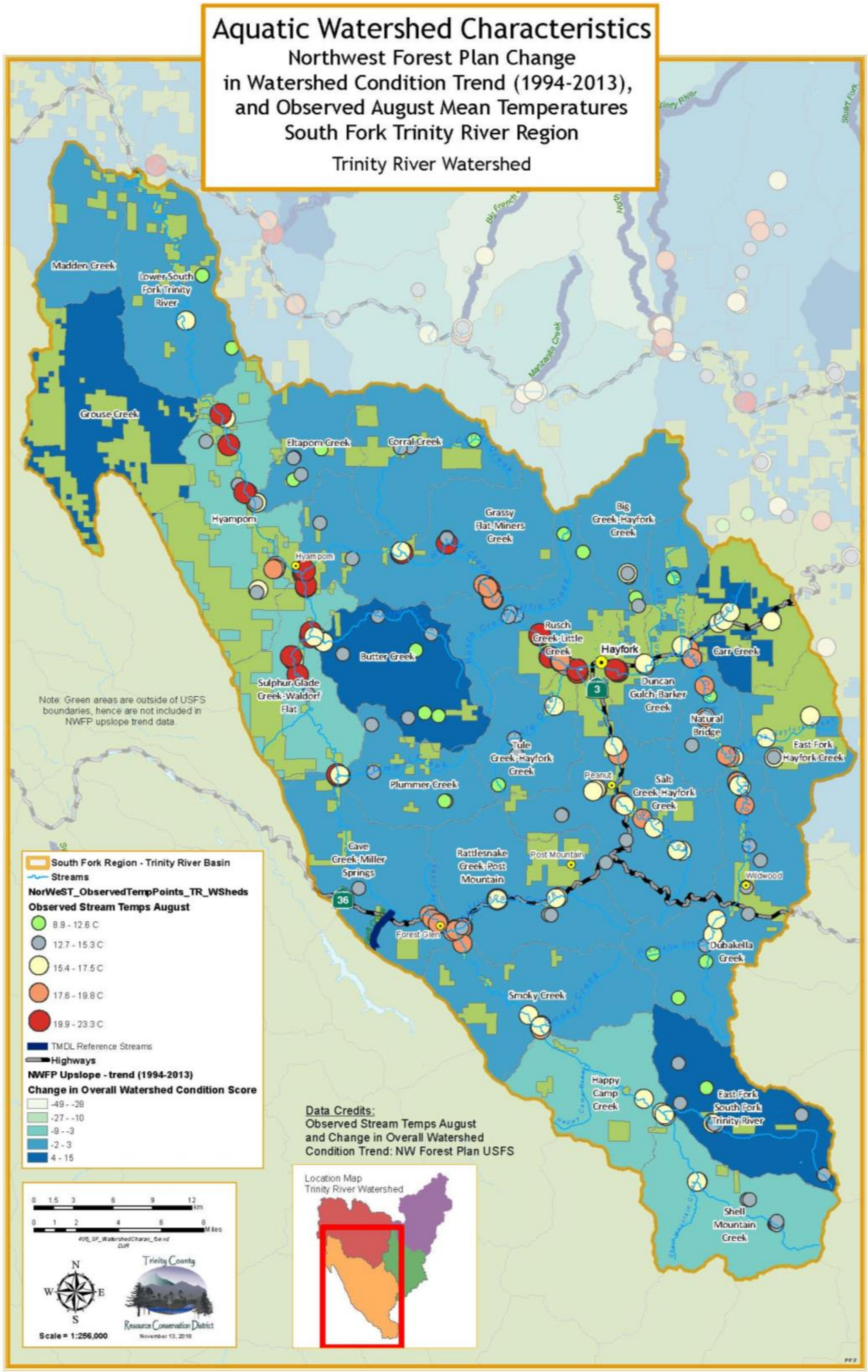


Figure 4.26 South Fork region watershed conditions and observed August stream temperatures.

South Fork Trinity Fisheries: Summer Snorkel Survey Salmonid Counts *(available for select subwatersheds)*

South Fork Trinity River Summer Snorkel Survey Salmonid Counts

Each year between July and August snorkel surveys are conducted on several streams in the Trinity River Watershed. Trained surveyors record numbers of steelhead, Chinook and coho observed. South Fork Trinity River counts for steelhead (Figure 4.27) are in higher than both Canyon and Hayfork Creeks, but lower than the North Fork Trinity River and New River. Chinook counts (Figure 4.28) are higher than the other waterways surveyed, with the exception of 2017. All Chinook counts have taken a precipitous fall since 2012.

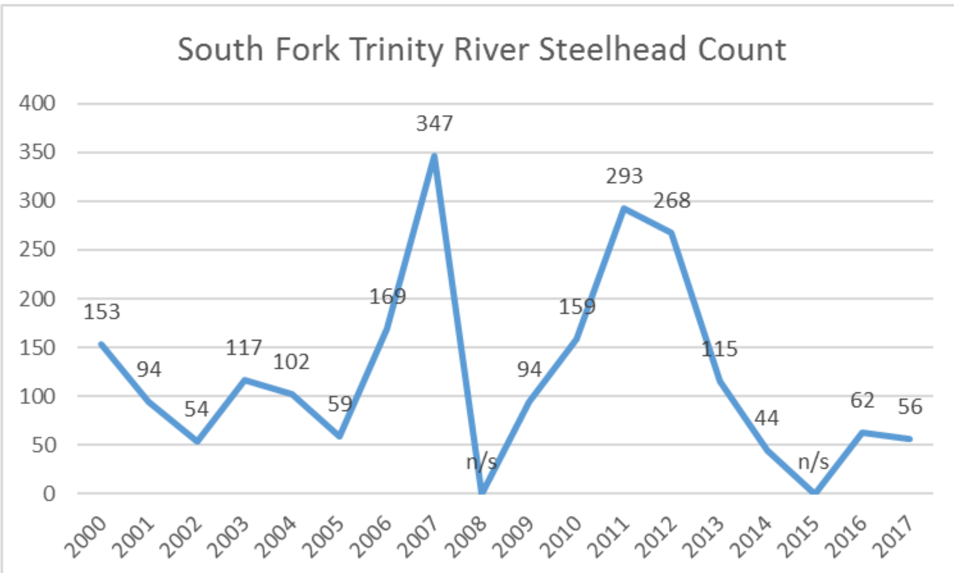


Figure 4.27 South Fork Trinity River summer snorkel survey steelhead counts 2000-2017 chart.
Note: n/s = no survey.

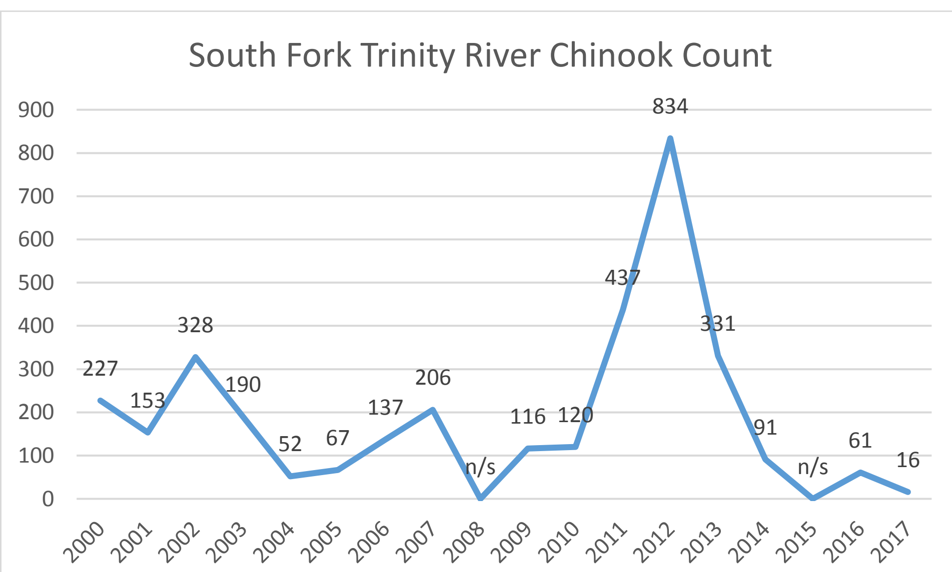


Figure 4.28 South Fork Trinity River summer snorkel survey Chinook counts 2000-2017 chart.
Note: n/s = no survey.

Steelhead counts by reach are illustrated in Figure 4.29.

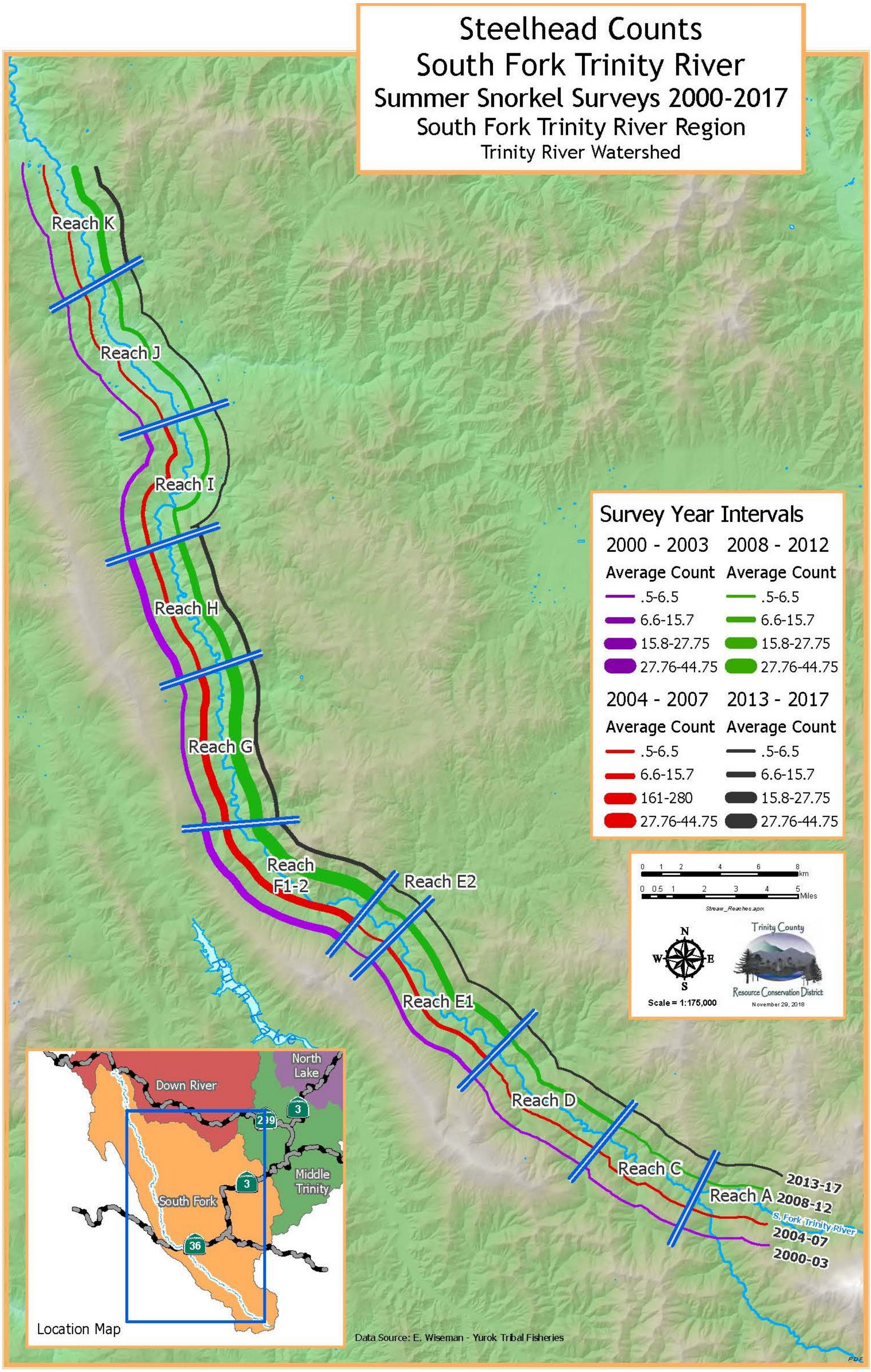


Figure 4.29 South Fork Trinity River steelhead counts by reach.

Hayfork Creek Summer Snorkel Survey Salmonid Counts

Hayfork Creek salmonid summer snorkel survey counts for both steelhead (Figure 4.30) and Chinook (Figure 4.31) have been low for at least 17 years. The creek has high water temperatures in the summer, which does account for lower numbers as the fish would need to migrate to cooler water to survive.

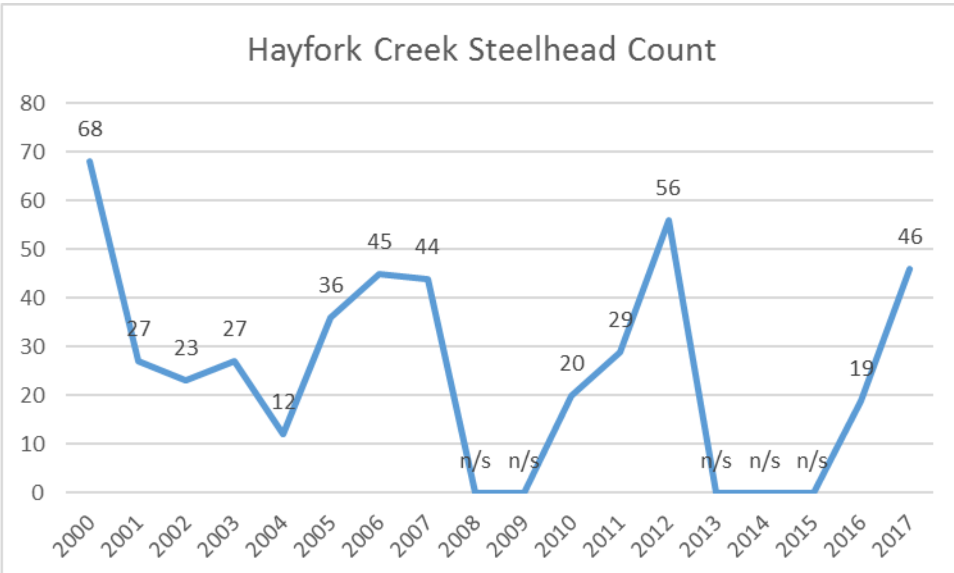


Figure 4.30 Hayfork Creek summer snorkel survey steelhead counts 2000-2017 chart.
Note: n/s = no survey.

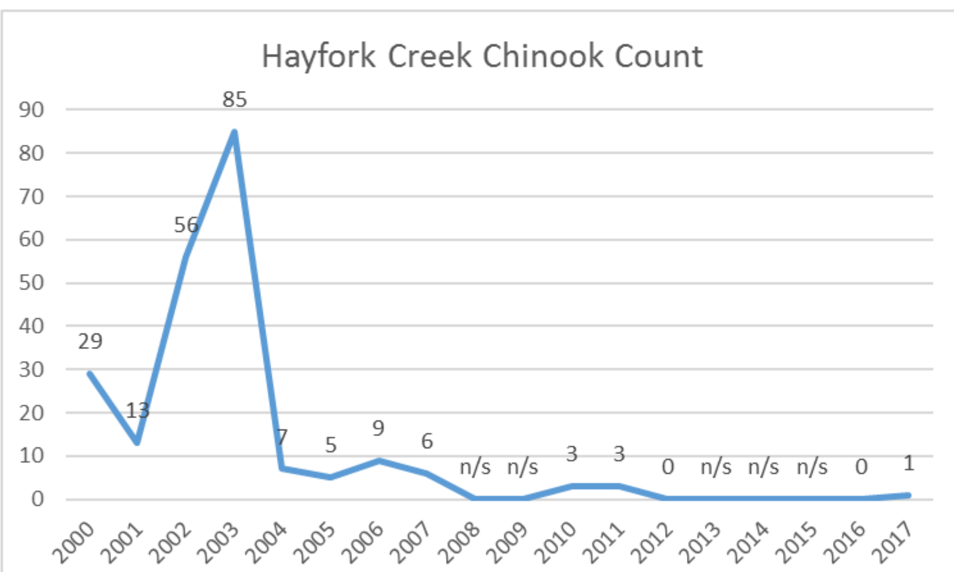


Figure 4.31 Hayfork Creek summer snorkel survey Chinook counts 2000-2017 chart.
Note: n/s = no survey.

4.1.4 Down River Watershed Characteristics

The Hoopa Valley Tribal lands account for a little over 15% of this region, with private property and BLM lands under 5% each. The balance is public, with the majority managed by the Shasta-Trinity National Forest and the remainder by the Six Rivers National Forest (Figure 4.32).

Figure 4.32 Down River region land ownership.

This region shows high terrestrial connectivity with the exception being in the northwest corner of the region, which corresponds to the Hoopa Valley Tribal lands (Figure 4.33). This lower connectivity ranking may indicate a lack of monitoring data rather than actual lower connectivity. High rare species counts tend to run along the western edge of the region. The lower species counts in the wilderness areas north of Highway 299 may indicate lower monitoring efforts due to the remoteness of the area.

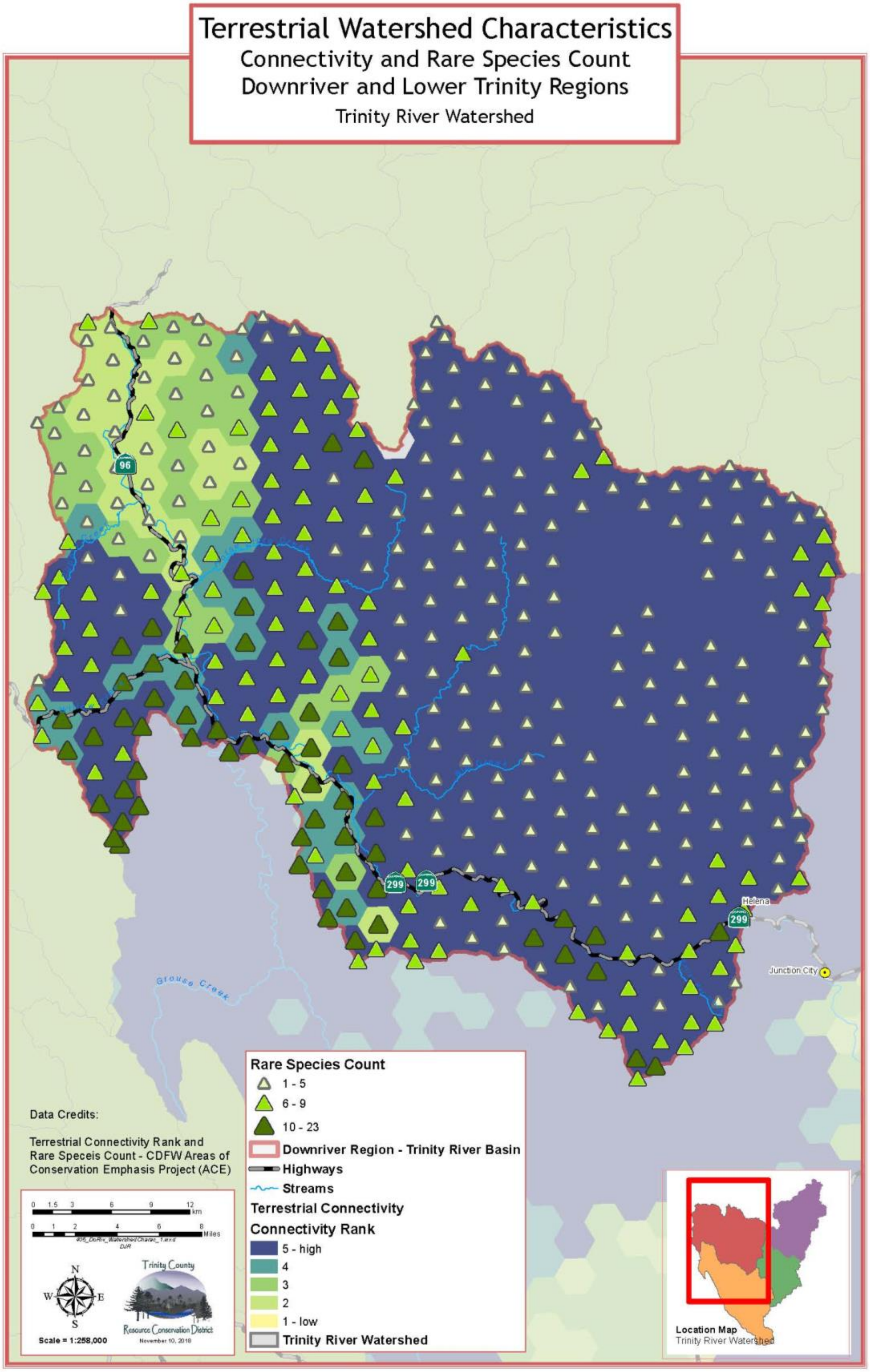


Figure 4.33 Down River region terrestrial connectivity and rare species counts.

The marbled murrelet critical habitat extends into the region as a continuation from the South Fork and is visible on the “hook” formed by Willow Creek on the western side of the region (Figure 4.34). The northern spotted owl critical habitat runs along the western side of the region. Both of these critical habitats overlap with high rare species counts as shown in Figure 4.33.

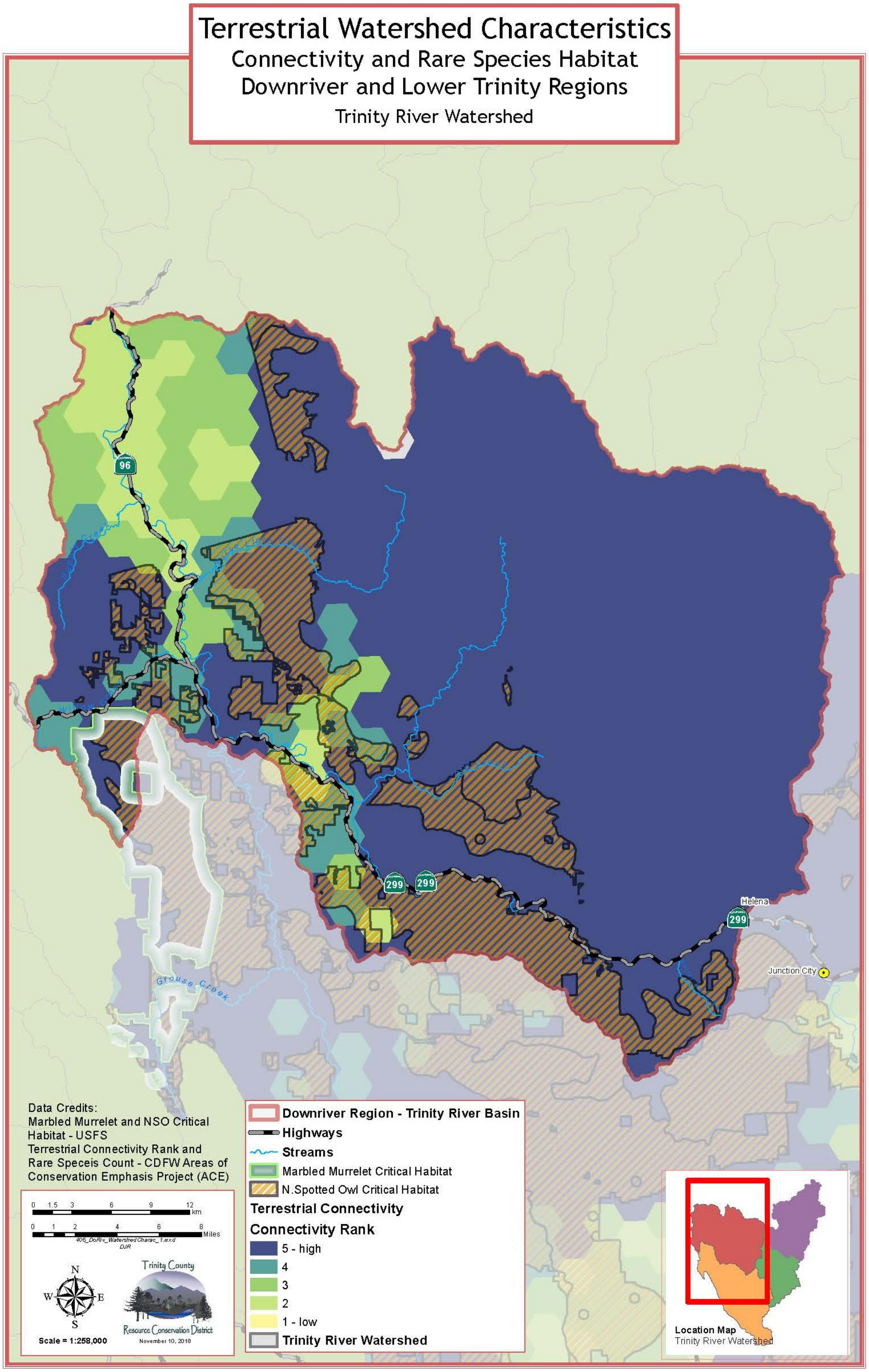


Figure 4.34 Down River region terrestrial connectivity and marbled murrelet and northern spotted owl critical habitat.

Terrestrial game species counts are strong within the region (Figure 4.35), although they don't show the higher counts found near large bodies of water.

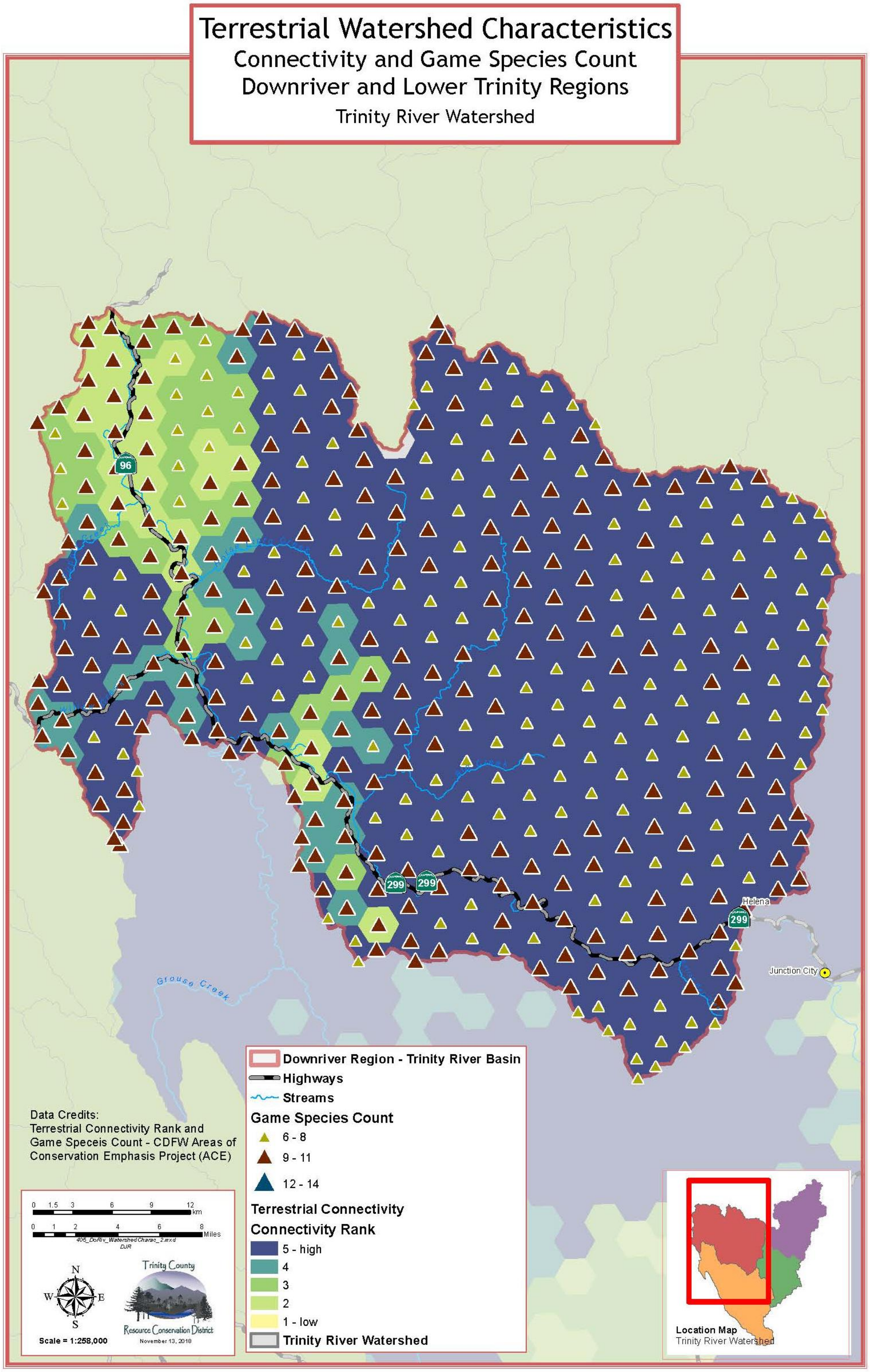


Figure 4.35 Down River region terrestrial connectivity and game species counts.

The ACE data for this region seems to be the most out of line with reality. The New River summer steelhead counts are the highest in the entire watershed (as shown in Figure 4.42), yet that subwatershed is ranked as low to medium for significant aquatic habitat. The lack of monitoring may be impacting the lower rankings. The native invertebrate counts indicate that no monitoring data is available for the New River, but in the watersheds where monitoring has taken place, the counts are all above 30 (Figure 4.36).

Figure 4.36 Down River region significant aquatic habitat and native species richness.

From discussions with Justin Alvarez, Hoopa Tribal Fisheries Biologist, the following watershed characteristics for creeks in the Hoopa Square, should also be noted:

- Green sturgeon are commonly found in a “hole” in the mainstem Trinity River within the Hoopa Square.
- Lamprey are found in all creeks within the Hoopa Square.
- Hospital Creek has a good salmonid run that returns every year despite a major barrier 100 yards from its confluence with the Trinity River.
- Campbell Creek has many distributaries at the confluence with the Trinity River, creating many shallow channels which “block” fish passage.
- Mill Creek offers the most potential for improved runs as there are few man-made impacts in this watershed. Mill Creek is one of the three creeks with the highest returns for Chinook and steelhead, with more Chinook than steelhead according to Alvarez. There is a natural barrier about 5-6 miles upstream of the mouth.
- Tish-Tang Creek has an unimpeded mouth, but there is a natural barrier about 2- 3 miles upstream from the mouth. It is one of the three creeks with highest returns for Chinook, coho and steelhead.
- Supply Creek is one of the three creeks with highest returns for Chinook and steelhead, with more steelhead than Chinook according to Alvarez.
- Hostler Creek has the most potential for coho habitat. Past restoration work on this creek includes in-stream habitat work and removal of a fish passage barrier.
- Soctish Creek does not have high numbers of returning salmonids, but has good aquatic biodiversity.

The observed coho range (hash marked areas in Figure 4.37) and IP rankings for this region show that at one time it provided a good deal of habitat for the species. With six TMDL reference streams, this region shows the strongest aquatic health in the watershed. The summer salmon snorkel survey counts (below) in the New River and North Fork Trinity River backup this observation. Monitoring data is lacking, but the three sites that were monitored for dissolved oxygen show healthy levels.

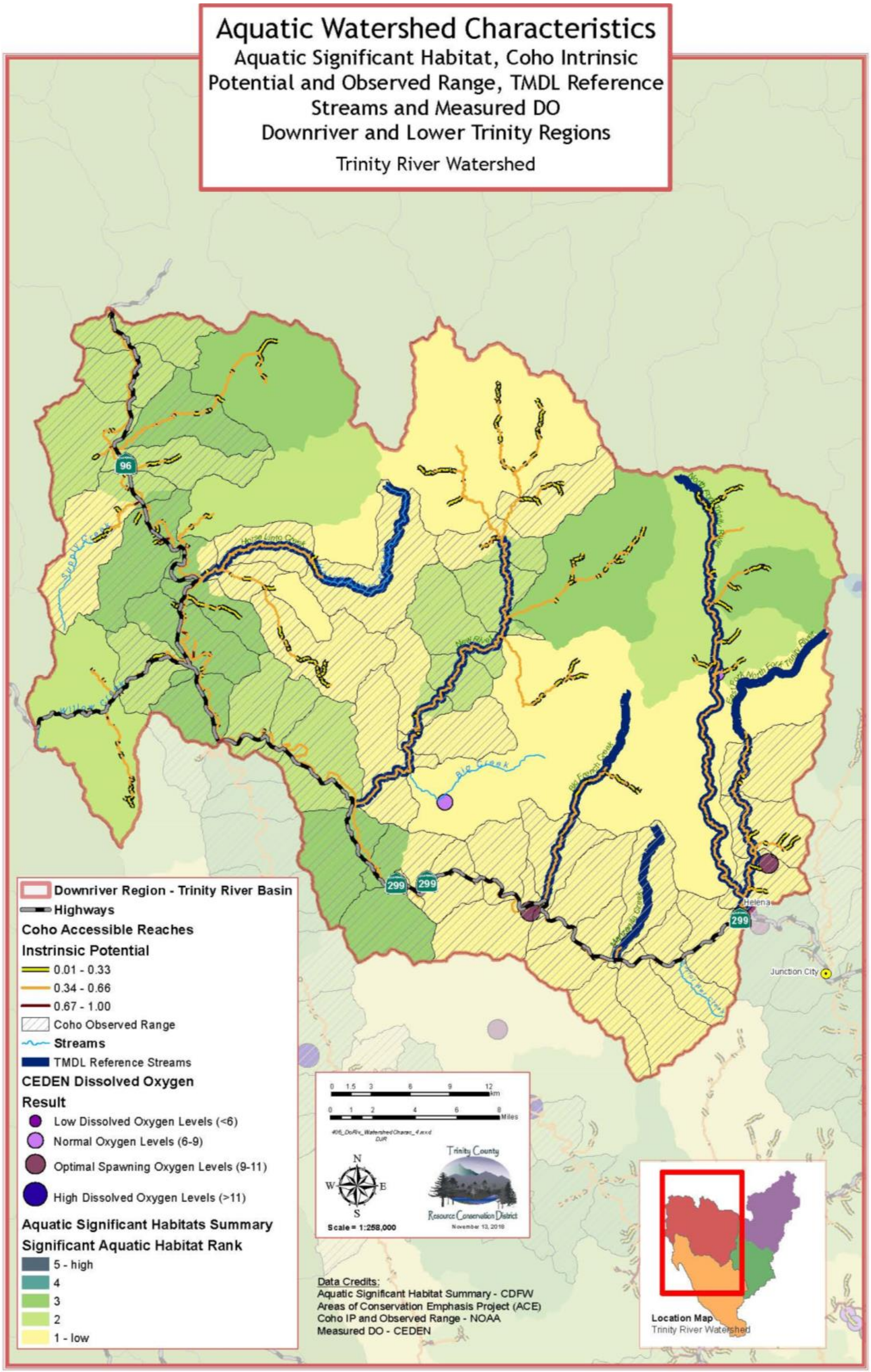


Figure 4.37 Down River region significant aquatic habitat and stream health indicators.

The only watershed showing an increase in overall watershed condition score according to the US Forest Service NW Forest Plan data is the Lower New River (Figure 4.38). The others in the region show a range from slight decreases to very large decreases, especially in the wilderness areas to the north. The high stream temperature measured in the New River Watershed (between the Upper and Lower subwatersheds) was taken in 2000. It seems to be an outlier. Several of the monitoring sites were visited in 1994 with return measurements in 2011.

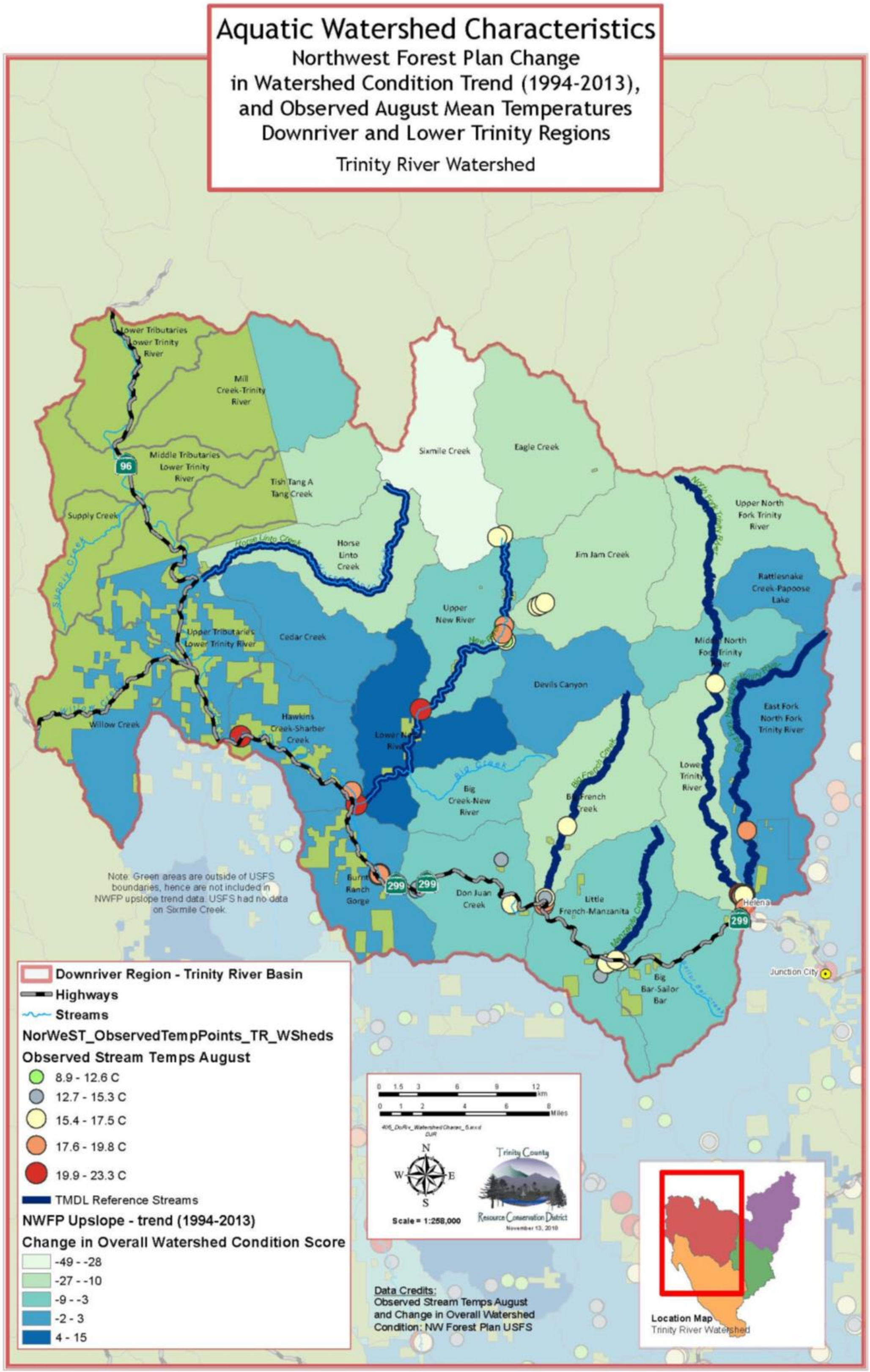


Figure 4.38 Down River region watershed conditions and observed August stream temperatures.

Down River Trinity Fisheries: Summer Snorkel Survey Salmonid Counts *(available for select subwatersheds)*

North Fork Trinity River Summer Snorkel Survey Salmonid Counts

Each year between July and August snorkel surveys are conducted on several streams in the Trinity River Watershed. Trained surveyors record numbers of steelhead, Chinook and coho observed. North Fork Trinity River counts for steelhead (Figure 4.39) are comparable to the New River counts in the last five years, although historically the New River had the highest counts. Chinook counts (Figure 4.40) have been historically low or non-existent.

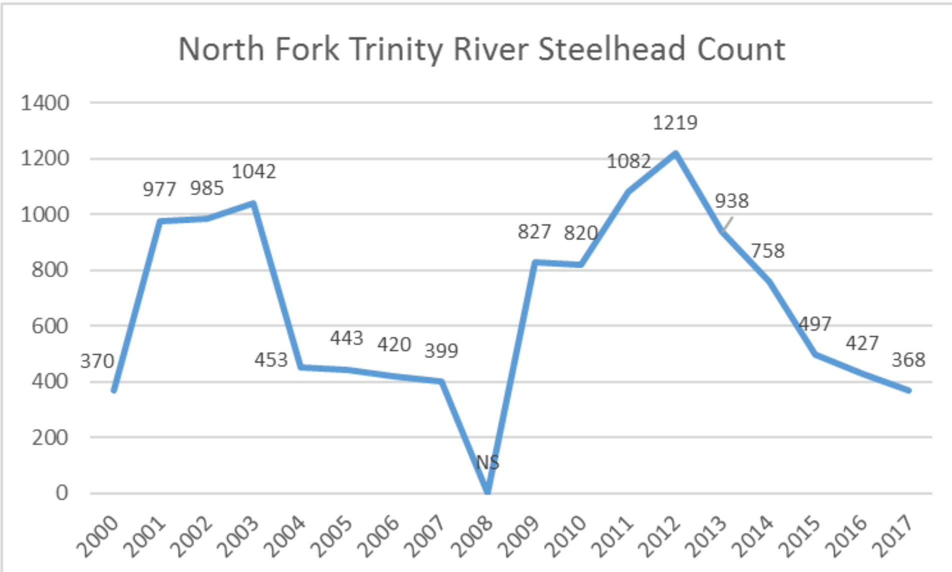


Figure 4.39 North Fork Trinity River summer snorkel survey steelhead counts 2000-2017 chart.
Note: n/s = no survey.

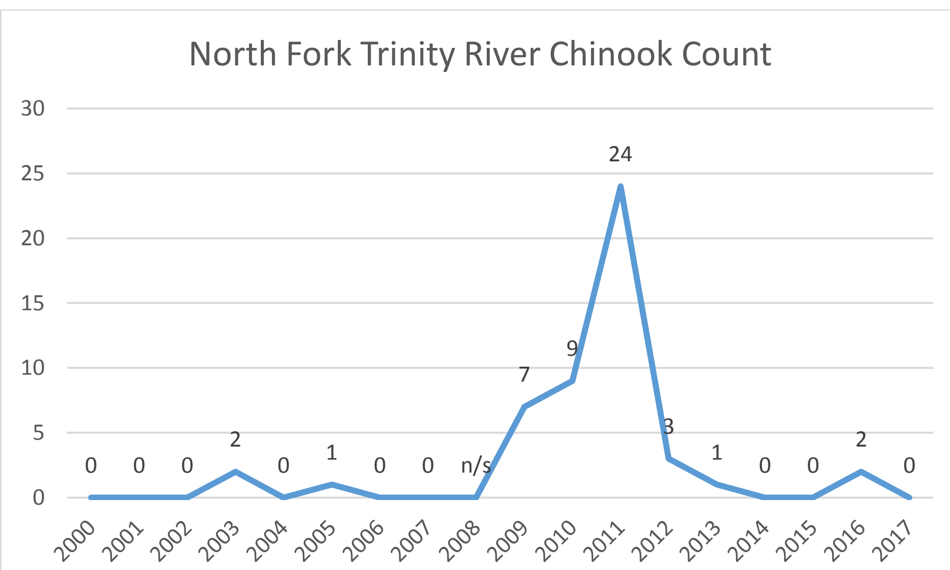


Figure 4.40 North Fork Trinity River summer snorkel survey Chinook counts 2000-2017 chart.
Note: n/s = no survey.

North Fork Trinity River steelhead counts by reach are illustrated in Figure 4.41.

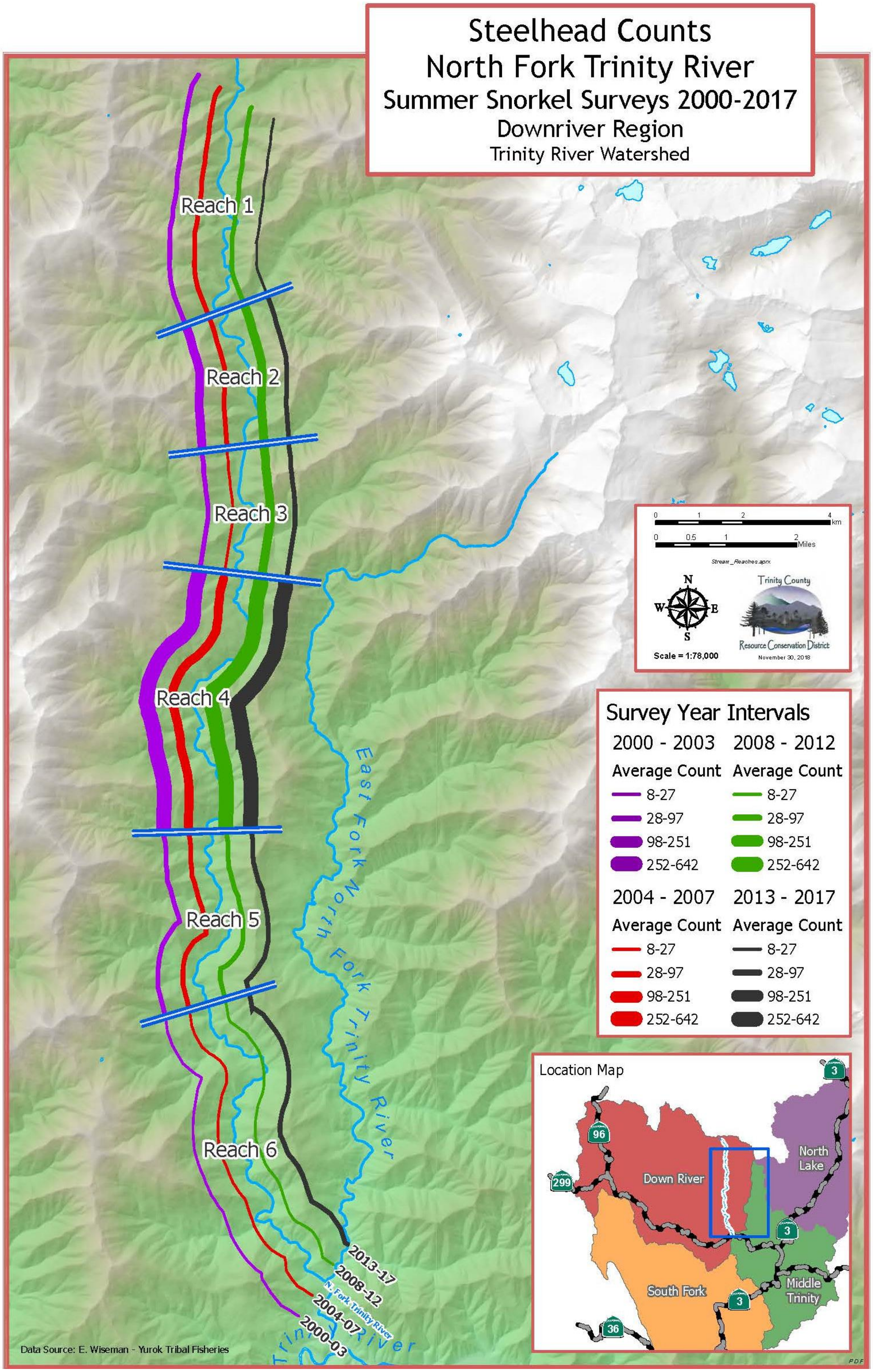


Figure 4.41 North Fork Trinity River steelhead counts by reach.

New River Summer Snorkel Survey Salmonid Counts

The New River has the highest historical steelhead counts in the watershed. Between 2004 and 2008 several reaches were not surveyed. Based on this lack of data, it would be reasonable to conclude that a trend line could be drawn between the count of 1156 in 2003 and 1088 in 2009 without as much of a downward dip as this chart (Figure 4.42) suggests. This lack of data also impacts the Chinook counts (Figure 4.43) as well, suggesting that there may have been a stronger peak in 2006 and not as much of a drop in 2008.

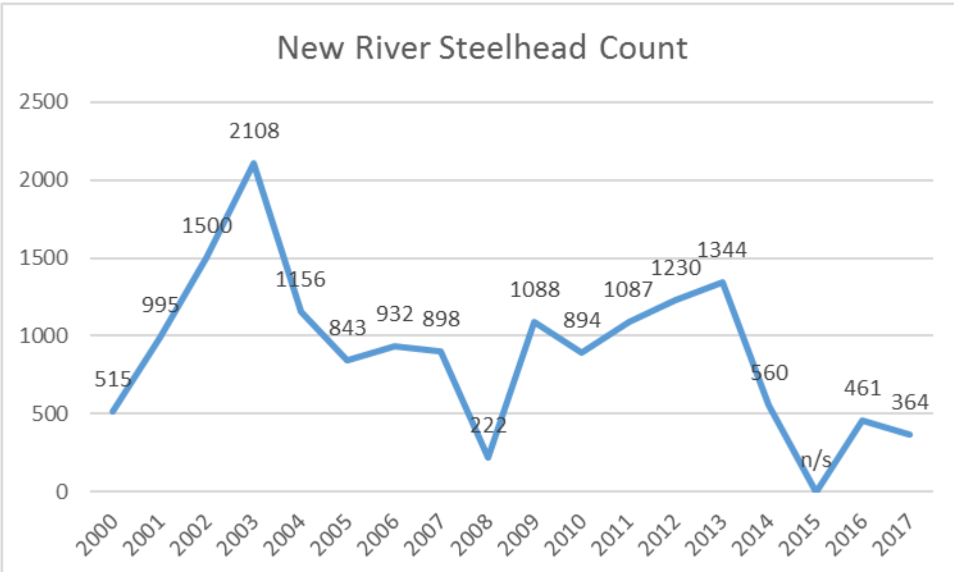


Figure 4.42 New River summer snorkel survey steelhead counts 2000-2017 chart.
Note: n/s = no survey.

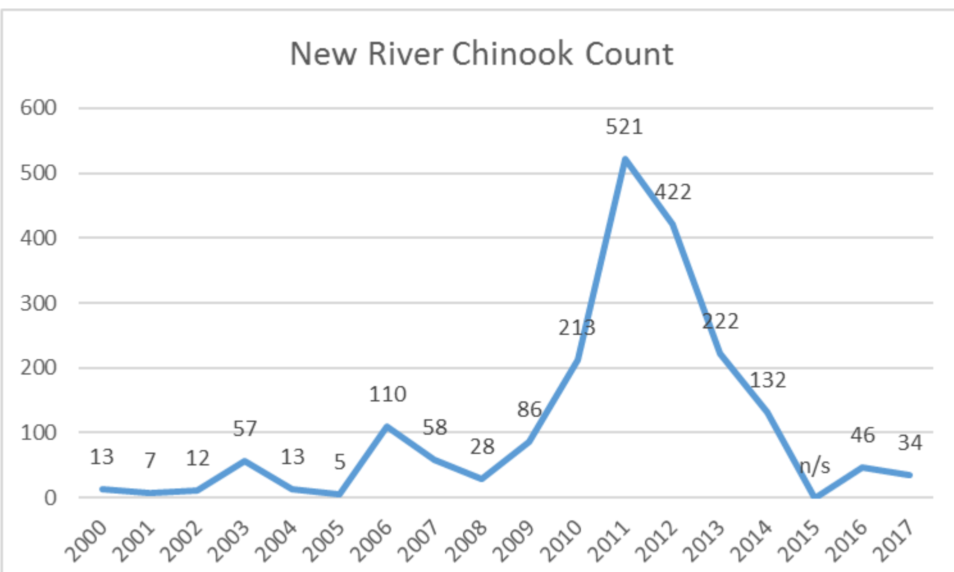


Figure 4.43 New River summer snorkel survey Chinook counts 2000-2017 chart.
Note: n/s = no survey.

New River steelhead counts by reach are illustrated in Figure 4.44.

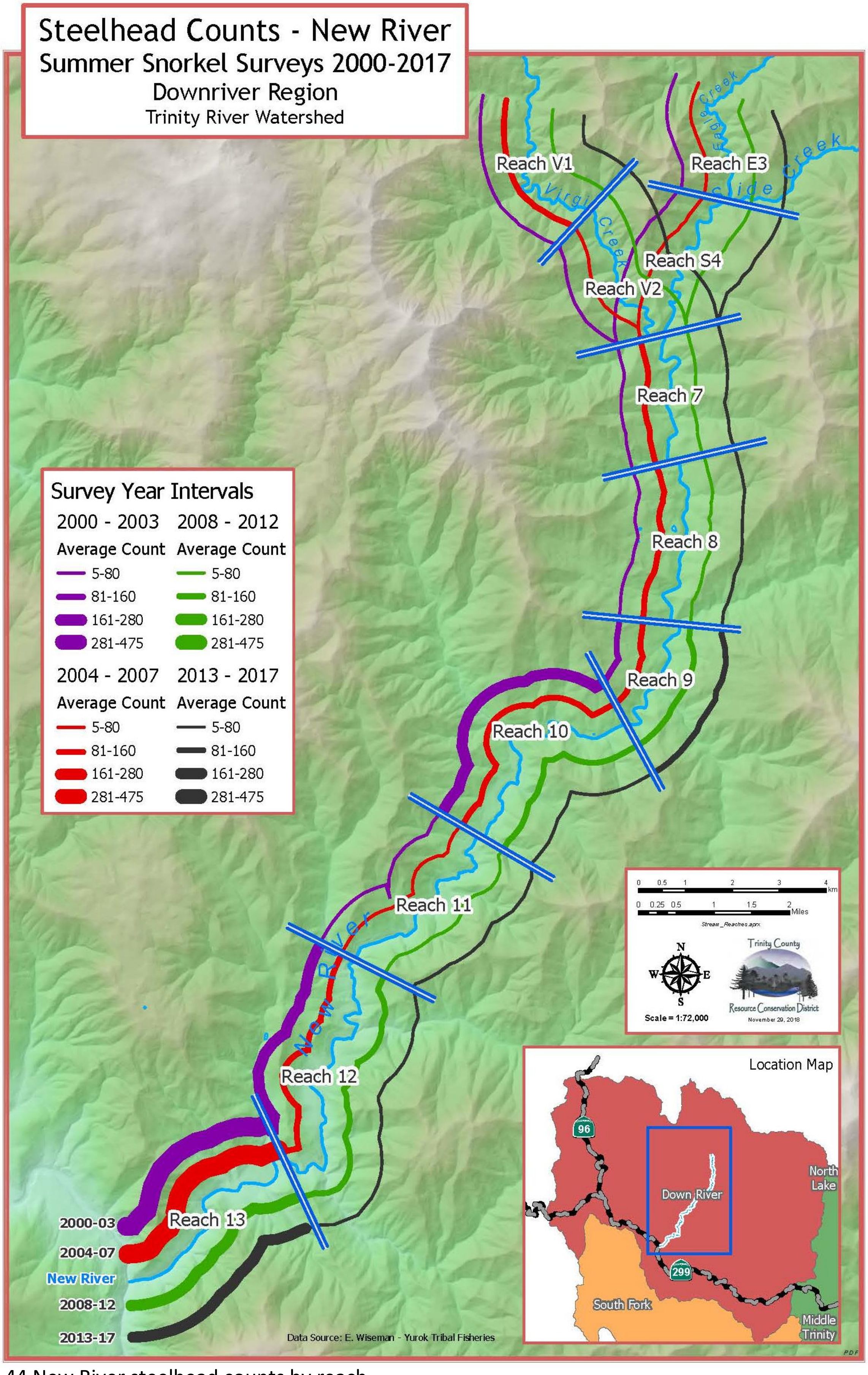


Figure 4.44 New River steelhead counts by reach.

4.2 Identify Key Issues Overview

Identifying key issues in such a large watershed has presented several challenges and some opportunities.

The attributes and features of Trinity River tributaries cover an immense physical range from alpine lakes to flat river valley floors, and everything in between. This geographic range created challenges of identifying key issues for all areas, which was not possible. Areas closer to population centers have had more restoration work completed, more monitoring data gathered, and more eyes on the ground. The vast, rugged landscape posed another challenge – access. Another challenge presented itself in the amount of papers written before GIS was commonly used. It has been impossible, with limited time and funding, to sift through all of the academic papers and convert the data stored there into a geo-referenced analysis. These challenges are two sides of the same coin.

This project funding did provide the opportunity to create new GIS datasets. Based on feedback from many stakeholders in the watershed, it became obvious that a priority had to be given to digitizing the visible mining tailings left in the tributary watersheds. Though mapping visible tailings piles would give some insight as to the effects of mining on the landscape, it was determined that mining impacts as a whole should be mapped. This effort includes tailings piles, hillsides cut by hydraulic mining, and modifications to streambeds and stream channels. Both local knowledge and aerial imagery were used to determine where past mining impacts occurred. Each subwatershed was examined as a whole using National Aerial Imagery Program (NAIP) 2016 imagery. Once evidence of mining impacts was identified, tributaries in which this evidence was present were examined in greater detail. Impacted areas were digitized at this point. Local knowledge was used to pinpoint certain areas along streams that are known to be impacted by mining (particularly Weaver Creek and stretches of the main stem Trinity River near Junction City and Coffee Creek). Once impacts were fully digitized using this method, GIS analysis was performed to calculate the acreage of impacts per subwatershed.

This is a first attempt at digitizing the mining impacts in the watershed and it is highly likely that sites were missed. Perhaps a future effort can be made to increase the detail of this data set.

Another opportunity came in the form of new data. With permission from Trinity County, this analysis includes aggregated data on current or pending commercial cannabis cultivation permits per subwatershed. Several discussions led to the decision to analyze permits rather than try to estimate illegal cultivation sites, past and present. While permitted legal cultivation sites will lead to current and future impacts, many of these sites were illegal at one point in time and the geographic distribution roughly mirrors the distribution of prior illegal cultivation sites, hence it's inclusion in "Past Impacts". Trespass grow sites on public property have had impacts that are not reflected in the permitted parcels. There will be some discussion about these sites as well.

An earlier GIS analysis was completed in 2014 using Google Earth (and on-the-ground monitoring for sediment, flow and excess nutrients) to estimate the impacts of cannabis cultivation in the Trinity River Watershed *(WRTC, 2014)*. However there has been so much change in the industry over the last 3-4 years that it became obvious that an aerial analysis of all cultivation sites would not be accurate due to the dynamic nature of the industry.

Using data held by Trinity County, the number of pending or approved commercial cannabis cultivation permits per subwatershed is analyzed for this report. The hope is that the illegal activity on public lands will subside once it is no longer profitable and the permits will provide an accurate indication of commercial cannabis cultivation activity in the watershed.

Cannabis cultivation requires a great deal of water, with some estimates putting it a 8 gallons of water per plant per day (*WRTC, 2014*) and this led to analyzing the number of cultivation site permits inside and outside of Community Service (water) Districts (CSD). The assumption is made that sites within CSD boundaries are less likely to have major streamflow impacts than sites outside of the CSD boundaries. Per Trinity County ordinances, cannabis cultivators are not allowed to divert surface water between April 1 and October 31, but that water will need to come from somewhere. This issue is analyzed in Section 4-4.

The key issues identified in this section fall into four broad categories and are analyzed for each of the four regions. They are:

A. Past Impacts covers mining, land use and planning, wildfire and cannabis cultivation.

B. Completed restoration projects provides an analysis of where and when projects have been completed, the types of projects completed and the funders involved.

C. Review of existing watershed assessments and analyses for subwatersheds covers management recommendations and priorities established by participating organizations. This section is not as complete as it could be, but all of the assessments are available for perusal at www.tcrcd.net.

D. Stakeholder priorities have been gathered from public outreach events, surveys, major restoration project funders, and members of the Trinity River Watershed Council and assembled here, by region when possible.

4.2.A Identification of Key Issues: Past Impacts Overview

The Trinity River Watershed covers a vast area, but human population density is under 5 people per square mile. However, humans have made a large and lasting impact on the landscape. This section on past impacts includes new human activity that also threatens to have lasting impacts on the health of the watershed. By viewing current conditions through the lens of past impacts, we can identify key issues and spot any new trends that may be developing. The impacts covered in this analysis include:

Mining: The California Gold Rush brought European settlers to the watershed and created the towns and communities that exist today, but their obsession with extracting every ounce of gold still scars the landscape decades later.

Land Use and Planning: Poorly constructed roads built mainly for resource extraction, have led to unnatural sediment loads and fish passage barriers. Lack of foresight in making planning decisions have impacted forest health and water resources.

Wildfire: Fire exclusion has created unintended consequences, with wildfires raging out of control nearly every year, while other areas are vulnerable to stand replacing fire due to fire exclusion.

Cannabis Cultivation: Switching from black market to legalized production is a step in the right direction, but issues concerning watershed health remain.

Mining

Gold was discovered in the watershed at Reading Creek, near current day Douglas City, in 1848. Gold fever hit the Trinity River Watershed bringing miners, businesses and settlers. After about a decade of pan and sluice box mining, the long tentacles of the industrial revolution extended to the local gold mining industry, bringing hydraulic mining to the watershed and forever changing the landscape of the region.

Hydraulic mining uses high pressure, giant water guns, called monitors, to completely wash away hillsides. Historic photos show 100-foot high cliffs with creeks dropping over the edge where a gentle hillside and creek bed were decimated by miners using monitors in search of gold. At the time, the practice was considered a great accomplishment as it required less manpower and was more efficient at extracting gold. Hydraulic mining peaked, in terms of the amount of gold and minerals extracted, in 1892 (*TRRP, April 2018*). However the environmental destruction lasted an estimated 30 years from 1880 to about 1910.

As the "easy" and efficient method of hydraulic mining ran its course, dredge mining became popular, although there was certainly overlap between the use of both methods in the late nineteenth and early twentieth centuries. Dredges ran 24 hours a day, clanking away in the pursuit of riches. Rather than wash away whole hillsides, dredge mining uses a machine to dig up the streambed sands and gravels up to 50 feet deep, process it on board to extract the gold, and then pile the leftovers back in the channel. These are the tailings piles that can still be found throughout the watershed today (*TRRP, April 2018*).

In the early years of the 20th century, the mining industry subsided due to the impact of World War I, which caused mineral prices to fall. During the depression years, 1930 through 1941, gold mining operations increased again, especially small ones. Most of this mining was more for subsistence than in the hopes of gaining wealth. The hard economic times forced many people back into the mountains where hunting, fishing and gardening could provide food for survival. Gold mining helped to provide some hard cash for those items that could not be gathered or grown. The cutting of timber was for building and heating. Between 1945 and 1985, the focus shifted from mining to forest management and logging *(U.S.D.A. Forest Service. March 2003*).

Mining continues today with several legal claims throughout the watershed.

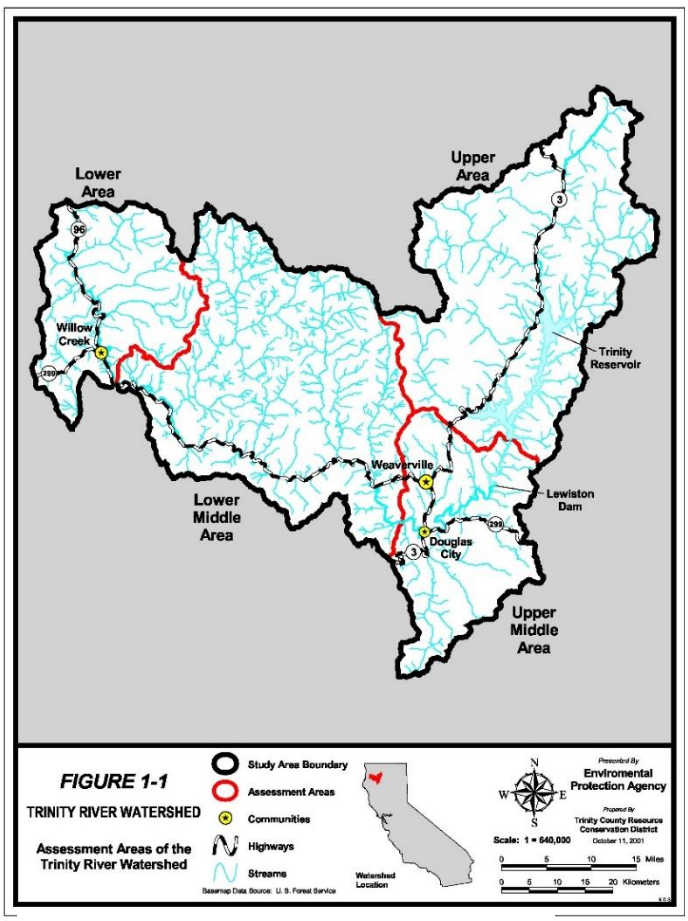
Mining practices destroyed many ecologically important ecotones, including riparian wetlands. Riparian wetlands are complex systems where water and soil meet to create productive micro-ecosystems. Some of the complexity of these systems are based on physical setting, hydrologic regime, soil properties, disturbance and nutrient cycles, and seed banks. Restoring this type of complex system is especially difficult to predict the outcome (*Zedler, October 2000*). The wetlands that existed prior to mining are gone. It is unrealistic to expect that restoration is possible to pre-mining conditions. The native soil was washed away. All of the native, undisturbed wetland plant life was buried at the bottom of tailings piles decades ago, along with the native seedbanks. The importance of wetlands in the ecosystem is recognized on many levels and benefits many species including migratory birds, amphibians, fish, plants, invertebrates and humans. Wetlands are now recognized as carbon sinks, and could help in mitigating climate change (*Zedler, October 2000*).

The number of wetlands destroyed in this watershed is nearly impossible to estimate as very little historic documentation exists. Extensive research would be required to piece together a picture of the native landscape prior to mining. There are areas in the watershed that have not been mined for 50 to 80 years and vegetation has still not regenerated on them. Other riparian areas have regrown trees and shrubs, but the unique wetland hydrology is gone, along with the species that inhabited them. The loss of wetland function as it relates to streamflow – flood attenuation and water storage and release over time – impacts the length of time "perennial" streams flow during the dry season. Many streams classified as perennial no longer have surface flow in August and September. Creating some proxy for wetland function in this watershed will take time and research, and could eventually begin to minimize the impacts of mining on streamflow 170 years after the destruction began.

Tangential impacts from historic gold mining are the restrictions placed on disturbing cultural mining sites, such as tin can dumps and tailings piles. Disturbance of these sites is necessary in order to rehabilitate stream form and function.

Land Use and Planning

A key issue in the watershed – sediment in waterways – is largely caused by historically poor road construction compounded by geologically unstable soils. However, the roads themselves are a result of poor forest health management, poor planning and outdated road construction techniques.



TMDL Regions (US EPA, December 2001)

Early timber harvest practices in the watershed were conducted with no regard for soil type or erosion potential. Creeks were a bother and early lumberjacks would just as soon fill them in as use them to float logs to more convenient places. Many landslides and slumps are directly attributable to roads and water re-direction. Past impacts on fish passage from under-sized culverts, burying streams, and complete blockage due to road construction continue to reduce habitat accessibility.

The first planning document published directing road work to reduce sediment was the Trinity River Total Maximum Daily Load (TMDL)for Sediment (*US EPA, December 2001*). Table 4.6 of the TMDL document summarizes source sediment by category and assessment area. The TMDL document provides detail on sediment source by category and subareas within their watershed regions (*pp 49-51*). At left is the map of the subareas used in the TMDL document. The full document can be found on www.tcrcd.net.

Table 4.6 Sediment Source Summary by Category and Assessment Area (*US EPA, December 2001*)

Source Category		Current Load Estimate by Assessment Area tons/mi^2/yr. (%)			
		Upper	Upper Middle	Lower Middle	Lower
Management Associated Load					
Roads	Landslides	108	186	219	1307
	Cut-Bank	15	59	8	20
	Tread	17	82	9	13
	Other	14	33	6	11
	Total Roads	154 (9%)	360 (27%)	242 (17%)	1351 (45%)
Timber Harvest	Landslides	335	146		124
	Various processes (plot data)	10	18	7	15
	Surface	4	146	3	2
	Total Timber Harvest	349 (21%)	310 (23%)	10 (1%)	141 (5%)
Legacy	Roads	17	31	12	na
	Mining (slides/gullies)	1	57	6	na
Total Management-related		521 (31%)	758 (57%)	270 (19%)	1492 (50%)
Background (Non-Management-associated) loads					
Land sliding		960	352	935	1280
Various Processes (plot data)		110	147	114	110
Bank Erosion		55	35	54	51
Soil Creep		30	40	30	30
Total Background		1155 (69%)	574 (43%)	1133 (81%)	1471 (50%)
Total Sediment Yield		1676	1332	1403	2963

Over the last 20 years a great deal of effort has been spent on mitigating old roads to reduce sediment and increase fish passage, as shown in section 4.2B – Completed Restoration Projects. Based on TCRCD GIS analysis, the estimated miles of "native" or rocked roads in Trinity County is 6,900, with the majority being on US Forest Service managed public lands.

Road inventory projects have created lists of needed work and ranked sites by priority. The first Trinity County effort completed in 2002 was the *Trinity County Culvert Inventory and Fish Passage Evaluation Report*. The final ranking matrix from that report is in Table 4.7. It has been updated with projects that have been completed since the inventory, added or dropped due to new information. Changes were made to the table based on personal communications with Mark Lancaster, Executive Director of The Five Counties Salmonid Conservation Program (5C). The original rankings are included, but comments on the ranking have been removed. Comments can be found in the original document on the 5C website (www.5counties.org).

Table 4.7 – Original complete ranking of Trinity County culvert inventory. Continued on next page.

Ranking for 53 culvert locations on the Trinity County road system (2004). Nine of the original culverts listed in 2004 have been removed from this table because they are not in the Trinity River Watershed (skipped numbers in table: 28, 35, 39, 40, 41, 45, 46, 50 & 52).

Final Rank	Stream Name	Road Name	Initial Rank	2018 COMMENTS
New	Conner Creek	Quail Road	n/a	Added by 5C 2018 – design for tunnel removal complete.
#1	West Weaver Creek	Oregon Street	Tied for 1st	COMPLETED
#2	Little Browns Creek	Roundy Road	Tied for 1st	COMPLETED
#3	Deadwood Creek	Hatchery Road	2nd	COMPLETED
#4	Oregon Gulch	Sky Ranch Road	Tied for 3rd	Not completed. Yurok currently considering this project.
#5	Garden Gulch (and Garden Gulch Dam)	Easter Avenue	Tied for 3rd	Projects 5 and 6 are under consideration by Caltrans
#6	Sidney Gulch	Memorial Drive (and at Hwy 229)	4 th	Projects 5 and 6 are under consideration by Caltrans
#7	East Branch Creek	East Weaver Creek Road	9th	Currently in design phase by 5C (December 2018)
#8	Kingsbury Gulch #1	Riverview Road	Tied for 3rd	
#9	Conner Creek #1	Conner Creek Road	5th	COMPLETED
#10	Kingsbury Gulch #2	Morgan Hill Road	Tied for 6th	
#11	Soldier Creek #1	Evans Bar Road	Tied for 8th	COMPLETED
#12	Soldier Creek #2	Dutch Creek Road	7th	COMPLETED
#13	Conner Creek #2	Red Hill Road	24th	COMPLETED
#14	Barney Gulch	East Fork Road	Tied for 6th	
#15	Quinby Creek	Denny Road	Tied for 8th	After survey, reassessed and declared not fish passage issue because of waterfall downstream
#16	Hall City Creek	Wildwood Road	Tied for 8th	COMPLETED
#17	Little East Fork Creek	Canyon Creek Road	10th	COMPLETED
#18	Sharber Creek	Fountain Ranch Road	11th	COMPLETED
#19	Rarick Gulch	Canyon Creek Road	Tied for 17th	Project to be addressed by 5C in 2019
#20	Conrad Gulch	Canyon Creek Road	Tied for 17th	Project to be addressed by 5C in 2019
#21	Donaldson Creek	Big Creek Road	16th	COMPLETED
#22	Little Barker Creek	Barker Creek Road	Tied for 12th	COMPLETED
#23	Hawkins Creek #1	Hawkins Bar Road	Tied for 20th	

Final Rank	Stream Name	Road Name	Initial Rank	2018 COMMENTS
#24	Hawkins Creek #2	Flame Tree Road	Tied for 12th	
#25	Alder Gulch	Goose Ranch Road	28th	After survey, reassessed and determined not suitable habitat.
#26	Grassy Flat Creek	Hyampom Road	13th	
#27	Summit Creek	Summit Creek Road	29th	COMPLETED
#29	Sidney Gulch	Oregon Street	18th	
#30	Jud Creek	Hyampom Road	Tied for 26th	
#31	Carrier Gulch	Wildwood Road	22nd	
#32	Gwin Gulch	Canyon Creek Road	42nd	Project to be addressed by 5C in 2019
#33	Middleton Gulch	Deerlick Springs Road	19th	
#34	Bell Creek	Denny Road	23rd	
#36	Un-named Trib to South Fork	South Fork Road	Tied for 26th	
#37	Barleyfield Creek	Reading Creek Road	30th	
#38	Un-named Trib to Trinity River	Underwood Mountain Road	27th	After survey, re-assessed and declared too steep for fish to access the limited amount of habitat upstream of culvert.
#42	Slide Creek	Lower South Fork Road	32nd	
#43	McKinney Gulch	Red Hill Road	33rd	Project to be addressed by 5C in 2019
#44	Spring Gulch	Deerlick Springs Road	35th	
#47	Trinity House Gulch	Browns Mountain Road	37th	After survey, re-assessed and declared no habitat upstream of culvert.
#48	Panther Creek – Trib to Trinity River	Denny Road	39th	
#49	Maple Creek	Dutch Creek Road	40th	Project to be addressed by 5C in 2019
#51	Duncan Creek	Summit Creek Rd	42nd	
#53	Mill Creek	Lower South Fork Road	43rd	

Table 4.7 continued.

After updating the original list, the following Table 4.8 provides a condensed ranking of culverts still needing upgrades based on the initial 2002 inventory. They are sorted by the watershed region. No surveys were completed in the North Lake region, as the goal of this inventory was focused on ultimately increasing anadromous salmonid fish passage and opening up habitat above barriers, once they were removed.

Remaining Projects from 2002 Trinity County Culvert Inventory

2018 Condensed rank	Original Final Rank	Stream Name	Road Name	Watershed Region	Subwatershed
5	#23	Hawkins Creek #1	Hawkins Bar Road	Down River	Hawkins Creek-Sharber Creek
6	#24	Hawkins Creek #2	Flame Tree Road	Down River	Hawkins Creek-Sharber Creek
12	#34	Bell Creek	Denny Road	Down River	Lower New River
17	#48	Panther Creek – Trib to Trinity River	Denny Road	Down River	Lower New River
1	#4	Oregon Gulch	Sky Ranch Road	Mid-Trinity	Lower Canyon Creek (Yurok currently considering this project.)
4	#14	Barney Gulch	East Fork Road	Mid-Trinity	Middle Canyon Creek
8	#29	Sidney Gulch	Oregon Street	Mid-Trinity	Weaver Creek
11	#33	Middleton Gulch	Deerlick Springs Road	Mid-Trinity	East Fork Browns Creek
14	#37	Barleyfield Creek	Reading Creek Road	Mid-Trinity	Reading Creek
16	#44	Spring Gulch	Deerlick Springs Road	Mid-Trinity	East Fork Browns Creek
2	#8	Kingsbury Gulch #1	Riverview Road	South Fork	Salt Creek – Hayfork Creek
7	#26	Grassy Flat Creek	Hyampom Road	South Fork	Grassy Flat-Miners Creek
9	#30	Jud Creek	Hyampom Road	South Fork	Rusch Creek-Little Creek
10	#31	Carrier Gulch	Wildwood Road	South Fork	Salt Creek – Hayfork Creek
13	#36	Un-named Trib to South Fork	South Fork Road	South Fork	Hyampom
15	#42	Slide Creek	Lower South Fork Road	South Fork	Happy Camp Creek
18	#51	Duncan Creek	Summit Creek Rd	South Fork	Duncan Gulch-Barker Creek
19	#53	Mill Creek	Lower South Fork Road	South Fork	Happy Camp Creek
3	#10	Kingsbury Gulch #2	Morgan Hill Road	South Fork	Salt Creek – Hayfork Creek

Table 4.8 2018 condensed, updated ranking of culverts still needing upgrades.

The Direct Inventory of Roads and Treatments (DIRT) (*5C, 2004*) completed by the Trinity County Planning Department – Natural Resources Division is another source of information on the state of the roads. This inventory is referred to as the 5C DIRT Report and/or data, as the 5C non-profit organization was created by former Trinity County Natural Resources Department employees after the department was closed by the county. The information in this data set is extensive and there is not time in this analysis to update it. It is believed that the majority of the "High" or "Moderately high" immediacy ditch relief culverts and stream crossings inventoried in the 2004 report are still in need of repair, especially if they are in prior burned areas (*pers. communications, M. Lancaster*). In the regional Past Impacts sections, these wildfire and the above mentioned DIRT data are paired for analysis using GIS.

A more recent road inventory completed by the US Forest Service Shasta Trinity National Forest for sediment source inventory and aquatic and riparian resources road analysis (*North State Resources, Inc., 2012*) provides detailed analysis and recommendations for six HUC5 level subwatersheds in the Trinity River Watershed. The watersheds analyzed are split between the Middle Trinity Region (Grass Valley-Weaver Creek, Browns Creek, and Canyon Creek) and the South Fork Region (Upper Hayfork Creek, Lower Hayfork Creek, and Lower South Fork Trinity River). The USFS has been working on correcting high priority roads listed in this report since 2012. Updated information on those road projects was not sourced for this report.

The California Department of Fish and Wildlife maintains and updates the California Fish Passage Assessment Database (PAD) with an inventory of known and potential barriers to fish passage in the state. Information from PAD covering both natural and man-made total barriers is incorporated into the regional GIS analysis on past impacts. The completed projects in the PAD dataset have been incorporated into Section 4.2B – Completed Restoration Projects.

The government of Trinity County, which is in charge of the practices, policies and procedures for the majority of the watershed, has suffered from lack of funding, lack of expertise, and lack of foresight for decades. Recently they have begun to seriously consider natural resource issues, and are making strides toward progress. Yet serious issues still remain:

- The planners who allowed the Trinity Pines subdivision to be built without concern for water availability were still functioning under the "Wild West" mentality in the 1970s.
- The planners who allowed all of the private parcels along lower Browns Creek and Little Browns Creek to have a "straw" in the creek without concern over future water availability certainly weren't concerned about future fish runs.
- About half of all households in Trinity County get their domestic drinking water from wells or surface water (*Trinity County Grand Jury Report, 2015*), meaning that when people need more water the impacts can be devastating for wildlife.
- Trinity County still remains without a comprehensive grading ordinance. The 2015-16 Grand Jury finding #10 "The Board of Supervisors should promptly adopt a grading ordinance" received a response in September 2016 saying in part "Will be implemented. This ordinance has been on the Planning Department's "to do" lists for several years…and will be drafted when the County finds the funding and staff…" Currently (December 2018) there is no adopted grading ordinance despite promises.
- The 2015-16 Trinity County Grand Jury found (#12) no evidence that the County has been managing water resources for sustainability (satisfying current needs without compromising the future). The BOS disagreed in part, however also answered that some recommendations were not possible due to funding (*Response to Recommendations to 2015-2016 Grand Jury Water Committee*.) The Planning Department offered no response to this finding.
- The permits currently (2018) being issued for commercial cannabis cultivation take no consideration for the number of permits allowed in each subwatershed or if any drainage has already been over allocated.

Norms change over time and as we move into the future we will have to try to mitigate for past decisions and make better ones going forward.

Wildfire

The Trinity County Fire Safe Council exists to coordinate Firewise efforts across agencies across the landscape. The Council celebrated 20 years of coordination in 2018. The Council includes representatives from local, state and federal land management agencies, non-governmental organizations, and interested public and stakeholders, seeking to improve cooperation in all aspects of wildfire management in Trinity County. Over the last 20 years the acknowledgement of the need for returning low-intensity fire on the landscape as a tool has grown in theory and practice, but still remains controversial.

The Trinity River Watershed lies in a fire adapted region where vegetation types and climate have resulted in a natural fire regime represented by frequent mixed-severity fires of every 5-15 years. Native Americans used fire on the landscape for thousands of years to "manage" the forests and over time this lead to adaptations in the ecosystem, plant communities and increased wildlife habitats.

With the exclusion of low-intensity fire from the watershed, combined with under-funded forest management practices, and increasing temperatures and decreasing precipitation, the watershed is at high risk for stand-replacing wildfires. The Trinity County Community Wildfire Protection Plan Update 2015 (CWPP, 2015) states the following:

“(T)he results of fire suppression, eliminating intentional fire use, and past practices such as logging, planting mono-culture tree plantations and failure to adequately manage such plantations, have resulted in unnaturally high accumulation of fuels and increasingly high intensity wildfires. Fire is now under-represented on the landscape, and every year we increase our fire deficit (the number of acres that should be subjected to fire, but are not).”

The CWPP looks at community protection. This report also considers the impact to natural resources, such as source water and the intrinsic value of the landscape when reviewing recommendations in Section 5. As shown in the regional maps, the past impact of wildfire in the watershed is undeniable.

The future impacts of wildfire will likely be much worse. A recent study (*Abatzoglou and Williams, 2016*) found that increased wildland fires in the western United States have been exacerbated by human caused climate change, accounting for an approximate 55% increase in fuel dryness between 1979 and 2015. While other factors also influence the rise in wildfire occurrence, observed warming and drying have created swaths of forest land ripe for stand-replacing fires. The authors state the trend in increased acres burned will continue, as long as forests are standing and fuel is available.

Another study (*Westerling, 2016*) showed a direct correlation between spring and summer temperature increase and large (>400 ha) forest fire frequency. This same study provided evidence that the length of the fire season has increased over the last four decades and that burn times for large fires have increased by over 50 days between 2003 and 2012. Years in which forests experience early snowmelt have more wild fires, with changes in cumulative water-year deficits adding to the potential for more fire.

Cannabis Cultivation

On January 1, 2018 recreational use of marijuana became legal in the state of California. Medical use and sale had been legal since 1996. Trinity County and the entire Trinity River Watershed is considered part of the “Emerald Triangle” as it provides ideal growing conditions for the plant, along with Humboldt and Mendocino Counties. In addition to the private property owners who had been growing it on their property for decades, drug cartels moved in and made trespass grows on public lands a common sight on Google Earth aerial images. Enforcement lagged behind due to the size of the watershed, the difficulty of detecting and accessing the sites and the insufficient number of law enforcement personnel.

With a path now open for legal production, it is hoped that illegal production will become less profitable and the cartels will withdraw from the public lands. Impacts from past illegal production can be viewed through a 2014 pilot study and on-going clean-ups of past sites.

The pilot agricultural impacts study in 2014 conducted by the Watershed Research and Training Center (*WRTC, 2014*) investigated impacts through monitoring streamflow, excess nutrients, land conversion and water use based on estimate cannabis plants in 12 subwatersheds between Lewiston Dam and Canyon Creek. The monitoring took place during an historic drought, providing results that were not as thorough as anticipated. The nutrient monitoring results did show some changes in concentrations below known cultivation sites, but they weren’t significant and had mostly cleared by mid-November when flows were higher. Low flows created difficulties in collecting samples and the authors noted that sampling should be done earlier in the season. The drought (combined with agricultural and domestic use of surface water) led to dry streambeds, creating a landscape that could not offer surface water use data. Many of the measured summer flows of tributaries were less than 1 cfs. Using careful GIS analysis, the authors of the study did provide an estimate of land conversion acres between 2005 and 2012 (Table 4.9), and estimated water use in the 12 subwatersheds (Table 4.10).

Table 4.9 GIS Assessment Results: number of acres of land converted from forest to agricultural production from 2005-2012. Total land area converted in all assessed watersheds was 25 acres. (*WRTC, 2014*)

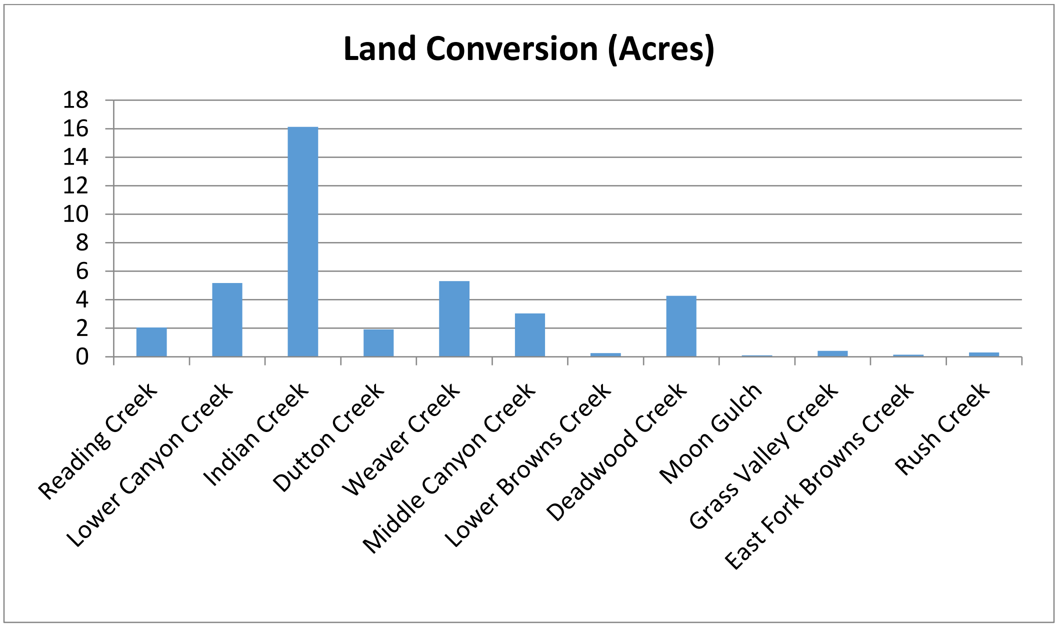


Table 4.10 GIS assessment results by subwatershed of the Trinity River: estimated* cannabis cultivation water use in select HUC6 subwatersheds. (*WRTC, 2014*)

HUC 6 Watershed	Number of Plants	Gallons/Season	CFS
Deadwood Creek	264	356928	0.003268
Dutton Creek	1902	2571504	0.023543
East Fork Browns Creek	99	133848	0.001225
Grass Valley Creek	225	304200	0.002785
Indian Creek	1375	1859000	0.01702
Lower Browns Creek	529	715208	0.006548
Lower Canyon Creek	1783	2410616	0.02207
Middle Canyon Creek	1239	1675128	0.015336
Moon Gulch	200	270400	0.002476
Reading Creek	1098	1484496	0.013591
Rush Creek	24	32448	0.000297
Weaver Creek	1417	1915784	0.017539
		Total Gallons/Season	**13729560**
		Total CFS/Season	**0.125697**

* Estimated water use between June 1 and October 31 using a moderate estimate of 8 gallons per day per plant.

On-going efforts to clean up grow sites from illegal cultivation on public lands continues. Integral Ecology Research Center (IERC) has been at the forefront of monitoring, cleaning and rehabilitating illegal sites once the plants have been removed by law enforcement. Their work with local agencies and non-profits has made inroads on the past impacts, but hundreds of sites remain to be reclaimed. Through a grant from the California Department of Fish and Wildlife, IERC has committed to reclaiming approximately 150 sites in the Trinity River Watershed, with Table 4.11 summarizing their completed work since 2013.

Table 4.11 IERC Trespass Cannabis Grow Site Clean Up Summaries *(www.iercecology.org, 2018)*

Year	Site Location	Pounds of Trash Removed	Pounds of Fertilizer	Toxicants	Water Estimated Returned from Diversions
2013	Hoopa – Supply Creek	1500-2000	1600	Insecticide and Anticoagulant Rodenticide	Not available
2013	Hoopa – Mill Creek Main	3000-5000	3600	Insecticide and Anticoagulant Rodenticide	Not available
2013	Hoopa - Mill Creek #1	Not available	1756	Not available	Not available
2013	Hoopa – Mill Creek #2	2500-3000	2975	Insecticide, Pesticide and Anticoagulant Rodenticide	Not available
2013	Hoopa – Mill Creek #4	Not available	Not available	Not available	Not available
2013	South Fork – Bear Creek	8000	4172	Insecticide, Pesticide and Anticoagulant Rodenticide	14,700 gallons held in dams and reservoirs
2014	Western edge of TR watershed – 7 sites total	8000	8188	Insecticide, Pesticide and Anticoagulant Rodenticide	67.5 million gallons per growing season restored
2015	South Fork tributaries – 7 sites total	24,000	8012	Insecticide, Pesticide and Anticoagulant Rodenticide	39.4 million gallons per growing season restored
2015	Western edge of TR watershed and re-visit Hoopa Supply and Mill Creeks – 6 sites	6100	Not available	Not available	Not available
2016	Large Dubakella site in Salt Creek Watershed	1600	430	Pesticide and Anticoagulant Rodenticide	11.25 million gallons per growing season
2016	Deerlick Springs – Browns Creek Watershed	7350	n/a	Insecticide and Anticoagulant Rodenticide	8.1 million gallons per growing season
2017	Oak Knob and Ganior – South Fork	5140	1387	Insecticide and Anticoagulant Rodenticide	16.45 million gallons per growing season
2017	Jim Jam and Denny – New River Tributaries	4200	~300	Pesticides	10 million gallons per growing season
2018	Hayfork and Burnt Ranch – 8 sites	13,380	Not available	Not available	Not available

IERC has also documented the impacts to wildlife at these trespass sites on public lands. Black-tailed deer (*Odocoileus hemionus columbianus*) have been illegally harvested, snared or poisoned. Black bear (*Ursus americana altifrontalis)* and gray foxes (*Urocyon cinereoargenteus*) have been poisoned. Poisoned rodents have passed toxins up the food chain to higher predators such as Pacific fishers (*Pekania pennant*) and northern spotted owls (*Strix occidentalis caurina)*. One 2016 rehabilitation site is located in the range of a known herd of Roosevelt elk (*Cervus canadensis roosevelti)*, with hunters being put in danger as they lawfully hunt big game. The IERC Deer Lick Springs report sums it up:

> *These illegal cultivation sites on public lands have a long list of deleterious impacts towards natural resources upon which many wildlife species are dependent. They divert large amounts of water, fragment landscapes in order to cultivate marijuana plants, and contaminate native plants, soil and water resources with either legal or illegal pesticides not intended for use in remote forested areas. Finally, due to the clandestine nature of this activity, armed growers occupy many of these sites for several months who in turn poach and maliciously poison wildlife.*

A recent research paper (*Gabriel, et.al 2018*) found anticoagulant rodenticides in 70% of northern spotted owls and 40% of barred owls *(Strix varia*) tested in remote locations in Humboldt County. This rodenticide is more commonly found in agricultural areas and not remote forested areas. The findings are of concern because of the remote location and the illegal use of the pesticide in cannabis cultivation in remote forested areas.

Further research on cannabis cultivation impacts on the watershed was undertaken by the Trinity County Grand Jury. In the 2014 – 2015 Trinity County Grand Jury Report section on impacts from illegal cannabis cultivation several areas of impacts were cited, including water diversion and depletion, water contamination, pesticides and fertilizers, soil contamination, illegal substandard road building/grading, illegal substandard land clearing, introduction of non-native soils and general nuisance. Since this report was written, the county has created and adopted several ordinances related to commercial cultivation. However, the Grand Jury report did include an analysis of the increase in the number of requests for well drilling permits compared to the number of permits issued for septic tanks, with the assumption that they should be about equal. Table 4.12 is from the Grand Jury report and also includes numbers for 2015-17 permits, as furnished by the County Planning Department.

Table 4.12 Number of well drilling and septic tank permits issued in Trinity County by year (*Trinity County Grand Jury 2014-2015 Report and Trinity County Planning Department*).

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Well Permits*	30	64	59	73	64	76	93	82	111	150	260	300	299	192	174
Septic Tank Permits**	17	115*	63	49	37	37	45	35	29	25	24	38	67	111	97
Ratio of Well to Septic Permits	1.76	0.55	0.94	1.49	1.73	2.05	2.07	2.34	3.83	6.00	10.83	7.89	4.46	1.73	1.79

* An ordinance for cannabis cultivation in 2012 led to an increase in well drilling permits.
** 2005 was the year before the septic permit fee was significantly increased, leading to a jump in the number of permit applications.

By calculating the ratio between the number of well permits and septic tank permits, the peak year was 2014, when nearly 11 well permits were issued for every 1 septic permit, indicating that cannabis cultivation outstripped development for residences. However, the ratio in 2017 and 2018 dropped back down to almost the same level as 2004. Without knowing where the wells and septic tanks are located, it is difficult to assess the impacts to individual subwatersheds.

Mining, land use, wildfire and cannabis cultivation have had impacts throughout the watershed to one degree or another. The following sections examine the impacts by region.

4.2.A1 North Lake Past Impacts

Mining

Mining impacts are still visible today in this region. Figure 4.45 provides an illustration of a recent analysis.

Figure 4.45 North Lake region mining impacts.

Note: This mining data is based on an analysis completed by the TCRCD GIS department and represents only an estimation of impacts. The digitization effort includes visually identifying tailings piles, hillsides cut by hydraulic mining, and modifications to streambeds and stream channels. Both local knowledge and aerial imagery (National Aerial Imagery

Program (NAIP) 2016) were used to locate past mining impacts. Once evidence of mining impacts was identified, tributaries in which this evidence was present were examined in greater detail. Impacted areas were digitized. Local knowledge was used to pinpoint certain areas along streams that are known to be impacted by mining (particularly Weaver Creek and stretches of the mainstem Trinity River near Junction City and Coffee Creek). Once impacts were fully digitized, GIS analysis was performed to calculate the acreage of impacts per subwatershed.

Almost directly east of the community of Coffee Creek is the site of the historic Bonanza King Mine. Without doing a ground-truthing exercise, it is difficult to tell from aerial imagery the exact size of impact. While acknowledging it in this narrative, it is not represented on the map.

The North Clair Engle Lake subwatershed shows the highest acreage for mining impacts. Tailings piles are up to 20-feet tall along Highway 3 and in the Trinity River channel. An area called “Carrville Ponds” are ponds formed by river water flowing through/under the tailings piles and creating ponds. Very little vegetation grows in this area.

The Coffee Creek watershed was mined all the way into the current Trinity Alps Wilderness Area. The East Fork of the Trinity River was also impacted by mining. The Altoona Mine contaminated portions of this watershed with mercury. The state of California has issued fish consumption advisories for Trinity Lake and East Fork Trinity River (https://oehha.ca.gov/fish/advisories/trinity-lake-and-east-fork-trinity-river), Carrville Pond (https://oehha.ca.gov/advisories/carrville-pond), the Trinity River upstream of Trinity Lake (https://oehha.ca.gov/fish/advisories/trinity-river-upstream-trinity-lake), and Lewiston Lake (https://oehha.ca.gov/advisories/lewiston-lake).

Land Use and Planning

In 2005 and 2006 two separate reports (*USFS, 2005*; and *TCRCD, 2006*) on the North Lake region reviewed sediment sources, forest health/vegetation management, watershed condition, fire and fuels, and managing Port Orford Cedar.

The 2006 TCRCD report cited the East Fork Trinity River Watershed as having the greatest amount of human caused erosion when it is expressed as a percentage over natural background erosion (*US EPA, 2001*). The Stuart Fork and Coffee Creek watersheds are the most predisposed to surface erosion from management activities. Based on the sediment source inventory prepared for the Trinity River TMDL, the Main Trinity River watershed contributes the most sediment per unit area from both natural and land-use activities. The report made several recommendations for road management to reduce sediment (see Section 4-2C. for a summary). The North Lake region road density and high priority roads map (Figure 4.46) shows the locations of the high priority roads needing treatment within the network of roads in the North Lake region cited in the 2006 TCRCD report, including:

> Coffee Creek Road, Delta Road, Eagle Creek Loop, Eagle Creek Road, Eastside Road, Long Canyon Road, North Derrick Flat Road, Rainier Road West, Ramshorn Road, Slate Mountain Road, Swift Creek Road, Trinity Alps Road, and Van Ness Road.

The communities in the North Lake region use septic tanks, as there are no sewer districts. Residents in Trinity Center are provided with domestic water from the Trinity Center Mutual Water District and the Trinity Knolls Mutual Water District. For other areas of the North Lake region, domestic water is sourced from wells, springs and surface water.

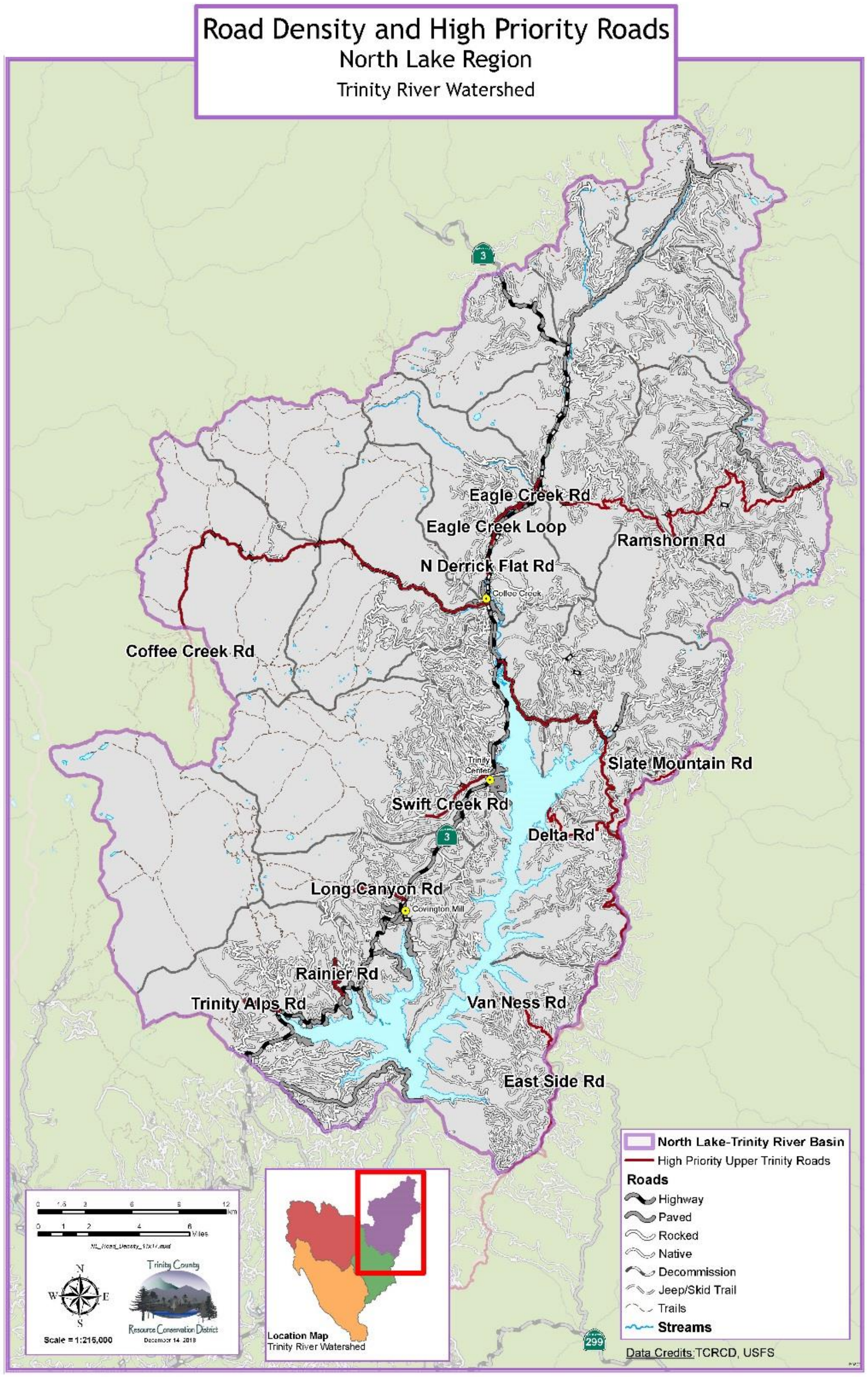


Figure 4.46 North Lake region road density and high priority roads.

Wildfire

The 2005 Upper Trinity Analysis (*USFS, 2005*) and the Upper Trinity Assessment (*TCRCD, 2006*) both provide excellent information regarding the threat of wildfire in this region. Wildfire has not been widespread over the last 40 years in this region as shown in Figure 4.47, creating an even greater need for forest management. The forest health described in the 2006 TCRCD assessment still remains accurate 12 years later:

> *'In general the low to mid-elevation forested areas of the watershed are at an increased hazard of stand-replacing fire due to high fuel loading. Effective fire prevention and suppression programs and the lack of timber management on federal forestlands have altered the character of the forests, resulting in*

extremely high fuel loads and combustibility. High fuel loads could produce catastrophic wildfires with the potential to destroy wildlife habitat and private property, including community water systems, houses and timber stocks, and to increase soil loss and sedimentation.'

High to medium high immediacy culvert and stream crossing projects recommended by the 2004 DIRT inventory are included with fire history since 1980 in Figure 4.47. Work on the majority of these sites remains to be completed (*personal comm. M. Lancaster*) and recent fire can worsen the conditions. The 2018 Carr Fire approached the North Lake region on the southeastern edge. It was stopped before advancing too far into the area. Fuels reduction projects near communities have been implemented over the last 20 years, however much of the region is unpopulated and needs immediate attention to reduce the risk of catastrophic fire.

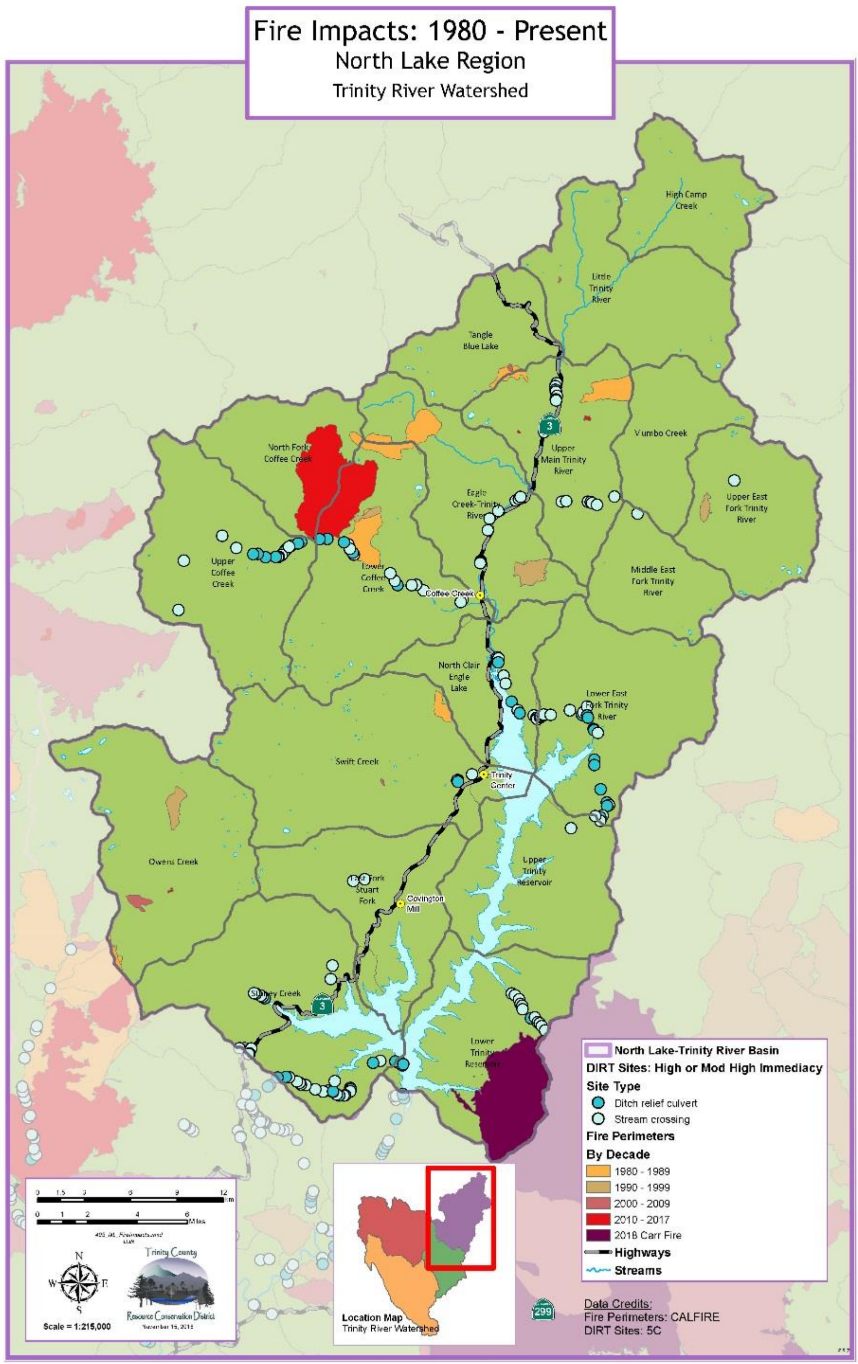


Figure 4.47 North Lake fire history and recommended culvert and stream crossing projects.

Cannabis Cultivation

The North Lake region of the watershed provides the least conducive climate for cultivating cannabis as it is colder than the rest of the watershed. No permits have been sought or issued within the few water districts in the region. As Figure 4.48 shows, cannabis cultivation permits are associated with two parcels in both the Swift Creek and Eagle Creek-Trinity River subwatersheds. Permits are associated with one parcel in each of the Lower Coffee Creek and Lower East Fork Trinity River subwatersheds. Trespass cultivation activity on public land has also been sparse in this region.

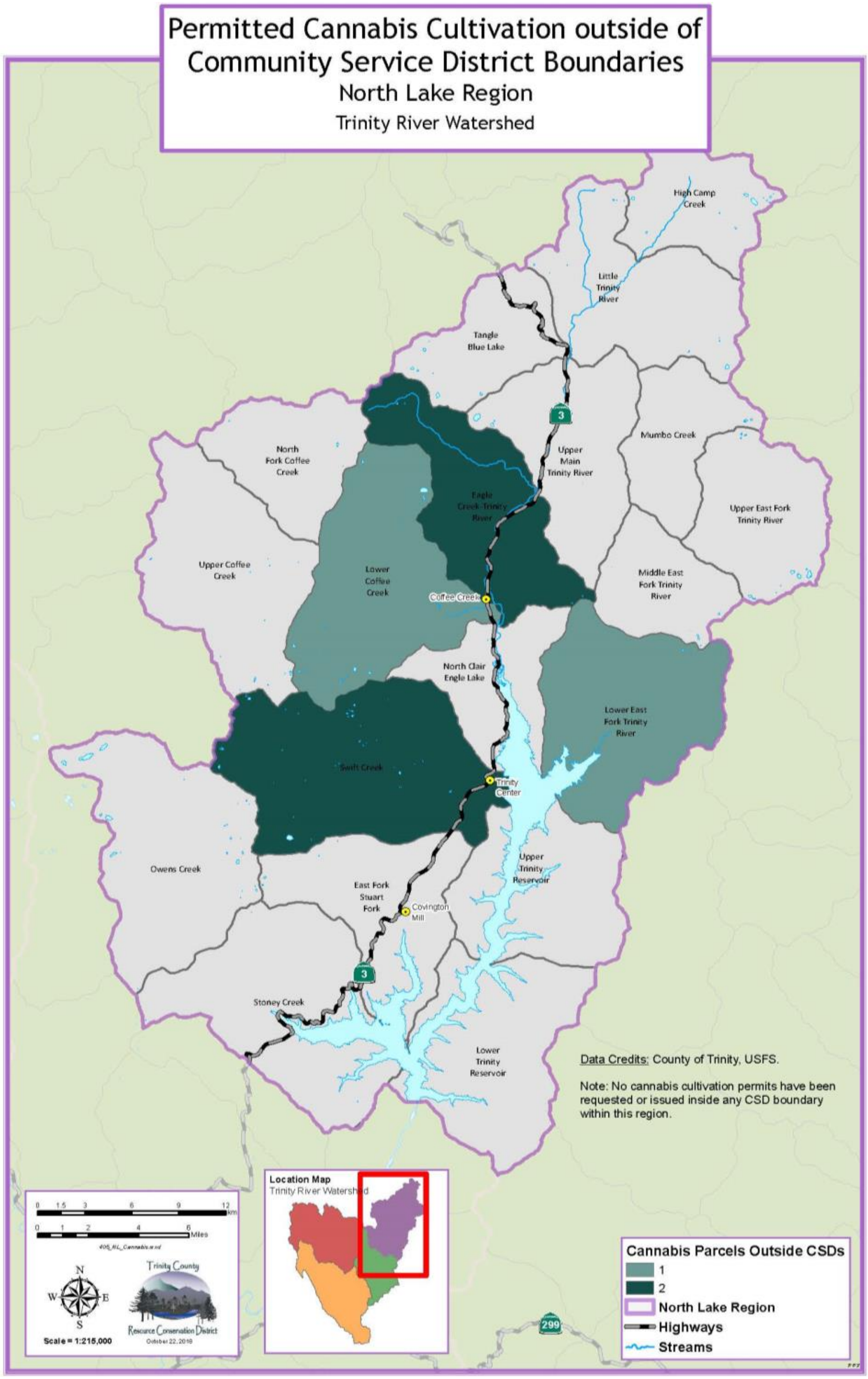


Figure 4.48 North Lake region cannabis cultivation permits outside water districts.

4.2.A2 Middle Trinity Past Impacts

Mining

The Middle Trinity region of the watershed still suffers from mining impacts (Figure 4.49). Thousands of acres of the watershed were turned over multiple times in search of gold and other precious minerals. The general consensus of residents of Weaverville is that the entire town was built on top of tailings. The topography is forever changed from pre-mining time. Many areas in the Middle Trinity region have tailings piles with no visible revegetation. Mining practices devastated many of the riparian areas and wetlands, with many areas devoid of native soils and seed banks.

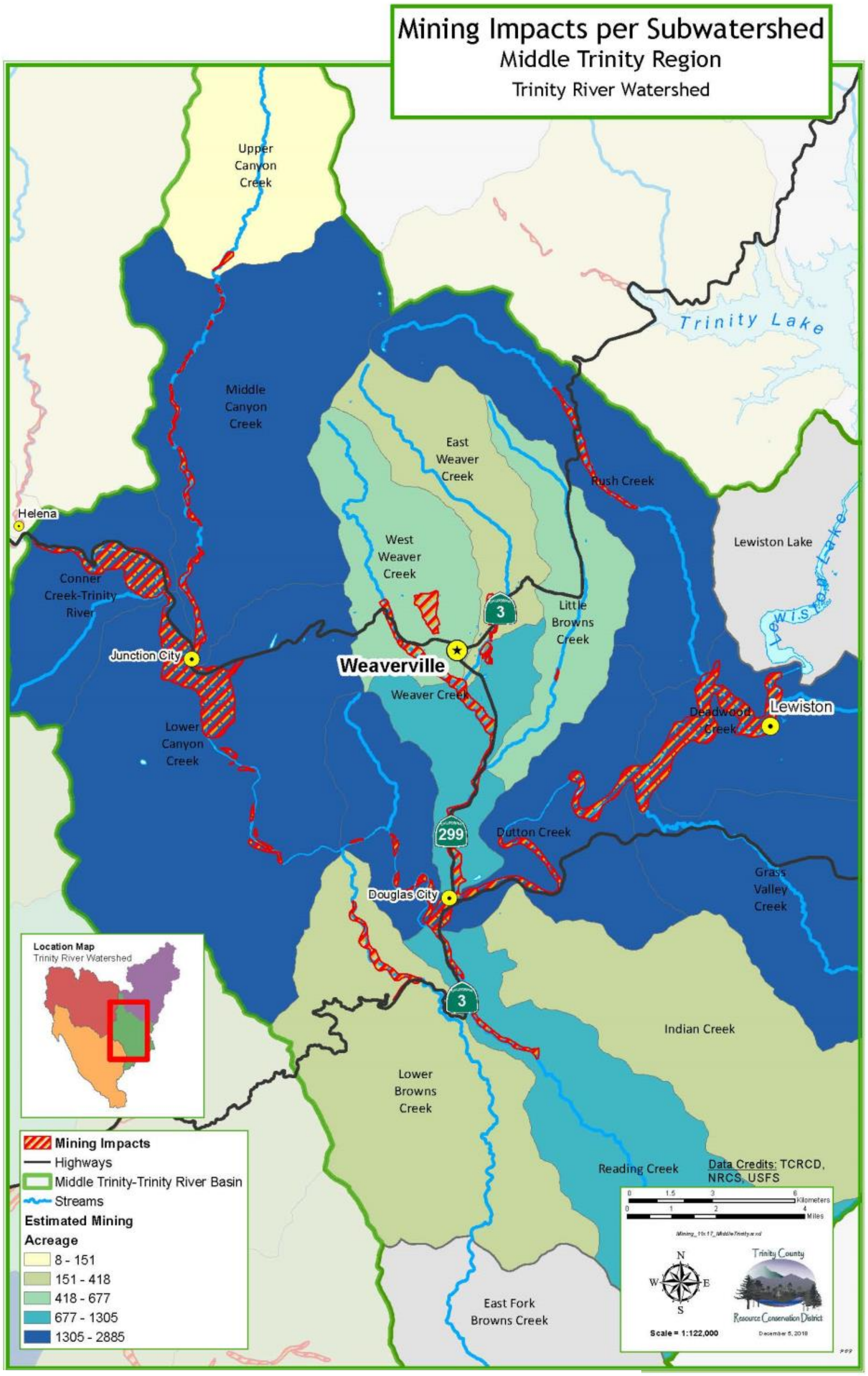


Figure 4.49 Middle Trinity region mining impacts.

Land Use and Planning

The Middle Trinity region of the watershed has the highest population of the entire watershed. More roads are paved in this region, but because of the higher population, sediment from unpaved roads is still high. Figure 4.50 illustrates the road density in the region.

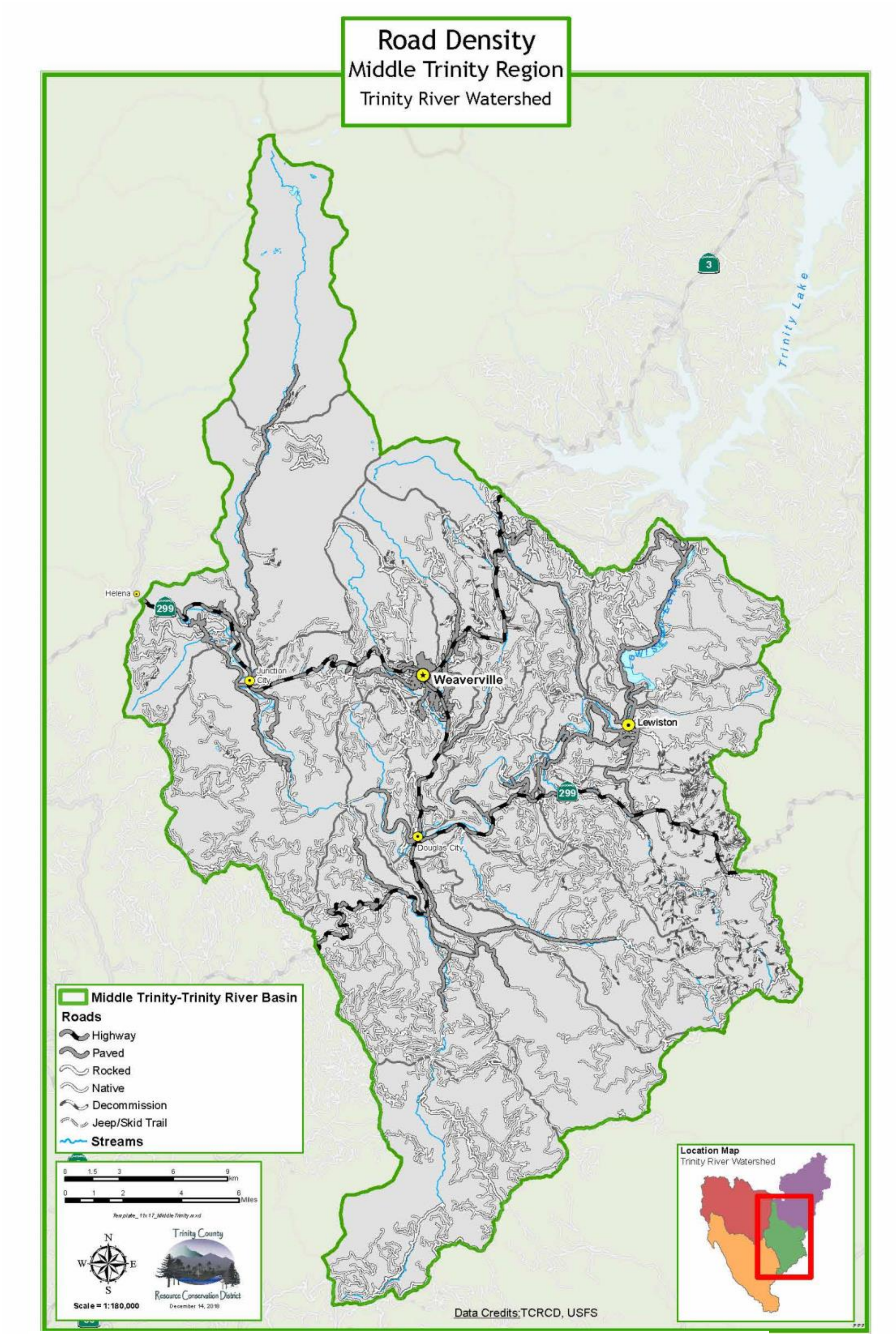


Figure 4.50 Middle Trinity region road density.

Tied closely with road density are fish passage barriers as shown in Figure 4.51 from the CDFW Passage Assessment Database (PAD), and erosion potential from the Direct Inventory of Roads and Treatments (DIRT), shown in Figure 4.52 respectively.

The “Total” barriers and “Partial” barriers in the fish passage barrier maps are from human related activity, such as the total barrier above Lewiston representing the Lewiston Dam. The partial barriers are mostly in conjunction with some type of road infrastructure or diversion. The natural barriers represent waterfalls (total barriers) or instream structures (partial barriers) that block passage at low flows.

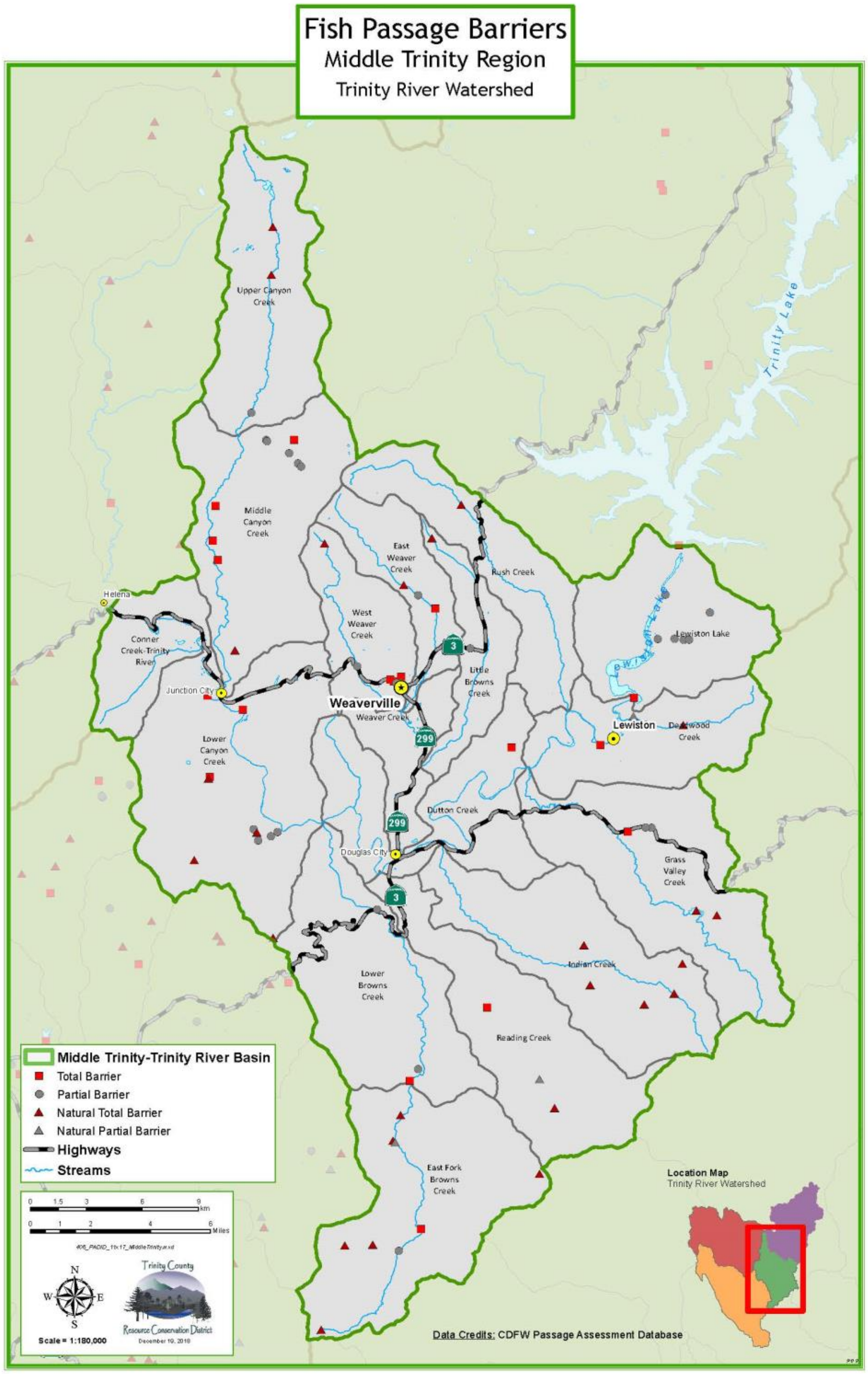


Figure 4.51 Middle Trinity region fish passage barriers.

The erosion potential locations were assessed in 2004. With 14 years having passed since the assessment, there are bound to be some changes, however the current areas of highest potential are likely to mirror those from this 2004 inventory. The Deadwood Creek Watershed east of Lewiston was impacted by the 2018 Carr Fire. On the ground surveys in October 2018 revealed high sediment loads from the fire impacts, which will erode into the Trinity River. The high erosion potential shown in the upper East Weaver Creek Watershed is still accurate as there was a mass-wasting event in 2015 on East Weaver Creek.

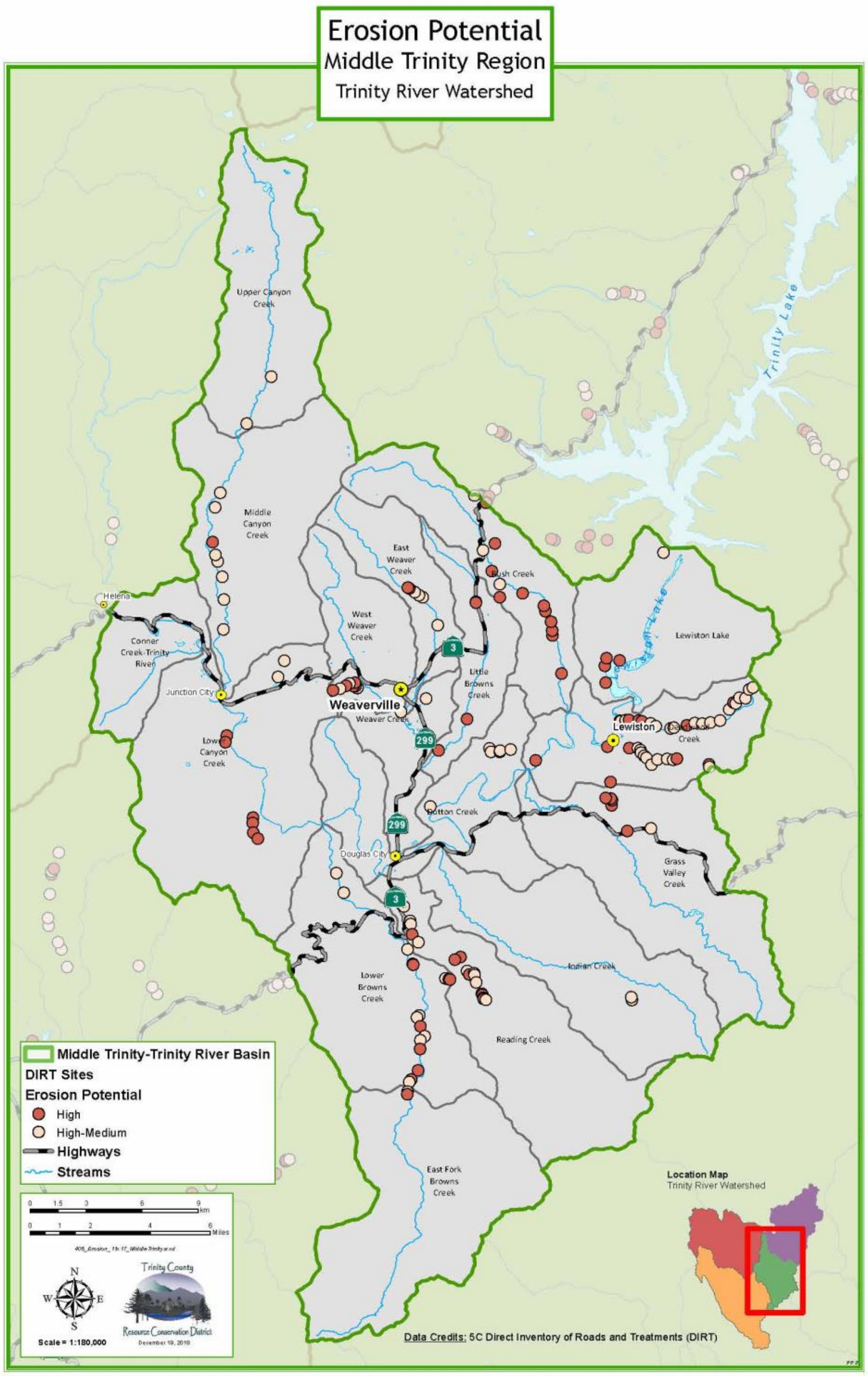


Figure 4.52 Middle Trinity region erosion potential.

The communities in the Middle Trinity region use septic tanks outside of Weaverville and parts of Lewiston. Residents in Weaverville, Douglas City, and certain parts of Lewiston receive treated domestic water from water districts. For other areas of the region, domestic water is sourced from wells, springs and surface water. Land use planning which allowed development without defined water sources is evident in both the Little Browns Creek subwatershed and Browns Creek Watershed. In Figure 4.53 the long narrow parcels were designed so more properties would have access to Little Browns Creek, a once perennial stream that now goes dry each summer. There are 123 parcels shown in this map covering approximately 1,400 acres. There are an estimated 79 dwellings in this area.

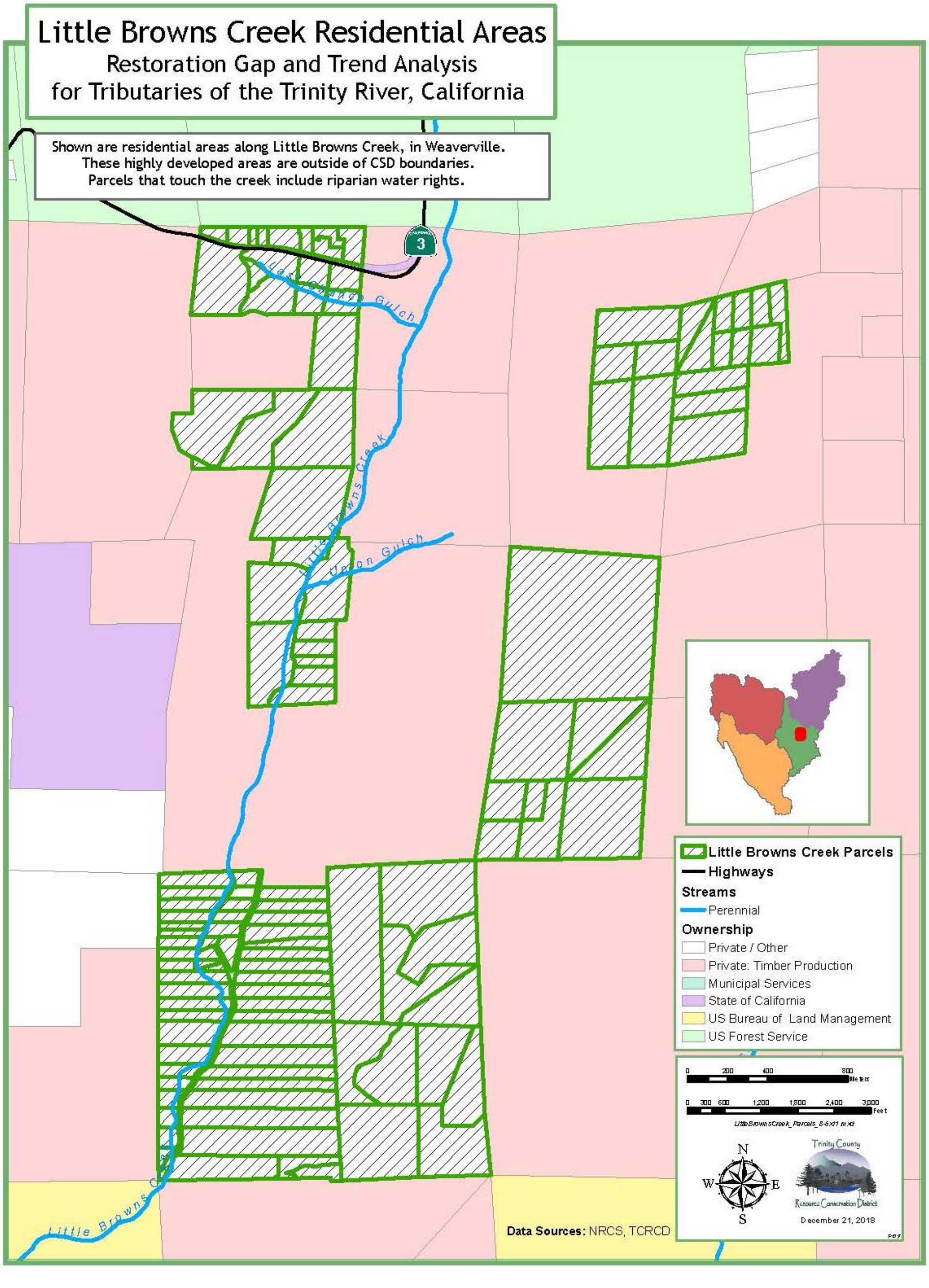


Figure 4.53 Middle Trinity region Little Browns Creek parcel density.

The Browns Creek watershed contains a total of 175 parcels, with 129 dwellings, covering approximately 1,600 acres. Several clusters of parcels within this subwatershed indicate planning efforts were made to offer as many riparian water rights as possible. Figure 4.54 shows several areas with long, narrow lots designed to contact the creek.

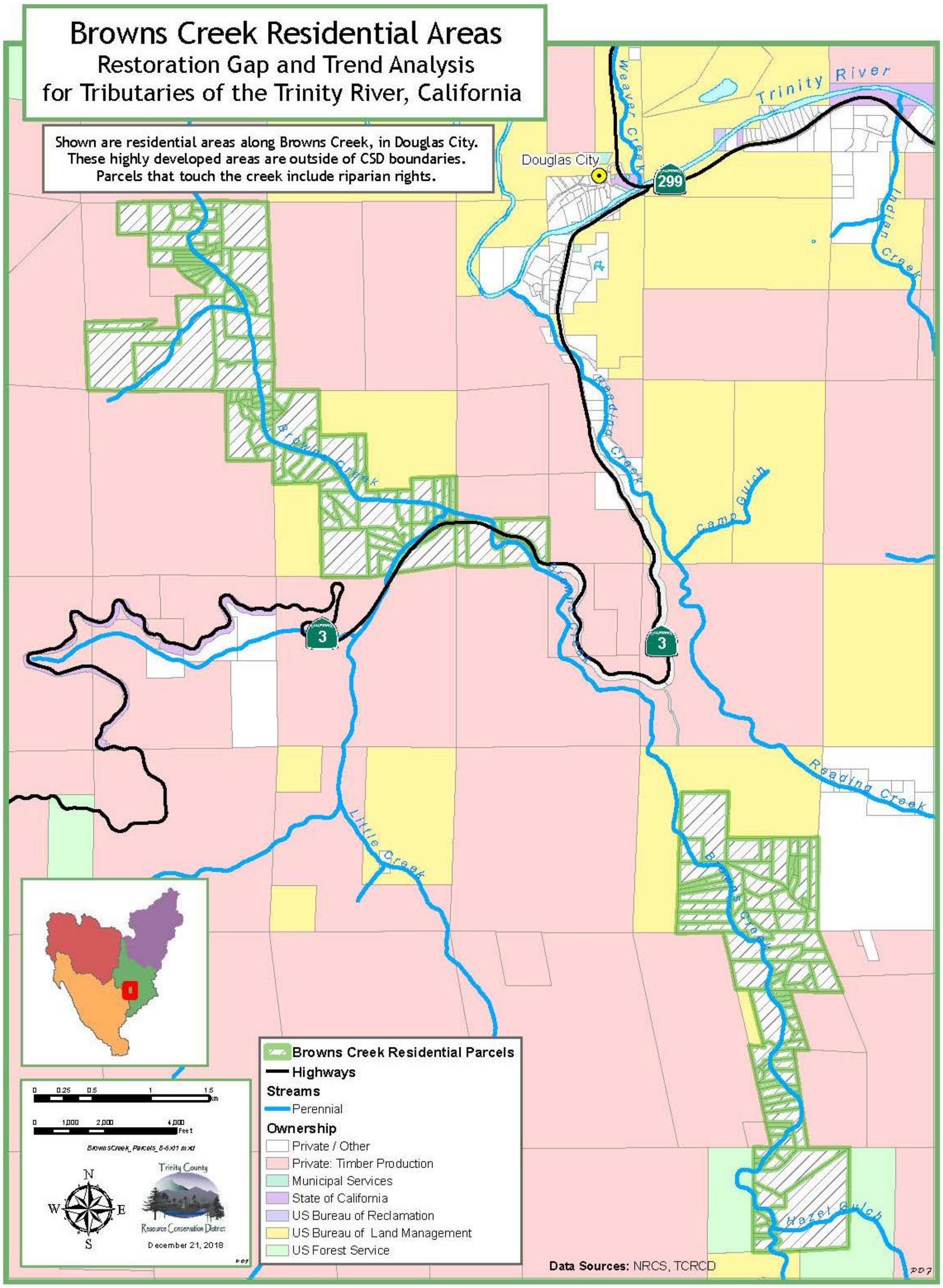


Figure 4.54 Middle Trinity region Browns Creek parcel density.

Wildfire

This region has the highest population in the watershed and the Community Wildfire Protection Plan (CWPP) focuses on protecting community resources. As shown in Figure 4.55 there are more fires in the western edge of the region due to hot, afternoon winds coming up the Trinity River valley from the west, and blowing sparks into ignition in an eastern direction. The 2018 Carr Fire moved against this trend, moving from east to west. All reports on the Carr Fire describe it as unusual in many aspects related to fire "behavior". The ditch culverts and stream crossings also depicted in this figure, show the impacts roads have had on this region.

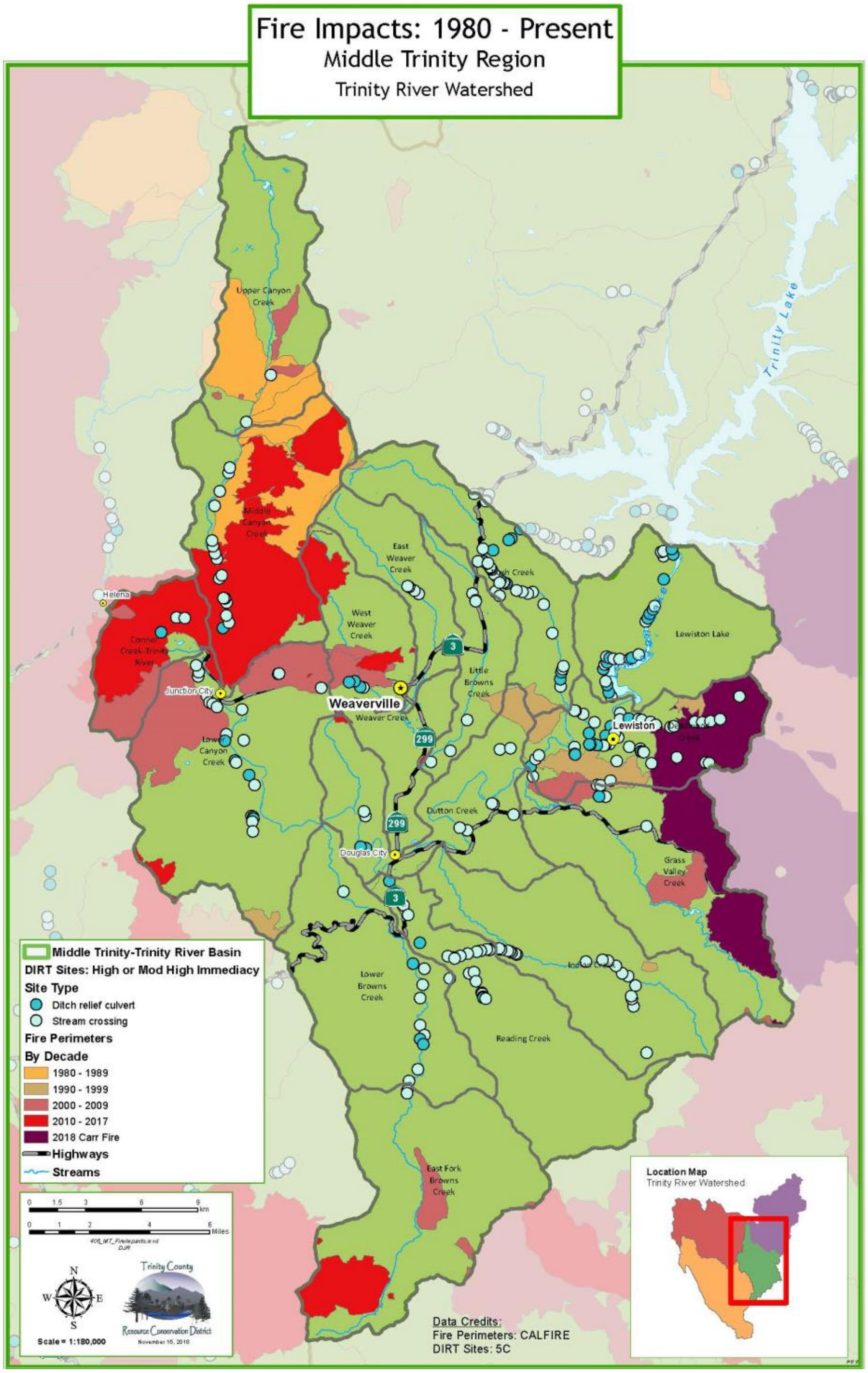


Figure 4.55 Middle Trinity region fire impacts and high immediacy road projects.

Cannabis Cultivation

In analyzing the commercial cannabis cultivation impacts on the region, the emphasis of location within subwatersheds inside or outside of community service water districts shows the Middle Trinity Region with the second largest difference between cultivation inside and outside of CSD boundaries, with the South Fork Trinity River Region offering the most stark differences. Due to ordinances enacted by the Trinity County Board of Supervisors in a bid to protect family neighborhoods from commercial cultivation, permits were only issued to cultivators within the Weaverville Community Service District (WCSD) who applied early in the process. Cultivation locations are also restricted by proximity to certain community institutions such as schools, rendering many "in town" locations ineligible for cultivation as well.

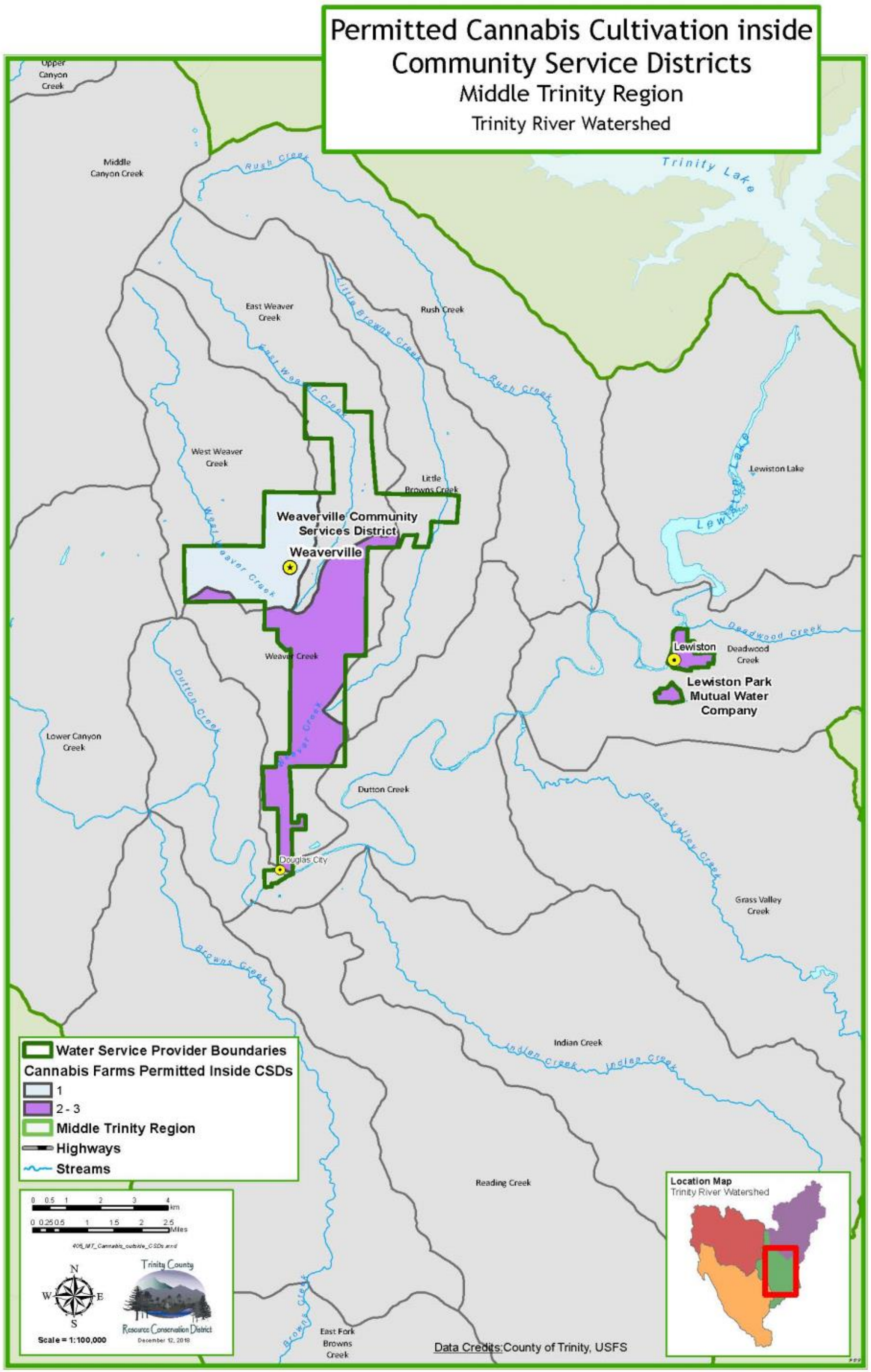


Figure 4.56

One permitted cannabis cultivation site lies in the West Weaver Creek subwatershed within the WCSD boundary, and up to three are in the Weaver Creek subwatershed within the WCSD boundary.

Up to three sites are within the Lewiston CSD boundary.

Figure 4.57 illustrates that of the 16 subwatersheds in this region, only four have no cannabis cultivation permits inside or outside of water districts: Upper Canyon Creek, East Weaver Creek, Lewiston Lake and East Fork Browns Creek. Lower Canyon Creek and the lower section of Weaver Creek show the highest counts of cannabis cultivation sites of between 15 and 21.

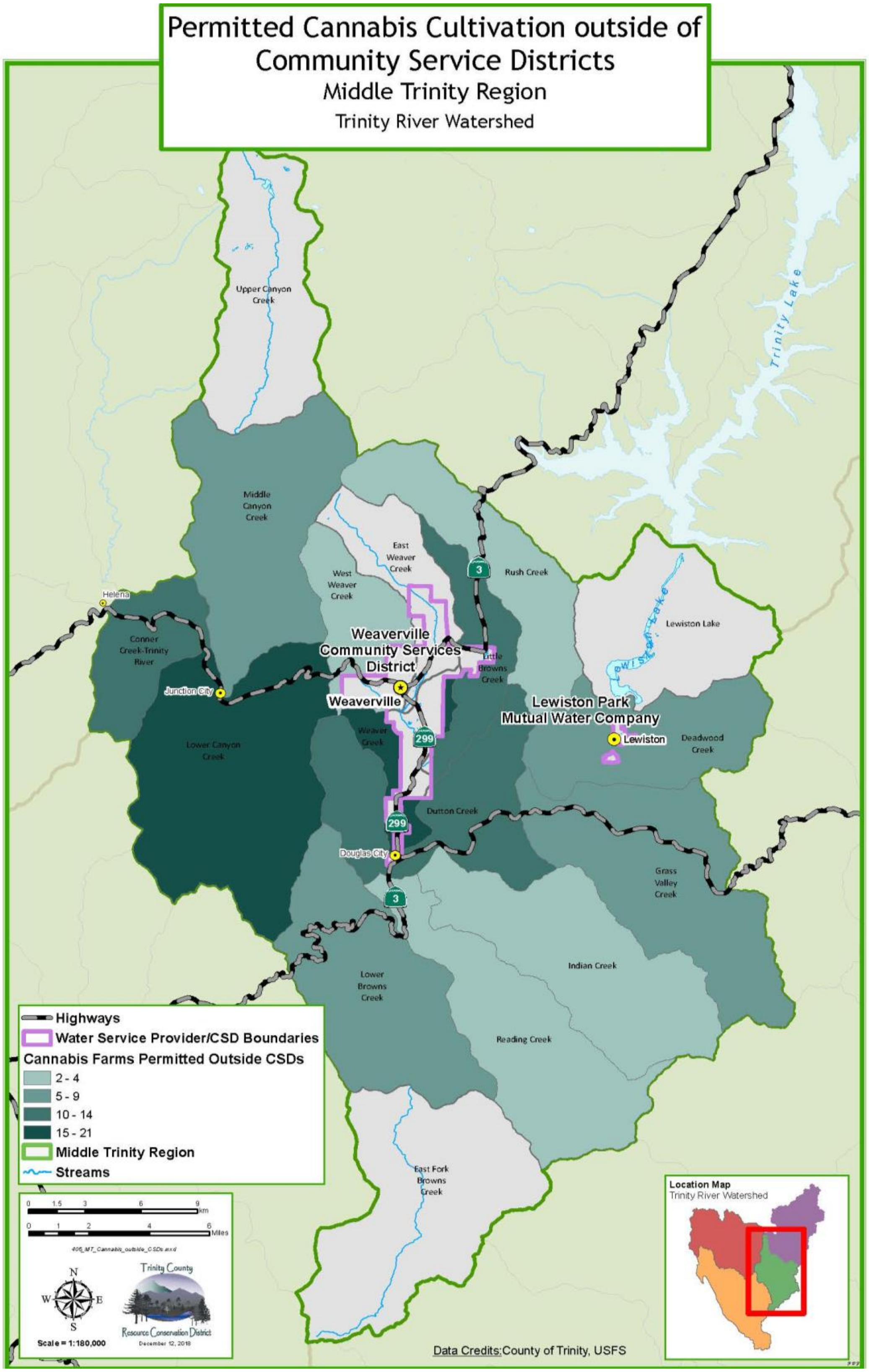


Figure 4.57

Cannabis cultivation outside of water district boundaries in the Middle Trinity region.

4.2.A3 South Fork Region Past Impacts

Mining

The South Fork region mining impacts (Figure 4.58) indicate heavy mining in the Hayfork Valley and throughout the flat regions of the subwatersheds. The upper South Fork Trinity River at the southern end of the map had almost no impacts, as seen in this analysis.

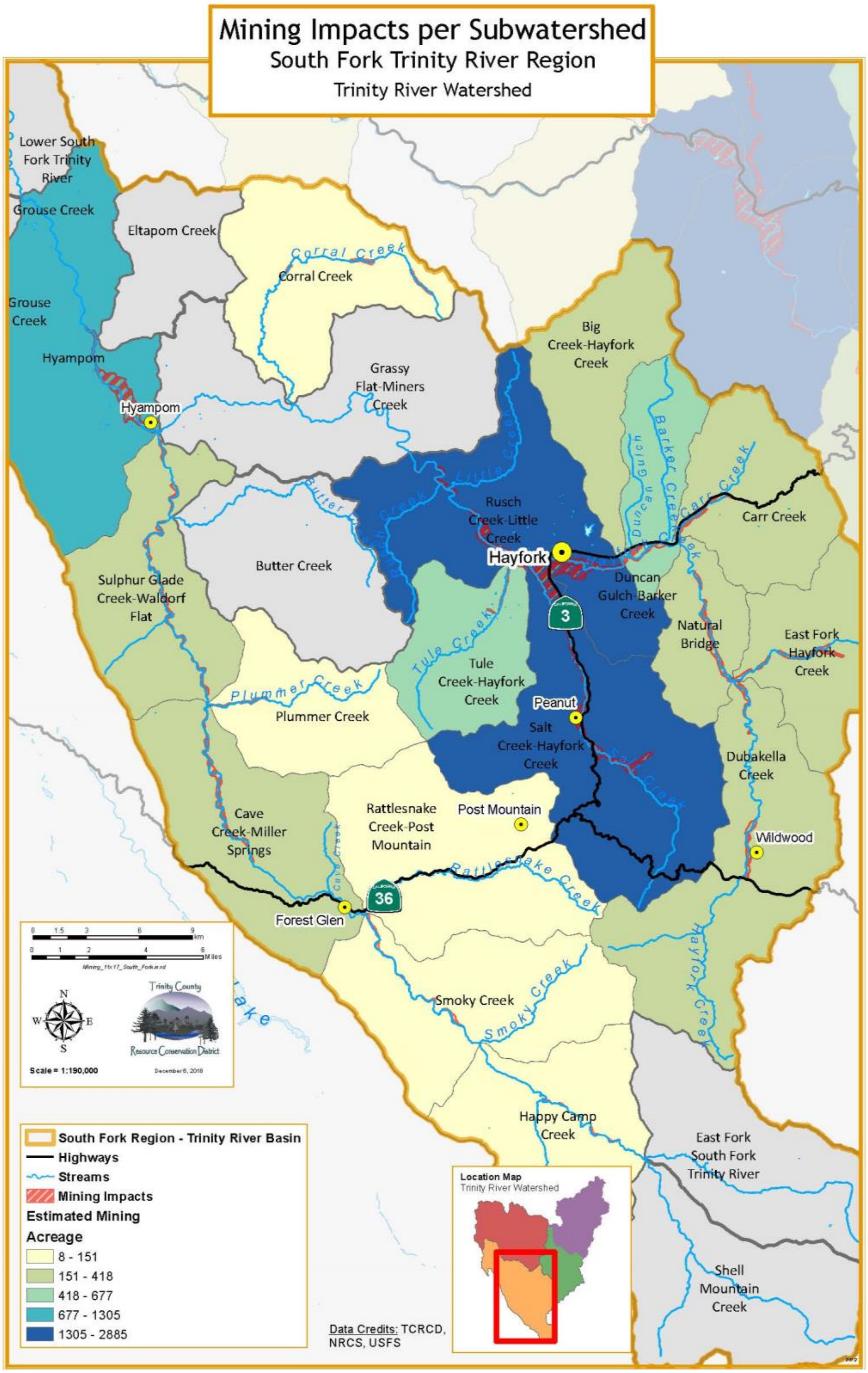


Figure 4.58 South Fork region mining impacts.

Land Use and Planning

The South Fork region has the highest number of US Forest Service roads in the watershed, as Figure 4.59 illustrates the road density in the region.

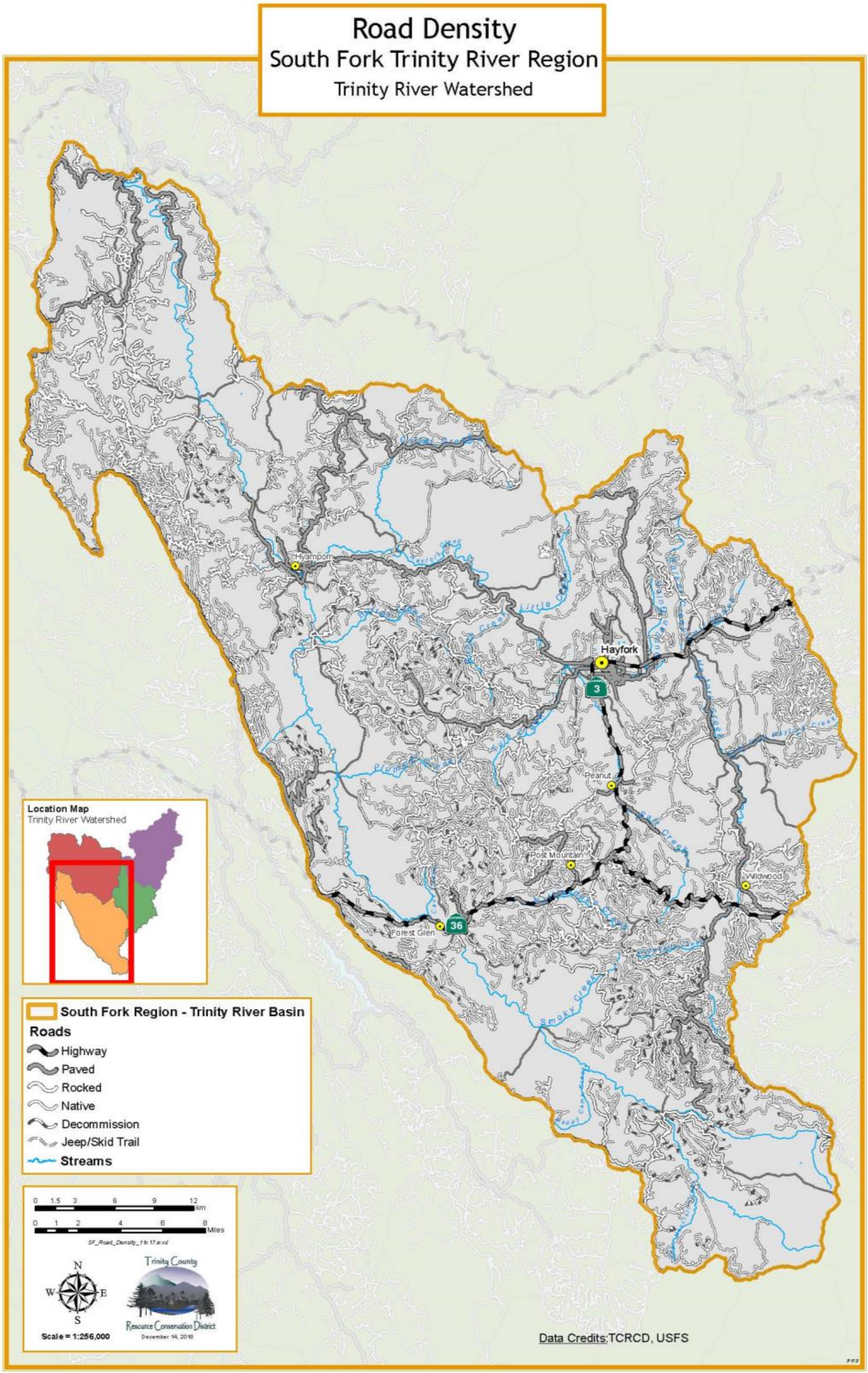


Figure 4.59 South Fork region road density.

Decommissioned road density is also high in this region.

Tied closely with road density are fish passage barriers as shown in Figure 4.60 from the CDFW Passage Assessment Database (PAD), and erosion potential from the Direct Inventory of Roads and Treatments (DIRT), shown in Figure 4.61, respectively.

The "Total" barriers and "Partial" barriers in the fish passage barrier map are from human related activity. This region has the highest density of road-related and diversion-related barriers. The natural barriers represent waterfalls (total barriers) or instream structural barriers that block passage at low flows.

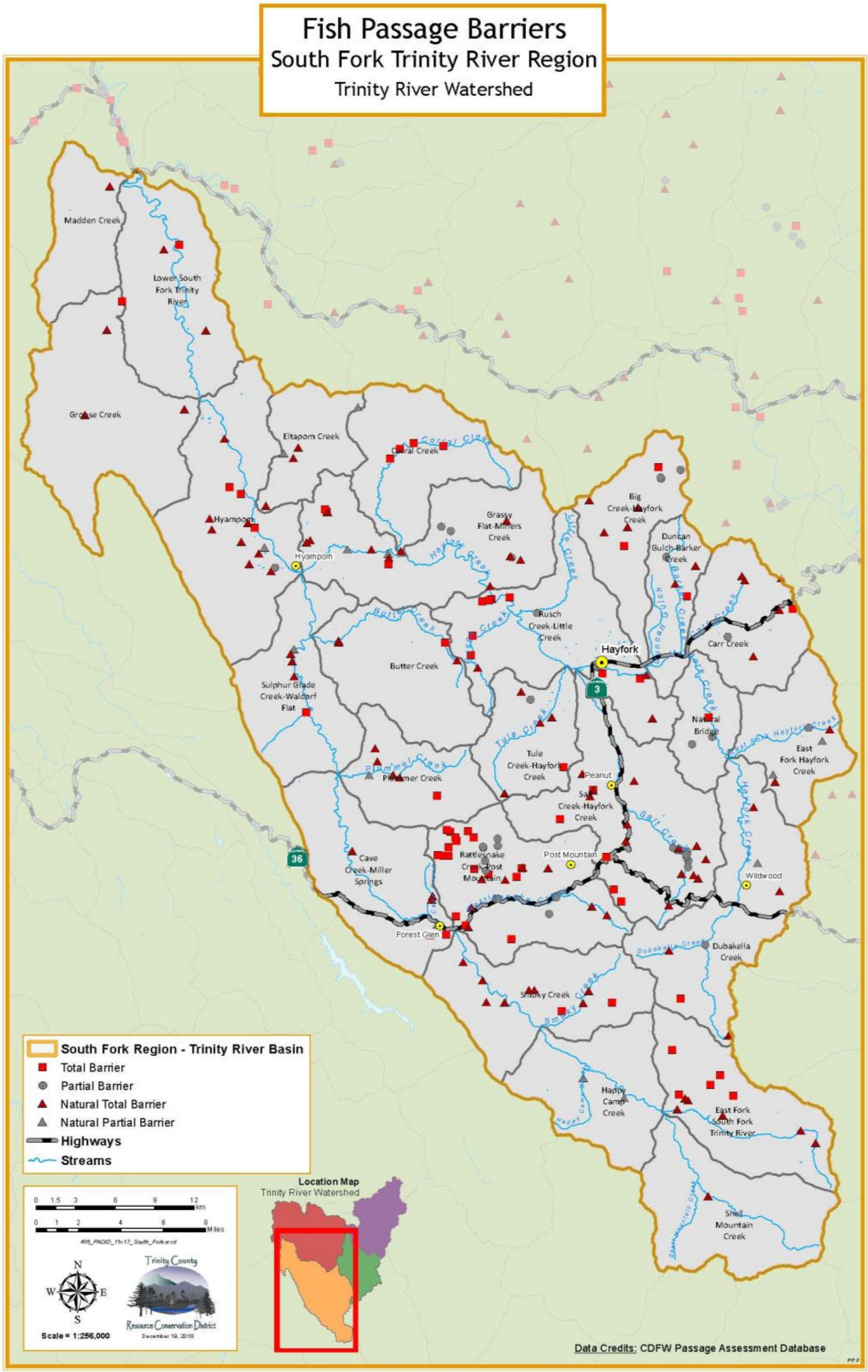


Figure 4.60 Fish passage barriers in the South Fork region.

The erosion potential locations were assessed in 2004. With 14 years having passed since the assessment, there are bound to be some changes, however the current areas of highest potential are likely to mirror those from the 2004 inventory. This erosion potential data is based on road inventories so does not account for the local geology that lends itself to mass wasting events, especially in the more remote areas south of Highway 36 and running north to south along the South Fork Mountain ridge, west of the South Fork Trinity River.

Figure 4.61 Erosion potential from roads in the South Fork region.

There are two water districts in this region. Trinity County Water Works District #1 (TCWWD) serves approximately 1500 residents in Hayfork. The water is diverted from Big Creek. A small water district also serves Hyampom. Hayfork installed a water treatment plant, also managed by TCWWD, about 20 years ago to replace faulty septic systems and saw an immediate increase in water quality in Hayfork Creek.

Recommendations to develop new water districts for several subwatersheds are included in the South Fork Trinity River Supplemental Watershed Assessment (*WRTC, 2016*) and can be found in Section 4.2C of this report.

One area that was allowed to be subdivided in the South Fork Trinity River region without any form of guaranteed domestic water other than surface water is the Trinity Pines development. Known as a hotspot for cannabis cultivation for years, the water supply issue here is staggering. There are 1049 parcel over 3100 acres with only 134 dwellings. Figure 4.62 shows the density of this development. Figure 4.63 shows a Google Earth ™ image with parcels cleared for cannabis cultivation easily visible.

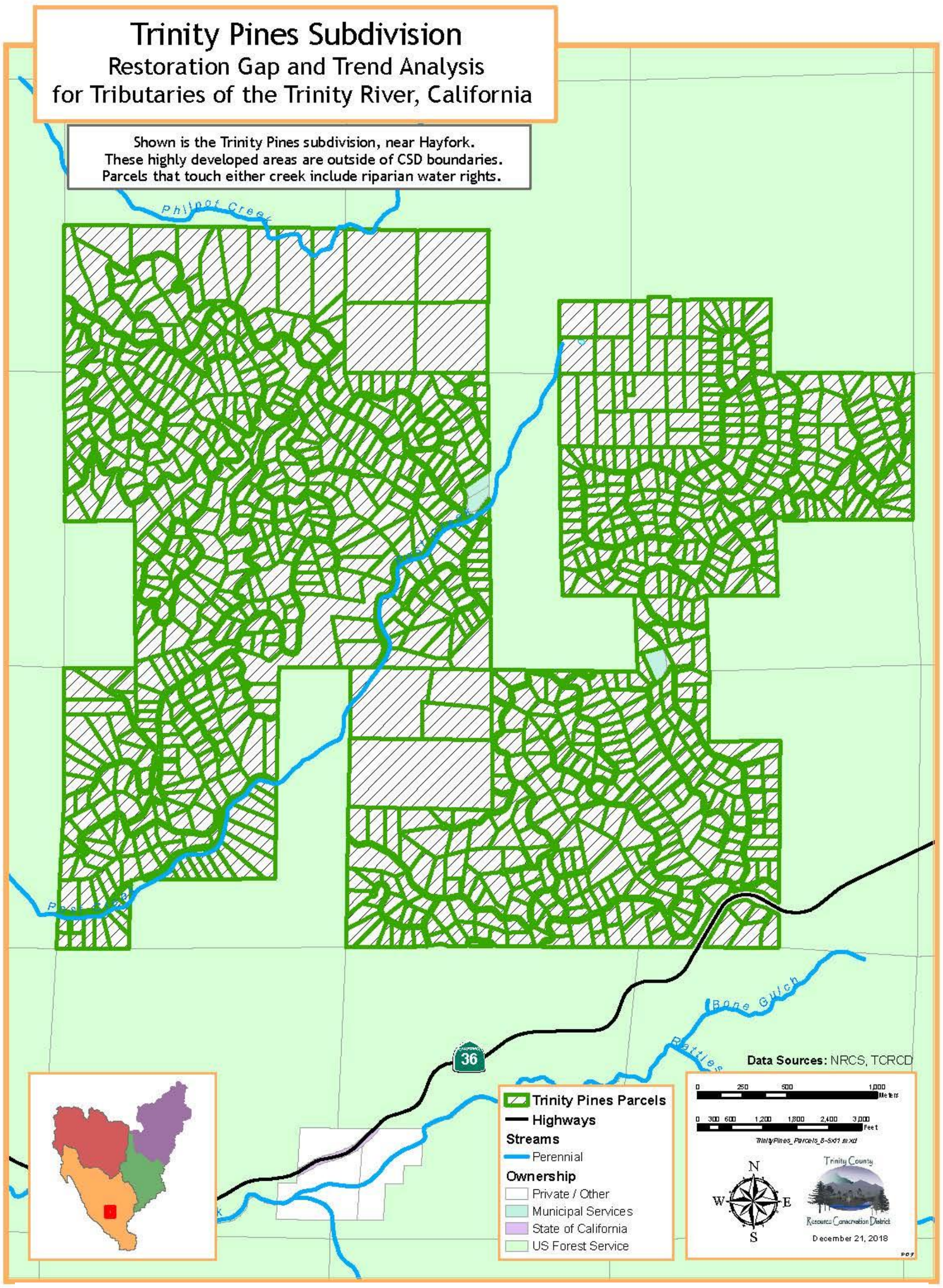


Figure 4.62 South Fork region Trinity Pines subdivision parcel density.

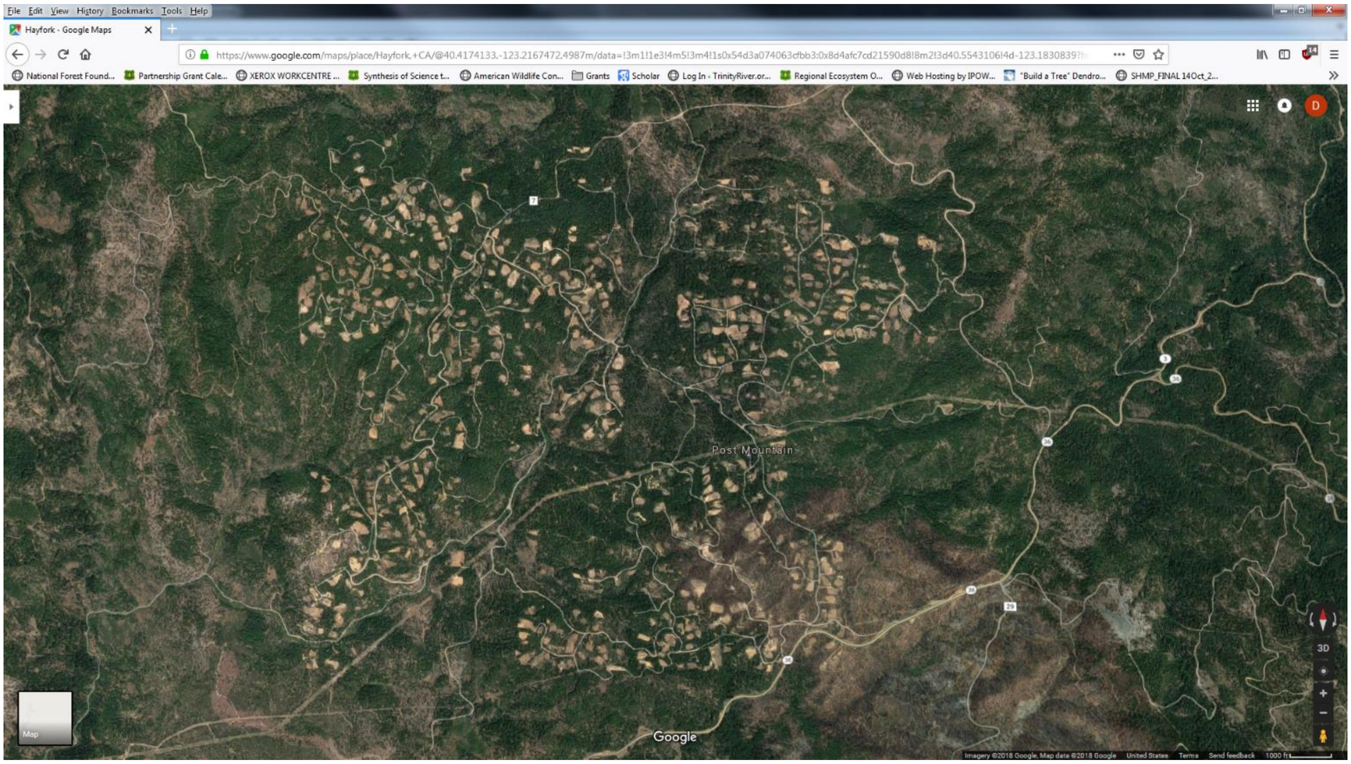


Figure 4.63 Aerial image of Trinity Pines subdivision with clearings for cannabis cultivation.

Wildfire

This region continues to be impacted by wildfire especially over the last decade, as shown in Figure 4.64. The more remote areas in the upper part of the watershed – Smokey, Dubakella, and Happy Camp Creeks – haven't seen fire in over 40 years.

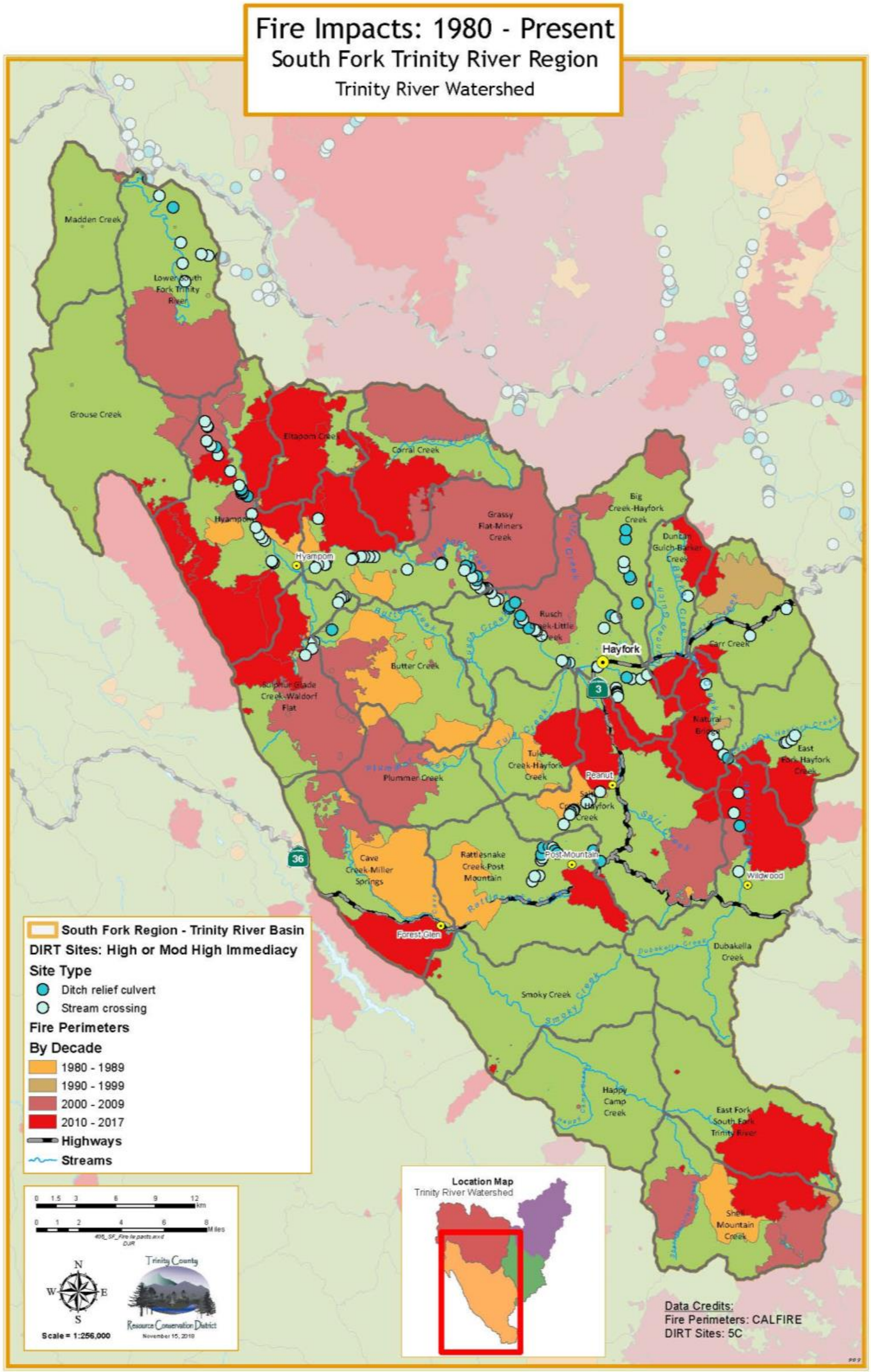


Figure 4.64 South Fork region fire impacts and high immediacy road projects.

Cannabis Cultivation

Cannabis cultivation in this region is the highest within the entire watershed. Cultivation within water district boundaries includes only one permitted parcel in the Hyampom area, and two in the portion of the Big Creek watershed that lies inside the boundaries, and 20 in and around Hayfork, as shown in Figure 4.65.

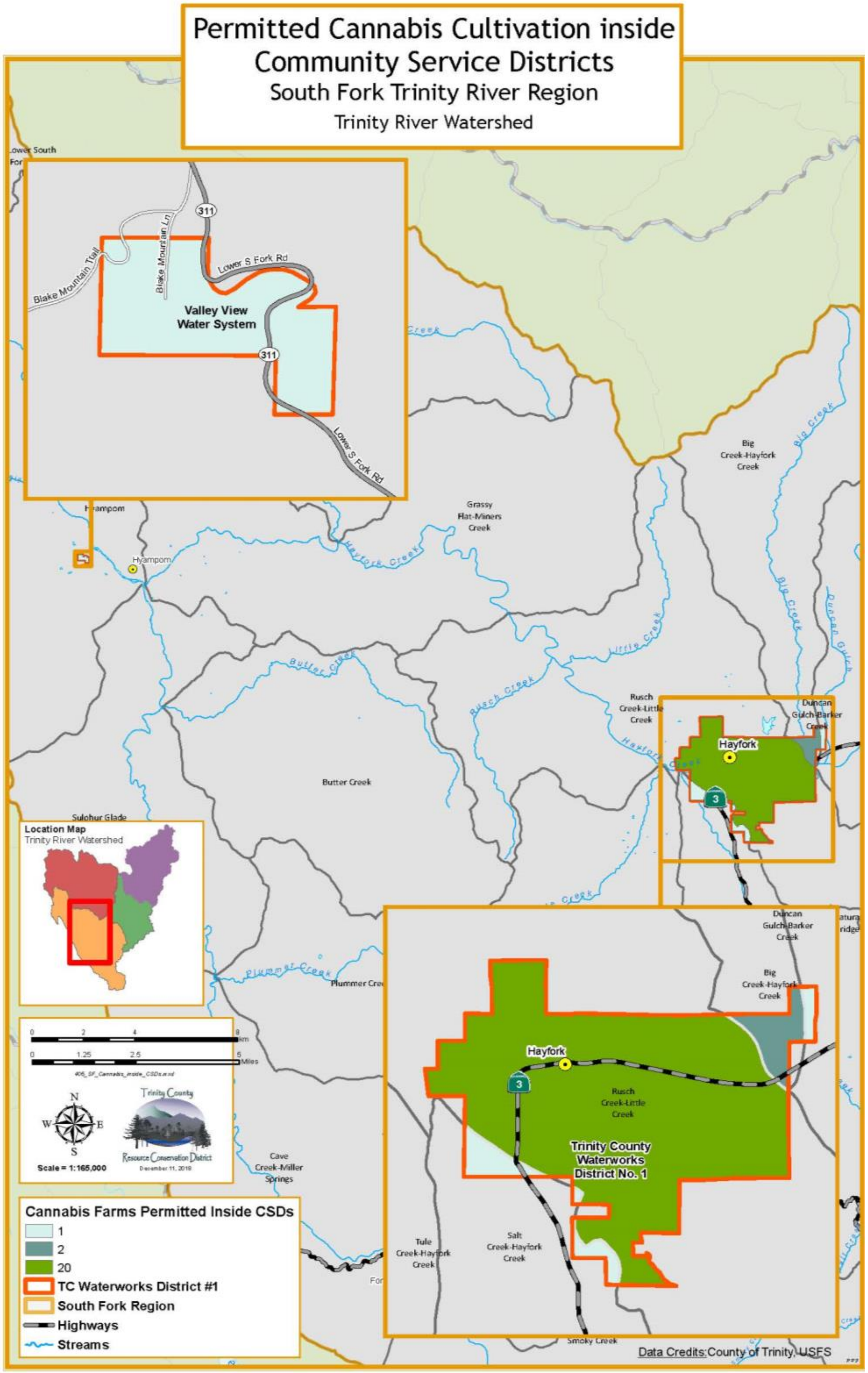


Figure 4.65 South Fork region cannabis cultivation permits inside water district boundaries.

Cannabis cultivation outside of water district boundaries in the region is illustrated in Figure 4.66 below.

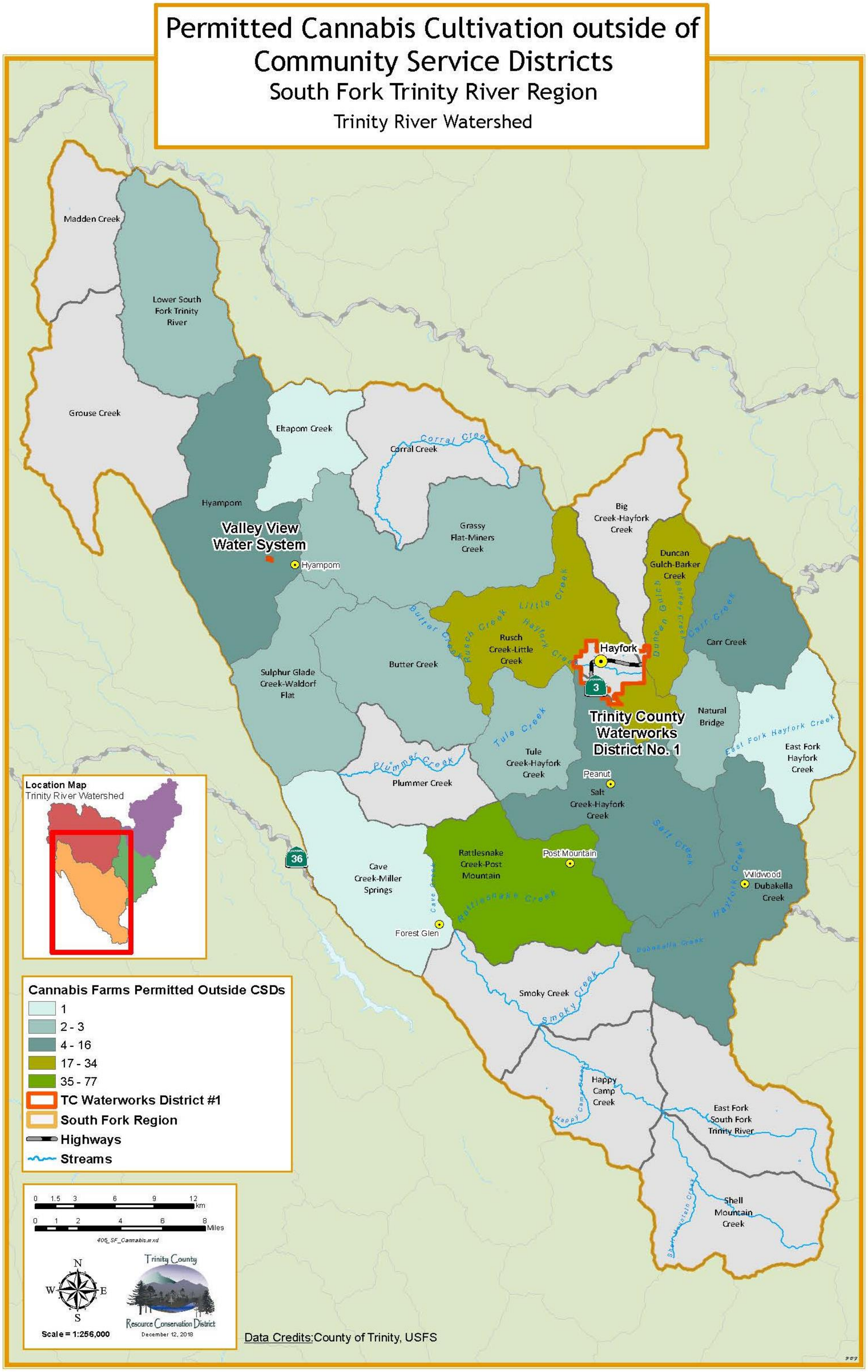


Figure 4.66

South Fork region cannabis cultivation permits outside water district boundaries.

4.2.A4 Down River Past Impacts

Mining

Mining impacts in the Down River region, as shown in Figure 4.67, are the lowest in the watershed based on the TCRCD analysis. However, the TCRCD analysis needs further refinement for this region. The town of Denney was established because of mining, but the impacts are no longer visible from aerial images. The parts of the watershed that were not subject to repeated mining efforts due to the ruggedness of the landscape and/or where the gold played out early, have the least visible impacts now because vegetation has grown over the old mining scars.

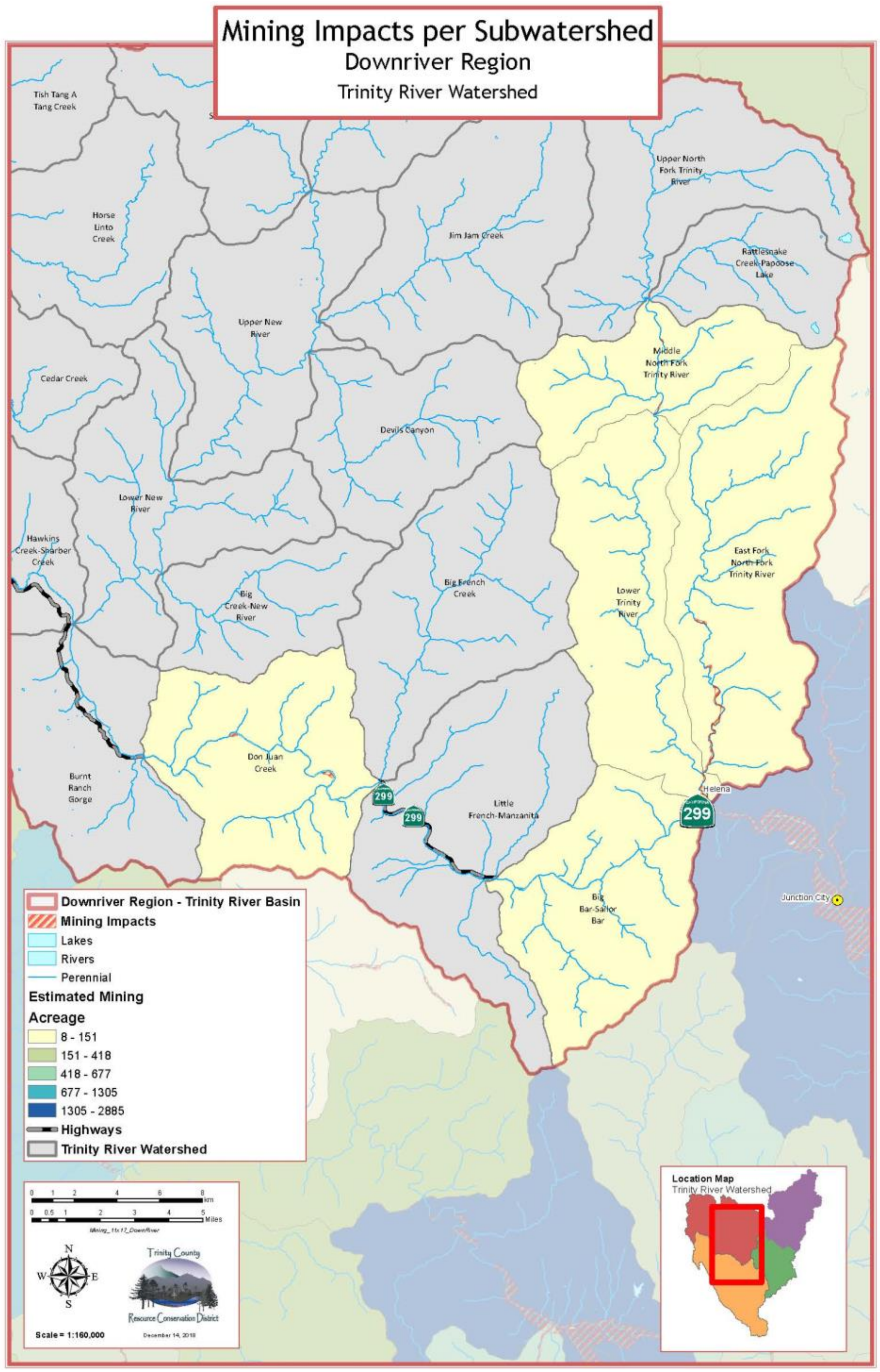


Figure 4.67 Down River region mining impacts.

Land Use and Planning

The Down River region has the lowest density of roads in the watershed, as Figure 4.68 illustrates the road density in the region. Much of this region lies in the Trinity Alps Wilderness Area. Due to the rugged terrain, early timber harvests and their associated roads could not penetrate this mountainous region.

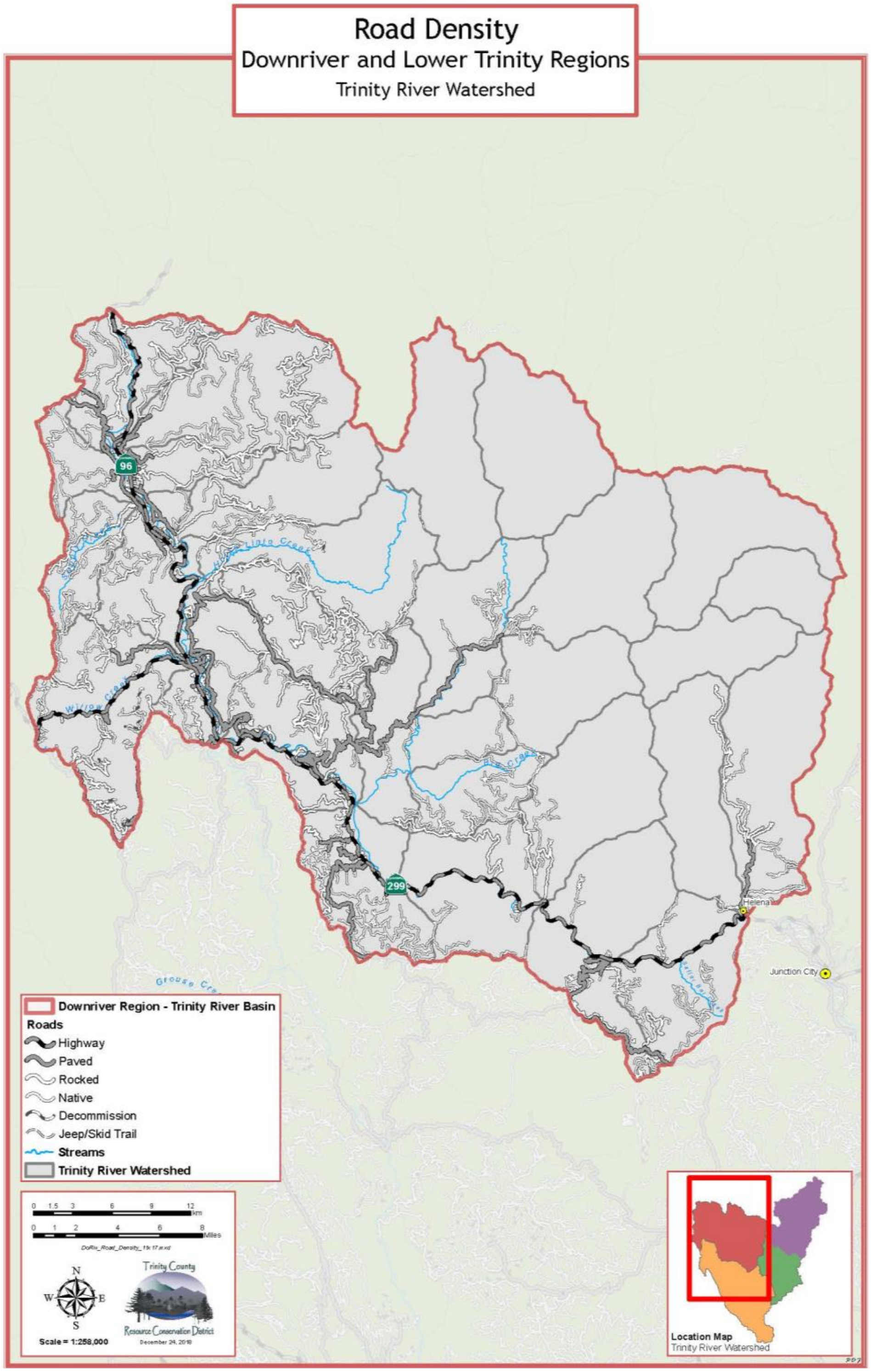


Figure 4.68 Down River region road density.

Tied closely with road density are fish passage barriers as shown in Figure 4.69 from the CDFW Passage Assessment Database (PAD), and erosion potential from the Direct Inventory of Roads and Treatments (DIRT), shown in Figure 4.70, respectively.

The "Total" barriers and "Partial" barriers in the fish passage barrier map are from human related activity. The majority of the total barriers in this region are related to the highways. The natural barriers represent waterfalls (total barriers) or instream structures (partial barriers) that block passage at low flows.

Figure 4.69 Down River region fish passage barriers.

The erosion potential locations were assessed in 2004. With 14 years having passed since the assessment, there are bound to be some changes, however the current areas of highest potential are likely to mirror those from this 2004 inventory. This erosion potential data is based on road inventories so does not account for the local geology that lends itself to mass wasting events, such as the event that happened on Highway 299 just west of Big French Creek in 2016.

Figure 4.70 Down River region erosion potential.

There is a small water district serving the Burnt Ranch Estates in this region. Mill Creek provides domestic water supply for the Hoopa Valley Reservation. Tish Tang Creek is identified as a potential future source of domestic water on the Hoopa Valley Reservation. The East Fork Horse Linto Creek has an out-of-basin diversion that contributes to Quimby Creek, the water supply for the town of Denny.

Wildfire

Over half of this region has burned in the last 40 years, with the majority of the fires in the last 20 years as shown in Figure 4.71. Our data is sourced from CALFIRE, which does not include any wildfires on the Hoopa Valley Reservation.

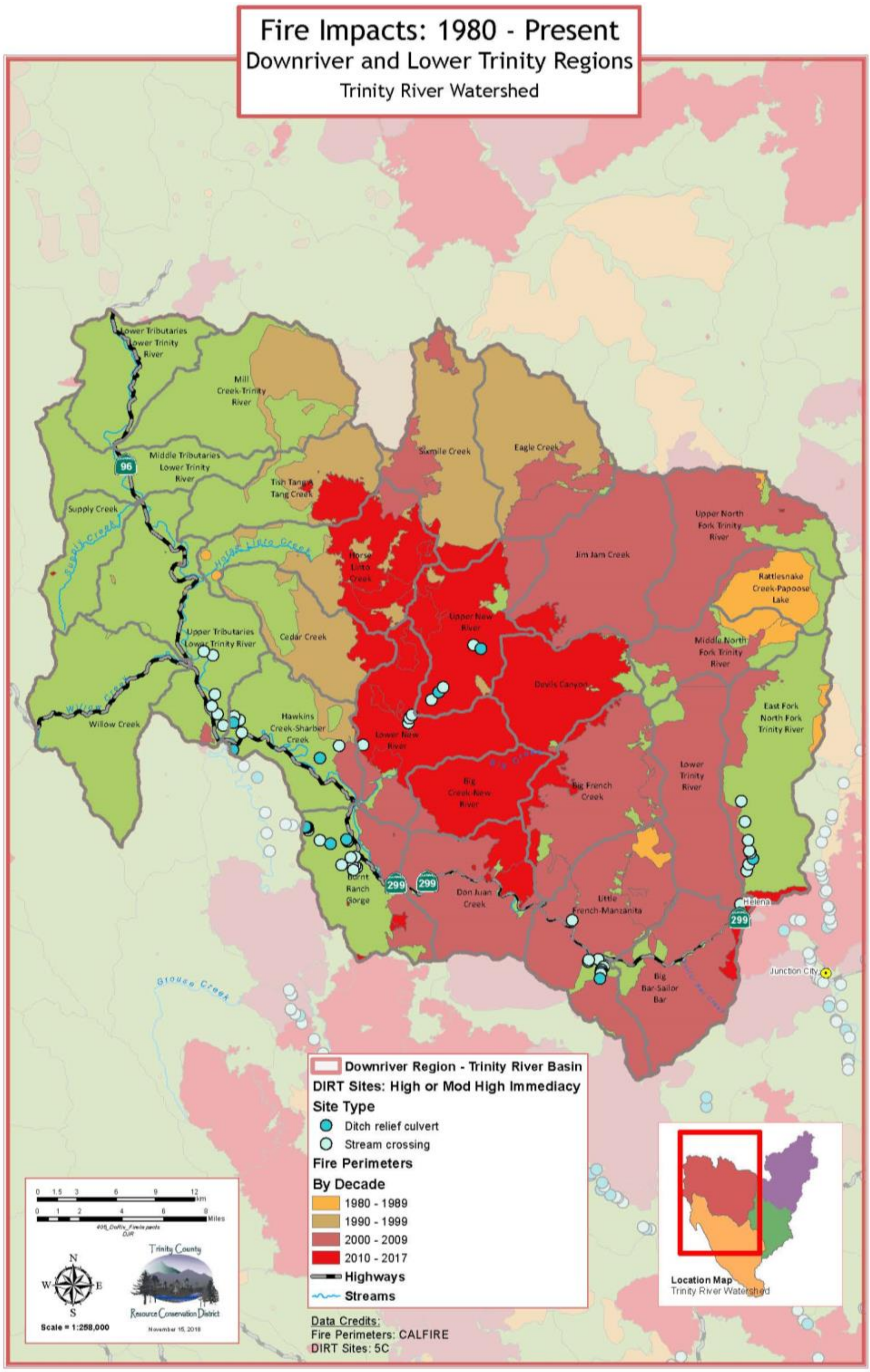


Figure 4.71 Down River region fire impacts and high immediacy road projects.

Cannabis Cultivation

The Burnt Ranch Gorge subwatershed has two permitted cultivation sites inside the water district, as shown in Figure 4.72.

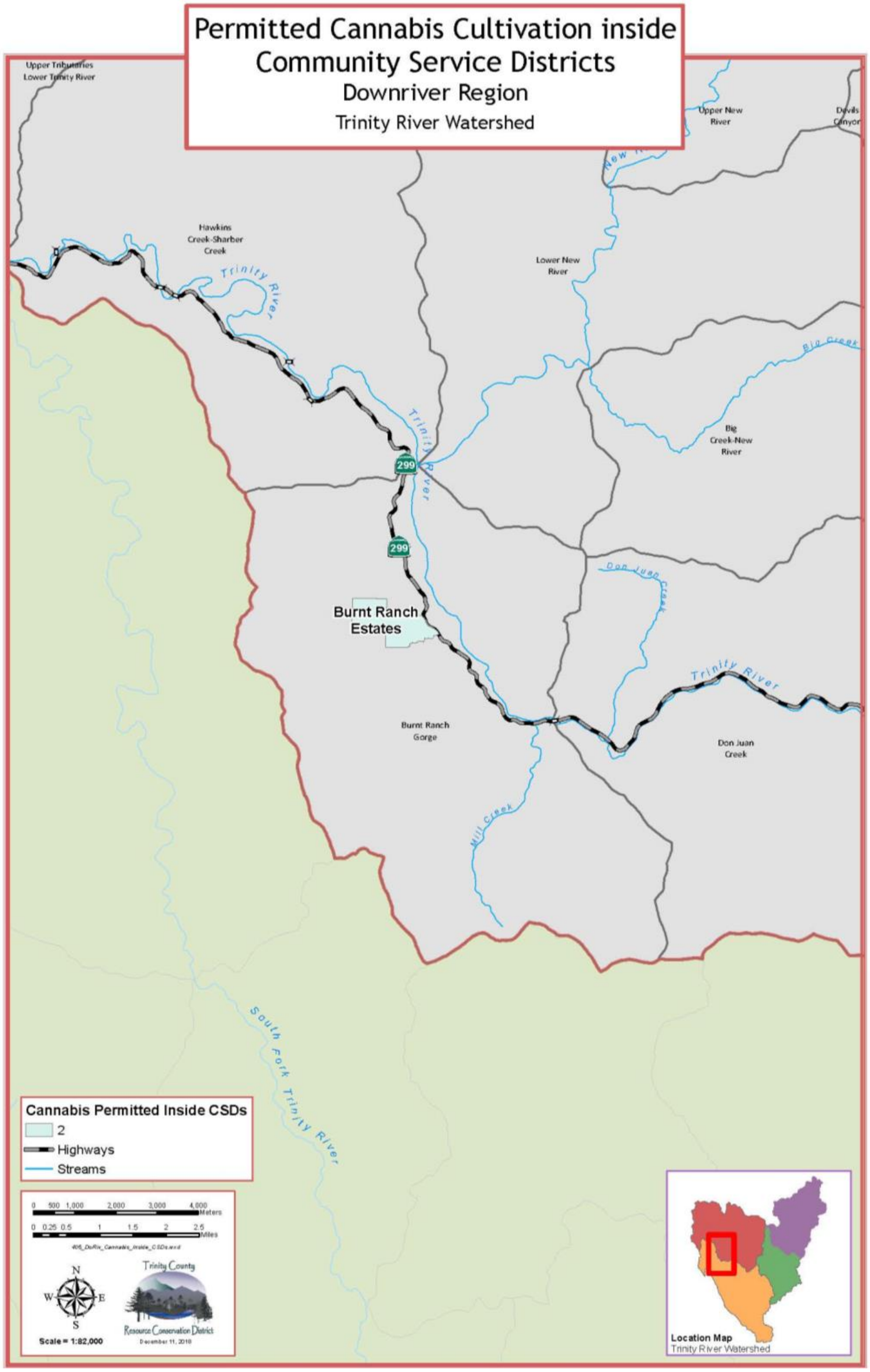


Figure 4.72 Down River region cannabis cultivation permits inside water district boundaries.

Cannabis cultivation permits outside of the water district boundary in this region reach a maximum of 10 in the Hawkins Creek-Sharber Creek subwatershed, with the next highest in the Little French-Manzanita Creek drainage (Figure 4.73).

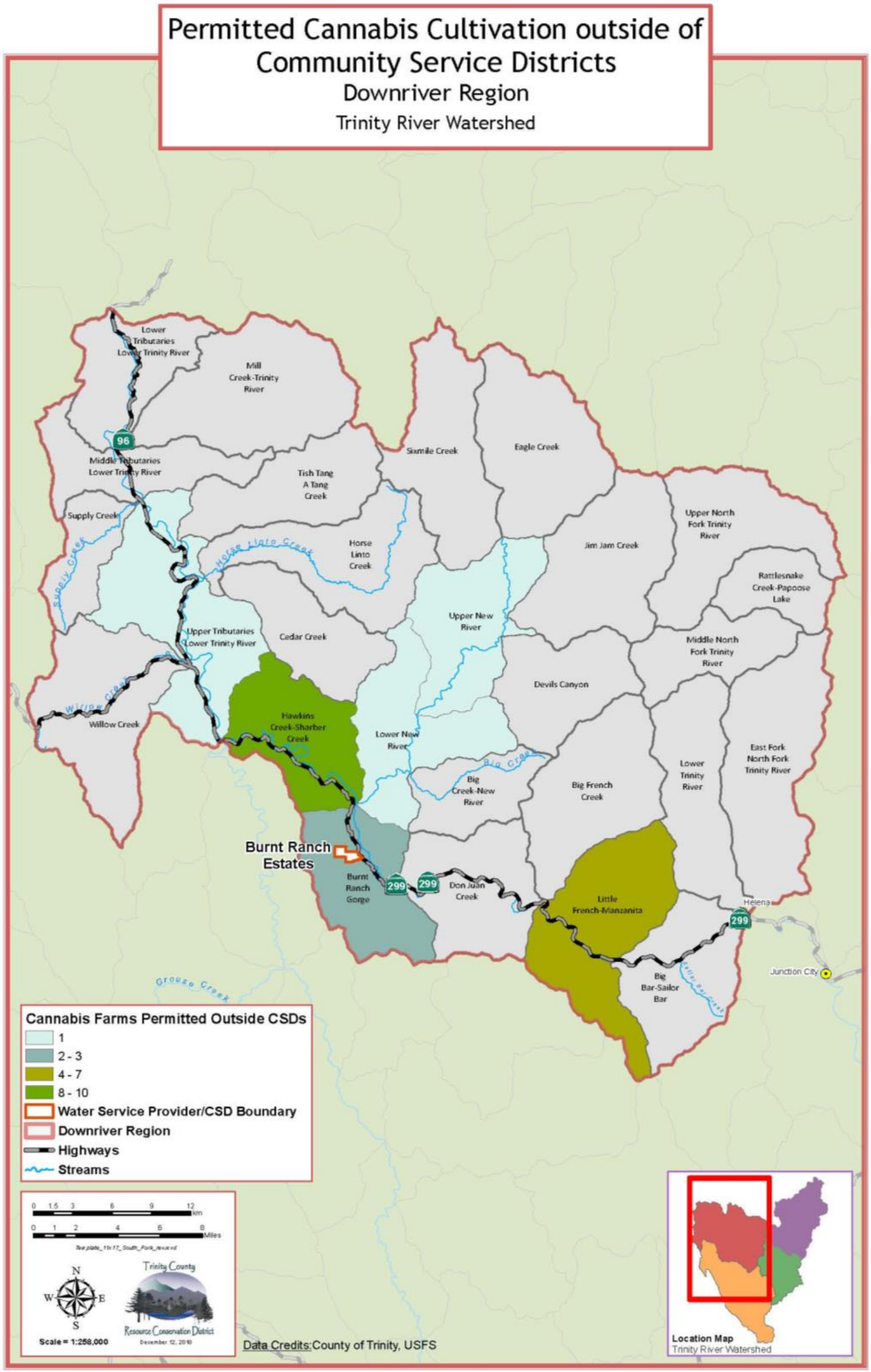


Figure 4.73 Down River region cannabis cultivation permits outside water district boundaries.

4-2.B Identification of Key Issues: Overview of Completed Restoration Projects

Completed restoration projects are an indicator of key issues in the watersheds, as they illustrate what funding agencies have shown to be their top priorities by approving work on these projects.

Several different federal, tribal, state, and non-profit agencies have completed restoration work in Trinity River tributaries since 2000. This information has never been analyzed on a landscape level. The majority of these projects were completed for the benefit of salmonids, but the final analysis in this plan takes a broader look beyond salmonids. Restoration science is continually evolving with many scientists now in support of multi-species restoration projects and landscape level watershed restoration efforts.

This data was gathered, cleaned, organized, and aggregated into one geodatabase to use in GIS for this report. Some of the data was easily accessible, while others were gleaned from websites and pulled from files. Every project was then assigned to a subwatershed based on notes and discussions with the lead agencies. However, most projects did not have geo-coordinates available, or the information was not easily accessible. *Due to this data gap, the project locations shown on the regional maps should not be interpreted to mean that the location indicated is the actual location of the project. A location within the subwatershed was assigned to each project in order to use geoprocessing functions.* Agency project leads would be able to tell you the exact location of the project. An Excel spreadsheet containing all of the completed project information is also available upon request.

Prior to this effort, restoration project data was scattered across multiple agencies and was not in compatible formats. As stated earlier, this analysis does not include restoration projects completed on the mainstem Trinity River, but only the subwatersheds.

Restoration projects completed by and/or funded by the following organizations are included in this analysis:

- 5C Salmonid Conservation Program
- Bureau of Reclamation
- California Department of Fish and Wildlife
- Hoopa Valley Tribe
- Natural Resources Conservation Service
- Trinity County
- Trinity County Resource Conservation District
- Trinity River Restoration Program
- US Forest Service
- USFS Resource Advisory Committee (Title II funding)
- Watershed Research and Training Center

Early in the process of creating this analysis, a request was made for an accounting of project funding by source. This report is not a financial analysis. That data was not requested and/or was not offered by all participants. Some project cost data are available and can be provided upon request.

A total of 337 restoration projects have been completed in the watershed since 2000. The number each year varies and there doesn't appear to be any type of trend. The year assigned to the project is the year funding was received. Projects are only counted in this analysis if they were completed by 2017, even if funding came in earlier.

Figure 4.74 shows number of projects completed by year.

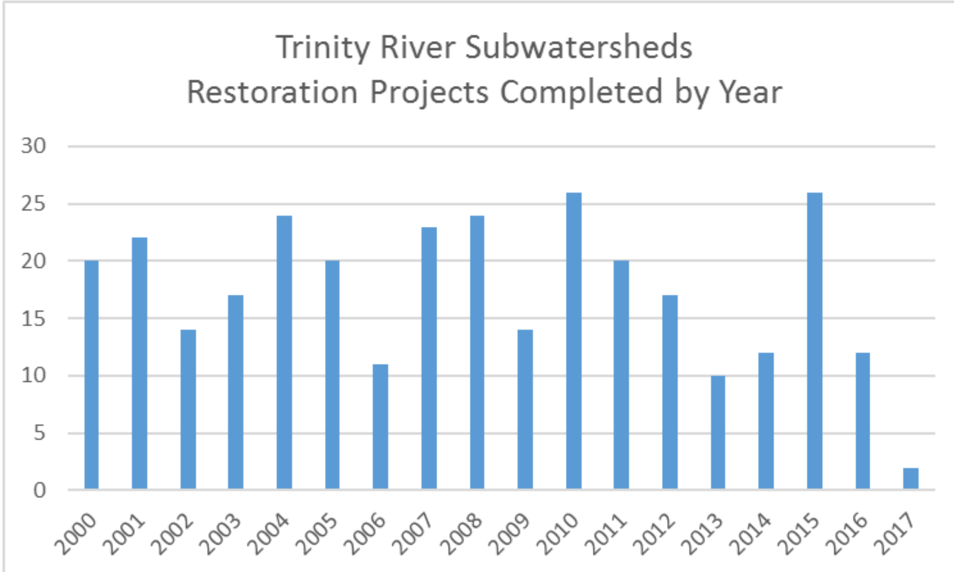


Figure 4.74 Number of projects completed by year.

Project Types

Based on input from the Trinity River Watershed Council members the project types to include in the analysis were reviewed and discussed. It was decided that the following project types will not be tracked in this analysis: coordination, stewardship, fuels reduction*, and education and outreach. While all of these project types have great impacts on restoration and the health of the watershed, they do not fit well within the confines of a mostly GIS-based analysis and the scope of this project.

The final Gap Analysis project types agreed to by the Trinity River Watershed Council are as follows:

1. Cultural Heritage
2. Design and Planning
3. Fish Passage
4. Floodplain
5. Gauging
6. Instream Habitat
7. Monitoring
8. Non-roads sediment
9. Revegetation
10. Riparian
11. Roads
12. Water Conservation
13. Weeds
14. Wetlands

A note about project type 5 – Gauging: This project type was funded by the California Department of Fish and Wildlife's Fisheries Restoration Grant Program (FRGP), but no gauging projects in this watershed have been funded since 2000.

The final project types were derived from multiple agencies' projects. The following Table 4.13 shows the legacy project types by funder, and the Gap Analysis project type.

*Hundreds of fuels reduction projects have been implemented in the watershed since 2000. The Trinity County Fire Safe Council is the organizational group for fuels reduction and fire safety projects, including forest health, shaded fuel breaks, ladder fuel reduction, chipping programs, etc. The Community Wildfire Protection Plan (CWPP) is the guiding document for this organization.

Funder Project Types Categorized into Gap Analysis Project Types			
Projects in the watershed were funded by several different organizations, each with their own method of categorizing the projects. This is a consolidated list providing the correlation between the original project type and the type used in this analysis.			
Funder	**Abbreviation**	**Description**	**Gap Analysis Project Type**
FRGP	FL	Fish Ladder (No longer an option)	Fish Passage
	FP	Fish Passage at Stream Crossings	Fish Passage
	HB	Instream Barrier Modification for Fish Passage	Fish Passage
	HI	Instream Habitat Restoration	Instream Habitat
	HR	Riparian Restoration	Riparian
	HS	Instream Bank Stabilization	Instream Habitat
	HU	Watershed Restoration (Upslope) FRGP includes roads and reveg	Split Into 2: Roads and Reveg
	MD	Monitoring Status and Trends	Monitoring
	MO	Monitoring Watershed Restoration	Monitoring
	PD	Project Design	Design and Planning
	PL	Watershed Evaluation, Assessment and Planning	Design and Planning
	SC	Fish Screening Diversions	Fish Passage
	WC	Water Conservation Measures	Water Conservation
	WD	Water Measuring Devices (Instream and Water Diversions)	Gauging
TRRP	2017 Funding Categories	**Fine Sediment Reduction and Prevention:** May include implementation (listed below), design and planning, monitoring to establish baselines, and monitoring to assess effectiveness.	
		1. Trapping removing sediments in tribs, floodplains, riparian areas, and associated wetlands	Non-roads sediment
		2. Road decom & treatment	Roads
		3. Upland erosion and sediment control	Non-roads sediment
		4. Increase stream roughness (LWS)	Instream Habitat
		5. Improved sediment storage on floodplains	Floodplain
		6. Stream bank treatment	Instream Habitat
TRRP	2017 Funding Categories	**Fish Habitat Connectivity Improvement:** Improve or enhance habitat connectivity through implementation in trib channels, floodplains, riparian areas and associated wetlands. Mostly focused on implementation, but may include design and planning.	
		1. Enhancement of fish passage	Fish Passage
		2. Improve floodplain connectivity	Floodplain
		3. Access to thermal refugia	Instream Habitat
		4. Instream pool frequency/depth	Instream Habitat
		5. Improve instream flow to connect fish habitats in tribs	Instream Habitat
USFS RAC		Non-Fuels,Non Roads_Fuels/Basketry	Cultural Heritage
		Non-Fuels,Non Roads_Restoration_Natural Bridge	Cultural Heritage
		Non-Fuels,Non Roads_Restoration_Native Plant	Reveg
		Non-Fuels,Non Roads_Restoration_Noxious Weeds	Weeds
		Roads - WSR Implementation	Roads
		Roads - WSR NEPA	Design and Planning
		Other/ Wetlands	Wetlands

Table 4.13 Legacy project type by funder and Gap Analysis project type.

Non-Geospatial Projects

Some projects completed in the watershed could not be assigned to a specific subwatershed as they benefited broad areas. They are listed in Table 4.14, and simply assigned to either the Mainstem or South Fork and are not represented on the GIS maps.

Sub Watershed	Project Description	Original Project Type	Gap Analysis Project Type	Year
Mainstem	Botanical Survey	Reveg	Design and Planning	2003
Mainstem	Native Seed Bank	Reveg	Reveg	2006
South Fork	South Fork Planning	Planning	Design and Planning	2010
South Fork	Spring Chinook in the SFTR: Management Recommendations and the Status of Their Implementation	Planning	Design and Planning	2012
Mainstem	Mod #1 Nursery	Reveg	Reveg	2013
Browns, Canyon, Weaver, Indian, Reading Creeks	Ag Practices: Evaluation of water use and impacts on streamflow and water quality.	Planning; Monitoring & Assessment	Monitoring	2013
Mainstem	Native Plant Nursery	Reveg	Reveg	2014
South Fork	South Fork Trinity River Watershed Assessment	PL	Design and Planning	2014
Mainstem	Nursery	Reveg- nursery	Reveg	2015
Mainstem	Native Plant Nursery	Veg	Reveg	2016

Table 4.14 Non-geospatial projects.

Further analysis of the project type data shows (Table 4.15) with project totals and types alphabetically listed by subwatersheds and (Table 4.16) a breakdown by project type, funder, and year funded.

Big Bar-Sailor Bar	**2**
Fish Passage	1
Instream Habitat	1
Big Creek-Hayfork Creek	**5**
Design and Planning	1
Fish Passage	1
Roads	3
Big Creek-New River	**1**
Roads	1
Burnt Ranch Gorge	**4**
Reveg	3
Roads	1
Butter Creek	**4**
Roads	4
Carr Creek	**3**
Instream Habitat	1
Reveg	1
Water Conservation	1
Cave Creek-Miller Springs	**10**
Roads	9
Weeds	1
Conner Creek-Trinity River	**9**
Design and Planning	1
Fish Passage	3
Reveg	1
Roads	4
Corral Creek	**2**
Roads	2
Deadwood Creek	**33**
Design and Planning	5
Fish Passage	3
Instream Habitat	2
Monitoring	7
Non-roads sediment	5
Reveg	1
Riparian	1
Roads	6
Weeds	1
Wetland	2
Dubakella Creek	**6**
Roads	6
Duncan Gulch-Barker Creek	**7**
Fish Passage	2
Instream Habitat	2
Roads	2
Water Conservation	1
Dutton Creek	**5**
Roads	2
Riparian	3
East Fork Hayfork Creek	**3**
Reveg	1
Roads	2
East Fork N. Fork Trinity River	**4**
Roads	4
East Fork South Fork Trinity Riv	**6**
Roads	6
East Fork Stuart Fork	**2**
Design and Planning	1
Roads	1
East Weaver Creek	**6**
Roads	2
Design and Planning	1
Instream Habitat	1
Non-roads sediment	1
Roads	1
Grass Valley Creek	**23**
Design and Planning	1
Fish Passage	2
Instream Habitat	3
Monitoring	1
Non-roads sediment	5
Reveg	6
Riparian	2
Roads	3
Grassy Flat-Miners Creek	**7**
Cultural	1
Reveg	1
Roads	3
Wetland	2
Grouse Creek	**1**
Design and Planning	1
Happy Camp Creek	**11**
Roads	11
Hawkins Creek-Sharber Crk	**3**
Fish Passage	1
Reveg	1
Roads	1
Horse Linto Creek	**2**
Monitoring	2
Hyampom	**13**
Design and Planning	2
Non-roads sediment	1
Roads	6
Weeds	4
Indian Creek	**9**
Design and Planning	1
Fish Passage	1
Instream Habitat	1
Reveg	2
Riparian	2
Roads	2
Lewiston Lake	**1**
Reveg	1
Little Browns Creek	**10**
Fish Passage	2
Monitoring	1
Riparian	1
Roads	6
Little Trinity River	**1**
Design and Planning	1
Lower Browns Creek	**6**
Design and Planning	1
Roads	5
Lower Canyon Creek	**20**
Fish Passage	1
Non-roads sediment	1
Reveg	1
Riparian	1
Roads	7
Weeds	9
Lower Hayfork Creek	**1**
Design and Planning	1
Lower New River	**2**
Roads	1
Weeds	1
Lower South Fork Trinity River	**1**
Roads	1
Middle Canyon Creek	**4**
Roads	4
Natural Bridge	**2**
Cultural	1
Roads	1
North Clair Engle Lake	**3**
Weeds	3
Plummer Creek	**4**
Riparian	1
Roads	3
Rattlesnake Creek-Post Mounta	**5**
Design and Planning	1
Fish Passage	1
Roads	3
Reading Creek	**1**
Water Conservation	1
Rusch Creek-Little Creek	**6**
Design and Planning	1
Roads	2
Water Conservation	1
Wetland	2
Rush Creek	**2**
Riparian	2
Salt Creek-Hayfork Creek	**8**
Fish Passage	3
Reveg	1
Roads	4
Shell Mountain Creek	**6**
Roads	6
Smoky Creek	**7**
Design and Planning	1
Roads	6
Stoney Creek	**2**
Reveg	2
Sulphur Glade Crk-Waldorf Flat	**8**
Design and Planning	1
Roads	6
Weeds	1
Supply Creek	**2**
Fish Passage	1
Instream Habitat	1
Tule Creek-Hayfork Creek	**10**
Fish Passage	1
Reveg	1
Riparian	1
Roads	3
Water Conservation	3
Weeds	1
Upper Main Trinity River	**2**
Weeds	2
Upper New River	**1**
Roads	1
Upper Tribs Lower Trinity River	**1**
Roads	1
Weaver Creek	**21**
Design and Planning	2
Fish Passage	3
Monitoring	1
Non-roads sediment	1
Riparian	3
Roads	7
Weeds	1
Wetland	3
West Weaver Creek	**17**
Design and Planning	3
Fish Passage	3
Instream Habitat	2
Non-roads sediment	1
Reveg	2
Riparian	2
Roads	3
Weeds	1
Willow Creek	**2**
Monitoring	2
Grand Total	**337**

Table 4.15 Alphabetical listing of subwatersheds, with total number of restoration projects types.

Project Type, Funder, and Year Funded

Cultural
- USFS RAC
  - 2004
  - 2005

Design and Planning
- BLM
  - 2014
- Bureau of Reclamation-TRRP
  - 2010
  - 2011
  - 2012
  - 2015
- CDFG
  - 2000
- CDFG/FRGP
  - 2001
- FRGP
  - 2007
  - 2015
- N.C. Regional Water Quality Control Board
  - 2008
- NorthWind-TRRP
  - 2010
  - 2011
  - 2013
- SWQRCB
  - 2004
- US Fish & Wildlife Service
  - 2001
- USFS
  - 2009
  - 2015
- USFS RAC
  - 2004
  - 2011

Fish Passage
- BLM
  - 2004
  - 2011
- Bureau of Reclamation-TRRP
  - 2011
  - 2015
- CDFG
  - 2000
- Coastal Conservancy /NOAA Open Rivers
  - 2006
- FRGP
  - 2000
  - 2002
  - 2003
  - 2004
  - 2007
  - 2015
- Trinity County
  - 2005
- Trinity County; CDFG (PSMFC)
  - 2005
- USFS
  - 2004
  - 2010
- USFS
  - 2006
  - 2008
  - 2014
- USFS RAC
  - 2005
  - 2007
  - 2010
  - 2012
- USFWS
  - 2009

Instream Habitat
- Bureau of Reclamation-TRRP
  - 2006
  - 2008
  - 2012
  - 2015
- Cal Dept of Water Resources (NCRP)
  - 2014

Instream Habitat, Cont.
- CDFG
  - 2000
  - 2006
  - 2007
- CDFG/FRGP
  - 2003
  - 2010
- CDFG/PSMF
  - 2001
- FRGP
  - 2016

Monitoring
- BLM
  - 2001
  - 2009
- Bureau of Reclamation-TRRP
  - 2015
- FRGP
  - 2000
  - 2001
  - 2003
- NorthWind-TRRP
  - 2013
  - 2014
  - 2015
- USFS RAC
  - 2010

Non-roads sediment
- BLM
  - 2000
  - 2001
  - 2002
- Bureau of Reclamation-TRRP
  - 2004
  - 2005
  - 2007
  - 2008
  - 2013
- CDFG/FRGP
  - 2001
- NRCS
  - 2003
- Trinity County
  - 2007
- US Fish & Wildlife Service
  - 2000
- USFS
  - 2007

Reveg
- BLM
  - 2001
  - 2002
  - 2003
  - 2004
- Bureau of Reclamation-TRRP
  - 2003
- CalTrans
  - 2001
  - 2006
  - 2009
  - 2014-2017
- CDFG
  - 2003
- DOT Federal Highway Administration
  - 2012
  - 2013
- NRCS
  - 2003
  - 2004
  - 2006
  - 2008
- Trinity County
  - 2002
- USFS RAC
  - 2009

Riparian
- BLM
  - 2009
- Bureau of Reclamation
  - 2000
- Bureau of Reclamation-TRRP
  - 2004
  - 2005
  - 2006
  - 2011
- CalTrans
  - 2000
  - 2002
  - 2007
- CDFG/TRRP
  - 2009
- NRCS
  - 2005
  - 2008
- Trinity County
  - 2004
  - 2007
- USFS RAC
  - 2009
  - 2012

Roads
- BLM
  - 2004
  - 2006
- Bureau of Reclamation-TRRP
  - 2000
  - 2002
  - 2004
  - 2008-2015
- Bureau of Reclamation-TRRP/BLM
  - 2008
- CDFG
  - 2001
  - 2006
- CDFG/ USFS RAC
  - 2003
- EPA
  - 2000
- FRGP
  - 2001
  - 2002
  - 2003
  - 2005
  - 2007
- NRCS
  - 2003-2009
  - 2011
  - 2012
- OHV Commission
  - 2011
  - 2012
  - 2014
  - 2016
- OHV Commission/ USFS RAC
  - 2014
- OHV Commission/SRWQCB/CDFG
  - 2000
- Private
  - 2010
  - 2015
- SWQRCB
  - 2014
- SWQRCB/OHV Commission
  - 2011
- Trinity County/DOT
  - 2013
  - 2001
- USFS
  - 2001-2003
  - 2005
  - 2007-2008
  - 2010
  - 2015-2016

Roads, Cont.
- USFS RAC
  - 2000
  - 2002-2010
  - 2012
  - 2015
- USFS RAC/Bureau of Reclamation-TRRP
  - 2008
- USFS/Bureau of Reclamation-TRRP
  - 2008
- USFS/CDFG/OHV Commission
  - 2004
- USFS/USFS RAC
  - 2010

Water Conservation
- CDFG/PSMF
  - 2004
- NRCS
  - 2005-2008

Weeds
- BLM
  - 2009
  - 2010
- Bureau of Reclamation-TRRP
  - 2010
- Cal Dept Food and Ag
  - 2001
  - 2010
- NFF
  - 2009
- North State Resources
  - 2016
- NRCS
  - 2002
  - 2005
- Trinity County
  - 2004
- Trinity County Ag
  - 2002
  - 2016
- USFS
  - 2008
  - 2009
  - 2011
- USFS RAC
  - 2007
  - 2010
  - 2011
  - 2015
  - 2016

Wetland
- BLM
  - 2003
- DOT Federal Highway Administration
  - 2011
  - 2014
- Trinity County
  - 2003
- Trinity County/Calif Parks & Rec
  - 2004
- Trinity Lumber Co
  - 2004
- US Fish & Wildlife Service
  - 2004
- USFWS
  - 2014
  - 2017

Table 4.16 Completed projects by type, year, and funder.

Number of Completed Projects by Type

Without having financial information from all project leads and funders, the total count of projects completed by type provides one way of viewing past priorities (Table 4.17). It is no surprise that road work projects are far and above all others, considering the TMDL in the watershed is for sediment. Figure 4.75 illustrates the amount of road projects completed in the watershed. Fish passage projects being second highest also reflects the priorities set by the Southern Oregon Northern California Coast (SONCC) Coho Recovery Plan and the Trinity River Restoration Program's Record of Decision to restore salmonid fisheries to health.

Project Type	Total
Cultural	2
Water Conservation	7
Wetland	9
Instream Habitat	14
Monitoring	14
Non-roads sediment	15
Riparian	19
Reveg	25
Weeds	25
Design and Planning	26
Fish Passage	29
Roads	152
	337

Table 4.17 Completed restoration projects by type, listed in ascending order by number competed.

To illustrate the completed projects by region, the following maps (Figures, 4.76 -4.79) illustrate the type and distribution of projects within subwatersheds.

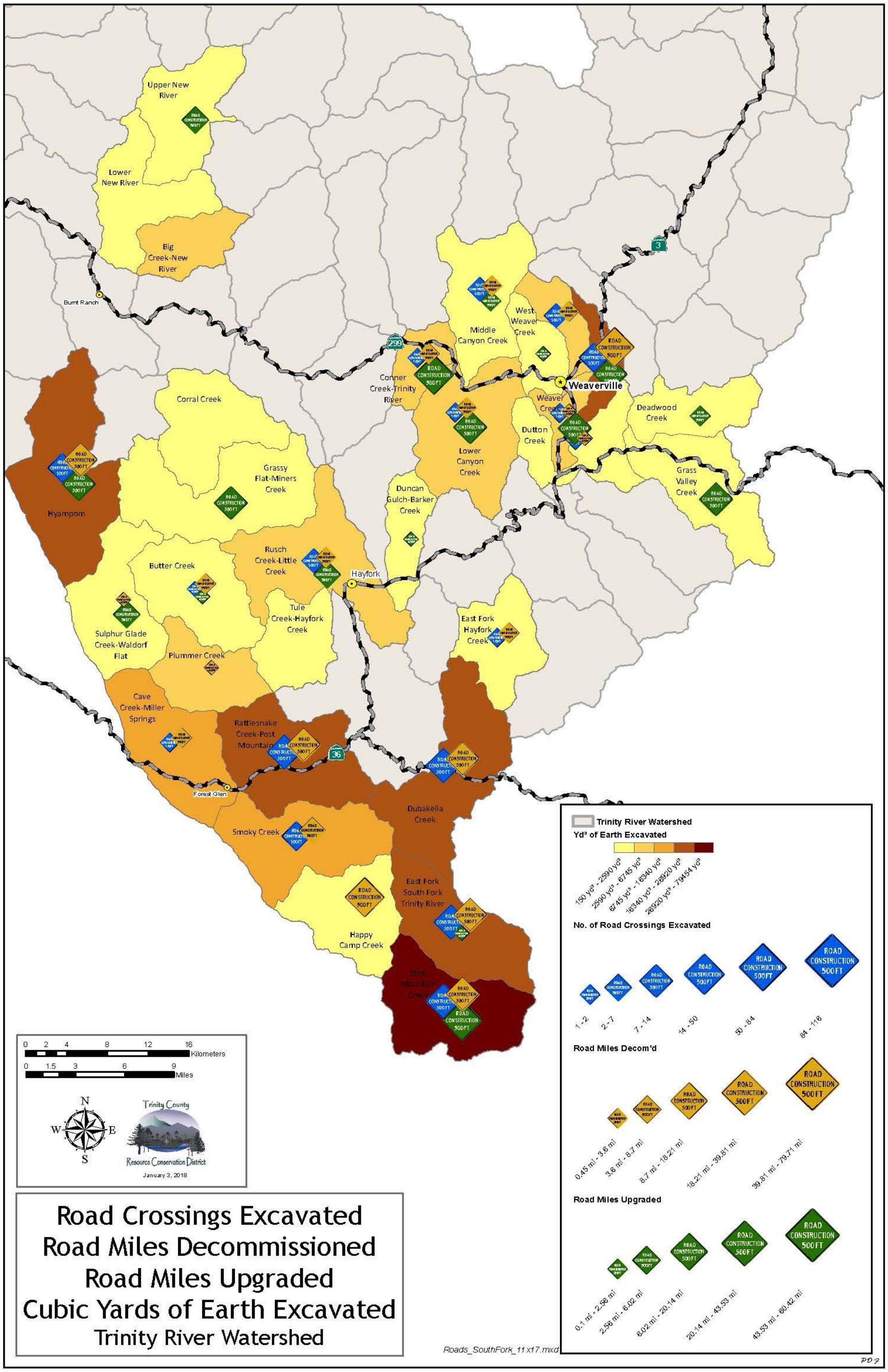


Figure 4.75 Amount and type of road projects completed between 2000 and 2017.

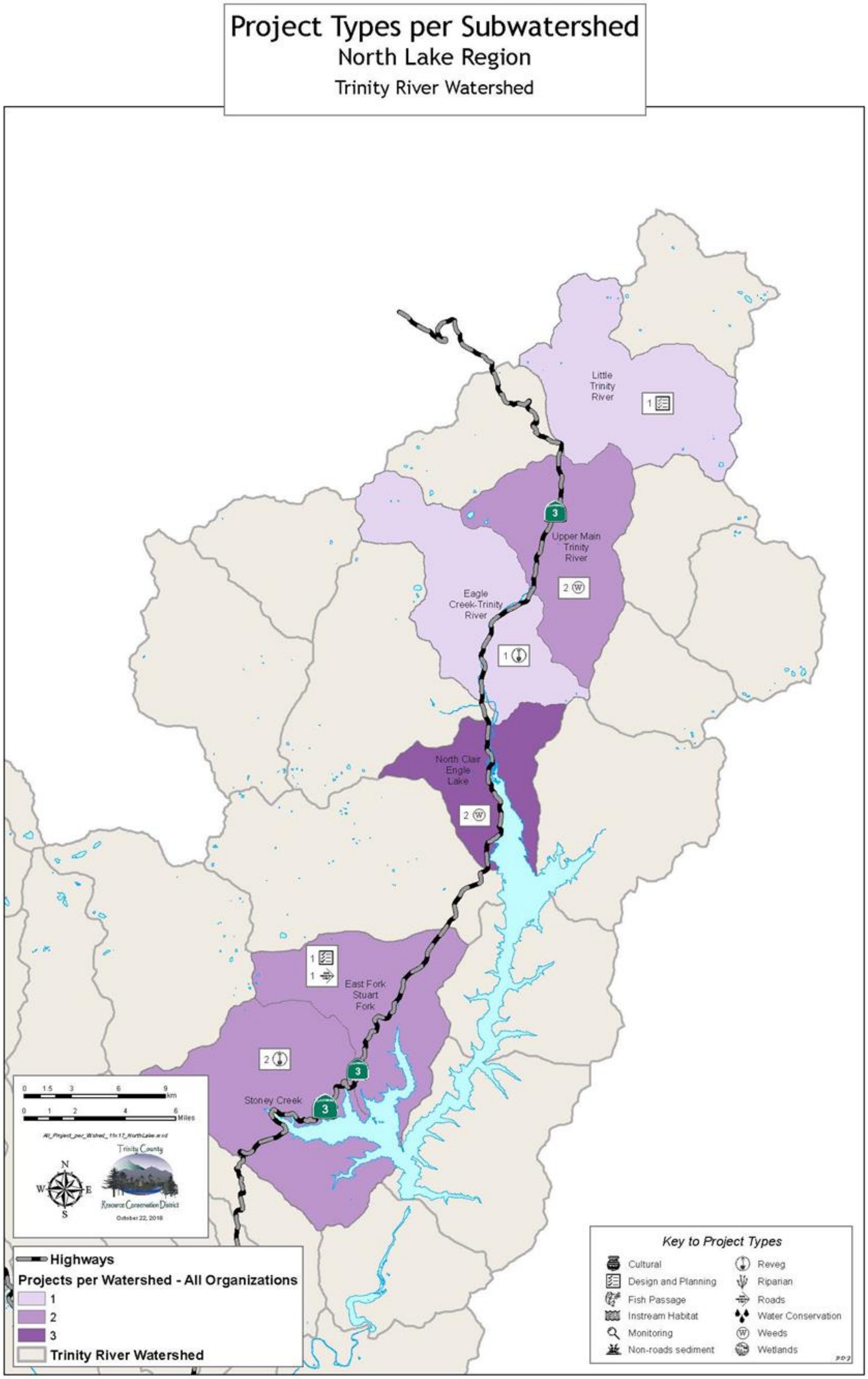


Figure 4.76 North Lake region completed projects.

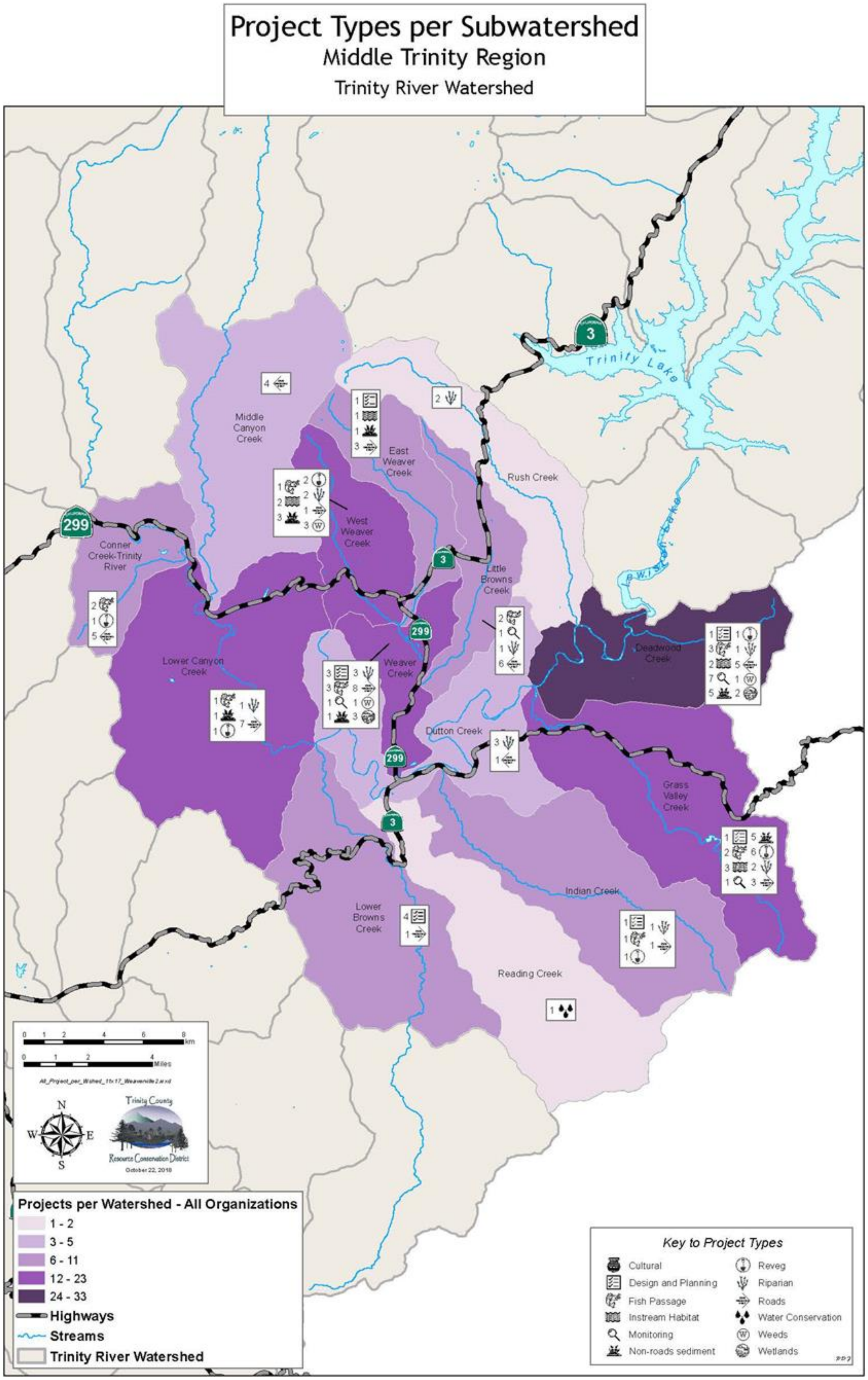


Figure 4.77 Middle Trinity region completed projects.

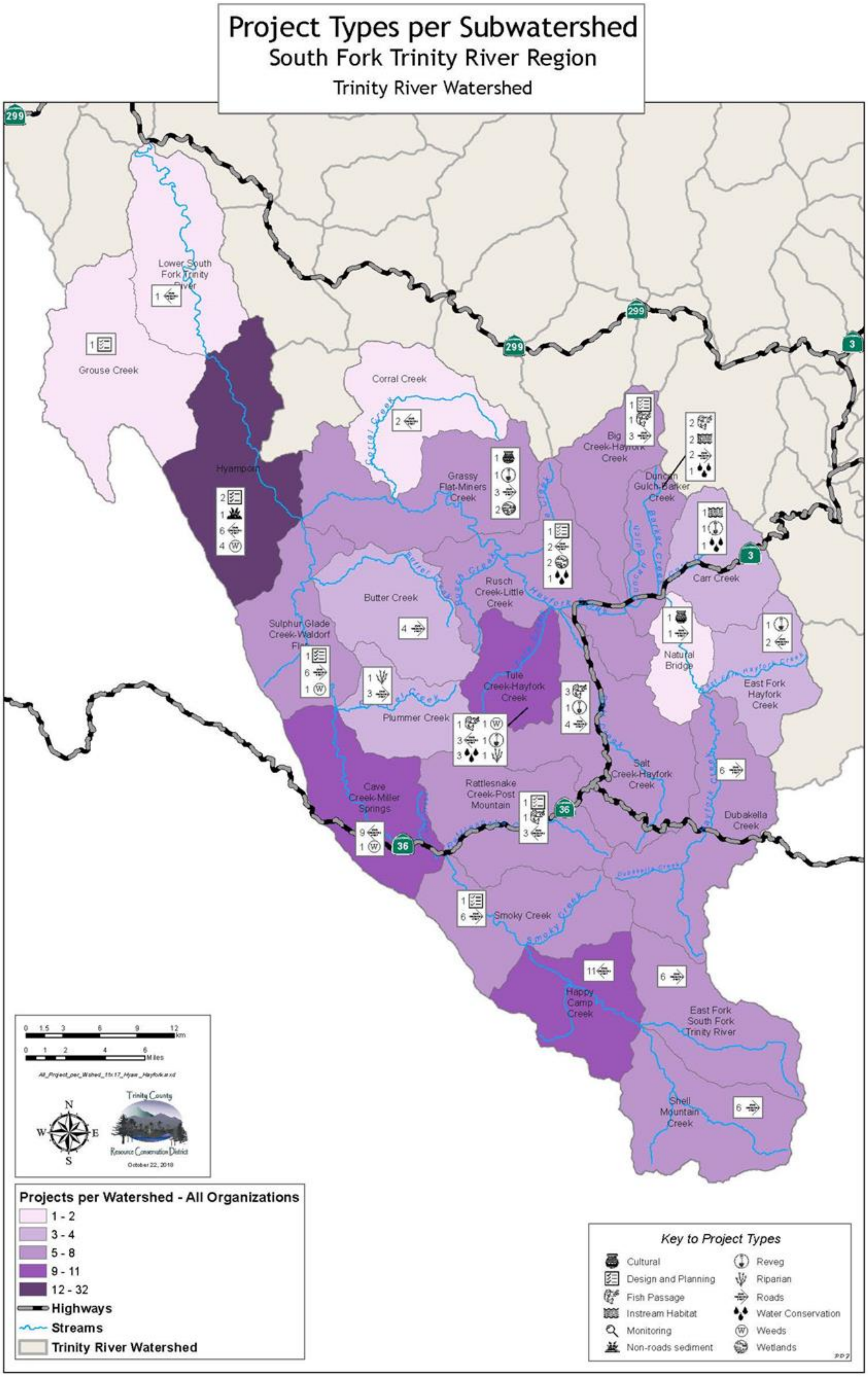


Figure 4.78 South Fork region completed projects.

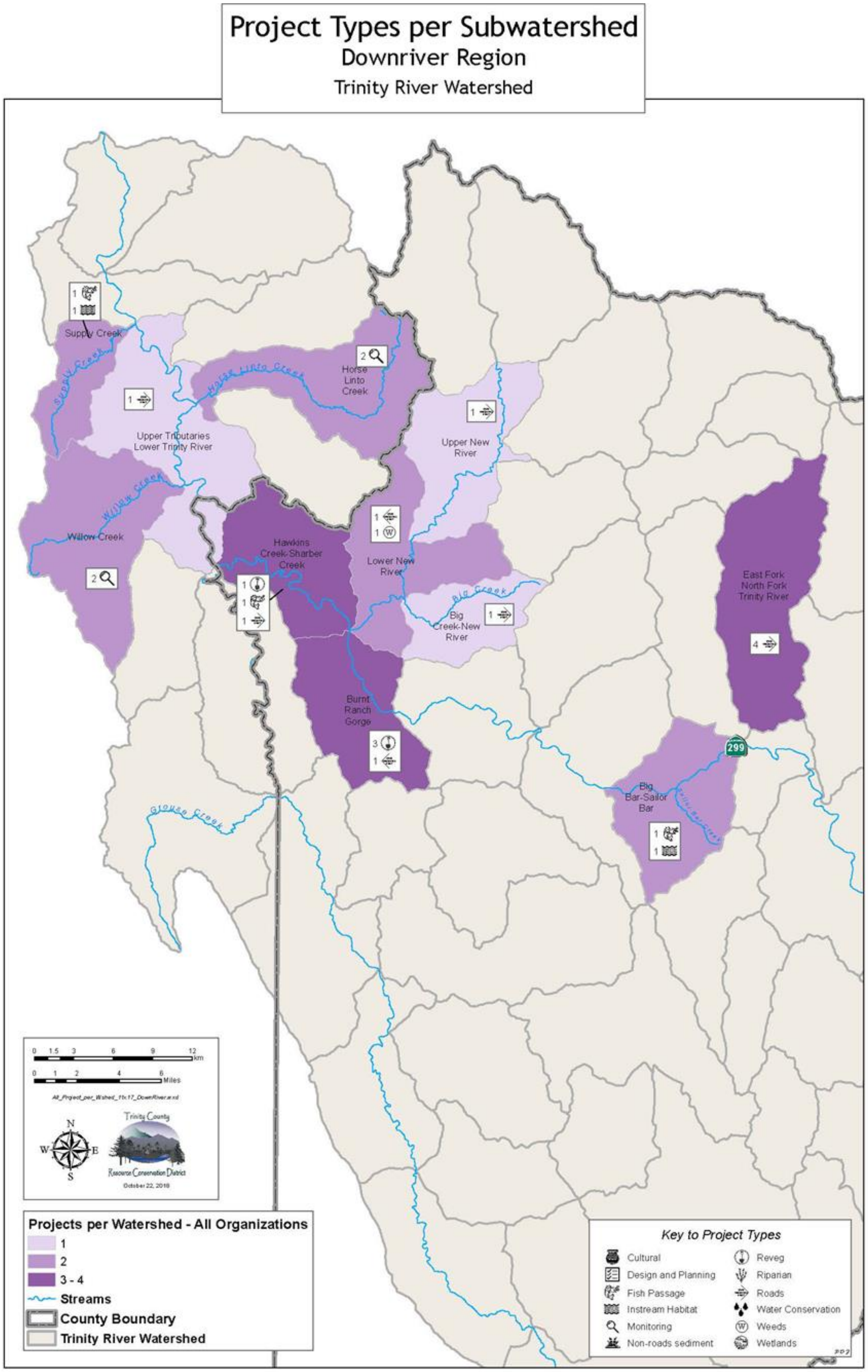


Figure 4.79 Down River region completed projects.

4.2.C Identification of Key Issues: Watershed Assessments Overview

For the purposes of this analysis, the Trinity River Watershed is divided into four geographic regions: North Lake, Middle Trinity, South Fork and Down River. These geographic regions do not align perfectly with two watersheds assessments - Burnt Ranch and Soldier Creek (USFS 2009); and North Fork Trinity River, East Fork North Fork Trinity River and Canyon Creek (USFS 2003). Soldier Creek and Canyon Creek are in the Middle Trinity region of this assessment, but because of the original assessments, summaries for these two creeks are included the Down River region review.

4.2.C1 North Lake Region Watershed Assessments

Summaries of management recommendations and priorities from watershed assessments and analyses in the North Lake Region. Summaries are in chronological order from newest to oldest:

2006, March. Upper Trinity River Watershed Assessment Report and Management and Action Plan, TCRCD.

2005, March. Upper Trinity River Analysis, including Main Trinity River, Coffee Creek, E. Fork Trinity River, Stuart Fork, and Trinity Reservoir Watersheds, USFS Shasta-Trinity National Forest.

2006, March. Upper Trinity River Watershed Assessment Report and Management and Action Plan, Trinity County Resource Conservation District.

This report focuses on sediment and turbidity delivery to streams, and ultimately to Trinity Lake. It includes good background information on the area, which aligns with the North Lake region in this gap analysis.

The goal of the document includes gathering watershed data for use in making informed decisions. A sediment source analysis was prepared for the report based on data gathered by Graham Matthews and Associates Recommendations are based on all of the gathered data and presented in the Management and Action Plan section of the report. Below is a summary of the recommendations. This summary does not include specific fuels reduction recommendations. The 2015 Community Wildfire Protection Plan (CWPP) would be the best resource for the most recent priorities for fuel reductions in this region. Both this 2006 action plan and the 2015 CWPP can be found on the TCRCD website at tcrcd.net.

- Complete road analyses and inventories of USFS roads and "shared" roads for the highest risk watersheds identified in the EPA Total Maximum Daily Load (TMDL) report.
- Complete watershed analyses for subwatersheds with a focus on identifying site specific opportunities for improving water quality.
- Implement past recommendations for road work to reduce sediment.
- Adopt a County Grading Ordinance.
- Adopt a County roads maintenance policy.
- Develop and implement an aquatic monitoring plan, including Stream Condition Inventories (SCI) in areas where work will take place as well as subwatersheds that are lacking data.
- Protect the Stuart Fork subwatershed soils resources as they are the most productive for timber regeneration.
- Highest priority county-maintained roads for treatment are:
  (See Figure 4.46 in Past Impacts section 4.2 A1 for a map of the locations)
  Eastside Road
  North Derrick Flat Road
  Trinity Alps Road
  Coffee Creek Road
  Van Ness Road
  Swift Creek Road
  Long Canyon Road
  Rainier Road West
  Delta Road
  Ramshorn Road
  Eagle Creek Road
  Eagle Creek Loop
  Slate Mountain Road
- Stream Restoration in Upper Coffee Creek to remove a fish barrier created by legacy mining activities.

- Treat overstocked stands by thinning and uneven-aged management; treat mature and poorly stocked stands, including knob cone pine; and treat young plantations by release, inter-planting and pre-commercial thinning.
- Manage LSR stands to develop old-growth characteristics and prevent large scale disturbances (fire, drought and insects.)
- Treat to reduce the risk of stand-replacing fire.

2005, March. Upper Trinity River Analysis, including Main Trinity River, Coffee Creek, E. Fork Trinity River, Stuart Fork, and Trinity Reservoir Watersheds, USFS Shasta-Trinity National Forest.

This report provides an overview of the physical and ecological conditions and processes within the five 5th field watersheds. It is intended to give direction to public and private managers for future high priority projects within the region.

The report is organized around four issues: vegetation management, Port Orford Cedar, fire protection and fuels management, and watershed condition. Each of the five watersheds are examined in regards to the four issues. The content leans heavily toward forestry management, fire and fuels issues.
Management opportunities/recommendations listed in the plan included many references to the CWPP. Those recommendations are not included here as there have been two updates to the CWPP since this report was published. Both this 2005 action plan and the 2015 CWPP can be found on the TCRCD website at tcrcd.net. Below is a summary of the recommendations.

Vegetation Management Recommendations

- Treat overstocked stands by thinning and uneven-aged management; treat mature and poorly stocked stands, including knob cone pine; and treat young plantations by release, inter-planting and pre-commercial thinning.
- Within individual watersheds the opportunities cover harvest prescriptions, timber management, fuels management and managing for Late Seral Reserves (LSR).
- In the Stuart Fork and Trinity Reservoir watersheds – develop bald eagle nest trees on the slopes overlooking Trinity Lake.
- Complete a timber inventory and establish plots for monitoring.

Port Orford Cedar Management Recommendations

- Incorporate measure to protect the population for all management activities and practices.
- Perform a restoration needs inventory and risk analysis.

Fire and Fuels

- Established priority fuels treatment areas (may be out of date now)
- Conduct fire shed analyses. This modeling tool allows planners to estimate fire behavior and changes in fire behavior/patterns with various fuels reduction treatments.
- Coordinate fuels reduction efforts with other agencies.

Watershed Condition

- Inventory and address sediment issues created by roads and timber harvest.
- Evaluate and limit effects of suction dredge operations in stream reaches that overlap spawning sites.
- Develop and implement an aquatic monitoring plan to include habitat, fish populations and management effectiveness.
- Provide for protection of soil resources and move soil resources toward desired future conditions.
- Allow vegetation management to occur within and adjacent to the buffers of Riparian Reserves when they are compatible with Aquatic Conservation Strategy Objectives.

- Consider desired future conditions and plan activities to maintain or enhance water quality, soul stability, fertility and productivity.
- Conduct Stream Condition Inventories along with habitat typing surveys and channel stability evaluations, as very little data exists pertaining to the characteristics and health of the stream channels in this watershed.

4.2.C2 Middle Trinity Region Watershed Assessments

Two watershed assessments cover tributaries in both the Middle Trinity and Down River regions as they are delineated in this document. Please refer to the Down River Watershed Assessments section for information on Soldier Creek (2009) and Canyon Creek (2003). The other tributary assessments are listed below in chronological order from newest to oldest:

2012, August. West Weaver Creek Assessment and Action Planning, Prepared for TCRCD by ESA PWA.

2004, March. Weaverville Watershed Analysis, Shasta-Trinity National Forest Trinity River Management Unit.

2012, August. West Weaver Creek Assessment and Action Planning, Prepared for TCRCD by ESA PWA.
This document was prepared in support of a proposed in-stream restoration project that was implemented in 2017. It provides physical, hydrological, and biological data on West Weaver Creek and proposes rehabilitation of in stream habitat to reduce fine sediment and increase salmon habitat quantity and quality.

Recommendations in this document included the rehabilitation project that was implemented in 2017. Additionally, it recommends a detailed fish passage and remediation assessment of the Highway 299 culvert.

2004, March. Weaverville Watershed Analysis, Shasta-Trinity National Forest.
The focus of the analysis is vegetation condition, especially in relation to timber harvest, and covers fuel loading, water quality, aquatic habitat, wildlife habitat and soil productivity. The area under study does not cover the entire Weaver Creek Watershed, but rather the northern portion of the drainage north of Weaverville, including the upper portions of Little Browns Creek and Rush Creek Watersheds.

This analysis examines seven issues: Human Uses and Values, Access and Travel Management, Erosional Processes, Aquatic Systems, Terrestrial Wildlife Habitat and Species, Fire and Fuels, and Plant Communities. The fisheries section has some data on anadromous fish in Rush Creek, Little Browns Creek, East and West Weaver Creeks, and Sidney Gulch. The report covers a good deal of geology and impacts from erosional processes. It also contains an informative appendix on deer habitat conditions. The complete analysis can be found online at http://www.tcrcd.net.

Issues, findings and recommendations relating to Human Uses and Values, and Access and Travel Management are not reviewed in this analysis.
Issue 3: Erosional Processes
3-1 Mass Wasting

- Avoidance of land disturbing activities.
- Maintenance of road structures to prevent blockages in culverts and reduce sediment transport.
- To control lateral cutting and bed load transport of sediment, measures such as log and rock check dams, head cut structures, planting of riparian vegetation and placement of large wood to aid channel stabilization.
- Use the mapped geology information to make informed land management decisions.

3-2 Restore and protect soils.

3-3 Improve the condition of the watershed within analysis area

- Perform sediment budget and source analysis for these watersheds, in order of priority: Rush Creek, Little Browns Creek, West Weaver Creek and East Weaver Creek.
- Inventory, implement and track watershed improvement needs on USFS lands
- Work with local agencies and private timber companies
- Reduce fuel load on landscape level to help prevent high severity wild fire
- Evaluate and limit effects of suction dredge operations un stream reaches that overlap spawning sites.
- Evaluate and limit effects of storm water run-off from Weaverville.

- Evaluate and implement water conservation practices in Weaverville.
- Prevent mass-wasting events.
- Upgrade culverts to pass 100 year flood events and allow fish passage.
- Limit new road construction and design new roads to meet current standards.

Issue 4: Aquatic Systems and Species
- Manage Riparian Reserve vegetation to promote growth and function
- Create complex habitat with in-stream structures
- Modify fish barriers to allow anadromous fishes full access to watersheds.
- Decommission roads within Riparian Reserves.
- Reduce cumulative impacts to restore function and flow.

Issue 5: Terrestrial Wildlife Habitat and Species
- Manage stands for old growth where possible and practicable.
- Reduce ladder fuels in designated stands.
- Defer timber harvest in all old growth stands as they are most likely the highest quality deer cover habitat in the watershed.
- Use prescribed burning or mastication to stimulate new nutritious growth for deer forage.
- Thin around existing viable black oak within conifer stands to maintain and improve acorn production for deer forage.
- Give priority to treatments within deer winter range.

Issue 6: Fire and Fuels
- Reduce the total number of acres at risk to severe wildland fire.
- Conduct and use research to support the reduction of hazardous fuels in the environment.
- Ensure local environmental conditions are factored into fuels treatment planning.
- Promote community assistance and engagement in forest health initiatives.
- Follow the Shasta-Trinity standards and guidelines relating to fire and fuels in this specific land allocation.
- Implement fuel management zones.

Issue 7: Plant Communities
- Reduce fuel loading in areas where habitat exists for mountain and Brownie lady slipper, English Peak greenbriar and Canyon Creek stonecrop.
- Discourage creation of user-created trails to reduce introduction of invasive weeds.
- Develop designated trail plan that will lessen impacts to soil and reduce spread of invasive weeds.
- Use signage to provide information of off-road vehicles and other recreational users on weed introduction and spread.

4.2.C3 South Fork Trinity Watershed Assessments

Summaries of management recommendations and priorities from watershed assessments and analyses in the South Fork Trinity Region. Summaries are in chronological order from newest to oldest:

2016, June. The South Fork Trinity River Supplemental Watershed Assessment, 2014-2016, Watershed Research and Training Center.

2008, July. Big Creek Watershed Assessment Report, Watershed Research and Training Center.
(Note – this assessment also contains summaries for 1996 CRMP; 1998 South Fork and Hayfork TMDL; 1999 Big Creek Stream Condition Inventory; and the 2000 Middle Hayfork and Salt Creek Watershed Assessment. Those finding/recommendation summaries are included here as well.)

2001, September. Hidden Valley, Plummer Creek, and Rattlesnake Creek Watershed Analysis

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2016, June. The South Fork Trinity River Supplemental Watershed Assessment 2014-2016, Watershed Research and Training Center.

This is the most recent and extensive assessment of the South Fork Watershed with excellent data sources. It was created with funding from the California Department of Fish and Wildlife Fisheries Restoration Grant Program. The focus of this assessment is anadromous fisheries and it includes a comprehensive collection of data and field work reports.

The five appendices cover water conservation measures, stream temperature analysis, riparian assessment, fish passage and water diversion assessment, and stream mouth assessment. The authors chose not to include a sediment analysis as it is considered significant enough to need a stand-alone report.

As each of the five appendices included recommendations, they have been copied from the report and are included in the following nine pages.

Recommnedations from the South Fork Trinity River Supplemental Watershed Assessment, 2016, WRTC. Appendix 1, Water Conservation.

Water Conservation Recommendations

Table 12. Prioritization of Water Conservation Techniques

Subwatershed	Priority 1	Priority 2	Priority 3	Priority 4
Salt Creek (Lower Salt Creek-Hayfork Creek, Gulch-Salt Creek, and Upper Salt Creek-Hayfork Creek)	Develop New Water District	Develop Off-Channel Pond Storage for Agriculture	Waterworks District Boundary Expansion	Improve Agricultural Water Delivery Systems (efficiency)
Big Creek (Lower Big Creek-Hayfork Creek and Upper Big Creek-Hayfork Creek)	Instream Water Right Dedication	Temporary Water Transaction	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)
Tule Creek (Lower Tule and Upper Tule)	Instream Water Right Dedication	Develop off channel storage for ranches	Temporary Water Transaction	Improve Agricultural Water Delivery Systems (efficiency)
East Fork Hayfork Creek (Upper East Fork Hayfork and Lower East Fork Hayfork creeks)	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	Temporary Water Transaction	
Barker Creek	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	
Carr Creek (Carr Creek, Duncan Creek, and Summit Creek)	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	
Hyampom Valley (Lower Hayfork Creek Canyon, Hyampom Valley and Wintoon Flat-Deep Gulch)	Develop New Water District	Develop Off Channel Pond Storage for Agriculture	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)
Olsen Creek	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	Tanks and Forbearance	Develop New Water District

Subwatershed	Priority 1	Priority 2	Priority 3	Priority 4
Hayfork Valley (Hayfork Valley, Kingsbury Gulch-Kellogg Gulch, and Lower Salt Creek-Hayfork Creek)	Waterworks District Boundary Expansion	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	
Rattlesnake Creek (Post Creek, Upper Rattlesnake Creek)	Develop New Water District	Unauthorized (illegal) Water Diversion Enforcement	Utilize Water Storage Tanks for Private Domestic and Agriculture	
Butter Creek (Butter Creek Meadows and Upper Indian Valley Creek)	Tanks and Forbearance	Develop Off Channel Pond Storage for Agriculture	Utilize Water Storage Tanks for Private Domestic and Agriculture	
Chanchelula Gulch-Shiel Gulch	Instream Water Right Dedication	Improve Agricultural Water Delivery Systems (efficiency)	Develop Off Channel Pond Storage for Agriculture	
Hayfork Creek near Wildwood (Stringbean Creek-Good Creek and Halls City Creek-Wilson Creek)	Instream Water Right Dedication	Temporary Water Transaction	Unauthorized (illegal) Water Diversion Enforcement	Improve Agricultural Water Delivery Systems (efficiency)

4 RECOMMENDATIONS FOR FUTURE MONITORING

Data gaps for each watershed are discussed above in sections 3.4.1.2, 3.4.2.2, 3.4.3.2, 3.4.4.2, 3.4.5.2, and 3.4.6.2. The highest priority for collecting stream temperature data at additional sites would be streams that have intrinsic potential for juvenile coho salmon but no temperature data (Table 4).

Table 4. Recommended additional sites for collection of stream temperature data in the South Fork Trinity River (SFTR) watershed.

Location(s)	Watershed	Justification
Big Creek, Mill Creek, and Kerlin Creek	Lower SFTR	No data in any year 1989-2015, but has intrinsic potential for coho salmon.
[None]	Middle SFTR	There are some un-monitored streams that are accessible to anadromous fish, but the length of habitat is limited by natural barriers and/or small private parcels that make watershed protection/restoration difficult.
SFTR below confluence with East Fork SFTR	Upper SFTR	For a period of one to two years, re-occupy the "SFT_Bridge_33_H20_temp" site that was monitored from 1989 to 2007 (Figure 35), so a crosswalk can be developed to the currently monitored site on the SFTR upstream of the EF SFTR confluence (Figure 36). Presently within the SFTR watershed, spring Chinook primarily utilize the mainstem between Hitchcock Creek and the East Fork of the SFTR for over-summering and spawning (Foster Wheeler Environmental Corporation 2001).
[None]	Lower Hayfork Creek	There are some un-monitored streams that are accessible to anadromous fish, but the length of habitat is relatively short and none has high intrinsic potential for coho juveniles.
West Fork Tule Creek, Kingsbury Gulch, and North Fork Philpot Creek	Middle Hayfork Creek	No data for those streams in any year 1989-2015, but has moderate/high intrinsic potential habitat for coho salmon that is located on public lands. Access of anadromous fish to Kingsbury Gulch is potentially limited by a long culvert under the airport runway.
Salt Creek near confluence with West Fork Salt Creek	Middle Hayfork Creek	Moderate/high intrinsic potential habitat for coho salmon that is located on public lands. Existing data approximately one mile downstream (at campground) suggests stream temperatures are slightly too high for juvenile coho and it is unknown how cool temperatures are upstream.
Ditch Gulch (tributary to Salt Creek) at USFS property boundary	Middle Hayfork Creek	Only one-third mile between natural total barrier and USFS property boundary, but has high intrinsic potential habitat for coho salmon that is located on public lands. MWMT was 16.4 °C in 2002 at site approximately 1.3 mile upstream (above barrier), but it is unknown how much the stream warms downstream.
East Fork Hayfork Creek headwaters, Hayfork Creek headwaters	Upper Hayfork Creek	High intrinsic potential habitat for coho salmon that is located on public lands. High probability of cold water.

Recommendations from the South Fork Trinity River Supplemental Watershed Assessment, 2016, WRTC. Appendix 3, Riparian Vegetation Assessment.

SFTR Watershed Assessment Table 14: The 50 riparian sites with highest restoration priority of 858 no cover sites in the SFTR watershed and associated prioritization metrics.

Planting Priority	Size (acres)	SiteName	Coho IP Rating	Solar Rating	IP x Solar	CO IP CURV	Mean Solar Value (Watt hours/ meter^2)	Latitude	Longitude
1	4.5	Hayfork Cr upstream of Goods Creek 1	3	6	18	0.89	805130	-123.066	40.3875
2	0.9	Little Barker Creek	3	6	18	0.69	803056	-123.109	40.5951
3	0.5	Hayfork Cr/ Wildwood 1	3	6	18	0.93	796205	-123.054	40.4183
4	0.4	Hayfork Cr/ Wildwood 2	3	6	18	0.75	796205	-123.052	40.4191
5	0.5	Hayfork Cr/ Wildwood 3	3	6	18	0.75	796205	-123.052	40.4199
6	11.7	Hayfork Cr upstream of Goods Creek 2	3	6	18	0.89	795066	-123.065	40.3861
7	1.3	Hayfork Cr/ Wildwood 4	3	6	18	0.93	794510	-123.055	40.4155
8	1.2	Hayfork Cr: Wilson Creek	3	6	18	0.93	794385	-123.056	40.4144
9	4.4	Bridge at Barker Creek	3	6	18	0.87	792780	-123.114	40.5835
10	20.1	Barker North Meadow 1	3	6	18	0.87	792780	-123.115	40.5832
11	1.4	Barker Valley 1	3	6	18	0.84	792780	-123.115	40.5858
12	5.6	Barker Valley 2	3	6	18	0.81	792780	-123.115	40.5887
13	0.7	Barker North Meadow 2	3	6	18	0.80	792780	-123.117	40.5896
14	0.8	Duncan Gulch 1	3	6	18	0.97	792033	-123.141	40.5748
15	0.8	Salt Creek: 13 Dips	3	6	18	0.95	791963	-123.152	40.4510
16	12.0	Hayfork Cr: Canon Ball	3	6	18	0.93	791624	-123.058	40.4139
17	1.7	Duncan Gulch 2	3	6	18	0.81	790540	-123.133	40.5794
18	8.6	Barker Cr: Cr Crossing	3	6	18	0.89	790073	-123.112	40.5768
19	8.9	Barker Cr: Little Barker Cr	3	6	18	0.75	789921	-123.115	40.5941
20	13.6	Slat Cr x Ditch Gulch 1	3	6	18	0.95	789832	-123.154	40.4507
21	0.8	Barker Cr: Sunshine Meadow Way	3	6	18	0.82	789294	-123.114	40.5935
22	4.5	Barker South Meadow	3	6	18	0.81	789221	-123.113	40.5753
23	1.0	Duncan Gulch 3	3	6	18	1.00	789091	-123.142	40.5735
24	2.5	East Fork Hayfork Cr 1	3	6	18	0.76	788817	-123.025	40.5002
25	2.7	East Fork Hayfork Cr 2	3	6	18	0.94	788817	-123.026	40.5013
26	3.5	Old Cold Creek Road 1	3	6	18	0.89	788256	-123.066	40.3859
27	6.9	East Fork Hayfork Cr: Rose Gulch	3	5	15	0.87	788088	-123.021	40.5006
28	0.3	Hayfork Cr/ Wildwood 5	3	5	15	0.93	787898	-123.059	40.4091
29	1.0	Hayfork Cr/ Wildwood 6	3	5	15	0.93	787898	-123.059	40.4096
30	1.0	Hayfork Cr/ Wildwood 7	3	5	15	0.93	787898	-123.060	40.4067
31	1.4	Hayfork Cr/ Wildwood 8	3	5	15	0.93	787898	-123.059	40.4082
32	0.6	Hayfork Cr/ Wildwood 9	3	5	15	0.93	787898	-123.060	40.4076
33	6.5	Hayfork Cr: Hall City Cr	3	5	15	0.72	787825	-123.059	40.4015
34	7.0	Duncan Gulch 4	3	5	15	0.93	787630	-123.140	40.5745
35	1.6	Old Cold Creek Road 2	3	5	15	0.90	787501	-123.067	40.3838
36	25.5	Big Creek Ranch 1	3	5	15	0.86	787372	-123.152	40.5787
37	6.8	Big Creek Ranch 2	3	5	15	0.86	787372	-123.150	40.5832
38	8.7	Big Creek Ranch 3	3	5	15	0.88	787372	-123.151	40.5693
39	3.3	Big Creek Ranch 4	3	5	15	0.88	787372	-123.150	40.5691
40	1.7	Big Creek Ranch 5	3	5	15	0.87	787372	-123.151	40.5805
41	1.4	Big Creek Ranch 6	3	5	15	0.87	787372	-123.151	40.5783
42	2.8	Big Creek Ranch 7	3	5	15	0.76	787372	-123.150	40.5739
43	5.0	Big Creek Ranch 8	3	5	15	0.86	787372	-123.151	40.5716
44	5.0	East Fork Hayfork Cr: Sims Creek	3	5	15	0.93	787051	-123.012	40.5040
45	0.7	Potato Creek	3	5	15	0.69	786518	-123.043	40.5036
46	2.9	Duncan Gulch 4	3	5	15	0.89	785679	-123.140	40.5704
47	5.9	Carr Creek	3	5	15	0.92	785609	-123.089	40.5752
48	4.3	East Fork Hayfork Cr 3	3	5	15	0.82	785549	-123.003	40.5068
49	8.6	Salt Creek Ditch Gulch2	3	5	15	.82	785325	-123.157	40.4529
50	2.5	Duncan Gulch;Hwy 3	3	5	15	.90	785271	-123.137	40.5572

Recommendations for improvements of fish passage on diversion structures

Olsen Creek was identified as the highest restoration priority because it is known to be historically occupied coho habitat. CDFW has previously retrofitted the fish passage structure at the diversion. Regular monitoring and maintenance of the structure by CDFW would allow improved passage by managing flows within the fish passage structure.

Silver Creek is the next highest restoration priority. There is a concrete dam impairing fish passage. This diversion is no longer used. Removal of the obsolete diversion structure would allow fish passage of all life history stages to high quality upstream habitat.

The upper diversion structure on Big Creek is trapping adult steelhead above the diversion due to creek flows being entirely diverted into the diversion. A more gradual decrease of flows in the creek may provide the necessary hydrologic cue to adult individuals to out-migrate. Additionally, the maintenance of minimal flows through the fish passage structure would allow this to be utilized year round.

The lower diversion structure on Big Creek is no longer being utilized and should be removed to restore fish passage upstream.

The restoration recommendations for Upper Tule Creek diversion structure are similar to the upper diversion structure on Big Creek. Flow management would allow fish to potentially use the existing fish passage structure by maintaining minimal flows.

Lastly, West Tule Creek needs some sort of flow management, if possible, or a fish passage structure in the concrete apron. Specific actions were difficult to determine due to the extremely low flows in the creek.

The implementation of a few relatively low cost and opportunistic actions in these important tributaries to the South Fork of the Trinity River would greatly enhance fish passage for all life history stages to these vital cold water refugia area.

RESTORATION RECOMMENDATIONS

Eleven streams were visually assessed (Table 5). Eight streams were found to be hydrologically connected to the SFTR and conditions at the mouth would allow passage of juvenile salmonids at the assessment flow. One site did not have sufficient fish passage at the mouth under observed flows, and visual observation indicates that handwork would not be sufficient to restore fish passage. Three sites were found to be a restoration priority at the observed flow for handwork to restore fish passage at the mouth. Rough Gulch, Grouse Creek, and Little Bear Wallow were the only sites determined to have restoration potential from the visual assessments at the observed flows.

Table 5. Restoration recommendations for each visually assessed stream relative to the streamflow at the Hyampom gauge on the SFTR. Restoration recommendations were Not Necessary (NN), or Restoration Priority (RP)

Stream	Flow during survey (cfs)	Restoration Recommendation
Duncan Gulch	535	NN
Miner's Creek	93	NN
Red Mountain Creek	17	NN
Rough Gulch	17	RP
Bear Creek (Hayfork Creek)	105	NN
Big Creek	866	NN
Carr Creek	830	NN
Grouse Creek	17	RP
Little Bear Wallow	600	RP
Olsen Creek	14	NN
Smokey Creek	830	NN

Thirteen streams were quantitatively surveyed in the summer of 2014 and 2015 (Table 6). Two streams, Rattlesnake and Corral Creeks, were found to be hydrologically connected to the SFTR and conditions at the mouth would allow passage of juvenile salmonids at or below historic base flow. One site, Crystal Creek, was reported by local landowners to be a high value coldwater refugia, however, investigations of aerial imagery showed this to be an orthfluvial oxbow on the SFTR floodplain. Restoration of fish passage from handwork at these sites is either not necessary or not applicable. Five sites (Big Creek and Mill Creek (Hyampom), Kerlin Creek, Olsen Creek, and Pelletreau Creek) were found to be disconnected at the mouth but handwork would not be sufficient to restore fish passage. Five sites were found to be restoration priorities for handwork to restore fish passage at the mouth; Eltapom, East Fork of Hayfork, Madden, Potato,and Plummer Creeks.

Table 6. Restoration recommendations for each surveyed stream relative to the streamflow at the Hyampom gauge on the SFTR. Restoration recommendations were Not Necessary (NN), Not Applicable (NA), Not Sufficient (NS), or Restoration Priority (RP).

Stream	Flow during survey (cfs)	Restoration Recommendation
Big Creek (Hyampom)	14	NS
Corral Creek	18	NN
Crystal Creek	74	NA
Eltapom Creek	18	RP
EF Hayfork Creek	74	RP
Kerlin Creek	74	NS
Madden Creek	55	RP
Mill Creek (Hyampom)	14	NS
Olsen Creek	14	NS
Pelletreau Creek	14	NS
Potato Creek	70	RP
Plummer Creek	66	RP
Rattlesnake Creek	17	NN

Coho salmon are currently found in the SFTR up to Butter Creek and in Hayfork Creek up to Corral Creek. There is occupied habitat in Eltapom Creek, Olsen Creek, and Madden which are characterized as important cool water refugia in the SONCC Recovery Plan (NOAA, 2014). Madden Creek was the only survey site in which coho salmon were observed and it had the highest species richness, 5, of any tributary surveyed. Eltapom Creek should be the second priority for restoration because it contains occupied coho habitat. These areas should be top priorities for restoration. Additionally, the SONCC Recovery Plan found moderate to high Intrinsic Potential habitat in Pelletreau Creek, and Rattlesnake Creek. Therefore, these streams should also be considered a high priority for recovery (NOAA, 2014). However, Rattlesnake Creek had sufficient hydrologic connectivity at the mouth to allow fish passage without restoration work. Fish passage at the mouth is not a limiting factor in coho recovery in this tributary. Pelletreau Creek was found to need more than handwork to restore fish passage into this tributary from the SFTR during base flows. Therefore, restoration priorities based on literature and field surveys to restore fish passage at the mouth using handwork should be:

1. Madden Creek
2. Eltapom Creek

3. Plummer Creek
4. East Fork of Hayfork Creek
5. Potato Creek
6. Rough Gulch
7. Grouse Creek
8. Little Bear Wallow

Madden Creek

Mouth restoration by handwork would be sufficient to restore passage from SFTR to Madden Creek (Figure 4.80). Although the creek is hydrologically connected by surface flows, the gradient at the mouth is fairly steep due to aggradation at the mouth.

Figure 4.80 Aggradation at the mouth of Madden Creek.

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CONCLUSIONS

Survey assessments indicate there are several opportunities for restoration of fish passage at tributary mouths in the SFTR watershed. Madden Creek, Eltapom Creek, EF of Hayfork Creek, Plummer Creek, and Potato Creek are good candidates for handwork activities to restore fish passage at tributary mouths. Rough Gulch, Little Bear Wallow, and Grouse Creek were the only sites determined to have handwork potential to restore fish passage at the tributary mouth based on the visual assessments. There are likely additional opportunities for handwork activities to restore fish passage at tributary mouths at other sites within the SFTR watershed. Priority sites for future quantitative assessments are Happy Camp Creek, Grouse Creek, Rough Gulch, Sulfur Glade Creek, Glen Creek, and Bierce Creek. The annual assessment of high value tributaries, particularly those in the Hyampom Valley such as Kerlin Creek, Mill Creek, Big Creek, Pelletreau Creek, and Eltapom Creek, is also recommended.

The restoration of fish passage at tributary mouths maximizes fishery benefits while minimizing planning and implementation costs. The availability of tributary habitat is particularly important in the SFTR watershed because tributaries offer high quality cold water refugia. Therefore, these areas are particularly important during summer months when the mainstem of the SFTR warms substantially and becomes more suitable to warm water fish assemblages. Attractant flows to tributary habitat would be enhanced by restoring hydrologic connectivity as well as other potential future restoration activities such as large wood projects to promote river scour. Access to and maintenance of tributary habitat represents a vital management action to sustaining salmonid assemblages in the SFTR watershed.

DATA GAPS

More data can be collected for the following stream mouths in order to create better designs for the following streams: Rough Gulch, Little Bear Wallow, and Grouse Creeks. Several tributaries upstream of Forest Glen have not been surveyed in this project including Collins, Farley, Marie, Silver, Charlton, Cable, Happy Camp, Bierce, and several un-named creeks.

2008, July. Big Creek Watershed Assessment Report, Watershed Research and Training Center.
This assessment focuses on watershed characteristics and covers all traditional areas of analysis. The focus of the report is stated:

> "This Watershed Assessment is an existing conditions report that will be used as an educational tool to help guide residents and stakeholders in prioritizing future watershed planning and restoration projects."

It is an exhaustive report with over 300 pages of information.

Findings/Recommendations from Big Creek Watershed Assessment:
Upper Big Creek

- Continue USFS Best Management Practices for forest health and burned area response
- Replant riparian vegetation
- Mitigation for sediment and water temperature

Lower Big Creek

- Work with land owner to upgrade diversion
- Develop ranch management plan to control sediment, manage riparian areas, manage hunting, and become compliant with CDFW on diversions.
- Develop water conservation education program
- Develop wildlife corridor connecting lower watershed to valley floor

The Big Creek report contains recommendations from several past plans for the South Fork Trinity River, and are listed below. Recommendations that have been implemented are removed from this summary.

South Fork Trinity River: Coordinated Resource Management Plan (CRMP; 1996)
(Summary from Big Creek Assessment)
Prepared by: Patrick Truman & Associates and Pacific Watershed & Associates

Project Summary
Coordinated Resource Management and Planning (CRMP) is a resource planning, problem solving, and management (decision making) process that allows for direct participation of everyone (stakeholders) concerned with resource management in a given planning area.
Findings/Recommendations

- Water quality and quantity are the major limiting factors to fisheries recovery in this management unit.
- Water diversions and water pollution along with high summer water temperatures are negatively affecting fish habitat in this reach and in downstream reaches.
- In management unit #5 (including Big Creek watershed) it is important to pursue conservation practices to reduce water use and to allow for adequate riparian habitat to protect and shade the streams in order to reduce temperatures. In many cases this may mean fencing off the riparian zone to protect it from cattle.
- Efforts to reduce water temperatures through a riparian revegetation program utilizing a mix of conifer and deciduous species should continue, as well as additional reductions in water diversions through installing more efficient delivery systems and improvements in irrigation operations.
- Plans for this management unit should include additional riparian exclusionary fencing, revegetating riparian zones, upland fuels reduction and erosion control projects on private lands, water quantity and quality projects such as piping old, leaky irrigation ditches.

South Fork Trinity River and Hayfork Creek Sediment TMDL (1998)
(Summary from Big Creek Assessment)
Prepared by US Environmental Protection Agency (EPA), Region 9

Project Summary
This TMDL addresses sediment loading in the entire South Fork Trinity River basin, including Hayfork Creek and its tributaries.
Findings/Recommendations

- The sedimentation in the South Fork Trinity River watershed was judged to exceed the existing Water Quality Standards (WQS) necessary to protect the beneficial uses of the basin, particularly the cold water fishery. Accelerated erosion from land use practices and natural sources impacts the migration, spawning, reproduction, and early development of cold water fish such as spring and fall run chinook salmon and steelhead trout.
- In the Hayfork Creek sub-basin, roads and bank erosion are the most significant components of the overall sediment production, largely due to the fact that mass wasting is a much less significant process in that sub-basin.
- Non-management surface erosion is more significant in [Big Creek] due to past fires as well as to chaparral vegetation types, which do not protect the surface slopes as well as tree coverage.
- Harvest-related surface erosion from harvest units is estimated at about 9 tons/mi2/yr, respectively.
- Existing information suggests that high temperatures could result from: natural conditions, water diversions (particularly in Hayfork Creek), loss of riparian vegetation in selected locations, and excess sedimentation that resulted in channel widening and decreased water depths.
- Improve substrate size distribution: Percent Fine Sediment <0.85 mm; Target Level: < 14%.
- Decreased Hillslope/Road-Related Sediment Production.
- Road Crossing Diversion Potential: Target Level: <1% of crossings with diversion potential in the basin.
- Road Crossing Failure: Target Level: < 1% of all roads would potentially fail. Adequate crossing failure protection is defined as culverts and crossings sized to pass the 100 year flood, including snowmelt, and associated sediment and debris.

Stream Condition Inventory Report: Big Creek (1999)
(Summary from Big Creek Assessment)
Prepared by: U.S. Forest Service, Shasta-Trinity National Forest, South Fork Management Unit, Hayfork, California.

Project Summary
Fisheries personnel from the South Fork Management Unit located on the Shasta Trinity National Forest conducted a stream condition inventory and biological inventory survey on Big Creek starting on July 12, 1999 and ending on August 9, 1999. The objectives of the field-extensive inventory are to collect information that will result in a description of the watershed's conditions at a specific point in time. The biological inventory is conducted to establish the presence or absence of anadromous fish fauna and establish baseline juvenile fish densities.
Findings/Recommendations

- Increase monitoring of stream conditions, habitat capacity and spawning surveys for steelhead.
- Control cattle grazing in riparian area.
- Increase irrigation efficiency to increase stream flow.

Middle Hayfork and Salt Creek Watershed Assessment (2000)
(Summary from Big Creek Assessment)
Prepared by: U.S. Forest Service, Shasta-Trinity National Forest, South Fork Management Unit, Hayfork, California

Project Summary
The watershed analyses for Middle Hayfork and Salt Creek watersheds provided a broad, landscape-scale evaluation of the watersheds that allow public, private, and government agencies to plan for future management of resources at a project level scale.

Findings/Recommendations

- Fluvial geomorphology and hydrologic assessments are needed as data is required to evaluate channel restoration opportunities.
- Implement water quality monitoring to gather more data.
- Reduce road related sediment delivery to stream channels through established best management practices.
- Conduct further stream conditions inventories to establish best locations for in-stream habitat enhancements.
- Evaluate streams for flood plain re-connection projects.
- Restore the historic hydrologic and sediment regimes of fish bearing streams by implementing a fuels reduction and prescribed fire program to reduce the occurrence of high intensity fires and water use by overstocked stands. This action can increase stream flow, reduce temperatures and provide increased channel substrate diversity.
- Test reintroduction of low-intensity prescribed fire in riparian zones.
- Improve riparian stand conditions by utilizing thinning where appropriate.

2001, September. Hidden Valley, Plummer Creek, & Rattlesnake Creek Watershed Analysis.
Prepared by: Foster Wheeler Environmental Corp for Shasta-Trinity National Forest.

Recommendations:
6.1 Erosion Processes, Hydrology, stream Channel and Water Quality

- Conduct detailed road inventories.
- Reduce road densities, with goal of achieving densities less than three miles per square miles.
- Reduce road-related erosion and sediment delivery to streams *(considerable work on roads has been completed in these watersheds since 2001)*
- Monitor burned areas
- Design and implement water quality monitoring plans to gather baseline data.
- Restore the historic hydrologic and sediment regimes of fish bearing streams by implementing a fuels reduction and prescribed fire program to reduce the occurrence of high intensity fires and water use by overstocked stands. This action can increase stream flow, reduce temperatures and provide increased channel substrate diversity.
- Inventory water rights claims and diversions within the analysis area.

6.2 Fish Habitat and Species, and Riparian Habitat
Fish Habitat

- Road-related sediment delivery is a contributing factor to impacts to fisheries resources. Reduce road-related impacts to stream channels by following BMPs for sediment reduction.
- Conduct surveys for LWD loads in Plummer and Rattlesnake Creeks and include a determination of best locations for use of LWD in stream.
- Consider riparian planting to lower stream temperature.
- Implement monitoring programs to assess effectiveness of restoration projects.

Riparian

- Plummer Creek and Rattlesnake Creek were impacted by fire in 1987. Forest management practices are required to release remaining and new growth trees for late-successional stage conditions.
- Test reintroduction of low-intensity prescribed fire in riparian zones.
- Improve riparian stand conditions by utilizing thinning where appropriate.

6.3 Vegetation and Fire/Fuels
Fire and Fuels

- Fuel reduction treatments need to be guided by Shasta-Trinity fire plan.

- Use prescribed fire to reintroduce low intensity fires, while also considering thinning in areas where growth is too dense for fire alone.

Vegetation

- Late-successional and Riparian Reserves need to be managed for development of old-growth forest characteristics and prevention of large scale fire disturbance.
- Plantation thinning through development of silviculture prescriptions.

6.4 Plant Species of Concern and Noxious Weeds

- Manage for serpentine endemic plant species.
- Identify wetlands and manage to reduce grazing impacts; monitor and mitigate for grazing impacts.
- Inventory and map noxious weeds and identify where they pose a threat to native species.
- Develop a systematic weed eradication plan, including diffuse and spotted knapweed.

6.5 Wildlife Habitats and Species

- Manage to restore for wildlife after fires
- Consider landscape level patterns of forest cover when implementing stand vegetation management.
- Thin dense understory within northern spotted owl home range to accelerate development of tree-dominated habitats. Thinning can be combined with low intensity prescribed fire.
- Additional data is needed on forest vegetation structure, special habitat components, and wildlife species distribution and occurrence.

4.2.C4 Down River Region Watershed Assessments

Summaries of management recommendations and priorities from watershed assessments and analyses in the Down River Region. Summaries are in chronological order from newest to oldest:

2010, February. French Creek Watershed Analysis, USFS Trinity River Management Unit.

2009, April. Burnt Ranch (Down River) & Soldier Creek (Middle Trinity) USFS Analysis.

2003, March. North Fork Trinity River, East Fork North Fork Trinity River and Canyon Creek (Middle Trinity) Watershed Analysis, USFS Shasta Trinity National Forest.

2000, April. New River Watershed Analysis, USFS.

2000, March. Horse Linto, Mill and Tish Tang Creek Watershed Analysis, Six Rivers National Forest.

2010, February. French Creek Watershed Analysis, USFS Trinity River Management Unit.

This watershed analysis covers all of Big French Creek subwatershed and portions north of the Trinity River/ Hwy. 299 of the Don Juan and Little French-Manzanita Creeks subwatersheds.

The focus of the French Creek watershed analysis is watershed function and vegetative condition as they relate to water quality and fisheries; wildlife habitat; fuel continuity, fuel loading and the potential for extreme fire behavior.

A theme that ran throughout this analysis was future impacts from the 2008 wildfire season. Concern was expressed over sediment and hope expressed that more instream large wood recruitment would happen from downed trees. Being that the fires took place 10 years ago, monitoring follow up to this analysis would provide an excellent opportunity to document wildfire impacts.

This analysis examines five issues: Fire and Fuels, Human Uses and Values (which includes Timber Harvest, Fuel Wood and Access), Erosional Processes; Aquatic Systems, and Terrestrial Wildlife Habitat and Species. The Aquatic Systems issue provides the most data (with 11 pages of content) and reinforces the conclusion that these watersheds are, for the most part, properly functioning. The terrestrial wildlife habitat offers a good review of wildfire impacts on the watersheds. The complete analysis can be found online at http://www.tcrcd.net.

The New River, North Fork Trinity, East Fork North Fork, Big French Creek and Manzanita Creek, all major tributaries to the lower-middle mainstem, are presently considered “properly functioning” with regard to aquatic habitat and watershed conditions (De la Fuente et al., 2000).

Based on the presence of adult coho salmon and the robustness of the steelhead fishery in Manzanita Creek, it has been determined to possess Outstanding Remarkable Values (ORV) for anadromous fisheries. The Manzanita Creek watershed is also a Research Natural Area (RNA), with the botanical target element of Ponderosa Pine-Douglas Fir. It is recognized for a high botanical diversity, with nine SAF forest types and 17 plant associations recognized (PSW GTR 2004).

In Big French Creek the overall habitat quality in terms of sustaining and increasing anadromous fish utilization is considered functional. Juvenile and adult coho, chinook and steelhead have unimpeded access to Big French Creek, it provides thermal refugia during critical summer months and sufficient spawning gravel is present. Significant trends for Big French Creek are the decrease of LWD, the filing of pools, and a decrease in stream shade components.

In Manzanita Creek the overall habitat quality in terms of sustaining and increasing anadromous fish utilization is considered functional. Significant trends for Manzanita Creek are the decrease of LWD and the loss of stream shading.

In Little French Creek the overall anadromous habitat quality is best described as fair. The creek is small and has been impaired by sediment, although it appears the current trend is towards reduction of fine sediments within the channel. The overall habitat quality in terms of sustaining anadromous fish utilization (primarily steelhead) is considered functional.

In Don Juan Creek the overall anadromous habitat quality is best described as fair. The unbalanced pool to riffle ratio limits the quality of spawning habitat. In addition, there are limited spawning gravels as the channel substrate is composed of large cobbles and boulders. The unstable upper reach also limits the quality of and access to spawning and rearing habitat. No habitat trends are apparent based on the limited collected data.

The following opportunities are listed in the "Management Opportunities to Meet Desired Conditions" chapter and are summarized here as they relate to the approach for this analysis. They are listed in this analysis as "priorities", although that is not the language used by the USFS.

Not included here are their stated issue two: Human Uses and Values (which includes Timber Harvest, Fuel Wood and Access). The remaining issues and the "management opportunities" are as follows:
Issue 1: Fire and Fuels

- Support efforts outlined in Community Wildfire Protection Plan.
- Treat overstocked plantations, develop fuel breaks, reduce fuel loading, work with adjacent private property owners, and use of prescribed fire to promote wildland fire safety.

Issue 3: Erosional Processes
3-1 Mass Wasting (See Figure 4.81 for 2016 mass wasting event)

- Avoidance of land disturbing activities.
- Maintenance of road structures to prevent blockages in culverts and reduce sediment transport.
- To control lateral cutting and bed load transport of sediment, measures such as log and rock check dams, head cut structures, planting of riparian vegetation and placement of large wood to aid channel stabilization.

3-2 Soil Erosion

- Reduce erosion hazard ratings throughout the Burnt Ranch and Soldier Creek watersheds.
- Reduce road and roadside erosion; and roaded acres.

Issue 4: Aquatic Systems
4-1 Anadromous Fish Distribution and Abundance (See Figure 4.82)

- Prescribe thinning and burning activities to minimize the threat of wildfire to riparian reserves.
- Monitor the fish passage structures located on streams along Highway 299 to insure upstream migration remains unimpeded, especially for spawning adults.
- Implement small scale rearing programs, using native anadromous stocks, for streams within the planning watershed excepting Big French Creek.
- Improve instream habitat by reintroducing suitable spawning gravel to increase available spawning habitat, add instream LWD and boulder substrate to promote favorable spawning and rearing cover.
- Continue to monitor spawning activity.

4-2 Instream Habitat

- Prescribe thinning and burning activities to minimize the threat of wildfire to riparian reserves.
- Replant vegetation in upland and riparian areas affected by fire activity.
- Place large woody debris to reduce streambank instability.
- Develop a long term flow monitoring program for Big French and Manzanita Creeks.
- Introduction and placement of LWD and Boulders to increase habitat complexity and trap coarse sediments within lower Big French Creek.
- Road decommissioning in riparian reserve area of lower French Creek. Forest road 5N20 leads to a primitive campsite and currently bisects the riparian reserve in this area.

- Road resurfacing of the lower 1.2 miles of forest road 5N13 to reduce the risk of fine sediment input to lower Big French Creek.

4-3 Watershed Condition

- Implement strategic fuels treatments to reduce the risk of landscape-scale fire.
- Use the results of the sediment source inventory and roads analysis to prioritize and perform road maintenance, upgrades and decommissioning to reduce source sediment and delivery.

Issue 5: Terrestrial Wildlife Habitat and Species

- Manage federal forest land to increase Late Successional Old Growth (LSOG) characteristics.
- Treat mature forest to reduce risk of stand replacing fires.
- Reduce fuel loading while maintaining snag and log levels in specific Late-Successional Reserves (LSR) areas to add to the likelihood that regenerated stands will survive future fire.

5-1 Amount and Quality of LSOG Habitat

- Reducing fuels and monitoring past fire impacts on LSOG habitat to assure that high intensity fires do not reduce this habitat below the 15% threshold.

5-2 Fire Effects on Suitable LSOG Habitat

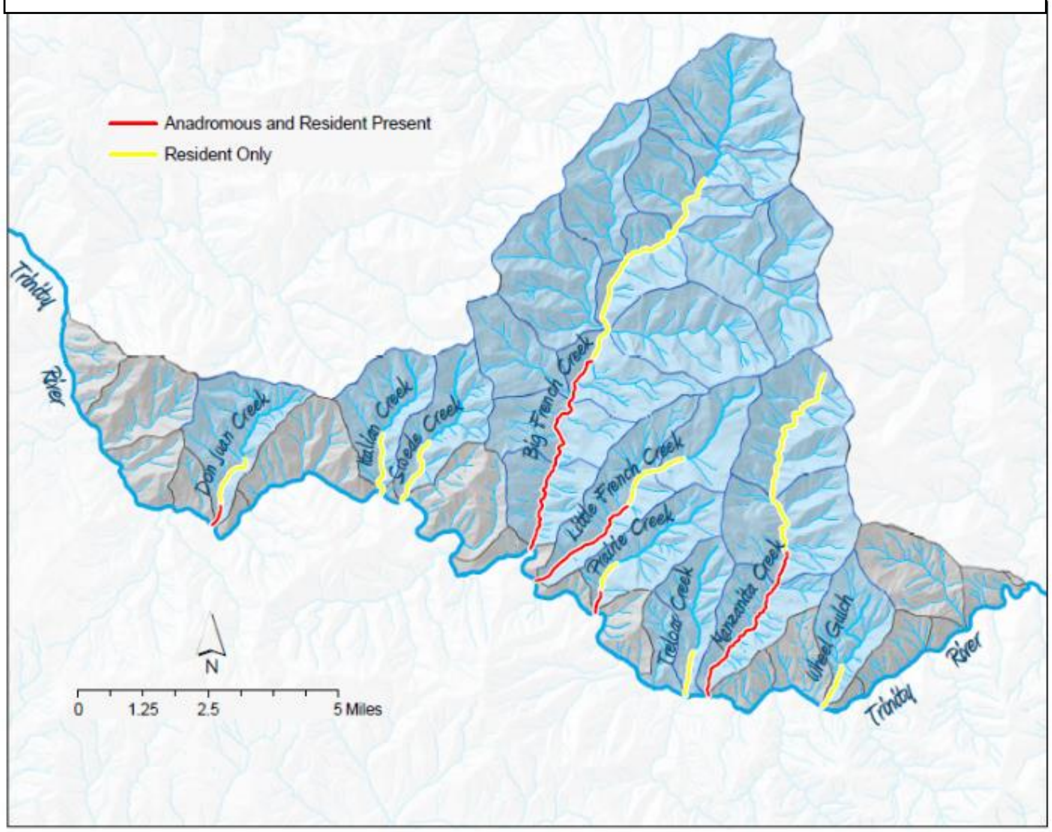
- Monitoring to detect future loss of connectivity habitat based on tree mortality from past fires; need to assure that overall connectivity in the area remains adequate.

5-3 Fire Effects on Habitat Conditions within the Territories and Home Ranges of Northern Spotted Owls

- Since the 2008 fires did reduce nesting, roosting, foraging and connectivity habitat; and additional losses may have happened as tree mortality increased after the fire, monitoring of NSO occupancy and reproductive status is appropriate to track short- and long-term effects of the fires and inform possible management actions.

Figure 4.81 Big French Creek slide, occurred December 9, 2016. Big French Creek is the tributary entering the Trinity River under the bridge. (Photo credit – Caltrans)

Figure 4.82 Fish bearing streams in French Creek Watershed.



2009, April. Burnt Ranch (Down River) & Soldier Creek (Middle Trinity) USFS Analysis.

The focus of this analysis is vegetation condition as it relates to fuel loading, water quality, aquatic habitat, wildlife habitat and soil productivity.

This analysis contains excellent information on the wood products and timber characteristics, erosional processes (geology, soil resources and hydrology) and fire/fuels characteristics in these watersheds. The complete analysis can be found online at http://www.tcrcd.net.

The following opportunities are listed in the "Management Opportunities to Meet Desired Conditions" chapter and are summarized here as they relate to the approach for this analysis. They are listed in this analysis as "priorities", although that is not the language used by the USFS.

Not included here are their stated issues one and two: Human Uses, Values and Expectations (which include recreation, wood products and cultural resources); and Access and Travel Management. The remaining issues and the "management opportunities" are as follows:

Issue 3: Erosional Processes
3-1 Mass Wasting

- Avoidance of land disturbing activities.
- Maintenance of road structures to prevent blockages in culverts and reduce sediment transport.
- To control lateral cutting and bed load transport of sediment, measures such as log and rock check dams, head cut structures, planting of riparian vegetation and placement of large wood to aid channel stabilization.

3-2 Soil Erosion and 3.3 Cumulative Watershed Effects

- Reduce soil compaction in Hocker and Eagle Ranch meadows (Mid- Trinity).
- Reduce roaded acres and erosion contributed by roads.
- Reduce fuels in Riparian Reserves.
- Identify instream flow and fish passage needs when reviewing and/or authorizing water diversions.

Issue 4: Aquatic Systems and Species

- Remove partial fish passage barriers on Soldier and Dutch Creeks (Mid-Trinity).

Issue 5: Terrestrial Wildlife Habitat and Species

- Manage federal forest land to increase Late Successional Old Growth characteristics.
- Treat mature forest to reduce risk of stand replacing fires.

Issue 6: Fire, Fuels and Air Quality

- Support efforts outlined in Community Wildfire Protection Plan.
- Treat overstocked plantations, develop fuel breaks, reduce fuel loading and work with adjacent private property owners on wildland fire safety.

Issue 7: Plant Communities
7-1 Unique species

- Reduce fuel loading in areas where two sensitive species grow.

7-2 Noxious Weeds

- Reduce fuel loading to reduce potential for high intensity wildfire, which would open up habitat for noxious weeds.
- Remove roadside broom in Junction City area (Mid-Trinity)
- Remove dyers woad to prevent spread from down river area to Humboldt County.

2003, March. North Fork Trinity River, East Fork North Fork Trinity River and Canyon Creek Watershed Analysis, USFS Shasta Trinity National Forest.

The focus of this assessment for these key watersheds is watershed function and vegetation condition as they relate to water quality, fisheries, wildlife habitat, fuel loading and soil productivity. Both the North Fork Trinity and Canyon Creek are "Key" watersheds according the USFS.
Current and past mining impacts are covered in this analysis under the Human Uses, Values and Expectations issue. The other issues covered in this analysis are Access and Travel Management; Erosional Processes, Aquatic Systems; Terrestrial Wildlife Habitat and Species; Fire, Fuels, and Air Quality; and Plant Communities. The complete analysis can be found online at http://www.tcrcd.net.

The following Key Findings and Management Recommendations apply to this analysis:
Issue 1: Human Uses, Values and Expectations
Minerals, Finding 1-3: Bench Operations (open pit mining) continue to impact Canyon Creek. As of 2003, there were none operating, but two were under environmental review. Five were undergoing rehabilitation in 2003. Previous mining sites and associated habitation sites in Canyon Creek are impacting riparian zones.
Management recommendation:

- Continue rehabilitation of mining sites and associated features, including revegetation. Ensure that future Plans of Operation have proper environmental review, rehab plans and bonding prior to allowing.

Wood Products, Finding 1-5: Timber Harvesting and fuelwood opportunities have decreased, but demand remains high. Management recommendation:

- Treat fuels and manage vegetation to promote LSOG habitat features, and monitor for availability of fuelwood.

Issue 3: Erosional Processes
Finding 3-2: Geomorphic and bedrock mapping is available. Management recommendation:

- Use mapping and data to establish priorities for road decommissioning or long-term road maintenance needs and to identify watershed restoration opportunities and problems.

Issue 4: Aquatic Systems and Species
Finding 4-1: The North Fork Trinity River has abundant and naturally occurring populations of summer steelhead; Canyon Creek and the East Fork North Fork have depressed runs of same, but have some fall chinook and coho runs. Management Recommendations:

- Continue to manage habitat in North Fork and look for opportunities to expand population and restore anadromous habitat in East Fork and Canyon Creek.
- Explore restoration of mining areas along Canyon Creek.

Issue 5: Terrestrial Wildlife Habitat and Species
Finding 5-1: Management of forest resources and fire management have reduced the quantity and quality of LSOG habitat in the NFCC watersheds. Management Recommendations:

- Treat fuels, thin plantations.

Issue 6: Fire Fuels and Air Quality
Finding 6-1: Maintain watersheds is a condition not susceptible to stand replacing fire. Management Recommendations:

- Use a variety of fuels management strategies to treat fuel load and promote a healthy forest.

Issue 7: Plant Communities
Findings: Both species of concern and invasive weeds are present in the watershed. Management Recommendations:

- Reduce human impacts on the species of concern through education and restriction of overnight visitors.
- Remove invasive weeds and rehabilitate mine sites along Canyon Creek
- Survey and map invasive species.

2000, April. New River Watershed Analysis, USFS.

The focus of this watershed analysis is to assess the affects the 1999 Big Bar Complex Fire had on the physical, biological and human processes within the New River Watershed.
As this analysis is nearly 20 years old and focuses on the effects of a fire, the priorities taken from the analysis are briefly outlined here. This analysis offers a detailed analysis and runs 102 pages. The complete analysis can be found online at http://www.tcrcd.net.
Issues addressed in the New River Watershed Analysis include: Health and Recovery of Vegetation; Terrestrial Wildlife Habitat and Species; Fire, Fuels and Air Quality: Erosional Processes and Aquatic Systems; Access and Travel Management; and Human Uses, Values and Expectations. The last two are not part of this analysis. Recommendations for immediate treatment after the fire are also not included here.

The following Key Findings and Management Recommendations apply to the current restoration analysis:
Key Finding 3: Invasive weed species are present and it is important to control the spread of undesirable plants. Management recommendation:

- Survey high-risk locations and develop a management strategy.

Key Finding 4: Fire created areas that no longer provide value to species associated with LSOG. Management recommendation:

- Reforest severely burned areas to accelerate development of late successional and old growth habitat.

Key Finding 5: Reduce fuel loading with LSR for resiliency and to reduce occurrence of stand replacing fire. Management recommendation:

- Reduce the large numbers of snags, logs, and other fuels.

Key Finding 11: Summer steelhead, the primary anadromous fish, has shown a stable population. Management recommendation:

- Monitor adult summer steelhead populations to assure wildfire impacts have not negatively affected the fish. (2018 – this has been done and the populations increased after the fire, then leveled off.)

Key Finding 12: Some Riparian Reserves may not be meeting Aquatic Conservation Strategy (ACS) objectives. Management recommendation:

- Design projects within and adjacent to riparian areas to meet and enhance ACS objectives. May need to consider some for fuel treatment.

Key Finding 17: Take opportunities to learn from the fire. Management recommendation:

- Develop research agreements, identify “control” areas, monitor, develop further studies in riparian areas.

2000, March. Horse Linto, Mill and Tish Tang Creek Watershed Analysis, Six Rivers National Forest.

The focus of this watershed analysis is to assess the affects the 1999 Megram Fire had on the physical, biological and human processes within the Horse Linto Creek, Mill Creek and Tish Tang Creek Watersheds.
As this analysis is nearly 20 years old and focuses on the effects of a fire, the priorities taken from the analysis are briefly outlined here.

This analysis offers a detailed analysis and runs 380 pages. The analysis offers a thorough section on cultural traditions, human uses and history of the Hupa people, including traditional plant species gathered for subsistence, ceremonial and shamanic uses. The complete analysis can be found online at http://www.tcrcd.net.

Horse Linto Creek is a Tier 1 Watershed. Tier 1 Key Watersheds serve as refugia for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. It has a high potential of being restored as part of a watershed restoration program. See Figure 4.83 for map of fish distribution in all watersheds in this analysis.

Mill Creek provides domestic water supply for the Hoopa Valley Reservation. Tish Tang Creek is identified as a potential source of domestic water on the Hoopa Valley Reservation. The East Fork Horse Linto Creek has an out-of-basin diversion that contributes to Quimby Creek, the water supply for the town of Denny.

Opportunities and Possible Management Practices listed as they apply to this analysis:

1. Reduce fuel levels in strategic locations to lower the potential for future catastrophic fire.
2. Protect remaining mature and old growth stands from catastrophic loss.
3. Accelerate the development of late-successional habitat.
4. Restore watershed functions and manage access to protect high quality habitat for riparian and aquatic species as well as domestic water supplies. Other watershed related recommendations:
    - Horse Linto Creek: Maintain good habitat conditions in areas that did not burn and rehabilitate stream corridors and riparian areas damaged by the fire through watershed restoration, flood proofing and road decommissioning. Maintain or enhance coarse woody debris loading and large roughness within channels as deemed appropriate by field review to provide suitable habitat conditions for anadromous and resident fish.
    - Monitor range allotment use and utilize livestock exclosures as needed to meet ACS objectives for stream and riparian habitat.
    - Mill and Tish Tang Creeks: Same as Horse Linto Creek, except no reference to enhance coarse woody debris loading.
5. Minimize the introduction and spread of noxious weeds.
6. Monitor and further analyze habitat conditions and trends for threatened, endangered and sensitive species, survey and manage species and species of concern.
7. Minimize grazing impacts to meadow and riparian habitats.

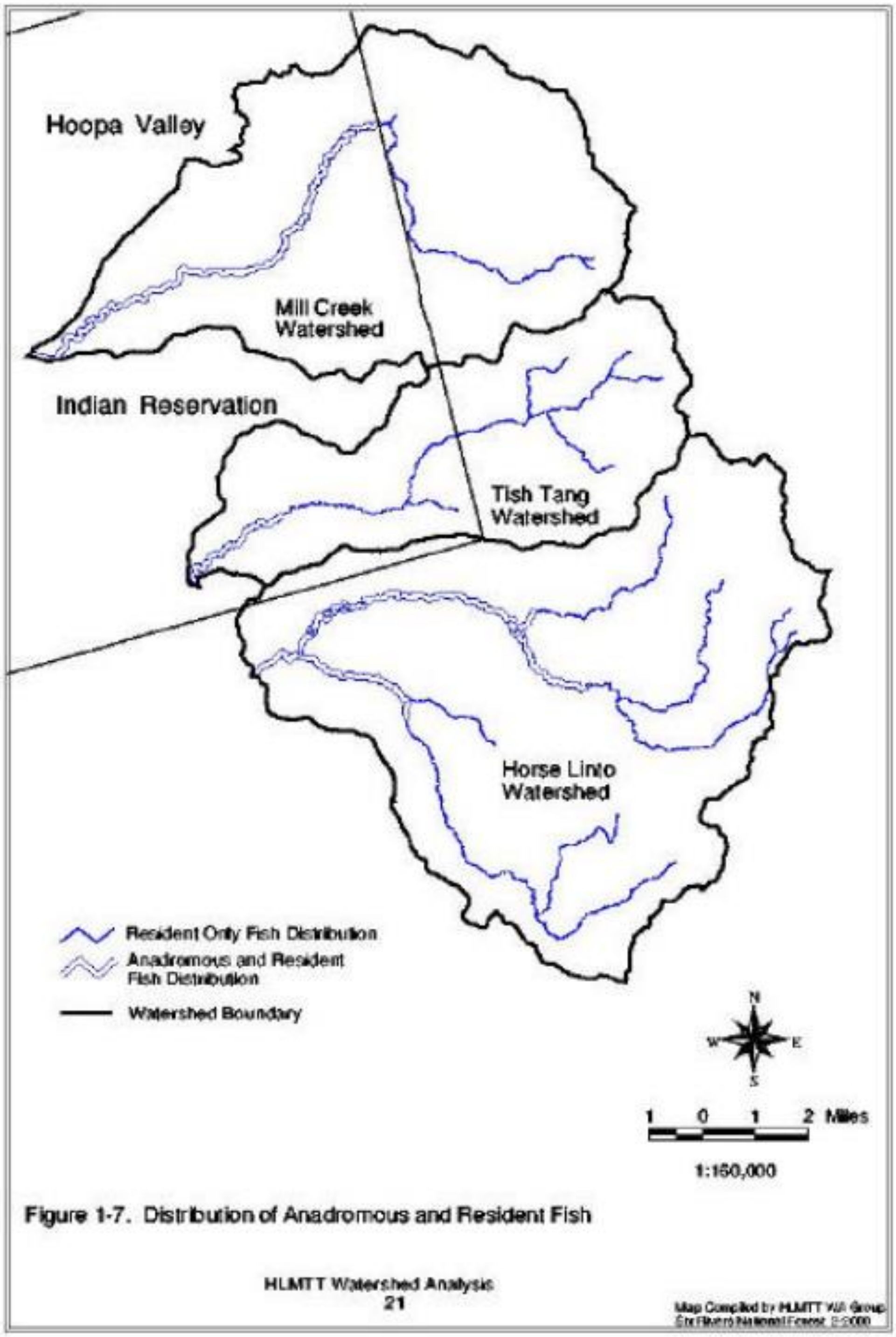


Figure 4.83 Fish distribution from Horse Linto, Mill and Tish Tang watershed assessment.

4.2.D. Identification of key issues – Stakeholder Priorities

Stakeholder's priorities were gathered from public outreach events, surveys, major restoration project funders, and members of the Trinity River Watershed Council and assembled here, by region where possible.

The focus of restoration within the watershed has been guided by natural resource professionals for the past twenty years. An extended effort was made to gather input from the general public for this assessment to supplement the professional viewpoint. Comments were gathered at public meetings in the different regions of the watershed including Community Service District meetings, the Trinity County Fair, the Trinity County Fish and Game Advisory Committee meetings, water conservation workshops and two cannabis cultivation focused workshops. Professional opinions from outside the watershed were gathered at regional meetings. Trinity River Watershed Council meetings were held quarterly, with news releases and social media announcements made to gather input and new attendees.

This section also benefits from the Bureau of Land Management's (BLM) effort to update their Integrated Regional Resource Plan. Survey answers from BLM "envisioning" meetings were combed for watershed priorities. Additionally, a stakeholder survey was conducted by the Trinity County Resource Conservation District as part of updating their strategic plan, and relevant results from those surveys are included. An analysis of the types of projects funded is included in this section, as this shows where funders have placed their priorities in the past.

<u>Priorities expressed by stakeholders during public meetings and events</u>

Watershed-wide:
There is a need for upland restoration for large game mammals (deer, elk) as well as other game species such as wild turkeys. Hunters' needs should be considered when setting restoration priorities.
Concern was expressed over bottled water companies taking spring water out of the watershed.

North Lake Region:
Upper Trinity River Watershed: Priorities set over 10 years ago in previous watershed assessments have yet to be implemented. The Information in previous plans for project implementation is still valid.

Middle Trinity Region:
Junction City resident: Concern about residual mercury from mining history, and cannabis cultivation impacts on the environment from use of chemical pesticides and fungicides.

South Fork Region:
Eltapom Creek Watershed: Concern about water rights and usage.
Hayfork Creek Watershed: Concern about algae in Hayfork Creek.
See Table 4.18 for results from a survey at a 2014 Hyampom community meeting

Down River Region:
Big Flat – Cedar Flat Watersheds: Cannabis growers are taking too much water from surface waters.
Hoopa – We can get big returns by doing little projects – combining road decommissions with culvert removals add up to cumulative impacts.

Table 4.18 – 2014 Hyampom community meeting watershed project priority survey results

Resident inputs on top watershed improvements needed in the South Fork Trinity River Watershed (2014)	
Attendees at a community meeting were given 5 sticky dots to vote for their top five concerns out of 15 that had been assembled by biologists and professionals.	
Improvement Project	**Number of votes**
Address poaching through increased law enforcement	11
Increase water quantity from illegal diversions by making a concerted effort to stop/remove them.	9
Reduce possible future sediment from wildfires by prioritizing fuels reduction work	8
Study genetics of spring Chinook in SFTR to address the possibility of a genetic bottleneck.	8
Address poaching through increased signage	7
Address poaching through casual information exchanges	6
Reduce sediment by prioritizing road work to focus on unstable geologic areas	6
Increase water quantity from legal diversions through water efficiency improvements.	6
Address high water temperatures through riparian planting of native vegetation.	6
Provide better juvenile rearing habitat by upgrading culverts in the watershed.	6
Improve water quality through an education program aimed at illegal dumping of fertilizers	5
Increase water quantity from illegal diversions through education programs	5
Reduce sediment through road maintenance, upgrades and decommissioning.	4
Reduce sediment by complying with and enforcing Forest Practices Laws.	3
Improve water quality through on-the-ground teams to dispose of illegal ag chemicals	3

<u>Priorities from surveys</u>

BLM: NW California Integrated Resource Management Plan (NCIP) Envisioning Meetings Comment Summary Report, July 2016:

> *"The Bureau of Land Management (BLM) Redding and Arcata Field Offices (FOs) are preparing to revise and combine two Resource Management Plans (RMPs) and associated land use plan amendments for the comprehensive assessment, evaluation, and updating of current land use decisions on public lands in northern California.*

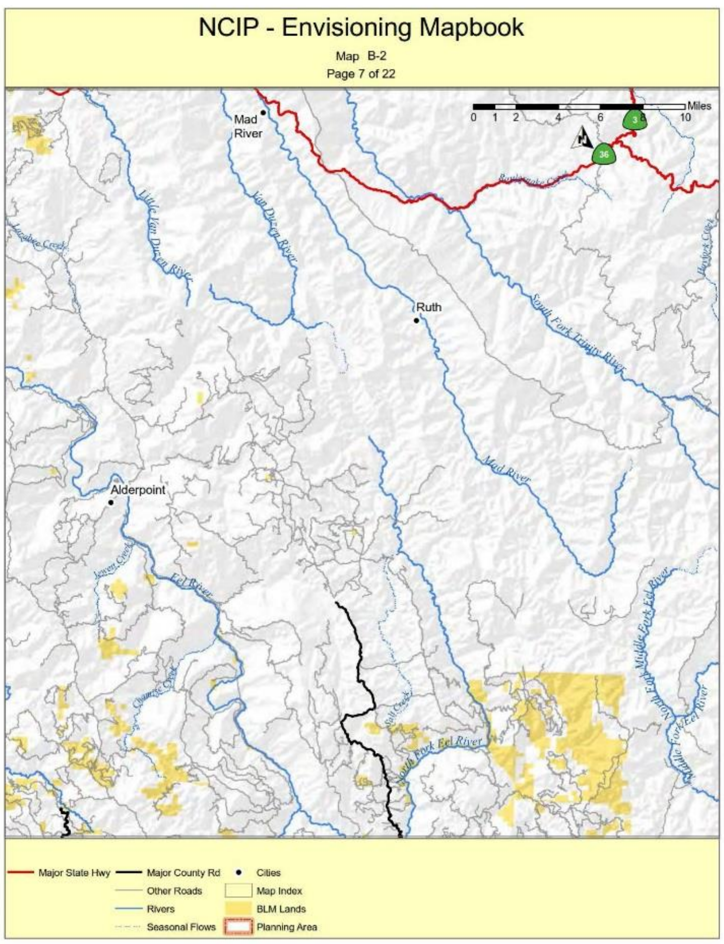
The BLM held a total of four public Envisioning Meetings between March and June 2016 (Arcata, Redding, Weaverville, and Arcata). An Envisioning Meeting was also held with the Resource Advisory Council on April 8, 2016. The second Arcata meeting was added due to low attendance at the first meeting."

Participants were asked to identify what BLM lands are valuable to them and describe those values within each map grid. The following map grids encompass the majority of the Trinity River Watershed. Comments on these areas were gathered for this assessment based on biological, physical, and wilderness values expressed. The full range of values at the envisioning meetings also included visual, recreation, economic, cultural, spiritual, future value, education/research, shooting and other.

Map Grid B-2, South Fork Trinity River region:

- "Thanks for not using pesticides in Trinity County. Plan and implement projects supported by the Trinity County Collaborative such as treating plantations and roadside shaded fuel breaks. "
- (Concerns) "Listed species (e.g. NSO); Headwater values as it relates to anadromous fish recovery; Old growth/contiguous forest. Please address: Water quality; Fire/Fuels; marijuana cultivation impacts."

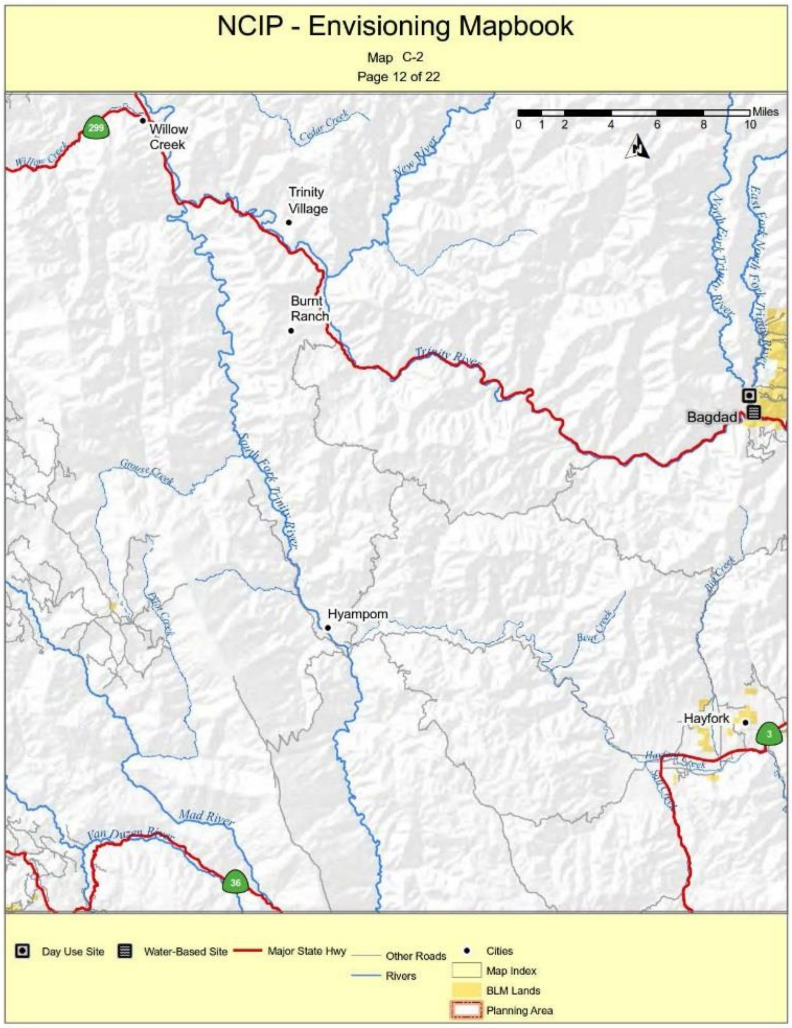
Figure 4.84 BLM Map Grid B-2, South Fork Trinity River region



Map Grid C-2, South Fork Trinity River and part of Down River regions:

- "I value habitat for flora and fauna. It is valuable to protect and restore wildlife habitat including soils, native vegetation, and fauna. This is increasingly true over time as more land is developed. These wild places offer a chance for native plants to flourish and animals to live. With populations of people encroaching on wildlife habitat, it is increasingly valuable to preserve the remnants that remain."
- "Hayfork Comments: Hunting; The interface of woods and water attracts a lot of wildlife especially a wide variety of birds, and provides nesting areas."

Figure 4.85 BLM Map Grid C-2, South Fork Trinity River and part of Down River regions

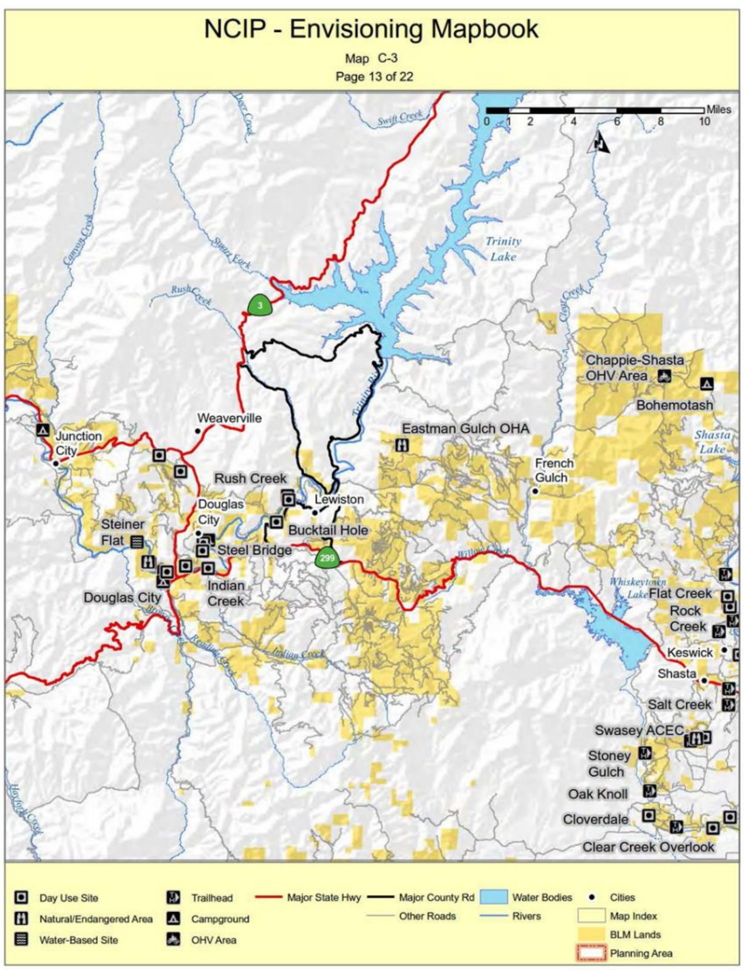


Map Grid C-3, Middle Trinity and part of North Lake regions:

- "Bucktail Hole: Comment: Valuable hunting area; close to population so gets use."
- "Grass Valley Creek: Comment: The Trinity Wild and Scenic River is one of California's most important anadromous fish streams. The BLM lands in the Grass Valley watershed help to maintain the stream's water quality in an area that was very heavily logged several decades ago. The parcels include oak woodlands, meadows, chaparral, and mixed conifer forests that will hopefully continue to recover in the years to come. *Values: biological."*
- "This area supports a variety of wildlife, including elk, deer, bear, foxes, cougars, bobcats, fishers, raccoons, quail, ravens, eagles, hawks, coyotes and a host of other creatures. There is a mix of conifer and hardwood tree species and shrubs, which provides a diversity of habitats. *Values: biological"*

- “Due to limited vehicle access this area doesn’t experience as much hunting pressure or human disturbance as many other BLM lands in Trinity County. It thus serves as a wildlife reserve, which protects T+E (threatened and endangered) wildlife. *Values: wilderness”*
- “Indian Creek: Comment: Valuable hunting area; close to population so gets use.”
- “There is a wide variety of species that live in and/or wander through this area. Species sighted multiple times are: deer, elk, black bear, cougar, bobcat, coyote, fox, fisher, ringtail cat, raccoon, skunk, ground squirrel, grey squirrel, chickaree, gophers, mice, voles, steelhead, trout, pond turtles, frogs, snakes (gopher, rattle, king, racers, garter, rubber boa), lizards (alligator, fence, black), birds (great blue heron, NSO, red-tail, hawk, Coopers hawk, sparrow hawk, raven, pileated woodpecker, quail, and a great variety of song birds). SPI lands in the upper watershed have been heavily clear cut, which has degraded habitat for those species dependent on mature/late serial forests composed of a diversity of tree species. *Values: biological”*
- “The mature conifer forests + oak woodlands, which occupy much of the BLM lands along with the shrub land, protects the watershed from erosion, sequesters carbon, enhances soil productivity, regulates water flow, and produces abundant oxygen. *Values: physical”*
- *“*Weaverville Community Forest: Comments: SPI has been extensively converting mature, mixed species conifer forests to primarily two species plantations. The mature forests on BLM lands are critical to those wildlife species that require such habitat. This is especially important given the proliferation of clearing on private and for marijuana grows + the increasing wildfire burns. *Values: biological”*
- *“*The mature forests provide clean, oxygen rich air, watershed protection and water regulation, soil stabilization, carbon sequestration, thermal cover for wildlife, and temperature moderation. *Values: physical”*

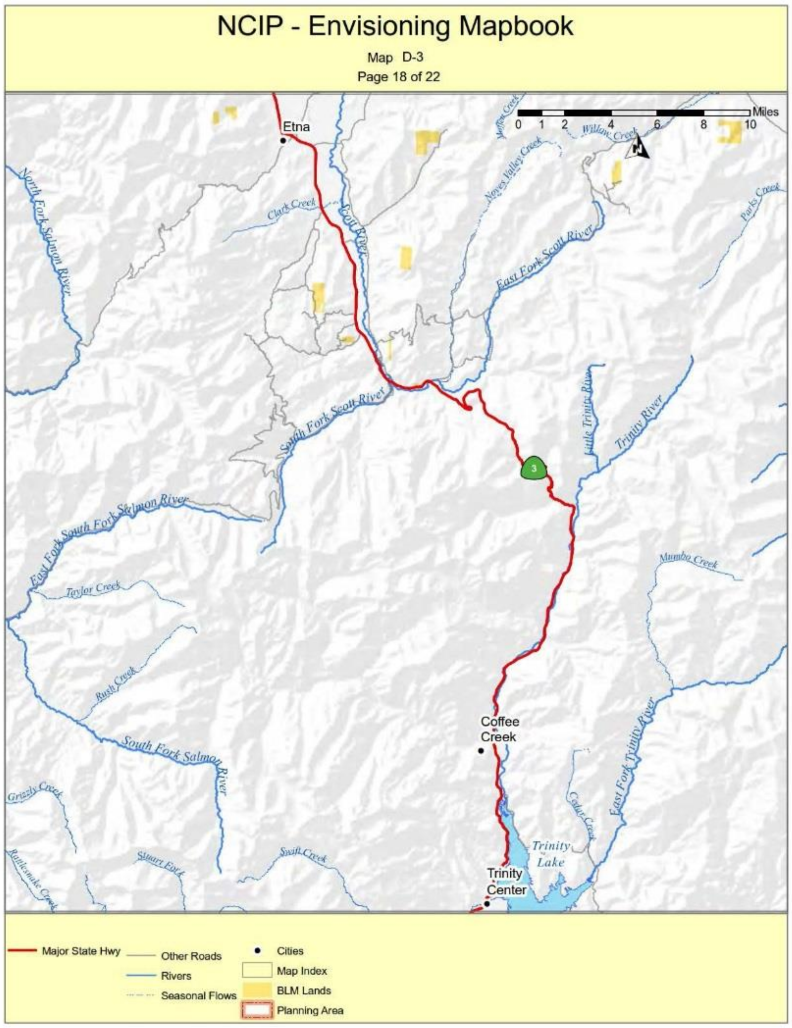
Figure 4.86 BLM Map Grid C-3, Middle Trinity and part of North Lake regions



Map Grid D-3, North Lake region:

"(Upper Trinity) Comments: Biodiversity. "Listed species (e.g. NSO); Headwater values as it relates to anadromous fish recovery; Old growth/contiguous forest. Please address: Water quality; Fire/Fuels; Marijuana cultivation impacts."

Figure 4.87 BLM Map Grid D-3, North Lake region



Priorities gathered from TCRCD survey

Thirty-three people responded to the TCRCD survey, administered between November 2017 and January 2018, through both an electronic site (Survey Monkey) and paper surveys.

Summaries of answers concerning watershed priorities are as follows:

- 82% of respondents see implementation of restoration projects (including fuels reduction and forest health; native plant revegetation; invasive plant removal; road work (erosion control); stream enhancement) as either the #1 or #2 top priority for projects that need to be completed in our watershed.

- Watershed collaboration, planning and assessment were ranked as one of the top three priorities for projects by 37% of the respondents.
- Environmental monitoring and data collection were ranked as one of the top three priorities for projects by 37% of the respondents as well.

In open-ended questions, repeated topics of concern were:

- Offering private landowners information and technical support
- Impacts from cannabis cultivation
- Fuels reduction and prescribed burns

The exact question in the survey was:

Q5. What are the most important natural resource issues that you believe should be addressed in Trinity County? (Rank Low, Med, High). This question allowed for multiple high, medium and low rankings, as there were 17 categories, with only three rankings to apply to the categories. See chart and graph on next page for full results.

One of the most telling results from this question is that no one ranked "Forest Health and Fuel Loads" and "Water Conservation, Quality and Quantity" as low priorities. On the flipside of those rankings, almost 82% of respondents consider "Forest Health and Fuel Loads" as an issue of high importance, with 72% considering "Water Conservation, Quality and Quantity" also of high importance. Rounding out the top five were "Fish Habitat and Stream Restoration", "Cannabis Cultivation", and "Illegal Use of Public Lands."

The category ranked of lowest importance was "Mining", with 51% ranking it as low importance, 32% ranking it of medium importance and 17% ranking it as high. Beyond Mining, "Agricultural Issues and Grazing" and "Organic Farming" ranked on the low side.

The two categories that really showed an equal spread among the respondents were Climate Change and Recreation Opportunities. Of the 31 who ranked Climate Change, 9 considered it a low priority, 9 a medium, and 13 a high priority. Of the 32 who ranked Recreational Opportunities, 11 considered it a low priority, 12 a medium and 9 a high priority. Based on these numbers, Climate Change ranges to medium-high, while Recreation Opportunities range to medium-low.

However, Climate Change impacts the top two priorities of Forest Health and Water Conservation, Quality and Quantity and should be ranked much higher to support the top two concerns.

See Table 4.19 for a full reporting of answers to this survey question.

What are the most important natural resource issues that you believe should be addressed in Trinity County? (Rank Low, Med, High)							
	Low	No. Low	Medium	No. Med	High	No. High	Total
Forest Health and Fuel Loads	0.00%	0	18.18%	6	81.82%	27	33
Water Conservation, Quality and Quantity	0.00%	0	28.13%	9	71.88%	23	32
Fish Habitat and Stream Restoration	3.13%	1	62.50%	20	34.38%	11	31
Cannabis Cultivation	6.25%	2	28.13%	9	65.63%	21	32
Illegal Use of Public Lands	9.38%	3	28.13%	9	62.50%	20	31
Invasive Plants and Animals	9.68%	3	48.39%	15	41.94%	13	32
Climate Change	12.50%	4	28.13%	9	59.38%	19	32
Wildlife Habitat	29.03%	9	29.03%	9	41.94%	13	31
Recreation Opportunities	34.38%	11	37.50%	12	28.13%	9	32
Agricultural Issues and Grazing	41.94%	13	38.71%	12	19.35%	6	31
Organic Farming	48.39%	15	29.03%	9	22.58%	7	32
Mining	51.61%	16	32.26%	10	16.13%	5	31
Other (see below)							8
						Answered	**33**

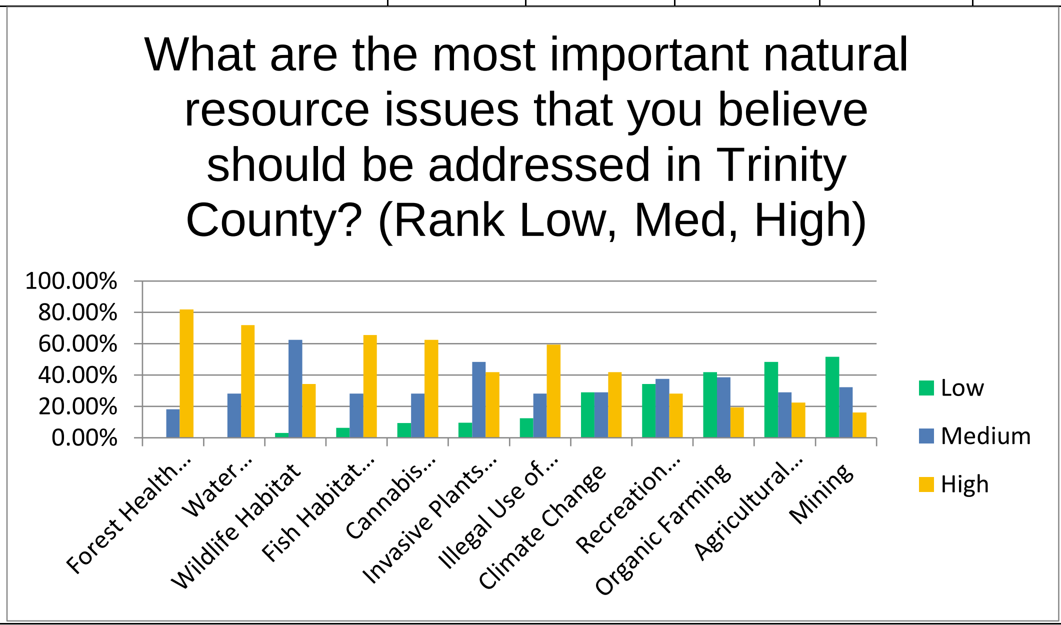


Table 4.19 TCRCD survey question responses.

Priorities from major funders

Funders of restoration projects cover a broad range of local, state, federal, and non-profit agencies. Priorities expressed by major funders are inherent in the projects funded since 2000. Table 4.20 shows the number and type. Section 4.2B, Completed Restoration Projects, offers a full analysis.

Table 4.20 Priority projects based on funding

Project Type	Total
Cultural	2
Water Conservation	7
Wetland	9
Instream Habitat	14
Monitoring	14
Non-roads sediment	15
Riparian	19
Reveg	25
Weeds	25
Design and Planning	26
Fish Passage	29
Roads	152
	337

Priorities from Trinity River Watershed Council:

Over the course of the last several years, members of the Watershed Council have discussed restoration priorities for the watershed. The Council supports following priorities already established in the following documents:

- Trinity and South Fork Rivers TMDL documents, US EPA
- Northwest Forest Plan, USDA Forest Service
- Final Recovery Plan for the Southern Oregon Northern CA Coast (SONCC) Evolutionarily Significant Unit of Coho Salmon, NOAA Fisheries Service
- CA Coastal Chinook Salmon and Northern CA Steelhead Recovery Outlines, National Marine Fisheries Service (NMFS)
- Recovery Strategy for California Coho Salmon, CA Dept. Fish and Wildlife
- Steelhead Restoration and Management Plan for CA , CA Dept. Fish and Wildlife
- CA Climate Adaptation Strategy, CA Natural Resources Agency
- CA Water Action Plan, CA Natural Resources Agency
- State Wildlife Action Plan, CA Dept. Fish and Wildlife
- Trinity County Road and Culvert Inventories, various authors
- Priorities established in existing watershed assessments, various authors

While considering everything within those existing documents, the Watershed Council is in agreement that the overall top restoration priority is water quantity/availability in all tributaries and the second priority is the need for more data and monitoring to increase data-driven restoration projects.

Other priorities stated by the watershed council, in no particular order are:

- Increase Connectivity: Connectivity of goals, projects, and habitats.
- Reduce human impacts on landscape and water availability.
- Support of beaver habitat and relocation for water quantity and fish habitat.
- Increase emphasis on floodplain connectivity/ground water re-charge.
- Build forest resiliency to decrease stand-replacing wildfire.
- Apply fuels management projects based on ecological value, not just community protection.
- Provide pathways for fish to reach cold refugia.
- Reduce or mitigate for climate change impacts.
- Reduce invasive species.
- Reduce pesticide/herbicide use.
- Increase wetland restoration – where were they and where should they be now?
- Decrease vulnerability to loss of undisturbed reference locales; to impacts from climate change; and to ongoing impacts from historic mining.

4.3 Assessment of possible future impacts

This section will not analyze each individual region of the watershed for possible future impacts, but rather provide a review of recent studies and data as they apply to the entire watershed.

The majority of future impacts within the watershed will be defined by the extent of human caused climate change and the earth's natural climate cycle, which will either worsen or lessen impacts from human caused climate change. Other factors influencing future impacts will be land use decisions made and implemented by governing bodies within the watershed.

Climate change and future impacts

A full generation of scientists have now spent nearly their entire careers studying climate change, with the next generation eagerly following in their footsteps. The amount of data, studies, analyses and doctoral dissertations available for review is overwhelming. The information available from the Intergovernmental Panel on Climate Change (IPCC) provides multiple possible future scenarios based on a scale of possible factors over different timelines. Just by entering one of the older IPCC climate scenarios – A1B – into a Google search delivers over 21,000 results in 0.07 seconds.

This watershed restoration gap and trend analysis cannot begin to assess all of the future impacts that might happen, but instead will review existing information and data from a local perspective.

The South Fork Trinity River Supplementary Watershed Assessment (*WRTC, 2016*) includes a data rich appendix on current, and possible future, stream temperatures in the South Fork Trinity River Watershed (*Asarian, 2016*). The streams most likely to provide resilience in the face of climate change are those with the coolest measured water temperatures during the hottest years. The author found that Mean Weekly Maximum Temperature (MWMT) is strongly correlated with drainage area. However, there are some tributaries in the South Fork Trinity River (SFTR) Watershed that break this rule by having abnormally cold water relative to the drainage area. These subwatersheds may provide refugia from climate change impacts. They include:

- Miners Creek and Bear Creek in the Lower Hayfork Creek subwatershed
- Little Creek, upper Barker Creek, and upper Big Creek in the Middle Hayfork Creek subwatershed
- Goods Creek in the Upper Hayfork Creek subwatershed
- Madden Creek in the Lower SFTR subwatershed
- Lower Butter Creek in the Middle SFTR subwatershed
- Cable Creek and Prospect Creek in the Upper SFTR watershed

The study found that within the range of temperatures throughout the watershed, "Upper and Lower Hayfork Creek have a greater percent of tributaries accessible to anadromous fish with MWMT likely suitable for coho salmon."

Further examination of the SFTR water temperature data provided insight into where climate change-induced warming temperatures may impact streams, by analyzing reach-level MWMT in only the warmest years of the study (2015, 2006, 2014, 2009, and 1994). Note that more than half of the warmest years of this 30-year database occurred within the last 10 years. The map shown in Figure 4.88 from the WRTC study shows the Mean Weekly Maximum Temperature for the five warmest years analyzed.

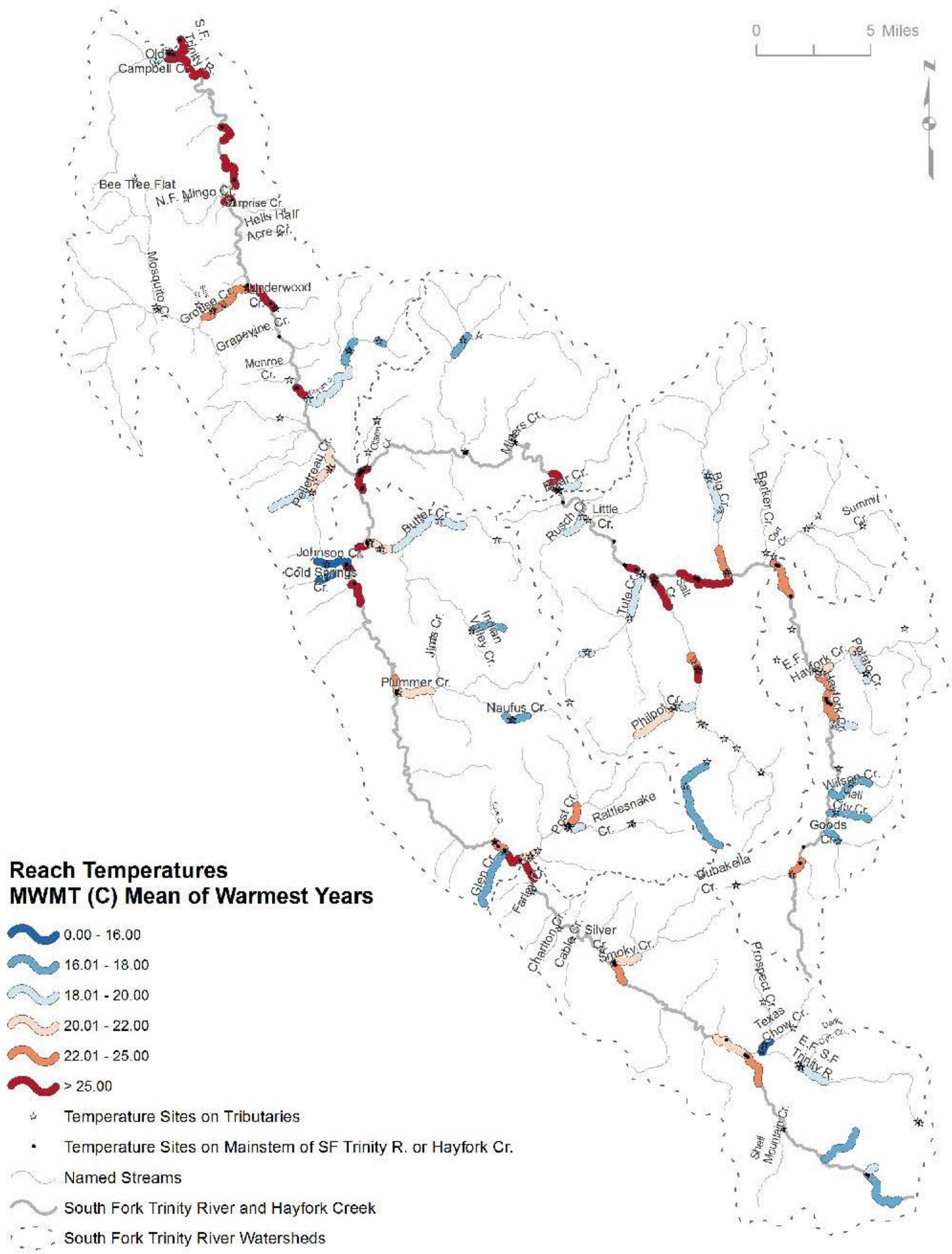


Figure 22. Map with warm-year reach-level summary of MWMT stream temperatures within the South Fork Trinity River watershed. Mean reach MWMT values were calculated as the mean MWMT from all sites within a reach for the five warmest years only (2015, 2006, 2014, 2009, and 1994). Reaches are color-coded according to the MWMT salmonid suitability categories in Table 2 and labeled by stream name.

South Fork Trinity River Stream Temperatures 31

Figure 4.88 Mean Weekly Maximum Temperature for the five warmest years analyzed in the South Fork Trinity River Stream Temperature Appendix *(WRTC, 2016)*.

The WRTC analysis also compared a current model of temperatures in the SFTR watershed with a predicted model for the 2080’s (Figure 4.89). The author of the stream temperature analysis noted that the model used by the US Forest Service Rocky Mountain Research Laboratory (RMRL) and represented here, has not been updated with more current stream data, hence the maps shown in Figure 4.89 are not showing the warmest stream temperatures possible. He further noted that based on a recent water temperature modeling report he created, the RMRL scenarios may be too optimistic because their model underestimates the proportional response of water temperatures to air temperatures (*personal communications, E. Asarian*).

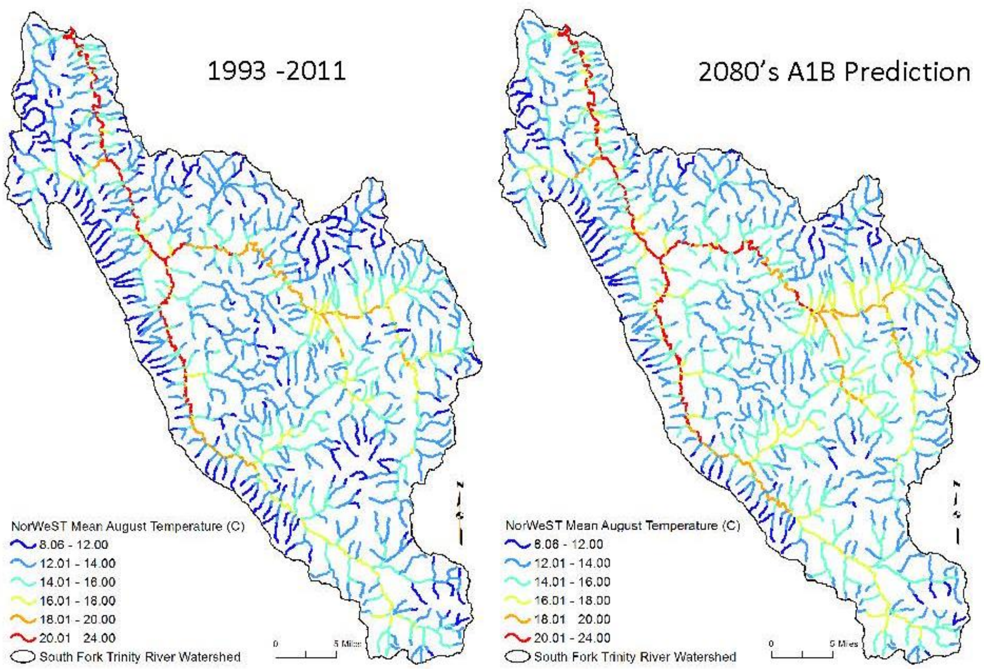


Figure 4.x. Comparison of NorWeST spatial stream network model predictions for mean August stream temperature in the South Fork Trinity River watershed for 1993-2013 and a future scenario based on global climate model ensemble averages that represents the A1B warming trajectory for 2080s (2070-2099).

Figure 4.89 Modeled predictions for August mean stream temperatures in the South Fork Trinity River (*WRTC, 2016).*

For context, the definition of the International Panel on Climate Change (IPCC) A1B climate prediction scenario is a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and a rapid introduction of new and more efficient technologies. This scenario also postulates that there will be cooperation among cultures with more interactions across regions, and a reduction in regional income gaps. The energy use for this scenario provides a balance of both fossil fuels and non-fossil fuels and relies on technological advances to increase efficiency.

Another local study regarding climate change, the *Trinity County Forest and Water Climate Adaptation Plan* (*Medley-Daniel, 2011)*, lists threats to forests, water resources, and the economy from climate change. The author’s assessment of the water resources includes concerns over inefficient water use locally and more demand regionally, with the possibility of decreasing water availability due to climate change impacts. The study adds that the ability to address concerns is hampered by the lack of monitoring data needed to guide restoration decisions.

The Shasta-Trinity National Forest assessment of vulnerability of watersheds to climate change (*USFS, 2012*) studied the impacts of climate change on the health of the forest with an emphasis on water resources. The objective for the assessment is to provide assistance and guidance for forest management through analysis of risks, opportunities, vulnerabilities and a strategy to promote resiliency.

Forest health, aquatic habitat and water supplies will be impacted by a changing climate. According to the assessment, *"More severe droughts, more frequent and larger floods, lower seasonal stream flows, higher peak flows, increasing water temperatures, increasing erosion and sedimentation are just a few of the changes that are likely to occur as a result of climate change…"*

The figures used from the US Forest Service climate vulnerability assessment include the entire Shasta-Trinity National Forest. For the purposes of this report, circles have been placed around the Trinity River Watershed, which is the focus of this analysis.

According to the US Forest Service report, the majority of the watershed is dependent on snow melt, with little influence from ground water. The only drainages that have meaningful amounts of ground water influence are in the North Fork Trinity River drainage, shown below and circled in red in Figure 4.90. Other areas with some ground water influence are along the South Fork Trinity River at the southern and western edge of the watershed, and around Lewiston Lake.

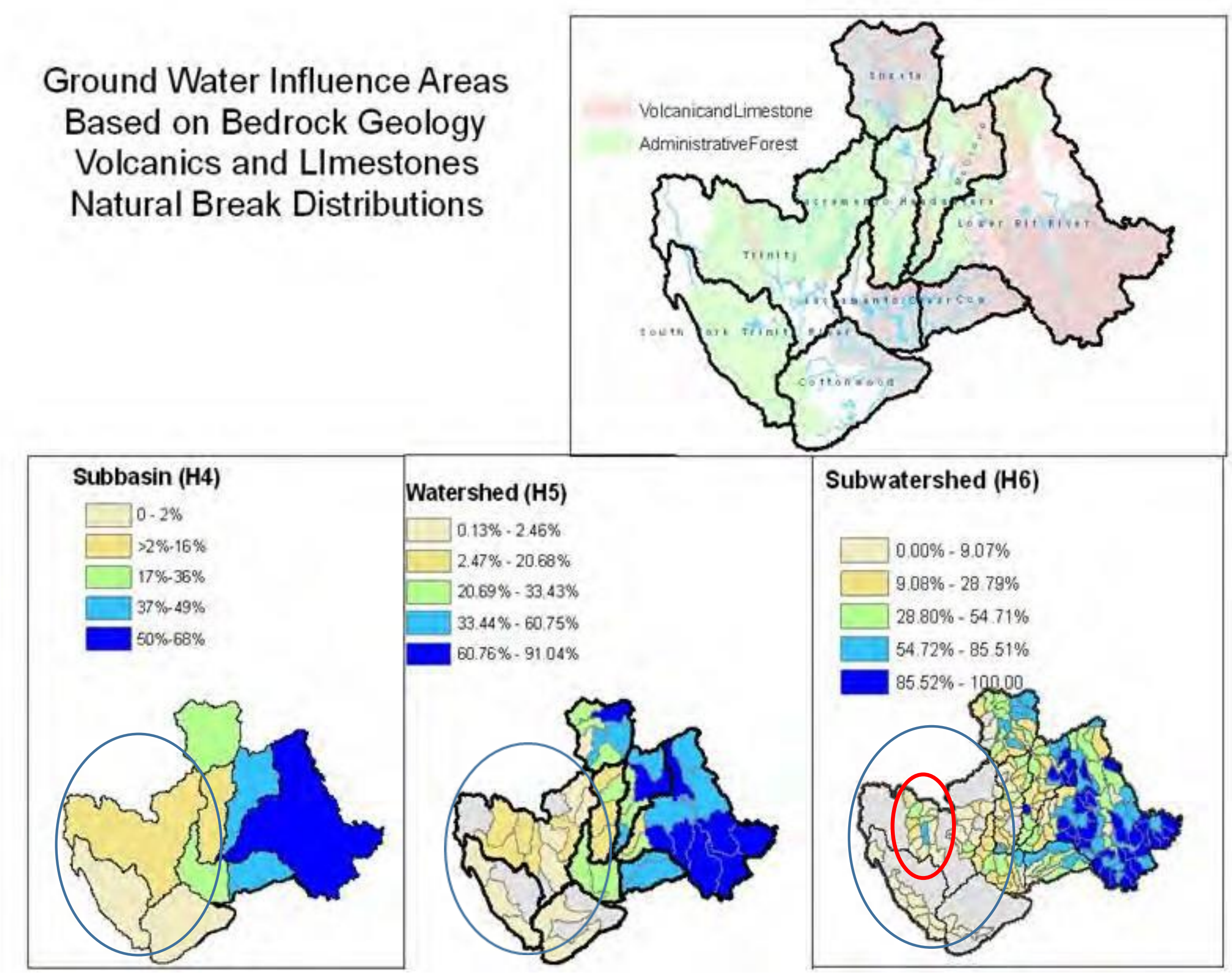


Figure 4.90 Percentage of hydrologic units in volcanic and limestone geologies; representing groundwater influence *(USFS, 2012*). North Fork Trinity River drainages circled in red.

Groundwater influenced watersheds tend to provide a buffer to the effects of climate change, but snowmelt dominated areas are likely to be the most vulnerable to change. Maximum snow depths at all stations in the Trinity River basin have decreased since 1960. Figure 4.91 illustrates the ranking of watershed sensitivity to climate change based on snowmelt influence.

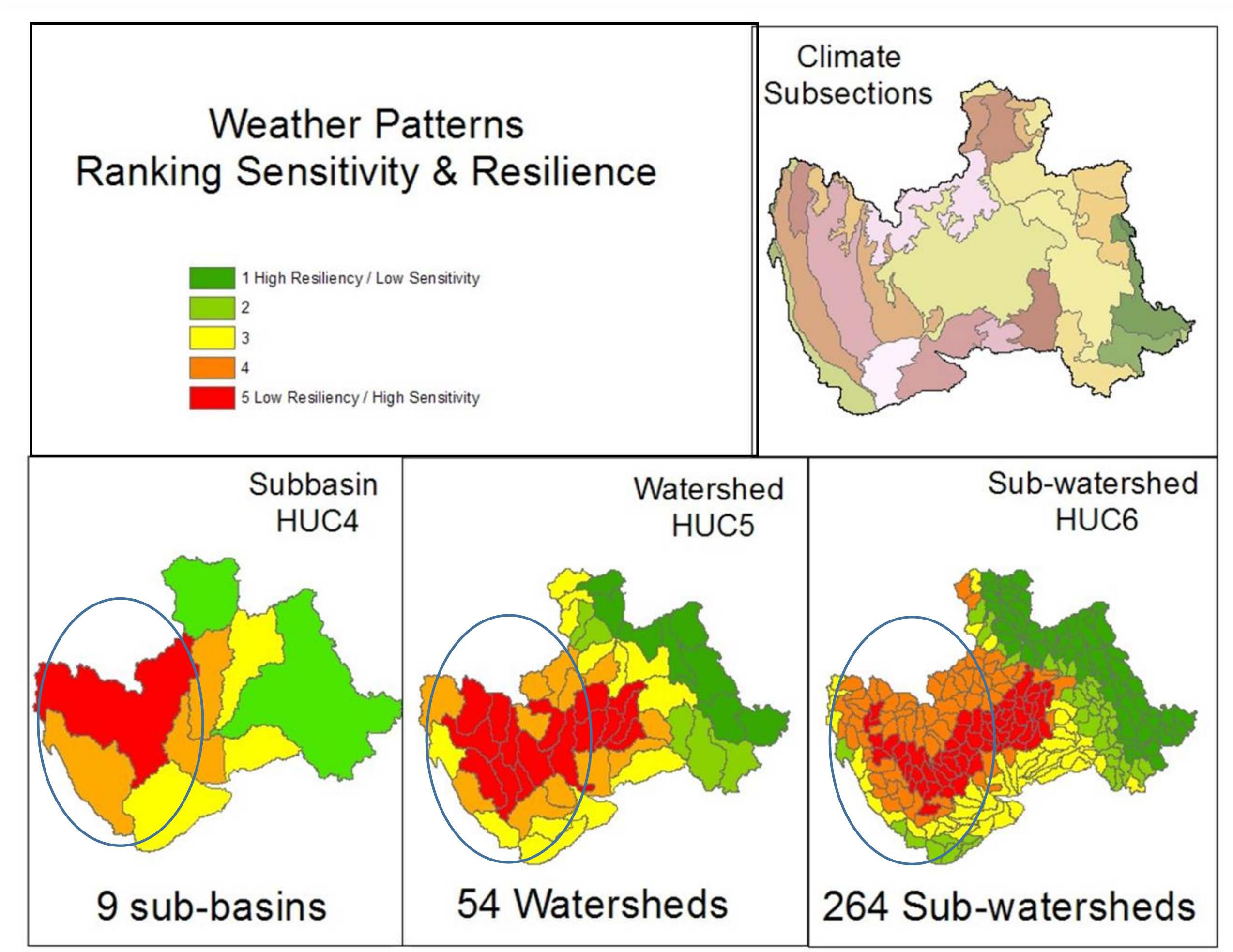


Figure 4.91 Ranking of watershed sensitivity based on snow dominated runoff processes. Higher numerical scores represent higher percentage of the watershed with snow *(USFS, 2012).*

In the snowmelt scenario above, only the southern and western edge of the watershed are projected to have a high resiliency/ low sensitivity from changing snow patterns.

The USFS study compared resource values, stressors and sensitivity and resiliency to analyze warming effects on watershed resources (Figure 4.92). When looking at the HUC 4 view, all of the watershed supports habitats that may be the most impacted by climate change. Going down to a more granular level (the map on the bottom right of the figure) some subwatersheds from the South Fork and up through the Down River region may offer more resiliency. The authors go on to advocate for restoration site selection being prioritized based on values in this model, population strongholds and refugia, and that the “highest priority actions are habitat protection and improving connectivity and access to existing habitat not currently occupied (by fish).”

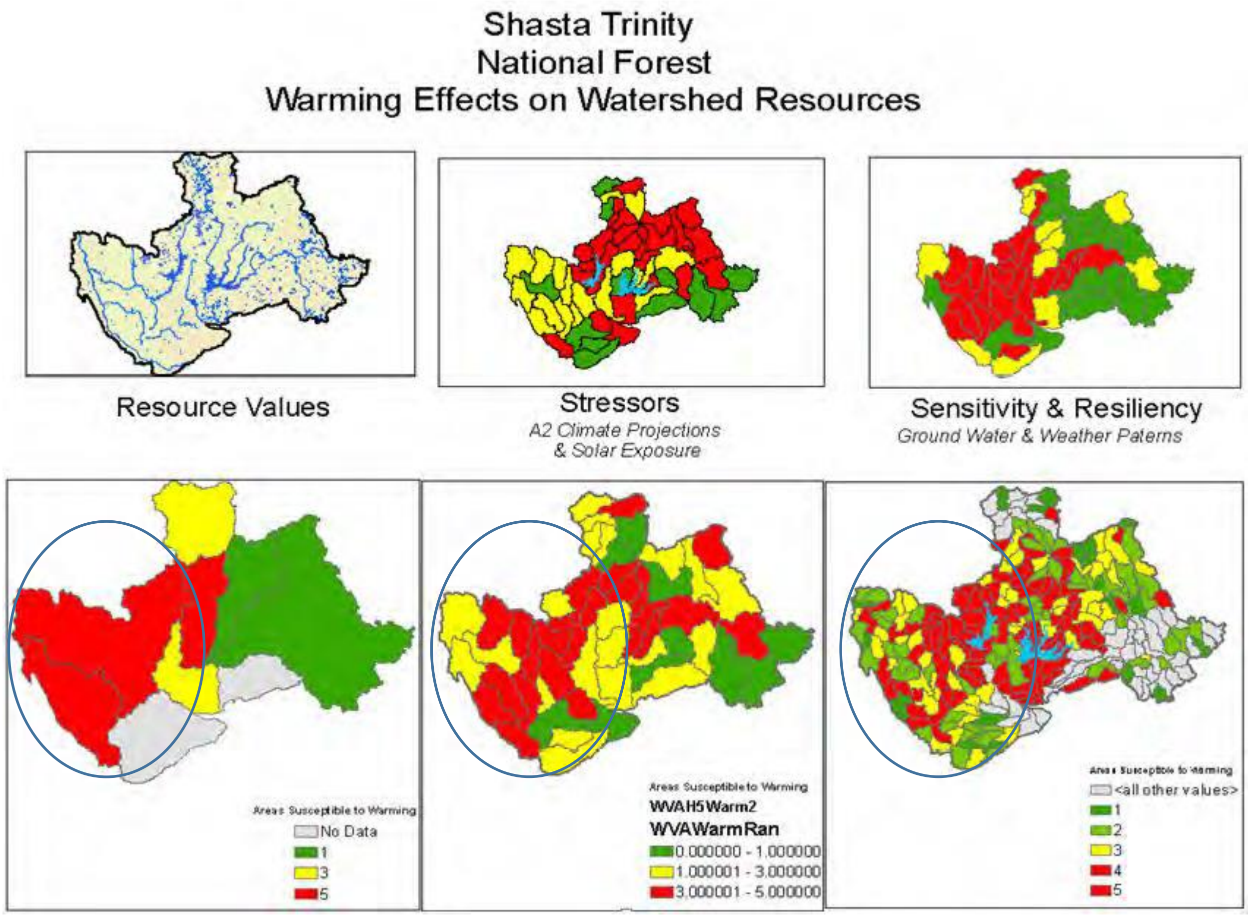


Figure 4.92 Combined ratings of resources, stressors and exposure produce relative ratings of watershed vulnerability (*USFS, 2012*).

With a caveat that the list is not complete, the Shasta Trinity Climate Change Vulnerability report included the following list of actions to maintain or improve resilience in the watershed:

- Maintain or increase habitat accessibility
- Prioritize aquatic habitat connectivity in refugia
- Road improvements to reduce sediment delivery and disconnect channel crossings
- Implementation of erosion prevention BMPs
- Replace undersized and damaged culverts
- Practice water conservation practices such as replacing leaky pipes, installing floats to force pump shutoff, and better controlling or eliminating overflow from developed water sources.
- Riparian improvements—thinning, enhancing native communities
- Meadow and stream improvements
- Maintain or increase water developments supporting key species
- Acquire water rights for critical resources
- Promote stricter enforcement of illegal water drafting, contest new applications for use and storage
- Explore creative solutions for FERC flows, relocating species above dams, removal of natural barriers, collaboration and communications
- Apply actions strategically (where infrastructure replacements or restoration can be most meaningful to increase aquatic species and watershed resiliency)

In addition to the impacts on water resources from climate change, the impacts on terrestrial resources will be severe. Multiple studies point to wildfire seasons increasing in length and severity due to climate change, with the 2018 California wildfire season providing on-the-ground proof with the deadliest fire in the state's history starting on November 8. The Trinity River Watershed is part of a fire adapted ecosystem, with plants and animals evolving to coexist with fire. However the adaptation to fire was developed under a different, more stable climate.

In one report (*Abatzoglou and Williams, 2016*), impacts from climate change were studied from 1979 to 2015, with a conclusion that over half of increased fuel dryness could be attributed to climate change. Between 1984 and 2015, the authors stated that human-caused climate change contributed to "nearly doubling the forest fire area expected in its absence."

Higher spring temperatures, earlier snow melt and drier climate over several years' time are factors contributing to forest health impacts. The time scale influences fuel drying on a seasonal level and fuel amounts, connectivity and structure at a decadal level (*Westerling, 2016*). Westerling's study found that " the frequency of large forest wildfires has continued to increase, with each decade, since the 1970's, showing an increased frequency of large wildfires at a regional scale compared with preceding decades." Furthermore he found that " the largest fire years occur in years with warm spring and summer temperatures and early spring snowmelt dates." These are the climate conditions we are facing now in the Trinity River Watershed.

Future impacts on the forest from climate change will come mostly in the form of increasing intensity, length, and severity of wildfire, but other impacts will be felt as well. Plants and animals adapted to the higher elevations within the watershed will have nowhere to go in a warmer watershed. A study conducted in the Blue Mountains in central Oregon *(Cassell, 2018*) used a forest landscape model to analyze the multiple, dynamic factors that impact forest health under a changing climate. The author found that "under climate change, wildfire was more frequent, more expansive, and more severe, and ponderosa pine expanded its range into existing shrub lands and high elevation zones. There was a near-complete loss of native high elevation tree species…under all climate and fuel treatment scenarios."

Post fire regeneration of trees will also be impacted by climate change. Increasing drought and temperatures will lead to degradation of post-fire tree regeneration, and will likely result in changes in forest composition or even transition to non-forested ecotones, as shown in a study completed at lower elevation forests around Missoula, Montana (*Hankin, 2018*).

In the *Trinity County Forest and Water Climate Adaptation Plan* (*Medley-Daniel, 2011)*, the author's assessment of threats to the forest reveals that an extended fire season will result from past management practices of fire exclusion and be exacerbated by increasing temperatures and decreasing precipitation. The future scenario includes critical habitat loss along with decreased carbon sequestration and watershed resilience.

Lack of funding to truly manage the forest on a landscape level with support from communities and federal agencies makes the forest at higher risk of devastating wildfires, according to Medley-Daniel. Desired future conditions need to be altered to acknowledge the changes expected from climate change in the forest composition, including a decrease in the range of Douglas fir forests, with an increase in oak and pine woodlands and madrone ranges as the forest becomes hotter and drier. The author notes that many sensitive species, including salmonids, Pacific fisher, northern spotted owl and several endemic plant species will be impacted by climate change in the diverse and complicated ecosystems within the watershed.

Land use decisions and future impacts

Trinity County is the governing body for the majority of the watershed owned by private entities, as the western edge lies in Humboldt County. The US Forest Service is the major land manager in the watershed for public lands. Both organizations could have major impacts, positive or negative, on the future health of the watershed.

The County controls who can build what, and where, on private lands. That control covers both water and forest resource issues. The past lack of analysis of human impacts on the watershed by the County can be seen in section 4.2A. Future negative impacts can be averted by adding thoughtful analysis requirements to the updated General Plan. Some ideas to consider are availability of domestic water sources; location of homes in fire prone areas; design of subdivisions that include two exists; analyzing commercial cannabis cultivation permits and well drilling permits based on subwatershed carrying capacity; and adopting a grading ordinance. Based on future actions the County is able and/or willing to take, the current state of watershed health could greatly improve or decline in the near future.

The US Forest Service management of the lands within the watershed is guided by several documents and plans, which are lengthy and detailed. Hundreds of thousands acres are currently protected as wilderness areas within the Trinity Alps, Chanchelulla and Yolla-Bolly Middle Eel Wilderness areas. Timber sales are active, but not numerous. In 2011 the Pacific Southwest Region of the US Forest Service released their Ecological Restoration Implementation Plan as guidance for the next 15-20 years. The US Forest Service plans and directives can be changed based on changing political climates in Washington DC, which leaves future impacts on the watershed a difficult subject to analyze.

5. Restoration Gaps and Trends

The preceding sections of this report cover large geographic areas and large amounts of information. Review of the watershed characteristics required 47 pages and over 40 maps. Key issues in the watershed were identified through review of past impacts including mining, land use and planning, wildfire, and cannabis cultivation; completed restoration projects; watershed assessments; and stakeholder priorities. Another 92 pages were required to review and identify these key issues in depth. Landscape level review of possible future impacts from climate change and land use planning decisions added another eight pages to the review.

To analyze, synthesize and interpret this much information, this section will look at overall gaps and trends in restoration at the landscape level, followed by an analysis by region. Future analysis of this report may reveal gaps and trends that are not obvious at this time.

Gaps in Landscape Level Restoration

In section 4.1, Watershed Characteristics, existing data from multiple sources is used to create GIS maps for analysis. In the process of combining and analyzing this data, large gaps in available data for the watershed were revealed.

1. Data gaps. The aquatic native species richness data for all four of the regions includes one indicator, aquatic invertebrates, that is based on actual monitoring rather than modeling. Aquatic invertebrate counts in this dataset were received from the California Department of Fish and Wildlife (CDFW) Areas of Conservation Emphasis (ACE) program. In Section 4.1, there are four maps which represent each region and include this information (Figures 4.7, 4.14, 4.24 and 4.36). In the North Lake region, 8 of the 19 subwatersheds have been monitored for aquatic invertebrates. In the Middle Trinity region, the count is 6 of 14. In the South Fork Trinity River region the count is 11 of 24. The Down River region count is 8 of 27. The total count indicates that 33 subwatershed have had actual aquatic invertebrate monitoring out of a total of 84. As percentages, this equals 39% subwatersheds monitored, and 61% unmonitored.

Beyond the counts for aquatic invertebrates, other monitoring data is also sparse including stream temperatures, dissolved oxygen in streams, stream flow measurements, terrestrial species type and count, and any monitoring data from private timber lands.

Section 4.2, Identification of Key Issues, reviews four critical areas to inform the key issues. Of those four areas, (past impacts including mining, land use and planning, wildfire, and cannabis cultivation; completed restoration projects; watershed assessments; and stakeholder priorities), two reveal gaps: completed restoration projects and watershed assessments.

2. Project gaps. Completed restoration projects in the watershed show a heavy emphasis on road projects to reduce sediment, with 45% of completed projects falling in this category. These projects were largely completed under existing US Forest Service environmental planning (NEPA) authority. Restoration projects are currently experiencing a gap in “shovel ready” projects due to the expense and difficulty of completing the design and environmental planning portion of projects. Completed design and planning projects number 26, with eight being completed by non-federal agencies before 2010 and 18 after, which supports the claim by many restoration professionals that federal agency help in this area has declined. In order for more restoration projects to be implemented in the tributaries, an increase in funding for this critical pre-implementation step is essential.

Another gap in completed restoration projects is a lack of landscape level planning, especially regarding aquatic habitat and restoration project connectivity. The decision to implement restoration projects in a specific area depends on many factors including habitat potential and carrying capacity, accessibility, property owner/manager cooperation, expense, availability of scientific data to inform the design, and ability of the project to meet funding criteria. However, no obvious pattern emerged regarding the location of the projects. In all of the research completed for this analysis, no document was uncovered that provided a logical strategy for completing restoration projects within subwatersheds based on cumulative benefits along connected aquatic habitats. Data on completed restoration projects for terrestrial species habitat connectivity could not be found for this watershed.

3. Landscape level restoration gaps. Certain restoration tools that have been introduced into restoration practice over the last decade are rarely implemented or completely absent in the Trinity River tributary watersheds. Landscape level restoration gaps include:

3.1. Source water protection in upper watersheds. Restoration project work has been driven largely by the Endangered Species Act listing of coho; the Clean Water Act listing of the South Fork and Trinity River Watersheds for impaired sediment loads and high temperatures; and the goals and objectives of the Trinity River Restoration Program (TRRP) to improve the health of the salmonid fisheries in the mainstem Trinity River between Lewiston Dam and the confluence of the North Fork and Mainstem Trinity Rivers (40 miles). The state of California currently has available funding to work on source water protection, but these projects have yet to be completed. Additionally, some non-profits are working to protect source water through land conservancy actions. The TRRP focus on the extent of anadromy limits its funding for source water protection in the mainstem Trinity, but the concept has not been explored for tributaries below the dam.

3.2. Serious consideration of climate change impacts on restoration projects. Working on restoration projects with the specter of climate change hanging overhead will require continuous adaptive management and the ability to manage natural resources with an eye toward an uncertain future, rather than relying on past concepts for guidance. Single species restoration projects will not be as effective under future climate change scenarios, with the suggestion being made (*Lawler, 2009*) that processes such as hydrology and disturbance regimes be restored to functioning states to build resilience, rather than focusing on structure alone. This focus on process rather than structure can be seen in in-stream habitat projects that include reconnection with floodplains, dynamic structures to build river complexity, and in terrestrial habitats where prescribed fire is used as a tool to build resilience. However, more emphasis is needed on building resilience to climate change impacts.

3.3. Strategic connectivity. As mentioned on the previous page, strategic connectivity between projects has not been addressed. Implementation of projects specifically to create terrestrial and aquatic connectivity to refugia from climate change is a large void. Aquatic connectivity to thermal refugia projects are absent from the tributaries, as are terrestrial connectivity projects for all land animals. As vegetation species composition changes with changing air and water temperatures and precipitation levels, all animals that can move to more suitable habitat will do so if they are able.

3.4. Addressing past mining impacts. In-stream projects and floodplain connectivity projects address the past impacts of mining in project reaches, but the overall floodplain and upland conditions that remain severely impaired from dredger and hydraulic mining have not been addressed specifically. The floodplains, riparian zones, wetlands and healthy uplands in the tributary watersheds that were destroyed from this resource extraction represent a loss of ecological function. The tailings occupy potential flood prone areas within the channel, which prevent creeks from spilling onto their floodplains and dissipating the floodwater energy. This, in turn, causes channel scour and incision leading to narrow, deep stream channels which increase the water velocity and create unfavorable conditions for fish. While the exact configuration that existed prior to the mining impacts will likely never be restored, the function that those features provided to the watersheds (ground water recharge, flood attenuation, organic matter for the food web from riparian vegetation, nursery habitat for fish and wildlife, carbon sequestration by soils) all need to be addressed through rehabilitation.

3.5. Recognition of, and adjustment for, commercial cannabis cultivation practices on restoration projects. Restoration practitioners have lamented the use of surface water by cannabis cultivators for nearly 10 years. County ordinances have been adopted to address some aspects of this impact, but they do not address cumulative impacts of cultivation at the HUC6 basin level. A data gap exists that connects cultivation practices with stream health, with the exception of work completed by the Watershed Research and Training Center for the South Fork Trinity River watershed.

3.6. Protection of sensitive subwatersheds outside of the wilderness areas. The US Forest Service does have management plans for Late Successional Reserves (old growth), Inventoried Roadless Areas (which prohibit roads and timber harvest) as well as other forest uses and practices. This report could not analyze all of the data available from the US Forest Service. It will have to be analyzed at another time. However, the County does not have any ordinances regarding private property uses in ecologically sensitive areas.

3.7. Use of beavers to help restore ecological function. Use of Beaver Dam Analogs (BDAs) in the tributaries could be an effective tool to recharge ground water, increase streamflows and increase aquatic and terrestrial habitat. BDAs are man-made structures hand built from willows and sediment that allow fish and water passage, but create pools and habitat. Because beavers were once hunted to near-extinction by early European explorers and fur traders, the loss of beaver dams throughout the watershed has had negative impacts on the hydrologic function, available habitat, and sediment dynamics of local waterways. Beavers themselves are not valued by all in the watershed. Ranchers currently trap and kill beavers as nuisances, Caltrans will also trap and kill them if their dams threaten highway infrastructure, and CDFW allows trapping for fur with the proper permits. The BDAs can be the first step in building resilience, with the second step being to change California law to allow transport of nuisance beavers to more suitable locations. Beavers are currently present in some subwatersheds, especially in the flat areas of the South Fork and North Lake regions.

3.8. Increase the use of scientific research; organize the availability of research; and use the findings to enhance the outcomes of restoration projects. Two examples have come to light in the creation of this analysis, and there are likely many more available. The climate change vulnerability study completed by the Shasta-Trinity National Forest (USFS, 2012) briefly covers the presence of springs as one variable that can provide some resilience to climate change. That study and the road inventories that have been conducted in the watershed contain data regarding locations of springs, but they haven't been monitored in years. Monitoring and development of springs may be one restoration project strategy to implement to build resilience. Another study (Welsh, et. al, 2005) used amphibian and reptile composition as an indicator of human impacts on biodiversity. The requirement of many amphibians for more than one habitat during their life cycle makes them especially vulnerable to changes in habitat.

3.9. There was no evidence of a focus on hand-built, non-mechanical solutions to address restoration problems. The 2016 South Fork supplemental assessment completed by the Watershed Center was the only plan that suggested the use of hand work at the mouth of tributaries to increase connectivity between the South Fork Trinity River and its tributaries. This type of work is low tech, low cost and has shown high returns in other watersheds. Other low-tech solutions include temporary ponds and Johads, small earthen check dams that capture and store rainwater, releasing it to surface water over time. As a bonus of using these approaches, they often involve youth volunteers who are instilled with stewardship values from their experiences.

3.10. Gaps in watershed assessments and analyses are obvious when reviewing Section 4.2C. With the exception of recently completed analyses in the South Fork Trinity region, watershed assessments are old or non-existent, and in need of updates. The last assessment in the North Lake region was completed in 2006, in the Middle Trinity region in 2012, and in the Down River region in 2010. In addition to updating existing assessments and analyses, a group effort by stakeholders is needed to inform recommendations once the assessments are completed. The majority of past assessments (with the exception of the South Fork region) were completed by the US Forest Service, which often results in a specific focus (post-fire rehabilitation, plantation thin, fisheries, etc.) and does not include recommendations that encompass the entire function of the subwatershed.

Trends in Landscape Level Restoration

The watershed characteristics presented in section 4.1 revealed trends in wildfire occurrence and wild salmonid population trends.

Wildfire occurrence over the last 40 years has repeatedly ravaged the western most region of the watershed, particularly in the Down River region, with expansion into the South Fork and Middle Trinity regions. The North Lake region and the southern most areas in the South Fork region have had very little wildfire in the last 40 years.

Wild salmonid counts are trending down in any tributary that has been surveyed over the last 18 years. The current trend for restoration project funding focuses only on species that are nearly extirpated already. Without funding to implement restoration projects for the salmonids that remain, they are in danger of going the way of the wild coho.

The impacts discussed in section 4.2 show a trend of uncertainty regarding land use and planning, and commercial cannabis cultivation. Successful completion of restoration projects depends on the ability of our governing bodies to make ecologically sound decisions.

Completed restoration projects discussed in section 4.2 reveal certain trends by project types, as follows:

- There have been no cultural restoration projects completed since 2004.
- As mentioned in the landscape level gaps section above, the trend for design and planning projects is moving away from federal completion of environmental planning and toward state, local and non-profit agencies.
- Fish passage projects have received steady support from the CDFW Fisheries Restoration Grant Program (FRGP) and the US Forest Service.
- Instream habitat projects have received steady support from CDFW and TRRP.
- The only monitoring projects completed in the last six years have been related to TRRP projects.
- Only one non-roads sediment project has been completed after 2008.
- Revegetation projects have shifted from habitat restoration to highway rehabilitation in the last six years.
- The last riparian only project was completed in 2012.
- Road work to reduce sediment has been steady since 2000.
- Water conservation projects are increasing and there is a trend, based on personal communications, toward implementing more to include forbearance of water during the dry season, increased efficiencies in water taken from surface waters, and working with water districts to increase the efficiency of their diversions.
- Noxious weeds projects were primarily funded by USFS Resource Advisory Committee since 2010. That funding source is not available and no other has taken its place with the exception of one recent project funded by the Trinity County Agricultural Department and one funded by North State Resources.
- Wetland projects are grouped around well-known sites and have not received much funding. Of the nine wetland projects, the two most recent ones are located at the Hayfork Community Wetlands.

Stakeholder priorities discussed in section 4.2D also reveal trends regarding needed projects within the watershed. Stakeholders who work within the natural resources field are most concerned with water quantity, as it drives nearly every other factor influencing watershed health. Stakeholders outside of the natural resource field repeatedly mentioned the need for fuels reduction, and improved habitat for deer and elk to improve hunting. They also listed cannabis cultivation as a concern relating to watershed health.

Trends related to climate change reveal an overwhelming amount of evidence supporting the need for quick, decisive and large scale projects to protect our watershed from the increasing intensity and destruction of wild fires and loss of both aquatic and terrestrial biodiversity. Species composition will also shift with a changing climate, creating opportunities and challenges for vegetation management. The survival trend for vegetation projects depends wholly on the availability of funding to irrigate project sites from May – October.

Gaps and Trends by Region

5.1 North Lake Region Restoration Gaps and Trends

Gaps: The North Lake region suffers from a lack of aquatic focused projects because it is above the limit of anadromy. Restoration project funding has mostly been related to noxious weed control. However, the region has had major landscape impacts from mining (Figure 5.1), which are not addressed in the type and quantity of projects that have been implemented.

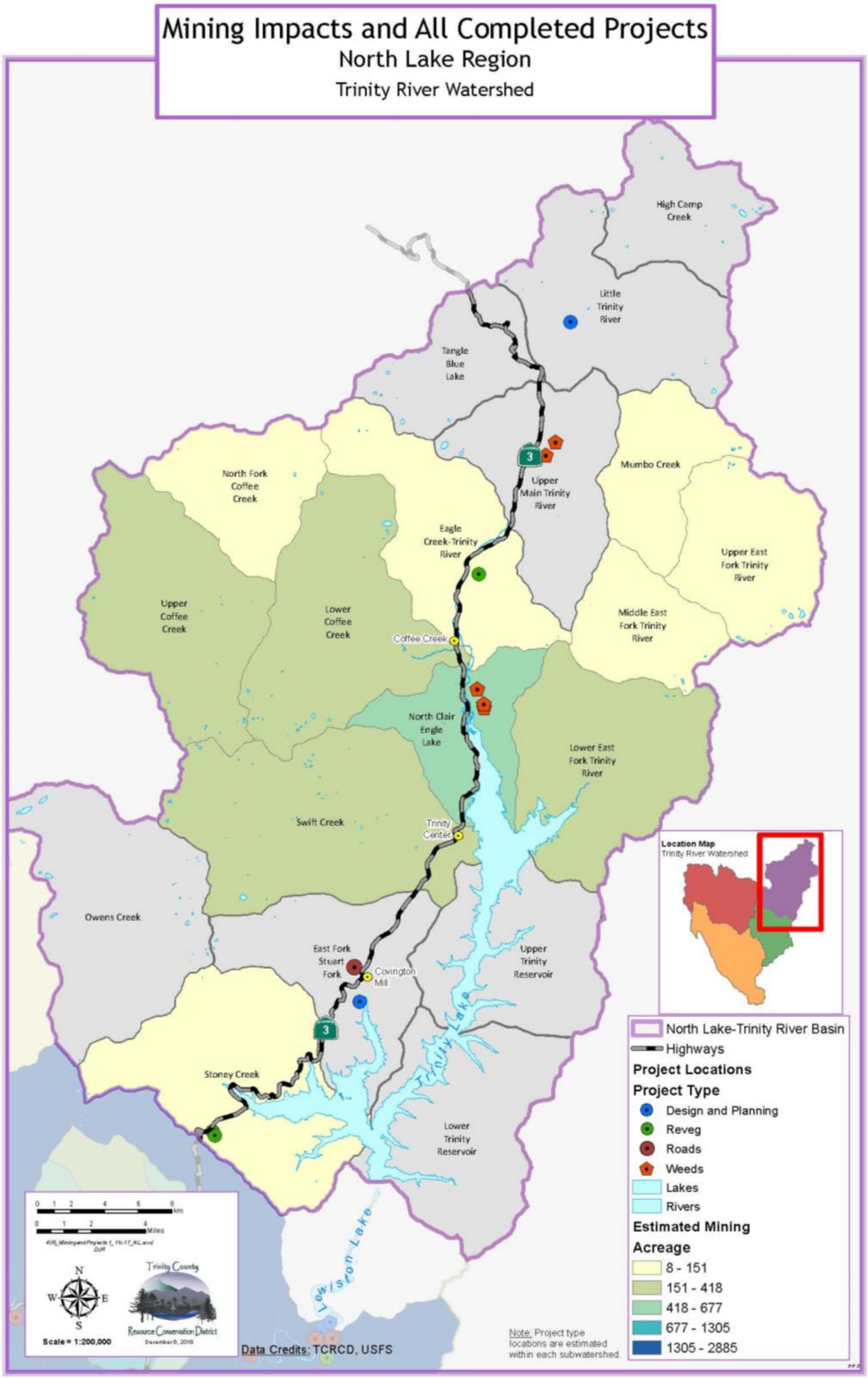


Figure 5.1 North Lake region mining impacts and project types. Note: Project locations are placed in the correct subwatershed, but not the specific location therein.

While the exact configuration that existed prior to mining will likely never be restored, the function that those features provided to the watersheds (ground water recharge, flood attenuation, organic matter for the food web from riparian vegetation, nursery habitat for fish and wildlife, carbon sequestration by soils) all need to be addressed through rehabilitation.

No work has been completed to protect the headwaters of the Trinity River. Current opportunities through the state of California may fund future restoration projects in this region based on forest health and the importance of protecting the headwaters. Wildfire has not burned the majority of this watershed in over 40 years, making it a prime candidate for stand-replacing fires in the future, especially with drying and warming climate trends.

This region has the highest and richest levels of game species counts in the watershed according to the CDFW Areas of Conservation Emphasis (ACE) database and discussed in section 4.1. A gap exists for addressing this resource - there are no known completed projects for game species habitat enhancement in the North Lake region.

Updated watershed assessments are lacking for this region, with the most recent one completed in 2006.The roads that were listed as priorities for sediment reduction in this 12-year-old plan still need to be addressed.

Over 100 miles of private timberland roads were inventoried in 2004 (*TCRCD, 2004*) coinciding roughly with the High Creek Camp and Little Trinity River subwatersheds, to identify and map sources of deliverable sediment. This inventory compiled a list of 173 sites of concern which still need to be addressed. The same study also identified 184 springs, which could now be considered for development of climate resilience projects.

Aquatic and terrestrial monitoring data is sparse for this region and could be used to inform future restoration projects and update the CDFW ACE database to enhance future modeling efforts. Gaps in knowledge are especially noticeable due to the checkerboard property ownership between private timberlands and those managed by the government.

Trends: Due to the lack of restoration and rehabilitation projects in the North Lake region, the only obvious trend is that the subwatersheds in this region continue to be ignored.

5.2 Middle Trinity Region Restoration Gaps and Trends

The Middle Trinity region contains thousands of acres impacted from mining activity. It also contains the county seat, the Lewiston Dam, and the highest population concentration in the watershed. Due to the large number of projects in this region, two maps (Figures 5.2 and 5.3) represent the number and type of projects per subwatershed.

Gaps: Water source supply and protection have not been addressed in this region. Surprisingly, completed water conservation projects are lacking in this region despite the fact that it includes two of the most overbuilt and unsustainable subwatersheds in terms of water supply – Little Browns Creek and Browns Creek. There are projects currently in progress to address water conservation in this region, but more public understanding of the area's water supply vulnerability could benefit future projects. Source protection has yet to be addressed, despite a recent study indicating that the Weaverville CSD water diversions on East and West Weaver Creeks are considered two of the top four most wildfire vulnerable municipal supplies in the state (*Comerford, 2018*).

Projects to specifically address mining impacts are non-existent, but are desperately needed for watershed health. Specific subwatersheds that have been identified for mining remediation in prior assessments and analyses include Canyon Creek, East Fork of the North Fork Trinity River, Rush Creek, and Weaver Creek. From review of Figures 5.2 and 5.3, and personal communications with residents, Browns Creek subwatershed also has high impacts from mining.

Based on the CDFW Passage Assessment Database (Figure 4.51) shown in section 4.2A, over 20 fish barriers remain throughout the region due to the road density and dams which limit salmonid habitat. Table 4.8 in the same section shows six recommended culvert replacements identified in 2002 in this region that have yet to be corrected.

As with the other regions, watershed assessments are needed on all subwatersheds throughout this region. Two have been written since 2004 for the Weaver Creek subwatershed. The most recent one written in 2012, West Weaver Creek Assessment and Action Planning, prepared for TCRCD by ESA PWA, was created as a pre-planning document in support of a restoration project that was implemented in 2017. The other, Weaverville Watershed Analysis by Shasta-Trinity National Forest Trinity River Management Unit, was written in 2004 in support of future timber harvests. The 2004 document refers to "Weaverville" rather than Weaver Creek, which leaves some parts of the subwatershed without any analysis, including Little Browns Creek, a historic coho stream.

Two other assessments also exist for this region: the 2003 analysis of Canyon Creek (which is included with Down River subwatersheds) and the 2009 analysis of Soldier Creek. Both were written by US Forest Service staff. The 2003 analysis specifically states that restoration of mining areas along Canyon Creek need to be explored. This gap still exists.

Trends: Watershed monitoring trends in this region as shown in section 4.1 point to major monitoring near population centers and very little in outlying areas.

Steelhead counts in Canyon Creek (Figure 4.17) have not been above 40 since the year 2000, and Chinook (Figure 4.18) are rarely found in numbers over 10. Some fisheries biologists are puzzled over the lack of fish in Canyon Creek as temperatures are cold enough, but dissolved oxygen has not been monitored. Some suggest that earlier mining practices in the creek may have altered the habitat to the point of no return.

Instream fish habitat projects in this area (Figure 5.2) have been limited to subwatersheds near the dam (which were all implemented over 10 years ago) and those in the West and East Weaver Creek subwatersheds. All of the other subwatersheds have not seen any instream habitat projects. Instream fish habitat projects in subwatersheds close to confluences with the mainstem Trinity River could provide refugia and holding habitat, but there has been no trend toward improving this potentially valuable habitat.

Early in the 2000s restoration work in Grass Valley and Deadwood Creeks for Trinity River Restoration Program (TRRP) included a full range of projects to benefit salmonids, but subwatershed restoration work close to Lewiston has not continued over the last eight years.

The highest number and diversity of restoration projects have been completed in this region due to the original focus of the TRRP on the first 40 miles of habitat below Lewiston Dam. This focus has broadened in the last few years to include all tributaries down to the confluence with the Klamath River, but completion of those projects has not yet reached the number and scale of earlier projects.

The Junction City area has had the highest number of noxious weed removal projects in the watershed.

With restrictions set in place by the County, cannabis cultivation within Community Service District (CSD) boundaries will remain minimal in the Middle Trinity region. However, the trend for cannabis cultivation outside of CSD boundaries (Figure 4.57) is highest in the Lower Canyon Creek and Weaver Creek subwatersheds, with Dutton and Little Browns Creek running a close second. With no restrictions in place on the number of cultivation permits allowed per subwatershed, the trend for these creeks to run dry by July or August could worsen, even in normal to wet water years.

While this region has the densest population in the watershed, there does not appear to be a trend toward converting forests to subdivisions. However, if the status quo were to change, planning to address future growth in an ecologically sustainable manner would become a top priority project.

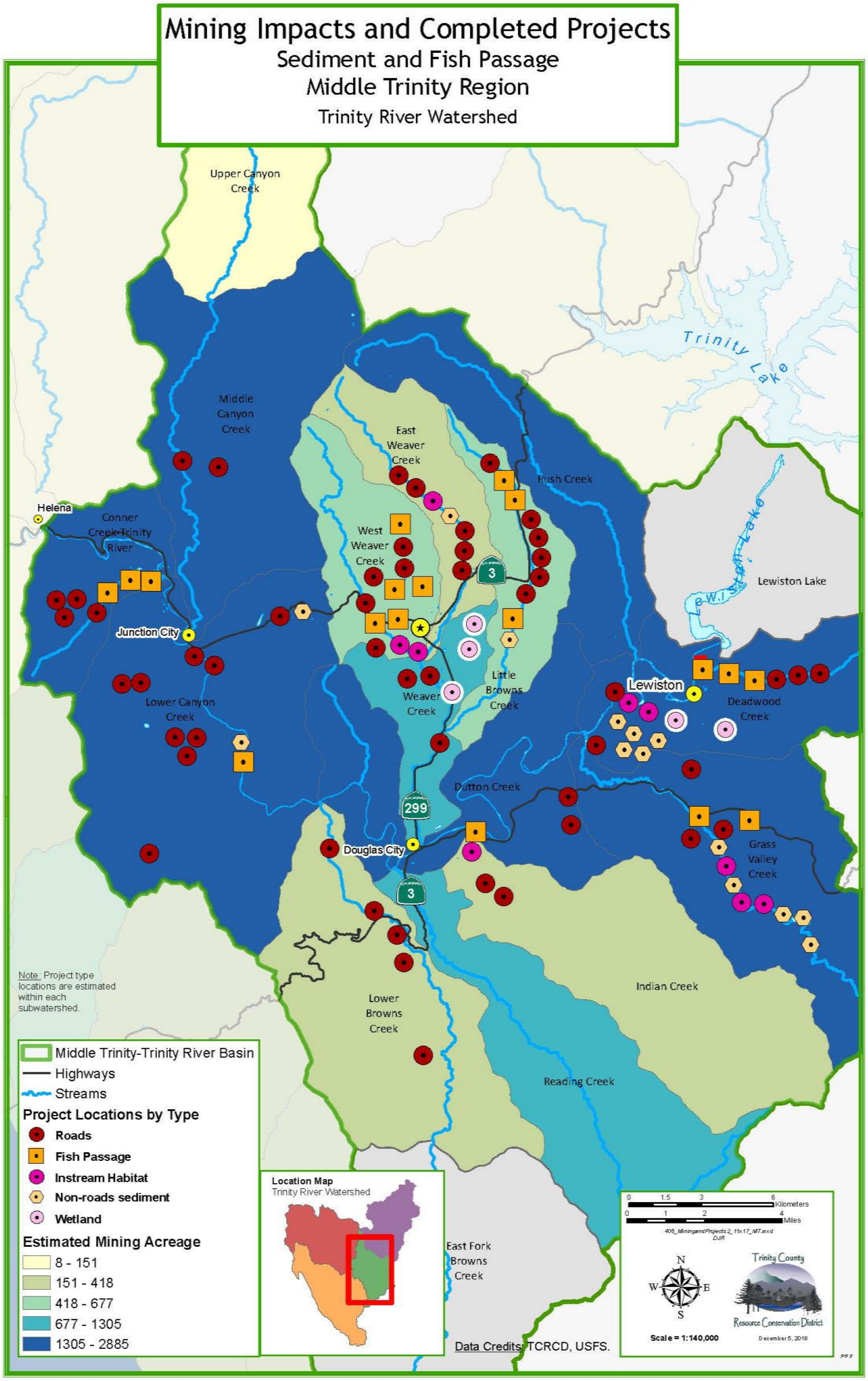


Figure 5.2 Sediment and fish passage related projects in the Middle Trinity region in relation to the acreage of mining impacts.

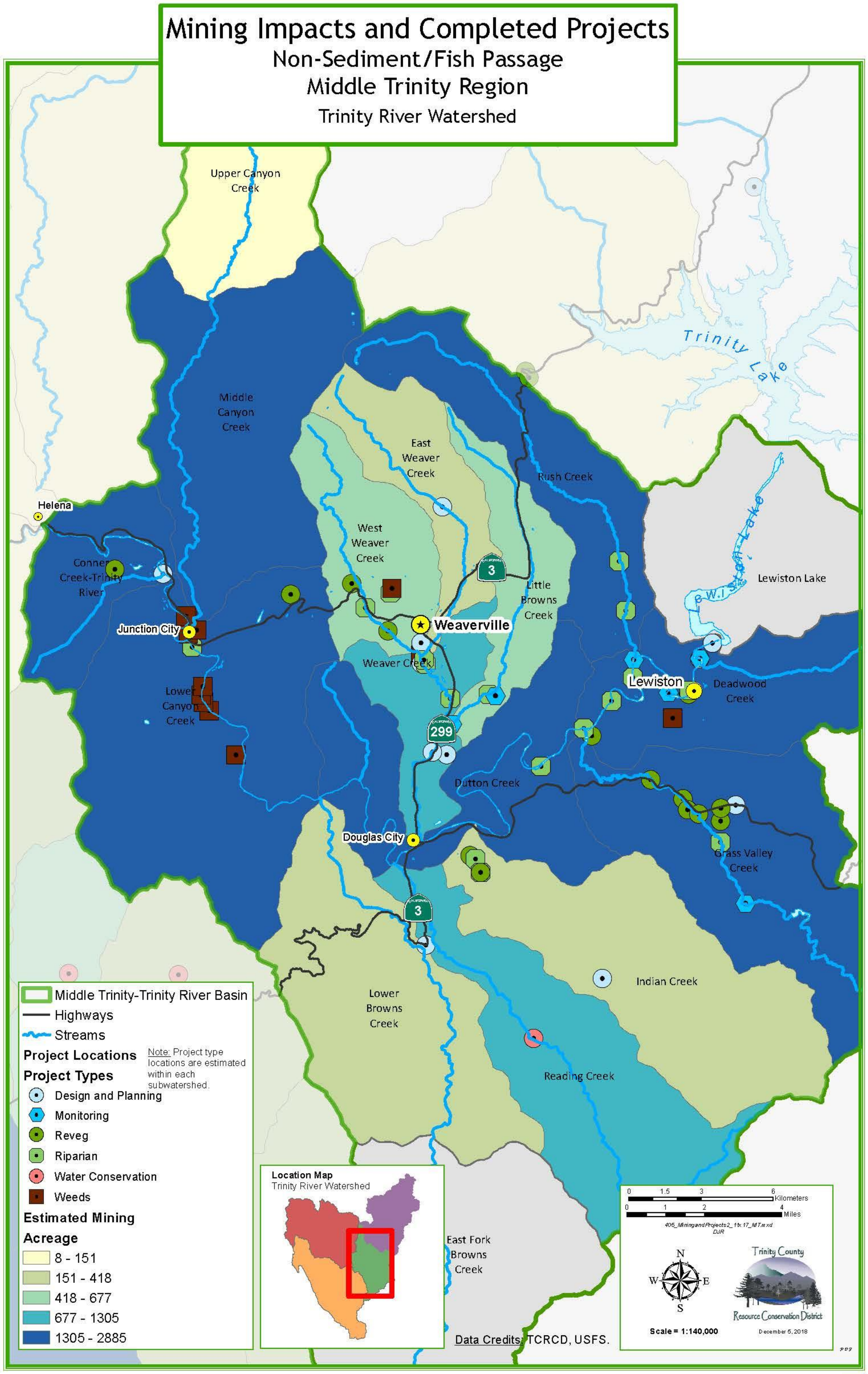


Figure 5.3 Non-sediment and non-fish passage related projects in the Middle Trinity region in relation to the acreage of mining impacts.

5.3 South Fork Region Restoration Gaps and Trends

The South Fork region is heavily impacted from sediment loads resulting from past mining and timber harvest practices on highly erodible soils, and now faces impacts from commercial cannabis cultivation. Cannabis cultivation can impact both sediment supply and surface water flow. Despite these impacts, the region holds promise for rehabilitation in the more populated areas and conservation in the more remote areas of the region. The Hayfork Valley is the only location in the watershed with large areas of land zoned for private agricultural preserves (Figure 4.20) which adds another layer of complexity when implementing rehabilitation projects. Due to the large number of projects in this region, two maps (Figures 5.4 and 5.5) represent the number and type of projects per subwatershed and estimated acres of mining impacts.

Gaps: Past projects have not addressed water source supply and protection, a top priority as established by the Trinity River Watershed Council. Big Creek supplies the Trinity Water Works District #1, which provides water for Hayfork. A thorough analysis of the Big Creek watershed was completed in 2008 by the Watershed Research and Training Center (*WRTC, 2008*). The WRTC followed up with a 2016 Watershed Assessment for the entire South Fork Trinity River Watershed which includes prioritized recommendations for thirteen subwatershed areas, shown in section 4.2C. While water conservation projects have been prioritized, only a few have been implemented.

The few completed water conservation projects (Figure 5.5) in this region are not in the Rattlesnake Creek-Post Mountain subwatershed, which has the highest density of commercial cannabis cultivation in the watershed. However, this subwatershed has been assessed and priority projects assigned. Many land owners in the Trinity Pines subdivision in this subwatershed are working with state and local authorities to bring their cannabis cultivation sites into compliance. There are projects in progress to address water conservation in this region, but more public understanding of the area's water supply vulnerability could benefit future projects.

The five subwatersheds in the lower reaches of the region – Eltapom, Hyampom, Grouse, Lower South Fork and Madden Creeks – have little or no completed projects outside of sediment reduction work around Hyampom, but also exhibit the most biodiversity and promising areas for rehabilitation and monitoring. Figures 4.21-4.23 in section 4.1 indicate high levels of biodiversity, but Figure 4.24 and 4.25 reveal that monitoring for aquatic macroinvertebrates and dissolved oxygen is missing. Further monitoring in these subwatersheds will help inform future aquatic and terrestrial projects and possible conservation measures.

Projects to specifically address mining impacts are non-existent but are desperately needed for watershed health. Specific subwatersheds that have been identified for mining remediation in prior assessments and analyses include Hayfork and Upper Hayfork Creeks and the entire Hayfork Valley. From review of Figures 5.4 and 5.5, the subwatersheds with high mining impacts include Rusch Creek-Little Creek, Salt Creek-Hayfork Creek and Tule Creek-Hayfork Creek. Some revegetation, riparian and wetland projects have been completed in these subwatersheds, but further analysis to tie the revegetation work with mining site rehabilitation is needed to accomplish better success rates.

The Watershed Assessment for the South Fork Trinity River Watershed (*WRTC, 2016*) recommends 50 riparian vegetation sites with high restoration potential. The top 10 sites are in areas with mid-range mining impacts, with six of the 10 in the upper Dubakella subwatershed around the Wildwood area, and the remainder in Duncan Gulch-Barker Creek subwatershed. Completed projects in these areas (Figures 5.4 and 5.5) have included fish passage, road work for sediment reduction, and one instream habitat project on Barker Creek. These two subwatersheds are also mentioned in section 4.3 as having unusually cold water for the size of the watershed, as well as showing good coho Intrinsic Potential (IP) for habitat. All of the data is indicating that this part of the SFTR region could provide climate change resilience for both aquatic and terrestrial species, but there is a gap in projects that would allow fish and land animals to reach the more hospitable areas. In the case of fish, they would have to survive traversing the warm waters of the Hayfork Valley. Land animals need to navigate private properties and fence lines. The project gaps that need to be addressed here include connectivity corridors on land and in the water.

Currently, coho have been found in Hayfork Creek only up to Corral Creek, and numbers of Chinook from the snorkel surveys are nearly non-existent (Figure 4.31), with no count over 10 since 2004. Hayfork Creek steelhead counts have been vacillating between 12 and 68 since 2000 (Figure 4.30). With new eDNA testing available, monitoring projects could determine if salmonids are making their way into the upper reaches of Hayfork Creek. If they are present, this would provide support for future restoration projects.

Additional climate change resilience and connectivity projects for aquatic thermal refugia would benefit the subwatersheds west of the mainstem South Fork Trinity River. Madden Creek, which is also near the confluence of the Trinity River, is the only tributary surveyed where coho were observed and also had the highest species richness of surveyed tributaries (*WRTC, 2016*). Monitoring this creek for refugia with resilience in mind will help inform future projects in the SFTR as well as create possible future projects in Madden Creek itself. Handwork at the mouth of Madden Creek to create fish passage could be implemented as an annual youth project after high flows, as proposed in the SFTR watershed assessment (*WRTC, 2016*).

In reviewing future impacts from climate change in section 4.3, stream temperature data from WRTC, 2016 monitoring looks to be circumstantially related to the groundwater connection and resiliency established in the Shasta-Trinity climate vulnerability assessment when comparing Figures 4.88-4.92. These figures point to areas in the SFTR region where cooler waters are available even during the hottest part of the year (Mean Weekly Maximum Temperatures). While some of the tributaries in the upper watershed on the west side of the South Fork Trinity River may be too steep for anadromous fish to utilize, the confluence where these tributaries enter the SFTR should be explored for development of refugia and resiliency projects. The Shasta-Trinity vulnerability report advocates for restoration site selection being prioritized based on values in their model, population strongholds and refugia, and that the "highest priority actions are habitat protection and improving connectivity and access to existing habitat not currently occupied (by fish)" (USFS, *Mai, 2012*). This cold water data has been analyzed and reported, but there is a need for projects to be implemented to create refugia based on the data throughout the region.

Other subwatersheds outlined for future refugia projects in the 2016 WRTC assessment include:

- Miners Creek and Bear Creek in the Lower Hayfork Creek subwatershed
- Little Creek, upper Barker Creek, and upper Big Creek in the Middle Hayfork Creek subwatershed
- Goods Creek in the Upper Hayfork Creek subwatershed
- Madden Creek in the Lower SFTR subwatershed
- Lower Butter Creek in the Middle SFTR subwatershed
- Cable Creek and Prospect Creek in the Upper SFTR watershed

The 2016 WRTC study found that within the range of temperatures throughout the watershed, "Upper and Lower Hayfork Creek have a greater percent of tributaries accessible to anadromous fish with Mean Weekly Maximum Temperatures (MWMT) likely suitable for coho salmon."

Based on the CDFW Passage Assessment Database (Figure 4.51) shown in section 4.2A and the passages identified in the WRTC 2016 assessment, several subwatersheds still need fish passage barriers addressed.

Trends: Road work for sediment reduction continues to be the most common completed project type in this region (Figure 5.4).

Monitoring projects are lacking, while instream habitat projects are limited to subwatersheds closest to Hayfork.

This region has the most recent, and complete, watershed assessments of any in the watershed. Further use of the data collected for the 2016 assessment is recommended.

Based on watershed characteristics highlighted in section 4.1, the region provides a critical habitat stronghold for northern spotted owls and marbled murrelets, while also showing good game species habitat.

The East Fork South Fork Trinity River, Butter Creek and parts of Carr Creek and Grouse Creek subwatersheds saw a positive increase in the overall watershed condition trend score by the US Forest Service NW Forest Plan (Figure 4.26).

This region is the center for legal commercial cannabis cultivation in the county. If this trend continues, water supply and surface water protection will continue to be critical issues for watershed health.

Illegal cultivation of cannabis on public lands continues in this region. The majority of the rehabilitation project sites summarized in Table 4.11 are in the South Fork region. With the legalization of cannabis in California, this trend may decrease if this illegal activity becomes unprofitable.

The temperature data collected and projected for the most recent watershed assessment, belies the strong coho Intrinsic Potential rating assigned to the Hayfork Valley by the National Marine Fisheries Service. This reflects a trend of locally collected data reporting not being incorporated into state and federal analyses in a timely manner.

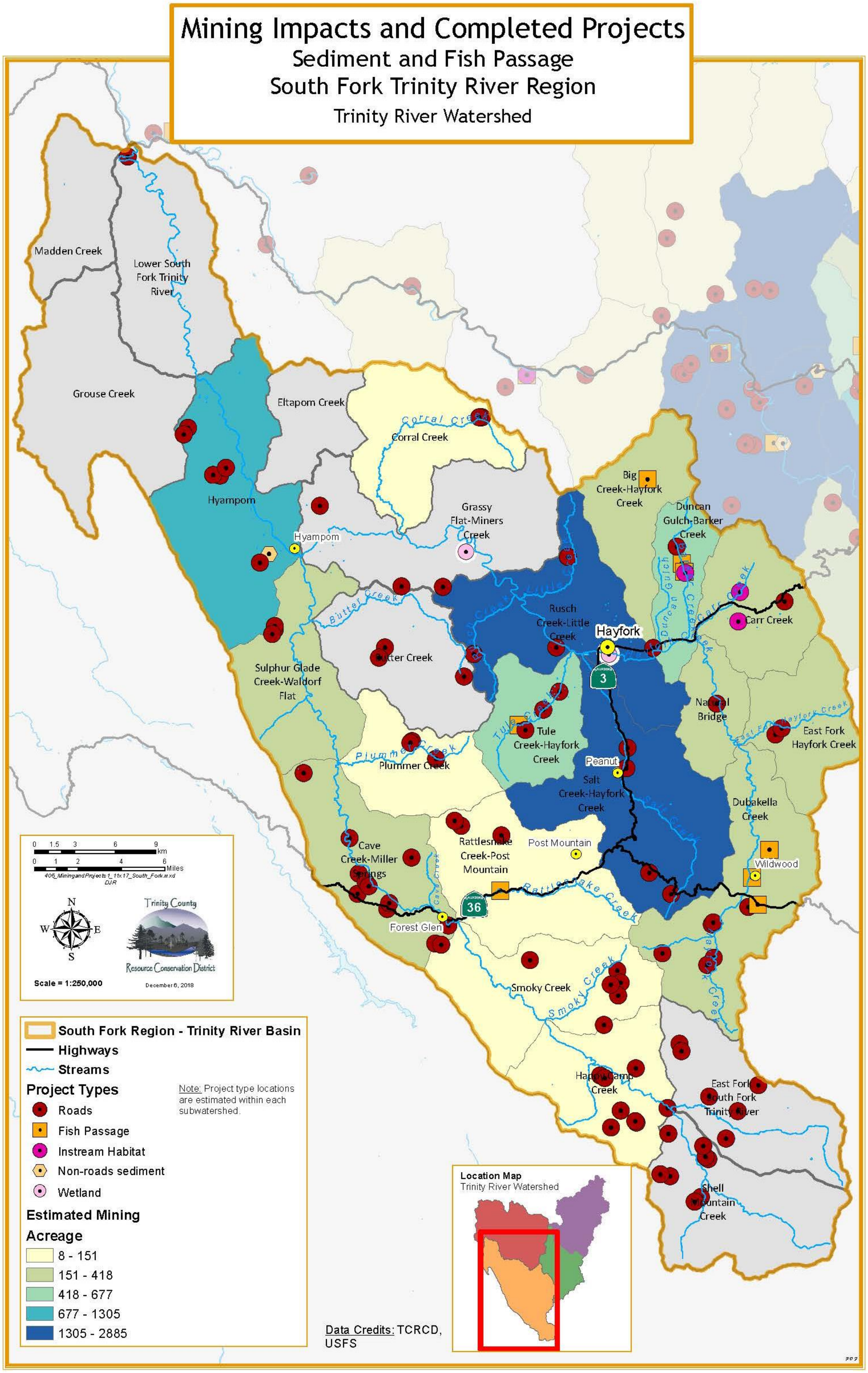


Figure 5.4 Sediment and fish passage related projects in the South Fork Trinity region in relation to the acreage of mining impacts.

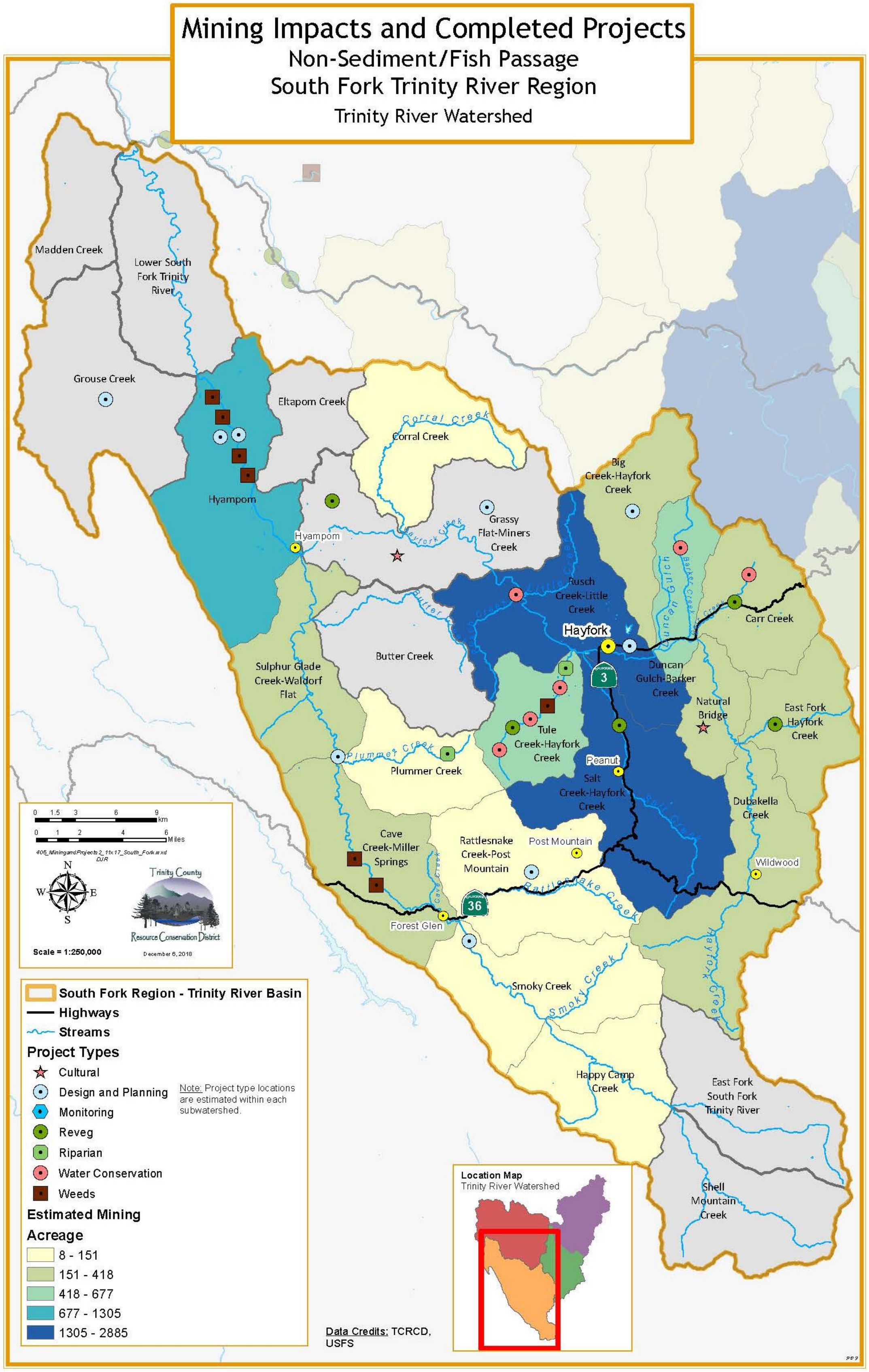


Figure 5.5 Non-sediment and non-fish passage related projects in the South Fork Trinity region in relation to the acreage of mining impacts.

Down River Region Restoration Gaps and Trends

A striking observation about this region is how little restoration work has been completed, despite recommendations outlined in five different watershed assessments. With little human impacts, this region holds the most promise for future refugia for both terrestrial and aquatic species. The region includes several healthy subwatersheds, that if monitored, could help inform restoration projects throughout the Trinity River Watershed.

Gaps: Major project gaps include monitoring of healthy creeks and conducting inventories for needed projects. The region is extremely remote and likely contains strong pockets of biodiversity and climate change refugia based on connectivity shown in Figure 4.34, but without monitoring it is impossible to pinpoint what is there.

Additional monitoring gaps include macroinvertebrates, which will inform the CDFW ACE database, which currently ranks some of the most pristine subwatersheds as "low" for significant aquatic habitat (Figure 4.36) in section 4.1. The TMDL reference streams (Figure 4.37) – Horse Linto Creek, New River, Big French Creek, Manzanita Creek, North Fork Trinity River and East Fork of North Fork Trinity River – are in subwatersheds ranked "low" for significant aquatic habitat by CDFW without any data to support this ranking. There is no dissolved oxygen or macroinvertebrate data, and only a few sites have outdated temperature monitoring data. Based on summer snorkel surveys (Figures 4.42 and 4.43), the New River has strong but declining steelhead counts and a Chinook population in steep decline since 2012. Again, data monitoring and sharing will inform the datasets as well as future restoration projects.

Another data sharing gap exists between state and federal agencies and the Hoopa Valley Tribe. Tribal lands include several healthy subwatersheds that could be analyzed through Stream Condition Inventories to find any similarities or ideas for restoration projects in other subwatersheds within the Trinity River Watershed.

The Willow Creek subwatershed offers high terrestrial connectivity, high critical habitat for northern spotted owls and marbled murrelets, and high Coho Intrinsic Potential (IP) but no restoration projects. Several of the Integral Ecology Research Center (IERC) trespass grow sites (Table 4.11) were rehabilitated in this subwatershed leaving the potential for further rehabilitation projects (revegetation, connectivity, climate change refugia) beyond the basics that are currently being performed by IERC.

Five watershed analyses were completed between 2000 and 2010 by the US Forest Service. Several management actions within these plans have not been addressed, including noxious weed removal, management of fuels to reduce stand replacing fires, fisheries monitoring, and development of research and design projects to manage riparian areas. These gaps will fuel the wildfires that have repeatedly hit this region in the last 40 years (Figure 4.71) and worsen impacts from climate change.

The groundwater connection in the North Fork Trinity River subwatersheds is clearly illustrated in section 4.3, Figure 4.90, based on the Shasta-Trinity climate change vulnerability analysis. This analysis indicates that the North Fork Trinity River should provide climate change resiliency for aquatic species. The snorkel survey results in Figure 4.41, especially in Reach 4 on the river, support that claim as the counts are consistently high and this reach is likely benefiting the most from the groundwater connection within the subwatershed. Groundwater connection based on bedrock geology cannot be easily duplicated, but monitoring in this section through stream condition inventories may help guide and inform future restoration projects in other subwatersheds.

Trends: The majority of projects completed (Figure 5.6) were roads projects to reduce sediment. The majority of projects completed (Figure 5.6) were roads projects to reduce sediment. Three significant fish passage projects were completed, along with two instream habitat projects.

In the Down River region, there is a disturbing trend of commercial cannabis farms outside of Community Service District (CSD) boundaries (Figure 4.73) locating in subwatersheds with prime fisheries habitats. Little French-Manzanita and Hawkins Creek Sharber Creek subwatersheds have completed fish passage and Instream habitat projects, as well as the two highest concentrations of cannabis cultivation sites in the region. In the USFS French Creek Watershed Analysis (2010) the presence of adult coho salmon along with a robust steelhead population in Manzanita Creek led the Forest Service to determine that Manzanita Creek "possess Outstanding Remarkable Values (ORV) for anadromous fisheries." The same subwatershed is also a Research Natural Area (RNA), with the botanical target element of Ponderosa Pine-Douglas Fir. It is recognized for a high botanical diversity, with nine SAF forest types and 17 plant associations recognized (*PSW-GTR, 2004*).

Data for cannabis cultivation in the Supply Creek subwatershed, location of the other completed fish passage and instream habitat projects, is unavailable as the Hoopa Valley Tribe has not legalized cannabis cultivation on the reservation. Supply Creek has high returns of both Chinook and steelhead.

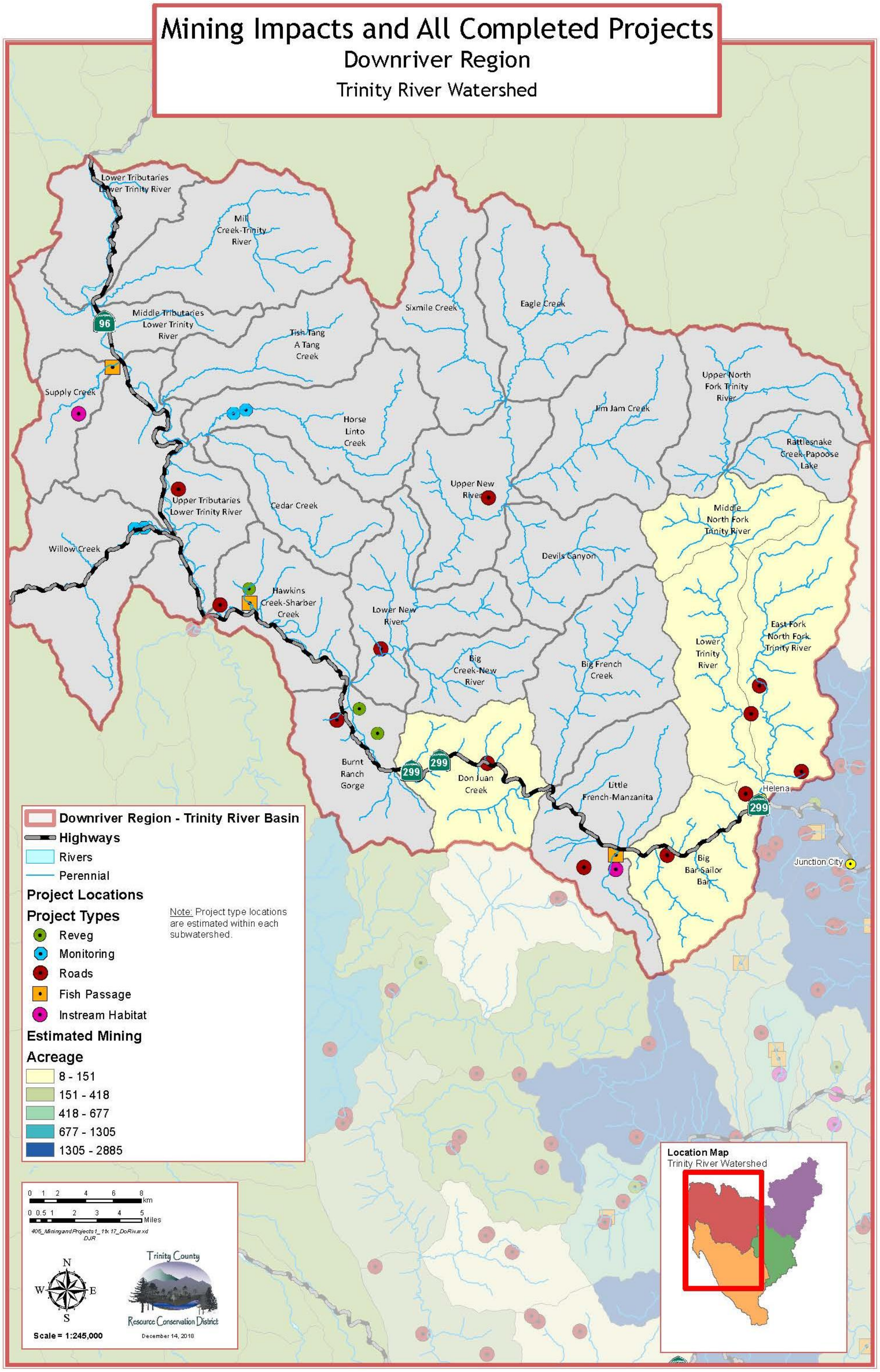


Figure 5.6 Down River region mining impacts and completed project types.

6. Restoration Project Recommendations

Landscape level restoration project recommendations are followed by regional recommendations. These recommendations are based on the gaps and trends discussed in section 5.

Landscape level project recommendations

1. All stakeholder surveys and nearly every past watershed assessment placed a high value on restoration projects for forest health, including reducing the risk of stand-replacing wildfire through fuel reduction, plantation thinning, timber harvest, and use of prescribed burns. While these forest health projects s were not reviewed in this analysis for gaps and trends, it remains a top priority project type for all stakeholders.
2. Increase the number of projects that protect and enhance stream flow. Several projects are currently being implemented. This item is listed as the top priority of the Trinity River Watershed Council.
3. Address the gaps outlined in section 5, including:
    - Gather scientific data through monitoring to increase accuracy of data sets for aquatic and terrestrial biodiversity, stream flow, stream temperature, dissolved oxygen levels in streams and climate impacts.
    - Use new monitoring data to create more science-driven restoration projects.
    - Create a logical strategy for completing restoration projects within subwatersheds based on cumulative benefits along connected aquatic habitats.
    - Create restoration projects for terrestrial species habitat connectivity.
    - Find additional avenues for funding design and environmental planning projects.
    - Work with federal and state agencies to reduce difficulty of implementing environmental planning projects.
    - Create projects to protect source waters.
    - Incorporate climate change predictions and modeling into all restoration projects to build resilience in the watershed.
    - Inventory, monitor and develop (if necessary) natural springs and seeps to build resilience.
    - Include funding for two years of dry season irrigation in all vegetation projects to mitigate for warming.
    - Establishment of protocols for restoration practices in tributaries that include commercial cannabis cultivation.
    - Establishment of criteria to designate high value subwatersheds and synthesis of data to support protection of those areas.
    - Use of existing research findings in creative ways and development of future research to inform restoration practices.
    - Incorporate low-tech approaches into rehabilitation projects.
    - Update existing or create new watershed assessments that encompass the entire function of HUC6 subwatersheds.
4. Address past mining impacts at the HUC 6 level through projects that rebuild ecological function lost through destruction of floodplains, riparian zones, wetlands and healthy uplands. Some possible projects could include:
    - Work with federal agencies on methods for mitigating the removal of, or reconfiguring of, “cultural resource” tailings within a set distance from creeks and rivers.
    - Rebuild soils through innovative approaches such as additions of bio-mass, biochar, local soils and fill material, mycorrhizae, and native seeds.
    - Where appropriate, use the “Stage 0” method of stream restoration to rehabilitate stream form and function.
    - Recognize mining rehabilitation as a project category in its own right, which will benefit both terrestrial and aquatic habitat and species.

5. In addition to including climate change predictions and modeling into all rehabilitation projects, new projects need to be developed to specifically address climate change impacts. Trends related to climate change reveal that there is an overwhelming amount of evidence supporting the need for quick, decisive and large-scale projects to protect our watershed from the increasing intensity and destruction of wild fires and loss of both aquatic and terrestrial biodiversity.

   The climate change scenario facing natural resource professionals in this watershed could force the use of triage techniques and hard decisions. In order for plants and animals to have a chance to adapt, existing stressors and impacts need to be reduced and connectivity needs to be enhanced (Lawler, 2009). While human impacts such as roads, dams, agriculture, and water diversions exist in this watershed, they are confined to a small area and human population is low, leaving great swaths of undeveloped land. The situation here is not nearly as dire as other watersheds with large urban centers which include heavy industry and large human populations. However our watersheds are still at great risk. Possible climate change mitigation projects could include:
   - Immediate, collaborative, landscape level projects to address forest conditions that are ripe for stand-replacing wildfire.
   - Reduce stressors to plant communities by increased dedication to removal of invasive vegetation. This action offers a two-fold benefit: 1) Allowing healthy established populations to propagate before climate change impacts increase; and 2) Changes in temperature, CO_2 concentrations and precipitation could allow invasive species to outcompete natives and spread into suitable habitat before the native species are able to migrate and become established.
   - Strategically locate reserves for connectivity that cross multiple ecotones and then establish protections to allow for future species migrations. This type of project relies on accurate models and would have to be developed for multiple species, but once developed will provide current and future habitat needs.
   - Examine aquatic pathways needed for salmon to reach higher and colder refugia for summer holding. At the same time, the colder refugia needs to be monitored for primary production and the health of the food web, along with cover/suitable habitat. This type of project needs to connect all of the dots and be implemented strategically to provide all of the necessary elements during the heat of the summer.
   - Investigate "seeding" salmon carcasses higher in the watersheds to provide missing nutrients and jump start the food web.
   - Manage riparian zones to allow sunlight to reach portions of the streambed to increase primary production in upper watersheds. While riparian vegetation is important for cooling stream temperature, some studies suggest that connection to groundwater can be just as important in cooling streams as shade. However, biodiversity increases when there are breaks in riparian cover because it diversifies habitat types.
   - Manage vegetation and timber harvests for an increase in streamflow.
   - Apply fuels management based on intrinsic ecological value, not just community protection.
   - Identify and conserve high priority refugia for at-risk species that provides resilient habitat, such as north-facing slopes, areas with springs, riparian corridors and mature forests.

6. Create projects that recognize the benefits of beavers on the landscape, such as:
   - Use of Beaver Dam Analogs (BDAs) to increase water availability and build ecological resilience.
   - Work with the state of California to allow relocation of nuisance beavers to areas in the watershed that will benefit from their presence.

7. Address land use and planning proactively. This is not normally considered a type of restoration project, but restoration and rehabilitation projects do not happen in a vacuum. The watershed is on the cusp of a great loss in biodiversity. Project funding needs to be found to restrict housing and agricultural development in sensitive subwatersheds. Future subdivisions cannot be allowed to move forward if they impact water resources as seen along Browns Creek and in the Trinity Pines subdivision. Commercial cannabis cultivation licenses need to be reviewed with an eye toward protecting critical aquatic and terrestrial habitat. As of

January 2019, Trinity County has not yet adopted a general grading ordinance, although an emergency grading ordinance is under consideration.

8. Increase the use of low-tech solutions in rehabilitation projects.
   - Johads (small earthen check dams that capture and store rainwater, releasing to surface water over time) provide hydrologic function in place of missing wetlands and riparian zones.
   - Hand removal of accumulated cobble at the mouth of tributaries to increase connectivity.
   - Off-channel ponds in groundwater-connected watersheds provide crucial summer holding habitat.
   - Signage, education and outreach provide information to the public and encourage support of projects.

9. Continue to analyze and update the data in this report. Gathering this data took a great deal more time than expected and future analysts will likely find additional gaps, trends and project recommendations not covered here.

6.1 North Lake Region Restoration Project Recommendations

The North Lake region has the fewest number of restoration projects, but holds great promise for watershed rehabilitation projects. Recommended projects include:

1. The headwaters of the Trinity River start in this region, yet it is often ignored for rehabilitation projects because of the dams and the recent focus on anadromous fisheries. Source water protection projects in this region need to be implemented. As mentioned in section 5, item 3.1, some non-profits are working with private timber companies on possible land conservation agreements. Protection of the source waters from stand-replacing wildfire needs to be addressed, in addition to implementation of conservation measures.
2. Stakeholders requested projects to address water quality, fire and fuels management, biodiversity, and cannabis cultivation impacts.
3. Mining sites need to be treated in this region to restore ecological function. The region above the dam provides a unique opportunity in the watershed to try new restoration approaches without threatening anadromous fisheries habitats. It could be used as a "test laboratory" to discern what works before using the same techniques in the rest of the watershed. Possible projects related to mining rehabilitation could include:
   a. Setting up piezometers to determine ground water connectivity to inform restoration.
   b. Determining mitigation actions needed for moving tailings, and then resculpting banks and floodplains.
   c. Importing biomass, biochar, local soils and seed banks to improve soils and revegetation to reduce sediment loads and water temperatures.
4. Incorporating projects that recharge ground water and supply a slower release to surface water such as Johads, off-channel ponds, and Beaver Dam Analogs.
5. Gather aquatic and terrestrial data and work with CDFW to update their Areas of Conservation Emphasis (ACE) data files in order to recognize the unique ecosystem that exists in this region.
6. Beaver transfer sites (if eventually approved by CDFW). The relative flatness along the Upper Main Trinity River subwatershed is listed as "inaccessible medium to high intrinsic potential" coho habitat. While coho are not above the dam, the subwatershed could provide habitat for relocated beavers, as both species co-evolved. Beaver currently live above the dam, which is removed from ranchers and infrastructure.
7. Habitat enhancement for game species including forest thinning, landscape level assessments to create terrestrial connectivity, and spring (water) development.
8. Protect forests and critical habitat from impacts of climate change through proactive management.
9. Using watershed characteristics data in this report, supplement the Community Wildfire Protection Plan (CWPP) to include a focus on source water protection, critical habitat protection, and the intrinsic value of the biodiversity on the landscape.
10. The 12 priority roads listed in the Upper Trinity River Assessment need to be revisited and the list of priorities re-evaluated, with project implementation to follow for sediment reduction.
11. Update watershed assessments as discussed in section 5.

6.2 Middle Trinity Restoration Project Recommendations

The Middle Trinity region has benefited from the highest number of salmonid related restoration projects. Major gaps still exist in rehabilitating the subwatersheds in this region as discussed in section 5. Recommended projects include:

1. Water supply source protection projects for both domestic supply and watershed health. This includes the Weaverville Community Services District (WCSD) domestic supplies on East and West Weaver, but also the smaller suppliers such as Rush Creek Estates. Surface water use for domestic supply will continue to impact watershed health until new solutions, such as dry season storage, use of Trinity River water, or expansion of the WCSD boundaries, are implemented. Source waters need protection from devastating wildfires.
2. Public education and outreach to address water conservation and water supply protection, especially in overbuilt subwatersheds dependent on surface water such as Little Browns and Browns Creek.
3. Create projects that recharge ground water and supply slower release to surface water such as Johads, off-channel ponds, and Beaver Dam Analogs.
4. Stakeholders requested projects to address possible impacts from residual mercury as a result of mining, cannabis cultivation impacts, increasing habitat for game animals, protecting mature forests, and fuels reduction.
5. Rehabilitation of mining sites to restore ecological function, which could include, but is not limited to:
    a. Setting up piezometers to determine ground water connectivity to inform restoration projects.
    b. Determining mitigation actions needed for moving tailings, and then resculpting banks and floodplains for better function.
    c. Importing biomass, biochar, local soils and seed banks to improve and rebuild soils.
    d. Revegetation to reduce sediment loads and water temperatures.
6. Address fish barriers and culvert replacements identified in earlier assessments and by CDFW.
7. Increase tributary instream habitat improvement starting with projects near the confluences with the mainstem Trinity River, working upstream into the subwatersheds to provide more and varied habitat types than those available in the Trinity River; and provide a logical connection between sites for access to upper watersheds, providing climate change resilience.
8. Monitor instream habitat in Canyon Creek and specifically explore the loss of fish counts in Reach D (Figure 4.19), which has seen a significant drop since 2012.
9. Update watershed assessments, as discussed in section 5, based on overall watershed health, not only task related criteria.
10. Begin habitat enhancement for game species including forest thinning and landscape level assessments to create terrestrial connectivity.
11. Develop springs to build resilience to climate change for plants and animals.
12. Study and address impacts of high density commercial cannabis cultivation when concentrated in subwatersheds.
13. Planning to address future growth in an ecologically sustainable manner.
14. Continue work to reduce noxious and invasive species for watershed health and climate change resiliency.

6.3 South Fork Region Restoration Project Recommendations

The South Fork region has benefited from a recent, and thorough, watershed assessment which contains long lists of recommended projects. This analysis supports those recommendations and adds more based on the data gathered here. Recommended projects include:

1. Water supply source protection projects for domestic supply are needed in this region. This includes the recommendations listed in section 4.2.C3 from the SFTR Supplemental Watershed Assessment, Appendix 1 *(WRTC, 2016)* for water conservation. Of the 13 subwatershed regions examined in the WRTC assessment the following top priorities by watershed are assigned as follows:
    a. Develop a new water district – Salt Creek (including part of Hayfork and Gulch Creeks), Barker Creek, Carr Creek, Hyampom Valley, and Rattlesnake Creek-Post Mountain.
    b. Instream water right dedication – Big Creek, Tule Creek, Chanchelulla Gulch-Shiel Gulch and Hayfork Creek near Wildwood (Dubakella).
    c. Improve agriculture water delivery system efficiency – East Fork Hayfork and Olsen Creek.
    d. Expand existing waterworks district boundaries – Hayfork Valley.
    e. Tanks and Forbearance – Butter Creek.
2. Protect watershed health, including headwaters, from devastating wildfires.
3. Public education and outreach to address water conservation and water supply protection, especially in overbuilt subwatersheds dependent on surface water such as Rattlesnake Creek – Post Mountain and Duncan Gulch-Barker Creek.
4. Increase monitoring to inform rehabilitation or conservation projects in the five lowest subwatersheds (closest to the confluence with the Trinity River) in the region - Eltapom, Hyampom, Grouse, Lower South Fork and Madden Creeks.
5. Create projects that recharge ground water and supply slower release to surface water such as Johads, off-channel ponds, and Beaver Dam Analogs.
6. Stakeholders requested projects to address water usage in the Eltapom Creek watershed; algae blooms in Hayfork Creek; and illegal water diversions throughout the watershed.
7. Stakeholders also requested projects to address poaching of spring Chinook, water quality, fire/ fuels reduction, cannabis cultivation, protection of old growth for listed species habitat, conservation of wild areas, and improving wild game habitat.
8. Rehabilitation of mining sites to restore ecological function, which could include, but is not limited to:
    a. Setting up piezometers to determine ground water connectivity to inform restoration projects.
    b. Determining mitigation actions needed for moving tailings, and then resculpting banks and floodplains for better function.
    c. Importing biomass, biochar, local soils and seed banks to improve and rebuild soils; and revegetation to reduce sediment loads and water temperatures.
9. Address fish barriers, diversion structures and culvert replacements identified in earlier assessments and by CDFW. Priority diversion structures for restoration outlined in the 2016 watershed assessment (*WRTC, 2016*) include diversions on Olsen Creek, Silver Creek, the upper and lower diversion structures on Big Creek, upper Tule Creek and West Tule Creek.
10. Examine aquatic pathways needed for salmon to reach higher and colder refugia for summer holding. At the same time, the colder refugia needs to be monitored for primary production and the health of the food web, along with cover/suitable habitat. This type of project needs to provide connectivity and be implemented strategically to provide all of the necessary elements for fish to reach areas in upper watersheds.

11. Monitor eDNA to determine presence/absence of salmonids in upper watersheds to inform instream restoration projects.
12. Hand clear the mouths of tributaries annually, especially Madden Creek, after high flows to allow for fish passage.
13. Prioritize climate change resiliency in projects by incorporating known cold water spots into rehabilitation projects, including tributaries in upper and lower Hayfork Creek subwatersheds, Lower Butter Creek, and the upper and lower SFTR subwatersheds.
14. Create holding areas in the South Fork Trinity River where the cool tributary waters can provide refugia using such methods as adding boulders or large wood at the confluences with tributaries to create scour and more SFTR main channel cold water refugia habitat.
15. Incorporate known coho intrinsic potential stream reaches into rehabilitation projects.
16. Create terrestrial connectivity projects for land animals.
17. Monitor instream habitat in the mainstem South Fork Trinity River and specifically explore the loss of fish counts in Reaches G and F1-F2 (Figure 4.29), which has seen a significant drop since 2012.
18. Update watershed assessments, as discussed in section 5, based on overall watershed health, not only task related criteria.
19. Begin habitat enhancement for game species including forest thinning and landscape level assessments to create terrestrial connectivity.
20. Develop springs to build resilience to climate change for plants and animals.
21. Study and address impacts of high density commercial cannabis cultivation when concentrated in subwatersheds.
22. Begin planning to address future growth in an ecologically sustainable manner.
23. Continue work to reduce noxious and invasive species for watershed health and climate change resiliency.
24. Increase communications to share data among local, state and federal partners to inform all data sets.

6.4 Down River Region Restoration Project Recommendations

The Down River region has had little restoration project work completed, as the majority of the region is extremely rugged and remote. Healthy subwatersheds exist where research and monitoring could be used to inform other project areas. With six TMDL reference streams in the region, future data from this region could set the standard for rehabilitation projects in the entire watershed. Recommended projects include:

1. Protect watershed health, including headwaters, from devastating wildfires. This region has had the highest impacts from stand-replacing wildfire in the last 40 years. The following actions can help surface water reliability in this region:
    a. Restoring structure and species composition in oak woodlands and glades can increase forest resilience and water availability.
    b. Forests that were formerly dominated by Klamath mixed conifer and have been converted to broadleaf stands are likely using more water in late summer. Restoration to a more conifer-dominated composition could help increase streamflow when the fish need it most.
2. Develop monitoring projects for healthy streams and rivers, especially those listed as reference streams in the US Environmental Protection Agency TMDL report. Use new data to inform future projects in this and other subwatersheds.
3. Share data with CDFW for updating their datasets.
4. Continue work to reduce noxious and invasive species for watershed health, wildfire reduction and climate change resilience.
5. Address fish barriers, diversion structures and culvert replacements identified in earlier inventories and assessments.
6. Begin habitat enhancement for game species including forest thinning and landscape level assessments to create terrestrial connectivity.
7. Research the biodiversity in this region to inform future projects.
8. Restrict legal cannabis cultivation in subwatersheds that provide high value for anadromous fisheries.
9. Rehabilitate and restore illegal cannabis grow sites in subwatersheds that provide critical habitat for sensitive terrestrial and aquatic species.
10. Examine aquatic pathways needed for salmon to reach higher and colder refugia for summer holding.
11. Complete project recommendations from past analyses.
12. Strategically combine projects to increase beneficial cumulative impacts.
13. Increase communications to share data among local, state tribal, and federal partners to inform all data sets.

7. References

Abatzoglou, John T. and Williams, A. Park. 2016. Impact of anthropogenic climate change on wildfire across western US forests. Proceedings of the National Academy of Sciences. October 18, 2016. V. 113 no. 42, pp 11770-11775.

Bureau of Land Management. 2016. Northwest California Integrated Resource Management Plan, Envisioning Meetings Comment Summary Report.

California Department of Fish and Wildlife. Areas of Conservation Emphasis (ACE) maps and data. 2018. https://www.wildlife.ca.gov/Data/Analysis/ACE#523731769-overview.

Cassell, Brooke Alyce. 2018. Assessing the Effects of Climate Change and Fuel Treatments on Forest Dynamics and Wildfire in Dry Mixed-Conifer Forests of the Inland West: Linking Landscape and Social Perspectives. https://pdxscholar.library.pdx.edu/open_access_etds/4226/ Dissertations and Theses. Paper 4226. Accessed December 18,2018.

Comerford, Sherri, based on research by R. Dwight Atkinson, retired. US EPA Office of Water. 2018. Identifying Communities with Drinking Water Supplies at High Risk from Wildfire and Post-fire Erosion. Presented at Western States Source Water Protection Workshop, Boise, ID. June 21.

Crotteau, Justin S., Keyes, Christopher R., et al. 2018. Stand dynamics 11 years after retention harvest in a lodgepole pine forest. Forest Ecology and Management, 427, pp 169-181.

Environmental Science Associates - Pacific Watershed Associates. 2012. West Weaver Creek Assessment and Action Planning. Prepared for Trinity County RCD.

Five Counties Salmonid Conservation Program (5C). 2004. The Direct Inventory of Roads and Treatments (DIRT).

Foster Wheeler Environmental Corporation. 2001. Hidden Valley, Plummer Creek, and Rattlesnake Creek Watershed Analysis.

Gabriel, M. W., L. V. Diller, et al. 2018. Exposure to rodenticides in Northern Spotted and Barred Owls on remote forest lands in northwestern California: evidence of food web contamination. Avian Conservation and Ecology 13(1):2. https://doi.org/10.5751/ACE-01134-130102.

Hankin, Lacey. 2018. Annual Climate impacts on tree growth and post-fire regeneration in ponderosa pine and Douglas fir in the northern Rocky Mountains. Graduate student Theses, Dissertations and Professional Papers. 11192. University of Montana.

Integral Ecology Research Center (IERC) website, http://www.iercecology.org/marijuana-grow-site-environmental-clean-up-project-summaries/. Accessed December 10, 2018.

Lawler, Joshua. 2009. Climate Change Adaptation Strategies for Resource Management and Conservation Planning. The Year in Ecology and Conservation Biology, 2009: Ann. N.Y. Acad. Sci. 1162: 79-98.

Medley-Daniel, M., Thaler, T., Griffith, G., Crossett, T., (Eds). 2011. Forest and Water Climate Adaptation: A Plan for Trinity County, CA. Model Forest Policy Program in association with The Watershed Research and Training Center and Cumberland River Compact. Sagle, ID.

Natural Resources Conservation Service website, https://websoilsurvey.nrcs.usda.gov/. Accessed December 3, 2018.

North State Resources, Inc. 2012. Shasta-Trinity National Forest Sediment Source Inventory and Aquatic and Riparian Resources Road Analysis Process Report.

Ravenscroft, Catherine, Scheller, Robert M., et.al. 2010. Forest restoration in a mixed-ownership landscape under climate change. Ecological Applications, 20(2), pp 327–346.

Smith, James P., Jr. 2017. Vascular plants endemic to the Klamath-Siskiyou Region. Humboldt State University Digital Commons at Humboldt State University, http://digitalcommons.humboldt.edu/botany_jps/66. Accessed December 18, 2018.

Taylor, Ross N., et al. 2002. Final Report: Trinity County Culvert Inventory and Fish Passage Evaluation.

Trinity County RCD. 2005. Upper Trinity River Watershed Road Inventory.

Trinity County, 2002. Trinity County Culvert Inventory and Fish Passage Evaluation Report.

Trinity County Grand Jury Report 2014-2015. DER 2014-2015-001- Environmental Impacts Related to Marijuana Grows and Law and Code Enforcement Problems Related to Marijuana Grows. www.trinitycounty.org/2014-2015-Grand-Jury-Reports-and-Responses

Trinity County Grand Jury Report and Responses 2015-2016. SDR 2015-2016-001. Water Committee. www.trinitycounty.org/2015-2016-Grand-Jury-Reports-and-Responses

Trinity County RCD. 2006. Upper Trinity River Watershed Assessment Report & Management and Action Plan..

Trinity County RCD and Watershed Research and Training Center. 2017. Trinity County Community Wildfire Protection Plan Update 2015.

Trinity River Restoration Program (TRRP) website, www.trrp.net. Accessed April 24, 2018.

U.S. Environmental Protection Agency. 2001. Trinity River total maximum daily load for sediment.

U.S. Forest Service, Pacific Southwest Region. 2006. Managing for Healthy Port Orford Cedar in the Pacific Southwest Region.

U.S. Forest Service, Shasta-Trinity National Forest. 2003. North Fork Trinity River, East Fork North Fork Trinity River and Canyon Creek Watershed Analysis.

U.S. Forest Service, Shasta-Trinity National Forest. 2004. Weaverville Watershed Analysis.

U.S. Forest Service, Shasta-Trinity National Forest. 2005. Upper Trinity River Watershed Analysis, Including Analysis for: Main Trinity River, Coffee Creek, E. Fork Trinity River, Stuart Fork, and Trinity Reservoir Watersheds.

U.S. Forest Service, Shasta-Trinity National Forest. 2009. Burnt Ranch and Soldier Creek Watershed Analysis.

U.S. Forest Service, Shasta-Trinity National Forest. 2010. French Creek Watershed Analysis.

U.S. Forest Service, Shasta-Trinity National Forest, authored by Mai, C., et al. 2012. Assessment of Watershed Vulnerability to Climate Change.

U.S. Forest Service, Six Rivers National Forest. 2000. Horse Linto, Mill and Tish Tang Creek Watershed Analysis.

Watershed Research and Training Center (WRTC). 2008. Big Creek Watershed Assessment Report.

Watershed Research and Training Center (WRTC). 2014. Trinity River Watershed Agricultural Practices: Sediment and Nutrient Deliveries.

Watershed Research and Training Center (WRTC). 2016. South Fork Trinity River Supplementary Watershed Assessment 2014-2016. Prepared for the California Department of Fish and Wildlife Fisheries Restoration Grant Program.

Welsh, H. H. Jr, Hodgson, G. R. and Lind, A. J. 2005. Ecogeography of the herpetofauna of a northern California watershed: linking species patterns to landscape processes. Ecography 28: 521-536.

Westerling, Anthony L. 2016. Increasing western US forest wildfire activity: sensitivity to changes in the timing of spring. Philosophical Transactions of the Royal Society B: Biological Sciences. June 5, 2016. Vol 371, Issue 1696.

Zedler, Joy. 2000. Progress in wetland restoration ecology. Trends Ecol. Evolution, 15, October. pp 402-407.